Assessment of Incidental Interactions with Marine Mammals in the Hawaii Longline Deep- and Shallow-set Fisheries from 2016 through 2020

Marti McCracken[1] and Brett Cooper[2]
[1]Pacific Islands Fisheries Science Center, National Marine Fisheries Service
[2]Cooperative Institute of Marine and Atmospheric Research, University of Hawaii

Attached are two Excel Workbooks: *pir.ssll.ceta.1620.xlsx* and *pir.dsll.ceta.1620.xlsx*. The first workbook provides numbers, by species and geographical region, for observed interactions and injury determinations in the 100% observed shallow-set Hawaii longline fishery. The second workbook provides observed and estimated total interactions and interactions resulting in death or a serious injury (DSI) classification for the deep-set Hawaii longline fishery. Numbers for years 2016 through 2020 and the average over these 5 years are provided for both fisheries. The regions are (1) within the Hawaiian Islands Exclusive Economic Zone (EEZ) and (2) outside the U.S. EEZ. Statistics for the regions defined by the EEZs of Palmyra Atoll and Kingman Reef, Johnston Atoll, Baker Island, Howland Island, and Jarvis Island are not provided because there has been so little effort in these regions that there are issues with confidential data. From 2016 to 2020, there were no observed interactions with marine mammals in these regions. Both workbooks include a worksheet labeled 'key' that provides definitions of the column headings and the items being estimated. The workbooks have a worksheet for all marine mammal species that have been observed bycaught at least once since 2011 in the fishery (deep or shallow) being tabulated.

Methods for estimating the number of interactions (bycatch) and DSI for 2020 are described in this report. For the 2016–2019 estimates, McCracken (2019) describes the estimation of the fleet's bycatch and McCracken (in prep) describes the estimators for number of DSI and the estimators used for subgeographical estimates. The observed and estimated numbers were derived using Hawaii Longline Logbook Data Set (Pacific Islands Fisheries Science Center, 2021) and the Longline Observer Data System (Pacific Islands Regional Office, 2021).

The systematic-plus (SYSPLUS) design described in McCracken (2019) is used to sample the deep-set fleet. A component of the SYSPLUS design is a systematic sample drawn at a coverage level slightly less than the targeted observer coverage for the year. The additional samples needed to achieve the targeted coverage are sampled in an adaptive manner also described in McCracken (2019). A vessel owner or operator must notify the observer program at least 72 hours prior to the intended departure date and declare the intended trip type (shallow-set or deep-set). A sample of deep-set trips for observer deployment is drawn from a list of these notifications. In 2020, the targeted observer coverage for the year was 20% and a systematic sample at 15% coverage was drawn. In 2020, there were two occasions when the observer coverage fell below the 15% coverage of the systematic sample. The first occasion occurred near the end of December 2019 (approximately between the 27th and 31st), and involved all notifications received during this period, approximately 45. Six notifications were selected by the

PIFSC Data Report DR-22-17
Issued 25 March 2022
https://doi.org/10.25923/6gaj-ns35

systematic sample and only 2 of these were sampled. Herein, this gap in 15% observer coverage is referred to as the 2019 gap. The second occasion, which occurred from March 10 through May 12, 2020, was due to concerns with the spread of COVID-19. During this period, 258 notifications were received. The trips selected by the systematic sampling did not have an observer on board, but 3 trips selected by the Pacific Islands Regional Observer Program (PIROP) were sampled. The 3 observed trips provided notification between March 13 and March 19. NOAA Fisheries issued a national emergency rule to waive observer coverage on March 24, 2020. This emergency action was taken to protect public health and to ensure the safety of fishermen, observers, and others. Herein, this gap in observer coverage is referred to as the COVID gap. Outside these gaps of coverage, the SYSPLUS sampling protocol was followed, and bycatch was estimated using the methods described in McCracken (2019). Bycatch was estimated separately for each of the two gaps. The bycatch for 2020 is the sum of the 3 bycatch estimates. Although the 3 bycatch estimates are not independent, time did not permit establishing an estimator of their covariance; therefore, independence was assumed when estimating the standard error of the estimated 2020 bycatch. Hence, the reported standard errors likely underestimate the uncertainty in the 2020 estimates.

The estimation of bycatch for the 2019 gap centered on the ratio of bycatch/effort where the bycatch is the total number of bycatch events in the specified domain and effort is the total number of trips in the domain. To estimate the bycatch within the 2019 gap, a synthetic estimator (Lohr 2010) was used. The bycatch/effort ratio was estimated over a span that included trips prior to and after the 2019 gap. The estimated bycatch was the product of this estimated ratio and the number of trips in the gap. Specifically, the ratio was estimated based on the sample drawn from December 10, 2019, through January 8, 2020. As coverage varies over time, the sampling frame for this period (notifications received) was split into 3 strata that represented time periods with similar levels of observer coverage. The second stratum includes the 2019 gap and 24 notifications prior to this gap. These 24 notifications were included in the second stratum as they overlapped with the fishing dates of trips in the gap. All trips in the second stratum took place in 2020. To facilitate bycatch estimation within a stratum, a simple random sample is assumed. First, the bycatch/effort ratio over the 3 strata was estimated using the combined ratio estimator (Lohr 2010; Cochran 1977). This estimated ratio was then multiplied by the number of trips in the second stratum to derive the estimated bycatch in the second stratum. The synthetic estimator assumes that the bycatch/effort is similar between strata and each of these ratios is similar to the bycatch/effort ratio over the 3 strata. If the ratio varies greatly over the 3 strata, this estimator may have a large bias. For this reason, we tried to balance the benefits of increasing the sample size with the potential bias introduced by extending the timeframe of the synthetic estimator too far before or after the gap. Additionally, as the sampling probabilities are approximated when assuming the stratified design, some estimation bias was likely introduced. As the 69 trips in the second stratum represent only a small fraction of effort in 2020, the biases in this stratum's point estimate and occupying standard error likely have little impact on the 2020 estimates.

The COVID gap involved a long period with no observer coverage and appears to be associated with changes in fishing behavior. Foremost, the effort became more concentrated closer to the main Hawaiian Islands, especially to the south of the islands. To estimate bycatch for this gap, a synthetic estimator similar to the estimator for the 2019 gap was used. Specifically, the

bycatch/effort ratio was estimated for notifications received between February 19 and June 14, 2020. The sampling frame for this period (notifications received) was split into 5 strata that represented time periods with similar levels of observer coverage. The third stratum is composed of notifications received during the period where the systematic samples were missed but PIROP selected 3 trips for observer deployment. The fourth stratum is composed of notifications received during the period with no observer coverage. As we do not expect species to be uniformly distributed over the fishing grounds, we expect the bycatch/effort ratio within the 5 strata to differ since the spatial distribution of effort was not similar. However, it appears that most trips concentrated the majority of their effort in 1 of 4 areas. These 4 areas are defined as: (1) latitude south of 20˚N and longitude west of 154.5˚W, (2) latitude south of 19.5˚N and longitude at or east of 154.5˚W and west of 142˚W, (3) latitude at or north of 20N˚ and longitude west of 154.5˚W or latitude at or north of 19.5˚N and longitude at or east of 154.5˚W and west of 142˚W, (4) longitude at or east of 142˚W. To estimate bycatch, all observed trips in the 5 strata and all (observed and unobserved) trips in strata 3 and 4 were assigned to one of the 4 areas. Using a trip's begin set locations recorded in the vessel logbook database (Pacific Islands Fisheries Science Center, 2021), the assigned area was the area where the majority of a trip's sets began. As there were fewer trips in the fourth area, its bycatch was estimated differently. Let us first consider the estimation of bycatch within the first three areas. The bycatch/effort ratio for each area (defined by its boundary and trip assignment protocol) is assumed to be similar between and over all strata and is estimated using the combined ratio estimator with the area's observed bycatch and effort. The estimated ratio is multiplied by the area's fishing effort (number of trips assigned to the area) in strata 3 and 4 to derive the area's estimated bycatch. To estimate the bycatch/effort ratio in the fourth area, records from observed trips that occurred in this area during the same months as the gap but in a different year were extracted from the Longline Observer Data System (Pacific Islands Regional Office, 2021) and combined with records from the 5 strata of observed trips in this area. The observed bycatch/effort ratio from this combined dataset was multiplied by the area's fishing effort in strata 3 and 4 to derive the estimated bycatch for the fourth area. The bycatch estimates for the four areas were summed to derive the total estimated bycatch for the COVID gap, strata 3 and 4.

The estimates for the regions defined by the U.S. EEZ were derived using the methods described above but with a trip's bycatch within the region replacing bycatch for the whole trip. The estimated DSI for 2020 followed the same methods as described in McCracken (in prep).

The variance was estimated assuming that the estimated bycatch/effort ratio for the fourth area was independent of the other three. The estimators used to estimate bycatch in the 2019 gap and COVID gap were selected because they could be used across species and easily adapted to fulfill all the annual bycatch reporting requirements. The 2019 gap was brief and included a few randomly selected observed trips; any potential bias in the estimates is unlikely to have much influence on the 2020 bycatch estimates. The COVID gap was longer and was due to an unprecedented major world event that affected many things. As there were no randomly selected observed trips during this period and only limited information in the vessel logbooks, it is not possible to evaluate the assumptions made to estimate bycatch during this gap. Therefore, the potential bias in the bycatch estimates for this gap could bias the 2020 estimates to a greater degree than the estimates for the 2019 gap.

References

Cochran WG. 1977. Sampling Techniques, 3rd ed. New York: Wiley.

Lohr SL. 2010. Sampling Design and Analysis, 2nd ed. Boston: Brooks/Cole.

Pacific Islands Fisheries Science Center. 2021. Hawaii Longline Logbook. https://inport.nmfs.noaa.gov/inport/item/2721.

Pacific Islands Regional Office. 2021. Longline Observer Data System. https://inport.nmfs.noaa.gov/inport/item/9027.

McCracken ML. 2019. Sampling the Hawaii deep-set longline fishery and point estimators of bycatch. U.S. Dept. of Commerce, NOAA Technical Memorandum NOAA-TM-NMFS-PIFSC-89, 22 p. https://doi.org/10.25923/2psa-7s55.

McCracken ML. (in prep). Domain Estimators for Subgeographical Areas and the Total Number of Cetacean Bycatch Events resulting in a Dead or Serious Injury Classification, Technical Report, PIFSC, NOAA, U.S. Department of Commerce.