Estimation of Incidental Interactions with Sea Turtles, Seabirds, and Marine Mammals in the 2005 Hawaii Longline Deep Set Fishery[1]

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This report provides estimates of the number of incidental interactions with protected species by the Hawaii longline deep set fishery in the year 2005 (Table 1). Within this report, an incidental interaction means an event during a longline fishing operation in which a protected animal is hooked or entangled by the fishing gear. An incidental interaction estimate refers to the estimated total number of incidental interactions for all longline deep set fishing trips landing in the specified time period. A longline deep set fishing trip is defined as any commercial fishing trip by a vessel with a Hawaii longline permit that departs or returns at a Hawaii port, excluding those trips using a certificate for swordfishing.

The interaction estimates are based on a random sample of longline trips on which scientific observers were deployed. In 2005, observed trips were selected using two sampling schemes. The primary scheme was a systematic sample. Before departing on a fishing trip, longline vessels were required to call the NOAA Fisheries Pacific Islands Regional Office (PIRO) observer program contractor at least 72 hours prior to their intended departure date. To enable sample selection, the PIRO contractor numbered calls sequentially in the order in which they were received. Herein, this assigned number is referred to as the call number. Prior to the beginning of a quarter, a systematic sample of call numbers was drawn by PIFSC and supplied to the contractor. The trips associated with these selected call numbers were designated to be sampled. Although every reasonable effort was made to sample selected trips, there were some selected trips that departed without an observer. In this situation, the PIRO contractor recorded that the trip was not sampled along with a short explanation of why it was not sampled. If a trip was selected but did not leave within a reasonable amount of time, the observer was usually reassigned to a different trip. When the selected vessel was ready to depart an observer was assigned to it.

Because the number of observers was limited, it was impractical to achieve the full targeted coverage under the systematic design. The sample selected under the systematic design was slightly under the targeted coverage, typically 5% under. The additional trips needed to reach the targeted level were then selected using a secondary sampling scheme. This secondary scheme was used when all trips selected by the systematic sample were already covered and an observer needed to be assigned to a trip. In this instance, a trip was randomly selected with equal probability from the calls received that day that had not already been selected. If more than one observer needed to be assigned, the appropriate number of trips was sampled with equal probability from this pool of call-ins. The coverage obtained by this secondary sampling scheme was flexible and dependent on the need to accommodate observers. The additional samples drawn under the secondary sampling scheme depart from traditional probability samples, however, because the days when additional samples were drawn were not randomly selected but determined by the need to sample additional trips.

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Because the systematic sample was selected quarterly, point estimates of incidental interactions were computed on a quarterly basis and then summed for the year's total estimate. All observed incidental interactions on a trip were assigned to the quarter when the vessel returned to port after completing the trip. The contractor's sampling records were used to approximate sampling probabilities. The sampling probabilities during the periods when additional (secondary) samples were drawn were computed by enumerating the number of call-ins during consecutive periods of comparable coverage. It was then assumed that the additional trips were selected with equal probability from those trips that had not been selected as part of the systematic sample. When coverage was below that of the anticipated systematic sample, the sampling probabilities were computed by enumerating all call-ins during this period and assuming that the trips sampled were selected with equal probability. Because the coverage level changed with the fluctuations in observer availability and fishing activity, trips were not selected with equal probability. Therefore, the Horvitz-Thompson estimator was used to estimate total interactions, as it takes into account unequal sampling probabilities. The incidental interaction records used to compute the Horvitz-Thompson estimator were those available in the Longline Observer Database System on 4 April 2006.

Confidence intervals for the quarterly incidental interactions were estimated using the approximated sampling probabilities and assuming that the number of incidental interactions per trip for a given species was an independent Poisson variate with a constant mean value. The assumption that the average rate of incidental interactions was constant throughout a quarter is questionable but necessary to compute confidence intervals. Confidence intervals for the yearly total were not computed, as it seems unreasonable to assume that incidental interaction rates were constant throughout the entire year.

During the third and fourth quarter of year 2005, several vessels participated in an experiment that involved alternating, within a set, between circle hooks and the hook type the vessel normally used. All trips involved in this experiment had an observer onboard. Because the protocol for this experiment fell under the current legal practices for this fishery, these trips were considered to be part of the Hawaii Longline Deep Set Longline Fishery activity. Because these trips had 100% coverage they were not part of the random sampling scheme. To estimate the total incidental interactions for all deep set longline fishing activity, the total observed interactions from these experimental trips were added to the total estimated number of interactions for trips subject to the random sampling scheme; i.e., all trips not participating in the experiment.

Table 1. Point estimates of the number of incidental interactions by species and corresponding 95% confidence intervals (C.I.) for the Hawaii deep set longline fishery in 2005.

	Quarter								Annual Total
	1		**2**		**3**		**4**		
	Number of Incidental Interactions								
Species	**Point Estimate**	**C.I.**	**Point Estimate**	**C.I.**	**Point Estimate**	**C.I.**	**Point Estimate**	**C.I.**	**Point Estimate**
Turtles									
Loggerhead	0	[0,16]	0	[0,19]	0	[0,10]	0	[0,15]	0
Leatherback	0	[0,16]	0	[0,19]	0	[0,10]	4	[1,19]	4
Olive Ridley	0	[0,16]	0	[0,19]	1	[1,11]	15	[3,35]	16
Green	0	[0,16]	0	[0,19]	0	[0,10]	0	[0,15]	0
Albatrosses									
Black-footed	68	[25,115]	11	[2,37]	0	[0,10]	3	[1,18]	82
Laysan	43	[11,85]	0	[0,19]	0	[0,10]	0	[0,15]	43
Dolphins									
Spotter	0	[0,16]	0	[0,19]	0	[0,10]	0	[0,15]	0
Spinner	0	[0,16]	0	[0,19]	0	[0,10]	0	[0,15]	0
Bottlenose	0	[0,16]	0	[0,19]	0	[0,10]	0	[0,15]	0
Risso	0	[0,16]	0	[0,19]	3	[1,14]	0	[0,15]	3
Whales									
Pilot	6	[1,24]	0	[1,19]	0	[0,11]	0	[0,15]	6
Humpback	0	[0,16]	0	[0,19]	0	[0,11]	0	[0,15]	0
False	0	[0,16]	0	[0,19]	3	[1,14]	3	[1,18]	6
Sperm	0	[0,16]	0	[0,19]	0	[0,10]	0	[0,15]	0
Beaked	0	[0,16]	0	[0,19]	0	[0,10]	6	[1,23]	6