Preliminary Estimates of Protected Species Bycatch Rates in the U.S. Atlantic Pelagic Longline Fishery Between 1 January and 31 March 2006

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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 central North Atlantic ocean. The longline fishery has a documented history of incidental takes of non-target species including billfish, marine turtles, and marine mammals. During recent years there have been elevated takes of leatherback turtles in the Gulf of Mexico (Garrison, 2003; Garrison and Richards, 2004). As a result, a Biological Opinion on the pelagic longline fishery was recently developed by NOAA Fisheries under the Endangered Species Act, requiring several actions to be taken to improve monitoring and reduce interactions with leatherback and loggerhead turtles. These regulations reopened the NED, with restrictions, on June 30, 2004 and similar restrictions were imposed upon the rest of the fleet effective August 5, 2004. These regulations mandate that all longline gear use 16/0 or 18/0 circle hooks and eliminates J-hooks from the fishery. This quarterly report includes fishing under the new regulatory regime.

The Biological Opinion requires quarterly reporting of interactions with protected species including marine mammals and marine turtles. The goal of this measure is to more closely monitor any potential short-term increases in interaction rates and thereby allow a more responsive management program. This report meets this requirement and includes the observed fishery effort and incidental takes observed by the pelagic longline observer program (POP) including sets from January 1, 2006 to March 31, 2006.

While it would be desirable to estimate the absolute level of takes (i.e. total number of turtles taken), this is not currently possible because the fishery effort data is reported on logbook forms by fishing captains. These data are not available until several months after the end of any given quarter. Therefore, we present the bycatch rate (i.e. catch per unit effort) 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 2006 is compared to that observed in 2005 and the average of the previous five years (2001-2005) to assess whether or not the observed rate in 2006 is unusually high or low. Bycatch rates are calculated applying the delta log-normal method using hooks as the unit of effort, and the analytical methods are described in detail in Garrison (2003).

Results and Discussion

A total of 121 longline sets (~86,620 hooks) were observed during quarter 1 of 2006 (Table 1). The Gulf of Mexico had by far the highest number of observed sets.

There were 6 observed interactions with leatherback turtles and 3 observed interactions with loggerhead turtles during this quarter (Table 2). All loggerhead turtles and 5 leatherback turtles were listed as released alive and injured by the observer (Appendix A). One leatherback turtle was listed as released alive uninjured. The interactions with both species were observed in the SAB (3 turtles), the SAR (3 turtles), the FEC (2 turtles), and the GOM (1 turtle) areas (Table 2). The locations of observed sets and turtle interactions are shown in Figure 1.

There were 7 marine mammal interactions observed, all with pilot whales (Table 3). Two pilot whales were released uninjured, and 5 were released with serious injury, based upon observer comments and serious injury criteria (see Garrison, 2003). Of the five pilot whales released with serious injury, 2 were listed as being hooked in the mouth and entangled, and 3 were listed as entangled but not hooked. Interactions with marine mammals were observed only in the MAB region (Figure 2).

The quarterly and regional bycatch rates are summarized for marine turtles in Table 4 and for marine mammals in Table 5. These rates are compared with those from the same quarter/area for 2005 and the average from 2001-2005 in Tables 6-7. Specific information on injuries to sea turtles and gear characteristics of each interaction are shown in Appendix A.

For leatherback turtles, the catch rate observed in the Gulf of Mexico was slightly lower than those observed during previous years in quarter 1 (Table 6A). However, the 95% confidence intervals for 2006 overlap with those from 2005 and the combined estimate of 2001-2005, and therefore the estimate from the current year is not significantly different from that in previous years. The bycatch rate in the FEC region was lower than those observed in previous years. Again, however, the 95% confidence intervals for 2006 overlap with those from 2005 and the combined estimate of 2001-2005, and thus are not significantly different than previous years. The bycate rate observed in the SAB was slightly lower than the combined estimate of 2001-2005, but was higher than the 2005 bycatch rate of zero. The 95% confidence intervals for 2006 overlap with those from the combined estimate of 2001-2005, and thus are not significantly different than these years. In the SAR, where there was a lack of coverage in 2005, the 2006 bycatch rate was lower than the combined 2001-2005 estimate, though the 95% confidence intervals for 2006 overlap with the 2001-2005 combined 95% confidence intervals and are thus not significantly different. In both 2006 and 2005 there no observed leatherback turtle takes in the MAB region, which was consistent with 2005, and lower than the combined estimated 2001-2005 rates. The TUN area, which had not been previously observed,

reported no turtle takes in 2006. The CAR, NCA, NEC, NED, and TUS regions were not observed in 2006.

For loggerhead turtles, the 2006 bycatch rates in the GOM, MAB, and SAB were zero, which were lower than the 2005 and the combined estimate for 2001-2005 (Table 6B; Garrison, 2005). The bycatch rate in the FEC was lower than the average observed during 2001-2005, but was an increase from the zero bycatch observed during 2005. The 95% confidence intervals for the FEC in 2006 overlap with those from the combined estimate of 2001-2005, and therefore the estimate from the current year is not significantly different from that in previous years. The interactions observed in the SAR were lower than the bycatch for the combined estimate of 2001-2005, though the 95% confidence intervals for 2006 overlap with the 2001-2005 95% confidence intervals, and thus are not significantly different. This SAR region was not observed in 2005.

Pilot whales were the only marine mammal observed taken in the pelagic longline fishery in 2006. The bycatch rate for 2006 in the MAB area was higher than the 2005 bycatch of zero, and significantly higher than the 2001-2005 combined estimated rates, as the 2006 95% confidence intervals did not overlap with the 95% combined 2001-2005 estimates (Table 7). All bycatch for pilot whales was observed in the Mid-Atlantic Bight region. No beaked whales, bottlenose dolphins, Risso's dolphins, or unidentified dolphins were observed caught in 2006, though bycatch had been observed in previous years for these species.

Only circle hooks (16/0 and 18/0) were observed during this quarter, consistent with recent regulations for this fishery. Concerted efforts by fishermen to remove hooks and disentangle captured turtles are also mandated by the Biological Opinion. One of the 6 leatherback turtles was entangled but not hooked on capture, and was released uninjured with no line remaining on release (Appendix A). The remaining 5 leatherback turtles were hooked in the flipper, shoulder or armpit. In 3 of these leatherback turtles, the hook was removed with no line left on release. In 2 leatherbacks, the hook was not removed, and no line was attached on release of one of these turtles, while 1 foot of line was attached in the other leatherback. All 3 loggerhead turtles captured during this quarter were hooked in the beak, and the hook was successfully removed with no entangling gear left on these turtles upon release.

There are a number of caveats and uncertainties associated with the current analysis. First, while these data have gone through an initial audit and review, they are subject to change upon further review after the end of the 2006 calendar year. Second, the delta log-normal estimator was applied to calculate bycatch consistent with previous estimates (e.g., Garrison 2003). This approach assumes 1) that catch rates (animals per hook) are log-normally distributed and 2) that the number of hooks is an appropriate unit of effort. The first assumption has been evaluated for turtles; however, 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. 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 bias in the estimate of bycatch rate and total bycatch.

The interaction between longline gear and marine turtles is a relatively rare event and is therefore inherently variable. Historically, there have been very large interannual fluctuations in bycatch rates and therefore 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

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Table 1. Number of sets and hooks (x1000) observed in the U.S. Atlantic Pelagic Longline Fishery between 1 January – 31 March, 2006 by sighting area.

Area	Sets	Hooks (x1000)
CAR	-	-
FEC	9	8.45
GOM	54	39.32
MAB	21	10.28
NCA	-	-
NEC	-	-
NED	-	-
SAB	11	7.59
SAR	16	14.88
TUN	10	6.11
TUS	-	-
Total	**121**	**86.62**

Table 2. Total observed interactions with marine turtles in the U.S. Atlantic Pelagic Longline Fishery for sets beginning between 1 January – 31 March, 2006 by fishing area. All turtles were recorded as being released alive. Areas with missing values indicate no observer coverage during this time period.

AREA	Leatherback	Loggerhead
CAR	-	-
FEC	1	1
GOM	1	0
MAB	0	0
NCA	-	-
NEC	-	-
NED	-	-
SAB	3	0
SAR	1	2
TUN	0	0
TUS	-	-
Total	**6**	**3**

Table 3. Interactions with marine mammals observed during 1 January – 31 March, 2006 in the U.S. Atlantic Pelagic Longline Fishery. Observer comments and criteria described in Angliss and DeMaster (1998) were used to evaluate serious injury.

Species	Region	Quarter	# Released Un-injured	# Dead	# Serious Injury
Pilot Whale	MAB	1	2	0	5

Table 4. Estimated bycatch rate (Catch per 1000 hooks) for (A) Leatherback and (B) Loggerhead turtles by geographic area during 1 January – 31 March, 2006 in the U.S. Atlantic Pelagic Longline Fishery. Missing values indicate areas with no observer coverage. CV indicates the coefficient of variation of the estimated rate. All turtles were recorded as released alive.

A. Leatherback Turtles

Area	Observed Sets	# Positive Sets	Mean CPUE	Var CPUE	CV
CAR	0	-	-	-	-
FEC	9	1	0.1077	0.0116	1.0000
GOM	54	1	0.0220	0.0005	1.0000
MAB	21	0	0	-	-
NCA	0	-	-	-	-
NEC	0	-	-	-	-
NED	0	-	-	-	-
SAB	11	2	0.3367	0.0580	0.7149
SAR	16	1	0.0671	0.0045	1.0000
TUN	10	0	0	-	-
TUS	0	-	-	-	-

B. Loggerhead Turtles

Area	Observed Sets	# Positive Sets	Mean CPUE	Var CPUE	CV
CAR	0	-	-	-	-
FEC	9	1	0.1033	0.0107	1.0000
GOM	54	0	0	-	-
MAB	21	0	0	-	-
NCA	0	-	-	-	-
NEC	0	-	-	-	-
NED	0	-	-	-	-
SAB	11	0	0	-	-
SAR	16	2	0.1260	0.0075	0.6855
TUN	10	0	0	-	-
TUS	0	-	-	-	-

Table 5. Estimated bycatch rate (Catch per 1000 hooks) for marine mammals by geographic area during 1 January – 31 March, 2006 in the U.S. Atlantic Pelagic Longline Fishery. CV indicates the coefficient of variation of the estimated rate.

Species	Serious Injury	Area	# Positive Sets	# Observed Sets	Mean CPUE	Var CPUE	CV
Pilot Whale	Y	MAB	4	21	0.4627	0.0586	0.5230
Pilot Whale	N	MAB	2	21	0.2778	0.0441	0.7559

Table 6. Bycatch rates for (A) Leatherback turtles and (B) Loggerhead turtles in the U.S. Atlantic Longline Fishery during 1 January – 31 March, 2006 and comparison to 2005 and the average rate from 2001-2005. 95% CI indicates the estimated 95% confidence interval of the mean bycatch rate (CPUE) in each cell assuming a lognormal distribution of rates.

A. Leatherback Turtles

Area	2006 CPUE	2006 95% CI	2005 CPUE	2005 95% CI	2001-2005 CPUE	2001-2005 95% CI
CAR	-	-	0	-	0.0621	0.0226 – 0.1706
FEC	0.1077	0.0220 - 0.5263	0.3262	0.0919 – 1.1583	0.2413	0.1520 – 0.3830
GOM	0.0220	0.0045 - 0.1078	0.0672	0.0295 – 0.1531	0.0974	0.0663 – 0.1429
MAB	0	-	0	-	0.0231	0.0047 – 0.1131
NCA	-	-	0	-	0	-
NEC	-	-	-	-	-	-
NED	-	-	-	-	-	-
SAB	0.3367	0.0989 - 1.1458	0	-	0.4849	0.2440 – 0.9635
SAR	0.0671	0.0137 - 0.3278	-	-	0.1237	0.0592 – 0.2585
TUN	0	-	-	-	-	-
TUS	-	-	-	-	-	-

B. Loggerhead Turtles

Area	2006 CPUE	2006 95% CI	2005 CPUE	2005 95% CI	2001-2005 CPUE	2001-2005 95% CI
CAR	-	-	0.2525	0.0795 – 0.8022	0.2452	0.1467 – 0.4098
FEC	0.1033	0.0211 - 0.5048	0	-	0.2458	0.1573 - 0.3841
GOM	0	-	0.0190	0.0057 - 0.0638	0.0100	0.0036 - 0.0278
MAB	0	-	0.0496	0.0101 - 0.2425	0.1150	0.0523 - 0.2532
NCA	-	-	0	-	0.1375	0.0459 - 0.4113
NEC	-	-	-	-	-	-
NED	-	-	-	-	-	-
SAB	0	-	0.3017	0.0617 - 1.4746	0.1688	0.0553 - 0.5150
SAR	0.1260	0.0386 - 0.4113	-	-	0.5492	0.3470 - 0.8693
TUN	0	-	-	-	-	-
TUS	-	-	-	-	-	-

Table 7. Summary of bycatch rates for marine mammals in the U.S. Atlantic Longline Fishery during 1 January - 31 March, 2006 and comparison to rates from the previous year (2005) and the average of the previous five years (2001-2005). 95% CI indicates the estimated 95% confidence interval of the mean bycatch (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	2006 CPUE	2006 95% CI	2005 CPUE	2005 95% CI	2001 - 2005 CPUE	2001-2005 95% CI
Beaked Whale	CAR	0	-	0	-	0.0346	0.0071 - 0.1693
Beaked Whale	SAR	0	-	0	-	0.0208	0.0043 - 0.1018
Bottlenose Dolphin	SAB	0	-	0.0833	0.0170 - 0.407	0.0293	0.0060 - 0.1430
Unid. Dolphin	GOM	0	-	0	-	0.0045	0.0009 - 0.0221
Pilot Whale	CAR	0	-	0	-	0.0386	0.0116 - 0.1287
Pilot Whale	MAB	0.7418	0.3506 - 1.5694	0	-	0.0258	0.0053 - 0.1263
Risso's Dolphin	GOM	0	-	00126	0.0026 - 0.0618	0.0045	0.0009 - 0.0220

Figure 1. Observed Pelagic Longline effort (light gray) and turtle interactions (symbols) during 1 January - 31 March, 2006. Seasonal closed areas for the pelagic longline fishery are indicated by shaded areas.

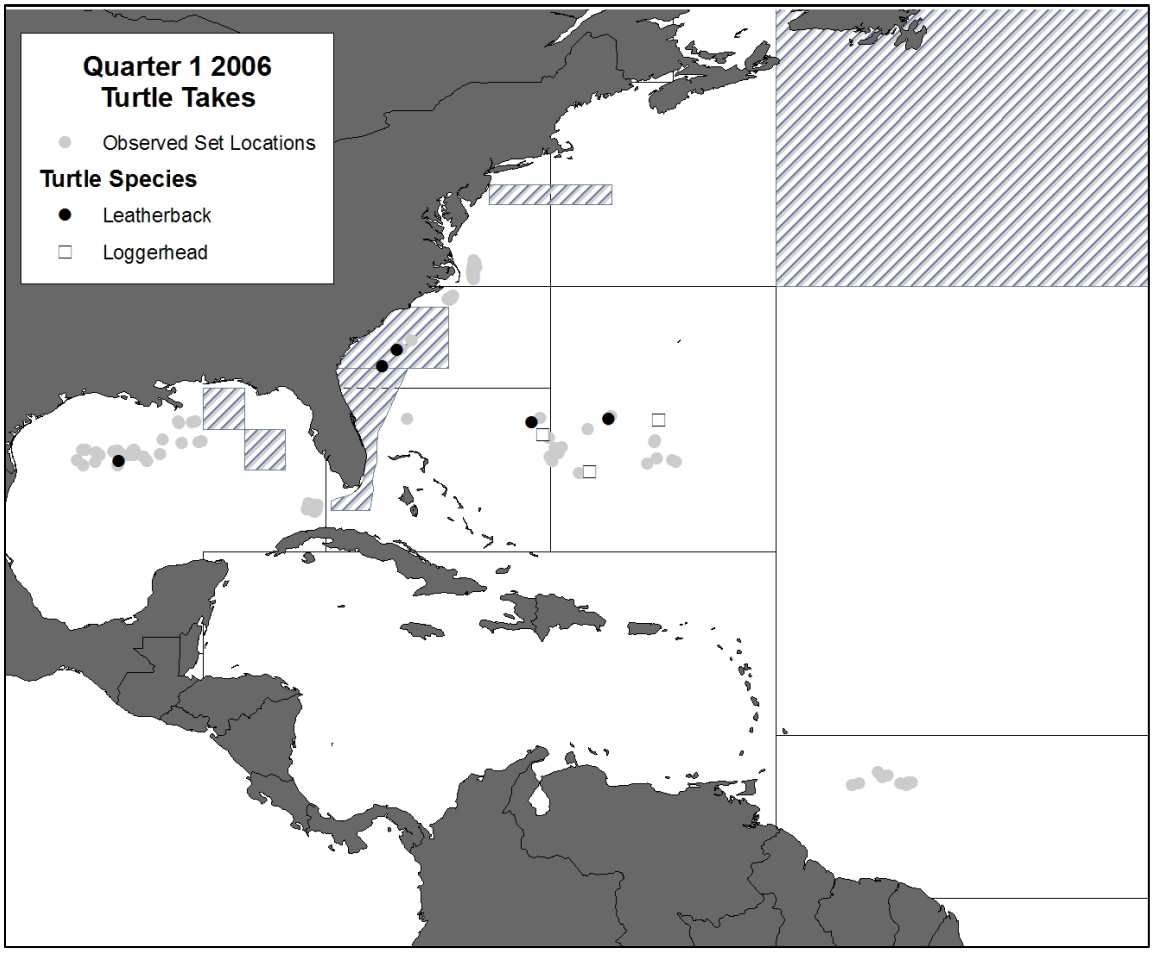
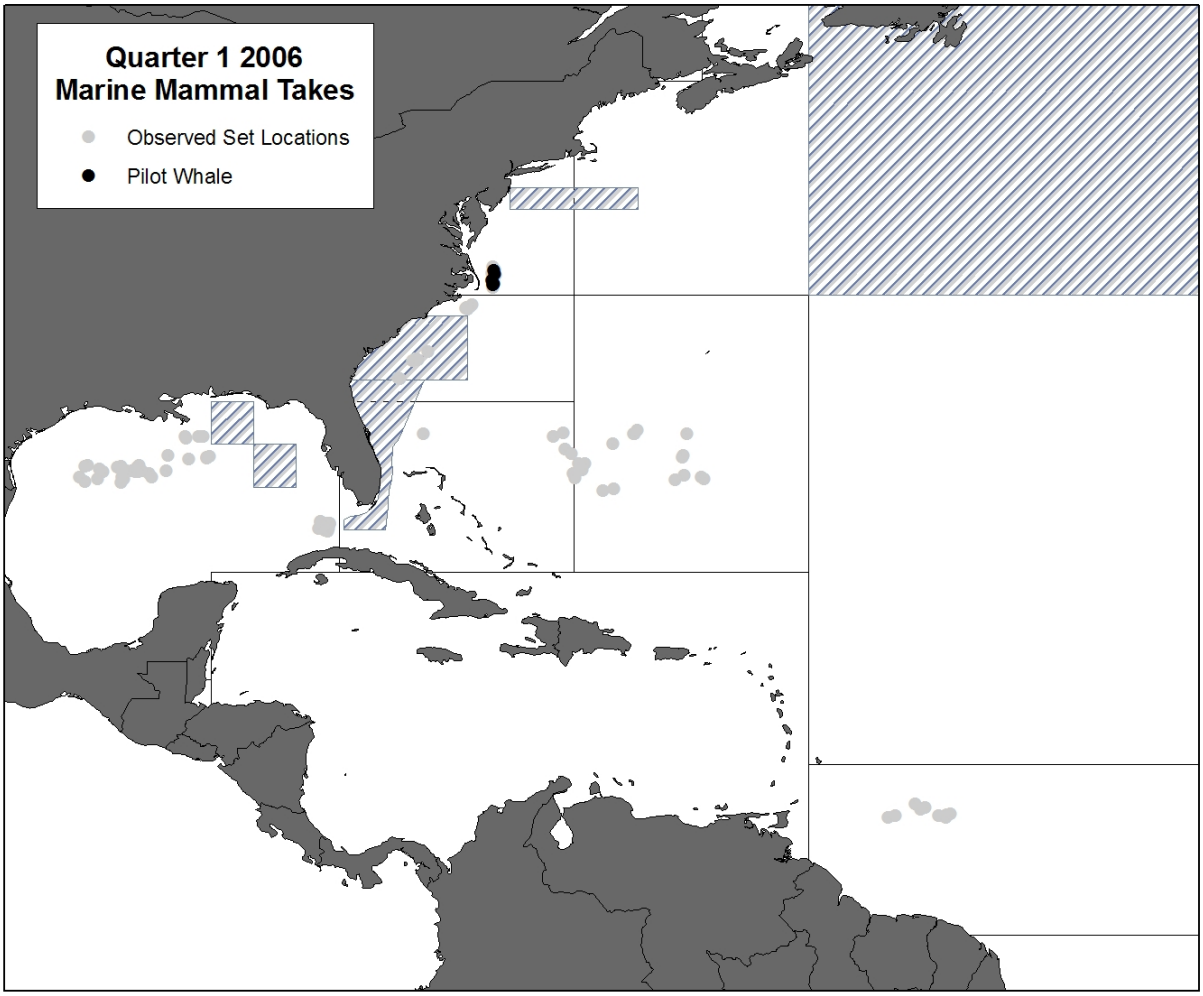


Figure 2. Observed Pelagic Longline effort (light gray) and marine mammal interactions (symbol) during 1 January - 31 March, 2006. Seasonal closed areas for the pelagic longline fishery are indicated by shaded areas.



Appendix A: Injury details and hook types for marine turtles captured in the pelagic longline fishery for sets beginning during 1 January - 31 March, 2006.

A. Leatherback Turtles

#	Area	Hook Type	Offset (degrees)	Bait	Bait Size (g)	Release Condition	Hook Location	Jaw Location	Hook Visible?	Hook Removed?	Entangled Capture?	Entangled Release?	Line Left (ft)	CL Est. (ft)	CCL (cm)	Straight N-N (cm)
1	FEC	C-18/0	10	mackerel	365	Alive, uninjured	not hooked	n/a	n/a	n/a	Yes	No	0.00	3.9		
2	GOM	C- 16/0	0	squid	112.5	Alive, injured	front flipper	n/a	n/a	No	No	No	1.00	5.0		
3	SAB	C-18/0	10	squid or mackerel	150 or 213	Alive, injured	shoulder	n/a	n/a	Yes	No	No	0.00	4.5		
4	SAB	C-18/0	10	squid or mackerel	150 or 213	Alive, injured	shoulder	n/a	n/a	No	No	No	0.00	5.0		
5	SAB	C-18/0	10	squid or mackerel	150 or 213	Alive, injured	armpit	n/a	n/a	Yes	No	No	0.00	5.5		
6	SAR	C-18/0	10	mackerel	365	Alive, injured	front flipper	n/a	n/a	Yes	Yes	No	0.00	3.8		

A**ppendix A (cont.):** Injury details and hook types for marine turtles captured in the pelagic longline fishery for sets beginning during 1 January - 31 March, 2006.

B. Loggerhead Turtles

#	Area	Hook Type	Offset (degrees)	Bait	Bait Size (g)	Release Condition	Hook Location	Jaw Location	Hook Visible?	Hook Removed?	Entangled Capture?	Entangled Release?	Line Left (ft)	CL Est. (ft)	CCL (cm)	Straight N-N (cm)
1	FEC	C-18/0	10	squid	325	Alive, injured	beak internal	lower other	n/a	Yes	No	No	0.00		72.1	66.4
2	SAR	C-18/0	10	squid	348	Alive, injured	beak internal	lower other	n/a	Yes	No	No	0.00		63.2	56.8
3	SAR	C-18/0	10	squid	235	Alive, injured	beak external	n/a	n/a	Yes	No	No	0.00		82.1	75.8