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

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

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ABSTRACT

False killer whales are the most frequently-recorded bycaught cetacean in the Hawai‘i-based deep-set longline fishery. Observer coverage averaged ~20% from 2000-2019, and mortality and serious injury (M&SI) rates calculated from observed interactions (i.e., hooking or entanglement) are extrapolated to unobserved effort to determine overall bycatch estimates. These estimates routinely exceed the Potential Biological Removal level for the Hawai‘i pelagic stock, and in 2010 a Take Reduction Team (TRT) was established. A Take Reduction Plan (TRP) in 2013 included both gear changes (i.e., “weak” circle hooks (≤ 4.5 mm wire diameter) and “strong” branchlines (≥ 2.0 mm diameter)) and handling guidelines, to put tension on the gear to straighten hooks and release individuals alive without gear attached. Since 2013, overall effort has increased, as have interaction rates and overall bycatch estimates. Based on observed trips, crew often fail to put tension on gear, and in 75.3% of cases branchlines break or are cut, releasing hooked animals with trailing gear, typically classified as “serious injuries” (i.e., having a $>50\%$ likelihood of mortality). In 2023 the industry voluntarily began distributing a “fighting line device” meant to improve handling of hooked individuals for the purposes of removing gear, although no cases of its use with false killer whales have yet been reported. Observer coverage in the fishery declined to 15% in 2023 and is expected to decline to 13% in 2024. Given the potential for an observer effect, on unobserved trips handling guidelines are less likely to be followed, invalidating extrapolation of observed M&SI rates to unobserved effort. Electronic monitoring (EM) in 100% of the fishery would both help incentivize crew to follow handling guidelines, and provide a basis for assessing effectiveness and compliance. In March 2023, there was a consensus recommendation from the TRT that EM be implemented fleet-wide, but to date no action has been taken.

INTRODUCTION

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 an average of about 20% observer coverage per year from 2000 through 2019. In 2020 observer coverage dropped to 16.4% inside the U.S. Exclusive Economic Zone (EEZ) surrounding the Hawaiian archipelago, and to 15.2% outside the U.S. EEZ, and is

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expected to be at ~13% overall in 2024. The number of vessels in the U.S. fleet has fluctuated from 135 to 146 each year since 2013, but the number of hooks in the water each year has shown an increasing trend, with 21,774 sets and 64 million hooks in the water in 2021. Most vessels are engaged in the deep-set fishery, and some switch 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 EEZ surrounding the Hawaiian archipelago, from about 5°N to 35°N, and from about 130°W to 180°W (Oleson et al. 2023).

Given the size of the fishery, 20% observer coverage has allowed 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 15 records a year between 2013 and 2022), 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 (PBR²) 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, 2013; Bradford et al. 2014, 2015, 2018, 2020), 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 final TRP that NOAA Fisheries produced did not match the consensus draft TRP entirely³, 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 U.S. fisheries that overlap with false killer whales around the main Hawaiian Islands, and a variety of evidence for fisheries interactions (Baird et al. 2015, 2017; Harnish et al. 2024), only the longline fisheries are currently the subject of the TRT and TRP.

With several meetings in the intervening period, the TRT met in person in April 2018 and again in March 2023 to review the success, or lack of success, of the TRP, and consider additional recommendations to address bycatch. While the overall mortality and serious injury rate (i.e., the proportion of observed hookings or entanglements that result in mortality or serious injury) on observed trips has declined slightly since the TRP went into effect (from 85.8% to

²The 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.

³The 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.

81.8%, based on known-outcome interactions), the plan is fatally flawed, as it relies in part on handling techniques of the captain and crew in the 80%-87% of the fishery when no observers are on board. I outline below the primary features of the Take Reduction Plan, its effectiveness in the 10 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 stock, and an open-ocean stock, referred to as the Hawai'i 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; Kratofil et al. 2023), so there is limited overlap with fisheries and bycatch is not a major concern (Harnish et al. 2024).

The main Hawaiian Islands insular population is relatively small, estimated at 138 individuals in 2021 (95% CRI 120-160; Badger et al. 2024) 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). There is, however, considerable overlap with unobserved nearshore fisheries (Baird et al. 2021) and evidence of regular fisheries interactions (Harnish et al. 2024). This population was listed as endangered under the Endangered Species Act in 2012 and appears to be declining in recent years (Badger et al. 2024). The PBR level for this stock is 0.26 false killer whales per year (Carretta et al. in review), or one false killer whale every four years.

The Hawai'i pelagic stock is a transboundary population, occasionally being found nearshore but primarily ranging in offshore waters throughout the EEZ around the Hawaiian archipelago, and extending into international waters (Anderson et al. 2020; Bradford et al. 2015; Fader et al. 2021). Prior to 2024, comparisons of estimated bycatch to PBR was primarily undertaken within the U.S. EEZ, but there has been a shift of U.S. longline fishing effort into international waters. A new management area for the Hawai'i pelagic stock has been defined, including both U.S. waters and international waters, based on a combination of satellite tag data, genetic samples, and survey data (Oleson et al. 2023). Abundance and density have been estimated for pelagic false killer whales in a larger area (Bradford et al. 2020), and extracted for this new management area (Carretta et al. in review). Based on this, abundance within this area has been estimated at 5,528 (CV=0.35), with a resulting PBR of 33 individuals. Given this is a transboundary stock, this new management area allows for better estimating bycatch in U.S. fisheries in relation to the stock abundance over the range of the stock.

TEN 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 whale pre-TRP had 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.

In the 10 years since the TRP has been in place, 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%, from 2013 through 2017. 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 increased: in the eight years pre-TRP the mean interactions/million hooks was 0.51, and in the 10 years post-TRP it was 0.84.

Outcomes of the interactions have also not improved as a result of the gear changes and handling guidelines. Of those that are hooked or entangled, immediate mortality rates are higher (9.9%) post-TRP than pre-TRP (3%)⁴. In 81 observed known-outcome interactions documented from 2013 through 2022, the animal came free from gear in 17.8% of the cases, either from the hook breaking, straightening, or presumably tearing free. The line broke in 37.0% of known-outcome cases, and the line was cut in 38.3% of known-outcome cases. Thus animals were released both with hooks and trailing gear in a combined 75.3% of cases. In terms of total number of animals that were observed either killed or seriously injured, in the four-year period immediately prior to the TRP the mean estimated M&SI inside and outside the EEZ was 25.0/year, while in the 10 years since the TRP implementation it was 38.7/year. Note, for the purposes of comparing M&SI to PBR, NMFS uses a 5-year running average.

⁴ Rates calculated on known-outcome interactions

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) was met in some individual years, 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 however that both the MHI and Hawaii pelagic stocks interact with unobserved fisheries closer to the islands, and bycatch in those is both undetermined and not accounted for. Thus, overall bycatch in U.S. fisheries could have exceeded PBR in all years for both stocks. 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 April 2018 and March 2023 meetings were 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). In the March 2023 meeting, fishermen presented a prototype of a “fighting line device” that was designed to slide down a branchline and engage with the crimp and weight where the leader was attached. In theory, this system would both reduce safety concerns for the crew (i.e., minimizing the likelihood of fly-back of the weight if the leader breaks or the hook came free of the whale), and reduce the frequency of line breakages and allow for the removal of more gear off hooked animals. These fighting line devices have been distributed to most of the vessels by the Hawai‘i Longline Association, but as of March 2024 no reports of crew using these to handle hooked false killer whales have been reported.

While the TRT did not reach consensus on these potential plan modifications, the partial (20%, decreasing to 15% in 2020) 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, or the use of a fighting line device to remove gear, have the potential to hide the problem, rather than solve it. For example, if 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 nine observed interactions in a year (the average from 2013 to 2022 was 9.1 interactions), and 20% observer coverage, this would extrapolate out to approximately 45⁵ interactions per year. With a mortality and serious injury rate of 86%, approximately 39 of these might be considered seriously injured (86% of 45 interactions), while with a 25% rate only about 11 would be considered seriously injured (25% of 45). 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

⁵ Note the actual observer coverage has varied from 15 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.

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 board⁶, 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., 86%) and was 25% for the observed portion of the fleet, with an estimated 45 interactions per year overall about 32 of those would have been 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 (EM) 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. At the March 2023 meeting, there was a consensus recommendation to implement EM in 100% of the fleet. 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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⁶ Although it should be noted that observer coverage is expected to be 13% in 2024.

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