NOAA TECHNICAL MEMORANDUM NMFS-SEFSC-539

Estimated Bycatch of Marine Mammals and Turtles in the U.S. Atlantic Pelagic Longline Fleet During 2005.

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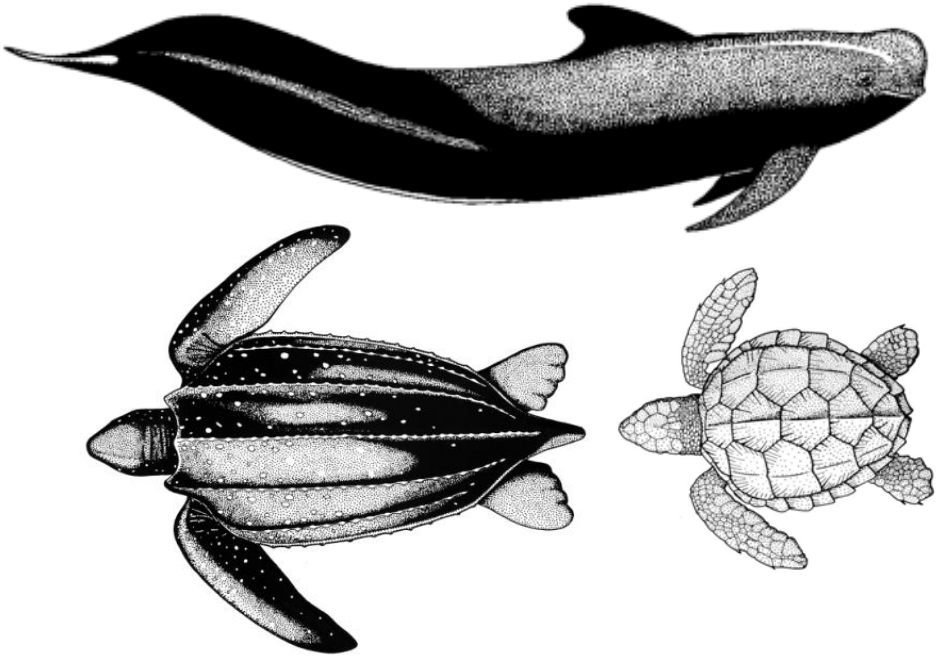

U.S. Department of Commerce
National Oceanic and Atmospheric Administration
NOAA Fisheries
Southeast Fisheries Science Center
75 Virginia Beach Drive
Miami, Florida 33149

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U.S. DEPARTMENT OF COMMERCE
Carlos M. Gutierrez, Secretary

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
Conrad C. Lautenbacher, Jr.
Under Secretary for Oceans and Atmosphere

NATIONAL MARINE FISHERIES SERVICE
William T. Hogarth
Assistant Administrator for Fisheries

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NOTICE

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Director, Protected Resources and Biodiversity Division
Southeast Fisheries Science Center
NOAA Fisheries Service
75 Virginia Beach Drive
Miami, FL 33149

or

National Technical Information Center
5825 Port Royal Road
Springfield, VA 22161
(703) 605-6000, (800) 553-6847
Http://www.ntis.gov/numbers.htm

Abstract

The U.S. Atlantic pelagic longline fleet operates throughout the Gulf of Mexico, along the entire U.S. Atlantic coast over the continental shelf and slope, and in distant water areas including the central North Atlantic and the Canadian Grand Banks. The Atlantic longline fleet is defined as a Category I fishery under the Marine Mammal Protection Act, and it is also the subject of management concerns under the Endangered Species Act due to interactions with leatherback and loggerhead turtles. Total bycatch of marine mammals and turtles in the longline fishery was estimated for 2005 using data from the pelagic longline fishery observer program and a mandatory fishery logbook reporting program. We applied a delta-lognormal approach to estimate region specific and total annual interactions with protected species for the fishery. During 2005, there were an estimated 351 (233 - 529 95%CI) interactions with leatherback turtles (*Dermochelys coriacea*) and 274 (195 - 384 95%CI) interactions with loggerhead turtles (*Caretta caretta*). The primary marine mammal species interacting with this fishery were pilot whales (*Globicephala* sp.) with an estimated 294 (180 – 473 95% CI) interactions and Risso's dolphin (*Grampus griseus*) with 42 (15 – 120 95% CI) interactions. Potential sources of bias and uncertainty in these bycatch estimates are discussed.

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Introduction

Pelagic longline fisheries operate throughout the world's oceans targeting large pelagic fish predators including swordfish, tunas, and sharks. The U.S. Atlantic pelagic longline fleet operates throughout the Gulf of Mexico, along the entire U.S. Atlantic coast over the continental shelf and slope, and in distant water areas including the central North Atlantic and the Canadian Grand Banks (Figure 1). The Atlantic longline fleet is defined as a Category I fishery under the Marine Mammal Protection Act (50 CFR Part 229, Federal Register Vol. 69, No. 135, 15 July 2003) due to frequently documented interactions with marine mammals.

The fishery is also the subject of management concerns under the Endangered Species Act (ESA) due to frequent interactions with marine turtles including leatherback (*Dermochelys coriacea*) and loggerhead turtles (*Caretta caretta*). In June 2004, a biological opinion was issued by the NOAA Fisheries Service, Southeast Regional Office, finding that the U.S. Pelagic Longline Fleet posed a jeopardy to leatherback turtles in the Atlantic Ocean as defined under the ESA. To allow continued operation of the fishery, the biological opinion mandated increases in the frequency in reporting of bycatch, education and outreach programs, and instituted large-scale changes in fishing gear. Most notably, the fishery was required to exclusively use "circle" hooks (size 16/0 or greater) after August, 2004. This mandate was based upon expected reductions in bycatch rate due to hook shape and size demonstrated in experimental studies conducted in the Northeast Distant Water (NED) fishing area (Watson *et al.*, 2005).

In addition to the recently mandated gear changes, several time-area closures were introduced into the fishery in 2000 and 2001 due to concerns over both finfish and protected species bycatch (NMFS 2003, 50 CFR Part 635). These include year-round closures near the Desoto canyon in the Gulf of Mexico after November 1, 2000 (Figure 1, Label A), and in waters off the Atlantic coast of Florida after March 1, 2001 (Figure 1, Label B). Seasonal closures are in effect in the Charleston Bump region between February 1 and April 30 (Figure 1, Label C), and a bluefin tuna area off of the New Jersey coast between June 1- to June 30 (Figure 1, Label D). The NED area had been closed to non-experimental longline fishing since 2001; however, it was reopened to fishing with restrictions on gear types in June, 2004.

During quarters 2 and 3, a cooperative research program (CRP) was conducted aboard six pelagic longline fleet vessels operating in the Gulf of Mexico and off of the U.S. east coast (Figure 2). These trips all had 100% observer coverage. In this project, fishermen conducted experimental fishing activities employing different hook baiting techniques and attaching hook timers and time-depth recorders to the fishing gear. The fishing gear used in this experiment also employed standardized gangion lengths, float line lengths, and other gear characteristics to reduce bias among various experimental treatments. Therefore, the fishing techniques and gear employed during the experimental fishery do not represent those used during "normal" fishing effort, and it is inappropriate to extrapolate bycatch rates observed in these sets across the rest of the reported fishing effort for the quarter. Observed protected species bycatch, and the resulting bycatch rates, are therefore separated between experimental and normal fishing observed during 2005.

The pelagic longline fishery has had a fishery observer program (Pelagic Observer Program, POP) in place since 1992 to document finfish bycatch, characterize fishery behavior, and quantify the interactions with protected species (Beerkircher *et al.*, 2002). In addition, a mandatory fishery logbook system (FLS) has been in place since 1992 requiring boat captains to report fishing effort, gear characteristics, and commercial catch. These data have been used to generate annual estimates of marine mammal and turtle bycatch (Johnson *et al.*, 1999; Yeung, 1999a; Yeung 1999b; Yeung, 2001; Garrison 2003; Garrison 2005; and Garrison and Richards, 2004).

In this report, marine mammal and marine turtle bycatch estimates are calculated for pelagic longline fishery effort during 2005. Bycatch rates (catch per 1000 hooks) are quantified based upon observer data by fishing area and quarter. The estimated bycatch rate is then multiplied by the total fishing effort (number of hooks) reported to the FLS program to obtain estimates of total interactions for each species of marine mammal and turtle.

Methodology

Geographic Stratification

Fishery observer effort is allocated among 11 large geographic areas and calendar quarter based upon the historical fishing range of the fleet (Figure 1). The target annual coverage during the last several years has been 8% of the total reported sets, and observer effort is allocated randomly based upon reported fishing effort during the previous fishing year/quarter/statistical reporting area (Beerkircher *et al.*, 2002). The bycatch estimates developed for each species are stratified by geographic area and quarter to reflect the design of the observer program.

Due to implementation of management actions under the June 2004 Biological Opinion, the pelagic longline fishery used exclusive 16/0 or 18/0 circle hooks throughout 2005. Prior to the 3rd quarter of 2004, the vast majority of fishing effort used smaller J-hooks that may have resulted in higher bycatch rates than those expected for 2005. This significant change in gear types complicates the use of historical data to correct for unobserved cells in 2005. There is insufficient data at this time to fully evaluate the effects of applying circle hooks throughout the fishery on realized turtle bycatch rates. Several options were explored as approaches to account for unobserved cells by applying data from previous years (Appendix C). Based upon this analysis, bycatch rates for quarter-area strata with reported longline fishery sets that had no corresponding observer coverage were replaced with the mean bycatch rate observed in the quarter-area stratum between 2000 and 2004 consistent with approaches in previous years. When additional data become available, a full analysis of the impact of circle hooks on bycatch rates can be conducted to estimate bycatch in unobserved strata.

Delta Estimator

Sets in which a portion of the longline broke away, and therefore had multiple recorded haul times, were combined into single sets. This is consistent with the approach of the most recent mortality estimates (Garrison, 2003; Garrison and Richards, 2004; Garrison, 2005). The mean and variance of catch rates for marine mammals and turtles observed in longline sets, was calculated using a delta estimator (Pennington 1993). The delta estimator is more appropriate than the simple mean because catch rates are generally log-normally distributed and bycatch events (i.e., positive sets) are rare. The

unit of effort in this analysis is the number of hooks, which is consistent with methods used to estimate total catch and bycatch of finfish and previous analyses of protected resource interactions (Johnson *et al.* 1999). The delta mean bycatch rate for each analytical stratum, t, is calculated as:

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

where:

m_t is the number of sets with observed bycatch,

n_t is the total number of observed sets,

L_t is the mean of the log-transformed number of animals taken per 1000 hooks when bycatch occurred,

s_L^2 is the observed sample variance of the log transformed bycatch rate, and

G is the cumulative probability function from the Poisson distribution given as:

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

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

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

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

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

and

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

The C_t calculated above gives the mean number of animals caught per 1000 hooks in the observed trips. To estimate total interactions, *N*, these rates are multiplied by the total number of hooks reported to the FLS database for each analytical stratum. The stratified estimates and associated variances were summed to provide annual estimates for each species. Approximate 95% confidence intervals were calculated assuming lognormal distribution of total mortality as *N/C* and *N·C* for the lower and upper confidence bounds respectively where:

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

and

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

where z_α is 1.906, the z score for $\alpha = 0.05$.

Sea Turtle Life History Form

Detailed information on the characteristics of longline interactions with sea turtles was recorded by the fisheries observers during 2005. These data include detailed descriptions of the type of interaction, the extent of entanglement, the location of any hook attached to the animal or swallowed, and other data (Appendix A). Information on entanglement, hooked animals, and the location of hooks are shown in Table B2.

Marine Mammal Serious Injury Determination

The Marine Mammal Protection Act (MMPA) requires that mortality and serious injury of marine mammals incidental to commercial fishing operations be reduced below Potential Biological Removal (PBR). "Serious injury" has been defined as an injury likely to result in mortality (NOAA Fisheries 50 CFR 229.2, Angliss and DeMaster, 1998). A workshop of NOAA Fisheries and external experts was convened in 1997 to evaluate the types of injuries occurring in commercial fisheries and guidelines for determining if a given marine mammal observed interacting with commercial fishing gear was seriously injured. For small cetaceans, including pilot whales and other delphinids, it was concluded that animals that ingested hooks, were released with significant amounts of trailing fishing gear, were swimming abnormally, or suffered some obvious severe external trauma should be considered seriously injured (Angliss and DeMaster, 1998). Serious injury determinations are made on a case by case basis after reviewing the observations and comments of fishery observers. For this report, observer comments for all takes of marine mammals from 2005 (Table B4) were reviewed and serious injury determinations were verified based upon observer comments and photographs consistent with current NOAA fisheries guidelines.

Results and Discussion

Reported Fishing Effort and Observer Coverage

The total reported pelagic longline fishing effort included 5.91 million hooks during 2005 including 120,558 hooks during experimental fishing (Table 1A). The reported fishery efforts included 7,883 sets during 2005, and of these 796 were observed

by the POP program for an overall coverage of 10.1% (Tables 1-3, Figure 2). In non-experimental fishing, the overall percent coverage was 7.7% expressed as a proportion of reported sets or 8.1% as a proportion of hooks. Observer coverage for specific area-quarter strata typically ranged between 4 and 9 % of reported sets (Table 3).

A total of 204 experimental sets were made in the NEC, GOM, FEC, MAB, and SAB fishing areas primarily during the second and third quarters. These experimental sets had 100% observer coverage, and were thus separated from the normal commercial fishery. Data from these sets are labeled "NCE, FCE, GME, MBE, and SBE" in the summary tables (Tables 1-3, Figure 2).

The area-quarter strata with reported fishing effort but with no observer coverage are identified in Table 3. Observer coverage was available for the majority of these within the previous five years with the exception of the NED in quarter 2 and in the TUN area for all four quarters. There has been very little historical observer coverage of the TUN area, and therefore no bycatch estimate is possible for that region.

Observed Protected Species Interactions

There were a total of 43 observed interactions with leatherback turtles and 25 with loggerheads (Table 4, Figure 3, Table B1) in 2005. One leatherback turtle was observed freshly dead on capture. The greatest number of leatherback takes occurred in the GOM region during the 1st, 2nd and 4th quarters followed by the GME, NEC and SAR regions (Table 4A, Figure 3, Table B1). Loggerhead takes were taken in the greatest numbers in the NEC during the 3rd quarter, followed by the MAB, SAR and SAB (Table 4B, Figure 3, Table B1). Ten leatherback turtles were captured during experimental fishing, with

nine of these occurring in the Gulf of Mexico. No loggerhead turtle captures occurred during experimental fishing (Table 4).

The vast majority of the turtles were characterized as being released alive and injured (i.e., most had been hooked) based upon recorded information on the sea turtle life history form (Table 5A-5B, Table B2). Leatherback turtles were most typically hooked externally, while loggerhead turtles primarily swallowed the hook or were hooked in the mouth (Table 5B). All gear was removed before release from 55 of the 68 turtles captured. Removing gear was most difficult from loggerheads that had swallowed the hook (Table 5).

There were a total of 24 interactions observed with marine mammals during 2005 (Table 6, Table B3, and Figure 4). The majority of these interactions was observed in the MAB region, and was with pilot whales (*Globicephala* sp.). Three marine mammal interactions were observed in experimental fishing, and these were all pilot whales in the MAB region. Ten of the observed marine mammal interactions were categorized as serious injuries, with all but one of these being pilot whales (Table 7). All except one of the serious injuries involved being hooked in the mouth and/or released with a significant amount of entangling gear (Table 7, Table B4).

Total Estimated Bycatch and Mortality

Stratum estimates of mortality and total interactions for marine turtles are shown in Table 8. During 2005, high leatherback estimated interactions occurred in the Gulf of Mexico and Florida East Coast regions during quarter 1, the GOM in quarter 2, the Northeast Coastal and Northeast Distant regions during quarter 3, and the GOM during

quarter 4 (Table 8A, Figure 3). For loggerhead turtles, the highest takes occurred during the 3rd quarter in the NEC area, and numbers approximately half as great were taken in the CAR during quarter 1, and the MAB during the 3rd quarter (Table 8B, Figure 3).

The quarter-area strata estimates for marine mammal mortality, serious injury, and live releases are presented in Table 9. The majority of marine mammal serious injury occurred in the Mid-Atlantic Bight region during the second quarter (Table 9A, Figure 4). However, it should be noted that only two sets were observed in this stratum, and both included pilot whale interactions. The relatively low observer coverage (1.6%) in this stratum may have resulted in spuriously high estimated interaction and serious injury rates with an artificially low variance. Experimental fishing in the second quarter in the MAB also included high rates of interactions with pilot whales.

The average bycatch rates and estimated catches in strata that were not observed during 2005 across the previous 5 years (2000-2004) are summarized in Table 10. The highest estimated take from these unobserved areas were for loggerheads including 67.0 in the NEC during quarter 3 and 26.7 in the SAR during quarter 1 (Table 10).

There were estimated to be a total of 351 (233 – 529 95% CI) interactions with leatherback turtles during 2005 (Table 11A). During 2005, the interactions with leatherback turtles were highest (179 animals) in the Gulf of Mexico. For loggerhead turtles, there were an estimated total of 274 interactions (195– 384 95% CI) during 2005. The majority of these interactions occurred in the NEC, MAB, CAR, SAR, and SAB (Table 11B).

The leatherback take estimate reached a historical high in 2004, and showed a nearly linear increase in the estimates since 1998 (Figure 5A). A significant decrease in

the overall leatherback bycatch rate and the total estimated number of interactions with leatherback turtles occurred in 2005. Likewise, loggerhead turtle interactions had been increasing since 2000, though not to historically high levels (Figure 5B). As with leatherbacks, the estimated loggerhead interactions declined in 2005.

These reductions in bycatch are in part correlated with a decrease in effort, particularly during quarters 2-4 in the Gulf of Mexico where leatherback interactions have been highest in recent years. The overall effort level in the GOM declined by 27% relative to 2004, and the effort was approximately 50% lower in the GOM during quarters 3 and 4, 2005 relative to those quarters in 2004. These reductions are largely associated with the impacts on the fleet from Hurricanes Katrina and Rita.

The declines in turtle bycatch rates are also correlated with the major changes in gear characteristics implemented during the later half of 2004. The fishery switched from one dominated by J-hooks to one fishing exclusively 16/0 and 18/0 sized circle hooks. This switch in gear was expected to produce a reduction in interaction rates based upon experimental work in the NED. Overall, there is an observed reduction in bycatch rate in 2005 compared to 2004. The 2004 estimates of leatherback interactions was 1,358 turtles and that for loggerheads was 734 with a total effort of 7,186 hooks (Garrison, 2005). Dividing the total estimate by the number of hooks provides an overall measure of the bycatch rate, and this ratio was 0.1889 for leatherbacks and 0.1021 for loggerheads in 2004. For 2005, these ratios were 0.0608 and 0.0474 (Table 1, Table 11) reflecting a 68% reduction in the bycatch rate for leatherbacks and a 53% reduction in bycatch rate for loggerheads. However, it is possible that the observed reduction in bycatch rate is associated with the changes in the spatial distribution and level of fishing effort following

Hurricane Katrina or other sources of inter-annual variability. The decrease in observed and reported effort in the Gulf of Mexico, where takes have been high in past years, may impact this bycatch rate as well as the overall estimate of total interactions. Additional years of data will be required to fully assess the impacts of the management efforts imposed to reduce turtle bycatch in the longline fishery.

A total of 208 pilot whales and 13 Risso's dolphins are estimated to have suffered serious injury in the longline fishery during 2005 (Table 12). The total estimated number of interactions was 291 (180 - 470 95% CI) for pilot whales and 36 (11 – 117 95% CI) for Risso's dolphins (Table 12). For pilot whales, the 2005 estimate reflects an increasing trend since 2003 (Figure 6). This is occurring despite an overall reduction in effort, though the level of effort during 2005 was similar to that in 2004 in the MAB where most of these interactions occur. However, the 2005 estimate may be biased by the very low level of observer coverage during the second quarter and the observation of two interactions on the two observed sets in this stratum. The apparent increase in pilot whale interaction rates over the last several years is a cause for concern that requires continued monitoring.

Sources of Bias and Uncertainty

The fishery logbook data is a mandatory reporting program, and thus it is expected that reporting rates are generally high. Due to the intense management focus on the longline fishery, there has been close monitoring of reporting rates, and observed trips can be directly linked to reported effort. In general, the gear characteristics and amount

of observed effort is consistent with the reported effort. However, underreporting is possible in this fishery and would result in a direct negative bias in bycatch estimates.

Observer coverage in the pelagic longline fishery is generally high, particularly in comparison to that of other commercial fisheries. The sampling level, on average, is sufficient to provide reasonable quantification of interactions with protected species. The observed coefficients of variation for annual estimates of both loggerhead and leatherback turtles are <30%, which is consistent with guidelines for precision set by NOAA Fisheries. However, in some strata there is little or no coverage during particular times of year. During 2005, the most notable gaps in coverage occurred in the TUN which had no observer coverage. In the NEC region during quarter 3, the FEC region during quarter 3, the NED area during quarters 2 and 4, the SAR area during quarter 1, and the SAB region during quarter 4, and the CAR during quarter 2, there were more than 10 longline sets reported, with no observer coverage. Applying observer data from previous years is inherently uncertain since bycatch rates can vary significantly in time and space. This is particularly problematic for this year, where the fishery effort from previous years included almost exclusively J-hooks, and the 2005 effort includes exclusively circle hooks. Estimates for those strata supplemented by previous observer coverage should therefore be treated with extreme caution.

For some strata, there has been no recent observer coverage, and thus regional and annual estimates of bycatch are potentially negatively biased. The most glaring omission is the low current and historical coverage of the offshore areas including the TUN regions. These offshore strata traditionally have low levels of observer coverage, and

therefore it is currently unknown if there are significant interactions with protected species in these sectors of the longline fishery.

The delta estimator was applied to calculate bycatch rates primarily to maintain consistency with previous estimates for this fishery (Johnson *et al.*, 1999; Yeung, 1999a; Yeung, 1999b; Yeung, 2001; Garrison, 2003; Garrison and Richards, 2004; Garrison, 2005). This approach assumes 1) that catch rates (animals per hook) are lognormally distributed and 2) that the number of hooks is an appropriate unit of effort. The first assumption was critically examined for turtles in Johnson *et al.* (1999); however, is difficult to verify for marine mammals given the generally low rate of these interactions. The delta estimator is sensitive to the assumption of log-normality, and violations of this assumption may result in biased (positive or negative) estimates of catch rate and associated variances. The second assumption has not been examined critically in previous analyses. The current approach assumes that total bycatch is linearly related to the total number of hooks fished. If this assumption is not correct, for example if there are saturation effects resulting in a non-linear relationship between the number of hooks and total catch, then there is potentially a direct bias, of unknown direction, in the estimate of total bycatch. This assumption is currently being evaluated along with other potential units of effort and statistical approaches to avoid bias and improve precision in bycatch estimates for the pelagic longline fleet.

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List of Tables and Figures

Table 9. Estimated (A) Serious Injury, (B) Live Releases, and (C) Total Interactions with marine mammals in the pelagic longline fishery during 2005 by fishing area and quarter.

Table 10. Estimated interactions in the pelagic longline fishery for strata with reported fishing effort but no observer coverage during 2005. Bycatch rates are the average of the stratum rates during the previous five years (2000-2004) where there was observer coverage. These rates exclude experimental fishing in previous years. Estimates are presented for those strata with previously observed bycatch. In the case of Risso's dolphins, the previously observed catch was a live release. All previously observed turtle catches were likewise released alive (injured or uninjured).

Table 11. Total estimated interactions with (A) Leatherback and (B) Loggerhead turtles in the pelagic longline fishery during 2005 by fishing area. These estimates include extrapolated values for areas with no observer coverage during 2005 that had observed interactions during the past five years (Table 10).

Table 12. Total estimated interactions with marine mammals in the pelagic longline fishery during 2005. These estimates include extrapolated values for areas with no observer coverage during 2005 that had observed interactions during the past five years (Table 10).

Figure 1. Pelagic longline fishing areas in the north Atlantic ocean indicating 11 defined fishing areas. CAR = Caribbean, GOM = Gulf of Mexico, FEC = Florida East Coast, SAB = South Atlantic Bight, SAR = Sargasso Sea, MAB = Mid-Atlantic bight, NEC = Northeast Coastal, NED = Northeast Distant, NCA = North Central Atlantic, TUN = Tuna North, TUS = Tuna South. Pelagic longline closed areas are indicated by shaded polygons and letter labels (A-E). The NED area was reopened on June 30, 2004.

Figure 2. Observed (grey symbols) and reported (dark symbols) pelagic longline fishing effort during 2005.

Figure 3. Observed pelagic longline fishing effort and marine turtle takes during 2005.

Figure 4. Observed pelagic longline fishing effort and marine mammal takes during 2005.

Figure 5. Historical trends in fishery effort and estimated marine turtle takes in the pelagic longline fishery between 1992 and 2005.

Figure 6. Historic trends in fishery effort and estimated marine mammal takes in the pelagic longline fishery between 1992 and 2005. Errors bars represent 95% confidence intervals.

Table 1. Total amount of fishing effort reported to the pelagic longline logbook program during 2005 by quarter and fishing area. Fishing effort is reported as A) Number of hooks (thousands) and B) Number of sets. FCE, GME, MBE, NCE, and SBE indicate experimental sets in the FEC, GOM, MAB, NEC and SAB fishing areas, respectively.

A. Number of Hooks (thousands)

Quarter	CAR	FEC	GOM	MAB	NCA	NEC	NED	SAB	SAR	TUN	TUS	FCE	GME	MBE	NCE	SBE	Total
1	151.2	186.6	975.4	76.9	17.8	0	0	62.2	47.6	35.9	0	0	0	0	0	0	1553.6
2	27.9	76.0	1047.8	93.1	37.9	40.9	58.6	298.3	0.9	20.2	0	3.6	58.6	4.9	0	3.8	1773.0
3	0	32.5	530.6	355.2	0	225.9	364.0	60.2	0	22.2	0	4.4	33.1	3.7	29.2	5.8	1666.9
4	0	20.5	382.0	303.9	0	60.7	39.9	34.2	59.1	14.1	0	0	2.2	0	0	0	916.6
Total	**179.1**	**315.6**	**2935.8**	**829.1**	**55.7**	**327.5**	**462.5**	**454.9**	**107.6**	**92.4**	**0**	**8.0**	**94.3**	**8.6**	**29.2**	**9.6**	**5910.0**

B. Number of Sets

Quarter	CAR	FEC	GOM	MAB	NCA	NEC	NED	SAB	SAR	TUN	TUS	FCE	GME	MBE	NCE	SBE	Total
1	166	290	1253	134	22	0	0	87	50	43	0	0	0	0	0	0	2045
2	30	127	1324	170	42	53	64	434	1	27	0	8	99	7	0	9	2395
3	0	85	692	521	0	270	356	120	0	25	0	9	51	4	34	13	2180
4	0	52	516	421	0	76	43	72	60	19	0	0	4	0	0	0	1263
Total	**196**	**554**	**3785**	**1246**	**64**	**399**	**463**	**713**	**111**	**114**	**0**	**17**	**154**	**11**	**34**	**22**	**7883**

Table 2. Total amount of fishing effort observed during 2005 by quarter and fishing area. Fishing effort is reported as A) Number of hooks (thousands) and B) Number of Sets. FCE, GME, MBE, NCE, and SBE indicate experimental sets in the FEC, GOM, MAB, NEC and SAB fishing areas, respectively. Dashes indicate cells where no fishery effort was reported.

A. Number of Hooks (thousands)

Quarter	CAR	FEC	GOM	MAB	NCA	NEC	NED	SAB	SAR	TUN	TUS	FCE	GME	MBE	NCE	SBE	Total
1	8.1	9.0	90.3	12.3	4.1	-	-	8.6	0	0	-	-	-	-	-	-	132.4
2	0	9.9	74.3	1.5	11.9	1.1	0	27.7	0	0	-	4.7	57.8	4.9	-	3.7	197.5
3	-	0	40.9	31.8	-	0	14.1	7.7	-	0	-	4.4	33.1	3.7	36.7	5.8	178.2
4	-	0.7	32.4	21.7	-	3.0	0	0	21.5	0	-	-	2.4	-	-	-	81.7
Total	**8.1**	**19.6**	**237.9**	**67.3**	**16.0**	**4.1**	**14.1**	**44.0**	**21.5**	**0**	**-**	**9.1**	**93.3**	**8.6**	**36.7**	**9.5**	**589.8**

B. Number of Sets

Quarter	CAR	FEC	GOM	MAB	NCA	NEC	NED	SAB	SAR	TUN	TUS	FCE	GME	MBE	NCE	SBE	Total
1	10	16	113	21	5	-	-	13	0	0	-	-	-	-	-	-	178
2	0	16	87	2	11	1	0	37	0	0	-	11	96	7	-	9	277
3	-	0	48	42	-	0	14	15	-	0	-	9	51	4	43	13	239
4	-	2	45	27	-	3	0	0	21	0	-	-	4	-	-	-	102
Total	**10**	**34**	**293**	**92**	**16**	**4**	**14**	**65**	**21**	**0**	**-**	**20**	**151**	**11**	**43**	**22**	**796**

Table 3. Percentage of reported fishing effort observed during 2005 by quarter and fishing area by A) Number of Hooks and B) Number of Sets. Dashes indicate no reported fishing effort. Cells in which >10 longline sets were reported with no observer coverage are indicated in bold. All experimental sets (FCE, GME, MBE, NCE and SBE) had 100% observer coverage. Totals indicate overall percentage coverage by area and quarter in non-experimental sets.

A. Number of Hooks

Quarter	CAR	FEC	GOM	MAB	NCA	NEC	NED	SAB	SAR	TUN	TUS	Total
1	5.37	4.84	9.26	15.97	22.88	-	-	13.86	**0**	**0**	-	**8.53**
2	**0**	13.08	7.09	1.61	31.36	2.64	**0**	9.29	0	**0**	-	**7.36**
3	-	**0**	7.71	8.96	-	**0**	3.88	12.75	-	**0**	-	**5.94**
4	-	3.40	8.48	7.15	-	5.00	**0**	**0**	36.35	**0**	-	**8.34**
Total	**4.53**	**6.23**	**8.10**	**8.12**	**28.65**	**1.26**	**3.06**	**9.68**	**19.96**	**0**	**-**	**7.44**

B. Number of Sets

Quarter	CAR	FEC	GOM	MAB	NCA	NEC	NED	SAB	SAR	TUN	TUS	Total
1	6.02	5.52	9.02	15.67	22.73	-	-	14.94	**0**	**0**	-	**8.70**
2	**0**	12.60	6.57	1.18	26.19	1.89	**0**	8.53	0	**0**	-	**6.73**
3	-	**0**	6.94	8.06	-	**0**	3.93	12.50	-	**0**	-	**5.75**
4	-	3.85	8.72	6.41	-	3.95	**0**	**0**	35.00	**0**	-	**7.54**
Total	**5.10**	**6.14**	**7.74**	**7.38**	**25.00**	**1.00**	**3.02**	**9.12**	**18.92**	**0**	**-**	**7.13**

Table 4. Total number of observed interactions with A) Leatherback turtles, B) Loggerhead turtles, and C) All marine turtles in the pelagic longline fishery during 2005 by quarter and fishing area. Dashes indicate areas where there was no observed fishing effort, and an X indicates an area where no effort was reported. Only loggerhead and leatherback turtles were observed captured.

A. Leatherback Turtles

Quarter	CAR	FEC	GOM	MAB	NCA	NEC	NED	SAB	SAR	TUN	TUS	FCE	GME	MBE	NCE	SBE	Total
1	0	3	6	0	0	x	x	0	-	-	x	x	x	x	x	x	9
2	-	0	4	0	0	0	-	0	-	-	x	0	7	0	x	0	11
3	x	-	0	1	x	-	2	0	x	-	x	1	2	0	7	0	13
4	x	0	5	0	x	0	-	-	5	-	x	x	0	x	x	x	10
Total	**0**	**3**	**15**	**1**	**0**	**0**	**2**	**0**	**5**	**-**	**x**	**1**	**9**	**0**	**7**	**0**	**43**

B. Loggerhead Turtles

Quarter	CAR	FEC	GOM	MAB	NCA	NEC	NED	SAB	SAR	TUN	TUS	FCE	GME	MBE	NCE	SBE	Total
1	2	0	2	1	0	x	x	2	-	-	x	x	x	x	x	x	7
2	-	0	0	0	1	0	-	0	-	-	x	0	0	0	x	0	1
3	x	-	0	3	x	-	0	1	x	-	x	0	0	0	8	0	12
4	x	0	0	1	x	0	-	-	4	-	x	x	0	x	x	x	5
Total	**2**	**0**	**2**	**5**	**1**	**0**	**0**	**3**	**4**	**-**	**x**	**0**	**0**	**0**	**8**	**0**	**25**

C. All Turtles

Quarter	CAR	FEC	GOM	MAB	NCA	NEC	NED	SAB	SAR	TUN	TUS	FCE	GME	MBE	NCE	SBE	Total
1	2	3	8	1	0	x	x	2	-	-	x	x	x	x	x	x	16
2	-	0	4	0	1	0	-	0	-	-	x	0	7	0	x	0	12
3	x	-	0	4	x	-	2	1	x	-	x	1	2	0	15	0	25
4	x	0	5	1	x	0	-	-	9	-	x	x	0	x	x	x	15
Total	**2**	**3**	**17**	**6**	**1**	**0**	**2**	**3**	**9**	**-**	**x**	**1**	**9**	**0**	**15**	**0**	**68**

Table 5. Summary of (A) Release condition, (B) Hook location in hooked animals, and (C) Animals with all gear removed, by hook location for marine turtles in the pelagic longline fishery during 2005. Hook location information is recorded on the sea turtle life history form (Appendix A) by the observer.

A. Release condition

Species	Alive, injured	Alive, uninjured	Alive, unknown	Fresh dead	Total
Leatherback	36	6	0	1	**43**
Loggerhead	23	1	1	0	**25**
Total	**59**	**7**	**1**	**1**	**68**

B. Hook Location

				Internal			External	
Species	**Not Hooked**	**Unknown if Hooked**	**Hooked, Location Unknown**	**Unknown Internal**	**Swallowed**	**Beak/Mouth**		**Total**
Leatherback	7	0	1	0	0	3	32	**43**
Loggerhead	1	1	0	0	8	14	1	**25**
Total	**8**	**1**	**1**	**0**	**8**	**17**	**33**	**68**

C. Animals with all gear removed, by hook location

				Internal			External	
Species	**Not Hooked**	**Unknown if Hooked**	**Hooked, Location Unknown**	**Unknown Internal**	**Swallowed**	**Beak/Mouth**		**Total**
Leatherback	7	0	0	0	0	3	25	**35**
Loggerhead	1	1	0	0	3	14	1	**20**
Total	**8**	**1**	**0**	**0**	**3**	**17**	**26**	**55**

Table 6. Total number of observed interactions with marine mammals in the pelagic longline fishery during 2005 by quarter and fishing area. Dashes indicate areas where there was no observed fishing effort, and an X indicates an area where no effort was reported.

Quarter	CAR	FEC	GOM	MAB	NCA	NEC	NED	SAB	SAR	TUN	TUS	FCE	GME	MBE	NCE	SBE	Total
1	0	0	1	0	0	x	x	1	-	-	x	x	x	x	x	x	2
2	-	0	0	2	0	0	-	0	-	-	x	0	0	3	x	0	5
3	x	-	1	11	x	-	0	0	x	-	x	0	0	0	0	0	12
4	x	0	0	2	x	1	-	-	2	-	x	x	0	x	x	x	5
Total	**0**	**0**	**2**	**15**	**0**	**1**	**0**	**1**	**2**	**-**	**x**	**0**	**0**	**3**	**0**	**0**	**24**

Table 7. Summary of release condition and serious injury types for marine mammals in the pelagic longline fishery during 2005. Serious injury determinations were based upon written observer comments (Table B3). "Entangled" indicates that the animal was released with > 4 feet of gear remaining attached.

Species	Alive	Dead	Serious Injury Type				Total
			Mouth hooked	Entangled	Mouth Hooked & entangled	Serious injury total	
Atlantic Spotted Dolphin	1	0	0	0	0	0	**1**
Bottlenose Dolphin	1	0	0	0	0	0	**1**
Pilot Whale	9	0	2	1	6	9	**18**
Risso's Dolphin	2	0	0	0	0	0	**2**
Unidentified Dolphin	1	0	0	0	0	0	**1**
Unidentified Marine Mammal	0	0	1	0	0	1	**1**
Total	**14**	**0**	**3**	**1**	**6**	**10**	**24**

Table 8. Estimated interactions with marine turtles in the pelagic longline fishery during 2005 by fishing area and quarter, including (A) Observed mortalities, (B) Live captures, and (c) Total interactions.

A. Observed Mortalities

Species	Quarter	Area	# Positive Sets	# Observed Sets	Mean CPUE	CV	Hooks Reported (x1000)	Estimated Catch
Leatherback	4	GOM	1	45	0.0404	1.000	382.0	15.4

B. Released Alive

Species	Quarter	Area	# Positive Sets	# Observed Sets	Mean CPUE	CV	Hooks Reported (x1000)	Estimated Catch
Leatherback	1	FEC	2	16	0.3262	0.7455	186.6	60.9
Leatherback	1	GOM	5	113	0.0672	0.4533	975.4	65.5
Leatherback	2	GOM	4	87	0.0524	0.5087	1047.8	54.9
Leatherback	4	GOM	4	45	0.1139	0.4941	382.0	43.5
Leatherback	3	MAB	1	42	0.0310	1.0000	355.2	11.0
Leatherback	3	NED	2	14	0.1417	0.6794	364.0	51.6
Leatherback	4	SAR	5	21	0.2385	0.4041	59.1	14.1
Loggerhead	1	CAR	2	10	0.2525	0.6667	151.2	38.2
Loggerhead	1	GOM	2	113	0.0190	0.7040	975.4	18.6
Loggerhead	1	MAB	1	21	0.0496	1.0000	76.9	3.8
Loggerhead	3	MAB	3	42	0.1026	0.5906	355.2	36.4
Loggerhead	4	MAB	1	27	0.0441	1.0000	303.9	13.4
Loggerhead	2	NCA	1	11	0.0842	1.0000	37.9	3.2
Loggerhead	1	SAB	1	13	0.3017	1.0000	62.2	18.8
Loggerhead	3	SAB	1	15	0.1201	1.0000	60.2	7.2
Loggerhead	4	SAR	3	21	0.1932	0.5717	59.1	11.4

Table 8 (cont.)

C. Total Interactions

Species	Quarter	Area	# Positive Sets	# Observed Sets	Mean CPUE	CV	Hooks Reported (x1000)	Estimated Catch
Leatherback	1	FEC	2	16	0.3262	0.7455	186.6	60.9
Leatherback	1	GOM	5	113	0.0672	0.4533	975.4	65.5
Leatherback	2	GOM	4	87	0.0524	0.5087	1047.8	54.9
Leatherback	4	GOM	5	45	0.1544	0.4399	382.0	58.9
Leatherback	3	MAB	1	42	0.0310	1.0000	355.2	11.0
Leatherback	3	NED	2	14	0.1417	0.6794	364.0	51.6
Leatherback	4	SAR	5	21	0.2385	0.4041	59.1	14.1
Loggerhead	1	CAR	2	10	0.2525	0.6667	151.2	38.2
Loggerhead	1	GOM	2	113	0.0190	0.7040	975.4	18.6
Loggerhead	1	MAB	1	21	0.0496	1.0000	76.9	3.8
Loggerhead	3	MAB	3	42	0.1026	0.5906	355.2	36.4
Loggerhead	4	MAB	1	27	0.0441	1.0000	303.9	13.4
Loggerhead	2	NCA	1	11	0.0842	1.0000	37.9	3.2
Loggerhead	1	SAB	1	13	0.3017	1.0000	62.2	18.8
Loggerhead	3	SAB	1	15	0.1201	1.0000	60.2	7.2
Loggerhead	4	SAR	3	21	0.1932	0.5717	59.1	11.4

Table 9. Estimated (A) Serious Injury, (B) Live Releases, and (C) Total Interactions with marine mammals in the pelagic longline fishery during 2005 by fishing area and quarter.

A. Serious Injury

Species	Quarter	Area	# Positive Sets	# Observed Sets	Mean CPUE	CV CPUE	# Hooks Reported (x1000)	Estimated Catch
Pilot Whale	2	MAB	2	2	1.3369	0.0000	93.1	124.5
Pilot Whale	3	MAB	3	42	0.2005	0.5878	355.2	71.2
Pilot Whale	4	MAB	1	27	0.0412	1.0000	303.9	12.5
Unidentified Marine Mammal	3	GOM	1	48	0.0248	1.0000	530.6	13.2

B. Released Alive

Species	Quarter	Area	# Positive Sets	# Observed Sets	Mean CPUE	CV CPUE	# Hooks Reported (x1000)	Estimated Catch
Atlantic Spotted Dolphin	4	SAR	1	21	0.0735	1.0000	59.1	4.3
Bottlenose Dolphin	1	SAB	1	13	0.0833	1.0000	62.2	5.2
Pilot Whale	3	MAB	5	42	0.1887	0.4860	355.2	67.0
Pilot Whale	4	MAB	1	27	0.0412	1.0000	303.9	12.5
Risso's Dolphin	1	GOM	1	113	0.0126	1.0000	975.4	12.3
Risso's Dolphin	4	NEC	1	3	0.3490	1.0000	60.7	21.2
Unidentified Dolphin	4	SAR	1	21	0.0441	1.0000	59.1	2.6

Table 9 cont.

C. Total Interactions

Species Name	Quarter	Area	# Positive Sets	# Observed Sets	Mean CPUE	CV CPUE	# Hooks Reported (x1000)	Estimated Catch
Atlantic Spotted Dolphin	4	SAR	1	21	0.0735	1.0000	59.1	4.3
Bottlenose Dolphin	1	SAB	1	13	0.0833	1.0000	62.2	5.2
Pilot Whale	2	MAB	2	2	1.3369	0.0000	93.1	124.5
Pilot Whale	3	MAB	6	42	0.3987	0.4952	355.2	141.6
Pilot Whale	4	MAB	1	27	0.0823	1.0000	303.9	25.0
Risso's Dolphin	1	GOM	1	113	0.0126	1.0000	975.4	12.3
Risso's Dolphin	4	NEC	1	3	0.3490	1.0000	60.7	21.2
Unidentified Dolphin	4	SAR	1	21	0.0441	1.0000	59.1	2.6
Unidentified Marine Mammal	3	GOM	1	48	0.0248	1.0000	530.6	13.2

Table 10. Estimated interactions in the pelagic longline fishery for strata with reported fishing effort but no observer coverage during 2005. Bycatch rates are the average of the stratum rates during the previous five years (2000-2004). Estimates are shwon for (A) Turtles and (B) Marine mammals. All previously observed turtle catches were likewise released alive (injured or uninjured).

A. Turtles

Species	Quarter	Area	# Positive Sets 2000-2004	# Observed Sets 2000-2004	Mean CPUE 2000-2004	CV CPUE 2000-2004	# Hooks Reported (X1000) - 2005	Estimated Catch - 2005
Leatherback Turtle	2	CAR	1	19	0.0598	1.00	27.926	1.7
Leatherback Turtle	3	FEC	1	51	0.0454	1.00	32.510	1.5
Leatherback Turtle	3	NEC	2	80	0.0256	0.71	225.900	5.8
Leatherback Turtle	4	NED	4	29	0.2942	0.55	39.935	11.8
Leatherback Turtle	4	SAB	2	35	0.2108	0.70	34.202	7.2
Leatherback Turtle	1	SAR	6	49	0.1262	0.40	47.566	6.0
Loggerhead Turtle	2	CAR	1	19	0.0575	1.00	27.926	1.6
Loggerhead Turtle	3	NEC	18	80	0.2966	0.22	225.900	67.0
Loggerhead Turtle	4	NED	2	29	0.4893	0.69	39.935	19.5
Loggerhead Turtle	4	SAB	4	35	0.2335	0.51	34.202	8.0
Loggerhead Turtle	1	SAR	16	49	0.5604	0.24	47.566	26.7

B. Marine Mammals

Species	Interaction Type	Quarter	Area	# Positive Sets 2000-2004	# Observed Sets 2000-2004	Mean CPUE 2000-2004	CV CPUE 2000-2004	# Hooks Reported (X1000) - 2005	Estimated Catch - 2005
Common Dolphin	Live Release	3	NEC	1	80	0.0250	1.00	225.9	5.6
Risso's Dolphin	Serious Injury	3	NEC	1	80	0.0131	1.00	225.9	2.9
Risso's Dolphin	Live Release	3	NEC	1	80	0.0147	1.00	225.9	3.3
Pilot Whale	Serious Injury	3	NEC	1	80	0.0145	1.00	225.9	3.3
Unid. Whale	Serious Injury	3	NEC	1	80	0.0150	1.00	225.9	3.4
Risso's Dolphin	Serious Injury	4	NED	1	29	0.0583	1.00	39.935	2.3
Beaked Whale	Serious Injury	1	SAR	1	49	0.0213	1.00	47.566	1.0

Table 11. Total estimated interactions with (A) Leatherback and (B) Loggerhead turtles in the pelagic longline fishery during 2005 by fishing area. These estimates include extrapolated values for areas with no observer coverage during 2005 that had observed interactions during the past five years (Table 10).

A. Leatherback Turtles

Area	Dead	Dead CV	Alive	Alive CV	Total	Total CV	Total 95% Confidence Interval
CAR			1.7	1.000	1.7	1.000	0.3 - 8.2
FEC			62.3	0.728	62.3	0.728	18.0 - 216.1
GOM	15.4	1.000	164.0	0.281	179.4	0.269	108.3 - 297.1
MAB			11.0	1.000	11.0	1.000	2.3 - 53.8
NEC			5.8	0.710	5.8	0.710	1.7 – 19.5
NED			63.3	0.563	63.3	0.563	23.3 - 172.1
SAB			7.2	0.698	7.2	0.698	2.2 - 24.0
SAR			20.1	0.308	20.1	0.308	11.3 - 35.6
Total	**15.4**	**1.000**	**335.4**	**0.224**	**350.9**	**0.218**	**232.5 – 529.4**

Table 11 cont.

B. Loggerhead Turtles

Area	Estimated Alive	CV Alive	95% Confidence Interval	Experimental Fishing
CAR	39.8	0.641	13.0 - 121.7	-
GOM	18.6	0.704	5.5 - 62.2	0
MAB	53.7	0.478	22.6 - 127.3	0
NCA	3.2	1.000	0.7 - 15.6	-
NEC	67.0	0.220	44.3 - 101.4	8
NED	19.5	0.695	5.9 - 64.6	-
SAB	34	0.603	11.7 - 98.3	-
SAR	38.1	0.242	24.2 - 60	-
Total	**273.8**	**0.179**	**195.3 – 383.9**	**8**

Table 12. Total estimated interactions with marine mammals in the pelagic longline fishery during 2005. These estimates include extrapolated values for areas with no observer coverage during 2005 that had observed interactions during the past five years (Table 10). Estimates for (A) normal pelagic longline fishing and (B) observed values for experimental sets are shown.

A. Pelagic Longline Fishery

Species	Estimated Serious Injury	CV Serious Injury	Estimated Alive	CV Alive	Estimated Total	CV Total	95% Confidence Interval
Atlantic Spotted Dolphin	-	-	4.3	1.0000	4.3	1.0000	0.9 - 21.2
Beaked Whale	1.0	1.0000	-	-	1.0	1.0000	0.2 - 5.0
Bottlenose Dolphin	-	-	5.2	1.0000	5.2	1.0000	1.1 - 25.3
Common Dolphin	-	-	5.7	1.0000	5.7	1.0000	1.2 - 27.6
Pilot Whale	211.5	0.2072	79.5	0.4387	294.4	0.2532	183.1 - 473.4
Risso's Dolphin	2.9	1.0000	39.2	0.6343	42.1	0.5938	14.8 – 120.1
Unidentified Dolphin	-	-	2.6	1.0000	2.6	1.0000	0.5 - 12.7
Unidentified Marine Mammal	13.2	1.0000	-	-	13.2	1.0000	2.7 - 64.3
Unidentified Whale	3.4	1.0000	-	-	3.4	1.0000	0.7 – 16.5

B. Experimental Fishing

Species	Serious Injury	Released Alive
Atlantic Spotted Dolphin	0	0
Beaked Whale	0	0
Bottlenose Dolphin	0	0
Common Dolphin	0	0
Pilot Whale	1	2
Risso's Dolphin	0	0
Unidentified Dolphin	0	0
Unidentified Marine Mammal	0	0
Unidentified Whale	0	0

Figure 1. Pelagic longline fishing areas in the north Atlantic ocean indicating 11 defined fishing areas. CAR = Caribbean, GOM = Gulf of Mexico, FEC = Florida East Coast, SAB = South Atlantic Bight, SAR = Sargasso Sea, MAB = Mid-Atlantic bight, NEC = Northeast Coastal, NED = Northeast Distant, NCA = North Central Atlantic, TUN = Tuna North, TUS = Tuna South. Pelagic longline closed areas are indicated by shaded polygons and letter labels (A-E). The NED area was reopened on June 30, 2004.

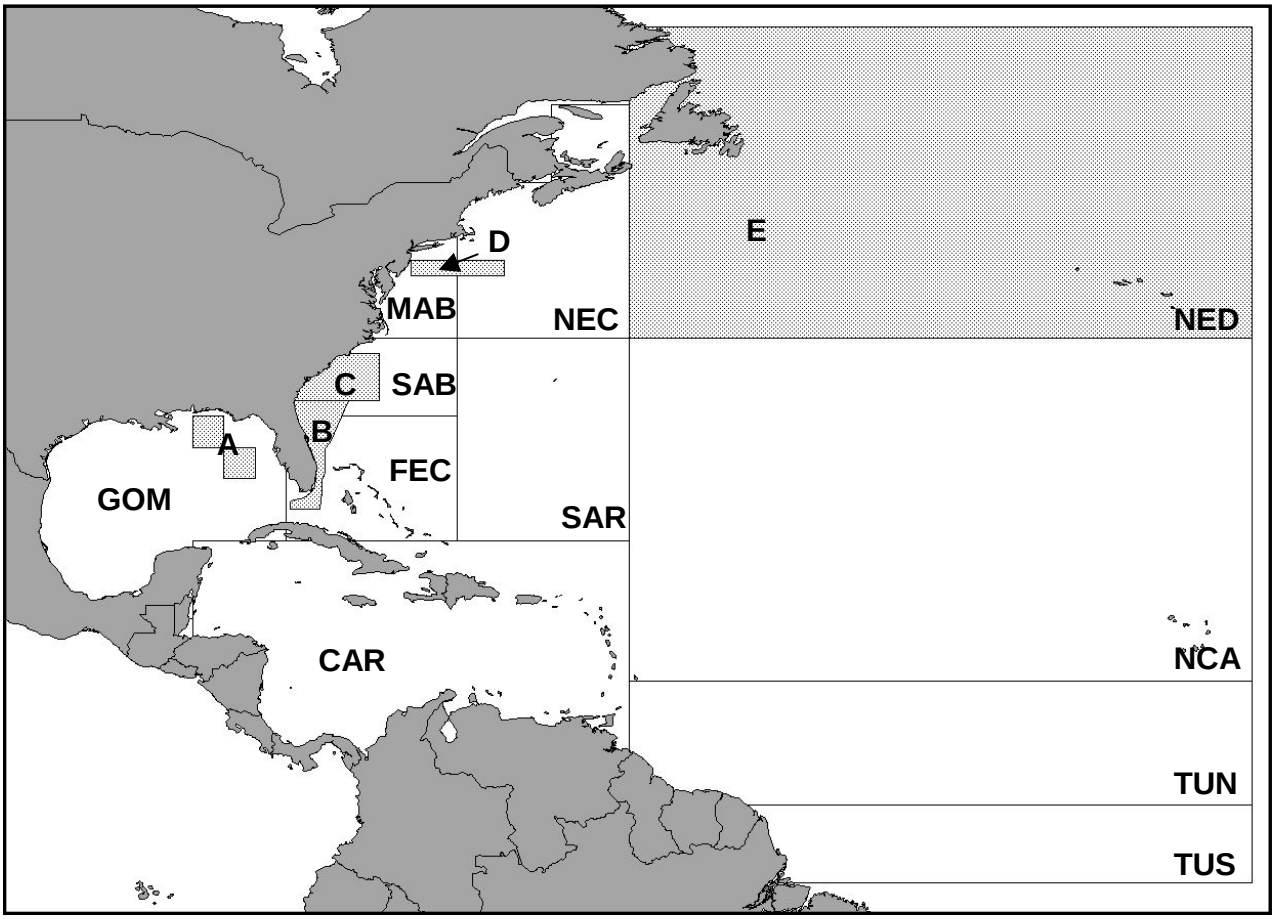


Figure 2. Observed and reported pelagic longline fishing effort during 2005.

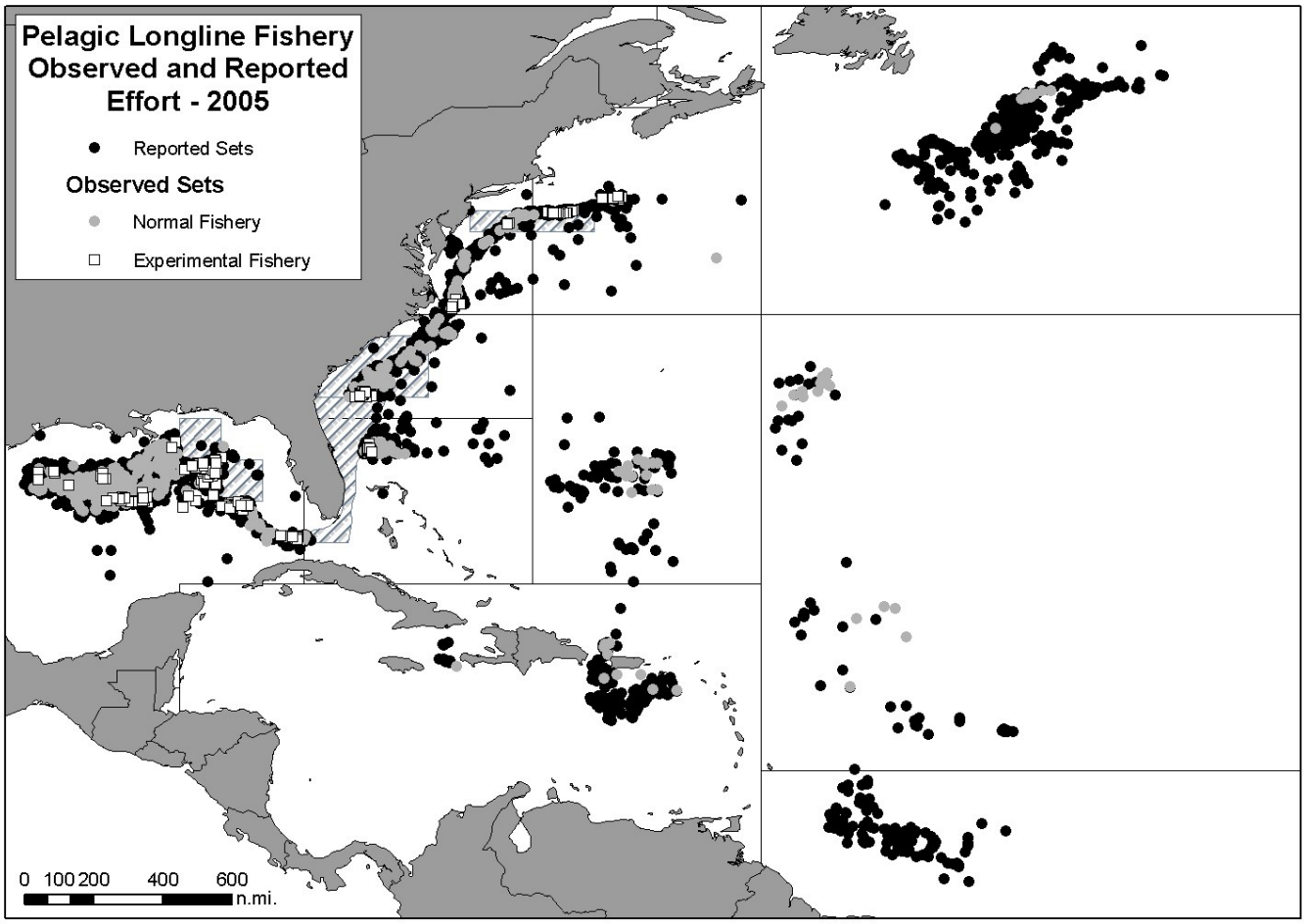


Figure 3. Observed pelagic longline fishing effort and marine turtle takes during 2005.

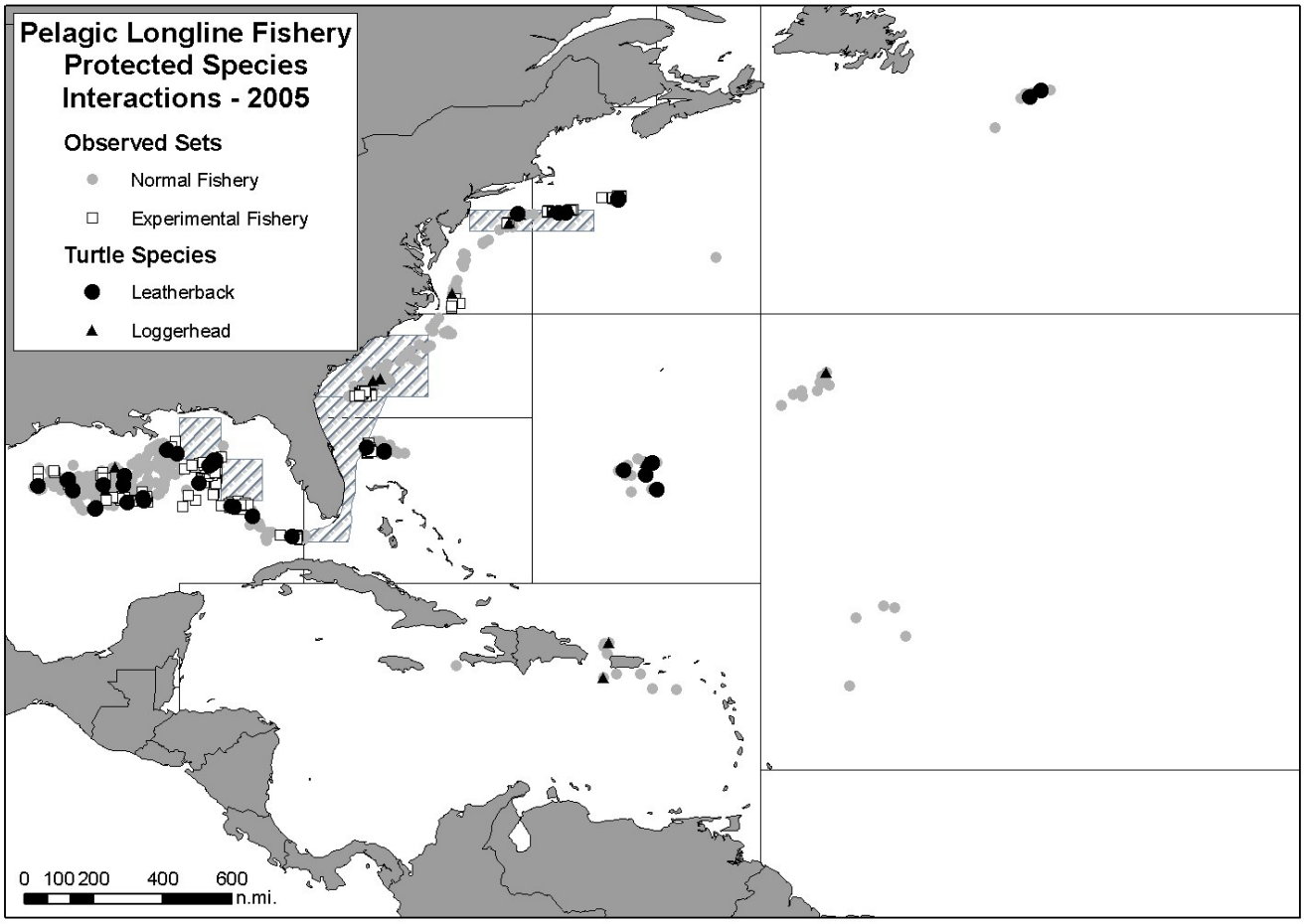


Figure 4. Observed pelagic longline fishing effort and marine mammal takes during 2005.

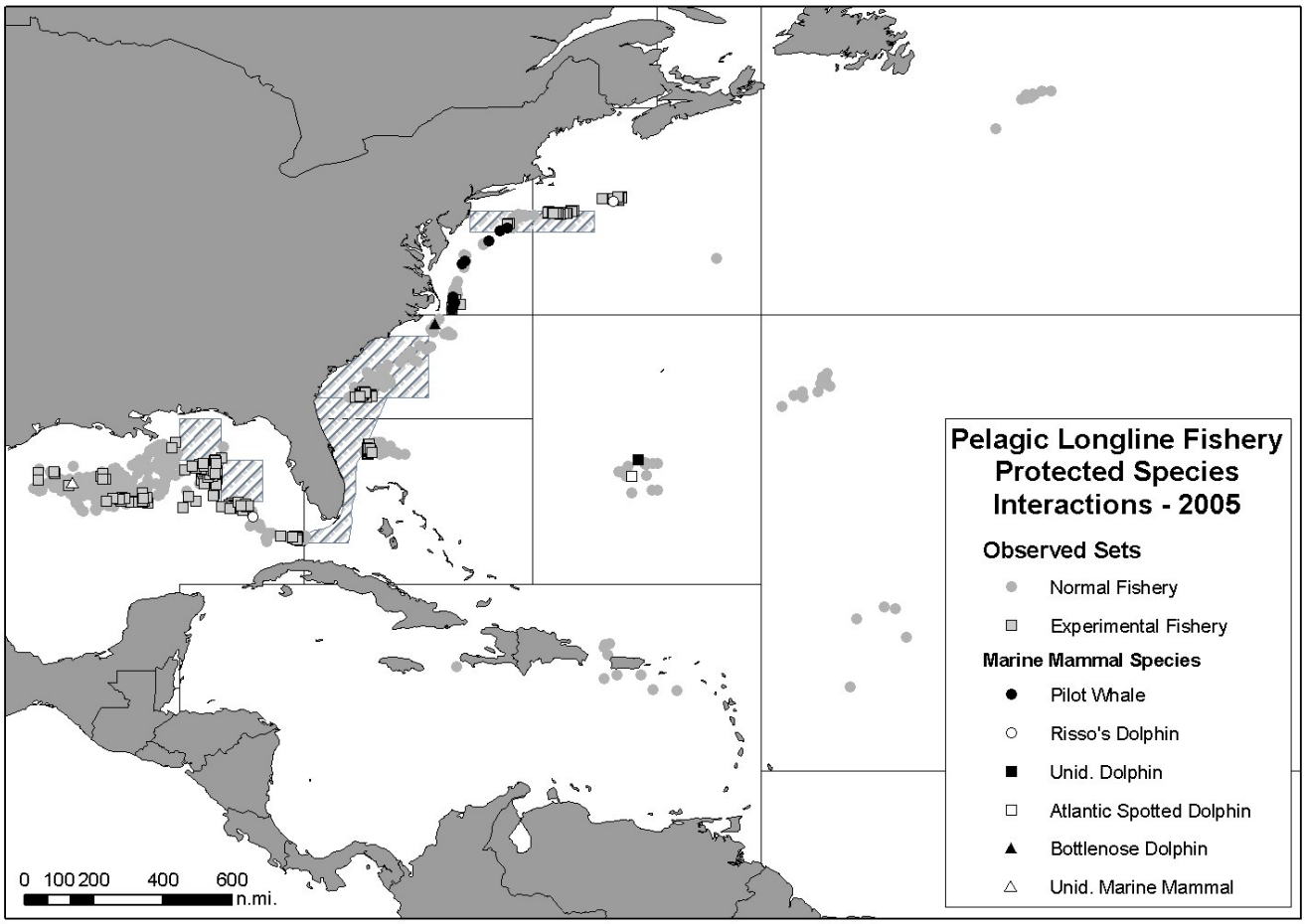
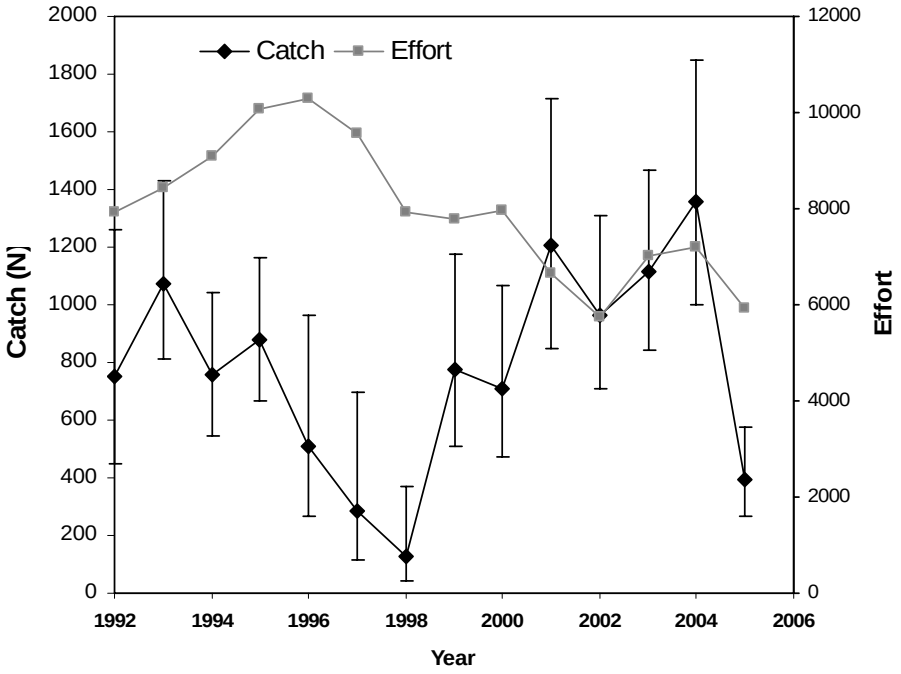


Figure 5. Historical trends in fishery effort and estimated marine turtle takes in the pelagic longline fishery between 1992 and 2005. Errors bars represent 95% confidence intervals.

A. Leatherback Turtles



B. Loggerhead Turtles

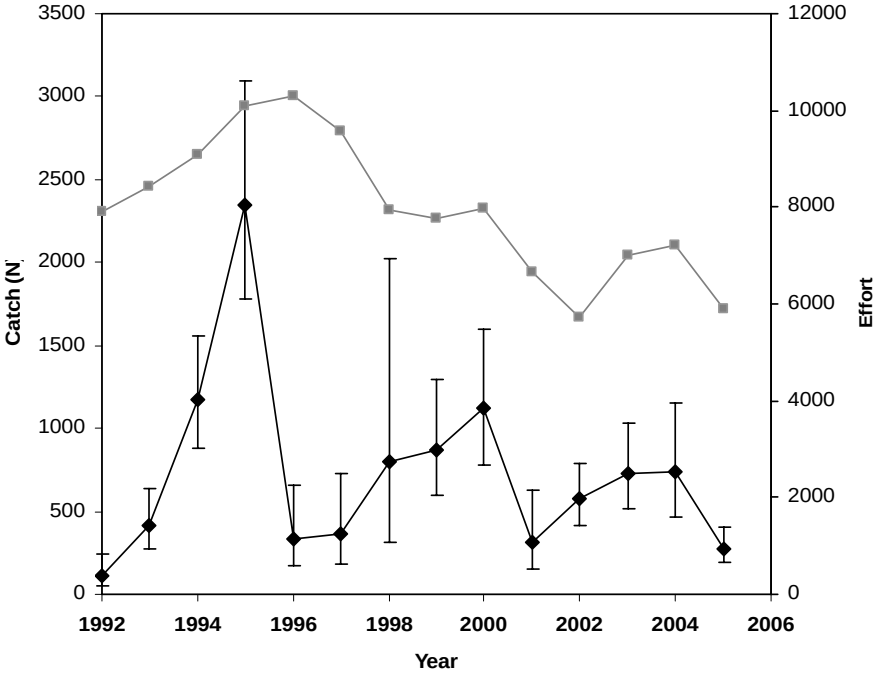
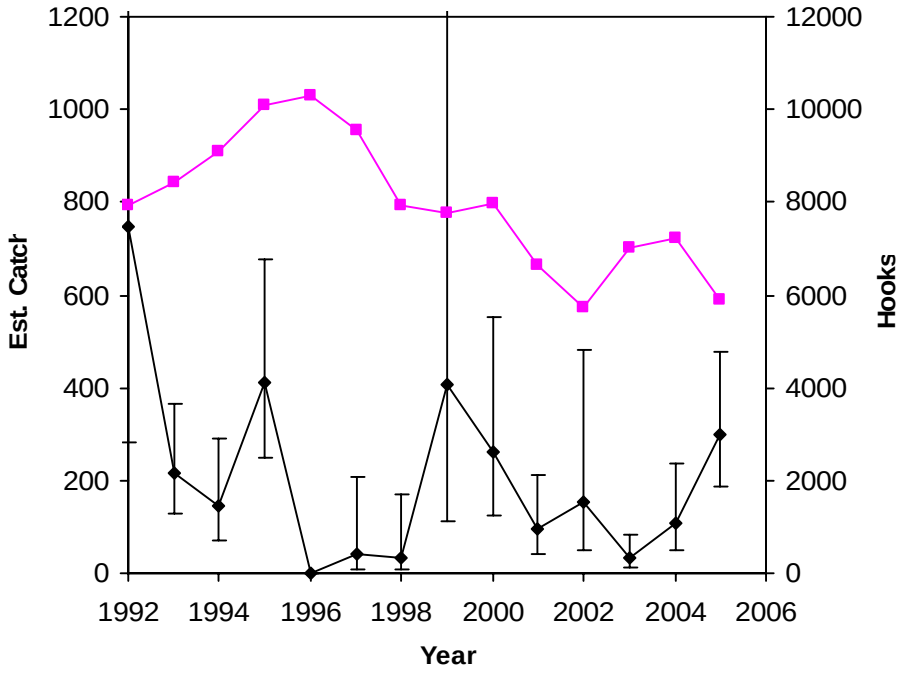
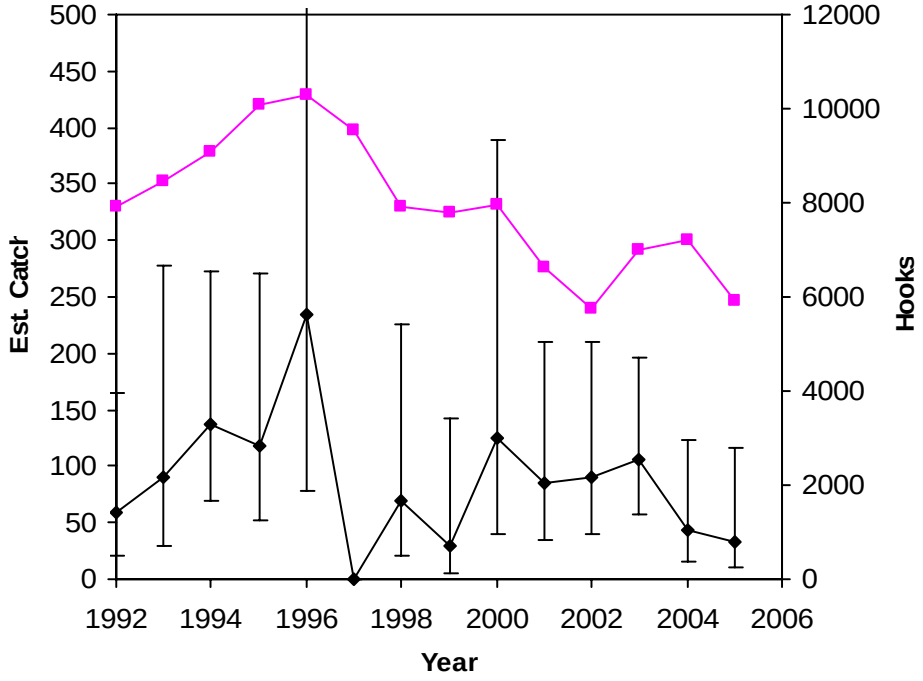


Figure 6. Historic trends in fishery effort and estimated marine mammal takes in the pelagic longline fishery between 1992 and 2005. Errors bars represent 95% confidence intervals.

A. Pilot Whale



B. Risso's Dolphin



Appendix A. Sea Turtle Life History Form

SEA TURTLE LIFE HISTORY FORM

12/04

CAPTURE INFORMATION

TRIP ☐☐☐☐☐☐ YEAR 20☐☐ MONTH☐☐ DAY☐☐

SET/HAUL/TOW ☐☐☐ SPECIMEN NUMBER BY TRIP ☐☐☐

GEAR TYPE: ☐Longline ☐Gill Net ☐Trawl (note trawl time in comments)
GEAR DEPTH: ☐Surface ☐Midwater ☐Bottom ☐ Other _____

TIME (24 hr) ☐☐☐☐ WATER TEMP (°F) ☐☐.☐

LATITUDE☐☐deg☐☐.☐min N / S LONGITUDE☐☐☐deg☐☐.☐min E / W

Did turtle slide out/escape from gear? Y / N Was turtle brought on board? Y / N

IDENTIFICATION (see back) Number of Photos Taken? ☐☐
SPECIES: ☐Leatherback ☐Loggerhead ☐Kemp's ridley ☐Green ☐Hawksbill ☐Olive ridley
☐Unidentified Hardshell ☐Unknown

CONDITION OF TURTLE
☐Previously dead ☐Fresh dead ☐Comatose (resuscitated**) ☐Other (describe)
☐Alive, injured (describe) ☐Alive, uninjured ☐Alive, injury unknown ☐Unknown (describe)

IF GEAR IS A FORM OF HOOK AND LINE, COMPLETE THIS SECTION, AS APPLICABLE:
HOOK TYPE ☐ "J" ☐ Circle ☐other (describe) _____ SIZE ☐☐/0
MANUFACTURER/STYLE NO. _____ DEGREE OFFSET ☐☐°
BAIT ☐Squid ☐Mackerel ☐Sardine ☐Unknown ☐Other (describe)_____SIZE_____
Caught on hook timer? Y / N If yes, fill in time elapsed ☐☐ ☐☐
Was light stick on hook? Y / N / U If yes (circle) White, Pink, Blue, Green, Black, Red, Yellow, Purple, Other, Unknown
If No, number of gangions to next light stick☐☐
Light Stick Color (circle)? White, Pink, Blue, Green, Black, Red, Yellow, Purple, Other, Unknown
Number of gangions to next float ☐☐

HOOK LOCATION
(circle specific location; check box if specifics are not known; annotate drawing on reverse to indicate location as needed):
☐ Not Hooked ☐ Not Known if Hooked ☐Hooked, but location totally Unknown

Internal: ☐ Unknown, internal
☐ Swallowed (Esophagus) Hook visible? Visible to insertion point / Partial hook / Not visible
☐ Beak/ Mouth (note location in jaw and circle specific location) ☐upper: soft palate/other ☐lower: tongue/glottis/other ☐side: jaw joint/other ☐other (describe)

External: ☐Unknown, external ☐Beak/Head/Neck ☐Carapace/Plastron
☐Front Flipper/Shoulder/Armpit ☐Rear Flipper/Groin/Tail

Was hook removed from this animal? Y / N / Unknown / Not Applicable

Was animal entangled in gear? At capture? Y / N / Unknown At Release? Y / N / Unknown
How much gear (linear feet) was left on turtle when released? ☐☐☐.☐ ft. (estimated/measured)
Estimated carapace length (notch-to-tip straight line): ☐☐.☐ ft (needed only if turtle is not boated & measured)

Appendix A. Sea Turtle Life History Form (cont.)

BIOLOGICAL INFORMATION

DIMENSIONS (cm)	Curved (measuring tape) Standard Measurements	Straight Line (calipers) Standard Measurements	Straight Line (calipers)
Carapace Length	☐☐☐.☐ notch-to-tip	☐☐☐.☐ notch-to-tip	☐☐☐.☐ notch-to-notch
Carapace Width	☐☐☐.☐	☐☐☐.☐	

TAGS (identify address on each tag in the comments section)

Flipper Tag Number	Metal (1) or Plastic (2)	Position (Flipper) LF, RF, LR, RR	Already Present (1) or Applied by Observer (2)	Were Tags Removed?
☐☐☐☐☐☐	☐	☐☐	☐	Y / N
☐☐☐☐☐☐	☐	☐☐	☐	Y / N
☐☐☐☐☐☐	☐	☐☐	☐	Y / N
☐☐☐☐☐☐	☐	☐☐	☐	Y / N

PIT Tag
☐☐☐☐☐☐☐☐☐☐ ☐☐ ☐ Scanned? Y / N

Living Tag (describe)_____ Other Tags (describe) _____

(Put PIT tag label here)

BIOPSY SAMPLES TAKEN? Y (itemize below) / N / Unsuccessful

RELEASE INFORMATION

LATITUDE ☐☐deg☐☐.☐min N / S LONGITUDE ☐☐☐deg☐☐.☐min E / W

TIME (24 hr) ☐☐☐☐ WATER TEMP (°F) ☐☐.☐

DATE, if different from capture: YEAR 20☐☐ MONTH☐☐ DAY☐☐

FINAL DISPOSITION

☐ Discarded Marked Carcass ☐ Discarded Unmarked Carcass ☐ Salvaged Carcass

☐ Released Alive ☐ Taken to Holding Facility ☐ Unknown (explain)

ADDITIONAL COMMENTS (list all biological samples collected; describe or sketch any anomalies):

_____

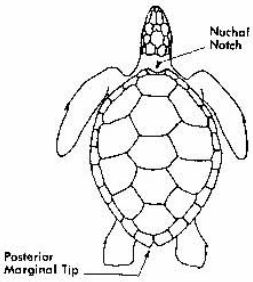
_____

_____

_____

_____

_____



IDENTIFICATION CRITERIA

Number of:				
Left Lateral Scutes	☐	Overlapping Scutes?	Y / N / U	Does Nuchal Scute Touch 1st Lateral Scute? Y / N / U
Right Lateral Scutes	☐	Inframarginal Pores?	Y / N / U	
Vertebral Scutes	☐	1 Pair Prefrontal Scales?	Y / N / U	
L. Inframarginal Scutes	☐	Lacks Bony Shell?	Y / N	
R. Inframarginal Scutes	☐			

Dorsal Coloration ☐ Black ☐ Orange/Red-Brown ☐ Brown ☐ Gray-Green ☐ Other_____

Appendix B. Detail Information on Observed Interactions with Protected Species

Table B1. Observed interactions per longline set with marine turtles during 2005. All turtles were released alive (injured or uninjured). The number of hooks set along with the number of turtles captured in each set is reported.

Species	Quarter	Area	# Hooks	# Turtles Alive	# Turtles Dead
Leatherback	1	FEC	648	1	0
Leatherback	1	FEC	544	2	0
Leatherback	1	GOM	924	2	0
Leatherback	1	GOM	864	1	0
Leatherback	1	GOM	700	1	0
Leatherback	1	GOM	900	1	0
Leatherback	1	GOM	576	1	0
Leatherback	2	GME	630	1	0
Leatherback	2	GME	565	1	0
Leatherback	2	GME	610	1	0
Leatherback	2	GME	675	1	0
Leatherback	2	GME	630	1	0
Leatherback	2	GME	600	1	0
Leatherback	2	GME	410	1	0
Leatherback	2	GOM	700	1	0
Leatherback	2	GOM	1410	1	0
Leatherback	2	GOM	864	1	0
Leatherback	2	GOM	799	1	0
Leatherback	3	FCE	490	1	0
Leatherback	3	GME	630	1	0
Leatherback	3	GME	750	1	0
Leatherback	3	MAB	768	1	0
Leatherback	3	NEC	945	1	0
Leatherback	3	NEC	945	2	0
Leatherback	3	NEC	945	1	0
Leatherback	3	NEC	810	2	0
Leatherback	3	NEC	870	1	0
Leatherback	3	NED	1008	1	0
Leatherback	3	NED	1008	1	0
Leatherback	4	GOM	556	1	0
Leatherback	4	GOM	550	0	1
Leatherback	4	GOM	900	1	0
Leatherback	4	GOM	864	1	0
Leatherback	4	GOM	936	1	0
Leatherback	4	SAR	1080	1	0
Leatherback	4	SAR	1080	1	0
Leatherback	4	SAR	1071	1	0
Leatherback	4	SAR	1053	1	0
Leatherback	4	SAR	784	1	0
Loggerhead	1	CAR	792	1	0
Loggerhead	1	CAR	792	1	0

Appendix B, Table B1 (cont.)

Loggerhead	1	GOM	924	1	0
Loggerhead	1	GOM	936	1	0
Loggerhead	1	MAB	960	1	0
Loggerhead	1	SAB	510	2	0
Loggerhead	2	NCA	1080	1	0
Loggerhead	3	MAB	1128	1	0
Loggerhead	3	MAB	616	1	0
Loggerhead	3	MAB	560	1	0
Loggerhead	3	NEC	945	1	0
Loggerhead	3	NEC	945	2	0
Loggerhead	3	NEC	945	1	0
Loggerhead	3	NEC	945	1	0
Loggerhead	3	NEC	210	1	0
Loggerhead	3	NEC	837	1	0
Loggerhead	3	NEC	835	1	0
Loggerhead	3	SAB	555	1	0
Loggerhead	4	MAB	840	1	0
Loggerhead	4	SAR	1080	2	0
Loggerhead	4	SAR	1074	1	0
Loggerhead	4	SAR	784	1	0

Table B2. Information on gear types and hooking locations based upon observed comments and the sea turtle life history form for each (A) loggerhead and (B) leatherback sea turtle observed taken during 2005. These data are summarized in Table 6. CL Est. indicates an estimated carapace length in feet, CCL indicates a measured curved carapace length in cm, Straight N-N indicates a straight line measurement of the turtle carapace from notch to notch (see Appendix A). Note: There were no Straight N-N measurements made for leatherback turtles, thus this column is not included for this species.

A. Loggerhead Turtles

#	Area	Quarter	Entangled on Capture?	Entangled on Release?	Hook Type	Hook Offset (degrees)	Bait Type	Hook Location	Jaw Location	Was the Hook Visible?	Hook Removed?	Line Left (ft)	CL Est. (ft)	CCL (cm)	Straight N-N (cm)
1	GOM	1	no	no	C-16/0	0	squid	swallowed	na	partial hook	no	0.60		73	65.4
2	CAR	1	no	no	C-18/0	10	squid	swallowed	na	not visible	no	0.50		77.5	70.2
3	CAR	1	no	no	C-18/0	10	squid	swallowed	na	visible to insertion	yes	0.00		56.8	51.1
4	SAB	1	no	no	C-18/0	10	sq or mack	glottis	lower	visible to insertion	yes	0.00		68.4	59.3
5	SAB	1	no	no	C-18/0	10	sq or mack	swallowed	na	not visible	no	0.10		70	63
6	MAB	1	no	no	C-18/0	10	sq or mack	mouth	side other	na	yes	0.00		63	59.5
7	GOM	1	no	no	C-16/0	0	squid	beak	lower other	na	yes	0.00		79.4	73.2
8	NCA	2	no	no	C-18/0	10	unk	mouth	lower other	na	yes	0.00		63.4	58.4
9	SAB	3	No	No	C-16/0	0	sq or mack	mouth	lower other	na	Yes	0.00			64.5
10	MAB	3	No	No	C-18/0	10	squid	mouth	lower other	na	Yes	0.00		69.5	63.9
11	MAB	3	No	No	C-16/0	0	squid	swallowed	na	partial hook	No	0.00		66.6	61.6
12	MAB	3	No	No	C-16/0	0	squid	mouth	lower other	na	Yes	0.00		66.2	59
13	NEC	3	No	No	C-18/0	0	squid	mouth	lower other	na	Yes	0.00		75.2	65.5
14	NEC	3	No	No	C-18/0	10	squid	mouth	unknown	na	Yes	0.00	2.10		
15	NEC	3	No	No	C-18/0	10	squid	mouth	unknown	na	Yes	0.00	2.30		
16	NEC	3	No	No	C-18/0	0	mackerel	tongue	lower	na	Yes	0.00		66.5	60.4

Appendix B, Table B2A Loggerhead Turtles (cont.)

#	Area	Quarter	Entangled on Capture?	Entangled on Release?	Hook Type	Hook Offset (degrees)	Bait Type	Hook Location	Jaw Location	Was the Hook Visible?	Hook Removed?	Line Left (ft)	CL Est. (ft)	CCL (cm)	Straight N-N (cm)
17	NEC	3	No	No	C-18/0	0	squid	swallowed	na	not visible	No	0.50		68.2	60.5
18	NEC	3	No	No	C-18/0	10	mackerel	beak internal	upper other	na	Yes	0.00		63	56.2
19	NEC	3	No	No	C-18/0	0	squid	beak internal	upper	na	Yes	0.00		65	58
20	NEC	3	Yes	No	C-18/0	0	squid	not hooked	na	na	na	0.00		73.6	67.2
21	SAR	4	No	No	C-18/0	10	squid	beak internal	lower other	na	Yes	0.00		69.6	63.6
22	MAB	4	No	No	C-18/0	10	squid	armpit	na	na	Yes	0.00		70	64.8
23	SAR	4	No	No	C-18/0	10	squid	not known if hooked	unknown	unknown	Yes	0.00	3.00		
24	SAR	4	No	No	C-18/0	10	sq or mack	swallowed	na	partial hook	No	0.10		62.4	55.3
25	SAR	4	No	No	C-18/0	10	sq or mack	swallowed	na	visible to insertion point	Yes	0.00		67.8	61

Appendix B, Table B2 (cont.)

B. Leatherbacks

#	Area	Quarter	Entangled on Capture?	Entangled on Release?	Hook Type	Hook Offset (degrees)	Bait Type	Hook Location	Jaw Location	Is the Hook Visible?	Hook Removed?	Line Left (ft)	CL Est. (ft)	CCL (cm)
1	FEC	1	no	no	C-18/0	10	squid	beak internal	side other	unknown	no	0.00	6.00	
2	FEC	1	no	no	C-18/0	10	squid	armpit	na	na	no	0.00	7.00	
3	FEC	1	no	no	C-18/0	10	squid	armpit	na	na	no	0.00	6.00	
4	FEC	3	No	No	C-18/0	10	mackerel	groin	na	na	No	2.00	6.00	
5	GOM	1	no	no	C-18/0	10	mackerel	shoulder	na	na	yes	0.00	4.00	
6	GOM	1	no	no	C-16/0	0	squid	beak internal	lower other	na	yes	0.00	4.00	
7	GOM	1	no	no	C-16/0	0	squid	armpit	na	na	yes	0.00	3.00	
8	GOM	1	no	no	C-16/0	0	squid	armpit	na	na	no	1.00	4.00	
9	GOM	1	no	no	C-16/0	0	squid	armpit	na	na	yes	0.00	4.00	
10	GOM	1	no	no	C-16/0	0	squid	shoulder	na	na	yes	0.00	4.50	
11	GOM	2	no	no	C-16/0	0	squid	armpit	na	na	yes	0.00	4.00	
12	GOM	2	no	no	C-16/0	0	squid	shoulder	na	na	no	2.00	4.00	
13	GOM	2	no	no	C-16/0	0	sardines	shoulder	na	na	yes	0.00	5.00	
14	GOM	2	no	no	C-16/0	0	squid	shoulder	na	na	no	6.00	5.00	
15	GOM	2	no	no	C-18/0	0	mackerel	front flipper	na	na	yes	0.00	4.50	
16	GOM	2	no	no	C-16/0	0	sardines	unknown external	na	na	no	5.00	5.50	
17	GOM	2	yes	no	C-16/0	0	sardines	not hooked	na	na	na	0.00	4.00	
18	GOM	2	no	no	C-16/0	0	sardines	shoulder	na	na	yes	0.00	4.00	
19	GOM	2	no	no	C-16/0	0	sardines	front flipper	na	na	no	0.00	5.50	
20	GOM	2	no	no	C-16/0	0	sardines	shoulder	na	na	no	0.00	4.50	

Appendix B, Table B2B Leatherback Turtles (cont.)

#	Area	Quarter	Entangled on Capture?	Entangled on Release?	Hook Type	Hook Offset (degrees)	Bait Type	Hook Location	Jaw Location	Is the Hook Visible?	Hook Removed?	Line Left (ft)	CL Est. (ft)	CCL (cm)
21	GOM	2	no	no	C-16/0	0	sardines	front flipper	na	na	yes	0.00	4.50	
22	GOM	3	Yes	No	C-16/0	0	sardines	not hooked	na	na	na	0.00	4.00	
23	GOM	3	Yes	No	C-16/0	0	sardines	not hooked	na	na	na	0.00	4.50	
24	GOM	4	No	No	C-16/0	0	squid	shoulder	na	na	No	1.00	5.00	
25	GOM	4	No	No	C-16/0	0	squid	rear flipper	na	na	Yes	0.00	4.00	
26	GOM	4	Yes	No	C-16/0	0	sardines	armpit	na	na	No	0.00	6.00	
27	GOM	4	Yes	No - Dead	C-16/0	0	sardines	not hooked	na	na	na	0.00		142.2
28	GOM	4	No	No	C-16/0	0	squid	armpit	na	na	No	0.10	5.00	
29	MAB	3	unknown	unknown	C-16/0	0	sq or mack	front flipper/shoulder/armpit	na	na	No	5.00	4.50	
30	NEC	3	Yes	No	C-18/0	na	squid	not hooked	na	na	na	0.00	4.80	
31	NEC	3	Yes	No	C-18/0	0	squid	front flipper	na	na	Yes	0.00	4.30	
32	NEC	3	No	No	C-18/0	10	squid	front flipper	na	na	Yes	0.00	4.40	
33	NEC	3	No	No	C-18/0	10	squid	shoulder	na	na	Yes	0.00	4.40	
34	NEC	3	Yes	No	C-18/0	na	squid	not hooked	na	na	na	0.00	4.00	
35	NEC	3	Yes	No	C-18/0	0	mackerel	beak external	na	na	Yes	0.00	5.30	
36	NEC	3	Yes	No	C-18/0	0	mackerel	shoulder	na	na	Yes	0.00	5.30	
37	NED	3	No	No	C-18/0	10	mackerel	armpit	na	na	Yes	0.00		155
38	NED	3	No	No	C-18/0	10	mackerel	armpit	na	na	Yes	0.00	4.50	
39	SAR	4	Yes	No	C-18/0	10	squid	not hooked	na	na	na	0.00	5.00	
40	SAR	4	No	No	C-18/0	10	squid	armpit	na	na	Yes	0.00	5.00	
41	SAR	4	No	No	C-18/0	10	squid	shoulder	na	na	Yes	0.00	5.00	
42	SAR	4	Yes	No	C-18/0	10	sq or mack	armpit	na	na	Yes	0.00	4.50	
43	SAR	4	No	No	C-18/0	10	sq or mack	armpit	na	na	No	0.00	5.00	

Table B3. Observed 2005 interactions per longline set with marine mammals. The number of hooks set along with the number of mammals by release status (alive or seriously injured) in each set is reported.

Species	Quarter	Area	# Hooks	# Alive	# Serious Injury
Atlantic Spotted Dolphin	4	SAR	648	1	0
Bottlenose Dolphin	1	SAB	924	1	0
Pilot Whale	2	MAB	748	0	1
Pilot Whale	2	MAB	748	0	1
Pilot Whale	2	MBE	790	2	1
Pilot Whale	3	MAB	720	1	2
Pilot Whale	3	MAB	780	1	0
Pilot Whale	3	MAB	540	2	1
Pilot Whale	3	MAB	528	0	2
Pilot Whale	3	MAB	1105	1	0
Pilot Whale	3	MAB	1180	1	0
Pilot Whale	4	MAB	900	1	1
Risso's Dolphin	1	GOM	700	1	0
Risso's Dolphin	4	NEC	955	1	0
Unidentified Dolphin	4	SAR	1080	1	0
Unidentified Marine Mammal	3	GOM	840	0	1

Table B4: 2005 observer comments and serious injury codes for marine mammals. Code numbers include 8 = cetacean is hooked internally or in the mouth and 10 = line entangling the animal is likely to further entangle. Lengths (cm) are estimated visually by the observer.

Animal #	Species	Animal Length (cm)	Release Condition	Injury Code(s)	Observer Comments
1	Atlantic Spotted Dolphin	150	Alive, No SI	-	Tail wrapped. Hook was cut off and line unraveled. MAD. Swam away strongly. No biopsy taken. Involved in Gangion only, all gear removed.
2	Bottlenose Dolphin	150	Alive, No SI	-	Tail wrapped a number of times around mainline. All gear removed, animal swam away immediately
3	Pilot Whale	180	Alive, No SI	-	Small whale tangled around tail and mouth. All gear removed. Released alive but sluggish on surface when released.
4	Pilot Whale	210	Alive, No SI	-	This whale had main line wrapped around lower jaw, not hooked, all gear removed. Whale swam away lively.
5	Pilot Whale	350	Alive, No SI	-	Leader wrapped around tail. Unwrapped and whale swam away. Disentanglement possible because whale tired but breathing.
6	Pilot Whale	300	Alive, No SI	-	Mainline wrapped around tail. Cut with ARC longhandled cutter. All mono removed. Lively on release.
7	Pilot Whale	240	Alive, No SI	-	Entangled with mainline only. Around lower jaw and pectoral fin. Used long-handled line cutters to remove all gear.
8	Pilot Whale	330	Alive, No SI	-	Entangled only around mid-body used long line cutters to release without any gear attached entangled w/mainline only
9	Pilot Whale	450	Alive, No SI	-	Mainline wrapped around tail. All line removed. Whale slowly swam away after release. Not Hooked
10	Pilot Whale	300	Alive, No SI	-	Mainline wrapped around tail + pectoral fins. All line removed. Animal not hooked. Swam away quickly when released.
11	Pilot Whale	210	Alive, No SI	-	Gear a mess, float line part of tangle, Pilot Whale tangled, not hooked. OK tail before flukes skinned up. (Debreif indicates all gear removed).
12	Pilot Whale	240	SI	8	This whale was hooked in mouth and not tangled. Cut leader with about 2 feet of line and hook remaining. Whale swam away lively. Observer saw hook in mouth under tongue.
13	Pilot Whale	150	SI	8	Gear a mess, # gangions to float not possible to say. Condition OK. Hook side of mouth, 1' line.
14	Pilot Whale	300	SI	10	MPW entangled in mainline around stock and midbody. Unknown if hooked. Released Alive, No gear removed. Appox. 4 F (ft.)mainline left.

Appendix B, Table B4 (cont.)

Animal #	Species	Animal Length (cm)	Release Condition	Injury Code(s)	Observer Comments
15	Pilot Whale	330	SI	8, 10	Mouth or gut hooked only. Released alive with 12 fathoms of gear left on. Dove immediately after release.
16	Pilot Whale	270	SI	8, 10	Mouth or gut hooked. Released alive with approx 4' of leader line attached
17	Pilot Whale	330	SI	8, 10	Mouth or gut hooked. This gangion tangled with 2-3 other gangions and snaps. Released alive w/approx 6' of leader line attached.
18	Pilot Whale	300	SI	8, 10	Hooked in mouth not entangled. ~3 feet of line left on animal. Swam away quickly when released.
19	Pilot Whale	480	SI	8, 10	Hooked in mouth not entangled. ~5 feet of line left on animal. Swam away quickly when released.
20	Pilot Whale	540	SI	8, 10	Hooked in mouth possibly swallowed hook. 5 fathoms of line left on animal swam away slowly while diving.
21	Risso's Dolphin	240	Alive, No SI	-	Risso's Unidentified Dolphin tangled in mainline and leader around tail, not hooked. All gear removed, dove immediately.
22	Risso's Dolphin	225	Alive, No SI	-	Mainline tangled around tail. Mainline cut with long handled cutter. 1-2' left on tail. Lively on release
23	Unidentified Dolphin	150	Alive, No SI	-	Unknown hook location. Observer went to fetch biopsy pole to find MDO cut off when returned. Capt. claimed it was an OCS (White tipped shark). Unknown amount of line remaining on animal. Animal was on gangion, not mainline
24	Unidentified Marine Mammal	120	SI	8	Small, very lively-squid on hook, in corner of jaw. About 1 ft. of line left on hook. Used scissors to cut line. Observer thought it looked like MPW except for color (animal was brown)

Appendix C. Evaluation of methods to account for unobserved quarter-area strata.

Several quarter-area strata had a significant amount of reported fishing effort with no observer coverage during 2005 (Table 3). The most important of these was the NEC region during quarter 3 where 225,900 hooks were reported, and there has been observed bycatch during the last five years (Table 10). During 2005 all of the fishing effort used circle hooks whereas the fishery primarily used j-hooks in all previous years' effort. Therefore, it is questionable whether or not the bycatch rates for the previous five years are representative of the bycatch rate during 2005.

Several options were explored to address unobserved strata in the 2005 bycatch estimates (Table C1). The first option, ignoring these cells and in effect applying a zero bycatch rate, was rejected because it imparts a known negative bias and thereby underestimates the impact of the longline fishery on marine turtles in 2005. The second approach explored was to apply the bycatch rates observed in quarters 3 and 4 of 2004 to strata in quarters 3 and 4 2005. The circle hook regulations were implemented part of the way through the 3rd quarter, 2004. This approach was rejected because: 1) it still imparts a known negative bias in quarters 1 and 2, 2) the 3rd quarter rates for 2004 reflect a mixture of J and circle hook effort, and 3) interannual variability in bycatch rates is high, and a single year value may therefore be spuriously high or low due to sampling effects.

The approach taken in prior reports based upon the average bycatch rate of the previous five years was chosen as the most robust method of accounting for unobserved cells. Applying this longer-term average reduces potential artifacts due to interannual variability and sampling effects, and it is most consistent with previous annual estimates. However, these estimates may include a positive bias since it is expected that the bycatch rate for circle hooks is lower than that for j-hooks. A more complete evaluation of apparent circle hook effects and the impacts on bycatch estimates will be conducted as additional data become available.

Table C1: Estimated total marine turtle bycatch rates under different approaches to account for unobserved quarter-area strata.

Option Considered	Leatherback Estimate	Leatherback CV	Loggerhead Estimate	Loggerhead CV
Assume a zero bycatch in all unobserved strata.	316.9	0.240	151	0.291
Apply observed bycatch rates for quarters 3 and 4 from 2004 to unobserved strata, and assume zero bycatch in other quarters.	331.7	0.231	230.1	0.238
Apply 5-year average bycatch rates from 2000-2004 in missng strata.	350.9	0.218	273.8	0.179