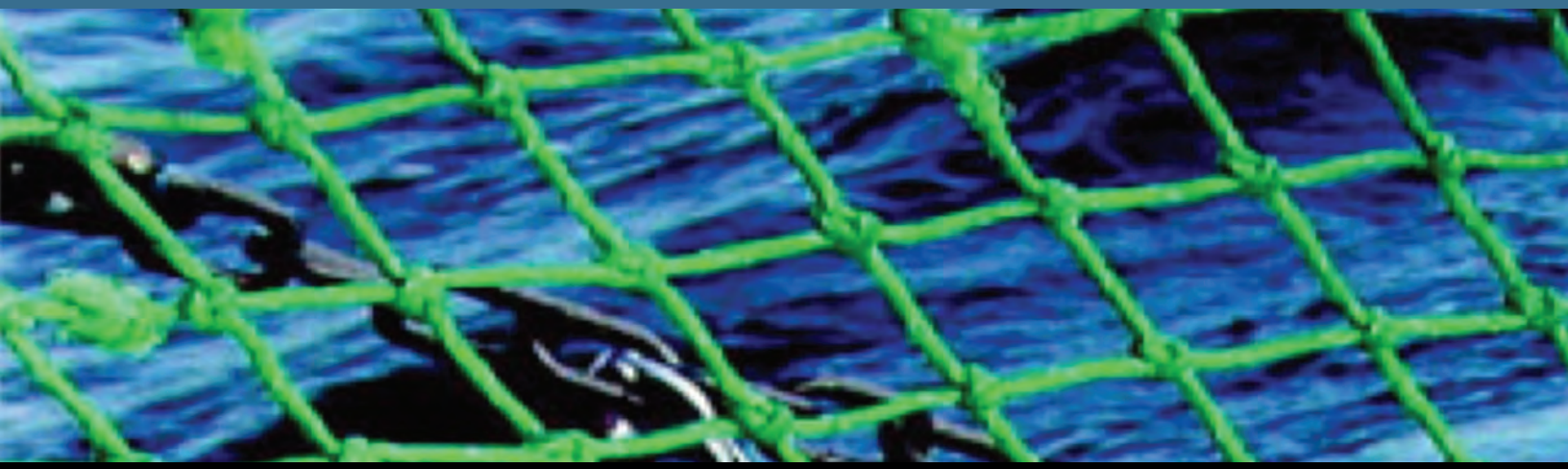
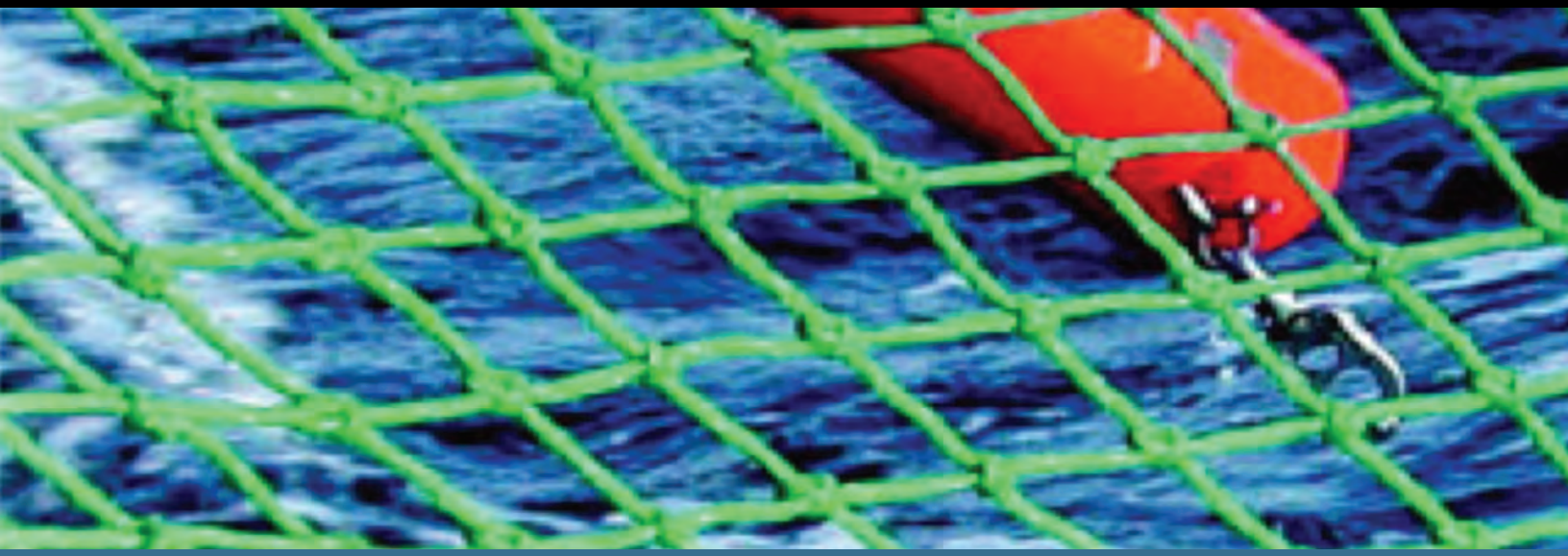
U.S. National Bycatch Report

First Edition





U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service

U.S. National Bycatch Report

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Background: fishing net, NMFS. Left to right: spotted dolphins inside a tuna purse-seine net, NMFS; loggerhead sea turtle escaping a trawl net via a turtle excluder device, NMFS; blue shark caught on longline gear, NMFS.

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First Edition

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Preface

Ensuring the sustainability of marine resources for future generations is the primary mission of the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NMFS). Reducing the unintentional capture, or bycatch, of fish, marine mammals, sea turtles, and seabirds is an essential part of this goal and is required under NMFS' guiding legislation. The first step in reducing bycatch is accurate characterization of current bycatch levels; this provides a benchmark for evaluating the effectiveness of our efforts to reduce bycatch. Understanding the amounts and types of bycatch in our nation's fisheries is also an important component of ecosystem-based management, which seeks to account for the complex connections among organisms, including humans and their environment.

The U.S. National Bycatch Report provides the first nationwide compilation by NMFS of estimated bycatch in U.S. commercial fisheries. It expands upon the conservation and management strategies articulated in previous NMFS publications such as *Managing the Nation's Bycatch* (1998) and *Evaluating Bycatch* (2004b), and mandated under the Magnuson-Stevens Act, Marine Mammal Protection Act, and Endangered Species Act. The U.S. National Bycatch Report also provides information on sampling and estimation methods, provides an objective framework for evaluating the quality of bycatch estimates, and establishes performance measures for monitoring improvements to bycatch data quality and estimates over time.

A great deal of work went into compiling the estimates contained herein, as well as in developing new processes for evaluating the quality of bycatch data, describing the impact of bycatch upon stocks and fisheries, and developing recommendations to improve the quality and extent of data collection and the quality of estimation methods. In each of its six regions, NMFS collects data that are used for bycatch estimation. Some of these data come directly from the fishing industry itself, such as fishermen's logbooks; bycatch data are also collected by observer programs. Using this information, in addition to data on commercial and recreational fishery landings, regional assessment scientists generate estimates of bycatch at the fishery and species level. The quality and amount of available data and the methods used to estimate bycatch vary widely among regions, fisheries, and species. Since this project was initiated in 2006, estimates presented are based upon data collected in 2005. We recognize that more recent bycatch estimates are available for many fisheries, and that changes to fisheries management practices have occurred in the interim, potentially affecting bycatch levels presented in this report.

NMFS is committed to compiling updated and new estimates in a timely manner. I am certain that you will find in these pages valuable insights into the nature of bycatch in our nation's fisheries as well as steps that NMFS, together with our partners at the regional Fisheries Management Councils, is taking to improve the quality of bycatch estimates and to reduce bycatch levels. In particular, research in the area of fishing gear technology, development of electronic fishery monitoring techniques, and the implementation of catch shares and other accountability measures, are advancing our goal of meeting our bycatch reduction mandates.

The report includes:

- A complete list of 274 Federal, state, international, and tribal commercial fisheries, identifying management authorities, gear types, target species, and bycatch data sources
- Evaluation of bycatch data sources and estimation methods for 152 Federal commercial fisheries, 46% percent of which were determined to have high-quality bycatch information
- Bycatch estimates for 81 Federal commercial fisheries
- 480 fish, 54 marine mammal, 12 sea turtle, and 28 seabird stock-level bycatch estimates
- An estimated overall national bycatch ratio for fish (bycatch/total catch) of 17%
- Identification of 396 key stocks that will be monitored over time for changes in bycatch levels
- 120 recommendations for improvements to bycatch data collection and estimation for key fisheries.

This is the first in a planned series of national bycatch reports designed to track and report on our efforts to monitor bycatch. The U.S. National Bycatch Report will serve as a cornerstone, aiding NMFS in meeting our bycatch reduction mandates and stewardship obligations by identifying trends in bycatch, guiding policy, and setting priorities for bycatch data collection.

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Acknowledgments

The U.S. National Bycatch Report was developed over the course of several years under the leadership of Dr. Lisa Desfosse (Director, Southeast Fisheries Science Center Pascagoula Laboratory) and Dr. Bill Karp (Deputy Director, Alaska Fisheries Science Center). Project coordination was provided by Samantha Brooke (Office of Science and Technology).

The methodological approach for the report was developed through numerous workshops and conference calls by the National Bycatch Report Steering Committee; bycatch information was provided by teams of scientists and fisheries managers from each of the NMFS regions. Steering Committee and Regional Team members are listed in Appendix G and F, respectively. Two SeaGrant fellows, Jessica Barkas (2006–07) and Catherine Purcell (2009–10), also provided extensive aid in the development of the report.

A collaborative effort, the U.S. National Bycatch Report is the product of extensive data, information, comments, suggestions, and research provided by colleagues throughout NOAA, both those engaged in the aforementioned Steering Committee and Regional Teams and those who provided additional insight on specific topics. We thank them for their efforts in ensuring the accuracy of the information included herein, as well as for providing insight into national and regional bycatch concerns. Without their support, this report would not have been possible.

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Executive Summary

Photo on previous page: Trawl contents, including bycatch. Photo: C. Nolan, MRAG Americas, under contract to the NMFS Observer Program.

INTRODUCTION

Bycatch occurs when fishing operations result in discard of fish and invertebrates or interactions with marine mammals, seabirds, and sea turtles. Discard of fish may occur because certain species, sexes, or sizes are not marketable or are of lower value than other components of the catch, or because regulations prohibit retention of specific species, sexes, and/or sizes. Bycatch impacts living marine resources worldwide and occurs in both commercial and recreational fisheries. It is of particular concern if bycaught species are overfished, threatened, or endangered. When bycatch estimates are available, they may be included as a component of overall fishing mortality during stock assessment or status evaluation. Thus, such estimates are essential to effective management of all living marine resources.

Development of this first National Bycatch Report was motivated by recognition of the need to review the status of information on bycatch in the Nation's fisheries, consistent with the National Oceanic and Atmospheric Administration's (NOAA's) statutory obligations as set forth in the U.S. Endangered Species Act (ESA), the Marine Mammal Protection Act (MMPA), and the reauthorized Magnuson-Stevens Fishery Conservation and Management Act (MSA). This Executive Summary provides an overview of report results; the full document, which is provided on the enclosed CD, contains the technical details.

The National Bycatch Report provides the first national compilation of bycatch estimates for living marine resources of the United States that are managed by NOAA's National Marine Fisheries Service (NMFS). The NMFS has prepared this report to evaluate the extent to which reliable quantitative bycatch information exists for federally managed commercial fisheries and fisheries with relevant Federal data-collection programs. The report also documents bycatch estimates and bycatch estimation methods for all fisheries for which this information was available in 2005.[1] In addition to reviewing the state of bycatch data and estimation, this report establishes a baseline for tracking changes in bycatch over time, and is designed to assist NMFS in meeting legislative mandates for bycatch reduction, guiding policy, and setting priorities.

Data sources for estimating bycatch

Data sources vary among regions, as well as among fisheries, primarily due to differences in data-collection program goals, objectives, priorities, and available resources.

[1] The year 2005 was selected as a base year during the report's development in 2006 since it was the most recent year for which complete information was available. The National Marine Fisheries Service intends to publish updated information in future editions of this report. Note that for some rare-event species (species that do not occur frequently as bycatch), multiple years of data were utilized to develop bycatch estimates.

Definition of bycatch

BYCATCH, for the purposes of this report, is defined as discarded catch of any living marine resource and as unobserved mortality[2] due to a direct encounter with fishing gear. Since information on unobserved mortality of fish is rarely available, it is not included in this report. Unobserved mortality is included in bycatch estimates for protected species where the data permit.

Commercial fisheries vary greatly in scale and fishing practice and these factors impact, and in some cases constrain, bycatch data-collection programs. The major sources of data used for the bycatch estimates presented in this report were observer data and self-reported logbook data. Multiple data sources were available for some fisheries. Total landings by fishery are provided for each NMFS region for consistency with other published reports. However, aggregate landings at the species level were obtained from the NMFS centralized landings database.[3]

Observer programs are conducted in all six NMFS regions, and observer data were available for 110 U.S. commercial fisheries in 2005 (72% of the subset of fisheries considered by the National Bycatch Report; Figure 1). Fisheries observers are trained biologists who collect data on fishing activities onboard commercial vessels (and at processing plants in some instances). Observers collect both quantity and composition information on catch and bycatch, as well as information on fish discards (e.g., released alive vs. dead) and condition of protected species bycatch (e.g., location of entanglement and/or hooking, condition of animal upon release). Biological samples, gear type, environmental conditions, economic data, and other information useful for stock assessments are also collected by observers. Observer data are considered the most reliable source of information on bycatch. Furthermore, observer data are subjected to rigorous quality-assurance procedures.

Data from commercial fisheries logbook programs, which are required under regulations for 39 fishery management plans (FMPs) established under the MSA, were used in

[2] Unobserved mortality describes the mortality of living marine resources due to a direct encounter with fishing gear that does not result in the capture of the species. This includes mortality due to lost or discarded fishing gear, as well as mortality of fish and other species that escape from fishing gear before it is retrieved but die due to the stress or injury resulting from the encounter (NMFS 2004b).

[3] http://www.st.nmfs.noaa.gov/st1/commercial/index.html.

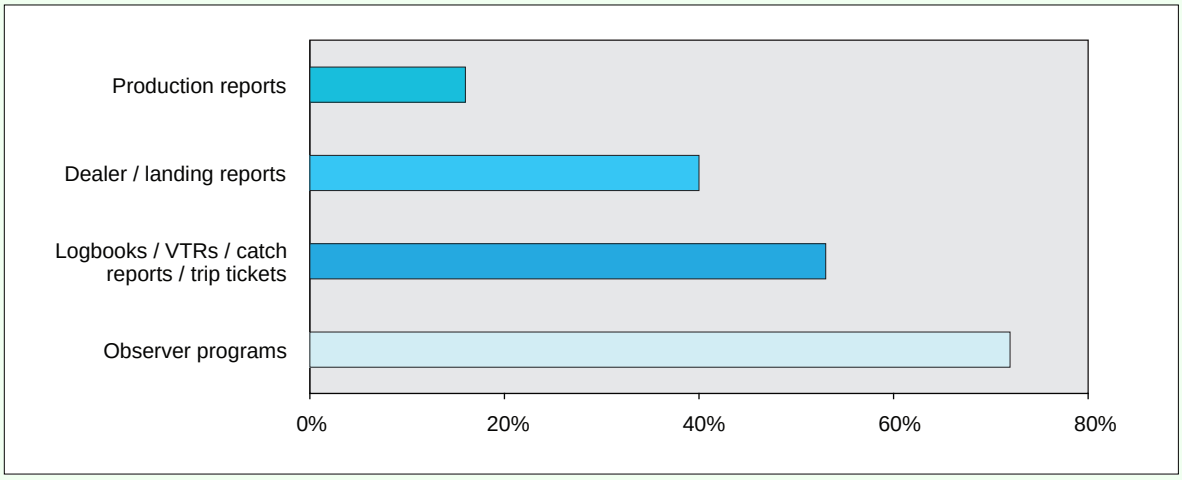


Figure 1
Primary data sources used in bycatch estimation for fisheries and species identified in the National Bycatch Report. Data are from the year 2005, except for some rare-event species that required data from a range of years. Note: Percentages do not total 100, as multiple data sources were used to estimate bycatch in some fisheries.

bycatch estimation for 80 U.S. commercial fisheries (53% of the subset of fisheries the U.S. National Bycatch Report focused on; Figure 1). Logbooks are completed on board the vessel by a designated crew member. Reporting requirements for logbooks (which may also be called vessel trip reports or VTRs, catch reports, or trip tickets) differ by NMFS region and fishery. Logbook data may be used to estimate bycatch in the absence of observer data, or may be used as supplemental data for extrapolating to the unobserved portion of the fishery. Logbooks are self-reported and the bycatch data are typically compared to data from observer programs for verification; this is possible only if an observer program has been implemented for the same fishery. If no observer data are available, logbook underreporting and other sources of bias are potential sources of error in estimating bycatch.

Additional data were provided through dealer or landings reports, production reports, and protected species stranding and entanglement reports. The data provided by these programs were not generally used alone to calculate bycatch, but served as ancillary information for estimation of overall bycatch when observer data were available for only a portion of a fishery. Data collected through dealer/landing reports were available for 61 fisheries (40%; Figure 1). Data collected through production reports were available for 25 Alaskan fisheries (16%).

Data from stranding and entanglement reports were used to assess relative levels of bycatch only when more reliable data sources were not available, the report was considered reliable, and the report clearly described a mortality or a serious injury that was likely to lead to mortality of the entangled animal. Strandings information is not included in Figure 1 but was used in marine mammal bycatch estimates for the Alaska and Northeast regions.

BYCATCH DATA QUALITY

Tier classification system

Precise and accurate bycatch estimates require high-quality data; these estimates contribute to improved understanding of the impact of bycatch among all species and fisheries, and are essential to managing the Nation's fisheries. Annual catch limits, fish and protected species stock assessments, and bycatch reduction measures all depend on the availability of this high-quality information. A tier classification system was developed to evaluate the quality of bycatch data and the reliability of bycatch estimation methods for selected U.S. fisheries (for details, see Section 3). The tier classification system provides a basis for defining the current state of knowledge regarding levels of bycatch, and quality of data and estimation methods; this establishes a benchmark point for defining the need for improvements in data collection and analysis, and evaluating these improvements over time.

Tier descriptions
(refer to Chapter 3 for details)

■ ■ ■ ■ For Tier 4 fisheries, bycatch estimates were available and were based on the highest quality data and analytical methods.

■ ■ ■ For Tier 3 fisheries, bycatch estimates were also generally available but higher quality data (e.g., data that are more reliable, accurate, and/or precise) were utilized to compute these estimates.

■ ■ For Tier 2 fisheries, bycatch estimates were generally available. However, these estimates would have benefited from improvements in data quality and/or analytical methods (such as improved sampling designs, increased coverage levels, and peer review of methods). Where bycatch estimates were not available, methods are being developed.

■ For Tier 1 fisheries, bycatch data were available but were generally unreliable (e.g., from unverified or potentially biased sources). In some cases, higher quality data were available but analytical methods had not been implemented.

□ For Tier 0 fisheries, bycatch data-collection programs or estimation methods did not exist, and therefore, bycatch estimates were not available.

The subset of fisheries evaluated through the tier classification, which is referenced throughout the report, consists of 152 federally managed fisheries and fisheries with relevant Federal data-collection programs. These fisheries were assessed based on a series of criteria and assigned to one of five tiers. The major criteria used in the tier classification system were: 1) adequacy of bycatch data collected through observer programs and self-reported industry logbooks; 2) availability of supplemental data (used as expansion factors for unobserved components of the fishery, for stratification and imputation, as model covariates, and to verify self-reported industry data); 3) database and information technology considerations (used to link data to generate timely bycatch estimates); and 4) quality of analytical approaches (bycatch estimation method assumptions, peer reviews, statistical bias of estimators, and availability of uncertainty estimates). Adequacy of observer data and quality of analytical approaches were more heavily weighted and, therefore, tier determination was primarily driven by these criteria.

Fisheries with low overall scores were assigned to lower tiers (Tier 0, Tier 1), and fisheries with high overall scores were assigned to higher tiers (Tier 3, Tier 4). It is important to note that tier scores are based on 2005 information, and that improvements to bycatch data collection and estimation may have occurred in some fisheries subsequently. Fisheries classified in Tier 0 typically lacked bycatch data-collection or estimation methods while fisheries classified in Tier 4 were considered to provide reliable bycatch estimates based on long-term observer data.

Results of the tier classification

The tier classification system was applied to the subset of 152 fisheries included in this report. The system was applied separately (on a fishery-by-fishery basis) for fish managed under the MSA, for marine mammals, and for all other protected species (ESA-listed fish and sea turtles, and all seabirds). This was done because some fisheries were grouped to be consistent with MMPA fishery definitions (and associated protected species bycatch estimation methods), and in some fisheries, bycatch data were only available for protected species. As a result, a total of 400 tier classifications were generated; 142 fisheries were evaluated for quality of fish bycatch data and estimation; 129 fisheries were evaluated for marine mammal bycatch data and estimation quality, and the same number were evaluated for protected species.

The majority of fisheries (41%) were classified in Tier 3, while 15% fell into Tier 2, and 16% into Tier 1. Only 4% were classified in Tier 4. Overall, bycatch data-collection programs and/or estimation methods did not exist for 24% of the fisheries evaluated and these were therefore classified as Tier 0 (Figure 2).

Results of the tier classification reveal some variation among the quality of data and estimation methods for different bycatch types (Figure 3). For fish bycatch, only 13% of the fisheries were classified in Tier 0, while 41% were classified in Tiers 1 and 2, and 46% in Tiers 3 and 4. For marine mammals and other protected species, 30% of the fisheries were classified in Tier 0, while approximately 25% were classified in Tiers 1 and 2, and 45% in Tiers 3 and 4. This suggests that there is less data-collection specifically

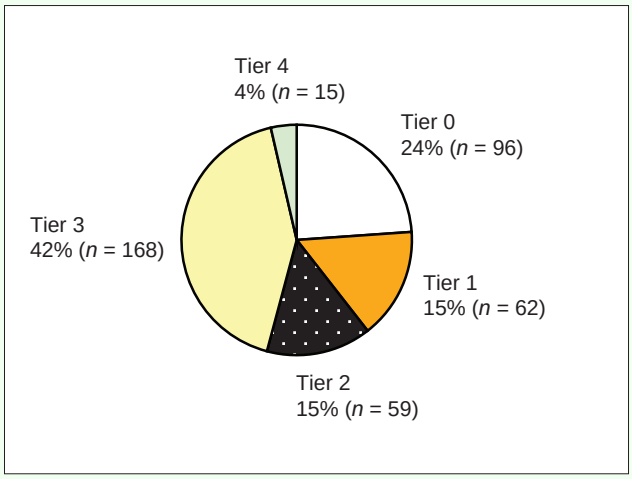
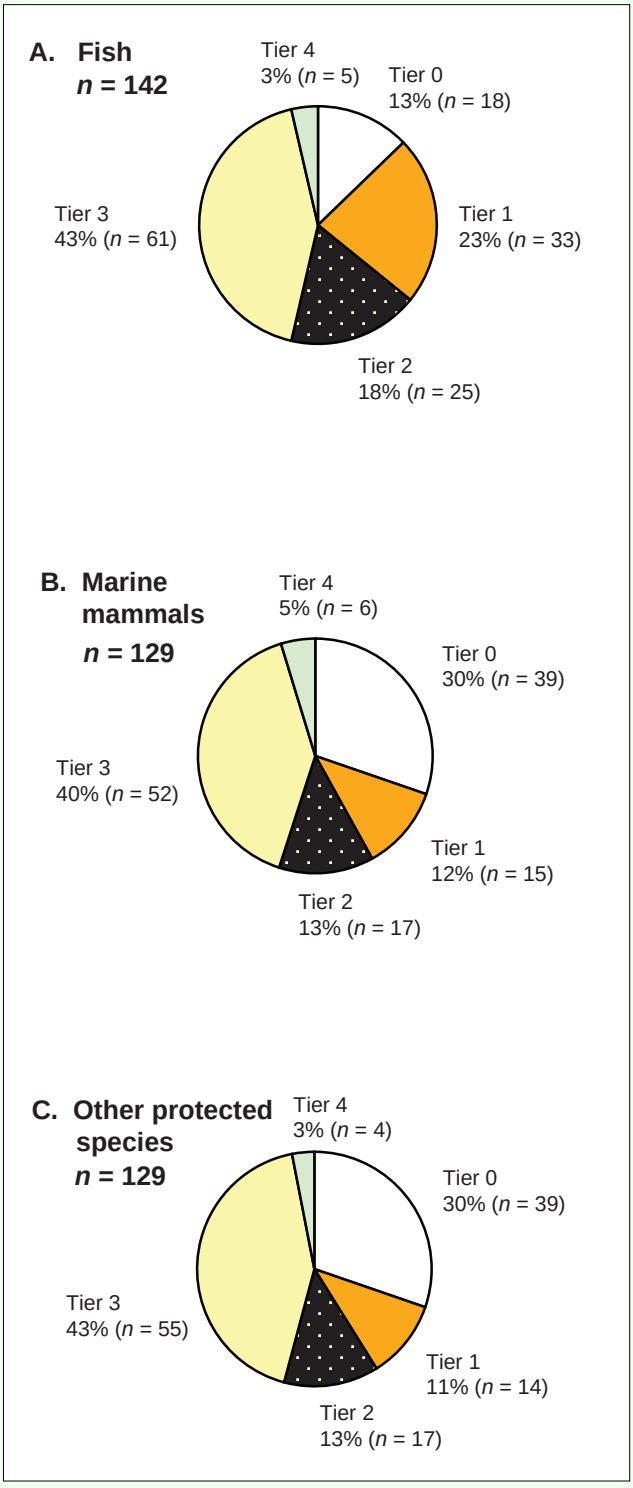


Figure 2 (above)
Distribution of tier scores for the quality of bycatch data and estimation summed across fisheries, regions, and bycatch categories. The total number of tier scores derived for this report was 400: fish (142) + marine mammals (129) + other protected species (129).

Figure 3 (right)
Distribution of tier scores for bycatch data and estimate quality summed across fisheries and regions for A) fish, B) marine mammals, and C) other protected species.



targeted to bycatch of marine mammals and other protected species than to bycatch of fish (more than double the percentage of fisheries were Tier 0 for marine mammals and other protected species). However, of the fisheries where data were available, the quality of the bycatch data and estimates was similar for fish species and for marine mammals and other protected resources (i.e., around 45% of fisheries in Tiers 3 and 4).

DESIGNATION OF KEY STOCKS

A subset of fish and protected species was identified for use in monitoring bycatch trends over time. In this report, stocks in this subset are referred to as *key stocks*,[4] and are defined as those stocks that have high bycatch levels, have special importance to management, and/or for which there are stock status concerns (for details, see Section 3). Note that all ESA-listed species were automatically considered to be key stocks, but non-ESA-listed fish, marine mammals, and seabirds were evaluated based on the factors listed above before being listed as key stocks. Changes in bycatch of key stocks over time will provide an indicator of how well NMFS is meeting the bycatch reduction goals of the ESA, MMPA, and MSA.

A total of 396 fish, marine mammal, seabird, and sea turtle stocks and populations were classified as key stocks. Stocks occurring in multiple regions were listed as “key” in each region where bycatch was of concern. The number of key fish stocks varied by region, with the Southwest Region identifying the highest number, 94 (35% of the total number of key fish stocks). Because no fish bycatch estimates were available in the region, all stocks of management importance were placed on the list of key stocks as a precautionary measure. Of the 269 key fish stocks, 68% are included in the NMFS Fish Stock Sustainability Index (FSSI) and 22% are listed under the ESA. Seventy-one marine mammal stocks (18% of the total number) were identified as key stocks, with the highest number in the Alaska Region (18). All sea turtle populations were classified as key stocks since they are listed under the ESA as either endangered or threatened. A total of 30 seabird populations were identified as key stocks. Detailed descriptions of key stocks, by region, are included in Section 4 of this report.

[4]The term *key stock* is used broadly in this report to include stocks, populations, species, and species groups.

PERFORMANCE MEASURES

Two performance measures were developed based on the information contained in this report: the tier scoring system and the key stocks concept. They will be used to monitor bycatch trends and changes in the quality of bycatch data collection and estimation over time.

Tier scores: As improvements are made to bycatch data collection, and new methods for estimating bycatch are developed and implemented, the tier scores of individual fisheries are expected to increase. This system provides a measure of the relative quality of bycatch estimates within and between regions, bycatch categories, stocks, and fisheries that is available to fisheries managers for use in fisheries conservation and management activities.

Key stocks: Future editions of the report will compare new estimates of key stock bycatch to those of previous editions. Monitoring bycatch trends over time for key stocks identified herein will provide an indicator of how well NMFS is meeting the bycatch reduction goals of the ESA, MMPA, and MSA. Additionally, key stocks showing increasing levels of bycatch may be identified for increased research and/or bycatch reduction efforts.

Because this is the first edition of the U.S. National Bycatch Report, it was not possible to evaluate changes in performance over time. Information presented in this report will, however, provide a baseline for such evaluation. Future editions of the report will define management targets for these performance measures.

NATIONAL AND REGIONAL BYCATCH SUMMARIES

Estimated fish bycatch for the U.S. commercial fisheries considered in this report totaled 1.22 B pounds, while associated landings for these fisheries totaled almost 6.068 B pounds (Table 1). The resulting estimated overall bycatch ratio (defined as the ratio of bycatch to total catch, where total catch equals landings plus bycatch) for fish bycatch in all U.S. commercial fisheries considered in this report is 0.17 (rounded from the actual calculated ratio of 0.167543 on which Table 2 is based). The ratio 0.17 is referred to as the "overall bycatch ratio" in the following discussion. The computation of an overall bycatch ratio did not include bycatch of protected species; for fisheries considered in this report, estimated bycatch of marine mammals totaled 1,887 individual animals, estimated bycatch of sea turtles totaled 11,772 animals, and estimated bycatch of seabirds totaled 7,769 animals.

In some fisheries, insufficient data were available for analysis. For other fisheries, analytical methods for estimating some types of bycatch were not available when this report was compiled (e.g., bycatch estimates were not provided for fish species in the Southwest Region or for seabirds in the Northeast and Southwest Regions). In addition, fish bycatch estimates were provided in numbers of individuals for some Southeast and Northwest Region fisheries, and these estimates were not included in the calculation of total U.S. bycatch, because factors for converting numbers to weights were not available.

Table 2 provides estimates of overall regional and national fish bycatch (i.e., bycatch associated with all U.S. fisheries including those with bycatch estimates included in this report and summarized in Table 1 and those without bycatch estimates and, therefore, excluded from Table 1). For each region, the calculated bycatch ratio (0.167543) was applied to the total landings for those fisheries not considered in the U.S. National Bycatch Report to compute an estimate of fish bycatch (i.e. calculating the unknown bycatch using the bycatch ratio for known bycatch and total landings). Computation employed the formula bycatch = (0.167543 × Landings) / (1 – 0.167543), where 0.167543 is the calculated bycatch ratio. This provided a means for estimating total bycatch for each region, and the resulting bycatch estimates were summed to provide an overall national bycatch estimate of 1.934 B pounds.

Bycatch ratios for U.S. commercial fisheries published by the Food and Agriculture Organization of the United Nations (FAO) (Kelleher 2004) and Harrington et al. (2005) for the period 2002–2003 were higher than the estimate cal-

Table 1

Total estimated fisheries landings and bycatch by type for each NMFS region included in the National Bycatch Report. Data are generally from 2005, except for some rare-event species estimates for which bycatch data from a range of years may have been used. Weights are rounded to the nearest thousand pounds. Note that details of individual regional calculations are described in Section 4 of the report.

Region	Fish bycatch (lb)	Fish landings (lb)	Marine mammal bycatch (individuals)	Sea turtle bycatch (individuals)	Seabird bycatch (individuals)
Northeast	165,888,000	1,006,370,000	1,287	1,062	Not available
Southeast	682,691,000	219,086,000	233	10,671 [a]	186
Alaska	338,573,000	4,487,167,000	62	0 [b]	7,280
Northwest	25,564,000	332,396,000	37	0 [b]	106
Southwest [c]	Not available	–	242	1	Not available
Pacific Islands	8,556,000	23,000,000	26	38	197
Totals	1,221,272,000	6,068,019,000	1,887	11,772	7,769

[a] The Southeast sea turtle bycatch estimate includes mortality estimates from the NMFS 2002 biological opinion on the shrimp fisheries of the Southeastern United States (NMFS 2002). Since that time, effort in the shrimp fishery, and associated bycatch, has decreased markedly.
[b] Sea turtle bycatch has not been observed in the Alaska or the Northwest Regions.
[c] Southwest Region landings are not included because fish bycatch estimates from the region were not available.

Table 2
Fish landings and bycatch by NMFS region for fisheries included, and estimated regional bycatch ratios.

	2005 landings (lb)				2005 bycatch (lb)			
Region	Fisheries considered in the National Bycatch Report	Fisheries not considered in the National Bycatch Report	Total	% of total landings sampled	Fisheries considered in the National Bycatch Report	Regional bycatch ratio [a,b]	Fisheries not considered in the National Bycatch Report	Total
Northeast	1,006,370,000	385,816,000	1,392,186,000	72	165,888,000	0.14	77,651,000	243,539,000
Southeast	219,086,000	1,093,033,000	1,312,119,000	17	682,691,000	0.76	219,987,000	902,678,000
Alaska	4,487,167,000	1,164,140,000	5,651,307,000	79	338,573,000	0.07	234,299,000	572,872,000
Northwest	332,396,000	523,464,000	855,860,000	39	25,564,000	0.07	105,354,000	130,918,000
Southwest	–	367,830,000	367,830,000	0	Not available	–	74,031,000	74,031,000
Pacific Islands	23,000,000	9,244,000	32,244,000	71	8,556,000	0.27	1,860,000	10,416,000
National totals	6,068,019,000	3,543,527,000	9,611,546,000	63	1,221,272,000	0.17	713,182,000	1,934,454,000

[a] Regional bycatch ratios are for fisheries included in this report only.
[b] Weights derived using the calculated bycatch ratio of 0.167543 and the formula bycatch / (bycatch + landings).

culated herein, which is based on 2005 data (Table 3). Correspondingly, the overall total bycatch estimate provided in this report is lower (1.934 B pounds) than those reported by FAO (Kelleher 2004; 2.045 B pounds) and Harrington et al. (2005; 2.333 B pounds). These reports obtained bycatch estimates and associated landings data from published and grey literature, while the estimates used here are based on raw data, as well as data obtained from a range of published and unpublished reports. In addition, FAO (Kelleher 2004) reports that their database may be biased in favor of fisheries with high discards and this would result in an overall overestimate of bycatch. This type of positive bias is also likely for the Harrington et al. (2005) report, which also included a subset of fisheries.

Since both reports drew information from a smaller subset of fisheries than this report and, apparently, were more likely to include information on fisheries with noteworthy bycatch concerns, higher overall bycatch ratio estimates might be expected. Since this report is more comprehen-

Table 3
Comparison of fish bycatch estimates for U.S. commercial fisheries from the National Bycatch Report with previously published estimates. Bycatch ratios are calculated as the total bycatch divided by the total catch (bycatch plus landings).

Reference	Year of source data	Total bycatch estimate (lb)	Total landings (lb)	Bycatch ratio
National Bycatch Report (2011)	2005	1,934,454,000	9,611,546,000	0.17
FAO (Kelleher 2004) [a]	2002	2,045,006,000	7,373,224,000	0.22
Harrington et al (2005) [a]	2002–03	2,332,894,000	8,194,516,000	0.22

[a] Converted from metric tons.

Credit: NMFS

Strategic offal discarding is a seabird bycatch reduction measure required in some parts of the Hawaii longline fishery.

sive, the bycatch ratio estimate in this report should be considered to be the best estimate currently available. It is apparent that the authors of the FAO (Kelleher 2004) and Harrington et al. (2005) reports encountered considerable difficulty in obtaining comprehensive and accurate catch and bycatch data and found it necessary to make extrapolations based on a range of assumptions. This report, while drawing on more data, also required extrapolation of estimates for some fisheries and species due to data limitations. This serves to emphasize the need for reporting of accurate and comprehensive information of the type presented here, and the importance of updating this report frequently and expanding its scope as information on additional U.S. fisheries becomes available.

Bycatch estimates for marine mammals, sea turtles, and seabirds were recently reported by Moore et al. (2009), who estimated total national bycatch only for marine mammals. This estimate was 3,029–3,187 animals annually for the period 1990–99, while our estimate is 1,887 animals annually (a baseline of 2005 data was used, plus data from a range of years). Because the data presented in Moore et al. (2009) were based on averages across a time-frame earlier than that utilized in this report, a direct comparison with estimates presented herein is not possible. In a broad comparison, the U.S. National Bycatch Report contains lower bycatch estimates, but this report does not speculate as to why the estimates are different.

Fishery bycatch estimates

Fishery bycatch ratios were calculated only for a subset of the fisheries considered during preparation of this report (63 of 152 fisheries; 41.5%) due to limitations in available data, as explained in the body of the report. Each fishery bycatch ratio was calculated as the total bycatch of all species caught within a fishery, divided by the total catch (bycatch plus landings of all species) for that fishery. Fisheries with bycatch ratios greater than 0.17 (the median of available fishery bycatch ratios) were designated as fisheries of focus, indicating a potential bycatch concern. Bycatch ratios for the fisheries included here range from 0.0 to 0.76, and vary by region (note that fishery bycatch ratios are for bycatch of fish only; bycatch of protected species is discussed in the next sections).

In general, the fisheries with the highest bycatch ratios were bottom trawl and bottom longline fisheries (Figures 4 and 5A). Relatively high bycatch ratios were estimated for some Alaska and Northeast bottom trawl fisheries and for the Southeast Gulf of Mexico shrimp trawl fishery; these ratios should, however, be considered in the context of overall fishing operations within each region. For example, bottom trawl fishing represents a small fraction of overall trawl fishing effort in Alaska (midwater trawl fishing effort is markedly higher); primary discards from Northeast trawl fisheries are non-marketable species bycaught when targeting commercially important species; and shrimp trawling effort in the Gulf of Mexico has declined substantially in recent years. The highest bycatch ratios among bottom longline fisheries occurred in the Bering Sea/Aleutian Islands (BSAI) and Gulf of Alaska sablefish longline fishery; the BSAI Greenland turbot longline fishery; and the Northeast bottom longline fishery. Pelagic longline fisheries (Figure 5B) had lower bycatch ratios than some bottom longline fisheries. However, the average bycatch ratio for pelagic longline fisheries was similar to that of bottom longline fisheries (0.25 and 0.23, respectively).

In the Northeast Region, bycatch ratios were also high for several large-mesh gillnet[5] fisheries (Figure 6). These included the New England large-mesh and extra-large-mesh gillnet fisheries, and the mid-Atlantic extra-large-mesh gillnet fishery. Bycatch ratios were generally lowest for fisheries using more selective gear types, such as troll, pot and traps, dredge, and jig gear (Figure 7). The federally managed West Coast salmon troll fisheries were the only fisheries using other gear types that had bycatch ratios above the cutoff value of 0.17 (0.23 and 0.19 for non-tribal and tribal fisheries, respectively).

[5]Gillnet size categories for the Northeast Region include small (mesh size less than 5.5 inches), large (mesh size 5.5 inches or greater but less than 8 inches), and extra-large (mesh size greater than 8 inches).

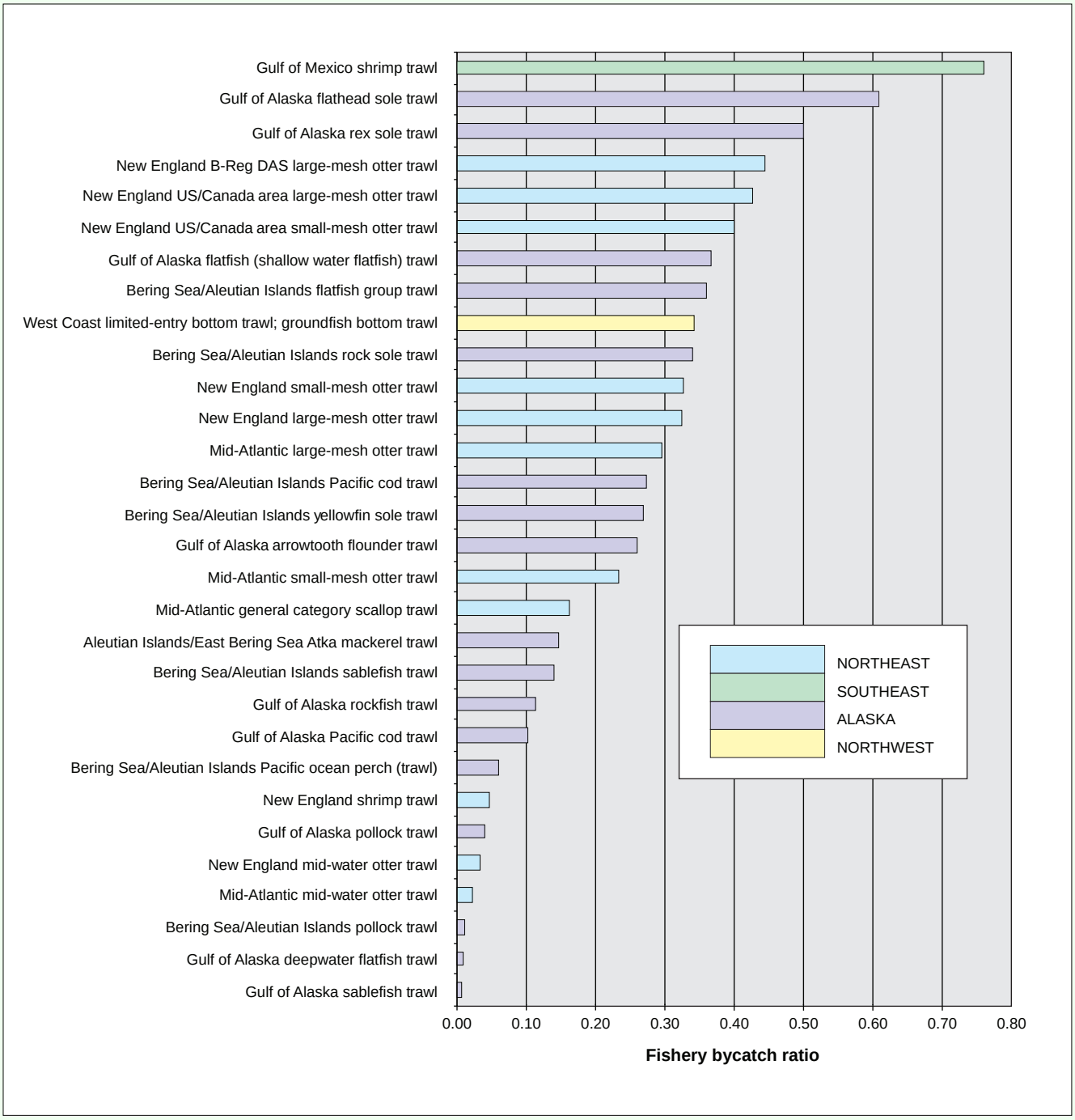


Figure 4
Fish bycatch ratios for U.S. commercial trawl fisheries by NMFS region (2005 data). The Bering Sea/Aleutian Islands Flatfish Group (arrowtooth flounder, flathead sole, and other flatfish) trawl fishery has been abbreviated as “BSAI Flatfish Group Trawl.”

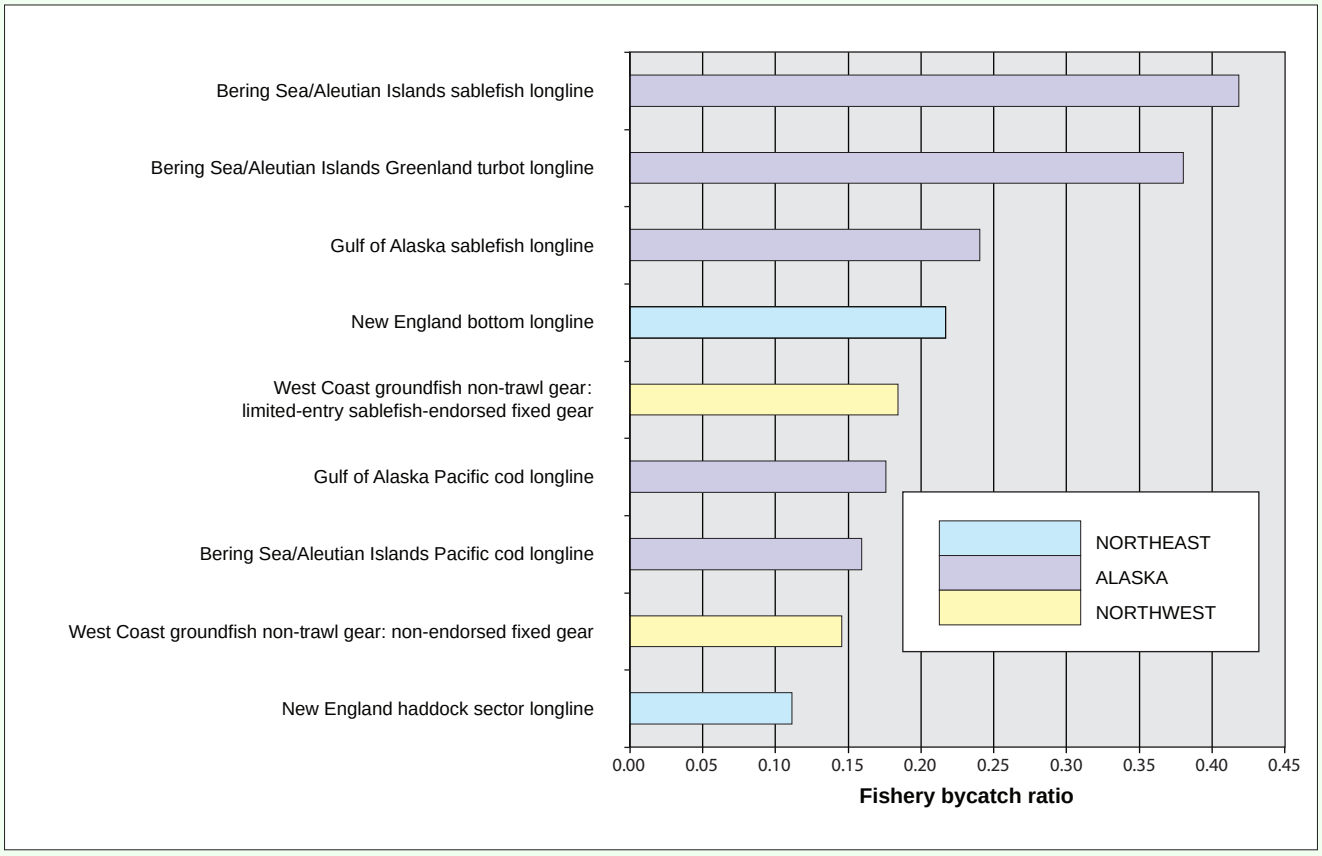


Figure 5A Fish bycatch ratios for U.S. commercial bottom longline fisheries by NMFS region (2005 data).

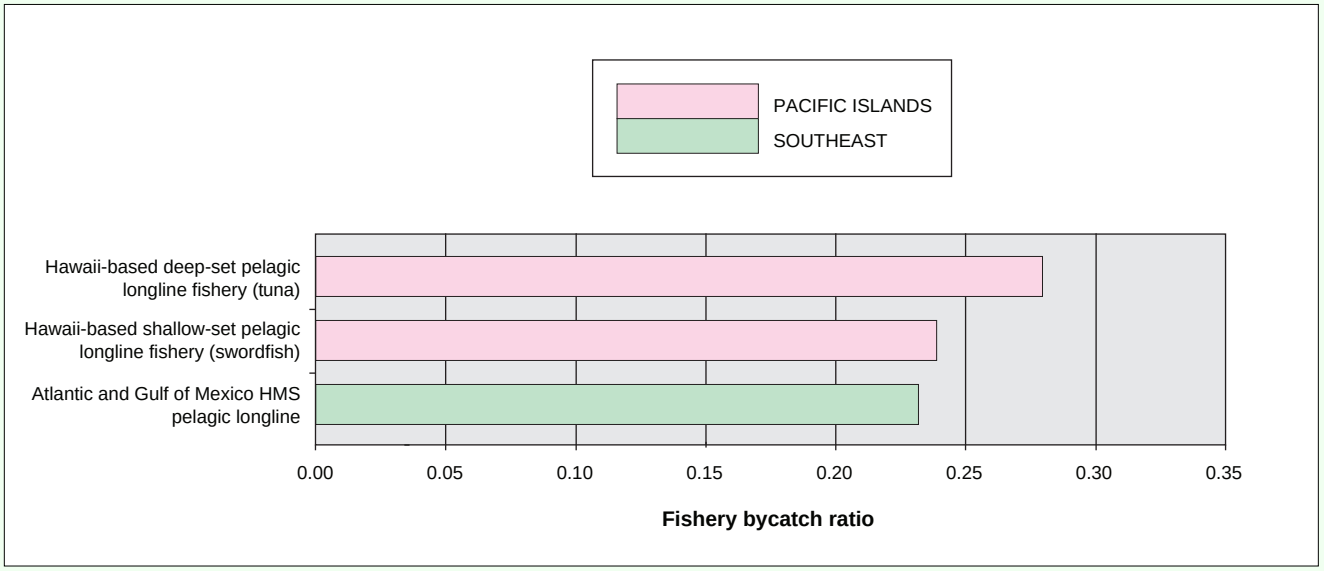


Figure 5B Fish bycatch ratios for U.S. commercial pelagic longline fisheries by NMFS region (2005 data).

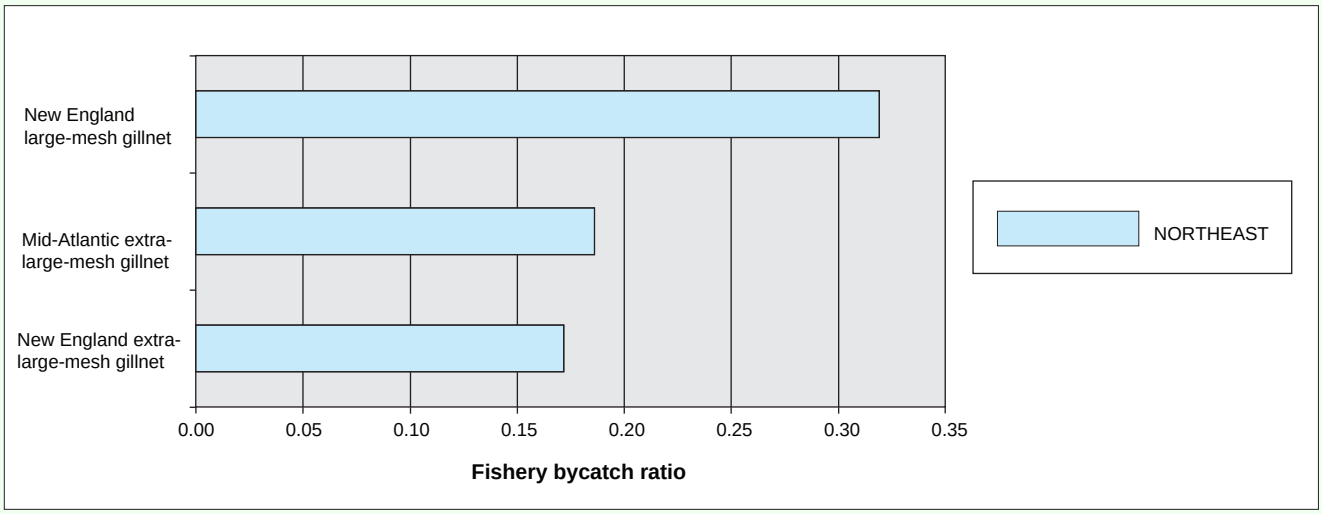


Figure 6 Fish bycatch ratios for U.S. commercial gillnet fisheries by NMFS region (2005 data).

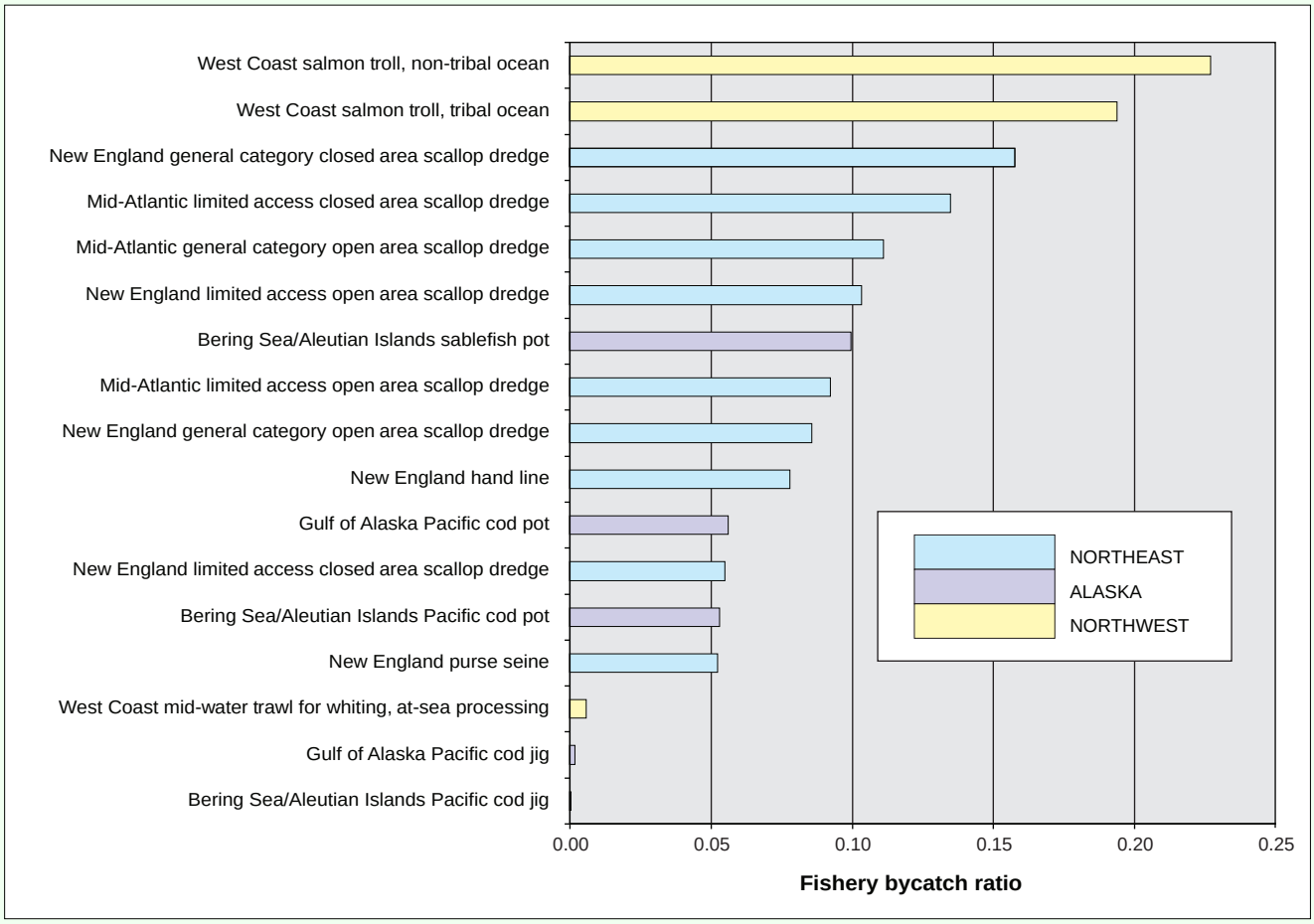


Figure 7 Fish bycatch ratios for fisheries using gears other than trawls, longlines, and gillnets by NMFS region (2005 data).

Credit: NMFS

Longline fishery bycatch: a bigeye thresher shark.

STOCK BYCATCH ESTIMATES

Fish bycatch

While the number of fish bycatch estimates varies by region, estimates are reported for a total of 480 fish stocks nationwide ("stock" is used broadly within this report to include stocks, populations, and species groups). Stock bycatch ratios[6] were available for only 93 (19.4%) of these, principally because for some fisheries, only numeric bycatch estimates were available (precluding calculation of weight-based ratios); or total catch-weight estimates were available only for species groups (where the group members were undefined), so that individual stock-specific ratios could not be calculated. Developing conversion factors to estimate bycatch by weight and resolving grouping issues are recommended by this report, and should increase the number of stocks for which bycatch ratios are available.

Stock bycatch ratios ranged from 0.01 to 1.0. It is difficult to compare bycatch estimates across regions due to the large number of stocks included in this report and differences in the quantity and quality of data among regions, as well as the fact that the same stock may be bycaught in multiple regions. Stocks with bycatch ratios greater than 0.127 (the median of available stock bycatch ratios), and which met certain criteria for management importance, were designated as key stocks (Figure 8).

It is important to evaluate stock bycatch ratios and key stock classifications in relation to other factors, such as landings, management regulations, and public concern. For example, the highest fish bycatch ratios for Pacific Island stocks were for ocean sunfish (1.0) and escolar (0.88).[7] The high ratios for these stocks reflect how seldom they are landed (a high ratio can occur when a stock is landed very rarely in relation to the frequency of catch). Thus, a stock may have a high bycatch ratio but it may not necessarily call for concern. These considerations and others, such as overfished/overfishing status, were taken into account during the selection of key stocks.

Stocks with the highest bycatch ratios were captured in bottom trawl, longline, and gillnet fisheries, including the following:

- Groundfish species, including windowpane flounder (0.91), Atlantic halibut (0.45), spiny dogfish (0.90), red hake (0.78), offshore hake (0.42), silver hake (0.27), and monkfish (0.18), are major bycaught species in the New England and mid-Atlantic otter trawl and gillnet fisheries.

- Atlantic croaker, Gulf of Mexico stock (0.90), is a major bycaught species in the Gulf of Mexico shrimp trawl fishery.

- Arrowtooth flounder (0.44), rock sole (0.32), and flathead sole (0.23) are bycaught species in Alaska Region flatfish trawl fisheries. However, biomass estimates of arrowtooth flounder are three times the Bmsy level, with stocks continuing to increase in abundance. In 2005 the species was not considered marketable for human consumption but the industry continues to develop markets for this species to reduce the amount of discard.

- Northwest Region species with high bycatch ratios include cowcod (0.97), boccacio (0.79), spiny dogfish (0.70), lingcod (0.69), canary rockfish (0.68), and arrowtooth flounder (0.40), the majority of which are taken in the bottom trawl fishery.[8]

[6]That is, the ratio of bycatch of a single stock to total catch of that stock (within a region), versus a fishery bycatch ratio (as discussed in the previous section), which refers to the ratio of total fishery bycatch to total fishery catch.

[7]Marketability of escloar bycatch (landed as Hawaiian butterfish) has increased over the past decade, and it is expected that bycatch ratios are currently lower.

[8]In 2005, it was prohibited to retain cowcod in all sectors of the groundfish fishery. Bocaccio and canary rockfish had very restrictive retention limits in some sectors of the groundfish fishery and were prohibited in others, but some overall retention was still allowed in the 2005 fishery.

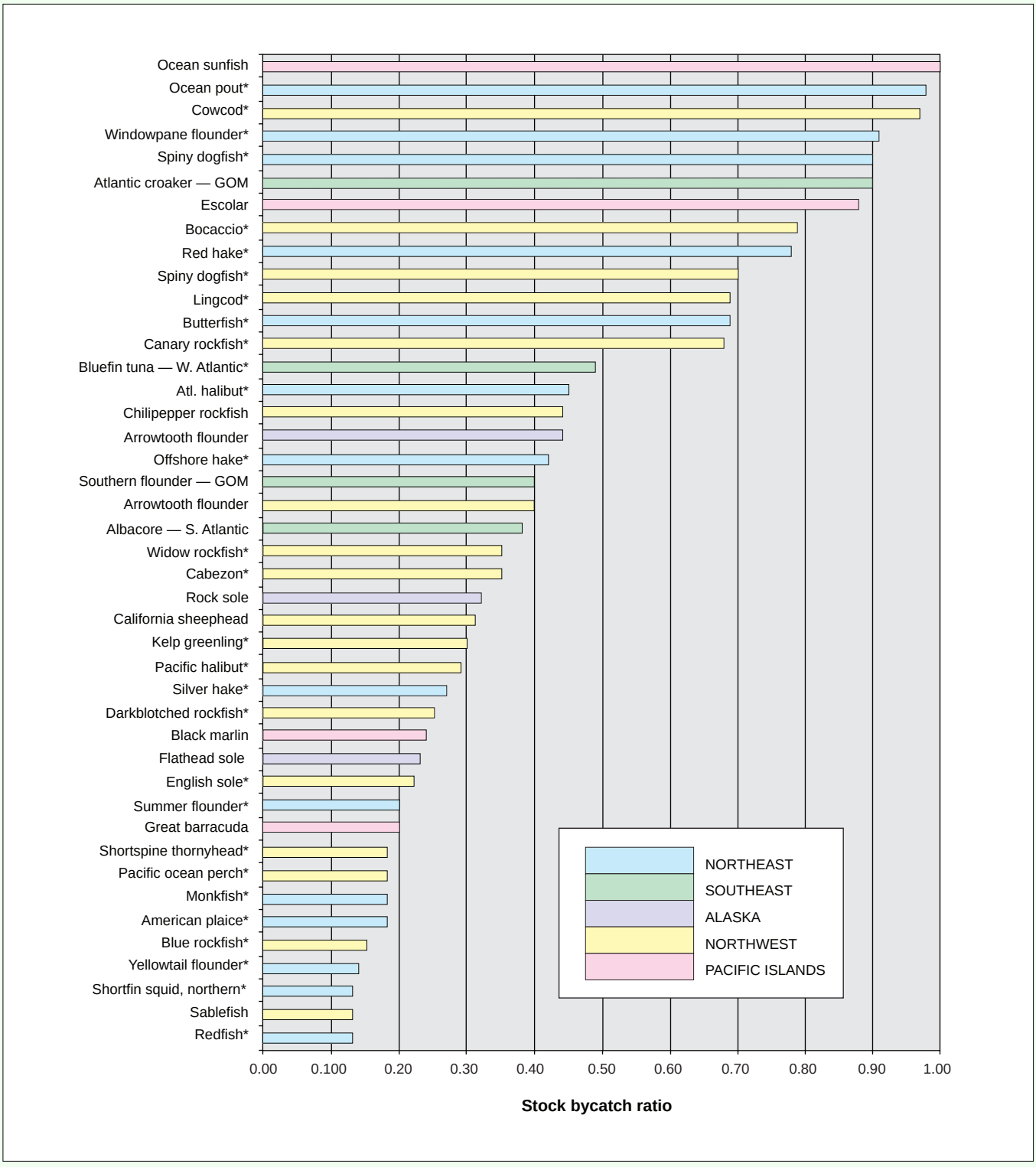


Figure 8
Fish stocks with fish bycatch ratios greater than 0.127 by NMFS region (2005 data). * indicates a key stock. GOM = Gulf of Mexico.

- Black marlin (0.24) and great barracuda (0.20), although they had high bycatch ratios, were rejected as key stocks due to low regional concern regarding these infrequently caught or landed species.

Marine mammal bycatch

Bycatch estimates for marine mammals, based on numbers of lethal takes and serious injuries, were calculated for 39 fisheries and totaled 1,887 animals from 54 stocks (Figures 9 and 10). The Northeast Region calculated marine mammal bycatch for 13 fisheries. This included 6 marine mammal stocks and a total bycatch estimate of 1,287 animals. The Pacific Islands Region calculated marine mammal bycatch for two fisheries, which encompassed 15 marine mammal stocks with a total of 26 bycaught animals.

The highest estimated marine mammal bycatch occurred in the Northeast Region and was comprised of harbor porpoise (652 animals), Atlantic white-sided dolphin (355), common dolphin (151), and long- and short-finned pilot whales (65). In the Southeast Region, bycatch of long- and short-finned pilot whales (135 animals) and the Western North Atlantic stock of Risso's dolphin (46) are being addressed through the Pelagic Longline Take Reduction Plan. The Bottlenose Dolphin Take Reduction Plan addresses both Southeast Region (105 animals) and Northeast Region (61) stocks of bottlenose dolphins. Bycatch of marine mammals in the Alaska, Northwest, and Southwest Regions is primarily composed of harbor porpoise in Alaska (36 animals), California sea lions in the Northwest and Southwest Regions (34 and 32, respectively), and northern right whale dolphins in the Southwest Region (18).

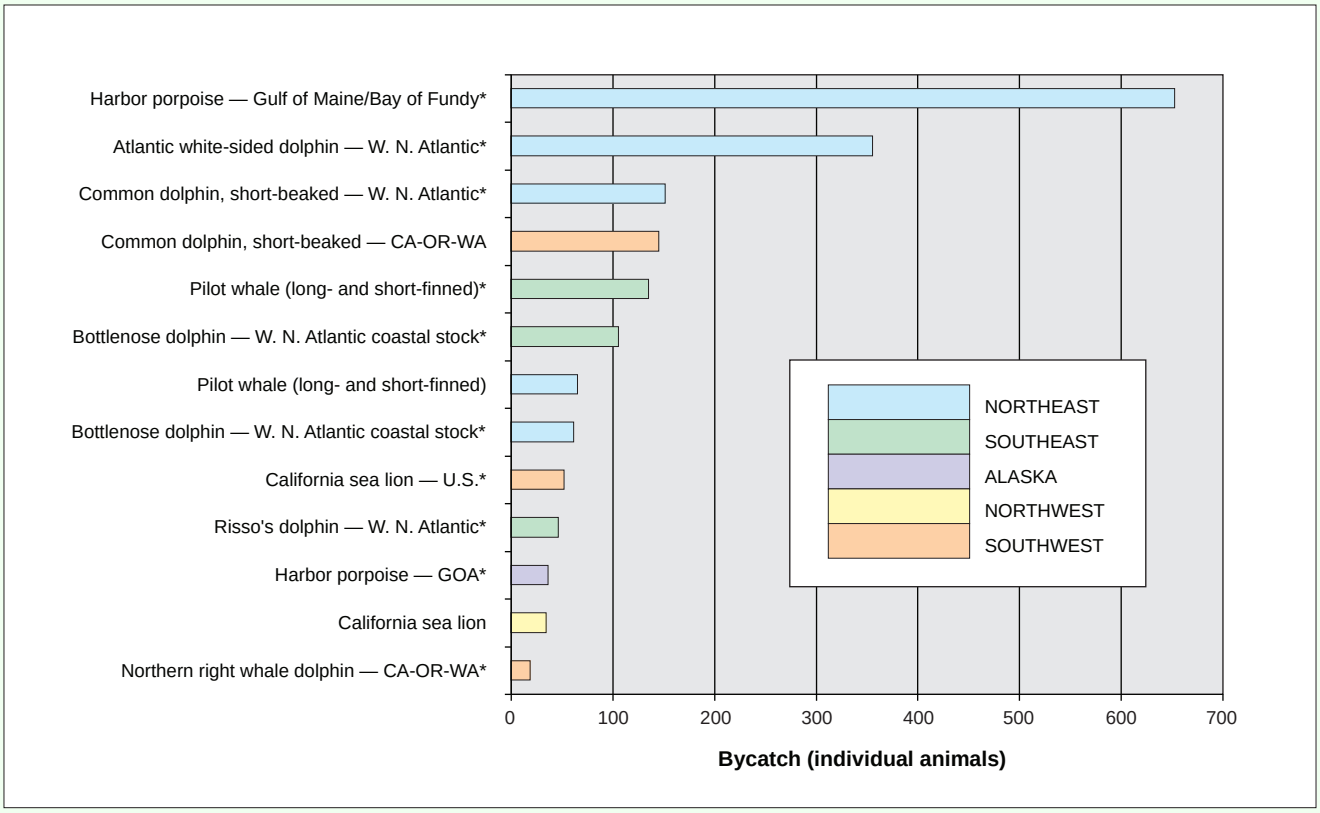


Figure 9
Marine mammal bycatch (lethal takes + serious injuries) for stocks with 10 or more bycaught animals by NMFS region. * indicates key stocks. The baseline year of data used in this report was 2005; however, for some rare-event species data from a range of years were used to generate a bycatch estimate. GOA = Gulf of Alaska.

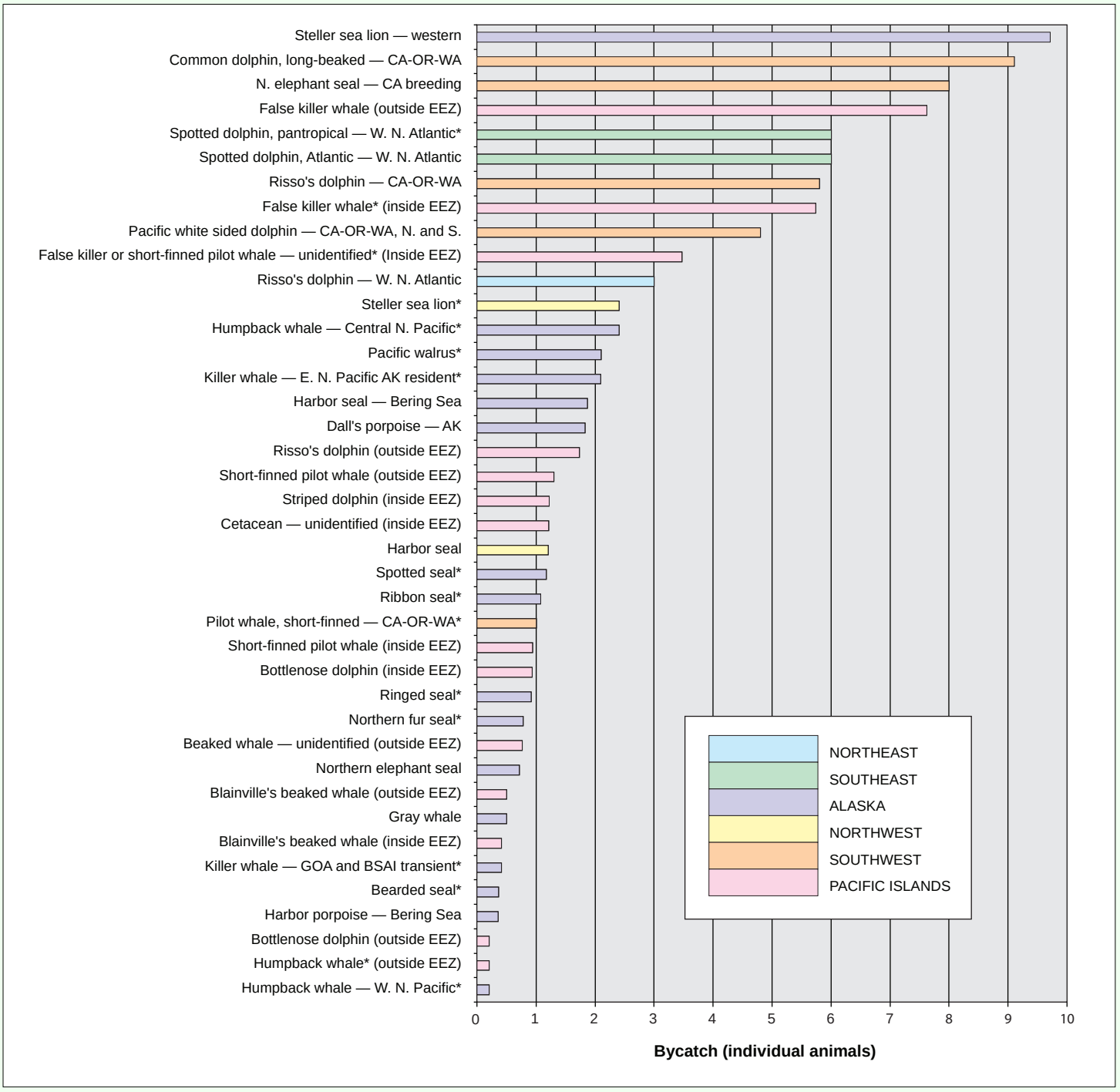


Figure 10

Marine mammal bycatch (lethal takes + serious injuries) for stocks with fewer than 10 bycaught animals by NMFS region. * indicates key stocks. The baseline year of data used in this report was 2005; however, for some rare-event species data from a range of years were used to generate a bycatch estimate. Data for marine mammal bycatch, which is considered a statistically rare event, are averaged over a number of years, occasionally resulting in a bycatch estimate that is a fraction. Note: zero estimates are not included in this figure, but are included in the regional chapters.

Sea turtle bycatch

Bycatch estimates for sea turtles were calculated for 21 fisheries, and included all U.S. sea turtle populations, with a total of 11,772 individual animals (Figure 11). Sea turtle bycatch estimates were not calculated for Alaskan fisheries, since sea turtles do not typically occur in this region. Also, sea turtle bycatch was not observed in any Northwest Region fisheries. The highest sea turtle bycatch estimates were for the Southeast Region, with estimates reported for ten fisheries and four sea turtle populations (and also for unidentified turtles), with a total sea turtle bycatch estimate of 10,671 individuals (shrimp trawl fishery estimates only included mortalities). Most bycaught sea turtles were loggerhead (5,209 animals), Kemp's ridley (4,222), and leatherback (537). These turtles were bycaught mainly in the reef fish, Atlantic pelagic longline, and Southeastern Atlantic and Gulf of Mexico shrimp trawl fisheries.[9] Note that the proportion of the stocks that these estimates represent is unknown because of the general lack of population size estimates for sea turtles.

[9]Bycatch estimates from the 2002 shrimp trawl fishery biological opinion (NMFS 2002). Since that time, effort in the shrimp fishery, and related bycatch, has decreased substantially.

Seabird bycatch

Bycatch of seabirds was estimated for 25 fisheries and totaled 7,769 animals with 28 individual estimates, including estimates for unidentified animals (Figure 12). Bycatch estimates were not calculated for the Northeast and Southwest Regions, although seabird data are collected by observer programs in these regions. This information will be analyzed and included in future editions of this report.

The highest reported bycatch levels were for the Alaska Region, which reported seabird bycatch in 19 fisheries, representing 12 seabird populations and totaling 7,280 seabirds. The major species of seabirds bycaught in the Alaska Region included northern fulmar (3,427 animals), gulls (2,101), shearwater (595), Laysan albatross (216), and unidentified seabirds (589; Figure 12). The majority of these seabirds were caught by trawl and longline fisheries. The Alaska Region has initiated cooperative work among industry, NMFS, Sea Grant, and the State of Alaska to develop gear modifications to reduce bycatch of seabirds. In addition, several studies have established methods to reduce seabird bycatch using streamers, which are now required by Federal regulation.

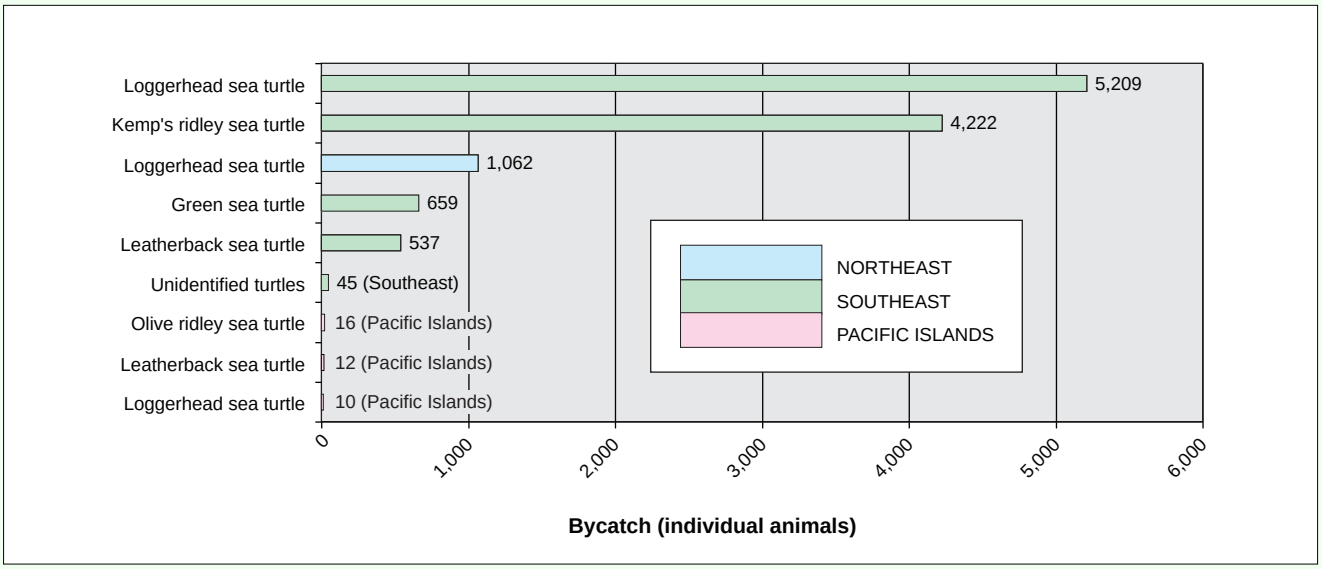


Figure 11

Bycatch estimates include mortalities and live releases for sea turtles. The baseline year of data used in this report was 2005; however, for some rare-event species data from a range of years were used to generate a bycatch estimate. Note that bycatch estimates for the Southeast and Gulf of Mexico shrimp trawl fisheries are from the 2002 shrimp trawl fishery biological opinion (NMFS 2002). Since 2002, effort and associated bycatch in the shrimp trawl fisheries have decreased substantially. Not shown is the bycatch of one olive ridley sea turtle in the Southwest Region.

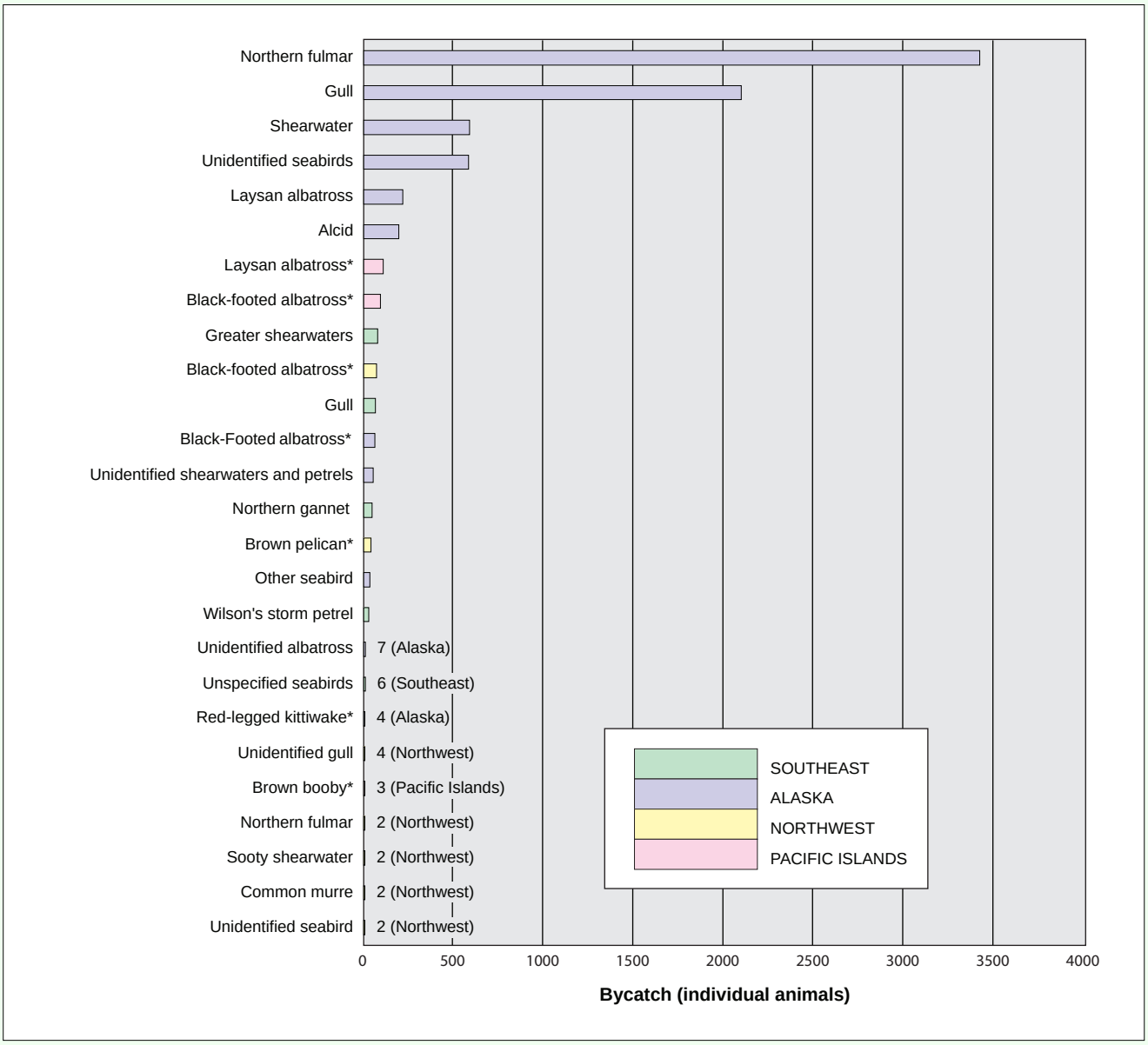


Figure 12
Estimated seabird bycatch by NMFS region. * indicates a key stock. The baseline year of data used in this report was 2005; however, for some rare-event species data from a range of years were used to generate the bycatch estimate. Note: zero estimates are not included.

Estimated seabird bycatch in the Southeast Region totaled 186[10] animals, with the highest bycatch of greater shearwater (75), gulls (61), northern gannet (44), and Wilson's storm petrel (24; Figure 12). The majority of these seabirds were bycaught in the Atlantic and Gulf of Mexico highly migratory species pelagic longline fishery and the South Atlantic coastal migratory pelagic longline fishery. In the Northwest, seabird bycatch totaled 106 animals, with the main species being black-footed albatross (59) and brown pelican (36). In the Pacific Islands, at total of 197 seabirds were reported as bycatch, with Laysan (105 animals) and black-footed albatross (89) having the highest bycatch levels. The only species with bycatch estimates of zero was a key stock, the short-tailed albatross (estimates of zero for the Alaska and Pacific Islands Regions—not shown in Figure 12).

[10]The estimation of total seabird bycatch was performed separately from the individual -species estimates, thus the individual species estimates do not sum to 186.

LOOKING AHEAD: IMPROVING BYCATCH DATA COLLECTION AND ESTIMATION

This report identifies eight national and regional recommendations to improve bycatch data collection and estimation. Maintenance and expansion of existing observer programs and implementation of new observer programs for fisheries and species with bycatch concerns are of particular importance. Funding levels for all existing regional observer programs, as of 2008, totaled $53.1 M (Federal and industry funds). Many specific recommendations are made to improve observer program data, supplemental data, and analytical techniques within each region; these recommendations are summarized here, and are presented in detail in the regional sections of Section 4. It was not possible to prioritize recommendations across regions due to the diversity in fisheries, management needs, and other factors. Eight national-level recommendations are provided below. These focus on improving data and estimation quality for fisheries and species considered in this edition of the U.S. National Bycatch Report, and on considering additional fisheries and species in future editions of the report. All recommendations should be considered high-priority, although some could be implemented relatively quickly and inexpensively, while others would require considerable investment of time and financial resources. As more fisheries and species are evaluated and reported, it is likely that additional resource needs will be identified.

Table 4
Resources needed to implement recommendations for improving bycatch data collection and estimation.[a]

Resources [a]	National Observer Program	Northeast	Southeast	Alaska	Northwest	Southwest	Pacific Islands	Total
Days-at-sea (DAS) [b] needed to maintain current observer programs	na	13,208	4,085	39,000	4,596	329	9,739	70,957
DAS needed to expand current observer programs	na	16,181 [e]	11,790	29,160	792	430	855	59,208
DAS needed to implement new observer programs	na	615	5,752	0 [f]	1,058	20	0	7,445
Full-time staff needed to implement improvements to estimation methods [c]	10 [d]	17	7	13	1	1	6	55

[a] Some recommendations may require additional resources such as equipment or staff support, which are not itemized.
[b] DAS estimates for maintaining and expanding current observer programs are based on 2008 figures.
[c] Observer program staffing and administrative needs are included when budgeting the cost for DAS and are not included in Table 4.
[d] Staffing support would not be directly for the National Observer Program, but would be used to assist with implementation of national recommendations.
[e] DAS estimate for the Northeast Region includes both fish and protected species needs; in some cases, this DAS estimate could be shared, and thus the overall number of DAS would be reduced.
[f] For the Alaska Region, much of the increased coverage would be applied to fisheries and vessels that have not previously been observed.

Recommendation #1: Develop and adopt best practices for estimating bycatch in U.S. commercial fisheries.

Methods for estimating bycatch vary by region and fishery. While all methods have been subjected to some level of review, many have not been formally peer reviewed. Further work to evaluate and improve current methods and to develop new approaches will lead to establishment of best practices, including procedures for estimation of variance and methods for extrapolating estimates from small sample sizes. Where count-based methods are currently employed, weight-based approaches should be developed and implemented. Improving the quantity and quality of bycatch estimates is essential to support information needs for management of commercial fisheries and protected resources. Providing measures of uncertainty associated with bycatch estimates is important for tracking improvements in both estimation methods and bycatch trends.

Recommendation #2: Improve national and regional catch databases.

Estimation of bycatch rates requires reliable information on total catch at the stock level. Inconsistencies between regional and national databases impeded estimation of stock bycatch ratios in a number of instances. Overall database improvements are necessary to resolve this problem. These improvements will enhance both quality and timeliness of bycatch estimates, as well as consistency of estimates made by different researchers.

Recommendation #3: Review and modify the tier classification system for application to commercial and recreational fisheries included in future editions of the U.S. National Bycatch Report.

Future editions of the U.S. National Bycatch Report should include bycatch estimates for additional commercial and recreational fisheries. The tier classification system developed in this report should be modified as necessary and applied to additional fisheries where possible. Coordination will be required with state, tribal, and international organizations to ensure accuracy and consistency. In order to maximize the usefulness of the tier system for tracking change and highlighting requirements for improvement, it will need to be as comprehensive as possible.

Recommendation #4: Increase the number of fishery and species bycatch estimates in future editions of the U.S. National Bycatch Report.

- **Commercial fisheries bycatch estimates:** Efforts should be made to develop bycatch estimates for all commercial fisheries where the necessary data are available. These estimates should be included in future editions of the U.S. National Bycatch Report. In the longer term, new data-collection programs should be implemented as a basis for bycatch estimation in those commercial fisheries identified as requiring bycatch monitoring.

- **Recreational fisheries bycatch estimates:** Inclusion of recreational bycatch estimates is necessary to estimate overall bycatch mortality for some species. Development of appropriate bycatch data-collection and analytical methods should be encouraged and supported.

- **Bycatch estimates for key stocks:** Lack of bycatch estimates for some of the key stocks identified in this report is of particular concern. Development of bycatch estimates for these stocks should be prioritized and these estimates should be included in future editons of the U.S. National Bycatch Report.

Additional stock- and fishery-specific bycatch estimates in future editons of the U.S. National Bycatch Report will provide new information to the public on the overall status of bycatch in the Nation's fisheries. Scientists and managers will be able to make use of this information for assessment and management, to evaluate the effectiveness of bycatch reduction measures, and to identify areas where improved management and/or innovative bycatch reduction methods are required.

Recommendation #5: Implement specific bycatch data-collection and estimation improvements in regional programs.

Several recommendations are made for improving bycatch data-collection and estimation within the regions. These include discard mortality studies; outreach; database infrastructure improvements; and collection and processing of supplemental data, especially logbook, VMS, and strandings and entanglement data, which are often essential for estimating bycatch. These types of data are required in many bycatch estimation approaches but are often lacking or of poor quality. Thus these improvements will result in overall improvements in bycatch data quality and the number of fisheries and stocks for which bycatch estimates are available.

Recommendation #6:
Maintain and expand existing regional observer programs.

Observer programs have been implemented in all NMFS regions; observer data are considered to be the most reliable source for bycatch estimation. Many U.S. observer programs are at suboptimal coverage levels, which vary depending on the characteristics of a fishery and the species of interest. Specific recommendations for maintaining and expanding observer coverage to optimal levels in existing programs are made in the regional sections. Maintenance of these programs is essential for ongoing estimation of bycatch and evaluation of mitigation measures. Expanding coverage of existing observer programs will improve the accuracy and precision of bycatch estimates in many instances.

Recommendation #7:
Implement new observer programs for fisheries and species with bycatch concerns.

New observer programs are recommended in most regions, for a total of 32 fisheries. These fisheries were identified through the fisheries of focus section process described in Section 3 (e.g., fisheries with a high bycatch ratio and bycatch of key stocks, or fisheries were identified through the qualitative process). Pilot observer coverage has been recommended by the relevant regional team as an initial step to address bycatch concerns in several instances. Recommendations for new observer programs also include electronic monitoring in some regions. Implementing new pilot observer programs will provide information on bycatch in fisheries where bycatch information is currently unavailable or available only in the form of unverified industry reports.

Recommendation #8:
Evaluate electronic monitoring systems, conduct pilot studies, and operationalize electronic monitoring technology where appropriate.

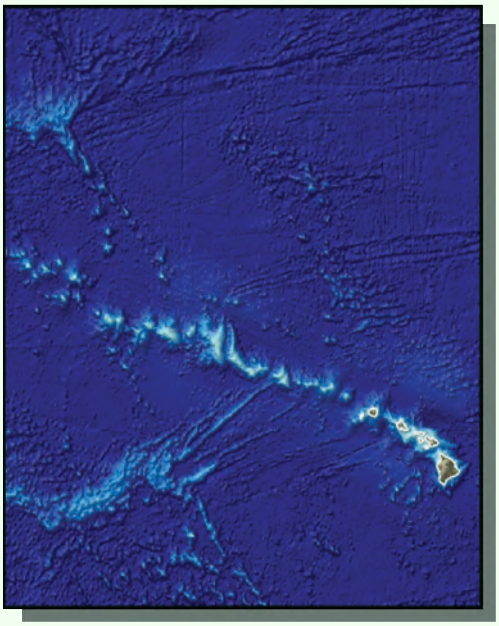
Use of video cameras and other electronic data acquisition systems has increased markedly during the last decade. Electronic monitoring has been used successfully for compliance monitoring and verification of self-reporting, and can provide useful information on catch quantity and composition, although species identification is only possible in some instances. The approach holds promise for addressing certain objectives (e.g., monitoring for compliance with discard prohibitions) and should be able to provide more detailed information on catch and bycatch composition as the technologies advance.

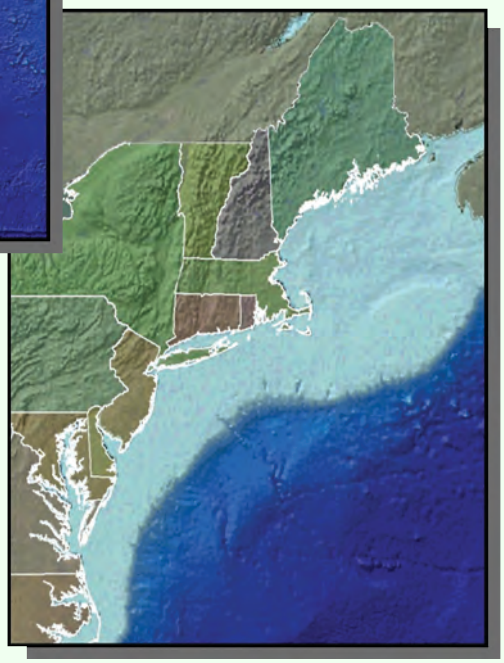
CONCLUSIONS

The recommendations included in this report provide guidance to the NMFS in setting priorities for maintaining existing bycatch data-collection programs, expanding programs where more reliable bycatch information is needed, and implementing new bycatch data-collection programs for fisheries with potential bycatch concerns. Implementation of these recommendations will assist NMFS to increase baseline knowledge of bycatch levels, help identify fisheries and/or species with potential bycatch concerns, and improve the monitoring of bycatch levels over time. Improved bycatch estimates will support the implementation of MSA-required annual catch limits and new management approaches such as catch-share programs, and in general will aid NMFS in addressing fishery-specific conservation and management concerns.

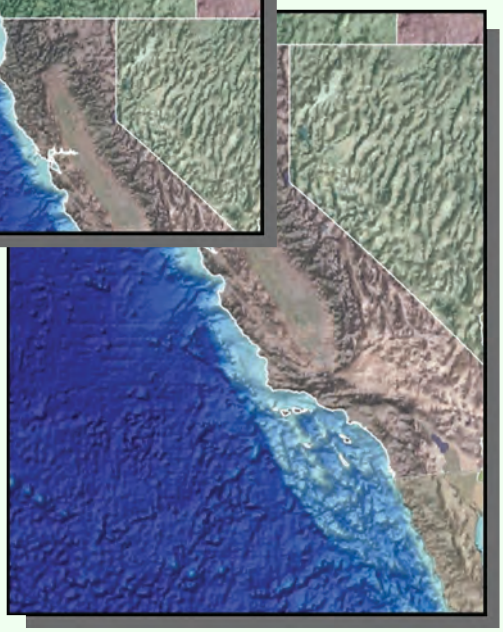
Two performance measures have been developed from the information compiled in this report: 1) the tier classification system, which will be used to monitor the quality of bycatch estimates in U.S. commercial fisheries; and 2) a list of key stocks, which will be used to monitor bycatch trends over time. These performance measures will assist NMFS in continuing to improve the effectiveness of bycatch monitoring programs, as well as reducing bycatch in key fisheries.

This is the first in a series of U.S. National Bycatch Reports. This edition contains bycatch estimates for federally managed commercial fisheries or with relevant federal data-collection programs. Future editions will include timely and periodic updates of bycatch estimates for federal fisheries, as well as estimates for state, international, and tribal fisheries where data are available. Inclusion of bycatch estimates for stocks with high recreational bycatch mortality will also be considered. Over time, the U.S. National Bycatch Report will provide NMFS, other fisheries management organizations, and the public with reliable bycatch estimates for all living marine resources, which can be used to more effectively meet NMFS' stewardship mission.



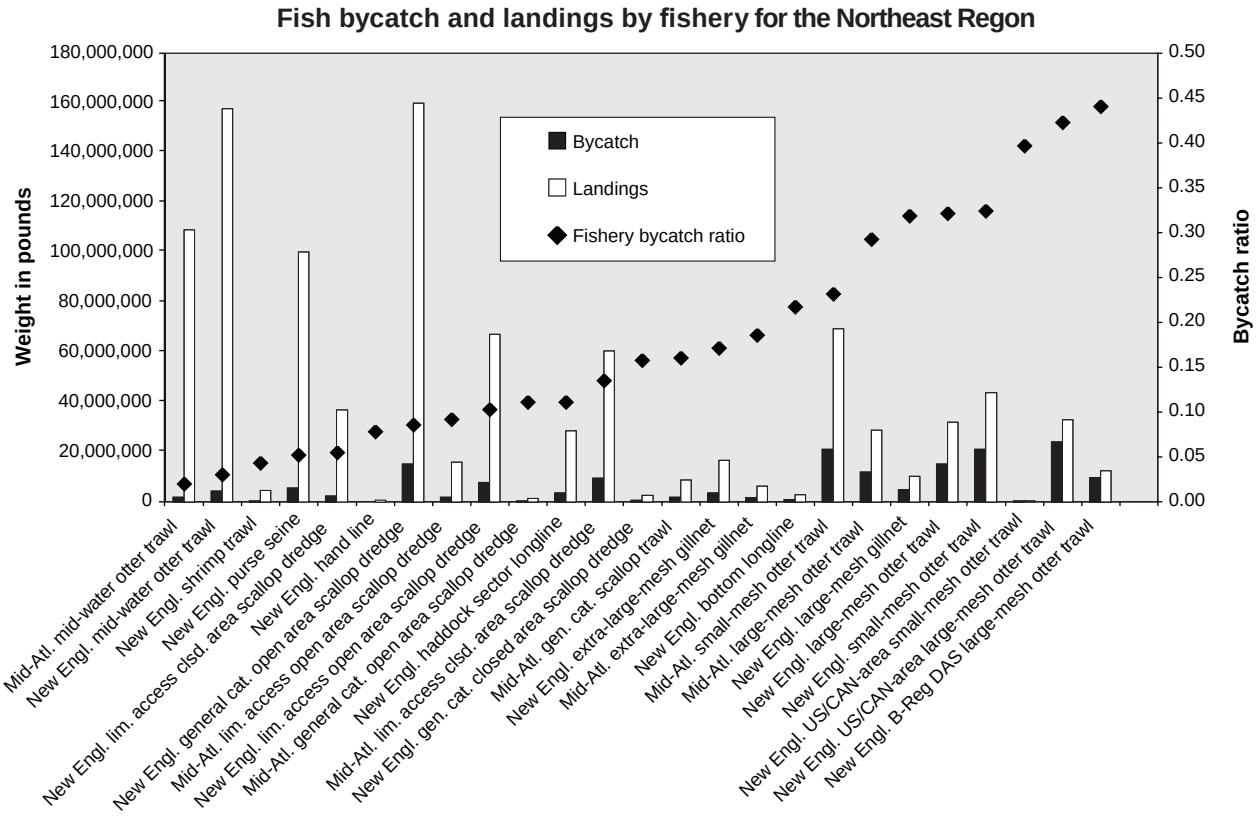


REGIONAL BYCATCH FACT SHEETS



Fast facts:

- A total of 63 commercial fisheries are included in this report for the Northeast Region.
- Landings from all Northeast fisheries were valued at approximately $1.4 billion in 2005.
- Thirteen FMPs regulate the harvest of federally managed species in the Northeast Region.
- An observer program monitors 33 of the 63 fisheries.
- Fish bycatch estimates are available for 25 fisheries and 34 species or species groups.
- Protected species bycatch estimates are available for 13 fisheries and 7 species or species groups.



Bycatch reduction success stories (2005 to present):

- "Weak links" are required on the surface system of gillnet and trap/pot fishing gear to reduce the risk of whales becoming entangled, injured, or killed.
- "Chain mats" are required in the Atlantic sea scallop dredge fishery to reduce the severity (i.e., mortality and injury) of sea turtle interactions with the gear.
- Implementation of acoustic deterrent devices (known as “pingers”) on fishing gear in the Northeast gillnet fishery within seasonal management areas under the Gulf of Maine Harbor Porpoise Take Reduction Plan reduced harbor porpoise bycatch interactions with gillnet gear by 92%.
- The Ruhle Trawl (World Wildlife Fund SmartGear competition winner) reduced bycatch in stocks of concern while catch of the target species did not significantly change (catch ratio of haddock to cod improved from 3:1 in the control net to 20:1 in the test trawl, and skate bycatch was reduced by 98%).

Bycatch of Northeast Region key stocks in 2005 [a]

Fish and invertebrates	Bycatch estimate (lb) [b]	Bycatch ratio
American plaice	667,000	0.18
Atlantic cod	1,920,000	0.12
Atlantic halibut	30,000	0.45
Atlantic salmon	0	*
Black sea bass	188,000	0.07
Butterfish	2,173,000	0.69
Haddock	1,190,000	0.07
Monkfish	9,100,000	0.18
Ocean pout	346,000	0.98
Offshore hake	21,000	0.42
Red hake	3,371,000	0.78
Redfish	186,000	0.13
Scup	1,207,000	0.11
Shortfin squid, northern	3,507,000	0.13
Shortnose sturgeon	0	*
Silver hake	6,083,000	0.27
Skate complex (multiple species)	79,561,000	*
Spiny dogfish	21,471,000	0.90
Summer flounder	3,250,000	0.20
Windowpane flounder	1,865,000	0.91
Yellowtail flounder	1,511,000	0.14

Protected species	Bycatch estimate (individuals) [b]
Atlantic white-sided dolphin	355
Blue whale	*
Bottlenose dolphin, western North Atlantic coastal stock	61
Common dolphin	151
Fin whale	*
Harbor porpoise	652
Humpback whale	*
North Atlantic right whale	*
Pilot whale (long- and short-finned)	65
Sei whale	*
Sperm whale	*
Green sea turtle	*
Hawksbill sea turtle	*
Kemp’s ridley sea turtle	*
Leatherback sea turtle	*
Loggerhead sea turtle	1,062
Cahow (Bermuda petrel)	*
Red-throated loon, Atlantic	*
Roseate tern, northeast nesting population	*

[a] Total # of key stocks for Northeast = 55; in some cases estimates are available only at the species (or species group) level and cannot be assigned to the appropriate key stock. Therefore, there are fewer than 55 bycatch estimates listed in this table. A full list of Northeast Region key stocks is included in Section 4.1. (Note: bycatch estimates of rare-event species may incorporate data from a range of years)

[b] Estimates have been rounded.

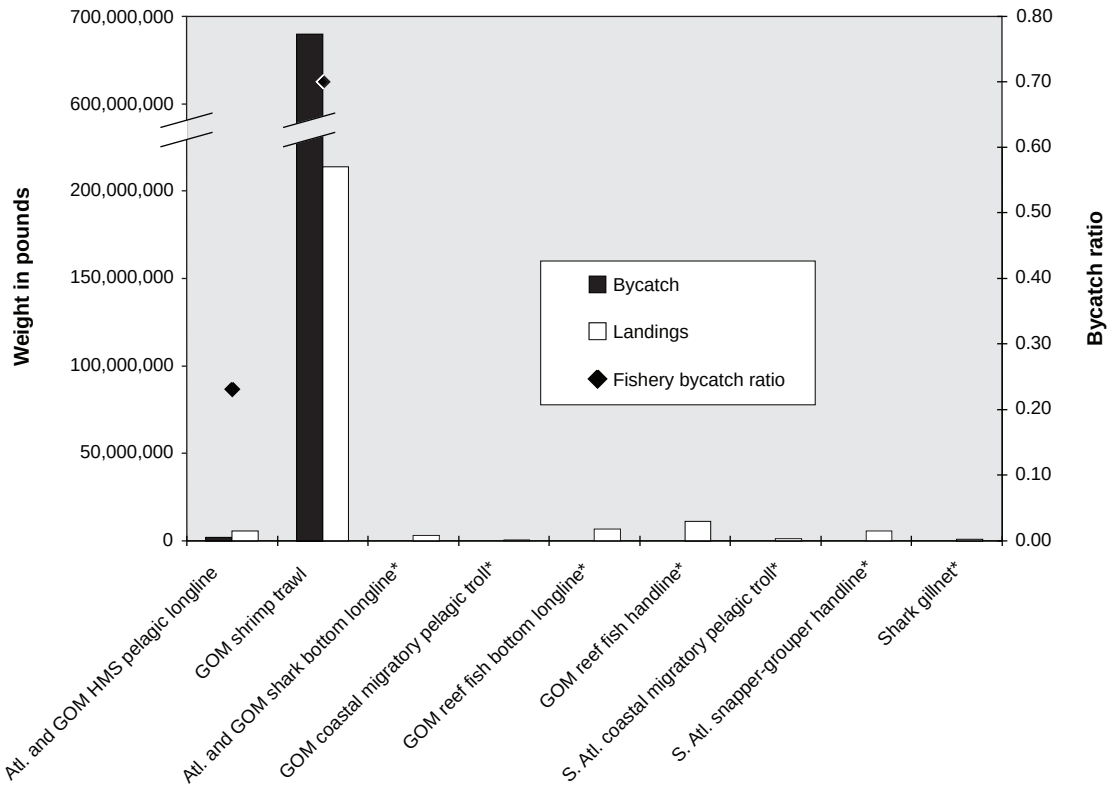
*Indicates that landings were not available for a species (or species is not landed, as for protected species), bycatch was not observed, or was observed but no estimate is available, or bycatch and landings were in different units, so no bycatch ratio could be developed (fish). Please see Section 4.1 for further information.

Fast facts:

- A total of 48 commercial fisheries are included in this report for the Southeast Region.
- Landings from all Southeast fisheries were valued at approximately $756 million in 2005.
- Seventeen FMPs regulate the harvest of federally managed species in the Southeast Region.
- Observer programs are in place for 12 of the 48 fisheries.
- Fish bycatch estimates are available for 9 fisheries and 214 species or species groups.
- Protected species bycatch estimates are available for 10 fisheries and 12 species or species groups.

Fish bycatch and landings by fishery in the Southeast Region

(* indicates bycatch data in number of individuals, no bycatch ratio possible)



Bycatch of Southeast Region key stocks in 2005 [a]

Fish and invertebrates	Bycatch estimate [b]	Unit	Bycatch ratio
Bigeye tuna, S. Atlantic	33,000	Pounds	0.08
Black grouper	72,000	Individuals	*
Black sea bass (multiple stocks)	15,000	Individuals	*
Black sea bass, S. Atlantic	10	Individuals	*
Black snapper	10	Individuals	*
Blackfin snapper	300	Individuals	*
Blue marlin, S. Atlantic	54,000	Pounds	*
Blue shark, S. Atlantic	146,000	Pounds	*
Bluefin tuna, W. Atlantic	288,000	Pounds	0.49
Bull shark	1,200	Individuals	*
	157,000	Pounds	*
Cobia (multiple stocks)	3,100	Individuals	*
Cobia, Gulf of Mexico	37,000	Pounds	*
Dolphinfish	4,800	Individuals	*
Dusky shark	2,700	Individuals	*
	571,000	Pounds	*
Gag (multiple stocks)	86,000	Individuals	*
Gag, Gulf of Mexico	7,400	Pounds	*
Gag, S. Atlantic	11,000	Pounds	*
Goliath grouper (multiple stocks)	3,800	Individuals	*
Goliath grouper, S. Atlantic/Gulf of Mexico	72,000	Pounds	*
Gray snapper	45,000	Individuals	*
Gray triggerfish	2,000	Individuals	*
Great hammerhead shark, S. Atlantic/Gulf of Mexico	192,000	Pounds	*
Greater amberjack	266,000	Individuals	*
Gulf sturgeon			*
Hogfish	240	Individuals	*
King mackerel, Atlantic group	270	Individuals	*
King mackerel, Gulf group	380,000	Pounds	*
Lane snapper	3,700	Individuals	*
	1,623,000	Pounds	*
Little tunny	3,000	Individuals	*
	48	Individuals	*
Lemon shark	650	Individuals	*
Mutton snapper	4,500	Individuals	*
Nassau grouper	1,300	Individuals	*
Red drum (multiple stocks)	47,500	Individuals	*
Red drum, Gulf of Mexico	406,000	Pounds	*
Red drum, S. Atlantic	4	Individuals	*
Red grouper (multiple stocks)	862,000	Individuals	*
Red grouper, Gulf of Mexico	51,000	Pounds	*
Red grouper, S. Atlantic	6,400	Pounds	*
Red porgy, S. Atlantic	33,000	Individuals	*
Red snapper (multiple stocks)	2,570,000	Individuals	*
Red snapper, Gulf of Mexico	713,000	Pounds	*
Sailfish (multiple stocks)	440	Individuals	*
Sailfish, West Atlantic	22	Individuals	*
Sandbar shark	4,900	Individuals	*
	149,000	Pounds	*
Scalloped hammerhead shark, S. Atlantic	139	Individuals	*
Scalloped hammerhead shark, S. Atlantic/Gulf of Mexico	117,000	Pounds	*
Scamp	37,000	Individuals	*
Shortnose sturgeon			*
Silk snapper	17	Individuals	*
Silky shark	34	Individuals	*
	42,000	Pounds	*
Smalltooth sawfish	61	Individuals	*
Snowy grouper	2,700	Individuals	*
Spanish mackerel	62,000	Individuals	*
Spanish mackerel, Gulf group	3,561,000	Pounds	*
Speckled hind	10,400	Individuals	*
Spinner shark	6,800	Individuals	*
	8	Individuals	*
Warsaw grouper	7,900	Individuals	*
White grunt	7,200	Individuals	*
White marlin, S. Atlantic	38,000	Pounds	*
Wreckfish	38	Individuals	*
Yellowedge grouper	1,900	Individuals	*
Yellowfin grouper	640	Individuals	*
Yellowtail snapper	410,000	Individuals	*

[a] Total # of key stocks for Southeast = 82; in some cases estimates are only available at the species (or species group) level and cannot be assigned to the appropriate key stock. Therefore, there are fewer than 82 bycatch estimates listed in this table. A full list of Southeast Region key stocks is included in Section 4.2. (Note: bycatch estimates of rare-event species may incorporate data from a range of years.)

[b] Estimates have been rounded.

[c] Bycatch estimates from the 2002 shrimp fishery biological opinion (NMFS 2002). Since that time, effort in the shrimp fishery, and presumably bycatch, has decreased dramatically.

* Indicates landings were not available for a species (or species is not landed, as for protected species), bycatch was not observed, or was observed but no estimate is available, or bycatch and landings were in different units, so no bycatch ratio could be developed (fish). Please see Section 4.2 for further information.

Bycatch reduction success stories (2005 to present):

- Bycatch reduction devices to reduce finfish bycatch are required in all Southeastern shrimp fisheries.
- Turtle excluder devices (TEDs) have been required in all shrimp trawls (with limited exceptions) since the mid-1990s. TEDs allow for release of an estimated 97% of the turtles caught in shrimp trawls.
- Gear regulations in the Atlantic pelagic longline fishery for Highly Migratory Species have reduced interactions with endangered and threatened sea turtles, while closures are utilized to reduce interactions with undersized swordfish and other species.
- Mesh size in the back panel of black sea bass pots has been increased to 2 inches to reduce bycatch of undersized black sea bass.
- Requirements for buoy lines on black sea bass pots have been modified to reduce takes of protected species.
- Harvest limits and time and area closures have resulted in bycatch reductions in some fisheries.

Bycatch of Southeast Region key stocks in 2005 [a]
(continued from previous page)

Protected species	Bycatch estimate (individuals) [b]
Green sea turtle [c]	659
Kemp's ridley sea turtle [c]	4,222
Leatherback sea turtle [c]	537
Loggerhead sea turtle [c]	5,209
Bottlenose dolphin, western North Atlantic coastal	105
Pilot whale, long- and short-finned	70
Risso's dolphin, western North Atlantic	46
Spotted dolphin, pantropical, western North Atlantic	6

[a] Total # of key stocks for Southeast = 82; in some cases estimates are available only at the species (or species group) level and cannot be assigned to the appropriate key stock. Therefore, there are fewer than 82 bycatch estimates listed in this table. A full list of Southeast Region key stocks is included in Section 4.2. (Note: bycatch estimates of rare-event species may incorporate data from a range of years.)

[b] Estimates have been rounded.

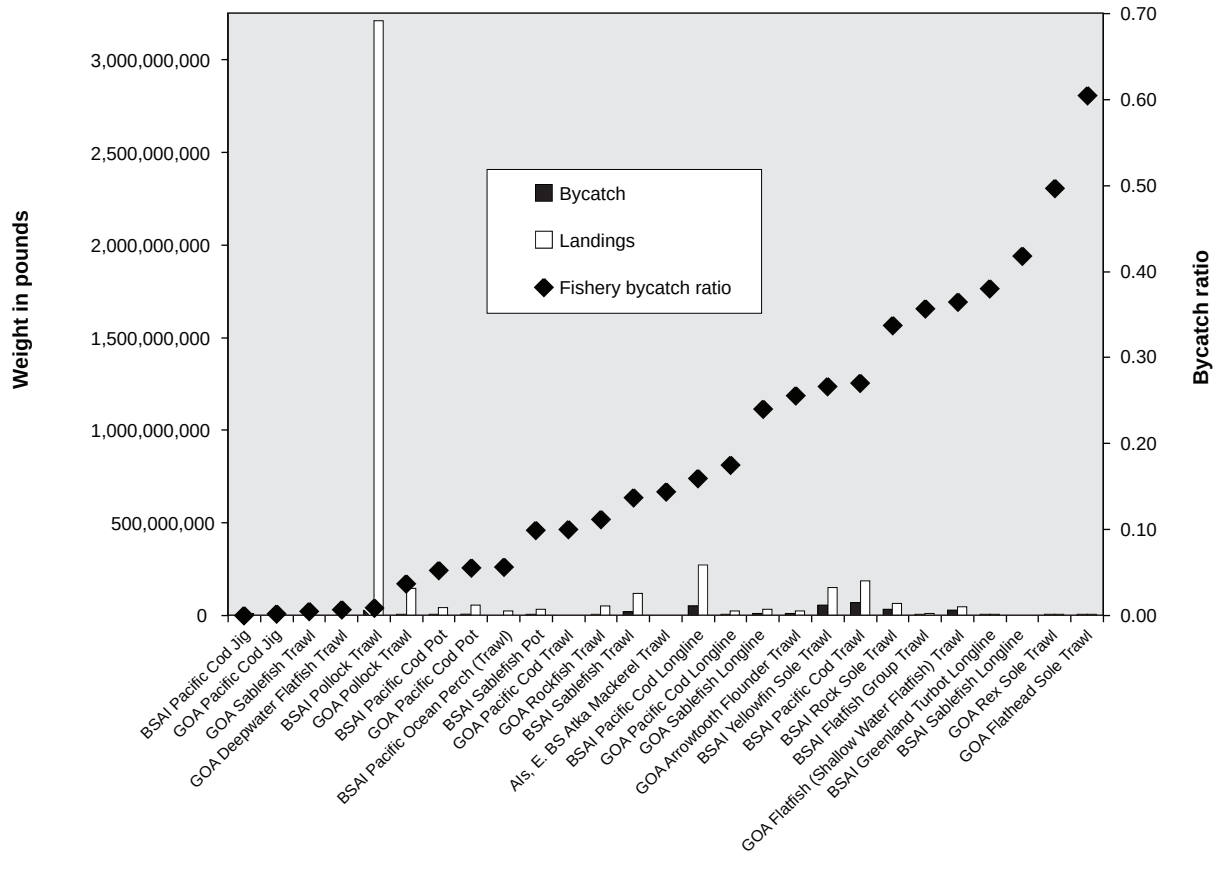
[c] Sea turtle bycatch estimate includes estimates from the 2002 shrimp fishery biological opinion (NMFS 2002). Since that time, effort in the shrimp fishery, and presumably bycatch, has decreased dramatically.

Fast facts:

- A total of 77 commercial fisheries are included in this report for the Alaska Region.
- Landings from all Alaskan fisheries were valued at approximately $1.367 billion in 2005.
- Five FMPs regulate the harvest of federally managed species in the Alaska Region.
- Observer programs are in place for 27 of the 77 fisheries. All Federal fisheries are observed.
- Fish bycatch estimates are available for 27 fisheries and 91 species or species groups.
- Protected species bycatch estimates are available for 19 fisheries and 29 species or species groups.

Fish bycatch and landings by fishery for the Alaska Region

The Bering Sea/Aleutian Islands Flatfish Group (arrowtooth flounder, flathead sole, and other flatfish) trawl fishery has been abbreviated as "BSAI Flatfish Group Trawl." (BSAI = Bering Sea / Aleutian Islands, BS = Bering Sea, GOA = Gulf of Alaska, Als = Aleutian Islands)



Bycatch reduction success stories (2005 to present):

- Catch-share programs have eliminated the race for fish in many fisheries, greatly reducing economic discards.
- Annual quota specification process results in fishery closures (and bycatch reductions) when target or bycatch quotas are reached.
- Regulations limit or prohibit discard in many fisheries.
- Agency/industry collaboration has resulted in innovative measures such as streamer lines to reduce bird bycatch and gear improvements to reduce finfish bycatch.
- Industry-managed cooperatives in some fisheries have changed fleet behavior, leading to reduction of bycatch.
- Bycatch retention or harvest limits and/or time and area closures have resulted in bycatch reductions in some fisheries.

Bycatch of Alaska Region key stocks in 2005 [a]

Fish and invertebrates	Bycatch estimate (lb) [b]	Bycatch ratio
Blue king crab (multiple stocks)	5,400	*
Chinook salmon	721,100	*
Demersal shelf rockfish (multiple stocks)	160	*
Golden king crab, Aleutian Islands	16,900	*
Non-Chinook salmon	3,350,000	*
Red king crab (multiple stocks)	630,000	*

[a] Total # of key stocks for Alaska = 36; in some cases estimates are only available at the species (or species group) level and cannot be assigned to the appropriate key stock. Therefore, there are fewer than 36 bycatch estimates listed in this table. A full list of Alaska Region key stocks is included in Section 4.3. (Note: bycatch estimates of rare-event species may incorporate data from a range of years.)

[b] Estimates have been rounded.

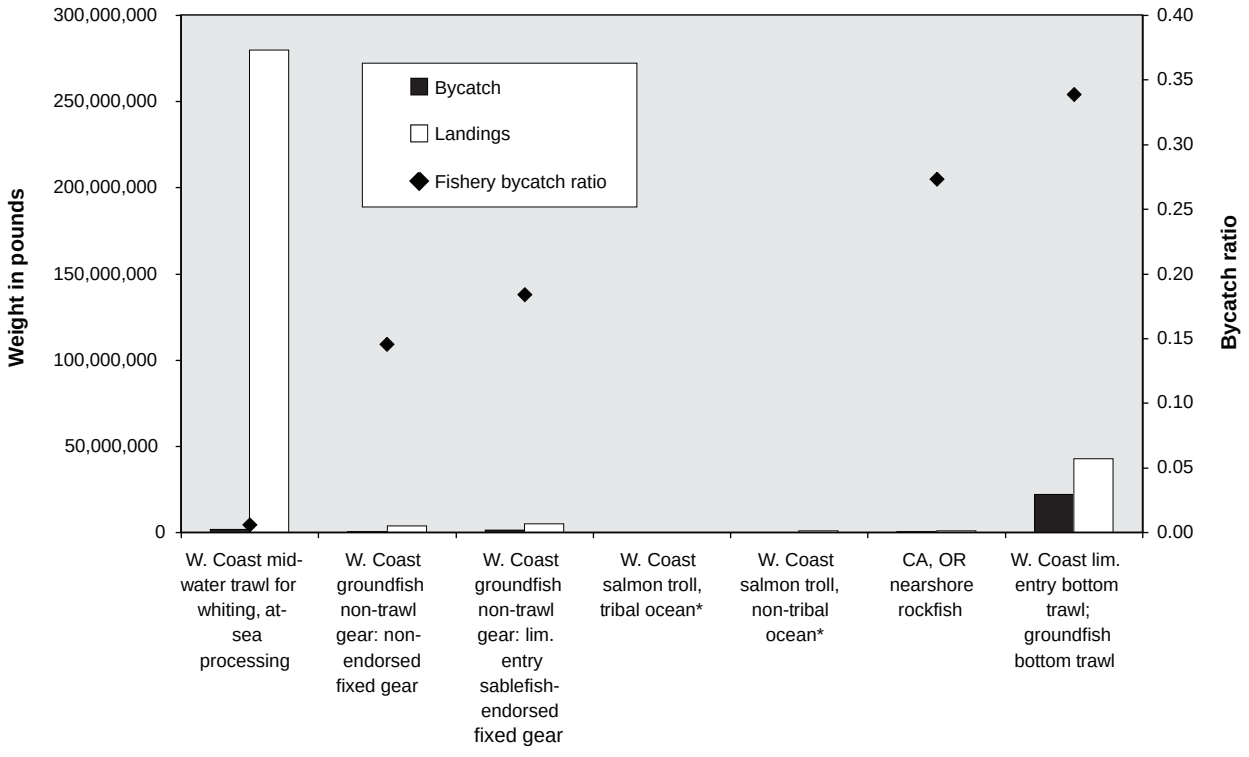
* Indicates landings were not available for a species (or species is not landed, as for protected species), bycatch was not observed or was observed but no estimate is available, or bycatch and landings were in different units, so no bycatch ratio could be developed (fish). Please see Section 4.3 for further information.

Protected species	Bycatch estimate (individuals) [b]
Bearded seal	0.4
Beluga whale, Cook Inlet	*
Bowhead whale	*
Fin whale	*
Harbor porpoise, Gulf of Alaska	36
Humpback whale, central north Pacific	2
Humpback whale, western north Pacific	0.2
Killer whale, eastern north Pacific Alaska resident	2
Killer whale, Gulf of Alaska, Aleutian Islands, and Bering Sea transient	0.4
Northern fur seal	0.8
Pacific walrus	2
Ribbon seal	1
Right whale, north Pacific	*
Ringed seal	1
Sei whale	*
Sperm whale	*
Spotted seal	1
Steller sea lion	10
Black-footed albatross	67
Red-legged kittiwake	4
Short-tailed albatross	0

Fast facts:

- A total of 30 commercial fisheries are included in this report for the Northwest Region.
- Landings from Oregon and Washington fisheries were valued at approximately $281 million dollars in 2005.
- Two FMPs regulate the harvest of federally managed species in the Northwest Region.
- Observer programs are in place for 9 of the 30 fisheries.
- Fish bycatch estimates are available for 7 fisheries and 53 species or species groups.
- Protected species bycatch estimates are available for 5 fisheries and 13 species or species groups.

Fish bycatch and landings by fishery for the Northwest Region
(* indicates bycatch data in number of individuals, no bycatch ratio possible)



Bycatch of Northwest Region key stocks in 2005 [a]

Fish and invertebrates	Bycatch estimate [b]	Unit	Bycatch ratio
Arrowtooth flounder	3,245,000	Pounds	0.4
Big skate	335,000	Pounds	*
Black rockfish	14,300	Pounds	0.04
Blue rockfish	7,720	Pounds	0.15
Bocaccio	61,200	Pounds	0.79
Cabezon	71,400	Pounds	0.35
Canary rockfish	57,000	Pounds	0.68
Chinook salmon (multiple DPS)	170,000	Individuals	*
Chum salmon (multiple DPS)		Individuals	*
Coho salmon (multiple DPS)	30,000	Individuals	*
Cowcod	3,090	Pounds	0.97
Darkblotched rockfish	62,200	Pounds	0.25
Deeper nearshore species (multiple species)	27,600	Pounds	*
Dover sole	1,454,000	Pounds	0.09
Dungeness crab	562,000	Pounds	0.01
English sole	666,000	Pounds	0.22
Kelp greenling	21,800	Pounds	0.3
Lingcod	989,000	Pounds	0.69
Longnose skate	1,515,000	Pounds	*
Longspine thornyhead	203,000	Pounds	0.12
Other minor nearshore rockfish (multiple species)	1,540	Pounds	*
Other nearshore rockfish (multiple stocks)	0	Pounds	*
Pacific halibut	954,000	Pounds	0.29
Pacific ocean perch	24,900	Pounds	0.18
Petrale sole	121,000	Pounds	0.02
Shortspine thornyhead	295,000	Pounds	0.18
Sockeye salmon (multiple DPS)			*
Spiny dogfish	2,765,000	Pounds	0.7
Steelhead (multiple DPS)			*
Unspecified skate 1 (multiple species)	342,000	Pounds	*
Unspecified skate 2 (multiple species)	2,200	Pounds	*
Widow rockfish	127,000	Pounds	0.35
Yelloweye rockfish	6,680	Pounds	*

Protected species	Bycatch estimate (individuals) [b]
Blue whale	*
Fin whale	*
Humpback whale	*
Killer whale, southern resident	*
Sei whale	*
Sea otter, CA	*
Sperm whale	*
Steller sea lion	2
Black-footed albatross	59
Brown pelican	36
California least tern	*
Hawaiian dark-rumped petrel	*
Least tern, interior population	*
Marbled murrelet, CA, OR, WA	*
Newell's Townsend's shearwater	*
Short-tailed albatross	*
Green sea turtle	*
Kemp's ridley sea turtle	*
Leatherback sea turtle	*
Loggerhead sea turtle	*
Olive ridley sea turtle	*

[a] Total # of key stocks for Northwest = 81; in some cases estimates are available only at the species (or species group) level and cannot be assigned to the appropriate key stock. Therefore, the total number of estimates listed in the table does not add up to 81. A full list of Alaska Region key stocks is included in Section 4.3. (Note: bycatch estimates of rare-event species may incorporate data from a range of years.)

[b] Estimates have been rounded.

* Indicates landings were not available for a species (or species is not landed, as for protected species), bycatch was not observed, or was observed but no estimate is available, or that bycatch and landings are in different units, so no bycatch ratio could be developed (fish). Please see Section 4.4 for further information.

DPS = Distinct Population Segment.

Bycatch reduction success stories (2005 to present):

- Bycatch caps instituted in the Pacific hake fishery ensure that bycatch of rebuilding rockfish stocks remains within target levels.
- Trawl gear regulations, such as footrope size limitation and the mandatory use of selective trawl net designs, assisted in reducing depleted rockfish species bycatch in the groundfish fisheries.
- Area- and depth-related closures in the groundfish fisheries further reduce bycatch of depleted rockfish species.
- Measures such as permit stacking and a permit/vessel buyback reduced fishing capacity in the groundfish fisheries to better match the amount of fishing effort needed to harvest available resources, and therefore reduced overall bycatch.

Fast Facts:

- A total of 25 commercial fisheries are included in this report for the Southwest Region.
- Landings from all Southwest Region fisheries were valued at approximately $116 million in 2005.
- Four FMPs regulate the harvest of federally managed species in the Southwest Region.
- Observer programs are in place for 10 of the 25 fisheries.
- Protected species bycatch estimates are available for 3 fisheries and 9 species or species groups.
- Fish bycatch estimates were not available for the Southwest Region when this report was developed (estimates will be included in the next edition of the National Bycatch Report).

Bycatch of Southwest Region Key Stocks in 2005

Protected species	Bycatch estimate (individuals) [a]
Blue whale	*
Bowhead whale	*
California sea lion	51
Common dolphin, long-beaked, CA/OR/WA	9
Fin whale	*
Guadalupe fur seal	*
Harbor seal, California	*
Humpback whale	*
Killer whale, Southern Resident	*
Northern right whale dolphin, CA/OR/WA	18
Sea otter, California	*
Sei whale	*
Short-finned pilot whale, CA/OR/WA	1
Sperm whale	*

Protected species	Bycatch estimate (individuals) [a]
Green sea turtle	*
Leatherback sea turtle	*
Loggerhead sea turtle	*
Olive ridley sea turtle (two stocks)	1
Ashy storm-petrel	*
Brown pelican, except US Atlantic coast, Florida	*
California least tern	*
Hawaiian dark-rumped petrel	*
Least tern, interior population	*
Marbled murrelet, CA/OR/ WA	*
Newell's Townsend's shearwater	*
Short-tailed albatross	*

[a] Estimates have been rounded.
* Indicates that no bycatch was observed, or that bycatch estimates are not available. See Section 4.5 for details.
Note: bycatch estimates of rare-event species may incorporate a range of years.

Southwest Region Key Fish Stocks

Fish and invertebrates
Albacore, N. Pacific
Albacore, S. Pacific
Arrowtooth flounder
Bank rockfish
Basking shark
Bigeye tuna, Pacific
Black rockfish, Pacific Coast, N.
Blackgill rockfish
Blue rockfish
Blue shark, N. Pacific
Bluefin tuna, Pacific
Bocaccio
Brown rockfish
Cabezon
California scorpionfish
Canary rockfish
Chilipepper rockfish
Chinook salmon (nine DPSs)
Coho salmon (three DPSs)
Chum salmon (two DPSs)
Cowcod
Darkblotched rockfish
Dolphinfish, Pacific
Dover sole
English sole
Giant sea bass
Gopher rockfish
Indo-Pacific blue marlin, Pacific
Jack mackerel
Kawakawa, tropical Pacific
Kelp greenling
Lingcod
Longnose skate
Longspine thornyhead
Market squid
Megamouth shark
Northern anchovy, central subpopulation

Fish and invertebrates
Northern anchovy, northern subpopulation
Opah, Pacific
Pacific chub mackerel
Pacific cod
Pacific grenadier
Pacific hake
Pacific ocean perch
Pacific sanddab
Pacific sardine
Petrale sole
Rex sole
Rougheye rockfish
Sablefish
Sand sole
Shortbelly rockfish
Shortbill spearfish, Pacific
Shortspine thornyhead
Skipjack tuna, central western Pacific
Skipjack tuna, eastern Pacific
Sockeye salmon (two DPSs)
Spiny dogfish
Splitnose rockfish
Starry flounder
Steelhead (ten DPSs)
Striped marlin, central Western Pacific
Striped marlin, eastern Pacific
Swordfish, N. Pacific
Totoaba
Vermilion rockfish
Wahoo, Pacific
White shark
Widow rockfish
Yelloweye rockfish
Yellowfin tuna, central western Pacific
Yellowfin tuna, eastern Pacific
Yellowtail rockfish

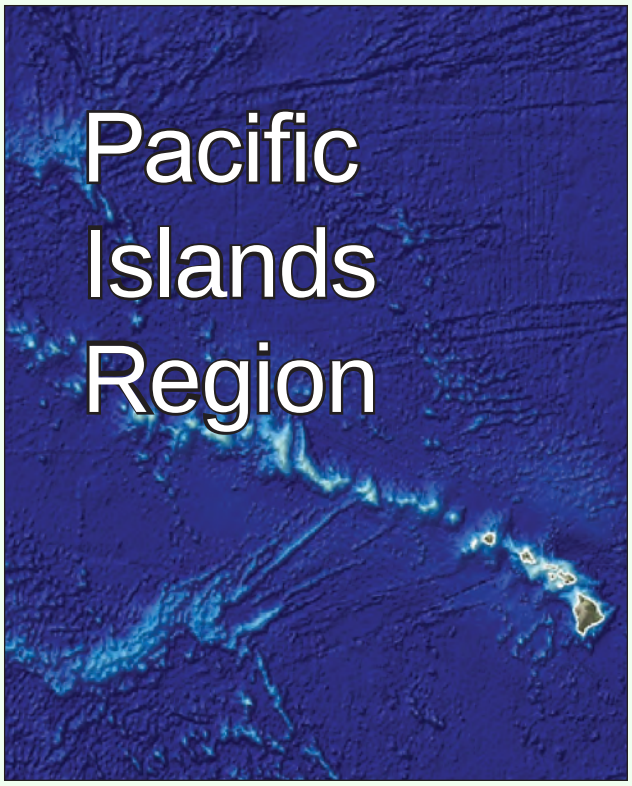
DPS = Distinct Population Segment.
Note: Because bycatch estimates were not available when the report was produced, all stocks with management importance are considered key stocks. See Section 4.5 for details.

Bycatch Reduction Success Stories (2005 to present):

- Use of acoustic pingers in the California/Oregon drift gillnet fishery has reduced cetacean (whales, dolphin, and porpoises) bycatch by approximately 50% since pinger use began in 1996. There have been no observed beaked whales taken since the use of pingers was mandated through implementation of the Pacific Offshore Cetacean Take Reduction Plan in 1997.

- Time and area closures are used in regional gillnet fisheries to protect leatherback and loggerhead sea turtles.

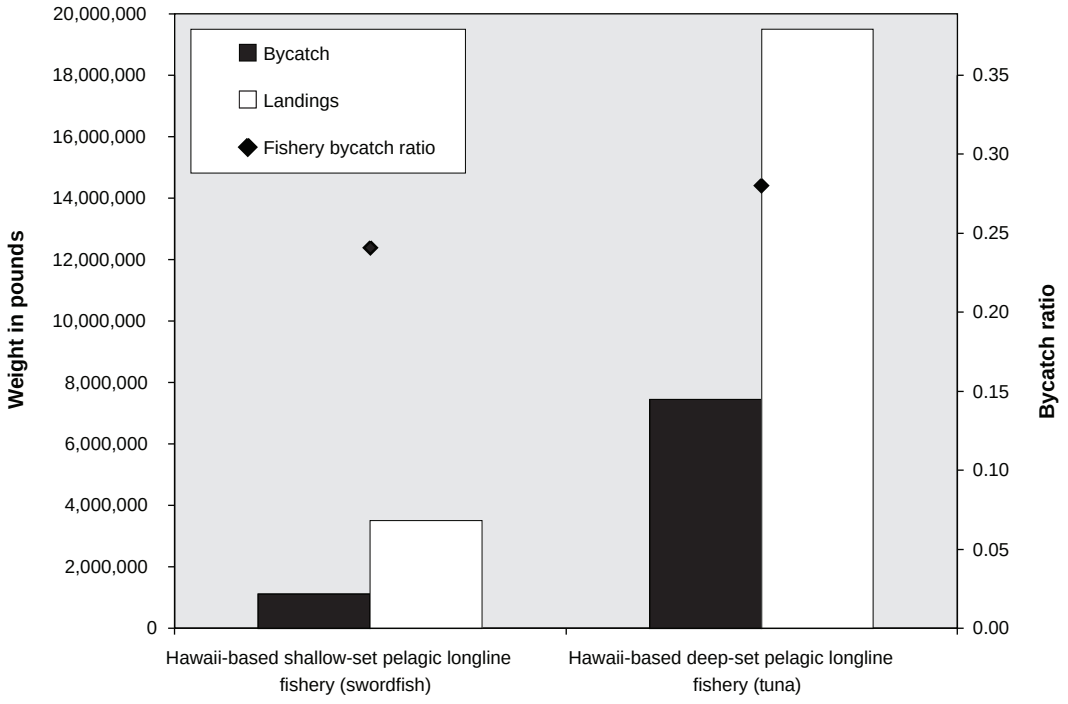
- Designation of a cowcod conservation area in California has successfully reduced bycatch and allowed rebuilding of cowcod, an overfished rockfish.



Fast facts:

- A total of 31 commercial fisheries are included in this report for the Pacific Islands Region.
- Landings from all Pacific Islands fisheries were valued at approximately $71 million in 2005.
- Five FMPs regulate the harvest of federally managed species in the Pacific Islands Region.
- Observer programs are in place for 3 of the 31 fisheries.
- Fish bycatch estimates are available for 2 fisheries and 88 species or species groups.
- Protected species bycatch estimates are available for 2 fisheries and 23 species or species groups.

Fish bycatch and landings by fishery for the Pacific Islands Region



Bycatch of Pacific Islands Region key stocks in 2005 [a]

Fish and invertebrates	Bycatch estimate (lb) [b]	Bycatch ratio
Bigeye thresher shark	433,000	*
Blue shark	5,639,000	*
Longnose lancetfish	928,000	*

Protected species	Bycatch estimate (individuals) [b] Inside EEZ	Bycatch estimate (individuals) [b] outside EEZ
Blue whale	*	*
False killer whale/false killer or short-finned pilot whale (unidentified)	9	8
Fin whale	*	*
Hawaiian monk seal	*	*
Humpback whale	0	0.2
Sei whale	*	*
Sperm whale	0	0

Protected species	Bycatch estimate (individuals) [b]
Green sea turtle	0
Hawksbill sea turtle	*
Leatherback sea turtle	12
Loggerhead sea turtle	10
Olive ridley sea turtle	16
Black-footed albatross	89
Brown booby	3
Hawaiian dark-rumped petrel	*
Laysan albatross	105
Newell's Townsend's shearwater	*
Short-tailed albatross	0

[a] Bycatch estimates of rare-event species may incorporate data from multiple years.
[b] Estimates have been rounded.
* Indicates landings were not available for a species (or species is not landed, as for protected species), bycatch was not observed, or was observed but no estimate is available, or that bycatch and landings were in different units, so no bycatch ratio could be developed (fish). See Section 4.4 for further information.

Bycatch reduction success stories (2005 to present):

- Annual incidental take limits for two species of sea turtles (leatherback and loggerhead) that result in fishery closures for Hawaii longline fisheries have been reached only once since 2004.
- Take limits that trigger management actions but not fishery closures are in place for other sea turtle species in Hawaii longline fisheries.
- Large circle hooks and fish bait (rather than squid) are required in the Hawaii-based shallow-set pelagic longline fishery for swordfish. These measures have reduced sea turtle bycatch in the fishery by 90% for loggerheads and by 83% for leatherbacks. These measures are also used voluntarily by many participants in the Hawaii-based deep-set pelagic longline fishery for tuna and the American Samoa pelagic longline fishery. Measures to reduce sea turtle bycatch have been very successful, resulting in a 90–95% reduction for all species across the entire longline fishery.
- In 2006, the use of "side-setting" in the Hawaii longline fishery was demonstrated to be more effective at reducing seabird bycatch than several other seabird avoidance methods. Fishermen may choose to side-set or utilize a combination of other measures to meet FMP seabird avoidance requirements. Overall, interaction numbers have been reduced by 92 to 95%. Measures developed to reduce seabird bycatch in the Pacific Islands form the foundation of measures used to reduce seabird bycatch in member countries of the Western and Central Pacific Fisheries Management Commission and the Inter-America Tropical Tuna Commission.

SECTION 1

Introduction

Photo on previous page: Preparing a sonar-equipped net off the Oregon coast. Credit: NMFS.

SECTION 1 Introduction

1.1 Overview

Effective management of living marine resources depends on understanding the population dynamics of target and bycatch species and related ecosystem processes. Reliable quantitative information about bycatch is essential to the assessment and management process. The goal of this report is to determine the extent to which reliable quantitative bycatch information exists for federally managed fisheries and for fisheries with relevant Federal data-collection programs, and to document bycatch estimates and bycatch estimation methods for all fisheries for which this information was available in 2005.[1] In addition to describing the "state of bycatch reporting and estimation," this report will be used to address and to prioritize sampling and estimation concerns.

Bycatch has long been recognized as a global issue (Alverson 1994; Hall 1996). Bycatch occurs because fishing methods are not perfectly selective for the target species (including targeted size range and/or sex), or because incidental take of marine mammals, sea turtles, or seabirds may occur as a result of fishing activities. Bycatch may also occur when regulatory restrictions prohibit retention of particular species, sexes, or size ranges. Therefore, some bycatch occurs in commercial fisheries, and higher rates of bycatch occur in fisheries with less selective fishing methods and practices.

Bycatch should be examined in the context of biological, ecological, economic, and social impacts to provide a comprehensive evaluation of its overall significance. Biological impacts of bycatch have been demonstrated at the species, population, and ecosystem levels (Hall et al. 2000; Kelleher 2004; Lewison et al. 2004; Read et al. 2006). Economic impacts may be substantial when current or potential future exploitable biomass is not available for harvest (Pascoe 1997; Larson et al. 1998; Kelleher 2004). When bycatch results in the mortality of endangered or protected species,[2] it is clearly of concern. Other issues arise when mortality of living marine resources results in lost productivity of commercially or recreationally important stocks, or when the public perceives bycatch as a waste. Costs for monitoring and mitigating bycatch may also be high, and some of these costs may be borne directly by the fishing industry (e.g., observer or other monitoring costs, costs of gear modification, and reduced target catch rates when bycatch mitigation devices are deployed).

Overall fishing mortality can be determined only if reliable, quantitative information on retained catch and bycatch (or total catch, from which bycatch estimates can be subtracted) is available. In some cases, even very low overall bycatch levels may be of concern, especially if the bycaught species are endangered or protected. When reliable bycatch estimates are available they can be factored into stock assessments. Management measures have been implemented in many U.S. fisheries to reduce bycatch; these include regulatory measures that place limits on bycatch quantities or close target fisheries when bycatch limits are reached. In some cases, other mitigation measures such as gear modifications have also been required.

This U.S. National Bycatch Report provides the first national compilation of bycatch estimates in commercial U.S. fisheries. It also provides comprehensive information on sampling and estimation methods and provides an objective framework for evaluating the quality of bycatch estimates. This report is the first in what is envisioned to be a series. Over time, the U.S. National Bycatch Report will improve the ability of the National Oceanic and Atmospheric Administration's (NOAA's) National Marine Fisheries Service (NMFS) to monitor bycatch trends. It is designed to assist NMFS in meeting legislative mandates for bycatch reduction, guiding policy, and setting priorities.

1.2 U.S. Laws and Regulations to Address Bycatch

The primary authorities for monitoring and reducing bycatch are contained in three statutes: the Magnuson-Stevens Fishery Conservation and Management Act (MSA), 16 U.S.C. 1801 et seq.; the Marine Mammal Protection Act (MMPA), 16 U.S.C. 1361 et seq.; and the Endangered Species Act (ESA), 16 U.S.C. 1531 et seq.

Under the MSA, all fishery management plans (FMPs) and their implementing regulations must be consistent with ten "National Standards." National Standard 9 requires that bycatch be avoided to the extent practicable or, where it cannot be avoided, that bycatch mortality be minimized; 16 U.S.C. 1851(a) (9). NMFS regulations implementing MSA bycatch provisions require that the following factors be considered in determining the practicability of a particular management action to minimize bycatch or bycatch mortality:

- Population effects for bycaught species
- Ecological effects due to changes in the bycatch of a species (effects on other species in the ecosystem)
- Changes in the bycatch of other species of fish and the resulting population and ecosystem effects

[1] The year 2005 was selected during the report's development in 2006, as the most recent year for which complete information was available. The National Marine Fisheries Service intends to publish updated information in future editions of this report.

[2] All species (fish, invertebrates, plants, seabirds, sea turtles, and marine mammals) protected under the Marine Mammal Protection Act and Endangered Species Act and managed by the National Marine Fisheries Service.

- Effects on marine mammals and birds
- Changes in fishing, processing, disposal, and marketing costs
- Changes in fishing practices and behavior of fishermen
- Changes in research, administration, and enforcement costs and management effectiveness
- Changes in the economic, social, or cultural value of fishing activities and non-consumptive uses of fishery resources
- Changes in the distribution of benefits and costs
- Social effects

The MSA also requires all FMPs to include a Standardized Bycatch Reporting Methodology (SBRM) to assess the amount and type of bycatch in managed fisheries;16 U.S.C. 1853(a)(11). These reporting methods are intended to improve the collection and estimation of bycatch, and to support the development of effective conservation and management strategies and mitigation measures.

The MMPA seeks to maintain marine mammal stocks at optimum sustainable population levels, principally by prohibiting take of marine mammals. The MMPA defines *take* as harassment, hunting, capture, and killing, as well as attempts to harass, hunt, capture, or kill. The MMPA allows limited exceptions to the take prohibition, including one for commercial fishing operations. The MMPA requires that each U.S. commercial fishery be classified according to whether there is frequent (Category I), occasional (Category II), or a remote (Category III) likelihood of incidental mortality and serious injury of marine mammals. It also has provisions for the establishment of take-reduction teams (TRTs) to develop take-reduction plans (TRPs) for those fisheries with the greatest impact on marine mammal stocks (Categories I and II).

The ESA mandates protection and conservation of threatened and endangered species, and conservation of the ecosystems on which these species depend. A species is considered endangered if it is in danger of extinction throughout all or a significant portion of its range. A species is considered threatened if it is likely to become endangered in the future. Some threatened and endangered species, including all species of sea turtles found in the U.S. and certain species of salmon, seabirds, and marine mammals, are captured as bycatch in the Nation's fisheries. The ESA requires development of recovery plans that identify criteria and actions to recover listed species.

Further information on these, as well as other statutes and international agreements pertaining to bycatch, is provided in Appendix B of this report.

1.3 The U.S. Bycatch Strategy

To address its legislative mandates, NMFS has developed a national approach to bycatch. This approach, as first articulated in *Managing the Nation's Bycatch* (NMFS 1998), expands on the MSA mandate "to implement conservation and management measures for living marine resources that will minimize, to the extent practicable, bycatch and the mortality of bycatch that cannot be avoided." Benaka and Dobrzynski (2004) provided guidance on implementation of this goal. They considered bycatch concerns in four categories: 1) population concerns in cases where bycatch contributes significantly to the status of the fish population; 2) social and economic concerns; 3) ecological concerns; and 4) public concerns. The article made recommendations in several areas, including bycatch monitoring and data-collection programs. The need for improved bycatch data collection and assessment was further discussed in *Evaluating Bycatch: A National Approach to Standardized Bycatch Monitoring Programs* (NMFS 2004b), which also provided details on implementation of NMFS' SBRM for all federally managed fisheries.[3]

1.4 Definition of Bycatch

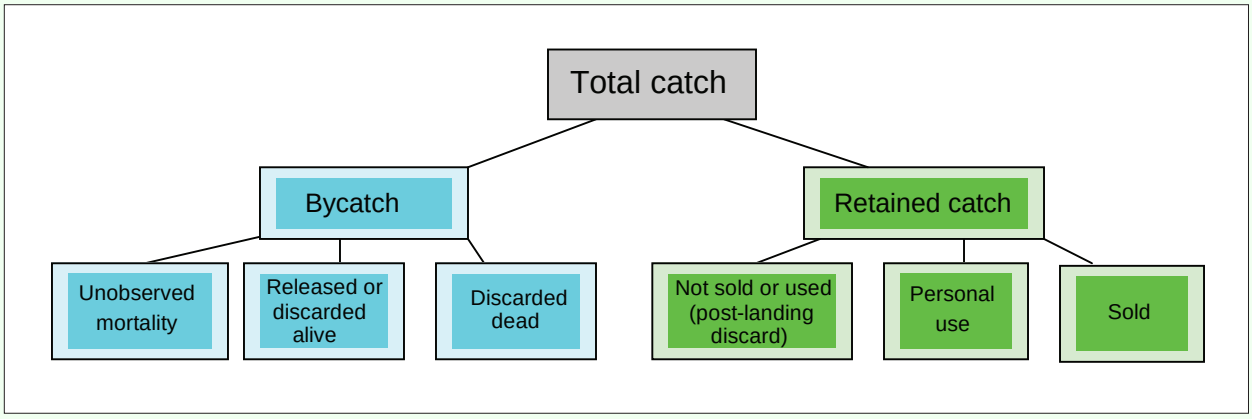
There are currently no universally accepted definitions for the terms *bycatch* and *discard*, and these terms are often used interchangeably. *Bycatch* for the purposes of this report is defined as discarded catch of any living marine resource plus unobserved mortality[4] due to a direct encounter with fishing gear (Figure 1.1). Since information on unobserved mortality of fish is rarely available, it is not included in this report. Unobserved mortality is included in bycatch estimates for protected species where the data permits.

The definition used here is similar to the definition of bycatch in the MSA, where bycatch is defined as "fish which are harvested in a fishery, but which are not sold or kept for personal use, and includes economic and regulatory discards," but not marine mammals, seabirds, or fish released alive under a recreational catch-and-release fish-

[3] The combination of data collection and analysis used to estimate bycatch in a fishery constitutes the SBRM for that fishery. Regional SBRM implementation plans are developed on an annual basis. Their action items are listed in Appendix C of this report.

[4] Unobserved mortality: mortality of living marine resources due to a direct encounter with fishing gear that does not result in the capture of the species. This includes mortality due to lost or discarded fishing gear, as well as fish and other species that escape from fishing gear before it is retrieved but die due to the stress or injury resulting from the encounter (NMFS 2004b).

Figure 1.1
Definitions used in the U.S. National Bycatch Report.



ery management program. The MSA does not specifically define the term *discard*. The definition of discards used in this report is "living marine resources returned unprocessed to sea or elsewhere, including those released alive" (Figure 1.1). While the issue is not addressed in this report, NMFS is also concerned about post-landing discards (i.e., fish discarded after landing). Post-landing discards are not included as a component of bycatch mortality estimated in this report since they are typically included in the landings data. Even though they differ slightly from those used in the MSA, the definitions in this report were selected to provide consistency with previous NMFS reports, including the 1998 and 2004 NMFS bycatch reports referenced above.

SECTION 2

Data Sources for Estimating Bycatch

Photo on previous page: A NMFS observer checks the dimensions of a net and its catch. Photo credit: NMFS AFSC, Marine Observer Program.

SECTION 2 Data Sources for Estimating Bycatch

2.1 Overview

Estimation of bycatch requires data from several sources. Fishery-dependent data, including bycatch data and the supplemental data used to estimate bycatch, are collected during fishing operations. Fishery observer programs are a good example of a source of fishery-dependent data. Observers are the only independent source for many types of information about fishing operations, including catch and bycatch composition, biological characteristics, and gear configuration. Information about bycatch may also be provided through self-reporting programs (i.e., data reported by fishermen or dealers/processors); these self-reporting programs are particularly important sources of supplemental data (e.g., effort and landings data). However, when bycatch information is submitted by the fishing industry, concerns regarding data quality must be addressed. These concerns may arise from the lack of training in data-collection methods and protocols, and potential underreporting by the industry; concerns may also be linked to the existence of incentives for misreporting.

Data on bycatch (species composition and quantity, specific information on marine mammal interactions, etc.) and retained catch are always required for bycatch estimation. Ancillary information (e.g., gear type, retained catch characteristics, observations on fishing operations, and environmental data) may also be necessary to the estimation process, depending on the estimation methods used. Verifiable sources of data, such as observers and vessel monitoring systems (VMS), are preferable, although certain kinds of industry-reported information may also be useful as supplemental data.

The choice of the method used for collecting bycatch data in a particular fishery is based on several factors, including:

- Completeness—do the data cover the entire range (temporal, spatial, depth, vessel attributes, etc.) of the fishery or fisheries that interact with the species of concern?
- Cost—is the method cost-effective?
- Timeliness—how quickly are the data available to fisheries scientists, managers, and fishermen?
- Safety—how safe is the data-collection method compared to other monitoring methods, and what safeguards are in place to ensure the safety of the data collectors?
- Logistics—how easily is the monitoring program implemented and maintained?
- Planned use of data—do management goals require a level of detail, quality, and timeliness that only certain data sources can provide?

This section focuses on fishery observer programs and commercial fishery logbook programs. These are the most common sources of data used in estimating fishery bycatch. Supplementary sources, such as landings reports completed by fishermen and/or dealers, port sampling reports, vessel monitoring systems, and stranding reports of protected species, will be discussed briefly. Costs and benefits associated with each data source must be considered with reference to the specific goals of the collection programs and the information requirements for bycatch estimation; these tradeoffs are discussed briefly toward the end of the section. This section is intended to provide a general overview of the data used to estimate bycatch and related issues; details about regional bycatch estimation methods and approaches are provided by region and fishery in Section 4.

2.2 Fishery Observer Programs

Fishery observers are trained biologists who collect data on fishing activities onboard commercial vessels (and at processing plants in some instances) to provide data in support of science and management programs. Each of the six NMFS regions is responsible for administering observer programs in its area. NMFS' authority to place observers aboard fishing vessels can be found in the MSA, the MMPA, and the ESA; in some cases state regulatory authority also exists. Observer programs are generally established to address one or more monitoring objectives, which may include bycatch (fish and protected species), catch, fishing operations, and regulatory compliance.

Observer program design and establishment of coverage levels will generally take into account specific management and science information needs. For example, an observer program designed to provide data for estimating protected species bycatch may require a high coverage level because fishery interactions with these species occur infrequently, while a program implemented to provide data for estimating total catch of target fish species may require lower levels of coverage. However, rare events may also be monitored at lower coverage levels, although this increases the level of uncertainty in the estimate. In some regulatory environments, for example when in-season management is supported by observer data, when bycatch limitations restrict target species harvest, or when monitoring for regulatory compliance is a priority, high (and in some cases 100%) observer coverage may be required.

Regardless of the primary reason for monitoring a fishery, observers are generally trained to collect quantity and composition information on catch and bycatch, as well as information on fish discard condition (e.g., released alive versus dead) and condition of protected species bycatch (e.g., location of entanglement and/or hooking, condition of animal upon release). Biological information collected by observers may include size composition of selected species, and

biological samples which can be used to determine age composition, maturity, feeding behavior, fecundity, stock characteristics, etc. Besides data on catch and bycatch, observers may also collect information on gear type and configuration, vessel type and power, fishing techniques, fishing effort, environmental conditions, and, in certain fisheries, economic information. Observers may also assist with fisheries research or tagging studies. Observer data are considered the most reliable source of information on bycatch, since the observers are independent and able to monitor bycatch directly.

In instances where the safety of observers is of particular concern or the logistics of placing observers aboard fishing vessels are unusually challenging, using small vessels to observe fishing operations may be an option. Government-owned or -leased "alternative platforms" have been employed in a few U.S. fisheries (e.g., the North Carolina small gillnet fisheries and the inshore Alaska salmon gillnet fisheries) to monitor bycatch. Sampling may target the fishery as a whole, or only those vessels that would otherwise be difficult to sample using an onboard observer.

Other approaches for collecting data at sea are under development. Use of video cameras to monitor fishing operations involves relatively new technologies (McElderry 2008) and has been used only in selected fisheries to date. Other sensors, such as global positioning systems (GPS) and hydraulic pressure monitors, may also be incorporated to provide accurate information regarding spatial and temporal characteristics of fishing. While electronic monitoring (EM) holds great promise for addressing certain objectives (e.g., compliance with discard prohibitions), it is not yet able to provide detailed information on catch and bycatch composition, or biological information.

Observer programs are expensive and logistically challenging. Detailed information on costs and logistics is provided in previous NMFS reports (e.g., NMFS 2004b). Logistical challenges and costs depend to a considerable degree on the size of the region being observed, the size of the fishing fleet, and the degree of difficulty associated with deploying observers. These aspects should be considered carefully prior to implementation of an observer program. Staff resources for training, debriefing, data management, etc. can also be substantial.

Even though observer programs provide the most reliable source of data, bias must be minimized and accounted for in the design of a program and in the use of any data collected. The sources of bias in observer programs fall into three broad categories: 1) incomplete sampling frame; 2) sampling bias caused by procedures for selecting vessels, problems with sample selection, or factors preventing the deployment of observers on all selected vessels; and 3) observer bias (i.e., measurement errors caused by changes in fishing behavior in the presence of observers). For some programs, it has been possible to develop vessel selection strategies to minimize bias. A complete discussion of potential bias in observer programs is provided in Appendix D (see also Vølstad and Fogarty 2006).

2.3 Marine Mammal Data-Collection Programs

Under the MMPA, commercial fishers are required to report any injuries or mortalities of marine mammals that occur incidental to their fishing operations. Underreporting of injuries and mortalities is of considerable concern (Credle et al. 1994; National Marine Mammal Laboratory unpublished information). Thus, this information may be used to suggest a minimum number of marine mammals that are killed or seriously injured incidental to fishing operations, but the number is generally considered unreliable and these data are not utilized for bycatch estimation in this report.

A second source of information on marine mammal bycatch, and one that is used to estimate bycatch in this report, is stranding data. Stranding occurs when a marine mammal or sea turtle swims or floats to the shore and becomes beached (alive or dead) on land or stuck in shallow water, and also applies to dead animals floating at sea. The Marine Mammal Health and Strandings Response Program (MMHSRP) was established to facilitate reporting of stranding events, respond to stranding events, and to collect biological information on stranded animals. Volunteer stranding networks in all coastal states carry out these activities. Human-caused mortality documented by stranding networks (e.g., as evidenced by vessel strikes, gunshot wounds, or net or knife marks) is counted toward total annual human-caused mortality in marine mammal stock assessments. These estimates include strandings that demonstrate clear evidence of a fishery interaction, and are therefore classified as bycatch. However, it is not always possible to link each interaction to a specific fishery or type of fishing activity.

2.4 Logbooks

Logbooks provide a detailed record of a vessel's fishing activity. They are completed onboard the vessel by the captain or a designated crew member (NMFS 2005). Reporting requirements for logbooks, which may also be called vessel trip reports (VTRs), catch reports, or trip tickets, are mandated and defined in Federal or state fishery management plans (FMPs) and differ by region and fishery. Typically, the information required includes gear type, date, time of day, location, weather conditions, deployment information (e.g., tow length and number of hooks set), and weight and species composition of catch (as well as total or retained catch, or product in some cases). Logbooks that require bycatch reporting are required under 39 FMPs (Table 2.1). Logbooks may also be a source of supplemental data, such

Table 2.1
Requirements for bycatch reporting by FMP. Where an FMP is implemented across NMFS regions, it is listed under the lead NMFS region only.

Region	Fishery Management Plan (FMP)	Bycatch required to be reported
Northeast	Groundfish Multispecies	All discards, including protected species
	Atlantic Scallop	All discards, including protected species
	Monkfish	All discards, including protected species
	Summer Flounder, Scup and Black Sea Bass	All discards, including protected species
	Tilefish	All discards, including protected species
	Atlantic Bluefish	All discards, including protected species
	Atlantic Herring	All discards, including protected species
	Spiny Dogfish	All discards, including protected species
	Deep Sea Red Crab	All discards, including protected species
	Atlantic Mackerel, Squid and Butterfish	All discards, including protected species
	Northeastern Skate	All discards, including protected species
	Northern Shrimp	All discards, including protected species, when a vessel has a Federal permit
	Surfclam and Ocean Quahog	All discards, including protected species
	Atlantic Salmon[1]	ESA-listed species with no commercial harvest. FMP prohibits possession of Atlantic salmon[1]
	Atlantic Lobster	All discards, including protected species, when a vessel has a Federal permit
Southeast	Consolidated Highly Migratory Species	All discards, including protected species
	Snapper/Grouper/Wreckfish	All discards, including protected species
	Coastal Migratory Pelagics	All discards, including protected species
	Reef Fish	All discards, including protected species
	Golden Crab	All discards, including protected species
	Shallow Water Reef Fish	All discards, including protected species
	Headboat/Charterboat	None
	Dolphin and Wahoo	All discards, including protected species
	Shrimp	All discards, including protected species
	Spiny Lobster	All discards, including protected species
	Stone Crab	All discards, including protected species
	Coral, Coral Reefs, and Live/Hard Bottom Habitats of the South Atlantic Region	All discards, including protected species
	Pelagic Sargassum Habitat of the South Atlantic Region	All discards, including protected species
Alaska	Bering Sea/Aleutian Islands Groundfish	All fish, for vessels over 60 feet
	Gulf of Alaska Groundfish	All fish, for vessels over 60 feet
	Salmon[2]	Discards of certain fish species (no Federal logbook requirement)
	King and Tanner Crab[3]	Discards of certain fish species (no Federal logbook requirement)
	Alaska Scallop[4]	Discards of certain fish species (no Federal logbook requirement)
Northwest	Pacific Coast Groundfish	All retained catch by limited-entry trawl fishery
	West Coast Salmon	Salmon (bycatch and mortalities)
Southwest	Coastal Pelagics	All discards, including protected species
	West Coast Fisheries for Highly Migratory Species	All discards, including protected species
Pacific Islands	Western Pacific Pelagics	All discards, including protected species
	Precious Corals	None
	Crustaceans	All fish
	Bottomfish and Seamount Groundfish	All fish
	Coral Reef Ecosystems	None

[1] FMP prohibits possession of Atlantic salmon and any directed or bycatch fishery for Atlantic salmon in Federal waters.
[2] Management delegated to the State of Alaska
[3] Management of the Crab FMP is deferred to the State of Alaska, with Federal oversight.
[4] The scallop fishery is jointly managed by the State of Alaska and NMFS.

as fishing effort and gear characteristics that are used in estimating bycatch.

Compared with observer programs, logbooks are considerably less expensive and present fewer logistical challenges. However, underreporting of bycatch species is a serious concern. Additionally, if there is inadequate compliance with logbook requirements, or reporting misrepresents actual fishing effort, the bycatch estimates derived from these data will be inaccurate. Where possible, analyses should be undertaken that compare self-reported bycatch data to observer data (e.g., Rago et al. 2005) so that biases in the data can be identified and addressed.

2.5. Production and Dealer Reports

Production and dealer reports typically do not provide bycatch data; in most cases they provide ancillary data that may be used in the bycatch estimation process. Production reports are completed on a daily or weekly basis, and provide information by species and reporting area. The NMFS requires this type of report for shoreside processors, factory motherships, catcher-processors, and floating processors that participate in the Alaska groundfish fisheries. Production reports contain information on species weights, types of each product produced, and discard that occurs during the reporting period. In other regions, dealers who purchase fish from commercial fishermen are required by regulation to complete reports indicating the species, weight, and value of fish purchased. These dealer reports provide important information about harvest levels, species composition, and economic value of the fishery. As with all industry-reported data it is generally not possible to verify the reported information.

2.6 Port Sampling and Dockside Monitoring

Port sampling utilizes trained biologists to collect fishery information and biological samples from fishermen and/or dealers at the dock. Port samplers collect information on biological characteristics of retained catch. Because bycatch is not observed by port samplers, they do not provide direct data on bycatch or discards. They may, however, provide ancillary information that is useful in bycatch estimation.

Dockside monitors are responsible for verifying species sorting and weighing at shoreside plants that receive deliveries from catcher vessels participating in the West Coast fishery for Pacific hake. Since discard at sea is severely restricted by regulation in this fishery, most of the catch is retained. However, retained catch composition and weight data may be useful ancillary information for bycatch estimation.

2.7 Vessel Monitoring Systems

Vessel monitoring systems (VMS) are required in many fisheries and have been installed on more than 5,000 fishing vessels in the U.S. These systems report vessel location information and can be used to track fishing operations. While VMS are implemented for compliance purposes, they can provide information that is useful in bycatch estimation. For example, VMS data on location, heading, and speed (derived from location information) may provide ancillary information for bycatch (or catch) estimation (Deng et al. 2005; Murawski et al. 2005; Mills et al. 2007).

SECTION 3

U.S. National Bycatch Report Methods

Photo on previous page: An inside view of a fishing net's bycatch reduction device. Photo credit: NOAA.

SECTION 3 U.S. National Bycatch Report Methods

3.1 Overview

This section describes the various processes developed during the preparation of the U.S. National Bycatch Report, including a system for evaluating data collection programs and estimation methods (the *tier classification system*); the identification of subsets of stocks (*key stocks*) and fisheries (*fisheries of focus*) based on levels of bycatch in relation to overall catch; and the development of fisheries bycatch estimation improvement plans. Two performance measures were derived from this process that will assist in monitoring improvements to bycatch estimates over time. First, the fisheries tier classification system will be used to monitor progress in bycatch data collection and estimation in fisheries recommended for improvements (i.e., advancing individual fisheries from lower to higher tiers over time). Second, the subset of key stocks will be used to monitor stock, population, and regional bycatch trends over time.

The tier classification system was used to evaluate the data collection programs and estimation methods for all fisheries included in this report. The classification system applied standardized criteria to evaluate bycatch data collection programs and analytical approaches used to estimate bycatch for each individual fishery. Fisheries were classified in one of five tiers (Tiers 0–4). Fisheries classified in lower tiers (Tiers 0–2) will require improvements in bycatch data collection and/or estimation methods, while fisheries classified in higher tiers (Tiers 3–4) are characterized by high-quality bycatch estimates. This process assumes that improvements in bycatch data collection programs and analytical approaches will translate into improvements in the reliability of bycatch estimates used in fisheries management. Section 3.2 provides further details on the tier classification system.

Bycatch estimates were provided for all fisheries in this report for which data and analytical methods supported estimation. Bycatch estimates were also provided for individual fish and marine mammal stocks, and sea turtle and seabird populations, where data were available. The bycatch estimates provided in this report are the best available information for federally managed commercial fisheries. However, in some cases they may be incomplete because bycatch data were not available for all fisheries where a given species is bycaught (e.g., state, international, tribal, or recreational fisheries). Fishery bycatch estimates were calculated as the sum of all bycatch within a particular fishery. Stock bycatch estimates were calculated as the sum of all bycatch of that stock across all fisheries where bycatch estimates were calculated (Figure 3.1). For simplicity, the term *stock* is used throughout this report in discussing estimates made at the population, species, or species group level.

Bycatch ratios were developed for both individual fish stocks (*stock bycatch ratio*) and individual fisheries (*fishery bycatch ratio*) to aid in the evaluation of bycatch levels (further described in sections 3.3.1.1 and 3.4, respectively). The ratio utilizes the basic calculation of bycatch divided by total catch (where total catch is calculated as bycatch plus landings). While other methods are available to calculate a bycatch ratio (e.g., bycatch/landings or a weighted average), utilizing total catch in the calculation is considered the standard approach (and is utilized in both comparative reports, Kelleher 2004 and Harrington et al. 2005). Bycatch ratios were not calculated for protected species since landings of protected species do not occur. The bycatch ratio is not a perfect measure of the contribution of bycatch to total mortality, because not all sources of mortality are accounted for and because not all discarded fish die. Often, the information necessary to correct for these two deficiencies was not available. For instance, a bycatch ratio was not calculated if either the bycatch or landings data were unavailable. Also, since this report did not include state, recreational, or international fisheries, both the bycatch and landings data for some fisheries may be incomplete.

Key stocks were identified based on the level of bycatch in relation to overall catch, the management importance of the stock/population, and overall stock status (see Section

	Fishery A	Fishery B	Fishery C	Total stock bycatch
Stock 1	1	0	0	1
Stock 2	1	2	0	3
Stock 3	2	5	3	10
Total fishery bycatch	4	7	3	

Figure 3.1
Bycatch estimates were calculated at both fishery and stock levels (sample values are included for illustration). The downward arrow illustrates how bycatch estimates were calculated by fishery (e.g., the total of all stocks caught within fishery A); the arrow pointing right illustrates how bycatch estimates were calculated by stock (e.g., the total amount of stocks 1–3 caught by all fisheries).

3.3 for further details). *Fisheries of focus* were identified as those having bycatch of key stocks or overall bycatch levels above a specified cutoff. All stocks and fisheries were further reviewed based on standardized qualitative criteria (described in Section 3.3.4 and Section 3.4.1, respectively) to address issues that were not explicitly included in the development of the bycatch estimates, such as public perception of a bycatch problem or lack of bycatch data.

Fisheries bycatch estimation improvement plans were developed for all fisheries of focus. All improvement plans were developed using a standard format, and address issues such as fishery tier, observer days at sea, feasibility, and management issues. Improvement plans may provide recommendations for implementing new or enhanced data collection programs and/or estimation methods, or may focus on the maintenance of current programs (see Section 3.4.2 for more information).

3.2 Tier Classification System

The tier classification system was developed to evaluate the quality of bycatch data and the reliability of estimation methods used to develop bycatch estimates for selected commercial fisheries. Appendix E lists the fisheries included in this report and identifies those evaluated through the tier process. Results of the tier classification process are presented by region and fishery in Section 4.

Some fisheries were grouped to reflect protected species bycatch estimation procedures (e.g., several types of gillnet might be grouped as “New England Gillnet Fisheries”). Grouped fisheries were evaluated as a whole for their data quality and methods for estimating protected species bycatch. So that those scores could be compared with tier scores for individual fisheries, the protected species tier score for each group was also assigned (“cascaded down”) to the individual fisheries in the group. It is important to stress, however, that in these cases (indicated in tables in this report by *) the fisheries were evaluated and assigned tier scores as part of a group.

3.2.1 Criteria and Scores for Tier Classification System

The tier classification system assigned each fishery to one of five tiers (Tier 0 to Tier 4). Fisheries classified in Tier 0 typically had no bycatch data collection or estimation method, while fisheries classified in Tier 4 had reliable bycatch estimates based on long-term observer data. The tiers are described in Section 3.2.2. The tier classification process was carried out for three separate groups of marine species:

- all fish and invertebrate stocks managed under the MSA (“MSA fish stocks”)
- all marine mammal stocks (“marine mammals”)
- all other protected species: includes all ESA-listed fish, sea turtle, and seabird populations (“other protected species”)

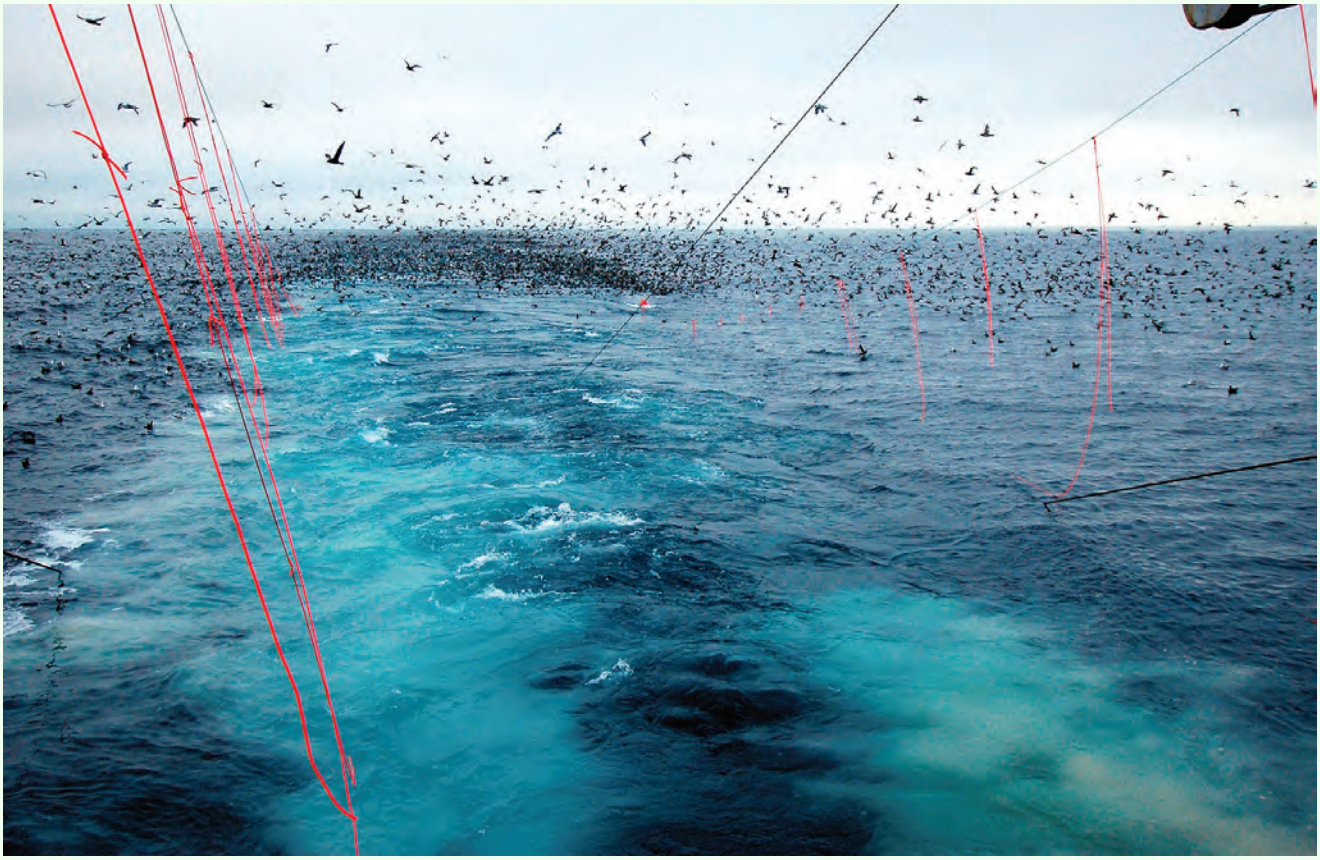
These categories ensured that the tier classifications within each grouping reflect the data and methods used to estimate bycatch.

The criteria used in the tier classification system were developed through a national workshop with participation from all regional National Marine Fisheries Service (NMFS) Science Centers and Regional Offices, as well as Headquarters Offices. The initial design of the classification system was based on a similar system applied to the evaluation of fish stock assessments (NMFS 2001). The criteria were based on the critical components required to provide reliable and accurate bycatch estimates. The classification system was tested on several regional fisheries during the workshop to ensure that the scoring system worked for the full range of fisheries. A team of regional experts (Appendix F) applied the standardized criteria to score all fisheries within their regions. A second workshop was conducted to review the initial regional scores from a national perspective. Modifications and clarifications were made to the criteria to ensure consistency. The final submitted scores were reviewed by the National Observer Program and the National Bycatch Report Steering Committee (Appendix G) and discrepancies were reconciled with the relevant regional teams.

The major criteria used in the tier classification system (Table 3.1) were:

1) adequacy of bycatch data, which evaluated bycatch data collected through observer programs and self-reported industry logbooks;
2) availability of supplemental data used as extrapolation factors for unobserved components of the fishery, for stratification and imputation (a way of filling in missing data), as model covariates, and to verify self-reported industry data;
3) adequacy of database and information technology (IT) considerations (used to link data to generate timely bycatch estimates); and
4) quality of analytical approaches (bycatch estimation method assumptions, peer reviews, statistical bias of estimators, and development of uncertainty estimates).

The scoring system for each of these criteria was developed to provide higher scores for higher-quality bycatch data and for more robust and reliable estimation methods. The major criteria were also weighted to provide higher scores for those criteria that are more important to the development of reliable bycatch estimates; for example, observer bycatch data were weighted more heavily than self-reported industry bycatch data because they are more reliable.



Washingotn Sea Grant, NOAA

Seabirds hover above the water near long, baited fishing lines deployed from the stern of a ship. The red streamers flap in the wind to discourage the birds from coming after the baited hooks.

The majority of the criteria used in the tier classification system were quantifiable. The longevity of observer programs, sampling design, availability of industry and supplemental data, peer review and/or publication of sampling design and analytical methods, and development of measures of uncertainty could all be evaluated and scored through the tier classification system in a systematic and standardized manner (Table 3.1). However, several of the criteria were more subjective, such as vessel-selection and observer bias, spatial and temporal coverage, database and IT considerations, and statistical bias of estimators. Guidance on the more subjective criteria was provided by the National Bycatch Report Steering Committee to ensure consistency in scoring among regions. Evaluations of vessel selection and observer bias were based on a formal review of bias in NMFS observer programs (Vølstad and Fogarty 2006). Spatial and temporal coverage levels were evaluated as either limited or synoptic based on the geographic and temporal scope of the program. Limited observer programs were defined to be of a lesser geographic and temporal scope than the scope of the fishery. Database and IT considerations were evaluated in the context of linking observer data with supplemental data to facilitate timely generation of bycatch estimates. Biases associated with the estimators used in the analytical methods were evaluated based on measures of association, cross validation, and other factors. The guidance provided on these criteria was intended to ensure consistency; however, the evaluation and scoring were also based on the in-depth knowledge of the biologists and assessment scientists within each region.

Table 3.1
Criteria and scoring used to evaluate bycatch data quality and estimation methods through the tier classification system. Details are provided in Appendix H.

TIER CLASSIFICATION CRITERIA	SCORES
ADEQUACY OF BYCATCH DATA	
Observer Data	**33 points total maximum score, broken down as:**
Longevity of Observer Data	
0 = No observer program has ever been implemented.	5 points
1 = Observer program was conducted prior to 1995.	
2 = Observer program was conducted on one or more occasions during 1995–2000, but not annually.	
3 = Observer program was conducted annually during 1995–2000 and not subsequently.	
4 = Observer program was conducted on one or more occasions from 2001 to present, but not annually.	
5 = Observer program has been conducted annually from 2001 to present.	
Sampling Frame	
0 = No sampling frame	3 points
2 = Partial sampling frame	
3 = Complete sampling frame	
Sampling Design	
Sampling of Vessels/Permits/ Licenses	4 points
0 = No observer program, or sampling design does not support bycatch or total catch estimation.	
1 = Opportunistic or haphazard sampling, including voluntary observer programs, to support bycatch or total catch estimation.	
2 = Random sampling scheme or probability-based sampling with moderate observer coverage levels to support bycatch or total catch estimation.	
3 = Random sampling scheme or probability sampling with adequate observer coverage levels to support bycatch or total catch estimation.	
4 = Near-census of vessels with estimation required, or census of vessels with no estimation required.	
Sampling of Trips	4 points
0 = No observer program, or sampling design does not support bycatch or total catch estimation.	
1 = Opportunistic or haphazard sampling, including voluntary observer programs, to support bycatch or total catch estimation.	
2 = Random sampling scheme or probability-based sampling with pilot/baseline observer coverage levels to support bycatch or total catch estimation.	
3 = Random sampling scheme or probability sampling with adequate observer coverage levels to support bycatch or total catch estimation.	
4 = Near-census of trips with estimation required, or census of trips with no estimation required.	
Sampling of Hauls	4 points
0 = No observer program, or sampling design does not support bycatch or total catch estimation.	
1 = Opportunistic or haphazard sampling, including voluntary observer programs, to support bycatch or total catch estimation.	
2 = Random sampling scheme or probability-based sampling to support bycatch or total catch estimation.	
3 = Near-census of hauls with estimation required.	
4 = Census of hauls with no estimation required.	
Design Implementation	
Spatial Coverage	2 points
Add 0 points if no observer program has ever been implemented.	
Add 1 point if spatial coverage is limited.	
Add 2 points if spatial coverage is synoptic.	

Table 3.1 (continued)

TIER CLASSIFICATION CRITERIA	SCORES
ADEQUACY OF BYCATCH DATA	
Observer Data (cont.)	**33 points total maximum score, broken down as:**
Temporal Coverage	2 points
Add 0 points if no observer program has ever been implemented.	
Add 1 point if temporal coverage is limited.	
Add 2 points if temporal coverage is synoptic.	
Vessel-Selection Bias	2 points
Add 0 points if vessel-selection bias is high or unknown	
Add 2 points if vessel-selection bias is negligible or no bias exists.	
Observer Bias	2 points
Add 0 points if observer bias is high or unknown.	
Add 2 points if observer bias is negligible or no bias exists.	
Data Quality Control	
0 = No observer program, or no data quality control.	5 points
1 = Limited or incomplete observer training, no debriefing or other quality control.	
2 = One-time observer training, no debriefing or other quality-control measures.	
3 = Periodic observer training, minimal quality-control measures.	
4 = One time observer training, comprehensive quality-control measures.	
5 = Periodic observer training, comprehensive quality-control measures.	
Industry Bycatch Data	**2 points total maximum score, broken down as:**
0 = No industry bycatch data are available, or industry bycatch data are not used as a basis for bycatch estimates.	2 points
1 = Industry bycatch data available prior to 2000 are used as a basis for bycatch estimates.	
2 = Industry bycatch data available from 2000 to present are used as a basis for bycatch estimates.	
Supplemental Data	**10 points total maximum score, broken down as:**
Data available for use as expansion factors for unobserved components of the fishery.	
Add 0 points if supplemental data are not available as expansion factors.	2 points
Add 1 point if limited supplemental data are available as expansion factors.	
Add 2 points if extensive supplemental data are available or data are not necessary as expansion factors.	
Data available for stratification.	
Add 0 points if supplemental data are not available for stratification.	2 points
Add 1 point if limited supplemental data are available for stratification.	
Add 2 points if extensive supplemental data are available or data are not necessary for stratification.	
Data available for imputation.	
Add 0 points if supplemental data are not available for imputation.	2 points
Add 1 point if limited supplemental data are available for imputation.	
Add 2 points if extensive supplemental data are available or data are not necessary for imputation.	
Data available for model covariates.	
Add 0 points if supplemental data are not available for model covariates.	2 points
Add 1 point if limited supplemental data are available for model covariates.	
Add 2 points if extensive supplemental data are available or data are not necessary for model covariates.	

Table 3.1 (continued)

TIER CLASSIFICATION CRITERIA	SCORES
ADEQUACY OF BYCATCH DATA	
Supplemental Data (cont.)	**10 points total maximum score, broken down as:**
Industry data verified.	
Add 0 points if industry data are not verified or no industry data are available.	2 points
Add 1 point if some relevant industry data are verified.	
Add 2 points if all relevant industry data are verified.	
Database / IT Considerations	**2 points total maximum score, broken down as:**
0 = No observer data and/or supplemental data are available.	2 points
1 = Analytical approach is constrained because of database/IT considerations.	
3 = Analytical approach is not constrained because of database/IT considerations.	
QUALITY OF THE BYCATCH ESTIMATE	
Analytical Approach	**25 points total maximum score, broken down as:**
Assumptions Identified, Tested, and Appropriate	
0 = No bycatch estimation methodologies.	10 points
1 = Assumptions not identified or tested.	
3 = Assumptions identified and tested, but no assumptions have been resolved.	
5 = Minor assumptions identified, tested, and determined to be appropriate or resolved.	
8 = Critical assumptions identified, tested, and determined to be appropriate or resolved.	
10 = All assumptions identified, tested, and determined to be appropriate or resolved.	
Peer Reviewed / Published	
Observer Program Sampling Design	4 points
Add 0 points if the observer program sampling design has not been peer reviewed, or if the sampling design is found to be seriously flawed during peer review.	
Add 2 points if the observer program sampling design has been internally peer reviewed, or if problems were found during a peer review but they have not been fully addressed.	
Add 4 points if the observer program design has been externally peer reviewed.	
Analytical Approach	4 points
Add 0 points if the analytical approach has not been peer reviewed, or if the analytical approach is found to be seriously flawed during peer review	
Add 2 points if the analytical approach has been internally peer reviewed, or if problems were found during a peer review but they have not been fully addressed.	
Add 4 points if the analytical approach has been externally peer reviewed.	
Statistical Bias of Estimators	
0 = No bycatch estimation methodologies, or statistical bias is unknown.	4 points
2 = Estimators have high statistical bias.	
4 = Estimators have negligible statistical bias or are not statistically biased, or census sampling.	
Measures of Uncertainty	
0 = No bycatch estimation methodologies.	4 points
1 = Measures of uncertainty are not calculated.	
2 = Measures of uncertainty are calculated, but not at all levels (vessel/permit/license, trip, and haul).	
3 = Measures of uncertainty are calculated at all levels (vessel/permit/license, trip, and haul).	

3.2.2 General Description of Tiers

The following provides a general description of the five tiers used to classify fisheries for each of the three stock or population groups. Tier descriptions were based on quality of bycatch and supplemental data and the reliability of the methods used to estimate bycatch.

Tier 0 (total score = 0). Bycatch data collection programs have not been implemented for Tier 0 fisheries; therefore, neither a method for estimating bycatch nor estimates of bycatch are available.

Tier 1 (total score = 1–31). The bycatch estimates calculated for Tier 1 fisheries were typically based on outdated or unreliable information. Observer data were not available, or had not been collected during the last ten years, or serious deficiencies or limitations in the design of the observer program were identified. Design deficiencies for Tier 1 fisheries with observer programs may include the lack of a complete sampling frame; inadequate temporal or spatial coverage; or opportunistic selection of vessels, trips, or hauls. Bias associated with vessel selection or observer sampling may be high or unknown in Tier 1 observer programs, and bycatch data quality-control systems were generally absent or inadequate. Self-reported data were used in place of or to supplement observer program data in approximately 50% of Tier 1 fisheries for which bycatch estimates were available. In other Tier 1 fisheries, supplemental data were unavailable or inadequate.

The majority of Tier 1 fisheries did not utilize analytical approaches for the calculation of bycatch estimates, or employed methods with outstanding issues which should be resolved. Where analytical approaches were implemented to estimate bycatch, they had generally not been peer reviewed, or had been reviewed only internally. For the majority of Tier 1 fisheries with bycatch estimates, assumptions in the analytical approach had been identified and tested, and some minor assumptions may have been resolved. Of the Tier 1 fisheries with an analytical approach, about half had high statistical bias. Measures of uncertainty were calculated for the majority of bycatch estimates, but typically those measures did not recognize uncertainty for all levels (vessel, trip, and haul). A few fisheries in Tier 1 did not have estimates of uncertainty associated with their bycatch estimates.

Tier 2 (total score = 32–48). Bycatch estimates calculated for Tier 2 fisheries were typically based on inconsistent or unreliable information. Bycatch data for the majority of these fisheries were derived from self-reported logbooks. Current or recent observer data were available for some of these fisheries. In those fisheries with observer programs, sampling frames were usually partial or complete but sampling designs were inadequate. Sampling at all levels (vessel, trip, and haul) may have been inadequate or inconsistent, with approaches ranging between opportunistic and census. Spatial or temporal coverage in the observer programs may have been limited or synoptic, and programs were often characterized by high or unknown levels of vessel selection and observer bias. Observer training, with an emphasis on data quality, occurred in the majority of observed Tier 2 fisheries. However, data quality control may have been lacking or absent. Supplemental data availability in Tier 2 fisheries varied in quality and scope; some supplemental data were available for most, but not all of these fisheries.

Analytical approaches to developing bycatch estimates in Tier 2 fisheries were generally deficient in several aspects. Methods employed in about half of those Tier 2 fisheries for which bycatch levels were estimated had not been peer reviewed, while the remainder had been peer reviewed internally or externally. In many cases, the analytical approach was constrained by database or other computational considerations (e.g., logbook and observer databases not linked). In most cases, assumptions were identified and tested, but problems with the assumptions were not resolved. Measures of uncertainty were calculated for the majority of the bycatch estimates, although they may not have accounted for uncertainty at all levels in the process (vessel, trip, and haul). For a small number of Tier 2 fisheries, bycatch estimates were available without measures of uncertainty, or were not available at all.

Tier 3 (total score = 49–65). Observer program data collection had occurred in 2001–2005 in the majority of Tier 3 fisheries, although not necessarily on an annual basis. Only older observer data were available for some fisheries in this tier, and observer data were not available at all in a few instances. Where observer data were available, sampling frames were either partial or complete. However, sampling designs varied markedly. While the majority of the sampling designs included either random or probability-based sampling with moderate observer coverage at all sampling levels, opportunistic and census or near-census sampling designs were also found. Sampling designs had been externally peer reviewed and determined to be appropriate for most Tier 3 fishery observer programs. Spatial and temporal coverage of observer programs was often limited or synoptic, and in most cases there was little to no vessel-selection or observer bias. For most Tier 3 fisheries, supplemental data were extensive or not required by the bycatch estimation process, although self-reported bycatch data were available in many cases. Data quality-control systems in Tier 3 fisheries varied, ranging from minimal observer training and data quality control to frequent training and comprehensive data quality controls.

The bycatch estimates calculated for Tier 3 fisheries were based on reliable observer program information or recent logbook data. Overall, the analytical approach for Tier 3 fisheries was typically robust and had been peer reviewed (internally or externally), but some analytical concerns

might remain. Analytical assumptions were identified, tested, and, in most cases, any problems with the assumptions had been resolved. Although estimators employed in the majority of analytical approaches had little to no statistical bias, high statistical bias did occur in some cases. Bycatch estimates typically included associated measures of uncertainty, although these measures may not have incorporated uncertainty associated with all levels in the sampling and estimation process (vessel, trip, and haul).

Tier 4 (total score = 66–73). Bycatch estimates were calculated for all Tier 4 fisheries. These estimates were based on reliable observer program data collected on an annual basis for at least the past five years. Design deficiencies in these programs were negligible or nonexistent. Sampling frames were partial or complete. Although a variety of sampling schemes was utilized, in all cases observer coverage was adequate at the vessel, trip, and haul sampling levels. In Tier 4 fisheries, sampling designs were externally peer reviewed and determined to be appropriate. Spatial and temporal coverage in the observer programs was synoptic, and vessel-selection and observer bias were negligible or absent. Appropriate supplemental data were available to extrapolate the observed bycatch to total fishery bycatch where not all fishing activities were observed. Comprehensive data-quality controls were in place, and integrated databases for the various data sources facilitated analytical procedures in most cases.

The analytical approaches used to estimate bycatch in Tier 4 fisheries were considered to be appropriate and defensible. In addition to being externally peer reviewed, all or at least the critical assumptions of the analytical methods had been addressed and determined to be acceptable. Statistical bias was negligible or absent in the estimators, and measures of uncertainty were calculated for the majority of bycatch estimates (though not necessarily incorporating the uncertainty associated with all levels of the process).

3.2.3 Application of the Tier Classification System

Scores derived from the tier classification system provided a method to evaluate bycatch data quality in relation to the reliability of bycatch estimates (Figure 3.2). A maximum score of 48 points was possible for bycatch data quality: the sum of Adequacy of Observer Bycatch Data + Adequacy of Industry Bycatch Data + Supplemental Data + Database / IT Considerations (Table 3.1). A maximum of 25 points was possible for the reliability of the bycatch estimation method (total score for Analytical Approach; Table 3.1). Scores for all three groups (MSA fish stocks, marine mammals, and other protected species) were included in the analysis. Fisheries classified as Tier 0 had no bycatch data and no bycatch estimation methods; therefore, the scores for both these criteria were zero. Due to the variations of scoring combinations that can occur when applying these criteria to individual fisheries, the range of overall scores for fisheries in Tier 1 through Tier 3 is broad. However, there is a general increasing trend in the reliability of the bycatch estimates as quality of the bycatch data improves (Figure 3.2).

To further illustrate the application of the tier classification system, and to show the range of possible tier scores, the cases of five individual regional fisheries are presented in Table 3.2. The examples provide information related to fish stocks only, but the application of the method was similar for the other resource categories (marine mammals and other protected species).

The California herring gillnet fishery (column 3 in Table 3.2) did not have any bycatch data collection programs or bycatch estimation methods. Therefore, this fishery scored zero for all criteria, which resulted in classification in Tier 0. The South Atlantic snapper–grouper handline fishery (column 4 in Table 3.2) has bycatch estimates developed from logbook data. However, given the lack of observer data, the overall score for this fishery was low—only 19. This resulted in classification in Tier 1.

The West Coast groundfish non-endorsed fixed gear fishery (column 5 in Table 3.2) has a recent long-term observer program and a self-reported industry program for the collection of bycatch data. However, the observer program does not have a sampling frame and the sampling design has problems with spatial and temporal coverage and bias associated with vessel selection. The methods for estimating bycatch in this fishery are not fully developed, which resulted in a lower score for analytical approach (4 out of a maximum of 25). Therefore, the overall score for this fishery was 33, resulting in placement in Tier 2.

The mid-Atlantic extra-large-mesh gillnet fishery (column 6 in Table 3.2) has a long-term observer program and a self-reporting program for collection of bycatch data. Supplemental data are available and the analytical approach received a high score. This fishery was classified as Tier 3, with an overall score of 62. However, the cutoff score between a Tier 3 and a Tier 4 fishery is 66. Therefore, only slight modifications would be required to move this fishery into Tier 4. This example illustrates the need to evaluate the overall score for each fishery, rather than simply relying on its placement in a certain tier.

The Bering Sea/Aleutian Islands pollock trawl fishery (column 7 in Table 3.2) has scores similar to the mid-Atlantic extra-large-mesh gillnet fishery, with a slightly higher overall score of 67. This fishery was classified in Tier 4.

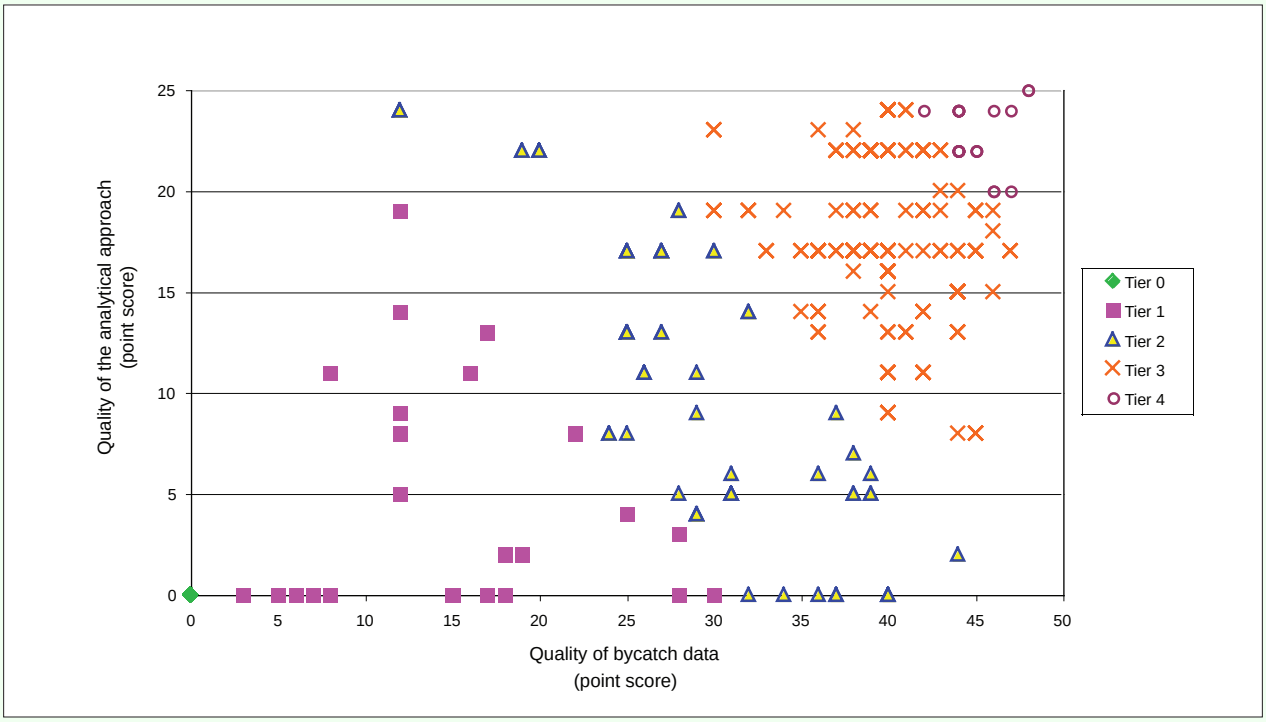


Figure 3.2
Quality of bycatch data and estimation method, and resulting tier classifications of fisheries included in the U.S. National Bycatch Report (*n* = 400).

Photo credit: Lee Beneka, NMFS

Skate bycatch off New England.

Table 3.2
Tier classification of fisheries on the basis of scores for bycatch data collection and estimation, illustrated for five selected fisheries. The examples provide tier scores for fish bycatch estimates only.

Scoring criteria	Maximum possible points	California herring gillnet	South Atlantic handline	West Coast groundfish non-endorsed fixed gear	Mid-Atlantic extra-large-mesh gillnet	Bering Sea/ Aleutian Islands pollock trawl
Adequacy of Observer Bycatch Data						
Longevity of observer program	5	0	0	5	5	5
Sampling frame	3	0	0	0	2	3
Sampling design						
Vessels / Permits / Licenses	4	0	0	1	2	4
Trips	4	0	0	3	2	4
Hauls	4	0	0	3	3	3
Design implementation						
Spatial coverage	2	0	0	1	2	2
Temporal coverage	2	0	0	2	1	2
Vessel-selection bias	2	0	0	0	2	2
Observer bias	2	0	0	0	2	2
Data-quality control	5	0	0	5	5	5
SECTION TOTAL	33	0	0	20	26	32
Adequacy of Industry Bycatch Data						
SECTION TOTAL	2	0	2	2	2	2
Supplemental Data						
Extrapolation factors for unobserved components of the fishery	2	0	1	2	2	2
Stratification	2	0	1	1	2	2
Imputation	2	0	1	1	2	2
Model covariates	2	0	1	1	2	2
Industry data verification	2	0	1	1	1	2
SECTION TOTAL	10	0	5	6	9	10
Database / IT Considerations						
SECTION TOTAL	3	0	1	1	3	3
Analytical Approach						
Assumptions	10	0	5	3	8	8
Peer review / Publication						
Observer program sampling design	4	0	2	0	4	4
Analytical approach	4	0	2	0	4	4
Statistical bias of estimators	4	0	2	0	4	3
Measures of uncertainty	3	0	2	1	2	1
SECTION TOTAL	25	0	11	4	22	20
OVERALL SCORE	73	0	19	33	62	67
TIER	4	0	1	2	3	4

3.3 Identification of Key Stocks

Bycatch estimates for individual fish stocks and marine mammal, sea turtle, and seabird populations were calculated for all fisheries where bycatch data and estimation methods were available. Standardized criteria were applied to all stocks with bycatch estimates to identify key stocks: those stocks that have high bycatch levels, are important to management, and/or for which there are stock status concerns. Bycatch of key stocks was used as one of the triggers to identify fisheries of focus (discussed in Section 3.4). Bycatch estimates from these key stocks will also be used to monitor stock, population, and regional bycatch trends over time.

The identification of key stocks was based on three criteria (details in Table 3.3 and Figure 3.3):

- bycatch level of the stock
- management importance of stock or population
- overall stock or population status

The criteria for evaluating management importance and overall stock or population status are partially linked, in particular for marine mammals. However, it was necessary to evaluate both criteria, since a fish stock may be important to management but not be overfished or experiencing overfishing. In this case, the stock would not be identified as a key stock even though it is important to management.

These three criteria were evaluated separately for MSA fish stocks, marine mammal stocks, seabird populations, and ESA populations. The initial process was based on a quantitative evaluation of stock or population bycatch estimates. Since bycatch estimates were not available for all stocks or populations, a qualitative process was also developed to help determine whether stocks or populations should be classified as key stocks. This was necessary since stocks that do not have bycatch estimates may still be of bycatch concern.

3.3.1 Evaluation of Stock Bycatch Level and Stock Bycatch Ratio

Bycatch estimates were evaluated using standardized criteria to identify whether a potential bycatch concern existed. Separate sets of criteria were developed for ESA populations, marine mammals, seabirds, and fish stocks.

ESA populations—all were designated as key stocks, regardless of bycatch levels.

Marine mammals—stocks for which the calculated bycatch level exceeded the zero mortality rate goal (ZMRG) (At this level the rate of incidental mortality and serious injury incidental to fishing is estimated to be insignificant, i.e. approaches a zero serious injury and mortality rate).

Table 3.3
Sources of criteria for identifying key stocks.

Stock/population	Evaluation of potential bycatch problems	Evaluation of management importance	Evaluation of stock/population status
ESA populations	All ESA populations are designated as key stocks		
MSA fish stocks	Ratio of discards to (discards + landings)	FSSI-listed species (Y/N)[a]	FSSI stock status[a]
Marine mammal stocks	Bycatch level greater than ZMRG[b]	ZMRG[b]	Marine mammal stock assessment stock status determinations
Seabird populations	Based on information provided by USFWS[c]	USFWS BCC[c] list	Based on information provided by USFWS[c]

[a] The Fish Stock Sustainability Index (FSSI) identifies high priority stocks for management purposes. See http://www.nmfs.noaa.gov/sfa/statusoffisheries/SOSmain.htm.

[b] Zero mortality-rate goal (ZMRG) is the common term for the "insignificance threshold," defined as 10% of a stock's potential biological removal level. See http://www.nmfs.noaa.gov/pr/interactions/zmrg.

[c] The U.S. Fish and Wildlife Service (USFWS) Birds of Conservation Concern (BCC) list identifies seabird species of management importance; the BCC list from 2002 (USFWS 2002) was used in this edition of the U.S. National Bycatch Report. See http://www.fws.gov/migratorybirds/.

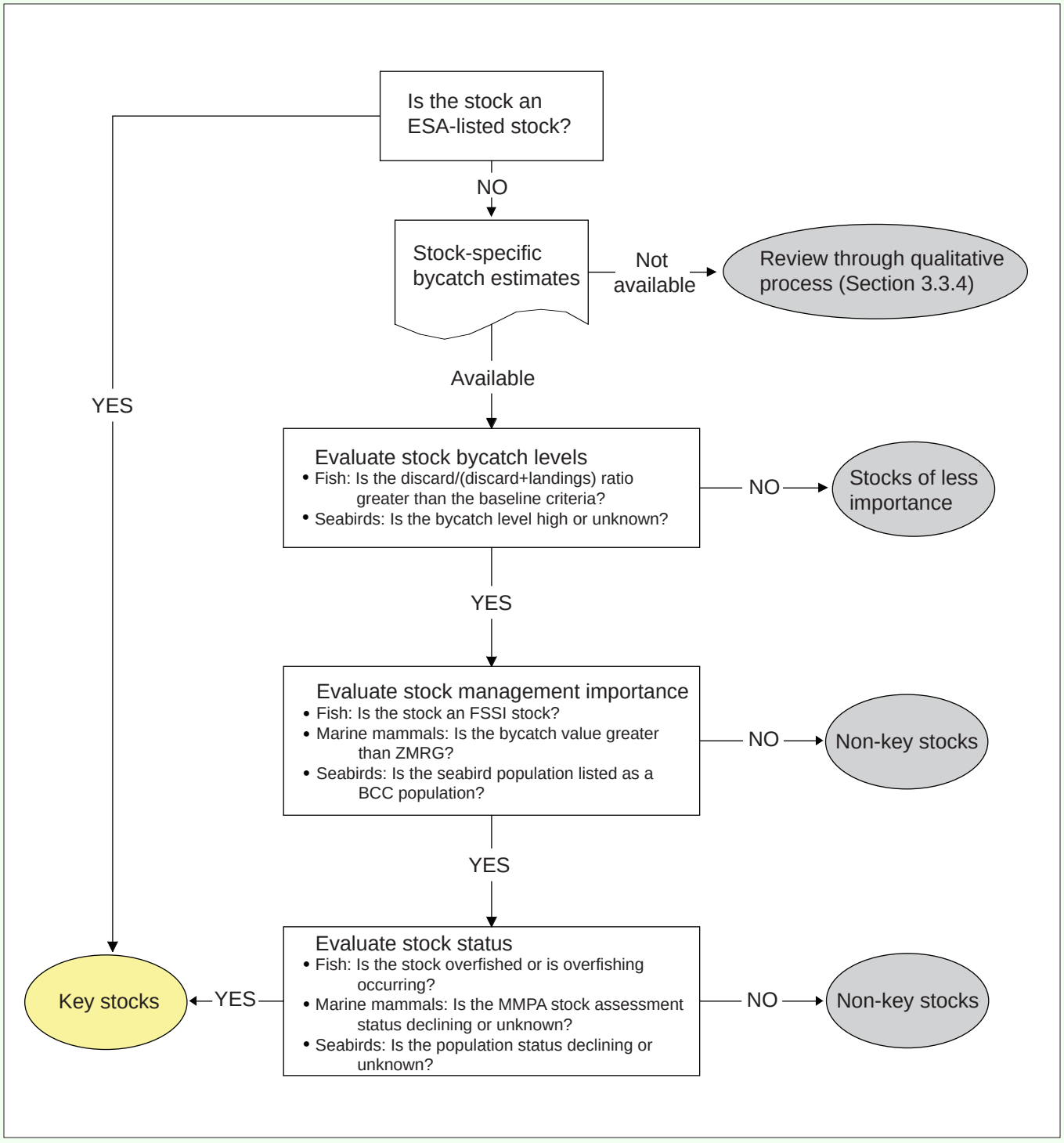


Figure 3.3
Quantitative process used to identify key stocks.

Seabirds – stocks identified by USFWS and NMFS scientists, based on documented interactions, research, and whether the population status was declining (yes, no, or unknown).

MSA fish stocks – stocks for which the ratio of fish discards to total fish catch (fish discards + fish landings) was above a certain level. See Section 3.3.1.1 for details on development of the cutoff point.

Stock Bycatch Ratios

Bycatch ratios were developed for fish stocks as d_s / (l_s + d_s) where d_s is the estimate of total bycatch of stock *s* in a given region and l_s is the estimate of total landings[1] of stock *s* in that region, where estimates of both discards and landings were available. Landings used to develop the stock bycatch ratio were obtained from the NMFS commercial landings database, in order to maintain a standard reference for commercial catch data included in this report.[2] Landings were associated with bycatch data based on NMFS region, stock names, and data years used in estimating bycatch (2005, except in the case of some rare-event species for which multiple years of data were used). This ratio was used because it provides a measure of the contribution of fish bycatch to the total fishing mortality of a stock.

The stock bycatch ratios are presented in a summary table at the end of each regional section (Section 4). A frequency analysis of all stock bycatch ratios was conducted to select the cutoff for determining whether to consider designating a stock as a key stock (Figure 3.4). The median of the frequency distribution (0.127) was selected as the cutoff point. All fish stocks with bycatch ratios greater than 0.127 were advanced to the next stage for consideration as key stocks (i.e., evaluation of importance to management).

For example, if the estimated bycatch for a stock was 50,000 lbs and total catch was 550,000 lbs, then the bycatch ratio was 0.09. Since this is less than the cutoff of 0.127, the stock was not further considered for key stock status. For this stock, improving the estimate of bycatch would have a minor effect on the estimate of total fishing mortality. Conversely, if the bycatch estimate for a stock was 400,000 lbs and total catch was 900,000 lbs, then the bycatch ratio was 0.44. This stock would move to the next step in the process, evaluation of stock status, since the bycatch ratio of 0.44 was higher than the cutoff of 0.127.

3.3.2 Evaluation of Management Importance

Management importance was evaluated for each category of marine resource, based on standardized criteria. Separate sets of criteria were used for marine mammals, seabirds, and fish stocks.

MSA fish stocks—The Fish Stock Sustainability Index (FSSI) was used as the criterion for evaluating management importance of MSA fish stocks. The FSSI is based on a set of 230 priority fish stocks selected for their importance to commercial and recreational fisheries. Criteria for selection of FSSI stocks include whether they are primary target species (landings greater than 200,000 pounds), whether they are overfished or subject to overfishing, whether they have assessments scheduled, whether they have previously been identified as important to management, or other factors as appropriate. These FSSI stocks represent about 90% of all commercial and recreational landings in the U.S. The process used in this edition of the report was based on the first quarter 2008 FSSI list of stocks, which was the most recent information available when the report was developed.

Marine mammal stocks—Marine mammal stocks of management importance were identified based on whether the bycatch levels were greater than ZMRG.[3] This criterion is the same as that used to evaluate bycatch level, so it was applied once in the process to evaluate both bycatch level and management importance.

Seabird populations—Seabird populations of management importance were those identified on the USFWS BCC list (USFWS 2002).

3.3.3 Evaluation of Stock or Population Status

Stock or population status was evaluated for each category of marine resource based on standardized criteria. Separate criteria were used for marine mammals, seabirds, and fish stocks. The evaluation of stock or population status was partially linked to the evaluation of management importance, in that management of stocks or populations with declining stock status may benefit from improved bycatch estimates.

MSA fish—Stock status for MSA fish stocks was determined from the first quarter 2008 FSSI stock list. Stock status was categorized according to overfished status (yes, no, unknown, undefined) and whether overfishing was occurring (yes, no, unknown, undefined).

→If the stock was overfished or overfishing was occurring as of the first quarter 2008, the stock was identified as a key stock.

[1] Landed catch data used to develop a stock bycatch ratio represented commercial catch sold (i.e., not for personal use, etc.).

[2] http://www.st.nmfs.noaa.gov/st1/commercial

[3] Under the MMPA, NMFS is directed to reduce bycatch below ZMRG, therefore stocks with bycatch levels greater than ZMRG are considered a management priority.

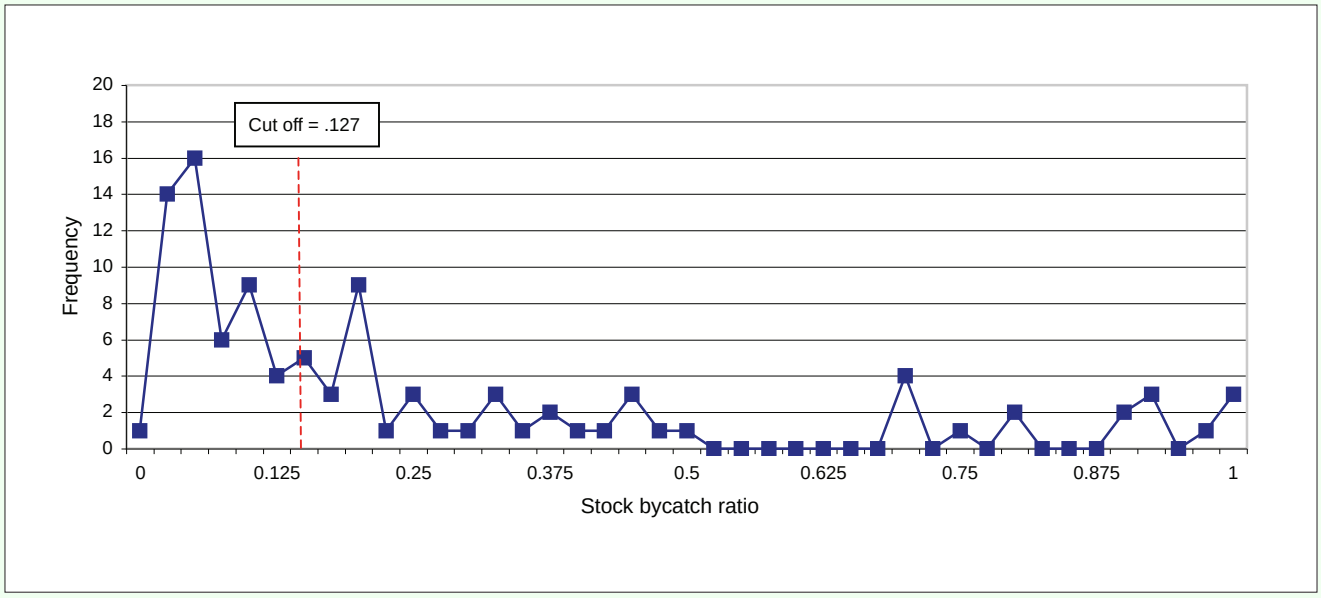


Figure 3.4
Distribution of stock bycatch ratios (ratios of fish discards to total catch) for all fish bycatch estimates included in the U.S. National Bycatch Report (*n* = 102). The red dotted line indicates the median of the frequency distribution, above which a stock was further considered for designation as a key stock.

Marine mammals—Stock status for marine mammals was determined from current marine mammal stock assessments.[4] Stock status was categorized as declining, stable, increasing, or unknown.

→If the stock status was declining or unknown, the stock was identified as a key stock.

Seabirds—Population status for seabird populations was determined in consultation with the USFWS. Population status was categorized as declining, stable, increasing, or unknown.

→If the stock status was declining or unknown, the stock was identified as a key stock.

3.3.4 Qualitative Evaluation of Key Stocks

Regardless of whether individual stocks or populations were classified as key stocks through this process, they were also evaluated against a set of standardized criteria that took into account an additional range of considerations. This qualitative process was important since many stocks and populations included in this report do not have bycatch estimates (i.e., these stocks would have automatically been classified as non-key stocks). Possible factors that could be considered as part of the qualitative process included:

- The FSSI stock status was used to identify fish stocks that were not overfished but were close to the threshold. These fish stocks were considered for addition to the list of key stocks since they had the potential to become overfished.
- Fish stocks that were not overfished but had a high bycatch ratio were considered for addition to the list of key stocks.
- Biological concerns, such as localized overfishing/overfished stocks, fish stocks important as prey species, recent declines in abundance trend, restrictions in geographic range of distribution, and other ecological issues, were considered even for fish stocks that were not overfished or experiencing overfishing, and for protected species with low known bycatch levels. These stocks were considered for addition to the list of key stocks.
- Biological opinions pursuant to ESA Section 7 may re-

[4] In this report, the most recent marine mammal stock assessment report as of 2007 was used to evaluate stock status for marine mammals. NMFS marine mammal stock assessments are posted at http://www.nmfs.noaa.gov/pr/sars/.

quire monitoring of a more abundant species as a proxy for species rarely caught in commercial or recreational fisheries. These proxy species were considered for addition to the list of key stocks.
- Regional consistency was ensured by evaluating the list of key stocks for adjacent regions. If a stock was distributed across adjacent regions (e.g., Gulf of Mexico and South Atlantic) or regional boundaries (e.g., Northeast and Southeast NMFS regions), the stock was considered for listing as a key stock in both areas.
- Any stock for which there were concerns regarding public perception and/or high visibility of a bycatch problem was considered for addition to the list of key stocks.

All changes based on the qualitative process, as well as the reasoning behind decisions to either add or remove stocks from the list of key stocks, are summarized in the regional sections. This information was reviewed by the National Observer Program and the National Bycatch Steering Committee to ensure consistency in application of these criteria across regions.

3.4 Identifying Fisheries of Focus

A fishery of focus is a fishery that takes one or more key stocks as bycatch, and/or has high total levels of fish bycatch. Fisheries for which bycatch estimates were available were initially evaluated through a quantitative process to determine the overall fishery bycatch ratio and/or determine whether key stocks were taken as bycatch within the fishery (Figure 3.5). Note that the fishery bycatch ratio is different from the stock bycatch ratio (discussed above), in that the formula used to develop a fishery bycatch ratio was $d_f / (l_f + d_f)$ where d_f represents the total fish bycatch of fishery f, and l_f represents the total landings of fishery f. The fishery landings data were obtained from previously published data used by NMFS regions to manage fisheries. In the majority of cases, it was possible to calculate fishery bycatch ratios. However, in some fisheries, some or all of the fish bycatch estimates were available only as numbers of fish; because associated landings were provided only as weights, it was not possible to calculate a fishery bycatch ratio. Confidentiality provisions also precluded calculation of fishery bycatch ratios in some instances. These instances are noted in the regional sections.

A frequency analysis of all fishery bycatch ratios was generated to determine the cut-off value for determining whether to designate a fishery as a fishery of focus (Figure 3.6). The median of the frequency distribution (0.17) was chosen as the cutoff. Fisheries with bycatch ratios greater than 0.17 were identified as fisheries of focus.

3.4.1 Qualitative Evaluation of Fisheries of Focus

Regardless of whether a fishery was identified as a fishery of focus through the quantitative process, all fisheries included in this report were also evaluated against a set of standardized criteria, that took into account a range of additional considerations. This qualitative process was important since bycatch estimates are not available for many fisheries included in this report (i.e., these fisheries would have been automatically classified as not being fisheries of focus). The additional criteria used in this qualitative process were:

- Fisheries with suspected or unknown bycatch might require pilot observer programs to provide more detailed bycatch information. These fisheries were considered for addition to the list of fisheries of focus.
- Fisheries where the standard error of the bycatch estimate exceeded the management goal or where uncertainty estimates were not currently calculated were considered for addition to the list of fisheries of focus.
- Fisheries using gear with potentially high bycatch were considered for addition to the list of fisheries of focus (e.g., gillnet fisheries).

All changes based on the qualitative process, as well as the reasoning behind decisions to either add or remove fisheries from the list of fisheries of focus, are summarized in the regional sections. This information was reviewed by the National Observer Program and the National Bycatch Steering Committee to ensure consistency in application of these criteria across regions.

3.4.2 Fishery Bycatch Estimation Improvement Plans

Fishery bycatch estimation improvement plans were developed for all fisheries of focus. The improvement plans provided documentation on each individual fishery, including its current tier, relevant management issues, deficiencies in bycatch data collection and estimation, and recommendations for improvements to bycatch data collection and estimation. A standard format was developed and applied to each fishery requiring an improvement plan, to ensure consistency across regions. The specific components of the improvement plans were:

- fishery name—the name of the fishery as listed in the regional list of fisheries included in the U.S. National Bycatch Report;
- fishery tiers—tiers assigned for each category (MSA fish stocks, marine mammals, and other protected species);
- relevant management issues—issues that may influence the collection of bycatch data or bycatch estimation within the fishery (e.g., management under bycatch quotas);

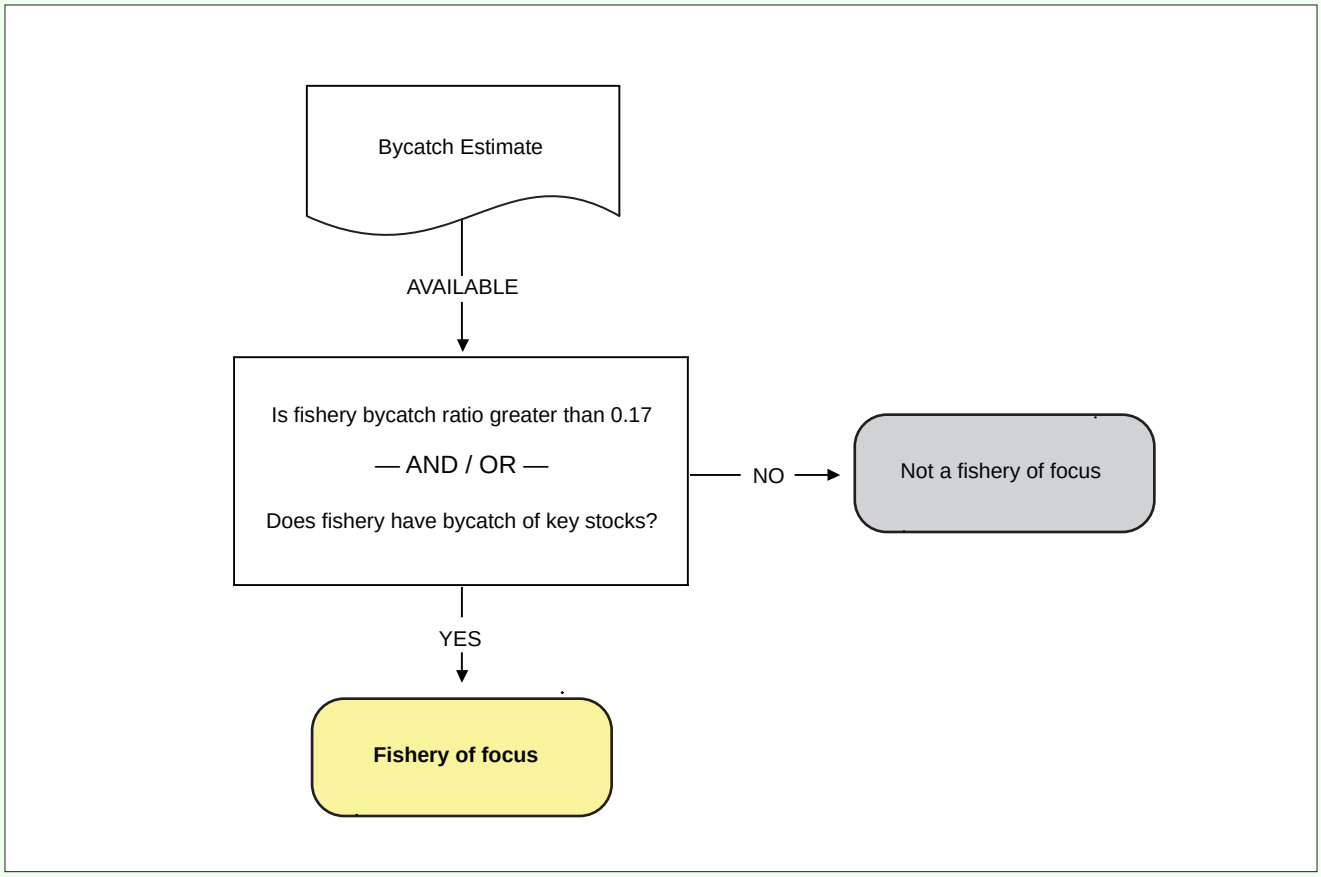


Figure 3.5
Quantitative process used to identify fisheries of focus.

- bycatch data collection and estimation deficiencies;
- recommendations for improving bycatch data collection and estimation—including information on feasibility, staffing requirements, and data collection needs. Recommendations were focused solely on improvements to bycatch data collection and analytical approaches, and did not consider possible management strategies for reduction of bycatch.

The recommendations in the fishery bycatch estimation improvement plans will be used by NMFS in budgeting and setting priorities. As recommendations are implemented, the quality of bycatch estimates will be greatly improved. Implementation of these recommendations and associated improvements in data quality can be monitored through the performance measures developed in this report:

- trends in bycatch over time for key stocks;
- improvements in the tier scores for individual fisheries.

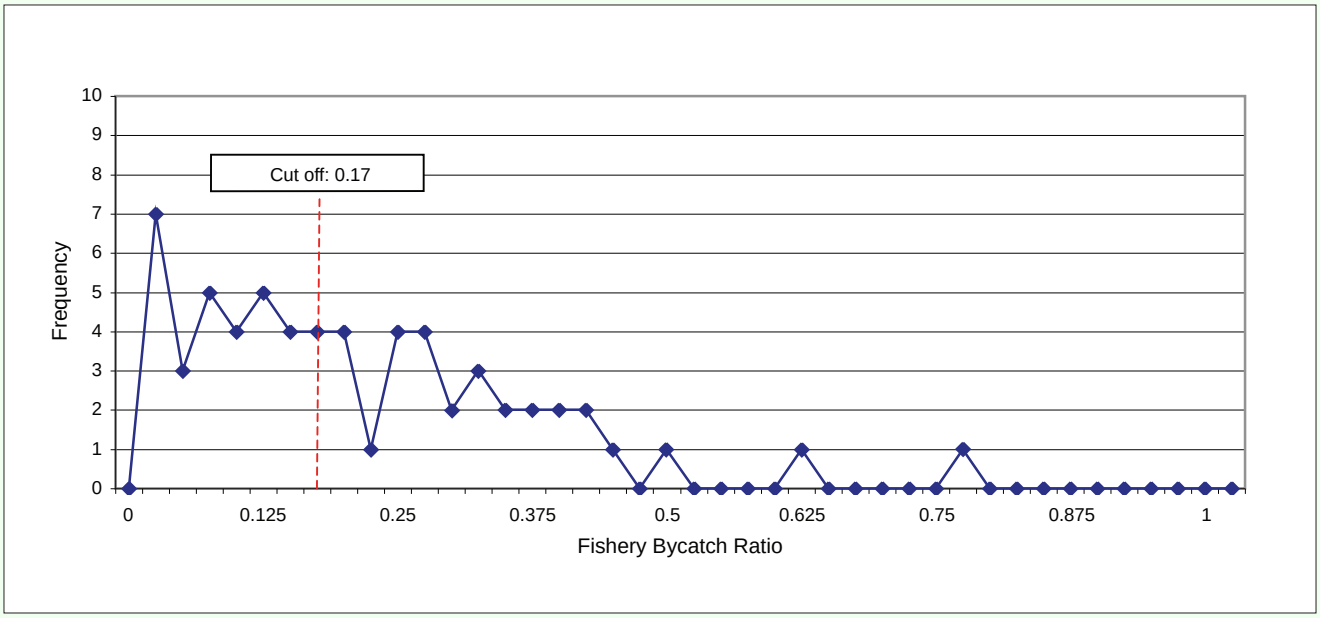
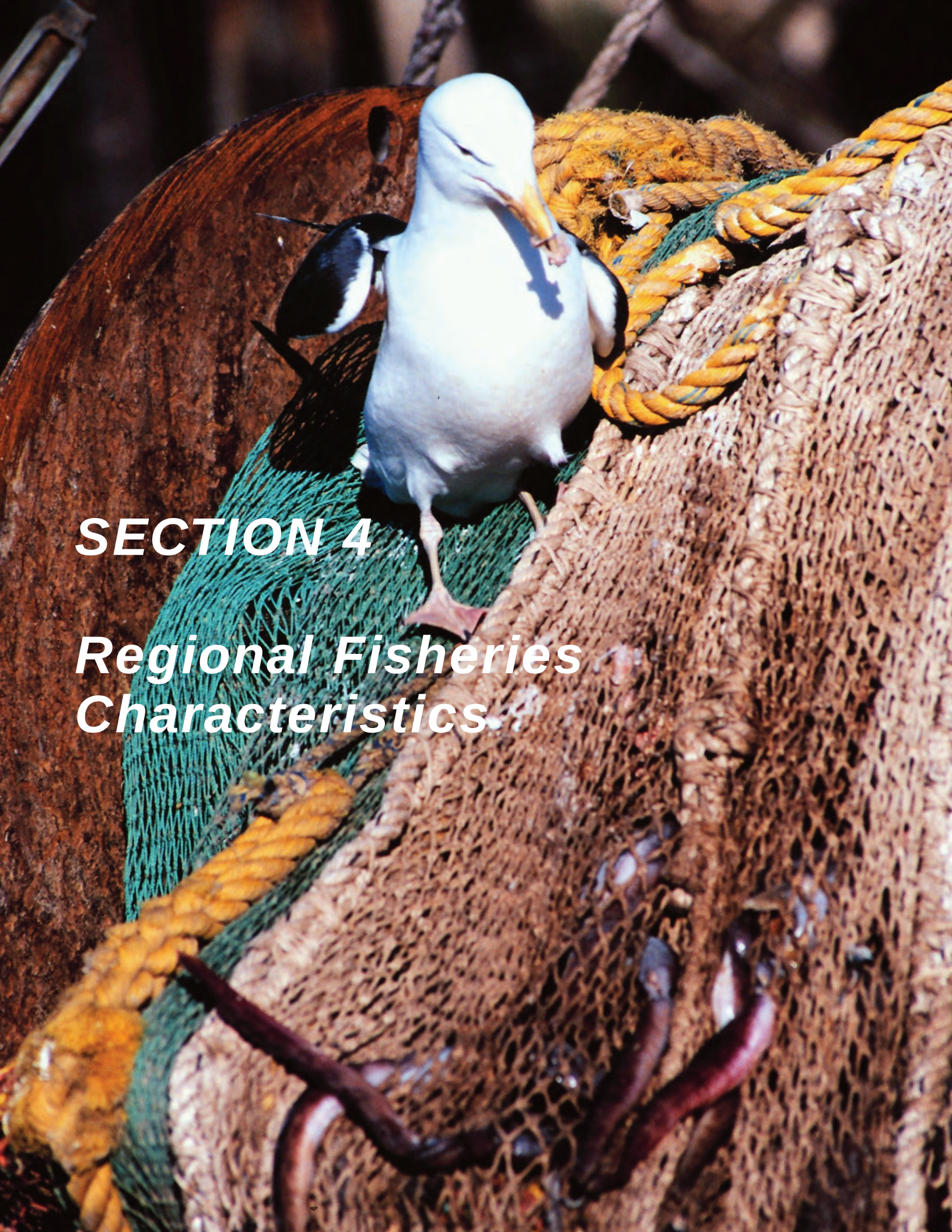


Figure 3.6
Distribution of bycatch ratios, for all fisheries in which fish bycatch estimates in pounds were included in the U.S. National Bycatch Report (*n* = 63). The red dotted line indicates the median of the frequency distribution, above which a fishery was designated as a fishery of focus.



SECTION 4

Regional Fisheries Characteristics

Photo on previous page: A gull picks bycaught eel from a fishing net in Maine. Photo credit: William B. Folsom, NMFS.

SECTION 4 Regional Fisheries Characteristics

This Section provides a region-by-region overview of fisheries bycatch and bycatch management for the six NMFS regions. Each regional section is divided into eight subsections:

- Fisheries overview. Identifies regional fisheries managed at the tribal, state, Federal, or international level, as well as fisheries characteristics (including Federal management plans, type of gear used, target species, and available bycatch data sources).

- Addressing regional bycatch issues. Provides information on regional bycatch concerns and actions taken by NMFS and regional fishery management councils to address regional bycatch issues.

- Data sources. Summarizes current bycatch data collection activities, including observer programs and self-reported data.

- Bycatch estimation methods. Outlines processes used for developing estimates of bycatch and the associated uncertainty of bycatch estimates for fish, marine mammal, sea turtle, and seabird bycatch in each of the region's fisheries for which bycatch estimates are currently available.

- Regional tier classification. Lists fish, marine mammal, and non-marine mammal protected species tiers (assigned according to the process outlined in Section 3.1) for Federally-managed fisheries and fisheries with Federal data collection programs.

- Regional key stocks. Identifies those stocks, species, and populations designated as key stocks within each region, using the processes outlined in Section 3.3.

- Regional bycatch estimates. Provides bycatch estimates and measures of uncertainty for fish, marine mammals, sea turtles, and seabirds, by fishery. Estimates were developed using 2005 data where available. For some rare-event species, multiple years of data were necessary to develop bycatch estimates.

- Bycatch estimate improvement plans for fisheries of focus. Presents recommendations for improving the quality of bycatch data collection and bycatch estimation for regional fisheries of focus, according to the process outlined in Section 3.

4.1 Northeast Region

The Northeast Region extends from Maine to Cape Hatteras, North Carolina. Geographically, the region is divided into three main oceanic areas: the Gulf of Maine, Georges Bank, and the Southern New England/Mid-Atlantic Bight. These three areas comprise the Northeast U.S. Continental Shelf Large Marine Ecosystem,[1] and contain some of the oldest fisheries in the Nation. The New England and Mid-Atlantic Fishery Management Councils, in conjunction with NMFS, are responsible for managing fisheries in the Northeast Region. These fisheries are diverse with respect to both the species targeted and the gear types employed.

4.1.1 Fisheries Overview

A total of 63 commercial fisheries are included in this report for the Northeast Region (Table 4.1.1), of which 37 are subject to a Council FMP. Landings from these fisheries were valued at approximately $1.4 billion dollars in 2005.[2] For the purposes of this report, the Northeast Region Protected Resources Division elected to group certain fisheries by gear type, in accordance with current protected species stock assessment and bycatch estimation practices; these groups and the individual fisheries comprising them are listed in Table 4.1.1. Fish bycatch was estimated at the individual fishery level, while protected species bycatch was estimated, in most cases, at the grouped fishery level.

Over half (51%) of the fisheries in the Northeast Region are managed at the Federal level (Figure 4.1.1). Federal management authority overlaps with state management authority in five fisheries (four pot/trap fisheries and the Mid-Atlantic Shrimp Trawl Fishery, which has no Federal FMP) and with international management authorities in six fisheries, primarily Highly Migratory Species (HMS) fisheries targeting tuna.

Atlantic U.S. fisheries for tuna, swordfish, and billfish are managed by NMFS under the authority of the Atlantic Tunas Convention Act (ATCA) and the MSA. The ATCA authorizes the promulgation of regulations, as necessary and appropriate, to implement conservation and management recommendations adopted by the International Commission for the Conservation of Atlantic Tunas (ICCAT). The U.S. reports catch statistics on HMS species managed under the ATCA to ICCAT each year. The NMFS Office of Sustainable Fisheries, HMS Management Division, manages Atlantic HMS including tunas, sharks, swordfish and billfish. All Atlantic HMS fisheries are managed under a Secretarial FMP (the Consolidated HMS FMP), and Northeast Region staff coordinate with staff from the HMS Management Division in the NMFS Offices of Sustainable Fisheries and Science and Technology and the Southeast Fisheries Science Center to manage these stocks.

Thirteen additional FMPs regulate the harvest of Federal stocks in the Northeast Region. Two fishery management councils, the New England Fishery Management Council (NEFMC) and the Mid-Atlantic Fishery Management Council (MAFMC), develop fisheries regulations for their respective FMPs. The NEFMC manages the Atlantic Herring; Atlantic Sea Scallop; Deep Sea Red Crab; Northeast Multispecies; Northeastern Skate Complex; and Atlantic Salmon FMPs. The Bluefish; Atlantic Mackerel, Squid, and Butterfish; Summer Flounder; Scup and Black Sea Bass; Surfclam and Ocean Quahog; and Tilefish FMPs are managed by the MAFMC. The Spiny Dogfish FMP and Monkfish FMP are joint NEFMC/MAFMC FMPs; the MAFMC is the administrative lead for the Dogfish FMP, while the NEFMC is the administrative lead for the Monkfish FMP (Table 4.1.1).

Twelve coastal states are represented within the Northeast Region: Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, and North Carolina. Management of several fisheries crosses state/Federal boundaries. In these cases, the NMFS and the Councils work with the individual states and the Atlantic States Marine Fisheries Commission (ASMFC), a deliberative body representing the 15 Atlantic coastal states, to coordinate the management of trans-boundary species. The NMFS Northeast Region also shares management authority for Federal fisheries with the states and regional fisheries management organizations in other contexts, such as FMP development and monitoring.

Photo: Lee Benaka, NMFS

Sorting the catch.

[1] http://www.lme.noaa.gov/.

[2] Ex-vessel landings value. Fisheries Economics of the U.S., 2006. Available online at: www.st.nmfs.noaa.gov/st5/publication/fisheries_economics_2006.html.

Table 4.1.1

Northeast Region fisheries included in the U.S. National Bycatch Report. Names of eight fishery groups appear in bold, each followed by the names of the individual fisheries it includes. Within each group, fisheries are listed alphabetically by fishery group name, then by management authority, and then by individual fishery name. Non-grouped fisheries are listed by management authority and then fishery name. Rows containing fisheries for which bycatch estimates are included in this report are shaded; a shaded group fishery name indicates at least one protected species bycatch estimate, and a shaded individual fishery name indicates at least one MSA fish stock or protected species bycatch estimate.

Fishery[a]	Management Authority	Federal Fishery Management Plan[b]	Gear Type	Target Species (common name)	Bycatch Data Sources[c]
Mid-Atlantic Gillnet Fisheries					
Mid-Atlantic Extra-Large-Mesh Gillnet[d]	Federal	Monkfish; Northeastern Skate Complex	Gillnet	Monkfish, skates, striped bass, other finfish	Observer data, DAS database, Vessel Trip Report, commercial landings database, North Carolina state landings
Mid-Atlantic Large-Mesh Gillnet[d]	Federal	Monkfish; Spiny Dogfish; Bluefish	Gillnet	Bluefish, monkfish, smooth dogfish, spiny dogfish, striped bass, other finfish	Observer data, DAS database, Vessel Trip Report, commercial landings database, North Carolina state landings
Mid-Atlantic Small-Mesh Gillnet[d]	Federal	Bluefish	Gillnet	Atlantic croaker, bluefish, Atlantic menhaden, other finfish	Observer data, DAS database,Vessel Trip Report, commercial landings database, North Carolina state landings
New England Gillnet Fisheries					
New England Extra-Large-Mesh Gillnet[d]	Federal	Monkfish; Northeastern Skate Complex; Northeast Multispecies; Spiny Dogfish	Gillnet	Monkfish, groundfish, skates, other finfish	Observer data, DAS database, Vessel Trip Report, commercial dealer landings database
New England Large-Mesh Gillnet[d]	Federal	Monkfish; Northeast Multispecies; Northeastern Skate Complex; Spiny Dogfish	Gillnet	Groundfish, monkfish, skates, spiny dogfish, other finfish	Observer data, DAS database, Vessel Trip Report, commercial dealer landings database
New England Small-Mesh Gillnet[d]	Federal	Northeast Multispecies	Gillnet	Various finfish	Observer data, DAS database, Vessel Trip Report, commercial dealer landings database

Table 4.1.1 (continued)

Fishery[a]	Management Authority	Federal Fishery Management Plan [b]	Gear Type	Target Species (common name)	Bycatch Data Sources[c]
New England Bottom Longline Fisheries					
New England Bottom Longline	Federal	Spiny Dogfish; Northeast Multispecies	Longlines (bottom)	Spiny dogfish, groundfish, monkfish, other finfish	Observer data, DAS database, Vessel Trip Report
New England Haddock Sector Longline	Federal	Northeast Multispecies	Longlines (bottom)	Haddock	Observer data, DAS database, Vessel Trip Report
Mid-Atlantic Otter Trawl Fisheries					
Mid-Atlantic Large-Mesh Otter Trawl [d]	Federal	Summer Flounder, Scup and Black Sea Bass; Monkfish; Northeast Multispecies; Northeast Skate	Otter trawl (bottom, fish)	Summer flounder, winter flounder, other finfish	Observer data, DAS database, Vessel Trip Report
Mid-Atlantic Small-Mesh Otter Trawl [d]	Federal	Atlantic Mackerel, Squid, and Butterfish; Northeast Multispecies; Spiny Dogfish; Summer Flounder, Scup, and Black Sea Bass	Otter trawl (bottom, fish)	Short-finned squid, long-finned squid, silver hake, other finfish	Observer data, DAS database, Vessel Trip Report
New England Otter Trawl Fisheries					
New England B-Reg DAS [e] Large-Mesh Otter Trawl [d]	Federal	Northeast Multispecies; Northeast Skate; Spiny Dogfish	Otter trawl (bottom, fish)	Spiny dogfish, groundfish, skates, other finfish	Observer data, DAS database, Vessel Trip Report
New England Large-Mesh Otter Trawl [d]	Federal	Northeast Multispecies; Northeast Skate; Monkfish	Otter trawl (bottom, fish)	Monkfish, groundfish, skates, other finfish	Observer data, DAS database, Vessel Trip Report
New England Small-Mesh Otter Trawl [d]	Federal	Northeast Multispecies; Summer Flounder, Scup, and Black Sea Bass; Atlantic Mackerel, Squid, and Butterfish	Otter trawl (bottom, fish)	Short-finned squid, long-finned squid, silver hake, other finfish	Observer data, (DAS database, Vessel Trip Report
New England US/CAN Area Large-Mesh Otter Trawl [d]	Federal	Northeast Multispecies; Northeast Skate; Monkfish	Otter trawl (bottom, fish)	Monkfish, Atlantic cod, skates, other finfish	Observer data, DAS database, Vessel Trip Report

Table 4.1.1 (continued)

Fishery[a]	Management Authority	Federal Fishery Management Plan [b]	Gear Type	Target Species (common name)	Bycatch Data Sources[c]
New England Otter Trawl Fisheries (cont.)					
New England US/ CAN Area Small-Mesh Otter Trawl [d]	Federal	Northeast Multispecies; Atlantic Mackerel, Squid, and Butterfish	Otter trawl (bottom, fish)	Short-finned squid, long-finned squid, silver hake, other finfish	Observer data, DAS database, Vessel Trip Report
Mid-Atlantic Scallop Dredge Fisheries					
Mid-Atlantic General Cat. Closed Area Scallop Dredge	Federal	Atlantic Sea Scallop; Monkfish	Dredge (New Bedford)	Atlantic sea scallop, monkfish	Observer data, DAS database, Vessel Trip Report
Mid-Atlantic General Cat. Open Area Scallop Dredge	Federal	Atlantic Sea Scallop; Monkfish	Dredge (New Bedford)	Atlantic sea scallop, monkfish	Observer data, DAS database, Vessel Trip Report
Mid-Atlantic Limited-Access Closed Area Scallop Dredge	Federal	Atlantic Sea Scallop; Monkfish	Dredge (New Bedford)	Atlantic sea scallop, monkfish	Observer data, DAS database, Vessel Trip Report
Mid-Atlantic Limited-Access Open Area Scallop Dredge	Federal	Atlantic Sea Scallop; Monkfish	Dredge (New Bedford)	Atlantic sea scallop, monkfish	Observer data, DAS database, Vessel Trip Report
New England Scallop Dredge Fisheries					
New England General Cat. Closed Area Scallop Dredge	Federal	Atlantic Sea Scallop; Monkfish	Dredge (New Bedford)	Atlantic sea scallop, monkfish	Observer data, DAS database, Vessel Trip Report
New England General Cat. Open Area Scallop Dredge	Federal	Atlantic Sea Scallop; Monkfish	Dredge (New Bedford)	Atlantic sea scallop, monkfish	Observer data, DAS database, Vessel Trip Report
New England Limited-Access Closed Area Scallop Dredge	Federal	Atlantic Sea Scallop; Monkfish	Dredge (New Bedford)	Atlantic sea scallop, monkfish	Observer data, DAS database, Vessel Trip Report
New England Limited-Access Open Area Scallop Dredge	Federal	Atlantic Sea Scallop; Monkfish	Dredge (New Bedford)	Atlantic sea scallop, monkfish	Observer data, DAS database, Vessel Trip Report

Table 4.1.1 (continued)

Fishery[a]	Management Authority	Federal Fishery Management Plan [b]	Gear Type	Target Species (common name)	Bycatch Data Sources[c]
Mid-Atlantic Scallop Trawl Fisheries					
Mid-Atlantic General Cat. Scallop Trawl	Federal	Atlantic Sea Scallop; Summer Flounder, Scup, and Black Sea Bass	Otter trawl (bottom, scallop)	Atlantic sea scallop, summer flounder	Observer data, DAS database, Vessel Trip Report
Mid-Atlantic Limited-Access Scallop Trawl	Federal	Atlantic Sea Scallop; Summer Flounder, Scup, and Black Sea Bass	Otter Trawl (bottom, scallop)	Atlantic sea scallop, summer flounder	Observer data, DAS database, Vessel Trip Report
Non-Grouped Fisheries					
Mid-Atlantic Bottom Longline	Federal	Tilefish; Northeast Multispecies	Longlines (bottom)	Tilefish, Atlantic cod, other finfish	Observer data, DAS database, Vessel Trip Report, commercial landings database
Mid-Atlantic Clam/ Quahog Dredge	Federal	Surfclam and Ocean Quahog	Dredge (clam)	Atlantic surfclam, ocean quahog	Clam Vessel Trip Report, commercial dealer landings database
Mid-Atlantic Mid-Water Otter Trawl	Federal	Atlantic Herring; Atlantic Mackerel, Squid, and Butterfish	Otter trawl (midwater)	Atlantic herring, Atlantic mackerel, blueback herring, other finfish	Observer data, DAS database, Vessel Trip Report, commercial dealer landings database
New England Clam/ Quahog Dredge	Federal	Surfclam and Ocean Quahog	Dredge (clam)	Atlantic surfclam, ocean quahog	Clam Vessel Trip Report, commercial dealer landings database
New England Crab Pots	Federal	Deep Sea Red Crab	Pots and traps	Deep sea red crab, Jonah crab	Vessel Trip Report, commercial dealer landings database
New England Mid-Water Otter Trawl	Federal	Atlantic Herring; Atlantic Mackerel, Squid, and Butterfish	Otter trawl (midwater)	Atlantic herring, Atlantic mackerel, other finfish	Observer data, DAS database, Vessel Trip Report, commercial dealer landings database
New England Scottish Seine	Federal	Northeast Multispecies	Scottish seine	Silver hake, Atlantic cod, winter flounder, other finfish	Observer data, DAS database, Vessel Trip Report, commercial dealer landings database

Table 4.1.1 (continued)

Fishery[a]	Management Authority	Federal Fishery Management Plan [b]	Gear Type	Target Species (common name)	Bycatch Data Sources[c]
Non-Grouped Fisheries (cont.)					
Gulf of Maine Mid-Atlantic Tuna, Shark, Swordfish Hook-and-Line	Federal, international	Consolidated Highly Migratory Species	Hook and line	Bluefin tuna, swordfish	
Gulf of Maine, Mid-Atlantic Tuna, Shark, Swordfish Harpoon	Federal, international	Consolidated Highly Migratory Species	Harpoons	Bluefin tuna, swordfish	
Mid-Atlantic Hand Line	Federal, international	Summer Flounder, Scup, and Black Sea Bass; Bluefish; Atlantic Mackerel, Squid, and Butterfish; Consolidated Highly Migratory Species	Hand line	Scup, bluefish, black sea bass, other finfish	Observer data, DAS database, Vessel Trip Report, commercial dealer landings database
Mid-Atlantic Purse Seine	Federal, international		Purse seine	Atlantic menhaden, other finfish	Observer data, DAS database, Vessel Trip Report, commercial dealer landings database
New England Hand Line	Federal, international	Northeast Multispecies; Summer Flounder, Scup, and Black Sea Bass; Bluefish; Consolidated Highly Migratory Species	Hand line	Atlantic cod, scup, bluefin tuna, other finfish	Observer data, DAS database, Vessel Trip Report
New England Purse Seine	Federal, international	Atlantic Herring; Northeast Multispecies; Consolidated Highly Migratory Species	Purse seine	Atlantic menhaden, Atlantic herring, bluefin tuna, other finfish	Observer data, DAS database, Vessel Trip Report
Mid-Atlantic Fish Pots and Traps	Federal, state	Summer Flounder, Scup, and Black Sea Bass	Pots and traps (fish)	Black sea bass, tautog other finfish	Observer data, DAS database, Vessel Trip Report, commercial dealer landings database
Mid-Atlantic Lobster Pots	Federal, state	Summer Flounder, Scup, and Black Sea Bass	Pots and traps (lobster)	American lobster, Jonah crab, black sea bass	Observer data, DAS database, Vessel Trip Report, commercial dealer landings database
Mid-Atlantic Shrimp Trawl	Federal, state		Otter trawl (bottom, shrimp)	Ocean shrimp, summer flounder, Atlantic sea scallop	Observer data, DAS database, Vessel Trip Report, commercial dealer landings database

Table 4.1.1 (continued)

Fishery[a]	Management Authority	Federal Fishery Management Plan [b]	Gear Type	Target Species (common name)	Bycatch Data Sources[c]
Non-Grouped Fisheries (cont.)					
New England Fish Pots and Traps	Federal, state	Summer Flounder, Scup, and Black Sea Bass	Pots and traps (fish)	Hagfish, black sea bass, scup, other finfish	Observer data, DAS database, Vessel Trip Report, commercial landings database
New England Lobster Pots	Federal, state		Pots and traps (lobster)	American lobster, Jonah crab, rock crab	Observer data, DAS database, Vessel Trip Report, commercial dealer landings database
Atlantic Blue Crab Trap/Pot	State		Pots and traps (blue crab)	Blue crab	Observer data, published papers
Chesapeake Bay Inshore Gillnet	State		Gillnet	Various finfish	Observer data, commercial dealer landings database
Delaware River Inshore Gillnet	State		Gillnet	Various finfish	Observer data, commercial dealer landings database
Gulf of Maine Herring and Atlantic Mackerel Stop Seine	State		Stop seine	Atlantic herring, Atlantic mackerel	
Gulf of Maine Herring and Atlantic Mackerel Weir	State		Weirs	Atlantic herring, Atlantic mackerel	
Gulf of Maine Mussel	State		Dredge	Blue mussel	
Gulf of Maine Urchin Dive, Hand/Mechanical Collection	State		Hand, diving gear	Urchin	
Long Island Sound Inshore Gillnet	State		Gillnet	Various finfish	Observer data, commercial dealer landings database
Mid-Atlantic Crab Pots	State		Pots and traps	Blue crab, deep sea red crab	Commercial dealer Landings database
Mid-Atlantic Crab Stop Seine	State		Stop seine	Blue crab	
Mid-Atlantic Crab Weir	State		Weirs	Blue crab	
Mid-Atlantic Eel Trap/Pot	State		Pots and traps (eel)	American eel	
Mid-Atlantic Hand Seine	State		Other seines	Various finfish	
Mid-Atlantic Haul/ Beach Seine	State		Haul seines	Various finfish	Observer data

Table 4.1.1 (continued)

Fishery[a]	Management Authority	Federal Fishery Management Plan [b]	Gear Type	Target Species (common name)	Bycatch Data Sources[c]
Non-Grouped Fisheries (cont.)					
Mid-Atlantic Oyster	State		Dredge	Eastern oyster	
New England Shrimp Trawl[f]	State		Otter trawl (bottom, shrimp)	Northern shrimp	Observer data, DAS database, Vessel Trip Report
Northeast Atlantic Finfish Aquaculture	State		Aquaculture		
Northeast Atlantic Shellfish Aquaculture	State		Aquaculture		
RI, S. MA (to Monomoy Is.), and NY Bight (Raritan and Lower NY Bays) Inshore Gillnet	State		Gillnet	Various finfish	Commercial dealer landings database
Virginia Pound Net	State		Pound nets	Various finfish	Observer data, commercial dealer landings database

[a] Aquaculture fisheries are listed for consistency with the MMPA List of Fisheries, but were not analyzed for the U.S. National Bycatch Report. Recreational fisheries are not included in this report.
[b] FMPs with the same name are differentiated by managing council. Note that non-Federal FMPs were not identified through this process.
[c] Bycatch data sources include data used for bycatch estimation and/or for tier scoring of fisheries (see Table 4.1.3). Stranding/entanglement, environmental, and satellite data sources were also used for marine mammal and sea turtle bycatch estimates and/or for tier scoring of fisheries, but were not identified in this table. For fisheries with bycatch estimates, observer data were used to estimate bycatch rates, and vessel trip report and/or commercial data were used to expand bycatch rates to total discards. For fisheries without bycatch estimates, observer coverage was conducted on one or more occasions, but not annually, from 1995 to present. DAS = days-at-sea.
[d] For otter trawls, two mesh-size groups are used: small (mesh less than 5.5 inches) and large (5.5-inch mesh and greater). For gillnets, three mesh-size groups were used: small (less than 5.5 inches), large (5.5–7.99 inches), and extra-large (8.0 inches and above).
[e] B-Reg days (B-Regular days at sea, a management measure in place when this report was compiled in 2005) were used to target the six groundfish stocks that could sustain additional effort, in ways that did not undermine longer-term rebuilding efforts for other stocks in the fishery.
[f] Commonly known as Northern Shrimp Trawl.

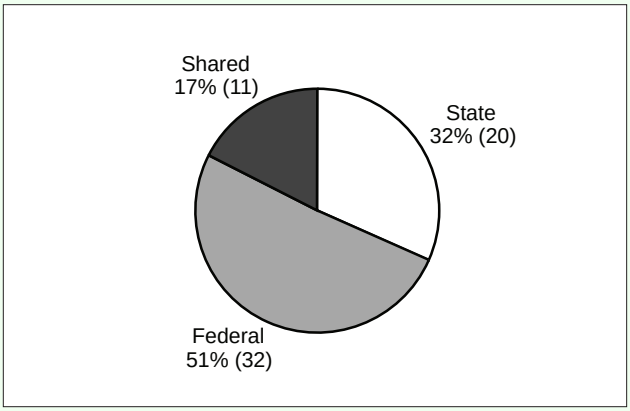


Figure 4.1.1
Management jurisdiction for Northeast Region fisheries (based on numbers of fisheries rather than volume or revenues). “Shared” indicates that international, federal, state, and/or tribal authorities share management jurisdiction.

4.1.2. Addressing Regional Bycatch Concerns

Together with the Councils and international management authorities, the NMFS Northeast Region has implemented many regulations to monitor and reduce fisheries bycatch.

Fish

FMP Measures[3]

In addition to the various fishing gear requirements described below, there are several other management measures intended to reduce bycatch.[3] Examples include time and area closures, such as Mid-Atlantic Gear Restricted Areas, intended to reduce the bycatch of scup in the squid fishery; and allowances for limited transfers of fish at sea, such as the scup transfer-at-sea provision. There are prohibitions on discarding certain species, e.g., under groundfish Special Access Programs (SAPs) established under the Northeast Multispecies FMP. More stringent reporting requirements were developed, such as the requirement in groundfish SAPs to report all catch on a daily basis via vessel monitoring systems. Additionally, incidental catch quotas were established that count discards against quotas, which are used in various programs established under the Northeast Multispecies FMP.

Bycatch Reduction

Collaborative efforts to reduce bycatch in the Northeast Region include the development of bycatch-reduction devices (BRDs). One recent example is the Ruhle trawl.[4] The Northeast Fisheries Science Center (NEFSC) and the Northeast Cooperative Research Partners Program (NCRPP) provided funds, field staff, and post-cruise data processing support to University of Rhode Island (URI) Sea Grant scientists, Rhode Island commercial fishermen, and a net manufacturer, for a collaborative effort to develop and test a new net design to reduce bycatch in the directed haddock bottom trawl fishery on Georges Bank. The new design has a selective trawl system that harvests rebuilt stocks while avoiding stocks of concern, reducing economic hardship for coastal fishing communities and also reducing bycatch.

Project design, field work, data analysis, and peer review for the Ruhle trawl occurred during 2005 and 2006. The device was evaluated during more than 100 side-by-side comparison tows completed during four seasonal sampling periods. While the catch of the target species, Georges Bank haddock (*Melanogrammus aeglefinus*), was not significantly different between the control and test nets, the bycatch of stocks of concern, notably Atlantic cod (*Gadus morhua*) and yellowtail flounder (*Limanda ferruginea*), was significantly reduced. The bycatch ratio of haddock to cod was improved from 3:1 in the control net to 20:1 in the test trawl, and the ratio of haddock to yellowtail flounder was improved from 13:1 in the control to 151:1 in the test trawl. The modified trawl virtually eliminated the bycatch of skates (a 98% reduction). As a result, this device was awarded first prize in the World Wildlife Fund Smart Gear Competition in 2007.[5] A presentation describing the net and results at the 2007 International Haddock Workshop at the University of New Hampshire, partially funded by NCRPP, resulted in collaboration and net orders from England. Field tests were conducted in the North Sea during December 2007. As a follow-up to the original study, the NCRPP awarded additional funding to URI in 2007 to scale down the net size for use aboard smaller trawlers operating in the Gulf of Maine (testing was initiated in 2008). Federal regulations allowing this device can be found at 50 CFR 648.85.

Additional fish BRDs developed or currently used in the Northeast Region include increased mesh size of scallop dredge twine top, the use of the Nordmore grate in the northern shrimp trawl fishery to reduce bycatch of finfish, and the raised-footrope trawl/Maine grate raised-footrope trawl to reduce bycatch of regulated groundfish. More information on these and other BRDs can be found on the NEFSC website.[6]

Protected Species

The MMPA requires NMFS to develop and implement Take Reduction Plans (TRPs) to assist in the recovery or prevent the depletion of strategic marine mammal stocks that are seriously injured or killed incidental to commercial fisheries. In the Northeast Region, TRPs have been implemented for the following stocks:

- Harbor porpoise (*Phocoena phocoena*)—Gulf of Maine/Bay of Fundy stock[7]
- Bottlenose dolphin (*Tursiops truncatus*)—Western North Atlantic coastal stock[8]
- Large whales, including North Atlantic right whales (*Eubalaena glacialis*), fin whales (*Balaenoptera physalus*), and humpback whales (*Megaptera novaeangliae*)—Western Atlantic, Western North Atlantic, and Gulf of Maine stocks, respectively[9]

Additionally, a take-reduction team (TRT) for Northeast and Mid-Atlantic bottom and mid-water trawl fisheries in-

[3] While the text presented herein reflects the measures that were in effect in 2005, recent changes in the management of the Northeast Multispecies fishery, including the more systematic integration of selective gear into fishing operations and the transition to a catch-based management regime in which both landings and discards control fishing operations, have substantially affected the way bycatch is addressed in this FMP; this should be noted in any discussion of bycatch issues.

[4] http://www.nefsc.noaa.gov/press_release/2008/News/NR0824/

[5] http://assets.panda.org/downloads/eliminator_november_2007_final.pdf

[6] http://www.nefsc.noaa.gov/

[7] http://www.nero.noaa.gov/prot_res/porptrp/

[8] http://www.nmfs.noaa.gov/pr/interactions/trt/bdtrp.htm

[9] http://www.nero.noaa.gov/whaletrp/

teracting with long- and/or short-finned pilot whales (*Globicephela* spp.), common dolphin (*Delphinus delphis*), and white-sided dolphin (*Lagenorhynchus acutus*) was convened in 2006.[10]

Many FMPs have measures in place to control fishing effort, limit fishing in certain areas or times of year, and establish total allowable catch limits. In addition to affecting catch of fish stocks, these measures may shift fishing effort and change fishing practices in ways that may also influence the bycatch of marine mammals and/or sea turtles.[11] Measures to reduce turtle bycatch have also been implemented within FMPs. For example, turtle excluder devices (TEDs) are required for the summer flounder fishery (see 57 FR 57358, 4 December 1992). Regulations specifying time/area closures and mandatory gear requirements further reduce bycatch of sea turtles (see 80 FR 24776, 26 April 2006).[12]

In addition, BRDs have been developed specifically for protected species. An example is the development of a modified pound net design to reduce bycatch of sea turtles in offshore pound nets. In 2004, NMFS prohibited the use of offshore pound net leaders (an important component of the pound net gear) in a portion of the Chesapeake Bay because of incidental takes of sea turtles in this component of the gear. In 2004 and 2005, a coordinated research study directed by the NEFSC with pound net industry participants and other interested parties was initiated to develop and test a modified pound net leader design, with the goal of eliminating or reducing sea turtle interactions while retaining an acceptable level of fish catch (DeAlteris and Silva 2008). A series of gear experiments led NMFS to publish regulations in 2006 permitting pound net fishermen to fish in previously closed areas of the Chesapeake Bay if they utilized the modified leader design. These measures should reduce incidental take of sea turtles in the Virginia pound net fishery, while enabling the fishery to continue.

Chain mats were also developed to reduce sea turtle bycatch in the Atlantic sea scallop dredge fishery. The NEFSC has been working collaboratively with the Southeast Fisheries Science Center, scallop industry, and other interested parties to reduce the severity of some sea turtle interactions with scallop dredge gear by preventing capture of the turtle in the dredge bag (DuPaul et al. 2004). Chain mats are not expected to reduce the total number of interactions (physical contact between the turtle and the dredge gear); however, they are expected to prevent injury and mortality from capture in the dredge bag. On 25 August 2006, NMFS issued a final rule requiring sea scallop dredge vessels fishing south of 41°9.0′N from 1 May to 30 November each year to have dredges equipped with chain mats (NMFS 2006b).

Another BRD developed in the Northeast is the "weak link" for gillnet and trap/pot gear. Whale interactions with commercial fixed fishing gear may occur while the whale is feeding or transiting through an area. Breakaway links or weak links are breakable sections or devices that part when subjected to certain loads. After parting, the rope will have a knotless end to prevent lodging in the whale's baleen. Weak links with specific breaking strengths are required on fixed fishing gear to reduce the risk of whales becoming entangled, injured, or killed. Weak links placed at the surface system of buoy lines (endlines attached to the buoy and/or rope attaching the buoy to the highflyer) are designed for entanglements that involve the mouth. The NMFS is also working with the Atlantic Large Whale TRT and researchers on the development of other devices or techniques to help reduce or eliminate the risk associated with buoy line entanglements. Note that sea turtles may also become entangled in fixed gear of trap/pots, but that weak links do not reduce interactions between turtles and vertical lines.

Acoustic deterrents (pingers) were shown to reduce harbor porpoise bycatch by 92% in a controlled scientific experiment conducted in gillnets off of New Hampshire (Kraus et al. 1997). Based on the success of this experiment, a TRP to reduce harbor porpoise bycatch was developed that required Northeast gillnets to use pingers during specified times and places when there were high densities of harbor porpoises (NOAA 1998). Following the general trend seen during the scientific experiment, the harbor porpoise bycatch in the normal operational gillnet fishery decreased from above 1500 harbor porpoises per year before 1996 to below 500 harbor porpoises per year during 1999 to 2001. This decrease in bycatch was attributed mainly to the use of the pingers. However, after a while the level of compliance with the TRP decreased, which corresponded with an increase in the level of bycatch. During 2006–07, outreach activities increased to remind fishers about the TRP requirements, compliance increased, and bycatch started decreasing. In the times and areas that pingers were required, the bycatch rate in gillnet hauls without pingers was much higher than that in hauls that used the required number of pingers. The conclusion from the experiences during the controlled scientific experiment and during the normal operational fishery is that pingers appear to reduce the bycatch of harbor porpoises in gillnets, particularly when the required number of pingers are used and in nets using mesh sizes of 6 in or less (Palka et al. 2008).

Examples of other activities in the Northeast Region to reduce bycatch of protected species include requiring sinking groundlines for whale bycatch reduction, and research on acoustic-reflective nets for harbor porpoise and coastal bottlenose dolphin bycatch reduction.

[10] http://www.nero.noaa.gov/prot_res/atgtrp/
[11] http://www.nero.noaa.gov/nero/fishermen/
[12] http://www.nero.noaa.gov/prot%5Fres/seaturtles/regs.html

Photo: William Millhouser, NOS.

A squid (*Illex illecebrosus*) cruising over a sandy area of Stellwagen Bank National Marine Sanctuary.

4.1.3 Data Sources

Data from commercial fishing trips have been collected in northeast ports for more than 100 years. Table 4.1.1 lists data sources used to estimate bycatch for federally managed Northeast Region fisheries and those northeast state fisheries with relevant Federal data-collection programs. In addition to observer programs, the Northeast Region collects fishing VTRs from federally permitted vessels operating under the region's FMPs.

4.1.3.1 Observer Program Data

In the 1970s and 1980s, foreign vessels fishing in the U.S. Exclusive Economic Zone (EEZ) paid for the costs of fishery observer coverage on their vessels. While the foreign fleets decreased their fishing time in these waters, the number of U.S. vessels increased and the observer program expanded. Throughout the 1990s, most of the observer program's sea days were used to monitor fixed-gear commercial fisheries for takes of protected species. Today, the Northeast Fishery Observer Program (NEFOP) collects, processes, and manages data and biological samples from vessels with Federal or state commercial fishing permits operating within Federal and state waters of the U.S. EEZ from Maine to North Carolina.

Fisheries observers are required under all Northeast Region FMPs and for some fisheries by other Federal laws and authorities such as the MMPA and the ESA. The NEFOP observers record weights of kept and discarded (actual or estimated) fish and crustacean species on observed hauls, as well as biological sampling information (tags, lengths, age, and sex) for all species caught, including bycatch of marine mammals, sea turtles, and seabirds. Data on vessel and gear characteristics and fishing practices are also collected. All data are collected for scientific and fisheries management purposes. As in many observer programs, bias may arise if vessels with observers consistently catch more or less than other vessels, or fish in different areas, or if average trip duration changes. The NEFOP has developed vessel selection protocols, including random selection procedures, to ensure representative sampling. Analyses to evaluate bias in the NEFOP have indicated no systematic bias in amount of kept pounds, trip duration, or area fished (Rago et al. 2005; Wigley et al. 2007).

In 2005, the NEFOP observed over 8,900 days of commercial fishing. The region has observer programs at developing or mature levels for several fisheries, including the Atlantic sea scallop dredge, Mid-Atlantic bottom longline, Mid-Atlantic gillnet fisheries, New England large-mesh trawl, New England sink gillnet, and New England/Mid-Atlantic small-mesh trawl. Other regional fisheries (e.g., Mid-Atlantic general category scallop trawl, New England and Mid-Atlantic purse seine, New England handline, and New England shrimp trawl) are observed at baseline/pilot levels of coverage. Northeast Region observer programs and observed fisheries are listed in Table 4.1.2.

4.1.3.2 Mandatory Self-Reported Data

A mandatory reporting system for landings and sales of all species was implemented by the Northeast Region in 1994. Required for all federally permitted fisheries in the Northeast, the mandatory reporting system has two components, dealer reporting and VTRs. Dealer reports contain total landings by market category, but do not contain information on trip effort, area fished, gear type, or mesh sizes. The VTRs contain information for each trip taken including catch, effort, gear characteristics, and spatial data variables. The VTR requirements apply to all trips made by vessels holding a Northeast Region Federal fishing permit for either Federal or state waters, regardless of species fished for or retained. Even if no fish are landed on a trip, the vessel owners/operators must still complete the report.

These data provide a near-census of commercial landings. Comparisons between dealer reports and VTR data have indicated general agreement between the sources, suggesting that misreporting of landings does not occur at sizeable levels (Rago et al. 2005; Wigley et al. 2008). Some extrapolation factors used to estimate total discards and the weighting factors for discard-to-kept ratios may be underestimated slightly and are being addressed through further work to identify the source of the disparities (Wigley et al. 2007).

In addition, data provided in entanglement reports submitted to the NMFS Northeast Regional Office and Southeast Regional Office by members of the National Stranding Network, large whale disentanglement teams, the U.S. Coast Guard, and civilian sources are used to estimate a minimum number of entanglements and ship strikes of large whales, though most entanglements cannot be assigned to a specific fishery (Glass et al. 2008).

Table 4.1.2
Current Northeast Region Federal observer programs, fisheries observed, and coverage levels. Programs and observed fisheries are listed alphabetically. Observer programs that ended over 10 years ago are not listed.

Observer Program	National Bycatch Report Fisheries	Authority to Place Observers	Program Duration	Coverage Level
Atlantic Sea Scallop Dredge Fishery	Mid-Atlantic General Cat. Closed Area Scallop Dredge	MSA (50 CFR 648)	1999–present	2005: <3% 2006: 8–10% 2007: 8–10% 2008: 10%
	Mid-Atlantic General Cat. Open Area Scallop Dredge			
	Mid-Atlantic Limited-Access Closed Area Scallop Dredge			
	Mid-Atlantic Limited-Access Open Area Scallop Dredge			
	New England General Cat. Closed Area Scallop Dredge			
	New England General Cat. Open Area Scallop Dredge			
	New England Limited-Access Closed Area Scallop Dredge			
	New England Limited-access Open Area Scallop Dredge			
Mid-Atlantic Gillnet Fisheries	Mid-Atlantic Extra-Large-Mesh Gillnet	MSA (50 CFR 648); MMPA Cat. I (50 CFR 229)	1994–present	2005: 3% 2006: <2% 2007: <1% 2008: <3%
	Mid-Atlantic Large-Mesh Gillnet			
	Mid-Atlantic Small-Mesh Gillnet			
	Mid-Atlantic Haul/Beach Seine			
Mid-Atlantic Illex Squid Trawl	Mid-Atlantic Small-Mesh Otter Trawl [a]	MSA (50 CFR 648); MMPA Cat. II (50 CFR 229)	2004–present	2005: <1% 2006: <1% 2007: <1% 2008: <3%

Table 4.1.2 (continued)

Observer Program	National Bycatch Report Fisheries	Authority to Place Observers	Program Duration	Coverage Level
New England Groundfish Trawl and Sink Gillnet Fisheries (also bottom longline/ tub, herring mid-water pair trawl, New England handline, shrimp trawl, and whiting trawl)	Mid-Atlantic Bottom Longline	MSA (50 CFR 648); MMPA Cat. I, II and III (50 CFR 229)	1990–present	2005: 5% A-days; 50% B-days 2006: 2–10% 2007: 5% 2008: 8-10%
	Mid-Atlantic Mid-Water Trawl			
	Mid-Atlantic Purse Seine			
	Mid-Atlantic Shrimp Trawl			
	New England Bottom Longline			
	New England Extra-Large-Mesh Gillnet			
	New England Haddock Sector Longline			
	New England Handline			
	New England Large-Mesh Gillnet			
	New England Mid-Water Trawl			
	New England Purse Seine			
	New England Shrimp Trawl			
	New England Small-Mesh Gillnet			
New England and Mid-Atlantic Large-Mesh Trawl Fisheries	Mid-Atlantic General Cat. Scallop Trawl	MSA (50 CFR 648); MMPA Cat. II (50 CFR 229.7)	1998–present	2005: 1% 2006: 5–30% 2007: 2% 2008: <3%
	Mid-Atlantic Large-Mesh Otter Trawl			
	New England B-Reg DAS [b] Large-Mesh Otter Trawl			
	New England Large-Mesh Otter Trawl			
	New England US/CAN Area Large-Mesh Otter Trawl			
New England and Mid-Atlantic Small- Mesh Trawl Fisheries	Mid-Atlantic Small-Mesh Otter Trawl [a]	MMPA Cat. II (50 CFR 229.7); MSFCMA (50 CFR 648)	1994–present	2005: 1% 2006: 1% 2007: <1% 2008: <3%
	New England Small-Mesh Otter Trawl			
	New England US/CAN Area Small-Mesh Otter Trawl			

MSA = Magnuson-Stevens Fisheries Conservation and Management Act; CFR = Code of Federal Regulations

[a] The Mid-Atlantic small-mesh otter trawl fishery is listed twice in this table. It is observed under two different programs, depending on target species.

[b] DAS = days-at-sea

4.1.4 Bycatch Estimation Methods

Northeast Region bycatch estimation methods for fish, marine mammals, and sea turtles are presented in this section. Bycatch estimation methods for seabirds are being developed for inclusion in a future edition of the U.S. National Bycatch Report.

4.1.4.1 Fish Bycatch Estimation Methods for Federally Managed Commercial Fisheries

In this analysis, the 2005 NEFOP data were used to calculate discard ratios, with 2005 logbook data used to expand the NEFOP discard ratios to total discards (Wigley et al. 2008). The sampling unit was an individual fishing trip. Trips were partitioned into fleet sectors using six classification variables: calendar quarter, area fished, gear type, mesh size, access area, and trip category. Calendar quarter was based on landed date and used to capture seasonal variation in fishing activity and discard rates. Areas fished were based on the statistical reporting area; trips where area was unknown were excluded. Two areas were defined: New England (NE), comprising statistical areas 511–543, 561, and 562 (which includes southern New England, Georges Bank, and the Gulf of Maine); and Mid-Atlantic (MA), comprising statistical areas 611–639 (Figure 4.1.2).

The gear type variable was based on Northeast gear codes. Some gear codes were combined, and trips for which gear type was unknown were excluded. Mesh-size groups were formed for otter trawl and gillnet gear. Five access area categories were formed: "closed area," "US/CAN," "B-day," "HOOK," and "open area" (Wigley et al. 2008). Trip categories were employed to subdivide the scallop fishery into general (Gen) and limited (Lim) trips; all other fisheries were categorized as "all."

Fishery codes, days-at-sea (DAS) codes, and access area codes were used to classify all VTR trips into one of five access area categories. Vessel permit number and date landed were used to link VTR trips with DAS trips. A detailed description of the method and the obstacles encountered in joining the VTR and DAS data is given in Wigley et al. (2008).

When one or no observer trips occurred in a calendar quarter, an imputation approach (Cochran 1963) was employed to fill in missing or incomplete information, using data from an adjoining stratum. In this simple imputation of temporal stratification only, the classification of calendar quarter was relaxed to half-year, recognizing that seasonal variation occurs for some species. The imputation was used to fill quarterly cells for which there were one or no observed trips. When all quarterly cells were missing or observer coverage was low, and this existed across all quarters for a fleet, the fleet was omitted and no discard estimation performed.

Photo: Nicole Gilles, NMFS

Observer measuring a striped bass.

Total annual discards were estimated using a combined *d*/*k* ratio estimator (Cochran 1963) where *d* = discard pounds of a given species and *k* = kept pounds of all species (as a measure of fishing effort). Numbers for 2005 VTR landings were used to expand the discard rate to estimate total discard weight.

The combined ratio method was based on a ratio estimate pooled over all strata and trips within each fleet. Total discards (in pounds) for species *j* were defined as:

$$(1)\quad \hat{D}_j = \sum_{h=1}^{Q} K_h r_{c,j}$$

where $\hat{D}_j$ is the total discarded pounds of species *j*;
h is the stratum;
Q is the number of strata;
K_h is the VTR total kept pounds in stratum *h*; and
$r_{c,j}$ is the combined ratio of species *j*, calculated as:

$$(2)\quad r_{c,j} = \frac{\sum_{h=1}^{Q} N_h \sum_{i=1}^{n_h} \frac{d_{jih}}{n_h}}{\sum_{h=1}^{Q} N_h \sum_{i=1}^{n_h} \frac{k_{ih}}{n_h}}$$

where N_h is the number of VTR trips in stratum *h*;
n_h is the number of observed trips in stratum *h*;
d_{jih} is the total discards (in pounds) of species *j* from trip *i* in stratum *h*; and
k_{ih} is the kept pounds of all species on trip *i* in stratum *h*.

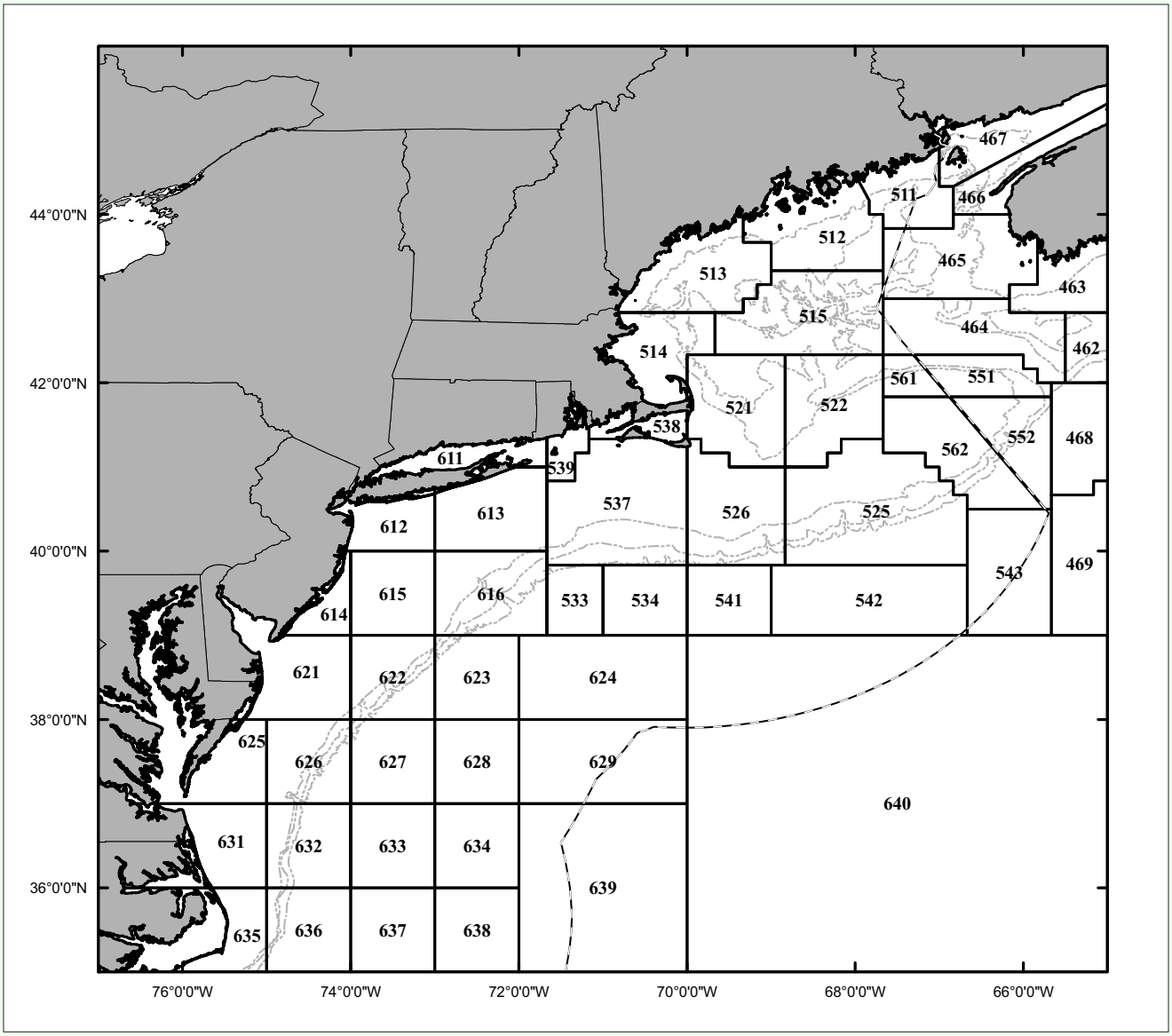


Figure 4.1.2
Northeast statistical areas (source: Northeast Fisheries Science Center).

In Equation 2 the summation over strata h = 1 to Q occurs over calendar quarters. Equation 3 (below) requires a more explicit definition of the stratum designation, since the summation over quarter relies on the annual combined ratio defined in Equation 2. Variance V of $\hat{D}_j$ for species j was defined as:

$$(3)\quad V(\hat{D}_j) = \sum_{q=1}^{4} K_{qh}^2 \left(\frac{N_{qh} - n_{qh}}{n_{qh} N_{qh}} \right) \frac{1}{\left(\frac{\sum_{i=1}^{n_h} k_{iqh}}{n_{qh}} \right)^2} \left[\frac{\sum_{i=1}^{n_{qh}} \left(d_{jiqh}^2 + (r_{c,j})^2 k_{iqh}^2 - 2 r_{c,j}\, d_{jiqh} k_{iqh} \right)}{n_{qh} - 1} \right]$$

where $\hat{D}_j$ is the total discards (in pounds) of species j;
K_{qh} is the VTR total kept pounds in quarter q and stratum h;
N_{qh} is the number of VTR trips in quarter q and stratum h;
n_{qh} is the number of observed trips in quarter q and stratum h;
k_{iqh} is the kept pounds of all species on trip i in quarter q and stratum h;
d_{jiqh} is the total discards (in pounds) of species j from trip i in quarter q and stratum h; and
$r_{c,j}$ is the combined ratio of species j.

Coefficient of variation (CV) of $\hat{D}_j$ was defined as:

$$(4)\quad CV(\hat{D}_j) = \frac{\sqrt{V(\hat{D}_j)}}{\hat{D}_j}$$

4.1.4.2 Caveats for Fish Bycatch Estimation

To evaluate a diverse range of species and fleets in the Northeast Region, the combined ratio method using the ratio of discard to kept weight was selected. The combined ratio method also accommodated the varying degrees of seasonal sparseness in the current observer program coverage. This design-based estimator used numbers kept of all species; kept of all species is more verifiable than data for effort (days absent or days fished) and better utilized the information associated with kept pounds. Total kept for all species in the ratio estimator was used as a surrogate for fishing effort. It was recognized that stratification alone may be insufficient to account for the heterogeneity of fleet behaviors or other specializations within a stratum. However, this was the best available method since other measures of fishing effort such as total days fished, crew size, and so forth are difficult to obtain for the entire fleet. Moreover, measures of fishing effort for fixed gears (e.g., gillnet soak time multiplied by net length multiplied by mesh size) were not collected for the fishery as a whole. The ratio estimator assumed a zero-intercept regression as an appropriate model of the relationship of discard to kept. Departures from linearity were recognized as a general limitation.

A total of 3,565 observed trips[13] were used in this analysis, with the majority of these occurring in the otter trawl, gillnet, and sea scallop dredge fleets (trips were partitioned when the trip characteristics fell into more than one fleet). Although observer coverage in 2005 was relatively high compared to previous years, some fleets had little or no observer coverage. For some fleets with limited temporal coverage by observers, imputation (Cochrane 1963) was used to derive discard estimates. However, using half-year estimates may not be appropriate for all species and, in some cases, quarterly discard ratios were based on very small sample sizes. This contributed to the lower precision (higher CV) associated with several of these estimates. Because discards were not estimated for all fisheries (due to data limitations), the total discard estimates presented in this report underestimate actual total discards in 2005.

As mentioned above, 2005 VTR landings (all species combined, live weight) by fleet and quarter were used to expand the discard ratios. Dealer data could not be used to expand the discard ratios because these data do not contain two key variables that define fisheries: mesh and area fished. As a surrogate for dealer data, VTR data were used.

In summary, a very broad stratification was used to encompass all species examined in the Northeast Regional fish analysis. The discard estimates provided in this report will differ from discard estimates derived for and used in stock assessments. For stock assessments, the stratification, as

[13] Observed trips (the sampling unit of the analysis) are a subset of the entire observer program's sampling activities and are not the same as number of days observed. Observed trips do not include trips where protected species sampling protocol were used, training trips, aborted trips, etc.

Photo credit: Peter Duley, NMFS.

The North Atlantic right whale.

well as the methods, is tailored to each species/stock to capture the appropriate seasonal, geographical, and gear/mesh discarding patterns that are species/stock specific. Details of the discard estimation for this analysis, including validation of the estimation method and the underlying data, are described in Wigley et al. (2008).

4.1.4.3 Marine Mammal Bycatch Estimation Methods for Federally Managed Commercial Fisheries

For all bycaught marine mammal species and all fisheries, the total number of marine mammal takes, *B*, was defined as the product of the observed bycatch rate and total annual fishing effort: *B* = bycatch rate • total effort, where the bycatch rate was defined as the number of animals taken per unit of fishing effort. Fisheries with no recorded takes had estimates of zero.

Since 1990, estimates of marine mammal bycatch rates have been derived from data collected by the NEFOP. Bycatch rates have been calculated using ratio and modeling estimation methods (see Sections 4.1.4.3.1 and 4.1.4.3.2). Bycatch rates were expanded using the most appropriate measure of fishing effort for a particular fishery. An appropriate measure was defined as a measure that increased as the number of takes increased, and was available in the observed sample and for the entire fishery.

Fishing effort information was obtained from four databases: the VTR database; Northeast Dealer Report Landings database (also sometimes referred to as the weighout database); North Carolina Division of Marine Fisheries trip ticket landings database; and Virginia Marine Resource Commission landings database. For some fisheries, information from the VTR or observer databases was used to prorate landings from a particular fishery to fishery-and-bycaught species-specific strata.

Standard bootstrapping techniques were used to derive the confidence intervals and CV for the bycatch estimates. The resampling unit used was usually an entire trip rather than individual hauls, to ensure that any within-trip dependence was carried over into the bycatch estimate's variance (Bisack 2003).

4.1.4.3.1 Marine Mammal Bycatch Estimation Methods for Federally Managed Gillnet Commercial Fisheries

Estimates of bycatch in the gillnet fishery were made for all species bycaught. For example, estimates for grey (*Halichoerus grypus*), harbor (*Phoca vitulina concolor*), and harp (*Phoca groenlandica*) seals and for harbor porpoise (*Phocena phocena*), white sided dolphin (*Lagerorhynchus acutus*), common dolphin (*Delphinus delphis*), and coastal bottlenose dolphin (*Tursiops truncatus*) were calculated using the ratio estimator method for bycaught species-specific strata, where the unit of effort was metric tons (m ton) of kept landings. Landings were considered the most appropriate unit of effort for this fishery, because it is presently the only unit of effort that is accurately recorded and available for the entire fishery.

The total annual number of marine mammal takes, *B*, was defined as the product of the observed annual bycatch rate and total annual effort within each stratum, *S*:

$$B = \sum_{i=1}^{S} \frac{\text{observed takes}_i}{\text{observed landings (m tons)}_i} \bullet \text{total landings (m tons)}_i$$

Strata were spatially and temporally specific, taking into account the seasonal and geographic distribution of the bycaught species and gillnet fishing practices. In all cases, separate estimates were calculated for the New England and mid-Atlantic gillnet fisheries, as defined in the *MMPA List of Fisheries for 2008* (NMFS 2007). Estimates for each calendar year were derived from only the corresponding year's data for all species except coastal bottlenose dolphins, where observer data were pooled over years to estimate the bycatch rate (due to the small numbers of observed takes) and effort was year-specific.

A weighted bycatch rate was calculated for strata within the Northeast gillnet fishery that had hauls fishing with and without pingers, where the weight was the proportion of hauls sampled with or without pingers.

Previous bycatch estimates for harbor porpoises are reported in Bisack (1993), Smith et al. (1993), Bravington and Bisack (1996), Bisack (1997), Rossman and Merrick (1999), Bisack (2003), Belden et al. (2006), Belden (2007), and Belden and Orphanides (2007). Previous bycatch estimates for harbor seals, gray seals, harp seals, common dolphins, and white sided dolphins are reported in Belden et al. (2006), Belden (2007), and Belden and Orphanides (2007). Bycatch estimates for coastal bottlenose dolphins during 2001 to 2005 using the ratio method and generalized linear modeling (GLM) are reported in Waring et al. (2007), and estimates from 1995 to 2000 using GLM are reported in Palka and Rossman (2001).

Currently, for harbor porpoises and seals, GLMs and generalized additive models (GAM) are being explored to better define strata to be used with the ratio method or to be used directly to estimate bycatch rate.

4.1.4.3.2 Marine Mammal Bycatch Estimation Methods for Federally Managed Trawl Commercial Fisheries

For both the New England and Mid-Atlantic Regions, bycatch was estimated separately for bottom trawl and mid-water (single and paired) trawl fisheries. In brief, observer data were used to develop bycatch rate models; VTR data were used as the primary source of fishing effort to expand the bycatch rate to a total bycatch estimate; and commercial dealer-reported landings data were used to expand the VTR data to the entire fishery (if needed).

The most appropriate unit of effort for trawl fisheries was determined to be "days fished," that is, the number of days the net is in the water (not the amount of time the ship is away from port). Bycatch rate models for cetaceans (Atlantic white-sided dolphins, common dolphins, and long- and/or short-finned pilot whales (*Globicephala* spp.)) were developed using GLMs, GAMs, classification trees, and zero-inflated GLM and GAMs, assuming a Poisson distribution. Many gear characteristics, fishing practices, spatial-temporal categories, and environmental factors were investigated to determine the best fitting bycatch rate model. Observer data collected from 2001 to 2005 were pooled to develop the bycatch rate model for the bottom trawl fisheries, and data from 2003 to 2006 were pooled to develop the bycatch rate model for the mid-water trawl fisheries. Poisson regression was used to model the bycatch rate (*y*/effort), where the number of takes (*y*) was a function of predictor variables:

$$\log(y) = \log(\text{effort}) + \beta_0 + f_1 x_1 + f_2 x_2 + \ldots + f_i x_i$$

where f_i was a smooth function when the model was a GAM model, and f_i was a coefficient value when the model was a GLM; x_i was a predictor variable describing an environmental, gear, or fishing characteristic: and log(effort) was an offset variable with a coefficient set to 1.0 (Allison 1999).

For bottom trawl fisheries, the best-fitting quasi-Poisson GLM bycatch rate models were species-specific and included the following significant predictors: statistical area, target fish species, sea surface temperature, bottom depth, bottom slope, and vessel horse power (Rossman, 2009). For mid-water trawl fisheries, a quasi-Poisson GAM bycatch rate model indicated that the most significant predictors of marine mammal bycatch were the latitude where fishing occurred and depth of the water column (Palka pers. comm.[14]).

4.1.4.4 Sea Turtle Bycatch Estimation Methods for all Federally Managed Commercial Fisheries

The same general estimation methods and data sources were used to estimate the bycatch of marine mammals and sea turtles. For sea turtle bycatch estimates, definitions of

[14] D. L. Palka. Northeast Fisheries Science Center, 166 Water Street, Woods Hole, MA 02543

strata and significant variables in bycatch rate models were fishery-specific and differed from the marine mammal bycatch rate models. Fisheries with no observed takes were given estimates of zero.[15]

4.1.4.4.1 Mid-Atlantic Region: Sea Turtle Bycatch Estimation Methods for Federally Managed Gillnet Commercial Fisheries

Bycatch estimates of turtles in gillnet gear were not available for inclusion in this report. However, observer data from 1994 to 2006 were examined in order to estimate sea turtle bycatch in this fishery in 2009 (see Murray 2009); updated estimates will be included in the next edition of this report.

4.1.4.4.2 Mid-Atlantic Region: Loggerhead Sea Turtle Bycatch Estimation Methods for Federally Managed Scallop Dredge Commercial Fisheries

Bycatch rate models, primarily for loggerhead species, were developed using GLM and GAM, assuming either a binomial or Poisson distribution (see Section 4.1.4.3.2). The unit of effort used for estimating total loggerhead bycatch in dredge fisheries was primarily "dredge hours," the cumulative amount of time that dredges were fishing in the water. For instance, if a vessel towed two dredges for one hour, the total number of dredge hours would be two. The primary source for commercial fishing effort in the scallop dredge fishery was VTR data.

Annual bycatch estimates for sea turtles in the scallop dredge fishery from 2001 to 2005[16] are reported in Murray (2004a, 2004b, 2005, and 2007).

4.1.4.4.3 Mid-Atlantic Region: Sea Turtle Bycatch Estimation Methods for Federally Managed Trawl Commercial Fisheries

Bycatch was estimated separately for bottom trawl gear designed to catch fish and those designed to catch scallops. Observer data from 1994 to 2004 were pooled to develop the bycatch rate model for bottom trawl fisheries for fish. Observer data from 2004 to 2005 were pooled to develop the bycatch rate model for bottom trawl fisheries for scallops. Bycatch rate models for loggerheads were developed using ratio estimation, or GLMs and GAMs, assuming a Poisson distribution (see section 4.1.4.3.2). The primary data source for commercial fishing effort in trawl fisheries was VTR data; however, the Northeast Dealer Report Landings database was used to adjust VTR effort for proper extrapolation of observed bycatch rates.

Bycatch estimates for sea turtles in the bottom otter trawl fishery are reported in Murray (2006). Bycatch estimates for sea turtles in the scallop trawl fishery are reported in Murray (2007).

4.1.4.5 Seabird Bycatch Estimation Methods for Federally Managed Commercial Fisheries

Bycatch estimates of seabirds in all fishing gear were not available for inclusion in this report. Observer data from 1996 to 2006 are currently being examined to develop estimates of seabird species-specific bycatch in gillnet fisheries.

4.1.5 Tier Classification of Northeast Region Fisheries

Data quality and bycatch estimation methods were evaluated for 52 of the 63 fisheries in the Northeast Region. Only relevant Federal data-collection programs were evaluated. Other data may be available for state, international, and tribal fisheries; however, these programs were beyond the scope of this initial report. Tier scores were assigned to 50 fisheries in the fish category and 52 in the marine mammal and other protected species categories, according to the scoring process outlined in Section 3. Two fisheries that received marine mammal/other protected species tier scores (the Atlantic blue crab trap/pot and the Mid-Atlantic haul/beach seine fisheries) were not evaluated for fish, as fish data and estimation methods were not available for evaluation. Fishery tier assignments for the Northeast Region U.S. National Bycatch Report fisheries are given in Table 4.1.3.

The largest percentage of fisheries, 68% (34), were assigned to Tier 3 (Figure 4.1.3A). Of the remaining fisheries, 8% of fisheries (4) were classified in the highest tier category, Tier 4. The remaining 12 fisheries were classified in Tiers 0, 1, and 2. For marine mammals (Figure 4.1.3B), 9% of fisheries (3) were classified as Tier 4, 65% (23) were classified as Tier 3, and 20% (7) were classified in Tiers 1 and 2. Similarly, for other protected species (Figure 4.1.3C), 9% of fisheries (3) were classified as Tier 4, with 65% (23) in Tier 3, and 20% (7) in Tier 2. No fisheries were classified as Tier 1 for other protected species.

Grouped fisheries were assigned to a single tier for the marine mammal and other protected species categories, based on current bycatch data-collection and estimation methods. Note that the total number of fisheries for marine mammal and other protected species shown in Figure 4.1.3

[15] Takes may have occurred in some of these fisheries; however, due to insufficient coverage and further statistical issues, the bycatch estimate is actually undefined or unknown because bycatch estimation is not feasible. Thus for simplicity at this time, a zero bycatch was assigned to fisheries.

[16] The bycatch estimates for sea turtles in 2001 and 2002 were for only part of the scallop dredge fishery in the Mid-Atlantic.

is based on the number of grouped fisheries evaluated (8) plus the number of individual fisheries evaluated for fish bycatch (27). The total number of fisheries for Fish is 50 (the number of individual fisheries evaluated). The tier for each group was "cascaded" down to individual U.S. National Bycatch Report fisheries (Table 4.1.3; see Section 3.2).

Of the fisheries evaluated, two HMS fisheries managed jointly by NMFS and ICCAT, the Gulf of Maine/Mid-Atlantic tuna, shark, and swordfish hook-and-line, and the Gulf of Maine/Mid-Atlantic tuna, shark, and swordfish harpoon, were classified as Tier 0 for bycatch data/estimation methods in all categories by the NMFS HMS Management Division. Little data were available on bycatch in these fisheries..

Table 4.1.3

Fishery tier classifications for Northeast Region fisheries for 2005. Grouped fisheries are listed alphabetically, first by fisheries group name, then by management authority, and then by individual fishery name. Non-grouped fisheries are listed next, by management authority and then fishery name. The marine mammal and other protected species tier scores for grouped fisheries represent the tier score for the group as a whole (denoted by asterisk*); individual fisheries were not evaluated. Shaded fisheries were evaluated for this report. Only relevant Federal data-collection programs were evaluated.

Fishery Name	Management Authority	Fish Tier	Marine Mammals Tier	Other Protected Species Tier
Mid-Atlantic Gillnet Fisheries				
Mid-Atlantic Extra-Large-Mesh Gillnet	Federal	3	3*	3*
Mid-Atlantic Large-Mesh Gillnet	Federal	3	3*	3*
Mid-Atlantic Small-Mesh Gillnet	Federal	3	3*	3*
Mid-Atlantic Otter Trawl Fisheries				
Mid-Atlantic Large-Mesh Otter Trawl	Federal	3	3*	4*
Mid-Atlantic Small-Mesh Otter Trawl	Federal	3	3*	4*
Mid-Atlantic Scallop Dredge Fisheries				
Mid-Atlantic General Cat. Closed Area Scallop Dredge	Federal	3	3*	4*
Mid-Atlantic General Cat. Open Area Scallop Dredge	Federal	3	3*	4*
Mid-Atlantic Limited-Access Closed Area Scallop Dredge	Federal	3	3*	4*
Mid-Atlantic Limited-Access Open Area Scallop Dredge	Federal	3	3*	4*

Table 4.1.3 (continued)

Fishery Name	Management Authority	Fish Tier	Marine Mammals Tier	Other Protected Species Tier
Mid-Atlantic Scallop Trawl Fisheries				
Mid-Atlantic General Cat. Scallop Trawl	Federal	3	3*	4*
Mid-Atlantic Limited-Access Scallop Trawl	Federal	3	3*	4*
New England Bottom Longline Fisheries				
New England Bottom Longline	Federal	3	3*	3*
New England Haddock Sector Longline	Federal	3	3*	3*
New England Gillnet Fisheries				
New England Extra-Large-Mesh Gillnet	Federal	4	4*	3*
New England Large-Mesh Gillnet	Federal	4	4*	3*
New England Small-Mesh Gillnet	Federal	3	4*	3*
New England Otter Trawl Fisheries				
New England B-Reg DAS Large-Mesh Otter Trawl	Federal	3	4*	3*
New England Large-Mesh Otter Trawl	Federal	4	4*	3*
New England Small-Mesh Otter Trawl	Federal	4	4*	3*
New England US/CAN Area Large-Mesh Otter Trawl	Federal	3	4*	3*
New England US/CAN Area Small-Mesh Otter Trawl	Federal	3	4*	3*
New England Scallop Dredge Fisheries				
New England General Cat. Closed Area Scallop Dredge	Federal	3	3*	3*
New England General Cat. Open Area Scallop Dredge	Federal	3	3*	3*

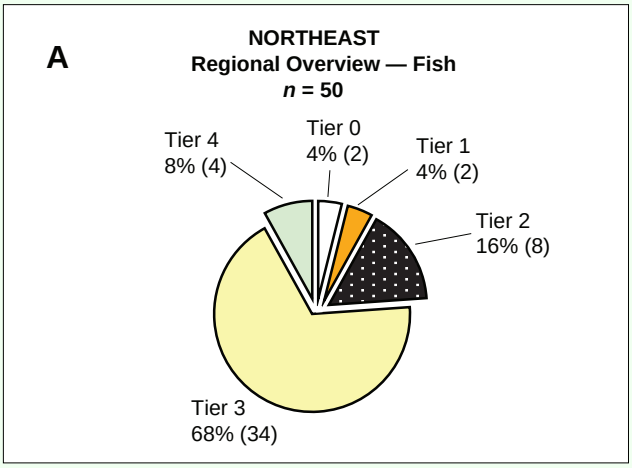
Table 4.1.3 (continued)

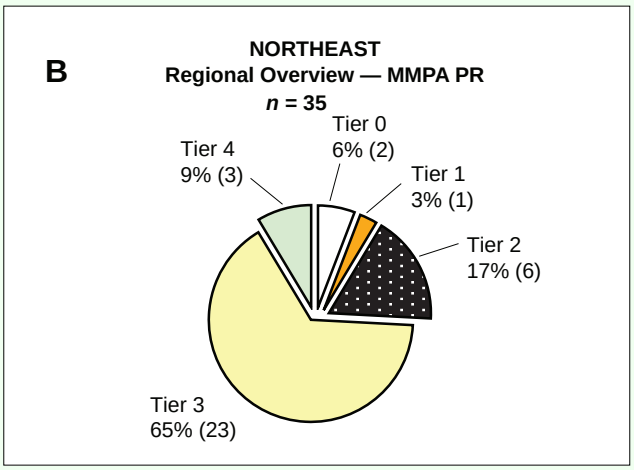
Fishery Name	Management Authority	Fish Tier	Marine Mammals Tier	Other Protected Species Tier
New England Scallop Dredge Fisheries (cont.)				
New England Limited-Access Closed Area Scallop Dredge	Federal	3	3*	3*
New England Limited-Access Open Area Scallop Dredge	Federal	3	3*	3*
Non-Grouped Fisheries				
Mid-Atlantic Bottom Longline	Federal	3	3	3
Mid-Atlantic Clam/ Quahog Dredge	Federal	2	3	3
Mid-Atlantic Mid-Water Otter Trawl	Federal	3	3	3
New England Clam/ Quahog Dredge	Federal	2	3	3
New England Crab Pots	Federal	2	2	2
New England Mid-Water Otter Trawl	Federal	3	4	3
New England Scottish Seine	Federal	3	3	3
Gulf of Maine, Mid-Atlantic Tuna, Shark, Swordfish Harpoon	Federal, international	0	0	0
Gulf of Maine, Mid-Atlantic Tuna, Shark, Swordfish Hook-and-Line	Federal, international	0	0	0
Mid-Atlantic Hand Line	Federal, international	3	3	3
Mid-Atlantic Purse Seine	Federal, international	3	3	3
New England Hand Line	Federal, international	3	3	3
New England Purse Seine	Federal, international	3	3	3
Mid-Atlantic Fish Pots and Traps	Federal, state	3	3	3
Mid-Atlantic Lobster Pots	Federal, state	2	3	3
Mid-Atlantic Shrimp Trawl	Federal, state	3	3	3
New England Fish Pots and Traps	Federal, state	3	3	3

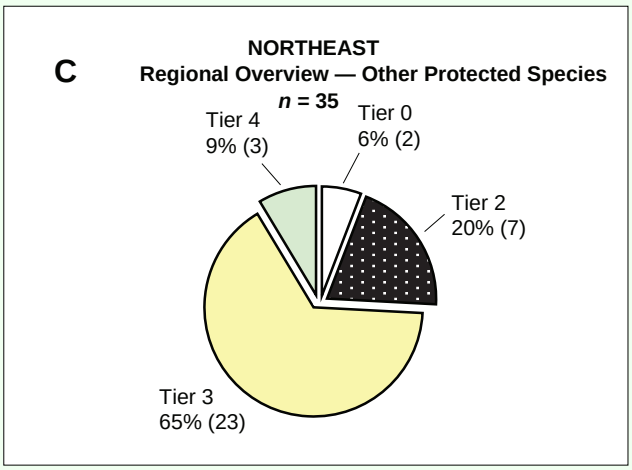
Table 4.1.3 (continued)

Fishery Name	Management Authority	Fish Tier	Marine Mammals Tier	Other Protected Species Tier
Non-Grouped Fisheries (cont.)				
New England Lobster Pots	Federal, state	3	3	3
Atlantic Blue Crab Trap/Pot	State		3	3
Chesapeake Bay Inshore Gillnet	State	2	2	2
Delaware River Inshore Gillnet	State	1	2	2
Gulf of Maine Herring and Atlantic Mackerel Stop Seine	State			
Gulf of Maine Herring and Atlantic Mackerel Weir	State			
Gulf of Maine Mussel	State			
Gulf of Maine Urchin Dive, Hand/Mechanical Collection	State			
Long Island Sound Inshore Gillnet	State	2	2	2
Mid-Atlantic Crab Pots	State	2	3	3
Mid-Atlantic Crab Stop Seine	State			
Mid-Atlantic Crab Weir	State			
Mid-Atlantic Eel Trap/Pot	State			
Mid-Atlantic Hand Seine	State			
Mid-Atlantic Haul/Beach Seine	State		2	2
Mid-Atlantic Oyster	State			
New England Shrimp Trawl	State	3	3	3
Northeast Atlantic Finfish Aquaculture	State			
Northeast Atlantic Shellfish Aquaculture	State			
RI, S. MA (to Monomoy Is.) and NY Bight (Raritan and Lower NY Bays) Inshore Gillnet	State	1	2	2
Virginia Pound Net	State	2	1	2

Figure 4.1.3
Number and percentage of Northeast Region fisheries in each fishery tier class, for fisheries with Federal management or Federal data-collection programs for A) fish, B) marine mammals, and C) other protected species. Tier scores are for the year 2005.







4.1.6 Northeast Regional Key Stocks

Fifty-five key stocks/populations were identified in the Northeast Region (Table 4.1.4). Sixty-four percent (35) are fish stocks, which includes stocks of individual key species as well as the stocks listed under the skate complex (Figure 4.1.4). All Northeast key fish stocks are listed at the species level in accordance with the regional management approach. The majority are FSSI[17] fish stocks, including one FSSI complex, the Northeast Skate Complex, which is made up of seven stocks. Seven FSSI fish stocks were added during the qualitative process: black sea bass (*Centropristis striata*), both FSSI stocks of haddock (*Melanogrammus aeglefinus*), redfish (*Sebastes fasciatus*), both FSSI stocks of silver hake (*Merluccius albidus*), and spiny dogfish (*Squalus acanthias*). Regulations influencing bycatch levels were cited as the reason for including haddock, while silver hake was listed due to public concern/high visibility. Three stocks, black sea bass, redfish, and spiny dogfish, were added due to their rebuilding status. A lack of data also contributed to the Northeast Regional team's decision to add black sea bass to the key stocks list.

As in all regions, ESA-listed stocks present in the Northeast were automatically added to the list of key stocks. This included two fish stocks, six marine mammal stocks, five sea turtle populations, and two seabird populations. Six marine mammal stocks were identified as key stocks through the quantitative process: the Western North Atlantic coastal stock of bottlenose dolphin, Western North Atlantic stock of short-beaked common and Atlantic white-sided dolphins, the Gulf of Maine/Bay of Fundy stock of harbor porpoise, and long- and/or short-finned pilot whales. These were added due to bycatch in excess of the zero mortality-rate goal and/or declining or unknown population status, according to the process outlined in Section 3. No marine mammals were added to the list of key stocks during the qualitative process. One seabird population, the Atlantic red-throated loon, was added during the qualitative process due to concerns over high levels of bycatch and the documented high level of oil spill takes during previous oil spills. The red-throated loon is also on the USFWS list of Birds of Conservation Concern.

[17] FSSI = fish stock sustainability index, a performance measure for the 230 stocks selected for importance to U.S. commercial and recreational fisheries.

Table 4.1.4

Key fish and marine mammal stocks, and key sea turtle and seabird populations for the Northeast Region. Northeast Region stocks were identified and are listed in this table at the species level for consistency with Northeast bycatch estimation methods, but were counted at the stock level in this report for consistency with other regions. Stocks are identified in the footnotes to this table. Overfishing/overfished status based on 2008 Quarter 1 FSSI report.

Key Fish Stocks Listed by FSSI			
Species/stock name		Overfishing	Overfished
Common name	Scientific name		
American plaice	*Hippoglossoides platessoides*	No	Yes
Atlantic cod[a]	*Gadus morhua*	Yes	Yes
Atlantic halibut	*Hippoglossus hippoglossus*	Unknown	Yes
Black sea bass	*Centropristis striata*	No	No–rebuilding
Butterfish	*Peprilus triacanthus*	No	Yes
Haddock[b]	*Melanogrammus aeglefinus*	No	Yes
Monkfish[c]	*Lophius americanus*	No	Yes
Ocean pout	*Zoarces americanus*	No	Yes
Offshore hake	*Merluccius albidus*	Undefined	No
Red hake[d]	*Urophycis chuss*	Unknown/undefined	No
Redfish	*Sebastes fasciatus*	No	No–rebuilding
Scup	*Stenotomus chrysops*	Yes	Yes
Shortfin squid, northern	*Illex illecebrosus*	No	Unknown
Silver hake[e]	*Merluccius bilinearis*	No	No
Spiny dogfish	*Squalus acanthias*	No	No–rebuilding
Summer flounder	*Paralichthys dentatus*	Yes	Yes
Windowpane flounder[f]	*Scophthalmus aquosus*	No	No/yes
Yellowtail flounder[g]	*Limanda ferruginea*	Yes	Yes
Skate Complex[h]			
Barndoor skate	*Dipturus laevis*	No	No–rebuilding
Clearnose skate	*Raja eglanteria*	No	No
Little skate	*Leucoraja erinacea*	No	No
Rosette skate	*Leucoraja garmani*	No	No
Smooth skate	*Malacoraja senta*	No	No
Thorny skate	*Amblyraja radiata*	No	Yes
Winter skate	*Leucoraja ocellata*	No	Yes

Key Fish Stocks Listed by ESA		
Species/stock name		Stock status
Common name	Scientific name	
Atlantic salmon, Gulf of Maine Distinct Population Segment	*Salmo salar*	Endangered
Shortnose sturgeon	*Acipenser brevirostrum*	Endangered

Table 4.1.4 (continued)

Key Fish Stocks Not Listed by FSSI or ESA		
Species/stock name		**Stock status**
Common name	**Scientific name**	
None		

Key Marine Mammal Stocks Listed by ESA		
Species/stock name		**Stock status**
Common name	**Scientific name**	
Blue whale	*Balaenoptera musculus*	Endangered
Humpback whale	*Megaptera novaeangliae*	Endangered
Fin whale	*Balaenoptera physalus*	Endangered
North Atlantic right whale	*Eubalaena glacialis*	Endangered
Sei whale	*Balaenoptera borealis*	Endangered
Sperm whale	*Physeter macrocephalus*	Endangered

Key Marine Mammal Stocks Not Listed by ESA			
Species/stock name		**ZMRG**	**Stock status** [i]
Common name	**Scientific name**		
Bottlenose dolphin - W. N. Atl. Coastal	*Tursiops truncatus*	Variable	Variable
Common dolphin, short beaked — W. N. Atl.	*Delphinus delphis*	100	Unknown
Harbor porpoise – Gulf of Maine/Bay of Fundy	*Phocoena phocoena*	61	Unknown
Pilot whale, long-finned	*Globicephala melaena (melas)*	24.9 [j]	Unknown
Pilot whale, short-finned	*Globicephala macrorhynchus*	24.9 [j]	Unknown
Atlantic white-sided dolphin — W. N. Atl.	*Lagenorhynchus acutus*	50.9	Unknown

Key Sea Turtle Populations		
Species/stock name		**Population status**
Common name	**Scientific name**	
Green sea turtle	*Chelonia mydas*	Threatened (except in Florida and the Pacific coast of Mexico, where the breeding populations are endangered)
Hawksbill sea turtle	*Eretmochelys imbricata*	Endangered
Kemp's ridley sea turtle	*Lepidochelys kempii*	Endangered
Leatherback sea turtle	*Dermochelys coriacea*	Endangered
Loggerhead sea turtle	*Caretta caretta*	Threatened

Table 4.1.4 (continued)

Key Seabird Populations Listed by ESA			
Species/stock name		**Population status**	
Common name	**Scientific name**		
Cahow	*Pterodroma cahow*	Endangered	
Roseate tern, Northeast nesting population	*Sterna dougallii dougallii*	Endangered	
Key Seabird Populations Not Listed by ESA			
Species/stock name		**Bycatch concern**	**Population status**
Common name	**Scientific name**		
Red-throated loon, Atlantic	Gavia stellata	Yes	Decreasing

[a] Atlantic cod has two stocks: Gulf of Maine and Georges Bank. Both are FSSI species, both are overfished, and overfishing is occurring for both.
[b] Haddock has two stocks: Gulf of Maine and Georges Bank. Both are FSSI species and both are overfished, but overfishing is not occurring.
[c] Monkfish have two stocks: North and South. Both are FSSI species and both are overfished, but overfishing is not occurring.
[d] Red hake has two stocks: Gulf of Maine/ Northern Georges Bank and Southern Georges Bank/ Middle Atlantic. Both are FSSI species. The Gulf of Maine/ Northern Georges Bank stock is not overfished and it is unknown whether overfishing is occurring. The Southern Georges Bank/ Middle Atlantic stock is not overfished and overfishing levels are undefined.
[e] Silver hake has two stocks: Gulf of Maine/ Northern Georges Bank and Southern Georges Bank/ Middle Atlantic. Both are FSSI species and are not overfished or undergoing overfishing.
[f] Windowpane flounder has two stocks: Gulf of Maine/ Georges Bank and Southern New England/ Middle Atlantic. Both are FSSI species and are not overfished, but overfishing is occurring. The Southern New England/ Middle Atlantic stock is overfished; the Gulf of Maine/ Georges Bank stock is not overfished.
[g] Yellowtail flounder has three stocks: Southern New England/ Middle Atlantic, Georges Bank, and Cape Cod/ Gulf of Maine. All are FSSI species, are overfished, and are undergoing overfishing.
[h] This grouping includes the species listed in addition to unidentified skates.
[i] Stock status based on Waring et al. (2007). http://www.nefsc.noaa.gov/nefsc/publications/tm/tm205/
[j] Long-finned and short-finned pilot whale species are combined for the purpose of evaluating bycatch and stock status because it is not currently possible to determine potential biological removal (PBR) or serious injury and mortality estimates separately for each species.

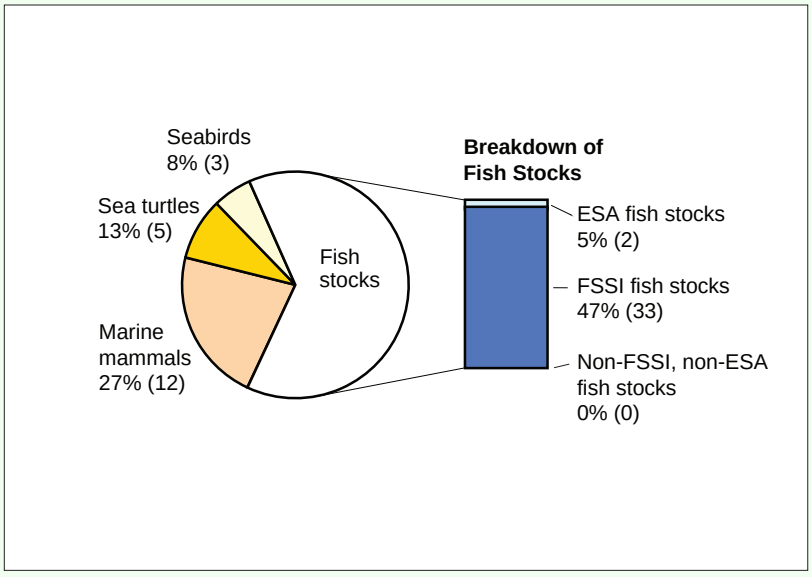


Figure 4.1.4
Number and percentage of key stocks in the Northeast Region.

4.1.7. Northeast Region Bycatch Estimates

Bycatch estimates for the Northeast Region by fishery are presented in Appendix 4.1, Tables 4.1.A through 4.1.D. Fish bycatch estimates are provided by individual fishery (Table 4.1.A) and by stock (Table 4.1.B). Marine mammal (Table 4.1.C) and sea turtle (Table 4.1.D) estimates are provided at the grouped fishery level and the non-grouped fishery level, according to Northeast Region protected species estimation procedures. Methods to estimate seabird bycatch are currently being developed. In this report, Northeast Region bycatch estimates were provided for 34 fish species, 6 marine mammal stocks, and 8 sea turtle populations. All fisheries with Federal observer data that had no recorded takes of marine mammals or sea turtles had estimates of zero.

4.1.7.1 Fish Bycatch Estimates

Fish bycatch estimates were provided for 25 fisheries. Estimates were not provided for the following Northeast Region federally managed commercial fisheries (listed alphabetically) due to limited or no at-sea observer coverage in 2005 (Table 4.1.2):

- Gulf of Maine Mid-Atlantic tuna, shark, swordfish harpoon
- Gulf of Maine, Mid-Atlantic tuna, shark, swordfish hook-and-line.
- Mid-Atlantic bottom longline
- Mid-Atlantic clam/quahog dredge
- Mid-Atlantic crab pots
- Mid-Atlantic fish pots and traps
- Mid-Atlantic general category closed area scallop dredge
- Mid-Atlantic hand line
- Mid-Atlantic large-mesh gillnet
- Mid-Atlantic limited-access scallop trawl
- Mid-Atlantic lobster pots
- Mid-Atlantic purse seine
- Mid-Atlantic small-mesh gillnet
- Mid-Atlantic shrimp trawl[18]
- New England clam/quahog dredge
- New England crab pots
- New England fish pots and traps
- New England Scottish seine
- New England small-mesh gillnet
- New England lobster pots

As bycatch data and estimation methods become available, estimates for these fisheries will be calculated and included in future editions of this report.

[18] The Mid-Atlantic shrimp trawl fishery is not managed under a Federal FMP.

4.1.7.2 Protected Species Bycatch Estimates

Marine mammal bycatch estimates were provided for eight grouped fisheries and five non-grouped fisheries. Sea turtle bycatch estimates were provided for seven grouped and two non-grouped fisheries. Seabird bycatch estimates are currently not available for any Northeast fisheries. Bycatch estimates of cetaceans and sea turtles were not provided for the following Northeast Region federally managed commercial fisheries (listed alphabetically) due to limited or no at-sea observer coverage in 2005:

- Mid-Atlantic bottom longline
- Mid-Atlantic clam/quahog dredge
- Mid-Atlantic crab pots
- Mid-Atlantic fish pots and traps
- Mid-Atlantic hand line
- Mid-Atlantic lobster pots
- Mid-Atlantic purse seine
- Mid-Atlantic shrimp trawl
- New England clam/quahog dredge
- New England crab pots
- New England fish pots and traps
- New England Scottish seine
- New England lobster pots

As bycatch data and estimation methods become available, estimates for these fisheries will be calculated and included in future editions of this report. Note that mortalities and/or serious injuries to ESA-listed marine mammal species that are attributed to fisheries based on entanglement data cannot be linked to a specific fishery, and were therefore not included in this report. This information is available online in Marine Mammal Stock Assessment Reports.[19]

4.1.8 Fishery Bycatch Estimation Improvement Plans

Fish bycatch estimation improvement plans were developed for the 25 Northeast Region Federal fisheries for which bycatch is currently estimated. These fisheries were identified through the quantitative process as having bycatch of key stocks/populations and/or high overall bycatch levels. Fish bycatch estimation improvement plans were also developed for the 18 Federal fisheries where data and/or bycatch estimation methods are unavailable. These fisheries were added through the qualitative process (outlined in Section 3) due to potential bycatch concerns and observer coverage levels below those stipulated by the Northeast Standardized Bycatch Reporting Methodology (SBRM; NEFMC and MAFMC 2007).

Protected species bycatch estimation improvement plans

[19] http://www.nmfs.noaa.gov/pr/sars/species.htm

were developed for six of the eight grouped fisheries (see Table 4.1.1). Due to insufficient data, it was not possible to evaluate protected species bycatch in the New England bottom longline or the New England scallop dredge fisheries. Bycatch of protected species for these fisheries may be included in the next editon of this report if there are observed takes.

Bycatch estimation improvement plans for the New England and Mid-Atlantic mid-water trawl fisheries were developed by both fish and protected species biologists.

Due to differences in sampling protocol and coverage goals, recommendations to improve bycatch data and estimation methodology for fish and protected species are listed separately. Deficiencies and recommendations for fish are listed in Section 4.1.8.1 by individual fishery, while deficiencies and recommendations for protected species in grouped fisheries are listed in Section 4.1.8.2. The deficiencies and recommendations for joint fish/protected species bycatch estimation improvement plans are listed in Section 4.1.8.3.

Improvement plans were not developed for the following HMS fisheries:

- Gulf of Maine, Mid-Atlantic Tuna, Shark, Swordfish Harpoon
- Gulf of Maine, Mid-Atlantic Tuna, Shark, Swordfish Hook-and-Line.

Though both fisheries occur in Northeast Region waters, these fisheries are managed by NMFS Office of Sustainable Fisheries, HMS Division. Little information was available on these fisheries; both are classified as Tier 0 in all three categories. Plans are for data sources, bycatch, and any recommendations for improvement to be included in future editions of this report.

4.1.8.1 Bycatch Estimation Improvement Plans for Northeast Fisheries of Focus—Fish

The Northeast Regional team developed a generic improvement plan for the following fisheries identified through the quantitative and qualitative processes (listed alphabetically):

Quantitative Process:
- Mid-Atlantic extra-large-mesh gillnet
- Mid-Atlantic general category open area scallop dredge
- Mid-Atlantic general category scallop trawl
- Mid-Atlantic large-mesh otter trawl
- Mid-Atlantic limited-access closed area scallop dredge
- Mid-Atlantic limited-access open area scallop dredge
- Mid-Atlantic small-mesh otter trawl
- New England B-DAS large-mesh otter trawl
- New England bottom longline
- New England extra-large gillnet
- New England general category closed area scallop dredge
- New England general category open area scallop dredge
- New England haddock sector longline
- New England handline
- New England large-mesh gillnet
- New England large-mesh otter trawl
- New England limited-access closed area scallop dredge
- New England limited-access open area scallop dredge
- New England purse seine
- New England shrimp trawl
- New England small-mesh otter trawl
- New England US/CAN area large-mesh otter trawl
- New England US/CAN area small-mesh otter trawl

Qualitative Process:
- Mid-Atlantic bottom longline
- Mid-Atlantic clam/quahog dredge
- Mid-Atlantic crab pots
- Mid-Atlantic fish pots and traps
- Mid-Atlantic handline
- Mid-Atlantic general category closed area scallop dredge
- Mid-Atlantic large-mesh gillnet
- Mid-Atlantic limited-access scallop trawl
- Mid-Atlantic lobster pots
- Mid-Atlantic purse seine
- Mid-Atlantic shrimp trawl
- New England small-mesh gillnet
- Mid-Atlantic small-mesh gillnet
- New England clam/quahog dredge
- New England crab pots;
- New England fish pots and traps
- New England lobster pots
- New England Scottish seine

Tier classes: See individual fishery tiers in Table 4.1.3.

Bycatch data-collection and estimation concerns: The Northeast Regional team identified several deficiencies in bycatch data-collection and estimation methods common across multiple fisheries. These elements were derived directly from the tier scoring system and included: faulty assumptions of the analytical approach; integration and linkages between observer data and supplemental data; sampling coverage; species/fleet-specific discard mortality; and verification of industry data.

Recommendations: Recommendations were made in multiple fisheries to improve the analytical approach (estimation methodology) through advances in the methodology of the estimators; to implement a study of discard mortality (via special studies, study fleets, etc.); and to improve verification of industry data (via expanded audits). For some fisheries, improvements to the database infrastructure were

also recommended. For several Northeast Region fisheries, recommendations were also made to improve the design implementation by increasing sampling coverage (see below).

The Northeast Region's recommendations for maintaining/increasing observer coverage levels were based on the stipulations of the Northeast Region Omnibus SBRM Amendment (NEFMC and MAFMC 2007). Detailed information on how these levels were calculated is available within the SBRM Amendment. Recommendations to maintain current observer coverage levels were made for 16 fisheries (Table 4.1.5). The total cost of existing Northeast Region observer programs in 2008 was $14.060M, including $2.2M in industry funding that supported coverage of the Atlantic sea scallop fishery. Recommendations to implement or increase observer coverage were made for 27 fisheries. Fishery-specific recommendations for changes to observer coverage are outlined in Table 4.1.5.

Table 4.1.5

Summary of Northeast Region recommendations and estimated needs for implementation in terms of full-time staff and observer days-at-sea (DAS[a]). General recommendations are listed first; then, grouped fisheries are listed alphabetically, first by fishery group name, then by individual fishery name. Non-grouped fisheries are listed last, by fishery name. Fisheries identified during the qualitative process appear in shaded rows; fisheries in unshaded rows were identified through a quantitative process. For further discussion of recommendations, see Section 5.8.

Note that observer programs collect data on both fish and protected species. Observer recommendations specific only to protected species are identified. ** denotes no additional resource requirements. For further discussion of recommendations, see Section 5.8.

Recommendation [b]	Additional DAS [c]	Feasibility
Recommendations for All Fisheries		
Improve industry data via expanded audits.	NA	High
Improve analytic approach via advances in the methodology of estimators.	NA	High
Research on discard mortality (via special studies, study fleets, etc.) for multiple fisheries.	NA	High
Improve database infrastructure for multiple fisheries.	NA	High
Improve industry data via expanded audits (protected species).	NA	High
Implement serious-injury protocol for determining serious injuries of protected species; update observer program data-collection forms (protected species).	NA	High
Conduct needs assessment for seabird bycatch data-collection and estimation (protected species).	NA	High (work has already been initiated)
Fishery-specific Recommendations		
Mid-Atlantic Gillnet Fisheries		
Increase observer coverage of the Mid-Atlantic extra-large-mesh gillnet fishery to obtain pilot coverage.[d]	20	High
To achieve 30% CV across all Mid-Atlantic gillnet fisheries, increase observer coverage (protected species).	500	High
Expand fishing effort variables collected by states across all Mid-Atlantic gillnet fisheries (protected species).	NA	Low
Obtain complete list of active gillnet vessels for all Mid-Atlantic gillnet fisheries (protected species).	NA	High

Table 4.1.5 (continued)

Recommendation [b]	Additional DAS [c]	Feasibility
Fishery-specific Recommendations		
Mid-Atlantic Gillnet Fisheries (cont.)		
Informational mailings to fishers in all Mid-Atlantic gillnet fisheries using VTR data forms (protected species).	NA	High
Implement pilot observer program for the Mid-Atlantic large-mesh gillnet fishery.	91	High
Implement pilot observer program for the Mid-Atlantic small-mesh gillnet fishery.	15	High
Mid-Atlantic Otter Trawl Fisheries		
Increase observer coverage in the Mid-Atlantic large-mesh otter trawl fishery.	342	High
To achieve 30% CV across all Mid-Atlantic otter trawl fisheries, increase observer coverage (protected species).	500	High
Direct observer coverage to areas of suspected high-sea turtle bycatch across all Mid-Atlantic otter trawl fisheries (protected species).	NA	Unknown
Update VTR logbooks to include fields for BRD presence/absence, and whether the BRD was functioning properly across all Mid-Atlantic otter trawl fisheries (protected species).	NA	Unknown
Increase observer coverage in the Mid-Atlantic small-mesh otter trawl fishery.	659	High
Mid-Atlantic Scallop Dredge Fisheries		
Implement pilot observer coverage for the Mid-Atlantic general category closed area scallop dredge fishery.	12	High
Maintain current observer program coverage levels in the Mid-Atlantic general category open area scallop dredge fishery.	**	High
Maintain current observer program coverage levels in the Mid-Atlantic limited-access closed area scallop dredge fishery.	**	High
Maintain current observer program coverage levels in the Mid-Atlantic limited-access open area scallop dredge fishery.	**	High
Hire employee to process VMS data for use in bycatch estimation in Mid-Atlantic limited-access open area scallop dredge fishery (protected species).	NA	Unknown
Implement observer program coverage for general category vessels operating in open areas (protected species).	Unknown	Unknown
Investigate the effectiveness of analyzing the sea turtle bycatch rate by pooling data over year (protected species).	NA	High
Mid-Atlantic Scallop Trawl Fisheries		
Maintain current observer program coverage levels in the Mid-Atlantic general category scallop trawl fishery.	**	High
Implement pilot observer coverage for the Mid-Atlantic limited-access scallop trawl fishery.	24	High
Implement observer program coverage for general category vessels operating in open areas.	Unknown	Unknown
Improve VTR gear log to capture additional gear information.	NA	Unknown
Hire employee to process VMS data for use in bycatch estimation.	NA	Unknown

Table 4.1.5 (continued)

Recommendation [b]	Additional DAS [c]	Feasibility
Fishery-specific Recommendations		
New England Bottom Longline Fisheries		
Maintain current observer program coverage levels in the New England bottom longline fishery.	**	High
Maintain current observer program coverage levels in the New England haddock sector longline.	**	High
New England Gillnet Fisheries		
Maintain current observer program coverage levels for the New England extra-large-mesh gillnet fishery.	**	High
Achieve 30% CV across all New England gillnet fisheries.	600	High
Informational mailings for all fisheries in New England gillnet fisheries using VTR data forms.	NA	High
Apply new regression methods to estimate bycatch of marine mammals in New England gillnet fisheries (protected species).	NA	High
Maintain current observer program coverage levels for the New England large-mesh gillnet fishery.	**	High
Implement pilot observer coverage for the New England small-mesh gillnet fishery.	12	High
New England Otter Trawl Fisheries		
Maintain current observer program coverage levels in the New England B-Reg DAS large-mesh otter trawl fishery.	**	High
Maintain current observer program coverage levels in the New England large-mesh otter trawl fishery.	**	High
Increase observer coverage in the New England small-mesh otter trawl fishery.	1,562	High
To achieve 30% CV across all New England otter trawl fisheries, increase observer coverage (protected species).	10,000	Moderate
Maintain current observer program coverage levels in the New England US/CAN area large mesh otter trawl fishery.	**	High
Maintain current observer program coverage levels in the New England US/CAN area small-mesh otter trawl fishery.	**	High
New England Scallop Dredge Fisheries		
Maintain current observer program coverage levels but improve temporal coverage in the New England general category closed area scallop dredge fishery.	**	High
Implement pilot observer coverage in the New England general category open area scallop dredge fishery.	127	High
Maintain current observer program coverage levels in the New England limited-access closed area scallop dredge fishery.	**	High
Increase observer coverage in the New England limited-access open area scallop dredge fishery.	91	High
Non-Grouped Fisheries		
Implement pilot observer coverage for the Mid-Atlantic bottom longline fishery.	19	High
Implement pilot observer coverage for the Mid-Atlantic clam/quahog dredge fishery.	21	High

Table 4.1.5 (continued)

Recommendation [b]	Additional DAS [c]	Feasibility
Non-Grouped Fisheries (cont.)		
Implement pilot observer coverage for Mid-Atlantic crab pot fishery.	12	High
Implement pilot observer coverage for Mid-Atlantic fish pots/traps fishery.	20	High
Implement pilot observer coverage in the Mid-Atlantic handline fishery.	33	High
Implement pilot observer coverage for Mid-Atlantic lobster pot fishery.	22	High
Increase observer coverage in the Mid-Atlantic mid-water otter trawl fishery.	512	High
Deploy an additional observer for all paired-trawl trips in the Mid-Atlantic mid-water paired trawl fishery (protected species).	Unknown	High
Implement pilot observer coverage for the Mid-Atlantic purse seine fishery.	6	High
Implement pilot observer coverage for the Mid-Atlantic shrimp trawl fishery.	19	High
Implement pilot observer coverage for the New England clam/quahog dredge fishery.	12	High
Implement pilot observer coverage for New England crab pot fishery.	25	High
Implement pilot observer coverage for New England fish pots/traps fishery.	12	High
Increase observer coverage in the New England handline fishery to obtain pilot coverage.	110	High
Implement pilot observer coverage for New England lobster pot fishery.	110	High
Maintain current observer program coverage levels in the New England purse seine fishery.	**	High
Increase observer coverage in the New England mid-water otter trawl fishery.	35	High
Increase observer coverage of the New England single mid-water trawl fishery (protected species).	1,250	Moderate
Implement pilot observer coverage for the New England Scottish seine fishery.	23	High
Maintain current observer program coverage levels but improve temporal coverage in the New England shrimp trawl fishery.	**	High
Number of new full-time staff needed to implement all data quality and estimation method improvements recommended by the Northeast region	17	
Total DAS requirement for all fish recommendations (not including “unknowns”)	3,946	
Total DAS requirement for all protected species recommendations (not including “unknowns”)	12,850	

[a] Some recommendations may require additional resource expenditures, such as equipment, which are not itemized.
[b] For some fisheries that have both fish and protected species recommendations for increased observer coverage, the FTE and DAS can be shared. Hence the requirement totals are not additive.
[c] One observer DAS includes the cost for the observer deployment as well as costs for associated equipment and program administrative functions (staffing).
[d] Pilot coverage is 0.5% of trips.

4.1.8.2 Bycatch Estimation Improvement Plans for Northeast Fisheries of Focus—Protected Species

Several common issues were identified by the Northeast Regional team in developing bycatch estimation improvement plans for marine mammals, sea turtles, and other protected species. In many cases, observer coverage is not sufficient to provide the recommended CV of 30% for rare-event species. In addition, a recommendation was made for all grouped fisheries to verify industry data more thoroughly through expanded audits of VTR data. Lastly, the Northeast Region recommended that the serious-injury determination protocol for cetaceans be implemented, as outlined in the Anderson et al. (2007) NMFS Technical Memorandum, including updating NEFOP data-collection forms as needed. To improve seabird bycatch data collection/estimation, the Northeast Regional team recommends completing a full assessment of needs.

Mid-Atlantic Gillnet Fisheries

Tier Classes: Fish: various (see Table 4.1.3); Marine Mammals: 3; Other Protected Species: 3

Bycatch Data-collection and Estimation Concerns:

Marine Mammals:

- Observer coverage is not sufficient in at least some time–area strata to adequately evaluate the effectiveness of the recently implemented Bottlenose Dolphin TRP measures (e.g., the summer Northern North Carolina management unit) and to obtain precise bycatch estimates (i.e., CV less than or equal to 30%).

- Some of the effort data reported in the gillnet VTR database appear inaccurate and/or incomplete.

- More effort data (e.g., number of nets, hauls, and soak duration) need to be recorded for the entire fishery, so that definitions of bycatch rates other than takes/total landings can be investigated.

- A complete list of active gillnet vessels that hold state and/or Federal permits is needed to ensure representative observer coverage of the entire gillnet fleet.

- Robust analytical methods (such as regression methods) that are appropriate for rare events (e.g., bycatch of marine mammals) have not been explored for all marine mammal species that are bycaught in gillnet fisheries, and there is currently a lack of turtle bycatch estimates (however, estimates are currently being developed).

Recommendations:

Marine Mammals:

- Achieving bycatch estimates of coastal bottlenose dolphins and harbor porpoises that have a 30% CV was recommended. It is projected that about 900 sea days are required (Rossman 2007), which is about 500 days more than was funded in 2007. Although the additional coverage in state waters is possible, it will be more difficult (especially for small vessels). However, it should be feasible to identify and monitor all state fishing vessels.

- It was recommended that a mailing be employed to remind gillnetters using VTR data forms of what data are required, the definitions of these data, and how to report effort data more accurately.

- Currently, only VTR and Virginia State data record several variables reflecting fishing effort; it was recommended that this should be changed. It would be a very large project to change the state data-collection variables. At this time, this does not seem feasible.

- It was recommended that to obtain a complete list of active vessels, all available databases (VTR, dealer, and state databases) need to be fully explored (which is feasible and possible with current resources). In addition, the SEFSC is currently visiting North Carolina ports to obtain a complete and up-to-date list of coastal fishers, in particular those using small vessels. Funding for an additional year would ensure this project is completed.

- Currently, regression methods are being explored to estimate bycatch for harbor porpoises. It was recommended that these methods should be applied using the current level of staffing and funding, and it is recommended that these methods continue to be explored for applicability to other species within the next year or two. Methods to estimate sea turtle bycatch using current resources should also continue to be explored.

New England Gillnet Fisheries

Tier Classes: Fish: various (see Table 4.1.3); Marine Mammals: 4; Other Protected Species: 3

Bycatch Data-collection and Estimation Concerns:

Marine Mammals:

- Observer coverage using the limited sampling protocol is insufficient in some time-area strata to obtain precise (CV less than or equal to 30%) bycatch estimates of marine mammals.

- Some of the effort data reported in the gillnet VTR database appear inaccurate and/or incomplete.

- Robust analytical methods (e.g., regression methods) that are appropriate for rare events have not been explored for all marine mammal species that are bycaught in gillnet fisheries.

Recommendations:

Marine Mammals:

- Achieving an estimate of harbor porpoise bycatch with a maximum 30% CV was recommended. It is projected that about 1,000 sea days are required, based on the estimates in Rossman (2007) plus an additional 200 days for summer coverage, which is about 600 days more than was funded in 2007.

- It was recommended that a mailing be employed to remind gillnetters using VTR data forms of what data are required, the definitions of these data, and how to report effort data more accurately.

- It was also recommended to continue exploring regression methods of estimating bycatch for harbor porpoises. It is feasible that with the current level of staffing and funding, these methods will be applied to other species within the next year or two.

New England Otter Trawl Fisheries

Tier Classes: Fish: various (see Table 4.1.3); Marine Mammals: 4; Other Protected Species: 3

Bycatch Data-collection and Estimation Concerns:

Marine Mammals:

- Observer coverage is insufficient in some time-area strata to obtain precise (maximum 30% CV) bycatch estimates for marine mammals in this fishery. There is currently a lack of a process or protocol for determining serious injuries.[20]

- Differences in total landings between VTR and dealer records have not been incorporated into previous marine mammal bycatch analyses; however, this is currently being investigated.

- The VTR data should be verified more thoroughly (see discussions above).

- Information on the kite panels of otter trawls, which may be correlated with marine mammal bycatch rates, was previously not collected by the observer program; in 2008, the observer program began to collect this information.

[20] Since 2005, great improvements have been made both in the level of observer coverage and in the methods used to estimate marine mammal bycatch.

Recommendations:

Marine Mammals:

- Achieving long- and/or short-finned pilot whale bycatch estimates that have a maximum CV of 30% was recommended, it is projected that an additional 10,000 sea days are required (Rossman 2007; Wigley et al. 2007). However, these sea-day projections do not account for overlap between fish and marine mammal sampling programs; therefore, the estimate of additional sea days is over-estimated, to an unknown degree.

Mid-Atlantic Otter Trawl Fisheries

Tier Classes: Fish: various (see Table 4.1.3); Marine Mammals: 3; Other Protected Species: 4

Bycatch Data-collection and Estimation Concerns:

Marine Mammals:

- Observer coverage is insufficient in some times and areas to obtain precise (maximum 30% CV) bycatch estimates.

- Differences in total landings between VTR and dealer records have not been incorporated into previous marine mammal bycatch analyses; however, this is currently being investigated.

- Information on the kite panels of otter trawls, which may be correlated with marine mammal bycatch rates, was previously not collected by the observer program; in 2008, the observer program began to collect this information.

Sea turtles:

- Observer coverage is insufficient in some bycatch strata to obtain precise (minimum 30% CV) bycatch estimates.

- Bycatch analyses should examine whether different types of trawl nets or TEDs affect turtle bycatch rates. In the past, the data for such an analysis were not available.

- The VTRs do not report use or condition of a TED, so it is difficult to monitor compliance and effectiveness of TED usage in reducing sea turtle bycatch. Discrepancies exist in the VTR database between what is reported on the logbooks and what is entered into the database.

Recommendations:

Marine mammals:

- Achieving bycatch estimates for long- and/or short-finned pilot whales that have a 30% CV was recommended. It is projected that an additional 500 sea-days are required (Rossman 2007; Wigley et al. 2007). However, these sea day projections do not account for overlap between the fish and marine mammal sampling programs. Therefore, the number of additional sea days is over-estimated, but to an unknown degree.

Sea turtles:

- It was recommended that observer coverage should be expanded in the Mid-Atlantic (average coverage from 1996 to 2004 was less than 1%) to improve the precision of bycatch estimates. Due to the large size and diversity of the trawl fishery, coverage could be directed to areas (e.g., warm shallow waters of the southern Mid-Atlantic) where the likelihood of turtle bycatch is highest, as determined from bycatch analyses. Analyses should be conducted to identify areas where observer coverage should be directed.

- Due to recent changes in observer data-collection protocols, observers are now collecting more information about the types of trawl nets used in the fishery, as well as different types of TEDs. It is recommended that as this type of data collection continues, the additional information will improve future bycatch analyses.

- It was also recommended that the VTRs should include a field for fishermen to indicate whether a BRD was used on their gear during a fishing trip, and ideally whether that TED was functioning properly (i.e., it was not clogged with debris or damaged in any way). More auditing procedures should be developed when VTR data are entered or scanned into the database for quality assurance.

Mid-Atlantic Scallop Dredge Fisheries

Tier Classes: Fish: various (see Table 4.1.3); Marine Mammals: 3; Other Protected Species: 4

Bycatch Data-collection and Estimation Concerns:

Sea turtles:

- There is no industry-funded observer coverage and only a low level of NMFS-funded observer coverage for vessels fishing under general category permits in open areas. Thus, there is a lack of data collection in this sector of the fishery.

- Further research is needed on factors associated with estimated bycatch rates to help design bycatch mitigation strategies.

- The VTR data have been used to expand bycatch rates to estimate an overall fishery total. Dredges are typically towed for approximately one hour, but the location of VTR fishing effort is represented by a single geographic point. As a result, the spatial distribution of estimated bycatch may not be adequately represented.

Recommendations:

Sea turtles:

- It was recommended that observers should be placed on vessels operating under general category permits in open areas, because these vessels are not part of the industry-funded program.

- To date, bycatch analyses have been conducted on an annual basis, for a very dynamic fishery regulated via rotational access areas.[21] It was recommended that analysis of bycatch rates should be conducted using a longer time series of data to help elucidate factors associated with bycatch rates.

- The use of VMS data (already collected in the dredge fishery) should improve bycatch estimation methods, as these data are a better representation of mobile fishing effort. It was recommended that a full- or part-time employee should be hired to process VMS data and make it easily available to users.

Mid-Atlantic Scallop Trawl Fisheries

Tier Classes: Fish: various (see Table 4.1.3); Marine Mammals: 3; Other Protected Species: 4

Bycatch Data-collection and Estimation Concerns:

Sea turtles:

- There is no industry-funded coverage for vessels fishing under general category permits in open areas, so there is a lack of data collection in this sector of the fishery.

- The VTR data have been used to derive total bycatch estimates. Because VTR fishing effort is represented only by a single geographic point, the spatial distribution of estimated bycatch may not be adequately represented.

[21] Rotational access areas are a system of alternating closed areas which is used to manage the Atlantic sea scallop fishery.

Recommendations:

Sea turtles:

- It was recommended that observers should be placed on vessels operating under general category permits in open areas, because these vessels are not part of the industry-funded program.
- Further work was recommended on characterizing trawl gear designed to harvest scallops versus trawl gear designed to harvest fish, and on whether these gear differences have an impact on turtle bycatch rates.
- The VTRs use different gear codes for trawls designed to catch fish and trawls designed to catch scallops, but it was recommended that information about the gear other than what is being caught should be included, to help differentiate the gear types.
- The use of VMS data (already collected in the scallop trawl fishery) could improve bycatch estimation methods because these data are a better representation of mobile fishing effort. It was recommended that a full or part-time employee could be hired to process VMS data and make it easily available to users.

4.1.8.3 Bycatch Estimation Improvement Plans for Northeast Region Fisheries of Focus—Fish and Protected Species

For two fisheries, the Mid-Atlantic mid-water trawl and the New England mid-water trawl, protected species recommendations were made at the U.S. National Bycatch Report fishery level. Combined fish/protected species improvement plans were developed for these fisheries. Based on the tier scoring system (see Appendix H for detailed descriptions of individual tier elements), the Northeast Regional team identified the following bycatch data-collection and estimation concerns for fish:

- Design implementation (sampling coverage)
- Assumptions of the analytical approach
- Species- and fleet-specific discard mortality
- Verification of industry data

Bycatch data-collection and estimation issues identified for marine mammals included concerns over the ability of a single observer to collect accurate data for paired trawl fisheries, as well as the need to observe the catcher and processor boat components that are involved in some parts of the mid-water trawl fisheries.

As in the previous sections, for both fisheries, recommendations were made for fish and protected species to verify industry data more thoroughly via extended audits.

Mid-Atlantic Mid-Water Trawl Fisheries

Tier Classes: Fish: 3; Marine Mammals: 3; Other Protected Species: 3

Bycatch Data-collection and Estimation Concerns:

Fish:

- See list above

Marine Mammals:

- In the single midwater trawl fishery, when a processing boat is involved, observers may miss bycatch because they are not on both the trawl vessel and the processing boat.
- In the paired midwater trawl fishery, observers may miss some marine mammal bycatch, because they are aboard only one of the two vessels operating a pair trawl.
- Observers may also miss recording bycatch when a processing boat is used, because not all of the catch is observed when a vessel pumps only part of the catch and then releases the rest.

Recommendations:

Fish:

- It was recommended that sampling coverage be improved to provide baseline coverage (518 additional observer days) for this fishery.
- It was recommended that the analytical approach could be improved via advances in methodology of estimators.
- It was also recommended that studies of discard mortality (via special studies, study fleets, etc.) should be implemented.

Marine Mammals:

- It was recommended that for paired-trawl trips, two observers should be deployed, one on each vessel. Each observer would record the data only from hauls where the landings were collected by the vessel they were on.
- It was also recommended that the processor boat and all involved single midwater trawl vessels should be observed, to document the landings and bycatch that are brought aboard. Prior to a haul being brought aboard, it is not feasible for an observer to see the either the species or quantity that has been released from the net while the net is still in the water.

New England Mid-Water Trawl Fisheries

Tier Classes: Fish: 3; Marine Mammals: 4; Other Protected Species: 3

Bycatch and Data-collection Concerns:

Fish:

- See above

Mammals:

- See above

Recommendations:

Fish:

- It was recommended that sampling coverage could be improved by adding additional sea days. Based on the Northeast Region SBRM, 35 additional observer days are needed to supplement observer coverage in this fishery.
- Another recommendation is that the analytical approach could be improved via advances in methodology of estimators.
- It was also recommended that studies of discard mortality (via special studies, study fleets, etc.) should be implemented.

Marine Mammals:

- The recommendation was that approximately 1,500 sea days are needed to achieve a precise bycatch estimate of all marine mammals in the New England single mid-water trawl fishery (Wigley et al. 2007); this is about 1,250 additional sea days over what is usually observed. However, this predicted number of sea days is an over-estimate because it does not account for marine mammal-specific spatial–temporal distribution patterns.
- It was recommended that for paired-trawl trips, two observers should be deployed, one on each vessel. Each observer would record the data only from hauls where the landings were collected from the vessel they were on.
- It was also recommended that the processor boat and all involved single midwater trawl vessels are observed to document the landings and bycatch that are brought aboard. However, at this time the number of additional observed trips is not known.

4.1.8.4 Summary of Northeast Region Recommendations

Table 4.1.5 outlines the bycatch data-collection and estimation improvements recommended by the Northeast Region. Differences in fish and protected species recommendations are based on different sampling goals. To accurately estimate bycatch of rare-event species such as marine mammals, high overall coverage levels are necessary.

A total of 68 Northeast Region recommendations are listed in Table 4.1.5. Of these, 47 apply exclusively to improving fish bycatch data collection/estimation, while the remaining 21 relate to protected species. Eighteen of the fish recommendations were for fisheries identified as fisheries of concern during the qualitative process (shaded in grey in Table 4.1.5). The known additional requirements for Northeast fisheries to meet the fish-related recommendations are 4,534 observer DAS. To meet protected species recommendations, 12,250 DAS are needed. However, it would not be accurate to add these figures together to arrive at a total set of requirements, due to the overlap in observer coverage for fish and protected species needs in individual fisheries. For example, if the recommendation for fish purposes is to increase observer coverage by 100 DAS, and the recommendation for protected species is to increase observer coverage by 200 DAS, in sum this is not a recommendation to increase observer coverage by 300 DAS. Depending on the spatial–temporal distribution of the recommended observer coverage, the recommended increase to deal with all concerns could be anywhere between 200 and 300 DAS. That is, the recommendation for increasing observer coverage by 200 DAS assumes that the first increase of 100 days would satisfy both fish and protected species recommendations. If there were no overlap between the coverage recommended for fish and coverage recommended for protected resources, then the total recommended increase would be the sum of the two requests (300 DAS). In addition, it is estimated that 17 full-time staff would be required to carry out recommendations for improvements to bycatch data and estimation quality. For all fisheries that have recommendations for increased observer coverage for both fish and protected species, staffing and DAS resources can be shared. In addition, there are many recommendations for which requirements were not determined and therefore were not included in the listed totals. These requirements would be in addition to current program resources.

The feasibility of each recommendation is listed in Table 4.1.5. All recommendations made for fish were considered feasible. Nearly all recommendations made for protected species were considered feasible. In a few fisheries, because marine mammal bycatch is rare, the number of observed sea days to estimate a bycatch rate with a CV of 30% would be extremely high.

4.1.8.5 Improvements Expected From Implementation of Recommendations

The majority of Tier 3 fisheries in the Northeast Region are in the upper 33% of the Tier 3 range, indicating that only minor improvements would result in a change to Tier 4. For most of these fisheries, only minor improvements in spatial or temporal coverage will be needed, as well as improvements in industry data (expanded audits and infrastructure links between databases). The fish and protected species bycatch estimations for Northeast Region fisheries will benefit from improved industry data via expanded data audits, as well as from infrastructure improvements to link associated databases. Only minor tier changes will result from such improvements, due to the low associated values of these criteria, but this does not accurately reflect the importance of these two improvements.

The majority of Tier 2 fisheries in the NE are in the lower 50% of the Tier 2 range, indicating that substantial improvements in sampling coverage and industry data will be needed to advance the tier score.

In a few fisheries (e.g., New England otter trawl and New England single mid-water trawl), protected species bycatch is very rare (Rossman 2007). If it were necessary to precisely estimate this bycatch, it would require an extremely high level of observer coverage, which would be prohibitively expensive.

Appendix 4.1 Northeast Region Bycatch Estimates

Table 4.1.A
Subtables showing annual fish and invertebrate bycatch estimates and coefficient of variation (CV; where available) for Northeast Region fisheries. Bycatch estimates are in live pounds. Key stocks are shaded. For the skate complex, bycatch estimates are available only for a generalized stock group, indicated by an * following the group name.

Subtable 4.1.A.1

		MID-ATLANTIC EXTRA-LARGE-MESH GILLNET				MID-ATLANTIC GENERAL CAT. OPEN AREA SCALLOP DREDGE			
COMMON NAME	SCIENTIFIC NAME	DATA YEAR	AMOUNT	UNIT	CV	DATA SOURCE	AMOUNT	UNIT	CV
American plaice	*Hippoglossoides platessoides*	2005	0	Pounds		2005	0	Pounds	
Atlantic cod	*Gadus morhua*	2005	649.31	Pounds	0.67	2005	0	Pounds	
Atlantic halibut	*Hippoglossus hippoglossus*	2005	0	Pounds		2005	0	Pounds	
Atlantic herring	*Clupea harengus*	2005	0	Pounds		2005	0	Pounds	
Atlantic mackerel	*Scomber scombrus*	2005	3,854.00	Pounds	0.74	2005	0	Pounds	
Atlantic salmon	*Salmo salar*	2005	0	Pounds		2005	0	Pounds	
Atlantic sea scallop	*Placopecten magellanicus*	2005	3,997.02	Pounds	0.55	2005	233,012.93	Pounds	0.35
Atlantic surfclam	*Spisula solidissima*	2005	0	Pounds		2005	1,026.12	Pounds	0.69
Black sea bass	*Centropristis striata*	2005	0	Pounds		2005	1,038.04	Pounds	0.36
Bluefish	*Pomatomus saltatrix*	2005	10,939.37	Pounds	0.33	2005	0	Pounds	
Butterfish	*Peprilus triacanthus*	2005	0	Pounds		2005	0	Pounds	
Deep sea red crab	*Chaceon quinquedens*	2005	0	Pounds		2005	0	Pounds	
Haddock	*Melanogrammus aeglefinus*	2005	0	Pounds		2005	0	Pounds	
Longfinned squid	*Loligo pealeii*	2005	0	Pounds		2005	1,234.77	Pounds	0.43
Monkfish	*Lophius americanus*	2005	491,819.01	Pounds	0.31	2005	244,138.15	Pounds	0.18
Ocean pout	*Zoarces americanus*	2005	0	Pounds		2005	325.03	Pounds	0.65
Ocean quahog	*Arctica islandica*	2005	0	Pounds		2005	1,301.47	Pounds	0.92
Offshore hake	*Merluccius albidus*	2005	0	Pounds		2005	0	Pounds	
Pollock	*Pollachius virens*	2005	0	Pounds		2005	0	Pounds	
Red hake	*Urophycis chuss*	2005	0	Pounds		2005	647.78	Pounds	0.93
Redfish	*Sebastes fasciatus*	2005	0	Pounds		2005	0	Pounds	
Scup	*Stenotomus chrysops*	2005	0	Pounds		2005	32.50	Pounds	0.83
Shortfin squid, northern	*Illex illecebrosus*	2005	0	Pounds		2005	14.14	Pounds	1.05

Table 4.1.A (continued)

(continuation of Subtable 4.1.A.1)		MID-ATLANTIC EXTRA-LARGE-MESH GILLNET				MID-ATLANTIC GENERAL CAT. OPEN AREA SCALLOP DREDGE			
COMMON NAME	**SCIENTIFIC NAME**	**DATA YEAR**	**AMOUNT**	**UNIT**	**CV**	**DATA SOURCE**	**AMOUNT**	**UNIT**	**CV**
Shortnose sturgeon	*Acipenser brevirostrum*	2005	0	Pounds		2005	0	Pounds	
Silver hake	*Merluccius bilinearis*	2005	34.86	Pounds	1.10	2005	398.63	Pounds	0.64
Skate complex*	*Rajidae*	2005	631,693.75	Pounds	0.45	2005	2,923,466.09	Pounds	0.11
Spiny dogfish	*Squalus acanthias*	2005	282,540.40	Pounds	0.31	2005	32,321.32	Pounds	0.31
Summer flounder	*Paralichthys dentatus*	2005	7,082.26	Pounds	0.34	2005	69,626.98	Pounds	0.21
Tilefish	*Lopholatilus chamaeleonticeps*	2005	0	Pounds		2005	0	Pounds	
White hake	*Urophycis tenuis*	2005	0	Pounds		2005	0	Pounds	
Windowpane flounder	*Scophthalmus aquosus*	2005	156.88	Pounds	1.00	2005	33,722.90	Pounds	0.20
Winter flounder	*Pseudopleuronectes americanus*	2005	0	Pounds		2005	11,434.77	Pounds	0.44
Witch flounder	*Glyptocephalus cynoglossus*	2005	0	Pounds		2005	518.44	Pounds	0.65
Yellowtail flounder	*Limanda ferruginea*	2005	0	Pounds		2005	451.17	Pounds	0.58
TOTAL FISHERY BYCATCH			1,432,766.86	Pounds			3,554,711.33	Pounds	
TOTAL FISHERY LANDINGS			6,278,084.92	Pounds			28,432,781.26	Pounds	
TOTAL CATCH (Bycatch + Landings)			7,710,851.78	Pounds			31,987,492.59	Pounds	
FISHERY BYCATCH RATIO (Bycatch/Total Catch)			0.19				0.11		

Subtable 4.1.A.2		MID-ATLANTIC GENERAL CAT. SCALLOP TRAWL				MID-ATLANTIC LARGE-MESH OTTER TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AMOUNT**	**UNIT**	**CV**	**DATA SOURCE**	**AMOUNT**	**UNIT**	**CV**
American plaice	*Hippoglossoides platessoides*	2005	22.76	Pounds	0.96	2005	71.57	Pounds	1.36
Atlantic cod	*Gadus morhua*	2005	0	Pounds		2005	0	Pounds	
Atlantic halibut	*Hippoglossus hippoglossus*	2005	0	Pounds		2005	0	Pounds	
Atlantic herring	*Clupea harengus*	2005	38.57	Pounds	1.00	2005	0	Pounds	
Atlantic mackerel	*Scomber scombrus*	2005	0	Pounds		2005	135.28	Pounds	0.71
Atlantic salmon	*Salmo salar*	2005	0	Pounds		2005	0	Pounds	
Atlantic sea scallop	*Placopecten magellanicus*	2005	992,563.55	Pounds	0.13	2005	30,775.94	Pounds	0.83
Atlantic surfclam	*Spisula solidissima*	2005	22.76	Pounds	0.96	2005	1,000.86	Pounds	0.74

Table 4.1.A (continued)

(continuation of Subtable 4.1.A.2)		MID-ATLANTIC GENERAL CAT. SCALLOP TRAWL				MID-ATLANTIC LARGE-MESH OTTER TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AMOUNT**	**UNIT**	**CV**	**DATA SOURCE**	**AMOUNT**	**UNIT**	**CV**
Black sea bass	*Centropristis striata*	2005	303.81	Pounds	0.48	2005	11,121.83	Pounds	0.68
Bluefish	*Pomatomus saltatrix*	2005	0	Pounds		2005	16,970.57	Pounds	1.07
Butterfish	*Peprilus triacanthus*	2005	108.78	Pounds	0.52	2005	8,332.53	Pounds	0.98
Deep sea red crab	*Chaceon quinquedens*	2005	0	Pounds		2005	4,203.63	Pounds	0.73
Haddock	*Melanogrammus aeglefinus*	2005	125.19	Pounds	0.59	2005	0	Pounds	
Longfinned squid	*Loligo pealeii*	2005	976.34	Pounds	0.40	2005	1,444.03	Pounds	0.59
Monkfish	*Lophius americanus*	2005	132,857.32	Pounds	0.11	2005	65,726.01	Pounds	0.52
Ocean pout	*Zoarces americanus*	2005	1,052.90	Pounds	0.42	2005	0	Pounds	
Ocean quahog	*Arctica islandica*	2005	4,874.24	Pounds	0.74	2005	156.12	Pounds	0.81
Offshore hake	*Merluccius albidus*	2005	0	Pounds		2005	0	Pounds	
Pollock	*Pollachius virens*	2005	0	Pounds		2005	0	Pounds	
Red hake	*Urophycis chuss*	2005	386.95	Pounds	0.51	2005	5,410.47	Pounds	1.07
Redfish	*Sebastes fasciatus*	2005	38.57	Pounds	1.01	2005	0	Pounds	
Scup	*Stenotomus chrysops*	2005	3.81	Pounds	1.14	2005	827,700.41	Pounds	0.75
Shortfin squid, northern	*Illex illecebrosus*	2005	201.63	Pounds	0.48	2005	393.61	Pounds	1.29
Shortnose sturgeon	*Acipenser brevirostrum*	2005	0	Pounds		2005	0	Pounds	
Silver hake	*Merluccius bilinearis*	2005	2,077.74	Pounds	0.38	2005	5,308.73	Pounds	1.16
Skate complex*	*Rajidae*	2005	451,525.91	Pounds	0.11	2005	8,257,235.38	Pounds	1.01
Spiny dogfish	*Squalus acanthias*	2005	24,015.05	Pounds	0.62	2005	2,204,477.26	Pounds	0.61
Summer flounder	*Paralichthys dentatus*	2005	1,170.76	Pounds	0.56	2005	185,965.96	Pounds	0.62
Tilefish	*Lopholatilus chamaeleonticeps*	2005	0	Pounds		2005	0	Pounds	
White hake	*Urophycis tenuis*	2005	816.29	Pounds	0.53	2005	14.31	Pounds	1.41
Windowpane flounder	*Scophthalmus aquosus*	2005	11,374.22	Pounds	0.30	2005	185,090.46	Pounds	0.87
Winter flounder	*Pseudopleuronectes americanus*	2005	0	Pounds		2005	30,842.66	Pounds	0.91
Witch flounder	*Glyptocephalus cynoglossus*	2005	331.95	Pounds	0.41	2005	4,592.26	Pounds	0.73
Yellowtail flounder	*Limanda ferruginea*	2005	57.97	Pounds	0.57	2005	364.99	Pounds	1.12
TOTAL FISHERY BYCATCH			1,624,947.27	Pounds			11,847,334.87	Pounds	
TOTAL FISHERY LANDINGS			8,525,063.72	Pounds			28,685,828.55	Pounds	
TOTAL CATCH (Bycatch + Landings)			10,150,010.99	Pounds			40,533,163.42	Pounds	
FISHERY BYCATCH RATIO (Bycatch/Total Catch)			0.16				0.29		

Table 4.1.A (continued)

Subtable 4.1.A.3

		MID-ATLANTIC LIMITED-ACCESS CLOSED AREA SCALLOP DREDGE				MID-ATLANTIC LIMITED-ACCESS OPEN AREA SCALLOP DREDGE			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AMOUNT**	**UNIT**	**CV**	**DATA SOURCE**	**AMOUNT**	**UNIT**	**CV**
American plaice	*Hippoglossoides platessoides*	2005	89.78	Pounds	0.72	2005	2,769.78	Pounds	0.76
Atlantic cod	*Gadus morhua*	2005	0	Pounds		2005	0	Pounds	
Atlantic halibut	*Hippoglossus hippoglossus*	2005	0	Pounds		2005	28.87	Pounds	1.08
Atlantic herring	*Clupea harengus*	2005	0	Pounds		2005	55.73	Pounds	0.97
Atlantic mackerel	*Scomber scombrus*	2005	200.97	Pounds	0.47	2005	2,787.01	Pounds	1.13
Atlantic salmon	*Salmo salar*	2005	0	Pounds		2005	0	Pounds	
Atlantic sea scallop	*Placopecten magellanicus*	2005	1,743,662.58	Pounds	0.23	2005	4,462,795.92	Pounds	0.38
Atlantic surfclam	*Spisula solidissima*	2005	0	Pounds		2005	0	Pounds	
Black sea bass	*Centropristis striata*	2005	3,573.97	Pounds	0.28	2005	5,579.43	Pounds	0.69
Bluefish	*Pomatomus saltatrix*	2005	0	Pounds		2005	0	Pounds	
Butterfish	*Peprilus triacanthus*	2005	29.07	Pounds	0.52	2005	176.71	Pounds	0.70
Deep sea red crab	*Chaceon quinquedens*	2005	298.84	Pounds	0.58	2005	0	Pounds	
Haddock	*Melanogrammus aeglefinus*	2005	64.58	Pounds	0.83	2005	0	Pounds	
Longfinned squid	*Loligo pealeii*	2005	3,262.87	Pounds	0.39	2005	2,075.82	Pounds	0.39
Monkfish	*Lophius americanus*	2005	1,691,490.12	Pounds	0.11	2005	2,057,543.71	Pounds	0.22
Ocean pout	*Zoarces americanus*	2005	348.73	Pounds	0.54	2005	3,067.41	Pounds	0.61
Ocean quahog	*Arctica islandica*	2005	357.39	Pounds	0.72	2005	20,314.84	Pounds	0.72
Offshore hake	*Merluccius albidus*	2005	0	Pounds		2005	0	Pounds	
Pollock	*Pollachius virens*	2005	0	Pounds		2005	0	Pounds	
Red hake	*Urophycis chuss*	2005	6,979.66	Pounds	0.36	2005	7,564.37	Pounds	0.49
Redfish	*Sebastes fasciatus*	2005	0	Pounds		2005	668.79	Pounds	0.82
Scup	*Stenotomus chrysops*	2005	2,246.79	Pounds	0.41	2005	891.72	Pounds	0.61
Shortfin squid, northern	*Illex illecebrosus*	2005	2,635.76	Pounds	0.50	2005	697.27	Pounds	0.64
Shortnose sturgeon	*Acipenser brevirostrum*	2005	0	Pounds		2005	0	Pounds	
Silver hake	*Merluccius bilinearis*	2005	4,213.69	Pounds	0.21	2005	11,578.39	Pounds	0.46
Skate complex*	*Rajidae*	2005	5,576,095.28	Pounds	0.13	2005	7,773,634.11	Pounds	0.13
Spiny dogfish	*Squalus acanthias*	2005	28,681.32	Pounds	0.32	2005	29,924.16	Pounds	0.29
Summer flounder	*Paralichthys dentatus*	2005	303,960.20	Pounds	0.17	2005	501,989.68	Pounds	0.22
Tilefish	*Lopholatilus chamaeleonticeps*	2005	0	Pounds		2005	0	Pounds	

Table 4.1.A (continued)

(continuation of Subtable 4.1.A.3)		MID-ATLANTIC LIMITED-ACCESS CLOSED AREA SCALLOP DREDGE				MID-ATLANTIC LIMITED-ACCESS OPEN AREA SCALLOP DREDGE			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AMOUNT**	**UNIT**	**CV**	**DATA SOURCE**	**AMOUNT**	**UNIT**	**CV**
White hake	*Urophycis tenuis*	2005	67.98	Pounds	0.71	2005	650.25	Pounds	0.94
Windowpane flounder	*Scophthalmus aquosus*	2005	286.73	Pounds	0.60	2005	32,481.00	Pounds	0.35
Winter flounder	*Pseudopleuronectes americanus*	2005	1,520.00	Pounds	1.09	2005	8,718.79	Pounds	0.47
Witch flounder	*Glyptocephalus cynoglossus*	2005	37,227.05	Pounds	0.16	2005	32,450.01	Pounds	0.45
Yellowtail flounder	*Limanda ferruginea*	2005	119.10	Pounds	0.45	2005	2,088.00	Pounds	0.66
TOTAL FISHERY BYCATCH			9,407,412.46	Pounds			14,960,531.77	Pounds	
TOTAL FISHERY LANDINGS			60,488,181.80	Pounds			159,845,821.40	Pounds	
TOTAL CATCH (Bycatch + Landings)			69,895,594.26	Pounds			174,806,353.17	Pounds	
FISHERY BYCATCH RATIO (Bycatch/Total Catch)			0.13				0.09		

Subtable 4.1.A.4		MID-ATLANTIC MID-WATER OTTER TRAWL				MID-ATLANTIC SMALL-MESH OTTER TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AMOUNT**	**UNIT**	**CV**	**DATA SOURCE**	**AMOUNT**	**UNIT**	**CV**
American plaice	*Hippoglossoides platessoides*	2005	0	Pounds		2005	4,207.04	Pounds	0.61
Atlantic cod	*Gadus morhua*	2005	0	Pounds		2005	216.52	Pounds	0.54
Atlantic halibut	*Hippoglossus hippoglossus*	2005	0	Pounds		2005	0	Pounds	
Atlantic herring	*Clupea harengus*	2005	618,910.69	Pounds	0.69	2005	400,211.67	Pounds	0.53
Atlantic mackerel	*Scomber scombrus*	2005	736,858.93	Pounds	0.83	2005	468,264.59	Pounds	0.64
Atlantic salmon	*Salmo salar*	2005	0	Pounds		2005	0	Pounds	
Atlantic sea scallop	*Placopecten magellanicus*	2005	0	Pounds		2005	94,258.41	Pounds	0.37
Atlantic surfclam	*Spisula solidissima*	2005	0	Pounds		2005	4,486.63	Pounds	1.95
Black sea bass	*Centropristis striata*	2005	0	Pounds		2005	142,643.63	Pounds	0.35
Bluefish	*Pomatomus saltatrix*	2005	0	Pounds		2005	76,573.58	Pounds	0.42
Butterfish	*Peprilus triacanthus*	2005	0	Pounds		2005	1,464,288.01	Pounds	0.30
Deep sea red crab	*Chaceon quinquedens*	2005	0	Pounds		2005	847.91	Pounds	0.62
Haddock	*Melanogrammus aeglefinus*	2005	0	Pounds		2005	9,360.90	Pounds	0.60

Table 4.1.A (continued)

(continuation of Subtable 4.1.A.4)		MID-ATLANTIC MID-WATER OTTER TRAWL				MID-ATLANTIC SMALL-MESH OTTER TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AMOUNT**	**UNIT**	**CV**	**DATA SOURCE**	**AMOUNT**	**UNIT**	**CV**
Longfinned squid	*Loligo pealeii*	2005	0	Pounds		2005	1,301,668.46	Pounds	0.26
Monkfish	*Lophius americanus*	2005	1,578.70	Pounds	0.86	2005	360,209.36	Pounds	0.19
Ocean pout	*Zoarces americanus*	2005	0	Pounds		2005	63.53	Pounds	0.43
Ocean quahog	*Arctica islandica*	2005	0	Pounds		2005	101.21	Pounds	0.89
Offshore hake	*Merluccius albidus*	2005	0	Pounds		2005	20,838.18	Pounds	0.62
Pollock	*Pollachius virens*	2005	442.04	Pounds	0.86	2005	50.87	Pounds	0.63
Red hake	*Urophycis chuss*	2005	0	Pounds		2005	1,759,337.69	Pounds	0.27
Redfish	*Sebastes fasciatus*	2005	0	Pounds		2005	2,495.50	Pounds	0.35
Scup	*Stenotomus chrysops*	2005	12,098.64	Pounds	0.82	2005	189,979.42	Pounds	0.33
Shortfin squid, northern	*Illex illecebrosus*	2005	0	Pounds		2005	3,062,891.05	Pounds	0.41
Shortnose sturgeon	*Acipenser brevirostrum*	2005	0	Pounds		2005	0	Pounds	
Silver hake	*Merluccius bilinearis*	2005	0	Pounds		2005	1,790,686.58	Pounds	0.29
Skate complex*	*Rajidae*	2005	0	Pounds		2005	4,191,935.87	Pounds	0.31
Spiny dogfish	*Squalus acanthias*	2005	349,325.85	Pounds	0.41	2005	4,619,452.67	Pounds	0.27
Summer flounder	*Paralichthys dentatus*	2005	0	Pounds		2005	568,816.42	Pounds	0.26
Tilefish	*Lopholatilus chamaeleonticeps*	2005	0	Pounds		2005	5,149.89	Pounds	0.42
White hake	*Urophycis tenuis*	2005	0	Pounds		2005	51,467.17	Pounds	0.46
Windowpane flounder	*Scophthalmus aquosus*	2005	0	Pounds		2005	118,665.65	Pounds	0.40
Winter flounder	*Pseudopleuronectes americanus*	2005	0	Pounds		2005	57,094.62	Pounds	0.82
Witch flounder	*Glyptocephalus cynoglossus*	2005	0	Pounds		2005	72,456.25	Pounds	0.28
Yellowtail flounder	*Limanda ferruginea*	2005	0	Pounds		2005	18,512.34	Pounds	0.58
TOTAL FISHERY BYCATCH			1,719,214.85	Pounds			20,857,231.63	Pounds	
TOTAL FISHERY LANDINGS			108,921,097.10	Pounds			69,347,982.19	Pounds	
TOTAL CATCH (Bycatch + Landings)			110,640,311.95	Pounds			90,205,213.82	Pounds	
FISHERY BYCATCH RATIO (Bycatch/Total Catch)			0.02				0.23		

Table 4.1.A (continued)

Subtable 4.1.A.5		NEW ENGLAND B-REG DAS LARGE-MESH OTTER TRAWL				NEW ENGLAND BOTTOM LONGLINE			
COMMON NAME	SCIENTIFIC NAME	DATA SOURCE	AMOUNT	UNIT	CV	DATA SOURCE	AMOUNT	UNIT	CV
American plaice	*Hippoglossoides platessoides*	2005	17,884.69	Pounds	0.11	2005	6.80	Pounds	0.65
Atlantic cod	*Gadus morhua*	2005	118,940.85	Pounds	0.22	2005	101,274.76	Pounds	0.27
Atlantic halibut	*Hippoglossus hippoglossus*	2005	2,241.25	Pounds	0.23	2005	211.10	Pounds	0.36
Atlantic herring	*Clupea harengus*	2005	12,509.61	Pounds	0.40	2005	0	Pounds	
Atlantic mackerel	*Scomber scombrus*	2005	192.03	Pounds	0.33	2005	0	Pounds	
Atlantic salmon	*Salmo salar*	2005	0	Pounds		2005	0	Pounds	
Atlantic sea scallop	*Placopecten magellanicus*	2005	30,947.18	Pounds	0.32	2005	13.06	Pounds	0.69
Atlantic surfclam	*Spisula solidissima*	2005	84.63	Pounds	0.85	2005	0	Pounds	
Black sea bass	*Centropristis striata*	2005	3.06	Pounds	0.62	2005	0	Pounds	
Bluefish	*Pomatomus saltatrix*	2005	1,466.15	Pounds	0.33	2005	0	Pounds	
Butterfish	*Peprilus triacanthus*	2005	13.34	Pounds	0.27	2005	0	Pounds	
Deep sea red crab	*Chaceon quinquedens*	2005	13,342.57	Pounds	0.19	2005	0	Pounds	
Haddock	*Melanogrammus aeglefinus*	2005	100,172.14	Pounds	0.15	2005	80,590.68	Pounds	0.17
Longfinned squid	*Loligo pealeii*	2005	555.03	Pounds	0.36	2005	0	Pounds	
Monkfish	*Lophius americanus*	2005	155,226.61	Pounds	0.11	2005	14.65	Pounds	0.83
Ocean pout	*Zoarces americanus*	2005	24,393.96	Pounds	0.14	2005	6,580.36	Pounds	0.32
Ocean quahog	*Arctica islandica*	2005	903.46	Pounds	0.58	2005	0	Pounds	
Offshore hake	*Merluccius albidus*	2005	7.64	Pounds	0.62	2005	0	Pounds	
Pollock	*Pollachius virens*	2005	5,695.65	Pounds	0.38	2005	444.52	Pounds	0.58
Red hake	*Urophycis chuss*	2005	28,151.18	Pounds	0.19	2005	1,770.24	Pounds	0.27
Redfish	*Sebastes fasciatus*	2005	29,825.54	Pounds	0.29	2005	823.38	Pounds	0.25
Scup	*Stenotomus chrysops*	2005	18.71	Pounds	0.63	2005	0	Pounds	
Shortfin squid, northern	*Illex illecebrosus*	2005	2,360.54	Pounds	0.22	2005	0	Pounds	
Shortnose sturgeon	*Acipenser brevirostrum*	2005	0	Pounds		2005	0	Pounds	
Silver hake	*Merluccius bilinearis*	2005	29,438.83	Pounds	0.28	2005	3.46	Pounds	0.55
Skate complex*	*Rajidae*	2005	8,483,162.11	Pounds	0.11	2005	227,748.15	Pounds	0.20
Spiny dogfish	*Squalus acanthias*	2005	162,301.87	Pounds	0.30	2005	338,563.65	Pounds	0.21
Summer flounder	*Paralichthys dentatus*	2005	185,029.58	Pounds	0.15	2005	0	Pounds	
Tilefish	*Lopholatilus chamaeleonticeps*	2005	87.08	Pounds	0.53	2005	0	Pounds	

Table 4.1.A (continued)

(continuation of subtable 4.1.A.5)		NEW ENGLAND B-REG DAS LARGE-MESH OTTER TRAWL				NEW ENGLAND BOTTOM LONGLINE			
COMMON NAME	SCIENTIFIC NAME	DATA SOURCE	AMOUNT	UNIT	CV	DATA SOURCE	AMOUNT	UNIT	CV
White hake	*Urophycis tenuis*	2005	4,653.39	Pounds	0.17	2005	2,409.64	Pounds	0.23
Windowpane flounder	*Scophthalmus aquosus*	2005	143,132.30	Pounds	0.13	2005	6.72	Pounds	0.75
Winter flounder	*Pseudopleuronectes americanus*	2005	5,543.31	Pounds	0.22	2005	0	Pounds	
Witch flounder	*Glyptocephalus cynoglossus*	2005	22,939.24	Pounds	0.10	2005	0	Pounds	
Yellowtail flounder	*Limanda ferruginea*	2005	94,918.15	Pounds	0.18	2005	29.85	Pounds	0.69
TOTAL FISHERY BYCATCH			9,676,141.68	Pounds			760,491.02	Pounds	
TOTAL FISHERY LANDINGS			12,311,245.88	Pounds			2,746,195.36	Pounds	
TOTAL CATCH (Bycatch + Landings)			21,987,387.56	Pounds			3,506,686.38	Pounds	
FISHERY BYCATCH RATIO (Bycatch/Total Catch)			0.44				0.22		

Subtable 4.1.A.6		NEW ENGLAND GENERAL CAT. OPEN AREA SCALLOP DREDGE				NEW ENGLAND HADDOCK SECTOR LONGLINE			
COMMON NAME	SCIENTIFIC NAME	DATA SOURCE	AMOUNT	UNIT	CV	DATA SOURCE	AMOUNT	UNIT	CV
American plaice	*Hippoglossoides platessoides*	2005	251.36	Pounds	0.67	2005	19.35	Pounds	0.60
Atlantic cod	*Gadus morhua*	2005	96.68	Pounds	0.78	2005	3278.24	Pounds	0.11
Atlantic halibut	*Hippoglossus hippoglossus*	2005	0	Pounds		2005	701.53	Pounds	0.31
Atlantic herring	*Clupea harengus*	2005	0	Pounds		2005	28.63	Pounds	0.88
Atlantic mackerel	*Scomber scombrus*	2005	0	Pounds		2005	0	Pounds	
Atlantic salmon	*Salmo salar*	2005	0	Pounds		2005	0	Pounds	
Atlantic sea scallop	*Placopecten magellanicus*	2005	1,101,691	Pounds	0.32	2005	4.03	Pounds	0.88
Atlantic surfclam	*Spisula solidissima*	2005	12,181	Pounds	0.78	2005	0	Pounds	
Black sea bass	*Centropristis striata*	2005	0	Pounds		2005	0	Pounds	
Bluefish	*Pomatomus saltatrix*	2005	0	Pounds		2005	0	Pounds	
Butterfish	*Peprilus triacanthus*	2005	0	Pounds		2005	0	Pounds	
Deep sea red crab	*Chaceon quinquedens*	2005	0	Pounds		2005	0	Pounds	
Haddock	*Melanogrammus aeglefinus*	2005	0	Pounds		2005	67,736.36	Pounds	0.08
Longfinned squid	*Loligo pealeii*	2005	0	Pounds		2005	0	Pounds	
Monkfish	*Lophius americanus*	2005	1,046.62	Pounds	0.54	2005	12.10	Pounds	0.87
Ocean pout	*Zoarces americanus*	2005	1,353.48	Pounds	0.79	2005	28.22	Pounds	0.68

Table 4.1.A (continued)

(continuation of Subtable 4.1.A.6)		NEW ENGLAND GENERAL CAT. OPEN AREA SCALLOP DREDGE				NEW ENGLAND HADDOCK SECTOR LONGLINE			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AMOUNT**	**UNIT**	**CV**	**DATA SOURCE**	**AMOUNT**	**UNIT**	**CV**
Ocean quahog	*Arctica islandica*	2005	96,580.43	Pounds	0.73	2005	0	Pounds	
Offshore hake	*Merluccius albidus*	2005	0	Pounds		2005	0	Pounds	
Pollock	*Pollachius virens*	2005	0	Pounds		2005	16.13	Pounds	0.70
Red hake	*Urophycis chuss*	2005	0	Pounds		2005	2,271.91	Pounds	0.20
Redfish	*Sebastes fasciatus*	2005	0	Pounds		2005	322.54	Pounds	0.23
Scup	*Stenotomus chrysops*	2005	0	Pounds		2005	0	Pounds	
Shortfin squid, northern	*Illex illecebrosus*	2005	0	Pounds		2005	0	Pounds	
Shortnose sturgeon	*Acipenser brevirostrum*	2005	0	Pounds		2005	0	Pounds	
Silver hake	*Merluccius bilinearis*	2005	0	Pounds		2005	36.29	Pounds	0.78
Skate complex*	*Rajidae*	2005	334,080.91	Pounds	0.38	2005	66,607.06	Pounds	0.11
Spiny dogfish	*Squalus acanthias*	2005	0	Pounds		2005	24,198.76	Pounds	0.33
Summer flounder	*Paralichthys dentatus*	2005	386.71	Pounds	0.78	2005	0	Pounds	
Tilefish	*Lopholatilus chamaeleonticeps*	2005	0	Pounds		2005	0	Pounds	
White hake	*Urophycis tenuis*	2005	0	Pounds		2005	2,231.19	Pounds	0.18
Windowpane flounder	*Scophthalmus aquosus*	2005	26,818.23	Pounds	0.47	2005	0	Pounds	
Winter flounder	*Pseudopleuronectes americanus*	2005	21,195.52	Pounds	0.43	2005	0	Pounds	
Witch flounder	*Glyptocephalus cynoglossus*	2005	0	Pounds		2005	4.03	Pounds	0.88
Yellowtail flounder	*Limanda ferruginea*	2005	10,555.39	Pounds	0.52	2005	0	Pounds	
TOTAL FISHERY BYCATCH			1,606,237.03	Pounds			167,496.37	Pounds	
TOTAL FISHERY LANDINGS			15,847,470.51	Pounds			1,342,529.51	Pounds	
TOTAL CATCH (Bycatch + Landings)			17,453,707.54	Pounds			1,510,025.88	Pounds	
FISHERY BYCATCH RATIO (Bycatch/Total Catch)			0.09				0.11		

Subtable 4.1.A.7		NEW ENGLAND EXTRA-LARGE-MESH GILLNET				NEW ENGLAND GENERAL CAT. CLOSED AREA SCALLOP DREDGE			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AMOUNT**	**UNIT**	**CV**	**DATA SOURCE**	**AMOUNT**	**UNIT**	**CV**
American plaice	*Hippoglossoides platessoides*	2005	2,293.16	Pounds	0.53	2005	0	Pounds	
Atlantic cod	*Gadus morhua*	2005	74,180.52	Pounds	0.17	2005	0	Pounds	
Atlantic halibut	*Hippoglossus hippoglossus*	2005	7,359.52	Pounds	0.39	2005	0	Pounds	
Atlantic herring	*Clupea harengus*	2005	777.92	Pounds	0.34	2005	0	Pounds	
Atlantic mackerel	*Scomber scombrus*	2005	55,926.74	Pounds	0.66	2005	0	Pounds	

Table 4.1.A (continued)

(continuation of subtable 4.1.A.7)		NEW ENGLAND EXTRA-LARGE-MESH GILLNET				NEW ENGLAND GENERAL CAT. CLOSED AREA SCALLOP DREDGE			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AMOUNT**	**UNIT**	**CV**	**DATA SOURCE**	**AMOUNT**	**UNIT**	**CV**
Atlantic salmon	*Salmo salar*	2005	0	Pounds		2005	0	Pounds	
Atlantic sea scallop	*Placopecten magellanicus*	2005	577.45	Pounds	0.39	2005	275,255.30	Pounds	0.17
Atlantic surfclam	*Spisula solidissima*	2005	10.05	Pounds	0.93	2005	8,244.65	Pounds	0.18
Black sea bass	*Centropristis striata*	2005	0	Pounds		2005	0	Pounds	
Bluefish	*Pomatomus saltatrix*	2005	31,486.21	Pounds	0.25	2005	0	Pounds	
Butterfish	*Peprilus triacanthus*	2005	0	Pounds		2005	0	Pounds	
Deep sea red crab	*Chaceon quinquedens*	2005	661.12	Pounds	0.50	2005	0	Pounds	
Haddock	*Melanogrammus aeglefinus*	2005	4,189.20	Pounds	0.23	2005	431.21	Pounds	0.56
Longfinned squid	*Loligo pealeii*	2005	0	Pounds		2005	0	Pounds	
Monkfish	*Lophius americanus*	2005	858,679.96	Pounds	0.19	2005	70,816.41	Pounds	0.18
Ocean pout	*Zoarces americanus*	2005	3,062.32	Pounds	0.80	2005	75.11	Pounds	0.87
Ocean quahog	*Arctica islandica*	2005	0	Pounds		2005	0	Pounds	
Offshore hake	*Merluccius albidus*	2005	0	Pounds		2005	0	Pounds	
Pollock	*Pollachius virens*	2005	30,095.12	Pounds	0.20	2005	0	Pounds	
Red hake	*Urophycis chuss*	2005	50.23	Pounds	0.62	2005	1,021.43	Pounds	0.51
Redfish	*Sebastes fasciatus*	2005	4,783.26	Pounds	0.78	2005	0	Pounds	
Scup	*Stenotomus chrysops*	2005	0	Pounds		2005	0	Pounds	
Shortfin squid, northern	*Illex illecebrosus*	2005	0	Pounds		2005	0	Pounds	
Shortnose sturgeon	*Acipenser brevirostrum*	2005	0	Pounds		2005	0	Pounds	
Silver hake	*Merluccius bilinearis*	2005	317.36	Pounds	0.29	2005	102.93	Pounds	0.56
Skate complex*	*Rajidae*	2005	1,441,001.13	Pounds	0.44	2005	70,668.47	Pounds	0.09
Spiny dogfish	*Squalus acanthias*	2005	809,447.86	Pounds	0.17	2005	250.38	Pounds	1.07
Summer flounder	*Paralichthys dentatus*	2005	47,622.22	Pounds	0.26	2005	2,225.58	Pounds	1.08
Tilefish	*Lopholatilus chamaeleonticeps*	2005	7,096.40	Pounds	0.53	2005	0	Pounds	
White hake	*Urophycis tenuis*	2005	23,781.18	Pounds	0.32	2005	5,041.37	Pounds	0.18
Windowpane flounder	*Scophthalmus aquosus*	2005	58.20	Pounds	0.51	2005	471.48	Pounds	1.05
Winter flounder	*Pseudopleuronectes americanus*	2005	4,300.86	Pounds	0.76	2005	3,018.45	Pounds	0.79
Witch flounder	*Glyptocephalus cynoglossus*	2005	345.05	Pounds	0.53	2005	0	Pounds	
Yellowtail flounder	*Limanda ferruginea*	2005	5,249.27	Pounds	0.87	2005	3,421.82	Pounds	0.16
TOTAL FISHERY BYCATCH			3,413,352.31	Pounds			441,044.59	Pounds	
TOTAL FISHERY LANDINGS			16,486,015.99	Pounds			2,359,046.28	Pounds	
TOTAL CATCH (Bycatch + Landings)			19,899,368.30	Pounds			2,800,090.87	Pounds	
FISHERY BYCATCH RATIO (Bycatch/Total Catch)			0.17				0.16		

Table 4.1.A (continued)

Subtable 4.1.A.8		NEW ENGLAND HAND LINE				NEW ENGLAND LARGE-MESH GILLNET			
COMMON NAME	SCIENTIFIC NAME	DATA SOURCE	AMOUNT	UNIT	CV	DATA SOURCE	AMOUNT	UNIT	CV
American plaice	*Hippoglossoides platessoides*	2005	0	Pounds		2005	2,691.19	Pounds	0.26
Atlantic cod	*Gadus morhua*	2005	51,170.32	Pounds	0.42	2005	202,334.25	Pounds	0.12
Atlantic halibut	*Hippoglossus hippoglossus*	2005	0	Pounds		2005	1,736.36	Pounds	1.50
Atlantic herring	*Clupea harengus*	2005	0	Pounds		2005	10,469.35	Pounds	0.40
Atlantic mackerel	*Scomber scombrus*	2005	0	Pounds		2005	1,634.98	Pounds	0.48
Atlantic salmon	*Salmo salar*	2005	0	Pounds		2005	0	Pounds	
Atlantic sea scallop	*Placopecten magellanicus*	2005	0	Pounds		2005	20.63	Pounds	0.43
Atlantic surfclam	*Spisula solidissima*	2005	0	Pounds		2005	0	Pounds	
Black sea bass	*Centropristis striata*	2005	0	Pounds		2005	0	Pounds	
Bluefish	*Pomatomus saltatrix*	2005	0	Pounds		2005	13,242.30	Pounds	0.42
Butterfish	*Peprilus triacanthus*	2005	0	Pounds		2005	0	Pounds	
Deep sea red crab	*Chaceon quinquedens*	2005	0	Pounds		2005	1,713.14	Pounds	0.45
Haddock	*Melanogrammus aeglefinus*	2005	0	Pounds		2005	6,940.58	Pounds	0.36
Longfinned squid	*Loligo pealeii*	2005	0	Pounds		2005	0	Pounds	
Monkfish	*Lophius americanus*	2005	0	Pounds		2005	9,741.65	Pounds	0.25
Ocean pout	*Zoarces americanus*	2005	0	Pounds		2005	1,418.37	Pounds	1.11
Ocean quahog	*Arctica islandica*	2005	0	Pounds		2005	0	Pounds	
Offshore hake	*Merluccius albidus*	2005	0	Pounds		2005	100.70	Pounds	0.43
Pollock	*Pollachius virens*	2005	0	Pounds		2005	74,578.13	Pounds	0.12
Red hake	*Urophycis chuss*	2005	0	Pounds		2005	931.82	Pounds	0.37
Redfish	*Sebastes fasciatus*	2005	0	Pounds		2005	4,645.65	Pounds	0.20
Scup	*Stenotomus chrysops*	2005	0	Pounds		2005	0	Pounds	
Shortfin squid, northern	*Illex illecebrosus*	2005	0	Pounds		2005	0	Pounds	
Shortnose sturgeon	*Acipenser brevirostrum*	2005	0	Pounds		2005	0	Pounds	
Silver hake	*Merluccius bilinearis*	2005	0	Pounds		2005	1,851.56	Pounds	0.24
Skate complex*	*Rajidae*	2005	0	Pounds		2005	123,214.61	Pounds	0.59
Spiny dogfish	*Squalus acanthias*	2005	0	Pounds		2005	4,199,078.01	Pounds	0.12
Summer flounder	*Paralichthys dentatus*	2005	0	Pounds		2005	8.90	Pounds	0.91
Tilefish	*Lopholatilus chamaeleonticeps*	2005	0	Pounds		2005	0	Pounds	
White hake	*Urophycis tenuis*	2005	0	Pounds		2005	24,233.90	Pounds	0.24
Windowpane flounder	*Scophthalmus aquosus*	2005	0	Pounds		2005	52.67	Pounds	0.46
Winter flounder	*Pseudopleuronectes americanus*	2005	0	Pounds		2005	9,226.73	Pounds	0.62
Witch flounder	*Glyptocephalus cynoglossus*	2005	0	Pounds		2005	2,957.19	Pounds	0.70
Yellowtail flounder	*Limanda ferruginea*	2005	0	Pounds		2005	26,106.07	Pounds	0.58
TOTAL FISHERY BYCATCH			51,170.32	Pounds			4,718,928.74	Pounds	
TOTAL FISHERY LANDINGS			606,807.70	Pounds			10,082,223.49	Pounds	
TOTAL CATCH (Bycatch + Landings)			657,978.02	Pounds			14,801,152.23	Pounds	
FISHERY BYCATCH RATIO (Bycatch/Total Catch)			0.08				0.32		

Table 4.1.A (continued)

Subtable 4.1.A.9		NEW ENGLAND LARGE-MESH OTTER TRAWL				NEW ENGLAND LIMITED-ACCESS CLOSED AREA SCALLOP DREDGE			
COMMON NAME	SCIENTIFIC NAME	DATA SOURCE	AMOUNT	UNIT	CV	DATA SOURCE	AMOUNT	UNIT	CV
American plaice	*Hippoglossoides platessoides*	2005	422,938.73	Pounds	0.13	2005	5,699.15	Pounds	0.33
Atlantic cod	*Gadus morhua*	2005	671,163.94	Pounds	0.20	2005	3,426.70	Pounds	0.27
Atlantic halibut	*Hippoglossus hippoglossus*	2005	10,184.33	Pounds	0.25	2005	0	Pounds	
Atlantic herring	*Clupea harengus*	2005	9,479.36	Pounds	0.29	2005	0	Pounds	
Atlantic mackerel	*Scomber scombrus*	2005	1,906.96	Pounds	0.45	2005	0	Pounds	
Atlantic salmon	*Salmo salar*	2005	0	Pounds		2005	0	Pounds	
Atlantic sea scallop	*Placopecten magellanicus*	2005	33,767.62	Pounds	0.26	2005	1,484,379.47	Pounds	0.30
Atlantic surfclam	*Spisula solidissima*	2005	10,410.17	Pounds	1.41	2005	438.52	Pounds	0.80
Black sea bass	*Centropristis striata*	2005	20,135.01	Pounds	0.52	2005	0	Pounds	
Bluefish	*Pomatomus saltatrix*	2005	13,692.24	Pounds	0.54	2005	0	Pounds	
Butterfish	*Peprilus triacanthus*	2005	1,306.15	Pounds	0.26	2005	20.12	Pounds	0.54
Deep sea red crab	*Chaceon quinquedens*	2005	91,857.57	Pounds	0.32	2005	0	Pounds	
Haddock	*Melanogrammus aeglefinus*	2005	44,827.73	Pounds	0.22	2005	5,333.58	Pounds	0.25
Longfinned squid	*Loligo pealeii*	2005	4,376.01	Pounds	0.47	2005	27.04	Pounds	0.87
Monkfish	*Lophius americanus*	2005	812,148.35	Pounds	0.16	2005	815,902.96	Pounds	0.19
Ocean pout	*Zoarces americanus*	2005	144,860.12	Pounds	0.20	2005	2,559.13	Pounds	0.25
Ocean quahog	*Arctica islandica*	2005	8,844.45	Pounds	1.20	2005	2,593.43	Pounds	0.54
Offshore hake	*Merluccius albidus*	2005	131.55	Pounds	0.65	2005	0	Pounds	
Pollock	*Pollachius virens*	2005	14,639.98	Pounds	0.31	2005	60.31	Pounds	1.04
Red hake	*Urophycis chuss*	2005	34,530.02	Pounds	0.17	2005	80,032.18	Pounds	0.26
Redfish	*Sebastes fasciatus*	2005	75,882.69	Pounds	0.23	2005	0	Pounds	
Scup	*Stenotomus chrysops*	2005	141,213.74	Pounds	0.81	2005	0	Pounds	
Shortfin squid, northern	*Illex illecebrosus*	2005	13,480.84	Pounds	0.30	2005	2.18	Pounds	1.07
Shortnose sturgeon	*Acipenser brevirostrum*	2005	0	Pounds		2005	0	Pounds	
Silver hake	*Merluccius bilinearis*	2005	47,162.82	Pounds	0.21	2005	8,783.60	Pounds	0.31
Skate complex*	*Rajidae*	2005	11,221,918.11	Pounds	0.11	2005	2,632,370.32	Pounds	0.10
Spiny dogfish	*Squalus acanthias*	2005	5,243,038.55	Pounds	0.16	2005	18,618.92	Pounds	0.34
Summer flounder	*Paralichthys dentatus*	2005	364,571.07	Pounds	0.30	2005	37,656.18	Pounds	0.22
Tilefish	*Lopholatilus chamaeleonticeps*	2005	853.41	Pounds	1.29	2005	0	Pounds	
White hake	*Urophycis tenuis*	2005	15,257.74	Pounds	0.34	2005	4,152.47	Pounds	0.42
Windowpane flounder	*Scophthalmus aquosus*	2005	349,216.03	Pounds	0.29	2005	19,900.04	Pounds	0.40
Winter flounder	*Pseudopleuronectes americanus*	2005	262,080.69	Pounds	0.18	2005	105,790.81	Pounds	0.21
Witch flounder	*Glyptocephalus cynoglossus*	2005	219,872.53	Pounds	0.12	2005	11,115.76	Pounds	0.29

Table 4.1.A (continued)

(continuation of subtable 4.1.A.9)		NEW ENGLAND LARGE-MESH OTTER TRAWL				NEW ENGLAND LIMITED-ACCESS CLOSED AREA SCALLOP DREDGE			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AMOUNT**	**UNIT**	**CV**	**DATA SOURCE**	**AMOUNT**	**UNIT**	**CV**
Yellowtail flounder	*Limanda ferruginea*	2005	550,227.73	Pounds	0.14	2005	272,309.34	Pounds	0.25
TOTAL FISHERY BYCATCH			20,855,976.24	Pounds			5,511,172.21	Pounds	
TOTAL FISHERY LANDINGS			43,557,613.40	Pounds			100,072,621.30	Pounds	
TOTAL CATCH (Bycatch + Landings)			64,413,589.64	Pounds			105,583,793.51	Pounds	
FISHERY BYCATCH RATIO (Bycatch/Total Catch)			0.32				0.05		

Subtable 4.1.A.10		NEW ENGLAND LIMITED-ACCESS OPEN AREA SCALLOP DREDGE				NEW ENGLAND MID-WATER OTTER TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AMOUNT**	**UNIT**	**CV**	**DATA SOURCE**	**AMOUNT**	**UNIT**	**CV**
American plaice	*Hippoglossoides platessoides*	2005	9,564.38	Pounds	0.86	2005	103.64	Pounds	0.37
Atlantic cod	*Gadus morhua*	2005	2,301.72	Pounds	1.01	2005	1,229.70	Pounds	0.49
Atlantic halibut	*Hippoglossus hippoglossus*	2005	13.00	Pounds	1.36	2005	0	Pounds	
Atlantic herring	*Clupea harengus*	2005	0	Pounds		2005	3,485,776.07	Pounds	0.49
Atlantic mackerel	*Scomber scombrus*	2005	160.34	Pounds	1.14	2005	15,514.15	Pounds	0.81
Atlantic salmon	*Salmo salar*	2005	0	Pounds		2005	0	Pounds	
Atlantic sea scallop	*Placopecten magellanicus*	2005	2,421,457.49	Pounds	0.50	2005	0	Pounds	
Atlantic surfclam	*Spisula solidissima*	2005	7,929.20	Pounds	1.36	2005	0	Pounds	
Black sea bass	*Centropristis striata*	2005	0	Pounds		2005	0	Pounds	
Bluefish	*Pomatomus saltatrix*	2005	0	Pounds		2005	1,261.71	Pounds	0.48
Butterfish	*Peprilus triacanthus*	2005	0	Pounds		2005	0	Pounds	
Deep sea red crab	*Chaceon quinquedens*	2005	0	Pounds		2005	0	Pounds	
Haddock	*Melanogrammus aeglefinus*	2005	1,825.18	Pounds	0.94	2005	129,197.10	Pounds	0.51
Longfinned squid	*Loligo pealeii*	2005	106.24	Pounds	0.62	2005	51.49	Pounds	0.58
Monkfish	*Lophius americanus*	2005	636,864.80	Pounds	0.34	2005	542.83	Pounds	0.47
Ocean pout	*Zoarces americanus*	2005	1,012.75	Pounds	0.61	2005	0	Pounds	
Ocean quahog	*Arctica islandica*	2005	703.06	Pounds	0.76	2005	0	Pounds	
Offshore hake	*Merluccius albidus*	2005	0	Pounds		2005	0	Pounds	
Pollock	*Pollachius virens*	2005	0	Pounds		2005	11,367.39	Pounds	0.58
Red hake	*Urophycis chuss*	2005	39,435.60	Pounds	0.59	2005	930.16	Pounds	0.72
Redfish	*Sebastes fasciatus*	2005	0	Pounds		2005	8,513.17	Pounds	0.89
Scup	*Stenotomus chrysops*	2005	85.15	Pounds	0.76	2005	0	Pounds	
Shortfin squid, northern	*Illex illecebrosus*	2005	16.03	Pounds	0.87	2005	2,507.32	Pounds	0.52

Table 4.1.A (continued)

(continuation of subtable 4.1.A.10)		NEW ENGLAND LIMITED-ACCESS OPEN AREA SCALLOP DREDGE				NEW ENGLAND MID-WATER OTTER TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AMOUNT**	**UNIT**	**CV**	**DATA SOURCE**	**AMOUNT**	**UNIT**	**CV**
Shortnose sturgeon	*Acipenser brevirostrum*	2005	0	Pounds		2005	0	Pounds	
Silver hake	*Merluccius bilinearis*	2005	11,088.39	Pounds	0.69	2005	22,304.94	Pounds	0.66
Skate complex*	*Rajidae*	2005	3,821,941.96	Pounds	0.20	2005	37.08	Pounds	0.94
Spiny dogfish	*Squalus acanthias*	2005	12,507.86	Pounds	0.38	2005	427,523.97	Pounds	0.45
Summer flounder	*Paralichthys dentatus*	2005	134,392.08	Pounds	0.43	2005	0	Pounds	
Tilefish	*Lopholatilus chamaeleonticeps*	2005	0	Pounds		2005	0	Pounds	
White hake	*Urophycis tenuis*	2005	1,261.89	Pounds	1.09	2005	971.69	Pounds	0.79
Windowpane flounder	*Scophthalmus aquosus*	2005	238,296.63	Pounds	0.66	2005	0	Pounds	
Winter flounder	*Pseudopleuronectes americanus*	2005	108,473.87	Pounds	0.28	2005	12.87	Pounds	0.81
Witch flounder	*Glyptocephalus cynoglossus*	2005	25,557.86	Pounds	0.72	2005	35.51	Pounds	0.38
Yellowtail flounder	*Limanda ferruginea*	2005	215,999.33	Pounds	0.35	2005	15.02	Pounds	0.90
TOTAL FISHERY BYCATCH			7,690,994.81	Pounds			4,107,895.81	Pounds	
TOTAL FISHERY LANDINGS			66,955,538.32	Pounds			157,559,426.00	Pounds	
TOTAL CATCH (Bycatch + Landings)			74,646,533.13	Pounds			161,667,321.81	Pounds	
FISHERY BYCATCH RATIO (Bycatch/Total Catch)			0.10				0.03		

Subtable 4.1.A.11		NEW ENGLAND PURSE SEINE				NEW ENGLAND SMALL-MESH OTTER TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AMOUNT**	**UNIT**	**CV**	**DATA SOURCE**	**AMOUNT**	**UNIT**	**CV**
American plaice	*Hippoglossoides platessoides*	2005	0	Pounds		2005	75,336.52	Pounds	0.45
Atlantic cod	*Gadus morhua*	2005	0	Pounds		2005	97,527.64	Pounds	0.58
Atlantic halibut	*Hippoglossus hippoglossus*	2005	0	Pounds		2005	1,326.23	Pounds	0.61
Atlantic herring	*Clupea harengus*	2005	2,116,551.85	Pounds	0.62	2005	556,568.37	Pounds	1.03
Atlantic mackerel	*Scomber scombrus*	2005	543.51	Pounds	1.00	2005	2,168,206.15	Pounds	0.57
Atlantic salmon	*Salmo salar*	2005	0	Pounds		2005	0	Pounds	
Atlantic sea scallop	*Placopecten magellanicus*	2005	0	Pounds		2005	7,856.78	Pounds	0.67
Atlantic surfclam	*Spisula solidissima*	2005	0	Pounds		2005	0	Pounds	
Black sea bass	*Centropristis striata*	2005	0	Pounds		2005	3,151.14	Pounds	0.32
Bluefish	*Pomatomus saltatrix*	2005	1,322.06	Pounds	1.11	2005	3,929.07	Pounds	0.40
Butterfish	*Peprilus triacanthus*	2005	0	Pounds		2005	695,470.49	Pounds	0.41
Deep sea red crab	*Chaceon quinquedens*	2005	0	Pounds		2005	49,696.99	Pounds	0.81

Table 4.1.A (continued)

(subtable 4.1.A.11 continued)		NEW ENGLAND PURSE SEINE				NEW ENGLAND SMALL-MESH OTTER TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AMOUNT**	**UNIT**	**CV**	**DATA SOURCE**	**AMOUNT**	**UNIT**	**CV**
Haddock	*Melanogrammus aeglefinus*	2005	0	Pounds		2005	208,029.68	Pounds	0.52
Longfinned squid	*Loligo pealeii*	2005	0	Pounds		2005	681,497.60	Pounds	0.34
Monkfish	*Lophius americanus*	2005	0	Pounds		2005	365,098.00	Pounds	0.18
Ocean pout	*Zoarces americanus*	2005	0	Pounds		2005	59,721.27	Pounds	0.68
Ocean quahog	*Arctica islandica*	2005	0	Pounds		2005	101.81	Pounds	1.52
Offshore hake	*Merluccius albidus*	2005	0	Pounds		2005	0	Pounds	
Pollock	*Pollachius virens*	2005	0	Pounds		2005	0	Pounds	
Red hake	*Urophycis chuss*	2005	0	Pounds		2005	1,317,305.02	Pounds	0.20
Redfish	*Sebastes fasciatus*	2005	0	Pounds		2005	4,012.77	Pounds	0.51
Scup	*Stenotomus chrysops*	2005	0	Pounds		2005	32,584.03	Pounds	0.43
Shortfin squid, northern	*Illex illecebrosus*	2005	0	Pounds		2005	418,777.28	Pounds	0.32
Shortnose sturgeon	*Acipenser brevirostrum*	2005	0	Pounds		2005	0	Pounds	
Silver hake	*Merluccius bilinearis*	2005	0	Pounds		2005	4,058,984.51	Pounds	0.27
Skate complex*	*Rajidae*	2005	29.38	Pounds	1.15	2005	1,553,176.40	Pounds	0.28
Spiny dogfish	*Squalus acanthias*	2005	9,785.14	Pounds	0.47	2005	1,897,558.52	Pounds	0.25
Summer flounder	*Paralichthys dentatus*	2005	0	Pounds		2005	298,536.16	Pounds	0.39
Tilefish	*Lopholatilus chamaeleonticeps*	2005	0	Pounds		2005	53,696.55	Pounds	0.90
White hake	*Urophycis tenuis*	2005	0	Pounds		2005	154,573.28	Pounds	0.85
Windowpane flounder	*Scophthalmus aquosus*	2005	0	Pounds		2005	35,985.42	Pounds	0.53
Winter flounder	*Pseudopleuronectes americanus*	2005	0	Pounds		2005	102,635.52	Pounds	0.47
Witch flounder	*Glyptocephalus cynoglossus*	2005	0	Pounds		2005	116,748.79	Pounds	0.28
Yellowtail flounder	*Limanda ferruginea*	2005	0	Pounds		2005	58,828.96	Pounds	0.42
TOTAL FISHERY BYCATCH			2,128,231.94	Pounds			15,076,920.95	Pounds	
TOTAL FISHERY LANDINGS			36,711,560.00	Pounds			31,812,284.60	Pounds	
TOTAL CATCH (Bycatch + Landings)			38,839,791.94	Pounds			46,889,205.55	Pounds	
FISHERY BYCATCH RATIO (Bycatch/Total Catch)			0.05				0.32		

Table 4.1.A (continued)

Subtable 4.1.A.12

		NEW ENGLAND SHRIMP TRAWL				NEW ENGLAND US/CAN AREA LARGE-MESH OTTER TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AMOUNT**	**UNIT**	**CV**	**DATA SOURCE**	**AMOUNT**	**UNIT**	**CV**
American plaice	*Hippoglossoides platessoides*	2005	39,828.50	Pounds	0.19	2005	82,000.42	Pounds	0.10
Atlantic cod	*Gadus morhua*	2005	5,841.96	Pounds	0.36	2005	583,161.74	Pounds	0.11
Atlantic halibut	*Hippoglossus hippoglossus*	2005	166.44	Pounds	0.95	2005	6,227.96	Pounds	0.12
Atlantic herring	*Clupea harengus*	2005	20,022.44	Pounds	0.33	2005	5,557.39	Pounds	0.24
Atlantic mackerel	*Scomber scombrus*	2005	6,074.97	Pounds	0.55	2005	704.41	Pounds	0.19
Atlantic salmon	*Salmo salar*	2005	0	Pounds		2005	0	Pounds	
Atlantic sea scallop	*Placopecten magellanicus*	2005	216.37	Pounds	0.73	2005	71,215.71	Pounds	0.20
Atlantic surfclam	*Spisula solidissima*	2005	0	Pounds		2005	1,346.96	Pounds	0.29
Black sea bass	*Centropristis striata*	2005	0	Pounds		2005	0	Pounds	
Bluefish	*Pomatomus saltatrix*	2005	0	Pounds		2005	11,984.66	Pounds	0.26
Butterfish	*Peprilus triacanthus*	2005	2,496.56	Pounds	0.59	2005	287.00	Pounds	0.69
Deep sea red crab	*Chaceon quinquedens*	2005	1,671.21	Pounds	1.12	2005	61,888.39	Pounds	0.13
Haddock	*Melanogrammus aeglefinus*	2005	116.51	Pounds	0.56	2005	529,686.87	Pounds	0.11
Longfinned squid	*Loligo pealeii*	2005	0	Pounds		2005	1,378.83	Pounds	0.23
Monkfish	*Lophius americanus*	2005	7,687.26	Pounds	1.02	2005	318,719.47	Pounds	0.07
Ocean pout	*Zoarces americanus*	2005	199.73	Pounds	0.80	2005	95,300.80	Pounds	0.11
Ocean quahog	*Arctica islandica*	2005	0	Pounds		2005	7,514.01	Pounds	0.19
Offshore hake	*Merluccius albidus*	2005	0	Pounds		2005	172.35	Pounds	0.65
Pollock	*Pollachius virens*	2005	249.66	Pounds	0.69	2005	18,152.22	Pounds	0.32
Red hake	*Urophycis chuss*	2005	1,090.08	Pounds	0.55	2005	82,623.28	Pounds	0.22
Redfish	*Sebastes fasciatus*	2005	2,402.22	Pounds	1.07	2005	51,173.16	Pounds	0.14
Scup	*Stenotomus chrysops*	2005	0	Pounds		2005	52.02	Pounds	0.71
Shortfin squid, northern	*Illex illecebrosus*	2005	675.60	Pounds	1.12	2005	2,647.02	Pounds	0.21
Shortnose sturgeon	*Acipenser brevirostrum*	2005	0	Pounds		2005	0	Pounds	
Silver hake	*Merluccius bilinearis*	2005	56,006.41	Pounds	0.27	2005	31,830.08	Pounds	0.24
Skate complex*	*Rajidae*	2005	13,214.84	Pounds	0.19	2005	19,632,726.61	Pounds	0.05
Spiny dogfish	*Squalus acanthias*	2005	66.58	Pounds	0.57	2005	745,185.03	Pounds	0.22
Summer flounder	*Paralichthys dentatus*	2005	0	Pounds		2005	537,739.01	Pounds	0.10
Tilefish	*Lopholatilus chamaeleonticeps*	2005	0	Pounds		2005	0	Pounds	
White hake	*Urophycis tenuis*	2005	2,181.47	Pounds	0.47	2005	12,790.65	Pounds	0.20
Windowpane flounder	*Scophthalmus aquosus*	2005	1,531.23	Pounds	0.31	2005	660,806.53	Pounds	0.10

Table 4.1.A (continued)

(subtable 4.1.A.12 continued)		NEW ENGLAND SHRIMP TRAWL				NEW ENGLAND US/CAN AREA LARGE-MESH OTTER TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AMOUNT**	**UNIT**	**CV**	**DATA SOURCE**	**AMOUNT**	**UNIT**	**CV**
Winter flounder	*Pseudopleuronectes americanus*	2005	28,577.33	Pounds	0.40	2005	29,621.89	Pounds	0.30
Witch flounder	*Glyptocephalus cynoglossus*	2005	7,207.96	Pounds	0.78	2005	78,527.31	Pounds	0.08
Yellowtail flounder	*Limanda ferruginea*	2005	4,593.68	Pounds	0.31	2005	243,356.10	Pounds	0.10
TOTAL FISHERY BYCATCH			202,119.01	Pounds			23,904,377.88	Pounds	
TOTAL FISHERY LANDINGS			4,447,929.00	Pounds			32,685,411.98	Pounds	
TOTAL CATCH (Bycatch + Landings)			4,650,048.01	Pounds			56,589,789.86	Pounds	
FISHERY BYCATCH RATIO (Bycatch/Total Catch)			0.04				0.42		

Subtable 4.1.A.13		NEW ENGLAND US/CAN AREA SMALL-MESH OTTER TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AMOUNT**	**UNIT**	**CV**
American plaice	*Hippoglossoides platessoides*	2005	769.82	Pounds	0.12
Atlantic cod	*Gadus morhua*	2005	3,387.73	Pounds	0.13
Atlantic halibut	*Hippoglossus hippoglossus*	2005	69.60	Pounds	0.14
Atlantic herring	*Clupea harengus*	2005	8.93	Pounds	0.15
Atlantic mackerel	*Scomber scombrus*	2005	5.02	Pounds	0.14
Atlantic salmon	*Salmo salar*	2005	0	Pounds	
Atlantic sea scallop	*Placopecten magellanicus*	2005	41.06	Pounds	0.19
Atlantic surfclam	*Spisula solidissima*	2005	79.62	Pounds	0.18
Black sea bass	*Centropristis striata*	2005	0	Pounds	
Bluefish	*Pomatomus saltatrix*	2005	29.31	Pounds	1.15
Butterfish	*Peprilus triacanthus*	2005	0.06	Pounds	0.18
Deep sea red crab	*Chaceon quinquedens*	2005	272.66	Pounds	0.18
Haddock	*Melanogrammus aeglefinus*	2005	1,194.15	Pounds	0.11
Longfinned squid	*Loligo pealeii*	2005	16.52	Pounds	0.34
Monkfish	*Lophius americanus*	2005	2,062.40	Pounds	0.08
Ocean pout	*Zoarces americanus*	2005	1,057.78	Pounds	0.09
Ocean quahog	*Arctica islandica*	2005	2.52	Pounds	0.16
Offshore hake	*Merluccius albidus*	2005	0	Pounds	
Pollock	*Pollachius virens*	2005	219.39	Pounds	0.40
Red hake	*Urophycis chuss*	2005	612.03	Pounds	0.53
Redfish	*Sebastes fasciatus*	2005	78.68	Pounds	0.14

Table 4.1.A (continued)

(subtable 4.1.A.13 continued)		NEW ENGLAND US/CAN AREA SMALL-MESH OTTER TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AMOUNT**	**UNIT**	**CV**
Scup	*Stenotomus chrysops*	2005	0.04	Pounds	0.29
Shortfin squid, northern	*Illex illecebrosus*	2005	9.36	Pounds	0.17
Shortnose sturgeon	*Acipenser brevirostrum*	2005	0	Pounds	
Silver hake	*Merluccius bilinearis*	2005	336.76	Pounds	0.40
Skate complex*	*Rajidae*	2005	133,817.52	Pounds	0.06
Spiny dogfish	*Squalus acanthias*	2005	12,375.92	Pounds	0.69
Summer flounder	*Paralichthys dentatus*	2005	3,409.43	Pounds	0.14
Tilefish	*Lopholatilus chamaeleonticeps*	2005	2.61	Pounds	0.42
White hake	*Urophycis tenuis*	2005	123.81	Pounds	0.15
Windowpane flounder	*Scophthalmus aquosus*	2005	6,445.28	Pounds	0.15
Winter flounder	*Pseudopleuronectes americanus*	2005	506.65	Pounds	0.12
Witch flounder	*Glyptocephalus cynoglossus*	2005	1,006.26	Pounds	0.13
Yellowtail flounder	*Limanda ferruginea*	2005	3,300.53	Pounds	0.12
TOTAL FISHERY BYCATCH			171,241.45	Pounds	
TOTAL FISHERY LANDINGS			260,788.84	Pounds	
TOTAL CATCH (Bycatch + Landings)			432,030.29	Pounds	
FISHERY BYCATCH RATIO (Bycatch/Total Catch)			0.40		

Table 4.1.B

Summary of 2005 total bycatch estimates by species for Northeast Region fisheries. All estimates are live weights. Species bycatch ratio = total regional bycatch of a species / (total regional landings of the species + total regional bycatch of the species); see Section 3 for details on ratio calculation. Confidential landings are not presented. Key stocks have been highlighted.

		TOTAL STOCK BYCATCH		TOTAL SPECIES BYCATCH		SPECIES LANDINGS*		SPECIES BYCATCH RATIO
COMMON NAME	SCIENTIFIC NAME	AMOUNT	UNIT	AMOUNT	UNIT	2005 SPECIES LANDINGS	UNIT	RATIO
American plaice	*Hippoglossoides platessoides*	No stock bycatch estimates: all Northeast Region bycatch estimates are provided at the species level.		666,548.63	Pounds	2,975,805	Pounds	0.18
Atlantic cod	*Gadus morhua*			1,920,182.60	Pounds	13,912,261	Pounds	0.12
Atlantic halibut	*Hippoglossus hippoglossus*			30,266.19	Pounds	37,057	Pounds	0.45
Atlantic herring	*Clupea harengus*			7,236,966.58	Pounds	213,381,830	Pounds	0.03
Atlantic mackerel	*Scomber scombrus*			3,462,970.05	Pounds	93,054,471	Pounds	0.04
Atlantic salmon	*Salmo salar*			0	Pounds	–	–	±
Atlantic sea scallop	*Placopecten magellanicus*			12,988,509.88	Pounds	470,795,573	Pounds	0.03
Atlantic surfclam	*Spisula solidissima*			47,261.48	Pounds	310,553,295	Pounds	< 0.01
Black sea bass	*Centropristis striata*			187,549.92	Pounds	2,489,824	Pounds	0.07
Bluefish	*Pomatomus saltatrix*			182,897.23	Pounds	4,084,963	Pounds	0.04
Butterfish	*Peprilus triacanthus*			2,172,528.82	Pounds	963,652	Pounds	0.69
Deep sea red crab	*Chaceon quinquedens*			226,454.03	Pounds	–	–	‡
Haddock	*Melanogrammus aeglefinus*			1,189,821.62	Pounds	16,714,062	Pounds	0.07
Longfinned squid	*Loligo pealeii*			1,998,671.05	Pounds	37,405,115	Pounds	0.05
Monkfish	*Lophius americanus*			9,099,925.45	Pounds	41,857,436	Pounds	0.18
Ocean pout	*Zoarces americanus*			346,480.99	Pounds	7,962	Pounds	0.98
Ocean quahog	*Arctica islandica*			144,348.44	Pounds	250,868,896	Pounds	<0.01
Offshore hake	*Merluccius albidus*			21,250.42	Pounds	29,816	Pounds	0.42
Pollock	*Pollachius virens*			156,011.40	Pounds	14,350,792	Pounds	0.01
Red hake	*Urophycis chuss*			3,371,082.10	Pounds	947,175	Pounds	0.78
Redfish	*Sebastes fasciatus*			185,665.91	Pounds	1,243,269	Pounds	0.13
Scup	*Stenotomus chrysops*			1,206,906.98	Pounds	9,305,230	Pounds	0.11
Shortfin squid, northern	*Illex illecebrosus*			3,507,309.73	Pounds	24,435,237	Pounds	0.13
Shortnose sturgeon	*Acipenser brevirostrum*			0	Pounds	0	Pounds	±

Table 4.1.B (continued)

		TOTAL STOCK BYCATCH		TOTAL SPECIES BYCATCH		SPECIES LANDINGS*		SPECIES BYCATCH RATIO
COMMON NAME	SCIENTIFIC NAME	AMOUNT	UNIT	AMOUNT	UNIT	2005 SPECIES LANDINGS	UNIT	RATIO
Silver hake	*Merluccius bilinearis*	No stock bycatch estimates: all Northeast Region bycatch estimates are provided at the species level.		6,082,546.55	Pounds	16,530,387	Pounds	0.27
Skate complex	*Rajidae*			79,561,301.04	Pounds	--	--	**
Spiny dogfish	*Squalus acanthias*			21,471,238.99	Pounds	2,484,182	Pounds	0.90
Summer flounder	*Paralichthys dentatus*			3,250,189.36	Pounds	13,193,821	Pounds	0.20
Tilefish	*Lopholatilus chamaeleonticeps*			66,885.93	Pounds	1,486,993	Pounds	0.04
White hake	*Urophycis tenuis*			306,679.69	Pounds	5,886,827	Pounds	0.05
Windowpane flounder	*Scophthalmus aquosus*			1,864,498.60	Pounds	195,173	Pounds	0.91
Winter flounder	*Pseudopleuronectes americanus*			790,595.33	Pounds	8,084,186	Pounds	0.09
Witch flounder	*Glyptocephalus cynoglossus*			633,893.41	Pounds	5,845,971	Pounds	0.10
Yellowtail flounder	*Limanda ferruginea*			1,510,504.79	Pounds	9,077,978	Pounds	0.14
TOTAL BYCATCH				165,887,943.22	Pounds			

* Landed weights are only for catch sold.
± Retention of Atlantic salmon and shortnose sturgeon are prohibited under the ESA.
‡ Deep sea red crab landings are confidential.
**Landings are not reported because this is a species complex. The U.S. National Bycatch Report does not use landings for complexes since species in the bycatch complex may be different than species in the landings complex, even though the complex name is the same.

Table 4.1.C
Subtables of marine mammal bycatch estimates and associated coefficients of variation (CVs) for Northeast Region fisheries. Bycatch estimates include incidental mortality and serious injury. Key stocks/populations are highlighted. Where multiple years of data are indicated, the estimate is an annual average.

Subtable 4.1.C.1

		MID-ATLANTIC GILLNET FISHERIES			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AVERAGE NUMBER**	**UNIT**	**CV**
Bottlenose dolphin, W. N. Atl. coastal stock	*Tursiops truncatus*	2001–05	61	Individuals	0.15
Harbor porpoise — Gulf of Maine/Bay of Fundy	*Phocoena phocoena*	2001–05	177	Individuals	0.40
TOTAL FISHERY BYCATCH			238	Individuals	

Subtable 4.1.C.2

		MID-ATLANTIC MID-WATER OTTER TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AVERAGE NUMBER**	**UNIT**	**CV**
Atlantic white-sided dolphin — W. N. Atl.	*Lagenorhynchus acutus*	2001–05	84	Individuals	0.34
Pilot whale (long- and/or short-finned)	*Globicephala spp.*	2001–05	7	Individuals	0.34
TOTAL FISHERY BYCATCH			91	Individuals	

Subtable 4.1.C.3

		MID-ATLANTIC OTTER TRAWL FISHERIES			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AVERAGE NUMBER**	**UNIT**	**CV**
Atlantic white-sided dolphin — W. N. Atl.	*Lagenorhynchus acutus*	2001–05	29	Individuals	0.11
Common dolphin, short beaked — W. N. Atl.	*Delphinus delphis*	2001–05	118	Individuals	0.13
Pilot whale (long- and/or short-finned)	*Globicephala* spp.	2001–05	38	Individuals	0.15
TOTAL FISHERY BYCATCH			182	Individuals	

Subtable 4.1.C.4

		MID-ATLANTIC SCALLOP DREDGE			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AVERAGE NUMBER**	**UNIT**	**CV**
All marine mammal species	–	2001–05	0	Individuals	
TOTAL FISHERY BYCATCH			0	Individuals	

Table 4.1.C (continued)

Subtable 4.1.C.5 — MID-ATLANTIC SCALLOP TRAWL

COMMON NAME	SCIENTIFIC NAME	DATA SOURCE	AVERAGE NUMBER	UNIT	CV
All marine mammal species	–	2001–05	0	Individuals	
TOTAL FISHERY BYCATCH			0	Individuals	

Subtable 4.1.C.6 — NEW ENGLAND BOTTOM LONGLINE

COMMON NAME	SCIENTIFIC NAME	DATA SOURCE	AVERAGE NUMBER	UNIT	CV
All marine mammal species	–	2001–05	0	Individuals	
TOTAL FISHERY BYCATCH			0	Individuals	

Subtable 4.1.C.7 — NEW ENGLAND HAND LINE

COMMON NAME	SCIENTIFIC NAME	DATA SOURCE	AVERAGE NUMBER	UNIT	CV
All marine mammal species	–	2001–05	0	Individuals	
TOTAL FISHERY BYCATCH			0	Individuals	

Subtable 4.1.C.8 — NEW ENGLAND GILLNET FISHERIES

COMMON NAME	SCIENTIFIC NAME	DATA SOURCE	AVERAGE NUMBER	UNIT	CV
Atlantic white-sided dolphin — W. N. Atl.	*Lagenorhynchus acutus*	2001–05	31	Individuals	0.35
Common dolphin, short beaked — W. N. Atl.	*Delphinus delphis*	2001–05	5	Individuals	0.80
Harbor porpoise — Gulf of Maine/Bay of Fundy	*Phocoena phocoena*	2001–05	475	Individuals	0.16
Risso's dolphin – W. N. Atl.	*Grampus griseus*	2001–05	3	Individuals	0.93
TOTAL FISHERY BYCATCH			514	Individuals	

Subtable 4.1.C.9 — NEW ENGLAND MID-WATER OTTER TRAWL

COMMON NAME	SCIENTIFIC NAME	DATA SOURCE	AVERAGE NUMBER	UNIT	CV
Atlantic white-sided dolphin — W. N. Atl.	*Lagenorhynchus acutus*	2001–05	19	Individuals	0.35
Pilot whale (long- and/or short-finned)	*Globicephala* spp.	2001–05	1	Individuals	0.35
TOTAL FISHERY BYCATCH			20	Individuals	

Table 4.1.C (continued)

Subtable 4.1.C.10		NEW ENGLAND OTTER TRAWL FISHERIES			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AVERAGE NUMBER**	**UNIT**	**CV**
Atlantic white-sided dolphin — W. N. Atl.	*Lagenorhynchus acutus*	2001–05	192	Individuals	0.13
Common dolphin, short beaked — W. N. Atl.	*Delphinus delphis*	2001–05	28	Individuals	0.13
Pilot whale (long- and/or short-finned)	*Globicephala* spp.	2001–05	19	Individuals	0.12
TOTAL FISHERY BYCATCH			239	Individuals	

Subtable 4.1.C.11		NEW ENGLAND PURSE SEINE			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AVERAGE NUMBER**	**UNIT**	**CV**
All marine mammal species	–	2001–05	0	Individuals	
TOTAL FISHERY BYCATCH			0	Individuals	

Subtable 4.1.C.12		NEW ENGLAND SCALLOP DREDGE			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AVERAGE NUMBER**	**UNIT**	**CV**
All marine mammal species	–	2001–05	0	Individuals	
TOTAL FISHERY BYCATCH			0	Individuals	

Subtable 4.1.C.13		NEW ENGLAND SHRIMP TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AVERAGE NUMBER**	**UNIT**	**CV**
All marine mammal species	–	2001–05	0	Individuals	
TOTAL FISHERY BYCATCH			0	Individuals	

Table 4.1.C (continued)

Subtable 4.1.C.14 (SUMMARY)		**TOTAL SPECIES BYCATCH**	
COMMON NAME	**SCIENTIFIC NAME**	**NUMBER**	**UNIT**
Atlantic white-sided dolphin — W. N. Atl.	*Lagenorhynchus acutus*	355	Individuals
Bottlenose dolphin — W. N. Atl. coastal stock	*Tursiops truncatus*	61	Individuals
Common dolphin, short beaked — W. N. Atl.	*Delphinus delphis*	151	Individuals
Harbor porpoise — Gulf of Maine/Bay of Fundy	*Phocoena phocoena*	652	Individuals
Pilot whale (long-and/or short-finned)	*Globicephala spp.*	65	Individuals
Risso's dolphin — W. N. Atl.	*Grampus griseus*	3	Individuals
TOTAL FISHERY BYCATCH		1,287	Individuals

Table 4.1.D
Subtables of sea turtle bycatch estimates (mortalities and individuals released alive) and associated coefficients of variation (CVs, where available), for Northeast Region fisheries. Key stocks/populations are highlighted. Where multiple years of data are indicated, the estimate is an annual average. Source: Murray (2004a, 2004b, 2005, 2007).

Subtable 4.1.D.1		MID-ATLANTIC MID-WATER OTTER TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AVERAGE NUMBER**	**UNIT**	**CV**
All sea turtle species		2001–05	0	Individuals	
TOTAL FISHERY BYCATCH			0	Individuals	

Subtable 4.1.D.2		MID-ATLANTIC OTTER TRAWL FISHERIES			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AVERAGE NUMBER**	**UNIT**	**CV**
Loggerhead sea turtle	*Caretta caretta*	1996–2004	616	Individuals	0.23
TOTAL FISHERY BYCATCH			616	Individuals	

Subtable 4.1.D.3		MID-ATLANTIC SCALLOP DREDGE FISHERIES			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AVERAGE NUMBER**	**UNIT**	**CV**
Loggerhead sea turtle	*Caretta caretta*	2003–05	310	Individuals	
TOTAL FISHERY BYCATCH			310	Individuals	

Subtable 4.1.D.4		MID-ATLANTIC SCALLOP TRAWL FISHERIES			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AVERAGE NUMBER**	**UNIT**	**CV**
Loggerhead sea turtle	*Caretta caretta*	2004–05	136	Individuals	
TOTAL FISHERY BYCATCH			136	Individuals	

Subtable 4.1.D.5		NEW ENGLAND BOTTOM LONGLINE			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AVERAGE NUMBER**	**UNIT**	**CV**
All sea turtle species		2001–05	0	Individuals	
TOTAL FISHERY BYCATCH			0	Individuals	

Table 4.1.D (continued)

Subtable 4.1.D.6		NEW ENGLAND GILLNET			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AVERAGE NUMBER**	**UNIT**	**CV**
All sea turtle species		2001–05	0	Individuals	
TOTAL FISHERY BYCATCH			0	Individuals	

Subtable 4.1.D.7		NEW ENGLAND MIDWATER OTTER TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AVERAGE NUMBER**	**UNIT**	**CV**
All sea turtle species		2001–05	0	Individuals	
TOTAL FISHERY BYCATCH			0	Individuals	

Subtable 4.1.D.8		NEW ENGLAND OTTER TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AVERAGE NUMBER**	**UNIT**	**CV**
All sea turtle species		2001–05	0	Individuals	
TOTAL FISHERY BYCATCH			0	Individuals	

Subtable 4.1.D.9		NEW ENGLAND SCALLOP DREDGE			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AVERAGE NUMBER**	**UNIT**	**CV**
All sea turtle species		2001–05	0	Individuals	
TOTAL FISHERY BYCATCH			0	Individuals	

Subtable 4.1.D.10 (SUMMARY)		TOTAL SPECIES BYCATCH	
COMMON NAME	**SCIENTIFIC NAME**	**NUMBER**	**UNIT**
Loggerhead sea turtle	*Caretta caretta*	1,062	Individuals

4.2 Southeast Region

The NMFS Southeast Region includes eight coastal states (North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, and Texas) that border the northwestern Atlantic Ocean and Gulf of Mexico. The Commonwealth of Puerto Rico and the territory of the U.S. Virgin Islands are also included within the Southeast Region's management jurisdiction. Three Large Marine Ecosystems (LMEs) occur within this region.[1] The Southeast U.S. Continental Shelf LME, which extends from Cape Hatteras, North Carolina, to the Straits of Florida, is wholly contained within the region, as are portions of the Caribbean Sea LME and the Gulf of Mexico LME. The South Atlantic, Gulf of Mexico, and Caribbean Fishery Management Councils, in conjunction with the NMFS, are responsible for managing fisheries in the Southeast Region. The wealth and variety of habitats contained within these ecosystems support a variety of marine species, from wide-ranging pelagics to coral reef communities.

4.2.1 Fisheries Overview

A total of 48 commercial fisheries are included in this report for the Southeast Region (Table 4.2.1). Landings for these fisheries were valued at approximately $756 million dollars in 2005.[2] Fisheries of the Southeast reflect the very diverse fauna of the region, with relatively few large fisheries, and many small fisheries. The region's fisheries have catches from more than 200 stocks of fish and fishery resources, and employ a variety of gear types. Two fisheries dominate economically: the menhaden purse seine fishery and the shrimp trawl fishery. While the menhaden purse seine fishery produces the most landings (annual landings approach two million tons), the shrimp trawl fishery generates the most revenue regionally. In some years, the Southeast shrimp trawl fishery is the most valuable fishery in the nation.

Management of Southeast Region fisheries is split between the Federal government and the states, with 44% managed at the Federal level and 52% at the state level (Figure 4.2.1). Only the North Carolina coastal gillnet, Southeastern Atlantic stone crab trap/pot, and Florida portion of the Florida, Puerto Rico, and U.S. Virgin Islands spiny lobster trap/pot fishery have shared Federal/state management.

Four primary regional fishery management councils have Federal FMPs in the Southeast Region: the Mid-Atlantic Fishery Management Council (MAFMC), South Atlantic Fisheries Management Council (SAFMC), Gulf of Mexico Fisheries Management Council (GMFMC), and the Caribbean Fisheries Management Council (CFMC).

[1] http://www.lme.noaa.gov/.

[2] Ex-vessel landings value, NMFS, Fisheries Economics of the U.S., 2006. Available online at http://www.st.nmfs.noaa.gov/st5/publication/fisheries_economics_2006.html.

The MAFMC FMPs are primarily focused on managing fish stocks within the U.S. EEZ waters of the northwest Atlantic Ocean. Mid-Atlantic states include Connecticut, New York, New Jersey, Delaware, Maryland, and Virginia. Most MAFMC FMPs are for fisheries managed by the Northeast Region, although some Southeast Region Federal fisheries in North Carolina are also managed under MAFMC regulations (e.g., flounder trawls).

The SAFMC manages stocks targeted by fisheries in the EEZ off North Carolina, South Carolina, Georgia, and Florida, from east Florida to Key West. In some cases, the SAFMC shares management with the Mid-Atlantic and New England Fishery Management Councils. The SAFMC currently develops regulations under eight FMPs:

- Coastal Migratory Pelagic Resources of the Gulf of Mexico and South Atlantic
- Dolphin and Wahoo Fishery of the Atlantic
- Golden Crab Fishery of the South Atlantic Region
- Shrimp Fishery of the South Atlantic Region
- Snapper–Grouper Fishery of the South Atlantic Region
- Spiny Lobster in the Gulf of Mexico and South Atlantic
- Coral, Coral Reefs, and Live/Hard Bottom Habitats of the South Atlantic Region
- Pelagic Sargassum Habitat of the South Atlantic Region (Note: management of red drum (*Sciaenops ocellatus*) has been transferred to the states.)

The Coastal Migratory Pelagic Resources and Spiny Lobster FMPs are joint efforts of the GMFMC and SAFMC. The GMFMC manages stocks targeted by fisheries in the Federal waters off Texas, Louisiana, Mississippi, Alabama, and the west coast of Florida. In addition to the two joint SAFMC/GMFMC FMPs, the GMFMC currently has five other FMPs under its jurisdiction:

- Reef Fish Resources of the Gulf of Mexico
- Shrimp Fishery of the Gulf of Mexico
- Stone Crab Fishery of the Gulf of Mexico
- Red Drum Fishery of the Gulf of Mexico
- Coral and Coral Reefs of the Gulf of Mexico

The CFMC is responsible for developing FMPs for fish stocks in the Federal waters surrounding Puerto Rico and the U.S. Virgin Islands. Currently, there are four FMPs in place:

- Shallow Water Reef Fish Fishery of Puerto Rico and the U.S. Virgin Islands
- Spiny Lobster Fishery of Puerto Rico and U.S. Virgin Islands
- Corals and Reef-Associated Plants and Invertebrates
- Queen Conch Resources of Puerto Rico and the U.S. Virgin Islands

As discussed in Section 4.1 on the Northeast Region, U.S. Atlantic fisheries, tuna, swordfish, and billfish are managed by NMFS under the authority of the ATCA and the MSA. In the Southeast Region, the Atlantic and Gulf of Mexico HMS pelagic longline, large coastal and small coastal shark aggregates (drift, strike, and bottom gillnet), and the southeastern Atlantic and Gulf of Mexico shark bottom longline fisheries are managed under the Consolidated Atlantic Highly Migratory Species FMP and monitored by both the NMFS, HMS Division, and the Southeast Fisheries Science Center (SEFSC).

Southeast Region NMFS staff also work with the ASMFC, a deliberative body representing the 15 Atlantic coastal states; the Gulf States Marine Fisheries Commission (GSMFC; a body representing the five Gulf of Mexico states); and state government agencies to coordinate the management of transboundary species. Four member states of the ASMFC border Federal waters of the Southeast Region: North Carolina, South Carolina, Georgia, and Florida. The five GSMFC states, bordering Federal waters of the Southeast Region, are Texas, Louisiana, Mississippi, Alabama, and Florida. Both the ASMFC and the GSMFC also coordinate the Regional state data-collection networks: the Atlantic Coastal Cooperative Statistics Program (ACCSP) on the Atlantic coast, and the Gulf of Mexico Fisheries Information Network (GulfFIN) in the Gulf region.

Table 4.2.1
Southeast Region fisheries included in the U.S. National Bycatch Report. Fisheries are listed alphabetically, first by management authority and then by fishery name. Rows containing fisheries for which bycatch estimates are included in this report are shaded.

Fishery[a]	Management Authority	Federal Fishery Management Plan (FMP)[b]	Gear Type	Target Species (Common Name)	Data Sources[c]
Caribbean Gillnet	Federal	Shallow Water Reef Fish Fishery of Puerto Rico and the U.S. Virgin Islands	Gillnet	Parrotfish, reef fish	
Caribbean Mixed Species Trap/Pot	Federal	Shallow Water Reef Fish Fishery of Puerto Rico and the U.S. Virgin Islands	Pots and traps, other	Caribbean spiny lobster, red snapper, reef fish	
Caribbean Spiny Lobster Trap/Pot	Federal	Spiny Lobster Fishery of Puerto Rico and the U.S. Virgin Islands (CFMC)	Pots and traps, lobster	Caribbean spiny lobster, reef fish	
Florida, Puerto Rico, and the U.S. Virgin Islands Spiny Lobster Trap/Pot Fishery	Federal/state [d]	Spiny Lobster in the Gulf of Mexico and South Atlantic (GMFMC/SAFMC)	Pots and traps, lobster	Caribbean spiny lobster	
Gulf of Mexico Coastal Migratory Pelagic Gillnet	Federal	Coastal Migratory Pelagic Resources of the Gulf of Mexico and South Atlantic (GMFMC, SAFMC)	Gillnet (floating)	Cobia, king mackerel, Spanish mackerel	
Gulf of Mexico Coastal Migratory Pelagic Troll	Federal	Coastal Migratory Pelagic Resources of the Gulf of Mexico and South Atlantic (GMFMC, SAFMC)	Troll lines	Cobia, king mackerel, Spanish mackerel	Logbook
Gulf of Mexico Reef Fish Bottom Longline	Federal	Reef Fish Resources of the Gulf of Mexico	Longline (bottom)	Red grouper, gag grouper, scamp, tilefish	Logbook, observer data

Table 4.2.1 (continued)

Fishery[a]	Management Authority	Federal Fishery Management Plan (FMP)[b]	Gear Type	Target Species (Common Name)	Data Sources[c]
Gulf of Mexico Reef Fish Handline	Federal	Reef Fish Resources of the Gulf of Mexico	Hand line	Red grouper, red snapper, vermilion snapper	Logbook, observer data
Gulf of Mexico Shrimp Trawl	Federal	Shrimp Fishery of the Gulf of Mexico (GMFMC)	Otter trawl	Brown shrimp, pink shrimp, white shrimp	Observer data, stock assessment or publication
Large Coastal and Small Coastal Shark Aggregates (Drift, Strike, and Bottom Gillnet)	Federal	Consolidated Atlantic Highly Migratory Species	Gillnet	Atlantic sharpnose shark, blacktip shark, bonnethead shark, sandbar shark	Logbook, observer data, stock assessment or publication
South Atlantic Coastal Migratory Pelagic Troll	Federal	Coastal Migratory Species	Troll lines	Cobia, dolphinfish, king mackerel, Spanish mackerel, wahoo	Logbook
South Atlantic Snapper–Grouper Bottom Longline	Federal	Snapper–Grouper Fishery of the South Atlantic Region	Longline (bottom)	Tilefish, snowy grouper	Logbook
South Atlantic Snapper–Grouper Handline/ Electric Reel	Federal	Snapper–Grouper Fishery of the South Atlantic Region	Hand line, electric reel	Black sea bass, gag grouper, gray triggerfish, red snapper, scamp, yellowtail snapper, vermilion snapper, white grunt	Logbook, observer data
Southeast, Atlantic, Black Sea Bass Pot	Federal	Snapper–Grouper Fishery of the South Atlantic Region	Pots and traps (black sea bass)	Black sea bass	
Southeastern, Atlantic and Gulf of Mexico HMS Pelagic Longline	Federal	Consolidated Atlantic Highly Migratory Species	Longline (surface)	Bigeye tuna, swordfish, yellowfin tuna	Logbook, observer data
Southeastern, Atlantic and Gulf of Mexico Shark Bottom Longline	Federal	Consolidated Atlantic Highly Migratory Species	Longline (bottom)	Sandbar shark, blacktip shark, other sharks	Logbook, observer data, regional database[e]
Southeastern, Atlantic Shrimp Trawl	Federal	Shrimp Fishery of the South Atlantic Region (SAFMC)	Otter trawl	Brown shrimp, pink shrimp, white shrimp	Stock assessment or publication, observer data
Southeastern, Atlantic, Golden Crab Trap/Pot	Federal	Golden Crab Fishery of the South Atlantic Region	Pots and traps (golden crab)	Deep-sea golden crab	
Spearfishing for Tuna	Federal	Consolidated Atlantic Highly Migratory Species	Spears	Bigeye, albacore, yellowfin, and skipjack tunas	
Winter Fluke (Flounder) Trawls	Federal	Northeast Multispecies	Otter trawl (bottom), other trawls	Flounder	
North Carolina Coastal Gillnet	Federal, state		Gillnet	Striped bass, monkfish, spot, croaker, weakfish, mackerel	Observer data (2006 only)

Table 4.2.1 (continued)

Fishery[a]	Management Authority	Federal Fishery Management Plan (FMP)[b]	Gear Type	Target Species (Common Name)	Data Sources[c]
Southeastern, Atlantic Stone Crab Trap/Pot	Federal, state	Stone Crab Fishery of the Gulf of Mexico	Pots and traps (stone crab)	Florida stone crab	
Caribbean Haul/ Beach Seine	State		Haul seines	Reef fish	
Florida West Coast Sardine Purse Seine	State		Purse seine, tarp seine	Sardine	
Gulf of Mexico Blue Crab	State		Pots and traps (blue crab)	Blue crab	
Gulf of Mexico Coastal Gillnet	State		Gillnet	King mackerel, Spanish mackerel	Observer data (starting in 2006)
Gulf of Mexico Haul/ Beach Seine	State		Haul seines, other seines	Striped mullet	
Gulf of Mexico Marine Shrimp Butterfly Nets	State		Butterfly nets	Brown shrimp, pink shrimp, white shrimp	Observer data (historic)
Gulf of Mexico Marine Shrimp Skimmer Trawls	State		Trawl (skimmer)	Brown shrimp, pink shrimp, white shrimp	Observer data (historic)
Gulf of Mexico Menhaden Purse Seine	State		Purse seine	Atlantic menhaden	Observer data (historic)
Gulf of Mexico Oyster	State		Dredge, tongs	Eastern oyster	
Gulf of Mexico Shrimp Cast Net	State		Cast nets	Brown shrimp, pink shrimp, white shrimp	
North Carolina Haul/ Beach Seine–Long Haul	State		Haul seine	Atlantic croaker, spot, weakfish	
North Carolina Inshore (Bays and Rivers) Gillnet	State		Gillnet	Striped bass, spot, Atlantic croaker, bluefish, weakfish	Observer data
North Carolina Pound Net (Croaker, Weakfish)	State		Pound net	Atlantic croaker, weakfish	
North Carolina Southern Flounder Pound Net	State		Pound Net	Southern flounder	
North Carolina Stop Nets	State		Stop net	Striped mullet	
South Atlantic Blue Crab	State		Pots and traps (blue crab)	Blue crab	
South Atlantic Coastal Gillnet	State		Gillnet	Atlantic croaker, bluefish, king mackerel, Spanish mackerel, southern kingfish	Logbook, observer data (starting in 2006)

Table 4.2.1 (continued)

Fishery[a]	Management Authority	Federal Fishery Management Plan (FMP)[b]	Gear Type	Target Species (Common Name)	Data Sources[c]
Southeast Calico Scallop Trawl	State		Trawl	Calico scallop	
Southeast Fish Trawl	State		Otter trawl (bottom fish)	Butterfish, squid	
Southeastern, Atlantic, Haul/Beach Seine	State		Haul seine	Brown shrimp, pink shrimp, white shrimp	
Southeastern, Atlantic Marine Shrimp Butterfly Nets	State		Butterfly net	Brown shrimp, pink shrimp, white shrimp	
Southeastern, Atlantic Marine Shrimp Cast Net	State		Cast net	Brown shrimp, pink shrimp, white shrimp	
Southeastern, Atlantic Menhaden	State		Purse seine	Atlantic menhaden	
Southeastern, Atlantic Ocean, Gulf of Mexico, Caribbean Shellfish Dive, Hand/Mechanical Collection	State		Hand, diving gear	Clams, oysters, spiny lobster	
Southeastern, Atlantic Skimmer Trawls	State		Trawl (skimmer)	Brown shrimp, pink shrimp, white shrimp	
Surface Trawl Jellyfish	State		Otter trawl (mid-water)	Jellyfish	

[a] Aquaculture fisheries are listed for consistency with the Marine Mammal Protection Act List of Fisheries when they occur, but were not analyzed for the U.S. National Bycatch Report. Recreational fisheries are not included in this report.

[b] FMPs with the same name are differentiated by managing council. CFMC = Caribbean Fisheries Management Council; GMFMC = Gulf of Mexico Fisheries Management Council; MAFMC = Mid-Atlantic Fisheries Management Council; SAFMC = South Atlantic Fisheries Management Council. Note that non-Federal FMPs were not identified through this process.

[c] Data sources were evaluated only for Federal fisheries and non-Federal fisheries with Federal data-collection programs.

[d] Management authority is shared with the State for the Florida for the Florida portion of the fishery. In areas other than Florida, NMFS maintains independent management of spiny lobsters in Federal waters.

[e] Southeast Regional Office (SERO) permits database.

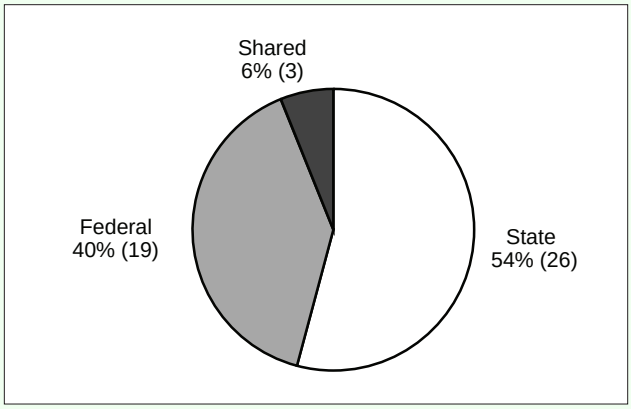


Figure 4.2.1.
Management jurisdiction for Southeast Region fisheries (percentages are based on numbers of fisheries, not volume or revenue). “Shared” indicates that international, Federal, state, and/or tribal authorities share management.

4.2.2 Addressing Regional Bycatch Concerns

The NMFS Southeast Region staff work closely with regional fisheries management agencies (state fishery management agencies, interstate marine fisheries commissions, fisheries monument councils, etc.). These partnerships have been central to addressing bycatch concerns in Southeast Region fisheries. This section discusses bycatch management measures implemented under regional FMPs.

Coastal Gillnet Fisheries

Bycatch of bottlenose dolphins (*Tursiops truncatus*) is known to occur in several Mid-Atlantic fisheries. In 2006, a final Bottlenose Dolphin Take Reduction Plan (BDTRP) was established under the MMPA. The plan includes recommendations to increase observer coverage, especially in North Carolina. Mid-Atlantic coastal gillnet fisheries, including in North Carolina and Virginia, have been observed by the Northeast Regional observer program consistently since 1996, at a low level (1–5% coverage). In 2006, the Southeast provided funds for Northeast observer programs to observe for an additional 117 sea days, in order to improve estimates of bottlenose dolphin serious injury and mortality in Mid-Atlantic coastal gillnet fisheries. An alternative platform program was also implemented in North Carolina to further augment observer coverage and improve the precision and accuracy of mortality and serious injury estimates. Both historical observer coverage and additional alternative platform data are used to develop bycatch estimates for marine mammals and to evaluate the success of the BDTRP. Sea turtle bycatch also occurs in coastal gillnet fisheries, both inshore (bays and sounds) and in coastal waters outside of the Outer Banks. A series of ESA Section 10 permits for the Pamlico Sound flounder gillnet fishery have been issued since 2000 addressing sea turtle bycatch through time and area closures, observer requirements, and gear restrictions. North Carolina Division of Marine Fisheries is initiating the application process for a Section 10 permit for all of its state gillnet fisheries as a result of observer coverage showing substantial takes in other inshore large-mesh gillnet fisheries.

Coastal Migratory Species

Southeast coastal migratory stocks were virtually unregulated prior to the 1980s. Technological advances, including the use of airplanes to locate schooling species, increased the industry's ability to harvest stocks to such a degree that harvest by all sectors exceeded capacity, leading to overfishing. Beginning in the mid-1980s, Federal regulations were implemented to control harvest and rebuild stocks. Coastal pelagics are co-managed under the Coastal Migratory Pelagic Resources FMP and regulations adopted by the SAFMC and GMFMC. Today, fisheries targeting coastal pelagic species, primarily mackerels, as well as dolphinfish (*Coryphaena hippurus*) and wahoo (*Acanthocybium solanderi*) are managed by quotas to contain harvest. For example, results from the most recent assessment for king mackerel (*Scomberomorus cavalla*) and Spanish mackerel (*Scomberomorus maculatus*) indicate stocks are not overfished and overfishing is not occurring. Incidental harvest is minimal and often marketable in the commercial sector. Release mortality is low for regulatory discards.

Gulf of Mexico Reef Fish

The commercial reef fish fishery in the Gulf of Mexico is another important Southeast Region fishery. Several hundred participating vessels target valuable red snapper (*Lutjanus campechanus*) and other reef fish species. The GMFMC and NMFS took action in Amendment 18A to the Reef Fish FMP (effective 8 September 2006) to comply with a 2005 ESA Biological Opinion (BiOp) requirement that any sea turtle or smalltooth sawfish taken in the reef fish fishery is handled to minimize stress to the animal and increase its survival probability. Regulations were implemented requiring that sea turtle release gear be onboard reef fish-permitted vessels when fishing, to facilitate the safe release of any sea turtles or smalltooth sawfish caught. In addition, vessels with commercial and for-hire reef fish vessel permits were required to possess specific documents providing instructions on the safe release of sea turtles or smalltooth sawfish incidentally caught with hook-and-line gear.

Amendment 22 to the Reef Fish Resources of the Gulf of Mexico FMP, which was passed in July 2005, provided NMFS the authority to implement an observer program for the commercial and for-hire sectors of this fishery. Starting in June of 2006, observers were placed on commercial reef fish vessels operating primarily in the eastern Gulf of Mexico. During its first year of operation, the observer program focused on characterization of finfish bycatch; estimation of managed finfish discard and release mortality levels, including estimates for red snapper and red grouper (*Epinephelus morio*); and estimating levels of protected species bycatch (e.g., sea turtles).

In 2007, NMFS implemented a GMFMC action to establish an individual fishing quota (IFQ) for the commercial red snapper fishery. While IFQs are intended to reduce derby fishing conditions and provide a more stable community benefit, they also tend to reduce bycatch and bycatch discards, as they allow fishermen to choose their own fishing times and target areas. This allows fishermen to better select times and locations to catch legal-size fish without the pressure of a derby situation.

The GMFMC has also developed Amendment 29 to the Reef Fish Resources of the Gulf of Mexico FMP. This amendment outlines a system of IFQs for the multi-species grouper and tilefish fisheries (based on, e.g., size limits, bag limits, or trip limits) which could lead to a reduction in regulatory discards and discard mortality. Implementation

of this new IFQ system for the multi-species grouper and tilefish fisheries, scheduled for January 2010, may lead to allowing red snapper and grouper/tilefish fishermen to transfer allocations between the two IFQ systems, thus offsetting and reducing regulatory discards. Other regulations implemented in the reef fish fishery in 2008 require the use of non-stainless steel circle hooks, de-hooking devices, and venting tools to reduce bycatch mortalities.

Amendments 30A and 30B were developed to end overfishing of gray triggerfish (*Balistes capriscus*), greater amberjack (*Seriola dumerili*), and gag grouper (*Mycteroperca microlepis*). Regulations in these amendments could also affect the magnitude of fish bycatch. Amendment 30B addresses the overfishing of gag, adjusts the allocation of gag and red grouper catches between recreational and commercial fisheries, and makes adjustments to the red grouper Total Allowable Catch (TAC) to reflect the current status of the stock, which is currently at Optimum Yield (OY) levels. In addition, the amendment considered alternatives to monitor and reduce bycatch and bycatch mortality in reef fish fisheries, and will consider expanding the number of marine reserves for reef fish spawning areas.

Amendment 27 to the Reef Fish FMP and Amendment 14 to the Shrimp FMP (jointly referred to as Amendment 27/14) address overfishing and bycatch issues in both the red snapper directed fishery and the shrimp fishery. The amendment sets TAC for red snapper at 5.0 million pounds between 2008 and 2010. The amendment also reduces the commercial size limit to 13 inches, reduces the recreational bag limit to two fish, eliminates a bag limit for captain and crew aboard a for-hire vessel, and sets the recreational fishing season from 1 June through 30 September. In addition, all commercial and recreational reef fish fisheries are required to use non-stainless steel circle hooks when using natural baits, as well as venting tools and de-hooking devices. For the shrimp fishery, the amendment establishes a target reduction goal for juvenile red snapper mortality of 74% of the mortality in the benchmark years of 2001–03, reduces that target goal to 67% beginning in 2011, and eventually reduces the target to 60% by 2032.

In 2010, Amendment 31 to the Reef Fish FMP was approved to reduce sea turtle bycatch in the bottom longline component of the reef fish fishery. The results of a recent SEFSC observer analysis indicate that the number of loggerhead sea turtle takes authorized in the 2005 BiOp on the bottom longline reef fish fishery in the Gulf of Mexico has been substantially exceeded (NMFS 2008). Amendment 31 includes actions to 1) modify fishing effort; 2) restrict fishing in certain areas, seasons, and depths; and 3) reduce effort through a longline endorsement program. This amendment replaces the emergency rule approved by the Gulf Council at their January 2009 meeting to reduce sea turtle takes in the short term while Amendment 31 was under development.

Pelagic Longline Fisheries

Atlantic HMS fisheries are managed under the Consolidated HMS FMP. Bycatch of billfish on commercial gear, undersized swordfish, sharks on commercial gear after a seasonal closure, bluefin tuna (*Thunnus thynnus*) on pelagic longline gear, and protected species such as sea turtles and marine mammals have been a particular concern of HMS fisheries, including the Atlantic pelagic longline fishery. Conservation measures have been implemented under ESA Section 7 BiOPs and proposed under marine mammal take reduction plans to address these concerns.

In 2004, a BiOp found that Atlantic pelagic longline fishery operations jeopardized the continued existence of leatherback sea turtles in the Atlantic, Gulf of Mexico, and Caribbean. To mitigate this threat, reasonable and prudent alternatives were implemented to avoid jeopardy. An Incidental Take Statement (ITS) was issued, authorizing incidental take levels of 1,981 leatherback and 1,869 loggerhead sea turtles for a 3-year period during 2004–06. The ITS authorizes incidental take levels of 1,764 leatherback and 1,905 loggerhead sea turtles in subsequent three-year periods. Fishermen are also reminded each year of the requirement to possess and use sea turtle release and disentanglement gear, and the need to comply with safe handling and release protocols. Pelagic longline fishermen are also required to use 18/0 or 16/0 circle hooks and either whole finfish or squid bait. In the Northeast Distant (NED) fishing area off the Canadian Grand Banks, fishermen are required to use 18/0 non-offset hooks. In addition, there are permanent time/area closures in the Gulf of Mexico and off the east coast of Florida, and seasonal closures in the mid-Atlantic.

The gear regulations are designed to reduce interactions with endangered and threatened sea turtles, while the closures are primarily designed to reduce interactions with juvenile target species and billfish. All pelagic longline fishermen are required to attend safe handling and release workshops, carry de-hooking equipment onboard, and make efforts to release hooked or entangled sea turtles and sawfish. A mandatory observer program collects catch and effort data on the U.S. pelagic longline fleet. Information is also collected on bycatch of protected species, including marine mammals, sea turtles, and seabirds.

Serious injury and mortality of two species of pilot whales, long-finned (*Globicephala melas*) and short-finned (*Globicephala macrorhynchus*), and Risso's dolphins (*Grampus griseus*) is also a significant problem for the pelagic longline fishery. This fishery accounts for approximately 80% of the serious injury of long- and/or short-finned pilot whales on the U.S. Atlantic coast, and the estimated bycatch exceeds management benchmarks under the MMPA. In addition, the bycatch of pilot whales has been increasing in recent years, including the period following implementation of circle hook regulations. A Pelagic Longline Take Reduction Team (PL-

TRT) was convened in June 2005 to develop a plan to reduce the bycatch of pilot whales and other marine mammals in this fishery. This plan includes both regulatory and non-regulatory actions to reduce bycatch (74 FR 23349, 19 May 2009).

The bycatch of seabirds in the U.S. Atlantic pelagic longline fishery has not been identified as a problem at this point, although it is a concern for pelagic longline fisheries worldwide. This issue is addressed in the U.S. National Plan of Action (NPOA) for Reducing the Incidental Catch of Seabirds in Longline Fisheries, which was jointly developed by NMFS, U.S. Fish and Wildlife Service, and the Department of State, and published by NMFS in February 2001. Its purpose is to outline actions that will reduce incidental catch of seabirds in U.S. longline fisheries, provide national guidance on reducing seabird bycatch, and encourage assessments of all U.S. longline fisheries to determine whether a seabird bycatch concern exists. In addition, the plan calls for the development of seabird BRDs for those fisheries identified as having a seabird bycatch concern.

Shark Fisheries

The Consolidated Atlantic Highly Migratory Species FMP also outlines measures for commercial shark fisheries. On 10 April 2008, NMFS released the Final EIS for Amendment 2 to the Consolidated HMS FMP, based on several stock assessments completed in 2005–06. Assessments for dusky (*Carcharhinus obscurus*) and sandbar (*Carcharhinus plumbeus*) sharks indicated that these species are overfished, with overfishing occurring, and that porbeagle sharks (*Lamna nasus*) are overfished. NMFS implemented management measures consistent with recent stock assessments for sandbar, porbeagle, dusky, and blacktip (*Carcharhinus limbatus*) sharks and the large coastal sharks complex. A 2008 BiOp for the Atlantic and Gulf of Mexico shark bottom longline fishery and the gill net fisheries (drift, strike, and bottom gillnet), encompassing large coastal, small coastal, and pelagic sharks, as managed under Amendment 2 to the Consolidated Atlantic Highly Migratory Species FMP, found that neither fishery was likely to jeopardize the incidental take of any ESA-listed species. NMFS anticipated a three-year total incidental take for the Atlantic shark fishery of 74 leatherback sea turtles (*Dermochelys coriacea*), 679 loggerhead sea turtles (*Caretta caretta*), 2 hawksbill sea turtles (*Eretmochelys imbricata*), 2 green sea turtles (*Chelonia mydas*), 2 Kemp's ridley sea turtles (*Lepidochelys kempii*), and 52 smalltooth sawfish (*Pristis pectinata*). The final measures in Amendment 2 implement a shark research fishery, which allows NMFS to select a limited number of commercial shark vessels on an annual basis to collect life history data and data for future stock assessments. Furthermore, the revised measures affect quotas, retention limits, and authorized species in commercial shark fisheries; affect authorized species in recreational shark fisheries; modify time/area closures for commercial shark vessels deploying bottom longline gear; require that all sharks be landed with all fins naturally attached; and modify regions, seasons, and shark dealer reporting frequency in the commercial shark fishery. The implementing regulations for Amendment 2 were published on 24 June 2008 (73 FR 35778; corrected version published 15 July 2008; 73 FR 40658).

Shark Bottom Longline

In an attempt to reduce bycatch of dusky shark (*Carcharhinus obscurus*), juvenile sandbar shark (*Carcharhinus plumbeus*), and sea turtles, NMFS established a time/area closure off North Carolina from January to July (NMFS 2006b). Since 1993, shark trip limits have also been in place. Trip limits were also reduced under Amendment 2 to the 2006 Consolidated HMS FMP. This may also alter fishing behavior and, in turn, impact the types and amount of bycatch. As in the pelagic longline fishery, shark permit holders are required to attend workshops and carry gear onboard to increase the post-hooking survival of any non-target catch they encounter, including sea turtles and marine mammals. Other measures currently in place for the shark bottom longline fishery include mandatory use of logbooks to describe catch and fishing methods, and the mandatory requirement for selected vessels to carry observers (observer program details provided in Section 4.2.3.1).

Shark Gillnet (drift, strike, and bottom gillnet)

The shark gillnet fishery has documented bycatch of marine mammals and sea turtles including right whales (*Eubalaena glacialis*), bottlenose dolphins (*Tursiops truncates*), Atlantic spotted dolphins (*Stenella attenuata*), leatherback sea turtles (*Dermochelys coriacea*) and loggerhead sea turtles (*Caretta caretta*). Regulations under the Atlantic Large Whale Take Reduction Plan (ALWTRP) and a BiOp issued under Section 7 of the ESA address fishing activity occurring in the southeast U.S. and the risks this gear poses to North Atlantic right whales during the calving season. Shark gillnetters are required to follow guidelines related to the ALWTRP regulations, including but not limited to vessel monitoring systems; area closures; retrieving gear completely when marine mammals are sighted; observer coverage; mesh restrictions; and net checks every two hours. Gillnet fishermen must also attend workshops on safe handling and release of non-target catch, including protected species. The fishery has also been included under the BDTRP because it interacts with bottlenose dolphins. Increasingly, the fishery is shifting away from long-duration drift net fishing to shorter-duration strike nets, reducing the risk of interactions with marine mammals and other protected species.

South Atlantic Snapper–Grouper

Size limits, trip limits, and other management measures lead to regulatory discards and discard mortality in the

South Atlantic snapper–grouper handline/electric reel and bottom-longline fisheries, especially for the deepwater grouper complex. An observer program that monitors the vertical line fishery (i.e., electric reels and handlines) is currently underway (observer program details provided in Section 4.2.3.1).

Amendment 13C to the SAFMC's Snapper–Grouper Fishery of the South Atlantic Region FMP placed additional restrictions on snowy grouper (*Epinephelus niveatus*), tilefish (*Lopholatilus chamaeleonticeps*), black sea bass (*Centropristis striata*), and vermilion snapper (*Rhomboplites aurorubens*), which could increase the number of regulatory discards. However, actions that specified quotas and modified size and bag limits took into consideration the potential increase in dead discards and estimates of release mortality. In addition, the mesh size in pots was increased. This is expected to reduce bycatch of undersized black sea bass.

Amendment 14 established eight Type II marine protected areas (MPAs), where fishing for and retention of snapper–grouper species is prohibited, except for trolling for pelagic species (e.g., tuna, dolphinfish, and billfish). The intent is to achieve a more natural sex ratio, age, and size structure of snapper–grouper populations within the proposed MPAs.

Amendment 15B implemented a plan to monitor and assess bycatch, and established measures to minimize incidental take of sea turtles and smalltooth sawfish.

Amendment 16 established actions to end overfishing of gag and vermilion snapper, and may potentially affect the magnitude of bycatch by implementing new management measures. Other measures in Amendment 16 intended to reduce bycatch include requiring de-hooking devices for fishermen targeting snapper–grouper species with any hooking-type gear. Amendment 16 also includes actions that would reduce the magnitude of dead discards by prohibiting harvest and possession of all shallow-water groupers when catch limits for snapper–grouper species are reached.

Amendments 17A and B (approved in December 2010) outline annual catch limits (ACLs) for the 10 species managed under the FMP that are experiencing overfishing, as required under the MSA. The ACLs apply to both commercial and recreational fisheries. Management alternatives under Amendments 17A and B outline accountability measures to ensure catch limits are not exceeded, in addition to other requirements to reduce bycatch.

The SAFMC has begun developing Amendment 18 (later split into 18A and B), which could reduce the existing number of black sea bass pots and enhance data-collection programs, as well as other actions. The SAFMC is also in the early phases of development of a Limited Access Permit Program for various fisheries, which should reduce regulatory discards.

Southeastern Shrimp Fisheries

While southeast Atlantic Ocean and Gulf of Mexico shrimp stocks are not overfished, many finfish species, sea turtles, smalltooth sawfish, and bottlenose dolphins are caught as bycatch during trawling operations. Beginning in the late 1980s, TEDs were required in various parts of the shrimp fishery through regulations implemented under the ESA. By the mid-1990s, TEDs were required in all shrimp trawls, with limited exceptions. It has been estimated that TEDs exclude 97% of the turtles caught in shrimp trawls. These regulations have been refined over the years to ensure that TED effectiveness is maximized through proper placement and installation, configuration (e.g., width of bar spacing), flotation, and more widespread use. Analyses by Epperly and Teas (2002) indicated that the required minimum escape opening dimensions were too small, and that as many as 47% of the loggerheads stranding annually along the Atlantic seaboard and Gulf of Mexico were too large to fit through existing openings. On 21 February 2003, NMFS published a final rule to require larger escape openings.

All Southeastern shrimp fisheries now require BRDs to reduce finfish bycatch. These requirements were implemented in 1997 under Amendment 2 to the Shrimp Fishery of the South Atlantic Region FMP. Similar regulations were implemented for the western Gulf of Mexico in 1998 (Amendment 9 to the Shrimp Fishery of the Gulf of Mexico FMP), and for the eastern Gulf of Mexico in 2004 (Amendment 10 to the Shrimp Fishery of the Gulf of Mexico FMP). New regulations implemented in February 2008 were intended to improve the quality of BRDs used by the South Atlantic and Gulf shrimp fishery to reduce bycatch. The regulations provide for a consistent criterion throughout the southeast by which a BRD can be certified for use in the fishery. In addition, three new BRDs were certified for use, which are more efficient than the industry-standard BRDs used today. In fact, the current industry-standard BRDs do not meet the new certification criterion, and NMFS has published additional regulations decertifying these BRDs.

Although the Gulf of Mexico and Southeast Atlantic shrimp trawl fisheries have been observed since 1992, participation in the observer program has been voluntary. Amendment 13 to the Shrimp Fishery of the Gulf of Mexico FMP (finalized in October 2006) and Amendment 6 to the Shrimp Fishery of the South Atlantic Region FMP (finalized in December 2005) established a mandatory observer program for Southeast shrimp fisheries. These amendments improve the observer program's ability to collect catch and bycatch data for these fisheries (observer program details are provided in Section 4.2.3.1).

Additional regulations implemented in 2008 are specifically intended to reduce fishing mortality on juvenile red snapper. The GMFMC Amendment 14, part of the joint Reef Fish Resources of the Gulf of Mexico FMP Amendment 27 and

Shrimp Fishery of the Gulf of Mexico FMP Amendment 14, established a target reduction goal for juvenile red snapper mortality of 74% of the mortality in the benchmark years of 2001–03. It also established a framework procedure whereby the Regional Administrator can seasonally close certain areas to trawling if the effort reduction target is not met for a given year.

In 2010, the Secretary of Commerce approved the Comprehensive Ecosystem-Based Amendment 1 (CE-BA 1). The intent of CE-BA 1 is to protect over 23,000 square miles of sensitive habitat, deemed coral Habitat Areas of Particular Concern (HAPCs) from impacts associated with bottom-tending fishing practices. The coral HAPCs are located off the coasts of the Carolinas, Georgia, and eastern Florida in waters ranging from 400 meters (1,200 feet) to 700 meters (2,300 feet) deep. The South Atlantic region is believed to contain the largest distribution of deepwater corals in the world, including the common Lophelia coral, largely responsible for reef mound construction in these cold water areas. These deep water coral areas are relatively undisturbed by the impacts of fishing.

Currently, the only commercial fisheries that operate in the areas are the wreckfish (*Polyprion americanus*), golden crab (*Chaceon fenneri*), and royal red shrimp (*Pleoticus robustus*) fisheries. The CE-BA 1 creates “allowable gear areas” for the golden crab fishery and “shrimp fishery access areas” for the deepwater shrimp fishery. The establishment of these areas allows for the continuation of these fisheries in their historical fishing grounds with little or no negative impacts to protected deepwater coral habitat. The amendment establishes deepwater coral HAPCs, where the possession of coral species and the use of all bottom-tending gear is prohibited, including bottom longline; trawl (bottom and mid-water); dredge; pot or trap; or the use of an anchor, anchor and chain, or grapple and chain by all fishing vessels.

4.2.3 Data Sources

Bycatch data sources available for federally managed Southeast Region fisheries and those southeast U.S. state fisheries with Federal data-collection programs are listed in Table 4.2.1. Two primary Federal data sources are available for Southeast Region fisheries, observer programs and logbooks.

4.2.3.1 Observer Programs

Six primary observer programs operate out of the Southeast Region (Table 4.2.2):

- North Carolina Coastal Gillnet Alternative Sampling Program
- Pelagic Longline Observer Program
- Reef Fish Observer Program
- Shark Gillnet Observer Program
- Shark Bottom Longline Observer Program
- Shrimp Trawl Observer Program

Three programs provide adequate coverage levels: the Pelagic Longline, Shark Bottom Longline, and Shark Gillnet Observer Programs. Pilot/baseline coverage is provided for the Reef Fish Observer Program and the Shrimp Trawl Observer Program. In 2005, Southeast Region programs monitored a total of 2,657 sea days.

Gulf of Mexico Reef Fish Observer Program

Amendment 22 to the GMFMC Reef Fish FMP includes a requirement for mandatory observer coverage of reef fish fisheries. In July 2006, a mandatory observer program was implemented for the Gulf of Mexico reef fish fishery. The primary gear types used by this fishery include bottom longline, electric reel, and hand line. Proportional sampling effort based on historical landings data across seasons in the eastern Gulf of Mexico and across seasons and gears in the western Gulf of Mexico is used to allocate observer effort. Fishery-specific data are collected by set for both retained and discarded fish species. The condition of fish when brought onboard is categorized. Non-target and undersized target species are processed first, recording length, weight, and disposition prior to release. Retained species are then processed, recording length and weight. A potential source of bias is non-compliance during the first year of the program. There was a substantial increase in compliance during 2007, primarily due to an increase in the number of industry participants that obtained USCG safety decals, as well as efforts by NMFS enforcement.

North Carolina Coastal Gillnet

The North Carolina coastal gillnet fishery encompasses the Pamlico Sound Gillnet Restricted Area (PSGNA), a shallow-water autumn gillnet fishery (Price 2007). The PSGNA observer program utilizes an alternative platform (independent boat) to observe gillnet trips within this small region of Pamlico Sound in North Carolina for interactions with sea turtles. Current North Carolina statutes prohibit the North Carolina Division of Marine Fisheries from providing contact information for commercial fishers to NMFS. Therefore, observers are unable to contact fishermen to schedule trips and a significant portion of the fishing community is not observed because observers are unable to locate them. The

Table 4.2.2
Southeast Region Federal observer programs, fisheries observed, and coverage levels. Programs and observed fisheries are listed alphabetically. Observer programs that ended over 10 years ago are not listed.

Observer Program	U.S. National Bycatch Report Fisheries	Authority to Place Observers	Program Duration	Coverage Level
Atlantic and Gulf of Mexico Directed Shark Bottom Longline Fishery	Atlantic and Gulf of Mexico Shark Bottom Longline	MSA (50 CFR 635)	1994–present	2005: 4% 2006: 5–6% 2007: 5–6% 2008: 100% sandbar shark research fishery; 4-6% non-sandbar shark fishery
Atlantic, Gulf of Mexico, and Caribbean Pelagic Longline Fishery	Atlantic and Gulf of Mexico HMS Pelagic Longline	MMPA Cat. I (50 CFR 229); MSA (50 CFR 635); ATCA	1992–present	2005: 5–9% 2006: 5–7.5% 2007: 11% 2008: ~13%
Gulf of Mexico Reef Fish Fishery	Gulf of Mexico Reef Fish Bottom Longline[a]	MSA (50 CFR 635)	2006–present	2005: NA 2006: <5% 2007: 1% 2008: 1%
	Gulf of Mexico Reef Fish Handline/electric reel[b]			
North Carolina Coastal Gillnet Fishery: Alternative Platform Sampling of Pamlico Sound Gillnet Restricted Area	North Carolina Coastal Gillnet	MMPA Cat.I (50 CFR 229); ESA	2006	2005: NA 2006: 8–9 % 2007-2008: NA
	North Carolina inshore bays/rivers gillnet			
Southeast and Gulf of Mexico Shrimp Otter Trawl Fisheries (including rock shrimp)	Atlantic Shrimp Trawl[b]	MSA (50 CFR 635)	1992–present	2005: <1% 2006: <5% 2007: <1% 2008: 2%
	Gulf of Mexico Shrimp Trawl[b]			
	S. Atlantic skimmer trawl			
Southeast Shark Gillnet Fishery	Gulf of Mexico coastal gillnet	MMPA Cat. I (50 CFR 229); MSA (50 CFR 635)	1993–present	2005 & 2006: 100% November–March; 38% April–November 2007: 39% of drift sets April–November, 100% strike sets November–March; 20% sink–shark sets. 2008: 100% shark strike, 38% shark drift, 5% shark and teleost sink net
	Large Coastal and Small Coastal Shark Aggregates (Drift, Strike, and Bottom Gillnet)			
	South Atlantic coastal gillnet			

[a] There is some observer coverage by the Gulf and South Atlantic Fisheries Foundation.
[b] This fishery was observed on a voluntary basis until 2007.

program has been in operation since March of 2006, but a lack of representative observer coverage may bias bycatch estimates either negatively or positively. Currently, the program's focus is on developing a database of fishermen and supplementing NEFOP's monitoring ability, to more effectively assess bottlenose dolphin bycatch and determine the success of the BDTRP.

Pelagic Observer Program

The SEFSC's Pelagic Observer Program (POP) has monitored the southeast Atlantic Ocean and Gulf of Mexico HMS pelagic longline fishery since May 1992. Each year, 3–8% of this highly mobile fleet is observed, and since 2003 the minimum coverage has been 8%, sometimes exceeding that level. This fishery ranges from the Grand Banks of Canada south to Brazil and into the Gulf of Mexico. All sets during an observed trip are observed. Statistical and biological data on all species of fish brought aboard or released (dead or alive) and all bycatch (dead or alive), including protected species such as mammals, sea turtles, and seabirds, are collected. A possible source of bias for data collected by the POP is that early coverage (pre-1992) was voluntary, with portions of the fleet non-compliant. Although carrying an observer on request has been mandatory since 1992, compliance is not linked to permits and portions of the fleet may remain non-compliant and unobserved. To decrease this source of bias, POP staff continue to work with the industry to increase overall fleet participation and cooperation with the observer program.

Shark Gillnet Observer Program

Since 1993, an observer program has been underway to estimate catch and bycatch in the directed large coastal and small coastal shark aggregates (drift, strike, and bottom gillnet) fisheries along the southeastern U.S. Atlantic coast. Statistical and biological data on all species of fish brought aboard or released at the surface (dead or alive) and all bycatch (dead or alive), including protected species such as mammals, sea turtles, and seabirds, are collected. Historically, the program provided 100% observer coverage for drift/strike gillnet vessels during the North Atlantic right whale calving season (15 November to 31 March). Outside the North Atlantic right whale calving season (1 April to 14 November), 38–40% observer coverage was maintained for drift gillnet vessels. No level of coverage was specified for other gillnet vessels. Due to the North Atlantic right whale coverage requirements and limited funding, observer coverage was limited in both time and space.

Starting in 2005, a pilot observer program was begun to include all vessels that have an active directed shark permit and fish with sink gillnet gear. These vessels were not previously subject to observer coverage because they either were targeting non-highly migratory species or were not fishing gillnets in a drift or strike fashion. These vessels were selected for observer coverage in an effort to determine their impact on shark resources when targeting species other than sharks. Further, in 2007 the regulations implementing the Atlantic Large Whale Take Reduction Plan were amended to include the removal of the mandatory 100% observer coverage for drift gillnet vessels during the North Atlantic right whale calving season; but they now prohibit all gillnets in an expanded restricted area in the southeast U.S., covering an area from Cape Canaveral, Florida, to the North Carolina–South Carolina border, from 15 November to 15 April. Limited exemptions are made in waters south of 29°N for shark strike net fishing during the same period, and for Spanish mackerel gillnet fishing in the months of December and March. Based on these regulations and on current funding levels, the shark gillnet observer program now provides year-round coverage for all anchored (sink, stab, and set), strike, and drift gillnet fishing by vessels that fish from Florida to North Carolina. There is some difficulty in identifying the entire universe of vessels as some participants fish only in state waters and do not carry any type of Federal permit.

Shark Bottom Longline Observer Program

Beginning in 1994, voluntary monitoring of the southeastern Atlantic Ocean and Gulf of Mexico shark bottom longline fishery was conducted by the University of Florida's Commercial Shark Fishery Observer Program. Starting with the 2002 fishing season, carrying an observer upon request became mandatory under the HMS FMP. In June 2005, responsibility for this program was transferred to the SEFSC Panama City Laboratory. In addition to gear characteristics and other vessel information, observers record species, numbers, length, and disposition (kept, discarded alive, or discarded dead) for sharks and other species caught. Biological samples of sharks and other species are taken as time permits. Released sharks are tagged to track movement patterns and determine stock structure. A possible source of bias for data collected on the shark bottom longline fishery is that early coverage was voluntary, with portions of the fleet non-compliant. Although carrying an observer upon request is mandatory today, compliance is not linked to permits. Without this incentive, portions of the fleet remain non-compliant and unobserved.

Shrimp Trawl Observer Program

The Southeast Shrimp Trawl Fishery Observer Program has been in existence since 1987, and is administered by the SEFSC Galveston Laboratory. The program was originally developed to provide an economic evaluation of TEDs in shrimp trawls, and continues to focus on research. While the program has historically relied on voluntary participation, carrying an observer became mandatory in 2006, with implementation of the program in July 2007. All observers are required to collect data following the NMFS BRD evaluation sampling protocol. To further standardize the data col-

Photo: NOAA

A loggerhead sea turtle escapes from a net equipped with a turtle excluder device (TED).

lected by observers, a ten- to twelve-day NMFS observer training program has been established. All data collected by fisheries observers are sent to, managed, archived, and analyzed by the SEFSC Galveston Laboratory. There is some bias in the historic observer data based on the opportunistic sampling that occurred under voluntary efforts. In addition, funding is limited and fluctuates annually and impacts observer retention and vessel participation.

4.2.3.2 Logbooks

Many of the Federal fisheries that are observed in the Southeast Region also have mandatory logbook programs, including the Atlantic Ocean and Gulf of Mexico shark bottom longline fisheries; Gulf of Mexico reef fish bottom longline and hook and line fisheries; large coastal and small coastal shark aggregates (drift, strike, and bottom gillnet); South Atlantic Ocean snapper–grouper bottom longline and hook and line fisheries; and the HMS pelagic longline fishery. The majority of these logbook programs were initiated in 1986, and have continued to the present. Data collected include vessel name, documentation number, gear type used, date, time, location of beginning set/haul, average floatline length, hook types and size, bait and hook type used, species caught and/or discarded, condition (alive or dead), and bycatch of any protected species. In most cases, these data are stored in an Oracle database, with aggregated data available online (http://www.sefsc.noaa.gov/commercialprograms.jsp).

In August 2001, the SEFSC initiated the Supplementary Discard Data Program to address bycatch reporting in Southeast fisheries (Poffenberger 2003). The SEFSC developed a supplemental form that is used with the Coastal Fisheries Logbook Program to collect discard data as mandated by the Sustainable Fisheries Act. Commercial reef fish fishers are required, if selected, to report the number and average size of fish being discarded by species and the reasons for those discards (regulatory or market conditions). The bycatch data are collected using a supplemental form sent to a stratified random sample of the commercial reef fish permit holders (20% coverage). The sampling system is designed so that the 20% of fishermen selected to report for a given year are not selected for the next four years; over the course of a five-year period, 100% of reef fish permit holders will have been required to report in one of the five years.

As with most self-reported data, logbook data from the Southeast Region are subject to reporting bias. The degree of bias can often be verified through comparisons with observer data. For example, bias has been evaluated in the pelagic longline fishery by comparing observer data to data collected through the Pelagic Longline Logbook (PLL) program. The PLL is a mandatory program that requires all U.S. Atlantic Ocean, Caribbean, and Gulf of Mexico fishing vessels with a swordfish permit to provide catch and effort data, as well as bycatch information on a set-by-set basis. The program started in October 1986 on a voluntary basis and became mandatory in 1992. A comparison of observer and logbook data for this fishery indicates that, for commercially valuable species, estimates of landed catch from observer data generally agree with landing statistics, which are reported independently from the observer data. However, observer data do indicate a tendency to under-report through logbooks most, but not all, catch of species with no commercial value (and thus not retained by the vessel).

One issue with logbook data for the region's several gillnet fisheries is that effort reported in coastal fishery logbooks is coded generically as "Gillnet, Other," and therefore it is not possible to directly distinguish among the four types of gillnet sets documented by the observer program. Thus, extrapolation to estimate total takes of protected species is difficult and estimates generally have a high degree of uncertainty.

4.2.4 Southeast Region Bycatch Estimation Methods

This section presents fish, marine mammal, and other protected species bycatch estimation methods for the Southeast Region fisheries bycatch estimates included in this report. Bycatch estimation methods are discussed first for fish (Section 4.2.4.1), then for marine mammals (4.2.4.2), then for other other protected species (4.2.4.3). For some fisheries, new observer programs have generated improved bycatch data (e.g., Gulf of Mexico reef fish fisheries); the bycatch estimation methods used in this report may no longer reflect the current bycatch estimation methods being used in those fisheries.

4.2.4.1 Fish Discard Estimation Methods

4.2.4.1.1 Atlantic and Gulf of Mexico Shark Bottom Longline Fishery

Observed takes for the shark bottom longline fishery came from the SEFSC Panama City observer program database for 2005–06. A delta lognormal approach (Pennington 1983) was used to estimate the mean and variance of fish bycatch per hook per set. This method combines a binomial model for the total observations with a lognormal model for the non-zero catch-per-unit-of-effort (CPUE) data, which were assumed to be log-normally distributed in this case.

Extrapolation to estimate total takes by the fishery was achieved by simply multiplying by total hook effort extracted from the logbooks. Because the final estimate of total effort depends on the method used to extract total hook effort, a Monte Carlo simulation, consisting of randomly selecting values from a probability distribution assumed to describe the level of effort (total number of hooks/year), was performed to represent the variability in total effort. Effort was assumed to follow a uniform distribution, with upper and lower bounds reflecting the range of annual effort. The process was repeated 10,000 times, yielding means and confidence intervals (calculated as the 2.5th and 97.5th percentiles) for the sampling estimates.

4.2.4.1.2 Southeast Large Coastal and Small Coastal Shark Aggregates (Drift, Strike, and Bottom Gillnet)

Observed takes for the shark gillnet fishery came from the SEFSC Panama City observer program database. A simple ratio estimator (number of animals/number of observed sets) was used to calculate bycatch rates. Estimates were derived for three gear types: drift, strike, and sink gillnet. Extrapolation to estimate total takes by the fishery was achieved by simply multiplying by total effort (number of sets) extracted from the logbooks. Because the vast majority of gillnet sets reported in the logbooks were coded generically as “Gillnet, Other” it was not possible to distinguish among the three types of sets represented by the observer program. Thus, a Monte Carlo simulation was conducted, as described above (Section 4.2.4.1.1) consisting of randomly selecting values from a probability distribution assumed to describe the level of effort (total number of sets/year) was performed. Effort was assumed to follow a uniform distribution, with upper and lower bounds reflecting the range of annual effort for all gillnet sets. The process was repeated 10,000 times, yielding means and confidence intervals (calculated as the 2.5th and 97.5th percentiles) for the sampling estimates.

4.2.4.1.3 Gulf of Mexico Shrimp Trawl Fishery

Species total weights and numbers were extrapolated from subsample weight to the total catch weight, and were based on one net per tow, and then extrapolated to an average of 3.1 nets per vessel. The nets used in the analyses were consistent with current BRD regulations at that time. Total weight and number were derived by multiplying the sample weight (or number) of the species of interest by the total weight of the sampled net, divided by the subsample weight for that net. In the absence of a weight or number for a given species, the entire tow was set aside from the analysis.

Ratio estimation and testing procedures were used for statistical analyses to determine specific catch rates. As described by Snedecor and Cochran (1967), the ratio estimation in equation (1) was used as the sample estimate of the mean:

$$(1)\quad R = \frac{\sum Y}{\sum X}$$

where
R = ratio estimate
Y = extrapolated kilograms for species of interest for selected strata
X = hours towed for selected strata.

The estimated standard error of the estimate was calculated as

$$(2)\quad s(R) = \frac{1}{\bar{x}}\sqrt{\frac{\sum (Y - RX)^2}{n(n-1)}}$$

where
$\bar{X}$ = mean of hours towed for selected strata
n = number of tows occurring in selected strata

To standardize bycatch estimates as prescribed in Evaluating Bycatch: A National Approach to Standardized Bycatch Monitoring Programs (NMFS 2004b), the coefficient of variation (CV) was calculated for selected species. The CV estimates were calculated by dividing the estimated standard error by the estimate of the mean for selected species.

4.2.4.1.4 Atlantic and Gulf of Mexico HMS Pelagic Longline Fishery

For management purposes, it is necessary to estimate the biomass (in numbers and weight) of the dead discards by this fleet. In the case of fish species, earlier studies have indicated that discarded catch is often inaccurately reported (Cramer et al. 1998). Cramer and Adams (1999) developed a technique to improve the estimation of fish dead discards by the pelagic longline fleet. This technique was revised

and approved by the Standing Committee on Research and Statistics (SCRS) of the ICCAT. This technique, described below, is used for most pelagic longline fish bycatch estimates. The sole exception at this time is bluefin tuna, for which a somewhat different approach (described later) is used.

The estimation of fish bycatch by the U.S. pelagic longline fleet utilizes data from the PLL and the POP. Bycatch estimates are prepared annually for each stock, species, or species complex for area/quarter stratum, where the areas correspond to the domestic fishing areas. Because several shark species are caught in very low numbers they are grouped into two categories to improve the accuracy of the estimates. "Pelagic sharks" includes the longfin mako (*Isurus paucus*), shortfin mako (*Isurus oxyrinchus*), oceanic whitetip (*Carcharhinus longimanus*), porbeagle (*Lamna nasus*), and unidentified pelagic sharks; while the "coastal sharks" category includes the bignose shark (*Carcharhinus altimus*), blacktip (*Carcharhinus limbatus*), sandbar (*Carcharhinus plumbeus*), tiger shark (*Galeocerdo cuvieri*), white shark (*Carcharodon carcharias*), spinner shark (*Carcharhinus brevipinna*), and other identified coastal sharks.

Dead discards were estimated in weight, using the estimated number of dead discards and the average weight (median in the case of swordfish) estimated from data collected by the POP. Observers in POP make measurements or estimatations of the length of dead discards, which were used to estimate weight. When less than 30 lengths were recorded for a particular area/quarter stratum, the average or median weight for the year was used.

Three different cases were considered for the estimation of fish dead discards:

1) Area/quarter stratum with no observed sets in the POP
2) Area/quarter stratum with ten or more observed sets in the POP
3) Area/quarter stratum with at least one set observed but less than ten observed in the POP.

Case 1: In the case of area/quarter strata where no sets were observed, the reported number of dead discards in the logbook was accepted and reported. Therefore, there was no measure of uncertainty associated with the number of discards.
Case 2: Observed catch rates were estimated for those area/quarter strata with more than ten observed sets using catch and effort data collected by the POP. The total number of hooks tended and the dead discards by species or species group in each stratum were used to estimate catch rates as number/1,000 hooks. These estimated catch rates were then multiplied by the reported total effort in the PLL for each stratum to estimate catch in numbers. This approach relies on the assumption that the catch rates of the observed trips were representative of the catch rates of the entire fleet. Because the catch rates for each stratum were estimated from the sum of all the effort (number of hooks) and the catch in that particular stratum, there was no measure of uncertainty associated with them.

Case 3: GLMs were run to obtain an estimate of catch rates for those strata with limited observer coverage (less than ten observed sets): ln(catch rate) = area/quarter source.

Where "catch rate" is the number of dead discards/1,000 hooks, "area/quarter" is a unique identifier for each area and quarter stratum, and "source" is PLL or POP. The GLM estimated catch rate was multiplied by the reported PLL effort (number of hooks) to estimate total number of discards. Measures of uncertainty could have been obtained for Case 3. However, given that they could not be estimated for the first two cases, the measures of uncertainty associated with this case were not reported.

Estimation of dead discards of pelagic longline bluefin tuna

Historical estimates of dead discards in the bluefin tuna longline fishery were revised in preparation for the 2006 ICCAT bluefin tuna stock assessment. The revised estimates make use of U.S. pelagic longline observer program data, which comprise numbers (and lengths) of bluefin tuna dead discards beginning in 1992. This approach was originally documented in Brown (2001).

Estimates of the dead discards of bluefin tuna by the U.S. Atlantic pelagic longline fleet permitted to land and sell Atlantic swordfish (*Xiphias gladius*) were based on logbook reports of fishing effort levels and scientific observer records of catch rates from a representative sample of the fleet. Estimates were constructed using the delta lognormal method described by Pennington (1983), taking into account possible geographical and seasonal effects, and coefficients of variation were calculated. The estimates ignored information that might have been available in self-reported data on catch rates of bluefin tuna. Catch rate samples were pooled as necessary across strata to achieve a minimum sample size of 30 observations. Since several closed areas were implemented at the end of 2001 and beginning of 2002 (which likely would have altered the bluefin tuna discard rates), the Brown (2001) approach was modified slightly so that the time periods 1992–2000 and 2001–05 were analyzed separately to preclude pooling across the two periods. The estimates of bluefin tuna dead discards in numbers were converted to weight using relevant observer data (if available) or comparable gear/area data.

Previously reported bluefin tuna longline dead discards were based upon tallies from the logbooks. However, since reported discard rates from the logbooks tend to be substantially lower than those reported by scientific observers, there was concern that discards might not be fully documented through the logbooks. However, the approach of

reporting logbook tallies to ICCAT was continued pending a review of the approach (Brown 2001). O'Brien et al. (2004) completed a detailed testing of model assumptions and validation and concluded that previous estimates in Brown (2001) were appropriate.

4.2.4.1.5 Gulf of Mexico Reef Fish Bottom Longline Fishery

Discard rates for all species except red grouper in the Gulf of Mexico reef fish bottom longline fishery were calculated from discard reports made to the SEFSC Miami coastal discard logbook program for the years 2005–06. Discard rate for each species was defined as the reported number of discards of a species per hook fished for each trip. Mean discard rate for each species was determined by year, along with between-trip CVs.

Total effort (in hooks fished) for the fishery was calculated from the SEFSC Miami coastal logbook program database for the years 2005–06. Extrapolation to estimate total discards by the fishery was accomplished by multiplying total hooks fished by species-specific mean discards per hook. Beween-year CVs of the estimated discards were also calculated for each species. In instances where a species was reported as discarded in only one of the two years examined, discards were estimated for the single year in which the species was reported discarded. Coefficients of variation of calculated discards could not be calculated for species reported from single years.

Red grouper discards from Gulf of Mexico bottom longline vessels had been estimated during the Southeast Data, Assessment, and Review (SEDAR) 12 red grouper assessment (McCarthy 2006a) and those results were included in this analysis. Initial estimates of red grouper discards from the Gulf of Mexico bottom longline fishery were much lower than those estimated from handline vessels, even though red grouper landings from bottom longline vessels were higher than handline vessel landings. The ratio of longline red grouper discards to pounds of red grouper landed was six to ten times lower than discards/landings ratios for other species. However, the ratio of handline red grouper discards to pounds landed was similar to ratios calculated for other species. Longline red grouper discards were estimated by applying the ratio of red grouper handline discards/pounds landed to the bottom longline red grouper landings. Data were stratified by areas fished (Gulf of Mexico statistical areas) and by target species (red grouper vs. targeting other species). Targeting was determined using the Stephens and MacCall (2004) approach, in which trips are categorized based upon reported species composition of the landings. The method is intended to identify trips that fished in locations containing red grouper habitat and therefore had the potential of catching (and discarding, as necessary) red grouper. The discards/pounds landed ratio for each stratum was then applied to the summed longline landings in the corresponding stratum to estimate the number of discards. Estimates were summed by year and the annual average was reported.

4.2.4.1.6 Gulf of Mexico Reef Fish Handline Fishery

Discard rates for the Gulf of Mexico reef fish handline fishery were calculated from discard reports made to the SEFSC Miami coastal discard logbook program for the years 2005–06. Discard rate for each species was defined as the reported number of discards of a species per hook–hour fished for each trip. Mean discard rate for each species was determined by year, along with among-trip coefficients of variation.

Total effort (in hook–hours fished) for the fishery was calculated from the SEFSC Miami coastal logbook program database for the years 2005–06. Extrapolation in order to estimate total discards by the fishery was accomplished by multiplying total hook–hours fished by species-specific mean discards per hook–hour. Between-year coefficients of variation of the estimated discards were also calculated for each species. In instances where a species was reported as discarded in only one of the two years examined, discards were estimated for the single year in which the species was reported discarded. Coefficients of variation of calculated discards could not be calculated for species reported from single years.

Gulf of Mexico handline vessel discards of greater amberjack, vermilion snapper, and gray triggerfish had been previously estimated for the SEDAR 9 assessment process (McCarthy 2005) and were used for the Gulf of Mexico reef fish handline fishery discard estimates. Estimates followed similar methods to those described above, with the exception that the data were stratified by year (2003 and 2004), discard period (January–July, August–December), and the number of hooks fished per handline. A GLM analysis identified the above factors as having a significant effect on discard rate. For these species, discard rate was calculated as discards per trip and the extrapolation to total discards was made by multiplying the mean discard rate per trip by the total trips reported within each stratum. Gray triggerfish data were not stratified beyond year because of sample size constraints.

Gag grouper handline vessel discards were also previously estimated for the SEDAR 10 gag grouper assessment (McCarthy 2006b) and were used for the Gulf of Mexico reef fish handline fishery discard estimates. Methods were similar to those described above for greater amberjack and vermilion snapper. A GLM was again used to identify factors that significantly affected discard rate. Discard rates (discards per trip) and total effort were calculated for each stratum. Estimated total discards were summed across strata.

Photo: NMFS SEFSC Pascagoula Lab., Brandi Noble Collection

A lane snapper, *Lutjanus synagris.*

Red grouper handline vessel discards were estimated for the SEDAR 12 red grouper assessment (McCarthy 2006a) and were used for the Gulf of Mexico reef fish handline fishery discard estimates. Methods differed from those previously described, primarily in the way red grouper trips were identified. The Stephens and MacCall (2004) approach (described in Section 4.2.4.1.5) was used to identify trips with the potential of catching and discarding red grouper. Factors that significantly affected discard rate were again identified using a GLM, and the data were then stratified appropriately. Discard rates were calculated as discards per hook–hour fished and multiplied by total hook–hours reported to the coastal logbook program for the fishery.

4.2.4.1.7 South Atlantic Snapper–Grouper Handline Fishery

Discard rates for the South Atlantic snapper–grouper handline fishery were calculated from discard reports made to the SEFSC's coastal discard logbook program for the years 2005–06. Discard rate for each species was defined as the reported number of discards of a species per hook–hour fished for each trip. Mean discard rate for each species was determined by year along with among-trips CVs.

Total effort (in hook–hours fished) for the fishery was calculated from the SEFSC's coastal logbook program database for the years 2005–06. Extrapolation to total discards by the fishery was accomplished by multiplying total hook–hours fished by the number of species-specific mean discards per hook–hour. Between-year coefficients of variation of the estimated discards were also calculated for each species. In instances where a species was reported as discarded in only one of the two years examined, discards were estimated for the single year in which the species was reported discarded. Coefficients of variation of calculated discards could not be calculated for species reported from single years.

Gag grouper handline vessel discards, estimated for the SEDAR 10 gag grouper assessment (McCarthy 2006b), were used for the South Atlantic snapper–grouper handline fishery discard estimates. Methods are described in Section 4.2.4.1.6.

South Atlantic handline vessel discards of greater amberjack and red snapper were estimated for the SEDAR 15 assessment process (McCarthy 2007) and were used for the discard estimates for the South Atlantic snapper–grouper handline fishery. Methods were similar to those described above, with discard rate calculated from coastal discard logbook data and total effort calculated from coastal logbook data. A GLM was used to identify factors with significant effects on discard rate, and data were stratified by those factors. Discards were estimated by stratum (mean stratum discard rate multiplied by stratum total effort) and summed across strata within each year.

Snowy grouper (*Epinephelus niveatus*), speckled hind (*Epinephelus drummondhayi*), and warsaw grouper (*Epinephelus nigritus*) discards for the South Atlantic handline vessel discard estimates were produced for the SEDAR 4 assessment process (Poffenberger 2003) and were used for the discard estimates of the South Atlantic snapper–grouper handline fishery. Data were stratified by year, area fished, and species targeted (defined as the species making up the largest percentage of the reported landings for the trip). For

each year, the areas fished and target species of all trips that reported discards of snowy grouper, speckled hind, or warsaw grouper were identified. Total effort was defined as the total number of trips made by handline vessels within strata that also contained trips reporting discards. Discard rate was defined as number of discards per trip. Total discards were estimated by multiplying the stratum mean discard rate by the total number of trips in the stratum, then summing across strata.

4.2.4.1.8 Gulf of Mexico Coastal Migratory Pelagic Troll Fishery

Discard rates for the Gulf of Mexico coastal migratory pelagic troll fishery were calculated from discard reports made to the SEFSC Miami's coastal discard logbook program for the years 2005–06. Discard rate for each species was defined as the reported number of discards of a species per hook–hour fished for each trip. Mean discard rate for each species was determined by year, along with the among-trips coefficients of variation.

Total effort (in hook–hours fished) for the fishery was calculated from the SEFSC coastal logbook program database for the years 2005–06. Extrapolation to estimate total discards by the fishery was accomplished by multiplying total hook–hours fished by the number of species-specific mean discards per hook–hour. Among-year CVs of the estimated discards were also calculated for each species. In instances where a species was reported as discarded in only one of the two years examined, discards were estimated for the single year in which the species was reported discarded. Coefficients of variation of calculated discards could not be calculated for species reported from single years.

4.2.4.1.9 South Atlantic Coastal Migratory Pelagic Troll Fishery (includes Atlantic Dolphin Wahoo Fishery)

Fishing effort directed to the South Atlantic coastal migratory pelagic troll fishery could not be differentiated from effort directed to the Atlantic dolphin wahoo fishery, based on the available coastal logbook and coastal discard logbook data. Discard estimates were confounded between those fisheries, and discards were estimated for the South Atlantic coastal migratory pelagic troll fishery only.

Discard rates for the South Atlantic coastal migratory pelagic troll fishery were calculated from discard reports made to the SEFSC coastal discard logbook program for the years 2005–06. Discard rate for each species was defined as the reported number of discards of a species per hook–hour fished for each trip. Mean discard rate for each species was determined by year, along with the among trip CVs.

Total effort (in hook–hours fished) for the fishery was calculated from the SEFSC coastal logbook program database for the years 2005–06. Extrapolation to total discards by the fishery was accomplished by multiplying total hook–hours fished by species-specific mean discards per hook–hour. Among-year CVs of the estimated discards were also calculated for each species. In instances where a species was reported as discarded in only one of the two years examined, discards were estimated for the single year in which the species was reported discarded. Coefficients of variation of calculated discards could not be calculated for species reported from single years.

Discards of greater amberjack (*Seriola dumerili*) from South Atlantic trolling vessels were estimated during SEDAR 15 (McCarthy 2007); those estimates were used for the South Atlantic coastal migratory pelagic troll fishery. Methods are described in Section 4.2.4.1.7.

4.2.4.1.10 Southeastern Atlantic Shrimp Trawl Fishery

Bycatch estimates were not available for inclusion in this report. The region is currently undergoing a peer review of fish bycatch estimates, which will be included in future editions of this report.

4.2.4.1.11 Fish Discard Estimation Methods for the North Carolina Inshore (Bays and Rivers) Gillnet Fishery

This is a state-managed fishery, so while some protected species bycatch estimates were developed from Federal observer program data, no fish discard estimates were available.

4.2.4.2 Marine Mammal Bycatch Estimation Methods

4.2.4.2.1 Atlantic and Gulf of Mexico Shark Bottom Longline Fishery

A delta lognormal-based ratio estimator method was used for estimating catch rates of marine mammals in the commercial directed shark bottom longline fishery. Extrapolation factors were based on logbook data. For a description of data and methods see Fairfield Walsh and Garrison (2006).

4.2.4.2.2 Large Coastal and Small Coastal Shark Aggregates (Drift, Strike, and Bottom Gillnet)

Several methods have been applied to estimate marine mammal bycatch rates in shark gillnet fisheries. Initially, a

delta lognormal-based ratio estimator method was used for estimating catch rates in drift nets only. However, a more recent examination of the available data, along with the expansion of the observer program to include other components of the fishery, resulted in the use of a simple ratio estimator. Bycatch rate estimates were expanded to total estimates using logbook-reported effort data. Estimates of bycatch were likely biased and highly uncertain, due to two factors. First, there was direct evidence of underreporting of fishing effort in the logbook. Second, the fishermen did not report the type of fishing (e.g., strike, sink, or drift) used in a particular set. Therefore, it was difficult to reliably attribute the bycatch rate of a particular set to the appropriate type of fishing employed. The most recent estimates of marine mammal bycatch are available in Garrison (2007).

4.2.4.2.3 Gulf of Mexico Shrimp Trawl Fishery

There have been occasional documented mortalities of bottlenose dolphins in shrimp trawls in both the Atlantic and the Gulf of Mexico. In addition, depredation of catch and scavenging of discarded bycatch by bottlenose dolphins is a common occurrence. There has been recent video documentation of bottlenose dolphins feeding inside TEDs during active trawling. Because the observer program for the shrimp fisheries has been voluntary and research driven, the extent and magnitude of marine mammal bycatch is unknown. Recent changes to the observer programs should allow estimation of bycatch for inclusion in future editions of this report.

4.2.4.2.4 Atlantic and Gulf of Mexico HMS Pelagic Longline Fishery

A delta lognormal-based ratio estimator method is used for estimating catch rates of marine mammal species in the Atlantic and Gulf of Mexico HMS pelagic longline fishery. For a description of data and methods see Garrison (2003b).

4.2.4.2.5 Gulf of Mexico Reef Fish Bottom Longline Fishery

Bycatch estimates were not available for inclusion in this report. The region is currently undergoing a peer review of marine mammal bycatch estimates, which will be included in future editions of this report.

4.2.4.2.6 Gulf of Mexico Reef Fish Handline Fishery

Marine mammal bycatch has not been documented in this fishery. No bycatch estimates were developed.

4.2.4.2.7 South Atlantic Snapper–Grouper Handline Fishery

Marine mammal bycatch has not been documented in this fishery. No bycatch estimates were developed.

4.2.4.2.8 Gulf of Mexico Coastal Migratory Pelagic Troll Fishery

Marine mammal bycatch has not been documented in this fishery. No bycatch estimates were developed.

4.2.4.2.9 South Atlantic Coastal Migratory Pelagic Troll Fishery (includes Atlantic Dolphin Wahoo Fishery)

Marine mammal bycatch has not been documented in this fishery. No bycatch estimates were developed.

4.2.4.2.10 Southeastern Atlantic Shrimp Trawl Fishery

There have been occasional documented mortalities of bottlenose dolphins in shrimp trawls in both the Atlantic and the Gulf of Mexico. In addition, depredation of catch and scavenging of discarded bycatch by bottlenose dolphins is a common occurrence. There has been recent video documentation of bottlenose dolphins feeding inside TEDs during active trawling. Because the observer program for the shrimp fisheries have been voluntary and research driven, the extent and magnitude of marine mammal bycatch is unknown. Recent changes to the observer programs should allow estimation of bycatch.

4.2.4.2.11 North Carolina Inshore (Bays and Rivers) Gillnet Fishery

Bycatch estimates were not available for inclusion in this report. The region is currently undergoing a peer review of marine mammal bycatch estimates, which will be included in future editions of this report.

4.2.4.3 Other Protected Species Bycatch Estimation Methods

The delta estimator (Pennington 1993) is the primary method used for estimating protected species bycatch rates at the SEFSC. This method has been used to develop estimates of sea turtle bycatch in pelagic longline fisheries since 1999 (Johnson et al. 1999) through 2005 (Fairfield Walsh and Garrison 2006), has recently been used in estimates made for the shark drift gillnet fishery, and is being used in the shark bottom longline fishery. The remainder

of this section on the details of the method has been taken from Garrison (2003a).

The mean and variance of catch rates for marine mammals and turtles in observed longline sets were calculated using a delta estimator (Pennington 1993). The unit of effort in this analysis is the number of hooks, consistent with methods used to estimate total catch and bycatch of finfish and previous analyses of protected species interactions (Johnson et al. 1999; Garrison 2003a). The delta mean bycatch rate for each analytical stratum *t* is calculated as

$$(1)\quad C_t = \frac{m_t}{n_t} e^{L_t} G\left(s_{L_t}^2/2\right)$$

where

m_t is the number of sets with observed bycatch
n_t is the total number of observed sets
L_t is the mean of the log-transformed number of animals taken per 1000 hooks when bycatch occurred
s_L^2 is the observed sample variance of the log-transformed bycatch rate
G is the cumulative probability function from the Poisson distribution given as:

$$(2)\quad G\left(s_L^2/2\right) = 1 + \frac{m_t - 1}{m_t}\left(s_L^2/2\right) + \sum_{j=2}^{\infty} \frac{(m_t-1)^{2j-1}}{m_t^j (m_t+1)(m_t+3)....(m_t+2j-3)} \times \frac{\left(s_L^2/2\right)^j}{j!}.$$

The series was computed numerically over *j* terms until it met a convergence criterion of a change in the function value of <0.0001 with additional terms *j*. Convergence was generally achieved with <10 terms. The variance of the delta estimator is:

$$(3)\quad \mathrm{var}(C_t) = \frac{m_t}{n_t}\left(e^{2L_t}\right)\left[\frac{m_t}{n_t} G^2\left(s_L^2/2\right) - \left(\frac{m_t - 1}{n_t - 1}\right) G\left(\frac{m-2}{m-1} s_L^2\right)\right].$$

When m_t is equal to 1, the mean bycatch rate reduces to the simple mean rate where

$$(4)\quad C_t = \frac{\exp(L_t)}{n_t}$$

and

$$(5)\quad \mathrm{var}(C_t) = \left(\frac{\exp(L_t)}{n_t}\right)^2.$$

The C_t calculated above gives the mean number of animals killed per 1,000 hooks in the observed trips. To estimate total interactions, *N*, these rates were multiplied by the total number of hooks reported to the Fisheries Logbook System for each analytical stratum. The stratified estimates and associated variances were summed to provide annual estimates for each species. Approximate 95% confidence intervals were calculated, assuming lognormal distribution of total mortality as N/C and $N \times C$ for the lower and upper confidence bounds, respectively, where

$$(6)\quad C = \exp\left[z_\alpha \sqrt{\mathrm{var}(\ln N)} \right]$$

and

$$(7)\quad \mathrm{var}(\ln N) = \ln\left[1 + \mathrm{var}(N)/N^2\right]$$

where z_α is 1.906, the *z* score for α = 0.05.

4.2.4.3.1 Atlantic and Gulf of Mexico Shark Bottom Longline Fishery

A binomial-based and delta lognormal-based ratio estimator method was used for estimating catch rates of ESA-listed species for the commercial directed Atlantic and Gulf of Mexico shark bottom longline fishery for 2004 and 2005. These were estimated as annual fully stratified (area and season) and annual pooled, expanded using logbook data. The largest estimate by species was used in the report. For a full description of data and methods see Richards (2007).

4.2.4.3.2 Large Coastal and Small Coastal Shark Aggregates (Drift, Strike, and Bottom Gillnet)

Several methods have been applied to estimate sea turtle bycatch rates in the shark gillnet fisheries. Initially, a delta lognormal-based ratio estimator method was used for estimating catch rates in drift nets only. However, a more recent examination of the available data, along with the expansion of the observer program to include other components of the fishery, resulted in the use of a simple ratio estimator. Bycatch rate estimates were expanded to total estimates using logbook-reported effort data. Estimates of bycatch were likely biased and were highly uncertain due to two factors. First, there was direct evidence of underreporting of fishing effort to the logbook. Second, the fishermen do not report the type of fishing (e.g., strike, sink, or drift) used in a particular set. Therefore, it was difficult to reliably attribute the bycatch rate of a reported set to the appropriate type of fishing employed. The most recent estimates of sea turtle bycatch were in Garrison (2007).

4.2.4.3.3 Gulf of Mexico Shrimp Trawl Fishery

A ratio estimator was used for estimating catch rates of sea turtle species in both the Southeast Atlantic shrimp trawl and Gulf of Mexico shrimp trawl fisheries. Expansion factors were based on logbook data. The most recent estimate available for loggerhead and leatherback sea turtles is from Epperly et al. (2002), and for green and Kemp's ridley is from NMFS (2002). The confidence intervals provided in Epperly et al. (2002) are not appropriate. For a description of data and methods see Epperly et al. (2002) and NMFS (2002). The estimates provided in both were based on catch rates in naked nets, i.e., nets without turtle excluder devices (TEDs) and were estimates of expected interactions. Because most trawls used in the shrimp fishery are required to use TEDs, the vast majority of the expected interactions never would be observed as the turtles should escape the trawl through the TED opening and presumably survive the interaction. TED designs must be certified by NMFS, based on specific protocols (Department of Commerce 1987; Renaud et al., 1990). Foremost among the criteria for certification is the requirement that a prospective design releases 97% of the turtles; however, at the time many loggerheads and leatherbacks were too large to escape (Epperly and Teas, 2002). For sea turtle bycatch we report the proportion of the catch expected to be retained in the TED-equipped nets and subjected to forced submergence, not the expected total number of interactions.

4.2.4.3.4 Atlantic and Gulf of Mexico HMS Pelagic Longline Fishery

A delta lognormal-based ratio estimator method was used for estimating catch rates of ESA-listed species in the Atlantic and Gulf of Mexico HMS pelagic longline fishery. For sea turtle estimate details see Fairfield Walsh and Garrison (2006). For sea bird estimates see Hata (2006).

4.2.4.3.5 Gulf of Mexico Reef Fish Bottom Longline Fishery[3]

Discard rates for the Gulf of Mexico reef fish bottom longline fishery were calculated from discard reports made to the SEFSC coastal discard logbook program for the years 2005–06. Discard rate for each species was defined as the reported number of discards of a species per hook fished for each trip. Mean discard rate for each species was determined by year, along with among-trip CVs.

Total effort (in hooks fished) for the fishery was calculated from the SEFSC coastal logbook program database for the years 2005–06. Extrapolation to the total discards by the fishery was accomplished by multiplying total hooks fished by the species-specific mean discards per hook. Among-year CVs of the estimated discards were also calculated for each species. In instances where a species was reported as discarded in only one of the two years examined, discards were estimated for the single year in which the species was reported discarded. Coefficients of variation of calculated discards could not be calculated for species reported from single years.

4.2.4.3.6 Gulf of Mexico Reef Fish Handline Fishery

Discard rates for the Gulf of Mexico reef fish handline fishery were calculated from discard reports made to the SEFSC coastal discard logbook program for the years 2005–06. Discard rate for each species was defined as the reported number of discards of a species per hook–hour fished for each trip. Mean discard rate for each species was determined by year, along with among-trips coefficients of variation.

[3] New bycatch estimation methods are discussed in SEFSC (2008).

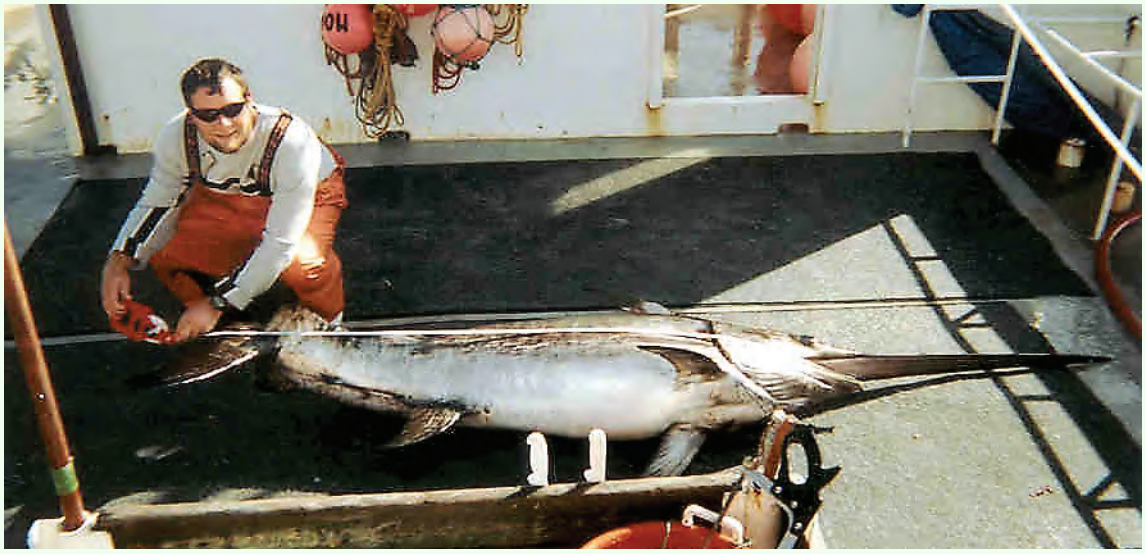


Photo: NMFS, SEFSC

An observer measures a swordfish.

Total effort for the fishery (in hook–hours fished) was calculated from the SEFSC coastal logbook program database for the years 2005–06. Extrapolation to the total discards by the fishery was accomplished by multiplying total hook-hours fished by the species-specific mean discards per hook-hour. Among-year CVs of the estimated discards were also calculated for each species. In instances where a species was reported as discarded in only one of the two years examined, discards were estimated for the single year in which the species was reported discarded. Coefficients of variation of calculated discards could not be calculated for species reported from single years.

4.2.4.3.7 South Atlantic Snapper–Grouper Handline Fishery

Discard rates for the South Atlantic snapper–grouper handline fishery were calculated from discard reports made to the SEFSC coastal discard logbook program for the years 2005–06. Discard rate for each species was defined as the reported number of discards of a species per hook-hour fished for each trip. Mean discard rate for each species was determined by year along, with among-trip CVs.

Total effort (in hook-hours fished) for the fishery was calculated from the SEFSC coastal logbook program database for the years 2005–06. Extrapolation to the total discards by the fishery was accomplished by multiplying total hook-hours fished by the species-specific mean discards per hook-hour. Among-year CVs of the estimated discards were also calculated for each species. In instances where a species was reported as discarded in only one of the two years examined, discards were estimated for the single year in which the species was reported discarded. Coefficients of variation of calculated discards could not be calculated for species reported from single years.

4.2.4.3.8 Gulf of Mexico Coastal Migratory Pelagic Troll Fishery

Discard rates for the Gulf of Mexico coastal migratory pelagic troll fishery were calculated from discard reports made to the SEFSC coastal discard logbook program for the years 2005–06. Discard rate for each species was defined as the reported number of discards of a species per hook-hour fished for each trip. Mean discard rate for each species was determined by year, along with among-trip CVs.

Total effort (in hook-hours fished) for the fishery was calculated from the SEFSC Miami coastal logbook program database for the years 2005–06. Extrapolation to total discards by the fishery was accomplished by multiplying total hook-hours fished by the species-specific mean discards per hook-hour. Among-year coefficients of variation of the estimated discards were also calculated for each species. In instances where a species was reported as discarded in only one of the two years examined, discards were estimated for the single year in which the species was reported discarded. Coefficients of variation of calculated discards could not be calculated for species reported from single years.

4.2.4.3.9 South Atlantic Coastal Migratory Pelagic Troll Fishery (includes Atlantic Dolphin Wahoo Fishery)

Fishing effort directed to the South Atlantic coastal migratory pelagic troll fishery cannot be differentiated from effort directed to the Atlantic Dolphin Wahoo fishery with the available coastal logbook and coastal discard logbook data. Discard estimates are therefore confounded between those fisheries and discards were estimated for the South Atlantic coastal migratory pelagic troll fishery only.

Discard rates for the South Atlantic coastal migratory pelagic troll fishery were calculated from discard reports made to the SEFSC, Miami's coastal discard logbook program for the years 2005–06. Discard rate for each species was defined as the reported number of discards of a species per hook-hour fished for each trip. Mean discard rate for each species was determined by year, along with among-trip CVs.

Total effort (in hook-hours fished) for the fishery was calculated from the SEFSC Miami's coastal logbook program database for the years 2005–06. Extrapolation to total discards by the fishery was accomplished by multiplying total hook-hours fished by the species-specific mean discards per hook-hour. Among-year CVs of the estimated discards were also calculated for each species. In instances where a species was reported as discarded in only one of the two years examined, discards were estimated for the single year in which the species was reported discarded. Coefficients of variation of calculated discards could not be calculated for species reported from single years.

4.2.4.3.10 Southeastern Atlantic Shrimp Trawl Fishery

A ratio estimator was used for estimating catch rates of sea turtle species in both the Southeast Atlantic shrimp trawl and Gulf of Mexico shrimp trawl fisheries. Expansion factors were based on logbook data. The most recent estimates available are from Epperly et al. (2002) for loggerhead and leatherback sea turtles and from NMFS (2002) for green and Kemp's ridley. The confidence intervals provided in Epperly et al. (2002) are not appropriate. For a description of data and methods see Epperly et al. (2002) and NMFS (2002). The estimates provided in both were based on catch rates in naked nets, i.e., nets without turtle excluder devices (TEDs) and were estimates of expected interactions. Because most trawls used in the shrimp fishery are required to use TEDs, the vast majority of the expected interactions never would be observed as the turtles should escape the trawl through the TED opening and presumably survive the interacation. TED designs must be certified by NMFS, based on specific protocols (Department of Commerce 1987, 1990). Foremost among the criteria for certification is the requirement that a prospective design releases 97% of the turtles; however, at the time many loggerheads and leatherbacks were too large to escape (Epperly and Teas, 2002). For sea turtle bycatch we report the proportion of the catch expected retained in the TED-equipped nets and subjected to forced submergence, not the expected total number of interactions.

4.2.4.3.11 North Carolina Inshore (Bays and Rivers) Gillnet Fishery

A ratio estimator with no measure of uncertainty was used for the North Carolina inshore gillnet fishery. Extrapolation factors were based on fishers' reports to the North Carolina Division of Marine Fisheries. For details of data see Price (2007).

4.2.4.3.12 North Carolina Southern Flounder Pound Net Fishery

A delta lognormal approach (Pennington 1983) was used to estimate the mean and variance of sea turtle catch per pound per week by stratum from data collected as part of a relative abundance index study. Weekly estimates from aerial surveys of the total pounds fished by stratum were used to extrapolate to total bycatch by week. Estimated total catch was summed across weeks and strata to produce annual estimates of estimated total catch.

4.2.5 Tier Classification for Southeast Region Fisheries

The quality of bycatch data and estimation methods were analyzed for 26 Southeast Region fisheries with Federal management authority or relevant Federal data-collection programs. Other data may be available for state, international, and tribal fisheries; however, these programs were beyond the scope of this initial report. The remaining 22 fisheries are not federally managed and have no relevant Federal data-collection programs, and were therefore excluded from the analysis.

Unique tier scores were assigned to each fishery using the tier scoring procedures outlined in Section 3 for fish, marine mammals, and other protected species (Table 4.2.3). Over half of Southeast Region fisheries were classified in Tiers 1, 2, or 3 for fish (Figure 4.2.2A). The remaining 10 fisheries (38%) were classified as Tier 0. Tier scores for marine mammals and other protected species were the same, with 10 fisheries (38%) scoring in tiers 1, 2, or 3, and the remaining 16 fisheries (62%) scoring in tier 0 (Figures 4.2.2B and C). No fisheries in the Southeast Region were classified as Tier 4.

Table 4.2.3
The 2005 fishery tier classifications for Southeast Region fisheries (listed alphabetically, first by management authority and then by fishery name). Shaded fisheries were evaluated for this report. Only relevant Federal data sources were evaluated for this report.

Fishery Name	Management Authority	Fish Tier	Marine Mammal Tier	Other Protected Species Tier
Caribbean Gillnet	Federal	0	0	0
Caribbean Mixed Species Trap/Pot	Federal	0	0	0
Caribbean Spiny Lobster Trap/Pot	Federal	0	0	0
Gulf of Mexico Coastal Migratory Pelagic Gillnet	Federal	1	0	0
Gulf of Mexico Coastal Migratory Pelagic Troll	Federal	1	0	0
Gulf of Mexico Reef Fish Bottom Longline	Federal	2	1	1
Gulf of Mexico Reef Fish Handline	Federal	2	1	1
Gulf of Mexico Shrimp Trawl	Federal	2	2	2
Large Coastal and Small Coastal Shark Aggregates (Drift, Strike, and Bottom Gillnet)	Federal	3	3	3
South Atlantic Coastal Migratory Pelagic Troll	Federal	1	0	0
South Atlantic Snapper–Grouper Bottom Longline	Federal	1	0	0
South Atlantic Snapper–Grouper Handline	Federal	1	0	0
Southeast Atlantic Black Sea Bass Pot	Federal	1	0	0
Atlantic and Gulf of Mexico HMS Pelagic Longline	Federal	3	2	2
Atlantic and Gulf of Mexico Shark Bottom Longline	Federal	3	2	2
Southeastern Atlantic Shrimp Trawl	Federal	2	2	2
Southeastern Atlantic, Gulf of Mexico Golden Crab Trap/Pot	Federal	0	0	0
Spearfishing for Tuna	Federal	0	0	0
Winter Fluke (Flounder) Trawls	Federal	0	0	0
Florida, Puerto Rico, and the U.S. Vigin Islands Spiny LobsterTrap/Pot Fishery	Federal, state	0	0	0
North Carolina Coastal Gillnet[a]	Federal, state	0	0	0
Southeastern Atlantic Stone Crab Trap/Pot	Federal, state	0	0	0
Southeastern Atlantic Skimmer Trawls	State			
Caribbean Haul/Beach Seine	State			
Florida West Coast Sardine Purse Seine	State			

Table 4.2.3 (continued)

Fishery Name	Management Authority	Fish Tier	Marine Mammal Tier	Other Protected Species Tier
Gulf of Mexico Blue Crab	State			
Gulf of Mexico Coastal Gillnet[b]	State			
Gulf of Mexico Haul/Beach Seine	State			
Gulf of Mexico Marine Shrimp Butterfly Nets	State	1	1	1
Gulf of Mexico Marine Shrimp Skimmer Trawls	State	1	1	1
Gulf of Mexico Menhaden Purse Seine	State	1	1	1
Gulf of Mexico Oyster	State			
Gulf of Mexico Shrimp Cast Net	State			
North Carolina Haul/Beach Seine - Long Haul	State			
North Carolina Inshore (Bays and Rivers) Gillnet	State			
North Carolina Pound Net (Croaker, Weakfish)	State			
North Carolina Southern Flounder Pound Net	State			
North Carolina Stop Nets	State			
South Atlantic Blue Crab	State			
South Atlantic Coastal Gillnet[b]	State			
Southeast Calico Scallop Trawl	State	0	0	0
Southeast Fish Trawl	State			
Southeastern Atlantic Marine Shrimp Butterfly Nets	State			
Southeastern Atlantic Marine Shrimp Cast Net	State			
Southeastern Atlantic Menhaden	State			
Southeastern Atlantic Ocean, Gulf of Mexico, and Caribbean Shellfish Dive, Hand/Mechanical Collection	State			
Southeastern Atlantic, Haul/Beach Seine	State			
Surface Trawl Jellyfish	State			

[a] The North Carolina coastal gillnet fishery was classified as Tier 0 in all three categories because, although there is a developing observer program in place, the observer program is for a relatively small portion of the entire fishery and is not considered representative.

[b] Federal data-collection programs for these fisheries were initiated in 2006; however, since the report is based on 2005 data, these fisheries were not evaluated for this report.

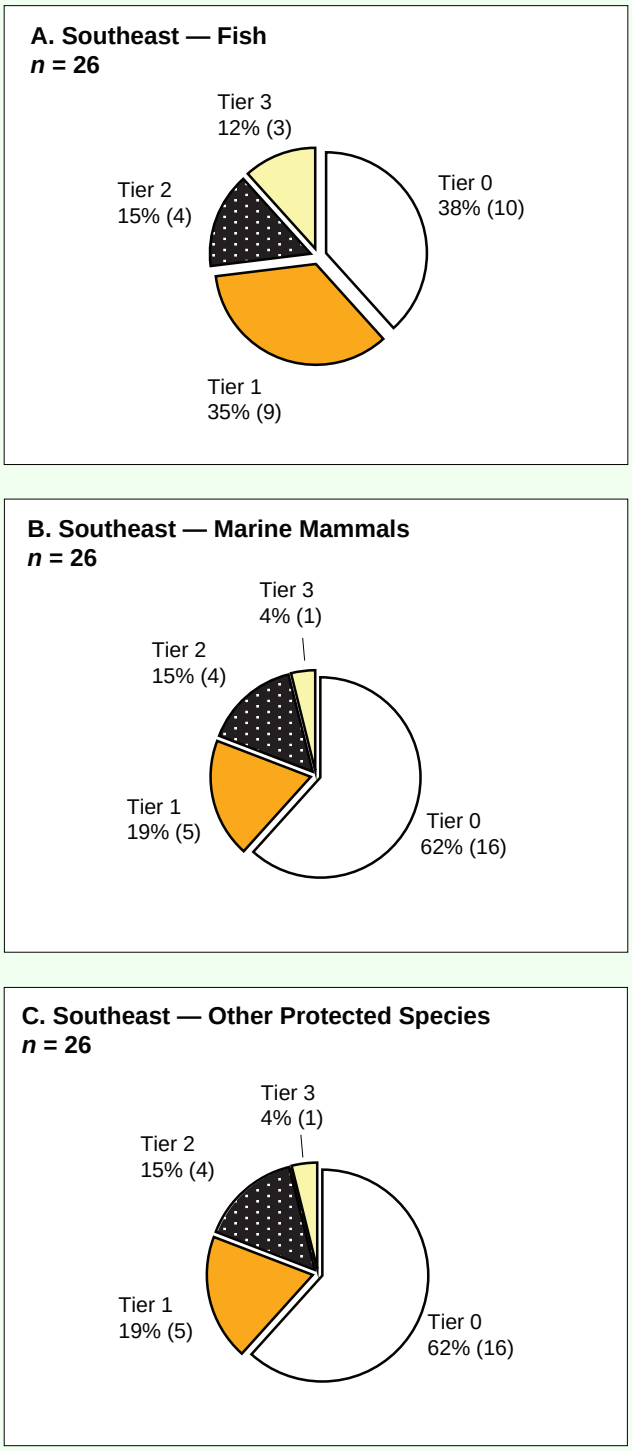


Figure 4.2.2
Southeast Region tier classifications by number and percentage for fisheries with Federal management or Federal data-collection programs for A) fish, B) marine mammals, and C) other protected species. Tier scores are for the year 2005.

4.2.6 Southeast Region Key Stocks

Eighty-two key stocks were identified in the Southeast Region (Table 4.2.4). As in all regions, not all stocks and populations listed as key stocks have bycatch estimates. For example, all ESA-listed populations found in the Southeast Region (16) were prioritized for inclusion in the list of key species, regardless of whether bycatch occurs.

Seventy-eight percent (63) of the key stocks identified in the Southeast were fish stocks (Figure 4.2.3). This includes three ESA-listed species: Gulf sturgeon (*Acipenser oxyrinchus desotio*), shortnose sturgeon (*Acipenser brevirostrum desotoi*), and smalltooth sawfish (*Pristis pectinata*). The majority of fish stocks were added through the quantitative analysis process, as described in Section 3. Nine FSSI fish stocks were added through the qualitative process: bigeye tuna (*Thunnus obesus*), the South Atlantic stock of red drum, the Gulf of Mexico stock of cobia (*Rachycentron canadum*), the South Atlantic/Gulf of Mexico stock of dolphinfish (*Coryphaena hippurus*), Gulf and Atlantic stocks of king mackerel (*Scomberomorus cavalla*), Gulf and Atlantic stocks of Spanish mackerel (*Scomberomorus maculatus*), and the Gulf of Mexico stock of tilefish (*Lopholatilus chamaeleonticeps*). Bigeye tuna was added due to increased public concern over the sustainability of Atlantic tuna harvests, while the South Atlantic stock of red drum was added for regional consistency (so that all substocks of red drum would be included, as it is impossible to determine which substock an individual fish comes from in some fisheries). The remaining five stocks were added due to high visibility/public concern, as they support regionally important fisheries. Four stocks were removed from the key stocks list due to high rates of post-release survival: blacktip shark (*Carcharhinus limbatus*), nurse shark (*Ginglymostoma cirratum*), tiger shark (*Galeocerdo cuvier*), and vermilion snapper[4] (*Rhomboplites aurorubens*).

The remaining 19 stocks are composed of 11 marine mammal stocks (six ESA-listed), six sea turtle populations (all ESA-listed), and two seabird populations (both ESA-listed). Five non-ESA-listed marine mammal species were added through the quantitative process. Both *Globicephala* species (long- and/or short-finned pilot whales) are included as key stocks; differentiating between the two species is difficult because they are physically similar and their ranges overlap, thus it is often unclear whether an individual belongs to one species or the other without detailed analysis. No protected species were added through the qualitative process.

[4] The post-release survival for vermilion rockfish differs between recreational (25%) and commercial fisheries (40%); this species was removed from the key stocks list because the report focused only on commercial fisheries. However, vermilion rockfish will be evaluated for inclusion as a key stock in future editions of this report.

Table 4.2.4
Key fish and marine mammal stocks and key sea turtle and seabird populations for the Southeast Region. Overfishing/ Overfished status based on First Quarter 2008 FSSI report.

Key Fish Stocks Listed by FSSI			
Species/stock name		Overfishing	Overfished
Common name	Scientific name		
Bigeye tuna, South Atlantic	*Thunnus obesus*	No	No — rebuilding
Black grouper, South Atlantic	*Mycteroperca bonaci*	Yes	Unknown
Black grouper, Gulf of Mexico	*Mycteroperca bonaci*	Unknown	Undefined
Black sea bass, South Atlantic	*Centropristis striata*	Yes	Yes
Blue marlin, South Atlantic	*Makaira nigricans*	Yes	Yes
Blue shark, South Atlantic[a]	*Prionace glauca*	Unknown	Unknown
Bluefin tuna, West Atlantic	*Thunnus thynnus*	Yes	Yes
Cobia, Gulf of Mexico	*Rachycentron canadum*	No	No
Dolphinfish, South Atlantic/Gulf of Mexico	*Coryphaena hippurus*	No	No
Dusky shark	*Carcharhinus obscurus*	Yes	Yes
Gag, Gulf of Mexico	*Mycteroperca microlepis*	Yes	Undefined
Gag, South Atlantic	*Mycteroperca microlepis*	Yes	No
Goliath grouper, South Atlantic/Gulf of Mexico	*Epinephelus itajara*	No	Unknown
Gray triggerfish, Gulf of Mexico	*Balistes capriscus*	Yes	Undefined
Gray triggerfish, South Atlantic	*Balistes capriscus*	No	Unknown
Greater amberjack, Gulf of Mexico	*Seriola dumerili*	Yes	Yes
Greater amberjack, South Atlantic	*Seriola dumerili*	No	No
Hogfish, Gulf of Mexico	*Lachnolaimus maximus*	Unknown	Undefined
Hogfish, South Atlantic	*Lachnolaimus maximus*	Unknown	Unknown
King mackerel, Gulf group	*Scomberomorus cavalla*	No	No — rebuilding
King mackerel, Atlantic group	*Scomberomorus cavalla*	No	No
Little tunny	*Euthynnus alletteratus*	No	Unknown
Nassau grouper, Gulf of Mexico	*Epinephelus striatus*	No	Undefined
Red drum, Gulf of Mexico	*Sciaenops ocellatus*	No	Undefined
Red drum, South Atlantic	*Sciaenops ocellatus*	Yes	Unknown
Red grouper, Gulf of Mexico	*Epinephelus morio*	No	No
Red grouper, South Atlantic	*Epinephelus morio*	Yes	Unknown
Red porgy,South Atlantic	*Pagrus pagrus*	No	Yes
Red snapper, Gulf of Mexico	*Lutjanus campechanus*	Yes	Yes
Red snapper, South Atlantic	*Lutjanus campechanus*	Yes	Unknown
Sailfish, West Atlantic	*Istiophorus platypterus*	Yes	Yes
Sandbar shark[a]	*Carcharhinus plumbeus*	Yes	Yes

Table 4.2.4 (continued)

Key Fish Stocks Listed by FSSI (cont.)			
Species/stock name		**Overfishing**	**Overfished**
Common name	**Scientific name**		
Scamp, South Atlantic	*Mycteroperca phenax*	No	Unknown
Snowy grouper, Gulf of Mexico	*Epinephelus niveatus*	Unknown	Undefined
Snowy grouper, South Atlantic	*Epinephelus niveatus*	Yes	Yes
Spanish mackerel, Gulf Group	*Scomberomorus maculatus*	No	No
Spanish mackerel, Atlantic Group	*Scomberomorus maculatus*	No	No
Speckled hind, South Atlantic	*Epinephelus drummondhayi*	Yes	Unknown
Tilefish, Gulf of Mexico	*Lopholatilus chamaeleonticeps*	Yes	No
Warsaw grouper, South Atlantic	*Epinephelus nigritus*	Yes	Unknown
White grunt	*Haemulon plumieri*	No	Unknown
White marlin, South Atlantic	*Tetrapturus albidus*	Yes	Yes
Wreckfish	*Polyprion americanus*	No	Unknown
Yellowedge grouper, Gulf of Mexico	*Epinephelus flavolimbatus*	Unknown	Undefined
Yellowtail snapper, South Atlantic/Gulf of Mexico	*Ocyurus chrysurus*	No	No
Large Coastal Shark Complex (key stocks only)		Unknown	Unknown
Bull shark	*Carcharhinus leucas*		
Lemon shark	*Negaprion brevirostris*		
Scalloped hammerhead, South Atlantic	*Sphyrna lewini*		
Scalloped hammerhead, South Atlantic/Gulf of Mexico	*Sphyrna lewini*		
Silky shark	*Carcharhinus falciformis*		
Spinner shark	*Carcharhinus brevipinna*		

Key Fish Stocks Listed by ESA		
Species/stock name		**Stock status**
Common name	**Scientific name**	
Gulf sturgeon	*Acipenser oxyrinchus desotoi*	Threatened
Shortnose sturgeon	*Acipenser brevirostrum*	Endangered
Smalltooth sawfish	*Pristis pectinata*	Endangered

Table 4.2.4 (continued)

Key Fish Stocks Not Listed by FSSI or ESA		
Species/stock name		**Stock status**
Common name	**Scientific name**	
Black snapper	*Apsilus dentatus*	Not applicable
Blackfin snapper	*Lutjanus buccanella*	
Gray snapper	*Lutjanus griseus*	
Great hammerhead, South Atlantic/Gulf of Mexico	*Sphyrna mokarran*	
Lane snapper	*Lutjanus synagris*	
Mutton snapper	*Lutjanus analis*	
Red drum, South Atlantic/Gulf of Mexico	*Sciaenops ocellatus*	
Silk snapper	*Lutjanus vivanus*	
Yellowfin grouper	*Mycteroperca venenosa*	

Key Marine Mammal Stocks Listed by ESA		
Species/stock name		**Stock status**
Common name	**Scientific name**	
Blue whale	*Balaenoptera musculus*	Endangered
Fin whale	*Balaenoptera physalus*	Endangered
Humpback whale	*Megaptera novaeangliae*	Endangered
North Atlantic right whale	*Eubalaena glacialis*	Endangered
Sei whale	*Balaenoptera borealis*	Endangered
Sperm whale	*Physeter macrocephalus*	Endangered

Key Marine Mammal Stocks Not Listed by ESA			
Species/stock name		**ZMRG**	**Stock status[b]**
Common name	**Scientific name**		
Bottlenose dolphin, Western North Atlantic Coastal	*Tursiops truncatus*	Variable	Variable
Pantropical spotted dolphin, Western North Atlantic	*Stenella attenuata*	0.3	Unknown
Pilot whale, long-finned	*Globicephala melaena (melas)*	24.9	Unknown
Pilot whale, short-finned	*Globicephala macrorhynchus*	24.9	Unknown
Risso's dolphin, Western North Atlantic	*Grampus griseus*	12.9	Unknown

Table 4.2.4 (continued)

Key Sea Turtle Populations		
Species/stock name		**Population Status**
Common name	**Scientific name**	
Green sea turtle	*Chelonia mydas*	Threatened (except in Florida and the Pacific coast of Mexico, where the breeding populations are endangered)
Hawksbill sea turtle	*Eretmochelys imbricata*	Endangered
Kemp's ridley sea turtle	*Lepidochelys kempii*	Endangered
Leatherback sea turtle	*Dermochelys coriacea*	Endangered
Loggerhead sea turtle	*Caretta caretta*	Threatened
Olive ridley sea turtle	*Lepidochelys olivacea*	Threatened (except the Pacific coast of Mexico breeding populations, which are endangered)

Key Seabird Populations Listed by ESA		
Species/stock name		**Population status**
Common name	**Scientific name**	
Cahow	*Pterodroma cahow*	Endangered
Roseate tern, northeast nesting population	*Sterna dougallii dougallii*	Endangered

Key Seabird Populations Not Listed by ESA			
Species/stock name		**Bycatch concern**	**Population status**
Common name	**Scientific name**		
None			

[a] Blue sharks and sandbar sharks are part of the Large Coastal Shark Complex under the HMS FMP, but are assessed separately.
[b] Stock status based on Waring et al. (2007).

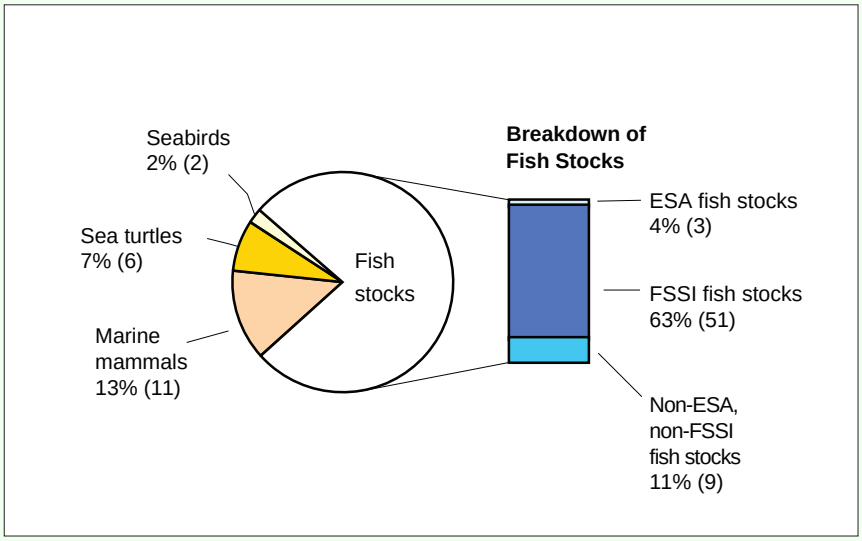


Figure 4.2.3
Number and percentage of key stocks in the Southeast Region by resource type and inclusion in FSSI.

4.2.7 Southeast Region Bycatch Estimates

Available bycatch estimates by fishery, based on data from the year 2005, or the most recent year of data if 2005 data were not available, are presented in Appendix 4.2, Tables 4.2.A–4.2.D. Bycatch estimates are included for five marine mammal, four sea turtle, and three seabird populations, in addition to 215 fish stocks or stock groups. For marine mammals and other rare-event stocks or populations, multiple years of data were used to calculate bycatch estimates. The timeframe of data used to calculate bycatch is included in Tables 4.2.A–4.2.D. Except for the North Carolina inshore (bays and rivers) gillnet fishery, bycatch estimates are averages across the years indicated. Bycatch estimates for the North Carolina gillnet fishery are totals for the years indicated.

Fish bycatch estimates are provided for nine fisheries (Table 4.2.A). For the Atlantic and Gulf of Mexico pelagic longline fishery, all fish estimates are for dead discards only. In some fisheries, bycatch estimates are available only for groups of species (e.g., bycatch estimates are provided for Chondrichthyes but not for individual shark and ray species in the Gulf of Mexico coastal migratory pelagic troll fishery) or for a management unit (e.g., coastal sharks). Members of species groups are listed in Appendix I.

Landings for both species and fisheries are reported in weights. Bycatch estimates for some fisheries were derived from logbook programs (such as in the Gulf of Mexico reef fish handline fishery) where bycatch amounts are reported in numbers of individuals. Reliable length/weight conversions were not available for these fisheries when the estimates were developed, and it was not possible to accurately calculate bycatch ratios at the fishery or species level in these cases.

Table 4.2.C lists available marine mammal bycatch estimates by fishery. Marine mammal bycatch estimates are provided for three fisheries. Many Southeast Region fisheries do not have reported incidences of marine mammal bycatch, and for those fisheries, bycatch was not estimated for this report (see Section 4.2.4 for fishery-specific details on bycatch estimation). Sea turtle bycatch estimates are available for ten Southeast Region fisheries, and are listed in Table 4.2.D. In some cases, it was not possible to identify the species of sea turtle; therefore bycatch estimates were made at a general level (e.g., for unclassified sea turtles). Seabird bycatch estimates are available for two fisheries. Available bycatch estimates for seabirds are listed in Table 4.2.E. The most recent seabird bycatch estimates for the Atlantic and Gulf of Mexico HMS pelagic longline were included; these estimates cover five different time periods: all seabird bycatch in 2004, and species-specific bycatch in the years 1995, 2000, 2004, and 2006. The total seabird bycatch estimate for this fishery is based only on 2004 data for the pooled category of all seabirds.

4.2.8 Bycatch Estimate Improvement Plans for Fisheries of Focus

Bycatch data-collection and estimation improvement plans were developed for the following 12 Southeast Region fisheries based on available information:

- Gulf of Mexico coastal migratory pelagic troll
- Gulf of Mexico reef fish bottom longline
- Gulf of Mexico reef fish handline
- Gulf of Mexico shrimp trawl
- Large coastal and small coastal shark aggregates (drift, strike, and bottom gillnet)
- North Carolina inshore (bays and rivers) gillnet
- South Atlantic coastal migratory pelagic troll
- South Atlantic snapper–grouper bottom longline
- South Atlantic snapper–grouper handline
- Atlantic and Gulf of Mexico HMS pelagic longline
- Atlantic and Gulf of Mexico shark bottom longline
- Southeastern Atlantic shrimp trawl

4.2.8.1 Bycatch estimation improvement plans

Gulf of Mexico Coastal Migratory Pelagic Troll

Tier Classes: Fish = 1; Marine Mammals = 0; Other Protected Species = 0

Bycatch and data-collection concerns: Bycatch data are currently collected through the coastal logbook program at SEFSC. Under this program, 20% of vessels are selected to report discards. Vessels are selected using a weighted (by a vessel's portion of the total effort reported from the fishery) random sample of all vessels with Federal permits that have reported deploying troll gear in the Gulf of Mexico. Estimates of total discards for the fishery are made by calculating a species-specific mean discard rate for the vessels reporting discards, and applying that rate to the calculated total effort reported from the fishery to the coastal logbook program.

- No mechanism exists to independently verify the accuracy of the discard logbook self-reported data.
- The level of compliance is impossible to estimate because fishers may submit a report of "no discards," effectively opting out of reporting while remaining within reporting compliance. A number of fishers report "no discards" almost exclusively.
- There have been no documented takes of marine mammals.

Recommendation:

- While available data indicate that little bycatch is as-

sociated with this fishery, a short-term observer program should be implemented to confirm the amount of bycatch. It was recommended that data from the current discard reporting program, as well as from other observer programs in the region, should be used to estimate the sample size needed to achieve a 30% CV for estimates of the ten most commonly observed species.

Gulf of Mexico Reef Fish Bottom Longline

Tier Classes: Fish= 2; Marine Mammals = 1; Other Protected Species = 1

Bycatch and data-collection concerns: Bycatch data are currently collected through the coastal logbook program at SEFSC. Under this program, 20% of vessels are selected to report discards. Vessels are selected using a weighted (by a vessel's portion of the total effort reported from the fishery) random sample of all vessels with Federal permits that have reported deploying longline gear in the Gulf of Mexico. Estimates of total discards for the fishery are made by calculating a species-specific mean discard rate for the vessels reporting discards, and applying that rate to the calculated total effort reported from the fishery to the coastal logbook program.

- No mechanism exists to independently verify the accuracy of the discard logbook self-reported data.
- Through a pilot project, mandatory observer coverage of the Gulf of Mexico reef fish fishery began in 2006. The current coverage level is less than 1%, and the current bycatch estimates in this report for fish, marine mammals, and other protected species bycatch rely on self-reporting.[5] In addition, it is difficult to allocate effort in this fishery based on logbook records.
- The level of compliance is impossible to estimate because fishers may submit a report of "no discards," effectively opting out of reporting while remaining within reporting compliance. A number of fishers report "no discards" almost exclusively. Red grouper discards reported from Gulf of Mexico longline vessels were believed to be grossly underreported during review of discard estimates for the SEDAR 12 red grouper assessment. The suspected underreporting, however, could not be confirmed by independent data.

Recommendations:

- It was recommended that current observer program coverage levels should be increased to assess and confirm the amount of bycatch for the fishery. Due to the potentially high number of discards from bottom longline vessels, improvements in discard estimates from this fishery should be a high priority. Data from the discard reporting program, as well as the pilot observer program, should be used to estimate the sample size needed to achieve a 30% CV for estimates of the ten most commonly observed species. A video monitoring program could be considered to enhance observer data, reduce the need for observers, and collect data on vessels unable to carry observers.
- It was recommended that once the enhanced observer program has been in place for multiple years, self-reported discard logbooks should be compared with observer data to attempt to define an optimal combination for estimating total discards and for monitoring catch rates.
- It was the recommendation that for marine mammals and non- ESA-listed marine species, needed coverage should be estimated by species and stratum (season and area). The estimated observer DAS needed may be about ten times the current observer program coverage levels.
- Lastly, it was also recommended that changes to the logbook system that identify target by set would also enhance the data collected from this fishery.

Gulf of Mexico Reef Fish Handline

Tier Classes: Fish = 2; Marine Mammals = 1; Other Proteced Species = 1

Bycatch and data-collection concerns: Bycatch data are currently collected through the coastal logbook program at SEFSC Miami. Under this program, 20% of vessels are selected to report discards. Vessels are selected using a weighted (by a vessel's portion of the total effort reported from the fishery) random sample of all vessels with Federal permits that have reported deploying handline gear in the Gulf of Mexico. Estimates of total discards for the fishery are made by calculating a species-specific mean discard rate for the vessels reporting discards, and applying that rate to the calculated total effort reported from the fishery to the coastal logbook program.

- A significant limitation of the current system is that the level of compliance is impossible to estimate because fishers may submit a report of "no discards," effectively opting out of reporting while remaining within reporting compliance. A number of fishers report "no discards" almost exclusively. Likewise, cases of underreporting have been suspected but cannot be confirmed by independent data.
- Through a pilot project, mandatory observer coverage of the Gulf of Mexico reef fish fishery began in 2006. The current coverage level is less than 1%, and the current bycatch estimates for fish, marine mammals, and other protected species bycatch rely on self-reporting.

[5] New sea turtle bycatch estimates are now based on the observed data (SEFSC 2008).

- It is difficult to allocate effort in this fishery based on logbook records.

Recommendations:

- It was recommended that current observer program coverage levels should be increased to assess and confirm the amount of bycatch for the fishery. Due to the potentially high number of discards from handline vessels, improvements in discard estimates from this fishery should be a high priority. Data from the discard reporting program, as well as the pilot observer program, should be used to estimate the sample size needed to achieve a 30% CV for estimates of the ten most commonly observed species. A video monitoring pilot study should be conducted in conjunction with the observer program, to determine whether electronic data can be used as a tool to enhance data collected by observers.

- It was recommended that once the enhanced observer program has been in place for multiple years, self-reported discard logbooks should be compared with observer data to attempt to define an optimal combination for estimating total discards and for monitoring catch rates.

- For marine mammals and other protected marine species, it was recommended that needed coverage by species and stratum (season and area) should be estimated. However, the estimated DAS needed may be about ten times the current observer program coverage levels.

- It was recommended that changes to the logbook system to identify target by set would also enhance the data collected from this fishery.

Gulf of Mexico Shrimp Trawl

Tier Classes: Fish = 2; Marine Mammals = 2; Other Protected Species = 2

Bycatch and data-collection concerns:

- Since the implementation of the shrimp trawl observer program in 1992 through mid-2007, sampling has been, for the most part, opportunistic.

- While CVs are low for common species, CVs are highly variable for less dominant species of interest.

- For other protected species, estimating the amount of fishing effort is problematic.

- Observers are unable to observe takes because a properly operating TED expels most non-target species before they can be observed on the deck of the shrimp trawl.

Recommendations:

- A mandatory observer program implemented in July 2007 allows for spatially and temporally stratified random sampling, thus enhancing data-collection efforts and subsequent CPUE and variance estimates. Proposed gear and landing data supplied by industry may allow for further stratification by gear type as well as other variables of interest. It was recommended that data from the current discard reporting (logbook) program and existing observer program should be used to estimate the sample size needed to achieve a 30% CV for estimates of the ten most common bycatch species.

- To improve bycatch estimates for marine mammals, it was recommended to develop and implement a marine mammal observer data form and subsequently estimate bycatch for marine mammals in this fishery.

- To improve bycatch estimates for marine mammals and other protected species, it was also recommended to develop a remote observer system (underwater video, etc.) to document takes, and to revise logbook and trip ticket programs. The primary purpose of the revision would be to better estimate effort; see Epperly et al. (2002).

Large Coastal and Small Coastal Shark Aggregates (Drift, Strike, and Bottom Gillnet)

Tier Classes: Fish = 3; Marine Mammals = 3; Other Proteced Species = 3

Bycatch and data-collection concerns:

- Low observer coverage results in very sparse data in some strata on bycatch of marine mammal and other protected species.

- Fishing effort has been difficult to allocate, beyond “gillnet,” from logbook records, and the logbooks are replete with invalid data.

- Under-reporting appears to be a problem for the fishery, which is compounded by the fact that logbook and observer data are difficult to associate.

Recommendations:

- It was recommended that changes to the logbook system to identify target by set, and specifics of gear type (i.e., sink, drift, strike gillnet), would enhance the data collected from this fishery and aid in extrapolation of expanded take estimates.

- A pilot observer program began in 2005. It was recommended that observer coverage should be expanded

beyond the 2007 coverage levels to include all vessels fishing gillnets, regardless of target.

North Carolina Inshore (Bays and Rivers) Gillnet

Tier Classes: Fish = 0; Marine Mammals = 0; Other Protected Species = 0

Bycatch and data-collection concerns:

- The bycatch estimate is based solely upon the Pamlico Sound restricted gillnet portion of the fishery.
- No error or uncertainty estimates have been made for the bycatch estimates.

Recommendations:

- It was recommended that observer coverage is needed for operational portions of the fishery other than Pamlico Sound.
- It was also recommended that error estimates should be made for the bycatch estimates.

South Atlantic Coastal Migratory Pelagic Troll

Tier Classes: Fish = 1; Marine Mammals = 0; Other Protected Species = 0

Bycatch and data-collection concerns:

Bycatch data are currently collected through the coastal logbook program at SEFSC. Under this program, 20% of vessels are selected to report discards. Vessels are selected using a weighted (by a vessel's portion of the total effort reported from the fishery) random sample of all vessels with Federal permits that have reported deploying troll gear in the South Atlantic. Estimates of total discards for the fishery are made by calculating a species-specific mean discard rate for the vessels reporting discards and applying that rate to the calculated total effort reported from the fishery to the coastal logbook program.

- The available discard data cannot be partitioned into South Atlantic coastal migratory pelagic troll and Atlantic dolphin/wahoo troll fisheries with confidence, as target species is not reported on the discard logbook form.
- No mechanism exists to independently verify the accuracy of the discard logbook self-reported data.
- A further limitation of the current system is that the level of compliance is impossible to estimate because fishers may submit a report of "no discards," effectively opting out of reporting while remaining within reporting compliance. A number of fishers report "no discards" almost exclusively.
- For marine mammals and other protected species, bycatch estimates rely on self-reporting, and fishing effort is difficult to allocate to different sectors of the fishery from logbook records.

Recommendations:

- Available data indicate that little bycatch may be associated with this fishery/gear. It was recommended that a pilot observer program should be organized to confirm this.
- It was recommended that observers may collect target species information so that data from individual fisheries (e.g., Atlantic coastal migratory pelagic troll versus Atlantic dolphin/wahoo troll) can be identified for use in analyses as necessary.
- Another recommendation was that data from the current discard reporting program and other existing observer programs should be used to estimate the sample size needed to achieve a 30% CV for estimates of the ten most common bycatch species.
- It was recommended that the observer program should include data-collection logs for marine mammals and other protected species bycatch.
- Lastly, it was recommended that changes to the logbook system to identify target by set would also enhance the data collected from this fishery.

South Atlantic Snapper–Grouper Bottom Longline

Tier Classes: Fish = 1; Marine Mammals = 0; Other Proteced Species = 0

Bycatch and data-collection concerns:

Bycatch data are currently collected through the coastal logbook program at SEFSC. Under this program, 20% of vessels are selected to report discards. Vessels are selected using a weighted (by a vessel's portion of the total effort reported from the fishery) random sample of all vessels with Federal permits that have reported deploying longline gear in the South Atlantic. Estimates of total discards for the fishery are made by calculating a species-specific mean discard rate for the vessels reporting discards and applying that rate to the calculated total effort reported by the fishery to the coastal logbook program.

- No mechanism exists to independently verify the accuracy of the discard logbook self-reported data.
- A further limitation of the current system is that the level of compliance is impossible to estimate because fishers may submit a report of "no discards," effectively opting

out of reporting while remaining within reporting compliance. A number of fishers report "no discards" almost exclusively. Few discard reports have been received from South Atlantic longline vessels, particularly from vessels in the snapper–grouper fishery. No discard estimates for this fishery can be made due to the very small sample size (fewer than five trips reported in 2005–06)

- For marine mammals and other protected species, bycatch estimates rely on self-reporting, and fishing effort is difficult to allocate to different sectors of the fishery from logbook records.

Recommendations:

- Due to the potentially high number of discards from bottom longline vessels and the near complete lack of discard data from snapper–grouper bottom longline vessels in the South Atlantic, it was recommended that improvements in discard estimates from this fishery should be a high priority. An observer program should be developed for this fishery/gear. Data from the discard reporting program and existing observer programs (e.g., the shark bottom longline observer program) should be used to estimate the sample size needed to achieve a 30% confidence interval for estimates of the ten most commonly observed species. A video monitoring pilot study could be conducted in conjunction with the observer program to determine whether electronic data can be used as a tool to enhance data collected by observers.

- Changes to the logbook system to identify target by set would also enhance the data collected from this fishery, although this may not be a feasible recommendation.

South Atlantic Snapper–Grouper Handline

Tier Classes: Fish = 1; Marine Mammals = 0; Other Protected Species = 0

Bycatch and data-collection concerns:

Bycatch data are currently collected through the coastal logbook program at SEFSC. Under this program, 20% of vessels are selected to report discards. Vessels are selected using a weighted (by a vessel's portion of the total effort reported from the fishery) random sample of all vessels with Federal permits that have reported deploying handline gear in the South Atlantic. Estimates of total discards for the fishery are made by calculating a species-specific mean discard rate for the vessels reporting discards and applying that rate to the calculated total effort reported by the fishery to the coastal logbook program.

- Target species is not reported on the discard logbook form.

- No mechanism exists to independently verify the accuracy of the discard logbook self-reported data.

- The level of compliance is impossible to estimate because fishers may submit a report of "no discards," effectively opting out of reporting while remaining within reporting compliance. A number of fishers report "no discards" almost exclusively. Likewise, cases of underreporting have been suspected but cannot be confirmed by independent data.

- For marine mammals and other protected species, bycatch estimates rely on self-reporting, and fishing effort is difficult to allocate to different sectors of the fishery from logbook records.

Recommendations:

- It was recommended to develop an observer program for this fishery/gear. Due to the potentially high number of discards from handline vessels, improvements in discard estimates from this fishery should be a high priority. Data from the discard reporting program, as well as from other observer programs in the region, should be used to estimate the sample size needed to achieve a 30% confidence interval for estimates of the ten most commonly observed species. A video monitoring pilot study could be conducted in conjunction with an observer program to determine whether electronic data can be used as a tool to enhance data collected by observers.

- It was recommended that once the enhanced observer program has been in place for multiple years, self-reported discard logs could be compared with observer data to attempt to define an optimal combination for estimating total discards and for monitoring catch rates.

- It was recommended that data should be collected on bycatch of marine mammals and other protected species in addition to fish discards.

- Changes to the logbook system to identify target by set would also enhance the data collected from this fishery, although this may not be a feasible recommendation.

Atlantic and Gulf of Mexico HMS Pelagic Longline

Tier Classes: Fish = 3; Marine Mammals = 2; Other Protected Species = 2

Bycatch and data-collection concerns:

- While coverage for fish species is high, for rare-event species (marine mammals and other protected species) current observer coverage levels are insufficient, resulting in very sparse data.

- Logbook and observer data are difficult to associate, which prevents error checking.

Recommendations:

- It was recommended that observer coverage for this fishery should be increased to improve protected species bycatch estimates. The amount of increased coverage needed should be estimated by species and stratum (season and area). The resulting DAS needed may be about ten times the current observer program coverage level (the Pelagic Longline TRT recommends 12–15% coverage in the Mid-Atlantic Bight to adequately estimate long- and/or short-finned pilot whale bycatch, for example).

- It was also recommended that observer databases be merged and the coastal logbook system be altered to identify target by set, although this may not be feasible.

- Lastly, it was recommended that data quality may also be improved by instructing fishers to report to one logbook program (either coastal or pelagic logbook program) and by correlating the logbook and observer databases.

Atlantic and Gulf of Mexico Shark Bottom Longline

Tier Score: Fish = 3; Marine Mammals = 2; Other Protected Species = 2

Bycatch and data-collection concerns:

- For marine mammals and other protected species, sparse data are a problem in some strata.

Recommendations:

- It was recommended that observer coverage should be increased to achieve a 30% CV for bycatch estimates for nearly all strata.

- In addition, correlating observer and logbook databases was also recommended.

Southeastern Atlantic Shrimp Trawl

Tier Classes: Fish = 2; Marine Mammals = 2; Other Protected Species = 2

Bycatch and data-collection concerns:

Since the implementation of the shrimp trawl observer program in 1992 through mid-2007, sampling was, for the most part, opportunistic. A mandatory observer program implemented in July 2007 allows for random sampling that is spatially and temporally stratified, thus enhancing data-collection efforts and subsequent CPUE and variance estimates.

- While CVs are low for dominant species, CVs are highly variable for less dominant species of interest.

- For other protected species, estimating the amount of fishing effort is problematic.

- Observers are unable to record sea turtle takes because a properly operating TED expels most takes before an observer can see them on the deck of the shrimp vessel.

Recommendations:

- Proposed gear and landing data supplied by industry may allow for further stratification by gear type as well as by other variables of interest. It was recommended that data from the current discard reporting program (logbook) and existing observer program should be used to estimate the sample size needed to achieve a 30% confidence interval for estimates of the ten most commonly discarded species.

- To improve bycatch estimates for marine mammals, it was recommended to develop and implement a marine mammal observer data form and subsequently to estimate bycatch for marine mammals in this fishery.

- To improve bycatch estimates for marine mammals and other protected species, development of a remote observer system (underwater video, etc.) to document takes, and revision of the logbook and trip ticket programs were recommended. The primary purpose of the revision would be to better estimate effort; see Epperly et al. (2002).

4.2.8.2 Summary of Southeast Region Recommendations

Table 4.2.5 outlines recommendations by the Southeast Region for improvement to bycatch data collection and estimation. A total of 15 recommendations were made to improve bycatch data collection and estimation for Federal fisheries and fisheries with relevant Federal data-collection programs, with resource requirements for implementation totaling seven full-time staff members and approximately 17,500 observer DAS (Table 4.2.5). The feasibility of recommendations was evaluated by the Southeast Regional team based on overall needs, available resources, and external factors. Observer program funding for the Southeast Region was approximately $6.538 in FY 2008. Enhancements to existing programs and implementing new pilot observer programs are recommended *in addition* to current program requirements.

Table 4.2.5
Summary of Southeast Region recommendations in terms of full-time staff and observer DAS. All requirements are annual unless otherwise indicated. For further discussion of recommendations, see Section 5.8.

Recommendation [a]	Additional DAS [b]	Feasibility
Change logbook system to identify target by set for multiple fisheries.	NA	Low
Develop a pilot observer program, including determination of needed sample size to achieve 30% CV for the ten most commonly discarded species, for the Gulf of Mexico coastal pelagic troll fishery.	416	Moderate
Maintain and refine observer program, including determination of needed sample size to achieve 30% CV for the ten most commonly discarded species, for the Gulf of Mexico reef fish bottom longline fishery.	1,667	High
Maintain and refine current Gulf of Mexico shrimp trawl observer program.	5,000	High
Develop remote observer program (underwater video, etc.) to document takes in Gulf of Mexico shrimp trawl fishery.	416	Low
Revise logbook and trip ticket programs to better estimate effort in Gulf of Mexico shrimp trawl fishery.	NA	Low
Increase observer coverage for the large coastal and small coastal shark aggregate (drift, strike, and bottom gillnet) fishery.	540	High
Correlate fishery observer and logbook databases for the large coastal and small coastal shark aggregate (drift, strike, and bottom gillnet) fisheries.	NA	High (currently being worked on)
Expand North Carolina inshore (bays and rivers) gillnet observer program to cover any additional open components of the fishery.	250	High
Develop a pilot observer program, including determination of needed sample size to achieve 30% CV for the ten most commonly discarded species, for the South Atlantic coastal migratory pelagic troll fishery.	1,600	Moderate
Increase observer coverage for the Atlantic and Gulf of Mexico HMS pelagic longline fishery to achieve a 30% CV in all strata.	3,500	Moderate
Instruct Atlantic and Gulf of Mexico shark bottom longline fishers to report to one logbook.	NA	Low
Relate Atlantic and Gulf of Mexico shark bottom longline fishery observer and logbook databases.	NA	High (currently being worked on)
Develop a pilot observer program; including determination of needed sample size to achieve 30% CV for the ten most commonly discarded species, for the South Atlantic snapper–grouper bottom longline fishery.	1,600	High
Develop a pilot observer program, including determination of needed sample size to achieve 30% CV for the ten most commonly discarded species, for the South Atlantic snapper–grouper handline fishery.	1,600	High
Maintain and refine the current Southeastern Atlantic shrimp trawl observer program.	833	High
Develop pilot programs to test the use of electronic video monitoring on reef fish vessels in the Gulf of Mexico and South Atlantic to augment data collected by observers.	120	High (currently being worked on)
Number of new full-time staff needed to implement all data quality and estimation method improvements recommended by the Southeast Region:	7	
Total DAS requirement for all recommendations*:	17,542	

* This amount is in addition to the annual requirements of the Southeast region observer programs.
[a] Some recommendations may require additional resource expenditures, such as equipment, which are not itemized.
[b] One observer DAS includes the cost for the observer deployment as well as costs for associated equipment and program administrative functions (staffing).

Appendix 4.2 Southeast Region Bycatch Estimates

Table 4.2.A

Subtables showing annual fish bycatch estimates and CVs (where available) for Southeast Region fisheries. In some fisheries (indicated with *), bycatch estimates were available only for a generalized stock group. Bycatch estimates are in live pounds or number of individuals, except where indicated, and reflect the average from the years identified. Key stocks are shaded. Fishery bycatch ratios = bycatch / (bycatch + landings). Some bycatch ratios (marked **) could not be developed, e.g., where bycatch was by weight and number of individuals, landings in pounds.

Subtable 4.2.A.1 — **GULF OF MEXICO COASTAL MIGRATORY PELAGIC TROLL**

COMMON NAME	SCIENTIFIC NAME	DATA SOURCE	BYCATCH	UNIT	CV
Black grouper	*Mycteroperca bonaci*	2006	18.17	Individuals	
Blacktip shark	*Carcharhinus limbatus*	2005	101.59	Individuals	
Bonito, Atlantic	*Sarda sarda*	2005	134.28	Individuals	
Cartilaginous fishes*	Chondrichthyes	2005–06	86.25	Individuals	65.60
Cobia	*Rachycentron canadum*	2005–06	19.49	Individuals	70.38
Crevalle jack	*Caranx hippos*	2005–06	23.07	Individuals	89.23
Hammerhead sharks*	Sphyrnida	2005	14.69	Individuals	
Ladyfish	*Elops saurus*	2005	1,057.48	Individuals	
Little tunny	*Euthynnus alletteratus*	2005	251.49	Individuals	
Mackerels*	*Scomberomorus spp.*	2005–06	584.27	Individuals	18.62
Red snapper	*Lutjanus campechanus*	2006	2,034.70	Individuals	
Sailfish	*Istiophorus platypterus*	2006	8.52	Individuals	
Spanish mackerel	*Scomberomorus maculatus*	2005–06	178.3	Individuals	78.25
Tarpon	*Megalops atlanticus*	2006	9.08	Individuals	
Yellowfin tuna	*Thunnus albacares*	2006	17.03	Individuals	
TOTAL FISHERY BYCATCH			4,538.41	Individuals	
TOTAL FISHERY LANDINGS			291,107.20	Pounds	
FISHERY BYCATCH RATIO			**		

Subtable 4.2.A.2 — **GULF OF MEXICO REEF FISH BOTTOM LONGLINE**

COMMON NAME	SCIENTIFIC NAME	DATA SOURCE	BYCATCH	UNIT	CV
Amberjacks and yellowtails*	*Seriola* spp.	2005–06	1,819.86	Individuals	116.68
Atlantic angel shark	*Squatina dumeril*	2005	25.94	Individuals	
Atlantic sharpnose shark	*Rhizoprionodon terraenovae*	2005	1,037.42	Individuals	
Barracudas*	*Sphyraenidae*	2005	691.62	Individuals	
Black grouper	*Mycteroperca bonaci*	2005–06	132.52	Individuals	80.69
Blacktip shark	*Carcharhinus limbatus*	2006	90.06	Individuals	

Table 4.2.A (continued)

(continuation of Subtable 4.2.A.2)		GULF OF MEXICO REEF FISH BOTTOM LONGLINE			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Blowfish*	Tetraodontidae	2006	144.09	Individuals	
Bluntnose sevengill shark	*Notorynchus cepedianus*	2006	3,896.69	Individuals	
Bull shark	*Carcharhinus leucas*	2005	62.25	Individuals	
Cartilaginous fishes*	Chondrichthyes	2005	1,242.64	Individuals	
Conger eel	*Conger oceanicus*	2005	52,167.60	Individuals	
Dogfish sharks*	Squalidae	2005–06	7,880.27	Individuals	39.99
Dusky shark	*Carcharhinus obscurus*	2006	798.48	Individuals	
Finfishes, unclassified, general		2005	5,532.93	Individuals	
Flatfishes*	Pleuronectiformes	2006	108.07	Individuals	
Gag	*Mycteroperca microlepis*	2005–06	610.11	Individuals	54.65
Goliath grouper	*Epinephelus itajara*	2005–06	475.51	Individuals	80.33
Greater amberjack	*Seriola dumerili*	2005–06	955.03	Individuals	
Hakes*	*Urophycis* spp.	2005–06	47,348.96	Individuals	56.70
Hammerhead sharks*	Sphyrnidae	2005–06	730.39	Individuals	129.37
Moray eels*	Muraenidae	2005–06	8,460.36	Individuals	140.12
Nurse shark	*Ginglymostoma cirratum*	2005–06	264.17	Individuals	45.00
Red grouper	*Epinephelus morio*	2004–05	582,118.00	Individuals	3.01
Red snapper	*Lutjanus campechanus*	2005–06	7,619.03	Individuals	113.87
Sand tiger shark	*Carcharhinus taurus*	2006	171.54	Individuals	
Sandbar shark	*Carcharhinus plumbeus*	2005–06	304.38	Individuals	99.58
Scamp	*Mycteroperca phenax*	2005–06	383.16	Individuals	126.97
Sixgill shark	*Hexanchus griseus*	2005–06	339.4	Individuals	118.37
Skates*	Rajidae	2005–06	114.28	Individuals	74.56
Snowy grouper	*Epinephelus niveatus*	2005	248.98	Individuals	
Spinner shark	*Carcharhinus brevipinna*	2005–06	6,790.15	Individuals	47.64
Spiny dogfish	*Squalus acanthias*	2005–06	15,870.78	Individuals	47.03
Swordfish	*Xiphias gladius*	2006	567.77	Individuals	
Thornback	*Platyrhinoidis triseriata*	2006	1,091.07	Individuals	
True eels*	Anguilliformes	2005–06	25,701.52	Individuals	91.37
Vermilion snapper	*Rhomboplites aurorubens*	2006	198.94	Individuals	
Warsaw grouper	*Epinephelus nigritus*	2006	18.42	Individuals	
Worm eels and snake eels*	Ophichthidae	2006	20,452.49	Individuals	
TOTAL FISHERY BYCATCH			796,464.88	Individuals	
TOTAL FISHERY LANDINGS			6,437,581.26	Pounds	
FISHERY BYCATCH RATIO			**		

Table 4.2.A (continued)

Subtable 4.2.A.3		GULF OF MEXICO REEF FISH HANDLINE			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Almaco jack	*Seriola rivoliana*	2005–06	923.22	Individuals	130.71
Amberjacks and yellowtails*	*Seriola* spp.	2005–06	52,472.86	Individuals	61.36
Atlantic sharpnose shark	*Rhizoprionodon terraenovae*	2005	1,431.49	Individuals	
Bar Jack	*Caranx ruber*	2005–06	1,431.90	Individuals	119.06
Barracudas	Sphyraenidae	2005–06	1,263.59	Individuals	141.11
Black grouper	*Mycteroperca bonaci*	2005–06	57,221.01	Individuals	103.86
Black snapper	*Apsilus dentatus*	2005	9.7	Individuals	
Blackfin snapper	*Lutjanus buccanella*	2005	301.9	Individuals	
Blackfin tuna	*Thunnus atlanticus*	2005	925.6	Individuals	
Blacknose shark	*Carcharhinus acronotus*	2006	1,280.64	Individuals	
Blacktip shark	*Carcharhinus limbatus*	2005–06	5,780.98	Individuals	39.01
Blowfish*	Tetraodontidae	2005–06	171.62	Individuals	125.12
Blue runner	*Caranx crysos*	2005–06	2,211.31	Individuals	48.33
Bluefish	*Pomatomus saltatrix*	2005–06	34,983.06	Individuals	
Bonito, Atlantic	*Sarda sarda*	2005–06	3,410.42	Individuals	113.02
Bonnethead shark	*Sphyrna tiburo*	2005–06	2,041.10	Individuals	140.97
Breams and porgies*	Sparidae	2005–06	220.35	Individuals	135.38
Bull shark	*Carcharhinus leucas*	2005–06	1,052.21	Individuals	102.04
Caribbean red snapper	*Lutjanus purpureus*	2005–06	19.54	Individuals	
Caribbean sharpnose shark	*Rhizoprionodon porosus*	2005–06	1,770.08	Individuals	102.65
Cartilaginous fishes*	Chondrichthyes	2005–06	39,863.02	Individuals	3.26
Cobia	*Rachycentron canadum*	2005–06	2,716.21	Individuals	101.42
Crimson rover	*Erythrocles monodi*	2005–06	6,091.85	Individuals	
Cutlassfish, Atlantic	*Trichiurus lepturus*	2005–06	242.6	Individuals	
Dogfish sharks*	Squalidae	2006	65.48	Individuals	
Dolphinfish*	*Coryphaena* spp.	2005–06	1,217.12	Individuals	90.35
Dusky shark	*Carcharhinus obscurus*	2005	1,940.77	Individuals	
Finfishes, unclassified, general		2005–06	15,494.12	Individuals	56.77
Flatfishes*	Pleuronectiformes	2005	776.31	Individuals	
Gag	*Mycteroperca microlepis*	2003–04	79,505.00	Individuals	47.99
Goliath grouper	*Epinephelus itajara*	2005–06	2,823.58	Individuals	74.60
Gray snapper	*Lutjanus griseus*	2005–06	15,345.26	Individuals	130.79
Gray triggerfish	*Balistes capriscus*	2003–04	1,250.00	Individuals	5.43
Greater amberjack	*Seriola dumerili*	2003–04	259,209.00	Individuals	13.32
Groupers and sea basses*	Serranidae	2005–06	10,927.15	Individuals	138.03
Grunts*	Haemulidae	2005–06	11,298.97	Individuals	99.24
Hogfish	*Lachnolaimus maximus*	2005	161.73	Individuals	

Table 4.2.A (continued)

(continuation of Subtable 4.2.A.3)		GULF OF MEXICO REEF FISH HANDLINE			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Knobbed porgy	*Calamus nodosus*	2005–06	99.97	Individuals	124.26
Lane snapper	*Lutjanus synagris*	2005	2,177.97	Individuals	
Lemon shark	*Negaprion brevirostris*	2005–06	557.1	Individuals	42.89
Lesser amberjack	*Seriola fasciata*	2005–06	1,621.13	Individuals	133.57
Little tunny	*Euthynnus alletteratus*	2005–06	250.73	Individuals	26.99
Mackerels*	*Scomberomorus* spp.	2005–06	2,236.41	Individuals	4.90
Mako sharks*	*Isurus* spp.	2005	278.18	Individuals	
Marlins and spearfishes*	*Tetrapturus* spp.	2005	1,035.07	Individuals	
Moray eels*	Muraenidae	2005–06	924.45	Individuals	30.61
Mutton snapper	*Lutjanus analis*	2005–06	2,609.02	Individuals	99.33
Nassau grouper	*Epinephelus striatus*	2005	258.77	Individuals	
Nurse shark	*Ginglymostoma cirratum*	2005–06	1,390.14	Individuals	23.97
Pinfish	*Lagodon rhomboides*	2005–06	1,470.63	Individuals	110.68
Red drum	*Sciaenops ocellatus*	2005–06	46,185.41	Individuals	121.66
Red grouper	*Epinephelus morio*	2004–05	273,665.50	Individuals	8.91
Red hind	*Epinephelus guttatus*	2005	323.46	Individuals	
Red porgy	*Pagrus pagrus*	2005–06	6,194.17	Individuals	18.78
Red snapper	*Lutjanus campechanus*	2005–06	1,701,727.37	Individuals	4.07
Remora	*Remora* spp.	2005–06	13,798.67	Individuals	69.31
Rock hind	*Epinephelus adscensionis*	2005	631.12	Individuals	
Rock sea bass	*Centropristis philadelphica*	2005–06	3,728.00	Individuals	108.7
Sand seatrout	*Cynoscion arenarius*	2005	3,881.53	Individuals	
Sandbar shark	*Carcharhinus plumbeus*	2005–06	4,114.70	Individuals	14.52
Scamp	*Mycteroperca phenax*	2005–06	33,465.70	Individuals	45.38
Sea catfishes*	Ariidae	2005	646.92	Individuals	
Sea chubs*	Kyphosidae	2005	3,881.53	Individuals	
Snappers*	Lutjanidae	2005–06	20,341.62	Individuals	34.35
Snowy grouper	*Epinephelus niveatus*	2005–06	875.93	Individuals	1.96
Spadefishes*	Ephippidae	2005	11,256.44	Individuals	
Spanish mackerel	*Scomberomorus maculatus*	2005–06	57,757.58	Individuals	17.87
Speckled hind	*Epinephelus drummondhayi*	2005–06	899.66	Individuals	92.29
Thresher sharks*	*Alopias* spp.	2005	161.73	Individuals	
Tiger shark	*Galeocerdo cuvier*	2006	656.41	Individuals	
Tilefish*	Malacanthidae	2006	317.46	Individuals	
Toad fishes*	Batrachoididae	2005	539.1	Individuals	
Triggerfishes*	Balistidae	2005–06	43,256.37	Individuals	122.34
Vermilion snapper	*Rhomboplites aurorubens*	2003–04	54,924.50	Individuals	42.34

Table 4.2.A (continued)

(continuation of Subtable 4.2.A.3)		GULF OF MEXICO REEF FISH HANDLINE			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Warsaw grouper	*Epinephelus nigritus*	2005–06	2,917.42	Individuals	36.08
White grunt	*Haemulon plumieri*	2005	6,469.22	Individuals	
Whitebone porgy	*Calamus leucosteus*	2005	1,186.02	Individuals	
Yellowedge grouper	*Epinephelus flavolimbatus*	2005–06	1,795.30	Individuals	27.96
Yellowfin grouper	*Mycteroperca venenosa*	2005	618.45	Individuals	
Yellowtail snapper	*Ocyurus chrysurus*	2005–06	280,020.06	Individuals	31.29
TOTAL FISHERY BYCATCH			3,211,582.76	Individuals	
TOTAL FISHERY LANDINGS			11,048,862.55	Pounds	
FISHERY BYCATCH RATIO			**		

Subtable 4.2.A.4		GULF OF MEXICO SHRIMP TRAWL[a]			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AVERAGE AMOUNT**	**UNIT**	**CV**
Black drum, Gulf of Mexico	*Pogonias cromis*	2005	106,072.93	Pounds	14.0
Cobia, Gulf of Mexico	*Rachycentron canadum*	2005	36,582.98	Pounds	27.6
Croaker, Atlantic, Gulf of Mexico	*Micropogonias undulatus*	2005	107,109,953.67	Pounds	1.7
Grouped finfish other than listed, Gulf of Mexico		2005	321,715,655.17	Pounds	0.8
Grouped sharks, Gulf of Mexico		2005	5,751,271.68	Pounds	4.5
King mackerel, Gulf group	*Scomberomorus cavalla*	2005	380,397.44	Pounds	6.2
Lane snapper, Gulf of Mexico	*Lutjanus synagris*	2005	1,623,481.71	Pounds	11.3
Longspine porgy, Gulf of Mexico	*Stenotomus caprinus*	2005	61,490,961.63	Pounds	1.9
Non-crustacean invertebrates, Gulf of Mexico		2005	26,997,043.37	Pounds	2.6
Non-Penaeid shrimp crustacean, Gulf of Mexico		2005	88,179,006.92	Pounds	1.4
Other snapper spp., Gulf of Mexico*		2005	784,083.29	Pounds	12.1
Red drum, Gulf of Mexico	*Sciaenops ocellatus*	2005	405,795.32	Pounds	12.7
Red snapper, Gulf of Mexico	*Lutjanus campechanus*	2005	2,569,676.96	Pounds	2.8
Seatrout and weakfish, Gulf of Mexico*	*Cynoscion* spp.	2005	58,720,836.76	Pounds	1.8
Southern flounder, Gulf of Mexico	*Paralichthys lethostigma*	2005	1,306,782.10	Pounds	4.1
Spanish mackerel, Gulf group	*Scomberomorus maculatus*	2005	3,560,615.21	Pounds	4.3
Vermilion snapper, Gulf of Mexico	*Rhomboplites aurorubens*	2005	300,909.20	Pounds	4.9
TOTAL FISHERY BYCATCH			681,019,126.33	Pounds	
TOTAL FISHERY LANDINGS			213,534,624.70	Pounds	
TOTAL CATCH (Bycatch + Landings)			894,553,751.03	Pounds	
FISHERY BYCATCH RATIO			0.76		

[a] Bycatch estimate for the offshore portion of the fishery only (COLREGS line [beach] out to 50 fathoms).

Table 4.2.A (continued)

Subtable 4.2.A.5		LARGE COASTAL AND SMALL COASTAL SHARK AGGREGATES (DRIFT, STRIKE, AND BOTTOM GILLNET)			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AVERAGE AMOUNT**	**UNIT**	**CV**
Atlantic bumper, South Atlantic	*Chloroscombrus chrysurus*	2005	459.2	Individuals	0.05
Atlantic manta, South Atlantic	*Manta birostris*	2001–05	2.80	Individuals	1.48
Atlantic menhaden, South Atlantic	*Brevoortia tyrannus*	2005	41.64	Individuals	0.58
Atlantic moonfish, South Atlantic	*Selene setapinnis*	2000–05	14.39	Individuals	
Atlantic sharpnose shark, South Atlantic	*Rhizoprionodon terraenovae*	2005	4,690.48	Individuals	0.03
Atlantic spadefish, South Atlantic	*Chaetodipterus faber*	2005	16.62	Individuals	1.46
Banded drum, South Atlantic	*Larimus fasciatus*	2005	390.29	Individuals	394.86
Black sea bass, South Atlantic	*Centropristis striata*	2005	10.04	Individuals	2.41
Blacktip shark, South Atlantic	*Carcharhinus limbatus*	2005	292.36	Individuals	0.08
Bluefish, South Atlantic	*Pomatomus saltatrix*	2005	70.31	Individuals	0.34
Bonnethead shark, South Atlantic	*Sphyrna tiburo*	2005	567.33	Individuals	0.04
Cobia, South Atlantic	*Rachycentron canadum*	2000–05	12.45	Individuals	
Cownose ray, South Atlantic	*Rhinoptera bonasus*	2001	22.19	Individuals	1.63
Crevalle jack, South Atlantic	*Caranx hippos*	2000–05	4.46	Individuals	
Gafftopsail catfish, South Atlantic	*Bagre marinus*	2005	16.31	Individuals	1.48
King mackerel, Atlantic Group	*Scomberomorus cavalla*	2005	273.01	Individuals	0.58
Little Tunny, South Atlantic	*Euthynnus alletteratus*	2000–05	48.43	Individuals	
Red drum, South Atlantic	*Sciaenops ocellatus*	2001–05	3.80	Individuals	2.09
Sailfish, West Atlantic	*Istiophorus platypterus*	2000–05	22.32	Individuals	
Scalloped hammerhead shark, South Atlantic	*Sphyrna lewini*	2005	139.47	Individuals	1.09
Silver seatrout, South Atlantic	*Cynoscion nothus*	2005	166.97	Individuals	0.14
Spinner shark, South Atlantic	*Carcharhinus brevipinna*	2005	8.18	Individuals	18.63
Spot, South Atlantic	*Leiostomus xanthurus*	2005	26.89	Individuals	5.67
Spotted eagle ray, South Atlantic	*Aetobatus narinari*	2001–05	4.00	Individuals	2.23
Tarpon, South Atlantic	*Megalops atlanticus*	2001–05	6.84	Individuals	2.23
Tiger shark, South Atlantic	*Galeocerdo cuvier*	2005	7.24	Individuals	21.05
Yellowfin menhaden, South Atlantic	*Brevoortia smithi*	2005	224.04	Individuals	0.68
TOTAL FISHERY BYCATCH			7,542.06	Individuals	
TOTAL FISHERY LANDINGS			782,523.75	Pounds	
FISHERY BYCATCH RATIO			**		

Table 4.2.A (continued)

Subtable 4.2.A.6		SOUTH ATLANTIC COASTAL MIGRATORY PELAGIC TROLL[b]			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Almaco jack	*Seriola rivoliana*	2005–06	110.8	Individuals	67.63
Amberjacks and yellowtails*	*Seriola* spp.	2005–06	39.24	Individuals	43.05
Barracudas*	Sphyraenidae	2005–06	65.32	Individuals	65.43
Black grouper	*Mycteroperca bonaci*	2005–06	87.02	Individuals	58.23
Black sea bass	*Centropristis striata*	2005	136.5	Individuals	
Blue runner	*Caranx crysos*	2005	27.3	Individuals	
Bluefish	*Pomatomus saltatrix*	2005–06	327.48	Individuals	139.46
Bonito, Atlantic	*Sarda sarda*	2005–06	240.22	Individuals	7.49
Cartilaginous fishes*	*Chondrichthyes*	2005–06	1,131.00	Individuals	128.54
Cobia	*Rachycentron canadum*	2005–06	27.93	Individuals	15.95
Crevalle jack	*Caranx hippos*	2005	13.65	Individuals	
Dolphinfish*	*Coryphaena* spp.	2005–06	1,173.00	Individuals	37.19
Greater amberjack	*Seriola dumerili*	2005–06	520.00	Individuals	3.54
Hammerhead sharks*	Sphyrnidae	2005–06	6.15	Individuals	36.74
Little tunny	*Euthynnus alletteratus*	2005–06	516.68	Individuals	41.03
Mackerels*	*Scomberomorus* spp	2005–06	3,210.90	Individuals	61.62
Mutton snapper	*Lutjanus analis*	2005–06	12.85	Individuals	8.83
Red grouper	*Epinephelus morio*	2005–06	81.09	Individuals	120.42
Remora	*Remora* spp.	2005	31.41	Individuals	36.82
Sailfish	*Istiophorus platypterus*	2005	32.76	Individuals	
Sandbar shark	*Carcharhinus plumbeus*	2005	46.07	Individuals	
Scamp	*Mycteroperca phenax*	2005–06	40.65	Individuals	
Skipjack tuna	*Euthynnus pelamis*	2005–06	71.72	Individuals	53.33
Spanish mackerel	*Scomberomorus maculatus*	2005–06	510.06	Individuals	91.33
Triggerfishes*	Balistidae	2005	13.65	Individuals	
Tripletail	*Lobotes surinamensis*	2005	13.65	Individuals	
Yellowfin tuna	*Thunnus albacares*	2005–06	82.64	Individuals	70.90
Yellowtail snapper	*Ocyurus chrysurus*	2005	204.74	Individuals	
TOTAL FISHERY BYCATCH			8,774.48	Individuals	
TOTAL FISHERY LANDINGS[c]			985,790	Individuals	
FISHERY BYCATCH RATIO			**		

[b] Data are from logbook report; species identifications were not verified.
[c] Coastal migratory pelagic troll landings for 2005–06.

Table 4.2.A (continued)

Subtable 4.2.A.7		SOUTH ATLANTIC SNAPPER-GROUPER HANDLINE			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Almaco jack	*Seriola rivoliana*	2005–06	95.69	Individuals	89.06
Amberjacks and yellowtails*	*Seriola* spp.	2005–06	11,111.49	Individuals	51.79
Atlantic sharpnose shark	*Rhizoprionodon terraenovae*	2005–06	7,202.64	Individuals	131.42
Ballyhoo	*Hemiramphus brasiliensis*	2005	2,995.56	Individuals	
Banded rudderfish	*Seriola zonata*	2005	246.17	Individuals	
Bank sea bass	*Centropristis ocyurus*	2005	750.81	Individuals	
Bar jack	*Caranx ruber*	2005–06	81.62	Individuals	71.85
Barracudas*	Sphyraenidae	2005–06	5,626.01	Individuals	140.02
Barrelfish	*Hyperoglyphe perciformis*	2005	13.85	Individuals	
Black grouper	*Mycteroperca bonaci*	2005–06	14,149.21	Individuals	69.59
Black sea bass	*Centropristis striata*	2005–06	14,646.93	Individuals	9.69
Blackfin tuna	*Thunnus atlanticus*	2005–06	26.45	Individuals	95.49
Blacktip shark	*Carcharhinus limbatus*	2005–06	2,500.27	Individuals	118.56
Blowfish*	Tetraodontidae	2005–06	206.20	Individuals	95.70
Blue runner	*Caranx crysos*	2005–06	5,109.27	Individuals	30.12
Bluefish	*Pomatomus saltatrix*	2005	402.54	Individuals	
Blueline tilefish	*Caulolatilus microps*	2005	35.39	Individuals	
Bonito, Atlantic	*Sarda sarda*	2005	5,780.71	Individuals	
Bonnethead shark	*Sphyrna tiburo*	2005–06	455.59	Individuals	88.06
Breams and porgies*	Sparidae	2005–06	571.86	Individuals	133.48
Bull shark	*Carcharhinus leucas*	2005	34.62	Individuals	
Butterflyfishes*	Chaetodontidae	2005	1,592.40	Individuals	
Caribbean reef shark	*Carcharhinus perezii*	2005	72.43	Individuals	
Caribbean sharpnose shark	*Rhizoprionodon porosus*	2005–06	743.50	Individuals	48.38
Cartilaginous fishes*	Chondrichthyes	2005–06	10,608.82	Individuals	103.74
Cobia	*Rachycentron canadum*	2005–06	333.62	Individuals	118.73
Conger eel	*Conger oceanicus*	2005	34.62	Individuals	
Crevalle jack	*Caranx hippos*	2005–06	274.10	Individuals	128.47
Dolphinfish*	*Coryphaena* spp.	2005–06	2,360.01	Individuals	25.39
Finfishes, unclassified, general		2005–06	1,439.45	Individuals	131.56
Flatfishes*	Pleuronectiformes	2005	92.31	Individuals	
French grunt	*Haemulon flavolineatum*	2006	133.83	Individuals	
Gag	*Mycteroperca microlepis*	2003–04	6,151.00	Individuals	24.16
Goliath grouper	*Epinephelus itajara*	2005–06	471.89	Individuals	104.25
Gray snapper	*Lutjanus griseus*	2005–06	29,825.90	Individuals	92.99
Gray triggerfish	*Balistes capriscus*	2005–06	701.57	Individuals	117.82

Table 4.2.A (continued)

(continuation of Subtable 4.2.A.7)		SOUTH ATLANTIC SNAPPER-GROUPER HANDLINE			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Graysby	*Epinephelus cruentatus*	2005	17.89	Individuals	
Greater amberjack	*Seriola dumerili*	2005–06	5,613.50	Individuals	9.21
Groupers and sea basses*	Serranidae	2005	689.61	Individuals	
Grunts*	Haemulidae	2005–06	5,340.50	Individuals	24.71
Hakes*	Urophycis	2005	15.39	Individuals	
Hammerhead sharks*	Sphyrnidae	2005–06	135.63	Individuals	64.13
Hogfish	*Lachnolaimus maximus*	2005–06	76.27	Individuals	29.75
Jacks and pompanos*	Carangidae	2006	5.35	Individuals	
Jolthead porgy	*Calamus bajonado*	2005–06	65.63	Individuals	101.64
Ladyfish	*Elops saurus*	2005–06	150.58	Individuals	9.41
Lane snapper	*Lutjanus synagris*	2005–06	1,570.88	Individuals	18.52
Lemon shark	*Negaprion brevirostris*	2006	89.22	Individuals	
Little tunny	*Euthynnus alletteratus*	2005–06	1,982.35	Individuals	129.06
Mackerels*	*Scomberomorus* spp.	2005–06	24,250.20	Individuals	16.24
Margate	*Haemulon album*	2005	50.27	Individuals	
Moray eels*	Muraenidae	2005–06	160.14	Individuals	110.85
Mutton snapper	*Lutjanus analis*	2005–06	1,872.66	Individuals	84.81
Nassau grouper	*Epinephelus striatus*	2005–06	1,066.68	Individuals	40.66
Needlefish, Atlantic	*Strongylura marina*	2005–06	3,760.19	Individuals	126.32
Nurse shark	*Ginglymostoma cirratum*	2005–06	466.12	Individuals	84.18
Parrotfishes*	Scaridae	2005–06	1,022.58	Individuals	69.26
Permit	*Trachinotus falcatus*	2005	69.23	Individuals	
Pinfish	*Lagodon rhomboides*	2005	345.39	Individuals	
Porkfish	*Anisotremus virginicus*	2005	83.08	Individuals	
Rainbow runner	*Elagatis bipinnulata*	2005–06	301.81	Individuals	103.16
Rays, sawfish, and skates*	Rajiformes	2005	33.57	Individuals	
Red drum	*Sciaenops ocellatus*	2006	702.63	Individuals	
Red grouper	*Epinephelus morio*	2005–06	6,284.83	Individuals	91.98
Red hind	*Epinephelus guttatus*	2005–06	310.16	Individuals	19.37
Red porgy	*Pagrus pagrus*	2005–06	26,262.76	Individuals	33.74
Red snapper	*Lutjanus campechanus*	2005–06	16,093.00	Individuals	7.22
Remora	*Remora* spp.	2005–06	3,277.41	Individuals	109.18
Rock hind	*Epinephelus adscensionis*	2005–06	40.27	Individuals	123.80
Rock sea bass	*Centropristis philadelphica*	2005	807.74	Individuals	
Sailfish	*Istiophorus platypterus*	2005–06	398.64	Individuals	18.23
Sand tiger shark	*Carcharhinus taurus*	2005	137.32	Individuals	

Table 4.2.A (continued)

(continuation of Subtable 4.2.A.7)		SOUTH ATLANTIC SNAPPER-GROUPER HANDLINE			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Sand tilefish	*Malacanthus plumieri*	2005	57.70	Individuals	
Sandbar shark	*Carcharhinus plumbeus*	2005–06	381.72	Individuals	86.02
Scamp	*Mycteroperca phenax*	2005–06	3,343.78	Individuals	6.26
Scorpionfishes*	Scorpaenidae	2005	52.89	Individuals	
Sea catfishes*	Ariidae	2005–06	494.07	Individuals	12.91
Sea chubs*	Kyphosidae	2005–06	924.16	Individuals	80.72
Silk snapper	*Lutjanus vivanus*	2005	17.31	Individuals	
Silky shark	*Carcharhinus falciformis*	2005	33.57	Individuals	
Skates*	Rajidae	2005–06	36.46	Individuals	37.60
Skipjack tuna	*Euthynnus pelamis*	2005	247.57	Individuals	
Smooth dogfish shark	*Mustelus canis*	2005	110.78	Individuals	
Snappers*	Lutjanidae	2005	103.85	Individuals	
Snowy grouper	*Epinephelus niveatus*	2001–03	1,578.00	Individuals	43.56
Soldierfishes and squirrelfishes*	Holocentridae	2005	293.72	Individuals	
Spadefishes*	Ephippidae	2005	484.64	Individuals	
Spanish mackerel	*Scomberomorus maculatus*	2005	3,356.58	Individuals	13.49
Speckled hind	*Epinephelus drummondhayi*	2001–03	9,533.00	Individuals	46.15
Spinner shark	*Carcharhinus brevipinna*	2006	26.77	Individuals	
Spiny dogfish	*Squalus acanthias*	2005–06	194.99	Individuals	101.25
Spotted seatrout	*Cynoscion nebulosus*	2005–06	44.61	Individuals	
Spottail pinfish	*Diplodus holbrookii*	2005–06	1,362.63	Individuals	111.66
Swordfish	*Xiphias gladius*	2005	22.31	Individuals	
Tarpon	*Megalops atlanticus*	2005	69.23	Individuals	
Tiger shark	*Galeocerdo cuvier*	2005–06	328.38	Individuals	3.55
Tilefish*	Malacanthidae	2005	23.08	Individuals	
Toad fishes*	Batrachoididae	2005–06	398.49	Individuals	120.95
Tomtate	*Haemulon aurolineatum*	2005	15,676.52	Individuals	
Triggerfishes*	Balistidae	2005–06	1,279.98	Individuals	135.51
True eels*	Anguilliformes	2005–06	103.87	Individuals	47.16
Vermilion snapper	*Rhomboplites aurorubens*	2005–06	16,638.82	Individuals	43.23
Warsaw grouper	*Epinephelus nigritus*	2001–03	5,000.00	Individuals	124.99
White grunt	*Haemulon plumieri*	2005	701.58	Individuals	
Whitebone porgy	*Calamus leucosteus*	2005	116.93	Individuals	
Wreckfish	*Polyprion americanus*	2005–06	38.09	Individuals	31.25
Yellow jack	*Caranx bartholomaei*	2005	168.19	Individuals	40.51
Yellowedge grouper	*Epinephelus flavolimbatus*	2005	71.54	Individuals	

Table 4.2.A (continued)

(continuation of Subtable 4.2.A.7)		SOUTH ATLANTIC SNAPPER-GROUPER HANDLINE			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Yellowfin grouper	*Mycteroperca venenosa*	2005–06	25.96	Individuals	40.85
Yellowmouth grouper	*Mycteroperca interstitialis*	2005	4.20	Individuals	
Yellowtail snapper	*Ocyurus chrysurus*	2005–06	129,459.39	Individuals	41.25
TOTAL FISHERY BYCATCH			423,233.1	Individuals	
TOTAL FISHERY LANDINGS			5,456,046.43	Pounds	
FISHERY BYCATCH RATIO			**		

Subtable 4.2.A.8		ATLANTIC AND GULF OF MEXICO HMS PELAGIC LONGLINE[d]			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Albacore, South Atlantic	*Thunnus alalunga*	2005	25,518.48	Pounds	
Atlantic sailfish, South Atlantic	*Istiophorus albicans*	2005	7,539.80	Pounds	
Bigeye tuna, South Atlantic	*Thunnus obesus*	2005	33,228.03	Pounds	
Blackfin tuna, South Atlantic	*Thunnus atlanticus*	2005	10,890.82	Pounds	
Blue marlin, South Atlantic	*Makaira nigricans*	2005	53,823.59	Pounds	
Blue shark, South Atlantic	*Prionace glauca*	2005	145,685.70	Pounds	
Bluefin tuna, West Atlantic	*Thunnus thynnus*	2005	288,465.71	Pounds	
Coastal shark group 1, South Atlantic		2005	287,592.68	Pounds	
Coastal shark group 2, South Atlantic		2005	173,276.52	Pounds	
Skipjack tuna, South Atlantic	*Katsuwonus pelamis*	2005	26,742.04	Pounds	
Swordfish, South Atlantic	*Xiphias gladius*	2005	478,651.66	Pounds	
White marlin, South Atlantic	*Tetrapturus albidus*	2005	37,699.00	Pounds	
Yellowfin tuna, South Atlantic	*Thunnus albacares*	2005	103,088.03	Pounds	
TOTAL FISHERY BYCATCH			1,672,202.06	Pounds	
TOTAL FISHERY LANDINGS			5,551,564.00	Pounds	
TOTAL CATCH (Bycatch + Landings)			7,223,766.06	Pounds	
FISHERY BYCATCH RATIO			0.23		

[d] Estimates are for dead discards only.

Table 4.2.A (continued)

Subtable 4.2.A.9

		ATLANTIC AND GULF OF MEXICO SHARK BOTTOM LONGLINE [e]			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Atlantic sharpnose shark, South Atlantic / Gulf of Mexico	*Rhizoprionodon terraenovae*	2005–06	349,613.05	Pounds	0.25
Blacknose shark, South Atlantic / Gulf of Mexico	*Carcharhinus acronotus*	2005–06	348,366.31	Pounds	0.36
Blacktip shark, South Atlantic / Gulf of Mexico	*Carcharhinus limbatus*	2005–06	225,066.53	Pounds	0.65
Bull shark, South Atlantic / Gulf of Mexico	*Carcharhinus leucas*	2005–06	156,832.68	Pounds	0.38
Dusky shark, South Atlantic / Gulf of Mexico	*Carcharhinus obscurus*	2005–06	570,896.75	Pounds	0.40
Gag, Gulf of Mexico	*Mycteroperca microlepis*	2005–06	7,446.39	Pounds	0.80
Gag, South Atlantic	*Mycteroperca microlepis*	2005–06	10,613.99	Pounds	11.00
Goliath grouper, South Atlantic / Gulf of Mexico	*Epinephelus itajara*	2005–06	71,823.65	Pounds	19.12
Great barracuda, South Atlantic / Gulf of Mexico	*Sphyraena barracuda*	2005–06	158,611.62	Individuals	0.25
Great hammerhead shark, South Atlantic / Gulf of Mexico	*Sphyrna mokarran*	2005–06	191,774.36	Pounds	0.25
Nurse shark, South Atlantic / Gulf of Mexico	*Ginglymostoma cirratum*	2005–06	190,291.75	Pounds	0.75
Rays, sawfish, and skates, South Atlantic / Gulf of Mexico*	Rajiformes	2005–06	190,488.54	Pounds	0.80
Red drum, South Atlantic / Gulf of Mexico	*Sciaenops ocellatus*	2005–06	531.00	Individuals	0.18
Red grouper, Gulf of Mexico	*Epinephelus morio*	2005–06	51,414.25	Pounds	0.50
Red grouper, South Atlantic	*Epinephelus morio*	2005–06	6,364.50	Pounds	0.25
Sand tiger, South Atlantic / Gulf of Mexico	*Carcharias taurus*	2005–06	32,902.15	Pounds	0.69
Sandbar Shark, South Atlantic / Gulf of Mexico	*Carcharhinus plumbeus*	2005–06	149,480.14	Pounds	0.28
Scalloped hammerhead Shark, South Atlantic / Gulf of Mexico	*Sphyrna lewini*	2005–06	116,989.17	Pounds	0.35
Silky shark, South Atlantic / Gulf of Mexico	*Carcharhinus falciformis*	2005–06	42,322.16	Pounds	0.42
Smalltooth sawfish [f]	*Pristis pectinata*	2005–06	61.00	Individuals	0.70
Smooth dogfish shark, South Atlantic / Gulf of Mexico	*Mustelus canis*	2005–06	191,857.96	Pounds	0.42
Spotted eagle ray, South Atlantic / Gulf of Mexico	*Aetobatus narinari*	2005–06	266.5	Individuals	0.12
Stingray spp., South Atlantic / Gulf of Mexico*	*Dasyatis spp.*	2005–06	1,599.15	Individuals	0.35
Tiger shark, South Atlantic / Gulf of Mexico	*Galeocerdo cuvier*	2005–06	2,032,149.40	Pounds	0.20
TOTAL FISHERY BYCATCH			2,457.65	Individuals	
			5,095,305.35	Pounds	
TOTAL FISHERY LANDINGS			2,925,997.00	Pounds	
FISHERY BYCATCH RATIO			**		

[e] Bycatch estimates for the shark bottom longline are currently being refined due to discrepancies in the calculation of total effort. Updates will be made as appropriate.

[f] The take of this species is prohibited without prior authorization because it is listed as endangered under the ESA.

Table 4.2.B

Southeast Region bycatch by stock and species. Landings are not available for species groups (marked *), as it was not possible to determine the exact composition of the bycatch group and the proportions of bycatch and landings to allocate to each species. Bycatch estimates are in live weight (pounds) or number of individuals. Species bycatch ratio = the total regional bycatch of a species / (total regional landings of the species + total regional bycatch of the species); see Section 3 for details on ratio calculation. Some bycatch ratios (marked **) could not be developed when bycatch estimates were provided in both numbers of individuals and in pounds, or where landings were not available. Data on confidential landings (marked ‡) are not presented. Key stocks have been shaded.

		TOTAL STOCK BYCATCH[a]		TOTAL SPECIES BYCATCH		SPECIES LANDINGS[b]		SPECIES BYCATCH RATIO
COMMON NAME	SCIENTIFIC NAME	AMOUNT	UNIT	AMOUNT	UNIT	2005 LANDINGS	UNIT	RATIO
Albacore, South Atlantic	*Thunnus alalunga*	See species column		25,518.48	Pounds	41,614	Pounds	0.38
Almaco jack	*Seriola rivoliana*	See species column		1,129.71	Individuals	109,676	Pounds	**
Amberjacks and yellowtails*	*Seriola* spp.	See species column		65,443.45	Individuals	–	–	**
Atlantic angel shark	*Squatina dumeril*	See species column		25.94	Individuals	–	–	**
Atlantic bumper, South Atlantic	*Chloroscombrus chrysurus*	See species column		459.20	Individuals	–	–	**
Atlantic croaker, Gulf of Mexico	*Micropogonias undulatus*	See species column		107,109,953.67	Pounds	11,580,031	Pounds	0.90
Atlantic manta, South Atlantic	*Manta birostris*	See species column		2.80	Individuals	–	–	**
Atlantic menhaden, South Atlantic[c]	*Brevoortia tyrannus*	See species column		41.64	Individuals	See footnote	–	**
Atlantic moonfish, South Atlantic	*Selene setapinnis*	See species column		14.39	Individuals	60,579	Pounds	**
Atlantic sailfish, South Atlantic	*Istiophorus albicans*	See species column		7,539.80	Pounds	–	–	**
Atlantic sharpnose shark	*Rhizoprionodon terraenovae*	9,671.55	Individuals	14,362.03 349,613.05	Individuals Pounds	522,459	Pounds	**
Atlantic sharpnose shark, South Atlantic	*Rhizoprionodon terraenovae*	4,690.48	Individuals					
Atlantic sharpnose shark, South Atlantic / Gulf of Mexico	*Rhizoprionodon terraenovae*	349,613.05	Pounds					
Atlantic spadefish, South Atlantic	*Chaetodipterus faber*	See species column		16.62	Individuals	–	–	**
Ballyhoo	*Hemiramphus brasiliensis*	See species column		2,995.56	Individuals	669,081	Pounds	**
Banded drum, South Atlantic	*Larimus fasciatus*	See species column		390.29	Individuals	–	–	**
Banded rudderfish	*Seriola zonata*	See species column		246.17	Individuals	39,513	Pounds	**
Bank sea bass	*Centropristis ocyurus*	See species column		750.81	Individuals	‡	–	**

Table 4.2.B (continued)

		TOTAL STOCK BYCATCH[a]		TOTAL SPECIES BYCATCH		SPECIES LANDINGS[b]		SPECIES BYCATCH RATIO
COMMON NAME	SCIENTIFIC NAME	AMOUNT	UNIT	AMOUNT	UNIT	2005 LANDINGS	UNIT	RATIO
Bar jack	*Caranx ruber*	See species column		1,513.52	Individuals	34,857	Pounds	**
Barracudas*	Sphyraenidae	See species column		7,646.54	Individuals	–	–	**
Barrelfish	*Hyperoglyphe perciformis*	See species column		13.85	Individuals	20,351	Pounds	**
Bigeye tuna, South Atlantic	*Thunnus obesus*	See species column		33,228.03	Pounds	383,587	Pounds	0.08
Black drum, Gulf of Mexico	*Pogonias cromis*	See species column		106,072.93	Pounds	4,588,669	Pounds	0.02
Black grouper	*Mycteroperca bonaci*	See species column		71,607.93	Individuals	332,950	Pounds	**
Black sea bass	*Centropristis striata*	14,783.43	Individuals	14,793.47	Individuals	872,930	Pounds	**
Black sea bass, South Atlantic	*Centropristis striata*	10.04	Individuals					
Black snapper	*Apsilus dentatus*	9.70	Individuals	9.70	Individuals	3,987	Pounds	**
Blackfin snapper	*Lutjanus buccanella*	301.90	Individuals	301.90	Individuals	4,740	Pounds	**
Blackfin tuna	*Thunnus atlanticus*	952.05	Individuals	952.05 10,890.82	Individuals Pounds	52,312	Pounds	**
Blackfin tuna, South Atlantic	*Thunnus atlanticus*	10,890.82	Pounds					
Blacknose shark	*Carcharhinus acronotus*	1,280.64	Individuals	1,280.64 348,366.31	Individuals Pounds	155,858	Pounds	**
Blacknose shark, South Atlantic / Gulf of Mexico	*Carcharhinus acronotus*	348,366.31	Pounds					
Blacktip shark	*Carcharhinus limbatus*	8,472.90	Individuals	8,869.86 225,066.53	Individuals Pounds	1,357,681	Pounds	**
Blacktip shark, South Atlantic	*Carcharhinus limbatus*	292.36	Individuals					
Blacktip shark, South Atlantic / Gulf of Mexico	*Carcharhinus limbatus*	225,066.53	Pounds					
Blowfish*	*Tetraodontidae*	See species column		521.91	Individuals	–	–	**
Blue marlin, South Atlantic	*Makaira nigricans*	See species column		53,823.59	Pounds	–	–	**
Blue shark, South Atlantic	*Prionace glauca*	See species column		145,685.70	Pounds	‡	–	**
Bluefin tuna, West Atlantic	*Thunnus thynnus*	See species column		288,465.71	Pounds	305,237	Pounds	0.49
Bluefish	*Pomatomus saltatrix*	35,713.08	Individuals	35,783.39	Individuals	3,123,949	Pounds	**
Bluefish, South Atlantic	*Pomatomus saltatrix*	70.31	Individuals					
Blueline tilefish	*Caulolatilus microps*	See species column		35.39	Individuals	181,935	Pounds	**
Blue runner	*Caranx crysos*	See species column		7,347.88	Individuals	368,751	Pounds	**

Table 4.2.B (continued)

		TOTAL STOCK BYCATCH[a]		TOTAL SPECIES BYCATCH		SPECIES LANDINGS[b]		SPECIES BYCATCH RATIO
COMMON NAME	SCIENTIFIC NAME	AMOUNT	UNIT	AMOUNT	UNIT	2005 LANDINGS	UNIT	RATIO
Bluntnose sevengill shark	*Notorynchus cepedianus*	See species column		3,896.69	Individuals	–	–	**
Bonito, Atlantic	*Sarda sarda*	See species column		9,565.63	Individuals	12,918	Pounds	**
Bonnethead shark	*Sphyrna tiburo*	2,496.69	Individuals	3,064.02	Individuals	46,278	Pounds	**
Bonnethead shark, South Atlantic	*Sphyrna tiburo*	567.33	Individuals					
Breams and porgies*	Sparidae	See species column		792.21	Individuals	–	–	**
Bull shark	*Carcharhinus leucas*	1,149.08	Individuals	1,149.08 156,832.68	Individuals Pounds	185,007	Pounds	**
Bull shark, South Atlantic / Gulf of Mexico	*Carcharhinus leucas*	156,832.68	Pounds					
Butterflyfishes*	*Chaetodontidae*	See species column		1,592.40	Individuals	–	–	**
Caribbean red snapper	*Lutjanus purpureus*	See species column		19.54	Individuals	‡	–	**
Caribbean reef shark	*Carcharhinus perezii*	See species column		72.43	Individuals	–	–	**
Caribbean sharpnose shark[c]	*Rhizoprionodon porosus*	See species column		2,513.58	Individuals	–	–	**
Cartilaginous fishes*	Chondrichthyes	See species column		52,931.73	Individuals	–	–	**
Coastal shark group 1, South Atlantic*		See species column		287,592.68	Pounds	–	–	**
Coastal shark group 2, South Atlantic*		See species column		173,276.52	Pounds	–	–	**
Cobia	*Rachycentron canadum*	3,097.25	Individuals	3,109.7 36,582.98	Individuals Pounds	159,194	Pounds	**
Cobia, Gulf of Mexico	*Rachycentron canadum*	36,582.98	Pounds					
Cobia, South Atlantic	*Rachycentron canadum*	12.45	Individuals					
Conger eel	*Conger oceanicus*	See species column		52,202.22	Individuals	3,327	Pounds	**
Cownose ray, South Atlantic	*Rhinoptera bonasus*	See species column		22.99	Individuals	–	–	**
Crevalle jack, South Atlantic	*Caranx hippos*	4.46	Individuals	315.28	Individuals	425,320	Pounds	**
Crevalle jack	*Caranx hippos*	310.82	Individuals					
Crimson rover	*Erythrocles monody*	See species column		6,091.85	Individuals	–	–	**
Cutlassfish, Atlantic	*Trichiurus lepturus*	See species column		242.60	Individuals	23,903	Pounds	**
Dogfish sharks*	Squalidae	See species column		7,945.75	Individuals	–	–	**
Dolphinfish*	*Coryphaena* spp.	See species column		4,750.13	Individuals	–	–	**

Table 4.2.B (continued)

		TOTAL STOCK BYCATCH[a]		TOTAL SPECIES BYCATCH		SPECIES LANDINGS[b]		SPECIES BYCATCH RATIO
COMMON NAME	SCIENTIFIC NAME	AMOUNT	UNIT	AMOUNT	UNIT	2005 LANDINGS	UNIT	RATIO
Dusky shark	*Carcharhinus obscurus*	2,739.25	Individuals	2,739.25 570,896.75	Individuals Pounds	–	–	**
Dusky shark, South Atlantic / Gulf of Mexico	*Carcharhinus obscurus*	570,896.75	Pounds					
Finfishes, unclassified, general*		See species column		22,466.50	Individuals	–	–	**
Flatfishes*	Pleuronectiformes	See species column		976.69	Individuals	–	–	**
French grunt	*Haemulon flavolineatum*	See species column		133.83	Individuals	–	–	**
Gafftopsail catfish, South Atlantic	*Bagre marinus*	See species column		16.31	Individuals	–	–	**
Gag	*Mycteroperca microlepis*	86,266.11	Individuals	86,266.11 18,060.38	Individuals Pounds	3,388,602	Pounds	**
Gag, Gulf of Mexico	*Mycteroperca microlepis*	7,446.39	Pounds					
Gag, South Atlantic	*Mycteroperca microlepis*	10,613.99	Pounds					
Goliath grouper	*Epinephelus itajara*	3,770.98	Individuals	3,770.98 71,823.65	Individuals Pounds	–	–	**
Goliath grouper, South Atlantic / Gulf of Mexico	*Epinephelus itajara*	71,823.65	Pounds					
Gray snapper	*Lutjanus griseus*	See species column		45,171.16	Individuals	358,224	Pounds	**
Gray triggerfish	*Balistes capriscus*	See species column		1,951.57	Individuals	45,454	Pounds	**
Graysby	*Epinephelus cruentatus*	See species column		17.89	Individuals	1,349	Pounds	**
Great barracuda, South Atlantic / Gulf of Mexico[d]	*Sphyraena barracuda*	See species column		158,611.62	Individuals	See footnote	–	**
Great hammerhead shark, South Atlantic / Gulf of Mexico	*Sphyrna mokarran*	See species column		191,774.36	Pounds	‡	–	**
Greater amberjack	*Seriola dumerili*	See species column		266,297.53	Individuals	1,442,512	Pounds	**
Grouped finfish other than listed, Gulf of Mexico*		See species column		321,715,655.17	Pounds	–	–	**
Grouped sharks, Gulf of Mexico*		See species column		5,751,271.68	Pounds	–	–	**
Groupers and sea basses*	Serranidae	See species column		11,616.76	Individuals	–	–	**
Grunts*	Haemulidae	See species column		16,639.47	Individuals	–	–	**
Hakes*	*Urophycis* spp.	See species column		47,364.35	Individuals	–	–	**
Hammerhead sharks*	Sphyrnidae	See species column		886.86	Individuals	–	–	**

Table 4.2.B (continued)

		TOTAL STOCK BYCATCH[a]		TOTAL SPECIES BYCATCH		SPECIES LANDINGS[b]		SPECIES BYCATCH RATIO
COMMON NAME	SCIENTIFIC NAME	AMOUNT	UNIT	AMOUNT	UNIT	2005 LANDINGS	UNIT	RATIO
Hogfish	*Lachnolaimus maximus*	See species column		238.00	Individuals	51,861	Pounds	**
Jacks and pompanos*	Carangidae	See species column		5.35	Individuals	–	–	**
Jolthead porgy	*Calamus bajonado*	See species column		65.63	Individuals	10,536	Pounds	**
King mackerel, Atlantic group	*Scomberomorus cavalla*	273.01	Individuals	273.01 380,397.44	Individuals Pounds	939,675	Pounds	**
King mackerel, Gulf group	*Scomberomorus cavalla*	380,397.44	Pounds					
Knobbed porgy	*Calamus nodosus*	See species column		99.97	Individuals	21,157	Pounds	**
Ladyfish	*Elops saurus*	See species column		1,208.06	Individuals	1,932,721	Pounds	**
Lane snapper	*Lutjanus synagris*	3,748.85	Individuals	3,748.85	Individuals	48,466	Pounds	**
Lane snaper, Gulf of Mexico	*Lutjanus synagris*	1,623,481.71	Pounds	1,623,481.71	Pounds			
Lemon shark	*Negaprion brevirostris*	See species column		646.32	Individuals	72,373	Pounds	**
Lesser amberjack	*Seriola fasciata*	See species column		1,621.13	Individuals	51,917	Pounds	**
Little tunny	*Euthynnus alletteratus*	3,001.25	Individuals	3,049.68	Individuals	497,551	Pounds	**
Little tunny, South Atlantic	*Euthynnus alletteratus*	48.43	Individuals					
Longspine porgy, Gulf of Mexico	*Stenotomus caprinus*	See species column		61,490,961.63	Pounds	‡	–	**
Mackerels*	*Scomberomorus* spp.	See species column		30,281.78	Individuals	–	–	**
Mako sharks*	*Isurus* spp.	See species column		278.18	Individuals	–	–	**
Margate	*Haemulon album*	See species column		50.27	Individuals	23,835	Pounds	**
Marlins and spearfishes*	*Tetrapturus* spp.	See species column		1,035.07	Individuals	–	–	**
Moray eels*	Muraenidae	See species column		9,544.95	Individuals	–	–	**
Mutton snapper	*Lutjanus analis*	See species column		4,494.53	Individuals	237,414	Pounds	**
Nassau grouper	*Epinephelus striatus*	See species column		1,325.45	Individuals	‡	–	**
Needlefish, Atlantic	*Strongylura marina*	See species column		3,760.19	Individuals	‡	–	**
Non-crustacean Invertebrates, Gulf of Mexico*		See species column		26,997,043.37	Pounds	–	–	**
Non-Penaeid shrimp crustacean, Gulf of Mexico*		See species column		88,179,006.92	Pounds	–	–	**

Table 4.2.B (continued)

		TOTAL STOCK BYCATCH[a]		TOTAL SPECIES BYCATCH		SPECIES LANDINGS[b]		SPECIES BYCATCH RATIO
COMMON NAME	SCIENTIFIC NAME	AMOUNT	UNIT	AMOUNT	UNIT	2005 LANDINGS	UNIT	RATIO
Nurse shark	*Ginglymostoma cirratum*	2,120.43	Individuals	2,120.43 19,0291.75	Individuals Pounds	–	–	**
Nurse shark, South Atlantic / Gulf of Mexico	*Ginglymostoma cirratum*	190,291.75	Pounds					
Other snapper spp., Gulf of Mexico*		See species column		784,083.29	Pounds	–	–	**
Parrotfishes*	Scaridae	See species column		1,022.58	Individuals	–	–	**
Permit	*Trachinotus falcatus*	See species column		69.23	Individuals	20,959	Pounds	**
Pilotfish	*Naucrates ductor*	See species column		2,582.30	Individuals			**
Pinfish	*Lagodon rhomboids*	See species column		1,816.02	Individuals	95,233	Pounds	**
Porkfish	*Anisotremus virginicus*	See species column		83.08	Individuals	–	–	**
Rainbow runner	*Elagatis bipinnulata*	See species column		301.81	Individuals	‡	–	**
Rays, sawfish, and skates*	Rajiformes	33.57	Individuals	33.57 190,488.54	Individuals Pounds	–	–	**
Rays, sawfish, and skates, South Atlantic / Gulf of Mexico*	Rajiformes	190,488.54	Pounds					
Red hind	*Epinephelus guttatus*	See species column		633.62	Individuals	16,750	Pounds	**
Red drum	*Sciaenops ocellatus*	46,888.04	Individuals	47422.84 405,795.32	Individuals Pounds	181,857	Pounds	**
Red drum, Gulf of Mexico	*Sciaenops ocellatus*	405,795.32	Pounds					
Red drum, South Atlantic	*Sciaenops ocellatus*	3.80	Individuals					
Red drum, South Atlantic / Gulf of Mexico	*Sciaenops ocellatus*	531.00	Individuals					
Red grouper	*Epinephelus morio*	862,149.42	Individuals	862149.42 57778.75	Individuals Pounds	6,588,286	Pounds	**
Red grouper, Gulf of Mexico	*Epinephelus morio*	51,414.25	Pounds					
Red grouper, South Atlantic	*Epinephelus morio*	6,364.50	Pounds					
Red porgy	*Pagrus pagrus*	32,456.93	Individuals	32,456.93	Individuals	120,657	Pounds	**
Red snapper	*Lutjanus campechanus*	1,727,474.10	Individuals	1,727,474.10 2,569,676.96	Individuals Pounds	4,236,011	Pounds	**
Red snapper, Gulf of Mexico	*Lutjanus campechanus*	2,569,676.96	Pounds					
Remora*	*Remora* spp.	See species column		171,07.49	Individuals	–	–	**
Rock hind	*Epinephelus adscensionis*	See species column		671.39	Individuals	17,603	Pounds	**

Table 4.2.B (continued)

		TOTAL STOCK BYCATCH[a]		TOTAL SPECIES BYCATCH		SPECIES LANDINGS[b]		SPECIES BYCATCH RATIO
COMMON NAME	SCIENTIFIC NAME	AMOUNT	UNIT	AMOUNT	UNIT	2005 LANDINGS	UNIT	RATIO
Rock sea bass	*Centropristis philadelphica*	See species column		4,535.74	Individuals	237	Pounds	**
Sailfish	*Istiophorus platypterus*	439.92	Individuals	462.24	Individuals	–	–	**
Sailfish, West Atlantic	*Istiophorus platypterus*	22.32	Individuals					
Sand seatrout	*Cynoscion arenarius*	See species column		3,881.53	Individuals	72,830	Pounds	**
Sand tiger shark	*Carcharhinus taurus*	308.86	Individuals	308.86 32,902.15	Individuals Pounds	‡	–	**
Sand tiger shark, South Atlantic / Gulf of Mexico	*Carcharias taurus*	32,902.15	Pounds					
Sand tilefish	*Malacanthus plumieri*	57.70	Individuals	57.70	Individuals	5,750	Pounds	**
Sandbar shark	*Carcharhinus plumbeus*	4,846.87	Individuals	4,846.87 149,480.14	Individuals Pounds	1,657,123	Pounds	**
Sandbar shark, South Atlantic / Gulf of Mexico	*Carcharhinus plumbeus*	149,480.14	Pounds					
Scalloped hammerhead shark, South Atlantic[e]	*Sphyrna lewini*	139.47	Individuals	139.47 116,989.17	Individuals Pounds	See footnote	–	**
Scalloped hammerhead shark, South Atlantic / Gulf of Mexico[e]	*Sphyrna lewini*	116,989.17	Pounds					
Scamp	*Mycteroperca phenax*	See species column		37,233.29	Individuals	659,292	Pounds	**
Scorpionfishes*	Scorpaenidae	See species column		52.89	Individuals	–	–	**
Sea catfishes*	Ariidae	See species column		1,140.99	Individuals	–	–	**
Sea chubs*	Kyphosidae	See species column		4,805.69	Individuals	–	–	**
Seatrout and weakfish spp., Gulf of Mexico*	*Cynoscion* spp.	See species column		58,720,836.76	Pounds	–	–	**
Silk snapper	*Lutjanus vivanus*	See species column		17.31	Individuals	53,261	Pounds	**
Silky shark	*Carcharhinus falciformis*	33.57	Individuals	33.57 42,322.16	Individuals Pounds	10,897	Pounds	**
Silky shark, South Atlantic / Gulf of Mexico	*Carcharhinus falciformis*	42,322.16	Pounds					
Silver seatrout, South Atlantic[f]	*Cynoscion nothus*	See species column		166.97	Individuals	See footnote	–	**
Sixgill shark	*Hexanchus griseus*	See species column		339.40	Individuals	–	–	**
Skates*	Rajidae	See species column		150.74	Individuals	–	–	**

Table 4.2.B (continued)

		TOTAL STOCK BYCATCH[a]		TOTAL SPECIES BYCATCH		SPECIES LANDINGS[b]		SPECIES BYCATCH RATIO
COMMON NAME	SCIENTIFIC NAME	AMOUNT	UNIT	AMOUNT	UNIT	2005 LANDINGS	UNIT	RATIO
Skipjack tuna	*Euthynnus pelamis*	319.29	Individuals	319.29 26742.04	Individuals Pounds	2,513	Pounds	**
Skipjack tuna, South Atlantic	*Katsuwonus pelamis*	26,742.04	Pounds					
Smalltooth sawfish[g]	*Pristis pectinata*	See species column		61.00	Individuals	–	–	**
Smooth dogfish shark	*Mustelus canis*	110.78	Individuals	110.78 191,857.96	Individuals Pounds	666,709	Pounds	**
Smooth dogfish shark, South Atlantic / Gulf of Mexico	*Mustelus canis*	191,857.96	Pounds					
Snappers*	Lutjanidae	See species column		20,445.47	Individuals	–	–	**
Snowy grouper	*Epinephelus niveatus*	See species column		2,702.91	Individuals	427,889	Pounds	**
Soliderfishes and squirrelfishes*	*Holocentridae*	See species column		293.72	Individuals	–	–	**
Spadefishes*	*Ephippidae*	See species column		11,741.08	Individuals	–	–	**
Spanish mackerel	*Scomberomorus maculates*	61,802.52	Individuals	61,802.52 3,560,615.21	Individuals Pounds	5,269,670	Pounds	**
Spanish mackerel, Gulf Group	*Scomberomorus maculates*	3,560,615.21	Pounds					
Speckled hind	*Epinephelus drummondhayi*	See species column		10,432.66	Individuals	90,660	Pounds	**
Spinner shark	*Carcharhinus brevipinna*	6,816.92	Individuals	6,825.10	Individuals	42,342	Pounds	**
Spinner shark, South Atlantic	*Carcharhinus brevipinna*	8.18	Individuals					
Spiny dogfish	*Squalus acanthias*	See species column		16,065.77	Individuals	18,865	Pounds	**
Southern flounder, Gulf of Mexico	*Paralichthys lethostigma*	See species column		1,306,782.10	Pounds	1,894,981	Pounds	0.40
Spot, South Atlantic	*Leiostomus xanthurus*	See species column		26.89	Individuals	1,746,559	Pounds	**
Spottail pinfish	*Diplodus holbrookii*	See species column		1,362.63	Individuals	9,508	Pounds	**
Spotted eagle ray, South Atlantic[h]	*Aetobatus narinari*	4.00	Individuals	270.50	Individuals	–	–	**
Spotted eagle ray, South Atlantic / Gulf of Mexico[h]	*Aetobatus narinari*	266.50	Individuals					
Spotted seatrout	*Cynoscion nebulosus*	See species column		44.61	Individuals	234,155	Pounds	**
Stingray spp., South Atlantic / Gulf of Mexico*	*Dasyatis* spp.	See species column		1,599.15	Individuals	–	–	**

Table 4.2.B (continued)

		TOTAL STOCK BYCATCH[a]		TOTAL SPECIES BYCATCH		SPECIES LANDINGS[b]		SPECIES BYCATCH RATIO
COMMON NAME	SCIENTIFIC NAME	AMOUNT	UNIT	AMOUNT	UNIT	2005 LANDINGS	UNIT	RATIO
Swordfish	*Xiphias gladius*	590.08	Individuals	590.08 478,651.66	Individuals Pounds	2,075,140	Pounds	**
Swordfish, South Atlantic	*Xiphias gladius*	478,651.66	Pounds					
Tarpon	*Megalops atlanticus*	78.31	Individuals	86.15	Individuals	–	–	**
Tarpon, South Atlantic	*Megalops atlanticus*	6.84	Individuals					
Thornback	*Platyrhinoidis triseriata*	See species column		1,091.07	Individuals	–	–	**
Thresher sharks*	*Alopias* spp.	See species column		161.73	Individuals	–	–	**
Tiger shark	*Galeocerdo cuvier*	984.79	Individuals	992.03 2,032,149.40	Individuals Pounds	38,603	Pounds	**
Tiger shark, South Atlantic	*Galeocerdo cuvier*	7.24	Individuals					
Tiger shark, South Atlantic / Gulf of Mexico	*Galeocerdo cuvier*	2,032,149.40	Pounds					
Tilefish*	Malacanthidae	See species column		340.54	Individuals	–	–	**
Toad fishes*	Batrachoididae	See species column		937.59	Individuals	–	–	**
Tomtate	*Haemulon aurolineatum*	See species column		15,676.52	Individuals	–	–	**
Triggerfishes*	Balistidae	See species column		44,550.00	Individuals	–	–	**
Tripletail	*Lobotes surinamensis*	See species column		13.65	Individuals	6,978	Pounds	**
True eels*	*Anguilliformes*	See species column		25,805.39	Individuals	–	–	**
Vermilion snapper	*Rhomboplites aurorubens*	71,762.26	Individuals	71,762.26 300,909.20	Individuals Pounds	2,995,399	Pounds	**
Vermilion snapper, Gulf of Mexico	*Rhomboplites aurorubens*	300,909.20	Pounds					
Warsaw grouper	*Epinephelus nigritus*	See species column		7,935.84	Individuals	162,303	Pounds	**
White grunt	*Haemulon plumieri*	See species column		7,170.80	Individuals	18,469	Pounds	**
White marlin, South Atlantic	*Tetrapturus albidus*	See species column		37,699.00	Pounds	–	–	**
Whitebone porgy	*Calamus leucosteus*	See species column		1,302.95	Individuals	6,836	Pounds	**
Worm eels and snake Eels*	Ophichthidae	See species column		20,455.28	Individuals	–	–	**
Wreckfish	*Polyprion americanus*	See species column		38.09	Individuals	‡	–	**
Yellow jack	*Caranx bartholomaei*	See species column		168.19	Individuals	–	–	**
Yellowedge grouper	*Epinephelus flavolimbatus*	See species column		1,866.84	Individuals	920,704	Pounds	**

Table 4.2.B (continued)

		TOTAL STOCK BYCATCH[a]		TOTAL SPECIES BYCATCH		SPECIES LANDINGS[b]		SPECIES BYCATCH RATIO
COMMON NAME	SCIENTIFIC NAME	AMOUNT	UNIT	AMOUNT	UNIT	2005 LANDINGS	UNIT	RATIO
Yellowfin grouper	*Mycteroperca venenosa*	See species column		644.41	Individuals	9,739	Pounds	**
Yellowfin menhaden, South Atlantic	*Brevoortia smithi*	See species column		224.04	Individuals	See footnote	–	**
Yellowfin tuna	*Thunnus albacares*	99.67	Individuals	99.67 103,088.03	Individuals Pounds	3,446,030	Pounds	**
Yellowfin tuna, South Atlantic	*Thunnus albacares*	103,088.03	Pounds					
Yellowmouth grouper	*Mycteroperca interstitialis*	See species column		4.20	Individuals	575	Pounds	**
Yellowtail snapper	*Ocyurus chrysurus*	See species column		409,684.19	Individuals	1,325,387	Pounds	**

[a] Bycatch at the stock level is listed only for species with bycatch of more than one substock. If one or no substocks occur, total bycatch is listed in the "species" column.
[b] Landed weights are for catch sold only.
[c] Southeast Region landings were not reported by menhaden species, but were reported for menhaden in general. Landings for 2005 for *Brevoortia* were 828,842,807 pounds, but could not be used to develop a bycatch ratio for menhaden species, as the exact composition of the *Brevoortia* group was unknown.
[d] Landings data for great barracuda were not available. It is possible that landings for this species are grouped with Sphyraenidae (barracudas), along with other Sphyraenidae species. Southeast Regional landings for Sphyraenidae were 126,158 pounds for the year 2005.
[e] Landings data were not available for scalloped hammerhead shark. It is possible that these landings were included in landings for Sphyrnidae (hammerhead sharks, generally) along with other hammerhead shark species. Southeast Regional landings for Sphyrnidae were 273,298 pounds for the year 2005.
[f] Landings data were not available for silver seatrout. It is possible that landings for this species were included in the weakfish landings (another common name for seatrout), along with other seatrout species. Southeast Region landings for weakfish were 428,767 pounds in 2005, but could not be used to develop a bycatch ratio for silver seatrout, as the exact composition of the weakfish group is unknown.
[g] Take of smalltooth sawfish is prohibited without prior authorization because this species is listed as endangered under the ESA.
[h] Landing spotted eagle ray is not federally prohibited, but is prohibited by the State of Florida. Spotted eagle rays are not landed elsewhere.

Table 4.2.C

Subtables showing marine mammal bycatch estimates and associated CVs (where available) for Southeast Region fisheries (source: Waring et al. 2007). Bycatch estimates are in numbers of individuals and include incidental mortality and serious injury. Key stocks/populations are shaded. Where multiple years of data are indicated, the estimate is an annual average.

Subtable 4.2.C.1 — LARGE COASTAL AND SMALL COASTAL SHARK AGGREGATES (DRIFT, STRIKE, AND BOTTOM GILLNET)

COMMON NAME	SCIENTIFIC NAME	DATA SOURCE	BYCATCH	UNIT	CV
Bottlenose dolphin, Western North Atlantic Coastal	*Tursiops truncatus*	2000–04	5	Individuals	0.49
TOTAL FISHERY BYCATCH			5	Individuals	

Subtable 4.2.C.2 — ATLANTIC AND GULF OF MEXICO HMS PELAGIC LONGLINE

COMMON NAME	SCIENTIFIC NAME	DATA SOURCE	BYCATCH	UNIT	CV
Pilot whale (long- and/or short-finned)	*Globicephala* spp.	2000–04	70	Individuals	0.37
Risso's dolphin, Western North Atlantic	*Grampus griseus*	2000–04	46	Individuals	0.37
Spotted dolphin, Atlantic, Western North Atlantic	*Stenella frontalis*	2001–05	6	Individuals	1
Spotted dolphin, pantropical, Western North Atlantic	*Stenella attenuata*	2001–05	6	Individuals	1
TOTAL FISHERY BYCATCH			116	Individuals	

Subtable 4.2.C.3 — ATLANTIC AND GULF OF MEXICO SHARK BOTTOM LONGLINE

COMMON NAME	SCIENTIFIC NAME	DATA SOURCE	BYCATCH	UNIT	CV
Bottlenose dolphin, Western North Atlantic Coastal	*Tursiops truncatus*	2003	100.25	Individuals	
TOTAL FISHERY BYCATCH			100.25	Individuals	

Subtable 4.2.C.4 (SUMMARY BY SPECIES) — TOTAL SPECIES BYCATCH

COMMON NAME	SCIENTIFIC NAME	AMOUNT	UNIT
Bottlenose dolphin, Western North Atlantic Coastal	*Tursiops truncatus*	105.25	Individuals
Pilot whale (long- and/or short-finned)	*Globicephala* spp.	70	Individuals
Risso's dolphin, Western North Atlantic	*Grampus griseus*	46	Individuals
Spotted dolphin, Atlantic, Western North Atlantic	*Stenella frontalis*	6	Individuals
Spotted dolphin, pantropical, Western North Atlantic	*Stenella attenuata*	6	Individuals
TOTAL FISHERY BYCATCH		233.25	Individuals

Table 4.2.D

Subtables showing sea turtle bycatch estimates and associated CVs (where available) for Southeast Region fisheries. Bycatch estimates are in number of individuals. Estimates are for live and dead releases in all fisheries with the exception of the shrimp trawl fisheries, where estimates are for mortalities only. Key stocks/populations are shaded. Where multiple years of data are indicated, the estimate is an annual average.

Subtable 4.2.D.1 — GULF OF MEXICO REEF FISH BOTTOM LONGLINE

COMMON NAME	SCIENTIFIC NAME	DATA SOURCE	BYCATCH	UNIT	CV
Unclassified sea turtles		2005	10.37	Individuals	
TOTAL FISHERY BYCATCH			10.37	Individuals	

Subtable 4.2.D.2 — GULF OF MEXICO REEF FISH HANDLINE

COMMON NAME	SCIENTIFIC NAME	DATA SOURCE	BYCATCH	UNIT	CV
Loggerhead sea turtle	*Caretta caretta*	2006	24.42	Individuals	
TOTAL FISHERY BYCATCH			24.42	Individuals	

Subtable 4.2.D.3 — GULF OF MEXICO SHRIMP TRAWL[a]

COMMON NAME	SCIENTIFIC NAME	DATA SOURCE	BYCATCH	UNIT	CV
Green sea turtle	*Chelonia mydas*	2002	486	Individuals	
Kemp's ridley sea turtle	*Lepidochelys kempii*	2002	3,884	Individuals	
Leatherback sea turtle	*Dermochelys coriacea*	2001	63	Individuals	
Loggerhead sea turtle	*Caretta caretta*	2001	2,416	Individuals	
TOTAL FISHERY BYCATCH			6,849	Individuals	

[a] Bycatch mortality estimates for Southeast shrimp fisheries from the NMFS 2002 Biological Opinion on the Shrimp Fisheries of the Southeastern United States. Since that time effort in the shrimp fishery and associated bycatch have decreased markedly.

Subtable 4.2.D.4 — LARGE COASTAL AND SMALL COASTAL SHARK AGGREGATES (DRIFT, STRIKE, AND BOTTOM GILLNET)[b]

COMMON NAME	SCIENTIFIC NAME	DATA SOURCE	BYCATCH	UNIT	CV
Leatherback sea turtle	*Dermochelys coriacea*	2002	3.40	Individuals	0.69
Loggerhead sea turtle	*Caretta caretta*	2002	1.70	Individuals	1.00
TOTAL FISHERY BYCATCH			5.10	Individuals	

[b] Estimates are only for the directed shark drift gillnet portion of the fishery.

Table 4.2.D (continued)

Subtable 4.2.D.5

		NORTH CAROLINA INSHORE (BAYS AND RIVERS) GILLNET[c]			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Green sea turtle	*Chelonia mydas*	2006	37	Individuals	
Leatherback sea turtle	*Dermochelys coriacea*	2005–07	19	Individuals	
Loggerhead sea turtle	*Caretta caretta*	2005–07	4	Individuals	
TOTAL FISHERY BYCATCH			60	Individuals	

[c] Bycatch estimates for this fishery are a sum over the years indicated, not averages.

Subtable 4.2.D.6

		NORTH CAROLINA SOUTHERN FLOUNDER POUND NET			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Green sea turtle	*Chelonia mydas*	2003 Fall	107.7	Individuals	0.235
Kemp's ridley sea turtle	*Lepidochelys kempii*	2003 Fall	13.6	Individuals	0.421
Loggerhead sea turtle	*Caretta caretta*	2003 Fall	536.8	Individuals	0.114
TOTAL FISHERY BYCATCH			658.1	Individuals	

Subtable 4.2.D.7

		SOUTH ATLANTIC SNAPPER–GROUPER HANDLINE			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Unclassified sea turtles		2005	3.22	Individuals	
TOTAL FISHERY BYCATCH			3.22	Individuals	

Subtable 4.2.D.8

		ATLANTIC AND GULF OF MEXICO HMS PELAGIC LONGLINE			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Leatherback sea turtle	*Dermochelys coriacea*	2005	350.90	Individuals	0.22
Loggerhead sea turtle	*Caretta caretta*	2005	273.80	Individuals	0.18
TOTAL FISHERY BYCATCH			624.70	Individuals	

Table 4.2.D (continued)

Subtable 4.2.D.9		ATLANTIC AND GULF OF MEXICO SHARK BOTTOM LONGLINE			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Leatherback sea turtle	*Dermochelys coriacea*	2005	83.20	Individuals	0.76
Loggerhead sea turtle	*Caretta caretta*	2005	420.00	Individuals	0.43
Unidentified sea turtle		2004	31.80	Individuals	1.00
TOTAL FISHERY BYCATCH			535.00	Individuals	

Subtable 4.2.D.10		SOUTHEASTERN ATLANTIC SHRIMP TRAWL[d]			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Green sea turtle	*Chelonia mydas*	2001	28	Individuals	
Kemp's ridley sea turtle	*Lepidochelys kempii*	2002	324	Individuals	
Leatherback sea turtle	*Dermochelys coriacea*	2001	17	Individuals	
Loggerhead sea turtle	*Caretta caretta*	2001	1,532	Individuals	
TOTAL FISHERY BYCATCH			1,901	Individuals	

[d] Bycatch estimates from the 2002 shrimp fishery Biological Opinion. Since that time, effort in the shrimp fishery (and thus associated bycatch) have decreased dramatically.

Subtable 4.2.D.11 (SUMMARY)		TOTAL SPECIES BYCATCH	
COMMON NAME	**SCIENTIFIC NAME**	**AMOUNT**	**UNIT**
Green sea turtle	*Chelonia mydas*	658.7	Individuals
Kemp's ridley sea turtle	*Lepidochelys kempii*	4,222	Individuals
Leatherback sea turtle	*Dermochelys coriacea*	536.5	Individuals
Loggerhead sea turtle	*Caretta caretta*	5,209	Individuals
Unidentified turtles		45.39	Individuals
TOTAL BYCATCH		10,670.91	Individuals

Table 4.2.E
Subtables showing seabird bycatch estimates for Southeast Region fisheries. Estimates reflect the annual average from the years identified, and are in numbers of individuals.

Subtable 4.2.E.1

		ATLANTIC AND GULF OF MEXICO HMS PELAGIC LONGLINE			
COMMON NAME	**SCIENTIFIC NAME**	**Data Source**	**Bycatch**	**Unit**	**CV**
Greater shearwaters	*Puffinus gravis*	2004	75	Individuals	
Gull		2004	61	Individuals	
Northern gannet	*Morus bassanus*	2000	22	Individuals	
Wilson's storm petrel	*Oceanites oceanicus*	1995	24	Individuals	
Unspecified seabirds		2004	6	Individuals	
TOTAL FISHERY BYCATCH			142[a]	Individuals	

[a] Separate total sea bird estimate (see Hata 2006), not the sum of the by-species estimates.

Subtable 4.2.E.2

		SOUTH ATLANTIC COASTAL MIGRATORY PELAGIC TROLL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Northern gannet	*Morus bassanus*	2006	24.09	Individuals	
TOTAL FISHERY BYCATCH			24.09	Individuals	

Subtable 4.2.E.3 (SUMMARY)

		TOTAL SPECIES BYCATCH	
COMMON NAME	**SCIENTIFIC NAME**	**AMOUNT**	**UNIT**
Greater shearwaters	*Puffinus gravis*	75	Individuals
Gull		61	Individuals
Northern gannet	*Morus bassanus*	44.09	Individuals
Wilson's storm petrel	*Oceanites oceanicus*	24	Individuals
Unspecified seabirds		6	Individuals
TOTAL STOCK BYCATCH		186.09[b]	Individuals

[b] Sum of the two fisheries totals, not the sum of the by-species estimates.

4.3 Alaska Region

Alaska is the largest U.S. state and is in itself an entire NMFS region. Its EEZ of over one million square miles contains more than 70% of the total area of U.S. continental shelves (NMFS 2004c). The Alaska Region includes part or all of several LMEs (Aleutian Islands, Eastern Bering Sea, Western Bering Sea, Gulf of Alaska, Chukchi Sea, and the Beaufort Sea).[1] The North Pacific Fishery Management Council (NPFMC), in conjunction with NMFS, is responsible for managing fisheries in the Alaska Region. These cold-water ecosystems provide resources that support abundant fisheries, many populations of marine mammals, and a variety of seabird species.

4.3.1 Fisheries Overview

A total of 77 state and Federal commercial fisheries are included in this report for the Alaska Region (Table 4.3.1). Landings from these fisheries were valued at approximately $1.367 billion dollars in 2005.[2] These fisheries are diverse with respect to the species targeted, the gear types employed, and the sizes of both harvesting and processing sectors. They target numerous groundfish species, Pacific halibut, Pacific herring, and several species of Pacific salmon, crab, and other shellfish. With a few exceptions, discard information of fish is available only for Federal groundfish fisheries because FMP regulations (50 CFR part 679) require specified levels of observer coverage in these fisheries to support information requirements for in-season management, scientific research, and compliance monitoring. Information on marine mammal bycatch is also available from the Federal Groundfish Observer Program and for some state fisheries that have been observed through the Alaska Marine Mammal Observer Program. Details about the information collected by observers can be found in Section 4.3.3.

In the Alaska Region, a total of 27 fisheries are managed solely by NMFS, while 48 fisheries (62%) have some form of state management (Figure 4.3.1). Only 3% of the fisheries are managed on an international level.

Federal management of finfish and shellfish species in the EEZ off Alaska is described in five FMPs developed by the NPFMC and approved by the Secretary of Commerce: Groundfish of the Bering Sea and Aleutian Islands (BSAI) Management Area FMP; Groundfish of the Gulf of Alaska (GOA) FMP; the BSAI King and Tanner Crab FMP; the Scallop Fishery off Alaska FMP; and the Salmon FMP in the EEZ off the Coast of Alaska. In general, these FMPs outline processes for setting harvest limits, provide for bycatch control and monitoring, and regulate certain aspects of limited-access privilege programs or license limitation programs. These plans also maintain Federal oversight where management functions are delegated to the State of Alaska by NMFS and the NPFMC through specific FMP language.

The State of Alaska Department of Fish and Game (ADFG) manages fisheries within Alaska State territorial waters (0–3 nautical miles) and fisheries that have management functions delegated to the state through a Federal FMP. The ADFG is the principal state agency responsible for management of fisheries with delegated authority. The following FMPs defer a portion of management responsibilities to ADFG:

- BSAI King and Tanner Crab FMP, which regulates fisheries for red, blue, and brown king crab; Tanner crab; and snow crab
- The Scallop Fishery off Alaska FMP, which regulates the weathervane scallop fishery in the GOA
- The Alaska Salmon FMP, which largely prohibits directed fishing for salmon in Federal waters except by a limited number of vessels using troll gear

A total of 27 groundfish fisheries are managed by NMFS in consultation with the NPFMC under the Groundfish of the GOA and Groundfish of the BSAI Management Area FMPs. Both FMPs have been amended substantially since they were first implemented, and many of the regulatory changes enabled by these amendments supported the evolution of the Alaska groundfish fisheries from a predominantly foreign operation to the largest exclusively U.S. fishing industry operation by the late 1980s. The Groundfish of the BSAI Management Area FMP, implemented in 1982, outlines management measures for Alaska groundfish stocks in the U.S. EEZ of the Bering Sea, including Bristol Bay and Norton Sound, and the portion of the North Pacific Ocean adjacent to the Aleutian Islands, which is between 170ºW longitude and the U.S. Russian Convention line of 1867. The area's northern limit is the Bering Strait.[3] The Groundfish of the GOA FMP regulates catch of groundfish within the U.S. EEZ, exclusive of the Bering Sea, between the eastern Aleutian Islands at 170ºW longitude and Dixon Entrance at 132ºE latitude 40ºW longitude.[4]

Most groundfish fisheries in waters off Alaska are managed under the groundfish FMPs for the BSAI and GOA Regions. The major species managed under the Groundfish FMPs are walleye pollock (*Theragra chalcogramma*), Pacific cod (*Gadus macrocephalus*), sablefish (*Anoplopoma fimbria*), rockfish, flatfish, and Atka mackerel (*Pleurogram-*

[1] http://www.lme.noaa.gov/.

[2] Ex-vessel landings value, Fisheries Economics of the U.S., 2006. Available online at http://www.st.nmfs.noaa.gov/st5/publication/fisheries_economics_2006.html.

[3] Description of BSAI FMP area is from the Groundfish of the Bering Sea and Aleutian Islands Management Area FMP, available at http://www.fakr.noaa.gov/npfmc/fmp/bsai/bsai.htm.

[4] Description of GOA FMP area is from the GOA Groundfish FMP, available at http://www.fakr.noaa.gov/npfmc/fmp/goa/GOA.pdf.

Table 4.3.1
Alaska Region fisheries included in the U.S. National Bycatch Report. Fishery group names appear in bold, followed by the individual fisheries within the group. Grouped fisheries are listed alphabetically, first by fisheries group name, then by management authority, and then by individual fishery name. Non-grouped fisheries are listed alphabetically by management authority and then fishery name. Rows containing fisheries for which bycatch estimates are included in this report are shaded.

Fishery[a]	Management Authority	Federal FMP[b]	Gear Type	Target Species (Common Name)	Data Sources[c]
Bering Sea/Aleutian Islands Flatfish Trawl Fisheries					
Bering Sea/Aleutian Islands Flatfish Group (Arrowtooth Flounder, Flathead Sole, other Flatfish) Trawl	Federal	Groundfish of the Bering Sea and Aleutian Islands Management Area	Trawl	Arrowtooth flounder, flathead sole, other flatfish	Landing report, at-sea production report, observer data
Bering Sea/Aleutian Islands Rock Sole Trawl	Federal	Groundfish of the Bering Sea and Aleutian Islands Management Area	Trawl	Rock sole	Landing report, at-sea production report, observer data
Bering Sea/Aleutian Islands Yellowfin Sole Trawl	Federal	Groundfish of the Bering Sea and Aleutian Islands Management Area	Trawl	Yellowfin sole	Landing report, at-sea production report, observer data
Gulf of Alaska Flatfish Trawl Fisheries					
Gulf of Alaska Arrowtooth Flounder Trawl	Federal	Groundfish of the Gulf of Alaska	Trawl	Arrowtooth flounder	Landing report, at-sea production report, observer data
Gulf of Alaska Flatfish (Deepwater Flatfish) Trawl	Federal	Groundfish of the Gulf of Alaska	Trawl	Dover sole, deepsea sole, Greenland turbot	Landing report, at-sea production report, observer data
Gulf of Alaska Flatfish (Shallow Water Flatfish) Trawl	Federal	Groundfish of the Gulf of Alaska	Trawl	Northern rock sole, southern rock sole, yellowfin sole	Landing report, at-sea production report, observer data
Gulf of Alaska Flathead Sole Trawl	Federal	Groundfish of the Gulf of Alaska	Trawl	Flathead sole	Landing report, at-sea production report, observer data
Gulf of Alaska Rex Sole Trawl	Federal	Groundfish of the Gulf of Alaska	Trawl	Rex sole	Landing report, at-sea production report, observer data
Non-Grouped Fisheries					
Aleutian Islands/ eastern Bering Sea/ Atka mackerel trawl	Federal	Groundfish of the Bering Sea and Aleutian Islands Management Area	Trawl	Atka mackerel	Landing report, at-sea production report, observer data

Table 4.3.1 (continued)

Fishery[a]	Management Authority	Federal FMP[b]	Gear Type	Target Species (Common Name)	Data Sources[c]
Non-Grouped Fisheries (cont.)					
Bering Sea/Aleutian Islands Greenland turbot longline	Federal	Groundfish of the Bering Sea and Aleutian Islands Management Area	Longline	Greenland turbot	Landing report, at-sea production report, observer data
Bering Sea/Aleutian Islands Pacific cod jig	Federal	Groundfish of the Bering Sea and Aleutian Islands Management Area	Hand Lines, Auto Jig	Pacific cod	Landing report, observer data
Bering Sea/Aleutian Islands Pacific cod pot	Federal	Groundfish of the Bering Sea and Aleutian Islands Management Area	Pots and Traps, fish	Pacific cod	Landing report, at-sea production report, observer data
Bering Sea/Aleutian Islands Pacific cod longline	Federal	Groundfish of the Bering Sea and Aleutian Islands Management Area	Longline	Pacific cod	Landing report, at-sea production report, observer data
Bering Sea/Aleutian Islands Pacific cod trawl	Federal	Groundfish of the Bering Sea and Aleutian Islands Management Area	Trawl	Pacific cod	Landing report, at-sea production report, observer data
Bering Sea/Aleutian Islands Pacific ocean perch	Federal	Groundfish of the Bering Sea and Aleutian Islands Management Area	Trawl	Pacific ocean perch	Landing report, at-sea production report, observer data
Bering Sea/Aleutian Islands pollock trawl	Federal	Groundfish of the Bering Sea and Aleutian Islands Management Area	Trawl	Pollock	Landing report, at-sea production report, observer data
Bering Sea/Aleutian Islands sablefish longline	Federal	Groundfish of the Bering Sea and Aleutian Islands Management Area	Longline	Sablefish	Landing report, at-sea production report, observer data
Bering Sea/Aleutian Islands sablefish pot	Federal	Groundfish of the Bering Sea and Aleutian Islands Management Area	Pots and Traps, Fish	Sablefish	Landing report, at-sea production report, observer data
Bering Sea/Aleutian Islands sablefish trawl	Federal	Groundfish of the Bering Sea and Aleutian Islands Management Area	Trawl	Sablefish	Landing report, at-sea production report, observer data
Gulf of Alaska Pacific cod jig	Federal	Groundfish of the Gulf of Alaska	Hand Lines, Auto Jig	Pacific cod	Landing report, observer data

Table 4.3.1 (continued)

Fishery[a]	Management Authority	Federal FMP[b]	Gear Type	Target Species (Common Name)	Data Sources[c]
Non-Grouped Fisheries (cont.)					
Gulf of Alaska Pacific cod longline	Federal	Groundfish of the Gulf of Alaska	Longline	Pacific cod	Landing report, at-sea production report, observer data
Gulf of Alaska Pacific cod pot	Federal	Groundfish of the Gulf of Alaska	Pots and Traps, Fish	Pacific cod	Landing report, at-sea production report, observer data
Gulf of Alaska Pacific cod trawl	Federal	Groundfish of the Gulf of Alaska	Trawl	Pacific cod	Landing report, at-sea production report, observer data
Gulf of Alaska pollock trawl	Federal	Groundfish of the Gulf of Alaska	Trawl	Pollock	Landing report, at-sea production report, observer data
Gulf of Alaska rockfish (northern rockfish, pelagic shelf rockfish, Pacific ocean perch) trawl	Federal	Groundfish of the Gulf of Alaska	Trawl	Northern rockfish, pelagic shelf rockfish, Pacific ocean perch	Landing report, at-sea production report, observer data
Gulf of Alaska sablefish longline	Federal	Groundfish of the Gulf of Alaska	Longline	Sablefish	Landing report, at-sea production report, observer data
Gulf of Alaska sablefish trawl	Federal	Groundfish of the Gulf of Alaska	Trawl	Sablefish	Landing report, at-Sea production report, observer data
Alaska halibut longline	International		Longline	Pacific halibut	
Alaska/North Pacific halibut handline and mechanical jig	International		Hand Lines, Auto Jig	Pacific halibut	
Alaska abalone	State		By Hand, Diving Gear; By Hand, No Diving Gear	Abalone	
Alaska Bristol Bay salmon drift gillnet	State		Gillnet, Floating Drift	Chum salmon, coho salmon, Chinook salmon, pink salmon, sockeye salmon	
Alaska Bristol Bay salmon set gillnet	State		Gillnet	Chum salmon, coho salmon, Chinook salmon, pink salmon, sockeye salmon	
Alaska clam	State		Shovel, diving gear	Geoducks, hardshell, razor clams	

Table 4.3.1 (continued)

Fishery[a]	Management Authority	Federal FMP[b]	Gear Type	Target Species (Common Name)	Data Sources[c]
Non-Grouped Fisheries (cont.)					
Alaska Cook Inlet drift gillnet	State		Gillnet, Floating Drift	Chum salmon, coho salmon, Chinook salmon, pink salmon, sockeye salmon	Observer data (protected species only)
Alaska Cook Inlet salmon set gillnet	State		Gillnet	Chum salmon, coho salmon, Chinook salmon, pink salmon, sockeye salmon	Observer data (protected species only)
Alaska Dungeness crab	State		By Hand, with and without Diving Gear	Dungeness crab	
Alaska groundfish longline/setline (including sablefish, rockfish, and miscellaneous) finfish)	State		Longline	Sablefish	
Alaska Herring Spawn on Kelp Pound Net	State		Pound net	Pacific herring	
Alaska Kodiak food/bait herring trawl	State		Otter trawl, midwater	Pacific herring	
Alaska Kodiak salmon set gillnet	State		Gillnet	Chum salmon, Coho salmon, Chinook salmon, pink salmon, sockeye salmon	Observer data (protected species only)
Alaska Kuskokwim, Yukon, Norton Sound, Kotzebue salmon gillnet	State		Gillnet	Chum salmon, Coho salmon, Chinook salmon, pink salmon, sockeye salmon	
Alaska Metlakatla/Annette Island salmon drift gillnet	State		Gillnet, Floating Drift	Chum salmon, Coho salmon, Chinook salmon, pink salmon, sockeye salmon	
Alaska Metlakatla salmon purse seine	State		Purse seine	Chum salmon, coho salmon, Chinook salmon, pink salmon, sockeye salmon	
Alaska miscellaneous finfish beach seine	State		Other Seines	Finfish	
Alaska miscellaneous finfish beam trawl	State		Other Trawls	Finfish	
Alaska miscellaneous finfish handline and mechanical jig	State		Hand Lines, Auto Jig	Finfish	
Alaska miscellaneous finfish pair trawl	State		Otter Trawl Midwater, Paired	Finfish	

Table 4.3.1 (continued)

Fishery[a]	Management Authority	Federal FMP[b]	Gear Type	Target Species (Common Name)	Data Sources[c]
Non-Grouped Fisheries (cont.)					
Alaska miscellaneous finfish purse seine	State		Purse Seine	Finfish	
Alaska miscellaneous finfish set gillnet	State		Gillnet	Finfish	
Alaska octopus/squid handline	State		Hand Line	Octopus, squid	
Alaska octopus/squid longline	State		Longline	Octopus, squid	
Alaska octopus/squid pot	State		Pots and traps, octopus	Octopus, squid	
Alaska Peninsula/Aleutian Islands salmon drift gillnet	State		Gillnet, Floating Drift	Chum salmon, Coho salmon, Chinook salmon, pink salmon, sockeye salmon	Observer data (protected species only)
Alaska Peninsula/Aleutians salmon set gillnet	State		Gillnet	Chum salmon, Coho salmon, Chinook salmon, pink salmon, sockeye salmon	
Alaska Prince William Sound salmon drift gillnet	State		Gillnet	Chum salmon, Coho salmon, Chinook salmon, pink salmon, sockeye salmon	Observer data (protected species only)
Alaska Prince William Sound salmon set gillnet	State		Gillnet	Chum salmon, Coho salmon, Chinook salmon, pink salmon, sockeye salmon	Observer data (protected species only)
Alaska Roe Herring and Food/Bait Herring Beach Seine	State		Other seines	Pacific herring	
Alaska Roe Herring and Food/Bait Herring Gillnet	State		Gillnets	Pacific herring	
Alaska Roe Herring and Food/Bait Herring Purse Seine	State		Purse Seine	Pacific herring	
Alaska salmon beach seine	State		Other seines	Chum salmon, coho salmon, Chinook salmon, pink salmon, sockeye salmon	
Alaska Salmon Purse Seine (except Southeast Alaska, which is in Category II)	State		Purse seine	Chum salmon, coho salmon, Chinook salmon, pink salmon, sockeye salmon	
Alaska salmon troll	State		Troll lines	Chum salmon, coho salmon, Chinook salmon, pink salmon, sockeye salmon	
Alaska Shrimp Otter Trawl and Beam Trawl (Statewide and Cook Inlet)	State		Other trawls	Pink shrimp, spot shrimp	

Table 4.3.1 (continued)

Fishery[a]	Management Authority	Federal FMP[b]	Gear Type	Target Species (Common Name)	Data Sources[c]
Non-Grouped Fisheries (cont.)					
Alaska snail pot	State		Pots and Traps	Green snails	
Alaska southeast herring roe/food/bait pound net	State		Pound net	Pacific herring	
Alaska southeast salmon drift gillnet	State		Gillnet, Floating Drift	Chum salmon, Coho salmon, Chinook salmon, pink salmon, sockeye salmon	Stranding and entanglement data
Alaska southeast salmon purse seine	State		Purse seine	Chum salmon, coho salmon, Chinook salmon, pink salmon, sockeye salmon	
Alaska urchin and other fish/shellfish	State		By Hand, Diving Gear; By Hand, No Diving Gear	Green urchin Red urchin	
Alaska Yakutat salmon set gillnet	State		Gillnet	Chum salmon, Coho salmon, Chinook salmon, pink salmon, sockeye salmon	Observer data (program initiated in 2007); strandings and entanglement data
Aleutian Islands state waters Pacific cod	State		Pots and Traps	Pacific cod	
Bering Sea/Aleutian Islands crab pot	State	Federal FMP, but deferred to state mangement	Pots and Traps	Blue king crab, red king crab, Tanner crab, snow crab	
Coastwide scallop dredge	State	Federal FMP, but deferred to state mangement	Dredge	Weathervane scallops	
Gulf of Alaska crab pot	State		Pots and Traps	Blue king crab, Dungeness crab, golden king crab, red king crab, Tanner crab	Strandings and entanglement data
Gulf of Alaska Pacific cod state fishery jig	State		Hand Lines, Auto Jig	Pacific cod	
Gulf of Alaska Pacific cod state fishery pot	State		Pots and Traps, Fish	Pacific cod	
Southeast Alaska crab pot	State		Pots and Traps	Blue king crab, Dungeness crab, golden king crab, red king crab, Tanner crab	
Southeast Alaska shrimp pot	State		Pots and Traps, Shrimp	Pink shrimp, spot shrimp	

[a] Aquaculture fisheries are listed for consistency with the MMPA List of Fisheries, but were not analyzed for the U.S. National Bycatch Report. Recreational fisheries are not included in this report.
[b] FMP = fisheries management plan. Note that non-federal FMPs were not identified through this process.
[c] Data sources were evaluated only for federal fisheries and non-federal fisheries with federal data-collection programs.

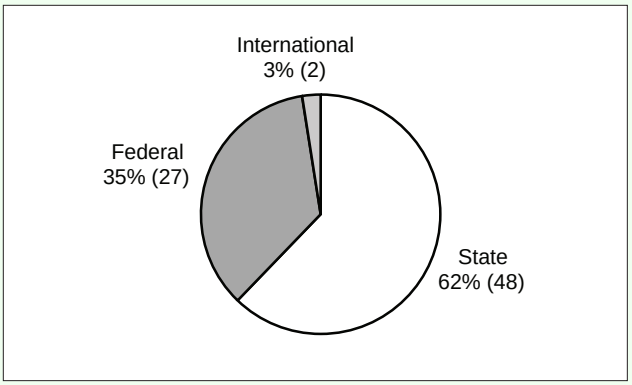


Figure 4.3.1
Management jurisdiction for Alaska Region fisheries (percentages are based on numbers of fisheries, not volume or revenue).

mus monopterygius). The status of groundfish stocks are summarized in annual stock assessment and fishery evaluation reports developed by NMFS and the NPFMC. For several groundfish stocks, fisheries occur in both Federal and state waters. These "parallel" groundfish fisheries are the pollock, Pacific cod, and Atka mackerel fisheries conducted with the same time and area restrictions and under the same total allowable catches as established for Federal fisheries. Several groundfish species are not managed by the Federal government because they are not covered by the groundfish FMPs for the GOA and BSAI. These include lingcod (*Ophiodon elongates*), groundfish caught in recreational fisheries (largely rockfish), black rockfish (*Sebastes melanops*), and blue rockfish (*Sebastes mystinus*).

The single international fishery in the region, the Pacific halibut fishery, is managed under a bilateral treaty between the U.S. and Canada, and with research and quota recommendations from the International Pacific Halibut Commission (IPHC). Under the North Pacific Halibut Act, NMFS is authorized to develop regulations that are in addition to, but not in conflict with, the regulations adopted by the IPHC. The NPFMC develops allocation and limited entry regulations for the commercial Alaska portion of the halibut fishery.

4.3.2. Addressing Regional Bycatch Concerns

Bycatch concerns in Alaska Region fisheries are complex, due to multispecies interactions, the use of quotas to allocate fishing privileges, and the large scale (both in harvesting capacity and geographic extent) of the fisheries. The NMFS staff work closely with the NPFMC to develop and implement fisheries regulations, which has been crucial to addressing regional bycatch issues.

BSAI/GOA Groundfish

Bycatch of fish in the Federal groundfish fisheries may occur when discard is required by regulation (regulatory discard) or when fish are discarded because they have low value or for some other economic reason (economic discard). Species-specific regulatory discards occur when regulations require certain species to be discarded to avoid exceeding allowable catch limits. Catch limits are also set for commercially important species that are caught incidentally in other groundfish fisheries. Regulations also require some species that are processed to achieve or exceed specified product-recovery rates, to discourage waste during processing.

The NPFMC has long recognized the need to reduce bycatch, minimize waste, collect the information necessary to monitor fisheries, and improve utilization of fish resources to the extent practicable. To meet this need, the NPFMC and NMFS have supported numerous actions to establish areas with special bycatch limits, reduce incentives to discard fish, and improve the selectivity of fishing gear. These actions include:

- Limited-access privilege and license limitation programs that reduce the incentives for vessel operators to maximize their harvest in order to obtain a larger share of available quota. There are seven Federal limited-access programs in the Alaska Region: the American Fisheries Act (AFA) Vessels Program, the non-American Fishery Act trawl limited-access program (Amendment 80 to the Groundfish of the BSAI FMP); the Rockfish Pilot Program (Amendment 68 to the Groundfish of the GOA FMP); the Crab Rationalization Program; the Halibut and Sablefish IFQ Program; Scallop License Limitation; and Groundfish License Limitation.

- Annual specifications for harvest and overfishing limits that are scientifically based on the best available data and subject to established protocols. On an annual basis, the Council recommends harvest and overfishing levels to the Secretary of Commerce. The process for establishing these benchmarks is described in the groundfish FMPs for the GOA and BSAI. In brief, the benchmarks are created as a joint effort between stock assessment scientists at the Alaska Fisheries Science Center (AFSC), FMP-specific Plan Teams, the Scientific and Statistical Committee of the NPFMC, and the NPFMC. Harvest levels, including incidental catches, for FMP species are maintained below the overfishing level through in-season actions by NMFS.

- Management programs designed to limit incidental catch and increase the retention and utilization of bycatch species. These programs include regulations that allow bycatch to be donated to food banks, regulations that require vessels to retain a certain amount of species-

specific bycatch, and regulations that require processors to create products that yield a certain amount of product from pollock and Pacific cod.

- Cooperative work between industry, NMFS, the Sea Grant Program, and the state to develop modifications to gear that reduce bycatch of halibut, salmon, and seabirds. In recent years, several exempted fishing permits have been issued to study modifications to trawl gear designed to reduce salmon bycatch in the BSAI pollock fishery, and halibut bycatch in the GOA trawl fisheries. Preliminary results from these studies are encouraging, but further work will be needed before widespread implementation of the technology.

- In addition, several cooperative studies established methods to reduce seabird bycatch using streamer lines (also called bird lines or tory lines) which are now required on longline vessels by Federal regulation. These lines extend from a high point near the stern of the vessel to a weighted buoy. As the vessel moves forward the weight creates tension in the line producing a span from the stern where the streamer line is aloft. When used in pairs, a fence-like effect is created by short, brightly colored lines that hang off the main streamer line.

- Regulations that allow industry to control fleet behavior to avoid areas of high bycatch, including the use of industry-sponsored cooperative agreements under AFA and other limited-access programs. The BSAI polluck cooperatives reach inter-cooperative agreements about bycatch reduction, over-harvest, area closures, data management, voluntary salmon and halibut bycatch reduction measures, and compliance with Steller sea lion conservation measures.

- Establishing area-specific bycatch limits and area closures. These include trawl closures in near-shore areas of Bristol Bay and other important habitat areas. These also include the Red King Crab Savings Area and the Salmon Savings Areas, which are specific hot-spot area closures that allow vessels to keep fishing for targeted species while reducing bycatch for these species.

- Amendments to the observer program to increase coverage in rationalized fisheries (fisheries where fisheries have some type of ownership of the resource, such as the limited-access priviledge programs described above) and require all fishing days to be observed. Increased coverage is critical to obtain the data needed track and manage individual catch and bycatch quotas. Sampling protocol has also been made more efficient, and in some situations more accurate, through the use of flow scales (allowing observers to accurately and precisely measure the size of larger samples than was previously possible) and other sampling modifications. One of the most substantive changes is that observers now collect and individually record at least three samples for species composition from each sampled haul or fishing event (previously, samples were pooled). This change allows NMFS to better understand the statistical properties of the data and the estimates derived from that data, including the within-haul variance.

State of Alaska Managed Fisheries

The FMPs for crab, scallop, and salmon delegate substantial management authority to the state. The scallop and crab fisheries in the BSAI are jointly managed by the state and Federal governments, while the salmon FMP delegates most management authority to the state. As a result, the state has certain delegated responsibilities that are described in the FMPs. Below is a brief summary of these fisheries.

The state and the NPFMC jointly manage six crab stocks in the BSAI under the BSAI King and Tanner Crabs FMP, whereas the state manages crab stocks in the GOA. For BSAI crab stocks, the BSAI Crab Plan Team provides recommendations to the NPFMC about annual harvest and overfishing levels. The six BSAI crab stocks are Bristol Bay red king crab (*Paralithodes camtschaticus*), Bering Sea Tanner crab (*Chionoecetes bairdi*), Bering Sea snow crab (*Chionoecetes opilio*), St. Matthew Island blue king crab (*Paralithodes platypus*), and Pribilof Islands red and blue king crabs. The Plan Teams have expertise in regulatory management, natural and social science, and crab stock assessment. All recommendations from a Plan Team must be designed to meet the requirements of the MSA and other applicable laws.

The state controls the opening and closing of all crab fisheries and is the primary entity that monitors harvest. The harvest of crab is monitored by the ADFG using an onboard observer program (different from the Federal observer program) and a shoreside reporting system. Bycatch of crab is controlled through state and Federal regulations for pot gear (e.g., escape openings), limits on the number of pots, and reporting requirements. The incidental mortality of crab species in non-crab fisheries is controlled through the use of prohibited species catch limits, which are set in concert with red king crab abundance and the closure of certain areas to trawl fishing. In addition, all crab fisheries have minimum size limits, restrictions that allow the harvest of male crabs only, and fishing seasons that protect crabs during spawning and molting periods.

The FMP for the scallop fishery off Alaska delegates most management measures to the state, excepting license limitation requirements in Federal waters. The fishery is monitored by State of Alaska observers who collect data on bycatch (notably crab and halibut bycatch), retained and discarded scallop catch, size composition, product recovery, and effort and location information. Bycatch of king,

Tanner, and snow crabs is controlled through the use of bycatch limits and the use of bycatch hotspot analysis by scallop fishermen. In 2000, six of the ten licensed scallop vessel owners formed a cooperative which allocates harvest shares based on past fishing history. The formation of this cooperative resulted in lower harvest rates and allowed vessels to reduce bycatch of crab species.

While most salmon fishery management responsibilities are carried out by the state, NMFS is responsible for monitoring salmon bycatch in the groundfish fisheries and, in some instances, monitoring marine mammal bycatch in directed salmon fisheries (see below for discussion of the Alaska Marine Mammal Observer Program). Management of salmon bycatch taken in the Federal groundfish fisheries must be consistent with requirements established in the MSA and other applicable laws. The NMFS is required under the ESA to consult with other affected regions on any Federal action that may adversely affect ESA-listed salmon caught in the groundfish fisheries. As a result, any take of ESA-listed surrogate stocks is reported and necessary action is taken by NMFS. Currently, NMFS has determined that any adverse effect from the groundfish fishery is limited to two ESA populations: Lower Columbia River (LCR) Chinook and Upper Willamette River (UWR) Chinook. The NMFS Northwest Region completed a supplemental BiOp on the effects of the Alaska groundfish fisheries on ESA-listed salmon. The supplemental BiOp concluded that the BSAI and GOA groundfish fisheries are not likely to jeopardize the continued existence or adversely modify critical habitat for the UWR and LCR ESA-listed Chinook salmon stocks.

The Bering Sea pollock fishery accounted for the majority of salmon bycatch, with Chinook (*Oncorhynchus tshawytscha*) and chum (*Oncorhynchus keta*) being the predominant salmon species caught. Overall bycatch rates in this fishery for all species were generally low compared with other fisheries in the region. During the past several years, the pollock industry has developed industry-based contractual agreements to address salmon bycatch by moving vessels away from areas with high bycatch amounts (“hot spots”). The NPFMC has continued to work towards a reduction in salmon bycatch. In 2008, the NPFMC considered a regulatory amendment (BSAI FMP Amendment 84b) that would limit the amount of salmon caught in the pollock fishery. Given the general concern regarding salmon bycatch in the groundfish (especially pollock) fisheries, Chinook and non-Chinook (generally chum but also some sockeye) salmon were designated as key stocks through the qualitative process described in Section 3.

Currently, four federally managed fisheries and 11 state-managed fisheries are classified as MMPA Category II fisheries in Alaska. Marine mammal interactions in Federal fisheries are reported by observers deployed by NMFS. The NMFS, through the Alaska Marine Mammal Observer Program (AMMOP), contracts observers to fulfill the MMPA obligations of the agency in state fisheries.

4.3.3 Data Sources

Monitoring groundfish harvest by non-recreational fisheries in Alaska is a joint effort of NMFS and the state. NMFS conducts real-time monitoring of total catch (landed catch plus at-sea discards) for in-season management, using a combination of observer information and mandatory industry reports, which are submitted with an electronic reporting system.

Table 4.3.1 lists sources of bycatch data available for federally managed Alaska Region fisheries and those Alaska State fisheries with relevant Federal data-collection programs. Several data sources were used to estimate bycatch, including observer reports, at-sea production reports (which included reports of discards), and landings reports (“fish tickets”).

Data collected by the observer program were used to estimate discards of FMP and prohibited species caught in the groundfish fisheries. Prohibited species included Pacific halibut (*Hippoglossus stenolepis*), salmon, several crab species, herring (*Clupea pallasi*), and groundfish species that were near their annual harvest limits. Regulations require prohibited species to be returned to the sea unless retention is required under other applicable laws.

4.3.3.1 Observer Programs

Alaskan fisheries are covered by two NMFS observer programs (Table 4.3.2). The AMMOP conducts observer coverage of state-managed fisheries classified in Category II under the MMPA annual List of Fisheries, including salmon set and drift gillnet and purse seine fisheries. The North Pacific Groundfish Observer Program (NPGOP) covers Bering Sea/Aleutian Islands and Gulf of Alaska groundfish trawl, longline, and pot fisheries. In 2005, a total of 35,683 sea days were observed by the NPGOP. The AMMOP targeted 663 permitted fishing vessels in 2005 in the Yakutat gillnet fishery. All NPGOP-observed fisheries were considered to have adequate or near-adequate coverage levels for the purposes of overall catch and bycatch estimation (see detailed discussion below), while the AMMOP provided baseline/pilot level coverage for the fisheries it observes.

Alaska Marine Mammal Observer Program

The AMMOP was initiated in 1990 with the objective of observing Alaskan fisheries listed as Category II by the annual MMPA List of Fisheries due to “occasional” incidental serious injuries/mortalities of marine mammals. Most of the fisheries of interest are state-managed, and many have very large numbers of participants (more than 1,000). Because of the large numbers of participants and the modest funding, observer coverage as a percentage of either permits or net days was far lower than observer coverage for the federally regulated fisheries.

Table 4.3.2
Current Alaska Region federal observer programs and fisheries observed (coverage level across all fisheries). Programs and observed fisheries are listed alphabetically. Observer programs that ended over 10 years ago are not listed, except for MMPA Category II salmon gillnet fisheries, which are observed on a rotating basis.

Observer Program	U.S. National Bycatch Report Fisheries	Authority to Place Observers	Program Duration	Coverage Level
Alaska Marine Mammal Observer Program (AMMOP)	Cook Inlet Drift Gillnet	MMPA Cat. II (50 CFR 229)	1999–2000	Number of permits sampled varies by fishery (generally from 2 to 8%).
	Cook Inlet Salmon Set Gillnet		1999–2000	
	Kodiak Salmon Set Gillnet		2002 and 2005	
	Peninsula/Aleutians Salmon Drift Gillnet		1990	
	Prince William Sound Salmon Drift Gillnet		1990–91	
	Prince William Sound Salmon Set Gillnet		1990–91	
	Yakutat Salmon Set Gillnet		2007–08	
Bering Sea, Aleutian Islands, and Gulf of Alaska Groundfish Trawl, Longline, and Pot Fisheries	Aleutian Islands/Eastern Bering Sea Atka Mackerel Trawl	MSFCMA (50 CFR 679.50)	1976–present (The program started in the foreign fishery and the domestic program was initiated in 1990)	2005–2008: 100% vessels > 125 ft and 30% vessels 60–124 ft and 30% or 100% shore plants
	Bering Sea/Aleutian Islands Flatfish Group (Arrowtooth Flounder, Flathead Sole, Other Flatfish) Trawl			
	Bering Sea/Aleutian Islands Greenland Turbot Longline			
	Bering Sea/Aleutian Islands Pacific Cod Jig			
	Bering Sea/Aleutian Islands Pacific Cod Longline			
	Bering Sea/Aleutian Islands Pacific Cod Pot			
	Bering Sea/Aleutian Islands Pacific Cod Trawl			
	Bering Sea/Aleutian Islands Pacific Ocean Perch			
	Bering Sea/Aleutian Islands Pollock Trawl			
	Bering Sea/Aleutian Islands Rock Sole Trawl			
	Bering Sea/Aleutian Islands Sablefish Longline			
	Bering Sea/Aleutian Islands Sablefish Pot			
	Bering Sea/Aleutian Islands Sablefish Trawl			
	Bering Sea/Aleutian Islands Yellowfin Sole Trawl			
	Gulf of Alaska Arrowtooth Flounder Trawl			
	Gulf of Alaska Flatfish (Deepwater Flatfish) Trawl			
	Gulf of Alaska Flatfish (Shallow Water Flatfish) Trawl			
	Gulf of Alaska Flathead Sole Trawl			
	Gulf of Alaska Pacific Cod Jig			
	Gulf of Alaska Pacific Cod Longline			
	Gulf of Alaska Pacific Cod Pot			
	Gulf of Alaska Pacific Cod Trawl			
	Gulf of Alaska Pollock Trawl			
	Gulf of Alaska Rex Sole Trawl			
	Gulf of Alaska Rockfish (Northern Rockfish, Pelagic Shelf Rockfish, Pacific Ocean Perch) Trawl			
	Gulf of Alaska Sablefish Longline			
	Gulf of Alaska Sablefish Trawl			

The AMMOP has conducted observer programs for 7 of the 14 Category II fisheries. The Prince William Sound set and drift gillnet fisheries were observed in 1990 and 1991, the Alaska Peninsula/Aleutians salmon drift gillnet fishery was observed in 1990, Cook Inlet salmon set and drift gillnet fisheries were observed in 1999 and 2000 (Manly 2006), the Kodiak Island salmon set gillnet fishery was observed in 2002 and 2005 (Manly 2007), and a pilot project was implemented for the Yakutat salmon set gillnet fishery in 2006, and was followed by a full observer program in 2007 and 2008 (see http://www.fakr.noaa.gov/protectedresources/observers/mmop.htm).

North Pacific Groundfish Observer Program

The observer program for federally managed groundfish fisheries was authorized in 1990 and implemented by NMFS, effective 7 February 1990 (55 CFR 4839, 12 February 1990). Under this program, NMFS provides operational oversight, certification training, definition of observer sampling duties and methods, debriefing of observers, and management of the data. Vessel and processing plant owners pay the cost of the observers, while the costs associated with managing the program are paid for by the Federal government. The design and focus of the NPGOP is on estimating fish and prohibited species catch and bycatch; protected species (marine mammal and seabird) bycatch information is also recorded.

Observer coverage is generally determined based on the size of the vessel prosecuting the fishery and, in several fisheries, the fishery in which the vessel is participating. Coverage levels for vessels harvesting groundfish are specified under the FMP, and are divided into three general categories: 1) vessels under 60 feet of length overall (LOA) are not required to carry observers; 2) vessels longer than 60 feet and shorter than 125 feet are required to carry observers on 30% of their fishing days; and 3) vessels 125 feet and longer are required to carry observers on 100% of their fishing days. Shoreside processors that process between 500 and 1000 metric tons of groundfish in a calendar month are required to have observers present 30% of the days that they receive or process groundfish. Shoreside processors that process 1,000 metric tons or more of groundfish in a calendar month are required to have observers present 100% of the days that they receive or process groundfish.

Observer coverage levels have been increased to implement certain limited-access programs with increased monitoring needs, such as the Western Alaska Community Development Quota (CDQ) Program, AFA pollock fishery, and more recently, the Rockfish Pilot Program and Groundfish of the BSAI Management Area FMP Amendment 80.

Detailed information about observer sampling protocols and extrapolations can be found in the North Pacific Groundfish Observer Sampling Manual (available at http://www.afsc.noaa.gov/fma/document.htm#Manuals1). In general, observers follow a standard sampling protocol (e.g., simple random sampling or systematic sampling). The observer information is shared with NMFS Alaska Regional office (AKR), which uses the data provided from observed hauls, together with industry-reported data (see details in next section), to calculate discard levels on unobserved hauls and trips using algorithms implemented in an Oracle database.

Bias in NPGOP observer data occurs because vessel operators decide when to take observers. Therefore, random sampling assumptions cannot be supported. For example, operators can choose to take observers knowing they will be fishing in low-bycatch areas or areas that are otherwise non-representative for a variety of reasons. In fisheries with 100% observer coverage, observers are present at all times, so vessel selection bias does not occur.

4.3.3.2 Logbooks

Hard-copy (paper) logbooks are required to be completed and submitted for all BSAI/GOA groundfish vessels (may include the use of catch and/or product logs, product transfer logs, effort logs, or other records, as specified in regulations) greater than 60 feet. The logbook program has been in place since 1991 and has been used largely for enforcement purposes. Estimates of harvest and bycatch are obtained from the electronic reporting systems described in Section 4.3.3.3, and from observer information. The NMFS Alaska Region would like to move toward electronic logbooks; however, full implementation is likely several years away. A small number of vessels are currently participating in an electronic logbook program.

4.3.3.3 Electronic Reports of Catch and Production

The NMFS Alaska Region, the State of Alaska, and the IPHC have implemented a joint electronic reporting system to reduce reporting redundancy and consolidate fishery landing information into one database. Vessels in both Federal and state fisheries report groundfish landing information through an electronic reporting application known as the Interagency Electronic Reporting System (IERS). There are different reporting requirements for vessels that catch and process groundfish (catcher/processors), vessels that do not process fish (catcher vessels), vessels that only receive and process fish (mother ships), and shoreside processing plants.

Production Reports: Production reports are mandatory for catcher/processors, mother ships, and shoreside processors. Collections are daily for shoreside processors and weekly for the at-sea fleet of catcher/processors and mother ships (starting in 2008, production reports will be sent daily from the at-sea fleet). Production reports include gear

type, area fished, and a breakdown of the weight of each species and product. At-sea production reports also include the weight or number of each species that was discarded at sea. All data collected from production reports are stored in a database and undergo internal validation checks.

Landing Reports: Landing reports (ADFG "fish tickets") are mandatory and originate from catcher vessels making deliveries to a shoreside plant or mother ship. The collection period is trip-based for shoreside processors and weekly for mother ships. Landing reports include gear type, NMFS and/or ADFG area fished, a breakdown of the weight and condition of each species delivered, the fishing start date, and the delivery date. Delivering vessels report at-sea discard to the processing facility, but these data are not verifiable. Therefore, at-sea discard estimates are obtained by creating species-specific bycatch rates based on information collected by the NPGOP and applying these rates to groundfish production or landing information. A detailed description of bycatch estimation in the Federal groundfish fisheries is in Section 4.3.4. All landing report data are stored in a database and undergo internal validation.

4.3.3.4 Other Data Sources

Strandings reports: strandings reports, sometimes called entanglement reports, are an important source of information on serious injury and mortality of marine mammals incidental to commercial fisheries for some geographic areas and for some species. In Alaska, most reports are of humpback whales entangled in various types of pot gear, gillnet gear, and miscellaneous line gear in Southeast Alaska. These reports may be submitted by researchers or the general public. Reports are used to assess relative levels of bycatch under the MMPA only when no better data exist to assess the level of bycatch (i.e., observer data would be used if available); the report is considered reliable; and the report clearly describes a mortality or an injury that is likely to lead to mortality of the entangled animal, as determined by regional NMFS Protected Resources Resources (PR) staff.

4.3.4 Alaska Region Bycatch Estimation Methods

The Alaska Fisheries Science Center (AFSC) and NMFS AKR estimated catch and bycatch for federally managed commercial fisheries and a few state-managed commercial fisheries in Alaska. The AKR and AFSC collaborated on estimates for the federally managed commercial groundfish fisheries in the BSAI and GOA Federal management areas. A small number of state fisheries are observed by the AMMOP, which is managed by the AKR and focuses on collecting bycatch data on marine mammals in certain state commercial fisheries. Accurate estimates of catch and bycatch are vital to the management, conservation, and scientific understanding of marine species that are impacted by commercial groundfish fisheries.

The Catch Accounting System (CAS)

The AKR manages groundfish and prohibited fish species catch (PSC), described in Section 4.3.4.1.1, under the groundfish FMPs for the BSAI and GOA. The AKR uses a combination of observer data and industry reports to estimate catch and bycatch to calculate total fishing mortality. In general, bycatch rates for fish are estimated from observer data; the rates consist of the total amount of a specific bycatch species caught, divided by the total amount of groundfish caught (including groundfish discards). Estimates are stratified by species, gear, area, and time. These bycatch rates are then multiplied by unobserved catch to provide a total estimate of fish and prohibited species bycatch. Rates are computed as metric tons of bycatch per metric tons of catch in all cases except for salmon and crab, which are computed in numbers per metric ton of catch.

The procedures used for catch and bycatch estimation for FMPs and prohibited species support in-season management of complex allocation schemes and harvest limits, and ensures that fisheries do not exceed TAC or violate other fishery restrictions, such as time and area closures. Prohibited species are required to be returned to the sea unless retention is required under other applicable laws. The procedures for estimating bycatch accommodate two important management components: first, the estimation procedures are designed to provide a quick turn-around (one or more days, up to a week) of the data so that in-season management has useable rates as quickly as possible after receiving landing reports and observer data. The system makes maximum use of small amounts of observer data quickly (at coarser aggregation levels), which are updated and refined as more data become available. Secondly, although complex, the system was designed so that changes to the management structure could be reflected in the catch accounting structure, to allow in-season management to stay current with fisheries regulations and specifications.

Five types of bycatch are estimated for the federally regulated Alaska commercial fisheries: prohibited species bycatch, non-target species bycatch, groundfish discards, marine mammal serious injury/mortality, and seabird mortality. Note that the CAS does not calculate marine mammal serious injury/mortality and seabird mortality. Methods used to determine these estimates differ markedly from those used for fish bycatch and PSC accounting. Further details of all methods are provided below.

4.3.4.1 Alaska Fish Bycatch Estimation Methods

4.3.4.1.1 Prohibited Species Bycatch Estimates

Bycatch management measures for groundfish fisheries in the BSAI and GOA have specific means to limit or reduce incidental catch species traditionally harvested by other fisheries. These species include salmon, Pacific halibut, Pacific herring, red king crab, Tanner crab, and snow crab. Collectively, these species are referred to as prohibited species. Regulations require that in the groundfish fisheries, PSC are returned to the sea with no additional injury. For Pacific halibut estimates, discard mortality rates (DMRs) are used to determine the fraction of the estimated halibut bycatch that dies. Observer data are used to estimate DMRs in the groundfish fisheries off Alaska, and NMFS manages these fisheries according to a schedule of DMRs that vary by fishery, gear, and area (Williams and Chen 2004).

All available observer data are used to estimate daily PSC bycatch rates at six levels of aggregation (Table 4.3.3). As landings data are received, PSC bycatch estimates are created by finding the best possible matching rate (e.g., the rate with the best resolution) and multiplying the landed catch by the rate. The rates are calculated in numbers of individuals for crab and salmon, and total weight of halibut and herring. All rates are specific to a given calendar year (i.e., 2006 information is not used for 2007).

4.3.4.1.2 Non-Target Species Bycatch Estimates

Non-target species include forage fish and a variety of species that are not specified for harvest, such as grenadiers, as well as species that are harvested within the fishery but are not targets (sharks, skates, sculpins, and octopus). Although they are not managed in-season, estimates of non-target species bycatch are important to stock assessment scientists and ecosystem modeling conducted by the ASFC. The AKR estimates bycatch amounts for approximately 50 non-target species groups and makes the results available to AFSC staff. The estimation methods for non-target bycatch estimation are similar to those for PSC bycatch estimation.

4.3.4.1.3 Groundfish Landings and Bycatch (Discard) Estimates

Different accounting methods are used to estimate groundfish retained catch and discards for vessels that catch and process fish (catcher/processors), vessels that do not process fish (catcher vessels), vessels that only receive and process fish (mother ships), and shoreside processing plants. For large catcher/processors and mother ships, which typically have 100% observer coverage, observer information is used for retained catch and bycatch accounting.

Table 4.3.3
Types of aggregated information used to calculate bycatch rates for PSC and non-target species. Note that there must be at least three observed hauls from which to calculate a rate.

Resolution	Type of Rate	Type of Information Aggregated	Aggregation Level
High ↑	Catcher vessel-specific[a]	Vessel-specific: date trip started, fishing gear, federal reporting area	Low ↓
	Catcher/processor vessel-specific[b]	Vessel-specific: week end date, and whether the trip occurred in the GOA or BSAI	
	Sector-specific 3-week moving average	Processing sector, target species, week end date, fishing gear, federal reporting area	
	3-week moving average	Target species, week end date, fishing gear, federal reporting area	
	3-month moving average	Target species, week end date, fishing gear, and whether fishing occurred in the GOA or BSAI	
	FMP area rate	Target species, gear, FMP area	
	3-month moving average	Target species, week end date, fishing gear, and whether fishing occurred in the GOA or BSAI	
Low ↓	FMP area rate	Target species, gear, FMP area	High ↑

[a]A Catcher Vessel is a fishing vessel that delivers its catch to a mother ship, to shore plants or to catcher/processors vessels.
[b]A Catcher–Processor is an at-sea fish processing vessel that catches, process, freezes, and stores aboard groundfish (primarily pollock and cod).

For catcher/processors and catcher vessels with 30% coverage, mandatory industry reports are used to estimate retained catch. Any catch that is delivered to a shoreside plant and then discarded is accounted for using bycatch reported by the plant. At-sea groundfish discards are estimated from observer data collected from the same component of the fleet (i.e., catcher vessels using the same gear and fishing in the same area and target fishery). Bycatch rates on observed vessels are then applied to the reported groundfish catch on unobserved vessels.

Similar to the procedure described for prohibited species, estimates of at-sea groundfish discards are based on deterministic criteria that match observer data with unobserved vessels. Two approaches are used to determine a level of aggregation, depending on availability of data; both are based on 14-day centered moving averages:

- aggregated based on target species, gear type used, and Federal reporting area
- aggregation similar to that described above; however, instead of aggregation at the higher-resolution Federal reporting area level, aggregation occurs at the broader FMP-area level

4.3.4.2 Species Bycatch Estimates for Protected Species

4.3.4.2.1 Marine Mammal Serious Injury/Mortality Estimates—Groundfish Fisheries

Observer-recorded marine mammal injuries/mortalities in a particular haul are assigned to one of 21 separate federally regulated fisheries based on information from the AKR CAS (see Section 4.3.4), which provides information on haul location, gear type, and fish target species. Detailed descriptions of injured marine mammals provided by observers are assessed by AFSC staff to determine whether the injury was serious and thus likely to lead to mortality of the marine mammal. Observed serious injury/mortality rates per observed metric ton of groundfish catch for each separate fishery are stratified by four-week period, statistical area, vessel class, and processing sector. The rate for each stratum is extrapolated to the total serious injury/mortality estimate for the stratum by multiplying the rate by the total catch for that stratum. The sum of the stratum totals provides an estimate of the annual incidental serious injury/mortality levels for a variety of species of marine mammals in Alaska. Bycatch rates and confidence intervals are calculated using data and extrapolated estimates based only on observed bycatch of marine mammals in randomly sampled, monitored fishing sets. Confidence intervals are based on a lognormal approximation. The natural log-transformation approximation is used to derive 95% confidence limits through calculations using the extrapolated bycatch values and their corresponding coefficients of variation. This is done to avoid reporting negative lower confidence limits using the normal approximation. However, the standard errors and coefficients of variation are still calculated using the normal approximation because the bycatch data values cannot be transformed directly due to the preponderance of zero values. Considerable additional information on the method is provided in Perez (2006).

4.3.4.2.2 Seabird Mortality Estimates

Seabird mortality occurs in groundfish fisheries when birds are hooked on longline gear during the set, captured in pots, caught in trawl nets, or entangled in trawl gear (trawl door cables, third wire cable, or parts of the netting on a trawl). Mortalities may also occur due to birds flying into a vessel's rigging or superstructure. Standard observer sampling accounts for birds hooked on longline gear, caught in pots, or included with fish catch in a trawl cod end. Seabird mortalities from other sources are not directly monitored but are noted in logbooks in an ad hoc manner when observed. For longline or pot gear, reports by observers of additional mortality not directly associated with the fishing gear occur infrequently. In some sectors of the trawl fleet, however, ad hoc reports indicate that seabird mortalities from interactions not accounted for by standard sampling may be substantial.

Current sampling and analytical methods only provide estimates of seabird mortalities from standard observer sampling techniques. Rate-based estimates of bycatch of seabirds in the trawl fisheries are based on the total weight of groundfish caught per haul or set, as is the case for estimates of mammal mortality. Bycatch rates for seabirds in the logline and pot fisheries are based on estimates of the amount of gear deployed, and total bycatch estimates are obtained by expanding to the total amount of gear in a given stratum. This approach was adopted for consistency with analyses of seabird bycatch in commercial longline fisheries in other parts of the world. Catch rates and estimates of bycatch are calculated for each four-week period (minimum stratum level) by year; statistical area; gear type; vessel class and/or processing sector (catcher/processor, mother ship/processor, or catcher-only vessel delivering to shoreside plants); and targeted groundfish catch species (fishery designation). Four-week periods were used to approximate monthly periods because the CAS provides only data summarized by weeks. No seabird bycatch estimates were made for strata that consist only of data from unobserved vessels. The extrapolated takes of all strata are summed to obtain the total extrapolated bycatch by year and area. Rates and variance of incidental take for each stratum are calculated from the sum of observed seabird bycatches in species-composition monitoring of fishing operations, divided by the sum of the effort (in tons for trawl sets, hooks for longline sets, and pots for pot sets) of groundfish catch (retained and discarded, including prohibited fish species)

in the sampled catch of monitored hauls. Total extrapolated bycatch is estimated by the stratified random sampling ratio-estimation method (Cochran 1977; Levy and Lemeshow 1999). The fraction of hauls observed in the total fishery is unknown; therefore, the percentage of total effort sampled is used as a basis for determining the fraction of total effort observed. A report is currently in preparation that describes these methods in greater detail (S. Fitzgerald, personal communication[5]).

4.3.4.3 Marine Mammal Serious Injury/Mortality Estimates—AMMOP

Estimates of total incidental serious injury and mortality of each marine mammal stock in observed fisheries are calculated using the ratio estimation approach; estimates and associated CVs are provided in reports on the studies (Manly 2006, 2007). Estimates and associated CVs are not available for approximately 12 MMPA Category II fisheries in Alaska which have not yet been observed.

4.3.4.4 Marine Mammal Serious Injury/Mortality Estimates—Entanglement/Stranding Data

Ideally, NMFS obtains estimates of marine mammal serious injury and mortality (bycatch) using independent observer programs. When data are collected using observer programs, observed bycatch can be extrapolated to provide an estimate of total bycatch, and an estimate of uncertainty can be calculated. Observations of dead stranded animals or entangled living animals can provide a minimum estimate of bycatch for some fisheries. When these data are used, great care is taken to ensure that the fishery is correctly identified and to ensure that the fishery was responsible for the injury or mortality. Although records of some stranded and entangled animals are excellent, many opportunistic records are not used for management purposes because of lack of information on either the severity of an injury or the responsible fishery. Because these observations are opportunistic, stranding and entanglement data provide only a minimum count of the level of bycatch in a particular fishery; because these are count data, there is no associated measurement of uncertainty.

[5] S. Fitzgerald. Alaska Fisheries Science Center, 7600 Sand Point Way NE, Seattle, WA 98115.

4.3.5 Tier Classification of Alaska Region Fisheries

The quality of bycatch data and estimation methods were analyzed for 33 Alaska Region fisheries with Federal management authority or relevant Federal data-collection programs. Only Federal data sources were evaluated for this report. Other data may be available for state, international, and tribal fisheries; however, these programs were beyond the scope of this initial report. The remaining fisheries are not federally managed and have no Federal data-collection programs, and were therefore excluded from the analysis.

Tiers were assigned to each fishery using the tier classification procedures outlined in Section 3 for fish, marine mammals, and other protected species (Table 4.3.4). Twenty-seven fisheries were classified based on the quality of fish bycatch data and estimation methods.

Table 4.3.4

Tier classifications for Alaska Region fisheries (2005 data). Fisheries in shaded rows were evaluated for this report. Grouped fisheries are listed first, alphabetically by fishery group name, then by management authority, then by individual fishery name. Non-grouped fisheries are then listed alphabetically by management authority and then by fishery name. Only relevant federal data sources were evaluated for this report.

Fishery	Management Authority	Fish Tier	Marine Mammals Tier[a]	Other Protected Species Tier[a]
Bering Sea/Aleutian Islands Flatfish Trawl Fisheries				
Bering Sea Aleutian Islands Flatfish Group (Arrowtooth Flounder, Flathead Sole, Other Flatfish) Trawl	Federal	3	3*	3*
Bering Sea Aleutian Islands Rock Sole Trawl	Federal	3	3*	3*
Bering Sea Aleutian Islands Yellowfin Sole Trawl	Federal	3	3*	3*

Table 4.3.4 (continued)

Fishery	Management Authority	Fish Tier	Marine Mammals Tier[a]	Other Protected Species Tier[a]
Gulf of Alaska Flatfish Trawl Fisheries				
Gulf of Alaska Arrowtooth Flounder Trawl	Federal	3	3*	3*
Gulf of Alaska Flatfish (Deepwater Flatfish) Trawl	Federal	3	3*	3*
Gulf of Alaska Flatfish (Shallow Water Flatfish) Trawl	Federal	2	3*	3*
Gulf of Alaska Flathead Sole Trawl	Federal	3	3*	3*
Gulf of Alaska Rex Sole Trawl	Federal	3	3*	3*
Non-Grouped Fisheries				
Aleutian Islands, Eastern Bering Sea Atka Mackerel Trawl	Federal	3	4	3
Bering Sea/Aleutian Islands Greenland Turbot Longline	Federal	3	3	3
Bering Sea/Aleutian Islands Pacific Cod Jig	Federal	1	1	1
Bering Sea/Aleutian Islands Pacific Cod Longline	Federal	3	3	3
Bering Sea/Aleutian Islands Pacific Cod Pot	Federal	3	3	3
Bering Sea/Aleutian Islands Pacific Cod Trawl	Federal	3	3	3
Bering Sea/Aleutian Islands Pacific Ocean Perch	Federal	3	3	3
Bering Sea/Aleutian Islands Pollock Trawl	Federal	4	4	3
Bering Sea/Aleutian Islands Sablefish Longline	Federal	3	3	3
Bering Sea/Aleutian Islands Sablefish Pot	Federal	3	3	3
Bering Sea/Aleutian Islands Sablefish Trawl	Federal	3	3	3
Gulf of Alaska Pacific Cod Jig	Federal	1	1	1
Gulf of Alaska Pacific Cod Longline	Federal	3	3	3
Gulf of Alaska Pacific Cod Pot	Federal	2	3	3
Gulf of Alaska Pacific Cod Trawl	Federal	3	3	3
Gulf of Alaska Pollock Trawl	Federal	3	3	3
Gulf of Alaska Rockfish (Northern Rockfish, Pelagic Shelf Rockfish, Pacific Ocean Perch) Trawl	Federal	3	3	3
Gulf of Alaska Sablefish Longline	Federal	3	3	3
Gulf of Alaska Sablefish Trawl	Federal	3	3	3
AK Halibut Longline	International			
AK Abalone	State			
AK Bristol Bay Salmon Drift Gillnet	State			
AK Bristol Bay Salmon Set Gillnet	State			
AK Clam	State			

Table 4.3.4 (continued)

Fishery	Management Authority	Fish Tier	Marine Mammals Tier[a]	Other Protected Species Tier[a]
Non-Grouped Fisheries (cont.)				
AK Cook Inlet Drift Gillnet	State		3	3
AK Cook Inlet Salmon Set Gillnet	State		3	3
AK Dungeness Crab	State			
AK Food/Bait Herring Trawl	State			
AK Groundfish Longline/Setline (Including Sablefish, Rockfish, and Miscellaneous Finfish)	State			
AK Herring Spawn on Kelp Pound Net	State			
AK Kodiak Salmon Set Gillnet	State		3	3
AK Kuskokwim, Yukon, Norton Sound, Kotzebue Salmon Gillnet	State			
AK Metlakatla Salmon Purse Seine	State			
AK Metlakatla/Annette Island Salmon Drift Gillnet	State			
AK Miscellaneous Finfish Beach Seine	State			
AK Miscellaneous Finfish Handline and Mechanical Jig	State			
AK Miscellaneous Finfish Otter or Beam Trawl	State			
AK Miscellaneous Finfish Pair Trawl	State			
AK Miscellaneous Finfish Purse Seine	State			
AK Miscellaneous Finfish Set Gillnet	State			
AK North Pacific Halibut Handline and Mechanical Jig	State			
AK Octopus/Squid Handline	State			
AK Octopus/Squid Longline	State			
AK Octopus/Squid Pot	State			
AK Peninsula/ Aleutians Salmon Drift Gillnet	State		1	1
AK Peninsula/ Aleutians Salmon Set Gillnet	State			
AK Prince William Sound Salmon Drift Gillnet	State		1	1
AK Prince William Sound Salmon Set Gillnet	State		1	1
AK Roe Herring and Food/Bait Herring Beach Seine	State			
AK Roe Herring and Food/Bait Herring Gillnet	State			
AK Roe Herring and Food/Bait Herring Purse Seine	State			
AK Salmon Beach Seine	State			
AK Salmon Purse Seine (except Southeast Alaska, which is in Category II)	State			
AK Salmon Troll	State			
AK Shrimp Otter Trawl and Beam Trawl (Statewide and Cook Inlet)	State			

Table 4.3.4 (continued)

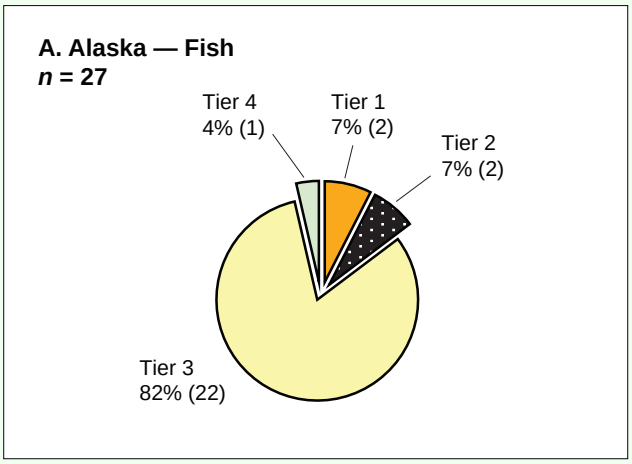
Fishery	Management Authority	Fish Tier	Marine Mammals Tier[a]	Other Protected Species Tier[a]
Non-Grouped Fisheries (cont.)				
AK Snail Pot	State			
AK Southeast Herring Roe/Food/Bait Pound Net	State			
AK Southeast Salmon Drift Gillnet	State		1	1
AK Southeast Salmon Purse Seine	State			
AK Urchin and Other Fish/Shellfish	State			
AK Yakutat Salmon Set Gillnet[b]	State			
Aleutian Islands State Waters Pacific Cod	State			
Bering Sea/Aleutian Islands Crab Pot	State			
Coastwide Scallop Dredge	State			
Gulf of Alaska Crab Pot	State		1	1
Gulf of Alaska Pacific Cod State Fishery Jig	State			
Gulf of Alaska Pacific Cod State Fishery Pot	State			
Southeast Alaska Crab Pot	State			
Southeast Alaska Shrimp Pot	State			

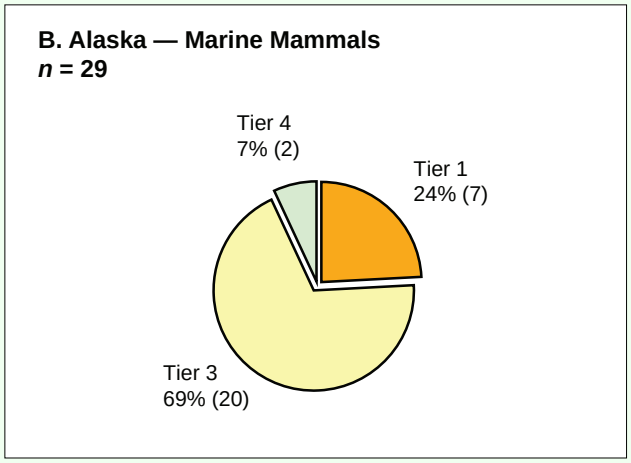
[a] Tier scores marked * were "cascaded" down from the fishery group that the individual fishery is part of; the individual fishery was not evaluated.
[b]The Yakutat salmon set gillnet fishery was not being observed at the time of compilation of this report, and therefore was not evaluated. Estimates for the fishery based on self-reported data were included. The fishery will be evaluated for the next edition of this report.

Grouped fisheries were classified in a single tier for marine mammals and other protected species, based on current bycatch data-collection and estimation methods. Note that in Figure 4.3.2, the total number of fisheries for marine mammals and other protected species was based on the number of grouped fisheries evaluated (two) plus the number of individual fisheries evaluated (27). The total number of fisheries classified for fish was 27 (the number of individual fisheries evaluated). In Table 4.3.4, the tier category for each group was assigned to ("cascaded" down to) the individual fisheries in that group (see Section 3.2 for details).

Six fisheries evaluated for marine mammals and other proteced species (all MMPA Category II State salmon fisheries) were not evaluated for fish, as fish bycatch data are not collected.

Of the Alaska Region fisheries evaluated, the majority of fisheries were classified as Tier 3 for fish (82%), marine mammals (69%), and other protected species (76%; Figure 4.3.2). For fish, one Tier 4 fishery (Bering Sea/Aleutian Islands pollock trawl), two Tier 1, and two Tier 2 fisheries were identified. Tier 1 made up the second largest component of marine mammal and other protected species classifications, with 24% of fisheries (7) in both categories. Additionally, two fisheries were assigned to Tier 4 for marine mammal bycatch data and estimation methods: Aleutian Islands, Eastern Bering Sea Atka mackerel trawl and Bering Sea/Aleutian Islands pollock trawl. No fisheries were classified as Tier 4 in the other protected species category.





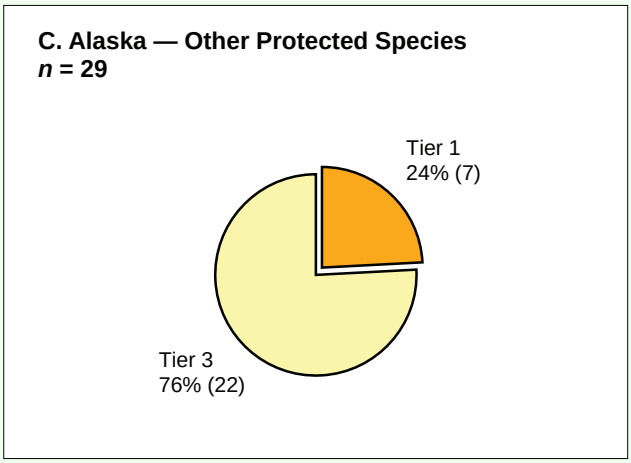


Figure 4.3.2
Alaska Region tier classifications by number and percentage, for fisheries with federal management or relevant Federal data-collection programs, for A) fish, B) marine mammals, and C) other protected species.

4.3.6 Alaska Region Key Stocks

Thirty-six key stocks were identified in the Alaska Region (Table 4.3.5). As in other regions, bycatch estimates were not available for all species listed as key stocks. All ESA-listed species (10) found in the Alaska Region were prioritized for inclusion in the list of key species, regardless of whether bycatch occurs.

Forty-two percent (15) of all Alaska Region key stocks identified are fish stocks, including the 6 individual stocks in the demersal shelf rockfish complex (Figure 4.3.3). This FSSI complex was identified as a key stock through the quantitative evaluation process outlined in Section 3. Within this complex, the status of yelloweye rockfish serves as an indicator for the entire group. Three species of king crab (blue, golden, and red) and two salmon groups (Chinook, which is ESA-listed, and non-Chinook) were identified as key stocks through the qualitative process; all are prohibited bycatch in groundfish fisheries due to their value as target catch in other fisheries. Two stocks, the BSAI stock of rougheye rockfish (*Sebastes aleutianus*) and the GOA stock of shortspine thornyhead (*Sebastolobus alascanus*) were removed from the initial list of Alaska Region key stocks identified through the quantitative process. These stocks are not overfished, have an undefined overfishing level, and have low levels of observed bycatch with no directed (targeted) catch. The species with the largest amount of discards in the Alaska trawl fisheries is arrowtooth flounder, however, this stock was not considered for key stock status because stock biomass is estimated at three times the B_{msy} level and stocks continue to increase in abundance. In 2005 the species was not considered marketable for human consumption; industry continues to work to to develop markets for arrowtooth flounder in order to reduce the amount of discard.

Note that regional bycatch data are reported by species or species group rather than stocks (see tables in Appendix 4.3). Since bycatch accounting cannot occur at a finer level of granularity than this, the key stocks/species described above were aggregated into six key species/species groups corresponding to species and species groups for which catch data were available. These species/species groups are: red king crab (comprising 4 stocks, as defined in Table 4.3.5), blue king crab (2 stocks), golden king crab (1 stock), demersal shelf rockfish (7 species), Chinook salmon, and non-Chinook salmon.

Protected species make up the remaining 58% of Alaskan key stocks. More than half (18) of the key stocks identified in Alaska are marine mammals (Figure 4.3.3), 8 of which are currently listed as endangered or threatened under the ESA. Of the remaining 10 marine mammal populations identified as key stocks, two were added through the qualitative process due to concerns over population levels: the Cook Inlet stock of beluga whales and the Northern fur seal. The Cook Inlet beluga whale stock is at a critically low level,

Table 4.3.5
Key fish and marine mammal stocks and sea turtle and seabird populations for the Alaska Region. Overfishing/ overfished status based on 2008 Quarter 1 FSSI report.

Key Fish Stocks Listed by FSSI			
Species/stock name		**Overfishing**	**Overfished**
Common name	**Scientific name**		
Blue king crab, Pribilof Islands	*Paralithodes platypus*	No	Yes
Blue king crab, Saint Matthews Island	*Paralithodes platypus*	No	No—rebuilding
Demersal shelf rockfish:[a]		No	Undefined
Canary rockfish	*Sebastes pinniger*		
China rockfish	*Sebastes nebulosus*		
Copper rockfish	*Sebastes caurinus*		
Quillback rockfish	*Sebastes maliger*		
Tiger rockfish	*Sebastes nigrocinctus*		
Yelloweye rockfish	*Sebastes ruberrimus*		
Golden king crab, Aleutian Islands	*Lithodes aequispina*	Unknown	Undefined
Red king crab, Aleutian Islands	*Paralithodes camtschaticus*	Unknown	Undefined
Red king crab, Bristol Bay	*Paralithodes camtschaticus*	No	No
Red king crab, Norton Sound	*Paralithodes camtschaticus*	Unknown	Undefined
Red king crab, Pribilof Islands	*Paralithodes camtschaticus*	No	No
Key Fish Stocks Listed by ESA			
Species/stock name		**Stock status**	
Common name	**Scientific name**		
Chinook salmon[b]	*Oncorhynchus tshawytscha*	Unknown	
Key Fish Stocks Not Listed by FSSI or ESA			
Species/stock name		**Stock status**	
Common name	**Scientific name**		
Non-Chinook salmon[b]	Salmonidae	Not applicable	
Key Marine Mammal Stocks Listed by ESA			
Species/stock name		**Stock status**	
Common name	**Scientific name**		
Bowhead whale	*Balaena mysticetus*	Endangered	
Fin whale	*Balaenoptera physalus*	Endangered	
Humpback whale	*Megaptera novaeangliae*	Endangered	

Table 4.3.5 (continued)

Key Marine Mammal Stocks Listed by ESA (cont.)			
Species/stock name			
Common name	**Scientific name**	**Stock status**	
Right whale, North Pacific	*Eubalaena japonica*	Endangered	
Sei whale	*Balaenoptera borealis*	Endangered	
Sperm whale	*Physeter macrocephalus*	Endangered	
Steller sea lion, Eastern	*Eumetopias jubatus*	Threatened	
Steller sea lion, Western	*Eumetopias jubatus*	Endangered	
Key Marine Mammal Stocks Not Listed by ESA			
Species/stock name			
Common name	**Scientific name**	**ZMRG**	**Stock Status[c]**
Bearded seal	*Erignathus barbatus*	Unknown	Unknown
Beluga whale, Cook Inlet	*Delphinapterus leucas*	Undermined	Declining
Harbor porpoise, Gulf of Alaska	*Phocoena phocoena*	34.7	Unknown
Killer whale, Eastern North Pacific Alaska Resident	*Orcinus orca*	1.12	Unknown
Killer whale, Gulf of Alaska, Aleutian Islands, and Bering Sea Transient	*Orcinus orca*	0.31	Unknown
Northern fur seal, Eastern Pacific	*Callorhinus ursinus*	1526.2	Declining
Pacific walrus	*Odobenus rosmarus divergens*	Unknown	Unknown
Ribbon seal	*Phoca fasciata*	Unknown	Unknown
Ringed seal	*Phoca hispida*	Unknown	Unknown
Spotted seal	*Phoca largha*	Unknown	Unknown
Key Seabird Populations Listed by ESA			
Species/stock name			
Common name	**Scientific name**	**Population status**	
Short-tailed albatross	*Phoebastria albatrus*	Endangered	

Table 4.3.5 (continued)

Key Seabird Populations Not Listed by ESA			
Species/stock name		**Bycatch concern**	**Population status**
Common name	**Scientific name**		
Black-footed albatross	*Phoebastria nigripes*	Yes	Stable/Increasing/ Decreasing[d]
Red-legged kittiwake	*Rissa brevirostris*	No	Stable

[a] The overfishing determination for the Demersal Shelf Rockfish group is based on the Optimal Fishing Level (OFL), which is computed by using estimates of yelloweye rockfish and then increased by 10% to account for the remaining members of the complex.
[b] Because the exact makeup of Chinook and non-Chinook salmon bycatch is not estimated, key stocks were not identified at the population level for Alaska, and these broad groups are counted as two key stocks despite being comprised of many sub-populations.
[c] Stock status based on 2007 NMFS Marine Mammal Stock Assessments: http://www.nmfs.noaa.gov/pr/pdfs/sars/ak2007.pdf
[d] USFWS is in the process of finalizing its black-footed albatross status assessment. The trend varies according to island colony surveyed (see Naughton et al. 2008a)

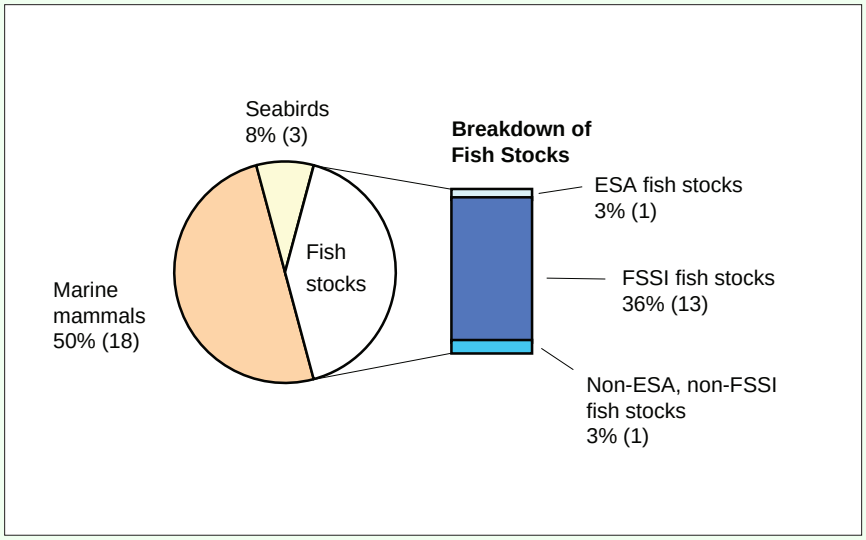


Figure 4.3.3
Numbers and percentages of key stocks for the Alaska Region by resource type.

is listed as depleted under the MMPA, and has been listed as Endangered under the ESA. While direct bycatch is very low and has not been observed in recent years, public concern about this stock is very high. The Northern fur seal is declining rapidly and is listed as depleted under the MMPA. One marine mammal, Dall's porpoise (Alaskan stock), was identified as a key stock through the quantitative process but removed from the final list of key stocks. Although potential biological removal (PBR) and therefore the ZMRG are technically undetermined for Dall's porpoise, this is because the last abundance survey is more than eight years old. The last survey indicated a minimum abundance of more than 70,000. Given the estimated annual fishery take of less than 30 animals, the stock is not a conservation concern at this time.

Lastly, three seabird populations were included in the Alaska Region's list of key stocks. The short-tailed albatross is ESA-listed, although it was also identified through the quantitative process as a species of concern. Additional key seabird stocks for the region include the black-footed albatross, identified as a key stock through the quantitative process, and the red-legged kittiwake, identified as a key stock through the qualitative process due to observed bycatch. Both of these species also occur on the 2002 USFWS list of Birds of Conservation Concern.

4.3.7 Alaska Region Bycatch Estimates

Bycatch estimates by fishery are provided in Appendix 4.3, Tables 4.3.A–D. Data are from the year 2005. For marine mammals and other rare-event stocks/populations, multiple years of data were used to calculate bycatch estimates; the years are noted in the tables.

Estimates of fish discards were provided for 27 groundfish fisheries (Table 4.3.A), for a total of 91 stocks or stock groups (Table 4.3.B). For some bycatch estimates, data were available only at broad taxonomic levels (e.g., bycatch estimates were provided for benthic Urochordata, but not for individual tunicate species), or for a generalized group (e.g., miscellaneous deep fish) where individual species could not be identified due to sampling procedures. Major members of each species group are listed in Appendix I.

Marine mammal bycatch estimates were provided for 13 fisheries (Table 4.3.C), for a total of 17 stocks. Seabird bycatch estimates were provided for 19 Federal fisheries (Table 4.3.D) for 12 different population groups. In some cases, estimates were provided only for a generalized group (e.g., gull or Alcid) or were for an unidentified bird (e.g., "unidentified seabird").

4.3.8 Alaska Region Fishery Bycatch Estimate Improvement Plans

Two "umbrella" bycatch data-collection and estimation improvement plans were developed for Alaska Regional fisheries, one for Federal groundfish fisheries and one for state-managed Alaskan salmon fisheries. Fisheries included in both plans were identified through the quantitative process as having high levels of overall bycatch and/or bycatch of key stocks. Nineteen fisheries were included under the improvement plan for Alaskan groundfish fisheries, and 14 fisheries under the generic improvement plan for Alaskan State salmon fisheries (all Category II salmon fisheries listed under the 2008 MMPA list of fisheries).

A total of four fisheries were removed from the list of fisheries needing improvement plans: Gulf of Alaska crab pot; Southeast Alaska crab pot; Alaska salmon purse seine (except for the Southeast portion of the fishery, which is a Category II fishery under the MMPA and was therefore included under the salmon fishery improvement plan); and the BSAI pollock trawl. The Gulf of Alaska crab pot, Southeast Alaska crab pot, and Alaska salmon purse seine fisheries were taken off the list because they are state fisheries without Federal data-collection programs. The BSAI pollock trawl was removed because the observer program currently in place provides high levels of coverage and an accurate accounting of catch and discards; the fishery was classified in the highest tier (4) of bycatch data quality and estimation methods for both fish and marine mammals.

4.3.8.1 Improvement Plan for Alaskan Groundfish Fisheries

A generic bycatch data improvement plan was developed for the Federal groundfish fisheries of the BSAI and GOA. The approach was selected because these fisheries are managed under two FMPs and are subject to general (not fishery-specific) observer requirements and catch/bycatch accounting methods. Observer coverage is defined by vessel size rather than gear type or target fishery, and many individual target fisheries have 100% observer coverage for some participants, 30% coverage for others, and, in some cases, zero coverage. In addition to the recommendations outlined in the generic improvement plan, the NPGOP recommends maintaining current coverage levels for those components of Alaska groundfish fisheries with adequate coverage levels. The generic improvement plan applies to the following fisheries (although several fisheries have had changes to observer coverage requirements since 2005, which is the base year for this report):

- Bering Sea Aleutian Islands Rock Sole Trawl
- Bering Sea Aleutian Islands Flatfish Group (Arrowtooth Flounder, Flathead Sole, Other Flatfish) Trawl
- Gulf of Alaska Flatfish (Shallow Water Flatfish) Trawl
- Bering Sea/Aleutian Islands Pacific Cod Longline
- Bering Sea/Aleutian Islands Pacific Cod Jig
- Bering Sea/Aleutian Islands Pacific Cod Pot
- Bering Sea/Aleutian Islands Sablefish Longline
- Bering Sea/Aleutian Islands Sablefish Pot
- Aleutian Islands, Eastern Bering Sea Atka Mackerel Trawl
- Bering Sea Aleutian Islands Pacific Cod Trawl
- Bering Sea Aleutian Islands Yellowfin Sole Trawl
- Bering Sea Aleutian Islands Sablefish Trawl
- Gulf of Alaska Arrowtooth Flounder Trawl
- Gulf of Alaska Flatfish (Deepwater Flatfish) Trawl
- Gulf of Alaska Flathead Sole Trawl
- Gulf of Alaska Rex Sole Trawl
- Gulf of Alaska Sablefish Trawl
- Bering Sea/Aleutian Islands Flatfish Trawl Fisheries.

Tier Classes: vary; see Table 4.3.4.

Bycatch and data-collection concerns:

- The overall design of the observer program is deficient in a number of ways. Coverage levels are determined by vessel size class. Larger vessels may have one (or sometimes two) observers onboard during all fishing operations, allowing most or all fishing operations to be observed. Intermediate-size vessels are required to carry observers during 30% of their fishing days per calendar quarter, and smaller vessels are not required to carry observers. Under the current observer program design, the agency does not have the authority to determine when and where observers are deployed in the less-than-100% observed sectors. Thus, random or systematic (or even directed) sampling assumptions cannot be substantiated. In some fisheries, most (or all) observer monitoring is at the 100% level, so these limitations are not of concern, but the overall problem can be solved only by a comprehensive redesign of the observer program. However, changes in the program design would require FMP and regulatory amendments, and program needs could increase substantially (see recommendations).

- The CAS has been developed by the AKR to provide fishery-specific catch and bycatch estimates on a nearly real-time basis. This system integrates data provided by observers and the fishing industry to provide managers with current information on the status of each fishery and supports fishery-closure decision-making. Fishing mortality estimates derived from this system are also used during the stock assessment process. As currently designed, this system uses an approach that does not provide measures of uncertainty for catch estimates.

- Analytical methods for estimating marine mammal and seabird bycatch have been developed and are employed for this purpose. These methods use generally accepted techniques. However, ratio estimators are used in some instances, and these may employ CAS-derived estimates of overall observed and unobserved fish catch. For the reasons outlined above, measures of uncertainty for these quantities are not currently calculated. Seabird monitoring on trawl fisheries is also deficient. Seabird mortalities occur due to gear interactions that are not currently monitored and are therefore not accounted for in current estimates.

Recommendations:

- Fundamental redesign of the data-collection system (observer program) is recommended to address the problems described above. Coverage increases would be required in the <60-foot vessel sector (currently unobserved) and, potentially, in the sector that is currently observed at 30%, to address temporal and spatial coverage deficiencies. Furthermore, the directed Pacific halibut fishery is currently unobserved. Under a new service delivery model incorporating industry cost recovery, some of these coverage cost increases would be borne by the industry, but it is recommended that appropriated funds would be required to meet coverage needs in some sectors. Overall annual coverage costs could increase by $5 million or more over current costs.At present, the overall annual cost for the NPGOP groundfish observer program exceeds $20 million; the agency share of this cost is 25%, and the remainder of the cost is borne by industry.

- Improvements to the CAS system are recommended; these would implement enhanced, statistically based estimation algorithms and the ability to provide uncertainty estimates. Some of these can be developed and implemented without change in the observer program, but some limitations (e.g., random sampling assumptions in the <100% observed sectors) must await changes in the observer program service delivery model. Improvements to the CAS will likely require additional resources and take two to three years to develop and implement.

- In addition, new resources are required to improve estimates of seabird bycatch resulting from interactions with fishing vessels other than being caught in the gear.

- Agency staffing resources and funding for observer DAS are also required for administering the observer program to accommodate proposed design changes and increased coverage

4.3.8.2 Improvement Plan for Category II State of Alaska Salmon Fisheries

Data collection for bycatch of marine mammals in State-managed Alaskan fisheries is implemented through the AMMOP. A general bycatch data-collection improvement plan was developed for monitoring these state fisheries. Management of these fisheries is the responsibility of the State of Alaska, and any marine mammal bycatch reduction requirements would be developed through a Take Reduction Plan as outlined by the MMPA Section 118. The following fisheries are included under the State of Alaska Salmon Fisheries generic improvement plan:

- AK Bristol Bay salmon drift gillnet
- AK Bristol Bay salmon set gillnet
- AK Cook Inlet salmon set gillnet
- AK Cook Inlet salmon drift gillnet
- AK Kodiak salmon set gillnet
- AK Peninsula/Aleutian Islands salmon drift gillnet
- AK Peninsula/Aleutian Islands salmon set gillnet
- AK Prince William Sound salmon drift gillnet
- AK Yakutat salmon set gillnet
- AK Southeast salmon purse seine

- AK Cook Inlet salmon purse seine
- AK Kodiak salmon purse seine

Tier Classes: Vary: see Table 4.3.4.

Bycatch and data-collection concerns:

The AMMOP data collection for bycatch of marine mammals in Alaska State-managed salmon fisheries is deficient in its ability to collect data in a timely and comprehensive manner due to the cost of the program and current resources allocated to the program.

- The number of state fisheries that require monitoring for marine mammal bycatch varies from year to year, since the list is made up of Category I and II fisheries as classified by the annual MMPA-mandated List of Fisheries. Since 1994, the number of state fisheries in Alaska that are Category I or II has varied between 11 and 14, with the majority of those fisheries remaining on the list year after year. Since 1990, seven of these fisheries have been monitored with one- or two-year observer programs resulting in bycatch estimates (including only serious injury and mortalities) that provide a snapshot for the time period in which the study was conducted. None of those fisheries monitored have been monitored more than once. Consequently, data for some fisheries is now 17 years old with no realistic anticipation of being updated, while approximately seven fisheries are still in need of observer coverage for even baseline bycatch estimation.

Recommendations:

- Approximately 9,000 DAS per year and three to five additional full-time equivalent (FTE) staff members are needed to improve coverage and update estimates for fisheries that have been observed, and to develop baseline estimates for fisheries that have not yet been observed. At present, the overall annual cost for the observer program is approximately $1.6 million to $2.7 million per year to monitor one fishery, depending on the fishery being observed. The agency provides 100% of this cost through several funding sources, and funding available to the program has varied from zero to approximately $800,000 per year. Because there is never a guarantee that enough funds will be available to complete an individual fishery monitoring study, it is extremely difficult to plan and commit to observe any given fishery.
- Further, monitoring one or two fisheries at a time, each for a 2-year study, results in a rotational cycle in which each fishery will only be observed once every 14 years. With the past and current uncertainty in funding, this rotation has actually been much longer, and a single rotation through all the fisheries that require monitoring has not yet been completed. A more acceptable timeframe for monitoring would be to monitor each fishery for two years with a maximum of five-year intervals between monitoring periods for each fishery. To meet this timetable, it is recommended that 3 to 5 fisheries are monitored each year, assuming the number of fisheries that require monitoring remains at 14.

4.3.8.3 Summary of Alaska Region Recommendations

Table 4.3.6 outlines bycatch data-collection/estimation improvements recommended by the Alaska Region. These improvements will result in better bycatch estimates for all Alaska fisheries. The feasibility of recommendations was evaluated by the Alaska Regional team based on overall cost, available resources, and external factors. A total of 7 recommendations are made, requiring 13 full-time staff and over 29,160 observer DAS split between the NPGOP and AMMOP program. Observer program costs for the Alaska Region were $18.589M for NPGOP (with $13M provided by the industry) and $0.183M for AMMOP in FY 2007. Resources for enhancing existing programs and implementing new observer programs are recommended in addition to current program operating costs.

Table 4.3.6
Summary of Alaska Region recommendations and estimated requirements for implementation in terms of full-time staff and observer DAS. All requirements are annual unless otherwise indicated; ** denotes no additional resource requirements. For further discussion of recommendations, see Section 5.8.

Recommendation [a]	Additional DAS [b]	Feasibility
Maintain observer coverage levels on all currently observed fisheries.[c]	**	High
Catch Accounting System (CAS) improvements and maintenance.	NA	High
Improve seabird monitoring and bycatch estimation.	NA	High
Observer program operations and administration adjustment.	NA	High
Increase coverage for sector observed at 30% and implement coverage for unobserved sectors (<60-foot vessels in Pacific halibut fishery).	20,000	High
Improve length of AMMOP observation cycle from 14 years to 5 years.	9,160	High
Hire staff to support AMMOP.	NA	High
Number of new full-time staff needed to implement all data quality and estimation method improvements recommended by the Alaska Region:	13	
Total DAS requirement for all recommendations:*	29,160	

* This amount is in addition to the annual requirements of Alaska Regional observer programs.
[a] Some recommendations may require additional resource expenditures, such as equipment, which are not itemized.
[b] One observer DAS includes the cost for the observer deployment as well as costs for associated equipment and program administrative functions (staffing).
[c] Cost shared between NMFS and industry.

Appendix 4.3 Alaska Regional Bycatch Estimates

Table 4.3.A

Subtables showing annual fish bycatch estimates for Alaska Region fisheries. Bycatch estimates are in live pounds or number of individuals, except where indicated. Estimates reflect the average from the years identified. Key stocks are shaded; * following the names of stock groups indicates fisheries for which bycatch estimates were available only for the generalized stock group Salmon and king crab estimates were converted from number of individuals to total weight, by multiplying the average weight of crab or salmon collected by observers by total estimated numbers.

Subtable 4.3.A.1

		ALEUTIAN ISLANDS/EASTERN BERING SEA ATKA MACKEREL TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Alaska plaice, Bering Sea/Aleutian Islands	*Pleuronectes quadrituberculatus*	2005	17,881.67	Pounds	
Arrowtooth flounder, Bering Sea/Aleutian Islands	*Atheresthes stomias*	2005	441,713.25	Pounds	
Atka mackerel, Bering Sea/Aleutian Islands	*Pleurogrammus monopterygius*	2005	5,770,348.14	Pounds	
Benthic Urochordata*	*Urochordata*	2003–05	683.62	Pounds	
Big skate	*Raja binoculata*	2005	0	Pounds	
Bivalves*	Bivalvia	2003–05	131.33	Pounds	
Blue king crab	*Paralithodes platypus*	2005	0	Pounds	
Brittle star, unidentified*	Ophiuroidea	2003–05	44.88	Pounds	
Bryozoans/hydroids*	Bryozoa	2003–05	26,920.08	Pounds	
Capelin	*Mallotus villosus*	2003–05	0	Pounds	
Chinook salmon	*Oncorhynchus tshawytscha*	2005	1,393.66	Pounds	
Deepsea smelts*	Bathylagidae	2003–05	0	Pounds	
Deepwater flatfish*		2005	0	Pounds	
Demersal shelf rockfish*		2005	0	Pounds	
Eelpouts*	Zoarcidae	2003–05	497.83	Pounds	
Eulachon (smelt)	*Thaleichthys pacificus*	2003–05	0	Pounds	
Flatfish*	Pleuronectiformes	2005	17,731.76	Pounds	
Flathead sole, Bering Sea/Aleutian Islands	*Hippoglossoides elassodon*	2005	35,895.62	Pounds	
Giant grenadier*	*Albatrossia pectoralis*	2003–05	0	Pounds	
Golden king crab, Aleutian Islands	*Lithodes aequispina*	2005	375.50	Pounds	
Greenland turbot, Bering Sea/Aleutian Islands	*Reinhardtius hippoglossoides*	2005	80,651.61	Pounds	
Greenlings*	Hexagrammidae	2003–05	3,395.06	Pounds	
Grenadier*	Macrouridae	2005	398.86	Pounds	
Gunnels*	Pholidae	2003–05	2.65	Pounds	
Hermit crab, unidentified*	Paguroidea	2003–05	14.40	Pounds	
Herring	*Clupea pallasi*	2005	24.03	Pounds	
Invertebrate, unidentified*	Invertebrata	2003–05	5,602.58	Pounds	
Lanternfishes*	Myctophidae	2003–05	5.39	Pounds	

Table 4.3.A (continued)

(continuation of subtable 4.3.A.1)

		ALEUTIAN ISLANDS/EASTERN BERING SEA ATKA MACKEREL TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Large sculpins*	Cottidae	2003–05	670,164.77	Pounds	
Longnose skate	*Raja rhina*	2005	0	Pounds	
Miscellaneous crabs*	Decapoda	2003–05	268.76	Pounds	
Miscellaneous crustaceans*	Crustaceamorpha	2003–05	70.77	Pounds	
Miscellaneous deep fish*	Teleostomi	2003–05	0	Pounds	
Miscellaneous fish*	Teleostomi	2003–05	235,297.59	Pounds	
Non-Chinook salmon*	Salmonidae	2005	16,187.76	Pounds	
Northern rockfish, Bering Sea/Aleutian Islands	*Sebastes polyspinis*	2005	6,038,370.40	Pounds	
Octopus*	Octopoda	2003–05	3,978.60	Pounds	
Other osmerids*	Osmeridae	2003–05	6.84	Pounds	
Other sculpins*	Cottidae	2003–05	222,730.72	Pounds	
Other species*		2005	1,168,578.67	Pounds	
Pacific cod, Bering Sea/Aleutian Islands	*Gadus macrocephalus*	2005	302,974.31	Pounds	
Pacific hake	*Merluccius productus*	2005	0	Pounds	
Pacific halibut	*Hippoglossus stenolepis*	2005	188,208.51	Pounds	
Pacific ocean perch, Bering Sea/Aleutian Islands	*Sebastes alutus*	2005	2,501,681.52	Pounds	
Pacific sand lance	*Ammodytes hexapterus*	2003–05	0	Pounds	
Pandalid shrimp*	*Pandalus* spp.	2003–05	837.37	Pounds	
Pelagic shelf rockfish*		2005	0	Pounds	
Polychaete, unidentified*	Polychaeta	2003–05	2.61	Pounds	
Pricklebacks*	Stichaeidae	2003–05	21.64	Pounds	
Red king crab	*Paralithodes camtschaticus*	2005	332.5	Pounds	
Rex sole, non-FSSI stock	*Glyptocephalus zachirus*	2005	0	Pounds	
Rock sole, Bering Sea/Aleutian Islands	*Paraplagusia bilineata*	2005	160,864.51	Pounds	
Rockfish, unspecified*	Sebastidae	2005	120,239.97	Pounds	
Rougheye rockfish, Bering Sea/Aleutian Islands	*Sebastes aleutianus*	2005	4,129.25	Pounds	
Sablefish	*Anoplopoma fimbria*	2005	3,022.53	Pounds	
Scypho jellies*	Scyphozoa	2003–05	752.3	Pounds	
Sea anemone, unidentified*	Actinaria	2003–05	286.84	Pounds	
Sea pens and whips*	Octocorallia	2003–05	45.00	Pounds	
Sea star*	Asteroidea	2003–05	7,853.58	Pounds	
Shallow-water flatfish*		2005	0	Pounds	
Shark*	Elasmobranchii	2003–05	13,881.02	Pounds	
Shortraker rockfish	*Sebastes borealis*	2005	0	Pounds	
Shortspine thornyhead, non-FSSI stock	*Sebastolobus alascanus*	2005	0	Pounds	

Table 4.3.A (continued)

(continuation of subtable 4.3.A.1)

COMMON NAME	SCIENTIFIC NAME	ALEUTIAN ISLANDS/EASTERN BERING SEA ATKA MACKEREL TRAWL			
		DATA SOURCE	BYCATCH	UNIT	CV
Skate, unidentified*	Rajidae	2005	0	Pounds	
Snails*	Gastropoda	2003–05	752.98	Pounds	
Snow crab, Bering Sea	*Chionoecetes opilio*	2005	8.17	Pounds	
Sponge, unidentified*	Porifera	2003–05	112,339.23	Pounds	
Squid*	Decapoda	2005	18,196.93	Pounds	
Surf smelt	*Hypomesus pretiosus*	2003–05	0	Pounds	
Tanner crab, Eastern Bering Sea	*Chionoecetes bairdi*	2005	1,158.19	Pounds	
Urchins/dollars/cucumbers*	Echinodermata	2003–05	3,092.49	Pounds	
Walleye pollock, Eastern Bering Sea	*Theragra chalcogramma*	2005	384,309.36	Pounds	
Yellowfin sole, Bering Sea/Aleutian Islands	*Limanda aspera*	2005	9,429.16	Pounds	
TOTAL FISHERY BYCATCH			18,593,786.77	Pounds	
TOTAL FISHERY LANDINGS			117,110,010.38	Pounds	
TOTAL CATCH (Bycatch + Landings)			135,703,797.15	Pounds	
FISHERY BYCATCH RATIO (Bycatch/Total Catch)			0.14		

Subtable 4.3.A.2

COMMON NAME	SCIENTIFIC NAME	BERING SEA/ALEUTIAN ISLANDS FLATFISH* GROUP (ARROWTOOTH FLOUNDER, FLATHEAD SOLE, OTHER FLATFISH) TRAWL*			
		DATA SOURCE	BYCATCH	UNIT	CV
Alaska plaice, Bering Sea/Aleutian Islands	*Pleuronectes quadrituberculatus*	2005	1,426,885.18	Pounds	
Arrowtooth flounder, Bering Sea/Aleutian Islands	*Atheresthes stomias*	2005	4,355,114.37	Pounds	
Atka mackerel, Bering Sea/Aleutian Islands	*Pleurogrammus monopterygius*	2005	563,033.49	Pounds	
Benthic Urochordata*	Urochordata	2003–05	65,233.26	Pounds	
Big skate	*Raja binoculata*	2005	0	Pounds	
Bivalves*	Bivalvia	2003–05	1,537.96	Pounds	
Blue king crab	*Paralithodes platypus*	2005	70.78	Pounds	
Brittle star, unidentified*	Ophiuroidea	2003–05	15,510.85	Pounds	
Byrozoans/hydroids*	Bryozoa	2003–05	773.61	Pounds	
Capelin	*Mallotus villosus*	2003–05	60.92	Pounds	
Chinook salmon	*Oncorhynchus tshawytscha*	2005	12,635.84	Pounds	
Deepsea smelts*	Bathylagidae	2003–05	0	Pounds	
Deepwater flatfish*		2005	0	Pounds	
Demersal shelf rockfish*		2005	0	Pounds	
Eelpouts*	Zoarcidae	2003–05	146,369.01	Pounds	

Table 4.3.A (continued)

(continuation of **Subtable 4.3.A.2)**

		BERING SEA/ALEUTIAN ISLANDS FLATFISH* GROUP (ARROWTOOTH FLOUNDER, FLATHEAD SOLE, OTHER FLATFISH) TRAWL*			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Eulachon (smelt)	*Thaleichthys pacificus*	2003–05	504.45	Pounds	
Flatfish*	Pleuronectiformes	2005	67,437.12	Pounds	
Flathead sole, Bering Sea/Aleutian Islands	*Hippoglossoides elassodon*	2005	2,277,584.10	Pounds	
Giant grenadier*	*Albatrossia pectoralis*	2003–05	11,373.36	Pounds	
Golden king crab, Aleutian Islands	*Lithodes aequispina*	2005	704.04	Pounds	
Greenland turbot, Bering Sea/Aleutian Islands	*Reinhardtius hippoglossoides*	2005	58,153.47	Pounds	
Greenlings*	Hexagrammidae	2003–05	502.9	Pounds	
Grenadier*	Macrouridae	2005	11,231.99	Pounds	
Gunnels*	Pholidae	2003–05	0	Pounds	
Hermit crab, unidentified*	Paguroidea	2003–05	16,013.26	Pounds	
Herring	*Clupea pallasi*	2005	2,485.11	Pounds	
Invertebrate, unidentified*	Invertebrata	2003–05	44,654.71	Pounds	
Lanternfishes*	Myctophidae	2003–05	0.67	Pounds	
Large sculpins*	Cottidae	2003–05	913,238.89	Pounds	
Longnose skate	*Raja rhina*	2005	0	Pounds	
Miscellaneous crabs*	Decapoda	2003–05	10,847.47	Pounds	
Miscellaneous crustaceans*	Crustaceamorpha	2003–05	406.7	Pounds	
Miscellaneous deep fish*	Teleostomi	2003–05	0	Pounds	
Miscellaneous fish*	Teleostomi	2003–05	83,865.51	Pounds	
Non-Chinook salmon*	Salmonidae	2005	2,922.44	Pounds	
Northern rockfish, Bering Sea/Aleutian Islands	*Sebastes polyspinis*	2005	8,811.87	Pounds	
Octopus*	Octopoda	2003–05	23,299.16	Pounds	
Other osmerids*	Osmeridae	2003–05	682.13	Pounds	
Other sculpins*	Cottidae	2003–05	446,162.66	Pounds	
Other species*		2005	2,959,984.54	Pounds	
Pacific cod, Bering Sea/Aleutian Islands	*Gadus macrocephalus*	2005	157,191.61	Pounds	
Pacific hake	*Merluccius productus*	2005	0	Pounds	
Pacific halibut	*Hippoglossus stenolepis*	2005	1,115,761.02	Pounds	
Pacific ocean perch, Bering Sea/Aleutian Islands	*Sebastes alutus*	2005	77,241.07	Pounds	
Pacific sand lance	*Ammodytes hexapterus*	2003–05	4.44	Pounds	
Pandalid shrimp*	*Pandalus* spp.	2003–05	880.48	Pounds	
Pelagic shelf rockfish*		2005	0	Pounds	
Polychaete, unidentified*	Polychaeta	2003–05	42.83	Pounds	
Pricklebacks*	Stichaeidae	2003–05	24.18	Pounds	

Table 4.3.A (continued)

(continuation of **Subtable 4.3.A.2)**

		BERING SEA/ALEUTIAN ISLANDS FLATFISH* GROUP (ARROWTOOTH FLOUNDER, FLATHEAD SOLE, OTHER FLATFISH) TRAWL*			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Red king crab	*Paralithodes camtschaticus*	2005	3,146.93	Pounds	
Rex sole, non-FSSI stock	*Glyptocephalus zachirus*	2005	0	Pounds	
Rock sole, Bering Sea/Aleutian Islands	*Paraplagusia bilineata*	2005	1,418,844.93	Pounds	
Rockfish, unspecified*	Sebastidae	2005	9,021.31	Pounds	
Rougheye rockfish, Bering Sea/Aleutian Islands	*Sebastes aleutianus*	2005	6,657.95	Pounds	
Sablefish	*Anoplopoma fimbria*	2005	49,778.11	Pounds	
Scypho jellies*	Scyphozoa	2003–05	39,614.05	Pounds	
Sea anemone, unidentified*	Actinaria	2003–05	55,930.30	Pounds	
Sea pens and whips*	Octocorallia	2003–05	639.56	Pounds	
Sea star*	Asteroidea	2003–05	467,854.14	Pounds	
Shallow water flatfish*		2005	0	Pounds	
Shark*	Elasmobranchii	2003–05	72,972.92	Pounds	
Shortraker rockfish	*Sebastes borealis*	2005	12,001.95	Pounds	
Shortspine thornyhead, non-FSSI stock	*Sebastolobus alascanus*	2005	0	Pounds	
Skate, unidentified*	Rajidae	2005	0	Pounds	
Snails*	Gastropoda	2003–05	66,391.20	Pounds	
Snow crab, Bering Sea	*Chionoecetes opilio*	2005	90,865.93	Pounds	
Sponge, unidentified*	Porifera	2003–05	3,223.19	Pounds	
Squid*	Decapoda	2005	34,766.86	Pounds	
Surf smelt	*Hypomesus pretiosus*	2003–05	0	Pounds	
Tanner crab, non-FSSI stock	*Chionoecetes bairdi*	2005	249,807.13	Pounds	
Urchins/dollars/cucumbers*	Echinodermata	2003–05	3,346.57	Pounds	
Walleye pollock, Aleutian Islands	*Theragra chalcogramma*	2005	6,716,390.26	Pounds	
Yellowfin sole, Bering Sea/Aleutian Islands	*Limanda aspera*	2005	1,071,385.80	Pounds	
TOTAL FISHERY BYCATCH			25,251,876.54	Pounds	
TOTAL FISHERY LANDINGS			44,069,597.62	Pounds	
TOTAL CATCH (Bycatch + Landings)			693,21,474.16	Pounds	
FISHERY BYCATCH RATIO (Bycatch/Total Catch)			0.36		

Table 4.3.A (continued)

Subtable 4.3.A.3

		BERING SEA/ALEUTIAN ISLANDS GREENLAND TURBOT LONGLINE			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Alaska plaice, Bering Sea/Aleutian Islands	*Pleuronectes quadrituberculatus*	2005	0	Pounds	
Arrowtooth flounder, Bering Sea/Aleutian Islands	*Atheresthes stomias*	2005	6,713.07	Pounds	
Atka mackerel, Bering Sea/Aleutian Islands	*Pleurogrammus monopterygius*	2005	0	Pounds	
Benthic Urochordata*	Urochordata	2003–05	24.07	Pounds	
Big skate	*Raja binoculata*	2005	0	Pounds	
Bivalves*	Bivalvia	2003–05	1.29	Pounds	
Blue king crab	*Paralithodes platypus*	2005	14.84	Pounds	
Brittle star, unidentified*	Ophiuroidea	2003–05	9.97	Pounds	
Byrozoans/hydroids*	Bryozoa	2003–05	81.93	Pounds	
Capelin	*Mallotus villosus*	2003–05	0	Pounds	
Chinook salmon	*Oncorhynchus tshawytscha*	2005	44.19	Pounds	
Deepsea smelts*	Bathylagidae	2003–05	0	Pounds	
Deepwater flatfish*		2005	0	Pounds	
Demersal shelf rockfish*		2005	0	Pounds	
Eelpouts*	Zoarcidae	2003–05	6,963.94	Pounds	
Eulachon (smelt)	*Thaleichthys pacificus*	2003–05	0	Pounds	
Flatfish*	*Pleuronectiformes*	2005	1,591.74	Pounds	
Flathead sole, Bering Sea/Aleutian Islands	*Hippoglossoides elassodon*	2005	10,117.00	Pounds	
Giant grenadier*	*Albatrossia pectoralis*	2003–05	949,470.86	Pounds	
Golden king crab, Aleutian Islands	*Lithodes aequispina*	2005	54.14	Pounds	
Greenland turbot, Bering Sea/Aleutian Islands	*Reinhardtius hippoglossoides*	2005	45,743.66	Pounds	
Greenlings*	Hexagrammidae	2003–05	0	Pounds	
Grenadier*	Macrouridae	2005	872,555.95	Pounds	
Gunnels*	Pholidae	2003–05	0	Pounds	
Hermit crab, unidentified*	Paguroidea	2003–05	0	Pounds	
Herring	*Clupea pallasi*	2005	0	Pounds	
Invertebrate, unidentified*	Invertebrata	2003–05	0.35	Pounds	
Lanternfishes*	Myctophidae	2003–05	0	Pounds	
Large sculpins*	Cottidae	2003–05	566.76	Pounds	
Longnose skate	*Raja rhina*	2005	0	Pounds	
Miscellaneous crabs*	Decapoda	2003–05	13.43	Pounds	
Miscellaneous crustaceans*	Crustaceamorpha	2003–05	0	Pounds	
Miscellaneous deep fish*	Teleostomi	2003–05	0	Pounds	
Miscellaneous fish*	Teleostomi	2003–05	4,077.31	Pounds	
Non-Chinook salmon*	Salmonidae	2005	180.45	Pounds	

Table 4.3.A (continued)

(continuation of Subtable 4.3.A.3)		BERING SEA/ALEUTIAN ISLANDS GREENLAND TURBOT LONGLINE			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Northern rockfish, Bering Sea/Aleutian Islands	*Sebastes polyspinis*	2005	0	Pounds	
Octopus*	Octopoda	2003–05	433.58	Pounds	
Other osmerids*	Osmeridae	2003–05	0	Pounds	
Other sculpins*	Cottidae	2003–05	1,427.71	Pounds	
Other species*		2005	325,053.58	Pounds	
Pacific cod, Bering Sea/Aleutian Islands	*Gadus macrocephalus*	2005	498.24	Pounds	
Pacific hake	*Merluccius productus*	2005	0	Pounds	
Pacific halibut	*Hippoglossus stenolepis*	2005	26,575.04	Pounds	
Pacific ocean perch, Bering Sea/Aleutian Islands	*Sebastes alutus*	2005	0	Pounds	
Pacific sand lance	*Ammodytes hexapterus*	2003–05	0	Pounds	
Pandalid shrimp*	*Pandalus* spp.	2003–05	0	Pounds	
Pelagic shelf rockfish*		2005	0	Pounds	
Polychaete, unidentified*	Polychaeta	2003–05	0	Pounds	
Pricklebacks*	Stichaeidae	2003–05	0	Pounds	
Red king crab	*Paralithodes camtschaticus*	2005	33.58	Pounds	
Rex sole, non-FSSI stock	*Glyptocephalus zachirus*	2005	0	Pounds	
Rock sole, Bering Sea/Aleutian Islands	*Paraplagusia bilineata*	2005	0	Pounds	
Rockfish, unspecified*	Sebastidae	2005	5,502.73	Pounds	
Rougheye rockfish, Bering Sea/Aleutian Islands	*Sebastes aleutianus*	2005	3,899.97	Pounds	
Sablefish	*Anoplopoma fimbria*	2005	23,534.32	Pounds	
Scypho jellies*	Scyphozoa	2003–05	21.80	Pounds	
Sea anemone, unidentified*	Actinaria	2003–05	267.11	Pounds	
Sea pens and whips*	Octocorallia	2003–05	2.96	Pounds	
Sea star*	Asteroidea	2003–05	1,090.65	Pounds	
Shallow-water flatfish*		2005	0	Pounds	
Shark*	Elasmobranchii	2003–05	11,382.45	Pounds	
Shortraker rockfish	*Sebastes borealis*	2005	2,028.25	Pounds	
Shortspine thornyhead, non-FSSI stock	*Sebastolobus alascanus*	2005	0	Pounds	
Skate, unidentified*	Rajidae	2005	0	Pounds	
Snails*	Gastropoda	2003–05	135.60	Pounds	
Snow crab, Bering Sea	*Chionoecetes opilio*	2005	2.87	Pounds	
Sponge, unidentified*	Porifera	2003–05	79.04	Pounds	
Squid*	Decapoda	2005	0	Pounds	
Surf smelt	*Hypomesus pretiosus*	2003–05	0	Pounds	
Tanner crab, non-FSSI stock	*Chionoecetes bairdi*	2005	0	Pounds	

Table 4.3.A (continued)

(continuation of Subtable 4.3.A.3)		BERING SEA/ALEUTIAN ISLANDS GREENLAND TURBOT LONGLINE			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Urchins/dollars/cucumbers*	Echinodermata	2003–05	804.14	Pounds	
Walleye pollock, Aleutian Islands	*Theragra chalcogramma*	2005	758.39	Pounds	
Yellowfin sole, Bering Sea/Aleutian Islands	*Limanda aspera*	2005	0	Pounds	
TOTAL FISHERY BYCATCH			2,301,756.96	Pounds	
TOTAL FISHERY LANDINGS			3,755,257.11	Pounds	
TOTAL CATCH (Bycatch + Landings)			6,057,014.07	Pounds	
FISHERY BYCATCH RATIO (Bycatch/Landings)			0.38		

Subtable 4.3.A.4		BERING SEA/ALEUTIAN ISLANDS PACIFIC COD JIG			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Alaska plaice, Bering Sea/Aleutian Islands	*Pleuronectes quadrituberculatus*	2005	0	Pounds	
Arrowtooth flounder, Bering Sea/Aleutian Islands	*Atheresthes stomias*	2005	0	Pounds	
Atka mackerel, Bering Sea/Aleutian Islands	*Pleurogrammus monopterygius*	2005	0	Pounds	
Benthic Urochordata*	Urochordata	2003–05	0	Pounds	
Big skate	*Raja binoculata*	2005	0	Pounds	
Bivalves*	Bivalvia	2003–05	0	Pounds	
Blue king crab	*Paralithodes platypus*	2005	0	Pounds	
Brittle star, unidentified*	Ophiuroidea	2003–05	0	Pounds	
Byrozoans/hydroids*	Bryozoa	2003–05	0	Pounds	
Capelin	*Mallotus villosus*	2003–05	0	Pounds	
Chinook salmon	*Oncorhynchus tshawytscha*	2005	0	Pounds	
Deepsea smelts*	Bathylagidae	2003–05	0	Pounds	
Deepwater flatfish*		2005	0	Pounds	
Demersal shelf rockfish*		2005	0	Pounds	
Eelpouts*	Zoarcidae	2003–05	0	Pounds	
Eulachon (smelt)	*Thaleichthys pacificus*	2003–05	0	Pounds	
Flatfish*	Pleuronectiformes	2005	0	Pounds	
Flathead sole, Bering Sea/Aleutian Islands	*Hippoglossoides elassodon*	2005	0	Pounds	
Giant grenadier*	*Albatrossia pectoralis*	2003–05	0	Pounds	
Golden king crab, Aleutian Islands	*Lithodes aequispina*	2005	0	Pounds	
Greenland turbot, Bering Sea/Aleutian Islands	*Reinhardtius hippoglossoides*	2005	0	Pounds	
Greenlings*	Hexagrammidae	2003–05	0	Pounds	

Table 4.3.A (continued)

(continuation of Subtable 4.3.A.4)

		BERING SEA/ALEUTIAN ISLANDS PACIFIC COD JIG			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Grenadier*	Macrouridae	2005	0	Pounds	
Gunnels*	Pholidae	2003–05	0	Pounds	
Hermit crab, unidentified*	Paguroidea	2003–05	0	Pounds	
Herring	*Clupea pallasi*	2005	0	Pounds	
Invertebrate, unidentified*	Invertebrata	2003–05	0	Pounds	
Lanternfishes*	Myctophidae	2003–05	0	Pounds	
Large sculpins*	Cottidae	2003–05	0	Pounds	
Longnose skate	*Raja rhina*	2005	0	Pounds	
Miscellaneous crabs*	Decapoda	2003–05	0	Pounds	
Miscellaneous crustaceans*	Crustaceamorpha	2003–05	0	Pounds	
Miscellaneous deep fish*	Teleostomi	2003–05	0	Pounds	
Miscellaneous fish*	Teleostomi	2003–05	0	Pounds	
Non-Chinook salmon*	Salmonidae	2005	0	Pounds	
Northern rockfish, Bering Sea/Aleutian Islands	*Sebastes polyspinis*	2005	0	Pounds	
Octopus*	Octopoda	2003–05	409.32	Pounds	
Other osmerids*	Osmeridae	2003–05	0	Pounds	
Other sculpins*	Cottidae	2003–05	0	Pounds	
Other species*		2005	182.98	Pounds	
Pacific cod, Bering Sea/Aleutian Islands	*Gadus macrocephalus*	2005	1,199.31	Pounds	
Pacific hake	*Merluccius productus*	2005	0	Pounds	
Pacific halibut	*Hippoglossus stenolepis*	2005	0	Pounds	
Pacific ocean perch, Bering Sea/Aleutian Islands	*Sebastes alutus*	2005	0	Pounds	
Pacific sand lance	*Ammodytes hexapterus*	2003–05	0	Pounds	
Pandalid shrimp*	*Pandalus* spp.	2003–05	0	Pounds	
Pelagic shelf rockfish*		2005	0	Pounds	
Polychaete, unidentified*	Polychaeta	2003–05	0	Pounds	
Pricklebacks*	Stichaeidae	2003–05	0	Pounds	
Red king crab	*Paralithodes camtschaticus*	2005	0	Pounds	
Rex sole, non-FSSI stock	*Glyptocephalus zachirus*	2005	0	Pounds	
Rock sole, Bering Sea/Aleutian Islands	*Paraplagusia bilineata*	2005	0	Pounds	
Rockfish, unspecified*	Sebastidae	2005	0	Pounds	
Rougheye rockfish, Bering Sea/Aleutian Islands	*Sebastes aleutianus*	2005	0	Pounds	
Sablefish	*Anoplopoma fimbria*	2005	0	Pounds	
Scypho jellies*	Scyphozoa	2003–05	0	Pounds	
Sea anemone, unidentified*	Actinaria	2003–05	0	Pounds	

Table 4.3.A (continued)

(continuation of Subtable 4.3.A.4)

COMMON NAME	SCIENTIFIC NAME	BERING SEA/ALEUTIAN ISLANDS PACIFIC COD JIG DATA SOURCE	BYCATCH	UNIT	CV
Sea pens and whips*	Octocorallia	2003–05	0	Pounds	
Sea star*	Asteroidea	2003–05	0	Pounds	
Shallow-water flatfish*		2005	0	Pounds	
Shark*	Elasmobranchii	2003–05	0	Pounds	
Shortraker rockfish	*Sebastes borealis*	2005	0	Pounds	
Shortspine thornyhead, non-FSSI stock	*Sebastolobus alascanus*	2005	0	Pounds	
Skate, unidentified*	Rajidae	2005	0	Pounds	
Snails*	Gastropoda	2003–05	0	Pounds	
Snow crab, Bering Sea	*Chionoecetes opilio*	2005	0	Pounds	
Sponge, unidentified*	Porifera	2003–05	0	Pounds	
Squid*	Decapoda	2005	0	Pounds	
Surf smelt	*Hypomesus pretiosus*	2003–05	0	Pounds	
Tanner crab, non-FSSI stock	*Chionoecetes bairdi*	2005	0	Pounds	
Urchins/dollars/cucumbers*	Echinodermata	2003–05	0	Pounds	
Walleye pollock, Aleutian Islands	*Theragra chalcogramma*	2005	0	Pounds	
Yellowfin sole, Bering Sea/Aleutian Islands	*Limanda aspera*	2005	0	Pounds	
TOTAL FISHERY BYCATCH			1,791.61	Pounds	
TOTAL FISHERY LANDINGS			375,091.84	Pounds	
TOTAL CATCH (Bycatch + Landings)			376,883.45	Pounds	
FISHERY BYCATCH RATIO (Bycatch/Total Catch)			>0.0		

Subtable 4.3.A.5

COMMON NAME	SCIENTIFIC NAME	BERING SEA/ALEUTIAN ISLANDS PACIFIC COD LONGLINE DATA SOURCE	BYCATCH	UNIT	CV
Alaska plaice, Bering Sea/Aleutian Islands	*Pleuronectes quadrituberculatus*	2005	868.62	Pounds	
Arrowtooth flounder, Bering Sea/Aleutian Islands	*Atheresthes stomias*	2005	2,177,699.39	Pounds	
Atka mackerel, Bering Sea/Aleutian Islands	*Pleurogrammus monopterygius*	2005	51,713.77	Pounds	
Benthic Urochordata*	Urochordata	2003–05	655.24	Pounds	
Big skate	*Raja binoculata*	2005	0	Pounds	
Bivalves*	Bivalvia	2003–05	11,090.09	Pounds	
Blue king crab	*Paralithodes platypus*	2005	3,233.10	Pounds	
Brittle star, unidentified*	Ophiuroidea	2003–05	419.66	Pounds	

Table 4.3.A (continued)

(continuation of Subtable 4.3.A.5)		BERING SEA/ALEUTIAN ISLANDS PACIFIC COD LONGLINE			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Byrozoans/hydroids*	Bryozoa	2003–05	3,870.23	Pounds	
Capelin	*Mallotus villosus*	2003–05	0	Pounds	
Chinook salmon	*Oncorhynchus tshawytscha*	2005	325.38	Pounds	
Deep-sea smelts*	Bathylagidae	2003–05	0	Pounds	
Deepwater flatfish*		2005	0	Pounds	
Demersal shelf rockfish*		2005	0	Pounds	
Eelpouts*	Zoarcidae	2003–05	20,663.72	Pounds	
Eulachon (smelt)	*Thaleichthys pacificus*	2003–05	0	Pounds	
Flatfish*	Pleuronectiformes	2005	542,334.32	Pounds	
Flathead sole, Bering Sea/Aleutian Islands	*Hippoglossoides elassodon*	2005	1,209,068.72	Pounds	
Giant grenadier*	*Albatrossia pectoralis*	2003–05	312,155.03	Pounds	
Golden king crab, Aleutian Islands	*Lithodes aequispina*	2005	1,195.10	Pounds	
Greenland turbot, Bering Sea/Aleutian Islands	*Reinhardtius hippoglossoides*	2005	134,545.75	Pounds	
Greenlings*	Hexagrammidae	2003–05	3,355.09	Pounds	
Grenadier*	Macrouridae	2005	478,908.32	Pounds	
Gunnels*	Pholidae	2003–05	139.82	Pounds	
Hermit crab, unidentified*	Paguroidea	2003–05	869.81	Pounds	
Herring	*Clupea pallasi*	2005	8.18	Pounds	
Invertebrate, unidentified*	Invertebrata	2003–05	14,844.26	Pounds	
Lanternfishes*	Myctophidae	2003–05	0	Pounds	
Large sculpins*	Cottidae	2003–05	1,769,278.52	Pounds	
Longnose skate	*Raja rhina*	2005	0	Pounds	
Miscellaneous crabs*	Decapoda	2003–05	7,254.14	Pounds	
Miscellaneous crustaceans*	Crustaceamorpha	2003–05	300.65	Pounds	
Miscellaneous deep fish*	Teleostomi	2003–05	0	Pounds	
Miscellaneous fish*	Teleostomi	2003–05	148,246.24	Pounds	
Non-Chinook salmon*	Salmonidae	2005	257.00	Pounds	
Northern rockfish, Bering Sea/Aleutian Islands	*Sebastes polyspinis*	2005	53,091.66	Pounds	
Octopus*	Octopoda	2003–05	87,490.34	Pounds	
Other osmerids*	Osmeridae	2003–05	1.16	Pounds	
Other sculpins*	Cottidae	2003–05	1,095,304.53	Pounds	
Other species*		2005	31,254,809.56	Pounds	
Pacific cod, Bering Sea/Aleutian Islands	*Gadus macrocephalus*	2005	6,210,072.82	Pounds	
Pacific hake	*Merluccius productus*	2005	0	Pounds	
Pacific halibut	*Hippoglossus stenolepis*	2005	1,206,379.38	Pounds	

Table 4.3.A (continued)

(continuation of Subtable 4.3.A.5)

		BERING SEA/ALEUTIAN ISLANDS PACIFIC COD LONGLINE			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Pacific ocean perch, Bering Sea/Aleutian Islands	*Sebastes alutus*	2005	4,779.62	Pounds	
Pacific sand lance	*Ammodytes hexapterus*	2003–05	0	Pounds	
Pandalid shrimp*	*Pandalus* spp.	2003–05	0	Pounds	
Pelagic shelf rockfish*		2005	0	Pounds	
Polychaete, unidentified*	Polychaeta	2003–05	89.23	Pounds	
Pricklebacks*	Stichaeidae	2003–05	9.33	Pounds	
Red king crab	*Paralithodes camtschaticus*	2005	75,224.136	Pounds	
Rex sole, non-FSSI stock	*Glyptocephalus zachirus*	2005	0	Pounds	
Rock sole, Bering Sea/Aleutian Islands	*Paraplagusia bilineata*	2005	115,502.25	Pounds	
Rockfish, unspecified*	Sebastidae	2005	61,771.25	Pounds	
Rougheye rockfish, Bering Sea/Aleutian Islands	*Sebastes aleutianus*	2005	14,034.61	Pounds	
Sablefish	*Anoplopoma fimbria*	2005	29,259.72	Pounds	
Scypho jellies*	Scyphozoa	2003–05	15,158.78	Pounds	
Sea anemone, unidentified*	Actinaria	2003–05	178,326.63	Pounds	
Sea pens and whips*	Octocorallia	2003–05	25,232.04	Pounds	
Sea star*	Asteroidea	2003–05	581,255.29	Pounds	
Shallow water flatfish*		2005	0	Pounds	
Shark*	Elasmobranchii	2003–05	307,870.77	Pounds	
Shortraker rockfish	*Sebastes borealis*	2005	35,714.84	Pounds	
Shortspine thornyhead, non-FSSI stock	*Sebastolobus alascanus*	2005	0	Pounds	
Skate, unidentified*	Rajidae	2005	0	Pounds	
Snails*	Gastropoda	2003–05	12,836.39	Pounds	
Snow crab, Bering Sea	*Chionoecetes opilio*	2005	34,833.84	Pounds	
Sponge, unidentified*	Porifera	2003–05	11,369.86	Pounds	
Squid*	Decapoda	2005	22.05	Pounds	
Surf smelt	*Hypomesus pretiosus*	2003–05	0	Pounds	
Tanner crab, non-FSSI stock	*Chionoecetes bairdi*	2005	11,332.00	Pounds	
Urchins/dollars/cucumbers*	Echinodermata	2003–05	467.14	Pounds	
Walleye pollock, Aleutian Islands	*Theragra chalcogramma*	2005	1,270,551.17	Pounds	
Yellowfin sole, Bering Sea/Aleutian Islands	*Limanda aspera*	2005	1,320,036.07	Pounds	
TOTAL FISHERY BYCATCH			50,906,126.61	Pounds	
TOTAL FISHERY LANDINGS			269,207,774.47	Pounds	
TOTAL CATCH (Bycatch + Landings)			320,113,901.08	Pounds	
FISHERY BYCATCH RATIO (Bycatch/Total Catch)			0.16		

Table 4.3.A (continued)

Subtable 4.3.A.6

		BERING SEA/ALEUTIAN ISLANDS PACIFIC COD POT			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Alaska plaice, Bering Sea/Aleutian Islands	*Pleuronectes quadrituberculatus*	2005	105.82	Pounds	
Arrowtooth flounder, Bering Sea/Aleutian Islands	*Atheresthes stomias*	2005	10,394.78	Pounds	
Atka mackerel, Bering Sea/Aleutian Islands	*Pleurogrammus monopterygius*	2005	535,208.98	Pounds	
Benthic Urochordata*	Urochordata	2003–05	41.48	Pounds	
Big skate	*Raja binoculata*	2005	0	Pounds	
Bivalves*	Bivalvia	2003–05	392.37	Pounds	
Blue king crab	*Paralithodes platypus*	2005	1,906.50	Pounds	
Brittle star, unidentified*	Ophiuroidea	2003–05	8.11	Pounds	
Byrozoans/hydroids*	Bryozoa	2003–05	54.41	Pounds	
Capelin	*Mallotus villosus*	2003–05	0	Pounds	
Chinook salmon	*Oncorhynchus tshawytscha*	2005	0	Pounds	
Deep-sea smelts*	Bathylagidae	2003–05	0	Pounds	
Deepwater flatfish*		2005	0	Pounds	
Demersal shelf rockfish*		2005	0	Pounds	
Eelpouts*	Zoarcidae	2003–05	109.90	Pounds	
Eulachon (smelt)	*Thaleichthys pacificus*	2003–05	0	Pounds	
Flatfish*	Pleuronectiformes	2005	1,446.23	Pounds	
Flathead sole, Bering Sea/Aleutian Islands	*Hippoglossoides elassodon*	2005	1,516.78	Pounds	
Giant grenadier*	*Albatrossia pectoralis*	2003–05	0	Pounds	
Golden king crab, Aleutian Islands	*Lithodes aequispina*	2005	0	Pounds	
Greenland turbot, Bering Sea/Aleutian Islands	*Reinhardtius hippoglossoides*	2005	22.05	Pounds	
Greenlings*	Hexagrammidae	2003–05	909.49	Pounds	
Grenadier*	Macrouridae	2005	0	Pounds	
Gunnels*	Pholidae	2003–05	0	Pounds	
Hermit crab, unidentified*	Paguroidea	2003–05	424.61	Pounds	
Herring	*Clupea pallasi*	2005	0	Pounds	
Invertebrate, unidentified*	Invertebrata	2003–05	31.56	Pounds	
Lanternfishes*	Myctophidae	2003–05	0	Pounds	
Large sculpins*	Cottidae	2003–05	310,676.07	Pounds	
Longnose skate	*Raja rhina*	2005	0	Pounds	
Miscellaneous crabs*	Decapoda	2003–05	1,857.05	Pounds	
Miscellaneous crustaceans*	Crustaceamorpha	2003–05	4.24	Pounds	
Miscellaneous deep fish*	Teleostomi	2003–05	0	Pounds	
Miscellanous fish*	Teleostomi	2003–05	42,148.39	Pounds	

Table 4.3.A (continued)

(continuation of Subtable 4.3.A.6)		BERING SEA/ALEUTIAN ISLANDS PACIFIC COD POT			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Non-Chinook salmon*	Salmonidae	2005	0	Pounds	
Northern rockfish, Bering Sea/Aleutian Islands	*Sebastes polyspinis*	2005	2,563.97	Pounds	
Octopus*	Octopoda	2003–05	363,910.01	Pounds	
Other osmerids*	Osmeridae	2003–05	0	Pounds	
Other sculpins*	Cottidae	2003–05	109,144.01	Pounds	
Other species*		2005	362,122.06	Pounds	
Pacific cod, Bering Sea/Aleutian Islands	*Gadus macrocephalus*	2005	139,539.22	Pounds	
Pacific hake	*Merluccius productus*	2005	0	Pounds	
Pacific halibut	*Hippoglossus stenolepis*	2005	6,409.98	Pounds	
Pacific ocean perch, Bering Sea/Aleutian Islands	*Sebastes alutus*	2005	449.74	Pounds	
Pacific sand lance	*Ammodytes hexapterus*	2003–05	0	Pounds	
Pandalid shrimp*	*Pandalus* spp.	2003–05	0	Pounds	
Pelagic shelf rockfish*		2005	0	Pounds	
Polychaete, unidentified*	Polychaeta	2003–05	0	Pounds	
Pricklebacks*	Stichaeidae	2003–05	0	Pounds	
Red king crab	*Paralithodes camtschaticus*	2005	16,717.99	Pounds	
Rex sole, non-FSSI stock	*Glyptocephalus zachirus*	2005	0	Pounds	
Rock sole, Bering Sea/Aleutian Islands	*Paraplagusia bilineata*	2005	3,042.38	Pounds	
Rockfish, unspecified*	Sebastidae	2005	7,325.95	Pounds	
Rougheye rockfish, Bering Sea/Aleutian Islands	*Sebastes aleutianus*	2005	101.41	Pounds	
Sablefish	*Anoplopoma fimbria*	2005	275.58	Pounds	
Scypho jellies	Scyphozoa	2003–05	4,458.94	Pounds	
Sea anemone, unidentified*	Actinaria	2003–05	71.64	Pounds	
Sea pens and whips*	Octocorallia	2003–05	0.71	Pounds	
Sea star*	Asteroidea	2003–05	71,974.88	Pounds	
Shallow-water flatfish*		2005	0	Pounds	
Shark*	Elasmobranchii	2003–05	0	Pounds	
Shortraker rockfish	*Sebastes borealis*	2005	0	Pounds	
Shortspine thornyhead, non-FSSI stock	*Sebastolobus alascanus*	2005	0	Pounds	
Skate, unidentified*	Rajidae	2005	0	Pounds	
Snails*	Gastropoda	2003–05	7,281.32	Pounds	
Snow crab, Bering Sea	*Chionoecetes opilio*	2005	50,111.31	Pounds	
Sponge, unidentified*	Porifera	2003–05	1,354.93	Pounds	
Squid*	Decapoda	2005	0	Pounds	
Surf smelt	*Hypomesus pretiosus*	2003–05	0	Pounds	

Table 4.3.A (continued)

(continuation of Subtable 4.3.A.6)

		BERING SEA/ALEUTIAN ISLANDS PACIFIC COD POT			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Tanner crab, non-FSSI stock	*Chionoecetes bairdi*	2005	96,525.35	Pounds	
Urchins/dollars/cucumbers*	Echinodermata	2003–05	2195.15	Pounds	
Walleye pollock, Aleutian Islands	*Theragra chalcogramma*	2005	4,530.49	Pounds	
Yellowfin sole, Bering Sea/Aleutian Islands	*Limanda aspera*	2005	165,699.24	Pounds	
TOTAL FISHERY BYCATCH			2,323,065.08	Pounds	
TOTAL FISHERY LANDINGS			41,563,290.80	Pounds	
TOTAL CATCH (Bycatch + Landings)			43,886,355.88	Pounds	
FISHERY BYCATCH RATIO (Bycatch/Total Catch)			0.05		

Subtable 4.3.A.7

		BERING SEA/ALEUTIAN ISLANDS PACIFIC COD TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Alaska plaice, Bering Sea/Aleutian Islands	*Pleuronectes quadrituberculatus*	2005	853,227.62	Pounds	
Arrowtooth flounder, Bering Sea/Aleutian Islands	*Atheresthes stomias*	2005	6,181,622.20	Pounds	
Atka mackerel, Bering Sea/Aleutian Islands	*Pleurogrammus monopterygius*	2005	1,500,625.31	Pounds	
Benthic Urochordata*	Urochordata	2003–05	20,230.17	Pounds	
Big skate	*Raja binoculata*	2005	0	Pounds	
Bivalves*	Bivalvia	2003–05	19,576.12	Pounds	
Blue king crab	*Paralithodes platypus*	2005	0	Pounds	
Brittle star, unidentified*	Ophiuroidea	2003–05	1,350.34	Pounds	
Byrozoans/hydroids*	Bryozoa	2003–05	36,118.44	Pounds	
Capelin	*Mallotus villosus*	2003–05	80.98	Pounds	
Chinook salmon	*Oncorhynchus tshawytscha*	2005	26,833.64	Pounds	
Deepsea smelts*	Bathylagidae	2003–05	0	Pounds	
Deepwater flatfish*		2005	0	Pounds	
Demersal shelf rockfish*		2005	0	Pounds	
Eelpouts*	Zoarcidae	2003–05	67,022.48	Pounds	
Eulachon (smelt)	*Thaleichthys pacificus*	2003–05	89.41	Pounds	
Flatfish*	Pleuronectiformes	2005	2,121,860.77	Pounds	
Flathead sole, Bering Sea/Aleutian Islands	*Hippoglossoides elassodon*	2005	1,992,912.55	Pounds	
Giant grenadier*	*Albatrossia pectoralis*	2003–05	0	Pounds	
Golden king crab, Aleutian Islands	*Lithodes aequispina*	2005	98.32	Pounds	

Table 4.3.A (continued)

(continuation of **Subtable 4.3.A.7)**

		BERING SEA/ALEUTIAN ISLANDS PACIFIC COD TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Greenland turbot, Bering Sea/Aleutian Islands	*Reinhardtius hippoglossoides*	2005	26,164.43	Pounds	
Greenlings*	Hexagrammidae	2003–05	5,407.91	Pounds	
Grenadier*	Macrouridae	2005	0	Pounds	
Gunnels*	Pholidae	2003–05	0	Pounds	
Hermit crab, unidentified*	Paguroidea	2003–05	6,706.95	Pounds	
Herring	*Clupea pallasi*	2005	31,283.25	Pounds	
Invertebrate, unidentified*	Invertebrata	2003–05	6,954.98	Pounds	
Lanternfishes*	Myctophidae	2003–05	3.55	Pounds	
Large sculpins*	Cottidae	2003–05	2,345,250.47	Pounds	
Longnose skate	*Raja rhina*	2005	0	Pounds	
Miscellaneous crabs*	Decapoda	2003–05	10,574.31	Pounds	
Miscellaneous crustaceans*	Crustaceamorpha	2003–05	642.07	Pounds	
Miscellaneous deep fish*	Teleostomi	2003–05	0	Pounds	
Miscellaneous fish*	Teleostomi	2003–05	394,439.33	Pounds	
Non-Chinook salmon*	Salmonidae	2005	3,440.93	Pounds	
Northern rockfish, Bering Sea/Aleutian Islands	*Sebastes polyspinis*	2005	426,741.68	Pounds	
Octopus*	Octopoda	2003–05	61,336.94	Pounds	
Other osmerids*	Osmeridae	2003–05	447.27	Pounds	
Other sculpins*	Cottidae	2003–05	833,488.29	Pounds	
Other species*		2005	3,583,682.56	Pounds	
Pacific cod, Bering Sea/Aleutian Islands	*Gadus macrocephalus*	2005	411,199.11	Pounds	
Pacific hake	*Merluccius productus*	2005	0	Pounds	
Pacific halibut	*Hippoglossus stenolepis*	2005	2,997,566.15	Pounds	
Pacific ocean perch, Bering Sea/Aleutian Islands	*Sebastes alutus*	2005	347,313.63	Pounds	
Pacific sand lance	*Ammodytes hexapterus*	2003–05	213.66	Pounds	
Pandalid shrimp*	*Pandalus* spp.	2003–05	322.29	Pounds	
Pelagic shelf rockfish*		2005	0	Pounds	
Polychaete, unidentified*	Polychaeta	2003–05	11.66	Pounds	
Pricklebacks*	Stichaeidae	2003–05	34.40	Pounds	
Red king crab	*Paralithodes camtschaticus*	2005	23,282.29	Pounds	
Rex sole – non-FSSI stock	*Glyptocephalus zachirus*	2005	0	Pounds	
Rock sole, Bering Sea/Aleutian Islands	*Paraplagusia bilineata*	2005	10,977,404.84	Pounds	
Rockfish, unspecified*	Sebastidae	2005	40,487.85	Pounds	
Rougheye rockfish, Bering Sea/Aleutian Islands	*Sebastes aleutianus*	2005	2,301.62	Pounds	
Sablefish	*Anoplopoma fimbria*	2005	11,184.04	Pounds	

Table 4.3.A (continued)

(continuation of **Subtable 4.3.A.7)**

		BERING SEA/ALEUTIAN ISLANDS PACIFIC COD TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Scypho jellies*	Scyphozoa	2003–05	1,336,611.13	Pounds	
Sea anemone, unidentified*	Actinaria	2003–05	31,115.78	Pounds	
Sea pens and whips*	Octocorallia	2003–05	703.88	Pounds	
Sea star*	Asteroidea	2003–05	220,890.48	Pounds	
Shallow-water flatfish*		2005	0	Pounds	
Shark*	Elasmobranchii	2003–05	39,287.80	Pounds	
Shortraker rockfish	*Sebastes borealis*	2005	0	Pounds	
Shortspine thornyhead, non-FSSI stock	*Sebastolobus alascanus*	2005	0	Pounds	
Skate, unidentified*	Rajidae	2005	0	Pounds	
Snails*	Gastropoda	2003–05	22,747.57	Pounds	
Snow crab, Bering Sea	*Chionoecetes opilio*	2005	32,797.10	Pounds	
Sponge, unidentified*	Porifera	2003–05	55,866.08	Pounds	
Squid*	Decapoda	2005	4,316.65	Pounds	
Surf smelt	*Hypomesus pretiosus*	2003–05	0	Pounds	
Tanner crab, non-FSSI stock	*Chionoecetes bairdi*	2005	127,240.61	Pounds	
Urchins/dollars/cucumbers*	Echinodermata	2003–05	25,880.36	Pounds	
Walleye pollock, Aleutian Islands	*Theragra chalcogramma*	2005	14,537,833.07	Pounds	
Yellowfin sole, Bering Sea/Aleutian Islands	*Limanda aspera*	2005	2,230,601.45	Pounds	
TOTAL FISHERY BYCATCH			54,035,426.77	Pounds	
TOTAL FISHERY LANDINGS			149,085,225.08	Pounds	
TOTAL CATCH (Bycatch + Landings)			203,120,651.85	Pounds	
FISHERY BYCATCH RATIO (Bycatch/Total Catch)			0.27		

Subtable 4.3.A.8

		BERING SEA/ALEUTIAN ISLANDS PACIFIC OCEAN PERCH TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Alaska plaice, Bering Sea/Aleutian Islands	*Pleuronectes quadrituberculatus*	2005	0	Pounds	
Arrowtooth flounder, Bering Sea/Aleutian Islands	*Atheresthes stomias*	2005	308,064.78	Pounds	
Atka mackerel, Bering Sea/Aleutian Islands	*Pleurogrammus monopterygius*	2005	118,831.22	Pounds	
Benthic Urochordata*	Urochordata	2003–05	108.43	Pounds	
Big skate	*Raja binoculata*	2005	0	Pounds	
Bivalves*	Bivalvia	2003–05	28.4	Pounds	
Blue king crab	*Paralithodes platypus*	2005	0	Pounds	
Brittle star, unidentified*	Ophiuroidea	2003–05	156.26	Pounds	

Table 4.3.A (continued)

(continuation of Subtable 4.3.A.8)

		BERING SEA/ALEUTIAN ISLANDS PACIFIC OCEAN PERCH TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Byrozoans/hydroids*	Bryozoa	2003–05	41,388.77	Pounds	
Capelin	*Mallotus villosus*	2003–05	0	Pounds	
Chinook salmon	*Oncorhynchus tshawytscha*	2005	0	Pounds	
Deepsea smelts*	Bathylagidae	2003–05	0	Pounds	
Deepwater flatfish*		2005	0	Pounds	
Demersal shelf rockfish*		2005	0	Pounds	
Eelpouts*	Zoarcidae	2003–05	4,743.63	Pounds	
Eulachon (smelt)	*Thaleichthys pacificus*	2003–05	0	Pounds	
Flatfish*	Pleuronectiformes	2005	1,902.59	Pounds	
Flathead sole, Bering Sea/Aleutian Islands	*Hippoglossoides elassodon*	2005	5,773.90	Pounds	
Giant grenadier*	*Albatrossia pectoralis*	2003–05	6,766.51	Pounds	
Golden king crab, Aleutian Islands	*Lithodes aequispina*	2005	10,480.27	Pounds	
Greenland turbot, Bering Sea/Aleutian Islands	*Reinhardtius hippoglossoides*	2005	10,740.91	Pounds	
Greenlings*	Hexagrammidae	2003–05	10.51	Pounds	
Grenadier*	Macrouridae	2005	5,228.98	Pounds	
Gunnels*	Pholidae	2003–05	0	Pounds	
Hermit crab, unidentified*	Paguroidea	2003–05	38.17	Pounds	
Herring	*Clupea pallasi*	2005	0	Pounds	
Invertebrate, unidentified*	Invertebrata	2003–05	4,303.65	Pounds	
Lanternfishes*	Myctophidae	2003–05	1.4	Pounds	
Large sculpins*	Cottidae	2003–05	9,155.67	Pounds	
Longnose skate	*Raja rhina*	2005	0	Pounds	
Miscellaneous crabs*	Decapoda	2003–05	248.42	Pounds	
Miscellaneous crustaceans*	Crustaceamorpha	2003–05	59.55	Pounds	
Miscellaneous deep fish*	Teleostomi	2003–05	0	Pounds	
Miscellaneous fish*	Teleostomi	2003–05	38,896.73	Pounds	
Non-Chinook salmon*	Salmonidae	2005	0	Pounds	
Northern rockfish, Bering Sea/Aleutian Islands	*Sebastes polyspinis*	2005	67,571.60	Pounds	
Octopus*	Octopoda	2003–05	1,177.27	Pounds	
Other osmerids*	Osmeridae	2003–05	0.43	Pounds	
Other sculpins*	Cottidae	2003–05	86,324.48	Pounds	
Other species*		2005	132,453.57	Pounds	
Pacific cod, Bering Sea/Aleutian Islands	*Gadus macrocephalus*	2005	0	Pounds	
Pacific hake	*Merluccius productus*	2005	0	Pounds	
Pacific halibut	*Hippoglossus stenolepis*	2005	38,043.67	Pounds	
Pacific ocean perch, Bering Sea/Aleutian Islands	*Sebastes alutus*	2005	273,394.93	Pounds	

Table 4.3.A (continued)

(continuation of Subtable 4.3.A.8)

		BERING SEA/ALEUTIAN ISLANDS PACIFIC OCEAN PERCH TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Pacific sand lance	*Ammodytes hexapterus*	2003–05	0	Pounds	
Pandalid shrimp*	*Pandalus* spp.	2003–05	46.55	Pounds	
Pelagic shelf rockfish*		2005	0	Pounds	
Polychaete, unidentified*	Polychaeta	2003–05	0	Pounds	
Pricklebacks*	Stichaeidae	2003–05	6.96	Pounds	
Red king crab	*Paralithodes camtschaticus*	2005	2,804.19	Pounds	
Rex sole, non-FSSI stock	*Glyptocephalus zachirus*	2005	0	Pounds	
Rock sole, Bering Sea/Aleutian Islands	*Paraplagusia bilineata*	2005	4,612.07	Pounds	
Rock sole, non-FSSI stock	*Paraplagusia bilineata*				
Rockfish, unspecified*	Sebastidae	2005	28,139.77	Pounds	
Rougheye rockfish, Bering Sea/Aleutian Islands	*Sebastes aleutianus*	2005	0	Pounds	
Sablefish	*Anoplopoma fimbria*	2005	0	Pounds	
Scypho jellies*	Scyphozoa	2003–05	126.6	Pounds	
Sea pens amd whips*	Octocorallia	2003–05	0.72	Pounds	
Sea anemone, unidentified*	Actinaria	2003–05	149.27	Pounds	
Sea star*	Asteroidea	2003–05	3,423.68	Pounds	
Shallow-water flatfish*		2005	0	Pounds	
Shark*	Elasmobranchii	2003–05	1,017.80	Pounds	
Shortraker rockfish	*Sebastes borealis*	2005	22,438.62	Pounds	
Shortspine thornyhead, non-FSSI stock	*Sebastolobus alascanus*	2005	0	Pounds	
Skate, unidentified*	Rajidae	2005	0	Pounds	
Snails*	Gastropoda	2003–05	322.98	Pounds	
Snow crab, Bering Sea	*Chionoecetes opilio*	2005	0	Pounds	
Sponge, unidentified*	Porifera	2003–05	47,684.37	Pounds	
Squid*	Decapoda	2005	15,716.74	Pounds	
Surf smelt	*Hypomesus pretiosus*	2003–05	0	Pounds	
Tanner crab, non-FSSI stock	*Chionoecetes bairdi*	2005	0	Pounds	
Urchins/dollars/cucumbers*	Echinodermata	2003–05	74.51	Pounds	
Walleye pollock, Aleutian Islands	*Theragra chalcogramma*	2005	13,267.40	Pounds	
Yellowfin sole, Bering Sea/Aleutian Islands	*Limanda aspera*	2005	0	Pounds	
TOTAL FISHERY BYCATCH			1,305,726.93	Pounds	
TOTAL FISHERY LANDINGS			21,808,952.76	Pounds	
TOTAL CATCH (Bycatch + Landings)			23,114,679.69	Pounds	
FISHERY BYCATCH RATIO (Bycatch/Total Catch)			0.06		

Table 4.3.A (continued)

Subtable 4.3.A.9

		BERING SEA/ALEUTIAN ISLANDS POLLOCK TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Alaska plaice, Bering Sea/Aleutian Islands	*Pleuronectes quadrituberculatus*	2005	93,248.81	Pounds	
Arrowtooth flounder, Bering Sea/Aleutian Islands	*Atheresthes stomias*	2005	481,356.73	Pounds	
Atka mackerel, Bering Sea/Aleutian Islands	*Pleurogrammus monopterygius*	2005	265,213.58	Pounds	
Benthic Urochordata*	Urochordata	2003–05	369.73	Pounds	
Big skate	*Raja binoculata*	2005	0	Pounds	
Bivalves*	Bivalvia	2003–05	23.97	Pounds	
Blue king crab	*Paralithodes platypus*	2005	0	Pounds	
Brittle star, unidentified*	Ophiuroidea	2003–05	218.51	Pounds	
Byrozoans/hydroids*	Bryozoa	2003–05	296.30	Pounds	
Capelin	*Mallotus villosus*	2003–05	498.21	Pounds	
Chinook salmon	*Oncorhynchus tshawytscha*	2005	463,579.01	Pounds	
Deepsea smelts*	Bathylagidae	2003–05	0.30	Pounds	
Deepwater flatfish*		2005	0	Pounds	
Demersal shelf rockfish*		2005	0	Pounds	
Eelpouts*	Zoarcidae	2003–05	6,590.87	Pounds	
Eulachon (smelt)	*Thaleichthys pacificus*	2003–05	22,264.33	Pounds	
Flatfish*	Pleuronectiformes	2005	180,185.80	Pounds	
Flathead sole, Bering Sea/Aleutian Islands	*Hippoglossoides elassodon*	2005	1,997,793.57	Pounds	
Giant grenadier*	*Albatrossia pectoralis*	2003–05	6,484.76	Pounds	
Golden king crab, Aleutian Islands	*Lithodes aequispina*	2005	2.15	Pounds	
Greenland turbot, Bering Sea/Aleutian Islands	*Reinhardtius hippoglossoides*	2005	26,907.39	Pounds	
Greenlings*	Hexagrammidae	2003–05	20.39	Pounds	
Grenadier*	Macrouridae	2005	5,526.37	Pounds	
Gunnels*	Pholidae	2003–05	0	Pounds	
Hermit crab, unidentified*	Paguroidea	2003–05	27.03	Pounds	
Herring	*Clupea pallasi*	2005	1,358,963.62	Pounds	
Invertebrate, unidentified*	Invertebrata	2003–05	180.15	Pounds	
Lanternfishes*	Myctophidae	2003–05	727.14	Pounds	
Large sculpins*	Cottidae	2003–05	217,592.96	Pounds	
Longnose skate	*Raja rhina*	2005	0	Pounds	
Miscellaneous crabs*	Decapoda	2003–05	759.73	Pounds	
Miscellaneous crustaceans*	Crustaceamorpha	2003–05	64.72	Pounds	
Miscellaneous deep fish*	Teleostomi	2003–05	55.86	Pounds	
Miscellaneous fish*	Teleostomi	2003–05	244,348.40	Pounds	

Table 4.3.A (continued)

(continuation of Subtable 4.3.A.9)		BERING SEA/ALEUTIAN ISLANDS POLLOCK TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Non-Chinook salmon	Salmonidae	2005	3,293,666.98	Pounds	
Northern rockfish, Bering Sea/Aleutian Islands	*Sebastes polyspinis*	2005	23,183.78	Pounds	
Octopus*	Octopoda	2003–05	3,551.64	Pounds	
Other osmerids*	Osmeridae	2003–05	9,445.30	Pounds	
Other sculpins*	Cottidae	2003–05	62,836.76	Pounds	
Other species*		2005	1,323,223.95	Pounds	
Pacific cod, Bering Sea/Aleutian Islands	*Gadus macrocephalus*	2005	67,024.86	Pounds	
Pacific hake	*Merluccius productus*	2005	46.50	Pounds	
Pacific halibut	*Hippoglossus stenolepis*	2005	224,214.43	Pounds	
Pacific ocean perch, Bering Sea/Aleutian Islands	*Sebastes alutus*	2005	539,263.28	Pounds	
Pacific sand lance	*Ammodytes hexapterus*	2003–05	0.79	Pounds	
Pandalid shrimp*	*Pandalus* spp.	2003–05	334.60	Pounds	
Pelagic shelf rockfish*		2005	0	Pounds	
Polychaete, unidentified*	Polychaeta	2003–05	6.77	Pounds	
Pricklebacks	Stichaeidae	2003–05	143.85	Pounds	
Red king crab	*Paralithodes camtschaticus*	2005	0	Pounds	
Rex sole, non-FSSI stock	*Glyptocephalus zachirus*	2005	0	Pounds	
Rock sole, Bering Sea/Aleutian Islands	*Paraplagusia bilineata*	2005	1,221,258.07	Pounds	
Rockfish, unspecified*	Sebastidae	2005	8,578.18	Pounds	
Rougheye rockfish, Bering Sea/Aleutian Islands	*Sebastes aleutianus*	2005	72.75	Pounds	
Sablefish	*Anoplopoma fimbria*	2005	5,628.39	Pounds	
Scypho jellies*	Scyphozoa	2003–05	12,396,189.14	Pounds	
Sea anemone, unidentified*	Actinaria	2003–05	804.44	Pounds	
Sea pens and whips*	Octocorallia	2003–05	2,338.75	Pounds	
Sea star*	Asteroidea	2003–05	77,428.96	Pounds	
Shallow water flatfish*		2005	0	Pounds	
Shark*	Elasmobranchii	2003–05	200,275.76	Pounds	
Shortraker rockfish	*Sebastes borealis*	2005	7,228.95	Pounds	
Shortspine thornyhead, non-FSSI stock	*Sebastolobus alascanus*	2005	0	Pounds	
Skate, unidentified*	Rajidae	2005	0	Pounds	
Snails*	Gastropoda	2003–05	6,688.52	Pounds	
Snow crab, Bering Sea	*Chionoecetes opilio*	2005	1,573.43	Pounds	
Sponge, unidentified*	Porifera	2003–05	128.13	Pounds	
Squid*	Decapoda	2005	680,877.05	Pounds	

Table 4.3.A (continued)

(continuation of Subtable 4.3.A.9)		BERING SEA/ALEUTIAN ISLANDS POLLOCK TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Surf smelt	*Hypomesus pretiosus*	2003–05	0	Pounds	
Tanner crab, non-FSSI stock	*Chionoecetes bairdi*	2005	575.15	Pounds	
Urchins/dollars/cucumbers*	Echinodermata	2003–05	47.38	Pounds	
Walleye pollock, Aleutian Islands	*Theragra chalcogramma*	2005	1,385,438.32	Pounds	
Yellowfin sole, Bering Sea/Aleutian Islands	*Limanda aspera*	2005	116,642.03	Pounds	
TOTAL FISHERY BYCATCH			27,032,017.28	Pounds	
TOTAL FISHERY LANDINGS			3,211,477,747.33	Pounds	
TOTAL CATCH (Bycatch + Landings)			3,238,509,764.61	Pounds	
FISHERY BYCATCH RATIO			0.01		

Subtable 4.3.A.10		BERING SEA/ALEUTIAN ISLANDS ROCK SOLE TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Alaska plaice, Bering Sea/Aleutian Islands	*Pleuronectes quadrituberculatus*	2005	2,974,074.27	Pounds	
Arrowtooth flounder, Bering Sea/Aleutian Islands	*Atheresthes stomias*	2005	690,207.00	Pounds	
Atka mackerel, Bering Sea/Aleutian Islands	*Pleurogrammus monopterygius*	2005	15,701.30	Pounds	
Benthic Urochordata*	Urochordata	2003–05	479,267.13	Pounds	
Big skate	*Raja binoculata*	2005	0	Pounds	
Bivalves*	Bivalvia	2003–05	3,831.60	Pounds	
Blue king crab	*Paralithodes platypus*	2005	0	Pounds	
Brittle star, unidentified*	Ophiuroidea	2003–05	1,956.20	Pounds	
Byrozoans/hydroids*	Bryozoa	2003–05	998.4	Pounds	
Capelin	*Mallotus villosus*	2003–05	304.41	Pounds	
Chinook salmon	*Oncorhynchus tshawytscha*	2005	2,214.29	Pounds	
Deepsea smelts	Bathylagidae	2003–05	0	Pounds	
Deepwater flatfish*		2005	0	Pounds	
Demersal shelf rockfish*		2005	0	Pounds	
Eelpouts*	Zoarcidae	2003–05	5,481.08	Pounds	
Eulachon (smelt)	*Thaleichthys pacificus*	2003–05	10.48	Pounds	
Flatfish*	Pleuronectiformes	2005	1,894,635.00	Pounds	
Flathead sole, Bering Sea/Aleutian Islands	*Hippoglossoides elassodon*	2005	401,924.27	Pounds	
Giant grenadier*	*Albatrossia pectoralis*	2003–05	0	Pounds	
Golden king crab, Aleutian Islands	*Lithodes aequispina*	2005	0	Pounds	

Table 4.3.A (continued)

(continuation of Subtable 4.3.A.10)

		BERING SEA/ALEUTIAN ISLANDS ROCK SOLE TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Greenland turbot, Bering Sea/Aleutian Islands	*Reinhardtius hippoglossoides*	2005	2,680.82	Pounds	
Greenlings*	Hexagrammidae	2003–05	1,380.73	Pounds	
Grenadier*	Macrouridae	2005	0	Pounds	
Gunnels*	Pholidae	2003–05	0	Pounds	
Hermit crab, unidentified*	Paguroidea	2003–05	24,751.09	Pounds	
Herring	*Clupea pallasi*	2005	34,453.47	Pounds	
Invertebrate, unidentified*	Invertebrata	2003–05	142,375.88	Pounds	
Lanternfishes*	Myctophidae	2003–05	0	Pounds	
Large sculpins*	Cottidae	2003–05	648,019.48	Pounds	
Longnose skate	*Raja rhina*	2005	0	Pounds	
Miscellaneous crabs*	Decapoda	2003–05	25,323.08	Pounds	
Miscellaneous crustaceans*	Crustaceamorpha	2003–05	421.83	Pounds	
Miscellaneous deep fish*	Teleostomi	2003–05	0	Pounds	
Miscellaneous fish*	Teleostomi	2003–05	38,255.24	Pounds	
Non-Chinook salmon*	Salmonidae	2005	0	Pounds	
Northern rockfish, Bering Sea/Aleutian Islands	*Sebastes polyspinis*	2005	736.34	Pounds	
Octopus*	Octopoda	2003–05	39,887.45	Pounds	
Other osmerids*	Osmeridae	2003–05	3,263.14	Pounds	
Other sculpins*	Cottidae	2003–05	225,165.06	Pounds	
Other species*		2005	1,742,134.82	Pounds	
Pacific cod, Bering Sea/Aleutian Islands	*Gadus macrocephalus*	2005	214,540.39	Pounds	
Pacific hake	*Merluccius productus*	2005	0	Pounds	
Pacific halibut	*Hippoglossus stenolepis*	2005	1,687,083.75	Pounds	
Pacific ocean perch, Bering Sea/Aleutian Islands	*Sebastes alutus*	2005	886.26	Pounds	
Pacific sand lance	*Ammodytes hexapterus*	2003–05	46.51	Pounds	
Pandalid shrimp*	*Pandalus* spp.	2003–05	231.49	Pounds	
Pelagic shelf rockfish*		2005	0	Pounds	
Polychaete, unidentified*	Polychaeta	2003–05	4.69	Pounds	
Pricklebacks*	Stichaeidae	2003–05	32.83	Pounds	
Red king crab	*Paralithodes camtschaticus*	2005	224,745.99	Pounds	
Rex sole, non-FSSI stock	*Glyptocephalus zachirus*	2005	0	Pounds	
Rock sole, Bering Sea/Aleutian Islands	*Paraplagusia bilineata*	2005	5,928,655.29	Pounds	
Rockfish, unspecified*	Sebastidae	2005	0	Pounds	
Rougheye rockfish, Bering Sea/Aleutian Islands	*Sebastes aleutianus*	2005	0	Pounds	
Sablefish	*Anoplopoma fimbria*	2005	791.46	Pounds	

Table 4.3.A (continued)

continuation of Subtable 4.3.A.10)		**BERING SEA/ALEUTIAN ISLANDS ROCK SOLE TRAWL**			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Scypho jellies*	Scyphozoa	2003–05	725,589.44	Pounds	
Sea anemone, unidentified*	Actinaria	2003–05	27,997.45	Pounds	
Sea pens and whips*	Octocorallia	2003–05	40.80	Pounds	
Sea star*	Asteroidea	2003–05	1,509,412.06	Pounds	
Shallow water flatfish*		2005	0	Pounds	
Shark*	Elasmobranchii	2003–05	1,498.41	Pounds	
Shortraker rockfish	*Sebastes borealis*	2005	0	Pounds	
Shortspine thornyhead, non-FSSI stock	*Sebastolobus alascanus*	2005	0	Pounds	
Skate, unidentified*	Rajidae	2005	0	Pounds	
Snails*	Gastropoda	2003–05	44,502.34	Pounds	
Snow crab, Bering Sea	*Chionoecetes opilio*	2005	405,378.77	Pounds	
Sponge, unidentified*	Porifera	2003–05	259,371.07	Pounds	
Squid*	Decapoda	2005	70.55	Pounds	
Surf smelt	*Hypomesus pretiosus*	2003–05	0	Pounds	
Tanner crab, non-FSSI stock	*Chionoecetes bairdi*	2005	346,076.62	Pounds	
Urchins/dollars/cucumbers*	Echinodermata	2003–05	23,201.27	Pounds	
Walleye pollock, Aleutian Islands	*Theragra chalcogramma*	2005	7,567,827.73	Pounds	
Yellowfin sole, Bering Sea/Aleutian Islands	*Limanda aspera*	2005	2,866,394.01	Pounds	
TOTAL FISHERY BYCATCH			31,233,833.04	Pounds	
TOTAL FISHERY LANDINGS			61,301,368.30	Pounds	
TOTAL CATCH (Bycatch + Landings)			9,253,521.34	Pounds	
FISHERY BYCATCH RATIO (Bycatch/Landings)			0.34		

Subtable 4.3.A.11		**BERING SEA/ALEUTIAN ISLANDS SABLEFISH LONGLINE**			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Alaska plaice, Bering Sea/Aleutian Islands	*Pleuronectes quadrituberculatus*	2005	0	Pounds	
Arrowtooth flounder, Bering Sea/Aleutian Islands	*Atheresthes stomias*	2005	36,640.78	Pounds	
Atka mackerel, Bering Sea/Aleutian Islands	*Pleurogrammus monopterygius*	2005	0	Pounds	
Benthic Urochordata*	Urochordata	2003–05	0	Pounds	
Big skate	*Raja binoculata*	2005	0	Pounds	
Bivalves*	Bivalvia	2003–05	0	Pounds	
Blue king crab	*Paralithodes platypus*	2005	51.25	Pounds	

Table 4.3.A (continued)

(continuation of Subtable 4.3.A.11)		BERING SEA/ALEUTIAN ISLANDS SABLEFISH LONGLINE			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Brittle star, unidentified*	Ophiuroidea	2003–05	1.68	Pounds	
Byrozoans/hydroids*	Bryozoa	2003–05	567.30	Pounds	
Capelin	*Mallotus villosus*	2003–05	0	Pounds	
Chinook salmon	*Oncorhynchus tshawytscha*	2005	0	Pounds	
Deepsea smelts*	Bathylagidae	2003–05	0	Pounds	
Deepwater flatfish*		2005	0	Pounds	
Demersal shelf rockfish*		2005	0	Pounds	
Eelpouts*	Zoarcidae	2003–05	1,517.10	Pounds	
Eulachon (smelt)	*Thaleichthys pacificus*	2003–05	0	Pounds	
Flatfish*	Pleuronectiformes	2005	749.57	Pounds	
Flathead sole, Bering Sea/Aleutian Islands	*Hippoglossoides elassodon*	2005	72.75	Pounds	
Giant grenadier*	*Albatrossia pectoralis*	2003–05	518,891.38	Pounds	
Golden king crab, Aleutian Islands	*Lithodes aequispina*	2005	341.46	Pounds	
Greenland turbot, Bering Sea/Aleutian Islands	*Reinhardtius hippoglossoides*	2005	22,670.11	Pounds	
Greenlings*	Hexagrammidae	2003–05	0	Pounds	
Grenadier*	Macrouridae	2005	608,455.41	Pounds	
Gunnels*	Pholidae	2003–05	0	Pounds	
Hermit crab, unidentified*	Paguroidea	2003–05	0	Pounds	
Herring	*Clupea pallasi*	2005	0	Pounds	
Invertebrate, unidentified*	Invertebrata	2003–05	4.28	Pounds	
Lanternfishes*	Myctophidae	2003–05	0	Pounds	
Large sculpins*	Cottidae	2003–05	50.12	Pounds	
Longnose skate	*Raja rhina*	2005	0	Pounds	
Miscellaneous crabs*	Decapoda	2003–05	56.17	Pounds	
Miscellaneous crustaceans*	Crustaceamorpha	2003–05	0	Pounds	
Miscellaneous deep fish*	Teleostomi	2003–05	0	Pounds	
Miscellaneous fish*	Teleostomi	2003–05	1,673.23	Pounds	
Non-Chinook salmon*	Salmonidae	2005	0	Pounds	
Northern rockfish, Bering Sea/Aleutian Islands	*Sebastes polyspinis*	2005	0	Pounds	
Octopus*	Octopoda	2003–05	41.15	Pounds	
Other osmerids*	Osmeridae	2003–05	0	Pounds	
Other sculpins*	Cottidae	2003–05	46.79	Pounds	
Other species*		2005	72,373.27	Pounds	
Pacific cod, Bering Sea/Aleutian Islands	*Gadus macrocephalus*	2005	2,420.67	Pounds	
Pacific hake	*Merluccius productus*	2005	0	Pounds	

Table 4.3.A (continued)

(continuation of Subtable 4.3.A.11)

		BERING SEA/ALEUTIAN ISLANDS SABLEFISH LONGLINE			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Pacific halibut	*Hippoglossus stenolepis*	2005	20,223.28	Pounds	
Pacific ocean perch, Bering Sea/Aleutian Islands	*Sebastes alutus*	2005	68.34	Pounds	
Pacific sand lance	*Ammodytes hexapterus*	2003–05	0	Pounds	
Pandalid shrimp*	*Pandalus* spp.	2003–05	0	Pounds	
Pelagic shelf rockfish*		2005	0	Pounds	
Polychaete, unidentified*	Polychaeta	2003–05	0	Pounds	
Pricklebacks*	Stichaeidae	2003–05	0	Pounds	
Red king crab	*Paralithodes camtschaticus*	2005	151.07	Pounds	
Rex sole,non-FSSI stock	*Glyptocephalus zachirus*	2005	0	Pounds	
Rock sole, Bering Sea/Aleutian Islands	*Paraplagusia bilineata*	2005	4.41	Pounds	
Rockfish, unspecified*	Sebastidae	2005	11,450.80	Pounds	
Rougheye rockfish, Bering Sea/Aleutian Islands	*Sebastes aleutianus*	2005	1,073.65	Pounds	
Sablefish	*Anoplopoma fimbria*	2005	8,829.50	Pounds	
Scypho jellies*	Scyphozoa	2003–05	0	Pounds	
Sea anemone, unidentified*	Actinaria	2003–05	12.21	Pounds	
Sea pens and whips*	Octocorallia	2003–05	3.00	Pounds	
Sea star*	Asteroidea	2003–05	108.41	Pounds	
Shallow-water flatfish*		2005	0	Pounds	
Shark*	Elasmobranchii	2003–05	15,890.17	Pounds	
Shortraker rockfish	*Sebastes borealis*	2005	6,274.35	Pounds	
Shortspine thornyhead, non-FSSI stock	*Sebastolobus alascanus*	2005	0	Pounds	
Skate, unidentified*	Rajidae	2005	0	Pounds	
Snails*	Gastropoda	2003–05	12.68	Pounds	
Snow crab, Bering Sea	*Chionoecetes opilio*	2005	0	Pounds	
Sponge, unidentified*	Porifera	2003–05	133.11	Pounds	
Squid*	Decapoda	2005	0	Pounds	
Surf smelt	*Hypomesus pretiosus*	2003–05	0	Pounds	
Tanner crab, non-FSSI stock	*Chionoecetes bairdi*	2005	0	Pounds	
Urchins/dollars/cucumbers*	Echinodermata	2003–05	134.11	Pounds	
Walleye pollock, Aleutian Islands	*Theragra chalcogramma*	2005	105.82	Pounds	
Yellowfin sole, Bering Sea/Aleutian Islands	*Limanda aspera*	2005	0	Pounds	
TOTAL FISHERY BYCATCH			1,331,099.38	Pounds	
TOTAL FISHERY LANDINGS			1,851,866.84	Pounds	
TOTAL CATCH (Bycatch + Landings)			3,182,966.22	Pounds	
FISHERY BYCATCH RATIO (Bycatch/Landings)			0.42		

Table 4.3.A (continued)

Subtable 4.3.A.12

		BERING SEA/ALEUTIAN ISLANDS SABLEFISH POT			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Alaska plaice, Bering Sea/Aleutian Islands	*Pleuronectes quadrituberculatus*	2005	0	Pounds	
Arrowtooth flounder, Bering Sea/Aleutian Islands	*Atheresthes stomias*	2005	71,087.97	Pounds	
Atka mackerel, Bering Sea/Aleutian Islands	*Pleurogrammus monopterygius*	2005	46.30	Pounds	
Benthic Urochordata*	Urochordata	2003–05	0.38	Pounds	
Big skate	*Raja binoculata*	2005	0	Pounds	
Bivalves*	Bivalvia	2003–05	0.47	Pounds	
Blue king crab	*Paralithodes platypus*	2005	0	Pounds	
Brittle star, unidentified*	Ophiuroidea	2003–05	206.51	Pounds	
Byrozoans/hydroids*	Bryozoa	2003–05	101.21	Pounds	
Capelin	*Mallotus villosus*	2003–05	0	Pounds	
Chinook salmon	*Oncorhynchus tshawytscha*	2005	0	Pounds	
Deepsea smelts*	Bathylagidae	2003–05	0	Pounds	
Deepwater flatfish*		2005	0	Pounds	
Demersal shelf rockfish*		2005	0	Pounds	
Eelpouts*	Zoarcidae	2003–05	985.40	Pounds	
Eulachon (smelt)	*Thaleichthys pacificus*	2003–05	0	Pounds	
Flatfish*	Pleuronectiformes	2005	654.77	Pounds	
Flathead sole, Bering Sea/Aleutian Islands	*Hippoglossoides elassodon*	2005	1,446.23	Pounds	
Giant grenadier*	*Albatrossia pectoralis*	2003–05	9,768.50	Pounds	
Golden king crab, Aleutian Islands	*Lithodes aequispina*	2005	3,360.18	Pounds	
Greenland turbot, Bering Sea/Aleutian Islands	*Reinhardtius hippoglossoides*	2005	20,827.05	Pounds	
Greenlings*	Hexagrammidae	2003–05	0	Pounds	
Grenadier*	Macrouridae	2005	6,377.24	Pounds	
Gunnels*	Pholidae	2003–05	0	Pounds	
Hermit crab, unidentified*	Paguroidea	2003–05	38.76	Pounds	
Herring	*Clupea pallasi*	2005	0	Pounds	
Invertebrate, unidentified*	Invertebrata	2003–05	0.41	Pounds	
Lanternfishes*	Myctophidae	2003–05	0.65	Pounds	
Large sculpins*	Cottidae	2003–05	46.39	Pounds	
Longnose skate	*Raja rhina*	2005	0	Pounds	
Miscellaneous crabs*	Decapoda	2003–05	1,498.99	Pounds	
Miscellaneous crustaceans*	Crustaceamorpha	2003–05	0.18	Pounds	
Miscellaneous deep fish*	Teleostomi	2003–05	0.27	Pounds	
Miscellaneous fish*	Teleostomi	2003–05	627.41	Pounds	
Non-Chinook salmon*	Salmonidae	2005	0	Pounds	

Table 4.3.A (continued)

(continuation of **Subtable 4.3.A.12)**

		BERING SEA/ALEUTIAN ISLANDS SABLEFISH POT			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Northern rockfish, Bering Sea/Aleutian Islands	*Sebastes polyspinis*	2005	0	Pounds	
Octopus*	Octopoda	2003–05	11.02	Pounds	
Other osmerids*	Osmeridae	2003–05	0	Pounds	
Other sculpins*	Cottidae	2003–05	724.29	Pounds	
Other species*		2005	4,404.83	Pounds	
Pacific cod, Bering Sea/Aleutian Islands	*Gadus macrocephalus*	2005	3,357.64	Pounds	
Pacific hake	*Merluccius productus*	2005	0	Pounds	
Pacific halibut	*Hippoglossus stenolepis*	2005	1,466.22	Pounds	
Pacific ocean perch, Bering Sea/Aleutian Islands	*Sebastes alutus*	2005	13.23	Pounds	
Pacific sand lance	*Ammodytes hexapterus*	2003–05	0	Pounds	
Pandalid shrimp*	*Pandalus* spp.	2003–05	0.13	Pounds	
Pelagic shelf rockfish*		2005	0	Pounds	
Polychaete, unidentified*	Polychaeta	2003–05	0	Pounds	
Pricklebacks*	Stichaeidae	2003–05	0	Pounds	
Red king crab	*Paralithodes camtschaticus*	2005	0	Pounds	
Rex sole, non-FSSI stock	*Glyptocephalus zachirus*	2005	0	Pounds	
Rock sole, Bering Sea/Aleutian Islands	*Paraplagusia bilineata*	2005	771.62	Pounds	
Rockfish, unspecified*	Sebastidae	2005	1,827.63	Pounds	
Rougheye rockfish, Bering Sea/Aleutian Islands	*Sebastes aleutianus*	2005	374.79	Pounds	
Sablefish	*Anoplopoma fimbria*	2005	60,058.26	Pounds	
Scypho jellies*	Scyphozoa	2003–05	70.72	Pounds	
Sea anemone, unidentified*	Actinaria	2003–05	8.10	Pounds	
Sea pens and whips*	Octocorallia	2003–05	0	Pounds	
Sea star*	Asteroidea	2003–05	413.53	Pounds	
Shallowwater flatfish*		2005	0	Pounds	
Shark*	Elasmobranchii	2003–05	10.29	Pounds	
Shortraker rockfish	*Sebastes borealis*	2005	1,047.19	Pounds	
Shortspine thornyhead, non-FSSI stock	*Sebastolobus alascanus*	2005	0	Pounds	
Skate, unidentified*	Rajidae	2005	0	Pounds	
Snails*	Gastropoda	2003–05	6,393.35	Pounds	
Snow crab, Bering Sea	*Chionoecetes opilio*	2005	54.62	Pounds	
Sponge, unidentified*	Porifera	2003–05	987.98	Pounds	
Squid*	Decapoda	2005	0	Pounds	
Surf smelt	*Hypomesus pretiosus*	2003–05	0	Pounds	
Tanner crab, non-FSSI stock	*Chionoecetes bairdi*	2005	218.79	Pounds	

Table 4.3.A (continued)

(continuation of **Subtable 4.3.A.12)**

		BERING SEA/ALEUTIAN ISLANDS SABLEFISH POT			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Urchins/dollars/cucumbers*	Echinodermata	2003–05	246.09	Pounds	
Walleye pollock, Aleutian Islands	*Theragra chalcogramma*	2005	32,445.39	Pounds	
Yellowfin sole, Bering Sea/Aleutian Islands	*Limanda aspera*	2005	771.62	Pounds	
TOTAL FISHERY BYCATCH			232,752.60	Pounds	
TOTAL FISHERY LANDINGS			2,082,134.25	Pounds	
TOTAL CATCH (Bycatch + Landings)			2,314,886.85	Pounds	
FISHERY BYCATCH RATIO (Bycatch/Total Catch)			0.1		

Subtable 4.3.A.13

		BERING SEA/ALEUTIAN ISLANDS SABLEFISH TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Alaska plaice, Bering Sea/Aleutian Islands	*Pleuronectes quadrituberculatus*	2005	0	Pounds	
Arrowtooth flounder, Bering Sea/Aleutian Islands	*Atheresthes stomias*	2005	0	Pounds	
Atka mackerel, Bering Sea/Aleutian Islands	*Pleurogrammus monopterygius*	2005	0	Pounds	
Benthic Urochordata*	Urochordata	2003–05	0	Pounds	
Big skate	*Raja binoculata*	2005	0	Pounds	
Bivalves*	Bivalvia	2003–05	0	Pounds	
Blue king crab	*Paralithodes platypus*	2005	0	Pounds	
Brittle star, unidentified*	Ophiuroidea	2003–05	0	Pounds	
Byrozoans/hydroids*	Bryozoa	2003–05	0	Pounds	
Capelin	*Mallotus villosus*	2003–05	0	Pounds	
Chinook salmon	*Oncorhynchus tshawytscha*	2005	0	Pounds	
Deepsea smelts*	Bathylagidae	2003–05	0	Pounds	
Deepwater flatfish*		2005	0	Pounds	
Demersal shelf rockfish*		2005	0	Pounds	
Eelpouts*	Zoarcidae	2003–05	280.77	Pounds	
Eulachon (smelt)	*Thaleichthys pacificus*	2003–05	0	Pounds	
Flatfish*	Pleuronectiformes	2005	240.30	Pounds	
Flathead sole, Bering Sea/Aleutian Islands	*Hippoglossoides elassodon*	2005	0	Pounds	
Giant grenadier*	*Albatrossia pectoralis*	2003–05	0	Pounds	
Golden king crab, Aleutian Islands	*Lithodes aequispina*	2005	75.85	Pounds	
Greenland turbot, Bering Sea/Aleutian Islands	*Reinhardtius hippoglossoides*	2005	0	Pounds	
Greenlings*	Hexagrammidae	2003–05	0	Pounds	

Table 4.3.A (continued)

(continuation of Subtable 4.3.A.13)

		BERING SEA/ALEUTIAN ISLANDS SABLEFISH TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Grenadier*	Macrouridae	2005	0	Pounds	
Gunnels*	Pholidae	2003–05	0	Pounds	
Hermit crab, unidentified*	Paguroidea	2003–05	1.93	Pounds	
Herring	*Clupea pallasi*	2005	0	Pounds	
Invertebrate, unidentified*	Invertebrata	2003–05	0	Pounds	
Lanternfishes*	Myctophidae	2003–05	0	Pounds	
Large sculpins*	Cottidae	2003–05	517.03	Pounds	
Longnose skate	*Raja rhina*	2005	0	Pounds	
Miscellaneous crabs*	Decapoda	2003–05	0	Pounds	
Miscellaneous crustaceans*	Crustaceamorpha	2003–05	0	Pounds	
Miscellaneous deep fish*	Teleostomi	2003–05	0	Pounds	
Miscellaneous fish*	Teleostomi	2003–05	3.67	Pounds	
Non-Chinook salmon*	Salmonidae	2005	0	Pounds	
Northern rockfish, Bering Sea/Aleutian Islands	*Sebastes polyspinis*	2005	0	Pounds	
Octopus*	Octopoda	2003–05	0	Pounds	
Other osmerids*	Osmeridae	2003–05	0	Pounds	
Other sculpins*	Cottidae	2003–05	28.40	Pounds	
Other species*		2005	74.96	Pounds	
Pacific cod, Bering Sea/Aleutian Islands	*Gadus macrocephalus*	2005	136.69	Pounds	
Pacific hake	*Merluccius productus*	2005	0	Pounds	
Pacific halibut	*Hippoglossus stenolepis*	2005	231.72	Pounds	
Pacific ocean perch, Bering Sea/Aleutian Islands	*Sebastes alutus*	2005	0	Pounds	
Pacific sand lance	*Ammodytes hexapterus*	2003–05	0	Pounds	
Pandalid shrimp*	*Pandalus* spp.	2003–05	0	Pounds	
Pelagic shelf rockfish*		2005	0	Pounds	
Polychaete, unidentified*	Polychaeta	2003–05	0	Pounds	
Pricklebacks*	Stichaeidae	2003–05	0	Pounds	
Red king crab	*Paralithodes camtschaticus*	2005	0	Pounds	
Rex sole, non-FSSI stock	*Glyptocephalus zachirus*	2005	0	Pounds	
Rock sole, Bering Sea/Aleutian Islands	*Paraplagusia bilineata*	2005	0	Pounds	
Rockfish, unspecified*	Sebastidae	2005	0	Pounds	
Rougheye rockfish, Bering Sea/Aleutian Islands	*Sebastes aleutianus*	2005	0	Pounds	
Sablefish	*Anoplopoma fimbria*	2005	0	Pounds	
Scypho jellies*	Scyphozoa	2003–05	0	Pounds	
Sea anemone, unidentified*	Actinaria	2003–05	20.41	Pounds	

Table 4.3.A (continued)

(continuation of Subtable 4.3.A.13)		BERING SEA/ALEUTIAN ISLANDS SABLEFISH TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Sea pens and whips*	Octocorallia	2003–05	0	Pounds	
Sea star*	Asteroidea	2003–05	28.88	Pounds	
Shallow water flatfish*		2005	0	Pounds	
Shark*	Elasmobranchii	2003–05	0	Pounds	
Shortraker rockfish	*Sebastes borealis*	2005	0	Pounds	
Shortspine thornyhead, non-FSSI stock	*Sebastolobus alascanus*	2005	0	Pounds	
Skate, unidentified*	Rajidae	2005	0	Pounds	
Snails*	Gastropoda	2003–05	6.20	Pounds	
Snow crab, Bering Sea	*Chionoecetes opilio*	2005	0	Pounds	
Snow crab, non-FSSI stock	*Chionoecetes opilio*				
Sponge, unidentified*	Porifera	2003–05	0	Pounds	
Squid*	Decapoda	2005	152.12	Pounds	
Surf smelt	*Hypomesus pretiosus*	2003–05	0	Pounds	
Tanner crab, non-FSSI stock	*Chionoecetes bairdi*	2005	393.50	Pounds	
Urchins/dollars/cucumbers*	Echinodermata	2003–05	0	Pounds	
Walleye pollock, Aleutian Islands	*Theragra chalcogramma*	2005	10,191.96	Pounds	
Yellowfin sole, Bering Sea/Aleutian Islands	*Limanda aspera*	2005	0	Pounds	
TOTAL FISHERY BYCATCH			12,384.39	Pounds	
TOTAL FISHERY LANDINGS			73,624.75	Pounds	
TOTAL CATCH (Bycatch + Landings)			86,009.14	Pounds	
FISHERY BYCATCH RATIO (Bycatch/Total Catch)			0.14		

Subtable 4.3.A.14		BERING SEA/ALEUTIAN ISLANDS YELLOWFIN SOLE TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Alaska plaice, Bering Sea/Aleutian Islands	*Pleuronectes quadrituberculatus*	2005	17,561,672.23	Pounds	
Arrowtooth flounder, Bering Sea/Aleutian Islands	*Atheresthes stomias*	2005	538,687.87	Pounds	
Atka mackerel, Bering Sea/Aleutian Islands	*Pleurogrammus monopterygius*	2005	53,867.69	Pounds	
Benthic Urochordata*	Urochordata	2003–05	2,891,413.15	Pounds	
Big skate	*Raja binoculata*	2005	0	Pounds	
Bivalves*	Bivalvia	2003–05	2,626.02	Pounds	
Blue king crab	*Paralithodes platypus*	2005	90.39	Pounds	
Brittle star, unidentified*	Ophiuroidea	2003–05	62,343.49	Pounds	

Table 4.3.A (continued)

(continuation of Subtable 4.3.A.14)

		BERING SEA/ALEUTIAN ISLANDS YELLOWFIN SOLE TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Byrozoans/hydroids*	Bryozoa	2003–05	1,109.00	Pounds	
Capelin	*Mallotus villosus*	2003–05	3,348.16	Pounds	
Chinook salmon	*Oncorhynchus tshawytscha*	2005	2,611.93	Pounds	
Deepsea smelts*	Bathylagidae	2003–05	0	Pounds	
Deepwater flatfish*		2005	0	Pounds	
Demersal shelf rockfish*		2005	0	Pounds	
Eelpouts*	Zoarcidae	2003–05	25,027.62	Pounds	
Eulachon (smelt)	*Thaleichthys pacificus*	2003–05	237.17	Pounds	
Flatfish*	Pleuronectiformes	2005	1,240,186.93	Pounds	
Flathead sole, Bering Sea/Aleutian Islands	*Hippoglossoides elassodon*	2005	632,730.35	Pounds	
Giant grenadier*	*Albatrossia pectoralis*	2003–05	0	Pounds	
Golden king crab, Aleutian Islands	*Lithodes aequispina*	2005	240.01	Pounds	
Greenland turbot, Bering Sea/Aleutian Islands	*Reinhardtius hippoglossoides*	2005	13,953.04	Pounds	
Greenlings*	Hexagrammidae	2003–05	991.30	Pounds	
Grenadier*	Macrouridae	2005	0	Pounds	
Gunnels*	Pholidae	2003–05	0	Pounds	
Hermit crab, unidentified*	Paguroidea	2003–05	161,133.40	Pounds	
Herring	*Clupea pallasi*	2005	106,070.07	Pounds	
Invertebrate, unidentified*	Invertebrata	2003–05	1,170,870.08	Pounds	
Lanternfishes*	Myctophidae	2003–05	0	Pounds	
Large sculpins*	Cottidae	2003–05	1,516,859.55	Pounds	
Longnose skate	*Raja rhina*	2005	0	Pounds	
Miscellaneous crabs*	Decapoda	2003–05	34,059.45	Pounds	
Miscellaneous crustaceans*	Crustaceamorpha	2003–05	306.18	Pounds	
Miscellaneous deep fish*	Teleostomi	2003–05	0	Pounds	
Miscellaneous fish*	Teleostomi	2003–05	181,951.11	Pounds	
Non-Chinook salmon*	Salmonidae	2005	2,287.97	Pounds	
Northern rockfish, Bering Sea/Aleutian Islands	*Sebastes polyspinis*	2005	6,825.50	Pounds	
Octopus*	Octopoda	2003–05	4,980.24	Pounds	
Other osmerids*	Osmeridae	2003–05	5,294.87	Pounds	
Other sculpins*	Cottidae	2003–05	1,021,749.49	Pounds	
Other species*		2005	3,984,220.13	Pounds	
Pacific cod, Bering Sea/Aleutian Islands	*Gadus macrocephalus*	2005	371,123.53	Pounds	
Pacific hake	*Merluccius productus*	2005	0	Pounds	
Pacific halibut	*Hippoglossus stenolepis*	2005	1,261,355.94	Pounds	

Table 4.3.A (continued)

(continuation of Subtable 4.3.A.14)		BERING SEA/ALEUTIAN ISLANDS YELLOWFIN SOLE TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Pacific ocean perch, Bering Sea/Aleutian Islands	*Sebastes alutus*	2005	2,244.30	Pounds	
Pacific sand lance	*Ammodytes hexapterus*	2003–05	165.46	Pounds	
Pandalid shrimp*	*Pandalus* spp.	2003–05	901.95	Pounds	
Pelagic shelf rockfish*		2005	0	Pounds	
Polychaete, unidentified*	Polychaeta	2003–05	84.32	Pounds	
Pricklebacks*	Stichaeidae	2003–05	69.39	Pounds	
Red king crab	*Paralithodes camtschaticus*	2005	283,005.32	Pounds	
Rex sole, non-FSSI stock	*Glyptocephalus zachirus*	2005	0	Pounds	
Rock sole, Bering Sea/Aleutian Islands	*Paraplagusia bilineata*	2005	8,844,900.17	Pounds	
Rockfish, unspecified*	Sebastidae	2005	132.28	Pounds	
Rougheye rockfish, Bering Sea/Aleutian Islands	*Sebastes aleutianus*	2005	0	Pounds	
Sablefish	*Anoplopoma fimbria*	2005	0	Pounds	
Scypho jellies*	Scyphozoa	2003–05	360,442.38	Pounds	
Sea anemone, unidentified*	Actinaria	2003–05	10,592.04	Pounds	
Sea pens and whips*	Octocorallia	2003–05	143.29	Pounds	
Sea star*	Asteroidea	2003–05	3,862,318.25	Pounds	
Shallow water flatfish*		2005	0	Pounds	
Shark*	Elasmobranchii	2003–05	2,582.34	Pounds	
Shortraker rockfish	*Sebastes borealis*	2005	0	Pounds	
Shortspine thornyhead, non-FSSI stock	*Sebastolobus alascanus*	2005	0	Pounds	
Skate, unidentified*	Rajidae	2005	0	Pounds	
Snails*	Gastropoda	2003–05	265,484.57	Pounds	
Snow crab, Bering Sea	*Chionoecetes opilio*	2005	1,713,577.19	Pounds	
Sponge, unidentified*	Porifera	2003–05	22,278.82	Pounds	
Squid*	Decapoda	2005	15.43	Pounds	
Surf smelt	*Hypomesus pretiosus*	2003–05	0	Pounds	
Tanner crab, non-FSSI stock	*Chionoecetes bairdi*	2005	657,969.24	Pounds	
Urchins/dollars/cucumbers*	Echinodermata	2003–05	3,718.58	Pounds	
Walleye pollock, Aleutian Islands	*Theragra chalcogramma*	2005	7,191,563.03	Pounds	
Yellowfin sole, Bering Sea/Aleutian Islands	*Limanda aspera*	2005	12,220,841.39	Pounds	
TOTAL FISHERY BYCATCH			68,303,253.60	Pounds	
TOTAL FISHERY LANDINGS			184,682,304.16	Pounds	
TOTAL CATCH (Bycatch + Landings)			252,985,557.76	Pounds	
FISHERY BYCATCH RATIO (Bycatch/Total Catch)			0.27		

Table 4.3.A (continued)

Subtable 4.3.A.15		GULF OF ALASKA ARROWTOOTH FLOUNDER TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Alaska plaice, non-FSSI stock	*Pleuronectes quadrituberculatus*	2005	0	Pounds	
Arrowtooth flounder, Gulf of Alaska	*Atheresthes stomias*	2005	4,546,790.65	Pounds	
Atka mackerel, non-FSSI stock	*Pleurogrammus monopterygius*	2005	2,193.60	Pounds	
Benthic Urochordata*	Urochordata	2003–05	132.63	Pounds	
Big skate	*Raja binoculata*	2005	26,673.70	Pounds	
Bivalves*	Bivalvia	2003–05	696.70	Pounds	
Blue king crab	*Paralithodes platypus*	2005	0	Pounds	
Brittle star, unidentified*	Ophiuroidea	2003–05	72.36	Pounds	
Byrozoans/hydroids*	Bryozoa	2003–05	53.53	Pounds	
Capelin	*Mallotus villosus*	2003–05	65.58	Pounds	
Chinook salmon	*Oncorhynchus tshawytscha*	2005	12,489.68	Pounds	
Deepsea smelts*	Bathylagidae	2003–05	0	Pounds	
Deepwater flatfish*		2005	195,847.42	Pounds	
Demersal shelf rockfish*		2005	0	Pounds	
Eelpouts*	Zoarcidae	2003–05	1,207.35	Pounds	
Eulachon (smelt)	*Thaleichthys pacificus*	2003–05	3,721.47	Pounds	
Flatfish*	Pleuronectiformes	2005	0	Pounds	
Flathead sole, Gulf of Alaska	*Hippoglossoides elassodon*	2005	337,040.10	Pounds	
Giant grenadier*	*Albatrossia pectoralis*	2003–05	62,518.17	Pounds	
Golden king crab, non-FSSI stock	*Lithodes aequispina*	2005	0	Pounds	
Greenland turbot, non-FSSI stock	*Reinhardtius hippoglossoides*	2005	0	Pounds	
Greenlings*	Hexagrammidae	2003–05	195.07	Pounds	
Grenadier*	Macrouridae	2005	87,035.84	Pounds	
Gunnels*	Pholidae	2003–05	0	Pounds	
Hermit crab, unidentified*	Paguroidea	2003–05	395.83	Pounds	
Herring	*Clupea pallasi*	2005	83.64	Pounds	
Invertebrate, unidentified*	Invertebrata	2003–05	1,829.90	Pounds	
Lanternfishes*	Myctophidae	2003–05	0	Pounds	
Large sculpins*	Cottidae	2003–05	17,105.07	Pounds	
Longnose skate	*Raja rhina*	2005	125,586.18	Pounds	
Miscellaneous crabs*	Decapoda	2003–05	266.70	Pounds	
Miscellaneous crustaceans*	Crustaceamorpha	2003–05	91.88	Pounds	
Miscellaneous deep fish*	Teleostomi	2003–05	0	Pounds	
Miscellaneous fish*	Teleostomi	2003–05	30,964.30	Pounds	

Table 4.3.A (continued)

(continuation of Subtable 4.3.A.15)		GULF OF ALASKA ARROWTOOTH FLOUNDER TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Non-Chinook salmon*	Salmonidae	2005	1,951.06	Pounds	
Northern rockfish, western/central Gulf of Alaska	*Sebastes polyspinis*	2005	56,292.77	Pounds	
Octopus*	Octopoda	2003–05	448.27	Pounds	
Other osmerids*	Osmeridae	2003–05	6,820.52	Pounds	
Other sculpins*	Cottidae	2003–05	14,319.99	Pounds	
Other species*		2005	266,534.15	Pounds	
Pacific cod, Gulf of Alaska	*Gadus macrocephalus*	2005	358,305.87	Pounds	
Pacific hake	*Merluccius productus*	2005	0	Pounds	
Pacific halibut	*Hippoglossus stenolepis*	2005	1,110,440.85	Pounds	
Pacific ocean perch, Gulf of Alaska	*Sebastes alutus*	2005	149,960.46	Pounds	
Pacific sand lance	*Ammodytes hexapterus*	2003–05	0	Pounds	
Pandalid shrimp*	*Pandalus* spp.	2003–05	2,343.50	Pounds	
Pelagic shelf rockfish*		2005	22,438.62	Pounds	
Polychaete, unidentified*	Polychaeta	2003–05	1.71	Pounds	
Pricklebacks*	Stichaeidae	2003–05	410.00	Pounds	
Red king crab	*Paralithodes camtschaticus*	2005	0	Pounds	
Rex sole, Gulf of Alaska	*Glyptocephalus zachirus*	2005	161,589.83	Pounds	
Rock sole, non-FSSI stock	*Paraplagusia bilineata*	2005	0	Pounds	
Rockfish, unspecified*	Sebastidae	2005	13,562.82	Pounds	
Rougheye rockfish, Gulf of Alaska	*Sebastes aleutianus*	2005	579.82	Pounds	
Sablefish	*Anoplopoma fimbria*	2005	81,308.59	Pounds	
Scypho jellies*	Scyphozoa	2003–05	6,882.69	Pounds	
Sea anemone, unidentified*	Actinaria	2003–05	1,451.32	Pounds	
Sea pens and whips*	Octocorallia	2003–05	14.87	Pounds	
Sea star*	Asteroidea	2003–05	20,923.03	Pounds	
Shallow water flatfish*		2005	23,113.24	Pounds	
Shark*	Elasmobranchii	2003–05	82,423.39	Pounds	
Shortraker rockfish	*Sebastes borealis*	2005	2,447.13	Pounds	
Shortspine thornyhead, Gulf of Alaska	*Sebastolobus alascanus*	2005	5,829.02	Pounds	
Skate, unidentified*	Rajidae	2005	287,621.34	Pounds	
Snails*	Gastropoda	2003–05	1,505.13	Pounds	
Snow crab, non-FSSI stock	*Chionoecetes opilio*	2005	0	Pounds	
Sponge, unidentified*	Porifera	2003–05	941.51	Pounds	
Squid*	Decapoda	2005	0	Pounds	
Surf smelt	*Hypomesus pretiosus*	2003–05	0	Pounds	

Table 4.3.A (continued)

(continuation of Subtable 4.3.A.15)		GULF OF ALASKA ARROWTOOTH FLOUNDER TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Tanner crab, non-FSSI stock	*Chionoecetes bairdi*	2005	61,315.80	Pounds	
Urchins/dollars/cucumbers*	Echinodermata	2003–05	1,873.05	Pounds	
Walleye pollock, western /central Gulf of Alaska	*Theragra chalcogramma*	2005	33,386.77	Pounds	
Yellowfin sole, non-FSSI stock	*Limanda aspera*	2005	0	Pounds	
TOTAL FISHERY BYCATCH			8,230,094.47	Pounds	
TOTAL FISHERY LANDINGS			23,919,130.51	Pounds	
TOTAL CATCH (Bycatch + Landings)			32,149,224.98	Pounds	
FISHERY BYCATCH RATIO (Bycatch/Total Catch)			0.26		

Subtable 4.3.A.16		GULF OF ALASKA FLATFISH (DEEPWATER FLATFISH) TRAWL[a]			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Alaska plaice, non-FSSI stock	*Pleuronectes quadrituberculatus*	2005	0	Pounds	
Arrowtooth flounder, Gulf of Alaska	*Atheresthes stomias*	2005	3,536.21	Pounds	
Atka mackerel, non-FSSI stock	*Pleurogrammus monopterygius*	2005	0	Pounds	
Benthic Urochordata*	*Urochordata*	2003–05	0	Pounds	
Big skate	*Raja binoculata*	2005	0	Pounds	
Bivalves*	Bivalvia	2003–05	0	Pounds	
Blue king crab	*Paralithodes platypus*	2005	0	Pounds	
Brittle star, unidentified*	Ophiuroidea	2003–05	0	Pounds	
Byrozoans/hydroids*	Bryozoa	2003–05	0	Pounds	
Capelin	*Mallotus villosus*	2003–05	0	Pounds	
Chinook salmon	*Oncorhynchus tshawytscha*	2005	0	Pounds	
Deepsea smelts*	Bathylagidae	2003–05	0	Pounds	
Deepwater flatfish*		2005	617.29	Pounds	
Demersal shelf rockfish*		2005	0	Pounds	
Eelpouts*	Zoarcidae	2003–05	0	Pounds	
Eulachon (smelt)	*Thaleichthys pacificus*	2003–05	0	Pounds	
Flatfish*	Pleuronectiformes	2005	0	Pounds	
Flathead sole, Gulf of Alaska	*Hippoglossoides elassodon*	2005	0	Pounds	
Giant grenadier*	*Albatrossia pectoralis*	2003–05	0	Pounds	
Golden king crab, non-FSSI stock	*Lithodes aequispina*	2005	0	Pounds	
Greenland turbot, non-FSSI stock	*Reinhardtius hippoglossoides*	2005	0	Pounds	

[a] The bycatch ratio for this fishery is reflective of low fishing effort, rather than an inherent low bycatch character of the fishery.

Table 4.3.A (continued)

(continuation of Subtable 4.3.A.16)

		GULF OF ALASKA FLATFISH (DEEPWATER FLATFISH) TRAWL[a]			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Greenlings*	Hexagrammidae	2003–05	0	Pounds	
Grenadier*	Macrouridae	2005	0	Pounds	
Gunnels*	Pholidae	2003–05	0	Pounds	
Hermit crab, unidentified*	Paguroidea	2003–05	0	Pounds	
Herring	*Clupea pallasi*	2005	0	Pounds	
Invertebrate, unidentified*	Invertebrata	2003–05	0	Pounds	
Lanternfishes*	Myctophidae	2003–05	0	Pounds	
Large sculpins*	Cottidae	2003–05	2,957.35	Pounds	
Longnose skate	*Raja rhina*	2005	0	Pounds	
Miscellaneous crabs*	Decapoda	2003–05	0	Pounds	
Miscellaneous crustaceans*	Crustaceamorpha	2003–05	0	Pounds	
Miscellaneous deep fish*	Teleostomi	2003–05	0	Pounds	
Miscellaneous fish*	Teleostomi	2003–05	0.61	Pounds	
Non-Chinook salmon*	Salmonidae	2005	0	Pounds	
Northern rockfish, western /central Gulf of Alaska	*Sebastes polyspinis*	2005	0	Pounds	
Octopus*	Octopoda	2003–05	6.61	Pounds	
Other osmerids*	Osmeridae	2003–05	0	Pounds	
Other sculpins*	Cottidae	2003–05	0	Pounds	
Other species*		2005	0	Pounds	
Pacific cod, Gulf of Alaska	*Gadus macrocephalus*	2005	0	Pounds	
Pacific hake	*Merluccius productus*	2005	0	Pounds	
Pacific halibut	*Hippoglossus stenolepis*	2005	0	Pounds	
Pacific ocean perch, Gulf of Alaska	*Sebastes alutus*	2005	0	Pounds	
Pacific sand lance	*Ammodytes hexapterus*	2003–05	0	Pounds	
Pandalid shrimp*	*Pandalus* spp.	2003–05	0	Pounds	
Pelagic shelf rockfish*		2005	0	Pounds	
Polychaete, unidentified*	Polychaeta	2003–05	0	Pounds	
Pricklebacks*	Stichaeidae	2003–05	0	Pounds	
Red king crab	*Paralithodes camtschaticus*	2005	0	Pounds	
Rex sole, Gulf of Alaska	*Glyptocephalus zachirus*	2005	0	Pounds	
Rock sole, non-FSSI stock	*Paraplagusia bilineata*	2005	0	Pounds	
Rockfish, unspecified*	Sebastidae	2005	0	Pounds	
Rougheye rockfish, Gulf of Alaska	*Sebastes aleutianus*	2005	0	Pounds	
Sablefish	*Anoplopoma fimbria*	2005	0	Pounds	
Scypho jellies*	Scyphozoa	2003–05	0	Pounds	

Table 4.3.A (continued)

(continuation of Subtable 4.3.A.16)

COMMON NAME	SCIENTIFIC NAME	GULF OF ALASKA FLATFISH (DEEPWATER FLATFISH) TRAWL[a] DATA SOURCE	BYCATCH	UNIT	CV
Sea anemone, unidentified*	Actinaria	2003–05	2.75	Pounds	
Sea pens and whips*	Octocorallia	2003–05	0	Pounds	
Sea star*	Asteroidea	2003–05	365.09	Pounds	
Shallow water flatfish*		2005	0	Pounds	
Shark*	Elasmobranchii	2003–05	2.94	Pounds	
Shortraker rockfish	*Sebastes borealis*	2005	0	Pounds	
Shortspine thornyhead, Gulf of Alaska	*Sebastolobus alascanus*	2005	0	Pounds	
Skate, unidentified*	Rajidae	2005	0	Pounds	
Snails*	Gastropoda	2003–05	0	Pounds	
Snow crab, non-FSSI stock	*Chionoecetes opilio*	2005	0	Pounds	
Sponge, unidentified*	Porifera	2003–05	0	Pounds	
Squid*	Decapoda	2005	0	Pounds	
Surf smelt	*Hypomesus pretiosus*	2003–05	0	Pounds	
Tanner crab, non-FSSI stock	*Chionoecetes bairdi*	2005	0	Pounds	
Urchins/dollars/cucumbers*	Echinodermata	2003–05	0	Pounds	
Walleye pollock, western /central Gulf of Alaska	*Theragra chalcogramma*	2005	0	Pounds	
Yellowfin sole, non-FSSI stock	*Limanda aspera*	2005	0	Pounds	
TOTAL FISHERY BYCATCH			7,488.85	Pounds	
TOTAL FISHERY LANDINGS			1,051,683.84	Pounds	
TOTAL CATCH (Bycatch + Landings)			1,059,172.69	Pounds	
FISHERY BYCATCH RATIO (Bycatch/Total Catch)			0.01		

Subtable 4.3.A.17

COMMON NAME	SCIENTIFIC NAME	GULF OF ALASKA FLATFISH (SHALLOW WATER FLATFISH) TRAWL DATA SOURCE	BYCATCH	UNIT	CV
Alaska plaice, non-FSSI stock	*Pleuronectes quadrituberculatus*	2005	0	Pounds	
Arrowtooth flounder, Gulf of Alaska	*Atheresthes stomias*	2005	1,954,314.06	Pounds	
Atka mackerel, non-FSSI stock	*Pleurogrammus monopterygius*	2005	54,921.49	Pounds	
Benthic Urochordata*	Urochordata	2003–05	1,216.75	Pounds	
Big skate	*Raja binoculata*	2005	7,656.65	Pounds	
Bivalves*	Bivalvia	2003–05	2,392.27	Pounds	
Blue king crab	*Paralithodes platypus*	2005	0	Pounds	
Brittle star, unidentified*	Ophiuroidea	2003–05	6.55	Pounds	

Table 4.3.A (continued)

(continuation of Subtable 4.3.A.17)		GULF OF ALASKA FLATFISH (SHALLOW WATER FLATFISH) TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Byrozoans/hydroids*	Bryozoa	2003–05	0	Pounds	
Capelin	*Mallotus villosus*	2003–05	0	Pounds	
Chinook salmon	*Oncorhynchus tshawytscha*	2005	414.31	Pounds	
Deepsea smelts*	Bathylagidae	2003–05	0	Pounds	
Deepwater flatfish*		2005	37,868.76	Pounds	
Demersal shelf rockfish*		2005	0	Pounds	
Eelpouts*	Zoarcidae	2003–05	117.89	Pounds	
Eulachon (smelt)	*Thaleichthys pacificus*	2003–05	20.36	Pounds	
Flatfish*	Pleuronectiformes	2005	0	Pounds	
Flathead sole, Gulf of Alaska	*Hippoglossoides elassodon*	2005	52,130.44	Pounds	
Giant grenadier*	*Albatrossia pectoralis*	2003–05	0	Pounds	
Golden king Crab, non-FSSI stock	*Lithodes aequispina*	2005	0	Pounds	
Greenland turbot, non-FSSI stock	*Reinhardtius hippoglossoides*	2005	0	Pounds	
Greenlings*	Hexagrammidae	2003–05	1,001.15	Pounds	
Grenadier*	Macrouridae	2005	929.73	Pounds	
Gunnels*	Pholidae	2003–05	0	Pounds	
Hermit crab, unidentified*	Paguroidea	2003–05	558.17	Pounds	
Herring	*Clupea pallasi*	2005	143.45	Pounds	
Invertebrate, unidentified*	Invertebrata	2003–05	10,009.09	Pounds	
Lanternfishes*	Myctophidae	2003–05	0	Pounds	
Large sculpins*	Cottidae	2003–05	233,559.71	Pounds	
Longnose skate	*Raja rhina*	2005	2,528.70	Pounds	
Miscellaneous crabs*	Decapoda	2003–05	407.19	Pounds	
Miscellaneous crustaceans*	Crustaceamorpha	2003–05	0	Pounds	
Miscellaneous deep fish*	Teleostomi	2003–05	0	Pounds	
Miscellaneous fish*	Teleostomi	2003–05	34,723.87	Pounds	
Non-Chinook salmon*	Salmonidae	2005	8,512.66	Pounds	
Northern rockfish, western /central Gulf of Alaska	*Sebastes polyspinis*	2005	11,750.62	Pounds	
Octopus*	Octopoda	2003–05	395.36	Pounds	
Other osmerids*	Osmeridae	2003–05	35.06	Pounds	
Other sculpins*	Cottidae	2003–05	86,021.62	Pounds	
Other species*		2005	361,308.56	Pounds	
Pacific cod, Gulf of Alaska	*Gadus macrocephalus*	2005	1,005,022.32	Pounds	
Pacific hake	*Merluccius productus*	2005	0	Pounds	
Pacific halibut	*Hippoglossus stenolepis*	2005	1,225,707.12	Pounds	

Table 4.3.A (continued)

(continuation of Subtable 4.3.A.17)

		GULF OF ALASKA FLATFISH (SHALLOW WATER FLATFISH) TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Pacific ocean perch, Gulf of Alaska	*Sebastes alutus*	2005	25,507.45	Pounds	
Pacific sand lance	*Ammodytes hexapterus*	2003–05	2.13	Pounds	
Pandalid shrimp*	*Pandalus* spp.	2003–05	59.72	Pounds	
Pelagic shelf rockfish*		2005	160.94	Pounds	
Polychaete, unidentified*	Polychaeta	2003–05	0.26	Pounds	
Pricklebacks	Stichaeidae	2003–05	0	Pounds	
Red king crab	*Paralithodes camtschaticus*	2005	409.56	Pounds	
Rex sole, Gulf of Alaska	*Glyptocephalus zachirus*	2005	8,789.82	Pounds	
Rock sole, non-FSSI stock	*Paraplagusia bilineata*	2005	0	Pounds	
Rockfish, unspecified*	Sebastidae	2005	0	Pounds	
Rougheye rockfish, Gulf of Alaska	*Sebastes aleutianus*	2005	2,769.00	Pounds	
Sablefish	*Anoplopoma fimbria*	2005	17,065.96	Pounds	
Scypho jellies*	Scyphozoa	2003–05	4,947.54	Pounds	
Sea anemone, unidentified*	Actinaria	2003–05	21,152.31	Pounds	
Sea pens and whips*	Octocorallia	2003–05	12.79	Pounds	
Sea star*	Asteroidea	2003–05	77,604.22	Pounds	
Shallow-water flatfish*		2005	498,226.48	Pounds	
Shark*	Elasmobranchii	2003–05	7,690.45	Pounds	
Shortraker rockfish	*Sebastes borealis*	2005	2,107.62	Pounds	
Shortspine thornyhead, Gulf of Alaska	*Sebastolobus alascanus*	2005	3,306.93	Pounds	
Skate, unidentified*	Rajidae	2005	63,995.71	Pounds	
Snails*	Gastropoda	2003–05	648.24	Pounds	
Snow crab, non-FSSI stock	*Chionoecetes opilio*	2005	13.65	Pounds	
Sponge, unidentified*	Porifera	2003–05	1,820.90	Pounds	
Squid*	Decapoda	2005	0	Pounds	
Surf smelt	*Hypomesus pretiosus*	2003–05	0	Pounds	
Tanner crab, non-FSSI stock	*Chionoecetes bairdi*	2005	5,355.43	Pounds	
Urchins/dollars/cucumbers*	Echinodermata	2003–05	1,470.83	Pounds	
Walleye pollock, western /central Gulf of Alaska	*Theragra chalcogramma*	2005	27,346.11	Pounds	
Yellowfin sole, non-FSSI stock	*Limanda aspera*	2005	0	Pounds	
TOTAL FISHERY BYCATCH			5,864,137.96	Pounds	
TOTAL FISHERY LANDINGS			10,563,660.87	Pounds	
TOTAL CATCH (Bycatch + Landings)			16,427,798.83	Pounds	
FISHERY BYCATCH RATIO (Bycatch/Landings)			0.36		

Table 4.3.A (continued)

Subtable 4.3.A.18		**GULF OF ALASKA FLATHEAD SOLE TRAWL**			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Alaska plaice, non-FSSI stock	*Pleuronectes quadrituberculatus*	2005	0	Pounds	
Arrowtooth flounder, Gulf of Alaska	*Atheresthes stomias*	2005	3,504,840.94	Pounds	
Atka mackerel, non-FSSI stock	*Pleurogrammus monopterygius*	2005	440.92	Pounds	
Benthic Urochordata*	Urochordata	2003–05	10.17	Pounds	
Big skate	*Raja binoculata*	2005	1,426.39	Pounds	
Bivalves*	Bivalvia	2003–05	1,087.22	Pounds	
Blue king crab	*Paralithodes platypus*	2005	0	Pounds	
Brittle star, unidentified*	Ophiuroidea	2003–05	0.78	Pounds	
Byrozoans/hydroids*	Bryozoa	2003–05	45.14	Pounds	
Capelin	*Mallotus villosus*	2003–05	0	Pounds	
Chinook salmon	*Oncorhynchus tshawytscha*	2005	110.51	Pounds	
Deepsea smelts*	Bathylagidae	2003–05	0	Pounds	
Deepwater flatfish*		2005	4,409.24	Pounds	
Demersal shelf rockfish*		2005	0	Pounds	
Eelpouts*	Zoarcidae	2003–05	1,425.43	Pounds	
Eulachon (smelt)	*Thaleichthys pacificus*	2003–05	16,017.47	Pounds	
Flatfish*	Pleuronectiformes	2005	0	Pounds	
Flathead sole, Gulf of Alaska	*Hippoglossoides elassodon*	2005	241,434.55	Pounds	
Giant grenadier*	*Albatrossia pectoralis*	2003–05	0	Pounds	
Golden king crab, non-FSSI stock	*Lithodes aequispina*	2005	0	Pounds	
Greenland turbot, non-FSSI stock	*Reinhardtius hippoglossoides*	2005	0	Pounds	
Greenlings*	Hexagrammidae	2003–05	61.60	Pounds	
Grenadier*	Macrouridae	2005	339.78	Pounds	
Gunnels*	Pholidae	2003–05	0	Pounds	
Hermit crab, unidentified*	Paguroidea	2003–05	20.66	Pounds	
Herring	*Clupea pallasi*	2005	0	Pounds	
Invertebrate, unidentified*	Invertebrata	2003–05	872.89	Pounds	
Lanternfishes*	Myctophidae	2003–05	0	Pounds	
Large sculpins*	Cottidae	2003–05	9,330.03	Pounds	
Longnose skate	*Raja rhina*	2005	0	Pounds	
Miscellaneous crabs*	Decapoda	2003–05	237.55	Pounds	
Miscellaneous crustaceans*	Crustaceamorpha	2003–05	0	Pounds	
Miscellaneous deep fish*	Teleostomi	2003–05	0	Pounds	
Miscellaneous fish*	Teleostomi	2003–05	9,180.69	Pounds	
Non-Chinook salmon*	Salmonidae	2005	0	Pounds	
Northern rockfish, western/central Gulf of Alaska	*Sebastes polyspinis*	2005	25,086.37	Pounds	

Table 4.3.A (continued)

(continuation of Subtable 4.3.A.18)		GULF OF ALASKA FLATHEAD SOLE TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Octopus*	Octopoda	2003–05	49.24	Pounds	
Other osmerids*	Osmeridae	2003–05	1,319.44	Pounds	
Other sculpins*	Cottidae	2003–05	3,325.74	Pounds	
Other species*		2005	162,923.62	Pounds	
Pacific cod, Gulf of Alaska	*Gadus macrocephalus*	2005	41,433.63	Pounds	
Pacific hake	*Merluccius productus*	2005	0	Pounds	
Pacific halibut	*Hippoglossus stenolepis*	2005	72,167.53	Pounds	
Pacific ocean perch, Gulf of Alaska	*Sebastes alutus*	2005	18,677.54	Pounds	
Pacific sand lance	*Ammodytes hexapterus*	2003–05	0	Pounds	
Pandalid shrimp*	*Pandalus* spp.	2003–05	1,576.51	Pounds	
Pelagic shelf rockfish*		2005	0	Pounds	
Polychaete, unidentified	Polychaeta	2003–05	0.84	Pounds	
Pricklebacks*	Stichaeidae	2003–05	1,398.21	Pounds	
Red king crab	*Paralithodes camtschaticus*	2005	0	Pounds	
Rex sole, Gulf of Alaska	*Glyptocephalus zachirus*	2005	101,602.12	Pounds	
Rock sole, non-FSSI stock	*Paraplagusia bilineata*	2005	0	Pounds	
Rockfish, unspecified*	Sebastidae	2005	0	Pounds	
Rougheye rockfish, Gulf of Alaska	*Sebastes aleutianus*	2005	1,543.23	Pounds	
Sablefish	*Anoplopoma fimbria*	2005	218.26	Pounds	
Scypho jellies*	Scyphozoa	2003–05	111.77	Pounds	
Sea anemone, unidentified*	Actinaria	2003–05	472.49	Pounds	
Sea pens and whips*	Octocorallia	2003–05	0.66	Pounds	
Sea star*	Asteroidea	2003–05	33,945.50	Pounds	
Shallow-water flatfish*		2005	313.06	Pounds	
Shark*	Elasmobranchii	2003–05	70,761.69	Pounds	
Shortraker rockfish	*Sebastes borealis*	2005	321.87	Pounds	
Shortspine thornyhead, Gulf of Alaska	*Sebastolobus alascanus*	2005	0	Pounds	
Skate, unidentified*	Rajidae	2005	64,758.51	Pounds	
Snails*	Gastropoda	2003–05	1,401.91	Pounds	
Snow crab, Bering Sea	*Chionoecetes opilio*				
Snow crab, non-FSSI stock	*Chionoecetes opilio*	2005	0	Pounds	
Sponge, unidentified*	Porifera	2003–05	1,604.38	Pounds	
Squid*	Decapoda	2005	0	Pounds	
Surf smelt	*Hypomesus pretiosus*	2003–05	0	Pounds	
Tanner crab, non-FSSI stock	*Chionoecetes bairdi*	2005	28,576.70	Pounds	
Urchins/dollars/cucumbers*	Echinodermata	2003–05	343.35	Pounds	

Table 4.3.A (continued)

(continuation of Subtable 4.3.A.18)		GULF OF ALASKA FLATHEAD SOLE TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Walleye pollock, western/central Gulf of Alaska	*Theragra chalcogramma*	2005	176.37	Pounds	
Yellowfin sole, non-FSSI stock	*Limanda aspera*	2005	0	Pounds	
TOTAL FISHERY BYCATCH			4,425,402.50	Pounds	
TOTAL FISHERY LANDINGS			2,891,707.46	Pounds	
TOTAL CATCH (Bycatch + Landings)			7,317,109.96	Pounds	
FISHERY BYCATCH RATIO (Bycatch/Total Catch)			0.6		

Subtable 4.3.A.19		GULF OF ALASKA PACIFIC COD JIG			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Alaska plaice, non-FSSI stock	*Pleuronectes quadrituberculatus*	2005	0	Pounds	
Arrowtooth flounder, Gulf of Alaska	*Atheresthes stomias*	2005	0	Pounds	
Atka mackerel, non-FSSI stock	*Pleurogrammus monopterygius*	2005	0	Pounds	
Benthic Urochordata*	Urochordata	2003–05	0	Pounds	
Big skate	*Raja binoculata*	2005	0	Pounds	
Bivalves*	Bivalvia	2003–05	0	Pounds	
Blue king crab	*Paralithodes platypus*	2005	0	Pounds	
Brittle star, unidentified*	Ophiuroidea	2003–05	0	Pounds	
Byrozoans/hydroids*	Bryozoa	2003–05	0	Pounds	
Capelin	*Mallotus villosus*	2003–05	0	Pounds	
Chinook salmon	*Oncorhynchus tshawytscha*	2005	0	Pounds	
Deepsea smelts*	Bathylagidae	2003–05	0	Pounds	
Deepwater flatfish*		2005	0	Pounds	
Demersal shelf rockfish*		2005	0	Pounds	
Eelpouts*	Zoarcidae	2003–05	0	Pounds	
Eulachon (smelt)	*Thaleichthys pacificus*	2003–05	0	Pounds	
Flatfish*	Pleuronectiformes	2005	0	Pounds	
Flathead sole, Gulf of Alaska	*Hippoglossoides elassodon*	2005	0	Pounds	
Giant grenadier*	*Albatrossia pectoralis*	2003–05	0	Pounds	
Golden king crab, non-FSSI stock	*Lithodes aequispina*	2005	0	Pounds	
Greenland turbot, non-FSSI stock	*Reinhardtius hippoglossoides*	2005	0	Pounds	
Greenlings*	Hexagrammidae	2003–05	0	Pounds	
Grenadier*	Macrouridae	2005	0	Pounds	
Gunnels*	Pholidae	2003–05	0	Pounds	

Table 4.3.A (continued)

Subtable 4.3.A.19		GULF OF ALASKA PACIFIC COD JIG			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Hermit crab, unidentified*	Paguroidea	2003–05	0	Pounds	
Herring	*Clupea pallasi*	2005	0	Pounds	
Invertebrate, unidentified*	Invertebrata	2003–05	0	Pounds	
Lanternfishes*	Myctophidae	2003–05	0	Pounds	
Large sculpins*	Cottidae	2003–05	0	Pounds	
Longnose skate	*Raja rhina*	2005	0	Pounds	
Miscellaneous crabs*	Decapoda	2003–05	0	Pounds	
Miscellaneous crustaceans*	Crustaceamorpha	2003–05	0	Pounds	
Miscellaneous deep fish*	Teleostomi	2003–05	0	Pounds	
Miscellaneous fish*	Teleostomi	2003–05	0	Pounds	
Non-Chinook salmon*	Salmonidae	2005	0	Pounds	
Northern rockfish, western/central Gulf of Alaska	*Sebastes polyspinis*	2005	0	Pounds	
Octopus*	Octopoda	2003–05	293.95	Pounds	
Other osmerids*	Osmeridae	2003–05	0	Pounds	
Other sculpins*	Cottidae	2003–05	0	Pounds	
Other species*		2005	4.41	Pounds	
Pacific cod, Gulf of Alaska	*Gadus macrocephalus*	2005	668.00	Pounds	
Pacific hake	*Merluccius productus*	2005	0	Pounds	
Pacific halibut	*Hippoglossus stenolepis*	2005	0	Pounds	
Pacific ocean perch, Gulf of Alaska	*Sebastes alutus*	2005	0	Pounds	
Pacific sand lance	*Ammodytes hexapterus*	2003–05	0	Pounds	
Pandalid shrimp*	*Pandalus* spp.	2003–05	0	Pounds	
Pelagic shelf rockfish*		2005	0	Pounds	
Polychaete, unidentified*	Polychaeta	2003–05	0	Pounds	
Pricklebacks*	Stichaeidae	2003–05	0	Pounds	
Red king crab	*Paralithodes camtschaticus*	2005	0	Pounds	
Rex sole, Gulf of Alaska	*Glyptocephalus zachirus*	2005	0	Pounds	
Rock sole, non-FSSI stock	*Paraplagusia bilineata*	2005	0	Pounds	
Rockfish, unspecified*	Sebastidae	2005	0	Pounds	
Rougheye rockfish, Gulf of Alaska	*Sebastes aleutianus*	2005	0	Pounds	
Sablefish	*Anoplopoma fimbria*	2005	0	Pounds	
Scypho jellies*	Scyphozoa	2003–05	0	Pounds	
Sea anemone, unidentified*	Actinaria	2003–05	0	Pounds	
Sea pens and whips*	Octocorallia	2003–05	0	Pounds	
Sea star*	Asteroidea	2003–05	0	Pounds	
Shallow water flatfish*		2005	0	Pounds	

Table 4.3.A (continued)

Subtable 4.3.A.19		GULF OF ALASKA PACIFIC COD JIG			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Shark*	Elasmobranchii	2003–05	0	Pounds	
Shortraker rockfish	*Sebastes borealis*	2005	0	Pounds	
Shortspine thornyhead, Gulf of Alaska	*Sebastolobus alascanus*	2005	0	Pounds	
Skate, unidentified*	Rajidae	2005	0	Pounds	
Snails*	Gastropoda	2003–05	0	Pounds	
Snow crab, non-FSSI stock	*Chionoecetes opilio*	2005	0	Pounds	
Sponge, unidentified*	Porifera	2003–05	0	Pounds	
Squid*	Decapoda	2005	0	Pounds	
Surf smelt	*Hypomesus pretiosus*	2003–05	0	Pounds	
Tanner crab, non-FSSI stock	*Chionoecetes bairdi*	2005	0	Pounds	
Urchins/dollars/cucumbers*	Echinodermata	2003–05	0	Pounds	
Walleye pollock, western/central Gulf of Alaska	*Theragra chalcogramma*	2005	0	Pounds	
Yellowfin sole, non-FSSI stock	*Limanda aspera*	2005	0	Pounds	
TOTAL FISHERY BYCATCH			966.36	Pounds	
TOTAL FISHERY LANDINGS			7,209,809.20	Pounds	
TOTAL CATCH (Bycatch + Landings)			7,210,775.56	Pounds	
FISHERY BYCATCH RATIO (Bycatch/Total Catch)			0		

Subtable 4.3.A.20		GULF OF ALASKA PACIFIC COD LONGLINE			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Alaska plaice, non-FSSI stock	*Pleuronectes quadrituberculatus*	2005	0	Pounds	
Arrowtooth flounder, Gulf of Alaska	*Atheresthes stomias*	2005	208,281.47	Pounds	
Atka mackerel, non-FSSI stock	*Pleurogrammus monopterygius*	2005	3,035.76	Pounds	
Benthic Urochordata*	Urochordata	2003–05	0	Pounds	
Big skate	*Raja binoculata*	2005	356,189.43	Pounds	
Bivalves*	Bivalvia	2003–05	245.46	Pounds	
Blue king crab	*Paralithodes platypus*	2005	0	Pounds	
Brittle star, unidentified*	Ophiuroidea	2003–05	58.36	Pounds	
Byrozoans/hydroids*	Bryozoa	2003–05	39.01	Pounds	
Capelin	*Mallotus villosus*	2003–05	0	Pounds	
Chinook salmon	*Oncorhynchus tshawytscha*	2005	0	Pounds	
Deepsea smelts*	Bathylagidae	2003–05	0	Pounds	
Deepwater flatfish*		2005	1,227.97	Pounds	

Table 4.3.A (continued)

(continuation of Subtable 4.3.A.20)

		GULF OF ALASKA PACIFIC COD LONGLINE			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Demersal shelf rockfish*		2005	2.20	Pounds	
Eelpouts*	Zoarcidae	2003–05	151.02	Pounds	
Eulachon (smelt)	*Thaleichthys pacificus*	2003–05	0	Pounds	
Flatfish*	Pleuronectiformes	2005	0	Pounds	
Flathead sole, Gulf of Alaska	*Hippoglossoides elassodon*	2005	9,733.40	Pounds	
Giant grenadier*	*Albatrossia pectoralis*	2003–05	120,826.34	Pounds	
Golden king crab, non-FSSI stock	*Lithodes aequispina*	2005	27.12	Pounds	
Greenland turbot, non-FSSI stock	*Reinhardtius hippoglossoides*	2005	0	Pounds	
Greenlings*	Hexagrammidae	2003–05	1,897.22	Pounds	
Grenadier*	Macrouridae	2005	292,119.60	Pounds	
Gunnels*	Pholidae	2003–05	0	Pounds	
Hermit crab, unidentified*	Paguroidea	2003–05	0	Pounds	
Herring	*Clupea pallasi*	2005	0	Pounds	
Invertebrate, unidentified*	Invertebrata	2003–05	1,570.59	Pounds	
Lanternfishes*	Myctophidae	2003–05	0	Pounds	
Large sculpins*	Cottidae	2003–05	225,473.39	Pounds	
Longnose skate	*Raja rhina*	2005	282,039.24	Pounds	
Miscellaneous crabs*	Decapoda	2003–05	41.90	Pounds	
Miscellaneous crustaceans*	Crustaceamorpha	2003–05	0	Pounds	
Miscellaneous deep fish*	Teleostomi	2003–05	0	Pounds	
Miscellaneous fish*	Teleostomi	2003–05	45,237.04	Pounds	
Non-Chinook salmon*	Salmonidae	2005	135.79	Pounds	
Northern rockfish, western/central Gulf of Alaska	*Sebastes polyspinis*	2005	4,470.97	Pounds	
Octopus*	Octopoda	2003–05	3,455.37	Pounds	
Other apecies		2005	491,445.07	Pounds	
Other osmerids*	Osmeridae	2003–05	0	Pounds	
Other sculpins*	Cottidae	2003–05	98,589.95	Pounds	
Pacific cod, Gulf of Alaska	*Gadus macrocephalus*	2005	240,316.81	Pounds	
Pacific hake	*Merluccius productus*	2005	0	Pounds	
Pacific halibut	*Hippoglossus stenolepis*	2005	1,221,207.09	Pounds	
Pacific ocean perch, Gulf of Alaska	*Sebastes alutus*	2005	8.82	Pounds	
Pacific sand lance	*Ammodytes hexapterus*	2003–05	0	Pounds	
Pandalid shrimp*	*Pandalus* spp.	2003–05	0	Pounds	
Pelagic shelf rockfish*		2005	16,214.98	Pounds	
Polychaete, unidentified*	Polychaeta	2003–05	0	Pounds	

Table 4.3.A (continued)

(continuation of Subtable 4.3.A.20)		GULF OF ALASKA PACIFIC COD LONGLINE			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Pricklebacks	Stichaeidae	2003–05	0	Pounds	
Red king crab	*Paralithodes camtschaticus*	2005	0	Pounds	
Rex sole, Gulf of Alaska	*Glyptocephalus zachirus*	2005	97.00	Pounds	
Rock sole, non-FSSI stock	*Paraplagusia bilineata*	2005	0	Pounds	
Rockfish, unspecified*	Sebastidae	2005	27,451.93	Pounds	
Rougheye rockfish, Gulf of Alaska	*Sebastes aleutianus*	2005	21,415.68	Pounds	
Sablefish	*Anoplopoma fimbria*	2005	85,955.93	Pounds	
Scypho jellies*	Scyphozoa	2003–05	0	Pounds	
Sea anemone, unidentified*	Actinaria	2003–05	1,562.94	Pounds	
Sea pen and whips	Octocorallia	2003–05	190.46	Pounds	
Sea star*	Asteroidea	2003–05	400,596.58	Pounds	
Shallow water flatfish*		2005	3,425.98	Pounds	
Shark*	Elasmobranchii	2003–05	118,890.01	Pounds	
Shortraker rockfish	*Sebastes borealis*	2005	2,740.34	Pounds	
Shortspine thornyhead, Gulf of Alaska	*Sebastolobus alascanus*	2005	3,822.81	Pounds	
Skate, unidentified*	Rajidae	2005	428,939.69	Pounds	
Snails*	Gastropoda	2003–05	28.40	Pounds	
Snow crab, Bering Sea	*Chionoecetes opilio*				
Snow crab, non-FSSI stock	*Chionoecetes opilio*	2005	0	Pounds	
Sponge, unidentified*	Porifera	2003–05	950.52	Pounds	
Squid*	Decapoda	2005	0	Pounds	
Surf smelt	*Hypomesus pretiosus*	2003–05	0	Pounds	
Tanner crab, non-FSSI stock	*Chionoecetes bairdi*	2005	1,212.96	Pounds	
Urchins/dollars/cucumbers*	Echinodermata	2003–05	0.90	Pounds	
Walleye pollock, western/central Gulf of Alaska	*Theragra chalcogramma*	2005	1,871.72	Pounds	
Yellowfin sole, non-FSSI stock	*Limanda aspera*	2005	0	Pounds	
TOTAL FISHERY BYCATCH			4,723,195.22	Pounds	
TOTAL FISHERY LANDINGS			22,205,996.74	Pounds	
TOTAL CATCH (Bycatch + Landings)			2,692,919,1.96	Pounds	
FISHERY BYCATCH RATIO (Bycatch/Total Catch)			0.18		

Table 4.3.A (continued)

Subtable 4.3.A.21		GULF OF ALASKA PACIFIC COD POT			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Alaska plaice, non-FSSI stock	*Pleuronectes quadrituberculatus*	2005	0	Pounds	
Arrowtooth flounder, Gulf of Alaska	*Atheresthes stomias*	2005	5,974.52	Pounds	
Atka mackerel, non-FSSI stock	*Pleurogrammus monopterygius*	2005	38,684.47	Pounds	
Benthic Urochordata*	Urochordata	2003–05	4.59	Pounds	
Big skate	*Raja binoculata*	2005	0	Pounds	
Bivalves*	Bivalvia	2003–05	258.15	Pounds	
Blue king crab	*Paralithodes platypus*	2005	0	Pounds	
Brittle star, unidentified*	Ophiuroidea	2003–05	168.21	Pounds	
Byrozoans/hydroids*	Bryozoa	2003–05	3.28	Pounds	
Capelin	*Mallotus villosus*	2003–05	0	Pounds	
Chinook salmon	*Oncorhynchus tshawytscha*	2005	0	Pounds	
Deepsea smelts*	Bathylagidae	2003–05	0	Pounds	
Deepwater flatfish*		2005	0	Pounds	
Demersal shelf rockfish*		2005	0	Pounds	
Eelpouts*	Zoarcidae	2003–05	5,401.88	Pounds	
Eulachon (smelt)	*Thaleichthys pacificus*	2003–05	0	Pounds	
Flatfish*	Pleuronectiformes	2005	0	Pounds	
Flathead sole, Gulf of Alaska	*Hippoglossoides elassodon*	2005	277.78	Pounds	
Giant grenadier*	*Albatrossia pectoralis*	2003–05	0	Pounds	
Golden king crab, non-FSSI stock	*Lithodes aequispina*	2005	0	Pounds	
Greenland turbot, non-FSSI stock	*Reinhardtius hippoglossoides*	2005	0	Pounds	
Greenlings*	Hexagrammidae	2003–05	1,428.09	Pounds	
Grenadier*	Macrouridae	2005	0	Pounds	
Gunnels*	Pholidae	2003–05	0	Pounds	
Hermit crab, unidentified*	Paguroidea	2003–05	425.76	Pounds	
Herring	*Clupea pallasi*	2005	0	Pounds	
Invertebrate, unidentified*	Invertebrata	2003–05	248.32	Pounds	
Lanternfishes*	Myctophidae	2003–05	0	Pounds	
Large sculpins*	Cottidae	2003–05	318,262.58	Pounds	
Longnose skate	*Raja rhina*	2005	0	Pounds	
Miscellaneous crabs*	Decapoda	2003–05	2,098.57	Pounds	
Miscellaneous crustaceans*	Crustaceamorpha	2003–05	0	Pounds	
Miscellaneous deep fish*	Teleostomi	2003–05	0	Pounds	
Miscellaneous fish*	Teleostomi	2003–05	104,987.41	Pounds	
Non-Chinook salmon*	Salmonidae	2005	0	Pounds	

Table 4.3.A (continued)

(continuation of Subtable 4.3.A.21)		GULF OF ALASKA PACIFIC COD POT			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Northern rockfish, western/central Gulf of Alaska	*Sebastes polyspinis*	2005	2,632.32	Pounds	
Octopus*	Octopoda	2003–05	207,470.17	Pounds	
Other osmerids*	Osmeridae	2003–05	0	Pounds	
Other sculpins*	Cottidae	2003–05	155,224.65	Pounds	
Other species*		2005	371,897.35	Pounds	
Pacific cod, Gulf of Alaska	*Gadus macrocephalus*	2005	257,876.61	Pounds	
Pacific hake	*Merluccius productus*	2005	0	Pounds	
Pacific halibut	*Hippoglossus stenolepis*	2005	100,601.60	Pounds	
Pacific ocean perch, Gulf of Alaska	*Sebastes alutus*	2005	59.52	Pounds	
Pacific sand lance	*Ammodytes hexapterus*	2003–05	0	Pounds	
Pandalid shrimp*	*Pandalus* spp.	2003–05	0	Pounds	
Pelagic shelf rockfish*		2005	17,467.20	Pounds	
Polychaete, unidentified*	Polychaeta	2003–05	0	Pounds	
Pricklebacks*	Stichaeidae	2003–05	0	Pounds	
Red king crab	*Paralithodes camtschaticus*	2005	0	Pounds	
Rex sole, Gulf of Alaska	*Glyptocephalus zachirus*	2005	33.07	Pounds	
Rock sole, non-FSSI stock	*Paraplagusia bilineata*	2005	0	Pounds	
Rockfish, unspecified*	Sebastidae	2005	7,597.12	Pounds	
Rougheye rockfish, Gulf of Alaska	*Sebastes aleutianus*	2005	4.41	Pounds	
Sablefish	*Anoplopoma fimbria*	2005	0	Pounds	
Scypho jellies*	Scyphozoa	2003–05	459.05	Pounds	
Sea anemone, unidentified*	Actinaria	2003–05	178.27	Pounds	
Sea pens and whips*	Octocorallia	2003–05	3.67	Pounds	
Sea star*	Asteroidea	2003–05	1,355,474.03	Pounds	
Shallow-water flatfish*		2005	5,134.56	Pounds	
Shark*	Elasmobranchii	2003–05	0	Pounds	
Shortraker rockfish	*Sebastes borealis*	2005	0	Pounds	
Shortspine thornyhead, Gulf of Alaska	*Sebastolobus alascanus*	2005	0	Pounds	
Skate, unidentified*	Rajidae	2005	44.09	Pounds	
Snails*	Gastropoda	2003–05	7,556.05	Pounds	
Snow crab, non-FSSI stock	*Chionoecetes opilio*	2005	0	Pounds	
Sponge, unidentified*	Porifera	2003–05	5.2	Pounds	
Squid*	Decapoda	2005	0	Pounds	
Surf smelt	*Hypomesus pretiosus*	2003–05	0	Pounds	
Tanner crab, non-FSSI stock	*Chionoecetes bairdi*	2005	102,171.66	Pounds	

Table 4.3.A (continued)

(continuation of Subtable 4.3.A.21)		GULF OF ALASKA PACIFIC COD POT			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Urchins/dollars/cucumbers*	Echinodermata	2003–05	492.68	Pounds	
Walleye pollock, western/central Gulf of Alaska	*Theragra chalcogramma*	2005	3,425.98	Pounds	
Yellowfin sole, non-FSSI stock	*Limanda aspera*	2005	0	Pounds	
TOTAL FISHERY BYCATCH			3,074,032.87	Pounds	
TOTAL FISHERY LANDINGS			51,964,701.92	Pounds	
TOTAL CATCH (Bycatch + Landings)			55,038,734.79	Pounds	
FISHERY BYCATCH RATIO (Bycatch/Total Catch)			0.06		

Subtable 4.3.A.22		GULF OF ALASKA PACIFIC COD TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Alaska plaice, non-FSSI stock	*Pleuronectes quadrituberculatus*	2005	0	Pounds	
Arrowtooth flounder, Gulf of Alaska	*Atheresthes stomias*	2005	1,076,000.06	Pounds	
Atka mackerel, non-FSSI stock	*Pleurogrammus monopterygius*	2005	5,857.68	Pounds	
Benthic Urochordata*	Urochordata	2003–05	6.00	Pounds	
Big skate	*Raja binoculata*	2005	46,138.29	Pounds	
Bivalves*	Bivalvia	2003–05	1,615.54	Pounds	
Blue king crab	*Paralithodes platypus*	2005	0	Pounds	
Brittle star, unidentified*	Ophiuroidea	2003–05	1.46	Pounds	
Byrozoans/hydroids*	Bryozoa	2003–05	62.01	Pounds	
Capelin	*Mallotus villosus*	2003–05	0	Pounds	
Chinook salmon	*Oncorhynchus tshawytscha*	2005	249.70	Pounds	
Deepsea smelts*	Bathylagidae	2003–05	0	Pounds	
Deepwater flatfish*		2005	43,433.22	Pounds	
Demersal shelf rockfish*		2005	0	Pounds	
Eelpouts*	Zoarcidae	2003–05	206.66	Pounds	
Eulachon (smelt)	*Thaleichthys pacificus*	2003–05	487.21	Pounds	
Flatfish*	Pleuronectiformes	2005	0	Pounds	
Flathead sole, Gulf of Alaska	*Hippoglossoides elassodon*	2005	23,172.76	Pounds	
Giant grenadier*	*Albatrossia pectoralis*	2003–05	620.92	Pounds	
Golden king crab, Aleutian Islands	*Lithodes aequispina*				
Golden king crab, non-FSSI stock	*Lithodes aequispina*	2005	0	Pounds	
Greenland turbot, non-FSSI stock	*Reinhardtius hippoglossoides*	2005	0	Pounds	
Greenlings*	Hexagrammidae	2003–05	4,720.63	Pounds	

Table 4.3.A (continued)

(continuation of Subtable 4.3.A.22)		GULF OF ALASKA PACIFIC COD TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Grenadier*	Macrouridae	2005	1,911.82	Pounds	
Gunnels*	Pholidae	2003–05	0	Pounds	
Hermit crab, unidentified*	Paguroidea	2003–05	727.83	Pounds	
Herring	*Clupea pallasi*	2005	0	Pounds	
Invertebrate, unidentified*	Invertebrata	2003–05	1,278.90	Pounds	
Lanternfishes*	Myctophidae	2003–05	0	Pounds	
Large sculpins*	Cottidae	2003–05	88,353.06	Pounds	
Longnose skate	*Raja rhina*	2005	12,500.20	Pounds	
Miscellaneous crabs*	Decapoda	2003–05	30.48	Pounds	
Miscellaneous crustaceans*	Crustaceamorpha	2003–05	1.24	Pounds	
Miscellaneous deep fish*	Teleostomi	2003–05	0	Pounds	
Miscellaneous fish*	Teleostomi	2003–05	130,395.31	Pounds	
Non-Chinook salmon*	Salmonidae	2005	666.84	Pounds	
Northern rockfish, western/central Gulf of Alaska	*Sebastes polyspinis*	2005	6,671.18	Pounds	
Octopus*	Octopoda	2003–05	2,979.18	Pounds	
Other osmerids*	Osmeridae	2003–05	43.95	Pounds	
Other sculpins*	Cottidae	2003–05	31,405.14	Pounds	
Other species*		2005	156,100.32	Pounds	
Pacific cod, Gulf of Alaska	*Gadus macrocephalus*	2005	62,542.86	Pounds	
Pacific hake	*Merluccius productus*	2005	0	Pounds	
Pacific halibut	*Hippoglossus stenolepis*	2005	1,437,414.15	Pounds	
Pacific ocean perch, Gulf of Alaska	*Sebastes alutus*	2005	10,408.01	Pounds	
Pacific sand lance	*Ammodytes hexapterus*	2003–05	6.29	Pounds	
Pandalid shrimp*	*Pandalus* spp.	2003–05	55.70	Pounds	
Pelagic shelf rockfish*		2005	8,992.64	Pounds	
Polychaete, unidentified*	Polychaeta	2003–05	0	Pounds	
Pricklebacks*	Stichaeidae	2003–05	81.92	Pounds	
Red king crab	*Paralithodes camtschaticus*	2005	0	Pounds	
Rex sole, Gulf of Alaska	*Glyptocephalus zachirus*	2005	8,280.55	Pounds	
Rock sole, non-FSSI stock	*Paraplagusia bilineata*	2005	0	Pounds	
Rockfish, unspecified*	Sebastidae	2005	2,306.03	Pounds	
Rougheye rockfish, Gulf of Alaska	*Sebastes aleutianus*	2005	553.36	Pounds	
Sablefish	*Anoplopoma fimbria*	2005	637.14	Pounds	
Scypho jellies*	Scyphozoa	2003–05	7,747.55	Pounds	
Sea anemone, unidentified*	Actinaria	2003–05	844.62	Pounds	

Table 4.3.A (continued)

(continuation of Subtable 4.3.A.22)		GULF OF ALASKA PACIFIC COD TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Sea pens and whips*	Octocorallia	2003–05	5.64	Pounds	
Sea star*	Asteroidea	2003–05	37,082.05	Pounds	
Shallow-water flatfish*		2005	135,667.91	Pounds	
Shark*	Elasmobranchii	2003–05	19,693.14	Pounds	
Shortraker rockfish	*Sebastes borealis*	2005	0	Pounds	
Shortspine thornyhead, Gulf of Alaska	*Sebastolobus alascanus*	2005	1,858.49	Pounds	
Skate, unidentified*	Rajidae	2005	40,679.65	Pounds	
Snails*	Gastropoda	2003–05	286.71	Pounds	
Snow crab, non-FSSI stock	*Chionoecetes opilio*	2005	0	Pounds	
Sponge, unidentified*	Porifera	2003–05	299.39	Pounds	
Squid*	Decapoda	2005	0	Pounds	
Surf smelt	*Hypomesus pretiosus*	2003–05	330.49	Pounds	
Tanner crab, non-FSSI stock	*Chionoecetes bairdi*	2005	1,270.86	Pounds	
Urchins/dollars/cucumbers*	Echinodermata	2003–05	1,305.55	Pounds	
Walleye pollock, western/central Gulf of Alaska	*Theragra chalcogramma*	2005	34,389.87	Pounds	
Yellowfin sole, non-FSSI stock	*Limanda aspera*	2005	0	Pounds	
TOTAL FISHERY BYCATCH			3,448,378.16	Pounds	
TOTAL FISHERY LANDINGS			31,255,118.20	Pounds	
TOTAL CATCH (Bycatch + Landings)			34,703,496.36	Pounds	
FISHERY BYCATCH RATIO (Bycatch/Total Catch)			0.1		

Subtable 4.3.A.23		GULF OF ALASKA POLLOCK TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Alaska plaice, non-FSSI stock	*Pleuronectes quadrituberculatus*	2005	0	Pounds	
Arrowtooth flounder, Gulf of Alaska	*Atheresthes stomias*	2005	510,645.11	Pounds	
Atka mackerel, non-FSSI stock	*Pleurogrammus monopterygius*	2005	0	Pounds	
Benthic Urochordata*	Urochordata	2003–05	0	Pounds	
Big skate	*Raja binoculata*	2005	26.46	Pounds	
Bivalves*	Bivalvia	2003–05	0.00	Pounds	
Blue king crab	*Paralithodes platypus*	2005	0	Pounds	
Brittle star, unidentified*	Ophiuroidea	2003–05	0	Pounds	
Byrozoans/hydroids*	Bryozoa	2003–05	0	Pounds	
Capelin	*Mallotus villosus*	2003–05	56,552.62	Pounds	

Table 4.3.A (continued)

(continuation of Subtable 4.3.A.23)		GULF OF ALASKA POLLOCK TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Chinook salmon	*Oncorhynchus tshawytscha*	2005	191,339.58	Pounds	
Deepsea smelts*	Bathylagidae	2003–05	0	Pounds	
Deepwater flatfish*		2005	0	Pounds	
Demersal shelf rockfish*		2005	0	Pounds	
Eelpouts*	Zoarcidae	2003–05	923.02	Pounds	
Eulachon (smelt)	*Thaleichthys pacificus*	2003–05	781,206.28	Pounds	
Flatfish*	Pleuronectiformes	2005	0	Pounds	
Flathead sole, Gulf of Alaska	*Hippoglossoides elassodon*	2005	20,522.81	Pounds	
Giant grenadier*	*Albatrossia pectoralis*	2003–05	33,375.18	Pounds	
Golden king crab, non-FSSI stock	*Lithodes aequispina*	2005	0	Pounds	
Greenland turbot, non-FSSI stock	*Reinhardtius hippoglossoides*	2005	0	Pounds	
Greenlings*	Hexagrammidae	2003–05	213.96	Pounds	
Grenadier*	Macrouridae	2005	40,211.34	Pounds	
Gunnels*	Pholidae	2003–05	8.22	Pounds	
Hermit crab, unidentified*	Paguroidea	2003–05	0.05	Pounds	
Herring	*Clupea pallasi*	2005	27,179.64	Pounds	
Invertebrate, unidentified*	Invertebrata	2003–05	0	Pounds	
Lanternfishes*	Myctophidae	2003–05	112.77	Pounds	
Large sculpins*	Cottidae	2003–05	63.64	Pounds	
Longnose skate	*Raja rhina*	2005	2,762.39	Pounds	
Miscellaneous crabs*	Decapoda	2003–05	54.40	Pounds	
Miscellaneous crustaceans*	Crustaceamorpha	2003–05	0	Pounds	
Miscellaneous deep fish*	Teleostomi	2003–05	0	Pounds	
Miscellaneous fish*	Teleostomi	2003–05	53,757.04	Pounds	
Non-Chinook salmon*	Salmonidae	2005	3,790.58	Pounds	
Northern rockfish, Western/Central Gulf of Alaska	*Sebastes polyspinis*	2005	0	Pounds	
Octopus*	Octopoda	2003–05	43.36	Pounds	
Other osmerids*	Osmeridae	2003–05	404,707.89	Pounds	
Other sculpins*	Cottidae	2003–05	649.83	Pounds	
Other species*		2005	625,135.43	Pounds	
Pacific cod, Gulf of Alaska	*Gadus macrocephalus*	2005	11,311.91	Pounds	
Pacific hake	*Merluccius productus*	2005	0	Pounds	
Pacific halibut	*Hippoglossus stenolepis*	2005	5,288.59	Pounds	
Pacific ocean perch, Gulf of Alaska	*Sebastes alutus*	2005	55,311.71	Pounds	
Pacific sand lance	*Ammodytes hexapterus*	2003–05	2.20	Pounds	

Table 4.3.A (continued)

(continuation of Subtable 4.3.A.23)		GULF OF ALASKA POLLOCK TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Pandalid shrimp*	*Pandalus* spp.	2003–05	6,969.55	Pounds	
Pelagic shelf rockfish*		2005	171.96	Pounds	
Polychaete, unidentified*	Polychaeta	2003–05	0	Pounds	
Pricklebacks*	Stichaeidae	2003–05	79.18	Pounds	
Red king crab	*Paralithodes camtschaticus*	2005	0	Pounds	
Rex sole, Gulf of Alaska	*Glyptocephalus zachirus*	2005	2,429.49	Pounds	
Rock sole, non-FSSI stock	*Paraplagusia bilineata*	2005	0	Pounds	
Rockfish, unspecified*	Sebastidae	2005	548.95	Pounds	
Rougheye rockfish, Gulf of Alaska	*Sebastes aleutianus*	2005	31,371.74	Pounds	
Sablefish	*Anoplopoma fimbria*	2005	753.98	Pounds	
Scypho jellies*	Scyphozoa	2003–05	158,956.91	Pounds	
Sea anemone, unidentified*	Actinaria	2003–05	81.18	Pounds	
Sea pens and whips*	Octocorallia	2003–05	187.77	Pounds	
Sea star*	Asteroidea	2003–05	1,071.03	Pounds	
Shallow water flatfish*		2005	3,309.13	Pounds	
Shark*	Elasmobranchii	2003–05	47,439.75	Pounds	
Shortraker rockfish	*Sebastes borealis*	2005	6,801.25	Pounds	
Shortspine thornyhead, Gulf of Alaska	*Sebastolobus alascanus*	2005	0	Pounds	
Skate, unidentified*	Rajidae	2005	1,201.52	Pounds	
Snails*	Gastropoda	2003–05	0	Pounds	
Snow crab, non-FSSI stock	*Chionoecetes opilio*	2005	0	Pounds	
Sponge, unidentified*	Porifera	2003–05	0	Pounds	
Squid*	Decapoda	2005	0	Pounds	
Surf smelt	*Hypomesus pretiosus*	2003–05	324.76	Pounds	
Tanner crab, non-FSSI stock	*Chionoecetes bairdi*	2005	4.92	Pounds	
Urchins/dollars/cucumbers*	Echinodermata	2003–05	0	Pounds	
Walleye pollock, western/central Gulf of Alaska	*Theragra chalcogramma*	2005	2,382,901.01	Pounds	
Yellowfin sole, non-FSSI stock	*Limanda aspera*	2005	0	Pounds	
TOTAL FISHERY BYCATCH			5,469,800.09	Pounds	
TOTAL FISHERY LANDINGS			143,715,905.41	Pounds	
TOTAL CATCH (Bycatch + Landings)			149,185,705.50	Pounds	
FISHERY BYCATCH RATIO (Bycatch/Total Catch)			0.04		

Table 4.3.A (continued)

Subtable 4.3.A.24		**GULF OF ALASKA REX SOLE TRAWL**			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Alaska plaice, non-FSSI stock	*Pleuronectes quadrituberculatus*	2005	0	Pounds	
Arrowtooth flounder, Gulf of Alaska	*Atheresthes stomias*	2005	3,443,074.10	Pounds	
Atka mackerel, non-FSSI stock	*Pleurogrammus monopterygius*	2005	13,227.72	Pounds	
Benthic Urochordata*	Urochordata	2003–05	126.54	Pounds	
Big skate	*Raja binoculata*	2005	4,605.45	Pounds	
Bivalves*	Bivalvia	2003–05	457.33	Pounds	
Blue king crab	*Paralithodes platypus*	2005	0	Pounds	
Brittle star, unidentified*	Ophiuroidea	2003–05	7.72	Pounds	
Byrozoans/hydroids*	Bryozoa	2003–05	140.24	Pounds	
Capelin	*Mallotus villosus*	2003–05	3.64	Pounds	
Chinook salmon	*Oncorhynchus tshawytscha*	2005	3,581.86	Pounds	
Deepsea smelts*	Bathylagidae	2003–05	0	Pounds	
Deep water flatfish*		2005	105,819.56	Pounds	
Demersal shelf rockfish*		2005	0	Pounds	
Eelpouts*	Zoarcidae	2003–05	76.21	Pounds	
Eulachon (smelt)	*Thaleichthys pacificus*	2003–05	55.93	Pounds	
Flatfish*	Pleuronectiformes	2005	0	Pounds	
Flathead sole, Gulf of Alaska	*Hippoglossoides elassodon*	2005	40,829.56	Pounds	
Giant grenadier*	*Albatrossia pectoralis*	2003–05	2,754.17	Pounds	
Golden king crab, non-FSSI stock	*Lithodes aequispina*	2005	0	Pounds	
Greenland turbot, non-FSSI stock	*Reinhardtius hippoglossoides*	2005	0	Pounds	
Greenlings*	Hexagrammidae	2003–05	34.43	Pounds	
Grenadier*	Macrouridae	2005	2,432.95	Pounds	
Gunnels*	Pholidae	2003–05	0	Pounds	
Hermit crab, unidentified*	Paguroidea	2003–05	149.84	Pounds	
Herring	*Clupea pallasi*	2005	21.69	Pounds	
Invertebrate, unidentified*	Invertebrata	2003–05	59.22	Pounds	
Lanternfishes*	Myctophidae	2003–05	0	Pounds	
Large sculpins*	Cottidae	2003–05	23,228.31	Pounds	
Longnose skate	*Raja rhina*	2005	0	Pounds	
Miscellaneous crabs*	Decapoda	2003–05	709.84	Pounds	
Miscellaneous crustaceans*	Crustaceamorpha	2003–05	65.04	Pounds	
Miscellaneousdeep fish*	Teleostomi	2003–05	0	Pounds	
Miscellaneous fish*	Teleostomi	2003–05	30,795.44	Pounds	
Non-Chinook salmon*	Salmonidae	2005	462.09	Pounds	

Table 4.3.A (continued)

(continuation of Subtable 4.3.A.24)		GULF OF ALASKA REX SOLE TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Northern rockfish, western/central Gulf of Alaska	*Sebastes polyspinis*	2005	61,949.82	Pounds	
Octopus*	Octopoda	2003–05	151.38	Pounds	
Other osmerids*	Osmeridae	2003–05	26.07	Pounds	
Other sculpins*	Cottidae	2003–05	19,209.63	Pounds	
Other species*		2005	63,764.22	Pounds	
Pacific cod, Gulf of Alaska	*Gadus macrocephalus*	2005	30,688.31	Pounds	
Pacific hake	*Merluccius productus*	2005	0	Pounds	
Pacific halibut	*Hippoglossus stenolepis*	2005	117,850.37	Pounds	
Pacific ocean perch, Gulf of Alaska	*Sebastes alutus*	2005	254,402.12	Pounds	
Pacific sand lance	*Ammodytes hexapterus*	2003–05	0	Pounds	
Pandalid shrimp*	*Pandalus* spp.	2003–05	403.12	Pounds	
Pelagic shelf rockfish*		2005	350.53	Pounds	
Polychaete, unidentified*	Polychaeta	2003–05	22.22	Pounds	
Pricklebacks*	Stichaeidae	2003–05	81.36	Pounds	
Red king crab	*Paralithodes camtschaticus*	2005	0	Pounds	
Rex sole, Gulf of Alaska	*Glyptocephalus zachirus*	2005	66,813.21	Pounds	
Rock sole, non-FSSI stock	*Paraplagusia bilineata*	2005	0	Pounds	
Rockfish, unspecified*	Sebastidae	2005	0	Pounds	
Rougheye rockfish, Gulf of Alaska	*Sebastes aleutianus*	2005	9,380.66	Pounds	
Sablefish	*Anoplopoma fimbria*	2005	2,392.01	Pounds	
Scypho jellies*	Scyphozoa	2003–05	204.67	Pounds	
Sea anemone, unidentified*	Actinaria	2003–05	384.64	Pounds	
Sea pens whips	Octocorallia	2003–05	14.84	Pounds	
Sea star*	Asteroidea	2003–05	15,479.26	Pounds	
Shallow water flatfish*		2005	249.12	Pounds	
Shark*	Elasmobranchii	2003–05	145,154.39	Pounds	
Shortraker rockfish	*Sebastes borealis*	2005	1,102.31	Pounds	
Shortspine thornyhead, Gulf of Alaska	*Sebastolobus alascanus*	2005	220.46	Pounds	
Skate, unidentified*	Rajidae	2005	32,348.39	Pounds	
Snails*	Gastropoda	2003–05	608.99	Pounds	
Snow crab, non-FSSI stock	*Chionoecetes opilio*	2005	0	Pounds	
Sponge, unidentified*	Porifera	2003–05	284.84	Pounds	
Squid*	Decapoda	2005	0	Pounds	
Surf smelt	*Hypomesus pretiosus*	2003–05	0	Pounds	
Tanner crab, non-FSSI stock	*Chionoecetes bairdi*	2005	6,964.14	Pounds	

Table 4.3.A (continued)

(continuation of Subtable 4.3.A.24)		GULF OF ALASKA REX SOLE TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Urchins/dollars/cucumbers*	Echinodermata	2003–05	1,879.39	Pounds	
Walleye pollock, western/central Gulf of Alaska	*Theragra chalcogramma*	2005	482.81	Pounds	
Yellowfin sole, non-FSSI stock	*Limanda aspera*	2005	0	Pounds	
TOTAL FISHERY BYCATCH			4,505,582.16	Pounds	
TOTAL FISHERY LANDINGS			4,568,268.79	Pounds	
TOTAL CATCH (Bycatch + Landings)			9,073,850.95	Pounds	
FISHERY BYCATCH RATIO (Bycatch/Total Catch)			0.5		

Subtable 4.3.A.25		GULF OF ALASKA ROCKFISH (NORTHERN ROCKFISH, PELAGIC SHELF ROCKFISH*, PACIFIC OCEAN PERCH) TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Alaska plaice, non-FSSI stock	*Pleuronectes quadrituberculatus*	2005	0.00	Pounds	
Arrowtooth flounder, Gulf of Alaska	*Atheresthes stomias*	2005	1,518,368.09	Pounds	
Atka mackerel, non-FSSI stock	*Pleurogrammus monopterygius*	2005	223,735.86	Pounds	
Benthic Urochordata*	Urochordata	2003–05	97.02	Pounds	
Big skate	*Raja binoculata*	2005	32,377.05	Pounds	
Bivalves*	Bivalvia	2003–05	3.78	Pounds	
Blue king crab	*Paralithodes platypus*	2005	0	Pounds	
Brittle star, unidentified*	Ophiuroidea	2003–05	145.96	Pounds	
Byrozoans/hydroids*	Bryozoa	2003–05	5,947.84	Pounds	
Capelin	*Mallotus villosus*	2003–05	0	Pounds	
Chinook salmon	*Oncorhynchus tshawytscha*	2005	3,243.64	Pounds	
Deepsea smelts*	Bathylagidae	2003–05	0	Pounds	
Deepwater flatfish*		2005	123,626.27	Pounds	
Demersal shelf rockfish*		2005	0	Pounds	
Eelpouts*	Zoarcidae	2003–05	8,644.81	Pounds	
Eulachon (smelt)	*Thaleichthys pacificus*	2003–05	217.00	Pounds	
Flatfish*	Pleuronectiformes	2005	0	Pounds	
Flathead sole, Gulf of Alaska	*Hippoglossoides elassodon*	2005	19,636.55	Pounds	
Giant grenadier*	*Albatrossia pectoralis*	2003–05	201,176.72	Pounds	
Golden king crab, non-FSSI stock	*Lithodes aequispina*	2005	0	Pounds	
Greenland turbot, non-FSSI stock	*Reinhardtius hippoglossoides*	2005	0	Pounds	
Greenlings*	Hexagrammidae	2003–05	13,842.56	Pounds	

Table 4.3.A (continued)

(continuation of Subtable 4.3.A.25)

		GULF OF ALASKA ROCKFISH (NORTHERN ROCKFISH, PELAGIC SHELF ROCKFISH*, PACIFIC OCEAN PERCH) TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Grenadier*	Macrouridae	2005	177,279.20	Pounds	
Gunnels*	Pholidae	2003–05	0	Pounds	
Hermit crab, unidentified*	Paguroidea	2003–05	46.16	Pounds	
Herring	*Clupea pallasi*	2005	0	Pounds	
Invertebrate, unidentified*	Invertebrata	2003–05	1,085.55	Pounds	
Lanternfishes*	Myctophidae	2003–05	0	Pounds	
Large sculpins*	Cottidae	2003–05	43,798.33	Pounds	
Longnose skate	*Raja rhina*	2005	20,161.25	Pounds	
Miscellaneous crabs*	Decapoda	2003–05	787.28	Pounds	
Miscellaneous crustaceans*	Crustaceamorpha	2003–05	17.82	Pounds	
Miscellaneous deep fish*	Teleostomi	2003–05	0	Pounds	
Miscellaneous fish	Teleostomi	2003–05	278,478.13	Pounds	
Non-Chinook salmon*	Salmonidae	2005	16,298.40	Pounds	
Northern rockfish, western/central Gulf of Alaska	*Sebastes polyspinis*	2005	247,547.96	Pounds	
Octopus*	Octopoda	2003–05	806.16	Pounds	
Other osmerids*	Osmeridae	2003–05	520.80	Pounds	
Other sculpins*	Cottidae	2003–05	39,390.36	Pounds	
Other species*		2005	81,198.36	Pounds	
Pacific cod, Gulf of Alaska	*Gadus macrocephalus*	2005	82,986.31	Pounds	
Pacific hake	*Merluccius productus*	2005	0	Pounds	
Pacific halibut	*Hippoglossus stenolepis*	2005	577,588.27	Pounds	
Pacific ocean perch, Gulf of Alaska	*Sebastes alutus*	2005	942,481.66	Pounds	
Pacific sand lance	*Ammodytes hexapterus*	2003–05	0	Pounds	
Pandalid shrimp*	*Pandalus* spp.	2003–05	1,080.39	Pounds	
Pelagic shelf rockfish*		2005	127,330.03	Pounds	
Polychaete, unidentified*	Polychaeta	2003–05	3.20	Pounds	
Pricklebacks*	Stichaeidae	2003–05	0	Pounds	
Red king crab	*Paralithodes camtschaticus*	2005	0	Pounds	
Rex sole, Gulf of Alaska	*Glyptocephalus zachirus*	2005	63,473.21	Pounds	
Rock sole, non-FSSI stock	*Paraplagusia bilineata*	2005	0	Pounds	
Rockfish, unspecified*	Sebastidae	2005	516,540.26	Pounds	
Rougheye rockfish, Gulf of Alaska	*Sebastes aleutianus*	2005	14,989.21	Pounds	
Sablefish	*Anoplopoma fimbria*	2005	295,502.86	Pounds	
Scypho jellies*	Scyphozoa	2003–05	2,740.79	Pounds	

Table 4.3.A (continued)

(continuation of Subtable 4.3.A.25)

		GULF OF ALASKA ROCKFISH (NORTHERN ROCKFISH, PELAGIC SHELF ROCKFISH*, PACIFIC OCEAN PERCH) TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Sea anemone, unidentified*	Actinaria	2003–05	4,806.91	Pounds	
Sea pens and whips*	Octocorallia	2003–05	33.18	Pounds	
Sea star*	Asteroidea	2003–05	5,052.29	Pounds	
Shallow-water flatfish*		2005	50,631.30	Pounds	
Shark*	Elasmobranchii	2003–05	3,540.62	Pounds	
Shortraker rockfish	*Sebastes borealis*	2005	21,697.87	Pounds	
Shortspine thornyhead, Gulf of Alaska	*Sebastolobus alascanus*	2005	49,004.29	Pounds	
Skate, unidentified*	Rajidae	2005	122,437.98	Pounds	
Snails*	Gastropoda	2003–05	648.14	Pounds	
Snow crab, non-FSSI stock	*Chionoecetes opilio*	2005	0	Pounds	
Sponge, unidentified*	Porifera	2003–05	4,472.48	Pounds	
Squid*	Decapoda	2005	0	Pounds	
Surf smelt	*Hypomesus pretiosus*	2003–05	0	Pounds	
Tanner crab, non-FSSI stock	*Chionoecetes bairdi*	2005	1,412.96	Pounds	
Urchins/dollars/cucumbers*	Echinodermata	2003–05	822.82	Pounds	
Walleye pollock, western/central Gulf of Alaska	*Theragra chalcogramma*	2005	38,957.84	Pounds	
Yellowfin sole, non-FSSI stock	*Limanda aspera*	2005	0	Pounds	
TOTAL FISHERY BYCATCH			5,986,713.78	Pounds	
TOTAL FISHERY LANDINGS			47,750,722.91	Pounds	
TOTAL CATCH (Bycatch + Landings)			53,737,436.69	Pounds	
FISHERY BYCATCH RATIO (Bycatch/Total Catch)			0.11		

Subtable 4.3.A.26

		GULF OF ALASKA SABLEFISH LONGLINE			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Alaska plaice, non-FSSI stock	*Pleuronectes quadrituberculatus*	2005	0	Pounds	
Arrowtooth flounder, Gulf of Alaska	*Atheresthes stomias*	2005	356,581.85	Pounds	
Atka mackerel, non-FSSI stock	*Pleurogrammus monopterygius*	2005	13.23	Pounds	
Benthic Urochordata*	Urochordata	2003–05	12.96	Pounds	
Big skate	*Raja binoculata*	2005	42,474.21	Pounds	
Bivalves*	Bivalvia	2003–05	8.59	Pounds	
Blue king crab	*Paralithodes platypus*	2005	65.60	Pounds	
Brittle star, unidentified*	Ophiuroidea	2003–05	196.64	Pounds	

Table 4.3.A (continued)

(continuation of Subtable 4.3.A.26)		GULF OF ALASKA SABLEFISH LONGLINE			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Byrozoans/hydroids*	Bryozoa	2003–05	688.22	Pounds	
Capelin	*Mallotus villosus*	2003–05	0	Pounds	
Chinook salmon	*Oncorhynchus tshawytscha*	2005	0	Pounds	
Deepsea smelts*	Bathylagidae	2003–05	0	Pounds	
Deepwater flatfish*		2005	24,570.49	Pounds	
Demersal shelf rockfish*		2005	158.73	Pounds	
Eelpouts*	Zoarcidae	2003–05	147.03	Pounds	
Eulachon (smelt)	*Thaleichthys pacificus*	2003–05	0	Pounds	
Flatfish*	Pleuronectiformes	2005	0	Pounds	
Flathead sole, Gulf of Alaska	*Hippoglossoides elassodon*	2005	264.55	Pounds	
Giant grenadier*	*Albatrossia pectoralis*	2003–05	2,229,538.74	Pounds	
Golden king crab, non-FSSI stock	*Lithodes aequispina*	2005	127.20	Pounds	
Greenland turbot, non-FSSI stock	*Reinhardtius hippoglossoides*	2005	0	Pounds	
Greenlings*	Hexagrammidae	2003–05	8.91	Pounds	
Grenadier*	Macrouridae	2005	4,418,987.04	Pounds	
Gunnels*	Pholidae	2003–05	0	Pounds	
Hermit crab, unidentified*	Paguroidea	2003–05	0	Pounds	
Herring	*Clupea pallasi*	2005	0	Pounds	
Invertebrate, unidentified*	Invertebrata	2003–05	65.66	Pounds	
Lanternfishes*	Myctophidae	2003–05	0	Pounds	
Large sculpins*	Cottidae	2003–05	13,342.01	Pounds	
Longnose skate	*Raja rhina*	2005	206,967.52	Pounds	
Miscellaneous crabs*	Decapoda	2003–05	29.95	Pounds	
Miscellaneous crustaceans*	Crustaceamorpha	2003–05	0	Pounds	
Miscellaneous deep fish*	Teleostomi	2003–05	0	Pounds	
Miscellaneous fish*	Teleostomi	2003–05	35,226.31	Pounds	
Non-Chinook salmon*	Salmonidae	2005	845.78	Pounds	
Northern rockfish, western/central Gulf of Alaska	*Sebastes polyspinis*	2005	308.65	Pounds	
Octopus*	Octopoda	2003–05	208.70	Pounds	
Other osmerids*	Osmeridae	2003–05	0	Pounds	
Other sculpins*	Cottidae	2003–05	770.97	Pounds	
Other species*		2005	770,172.97	Pounds	
Pacific cod, Gulf of Alaska	*Gadus macrocephalus*	2005	111,059.94	Pounds	
Pacific hake	*Merluccius productus*	2005	0	Pounds	
Pacific halibut	*Hippoglossus stenolepis*	2005	655,301.66	Pounds	

Table 4.3.A (continued)

(continuation of Subtable 4.3.A.26)		GULF OF ALASKA SABLEFISH LONGLINE			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Pacific ocean perch, Gulf of Alaska	*Sebastes alutus*	2005	0	Pounds	
Pacific sand lance	*Ammodytes hexapterus*	2003–05	0	Pounds	
Pandalid shrimp*	*Pandalus* spp.	2003–05	0	Pounds	
Pelagic shelf rockfish*		2005	1,285.29	Pounds	
Polychaete, unidentified*	Polychaeta	2003–05	0	Pounds	
Pricklebacks*	Stichaeidae	2003–05	0	Pounds	
Red king crab	*Paralithodes camtschaticus*	2005	482.83	Pounds	
Rex sole, Gulf of Alaska	*Glyptocephalus zachirus*	2005	0	Pounds	
Rock sole, non-FSSI stock	*Paraplagusia bilineata*	2005	0	Pounds	
Rockfish, unspecified*	Sebastidae	2005	73,832.72	Pounds	
Rougheye rockfish, Gulf of Alaska	*Sebastes aleutianus*	2005	63,206.46	Pounds	
Sablefish	*Anoplopoma fimbria*	2005	429,680.44	Pounds	
Scypho jellies*	Scyphozoa	2003–05	99.60	Pounds	
Sea anemone, unidentified*	Actinaria	2003–05	465.08	Pounds	
Sea pens and whips	Octocorallia	2003–05	162.36	Pounds	
Sea star*	Asteroidea	2003–05	2,546.31	Pounds	
Shallow-water flatfish*		2005	16,380.33	Pounds	
Shark*	Elasmobranchii	2003–05	26,052.73	Pounds	
Shortraker rockfish	*Sebastes borealis*	2005	142,092.17	Pounds	
Shortspine thornyhead, Gulf of Alaska	*Sebastolobus alascanus*	2005	86,458.58	Pounds	
Skate, unidentified*	Rajidae	2005	260,663.25	Pounds	
Snails*	Gastropoda	2003–05	20.99	Pounds	
Snow crab, non-FSSI stock	*Chionoecetes opilio*	2005	0	Pounds	
Sponge, unidentified*	Porifera	2003–05	307.30	Pounds	
Squid*	Decapoda	2005	0	Pounds	
Surf smelt	*Hypomesus pretiosus*	2003–05	0	Pounds	
Tanner crab, non-FSSI stock	*Chionoecetes bairdi*	2005	334.46	Pounds	
Urchins/dollars/cucumbers*	Echinodermata	2003–05	1.47	Pounds	
Walleye pollock, western/central Gulf of Alaska	*Theragra chalcogramma*	2005	238.10	Pounds	
Yellowfin sole, non-FSSI stock	*Limanda aspera*	2005	0	Pounds	
TOTAL FISHERY BYCATCH			9,972,454.58	Pounds	
TOTAL FISHERY LANDINGS			31,517,893.47	Pounds	
TOTAL CATCH (Bycatch + Landings)			41,490,348.05	Pounds	
FISHERY BYCATCH RATIO (Bycatch/Total Catch)			0.24		

Table 4.3.A (continued)

Subtable 4.3.A.27		GULF OF ALASKA SABLEFISH TRAWL[b]			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Alaska plaice, non-FSSI stock	*Pleuronectes quadrituberculatus*	2005	0	Pounds	
Arrowtooth flounder, Gulf of Alaska	*Atheresthes stomias*	2005	0	Pounds	
Atka mackerel, non-FSSI stock	*Pleurogrammus monopterygius*	2005	0	Pounds	
Benthic Urochordata*	Urochordata	2003–05	0	Pounds	
Big skate	*Raja binoculata*	2005	0	Pounds	
Bivalves*	Bivalvia	2003–05	0	Pounds	
Blue king crab	*Paralithodes platypus*	2005	0	Pounds	
Brittle star, unidentified*	Ophiuroidea	2003–05	0	Pounds	
Byrozoans/hydroids*	Bryozoa	2003–05	0	Pounds	
Capelin	*Mallotus villosus*	2003–05	0	Pounds	
Chinook salmon	*Oncorhynchus tshawytscha*	2005	0	Pounds	
Deepsea smelts*	Bathylagidae	2003–05	0	Pounds	
Deepwater flatfish*		2005	0	Pounds	
Demersal shelf rockfish*		2005	0	Pounds	
Eelpouts*	Zoarcidae	2003–05	0	Pounds	
Eulachon (smelt)	*Thaleichthys pacificus*	2003–05	0	Pounds	
Flatfish*	Pleuronectiformes	2005	0	Pounds	
Flathead sole, Gulf of Alaska	*Hippoglossoides elassodon*	2005	0	Pounds	
Giant grenadier*	*Albatrossia pectoralis*	2003–05	0	Pounds	
Golden king crab, non-FSSI stock	*Lithodes aequispina*	2005	0	Pounds	
Greenland turbot, non-FSSI stock	*Reinhardtius hippoglossoides*	2005	0	Pounds	
Greenlings*	Hexagrammidae	2003–05	0	Pounds	
Grenadier*	Macrouridae	2005	0	Pounds	
Gunnels*	Pholidae	2003–05	0	Pounds	
Hermit crab, unidentified*	Paguroidea	2003–05	0	Pounds	
Herring	*Clupea pallasi*	2005	0	Pounds	
Invertebrate, unidentified*	Invertebrata	2003–05	0	Pounds	
Lanternfishes*	Myctophidae	2003–05	0	Pounds	
Large sculpins*	Cottidae	2003–05	0	Pounds	
Longnose skate	*Raja rhina*	2005	0	Pounds	
Miscellaneous crabs*	Decapoda	2003–05	0	Pounds	
Miscellaneous crustaceans*	Crustaceamorpha	2003–05	0	Pounds	
Miscellaneous deep fish*	Teleostomi	2003–05	0	Pounds	
Miscellaneous fish*	Teleostomi	2003–05	147.25	Pounds	
Non-Chinook salmon*	Salmonidae	2005	0	Pounds	

[b] In 2005, vessels in the "Gulf of Alaska sablefish trawl fishery" caught sablefish as part of the Gulf of Alaska rockfish trawl fishery

Table 4.3.A (continued)

(continuation of Subtable 4.3.A.27)		GULF OF ALASKA SABLEFISH TRAWL[b]			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Northern rockfish, western/central Gulf of Alaska	*Sebastes polyspinis*	2005	0	Pounds	
Octopus*	Octopoda	2003–05	0	Pounds	
Other osmerids*	Osmeridae	2003–05	0	Pounds	
Other sculpins*	Cottidae	2003–05	26.71	Pounds	
Other species*		2005	0	Pounds	
Pacific cod, Gulf of Alaska	*Gadus macrocephalus*	2005	0	Pounds	
Pacific hake	*Merluccius productus*	2005	0	Pounds	
Pacific halibut	*Hippoglossus stenolepis*	2005	0	Pounds	
Pacific ocean perch, Gulf of Alaska	*Sebastes alutus*	2005	0	Pounds	
Pacific sand lance	*Ammodytes hexapterus*	2003–05	0	Pounds	
Pandalid shrimp*	*Pandalus* spp.	2003–05	0	Pounds	
Pelagic shelf rockfish*		2005	0	Pounds	
Polychaete, unidentified*	Polychaeta	2003–05	0	Pounds	
Pricklebacks*	Stichaeidae	2003–05	0	Pounds	
Red king crab	*Paralithodes camtschaticus*	2005	0	Pounds	
Rex sole, Gulf of Alaska	*Glyptocephalus zachirus*	2005	0	Pounds	
Rock sole, non-FSSI stock	*Paraplagusia bilineata*	2005	0	Pounds	
Rockfish, unspecified*	Sebastidae	2005	0	Pounds	
Rougheye rockfish, Gulf of Alaska	*Sebastes aleutianus*	2005	0	Pounds	
Sablefish	*Anoplopoma fimbria*	2005	0	Pounds	
Scypho jellies*	Scyphozoa	2003–05	0	Pounds	
Sea anemone, unidentified*	Actinaria	2003–05	0	Pounds	
Sea pens and whips*	Octocorallia	2003–05	0	Pounds	
Sea star*	Asteroidea	2003–05	0	Pounds	
Shallow-water flatfish*		2005	0	Pounds	
Shark*	Elasmobranchii	2003–05	0	Pounds	
Shortraker rockfish	*Sebastes borealis*	2005	0	Pounds	
Shortspine thornyhead, Gulf of Alaska	*Sebastolobus alascanus*	2005	0	Pounds	
Skate, unidentified*	Rajidae	2005	0	Pounds	
Snails*	Gastropoda	2003–05	0	Pounds	
Snow crab, non-FSSI stock	*Chionoecetes opilio*	2005	0	Pounds	
Sponge, unidentified*	Porifera	2003–05	0	Pounds	
Squid*	Decapoda	2005	0	Pounds	
Surf smelt	*Hypomesus pretiosus*	2003–05	0	Pounds	

Table 4.3.A (continued)

(continuation of Subtable 4.3.A.27)		GULF OF ALASKA SABLEFISH TRAWL[b]			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Tanner crab, non-FSSI stock	*Chionoecetes bairdi*	2005	0	Pounds	
Urchins/dollars/cucumbers*	Echinodermata	2003–05	0	Pounds	
Walleye pollock, western/central Gulf of Alaska	*Theragra chalcogramma*	2005	0	Pounds	
Yellowfin sole, non-FSSI stock	*Limanda aspera*	2005	0	Pounds	
TOTAL FISHERY BYCATCH			173.96	Pounds	
TOTAL FISHERY LANDINGS			108,353.4	Pounds	
TOTAL CATCH (Bycatch +Landings)			108,527.36	Pounds	
FISHERY BYCATCH RATIO (Bycatch/Total Catch)			0.0		

Table 4.3.B

Summary of Alaska region bycatch by stocks and species. All estimates are live weights. The species bycatch ratio is the total regional bycatch of a species / (total regional landings of the species + total regional bycatch the species); see Chapter 3 for details on ratio calculation. * following the names of species groups indicates landings were not available by species, as it was not possible to determine the exact composition of the bycatch and the proportion of bycatch and landings to allocate to each species. ** indicates that a bycatch ratio could not be developed because bycatch estimates were provided in both numbers of individuals and in pounds, or because landings were not available. Confidential landings are not presented. Key species have been shaded.

		TOTAL STOCK BYCATCH[a]		TOTAL SPECIES BYCATCH		SPECIES LANDINGS[b]		SPECIES BYCATCH RATIO
COMMON NAME	**SCIENTIFIC NAME**	**AMOUNT**	**UNIT**	**AMOUNT**	**UNIT**	**2005 LANDINGS**	**UNIT**	**RATIO**
Alaska plaice, Bering Sea/Aleutian Islands[c]	*Pleuronectes quadrituberculatus*	22,927,964.22	Pounds	22,927,964.22	Pounds	See footnote	–	**
Alaska plaice, non-FSSI stock[c]	*Pleuronectes quadrituberculatus*	0	Pounds					
Arrowtooth flounder, Bering Sea/Aleutian Islands	*Atheresthes stomias*	15,299,302.19	Pounds	32,427,709.25	Pounds	42,157,859.00	Pounds	0.44
Arrowtooth flounder, Gulf of Alaska	*Atheresthes stomias*	17,128,407.06	Pounds					
Atka mackerel, Bering Sea/Aleutian Islands	*Pleurogrammus monopterygius*	8,874,589.78	Pounds	9,216,700.51	Pounds	129,482,451.00	Pounds	0.07
Atka mackerel, non-FSSI stock	*Pleurogrammus monopterygius*	342,110.73	Pounds					
Benthic Urochordata*	Urochordata	See species column		3,459,633.32	Pounds	–	–	**
Big skate[d]	*Raja binoculata*			517,567.63	Pounds	See footnote	–	**
Bivalves*	Bivalvia			46,004.66	Pounds	–	–	**
Blue king crab[e]	*Paralithodes platypus*			5,432.46	Pounds	See footnote	–	**
Brittle star, unidentified*	Ophiuroidea			82,884.50	Pounds	–	–	**
Byrozoans/hydroids*	Bryozoa			119,258.95	Pounds	–	–	**
Capelin[f]	*Mallotus villosus*			60,914.52	Pounds	See footnote	–	**
Chinook salmon[e]	*Oncorhynchus tshawytscha*			721,067.22	Pounds	See footnote	–	**
Deepsea smelts	Bathylagidae			0.30	Pounds	–	–	**
Deepwater flatfish*				537,420.22	Pounds	–	–	**
Demersal shelf rockfish*				160.93	Pounds	–	–	**
Eelpouts*	Zoarcidae			304,554.65	Pounds	–	–	**
Eulachon (smelt)	*Thaleichthys pacificus*			824,831.56	Pounds	^	–	**
Flatfish*	Pleuronectiformes			6,070,956.90	Pounds	–	–	**
Flathead sole, Bering Sea/Aleutian Islands	*Hippoglossoides elassodon*	8,566,835.84	Pounds	9,311,878.34	Pounds	31,867,547.00	Pounds	0.23

Table 4.3.B (continued)

		TOTAL STOCK BYCATCH[a]		TOTAL SPECIES BYCATCH		SPECIES LANDINGS[b]		SPECIES BYCATCH RATIO
COMMON NAME	**SCIENTIFIC NAME**	**AMOUNT**	**UNIT**	**AMOUNT**	**UNIT**	**2005 LANDINGS**	**UNIT**	**RATIO**
Flathead sole, Gulf of Alaska	*Hippoglossoides elassodon*	745,042.50	Pounds					
Giant grenadier*	*Albatrossia pectoralis*	See species column		4,465,720.64	Pounds	–	–	**
Golden king crab, Aleutian Islands[e]	*Lithodes aequispina*	16,927.02	Pounds	17,081.34	Pounds	See footnote	–	**
Golden king crab, non-FSSI stock[e]	*Lithodes aequispina*	154.32	Pounds					
Greenland turbot, Bering Sea/Aleutian Islands	*Reinhardtius hippoglossoides*	443,060.29	Pounds	443,060.29	Pounds	5,219,457.00	Pounds	0.08
Greenland turbot, non-FSSI stock	*Reinhardtius hippoglossoides*	0	Pounds					
Greenlings*	Hexagrammidae	See species column		39,377.00	Pounds	–	–	**
Grenadier*	Macrouridae			7,009,930.42	Pounds	–	–	**
Gunnels*	Pholidae			150.69	Pounds	–	–	**
Hermit crab, unidentified*	Paguroidea			212,343.71	Pounds	–	–	**
Herring[e]	*Clupea pallasi*			1,560,716.15	Pounds	See footnote	–	**
Invertebrate, unidentified*	Invertebrata			1,406,843.01	Pounds	–	–	**
Lanternfishes*	Myctophidae			851.57	Pounds	–	–	**
Large sculpins*	Cottidae			9,376,890.16	Pounds	–	–	**
Longnose skate[d]	*Raja rhina*			652,545.48	Pounds	See footnote	–	**
Miscellaneous crabs*	Decapoda			97,424.86	Pounds	–	–	**
Miscellaneous crustaceans*	Crustaceamorpha			2,452.87	Pounds	–	–	**
Miscellaneous deep fish*	Teleostomi			56.13	Pounds	–	–	**
Miscellaneous fish*	Teleostomi			2,167,723.56	Pounds	–	–	**
Non-Chinook salmon*[e]	Salmonidae			3,351,606.73	Pounds	See footnote	–	**
Northern rockfish, Bering Sea/Aleutian Islands	*Sebastes polyspinis*			7,044,607.46	Pounds	–	–	**
Northern rockfish, western/central Gulf of Alaska	*Sebastes polyspinis*							
Octopus*	Octopoda			806,814.47	Pounds	–	–	**
Other osmerids*	Osmeridae			432,614.87	Pounds	–	–	**
Other sculpins*	Cottidae			4,554,067.80	Pounds	–	–	**
Other species*				50,263,783.94	Pounds	–	–	**
Pacific cod, Bering Sea/Aleutian Islands	*Gadus macrocephalus*	7,881,278.40	Pounds	10,083,490.97	Pounds	546,748,030.00	Pounds	0.02
Pacific cod, Gulf of Alaska	*Gadus macrocephalus*	2,202,212.57	Pounds					

Table 4.3.B (continued)

		TOTAL STOCK BYCATCH[a]		TOTAL SPECIES BYCATCH		SPECIES LANDINGS[b]		SPECIES BYCATCH RATIO
COMMON NAME	**SCIENTIFIC NAME**	**AMOUNT**	**UNIT**	**AMOUNT**	**UNIT**	**2005 LANDINGS**	**UNIT**	**RATIO**
Pacific hake[f]	*Merluccius productus*	See species column		46.5	Pounds	See footnote	–	0.11
Pacific halibut[e]	*Hippoglossus stenolepis*			15,297,086.32	Pounds	See footnote	–	**
Pacific ocean perch, Bering Sea/Aleutian Islands	*Sebastes alutus*	3,747,335.92	Pounds	5,204,153.21	Pounds	42,818,965.00	Pounds	0.11
Pacific ocean perch, Gulf of Alaska	*Sebastes alutus*	1,456,817.29	Pounds					
Pacific sand lance[f]	*Ammodytes hexapterus*	441.48	Pounds	441.48	Pounds	See footnote	–	**
Pandalid shrimp*	*Pandalus* spp.	See species column		16,043.35	Pounds	–	–	**
Pelagic shelf rockfish*				194,412.19	Pounds	–	–	**
Polychaete, unidentified*	Polychaeta			270.34	Pounds	–	–	**
Pricklebacks*[f]	Stichaeidae			2,393.25	Pounds	See footnote	–	**
Red king crab[e]	*Paralithodes camtschaticus*			630,336.38	Pounds	See footnote	–	
Rex sole, Gulf of Alaska	*Glyptocephalus zachirus*	413,108.30	Pounds	413,108.30	Pounds	8,005,331.00	Pounds	0.05
Rex sole, non-FSSI stock	*Glyptocephalus zachirus*	0	Pounds					
Rock sole, Bering Sea/ Aleutian Islands	*Paraplagusia bilineata*	28,675,860.54	Pounds	28,675,860.54	Pounds	62,235,112.00	Pounds	0.32
Rock sole, non-FSSI stock	*Paraplagusia bilineata*	0	Pounds					
Rockfish, unspecified*	Sebastidae	Bycatch not available at stock level; See species column		936,317.55	Pounds	–	–	**
Rougheye rockfish, Bering Sea/Aleutian Islands[g]	*Sebastes aleutianus*	32,646.00	Pounds	178,459.57	Pounds	See footnote	–	**
Rougheye rockfish, Gulf of Alaska[g]	*Sebastes aleutianus*	145,813.57	Pounds					
Sablefish	*Anoplopoma fimbria*	See species column		1,105,877.08	Pounds	37,351,512.00	Pounds	0.03
Scypho jellies*	Scyphozoa			15,061,185.85	Pounds	–	–	**
Sea anemone, unidentified*	Actinaria			336,984.73	Pounds	–	–	**
Sea pens and whips*	Octocorallia			29,776.95	Pounds	–	–	**
Sea star*	Asteroidea			8,754,192.18	Pounds	–	–	**
Shallow-water flatfish*				736,451.11	Pounds	–	–	**
Shark*	Elasmobranchii			1,188,318.84	Pounds	–	–	**
Shortraker rockfish[g]	*Sebastes borealis*			266,044.71	Pounds	See footnote	–	**

Table 4.3.B (continued)

		TOTAL STOCK BYCATCH[a]		TOTAL SPECIES BYCATCH		SPECIES LANDINGS[b]		SPECIES BYCATCH RATIO
COMMON NAME	**SCIENTIFIC NAME**	**AMOUNT**	**UNIT**	**AMOUNT**	**UNIT**	**2005 LANDINGS**	**UNIT**	**RATIO**
Shortspine thornyhead, Gulf of Alaska[c]	*Sebastolobus alascanus*	150,500.58	Pounds	150,500.58	Pounds	See footnote	–	**
Shortspine thornyhead, non-FSSI stock[c]	*Sebastolobus alascanus*	0	Pounds					
Skate, unidentified*	Rajidae	See species column		1,302,690.13	Pounds	–	–	**
Snails*	Gastropoda			446,260.26	Pounds	–	–	**
Snow crab, Bering Sea[e]	*Chionoecetes opilio*	2,329,203.23	Pounds	2,329,216.88	Pounds	See footnote	–	**
Snow crab, non-FSSI stock[e]	*Chionoecetes opilio*	13.65	Pounds					
Sponge, unidentified*	Porifera	See species column		525,502.33	Pounds	–	–	**
Squid*	Decapoda			97,424.86	Pounds	–	–	**
Surf smelt[f]	*Hypomesus pretiosus*			655.25	Pounds	See footnote	–	**
Tanner crab, Eastern Bering Sea[e]	*Chionoecetes bairdi*	1,158.19	Pounds	1,699,916.47	Pounds	See footnote	–	**
Tanner crab, non-FSSI stock	*Chionoecetes bairdi*	1,698,758.28	Pounds					
Urchins/dollars/ cucumbers*	Echinodermata	71,397.83	Pounds	71,397.83	Pounds	–	–	**
Walleye pollock, Aleutian Islands	*Theragra chalcogramma*	38,730,903.03	Pounds	41,638,388.97	Pounds	3,410,064,761.00	Pounds	0.01
Walleye pollock, eastern Bering Sea	*Theragra chalcogramma*	384,309.36	Pounds					
Walleye pollock, western/central Gulf of Alaska	*Theragra chalcogramma*	2,523,176.58	Pounds					
Yellowfin sole, Bering Sea/Aleutian Islands	*Limanda aspera*	20,001,800.77	Pounds	20,001,800.77	Pounds	188,105,064.00	Pounds	0.1
Yellowfin sole, non-FSSI stock	*Limanda aspera*	0	Pounds					

[a] Bycatch at the stock level is listed only for species with bycatch of more than one substock. If one or no substocks occur, total bycatch is listed in the species column.

[b] Landed weights are for catch sold only.

[c] Landings were not available from the NMFS commercial landings database for these species. Alaskan plaice may be included under Other Pacific flatfish, while the landings for shortspine thornyhead may be included under Pacific rockfishes. Both categories are too general to compare landings to bycatch. These landings may be available at the regional level; however, for national consistency NMFS has elected to use the national landings database in this report. Landings from both species are being identified and will be included in future editions of this report.

[d] Landings were not available from the national database for big or longnose skates. It is possible that landings for these species are included in landings of "skates," along with other skate species. Within the national database, Alaska Region landings for skates were listed as 20,726,120 pounds in 2005, but this value cannot be used to develop a bycatch ratio for skate species, as the exact composition of the landings is unknown.

[e] Landing this species is prohibited in Federal groundfish fisheries.

[f] Species is not landed (forage/non-target species).

[g] Landings were not available for several landed rockfish species. It is possible that landings for these species are included in the landings for "rockfish," along with other rockfish species. Alaska Region landings for rockfish were 166,705 pounds in 2005, but this value cannot be used to develop a bycatch ratio for rockfish species, as the exact composition of the landings is unknown.

Table 4.3.C
Subtables showing average annual marine mammal bycatch estimates in Alaska Region fisheries. Estimates are of incidental mortality and serious injury, in number of individuals, and reflect the annual averages for the years listed. Key stocks/populations are shaded.

Subtable 4.3.C.1		AK COOK INLET SALMON SET GILLNET[a]			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Humpback whale, Central North Pacific	*Megaptera novaeangliae*	2001–05	0.20	Individuals	NA
TOTAL FISHERY BYCATCH			0.20	Individuals	

[a] Minimum documented entanglements, derived from the NMFS stranding database.

Subtable 4.3.C.2		AK KODIAK SALMON SET GILLNET			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Harbor porpoise, Gulf of Alaska	*Phocoena phocoena*	2002, 2005	35.80	Individuals	0.68
TOTAL FISHERY BYCATCH			35.80	Individuals	

Subtable 4.3.C.3		AK SOUTHEAST SALMON DRIFT GILLNET[b]			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Humpback whale, Central North Pacific	*Megaptera novaeangliae*	2001–05	0.20	Individuals	NA
TOTAL FISHERY BYCATCH			0.20	Individuals	

[b] Minimum documented entanglements, derived from the NMFS stranding database.

Subtable 4.3.C.4		AK YAKUTAT SALMON SET GILLNET[c]			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Humpback whale, Central North Pacific	*Megaptera novaeangliae*	2001–05	0.20	Individuals	NA
TOTAL FISHERY BYCATCH			0.20	Individuals	

[c] Minimum documented entanglements, derived from self-reported data. This fishery is currently observed, and updated estimates will be included in future editions of this report.

Subtable 4.3.C.5		ALEUTIAN ISLANDS, EASTERN BERING SEA ATKA MACKEREL TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Steller sea lion, Western U.S.	*Eumetopias jubatus*	2001–05	0.49	Individuals	0.31
TOTAL FISHERY BYCATCH			0.49	Individuals	

Table 4.3.C (continued)

Subtable 4.3.C.6

		BERING SEA/ALEUTIAN ISLANDS FLATFISH TRAWL FISHERIES			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Bearded seal	*Erignathus barbatus*	2001–05	0.36	Individuals	0.67
Harbor porpoise, Bering Sea	*Phocoena phocoena*	2001–05	0.35	Individuals	0.65
Harbor seal, Bering Sea	*Phoca vitulina richardsi*	2001–05	0.79	Individuals	0.41
Killer whale, Eastern North Pacific Alaska resident	*Orcinus orca*	2001–05	0.84	Individuals	0.44
Northern fur seal	*Callorhinus ursinus*	2001–05	0.57	Individuals	0.39
Pacific walrus	*Odobenus rosmarus divergens*	2001–05	2.10[d]	Individuals	0.22
Ribbon seal	*Phoca fasciata*	2001–05	0.27	Individuals	0.50
Ringed seal	*Phoca hispida*	2001–05	0.49	Individuals	0.56
Spotted seal	*Phoca largha*	2001–05	1.17	Individuals	0.28
Steller sea lion, Western U.S.	*Eumetopias jubatus*	2001–05	2.78	Individuals	0.31
TOTAL FISHERY BYCATCH			9.72	Individuals	

[d] Source for this estimate is M. Perez (AKFSC-retired), unpublished data.

Subtable 4.3.C.7

		BERING SEA/ALEUTIAN ISLANDS PACIFIC COD LONGLINE			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Killer whale, Eastern North Pacific Alaska resident	*Orcinus orca*	2001–05	0.84	Individuals	0.87
Ribbon seal	*Phoca fasciata*	2001–05	0.60	Individuals	0.82
Steller sea lion, Western U.S.	*Eumetopias jubatus*	2001–05	0.74	Individuals	0.86
TOTAL FISHERY BYCATCH			2.18	Individuals	

Subtable 4.3.C.8

		BERING SEA/ALEUTIAN ISLANDS PACIFIC COD TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Steller sea lion, Western U.S.	*Eumetopias jubatus*	2001–05	0.85	Individuals	0.73
Harbor seal, Bering Sea	*Phoca vitulina richardsi*	2001–05	0.79	Individuals	0.50
TOTAL FISHERY BYCATCH			1.64	Individuals	

Table 4.3.C (continued)

Subtable 4.3.C.9

COMMON NAME	SCIENTIFIC NAME	BERING SEA/ALEUTIAN ISLANDS POLLOCK TRAWL: DATA SOURCE	BYCATCH	UNIT	CV
Dall's porpoise, Alaska	*Phocoenoides dalli*	2001–05	1.35	Individuals	0.24
Harbor seal, Bering Sea	*Phoca vitulina richardsi*	2001–05	0.29	Individuals	0.56
Killer whale, Gulf of Alaska, Aleutian Islands, and Bering Sea Transient	*Orcinus orca*	2001–05	0.41	Individuals	0.22
Northern fur seal	*Callorhinus ursinus*	2001–05	0.21	Individuals	0.21
Ribbon seal	*Phoca fasciata*	2001–05	0.20	Individuals	–[e]
Ringed seal	*Phoca hispida*	2001–05	0.42	Individuals	0.16
Steller sea lion, Western U.S.	*Eumetopias jubatus*	2001–05	2.58	Individuals	0.14
TOTAL FISHERY BYCATCH			5.46	Individuals	

[e] No CV was calculated; bycatch seen by observers occurred only in the unmonitored hauls/sets of observed cruises in some strata. Source: M. Perez, AKFSC (retired), unpublished data.

Subtable 4.3.C.10

COMMON NAME	SCIENTIFIC NAME	BERING SEA/ALEUTIAN ISLANDS SABLEFISH POT: DATA SOURCE	BYCATCH	UNIT	CV
Humpback whale, central North Pacific	*Megaptera novaeangliae*	2001–05	0.20	Individuals	–[f]
Humpback whale, western North Pacific	*Megaptera novaeangliae*	2001–05	0.20	Individuals	–[f]
TOTAL FISHERY BYCATCH			0.20[g]	Individuals	

[f] No CV was calculated; bycatch seen by observers occurred only in the unmonitored hauls/sets of observed cruises in some strata. Source: M. Perez, AKFSC (retired), unpublished data.

[g] A single whale was seriously injured/killed in this fishery during this five-year period. Because this is an area of stock overlap, it is not known which stock incurred the serious injury/mortality. Thus, the total fishery bycatch is 0.20 humpback whales over the five-year period, and this could have come from either the central North Pacific or the western North Pacific stock.

Subtable 4.3.C.11

COMMON NAME	SCIENTIFIC NAME	GULF OF ALASKA CRAB POT[h]: DATA SOURCE	BYCATCH	UNIT	CV
Humpback whale, central North Pacific	*Megaptera novaeangliae*	2001–05	0.60	Individuals	NA
TOTAL FISHERY BYCATCH			0.60	Individuals	

[h] Minimum documented entanglements, derived from the NMFS strandings database.

Subtable 4.3.C.12

COMMON NAME	SCIENTIFIC NAME	GULF OF ALASKA POLLOCK TRAWL: DATA SOURCE	BYCATCH	UNIT	CV
Dall's porpoise, Alaska	*Phocoenoides dalli*	2001–05	0.48	Individuals	0.70
Northern elephant seal	*Mirounga angustirostris*	2001–05	0.71	Individuals	0.86
Steller sea lion, Western U.S.	*Eumetopias jubatus*	2001–05	1.33	Individuals	0.66
TOTAL FISHERY BYCATCH			2.52	Individuals	

Table 4.3.C (continued)

Subtable 4.3.C.13		GULF OF ALASKA PACIFIC COD TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Steller sea lion, Western U.S.	*Eumetopias jubatus*	2001–05	0.94	Individuals	0.83
TOTAL FISHERY BYCATCH			0.94	Individuals	

Subtable 4.3.C.14 (SUMMARY)		Total Species Bycatch	
COMMON NAME	**SCIENTIFIC NAME**	**AVERAGE AMOUNT**	**UNIT**
Bearded seal	*Erignathus barbatus*	0.36	Individuals
Dall's porpoise, Alaska	*Phocoenoides dalli*	1.83	Individuals
Gray whale	*Eschrichtius robustus*	0.50	Individuals
Harbor porpoise, Bering Sea	*Phocoena phocoena*	0.35	Individuals
Harbor porpoise, Gulf of Alaska	*Phocoena phocoena*	35.80	Individuals
Harbor seal, Bering Sea	*Phoca vitulina richardsi*	1.87	Individuals
Humpback whale, central North Pacific	*Megaptera novaeangliae*	2.40	Individuals
Humpback whale, Western North Pacific	*Megaptera novaeangliae*	0.20	Individuals
Killer whale, eastern North Pacific Alaska resident	*Orcinus orca*	2.09	Individuals
Killer whale, Gulf of Alaska, Aleutian Islands, and Bering Sea transient	*Orcinus orca*	0.41	Individuals
Northern elephant seal	*Mirounga angustirostris*	0.71	Individuals
Northern fur seal	*Callorhinus ursinus*	0.78	Individuals
Pacific walrus	*Odobenus rosmarus divergens*	2.10	Individuals
Ribbon seal	*Phoca fasciata*	1.07	Individuals
Ringed seal	*Phoca hispida*	0.91	Individuals
Spotted seal	*Phoca largha*	1.17	Individuals
Steller sea lion, Western U.S.	*Eumetopias jubatus*	9.71	Individuals
TOTAL BYCATCH		62.26	Individuals

Table 4.3.D
Subtables showing seabird bycatch estimates for Alaska Region fisheries. Bycatch estimates are in numbers of individuals, and reflect averages for the years listed. Key stocks/populations are shaded.

Subtable 4.3.D.1

		ALEUTIAN ISLANDS, EASTERN BERING SEA ATKA MACKEREL TRAWL				BERING SEA/ALEUTIAN ISLANDS GREENLAND TURBOT LONGLINE			
COMMON NAME	SCIENTIFIC NAME	DATA SOURCE	BYCATCH	UNIT	CV	DATA SOURCE	BYCATCH	UNIT	CV
Alcid	Alciidae	2001–05	0	Individuals		2001–05	0	Individuals	
Black-footed albatross	*Phoebastria nigripes*	2001–05	0	Individuals		2001–05	0	Individuals	
Gull	Laridae	2001–05	0	Individuals		2001–05	27	Individuals	
Laysan albatross	*Phoebastria immutabilis*	2001–05	0	Individuals		2001–05	35	Individuals	
Northern fulmar	*Fulmarus glacialis*	2001–05	76	Individuals		2001–05	108	Individuals	
Other seabird		2001–05	0	Individuals		2001–05	3	Individuals	
Red-legged kittiwake	*Rissa brevirostris*	2001–05	0	Individuals		2001–05	1	Individuals	
Shearwater	Procellariidae	2001–05	93	Individuals		2001–05	19	Individuals	
Short-tailed albatross	*Phoebastria albatrus*	2001–05	0	Individuals		2001–05	0	Individuals	
Unidentified albatross	Diomedeidae	2001–05	0	Individuals		2001–05	1	Individuals	
Unidentified shearwaters and petrels	Procellariidae	2001–05	0	Individuals		2001–05	2	Individuals	
Unidentified seabirds		2001–05	0	Individuals		2001–05	17	Individuals	
TOTAL BYCATCH			169	Individuals			213	Individuals	

Subtable 4.3.D.2

		BERING SEA/ALEUTIAN ISLANDS FLATFISH TRAWL FISHERIES				BERING SEA/ALEUTIAN ISLANDS PACIFIC COD LONGLINE			
COMMON NAME	SCIENTIFIC NAME	DATA SOURCE	BYCATCH	UNIT	CV	DATA SOURCE	BYCATCH	UNIT	CV
Alcid	Alciidae	2001–05	75	Individuals		2001–05	15	Individuals	
Black-footed albatross	*Phoebastria nigripes*	2001–05	0	Individuals		2001–05	6	Individuals	
Gull	Laridae	2001–05	0	Individuals		2001–05	1970	Individuals	
Laysan albatross	*Phoebastria immutabilis*	2001–05	0	Individuals		2001–05	73	Individuals	
Northern fulmar	*Fulmarus glacialis*	2001–05	0	Individuals		2001–05	2617	Individuals	
Other seabird		2001–05	0	Individuals		2001–05	26	Individuals	

Table 4.3.D (continued)

(continuation of Subtable 4.3.D.2)		BERING SEA/ALEUTIAN ISLANDS FLATFISH TRAWL FISHERIES				BERING SEA/ALEUTIAN ISLANDS PACIFIC COD LONGLINE			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Red-legged kittiwake	*Rissa brevirostris*	2001–05	0	Individuals		2001–05	2	Individuals	
Shearwater	Procellariidae	2001–05	14	Individuals		2001–05	413	Individuals	
Short-tailed albatross	*Phoebastria albatrus*	2001–05	0	Individuals		2001–05	0	Individuals	
Unidentified albatross	Diomedeidae	2001–05	0	Individuals		2001–05	2	Individuals	
Unidentified shearwaters and petrels	Procellariidae	2001–05	0	Individuals		2001–05	42	Individuals	
Unidentified seabirds		2001–05	22	Individuals		2001–05	495	Individuals	
TOTAL BYCATCH			111	Individuals			5661	Individuals	

Subtable 4.3.D.3		BERING SEA/ALEUTIAN ISLANDS PACIFIC COD POT				BERING SEA/ALEUTIAN ISLANDS PACIFIC COD TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Alcid	Alciidae	2001–05	0	Individuals		2001–05	17	Individuals	
Black-footed albatross	*Phoebastria nigripes*	2001–05	0	Individuals		2001–05	0	Individuals	
Gull	Laridae	2001–05	1	Individuals		2001–05	17	Individuals	
Laysan albatross	*Phoebastria immutabilis*	2001–05	0	Individuals		2001–05	47	Individuals	
Northern fulmar	*Fulmarus glacialis*	2001–05	31	Individuals		2001–05	82	Individuals	
Other seabird		2001–05	0	Individuals		2001–05	0	Individuals	
Red-legged kittiwake	*Rissa brevirostris*	2001–05	0	Individuals		2001–05	0	Individuals	
Shearwater	*Procellariidae*	2001–05	2	Individuals		2001–05	15	Individuals	
Short-tailed albatross	*Phoebastria albatrus*	2001–05	0	Individuals		2001–05	0	Individuals	
Unidentified albatross	Diomedeidae	2001–05	0	Individuals		2001–05	0	Individuals	
Unidentified shearwaters and petrels	Procellariidae	2001–05	0	Individuals		2001–05	0	Individuals	
Unidentified seabirds		2001–05	1	Individuals		2001–05	0	Individuals	
TOTAL BYCATCH			35	Individuals			178	Individuals	

Table 4.3.D (continued)

Subtable 4.3.D.4

		BERING SEA/ALEUTIAN ISLANDS PACIFIC OCEAN PERCH TRAWL				BERING SEA/ALEUTIAN ISLANDS POLLOCK TRAWL			
COMMON NAME	SCIENTIFIC NAME	DATA SOURCE	BYCATCH	UNIT	CV	DATA SOURCE	BYCATCH	UNIT	CV
Alcid	Alciidae	2001–05	0	Individuals		2001–05	63	Individuals	
Black-footed albatross	*Phoebastria nigripes*	2001–05	0	Individuals		2001–05	0	Individuals	
Gull	Laridae	2001–05	0	Individuals		2001–05	5	Individuals	
Laysan albatross	*Phoebastria immutabilis*	2001–05	0	Individuals		2001–05	1	Individuals	
Northern fulmar	*Fulmarus glacialis*	2001–05	87	Individuals		2001–05	179	Individuals	
Other seabird		2001–05	0	Individuals		2001–05	2	Individuals	
Red-legged kittiwake	*Rissa brevirostris*	2001–05	0	Individuals		2001–05	1	Individuals	
Shearwater	Procellariidae	2001–05	0	Individuals		2001–05	27	Individuals	
Short-tailed albatross	*Phoebastria albatrus*	2001–05	0	Individuals		2001–05	0	Individuals	
Unidentified albatross	Diomedeidae	2001–05	0	Individuals		2001–05	0	Individuals	
Unidentified shearwaters and petrels	Procellariidae	2001–05	0	Individuals		2001–05	5	Individuals	
Unidentified seabirds		2001–05	0	Individuals		2001–05	39	Individuals	
TOTAL BYCATCH			87	Individuals			322	Individuals	

Subtable 4.3.D.5

		BERING SEA/ALEUTIAN ISLANDS SABLEFISH LONGLINE				BERING SEA/ALEUTIAN ISLANDS SABLEFISH POT			
COMMON NAME	SCIENTIFIC NAME	DATA SOURCE	BYCATCH	UNIT	CV	DATA SOURCE	BYCATCH	UNIT	CV
Alcid	Alciidae	2001–05	0	Individuals		2001–05	0	Individuals	
Black-footed albatross	*Phoebastria nigripes*	2001–05	0	Individuals		2001–05	0	Individuals	
Gull	Laridae	2001–05	4	Individuals		2001–05	0	Individuals	
Laysan albatross	*Phoebastria immutabilis*	2001–05	39	Individuals		2001–05	0	Individuals	
Northern fulmar	*Fulmarus glacialis*	2001–05	16	Individuals		2001–05	1	Individuals	
Other seabird		2001–05	0	Individuals		2001–05	0	Individuals	
Red-legged kittiwake	*Rissa brevirostris*	2001–05	0	Individuals		2001–05	0	Individuals	

Table 4.3.D (continued)

(continuation of Subtable 4.3.D.5)		BERING SEA/ALEUTIAN ISLANDS SABLEFISH LONGLINE				BERING SEA/ALEUTIAN ISLANDS SABLEFISH POT			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Shearwater	*Procellariidae*	2001–05	0	Individuals		2001–05	1	Individuals	
Short-tailed albatross	*Phoebastria albatrus*	2001–05	0	Individuals		2001–05	0	Individuals	
Unidentified albatross	Diomedeidae	2001–05	0	Individuals		2001–05	0	Individuals	
Unidentified shearwaters and petrels	Procellariidae	2001–05	0	Individuals		2001–05	0	Individuals	
Unidentified seabirds		2001–05	0	Individuals		2001–05	0	Individuals	
TOTAL BYCATCH			59	Individuals			2	Individuals	

Subtable 4.3.D.6		BERING SEA/ALEUTIAN ISLANDS SABLEFISH TRAWL				GULF OF ALASKA FLATFISH TRAWL FISHERIES			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Alcid	Alciidae	2001–05	0	Individuals		2001–05	0	Individuals	
Black-footed albatross	*Phoebastria nigripes*	2001–05	0	Individuals		2001–05	0	Individuals	
Gull	Laridae	2001–05	0	Individuals		2001–05	0	Individuals	
Laysan albatross	*Phoebastria immutabilis*	2001–05	0	Individuals		2001–05	0	Individuals	
Northern fulmar	*Fulmarus glacialis*	2001–05	0	Individuals		2001–05	24	Individuals	
Other seabird		2001–05	0	Individuals		2001–05	0	Individuals	
Red-legged kittiwake	*Rissa brevirostris*	2001–05	0	Individuals		2001–05	0	Individuals	
Shearwater	Procellariidae	2001–05	0	Individuals		2001–05	0	Individuals	
Short-tailed albatross	*Phoebastria albatrus*	2001–05	0	Individuals		2001–05	0	Individuals	
Unidentified albatross	Diomedeidae	2001–05	0	Individuals		2001–05	0	Individuals	
Unidentified shearwaters and petrels	Procellariidae	2001–05	0	Individuals		2001–05	0	Individuals	
Unidentified seabirds		2001–05	0	Individuals		2001–05	0	Individuals	
TOTAL BYCATCH			0	Individuals			24	Individuals	

Table 4.3.D (continued)

Subtable 4.3.D.7		GULF OF ALASKA PACIFIC COD LONGLINE				GULF OF ALASKA PACIFIC COD POT			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Alcid	Alciidae	2001–05	1	Individuals		2001–05	12	Individuals	
Black-footed albatross	*Phoebastria nigripes*	2001–05	10	Individuals		2001–05	0	Individuals	
Gull	Laridae	2001–05	28	Individuals		2001–05	0	Individuals	
Laysan albatross	*Phoebastria immutabilis*	2001–05	8	Individuals		2001–05	0	Individuals	
Northern fulmar	*Fulmarus glacialis*	2001–05	23	Individuals		2001–05	25	Individuals	
Other seabird		2001–05	0	Individuals		2001–05	0	Individuals	
Red-legged kittiwake	*Rissa brevirostris*	2001–05	0	Individuals		2001–05	0	Individuals	
Shearwater	Procellariidae	2001–05	4	Individuals		2001–05	0	Individuals	
Short-tailed albatross	*Phoebastria albatrus*	2001–05	0	Individuals		2001–05	0	Individuals	
Unidentified albatross	Diomedeidae	2001–05	0	Individuals		2001–05	0	Individuals	
Unidentified shearwaters and petrels	Procellariidae	2001–05	0	Individuals		2001–05	0	Individuals	
Unidentified seabirds		2001–05	6	Individuals		2001–05	0	Individuals	
TOTAL BYCATCH			80	Individuals			37	Individuals	

Subtable 4.3.D.8		GULF OF ALASKA PACIFIC COD TRAWL				GULF OF ALASKA POLLOCK TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Alcid	Alciidae	2001–05	0	Individuals		2001–05	2	Individuals	
Black-footed albatross	*Phoebastria nigripes*	2001–05	0	Individuals		2001–05	0	Individuals	
Gull	Laridae	2001–05	0	Individuals		2001–05	0	Individuals	
Laysan albatross	*Phoebastria immutabilis*	2001–05	0	Individuals		2001–05	0	Individuals	
Northern fulmar	*Fulmarus glacialis*	2001–05	0	Individuals		2001–05	0	Individuals	
Other seabird		2001–05	0	Individuals		2001–05	0	Individuals	
Red-legged kittiwake	*Rissa brevirostris*	2001–05	0	Individuals		2001–05	0	Individuals	
Shearwater	Procellariidae	2001–05	0	Individuals		2001–05	0	Individuals	
Short-tailed albatross	*Phoebastria albatrus*	2001–05	0	Individuals		2001–05	0	Individuals	

Table 4.3.D (continued)

(continuation of Subtable 4.3.D.8)		GULF OF ALASKA PACIFIC COD TRAWL				GULF OF ALASKA POLLOCK TRAWL			
COMMON NAME	SCIENTIFIC NAME	DATA SOURCE	BYCATCH	UNIT	CV	DATA SOURCE	BYCATCH	UNIT	CV
Unidentified albatross	Diomedeidae	2001–05	0	Individuals		2001–05	0	Individuals	
Unidentified shearwaters and petrels	Procellariidae	2001–05	0	Individuals		2001–05	0	Individuals	
Unidentified seabirds		2001–05	0	Individuals		2001–05	0	Individuals	
TOTAL BYCATCH			0	Individuals			2	Individuals	

Subtable 4.3.D.9		GULF OF ALASKA ROCKFISH (NORTHERN ROCKFISH, PELAGIC SHELF ROCKFISH, PACIFIC OCEAN PERCH) TRAWL				GULF OF ALASKA SABLEFISH LONGLINE			
COMMON NAME	SCIENTIFIC NAME	DATA SOURCE	BYCATCH	UNIT	CV	DATA SOURCE	BYCATCH	UNIT	CV
Alcid	Alciidae	2001–05	0	Individuals		2001–05	9	Individuals	
Black-footed albatross	*Phoebastria nigripes*	2001–05	0	Individuals		2001–05	51	Individuals	
Gull	Laridae	2001–05	0	Individuals		2001–05	49	Individuals	
Laysan albatross	*Phoebastria immutabilis*	2001–05	0	Individuals		2001–05	13	Individuals	
Northern fulmar	*Fulmarus glacialis*	2001–05	71	Individuals		2001–05	87	Individuals	
Other seabird		2001–05	0	Individuals		2001–05	0	Individuals	
Red-legged kittiwake	*Rissa brevirostris*	2001–05	0	Individuals		2001–05	0	Individuals	
Shearwater	Procellariidae	2001–05	0	Individuals		2001–05	7	Individuals	
Short-tailed albatross	*Phoebastria albatrus*	2001–05	0	Individuals		2001–05	0	Individuals	
Unidentified albatross	Diomedeidae	2001–05	0	Individuals		2001–05	4	Individuals	
Unidentified shearwaters and petrels	Procellariidae	2001–05	0	Individuals		2001–05	0	Individuals	
Unidentified seabirds		2001–05	0	Individuals		2001–05	9	Individuals	
TOTAL BYCATCH			71	Individuals			229	Individuals	

Table 4.3.D (continued)

Subtable 4.3.D.10		GULF OF ALASKA SABLEFISH TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**BYCATCH**	**UNIT**	**CV**
Alcid	Alciidae	2001–05	0	Individuals	
Black-footed albatross	*Phoebastria nigripes*	2001–05	0	Individuals	
Gull	Laridae	2001–05	0	Individuals	
Laysan albatross	*Phoebastria immutabilis*	2001–05	0	Individuals	
Northern fulmar	*Fulmarus glacialis*	2001–05	0	Individuals	
Other seabird		2001–05	0	Individuals	
Red-legged kittiwake	*Rissa brevirostris*	2001–05	0	Individuals	
Shearwater	Procellariidae	2001–05	0	Individuals	
Short-tailed albatross	*Phoebastria albatrus*	2001–05	0	Individuals	
Unidentified albatross	Diomedeidae	2001–05	0	Individuals	
Unidentified shearwaters and petrels	Procellariidae	2001–05	0	Individuals	
Unidentified seabirds		2001–05	0	Individuals	
TOTAL BYCATCH			0	Individuals	

Subtable 4.3.D.11 (SUMMARY)		TOTAL SEABIRD BYCATCH IN ALL FISHERIES	
COMMON NAME	**SCIENTIFIC NAME**	**BYCATCH**	**UNIT**
Alcid	Alciidae	194	Individuals
Black-footed albatross	*Phoebastria nigripes*	67	Individuals
Gull	Laridae	2,101	Individuals
Laysan albatross	*Phoebastria immutabilis*	216	Individuals
Northern fulmar	*Fulmarus glacialis*	3,427	Individuals
Other seabird		31	Individuals
Red-legged kittiwake	*Rissa brevirostris*	4	Individuals
Shearwater	Procellariidae	595	Individuals
Short-tailed albatross	*Phoebastria albatrus*	0	Individuals
Unidentified albatross	Diomedeidae	7	Individuals
Unidentified shearwaters and petrels	Procellariidae	49	Individuals
Unidentified seabirds		589	Individuals
TOTAL BYCATCH		7,280	Individuals

4.4 Northwest Region

The NMFS Northwest Region is responsible for collecting scientific data and managing marine resources and habitats in Federal waters off the states of California, Oregon, and Washington: the area comprising the California Coastal Current LME[1] as well as coastal and inland waters utilized by species protected under the MMPA and ESA. The Pacific Fishery Management Council (PFMC), in conjunction with the NMFS, is responsible for managing fisheries in the Northwest Region.

4.4.1 Fisheries Overview

A total of 30 commercial fisheries are included in this report for the Northwest Region (Table 4.4.1). Landings from these fisheries in Oregon and Washington were valued at approximately $281 million in 2005.[2] A variety of gear types (e.g., longlines, pots/traps, trawls, and gillnets) are used to capture groundfish and salmon species. In addition, crab, anchovy, sardines, herring, mackerel, shrimp, squid, and other shellfish and mollusks provide other important fishing opportunities.

Sixty-three percent of Northwest Regional fisheries are managed at the state level (Figure 4.4.1). Of the 11 remaining fisheries, four are managed at the Federal level, one is managed by tribal authorities, and six are under shared management.

Two PFMC FMPs regulate harvest of Pacific Coast groundfish and salmon in the Northwest Region. Through the management process, the PFMC develops and recommends to NMFS harvest specifications and management measures for over 82 species of groundfish managed under the Pacific Coast Groundfish FMP. Pacific hake (*Merluccius productus*, also referred to as whiting) comprises the largest proportion of groundfish catch by volume. Management of the Pacific hake mid-water trawl fishery is shared between Federal and state governments and tribal authorities (an international treaty is currently being developed between Canada and the U.S). Groundfish bottom trawl fisheries targeting other species are primarily federally managed. The California/Oregon nearshore rockfish fisheries have shared Federal/state management.

The PFMC's Pacific Coast Salmon FMP manages species of Pacific salmon, which support important commercial, recreational, and tribal fisheries in the states of California, Idaho, Oregon, and Washington. Managed fisheries include a number of state-managed coastal and inland salmon fisheries. These "inside water" commercial fisheries primarily utilize gillnets and purse seine gear. Federally managed ocean salmon fisheries include commercial troll and recreational fisheries (recreational fisheries are not addressed in this edition of the report). Of the two salmon fisheries addressed in this report, one is federally managed (West Coast salmon troll, non-tribal ocean), and the other has shared management by the Federal government and the coastal Native American tribes (West Coast salmon troll, tribal ocean).

The regional interstate commission, the Pacific States Marine Fisheries Commission (PSMFC), does not have regulatory or management authority, but works to advance policies and actions to conserve, develop, and manage fishery resources in the states of California, Oregon, Washington, Idaho, and Alaska. The Pacific Coast Fisheries Information Network (PacFIN), run by PSMFC, is a joint Federal–state data-collection and information system used to compile and maintain data for Pacific Coast commercial fisheries.

In 2005, the Pacific halibut (*Hippoglossus stenolepis*) longline fishery was the only fishery in the Northwest that included an international management authority, the IPHC. The IPHC, established in 1923, conducts research on and manages Pacific halibut stocks within U.S. and Canadian waters.

4.4.2. Addressing Regional Bycatch Concerns

The PFMC and NMFS have implemented a variety of regulations to monitor and reduce bycatch in Federal fisheries. Note that the information in this report is based on the regulations in place at the time of writing. Sine that time, new regulations implementing trawl-rationalization for the West Coast groundfish fishery have been implemented (discussed in a later section).

Groundfish

The Pacific Coast Groundfish FMP outlines a number of conservation measures including periodic vessel landing limits (trip limits), seasonal closures, and area and gear restrictions, in addition to reduced capacity. Periodic vessel landing limits are the designated weight of a fish species or species group that can be landed during a designated time period, usually two months. Periodic vessel landing limits constrain the amount of a species or species group that can be landed; however, they do not constrain how much of a species or species group can be caught. Therefore, regulatory discard is common as vessels reach landing limits for one species before the limits for other species. Since the FMP was established, trip limits have become more restrictive, and as trip limits apply to more species, regulatory discards have increased. Discard also occurs when vessels catch species or sizes of fish which have no value to processors or other available buyers.

[1] http://www.lme.noaa.gov/.

[2] Ex-vessel landings value, Fisheries Economics of the U.S., 2006. Available online http://www.st.nmfs.noaa.gov/st5/publication/fisheries_economics_2006.html.

Table 4.4.1
Northwest Region fisheries included in the U.S. National Bycatch Report. Fisheries are listed alphabetically, first by management authority and then by fishery name. Rows containing fisheries for which bycatch estimates are included in this report are shaded.

Fishery[a]	Management Authority	Federal Fishery Management Plan (FMP)[b]	Gear Type	Target Species (Common Name)	Data Sources[c]
West Coast Groundfish Non-Trawl Gear: Limited-Entry Sablefish-Endorsed Fixed Gear	Federal	Pacific Coast Groundfish	Longline, Bottom; Pots and Traps, Other	Sablefish	Landing receipt (fish ticket), observer data
West Coast Groundfish Non-Trawl Gear: Non-Endorsed Fixed Gear	Federal	Pacific Coast Groundfish	Longline, Bottom; Pots and Traps, Other	Sablefish, groundfish	Landing receipt (fish ticket), observer data
West Coast Limited-Entry Bottom Trawl: Groundfish Bottom Trawl	Federal	Pacific Coast Groundfish	Otter Trawl Bottom, Fish	Groundfish	Landing receipt (fish ticket), logbook, observer data
West Coast Salmon Troll, Non-Tribal Ocean	Federal	Pacific Coast Salmon	Troll Lines	Salmon	Landing receipt (fish ticket), logbook, Observer data
CA Halibut Trawl	Federal, State		Bottom Trawl, Fish	California halibut	Observer data
CA/OR Nearshore Rockfish	Federal, State	Pacific Coast Groundfish	Combined Gears	Nearshore rockfish	Landing receipt (fish ticket), observer data, state logbook
West Coast Pacific Halibut Longline, Non-Tribal	Federal, State, International	Pacific Coast Groundfish	Longline	Pacific halibut	
West Coast Mid-Water Trawl For Whiting, Shoreside Processing	Federal, State, Tribal	Pacific Coast Groundfish	Mid-water Trawl	Pacific whiting	Observer data
West Coast Mid-Water Trawl For Whiting, At-Sea Processing	Federal, Tribal	Pacific Coast Groundfish	Mid-water Trawl	Pacific whiting	Observer data
West Coast Salmon Troll, Tribal Ocean	Federal, Tribal	Pacific Coast Salmon	Troll Lines	Salmon	Landing receipt (fish ticket), logbook, observer data
OR/CA Pink Shrimp	State		Shrimp Trawls	Pink shrimp	Observer data
OR/CA Spot Prawn	State		Pots and Traps, Shrimp	Spot shrimp	Observer data
WA Beach Seine / OR Drag Seine	State		Other Seines		
WA Grays Harbor Salmon Drift Gillnet (excluding Treaty Tribal Fishing)	State		Gillnet	Salmon	

Table 4.4.1 (continued)

Fishery[a]	Management Authority	Federal Fishery Management Plan (FMP)[b]	Gear Type	Target Species (Common Name)	Data Sources[c]
WA Grays Harbor Salmon Set and Drift Gillnet	State		Gillnet	Salmon	
WA Herring Brush Weir	State		Weirs	Pacific herring	
WA/OR Gillnet	State		Gillnet	Salmon	
WA/OR Herring, Smelt, Squid Purse Seine	State		Purse Seine	Coastal pelagic species	
WA/OR Lower Columbia River Drift Gillnet	State		Gillnet	Salmon	
WA/OR Shrimp Pot and Trap	State		Pots and Traps, Shrimp	Shrimp spp.	
WA/OR Smelt, Herring Dip Net	State		Dip Nets	Coastal pelagic species	
WA/OR Lower Columbia River Salmon Drift	State		Gill Nets	Salmon	
WA/OR Misc. Invertebrate	State		By Hand, Diving Gear		
WA/OR/CA Dungeness Crab Pot	State		Pots and Traps, Other	Dungeness crab	
WA Puget Sound Region Salmon Drift Gillnet	State		Gillnet	Salmon	
WA Salmon Purse Seine	State		Purse Seine	Salmon	
WA Salmon Reef Net	State		Other Fixed Nets	Salmon	
WA Willapa Bay Drift Gillnet	State		Gillnet	Salmon	
Willapa Bay Salmon Drift	State		Gillnet	Salmon	
Makah Salmon Set Gillnet Areas 4, 4A, 4B	Tribal		Gillnet	Salmon	

[a] Aquaculture fisheries are listed for consistency with the MMPA List of Fisheries when they occur, but were not analyzed for the U.S. National Bycatch Report. Recreational fisheries are not included in this edition of the report and are not listed.
[b] Note that non-Federal FMPs were not identified through this process..
[c] Data sources were evaluated only for Federal fisheries and non-Federal fisheries with Federal data-collection programs.

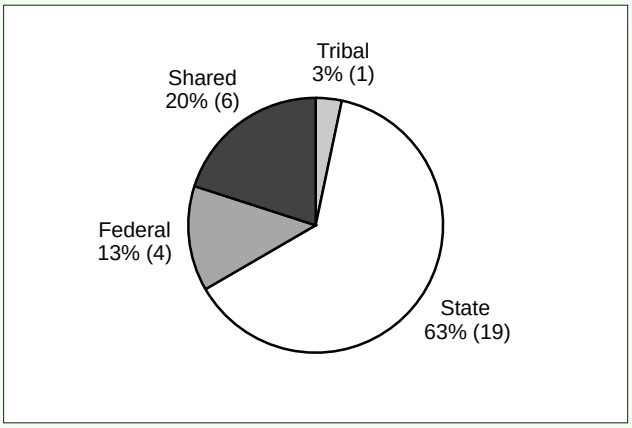


Figure 4.4.1
Management jurisdictions for Northwest Region fisheries (percentages based on numbers of fisheries, not volume or revenue); "shared" indicates that international, Federal, state, and/or tribal authorities share management jurisdiction for the fishery.

Several additional measures have been taken to shift fishing incentives away from depleted rockfish species. In 2000, the PFMC imposed a restriction on bottom trawl footrope size for landing shelf and nearshore rockfish species. Footrope configuration and the use of chafing gear were linked to various groundfish trip limits. In 2002, area- and depth-related closures were instituted to further reduce bycatch of depleted rockfish species, while also dictating where different footrope configurations could be used. By 2003, area- and depth-related closures were established in both the limited-entry and open-access sectors of the groundfish fishery for both trawl and fixed gears. In 2005, a selective flatfish trawl gear requirement was established to further reduce bycatch of depleted rockfish based on net design. This requirement was again linked to the area- and depth-related closures. Area- and depth-related closures continue to change over time in response to bycatch rates and fishery management.

In 2001, the PFMC began to institute measures to reduce capacity in the groundfish fishery. That year, permit stacking was instituted in the limited-entry sablefish-endorsed fixed gear fishery. Permit stacking allows for up to three limited-entry sablefish (*Anoplopoma fimbria*)-endorsed permits to be stacked on a single vessel. Prior to this measure, a single vessel fished each permit. In 2003, groundfish and pink shrimp (*Pandalus jordani*) fishers, in cooperation with the Federal government, reduced capacity in the limited-entry groundfish bottom trawl fleet through a permit and vessel buyback program. Ninety-two permits and vessels, representing about a third of the overall trawl effort, were removed from the fishery.

The PFMC and NMFS have developed rebuilding plans for all overfished stocks, as required under the Magnuson-Stevens Reauthorization Act of 2006 (MSRA). Because many overfished groundfish stocks co-occur with healthy stocks, harvest of healthy stocks is often constrained to ensure that rebuilding stocks are not subject to overfishing and may be rebuilt within the established time frame. To achieve a balance, NMFS and PFMC work to identify a rebuilding period for each species that is as short as possible, taking into account the status and biology of the species and the impacts of management alternatives on fishing communities.

In 2001, the NMFS implemented the West Coast Groundfish Observer Program (WCGOP) to gather data necessary to manage Federal groundfish fisheries off the coasts of Washington, Oregon, and California. The program's focus is estimation of groundfish species bycatch in West Coast fisheries. Also in 2001, the At-Sea Hake Observer Program (A-SHOP) was transferred from the AFSC to the Northwest Fisheries Science Center (NWFSC). The A-SHOP program monitors total catch and bycatch of the Pacific hake sectors that process their catch at sea (catcher–processors and motherships). Bycatch caps were instituted in this fishery in 2005 for several overfished and rebuilding stocks known to be taken. Specifically, bycatch caps were instituted for canary rockfish (*Sebastes pinniger*), widow rockfish (*Sebastes entomelas*), and darkblotched rockfish (*Sebastes crameri*).

Due to the conservation efforts of the PFMC and NMFS, populations of several groundfish stocks are increasing. Lingcod (*Ophiodon elongates*), which was declared overfished in 1999, had been rebuilt by 2005. Pacific hake was declared overfished in 2002, but was rebuilt by 2004. In addition, bocaccio and darkblotched rockfish, Pacific Ocean perch (*Sebastes alutus*), and widow rockfish (*Sebastes entomelas*) are no longer overfished and are rebuilding.

In 2010, the NMFS and the PFMC approved Amendments 20 and 21 to the Pacific Coast Groundfish FMP. The new measures move the Pacific Coast groundfish bottom trawl fishery from a limited-entry permit system to a catch-share program. The management options implemented under an individual transferable quota (ITQ) system significantly affect data collection and bycatch monitoring, as well as the methods of estimation used, and also influence bycatch levels in this fishery. This program is currently in its first year of implementation.

Salmon

In ocean salmon troll fisheries, the primary bycatch is incidental salmon species. Bycatch of non-salmonid fish species in salmon fisheries is generally very limited. Under the Pacific Coast Salmon FMP, only hook-and-line gear is allowed in oceanic salmon fisheries, and regulations allow for retention of most groundfish species and limited numbers of Pacific halibut that are caught incidentally. All ocean salmon fisheries are mixed-stock fisheries, and may either allow retention of mixed species or be limited to retention of single species. At-sea differentiation between salmon stocks is not currently feasible, except for distinguishing marked hatchery fish from unmarked fish. In single-species fisheries, captured individuals of other species must be discarded.

Conservation measures in recent years, intended to reduce the mortality of stocks of concern (e.g., mark-selective fisheries and single-species fisheries), have increased the ratio of bycatch to landed catch in the non-tribal portion of the fishery. Major regulations currently in place under the Salmon FMP include setting annual goals for the number of spawners of major salmon stocks ("spawner escapement goals") and the allocation of harvest among different groups of fishers. The NMFS and PFMC must also ensure that all salmon fisheries comply with ESA regulations, as several ESA-listed fish populations occur in the region.

Other fisheries

The remaining fisheries listed in Table 4.4.1 have limited or no bycatch information available. With the exception of the

pink shrimp and Dungeness crab fisheries, the remaining fisheries are sporadic, or effort occurs at levels much lower than in the observed fisheries.

The pink shrimp trawl fisheries in Oregon and Northern California have limited observer coverage and are known to take small quantities of groundfish and squid. To reduce groundfish bycatch in the pink shrimp fisheries, Washington, Oregon, and California instituted mandatory requirements for the use of BRD's. The Oregon pink shrimp fishery was certified by the Marine Stewardship Council in 2007 due in part to the effectiveness of the required rigid type of BRD. Bycatch of groundfish, Dungeness crab (*Cancer magister*), and other species is known to occur in the California halibut bottom trawl fishery. Limited observer data are available, as it is also a state-managed fishery.

4.4.3 Data Sources

Table 4.4.1 lists sources of bycatch data available for federally managed Northwest fisheries and for those state fisheries with relevant Federal data-collection programs. Three primary data sources are available for Northwest Regional fisheries: observer programs, logbooks, and landing receipts (also known as fish tickets). Both the NMFS and state agencies utilize PacFIN (the regional database clearinghouse maintained by PSMFC) to compile and maintain data on Pacific coast fisheries.

4.4.3.1 Observer Programs

Prior to 2002, comprehensive total catch data were not available, as only limited state or NMFS observer programs (implemented primarily under the MMPA) existed through the 1980s and 1990s. In 2001, under the Pacific Coast Groundfish FMP, NMFS established and authorized the WCGOP to collect data on at-sea discards in the West Coast non-hake groundfish fleet. The A-SHOP, which had originally focused on incidental take of marine mammals and salmon, evolved to collect data for estimating total catch by the early 1990s. Although domestic at-sea hake processors had historically carried NMFS-trained observers voluntarily, observer coverage for the Federal at-sea hake fishery became mandatory in 2004 under the Pacific Coast Groundfish FMP. In addition, an electronic monitoring (EM) video program was tested in the shore-based mid-water trawl hake fishery from 2004 to 2009. The EM system was tested to confirm that landings data accurately represented what was being caught at sea, i.e., that instances of at-sea discard were recorded.

The WCGOP and A-SHOP observers monitor and record haul-related information; determine the total catch; sample hauls for species composition; collect length, weight, age structure, and tagged fish data; and record marine mammal and seabird sightings and interactions. Data collected by the WCGOP and A-SHOP programs are compiled and maintained by NMFS. Possible biases in data collected by WCGOP observers include changes in fishing behavior by observed vessels relative to non-observed vessels, pooling of data across ports without weighting by relative strataum size (e.g., fraction of trips or landings), and deviations from the sampling plan due to implementation issues (e.g., vessel safety, size, etc.). Biases in the A-SHOP data are minimal, as the fishery is a census of vessels, and samples of catch are random and include approximately 50% of the total catch. One caveat is that catcher vessels delivering to motherships are currently unobserved and may represent a source of unaccounted-for discards.

Observer programs at developing or mature coverage levels are in place for several fisheries including the West Coast mid-water trawl fishery for hake with at-sea processing, and the limited-entry groundfish fisheries (trawl and fixed gear). Other regional fisheries are observed at baseline or pilot levels. Current observer programs are listed in Table 4.4.2. In FY 2005, over 6,184 sea days of commercial fishing were observed in the Northwest Region (approximately 36% of this was EM coverage of the mid-water trawl fishery for hake with shoreside processing).

4.4.3.2 Logbooks

Mandatory logbook programs are currently in place for some of the fisheries for which discards were estimated. Logbooks were used to estimate discards in the West Coast limited-entry groundfish bottom trawl fishery.

Logbook record-keeping for the limited-entry groundfish trawl fishery is a state-mandated requirement in Washington, Oregon, and California. A common format of logbook is used by all three states. Information in paper logbooks is recorded by vessel personnel. Data collected include vessel name, departure date, return date, departure port, return port, gear type, haul set/retrieval location (latitude/longitude), average depth, haul number, haul set/retrieval date/time, and retained catch in pounds by category (single species or species group). Discard information is not recorded in logbooks, although all commercial fishermen are required under the MMPA to submit a marine mammal take form if they incidentally take a marine mammal.

Trawl logbooks are submitted to each state agency: California Department of Fish and Game (CDFG), Oregon Department of Fish and Wildlife (ODFW), and Washington Department of Fish and Wildlife (WDFW), and recorded information is entered into state agency databases. Electronic logbook data are then uploaded on a quarterly basis to PacFIN. Often, the most complete logbook data for a calendar year are not available until April of the following year. For the Pacific Coast groundfish bottom trawl fishery, the

Table 4.4.2
Current Northwest Regional Federal observer programs and fisheries observed. Coverage level was determined by observed landings. Programs and observed fisheries are listed alphabetically. Observer programs that ended over 10 years ago are not listed in this table.

Observer Program	U.S. National Bycatch Report Fisheries	Authority to Place Observers	Program Duration	Coverage Level
At-Sea Hake Observer Program	West Coast Mid-Water Trawl For Whiting, At-Sea Processing	MSFCMA (50 CFR 660)	1975–present	2005-08: 100%
West Coast Groundfish Observer Program	CA Halibut Trawl	MSFCMA (50 CFR 660)	2001–present	2005: 1–10% 2006: <1–10% 2007: <1–10% 2008: <1–10%
	CA/OR Nearshore Rockfish			
	CA/OR Pink Shrimp			
	CA/OR Spot Prawn			
	West Coast Groundfish Bottom Trawl; West Coast Limited-Entry Bottom Trawl	MSFCMA (50 CFR 660)	2001–present	2005: 24% 2006: 22% 2007: 18.5% 2008: 17–30%
	West Coast Groundfish Non-Trawl Gear: Limited-Entry Sablefish-Endorsed Fixed Gear			2005: 42% 2006: 28% 2007: 25.1% 2008: 17–30%
	West Coast Groundfish Non-Trawl Gear: Non-Endorsed Fixed Gear	MSFCMA (50 CFR 660)	2001–present	2005: 3% 2006: 7% 2007: 12.6% (program does not cover all portions of non-endorsed fishery) 2008: 17–30%
	West Coast Mid-Water Trawl For Hake, Shoreside Processing	MSFCMA (50 CFR 660)	2004–09	2005–08: 100% of vessels (covered with pilot EM)

completeness of logbook submission is not fully known. As with most self-reported data, the trawl logbooks are unverified, creating a potential for bias. However, the state agencies all employ similar procedures during data processing to adjust logbook weights, based on trip-level comparison of logbook trip entries and corresponding landing receipts.

The State of Oregon requires logbooks for its state-managed fisheries, such as nearshore rockfish, although currently these logbooks are not directly available to NMFS.

4.4.3.3 Landing Receipts

Landing receipts, also known as fish tickets, are required to be completed by fish buyers in each port for every shoreside delivery of fish by a vessel. Each state agency issues blank fish tickets to fish buyers to complete and return to the agency for processing. Fish tickets are available for all of the fisheries for which bycatch estimates are presented here, with the exception of the West Coast mid-water trawl for Pacific hake with at-sea processing, as only processed catch is ever landed. Potential fish ticket biases include the possibility that not all landings are recorded on submitted fish tickets and inconsistencies in the recording of species between fish buyers, ports, and states.

State laws require that all fish landed by a vessel be recorded on a landing receipt. Washington, Oregon, and California each have a slightly different format of landing receipt. Data collected include delivery date, port, processor identification, vessel identification, fisherman name, gear

type, catch category (single species or species group), and landed weight or number of fish (for salmon). These data pertain only to fish being retained and landed by the vessel; discards at sea are not recorded on the landing receipt. Landing receipts are recorded by fish buyers and then sent to the issuing state agency. The receipts are then entered into state agency databases and uploaded electronically to the PacFIN regional database. The data are uploaded to PacFIN within a week, or up to every two months, depending on the state agency.

In many observed Northwest fisheries, it is necessary to adjust retained catch weight recorded by observers to landings receipt(s) weight. Matching observed catch with landing receipts can be problematic due to differences in dates (end dates of observed trips do not always match the date of landing) or differences in the recorded species/fish category assignments between the observer program and landing receipts.

4.4.4 Northwest Region Bycatch Estimation Methods

4.4.4.1 Fish Discard Estimation Methods for the West Coast Limited-Entry Bottom Trawl, Groundfish Bottom Trawl Fishery

Fish discard estimation methods in this fishery are detailed in the report on mortality in the West Coast groundfish fishery by Hastie and Bellman (2006) and the WCGOP data report (NWFSC 2006a). For WCGOP observer data-collection methods, refer to the program's manual (NWFSC 2006b). Fleet-wide discard estimates are derived from WCGOP observer data, landing receipt data, and trawl industry logbook data. WCGOP observer data and trawl logbook data are stratified by area, season, and depth. The approach is to estimate discards as a direct function of retained catch.

Discard ratios are calculated from observer data for three sets of species: rebuilding species (species that are under rebuilding plans), fishery target species, and other incidentally caught species. Stratum discard ratios for rebuilding species and other incidental species, where the majority of species catch is often discarded, are calculated by dividing a rebuilding or other incidental species' discarded weight by the aggregate retained weight of the target species in the stratum. Stratum discard ratios for target species, where the species catch is characterized by a mix of retention and discard, are calculated by dividing each target species' discarded weight by its retained weight.

Stratum estimates of discard for individual rebuilding species and other incidental species are calculated by multiplying the aggregate logbook target species catch in each stratum by the appropriate discard ratio. Stratum estimates of discard are calculated for each target species by multiplying the logbook retained species catch by the appropriate discard ratio. The stratum discard estimates are then summed for each area and two-month period. Logbook data do not provide a complete synopsis of all trawl trips, thus discard estimates must be expanded to reflect the difference between landed catch reported on landing receipts and that reported in logbooks. The extrapolation ratio for rebuilding and other incidentally caught species is equal to the landing receipt weight of the combined target species, divided by logbook weight for the combined target species. The extrapolation ratio for target species is equal to landing receipt weight divided by logbook weight for each state and two-month period. Measures of uncertainty were not calculated for this report, but methods to do so are being developed.

4.4.4.2 Fish Discard Estimation Method for Pacific Halibut in the West Coast Limited-Entry Bottom Trawl, Groundfish Bottom Trawl Fishery

Fish discard estimation methods for Pacific halibut (*Hippoglossus stenolepis*) caught in the limited-entry groundfish bottom trawl fishery are detailed in a report by Wallace and Hastie (2006). The estimation method employed here is based upon methods developed for Pikitch et al. (1998). The analysis is limited in geographic extent to Washington and Oregon as Pacific halibut are rarely caught south of Oregon. The method calculates Pacific halibut bycatch rates, which are stratified by season, depth, latitude, and by the amount of arrowtooth flounder (*Atheresthes stomias*) landed. Arrowtooth flounder is the species most highly correlated with Pacific halibut discard from the bottom trawl fishery in this area. The Pacific halibut bycatch rates (weight per hour) are then multiplied by the amount of trawl effort (hours towed) in each stratum, as determined from trawl industry logbooks. Pacific halibut bycatch for the bottom trawl fleet is estimated by summing across strata. Measures of uncertainty were not calculated for 2005, the baseline of data used for this report. Starting in 2007, measures of uncertainty for the Pacific halibut bycatch rate are reported, and these measures will be included in future editions of this report.

4.4.4.3 Fish Discard Estimation Methods for the West Coast Limited-Entry Sablefish-Endorsed Fixed-Gear Fishery and the Non-Sablefish-Endorsed Fixed-Gear Fishery

Fish discard estimation methods in these fisheries are detailed in a data report by Hastie and Bellman (2006), but further separation of landings by the limited-entry sablefish-endorsed fishery and the non-sablefish-endorsed fixed gear fishery was necessary in calculating discard estimates for this report. The WCGOP data reports also contain ad-

ditional details (NWFSC 2006c,d). Fleet-wide discard estimates in these fisheries are derived from WCGOP and landing receipt data. The primary limited-entry sablefish-endorsed fixed gear fishery takes place from April to the end of October and operates under a tier-limit endorsement program. The non-sablefish-endorsed fixed gear fishery can occur year-round under daily trip limit management. These fisheries are stratified by area and gear type and by the area-specific depth zones dictated by fishery management. The analysis is limited in geographic extent to north of 36°N latitude.

Sablefish landings and discard estimates are calculated by gear type and area. Estimated discard of sablefish is calculated by multiplying the landed catch from fish ticket receipts by the corresponding observed discard ratio. Discard ratios for rebuilding and other groundfish species are calculated by dividing the stratum discard weight of each species by the retained catch weight of sablefish. Estimated discard of rebuilding and other groundfish species is calculated by multiplying the observed discard ratio by sablefish landing weight. A sablefish mortality rate was not applied in discard estimation for the U.S. National Bycatch Report. Measures of uncertainty were not calculated for this report, but the development of methods is underway.

4.4.4.4 Fish Discard Estimation Methods for the Oregon/California Nearshore Rockfish Fishery

Fish discard estimation methods in this fishery are detailed in a data report by Hastie and Bellman (2006), but further correction of the fishery landings data was necessary in calculating discard estimates for this report. The WCGOP data report also contains additional details (NWFSC 2007). Fleet-wide discard estimates in the nearshore (depths less than 50 fathoms) fishery are derived from WCGOP data, landing receipt data, and other parameters developed through modeling efforts by the Groundfish Management Team (GMT) of the PFMC.

The total observed catch weights of nearshore species or species groups are stratified by area and depth. The discard percentage of observed species or species group is calculated for each stratum. Landed fish ticket weights for each species or species group are expanded to produce fleet-wide total catch estimates (landed + discard), using various retention rates for all depths less than 50 fathoms. Total catch is then distributed among three depth intervals, based on GMT estimates. Within each depth stratum, discard estimates for rebuilding species are calculated by multiplying the observed discard ratios by total nearshore target species landing weight. The total nearshore target species landing weights were corrected in the southern area depth stratums when calculating discard estimates for this report. Mortality or survivorship rates were not applied when reporting discard estimates for this report. Measures of uncertainty were not calculated for this report, but the development of methods is underway.

4.4.4.5 Fish Discard Estimation Methods for the West Coast Mid-Water Trawl for Whiting, At-Sea Processing Fishery

Discard estimates in this fishery were obtained directly from observer data collected by the A-SHOP program. For observer data-collection methods, refer to the program's data manuals (AFSC 2006; NWFSC 2006e). Summaries of target and bycatch are presented in an annual report by the Northwest Regional Office (NMFS 2006a). The same data are also incorporated in the total mortality data report for the West Coast groundfish fishery (Hastie and Bellman 2006). The A-SHOP obtains data on total bycatch in the fishery, not specifically on discard. Discard estimates are based on an observer's visual approximation of the portion of bycatch that is potentially discarded. Thus, the discard estimates are largely tentative and should be viewed with caution. The discard estimates for the at-sea hake mid-water trawl fishery do not include data collected in the Makah Tribal sector of the fishery. Measures of uncertainty were not calculated.

4.4.4.6 Marine Mammal and Seabird Bycatch Estimation Methods for the West Coast Mid-Water Trawl for Whiting, At-Sea Processing; West Coast Limited-Entry Bottom Trawl–Groundfish Bottom Trawl; Limited-Entry Sablefish-Endorsed Fixed Gear; Non-Sablefish-Endorsed Fixed Gear; and Oregon–California Nearshore Rockfish Fisheries

Marine mammal and seabird bycatch estimation methods for these fisheries are detailed in a data report by the Northwest Fisheries Science Center (NWFSC 2008). Observer program data were analyzed from WCGOP and A-SHOP. Observations of WCGOP-observed fisheries and landings made by these fisheries were aggregated into general groundfish management areas based on vessel return port. In the at-sea hake trawl fishery, only tows that were monitored for marine mammals were used for marine mammal bycatch calculation. All of the sampled tows were used for calculating seabird bycatch in the at-sea hake trawl fishery, as the seabirds were mixed in with the fish catch.

For marine mammal takes in all fisheries and seabird takes in all fisheries except the at-sea hake trawl fishery, bycatch estimates and variance were calculated using a ratio estimator technique (Cochran 1977). This estimator was selected because the variance estimate does not assume that the numerator and denominator are independent. The ratio estimator was used to calculate bycatch rates from observer data, and then the rates were multiplied by the total target catch recorded on landing receipts to obtain bycatch

estimates for the fishery. The target catch is sablefish in the fixed gear fisheries, catch weight of all fish species in the at-sea hake fishery, and a subset of target groundfish species in the bottom trawl fishery. Total bycatch estimates were calculated by summing the bycatch estimates across all groundfish management areas. Calculation of the variance of the total bycatch estimate assumed that the bycatch estimates between management areas were independent, and was accomplished by summing variances across all areas.

A different method was used for seabird bycatch calculations in the at-sea hake trawl fishery. Approximately 99% of all tows in the fishery were sampled. To calculate the total number of seabirds in the catch, the number of seabirds was first extrapolated from the subsample to the tow level by dividing the number of seabirds by the percentage of the tow sampled. Total seabird takes were then calculated by dividing the sum of the number of birds, extrapolated to the tow level, by the percentage of tows sampled.

For all of the fisheries except the at-sea hake fishery, confidence intervals of 90% were calculated because the coefficients of variance were high. For the at-sea hake fishery, 95% confidence intervals were calculated because the estimates were more precise. A lognormal approximation (Burnham et al. 1987) was used to calculate confidence intervals. The advantage in using this method is that it captures the skewed nature of data distribution and avoids calculating lower bounds less than zero.

In the Oregon and California nearshore fisheries, no marine mammal or seabird takes were observed, and thus no further analysis of the fisheries was completed.

4.4.4.7 Fish Discard Estimation Methods for the West Coast Salmon Troll, Non-Tribal, and Tribal Ocean Fisheries

Pacific Coast Federal salmon fisheries focus on Chinook (*Oncorhynchus tshawytscha*) and coho (*Oncorhynchus kisutch*) salmon. Ocean salmon fisheries are divided into geographic areas and the commercial ocean tribal fishery is conducted only north of Cape Falcon, Oregon. The primary bycatch that occurs is bycatch of salmon species. Beginning in 2000, nearly all non-tribal commercial fisheries for coho salmon have allowed retention only of marked hatchery fish. Fisheries were sampled by state programs through limited onboard observation and dockside interviews.

Summary information on the estimated bycatch of Chinook and coho salmon is included in a pre-season process when recommendations are developed for management and also in post-season stock assessment and fishery evaluation (SAFE) reports (PFMC 2005, 2006). Incidental mortality is calculated as shaker mortality plus drop-off mortality. Shaker mortality includes sublegal fish and unmarked fish caught and released in mark-selective fisheries. Drop-off mortality includes fish that escape from gear and subsequently die, and fish removed from gear by marine mammals. Drop-off mortality is calculated as 5% of the total encounters (landed catch + discards). Shaker mortality is calculated as discards × HRM, where HRM is the hooking release mortality rate. The HRM is 26% for commercial salmon fisheries.

Given that incidental mortality (*IM*) and catch (*C*) are related to discards (*D*) as:

$$IM = 0.05(C + D) + D(HRM)$$

then discards were solved for as:

$$D = [(IM / 0.05) - C] \times [0.05 / (0.05 + HRM)].$$

The catch and bycatch mortality numbers used to calculate discard estimates for this report are included in Table I-7 of the Review of 2005 Ocean Salmon Fisheries (PFMC 2006). Measures of uncertainty were not calculated.

4.4.4.8 Marine Mammal and Seabird Bycatch Estimation Methods for the West Coast Salmon Troll, Non-Tribal, and Tribal Ocean Fisheries

Bycatch estimates of marine mammals and seabirds in these fisheries are not available. Pacific Coast salmon fisheries have a minimal impact on marine mammals, according to the Pacific salmon fisheries management final programmatic EIS (NMFS 2003). Northwest Region oceanic salmon fisheries are classified under the MMPA as Category III, with remote likelihood of causing, or no known cases of, serious injuries or mortalities of marine mammals. Direct impacts on seabirds are also minimal to non-existent, as determined in both the supplemental and programmatic EIS (PFMC 2000; NMFS 2003). The supplemental EIS also considered impacts to other ESA-listed species such as sea turtles and concluded that they were not significant.

4.4.5 Tier Scores for Northwest Region Fisheries

Ten Northwest fisheries with Federal or shared management were scored, based on the quality and availability of bycatch data and current estimation methods. Other data may be available for state, international, and tribal fisheries; however, these programs were beyond the scope of this initial report. The remaining twenty fisheries do not have any Federal management component, are inconsistently monitored by Federal data-collection programs, or have no relevant Federal data collection. In addition, many of these fisheries have had limited effort in recent years. For those with large amounts of effort, such as the Dungeness crab pot fishery, bycatch of finfish is very rare and the likelihood of marine mammal, sea turtle, and seabird injuries is very low.

Unique tier scores were assigned to evaluated fisheries using the tier scoring procedures outlined in Section 3 for fish, marine mammals and other protected species (Table 4.4.3). For all three bycatch types, 50% of Northwest fisheries scored in Tier 2 (Figure 4.4.2). For marine mammals and other protected species, the distribution of scores was the same: 30% in Tier 0, 10% in Tier 1, 50% in Tier 2, and 10% in Tier 3 (Figure 4.4.2 B and C). Scores for fish placed 10% of fisheries in Tier 0, 30% in Tier 1, 50% in Tier 2, and 10% in Tier 3. No Northwest fisheries scored in Tier 4 for fish, marine mammals, or other protected species.

Table 4.4.3

The 2005 fishery tier scores for the Northwest Region (listed alphabetically, first by management authority and then by fishery name). Fisheries in shaded rows were scored for this report. Only Federal data-collection programs were evaluated. Some state fisheries with a Federal bycatch data-collection component, such as the pink shrimp and spot prawn fisheries, could not be properly assigned to a tier due to limited data at the time.

Fishery	Management Authority	Fish	Marine Mammal	Other Protected Species
West Coast Groundfish Non-Trawl Gear: Limited-Entry Sablefish-Endorsed Fixed Gear	Federal	2	2	2
West Coast Groundfish Non-Trawl Gear: Non-Endorsed Fixed Gear	Federal	2	2	2
West Coast Limited-Entry Bottom Trawl; Groundfish Bottom Trawl	Federal	2	2	2
West Coast Salmon Troll, Non-Tribal Ocean	Federal	1	0	0
CA Halibut Trawl	Federal, State	1	1	1
CA/OR Nearshore Rockfish	Federal, State	2	2	2
West Coast Pacific Halibut Longline, Non-Tribal	Federal, State, International	0	0	0
West Coast Mid-Water Trawl for Whiting, Shoreside Processing	Federal, State, Tribal	2	2	2
West Coast Mid-Water Trawl for Whiting, At-Sea Processing	Federal, Tribal	3	3	3
West Coast Salmon Troll, Tribal Ocean	Federal, Tribal	1	0	0
OR/CA Pink Shrimp	State			
OR/CA Spot Prawn	State			
WA Beach Seine / OR Drag Seine	State			
WA Grays Harbor Salmon Drift Gillnet (excluding Treaty Tribal Fishing)	State			
WA Grays Harbor Salmon Set and Drift Gillnet	State			
WA Herring Brush Weir	State			
WA/OR Gillnet	State			
WA/OR Herring, Smelt, Squid Purse Seine	State			
WA/OR Lower Columbia River Drift Gillnet	State			
WA/OR Lower Columbia River Salmon Drift	State			
WA/OR Misc Invertebrate	State			
WA/OR Shrimp Pot and Trap	State			

Table 4.4.3 (continued)

Fishery	Management Authority	Fish	Marine Mammal	Other Protected Species
WA/OR Smelt, Herring Dip Net	State			
WA/OR/CA Dungeness Crab Pot	State			
WA Puget Sound Region Salmon Drift Gillnet	State			
WA Salmon Purse Seine	State			
WA Salmon Reef Net	State			
WA Willapa Bay Drift Gillnet	State			
Willapa Bay Salmon Drift	State			
Makah Salmon Set Gillnet Areas 4, 4A, 4B	Tribal			

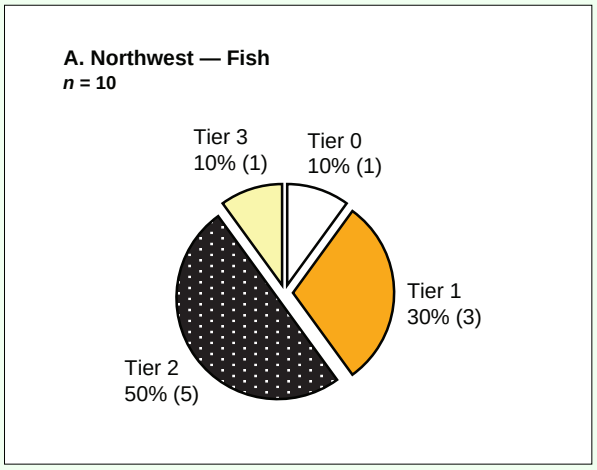
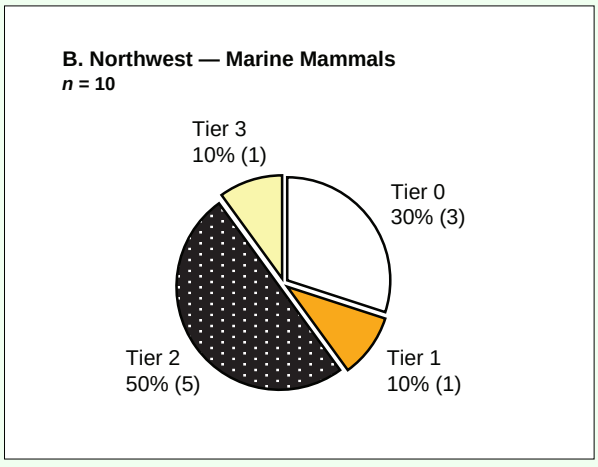
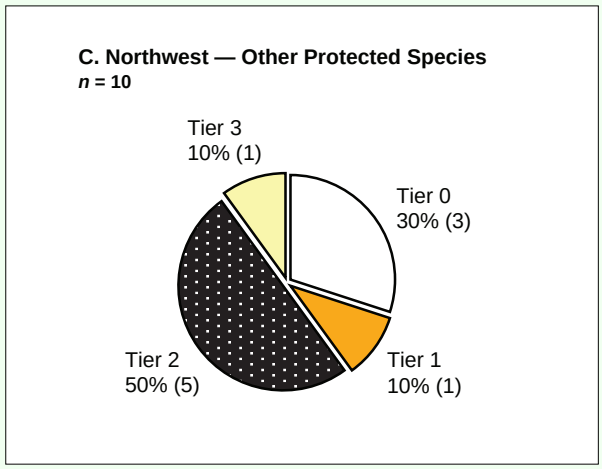


Figure 4.4.2
Tier classifications by number and percentage for Northwest Region fisheries, for fisheries with Federal or shared management or relevant Federal data-collection programs for A) fish, B) marine mammals, and C) other protected species. Tier scores are for the year 2005.





4.4.6. Northwest Region Key Stocks

Eighty-one key stocks were identified in the Northwest Region (Table 4.4.4). As in all regions, not all species listed as key stocks have available bycatch estimates. All ESA-listed populations found in the Northwest Region (47) were automatically included in the list of key stocks, regardless of whether bycatch has been recorded. In other cases, stocks were listed due to conservation concerns, data needs, and/or public interest in the stock. Seventy-three percent of key stocks identified for the Northwest Region were fish stocks, including 26 ESA-listed salmon stocks (Figure 4.4.3). A similar number of stocks listed under the FSSI (22) were identified. Four fish groups (categories), which included both FSSI and non-FSSI/non-ESA-listed stocks, were also included as key stocks. Fish groups are used by the Northwest Region as the basis for calculating and presenting discard estimates; fishery managers use them to determine if target harvest specifications for that group have been exceeded or if sorting is not required to the species level. In some cases, fish groups are used when individual fish are not identified to the stock or species level, on landing receipts in particular. For example, an observer may record species-level information on several retained skate species, but the landing receipt is recorded using "unspecified skates," which can include multiple species of skates. Species included in a particular fish group can differ between fisheries, as they are determined by the specific catch or landings during a given year. The FSSI fish stocks from each grouping are included in the FSSI section of Table 4.4.4, along with their status information. The non-FSSI/non-ESA key fish stocks have been listed separately; no status information is available for these stocks.

Table 4.4.4
Key fish and marine mammal stocks and key sea turtle and seabird populations for the Northwest Region. Overfishing and overfished status is based on 2008 Quarter 1 FSSI report. Some species are listed twice due to occurrences in multiple groups.

Key Fish Stocks Listed by FSSI[a]			
Species/stock name		Overfishing	Overfished
Common name	Scientific name		
Arrowtooth flounder	*Atheresthes stomias*	No	No
Black rockfish, North	*Sebastes melanops*	No	No
Blue rockfish	*Sebastes mystinus*	Unknown	No
Bocaccio	*Sebastes paucispinis*	No	Yes
Cabezon, South	*Scorpaenichthys marmoratus*	No	No
Canary rockfish	*Sebastes pinniger*	No	No — rebuilding
Cowcod	*Sebastes levis*	No	Yes
Darkblotched rockfish	*Sebastes crameri*	No	Yes
Dover sole	*Microstomus pacificus*	No	No
English sole	*Parophrys vetulus*	No	No
Kelp greenling, Oregon	*Hexagrammos decagrammus*	Unknown	No
Lingcod	*Ophiodon elongatus*	No	No
Longspine thornyhead	*Sebastolobus altivelis*	No	No
Pacific ocean perch	*Sebastes alutus*	No	No — rebuilding
Petrale sole	*Eopsetta jordani*	No	No
Shortspine thornyhead	*Sebastolobus alascanus*	No	No
Spiny dogfish	*Squalus acanthias*	Unknown	Unknown

Table 4.4.4 (continued)

Key Fish Stocks Listed by FSSI[a] (cont.)			
Species/stock name			
Common name	**Scientific name**	**Overfishing**	**Overfished**
Widow rockfish	*Sebastes entomelas*	No	No — rebuilding
Yelloweye rockfish	*Sebastes ruberrimus*	No	Yes
Deeper nearshore species:			
Blue rockfish	*Sebastes mystinus*	Unknown	No
Brown rockfish	*Sebastes auriculatus*	Unknown	Unknown
Other minor nearshore rockfish:			
Brown rockfish	*Sebastes auriculatus*	Unknown	Unknown
Gopher rockfish	*Sebastes carnatus*	Unknown	No
Unspecified skate:			
Longnose skate	*Raja rhina*	Unknown	No
Other nearshore rockfish:			
Gopher rockfish	*Sebastes carnatus*	Unknown	No

Key Fish Stocks Listed by ESA		
Species/stock name		
Common name	**Scientific name**	**Stock status**
Chinook salmon, California coastal	*Oncorhynchus tshawytscha*	Threatened
Chinook salmon, Central Valley spring run	*Oncorhynchus tshawytscha*	Threatened
Chinook salmon, Lower Columbia River	*Oncorhynchus tshawytscha*	Threatened
Chinook salmon, Puget Sound	*Oncorhynchus tshawytscha*	Threatened
Chinook salmon, Sacramento River winter run	*Oncorhynchus tshawytscha*	Endangered
Chinook salmon, Snake River fall run	*Oncorhynchus tshawytscha*	Threatened
Chinook salmon, Snake River spring/summer run	*Oncorhynchus tshawytscha*	Threatened
Chinook salmon, Upper Columbia River spring run	*Oncorhynchus tshawytscha*	Endangered
Chinook salmon, Upper Willamette River	*Oncorhynchus tshawytscha*	Threatened
Chum salmon, Columbia River	*Oncorhynchus keta*	Threatened
Chum salmon, Hood Canal summer run	*Oncorhynchus keta*	Threatened
Coho salmon, Central California coast	*Oncorhynchus kisutch*	Endangered
Coho salmon, Lower Columbia River	*Oncorhynchus kisutch*	Threatened
Coho salmon, Southern Oregon and Northern California coasts	*Oncorhynchus kisutch*	Threatened
Sockeye salmon, Ozette Lake	*Oncorhynchus nerka*	Threatened
Sockeye salmon, Snake River	*Oncorhynchus nerka*	Endangered
Steelhead, California Central Valley	*Oncorhynchus mykiss*	Threatened

Table 4.4.4 (continued)

Key Fish Stocks Listed by ESA (cont.)		
Species/stock name		**Stock status**
Common name	**Scientific name**	
Steelhead, Central California coast	*Oncorhynchus mykiss*	Threatened
Steelhead, Lower Columbia River	*Oncorhynchus mykiss*	Threatened
Steelhead, Middle Columbia River	*Oncorhynchus mykiss*	Threatened
Steelhead, Northern California	*Oncorhynchus mykiss*	Threatened
Steelhead, Snake River Basin	*Oncorhynchus mykiss*	Threatened
Steelhead, South-Central California coast	*Oncorhynchus mykiss*	Threatened
Steelhead, Southern California	*Oncorhynchus mykiss*	Endangered
Steelhead, Upper Columbia River	*Oncorhynchus mykiss*	Endangered
Steelhead, Upper Willamette River	*Oncorhynchus mykiss*	Threatened
Key Fish Stocks Not Listed by FSSI or ESA[a]		
Species/stock name		**Stock status**
Common name	**Scientific name**	
Dungeness crab	*Cancer magister*	Not applicable
Pacific halibut	*Hippoglossus stenolepis*	
Deeper nearshore species:		
Black-and-yellow rockfish	*Sebastes chrysomelas*	
Copper rockfish	*Sebastes caurinus*	
Olive rockfish	*Sebastes serranoides*	
Treefish	*Sebastes serriceps*	
Other minor nearshore rockfish:		
Black-and-yellow rockfish	*Sebastes chrysomelas*	
China rockfish	*Sebastes nebulosus*	
Copper rockfish	*Sebastes caurinus*	
Grass rockfish	*Sebastes rastrelliger*	
Quillback rockfish	*Sebastes maliger*	
Unspecified skate:		
Big skate	*Raja binoculata*	
Other nearshore rockfish:		
China rockfish	*Sebastes nebulosus*	
Grass rockfish	*Sebastes rastrelliger*	
Kelp rockfish	*Sebastes atrovirens*	
Quillback rockfish	*Sebastes maliger*	

Table 4.4.4 (continued)

Key Marine Mammal Stocks Listed by ESA		
Species/stock name		
Common name	**Scientific name**	**Stock status**
Blue whale	*Balaenoptera musculus*	Endangered
Fin whale	*Balaenoptera physalus*	Endangered
Humpback whale	*Megaptera novaeangliae*	Endangered
Killer whale, Southern Resident	*Orcinus orca*	Endangered
Sea otter, California	*Enhydra lutris nereis*	Endangered
Sei whale	*Balaenoptera borealis*	Endangered
Sperm whale	*Physeter macrocephalus*	Endangered
Steller sea lion, Eastern	*Eumetopias jubatus*	Threatened
Steller sea lion, Western	*Eumetopias jubatus*	Endangered

Key Marine Mammal Stocks Not Listed by ESA			
Species/stock name			
Common name	**Scientific name**	**ZMRG**	**Stock status[b]**
None			

Key Sea Turtle Populations		
Species/stock name		
Common name	**Scientific name**	**Population Status**
Green sea turtle	*Chelonia mydas*	Threatened
Kemp's ridley sea turtle	*Lepidochelys kempii*	Endangered
Leatherback sea turtle	*Dermochelys coriacea*	Endangered
Loggerhead sea turtle	*Caretta caretta*	Threatened
Olive ridley sea turtle	*Lepidochelys olivacea*	Threatened

Key Seabird Populations Listed by ESA		
Species/stock name		
Common name	**Scientific name**	**Population status**
Brown pelican	*Pelecanus occidentalis*	Endangered
California least tern	*Sterna antillarum browni*	Endangered
Hawaiian dark-rumped petral	*Pterodroma phaeopygia sandwichensis*	Endangered
Least tern, Interior population	*Sterna antillarum*	Endangered
Marbled murrelet, CA, OR, WA	*Brachyramphus marmoratus marmoratus*	Threatened
Newell's Townsend's shearwater	*Puffinus auricularis newelli*	Threatened
Short-tailed albatross	*Phoebastria albatrus*	Endangered

Key Seabird Populations Not Listed by ESA			
Species/stock name			
Common name	**Scientific name**	**Bycatch concern**	**Population status**
Black-footed albatross	*Phoebastria nigripes*	Yes	Stable/Increasing/ Decreasing[c]

[a] Several species are listed multiple times, as they are members of multiple fish groups. However, each species is counted only once as a key stock.
[b] Stock status based on NMFS marine mammal stock assessments (Caretta, Forney, Lowry, et al. 2007).
[c] Different colonies of black-footed albatross have different population trends (see Naughton et al. 2008a).

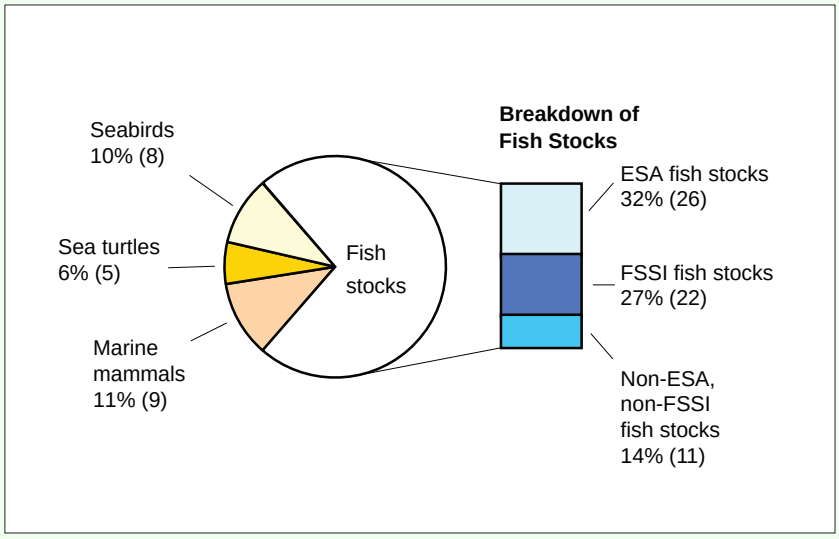


Figure 4.4.3
Key stocks in the Northwest Region, by resource type (*n* = 81).

The majority of key fish stocks were added through the quantitative analysis process, as described in Section 3. Several fish stocks were also added through the qualitative process. A number of FSSI groundfish stocks—arrowtooth flounder (*Atheresthes stomias*), black rockfish (*Sebastes melanops*), cabezon (*Scorpaenicthys marmoratus*), Dover sole (*Microstomus pacificas*), English sole (*Parophrys vetulus*), lingcod (*Ophiodon elongates*), longspine thornyhead (*Sebastolobus altivelis*), Pacific ocean perch (*Sebastes alutus*), petrale sole (*Eopsetta jordanii*), shortspine thornyhead (*Sebastolobus alascanus*), and unspecified skate—were added through the qualitative process, due to their importance as either catch or bycatch. The need to monitor discard of Pacific halibut and Dungeness crab, which are targets of important state fisheries, led the Northwest Region to add both species to the list of key stocks.

The remaining 22 stocks are composed of 8 seabird populations (7 ESA-listed), 9 ESA-listed marine mammal populations, and 5 sea turtle populations (all sea turtles are ESA-listed; Figure 4.4.3). Note that the brown pelican (*Pelecanus occidentalis*) was delisted in 2009 due to its recovery; however, it is listed in this report as an ESA species for consistency with the timeframe of the data and management regulations discussed herein. Of the nine ESA-listed marine mammal key stocks, six are cetaceans, two are pinnipeds (Steller sea lion, eastern and western U.S. populations, which are listed separately under the ESA as distinct population segments), and one is a mustalid (California sea otter). Both populations of Steller sea lions may be taken in Northwest Regional fisheries, but the two cannot be differentiated without genetic sampling. One non-ESA-listed population of seabird, the black-footed albatross (*Phoebastria nigripes*), was added through the qualitative process. The black-footed albatross is also on the USFWS list of Birds of Conservation Concern.

4.4.7. Northwest Region Bycatch Estimates

Bycatch estimates were provided for 3 marine mammal stocks, all sea turtle populations, 6 seabird populations, and 53 fish stocks found in the Northwest Region.

In Appendix 4.4, Tables A and B list fish bycatch estimates by fishery and species. Fish discard estimates were provided for seven of the nine fisheries in the Northwest Region with Federal or shared management or relevant Federal data-collection programs. Fish discard estimates were not available for the remaining fisheries with Federal or shared management: California halibut trawl, West Coast non-tribal Pacific halibut longline, and West Coast mid-water trawl for hake with shoreside processing.

As discussed in Section 4.4.4, fish groups (e.g., deeper nearshore species) were used, as well as individual species. Members of species groups are listed in Appendix I of this report. Bycatch of two salmon species were provided in numbers of individuals, in accordance with current reporting requirements and the salmon fishery management structure. Individual number-to-weight conversions were not available.

Appendix 4.4, Tables C, D, and E list bycatch estimates by fishery for marine mammals, sea turtles, and seabirds. All fisheries with Federal observer data that have no recorded takes of marine mammals, sea turtles, or seabirds have estimates of zero for those bycatch types. Bycatch estimates of marine mammals and seabirds in Pacific Coast ocean salmon fisheries were not available; however, these fisheries have minimal impact on marine mammals (PFMC 2000; NMFS 2003) and are listed as Category III fisheries under the MMPA.

It should be noted that discard estimates provided in the U.S. National Bycatch Report appear higher than those used in regional total mortality reporting. This is in part due to the fact that regional total mortality reports apply discard mortality rates (DMRs) to some species or species groups, unlike the discard estimates provided in this report, which do not.

4.4.8 Bycatch Estimate Improvement Plans for Northwest Region Fisheries

Bycatch data collection and estimation improvement plans were developed for the seven Northwest fisheries with Federal management or relevant Federal data-collection programs, for which bycatch is currently estimated:

- West Coast groundfish non-trawl gear: limited-entry sablefish-endorsed fixed gear
- West Coast groundfish non-trawl gear: non-endorsed fixed gear
- West Coast groundfish limited-entry bottom trawl: groundfish bottom trawl
- West Coast mid-water trawl for whiting, at-sea processing
- California/Oregon nearshore rockfish
- West Coast salmon troll, non-tribal ocean
- West Coast salmon troll, tribal ocean

These fisheries were identified through the quantitative process as having bycatch of key species and/or high overall bycatch levels.

4.4.8.1 Bycatch Estimation Improvement Plans for Northwest Fisheries of Focus

General Recommendations

In addition to maintaining current coverage levels for all fisheries monitored by WCGOP and A-SHOP, the Northwest Regional team recommends funding to allow for dedicated staff analyst time to complete the following tasks for all WCGOP observed fisheries:

- Improve estimation methods by incorporating improvements for linking and tracking permits with landing receipts.
- Improve estimation methods by including measures of uncertainty for finfish bycatch.
- Explore alternative methods of improving analyses of marine mammal and seabird bycatch data.

These are feasible recommendations and can be implemented through providing additional time for a data analyst to explore and develop potential new methods.

4.4.8.2 Fishery-Specific Improvements

California/Oregon Nearshore Rockfish

Tier Scores: Fish = 2; Marine Mammals = 2; Other Protected Species = 2

Bycatch and data-collection concerns:

- Increased coverage of this fishery by the WCGOP is desired for improved characterization of fleet-wide discard and bycatch.
- The potential observer effect on observed vessels compared to non-observed vessels has yet to be resolved.
- Fishery landings data are still difficult to identify and define for this fishery overall.
- Appropriate depth stratification of fishing effort in this fishery is also challenging.
- A method is currently lacking for calculating a coefficient of variance or other measure of uncertainty.

Recommendations:

- The Northwest Regional team has recommended increasing observer coverage of this fishery: this is a feasible recommendation since the WCGOP already provides some fishery coverage and has, therefore, already implemented the infrastructure to collect bycatch data.
- It was recommended that additional sources of fishery data for improving estimation methods be explored: this is a feasible recommendation and can be implemented through providing additional time for data analysts to develop collaborations with state agencies and develop new methods based on incorporation of information found in state nearshore logbook data, or on a tracking system for state landings data.
- Improving the estimation methods to include measures of uncertainty was also recommended.

Ed Bowlby, NOAA

A rockfish swims among deep-sea coral off the Washington State coast.

West Coast Groundfish Limited-Entry Bottom Trawl: Groundfish Bottom Trawl

Tier Scores: Fish = 2; Marine Mammals = 2; Other Protected Species = 2

Bycatch and data-collection concerns:

- A method is currently lacking for calculating a CV or other measure of uncertainty.

Recommendations:

- The Northwest team has recommended improving the estimation method to include measures of uncertainty for estimates of finfish discard.
- It was recommended to explore alternative methods of improving analyses of marine mammal and seabird bycatch data.

West Coast Groundfish Non-Trawl Gear: Limited-Entry Sablefish-Endorsed Fixed Gear

Tier Scores: Fish = 2; Marine Mammals = 2; Other Protected Species = 2

Bycatch and data-collection concerns:

- The fishery has not previously tracked the limited-entry permit number on landing receipts to assist in determination of landings specific to this fishery and to assist in the determination of vessel participation in this fishery. Recent regulations (2007) now require the permit number to be listed on landing receipts to assist in tracking catch and landings for each permit associated with this fishery.
- Estimation methods will need to be further adapted to incorporate the improved tracking of landings and vessel participation.
- This fishery lacks a method for calculating a CV or other measure of uncertainty.

Recommendations:

- The Northwest team recommends adapting the estimation method to incorporate the use of landing receipts to link and track permits.
- It was recommended that the estimation method be improved to include measures of uncertainty for estimates of finfish discard.

- Exploring alternative methods to improve analyses of marine mammal and seabird bycatch data was also recommended.

West Coast Groundfish Non-Trawl Gear: Non-Endorsed Fixed Gear

Tier Scores: Fish = 2; Marine Mammals = 2; Other Protected Species = 2

Bycatch and data-collection concerns:

- Increased coverage of this fishery by the WCGOP is desired for improved characterization of fleet-wide discard and bycatch.

- A method is currently lacking for calculating a CV or other measure of uncertainty.

Recommendations:

- The Northwest Regional team has recommended increasing observer coverage of this fishery: this is a feasible recommendation since the WCGOP already provides some fishery coverage and has, therefore, already implemented the infrastructure to collect bycatch data. However, depending on recent coverage (during 2007), current rates may be high enough and no further increase would be needed.

- It was recommended that the estimation method be improved to include measures of uncertainty for estimates of finfish discard.

- Exploring alternative methods to improve analyses of marine mammal and seabird bycatch data was also recommended.

West Coast Mid-Water Trawl for Whiting, At-Sea Processing

Tier Scores: Fish = 2; Marine Mammals = 2; Other Protected Species = 2

Bycatch and data-collection concerns:

- At-sea monitoring to collect potential discard information is not currently in place for catcher vessels delivering to mother ships.

Recommendations:

- The Northwest Regional team has recommended testing and deployment of EM systems aboard all at-sea catcher vessels.

- Exploring alternative methods to improve analyses of marine mammal and seabird bycatch data was also recommended.

West Coast Salmon Troll, Non-Tribal Ocean

Tier Scores: Fish = 1; Marine Mammals = 0; Other Protected Species = 0

Bycatch and data-collection concerns:

- Formerly limited state and tribal observer programs covering the ocean salmon fisheries have been discontinued due to lack of funding. This eliminates the ability to estimate discard with any scientific basis or accuracy.

- A genetic stock identification (GSI) program is feasible for Chinook salmon and would provide estimates of the stock composition of discards, though there is not a perfect match between stocks that can be discriminated with GSI and those of fishery management and ESA concern.

Recommendations:

- The Northwest Regional team has recommended restoring and expanding observer programs, including non-lethal tissue collection for GSI, from discards. A minimal program could be implemented for approximately 750 observer DAS, not including resources required for processing genetic samples. Obtaining adequate sample sizes may be an issue, given recent catch rates and current salmon abundance.

West Coast Salmon Troll, Tribal Ocean

Tier Scores: Fish = 1; Marine Mammals = 0; Other Protected Species = 0

Bycatch and data-collection concerns:

- Formerly limited state and tribal observer programs covering the ocean salmon fisheries have been discontinued due to lack of funding. This eliminates the ability to estimate discard with any scientific basis or accuracy.

- A GSI program is feasible for Chinook salmon and would provide estimates of the stock composition of discards, though there is not a perfect match between stocks that can be discriminated with GSI and those of fishery management and ESA concern.

Recommendations:

- The Northwest Regional team has recommended restoring state and tribal monitoring observer programs. Based on the requirements of the previous program, the tribal portion of the observer program could be implemented

with 83 DAS per year. This would be a minimal program, and obtaining adequate sample sizes may be an issue, given the catch rates associated with current salmon abundance.

4.4.8.3 Summary of Northwest Region Recommendations

Table 4.4.5 outlines bycatch data collection and estimation improvements recommended by the Northwest Region. In addition to maintaining current coverage levels for observed fisheries, a total of seven recommendations are made. All recommendations are specific to a particular fishery, with the exception of the team's recommendation to fund additional data analyst time to improve estimation methods for WCGOP-observed fisheries. This recommendation has several components and applies to multiple fisheries. The cost of maintaining current coverage levels for Northwest observer programs was $5.941M (including $ 0.390M in industry funding) in FY 2008. The total known requirements to meet regional recommendations are one full-time staff member and 1,855 DAS per year. The feasibility of implementing these recommendations, as evaluated by the Northwest Regional team, is included in Table 4.4.5.

Table 4.4.5
Summary of the Northwest Region's recommendations and estimated needs for implementation in terms of full-time staff and observer DAS.[a] All requirements are annual unless otherwise indicated; ** denotes no additional resource requirements. For further discussion of recommendations, see Section 5.8.

Recommendation[a]	Additional DAS[b]	Feasibility
Maintain observer coverage levels on all currently observed fisheries.	**	High
Fund additional data analyst time to improve estimation methods for WCGOP.	NA	High
Increase observer coverage for the West Coast groundfish non-trawl gear, non-endorsed fixed gear fishery.	167	High
Explore additional sources of data for improving estimation methods in the CA/OR nearshore rockfish fishery.	NA	High
Increase observer coverage of the CA/OR nearshore rockfish fishery.	625	High
Test and deploy EM systems aboard all West Coast mid-water trawls for whiting, at-sea catcher vessels.	225	High
Restore and expand observer programs for the West Coast non-tribal ocean salmon troll fishery.	750	Moderate
Restore and expand state and tribal observer programs for the West Coast tribal ocean troll fishery.	83	Moderate
Number of new full-time staff needed to implement all data-quality and estimation method improvements recommended by the Northwest Region:	1	
Total DAS requirement for all recommendations*:	1,850	

* This amount is in addition to the annual requirements of Northwest Regional observer programs.
[a] Some recommendations may require additional resource expenditures, such as equipment, which are not itemized.
[b] One observer DAS includes the cost for the observer deployment as well as costs for associated equipment and program administrative functions (staffing).

Appendix 4.4 Northwest Region Bycatch Estimates

Table 4.4.A
Subtables showing annual fish bycatch estimates and coefficient of variation (CV), where available, for Northwest fisheries. Bycatch estimates are in pounds or number of individuals. Key stocks are shaded. * following the name of a stock group (members of which are described in Appendix I) indicates a fishery for which bycatch estimates were available only for the generalized stock group. Fishery bycatch ratios = bycatch / (bycatch + landings).

Subtable 4.4.A.1		CA/OR NEARSHORE ROCKFISH			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AMOUNT**	**UNIT**	**CV**
Black rockfish	*Sebastes melanops*	2005	12,125.41	Pounds	
Blue rockfish	*Sebastes mystinus*	2005	7,716.17	Pounds	
Bocaccio	*Sebastes paucispinis*	2005	132.28	Pounds	
Cabezon	*Scorpaenichthys marmoratus*	2005	71,429.69	Pounds	
California sheephead	*Semicossyphus pulcher*	2005	40,565.01	Pounds	
Canary rockfish	*Sebastes pinniger*	2005	8,465.74	Pounds	
Deeper nearshore species*		2005	27,557.78	Pounds	
Kelp greenling	*Hexagrammos decagrammus*	2005	21,825.74	Pounds	
Lingcod	*Ophiodon elongatus*	2005	119,732.91	Pounds	
Other minor nearshore rockfish, north*	Sebastidae	2005	1,543.23	Pounds	
Shallow nearshore species*		2005	20,943.89	Pounds	
Widow rockfish	*Sebastes entomelas*	2005	198.42	Pounds	
Yelloweye rockfish	*Sebastes ruberrimus*	2005	3,813.99	Pounds	
TOTAL FISHERY BYCATCH			336,050.23	Pounds	
TOTAL FISHERY LANDINGS			894,561.00	Pounds	
TOTAL FISHERY CATCH (BYCATCH + LANDINGS)			1,230,611.23	Pounds	
FISHERY BYCATCH RATIO (BYCATCH/TOTAL CATCH)			0.27		

Table 4.4.A (continued)

Subtable 4.4.A.2		WEST COAST GROUNDFISH NON-TRAWL GEAR: LIMITED-ENTRY SABLEFISH-ENDORSED FIXED GEAR			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AMOUNT**	**UNIT**	**CV**
Arrowtooth flounder	*Atheresthes stomias*	2005	115,963.01	Pounds	
Big skate	*Raja binoculata*	2005	63,933.98	Pounds	
Blackgill rockfish	*Sebastes melanostomus*	2005	220.46	Pounds	
Bocaccio	*Sebastes paucispinis*	2005	0.00	Pounds	
Canary rockfish	*Sebastes pinniger*	2005	0.00	Pounds	
Chilipepper rockfish	*Sebastes goodei*	2005	0.00	Pounds	
Cowcod	*Sebastes levis*	2005	0.00	Pounds	
Darkblotched rockfish	*Sebastes crameri*	2005	661.39	Pounds	
Dover sole	*Microstomus pacificus*	2005	4,409.25	Pounds	
Dungeness crab	*Cancer magister*	2005	1,543.24	Pounds	
English sole	*Parophrys vetulus*	2005	0.00	Pounds	
Lingcod	*Ophiodon elongatus*	2005	14,991.42	Pounds	
Longnose skate	*Raja rhina*	2005	69,665.99	Pounds	
Longspine thornyhead	*Sebastolobus altivelis*	2005	0.00	Pounds	
Other flatfish 3*	Pleuronectiformes	2005	0.00	Pounds	
Other groundfish 3*		2005	11,464.02	Pounds	
Other shelf rockfish 3*	Sebastidae	2005	20,062.04	Pounds	
Other slope rockfish 3*	Sebastidae	2005	24,912.21	Pounds	
Pacific cod	*Gadus macrocephalus*	2005	3,306.93	Pounds	
Pacific ocean perch	*Sebastes alutus*	2005	440.92	Pounds	
Pacific whiting	*Merluccius productus*	2005	881.85	Pounds	
Petrale sole	*Eopsetta jordani*	2005	0.00	Pounds	
Sablefish	*Anoplopoma fimbria*	2005	537,927.28	Pounds	
Shortspine thornyhead	*Sebastolobus alascanus*	2005	1,543.23	Pounds	
Spiny dogfish	*Squalus acanthias*	2005	197,974.88	Pounds	
Splitnose rockfish	*Sebastes diploproa*	2005	0.00	Pounds	
Tanner crab	*Chionoecetes* spp.	2005	9,920.79	Pounds	
Unspecified skate 1*	Rajidae	2005	26,675.90	Pounds	
Widow rockfish	*Sebastes entomelas*	2005	1,102.31	Pounds	
Yelloweye rockfish	*Sebastes ruberrimus*	2005	1,102.31	Pounds	
Yellowtail rockfish	*Sebastes flavidus*	2005	661.39	Pounds	
TOTAL FISHERY BYCATCH			1,109,364.78	Pounds	
TOTAL FISHERY LANDINGS			4,925,940.00	Pounds	
TOTAL FISHERY CATCH (BYCATCH + LANDINGS)			6,035,304.78	Pounds	
FISHERY BYCATCH RATIO (BYCATCH/ TOTAL CATCH)			0.18		

Table 4.4.A (continued)

Subtable 4.4.A.3		WEST COAST GROUNDFISH NON-TRAWL GEAR: NON-ENDORSED FIXED GEAR			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AMOUNT**	**UNIT**	**CV**
Arrowtooth flounder	*Atheresthes stomias*	2005	48,942.56	Pounds	
Big skate	*Raja binoculata*	2005	26,675.90	Pounds	
Blackgill rockfish	*Sebastes melanostomus*	2005	661.39	Pounds	
Bocaccio	*Sebastes paucispinis*	2005	0.00	Pounds	
Canary rockfish	*Sebastes pinniger*	2005	0.00	Pounds	
Chilipepper rockfish	*Sebastes goodei*	2005	0.00	Pounds	
Cowcod	*Sebastes levis*	2005	0.00	Pounds	
Darkblotched rockfish	*Sebastes crameri*	2005	440.92	Pounds	
Dover sole	*Microstomus pacificus*	2005	3,086.47	Pounds	
Dungeness crab	*Cancer magister*	2005	881.85	Pounds	
English sole	*Parophrys vetulus*	2005	0.00	Pounds	
Lingcod	*Ophiodon elongatus*	2005	6,172.94	Pounds	
Longnose skate	*Raja rhina*	2005	40,785.47	Pounds	
Longspine thornyhead	*Sebastolobus altivelis*	2005	0.00	Pounds	
Other flatfish 3*		2005	0.00	Pounds	
Other groundfish 3*		2005	6,393.40	Pounds	
Other shelf rockfish 3*	Sebastidae	2005	8,377.56	Pounds	
Other slope rockfish 3*	Sebastidae	2005	10,361.71	Pounds	
Pacific cod	*Gadus macrocephalus*	2005	1,322.77	Pounds	
Pacific ocean perch	*Sebastes alutus*	2005	220.46	Pounds	
Pacific whiting	*Merluccius productus*	2005	440.92	Pounds	
Petrale sole	*Eopsetta jordani*	2005	0.00	Pounds	
Sablefish	*Anoplopoma fimbria*	2005	315,260.66	Pounds	
Shortspine thornyhead	*Sebastolobus alascanus*	2005	661.39	Pounds	
Spiny dogfish	*Squalus acanthias*	2005	104,719.45	Pounds	
Splitnose rockfish	*Sebastes diploproa*	2005	0.00	Pounds	
Tanner crab	Chionoecetes	2005	7,716.17	Pounds	
Unspecified skate 1*	Rajidae	2005	11,243.56	Pounds	
Widow rockfish	*Sebastes entomelas*	2005	440.92	Pounds	
Yelloweye rockfish	*Sebastes ruberrimus*	2005	440.92	Pounds	
Yellowtail rockfish	*Sebastes flavidus*	2005	220.46	Pounds	
TOTAL FISHERY BYCATCH			595,467.85	Pounds	
TOTAL FISHERY LANDINGS			3,498,089.00	Pounds	
TOTAL FISHERY CATCH (BYCATCH + LANDINGS)			4,093,556.85	Pounds	
FISHERY BYCATCH RATIO (BYCATCH/ TOTAL CATCH)			0.15		

Table 4.4.A (continued)

Subtable 4.4.A.4		WEST COAST LIMITED-ENTRY BOTTOM TRAWL; GROUNDFISH BOTTOM TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AMOUNT**	**UNIT**	**CV**
Arrowtooth flounder	*Atheresthes stomias*	2005	3,079,854.14	Pounds	
Big skate	*Raja binoculata*	2005	244,712.82	Pounds	
Black rockfish	*Sebastes melanops*	2005	2,204.62	Pounds	
Blackgill rockfish	*Sebastes melanostomus*	2005	4,409.24	Pounds	
Bocaccio	*Sebastes paucispinis*	2005	61,067.97	Pounds	
Canary rockfish	*Sebastes pinniger*	2005	47,619.79	Pounds	
Chilipepper rockfish	*Sebastes goodei*	2005	114,640.24	Pounds	
Cowcod	*Sebastes levis*	2005	3,086.47	Pounds	
Darkblotched rockfish	*Sebastes crameri*	2005	52,249.49	Pounds	
Dover sole	*Microstomus pacificus*	2005	1,446,232.44	Pounds	
Dungeness crab	*Cancer magister*	2005	559,974.15	Pounds	
English sole	*Parophrys vetulus*	2005	665,795.24	Pounds	
Lingcod	*Ophiodon elongatus*	2005	844,369.46	Pounds	
Longnose skate	*Raja rhina*	2005	1,404,342.94	Pounds	
Longspine thornyhead	*Sebastolobus altivelis*	2005	202,825.04	Pounds	
Other flatfish 1*	Pleuronectiformes	2005	1,611,577.22	Pounds	
Other groundfish 1*		2005	3,359,840.88	Pounds	
Other nearshore rockfish	Sebastidae	2005	0.00	Pounds	
Other shelf rockfish 1*	Sebastidae	2005	178,574.22	Pounds	
Other slope rockfish 1*	Sebastidae	2005	59,524.74	Pounds	
Pacific cod	*Gadus macrocephalus*	2005	8,818.48	Pounds	
Pacific halibut	*Hippoglossus stenolepis*	2005	954,172.76	Pounds	
Pacific ocean perch	*Sebastes alutus*	2005	23,809.90	Pounds	
Pacific whiting	*Merluccius productus*	2005	1,812,197.64	Pounds	
Petrale sole	*Eopsetta jordani*	2005	121,254.10	Pounds	
Sablefish	*Anoplopoma fimbria*	2005	1,155,220.88	Pounds	
Shortbelly rockfish	*Sebastes jordani*	2005	2,204.62	Pounds	
Shortspine thornyhead	*Sebastolobus alascanus*	2005	293,214.46	Pounds	
Spiny dogfish	*Squalus acanthias*	2005	2,352,329.54	Pounds	
Splitnose rockfish	*Sebastes diploproa*	2005	317,465.28	Pounds	
Tanner crab	Chionoecetes	2005	555,564.24	Pounds	
Unspecified skate 1*	Rajidae	2005	304,237.56	Pounds	
Widow rockfish	*Sebastes entomelas*	2005	7,275.25	Pounds	
Yelloweye rockfish	*Sebastes ruberrimus*	2005	1,322.77	Pounds	
Yellowtail rockfish	*Sebastes flavidus*	2005	63,933.98	Pounds	
TOTAL FISHERY BYCATCH			21,915,920.18	Pounds	
TOTAL FISHERY LANDINGS			42,728,085.00	Pounds	
TOTAL FISHERY CATCH (BYCATCH + LANDINGS)			64,644,005.18	Pounds	
FISHERY BYCATCH RATIO (BYCATCH/ TOTAL CATCH)			0.34		

Table 4.4.A (continued)

Subtable 4.4.A.5		WEST COAST MID-WATER TRAWL FOR WHITING, AT-SEA PROCESSING			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AMOUNT**	**UNIT**	**CV**
Arrowtooth flounder	*Atheresthes stomias*	2005	0.00	Pounds	
Canary rockfish	*Sebastes pinniger*	2005	881.85	Pounds	
Darkblotched rockfish	*Sebastes crameri*	2005	8,818.48	Pounds	
Dover sole	*Microstomus pacificus*	2005	0.00	Pounds	
Dungeness crab	*Cancer magister*	2005	0.00	Pounds	
English sole	*Parophrys vetulus*	2005	0.00	Pounds	
Lingcod	*Ophiodon elongatus*	2005	3,306.93	Pounds	
Longspine thornyhead	*Sebastolobus altivelis*	2005	0.00	Pounds	
Other flatfish 2*	Pleuronectiformes	2005	2,204.62	Pounds	
Other groundfish 2*		2005	0.00	Pounds	
Other shelf rockfish 2*	Sebastidae	2005	2,204.62	Pounds	
Other slope rockfish 2*	Sebastidae	2005	17,636.96	Pounds	
Pacific cod	*Gadus macrocephalus*	2005	0.00	Pounds	
Pacific ocean perch	*Sebastes alutus*	2005	440.92	Pounds	
Pacific whiting	*Merluccius productus*	2005	1,223,564.10	Pounds	
Petrale sole	*Eopsetta jordani*	2005	0.00	Pounds	
Sablefish	*Anoplopoma fimbria*	2005	11,023.10	Pounds	
Shortspine thornyhead	*Sebastolobus alascanus*	2005	0.00	Pounds	
Spiny dogfish	*Squalus acanthias*	2005	110,231.00	Pounds	
Tanner crab	Chionoecetes	2005	0.00	Pounds	
Unspecified skate 2*	Rajidae	2005	2,204.62	Pounds	
Widow rockfish	*Sebastes entomelas*	2005	118,388.09	Pounds	
Yelloweye rockfish	*Sebastes ruberrimus*	2005	0.00	Pounds	
Yellowtail rockfish	*Sebastes flavidus*	2005	105,821.76	Pounds	
TOTAL FISHERY BYCATCH			1,606,727.05	Pounds	
TOTAL FISHERY LANDINGS			279,653,842.38	Pounds	
TOTAL FISHERY CATCH (BYCATCH + LANDINGS)			281,260,569.43	Pounds	
FISHERY BYCATCH RATIO (BYCATCH/ TOTAL CATCH)			0.01		

Table 4.4.A (continued)

Subtable 4.4.A.5		WEST COAST SALMON TROLL, NON-TRIBAL OCEAN			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AMOUNT**	**UNIT**	**CV**
Chinook salmon	*Oncorhynchus tshawytscha*	2005	157,200.00	Individuals	
Coho salmon	*Oncorhynchus kisutch*	2005	27,400.00	Individuals	
TOTAL FISHERY BYCATCH			184,600.00	Individuals	
TOTAL FISHERY LANDINGS			629,600.00	Individuals	
TOTAL FISHERY CATCH (BYCATCH + LANDINGS)			814,200.00	Individuals	
FISHERY BYCATCH RATIO (BYCATCH/TOTAL CATCH)			0.23		

Subtable 4.4.A.6		WEST COAST SALMON TROLL, TRIBAL OCEAN			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AMOUNT**	**UNIT**	**CV**
Chinook salmon	*Oncorhynchus tshawytscha*	2005	13,200.00	Individuals	
Coho salmon	*Oncorhynchus kisutch*	2005	2,600.00	Individuals	
TOTAL FISHERY BYCATCH			15,800.00	Individuals	
TOTAL FISHERY LANDINGS			65,800.00	Individuals	
TOTAL FISHERY CATCH (BYCATCH + LANDINGS)			81,600.00	Individuals	
FISHERY BYCATCH RATIO (BYCATCH/ TOTAL CATCH)			0.19		

Table 4.4.B

Summary of Northwest Region fish bycatch by stocks and species. Key stocks are shaded. Where data were available, species bycatch ratios were calculated using the following formula: species bycatch ratio = bycatch of all substocks/(bycatch of all substocks + species landings). * Landings are not available for species groups, as it was not possible to determine the exact composition of the bycatch group and the proportion of bycatch and landings to allocate to each species. **Bycatch ratios could not be developed when bycatch estimates were provided either as numbers of individuals or as both individuals and pounds, or where landings were not available.

		TOTAL STOCK BYCATCH		TOTAL SPECIES BYCATCH		SPECIES LANDINGS		SPECIES BYCATCH RATIO
COMMON NAME	SCIENTIFIC NAME	AMOUNT	UNIT	AMOUNT	UNIT	2005 LANDINGS	UNIT	RATIO
Arrowtooth flounder	*Atheresthes stomias*	All Northwest Region bycatch estimates are provided at the species level.		3,244,759.71	Pounds	4,921,775.00	Pounds	0.40
Big skate[a]	*Raja binoculata*			335,322.70	Pounds	–	–	**
Black rockfish	*Sebastes melanops*			14,330.03	Pounds	390,830.00	Pounds	0.04
Blackgill rockfish	*Sebastes melanostomus*			5,291.09	Pounds	119,722.00	Pounds	0.04
Blue rockfish	*Sebastes mystinus*			7,716.17	Pounds	42,134.00	Pounds	0.15
Bocaccio	*Sebastes paucispinis*			61,200.25	Pounds	15,797.00	Pounds	0.79
Cabezon	*Scorpaenichthys marmoratus*			71,429.69	Pounds	131,988.00	Pounds	0.35
California sheephead	*Semicossyphus pulcher*			40,565.01	Pounds	88,287.00	Pounds	0.31
Canary rockfish	*Sebastes pinniger*			56,967.38	Pounds	26,671.00	Pounds	0.68
Chilipepper rockfish	*Sebastes goodei*			114,640.24	Pounds	146,380.00		0.44
Chinook salmon	*Oncorhynchus tshawytscha*			170,400.00	Individuals	12,992,711.00	Pounds	**
Coho salmon	*Oncorhynchus kisutch*			30,000.00	Individuals	5,005,112.00	Pounds	**
Cowcod	*Sebastes levis*			3,086.47	Pounds	85.00	Pounds	0.97
Darkblotched rockfish	*Sebastes crameri*			62,170.28	Pounds	188,740.00	Pounds	0.25
Deeper nearshore species*				27,557.75	Pounds	–	–	**
Dover sole	*Microstomus pacificus*			1,453,726.43	Pounds	15,204,016.00	Pounds	0.09
Dungeness crab	*Cancer magister*			562,398.56	Pounds	60,674,411.00	Pounds	0.01
English sole	*Parophrys vetulus*			665,795.24	Pounds	2,426,006.00	Pounds	0.22
Kelp greenling	*Hexagrammos decagrammus*			21,825.74	Pounds	49,991.00	Pounds	0.30
Lingcod	*Ophiodon elongatus*			988,573.66	Pounds	448,785.00	Pounds	0.69
Longnose skate[a]	*Raja rhina*			1,514,794.40	Pounds	–	–	**
Longspine thornyhead	*Sebastolobus altivelis*			202,825.04	Pounds	1,463,267.00	Pounds	0.12
Other flatfish 1*	Pleuronectiformes			1,611,577.22	Pounds	–	–	**
Other flatfish 2*	Pleuronectiformes			2,204.62	Pounds	–	–	**

Table 4.4.B (continued)

		TOTAL STOCK BYCATCH		TOTAL SPECIES BYCATCH		SPECIES LANDINGS		SPECIES BYCATCH RATIO
COMMON NAME	SCIENTIFIC NAME	AMOUNT	UNIT	AMOUNT	UNIT	2005 LANDINGS	UNIT	RATIO
Other flatfish 3*	Pleuronectiformes	All Northwest Region bycatch estimates are provided at the species level.		0.00	Pounds	–	–	**
Other groundfish 1*				3,359,840.88	Pounds	–	–	**
Other groundfish 2*				0.00	Pounds	–	–	**
Other groundfish 3*				17,857.42	Pounds	–	–	**
Other minor nearshore rockfish - north*	Sebastidae			1,543.23	Pounds	–	–	**
Other nearshore rockfish	Sebastidae			0.00	Pounds	–	–	**
Other shelf rockfish 1*	Sebastidae			178,574.22	Pounds	–	–	**
Other shelf rockfish 2*	Sebastidae			2,204.62	Pounds	–	–	**
Other shelf rockfish 3*	Sebastidae			28,439.60	Pounds	–	–	**
Other slope rockfish 1*	Sebastidae			59,524.74	Pounds	–	–	**
Other slope rockfish 2*	Sebastidae			17,636.96	Pounds	–	–	**
Other slope rockfish 3*	Sebastidae			35,273.92	Pounds	–	–	**
Pacific cod	*Gadus macrocephalus*			13,448.18	Pounds	1,997,855.00	Pounds	0.01
Pacific halibut	*Hippoglossus stenolepis*			954,172.76	Pounds	2,305,632.00	Pounds	0.29
Pacific ocean perch	*Sebastes alutus*			24,912.20	Pounds	112,561.00	Pounds	0.18
Pacific whiting	*Merluccius productus*			3,037,084.51	Pounds	237,592,889.00	Pounds	0.01
Petrale sole	*Eopsetta jordani*			121,254.10	Pounds	6,026,883.00	Pounds	0.02
Sablefish	*Anoplopoma fimbria*			2,019,431.92	Pounds	13,717,108.00	Pounds	0.13
Shallow nearshore species*				20,943.89	Pounds	–	–	**
Shortbelly rockfish[b]	*Sebastes jordani*			2,204.62	Pounds	–	–	**
Shortspine thornyhead	*Sebastolobus alascanus*			295,419.08	Pounds	1,375,932.00	Pounds	0.18
Spiny dogfish	*Squalus acanthias*			2,765,254.87	Pounds	1,207,583.00	Pounds	0.70
Splitnose rockfish[a]	*Sebastes diploproa*			317,465.28	Pounds	–	Pounds	**
Tanner crab[b]	Chionoecetes			573,201.20	Pounds	–	–	
Unspecified skate 1*	Rajidae			342,157.02	Pounds	–	–	**
Unspecified skate 2*	Rajidae			2,204.62	Pounds	–	–	**
Widow rockfish	*Sebastes entomelas*			127,404.99	Pounds	236,018.00	Pounds	0.35
Yelloweye rockfish	*Sebastes ruberrimus*			6,679.99	Pounds	–	–	**
Yellowtail rockfish	*Sebastes flavidus*			170,637.59	Pounds	1,685,646.00	Pounds	0.09

[a] It was not possible to allocate landings to species.
[b] Species is not targeted and is not landed or rarely landed.

Table 4.4.C

Subtables showing marine mammal bycatch estimates for Northwest Region fisheries. All bycatch estimates and coefficients of variation (CVs) are in number of individuals. Bycatch estimates are from the year 2005 exclusively and reflect incidental mortality and serious injury. Key stocks and populations are shaded.

Subtable 4.4.C.1		WEST COAST GROUNDFISH NON-TRAWL GEAR: LIMITED-ENTRY SABLEFISH-ENDORSED FIXED GEAR			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**NUMBER**	**UNIT**	**CV**
California sea lion	*Zalophus californianus*	2005	14.0	Individuals	0.41
TOTAL FISHERY BYCATCH			14.0	Individuals	

Subtable 4.4.C.2		WEST COAST GROUNDFISH NON-TRAWL GEAR: NON-ENDORSED FIXED GEAR			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**NUMBER**	**UNIT**	**CV**
All marine mammal species		2005	0	Individuals	
TOTAL FISHERY BYCATCH			0	Individuals	

Subtable 4.4.C.3		WEST COAST LIMITED-ENTRY BOTTOM TRAWL; GROUNDFISH BOTTOM TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**NUMBER**	**UNIT**	**CV**
California sea lion	*Zalophus californianus*	2005	19.7	Individuals	0.45
TOTAL FISHERY BYCATCH			19.7	Individuals	

Subtable 4.4.C.4		WEST COAST MID-WATER TRAWL FOR WHITING, AT-SEA PROCESSING			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**NUMBER**	**UNIT**	**CV**
Steller sea lion	*Eumetopias jubatus*	2005	2.4	Individuals	0.30
Harbor seal	*Phoca vitulina*	2005	1.2	Individuals	0.42
TOTAL FISHERY BYCATCH			3.6	Individuals	

Subtable 4.4.C.5		CA/OR FOR NEARSHORE ROCKFISH			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**NUMBER**	**UNIT**	**CV**
All marine mammal species		2005	0	Individuals	
TOTAL FISHERY BYCATCH			0	Individuals	

Subtable 4.4.C.6 (SUMMARY)		TOTAL SPECIES BYCATCH	
COMMON NAME	**SCIENTIFIC NAME**	**NUMBER**	**UNIT**
California sea lion	*Zalophus californianus*	33.7	Individuals
Harbor seal	*Phoca vitulina*	1.2	Individuals
Steller sea lion	*Eumetopias jubatus*	2.4	Individuals
TOTAL FISHERY BYCATCH		37.3	Individuals

Table 4.4.D
Subtables showing sea turtle bycatch estimates (mortalities + individuals released alive) for Northwest Region fisheries. Shading indicates key species. All bycatch estimates are in number of individuals. Bycatch estimates are from the year 2005 exclusively.

Subtable 4.4.D.1 — WEST COAST GROUNDFISH NON-TRAWL GEAR: LIMITED-ENTRY SABLEFISH-ENDORSED FIXED GEAR

COMMON NAME	SCIENTIFIC NAME	DATA SOURCE	NUMBER	UNIT	CV
All sea turtle species		2005	0	Individuals	
TOTAL FISHERY BYCATCH			0	Individuals	

Subtable 4.4.D.2 — WEST COAST GROUNDFISH NON-TRAWL GEAR: NON-ENDORSED FIXED GEAR

COMMON NAME	SCIENTIFIC NAME	DATA SOURCE	NUMBER	UNIT	CV
All sea turtle species		2005	0	Individuals	
TOTAL FISHERY BYCATCH			0	Individuals	

Subtable 4.4.D.3 — WEST COAST LIMITED-ENTRY BOTTOM TRAWL; GROUNDFISH BOTTOM TRAWL

COMMON NAME	SCIENTIFIC NAME	DATA SOURCE	NUMBER	UNIT	CV
All sea turtle species		2005	0	Individuals	
TOTAL FISHERY BYCATCH			0	Individuals	

Subtable 4.4.D.4 — WEST COAST MID-WATER TRAWL FOR WHITING, AT-SEA PROCESSING

COMMON NAME	SCIENTIFIC NAME	DATA SOURCE	NUMBER	UNIT	CV
All sea turtle species		2005	0	Individuals	
TOTAL FISHERY BYCATCH			0	Individuals	

Subtable 4.4.D.5 — CA/OR FOR NEARSHORE ROCKFISH

COMMON NAME	SCIENTIFIC NAME	DATA SOURCE	NUMBER	UNIT	CV
All sea turtle species		2005	0	Individuals	
TOTAL FISHERY BYCATCH			0	Individuals	

Subtable 4.4.D.6 (SUMMARY) — TOTAL SPECIES BYCATCH

COMMON NAME	SCIENTIFIC NAME	NUMBER	UNIT
All sea turtle species		0	Individuals

Table 4.4.E

Subtables showing seabird bycatch estimates for Northwest fisheries. All bycatch estimates and coefficients of variation (CVs) are in number of individuals. Bycatch estimates are from the year 2005 exclusively. Key stocks/populations are shaded.

Subtable 4.4.E.1		WEST COAST GROUNDFISH NON-TRAWL GEAR: LIMITED-ENTRY SABLEFISH-ENDORSED FIXED GEAR			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AMOUNT**	**UNIT**	**CV**
Black-footed albatross	*Phoebastria nigripes*	2005	56.8	Individuals	0.40
TOTAL FISHERY BYCATCH			56.8	Individuals	

Subtable 4.4.E.2		WEST COAST GROUNDFISH NON-TRAWL GEAR: NON-ENDORSED FIXED GEAR			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AMOUNT**	**UNIT**	**CV**
Brown pelican	*Pelecanus occidentalis*	2005	35.6	Individuals	1.00
TOTAL FISHERY BYCATCH			35.6	Individuals	

Subtable 4.4.E.3		WEST COAST LIMITED-ENTRY BOTTOM TRAWL; GROUNDFISH BOTTOM TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AMOUNT**	**UNIT**	**CV**
Unidentified gull	Laridae	2005	3.8	Individuals	0.86
TOTAL FISHERY BYCATCH			3.8	Individuals	

Subtable 4.4.E.4		WEST COAST MID-WATER TRAWL FOR WHITING, AT-SEA PROCESSING			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AMOUNT**	**UNIT**	**CV**
Black-footed albatross	*Phoebastria nigripes*	2005	2.0	Individuals	
Common murre	*Uria aalge*	2005	2.0	Individuals	
Northern fulmar	*Fulmarus glacialis*	2005	2.0	Individuals	
Sooty shearwater	*Puffinus griseus*	2005	2.0	Individuals	
Unidentified sea bird	Laridae	2005	2.0	Individuals	
TOTAL FISHERY BYCATCH			10.0	Individuals	

Subtable 4.4.E.6		CA/OR FOR NEARSHORE ROCKFISH			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AMOUNT**	**UNIT**	**CV**
All seabird species		2005	0	Individuals	
TOTAL FISHERY BYCATCH			0	Individuals	

Table 4.4.E (continued)

Subtable 4.4.E.7 (SUMMARY)		**TOTAL SPECIES BYCATCH**	
COMMON NAME	**SCIENTIFIC NAME**	**AMOUNT**	**UNIT**
Black-footed albatross	*Phoebastria nigripes*	58.8	Individuals
Brown pelican	*Pelecanus occidentalis*	35.6	Individuals
Common murre	*Uria aalge*	2.0	Individuals
Northern fulmar	*Fulmarus glacialis*	2.0	Individuals
Sooty shearwater	*Puffinus griseus*	2.0	Individuals
Unidentified gull	Laridae	3.8	Individuals
Unidentified seabird		2.0	Individuals
TOTAL FISHERY BYCATCH		106.2	Individuals

4.5 Southwest Region

The NMFS Southwest Region is responsible for the management, conservation, and protection of marine species found off the coast of California in the U.S. EEZ. These waters include the U.S. portion of the California Coastal Current LME, known as one of the major coastal upwelling areas of the world.[1] This nutrient-rich environment supports a wide variety of marine life as well as diverse fisheries. The PFMC, in conjunction with NMFS, is responsible for managing fisheries in the Southwest Region.

4.5.1 Fisheries Overview

A total of 25 commercial fisheries are included in this report on the Southwest Region (Table 4.5.1). These fisheries were valued at approximately $116 million[2] in 2005. Management jurisdiction for Southwest Region fisheries occurs at many levels (Figure 4.5.1) since species and fisheries cross regional and national boundaries. For example, the NMFS Northwest Region manages Federal groundfish fisheries extending the length of the U.S. West Coast, and it also manages Federal salmon fisheries with support from the Southwest Region. Additionally, three Southwest Region HMS fisheries occur in international waters.

Over half of the commercial fisheries prosecuted in the Southwest Region are managed at the state level (Figure 4.5.1). Twenty percent of Southwest Region commercial fisheries are federally managed.

The Southwest Region coordinates with PFMC to provide information necessary to develop and monitor Federal FMPs for the Southwest Region. The PFMC has two FMPs in place in this region: the Coastal Pelagics Species FMP and the U.S. West Coast Fisheries for Highly Migratory Species FMP. The Coastal Pelagics FMP, implemented in 1999, was developed from the PFMC's 1978 Northern Anchovy FMP to manage all CPS. The coastal purse seine fishery for anchovy, mackerel, and sardine is managed under this FMP. The U.S. West Coast Fisheries for Highly Migratory Species FMP (implemented in 2004) regulates catch of tunas, billfish/swordfish, sharks, and other HMS species in West Coast fisheries, e.g., mahi-mahi (*Coryphaena hippurus*), also known as dorado or dolphinfish. Seven of the Southwest Region's fisheries are managed under this FMP. Fisheries managed under this FMP are described in the annual SAFE report published each year by the PFMC (available at http://www.pcouncil.org).

The CDFG is the primary management authority for regional state-managed fisheries. The CDFG works jointly with the Southwest Region to manage fisheries that cross the state/Federal border. Data-sharing agreements are in place for all fisheries. For example, CDFG shares effort and logbook data for state fisheries such as the halibut set gillnet fishery and coastal pelagic purse seine fisheries for squid, anchovy, mackerel, and sardine. The Southwest Region also works with the ODFW to manage the northern portion of the pelagic drift gillnet fishery, where the fishing area includes state and Federal waters.

In international waters, the Eastern Tropical Pacific (ETP) bait-boat and Eastern Pacific Ocean (EPO) tuna purse seine fisheries are regulated by the Inter-American Tropical Tuna Commission (IATTC), whereas the Central Western Pacific tuna purse seine fishery is regulated by the Forum Fisheries Agency (FFA) under a FMP administered by the Western Pacific Fisheries Management Council (WPFMC).

4.5.2 Addressing Regional Bycatch Concerns

Staff at the NMFS Southwest Regional Office, Southwest Fisheries Science Center, and regional NMFS field offices work with staff of the PSMFC (the regional interstate fisheries management commission) and state offices to conserve, manage, and develop the fishery resources of the U.S. West Coast. These partnerships are critical to developing bycatch reduction strategies for West Coast fisheries. Efforts have been concentrated on the dominant fisheries and gear types of the Southwest Region: gillnet, coastal purse seine, and tuna purse seine.

Gillnet

Attention to bycatch in the Southwest Region has been largely limited to three gillnet fisheries with a history of marine mammal interactions: the California/Oregon drift gillnet fishery (mesh size greater than 14 inches) targeting swordfish (*Xiphias gladius*) and thresher shark (*Alopias vulpinus*); the California set gillnet fishery (mesh size up to 14 inches) targeting halibut (*Hippoglossus stenolepis*) and white seabass (*Atractoscion nobilis*); and the California small-mesh drift gillnet fishery (mesh size between 3.5 and 14 inches) targeting yellowtail (*Seriola lalandei*) and white seabass (*Atractoscion nobilis*). Marine mammal bycatch has been estimated for fisheries with observer programs since 1990, as required by the MMPA. Amendments to the MMPA in 1994 required fisheries and management agencies to reduce marine mammal bycatch to sustainable levels. In 1996, the Pacific Offshore Cetacean TRT was created to address bycatch of several marine mammal species in the swordfish and thresher shark gillnet fishery (bycatch reduction efforts are described further in Barlow and Cameron 2003). In 1997, a TRP was implemented. The main technology introduced to reduce cetacean bycatch in this fishery was acoustic pingers. Although cetacean bycatch has been reduced by approximately 50% in the California/Oregon

[1] http://www.lme.noaa.gov/.

[2] Ex-vessel landings value, Fisheries Economics of the U.S., 2006. Available online at http://www.st.nmfs.noaa.gov/st5/publication/fisheries_economics_2006.html. Landings values are for the State of California only.

Table 4.5.1
Southwest Region fisheries included in the U.S. National Bycatch Report. Fisheries are listed alphabetically by management authority and then by individual fishery name. Rows containing fisheries for which bycatch estimates are included in this report are shaded.

Fishery[a]	Management Authority	Federal Fishery Management Plan (FMP)[b]	Gear Type	Target Species (common name)	Data Sources[c]
California Coastal Purse Seine for Tuna	Federal	U.S. West Coast Fisheries for Highly Migratory Species	Purse seine	Pacific bluefin, yellowfin, and skipjack tunas	Observer, logbook, landing receipts
California Pelagic Longline	Federal	U.S. West Coast Fisheries for Highly Migratory Species	Longline, surface, mid-water	Swordfish, bigeye tuna	Observer, logbook, MMPA form[d]
North Pacific Albacore Baitboat: Pole and Line	Federal	U.S. West Coast Fisheries for Highly Migratory Species	Hook and line	Albacore tuna	Observer, logbook
North Pacific Albacore Troll	Federal	U.S. West Coast Fisheries for Highly Migratory Species	Troll lines	Albacore tuna	Observer, logbook
South Pacific Albacore Troll	Federal	U.S. West Coast Fisheries for Highly Migratory Species	Troll lines	Albacore tuna	Observer, logbook
California Coastal Purse Seine for Anchovy, Mackerel, Sardine	Federal, State	Coastal Pelagic Species (PFMC)	Purse seine	Northern anchovy, Pacific mackerel, sardine	Observer, logbook, landing receipts
CA/OR Drift Gillnet (mesh size >14 inches) for Swordfish and Thresher Shark	Federal, State	U.S. West Coast Fisheries for Highly Migratory Species	Gillnet, floating drift	Swordfish and thresher shark	Observer, logbook, MMPA form[d]
California Swordfish Harpoon	Federal, State	U.S. West Coast Fisheries for Highly Migratory Species	Harpoons	Swordfish	Logbook
Central Western Pacific Tuna Purse Seine	International		Purse seine	Yellowfin, bigeye, and skipjack tunas	
Eastern Pacific Ocean (EPO) Tuna Purse Seine	International		Purse seine and fish aggregating devices (FADs)	Yellowfin, bigeye, and skipjack tunas	
Eastern Tropical Pacific (ETP) Baitboat	International		Hook and line	Yellowfin, bigeye, and skipjack tunas	
California Abalone	State		By hand, no scuba diving gear permitted	Abalone	
California Coastal Purse Seine for Squid	State		Purse seine	Market squid	Observer, logbook, landing receipts
California Herring Gillnet	State		Gillnet	Pacific herring	
California Live Fish Hook-and-Line	State		Hook and line	Rockfish	

Table 4.5.1 (continued)

Fishery[a]	Management Authority	Federal Fishery Management Plan (FMP)[b]	Gear Type	Target Species (common name)	Data Sources[c]
California Salmon Enhancement Rearing Pen	State		Aquaculture	Pacific salmon	
California Sea Urchin	State		By hand, diving gear	Sea urchin	
California Set Gillnet (mesh size up to 14 inches)	State		Gillnet, sink anchor	California halibut, white seabass	Observer, logbook
California Set Gillnet (stretched mesh size of 3.5 or less)	State		Gillnet	Barracuda, perch, croaker	
California Small-Mesh Drift Gillnet (mesh size >3.5 in and <14 in)	State		Gillnet, floating drift	White seabass, yellowtail	Observer, logbook
California Squid Dip Net	State		Dip nets	Market squid	
California Trap/Pot	State		Pots and traps	California spiny lobster	
California White Seabass Enhancement Net Pens	State		Aquaculture	White seabass	
CA/OR/WA Bait Pens	State		Aquaculture	Northern anchovy	
CA/OR Hagfish Pot or Trap	State		Pots and traps	Hagfish	

[a] Aquaculture fisheries are listed for consistency with the MMPA List of Fisheries when they occur, but are not analyzed for the U.S. National Bycatch Report. Recreational fisheries are not included in this report.
[b] Note that non-Federal FMPs were not identified through this process.
[c] Bycatch data sources were evaluated only for Federal fisheries and non-Federal fisheries with Federal data-collection programs.
[d] This is the self-reporting form required under the MMPA for any injured or killed marine mammal.

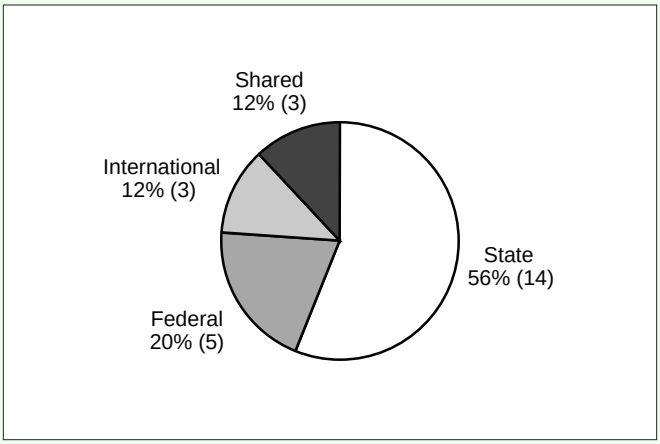


Figure 4.5.1
Management jurisdiction for Southwest Region fisheries (percentages are based on numbers of fisheries, not volume or revenue; *n* = 25). "Shared" indicates fisheries for which international, Federal, state, and/or tribal authorities share management.

drift gillnet fishery (mesh size greater than 14 inches), the TRT still meets to discuss measures that will further reduce bycatch, in an effort to meet ZMRG measures under the MMPA. Gillnet fisheries in this region have also been subject to time and area closures to protect leatherback (*Dermochelys coriacea*) and loggerhead (*Caretta caretta*) sea turtles and seabird (NMFS 2000). Although other species, such as sharks and finfish, occur as bycatch in Southwest Region gillnet fisheries, efforts to estimate bycatch of these species have only recently been implemented.

Coastal Purse Seine

Purse seine fisheries also operate off the U.S. West Coast, targeting tuna and CPS such as jack mackerel (*Trachurus symmetricus*), market squid (*Loligo opalescens*), northern anchovy (*Engraulis mordax*), Pacific mackerel (*Scomber japonicus*), and Pacific sardine (*Sardinops sagax*). These fisheries use encircling nets to capture single-species schools of these ecologically important components of the Pacific Coast ecosystem. Many other fish, marine mammal, sea turtle, and seabird populations depend on CPS stocks for food. These CPS fisheries are also subject to observer programs and monitoring. A pilot observer program was initiated in 2004 for the coastal purse seine fishery targeting CPS species operating off California. Trans-boundary stocks of CPS species are exploited in fisheries from northern California to Mexico. West Coast CPS fisheries are generally viewed as healthy and well managed, and even underutilized in some cases (e.g., jack mackerel and northern anchovy). Within the Southwest Region, the federally managed fisheries target primarily anchovy, sardine, and mackerel stocks, while the state-managed coastal purse seine fishery targets squid. Although stocks of ESA-listed salmon species may occasionally occur as bycatch in both Federal and state fisheries, bycatch is negligible overall, primarily consisting of other CPS species. Several measures have been proposed to minimize bycatch (e.g., the use of grates to cover openings of holds through which fish are pumped). A small portion of the Federal fleet also targets bluefin (*Thunnus orientalis*) and yellowfin (*Thunnus albacares*) tuna in southern California waters during warm-water years, and a pilot observer program has also been implemented to monitor these activities.

Tuna Purse Seine

During the 1970s, the EPO tuna purse seine fishery's practice of setting nets around dolphins to capture associated tuna schools resulted in high annual dolphin mortality rates. In 1972, Congress ratified the MMPA, and NMFS began placing fishery observers aboard EPO tuna purse seine vessels to monitor incidental capture rates of dolphins. The tuna–dolphin observer program was turned over to the IATTC in 1995, as U.S. vessel participation in the fishery declined. Bycatch of dolphins by the tuna purse seine fishery is limited by the Agreement on the International Dolphin Conservation Program (AIDCP). Today, U.S. fishery vessel participation in this fishery is extremely low, and no U.S. vessels currently set on dolphins. Under current regulations, all large U.S. vessels carry observers while fishing, and the IATTC tracks estimates of finfish and dolphin mortality for all vessel classes. NMFS continues its efforts to reduce bycatch of dolphins in the ETP by U.S. and foreign vessels through its support of the IATTC and through the certification of "Dolphin Safe" tuna.

4.5.3 Data Sources

Table 4.5.1 lists bycatch data sources available for Southwest Region fisheries that are federally managed or have relevant Federal data-collection programs. Observer programs in the region focus on estimating marine mammal bycatch, although fish discard data are collected by observers as well. Bycatch data may also be collected through Federal and state logbook reporting programs, though the level of underreporting of bycatch through self-reports is typically high.

4.5.3.1 Observer Program

Observer programs conducted in the past 10 years are listed in Table 4.5.2. Observer data include information on the number of fishing sets observed, bycatch per set, fishing location, and oceanographic variables such as sea surface temperature. Fishing gear variables such as net length, presence or absence of acoustic deterrent devices, and extender lengths are also part of the observer database. Biological samples such as teeth, skin, and gonads are collected when possible. In some cases the entire carcass may be retained for analysis. The region's observer data are stored in Microsoft Access files and screened manually, following observer debriefing.

During 2005, the Southwest Region observed 499 sea days of commercial fishing activities and maintained 50% coverage for the pelagic longline fishery. The region has implemented pilot or baseline observer programs for several fisheries (the Pacific albacore troll, California CPS purse seine, Southern California set gillnet, and West Coast HMS recreational charter fisheries). Two of the region's observer programs (California/Oregon pelagic drift gillnet and California pelagic longline) are observed at adequate or near-adequate levels of coverage.

4.5.3.2 Self-Reported Data

Two types of self-reported data are available for use in bycatch estimation: logbook data and landings receipts. Logbooks document catch, fishing effort, and location, as well as some information on fishing gear, and are avail-

Table 4.5.2
Current Southwest Region Federal observer programs (fisheries observed and coverage levels across all fisheries), listed alphabetically by program and then by fishery. Observer programs that ended over 10 years ago are not listed here.

Observer Program	Fisheries	Authority to Place Observers	Program Duration	Coverage Level
California Coastal Pelagic Species Purse Seine	CA coastal purse seine for anchovy, mackerel, sardine	MMPA Cat. II (50 CFR 660.519)	2004–present	2005: 1.5% 2006: 1.5% 2007: 1.5–5% 2008: NA
	CA coastal purse seine forsquid			
California/Oregon Pelagic Drift Gillnet	CA/OR drift gillnet (mesh size >14 inches) for swordfish and thresher shark	MMPA Cat. I, MSA (50 CFR 660.719)	1990–present	2005–07: 20% 2008: 13–14%
California Pelagic Longline	CA pelagic longline	MMPA Cat. II, MSA (50 CFR 660.719)	2001–present	2005: 50% 2006–08: 100%
California Small-Mesh Drift Gillnet	California small mesh drift gillnet (mesh size >3.5 in and < 14 in)	MMPA Cat. II, MSA (50 CFR 660.719)	2002–04	2005–08: NA
California Set Gillnet	California set gillnet (mesh size up to 14 inches)	MMPA Cat. I (50 CFR 229)	2006	2005: NA 2006: <1% 2007–08: NA
Pacific Albacore Troll	North Pacific albacore baitboat: pole and line	MSA (50 CFR 660.719)	1990–2006	2005: <1% 2006: <1% 2007–08: NA
	North Pacific albacore troll			
	South Pacific albacore troll			
Southern California Tuna Purse Seine	CA coastal purse seine for tuna	MSA (50 CFR 660.719)	2004–05	2005: 20% 2006–08: NA
West Coast HMS Recreational Charter Vessels	NA—no recreation fisheries included in this edition of the U.S. National Bycatch Report	MSA (50 CFR 660.719)	2006	2005: NA 2006: 2% 2007–08: NA

able for several Southwest Region fisheries (Table 4.5.1). The Southwest Region and CDFG collect information on catch and discard in jointly managed fisheries including the coastal purse seine fishery for squid, drift gillnet fishery (1981 to present), and the state-managed set gillnet fishery (1990 to present). Logbooks are required for these fisheries, either by the CDFG (for state waters) or by NMFS (for Federal waters). NMFS also requires logbooks for some Federal fisheries, such as the pelagic longline fishery and the coastal purse seine fishery for tuna.

In addition to logbook reporting, there is a requirement under the MMPA marine mammal authorization program (MMAP) that all vessel owners or operators, regardless of the category of fishery they participate in, must report all incidental injuries and mortalities of marine mammals that occur as a result of commercial fishing operations. Reports must be sent to NMFS by mail or fax within 48 hours of the end of a fishing trip in which the serious injury or mortality occurred or, for non-vessel fisheries, within 48 hours of the occurrence. Direct comparisons of self-reported data and observer data for specific fisheries show that the number of self-reports is biased low.

Once received by NMFS, logbook data are entered into a database and edited. Logbook estimates of discard are reported to regional fisheries management organizations (RFMOs) for all international fisheries. NMFS also receives copies of U.S. logbook and observer reports from IATTC.

4.5.3.3 Landings Receipts

Landings data are also available for all the fisheries discussed above, spanning the time period from 1981 to the present, and are used in extrapolating discard estimates to the entire fishery. Landings data are available from the PacFIN system, which houses landing receipt data from California, Oregon, and Washington.

4.5.4 Southwest Region Bycatch Estimation Methods

Estimation of marine mammal, sea turtle, and seabird bycatch in the Southwest Region was accomplished using mean per-unit or ratio estimators (Cochran 1977) and the resulting bycatch estimates have been published in peer-reviewed journals (Julian and Beeson 1998; Forney et al. 2001; Carretta et al. 2005). Estimates of finfish bycatch are currently being developed for select fisheries, and analytical methods will be similar to those used for marine mammals.

Bycatch estimation in the Southwest Region requires a combination of observer program data and estimates of overall fishing effort. Observer data include information on the number of fishing sets observed, bycatch per set, fishing location, and oceanographic variables such as sea surface temperature. Fishing gear variables such as net length, presence or absence of acoustic deterrent devices, and extender lengths are also part of the observer database. Fishing effort estimates may come directly from vessel logbooks, dock surveys of vessel activity, landing receipts, systematic tallies of fishing effort by the observer program contractor with the cooperation of the fishermen, or a combination of all of these sources. Once observer and fishing effort data are in hand, bycatch estimates can be generated.

The Southwest Region uses a mean per-unit or ratio estimator to extrapolate bycatch observations from a small percentage of overall fishing effort to an entire fishery. The critical assumption in this method is that fishing methods are homogeneous across all vessels and areas in the fishery. For this reason, vessels are selected at random so that a representative sample of fishing effort is obtained by the observer program. Some vessels in a fishery are not observable because they may lack berthing space for an observer. In these cases, alternative methods of observation (such as video monitoring systems) may be employed.

Bycatch is estimated annually, rather than within a fishing season, to better overlap with fishery management reporting requirements. No geographic or seasonal strata are used in estimating bycatch rates, because previous studies showed no improvement in mortality estimates or coefficients of variation (CVs) with stratification (Carretta 2001). Yeung (1999) also found that point estimates of marine mammal and sea turtle bycatch were insensitive to stratification, while pooling improved the precision of bycatch estimates. The bycatch ratio for each species is calculated as:

$$(1)\quad \hat{r}_s = \frac{\sum b_s}{\sum d}$$

where b_s is the observed bycatch of species s during a fishing trip and d is the number of days (i.e., sets) observed during the trip. The variance of the bycatch rate (σ^2 of $\hat{r}_s$), is estimated using a bootstrap procedure where one trip represents the sampling unit. Trips are resampled with replacement until each bootstrap sample contains the same number of trips as the actual observed effort level. A bycatch rate is then calculated from each bootstrap sample. This procedure is repeated 1,000 times, from which the bootstrap or bycatch rate sample variance is calculated.

Annual bycatch estimates ($\hat{m}_s$) for species s and the variance of the bycatch estimate (σ^2_m) are estimated for each species using the following formulae:

$$(2)\quad \hat{m}_s = \hat{D}\,\hat{r}_s$$

$$(3)\quad \sigma^2_m = \hat{D}^2\sigma^2_r$$

where

$\hat{D}$ is the estimated maximum number of days (i.e., sets fished,

$\hat{r}_s$ is the kill rate per set for species s, and

σ^2_r is the bootstrap estimate of the kill rate variance.

The precision of a bycatch estimate is typically reported as a CV, where lower values represent increased precision. The CV of a bycatch estimate is calculated simply as the square root of the bycatch estimate variance, divided by the bycatch estimate:

$$(4)\quad \mathrm{CV} = \frac{\sqrt{\sigma^2_m}}{\hat{m}_s}$$

4.5.5 Tier Classification for Southwest Region Fisheries

Data quality and bycatch estimation methods were evaluated for 11 of the 25 fisheries in the Southwest Region. Only Federal fisheries and fisheries with relevant Federal data-collection programs were evaluated. Other data may be available for state, international, and tribal fisheries; how-

ever, these programs were beyond the scope of this initial report. The remaining fisheries were not evaluated due to a lack of data or an absence of bycatch issues (examples are the California abalone and sea urchin fisheries, where target species are collected by hand). Each fishery was given a tier score based on data-collection and estimation methods, through the scoring procedure outlined in Section 3 for fish, marine mammals and other protected species (Table 4.5.3). Two Federal fisheries (North Pacific albacore baitboat pole and line and South Pacific albacore troll) were classified as Tier 0 in all categories (Figure 4.5.2). Of the nine remaining fisheries evaluated, 46% (five) were classified as Tier 1 for the fish category, and 36% (four) were classified as Tier 2. No fisheries were classified as Tier 3 or 4 for fish. In the marine mammal category, 46% (five) of the evaluated fisheries were designated as Tier 3; in the other protected species category, 55% (six) were scored as Tier 3. One additional fishery (California swordfish harpoon) was classified as Tier 0 for both marine mammals and other protected species.

Table 4.5.3
The 2005 fishery tier classifications for the Southwest Region (listed alphabetically, first by management authority and then by fishery). Shaded fisheries were evaluated for this report. Only Federal data-collection programs were evaluated.

Fishery	Management Authority	Fish Tier	Marine Mammals Tier	Other Protected Species Tier
California Coastal Purse Seine forTuna	Federal	2	3	3
California Pelagic Longline	Federal	2	3	3
CA/OR Drift Gillnet (mesh size >14 inches) for Swordfish and Thresher Shark	Federal	2	3	3
North Pacific Albacore Baitboat: Pole and Line	Federal	0	0	0
North Pacific Albacore Troll	Federal	1	1	1
South Pacific Albacore Troll	Federal	0	0	0
California Coastal Purse Seine for Anchovy, Mackerel, and Sardine	Federal, State	1	2	2
California Swordfish Harpoon	Federal, State	1	0	0
Central Western Pacific Tuna Purse Seine	International			
Eastern Pacific Ocean (EPO) Tuna Purse Seine	International			
Eastern Tropical Pacific (ETP) Baitboat	International			
California Abalone	State			
California Coastal Purse Seine for Squid	State	1	2	3
California Hagfish Pot or Trap	State			
California Herring Gillnet	State			
California Live Fish Hook-and-Line	State			
California Salmon Enhancement Rearing Pen	State			
California Sea Urchin	State			
California Set Gillnet (mesh size up to 14 inches)	State	1	3	3
California Set Gillnet (stretched mesh size of 3.5 inches or less)	State			
California Small-Mesh Drift Gillnet (mesh size >3.5 inches and < 14 inches)	State	2	3	3
California Squid Dip Net	State			
California Trap/Pot	State			
California White Seabass Enhancement Net Pens	State			
CA/OR/WA Bait Pens	State			

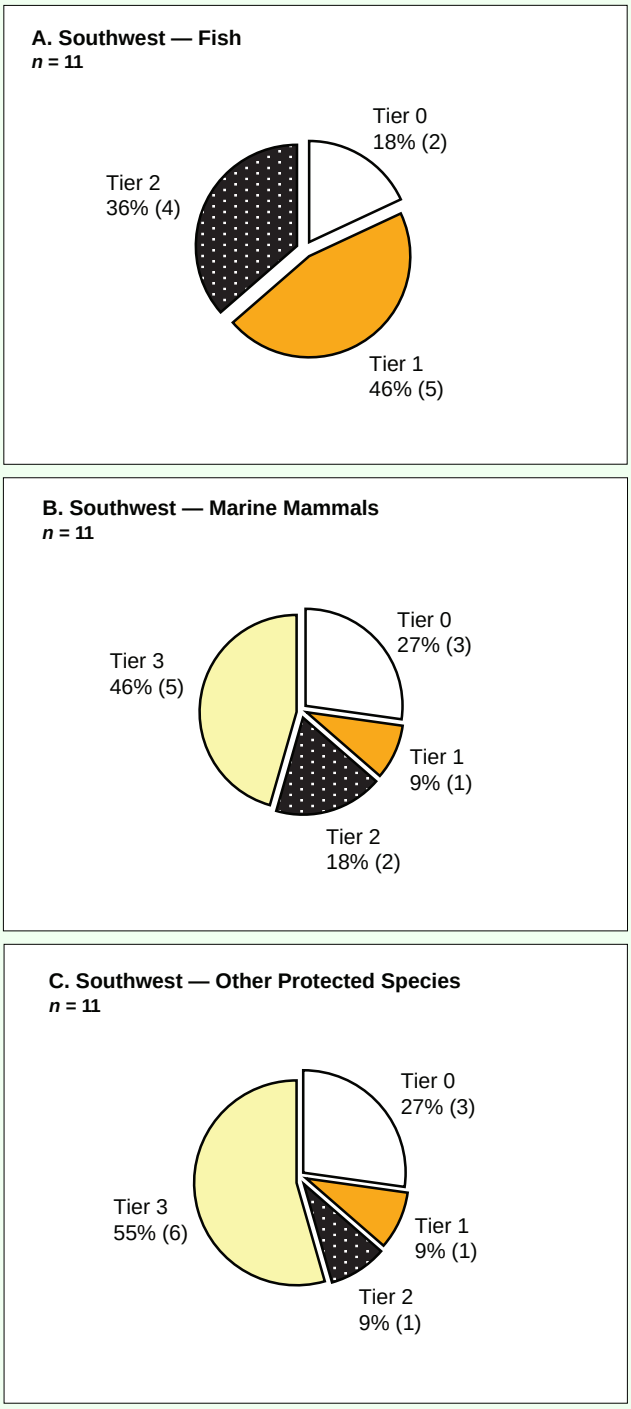


Figure 4.5.2
Southwest Region fishery classifications by number and percentage, for fisheries with Federal management or relevant Federal data-collection programs, for A) fish, B) marine mammals, and C) other protected species. Tier scores are for the year 2005.

Several of the fisheries in the Southwest utilize gear that is known to incidentally capture marine mammals and other protected species, and the region's data-collection programs have been tailored in many cases to address this issue. Methods to estimate fish bycatch using logbook and observer data are in development. The implementation of these methods is expected to increase Southwest Region tier scores in the fish bycatch category.

Fourteen Southwest Region fisheries were not evaluated for this report. The Central Western Pacific tuna purse seine, EPO tuna purse seine, and ETP baitboat fishery were not evaluated because they occur only in international waters, with limited U.S. vessel participation. International data sources are available for these fisheries; however, this report focuses on Federal data-collection programs. Of the remaining fisheries that were not evaluated for this report, three are aquaculture fisheries and the remaining eight fisheries are managed at the state level and have no relevant Federal data-collection programs.

4.5.6 Southwest Region Key Stocks

One hundred and twenty-one key stocks were identified within the Southwest Region (Table 4.5.4). The majority of these stocks (78%) are fish stocks, including 63 FSSI stocks, 27 ESA-listed stocks, and 4 non-FSSI/non-ESA stocks (Figure 4.5.3). No methods were available to estimate bycatch of fish stocks in Southwest Region fisheries, and therefore the quantitative method outlined in Section 3 was not used to identify key regional fish stocks. All fish stocks for which the region has concerns regarding status and bycatch were added through the qualitative process. Listing these fish stocks as key stocks will allow the region to focus on identifying bycatch data deficiencies and information gaps that may stimulate research efforts and development of bycatch estimation methods for inclusion in the second edition of this report.

The remaining 22% of Southwest Region key stocks are protected species populations, including marine mammals, sea turtles, and seabirds (Figure 4.5.3). As in all regions, ESA-listed species were prioritized for inclusion. Nine ESA-listed marine mammal populations (seven cetacean stocks, one pinniped stock, and one mustelid stock, the California sea otter, *Enhydra lutris nereis*) are included as key stocks. Five marine mammal populations were also identified as key stocks through the quantitative process outlined in Section 3; three of these species are cetacean and two are pinnipeds (Table 4.5.4). No marine mammal populations were added through the qualitative process.

All sea turtle species that occur within the Southwest Region were listed as key stocks (Table 4.5.4). The four sea turtle species comprise five separate populations, two of which are endangered: the leatherback sea turtle and Mexico's

Table 4.5.4
Key fish and marine mammal stocks and key sea turtle and seabird populations for the Southwest Region. Overfishing/ overfished status based on 2008 Quarter 1 FSSI report.

Key Fish Stocks Listed by FSSI			
Species/stock name		Overfishing	Overfished
Common name	Scientific name		
Albacore, North Pacific	*Thunnus alalunga*	Unknown	Unknown
Albacore, South Pacific	*Thunnus alalunga*	No	No
Arrowtooth flounder	*Atheresthes stomias*	No	No
Bank rockfish	*Sebastes rufus*	No	No
Bigeye tuna, Pacific	*Thunnus obesus*	Yes	No
Black rockfish, Pacific Coast, north	*Sebastes melanops*	No	No
Blackgill rockfish	*Sebastes melanostomus*	No	No
Blue rockfish	*Sebastes mystinus*	Unknown	Unknown
Blue shark, North Pacific	*Prionace glauca*	No	No
Bluefin tuna, Pacific	*Thunnus orientalis*	Unknown	Unknown
Bocaccio	*Sebastes paucispinis*	No	Yes
Brown rockfish	*Sebastes auriculatus*	Unknown	Unknown
Cabezon	*Scorpaenichthys marmoratus*	No	No
California scorpionfish	*Scorpaena guttata*	Unknown	No
Canary rockfish	*Sebastes pinniger*	No	No—rebuilding
Chilipepper rockfish	*Sebastes goodei*	No	No
Cowcod	*Sebastes levis*	No	Yes
Darkblotched rockfish	*Sebastes crameri*	No	Yes
Dolphinfish, Pacific	*Coryphaena hippurus*	Unknown	Unknown
Dover sole	*Microstomus pacificus*	No	No
English sole	*Parophrys vetulus*	No	No
Gopher rockfish	*Sebastes carnatus*	Unknown	No
Indo-Pacific blue marlin, Pacific	*Makaira mazara*	No	No
Jack mackerel	*Trachurus symmetricus*	No	Undefined
Kawakawa, tropical Pacific	*Euthynnus affinis*	Unknown	Unknown
Kelp greenling	*Hexagrammos decagrammus*	Unknown	No
Lingcod	*Ophiodon elongatus*	No	No
Longnose skate	*Raja rhina*	Unknown	No
Longspine thornyhead	*Sebastolobus altivelis*	No	No
Market squid	*Loligo opalescens*	Unknown	Unknown
Northern anchovy, central subpopulation	*Engraulis mordax*	No	Undefined
Northern anchovy, northern subpopulation	*Engraulis mordax*	Undefined	Undefined
Opah, Pacific	*Lampris guttatus*	Unknown	Unknown

Table 4.5.4 (continued)

Key Fish Stocks Listed by FSSI (cont.)			
Species/stock name		**Overfishing**	**Overfished**
Common name	**Scientific name**		
Pacific chub mackerel	*Scomber japonicus*	No	No
Pacific cod	*Gadus macrocephalus*	Unknown	Unknown
Pacific hake	*Merluccius productus*	No	No
Pacific grenadier	*Coryphaenoides acrolepis*	Unknown	Unknown
Pacific ocean perch	*Sebastes alutus*	No	No—rebuilding
Pacific sanddab	*Citharichthys sordidus*	Unknown	Unknown
Pacific sardine	*Sardinops sagax*	No	No
Petrale sole	*Eopsetta jordani*	No	No
Rex sole	*Glyptocephalus zachirus*	Unknown	Unknown
Rougheye rockfish	*Sebastes aleutianus*	Unknown	Unknown
Sablefish	*Anoplopoma fimbria*	No	No
Sand sole	*Psettichthys melanostictus*	Unknown	Unknown
Shortbelly rockfish	*Sebastes jordani*	No	No
Shortbill spearfish, Pacific	*Tetrapturus angustirostris*	Unknown	Unknown
Shortspine thornyhead	*Sebastolobus alascanus*	No	No
Skipjack tuna, central western Pacific	*Katsuwonus pelamis*	No	No
Skipjack tuna, eastern Pacific	*Katsuwonus pelamis*	No	No
Spiny dogfish	*Squalus acanthias*	Unknown	Unknown
Splitnose rockfish	*Sebastes diploproa*	No	Unknown
Starry flounder	*Platichthys stellatus*	Unknown	No
Striped marlin, central western Pacific	*Tetrapturus audax*	Unknown	Unknown
Striped marlin, eastern Pacific	*Tetrapturus audax*	No	No
Swordfish, North Pacific	*Xiphias gladius*	No	No
Vermilion rockfish	*Sebastes miniatus*	Unknown	Unknown
Wahoo, Pacific	*Acanthocybium solandri*	Unknown	Unknown
Widow rockfish	*Sebastes entomelas*	No	No—rebuilding
Yelloweye rockfish	*Sebastes ruberrimus*	No	Yes
Yellowfin tuna, central Western Pacific	*Thunnus albacares*	Yes	No
Yellowfin tuna, eastern Pacific	*Thunnus albacares*	Yes	No
Yellowtail rockfish	*Sebastes flavidus*	No	No

Table 4.5.4 (continued)

Key Fish Stocks Listed by ESA		
Species/stock name		**Stock status**
Common name	**Scientific name**	
Chinook salmon, California coastal	*Oncorhynchus tshawytscha*	Threatened
Chinook salmon, Central Valley spring run	*Oncorhynchus tshawytscha*	Threatened
Chinook salmon, Lower Columbia River	*Oncorhynchus tshawytscha*	Threatened
Chinook salmon, Puget Sound	*Oncorhynchus tshawytscha*	Threatened
Chinook salmon, Sacramento River winter run	*Oncorhynchus tshawytscha*	Endangered
Chinook salmon, Snake River fall run	*Oncorhynchus tshawytscha*	Threatened
Chinook salmon, Snake River spring/summer run	*Oncorhynchus tshawytscha*	Threatened
Chinook salmon, upper Columbia River spring run	*Oncorhynchus tshawytscha*	Endangered
Chinook salmon, upper Willamette River	*Oncorhynchus tshawytscha*	Threatened
Chum salmon, Columbia River	*Oncorhynchus keta*	Threatened
Chum salmon, Hood Canal summer run	*Oncorhynchus keta*	Threatened
Coho salmon, central California coast	*Oncorhynchus kisutch*	Threatened
Coho salmon, lower Columbia River	*Oncorhynchus kisutch*	Threatened
Coho salmon, southern Oregon & sorthern California coasts	*Oncorhynchus kisutch*	Threatened
Sockeye salmon, Ozette Lake	*Oncorhynchus nerka*	Threatened
Sockeye salmon, Snake River	*Oncorhynchus nerka*	Endangered
Steelhead, California Central Valley	*Oncorhynchus mykiss*	Threatened
Steelhead, central California coast	*Oncorhynchus mykiss*	Threatened
Steelhead, lower Columbia River	*Oncorhynchus mykiss*	Threatened
Steelhead, middle Columbia River	*Oncorhynchus mykiss*	Threatened
Steelhead, northern California	*Oncorhynchus mykiss*	Threatened
Steelhead, Snake River Basin	*Oncorhynchus mykiss*	Threatened
Steelhead, south-central California coast	*Oncorhynchus mykiss*	Threatened
Steelhead, southern California	*Oncorhynchus mykiss*	Endangered
Steelhead, upper Columbia River	*Oncorhynchus mykiss*	Endangered
Steelhead, upper Willamette River	*Oncorhynchus mykiss*	Threatened
Totoaba	*Totoaba macdonaldi*	Endangered

Table 4.5.4 (continued)

Other Key Fish Stocks		
Species/stock name		**Stock status**
Common name	**Scientific name**	
Basking shark	*Cetorhinus maximus*	Prohibited species in HMS fisheries
Giant sea bass	*Stereolepis gigas*	Protected by State of CA
White shark	*Carcharodon carcharias*	Prohibited species in HMS fisheries
Megamouth shark	*Megachasma pelagios*	Prohibited species in HMS fisheries

Key Marine Mammal Stocks Listed by ESA		
Species/stock name		**Stock status**
Common name	**Scientific name**	
Blue whale	*Balaenoptera musculus*	Endangered
Bowhead whale	*Balaena mysticetus*	Endangered
Fin whale	*Balaenoptera physalus*	Threatened
Guadalupe fur seal	*Arctocephalus townsendi*	Endangered
Humpback whale	*Megaptera novaeangliae*	Endangered
Killer whale, Southern Resident	*Orcinus orca*	Endangered
Sea otter, California	*Enhydra lutris nereis*	Endangered
Sei whale	*Balaenoptera borealis*	Endangered
Sperm whale	*Physeter macrocephalus*	Endangered

Key Marine Mammal Stocks Not Listed by ESA			
Species/stock name		**ZMRG**	**Stock status [a]**
Common name	**Scientific name**		
California sea lion	*Zalophus californianus*	39.5	Increasing
Common dolphin, long-beaked, CA, OR, WA	*Delphinus capensis*	1.1	Unknown
Harbor seal, California	*Phoca vitulina*	189.6	Stable
Northern right whale dolphin, CA, OR, WA	*Lissodelphis borealis*	11.3	Unknown
Short-finned pilot whale, CA, OR, WA	*Globicephala macrorhynchus*	0.098	Unknown

Key Sea Turtle Populations		
Species/stock name		**Population status**
Common name	**Scientific name**	
Green sea turtle	*Chelonia mydas*	Threatened (except Florida's and Mexico's Pacific Coast breeding colonies, which are Endangered)
Leatherback sea turtle	*Dermochelys coriacea*	Endangered
Loggerhead sea turtle	*Caretta caretta*	Threatened
Olive ridley sea turtle	*Lepidochelys olivacea*	Threatened
Olive ridley sea turtle, Mexico's Pacific Coast breeding colonies	*Lepidochelys olivacea*	Endangered

Table 4.5.4 (continued)

Key Seabird Populations Listed by ESA		
Species/stock name		**Population status**
Common name	**Scientific name**	
Brown pelican, except US (Florida) Atlantic Coast	*Pelecanus occidentalis*	Endangered
California least tern	*Sterna antillarum browni*	Endangered
Hawaiian dark-rumped petrel	*Pterodroma phaeopygia sandwichensis*	Endangered
Least tern, interior population	*Sterna antillarum*	Endangered
Marbled murrelet, CA, OR, WA	*Brachyramphus marmoratus marmoratus*	Threatened
Newell's Townsend's shearwater	*Puffinus auricularis newelli*	Threatened
Short-tailed albatross	*Phoebastria albatrus*	Endangered

Key Seabird Populations Not Listed by ESA			
Species/stock name		**Bycatch concern**	**Population status**
Common name	**Scientific name**		
Ashy storm-petrel	*Oceanodroma homochroa*	Yes	Under review for potential ESA listing as threatened or endangered

[a]Stock status based on NMFS Marine Mammal Stock Assessments (Caretta, Forney, Lowry, et al. 2007).

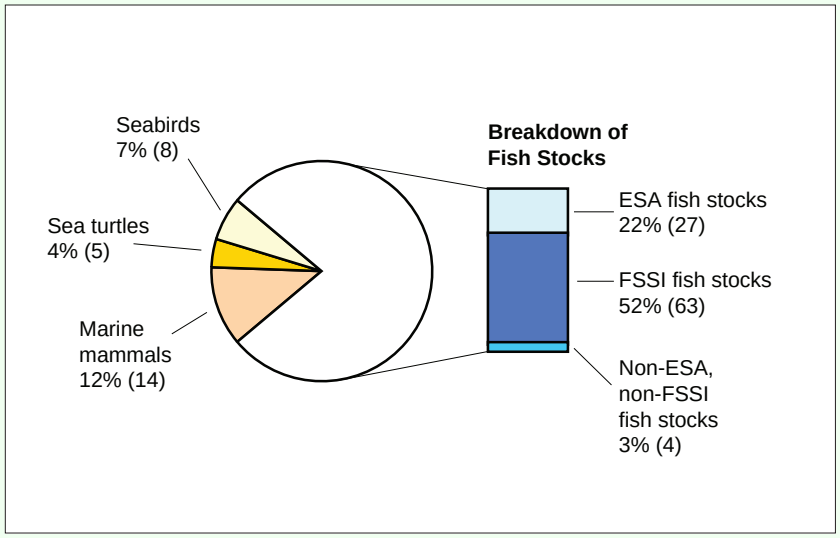


Figure 4.5.3
Numbers and percentages of key stocks for the Southwest Region, by resource type.

Pacific breeding populations of olive ridley (*Lepidochelys olivacea*). Other Southwest Region key populations of olive ridley and green turtles are listed as threatened, as is the loggerhead sea turtle.

Seven ESA-listed seabird populations are listed as key stocks for the Southwest Region. Note that the brown pelican (*Pelecanus occidentalis*) was delisted in 2009 due to its recovery; however, it is listed in this report as an ESA species for consistency with the timeframe of the data and management regulations discussed herein. An eighth seabird species, the ashy storm-petrel (*Oceanodroma homochroa*), is currently being considered for listing under the ESA and was included as a key seabird stock through the qualitative evaluation process. This species is also on the USFWS list of Birds of Conservation Concern.

4.5.7 Southwest Region Bycatch Estimates

Bycatch estimates are currently available for eight marine mammal stocks in the Southwest Region (Appendix 4.5, Table 4.5.A). Marine mammal estimates were provided for three fisheries: the California/Oregon drift gillnet fishery (mesh size >14 inches) for swordfish and thresher shark is an MMPA Category I fishery, whereas the California coastal purse seine fishery for squid and the California small-mesh drift gillnet fishery (mesh size >3.5 inches and < 14 inches) are MMPA Category II fisheries. Stranding evidence also indicates that marine mammal bycatch occurs in currently unobserved or unidentified fisheries in this region. These stranding events represent minimum bycatch numbers, which are reported in the annual Pacific Regional Stock Assessment Reports (Carretta, Forney, Muto, et al. 2007).

Bycatch estimates are provided for one sea turtle stock in the Southwest Region (Table 4.5.B). There was one sea turtle bycatch event in 2005 (an olive ridley turtle), but the fishery is not identified in this report due to data confidentiality restrictions under the MSA. The bycatch of this single turtle occurred outside the U.S. EEZ, but is included here because this species does occur in U.S. waters.

4.5.8 Bycatch Estimate Improvement Plans for Southwest Region Fisheries

Bycatch estimation improvement plans were developed for the three Southwest Region fisheries where bycatch is currently estimated:

- California coastal purse seine fishery for squid
- California/Oregon drift gillnet fishery (mesh size >14 inches) for swordfish and thresher shark
- California small-mesh drift gillnet fishery (mesh size >3.5 inches and < 14 inches)

Bycatch estimation improvement plans for five additional Southwest Region Federal fisheries were also developed. These fisheries were selected due to known bycatch of protected species, potential undocumented bycatch concerns, data confidentiality restrictions on reporting bycatch, and/or less than adequate levels of observer coverage to document the bycatch of rare or sensitive species (Barlow 1989; Babcock and Pikitch 2003; Carretta 2003):

- California coastal purse seine fishery for anchovy, mackerel, and sardine
- California coastal purse seine fishery for tuna
- California pelagic longline fishery
- California set gillnet fishery (mesh size up to 14 inches)
- California swordfish harpoon fishery

In addition to fishery-specific recommendations to address bycatch and data-collection issues, the Southwest Regional team also recommends implementation of the June 2007 SAFE report (PFMC 2007) recommendations to improve data collection for all regional coastal purse seine fisheries. These recommendations included: standardization of data fields, development of fishery-specific observer program manuals, construction of a relational database for observer data, and creation of a statistically reliable sampling plan. The first three recommendations have been implemented, with continued progress on sampling plan designs.

4.5.8.1 Plans for Improving Bycatch Estimation for Southwest Fisheries of Focus

4.5.8.1.1 Fisheries identified through the quantitative process

California Coastal Purse Seine Fishery for Squid

Tier Classes: Fish = 1; Marine Mammals = 2; Other Protected Species = 3

Bycatch and data-collection concerns:

- Bycatch and/or discard of market squid, anchovy, sardine, California sea lion (*Zalophus californianus*), harbor seal (*Phoca vitulina*), and ashy storm-petrel (*Oceanodroma homochroa*) have been documented by the observer program.

- Bycatch of other species may occur, but has not been documented.

- Quantitative estimates of fish bycatch are lacking, and observer coverage is too low to reliably detect rare species of management concern that may interact with this fishery.

Recommendations:

- It was recommended to increase observer coverage to adequate levels (at least 10%) to address concerns or confirm that no bycatch concern exists.
- Developing finfish bycatch estimation methods and using these methods to generate initial estimates of bycatch was recommend.

California/Oregon Drift Gillnet Fishery (mesh size >14 inches) for Swordfish and Thresher Shark

Tier Classes: Fish = 2; Marine Mammals = 3; Other Protected Species = 3

Bycatch and data-collection concerns:

- Bycatch of three marine mammal stocks—the long-beaked common dolphin (*Delphinus capensis*), short-finned pilot whale (*Globicephala macrorhynchus*), and Northern right whale dolphin (*Lissodelphis borealis*)—exceeds PBR[3] levels and/or ZMRG. Bycatch of loggerhead sea turtles occurred in 2006,[4] and bycatch of prohibited species such as white shark (*Carcharodon carcharias*), megamouth shark (*Megachasma pelagios*), and basking shark (*Cetorhinus maximus*) has also occurred in the past.
- Some vessel-selection biases exist in this fishery.
- Six of the forty-two active vessels lack berthing space for an observer. These vessels are still required to abide by MMPA take-reduction regulations (e.g., use of pingers on nets, 36-foot extenders).

Recommendations:

- It was recommended that observer coverage should be increased to 30% (currently at 20%) to better document bycatch of rare and sensitive species.
- It was recommended that coverage biases due to unobservable vessels should be reduced through the implementation of a pilot EM system.

California Small-Mesh Drift Gillnet Fishery (mesh size >3.5 inches and < 14 inches)

Tier Classes: Fish = 2; Marine Mammals = 3; Other Protected Species = 3

Bycatch and data-collection concerns:

- Bycatch mortality of long-beaked common dolphin exceeds ZMRG.
- Observer coverage is low and opportunistic (not annual).

Recommendations:

- An increase in observer coverage to above 20% to better document bycatch of rare and sensitive species is recommended.
- It is also recommended to implement year-round observer coverage for this fishery.

4.5.8.1.2 Fisheries identified through the qualitative process

California Coastal Purse Seine Fishery for Anchovy, Mackerel, and Sardine

Tier Classes: Fish = 1; Marine Mammals = 2; Other Protected Species = 3

Bycatch and data-collection concerns:

- Observer coverage of this fishery is too low (2% in 2006) to reliably detect rare species of management concern that may interact with this fishery.
- Quantitative estimates of fish bycatch are lacking; fish bycatch estimation methods have not been developed or peer-reviewed for this fishery.

Recommendations:

- An increase of observer program coverage levels to 10% in order to confirm that no bycatch concern exists was recommended.
- It was also recommended to develop bycatch estimation methods and generate initial estimates of bycatch.

California Coastal Purse Seine Fishery for Tuna

Tier Classes: Fish = 2; Marine Mammals = 3; Other Protected Species = 3

Bycatch and data-collection concerns:

- Quantitative or qualitative estimates of fish bycatch are lacking for this fishery.
- Observer coverage is too low (not observed in 2006, 20%

[3] The PBR level is defined in the MMPA as the maximum number of animals (not including natural mortalities) that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population.

[4] This estimate is not included as data in this report, but included here for information purposes; this estimate will be included in the next edition of the U.S. National Bycatch Report.

coverage in 2005) to reliably detect rare species of management concern that may interact with this fishery.

- Bycatch of other species may occur but has not been documented.

Recommendations:

- The development of bycatch estimation methods and generation of initial bycatch estimates were recommended for this fishery.

- The HMS management team of the Southwest Region recommended that this fishery be observed at 100%, which is currently feasible, given the small number of vessels (less than 10) landing tuna species.

California Pelagic Longline Fishery

Tier Classes: Fish = 2; Marine Mammals = 3; Other Protected Species = 3

Bycatch and data-collection concerns:

- Due to data confidentiality issues, bycatch cannot be reported for the fishery.

Recommendations:

- It was recommended that bycatch from this fishery should be aggregated with the bycatch of longline fisheries operating out of Hawaii to avoid data confidentiality issues.

California Set Gillnet Fishery (mesh size up to 14 inches)

Tier Classes: Fish = 1; Marine Mammals = 3; Other Protected Species = 3

Bycatch and Data-collection concerns:

- The California set gillnet fishery (mesh size up to 14 inches) has historic bycatch of protected marine mammal and sea turtle species; bycatch of California sea lions and harbor seals has exceeded ZMRG in the past. There has also been highly publicized bycatch of white sharks in this fishery. A pilot observer program was renewed in 2006 for this fishery, with less than 1% observer coverage in 2006. The observer program continued in 2007, with approximately 18% observer coverage.

Recommendations:

- It was recommended to increase observer coverage to at least 20% to better document bycatch of key species with low abundance.

California Swordfish Harpoon Fishery

Tier Classes: Fish = 1; Marine Mammals = 0; Other Protected Species = 0

Bycatch and Data-collection concerns:

- Bycatch of swordfish or other species struck and lost is unknown.

- Bycatch information (struck and lost fish) comes solely from logbook data.

Recommendations:

- It was recommended to implement an observer program for the swordfish harpoon fishery at 10% observer coverage.

4.5.8.2 Southwest Region Recommendations

A total of nine recommendations are made here to improve bycatch data collection and estimation for Federal fisheries and fisheries with relevant Federal data-collection programs in the Southwest Region, with total resource requirements for implementation totaling one full-time staff member and 450 observer DAS (Table 4.5.5). Observer program costs were $0.619M in 2008, with two fisheries observed (the California/Oregon pelagic drift gillnet and California pelagic longline fisheries). For this report, improvement recommendations for Southwest fisheries were based on the most complete year of observer program funding and coverage levels ($1.474M in 2006, with six fisheries observed). In 2006, the deep-set pelagic longline fishery had 100% observer coverage, the large-mesh drift gillnet fishery for swordfish and thresher shark had 18.5% observer coverage, the halibut set gillnet fishery had less than 1% observer coverage, and three purse seine fisheries targeting tunas, market squid, and sardine/anchovy each had less than 5% observer coverage.

If funded and implemented successfully, improvement plan elements would result in improved tier scores for the eight fisheries listed at the beginning of Section 4.5.8. Most tier score improvements would be the direct result of increased or newly initiated observer coverage. The development of fish bycatch estimates for the next edition of this report will also significantly improve regional tier scores.

Table 4.5.5
Summary of Southwest Region recommendations and estimated requirements of implementation in terms of full-time staff and observer DAS. All requirements are annual unless otherwise indicated; ** denotes no additional resource requirements. For further discussion of recommendations, see Section 5.8.

Recommendation[a]	Additional DAS[b]	Feasibility
General Recommendations		
Hire finfish bycatch analyst to generate annual bycatch estimates for multiple fisheries.	NA	High
Fishery-Specific Recommendations		
Increase observer coverage of the California coastal purse seine for anchovy, mackerel, and sardine fishery to 10%.	50	High
Increase observer coverage of the California coastal purse seine fishery for tuna to 100%.	20	High
Increase observer coverage of the California coastal purse seine fishery for squid to at least 10% of all sets.	110	High
Increase observer coverage of the California/Oregon drift gillnet (mesh size >14 inches) fishery targeting swordfish and thresher shark to 30%.	130	High
Aggregate bycatch of the California pelagic longline fishery with that of longline fisheries operating out of Hawaii, to avoid data confidentiality issues.	No cost	High
Increase observer coverage of the California set gillnet (mesh size up to 14 inches) to 20%.	100	High
Increase observer coverage of the California small mesh drift gillnet (mesh size >3.5 inches and <14 inches) to 20%.	20	High
Implement a pilot observer program for the California swordfish harpoon fishery at 10% observer coverage.	20	High
Number of new full-time staff needed to implement all data quality and estimation method improvements recommended by the Southwest region:	1	
Total DAS requirement for all recommendations[c]:	450	

[a] Some recommendations may require additional resource expenditures, such as equipment, which are not itemized.
[b] One observer DAS includes the cost for the observer deployment as well as costs for associated equipment and program administrative functions (staffing).
[c] This amount is in addition to current Southwest Region observer program requirements.

Appendix 4.5 Southwest Region Bycatch Estimates

Table 4.5.A
Subtables showing marine mammal bycatch estimates and associated coefficients of variation (CVs) for Southwest Region fisheries. All bycatch estimates are in number of individuals and include incidental mortality and serious injury. Bycatch estimates reflect an annual average from the years identified. Key stocks and populations are shaded.

Subtable 4.5.A.1

		CALIFORNIA/OREGON DRIFT GILLNET (MESH SIZE >14 INCHES) FOR SWORDFISH AND THRESHER SHARK			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AVERAGE NUMBER**	**UNIT**	**CV**
California sea lion, U.S.	*Zalophus californianus*	2000–04	38	Individuals	0.38
Common dolphin, long-beaked, CA, OR, WA	*Delphinus capensis*	2000–04	4.4	Individuals	1.69
Common dolphin, short-beaked, CA, OR, WA	*Delphinus delphis*	2000–04	58	Individuals	0.15
Northern elephant seal, California breeding	*Mirounga angustirostris*	2000–04	8	Individuals	0.4
Northern right whale dolphin, CA, OR, WA	*Lissodelphis borealis*	2000–04	18	Individuals	0.31
Pacific white sided dolphin, CA, OR, WA, north and south	*Lagenorhynchus obliquidens*	2000–04	4.8	Individuals	0.72
Pilot whale, short-finned, CA, OR, WA	*Globicephala macrorhynchus*	2000–04	1	Individuals	1
Risso's dolphin, CA, OR, WA	*Grampus griseus*	2000–04	5.8	Individuals	1.02
TOTAL FISHERY BYCATCH			138	Individuals	5.67

Subtable 4.5.A.2

		CALIFORNIA PURSE SEINE FISHERY — SQUID			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AVERAGE NUMBER**	**UNIT**	**CV**
Common dolphin, short-beaked, CA, OR, WA	*Delphinus delphis*	2005	87	Individuals	0.98
TOTAL FISHERY BYCATCH			87	Individuals	0.98

Subtable 4.5.A.3

		CALIFORNIA SMALL MESH DRIFT GILLNET MESH SIZE >3.5 INCHES AND <14 INCHES			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AVERAGE NUMBER**	**UNIT**	**CV**
California sea lion, U.S.	*Zalophus californianus*	2003–04	13.5	Individuals	0.57
Common dolphin, long-beaked, CA, OR, WA	*Delphinus capensis*	2002–04	4.7	Individuals	0.98
TOTAL FISHERY BYCATCH			22.5	Individuals	1.24

Table 4.5.A (continued)

Subtable 4.5.A.4 (SUMMARY)		TOTAL SPECIES BYCATCH	
COMMON NAME	**SCIENTIFIC NAME**	**NUMBER**	**UNIT**
California sea lion, U.S.	*Zalophus californianus*	51.5	Individuals
Common dolphin, long-beaked, CA, OR, WA	*Delphinus capensis*	9.1	Individuals
Common dolphin, short-beaked, CA, OR, WA	*Delphinus delphis*	145	Individuals
Northern elephant seal, California breeding	*Mirounga angustirostris*	8	Individuals
Northern right whale dolphin, CA, OR, WA	*Lissodelphis borealis*	18	Individuals
Pacific white sided dolphin, CA, OR, WA, north and south	*Lagenorhynchus obliquidens*	4.8	Individuals
Pilot whale, short-finned, CA, OR, WA	*Globicephala macrorhynchus*	1	Individuals
Risso's dolphin, CA, OR, WA	*Grampus griseus*	5.8	Individuals
TOTAL FISHERY BYCATCH		243.3	Individuals

Table 4.5.B
Subtable showing sea turtle bycatch (observed mortality) for Southwest Region fisheries. Bycatch is reported in number of individuals. Key stocks are shaded.

Subtable 4.5.B.1		ALL WEST COAST FISHERIES			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AMOUNT**	**UNIT**	**CV**
Olive ridley sea turtle	*Lepidochelys olivacea*	2005	1	Individuals	
TOTAL FISHERY BYCATCH			1	Individuals	

Subtable 4.5.B.2 (SUMMARY)		TOTAL SPECIES BYCATCH	
COMMON NAME	**SCIENTIFIC NAME**	**NUMBER**	**UNIT**
Olive ridley sea turtle	*Lepidochelys olivacea*	1	Individuals

4.6 Pacific Islands Region

The NMFS Pacific Islands Region consists of the EEZs of American Samoa, Guam, Hawaii, the Northern Mariana Islands, and the Pacific Remote Island Areas, forming the largest regional EEZ in the U.S. (two million square miles). One LME has been designated in the region, the Insular-Pacific Hawaiian LME.[1] The WPFMC, in conjunction with NMFS, is responsible for managing Federal fisheries in the Pacific Islands Region. Much of the Pacific Island culture reflects the island inhabitants' dependency on the sea. The relationship between land and sea remains close today, with fish consumption much higher than the national average, broad participation in artisanal fisheries, and several large fleets targeting HMS in the open ocean.

4.6.1 Fisheries Overview

A total of 31 domestic commercial fisheries are included in this report for the Pacific Islands Region (Table 4.6.1). Hawaii landings from these fisheries were valued at approximately $71 million dollars in 2005.[2] Fisheries in this region are diverse, falling into three general categories: fisheries for deep-water bottomfish (snapper, grouper, and jack species); fisheries targeting tuna and swordfish (*Xiphias gladius*); and fisheries for crustaceans, coral reef fishes, and corals. Island-based fisheries operate in American Samoa, the Marianas, and Hawaiian archipelagos, and catches are landed almost exclusively within each local area. Not evaluated in this edition of the U.S. National Bycatch Report are the very large-scale purse seine fisheries for skipjack (*Katsuwonus pelamis*) and yellowfin tuna (*Thunnus albacares*), or the distant-water troll fishery for albacore (*Thunnus alalunga*). These fisheries are discussed in the Southwest Regional section but are not evaluated, as they operate almost entirely outside the U.S. EEZ and are managed under international agreements.

Fifty-five percent of Pacific Islands Region fisheries are federally managed (Figure 4.6.1). A few fisheries have shared Federal–state management (e.g., Hawaii bottomfish) or a state counterpart, such as the Hawaii Federal and state fisheries for precious corals.

The staff of NMFS Pacific Islands Regional Office (PIRO), Pacific Islands Fisheries Science Center (PIFSC), and the WPFMC work closely with state partner agencies the American Samoa Department of Marine and Wildlife Resources, the CNMI Department of Fish and Wildlife, the Hawaii Department of Aquatic Resources, and the Guam Division of Aquatic and Wildlife Resources to regulate and monitor the marine species of the Pacific Islands. In 2005, the WPFMC had five FMPs in place to manage Federal fisheries.[3]

The Bottomfish and Seamount Groundfish Fisheries of the Western Pacific Region FMP, developed in 1986, covers a diverse group of species and fisheries that occur throughout the western Pacific region. Commercial bottomfish stocks are divided into two groups: seamount groundfish and deep-slope bottomfish. The seamount fishery includes alfonsin (*Beryx splendens*) and armorhead (*Pseudopentaceros* spp.). This fishery was never fished domestically and the only area in the U.S. EEZ where this fishery occurred (a portion of Hancock Seamount) has been closed to fishing since 1986 due to heavy overfishing of armorhead stocks by foreign trawl fleets. Deep-slope bottomfish fisheries targeting snappers, groupers, and emperors occur throughout the western Pacific, although the largest occur in the Hawaiian Archipelago. The fishery in the main Hawaiian Islands is managed through an annual total allowable catch limit to prevent overfishing. The limited-access fishery in the Northwestern Hawaiian Islands (NWHI), although exploiting a satisfactory level of biomass, was closed in 2010. The bottomfish fisheries in the other parts of the region exploit a broader depth range (including shallower areas) and a more diverse assemblage of fishes, including deepwater reef species, than in Hawaii.

Under the Crustacean Fisheries of the Western Pacific Region FMP (1981), red spiny (*Panulirus marginatus*) and slipper (*Scyllarides squammosus*) lobsters in the NWHI were harvested until 2000, when the fishery was closed due to protracted uncertainty over the status of the stocks. While smaller-scale lobster fisheries take place throughout the U.S. Pacific, the NWHI lobster fishery was of particular importance, as it was the region's most valuable demersal fishery. Although a comprehensive research program was initiated to better understand NWHI stock dynamics, all fishing in that area ended in 2001, and lobster fishing has not resumed in the interim. The fishery continues in the eight main Hawaiian Islands under state regulations. Other crustacean fisheries in the region are very small.

The Precious Coral Fisheries of the Western Pacific Region FMP, implemented in 1983, treats each coral bed as a separate management unit. The life history of corals makes them particularly susceptible to over-harvesting, and the high demand for coral jewelry and other coral products encouraged high levels of harvest prior to effective regulation. Collected species once included black, gold, and pink coral, but currently there are no active permits anywhere in the region to harvest species other than black coral. Black coral, which can be reached at depths accessible by scuba gear, is harvested by hand. A state fishery for black coral also exists in the Hawaiian Islands. The most serious conservation

[1] http://www.lme.noaa.gov/.

[2] Ex-vessel landings value, Fisheries Economics of the U.S., 2006. Available online at http://www.st.nmfs.noaa.gov/st5/publication/fisheries_economics_2006.html.

[3] These FMPs were replaced by five fishery ecosystem plans (FEPs) (75 FR 2198, 14 January 2010).

Table 4.6.1
Pacific Islands Region fisheries included in the U.S. National Bycatch Report. Fisheries are listed alphabetically, first by management authority and then by fishery name. Shaded rows indicate those fisheries for which bycatch estimates are currently available.

Fishery[a]	Management Authority	Federal Fishery Management Plan (FMP)[b]	Gear Type	Target Species (Common Name)	Data Sources[c]
American Samoa Bottomfish	Federal	Bottomfish and Seamount Groundfish Fisheries of the Western Pacific Region	Hand Line	Deep snappers (pink, red, gray/jobfish), other snappers/jobfishes, emperors, and groupers	Creel survey data
American Samoa Lobster	Federal	Crustacean Fisheries of the Western Pacific Region	By Hand, Diving Gear	Green spiny lobster, slipper lobster	
American Samoa Pelagic Longline Fishery	Federal	Pelagic Fisheries of the Western Pacific Region	Longline	Albacore and other tunas (bigeye, yellowfin), wahoo	Logbooks, observer data
American Samoa Troll	Federal	Pelagic Fisheries of the Western Pacific Region	Troll Lines	Tunas (skipjack and yellowfin), blue marlin, dolphinfish, wahoo	Creel survey data
Commonwealth of the Northern Mariana Islands Bottomfish	Federal	Bottomfish and Seamount Groundfish Fisheries of the Western Pacific Region	Hook and Line, Electric	Shallow-water emperors, snappers, groupers, and, deepwater snappers (red, pink, gray/jobfish)	Creel survey data
Commonwealth of the Northern Mariana Islands Lobster	Federal	Crustacean Fisheries of the Western Pacific Region	Pots and Traps, Spiny Lobster	Spiny lobsters (green, long-legged, painted)	
Commonwealth of the Northern Mariana Islands Tuna Troll	Federal	Pelagic Fisheries of the Western Pacific Region	Troll Lines	Tunas (skipjack, yellowfin, kawakawa), wahoo dolphinfish, Indo-Pacific blue marlin	Creel survey data
Guam Bottomfish Handline	Federal	Bottomfish and Seamount Groundfish Fisheries of the Western Pacific Region	Hook and Line, Electric	Deepwater snappers and Hawaiian groupers	Creel survey data
Guam Longline	Federal	Pelagic Fisheries of the Western Pacific Region	Longlines	Bigeye tuna, yellowfin tuna	Creel survey data, logbooks
Guam Troll	Federal	Pelagic Fisheries of the Western Pacific Region	Troll Lines	Tunas (skipjack, yellowfin), dolphinfish, wahoo, Indo-Pacific blue marlin	Creel survey data
Hawaii Shrimp Trap	Federal	Crustacean Fisheries of the Western Pacific Region	Pots and Traps, Shrimp	Deepwater Caridean shrimp	State commercial catch report data, state dealer data
Hawaii-Based Deep-Set Pelagic Longline Fishery for Tuna	Federal	Pelagic Fisheries of the Western Pacific Region	Longline	Bigeye tuna, yellowfin tuna, albacore	Logbook data, observer data, state dealer data
Hawaii-Based Shallow-Set Pelagic Longline Fishery for Swordfish	Federal	Pelagic Fisheries of the Western Pacific Region	Longline	Swordfish, bigeye tuna	Logbook data, observer data with 100% coverage, state dealer data
Hawaii Non-Longline Commercial Pelagic Fishery	Federal	Pelagic Fisheries of the Western Pacific Region	Combined Gears	Tunas (yellowfin, skipjack, bigeye, albacore), blue marlin, dolphinfish, wahoo	State commercial catch report data, state dealer data

Table 4.6.1 (continued)

Fishery [a]	Management Authority	Federal Fishery Management Plan (FMP) [b]	Gear Type	Target Species (Common Name)	Data Sources [c]
Northwestern Hawaiian Islands Bottomfish	Federal	Bottomfish and Seamount Groundfish Fisheries of the Western Pacific Region	Combined Gears	Deepwater snappers (gray/jobfish, red, pink), Hawaiian grouper, and thick-lipped trevally	Logbook data, observer data, state commercial catch report data, state dealer data
Precious Coral (Federal Waters)	Federal	Precious Coral Fisheries of the Western Pacific Region	By Hand, Diving Gear	Black coral	
Western Pacific Squid Jig	Federal	Pelagic Fisheries of the Western Pacific Region	Hand Lines, Auto Jig	Neon flying squid	State commercial catch report data, State dealer data
Hawaii Bottomfish	Federal, State	Bottomfish and Seamount Groundfish Fisheries of the Western Pacific Region	Combined Gears	Deepwater snappers (pink, red, gray/jobfish, and Hawaiian grouper)	State commercial catch report data, State dealer data
Hawaii Crab Trap	State		Pots and Traps	Kona crab, Samoan crab	
Hawaii Fish Pond	State		Unspecified Gear	Mullet, milkfish, Pacific threadfin, bonefish, coral reef fishes	
Hawaii Fish Trap	State		Pots and Traps, Fish	Coral reef fishes (surgeonfishes, jacks, squirrelfishes, parrotfishes, goatfishes, etc.)	
Hawaii Inshore Handline	State		Hand Line	Mackerel scad, bigeye scad, coral reef fishes	
Hawaii Lay Net	State		Gillnets, Other	Coral reef fishes (surgeonfishes, jacks, squirrelfishes, parrotfishes, goatfishes, etc.)	
Hawaii Lobster Diving	State		By Hand, Diving Gear	Spiny lobsters (green and red), slipper lobsters	
Hawaii Lobster Trap	State		Pots and Traps, Lobster	Spiny lobsters (green and red), slipper lobsters	
Hawaii Octopus, Spear	State		Spears	Octopus, coral reef fishes	
Hawaii Opelu/Akule Net	State		Nets, Other	Mackerel scad, bigeye scad	
Hawaii Pelagic Handline	State		Handline	Tunas (yellowfin, bigeye)	
Hawaii Throw Net, Cast Net	State		Cast Nets	Convict tang, Āholehole (flagtail), Hawaiian threadfin, other coral reef fishes	
Hawaii Trolling, Rod and Reel	State		Troll Lines	Tunas (yellowfin, skipjack), Indo-Pacific blue marlin, dolphinfish, wahoo	
Precious Coral (State Waters)	State		By Hand, Diving Gear	Black coral, pink coral	

[a] Aquaculture fisheries are listed for consistency with the MMPA List of Fisheries when they occur, but were not analyzed for the U.S. National Bycatch Report. Recreational fisheries are not included in this report.

[b] FMPs as of 2005. Note that non-Federal FMPs were not identified through this process.

[c] Data sources were evaluated only for Federal fisheries and for non-Federal fisheries with Federal data-collection programs.

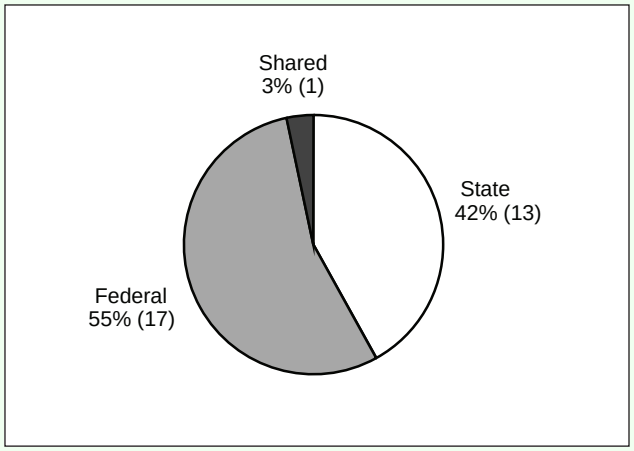


Figure 4.6.1.
Management jurisdiction for Pacific Islands Region fisheries (percentages are based on numbers of fisheries, not volume or revenue; *n* = 31). "Shared" indicates that international, Federal, and state authorities share management jurisdiction for the fishery.

concern over black coral is the spread of an exotic coral species (the octocoral *Carijoa riisei*) that overgrows black coral.

The first ecosystem-based FMP in the U.S., the WPFMC Coral Reef Ecosystem of the Western Pacific Region FMP (2001), was implemented to conserve and protect coral reefs and their associated biota and fisheries in the Pacific Islands Region through a system of MPAs and fishery regulations. This FMP is distinct from the FMP for precious corals. Precious corals are mostly found below the photic zone where reef-building corals live. The Coral Reef Ecosystem of the Western Pacific Region FMP addresses an enormous diversity of fishes and other biota not covered in any other FMP. Fishery regulations for coral reef ecosystem resources, including the creation of several MPAs in the Pacific Remote Island Areas were implemented in 2004 (69 FR 8336, 24 February 2004). In addition, this FMP encourages coordination with local governments to conserve coral reef ecosystems through such actions as prohibitions on taking of live corals.

Implemented in 1987, the Pelagic Fisheries of the Western Pacific Region FMP regulates fisheries for HMS species in the Pacific Islands Region. While the FMP was initially developed to regulate foreign fisheries within the U.S. EEZ, the requirement for foreign operators to obtain licenses and carry observers was a deterrent. No foreign fisheries currently operate within the U.S. EEZ, though international fisheries on the high seas and in EEZs of other nations dominate pelagic harvests in the region. Current FMP management focuses primarily on regulating large limited-access domestic longline fisheries in Hawaii and American Samoa, which are by far the most developed fisheries in the U.S. Pacific Islands EEZ. These U.S.-based longliners also fish outside of the U.S. EEZ and are managed both inside and outside the zone by the FMP, as well as by U.S. participation in RFMOs. These organizations include the IATTC, which regulates pelagic fishing east of longitude 150°W, and the Western and Central Pacific Fishery Commission (WCPFC), which regulates pelagic fishing to the west of 150°W. The RFMOs also manage the very large-scale tropical tuna purse seine fishery and albacore troll fishery in the region.

This section of the Bycatch Report focuses on two Pacific Islands fisheries regulated under the Pelagic FMP for which adequate bycatch data and estimation methods are currently available: the Hawaii-based deep-set pelagic longline fishery targeting tuna, and the Hawaii-based shallow-set pelagic longline fishery targeting swordfish. Future editions of this report will include bycatch estimates for other Federal fisheries that have observer programs in place, such as the American Samoa pelagic longline fishery, and fisheries where data become available to develop such estimates.

4.6.2 Addressing Regional Bycatch Concerns

The staff members of PIFSC and PIRO have worked with WPFMC to implement a variety of operational and management measures to minimize bycatch and bycatch mortality in Pacific Islands Federal fisheries.

Bottomfish

The management of Hawaiian Archipelago bottomfish is conducted on an area-specific basis with Federal management measures in the NWHI and shared Federal–state measures in the eight main islands. This is the largest bottomfish fishery in the region, although it is shrinking under regulation. Bycatch of non-target fish, sharks, and two protected species, Hawaiian monk seals (*Monachus schauinslandi*) and Pacific bottlenose dolphins (*Tursiops truncatus*), are known to have occurred. In 2002, NMFS completed an ESA Section 7 BiOp on the bottomfish fishery's interactions with endangered Hawaiian monk seals. The BiOp ruled that bottomfish fisheries of the western Pacific did not jeopardize the continued existence of Hawaiian monk seals. Due to concern over the fishery's interactions with protected species, however, a mandatory observer program was implemented from 2003 through 2005. Funding for this program was diverted in 2005 in order to meet the 100% court-ordered coverage requirement for the Hawaii-based shallow-set pelagic longline fishery for swordfish.

In 2006, the NWHI were designated as the Papahānaumokuākea Marine National Monument, an area that encompasses 137,797 square miles of land and sea in the Pacific Ocean.

Photo: Dwayne Meadows, NMFS

A school of sergeant major fish swim at a shipwreck at Pearl and Hermes Reef in Hawaiian waters.

All commercial fishing activities ceased in 2010 in order to promote recovery of the ecosystem to an unexploited state. Previous bycatch data from the NWHI observer program do not indicate any recent direct interactions with marine mammals, and the data for fish bycatch for that fishery have not been evaluated since the fishery is closed.

For the other bottomfish fisheries (American Samoa, CNMI, Guam, and the main Hawaiian Islands), reliable bycatch data are currently unavailable. Attempts have been made to estimate bycatch as the difference between fishers' self-reported catch and self-reported sales (from State Commercial catch report data in Hawaii) and from creel survey interviews in the other island areas (see the Bottomfish and Seamount Groundfish Resources of the Western Pacific Region 2005 annual report (WPFMC 2006). These estimates indicate an extremely low amount of fish bycatch; however, fishers' self-reporting and creel survey interview comments have not been validated.

Unobserved mortality as a result of hook escapement, barotrauma, and depredation may also be a significant source of mortality in all bottomfish fisheries. Studies indicate that perhaps as many as 23 to 27 fish are lost for every 100 brought aboard in the NWHI fishery. Much of this loss is attributed to depredation by sharks, although bycatch of sharks in the fishery is believed to be low overall. Fish mortality may also occur due to barotrauma (expansion of fish gas bladders as fish are pulled up from depth). A program encouraging fishermen to employ special bycatch release methods including venting and weighted return to depth has been developed and is being promoted for voluntary use in the region (Pacific Islands Fisheries Group n.d.).

Post-hooking survival rates for several bycatch species jacks and sharks) are believed to be high, as these species do not suffer from the effects of barotrauma. Long-standing FMP regulations such as prohibitions on the use of bottom trawls, bottom gillnets, explosives, poisons, and other gear restrictions are presumed to have been effective in limiting bycatch in the bottomfish fishery.

Crustaceans

Prior to its closure, a number of management measures had been instituted to reduce discards in the NWHI lobster fishery, including size limits, trap vents, and full retention of the target species. Size limits remain in place in the state-managed fishery, where the great majority of the catch is hand-collected by divers. Tag-and-release research in the NWHI using underwater video indicated that if lobsters were kept wet during sorting and quickly returned to depth in traps that were then remotely opened, very little predation was observed, even in the presence of very high observed predator density. This method could be applied in other fisheries.

Highly migratory species

Only the longline fisheries are described in this section, as they represent the predominance of effort in Federal waters. Sharks, especially blue sharks (*Prionace glauca*), form the largest component of bycatch for Hawaii longline fisheries. Prior to regulations initiated in 2001–04 to prevent shark-finning and reduce sea turtle bycatch, under-utilized shark catch (finned and carcasses dumped) and especially the rate of shark catch (per unit of fishing effort) by the shallow-set longline fishery was much greater than in more recent times. Blue sharks were less frequent in the deep-set longline fishery, which remained opened while the shallow-set fishery was closed over turtle concerns in 2001–04. Although many shark species can have very high post-release survival rates (Moyes et al. 2006), prior to 2001, shark mortality was high as sharks were often finned. Prohibitions on shark finning, implemented under the Shark Finning Prohibition Act of 2000, appear to have been largely effective in eliminating the dumping of finned shark carcasses. Today, most of the shark catch is now categorized as discards, which was not the case when fins were harvested. Discards have therefore increased, but discards with long-term survival remain classified as bycatch in commercial fisheries. Since 2004, over 90% of the total shark catch has been released alive (WPFMC 2007). Required use of circle hooks with fish bait in the reopened (2004–present) shallow-set fishery appears also to have benefited sharks.

A 2001 BiOp under ESA Section 7 on the combined deep-set tuna and shallow-set swordfish fisheries concluded that the Hawaii-based longline fisheries jeopardized the continued existence of three sea turtle species: loggerhead (*Caretta caretta*), leatherback (*Dermochelys coriacea*), and

green (*Chelonia mydas*), but did not jeopardize the continued existence of the olive ridley sea turtle (*Lepidochelys olivacea*) or any ESA-listed marine mammals. This BiOp was overturned in litigation, but not before extensive changes were effected to dramatically reduce turtle bycatch and mortality, including a three-year closure of the swordfish fishery, a regulatory definition of gear and turtle take limits for the continued deep-set tuna fishery, measures for handling and release of protected species, and certified training for vessel operators. A 2004 BiOp on the region's pelagic fisheries, a 2005 BiOp on the deep-set fishery, and a 2008 BiOp on the shallow-set fishery concluded that neither fishery was likely to jeopardize the continued existence of a listed species. Litigation continues on the operation of this fishery, with challenges to NMFS policy by both industry associations and environmental groups.

Limits on incidental take of sea turtles were established by the 2004 and 2008 BiOps, mandating immediate closure of the Hawaii-based shallow-set pelagic longline fishery for swordfish when limits are reached in a calendar year. Take limits that trigger reconsultation but not closure were also established for green and olive ridley sea turtles in the swordfish fishery (one-year limits), and for all four turtle species in the Hawaii-based deep-set pelagic longline fishery for tuna (three-year limits). Currently, there is also a cap on effort (number of sets) that applies only in the shallow-set swordfish fishery, which has 100% mandatory observer coverage to monitor sea-turtle interactions (the deep-set longline fishery is known to have significantly lower bycatch of marine turtles).When the swordfish fishery bycatch of loggerhead or leatherback sea turtles reaches the take limit, the fishery is closed for the remainder of the year, which occurred in 2006 but not in 2004, 2005, or 2007–2009. Sea turtle bycatch in the deep-set longline fishery stayed under the take limit through 2011.

The changes in fishing gear that were required to reduce sea turtle bycatch in the swordfish fishery were the result of a success story that began in the Atlantic and continued to the Pacific. Watson et al. (2005) conducted experiments in the Atlantic Ocean which showed that replacing "J" hooks with large (size 18) circle hooks and replacing squid bait with fish bait could greatly reduce both loggerhead and leatherback sea turtle bycatch in swordfish longline fishing. Both measures were required in the reopened Hawaii swordfish fishery in 2004 and were as effective as expected in reducing turtle bycatch. In addition, the average rate of shark catch in the reopened swordfish fishery was much lower than before the gear was changed, perhaps due to the elimination of the previously used type of bait, squid, which is a preferred food of blue shark (Gilman et al. 2006). The fishery has also been much more concentrated in the early part of the calendar year than it was before effort was capped in 2004. This may also have reduced blue shark catch rates, which tended to be higher later in the year. Although not required to do so, the American Samoa longline fishery has always used circle hooks of varying size, and the Hawaii deep-set longline fishery, which used tuna hooks almost exclusively prior to 2004, has greatly increased its use of circle hooks.

Other Pacific longline fisheries may have high levels of sea turtle bycatch, although the shallow-set type of fishing for swordfish, which has the highest turtle bycatch rates, has not yet been used in American Samoa or Guam. In fiscal year 2006, an observer program was implemented for the deep-set American Samoa longline fishery for albacore. Annual observer reports indicate that this fishery interacts with a large number of green sea turtles, false killer whales, and possibly other protected species. However, observer coverage has been inadequate for any statistically meaningful determinations to be made. As discussed previously, this fishery voluntarily uses circle hooks, which may have an ameliorating effect on bycatch.

In the Hawaii-based deep-set longline fishery (and less so in the shallow-set fishery), false killer whales become hooked or entangled in fishing gear and, as a result, may become seriously injured or killed. In 2010, NMFS convened a TRT to draft recommendations for a TRP for reducing serious injuries and mortalities of false killer whales that occur incidental to commercial fishing activities. NMFS will monitor its progress and ensure the TRP meets the MMPA goal of reducing false killer whale mortalities and serious injuries in the fisheries to appropriate levels. If not, NMFS will reconvene the TRT to develop additional consensus recommendations for reducing mortalities and serious injuries and amending the TRP.

The Hawaii longline fishery is treated as two separate fisheries (deep-set and shallow-set) under the MMPA, without substantially altering the management strategy for either sector. The shallow-set sector is classified as a Category II fishery, and the deep-set sector is classified as a Category I fishery. There are no fish bycatch limits or fish bycatch management measures in the fishery, although there is a regulatory limit on the number of swordfish that may be retained per trip in the Hawaii tuna longline fishery, designed to discourage shallow fishing outside of the effort limits for the shallow-set swordfish fishery. The regulatory bycatch of non-retained swordfish under this rule is quite small compared with the retained catch in the swordfish fishery. Information on bycatch in small-scale island fisheries is available only from creel survey data in American Samoa, CNMI, and Guam. Fishermen interviewed indicate that they discard very little because few species and sizes are unwanted, and because when fish are discarded they are often in viable condition. These self-reported data are not used in the U.S. National Bycatch Report. No data on unobserved mortality in these fisheries are available.

Interactions with seabirds are also of concern for longline fisheries in the Pacific Islands. In 2000 and 2004, the U.S.

Fish and Wildlife Service issued BiOps for the deep-set and shallow-set components of the Hawaii longline fishery. Of primary concern were potential interactions with the short-tailed albatross (*Phoebastria albatrus*), an ESA-listed species. Bycatch of black-footed albatross (*Phoebastria nigripes*), Laysan albatross (*Phoebastria immutabilis*), and other seabirds is also known to occur. Under the BiOps, reasonable and prudent measures (RPMs) for reducing seabird bycatch were identified, including testing of "side-setting" (setting longline gear off the side of the boat versus the stern) and other seabird deterrents (dyed bait, weighted branch lines, and streamers) that had been shown by research fishing experiments to be highly effective in reducing interactions (Boggs 2001). Also mandated were safe-release and handling workshops for vessel operators, who are provided with handling guidelines and seabird identification cards. In 2006, side-setting was demonstrated by directed research, observer data, and other sources to be more effective at reducing seabird bycatch than several other seabird avoidance methods. The 2006 regulatory Amendment 5 to the WPFMC Pelagic FMP included side-setting as one of the seabird avoidance techniques that fishermen may adopt to meet FMP requirements.

The NMFS monitors seabird bycatch in the deep-set and shallow-set fisheries. The black-footed albatross is used as a proxy species to anticipate likely impacts to the much rarer endangered short-tailed albatross. To date, with 100% observer coverage in the shallow-set longline fishery (the fishery historically most susceptible to seabird bycatch) and approximately 20% coverage in the deep-set fishery, there has been no observed bycatch of a short-tailed albatross. Recent analyses have shown reductions in both numbers and catch rates for albatrosses in Hawaii longline fisheries. Overall, interaction numbers have been reduced by 95 to 99%, and interaction rates have been reduced in both sectors of the fishery by at least 83%.

Precious Corals

Restriction under the FMP of harvesting methods to those that require species identification and measurement of coral before it is removed from the bottom prevented the type of widespread bycatch and bed destruction that characterizes such fisheries when corals are harvested by dredges or tangle nets.

4.6.3 Data Sources

Table 4.6.1 lists bycatch data sources available for federally managed Pacific Islands Region fisheries and those state fisheries with relevant Federal data-collection programs.

4.6.3.1 Observer Programs

Currently, there are two observer programs in place for the Pacific Islands Region (Table 4.6.2). The Hawaii longline program, which provides coverage of both the deep-set and the shallow-set longline fisheries, monitored 10,393 days in 2005 (7,099 and 3,294, respectively). The American Samoa longline observer program, which was initiated in 2006, monitored a total of 381 fishing days in its first year.

American Samoa Longline

A mandatory observer program for the American Samoa longline fishery was initiated in 2006 as a result of a Federal limited-entry permit system instituted at the end of 2005. The observer coverage levels are based on the total number of trip departures by permitted vessels (at least 20% observer coverage has been recommended but has not been achieved and is not currently targeted). Since the opening of the American Samoa Observer Program, 16% of the permitted fleet remains inactive. When an observer is ready for deployment, longline vessels are chosen using a random sampling scheme to select a vessel from the pool of candidates. All sets within a sampled trip are observed. Contract observers for the program are chosen from experienced observers who have previously worked in the Hawaii longline fisheries. Upon arrival, observers receive additional training in collection, identification, safety, and cultural awareness that is specific to this fishery. Observers are directed to collect data on fishing effort (gear configuration, deployment and retrieval, environmental conditions, etc.); biological data (target and bycatch composition, physical condition at capture and/or release, morphometrics, and sex identification); interactions with protected species; and samples for various research projects.

A fragment of this fishery utilizes open-deck, motorized catamarans called "alias" that are too small (less than 40 feet in length) to safely accommodate an observer. The active permitted alia fleet is currently comprised of one vessel. While the inability to observe this vessel may create a bias in observer coverage, this vessel does self-report catch and bycatch through a mandatory Federal logbook program. Alias once dominated the fishery, but alia participation greatly diminished as larger vessels moved into the fishery, so this issue may become much less important. Among the larger vessels there could be a sampling bias arising from the two differing patterns of trip length. Some vessels stay out for two months or more and others stay for three to four weeks. Because sampling is performed on a trip-by-trip basis, long trips may result in over-estimation of the average trip estimates, while short-trips may produce under estimation. Accounting for effort differences may address this bias but also complicates the quantification of statistical confidence and coverage. Alternative coverage

Table 4.6.2
Current Pacific Islands Region Federal observer programs and fisheries observed. Programs and observed fisheries are listed alphabetically. Observer programs that ended over 10 years ago are not listed here.

Observer Program	U.S. National Bycatch Report Fisheries	Authority to Place Observers	Program Duration	Coverage Level
American Samoa Pelagic Longline	American Samoa Pelagic Longline Fishery	MSFCMA (50 CFR 665)	2006–present	2005: 0% 2006: 7.4% 2007: 7% 2008: 12%
Hawaii Bottomfish	Northwestern Hawaiian Islands Bottomfish	MSFCMA (50 CFR 665)	2003–06	2005: 21% 2006: 9.30% 2007–08: NA
Hawaii Pelagic Longline	Hawaii-Based Deep-Set Pelagic Longline Fishery (Tuna)	MSFCMA (50 CFR 665)	1994 [a]–present	2005: 26.1% deep-set, 100% shallow-set 2006: 21% deep-set, 100% shallow-set 2007–08: 20% deep-set, 100% shallow-set
	Hawaii-Based Shallow-Set Pelagic Longline Fishery (Swordfish)			

[a] Coverage levels were approximately 5% prior to 1994.

methods, such as comparing fleet hook and set effort to observed effort, are being evaluated during the program's pilot stage.

Hawaii Bottomfish

The Hawaii Bottomfish observer program became redundant with the closure of the fishery in 2010. Analyzing the fishery bycatch data would be useful in providing information on other unobserved bottomfish fisheries, although results would likely have some unknown bias due to dissimilar gear, habitat, and other factors in other fisheries.

Hawaii Longline

Mandatory sampling programs have been in place for Hawaii pelagic longline fisheries since 1994. In the Hawaii deep-set longline fishery, a probability sampling design for selecting trips has been used since 2002. Prior to 2002 there was low coverage, around 5%, and various sampling protocols were used for selecting trips. Current coverage levels are around 20%. Trips are selected randomly for sampling, and all sets within a selected trip are observed.

Since its re-opening in late 2004, 100% coverage of the Hawaii shallow-set longline fishery has been maintained. From 2002 to 2004 the fishery was closed, and prior to that the observer coverage was low, around 5%, with various sampling protocols used for selecting trips. All sampled hauls are watched in their entirety, with every fish recorded and biological information collected on selected species. Measurements are taken on a subset of fish. Scanning seabird abundance during setting may help explain the frequency of hooking during haulback, so observers are required to make two scan counts of seabird abundance during each set as well as at the beginning, during every other hour, and at the end of the hauling operation. Every haul is watched in its entirety with all marine mammal, sea turtle, and seabird bycatch being recorded, as well as biological information when feasible. Additionally, any seabird mitigation measures undertaken are recorded.

Sampling bias is not a concern for either fishery. All trips are observed in the shallow-set longline fishery. In the deep-set longline fishery, all vessels are subject to being randomly sampled, and it is mandatory that they take an observer if selected. After completing the trip the observer returns to port for debriefing and data entry. The data then go through several quality control checks before the trip is identified as an approved trip.

4.6.3.2 Logbooks

A mandatory logbook program is currently in place for the Hawaii, American Samoa, and western Pacific general longline fisheries. The first complete year of Hawaii longline logbook reporting was 1991, and since then logbook data have been consistently collected. American Samoa logbook data have been collected since 1996, but submission of the General Fisheries Logbook (Guam) has been very infrequent. In addition, poor logbook reporting by some sectors of the fishery has created a bias in logbook catch estimates, which have been corrected using data from a creel survey. Effort data are collected on the number of hooks, location, and time of set and haul. Catch of pelagic species is recorded by species as numbers kept and released. All discards of all pelagic species are recorded, as well as bycatch of protected species. Records of non-target species are considered less reliable, especially concerning bycatch of seabirds and protected species. All hard-copy data are checked for quality, and then the data are entered and verified by NMFS staff.

4.6.3.3 State Dealer Data

A mandatory state dealer data-collection program is also in place for the Hawaii longline fishery and all other fisheries selling fish landed in the State of Hawaii. Data from 2000 through the present are available in electronic format. The program tracks species of fish brought to the market, price, and weight (when practical). No data on bycatch are collected.

4.6.3.4 Commercial Catch Reports

A mandatory commercial catch report is required of all commercial fishermen landing catch in the State of Hawaii, except for longliners. Data from 1948 through the present are available in electronic format, although not all data files are available for the early decades. The report includes information on catch by species, gear type, and area fished, and until the state sealer data system took over that function, the report also included weight of catch, pounds sold, and value. The difference between catch and pounds sold from these reports has sometimes been used as an estimate of bycatch.[4] This method was not used in this report because this difference is thought to represent only retained catch that is not sold at first attempt, and which may be sold later or otherwise utilized. This would exclude it from the definition of bycatch used in this report.

[4] http://www.wpcouncil.org/bottomfish/BSAW2004/Documents/PanelReport.pdf.

4.6.4 Pacific Islands Region Bycatch Estimation Methods

Bycatch data and estimation methods were available for two Pacific Island Region fisheries: the Hawaii deep-set longline for tuna and the Hawaii shallow-set longline for swordfish. Estimation methods are currently being developed for other fisheries and will be included in future editions of this report.

Bycatch estimates for the 2005 Hawaii longline deep-set fishery were based on a random sample of longline trips on which scientific observers were deployed. Observed trips were selected using two sampling schemes. The primary scheme was a systematic sample. Before departing on a fishing trip, longline vessels were required to call the NMFS PIRO observer program contractor at least 72 hours prior to their intended departure date. To enable sample selection, the PIRO contractor numbered calls sequentially in the order in which they were received (referred to as the “call number”). Prior to the beginning of a quarter, a systematic sample of call numbers was drawn by PIFSC and supplied to the contractor. The trips associated with these selected call numbers were designated to be sampled.

Because the number of observers was limited, it was impractical to achieve the full targeted coverage under the systematic design. The sample selected under the systematic design was slightly less than the targeted coverage rate, typically 5% less. The additional trips needed to reach the targeted level were then selected using a secondary sampling scheme when all trips selected by the systematic sample were already covered, and additional observers were available. In this instance, a trip was randomly selected from recently received call numbers that had not already been selected.

Because the systematic sample was selected quarterly, point estimates of bycatch (counts) were computed on a quarterly basis and then summed for the total annual estimate. All observed bycatch on a trip was assigned to the quarter when the vessel returned to port after completing the trip. The approximate sampling probabilities during the periods when additional (secondary) samples were drawn were computed by enumerating the number of call-ins during consecutive periods of comparable coverage. It was then assumed that the additional trips were selected with equal probability from those trips that had not been selected as part of the systematic sample. When coverage was below that of the anticipated systematic sample, the sampling probabilities were computed by enumerating all call-ins during this period and assuming that the trips sampled were selected with equal probability. Because the coverage level changed with fluctuations in observer availability and fishing activity, trips were not selected with equal probability. Therefore, the Horvitz-Thompson estimator (Thompson 1992) was used to estimate total bycatch (counts), as

it takes into account unequal sampling probabilities. This estimator was used for fish, marine mammals, sea turtles, and seabirds.

Approximate 95% confidence intervals (in units of counted bycaught individuals) for estimated total bycatch were computed on a quarterly basis for animals rarely caught, and on a quarterly and yearly basis for animals more frequently caught. For animals frequently caught, the confidence intervals were computed based on a normal approximation of the distribution of estimated total bycatch. Measures of uncertainty were not available for the bycatch estimates of fish in units of weight (as presented in this report) as a statistical estimator has not been developed. For rarely caught animals such as marine mammals, sea turtles, and seabirds, confidence intervals were computed on a quarterly basis, under the assumption that counts are Poisson variants.

During the third and fourth quarter of 2005, several vessels participated in an experiment that involved alternating, within a set, between circle hooks and the hook type the vessel normally used. All trips involved in this experiment had an observer onboard. These trips were considered to be part of the Hawaii longline deep-set fishery, as the protocol for this experiment fell under current legal practices for this fishery. Because these trips had 100% coverage they were not part of the random sampling scheme. To estimate the total bycatch for all deep-set longline fishing activity, the total observed bycatch from these experimental trips was added to the total estimated bycatch for trips subject to the random sampling scheme (i.e., all trips not participating in the experiment).

Bycatch estimates for the 2005 Hawaii longline shallow-set fishery were based on a census of longline trips on which scientific observers were deployed. Because the total bycatch (counts) of all animals was recorded for all trips in the shallow set fishery, the total bycatch was known.

Estimates of bycatch weights were computed from the estimated counts using observer information on discarded fish size and available weight–length regressions. Longline fishery observers make two kinds of observations of fish size: actual measurements of decked fish length (in centimeters) and visual estimation of fish length (in feet) for fish released without being brought aboard. The protocol for size data collection has changed over time from measuring all fish of only certain species (tunas, billfishes, and sharks) to measuring every third fish of any species that comes aboard the vessel. This change in protocol occurred during 2005, and it was only after the change that substantial numbers of measurements became available for species that are predominantly discarded. To obtain larger sample sizes of discarded fish, all size data from 2004 to 2006 were used.

The numbers of discarded fish size observations in the 2004–06 data sets varied from thousands of observations on discards of target species to zero for the more infrequent bycatch species. The first priority for estimating the size of a species was to use actual measurements. Separate fish-size estimates were compiled for the two longline fishery sectors (swordfish and tuna). Often, there were very few or no actual measurements. A size estimate was calculated as the mean of the actual measurements if there were at least five observations. Otherwise a five-point weighted average was used to include data from other sources, such as visually estimated fish lengths. For example, if there were less than five measurements (e.g., only two) the remaining point weight (three) for the weighted average was provided from the average of the visually estimated weights. If at least three visual observations were not available, the remaining point weight was provided from data on the same species from the other fishery sector. Still, there were sometimes fewer than five observations available to estimate discarded fish size (e.g., black marlin, *Makaira indica*). Estimates of the variance for such estimates were not possible.

Weight–length regressions available for most species from the literature or on the web (e.g., from Fishbase; see http://www.fishbase.org) were used to convert length estimates to weight estimates. Where a regression was not available, one was sometimes used for a closely related species with similar allometry. For groupings of taxa, regression-based weight estimates for one or more of the predominant taxa in the grouping were averaged.

4.6.5 Tier Classification of Pacific Islands Region Fisheries

The quality of bycatch data and estimation methods were analyzed for 18 Pacific Islands Region fisheries with Federal management authority, relevant Federal data-collection programs, or shared Federal–state management. Only Federal data sources were evaluated for this report. Other data may be available for state and international fisheries; however, these programs were beyond the scope of this initial report. The remaining 13 fisheries are not federally managed and have no relevant Federal data-collection programs, or are recreational or aquaculture fisheries, and were therefore excluded from the analysis in this report. Catches in unscored fisheries amounted to only about 300,000 pounds of primarily reef fish species in 2005, a very small fraction of regional landings.

Tier classifications were assigned to each fishery using the tier scoring procedures outlined in Section 3 for fish, marine mammals, and other protected species (Table 4.6.3). Regional fisheries were evaluated based on the quality of Fish, Marine Mammals, and Other Protected Species bycatch data and estimation methods.

The majority of fisheries were classified as Tier 1 for fish (66%, Figure 4.6.2A). Eleven percent of fisheries were clas-

Table 4.6.3
The 2005 fishery tier classifications for the Pacific Islands region (listed alphabetically, first by management authority and then by fishery). Shaded fisheries were evaluated for this report. Only Federal data sources were evaluated for this report.

Fishery	Management Authority	Fish Tier	Marine Mammals Tier	Other Protected Species Tier
American Samoa Bottomfish	Federal	1	0	0
American Samoa Lobster	Federal	0	0	0
American Samoa Pelagic Longline Fishery	Federal	1	0	0
American Samoa Troll	Federal	1	0	0
Commonwealth of the Northern Mariana Islands Bottomfish	Federal	1	0	0
Commonwealth of the Northern Mariana Islands Lobster	Federal	0	0	0
Commonwealth of the Northern Mariana Islands Tuna Troll	Federal	1	0	0
Guam Bottomfish Handline	Federal	1	0	0
Guam Longline	Federal	1	0	0
Guam Troll	Federal	1	0	0
Hawaii Shrimp Trap	Federal	1	0	0
Hawaii-Based Deep-Set Pelagic Longline Fishery for Tuna	Federal	2	3	3
Hawaii-Based Shallow-Set Pelagic Longline Fishery for Swordfish	Federal	3	4	4
Non-Longline Commercial Pelagic Fishery	Federal	1	0	0
Northwestern Hawaiian Islands Bottomfish	Federal	2	3	3
Precious Coral (Federal Waters)	Federal	1	0	0
Western Pacific Squid Jig	Federal	1	0	0
Hawaii Bottomfish	Federal, State	0	0	0
Hawaii Crab Trap	State			
Hawaii Fish Pond	State			
Hawaii Fish Trap	State			
Hawaii Inshore Handline	State			
Hawaii Lay Net	State			
Hawaii Lobster Diving	State			
Hawaii Lobster Trap	State			
Hawaii Octopus, Spear	State			
Hawaii Opelu/Akule Net	State			
Hawaii Pelagic Handline	State			
Hawaii Throw Net, Cast Net	State			
Hawaii Trolling, Rod and Reel	State			
Precious Coral (State Waters)	State			

sified as Tier 2 for fish, 6% as Tier 3, and the remainder as Tier 0 (three fisheries, or 17%). No fisheries were classified as Tier 4 for fish bycatch data collection and estimation. Of the fisheries evaluated, one fishery (the Hawaii-based shallow-set pelagic longline fishery for swordfish) was classified as Tier 4 for both marine mammals and other protected species. Two evaluated Pacific Islands fisheries were classified as Tier 3 for both marine mammals and other protected species (Figure 4.6.2B and C). The remaining fisheries were classified as tier 0 for marine mammals and other protected species.

4.6.6 Pacific Islands Region Key Stocks

Twenty-one key stocks were identified in the Pacific Islands Region (Table 4.6.4). As in other regions, not all species listed as key stocks had available bycatch estimates. For example, all 14 ESA-listed species found in the Pacific Islands Region were prioritized for inclusion in the list of key stocks, regardless of whether bycatch was reported. The 21 key stocks were split fairly evenly between fish (15%), marine mammals (32%), sea turtles (24%), and seabirds (29%) (Figure 4.6.3). In some cases, species identified for analysis were subsequently shown not to merit further consideration.[5]

All ESA-listed marine mammal populations found in the Pacific Islands (five cetaceans and one pinniped) were included in the list of key stocks. Additionally, the false killer whale (*Pseudorca crassidens*) was identified as a key stock through the quantitative evaluation process. It is considered a strategic stock under the MMPA.

All species of sea turtles found in the Pacific Islands were designated as key stocks, as all sea turtle species are listed under the ESA and are therefore prioritized as key stocks. The leatherback and the Mexican breeding populations of olive ridley and green turtles are endangered, while the log-

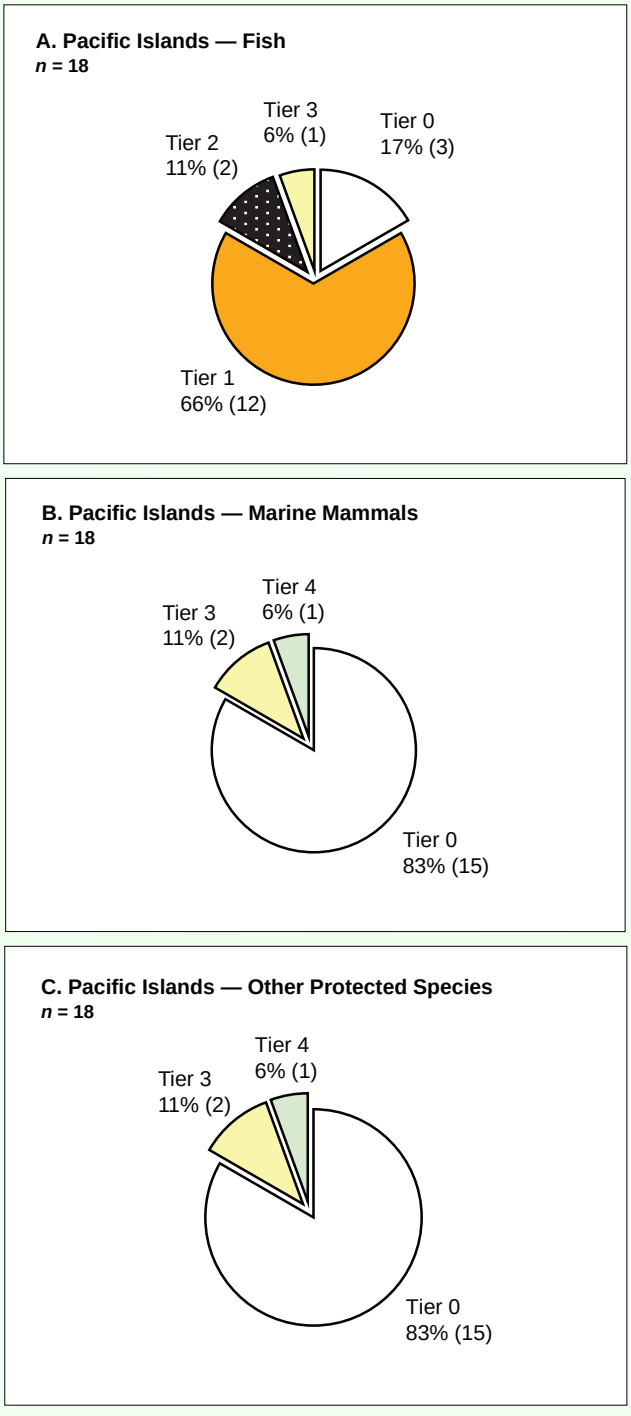


Figure 4.6.2
Pacific Islands Region fishery tier classifications, by number and percentage, for fisheries with Federal management or relevant Federal data-collection programs for A) fish, B) marine mammals, and C) other protected species. Tier scores are for the year 2005.

[5] Great barracuda (*Sphyraena barracuda*) was initially identified as a key stock through the quantitative process due to unknown FSSI status as part of the Coral Reef Complex (both overfished and overfishing status were listed as unknown). After evaluating the biological and economic conditions, the Pacific Islands Regional team concluded that the (approximately) four tons of discarded barracuda, potentially worth only about $8,000, was negligible compared with the reported 366 tons harvested in the same Food and Agriculture Organization of the United Nations area (FAO area 77) by fisheries of all nations in 2005 (FAO 2007). Additionally, in the adjacent Western Pacific (FAO Area 71), the reported barracuda harvest by all nations) was about 20,000 tons. Although the harvests were from separate stocks, they provide an indication that the productivity of regional great barracuda stocks should easily support small amounts of discards. For these reasons, the regional team elected to remove great barracuda from the list of key stocks. Through the qualitative process, the Pacific Islands team added to the list of key stocks one FSSI stock, the blue shark, and two non-FSSI fish stocks, the longnose lancetfish (*Alepisaurus ferox*) and the big-eye thresher shark (*Alopias superciliosus*). These three species are the most numerous discarded fish species in the longline fishery, and are also those with the greatest discarded weight.

Table 4.6.4
Key fish and marine mammal stocks and key sea turtle and seabird populations for the Pacific Islands Region. Overfishing/ overfished status based on 2008 Quarter 1 FSSI report

Key Fish Stocks Listed by FSSI			
Species/stock name			
Common name	Scientific name	Overfishing	Overfished
Blue shark	*Prionace glauca*	No	No

Key Fish Stocks Listed by ESA		
Species/stock name		
Common name	Scientific name	Stock status
None		

Key Fish Stocks Not Listed by FSSI or ESA		
Species/stock name		
Common name	Scientific name	Stock status
Bigeye thresher shark	*Alopias superciliosus*	Not applicable
Longnose lancetfish	*Alepisaurus ferox*	

Key Marine Mammal Stocks Listed by ESA		
Species/stock name		
Common name	Scientific name	Stock status
Blue whale	*Balaenoptera musculus*	Endangered
Fin whale	*Balaenoptera physalus*	Endangered
Hawaiian monk seal	*Monachus schauinslandi*	Endangered
Humpback whale	*Megaptera novaeangliae*	Endangered
Sei whale	*Balaenoptera borealis*	Endangered
Sperm whale	*Physeter macrocephalus*	Endangered

Key Marine Mammal Stocks Not Listed by ESA			
Species/stock name			
Common name	Scientific name	ZMRG	Stock status [a]
False killer whale	*Pseudorca crassidens*	0.24	Unknown

Key Sea Turtle Populations		
Species/stock name		
Common name	Scientific name	Population status
Green sea turtle	*Chelonia mydas*	Threatened (except in Florida and the Pacific coast of Mexico, where the breeding populations are endangered)
Hawksbill sea turtle	*Eretmochelys imbricata*	Threatened
Leatherback sea turtle	*Dermochelys coriacea*	Endangered
Loggerhead sea turtle	*Caretta caretta*	Threatened
Olive ridley sea turtle	*Lepidochelys olivacea*	Endangered (except the Pacific coast of Mexico breeding populations, which are endangered)

Table 4.6.4 (continued)

Key Seabird Populations Listed by ESA			
Species/stock name			
Common name	**Scientific name**	**Population status**	
Hawaiian dark-rumped petrel	*Pterodroma phaeopygia sandwichensis*	Endangered	
Newell's Townsend's shearwater	*Puffinus auricularis newelli*	Threatened	
Short-tailed albatross	*Phoebastria albatrus*	Endangered	
Key Seabird Populations Not Listed by ESA			
Species/stock name		**Bycatch concern**	**Population status**
Common name	**Scientific name**		
Black-footed albatross	*Phoebastria nigripes*	Yes	Increasing/Decreasing/ Stable[b]
Brown booby	*Sula leucogaster*	Unknown	Unknown
Laysan albatross	*Phoebastria immutabilis*	Yes	Increasing/Decreasing/ Stable[c]

[a] Stock status based on NMFS Marine Mammal Stock Assessments (Caretta, Forney, Lowry, et al. 2007).
[b] Different colonies have different population trends (see Naughton et al. 2008a).
[c] Different colonies have different population trends (see Naughton et al. 2008b).

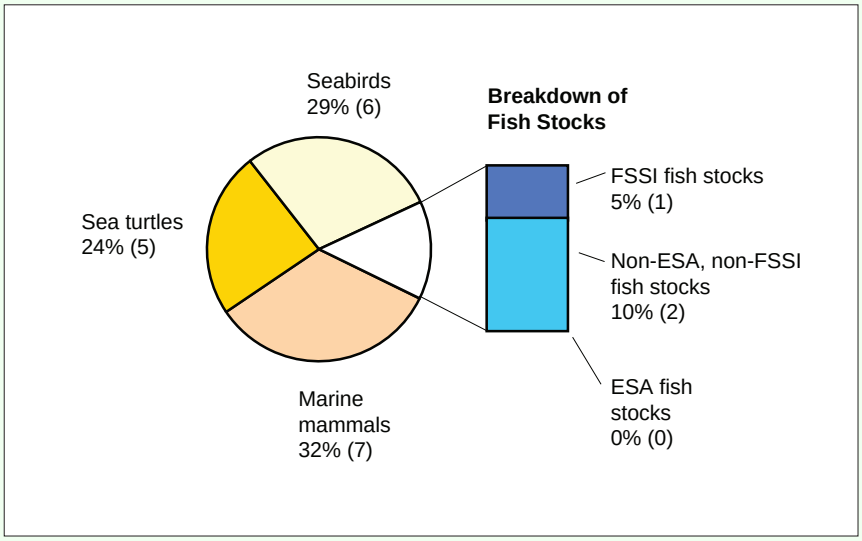


Figure 4.6.3
Numbers and percentages of key stocks for the Pacific Islands Region by resource type (*n* = 21).

gerhead, hawksbill, and other breeding populations of olive ridley and green turtles are threatened.

Due to unknown bycatch status and listing as a bird of conservation concern, the brown booby (*Sula leucogaster*) was listed as a key stock during the quantitative evaluation process. Two albatross species were also added to the Pacific Islands list of key stocks, one through the quantitative process (black-footed) and one through the qualitative process (Laysan). The black-footed and Laysan albatross are also on the USFWS List of Birds of Conservation Concern. Under the BiOp for the Hawaii longline fishery, the black-footed albatross is used as a proxy for the short-tailed albatross, an ESA-listed species. In addition to the short-tailed albatross, two other species were included as regional key stocks due to their ESA status: the Hawaiian dark-rumped petrel (*Pterodroma phaeopygia sandwichensis*) and Newell's Townsend's shearwater (*Puffinus auricularis newelli*).

4.6.7 Pacific Islands Region Bycatch Estimates

Appendix 4.6, Tables 4.6.A–F list available bycatch estimates by fishery, based on 2005 data (for fish, turtles, and seabirds) or the average from the years 2002–06 (marine mammals). Bycatch estimates were available for only two fisheries (Hawaii deep-set and Hawaii shallow-set longline) for inclusion in this report. Bycatch estimates were computed for all species observed caught in recent years. Bycatch estimates were provided for 88 fish stocks and stock groups, 15 marine mammal stocks, 4 sea turtle populations, and 4 seabird populations. Disposition of one of the most numerous bycatch species (blue sharks) has been discussed previously in this section. Over the last decade, populations of some high-bycatch species, such as longnose lancetfish, appear to be increasing; while others, such as escolar, are experiencing increased marketability (escolar is marketed as Hawaiian butterfish).

Landings information was available for 19 bycatch fish stocks. Bycatch reported for stock groups could not be compared with landings data, as the individual stocks making up the bycatch were unknown (e.g., reported as "billfish" or "unidentified bony fish"). In other cases, landings data may be confidential or unavailable, or the stock may not be landed. Where landings data were available, they are presented in Table 4.6.5. The timeframe of data used to calculate bycatch is included in Tables 4.6A–F.

Table 4.6.5
Summary of Pacific Islands Region recommendations and estimated requirements for implementation in terms of full-time staff and observer DAS. All requirements are annual unless otherwise indicated; ** denotes no additional annual cost. For further discussion of recommendations, see Section 5.8.

Recommendation [a]	Additional DAS [b]	Feasibility
Develop statistical estimator for discarded fish weight in the Hawaii deep-set and shallow-set longline fisheries.	NA	High
Maintain current observer program coverage levels for the Hawaii deep- and shallow-set pelagic longline fisheries.	**	High
Increase observer program coverage levels for the American Samoa pelagic longline fishery to 40% (4 observers, based on 2006 data).	855	High
Develop statistical estimator for discarded fish weight in the American Samoa Longline fishery.	NA	High
Number of new full-time staff needed to implement all data-quality and estimation method improvements recommended by the Pacific Islands Region:	6	
Total requirement for all DAS recommendations: [c]	855	

[a] Some recommendations may require additional resource expenditures, such as equipment, which are not itemized.
[b] One observer DAS includes the cost for the observer deployment as well as costs for associated equipment and program administrative functions (staffing).
[c] This amount is in addition to the annual requirements of Pacific Islands Region observer programs.

4.6.8 Bycatch Estimate Improvement Plans for Pacific Islands Region Fisheries

An improvement plan was developed for the two Pacific Islands Region fisheries where bycatch data and estimation methods are currently available. The improvement plan for Hawaii longline fisheries covers both sectors (deep-set and shallow-set longline) and focuses on improving the quality of length–weight conversions for bycatch species. The Pacific Islands Regional team also recommends maintaining observer coverage for the fishery at current levels.

4.6.8.1 Improvement Plans

American Samoa Longline Fishery

Tier Classes: Fish = 1; Marine Mammals = 0; Other Protected Species = 0

Bycatch and data-collection concerns:

- Observer coverage of this fishery is too low (7% in 2007) to reliably detect rare species of management concern that may interact with this fishery.
- Sample size of fish bycatch estimates is at baseline levels.
- Vessel sampling bias exists as a result of vessel safety compliance issues.

Recommendations

- It was recommended to increase observer coverage to 40% to increase the likelihood of documenting rare interactions, and increase bycatch sample size.
- Increased measurement of discards, improvement in length–weight relationships, and the development of a statistical method to better estimate total fish discard weight and provide confidence limits were recommended.
- It was also recommended to minimize vessel sampling bias by increasing the number of observers available to ensure compliance.

Hawaii Longline Fisheries

Tier Classes:
Deep-set: Fish = 2; Marine Mammals = 3; Other Protected Species = 3
Shallow-set: Fish = 3; Marine Mammals = 4; Other Protected Species = 4

Bycatch and data-collection concerns:

- Sufficient measurements of bycatch fish lengths and adequate length–weight regressions to produce good estimates of fish bycatch weight are not yet available for most species. For the key fish stocks there are length–weight regressions available, along with dozens (bigeye thresher shark), hundreds (blue shark), or thousands (lancetfish) of length measurements.
- More measurements and better length–weight regressions are needed. (Currently 55 measurements are available for bigeye thresher shark and 11 for lancetfish.)
- A method of estimating the statistical properties of the estimated fish bycatch weights is lacking.

Recommendations:

- Increased measurement of discards, improvement in length–weight relationships, and development of a statistical method to better estimate total fish discard weight and provide confidence limits were recommended.
- In 2006, observers started measuring a subsample of fish on each haul, which will eventually provide sufficient data for improved estimates, but to adequately characterize all species a total census of lengths was recommended to provide more accurate estimates.
- The development of a statistical estimator for discarded fish weight that takes into account the variability in recorded lengths and the uncertainty in the weight–length relationships used to convert these lengths into weights was also recommended.
- The estimated resources needed to implement improvements were three full-time staff for two years, with only two full-time staff members needed for maintenance following the initial two-year period.

4.6.8.2 Summary of Cost and Feasibility of Pacific Islands Region Recommendations

Table 4.6.5 outlines bycatch data-collection and estimation improvements recommended by the Pacific Islands Region. The feasibility of implementing these recommendations was evaluated by the Pacific Islands Regional team based on overall resource requirements, currently available resources, and external factors. A total of four recommendations were made, involving new resources of six full-time staff members and 855 observer DAS. These improvements

would raise the fish tier classifications one level in three fisheries, and the marine mammal and other protected species tier classifications by at least one level in one fishery. Costs for enhancing existing programs or implementing new observer programs are recommended in addition to current program operating costs. Observer program costs for the Pacific Islands Region were $5.7M in FY 2008. The American Samoa longline fishery has only preliminary bycatch estimates for protected species (from annual reports starting in 2006), and is not listed in Appendix 4.6. Fish bycatch estimates have not yet been made, and the existing pilot observer program has inadequate coverage and funding to provide such estimates. This fishery would have the highest priority for future work.

Photo: NMFS, PIRO

Bigeye tuna.

Photo: NMFS, PIRO

Yellowfin tuna.

Photo: NMFS, PIRO

Observer measures a tuna.

Appendix 4.6 Pacific Islands Region Bycatch Estimates

Table 4.6.A

Subtables showing estimates of annual fish bycatch in Pacific Islands Region fisheries, in live pounds. Estimates reflect the average of the years identified. Key stocks are shaded. * following the names of stock groups indicates fisheries for which bycatch estimates were available only for the generalized stock group. Fishery bycatch ratios = bycatch / (bycatch + landings).

Subtable 4.6.A.1 — **HAWAII-BASED DEEP-SET PELAGIC LONGLINE FISHERY (TUNA)**

COMMON NAME	SCIENTIFIC NAME	DATA SOURCE	AVERAGE AMOUNT	UNIT	CV
Albacore	*Thunnus alalunga*	2005	8,027.02	Pounds	
Bigeye thresher shark	*Alopias superciliosus*	2005	426,336.03	Pounds	
Bigeye tuna	*Thunnus obesus*	2005	128,090.63	Pounds	
Bignose shark	*Carcharhinus altimus*	2005	66.14	Pounds	
Billfishes*	Istiophoridae	2005	24,738.04	Pounds	
Black mackerel	*Scombrolabrax heterolepis*	2005	55.12	Pounds	
Black marlin	*Makaira indica*	2005	610.68	Pounds	
Blacktip shark	*Carcharhinus limbatus*	2005	0.00	Pounds	
Blue shark	*Prionace glauca*	2005	4,816,697.87	Pounds	
Bony fishes*	Osteichthyes	2005	119.05	Pounds	
Bony fishes (unidentified)*	Osteichthyes	2005	257.94	Pounds	
Brama pomfrets (unidentified)*	Bramidae	2005	1,168.45	Pounds	
Brilliant pomfret	*Eumegistus illustris*	2005	723.12	Pounds	
Cookie cutter shark	*Isistius brasiliensis*	2005	0.00	Pounds	
Cottonmouth jacks (unidentified)*	*Uraspis* spp.	2005	48.50	Pounds	
Crestfish	*Lophotus lacepede*	2005	2,998.28	Pounds	
Crocodile shark	*Pseudocarcharias kamoharai*	2005	6,417.65	Pounds	
Dolphinfish	*Coryphaena hippurus*	2005	37,405.79	Pounds	
Driftfishes	*Cubiceps* spp.	2005	41.89	Pounds	
Escolar	*Lepidocybium flavobrunneum*	2005	11,378.04	Pounds	
Galapagos shark	*Carcharhinus galapagensis*	2005	1,324.98	Pounds	
Great barracuda	*Sphyraena barracuda*	2005	8,489.99	Pounds	
Grey reef shark	*Carcharhinus amblyrhynchos*	2005	0.00	Pounds	
Hammerhead sharks*	*Sphyrna* spp.	2005	2,414.06	Pounds	
Indo-Pacific blue marlin	*Makaira mazara*	2005	27,352.72	Pounds	
Kawakawa	*Euthynnus affinis*	2005	0.00	Pounds	
King-of-salmon	*Trachipterus altivelis*	2005	0.00	Pounds	
Knifetail pomfret	*Taractes rubescens*	2005	12,932.30	Pounds	
Longfin mako shark	*Isurus paucus*	2005	2,504.45	Pounds	

Table 4.6.A (continued)

(continuation of Subtable 4.6.A.1)		HAWAII-BASED DEEP-SET PELAGIC LONGLINE FISHERY (TUNA)			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AVERAGE AMOUNT**	**UNIT**	**CV**
Longnose lancetfish	*Alepisaurus ferox*	2005	922,036.02	Pounds	
Louvar	*Luvarus imperialis*	2005	0.00	Pounds	
Makos*	*Isurus* spp.	2005	2,475.79	Pounds	
Manta	*Manta birostris*	2005	617.29	Pounds	
Mantas, mobulas (unidentified)*	Mobulidae	2005	0.00	Pounds	
Mantas (unidentified)*	*Mobula* spp.	2005	1,388.91	Pounds	
Oarfish	*Regalecus glesne*	2005	0.00	Pounds	
Ocean sunfish	*Mola mola*	2005	37,967.97	Pounds	
Oceanic whitetip shark	*Carcharhinus longimanus*	2005	58,402.59	Pounds	
Oilfish	*Ruvettus pretiosus*	2005	5,158.81	Pounds	
Omosudid (hammerjaw)	*Omosudis lowei*	2005	268.96	Pounds	
Opah	*Lampris guttatus*	2005	36,563.62	Pounds	
Pacific (chub) mackerel	*Scomber japonicus*	2005	0.00	Pounds	
Pacific bluefin tuna	*Thunnus orientalis*	2005	0.00	Pounds	
Pacific bonito	*Sarda chiliensis*	2005	0.00	Pounds	
Pelagic puffer	*Lagocephalus lagocephalus*	2005	2,021.64	Pounds	
Pelagic stingray	*Dasyatis violacea*	2005	38,042.92	Pounds	
Pelagic thresher shark	*Alopias pelagicus*	2005	5,418.96	Pounds	
Pompano dolphin	*Coryphaena equiselis*	2005	401.24	Pounds	
Rainbow runner	*Elagatis bipinnulatus*	2005	154.32	Pounds	
Rays (other)*	Rajiformes	2005	0.00	Pounds	
Rays (unidentified)*	Rajiformes	2005	0.00	Pounds	
Razorback scabbardfish	*Assurger anzac*	2005	2,691.84	Pounds	
Roudi escolar	*Promethichthys prometheus*	2005	2,387.60	Pounds	
Rough pomfret	*Taractes asper*	2005	1,671.10	Pounds	
Rough triggerfish	*Canthidermis maculata*	2005	4.41	Pounds	
Sailfish	*Istiophorus platypterus*	2005	346.13	Pounds	
Salmon shark	*Lamna ditropis*	2005	599.66	Pounds	
Sandbar shark	*Carcharhinus plumbeus*	2005	3,225.36	Pounds	
Scalloped hammerhead shark	*Sphyrna lewini*	2005	773.82	Pounds	
Scalloped ribbonfish	*Zu cristatus*	2005	35.27	Pounds	
Shark (other)*	Chondrichthyes	2005	130.07	Pounds	
Sharks (unidentified)*	Chondrichthyes	2005	51,085.45	Pounds	
Sharptail mola	*Masturus lanceolatus*	2005	6,217.03	Pounds	
Shortbill spearfish	*Tetrapturus angustirostris*	2005	36,217.50	Pounds	
Shortfin mako shark	*Isurus oxyrinchus*	2005	156,618.41	Pounds	

Table 4.6.A (continued)

(continuation of Subtable 4.6.A.1)		HAWAII-BASED DEEP-SET PELAGIC LONGLINE FISHERY (TUNA)			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AVERAGE AMOUNT**	**UNIT**	**CV**
Shortnose lancetfish	*Alepisaurus brevirostris*	2005	0.00	Pounds	
Sickle pomfret	*Taractichthys steindachneri*	2005	4,995.67	Pounds	
Silky shark	*Carcharhinus falciformis*	2005	36,034.51	Pounds	
Skipjack tuna	*Katsuwonus pelamis*	2005	81,196.15	Pounds	
Slender mola	*Ranzania laevis*	2005	34,557.42	Pounds	
Smooth hammerhead shark	*Sphyrna zygaena*	2005	2,453.74	Pounds	
Snake mackerel	*Gempylus serpens*	2005	156,338.42	Pounds	
Striped marlin	*Tetrapturus audax*	2005	27,277.76	Pounds	
Swordfish	*Xiphias gladius*	2005	23,734.94	Pounds	
Tapertail ribbonfish	*Trachipterus fukuzakii*	2005	2,546.34	Pounds	
Thresher shark	*Alopias vulpinus*	2005	0.00	Pounds	
Thresher sharks (unidentified)*	Alopiidae	2005	57,203.28	Pounds	
Tiger shark	*Galeocerdo cuvieri*	2005	4,310.03	Pounds	
Triggerfish (unidentified)*	Balistidae	2005	0.00	Pounds	
Tunas*	Scombridae	2005	20,719.02	Pounds	
Velvet dogfish	*Scymnodon squamulosus*	2005	844.37	Pounds	
Wahoo	*Acanthocybium solandri*	2005	13,287.24	Pounds	
White shark	*Carcharodon carcharias*	2005	92.59	Pounds	
Yellowfin tuna	*Thunnus albacares*	2005	86,273.39	Pounds	
Yellowtail jack	*Seriola lalandi*	2005	0.00	Pounds	
TOTAL FISHERY BYCATCH			7,436,959.28	Pounds	
TOTAL FISHERY LANDINGS			19,000,500.00	Pounds	
TOTAL CATCH (Bycatch + Landings)			26,936,959.28	Pounds	
FISHERY BYCATCH RATIO (Bycatch/Total Catch)			0.28		

Table 4.6.A (continued)

Subtable 4.6.A.2		HAWAII-BASED SHALLOW-SET PELAGIC LONGLINE FISHERY (SWORDFISH)			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AVERAGE AMOUNT**	**UNIT**	**CV**
Albacore	*Thunnus alalunga*	2005	15,928.38	Pounds	
Bigeye thresher shark	*Alopias superciliosus*	2005	6,538.90	Pounds	
Bigeye tuna	*Thunnus obesus*	2005	5,985.54	Pounds	
Bignose shark	*Carcharhinus altimus*	2005	66.14	Pounds	
Billfishes*	Istiophoridae	2005	4,720.09	Pounds	
Black marlin	*Makaira indica*	2005	152.12	Pounds	
Blue shark	*Prionace glauca*	2005	822,523.88	Pounds	
Bony fishes (other)*	Osteichthyes	2005	2.20	Pounds	
Bony fishes (unidentified)*	Osteichthyes	2005	94.80	Pounds	
Brama pomfrets (unidentified)*	Bramidae	2005	0.00	Pounds	
Brilliant pomfret	*Eumegistus illustris*	2005	4.41	Pounds	
Cartilaginous fishes*	Chondricthyes	2005	6,968.80	Pounds	
Cookie cutter shark	*Isistius brasiliensis*	2005	2.20	Pounds	
Crocodile shark	*Pseudocarcharias kamoharai*	2005	50.71	Pounds	
Dolphinfish	*Coryphaena hippurus*	2005	19,418.29	Pounds	
Escolar	*Lepidocybium flavobrunneum*	2005	12,912.46	Pounds	
Galapagos shark	*Carcharhinus galapagensis*	2005	817.91	Pounds	
Great barracuda	*Sphyraena barracuda*	2005	22.05	Pounds	
Indo-Pacific blue marlin	*Makaira mazara*	2005	11,397.89	Pounds	
Knifetail pomfret	*Taractes rubescens*	2005	88.18	Pounds	
Longfin mako shark	*Isurus paucus*	2005	277.78	Pounds	
Longnose lancetfish	*Alepisaurus ferox*	2005	5,676.90	Pounds	
Louvar	*Luvarus imperialis*	2005	15.43	Pounds	
Mako sharks*	*Isurus* spp.	2005	3,331.18	Pounds	
Mantas (unidentified)*	*Mobula* spp.	2005	132.28	Pounds	
Ocean sunfish	*Mola mola*	2005	5,767.29	Pounds	
Oceanic whitetip shark	*Carcharhinus longimanus*	2005	38,640.37	Pounds	
Oilfish	*Ruvettus pretiosus*	2005	2,777.82	Pounds	
Opah	*Lampris guttatus*	2005	2,780.03	Pounds	
Pelagic puffer	*Lagocephalus lagocephalus*	2005	145.50	Pounds	
Pelagic stingray	*Dasyatis violacea*	2005	487.22	Pounds	
Pelagic thresher shark	*Alopias pelagicus*	2005	149.91	Pounds	
Salmon shark	*Lamna ditropis*	2005	628.32	Pounds	
Sandbar shark	*Carcharhinus plumbeus*	2005	1,082.47	Pounds	
Shortbill spearfish	*Tetrapturus angustirostris*	2005	3,168.04	Pounds	

Table 4.6.A (continued)

(continuation of Subtable 4.6.A.2)		HAWAII-BASED SHALLOW-SET PELAGIC LONGLINE FISHERY (SWORDFISH)			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AVERAGE AMOUNT**	**UNIT**	**CV**
Shortfin mako shark	*Isurus oxyrinchus*	2005	31,521.66	Pounds	
Sickle pomfret	*Taractichthys steindachneri*	2005	167.55	Pounds	
Silky shark	*Carcharhinus falciformis*	2005	2,500.04	Pounds	
Skipjack tuna	*Katsuwonus pelamis*	2005	171.96	Pounds	
Slender mola	*Ranzania laevis*	2005	11.02	Pounds	
Smooth hammerhead shark	*Sphyrna zygaena*	2005	930.35	Pounds	
Snake mackerel	*Gempylus serpens*	2005	685.64	Pounds	
Striped marlin	*Tetrapturus audax*	2005	17,698.69	Pounds	
Swordfish	*Xiphias gladius*	2005	76,784.71	Pounds	
Thresher sharks*	Alopiidae	2005	1,029.56	Pounds	
Tiger shark	*Galeocerdo cuvieri*	2005	5,577.69	Pounds	
Tunas*	Scombridae	2005	776.03	Pounds	
Wahoo	*Acanthocybium solandri*	2005	72.75	Pounds	
Yellowfin tuna	*Thunnus albacares*	2005	628.32	Pounds	
TOTAL FISHERY BYCATCH			1,111,311.46	Pounds	
TOTAL FISHERY LANDINGS			3,500,000.00	Pounds	
TOTAL CATCH (Bycatch + Landings)			4,611,311.46	Pounds	
FISHERY BYCATCH RATIO (Bycatch/Total Catch)			0.24		

Table 4.6.B

Summary of Pacific Islands Region bycatch by species. All estimates are live weights. Key stocks are shaded. * following the names of stock groups indicates fisheries for which bycatch estimates were available only for the generalized stock group. Species bycatch ratio = the total regional bycatch of a species / (total regional landings of the species + total regional bycatch of the species).

		TOTAL STOCK BYCATCH[a]		TOTAL SPECIES BYCATCH[b]		SPECIES LANDINGS[c]		SPECIES BYCATCH RATIO[d]
COMMON NAME	SCIENTIFIC NAME	AMOUNT	UNIT	AMOUNT	UNIT	2005 LANDINGS	UNIT	RATIO
Albacore	*Thunnus alalunga*	See species column		23,955.40	Pounds	1,008,007.00	Pounds	0.02
Bigeye thresher shark[e]	*Alopias superciliosus*			432,874.93	Pounds	see footnote		**
Bigeye tuna	*Thunnus obesus*			134,076.17	Pounds	10,934,544.00	Pounds	0.01
Bignose shark	*Carcharhinus altimus*			132.28	Pounds	^	–	**
Billfishes*	Istiophoridae			29,458.13	Pounds	–	–	**
Black mackerel	*Scombrolabrax heterolepis*			55.12	Pounds	^	–	**
Black marlin	*Makaira indica*			762.80	Pounds	2,461.00	Pounds	0.24
Blacktip shark	*Carcharhinus limbatus*			0.00	Pounds	^	–	**
Blue shark[f]	*Prionace glauca*			5,639,221.75	Pounds	see footnote		**
Bony fishes*	Osteichthyes			119.05	Pounds	–	–	**
Bony fishes (other)*	Osteichthyes			2.20	Pounds	–	–	**
Bony fishes (unidentified)*	Osteichthyes			352.74	Pounds	–	–	**
Brama pomfrets (unidentified)[g]	Bramidae			1,168.45	Pounds	see footnote	–	**
Brilliant pomfret[g]	*Eumegistus illustris*			727.53	Pounds	see footnote		**
Cartilaginous fishes*	Chondricthyes			6,968.80	Pounds	–	–	**
Cookie cutter shark	*Isistius brasiliensis*			2.20	Pounds	^	–	**
Cottonmouth jacks (unidentified)*	*Uraspis* spp.			48.50	Pounds	–	–	**
Crestfish	*Lophotus lacepede*			2,998.28	Pounds	^	–	**
Crocodile shark	*Pseudocarcharias kamoharai*			6,468.36	Pounds	^	–	**
Dolphinfish	*Coryphaena hippurus*			56,824.08	Pounds	1,439,168.00	Pounds	0.04
Driftfishes	*Cubiceps* spp			41.89	Pounds	^	–	**
Escolar	*Lepidocybium flavobrunneum*			24,290.50	Pounds	3,436.00	Pounds	0.88

Table 4.6.B (continued)

		TOTAL STOCK BYCATCH[a]		TOTAL SPECIES BYCATCH[b]		SPECIES LANDINGS[c]		SPECIES BYCATCH RATIO[d]
COMMON NAME	SCIENTIFIC NAME	AMOUNT	UNIT	AMOUNT	UNIT	2005 LANDINGS	UNIT	RATIO
Galapagos shark	*Carcharhinus galapagensis*	See species column		2,142.89	Pounds	^	–	**
Great barracuda	*Sphyraena barracuda*			8,512.04	Pounds	33,878.00	Pounds	0.20
Grey reef shark	*Carcharhinus amblyrhynchos*			0.00	Pounds	^	–	**
Hammerhead sharks*	*Sphyrna* spp.			2,414.06	Pounds	–	–	**
Indo-Pacific blue marlin	*Makaira mazara*			38,750.61	Pounds	969,226.00	Pounds	0.04
Kawakawa	*Euthynnus affinis*			0.00	Pounds	3,342.00	Pounds	0.00
King-of-salmon	*Trachipterus altivelis*			0.00	Pounds	^	–	**
Knifetail pomfret[g]	*Taractes rubescens*			13,020.48	Pounds	see footnote		**
Longfin mako shark[h]	*Isurus paucus*			2,782.23	Pounds	see footnote		**
Longnose lancetfish	*Alepisaurus ferox*			927,712.92	Pounds	^	–	**
Louvar	*Luvarus imperialis*			15.43	Pounds	^	–	**
Mako sharks[h]	Isurus			5806.97	Pounds	see footnote	–	**
Manta	*Manta birostris*			617.29	Pounds	^	–	**
Mantas, mobulas (unidentified)*	Mobulidae			0.00	Pounds	–	–	**
Mantas (unidentified)*	*Mobula* spp.			1,521.19	Pounds	–	–	**
Oarfish	*Regalecus glesne*			0.00	Pounds	^	–	**
Oceanic whitetip shark	*Carcharhinus longimanus*			97,042.96	Pounds	^	–	**
Ocean sunfish	*Mola mola*			43,735.26	Pounds	123.00	Pounds	1.00
Oilfish	*Ruvettus pretiosus*			7,936.63	Pounds	385,809.00	Pounds	0.02
Omosudid (hammerjaw)	*Omosudis lowei*			268.96	Pounds	^	–	**
Opah	*Lampris guttatus*			39,343.65	Pounds	1,086,076.00	Pounds	0.03
Pacific (chub) mackerel	*Scomber japonicus*			0.00	Pounds	–	–	**
Pacific bluefin tuna	*Thunnus orientalis*			0.00	Pounds	–	–	**
Pacific bonito	*Sarda chiliensis*			0.00	Pounds	–	–	**
Pelagic puffer	*Lagocephalus lagocephalus*			2,167.14	Pounds	^	–	**
Pelagic stingray	*Dasyatis violacea*			38,530.14	Pounds	^	–	**

Table 4.6.B (continued)

		TOTAL STOCK BYCATCH[a]		TOTAL SPECIES BYCATCH[b]		SPECIES LANDINGS[c]		SPECIES BYCATCH RATIO[d]
COMMON NAME	SCIENTIFIC NAME	AMOUNT	UNIT	AMOUNT	UNIT	2005 LANDINGS	UNIT	RATIO
Pelagic thresher shark[e]	*Alopias pelagicus*	See species column		5,568.87	Pounds	^	–	**
Pompano dolphin	*Coryphaena equiselis*			401.24	Pounds	^	–	**
Rainbow runner	*Elagatis bipinnulatus*			154.32	Pounds	4,265.00	Pounds	0.03
Rays (other)*	Rajiformes			0.00	Pounds	–	–	**
Rays (unidentified)*	Rajiformes			0.00	Pounds	–	–	**
Razorback scabbardfish	*Assurger anzac*			2,691.84	Pounds	^	–	**
Roudi escolar	*Promethichthys prometheus*			2,387.60	Pounds	^	–	**
Rough pomfret[g]	*Taractes asper*			1,671.10	Pounds	see footnote		**
Rough triggerfish	*Canthidermis maculata*			4.41	Pounds	^	–	**
Sailfish	*Istiophorus platypterus*			346.13	Pounds	7,420.00	Pounds	0.04
Salmon shark	*Lamna ditropis*			1,227.98	Pounds	^	–	**
Sandbar shark	*Carcharhinus plumbeus*			4,307.83	Pounds	^	–	**
Scalloped hammerhead shark	*Sphyrna lewini*			773.82	Pounds	^	–	**
Scalloped ribbonfish	*Zu cristatus*			35.27	Pounds	^	–	**
Shark (other)*	Elasmobranchii			130.07	Pounds	–	–	**
Shark (unidentified)	Chondrichthyes			51,085.45	Pounds	^	–	**
Sharptail mola	*Masturus lanceolatus*			6,217.03	Pounds	^	–	**
Shortbill spearfish	*Tetrapturus angustirostris*			39,385.54	Pounds	467,748.00	Pounds	0.08
Shortfin mako shark[h]	*Isurus oxyrinchus*			188,140.07	Pounds	see footnote		**
Shortnose lancetfish	*Alepisaurus brevirostris*			0.00	Pounds	^	–	**
Sickle pomfret[g]	*Taractichthys steindachneri*			5,163.22	Pounds	see footnote		**
Silky shark	*Carcharhinus falciformis*			38,534.55	Pounds	^	–	**
Skipjack tuna	*Katsuwonus pelamis*			81,368.11	Pounds	964,402.00	Pounds	0.08
Slender mola	*Ranzania laevis*			34,568.44	Pounds	^	–	**

Table 4.6.B (continued)

		TOTAL STOCK BYCATCH[a]		TOTAL SPECIES BYCATCH[b]		SPECIES LANDINGS[c]		SPECIES BYCATCH RATIO[d]
COMMON NAME	SCIENTIFIC NAME	AMOUNT	UNIT	AMOUNT	UNIT	2005 LANDINGS	UNIT	RATIO
Smooth hammerhead shark	*Sphyrna zygaena*	See species column		3,384.09	Pounds	^	–	**
Snake mackerel	*Gempylus serpens*			157,024.06	Pounds	^	–	**
Striped marlin	*Tetrapturus audax*			44,976.45	Pounds	1,218,030.00	Pounds	0.04
Swordfish	*Xiphias gladius*			100,519.65	Pounds	3,445,598.00	Pounds	0.03
Tapertail ribbonfish	*Trachipterus fukuzakii*			2,546.34	Pounds	^	–	**
Thresher shark[e]	*Alopias vulpinus*			0.0	Pounds	see footnote	–	**
Thresher sharks[e]	Alopiidae			1029.56	Pounds	see footnote	–	**
Thresher sharks (unidentified)[e]	Alopiidae			57,203.28	Pounds	see footnote	–	**
Tiger shark	*Galeocerdo cuvieri*			9,887.72	Pounds	^	–	**
Triggerfish (unidentified)*	Balistidae			0.00	Pounds	–	–	**
Tunas	Scombridae			21,495.05	Pounds			**
Velvet dogfish	*Scymnodon squamulosus*			844.37	Pounds	^	–	**
Wahoo	*Acanthocybium solandri*			13,359.99	Pounds	817,249.00	Pounds	0.02
White shark	*Carcharodon carcharias*			92.59	Pounds	±	–	**
Yellowfin tuna	*Thunnus albacares*			86,901.71	Pounds	3,208,468.00	Pounds	0.03
Yellowtail jack	*Seriola lalandi*			0.00	Pounds			**

[a] Bycatch is listed in the species column, as there were no species with bycatch of more than one substock.
[b] Landed weights are for catch sold only.
[c] Species marked ^ were not landed or rarely landed; these may be kept and consumed. Species marked ± are federally prohibited to land.
[d] A double asterisk (**) indicates that bycatch ratios could not be developed, where bycatch estimates were provided in both numbers of individuals and in pounds, or where landings were not available.
[e] Pacific Region landings were not reported by thresher shark species, but were reported for thresher sharks in general. Landings for the year 2005 for the thresher shark family (Alopiidae) were 63,314 pounds, but could not be used to develop a bycatch ratio for thresher shark species, as the exact composition of the landings reported for Alopiidae is unknown.
[f] Landings for all sharks (primarily blue sharks) for the year 2005 were 8,314 pounds, but could not be used to develop a bycatch ratio for shark species, as the exact composition of the landings reported for sharks in general is unknown. Blue sharks are the only other major landed shark species other than thresher and mako sharks, which are listed separately (below), and comprise the majority of the landings for sharks.
[g] Pacific Region landings were not reported by pomfret species, but were reported for pomfret in general. Landings for the year 2005 for the pomfret family (Bramidae) were 646,000 pounds, but cannot be used to develop a bycatch ratio for pomfret species, as the exact composition of the landings reported for Bramidae is unknown.
[h] Pacific Region landings were not reported by mako shark species, but were reported for mako sharks in general. Landings for the year 2005 for the mako shark genus (*Isurus*) were 203,827 pounds, but could not be used to develop a bycatch ratio for mako shark species, as the exact composition of the landings reported for *Isurus* spp. is unknown.

Table 4.6.C

Subtables showing estimates of marine mammal incidental mortality and serious injury for Pacific Islands fisheries within the Hawaiian Islands EEZ. All bycatch estimates are in numbers of individuals and are an average for the years indicated. Key stocks/populations are shaded.

Subtable 4.6.C.1

		HAWAII-BASED DEEP-SET PELAGIC LONGLINE FISHERY (TUNA)			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AVERAGE AMOUNT**	**UNIT**	**CV**
Beaked whale (unidentified)	Ziphiidae	2002–06	0	Individuals	
Blainville's beaked whale	*Mesoplodon densirostris*	2002–06	0.41	Individuals	2.02
Bottlenose dolphin	*Tursiops truncatus*	2002–06	0.93	Individuals	
Bryde's whale	*Balaenoptera edeni*	2002–06	0	Individuals	
Cetacean (unidentified)	Cetacea	2002–06	1.21	Individuals	1.14
False killer whale	*Pseudorca crassidens*	2002–06	5.74	Individuals	0.64
False killer or short-finned pilot whale (unidentified)	Delphinidae	2002–06	3.47	Individuals	0.62
Humpback whale	*Megaptera novaeangliae*	2002–06	0	Individuals	
Risso's dolphin	*Grampus griseus*	2002–06	0	Individuals	
Short-beaked common dolphin (unidentified)	*Delphinus delphis*	2002–06	0	Individuals	
Short-finned pilot whale	*Globicephala macrorhynchus*	2002–06	0.94	Individuals	
Sperm whale	*Physeter macrocephalus*	2002–06	0	Individuals	
Spinner dolphin	*Stenella longirostris*	2002–06	0	Individuals	
Striped dolphin	*Stenella coeruleoalba*	2002–06	1.22	Individuals	
Pantropical spotted dolphin	*Stenella attenuata*	2002–06	0	Individuals	
TOTAL FISHERY BYCATCH			13.92	Individuals	

Table 4.6.C (continued)

Subtable 4.6.C.2		HAWAII-BASED SHALLOW-SET PELAGIC LONGLINE FISHERY (SWORDFISH)			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AVERAGE AMOUNT**	**UNIT**	**CV**
Beaked whale (unidentified)	Ziphiidae	2002–06	0	Individuals	0
Blainville's beaked whale	*Mesoplodon densirostris*	2002–06	0	Individuals	0
Bottlenose dolphin	*Tursiops truncatus*	2002–06	0	Individuals	0
Bryde's whale	*Balaenoptera edeni*	2002–06	0	Individuals	0
Cetacean (unidentified)	Cetacea	2002–06	0	Individuals	0
False killer whale	*Pseudorca crassidens*	2002–06	0	Individuals	0
False killer or short-finned Pilot whale (unidentified)	Delphinidae	2002–06	0	Individuals	0
Humpback whale	*Megaptera novaeangliae*	2002–06	0	Individuals	0
Risso's dolphin	*Grampus griseus*	2002–06	0	Individuals	0
Short-beaked common dolphin (unidentified)	*Delphinus delphis*	2002–06	0	Individuals	0
Short-finned pilot whale	*Globicephala macrorhynchus*	2002–06	0	Individuals	0
Sperm whale	*Physeter macrocephalus*	2002–06	0	Individuals	0
Spinner dolphin	*Stenella longirostris*	2002–06	0	Individuals	0
Striped dolphin	*Stenella coeruleoalba*	2002–06	0	Individuals	0
Pantropical spotted dolphin	*Stenella attenuata*	2002–06	0	Individuals	0
TOTAL FISHERY BYCATCH			0	Individuals	

Table 4.6.C (continued)

Subtable 4.6.C.3 (SUMMARY)		**TOTAL SPECIES BYCATCH**	
COMMON NAME	**SCIENTIFIC NAME**	**AVERAGE AMOUNT**	**UNIT**
Beaked whale (unidentified)	Ziphiidae	0	Individuals
Blainville's beaked whale	*Mesoplodon densirostris*	0.41	Individuals
Bottlenose dolphin	*Tursiops truncatus*	0.93	Individuals
Bryde's whale	*Balaenoptera edeni*	0	Individuals
Cetacean (unidentified)	Cetacea	1.21	Individuals
False killer whale	*Pseudorca crassidens*	5.74	Individuals
False killer or short-finned pilot whale (unidentified)	Delphinidae	3.47	Individuals
Humpback whale	*Megaptera novaeangliae*	0	Individuals
Risso's dolphin	*Grampus griseus*	0	Individuals
Short-beaked common dolphin (unidentified)	*Delphinus delphis*	0	Individuals
Short-finned pilot whale	*Globicephala macrorhynchus*	0.94	Individuals
Sperm whale	*Physeter macrocephalus*	0	Individuals
Spinner dolphin	*Stenella longirostris*	0	Individuals
Striped dolphin	*Stenella coeruleoalba*	1.22	Individuals
Pantropical spotted dolphin	*Stenella attenuata*	0	Individuals
TOTAL FISHERY BYCATCH		13.92	Individuals

Table 4.6.D
Subtables showing estimates of marine mammal incidental mortality and serious injury for Pacific Islands fisheries outside the US EEZ. All bycatch estimates are in numbers of individuals and are an average for the years indicated. Key stocks/populations are shaded.

Subtable 4.6.D.1

		HAWAII-BASED DEEP-SET PELAGIC LONGLINE FISHERY (TUNA)			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AVERAGE AMOUNT**	**UNIT**	**CV**
Beaked whale (unidentified)	Ziphiidae	2002–06	0.76	Individuals	1.09
Blainville's beaked whale	*Mesoplodon densirostris*	2002–06	0.50	Individuals	1.06
Bottlenose dolphin	*Tursiops truncatus*	2002–06	0	Individuals	
Bryde's whale	*Balaenoptera edeni*	2002–06	0	Individuals	
Cetacean (unidentified)	Cetacea	2002–06	0	Individuals	
False killer whale	*Pseudorca crassidens*	2002–06	7.62	Individuals	0.43
False killer or short-finned pilot whale (unidentified)	Delphinidae	2002–06	0	Individuals	
Humpback whale	*Megaptera novaeangliae*	2002–06	0	Individuals	
Risso's dolphin	*Grampus griseus*	2002–06	1.13	Individuals	0.74
Short-beaked common dolphin (unidentified)	*Delphinus delphis*	2002–06	0	Individuals	
Short-finned pilot whale	*Globicephala macrorhynchus*	2002–06	1.30	Individuals	
Sperm whale	*Physeter macrocephalus*	2002–06	0	Individuals	
Spinner dolphin	*Stenella longirostris*	2002–06	0	Individuals	
Striped dolphin	*Stenella coeruleoalba*	2002–06	0	Individuals	
Pantropical spotted dolphin	*Stenella attenuata*	2002–06	0	Individuals	
TOTAL FISHERY BYCATCH			11.31	Individuals	

Table 4.6.D (continued)

Subtable 4.6.D.2		HAWAII-BASED SHALLOW-SET PELAGIC LONGLINE FISHERY (SWORDFISH)			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AVERAGE AMOUNT**	**UNIT**	**CV**
Beaked whale (unidentified)	Ziphiidae	2002–06	0	Individuals	
Blainville's beaked whale	*Mesoplodon densirostris*	2002–06	0	Individuals	
Bottlenose dolphin	*Tursiops truncatus*	2002–06	0.2	Individuals	
Bryde's whale	*Balaenoptera edeni*	2002–06	0	Individuals	
Cetacean (unidentified)	Cetacea	2002–06	0	Individuals	
False killer whale	*Pseudorca crassidens*	2002–06	0	Individuals	
False killer or short-finned pilot whale (unidentified)	Delphinidae	2002–06	0	Individuals	
Humpback whale	*Megaptera novaeangliae*	2002–06	0.2	Individuals	
Risso's dolphin	*Grampus griseus*	2002–06	0.6	Individuals	
Short-beaked common dolphin (unidentified)	*Delphinus delphis*	2002–06	0	Individuals	
Short-finned pilot whale	*Globicephala macrorhynchus*	2002–06	0	Individuals	
Sperm whale	*Physeter macrocephalus*	2002–06	0	Individuals	
Spinner dolphin	*Stenella longirostris*	2002–06	0	Individuals	
Striped dolphin	*Stenella coeruleoalba*	2002–06	0	Individuals	
Pantropical spotted dolphin	*Stenella attenuata*	2002–06	0	Individuals	
TOTAL FISHERY BYCATCH			1.0	Individuals	

Table 4.6.D (continued)

Subtable 4.6.D.3 (SUMMARY)		**TOTAL SPECIES BYCATCH**	
COMMON NAME	**SCIENTIFIC NAME**	**AVERAGE AMOUNT**	**UNIT**
Beaked whale (unidentified)	Ziphiidae	0.76	Individuals
Blainville's beaked whale	*Mesoplodon densirostris*	0.50	Individuals
Bottlenose dolphin	*Tursiops truncatus*	0.20	Individuals
Bryde's whale	*Balaenoptera edeni*	0	Individuals
Cetacean (unidentified)	Cetacea	0	Individuals
False killer whale	*Pseudorca crassidens*	7.62	Individuals
False killer or short-finned pilot whale (unidentified)	Delphinidae	0	Individuals
Humpback whale	*Megaptera novaeangliae*	0.20	Individuals
Risso's dolphin	*Grampus griseus*	1.73	Individuals
Short-beaked common dolphin (unidentified)	*Delphinus delphis*	0	Individuals
Short-finned pilot whale	*Globicephala macrorhynchus*	1.3	Individuals
Sperm whale	*Physeter macrocephalus*	0	Individuals
Spinner dolphin	*Stenella longirostris*	0	Individuals
Striped dolphin	*Stenella coeruleoalba*	0	Individuals
Pantropical spotted dolphin	*Stenella attenuata*	0	Individuals
TOTAL FISHERY BYCATCH		12.31	Individuals

Table 4.6.E
Subtables showing estimates of sea turtle bycatch (mortalities and individuals released alive) in Pacific Islands Region fisheries, in numbers of individuals. Key populations are shaded.

Subtable 4.6.E.1

		HAWAII-BASED DEEP-SET PELAGIC LONGLINE FISHERY (TUNA)				HAWAII-BASED SHALLOW-SET PELAGIC LONGLINE FISHERY (SWORDFISH)			
COMMON NAME	SCIENTIFIC NAME	DATA SOURCE	AVERAGE AMOUNT	UNIT	CV	DATA SOURCE	AVERAGE AMOUNT	UNIT	CV
Green sea turtle	*Chelonia mydas*	2005	0	Individuals		2005	0	Individuals	
Leatherback sea turtle	*Dermochelys coriacea*	2005	4	Individuals		2005	8	Individuals	
Loggerhead sea turtle	*Caretta caretta*	2005	0	Individuals		2005	10	Individuals	
Olive ridley sea turtle	*Lepidochelys olivacea*	2005	16	Individuals		2005	0	Individuals	
TOTAL BYCATCH			20	Individuals			18	Individuals	

Subtable 4.6.E.2 (SUMMARY)

		TOTAL SPECIES BYCATCH	
COMMON NAME	SCIENTIFIC NAME	AVERAGE AMOUNT	UNIT
Green sea turtle	*Chelonia mydas*	0	Individuals
Leatherback sea turtle	*Dermochelys coriacea*	12	Individuals
Loggerhead sea turtle	*Caretta caretta*	10	Individuals
Olive ridley sea turtle	*Lepidochelys olivacea*	16	Individuals
TOTAL BYCATCH		38	Individuals

Table 4.6.F

Subtables showing estimates of seabird bycatch in Pacific Islands Region fisheries, in numbers of individuals. Bycatch estimates reflect the average of the years identified. Key populations are highlighted.

Subtable 4.6.F.1

		HAWAII-BASED DEEP-SET PELAGIC LONGLINE FISHERY (TUNA)				HAWAII-BASED SHALLOW-SET PELAGIC LONGLINE FISHERY (SWORDFISH)			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AMOUNT**	**UNIT**	**CV**	**DATA SOURCE**	**AMOUNT**	**UNIT**	**CV**
Black-footed albatross	*Phoebastria nigripes*	2005	82	Individuals		2005	7	Individuals	0
Brown booby	*Sula leucogaster*	2005	3	Individuals		2005	0	Individuals	0
Laysan albatross	*Phoebastria immutabilis*	2005	43	Individuals		2005	62	Individuals	0
Short-tailed albatross	*Phoebastria albatrus*	2005	0	Individuals		2005	0	Individuals	0
TOTAL BYCATCH			128	Individuals			69	Individuals	

Subtable 4.6.F.2 (SUMMARY)

		TOTAL SPECIES BYCATCH	
COMMON NAME	**SCIENTIFIC NAME**	**AMOUNT**	**UNIT**
Black-footed albatross	*Phoebastria nigripes*	89	Individuals
Brown booby	*Sula leucogaster*	3	Individuals
Laysan albatross	*Phoebastria immutabilis*	105	Individuals
Short-tailed albatross	*Phoebastria albatrus*	0	Individuals
TOTAL BYCATCH		197	Individuals

SECTION 5

National Overview

Photo on previous page: a sea turtle swims towards a pound net. Credit: NMFS NEFSC.

SECTION 5 National Overview

5.1 Introduction

A total of 274 U.S. commercial fisheries are identified in the U.S. National Bycatch Report (Table 5.1). Of these, 152 are federally managed fisheries or fisheries with a relevant Federal data-collection component and form the basis of the analyses contained herein. These fisheries were evaluated for the quality of bycatch data-collection and estimation methods through a scoring system, and assigned to ranked tiers. Specific bycatch estimates were also provided by fishery and species where they were available. The remaining 122 fisheries identified in this report are managed by international, tribal, or state fishery management agencies. These fisheries were not evaluated through the tier scoring system and bycatch estimates were not calculated.

Credit: NMFS, SEFSC

A finetooth shark.

The bycatch information included in this report is very comprehensive and covers, either partially or entirely, a total of 11 LMEs.[1] These ecosystems and the fisheries they support vary among regions, with some fisheries crossing LME. Bycatch monitoring requirements are included in regional FMPs (Table 5.2), Take Reduction Plans (Table 5.3), and Biological Opinions (Table 5.3). The NMFS also collaborates with state fishery management agencies, interstate marine fisheries commissions, fishery management councils, and other organizations involved in bycatch monitoring and reduction activities. Several of the fisheries in this report are managed by international organizations, including ICCAT, IPHC, IATTC, and WCPMC.

[1] http://www.lme.noaa.gov/

Table 5.1
U.S. commercial fisheries included in the U.S. National Bycatch Report, by NMFS region (data from the year 2005).

Region	Commercial fisheries	Fisheries under Federal management authority and/or with relevant Federal data collection	Fisheries under other management authority only[a]
Northeast	63	52[b]	11
Southeast	48	26	22
Alaska	77	35[c]	42
Northwest	30	10[d]	20
Southwest	25	11	14
Pacific Islands	31	18	13
Total	274	152	122

[a] Other management authorities include state, international, and tribal fisheries organizations with no Federal data-collection component.
[b] Sixteen fisheries are grouped in the Northeast for purposes of protected species bycatch estimation.
[c] Five Alaska state fisheries are observed for protected resource interactions under the AMMOP. An additional six Alaska fisheries are grouped for purposes of protected species bycatch estimation.
[d] Two state fisheries with a Federal data-collection component (the Oregon pink shrimp and Oregon spot prawn fisheries) were not evaluated for this report.

Table 5.2
Fishery management plans and the fishery management councils that supervise them, by NMFS region and ecosystem (LME). FMPs managed jointly are listed under the lead Council.

Region	Large marine ecosystem	Fishery management council	Fishery management plans
Northeast	Northeast U.S. Continental Shelf	New England Fishery Management Council	Atlantic Herring FMP
			Atlantic Sea Scallop FMP
			Deep Sea Red Crab FMP
			Northeast Multispecies FMP
			Northeast Skate Complex FMP
			Atlantic Salmon FMP
			Monkfish FMP
		Mid-Atlantic Fishery Management Council	Bluefish FMP
			Atlantic Mackerel, Squid, and Butterfish FMP
			Summer Flounder, Scup, and Black Sea Bass FMP
			Surfclam and Ocean Quahog FMP
			Tilefish FMP
			Spiny Dogfish FMP
Southeast	Southeast U.S. Continental Shelf, Gulf of Mexico, and Caribbean	Mid-Atlantic Fishery Management Council	Regulations in several FMPs apply to North Carolina EEZ waters
		South Atlantic Fishery Management Council	Atlantic Coast Red Drum FMP[a]
			Coastal Migratory Pelagic Resources of the Gulf of Mexico and South Atlantic FMP
			Dolphin and Wahoo Fishery of the Atlantic FMP
			Golden Crab Fishery of the South Atlantic Region FMP
			Shrimp Fishery of the South Atlantic Region FMP
			Snapper–Grouper Fishery of the South Atlantic Region FMP
			Coral, Coral Reefs, and Live/Hard Bottom Habitats of the South Atlantic Region FMP
			Pelagic Sargassum Habitat of the South Atlantic Region FMP
		Gulf of Mexico Fishery Management Council	Reef Fish Resources of the Gulf of Mexico FMP
			Stone Crab Fishery of the Gulf of Mexico FMP
			Shrimp Fishery of the Gulf of Mexico FMP
			Red Drum Fishery of the Gulf of Mexico FMP
			Coral and Coral Reefs of the Gulf of Mexico FMP
		Joint South Atlantic and Gulf Fishery Management Councils	Coastal Migratory Pelagic Resources FMP
			Spiny Lobster in the Gulf of Mexico and South Atlantic FMP
		Caribbean Fishery Management Council	Shallow Water Reef Fish Fishery FMP of Puerto Rico and the U.S. Virgin Islands
			Spiny Lobster Fishery FMP of Puerto Rico and the U.S. Virgin Islands
			Corals and Reef Associated Plants and Invertebrates FMP
			Queen Conch Resources FMP of Puerto Rico and the U.S. Virgin Islands

Table 5.2 (continued)

Region	Large marine ecosystem	Fishery management council	Fishery management plans
Alaska	Aleutian Islands, Eastern Bering Sea, Western Bering Sea, Gulf of Alaska, Chukchi Sea, Beaufort Sea	North Pacific Fishery Management Council	Groundfish of the Bering Sea and Aleutian Islands (BSAI) Management Area FMP
			Groundfish of the Gulf of Alaska (GOA) FMP
			BSAI King and Tanner Crab FMP
			Scallop Fishery off Alaska FMP
			Salmon FMP in the EEZ off the Coast of Alaska
Northwest	California Coastal Current	Pacific Fishery Management Council	Pacific Coast Groundfish FMP
			Pacific Coast Salmon FMP
Southwest			Coastal Pelagics Species FMP
			U.S. West Coast Fisheries for Highly Migratory Species FMP
Pacific Islands	Insular-Pacific Hawaiian	Western Pacific Fishery Management Council	Bottomfish and Seamount Groundfish Fisheries of the Western Pacific Region FMP
			Crustacean Fisheries of the Western Pacific Region FMP
			Precious Coral Fisheries of the Western Pacific Region FMP
			WPFMC Coral Reef Ecosystem of the Western Pacific Region FMP
			Pelagic Fisheries of the Western Pacific Region FMP

[a] Management of red drum was transferred to the ASMFC in 2008.

Credit: NOAA

A great frigate bird from the Hawaiian Islands.

Table 5.3
Take Reduction Plans required under the MMPA and Biological Opinions required under the ESA, which may include mandatory and/or voluntary measures for reducing bycatch of marine mammals, sea turtles, and seabirds.

Region	Take reduction plans (TRPs)	Biological opinions (BiOps)
Northeast	Harbor Porpoise TRP	Authorization of Fisheries under the Federal Lobster Regulations (2001)
	Atlantic Large Whale TRP	Federal Lobster Management in the EEZ for Implementation of Historic Participation (2002)
	Cetacean Bycatch in Trawl Fisheries (TRT convened in 2006)	Federal Atlantic Herring FMP
		Atlantic Sea Scallop FMP
		Atlantic Bluefish FMP
		Authorization of Fisheries under the Spiny Dogfish FMP
		Authorization of Fisheries under the Monkfish FMP
		Authorization of Fisheries under the Multispecies FMP
		Sea Turtle Conservation Measures for the Pound Net Fishery in Virginia Waters of the Chesapeake Bay
		Implementation of the Deep-Sea Red Crab FMP
		Authorization of Fisheries under the Skate FMP
		FMP for the Atlantic Mackerel, Squid, and Atlantic Butterfish Fishery and Amendment 8 to the FMP
		Authorization of Fisheries under the Summer Flounder, Scup, and Black Sea Bass FMP
		NMFS' Approval of the Tilefish FMP
Southeast	Bottlenose Dolphin TRP	Atlantic Pelagic Longline BiOp 2004
	Pelagic Longline TRP	Caribbean Fisheries BiOp
		Coastal Migratory Pelagics (Mackerel) fishery in the Gulf of Mexico and South Atlantic Regions — 2007 BiOp
		Gulf of Mexico Reef Fish Fishery — 2005 BiOp[a]
		Gulf of Mexico and South Atlantic Spiny Lobster Fishery — 2009 BiOp
		Gulf of Mexico Shrimp Fishery and its Effects on Smalltooth Sawfish — 2006 BiOp
		Gulf of Mexico Stone Crab Fishery — 2009 BiOp
		Shrimp Fisheries of the Southeastern United States — 2002 BiOp
		South Atlantic FMP for Dolphin and Wahoo — 2003 BiOp
		South Atlantic Snapper-Grouper Fishery — 2006 BiOp
		South Atlantic Shrimp Fishery and its Effects on Smalltooth Sawfish — 2005 BiOp
		Southeastern Atlantic and Gulf of Mexico Shark Bottom Longline / Large Coastal and Coastal Shark Aggregate Fisheries — 2008 BiOp
Alaska	None	Groundfish of the Bering Sea and Aleutian Islands (BSAI) Management Area FMP
		Groundfish of the Gulf of Alaska (GOA) FMP BiOp (Seabirds)

Table 5.3 (continued)

Region	Take reduction plans (TRPs)	Biological opinions (BiOps)
Northwest	None	None currently in place
Southwest	Pacific Offshore Cetacean TRP	None currently in place
Pacific Islands	None	Bottomfish Fishery BiOp
		Deep-Set Tuna and Shallow-Set Swordfish Fishery BiOps (one per fishery for sea turtles and marine mammals)
		USFW BiOp for short-tailed albatross

[a] The 2005 Reef Fish Biological Opinion was superseded by a new Biological Opinion in 2009.

5.2 Bycatch Data-Collection Sources and Estimation Methods

Monitoring of bycatch is an essential component of effective management of fisheries. The data sources identified in this report vary among regions as well as among fisheries primarily due to differences in data-collection program goals, objectives, and priorities, but the differing data sources are also related to the diversity of U.S. commercial fisheries and variation in fishing practices. Multiple data sources were available for some of these fisheries. The primary data sources used to calculate estimates of bycatch were observer data (110 fisheries) and self-reported logbooks (80 fisheries; Table 5.4). Total landings by fishery were provided by each NMFS region for consistency with other published reports. However, aggregate landings at the species level were obtained from the NMFS centralized landings database.[2]

Observer programs are conducted in all six NMFS regions, and observer data were available for 110 U.S. commercial fisheries (72% of the 152 fisheries in this report). Coverage levels vary among fisheries due to factors such as program objectives, availability of funds, fishery characteristics, and uncontrollable factors such as weather conditions and unsafe vessels (e.g. vessels that have safety decal, but are determined to be unsafe for operational purposes). While specifics on individual observer programs are described in the regional sections of Section 4, the data collected by all regional observer programs were the main source of information used to estimate bycatch in this report.

Logbook data were used in bycatch estimation for 80 of the U.S. commercial fisheries discussed in this report. Logbook data were used to estimate bycatch in the absence of observer data, or were used as supplemental data. Since logbook data are self-reported, external verification is necessary to validate the information. This typically involves comparison of self-reported bycatch data to bycatch data directly observed in an observer program, and is possible only if an observer program has been implemented for the same fishery. In the absence of verification, logbook underreporting is a potential source of bias and error when estimating bycatch.

Other supplemental data were provided through dealer and landings reports, production reports, and stranding/entanglement data. The data provided by these programs were not used to calculate bycatch alone, but were used as ancillary information in developing extrapolation factors to estimate overall bycatch when data from only partial (less than 100%) observer coverage were available. Data collected through dealer or landing reports were available for 61 fisheries included in this report. Data collected through production reports were available for 25 Alaskan fisheries. Stranding and entanglement data recorded under the MMPA were used to assess relative levels of bycatch only when more reliable data sources were not available, a report was considered reliable, and the report clearly described a mortality or serious injury that was likely to lead to mortality of the entangled animal. These data sources were used to generate bycatch estimates for some protected resources reported (e.g., in the Alaska and Northeast regions).

As might be expected, bycatch estimation approaches varied widely among regions and, in many instances, within regions, where fishery-specific differences in data availability and data quality occur. However, all regional estimation methods were evaluated during an internal NMFS workshop and found to be appropriate for estimating bycatch. Readers are encouraged to review comprehensive information on regional bycatch estimation methods presented in Section 4. Further work is needed to develop best practice approaches to bycatch estimation; this can be addressed through national workshops or external peer review processes.

[2] http://www.st.nmfs.noaa.gov/st1/commercial/index.html

Table 5.4
Data sources used to develop 2005 estimates, by region and fishery. A blank means the data source was not used in developing bycatch estimates, not that the data source does not exist in the region.

Region / # fisheries [a]	Fisheries observed [b]	Observed days at sea [c]	Fisheries with production reports / dealer reports [d]	Fisheries with logbooks / vessel trip reports / catch reports / trip tickets [e]	Fisheries with production reports
Northeast / 63	47	11,381	27	42	
Southeast / 48	12	2,657		9	
Alaska / 77	27	35,683	27		25
Northwest / 30	11	6,184		9	
Southwest / 25	10[f]	499		10	
Pacific Islands / 31	3	7,099	7	10	
Total / 274	110	67,030	61	80	25

[a] Numbers of U.S. commercial fisheries included in the U.S. National Bycatch Report.
[b] Maximum number of fisheries observed, 2005 to present.
[c] Numbers of observed sea days are for calendar year 2005; totals for days at sea only, does not include observations of 663 permit samples.
[d] Production and Dealer (landing) reports are submitted by either dealers or processors upon landing of catch.
[e] Logbooks, vessel trip reports, catch reports, and fish tickets are all names for similar reports submitted by fishermen.
[f] One fishery listed as observed for the Southwest Region is a recreational fishery, and bycatch estimates are not included in the U.S. National Bycatch Report for this fishery.

5.3 Evaluation of Bycatch Data and Bycatch Estimation Methods

A standardized set of criteria was used to evaluate data quality and bycatch estimation methods for the subset of 152 fisheries included in this report. Tier scores were assigned to each fishery using the tier scoring procedures outlined in Section 3 for fish, marine mammals, and other protected species. Fisheries with lower overall scores were assigned to a low tier (e.g., Tier 0, Tier 1) and fisheries with a high overall score were assigned to higher tiers (Tier 3, Tier 4). It is important to note that tier scores are based on 2005 information and many fisheries may have made improvements since then.

Tier Descriptions:

- For Tier 4 fisheries, bycatch estimates were available and were based on the highest-quality data and analytical methods.
- For Tier 3 fisheries, bycatch estimates were also generally available but higher quality data (i.e., data that are more reliable, accurate, and/or precise than those used in lower tiers) were utilized to compute these estimates.
- For Tier 2 fisheries, bycatch estimates were generally available. However, these estimates would have benefited from improvements in data quality and/or analytical methods (such as improved sampling designs, increased coverage levels, and peer review of methods). Where bycatch estimates were not available, methods are being developed.
- For Tier 1 fisheries, bycatch data were available but were generally unreliable (e.g., from unverified or potentially biased sources). In some cases, higher quality data were available but analytical methods had not been implemented.
- For Tier 0 fisheries, bycatch data-collection programs or estimation methods did not exist and, therefore, bycatch estimates were not available.

Estimates for all three types of bycatch (fish, marine mammals, and other protected species) were not available for all fisheries; therefore, the total number of fisheries evaluated varied by bycatch type. In addition, the total numbers of fisheries shown as evaluated for fish and for protected species differ due to the grouping of some fisheries. Further, only protected species data are collected in some fisheries, for example those observed by the AMMOP. A total of 142 fisheries were evaluated for fish bycatch data quality and estimation, while 129 were evaluated for data quality and estimation of marine mammal bycatch, with the same number evaluated for other protected species.

The majority of fisheries (42% of the 400 tier classifications assigned) were classified in Tier 3, while 15% fell into Tier 2, and 16% into Tier 1. Only 4% were classified in Tier 4. Bycatch data-collection programs and/or estimation methods did not exist for 24% of the fisheries evaluated and these were therefore classified as Tier 0 (Figure 5.1).

Results of the tier classification reveal some variation among the quality of data and estimation methods for different bycatch types (Figure 5.2). For fish bycatch, only 13% of the fisheries were classified in Tier 0, while 41% were classified in Tiers 1 and 2, and 46% in Tiers 3 and 4. For marine mammals and other protected species, 30% of the fisheries were classified in Tier 0, while approximately 25% were classified in Tiers 1 and 2, and 45% in Tiers 3 and 4. This suggests that there is less data collection specifically targeted to bycatch of marine mammals and other protected species than to bycatch of fish (more than double the percentage of fisheries were Tier 0 for marine mammals and other protected species). However, of the fisheries where data were available (i.e., around 45% of fisheries in Tiers 3 and 4), the quality of the bycatch data and estimates was similar for fish species and for marine mammals and other protected resources.

The tier scoring system can be used as a national performance measure to monitor changes in the quality of bycatch data collection and estimation. It also provides a measure of the relative quality of bycatch estimates within and between regions, bycatch categories, stocks, and fisheries. As improvements are made to bycatch data collection, and new methods for estimating bycatch are developed and implemented, the tier scores of individual fisheries are also expected to increase.

This first edition of the U.S. National Bycatch Report includes bycatch estimates for federally managed commer-

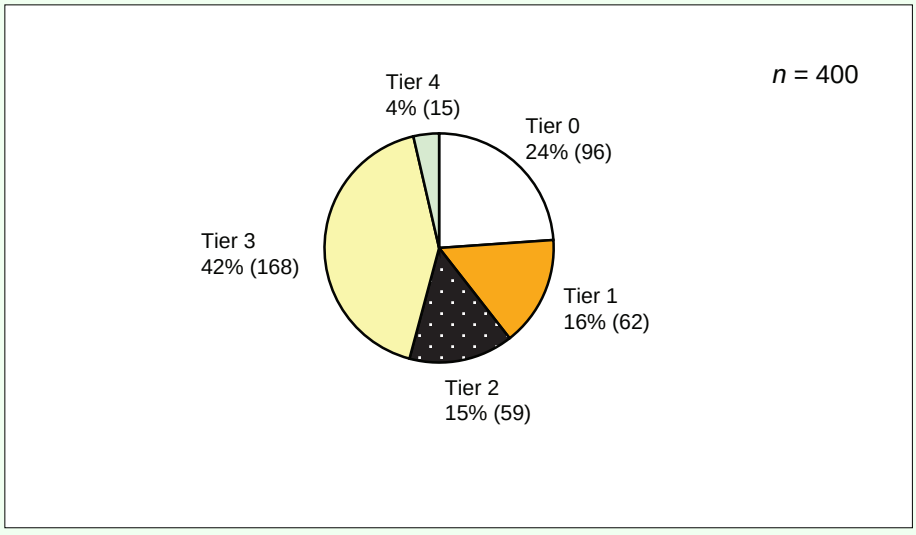


Figure 5.1
Distribution of the 400 separate tier scores assigned to fisheries for the year 2005 for fish (142), marine mammal (129), and other protected species (129) bycatch.

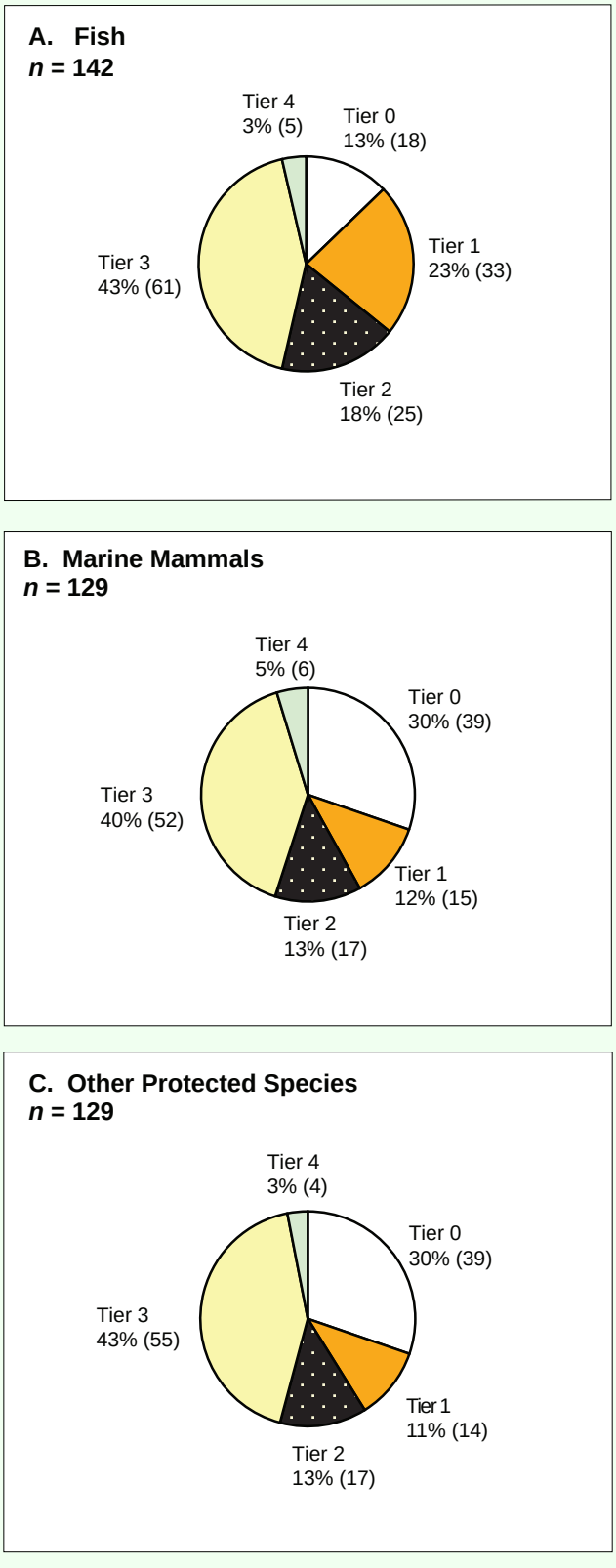


Figure 5.2
Distribution of tier scores assigned to fisheries for the year 2005 for bycatch of A) fish, B) marine mammals, and C) other protected species.

cial fisheries and fisheries with a relevant Federal data-collection component. Bycatch data are also available for some state, tribal, and international commercial fisheries. In future editions of this report, the tier classification system should be applied to additional commercial fisheries. In addition, because some stocks have higher bycatch mortality attributable to recreational fisheries than to commercial fisheries, consideration should be given to including recreational fisheries. Coordination will be required with state, tribal, and international organizations to ensure accuracy and consistency in this information.

5.4 Identification of Key Stocks

Key stocks were identified based on the level of bycatch, management importance, and stock status. A total of 396 key stocks were so identified nationwide. Of the 396 key stocks, the majority (68%) were fish stocks. Forty-six percent of key fish stocks were FSSI stocks, which reflects the importance of these stocks to management. All ESA-listed stocks were classified as key stocks, including all sea turtle populations. Stocks occurring in multiple regions were listed as key in every region where bycatch was a concern.

The total number of key stocks varied by region, with the Southwest Region identifying the highest number, 121 stocks (31% of the national total). The high number of key stocks identified in the Southwest Region was mainly due to the lack of bycatch estimates for fish species. Because no fish bycatch estimates were available in the region, all stocks of management importance were placed on list of key stocks as a precautionary measure. Bycatch estimation methods are currently being developed for this region and estimates will be included in future editons of this report.

The list of key stocks, which includes a significant number of stocks from each region and bycatch type, will be used as a performance measure to monitor bycatch trends over time. Bycatch estimation methods are currently being developed in some regions to expand the regions' ability to calculate bycatch estimates for key stocks. As these bycatch estimates become available they should be included in future editions of the report, which will allow for the evaluation of trends in bycatch for more key stocks.

Credit: NMFS NWFSC

Catch of Pacific hake.

5.5 Fishery Bycatch

Bycatch estimates were not available for all commercial fisheries included in this report, even though data may exist. Fishery bycatch ratios (bycatch ratio = bycatch/(bycatch+landings) were calculated for each fishery where fish bycatch estimates and total fish catch data were available. These ratios can be used as relative measures of the total bycatch occurring in each fishery. Fishery bycatch ratios could be calculated for only a subset of the fisheries where bycatch estimates were calculated (63 fisheries, or 41.5%). For the remaining 7 fisheries, it was not possible to calculate fishery bycatch ratios for various reasons. For example, in some Southeast Region fisheries, fish bycatch estimates were available only in numbers, but total catch was reported by weight.

Bycatch estimation methods are currently being developed in some regions to allow calculation of bycatch estimates for additional fisheries. As additional bycatch estimates become available they should be included in future editons of this report to provide a more comprehensive and accurate estimate of total bycatch mortality.

Fishery bycatch ratios ranged from zero to 0.76, and varied by region (Figure 5.3 – 5.7). Fishery bycatch estimates, and therefore bycatch ratios, were not calculated for Southwest Region fisheries since fish bycatch estimation methods were not available during the time when this report was developed. The Pacific Islands Region calculated fish bycatch estimates for only two fisheries.

Fisheries with a bycatch ratio of greater than 0.17 were classified as “fisheries of focus,” indicating a potential bycatch concern (Figure 5.3–5.7).[3] Fisheries with potential bycatch concerns were also evaluated through a qualitative process, as described in Section 3. In general, the fisheries with the highest bycatch ratios were trawl and bottom longline fisheries

[3] The process of selecting this cutoff is described in Section 3. This number represents the median of available fishery bycatch ratios.

5.5.1 Northeast Region Fishery Bycatch

Bycatch estimates were provided for 25 Northeast Region commercial fisheries, ranging from 51,000 lb in the New England handline fishery to over 20 M lb in the New England and Mid-Atlantic otter trawl fisheries. Bycatch ratios ranged from 0.02 to 0.44; they were lowest in the New England and Mid-Atlantic mid-water otter trawl fisheries (0.02 and 0.03, respectively; Figure 5.3), even though the fish bycatch weight estimates for these fisheries are 1.7 and 4.1 M lb, respectively. Bycatch ratios were also low for the New England shrimp trawl (0.04), the New England purse seine (0.05), the New England handline (0.08), and the New England haddock sector longline (0.11) fisheries.

Bycatch levels and ratios for the scallop dredge fisheries were variable but generally below 0.17. Bycatch levels for the three regional gillnet fisheries range between 1.4 M and 4.7 M lb, with bycatch ratios of 0.17 to 0.32. The highest levels of bycatch were in the New England and Mid-Atlantic otter trawl fisheries (small- and large-mesh). Bycatch estimates for these four fisheries ranged from 11.8 to 20.9 M lb, with bycatch ratios between 0.23 and 0.32.

In addition to the above-mentioned fisheries, two fisheries in this region were associated with special-access programs (SAPs) during the time period the data were collected: the New England U.S./Canada Management Area large-mesh otter trawl fishery, and the New England B-day DAS large-

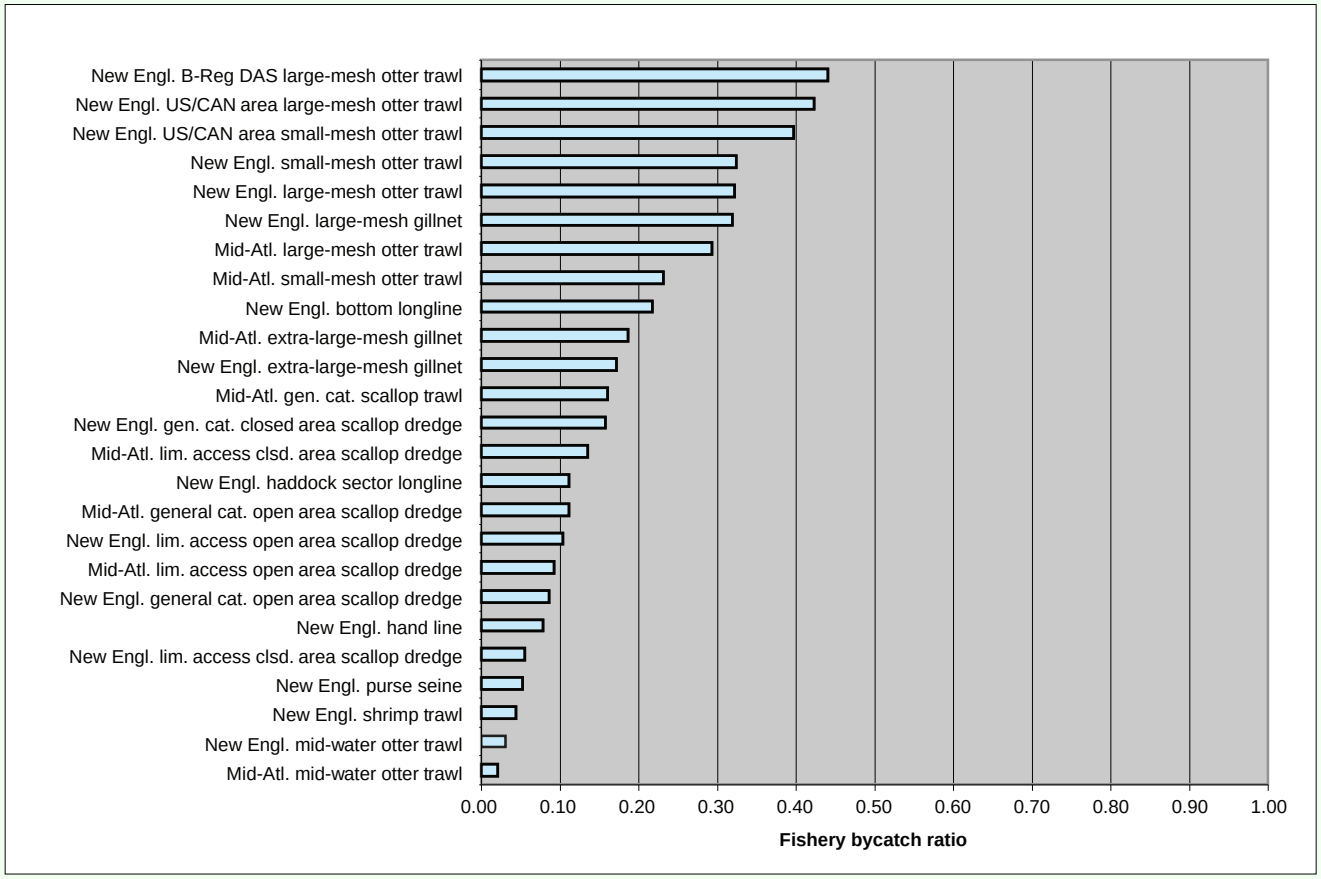


Figure 5.3
Fishery bycatch ratios for Northeast Region fisheries (2005 data).

mesh otter trawl fishery. The number of days vessels could use to harvest groundfish under the New England Fisheries Management Council's Northeast Multispecies FMP was limited; in 2005, about 60% of the days were used at the owner's discretion under the FMP. These were called "A days." The remaining 40%, called B days, were evenly divided between two "B" categories: B Regular and B Reserve days-at-sea. These could only be used to target the six groundfish stocks that could sustain additional effort, in ways that did not undermine longer-term rebuilding efforts for other stocks in the fishery. Bycatch ratios for these fisheries were relatively high (0.40 to 0.44). Due to the difficulties of identifying trips participating in these fisheries, total bycatch, total landings, and the resultant bycatch ratios should be viewed with caution. Readers are encouraged to refer to Wigley et al. (2008) for further information.

Credit: NMFS SWFSC, Brandi Noble Collection

Gag grouper.

5.5.2 Southeast Region Fishery Bycatch

Fish bycatch estimates were provided for nine Southeast Region commercial fisheries. However, the Gulf of Mexico shrimp trawl fishery and the Southeastern Atlantic and Gulf of Mexico HMS pelagic longline fishery were the only two fisheries for which both bycatch and landings information were available in weight. Therefore, bycatch ratios were calculated for only these two fisheries (Figure 5.4). The bycatch estimate for the HMS pelagic longline fishery was 1.7 M lb and landings were about 5.6 M lb, resulting in a bycatch ratio of 0.23. Bycatch was estimated for the offshore portion of the Gulf of Mexico shrimp fishery at 681 M lbs. Landings for the Gulf of Mexico shrimp trawl fishery were 213 M lbs. The resulting bycatch ratio for the fishery is 0.76.

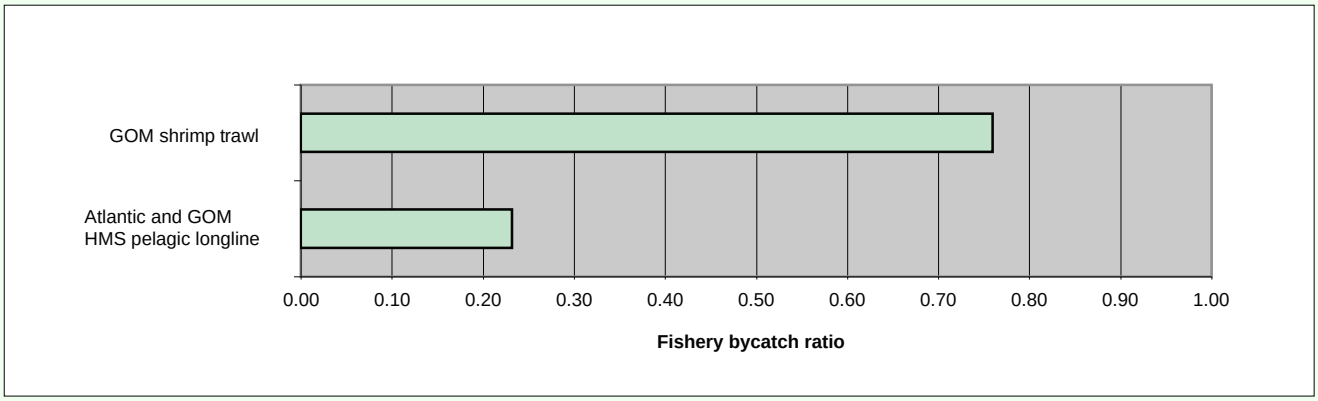


Figure 5.4
Fishery bycatch ratios for Southeast Region fisheries (2005 data). Bycatch ratios were not possible for many Southeast Region fisheries where landings were in pounds but bycatch was estimated in number of individuals. GOM = Gulf of Mexico.

5.5.3 Alaska Region Fishery Bycatch

Bycatch estimates were provided for 27 Alaska Region commercial fisheries (Figure 5.5). Fourteen of these fisheries were BSAI fisheries and 13 occurred in the GOA. The principal BSAI fisheries were prosecuted with pelagic and non-pelagic (demersal) trawl longline and with pots, with one small jig fishery. Fish bycatch estimates and overall landings were very low for the jig fishery (BSAI Pacific cod), with catch estimated at 375 K lb (bycatch ratio of zero). For the remaining BSAI fisheries, bycatch ratios ranged between 0.01 and 0.57. The lowest bycatch ratio was documented for the BSAI pelagic trawl fishery for walleye pollock (0.01). This is a very large fishery, with landings in excess of 3.2 B lb and an estimated bycatch of 27 M lb. Bycatch ratios for the two BSAI pot fisheries (sablefish and Pacific cod) were relatively low: 0.10 and 0.05, respectively, with total bycatch estimates of 232 K lb and 2.3 M lb, respectively. The Atka mackerel trawl fishery bycatch ratio was also relatively low: 0.16, representing a bycatch estimate of 18.5 M lb. Longline and non-pelagic (or demersal) trawl fisheries generally produced larger bycatch ratio estimates (0.14–0.42). The BSAI longline fisheries for Greenland turbot, Pacific cod, and sablefish produced bycatch ratios of 0.38 (2.3 M lb bycatch), 0.16 (50.9 M lb. bycatch), and 0.42 (1.33 M lb bycatch), respectively. Several non-pelagic trawl fisheries produced bycatch ratios greater than 0.25, including several flatfish fisheries with bycatch estimates of 25–68 M lb, and a Pacific cod fishery with a bycatch estimate 54 M lb.

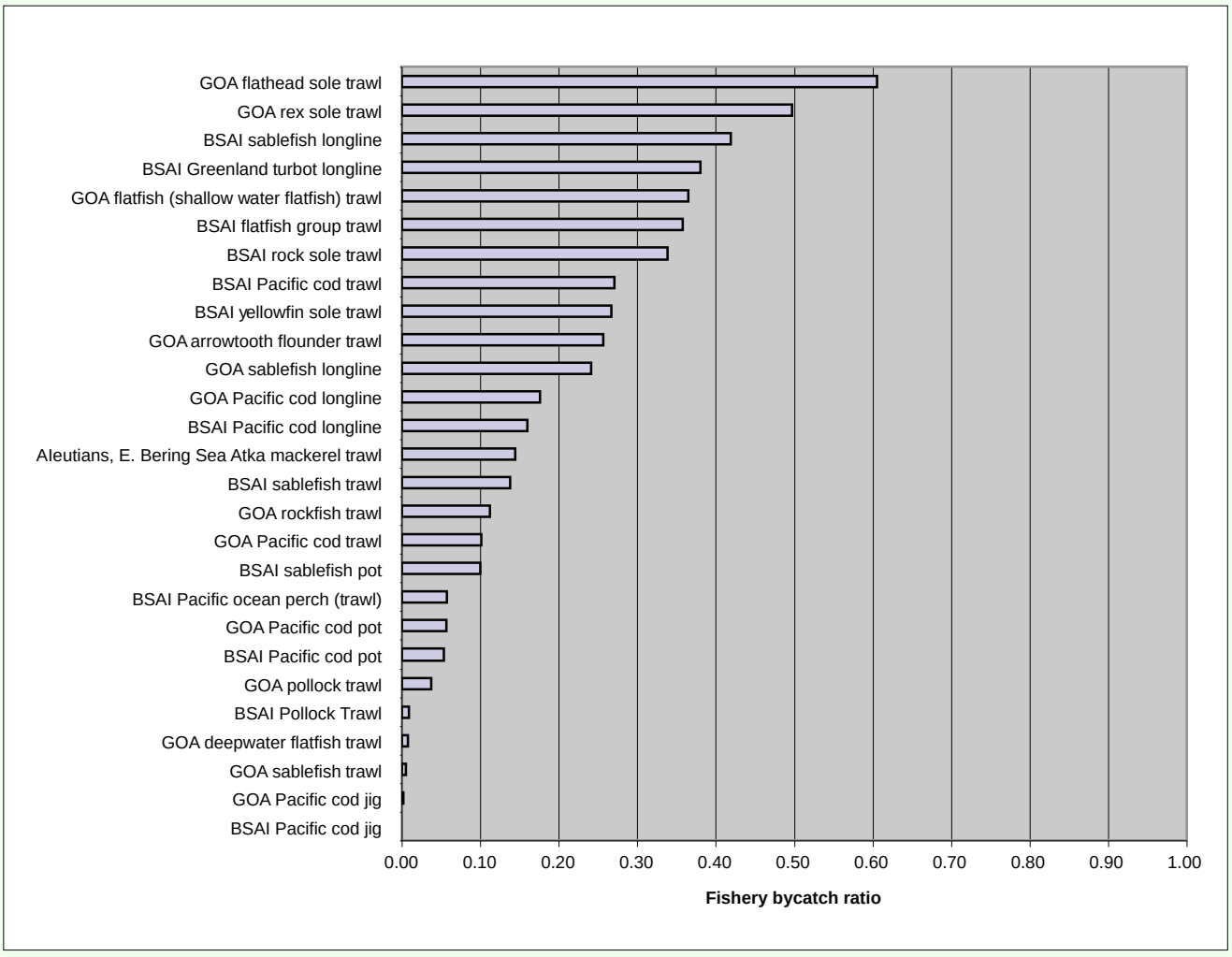


Figure 5.5
Fishery bycatch ratios for Alaska Region fisheries (2005 data). Note that the Bering Sea/Aleutian Islands flatfish group (arrowtooth flounder, flathead sole, and other flatfish) trawl fishery has been abbreviated as “BSAI flatfish group trawl.”

Trends in bycatch ratios for the GOA were similar to those observed in the BSAI, although the total volume of fish landed was generally much lower. The bycatch ratio for the GOA Pacific cod jig fishery was less than 0.001, representing less than 1,000 lb of bycatch for cod landings in excess of 7 M lb. The GOA Pacific cod fishery bycatch ratio was 0.06, equivalent to a bycatch estimate of 3.0 M lb for total cod landings of 52 M lb. Longline fishery bycatch ratios were 0.18 and 0.24 for the Pacific cod (bycatch estimate 4.7 M lb) and sablefish (bycatch estimate of 10 M lb) fisheries, respectively. The estimated bycatch ratio for the GOA pelagic trawl fishery was 0.04, with estimated bycatch of 5.5 M lb for pollock landings of 143.7M lb. For the non-pelagic trawl fisheries, bycatch ratios ranged between <0.001 for the very low-volume sablefish trawl fishery, to 0.50 and 0.60 for the rex sole (estimated bycatch 4.5M lb) and flathead sole (estimated bycatch 4.2 M lb) fisheries, respectively.

Catch and bycatch of managed fish and invertebrate stocks in Alaska are generally accounted for in the stock assessment and in-season management processes. That is, fishing mortality estimates are calculated by summing estimates of retained and discarded weights. Low levels of bycatch mortality of sensitive or key species may be of greater concern than high bycatch levels for populations that are abundant and for which allowable catch levels are also high. Discard mortality is assumed to be 100% for all species except Pacific halibut.

5.5.4 Northwest Region Fishery Bycatch

Fishery bycatch estimates were provided for seven Northwest Region commercial fisheries. Trawl (pelagic and non-pelagic), demersal longline, pots, troll, and other hook-and-line gear (fishing poles) were used to prosecute these fisheries. Computed fishery bycatch ratios for Northwest commercial fisheries ranged from 0.01 to 0.34 (Figure 5.6).

The lowest overall fishery bycatch ratios occurred in the West Coast mid-water hake trawl (at-sea processing) fishery and the West Coast groundfish non-trawl gear (non-endorsed fixed gear) fishery. The West Coast mid-water hake trawl (at-sea processing) fishery is a very large-volume fishery, with total retained weight of approximately 280 M lb and a bycatch estimate of 1.6 M lb, resulting in a low fishery bycatch ratio (0.01). Bycatch in the West Coast groundfish non-trawl gear (non-endorsed fixed gear) fishery was estimated to be approximately 600 K lb, with a fishery bycatch ratio of 0.15.

Bycatch estimates in the West Coast tribal and non-tribal ocean salmon troll fisheries were 15.8 K and 184.6 K fish, respectively, with fishery bycatch ratios of 0.19 and 0.23, respectively (note that both catch and bycatch are reported in numbers of individuals for these fisheries). The California/Oregon nearshore rockfish fishery bycatch estimate was 336 K lb, with a fishery bycatch ratio of 0.27.

The West Coast limited-entry bottom trawl (groundfish bottom trawl) fishery bycatch estimate was over 21 M lb, with a fishery bycatch ratio of 0.34. Bycatch of target species comprised a substantial proportion of overall bycatch in this fishery. Target species were discarded for a variety of reasons including economic market factors, size, and regulations.

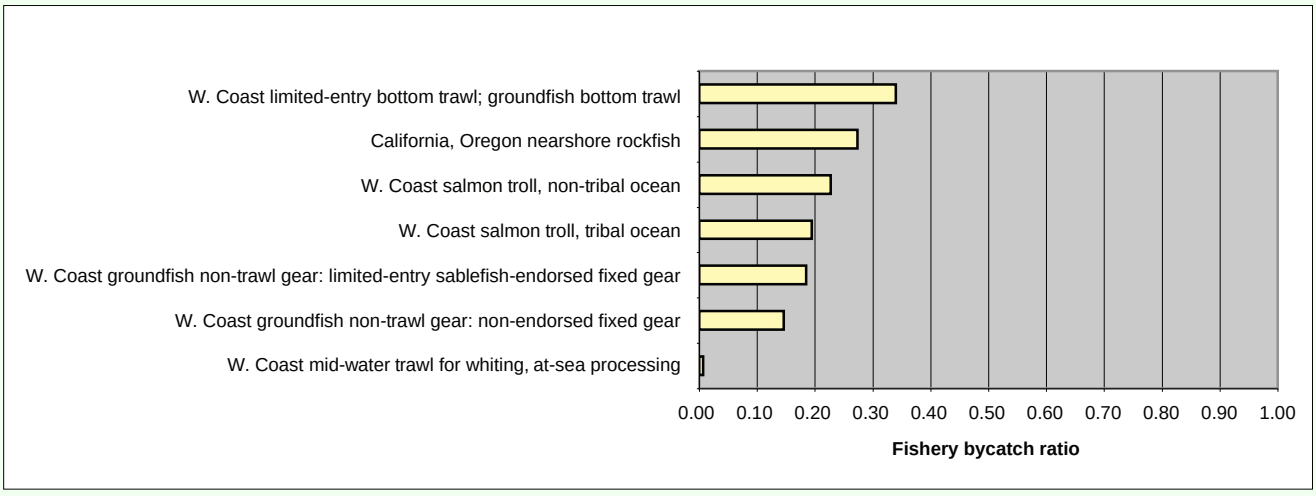


Figure 5.6
Fishery bycatch ratios for Northwest Region fisheries (2005 data).

5.5.5 Pacific Islands Region Fishery Bycatch

Bycatch estimates were provided for two Pacific Islands Region commercial fisheries: the Hawaii-based shallow-set pelagic longline fishery (swordfish) and the Hawaii-based deep-set pelagic longline fishery (tuna). Overall fishery bycatch estimates for these two fisheries were 1.1 M lb and 7.4 M lb, respectively, with fishery bycatch ratios of 0.24 for the shallow-set and 0.28 for the deep-set fishery (Figure 5.7).

5.6 Bycatch by Resource Type

Estimates were calculated for bycatch of fish, marine mammals, sea turtles, and seabirds where supporting data were available. Bycatch was estimated for a total of 480 fish species, 54 marine mammal stocks, all U.S. sea turtle populations, and 28 seabird populations (Table 5.5). Stocks were counted more than once if estimates were produced in more than one region.

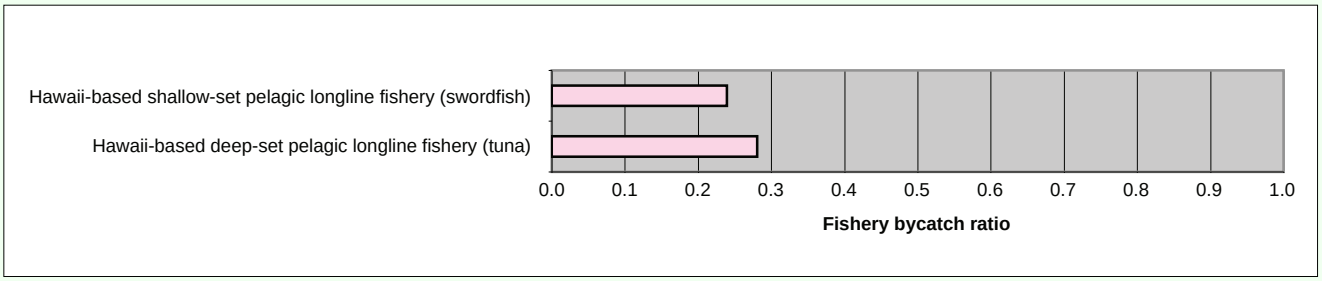


Figure 5.7
Fishery bycatch ratios for Pacific Islands Region fisheries (2005 data).

Credit: Adam Li, NMFS

Pilot whale.

Table 5.5
Bycatch estimates by region and resource type. Note that a single species or population may occur in multiple regions and that estimates for unidentified animals are included. Estimates in this report employed data from 2005; however, for some rare-event species multiple years of data were used to calculate estimates.

Region	Fish stocks with bycatch estimates	Marine mammal stocks with bycatch estimates	Sea turtle populations with bycatch estimates[a]	Seabird populations with bycatch estimates
Northeast	34	6	1[b]	NA[c]
Southeast	215	5	6	5
Alaska	91	17	NA[d]	12
Northwest	52	3	NA[e]	7
Southwest	0[f]	8	1	0[f]
Pacific Islands	88	15	4	4
Total number of bycatch estimates by resource type	480	54	12	28

[a] Six sea turtle populations are found in the U.S. Note that some regions provided estimates for unidentified sea turtles in addition to those for specific populations.
[b] The Northeast Region provided bycatch estimates of zero for all sea turtle species that occur in the region, except for the loggerhead sea turtle.
[c] The Northeast Region is currently developing seabird bycatch estimation methods.
[d] Sea turtles occur rarely in the Alaska Region, and no sea turtle bycatch has been observed.
[e] No sea turtle bycatch was observed in the Northwest Region (bycatch was reported as 0 for all sea turtle populations for all fisheries). However, it was not possible to determine the number of populations that would be included in the zero estimates; therefore a number is not listed in this table.
[f] The Southwest Region is currently developing fish bycatch estimation methods.

5.6.1 Fish Bycatch

This report provides bycatch estimates for 480 fish stocks. Bycatch ratios were calculated for each stock where bycatch estimates and total fish catch data were available. Stock bycatch ratios were developed to measure the relative amount of bycatch to total catch for each fish stock, although both the amount of bycatch and the bycatch ratio are important when examining the impact of bycatch.

The number of fish stocks for which bycatch estimates were made varied by region. The Southeast Region provided the highest number (206) due to the large diversity in South Atlantic, Gulf of Mexico, and Caribbean fisheries. The Southwest Region did not provide bycatch estimates for fish stocks.

Stock bycatch ratios could be calculated for only the small subset of fish where bycatch estimates were calculated (93 fish stocks; 19.4%), for two principal reasons. First, fish bycatch estimates were calculated in numbers of fish in several fisheries, while landings were generally provided in weight. Since factors to convert the numeric estimates into weight were not always available, it was not always possible to calculate bycatch ratios for these stocks. Second, many of the landings statistics contained in the national database were provided for groups of fish species, while bycatch estimates were calculated at the species or stock level. Since no method was available to determine individual species catch for grouped species, it was not possible to calculate stock bycatch ratios. Database improvements are needed to allow development of stock bycatch ratios in future editions of this report.

Stock bycatch ratios ranged from 0.01 to 1.0 (Figure 5.8–5.12). It is difficult to compare species bycatch estimates among regions due to the large number of species included in this report and differences in the quantity and quality of data among regions. When a fish stock had a bycatch ratio of greater than 0.127 and other considerations were met, it was classified as a key stock (refer to Section 3 for a complete description of the criteria).

5.6.1.1 Northeast Region Fish Bycatch

Fish and invertebrate bycatch estimates were provided for 34 Northeast Region stocks, with 21 identified as key stocks (Figure 5.8). Stock bycatch estimates ranged up to 79.6 M lb, with the highest estimated bycatch for the skate complex (see Section 4.1, Appendix table 4.1.A for this estimate). Fish stocks with high bycatch ratios included ocean pout (0.98), windowpane flounder (0.91), spiny dogfish (0.90), red hake (0.78), butterfish (0.69), Atlantic halibut (0.45), and offshore hake (0.42). Species with low stock bycatch ratios included Atlantic surfclams (<0.01), ocean quahog (<0.01), pollock (0.01), Atlantic sea scallop (0.03), and Atlantic herring (0.03). A stock bycatch ratio was not presented for the skate complex because it comprises seven stocks, and the bycaught species may be different from the landed stocks. No stock bycatch ratios were provided for Atlantic salmon and shortnose sturgeon because landings are prohibited for these ESA-listed species, nor for red crab due to confidentiality of the commercial landings. Nineteen FSSI stocks and two ESA-listed stocks were identified as key fish stocks; the majority of these were classified as overfished in the 2008 First Quarter FSSI report.

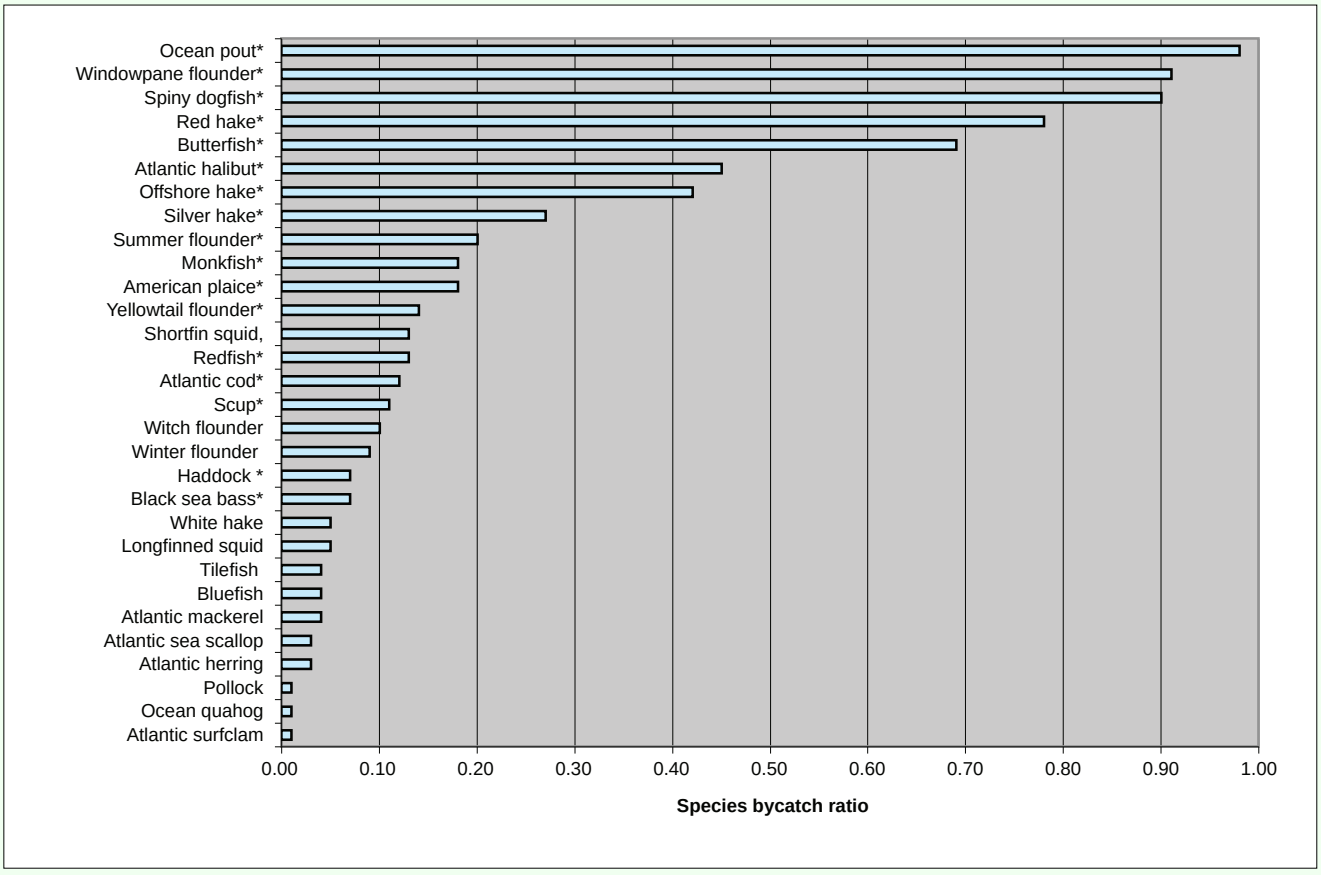


Figure 5.8
Stock bycatch ratios for the Northeast Region (2005 data). * indicates key stocks. Northeast region key stocks without bycatch ratios: skate complex and Atlantic salmon (zero bycatch).

5.6.1.2 Southeast Region Fish Bycatch

Fish bycatch estimates were calculated for 206 Southeast Region fish stocks, with 64 identified as key stocks (Figure 5.9). In some cases, bycatch and landings were reported by weight, and in other cases by numbers. Therefore, it was possible only to develop bycatch ratios for a small subset of these. For those stocks where stock bycatch ratios were calculated, the highest ratios were for the Gulf of Mexico Atlantic croaker stock (0.90), the West Atlantic bluefin tuna stock[4] (0.49), and the South Atlantic albacore stock (0.38). Of these, only the West Atlantic bluefin tuna stock was identified as a key stock. For fish stocks where bycatch ratios could not be developed, species with high bycatch estimates included Gulf of Mexico seatrout and weakfish (58.7 M lb), non-Panaeid shrimp (88 M lb), longspine porgy (61.5 M lb), tiger shark (2.0 M lb), and Gulf of Mexico Spanish mackerel (3.6 M lb). These stocks, however, were not identified as key stocks. Key stocks with high bycatch estimates included red snapper (estimates in both number of fish, 1.7 M, and pounds, 2.6 M lb), red grouper (estimates in both number of fish, 862.1 K, and pounds, 57.8 K lb), South Atlantic/Gulf of Mexico dusky shark (570 K lb), greater amberjack (266 K fish), Gulf of Mexico lane snapper (1.6 M lb), and South Atlantic/Gulf of Mexico great hammerhead shark (191.8 K lb). The majority of these key stocks were subject to overfishing and were also overfished, as classified in the 2008 First Quarter FSSI report.

[4] Regulations prohibit targeting the Western Atlantic stock of bluefin tuna.

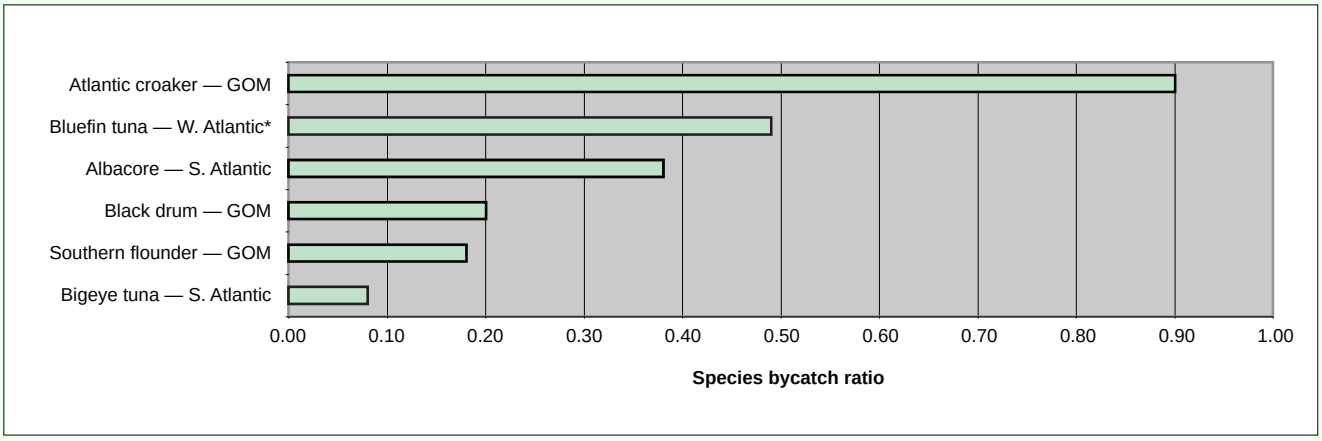


Figure 5.9

Stock bycatch ratios for the Southeast Region (2005 data). GOM = Gulf of Mexico. * indicates key stocks. Southeast Region key stocks without bycatch ratios: black grouper, black sea bass, black snapper, blackfin snapper, blue marlin, blue shark, bull shark, cobia, dolphinfish, dusky shark, gag grouper, goliath grouper, gray snapper, great hammerhead shark, greater amberjack, Gulf sturgeon, hogfish, king mackerel, lane snapper, little tunny, lemon shark, Nassau grouper, red drum, red grouper, red porgy, red snapper, sailfish, sandbar shark, scalloped hammerhead, scamp, shortnose sturgeon, silk snapper, silky shark, smalltooth sawfish, snowy grouper, Spanish mackerel, speckeled hind, spinner shark, Warsaw grouper, white grunt, white marlin, wreckfish, yellowledge grouper, yellowfin grouper.

5.6.1.3 Alaska Region Fish Bycatch

Bycatch estimates were provided for 73 Alaska Region fish and invertebrate stocks, with six identified as key stocks: red king crab (four distinct stocks), Aleutian Islands golden king crab, blue king crab, the demersal shelf rockfish complex (seven species), Chinook salmon, and non-Chinook salmon (Figure 5.10). Estimated bycatch ranged from trace amounts to 41.6 M lb. The highest estimated bycatch was for walleye pollock (41.6 M lb), BSAI arrowtooth flounder (32.4 M lb), rocksole (28.7 M lb), and yellowfin sole (20.0M lb); abundance and harvest levels were very high for these stocks and overall bycatch represented only a small fraction of total fishing mortality. Bycatch estimates for the four key stocks were relatively low, although landings data were not available because retention of these stocks in Federal groundfish fisheries is prohibited. Key stock bycatch estimates were 630 K lb for red king crab; 17 K lb. for Aleutian Islands golden king crab; 5.4 K lb for blue king crab; and 160 lb for demersal shelf rockfish. In many cases, bycatch of target species comprised a substantial proportion of overall bycatch in a specific fishery, due to discard of undersize or otherwise undesirable species. For example, bycatch of Atka mackerel comprised 31% of overall bycatch in the BSAI Atka mackerel trawl fishery; and Pacific cod comprised 12% of the total bycatch in the BSAI Pacific cod longline fishery.

Quantity or proportion of bycatch may not be a good indicator of the need for concern. This is certainly the case for key stocks where even small quantities of bycatch are an important consideration in the management of the species. Examples include the Chinook salmon and non-Chinook salmon key stock categories. Bycatch of Pacific salmon species in the BSAI pollock trawl fishery was small as a proportion of the overall catch; nevertheless, there is concern regarding the impacts of this bycatch on some of the stocks from which they originate.

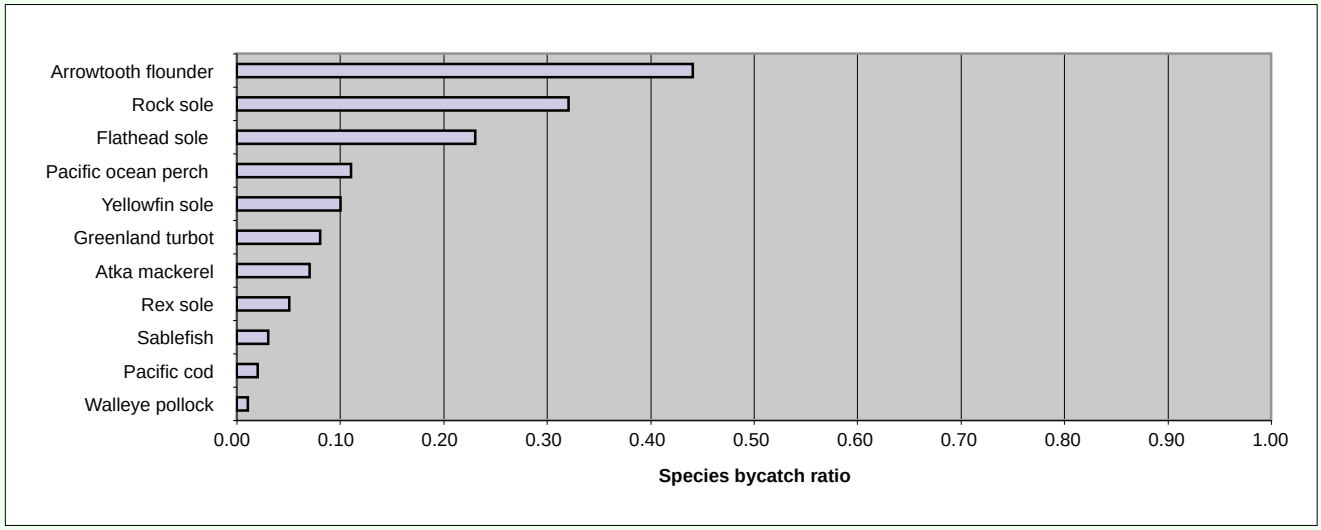


Figure 5.10
Stock bycatch ratios for Alaska Region (2005 data). Alaska Region key stocks without bycatch ratios are red king crab (four stocks), Aleutian Islands golden king crab, blue king crab, the demersal shelf rockfish complex (seven species), Chinook salmon, and non-Chinook salmon. * indicates key stocks.

5.6.1.4 Northwest Region Fish Bycatch

Fish bycatch estimates were provided for 53 Northwest Region fish stocks, with 33 identified as key stocks (Figure 5.11). Overall, stock bycatch ratios ranged from 0.01 to 0.97. The highest bycatch estimates were reported for arrowtooth flounder (3.2 M lb), Pacific hake (3.0 M lb), and spiny dogfish (2.8 M lb). Although the bycatch for Pacific hake was high, the stock bycatch ratio was very low at 0.01. The stock bycatch ratios for arrowtooth flounder and spiny dogfish were 0.40 and 0.70, respectively. Stocks with the highest stock bycatch ratios included cowcod (0.97), bocaccio (0.79), and canary rockfish (0.68). As these stocks are overfished, landings are extremely restricted or prohibited by fishery management;[5] therefore, the majority of the catch of these stocks is discarded (hence the high stock bycatch ratio shown in Figure 5.11). Some fish stocks were identified in the Northwest Region as key stocks due to the potential for high bycatch mortality. FSSI stocks were identified as key stocks, with none of the stocks experiencing overfishing. Cowcod, bocaccio, darkblotched rockfish, and yelloweye rockfish stocks were classified as overfished in the 2008 First Quarter FSSI report.

All catch and bycatch of managed fish and invertebrate stocks are accounted for in stock assessments and fishery management. Each year, total mortality estimates are calculated for most Northwest fisheries. These estimates include the retained and discarded components of catch. When computing total mortality, rates of survivorship (less than 100% mortality) are applied for some individual species or species groups. These survivorship rates were not applied in the bycatch estimates included in this report. Quantity or proportion of bycatch may not be the only indicator of concern. Low levels of bycatch may be of greater concern for those species whose populations are less abundant and/or overfished.

[5] As of 2005, cowcod was prohibited from retention in all sectors of the groundfish fishery. Bocaccio and canary rockfish had very restricted retention limits in some sectors of the groundfish fishery and were prohibited in others, but some overall retention was still allowed in the 2005 fishery.

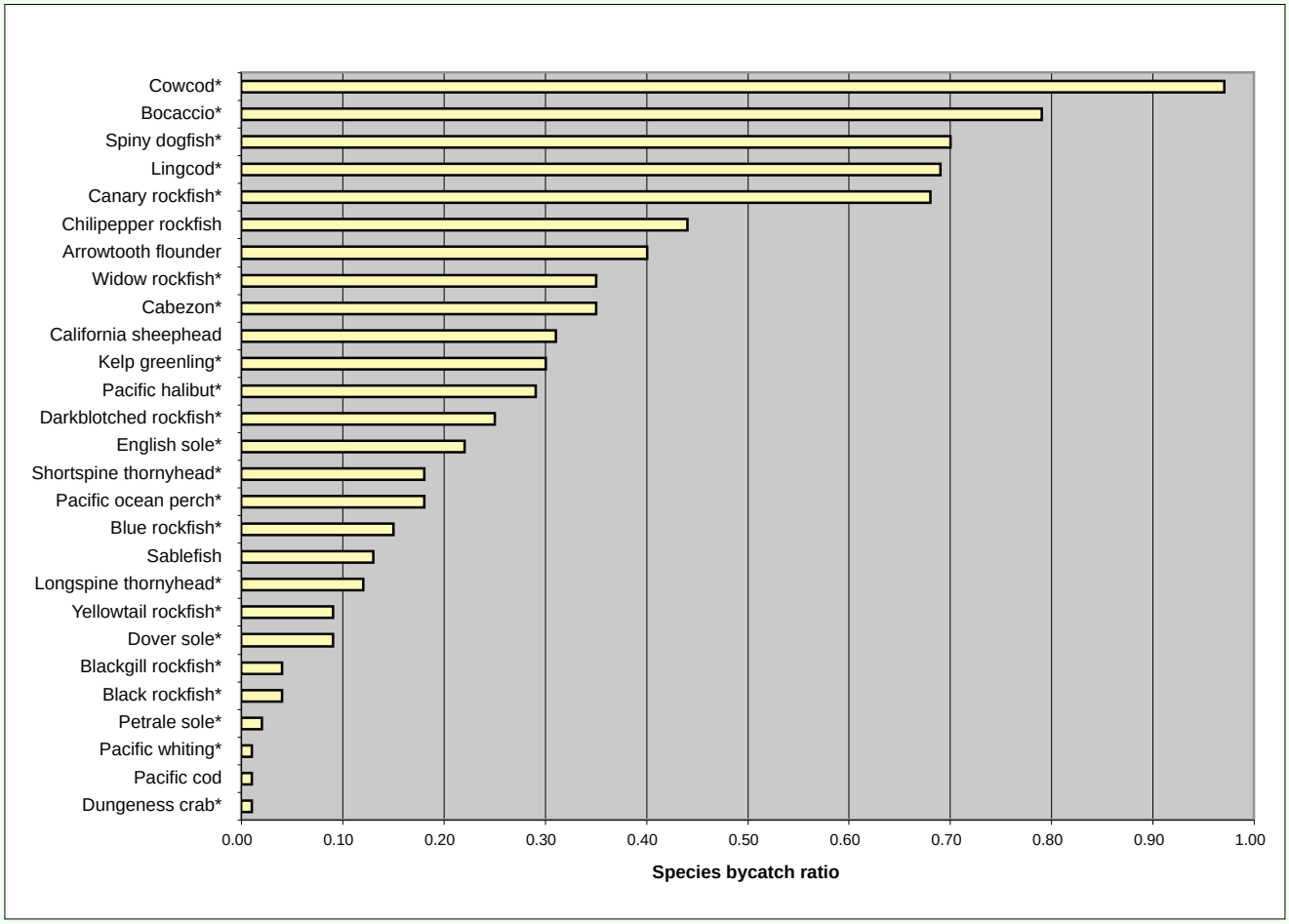


Figure 5.11
Stock bycatch ratios for the Northwest Region (2005 data). * indicates key stocks.

5.6.1.5 Southwest Region Fish Bycatch

Fish and invertebrate bycatch estimates were not calculated for Southwest Region commercial fisheries at the time this report was drafted. Recently published bycatch estimates of fish, sharks, and invertebrates in the California swordfish drift gillnet fishery (Larese and Coan 2008) will be included in the next edition of the U.S. National Bycatch Report. Fish and invertebrate bycatch estimates for the California halibut and white seabass set gillnet fisheries will also be included.

5.6.1.6 Pacific Islands Region Fish Bycatch

Fish bycatch estimates were provided for a total of 89 Pacific Islands stocks, with three stocks classified as key stocks (Figure 5.12). The range in overall bycatch estimates for all stocks was 0 to 5.6 M lb. Stock bycatch ratios ranged from 0 to 1.0, with the majority of stocks having very low bycatch ratios. The highest bycatch ratios occurred for the ocean sunfish (1.0) and escolar (0.88). The high ratios for both of these stocks reflect how seldom they are landed (the ratio is equal to one if none are landed). The estimated catches of ocean sunfish and escolar in these fisheries in 2005 were 85 and 3,300 individuals, respectively. The three key Pacific Islands fish stocks identified in this report were bigeye thresher shark (432.8 K lb), blue shark (5.6 M lb), and longnose lancetfish (927.7 K lb). Bycatch ratios were not calculated for these stocks since landings at the national level were reported for sharks in general, and longnose lancetfish were rarely landed. Blue shark stocks were identified as key because they are FSSI stocks.

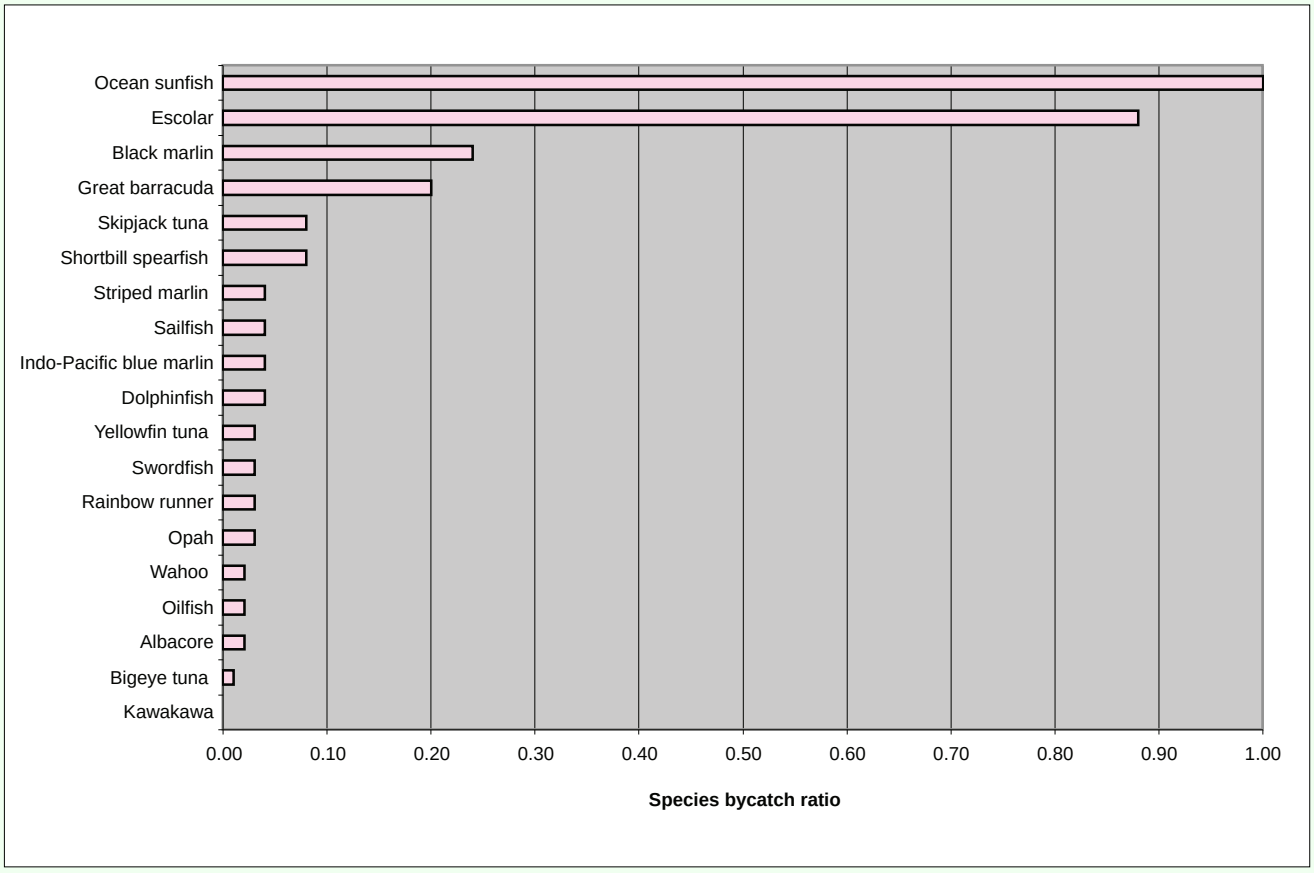


Figure 5.12
Stock bycatch ratios for the Pacific Islands Region (2005 data). Pacific Islands Region key stocks without bycatch ratios: bigeye thresher shark, blue shark, longnose lancetfish.

5.6.2 Marine Mammal Bycatch

The total bycatch estimate (lethal takes and serious injuries) for marine mammals for 39 fisheries and 54 marine mammal stocks was 1,887 individual animals (Figures 5.13–5.19). The number of bycatch estimates varied by region, as discussed in the following sections. Some estimates contain decimals due to averaging across years.

5.6.2.1 Northeast Region Marine Mammal Bycatch

Marine mammal bycatch estimates were provided for 15 Northeast Region commercial fisheries; there was no documented marine mammal bycatch during 2001–2005 for the majority of the other Northeast fisheries. The Mid-Atlantic mid-water trawl fishery produced an average annual bycatch of 91 animals, while the Mid-Atlantic otter trawl fishery produced an annual average of 182 animals, 118 of which were western North Atlantic short-beaked common dolphin. The Mid-Atlantic and New England gillnet fisheries and the New England otter trawl fishery had the highest marine mammal bycatch estimates, ranging from 238 to 514 animals per year. Bycatch in the gillnet fisheries was mainly harbor porpoises (Gulf of Maine/Bay of Fundy stock), with an annual average of 177 animals bycaught in the Mid-Atlantic gillnet fishery and 475 bycaught in the New England gillnet fishery. Western North Atlantic white-sided dolphin was the most commonly bycaught species in the New England otter trawl fishery, with an annual average of 192 animals.

Marine mammal bycatch estimates were provided for six stocks, with five identified as key stocks (Figure 5.13). The total marine mammal bycatch estimate was 1,287 animals per year (2001–05 average). The stocks with the highest average annual bycatch estimates included the Gulf of Maine/Bay of Fundy stock of harbor porpoise (652 animals), western North Atlantic white-sided dolphin (355 animals), and western North Atlantic short-beaked common dolphin (151 animals). These were followed by pilot whale (65 animals), the western North Atlantic coastal stock of bottlenose dolphin (61 animals), and western North Atlantic Risso's dolphin (3 animals). The status of these stocks was unknown.

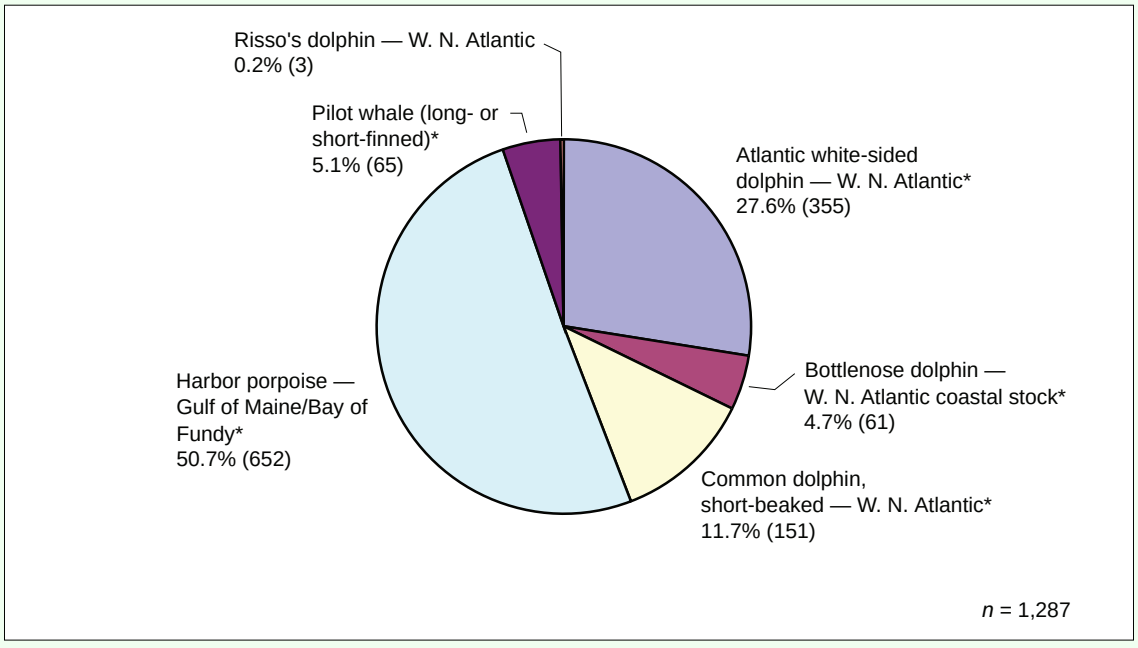


Figure 5.13
Marine mammal bycatch (lethal + serious injury) in the Northeast Region (*n* = total number of bycaught animals). The baseline year of data used in this report was 2005, however, for some rare-event species multiple years of data were used to generate a bycatch estimate. Stocks for which bycatch estimates were zero are not shown. * indicates key stocks.

5.6.2.2 Southeast Region Marine Mammal Bycatch

Marine mammal bycatch estimates were provided for three Southeast Region commercial fisheries. Bycatch in the large and small coastal shark aggregate fisheries (drift, strike, and bottom gillnet) was relatively low, with an estimate of five bottlenose dolphins bycaught annually. Average annual marine mammal bycatch in the Southeastern Atlantic and Gulf of Mexico HMS pelagic longline and shark bottom longline fisheries was 116 and 100 animals, respectively. In the HMS pelagic longline fishery, 70 pilot whales and 46 Risso's dolphins, as well as both spotted pantropical and Atlantic spotted dolphin (both western N. Atlantic stocks) were taken, while bottlenose dolphin was the only species bycaught in the shark bottom longline fishery.

Marine mammal bycatch estimates were provided for five stocks, with four identified as key stocks (Figure 5.14). The total number of marine mammals bycaught in the Southeast Region was 233.25 animals. The majority of the bycatch was western North Atlantic coastal bottlenose dolphin, with 105 animals. Seventy long-finned or short-finned pilot whales and 46 western North Atlantic Risso's dolphins were also bycaught. Status for these key marine mammal stocks is either varied or unknown.

5.6.2.3 Alaska Region Marine Mammal Bycatch

Marine mammal bycatch estimates were provided for 13 Alaska Region commercial fisheries, with bycatch estimates ranging from 0.20 to 35.8 animals per year (note that annual estimates are based on multi-year averages, hence some values are fractional). Four of these fisheries are State of Alaska salmon gillnet fisheries located in Cook Inlet, Kodiak, Yakutat, and Southeast Alaska (AMMOP fisheries). Bycatch data were obtained from the North Pacific Groundfish Observer Program, AMMOP, and/or from stranding network data. Only very low levels of bycatch (central North Pacific humpback whale bycatch; 0.2 animals/yr) were estimated for the Cook Inlet, Yakutat, and Southeast fisheries. For the Kodiak fishery, however, an annual bycatch estimate of 35.8 animals (harbor porpoise, GOA stock) was reported.

Although average annual marine mammal bycatch estimates were numerically very low for the majority of nine groundfish fisheries with bycatch estimates, a serious injury or mortality problem may still exist (i.e., even a small amount of bycatch may be significant).

- For the BSAI Atka mackerel trawl fishery, only Steller sea lions (western stock) were taken, with an average annual mortality of 0.49 animals.

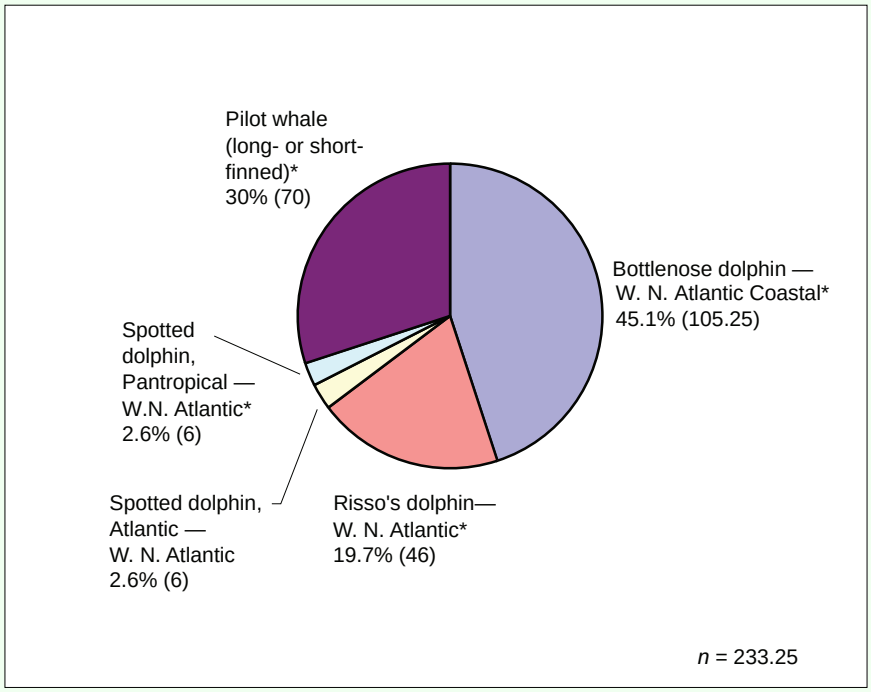


Figure 5.14
Marine mammal bycatch (lethal + serious injury) in the Southeast Region (*n* = total number of bycaught animals). The baseline year of data used in this report was 2005; however, for some rare-event species multiple years of data were used to generate a bycatch estimate. Note: Stocks for which bycatch estimates were zero are not shown. * indicates key stocks.

- For the BSAI flatfish trawl fisheries, average annual marine mammal bycatch mortality was 9.72 animals and was comprised of western Steller sea lion (2.78), spotted seal (1.17), ringed seal (0.49), ribbon seal (0.27), Pacific walrus (2.10), northern fur seal (0.57), Bering sea harbor seal (0.79), Bering sea harbor porpoise (0.35), killer whale – Eastern North Pacific Alaska resident stock (0.84), and bearded seal (0.36).
- For the BSAI Pacific cod longline fishery, average annual marine mammal bycatch mortality was 2.18 animals and was comprised of killer whale—Gulf of Alaska, Aleutian Islands, and Bering Sea transient stock (0.84), ribbon seal (0.60), and western Steller sea lion (0.74).
- For the BSAI Pacific cod trawl fishery, average annual marine mammal bycatch mortality was 1.64 animals, comprised of Bering Sea harbor seal (0.79) and western Steller sea lion (0.85).
- For the BSAI pollock pelagic trawl fishery, average annual marine mammal bycatch mortality was 5.46 animals, including western Steller sea lion (2.58), ringed seal (0.42), ribbon seal (0.20), northern fur seal (0.21), Bering Sea harbor seal (0.29), Dall's porpoise (1.35), and killer whale—Gulf of Alaska, Aleutian Islands, and Bering Sea transient stock (0.41).
- For the BSAI sablefish pot fishery, overall marine mammal bycatch was estimated at 0.20 animals per year, comprised of central North Pacific and western North Pacific humpback whale, in equal proportions.
- For the GOA crab pot fishery, only central North Pacific humpback whale bycatch mortality was reported (0.60).
- For the GOA pollock pelagic trawl fishery, marine mammal bycatch mortality was estimated at 2.52 animals per year, consisting of Dall's porpoise (0.48), northern elephant seal (0.71), and western Steller sea lion (1.33).
  For the GOA Pacific cod trawl fishery, only western Steller sea lion bycatch was reported (0.94).

Marine mammal bycatch was calculated for 17 stocks, with 12 identified as key stocks (Figure 5.15). The total annual marine mammal bycatch estimated for the BSAI and GOA

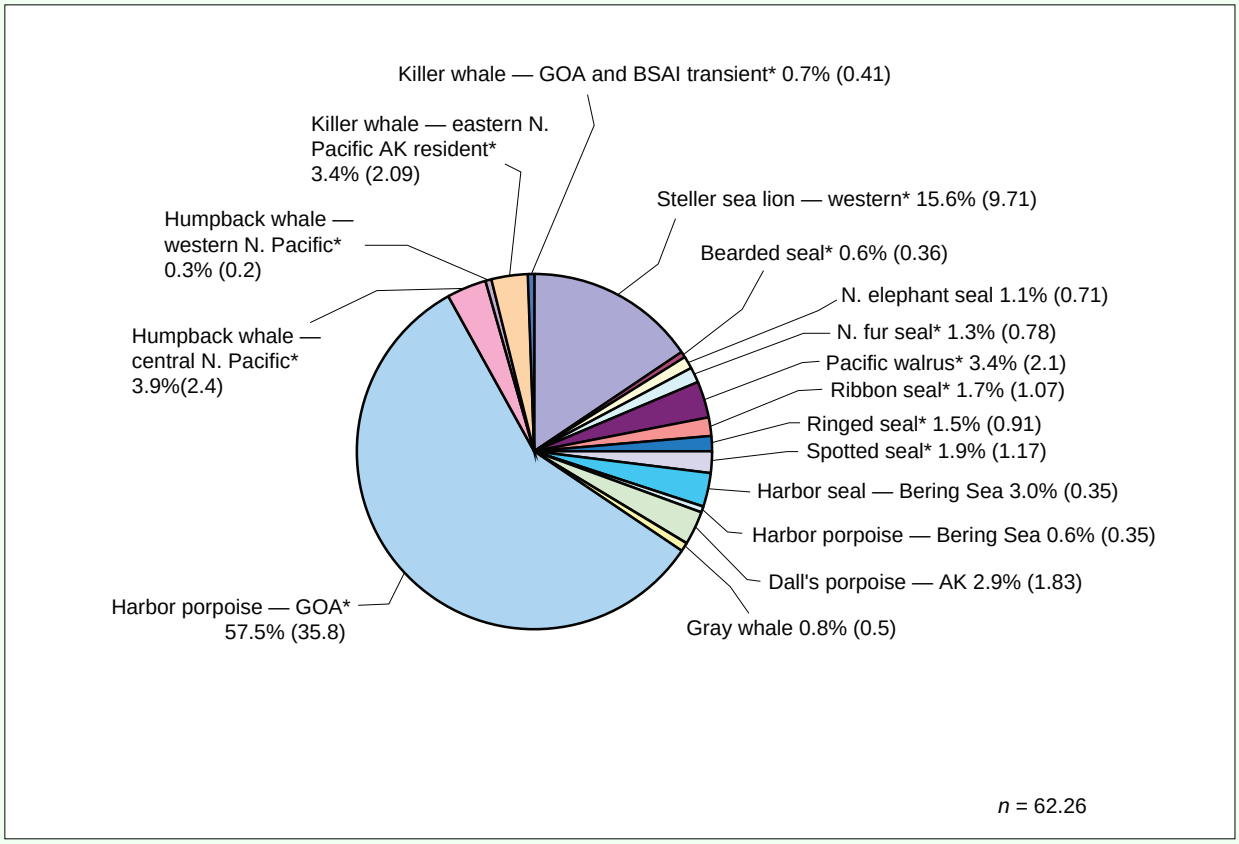


Figure 5.15
Marine mammal bycatch (lethal + serious injury) in the Alaska Region (*n* = total number of bycaught animals). The baseline year of data used in this report was 2005; however, for some rare-event species multiple years of data were used to generate a bycatch estimate. Note: zero estimates are not shown. Stocks for which bycatch estimates were zero are not shown. * indicates key stocks.

was 61 animals; 35 were Gulf of Alaska harbor porpoises (documented from a single fishery) and 10 were western Steller sea lions from several fisheries. Lower levels of estimated bycatch of key stocks included bearded seal (<1 animal), humpback whale (0.2–2.4), killer whale (0.4–2.1), Northern fur seal (0.8), Pacific walrus (2.1), ribbon seal (1.1), ringed seal (0.9), and spotted seal (1.2). For the majority of these stocks, ZMRG and stock status is unknown or declining. The western Steller sea lion is listed as endangered.

5.6.2.4 Northwest Region Marine Mammal Bycatch

Marine mammal bycatch estimates were provided for 2005 for five Northwest Region commercial fisheries. Although bycatch estimates were based on a single year of data, some fractional values were reported due to the estimation process. No marine mammal bycatch occurred in the West Coast groundfish non-trawl gear (non-endorsed fixed gear) or the California/Oregon nearshore rockfish fishery. Low levels of bycatch occurred in the West Coast groundfish non-trawl gear (sablefish-endorsed fixed gear) fishery (14 California sea lions), the West Coast limited-entry bottom trawl (groundfish bottom trawl) fishery (20 California sea lions), and the West Coast mid-water hake trawl fishery for at-sea processors (four animals).

Marine mammal bycatch estimates were provided for three Northwest Region stocks, with one stock identified as a key stock (Figure 5.16). Total annual marine mammal bycatch in the West Coast fisheries was estimated at 37 animals. The highest species bycatch was for the California sea lion stock, with 33.7 animals. The only key marine mammal stock identified was the Steller sea lion, with an annual bycatch estimate of 2.4 animals.

5.6.2.5 Southwest Region Marine Mammal Bycatch

Estimates of marine mammal bycatch from three California commercial fisheries were calculated. Bycatch estimates were provided for eight stocks, four of which were classified as key stocks (Figure 5.17). Annual bycatch estimates

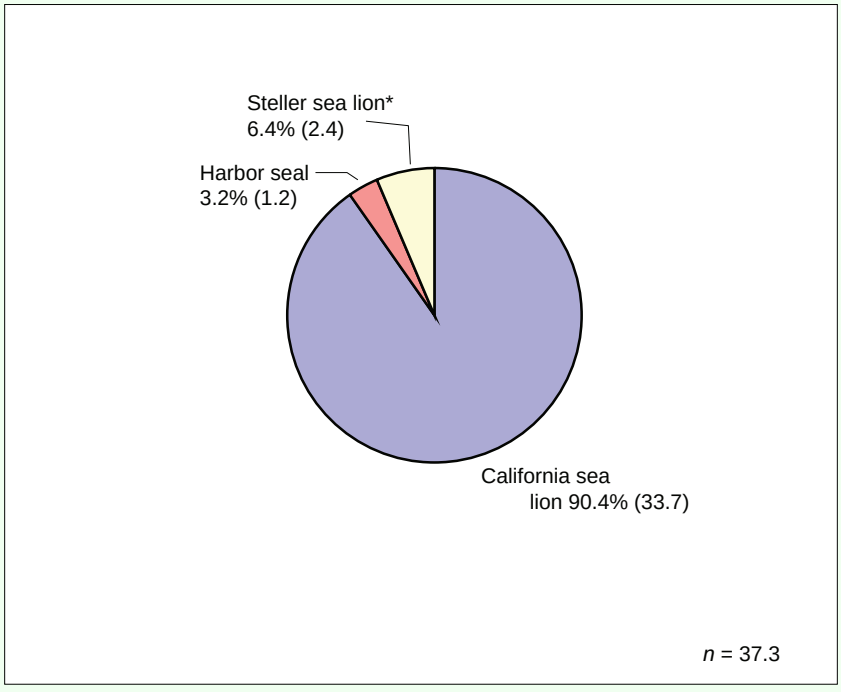


Figure 5.16
Marine mammal bycatch (lethal + serious injury) in the Northwest Region (*n* = total number of bycaught animals). The baseline year of data used in this report was 2005; however, for some rare-event species, multiple years of data were used to generate a bycatch estimate. Stocks for which bycatch estimates were zero are not shown. * indicates key stocks.

ranged from 1 to 145 animals (common short-beaked dolphin CA/OR/WA). Bycatch estimates for the key populations were 51.5 California sea lions (U.S.), 9.1 common long-beaked dolphin (CA/OR/WA), 18 northern right whale dolphin (CA/OR/WA), and one short-finned pilot whale. The majority of marine mammal stocks identified as key stocks in the Southwest region have unknown stock status.

The highest bycatch levels were from the California drift gillnet fishery for swordfish and thresher shark, which has had an observer program since 1990. For the period 2000–04, annual average marine mammal mortality in this fishery was 38 California sea lions, 4.4 long-beaked common dolphin, 58 short-beaked common dolphin, eight northern elephant seals, 18 northern right whale dolphin, 4.8 Pacific white-sided dolphin, 5.8 Risso's dolphin, and 1 short-finned pilot whale. In recent years, cetacean entanglements in this fishery have averaged approximately four per 100 sets fished. Current cetacean bycatch rates in the drift gillnet fishery are significantly lower since acoustic pingers were introduced into this fishery in the mid-1990s (Barlow and Cameron 2003; Carretta et. al. 2008). Bycatch in the California squid purse seine fishery averaged 87 short-beaked common dolphin, although this estimate had a high degree of uncertainty due to the low level of observer coverage. Annual bycatch in the California white seabass and yellowtail small-mesh drift gillnet fisheries was estimated to average 13.5 California sea lions and 4.7 long-beaked common dolphin, respectively.

Of the three Southwest fisheries for which cetacean and pinniped bycatch were reported, only one, the swordfish gillnet fishery, currently has an observer program. Total bycatch over all three fisheries was 51.5 California sea lions, 9.1 long-beaked common dolphin, 145 short-beaked common dolphin, eight northern elephant seals, 18 northern right whale dolphin, 4.8 Pacific white-sided dolphin, 5.8 Risso's dolphin, and one short-finned pilot whale. Because not all fisheries were observed in all years, these estimates should be considered minimum bycatch estimates. These bycatch estimates appear in the U.S. Pacific Marine Mammal Stock Assessments, which are published annually. More recent estimates of marine mammal bycatch are available in the 2008 U.S. Pacific Stock Assessment Report (Carretta et al. 2009).

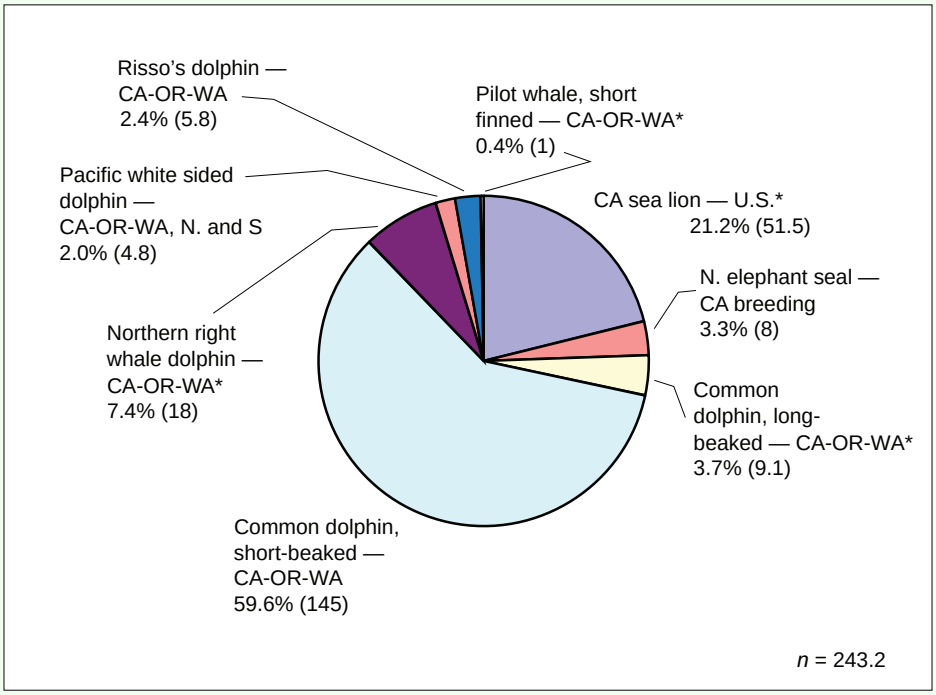


Figure 5.17
Marine mammal bycatch (lethal + serious injury) in the Southwest Region (*n* = total number of bycaught animals). The baseline year of data used in this report was 2005; however, for some rare-event species multiple years of data were used to generate a bycatch estimate. Stocks for which bycatch estimates were zero are not shown. * indicates key stocks.

5.6.2.6 Pacific Islands Region Marine Mammal Bycatch

An annual average, over five years, of one marine mammal was observed caught in the Hawaii-based shallow-set pelagic longline fishery for swordfish within and outside the Hawaiian EEZ, while minimal bycatch was observed within and outside the Hawaiian EEZ in the deep-set pelagic longline fishery for tuna (an annual average of approximately 25.23 animals from 15 separate marine mammal stocks).

Marine mammal bycatch estimates were provided for a total of 15 stocks, with four identified as key stocks (Figures 5.18 and 5.19). Bycatch ranged from 0 to 7.62 animals, reported for specific fisheries rather than for stocks. The key stocks included false killer whale, unidentified false killer whale or short-finned pilot whale, humpback whale, and sperm whale. The stock status of false killer whale stock is unknown, while humpback and sperm whales are listed as endangered under the ESA.

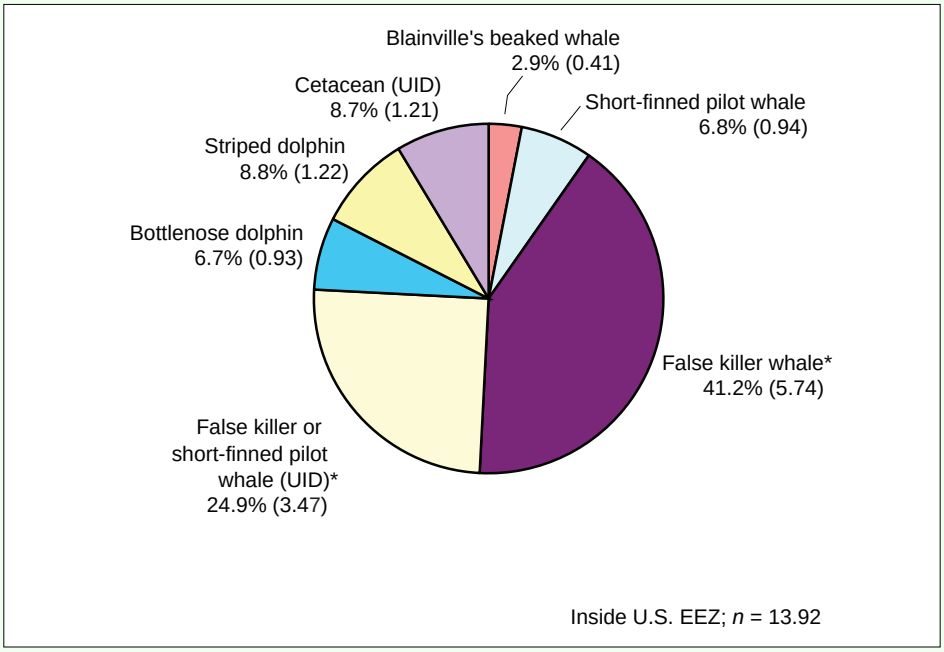


Figure 5.18
Marine mammal bycatch (lethal + serious injury) in the Pacific Islands Region, within the EEZ (*n* = total number of bycaught animals). The baseline year of data used in this report was 2005; however, for some rare-event species multiple years of data were used to generate a bycatch estimate. Stocks for which bycatch estimates were zero are not shown. * indicates key stocks. UID = unidentified.

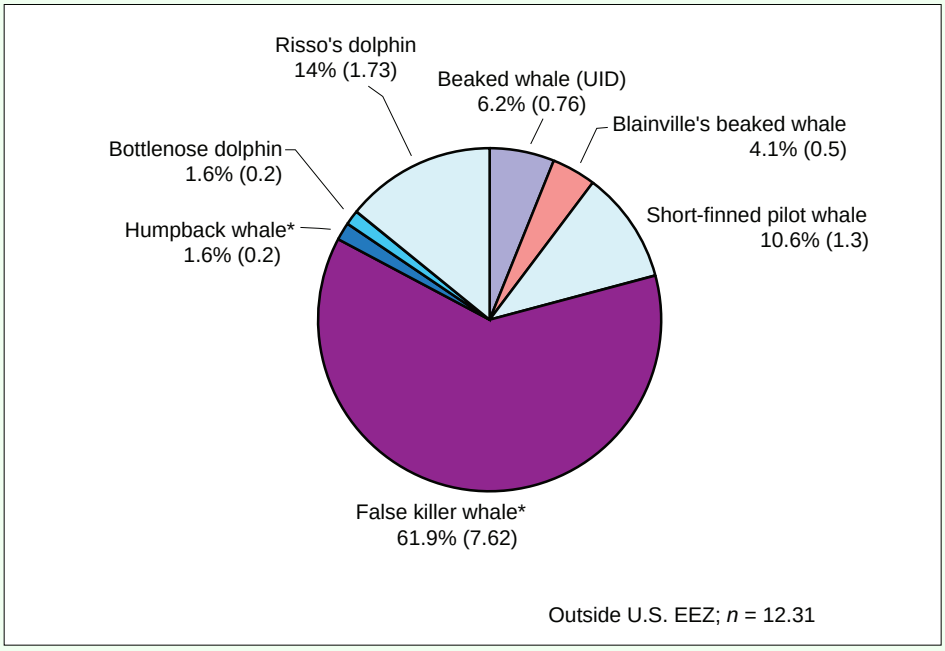


Figure 5.19
Marine mammal bycatch (lethal + serious injury) in the Pacific Islands Region beyond the EEZ (*n* = total number of bycaught animals). The baseline year of data used in this report was 2005; however, for some rare-event species multiple years of data were used to generate a bycatch estimate. Stocks for which bycatch estimates were zero are not shown. * indicates key stocks. UID = unidentified.

5.6.3 Sea Turtle Bycatch

Estimates for bycatch of turtles from all U.S. sea turtle populations were calculated for 21 fisheries, and totaled 11,772 individual animals. Sea turtle bycatch estimates were not calculated for Alaskan fisheries, since sea turtles do not typically occur in this region. Also, sea turtle bycatch was not observed in any Northwest Region fisheries. The highest sea turtle bycatch estimates were for the Southeast Region, with estimates reported for ten fisheries and four sea turtle populations (and also for unidentified turtles), with a total bycatch estimate of 10,671 individuals (note shrimp trawl fishery estimates included mortalities only). Most bycaught sea turtles were loggerhead (5,209 animals), Kemp's ridley (4,222), and leatherback (537). These turtles were bycaught mainly in the reef fish, Atlantic pelagic longline, and southeastern Atlantic and Gulf of Mexico shrimp trawl fisheries.[6] Note that the proportion of the total stocks that these estimates represent is generally unknown because of the general lack of population size estimates for sea turtles.

Some estimates were based on multiple years of data, and may be fractional due to averaging across years.

Credit: NOAA

A loggerhead sea turtle.

5.6.3.1 Northeast Region Sea Turtle Bycatch

Sea turtle bycatch estimates were provided for nine Northeast Region commercial fisheries, with the majority of other Northeast fisheries having no documented sea turtle bycatch. Bycatch estimates were presented for loggerhead turtles only, because this was the only species with enough observed interactions to produce a defensible estimate. Loggerhead sea turtles are currently listed as threatened under the ESA, and are thus a key stock. Estimated bycatch for the loggerhead sea turtle during 1996–2005 in the Northeast Region, across the nine gear types presented, was 1,062 loggerhead sea turtles per year, with an estimated annual average of 136 in the Mid-Atlantic scallop trawl fishery (2004–05), 310 in the Mid-Atlantic scallop dredge fishery (2003–05), and 616 in the Mid-Atlantic otter trawl fishery (1996–2004).

5.6.3.2 Southeast Region Sea Turtle Bycatch

Estimates of sea turtle bycatch were provided for ten Southeast Region commercial fisheries. The bycatch estimates encompassed years 2001–06, depending on the fishery (more recent data were used to estimate bycatch of rare-event species). Low numbers of bycaught sea turtles were reported in the Gulf of Mexico reef fish bottom longline fishery (10 unclassified turtles), the Gulf of Mexico reef fish handline fishery (24 loggerheads), the large and small coastal shark aggregate fisheries (5 loggerheads), and the South Atlantic snapper–grouper handline fishery (3 individuals). It should be noted that any bycatch of these ESA-listed species is of concern and more recent observer data may indicate higher bycatch levels in these fisheries. For example, a September 2008 report indicated Gulf of Mexico reef fish bottom longline gear took between 339 and 1,884 loggerhead sea turtles over an 18-month period (July 2006–December 2007; a monthly average of 800) based on extrapolation of observer data during that time period.[7]

Higher levels of estimated sea turtle bycatch were found in pound net, longline, and trawl fisheries. Total sea turtle bycatch estimated for the North Carolina southern flounder pound net fishery was 657 animals, with 536 loggerheads, 107 green turtles, and 13.6 Kemp's ridley turtles. Total sea turtle bycatch estimated for the Atlantic and Gulf of Mexico HMS pelagic longline fishery was similar, at 625 animals (350.9 leatherback and 273.8 loggerhead turtles), as was the Atlantic and Gulf of Mexico Shark Bottom Longline fishery (83.2 leatherback and 420 loggerhead turtles, plus nearly 32 unidentified sea turtles). The bycatch in the North Carolina inshore gillnet fishery was 60 animals (37 green, 19 leatherback, and 4 loggerhead turtles).

The Gulf of Mexico and Southeastern Atlantic shrimp trawl fisheries had the highest bycatch estimates, at 6,849 and 1,901 sea turtles, respectively. The majority of bycaught

[6] Bycatch estimates from the 2002 shrimp trawl fishery Biological Opinion. Since that time, effort in the shrimp fishery, and related bycatch, have decreased substantially.

[7] http://sero.nmfs.noaa.gov/pr/pdf/SEFSC2008.pdf

sea turtles were Kemp's ridley (3,884 in the Gulf of Mexico and 324 in the South Atlantic) and loggerheads (2,416 in the Gulf of Mexico and 1,532 in the South Atlantic). Note that estimates for both shrimp trawl fisheries were based on levels of fishery effort reported in 2001 (NMFS 2002) and since that time, effort (and presumably bycatch) have decreased.

Four of the populations with bycatch estimates were identified as key stocks (Figure 5.20); the fifth set of estimates were for unidentified animals. The total number of sea turtles bycaught in the Southeast Region was 10,671 animals. The highest bycatch occurred for loggerhead sea turtles (5,209 animals) and Kemp's ridley (4,222 animals). Loggerhead and leatherback sea turtles are listed as threatened and endangered, respectively, under the ESA.

5.6.3.3 Alaska Region Sea Turtle Bycatch

Sea turtle bycatch estimates were not provided for any Alaska Region commercial fisheries, since sea turtles do not typically occur in Alaska waters. Sea turtle bycatch has never been observed in Alaska, even with high levels of observer coverage in this region.

5.6.3.4 Northwest Region Sea Turtle Bycatch

Sea turtle bycatch estimates of zero were provided for five Northwest Region commercial fisheries. No bycatch of sea turtles has ever been observed.

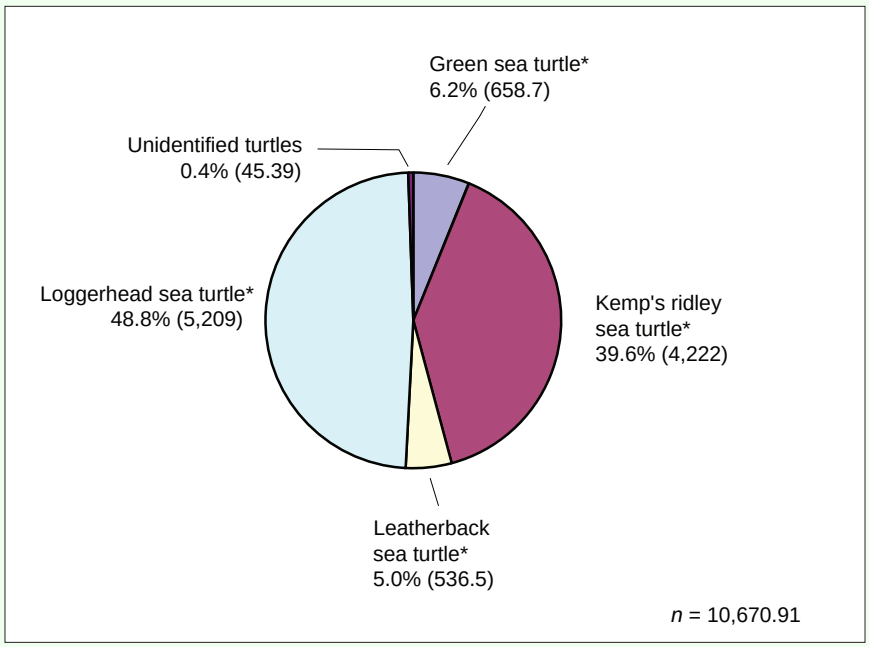


Figure 5.20
Sea turtle bycatch in the Southeast Region (*n* = total number of bycaught animals). Estimates include mortalities and those individuals released alive for all regional fisheries, with the exception of the shrimp trawl fisheries, for which only estimates of mortalities are provided. The baseline year of data used in this report was 2005; however, for some rare-event species multiple years of data were used to generate a bycatch estimate. Stocks for which bycatch estimates were zero are not shown. * indicates key stocks.

5.6.3.5 Southwest Region Sea Turtle Bycatch

Sea turtle bycatch estimates were provided for one Southwest Region fishery, which cannot be identified due to confidentiality concerns. The bycatch consisted of one olive ridley sea turtle. This population was identified as a key stock by the Southwest Region.

5.6.3.6 Pacific Islands Region Sea Turtle Bycatch

Sea turtle bycatch was observed in the Hawaii-based shallow-set pelagic longline fishery (swordfish) and the Hawaii-based deep-set pelagic longline fishery (tuna), with an estimated total of 20 sea turtles bycaught in the deep-set and 18 loggerhead turtles in the shallow-set pelagic longline fishery. The deep-set fishery bycatch was principally olive ridleys (16 of the 20 sea turtles).

Sea turtle bycatch estimates were provided for four populations, all identified as key stocks (Figure 5.21). Annual bycatch estimates ranged from zero to 16, with a total of 38 animals. Key stocks included green sea turtle (0 animals), leatherback turtle (12), loggerhead turtle (10), and olive ridley turtle (16). While green sea turtles are listed as threatened, the Florida and Mexico breeding populations of this species are listed as endangered. Due to the inability to distinguish between these populations away from the nesting beaches, NMFS considers green sea turtles endangered whenever they occur in U.S. waters. Loggerhead sea turtles are listed as threatened under the ESA, while leatherback and olive ridley sea turtles are listed as endangered.

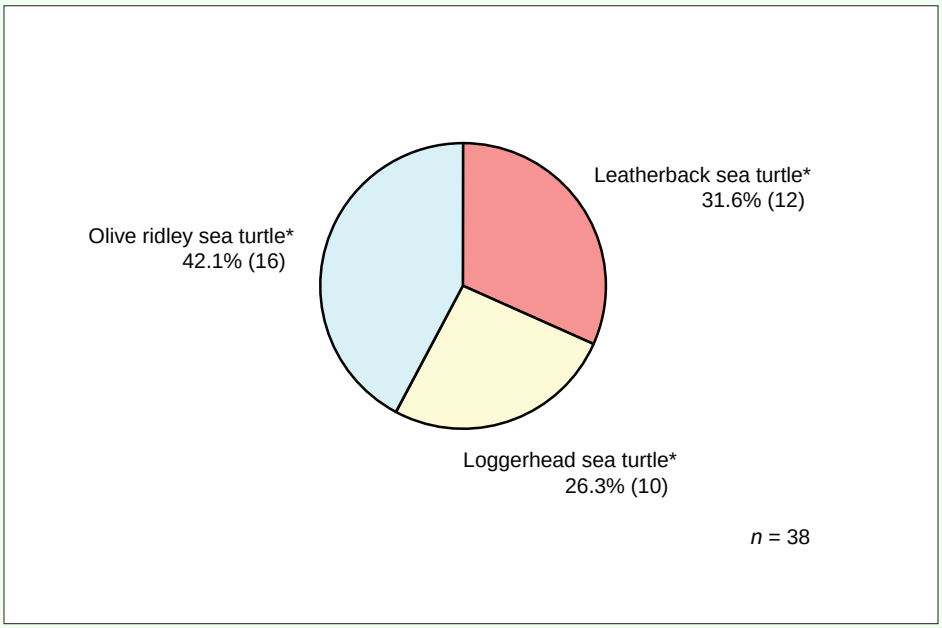


Figure 5.21
Sea turtle bycatch in the Pacific Islands Region (*n* = total number of bycaught animals). Estimates include mortalities and those individuals released alive. The baseline year of data used in this report was 2005, however; for some rare-event species multiple years of data were used to generate a bycatch estimate. Stocks for which bycatch estimates were zero are not shown. * indicates key stocks.

5.6.4 Seabird Bycatch

Bycatch estimates for seabirds were calculated for 25 fisheries, totaling 28 seabird populations and 7,769 individual bycaught animals (Figure 5.22–5.25). The number of bycatch estimates varied by region. The highest bycatch estimates were calculated for the Alaska Region and were provided for 16 fisheries, representing 12 seabird populations and totaling 7,280 seabirds.

5.6.4.1 Northeast Region Seabird Bycatch

Seabird bycatch estimates were not calculated for the Northeast Region; estimation methods are currently being developed.

5.6.4.2 Southeast Region Seabird Bycatch

Seabird bycatch estimates were provided for two Southeast Region commercial fisheries. An estimated total of 24 seabirds were bycaught in the South Atlantic coastal migratory pelagic troll fishery and an estimated 142 seabirds were bycaught in the southeastern Atlantic and Gulf of Mexico HMS pelagic longline fishery. The majority of seabirds bycaught in the longline fishery were greater shearwater (75) and gulls (61).

Seabird bycatch estimates were provided for six populations, with none of these populations identified as key stocks (Figure 5.22). Total seabird bycatch in the Southeast Region was 186 animals.[8] The highest bycatch occurred for greater shearwaters and gulls.

[8] This is an estimate of total seabird bycatch mortality in the region, and differs from the sum of the species mortality estimates.

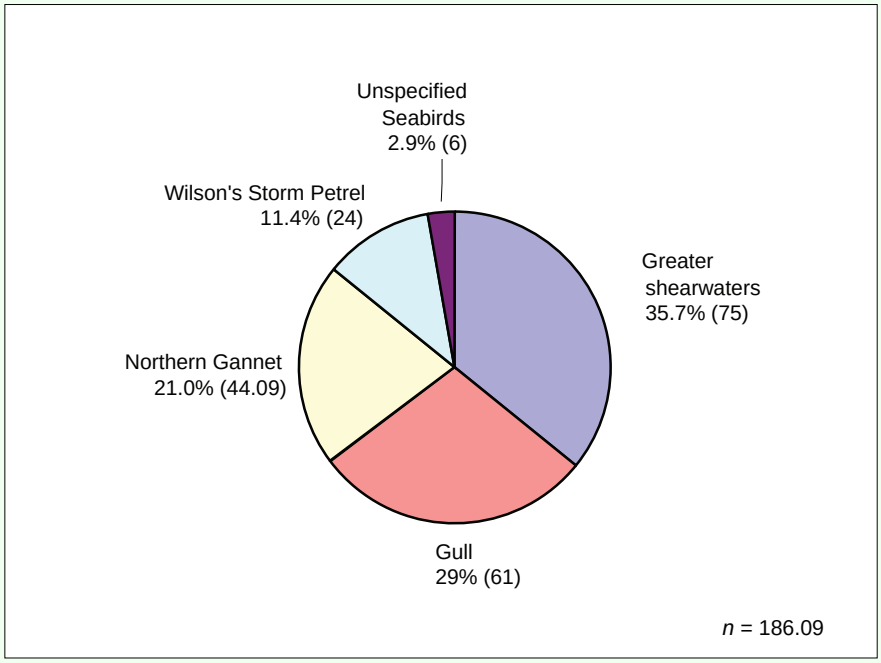


Figure 5.22
Seabird bycatch in the Southeast Region (*n* = total number of bycaught animals). The baseline year of data used in this report was 2005; however, for some rare-event species multiple years of data were used to generate a bycatch estimate. Stocks for which bycatch estimates were zero are not shown. * indicates key stocks. The total (*n* = 186.09) is an estimate of total seabird bycatch mortality in the region, and differs from the sum of the species mortality estimates.

5.6.4.3 Alaska Region Seabird Bycatch

Seabird bycatch estimates were provided for 19 Alaska Region commercial fisheries. For the majority of fisheries, seabird bycatch was comprised of several species. Seabird bycatch estimated for the BSAI pollock pelagic trawl fishery was 322 animals comprised of nine different species; Northern fulmar was the most frequently taken bird species in this fishery (179 animals). The fishery with the highest seabird bycatch estimate was the BSAI Pacific cod longline fishery, with 5,661 seabirds from 11 different populations; most numerous were gulls (1,970 animals) and northern fulmars (2,617).

Seabird bycatch estimates represented 12 populations, with three identified as key stocks (Figure 5.23). The total seabird bycatch estimate for the BSAI and GOA combined was 7,280 seabirds. Most numerous among these were northern fulmar (3,427) and gulls (2,101), neither of which was identified as a key stock. The key stocks represented in the bycatch were black-footed albatross (57) and red-legged kittiwake (4). Short-tailed albatross populations are listed as endangered under the ESA, while black-footed albatross and kittiwake are listed as Birds of Conservation Concern by the USFWS.

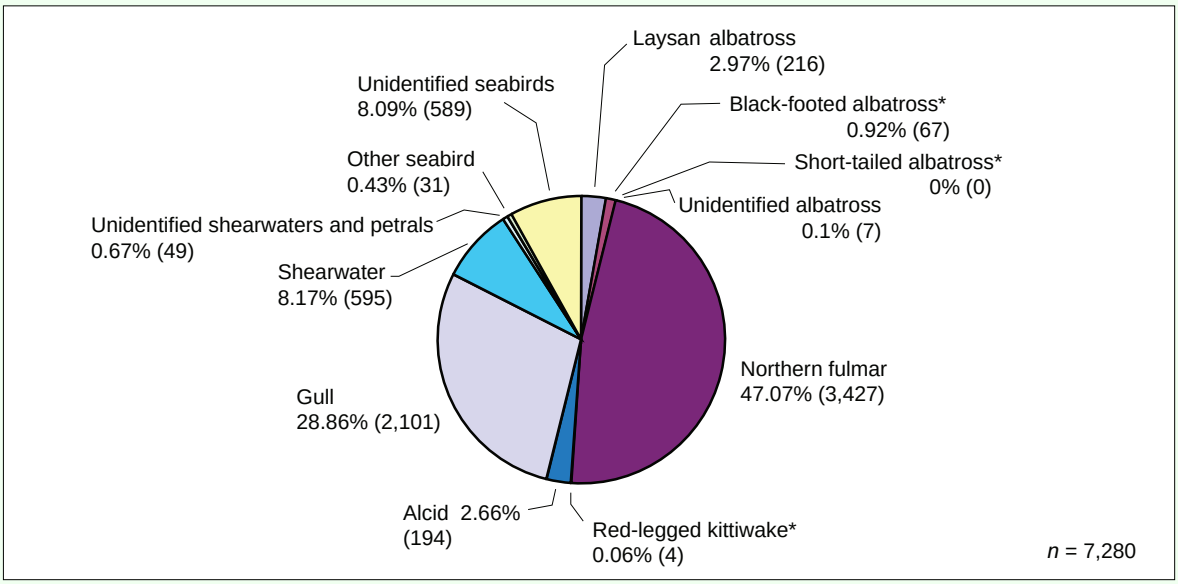


Figure 5.23
Seabird bycatch in the Alaska Region (*n* = total number of bycaught animals). The baseline year of data used in this report was 2005; however, for some rare-event species multiple years of data were used to generate a bycatch estimate. Stocks for which bycatch estimates were zero are not shown. * indicates key stocks.

5.6.4.4 Northwest Region Seabird Bycatch

Seabird bycatch estimates were provided for five Northwest Region commercial fisheries. Although bycatch estimates were based on a single year of data (2005), some fractional values were reported due to the estimation process. No seabird bycatch was reported in the California/Oregon nearshore rockfish fishery. Low levels of seabird bycatch were reported for the West Coast groundfish non-trawl limited-entry sablefish-endorsed fixed gear fishery (56 black-footed albatross), the West Coast groundfish non-trawl non-endorsed fixed gear fishery (36 brown pelicans), the West Coast mid-water hake trawl fishery (10 seabirds from five populations), and the West Coast limited-entry groundfish bottom trawl fishery (4 unidentified gulls).

Seabird bycatch estimates were provided for seven populations, with two populations identified as key stocks (Figure 5.24). Total seabird bycatch in the 2005 West Coast fisheries was estimated at 106 animals. Black-footed albatross and brown pelican, considered key stocks, had bycatch estimates of 58.8 and 35.6 animals, respectively. The black-footed albatross is on the USFWS list of Birds of Conservation Concern; under the ESA, it is considered either stable, increasing, or decreasing, because different colonies are experiencing different population trends (Naughton et al. 2008a). The brown pelican was listed as endangered under the ESA, but was delisted in 2009; however, this report shows it as ESA-listed for consistency with the timeframe of the report overall.

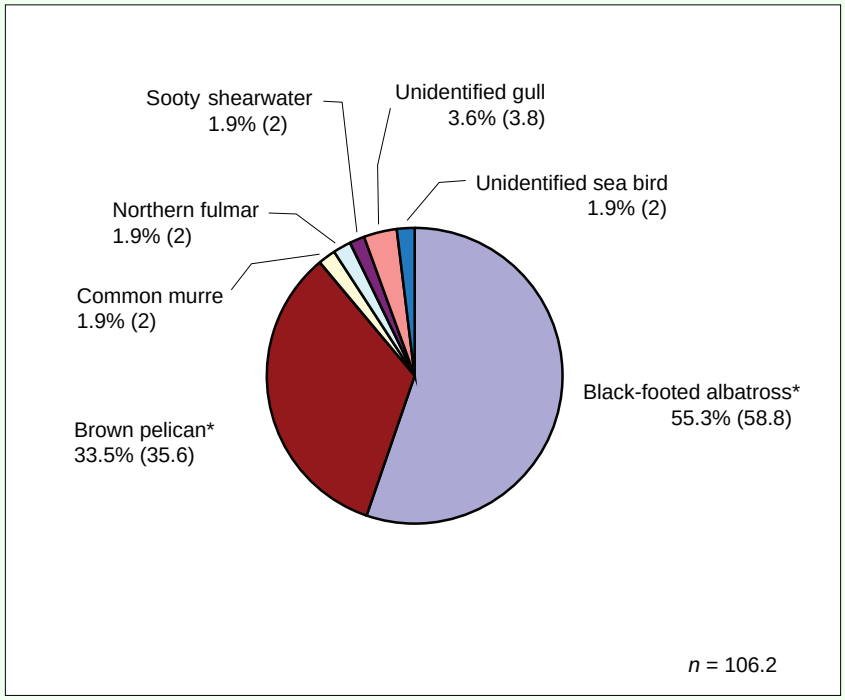


Figure 5.24
Seabird bycatch in the Northwest Region (*n* = total number of bycaught animals). The baseline year of data used in this report was 2005; however, for some rare-event species multiple years of data were used to generate a bycatch estimate. Stocks for which bycatch estimates were zero are not shown. * indicates key stocks.

5.6.4.5 Southwest Region Seabird Bycatch Estimates

Seabird bycatch estimates were not calculated for Southwest Region commercial fisheries for the period covered by this report. Previous estimates of seabird bycatch for fisheries in this region can be found in journal articles published by the Southwest Region (Julian and Beeson 1998; Carretta et. al. 2005).

5.6.4.6 Pacific Islands Region Seabird Bycatch

Seabird bycatch was observed in the Hawaii-based shallow-set pelagic longline fishery (swordfish) and the Hawaii-based deep-set pelagic longline fishery (tuna), with an estimated annual total of 128 seabirds bycaught in the deep-set fishery and 69 seabirds bycaught in the shallow-set fishery. Laysan albatross were the main bycatch in the shallow-set fishery (62 of the 69 animals), while black-footed albatross and Laysan albatross were both bycaught in the deep-set fishery (82 and 43 animals, respectively).

Seabird bycatch estimates were provided for four populations, with all populations identified as key stocks (Figure 5.25). The estimated annual total number of seabirds bycaught in Pacific Islands fisheries was 197 animals. Bycatch estimates were 89 black-footed albatross, 3 brown booby, 105 Laysan albatross, and 0 short-tailed albatross. The stock status for these populations is unknown.

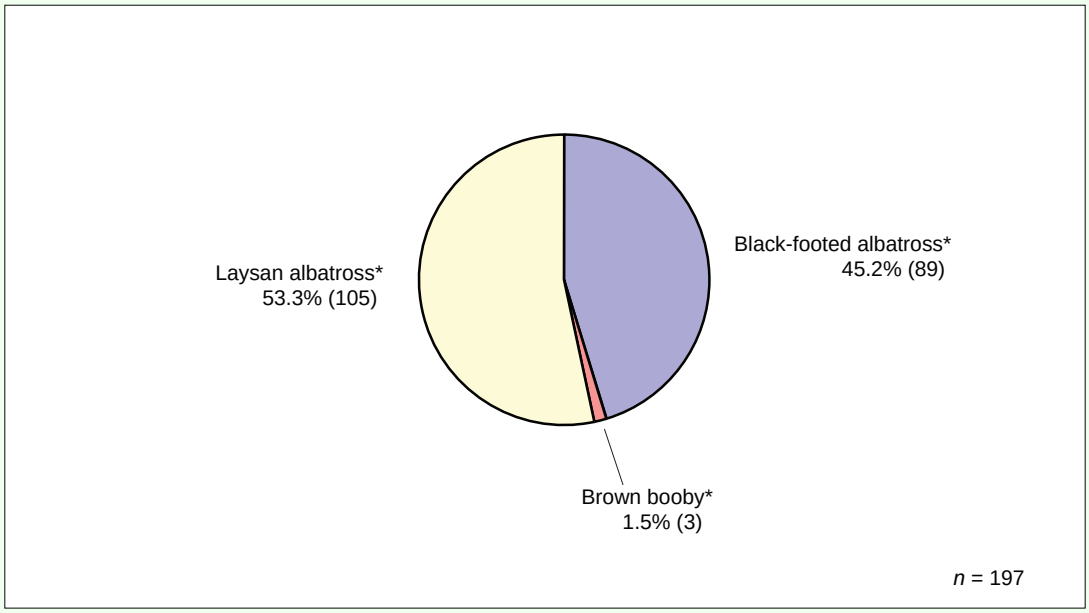


Figure 5.25
Seabird bycatch in the Pacific Islands Region (*n* = total number of bycaught animals). The baseline year of data used in this report was 2005; however, for some rare-event species multiple years of data were used to generate a bycatch estimate. Stocks for which bycatch estimates were zero are not shown. * indicates key stocks.

5.7 National and Regional Estimates of Overall Bycatch

Estimated fish bycatch for the U.S. commercial fisheries considered in this report totaled 1.221 B pounds, while associated landings for these fisheries totaled over 6.068 B pounds (Table 5.6). The resulting estimated overall bycatch ratio (defined as the ratio of bycatch to total catch, where total catch equals landings plus bycatch) for fish bycatch in all U.S. commercial fisheries considered in this report is 0.17 (rounded from the calculated ratio of 0.167543); note that calculations in Table 5.7 are based on the true ratio (0.167543). The ratio 0.17 is referred to as the "overall bycatch ratio" in the subsequent discussion. The computation of an overall bycatch ratio did not include bycatch of protected species; for fisheries considered in this report, total estimated bycatch of marine mammals was 1,887 individual animals, of sea turtles was 11,772 animals, and of seabirds was 7,769 animals.

In some fisheries, insufficient data were available for analysis. For other fisheries, analytical methods for estimating some types of bycatch were not available when the report was compiled (e.g., bycatch estimates were not provided for fish species in the Southwest Region or for seabirds in the Northeast and Southwest Regions). In addition, fish bycatch estimates were provided in numbers of individuals for some Southeast and Northwest Region fisheries, and these estimates were not included in the calculation of total U.S. bycatch, because factors for converting numbers to weights were not available.

Table 5.7 provides estimates of overall regional and national fish bycatch (i.e., bycatch associated with all U.S. fisheries including those considered in this report and summarized in Table 5.6 and those not considered in this report). For each region, the overall bycatch ratio (0.167543) was applied to the total landings for those fisheries not considered in the U.S. National Bycatch Report to compute an estimate of fish bycatch (i.e., unknown bycatch was calculated using the bycatch ratio for known bycatch and landings). Computation employed the formula bycatch = (0.167543356 × Landings) / (1 – 0.167543), where 0.167543 is the overall bycatch ratio described above. This provided a basis for estimating total bycatch for each region, and the resulting bycatch estimates were summed to provide an overall national bycatch estimate of 1.934 B pounds (Table 5.7).

Bycatch ratios for U.S. commercial fisheries published by the FAO (Kelleher 2004) and Harrington et al. (2005) for the period 2002–2003 were higher than the estimate calculated herein, which is based on 2005 data (Table 5.8). Correspondingly, the overall total bycatch estimate provided in this report is lower than those reported by FAO (Kelleher 2004; 2.045 B pounds) and Harrington et al. (2005; 2.333 B pounds). These reports obtained bycatch estimates and as-

Table 5.6

Estimated total fisheries landings and bycatch, by type and region, for fisheries considered in the U.S. National Bycatch Report. Data are generally from 2005, except for some rare-event species estimates for which bycatch data are averaged over a number of years. Weights were rounded to the nearest thousand pounds.

Region	Fish bycatch (lb)	Fish landings (lb)	Marine mammal bycatch (individuals)	Sea turtle bycatch (individuals)	Seabird bycatch (individuals)
Northeast	165,888,000	1,006,370,000	1,287	1,062	Not available
Southeast	682,691,000	219,086,000	233	10,671[a]	186
Alaska	338,573,000	4,487,167,000	62	0[b]	7,280
Northwest	25,564,000	332,396,000	37	0[b]	106
Southwest[c]	–	–	242	1	Not available
Pacific Islands	8,556,000	23,000,000	26	38	197
TOTALS	1,221,272,000	6,068,019,000	1,887	11,772	7,769

[a] Bycatch mortality estimates from the NMFS 2002 Biological Opinion on the Shrimp Fisheries of the Southeastern United States. Since that time, effort in the shrimp fishery, and associated bycatch, has decreased markedly.
[b] Sea turtle bycatch has not been observed in Alaska or the Northwest Region.
[c] Southwest region landings are not included, since fish bycatch estimates from the region were not available.

Table 5.7
Regional and national fish bycatch and ratio estimates for all U.S. commercial fisheries.

	2005 landings (lb)				2005 bycatch (lb)			
Region	Fisheries considered in the U.S. National Bycatch Report	Fisheries not considered in the U.S. National Bycatch Report	Total	% of total landings sampled	Fisheries considered in the U.S. National Bycatch Report	Regional bycatch Ratios [a,b]	Fisheries not considered in the U.S. National Bycatch Report	Total
Northeast	1,006,370,000	385,816,000	1,392,186,000	0.72	165,888,000	0.14	77,651,000	243,539,000
Southeast	219,086,000	1,093,033,000	1,312,119,000	0.17	682,691,000	0.76	219,987,000	902,678,000
Alaska	4,487,167,000	1,164,140,000	5,651,307,000	0.79	338,573,000	0.07	234,299,000	572,872,000
Northwest	332,396,000	523,464,000	855,860,000	0.39	25,564,000	0.07	105,354,000	130,918,000
Southwest	–	367,830,000	367,830,000	0.00	–	–	74,031,000	74,031,000
Pacific Islands	23,000,000	9,244,000	32,244,000	0.71	8,556,000	0.27	1,860,000	10,416,000
National Total	6,068,019,000	3,543,527,000	9,611,546,000	0.63	1,221,272,000	0.17	713,182,000	1,934,454,000

[a] Regional bycatch ratios include only fisheries considered in the U.S. National Bycatch Report.
[b] The formula for the bycatch ratios used in this report is bycatch / (bycatch + landings).

sociated landings data from published and grey literature, while the estimates used here are based on raw data, as well as data obtained from a range of published and unpublished reports. In addition, FAO (2002) reports that their database may be biased in favor of fisheries with high discards and this would result in an overall overestimate of bycatch. This type of positive bias is also likely for the Harrington et al. (2005) report, which also included a subset of fisheries.

Since both reports drew information from a smaller subset of fisheries than this report and, apparently, were more likely to include information on fisheries with noteworthy bycatch concerns, higher overall bycatch rate estimates might be expected. Since this report is more comprehensive, the bycatch ratio estimate in this report should be considered to be the best estimate currently available. It is apparent that the authors of the FAO (Kelleher 2004) and Harrington et al. (2005) reports encountered considerable difficulty in obtaining comprehensive and accurate catch and bycatch data and found it necessary to make extrapolations based on a range of assumptions. This report, while more inclusive,

Table 5.8
Comparison of fish bycatch estimates for U.S. commercial fisheries from the National Bycatch Report with previously published estimates. Bycatch ratios are calculated as the total bycatch divided by the total catch (bycatch plus landings).

Reference	Year of source data	Total bycatch estimate (lb)	Total landings (lb)	Bycatch ratio
U.S. National Bycatch Report (2011)	2005	1,934,454,000	9,611,546,000	0.17
FAO (Kelleher 2004)*	2002	2,045,006,000*	7,373,224,000*	0.22
Harrington et al (2005)	2002–03	2,332,894,000*	8,194,516,000*	0.22

* Converted from metric tons.

also required extrapolation of estimates for many fisheries and species due to data limitations. This serves to emphasize the need for reporting of accurate and comprehensive information of the type presented here, and the importance of updating this report frequently and expanding its scope as information on additional U.S. fisheries becomes available.

Bycatch estimates for marine mammals, sea turtles, and seabirds were recently reported by Moore et al. (2009). which provided an overall national estimate for marine mammals only. The estimate of national marine mammal mortality by Moore et al. (2009) was 3,029–3,187 animals annually for the period 1990–99, while our estimate is 1,887 animals annually (using 2005 data, although some were for a range of years). Because the data presented in Moore et al. (2009) are based on averages across a time-frame earlier than that utilized in this report, a direct comparison with estimates presented herein is not possible. In a broad comparison, the U.S. National Bycatch Report contains lower bycatch estimates, but this report does not speculate as to the reasons that the estimates are different.

5.8 Improving Bycatch Data Collection and Estimation

This report identifies national and regional recommendations to improve bycatch data collection and estimation (summarized in Table 5.9). Maintenance and expansion of existing observer programs and implementation of new observer programs for fisheries and species with bycatch concerns are of particular importance. Funding levels for

Table 5.9
Resources needed to implement recommendations for improving bycatch data collection and estimation. Details are provided in Appendix 5.

Recommendation [a]	National Observer Program	Northeast	Southeast	Alaska	Northwest	Southwest	Pacific Islands	Total
Days at sea (DAS) [b] needed to maintain current observer programs	na	13,208	4,085	39,000	4,596	329	9,739	70,957
DAS needed to expand current observer programs	na	16,181[e]	11,790	29,160	792	430	855	59,209
DAS needed to implement new observer programs	na	615	5,752	0 [f]	1,058	20	0	7,425
Full-time staff needed to implement improvements to estimation methods [c]	10 [d]	17	7	13	1	1	6	55

[a] Some recommendations may require additional resources such as equipment or staff support, which are not itemized.
[b] DAS estimates for maintaining and expanding current observer programs are based on 2008 figures.
[c] Observer program staffing and administrative needs are included when budgeting the cost for DAS and are not included in this table.
[d] Staffing support would not be directly for the National Observer Program, but would be used to assist with implementation of national recommendations.
[e] DAS estimate for the Northeast includes both fish and protected species needs; in some cases, DAS could be shared, and thus the overall number of DAS would be reduced.
[f] For the Alaska Region, much of the increased coverage would be applied to fisheries and vessels that have not previously been observed.

all existing regional observer programs, as of 2008, totaled $53.1 M (Federal and industry funds). Many specific recommendations are made here to improve observer program data, supplemental data, and analytical techniques within each region; these recommendations are summarized here, and are presented in detail in the regional sections of Section 4. It was not possible to prioritize individual recommendations among regions due to the diversity in fisheries, management needs, and other factors. Eight national-level recommendations are provided below. These focus on improving data and estimation quality for fisheries and species considered in this edition of the U.S. National Bycatch Report, and on considering additional fisheries and species in future editons of the report. All recommendations should be considered to have high priority, although some could be implemented relatively quickly and inexpensively while others would require considerable investment of time and financial resources. As more fisheries and species are evaluated and reported, it is likely that additional resource needs will be identified.

Recommendation #1:
Develop and adopt best practices for estimating bycatch in U.S. commercial fisheries.

Methods for estimating bycatch vary by region and fishery. While all methods have been subjected to some level of review, many have not been formally peer reviewed. Further work to evaluate and improve current methods and to develop new approaches will lead to establishment of best practices, including procedures for estimation of variance and methods for extrapolating estimates from small sample sizes. Where numbers-based methods are currently employed, weight-based approaches should be developed and implemented. Improving the quantity and quality of bycatch estimates is essential to support the information needs for management of commercial fisheries and protected resources. Provision of measures of uncertainty associated with bycatch estimates is important for tracking improvements in estimation methods and bycatch trends.

Recommendation #2:
Improve national and regional catch databases.

Estimation of bycatch rates requires reliable information on total catch at the stock level. Inconsistencies between regional and national databases impeded estimation of stock bycatch ratios in a number of instances. Overall database improvements are necessary to resolve this problem. These types of improvements will enhance both quality and timelines of bycatch estimates, as well as consistency of estimates made by different researchers.

Recommendation #3:
Review and modify the tier classification system for application to commercial and recreational fisheries included in future editions of the U.S. National Bycatch Report.

Future editions of the U.S. National Bycatch Report should include bycatch estimates for additional commercial and recreational fisheries. The tier classification system developed in this report should be modified as necessary and applied to additional fisheries where possible. Coordination will be required with state, tribal, and international organizations to ensure accuracy and consistency. In order to maximize the usefulness of the tier system for tracking change and highlighting requirements for improvement, it will need to be as comprehensive as possible.

Recommendation #4:
Increase the number of fishery and species bycatch estimates included in future editions of the U.S. National Bycatch Report.

- Commercial Fisheries Bycatch Estimates: Efforts should be taken to develop bycatch estimates for all commercial fisheries where the necessary data are available. These estimates should be included in future editions of the U.S. National Bycatch Report. In the longer term, new data-collection programs should be implemented to address bycatch estimation information needs for those commercial fisheries identified as requiring bycatch monitoring.

- Recreational Fisheries Bycatch Estimates: Inclusion of recreational bycatch estimates is necessary to estimate overall bycatch mortality for some stocks. Development of appropriate bycatch data-collection and analytical methods should be encouraged and supported.

- Bycatch Estimates for Key Stocks: Lack of bycatch estimates for some of the key stocks identified in this report is of particular concern. Development of bycatch estimates for these stocks should be prioritized and should be included in future editions of the U.S. National Bycatch Report.

Providing additional stock- and fishery-specific bycatch estimates in future editions of the U.S. National Bycatch Report will provide new information to the public on the overall status of bycatch in the Nation's fisheries. Scientists and managers will be able to make use of this information for assessment and management, for evaluating the effectiveness of bycatch reduction measures, and for identifying areas where improved management and/or innovative bycatch reduction methods are required.

Recommendation #5:
Implement specific bycatch data-collection and estimation improvements in regional programs.

Several recommendations were made for improvement of bycatch data collection and estimation within the regions. These include discard mortality studies; outreach; database infrastructure improvements; and collection and processing of supplemental data, especially logbooks, VMS, and strandings and entanglement data, which are often essential for estimating bycatch. These types of data are required in many bycatch estimation approaches and are often lacking or of poor quality. Thus these types of improvements will result in overall improvements in bycatch data quality and the number of fisheries and stocks for which bycatch estimates are available.

Recommendation #6:
Maintain and expand existing regional observer programs.

Observer programs have been implemented in all NMFS regions; observer data are considered to be the most reliable basis for bycatch estimation. Many U.S. observer programs are at suboptimal coverage levels, which vary depending on the characteristics of a fishery and the species of interest. Specific recommendations for maintaining and expanding observer coverage to optimal levels in existing programs are made in the regional sections. Maintenance of these programs is essential for ongoing estimation of bycatch and evaluation of mitigation measures. Expanding coverage of existing observer programs will improve the accuracy and precision of bycatch estimates in many instances.

Recommendation #7:
Implement new observer programs for fisheries and species with bycatch concerns.

New observer programs are recommended in most regions for a total of 32 fisheries. These fisheries were identified as fisheries of focus, as describesd in Section 3 (e.g. fisheries with a high bycatch ratio, bycatch of key stocks, or that were identified through the qualitative process). Pilot observer coverage has been recommended by the applicable regional team as an initial step address bycatch concerns in several instances. Recommendations for new observer programs also include electronic monitoring in some regions. Implementing new pilot observer programs will provide information on bycatch in fisheries where bycatch information is currently unavailable or available only in the form of unverified industry reports.

Recommendation #8:
Evaluate electronic monitoring systems, conduct pilot studies, and operationalize electronic monitoring technology where appropriate.

Use of video cameras and other electronic data acquisition systems (collectively termed electronic monitoring or EM) has increased markedly during the last decade. Electronic monitoring has been used successfully for compliance monitoring and verification of self-reporting, and can provide useful information on catch quantity and composition, although species identification is only possible in some instances. The approach holds promise for addressing certain types of objectives (e.g., monitoring for compliance with discard prohibitions) and should be able to provide more detailed information on catch and bycatch composition as the technologies advance.

5.9 Conclusions

The recommendations included in this report provide guidance to the Agency in setting priorities for maintaining existing bycatch data-collection programs, expanding programs where more reliable bycatch information is needed, and implementing new bycatch data-collection programs for fisheries with potential bycatch concerns. Implementation of these recommendations will assist NMFS in increasing baseline knowledge of bycatch levels, help identify fisheries and/or stocks with potential bycatch concerns, and improve the monitoring of bycatch levels over time. Improved bycatch estimates will support the implementation of MSA-required annual catch limits (ACLs) and new management approaches such as catch-share programs, and in general will aid the NMFS in addressing fishery-specific conservation and management concerns.

Two performance measures have been developed from the information compiled in this report: 1) the tier classification system, which will be used to monitor the quality of bycatch estimates in U.S. commercial fisheries, and 2) a list of key stocks, which will be used to monitor bycatch trends over time. These performance measures will assist NMFS in continuing to improve the effectiveness of bycatch monitoring programs, as well as reducing bycatch in key fisheries.

This is the first in a series of U.S. National Bycatch Reports. This edition contains bycatch estimates for federally managed commercial fisheries or with relevant Federal data-collection programs. Future editions will include timely and period updates on bycatch estimates for Federal fisheries, as well as estimates for state, international, and tribal fisheries where data are available. Inclusion of bycatch estimates

for stocks with high recreational bycatch mortality will also be considered. Over time, the U.S. National Bycatch Report will provide NMFS, other fisheries management organizations, and the public with reliable bycatch estimates for all living marine resources which can be used to more effectively meet NMFS' stewardship mission.

Appendix 5 Recommendations for Improvement.

Table 5.A

Recommendations by region for improving bycatch data-collection and estimation methods, including estimates of observer DAS and feasibility of implementation. Requirements for maintaining existing programs are not listed for individual fisheries, but are listed as a total cost for each region (**). Recommendations in this table are summarized from information contained in the regional sections; please refer to Sections 4.1–4.6 for detailed information on the DAS and feasibility, as well as rationale, for each recommendation included herein.

REGION	FISHERY	RECOMMENDATION	DAS	FEASIBILITY
General Recommendations				
National	All Fisheries	The NMFS should continue internal review of regional bycatch estimation methods and evaluate the potential development and adoption of a national standardized method for estimating bycatch in U.S. commercial fisheries.	NA	High
National	All Fisheries	The tier classification system should be applied to all fisheries included in future editions of the U.S. National Bycatch Report, including state, tribal, and international fisheries.	NA	Medium
National	All Fisheries	A modified tier classification system should be developed to evaluate recreational fishery bycatch estimates.	NA	High
National	All Fisheries	Bycatch estimates should be provided in future editions of the U.S. National Bycatch Report for all key stocks, to allow for monitoring of bycatch trends over time at both the regional and national levels.	NA	High
National	All Fisheries	Fishery bycatch estimates should be calculated for additional U.S. commercial fisheries.	NA	Medium
National	All Fisheries	Where fishery bycatch estimates are calculated in numbers of fish, conversion factors to pounds should be developed or bycatch data should be collected in pounds of fish.	NA	High
National	All Fisheries	Improvements should be made in the collection of total catch figures by individual species, to allow calculation of stock bycatch ratios.	NA	High
Northeast	All Fisheries	Initiate study of discard mortality (via special studies, study fleets, etc.) for multiple fisheries.	NA	High
Northeast	All Fisheries	Improve database infrastructure for multiple fisheries.	NA	High
Northeast	All Fisheries	Implement Serious Injury Protocol for determining serious injuries, and update observer program data-collection forms (protected species).	NA	High
Northeast	All Fisheries	Conduct assessment of needs for seabird bycatch data collection and estimation (protected species).	NA	High
Northeast	Mid-Atlantic Gillnet Fisheries	Informational mailing to gillnetters using vessel trip report forms (protected species).	NA	High

Table 5.A (continued)

REGION	FISHERY	RECOMMENDATION	DAS	FEASIBILITY
General Recommendations (cont.)				
Northeast	New England Gillnet Fisheries	Informational mailings for all fisheries in New England gillnet fisheries using vessel trip report forms (protected species).	NA	High
Southeast	Southeastern Atlantic and Gulf of Mexico Shark Bottom Longline Fishery	Instruct Southeastern Atlantic and Gulf of Mexico shark bottom longline fishers to report to one logbook.	NA	Low
Observer Coverage Maintain and Expand Current Observer Coverage				
Northeast	Mid-Atlantic Scallop Dredge Fisheries	Maintain current observer program coverage levels in the Mid-Atlantic general category open-area scallop dredge fishery.	**	High
Northeast	Mid-Atlantic Scallop Dredge Fisheries	Maintain current observer program coverage levels in the Mid-Atlantic limited-access closed-area scallop dredge fishery.	**	High
Northeast	Mid-Atlantic Scallop Dredge Fisheries	Maintain current observer program coverage levels in the Mid-Atlantic limited-access open-area scallop dredge fishery.	**	High
Northeast	Mid-Atlantic Scallop Trawl Fisheries	Maintain current observer program coverage levels in the Mid-Atlantic general category scallop trawl fishery.	**	High
Northeast	New England Bottom Longline Fisheries	Maintain current observer program coverage levels in the New England bottom longline fishery.	**	High
Northeast	New England Bottom Longline Fisheries	Maintain current observer program coverage levels in the New England haddock sector longline.	**	High
Northeast	New England Gillnet Fisheries	Maintain current observer program coverage levels for the New England extra-large-mesh gillnet fishery.	**	High
Northeast	New England Gillnet Fisheries	Maintain current observer program coverage levels for the New England large-mesh gillnet fishery.	**	High
Northeast	New England Otter Trawl Fisheries	Maintain current observer program coverage levels in the New England large-mesh otter trawl fishery.	**	High
Northeast	New England Otter Trawl Fisheries	Maintain current observer program coverage levels in the New England B REG DAS large mesh otter trawl fishery.	**	High
Northeast	New England Otter Trawl Fisheries	Maintain current observer program coverage levels in the New England US/CAN area large-mesh otter trawl fishery.	**	High
Northeast	New England Otter Trawl Fisheries	Maintain current observer program coverage levels in the New England US/CAN area small-mesh otter trawl fishery.	**	High
Northeast	New England Otter Trawl Fisheries	Increase observer coverage in the New England small-mesh otter trawl fishery.	1,562	High
Northeast	New England Scallop Dredge Fisheries	Maintain current observer program coverage levels but improve temporal coverage in the New England general category closed-area scallop dredge fishery.	**	High

Table 5.A (continued)

REGION	FISHERY	RECOMMENDATION	DAS	FEASIBILITY
Observer Coverage Maintain and Expand Current Observer Coverage (cont.)				
Northeast	New England Scallop Dredge Fisheries	Maintain current observer program coverage levels in the New England limited-access closed-area scallop dredge fishery.	**	High
Northeast	New England Scallop Dredge Fisheries	Increase observer coverage in the New England limited-access open area scallop dredge fishery.	91	High
Northeast	Mid-Atlantic Gillnet Fisheries	Increase observer coverage of the Mid-Atlantic extra-large-mesh gillnet fishery to obtain pilot coverage.	20	High
Northeast	Mid-Atlantic Gillnet Fisheries	Increase observer coverage to achieve 30% uncertainty[a] across all Mid-Atlantic gillnet fisheries (protected species).	500	High
Northeast	Mid-Atlantic Otter Trawl Fisheries	Increase observer coverage in the Mid-Atlantic large-mesh otter trawl fishery .	342	High
Northeast	Mid-Atlantic Otter Trawl Fisheries	Increase observer coverage in the Mid-Atlantic small-mesh otter trawl fishery.	659	High
Northeast	Mid-Atlantic Otter Trawl Fisheries	Increase observer coverage to achieve 30% uncertainty[a] across all Mid-Atlantic otter trawl fisheries (protected species).	500	High
Northeast	New England Gillnet Fisheries	Increase observer coverage to achieve 30% CV across all New England gillnet fisheries (protected species).	600	High
Northeast	Mid-Atlantic Mid-Water Paired Trawl Fishery	Deploy an additional observer for all paired-trawl trips in the Mid-Atlantic mid-water paired trawl fishery.	NA	High
Northeast	Mid-Atlantic Mid-Water Otter Trawl Fishery	Increase observer coverage in the Mid-Atlantic mid-water otter trawl fishery.	512	High
Northeast	New England Handline Fishery	Increase observer coverage in the New England handline fishery to obtain pilot coverage.	110	High
Northeast	New England Purse Seine Fishery	Maintain current observer program coverage levels in the New England purse seine fishery.	**	High
Northeast	New England Mid-Water Otter Trawl Fishery	Increase observer coverage in the New England mid-water otter trawl.	35	High
Northeast	New England Shrimp Trawl Fishery	Maintain current observer program coverage levels but improve temporal coverage in the New England shrimp trawl fishery.	**	High
Northeast	New England Otter Trawl Fisheries	Increase observer coverage to achieve 30% uncertainty[a] across all New England otter trawl fisheries (protected species).	10,000	Moderate
Northeast	Mid-Atlantic Gillnet Fisheries	Expand number of fishing effort variables collected by states across all Mid-Atlantic gillnet fisheries.	NA	Low
Northeast	New England Single Mid-Water Trawl Fishery	Increase observer coverage of the New England single mid-water trawl fishery (protected species).	1,250	Moderate

Table 5.A (continued)

REGION	FISHERY	RECOMMENDATION	DAS	FEASIBILITY
Observer Coverage Maintain and Expand Current Observer Coverage (cont.)				
Northeast	Mid-Atlantic Otter Trawl Fisheries	Direct observer coverage to areas of suspected high sea turtle bycatch.	Unknown	Unknown
TOTAL NORTHEAST TO MAINTAIN CURRENT OBSERVER COVERAGE[b]			13,208	
TOTAL NORTHEAST TO EXPAND CURRENT OBSERVER COVERAGE			16,181	
TOTAL NORTHEAST TO MAINTAIN AND EXPAND CURRENT OBSERVER COVERAGE[b]			29,389	
Southeast	Gulf of Mexico Reef Fish Bottom Longline Fishery	Maintain and refine observer program, including determination of needed sample size to achieve 30% uncertainty[a] for the ten most commonly discarded species, for the Gulf of Mexico reef fish bottom longline fishery.	1,667	High
Southeast	Gulf of Mexico Shrimp Trawl Fishery	Maintain and refine current Gulf of Mexico shrimp trawl observer program.	5,000	High
Southeast	Large Coastal and Small Coastal Shark Aggregate Fishery	Increase observer coverage for the large coastal and small coastal shark aggregate (drift, strike, and bottom gillnet) fishery.	540	High
Southeast	North Carolina Inshore Gillnet Fishery	Expand North Carolina inshore (bays and rivers) gillnet observer program to cover any additional open components of the fishery.	250	High
Southeast	Southeastern Atlantic Shrimp Trawl Fishery	Maintain and refine current Southeastern Atlantic shrimp trawl observer program.	833	High
Southeast	Southeastern Atlantic and Gulf of Mexico HMS Pelagic Longline Fishery	Increase observer coverage for the Southeastern Atlantic and Gulf of Mexico HMS pelagic longline fishery to achieve 30% uncertainty[a] in all strata.	3,500	Moderate
TOTAL SOUTHEAST TO MAINTAIN CURRENT OBSERVER COVERAGE[b]			4,085	
TOTAL SOUTHEAST TO EXPAND CURRENT OBSERVER COVERAGE			11,790	
TOTAL SOUTHEAST TO MAINTAIN AND EXPAND CURRENT OBSERVER COVERAGE[b]			15,875	
Alaska	Multiple Fisheries	Maintain current levels for currently observed fisheries.	**	High
Alaska	Multiple Fisheries	Observer program operations and administration adjustment.	NA	High
Alaska	Multiple Fisheries	Increase coverage for sector observed at 30% and implement coverage for unobserved sectors (<60 feet, Pacific halibut fishery).	20,000	High
Alaska	Multiple Fisheries	Improve length of AMMOP observation cycle from 14 to 5 years.	9,160	High
Alaska	Multiple Fisheries	Hire 3 to 5 FTEs to support AMMOP.	NA	High
TOTAL ALASKA TO MAINTAIN CURRENT OBSERVER COVERAGE[b,c]			39,000	
TOTAL ALASKA TO EXPAND CURRENT OBSERVER COVERAGE[d]			29,160	
TOTAL ALASKA TO MAINTAIN AND EXPAND CURRENT OBSERVER COVERAGE[b,c,d]			68,160	

Table 5.A (continued)

REGION	FISHERY	RECOMMENDATION	DAS	FEASIBILITY
Observer Coverage Maintain and Expand Current Observer Coverage (cont.)				
Northwest	Multiple Fisheries	Maintain current levels for currently observed fisheries.	**	High
Northwest	West Coast Groundfish Non-Trawl Gear, Non-Endorsed Fixed Gear	Increase observer coverage for West Coast groundfish non-trawl gear, non-endorsed fixed gear.	167	High
Northwest	CA/OR Nearshore Rockfish Fishery	Increase observer coverage of the California/Oregon nearshore rockfish fishery.	625	High
TOTAL NORTHWEST TO MAINTAIN CURRENT OBSERVER COVERAGE [b,c]			4,596	
TOTAL NORTHWEST TO EXPAND CURRENT OBSERVER COVERAGE [d]			792	
TOTAL NORTHWEST TO MAINTAIN AND EXPAND CURRENT OBSERVER COVERAGE [b,c,d]			5,388	
Southwest	California Coastal Purse Seine Fishery (anchovy, mackerel, sardine)	Increase observer coverage of the California coastal purse seine for anchovy, mackerel, and sardine fishery to 10%.	50	High
Southwest	California Coastal Purse Seine Fishery (tuna)	Increase observer coverage of the California coastal purse seine fishery for tuna to 100%.	20	High
Southwest	California Coastal Purse Seine Fishery (squid)	Increase observer coverage of the California coastal purse seine fishery for squid to at least 10% of all sets.	110	High
Southwest	California Small-Mesh Drift Gillnet Fishery	Increase observer coverage of the California small-mesh drift gillnet (mesh size >3.5 inches and < 14 inches) to 20%.	20	High
Southwest	California/Oregon Drift Gillnet Fishery	Increase observer coverage of the California/Oregon drift gillnet (mesh size >14 inches) fishery targeting swordfish and thresher shark to 30%.	130	Moderate
Southwest	California Set Gillnet Fishery	Increase observer coverage of the California set gillnet (mesh size up to 14 inches) to 20%.	100	Moderate
TOTAL SOUTHWEST TO MAINTAIN CURRENT OBSERVER COVERAGE [b]			329	
TOTAL SOUTHWEST TO EXPAND CURRENT OBSERVER COVERAGE			430	
TOTAL SOUTHWEST TO MAINTAIN AND EXPAND CURRENT OBSERVER COVERAGE [b]			759	
Pacific Islands	Hawaii Deep- and Shallow-Set Pelagic Longline Fisheries	Maintain current observer program coverage levels for the Hawaii deep- and shallow-set pelagic longline fisheries.	**	High
Pacific Islands	American Samoa Pelagic Longline Fishery	Increase observer program coverage levels for the American Samoa pelagic longline fishery to 40%.	855	High
TOTAL PACIFIC ISLANDS TO MAINTAIN CURRENT OBSERVER COVERAGE [b]			9,739	
TOTAL PACIFIC ISLANDS TO EXPAND CURRENT OBSERVER COVERAGE			855	
TOTAL PACIFIC ISLANDS TO MAINTAIN AND EXPAND CURRENT OBSERVER COVERAGE [b]			10,594	
NATIONAL TOTAL TO MAINTAIN CURRENT OBSERVER COVERAGE [b,c,d]			70,957	
NATIONAL TOTAL TO EXPAND CURRENT OBSERVER COVERAGE [d]			59,208	
NATIONAL TOTAL TO MAINTAIN AND EXPAND CURRENT OBSERVER COVERAGE [b,c,d]			130,165	

Table 5.A (continued)

REGION	FISHERY	RECOMMENDATION	DAS	FEASIBILITY
Observer Coverage Implement New Observer Programs				
Northeast	Mid-Atlantic Scallop Dredge Fisheries	Implement pilot observer coverage for the Mid-Atlantic general category closed-area scallop dredge fishery.	12	High
Northeast	New England Scallop Dredge Fisheries	Implement pilot observer coverage in the New England general category open-area scallop dredge fishery.	127	High
Northeast	Mid-Atlantic Gillnet Fisheries	Implement pilot observer program for the Mid-Atlantic large-mesh gillnet fishery.	91	High
Northeast	New England Gillnet Fisheries	Implement pilot observer coverage for the New England small-mesh gillnet fishery.	12	High
Northeast	Mid-Atlantic Gillnet Fisheries	Implement pilot observer program for the Mid-Atlantic small-mesh gillnet fishery.	15	High
Northeast	Mid-Atlantic Bottom Longline Fishery	Implement pilot observer coverage for the Mid-Atlantic bottom longline fishery.	19	High
Northeast	Mid-Atlantic Crab Pot Fishery	Implement pilot observer coverage for Mid-Atlantic crab pots.	12	High
Northeast	Mid-Atlantic Clam/ Quahog Dredge Fishery	Implement pilot observer coverage for the Mid-Atlantic clam/quahog dredge fishery.	21	High
Northeast	Mid-Atlantic Fish Pots/Traps Fishery	Implement pilot observer coverage for Mid-Atlantic fish pots/traps.	20	High
Northeast	Mid-Atlantic Atlantic Handline Fishery	Implement pilot observer coverage in the Mid-Atlantic handline fishery.	33	High
Northeast	Mid-Atlantic Lobster Pots	Implement pilot observer coverage for the Mid-Atlantic lobster pot fishery.	22	High
Northeast	Mid-Atlantic Purse Seine Fishery	Implement pilot observer coverage for the Mid-Atlantic purse seine fishery.	6	High
Northeast	Mid-Atlantic Shrimp Fishery	Implement pilot observer coverage for the Mid-Atlantic shrimp trawl fishery.	19	High
Northeast	New England Crab Pots	Implement pilot observer coverage for the New England crab pot fishery.	25	High
Northeast	New England Clam/Quahog Dredge Fishery	Implement pilot observer coverage for the New England clam/quahog dredge fishery.	12	High
Northeast	New England Fish Pots/Traps	Implement pilot observer coverage for the New England fish pot/trap fishery.	12	High
Northeast	New England Lobster Pots	Implement pilot observer coverage for the New England lobster pot fishery.	110	High
Northeast	New England Scottish Seine Fishery	Implement pilot observer coverage for the New England Scottish seine fishery.	23	High
Northeast	Mid-Atlantic Scallop Dredge Fisheries	Implement observer program coverage for general category vessels operating in open areas.	Unknown	High
Northeast	Mid-Atlantic Scallop Trawl Fisheries	Implement pilot observer coverage for the Mid-Atlantic limited-access scallop trawl fishery.	24	High

Table 5.A (continued)

REGION	FISHERY	RECOMMENDATION	DAS	FEASIBILITY
Observer Coverage Implement New Observer Programs (cont.)				
Northeast	Mid-Atlantic Scallop Trawl Fisheries	Implement observer program coverage for general category vessels operating in open areas.	Unknown	High
TOTAL NORTHEAST TO IMPLEMENT NEW OBSERVER PROGRAMS			615	
Southeast	South Atlantic Snapper–Grouper Bottom Longline Fishery	Develop a pilot observer program, including determination of needed sample size to achieve 30% uncertainty[a] for the ten most commonly discarded species, for the South Atlantic snapper–grouper bottom longline fishery.	1,600	High
Southeast	South Atlantic Snapper–Grouper Handline Fishery	Develop a pilot observer program, including determination of needed sample size to achieve 30% uncertainty[a] for the ten most commonly discarded species, for the South Atlantic snapper–grouper handline fishery.	1,600	High
Southeast	South Atlantic and Gulf of Mexico Reef Fish Fishery	Develop pilot programs to test the use of electronic video monitoring on reef fish vessels in the Gulf of Mexico and South Atlantic to augment data collected by observers. Pilot project on six vessels for 2 months.	120	Low
Southeast	Gulf of Mexico Coastal Pelagic Troll Fishery	Develop a pilot observer program, including determination of needed sample size to achieve 30% uncertainty[a] for the ten most commonly discarded species, for the Gulf of Mexico coastal pelagic troll fishery.	1,600	Moderate
Southeast	South Atlantic Coastal Migratory Pelagic Troll Fishery	Develop a pilot observer program, including determination of needed sample size to achieve 30% uncertainty[a] for the ten most commonly discarded species, for the South Atlantic coastal migratory pelagic troll fishery.	416	Moderate
Southeast	Gulf of Mexico Shrimp Trawl Fishery	Develop remote observer program (underwater video, etc.) for Gulf of Mexico shrimp trawl fishery to document takes.	416	High
TOTAL SOUTHEAST TO IMPLEMENT NEW OBSERVER PROGRAMS			5,752	
Northwest	West Coast Mid-Water Trawl Hake Fishery	Test and deploy electronic monitoring systems aboard the entire West Coast mid-water trawl hake fishery for at-sea catcher vessels.	225	High
Northwest	West Coast Non-Tribal Ocean Salmon Troll Fishery	Restore and expand state and tribal observer programs for the West Coast non-tribal ocean salmon troll fishery.	750	Moderate
Northwest	West Coast Tribal Ocean Troll Fishery	Restore and expand state and tribal observer programs for the West Coast tribal ocean troll fishery.	83	Moderate
TOTAL NORTHWEST TO IMPLEMENT NEW OBSERVER PROGRAMS			1058	
Southwest	California Swordfish Harpoon Fishery	Implement a pilot observer program for the California swordfish harpoon fishery at 10% observer coverage.	20	High
TOTAL SOUTHWEST TO IMPLEMENT NEW OBSERVER PROGRAMS			20	
NATIONAL TOTAL TO IMPLEMENT NEW OBSERVER PROGRAMS[d]			7,425	
NATIONAL TOTAL OBSERVER COVERAGE COST (MAINTAIN AND EXPAND EXISTING PROGRAMS, AND IMPLEMENT NEW PROGRAMS)[d]			137,591	

Table 5.A (continued)

REGION	FISHERY	RECOMMENDATION	DAS	FEASIBILITY
Supplemental Data				
Northeast	All fisheries	Improve industry data via expanded audits (fish and PR).	NA	High
Northeast	Mid-Atlantic Gillnet Fisheries	Expand number of fishing effort variables collected by states.	NA	Low
Northeast	Mid-Atlantic Otter Trawl Fisheries	Update vessel trip report logbooks to include a field for BRD presence/absence, and whether BRD was functioning properly.	NA	Unknown
Northeast	Mid-Atlantic Scallop Trawl Fisheries	Improve vessel trip report gear log to capture additional gear information.	NA	Unknown
Southeast	Multiple Fisheries	Change logbook system to define target by set for multiple fisheries.	NA	Low
Southeast	Gulf of Mexico Shrimp Trawl Fishery	Revise logbook and trip ticket programs for Gulf of Mexico shrimp trawl fishery to better estimate effort.	NA	Low
Southeast	Large Coastal and Small Coastal Shark Aggregate	Relate large coastal and small coastal shark aggregate (drift, strike, and bottom gillnet) fishery observer and logbook databases.	NA	High; currently being worked on
Southeast	Southeastern Atlantic and Gulf of Mexico Shark Bottom Longline Fishery	Correlate Southeastern Atlantic and Gulf of Mexico shark bottom longline fishery observer and logbook databases.	NA	High; currently being worked on
Northwest	California/Oregon Nearshore Rockfish Fishery	Explore additional sources of data for improving estimation methods in the California/Oregon nearshore rockfish fishery.	NA	High
Analytical Approach				
Northeast	Multiple Fisheries	Improve analytic approach via advances in the methods of estimators.	NA	High
Northeast	Mid-Atlantic Scallop Dredge Fisheries	Hire employee to process vessel monitoring system data for use in bycatch estimation in Mid-Atlantic limited-access open-area scallop dredge fishery (protected species).	NA	Unknown
Northeast	Mid-Atlantic Scallop Dredge Fisheries	Investigate effectiveness of analyzing the sea turtle bycatch rate by pooling data over year (protected species).	NA	High
Northeast	Mid-Atlantic Scallop Trawl Fisheries	Hire employee to process vessel monitoring system data for use in bycatch estimation.	NA	Unknown
Northeast	New England Gillnet Fisheries	Apply new regression methods to estimate bycatch of marine mammals in New England gillnet fisheries (protected species).	NA	High
Alaska	Multiple Fisheries	Catch Accounting System (CAS) improvements (one-time cost).	Unknown	High
Alaska	Multiple Fisheries	Improve seabird monitoring and bycatch estimation (one-time cost).	Unknown	High
Northwest	Multiple Fisheries	Fund additional data analyst time to improve estimation methods for West Coast Groundfish Observer Program.	NA	High

Table 5.A (continued)

REGION	FISHERY	RECOMMENDATION	DAS	FEASIBILITY
Analytical Approach (cont.)				
Southwest	Multiple Fisheries	Hire finfish bycatch analyst to generate annual bycatch estimates for multiple fisheries	NA	High
Southwest	California Pelagic Longline Fisheries	Aggregate bycatch of the California pelagic longline fishery with longline fisheries operating out of Hawaii to avoid data confidentiality issues.	NA	High
Pacific Islands	Hawaii Deep- and Shallow-Set Longline Fisheries	Develop and maintain statistical estimator for discarded fish weight in the Hawaii deep- and shallow-set longline fisheries.	NA	High
Pacific Islands	Hawaii Deep- and Shallow-Set Longline Fisheries	Develop and maintain statistical estimator for discarded fish weight in the American Samoa Longline fishery.	NA	High
DAS REQUIREMENTS TO BE MAINTAINED [b,c]			70,957	
TOTAL ADDITIONAL DAS NEED TO MEET REPORT RECOMMENDATIONS [c,d]			66,634	

[a] Coefficient of variation (CV).
[b] Estimations of requirements to maintain current observer coverage are based on FY 2008 data.
[c] Estimates include DAS that are industry funded.
[d] Does not include unknowns or staff time.

SECTION 6

References

Photo on previous page: Cliff fishing with a seine net near Sitka, Alaska. Photo: David Csepp, NMFS.

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Appendices

Photo on previous page: Steller sea lions hauled out on rocky shore. Credit: NOAA.

APPENDIX A

Acronyms Used in the U.S. National Bycatch Report

ACCSP	Atlantic Coastal Cooperative Statistics Program
ACL	annual catch limit
ADFG	Alaska Department of Fish and Game
AFA	American Fisheries Act
AFSC	Alaska Fisheries Science Center [of NMFS]
AKR	Alaska Regional Office [of NMFS]
AIDCP	Agreement on the International Dolphin Conservation Program
ALWTRP	Atlantic Large Whale Take Reduction Plan
AMMOP	Alaska Marine Mammal Observer Program
A-SHOP	At-Sea Hake Observer Program
ASMFC	Atlantic States Marine Fisheries Commission
ATCA	Atlantic Tunas Convention Act
BCC	Birds of Conservation Concern
BDTRP	Bottlenose Dolphin Take Reduction Plan
BiOp	Biological Opinion
BRD	bycatch reduction device
B Reg	B Regular [days at sea]
BSAI	Bering Sea and Aleutian Islands
CAS	Catch Accounting System [Alaska]
CCAMLR	Commission for the Conservation of Antarctic Marine Living Resources
CDFG	California Department of Fish and Game
CDQ	Community Development Quota [western Alaska]
CFMC	Caribbean Fisheries Management Council
CFR	Code of Federal Regulations
CNMI	Commonwealth of the Northern Mariana Islands
CPS	coastal pelagic species
CPUE	catch per unit of effort
CV	coefficient of variation
DAS	days at sea
DMR	discard mortality rate
DPS	distinct population segment
EEZ	exclusive economic zone
EIS	environmental impact statement
EM	electronic monitoring
EPO	eastern Pacific Ocean
ESA	Endangered Species Act
ETP	eastern tropical Pacific
FAD	fish-aggregating device
FAO	Food and Agriculture Organization of the United Nations
FFA	Forum Fisheries Agency
FMP	fishery management plan
FSSI	Fish Stock Sustainability Index
FTE	full-time equivalent
GAM	generalized additive model
GLM	generalized linear model
GMFMC	Gulf of Mexico Fisheries Management Council
GMT	groundfish management team
GOA	Gulf of Alaska
GPS	global positioning system
GSI	genetic stock identification

GSMFC	Gulf States Marine Fisheries Commission
GulfFIN	Gulf of Mexico Fisheries Information Network
HAPC	habitat area of particular concern
HMS	highly migratory species
HRM	hooking release mortality
IATTC	Inter-American Tropical Tuna Commission
ICCAT	International Commission for the Conservation of Atlantic Tunas
IERS	Interagency Electronic Reporting Program [Alaska]
IFQ	individual fishing quota
IPHC	International Pacific Halibut Commission
IPOA	international plan of action
IT	information technology
ITQ	individual transferable quota
ITS	incidental take statement
LAPP	limited-access privilege program
LCR	Lower Columbia River [Chinook salmon population]
LCS	large coastal species [shark complex]
LME	large marine ecosystem
LOA	length overall [vessel]
MAFMC	Mid-Atlantic Fishery Management Council
MBTA	Migratory Bird Treaty Act
MMAP	Marine Mammal Authorization Program
MMHSRP	Marine Mammal Health and Stranding Response Program
MMPA	Marine Mammal Protection Act
MP	milllions of pounds
MPA	marine protected area
MSA	Magnuson-Stevens Fishery Conservation and Management Act
MSRA	Magnuson-Stevens Fishery Conservation and Management Reauthorization Act of 2006
NAFO	Northwest Atlantic Fisheries Organization
NCRPP	Northeast Cooperative Research Partners Program
NED	Northeast Distant [fishing area]
NEFMC	New England Fishery Management Council
NEFOP	Northeast Fisheries Observer Program
NEFSC	Northeast Fisheries Science Center [of NMFS]
NERO	Northeast Regional Office [of NMFS]
NMFS	National Marine Fisheries Service, aka NOAA Fisheries
NMML	National Marine Mammal Lab
NOAA	National Oceanic and Atmospheric Administration
NOP	National Observer Program
NPFMC	North Pacific Fishery Management Council
NPGOP	North Pacific Groundfish Observer Program
NPOA	National Plan of Action
NWFSC	Northwest Fisheries Science Center [of NMFS]
NWHI	Northwestern Hawaiian Islands
ODFW	Oregon Department of Fish and Wildlife
OFL	optimal fishing level
OY	optimum yield
PacFIN	Pacific Fisheries Information Network
PBR	potential biological removal
PFMC	Pacific Fishery Management Council
PIFSC	Pacific Islands Fisheries Science Center [of NMFS]
PIRO	Pacific Islands Regional Office [of NMFS]
PLL	Pelagic Longline Logbook [program]
PLTRT	Pelagic Longline Take Reduction Team
POP	Pelagic Observer Program
PR	protected resources

PSC	prohibited species catch
PSGNA	Pamlico Sound Gillnet Restricted Area
PSMFC	Pacific States Marine Fisheries Commission
RFMO	regional fisheries management organization
RPA	reasonable and prudent alternatives
RPM	reasonable and prudent measures
SAFE	stock assessment and fishery valuation [report]
SAFMC	South Atlantic Fishery Management Council
SAP	special-access program
SBRM	standardized bycatch reporting methodology
SCRS	Standing Committee on Research and Statistics
SEDAR	Southeast Data, Assessment, and Review
SEFSC	Southeast Fisheries Science Center [of NMFS]
SERO	Southeast Regional Office [of NMFS]
SFA	Sustainable Fisheries Act
SWFSC	Southwest Fisheries Science Center [of NMFS]
TAC	total allowable catch
TED	turtle excluder device
TRP	take-reduction plan
TRT	take-reduction team
URI	University of Rhode Island
USCG	U.S. Coast Guard
USFWS	U.S. Fish and Wildlife Service
UWR	Upper Willamette River [Chinook salmon population]
V	variance
VMS	vessel monitoring system
VTR	vessel trip report
WCGOP	West Coast Groundfish Observer Program
WCPFC	Western and Central Pacific Fishery Commission
WDFW	Washington Department of Fish and Wildlife
WPFMC	Western Pacific Fishery Management Council
WWF	World Wildlife Fund
ZMRG	Zero Mortality Rate Goal

APPENDIX B DOMESTIC STATUTES AND REGULATIONS AND INTERNATIONAL AGREEMENTS

DOMESTIC STATUTES AND REGULATIONS

Endangered Species Act

The Endangered Species Act (ESA) requires the Federal government to protect and conserve species and populations that are endangered or threatened with extinction, and to conserve the ecosystems on which these species depend. Some threatened and endangered species, including all sea turtle species and certain species of salmon, seabirds, and marine mammals, are captured as bycatch in the Nation's fisheries. The ESA requires development of a recovery plan that identifies criteria and actions to recover each listed species. Recovery plans for marine species generally include reducing incidental capture of protected species in fishing operations as a first-priority action that is necessary to prevent extinction or irreversible declines. In some cases, fisheries can be restricted or terminated because they are likely to jeopardize the continued existence of a species. Other provisions of the ESA ensure that sources of mortality for protected species are identified and minimized or mitigated.

ESA Section 9 prohibits the take of endangered species within the United States or the territorial sea of the United States, and on the high seas. "Take" is defined by the ESA as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct" (16 U.S.C. 1536(18)). NMFS has issued regulations, pursuant to 4(d) of the ESA, extending the prohibition of take, with exceptions, to threatened species. The ESA does allow for exceptions to the take prohibitions. NMFS may grant exceptions to the take prohibitions with an incidental take statement or an incidental take permit issued under Section 7 or 10, respectively. Of particular relevance for fisheries bycatch is Section 7, which provides that "Each Federal agency shall . . . insure that any action authorized, funded, or carried out by such agency . . . is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species" (16 U.S.C. §1536(a)(2)).

Under Section 7(a)(2) of the ESA, Federal agencies must consult with NOAA Fisheries on activities that may affect a listed species. For commercial fisheries, NMFS must formally consult with itself on the effects fisheries management plans may have on listed species and their critical habitat. These Section 7 Consultations are designed to assist Federal agencies in fulfilling their duty to ensure their actions are not likely to jeopardize the continued existence of a species or destroy or adversely modify critical habitat. Should an action be determined by NMFS to be likely to jeopardize a species or adversely modify critical habitat, NMFS will suggest Reasonable and Prudent Alternatives (RPAs) that would not violate Section 7(a)(2). Biological Opinions document NMFS' opinion as to whether a Federal action is likely to jeopardize the continued existence of listed species, or result in the destruction or adverse modification of critical habitat. Where appropriate, biological opinions include an incidental take statement that provides an exemption for the take of listed species while specifying the amount or extent of take allowed, the RPMs necessary to minimize impacts from the Federal action, and the Terms and Conditions with which the action agency must comply.

In 2007, the NMFS Office of Protected Resources developed a regulation requiring U.S. fishing vessels, recreational or commercial, operating in U.S. territorial waters, the U.S. EEZ or on the high seas, or vessels otherwise subject to the jurisdiction of the U.S. where sea turtles may be present and interactions likely to occur, to carry observers when requested to do so by NMFS. Previous ESA regulations allowed only for limited, temporary monitoring of vessels suspected of sea turtle interactions, usually only after an emergency event, such as a mass sea turtle stranding, or under a Biological Opinion. Consequently, NMFS relied on the MSA to observe sea turtles as they are considered "fish" under the MSA, and relied on the Marine Mammal Protection Agency (MMPA), which allowed sea turtle interactions to be recorded although the primary authority was to observe marine mammal interactions. This approach did not always allow the agency to monitor fisheries it needed to monitor or to design monitoring programs to optimize collection of sea turtle bycatch data. The 2007 regulation will enable NMFS to learn more about interactions between fishing operations and sea turtles, to evaluate existing measures to reduce sea turtle takes, and to determine whether additional measures to address sea turtle bycatch may be necessary.

Magnuson-Stevens Fishery Conservation and Management Act

In 1996 Congress passed the Sustainable Fisheries Act which made major revisions to the Magnuson-Stevens Fishery Conservation and Management Act (MSA; 16 U.S.C. 1801 et seq.) including significant new provisions on bycatch. Congress defined the term bycatch (see 16 U.S.C. 1802(2)) and required that bycatch be minimized to the extent practicable. Although the bycatch reduction and monitoring requirement described in the 1996 MSA amendments applied to a broad range of living marine species, including finfish, shellfish, sea turtles, and deep-water corals, they did not apply to marine mammals or seabirds.

Under MSA National Standard 9, "conservation and management measures shall, to the extent practicable, (A) minimize bycatch and (B) to the extent bycatch cannot be

avoided, minimize the mortality of such bycatch" (16 U.S.C. § 1851(9)). MSA section 303 of the 1996 MSA expands on this requirement by mandating that fishery management plans "establish a standardized reporting methodology to assess the amount and type of bycatch occurring in the fishery, and include conservation and management measures that, to the extent practicable and in the following priority (A) minimize bycatch; and (B) minimize the mortality of bycatch which cannot be avoided" (16 U.S.C. § 1853(11)).

NMFS regulations provide the following guidance on factors that should be considered in determining the practicability of a particular management action to minimize bycatch or the mortality of bycatch. They state: "A determination of whether a conservation or management measure minimizes bycatch or bycatch mortality to the extent practicable, consistent with other national standards and maximization of net benefits to the Nation, should consider the following factors: (A) Population effects for bycatch species; (B) Ecological effects due to changes in the bycatch of that species (effects on other species in the ecosystem); (C) Changes in the bycatch of other species of fish and the resulting population and ecosystem effects; (D) Effects on marine mammals and birds; (E) Changes in fishing, processing, disposal, and marketing costs; (F) Changes in fishing practices and behavior of fishermen; (G) Changes in research, administration, and enforcement costs and management effectiveness; (H) Changes in the economic, social, or cultural value of fishing activities and non-consumptive uses of fishery resources; (I) Changes in the distribution of benefits and costs; and (J) Social effects." (50 CFR 600.350(d)(3))

The 2007 Magnuson-Stevens Reauthorization Act (MSRA) expanded upon the bycatch provisions of the MSA with a focus on international conservation, seabirds, and bycatch reduction engineering. The MSRA amendments established a Bycatch Reduction Engineering Program to minimize bycatch, seabird interactions, bycatch mortality, and post-release mortality in federally managed fisheries through the development of bycatch reduction devices and other gear modifications. The MSRA amendments also authorized regional fishery management councils to include incentives in their fishery management plans to reduce total bycatch and seabird interactions, amounts, bycatch rates, and post-release mortality in federally managed fisheries by incorporating bycatch into quotas, and by adding measures to promote the use of gear with verifiable and monitored low bycatch and seabird interactions, as well as measures to reduce bycatch and seabird interactions, bycatch mortality, post-release mortality, or regulatory discards in the fishery. (16 U.S.C. §1865).

International provisions of the MSRA amend the MSA to strengthen the United States's commitment to monitoring and reducing bycatch (16 U.S.C. §1826). These amendments require the Secretary of State to ensure that "statistically reliable monitoring by the U.S. is carried out, through the use of on-board observers or through dedicated platforms provided by foreign nations that are parties to the agreement, of all target and non-target fish species, marine mammals, sea turtles, and seabirds entangled or killed by large-scale driftnets used by fishing vessels of foreign nations that are parties to the agreement" and that "the taking of non-target fish species, marine mammals, sea turtles, seabirds, and endangered species or other species protected by international agreements to which the U.S. is a party is minimized and does not pose a threat to existing fisheries or the long-term health of living marine resources."

In addition, the MSRA also amends the High Seas Driftnet Fishing Moratorium Protection Act to require the Secretary to identify and certify nations whose vessels engage in illegal, unreported and unregulated fishing practices, and/or bycatch of protected living marine resources, in certain areas, and facilitate international cooperation and provide assistance for monitoring and reducing bycatch of living marine resources. (16 U.S.C. §1826d-k).

Marine Mammal Protection Act

The Marine Mammal Protection Act (MMPA) seeks to maintain marine mammal stocks at optimum sustainable population levels, principally by regulating the human-induced mortality and serious injury of marine mammals. This includes fishing-related mortality and serious injury. Although the MMPA prohibits the take of marine mammals, it provides exceptions for incidental take during the operation of commercial fishing, as well as other activities. Take is defined in the MMPA as "to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal" (16 U.S.C. § 1362 (13)). In 1994, Congress amended the MMPA to include Section 118, which established a regime to regulate the take of marine mammals incidental to commercial fishing so that it does not occur at a level that jeopardizes a marine mammal stock's ability to reach its "optimum sustainable population," defined as "the number of animals which will result in the maximum productivity of the population or the species, keeping in mind the carrying capacity of the habitat and the health of the ecosystem of which they form a constituent element" (16 U.S.C. § 1362(9)).

Section 118 of the MMPA requires that NMFS classify each U.S. commercial fishery according to whether there is a frequent (Category I), occasional (Category II), or a remote (Category III) likelihood of incidental mortality and serious injury of marine mammals. It also has provisions for the establishment of take reduction teams to develop take reduction plans (TRPs) for those fisheries with the greatest impact on marine mammal stocks (i.e., to assist in the recovery or prevent the depletion of strategic marine mammal stocks that interact with Category I and II fisheries). Participants in Category I or II fisheries are required to reg-

ister with NMFS, take on board an observer if requested by NMFS, and comply with all applicable TRP regulations. All fishermen, including those participating in Category III fisheries, are required to report the incidental mortality and serious injury of marine mammals should it occur during commercial fishing operations.

The MMPA establishes both a short-term (six-month) and a long-term (five-year) goal for marine mammal bycatch reduction. Take reduction plans are required to reduce, within six months of implementation, the incidental mortality or serious injury of marine mammals incidentally taken in the course of commercial fishing operations to levels less than a stock's potential biological removal (PBR) level. Within five years of implementation, TRPs are required to reduce the mortality or serious injury of marine mammals incidentally taken in the course of commercial fishing operations to insignificant levels approaching a zero mortality and serious injury rate (commonly referred to as the Zero Mortality Rate Goal or ZMRG), taking into account the economics of the fishery, the availability of existing technology, and existing state or regional fishery management plans (16 U.S.C. § 1387(f)).

Migratory Bird Treaty Act

In 1918, the United States affirmed or implemented commitments to four international conventions (with Canada, Japan, Mexico, and Russia) under the Migratory Bird Treaty Act (MBTA). The MBTA is a domestic regulation for the protection of shared migratory bird resources, including seabirds administered by the U.S. Department of the Interior through the U.S. Fish and Wildlife Service (USFWS). Each of the conventions protects selected species of birds that are common to both countries (i.e., they occur in both countries at some point during their annual life cycle). The Fish and Wildlife Conservation Act of 1980, as amended, requires the USFWS to monitor and assess migratory nongame birds, determine the effects of human activities, and identify populations of migratory birds that, without additional conservation measures, are likely to become candidates for listing under the ESA. In response, the USFWS released a report entitled *Birds of Conservation Concern 2002*, which identifies bird species (not already listed under the ESA) that represent the agency's highest conservation priorities. Provisions on seabird bycatch were also strengthened in 2006 under the MSRA, as described previously.

INTERNATIONAL AGREEMENTS

Section 202(h)(1) of the Magnuson-Stevens Fishery Conservation and Management Act calls on the Secretary of State, in cooperation with the Secretary of Commerce, to seek to secure international agreements to establish standards and measures for bycatch reduction that are comparable to the standards and measures applicable to U.S. fishermen, if they conclude that it is necessary and appropriate. Similar provisions are also contained in both the Marine Mammal Protection Act and the Endangered Species Act. Full summaries of the international fisheries agreements in which the U.S. has interests can be found at the NMFS Office of International Affairs website: http://www.nmfs.noaa.gov/ia/intlagree/. A brief discussion of international agreements with bycatch provisions is presented here.

Commission for the Conservation of Antarctic Marine Living Resources

The Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) was established in 1982 by the Convention on the Conservation of Antarctic Living Marine Resources to protect and conserve the living marine resources in the waters surrounding Antarctica (the domestic implementing legislation is the Antarctic Marine Living Resources Convention Act of 1984, 16 U.S.C. 2431 et seq.). CCAMLR restricts catch and bycatch in fish, krill, and crab fisheries. The Commission has also required fishing gear and time modifications to minimize seabird bycatch in some longline fisheries, and has endorsed the recommendations of its Scientific Committee regarding the reduction of seal bycatch through the use of excluder devices. More information can be found on the CCAMLR website: http://www.ccamlr.org/.

FAO Code of Conduct for Responsible Fisheries

More than 170 Members of the United Nations Food and Agriculture Organization (FAO) adopted the Code of Conduct for Responsible Fisheries in 1995. The Code of Conduct is voluntary and consists of a collection of principles, goals, and elements for action. Among other things, the Code of Conduct maintains that fishing methods and gear should be selective and designed to minimize waste and promote high survival rates for escaping fish. The Code of Conduct states that appropriate measures should be taken to minimize waste, discards, catch by lost or abandoned gear, catch of non-target species (both fish and non-fish species), and negative impacts on associated or dependent species, in particular endangered species. Where appropriate, such measures may include technical measures related to fish size, mesh size, or gear, discards, closed seasons, and areas and zones reserved for selected fisheries,

particularly artisanal fisheries. Such measures should be applied, where appropriate, to protect juveniles and spawners. NMFS has been very active in promoting implementation of FAO's International Plan of Action (IPOA) for Reducing Incidental Catch of Seabirds in Longline Fisheries and the FAO IPOA for the Conservation and Management of Sharks, both of which have developed out of the Code of Conduct. More information on the IPOAs can be found at the following website: http://www.nmfs.noaa.gov/ia/.

Inter-American Tropical Tuna Commission

The Inter-American Tropical Tuna Commission (IATTC) contains several provisions that pertain to reducing bycatch of dolphins, seabirds, sea turtles, and finfish (the domestic implementing statute is the Tuna Conventions Act of 1950, 64 Stat. 777, as amended: 16 U.S.C., 951 et seq.). IATTC includes parties to the Agreement on the International Dolphin Conservation Program (AIDCP). The AIDCP is a legally binding instrument for dolphin conservation and ecosystem management in the eastern tropical Pacific Ocean (ETP). The objectives of the Agreement are to reduce incidental dolphin mortalities in the tuna purse seine fishery through setting annual limits, seeking alternative means of capturing large yellowfin tunas not in association with dolphins, and ensuring long-term sustainability of tuna stocks and marine resources in the ETP. The IATTC has also adopted several resolutions pertaining to sea turtle bycatch. More information can be found on the IATTC website: http://www.iattc.org/HomeENG.htm.

International Commission for the Conservation of Atlantic Tunas

The International Commission for the Conservation of Atlantic Tunas (ICCAT) is a regional fishery management organization responsible for the conservation of tunas and tuna-like species in the Atlantic Ocean and its adjacent seas. The U.S. implementing statute for ICCAT is the Atlantic Tunas Convention Act (ATCA) of 1975 (16 U.S.C. 971 et. seq.). ICCAT member countries have agreed on several non-binding bycatch data-sharing resolutions; studied bycatch of sharks and sea turtles; and required the live release of certain species (e.g., Atlantic blue and white marlins). ICCAT has also agreed to non-binding information-sharing measures on the safe release and avoidance of bycatch of sea turtles. ICCAT has passed resolutions to encourage its members to report on the implementation of their seabird bycatch plans of action under the FAO IPOA, and to share data on incidental take of seabirds. In 2007, ICCAT adopted a binding resolution on reducing the incidental bycatch of seabirds in longline fisheries. This resolution includes mandatory requirements for seabird avoidance measures and the collection of seabird bycatch data. Additional information can be found on the ICCAT website: http://www.iccat.int/en/.

International Pacific Halibut Commission

The International Pacific Halibut Commission (IPHC) was established in 1923 by a Convention between the United States and Canada (the domestic implementing legislation is the Northern Pacific Halibut Act of 1982, 16 U.S.C. 773, 773a–773k). The purpose of the IPHC is to conserve, manage, and rebuild the halibut stocks in the Convention Area to those levels that would achieve and maintain the maximum sustainable yield from the fishery. In addition to managing the Pacific halibut fishery, the Commission conducts research on Pacific halibut bycatch and discard mortality, as well as bycatch reduction devices. The two countries have agreed to take measures to reduce halibut bycatch in non-target fisheries. More information can be found on the IPHC website: http://www.iphc.washington.edu/halcom/.

Northwest Atlantic Fisheries Organization

The Northwest Atlantic Fisheries Organization (NAFO) is an intergovernmental fisheries science and management body formed to consult and cooperate to attain the optimum utilization, rational management, and conservation of the fishery resources of the northwest Atlantic (the domestic implementing statute is the Northwest Atlantic Fisheries Convention Act of 1995, 16 U.S.C. 5601 et seq.). Article 12 of the 2010 NAFO Conservation and Enforcement Measures limits bycatch to a certain proportion of haul weight or to an assigned quota. Article 17 prohibits shark finning, and Article 28 requires fisheries observers aboard all vessels participating in NAFO fisheries. Beginning in 2007, contracting parties now provide sea turtle bycatch data to NAFO. Additional information can be found on the NAFO website: http://www.nafo.int/fisheries/frames/fishery.html.

Western and Central Pacific Fishery Commission

In 2007, the United States became a member of the Western and Central Pacific Fisheries Commission (WCPFC). The Commission was established in 2004 by the Convention on the Conservation and Management of the Highly Migratory Fish Stocks in the Western and Central Pacific Ocean as a regional fishery management organization to conserve and manage tunas and other highly migratory fish stocks across a vast range of the Pacific Ocean (the domestic implementing legislation is the Western and Central Pacific Fisheries Convention Implementation Act, 16 U.S.C. 6901 et seq.). The goal of the WCPFC is to ensure the long-term conservation and sustainable use of highly migratory fish stocks in the west and central Pacific. While the Commission focuses mainly on tuna species, it also works to reduce bycatch of seabirds and sea turtles and sharks in commercial longline and purse seine fisheries. In 2007, the Commission finalized a binding conservation resolution to reduce seabird bycatch (7 Dec 2007, CMM 2007-04), and

in 2008 a similar resolution was finalized to reduce bycatch and increase post-release survivorship in sea turtles (12 Dec 2008, CMM 2008-03). Another conservation resolution was finalized for sharks (12 Dec 2008, CMM 2008-06) to reduce discards and increase the proportion of live releases from incidental catches. More information can be found on the WCPFC website: http://www.wcpfc.int.

APPENDIX C Monitoring-Related Action Items from Regional Bycatch Implementation Plans: Updates for FY08–FY09

The NOAA Assistant Administrator for Fisheries each year asks NOAA Fisheries Regional Administrators, Science Center Directors, and Office Directors to submit updates to action items related to their Regional and Atlantic HMS Bycatch Implementation Plans. Action items fall under the following categories: monitoring, bycatch reduction engineering and other research, management (including international efforts), and education/outreach. A subset of the actions is listed below. Current Bycatch Implementation Plans and updated action items can be found at http://www.nmfs.noaa.gov/by_catch/bycatch_strategy.htm.

Northeast Region

- Improve Northeast Fisheries Science Center communication with constituents regarding observer programs, and obtain observer program feedback from observed vessel operators.
- Improve quantitative estimates of bycatch by gear and fishery.
- Optimally allocate observer coverage to address regional priorities.
- Develop electronic data entry at sea.
- Explore the use of video monitoring systems to view scallop dredge interactions with sea turtles.

Atlantic Highly Migratory Species (HMS)

- Maintain appropriate observer coverage levels in the pelagic longline, bottom longline, and shark gillnet fisheries.
- Evaluate mandatory observer coverage for headboats possessing HMS permits.
- Increase sample sizes for the Large Pelagic Survey in for-hire fisheries.

Southeast Region

- Enhance observer programs in the Gulf of Mexico and South Atlantic shrimp trawl fisheries.
- Enhance observer programs in the Gulf of Mexico bottom longline reef fish fishery.
- Improve bycatch estimates for red snapper, vermilion snapper, and other reef fishes in the commercial and for-hire reef fish fishery with respect to season, depth, and location.
- Monitor and assess bycatch in the South Atlantic reef fish fishery to minimize the impacts of incidental take on sea turtles and smalltooth sawfish.
- Reduce and monitor bycatch in Caribbean fisheries.
- Improve bycatch estimates of protected species for the shark bottom longline fishery with respect to season and location.
- Monitor right whale bycatch from gillnet or other commercial fisheries gear in the Southeast Restricted Area.
- Enhance observer coverage in the Mid-Atlantic coastal gillnet fishery via alternate platforms.
- Develop observer programs for the Gulf of Mexico recreational charter vessel fishery.

Southwest Region

- Determine whether the Coastal Pelagic Species Fishery Management Plan should be amended to explicitly establish a standardized reporting methodology.
- Ensure that a pilot at-sea observer program in California to supplement and confirm the bycatch assessments derived from dock-side sampling conducted by the State of California is a component of a standardized reporting methodology.
- Continue efforts, through support of the Inter-American Tropical Tuna Commission and international agreements, to ensure that bycatch by vessels flagged by the United States and other nations is accurately reported.
- Maintain drift gillnet observer coverage at 20%.
- Prepare reports that include estimates of the total bycatch of finfish in the drift gillnet fishery, as well as estimates of precision associated with measures of sea turtle and finfish bycatch.
- Characterize the size composition of fish bycatch species in drift gillnet fishery.
- Review the efficiency of drift gillnet observer coverage for estimating drift gillnet finfish and other non-turtle and marine mammal bycatch to determine whether enough samples [are] being collected, given variability.

Northwest Region

- Expand West Coast Groundfish Observer Program coverage to ancillary fleets making groundfish landings.
- Implement a mandatory catch monitoring program for the shore-based whiting fishery, possibly with camera or other technological observation systems.
- Expand the vessel monitoring system program to cover commercial open access and fleets that target groundfish.
- Update the Northwest Fisheries Science Center bycatch model with 2001–07 West Coast Groundfish Observer Program data to improve precision of bycatch rate estimates.
- Work with the states to improve the landings receipt system, possibly moving to electronic fish tickets.
- Assist in the creation of a comprehensive NOAA Fisheries U.S. National Bycatch Report.
- Conduct further observer data analysis to refine the West Coast Groundfish Observer Program's sampling design and fleet monitoring strategies.

- Test electronic monitoring (EM) equipment on small fixed-gear vessels.
- Test equipment to record trawl tracks to better represent areas trawled.
- Continue to monitor the bycatch of Endangered Species Act-listed salmonids in the West Coast groundfish fishery for compliance with provisions of the current biological opinion.

Pacific Islands Region

- Continue to implement the High-Seas Protected Species Observer Reporting System, including the use of satellite phones by observers.
- Continue to develop estimation models for the take of non-targeted billfish in the tuna and swordfish longline fisheries.
- Refine and expand estimation of fishery takes of sea turtles, seabirds, and marine mammals for the Hawaii-based longline fishery based on observer data and logbooks.
- Refine and expand estimation of fishery bycatch of sharks and other fishes using longline logbook and observer data.

Alaska Region

- Ensure special fishery-dependent data collections outside of standard observer protocols to meet short-term user needs.
- Evaluate technologies suitable for monitoring groundfish fisheries.
- Develop approaches for expanding observer deployments to meet additional agency information needs for catch and bycatch estimation.
- Revise observer data-collection protocols to meet evolving needs and improve bycatch data quality.
- Investigate the impact of a real-time bycatch monitoring system on bycatch levels and fishing location choice in the Bering Sea and Aleutian Islands.
- Improve methodologies for estimating prohibited species bycatch.
- Prepare information and text for the first edition of the U.S. National Bycatch Report.
- Evaluate whether measures of effort other than total catch can be used to extrapolate from observed to total marine mammal bycatch.
- Evaluate the need for additional compliance resources to maintain the integrity of observer data.
- Promote the use of electronic logbooks to facilitate identification and correction of bias in estimating bycatch for unobserved vessels.
- Promote interagency efforts to develop electronic reporting of landings data by trip.
- Evaluate methods for improving bycatch estimates of marine mammals in state-managed Marine Mammal Protection Act Category II salmon fisheries.
- Improve accuracy and precision in estimates of seabird interactions and bycatch.
- Improve spatio-temporal characterization of seabird bycatch estimates.

APPENDIX D Precision, Accuracy, and Bias[1]

The measure of precision used in the U.S. National Bycatch Report is the *coefficient of variation* (CV), which is the ratio of the square root of the variance of the bycatch estimate (i.e., the standard error) to the estimate itself. The CV of an estimate can be decreased by increasing the number of observations, which increases sampling cost (NMFS 2004a). However, as the number of observations is increased, the CV decreases at a decreasing rate. For large samples, the CV of an estimate is inversely proportional to the square root of the size of the sample. This means that at some point a further increase in the number of observations cannot be justified in terms of the reduction in the CV and the associated benefits of the more precise estimate, given the increase in sampling cost (Figure D.1).

Precision requirements for bycatch estimates depend upon the management procedures for which the estimates are being used. Additionally, there are a number of sampling issues that impede our ability to obtain precise bycatch estimates for individual stocks or species, including:

- management uses of bycatch estimates (e.g., setting of bycatch quotas, development of mitigation measures);
- assessment uses of bycatch estimates (i.e., evaluation of stock status, estimation of total allowable catches, estimation of PBR);
- monitoring relative to management standards (i.e., comparison of bycatch estimate with some management standard);
- developing mitigation plans (i.e., bycatch estimates used to design measures to reduce bycatch).

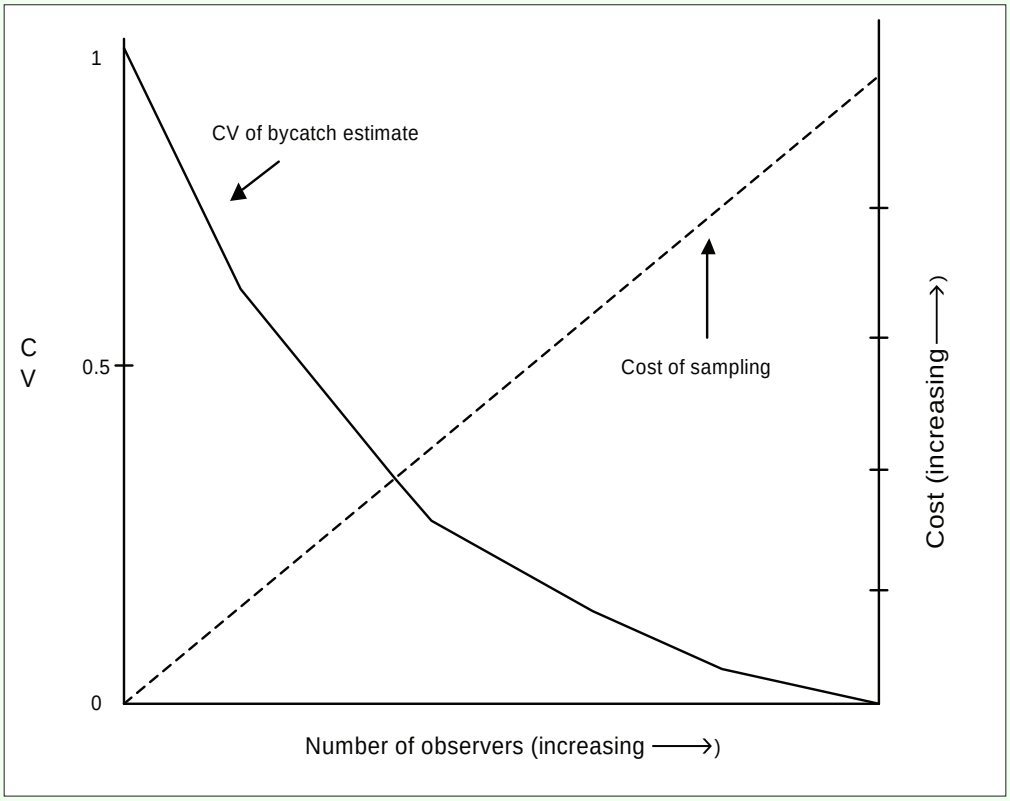

Figure D.1
Trade-offs between precision, number of samples, and cost (NMFS 2004a).

[1] Summary Information from NMFS (2004a) and Vølstad and Fogarty (2006).

When estimating catch or bycatch from fisheries data, survey or observer programs usually are designed to address estimation of bycatch of multiple species, rather than being designed specifically for the estimate of bycatch of an individual species. Therefore, observer programs are often designed to obtain bycatch estimates of the aggregate of all fish species combined with a specified precision level. However, when a species comprises a small percentage of the aggregate the estimate of an individual species will be less precise.

Bias refers to systematic errors that cause the average survey value to deviate from the true population value for any sample selected under a specific survey design (Vølstad and Fogarty 2006). For observer monitoring programs, the total error in estimates of catch and bycatch is linked to vessel selection and observer deployment procedures, field data-collection procedures, and analytical methods for estimating catch and bycatch. Ideally, an overall design for observer programs is chosen to minimize the total error in the catch and bycatch estimates for the target fleet, within the resources available for the program and practical constraints.

A vessel selection procedure is considered biased if it results in catch and bycatch data that do not represent the fleet (and its fishing operations) on average (i.e., the procedure will tend to result in observer data that systematically deviate from data that would be representative of the fleet and its fishery). Random selection is a safeguard against systematic bias in the selection procedure (i.e., on average, the samples will represent the total population of vessels in the list). A random selection of vessels, however, does not in itself eliminate systematic bias. If observers cannot be deployed on the vessels selected by a representative method such as random sampling, or if some of the vessels selected change their fishing behavior, then the resulting sample is biased. Bias resulting from logistical problems and lack of compliance is particularly difficult to quantify and control and is not likely to be reduced by increasing sample sizes.

The sources of bias in observer programs can be classified into three broad categories: (1) incomplete sampling frame, (2) sampling bias caused by procedures for selecting vessels from the sampling frame or by factors preventing the deployment of observers on all selected vessels, and (3) observer bias (i.e., measurement errors caused by changes in fishing behavior in the presence of observers).

Bias related to errors in the sampling frame (i.e., the list from which vessels are selected for observation) can occur when the list fails to include all active vessels in the fishery for which inferences about catch and bycatch are to be made (NMFS 2004a). If the list omits an appreciable portion of vessels in the fleet for which estimates are required, then even a census (i.e., placing observers on all vessels and trips on the list) could yield poor (biased) estimates of catch and bycatch. Errors in the sampling frame can result when using lists of vessels that are not up-to-date, or when vessels are included that are not actively fishing. If the fraction of vessels not observed accounts for an appreciable portion of the total catch for a fishery, then the resulting bias in overall estimates of catch and bycatch based on observer data could be significant.

Performing a census would eliminate the potential for bias (assuming that the sample frame is complete and there is 100% compliance), but this approach usually is prohibitively expensive. Typically, available resources allow for observing only a fraction of the vessels in a given fleet. Precise estimates of catch and bycatch, nevertheless, can be achieved by sampling only a small fraction of vessels in the fleet if the sampled vessels are representative and the sample size is sufficient. Ad-hoc vessel selection has the greatest potential for generating bias because this method does not guarantee that repeated selections result in samples that, on average, represent the fleet. Conducting a probability-based survey with 100% compliance (i.e., all selected vessels agree to take an observer) would also eliminate sample bias. All the methods that involve randomization (i.e., selection of vessels with known inclusion probabilities) fall in the category of probability-based sampling. Probability-based selection of vessels does not guarantee that observer data can be collected representatively because various constraints can limit NMFS' ability to place observers on all selected vessels. Concerns regarding safety of selected vessels or lack of accommodations may limit the pool of sampled vessels and reduce the ability to achieve a representative sample. Bias related to deployment can sometimes nullify the benefit of a well-planned survey. In effect, an inability to place observers on selected vessels is equivalent to implementing a program with an incomplete sampling frame because a portion of the fishery fleet is eliminated from observation. Deployment bias is equivalent to non-response error and is most often caused by logistical constraints, for example when the operators of vessels in the sample refuse to take observers, when some of the vessels selected for observer deployment are unsafe, or when selected vessels do not have space for observers. In principle, an ad-hoc selection with full compliance may cause no more systematic error than a random selection procedure with poor compliance (equivalent to a low response rate).

The implication of observer bias is that data recorded on selected vessels is not representative of the fishery as a whole. Observer bias can occur when vessel operators systematically change their fishing behavior, effort, and location when observers are aboard. In this case, the catch and bycatch rates for observed trips would deviate from the typical rates. This could occur if the fisher has an incentive to lower bycatch estimates (e.g., if the fisher believes that actual bycatch estimates could result in early closure of a

fishery due to in-season management or changes in regulations that could restrict his future fishing opportunities). This form of sampling bias is the most difficult to evaluate and correct. Systematic errors in data collection and recording also fall into the category of observer bias.

The vessel selection bias workshop conducted by NMFS in 2006 provided a full evaluation of 24 U.S. observer programs and recommendations to address biases in these programs (Vølstad and Fogarty 2006). These recommendations are currently being implemented by the regional observer programs and continued monitoring of potential bias is being conducted.

APPENDIX E Fisheries Identified by the U.S. National Bycatch Report, and Fisheries Included in the Report.

Appendix E lists all fisheries identified by the U.S. National Bycatch Report regional teams. Those fisheries that are shaded are the Federally managed commercial fisheries, or state fisheries with a Federal data-collection component, that were evaluated for bycatch data and estimation quality. Within each region, fisheries are listed alphabetically by management authority and then by name of fishery.

REGION	FISHERY	MANAGEMENT AUTHORITY	INDIVIDUAL OR GROUPED FISHERY
NORTHEAST (fisheries included in the U.S. National Bycatch Report)	MID-ATLANTIC BOTTOM LONGLINE	Federal	Individual
	MID-ATLANTIC CLAM/QUAHOG DREDGE	Federal	Individual
	MID-ATLANTIC EXTRA-LARGE-MESH GILLNET	Federal	Part of Mid-Atlantic Gillnet Fisheries Group
	MID-ATLANTIC GENERAL CAT. CLOSED-AREA SCALLOP DREDGE	Federal	Part of Mid-Atlantic Scallop Dredge Fisheries Group
	MID-ATLANTIC GENERAL CAT. OPEN-AREA SCALLOP DREDGE	Federal	Part of Mid-Atlantic Scallop Dredge Fisheries Group
	MID-ATLANTIC GENERAL CAT. SCALLOP TRAWL	Federal	Part of Mid-Atlantic Scallop Trawl Fisheries Group
	MID-ATLANTIC LARGE-MESH GILLNET	Federal	Part of Mid-Atlantic Gillnet Fisheries Group
	MID-ATLANTIC LARGE-MESH OTTER TRAWL	Federal	Part of Mid-Atlantic Otter Trawl Fisheries Group
	MID-ATLANTIC LIMITED-ACCESS CLOSED-AREA SCALLOP DREDGE	Federal	Part of Mid-Atlantic Scallop Dredge Fisheries Group
	MID-ATLANTIC LIMITED-ACCESS OPEN-AREA SCALLOP DREDGE	Federal	Part of Mid-Atlantic Scallop Dredge Fisheries Group
	MID-ATLANTIC LIMITED-ACCESS SCALLOP TRAWL	Federal	Part of Mid-Atlantic Scallop Trawl Fisheries Group
	MID-ATLANTIC MID-WATER OTTER TRAWL	Federal	Part of Mid-Atlantic Otter Trawl Fisheries Group
	MID-ATLANTIC SMALL-MESH GILLNET	Federal	Part of Mid-Atlantic Gillnet Fisheries Group
	MID-ATLANTIC SMALL-MESH OTTER TRAWL	Federal	Part of Mid-Atlantic Otter Trawl Fisheries Group
	NEW ENGLAND BOTTOM LONGLINE	Federal	Part of New England Bottom Longline Fisheries Group
	NEW ENGLAND B REG DAS LARGE-MESH OTTER TRAWL	Federal	Part of New England Otter Trawl Fisheries Group
	NEW ENGLAND CLAM/QUAHOG DREDGE	Federal	Individual
	NEW ENGLAND CRAB POTS	Federal	Individual
	NEW ENGLAND EXTRA-LARGE-MESH GILLNET	Federal	Part of New England Gillnet Fisheries Group

REGION	FISHERY	MANAGEMENT AUTHORITY	INDIVIDUAL OR GROUPED FISHERY
NORTHEAST (fisheries included in the U.S. National Bycatch Report) (cont.)	NEW ENGLAND GENERAL CAT. CLOSED-AREA SCALLOP DREDGE	Federal	Part of New England Scallop Dredge Fisheries Group
	NEW ENGLAND GENERAL CAT. OPEN-AREA SCALLOP DREDGE	Federal	Part of New England Scallop Dredge Fisheries Group
	NEW ENGLAND HADDOCK SECTOR LONGLINE	Federal	Part of New England Bottom Longline Fisheries Group
	NEW ENGLAND LARGE-MESH GILLNET	Federal	Part of New England Gillnet Fisheries Group
	NEW ENGLAND LARGE-MESH OTTER TRAWL	Federal	Part of New England Otter Trawl Fisheries Group
	NEW ENGLAND LIMITED-ACCESS CLOSED-AREA SCALLOP DREDGE	Federal	Part of New England Scallop Dredge Fisheries Group
	NEW ENGLAND LIMITED-ACCESS OPEN-AREA SCALLOP DREDGE	Federal	Part of New England Scallop Dredge Fisheries Group
	NEW ENGLAND MID-WATER OTTER TRAWL	Federal	Individual
	NEW ENGLAND SCOTTISH SEINE	Federal	Individual
	NEW ENGLAND SMALL-MESH GILLNET	Federal	Part of New England Gillnet Fisheries Group
	NEW ENGLAND SMALL-MESH OTTER TRAWL	Federal	Part of New England Otter Trawl Fisheries Group
	NEW ENGLAND US/CAN AREA LARGE-MESH OTTER TRAWL	Federal	Individual
	NEW ENGLAND US/CAN AREA SMALL-MESH OTTER TRAWL	Federal	Individual
	GULF OF MAINE, MID-ATLANTIC TUNA, SHARK, SWORDFISH HARPOON	Federal, International	Individual
	GULF OF MAINE, MID-ATLANTIC TUNA, SHARK, SWORDFISH HOOK-AND-LINE	Federal, International	Individual
	MID-ATLANTIC HAND LINE	Federal, International	Individual
	MID-ATLANTIC PURSE SEINE	Federal, International	Individual
	NEW ENGLAND HAND LINE	Federal, International	Individual
	NEW ENGLAND PURSE SEINE	Federal, International	Individual
	MID-ATLANTIC FISH POTS AND TRAPS	Federal, State	Individual
	MID-ATLANTIC LOBSTER POTS	Federal, State	Individual
	MID-ATLANTIC SHRIMP TRAWL	Federal, State	Individual
	NEW ENGLAND FISH POTS AND TRAPS	Federal, State	Individual
	NEW ENGLAND LOBSTER POTS	Federal, State	Individual
	ATLANTIC BLUE CRAB TRAP/POT	State	Individual

REGION	FISHERY	MANAGEMENT AUTHORITY	INDIVIDUAL OR GROUPED FISHERY
NORTHEAST (fisheries included in the U.S. National Bycatch Report) (cont.)	CHESAPEAKE BAY INSHORE GILLNET	State	Individual
	DELAWARE RIVER INSHORE GILLNET	State	Individual
	LONG ISLAND SOUND INSHORE GILLNET	State	Individual
	MID-ATLANTIC CRAB POTS	State	Individual
	MID-ATLANTIC HAUL/BEACH SEINE	State	Individual
	NEW ENGLAND SHRIMP TRAWL	State	Individual
	RI, S. MA (TO MONOMOY IS.) AND NY BIGHT (RARITAN AND LOWER NY BAYS) INSHORE GILLNET	State	Individual
	VIRGINIA POUND NET	State	Individual
NORTHEAST (fisheries not included in the U.S. National Bycatch Report)	GULF OF MAINE HERRING AND ATLANTIC MACKEREL STOP SEINE	State	Individual
	GULF OF MAINE HERRING AND ATLANTIC MACKEREL WEIR	State	Individual
	GULF OF MAINE MUSSEL	State	Individual
	GULF OF MAINE URCHIN DIVE, HAND/MECHANICAL COLLECTION	State	Individual
	MID-ATLANTIC CRAB STOP SEINE	State	Individual
	MID-ATLANTIC CRAB WEIR	State	Individual
	MID-ATLANTIC EEL TRAP/POT	State	Individual
	MID-ATLANTIC HAND SEINE	State	Individual
	MID-ATLANTIC OYSTER	State	Individual
	NORTHEAST ATLANTIC FINFISH AQUACULTURE	State	Individual
	NORTHEAST ATLANTIC SHELLFISH AQUACULTURE	State	Individual
SOUTHEAST (fisheries included in the U.S. National Bycatch Report)	CARIBBEAN GILLNET	Federal	Individual
	CARIBBEAN MIXED-SPECIES TRAP/POT	Federal	Individual
	CARIBBEAN SPINY LOBSTER TRAP/POT	Federal	Individual
	FLORIDA SPINY LOBSTER TRAP/POT	Federal	Individual
	GULF OF MEXICO COASTAL MIGRATORY PELAGIC GILLNET	Federal	Individual
	GULF OF MEXICO COASTAL MIGRATORY PELAGIC TROLL	Federal	Individual
	GULF OF MEXICO REEF FISH BOTTOM LONGLINE	Federal	Individual
	GULF OF MEXICO REEF FISH HANDLINE	Federal	Individual
	GULF OF MEXICO SHRIMP TRAWL	Federal	Individual
	LARGE COASTAL AND SMALL COASTAL SHARK AGGREGATES (DRIFT, STRIKE, AND BOTTOM GILLNET)	Federal	Individual
	SOUTH ATLANTIC COASTAL MIGRATORY PELAGIC TROLL	Federal	Individual
	SOUTH ATLANTIC SNAPPER–GROUPER BOTTOM LONGLINE	Federal	Individual
	SOUTH ATLANTIC SNAPPER–GROUPER HANDLINE	Federal	Individual
	SOUTHEAST ATLANTIC BLACK SEA BASS POT	Federal	Individual
	SOUTHEASTERN ATLANTIC AND GULF OF MEXICO HMS PELAGIC LONGLINE	Federal	Individual
	SOUTHEASTERN ATLANTIC AND GULF OF MEXICO SHARK BOTTOM LONGLINE	Federal	Individual

REGION	FISHERY	MANAGEMENT AUTHORITY	INDIVIDUAL OR GROUPED FISHERY
SOUTHEAST (fisheries included in the U.S. National Bycatch Report) (cont.)	SOUTHEASTERN ATLANTIC SHRIMP TRAWL	Federal	Individual
	SOUTHEASTERN ATLANTIC, GULF OF MEXICO GOLDEN CRAB TRAP/POT	Federal	Individual
	SPEARFISHING FOR TUNA	Federal	Individual
	WINTER FLUKE (FLOUNDER) TRAWLS	Federal	Individual
	NORTH CAROLINA COASTAL GILLNET	Federal, State	Individual
	SOUTHEASTERN ATLANTIC STONE CRAB TRAP/POT	Federal, State	Individual
SOUTHEAST (fisheries not included in the U.S. National Bycatch Report)	CARIBBEAN HAUL/BEACH SEINE	State	Individual
	FLORIDA WEST COAST SARDINE PURSE SEINE	State	Individual
	GULF OF MEXICO BLUE CRAB	State	Individual
	GULF OF MEXICO COASTAL GILLNET	State	Individual
	GULF OF MEXICO HAUL/BEACH SEINE	State	Individual
	GULF OF MEXICO MARINE SHRIMP BUTTERFLY NETS	State	Individual
	GULF OF MEXICO MARINE SHRIMP SKIMMER TRAWLS	State	Individual
	GULF OF MEXICO MENHADEN PURSE SEINE	State	Individual
	GULF OF MEXICO OYSTER	State	Individual
	GULF OF MEXICO SHRIMP CAST NET	State	Individual
	NORTH CAROLINA HAUL/BEACH SEINE, LONG HAUL	State	Individual
	NORTH CAROLINA INSHORE (BAYS AND RIVERS) GILLNET	State	Individual
	NORTH CAROLINA POUND-NET (CROAKER, WEAKFISH)	State	Individual
	NORTH CAROLINA SOUTHERN FLOUNDER POUND-NET	State	Individual
	NORTH CAROLINA STOP NETS	State	Individual
	SOUTH ATLANTIC BLUE CRAB	State	Individual
	SOUTH ATLANTIC COASTAL GILLNET	State	Individual
	SOUTHEAST CALICO SCALLOP TRAWL	State	Individual
	SOUTHEASTERN ATLANTIC, HAUL/BEACH SEINE	State	Individual
	SOUTHEASTERN ATLANTIC MARINE SHRIMP BUTTERFLY NETS	State	Individual
	SOUTHEASTERN ATLANTIC MARINE SHRIMP CAST NET	State	Individual
	SOUTHEASTERN ATLANTIC MENHADEN	State	Individual
	SOUTHEASTERN ATLANTIC OCEAN, GULF OF MEXICO, CARIBBEAN SHELLFISH DIVE, HAND/MECHANICAL COLLECTION	State	Individual
	SOUTHEASTERN ATLANTIC SKIMMER TRAWLS	State	Individual
	SOUTHEAST FISH TRAWL	State	Individual
	SURFACE TRAWL JELLYFISH	State	Individual
ALASKA (fisheries included in the U.S. National Bycatch Report)	ALEUTIAN ISLANDS, EASTERN BERING SEA ATKA MACKEREL TRAWL	Federal	Individual
	BERING SEA ALEUTIAN ISLANDS FLATFISH GROUP (ARROWTOOTH FLOUNDER, FLATHEAD SOLE, OTHER FLATFISH) TRAWL	Federal	Part of BSAI Flatfish Trawl Fisheries Group

REGION	FISHERY	MANAGEMENT AUTHORITY	INDIVIDUAL OR GROUPED FISHERY
ALASKA (fisheries included in the U.S. National Bycatch Report) (cont.)	BERING SEA ALEUTIAN ISLANDS GREENLAND TURBOT LONGLINE	Federal	Individual
	BERING SEA ALEUTIAN ISLANDS PACIFIC COD JIG	Federal	Individual
	BERING SEA ALEUTIAN ISLANDS PACIFIC COD LONGLINE	Federal	Individual
	BERING SEA ALEUTIAN ISLANDS PACIFIC COD POT	Federal	Individual
	BERING SEA ALEUTIAN ISLANDS PACIFIC COD TRAWL	Federal	Individual
	BERING SEA ALEUTIAN ISLANDS PACIFIC OCEAN PERCH	Federal	Individual
	BERING SEA ALEUTIAN ISLANDS POLLOCK TRAWL	Federal	Individual
	BERING SEA ALEUTIAN ISLANDS ROCK SOLE TRAWL	Federal	Part of BSAI Flatfish Trawl Fisheries Group
	BERING SEA ALEUTIAN ISLANDS SABLEFISH LONGLINE	Federal	Individual
	BERING SEA ALEUTIAN ISLANDS SABLEFISH POT	Federal	Individual
	BERING SEA ALEUTIAN ISLANDS SABLEFISH TRAWL	Federal	Individual
	BERING SEA ALEUTIAN ISLANDS YELLOWFIN SOLE TRAWL	Federal	Part of BSAI Flatfish Trawl Fisheries Group
	GULF OF ALASKA ARROWTOOTH FLOUNDER TRAWL	Federal	Part of GOA Flatfish Trawl Fisheries Group
	GULF OF ALASKA FLATFISH (DEEP-WATER FLATFISH) TRAWL	Federal	Part of GOA Flatfish Trawl Fisheries Group
	GULF OF ALASKA FLATFISH (SHALLOW-WATER FLATFISH) TRAWL	Federal	Part of GOA Flatfish Trawl Fisheries Group
	GULF OF ALASKA FLATHEAD SOLE TRAWL	Federal	Part of GOA Flatfish Trawl Fisheries Group
	GULF OF ALASKA PACIFIC COD JIG	Federal	Individual
	GULF OF ALASKA PACIFIC COD LONGLINE	Federal	Individual
	GULF OF ALASKA PACIFIC COD POT	Federal	Individual
	GULF OF ALASKA PACIFIC COD TRAWL	Federal	Individual
	GULF OF ALASKA POLLOCK TRAWL	Federal	Individual
	GULF OF ALASKA REX SOLE TRAWL	Federal	Part of GOA Flatfish Trawl Fisheries Group
	GULF OF ALASKA ROCKFISH (NORTHERN ROCKFISH, PELAGIC SHELF ROCKFISH, PACIFIC OCEAN PERCH) TRAWL	Federal	Individual
	GULF OF ALASKA SABLEFISH LONGLINE	Federal	Individual
	GULF OF ALASKA SABLEFISH TRAWL	Federal	Individual
	AK HALIBUT LONGLINE	International	Individual
	AK COOK INLET DRIFT GILLNET	State	Individual
	AK COOK INLET SALMON SET GILLNET	State	Individual
	AK PENINSULA/ ALEUTIANS SALMON DRIFT GILLNET	State	Individual
	AK PRINCE WILLIAM SOUND SALMON DRIFT GILLNET	State	Individual
	AK PRINCE WILLIAM SOUND SALMON SET GILLNET	State	Individual
	AK SOUTHEAST SALMON DRIFT GILLNET	State	Individual
	GULF OF ALASKA CRAB POT	State	Individual

REGION	FISHERY	MANAGEMENT AUTHORITY	INDIVIDUAL OR GROUPED FISHERY
ALASKA (fisheries not included in the U.S. National Bycatch Report)	AK ABALONE	State	Individual
	AK BRISTOL BAY SALMON DRIFT GILLNET	State	Individual
	AK BRISTOL BAY SALMON SET GILLNET	State	Individual
	AK CLAM	State	Individual
	AK DUNGENESS CRAB	State	Individual
	AK FOOD/BAIT HERRING TRAWL	State	Individual
	AK GROUNDFISH LONGLINE/SETLINE (INCLUDING SABLEFISH, ROCKFISH, AND MISC. FINFISH)	State	Individual
	AK HERRING SPAWN ON KELP POUND-NET	State	Individual
	AK KODIAK SALMON SET GILLNET	State	Individual
	AK KUSKOKWIM, YUKON, NORTON SOUND, KOTZEBUE SALMON GILLNET	State	Individual
	AK METLAKATLA/ANNETTE ISLAND SALMON DRIFT GILLNET	State	Individual
	AK METLAKATLA SALMON PURSE SEINE	State	Individual
	AK MISC. FINFISH BEACH SEINE	State	Individual
	AK MISC. FINFISH HANDLINE AND MECHANICAL JIG	State	Individual
	AK MISC. FINFISH OTTER OR BEAM TRAWL	State	Individual
	AK MISC. FINFISH PAIR TRAWL	State	Individual
	AK MISC. FINFISH PURSE SEINE	State	Individual
	AK MISC. FINFISH SET GILLNET	State	Individual
	AK NORTH PACIFIC HALIBUT HANDLINE AND MECHANICAL JIG	State	Individual
	AK OCTOPUS/SQUID HANDLINE	State	Individual
	AK OCTOPUS/SQUID LONGLINE	State	Individual
	AK OCTOPUS/SQUID POT	State	Individual
	AK PENINSULA/ ALEUTIANS SALMON SET GILLNET	State	Individual
	AK ROE HERRING AND FOOD/BAIT HERRING BEACH SEINE	State	Individual
	AK ROE HERRING AND FOOD/BAIT HERRING GILLNET	State	Individual
	AK ROE HERRING AND FOOD/BAIT HERRING PURSE SEINE	State	Individual
	AK SALMON BEACH SEINE	State	Individual
	AK SALMON PURSE SEINE (EXCEPT SOUTHEAST ALASKA, WHICH IS IN CATEGORY II)	State	Individual
	AK SALMON TROLL	State	Individual
	AK SHRIMP OTTER TRAWL AND BEAM TRAWL (STATEWIDE AND COOK INLET)	State	Individual
	AK SNAIL POT	State	Individual
	AK SOUTHEAST HERRING ROE/FOOD/BAIT POUND NET	State	Individual
	AK SOUTHEAST SALMON PURSE SEINE	State	Individual
	AK URCHIN AND OTHER FISH/SHELLFISH	State	Individual
	AK YAKUTAT SALMON SET GILLNET	State	Individual
	ALEUTIAN ISLANDS STATE WATERS PACIFIC COD	State	Individual
	BERING SEA, ALEUTIAN ISLANDS CRAB POT	State	Individual

APPENDIX E

REGION	FISHERY	MANAGEMENT AUTHORITY	INDIVIDUAL OR GROUPED FISHERY
ALASKA (fisheries not included in the U.S. National Bycatch Report) (cont.)	COASTWIDE SCALLOP DREDGE	State	Individual
	GULF OF ALASKA PACIFIC COD STATE FISHERY JIG	State	Individual
	GULF OF ALASKA PACIFIC COD STATE FISHERY POT	State	Individual
	SOUTHEAST ALASKA CRAB POT	State	Individual
	SOUTHEAST ALASKA SHRIMP POT	State	Individual
NORTHWEST (fisheries included in the U.S. National Bycatch Report)	WEST COAST GROUNDFISH NON-TRAWL GEAR: LIMITED-ENTRY SABLEFISH-ENDORSED FIXED GEAR	Federal	Individual
	WEST COAST GROUNDFISH NON-TRAWL GEAR: NON-ENDORSED FIXED GEAR	Federal	Individual
	WEST COAST LIMITED-ENTRY BOTTOM TRAWL; GROUNDFISH BOTTOM TRAWL	Federal	Individual
	WEST COAST SALMON TROLL, NON-TRIBAL OCEAN	Federal	Individual
	CALIFORNIA HALIBUT TRAWL	Federal, State	Individual
	CA/OR NEARSHORE ROCKFISH	Federal, State	Individual
	WEST COAST PACIFIC HALIBUT LONGLINE, NON-TRIBAL	Federal, State, International, Tribal	Individual
	WEST COAST MID-WATER TRAWL FOR WHITING, SHORESIDE PROCESSING	Federal, State, Tribal	Individual
	WEST COAST MID-WATER TRAWL FOR WHITING, AT-SEA PROCESSING	Federal, Tribal	Individual
	WEST COAST SALMON TROLL, TRIBAL OCEAN	Federal, Tribal	Individual
NORTHWEST (fisheries not included in the U.S. National Bycatch Report)	OREGON AND CALIFORNIA PINK SHRIMP	State	Individual
	OREGON AND CALIFORNIA SPOT PRAWN	State	Individual
	WA BEACH SEINE OR DRAG SEINE	State	Individual
	WA GRAYS HARBOUR SALMON DRIFT GILLNET (EXCLUDING TREATY TRIBAL FISHING)	State	Individual
	WA GRAYS HARBOUR SALMON SET AND DRIFT GILLNET	State	Individual
	WA HERRING BRUSH WEIR	State	Individual
	WA PUGET SOUND REGION SALMON DRIFT GILLNET	State	Individual
	WA SALMON PURSE SEINE	State	Individual
	WA SALMON REEF NET	State	Individual
	WA WILLAPA BAY DRIFT GILLNET	State	Individual
	WA/OR GILLNET	State	Individual
	WA/OR HERRING, SMELT, SQUID PURSE SEINE	State	Individual
	WA/OR LOWER COLUMBIA RIVER DRIFT GILLNET	State	Individual
	WA/OR SHRIMP POT AND TRAP	State	Individual
	WA/OR SMELT, HERRING DIP NET	State	Individual
	WA/OR/CA DUNGENESS CRAB POT	State	Individual
	WA/OR LOWER COL. RIVER SALMON DRIFT	State	Individual
	WA/OR MISC. INVERTEBRATE	State	Individual
	WILLAPA BAY SALMON DRIFT	State	Individual
	MAKAH SALMON SET GILLNET AREAS 4,4A, 4B	Tribal	Individual

REGION	FISHERY	MANAGEMENT AUTHORITY	INDIVIDUAL OR GROUPED FISHERY
SOUTHWEST (fisheries included in the U.S. National Bycatch Report)	CA COASTAL PURSE SEINE FOR TUNA	Federal	Individual
	CA/OR DRIFT GILLNET (MESH SIZE >14 INCHES) FOR SWORDFISH AND THRESHER SHARK	Federal	Individual
	CA PELAGIC LONGLINE	Federal	Individual
	NORTH PACIFIC ALBACORE BAITBOAT, POLE AND LINE	Federal	Individual
	NORTH PACIFIC ALBACORE TROLL	Federal	Individual
	SOUTH PACIFIC ALBACORE TROLL	Federal	Individual
	CA COASTAL PURSE SEINE FOR ANCHOVY, MACKEREL, SARDINE	Federal, State	Individual
	CA SWORDFISH HARPOON	Federal, State	Individual
	CA COASTAL PURSE SEINE FOR SQUID	State	Individual
	CA SET GILLNET (MESH SIZE UP TO 14 INCHES)	State	Individual
	CA SMALL-MESH DRIFT GILLNET (MESH SIZE >3.5 IN AND <14 IN)	State	Individual
SOUTHWEST (fisheries not included in the U.S. National Bycatch Report)	CENTRAL WESTERN PACIFIC TUNA PURSE SEINE	International	Individual
	EPO TUNA PURSE SEINE	International	Individual
	ETP BAITBOAT	International	Individual
	CA ABALONE	State	Individual
	CA HERRING GILLNET	State	Individual
	CA LIVE FISH HOOK-AND-LINE	State	Individual
	CA SALMON ENHANCEMENT REARING PEN	State	Individual
	CA SEA URCHIN	State	Individual
	CA SET AND DRIFT GILLNET (STRETCHED MESH SIZE OF 3.5 OR LESS)	State	Individual
	CA SQUID DIP NET	State	Individual
	CA TRAP/POT	State	Individual
	CA WHITE SEABASS ENHANCEMENT NET PENS	State	Individual
	OR/CA HAGFISH POT OR TRAP	State	Individual
	WA/OR/CA BAIT PENS	State	Individual

APPENDIX E

REGION	FISHERY	MANAGEMENT AUTHORITY	INDIVIDUAL OR GROUPED FISHERY
PACIFIC ISLANDS (fisheries included in the U.S. National Bycatch Report)	AMERICAN SAMOA BOTTOMFISH	Federal	Individual
	AMERICAN SAMOA LOBSTER	Federal	Individual
	AMERICAN SAMOA PELAGIC LONGLINE FISHERY	Federal	Individual
	AMERICAN SAMOA TROLL	Federal	Individual
	COMMONWEALTH OF THE NORTHERN MARIANA ISLANDS BOTTOMFISH	Federal	Individual
	COMMONWEALTH OF THE NORTHERN MARIANA ISLANDS LOBSTER	Federal	Individual
	COMMONWEALTH OF THE NORTHERN MARIANA ISLANDS TUNA TROLL	Federal	Individual
	GUAM BOTTOMFISH HANDLINE	Federal	Individual
	GUAM LONGLINE	Federal	Individual
	GUAM TROLL	Federal	Individual
	HAWAII-BASED DEEP-SET PELAGIC LONGLINE FISHERY (TUNA)	Federal	Individual
	HAWAII-BASED SHALLOW-SET PELAGIC LONGLINE FISHERY (SWORDFISH)	Federal	Individual
	HAWAII SHRIMP TRAP	Federal	Individual
	NON-LONGLINE COMMERCIAL PELAGIC FISHERY	Federal	Individual
	NORTHWESTERN HAWAIIAN ISLANDS BOTTOMFISH	Federal	Individual
	PRECIOUS CORAL (FEDERAL WATERS)	Federal	Individual
	WESTERN PACIFIC SQUID JIG	Federal	Individual
	HAWAII BOTTOMFISH	Federal, State	Individual
PACIFIC ISLANDS (fisheries not included in the U.S. National Bycatch Report)	HAWAII CRAB TRAP	State	Individual
	HAWAII FISH POND	State	Individual
	HAWAII FISH TRAP	State	Individual
	HAWAII INSHORE HANDLINE	State	Individual
	HAWAII LAY NET	State	Individual
	HAWAII LOBSTER DIVING	State	Individual
	HAWAII LOBSTER TRAP	State	Individual
	HAWAII OCTOPUS, SPEAR	State	Individual
	HAWAII OPELU/AKULE NET	State	Individual
	HAWAII PELAGIC HANDLINE	State	Individual
	HAWAII THROW NET, CAST NET	State	Individual
	HAWAII TROLLING, ROD AND REEL	State	Individual
	PRECIOUS CORAL (STATE WATERS)	State	Individual

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APPENDIX H Details of Scoring and Tier Classification System

A1. Bycatch Data Adequacy: Observer Data (maximum of 33 points)

An evaluation of the adequacy of at-sea observer bycatch data was conducted for each fishery that is currently observed, or has been observed in the past. All fisheries with at-sea observer programs designed to either estimate bycatch or total catch were evaluated. Fisheries that have never had observer coverage were scored as zero. The criteria included in evaluating observer bycatch data were:

Longevity of Observer Program (maximum of 5 points): This criterion evaluated the longevity of the observer program and whether the program is multiyear in nature.

0 = No observer program has ever been implemented
1 = Observer program was conducted prior to 1995
2 = Observer program was conducted on one or more occasions during 1995–2000, but not annually
3 = Observer program was conducted annually during 1995–2000 and not subsequently
4 = Observer program was conducted on one or more occasions from 2001 to present (i.e. 2006), but not annually
5 = Observer program has been conducted annually from 2001 to present (i.e. 2006)

Sampling Frame (maximum of 3 points): This criterion evaluated the sampling frame for placing observers on commercial fishing vessels. An evaluation of the sampling frame considered whether the frame is partially or completely developed, and assessed how well the sampling frame reflects the target population and program goals.

0 = No sampling frame
2 = Partial sampling frame
3 = Complete sampling frame

Sampling Design (maximum of 12 points): This criterion evaluated the overall sampling design of the observer program, relative to the goal of bycatch or total catch estimation. If a formal observer program sampling design had been developed, the scores indicated the type of sampling conducted at the vessel/permit/license, trip, and haul levels.

Sampling of Vessels/Permits/Licenses

0 = No observer program, or sampling design does not support bycatch or total catch estimation
1 = Opportunistic or haphazard sampling, including voluntary observer programs, to support bycatch or total catch estimation
2 = Random sampling scheme or probability-based sampling with moderate observer coverage levels to support bycatch or total catch estimation
3 = Random sampling scheme or probability sampling with adequate observer coverage levels to support bycatch or total catch estimation
4 = Near-census of vessels with estimation required, or census of vessels with no estimation required

Sampling of Trips

0 = No observer program, or sampling design does not support bycatch or total catch estimation
1 = Opportunistic or haphazard sampling, including voluntary observer programs, to support bycatch or total catch estimation
2 = Random sampling scheme or probability-based sampling with pilot/baseline observer coverage levels to support bycatch or total catch estimation
3 = Random sampling scheme or probability sampling with adequate observer coverage levels to support bycatch or total catch estimation
4 = Near-census of trips with estimation required, or census of trips with no estimation required

Sampling of Hauls

0 = No observer program, or sampling design does not support bycatch or total catch estimation
1 = Opportunistic or haphazard sampling, including voluntary observer programs, to support bycatch or total catch estimation
2 = Random sampling scheme or probability-based sampling to support bycatch or total catch estimation
3 = Near-census of hauls with estimation required
4 = Census of hauls with no estimation required

Design Implementation (maximum of 8 points): This criterion evaluated the overall implementation of the observer program sampling design. Factors considered include the spatial and temporal coverage of the program, vessel selection bias, and observer bias.

Sub-criteria	Point Scores		
Spatial Coverage	Add 0 points if no observer program has ever been implemented.	Add 1 point if spatial coverage is limited.	Add 2 points if spatial coverage is synoptic.
Temporal Coverage	Add 0 points if no observer program has ever been implemented.	Add 1 point if temporal coverage is limited.	Add 2 points if temporal coverage is synoptic.
Vessel Selection Bias	Add 0 points if vessel selection bias is high or unknown.		Add 2 points if vessel selection bias is negligible or no bias exists.
Observer Bias	Add 0 points if observer bias is high or unknown.		Add 2 points if observer bias is negligible or no bias exists.

Data Quality Control (maximum of 5 points): This criterion evaluated the overall data quality control of the observer program. Data quality control for observer programs involves a variety of activities, including observer training, observer debriefing, data editors, electronic range and other data checks, and observer/contractor incentive programs to improve data quality. The scoring system attempted to quantify the level of data quality control.

0 = No observer program, or no data quality control
1 = Limited or incomplete observer training, no debriefing or other quality control
2 = One-time observer training, no debriefing or other quality control measures
3 = Periodic observer training, minimal quality control measures
4 = One-time observer training, comprehensive quality control measures
5 = Periodic observer training, comprehensive quality control measures

A2. Bycatch Data Adequacy: Industry Bycatch Data (maximum of 2 points)

This criterion evaluated the availability and use of self-reported industry bycatch data (e.g. logbooks, trip tickets). This criterion was evaluated for all fisheries. However, if the observer bycatch data are used as the basis of the bycatch estimation the maximum score of 2 points was applied.

0 = No industry bycatch data available, or industry bycatch data are not used as a basis for bycatch estimates
1 = Industry bycatch data available prior to 2000 are used as a basis for bycatch estimates
2 = Industry bycatch data available from 2000 to present are used as a basis for bycatch estimates

B. Bycatch Data: Supplemental Data (maximum of 10 points)

These criteria evaluated the quantity and quality of supplemental data (e.g. logbooks, state data, and environmental data). Specific criteria evaluated the use of supplemental data to estimate or verify the sampling frame, expand observer data for unobserved components of the fishery, verify logbook data, stratify data and impute estimates, and identify model covariates.

Sub-criteria	Point Scores		
Data available for use as expansion factors for unobserved components of the fishery	Add 0 points if supplemental data are not available as expansion factors.	Add 1 point if limited supplemental data are available as expansion factors.	Add 2 points if extensive supplemental data are available or data are not necessary as expansion factors.
Data available for stratification	Add 0 points if supplemental data are not available for stratification.	Add 1 point if limited supplemental data are available for stratification.	Add 2 points if extensive supplemental data are available or data are not necessary for stratification.
Data available for imputation	Add 0 points if supplemental data are not available for imputation.	Add 1 point if limited supplemental data are available for imputation.	Add 2 points if extensive supplemental data are available or data are not necessary for imputation.
Data available for model covariates	Add 0 points if supplemental data are not available for model covariates.	Add 1 point if limited supplemental data are available for model covariates.	Add 2 points if extensive supplemental data are available or data are not necessary for model covariates.
Industry data verified	Add 0 points if industry data are not verified or no industry data are available.	Add 1 point if some relevant industry data are verified.	Add 2 points if all relevant industry data are verified.

C. Database / IT Considerations (maximum of 3 points)

This criterion evaluated the integration and linkages between observer data and supplemental data in order to improve the ability to produce timely bycatch estimates. If no observer data and/or supplemental data are available this criterion was scored as zero.

0 = No observer data and/or supplemental data available
1 = Analytical approach is constrained because of database/IT considerations
3 = Analytical approach is not constrained because of database/IT considerations

D. Analytical Approach (maximum of 25 points)

All fisheries were evaluated for analytical approach; however, if no analytical approach had been developed for estimation of total catch or bycatch in a fishery, the overall score for this criterion is zero.

Assumptions Identified, Tested, and Appropriate (maximum of 10 points): This criterion evaluated the assumptions of the analytical approach. The evaluation involved a determination of how well the assumptions of the approach have been identified and resolved. The scoring system attempted to provide a measure of gradient in these attributes.

0 = No bycatch estimation methodologies
1 = Assumptions not identified or tested
3 = Assumptions identified and tested, but no assumptions have been resolved
5 = Minor assumptions identified, tested, and determined to be appropriate or resolved
8 = Critical assumptions identified, tested, and determined to be appropriate or resolved
10 = All assumptions identified, tested, and determined to be appropriate or resolved

Peer Reviewed / Published (maximum of 8 points): This criterion evaluated whether the observer program sampling design and the analytical approach for estimating bycatch or total catch have been peer reviewed.

Sub-criteria	Point Scores		
Observer Program Sampling Design	Add 0 points if the observer program sampling design has not been peer reviewed, or if the sampling design is found to be seriously flawed during peer review.	Add 2 points if the observer program sampling design has been internally peer reviewed, or if problems were found during a peer review but they have not been fully addressed.	Add 4 points if the observer program sampling design has been externally peer reviewed.
Analytical Approach	Add 0 points if the analytical approach has not been peer reviewed, or if the analytical approach is found to be seriously flawed during peer review.	Add 2 points if the analytical approach has been internally peer reviewed, or if problems were found during a peer review but they have not been fully addressed.	Add 4 points if the analytical approach has been externally peer reviewed.

Statistical Bias of Estimators (maximum of 4 points): This criterion evaluated the statistical bias of the bycatch estimators, in particular whether there is any statistical bias associated with the estimator. Factors that were considered included measures of association, cross validation, and overfitting.

0 = No bycatch estimation methods, or statistical bias is unknown
2 = Estimators have high statistical bias
4 = Estimators have negligible statistical bias or are not statistically biased, or census sampling was used

Measures of Uncertainty (maximum of 3 points): This criterion evaluated whether measures of uncertainty (coefficients of variation) are calculated at various levels of sampling (vessel/permit/license, trip, and haul).

0 = No bycatch estimation methods
1 = Measures of uncertainty are not calculated
2 = Measures of uncertainty are calculated, but not at all levels (vessel/permit/license, trip, and haul)
3 = Measures of uncertainty are calculated at all levels (vessel/permit/license, trip, and haul)

APPENDIX I Living Marine Resources with U.S. National Bycatch Report Bycatch Estimates

Due to differences in naming conventions between NMFS regions, some listings may appear redundant (e.g. “unidentified skates” and “other skates”). All taxa used in the report are included in this appendix. Marine resource types are those categories used within the report (e.g., fish, marine mammal, sea turtle, seabird).

RESOURCES BY SPECIES NAME AND TYPE		
SCIENTIFIC NAME	**COMMON NAME**	**MARINE RESOURCE TYPE**
Acanthocybium solandri	Wahoo	Fish
Actinaria	Sea anemone, unidentified	Fish
Aetobatus narinari	Spotted eagle ray	Fish
Albatrossia pectoralis	Giant grenadier	Fish
Alepisaurus brevirostris	Shortnose lancetfish	Fish
Alepisaurus ferox	Longnose lancetfish	Fish
Alopiidae	Thresher sharks (unidentified)	Fish
Alopias spp.	Thresher sharks	Fish
Alopias pelagicus	Pelagic thresher	Fish
Alopias superciliosus	Bigeye thresher	Fish
Alopias vulpinus	Thresher shark	Fish
Ammodytes hexapterus	Pacific sand lance	Fish
Anguilliformes	True eels	Fish
Anisotremus virginicus	Porkfish	Fish
Anoplopoma fimbria	Sablefish	Fish
Apsilus dentatus	Black snapper	Fish
Arctica islandica	Ocean quahog	Fish
Ariidae	Sea catfishes	Fish
Assurger anzac	Razorback scabbardfish	Fish
Asteroidea	Sea star	Fish
Atheresthes stomias	Arrowtooth flounder	Fish
Bagre marinus	Gafftopsail catfish	Fish
Balaenoptera edeni	Brydes whale	Marine mammal
Balistes capriscus	Gray triggerfish	Fish
Balistidae	Triggerfish (unidentified)	Fish
Balistidae	Triggerfishes	Fish
Batrachoididae	Toad fishes	Fish
Bivalvia	Bivalves	Fish
Brevoortia smithi	Yellowfin menhaden	Fish
Brevoortia tyrannus	Atlantic menhaden	Fish
Calamus bajonado	Jolthead porgy	Fish
Calamus leucosteus	Whitebone porgy	Fish

RESOURCES BY SPECIES NAME AND TYPE		
SCIENTIFIC NAME	**COMMON NAME**	**MARINE RESOURCE TYPE**
Calamus nodosus	Knobbed porgy	Fish
Callorhinus ursinus	Northern fur seal	Marine mammal
Cancer magister	Dungeness crab	Fish
Canthidermis maculata	Rough triggerfish	Fish
Carangidae	Jacks and pompanos	Fish
Caranx bartholomaei	Yellow jack	Fish
Caranx crysos	Blue runner	Fish
Caranx hippos	Crevalle jack	Fish
Caranx ruber	Bar jack	Fish
Carcharhinus acronotus	Blacknose shark	Fish
Carcharhinus altimus	Bignose shark	Fish
Carcharhinus amblyrhynchos	Grey reef shark	Fish
Carcharhinus brevipinna	Spinner shark	Fish
Carcharhinus falciformis	Silky shark	Fish
Carcharhinus galapagensis	Galapagos shark	Fish
Carcharhinus leucas	Bull shark	Fish
Carcharhinus limbatus	Blacktip shark	Fish
Carcharhinus longimanus	Oceanic whitetip shark	Fish
Carcharhinus obscurus	Dusky shark	Fish
Carcharhinus perezii	Reef shark	Fish
Carcharhinus plumbeus	Sandbar shark	Fish
Carcharias taurus	Sand tiger	Fish
Carcharodon carcharias	White shark	Fish
Caretta caretta	Loggerhead sea turtle	Sea turtle
Caulolatilus microps	Blueline tilefish	Fish
Centropristis ocyurus	Bank sea bass	Fish
Centropristis philadelphica	Rock sea bass	Fish
Centropristis striata	Black sea bass	Fish
Cetacea	Cetacean (unidentified)	Marine mammal
Chaceon quinquedens	Red deepsea crab	Fish
Chaetodipterus faber	Atlantic spadefish	Fish
Chaetodontidae	Butterflyfishes	Fish
Chelonia mydas	Green sea turtle	Sea turtle
Chionoecetes bairdi	Southern Tanner crab	Fish
Chionoecetes opilio	Snow crab	Fish
Chloroscombrus chrysurus	Atlantic bumper	Fish
Chondrichthyes	Cartilaginous fishes	Fish

RESOURCES BY SPECIES NAME AND TYPE		
SCIENTIFIC NAME	**COMMON NAME**	**MARINE RESOURCE TYPE**
Chondrichthyes	Shark (unidentified)	Fish
Clupea harengus	Atlantic herring	Fish
Clupea pallasi	Herring	Fish
Conger oceanicus	Conger eel	Fish
Coryphaena spp.	Dolphinfishes	Fish
Coryphaena equiselis	Pompano dolphinfish	Fish
Coryphaena hippurus	Dolphinfish	Fish
Cottidae	Large sculpins	Fish
Cottidae	Other sculpins	Fish
Crustaceamorpha	Miscellaneous crustaceans	Fish
Cubiceps spp.	Driftfishes	Fish
Cynoscion spp.	Seatrouts and weakfishes	Fish
Cynoscion arenarius	Sand seatrout	Fish
Cynoscion nebulosus	Spotted seatrout	Fish
Cynoscion nothus	Silver seatrout	Fish
Dasyatis spp.	Whiptail stingray—South Atlantic/Gulf of Mexico	Fish
Dasyatis violacea	Pelagic stingray	Fish
Decapoda	Miscellaneous crabs	Fish
Decapoda	Squid	Fish
Delphinus capensis	Common dolphin, long-beaked	Marine mammal
Delphinus delphis	Common dolphin	Marine mammal
Dermochelys coriacea	Leatherback sea turtle	Sea turtle
Diplodus holbrookii	Spottail pinfish	Fish
Elagatis bipinnulata	Rainbow runner	Fish
Elasmobranchii	Sharks	Fish
Elops saurus	Ladyfish	Fish
Eopsetta jordani	Petrale sole	Fish
Ephippidae	Spadefishes	Fish
Epinephelus adscensionis	Rock hind	Fish
Epinephelus cruentatus	Graysby	Fish
Epinephelus drummondhayi	Speckled hind	Fish
Epinephelus flavolimbatus	Yellowedge grouper	Fish
Epinephelus guttatus	Red hind	Fish
Epinephelus itajara	Goliath grouper	Fish
Epinephelus morio	Red grouper	Fish
Epinephelus nigritus	Warsaw grouper	Fish

RESOURCES BY SPECIES NAME AND TYPE		
SCIENTIFIC NAME	**COMMON NAME**	**MARINE RESOURCE TYPE**
Epinephelus niveatus	Snowy grouper	Fish
Epinephelus striatus	Nassau grouper	Fish
Erignathus barbatus	Bearded seal	Marine mammal
Erythrocles monodi	Crimson rover	Fish
Eschrichtius robustus	Gray whale	Marine mammal
Eumegistus illustris	Lustrous pomfret	Fish
Eumetopias jubatus	Steller sea lion	Marine mammal
Euthynnus affinis	Kawakawa	Fish
Euthynnus alletteratus	Little tunny	Fish
Euthynnus pelamis	Skipjack tuna	Fish
Fulmarus glacialis	Northern fulmar	Seabird
Gadus macrocephalus	Pacific cod	Fish
Gadus morhua	Atlantic cod	Fish
Galeocerdo cuvier	Tiger shark	Fish
Galeocerdo cuvieri	Tiger shark	Fish
Gastropoda	Snails	Fish
Gempylus serpens	Snake mackerel	Fish
Ginglymostoma cirratum	Nurse shark	Fish
Globicephala spp.	Pilot whales	Marine mammal
Globicephala macrorhynchus	Short-finned pilot whale	Marine mammal
Glyptocephalus cynoglossus	Witch flounder	Fish
Glyptocephalus zachirus	Rex sole	Fish
Grampus griseus	Risso's dolphin	Marine mammal
Haemulidae	Grunts	Fish
Haemulon album	Margate	Fish
Haemulon aurolineatum	Tomtate	Fish
Haemulon flavolineatum	French grunt	Fish
Haemulon plumieri	White grunt	Fish
Hemiramphus brasiliensis	Ballyhoo	Fish
Hexagrammidae	Greenlings	Fish
Hexagrammos decagrammus	Kelp greenling	Fish
Hexanchus griseus	Bluntnose sixgill shark	Fish
Hippoglossoides elassodon	Flathead sole	Fish
Hippoglossoides platessoides	American plaice	Fish
Hippoglossus hippoglossus	Atlantic halibut	Fish
Hippoglossus stenolepis	Pacific halibut	Fish
Holocentridae	Squirrelfishes	Fish

RESOURCES BY SPECIES NAME AND TYPE		
SCIENTIFIC NAME	**COMMON NAME**	**MARINE RESOURCE TYPE**
Hyperoglyphe perciformis	Barrelfish	Fish
Hypomesus pretiosus	Surf smelt	Fish
Illex illecebrosus	Northern shortfin squid	Fish
Isistius brasiliensis	Cookiecutter shark	Fish
Istiophorus albicans	Atlantic sailfish	Fish
Istiophorus platypterus	Sailfish	Fish
Isurus spp.	Mako sharks	Fish
Isurus oxyrinchus	Shortfin mako	Fish
Isurus paucus	Longfin mako	Fish
Katsuwonus pelamis	Skipjack tuna	Fish
Kyphosidae	Sea chubs	Fish
Lachnolaimus maximus	Hogfish	Fish
Lagenorhynchus acutus	Atlantic white-sided dolphin	Marine mammal
Lagenorhynchus obliquidens	Pacific white-sided dolphin	Marine mammal
Lagocephalus lagocephalus	Pelagic puffer	Fish
Lagodon rhomboides	Pinfish	Fish
Lamna ditropis	Salmon shark	Fish
Lampris guttatus	Opah	Fish
Larimus fasciatus	Banded drum	Fish
Leiostomus xanthurus	Spot	Fish
Lepidochelys kempii	Kemp's ridley sea turtle	Sea turtle
Lepidochelys olivacea	Olive ridley sea turtle	Sea turtle
Lepidocybium flavobrunneum	Escolar	Fish
Limanda aspera	Yellowfin sole	Fish
Limanda ferruginea	Yellowtail flounder	Fish
Lissodelphis borealis	Northern right whale dolphin	Marine mammal
Lithodes aequispina	Golden king crab	Fish
Lobotes surinamensis	Tripletail	Fish
Loligo pealeii	Longfin inshore squid	Fish
Lophius americanus	Goosefish	Fish
Lopholatilus chamaeleonticeps	Tilefish	Fish
Lophotus lacepede	Crestfish	Fish
Lutjanidae	Snappers	Fish
Lutjanus analis	Mutton snapper	Fish
Lutjanus buccanella	Blackfin snapper	Fish
Lutjanus campechanus	Red snapper	Fish
Lutjanus griseus	Gray snapper	Fish

RESOURCES BY SPECIES NAME AND TYPE		
SCIENTIFIC NAME	**COMMON NAME**	**MARINE RESOURCE TYPE**
Lutjanus purpureus	Caribbean red snapper	Fish
Lutjanus synagris	Lane snapper	Fish
Lutjanus vivanus	Silk snapper	Fish
Luvarus imperialis	Louvar	Fish
Makaira indica	Black marlin	Fish
Makaira mazara	Indo-Pacific blue marlin	Fish
Makaira nigricans	Blue marlin	Fish
Malacanthidae	Tilefishes	Fish
Malacanthus plumieri	Sand tilefish	Fish
Mallotus villosus	Capelin	Fish
Manta birostris	Atlantic manta	Fish
Masturus lanceolatus	Sharptail mola	Fish
Megalops atlanticus	Tarpon	Fish
Megaptera novaeangliae	Humpback whale	Marine mammal
Melanogrammus aeglefinus	Haddock	Fish
Merluccius albidus	Offshore hake	Fish
Merluccius bilinearis	Silver hake	Fish
Merluccius productus	Pacific hake	Fish
Mesoplodon densirostris	Blainville's beaked whale	Marine mammal
Micropogonias undulatus	Atlantic croaker	Fish
Microstomus pacificus	Dover sole	Fish
Mirounga angustirostris	Northern elephant seal	Marine mammal
Mobula spp.	Mobulas (unidentified)	Fish
Mobulidae	Mantas (unidentified)	Fish
Mola mola	Ocean sunfish	Fish
Morus bassanus	Northern gannet	Seabird
Muraenidae	Moray eels	Fish
Mustelus canis	Smooth dogfish	Fish
Mycteroperca bonaci	Black grouper	Fish
Mycteroperca interstitialis	Yellowmouth grouper	Fish
Mycteroperca microlepis	Gag	Fish
Mycteroperca phenax	Scamp	Fish
Mycteroperca venenosa	Yellowfin grouper	Fish
Myctophidae	Lanternfishes	Fish
Naucrates ductor	Pilotfish	Fish
Negaprion brevirostris	Lemon shark	Fish
Notorynchus cepedianus	Bluntnose sevengill shark	Fish

RESOURCES BY SPECIES NAME AND TYPE		
SCIENTIFIC NAME	**COMMON NAME**	**MARINE RESOURCE TYPE**
Oceanites oceanicus	Wilson's storm-petrel	Seabird
Octocorallia	Blue coral, soft corals, sea pens, and gorgonians	Fish
Octopoda	Octopus	Fish
Ocyurus chrysurus	Yellowtail snapper	Fish
Odobenus rosmarus divergens	Pacific walrus	Marine mammal
Odontaspis taurus	Sand tiger shark	Fish
Omosudis lowei	Hammerjaw	Fish
Oncorhynchus kisutch	Coho salmon	Fish
Oncorhynchus tshawytscha	Chinook salmon	Fish
Ophichthidae	Snake eels	Fish
Ophiodon elongatus	Lingcod	Fish
Ophiuroidea	Brittle star (unidentified)	Fish
Orcinus orca	Killer whale	Marine mammal
Pagrus pagrus	Red porgy	Fish
Paguroidea	Hermit crab (unidentified)	Fish
Paralichthys dentatus	Summer flounder	Fish
Paralichthys lethostigma	Southern flounder	Fish
Paralithodes camtschaticus	Red king crab	Fish
Paralithodes platypus	Blue king crab	Fish
Paraplagusia bilineata	Doublelined tonguesole	Fish
Parophrys vetulus	English sole	Fish
Pelecanus occidentalis	Brown pelican	Seabird
Pandalus spp.	Pandalid shrimp	Fish
Peprilus triacanthus	Butterfish	Fish
Phoca fasciata	Ribbon seal	Marine mammal
Phoca hispida	Ringed seal	Marine mammal
Phoca largha	Spotted seal	Marine mammal
Phoca vitulina	Harbor seal	Marine mammal
Phoca vitulina richardsi	Harbor seal	Marine mammal
Phocoena phocoena	Harbor porpoise	Marine mammal
Phocoenoides dalli	Dall's porpoise	Marine mammal
Phoebastria albatrus	Short-tailed albatross	Seabird
Phoebastria immutabilis	Laysan albatross	Seabird
Phoebastria nigripes	Black-footed albatross	Seabird
Pholidae	Gunnels	Fish
Physeter macrocephalus	Sperm whale	Marine mammal
Placopecten magellanicus	Sea scallop	Fish

RESOURCES BY SPECIES NAME AND TYPE		
SCIENTIFIC NAME	**COMMON NAME**	**MARINE RESOURCE TYPE**
Platyrhinoidis triseriata	Thornback	Fish
Pleurogrammus monopterygius	Atka mackerel	Fish
Pleuronectes quadrituberculatus	Alaska plaice	Fish
Pleuronectiformes	Flatfishes	Fish
Pogonias cromis	Black drum	Fish
Pollachius virens	Pollock	Fish
Polychaeta	Polychaete (unidentified)	Fish
Polyprion americanus	Wreckfish	Fish
Pomatomus saltatrix	Bluefish	Fish
Porifera	Sponge (unidentified)	Fish
Prionace glauca	Blue shark	Fish
Pristis pectinata	Smalltooth sawfish	Fish
Promethichthys prometheus	Roudi escolar	Fish
Pseudocarcharias kamoharai	Crocodile shark	Fish
Pseudopleuronectes americanus	Winter flounder	Fish
Pseudorca crassidens	False killer whale	Marine mammal
Puffinus gravis	Greater shearwater	Seabird
Rachycentron canadum	Cobia	Fish
Raja binoculata	Big skate	Fish
Raja rhina	Longnose skate	Fish
Rajidae	Skate	Fish
Rajiformes	Other rays	Fish
Rajiformes	Ray (unidentified)	Fish
Rajiformes	Rays, sawfish, and skates	Fish
Rajiformes	Rays, sawfish, and skates—South Atlantic/Gulf of Mexico	Fish
Ranzania laevis	Slender mola	Fish
Regalecus glesne	Oarfish	Fish
Reinhardtius hippoglossoides	Greenland halibut	Fish
Remora remora	Remora	Fish
Rhinoptera bonasus	Cownose ray	Fish
Rhizoprionodon porosus	Caribbean sharpnose shark	Fish
Rhizoprionodon terraenovae	Atlantic sharpnose shark	Fish
Rhomboplites aurorubens	Vermilion snapper	Fish
Rissa brevirostris	Red-legged kittiwake	Seabird
Ruvettus pretiosus	Oilfish	Fish
Salmo salar	Atlantic salmon	Fish

RESOURCES BY SPECIES NAME AND TYPE		
SCIENTIFIC NAME	**COMMON NAME**	**MARINE RESOURCE TYPE**
Sarda chiliensis	Pacific bonito	Fish
Sarda sarda	Atlantic bonito	Fish
Scaridae	Parrotfishes	Fish
Sciaenops ocellatus	Red drum	Fish
Scomber japonicus	Pacific chub mackerel	Fish
Scomber scombrus	Atlantic mackerel	Fish
Scomberomorus spp.	Mackerels	Fish
Scomberomorus cavalla	King mackerel	Fish
Scomberomorus maculatus	Spanish mackerel	Fish
Scombrolabrax heterolepis	Black mackerel	Fish
Scophthalmus aquosus	Windowpane	Fish
Scorpaenichthys marmoratus	Cabezon	Fish
Scorpaenidae	Scorpionfishes	Fish
Scymnodon squamulosus	Velvet dogfish	Fish
Scyphozoa	Scypho jellies	Fish
Sebastes aleutianus	Rougheye rockfish	Fish
Sebastes alutus	Pacific ocean perch	Fish
Sebastes borealis	Shortraker rockfish	Fish
Sebastes crameri	Darkblotched rockfish	Fish
Sebastes diploproa	Splitnose rockfish	Fish
Sebastes entomelas	Widow rockfish	Fish
Sebastes fasciatus	Acadian redfish	Fish
Sebastes flavidus	Yellowtail rockfish	Fish
Sebastes goodei	Chilipepper	Fish
Sebastes jordani	Shortbelly rockfish	Fish
Sebastes levis	Cowcod	Fish
Sebastes melanops	Black rockfish	Fish
Sebastes melanostomus	Blackgill rockfish	Fish
Sebastes mystinus	Blue rockfish	Fish
Sebastes paucispinis	Bocaccio	Fish
Sebastes pinniger	Canary rockfish	Fish
Sebastes polyspinis	Northern rockfish	Fish
Sebastes ruberrimus	Yelloweye rockfish	Fish
Sebastolobus alascanus	Shortspine thornyhead	Fish
Sebastolobus altivelis	Longspine thornyhead	Fish
Selene setapinnis	Atlantic moonfish	Fish
Semicossyphus pulcher	California sheephead	Fish

RESOURCES BY SPECIES NAME AND TYPE		
SCIENTIFIC NAME	**COMMON NAME**	**MARINE RESOURCE TYPE**
Seriola spp.	Amberfishes, banded rudderfish, amberjacks, and yellowtails	Fish
Seriola dumerili	Greater amberjack	Fish
Seriola fasciata	Lesser amberjack	Fish
Seriola lalandi	Yellowtail jack	Fish
Seriola rivoliana	Almaco jack	Fish
Seriola zonata	Banded rudderfish	Fish
Serranidae	Groupers and sea basses	Fish
Sparidae	Breams and porgies	Fish
Sphyraena barracuda	Great barracuda	Fish
Sphyraenidae	Barracudas	Fish
Sphyrna spp.	Hammerhead sharks	Fish
Sphyrna lewini	Scalloped hammerhead	Fish
Sphyrna mokarran	Great hammerhead	Fish
Sphyrna tiburo	Bonnethead	Fish
Sphyrna zygaena	Smooth hammerhead	Fish
Sphyrnidae	Hammerhead sharks	Fish
Spisula solidissima	Atlantic surfclam	Fish
Squalidae	Dogfish sharks	Fish
Squalus acanthias	Spiny dogfish	Fish
Squatina dumeril	Atlantic angelshark	Fish
Stenella attenuata	Pantropical spotted dolphin	Marine mammal
Stenella coeruleoalba	Striped dolphin	Marine mammal
Stenella frontalis	Atlantic spotted dolphin	Marine mammal
Stenella longirostris	Spinner dolphin	Marine mammal
Stenotomus caprinus	Longspine porgy	Fish
Stenotomus chrysops	Scup	Fish
Strongylura marina	Atlantic needlefish	Fish
Sula leucogaster	Brown booby	Seabird
Taractes asper	Rough pomfret	Fish
Taractes rubescens	Knifetail pomfret	Fish
Taractichthys steindachneri	Sickle pomfret	Fish
Teleostomi	Miscellaneous deep fish	Fish
Teleostomi	Miscellaneous fish	Fish
Tetraodontidae	Blowfishes	Fish
Tetrapturus spp.	Marlins and spearfishes	Fish
Tetrapturus albidus	White marlin	Fish
Tetrapturus angustirostris	Shortbill spearfish	Fish

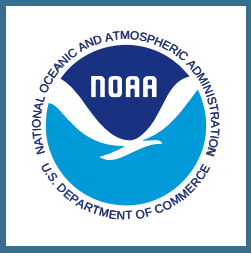
RESOURCES BY SPECIES NAME AND TYPE		
SCIENTIFIC NAME	**COMMON NAME**	**MARINE RESOURCE TYPE**
Tetrapturus audax	Striped marlin	Fish
Thaleichthys pacificus	Eulachon	Fish
Theragra chalcogramma	Walleye pollock	Fish
Thunnus alalunga	Albacore	Fish
Thunnus albacares	Yellowfin tuna	Fish
Thunnus atlanticus	Blackfin tuna	Fish
Thunnus obesus	Bigeye tuna	Fish
Thunnus orientalis	Pacific bluefin tuna	Fish
Thunnus thynnus	Bluefin tuna	Fish
Trachinotus falcatus	Permit	Fish
Trachipterus altivelis	King-of-salmon	Fish
Trachipterus fukuzakii	Tapertail ribbonfish	Fish
Trichiurus lepturus	Atlantic cutlassfish	Fish
Tursiops truncatus	Bottlenose dolphin	Marine mammal
Uraspis spp.	Jacks (unidentified)	Fish
Urochordata	Benthic urochordata	Fish
Urophycis spp.	Hakes	Fish
Urophycis chuss	Red hake	Fish
Urophycis tenuis	White hake	Fish
Xiphias gladius	Swordfish	Fish
Zalophus californianus	California sea lion	Marine mammal
Zoarces americanus	Ocean pout	Fish
Zoarcidae	Eelpouts	Fish
Zu cristatus	Scalloped ribbonfish	Fish

RESOURCES BY GROUP NAME AND TYPE		
GROUP	**SPECIES GROUP TYPE**	**GROUP DESCRIPTION (MAJOR SPECIES)**
Alcid	Seabird	Auks, auklets, murres, murrelets, puffins, and guillemots
All seabirds	Seabird	All seabirds
Beaked whale (unidentified)	Marine mammal	Family Ziphiidae
Billfishes	Fish	Sailfishes, spearfishes, marlins
Bony fishes	Fish	Class Osteichthyes
Bony fishes (other)	Fish	Class Osteichthyes
Bony fishes (unidentified)	Fish	Class Osteichthyes
Brama pomfrets (unidentified)	Fish	Unidentified brama pomfret

RESOURCES BY GROUP NAME AND TYPE		
GROUP	**SPECIES GROUP TYPE**	**GROUP DESCRIPTION (MAJOR SPECIES)**
Cartilaginous fishes	Fish	Class Chondrichthyes
Coastal shark group 1, South Atlantic	Fish	Night, silky, scalloped hammerhead, tiger, dusky, hammerhead, sandbar, bignose, and spinner sharks
Coastal shark group 2, South Atlantic	Fish	Shortfin mako, longfin mako, thresher, porbeagle, oceanic whitetip, common thresher, mako, and bigeye thresher sharks
Bryozoans/hydroids	Fish	Unidentified bryozoans, hydroids, and corals
Deep sea smelts (Bathylagidae)	Fish	Unclassified deep sea smelt
Deep water flatfish	Fish	Unclassified deep water flatfish
Deeper nearshore species	Fish	Black-and-yellow rockfish, blue rockfish, brown rockfish, calico rockfish, copper rockfish, olive rockfish, treefish, unspecified nearshore rockfish
Demersal shelf rockfish	Fish	Unclassified demersal shelf rockfish
False killer or short-finned pilot whale (unidentified)	Marine mammal	Unidentified whale: either short-finned pilot whale or false killer whale
Finfishes, unclassified, general	Fish	Unclassified finfish
Flatfish	Fish	Unclassified flatfish
Gannet	Seabird	Unclassified gannet
Grenadier	Fish	Unclassified grenadier
Grouped finfish other than listed, Gulf of Mexico	Fish	Other grouped finfishes
Grouped sharks, Gulf of Mexico	Fish	Grouped sharks other than listed
Gull	Seabird	Unclassified gull
Invertebrate, unidentified	Fish	Unidentified invertebrate
Mako sharks	Fish	Unclassified mako shark
Non-Chinook salmon	Fish	Unclassified non-Chinook salmon
Non-crustacean invertebrates, Gulf of Mexico	Fish	Unidentified non-crustacean invertebrate
Non-penaeid shrimp crustacean, Gulf of Mexico	Fish	Unidentified shrimp, non-penaeid
Other flatfish1	Fish	Alaska plaice, butter sole, Curlfin sole, flathead sole, greeenland turbot, Kamchatka flounder, rex sole, rock sole, sand sole, yellowfin sole, other flatfish, unspecified turbot, unspecified flatfish
Other flatfish 2	Fish	Flathead sole, Pacific sandab, rex sole
Other flatfish 3	Fish	Rock sole, sand sole, unspecified turbot, unspecified flatfish
Other groundfish 1	Fish	Atka mackerel, big skate, cabezon, California skate, capelin, kelp greenling, lepard shark, longnose skate, Pacific skate, soupfin shark, spotted ratfish, walleye pollock, unspecified rockfish, unspecified roundfish, unspecified groundfish, unspecified skates, unspecified sharks, unspecified flatfish, unspecified grenardiers

RESOURCES BY GROUP NAME AND TYPE		
GROUP	**SPECIES GROUP TYPE**	**GROUP DESCRIPTION (MAJOR SPECIES)**
Other groundfish 2	Fish	Kelp greenling, soupfin shark, spotted ratfish
Other groundfish 3	Fish	Lepoard shark, Pacific whiting, soupfin shark, spotted ratfish, unspecified grenadiers
Other *Lutjanus* spp., Gulf of Mexico	Fish	Other snapper species
Other minor nearshore rockfish, North	Fish	Black-and-yellow rockfish, brown rockfish, calico rockfish, China rockfish, copper rockfish, gopher rockfish, grass rockfish, kelp rockfish, olive rockfish, quillback rockfish, treefish, unspecified nearshore rockfish
Other nearshore rockfish	Fish	Black-and-yellow rockfish, blue rockfish, brown rockfish, calico rockfish, california scorpionfish, China rockfish, copper rockfish, gopher rockfish, grass rockfish, kelp rockfish, olive rockfish, quillback rockfish, treefish, unspecified nearshore rockfish
Other osmerids	Fish	Other smelts
Other seabird	Seabird	Other seabird
Other shelf rockfish 1	Fish	Bocaccio, bronzespotted rockfish, chameleon rockfish, dwarf-red rockfish, flag rockfish, freckled rockfish, greenblotched rockfish, greenspotted rockfish, greenstriped rockfish, halfbanded rockfish, honeycomb rockfish, Mexican rockfish, pink rockfish, pinkrose rockfish, Puget Sound rockfish, pygmy rockfish, redbanded rockfish, redstripe rockfish, rosethorn rockfish, rosy rockfish, silvergrey rockfish, speckled rockfish, squarespot rockfish, starry rockfish, stripetail rockfish, swordspine rockfish, tiger rockfish, vermillion rockfish, unspecified shelf rockfish
Other shelf rockfish 2	Fish	Greenstriped rockfish, redstripe rockfish, rosethorn rockfish, silvergray rockfish, stripetail rockfish
Other shelf rockfish 3	Fish	Bocaccio, bronzespotted rockfish, chameleon rockfish, chilipepper rockfish, dwarf-red rockfish, flag rockfish, freckled rockfish, greenblotched rockfish, greenspotted rockfish, greenstriped rockfish, halfbanded rockfish, harlequin rockfish, honeycomb rockfish, Mexican rockfish, pink rockfish, pinkrose rockfish, Puget Sound rockfish, pygmy rockfish, redbanded rockfish, redstripe rockfish, rosethorn rockfish, rosy rockfish, silvergrey rockfish, speckled rockfish, squarespot rockfish, starry rockfish, stripetail rockfish, swordspine rockfish, tiger rockfish, vermillion rockfish, yellowtail rockfish, unspecified shelf rockfish

RESOURCES BY GROUP NAME AND TYPE		
GROUP	**SPECIES GROUP TYPE**	**GROUP DESCRIPTION (MAJOR SPECIES)**
Other slope rockfish 1	Fish	Aurora rockfish, bank rockfish, blackgill rockfish. darkblotched rockfish, rougheye rockfish, sharpchin rockfish, shortraker rockfish, splitnose rockfish, yellowmouth rockfish, unspecified slope rockfish
Other slope rockfish 2	Fish	Aurora rockfish, bank rockfish, redbanded rockfish, rougheye rockfish, sharpchin rockfish, shortraker rockfish
Other slope rockfish 3	Fish	Aurora rockfish, bank rockfish, blackgill rockfish, rougheye rockfish, sharpchin rockfish, shortraker rockfish, splitnose rockfish, yellowmouth rockfish, unspecified slope rockfish
Other species	Fish	Other species
Pelagic shelf rockfish	Fish	Dusky rockfish, dark rockfish, yellowtail rockfish, widow rockfish.
Pricklebacks (Stichaeidae)	Fish	Unclassified pricklebacks
Rockfish	Fish	Unlcassified rockfish
Shallow nearshore species	Fish	California scorpionfish, China rockfish, gopher rockfish, grass rockfish, kelp rockfish, quillback rockfish
Shallow water flatfish	Fish	Northern rock sole, southern rock sole, butter sole, yellowfin sole, starry flounder
Shark (other)	Fish	Other sharks
Shearwater	Seabird	Unclassified shearwater
Short-beaked common dolphin (unidentified)	Marine mammal	Unidentified short-beaked common dolphin
Skate complex (NE)	Fish	Winter skate, barndoor skate, thorny skate, smooth skate, little skate, clearnose skate, and rosette skate
Tanner crab	Fish	Opilio Tanner crab, unspecified Tanner crab
Thresher sharks	Fish	Unidentified thresher shark
Tunas	Fish	Unclassified tuna species
Unidentified albatross	Bird	Unidentified albatross species
Unidentified gull	Bird	Unidentified gull species
Unidentified procellarids	Bird	Unidentified shearwater or petrel
Unidentified seabirds	Bird	Unidentified seabird
Unidentified sea turtle	Sea turtle	Unidentified sea turtle
Unspecified seabirds	Seabird	Unspecified seabird
Unspecified skate 1 (NW)	Fish	Unspecified skate species
Unspecified skate 2 (NW)	Fish	Big skate, longnose skate, unspecified skate
Urchins, dollars, cucumbers	Fish	Unspecified urchin, sand dollar, sea cucumber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