Recent Trends in the Catch of Undersized Swordfish by the U.S. Pelagic Longline Fishery

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Introduction

In 1990 the Standing Committee on Research and Statistics (SCRS), the scientific body of the International Commission for the Conservation of Atlantic Tuna (ICCAT), determined that the recent (1988–89) levels of swordfish mortality in the north Atlantic, north of 5° north latitude (Fig. 1), could not be maintained without a significant probability of detrimental effects on future swordfish yields (Anonymous, 1995). In response to these findings, ICCAT recommended a 15% decrease in the mortality of swordfish in the North Atlantic compared to 1988 levels (Anonymous, 1995). Furthermore, SCRS analyses indicated that the greatest opportunity for increasing long-term yields was to increase the effective minimum size (Anonymous, 1995). All ICCAT contracting parties were asked to take measures to reduce landings of swordfish weighing less than 25 kg whole weight (125 cm lower jaw fork length (LJFL)) to an incidental catch of not greater than 15%, by number, of the total swordfish caught (Anonymous, 1995).

In compliance with ICCAT recommendations, in June 1991, the United States established a total allowable catch (TAC) for swordfish of 4,163 metric tons (t) whole weight and a minimum size limit of 25 kg whole weight with a 15% allowance for undersized swordfish based on the number of swordfish landed per fishing trip. A final ruling in August 1992 set the U.S. TAC at 4,560 t (Matlock, 1995).

Although swordfish landings by U.S. and Spanish fishermen decreased each year from 1991 to 1993, swordfish landings of some other nations increased. The 1994 SCRS analyses for North Atlantic swordfish indicated that mortality had not declined below 1988 levels and may have substantially increased. In addition, the effectiveness of the minimum size regulation was limited since relatively high numbers of swordfish were discarded dead. The only marked declines in landings of swordfish less than 125 cm LJFL in the Atlantic Ocean were in the U.S. pelagic longline fishery landings. The majority of swordfish discarded dead, assumed to consist primarily of undersized fish, were also attributable to the U.S. pelagic longline fishery (Anonymous, 1995).

Based on these findings, ICCAT, recommended further reductions in swordfish landings in the North Atlantic and

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ABSTRACT—U.S. commercial vessels fishing in the Atlantic Ocean, Caribbean Sea, and the Gulf of Mexico have been subject to regulations limiting the landing of swordfish less than 25 kg whole weight since June 1991. The intent of those regulations was to reduce the mortality of immature swordfish. Plots of fishing effort from 1990 to 1994 indicate that the regulations were effective in some areas. Fishing effort decreased after 1991 in the Venezuelan Basin, a swordfish nursery area. However, in areas close to the U.S. coastline, effort did not appear to shift away from areas where immature swordfish were caught. In these areas, many swordfish were discarded . To identify areas with high rates of discarding, plots were made showing areas where the number of discarded swordfish was equal to or greater than the number of fish landed.

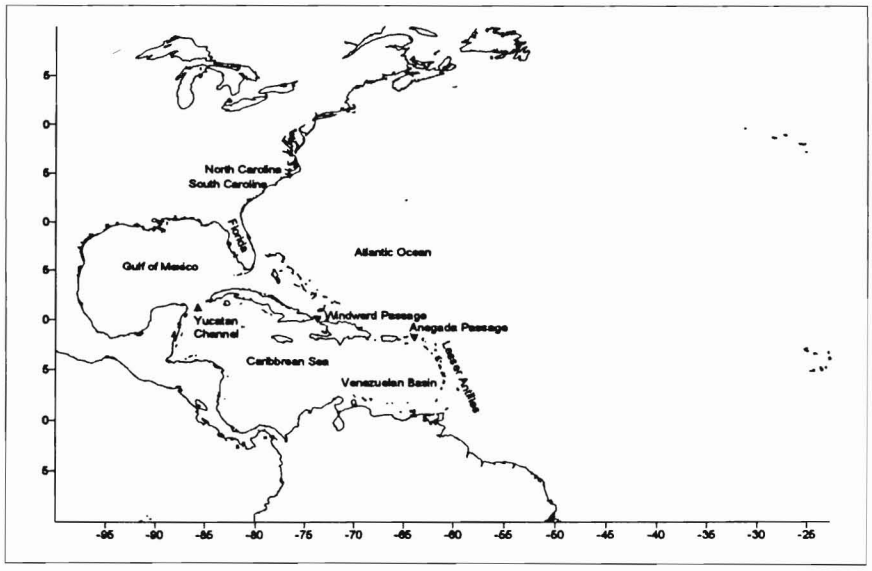


Figure 1.—Locations referred to in the text.

encouraged contracting parties to retain minimum swordfish size regulations and to take other appropriate measures to protect small swordfish including, but not limited to, the establishment of time and area closures.[1] This paper examines changes in U.S. swordfish longline landings and effort since 1990, identifies areas with high swordfish discard rates, and estimates the cost, in terms of landings, of reducing the catch of undersized swordfish by this fishery.

Materials and Methods

U.S. commercial vessels that land swordfish in the Atlantic Ocean, Caribbean Sea, and the Gulf of Mexico are required to submit daily records of effort and catch, including the number of hooks set, the location in latitude and longitude at the beginning of the set, and the numbers and species of fish kept, discarded dead, and discarded alive. In addition, records of fish sold, including dressed weights and species of fish, must be submitted after each fishing trip.

Reported dressed weights were used to calculate the percentage (by number) of swordfish caught in 12 kg size categories and cumulative monthly weights for years 1990 through 1994. Whole weights were estimated from the reported dressed weights by multiplying by a conversion factor of 1.33 (Miyake, 1990).

To look at changes in effort between years, records were grouped by one-degree (latitude and longitude) squares. Hooks were summed for each of these one-degree areas. Yearly minimum, maximum, and median values for hooks are given in Table 1. Locations of reported effort were plotted on maps for each year from 1990 through 1994. The size of the circles at each one-degree area was set proportionally to the number of hooks set in that area.

Records for each year from 1992 through 1994 were grouped by one-degree area and quarter (A/Q) to identify areas and seasons with high rates of swordfish discarding. In this paper, all discarded swordfish are assumed to be undersized. Quarters are defined in Table 2.

A discard ratio was calculated for each A/Q. The discard ratio is taken as:

$$\textit{Discard Ratio} = (\textit{swod} + \textit{swoa}) / (\textit{swod} + \textit{swoa} + \textit{land}),$$

where *swod* is the number of swordfish discarded dead, *swoa* is the number of swordfish discarded alive, and *land* is the sum of the numbers of swordfish, tunas, and sharks landed. Fish that are not discarded, and are generally sold, are referred to as landed.

To determine the cost of reducing the catch of undersized swordfish in years 1992 through 1994, in terms of the reduction in the numbers of fish landed, A/Q's were sorted in descending order by the discard ratio. A/Q's were then removed in order starting with the highest discard ratio. The percentage of swordfish removed and the percentage of total landed fish (swordfish + tuna + sharks landed) removed were calculated and plotted.

Results and Discussion

Monthly cumulative landing of swordfish for years 1990 through 1994 are shown in Figure 2. Yearly swordfish landings declined from 1990 to 1994 and have remained below the U.S. TAC of 4,560 t since 1991 (Table 3). At least part of this decline is a result of the 1991 minimum size regulation. In

[1]Management recommendations and related resolutions adopted by ICCAT for the conservation of Atlantic tunas and tuna-like species. Unpubl. Rep. Com-95-26, p. 35. 1995. Estebanez Calderon 3, 28020 Madrid, Spain.

Table 1.—Range of hooks reported for data grouped by one-degree areas within years.

Years	Minimum	Median	Maximum
1990	132	2,400	229,610
1991	180	3,450	206,737
1992	200	2,548	285,384
1993	240	3,100	319,466
1994	150	3,220	388,738

Table 2.—Quarters used in these analyses begin and end on the calender days indicated in this table.

Quarter	Beginning	Ending
1	January 1	March 31
2	April 1	June 30
3	July 1	September 30
4	October 1	December 31

Table 3.—Annual U.S. swordfish landings.

	Whole weights (t)	
Year	Landings	Discards
1990	5,494	NA[1]
1991	4,310	215
1992	3,852	384
1993	3,782	409
1994	3,365	508

[1] NA = not available

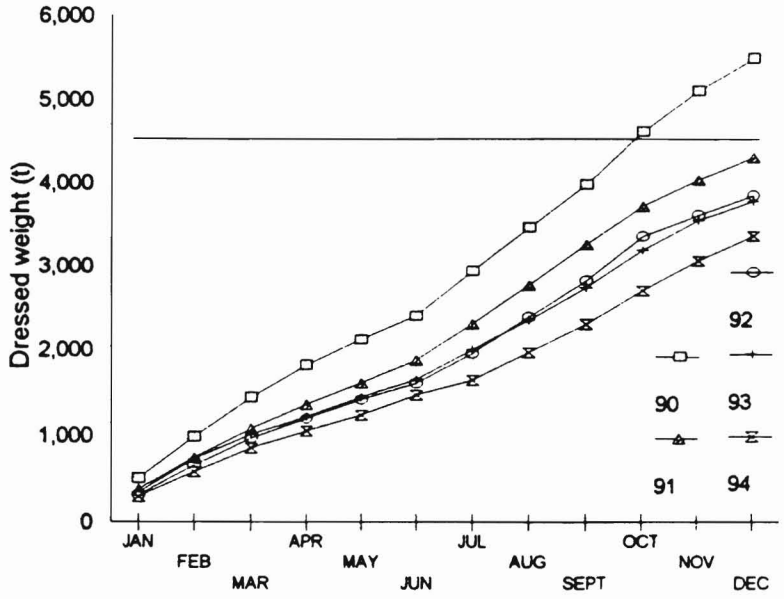


Figure 2.—Cumulative swordfish landings.

1990 the highest percentage (in number) of fish landed was in the predominantly juvenile 13–24 kg size category. In 1991 this peak shifted to the 25–36 kg category where it has remained (Fig. 3). Although the landings of small fish have declined, the minimum size regulation has had limited success in decreasing the estimated mortality of juvenile swordfish because the number of swordfish discarded dead has increased each year since 1991 (Table 3).

In some sectors, the U.S. pelagic longline fleet has altered fishing patterns, presumably to avoid capturing undersized swordfish. Between 1990 and 1994, longline effort shifted away from areas in the southern Caribbean such as the Venezuelan Basin. The Venezuelan Basin is thought to be a nursery area for swordfish since a high proportion of swordfish caught in this area are undersized.[2] At the same time, effort increased in swordfish spawning areas such as the Yucatan Channel, the Windward Passage, the Anegada Passage, and northeast of the Lesser Antilles where mature swordfish are predominant (Arocha and Lee, 1995). Altered fishing patterns were not apparent closer to the U.S. coastline where catches of undersized swordfish tend to be high such as near shore areas off the Florida east and west coasts and off the Carolinas (Fig. 4–9).

The graphs in Figure 9 show the relationship between swordfish discards and total landings of swordfish, tuna and sharks in each full year since the minimum size regulation (1992 through 1994). The reductions in the percentage of swordfish discarded were plotted against reductions in the total landings (swordfish, tuna, and sharks landed) as A/Q's were systematically eliminated starting with the highest discard ratios. Reductions in the percentage of swordfish discarded were also plotted against reductions in the percentage of swordfish landed (a subset of the total landings). Reductions in swordfish discards of 50% corresponded to a reduction of approximately 10% of total landings and reductions of approximately 30% of swordfish landings. These figures indicated that undersized swordfish are more likely to be caught on sets targeting swordfish than on sets targeting tuna or sharks, and that they seem to be becoming more concentrated by area and quarter.

A/Q's with discard ratios equal to or above 50% were plotted on maps for each year and quarter from 1992 to 1994 (Fig. 10–12). The size of the indicators on these maps is proportional to the number of swordfish discarded in each A/Q (Table 4). A growing percentage of swordfish discards are being caught in A/Q where 50% or more of the catch of a longline set must be discarded. These A/Q's appear to be concentrated and fairly consistent between years. A/Q's with reported discard rates at or above 50% accounted for only 8% of the swordfish discarded in 1992. In 1993, 27%, and in 1994, 37% of discarded swordfish were caught in sets reporting a discard rate of at least 50% (Table 5). In 1993 and 1994, both the number of A/Q's records having discard ratios at or above 50% and the number of swordfish reported discarded at these A/Q's, increased.

[2]Freddy Arocha, Rosenstiel School of Marine and Atmospheric Science, 4600 Rickenbacker Causeway, Miami, FL 33149. Personal commun., 1995.

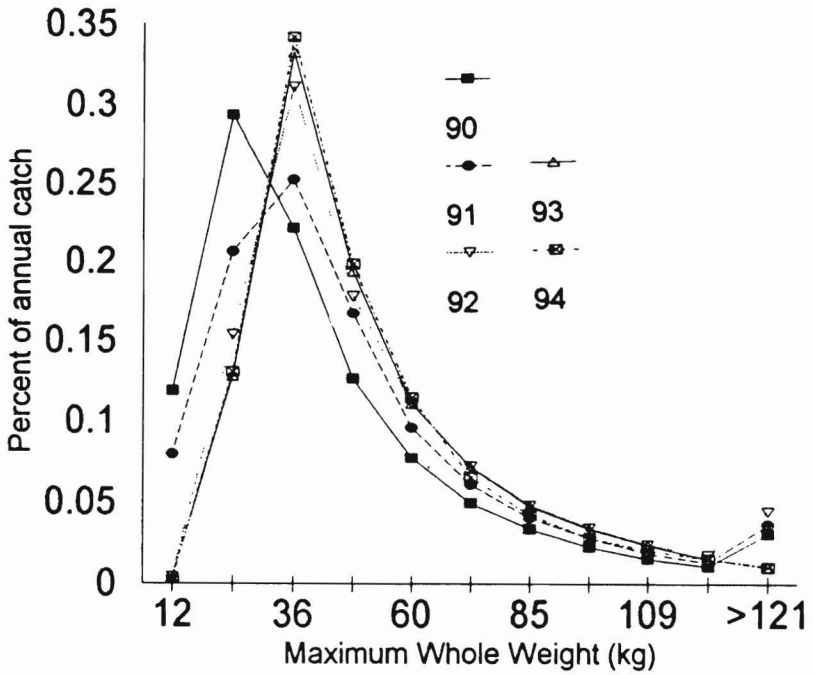


Figure 3.—U.S. swordfish catch at size.

Summary

The 1992 minimum swordfish size regulations have had limited success in deceasing the estimated mortality of juvenile swordfish. Although the times and locations having high rates of swordfish discarding are fairly consistent, a shift in fishing patterns has not been apparent close to the U.S. coastline. High swordfish discard rates have continued and occur primarily when swordfish are targeted.

Table 4.—Range of number of discards reported in one-degree areas and quarters (A/Q) where discard ratios were 50% or higher.

Year	Minimum	Maximum
1992	1	459
1993	2	1,199
1994	1	1,484

Table 5.—Percentage of swordfish discards, total landings (swordfish, tuna, and sharks), and swordfish landings remaining after one-degree area and quarter (A/Q) records with discard ratios equal to or greater than 50% are removed.

Year	Swordfish discards	Total landings	Swordfish landings
1992	8	1	2
1993	27	3	8
1994	37	4	11

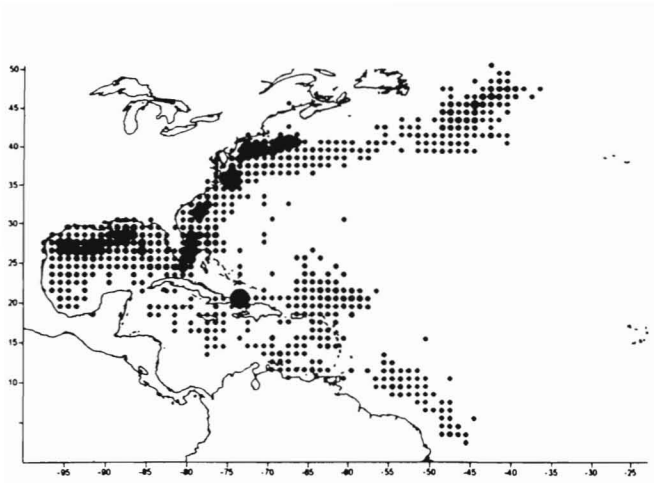


Figure 4.—Location and density of reported commercial fishing effort in 1990.

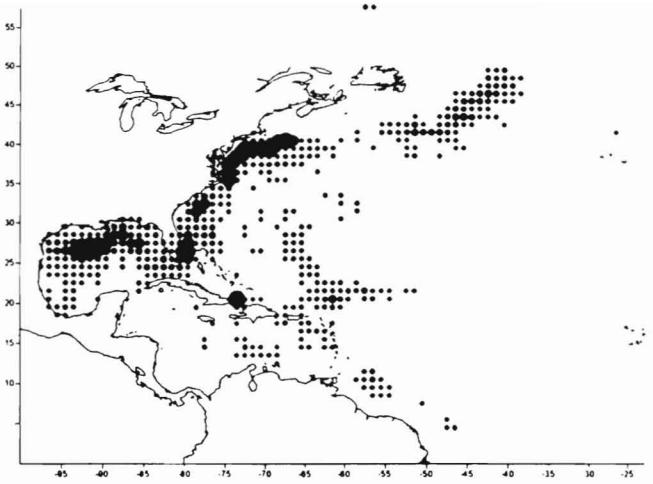


Figure 6.—Location and density of reported commercial fishing effort in 1992.

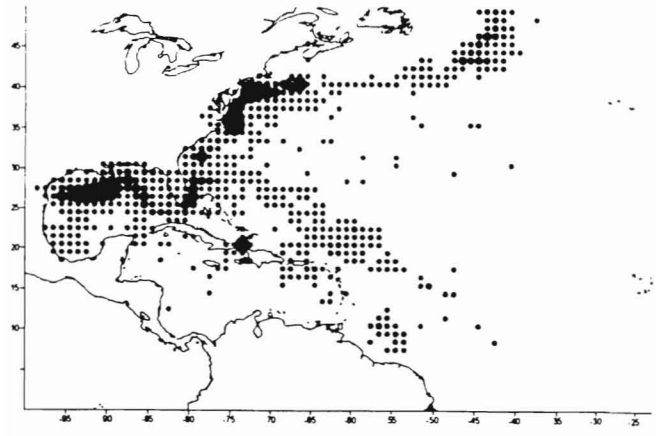


Figure 5.—Location and density of reported commercial fishing effort in 1991.

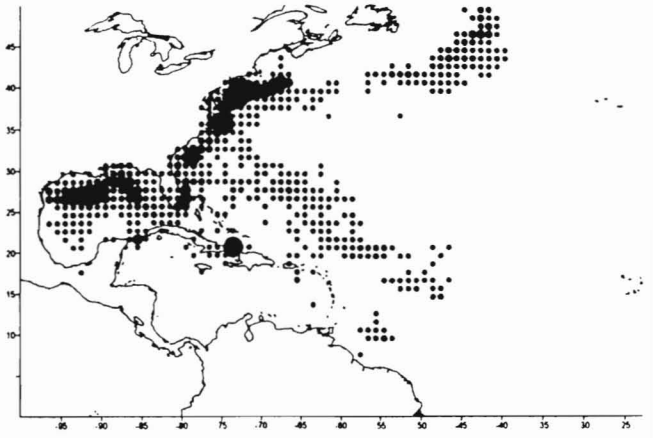


Figure 7.—Location and density of reported commercial fishing effort in 1993.

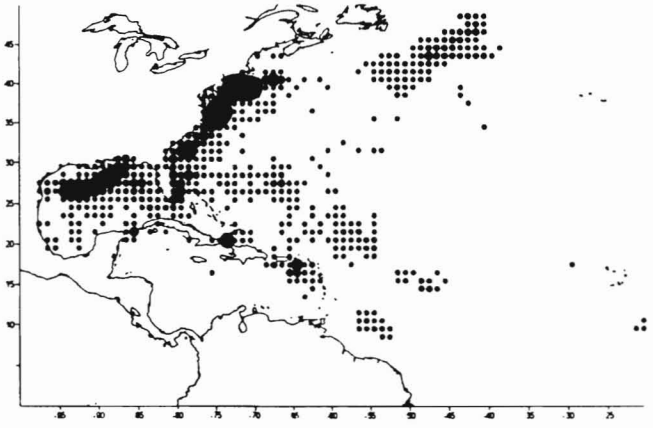
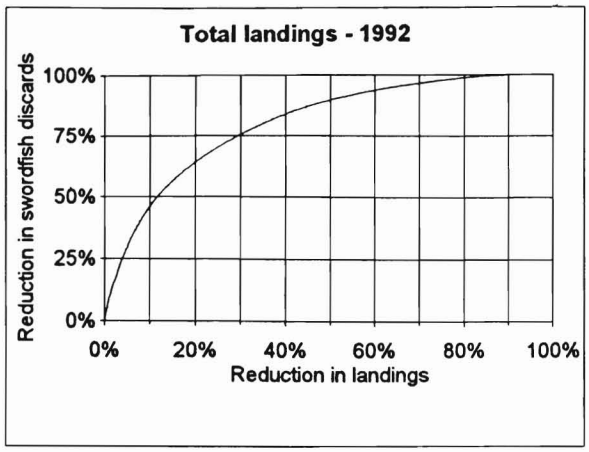
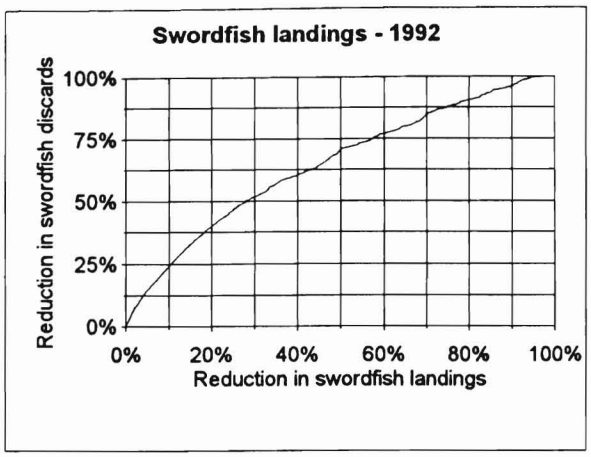
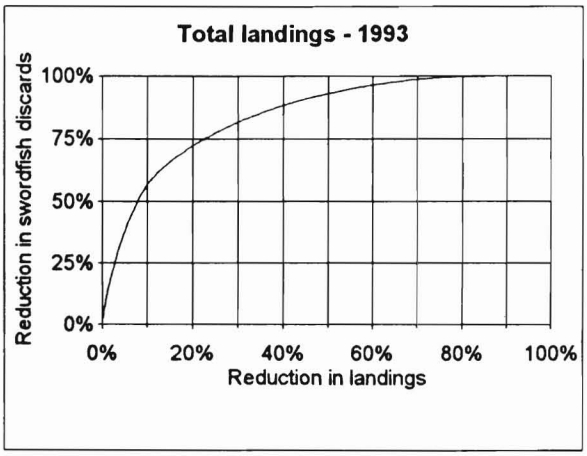
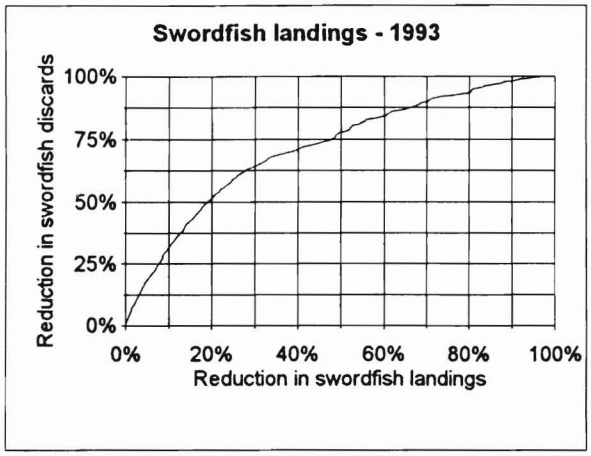


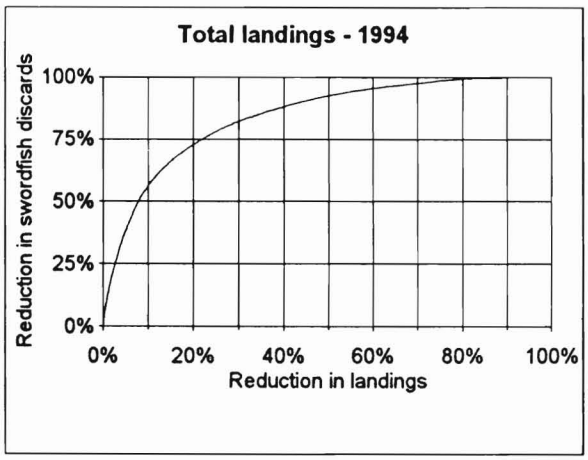
Figure 8.—Location and density of reported commercial fishing effort in 1994.











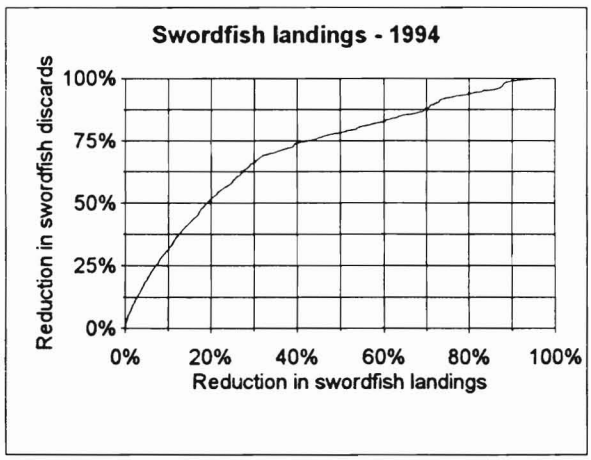


Figure 9.—The cost, in terms of total landings, of reducing swordfish discards.

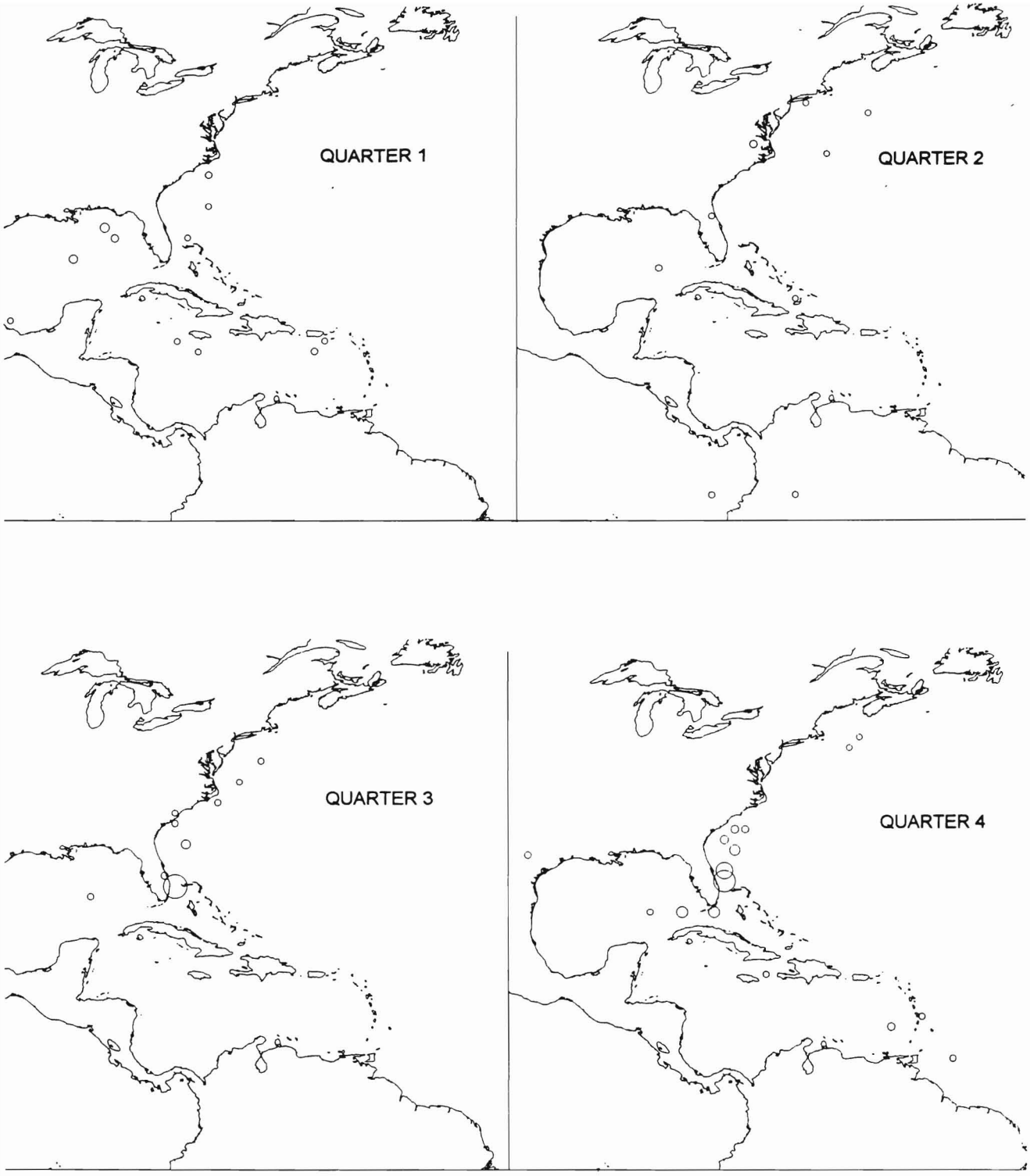


Figure 10.—U.S. longline locations where the number of swordfish discarded was equal to or greater than the number of fish landed in each one-degree square area and quarter of 1992. Circles are proportional to the number of swordfish discarded.

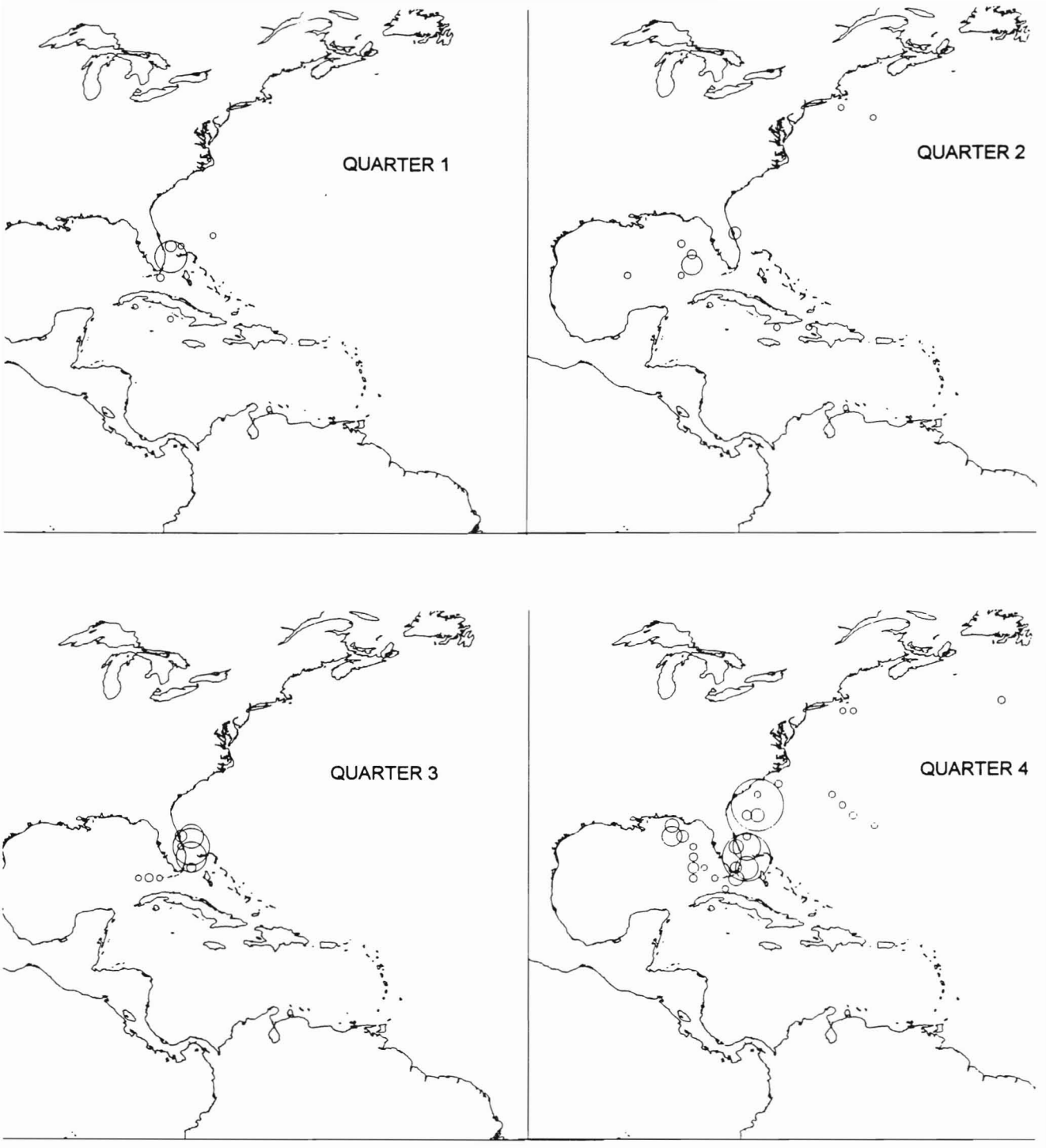


Figure 11.—U.S. longline locations where the number of swordfish discarded was equal to or greater than the number of fish landed in each one-degree square area and quarter of 1993. Circles are proportional to the number of swordfish discarded.

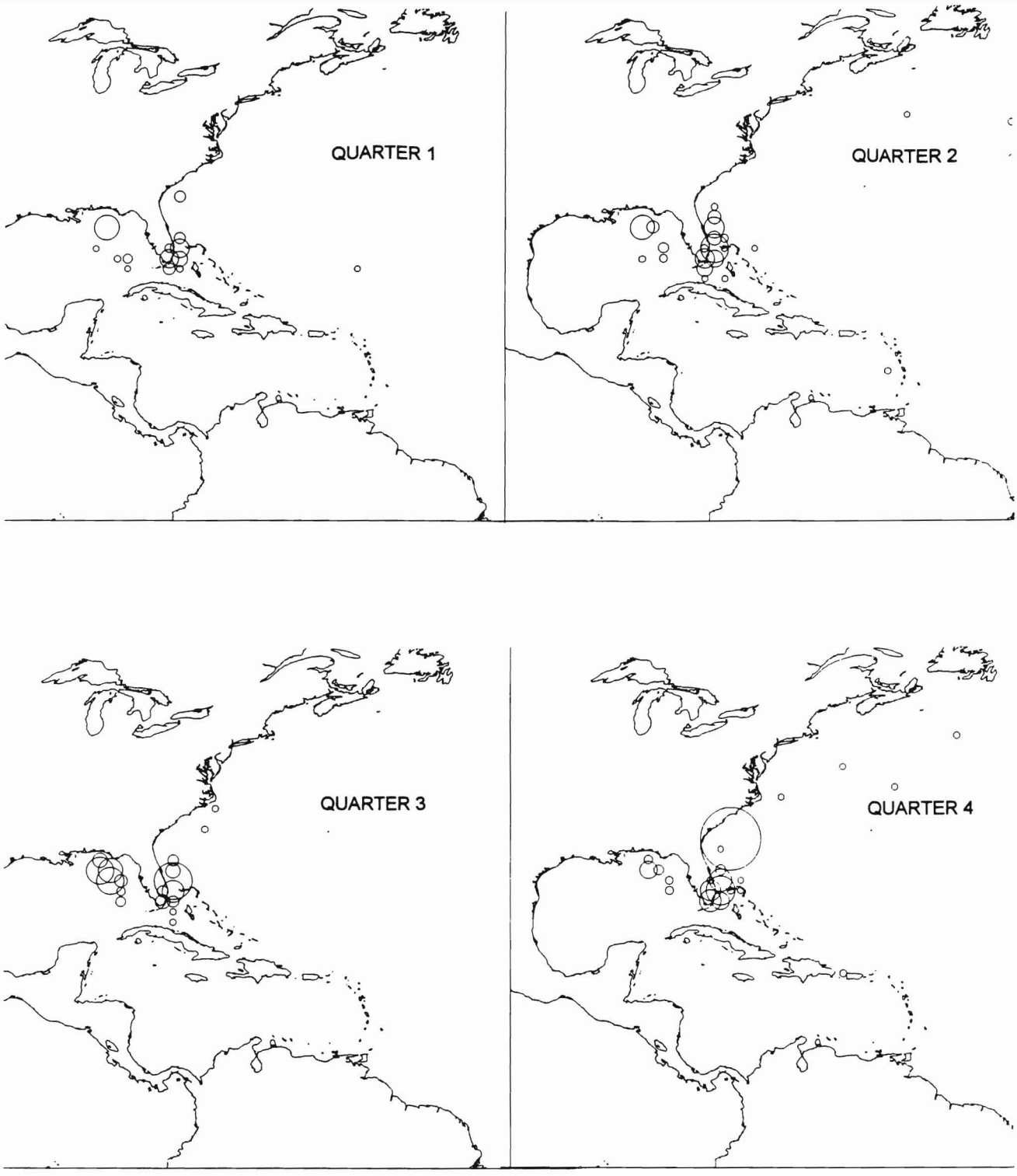


Figure 12.—U.S. longline locations where the number of swordfish discarded was equal to or greater than the number of fish landed in each one-degree square area and quarter of 1994. Circles are proportional to the number of swordfish discarded.

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