

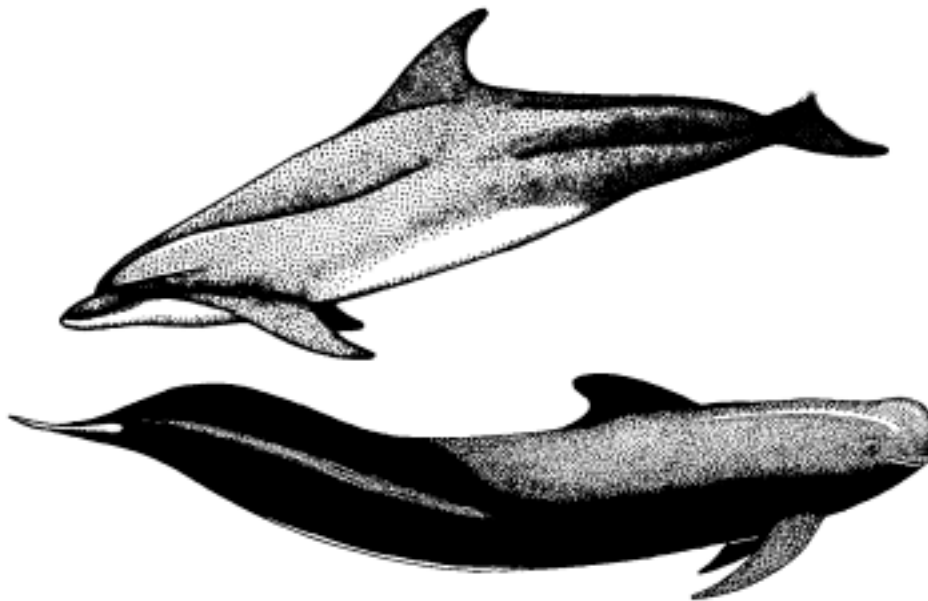


NOAA Technical Memorandum NMFS-SEFSC-430

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U.S. ATLANTIC PELAGIC LONGLINE FLEET IN 1998

BY

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This report should be cited as follows:

Yeung, Cynthia. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1998. NOAA Technical Memorandum NMFS-SEFSC-430, 26p.

This report has an internal document number PRD-99/00-02.

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Introduction

Summary

This report presents the 1998 estimates of the bycatch of marine mammal and sea turtle taken by the part of the U.S. Atlantic pelagic longline fleet that lands tuna and Atlantic swordfish. The information is required by NOAA Fisheries to meet its responsibility for management of interactions between protected species and commercial fisheries based on the level of incidental serious injury and mortality. Serious injury is defined under proposed guidelines drafted by the NOAA Office of Protected Resources, and is equated to mortality for the purpose of bycatch estimation. Estimates were based on bycatch rates from a representative sample of the fleet recorded by scientific observers, and fishing effort reported by the fleet. Bycatch rates reported by the fleet were omitted. Estimates were constructed using the Delta-lognormal method. Robustness of the estimates to geographical and temporal effects was examined by pooling across strata (calendar quarters, fishing areas, and groups of species). Point estimates of bycatch were relatively insensitive to pooling treatments, but gains in precision of estimates (coefficient of variation) were attained in cases where bycatch numbers were relatively high. The total observed bycatch in 1998 amounted to six for marine mammals and 20 for marine turtles. Extrapolated to total fleet effort, the most precise estimate (pooling within years, within the three major fishing areas, and grouping of species) indicates that the US pelagic longline fleet operating in the Atlantic caught a total of 205 (57-828, 95% CI) marine mammals in 1998. Of these, the estimated number of marine mammals that were dead or seriously injured and thus presumed dead is 54 (10-277, 95% CI). For marine turtles, an estimated total of 728 (337-1824, 95% CI) were caught by the fleet in 1998. Of these, the estimated number that were dead or seriously injured and presumed dead is 708 (324-1788, 95% CI). Both marine mammals and turtles were mostly caught from the Grand Banks (Northeast Coastal region) fishing area of the US Atlantic EEZ.

Longline is the principal gear used to fish for tuna (*Thunnus spp.*) and swordfish (*Xiphias*

gladius) in the U.S. North Atlantic (including the Gulf of Mexico) (Berkeley et al. 1981; Hoey and Bertolino 1988). Non-targeted bycatch of this fishery includes species of marine mammals and sea turtles, which are hooked or entangled in the longline. Under the 1994 Amendments to the Marine Mammal Protection Act, sec. 118, all U. S. commercial fisheries are categorized according to the level of marine mammal mortality and serious injury they are associated with. The U.S. pelagic longline fishery operating in the Atlantic Ocean, Gulf of Mexico, and Caribbean is categorized as a Category I fishery and requires a monitoring program to establish the level of marine mammal takes and to collect data to aid in the development of take reduction plans. Estimates of the bycatch of marine mammals and turtles by the U.S. pelagic longline fishery in 1992-1997 were previously published (Johnson et al. 1999). Estimates for 1998 are presented in this report.

Methods

The methods for estimating bycatch have been described in detail in the previous report on the 1992-1997 estimates (Johnson et al. 1999), and are briefly recapitulated here:

Data

Self-reported effort was obtained from the Atlantic Large Pelagic Logbook database maintained by the SEFSC (Southeast Fisheries Science Center), which contains daily fishing effort reported by all U.S. Atlantic longline vessels landing swordfish and tuna (Cramer 1994). Observed catch and effort were obtained from the SEFSC Observer Program database.

Large Pelagic Logbook Data

Daily logbook reports of catch and effort from permitted U.S. vessels targeting large pelagic fishes have been required under the Atlantic Swordfish Fishery Management Plan since 1986. The fleet reporting under the permit system targets a number of species of tuna and swordfish and these data are utilized in fishery resource stock assessment analyses. Expansion of logbook reporting requirements to other fisheries, utilization of several gear types for targeting swordfish and tunas, and the open access nature of the fishery results in a large number of fishermen presently reporting under this system which utilize gear other than pelagic longline and/or which target species other than swordfish and tunas.

The Large Pelagic Logbook data provide a basis for monitoring the permitted effort fished during the year. Notwithstanding errors due to mis-reporting, which presently cannot be validated for lack of a fishery-independent sampling system, self-reported effort from the logbook (reported effort) is taken as representative of the actual effort expended by the U.S. pelagic longline fleet in the Atlantic. Reported effort was thus used in the analyses in this report as the sampling frame over which observed bycatch rates were expanded for estimating total bycatch. It was defined as individual set (gear deployment) records reporting at least 100 hooks fished, and which were not reported to be bottom longline sets or which did not indicate a target of sharks or species other than tunas or swordfish. Reported effort (hooks and sets fished) were classified by fishing area (Figure 1) and calendar quarters. Effort missing location data was proportionally distributed among fishing areas based on the distribution of known set locations for the pertinent year and calendar quarter.

Effort missing calendar quarter data within a fishing area was proportionally distributed among quarters based on the distribution of effort across quarters within the area.

Observer Data

Systematic sampling by scientific observers on board U.S. pelagic longline vessels in the Atlantic permitted to land and sell swordfish was implemented in 1992, under the mandate of the 1991 amendments to the U.S. Fishery Management Plan (FMP) for Swordfish. The objective of the observer sampling program was to provide a representative basis for estimating the total composition of the catch (retained and discarded, targeted and incidental), as well as validate and augment self-reported and port sampling programs, in order to assure compliance to international agreements and to meet national goals for the management of pelagic fisheries. Among the demands on the data collected was to provide estimates of the discarded (dead) catch of species for which harvests are restricted by regulation (e.g. undersized swordfish, billfishes, bluefin tuna, sharks, etc.), and of unintentional catch of species protected from harvest by regulation (e.g. marine mammals, marine turtles, etc.). The design of the observer sampling program and the process of vessel selection were discussed in Johnson et al. (1999). Since October 1995, the SEFSC has fully assumed the implementation and data management of the observer program for the entire Atlantic longline fishery, which was previously shared with the Northeast Fisheries Science Center (NEFSC).

Geographical stratification

The span of ocean fished by the U.S. Atlantic pelagic longline fleet is divided into eleven AREAs, which are further classified into six NAREAs (grouped fishing areas) (Figure 1). The NAREAs are the 1) Caribbean (CAR), 2) Gulf of Mexico (GOM), and 3) Northeast Distant (NED) AREAs, along with the pooled 4) Southeast Coastal (SEC) [Florida East Coast (FEC) + South Atlantic Bight (SAB)], 5) Northeast Coastal (NEC) [Northeast Coastal (NEC) + Mid-Atlantic Bight (MAB)], and 6) Offshore South (OFS) [Sargasso (SAR) + North Central Atlantic (NCA) + Tuna South (TUS) + Tuna North (TUN)] AREAs. For reporting the bycatch estimates and for testing the sensitivity of the estimation method to pooling, NAREAs are classified into three MAREAs (major ocean areas): generally within the 1) U.S. Atlantic EEZ (US Atl: SEC and NEC), 2) other Atlantic waters (OthAtl: NED, OFS, and CAR), and 3) the Gulf of Mexico (GOM).

In general, fishing effort are classified based on reported or observed latitude and longitudes. When in some cases location information was not available, fishing areas (for catch and effort) were assigned based on examination of neighboring sets (neighboring days of fishing on the same trip) or observer logs. Where specific locations could not be determined or extrapolated from neighboring days, the most frequently observed latitude and longitude in the data for the fishing area were assigned.

Serious Injury and Mortality

Each marine mammal or marine turtle observed to be caught incidentally by the U.S. Atlantic pelagic longline fishery was classified by its condition upon release from the gear and return to the sea as either alive, dead, or unknown for the purpose of this analysis. An animal usually sustains

trauma or injury to various degrees during interaction with longline gear. "Serious injury" is interpreted as injury of sufficient severity to significantly increase the near-term probability of death of the animal (Angliss and DeMaster 1998). Failure to take into account serious injury to an animal that might result in death after its release would underestimate the impact of the fishery on a species.

A set of proposed serious injury guidelines was drafted by the Marine Mammal Conservation Division, Office of Protected Resources, NOAA Fisheries (Federal Register Docket No., I.D. 051398C) based on the reports of the Serious Injury Workshop (Angliss and DeMaster 1998) and Guidelines for Assessing Marine Mammal Stocks (GAMMS) Workshop (Wade and Angliss 1997). The guidelines are condensed into the following fifteen criteria for determining whether a marine mammal or turtle in the longline bycatch is considered to be seriously injured:

1. Loss of/damage to appendage/jaw.
2. Inability to use appendage(s).
3. Asymmetry in body shape.
4. Rupture/puncture of eyeball.
5. Inability to swim or dive.
6. Ingestion of gear.
7. Mouth is bound by the gear.
8. Cetacean is hooked internally (e.g., in the mouth).
9. Animal is anchored.
10. Line/net entangling the animal is likely to further entangle the animal.
11. Visible blood flow.
12. Swelling or hemorrhage.
13. Laceration.
14. Listlessness/inability to defend itself.
15. Equilibrium imbalance

Criteria #1-10 comprise the type of injury that is highly likely to directly prevent or impair movement or feeding, and thus should always be considered serious injury. Criteria #11-15 do not necessarily indicate that movement or feeding has been directly prevented or impaired and will not automatically be considered serious.

Observers record the species, estimated length, and codes concerning the condition/status of each animal caught incidentally by the longline gear into an incidental take log sheet. The condition/status code generally classifies the animal as dead, alive, or of unknown state. To supplement this information, observers usually describe the manner in which the animal was hooked/entangled and released, and the types of injury sustained in greater detail in the comments section of the log sheet, and take photographs of the animal whenever possible. The designation of an animal as being "seriously injured" is based on checking observer comments on the animal against the criteria listed above. If the animal exhibited a condition matching one or more of criteria #1-10, then it is designated as "seriously injured", and for the purpose of the bycatch estimates is presumed to be dead.

Catch Estimation

Estimates of bycatch of marine mammals and marine turtles were constructed using the Delta-lognormal method (Pennington 1983). The method assumes a lognormal distribution of the positive bycatch rate observations. Effectively, the estimates were constructed as a product of the proportion of successful occurrences of an event and the average rate at which the event occurs for those successful events. The variance was a function of the variability of the positive bycatch rates as well the number of successful and unsuccessful sets. Total bycatch in each fishing region (see Figure 1) and calendar quarter for species or species groups of concern (C_t), was estimated as:

$$C_t = H \frac{m_c}{N} e^L G_{m_c} \left(\frac{s_L^2}{2} \right), \quad (1)$$

where H is the reported number of hooks set per analytical stratum, divided by 1000; m_c is the number of sets upon which a bycatch of the species or species group of concern was observed; N is the total number of sets observed per analytical stratum; $L = \frac{\sum \log_e L_i}{m_c}$ is the average of the $i = 1, \dots, m_c$ observations of \log_e -transformed bycatch per 1000 hooks fished, $L_i = \log_e(\text{catch}_i / \text{hooks}_i \times 1000)$; $s_L^2 = \sqrt{\frac{\sum (L_i - L)^2}{m_c - 1}}$ is the sample variance of the \log_e -transformed positive bycatch rates; and the function $G_{m_c} \left(\frac{s_L^2}{2} \right)$ is the cumulative probability from the Poisson distribution:

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

Numerically, the series was computed over j terms, until a convergence criterion of <0.001 change in the function was achieved (usually less than 10 terms were required). The estimate of variance of the bycatch takes the form:

$$V(C_t) = \frac{m_c}{N} (He^L)^2 \left[\frac{m_c}{N} G_{m_c}^2 \left(\frac{s_L^2}{2} \right) - \left(\frac{m_c - 1}{N - 1} \right) G_{m_c} \left(\frac{m_c - 2}{m_c - 1} s_L^2 \right) \right]. \quad (3)$$

Bycatch estimates by stratum were assumed independent and as such estimated bycatch and the associated variances were summed across strata to produce region-wide annual estimates. The coefficient of variation for the stratum-wise estimate of bycatch was taken as:

$$CV = \frac{\sqrt{V(C_t)}}{C_t} \quad (4)$$

and approximate $1 - \alpha$ confidence intervals were constructed assuming a lognormal distribution as: $(U_{1-\alpha/2}, L_{1-\alpha/2}) = (C_t k, C_t/k)$, where $U_{1-\alpha/2}$ and $L_{1-\alpha/2}$ represent the upper and lower confidence bounds, $k = \exp[z_\alpha (\log_e (1 + CV^2))^{1/2}]$, and z_α the associated $1 - \alpha$ z-score.

Estimates of animals returned to the sea alive and dead were likewise constructed, except that the appropriate number of positive sets, average log-transformed bycatch rates and variance terms were substituted into equations 1-4 above. Additionally, the robustness of the estimates to pooling across calendar quarters, large geographical regions, and within coarser taxonomic groupings (i.e. marine mammals and marine turtles) was examined. Also in these cases, the appropriate number of positive bycatch sets, average (\log_e) bycatch rates and variance terms were substituted.

Results and Discussion

Reported and observed effort (hooks and sets) for each quarter-AREA in 1998 are respectively summarized in Tables 1-2. Total reported effort was 6337.9 thousand hooks in 9903 sets (Table 1). Total observed effort was 180.9 thousand hooks in 286 sets (Table 2). The total reported effort (hooks) and the percent observer coverage (observed effort/reported effort) by quarter-NAREA are shown in Figure 2. The observer coverage ranged from 0-19% (Figure 2). The NAREA of NED had no observer coverage at all during 1998, and CAR and OFS were only covered for part of the year. Observer coverage by the fleet differs slightly when calculated in units of hooks and when calculated in units of sets. A quarterly comparison of the observed effort and percent coverage in hooks and in sets is shown in Figure 3. In hooks, the total annual percent coverage was 4.5%, while in sets the coverage was reduced to 2.9%, but generally the trends of effort described by the two units mirrored each other closely (Figure 3). The number of hooks was used as the unit of effort in all of the bycatch estimates.

Approximately 1% of the reported effort had missing areal information (Table 1). In addition, reported effort may also be confounded by various errors in reporting and misclassification of gear types. Therefore, reported effort may not equal exactly the actual total pelagic longline fishing effort expended. The direction and magnitude of difference between the reported and actual effort cannot be predicted on the basis of present information. If actual effort expended is greater than indicated in Table 1, then the resulting estimates of bycatch would be higher. Likewise, if the actual effort expended was lower than indicated in Table 1, then the estimates of bycatch would be lower.

A total of six marine mammals were observed to be caught in 1998 on six different sets, i.e. at a constant rate of one animal caught per set (Tables 3, 4). Four of the six were caught in the Mid-Atlantic Bight (MAB) of the U.S. Atlantic EEZ waters, one in the Gulf of Mexico (GOM) and another in the Caribbean (CAR) (Table 3). The species caught were two bottlenose dolphins (*Tursiops truncatus*) and two Risso's (*Grampus griseus*) dolphins, one pilot whale (*Globicephala* sp.) and one beaked whale (*Ziphiidae* sp.) (Table 4). All of them were actually observed to be alive upon return to the sea. However, according to the serious injury criteria, one bottlenose dolphin and one Risso's dolphin were presumed dead (Table 10).

Twenty marine turtles were observed to be caught on 16 different sets, ranging from 1-3 animals caught per set (Tables 3, 4). Nine of them were caught in the Mid-Atlantic Bight (MAB), four in the Northeast Coast (NEC), and four in the Florida East Coast (FEC) area in the U.S. Atlantic EEZ waters, one in the Gulf of Mexico (GOM) and two in the Caribbean (CAR) (Table 3). There were fifteen loggerheads (*Caretta caretta*), four leatherbacks (*Dermochelys coriacea*) and one hawksbill (*Eretmochelys imbricata*). All of them were actually observed to be alive upon return to the sea, but according to the serious injury criteria, all but one leatherback were ultimately presumed dead (Table 10).

The bycatch events by quarter-area-taxon strata used in the catch estimation are listed in Table 4. Estimates of marine mammal and marine turtle bycatch by the U.S. pelagic longline fleet operating in the Atlantic in 1998 are summarized in Tables 5-8. By quarter-NAREA and for the lowest taxonomic grouping possible, the proportion of observed sets in a stratum in which at least one marine mammal was caught (PPT - proportion of sets with positive catch) was between 3-10%, and the proportion of observed sets on which at least one turtle was caught was 3-20% (Table 5). Overall, only six of the total 286 observed sets (2.1%) caught one marine mammal and 16 (5.6%) caught at least one marine turtle.

Annual bycatch of marine mammal and marine turtle were estimated for the lowest taxonomic grouping possible by NAREA (Table 6) and by MAREA (Table 7). Robustness of the estimates to geographical and time of year effects was examined by pooling within MAREA and within the general taxonomic categories of marine mammals and marine turtles (Table 8). Figures 4 and 5 contrast the resulting estimates for 1998 by the stratified approach (Table 7) and the pooling approach (Table 8). Also included in the figures are the 1992-1997 estimates previously reported in Johnson et al. (1999). Again, the point estimates of bycatch were relatively insensitive to the pooling of data, but considerable gains in precision of the estimates were attained by pooling where bycatch numbers were relatively high, as was the case for marine turtles in general, and for the U.S. Atlantic EEZ area in 1998 (Figures 4, 5). The more precise pooled estimates (pooling within MAREA and major taxonomic groups - Table 8) indicate that the U.S. pelagic longline fleet operating in the Atlantic (including the Gulf of Mexico) during 1998 caught an estimated total of 205 (57-828, 95%CI) marine mammals, which included: pilot whale - 24 (5-123), Risso's dolphins - 47 (14-163), and bottlenose dolphins - 46 (9-236) (Table 7). None was actually observed to be dead upon return to sea, but an estimated 54 (10-277) were presumed dead due to serious injury, including: bottlenose dolphins - 31 (6-159), and Risso's dolphins - 23 (4-118). It was also estimated that the fleet caught a total of 730 (337-1824) marine turtles in 1998 (Table 8), which included: loggerhead - 510 (225-1250), leatherback - 167 (41-698), and hawksbill - 51 (10-261) (Table 7). None was actually observed to be dead upon return to sea, but all except an estimated 21 (4-107) leatherback turtles caught were presumed dead due to serious injury. Although more precise than estimates made for AREA/NAREA and species, pooled estimates should be interpreted with caution - when sampling is inadequate in the individual smaller areas (AREA/NAREA) comprising the larger MAREA regions, the pooled estimates of bycatch may not be representative of the larger pooled area. For example, the absence of observer sampling for the NAREA of NED in 1998 might

lead to the underestimation of the bycatch of the pooled MAREA of the "Other Atlantic", of which NED is a component.

The estimated bycatch of marine turtles from observer data was significantly greater than the total bycatch reported in logbooks for 1992-1997, although both data sets showed similar trends (Johnson et al. 1999). The discrepancy had drawn to attention the necessity for a high percentage of observer coverage of the fleet to mitigate the errors in catch and effort data reported by the fishery. However, the gap between the point estimate of total annual bycatch of marine turtles (730) and the number reported in the logbook (850) has narrowed considerably for 1998 (Figure 6), although the observer coverage in 1998 was not greater than in other years (Table 9).

Condition/status codes and comments made by observers on the incidental take log sheets for each individual animal caught in the longline gear were the basis for classifying the animal as "seriously injured" according to the criteria aforementioned. The available observer comments and/or codes for each marine mammal and turtle observed caught in 1998 are given in Table 10. As the Marine Mammals Protection Act definition can be broadly interpreted to mean that any marine mammal caught is injured in some way, the most stringent management measure would equate the estimates of bycatch to the estimates of the numbers of animals killed. In this analysis, only animals that meet the "serious injury" criteria were considered killed. Table 10 also gives the injury criteria (#1-15) that each incidentally-caught marine mammal or turtle was known to or assumed to meet. An animal ascertained to meet one or more of the criteria #1-10 was classified in Table 10 as "seriously injured" (S.I.) = Yes (dead), otherwise S.I. = No (alive).

One of the most frequent types of serious injury was #10 – "line entangled the animal and is likely to further entangle the animal". However, "... (the likelihood) of the line to further entangle the animal" is difficult to ascertain. Usually animals entangled in or hooked on the longline would have some line left on them upon release. It is assumed here that a line of length greater than the estimated length of the animal is likely to further entangle the animal. More accurate assessment of this criterion would require that observers report the amount of line left and the location of the line on the animal. Another frequent type of injury was #8 – "hooked internally (e.g. in the mouth)", which may also imply injury of type #6 – "ingestion of gear". This is an extremely serious injury, but often observers were not able to see the caught animal clearly enough to judge whether gear was ingested. If the animal is hooked in an unspecified part of the mouth and the hook and all the line were not removed upon release of the animal, it is likely that gear could be ingested. By this reasoning, #8 – hooked internally, #6 – ingestion of gear, and #10 – further line entanglement may often occur concurrently. There is also the possibility of injury type #1 – "damage to appendage/jaw" being linked with #8 – "hooked internally (e.g. in the mouth)". It is recommended that observer training and reporting should emphasize the assessment of animal condition in the field according to the proposed set of injury criteria, especially to the types that occur most frequently, and research should focus on assessing the probability of mortality due to the frequently occurring injury types.

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Table 1. Effort in A) number of hooks ($\times 1000$) and B) number of sets, reported in logbook for the pelagic longline fishery in the U.S. Atlantic in 1998 by calendar quarter and fishing area (AREA). Effort data lacking area and quarter information are designated unknown (UNK). Blank spaces indicate no reported effort for that quarter and area.

A. Number of hooks ($\times 1000$)

QTR	CAR	FEC	GOM	MAB	NCA	NEC	NED	SAB	SAR	TUN	TUS	unk	Total
1	189.3	140.7	565.0	74.3	183.7			149.3		82.0	38.2	26.7	1449.2
2	13.9	246.8	594.6	87.1	2.4	42.0	41.7	213.5	1.0	19.9	136.3	13.9	1413.1
3		94.0	589.8	368.2		520.8	347.6	74.2		2.9		16.8	2014.2
4	33.2	99.8	505.1	424.0	47.8	155.9	99.4	84.0	2.5			9.7	1461.4
Total	236.4	581.3	2254.5	953.6	233.9	718.6	488.7	521.0	3.5	104.7	174.5	67.1	6337.9

B. Number of sets

QTR	CAR	FEC	GOM	MAB	NCA	NEC	NED	SAB	SAR	TUN	TUS	unk	Total
1	345	385	825	119	236			250		92	46	37	2335
2	21	653	797	147	3	51	48	390	1	30	175	19	2335
3		308	851	547		612	422	200		4		34	2978
4	53	323	665	584	68	190	132	218	3			19	2255
Total	419	1669	3138	1397	307	853	602	1058	4	126	221	109	9903

Table 2. Observed effort in A) number of hooks ($\times 1000$) and B) number of sets, sampled from the pelagic longline fishery in the U.S. Atlantic in 1998 by calendar

quarter and fishing area (AREA). Blank areas indicate no observed effort for that quarter and area.

A. Number of hooks ($\times 1000$)

QTR	CAR	FEC	GOM	MAB	NCA	NEC	NED	SAB	SAR	TUN	TUS	Total
1		4.79	23.55	13.97	6.55			9.39				58.25
2		7.36	12.21	5.46				15.25			2.96	43.24
3		0.86	14.96	14.35		6.57						36.74
4	6.06	5.75	11.76	1.79		11.74		5.61				42.70
Total	6.06	18.76	62.48	35.57	6.55	18.31		30.25			2.96	180.93

B. Number of sets

QTR	CAR	FEC	GOM	MAB	NCA	NEC	NED	SAB	SAR	TUN	TUS	Total
1		14	26	20	8			10				78
2		20	14	8				33			4	79
3		4	21	22		8						55
4	10	18	12	3		15		16				74
Total	10	56	73	53	8	23		59			4	286

Table 3. Observed total number of A) marine mammals and B) marine turtles caught in the pelagic longline fishery in the U.S. Atlantic in 1998 by calendar quarter and fishing area. In parenthesis is the corresponding bycatch per set (= total number/total sets). Blank areas indicate no observed effort for that quarter and area.

A. Marine mammals

QTR	CAR	FEC	GOM	MAB	NCA	NEC	NED	SAB	SAR	TUN	TUS	Total
1			(.04) 1	(.05) 1								2
2												
3				(.14) 3								3
4	(.10) 1											1
Total	1		1	4								6

B. Marine turtle

QTR	CAR	FEC	GOM	MAB	NCA	NEC	NED	SAB	SAR	TUN	TUS	Total
1		(.14) 2	(.04) 1	(.05) 1								4
2												
3				(.32) 7		(.13) 1						8
4	(.20) 2	(.11) 2		(.33) 1		(.20) 3						8
Total	2	4	1	9		4						20

Table 4. A) Marine mammal and B) marine turtle bycatch observed in U.S. Atlantic pelagic longline fishery in 1998, listed by calendar quarter (QTR), vessel trip identifier (TRIP), set on which bycatch was observed (HAUL#), the number of hooks set (HOOKS), fishing region (AREA, NAREA, MAREA), the TOTAL number observed, the number out of the total which were observed to be ALIVE and the number out of the total which were considered seriously injured (= DEAD) upon return to the sea.

COMMON NAME	SPECIES	QTR	TRIP	HAUL#	TOTAL	DEAD	ALIVE	HOOKS	AREA	NAREA	MAREA
A) MARINE MAMMALS											
bottlenose dolphin	<i>Tursiops truncatus</i>	1	L22	9	1	0	1	960	MAB	NEC	US Atl
bottlenose dolphin	<i>Tursiops truncatus</i>	1	P34	3	1	1	0	1010	GOM	GOM	GOM
Risso's dolphin	<i>Grampus griseus</i>	3	L26	3	1	1	0	630	MAB	NEC	US Atl
Risso's dolphin	<i>Grampus griseus</i>	3	L26	4	1	0	1	612	MAB	NEC	US Atl
pilot whale	<i>Globicephala</i> sp.	3	L28	5	1	0	1	620	MAB	NEC	US Atl
beaked whale	Ziphiidae	4	T41	5	1	0	1	648	CAR	CAR	OthAtl
B) MARINE TURTLES											
leatherback	<i>Dermochelys coriacea</i>	1	T31	1	1	1	0	256	FEC	SEC	US Atl
loggerhead	<i>Caretta caretta</i>	1	T31	3	1	1	0	340	FEC	SEC	US Atl
hawksbill	<i>Eretmochelys imbricata</i>	1	F56	3	1	1	0	288	MAB	NEC	US Atl
leatherback	<i>Dermochelys coriacea</i>	1	K22	1	1	1	0	450	GOM	GOM	GOM
loggerhead	<i>Caretta caretta</i>	3	T38	1	1	1	0	715	MAB	NEC	US Atl
loggerhead	<i>Caretta caretta</i>	3	T38	2	2	2	0	440	MAB	NEC	US Atl
leatherback	<i>Dermochelys coriacea</i>	3	T38	3	2	1	1	712	MAB	NEC	US Atl
loggerhead	<i>Caretta caretta</i>	3	T39	2	1	1	0	770	NEC	NEC	US Atl
loggerhead	<i>Caretta caretta</i>	3	L28	3	1	1	0	730	MAB	NEC	US Atl
loggerhead	<i>Caretta caretta</i>	3	L28	5	1	1	0	620	MAB	NEC	US Atl
loggerhead	<i>Caretta caretta</i>	4	L28	16	1	1	0	725	MAB	NEC	US Atl
loggerhead	<i>Caretta caretta</i>	4	F62	7	3	3	0	960	NEC	NEC	US Atl
loggerhead	<i>Caretta caretta</i>	4	T41	4	1	1	0	648	CAR	CAR	OthAtl
loggerhead	<i>Caretta caretta</i>	4	S09	3	1	1	0	440	FEC	SEC	US Atl
loggerhead	<i>Caretta caretta</i>	4	S09	4	1	1	0	440	FEC	SEC	US Atl
loggerhead	<i>Caretta caretta</i>	4	T41	10	1	1	0	575	CAR	CAR	OthAtl

Table 5. Quarterly (QTR) observed (obs.) and estimated (est.) total bycatch of A) marine mammals and B) marine turtles in the U.S. Atlantic longline fishery for 1998, stratified by species-NAREA-quarter. The three categories are the TOTAL number of animals, the number of animals out of the total which were seriously injured (presumed DEAD), and the number out of the total which were ALIVE upon return to the sea. The estimated coefficients of variation for the bycatch estimates (CV_T, CV_D, CV_A for total, dead, and alive catches, respectively), and upper and lower 95% lognormal confidence bounds (UTTL, LTTL for total catch; UDED, LDED for dead animals; and UALV, LALV for living animals) are also given. The proportion of positive bycatch (PPT) is the proportion of sets observed in the stratum (N) in which at least one marine mammal or turtle was captured; PPD is the subset of PPT in which the animal was observed to be seriously injured=dead (PPD); PPA is the subset of PPT in which the animal was observed to be alive upon return to the sea. The coverage (PERCOV) for a stratum is the ratio of observed to reported effort (hooks). Coverage below 0.05 is in bold type. Decimals are rounded to the nearest hundredth.

	NAREA	QTR	N	PPT	obs.	est.	CV_T	UTTL	LTTL	PPD	obs.	est.	CV_D	UDED	LDED	PPA	obs.	est.	CV_A	UALV	LALV	PERCOV
					TOTAL	TOTAL					DEAD	DEAD					ALIVE	ALIVE				
A) MARINE MAMMALS																						
beaked whale	CAR	4	10	0.1	1	5	1.01	26	1	0	0	0	.	.	.	0.1	1	5	1.01	26	1	0.18
bottlenose dolphin	GOM	1	26	0.04	1	22	1	112	4	0.04	1	22	1	112	4	0	0	0	.	.	.	0.04
bottlenose dolphin	NEC	1	20	0.05	1	4	0.98	20	1	0	0	0	.	.	.	0.05	1	4	0.98	20	1	0.19
Risso's dolphin	NEC	3	30	0.07	2	96	0.7	329	28	0.03	1	47	1	240	9	0.03	1	49	1	251	10	0.02
pilot whale	NEC	3	30	0.03	1	48	1	245	9	0	0	0	.	.	.	0.03	1	48	1	245	9	0.02
total					6	175		732	43		2	69		352	13		4	106		342	21	
B) MARINE TURTLES																						
hawksbill	NEC	1	20	0.05	1	13	0.99	66	3	0.05	1	13	0.99	66	3	0	0	0	.	.	.	0.19
leatherback	GOM	1	26	0.04	1	49	1	251	10	0.04	1	49	1	251	10	0	0	0	.	.	.	0.04
leatherback	NEC	3	30	0.03	2	84	1	430	16	0.03	1	42	1	215	8	0.03	1	42	1	215	8	0.02
leatherback	SEC	1	24	0.04	1	48	1	245	9	0.04	1	48	1	245	9	0	0	0	.	.	.	0.05
loggerhead	CAR	4	10	0.2	2	11	0.66	36	3	0.2	2	11	0.66	36	3	0	0	0	.	.	.	0.18
loggerhead	NEC	3	30	0.17	6	298	0.47	711	125	0.17	6	298	0.47	711	125	0	0	0	.	.	.	0.02
loggerhead	NEC	4	18	0.11	4	146	0.74	534	40	0.11	4	146	0.74	534	40	0	0	0	.	.	.	0.02
loggerhead	SEC	1	24	0.04	1	36	1	184	7	0.04	1	36	1	184	7	0	0	0	.	.	.	0.05
loggerhead	SEC	4	34	0.06	2	25	0.7	86	7	0.06	2	25	0.7	86	7	0	0	0	.	.	.	0.06
total					20	710		2543	220		19	668		2328	212		1	42		215	8	

Table 6. Annual observed (obs.) and estimated (est.) bycatch of A) marine mammals and B) marine turtles in the U.S. Atlantic longline fishery for 1998, stratified by species-NAREA. The three categories are the TOTAL number of animals, the number of animals out of the total which were seriously injured (presumed DEAD), and the number out of the total which were ALIVE upon return to the sea. The estimated coefficients of variation for the bycatch estimates (CV_T, CV_D, CV_A for total, dead, and alive catches, respectively), and upper and lower 95% lognormal confidence bounds (UTTL, LTTL for total catch; UDED, LDED for dead animals; and UALV, LALV for living animals) are also given. The proportion of positive bycatch (PPT) is the proportion of sets observed in the stratum (N) in which at least one marine mammal or turtle was captured; PPD is the subset of PPT in which the animal was observed to be seriously injured=dead (PPD); PPA is the subset of PPT in which the animal was observed to be alive upon return to the sea. The coverage (PERCOV) for a stratum is the ratio of observed to reported effort (hooks). Decimals are rounded to the nearest hundredth.

	NAREA	N	PPT	obs.	est.	CV_T	UTTL	LTTL	PPD	obs.	est.	CV_D	UDED	LDED	PPA	obs.	est.	CV_A	UALV	LALV	PERCOV
				TOTAL	TOTAL					DEAD	DEAD					ALIVE	ALIVE				
A) MARINE MAMMALS																					
beaked whale	CAR	10	0.1	1	37	1	189	7	0	0	0	.	.	.	0.1	1	37	1	189	7	0.03
bottlenose dolphin	GOM	73	0.01	1	31	1	159	6	0.01	1	31	1	159	6	0	0	0	.	.	.	0.03
bottlenose dolphin	NEC	76	0.01	1	23	1	118	4	0	0	0	.	.	.	0.01	1	23	1	118	4	0.03
Risso's dolphin	NEC	76	0.03	2	72	0.7	249	21	0.01	1	35	1	179	7	0.01	1	36	1	184	7	0.03
pilot whale	NEC	76	0.01	1	36	1	184	7	0	0	0	.	.	.	0.01	1	36	1	184	7	0.03
total				6	199		899	45		2	66		338	13		4	132		675	25	
A) MARINE TURTLES																					
hawksbill	NEC	76	0.01	1	77	1	394	15	0.01	1	77	1	394	15	0	0	0	.	.	.	0.03
leatherback	GOM	73	0.01	1	69	1	353	13	0.01	1	69	1	353	13	0	0	0	.	.	.	0.03
leatherback	NEC	76	0.01	2	62	1	317	12	0.01	1	31	1	159	6	0.01	1	31	1	159	6	0.03
leatherback	SEC	116	0.01	1	38	1	194	7	0.01	1	38	1	194	7	0	0	0	.	.	.	0.04
loggerhead	CAR	10	0.2	2	78	0.67	257	24	0.2	2	78	0.67	257	24	0	0	0	.	.	.	0.03
loggerhead	NEC	76	0.09	10	322	0.4	689	151	0.09	10	322	0.4	689	151	0	0	0	.	.	.	0.03
loggerhead	SEC	116	0.03	3	72	0.58	206	25	0.03	3	72	0.58	206	25	0	0	0	.	.	.	0.04
total				20	718		2410	247		19	687		2252	241		1	31		159	6	

Table 7. Annual observed (obs.) and estimated (est.) bycatch of A) marine mammals and B) marine turtles in the U.S. Atlantic longline fishery for 1998, stratified by species-MAREA. The three categories are the TOTAL number of animals, the number of animals out of the total which were seriously injured (presumed DEAD), and the number out of the total which were ALIVE upon return to the sea. The estimated coefficients of variation for the bycatch estimates (CV_T, CV_D, CV_A for total, dead, and alive catches, respectively), and upper and lower 95% lognormal confidence bounds (UTTL, LTTL for total catch; UDED, LDED for dead animals; and UALV, LALV for living animals) are also given. The proportion of positive bycatch (PPT) is the proportion of sets observed in the stratum (N) in which at least one marine mammal or turtle was captured; PPD is the subset of PPT in which the animal was observed to be seriously injured=dead (PPD); PPA is the subset of PPT in which the animal was observed to be alive upon return to the sea. The coverage (PERCOV) for a stratum is the ratio of observed to reported effort (hooks). Decimals are rounded to the nearest hundredth.

	MAREA	N	PPT	obs.	est.	CV_T	UTTL	LTTL	PPD	obs.	est.	CV_D	UDED	LDED	PPA	obs.	est.	CV_A	UALV	LALV	PERCOV
				TOTAL	TOTAL					DEAD	DEAD					ALIVE	ALIVE				
A) MARINE MAMMALS																					
beaked whale	OTHATL	22	0.05	1	88	1	450	17	0	0	0	.	.	.	0.05	1	88	1	450	17	0.01
bottlenose dolphin	GOM	73	0.01	1	31	1	159	6	0.01	1	31	1	159	6	0	0	0	.	.	.	0.03
bottlenose dolphin	US ATL	192	0.01	1	15	1	77	3	0	0	0	.	.	.	0.01	1	15	1	77	3	0.04
Risso's dolphin	US ATL	192	0.01	2	47	0.7	163	14	0.01	1	23	1	118	4	0.01	1	24	1	123	5	0.04
pilot whale	US ATL	192	0.01	1	24	1	123	5	0	0	0	.	.	.	0.01	1	24	1	123	5	0.04
total				6	205		972	45		2	54		277	10		4	151		773	30	
B) MARINE TURTLES																					
hawksbill	US ATL	192	0.01	1	51	1	261	10	0.01	1	51	1	261	10	0	0	0	.	.	.	0.04
leatherback	GOM	73	0.01	1	69	1	353	13	0.01	1	69	1	353	13	0	0	0	.	.	.	0.03
leatherback	US ATL	192	0.01	3	98	0.71	345	28	0.01	2	78	0.78	301	20	0.01	1	21	1	107	4	0.04
loggerhead	OTHATL	22	0.09	2	187	0.69	637	55	0.09	2	187	0.69	637	55	0	0	0	.	.	.	0.01
loggerhead	US ATL	192	0.05	13	323	0.34	613	170	0.05	13	323	0.34	613	170	0	0	0	.	.	.	0.04
total				20	728		2209	276		19	708		2165	268		1	21		107	4	

Table 8. Annual observed (obs.) and estimated (est.) bycatch of A) marine mammals and B) marine turtles in the U.S. Atlantic longline fishery for 1998, stratified by group (marine mammal or marine turtle)-MAREA. The three categories are the TOTAL number of animals, the number of animals out of the total which were seriously injured (presumed DEAD), and the number out of the total which were ALIVE upon return to the sea. The estimated coefficients of variation for the bycatch estimates (CV_T, CV_D, CV_A for total, dead, and alive catches, respectively), and upper and lower 95% lognormal confidence bounds (UTTL, LTTL for total catch; UDED, LDED for dead animals; and UALV, LALV for living animals) are also given. The proportion of positive bycatch (PPT) is the proportion of sets observed in the stratum (N) in which at least one marine mammal or turtle was captured; PPD is the subset of PPT in which the animal was observed to be seriously injured=dead (PPD); PPA is the subset of PPT in which the animal was observed to be alive upon return to the sea. Decimals are rounded to the nearest hundredth.

MAREA	N	PPT	obs.	est.	CV_T	UTTL	LTTL	PPD	obs.	est.	CV_D	UDED	LDED	PPA	obs.	est.	CV_A	UALV	LALV
			TOTAL	TOTAL					DEAD	DEAD					ALIVE	ALIVE			
A) MARINE MAMMAL																			
GOM	73	0.01	1	31	1	159	6	0.01	1	31	1	159	6	0	0	0	.	.	.
OTHATL	22	0.05	1	88	1	450	17	0	0	0	.	.	.	0.05	1	88	1	450	17
US ATL	192	0.02	4	86	0.51	219	34	0.01	1	23	1	118	4	0.02	3	63	0.59	183	22
total			6	205		828	57		2	54		277	10		4	151		633	39
B) MARINE TURTLE																			
GOM	73	0.01	1	69	1	353	13	0.01	1	69	1	353	13	0	0	0	.	.	.
OTHATL	22	0.09	2	187	0.69	637	55	0.09	2	187	0.69	637	55	0	0	0	.	.	.
US ATL	192	0.07	17	474	0.29	834	269	0.07	16	452	0.3	798	256	0.01	1	21	1	107	4
total			20	730		1824	337		19	708		1788	324		1	21		107	4

Table 9. Annual observed and logbook-reported effort (hooks and sets) by MAREA for 1992-1998. An adjustment was made to the logbook-reported effort by distributing effort with unknown area information proportionally among the areas with known effort. Numbers are rounded to the nearest integer. The coverage (PERCOV) is the ratio of observed to reported effort (hooks).

YR	MAREA	OBSERVED HOOKS	OBSERVED SETS	REPORTED HOOKS	REPORTED SETS	PERCOV
92	GOM	38185	61	2610889	3880	0.01
92	OTHATL	67984	92	1569484	2683	0.04
92	US ATL	91750	176	3146014	6990	0.03
93	GOM	195421	233	2503847	3589	0.08
93	OTHATL	109543	170	1633802	2804	0.07
93	US ATL	229538	412	3328879	6893	0.07
94	GOM	113097	154	2138878	2978	0.05
94	OTHATL	83472	115	1792501	2910	0.05
94	US ATL	225290	380	3392812	6532	0.07
95	GOM	172200	208	2155529	3104	0.08
95	OTHATL	137160	204	2232779	3518	0.06
95	US ATL	181601	284	3968585	6568	0.05
96	GOM	89122	128	2957228	4326	0.03
96	OTHATL	54453	83	2315064	3393	0.02
96	US ATL	82025	150	3597028	6443	0.02
97	GOM	114195	163	2677590	3929	0.04
97	OTHATL	74882	98	1813788	2422	0.04
97	US ATL	128363	193	3070056	5554	0.04
98	GOM	62480	73	2278665	3173	0.03
98	OTHATL	15563	22	1255067	1698	0.01
98	US ATL	102918	192	2804145	5032	0.04

Table 10. Observer comments relating to the condition of A) marine mammals and B) marine turtles observed caught in 1998 by U.S. pelagic longline vessels operating in the North Atlantic. Unique trip identifier (TRIP #), date landed, common name of species taken, latitude (Lat), longitude (Lon), and estimated body length are also given. Injury codes 1-15 refer to criteria used to classified animals as "seriously injured":

- 1=Loss of/damage to appendage/jaw 2=Inability to use appendage(s) 3=Asymmetry in body shape
 4=Rupture/puncture of eyeball 5=Inability to swim or dive 6=Ingestion of gear
 7=Mouth is bound by the gear 8=Cetacean is hooked internally (e.g., in the mouth)
 9=Animal is anchored 10=Line/net entangling the animal is likely to further entangle the animal
 11=Visible blood flow. 12=Swelling or hemorrhage. 13=Laceration.
 14=Listlessness/inability to defend itself. 15=Equilibrium imbalance.

A '?' beside the code number indicates that such injury was probably sustained. Animals with injuries matching at least one of criteria 1-10 are considered to be seriously injured (S.I. = 'Y') and is assumed to have died. Other injuries are not considered serious (S.I. = 'N') and the animal is assumed to have survived.

Trip #	Date Landed	Common Name	Lat (deg min)	Lon (deg min)	Est. Length (cm)	Injury Codes	S.I.	Observer Comments
MARINE MAMMALS								
L22	1/15/98	bottlenose dolphin	36 07	74 43	250	10?	N	female; when released dove straight down and did not come up in the vicinity of the boat; tail flipper entangled in mainline; 3 wraps on tail; no visible injury.
P34	2/12/98	bottlenose dolphin	26 50	92 19	210	6?,8,10	Y	hooked in mouth; excellent strength; approx. 70 ft of line cut off to release animal; also has a swivel in line attached to trailing gangion.
L26	8/1/98	Risso's dolphin	39 06	72 36	250	8,10?	Y	hooked in lip; swam away strongly; cooperated by not struggling; cut leader and freed; no bleeding evident.
L26	8/1/98	Risso's dolphin	38 48	72 53	250		N	tail wrapped; retrieved and cut mono away; swam away strongly; no serious injury sustained; no bleeding evident.
L28	10/11/98	pilot whale	38 35	73 09	300		N	tail entangled in mainline; removed and swam away
T41	12/7/98	beaked whale	20 22	73 34	455		N	unidentified whale, possibly bottlenose, entered as beaked whale; wrapped only on mainline; unwrapped; swam away freely, good condition (some fatigue).

Landed			(deg min)		Length	Codes		
					(cm)			
MARINE TURTLES								
T31	2/2/98	leatherback	26 06	79 57	152	8,10	Y	mouth-hooked; released with approx. 40 ft of monofilament.
T31	2/2/98	loggerhead	27 59	79 56	140	8,10	Y	mouth-hooked; released with approx. 40 ft of monofilament.
F56	2/12/98	hawksbill	35 57	74 39	66	8,10	Y	hooked in the mouth; gangion line was cut to within approximately 3 ft of the hook; swam away vigorously, seemingly unharmed.
K22	3/19/98	leatherback	23 25	82 17	180	1,10	Y	tangled on gangion with hook in left front flipper; pulled to railing, released by cutting gangion line with 8 ft line remaining attached to animal; very lively, dove immediately.
T38	8/11/98	loggerhead	39 55	71 14	90	8	Y	captain cut leader to hook, hook left in lip (mouth-hooked); turtle looked to be in good condition.
T38	8/11/98	loggerhead	39 52	71 32	70	1,8	Y	alive, condition unknown; about one foot leader left; mouth-hooked and possibly throat-hooked.
T38	8/11/98	loggerhead	39 52	71 32	50	1,8	Y	alive, condition unknown; about one foot leader left; mouth-hooked and possibly throat-hooked.
T38	8/11/98	leatherback	39 36	71 59	183	6?,8,10	Y	alive; leader cut with 36 ft left; location of hook unknown.
T38	8/11/98	leatherback	39 36	71 59	183		N	mainline wrapped, no hook present.
T39	8/26/95	loggerhead	40 27	67 01	--	1?,6?,8?10	Y	alive, condition unknown; unknown hook location; released with 48 ft of mono leader.
L28	10/11/98	loggerhead	38 35	73 06	75	1,6,8	Y	captain brought turtle on board to remove hook but was only able to remove mono line from hook; observer suggested to let hook rust out rather than tear turtle's oesophagus; did not measure due to stress sustained during mono removal; swam away strongly.
L28	10/11/98	loggerhead	38 35	73 09	125	10	Y	caught in beeper with mono from previous encounter with another longliner.
L28	10/11/98	loggerhead	38 42	72 51	60	11,13	Y	pulled aboard; hook impaled in jaw; removed hook with some bleeding; animal swam away.
F62	11/11/98	loggerhead	39 53	68 29	51	6?,8,10	Y	hooked in the mouth; gangion line was cut with approximately one fathom of line trailing from hook.
F62	11/11/98	loggerhead	39 53	68 29	36	6?,8,10	Y	hooked in the mouth; gangion line was cut with approximately one fathom of line trailing from hook.
F62	11/11/98	loggerhead	39 53	68 29	36	6?,8,10	Y	hooked in the mouth; gangion line was cut with approximately one fathom of line trailing from hook.
T41	12/7/98	loggerhead	20 18	73 33	80	6?,8,10	Y	alive; leader cut at 5 ft; mouth-hooked.

Trip #	Date Landed	Common Name	Lat (deg min)	Lon (deg min)	Est. Length	Injury Codes	S.I.	Observer Comments
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(cm)

MARINE TURTLES

S09	12/6/98	loggerhead	28 56	76 39	80	6?,8	Y	hooked in mouth; about 6 inches of leader was left with hook in animal; was not brought on board; seemed energetic, swam off immediately.
S09	12/6/98	loggerhead	28 56	76 34	90	6?,8	Y	cut loose with approx. 6 inches of leader left in lip; seemed in good condition and swam off immediately.
T41	12/7/98	loggerhead	20 24	73 42	90	6?,8	Y	mouth-hooked; leader cut, about 1 ft of leader left; good condition.

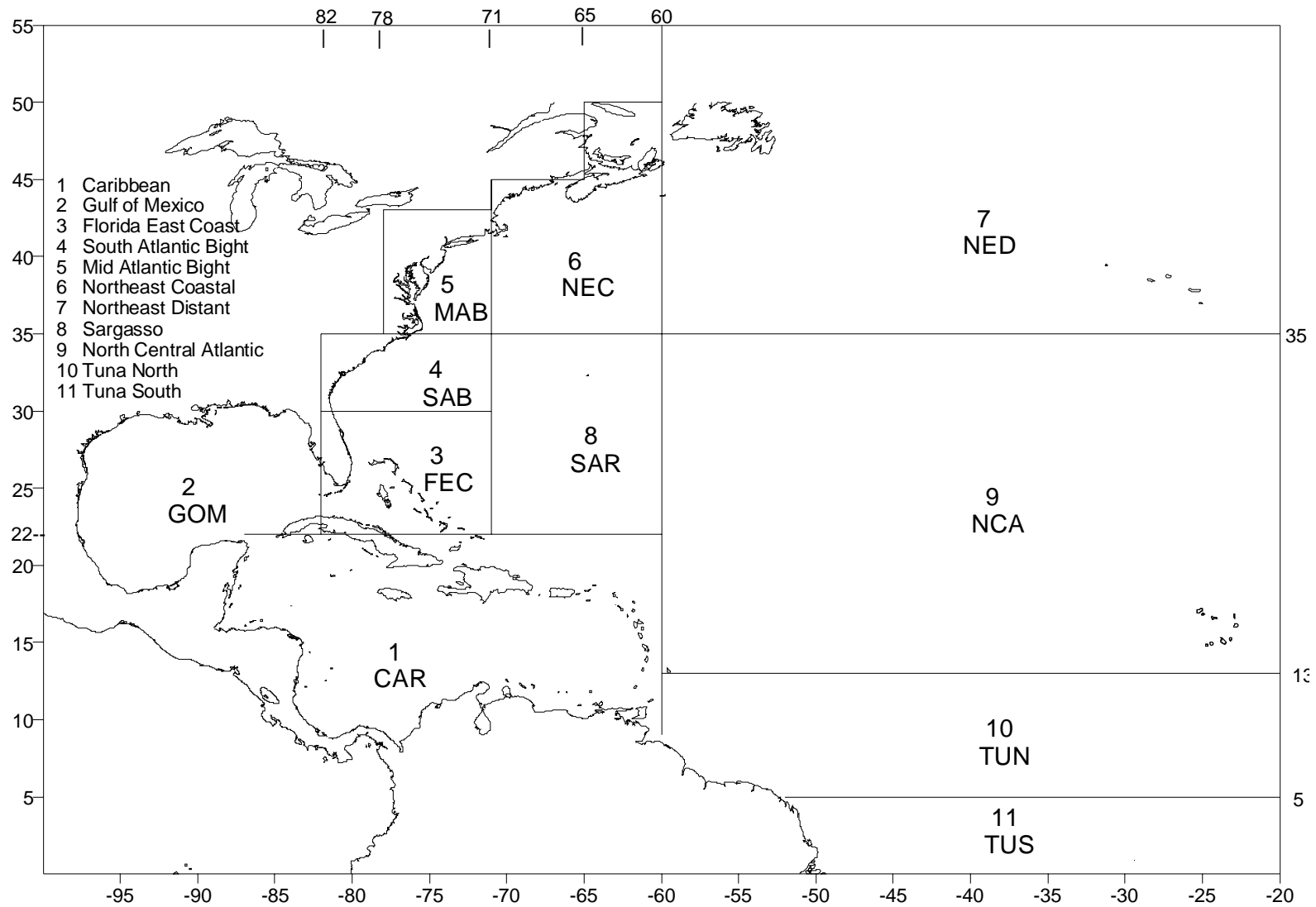


Figure 1. The geographical zones used to classify observed and reported U.S. Atlantic pelagic longline fishing effort. For the purpose of estimation, several strata were combined. The Southeast Coastal (SEC) stratum was defined as areas 3 and 4; the Northeast Coastal (NEC) stratum was defined as areas 5 and 6; and the Offshore South (OFS) was defined as areas 8, 9, 10, and 11. Larger regions were also defined as those generally within the US Atlantic EEZ (USATL: SEC, NEC), other Atlantic waters (OTHATL: OFS, areas 1 and 7); and the Gulf of Mexico (GOM: area 2).

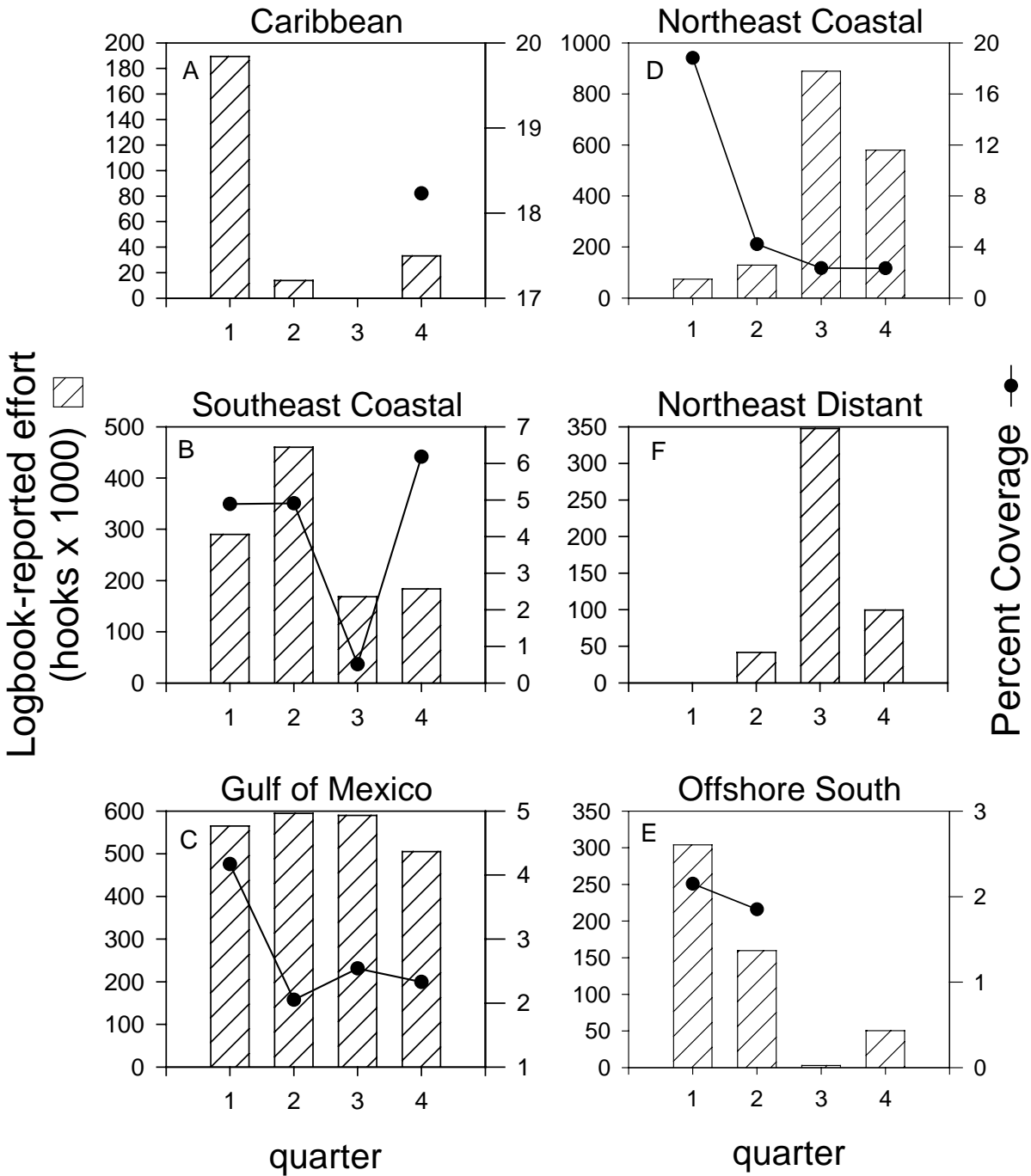


Figure 2. Effort (number of hooks $\times 10^3$) reported in logbook (bar) and percent coverage (observed hooks/reported hooks) (line) in 1998 by calendar quarter for the A) Caribbean (CAR), B) Southeast Coastal (SEC), C) Gulf of Mexico (GOM), D) Northeast Coastal (NEC), E) Northeast Distant (NED), and F) Offshore South (OFS) areas.

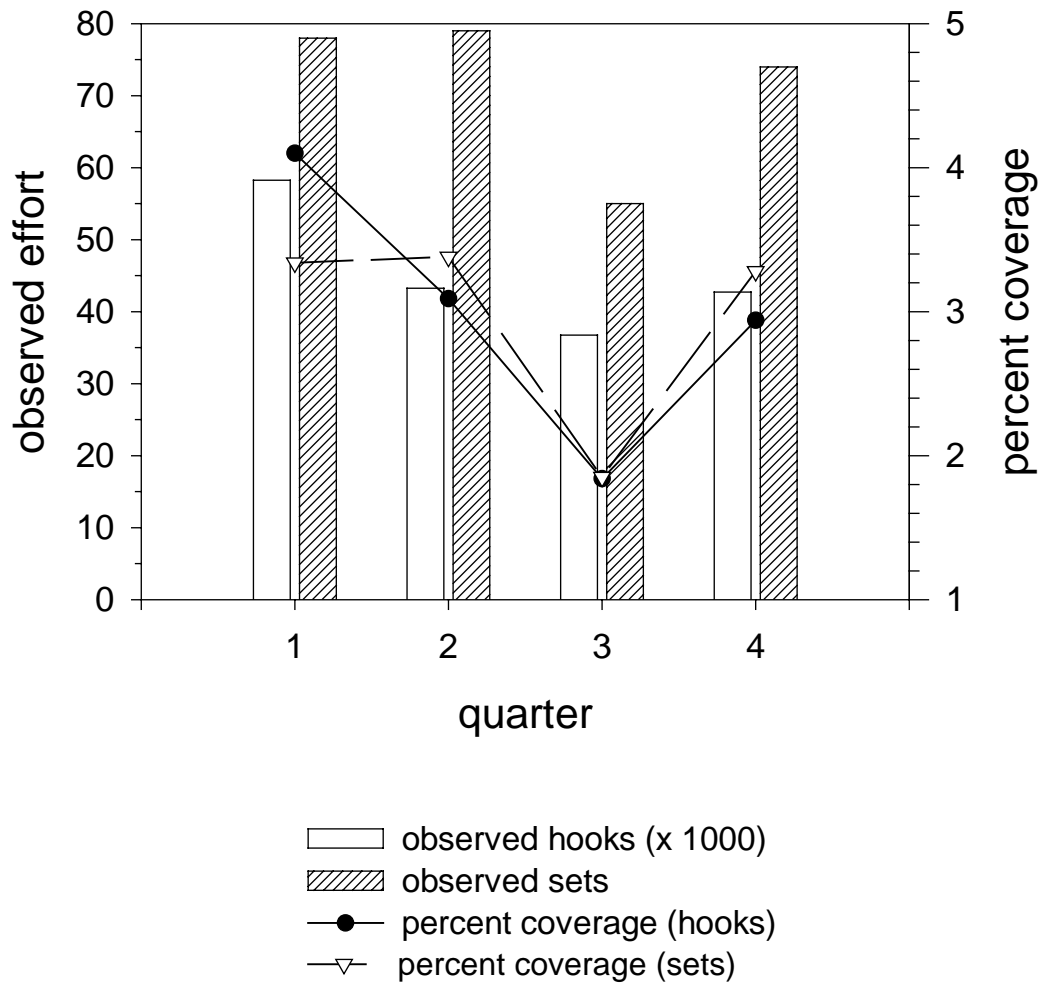


Figure 3. The number of observed hooks and observed sets on board U.S. pelagic longline vessels operating in the Atlantic in 1998. Also indicated are the realized (1998) percent coverage (observed hooks (sets)/logbook-reported hooks (sets)). A 5% coverage, was agreed upon at the 1996 ICCAT Commission meeting (San Sebastian, Spain) for observer sampling of pelagic longline vessels operating in the Atlantic.

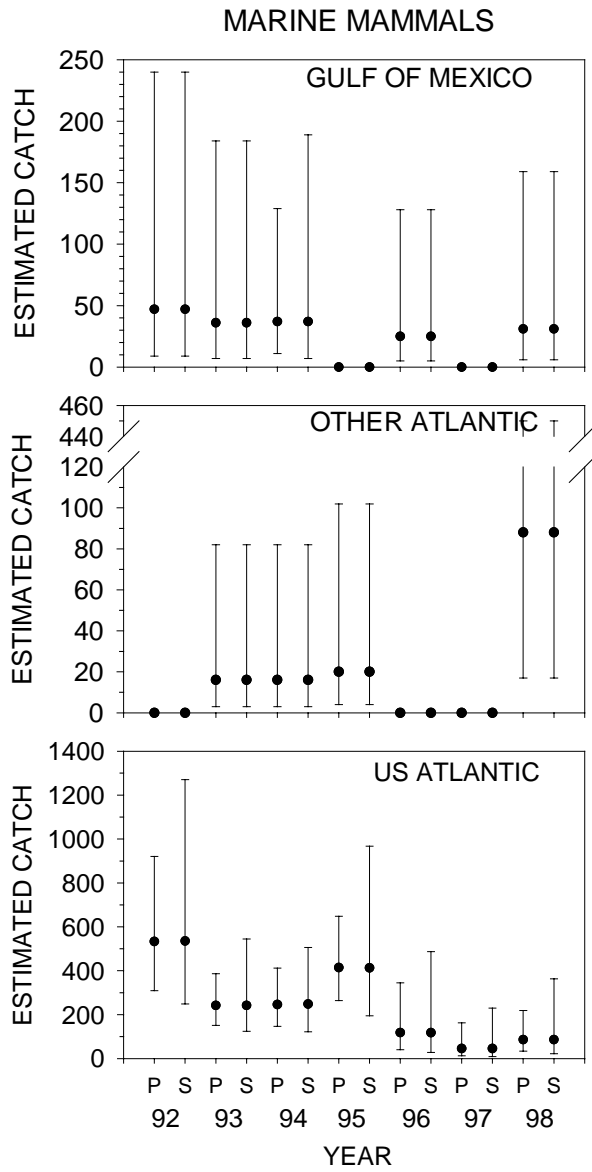


Figure 4. Comparison of stratified (S) and pooled (P) estimates of marine mammal bycatch by the U.S. pelagic longline fishery operating in the major ocean areas (MAREA) in 1992-1998. Considerable gains in precision (shown here as approximate 95% confidence ranges, error bars) can be seen about the central estimates in the pooling method. The point estimates are relatively insensitive to pooling, as is evident in the close proximity of the stratified and pooled point estimates. The stratified estimates represent the sum of independent estimates of different species groupings by major ocean MAREA as shown in Table 7. The pooled estimates are those shown in Table 8.

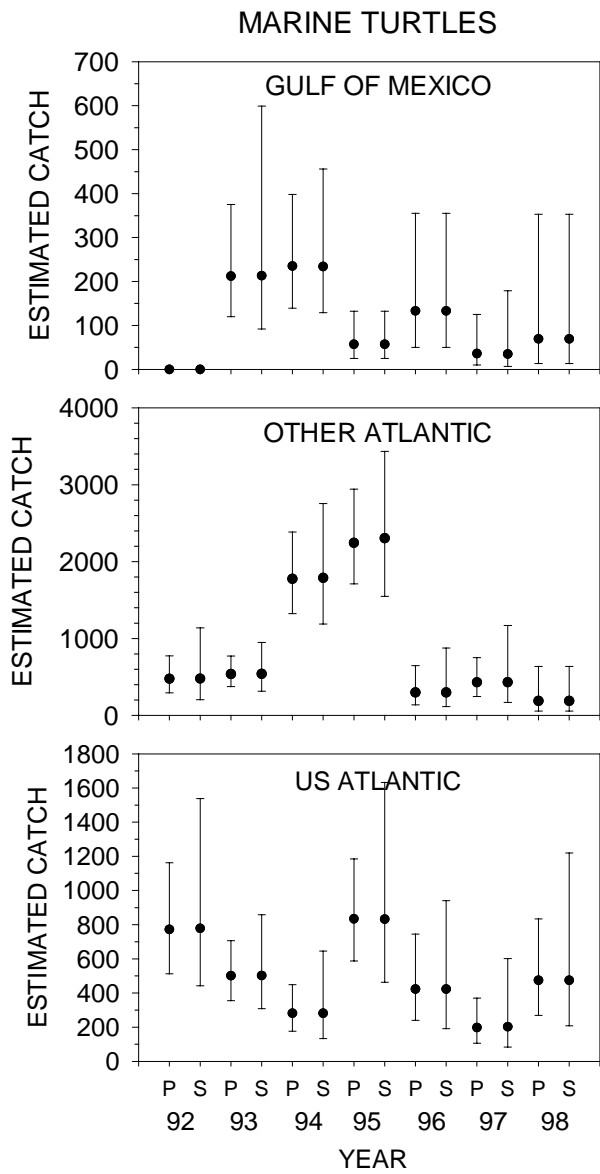


Figure 5. Comparison of stratified (S) and pooled (P) estimates of marine turtle bycatch by the U.S. pelagic longline fishery operating in the major ocean areas (MAREA) in 1992-1998. Considerable gains in precision (shown here as approximate 95% confidence ranges, error bars) can be seen about the central estimates in the pooling method. The point estimates are relatively insensitive to pooling, as is evident in the close proximity of the stratified and pooled point estimates. The stratified estimates represent the sum of independent estimates of different species groupings by MAREA as shown in Table 7. The pooled estimates are those shown in Table 8.

MARINE TURTLES

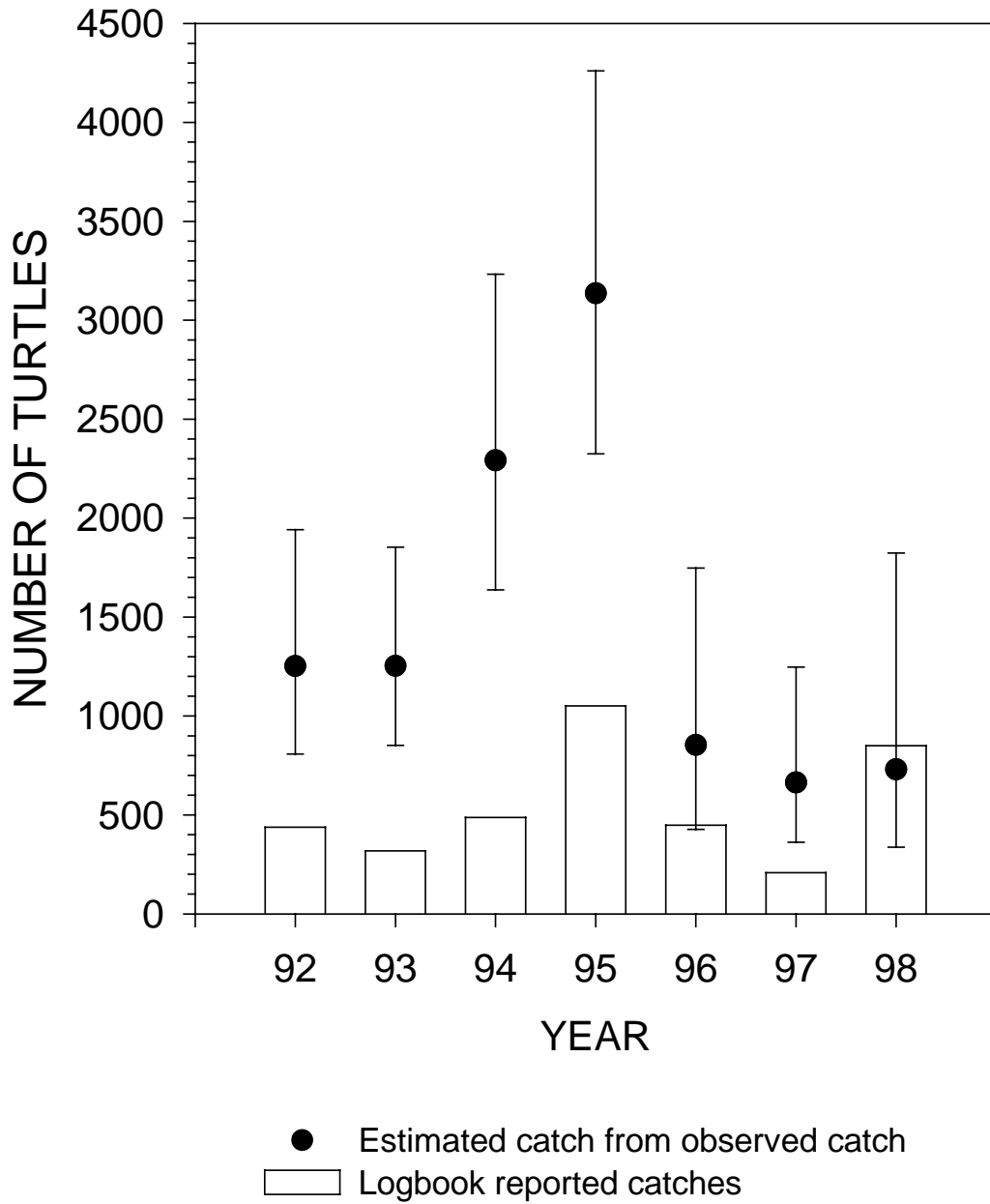


Figure 6. Comparison of annual (1992-1998) estimated marine turtle bycatch from observed sets in the U.S. Atlantic pelagic longline fishery, with 95% confidence intervals for all areas combined (Table 8), and the logbook-reported marine turtle bycatch.