

Federal Fisheries Observer Programs in the United States: Over 40 Years of Independent Data Collection

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Introduction

Federal fisheries observer programs of the National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service

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ABSTRACT—The National Marine Fisheries Service, NOAA, placed trained fishery observers aboard commercial fishing vessels to collect a variety of data on catch, bycatch, and fishing operations beginning in the 1970's. Prior to this review, a full documentation of the agency's 40+ year history of fisheries observations had not been completed. The first conclusion drawn from this review is that a substantial shift in the mission and sampling plans of NMFS observer programs that occurred over the past 40 year. This reflects a shift from focused efforts to monitor fishery interactions with marine mammals and the harvest of U.S. resources by foreign fishing vessels to meeting broader needs for the conservation and preservation of marine resources. Second is that the strategy of implementing broad-based sampling programs designed to achieve a specified level of confidence evolved as NMFS moved towards a more fully documented, science-based strategy for fisheries management. Related to this point is the increase in the use of fisheries independent data over time. It is also clear that funding is a key driver of observer coverage levels, and that these costs may increase as management strategies require real-time data for sector and catch-share systems. Continued investment in observer programs, as well as the exploration of new technologies to augment them, will be necessary to maintain the wide availability of observer data for fisheries science and management.

(NMFS) have provided scientific data on the nation's commercial fisheries since 1971. Fishery observers are trained biologists who collect data on fishing activities onboard commercial vessels (and at processing plants in some instances) in support of science and management programs.¹ Observer programs collect a variety of data including catch, bycatch, fishing effort, biological characteristics, interactions with protected species, and socioeconomic information.

This information is used by NMFS to perform stock assessments, construct fishery management plan regulations, develop bycatch reduction devices, and identify the need for protective regulations for protected species. Federal fisheries observer programs are administered under the Magnuson-Stevens Fisheries Conservation and Management Act (MSA), the Marine Mammal Protection Act (MMPA), and the Endangered Species Act (ESA); this authorizing legislation is critical to program operation and is discussed in the next section.

In 2012², NMFS deployed observers in 47 different fisheries nationwide, monitoring over 83,000 days-at-sea. Fisheries observer programs have been managed by the six NMFS Fisheries Management Regions: the Northeast, Southeast, Alaska, Northwest,

Southwest, and Pacific Islands (Fig. 1).³ Program activities vary widely from fishery to fishery because of differences in fishing location, types of vessels and gear, interactions with protected or prohibited species, and overall program objectives. The scope and complexity of an observer program, as well as the fisheries monitored, may change annually. Changes in observer program activities also occur as management data needs shift or as new regulations are introduced.

One of the key variables in implementing an observer program is determining the level of sampling intensity (coverage) required. Coverage levels are referenced throughout this report, and they are measured for a fishery in terms of the amount of fishing effort that is monitored. The 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 (e.g., are "rare events"), while one implemented to provide data for estimation of total catch of target fish species may require lower levels of coverage to achieve the desired level of statistical precision. Rare events may also be monitored at lower coverage levels, although this increases the uncertainty in the estimate.

¹Several types of nonfishery observer programs exist in U.S. waters, such as seismic observers placed aboard oil and gas exploration vessels to monitor for marine mammals. State, tribal, and international organizations also observe non-federal commercial and recreational fisheries. Discussion in this document is limited to programs implemented by the NMFS to monitor commercial fisheries.

²Fisheries observer coverage levels are calculated post-season. At press time, the most recent coverage level information available was for the year 2012.

³While this paper was in press, the NMFS Southwest Region was merged administratively with the Northwest Region, becoming the West Coast Region and the Northeast Region was renamed the Greater Atlantic Region. To facilitate linkage with historical records, the regional names "Northwest," "Southwest," and "Northeast" are used herein.

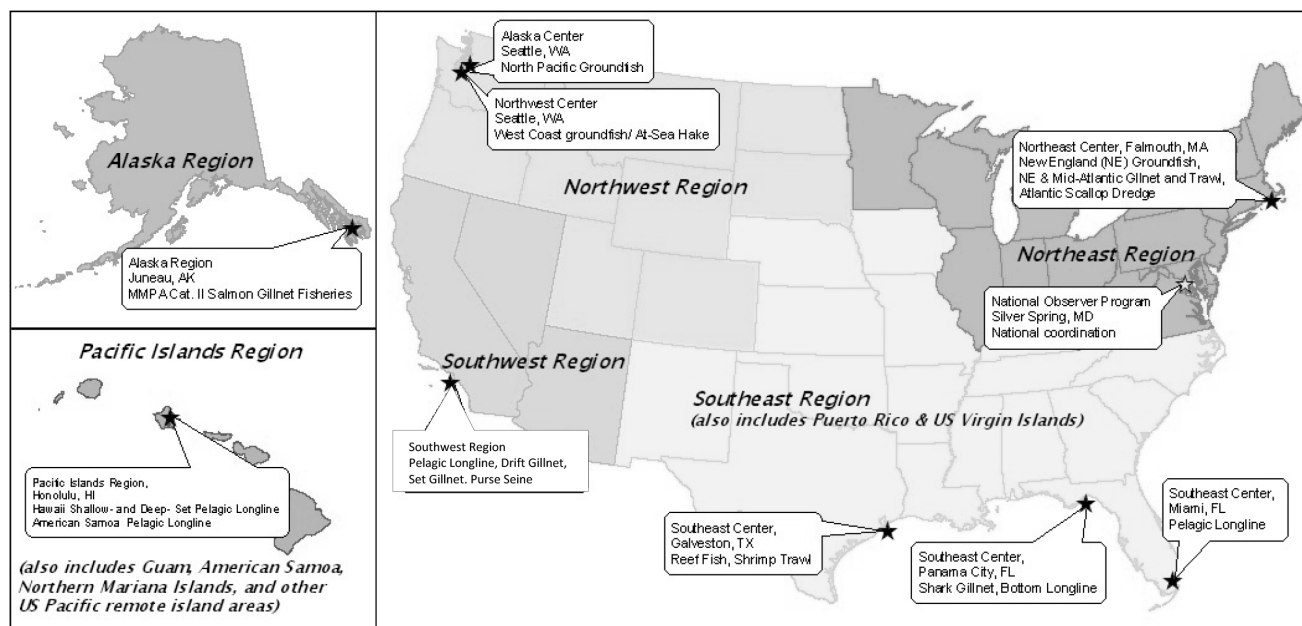


Figure 1.—Location of NMFS regional observer programs and the fisheries observed by program (2012).

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. The 2004 NMFS Evaluating Bycatch Report (NMFS, 2004a) recommended precision levels as a coefficient of variation (CV) of 20–30% for estimates of bycatch for each protected species taken by a fishery. An overall CV of 20–30% for estimates of total discards (aggregated over all species) was recommended for other fishery resources (NMFS, 2004a). However, the report also recognized that these levels of precision may exceed legal requirements, that higher levels of precision may be necessary in some cases, and that funding and logistical constraints, as well as safety considerations and additional objectives, may prevent attaining the desired CV.

During the early years of NMFS observer programs, many observers were hired as direct federal employees. However, federal restrictions on the total number of employees allowed,

plus an inability to quickly replace observers who left, made it difficult to achieve the desired coverage levels. The practice of hiring observers as federal employees ceased in 1996, following NMFS efforts to downsize the federal workforce as required by the National Performance Review.⁴

Today, most regional programs work with private contracting companies to recruit and deploy observers. In some cases the fishing industry contracts directly with a private contracting company to provide observer coverage.⁵

⁴The National Performance Review was initiated in 1993 by President Clinton, with the goal of creating a government that worked better and cost less. More information on the National Performance Review can be found at: <http://govinfo.library.unt.edu/npr/library/papers/bkgrd/brief.html>.

⁵Several external reviews of NMFS observer programs expressed concerns over this model, including lack of oversight and management control, potential for conflict of interest, and subsequent impacts on data quality. The issue of industry funding of observer programs is discussed in detail by the following sources: NMFS. 2000. Management control review of National Marine Fisheries Service observer programs/service delivery models. U.S. Dep. Commer., NOAA, Natl. Mar. Fish. Serv., 522 p. (avail. at: <https://www.st.nmfs.noaa.gov/Assets/Observer-Program/pdf/MCR.pdf>); NMFS. 2000. Independent review of the North Pacific groundfish observer program. U.S. Dep. Com-

However, observers who are injured on the job are considered federal employees for the purpose of compensation under the Federal Employee Compensation Act (5 U.S.C. 8101 et seq.).

The NMFS Office of Science and Technology coordinates observer programs at the national level through the National Observer Program (NOP). In addition to handling national program administration, budgeting, and planning, the NOP works with the regional observer programs to develop national policy and observer data quality standards. The NOP also provides regional observer programs with a forum to increase communication and consistency.

Fisheries selected for observation are determined by each NMFS region in accordance with statutory and legislative mandates, as well as regional priorities. Regional programs are re-

mer., NOAA, NMFS prepared by MRAG Am., Inc., 127 p. (avail. at: http://www.afsc.noaa.gov/FMA/PDF_DOCS/NPGOP%20Review%20Final%20Report.pdf); and DOC. 2004. NMFS observer programs should improve data quality, performance monitoring, and outreach efforts. U.S. Dep. Commer., Off. Inspect. Gen., Final Audit Rep. No. IPE-15721/March 2004, 64 p. (avail. at: http://www.apo-observers.org/docs/Inspector%20General%20Report_2004_1.pdf).

sponsible for the day-to-day operation of fishery observer programs. Program scientists determine the appropriate sampling protocols and necessary observer coverage levels for each fishery. The programs also conduct observer training. Following a fishing trip, observers are debriefed, and the trip's data are quality-checked before being entered into a database system and made available to regional fishery biologists and managers.

Although NMFS has utilized fishery observers to collect data since 1971, the Office of Science and Technology's NOP was not established until 1999. Prior to 1998, the majority of funding for regional observer programs was provided through indirect sources, such as Congressional allocations supporting fisheries management and protected species legislation.

Beginning in the late 1990's, industry funds were also used to support observer coverage in some fisheries. In 2012, three U.S. fisheries had observer programs partially funded by industry: the North Pacific Groundfish Observer Program (NPGOP), the Atlantic sea scallop, *Placopecten magellanicus*, dredge fishery (part of the Northeast Fishery Observer Program (NEFOP), and the West Coast Groundfish Trawl Catch-Share Program.

In 1999, the first dedicated Congressional funds were appropriated for observer program budget lines. Funding is also available from two national budget lines (the "National Observer Program" and "Reducing Bycatch" budget lines), which are equally allocated to regional programs and are also used to support NOP activities.

All regions have at least one dedicated budget line supporting observer program activities except the Southwest, which has never had a dedicated budget line for observer programs. Although the Alaska Region does have a Congressional line item, this is strictly for the program that covers federal fisheries (the NPGOP). There is no Congressional line item for the Alaska Marine Mammal Observer Program (AMMOP), which monitors state fisheries.

In addition to direct budget lines, observer programs may receive funding from federal appropriations supporting programs under the ESA, MMPA, and the MSA (including funding to support management of federal catch-share programs). The NOP Annual Report⁶ provides further detail on program budgets and activities.

An observer program may be funded by more than one budget line, and a single budget line may support observer program activities in more than one region. Many observer programs are funded through a combination of funding sources to maintain sufficient observer coverage and infrastructure. In general, funding for observer programs has increased over time as have the total number of fisheries observed, as programs implement coverage for new or experimental fisheries, or fisheries with developing bycatch concerns. However, funding is a balancing act, where managers are required to both maintain established programs at certain coverage levels and also address rising concerns in other fisheries.

Despite funding constraints, observer data are widely recognized as one of the most reliable sources of information for use in fisheries management, especially in calculation of bycatch (NMFS, 2004a; Lapointe et al.⁷; ICES⁸). Fisheries managers and stakeholders depend on having the best available information when making decisions that impact the long-term sustainability of resources and communities. Observer data are used for a variety of purposes including monitoring and projecting fishery landings to ensure that catch levels are not ex-

ceeded; calculating fish and marine mammal population sizes, understanding rates of interactions with protected species (e.g., marine mammals, sea turtles, seabirds).

In this paper, the history of U.S. federal fisheries observer programs is described for the first time, within the context of the agency's history and the development of important U.S. fisheries legislation. To date, no comprehensive documentation of this kind has been completed, despite an over 40 year program history.⁹ While this paper has made every effort to accurately document observer programs past and present, the author recognizes that, given the age of some resources, additional information may exist. Readers with more detailed information pertaining to the history of federal observer programs are urged to contact the author so that these resources may be incorporated in a future update.

Setting the Stage

From 1871 to 1970, the United States federal fisheries research and development was conducted by first the U.S. Fish Commission (1871–1903), the Bureau of Fisheries (1903–1940), and by the Bureau of Commercial Fisheries (BCF) (1940–1970) then located in the U.S. Fish and Wildlife Service under the Department of the Interior (Hobart, 1995). In 1970, the National Oceanographic and Atmospheric Administration (NOAA) was formed. The BCF was included in the suite of agencies established under NOAA, and was retitled the National Marine Fisheries Service (NMFS). The NMFS was tasked with three areas of fisheries work: resource research, resource utilization, and resource management (Hobart, 1995).

⁶Reports are online at <http://www.st.nmfs.noaa.gov/observer-home/reports/nopannualreports/index>.

⁷Lapointe, G., L. Mercer, and M. Conathan. 2012. Counting fish 101, an analysis of stock assessments. *Cent. Am. Prog.*, 15 p. Avail. online at: <http://scienceprogress.org/2012/09/counting-fish-101-an-analysis-of-fish-stock-assessments>.

⁸ICES. 2013. Report of the workshop to review and advise on seabird bycatch (WKBYCS), 14–18 October 2013, Copenhagen, Denmark. ICES CM 2013/ACOM:77, 79 p. Avail. online at: http://www.ices.dk/sites/pub/Publication%20Reports/Expert%20Group%20Report/acom/2013/WKBYCS/wkbycs_final_2013.pdf.

⁹Sections of this review concerning the recent history of NMFS observer programs utilized: NMFS. 2000. Management control review of National Marine Fisheries Service observer programs/service delivery models. U.S. Dep. Commer., NOAA, Natl. Mar. Fish. Serv., 522 p. (avail. at: <https://www.st.nmfs.noaa.gov/Assets/Observer-Program/pdf/MCR.pdf>). In addition, uncredited portions of the text in this publication are derived from the National Observer Program annual reports (2005–11), which were written by the author, and the author's own observations.

The foundations for U.S. observer programs were built in the late 1960's and early 1970's. During this period, many pieces of important environmental legislation were passed, including the National Environmental Policy Act (NEPA, 1969), the Marine Mammal Protection Act (MMPA, 1972), and the Endangered Species Act (ESA, 1973). The goals of these acts are widely known, and are not described herein. However, their passage reflected a growing awareness within the United States of the value of natural resources and a desire to manage and protect them (Vig and Kraft, 1984). The need for increased protection of fisheries, one of the nation's most important natural resources, gained the attention of the U.S. public.

At the same time, the NMFS had already begun working to address the increasing concern over conservation of the nation's marine resources for the future, representing a shift away from a primarily harvest-oriented perspective. Two very different observer programs were implemented, which contributed directly to the research and management goals of the new fisheries service and helped set the stage for the development of later observer programs.

Early 1970's—Tuna/Porpoise Observer Program

The first official observer program, the Tuna/Porpoise Observer Program¹⁰, was initiated in response to a 1969 proposal submitted to the NMFS Southwest Fisheries Science Center (SWFSC) director by W. F. Perrin, a fishery biologist at the Center. Perrin, who conducted research aboard vessels fishing for tuna, Scombridae, in the Eastern Tropical Pacific (ETP), noted high levels of mortality among the dolphins (primarily pantropical spotted, *Stenella attenuata*; spinner, *S. longirostris*; and common, *Delphinus delphis*, dolphins) caught incidentally to tuna purse-seine fishing operations during the late 1960's (Perrin, 1968, 1969a,b, as cited in Edwards, 1989).

¹⁰This program was later referred to as the "Tuna-Dolphin observer program."

Dolphins provided a sighting cue to the presence of tuna schooling beneath the surface, and this relationship was quickly capitalized upon by early purse seiners, to the detriment of dolphin populations. Speedboats launched from vessels were used to herd the dolphin school into a bunched group that the purse seiner then surrounded with the net. Perrin noted that the strength of the tuna-dolphin association was such that the tuna remained with the dolphins even during the chase and subsequent capture (e.g., Perrin, 1968, 1969a, b).

As public awareness and outcry over dolphin bycatch increased, Perrin received funding in 1970 to conduct research on this issue. The goals of his initial research program, which later became the NMFS' Tuna/Porpoise Observer Program, included placing observers aboard commercial fishing vessels, performing gear research, and collecting data on the magnitude of the problem.

The program began collecting data on a voluntary basis in 1971, but was mandated by law for U.S. purse seiners in 1974, with coverage levels ranging from zero to nearly 100% (Edwards, 1989). In 1983 the observer program was temporarily suspended by court order initiated by members of the fishing community, but it was reinstated in 1984 (Edwards, 1989).

Information collected by the observer program was used by NMFS to set limits on incidental mortality of dolphins interacting with the fishery. Beginning in 1979, Inter-American Tropical Tuna Commission (IATTC) observers were also placed on foreign purse-seine fishing vessels, with coverage between 5 and 10% (Edwards, 1989). Increased regulations, declining catches, and foreign competition in subsequent years caused the U.S. fleet to dwindle, and in 1995 NMFS ceased observations of the ETP tuna purse-seine fishery. Observer coverage of the remaining U.S. vessels was transferred to the IATTC which continues its international observer program today.

North Pacific Foreign Fishery Observer Program, 1972

The second federal observer program to be implemented began as a response to concerns over foreign fishing activities in the North Pacific. U.S. scientists had been collecting data through agreements with foreign nations since at least the 1950's; reports describe two of these early research trips (Miyahara, 1954; Tanonaka and Nishimoto, 1965). In the late 1960's, contention over differences in U.S. and Japanese estimates of Pacific halibut, *Hippoglossus stenolepis*, bycatch in the Japanese Bering Sea trawl fishery, and the lack of an independent U.S. government source of fishery data, led to the placement of U.S. observers aboard Japanese vessels for a limited period in 1972 (Miller et al., 1976; Megrey and Weststad, 1990).

The International North Pacific Fisheries Commission (INPFC, the governing research body at the time) reported that only two observers were actually placed aboard the vessels and only one observer was actually able to collect usable data from 1 June through 20 June 1972 (INPFC, 1979). With Japanese approval, the program was expanded in 1973. The Alaska Department of Fish and Game, the International Pacific Halibut Commission, and NMFS provided the majority of observers, although the Fisheries Agency of Japan did provide one observer (Miller et al., 1976). A 1975 agreement with the Soviet Union allowed observers aboard Soviet vessels (Megrey and Weststad, 1990).

From 1973 through 1976, international treaties between the United States, Japan, Canada, and the Soviet Union formed the basis for a "Foreign Fisheries Observer Program" in Alaska waters. The foreign fisheries observers' goals were to determine incidental catch rates of Pacific halibut; estimate catch amount (ensuring catch allowances were not exceeded); collect biological data and species composition information for groundfish catches (Megrey and Weststad, 1990); and to verify catch statistics in the Japa-

nese fishery for king, *Paralithodes camtschaticus*, and Tanner, *Chionoecetes bairdi*, crabs (Barnes et al.¹¹).

This early program had several problems (described in Williams¹²), including manipulation of observer data by foreign fishermen. Observers did not routinely make independent estimates of catch weight, and instead accepted the master's estimate for reporting purposes. In some cases, catch weight may have been purposely underreported to the observer; this underreporting would not be caught unless an independent estimate was performed. Additionally, no reliable method was available to estimate foreign fishing effort in advance, and quarterly collections only permitted the programs to obligate funds for a few months at a time, leaving insufficient funds available to cover all applicant vessels.

To address some of these issues, observer training was improved to emphasize sampling methods and the importance of independent estimates and to educate observers on reporting bribery and coercion. Foreign governments were also informed of violations and asked to take corrective action. In 1982, Congress directed the Secretary of Commerce to establish a pool of qualified observers available to foreign vessels. When funding was unavailable to provide all applicant foreign vessels with an observer, the vessel or its agent was to contract directly with individuals from the observer pool.

Laws regulating foreign fishing were implemented under the MSA in 1976. As discussed in the following sections, under the new laws foreign fishing activities occurred primarily through joint ventures between U.S. catcher vessels and foreign processors. The Alaska foreign fisheries observer program was later expanded to include

¹¹Barnes, A., M. Loefflad, and W. Karp. 2005. New Fisheries Monitoring and Analysis Division assumes the role of the North Pacific Groundfish Observer Program. U.S. Dep. Commer., NOAA, NMFS, AFSC, Quarterly Rep. (July-August-September), 7 p.

¹²Williams, N. 1984. Internal control review of the observer program data integrity and cost determination. On file at: U.S. Dep. Commer., NOAA, NMFS Off. Sci. Tech., Silver Spring, Md.

similar fisheries in the Northwest Region. In Alaska, the program continued to observe foreign vessels until 1990. Beginning in 1991 the fleet became entirely domestic (Barnes et al.¹¹); the domestic observer program continues today as the North Pacific Groundfish Observer Program (NPGOP, discussed further in later sections).

Authorizing Federal Observer Programs

The issues addressed by early fisheries observer programs were not new to U.S. fisheries managers. Ensuring access rights to key north Atlantic fishing grounds was already a major issue when the United States became an independent nation (Jefferson, 1791; Sabine, 1853). More recently, tuna-dolphin interactions in the Eastern Pacific became a concern when the industry switched from a troll fishery to purse seines between 1958 and 1961 (Edwards, 1989).

The United States included language to address these issues in 1972 (the MMPA), and in 1976 (the Fisheries Management Act, later renamed the Magnuson Fishery Conservation and Management Act, commonly referred to as the Magnuson-Stevens Act or MSA). Both acts contained language that authorized the government to require placement of fisheries observers aboard commercial fishing vessels fishing in federal waters to monitor fishing activities. Much later (in 2007), authorizing language for observer programs was also developed under the Endangered Species Act (ESA) that enabled placement of observers aboard federal or state, commercial or recreational, fishing vessels.

Marine Mammal Protection Act (MMPA) of 1972

The MMPA provided the initial authority to observe many fisheries, and it remains an important authorizing statute today, particularly for state fisheries such as those observed by the AMMOP, which relies solely on its authority. The MMPA enables observers to be placed on fisheries conducted in state or federal waters: observers

may be required for vessels engaged in fishing operations that frequently or occasionally take¹³ marine mammals (16 U.S.C. §1383(e)).

Observer programs in all regions (regardless of authorization legislation) have been essential in collecting data on incidental take of marine mammals. These data are used in management actions, including federally mandated "Take Reduction Plans" (TRP's) required under the MMPA to assist in the recovery or prevent the depletion of strategic marine mammal stocks that interact with Category I or II fisheries.¹⁴ Observer data are also critical to monitoring the effectiveness of such bycatch reduction measures as closures and changes in fishing gear and/or practices, as well as for developing estimates of fishery-related mortality of marine mammals.

Endangered Species Act (ESA) of 1973

Although observer data are frequently used by fisheries managers to develop requirements and regulations necessary for the protection of endangered and threatened marine mammals, sea turtles, seabirds, and fish, as well as in determining their population size and structure, no direct ESA authority to monitor fisheries for interactions with endangered or threatened species was included in the original act. Regulations were promulgated under the act in the 1990's that allowed for "emergency" observer programs to be implemented for up to several months. However, authority to monitor fisheries for interactions with ESA-

¹³"Take" of a marine mammal under the MMPA is defined as: "to harass, hunt, capture, or kill, or attempt to harass, hunt, capture or kill any marine mammal" (16 U.S.C. 1362).

¹⁴The MMPA requires that NMFS publish, at least annually, a List of Fisheries (LOF) that classifies U.S. commercial fisheries into one of three categories. These categories are based on the level of serious injury and mortality of marine mammals that occurs incidental to each fishery. Specifically, the MMPA mandates that each fishery be classified according to whether it has frequent (Category I), occasional (Category II), or a remote likelihood of or no known incidental mortality or serious injury of marine mammals (Category III).

listed species in the long term was still missing.

In 2007, NMFS issued a rule under the ESA to require fishing vessels in certain fisheries to take observers on board for collection of sea turtle bycatch data. The rule applies to designated fishing vessels operating in both state and federal waters (including recreational fishing vessels), and to designated U.S. fishing vessels on the high seas. The first Annual Determination (a list of fisheries potentially required to carry observers, if requested, to monitor potential interactions with sea turtles) was made in 2010, and identified 19 fisheries that could be monitored (no additional fisheries were identified in 2011 or 2012); however, no new observer programs have been implemented specifically under this authority.

In addition, under Section 7 of the ESA, consultations are required for all federal activities such as federally authorized fisheries, as well as dredging, sonar testing, etc. Following a consultation, certain terms and conditions may be required if takes of ESA-listed species are expected to occur. These terms and conditions may include time and/or area closures, mandatory use of bycatch reduction devices, changes in fishing practices, and/or observer programs, including specific levels of observer coverage, or concentration of coverage in certain areas/times.

Magnuson-Stevens Act (MSA) of 1976

The 1976 passage of the MSA was a turning point in U.S. fisheries management. The act implemented a 200-nmi zone of exclusive U.S. fishing rights (later referred to as the Exclusive Economic Zone or EEZ), asserted U.S. authority to management over all marine life (other than birds, marine mammals, and highly migratory species of tuna) within the 200-nmi zone and enacted the first federal regulations governing commercial and recreational domestic marine fisheries.

Under the MSA, eight regional fishery management councils (FMC's) were established: North Pacific, Pa-

cific, Western Pacific, New England, Mid-Atlantic, South Atlantic, Gulf of Mexico, and Caribbean. The councils are decision-making bodies that oversee marine fisheries within the U.S. EEZ. Each council develops and recommends specific conservation and management measures for fishery resources in the form of Fishery Management Plans (FMP's), subject to approval and implementation by NMFS.

Under a FMP, councils may "require that one or more observers be carried on board a vessel of the United States engaged in fishing for species that are subject to the plan, for the purpose of collecting data necessary for the conservation and management of the fishery" (16 U.S.C. § 1853).

The MSA has been amended several times since 1976. The 1996 Sustainable Fisheries Act (SFA) provisions outlined a precautionary approach to fisheries management, emphasizing the role of science in management and conservation actions by NMFS. The SFA amendments also emphasized the need to reduce bycatch and to "reduce bycatch to the extent practicable." Subsequently, monitoring bycatch became an increasingly important part of modern fisheries observer programs. Observer data are critical to understanding the bycatch mortality component of fish and marine mammal stock assessments, maximizing fisheries sustainability, and understanding the effectiveness of experimental fishing gears and methods used to reduce bycatch.

The 2007 Magnuson-Stevens Reauthorization Act (16 U.S.C. § 1853) expanded upon the considerations outlined in the SFA by focusing on four theme areas: 1) ending overfishing, 2) promoting market-based management approaches, 3) improving science and expanding the role of science in management, and 4) enhancing international cooperation.

A New Era

The implementation of these three laws over a short period of time signified a new era in U.S. fisheries

management. Under the regulations outlined in the MSA, fishing by foreign vessels in the U.S. EEZ became a privilege subject to U.S. approval. The MSA authorized the placement of observers on foreign vessels fishing in U.S. waters, and also authorized the payment for observer coverage by the foreign nation in some cases. Observer programs for these fisheries were authorized under the MSA and the Atlantic Tuna Convention Act (ATCA).

An Internal Control Review (Williams¹²) identified three field programs that were part of the "Foreign Fishing Vessel Observer Program":

- 1) The Northwest Observer Program, originally headquartered in what was referred to as the Northwest and Alaska Fisheries Science Center¹⁵, monitoring foreign fisheries in the Northeast Pacific and Bering Sea;
- 2) The Northeast Observer Program, headquartered in the Northeast Regional Office, monitoring foreign fisheries in the Atlantic Ocean, Gulf of Mexico, and Caribbean Sea; and
- 3) The Southwest Observer Program, headquartered in the Southwest Fisheries Science Center's Honolulu Laboratory, monitoring longline vessels fishing for billfish and sharks.¹⁶

According to the NMFS Internal Control Review, foreign fishery observers in all three programs were responsible for collecting the following types of data (exact collection requirements varied by program):

- estimates of total catch by species, including those caught incidentally;
- estimates of the total effort expended by the vessel;
- biological samples of the catch (such as length, age, sex, sexual maturity, and stomach contents);

¹⁵In 1984 it became the Alaska Fisheries Science Center.

¹⁶The Pacific Islands Region was not established until 2003. Prior to that time, the NMFS Southwest Region managed Pacific Islands programs.

- sighting and tagging of marine mammals, sharks, billfishes, tunas, and sea turtles;
- vessel permits;
- vessel movement reports and communication logs;
- daily cumulative catch logs;
- weekly catch reports for foreign and joint venture catches;
- cargo transfer and other logs;
- incidental catch of prohibited species;
- handling and reporting of marine mammal catch;
- gear conflicts; and
- dumping restrictions.

These duties are similar to those specifically outlined for observers in the North Pacific groundfish foreign trawl program described by French et al. (1982).

Foreign fishery observer data were used for multiple purposes, including stock assessments, fishery management, and compliance.

Stock Assessments

Data could be used to determine removals of biomass from the various fish stocks; size and age composition of the removals (to estimate annual mortality rates), trends in catch per unit of effort, and total fishing effort expended. Data were also used in preparing annual stock assessments for several species.

Fishery Management

Data could be used to make management decisions. These data described the catch of a single vessel by species, area, days and/or hours fished, target species, and the number of trawls completed by the vessel. They could be used to determine (for the vessels of a particular nation, fishery, or class) catch per unit of effort, incidence of prohibited species by fishery, or catch of allocated species relative to the amount allocated, to estimate when that nation's allocation would be reached. Data on Japanese longline vessels were routinely summarized by month, species, number and/or weight caught, and amount of gear utilized.

Compliance

Observers' weekly catch reports were also routinely cross-checked with foreign catch reports. When it was suspected that the catch of a particular vessel was being underreported or misreported, the observer reports were used for comparative purposes as part of the investigation. Some of these uses of observer data apply today.

Observations of Foreign Fisheries in U.S. Waters

In the North Pacific, the scope of the observer program in Alaska and the Northwest waters increased to meet coverage and data collection needs. French et al. (1981), Nelson et al. (1981), Wall et al. (1981), and Megrey and Weststad (1990) provide detailed discussion of the foreign observer program in these regions. Coverage of foreign vessels under the MSA varied by nation and ranged from zero to nearly 100% from 1976 to 1987 (Megrey and Weststad, 1990). Average coverage levels across all fleets from 1979 to 1990 were between 10% and nearly 100%¹⁷ (Megrey and Weststad, 1990).

Diverse fish species were targeted with trawl and longline gear, including Atka mackerel, *Pleurogrammus monopterygius*; Pacific cod, *Gadus macrocephalus*; Pacific Ocean perch, *Sebastes alutus*; walleye pollock, *Theragra chalcogramma*; and sablefish, *Anoplopoma fimbria*. Retention of Pacific salmon, *Oncorhynchus* spp.; Pacific halibut; king crab, *Paralithodes* and *Lithodes* sp.; and snow crab, *Chionoecetes* sp., was prohibited in these fisheries, due to concerns over their population status, and observers were required to ensure that these species were discarded.

Foreign effort also expanded in areas off of California, Oregon, and Washington during the 1960's to target Pacific hake (whiting), *Merluccius productus*. These vessels were observed under the same program as

¹⁷Detailed information on fisheries observed, including coverage levels, is provided in the sections discussing each regional program.

North Pacific fisheries, with average coverage levels ranging from 21 to 90% across all fleets (Berger¹⁸).

In the Pacific Islands region, the MSA gave NMFS the authority to place federal observers aboard Japanese trawl and bottom longline vessels targeting pelagic armorhead, *Pseudopentaceros wheeleri* (formerly *Pentaceros richardsoni*) on the Hancock Seamounts (the portion of the fishery under U.S. jurisdiction). A preliminary FMP for the fishery included a requirement for observer coverage (Uchida and Tagami, 1984). No U.S. vessels were active in this fishery.

The fleet consisted of six permitted Japanese vessels with an annual quota of approximately 2,000 t (although that quota was never reached) (Humphries¹⁹). Following the implementation of the MSA there were five or six observers who were deployed on permitted Japanese trawl vessels. A coverage level of 100% was required for fishing in the U.S. EEZ.

The number of trips observed ranged from one to three per year. Throughout the life of the observer program, there were 11 or 12 observed trips (Humphries¹⁹). Observer reports from many of these trips²⁰ are available on the Pacific Islands Fisheries Science Center (PIFSC) website.²¹ In 1986, a moratorium on armorhead fishing was put in place for the sea-

¹⁸Berger, J. U.S. Dep. Commer., NOAA, NMFS Alaska Fisheries Science Cent., Seattle WA, ret. Personal commun., 20 Oct. 2010.

¹⁹Humphries, B. interviewed by S. Arceneaux. U.S. Dep. Commer., NOAA, NMFS Pacific Islands Fisheries Science Center. Transcript provided to author, 8 Nov. 2010.

²⁰Seamount fishery, foreign vessel observer reports, avail. as SWFSC Admin. Rep. at the SWFC Honolulu Lab., NMFS, NOAA, Honolulu, HI 96812: Kazama, T. 1978. Ryuyo Maru No.2 (22 April-3 June 1978). SWFC Admin. Rep. ISH, 10 p.; Evering, G. 1979. Aso Marti (27 May-10 July 1979). SWFC Admin. Rep. H-79-14, 10 p.; Everson, A. 1980. Kitakami Mam (9 Aug.-4 Oct. 1980). SWFC Admin. Rep. H-80-15, 13 p.; Everson, A. 1980. Aso Marti (24-30 Sept. 1980). SWFC Admin. Rep. H-80-16, 10 p.; Shippen, N. 1981. Aso Marti (9-19 June 1981). SWFC Admin. Rep. H-81-4, 8 p.; Barnett, W. 1981. Kitakami Marti (15 Aug.-1 Oct. 1981). SWFC Admin. Rep. H-81-9, 12 p..

²¹http://www.pifsc.noaa.gov/library/publication_search.php

U.S. Driftnet Observers on Foreign Fishing Vessels Outside the EEZ

While this paper deals with federally managed commercial fisheries within the U.S. EEZ, a brief mention of the important contribution of U.S. observers to international fisheries management and conservation is necessary. In 1989, following a mandate from the U.S. Congress as required by the Driftnet Impact Monitoring, Assessment, and Control Act 1987, agreements were made with Japan, Korea, and Taiwan to initiate a pilot program to jointly monitor the commercial large-scale driftnet fleets in the North Pacific outside the U.S. EEZ. The program placed observers from the governments of the United States, Canada, Taiwan, Korea, and Japan on board Taiwanese, Korean, and Japanese vessels between June 1989 and December 1991.

Then on 20 Dec. 1991, the United Nations adopted General Assembly Resolutions 44-225, 45-197, and 46-215, thereby establishing a worldwide moratorium on all high seas large-scale driftnet fishing (and ending related observer coverage) and to be in effect by 31 Dec. 1992. The ban is in force in all the world's oceans, enclosed seas, and semi-enclosed seas. It is probable that the data collected by these observers gave the United Nations the information necessary for establishing these moratoriums, ending an ecologically damaging fishing practice.

Today, the U.S. government does not directly pay for U.S. citizens to observe vessels on the high seas; however, several international agreements, to which the United States is a party, require observer coverage, including the previously mentioned IATCC, as well as the International Commission for the Conservation of Atlantic Tunas (ICCAT), among others.

mount in the U.S. EEZ, and fishing activity ceased.

In the U.S. Northeast, observers were also placed aboard Japanese longline vessels targeting tuna in the Gulf of Mexico (1978 through 1981) and areas off the southeast and northeast Atlantic coasts along the edge of the continental shelf and on Georges Bank (1978–1988) under MSA authority (Lopez et al., 1979; Witzell, 1984; Hoey et al., 2002). A total of 5,640 sets was recorded by U.S. observers (Hoey et al., 2002). The observer program was initially run out of the NMFS Northeast Regional Office in Gloucester, Mass., under the Division of Law Enforcement and was implemented to monitor impacts of the Japanese fleet on the tuna resource, to ensure compliance with billfish and shark discarding regula-

tions (targeted by U.S. recreational fisheries), and to monitor bycatch of sea turtles, marine mammals, and other species.

The foreign squid fishery (targeting *Loligo* and *Illex* spp. with trawl gear) in the Atlantic Ocean was also observed under MSA authority. The squid fishery, which had been active since the 1880's, was prosecuted by Russia, Japan, Spain, Poland, and Italy. Observers placed aboard vessels in this fishery monitored the accuracy of the vessels' catch logs (Kolator and Long, 1979). Observer coverage on foreign vessels in the Northeast was 25–35% during 1977 to 1982, and increased to 58%, 86%, 95%, and 98%, respectively, in 1983–86 (Waring et al., 1990). From 1987 to 1991, 100% observer coverage was maintained (Blaylock et al., 1995).

To encourage domestic investment in fishery resources, the MSA was amended in 1980 by the American Fisheries Promotion Act (AFPA). The AFPA required that fish quotas be given preferentially to nations that contributed heavily to the development of the U.S. fishing industry. This resulted in a new type of fishery, referred to as "joint venture processing agreements" (JVP's). Under these operations, U.S. fishermen (who had higher fishing quotas than foreign fleets, but often lacked the capacity to process the catch or found the species unmarketable in the U.S.) would harvest their allotment, and then sell it to foreign processor vessels.

The U.S. fishermen were paid for their catch by the foreign agency, and the processing ships sold the processed catch. Joint venture operations arose in Alaska, the Pacific Northwest, and Northeast in the late 1970's. Starting in 1987 in the Gulf of Alaska (GOA) and 1988 in the Bering Sea and Aleutian Islands (BSAI), foreign vessels were only allowed to fish in U.S. waters if they were participants in a joint venture (Barnes et al.¹¹).

The AFPA also added a provision to the MSA for 100% observer coverage on all foreign vessels fishing in the EEZ (16 U.S.C. § 1821 (h)). Prior to that point, observer deployment decisions were made using region-specific criteria. Thus, the AFPA helped to achieve nationwide consistency in observer coverage levels for foreign fleets. The AFPA also established a "Foreign Fisheries Observer Fund," composed of fees collected from foreign fleets fishing in U.S. waters. That fund was used to pay for the cost of providing observers.

Phasing Out Foreign Fisheries

As the United States shifted focus toward growing domestic fisheries, foreign fishing activities became increasingly limited. Fisheries managers (and the fishermen themselves) began to realize the impact foreign harvest was having on resources available to U.S. fishermen, and the quotas available for JVP's and foreign fleets

decreased. In some cases, fisheries closed entirely; an FMP for bottom-fish was implemented in 1986 by the Western Pacific Fishery Management Council (WPFMC) that closed the sea-mount fishery.

For many countries, the severely restricted fishing quotas and restricted fishing areas made fishing in U.S. waters unprofitable. By 1991 foreign fishing vessels no longer operated in U.S. waters. Since that time, some foreign fishing (under JVP agreements) has been allowed on a limited basis in the northeast in 1998 (one Estonian and two Lithuanian vessels targeting Atlantic mackerel, *Scomber scombrus*) and from 2001 through 2003 (1–3 Russian vessels targeting Atlantic herring, *Clupea harengus*). All were observed at 100% coverage levels (Yoos and Foster²²). Joint venture fisheries have not occurred again since 2003, although if one were to occur, 100% observer coverage would be required.

Monitoring Domestic Fisheries

While foreign fisheries were being phased out, U.S. fisheries were growing. Under the MSA, NMFS had the authority to place observers on all U.S. vessels fishing for species subject to a FMP with observer requirements (16 USC 1853 §303 (b)). Although the number of observer programs remained relatively constant through the 1980's, during the early 1990's, many new observer programs were developed to provide the growing support for science-based fisheries management.

The initial goal of many domestic observer programs was to collect basic data to characterize the fishery, such as target and bycatch species, gear types, and fishing areas. This information could then be used by NMFS and the FMC's to evaluate the condition of species managed under an FMP and to set harvest limits. Most early observer programs also focused data collection on bycatch of protected species for the

²²Yoos, P., and H. Foster. NEFSC Observer Program Activities 1996–2006. Unpubl. info. on file at NMFS Northeast Fish. Sci. Center, 166 Water Street, Woods Hole, MA 02543-1026.

MMPA (e.g., classifying fisheries on the List of Fisheries) and ESA (e.g., developing conservation measures to reduce sea turtle bycatch).

The scope of many observer programs evolved to include data collection of life history information from target and nontarget fish stocks and a variety of protected species (protected fish, marine mammals, sea turtles, and sea birds). Today, information is also collected on logistical, social, and economic data, and on marine debris. Special research projects, such as testing the efficacy of new bycatch reduction devices or collecting DNA samples from specific species, are also carried out.

Several programs initiated during the 1990's continue through the present, such as the California/Oregon Drift Gillnet Fishery Observer Program (Southwest Region) and the Directed Large Coastal Shark Bottom Longline Fishery Observer Program (Southeast Region). Other programs fulfilled their purpose within only a few years of observation (such as a short-term project for obtaining snapshot estimates of bycatch or fishery characterizations) or were eliminated as management needs evolved or fishing patterns changed.

A Brief Look at Regional Observer Program History

This section describes in detail federal fisheries observer programs, past and present. The goal of these descriptions is not to provide an analysis of program operations, accomplishments, or issues (although these things may be discussed), but rather to provide a sense of the relationship between NMFS observer programs and U.S. fisheries management over time.

Northeast Region

Informal Sampling of Domestic Fleets, 1970's

Long before the implementation of the Northeast Fishery Observer Program, NMFS fisheries biologists and technicians were accompanying domestic vessels on fishing trips to col-

lect biological and catch and effort data for stock assessments as part of the Northeast sea sampling program.²³ Many of the trips were on commercial vessels participating in fisheries with high levels of finfish discards, such as the winter Gulf of Maine shrimp fleet and the silver hake, *Merluccius bilinearis*, small-mesh trawl fleet.

Infrequent trips were also made on vessels in many other fisheries at least as early as the 1970's. In 1989, administrative duties for the foreign observer program were transferred to the NMFS Northeast Fisheries Science Center (NEFSC) at Woods Hole, Mass., where the newly instituted observer program was based. The NMFS Northeast Regional Office (NERO) began officially placing observers on domestic fishing vessels under the authorities of both the MSA and the MMPA in 1989 (see descriptions below and summaries in Table 1 and Fig. 2).

Lobster Trap/Pot, 1989

Observers were placed in the American lobster, *Homarus americanus*, pot/trap fishery beginning in 1989 to collect data on bycatch and discards for stock assessment purposes. Coverage levels were extremely low throughout the life of the program, generally not even reaching 1% (Potter²⁴).

In 1996 it was proposed that both the inshore and offshore sectors of the Mid-Atlantic and Gulf of Maine lobster pot/trap fisheries be reclassified from Category III to Category I under the MMPA because of interactions with marine mammals, specifically the critically endangered North Atlantic right whale, *Eubalaena glacialis* (NOAA, 1995). This had no effect on observer coverage levels as the primary reason for observer placement in the fishery was not to characterize marine mammal interactions but to collect data for stock assessment purposes (observing a marine mammal interacting with pot gear would be an extremely rare occurrence).

²³<http://www.nefsc.noaa.gov/fsb/faq.html>

²⁴Potter, D. U.S. Dep. Commer., NOAA, NMFS Northeast Fish. Sci. Center, Woods Hole, MA, ret. Personal commun., 6 Aug. 2006.

Table 1.—Fisheries observed in the Northeast Region. Note: This table represents the information located during the development of this report. In many cases, supplemental information may exist, particularly in the case of historical records, but it was not located. The information below provides a general sense of the scale of fisheries and observations. Coverage level information was located from Fishery Fact sheets (<http://www.nmfs.noaa.gov/pr/interactions/lof/>) and National Observer Program annual reports.

Fishery	Fleet Size	Authority to Place Observers	Season of Operation	Program Initial Year	Program Final Year	% coverage
Distant water fleet (DWF) Japanese longline fishery	Between 1982 and 1988, the numbers of DWF vessels included 18, 3, 5, 7, 6, 8, and 8, respectively, Japanese longline vessels.	MSA	March–July	1978	1991	Observer coverage on DWF vessels was 25–35% during 1977–82, and increased to 58%, 86%, 95%, and 98%, respectively, in 1983–86. From 1987–91, 100% observer coverage was maintained.
Distant water fleet (DWF) Mid Atlantic foreign mackerel trawl	93 (112 total, minus the 19 Japanese longline vessels)	MSA	Dec–May	1983	1991	
Atlantic multispecies trawl	1992: 5,828 permitted vessels	MSA	Year-round	1989	Present	1992: <5% 1996: <1%; (later part of NE groundfish coverage)
Atlantic pelagic drift gillnet for swordfish, tuna and shark	115 permits, 16 fished in '93, by '96 ~30+ permits, 15 active	MMPA & MSA	2 openings: Jan–June, July–Aug	1989	1998	8% in 1989, 6% in 1990, 20% in 1991, 40% in 1992, 42% in 1993, 87% in 1994, 99% in 1995, 64% in 1996 and 99% in 1998
Lobster pot fishery	13,000	MSA, MMPA, & ESA	Early spring– mid-Dec	1989	2006, reinitiated in 2012	<0.1%, 2012: 0.01%
New England sink gillnet fishery for groundfish	341 vessels	MMPA & MSA	Year-round	1989	Present	1%, 6%, 7%, 5%, 7%, 5%, 4%, 6%, 5%, 6%, 6%, 4%, 2%, 3%, 6%, 7%, 4%, 7% for 1991– 2007. Presently incorporated in to NE groundfish coverage)
Northwest Atlantic pelagic Longline	1992: 539 permitted; 314 fished	MMPA & MSA	~April–Dec	1990	At least 2000	~5%
Mid-Atlantic bottom pair-trawl fishery for groundfish	20 vessels	MSA	Spring–early summer	1992	1993	<5%
Atlantic pelagic experimental tuna pair-trawl fishery	1992:15 permitted; 11 fished	MMPA & MSA	~June–Nov	1992	1995	1992: 9% 1993: 17%, 1994: 52%, 1995: 55%
Mid-Atlantic coastal gillnet	>655 vessels	MMPA	Year-round	1993/94	Present	2–4%; 8% 2011; <8% 2012
Atlantic tuna purse seine fishery	1993: 5 vessels	MSA	Small fish June–Aug; bluefin tuna Aug–Oct	1993	At least 1996	1996; 95.6%
Atlantic small mesh trawl (squid, mackerel, butterfish)	2,138 permits, 620 active vessels	MMPA & MSA	Year-round	1996	Present	During the period 1996–2007, estimated observer coverage (measured in trips) for the mixed groundfish bottom trawl fishery was 0.24%, 0.22%, 0.15%, 0.14%, 1%, 1%, 1%, 1%, 3%, 3%, 2%, and 3% respectively. %; 8% 2011; <8% 2012
Atlantic scallop fishery (access areas added in 1999)	1992: 2,811 permitted vessels 2002: 250 permitted, 185 active	MSA	Year-round	1992	Present	2–13%
Atlantic sea scallop dredge, closed areas exempted fishery	250 permits, 185 active	MSA	Year-round	1999	Present	
Large mesh trawl (summer flounder, bluefish, monkfish, dogfish)	719 permits	MSA, ESA	Year-round	2001	Present	<5 %
New England groundfish	1,200 trawl vessels and 250 gillnet vessels	MSA	Year-round	2002	Present	5% - 2011: 38% for groundfish sectors, 30% for groundfish pool, 20% for herring; 2012: 30% groundfish pool, 25% for groundfish sectors, 20% herring.
Mid-Atlantic <i>Illex</i> squid trawl	76 permits	MSA, MMPA	Year-round	2004	Present	<5%

A federal FMP for the lobster fishery was never developed; instead, the management of the fishery is carried out under an interstate FMP (developed in 1997 by the Atlantic States Marine Fisheries Commission in coordination with the fishing industry). David Potter, manager of the Northeast Fisheries Observer Program (2000–2008) reported²⁴ that observations of the lobster fishery in the 2000's were carried out on an irregular basis, primarily at the request of various state agencies. Coverage was reinitiated during the 2012–13 fishing season to support finfish and lobster stock assessments. (Chamberlain et al., 2014).

Northeast Bottom Otter Trawl, 1989

Data on total catch, bycatch, and discard rates for the Northeast bottom otter trawl fishery were requested for stock assessments, so in 1989 the NMFS Northeast Region opted to place observers on board these vessels (McEldery et al., 1999). No special funding was provided for this program, so money was allocated from NMFS base program funds (Credle et al., 1994). Carrying an observer was voluntary during the early years of the program, but it was later treated as mandatory as additional resources and coverage requirements arose (see discussion under New England Groundfish Fisheries—combined).

This program was initiated to meet fishery management needs (McEldery et al., 1994). Observed marine mammal bycatch was low, initially, and the fishery was classified as Category III under the MMPA. From 1994 to 2007, estimated observer coverage was 4%, 1.1%, 0.2%, 0.2%, 0.1%, 0.3%, 1%, 1%, 3%, 4%, 5%, 12%, 6%, and 6%, respectively.²⁵ In 2005, the fishery was elevated to a Category II fishery based on observed interactions with Atlantic white-sided dolphins, *Lagenorhynchus acutus*.

²⁵“NMFS List of Fisheries” fishery descriptions (avail. at: www.nmfs.noaa.gov/pr/interactions/lof).

Pelagic Drift Gillnet Fishery, 1989

Incidental take of marine mammals motivated observations of the pelagic drift gillnet (or “driftnet”) fishery off of the U.S. Atlantic coast (McEldery et al., 1999). This fishery, which targeted swordfish, *Xiphias gladius*, tunas, and sharks, was classified as a Category I fishery under the MMPA due to interactions with a variety of marine mammal species, including the North Atlantic right whale.

Mandatory observer coverage was initiated in 1989 to monitor catches of swordfish as well as protected species interactions. Coverage levels increased yearly, from 8% in 1989 to 42% in 1993 (Podziba²⁶). It was also included under the 1996 Atlantic Offshore Cetacean (draft) TRP. Coverage of this fishery attained high levels, reaching levels of nearly 100%. Some management alternatives were considered by the Take Reduction Team (TRT) to reduce marine mammal takes; however, the costs of implementation were found to exceed the net revenues from the landed swordfish.

Measures necessary for reducing marine mammal takes and for monitoring the fishery (specifically, monitoring the limited quota and observer coverage) were deemed too costly and were not implemented (NOAA, 1999a). Instead, emergency rules implemented fishery closures, continuing from 1996 to 1998. After a brief (14-day) opening in 1998, NMFS decided not to fully reopen the fishery (due to the high bycatch levels of protected species during that short time), and in 1999, the pelagic drift gillnet fishery was closed permanently. The fishery was very small, both in number of participants and total landings, and no cost effective solutions for reducing and monitoring marine mammal bycatch could be identified (NOAA, 1999).

²⁶Podziba, S. 1996. Atlantic offshore cetaceans take reduction plan: final draft. Susan Podziba & Associates and RESOLVE, Contract No. 50-DGNF-5-00164, 64 p. (avail. at: www.nmfs.noaa.gov/pr/pdfs/interactions/aoc-trp.pdf).

Sink and Surface Gillnet Fisheries: New England, 1989

Sink and surface gillnet fisheries were one of the first Northeast fisheries targeted for coverage with MMPA funds. These fisheries were identified as Category I under the MMPA due to known levels of significant bycatch of harbor porpoise, *Phocoena phocoena*. An observer program was implemented in 1989 (McEldery et al., 1999). Data from the program established that high levels of harbor porpoise bycatch (relative to population size) occurred in the fishery year-round, but that the majority of takes occurred in November and December in a relatively small area in the Gulf of Maine (around Jeffery's Ledge).

Based on concerns regarding interactions, NMFS asked the New England Fishery Management Council (NEFMC) in 1991 to develop a plan for reducing harbor porpoise bycatch. The fishing industry proposed a plan based on intensive observer coverage that would involve short notice small area closures. Amendment 5 to the New England Groundfish FMP incorporated a phased-in approach to the closures, with the goal being a 20% reduction in harbor porpoise bycatch at the end of 5 years.²⁷

In 1995, NMFS notified the New England Council that the time/area closure efforts were not working. The New England Council agreed to expand closed area.²⁷ At the same time that the New England Council was revising fishery regulations, NMFS conducted a stock assessment for Gulf of Maine harbor porpoise; the results of the assessment indicated that Gulf of Maine harbor porpoise was a strategic stock.²⁸

²⁷Resolve, Inc. 1996. Final Draft Gulf of Maine/Bay of Fundy Harbor Porpoise Take Reduction Team Take Reduction Plan, 38 p. (avail. online at: http://www.greateratlantic.fisheries.noaa.gov/prot_res/porptrp/HarborPorpoiseTRP.pdf).

²⁸A strategic marine mammal stock is defined by the MMPA as a marine mammal stock for which the level of direct human-caused mortality exceeds the potential biological removal level; which, based on the best available scientific information, is declining and is likely to be listed

(continued)

U.S. Observer Programs - Northeast Region

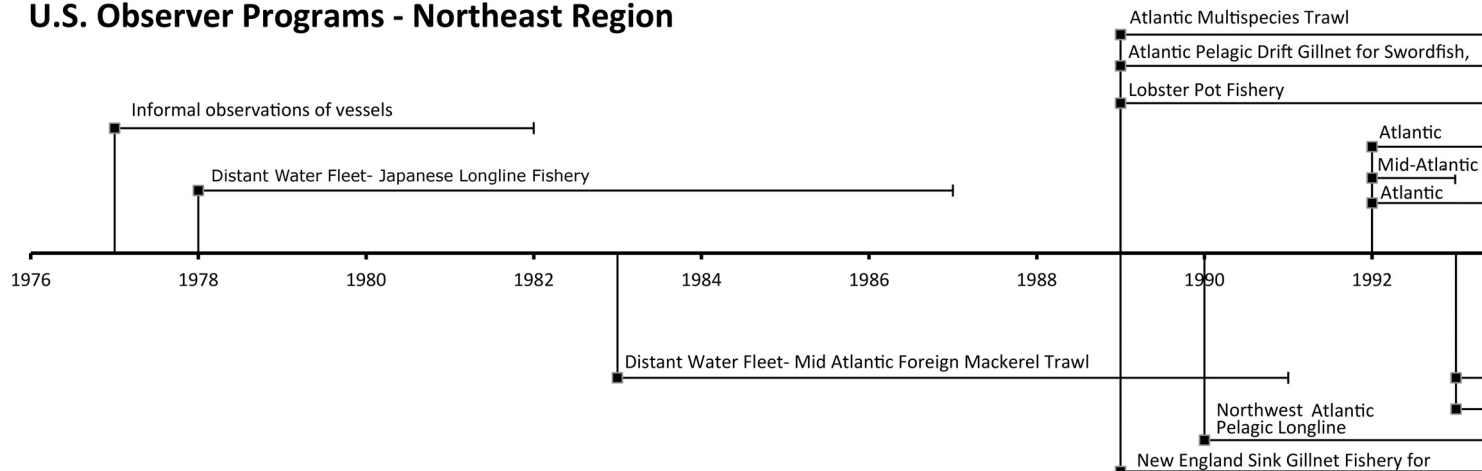


Figure 2.—Timeline of federal fisheries observer programs in the Northeast Region. Observer coverage levels vary between fisheries and are provided in Table 1.

The MMPA requires a TRT be convened when a strategic stock interacts with a Category I or II fishery; accordingly the Gulf of Maine Harbor Porpoise TRT was convened in 1996. The resulting TRP consisted of two primary measures: seasonal and area closures, and required the use of acoustic deterrents (“pingers”), which had proven effective in reducing harbor porpoise bycatch during a 1994 cooperative study.²⁷ While modifications have been made to the plan since that time, these core principles are still in effect.

Management of the Gillnet Observer Program was initially handled by the Manomet Center for Conservation Sciences but then transitioned to the NEFSC’s Fishery Sampling Branch in 1991 (Payne²⁹). A study in 2007 (Palka et al., 2008) evaluated the effectiveness of pinger use, based on observed bycatch, and found that pinger use did significantly reduce marine mammal bycatch, but that all pingers must be working for the deterrent to be effective.

as a threatened species under the ESA within the foreseeable future; or which is listed as a threatened or endangered species under the ESA, or is designated as depleted under the MMPA.

²⁹Payne, M. U.S. Dep. Commer., NOAA, NMFS Office of Prot. Resour., Silver Spring, MD, ret. Personal commun., 11 Jan. 2011.

Concerns over pinger noncompliance (e.g., not having working pingers, having less than the required number of pingers), as well as bycatch in non-regulated waters and bycatch of harbor porpoise greater than the potential biological removal rate (PBR) led to the TRT reconvening in 2007 and 2008. A comprehensive series of recommendations, including a revised monitoring strategy (which included observers testing for working pingers), was published in 2009 (NOAA, 2009a), and new regulations were finalized in 2010.

Atlantic Sea Scallop Fishery, 1992

Commercial harvest of Atlantic sea scallops, *Placopecten magellanicus*, has been recorded since the 1800’s, although the fishery did not expand until after World War II (NEFMC, 1982). Most fishermen in the Northeast use dredge gear to harvest sea scallops; in the Mid-Atlantic region, they are harvested using dredges as well as trawl-net gear. A FMP to stabilize fluctuating catch levels and prevent over-exploitation was implemented in 1982. The observer program for the Atlantic sea scallop fishery began in 1992, under MSA authority, with the goal of characterizing the fishery. Carrying an observer was initially voluntary, with extremely low levels of coverage (less

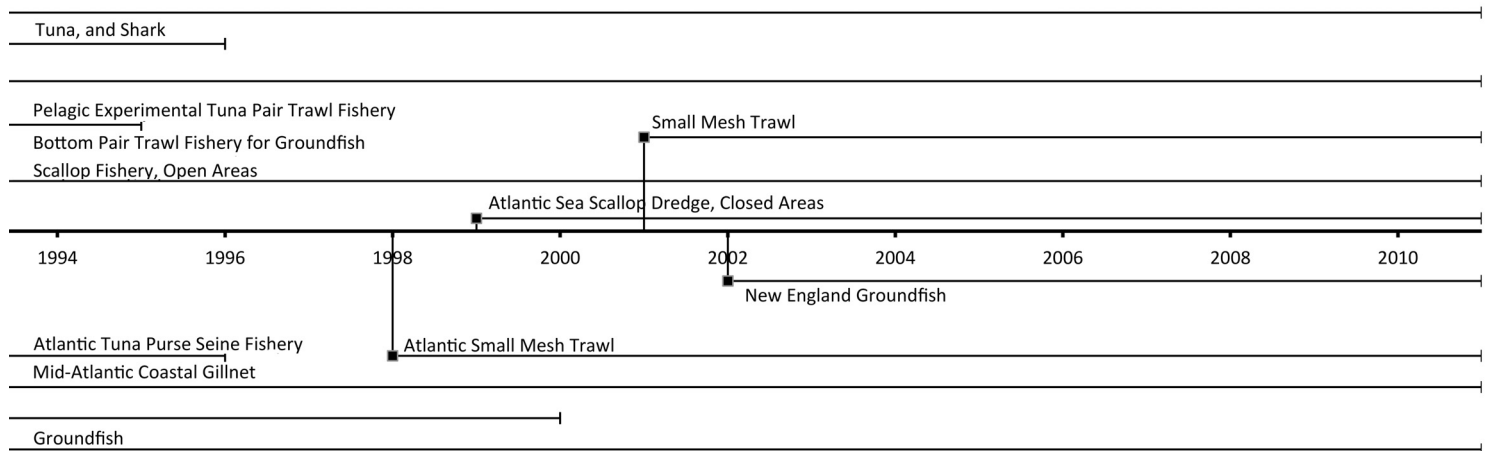
than 1% in 1992). Coverage became mandatory in 1999, following the opening of the Georges Bank closed area (Van Atten³⁰).

Since the enactment of the SFA in 1996, estimation of bycatch has also been required for fishery management plans. In the Mid-Atlantic region, fisheries observers documented the incidental capture of loggerhead sea turtles, *Caretta caretta*, in both dredge and trawl gear harvesting Atlantic sea scallops. In 2004 the program also began to focus on documentation of sea turtle interactions and monitoring the bycatch cap of yellowtail flounder, *Limanda ferruginea*.

The bycatch cap was revised in Amendment 10 to the Scallop FMP in 2004 to also apply to trips by limited-access vessels into open areas. An emergency rule in 2006 was issued to address a legal problem with the payment mechanism (under Amendment 13 to the Scallop FMP); it established a third-party provider system and direct payments by the industry.³¹

³⁰Van Atten, A. U.S. Dep. Commer., NOAA, NMFS Northeast Fish. Sci. Center, Woods Hole, MA, Personal commun., 6 June 2011.

³¹Payment mechanisms for observer programs are further discussed in “Factors important in setting up and implementing industry-funded fishery observer programs” on file at NOAA



Today, Atlantic sea scallop observers monitor bycatch in the scallop fishery (primarily yellowtail flounder). Monitoring of yellowtail flounder bycatch in the scallop access areas within the year-round closed areas under the Northeast Multispecies FMP is of particular concern, because the scallop fishery is constrained by a fishery-specific TAC of yellowtail flounder, an overfished species.³² Observer coverage is also needed to monitor interactions of the scallop fishery with endangered and threatened sea turtles. The observer program typically targets 2–13% of all scallop trips in the scallop access areas (depending on permit type, area fished, and turtle takes) for observer coverage.

Pair-Trawl Fishery for Tuna, 1992

The Northeast Region also monitored bycatch of marine mammals in the pair-trawl fishery. The fishery, which targeted tunas and sharks, was considered experimental and had limited participation in 1991. By 1992, it had more than doubled (from around 100 hauls in 1991 to over 500 in 1992) (Northridge, 1996). In 1992 an ob-

server program was implemented to document incidental takes of marine mammals and sea turtles in the growing fishery (to aid in classifying the fishery under the MMPA), and to record catch.

The fishery was reclassified as Category I under the MMPA based on the 1992 observer data (Gerritor et al., 1994). As a Category I fishery, observer coverage became mandatory. Observer coverage levels reached 9% in 1992, 17% in 1993, 52% in 1994, and approximately 55% in 1995. During the 1994 and 1995 fishing seasons, observer experiments were organized and run by the Massachusetts Institute of Technology Sea Grant Center for Fisheries Engineering Research, with the goals of examining species and size selectivity, understanding patterns of catch and bycatch, and identifying methods to reduce bycatch (Goudey, 1994, 1995).

The Atlantic Offshore Cetacean Take Reduction Plan (AOCTRP) was implemented in 1996. The TRP included the pair-trawl fishery, despite the fact that it was no longer in operation, having been denied authorization by NMFS for the 1996 season due to concerns that bigeye tuna, *Thunnus obesus*, was over-exploited. The TRT included it in the plan as a precaution; the fishery has not been active since.

Atlantic Tuna Purse Seine, 1993

A voluntary observer program began in the Atlantic tuna purse-seine fishery in 1993. This was a very small fishery, with only five vessels participating (Credle et al., 1994). During the first year of program operations, only NMFS staff were deployed as observers, so that they might gain first-hand knowledge of the fishery and develop data collection protocols and forms. Only two vessels and trips were covered for a total of 13 sea days. After the first year observer coverage was obtained through a contractor, and data collection priorities included sampling tuna (sex, maturity) and recording protected species interactions (Van Atten³³). The Northeast Region last provided full-time observers for the fishery in 1996 (coverage level of 95.6%) (Waring et al., 2010).

The purse-seine fishery was authorized under the consolidated Highly Migratory Species (HMS) FMP in 1999. From 2000 to 2003, five tuna purse-seine vessels were issued experimental permits to fish in Multispecies Closed Area 1 (NOAA, 2003). Observers were randomly assigned to monitor trips taken by these vessels. The primary objective of this experimental fishery was to collect informa-

NMFS Office of Science and Technology, 1315 East-West Highway, Silver Spring, MD 20910.

³²Current status as of 2011 Report to Congress (avail. at: www.nmfs.noaa.gov/sfa/statusof/fisheries/2011/RTC/2011_RTC_FSSI_nonFSSI_TabA_D.pdf).

³³Van Atten, A. U.S. Dep. Commer., NOAA, NMFS Northeast Fish. Sci. Center, Woods Hole, MA, Personal commun., 1 June 2011.

tion on bycatch of groundfish, as well as interactions with protected species. Information on damage to the substrate by the gear was also recorded. Subsequently, Amendment 13 (2003) to the Northeast Multispecies FMP defined this gear type as “exempt” from groundfish closed area regulations (subject only to the normal rule governing use of exempted gear within the closed areas).

An international binding recommendation was adopted by ICCAT in 2010 that requires this fishery be observed at a minimum level of five percent, as measured in number of sets or trips (ICCAT Rec 2010-10). Observers are provided through the ICCAT program.

Mid-Atlantic Coastal Gillnet, 1994

The Mid-Atlantic coastal gillnet fishery ranges from New Jersey to North Carolina and utilizes both drift and sink anchored gillnet gear. Observer coverage was implemented in mid-1994 to monitor the incidental take of marine mammals. Coverage levels have been fairly consistent (generally 2–4%, reaching near 8% in 2011 and 2012) in federal waters. In addition to marine mammals, in some areas of Virginia and North Carolina sea turtle interactions are a concern for the fishery. However, this part of the fishery occurs in state waters and NMFS’ authority to observe fisheries under the ESA was limited until expanded ESA authority was authorized in 2007.

This fishery was listed for observation on the first (2010) Annual Determination issued under the new ESA regulations (NOAA, 2010). Federal coverage of fishing activity in North Carolina state waters occurred in 2010, although funding by month and region varied (Vidal³⁴). Data collected by observers in this fishery are important to understanding the extent of protected species interactions in previously unobserved areas.

³⁴Vidal, T., U.S. Dep. Commer., NOAA, NMFS Northeast Fish. Sci. Center, Woods Hole, MA, Personal commun. 22 April 2011.

Herring Single and Pair Trawl, 1994

The U.S. Atlantic herring fishery occurs over the Mid-Atlantic shelf region and has been prosecuted for several hundred years. Fixed gears were used initially, but they were later replaced by purse seines and subsequently by mid-water trawls (single and paired). The fishery is managed under the New England Fishery Management Council’s Northeast Multispecies FMP. Monitoring efforts focus on both protected species bycatch and on incidental bycatch of river herring, *Alosa pseudoharengus*, and haddock, *Melanogrammus aeglefinus*.

Since 2005, efforts have focused on Atlantic herring trips; coverage is determined as part of the combined “New England groundfish fisheries” discussed below. Of particular interest is bycatch of river or blueback herring, *A. aestivalis*, species that some believe are over exploited and that was petitioned for listing under the ESA in 2011 (later determined not to be warranted).³⁵

Mid-Atlantic Small Mesh Trawl Fishery for Squid, Mackerel, and Butterfish, 1996

In 1996, mackerel, Atlantic squid (*Illex* and *Loligo*), and butterfish, *Peprilus triacanthus*, trawl fisheries were combined into one Atlantic squid, mackerel, and butterfish FMP and designated as a Category II fishery. Although managed under the same FMP, the fisheries for squid and mackerel/butterfish take place in spatially and temporally separate areas, and have different management measures in place. Coverage levels for the mackerel/butterfish fishery approached 8% in 2011, but dropped to 5% in 2012.

Illex are harvested offshore mainly by small-mesh bottom trawlers, as is *Loligo*. The squid harvest is managed under gear and area restrictions, quotas, and trip limits. Vessels target-

³⁵No determination on river herring listing was made at the time of writing. Information on the current status of river herring petition can be found at: <http://www.nero.noaa.gov/Protected/riverherring/>

ing mackerel/butterfish use mid-water trawls. During the period 1996–2007, estimated observer coverage (measured in trips) for all components of this fishery ranged from less than 1% to 3%. Data from observers are used to estimate bycatch of protected species, and to estimate the butterfish catch rate, which is applied to a butterfish mortality cap for the directed *Loligo* fishery. Coverage levels for the mid-water trawl fishery approached 8% in 2012. A subset of vessels have fished under a moratorium permit since 2004 (76 permits), initiated to prevent overcapitalization of the fleet. Coverage levels of this sector were <5% in 2012.

Large Mesh Trawl Fisheries, 2001

The New England and Mid-Atlantic large mesh trawl fishery targets summer flounder, *Paralichthys dentatus*; bluefish, *Pomatomus saltatrix*; monkfish, *Lophius americanus*; and spiny dogfish, *Squalus acanthias*. The fisheries operate year round. Bycatch concerns exist for several marine mammal species, and the Mid-Atlantic portion of the fishery was included on the 2010 Annual Determination of fisheries identified for observer coverage due to potential sea turtle interactions. Coverage of this fleet is allocated as part of the overall New England groundfish monitoring program, discussed below.

New England Groundfish Fisheries—Combined, 2002

The monitoring efforts referred to today as “New England groundfish” by the Northeast Fisheries Observer Program are an amalgamation of several of the previously described programs. This assemblage more closely matches the structure of the Northeast Multispecies FMP, which groups 15 species and multiple gear types into a single management plan. Several of the fisheries discussed above, including the sink gillnet fisheries, are incorporated into this group. Also included are Northeast shrimp trawl, bottom longline/tub, herring mid-wa-

ter single and pair trawl, and silver hake trawl.

In 2001 the Conservation Law Foundation, National Audubon Society, the Natural Resources Defense Council, and the Ocean Conservancy (represented by Oceana) filed a lawsuit charging that groundfish catch levels proposed by the New England Fishery Management Council and approved by NMFS were too high and violated federal law by risking further depletion of New England groundfish populations. In March 2002, the court ordered, effective 1 Aug. 2002, that “for all gear sectors, NMFS shall provide 5% observer coverage, or higher, if necessary to provide statistically reliable data. Then, effective 1 May 2003, NMFS shall provide 10% observer coverage for all gear sectors, unless it can establish by the most reliable and current scientific information available that such increase is not necessary” (Conservation Law Foundation v. Evans, 2002).

Average coverage rates from 2003 to 2010 approximated 10%; however certain fisheries have had higher coverage to achieve specific data needs. Special Management Programs, which allowed fishermen opportunities to target healthy stocks by adhering to strict area and gear regulations, typically received coverage rates higher than the standard 10%, occasionally approaching 50–100% (e.g., in the herring fishery).

In an effort to rebuild fish stocks and end overfishing in the Northeast multispecies groundfish fishery, the New England Fishery Management Council adopted Amendment 16 to the Northeast Multispecies FMP in 2010. Amendment 16 included new MSA requirements for annual catch limits and accountability measures and allowed for the development of a sectors program.³⁶ In 2012, mandated observer coverage levels were set at 25% for the groundfish sector fleet, 30% for the common pool, and 20% for the herring.³⁷ These

³⁶A sector fishery management program allocates a specific portion of a total fishery catch to individuals, communities, or self-selected groups.

³⁷“Common pool” is the segment of groundfish permit holders that opts not to join a voluntary

A Note on Allocation of Observer Coverage

Throughout this paper, within the different regions, the reader will perceive a movement over time away from the investigative, response-oriented strategy of placing observers on vessels, and toward strategic allocation of sea days to achieve specific management objectives. However, this is an often difficult task, given funding available, regional data needs, and the increasing interest of outside organizations in fisheries observer programs.

For example, in 2011, The NMFS Northeast Region developed a Standardized Bycatch Reduction Methodology (SBRM), which outlined sea-day needs, projected coverage levels, and species/fishery prioritization for sampling through its observer programs.⁴¹

The 2011 Omnibus Amendment implementing this strategy was challenged in court, due in part to provisions that allowed NMFS and the councils to set aside the SBRM due to operational constraints and also because it focused on species targeted by federal fisheries, rather than the full range of species potentially taken as bycatch. Following the court decision, NMFS removed the SBRM regulations.

However, a need to estimate the number of sea days still existed, and the estimation methods described by the SBRM were still applicable. Coverage levels for each season are calculated using these methods, and they are allocated according to funding available for observer coverage. Many other regions use a similar, albeit less formal, process for determining observer coverage.

levels were achieved via a combination of at-sea monitors³⁸ and NEFOP observers in 2012, and reflect funding availability.

As more and more fisheries move toward quota allocations, observer data are relied on heavily for this monitoring of all catch, especially with regard to portions of the catch that are discarded at sea. Coverage rates are directly impacted by this increasing need and as a result have become highly variable based on council mandates, funding sources, and scientific and regulatory needs.

In 2012, the industry was scheduled to begin paying for monitoring in the

sector and instead fishes under traditional effort controls (days at sea and trip limits).

³⁸Under Amendment 16, an at-sea monitoring program was established that has lower education requirements than those in place for fishery observers. The monitors perform many of the same tasks as observers.

Northeast Multispecies Fishery. However, recent economic performance has prevented the industry from taking on these costs. In 2014, NOAA announced that NMFS would continue to pay these costs through the end of the 2014 fishing year (01 May 2014–30 April 2015).³⁹

Southeast Region

Shrimp Trawl, 1980

Observations of southeastern U.S. shrimp trawl fisheries were implemented in the early 1980’s under a voluntary program.⁴⁰ The program was research oriented from its incep-

³⁹Gloucester Daily Times, Gloucester, MA. 14 Feb. 2014, “NOAA set to cover the cost of monitors.” Avail. at <http://www.gloucestertimes.com/local/x1196453392/NOAA-et-to-cover-cost-of-monitors>.

⁴⁰<http://www.dnr.sc.gov/seaturtle/Literature/incidentalcatchturtlesSC-1980.pdf>

⁴¹SBRM documents are posted at: <http://www.nefsc.noaa.gov/fsb/SBRM/>

Table 2.—Fisheries observed in the Southeast Region. Note: This table represents the information located during the development of this report. In many cases, supplemental information may exist, particularly in the case of historical records, but it was not located. The information below provides a general sense of the scale of fisheries and observations. Coverage level information was located from Fishery Fact sheets (<http://www.nmfs.noaa.gov/pr/interactions/lof/>) and National Observer Program annual reports.

Fishery	Fleet Size	Authority to Place Observers	Season of Operation	Program Initial Year	Program Final Year	% coverage
Southeastern shrimp otter trawl	3,000 federal, unknown state, 411 rock shrimp	Voluntary until 2007, mandatory 2007–present	Year-round	Early 1980's: Pascagoula, MS; 1992: moved to Galveston, TX	Present	>1%, 2% 2008–12
Atlantic Ocean, Caribbean, Gulf of Mexico large pelagics longline	70–80 active vessels	MSA, MMPA, ATCA	Year-round	1992	Present	5–8% historically, 2009: 16%, 2010: 10%, 2011–12: 10%
Coastal shark gillnet fisheries	4–50 vessels	MSA and MMPA	Year-round	1993–present	Present	Historically: 100% strike net, 4–6% April–Nov; 2012: 100% strike, 38% drift, 5% sink.
Directed large coastal shark bottom longline	251 permits (2002 data)	MSA	3 seasons; Jan–April, May–Aug, Sept–Nov	1994	Present	Historically: 100% sandbar shark; 2012: 100% sandbar shark, 4–6% non-sandbar shark.
Southeast flynet	21	Voluntary	Seasonal (Oct–Nov)	2001	2002	12 trips
Southeast rock shrimp trawl	411 vessels (153 actively fish)	Voluntary	Year-round	2001	2003, then incorporated into Southeast shrimp trawl observer program	>1%
Calico scallop trawl	25 vessels, 1 at-sea processing vessel	Voluntary	Seasonal	2001	2003, then incorporated into Southeast shrimp trawl observer program	> 1%
Gulf of Mexico reef fish	1,000	MSA	Year-round	2006	Present	2006 – 2009: >1%–2% 2010: 5%, 2011: 6%, 2012: 8–10% longline, 8% vertical line emphasis, 1% across all gear types.
North Carolina gillnet	94	MMPA	Year-round	2005	Intermittent	>1%
Gulf of Mexico menhaden fishery	41 (2011)	MMPA/ESA	April–Nov	2011	Present	~1%

tion, with the primary goal of evaluating new types of gear to reduce bycatch, specifically of sea turtles and red snapper, *Lutjanus campechanus*. Data collected by observers led to implementation of a number of bycatch reduction devices, including the highly successful Turtle Excluder Device (TED) technology, which became mandatory for the entire fleet in 1989 (NOAA, 1987), due partially to information collected by the fishery observer program.

In the late 1980's the program office was moved from its original Pascagoula Laboratory site in Mississippi to its current home at the Galveston Laboratory, Southeast Fisheries Sci-

ence Center (SEFSC) Laboratory in Texas. By 1992, with fleet-wide use of TED's in place, the focus of the program shifted to researching the use of finfish bycatch reduction devices (BRD's). Since that time the program has tested over 100 different BRD's.⁴² Initially voluntary, observer coverage became mandatory in 2007 in an effort to reduce sampling bias. Coverage levels have remained consistently around 1% throughout the program's history, increasing to 2% beginning 2008 and continuing through the present (Table 2, Fig. 3).

⁴²http://safmc.net/Library/Ecosystem/SERfinal_bycatchplan.pdf

In 2012, the shrimp fishery observer program expanded coverage to include the skimmer, pusher-head, and butterfly trawls for shrimp (collectively referred to as "skimmer trawl fisheries"). Coverage was initiated for these fisheries over concerns that they were contributing to high numbers of drowned sea turtles observed in 2010 and 2011. Previously, these fisheries had an alternate tow-time in lieu of using TED's. Low levels of turtle bycatch were observed, although it was concluded this could be due to weather, water temperature, population variations, or other factors (Pulver, 2014). Concerns over bycatch of another protected species, smalltooth sawfish, *Pristis pecti-*

nata, resulted in a partnership to test the ability of electronic technology to monitor interactions in 2013.⁴³

Florida Mackerel Drift

From May to September, 1987, SEFSC staff observed the driftnet fishery off the east coast of Florida. Targeting king mackerel, *Scomberomorus cavalla*, the fishery had been conducted since the early 1960's and was previously unstudied. The bycatch, landings, and economic data collected by observers were needed by the South Atlantic and Gulf of Mexico Fishery Management Councils for management. Schaefer et al. (1989), who described the fishery and summarized the results of the observer program, stated that all fishermen asked to carry observers did so willingly. Overall, little bycatch was recorded.

Pelagic Longline–Atlantic Ocean, Gulf of Mexico, and Caribbean Sea, 1992

The Atlantic pelagic longline fishery⁴⁴, which targets tuna and swordfish, has been observed since 1992, following the implementation of the 1985 U.S. FMP for swordfish and the 1990 ICCAT management plan for swordfish, which recommended 5% observer coverage. The fishery is monitored by the SEFSC Sustainable Fisheries Division at the Miami Laboratory. Because of wide-spread support from the industry, it was initially thought that Secretarial authority requiring vessels to take observers would not be invoked. However, compliance was made mandatory to minimize bias when selecting vessels to observe.

The observer program was implemented to provide a representative basis for estimating the total composition of the catch (retained and discarded, targeted, and incidental), as well as to validate and augment self-

reported and port sampling programs, to assure compliance to international agreements, and to meet national goals for the management of pelagic fisheries (Keene et al., 2007, 2010). Eventually the goals of the observer program expanded to include better documentation of protected species bycatch levels for use in determining an appropriate MMPA category and to provide better estimates of marine mammal and sea turtle bycatch.

From 1992 to 1995, responsibility for coverage of the fleet was shared by the SEFSC's Miami Laboratory (as the "Pelagic Observer Program") and the NEFSC's Woods Hole Laboratory. The Miami Laboratory was primarily responsible for the assessments of the North Atlantic pelagic fish stocks, which relied in part on observer data from this program; thus, the Southeast Region received all of the funding for observer coverage, and selected the vessels for observation (Beerkircher et al., 2002).

During this time (1992 through 2003), coverage levels ranged between 3% and 5% (Beerkircher et al., 2002). Because a large portion of the pelagic longline fleet was located in Mid-Atlantic and New England waters, the SEFSC would provide the NEFSC with a list of the vessels selected for coverage and funding sufficient to provide coverage for those vessels. The Northeast Region's observer program placed observers on vessels fishing north of lat. 35°N, while the Southeast observer program covered vessels south of lat. 35° N, including the Gulf of Mexico and the Caribbean.

In 1996, the SEFSC was given sole responsibility for running the observer program and providing observers (Beerkircher et al., 2002). However, there were a few occasions in the following years when some funding was transferred to the NEFSC to finance observer coverage of the pelagic longline fleet fishing in the northern waters. Currently, all observer data collection is run out of the SEFSC.

Interactions with sea turtle and marine mammal species have resulted in a number of bycatch-related research

projects and regulations for the observer program. From 2001 to 2003 the program participated in a cooperative research project testing the potential of circle hooks to reduce sea turtle bycatch (Garrison, 2003). The research took place in the "Northeast Distant Fishing Area," or NED, an area off of Canada and Newfoundland that was closed to U.S.-flagged vessels not participating in this experimental research. One hundred percent observer coverage was required for participants who tested the ability of various circle hook sizes and bait combinations to reduce sea turtle bycatch. Results of this study led to the banning of "J" style hooks in Atlantic longline fisheries (including the Gulf of Mexico and Caribbean), as well as to the reopening of the NED area.

In 2004, an ESA Biological Opinion (NMFS, 2004b) for the fishery required an observer coverage increase to a minimum of 8% of total annual reported sets, to ensure that incidental takes of endangered leatherback sea turtles, *Dermochelys coriacea*, were adequately monitored and did not exceed authorized levels. The required 8% coverage for the Atlantic portion of the fishery has been met since that time.

In 2006 NMFS established a TRP to address the incidental mortality and serious injury of long-finned pilot whales, *Globicephala melas*, and short-finned pilot whales, *G. macrorhynchus*, in the Mid-Atlantic region of the pelagic longline fishery.

Recommendations from the TRP specific to the observer program included increasing coverage in the Mid-Atlantic Bight region to 12–15% due to high interaction rates in that area. Development of the Cape Hatteras Special Research area (CHSRA) was also recommended.

Regulations effective in June 2009 required pelagic longline vessels to contact the observer program on a special toll-free line at least 48 h in advance of fishing in the CHSRA (NOAA, 2009b). Overall, reported compliance with these requirements has been high, and the Pelagic Observ-

⁴³<http://www.saltwaterinc.com/selected-emp-projects.html>

⁴⁴The term "Atlantic pelagic longline fishery" is used herein for shorthand to include the Atlantic Ocean, Gulf of Mexico, and Caribbean longline fisheries.

U.S. Observer Programs - Southeast Region

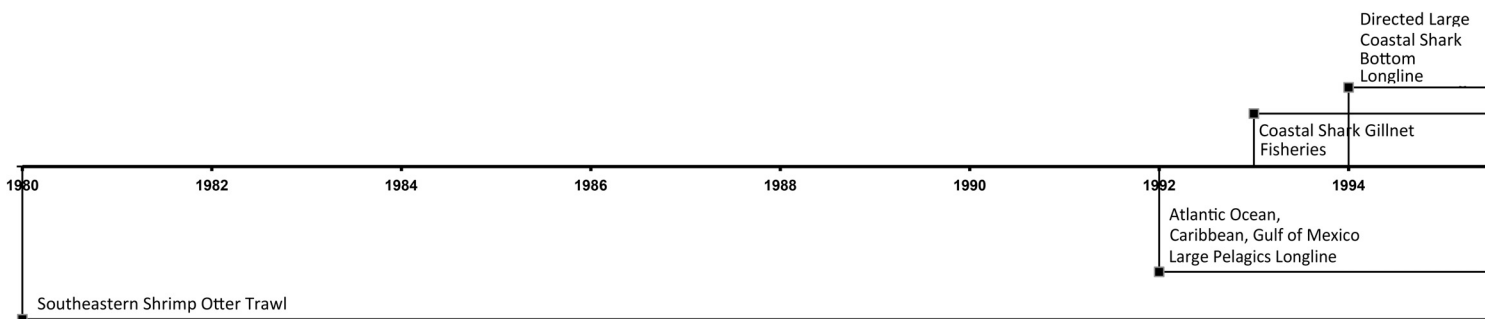


Figure 3.—Timeline of federal fisheries observer programs in the Southeast Region. Observer coverage levels vary between fisheries and are provided in Table 2.

er Program has been working within funding constraints to increase observer coverage, achieving 11% overall coverage in 2007; 13% in 2008; and 16% in 2009. From 2010–12, coverage levels decreased slightly to approximately 10%.

Coverage level increases were primarily due to enhanced coverage of the Gulf of Mexico segment of the fishery during bluefin tuna, *Thunnus thynnus*, spawning season⁴⁵, but also as a result of improved compliance enforcement efforts. In 2012, coverage levels of 50% were achieved during this important time.

Regulations were implemented in 2011 (NOAA, 2011a) that require the use of “weak hooks” in the Gulf of Mexico portion of the fishery following several years of experimental use and analysis of observer data demonstrating their effectiveness. The weak hook releases larger fish (e.g., bluefin tuna) while retaining smaller target species (e.g., yellowfin tuna, *Thunnus albacares*, and swordfish).

In addition to its use in monitoring for interactions with protected species and use in fisheries stock assessments, data collected on this fishery are reported to ICCAT for use in managing transboundary tuna stocks.

Shark Fisheries, 1993–1994

During the early 1990’s an observer program was initiated for the shark gillnet fishery operating off Georgia and east Florida (Credle et al., 1994). The vessels fishing in the shark fishery had previously targeted king mackerel with drift gillnets, but many switched to sharks (targeting small coastal species such as sandbar, *Carcharhinus plumbeus*; blacknose, *Carcharhinus acronotus*; Atlantic sharpnose *Rhizoprionodon terraenovae*; and finetooth *Carcharhinus isodon*, sharks) to compensate for reduced quotas in the early 1990’s. Protected species bycatch in drift gillnet fisheries was an issue of special concern to NMFS scientists, and the role of the observer program was to characterize bycatch of marine mammals and sea turtles.

The program was discontinued in 1995 due to a lack of funding, but it was reestablished in 1998 as the Southeast Atlantic Shark Drift Gillnet/Strike Net Observer Program. This was necessary because in 1997 NMFS issued a Biological Opinion⁴⁶ concluding that continued operation of the fishery was likely to jeopardize the continued existence of the North Atlantic right whale. For the shark fishery to continue to operate, 100% observer coverage of the southeast shark drift gillnet fish-

ery during the right whale calving season (15 Nov.–31 Mar.) was mandated. Outside the right whale calving season a level of observer coverage equal to that which would attain a sample size needed to provide estimates of protected resource interactions with an expected CV of 30% was required.

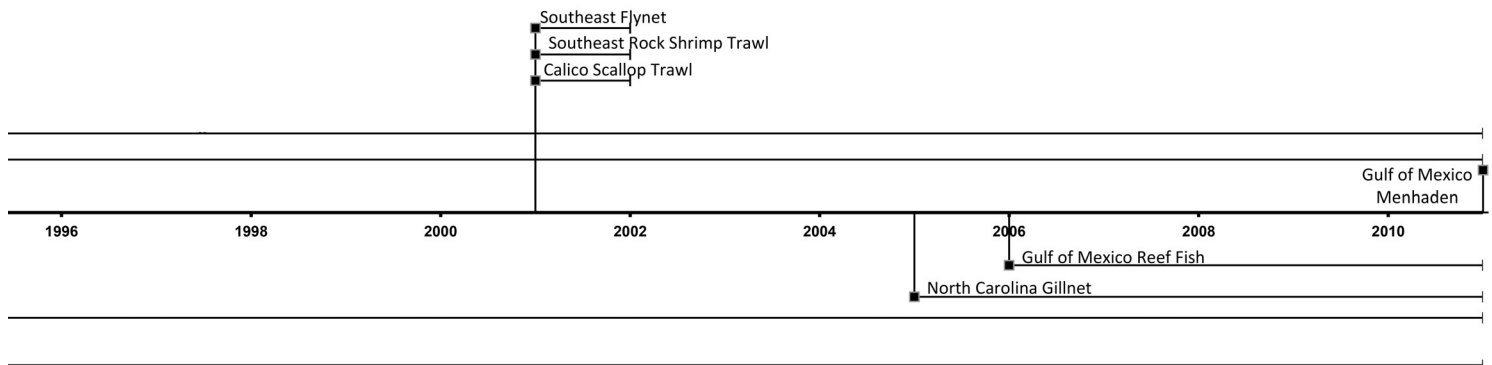
In 2005, the shark gillnet observer program was expanded to include all vessels with an active directed shark permit fishing with sink gillnet gear (including those targeting teleosts such as Spanish mackerel, *Scomberomorus maculatus*; king mackerel; and bluefish. Sink gillnet vessels were included in the selection in an effort to determine their impact on shark resources when not targeting sharks. These vessels were not previously subject to observer coverage because they were either targeting non-highly migratory species or were not fishing gillnets in a drift or strike fashion.⁴⁷

In 2006 the NMFS Southeast Regional Office (SERO) requested further expansion of the scope of the shark gillnet observer program to include all vessels fishing gillnets regardless of target, and for coverage to be extended to cover the full geographic range of gillnet fishing effort in the southeast U.S. region. This request was made as part of an effort to monitor (at statistically adequate levels) all

⁴⁵Observer coverage of longline fishing in the Gulf of Mexico during bluefin tuna spawning season targets levels approaching 100%.

⁴⁶NMFS. 1997. Biological opinion for the Atlantic pelagic fishery. Avail. from NOAA, NMFS, Off. Sustainable Fish., 1315 East-West Hwy, Silver-Spring, MD 20910.

⁴⁷Strike net fishing is a method of fishing similar to gillnetting, with the modification that the net is retrieved immediately after it is cast.



gillnet fishing effort and assess risks to right whales and other protected species. Also in the same year, nonregulatory recommendations were made to increase observer coverage under the common bottlenose dolphin, *Tursiops truncatus*, TRP.

In 2007 the regulations implementing the Atlantic Large Whale TRP were amended to prohibit all gillnets in an expanded southeastern U.S. restricted area from Cape Canaveral, Fla., to the North Carolina/South Carolina border during right whale calving season (eliminating the need for 100% observer coverage during this time). The regulation contained limited exemptions for waters south of lat. 29° N, for shark strike net fishing during this 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 covers all anchored (sink, stab, set), strike, or drift gillnet fishing by vessels that fish from Florida to North Carolina year-round. Coverage levels in 2012 were 100% for the shark strike net, 38% for shark drift net, and 5% for shark and teleost sink net fisheries.

A second shark observer program, focused on the directed shark bottom longline fishery, began as a cooperative effort between the Gulf and South Atlantic Fisheries Foundation (with a subcontract to the Florida Program for Shark Research at the Florida Museum of Natural History, part of the Uni-

versity of Florida) and the fishermen of the U.S. Atlantic commercial shark fishery.

Monitoring of the southeastern U.S. shark bottom longline fishery began in January 1994 (Burgess and Morgan, 2003) and continued as a voluntary program through the end of 2001. During this period, coverage ranged from 2 to 3% of the landed catch. Data collected from the fishery were utilized in developing management strategies for the fishery (Hale and Carlson, 2007).

In 2002 observer coverage became mandatory under the FMP for Atlantic tunas, swordfish, and sharks (later referred to as the “Atlantic HMS FMP”) (NOAA, 1999b). The University of Florida continued to manage the observer program with NMFS funding until 2005, and in 2006 management was transferred to the SEFSC Panama City Laboratory (Hale and Carlson, 2007).

Initially, vessels were randomly selected for observer coverage if they possessed a current directed shark permit and reported fishing for sharks with bottom longline gear in the same season of the previous year. However, in 2006, regardless of the target species, if a vessel was selected during the coverage period, it was required to carry an observer (Hale and Carlson, 2007). Thus, observers also boarded bottom longline fishing trips that targeted shallow-water groupers (mainly red grouper, *Epinephelus morio*), snapper (primarily red snapper), and deepwater groupers and tilefish (yel-

lowedge grouper, *Epinephelus flavo- limbatus*, and tilefish, *Lopholatilus chamaeleonticeps*).

Observer coverage ranged between 5 and 8% from 2006 through 2010. Additionally, in 2008 observations of a sandbar shark, *Carcharhinus plumbeus*, research fishery were initiated under the shark bottom longline program’s umbrella; 100% coverage was required. Coverage levels in 2012 were 100% for the sandbar shark research fishery and 4–6% non-sandbar shark fishery.

Reef Fish, 2006

The commercial reef fish fishery in the Gulf of Mexico involves several hundred vessels that target red snapper, red grouper, and many other reef fish species. The fishery is prosecuted with a variety of gear types, including electric reel, handline, and longline gears. Amendment 22 to the Gulf of Mexico Fishery Management Council’s Reef Fish Fishery Management Plan dictates mandatory observer coverage of this fishery. In 2006 an observer program for the Gulf reef fishery was initiated; this program is also based at the SEFSC Galveston Lab. Coverage levels for the fishery were approximately 1% in the first years of the program, but increased to 2% in 2009, and nearly 5% in 2010. In 2011, approximately 6% coverage was achieved across the reef fish fishery. In 2012, coverage levels of 1% were obtained in the fishery, with higher levels in the vertical line component.

Since the program's inception, observer data have been used to enhance stock assessments for several species of concern, improve discard-to-landing estimates, and assess current and proposed catch share programs. Moreover, the new observer data indicated that numbers of sea turtle interactions for the bottom longline sector of the fishery had been underestimated in previous analyses that relied on self-reported commercial logbook data. Recent NMFS reports (SEFSC^{48,49}) extrapolated observed bycatch to the entire fleet. Those analyses indicated that nearly 1,000 sea turtles were caught in the bottom longline fishery, greatly exceeding the incidental take authorized under the ESA for the fishery.

In 2009, several environmental organizations filed their intent to sue NMFS on this issue. At the same time, NMFS and the Gulf of Mexico Fishery Management Council took action, implementing emergency area restrictions for the bottom longline fleet, and they began work on Amendment 31 to the Reef Fish FMP that would address sea turtle bycatch.

Amendment 31 was implemented in January 2010 and contained actions for time/area closures, gear restrictions, and limiting the number of vessels participating in the bottom longline component of the fishery. Also in 2010, funding for increased observer coverage in the bottom longline sector of the fishery was obtained to improve precision of sea turtle bycatch estimates.

The potential use of electronic monitoring has been studied fairly extensively in this fishery. Pilot studies were conducted in 2008, 2010, and 2011 by various organizations in partnership

⁴⁸SEFSC. 2008. Estimated takes of sea turtles in the bottom longline portion of the Gulf of Mexico reef fish fishery July 2006 through 2007 based on observer data. NMFS Southeast Fish. Sci. Cent. Contrib. PRD-07/08-15, Sept. 2008, 21 p.

⁴⁹SEFSC. 2009. Estimated takes of sea turtles in the bottom longline portion of the Gulf of Mexico reef fish fishery July 2006 through 2008 based on observer data. NMFS Southeast Fish. Sci. Cent. Contrib. PRD-08/09-07, Mar., 2009, 23 p.

with NOAA. As of 2013, ten vessels continued to test the potential of this technology.

Gulf of Mexico Menhaden Fishery, 1992–95; 2011–Present

The Gulf of Mexico fishery for Atlantic menhaden, *Brevoortia patronus*, dates back to the 1800's. Today, by volume, it is one of the nation's largest fisheries, although only 41 boats participated in the 2011 fishery. The fishery was observed in 1992 and 1994–95 by Louisiana State University (through a grant from the Federal Government), and documented bycatch of bottlenose dolphins. The fishery was originally classified as Category III under the MMPA in 1996, but was reclassified to Category II following revisions to bottlenose dolphin stock structure.⁵⁰ In 2011, observations of the fishery were reinitiated; past observer data were considered out-of-date and new information on the amount and types of bycatch was needed. Coverage levels in 2011 were less than 1%.

Short-term Programs

In addition to the longer-term programs described above, several smaller scale, short-term programs have operated in the Southeast Region. Voluntary pilot observer programs for the southeast flynet, calico scallop, *Argopecten gibbus*, trawl, and southeast rock shrimp, *Sicyonia brevirostris*, trawl fisheries were funded by NMFS in late 2001.⁵¹ None of these fisheries had been previously observed; observations for all three fisheries were focused on interactions with sea turtles. The Southeast Region flynet fishery was observed for only one year (2001–02) while both shrimp-trawl and the calico scallop trawl fisheries were incorporated into the Southeast Region's shrimp trawl observer program in 2003.

An alternative platform observer program was also initiated in 2005 to monitor marine mammal interactions

⁵⁰www.nmfs.noaa.gov/pr/pdfs/fisheries/2011final/gom_menhaden_purse_seine.pdf

⁵¹<http://www.mmc.gov/reports/annual/pdf/2001annualreport.pdf>

with the North Carolina gillnet fishery under the MMPA, as recommended by the bottlenose dolphin TRP. This fishery is a state-waters extension of the Mid-Atlantic gillnet fishery, which is observed by the NEFOP. The program's objective was to monitor the gillnet fishery for interactions between coastal bottlenose dolphins and the traditionally unobservable fleet (vessels that could not carry observers due to their small size). Initial years of the program were spent collecting data on fishery participants to develop a sampling scheme. Minimal coverage of the fishery was achieved, due to a lack of steady funding for the program and the difficulty in obtaining a complete list of fishery participants. The North Carolina Division of Marine Fisheries provides some observer coverage (up to 10%)⁵² of this fishery in Pamlico Sound under an ESA section 10 permit.

Pacific Northwest

Marine Mammal Observer Programs in the Pacific Northwest, 1990

Historically, coastal Pacific salmon fisheries were observed in Washington and Oregon by the NMFS Northwest Region in cooperation with the Oregon and Washington state fisheries agencies and the Pacific States Marine Fisheries Commission. These programs were short-term for the most part and included observations of the Makah Indian salmon set gillnet (1990–96), Washington/Oregon Lower Columbia River salmon drift gillnet (1991–93), Washington (Grays Harbor) salmon set and drift gillnet (1992–93), and the Willapa Bay salmon drift gillnet (1992–93) fisheries. Authorization and program funding was provided through the MMPA; coverage levels ranged from 1 to 7% (Table 3, Fig. 4).

⁵²Byrd, B., A. Hohn, and M. Godfrey. 2011. Emerging fisheries, emerging fishery interactions with sea turtles: A case study of the largemouth gillnet fishery for flounder in Pamlico Sound, North Carolina, USA. *Mar. Policy* 35(3): 271–285.

Table 3.—Fisheries observed in the Northwest Region. Note: This table represents the information located during the development of this report. In many cases, supplemental information may exist, particularly in the case of historical records, but it was not located. The information below provides a general sense of the scale of fisheries and observations. Coverage level information was located from Fishery Fact sheets (<http://www.nmfs.noaa.gov/pr/interactions/lof/>) and National Observer Program annual reports.

Fishery	Fleet Size	Authority to Place Observers	Season of Operation	Program Initial Year	Program Final Year	% coverage
At-sea Pacific hake–foreign	28 Russian vessels (1978) 6 Polish vessels (1978)	treaties and agreements	May–Oct	1975	1986	1977: 25.7%, 1978: 34.7%, 1979: 33.8%, 1980: 21.3%, 1981: 24.2%, 1982: 86.2%, 1983 ¹ 1984: 93.1%, 1985: 95.5%, 1986: 94.9%
At-sea Pacific hake–joint venture	2 U.S./Russia (1978) 16 U.S./Poland and 8 U.S./Russia in 1986	MSFCMA	May–Oct	1978	1990	1978: 100%; 1979: 57.4%, 1980: 76.6%, 1981: 33.1%, 1982: 77.1%; 1983: 86.4%, 1984: 90.2%, 1985: 92.7%, 1986: 95.4%, 1987: 95%, 1988: 95.1%, 1989: 96.7%, 1990: 96%
At-sea Pacific hake–domestic	6 motherships, 9 catcher processors	MSFCMA	May–Oct	1990	Present	100%; included in West Coast groundfish starting in 2012.
Northern Washington marine Chinook salmon set-set	4–12 vessels	MMPA	May–Sept	1989	1997	20–80%
Columbia River salmon gillnet fishery	750	MMPA	Fall/winter	1991	1993	5–27%
Willapa Bay salmon gillnet fishery	300+	MMPA	Summer/Fall	1991	1993	1–3%
Grays Harbor salmon drift and set gillnet fisheries	300+	MMPA	Summer/Winter	1991	1993	4–5%
Shore-based Pacific hake	40	EFP	Spring/Summer	1992	1997	46% (1994), 14% (1997); 100% electronic monitoring (1995–2010); included in West Coast groundfish starting in 2012.
Puget Sound non-treaty salmon gillnet (all areas and species)		MMPA	Summer/Fall	1993	1993	1.30%
Puget Sound non-treaty chum salmon gillnet (areas 10/11 and 12/12B)		MMPA	Summer/Fall	1994	1994	11.00%
Puget Sound treaty chum salmon gillnet (areas 12, 12B, and 12C)	Varied by year. Estimates for participation in all salmon gillnet fisheries: 1994: ~1,044; 2007: 110	MMPA	Summer/Fall	1994	1994	2.20%
Puget Sound treaty chum and sockeye salmon gillnet (areas 4B, 5, and 6C)		MMPA	July–Oct	1994	1994	7.50%
Puget Sound treaty and non-treaty sockeye salmon gillnet (areas 7 and 7A)		MMPA	July–Oct	1994	1994	7.00%
Oregon shrimp trawl		142 (approx. 40 active)	MSFCMA	April–Oct	1995	1998
West Coast groundfish	179 trawl, 190 longline, 30 trap permits	MSFCMA	Year-round	2001	Present	10–20%; in 2011 coverage split between limited entry (15–25%) and catch share fleets (100%); 2012: limited entry (15–25%), open access (1–8%), 100% shoreside.
State managed and open access fisheries (includes California halibut trawl, nearshore rockfish, pink shrimp, prawn and open access fixed gear fisheries)	~1,000	MSFCMA	Year-round	2003	Present	2006–08: <1–10%; 2009–11: 3–8%
Shore-based hake mid-water trawl fishery (electronic monitoring)	35	MSFCMA	June–Aug	2004	2010	100%

¹No foreign fishing in 1983 due to political considerations (J. Berger text footnote 55).

U.S. Observer Programs - Northwest Region

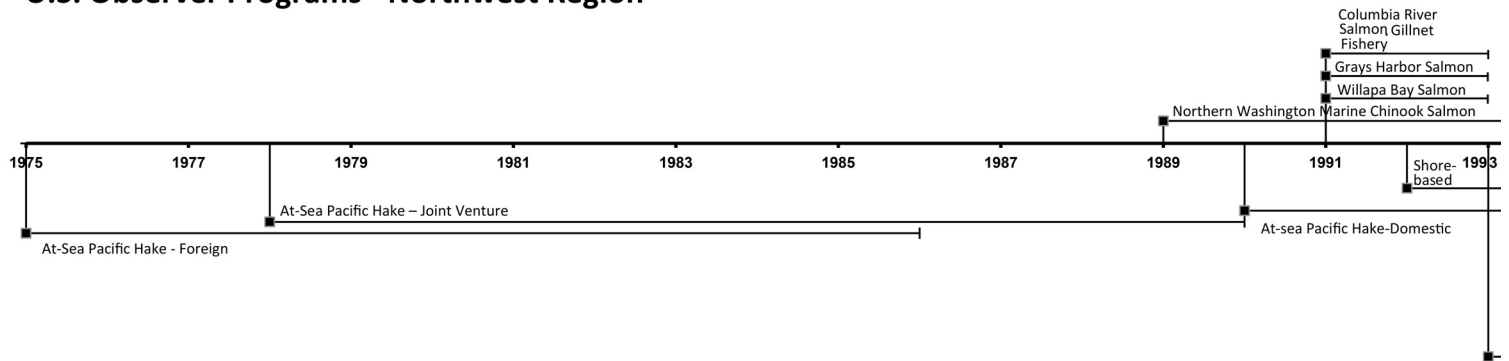


Figure 4.—Timeline of federal fisheries observer programs in the Northwest Region. Observer coverage levels vary between fisheries and are provided in Table 3.

The data collected by NMFS Northwest Region salmon observer programs in state waters documented interactions between marine mammals and regional salmon gillnet fisheries. While impacts from interactions in these fisheries may have been high in the mid-1990's, fishery size, and presumably bycatch of marine mammals, decreased significantly by the early 2000's under ESA efforts to recover endangered and threatened salmonid populations (NMFS⁵³). For example, a NMFS 2009 stock assessment report for California sea lions⁵⁴ states that the Oregon Columbia River gillnet fishery had been reduced to such levels that California sea lion, *Zalophus californianus*, mortality, if any, was negligible. No state-waters salmon fisheries have been observed since.

Pacific Hake Fisheries: Domestic Fishery Observations, 1990

As discussed in the previous section, the foreign fishery for Pacific hake began off the coasts of Washington, Oregon, and California in the early 1960's as an extension of the Russian and Japanese distant-water trawl fisheries in the Bering Sea and Gulf of Alaska. A few observers were placed on the foreign vessels (by invitation); from

⁵³2003 stock assessment for Washington inland stock of harbor seals (avail. at: www.nmfs.noaa.gov/pr/sars/species.htm#otariids).

⁵⁴2009 stock assessment for CA sea lions (avail. at: www.nmfs.noaa.gov/pr/sars/species.htm#otariids).

1975 to 1981, coverage levels ranged from about 20 to 30% (Edwards et al., 1981).

Following implementation of the MSA, the U.S. gained authority to require foreign vessels fishing in U.S. waters to carry observers. From 1978 to 1989 observers were placed aboard Russian and Polish vessels (French et al., 1979; Dorn et al., 1991) targeting hake under joint venture agreements. Higher levels of coverage were achieved in the 1980's, nearing 100% (Berger⁵⁵). By 1990, foreign fishing effort had ceased. Joint-venture fisheries also operated in the region from the late 1970's to 1989, with higher levels of coverage (Berger⁵⁵).⁵⁶

The domestic at-sea hake fishery is a mid-water trawl fishery that is composed of three offshore fishing sectors: catcher processors, mothership processors with supporting catcher vessels, and tribal catchers delivering to a mothership. Beginning in 1990, domestic catcher processors and motherships voluntarily carried NMFS-trained observers (AFSC⁵⁷).

⁵⁵Berger, J. U.S. Dep. Commer., NOAA, NMFS Alaska Fish. Sci. Cent., Seattle WA, ret. Personal commun., 19 Oct. 2010.

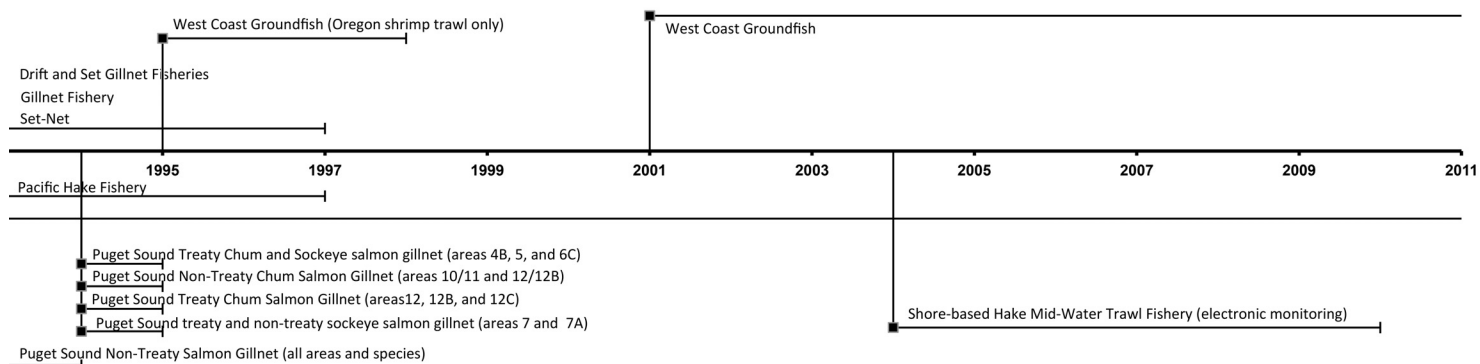
⁵⁶The introductory section provides a complete discussion of the role of joint venture fisheries in U.S. waters and the eventual exclusion of foreign fleets from the U.S. EEZ.

⁵⁷AFSC. 1992. Summaries of domestic and joint venture groundfish catches (metric tons) in the northeast Pacific Ocean and Bering Sea, 1990. U.S. Dep. Commer., NOAA, Natl. Mar. Fish. Serv., Alaska Fish. Sci. Cent. AFSC Processed Rep. 92-06, 143 p.

The hake fishery is managed under the West Coast Groundfish FMP. From 1990 until 2000, observer coverage in the domestic hake fishery was the result of shared effort between the NMFS Northwest Regional Office (NWR) and the NPGOP. In 2001 Admendment 13 to the West Coast Groundfish FMP established mandatory 100% observer coverage on catcher vessels. The NPGOP provided prehire screenings, field training, debriefing interviews, at-sea support, sampling equipment, and data management services. Responsibility for the observer program shifted to the Northwest Fisheries Science Center (NWFSC) in 2001.

The At-Sea Hake Observer Program (ASHOP) began in 2004, when observer coverage became mandatory (NOAA, 2004) for every at-sea processing vessel (processing vessels 125 ft or longer are required to carry two observers or one observer if less than 125 ft). Observer coverage is maintained to comply with an ESA Section 7 consultation on the Pacific Coast groundfish fishery requiring all incidental takes of ESA-listed salmon to be recorded, and more recently to address catch and discard monitoring in the newly implemented trawl rationalization program.

The shoreside component of the Pacific hake fishery consists of vessels that deliver unsorted catch to shoreside processors. From 1992 through the present, the fishery has operated



under an exempted fishing permit (EFP).⁵⁸ As part of the EFP requirement, state and federal observations of the fishery are conducted to document and estimate bycatch. Observers were deployed aboard vessels until 1994, after which the program shifted its focus to observer sampling at the processing plants (Jesse, 2008).

In 2004 NMFS initiated an electronic monitoring pilot study “to determine whether video monitoring could be used to verify compliance with the EFP’s maximized retention requirements and to help characterize daily process of the fishery” (Jesse, 2008:4). Electronic monitoring was required aboard all shoreside Pacific hake vessels from 2004 through 2010. Electronic monitoring of the fishery for compliance with the maximized-retention requirement was transitioned from pilot to operational in 2008 and was managed by the NMFS Northwest Regional Office.

In 2011, with the conversion to a catch-share management program, the program reverted to observer coverage with coverage levels of 100%. The Pacific Fisheries Management Council (PFMC) was concerned about the high cost of monitoring, and likely also the increased incentive for non-reporting of discards, under the catch-share system. Shifting costs for coverage to the industry was viewed as one way to increase the incentive for finding a less

costly monitoring solution in the future.⁵⁹ The potential use of electronic monitoring for all west coast groundfish fisheries (including hake) is still being explored, as discussed in next session.

West Coast Groundfish Fishery, 2001

In addition to the vessels targeting hake described above, additional vessels target other groundfish species (e.g., rockfish, flatfish, non-hake roundfish, sharks, skates, among others) along the west coast. These vessels use trawl and fixed gear and deliver their catch to shoreside plants for processing. This fleet ranges in size from skiffs targeting nearshore groundfish species to 100 ft-plus trawlers fishing along the continental slope.

Three voluntary observer projects were conducted in this fishery, primarily off Oregon, aboard shoreside trawlers during the years 1985–87, 1988–90, and 1995–98. The first and second studies focused on the discard of groundfish species regulated by trip limits, bycatch of Pacific salmon species and Pacific halibut, and impact of changes in codend mesh size (Pikitch et al., 1988; Bergh, 1990; Pikitch, 1991).

The third, a voluntary pilot program called the Enhanced Data Collection Project (EDCP), was a joint effort between industry and state and federal agencies to place observers and en-

hanced logbooks on board groundfish trawl vessels off the coast of Oregon between 1995 and 1998 as summarized in the 2000 report “National Evaluation of Cooperative Data Gathering Efforts in Fisheries” (Bernstein and Iudicello). This joint effort focused on the collection of discard and bycatch data. While the data from all three projects were used in various management applications, there were concerns the data were not representative of the fishery as a whole due to the projects’ limited geographic range, voluntary coverage, and focus on trawlers. Discard rates produced were for a limited number of species, so there was still little or no data available for many species and gear groups.

A 1998 NMFS Report to Congress⁶⁰ regarding the status of overfished stocks noted that, out of 54 rockfish, *Sebastes* spp., listed in the ocean off Washington, Oregon, and California, five were listed as “approaching overfished condition,” four were listed as “not approaching overfished condition,” and the status of the remaining 45 species (83%) was listed as unknown. It was widely agreed that comprehensive information on discarded catch in the west coast groundfish fishery was needed to assess and account for total fishing mortality (especially for rockfish) and to evaluate the effectiveness of management measures, including those aimed at rebuilding depleted stocks.

⁵⁸Exempted fishing is defined to be fishing practices that are new to a fishery and not otherwise allowed under an FMP.

⁵⁹www.pcouncil.org/groundfish/trawl-catch-share-program-em/

⁶⁰<http://www.nmfs.noaa.gov/sfa/98stat.pdf>

In 1999, the PFMC, which has jurisdiction over the U.S. EEZ off the coast of Washington, Oregon and California, imposed drastic cuts, ranging from 14 to 85% depending on the species, on the amount of allowable groundfish harvest. On 19 Jan. 2000, the Federal Government declared a commercial fishery failure (fishery disaster) for west coast groundfish.⁶¹

By 2001 the PFMC listed seven overfished species: lingcod, *Ophiodon elongatus*; widow rockfish, *Sebastes entomelas*; dark-blotched rockfish, *Sebastes crameri*; Pacific Ocean perch, *S. alutus*; canary rockfish, *S. pinniger*; bocaccio, *S. paucispinis*; and cowcod, *S. levis*. In 2002 yelloweye rockfish, *S. ruberrimus*, and Pacific hake were added, bringing the total to nine overfished species. Because of the lack of knowledge about the fisheries, and in particular the discard rates, the PFMC implemented the groundfish observer program in 2001 as part of the Pacific Coast Groundfish FMP to gather the data needed to manage the groundfish fishery off the coasts of Washington, Oregon, and California.

The FMP regulations required all vessels that participate in the groundfish fishery to carry an observer when notified to do so by NMFS or its designated agent. The West Coast Groundfish Observer Program (WCGOP) was established within the NWFSC with the goals of collecting data for estimating total landed catch and discards, monitoring the attainment of annual groundfish allocations, estimating catch rates of prohibited species, and assessing stock conditions. Under these regulations observer coverage was required on all limited-entry and open-access vessels in the groundfish fishery. The Federal Government covered the costs associated with the operation of the program, observer training and briefing, debriefing, and management of the data.

In 2001, the WCGOP began deploying observers aboard the limited entry trawl and fixed-gear fleets. In 2002, the program began deploying observers in

open access groundfish fisheries, while increasing its coverage of the limited entry trawl fishery. In 2005, the WCGOP increased its coverage of the limited entry fixed-gear fishery, and in 2006 the WCGOP increased coverage of the nearshore fishery. In addition to being incorporated into stock assessments and determination of protected species takes, the data collected by the program were fully incorporated into groundfish management, including annually updated discard and bycatch rates for dozens of species in multiple fisheries in a multitude of management areas.

In 2010 the NMFS adopted a catch-share program for the west coast groundfish trawl fishery (also referred to as “trawl rationalization”). The new program (implemented in January 2011) established individual fishing quotas for shore-based trawl fleets, as well as fishing cooperatives for the at-sea mothership and catcher/processor sectors. The program required 100% at-sea observer coverage, which will be critical to managing bycatch caps and monitoring quotas. Fishermen not participating in the catch share fishery (e.g., limited entry trawl, Oct.–Dec. only, and fixed gear) are not included in the 100% requirement; this portion of the fleet was observed at levels of 15–25% in 2011 and 25% in 2012.

Additionally in 2012, a Section 7 consultation was completed under the ESA on the fishery reauthorization.⁶² Reasonable and prudent alternatives identified new requirements for observer data collection on green sturgeon, *Acipenser medirostris*, and reporting on Steller sea lion, *Eumetopias jubatus*, interactions. This information will improve understanding of the fisheries impacts on these endangered species.

Electronic monitoring is also of interest in the groundfish fisheries. Studies evaluating the potential of electronic monitoring (EM) for supplementing observer coverage were

conducted by the observer program in the west coast groundfish small vessel fixed-gear fishery in coordination with the Nature Conservancy (TNC). TNC obtained from NMFS an experimental fishing permit that allowed for the EM project and worked with NMFS to engage fishermen and fishing organizations in the project. Participating fishermen then leased TNC owned permits and operated under specific constraints. Catch and discard data collected through the EM were compared to observer data for the same trip. Initial results from the study showed promise.⁶³ Electronic monitoring was conducted in the hake fishery from 2002–10, as discussed above. In 2012, NMFS began work on a new electronic monitoring program. The project, planned in coordination with the Pacific States Marine Fisheries Commission, will determine how electronic monitoring systems function in comparison to observer data in selected fisheries.

Other Observed Fisheries

Occasionally the WCGOP has observed state-managed fisheries and fisheries operating under an exempted fishing permit. These fisheries have included California halibut, *Paralichthys californicus*, trawl; nearshore rockfish; pink shrimp, *Pandalus jordani*; prawn, *Pandalus platyceros*; and open access fixed-gear fisheries. These fisheries are targeted for observation at coverage levels of <1–10% (3–8% was achieved in 2011 and 2012).

Southwest Region

As discussed in the previous section, the NMFS Southwest Region managed the U.S. Eastern Tropical Pacific Ocean Tuna Purse-Seine Fishery Observer Program from the mid-1970's until 1995, when the program was transferred over to the IATTC. Prior to 2003, NMFS had no Pacific Islands Region⁶⁴, and thus the Southwest Re-

⁶¹NOAA news release, 19 Jan. 2000, www.publicaffairs.noaa.gov/releases2000/jan00/noaa00r103.html.

⁶²NMFS. 2012. Pacific coast groundfish biological opinion. Available from: www.pcouncil.org.

⁶³http://www.pcouncil.org/wp-content/uploads/H4a_ATT3_TNC_EFP_NOV2010BB.pdf

⁶⁴NMFS did operate a Pacific Islands Area Office and Honolulu Laboratory prior to the creation of the Pacific Islands Regional Office.

Table 4.—Fisheries observed in the Southwest Region. Note: This table represents the information located during the development of this report. In many cases, supplemental information may exist, particularly in the case of historical records, but it was not located. The information below provides a general sense of the scale of fisheries and observations. Coverage level information was located from Fishery Fact sheets (<http://www.nmfs.noaa.gov/pr/interactions/lof/>), National Observer Program annual reports, and specific articles where cited.

Fishery	Fleet Size	Authority to Place Observers	Season of Operation	Program Initial Year	Program Final Year	% coverage
Eastern tropical Pacific tuna purse seine fishery (tuna-porpoise observer program)	155	MMPA	Year-round	1976	1995	100%
California/Oregon drift gillnet fishery (>14" mesh - swordfish and thresher shark)	35 active vessels (2011)	MMPA MSA	May–June	1990	Present	CA DFG - 1% observer coverage of fishing effort between 1980 and 1985. The estimated observer coverage for this fishery from 1990 through 2006 was: 4%, 10%, and 14%. 18%, 16%, 12%, 23%, 18%, 20%, 23%, 20%, 22%, 20%, 21%, 21%, 19% (Larese and Coan, 2008); 2007: 16%, 2008: 13–14%; 2009: 13%; 2010: 12%; 2011: 20%
California set gillnet fishery (CA halibut, angel shark, white seabass, soupfin shark, and yellowtail)	114 vessels, 50 active (1990–00); 40 vessels (2011)	MMPA	Year-round	1990–94, 1999–2000, 2006–07; reinitiated 2010–present		The estimated observer coverage from 1990 through 2006 was: 5%, 10%, 13%, 15%, 8%, 0%, 0%, 0%, 0%, 4%, 2%, 0%, 0%, 0%, 0%, 0%, 1% (source: NMFS 2010 List of Fisheries; Fisheries Classification and Larese, 2009); 2011: targeted at 10%.
California pelagic longline fishery	1 vessel	MSA	Sept–June	2001	Present	2001–2004: 10%, 2005: 50%, 2006 to present: 100%
Small-mesh drift gillnet fishery (includes- yellowtail, white sea bass)	30 vessels (2003–04); 20 vessels (2011)	MMPA	yellowtail (May–Aug); white sea bass (June–March)	2002–04; reinitiated in 2010–present		2003–04: 10%; 2010/2011 target coverage levels of 20%.
California coastal pelagic species purse seine fishery	70 vessels (2004–06) 60 vessels (2011)	MMPA	Jan–Dec	2004–08; reinitiated in 2011.		2004–08: <10%; 2011: targeted coverage level of 116 sea days.
California highly migratory species purse seine fishery	5 vessels≠	MSA	June–July	2004	2005	A pilot observer program for this fishery began in July 2004 and ended in January 2006. A total of 9 trips and 15 sets were observed
Pacific albacore troll/baitboat fishery	800 vessels	MSA	May–Nov	2004	2006	<1%
Deep-set buoy gear fishery	1 vessel		June–Sept	2012	Present	Experimental/pilot

gional Office managed observer programs in Pacific Islands, including the Foreign Armorhead Seamount Fishery (northwest of Midway Island, 1978–84), the Northwestern Hawaiian Islands Bottomfish Fishery (1991–94), the Hawaii Pelagic Longline Fishery (1994–99), and the Northwestern Hawaiian Islands Lobster Fishery (targeting the endemic spiny lobster, *Panulirus marginatus*, and the slipper lobster, *Scyllarides squammosus*) from 1996 to 1998. Other fisheries observed

historically in the Southwest Region have included the California Halibut/Angel Shark, *Squatina californica*, Set Gillnet Fishery (1990–93), and the California/Oregon Drift Gillnet Fishery (1990–present). Observer programs in the Pacific Islands Region are described in the next section; this section focuses on the NMFS Southwest Region observer programs conducted in the EEZ off California and adjacent high seas (Table 4, Fig. 5 provide a summary).

California Set Gillnet Fishery, 1990

The California Set Gillnet Observer Program was implemented as a direct result of the 1988 amendments to the MMPA: the fishery, targeting California halibut and angel sharks, was classified as a Category I fishery, and a mandatory observer program was implemented in July 1990. The desired coverage level was 20% of fleet effort, but actual coverage levels ranged from 2 to 15% (average 9.6%; Julian and

U.S. Observer Programs - Southwest Region

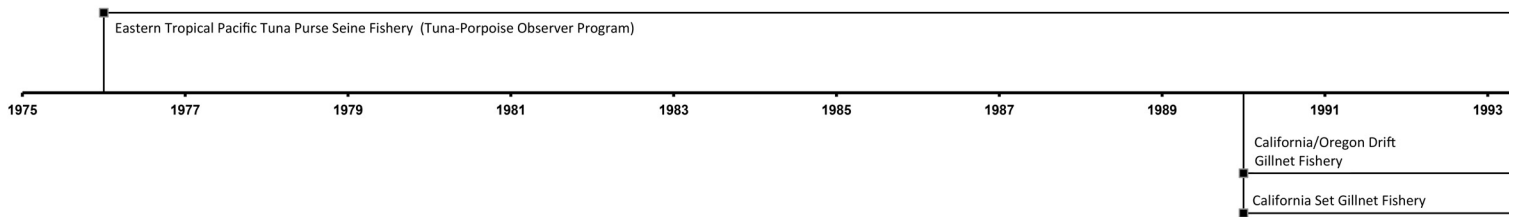


Figure 5.—Timeline of federal fisheries observer programs in the Southwest Region. Observer coverage levels vary between fisheries and are provided in Table 4.

Beeson, 1998) during the first 4 years the program was in operation.

Observers documented the interactions of the fishing gear with marine mammals (primarily harbor porpoise), sea turtles, and sea birds as well as recording all target and nontarget fish species caught. The observer program was discontinued in 1994 because total fishing effort had declined following a ban on set gillnet fishing 3 nmi off the southern California coast and 1 nmi off the Channel Islands.

Reduced fishing effort led to reduced bycatch of marine mammals. However, the ban also had the effect of increasing fishing effort in Monterey Bay, from about 500 sets per year by three vessels in the early 1990's to nearly 1,400 sets by ten vessels in 1997 (Forney⁶⁵).

To address concerns that a reported increase in harbor porpoise strandings was caused by the increased fishing effort, NMFS started a localized set gillnet observer program focused on the Monterey Bay area in 1999 (Caretta and Chivers⁶⁶). The target coverage

⁶⁵Forney, K. A. 1998. A review of 1990-97 set gillnet fisheries in the Monterey Bay area and revised estimates of mortality for harbor porpoise, *Phocoena phocoena*, and sea otters, *Enhydra lutris*. Background paper 98-PSRG-4 submitted to the Pacific Scientific Review Group Meeting, Seattle, WA, Nov. 16-18, 1998.

⁶⁶Carretta, J. V., and S. J. Chivers. 2004. Preliminary estimates of marine mammal mortality and biological sampling of cetaceans in California gillnet fisheries for 2003. U.S. Dep. Commer., NOAA, NMFS Southwest Fish. Sci. Center, Internal Rep. SC/56/SM1 (avail. online at: <http://swfsc.noaa.gov/uploadedFiles/Divisions/PRD/>

level was set at 20–30% of fishing days (20% coverage was determined by statistical design to be the minimal level for an acceptable extrapolation of the observed take of harbor porpoise, the primary species of concern).

Two observers were hired each year as full-time temporary federal employees. With 239 observer sea days completed, the Monterey Bay program achieved over 20% coverage in both 1999 and 2000.⁶⁷ Subsequent changes in California Department of Fish and Game (CDFG) regulations for the fishery essentially stopped all fishing effort in Monterey Bay, and once again the set gillnet observer program was discontinued (Caretta and Chivers⁶⁶).

In 2006, at the request of the Pacific Scientific Review Group⁶⁸, the NMFS Southwest Region obtained funds to reinstate the observer program. Although the set gillnet closure off central California likely eliminated the potential for this fishery to interact with harbor porpoise, limited information was available on the fishery's potential to take other marine mammals in the federal waters off southern California. Observer data for the southern portion of the fishery were over 10

Programs/Coastal_Marine_Mammal/SC56SM1.pdf)

⁶⁷<http://seaotters.org/pdfs/assessment.pdf>

⁶⁸The Pacific Scientific Review Group is an independent scientific review group made up of conservationists, fishermen, and management officials mandated under the MMPA to review and recommend marine mammal research and management efforts undertaken by NMFS.

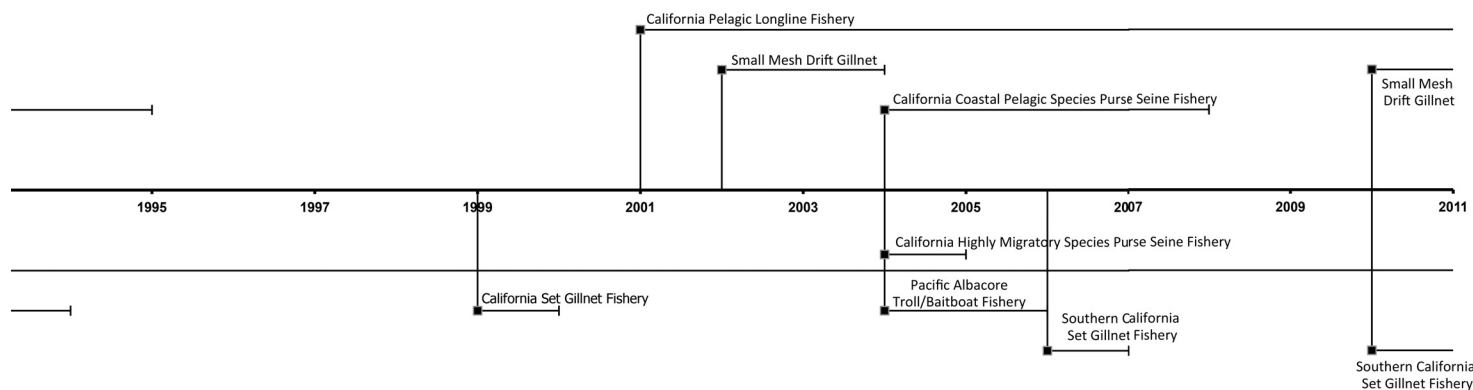
years old and were no longer considered reliable for calculating mortality estimates. The fishery was observed at levels of less than 1% in 2006 for a number of reasons (funds arrived late, observers were trained late in the season, and fishing activity was very low at that time (Enriquez⁶⁹)).

In general, this fishery has been monitored as resources allow, secondary to the drift gillnet observer program (Larese, 2009). Only four trips were observed by the end of 2006, and 55 trips were observed in 2007. Due to funding limitations, the fishery was not observed during 2008–09. In 2009, NMFS reclassified the fishery from Category I to Category II because gillnet effort had shifted to the south, and it was believed to no longer interact with harbor porpoise stocks of concern. In 2010, 82 sea days were observed (% coverage not calculated), and in 2011, coverage levels of 10% were targeted, with 64 sea days observed. The fishery was also observed in 2012 (target levels of 10%) but coverage levels were not available at press time.

California/Oregon Drift Gillnet Fishery, 1990

During the 1980's, the CDFG ran a voluntary Drift Gillnet Fishery Observer Program. The program was initiated based on concerns over Cali-

⁶⁹Enriquez, L. U.S. Dep. Commer., NOAA, NMFS Southwest Reg. Off., Long Beach, CA, Personal commun., 20 April 2011.



ifornia sea lion, *Zalophus californianus*, bycatch, and was focused around the Channel Islands. Coverage levels were extremely low, less than 1% (Diamond et al.⁷⁰). Observations by CDFG ceased in 1990, although reports highlighted that little observation of fishing activity had occurred, when it had been, incidental takes of several other species of marine mammal were observed.

In 1990, the NMFS SWR began placing observers on board the portion of the California drift gillnet fishery targeting swordfish and thresher sharks, *Alopias vulpinus*. The target coverage level for the program was 20% of total fleet effort, determined by statistical design to be the minimal level for an acceptable extrapolation of the observed take of marine mammals (primarily California sea lions). With the observers' primary objective to document fishery interactions with marine mammals, SWFSC biologists initially designed data collection protocols to validate reproductive rates and determine stock structure of the associated marine mammal species.

Biologists at the SWFSC also designed a protocol for collection of life history and distribution data on swordfish, marlins (primarily striped marlin, *Tetrapturus audax*), and pelagic sharks (primarily common thresher, *Alopias vulpinus*; shortfin mako, *Isurus oxyrinchus*; and blue, *Prionace glauca*).

⁷⁰Diamond, S. L., J. P. Scholl, and D. A. Hanan. 1987. Drift gillnet observations for the 1985–86 fishing season. Admin. Rep. SWR 87-4, 21 p.

These data and collections formed the basis of several ongoing life history and species distribution projects.

In 1996 the California/Oregon commercial drift gillnet fishery for thresher sharks and swordfish was designated as a Category I fishery under the MMPA. Due to the fishery's interactions with several strategic marine mammal stocks, the Pacific Offshore Cetacean TRT was formed to prepare and implement a TRP with the goals of preventing further depletion and assisting in the recovery of these strategic stocks.

The TRT recommended that the observer program conduct an experiment to determine whether acoustic pingers would be as effective in reducing cetacean entanglement in the Pacific as they had been in U.S. northeast waters. Acoustic pingers became mandatory in the California/Oregon drift gillnet fishery in 1998, after data from the Southwest Region observer program showed a significant decrease in cetacean entanglement rates in the experimental sets that had pingers attached (Barlow and Cameron, 2003).

Observations continued in the 2000's, with target coverage levels of 15–20%. During this time, bycatch of leatherback sea turtles was also identified as a concern for the fishery.⁷¹ In

⁷¹In 2000, through a Section 7 consultation initiated under the TRP process, NMFS reviewed observer data and concluded that continued operation of the fishery jeopardized leatherback sea turtles. A drift gillnet closure/leatherback conservation area was implemented as a requirement of the biological opinion in order to continue operating the fishery. The closure was then

2008 observer coverage decreased, and levels of only 13–14% were achieved, despite a decline in fishery participation (permitted vessels dropped from 90 in 2002 to 40 in 2008). The decrease in coverage was primarily due to increasing costs of observer coverage and the need to observe the west coast pelagic longline fishery at 100% levels (Enriquez⁶⁹).

However, based on observer data, the Pacific Offshore TRT reported in 2009 that it had achieved its short-term goal of reducing serious injuries and mortalities of all strategic stocks incidentally taken by the fishery to acceptable levels and achieved its long-term goal of reducing serious injuries and mortalities of all marine mammals except long-beaked common dolphins, *Delphinus capensis*, to insignificant levels (NMFS⁷²).

The TRT also recommended maintenance of observer coverage levels at 20%. In 2011, the fishery was reclassified on the MMPA List of Fisheries⁷³, due to the fact that no interactions with short-finned pilot whales had been observed in the past 5 years. The fishery's name was also changed to "California drift gillnet fishery for thresher sharks and swordfish," as the State of Oregon had not issued permits for several

adopted by the Pacific HMS FMP in 2004 when the fishery came under the HMS program.

⁷²NMFS. 2009. Recommendations report; Pacific Offshore Cetacean Take Reduction Team (four page report available at: www.nmfs.noaa.gov/pr/interactions/trt/poctrp.htm).

⁷³The MMPA List of Fisheries can be found at: <http://www.nmfs.noaa.gov/pr/interactions/lof/>.

years. Coverage levels reached 19.5% in 2011. The fishery was observed in 2012 (target coverage levels of 20%), but coverage levels were not available at press time. In 2013, NMFS adopted an emergency rule (renewed in 2014, NOAA, 2014) to protect sperm whales from being caught in drift gillnets, after two of the whales were entangled in 2010. Observer coverage requirements are critical to monitoring for these interactions.

West Coast Pelagic Longline, 2001

The California pelagic longline fishery targeting swordfish and tuna operating off the U.S. west coast was at its largest in the early 1990's. The fishery was closely linked to the Hawaii-based pelagic longline fishery; both fished around long. 135°W, during similar times of the year. The fishery was observed during 2001–04, with coverage levels of 10% targeted.

In 2004 an FMP for Pacific West Coast HMS established a general prohibition on the use of pelagic longline gear in the U.S. EEZ. In addition, pelagic longline gear is prohibited by the State of California. However, longliners may fish outside the EEZ and land their catches in California.

Since 2004 California-based longliners have been prohibited from using shallow-set gear to target swordfish outside the EEZ, but they are allowed to use deep-set gear targeting tuna. California-based deep-set longliners were observed at a rate of 50% in 2005, and 100% since 2006; current regulations require these vessels to be observed at 100% levels.

Southern California Small-mesh Drift Gillnet, 2002

A small-mesh drift gillnet fishery operates off southern California targeting white seabass, *Atractoscion nobilis*; yellowtail, *Seriola lalandi*; barracuda, *Sphyrnaea argentea*; and tuna species. Historical records of marine mammal entanglements (harbor porpoise; Norris and Prescott, 1961) existed, but it was not until 2002 that observation of the fishery was initiated. Observations occurred

in 2002, 2003, and 2004. One common dolphin, either *Delphinus capensis* or *Delphinus delphis*, and two California sea lions were observed as bycatch (Carretta and Chivers⁶⁶). The fishery is classified as MMPA Category II by analogy to the California set gillnet fishery. In 2004, Carretta and Chivers⁶⁶ reported that data from the fishery were considered insufficient to estimate mortality. Observations were reinitiated in 2010 (15 sea days observed) and continued in 2011 (11 sea days observed; coverage levels not calculated) and 2012 (target coverage levels 20%; actual levels not available at press time).

Short-term Observations

In 2004, Southwest Region observer programs were able to provide observer coverage for a total of six fisheries: the California/Oregon Pelagic Drift Gillnet Fishery, California Small-Mesh Drift Gillnet Fishery, California Pelagic Longline Fishery, California Coastal Pelagic Species Purse-Seine Fishery, California Highly Migratory Species Purse-Seine Fishery, and Pacific Albacore Troll/Baitboat Fishery. In 2006, two fisheries were added: the California Set Gillnet Fishery (discussed in detail above) and the West Coast Recreational Charter Fishery for Highly Migratory Species. Increasing costs of contracting for observers led the Southwest Region to focus observer coverage in fewer fisheries (four in 2011). In 2012, the program began observations of a test fishery that uses deep-set buoys to target swordfish off the California coast. Target coverage levels were not calculated and actual levels were not available at press time.

Alaska Region

North Pacific Groundfish Observer Program (NPGOP), 1991

The commercial groundfish fishery in Alaska is reported to have begun in 1864, with the harvesting of Pacific cod, primarily by foreign fleets. Foreign fisheries for Pacific halibut and sablefish developed during the 1900's, and in the 1930's, Japanese vessels tar-

geting pollock and flatfish were common (Barnes et al.¹¹). Other foreign countries joined Japan, initially only Russia (in 1958) but later Korea, Poland, Taiwan, West Germany, Bulgaria, and Mexico (Narita et al., 1994). Species targeted included Pacific ocean perch; Pacific herring, *Clupea pallasii*; and yellowfin sole, *Limanda aspera* (Megrey and Westestad, 1990).

As discussed in the introductory sections, from the early 1970's through 1990, observers were deployed aboard foreign fishing vessels. Following the rise in joint venture fisheries and the subsequent investment in American fleets, domestic catch in the region increased (Narita et al., 1994). In 1991, the domestic fleet received 100% of the groundfish allocation, effectively excluding foreign fishing fleets from the EEZ.

The North Pacific Fishery Management Council (NPFMC) has jurisdiction over the federal fisheries off the coast of Alaska. The NPFMC initiated a pilot program in 1987 to observe domestic vessels. Administered by the Alaska Sea Grant Program, the objectives included collection of catch and bycatch data from the emerging domestic groundfish fleet (Hare and Wall⁷⁴). Given that the fishery did not generate enough revenue to cover the cost of observers, and it was voluntary, participation was limited (Megrey and Westestad, 1990).

During the same time frame, an area of the Bering Sea was closed to groundfish trawling due to concerns over bycatch of prohibited species; however, limited fishing (for Pacific cod) was allowed (Hare⁷⁵). Observer coverage was required for this segment, known as the "Port Moller Pacific cod fishery." Hare⁷⁵ notes cov-

⁷⁴Hare, S. R., and J. M. Wall. 1988. Provisional data summaries for the NPFMC pilot domestic observer program, winter 1988. NMFS Northwest Alaska Fish. Cent., Natl. Mar. Fish. Serv., Seattle. NWAFC Processed Rep. 88-10, 30 p.

⁷⁵Hare, S. 1988. Report on the Port Moller Pacific cod trawl fishery, summer 1988. NWAFC Processed Rep. 88-25, 22 p. Northwest and Alaska Fish. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way NE, Seattle, WA 98115-0070.

Table 5.—Fisheries observed in the Alaska Region. Note: This table represents the information located during the development of this report. In many cases, supplemental information may exist, particularly in the case of historical records, but was not located. The information below provides a general sense of the scale of fisheries and observations. Citations are listed where information was drawn from a specific publication, rather than observer program records. Coverage level information was located from Fishery Fact sheets (<http://www.nmfs.noaa.gov/pr/interactions/lof/>), National Observer Program annual reports, and specific articles where cited.

Fishery	Fleet Size	Authority to Place Observers	Season of Operation	Program Initial Year	Program Final Year	% coverage
U.S. biologists were placed on some Japanese trawlers and factory ships in the Bering Sea and Gulf of Alaska to obtain data on the catch by species, area, and quantity and on gear efficiency. In essence, this was the first observer program. (1963)						
North Pacific and Bering Sea foreign groundfish trawl and fixed gear fisheries	Varies by year and country. Snapshot for 1979: 252 independent vessels fishing in BSAI, 55 in GOA (French et al., 1982). These were primarily trawl and longline vessels from (in order of size of fleet): Japan, Russia, Korea, Poland, Taiwan,	Treaties and bilateral agreements	Year-round	1973	1990	BSAI: 1977: 26%, 1978–81: around 10%; 1982: 28%, 1983: 43.5%, 1984–89: 80 %-upper 90% GOA: 1977: 98.5%, 1978: 14%, 1979: 16.5%, 1980: 9.3%, 1981: 9.4%, 1982: 32.2%, 1983: 45.9%, 1984: 86.7%, 1985: 93.3% ²
North Pacific joint venture	Varies by year and country. Snapshot for 1985 (Berger et al., 1987): 96. Participating counties (by size of fleet): Japan, Russia, Korea, Poland, Portugal, Taiwan	MFCMA	Year-round	1978	1990	BSAI: 1980: 29.2%, 1981: 21.8%, 1982: 1.9%, 1983: 56.6%, 1984: 82.6%, 1985: 85.8%, 1986: 94.2%, 1987 95.9%, 1988: 93.5%, 1989: 98.4%, 1990: 83.3% GOA: 1978: 100%, 1979: 27.1, 1980: 47.9%, 1981: 15.6%, 1982 38.4%, 1983: 72.9%, 1984: 87.1%, 1985 90.7%, 1986: 97.4; 1987: 99.7, 1988: 91.9% ²
Port Moller Pacific cod trawl fishery	1988 (Hare 1988) 2 factory trawler, 3 catcher vessels, 1 floating processor	MFCMA	Summer	1986	1989	100% 1986; 20% 1987; 33% 1989 low
Pilot groundfish observer program	Observers sampled 4 vessels (Hare and Wall text fn 74)	MFCMA	Sept.–spring	1987	1988	1987: ~75%, 1988: 61%
High seas driftnet	varied	MFCMA	Spring–Winter	1989	1991	(1991) Japan =10%, Korea = 2.1%, Taiwan = 3.1%
Alaska Peninsula drift gillnet fishery	150	MMPA	June–July	1990	1990	4.1% of sets
Prince William Sound drift and set gillnet fisheries	611	MMPA	May–Oct	1990	1991	5% of all sets
North Pacific groundfish (domestic)	303 vessels/ 24 shore plants	MFCMA	Year-round	1990	Present	100% vessels > 125 ft., 30% vessels 60–124 ft., 30 or 100% shore plants.
Cook Inlet drift and set gillnet fisheries	740	MMPA	June–Sept	1999	2000	1.6% of sets
Kodiak set gillnet fishery	170	MMPA	June–Sept	2002	2002	6% of sets
Kodiak set gillnet fishery	170	MMPA	June–Sept	2005	2005	4.6% of sets
Yakutat set gillnet fishery	100	MMPA	June–Sept	2008	2009	7.6%
Southeast Alaska drift gillnet fishery	480 permits	MMPA	May–Oct	2012	Present	387 sea days

¹ Coverage levels varied across fleets.

² Coverage levels obtained from J. Berger (text footnote 55).

erage levels of 100% in 1986 and 20% in 1987.⁷⁶ Some observations of the fishery also occurred in 1988 (estimated at 33% of catcher boats and 33% of factory trawlers; Hare and Wall.⁷⁴ The observers' objectives were similar to those of the pilot groundfish ob-

⁷⁶The 20% level was established by agreement between NMFS and the vessel operators.

server program, but they also specified prevention of overfishing of fish and shellfish as a goal (Hare and Wall⁷⁴).

Both the pilot and the Port Moller programs continued in 1989, but reports were not published on coverage as NMFS was working with the NPFMC to implement a broad observer program for the region (Berger⁵⁵). To address the need for data on

this fishery, a full domestic observer program (NPGOP) was authorized in 1990 through implementation of Amendments 13 and 18 to the groundfish FMP's for the BSAI and GOA, respectively. Those amendments required the following: vessels 125 ft or longer to carry an NMFS-certified observer 100% of the time while fishing for groundfish; vessels 60–124 ft

U.S. Observer Programs - Alaska Region

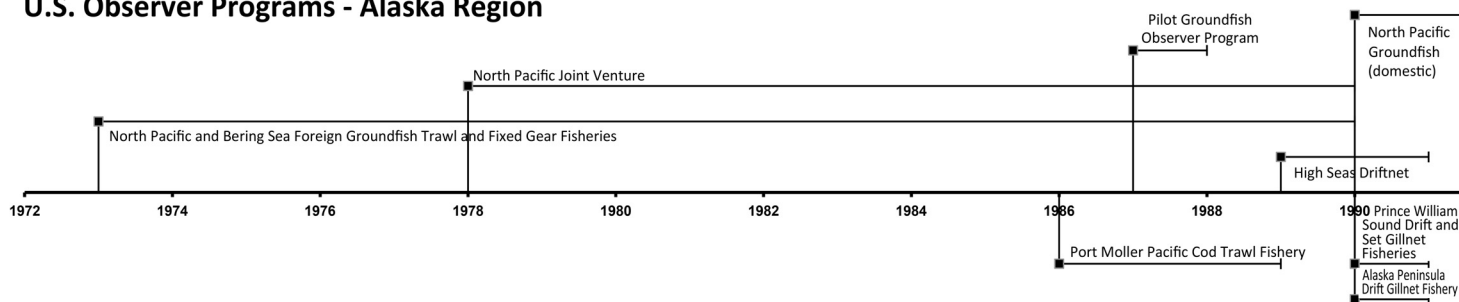


Figure 6.—Timeline of federal fisheries observer programs in the Alaska Region. Observer coverage levels vary between fisheries and are provided in Table 5.

long to carry an NMFS-certified observer during 30% of their fishing days in each calendar quarter of the year in which they fish more than 10 days; plants processing 1,000 t or more in a month to have an observer in the plant each day they process groundfish; and plants processing 500–1,000 t to have observers 30% of their days.

As part of a broader 2004 report, the DOC Office of Inspector General recommended that NMFS work with the NPFMC to establish requirements for an observer program that included a scientifically valid and unbiased vessel selection process.⁷⁷ In October 2010, the NPFMC took final action and selected a restructuring alternative, which was to be implemented in 2013. The final rule for this action, published in the Federal Register on 21 Nov. 2012, provides an overview of the new requirements (NOAA, 2012). The restructuring established a system of fees from all vessels with less than 100% observer coverage and provided NMFS with the authority to select observers for placement aboard fishing vessels as necessary.

As a replacement for the existing vessel length-based categories, the new rule included a two-tier system of coverage. Vessels and proces-

sors will either be in the category of <100% coverage or ≥100% coverage (two observers), based on their fishery and operating mode. The ≥100% category includes: a) all catcher-processors and motherships, and b) catcher vessels fishing within a management system that uses prohibited species caps in conjunction with catch share programs.

Under the restructured program, NMFS will develop and implement a statistically designed vessel selection process for observer coverage on all vessels that are not covered 100% of the time. This will give NMFS flexibility to decide when and where to deploy observers. The restructured program includes coverage on vessels < 60 ft in length and the commercial halibut fishery.

In the early years of the NPGOP, data were often collected in an unsystematic rather than a truly random manner. This became a matter of increasing concern as fishery managers began to implement programs that relied solely on observer data to determine individual vessel catch and bycatch rates. Observer duties have increased over the years in response to changing data needs both from scientists and fisheries managers. Data collection methodologies have been improved to ensure optimum data quality. Data reporting systems have been improved to the point where, for many of the fisheries covered, data are available on a near real-time ba-

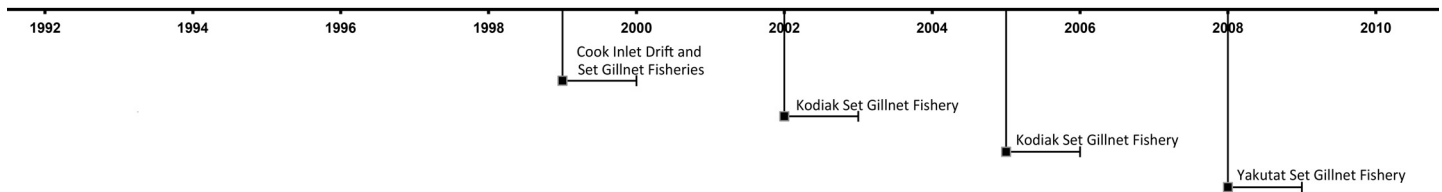
sis. The NPGOP remains NMFS' largest observer program, with more than 48,000 days observed in 2012 at-sea and shoreside (summarized in Table 5, Fig. 6). In 2011 and 2012, NPGOP also began investigations into the use of electronic monitoring technology with a project to monitor catch and discard effort aboard volunteer sablefish and halibut vessels. The project was successful, with expanded testing beginning in 2013.

Alaska Marine Mammal Observer Program, 1990

The second observer program operating out of the NMFS Alaska Region is quite different from the NPGOP. The Alaska Marine Mammal Observer Program (AMMOP) collects information on marine mammal interactions with commercial fisheries, the majority of which occur in state waters. The AMMOP began in response to the 1988 amendments to the MMPA. The program goals and objectives set out in the MMPA section 118 (section 114 prior to 1994) are to:

- obtain reliable estimates of serious injury and mortality of marine mammals and seabirds;
- identify changes in fishing methods or technology that may influence incidental interactions;
- collect biological samples to support and promote scientific studies; and
- record data on bycatch and discard levels of all species.

⁷⁷This specific recommendations from the 2004 Inspector General Report addresses only the North Pacific Groundfish Program, and so is discussed in this section. The remaining nationwide recommendations from the 2004 report are discussed in the "Summary" section.



Of the salmon gillnet fisheries that have been listed as Category II fisheries in Alaska, eight have been observed by the AMMOP since its establishment in 1990: the Prince William Sound drift and set gillnet fisheries (1990–91, the set gillnet fishery was reclassified from Category II to Category III in the 1996 List of Fisheries), the Alaska Peninsula drift gillnet fishery (1990), the Cook Inlet drift and set gillnet fisheries (1999–2000), the Kodiak set gillnet fishery (2002 and 2005), the Yakutat set gillnet fishery (2007–09), and southeast Alaska drift gillnet (2012 and 2013). Fisheries range in size from 100 permit holders to more than 700 permit holders.

After 1991 a lack of available funding and dedicated personnel led to an interruption in the AMMOP. Logbook (1990 through 1993) and fishermen self-reporting (1995 to the present) programs were established as an attempt to estimate fishery-related mortality. However, logbook data were found to underestimate mortality levels when compared to observer data (Credle et al., 1994), and the fishermen self-report program provides almost no information on marine mammal injuries or mortalities in Alaska fisheries. Accordingly, the Alaska Scientific Review Group directed NMFS to not use fishermen self-report data in developing estimates of fishery-related mortality.

It was not until 1999 that another marine mammal program was implemented. Since 1999 funding for AM-

MOP has been provided by the NOP through the Alaska Fisheries Science Center and supplemented with MMPA funds. Because adequate funding to conduct observations is not available every year, the AMMOP, based in the NMFS Alaska Regional Office, adds funding to existing contracts until sufficient funding has been compiled to conduct observations.

Each fishery is observed for approximately 2 years. This allows for the collection of baseline data on parameters known or suspected to affect interactions and to measure the effectiveness of mitigation measures to decrease incidental catch. Sampling strategies are determined for each fishery prior to implementation to maximize program efficiency. Data collected during these rotational observation periods are used in marine mammal stock assessments to estimate annual serious injury and mortality and to classify fisheries in the annual MMPA List of Fisheries. The Southeast Alaska salmon drift gillnet fishery is currently under observation (observed in the 2012 and 2013 fishing seasons, coverage suspended for 2014 due to lack of funds), due to in large part a history of humpback whale, *Megaptera novaeangliae*, takes.⁷⁸

Pacific Islands Region

Prior to the establishment of the Pacific Islands Region, the NMFS Southwest Regional Office managed Pacific

⁷⁸http://www.fakr.noaa.gov/protectedresources/observers/2012-13/ammopbookletfinal_2010.pdf

Islands fisheries. Early fisheries observed included the Foreign Armorhead Seamount Fishery (northwest of Midway Island: 1978–84; discussed in the foreign fisheries section), the Northwestern Hawaiian Islands Bottomfish Fishery (1991–93 and 2003–05), the Hawaii Pelagic Longline Fishery (1994–99), and the Northwestern Hawaiian Islands (NWHI) Lobster Fishery (1996–98).

Many of those fisheries are now closed, and thus observations have ceased. As discussed previously, the fishery for armorhead has been closed to fishing since 1986 due to heavy overfishing by foreign trawl fleets. All fishing for lobster in the Northwest Hawaiian Islands ended in 2001, although state-water fisheries still exist in the main Hawaiian Islands. In 2003 the Pacific Islands Regional Office (PIRO) was established in Honolulu, and management of fisheries in the Western Pacific region was fully transferred to PIRO (summarized in Table 6, Fig. 7).

Northwest Hawaiian Islands Bottomfish, 1990

Although not required by regulation, a single observer was placed aboard one bottomfish vessel on a voluntary basis between July and October 1990 (Nitta and Henderson, 1993) due to concern over the bottomfish fishery's potential for interactions with protected species (particularly the Hawaiian monk seal, *Monachus schauinslandi*) in the Northwest Hawaiian Islands.

U.S. Observer Programs - Pacific Islands Region

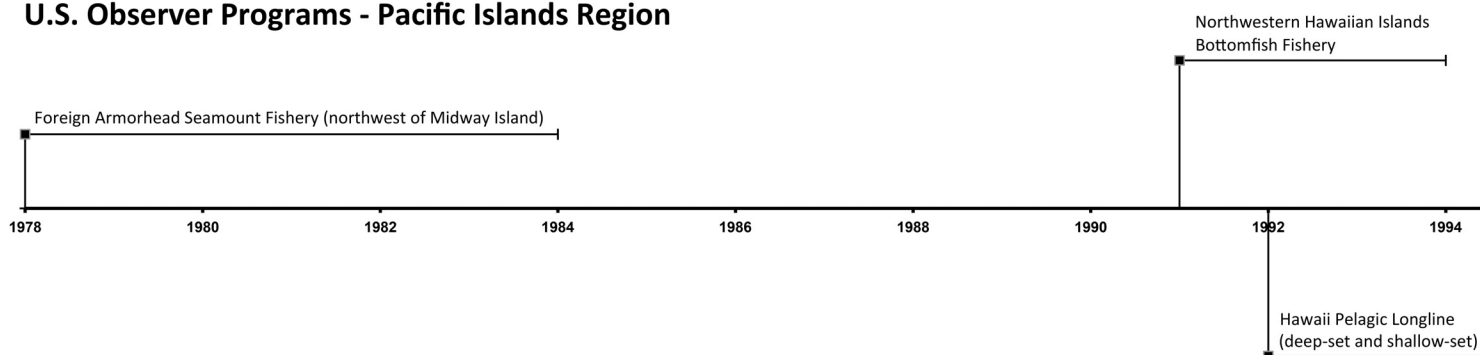


Figure 7.—Timeline of federal fisheries observer programs in the Pacific Islands Region. Observer coverage levels vary between fisheries and are provided in Table 6.

Table 6.—Fisheries observed in the Pacific Islands Region. Note: This table represents the information located during the development of this report. In many cases, supplemental information may exist, particularly in the case of historical records, but it was not located. The information below provides a general sense of the scale of fisheries and observations. Coverage level information was located from Fishery Fact sheets (<http://www.nmfs.noaa.gov/pr/interactions/lof/>) and National Observer Program annual reports. All observer programs in the Pacific Islands Region were run out of the Southwest Region in coordination with the NMFS Honolulu Lab until 2003, when the Pacific Islands Region was officially designated.

Fishery	Fleet Size	Authority to Place Observers	Season of Operation	Program Initial Year	Program Final Year	% coverage
Foreign armorhead seamount fishery (northwest of Midway Island)	6	MSA	Dec–July	1978	1984	1–3 trips observed per year
Northwestern Hawaiian Islands bottomfish fishery (various species, especially snappers and jacks)	30	MSA	Year-round	1991	1994	Coverage levels around 20%
Hawaii pelagic longline (deep-set and shallow-set)	164 vessels with permits (112 active)	MSA, MMPA, ESA	Year-round	1992	Present	Historically, >5%, 20% in the 2000's, 100% coverage for swordfish, 2004– present (20% tuna)
North Hawaiian Islands lobster program	15 permits (9 vessels active in 1997)	MSA	Summer	1996	1998	1997: 66%
Northwestern Hawaiian Islands bottomfish fishery (various species, especially snappers and jacks)	9	MSA	Year-round	2003	2005	20% 2004/2005, 4% 2006
American Samoa pelagic longline	30	MSA	Year-round	2006	Present	2006: 9.3%, 2007: 6%, 2008: 12%, 2009: 12%, 2010: 7–12%, 2011: 40%; 2012: 20%

Emergency regulations were subsequently implemented to restrict the fishing area and provide monk seals with a safety zone. Nitta and Henderson (1993:90) noted that those restrictions were “waived on a trip by trip basis however, provided the operator of the vessel allowed NMFS the opportunity to place an observer aboard to document and describe interactions with protected species.”

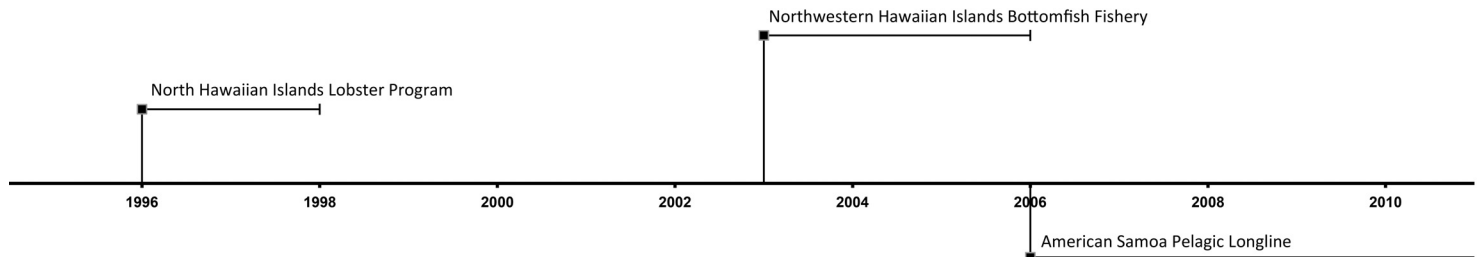
The emergency restrictions were made permanent in 1991 under the FMP for Bottomfish and Seamount

Groundfish Fisheries in the Western Pacific Region FMP. Observer coverage was also made mandatory for the fishery, due to its potential to interact with monk seals. Targeted coverage levels were 30% (Nitta and Henderson, 1993), and observations were coordinated by the SWFSC, which managed the NMFS Honolulu Laboratory at the time.

Observations were reintiated in 2003 and carried out by the Pacific Islands observer program. National Observer Program records indicate that

observer coverage levels of 20% were achieved in 2003 and 2004. Funding for this program was diverted in 2005 to meet the 100% court-ordered coverage requirement for the Hawaii-based shallow-set pelagic longline fishery for swordfish (discussed below), and only 4% coverage was reached in the bottomfish fishery.⁷⁹ No coverage occurred in 2006 or in subsequent years.

⁷⁹Reports for the 2003–2005 observer programs are available at: http://www.fpir.noaa.gov/OBS/obs_hi_bf_rprts.html.



The NWHI bottomfish fishery has had almost nonexistent levels of fishing effort over the past decade. Per the 2006 directive of Presidential Proclamation 8031, which established Papahānaumokuākea Marine National Monument, all NWHI bottomfish fishing ceased at the end of 2010. At that time, only eight permits remained active, and these were given a buy-out option from the Federal Government. Bycatch data collected from the NWHI bottomfish observer program during its active years did not indicate any direct interactions with marine mammals. The data for fish bycatch were not evaluated.

Hawaii Longline Fisheries, 1994

Implemented in 1987, the Pelagic Fisheries of the Western Pacific Region FMP regulates fisheries for HMS 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 for HMS currently operate within the U.S. EEZ, though international fisheries on the high seas and in EEZ's of other nations dominate pelagic harvests in the region. The largest fishery in the region, the Hawaii-based longline fishery, is made up of two fleets, a deep-set fishery targeting tunas and a shallow-set fishery targeting swordfish.

The Hawaii-based pelagic longline fishery has been monitored under a

mandatory observer program since February 1994, with some voluntary observations occurring in the preceding years (Dollar⁸⁰). The program was established with the goal of monitoring interactions between protected species and commercial fishing vessels. Early in the program's history, administration was handled by the Southwest Region, although observer program staff was stationed in Honolulu within the NOAA Pacific Islands Area Office.

In the late 1990's concern for protecting the green, *Chelonia mydas*; leatherback; loggerhead; and olive ridley, *Lepidochelys olivacea*, sea turtles was prompted by the frequency of sea turtle interactions with Hawaii longline fishing gear. Litigation by conservation groups concerning incidental catch (take) of threatened and endangered sea turtles was initiated in 1999 (Laurs and Karnella⁸¹).

As a result, the Federal Court in Honolulu issued an injunction, which led to the temporary closure of certain waters (north of Hawaii) to Hawaii-based pelagic longline vessels (Allen and Gough, 2007). Subsequently, NMFS was ordered to limit longline fishing for swordfish and prepare an environmental impact statement. The im-

pact statement prepared by NMFS in 2000⁸² resulted in closure of the shallow-set portion of the longline fishery. This was a significant economic and sociological event for the Hawaiian fishing community (Allen and Gough, 2007). The deep-set longline fishery, which was known to have significantly lower bycatch of sea turtles, remained open.

Coverage level goals for the deep-set longline fishery were initially established at 20% to achieve estimates of sea turtle take within 25–30% of the true (unknown) take with a higher level of statistical confidence (Skillman et al.⁸³), equivalent to a statistically acceptable CV of about 10–15%. An ESA Biological Opinion outlines take limits for all four turtle species in this fishery (3-year limits). Sea turtle bycatch in the deep-set longline fishery has remained under the take limit through the present.

The Hawaii-based shallow-set fishery was reopened in 2004 with required coverage levels of 100%. Take limits that trigger reconsultation but not closure were also established for

⁸²EIS No. 010104, Final EIS, HI, GU, AS, Pelagic Fisheries of the Western Pacific Region, Fishery Management Plan, to Analyze Longline Fisheries, Commercial Troll and Recreational Troll Fisheries, Commercial Pelagic Handliner and Commercial Pole and Line Skipjack Fishery, Hawaii, American Samoa, Guam and Commonwealth of the Northern Mariana Island, Due: May 07, 2001, (avail. at: www.fpir.noaa.gov/DIR/dir_public_documents.html).

⁸⁰Dollar, R. A. 1991. Summary of swordfish longline observations in Hawaii, July 1990–March 1991. U.S. Dep. Commer., NOAA, Nat. Mar. Fish. Serv., Southwest Fish. Sci. Cent. Admin. Rep. H-91-09, 13 p.

⁸¹Laurs, M., and Karnella, C. 2001. Status and impacts of litigation on the Hawaii longline fishery for swordfish and tunas. Standing Committee on Tuna and Billfish 14 Working Paper BBRG-6, 3p.

⁸³Skillman R. A., J. A. Wetherall, and G. T. DiNardo. 1996. Recommendations for scoping the sea turtle observer program for the Hawaii-based longline fishery. NMFS Southwest Fish. Sci. Center Admin. Rep. H-96-02, 12 p.

green and olive ridley sea turtles in the swordfish fishery (1-year limits).

In 2009 the WPFMC attempted to raise the bycatch cap for loggerhead sea turtles from 17 to 46. The measure passed, but it was subsequently retracted when several conservation organizations challenged it through a lawsuit. At that time, the U.S. District Court ordered NMFS to issue a new biological opinion for the shallow-set fishery. Under the new Biological Opinion, effective 5 Nov. 2012, fishery interaction limits were raised to 26 leatherback and 34 North Pacific loggerhead sea turtles (NMFS, 2012), although this has also been challenged.

The ESA Biological Opinion for the fishery mandates immediate closure when bycatch limits are reached in a calendar year, which occurred in 2006 and 2011, but not in 2004, 2005, 2007, 2008, 2009, or 2010. Higher coverage levels for both fishery sectors were made possible by additional funding from a Congressional budget earmark for Hawaii sea turtles from 2004 through 2010.

The Hawaii stocks of false killer whale, *Pseudorca crassidens*, are also known to interact with this fishery at levels exceeding the stocks' potential biological removal⁸⁴ levels. A TRT was established for the species in 2010. The TRT developed a TRP, which was finalized in 2012. The TRT relied heavily on observer data in developing the plan. The final TRP recommend changes to observer data collection forms, as well as increased observer training in responding to marine mammal interactions.

In 2012, regulations for the deep-set fishery were revised to allow unlimited catch of swordfish if an observer was

⁸⁴From NMFS Protected Species glossary (<http://www.nmfs.noaa.gov/pr/glossary.htm>): Potential Biological Removal (PBR) Level is defined by 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. The PBR level is the product of the following factors: the minimum population estimate of the stock; one-half the maximum theoretical or estimated net productivity rate of the stock at a small population size; and a recovery factor of between 0.1 and 1.0.

present. The unlimited catch allowance would not apply without an observer due to concerns over sea turtle bycatch. Increasing the retention limit will reduce the number of fish that are discarded for this healthy stock, improving catch utilization for this fishery.

Prior to 2004, percent coverage was not separated into shallow-set and deep-set fisheries. Combined coverage levels ranged from 5.3% in 1994 to just over 20% in 2003. Coverage since 2004 has been maintained at required levels (20% deep-set and 100% shallow-set).

American Samoa Longline, 2006

In 2006, observations of the American Samoa pelagic longline fishery were initiated under Amendment 11 to the FMP for the Pelagic Fisheries of the Western Pacific Region. The American Samoa pelagic longline fleet (which targets tuna) is composed of two main fleets: vessels >40 ft and <40 ft. The smaller vessels (<40 ft) are called "alias," and are usually aluminum catamarans. Only vessels > 40 feet are required to carry a NMFS observer if requested.

In April 2006 the first two observers were deployed out of Pago Pago, providing NMFS with the opportunity to learn more about fisheries in this remote area. Baseline data from the program highlighted the diverse marine resources of American Samoa and demonstrated a need for more protected-species-related data to develop regionally specific management measures. A coverage level of 20% was recommended; coverage levels have increased each year of the program's operation, from 7% in 2006, 12% in 2008, 7–12% in 2009 and 2010, to 40% in 2011.

Due to concerns over interactions with marine mammals and sea turtles (particularly false killer whales, *Pseudorca crassidens*; rough-toothed dolphins, *Steno bredanensis*; and green sea turtles), an increase in coverage levels to approximately 40% was recommended by NMFS protected

resources staff. Congressional funding for the observer program was increased in 2010 and allowed the program to achieve 40% coverage in 2011. A final rule in 2011 (NOAA, 2011b) required specific gear configurations for the American Samoa fishery to reduce interactions with Pacific green sea turtles. Data collected by observers was critical to its development. However, coverage levels in 2012 were reduced (20%) but still met the target coverage level objective.

Observer Program Challenges

Although current observer programs collect a variety of data, each observer program focuses on one or more specific monitoring tasks that help in some way with the regional management of the fishery, either from a scientific or regulatory standpoint. Examples include monitoring catch/effort for in-season management and/or stock assessment, bycatch monitoring for in-season management and/or stock assessment, protected species bycatch monitoring, technical monitoring for better understanding of fishing effort and catch per unit of effort, and compliance monitoring (NMFS, 2004a).

However, many issues of the past remain challenges today, such as minimizing bias, allocating coverage between fisheries, and balancing the need to capture rare events (e.g., protected species bycatch) with collection of data on commercially important species. In 2004, the Inspector General's Office conducted a review entitled "NMFS Observer Programs Should Improve Data Quality, Performance Monitoring, And Outreach Efforts."⁸⁵

The report identified 10 recommendations centered on three focus areas: 1) meeting data collection needs, 2) ensuring high quality data, and 3) communicating observer programs' missions and objectives. Issues iden-

⁸⁵DOC. 2004. NMFS observer programs should improve data quality, performance monitoring, and outreach efforts. U.S. Dep. Commer., Off. Inspect. Gen., Final Audit Rep. No. IPE-15721/March 2004, 64 p. (avail. at: http://www.apo-observers.org/docs/Inspector%20General%20Report_2004_1.pdf).

tified were broad (with the exception of the single recommendation that pertained only the NPGOP, discussed previously). The inspector general noted that recommendations applied to different programs to a varying degree (e.g., some programs may have already addressed a concern). NOAA concurred with the recommendations, generally, and took steps to address them.

In some areas, such as reducing bias and improving observer safety, NMFS has made great progress. The movement from voluntary to mandatory observer programs in the late 1990's and early 2000's was an important step forward in reducing bias.

In many cases, fisheries for which NMFS had authority to make observer coverage mandatory were still treated as voluntary due to limited staff available to enforce observer coverage requirements. Today, all observer programs function with mandatory coverage. The work of enforcement officers to ensure that vessels comply with these requirements is critical to reducing bias in this area.

In 2006, NMFS observer programs further improved the reliability of observer data by holding a "Vessel Selection Bias" workshop (Volstad and Fogarty⁸⁶). This workshop focused on evaluating procedures employed in observer programs to select vessels for observation and other factors that could cause bias in estimates of catch and bycatch. Based on the evaluations, recommendations were developed by regional observer program managers, observer trainers, and data analysts to address potential biases. The recommendations were national in scope to be applied to all regional observer programs, as well as specific recommendations for reducing bias in each program.

In 2007, Observer Health and Safety regulations were implemented (50 U.S.C. §600.725). The purpose of

these regulations was to clarify prohibited actions regarding observers and to reinforce that an observer would not be deployed nor stay aboard an unsafe vessel (and clarify when a fishing vessel is inadequate for observer deployment and how an owner or operator can resolve discrepancies), among other actions.

In 2007 NMFS also implemented a National Eligibility Policy⁸⁷ for fisheries observers (requiring, among other things, a bachelor's degree in the natural sciences), to ensure a consistently high caliber of observers among regional observer programs. In 2012, the Office of Inspector General opened a new investigation into NMFS observer programs. This investigation was targeted at address observer reporting concerns, specifically in the Southeast Region. NMFS is currently engaged in a national review of observer programs and policies with respect to the issues raised in the inquiry.

Summary

The first conclusion that can be drawn from this review is that since 1971, from the "Americanization" of U.S. fisheries through the expansion era and into today's science-based approach to sustainable fisheries management, the work of NMFS observer programs has supported U.S. management efforts and addressed the concerns of the public. Observer data are the only independent source of most fishery dependent data. Observer programs address many of the scientific concerns that stem from using fishermen to report data in management; for example, observers are highly trained and lack incentives for misreporting.

The passage and implementation of the MSA made observer programs one of the most important federal programs associated with the collection of fisheries data. Legislation such as the MMPA and ESA expanded the scope of observer programs and reinforced the critical role of these programs in fisheries monitoring, while the 1996 and 2007 amendments to the

MSA recognized the need for long-term planning to ensure sustainability.

Observer data, both past and present, are considered the most reliable source of information on bycatch since the observers are independent and able to monitor bycatch directly. They are also used to verify levels of fishing effort and catch reports. For many of the early observer programs, target coverage levels were not established in relation to a target coefficient of variation. Often, data on fishing effort that was needed to calculate the appropriate sample size were unavailable. Sampling was often targeted to achieve specific objectives. For example, in the Northeast Region, the implementation of TRT's resulted in strategic allocation of observer coverage targeting times and areas where takes of marine mammals would be likely to occur, while in the Southeast Region, observers monitored TED research.

Another key point is that this strategy has been replaced by the use of broad-based observer programs and random sampling in the majority of observed fisheries, reflecting the NMFS move towards science-based fisheries management. For example, section 303(a)(11) of the MSA requires that all FMP's "establish a standardized reporting methodology to assess the amount and type of bycatch occurring in the fishery." A Standardized Bycatch Reporting Methodology (SBRM) may include requirements for observer coverage.

The methods for allocating observer coverage developed by the NMFS Northeast Region and discussed earlier in this report are an excellent example; they define the amount of sampling necessary to meet goals of statistical reliability for estimating bycatch of various species. This allocation forms the basis of the region's observer sampling strategy. The new selection model developed by the North Pacific Groundfish Observer Program is a second example of moving towards a statistically based sampling system.

As mentioned in the introductory section, the NMFS Evaluating Bycatch Report (NMFS, 2004) establishes rec-

⁸⁶Volstad, J. H., and M. Fogarty. 2006. Report on the National Observer Program Vessel Selection Bias Workshop, 17-19 May 2006, 532 p. (avail. at: www.nefsc.noaa.gov/fsb/reports/Vessel_Selection_Bias_Report_final.pdf).

⁸⁷www.st.nmfs.noaa.gov/st4/nop/index.html

ommended levels of precision for estimates of bycatch that can be translated into observer coverage levels, but it recognizes that there may be reasons why these levels are not practicable or possible.

At times it may also be appropriate to target observer coverage to specific times/areas to maximize the number of observations. The NMFS Pelagic Longline TRP includes special observer and research participation requirements for fishermen operating in the Cape Hatteras Special Research Area, an area defined to capture “hot spots” where marine mammal bycatch and high concentrations of fishing effort overlap.

This review also shows that for past and present observer programs, funding is still the major driver of coverage levels. In 2011, almost \$70 million were dedicated to observer program funding (over \$18 million of this was industry funding). Currently, 110 of 152 federal commercial fisheries have observer data available, with high-quality bycatch data and estimation methods available in 46% of these in 2005 (NMFS, 2011).

A recent independent estimate (MFCN⁸⁸) put the cost of observing all of the nation’s fisheries between an additional \$20 million (raising all current coverage levels to 10%) and an additional \$200 million (to achieve 50% coverage in all currently observed fisheries). While not every fishery needs to be observed at this high level, even small increases in coverage levels for key fisheries, or the establishment of pilot programs in unobserved fisheries, will have the benefit of increasing understanding of bycatch and will help to identify where additional data collection is needed.

Because of the high cost of observer coverage, investigations into the use of video monitoring and other means of electronic data collection have in-

creased markedly during the last decade. Electronic monitoring (EM) has been used successfully for compliance monitoring and verification of self-reporting in the Northwest and Alaska Regions (NMFS⁸⁹), and it can provide useful information on catch quantity and composition, although species identification is only possible in some instances. The approach holds promise as a lower-cost alternative for addressing certain types of objectives and will be an important tool to supplement observer programs as the technologies advance.

Observer programs provide reliable, credible information on fishing activities nationwide. These data are critical to NMFS bycatch reduction efforts, as well as to the assessment and management of fish, marine mammals, seabirds, and sea turtles.

They are increasingly important to NMFS’ MSA requirements such as annual catch limits, and to management strategies, such as the catch-share and sector-management programs being implemented in the U.S. Northwest, Northeast, and elsewhere. Implementation and monitoring of these measures requires fine-scale baseline discard estimates that only observer data can provide. However, the need for real-time information to manage catch-shares can further increase the cost of monitoring. NMFS observer programs across the U.S. are engaging in cross-sector partnerships to explore the potential of electronic monitoring to augment observer programs in a cost-efficient manner. New observer programs are also needed to document sea turtle bycatch now that ESA regulations have provided authority to observe state and recreational fisheries. Increasingly, NMFS observer program specialists are also being called upon by foreign countries and international organizations interested in developing their own observer programs to share the benefit of NMFS’ 40-plus years of

experience. From this perspective, it is clear that the demand upon observer programs will only increase.

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Literature Cited

- Allen, S., and A. Gough. 2007. Hawaii longline fishermen’s experiences with the observer program. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-PIFSC-8, 47 p.
- Barlow, J., and G. Cameron. 2003. Field experiments show that acoustic pingers reduce marine mammal bycatch in the California drift gillnet fishery. *Mar. Mammal Sci.* 19(2):265–283.
- Beerkircher, L. R., C. J. Brown, and D. W. Lee. 2002. SEFSC Pelagic Observer Program data summary for 1992–2000. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SE-FC-486, 26 p.
- Berger, J., J. Wall, and R. Nelson, Jr. 1987. Summary of U.S. observer sampling of foreign and joint venture fisheries in the northeast Pacific Ocean and eastern Bering Sea, 1985. U.S. Dep. Commer., NOAA Tech. Memo. NMFS F/NWC-112, 169 p.
- Bergh, M. O., E. K. Pikitch, J. R. Skalski, and J. R. Wallace. 1990. The statistical design of comparative fishing experiments. *Fish. Res.* 9:143–160.
- Bernstein, B., and S. Iudicello. 2000. National Evaluation of Cooperative Data Gathering Efforts in Fisheries. Submitted to the Natl. Mar. Fish. Serv., Natl. Fish. Conserv., 78 p.
- Blaylock, R. A., J. W. Hain, L. J. Hansen, D. L. Palka, and G. T. Waring. 1995. U.S. Atlantic and Gulf of Mexico marine mammal stock assessments. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-363, 211 p.
- Burgess, G. and A. Morgan. 2003. Commercial Shark Fishery Observer Program. Renewal of an observer program to monitor the directed commercial shark fishery in the Gulf of Mexico and U.S. Atlantic Ocean: 2002(2) and 2003(1) fishing seasons. Final rep., U.S. Dep. Commer., NOAA, NMFS, Highly Migratory Spec. Manage. Div. Award NA16FM1598, 15 p.
- Chamberlain, G., S. Weeks, B. Shank, L. O’Brien, L. Jacobson, and S. Wigley. 2014.

⁸⁸MFCN. 2010. Meeting information demands of 21st century fisheries: a needs assessment for fisheries observer programs. *Mar. Fish Conserv. Network*, Wash., D.C., 28 p (avail. at: www.conservefish.org/index.php?option=com_content&task=view&id=428&Itemid=228).

⁸⁹NMFS. 2008. Electronic fisheries monitoring workshop proceedings. Unpubl. rep., U.S. Dep. Commer., NOAA, AFSC, 95 p. (avail. at: www.alaskafisheries.noaa.gov/scales/electmonworkshop_proceedings2008.pdf).

- Renewed observer coverage of the lobster pot and trap fishery in the northeastern United States. Abstract, Am. Fish. Soc. Annu. Meeting.
- Conservation Law Foundation v. Evans. 2002. 211 F. Supp. 2d 55. Dist. Court, Dist. of Columbia.
- Credle, V. R., D. P. DeMaster, M. M. Merklein, M. B. Hanson, W. A. Karp, and S. M. Fitzgerald (Editors). 1994. NMFS observer programs: minutes and recommendations from a workshop held in Galveston, Texas, November 10–11, 1993. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-94-1, 96 p.
- Dorn, M., R. Methot, E. Nunnallee, and M. Wilkins. 1991. Status of the coastal Pacific whiting resource in 1990. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-F/NWC-204, 104 p.
- Edwards, E. 1989. Using tuna-vessel observer data to detect trends in abundance of dolphin populations: history and research to date (1988). U.S. Dep. Commer., NOAA Tech. Memo. NOAA-TM-NMFS-SWFC-122, 130 p.
- Edwards, K., C. Thomas, R. Dark, R. Nelson, and J. Wall. 1981. A summary of foreign Pacific whiting catches and trawl positions in the Washington-California region, 1977–1980. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-F/NWC-11, 208 p.
- Endangered Species Act. 1973. 16 USC Sec. 1531.
- French, R., R. Nelson Jr., and J. Wall. 1979. Observations of foreign fishing fleets off the coast of California, Oregon, and Washington, 1978. Pac. Fish. Comm. Doc. 2198, 18 p.
- _____, _____, and _____. 1981. The foreign fisheries off Washington, Oregon, and California 1977–78. Mar. Fish. Rev. 43(5):36–44.
- _____, _____, and _____. 1982. Role of the United States observer program in management of foreign fisheries in the northeast Pacific Ocean and eastern Bering Sea. N. Am. J. Fish. Manage. 2:2, 122–131.
- Garrison, L. 2003. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2001–2002. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-515, 52 p.
- Gerritor, P., A. Williams, and D. Christensen. 1994. Observations of the 1992 U.S. pelagic pair trawl fishery in the Northwest Atlantic. Mar. Fish. Rev. 56(3):24–27.
- Goudey, C. 1995. The 1994 experimental pair trawl fishery for tuna in the northwest Atlantic. Mass. Inst. Tech., Sea Grant, MITSG 95-06, Camb., Mass., 10 p.
- _____. 1996. The 1995 experimental pair trawl fishery for tuna in the northwest Atlantic. Mass., Inst. Tech., Sea Grant, MITSG 96-17, Camb., Mass., 13 p.
- Hale, L. F., and J. K. Carlson. 2007. Characterization of the shark bottom longline fishery, 2005–2006. U.S. Dep. Commer., NOAA Technical Memorandum NMFS-SEFSC-554, 28 p.
- Hoey, J., E. Prichard, C. Brown, and M. Showell. 2002. Pelagic shark abundance indices based on fishery-dependent and fishery-independent data from the western North Atlantic. Collect. Vol. Sci. Pap. ICCAT 54(4):1,199–1,211.
- Hobart, W. L. (Editor). 1995. Baird's legacy: the history and accomplishments of NOAA's National Marine Fisheries Service, 1871–1996. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-F/SPO-18, 47 p.
- INPFC. 1979. Observations of incidental catch of halibut aboard the Shikishima Maru. INPFC Rep. 1519, 15 p.
- Jefferson, T. 1791. Report of Secretary of State Thomas Jefferson on the subject of the cod and whale fisheries. John Fenno, Boston, 15 p. (avail. online at: http://www.penbay.org/jefferson_whales_1791.html).
- Jesse, L. 2008. Shoreside hake observation program: 2007 annual report. Mar. Res. Prog. Oreg. Dep. Fish Wild., 29 p.
- Julian, F., and M. Beeson. 1998. Estimates of marine mammal, turtle, and seabird mortality for two California gillnet fisheries: 1990–1995. Fish. Bull. 96(2):271–284.
- Keene, K. F., L. R. Beerkircher, and D. W. Lee. 2007. SEFSC pelagic observer program data summary for 1992–2004. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-562, 23 p.
- _____, _____, and _____. 2010. SEFSC pelagic observer program data summary for 2005 & 2006. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-603, 24 p.
- Kolator, D. J., and D. P. Long. 1979. The foreign squid fishery off the Northeast United States coast. Mar. Fish. Rev. 41(7):1–15.
- Larese, J. 2009. Fish and invertebrate bycatch estimates for the California set gillnet fishery targeting halibut and white seabass, 1990–2006. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SWFSC-441, 49 p.
- _____, _____, and A. Coan. 2008. Fish and invertebrate bycatch estimates for the California drift gillnet fishery targeting swordfish and thresher shark, 1990–2006. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SWFSC-426, 53 p.
- Lopez, A. M., D. B. McClellan, A. R. Bertolino, and M. D. Lange. 1979. The Japanese longline fishery in the Gulf of Mexico, 1978. Mar. Fish. Rev. 41(10):23–28.
- Magnuson-Stevens Fishery Conservation and Management Act. 1976. 16 U.S.C. §§ 1801–1884.
- Marine Mammal Protection Act. 1972. 16 U.S.C. § 1361 et seq, 1401–1407, 1538, 4107.
- McElderry, H., W. A. Karp, J. Twomey, M. Merklein, V. Cornish, and M. Saunders. 1999. Proceedings of the first biennial Canada/U.S. observer program workshop Part II. U.S. Dep. Commer., NOAA Tech. Memo. AFSC-101, 49 p.
- Megrey, B., and V. Wespsetad. 1990. Alaskan groundfish resources: 10 years of management under the Magnuson Fishery Conservation and Management Act. N. Am. J. Fish. Manage. 10:2, 123–143.
- Miller, M., L. Nelson, R. French, and S. Haag. 1976. U.S. observers board Japanese trawl vessels in the Bering Sea. Mar. Fish. Rev. 38(4):1–10.
- Miyahara, T. 1954. The 1953 Japanese king-crab factoryship expedition. Comm. Fish. Rev. 16(12):1–12.
- Narita, R., M. Guttormsen, J. Gharrett, G. Tromble, and J. Berger. 1994. Summary of observer sampling of domestic groundfish fisheries in the northeast Pacific Ocean and eastern Bering Sea, 1991. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-48, 540 p.
- National Environmental Policy Act. 1969. 42 U.S.C. §§ 4321–4347.
- NEFMC. 1982. Fishery management plan final environmental impact statement for Atlantic sea scallops. New Engl. Fish. Manage. Council, 9 p. (avail. online at: www.nefmc.org/scallops/).
- Nelson, R. Jr., R. French, and J. Wall. 1981. Sampling by U.S. observers on foreign fishing vessels in the eastern Bering Sea and Aleutian Island region, 1977–78. Mar. Fish. Rev. 43(5):1–20.
- Nitta, E., and J. Henderson. 1993. A review of interactions between Hawaii's fisheries and protected species. Mar. Fish. Rev. 55(2):83–92.
- NMFS. 2004a. Evaluating bycatch: A national approach to standardized bycatch monitoring programs. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-F/SPO-66, 108 p.
- _____. 2004b. Endangered Species Act Section 7 reinitiation of consultation on the Atlantic pelagic longline fishery for highly migratory species. Biol. Opinion, June 1 (avail. online at: www.nmfs.noaa.gov/sfa/hms/Protected%20Resources/June_1_2004_Biological_Opinion.pdf).
- _____. 2011. U.S. National bycatch report. [W.A. Karp, L.L. Desfosse, S. G. Brooke, Editors]. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-F/SPO-117, 500 p.
- _____. 2012. NMFS Biological opinion on the Hawaii shallow-set longline fishery. 30 Jan. 2012 (avail. online at: www.fpir.noaa.gov/DIR/dir_public_documents.html).
- NOAA. 1987. NOAA—sea turtle conservation; shrimp trawling requirements. 52 Fed. Regist. 24244 (29 June 1987), p. 24,244–24,262.
- _____. 1995. Final list of fisheries for 1996. 60 Fed. Regist. 67063 (28 Dec. 1995), p. 67,063–67,090 (avail. online at: <http://www.gpo.gov/fdsys/pkg/FR-1995-12-28/pdf/95-31252.pdf>).
- _____. 1999a. Atlantic swordfish fishery; management of driftnet gear. 64 Fed. Regist. 4055 (27 Jan. 1999), p. 4,055–4,059 (avail. online at: <http://www.gpo.gov/fdsys/pkg/FR-1999-01-27/pdf/99-1872.pdf>).
- _____. 1999b. Atlantic highly migratory species (HMS) fisheries; Fishery Management Plan (FMP), plan amendment, and consolidation of regulations. 69 Fed. Regist. 103 (28 May 1999), p. 29,090–29,160 (avail. online at: <http://www.gpo.gov/fdsys/pkg/FR-1999-05-28/pdf/99-13090.pdf>).
- _____. 2003. Magnuson-Stevens Act provisions; general provisions for domestic fisheries; application for exempted fishing permit (EFP). 68 Fed. Regist. 43072 (21 July 2003), p. 43,072–43,074 (avail. online at: <http://www.gpo.gov/fdsys/pkg/FR-2003-07-21/pdf/03-18488.pdf>).
- _____. 2004. Fisheries off west coast states and in the Western Pacific; Pacific Coast groundfish fishery; groundfish observer program. 69 Fed. Regist. 31751 (07 June 2004), p. 31,751–31,758 (avail. online at: <https://federalregister.gov/a/04-12707>).
- _____. 2009a. Taking of marine mammals incidental to commercial fishing operations; harbor porpoise take reduction plan regulations. 74 Fed. Regist. 138 (21 July 2009), p. 36,058–36,074 (avail. online at: <http://www.federalregister.gov/a/09-12707>).

- gpo.gov/fdsys/pkg/FR-2009-07-21/pdf/E9-17190.pdf).
- _____. 2009b. Taking of marine mammals incidental to commercial fishing operations; Atlantic pelagic longline take reduction plan. 74 Fed. Regist. 23349 (19 May 2009), p. 23,349–23,358 (avail. online at: <https://federalregister.gov/a/E9-11664>).
- _____. 2010. Annual determination for sea turtle observer requirement. 75 Fed. Regist. 81201 (27 Dec. 2010), p. 81,201–81,203 (avail. online at: <https://federalregister.gov/a/2010-32341>).
- _____. 2011a. Atlantic highly migratory species; bluefin tuna bycatch reduction in the Gulf of Mexico pelagic longline fishery. 76 Fed. Regist. 18653 (05 April 2011), p. 18,653–18,661 (avail. online at: <https://federalregister.gov/a/2011-8052>).
- _____. 2011b. Western Pacific pelagic fisheries; American Samoa longline gear modifications to reduce turtle interactions. 76 Fed. Regist. 52888 (24 Aug. 2011), p. 52,888–52,889 (avail. online at: <https://federalregister.gov/a/2011-21655>).
- _____. 2012. Fisheries of the Exclusive Economic Zone off Alaska and Pacific halibut fisheries; observer program. 77 Fed. Regist. 29961 (21 May 2012), p. 29,961–29,962 (avail. online at: <https://federalregister.gov/a/2012-12273>).
- _____. 2014. Fisheries off west coast states; highly migratory fisheries; California drift gillnet fishery; sperm whale interaction restrictions. 79 Fed. Regist. 29377 (22 May 2014), p. 29,377–29,379 (avail. online at: <https://federalregister.gov/a/2014-11658>).
- Norris, K. S., and J. H. Prescott. 1961. Observations on Pacific cetaceans of Californian and Mexican waters. Univ. Calif. Publ. Zool. 63(4):291–402.
- Northridge, S. 1996. Estimation of cetacean mortality in the U.S. Atlantic and swordfish and tuna driftnet and pair-trawl fisheries. U.S. Dep. Commer., NOAA, NMFS, NEFSC, Prot. Species. Div., 21 p.
- Palka, D. L., M. C. Rossman, A. S. Van Atten, and C. D. Orphanides. 2008. Effect of pingers on harbor porpoise (*Phocoena phocoena*) bycatch in the U.S. northeast gillnet fishery. J. Cetacean Res. Manage. 10(3):217–226.
- Perrin, W. F. 1968. The porpoise and the tuna. Sea Front. 14(3):166–174.
- _____. 1969a. Using porpoise to catch tuna. World Fish. 18(6):1–4.
- _____. 1969b. The problem of porpoise mortality in the U.S. tropical tuna fishery. In Proc. 6th Ann. Conf. Biol. Sonar Diving Mammals, p. 45–48. Stanford Res. Inst., Menlo Park.
- Pikitch, E. K. 1991. Technological interactions in the U.S. west coast groundfish trawl fishery and their implications for management. ICES Mar. Sci. Symp. 193:253–263.
- _____, E. A. Erikson, and J. R. Wallace. 1988. An evaluation of the effectiveness of trip limits as a management tool. U.S. Dep. Commer., NOAA, NMFS, NWFSC Proc. Rep. 88-27, 33 p.
- Pulver, J. R., E. Scott-Denton, and J. A. Williams. 2014. Observer coverage of the 2013 Gulf of Mexico skimmer trawl fishery. NOAA Tech. Memo. NMFS-SEFSC-654, 25 p.
- Sabine, L. 1853. The principle fisheries of the American seas. R. Armstrong Printers, Wash. D.C., 317 p.
- Schaefer, C., L. Barger, and H. Kumpf. 1989. The driftnet fishery in the Fort Pierce-Port Salerno Area off Southeast Florida. Mar. Fish. Rev. 51(1):41–49.
- Tanonaka, G., and J. Nishimoto. 1965. A Japanese gill-net fishery for bottomfish in the Gulf of Alaska. Comm. Fish. Rev. 27(12):1–12.
- Uchida, R. and D. Tagami. 1984. Groundfish fisheries and research in the vicinity of sea-mounts in the North Pacific Ocean. Mar. Fish. Rev. 46(2):1–17.
- Vig, N., and M. Kraft. 1984. Environmental policy in the 1980's. Wash., D.C.: Cong. Quart. Books, 377 p.
- Wall, J., R. French, and R. Nelson, Jr. 1981. Foreign fisheries in the Gulf of Alaska, 1977–78. Mar. Fish. Rev. 43(5):20–35.
- Waring, G., M. Payne, B. Parry, and J. Nicolas. 1990. Incidental take of marine mammals in foreign fishery activities off the northeast United States. Fish. Bull. 88(2):347–360.
- Waring, G. T., E. Josephson, K. Maze-Foley, and P. E. Rosel (Editors). 2009. U.S. Atlantic and Gulf of Mexico marine mammal stock assessments—2009. U.S. Dep. Commer., NOAA Tech Memo NMFS-NE-213, 528 p.
- Witzel, W. N. 1984. The incidental capture of sea turtles in the Atlantic U.S. Fishery Conservation Zone by the Japanese tuna longline fleet, 1978–81. Mar. Fish. Rev. 46(3):56–58.