Estimation of Incidental Interactions with Sea Turtles and Seabirds in the 2008 Hawaii Longline Deep Set Fishery[1]

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This report provides estimates of the number of incidental interactions with protected species of marine turtles and seabirds by the Hawaii longline deep set fishery in the year 2008 (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 certificates for swordfish fishing.

The interaction estimates are based on a random sample of longline trips on which scientific observers are deployed. In 2008, observed trips were selected using two sampling schemes to accommodate fluctuating coverage levels and utilize observers efficiently. Coverage levels vary throughout the year because of fluctuation in the fleet's activity level, demands of 100% coverage in the Hawaii longline shallow set fishery for swordfish, and an influx of observers after completion of NMFS observer training. Because observers are not paid while waiting to be deployed, they must be assigned with minimal delay when available. The alternative of paying them while they are waiting to be deployed would increase the cost of the observer program. The two sampling schemes attempt to reach a balance between obtaining a probability sample and being cost effective. A probability sample implies that all trips have a probability of being sampled and the sampling probabilities are known. These sampling probabilities form the basis of design-based estimators. An unbiased design-based estimator has the merit that it is unbiased regardless of the characteristics of the population being surveyed.

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 the vessel did not leave within a reasonable amount of time, usually the observer was reassigned to a different vessel trip. When the selected vessel was ready to depart, a different observer was assigned to it.

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The systematic sample requires having an observer available to be deployed whenever a selected trip is ready to depart. Achieving this requirement under full targeted coverage, typically 20% coverage, throughout the year requires having enough observers on contract to accommodate higher levels of fleet activity and paying them when they are not deployed on a vessel. These requirements frequently cannot be met under the current level of funding; therefore, the quarterly sample selected under the systematic design was usually slightly smaller than the targeted coverage, typically 5% less. When this occurred, the additional trips needed to reach the full targeted level were 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 was ready to be deployed. 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 deploy observers. The additional samples drawn under the secondary sampling scheme depart from traditional probability samples because the days when additional samples were drawn were not randomly selected but determined by the need to deploy observers. Trips sampled by the systematic and secondary protocols are used to estimate incidental take.

Because the systematic sample was selected quarterly, point estimates of incidental interactions were computed on a quarterly basis and then summed to estimate the year's total interactions. All observed incidental interactions on a trip were assigned to the quarter when the vessel returned to port after completing the trip. Some quarterly estimates of interactions therefore involve interactions that occurred during an earlier quarter. Accordingly, these estimates are not the best source of information on seasonality of interactions.

The contractor's sampling records were used to approximate sampling probabilities. Examination of these records revealed periods of time within a quarter when coverage appeared to have been greater or less than the full targeted coverage. Specifically, periods of time for which the number of secondary samples were greater than expected represent higher coverage, and those for which the number of secondary trips were fewer than expected represent lower coverage. Before computing the sampling probabilities, periods of comparable coverage were identified. The sampling probabilities were computed by enumerating the number of call-ins during consecutive time periods of comparable coverage and assuming that the secondary samples 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, the observed 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 10 March 2009.

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. A quarter's confidence interval does not incorporate information beyond the quarter's data. Therefore, for some species the upper bound of the confidence interval may seem high given historical records. For example, there has not been an observed incidental interaction with a short-tailed albatross during the history of the observer program and based on this information it seems highly improbable that the incidental interaction levels would be as high as the upper bounds of the confidence intervals for this species.

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 2008. Point estimates were computed by quarter, using data for vessels returning to port during the quarter, then summed to derive the annual statistics. All protected species of sea turtles and seabirds with an observed interaction are listed as well as species that most commonly interact with the fishery or are of special concern because of their endangered species status.

	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	[0,17]	0	[0,11]	0	[0,12]	0	[0,22]	0
Leatherback	0	[0,17]	0	[0,11]	0	[0,12]	11	[1,34]	11
Olive Ridley	8	[1,31]	10	[2,26]	0	[0,12]	0	[0,22]	18
Green	0	[0,17]	0	[0,11]	0	[0,12]	0	[0,22]	0
Albatrosses									
Black-footed	26	[8,57]	92	[52,132]	0	[0,12]	0	[0,22]	118
Laysan	17	[5,44]	38	[16,64]	0	[0,12]	0	[0,22]	55
Short-tailed	0	[0,17]	0	[0,11]	0	[0,12]	0	[0,22]	0
Red –footed Booby	0	[0,17]	4	[1,14]	0	[0,12]	0	[0,22]	4
Unidentified Seabird	0	[0,17]	2	[1,13]	0	[0,12]	0	[0,22]	2
Unidentified Shearwater	0	[0,17]	62	[34,96]	0	[0,12]	0	[0,22]	62