The perils of relying on handling techniques to reduce bycatch in a partially observed fishery: a potential fatal flaw in the False Killer Whale Take Reduction Plan

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Fisheries bycatch is one of the greatest threats facing many cetacean species (Read et al. 2006), and most of what we know of bycatch levels comes from observer programs in the fisheries themselves. In Hawai‘i the only fisheries with observer programs are two longline fisheries, a deep-set fishery targeting bigeye tuna (*Thunnus obesus*), and a shallow-set fishery targeting swordfish (*Xiphias gladius*), with some boats switching fishing methods during the year. The observer program in these fisheries was originally implemented to assess bycatch of protected species (Brooke 2015), with the shallow-set fishery having 100% observer coverage, and the deep-set fishery having approximately 20% observer coverage. There were 145 longline vessels in 2017, with most in the deep-set fishery, and some switching between shallow-set and deep-set within the year. While the majority of boats are based in Hawai‘i, the fishing effort is broadly distributed inside and outside the Exclusive Economic Zone (EEZ) surrounding the Hawaiian archipelago, from about 5°N to 35°N, and from about 130°W to 180°W.

Given the size of the fishery, 20% observer coverage allows for the detection of relatively infrequent events such as bycatch of false killer whales (*Pseudorca crassidens*). While such events are not commonly recorded in the deep-set fishery (e.g., ranging from 4 to 11 records a year in the last 10 years), false killer whales are naturally rare and have a low rate of population growth (Baird 2018), thus even low levels of bycatch have the potential to affect populations. Analyses of bycatch in relation to abundance resulted in the Hawai‘i false killer whale stock being listed as “strategic” under the Marine Mammal Protection Act in 2000, as estimated bycatch rates exceeded the Potential Biological Removal (PBR[1]) level of the population (Forney et al. 2000). While knowledge of stock structure and abundance have changed dramatically since 2000 (e.g., Barlow 2006; Baird et al. 2008, 2012, 2014; Bradford et al. 2014, 2015), with three different stocks now recognized inside the EEZ (Carretta et al. 2018), what is now known as the Hawai‘i pelagic stock has remained strategic for most years since 2000. This strategic listing eventually led, after legal action, to the formation of a False Killer Whale Take Reduction Team (TRT) in January 2010. The TRT is a multi-stakeholder group including longline fishermen, representation from the Hawai‘i Longline Association, NOAA Fisheries, the State of Hawai‘i, the Marine Mammal Commission and the Western Pacific Fishery Management Council, as well as environmental groups and researchers. In July 2010 the TRT produced a consensus draft Take Reduction Plan (TRP) to reduce false killer whale bycatch in the longline fishery. Although the

[1]The Potential Biological Removal level is defined under the Marine Mammal Protection Act to be the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population.

final TRP that NOAA Fisheries produced did not match the consensus draft TRP entirely[2], the TRP went into effect in 2013 and includes both gear "fixes" and handling guidelines, with the combination of the two potentially leading to reduced rates of false killer whale mortality and serious injury in the fishery. Although there are a large number of other fisheries that overlap with false killer whales around the main Hawaiian Islands, and a variety of evidence for fisheries interactions (Baird et al. 2014, 2017), only the longline fisheries are the subject of the TRT and TRP.

With several meetings in the intervening period, five years after the TRP went into effect the TRT met in person in April 2018 to review the success, or lack of success, of the plan. While the overall mortality and serious injury rate on observed trips has declined since the TRP went into effect, I contend that the plan is fatally flawed, as it relies in part on handling techniques of the captain and crew in the 80% of the fishery when no observer is on board. I outline below the primary features of the Take Reduction Plan, its effectiveness in the five years since it went into effect, and why relying on handling techniques to reduce bycatch in a partially observed fishery has the potential to mask the bycatch issue, rather than solve it.

False killer whales in Hawaiian waters

There are three populations of false killer whales in Hawaiian waters that are recognized as distinct stocks: a main Hawaiian Islands insular stock, a Northwestern Hawaiian Islands insular stock, and a pelagic stock (Carretta et al. 2018). While there is some overlap of these populations, a combination of genetics (Martien et al., 2014), photo-identification (Baird et al., 2008, 2012; Oleson et al., 2010), and satellite tagging (Bradford et al., 2015) have all been used to confirm the discreteness of these three populations. Little is known about the Northwestern Hawaiian Islands insular stock, though most of their range is within the Papahānaumokuākea Marine National Monument (Baird et al. 2013; Baird 2016), so bycatch is not a major concern.

The main Hawaiian Islands insular population is relatively small (<200 individuals; Bradford et al. 2018) and ranges from west of Ni‘ihau to east of Hawai‘i Island, and offshore as far as about 120 km (Bradford et al. 2015). Longline fishing has been excluded from nearshore waters around the main Hawaiian Islands since 1991, to minimize conflicts with nearshore fishermen, thus there is only limited overlap between the main Hawaiian Islands population and the longline fishery (Bradford et al. 2015). This population was listed as endangered under the Endangered Species Act in 2012. The PBR level for this stock is 0.3 false killer whales per year (Carretta et al. 2018).

The pelagic population is a transboundary population, ranging in offshore waters throughout the EEZ around the Hawaiian archipelago and extending into international waters (Bradford et al. 2015). The most recent published abundance estimate for the proportion of the stock that resides in U.S. waters is from a line-transect survey undertaken in 2010, with abundance estimated as 1,540 individuals (CV=0.66), although there is some potential that this

[2]The consensus draft TRP produced by the TRT recommended a hook with a maximum wire diameter of 4.0 mm, although the final TRP produced by NOAA Fisheries had a maximum wire diameter of 4.5 mm.

estimate is artificially high, as false killer whales appear to be attracted to vessels (Bradford et al. 2014). The PBR level for this stock, inside the U.S. EEZ, is 9.3 false killer whales per year. It is important to note that this estimate is of the number of individuals inside the EEZ during the time of the survey. Given it is a transboundary population, this number may vary by year to year as a result of large-scale shifts in distribution of the population in response to varying oceanographic factors or shifts in the distribution of their prey. There is no estimate for abundance of the stock outside the EEZ, nor of bycatch from other nations that fish outside the EEZ, even though foreign fisheries makes up the majority of effort in international waters surrounding the Hawaiian archipelago.

Five years in: the False Killer Whale Take Reduction Plan

The TRP covers both the pelagic and main Hawaiian Islands insular stocks, and has three primary goals: 1) reducing mortality and serious injury (M&SI) inside the U.S. EEZ to below the PBR levels for both stocks within 6 months of plan implementation; 2) reducing M&SI inside the EEZ to less than 10% of PBR within five years (the "Zero Mortality Rate" goal); and 3) not increasing the level of M&SI outside the EEZ above pre-TRP levels. In the five years immediately prior to the TRP going into effect, the average estimated mortality and serious injury outside the EEZ was about 10 individuals (Carretta et al. 2018).

The TRP itself has several components to try to meet these goals: 1) the elimination of the seasonal contraction of the longline exclusion zone around the main Hawaiian Islands (MHI), resulting in greater protection for the MHI insular population; 2) a requirement for using only circle hooks in the fishery, which in theory may reduce hooking rates, as depredating false killer whales often leave the fish head behind and circle hooks are more likely to jaw-hook a fish; 3) hooks must be “weak” and terminal gear “strong”, so that the hooks are the weakest link in the system (i.e., hooks with a maximum wire diameter of 4.5 mm and branch lines with a minimum diameter of 2.0 mm); and 4) handling guidelines for captains and crew, to put tension on the gear to increase the likelihood that any hooked whales will straighten the hook and be released without gear (given the combination of weak circle hooks and strong terminal gear). This latter component is particularly important, as the captain and/or crew’s frequent response to hooking a false killer whales has been to cut the branch line, leaving an animal with up to about 13 m of trailing gear. Based on the guidelines that NMFS uses to determine whether an animal is considered seriously injured, releasing an animal with more than a few meters of trailing gear is likely to result in the interaction being classified as a serious injury.

At the April 2018 in-person meeting of the false killer whale TRT, information was presented on bycatch data from the five years post-TRP implementation in comparison to the five years pre-TRP implementation. False killer whales remain the most frequently-reported species of cetacean interacting with the deep-set fishery: the proportion of the total number of cetaceans that were either false killer whales or unidentified “blackfish” that were interacting with gear (i.e., getting hooked or entangled) remained the same pre- and post-TRP, at 64%. The idea that mandating circle hooks would reduce the overall hooking rate has not proven to be the case. The interaction rate, measured in terms of number of hooked or entangled animals per 1,000,000 hooks, has remained more or less the same pre- (1.50) and post- (1.55) TRP. Since overall effort has increased since the TRP was put in place, the total number of bycaught animals remains high. The proportion of effort inside the U.S. EEZ has dropped from 33% to 27% post-TRP, and interaction rates appear to be lower inside the EEZ than outside the EEZ, although there was no good explanation for this difference in interaction rates.

Outcomes of the interactions have also not improved dramatically as a result of the gear changes and handling guidelines. Of those that are hooked or entangled, immediate mortality rates are a bit higher (8%) post-TRP than pre-TRP (3%), while there was a drop in the serious injury rate post-TRP, from 83% to 65%, although neither of these rate changes were statistically significant. In only four cases (out of 38 observed interactions post-TRP) did the hook straighten and the animal was released without trailing gear. The line broke in 13 cases, and the line was cut in 11 cases, thus releasing animals both with hooks and trailing gear. The hook broke in one case. In terms of total number of animals that were observed either killed or seriously injured, in the five-year period immediately prior to the TRP there were 26 M&SI, while in the five years since the TRP there were 27.

Has the TRP met the three original goals noted above? For both the main Hawaiian Islands insular stock and the pelagic stock goal #1 (reducing M&SI inside the EEZ below PBR) had been met based on data available through 2017, although meeting this goal has relied in part on the reduction in the M&SI rate on observed trips, and there is no evidence to assess whether the M&SI rates on unobserved trips is the same. It should be noted that four M&SI were documented inside the EEZ in 2018, and two more were documented inside the EEZ in January 2019, and estimated M&SI is likely to exceed PBR for both years. Based on data available through 2017, goal # 2 (reducing M&SI to less than 10% of PBR) has not been met, nor has goal #3, since the estimated number of bycaught individuals outside the US EEZ has increased above how many were being caught prior to the plan implementation. Given the evidence that the existing TRP is not working as it was intended, much of the last two days of the April 2018 meeting was spent discussing possible plan modifications and whether the TRT could reach consensus on them. These included going to “weaker” circle hooks (e.g., maximum 4.0 or 4.2 mm wire diameter, the former of which was what the Team recommended in the original draft plan), and even stronger branch lines (e.g., minimum 4.3 diameter branch lines).

While the TRT did not reach consensus on these potential plan modifications[3], the partial (20%) observer coverage and reliance on handling techniques to release animals with little or no gear produces a situation where further gear “fixes”, such as stronger branch lines and weaker circle hooks, have the potential to hide the problem, rather than solve it. Let’s take the hypothetical situation where, for example, the combination of gear fixes and handling techniques reduce the serious injury and mortality rate to some very low level, e.g., 25% compared to the 86% rate prior to the implementation of the TRP. With seven observed interactions in a year (the average from 2013 to 2017 was 7.2 interactions), and 20% observer coverage, this would extrapolate out to approximately 35[4] interactions per year. With a mortality and serious injury

[3] Deliberation of Team members has continued since the April 2018 meeting, but as of February 2019 the Team has not reached consensus on TRP modifications.

[4] Note the actual observer coverage has varied from 20 to 22% per year since 2008 and the calculation of serious injury and mortality rates is more complex than presented here; this is meant to serve as a ‘ballpark’ example. See Carretta et al. (2018) for more information.

rate of 86%, approximately 30 of these might be considered seriously injured (86% of 35 interactions), while with a 25% rate only about nine would be considered seriously injured (25% of 35). Depending on the proportion of interactions observed inside and outside the EEZ, such a low level could result in meeting goal #2 (the zero mortality rate goal), and would result in meeting goal #3 (not increasing the level of mortality and serious injury outside the EEZ, since the five-year average prior to the TRP was 10 individuals per year.

Not surprisingly, fisheries management actions are most likely to be implemented when there is a legal obligation to do so (such as under the Marine Mammal Protection Act), and are most likely to be accepted by affected parties (e.g., fishermen) when the best available scientific evidence backs up such actions, reducing the likelihood that a court ruling would challenge (or repeal) the management actions. In the case of the false killer whale Take Reduction Team, fishermen and industry representatives have come to the table with some willingness to negotiate additional changes to fishing practices because at least two of the three goals of the TRP have not been met. If additional changes to fishing practices (e.g., further gear fixes, combined with gear handling) do reduce mortality and serious injury rates to such an extent that those goals are met, much of the motivation to take further action to reduce the problem will evaporate. But consider the hypothetical situation that, in the 80% of the fishery with no observers on board, that gear handling is driven primarily by expediency, rather than by trying to reduce bycatch of protected species. In this case, if the serious injury and mortality rate was the same as prior to the TRP for 80% of the fleet (i.e., 83%) and was 25% for the observed portion of the fleet, with an estimated 35 interactions overall about 24 of those would be classified as serious injuries or mortalities. Such a scenario produces a perception that the false killer whale bycatch problem has been solved, while instead rates could remain high.

The solution to such a dilemma is clearly not to avoid additional attempts to reduce mortality and serious injury rates in this fishery, but to include components in any revised TRP that would allow the management agency (and the TRT) to assess compliance with gear handling components of the plan. Electronic monitoring is an obvious option (e.g., Plet-Hansen et al 2017), and in fact, the Hawai‘i-based longline fisheries have had a voluntary electronic monitoring program in place since the start of 2017, with approximately 7% of trips “observed” electronically in 2017. Of course there are financial costs associated with implementing electronic monitoring, and identifying who would pay those costs (industry, government, outside organization) is needed. Additional benefits of electronic monitoring, in terms of reducing the uncertainty associated with bycatch estimates, would also aid in management of protected species bycatch. I suggest that any additional gear fixes to address the false killer whale bycatch issue in this fishery should be done in conjunction with electronic monitoring systems, to allow for assessment of the efficacy of gear modifications and handling approaches with and without the presence of onboard observers.

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