

## **Preliminary Estimates of Protected Species Bycatch Rates in the U.S. Atlantic Pelagic Longline Fishery Between 1 July and 30 September, 2008**

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### **Background**

The U.S. Atlantic Pelagic Longline fleet operates throughout the Northwestern Atlantic Ocean including along the U.S. coast from the Gulf of Mexico to New England, the waters of the Caribbean, and in international waters of the North Atlantic Ocean. The longline fishery has a documented history of incidental takes of non-target species including sea turtles and marine mammals. In June 2004, regulations were implemented to reduce interactions with sea turtles by requiring the use of “circle” hooks. The June 2004 Biological Opinion also required quarterly reporting of interactions with protected species including sea turtles and marine mammals. The goal of this measure is to more closely monitor any short-term changes in interaction rates to allow more responsive management. This report meets this requirement and includes the observed fishery effort and incidental takes reported by the Pelagic Observer Program (POP) from 1 July to 30 September, 2008.

While it is desirable to estimate the absolute level of takes (i.e., the total number of turtles or mammals estimated to be taken by the fishery), fishery effort data are reported on logbook forms by fishing captains, and current data are therefore not available until several months after the end of any given quarter. Therefore, the bycatch rate (i.e., catch per unit effort) is presented in this report based solely on observer data as an indicator of the relative level of interactions with protected species. The observed bycatch rate by fishing area during quarter 3 of 2008 is compared to that observed in quarter 3 during the three year period prior to implementation of regulations (2002-2004) and after (2005-2007) to determine if the current rates are unusually high or low. Bycatch rates were calculated by fishing area (Figure 1) using the delta log-normal method using hooks as the unit of effort. The analytical methods were described in detail in Garrison (2003).

### **Results and Discussion**

A total of 209 longline sets (178,969 hooks) were observed during quarter 3 of 2008 (Table 1) during normal fishing effort with only circle hooks (16/0 and 18/0) recorded. The majority of

the observed sets occurred in the Mid-Atlantic Bight (MAB) and the Northeast Coastal (NEC) fishing areas. In addition, a cooperative research program was conducted during the third quarter of 2008 that included longline fishing in the GOM area to test the effectiveness of “weak” hooks as a potential bycatch mitigation tool. No turtles or marine mammals were taken in the experimental fishery. The experimental fishing is not included in estimates of bycatch rates because they are not representative of the normal fishing effort.

The locations of observed sets and turtle interactions are shown in Figure 1. During normal fishing, there were 21 observed interactions with leatherback turtles and 67 observed interactions with loggerhead turtles (Table 2). Two leatherbacks were observed dead in the NEC. The loggerhead turtles were all released alive (Appendix A).

Concerted efforts by fishers to remove hooks and disentangle captured turtles are mandated by the Biological Opinion. Specific information on injuries to sea turtles and gear characteristics of each interaction are shown in Appendix A. The release status for all turtles is summarized in Table 3. Of the 21 leatherback turtles observed captured, 17 were released with either all gear removed or with the hook and trailing line less than one-half the carapace length (Table 3). There were four leatherback turtles released with the hook and trailing line greater than one-half the carapace length, and one of which was entangled upon release. There were two leatherback mortalities observed in the NEC area. Of the 67 captured loggerhead turtles, 64 were released alive with all gear removed or with the hook and trailing line less than one-half the carapace length (Table 3), while three additional loggerheads had swallowed the hook and were released with the hook but no trailing line.

Ten interactions were observed with marine mammals during this quarter in the MAB and NEC fishing areas (Table 4, Figure 2). One Risso’s dolphin and four pilot whales were considered seriously injured based upon NOAA guidelines (Angliss and DeMaster, 1998). The Risso’s dolphin was hooked in the upper left jaw and released with the hook and two feet of leader. Three pilot whales were hooked near the head or mouth, the line was cut, and the animals were released alive with 6, 15, and 48 feet of trailing line remaining, respectively. For the remaining pilot whale, it was unknown if the animal was hooked or wrapped, and the animal was released with 8 feet of trailing gear.

The remaining whales were released with all gear removed, and were not considered to be seriously injured. One bottlenose dolphin, two Risso’s dolphins, and one pilot whale were entangled around the flukes, but not hooked (for one Risso’s dolphin it was unknown if it was hooked), and released with no gear. A beaked whale was entangled around the flipper and flukes, and all the gear was removed upon release.

The quarterly and regional bycatch rates are summarized for sea turtles in Table 5 and for marine mammals in Table 6. These rates were compared with those from the same quarter/area for 2002-2004 before the implementation of the circle hook regulations and the average for 2005-2007 after implementation (Tables 7 and 8).

There was no observed bycatch in the FEC area for leatherbacks, similar to that observed for this quarter since 2002 (Table 7). For leatherback turtles, the observed bycatch rate in the GOM

fishing area in 2008 was lower than or consistent with the past averages in the GOM (where zero bycatch was observed) and the MAB areas. The observed bycatch of leatherback turtles in the NEC area was significantly higher than that observed during both the 2002-2004 as well as the 2005-2007 time periods.

For loggerhead turtles, the observed bycatch rates for 2008 in the FEC and MAB was zero, as it was during the 2002-2004 period, which was lower than the average observed between 2005-2007 during the third quarter. The observed bycatch in the GOM fishing area was zero, as was the 2005-2007 average observed bycatch, which was lower than the average reported for 2002-2004. In the NEC area, the third quarter bycatch during 2008 was elevated in comparison to the previous averages since 2002, though this was not statistically significant as demonstrated by the overlap of the 95% confidence limits for the three time periods. In the NED fishing area, the 2008 third quarter bycatch during 2008 was much higher than the average for the 2005-2007 period (Table 7).

For marine mammals, the bycatch of bottlenose dolphins in the NEC fishing area was elevated in comparison to the zero bycatch observed since 2002 (Table 8). The zero bycatch of Risso's dolphins reported in the MAB during the third quarter of 2008 was lower than that observed in both 2002-2004 as well as 2005-2007. In the NEC area, however, the 2008 reported bycatch of Risso's dolphins was similar to the average bycatch reported during 2002-2004, but was elevated in comparison to the zero bycatch observed during 2005-2007. The bycatch of pilot whales in the MAB area during 2008 was slightly lower than that observed since 2002, but not statistically so, given the overlap of the 95% confidence intervals for all three time periods. In the NEC area, however, zero bycatch of pilot whales was reported during 2008, as well as during 2002-2004, which is a reduction relative to the average bycatch reported during 2005-2007 in this area. The beaked whale bycatch during 2008 was elevated in comparison to the zero bycatch reported for these species since 2002. There were no reported bycatch during 2008 for common dolphins in the MAB and NED areas, and for unidentified marine mammals in the GOM and MAB areas, where bycatch had been reported in previous years.

There are a number of caveats and uncertainties associated with the current analysis. First, while these data have undergone an initial audit and review, they are subject to change upon further review after the end of the 2008 calendar year. Second, the delta log-normal estimator was applied to calculate bycatch rates consistent with previous estimates (e.g., Garrison 2003). This approach assumed 1) that catch rates (animals per hook) were log-normally distributed, and 2) that the number of hooks was an appropriate unit of effort. The first assumption has been evaluated for turtles; however, violations of this assumption may have resulted in biased (positive or negative) estimates of catch rate and associated variances. The second assumption has not been examined critically in previous analyses. If this assumption was not correct, for example if there were saturation effects resulting in a non-linear relationship between the number of hooks and total catch, then there potentially may have been a bias in the estimate of bycatch rates.

The interaction between longline gear and protected species is a relatively rare event and is therefore inherently variable. Historically, there have been very large inter-annual fluctuations in bycatch rates and estimates of total bycatch. Thus, any differences observed between short

term observations of bycatch rates and long term averages may be simply stochastic events and are not necessarily indicative of a significant change in the interactions between the longline fishery and protected species.

### **Literature Cited**

Angliss, R.P. and D.P. DeMaster. 1998. Differentiating Serious and Non-Serious Injury of Marine Mammals Taken Incidental to Commercial Fishing Operations: Report of the Serious Injury Workshop 1-2 April 1997, Silver Spring, Maryland. NOAA Technical Memorandum NMFS-OPR-13: 48 p.

Garrison, L.P. 2003. Estimated Bycatch of Marine Mammals and Turtles in the U.S. Atlantic Pelagic Longline Fleet During 2001-2002. NOAA Technical Memorandum NOAA NMFS-SEFSC-515: 52 p.

**Table 1.** Number of sets and hooks observed in the U.S. Atlantic Pelagic Longline Fishery between 1 July and 30 September, 2008 by fishing area during normal fishery operations. NR indicates strata where observed effort levels can not be reported due to confidentiality considerations.

<b>Area</b>	<b>Sets</b>	<b>Hooks</b>
CAR	0	0
FEC	NR	NR
GOM	35	30,306
MAB	54	48,578
NCA	0	0
NEC	78	73,485
NED	NR	NR
SAB	0	0
SAR	0	0
TUN	0	0
<b>Total</b>	<b>209</b>	<b>178,969</b>

**Table 2.** Total observed interactions with marine turtles in the U.S. Atlantic Pelagic Longline Fishery for sets beginning between 1 July – 30 September, 2008 by fishing area during (A) Normal and (B) Experimental fishing operations. Areas with missing values indicate no observer coverage during this time period.

**(A) Normal Fishing**

<b>Area</b>	<b>Leatherback</b>	<b>Loggerhead</b>
CAR	-	-
FEC	0	0
GOM	0	0
MAB	2	0
NCA	-	-
NEC*	19	39
NED	0	28
SAB	-	-
SAR	-	-
TUN	-	-
<b>Total</b>	<b>21</b>	<b>67</b>

\* Two leatherbacks were reported as dead in the NEC area.

**(B) Experimental Fishing**

<b>Area</b>	<b>Leatherback</b>	<b>Loggerhead</b>
CAR	-	-
FEC	0	0
GOM	0	0
MAB	0	0
NCA	-	-
NEC	0	0
NED	0	0
SAB	-	-
SAR	-	-
TUN	-	-
<b>Total</b>	<b>0</b>	<b>0</b>

**Table 3.** Released status and gear removal for sea turtles captured in the U.S. Atlantic Pelagic Longline Fishery during 1 July – 30 September 2008. This includes leatherback turtles captured during experimental fishing.

<b>Release Status</b>	<b>Leatherback</b>	<b>Loggerheads</b>
Released entangled	1	0
Released with hook and line $\geq \frac{1}{2}$ carapace length	4	0
Released with hook and line $\leq \frac{1}{2}$ carapace length	5	15
Released with hook and no line (i.e. hook swallowed)	0	3
Released with all gear removed	12	49

**Table 4.** Interactions with marine mammals observed during 1 July – 30 September, 2008 in the U.S. Atlantic Pelagic Longline Fishery by fishing area during normal fishing operations. Observer comments and criteria described in Angliss and DeMaster (1998) were used to evaluate serious injury.

<b>Species</b>	<b>Region</b>	<b># Released Un-injured</b>	<b># Dead</b>	<b># Serious Injury</b>
Bottlenose Dolphin	NEC	1	0	0
Risso's Dolphin	NEC	2	0	1
Pilot Whale	MAB	1	0	4
Beaked Whale	NEC	1	0	0

**Table 5.** Estimated bycatch rate (Catch per 1000 hooks) for (A) Leatherback and (B) Loggerhead turtles by geographic area and during 1 July – 30 September, 2008 in the U.S. Atlantic Pelagic Longline Fishery during normal fishing operations. Missing values indicate areas with no observer coverage. CV indicates the coefficient of variation of the estimated rate. NR indicates areas where the number of observed sets cannot be reported due to confidentiality considerations.

**(A) Leatherback Turtles**

Area	Interaction Type	# Observed Sets	# Positive Sets	Mean CPUE	CV CPUE	95% Confidence Interval
CAR	Alive	0	-	-	-	-
FEC	Alive	NR	0	0	-	-
GOM	Alive	35	0	-	-	-
MAB	Alive	54	1	0.0396	1.0000	0.0081 – 0.1934
NCA	Alive	0	-	-	-	-
NEC	Alive	78	14	0.2399	0.2644	0.1462 – 0.3937
NEC	Dead	78	1	0.0333	1.0000	0.0068 – 0.1628
NED	Alive	NR	0	0	-	-
SAB	Alive	0	-	-	-	-
SAR	Alive	0	-	-	-	-
TUN	Alive	0	-	-	-	-

**(B) Loggerhead Turtles**

Area	Interaction Type	# Observed Sets	# Positive Sets	Mean CPUE	CV CPUE	95% Confidence Interval
CAR	Alive	0	-	-	-	-
FEC	Alive	NR	0	0	-	-
GOM	Alive	35	0	0	-	-
MAB	Alive	54	0	0	-	-
NCA	Alive	0	-	-	-	-
NEC	Alive	78	26	0.5450	0.1952	0.3769 – 0.7879
NED	Alive	NR	4	2.0638	0.6489	0.6668 – 6.3876
SAB	Alive	0	-	-	-	-
SAR	Alive	0	-	-	-	-
TUN	Alive	0	-	-	-	-

**Table 6.** Estimated bycatch rate (Catch per 1000 hooks) for marine mammals by geographic area and quarter during 1 July – 30 September, 2008 in the U.S. Atlantic Pelagic Longline Fishery during normal fishing operations. CV indicates the coefficient of variation of the estimated rate.

Species	Serious Injury?	Area	# Observed Sets	# Positive Sets	Mean CPUE	CV CPUE	95% Confidence Interval
Bottlenose Dolphin	N	NEC	78	1	0.0146	1	0.0030 – 0.0712
Risso's Dolphin	N	NEC	78	1	0.0240	1	0.0050 – 0.1171
Risso's Dolphin	Y	NEC	78	1	0.0144	1	0.0030 – 0.0705
Pilot Whale	N	MAB	54	1	0.0192	1	0.0039 – 0.09371
Pilot Whale	Y	MAB	54	4	0.0761	0.4886	0.0315 – 0.1839
Beaked Whale	N	NEC	78	1	0.0143	1	0.0029 – 0.0699

**Table 7.** Bycatch rates for (A) Leatherback turtles, (B) Loggerhead turtles, (C) Kemp’s ridley turtles, and (D) Unidentified marine turtles, in the U.S. Atlantic Pelagic Longline fishery during 1 July – 30 September, 2008 comparison to the second quarter average rate from 2002-2004 and the average rate from 2005-2007. 95% CI indicates the estimated 95% confidence interval of the mean bycatch rate (CPUE) in each cell assuming a lognormal distribution of rates. These rates reflect combined alive, dead and unknown turtles.

**(A) Leatherback turtles**

Area	2002-2004 CPUE	2002-2004 95% CI	2005-2007 CPUE	2005-2007 95% CI	2008 CPUE	2008 95% CI
CAR	-	-	-	-	-	-
FEC	0	-	0	-	0	-
GOM	0.1408	0.0876 – 0.2265	0.0211	0.0059 – 0.0757	0	-
MAB	0.0648	0.0183 – 0.2293	0.0358	0.0145 – 0.0883	0.0396	0.0081 – 0.1934
NCA	-	-	-	-	-	-
NEC	0.0208	0.0042 – 0.1015	0.1697	0.0893 – 0.3224	0.2732	0.1687 – 0.4426
NED*	-	-	0.2380	0.1592-0.3558	0	-
SAB	0.0526	0.0108 – 0.2571	-	-	-	-
SAR	-	-	-	-	-	-
TUN	-	-	-	-	-	-

**(B) Loggerhead turtles**

Area	2002-2004 CPUE	2002-2004 95% CI	2005-2007 CPUE	2005-2007 95% CI	2008 CPUE	2008 95% CI
CAR	-	-	-	-	-	-
FEC	0	-	0.1678	0.0617 – 0.4565	0	-
GOM	0.0248	0.0101 – 0.0607	0	-	0	-
MAB	0.0477	0.0133 – 0.1715	0.1549	0.0965 – 0.2486	0	-
NCA	-	-	-	-	-	-
NEC	0.2497	0.1335 – 0.4671	0.3573	0.2217 – 0.5756	0.5450	0.3769 – 0.7879
NED*	-	-	0.4257	0.2635 – 0.6870	2.0638	0.6668 – 6.3876
SAB	0	-	0.0889	0.0268 – 0.2956	-	-
SAR	-	-	-	-	-	-
TUN	-	-	-	-	-	-

\*Prior to June of 2004, only experimental fishing took place in the NED area. The 2005-2007 averages for the NED area include all fishing after implementation of regulations in June 2004.

**(C) Kemp's ridley turtles**

<b>Area</b>	<b>2002-2004 CPUE</b>	<b>2002-2004 95% CI</b>	<b>2005-2007 CPUE</b>	<b>2005-2007 95% CI</b>	<b>2008 CPUE</b>	<b>2008 95% CI</b>
CAR	-	-	-	-	-	-
FEC	0.0535	0.0109 – 0.2615	0	-	0	-
GOM	0	-	0	-	0	-
MAB	0	-	0	-	0	-
NCA	-	-	-	-	-	-
NEC	0	-	0	-	0	-
NED	0	-	0	-	0	-
SAB	0	-	0	-	-	-
SAR	-	-	-	-	-	-
TUN	-	-	-	-	-	-

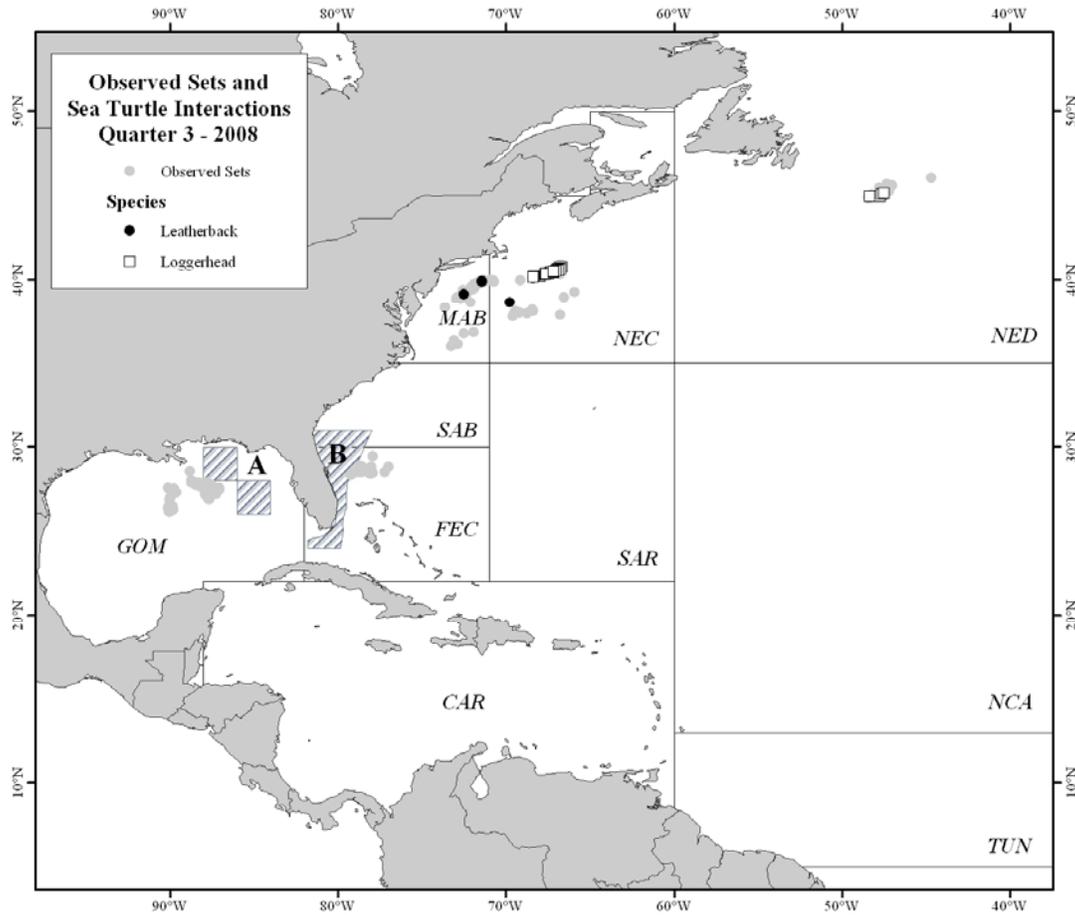
**(D) Unidentified marine turtles**

<b>Area</b>	<b>2002-2004 CPUE</b>	<b>2002-2004 95% CI</b>	<b>2005-2007 CPUE</b>	<b>2005-2007 95% CI</b>	<b>2008 CPUE</b>	<b>2008 95% CI</b>
CAR	-	-	-	-	-	-
FEC	0	-	0	-	0	-
GOM	0.0060	0.0012 – 0.0293	0	-	0	-
MAB	0	-	0	-	0	-
NCA	-	-	-	-	-	-
NEC	0	-	0	-	0	-
NED	0	-	0	-	0	-
SAB	0	-	0	-	-	-
SAR	-	-	-	-	-	-
TUN	-	-	-	-	-	-

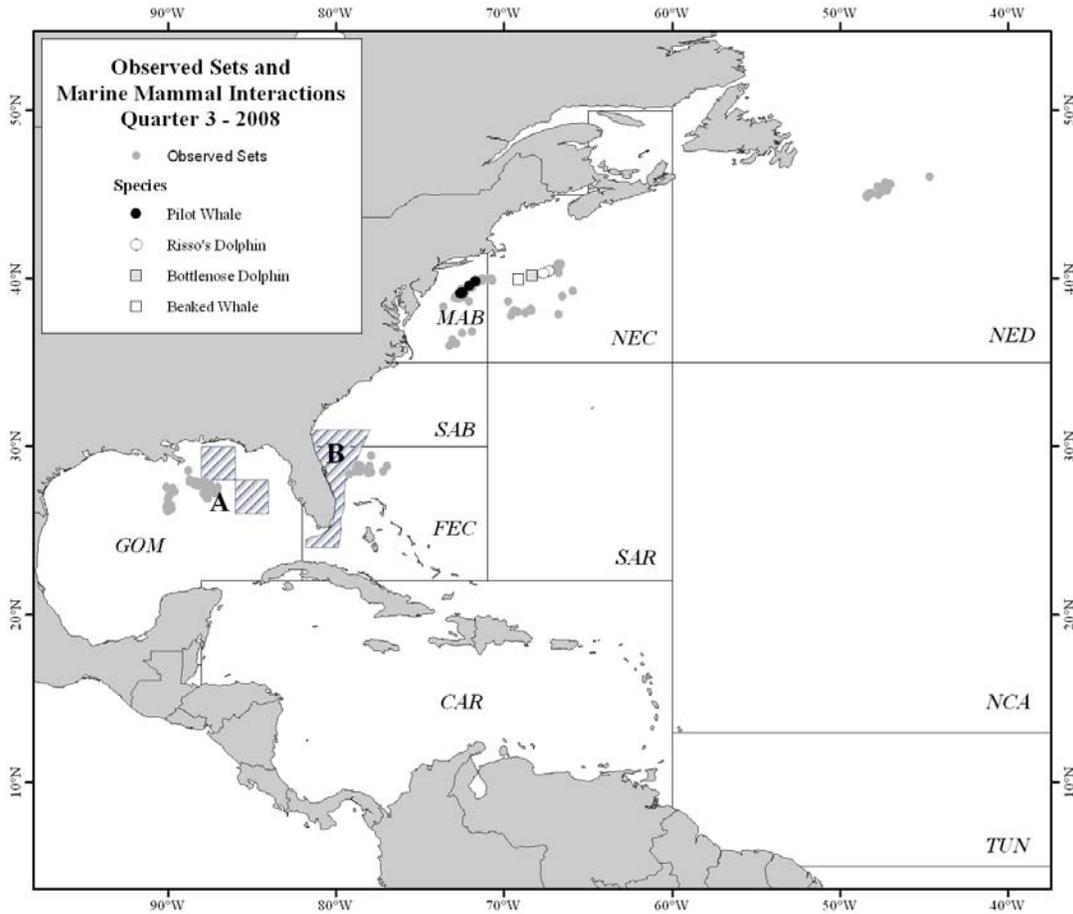
**Table 8.** Bycatch rates for marine mammals in the U.S. Atlantic Pelagic Longline Fishery during 1 July – 30 September, 2008 comparison to the second quarter average rate from 2002-2004 and the average rate from 2005-2007. 95% CI indicates the estimated 95% confidence interval of the mean bycatch rate (CPUE) in each cell assuming a lognormal distribution of rates. CPUEs reflect total marine mammals caught including alive, dead, and seriously injured animals.

Species	Area	2002-2004 CPUE	2002-2004 95% CI	2005-2007 CPUE	2005-2007 95% CI	2008 CPUE	2008 95% CI
Bottlenose Dolphin	NEC	0	-	0	-	0.0146	0.0030 – 0.0712
Common Dolphin	MAB	0.0181	0.0037 – 0.0883	0	-	0	-
Common Dolphin	NED	0.0184	0.0038 – 0.0902	0	-	0	-
Risso's Dolphin	MAB	0.0141	0.0029 – 0.0689	0.0068	0.0014 – 0.0332	0	-
Risso's Dolphin	NEC	0.0518	0.0155 – 0.1725	0	-	0.0384	0.0111 – 0.1324
Pilot Whale	MAB	0.1010	0.0429 – 0.2379	0.2219	0.1193 – 0.4129	0.0952	0.0433 – 0.2097
Pilot Whale	NEC	0	-	0.0276	0.0057 – 0.1351	0	-
Beaked Whale	NEC	0	-	0	-	0.0143	0.0029 – 0.0699
Unidentified Marine Mammal	GOM	0	-	0.0069	0.0014 – 0.0336	0	-
Unidentified Marine Mammal	MAB	0	-	0.0161	0.0048 – 0.0540	0	-

**Figure 1.** Observed Pelagic Longline effort and turtle interactions during 1 July – 30 September, 2008. Pelagic longline fishing areas include: 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. Year-round closed areas in the DeSoto Canyon (A) and the Florida East Coast (B) are indicated.



**Figure 2.** Observed Pelagic Longline effort and marine mammal interactions during 1 July – 30 September, 2008. Pelagic longline fishing areas include: 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. Year-round closed areas in the DeSoto Canyon (A) and the Florida East Coast (B) are indicated.



**Appendix A:** Injury details and hook types for turtles captured in the U.S. Atlantic Pelagic Longline Fishery for sets during normal fishing operations from 1 July – 30 September 2008. “CL Est.” indicates an estimated carapace length in feet; “CCL” indicates a measured curved carapace length in cm; and “Straight N-N” indicates a straight line measurement of the turtle carapace from notch to notch.

**A1. Leatherback Turtles**

#	Species	Area	Hook Type	Offset (degrees)	Bait	Bait Size (g)	Capture Condition	Final Disposition	Hook Location	Hook Removed?	Entangled Capture?	Entangled Release?	Line Left (ft)	CL Est. (ft)	CCL (cm)	Straight N-N (cm)
1	Leatherback	NEC	18/0-C or 16/0-C	10 deg or 0 deg	Squid or mackerel	168 or 263	Alive, injured	Released alive	unknown external	No	No	No	5.00	5.50		
2	Leatherback	NEC	C-18/0	10	Mackerel	263	Alive, injured	Released alive	armpit	Yes	No	No	0.00	5.50		
3	Leatherback	NEC	C-18/0	10	Squid	227	Alive, injured	Released alive	shoulder	Yes	No	No	0.00	5.00		
4	Leatherback	NEC	C-18/0	10	Squid	227	Alive, injured	Released alive	armpit	Yes	Yes	No	0.00	5.00		
5	Leatherback	NEC	C-18/0	10	Squid	227	Alive, injured	Released alive	armpit	Yes	Yes	No	0.00	6.00		
6	Leatherback	NEC	C-18/0	10	Squid	227	comatose (not successfully resuscitated)	Discarded unmarked dead/unresponsive carcass	not hooked	n/a	Yes	No	0.00		147.2	
7	Leatherback	NEC	C-18/0	10	Squid	227	Alive, injured	Discarded unmarked dead/unresponsive carcass	not hooked	n/a	Yes	Yes	8.00	4.00		
8	Leatherback	NEC	C-18/0	10	Squid	227	Alive, injured	Released alive	mouth, lower, other	No	No	No	0.30	5.00		
9	Leatherback	NEC	C-18/0	10	Squid	227	Alive, injured	Released alive	armpit	No	No	No	3.00	4.00		
10	Leatherback	NEC	C-18/0	10	Squid	227	Alive, injured	Released alive	armpit	Yes	No	No	0.00	5.00		
11	Leatherback	NEC	C-18/0	10	Squid	227	Alive, injured	Released alive	rear flipper	No	No	No	0.30	4.00		
12	Leatherback	NEC	C-18/0	10	Squid or mackerel	186.3 or 362	Alive, injured	Released alive	shoulder	No	No	No	6.00	4.00		
13	Leatherback	NEC	C-18/0	10	Squid or mackerel	185.5 or 363.8	Alive, uninjured	Released alive	not hooked	n/a	Yes	No	0.00	4.50		

### Appendix A1. Leatherback Turtles (cont.)

#	Species	Area	Hook Type	Offset (degrees)	Bait	Bait Size (g)	Capture Condition	Final Disposition	Hook Location	Hook Removed?	Entangled Capture?	Entangled Release?	Line Left (ft)	CL Est. (ft)	CCL (cm)	Straight N-N (cm)
14	Leatherback	NEC	C-18/0	10	Squid or mackerel	188.3 or 362.6	Alive, uninjured	Released alive	not hooked	n/a	Yes	No	0.00	5.00		
15	Leatherback	NEC	C-18/0	10	Squid	113	Alive, injured	Released alive	shoulder	No	No	No	1.00	4.00		
16	Leatherback	NEC	C-18/0	10	Squid or mackerel	284 or 293	Alive, injured	Released alive	armpit	No	Yes	No	0.20	5.00		
17	Leatherback	NEC	C-18/0	10	Squid or mackerel	284 or 293	Alive, injured	Released alive	armpit	No	No	No	0.20	5.00		
18	Leatherback	NEC	C-18/0	10	Squid or mackerel	284 or 293	Alive, uninjured	Released alive	not hooked	n/a	Yes	No	0.00	4.00		
19	Leatherback	NEC	C-18/0	10	Squid	153	Alive, injured	Released alive	shoulder	Yes	Yes	No	0.00	4.00		
20	Leatherback	MAB	C-18/0	10	Squid	135	Alive, uninjured	Released alive	not hooked	n/a	Yes	No	0.00	6.00		
21	Leatherback	MAB	C-18/0	10	Squid	135	Alive, injured	Released alive	armpit	No	No	No	0.00	5.00		

## Appendix A2. Loggerhead Turtles

#	Species	Area	Hook Type	Offset (degrees)	Bait	Bait Size (g)	Capture Condition	Final Disposition	Hook Location	Hook Removed?	Entangled Capture?	Entangled Release?	Line Left (ft)	CL Est. (ft)	CCL (cm)	Straight N-N (cm)
1	Loggerhead	NEC	C-18/0	10	Squid	227	Alive, injured	Released alive	mouth, side	Yes	No	No	0.00		66.8	59.8
2	Loggerhead	NEC	C-18/0	10	Squid	227	Alive, injured	Released alive	tongue	No	No	No	0.10		72.1	65.2
3	Loggerhead	NEC	C-18/0	10	Squid	227	Alive, injured	Released alive	tongue	Yes	No	No	0.00		70	64.3
4	Loggerhead	NEC	C-18/0	10	Squid	227	Alive, injured	Released alive	tongue	Yes	No	No	0.00		58	53.7
5	Loggerhead	NEC	C-18/0	10	Squid	227	Alive, injured	Released alive	swallowed, hook partially visible	No	No	No	0.20		63.7	57.3
6	Loggerhead	NEC	C-18/0	10	Squid	227	Alive, injured	Released alive	swallowed, hook not visible	No	No	No	0.30		58.8	53.9
7	Loggerhead	NEC	C-18/0	10	Squid	227	Alive, injured	Released alive	swallowed, hook partially visible	Yes	No	No	0.00		68.9	65.4
8	Loggerhead	NEC	C-18/0	10	Squid	227	Alive, injured	Released alive	swallowed, hook not visible	No	No	No	0.20		70.4	65.7
9	Loggerhead	NEC	C-18/0	10	Squid	227	Alive, injured	Released alive	neck	Yes	No	No	0.00		60.8	55.6
10	Loggerhead	NEC	C-18/0	10	Squid	227	Alive, injured	Released alive	swallowed, hook not visible	No	No	No	0.20		69.2	63.7
11	Loggerhead	NEC	C-18/0	10	Squid	227	Alive, injured	Released alive	tongue	Yes	No	No	0.00		75.2	68.8
12	Loggerhead	NEC	C-18/0	10	Squid	227	Alive, injured	Released alive	swallowed, hook partially visible	Yes	No	No	0.00		65.1	59
13	Loggerhead	NEC	C-18/0	10	Squid	227	Alive, injured	Released alive	swallowed, hook not visible	No	No	No	0.20		71.3	64.1
14	Loggerhead	NEC	C-18/0	10	Squid	227	Alive, injured	Released alive	swallowed, hook not visible	No	No	No	0.20		74.1	65.6
15	Loggerhead	NEC	C-18/0	10	Squid	227	Alive, injured	Released alive	swallowed, hook not visible	No	No	No	0.10		77	70.2
16	Loggerhead	NEC	C-18/0	10	Squid	184	Alive, injured	Released alive	side jaw joint	Yes	No	No	0.00		77	70.3

## Appendix A2. Loggerhead Turtles (cont.)

#	Species	Area	Hook Type	Offset (degrees)	Bait	Bait Size (g)	Capture Condition	Final Disposition	Hook Location	Hook Removed?	Entangled Capture?	Entangled Release?	Line Left (ft)	CL Est. (ft)	CCL (cm)	Straight N-N (cm)
17	Loggerhead	NEC	C-18/0	10	Mackerel	358	Alive, injured	Released alive	swallowed, hook partially visible	No	No	No	0.10		66.8	56.9
18	Loggerhead	NEC	C-18/0	10	Mackerel	358	Alive, injured	Released alive	side jaw joint	Yes	No	No	0.00		52	46.5
19	Loggerhead	NEC	C-18/0	10	Mackerel	358	Alive, injured	Released alive	glottis	Yes	No	No	0.00		67	59.5
20	Loggerhead	NEC	C-18/0	10	Mackerel	358	Alive, injured	Released alive	swallowed, hook not visible	No	No	No	0.20		81.2	73
21	Loggerhead	NEC	C-18/0	10	Squid or mackerel	284 or 293	Alive, injured	Released alive	armpit	Yes	No	No	0.00		74.5	64.8
22	Loggerhead	NEC	C-18/0	10	Squid or mackerel	284 or 293	Alive, injured	Released alive	tongue	Yes	No	No	0.00		64.2	63.5
23	Loggerhead	NEC	C-18/0	10	Squid or mackerel	284 or 293	Alive, injured	Released alive	swallowed, hook not visible	No	No	No	0.20		68	61
24	Loggerhead	NEC	C-18/0	10	Squid or mackerel	284 or 293	Alive, injured	Released alive	glottis	Yes	No	No	0.00		72	70.8
25	Loggerhead	NEC	C-18/0	10	Squid or mackerel	284 or 293	Alive, injured	Released alive	swallowed, hook not visible	No	No	No	0.20		69.5	61.2
26	Loggerhead	NEC	C-18/0	10	Squid or mackerel	284 or 293	Alive, injured	Released alive	armpit	Yes	No	No	0.00		61	
27	Loggerhead	NEC	C-18/0	10	Squid	284	Alive, injured	Released alive	armpit	Yes	No	No	0.00		58.8	52
28	Loggerhead	NEC	C-18/0	10	Squid or mackerel	284 or 293	Alive, injured	Released alive	armpit	Yes	No	No	0.00		70.2	64
29	Loggerhead	NEC	C-18/0	10	Mackerel	293	Alive, injured	Released alive	mouth, lower	Yes	No	No	0.00	2.30		
30	Loggerhead	NEC	C-18/0	10	Squid or mackerel	371 or 293	Alive, injured	Released alive	tongue	Yes	No	No	0.00		77.5	76
31	Loggerhead	NEC	C-18/0	10	Squid or mackerel	371 or 293	Alive, injured	Released alive	armpit	Yes	No	No	0.00		67	60.7
32	Loggerhead	NEC	C-18/0	10	Squid	200	Alive, injured	Released alive	mouth, side, unknown	Yes	No	No	0.00		67.2	60.3

## Appendix A2. Loggerhead Turtles (cont.)

#	Species	Area	Hook Type	Offset (degrees)	Bait	Bait Size (g)	Capture Condition	Final Disposition	Hook Location	Hook Removed?	Entangled Capture?	Entangled Release?	Line Left (ft)	CL Est. (ft)	CCL (cm)	Straight N-N (cm)
33	Loggerhead	NEC	C-18/0	10	Squid or mackerel	198 or 320	Alive, injured	Released alive	swallowed, hook not visible	No	No	No	0.50		68.4	61.9
34	Loggerhead	NEC	C-18/0	10	Squid	153	Alive, injured	Released alive	swallowed, hook not visible	No	No	No	0.30		69	64.5
35	Loggerhead	NEC	C-18/0	10	Squid or mackerel	153 or 347	Alive, injured	Released alive	glottis	Yes	No	No	0.00		68	63.4
36	Loggerhead	NEC	C-18/0	10	Mackerel	333	Alive, injured	Released alive	front flipper	Yes	No	No	0.00		59.2	54.2
37	Loggerhead	NEC	C-18/0	10	Squid or mackerel	153 or 333	Alive, injured	Released alive	tongue	Yes	No	No	0.00		65.4	58.9
38	Loggerhead	NEC	C-18/0	10	Mackerel	333	Alive, injured	Released alive	beak internal, unknown	Yes	No	No	0.00		69.8	63.6
39	Loggerhead	NEC	C-18/0	10	Squid	163	Alive, injured	Released alive	tongue	Yes	No	No	0.00		69.4	62.5
40	Loggerhead	NED	C-18/0	10	Mackerel	423	Alive, injured	Released alive	swallowed, hook not visible	No	No	No	0.00		64	61.5
41	Loggerhead	NED	C-18/0	10	Squid or mackerel	171 or 252	Alive, injured	Released alive	beak internal, upper jaw	Yes	No	No	0.00		63.1	
42	Loggerhead	NED	C-18/0	10	Squid or mackerel	171 or 252	Alive, injured	Released alive	front flipper	Yes	No	No	0.00		52.5	
43	Loggerhead	NED	C-18/0	10	Squid or mackerel	171 or 252	Alive, injured	Released alive	glottis	Yes	No	No	0.00		43	
44	Loggerhead	NED	C-18/0	10	Squid or mackerel	171 or 252	Alive, injured	Released alive	swallowed, hook visible to insertion pt	Yes	No	No	0.00		67.5	
45	Loggerhead	NED	C-18/0	10	Squid or mackerel	171 or 252	Alive, injured	Released alive	roof of mouth	Yes	No	No	0.00		55	
46	Loggerhead	NED	C-18/0	10	Squid or mackerel	171 or 252	Alive, injured	Released alive	swallowed, hook not visible	No	No	No	0.10		69.4	
47	Loggerhead	NED	C-18/0	10	Squid or mackerel	171 or 252	Alive, injured	Released alive	tongue	Yes	No	No	0.00		59	

## Appendix A2. Loggerhead Turtles (cont.)

#	Species	Area	Hook Type	Offset (degrees)	Bait	Bait Size (g)	Capture Condition	Final Disposition	Hook Location	Hook Removed?	Entangled Capture?	Entangled Release?	Line Left (ft)	CL Est. (ft)	CCL (cm)	Straight N-N (cm)
48	Loggerhead	NED	C-18/0	10	Squid or mackerel	171 or 252	Alive, injured	Released alive	tongue	Yes	No	No	0.00		72.8	
49	Loggerhead	NED	C-18/0	10	Squid or mackerel	171 or 252	Alive, injured	Released alive	tongue	Yes	No	No	0.00		63	
50	Loggerhead	NED	C-18/0	10	Squid or mackerel	171 or 252	Alive, injured	Released alive	side jaw joint	Yes	No	No	0.00		76	
51	Loggerhead	NED	C-18/0	10	Squid or mackerel	171 or 252	Alive, injured	Released alive	unknown location	Yes	No	No	0.00	2.00		
52	Loggerhead	NED	C-18/0	10	Squid or mackerel	140 or 207	Alive, injured	Released alive	shoulder	Yes	No	No	0.00		57.1	
53	Loggerhead	NED	C-18/0	10	Squid or mackerel	140 or 207	Alive, injured	Released alive	front flipper	Yes	No	No	0.00	2.00		
54	Loggerhead	NED	C-18/0	10	Mackerel	207	Alive, injured	Released alive	side jaw joint	Yes	No	No	0.00		57.5	
55	Loggerhead	NED	C-18/0	10	Squid or mackerel	140 or 207	Alive, injured	Released alive	tongue	Yes	No	No	0.00		58	
56	Loggerhead	NED	C-18/0	10	Squid or mackerel	140 or 207	Alive, uninjured	Released alive	not hooked	n/a	Yes	No	0.00		58	
57	Loggerhead	NED	C-18/0	10	Squid or mackerel	140 or 207	Alive, injured	Released alive	tongue	Yes	No	No	0.00		67	
58	Loggerhead	NED	C-18/0	10	Squid or mackerel	140 or 207	Alive, injured	Released alive	unknown location	Yes	No	No	0.00	2.30		
59	Loggerhead	NED	C-18/0	10	Squid or mackerel	135 or 203	Alive, injured	Released alive	armpit	Yes	No	No	0.00		68.5	
60	Loggerhead	NED	C-18/0	10	Squid or mackerel	135 or 203	Alive, injured	Released alive	swallowed, hook visible to insertion pt	No	No	No	0.00		67	
61	Loggerhead	NED	C-18/0	10	Squid or mackerel	135 or 203	Alive, injured	Released alive	tongue	Yes	No	No	0.00		61.5	
62	Loggerhead	NED	C-18/0	10	Squid or mackerel	135 or 203	Alive, uninjured	Released alive	not hooked	n/a	Yes	No	0.00		49	

**Appendix A2. Loggerhead turtles (cont.)**

#	Species	Area	Hook Type	Offset (degrees)	Bait	Bait Size (g)	Capture Condition	Final Disposition	Hook Location	Hook Removed?	Entangled Capture?	Entangled Release?	Line Left (ft)	CL Est. (ft)	CCL (cm)	Straight N-N (cm)
63	Loggerhead	NED	C-18/0	10	Squid or mackerel	135 or 203	Alive, injured	Released alive	tongue	Yes	No	No	0.00		68.3	
64	Loggerhead	NED	C-18/0	10	Squid or mackerel	135 or 203	Alive, injured	Released alive	tongue	Yes	No	No	0.00		53.2	
65	Loggerhead	NED	C-18/0	10	Squid or mackerel	135 or 203	Alive, injured	Released alive	swallowed, hook not visible	No	No	No	0.00		66.5	
66	Loggerhead	NED	C-18/0	10	Squid or mackerel	135 or 203	Alive, injured	Released alive	tongue	Yes	No	No	0.00		53.2	
67	Loggerhead	NED	C-18/0	10	Squid or mackerel	135 or 203	Alive, injured	Released alive	tongue	Yes	No	No	0.00		61	