False Killer Whale Take Reduction Plan Research Priorities

The False Killer Whale Take Reduction Team's Research Work Group, formed at the May 2013 Team meeting, was convened to review and update the list of research activities/projects that were originally identified and ranked by the Team in 2010 (see Chapter 9 of the Draft Take Reduction Plan). The Work Group's objective was to identify and prioritize research activities that would primarily support implementation of the Take Reduction Plan or inform development of potential future amendments. We expect the list to be used internally within NMFS and by external researchers or partners to focus future research and funding to address the program's needs.

Work Group members included Robin Baird, Hannah Bernard, Paul Dalzell/Asuka Ishizaki, Eric Gilman, John La Grange, David Laist, Paul Nachtigall, Tory O'Connell, and Ryan Steen. Sharon Young and Andy Read were also members but were not able to provide project rankings.

The Work Group met by teleconference three times between July and November 2013 to develop and refine the list of projects, and to conduct and discuss the scores and draft rankings. Teleconference summaries are available on the Team website. The draft rankings were then made available to the full Team for review and approval in February 2014, and were finalized with no additional changes in March 2014.

Ranking Procedure

The Work Group began its work by first reviewing and revising the existing list of research projects, incorporating information from both the May 2013 Team meeting and the Work Group's discussions. As was done in 2010, projects were grouped into four major topic categories: false killer whale biology (FB), longline gear (LL), false killer whale assessment (FA), and state fisheries (SF, broadened from only shortline and kaka line). Once the list was finalized (see **Attachment 1** – complete revised list, by category), Work Group members were asked to score individual projects as high/medium/low priority, based on a consideration of the research activity, approach and purpose/benefit, feasibility, cost, and whether funding or partners had already been identified or secured. All scores were then converted to values (2 = high, 1 = medium, 0 = low) and averaged for each project. Projects were ranked by their average scores – both within and across the four major topic categories.

The procedure described above was relatively straightforward, but in practice it was challenging to maintain a consistent approach to describing and scoring the projects. For example:

- Some projects did not fall neatly into one of the four research categories, but each project had to be included in only one category (which potentially affected within-category rankings).
- Work Group members had to decide whether to combine or split projects that had similar research questions but different methods, or that had similar methods to address different research questions.
- It was difficult to describe and assign a relative cost or feasibility to projects that might be modular or scalable, or those that could be "piggy-backed" to other projects. (See below for more discussion on this point.)
- In many cases, we lacked detailed information on a project's likely cost or feasibility, and thus we were not able to apply a standardized scale across projects to describe these factors.

- It was up to Work Group members to consider and weight various factors to arrive at their rankings. Accordingly, individual Work Group members might have considered and weighted various factors (e.g., cost, feasibility) differently.

Despite this array of challenges, Work Group deliberations generated several rankings for the full Team's review and consideration.

Overall Rankings

We are providing the Work Group's rankings in two ways:

- **Attachment 2** contains the full list of 57 projects/activities, in overall rank order.
- **Attachment 3** contains the top 5-8 projects in each category. The number of top-ranked projects is not consistent across categories because numerous projects had tied scores.

The 21 highest-ranked projects, which include those with an average score of 1.0 (medium priority) or higher, are:

Topic ID	Research Activity	Avg. Score	Overall Rank
FB.21	Conduct hook-tissue interaction research to better understand the relationship between type of gear and where the animal is hooked and the severity of the injury.	1.625	1
FB.19	Evaluate survival of FKWs and similar species following fisheries interactions.	1.444	2
FA.01	Hawaiian EEZ survey (at least every 5 years)	1.375	3
FA.04	Survey windward side of Hawaiian Islands to assess differential FKW encounter rates	1.375	3
LL.04	Survey all longline vessels to identify commonalities among those with high depredation rates	1.333	5
FA.02	Continue research into FKW abundance using towed and stationary acoustics. Develop new towed systems that allow for real-time localization of vocal FKWs	1.250	6
FA.06	Evaluate alternative methods for estimating abundance, with emphasis on improving precision	1.250	6

Topic ID	Research Activity	Avg. Score	Overall Rank
FB.05	Develop real-time assessment capability for distinguishing between FKWs and other odontocetes using whistles and echolocation clicks	1.222	8
FB.10	Conduct vessel sound playbacks	1.222	8
LL.02	Develop new or test existing methods for fleet to use acoustic recorders to determine FKW presence prior to setting	1.222	8
LL.12	Evaluate performance of gear used in deep-set fishery	1.222	8
LL.16	Evaluate impact of weak hooks on FKW bycatch rates	1.222	8
FB.06	Evaluate acoustic behavior near longlines using recorders on fishing gear	1.111	13
FB.13	Determine range at which a hook in a fish can be detected by FKW	1.111	13
FA.03	Monitor abundance and trends of MHI insular stock	1.000	15
FA.07	Use Observer Program data (in combination with other fishery-dependent data where applicable) on FKW sightings, interactions, and depredation to develop abundance estimates, estimate depredation rates, and identify hot spots.	1.000	15
FA.08	Use mark/recapture studies to supplement info on abundance, demographics, stock structure, and injury categorization	1.000	15
FA.12	Re-analyze the proportion of SI vs. NSI for circle hooks vs. tuna and J-hooks	1.000	15
LL.11	Determine types of hooks and hook manufacturers used by Hawaii deep-set longline vessels	1.000	15
LL.14	Desktop study to assess size of false killer whales caught	1.000	15
LL.17	Collect straightened hooks for genetic sampling	1.000	15

Other Considerations

In addition to the preliminary rankings, the Work Group identified two additional considerations that could suggest a different way of presenting/framing the relative priorities. The Work Group noted that these considerations do not necessarily require re-ranking of the projects, but, instead suggested they should be considered when interpreting the results and pursuing funding opportunities.

A. **Sequencing considerations** – a particular research project may not be feasible (or deemed fundable) without first having the data collected or technology developed by another research project. The linkages between "prerequisite" projects and "successive" projects should be considered when considering research needs and funding. Below is a table summarizing potentially paired projects, as identified by Work Group members.

"Successive" Projects: To do this…	**"Prerequisite" Projects: …you first need to do this**
LL.01 - evaluate feasibility of using FADs to determine presence of FKWs before fishing trips	FB.11 - determine extent to which FADs attract FKWs
LL.02 - use acoustic recorders aboard longline boats to determine presence of FKWs	FB.05 - develop real time assessment capability for distinguishing FKWs from other cetaceans using clicks and whistles
LL.08 - use FADs as decoys for FKWs	FB.11 – determine extent to which FADs attract FKWs
LL.10 – evaluate the potential for modifying hooks to increase/decrease detection range	FB.13 - determine range at which FKWs can detect hooks in a fish
LL.13 - identify factors (other than wire diameter) that may affect hook strength and severity of injury	LL.12 - evaluate performance of different hooks in use by longline vessels to catch tuna and bycatch
FB.10 – conduct vessel sound playbacks	LL.03 – record acoustic profile of vessels and fishing gear across the fleet during transiting, soaking, and hauling to assess potential cues to FKWs

B. **Synergy considerations**: While each research activity was identified as an independent study, field efforts to obtain data can be combined for a number of different research projects identified by the Work Group, as a way of reducing the per project costs and maximizing opportunities available from relatively infrequent encounters. For example, during small boat-based field efforts off of Kona, it is possible to encounter both pelagic and main Hawaiian Island insular false killer whales, and undertake data collection (biopsy sampling, photo-ID, tagging) that will directly address and/or provide samples for a number of research projects outlined in the table below (FB.01, FB.03, FB.17, FA.03, FA.08, FA.09, FA.10). In addition, if tags are deployed on groups as part of FB.01 and/or FB.03, these provide the basis for tracking animals in relation to sound playback studies (FB.10), as well as potentially repeatedly encountering groups if they remain near or return to the islands for additional sampling for most of the studies noted above, as well as potentially for data collection for FB.04, FB.07 and/or FB.08. Data collection for projects FB.04, FB.07 and FB.08 can also be undertaken concurrently with the above-noted projects.

Research activities that can be undertaken during combined field efforts with limited additional incremental costs for data collection.

Topic ID	Research Activity
FB.01	Continue telemetry studies on the pelagic stock FKWs
FB.03	Continue telemetry studies on the MHI insular stock FKWs
FB.17	Assess hormones to examine stress and reproductive rates
FA.03	Monitor abundance and trends of MHI insular stock
FA.08	Use mark/recapture studies to supplement info on abundance, demographics, stock structure, and injury categorization
FA.09	Collect additional genetic samples from the pelagic, NWHI, and other distant FKWs to assess population structure
FA.10	Evaluate degree of genetic differentiation between insular and pelagic stocks
FB.10	Conduct vessel sound playbacks
FB.04	Examine call types and rates by different FKW populations to better understand the variability and nuances of the acoustic data, allowing for more precise and useful examination of existing and ongoing acoustic data.
FB.08	Carry out underwater observations of foraging behavior
FB.07	Use acoustic tags to understand foraging and acoustic behavior

Attachments

1 – Revised List of Research Projects

2 – All Research Projects in Rank Order

3 – Top Rank Projects in Each Category

False Killer Whale Biology

Topic ID	Research Activity	Approach & Purpose/Benefit	Feasibility	Cost	Funding Opportunities or Partners?
FB.01	Continue telemetry studies on the pelagic stock FKWs	Assess pelagic FKW movements relative to fishing activity and refine stock boundaries	Possible, but requires significant search effort as FKW densities are low	$50K-$100K+, scalable, can piggy-back with other projects Tags cost ~$4000 ea. Need several tags deployed on a number of groups to assess population movements. Will require large vessel with small vessel launch capability	
FB.02	Continue telemetry studies on the NWHI stock FKWs	Assess NWHI FKW movements relative to fishing activity, degree of geographic overlap with pelagic and MHI stocks, and differences in ecology between MHI and NWHI insular animals	Possible, but requires significant search effort as FKW densities are low. Requires genetic samples for stock-ID confirmation.	$50K-$100K+, scalable, can piggy-back with other projects Tags cost ~$4000 ea. Need several tags deployed on a number of groups to assess population movements. Tagging possible in NWHI with large/small vessel combinations or off Kauai with small vessels, with lower costs for small vessel work. Efforts off Kauai could be incremental, i.e., field time could be added on to field efforts funded for other projects	
FB.03	Continue telemetry studies on the MHI insular stock FKWs	Focus tagging efforts on cluster 2 individuals and during the winter and early spring. No individuals from cluster 2 have been tagged previously and there is some suggestion that they may use different areas than cluster 1 and 3 individuals. Very little telemetry data are available in the winter and spring so seasonal variations in insular FKW movements are difficult to assess	Possible. Deployments during winter and spring will be difficult due to weather conditions. Cluster 2 individuals are encountered less frequently than other social clusters.	$50K-$100K+, scalable, can piggy-back with other projects Tags cost ~$4000 ea. Lower cost than NWHI or pelagic tagging, as animals are relatively accessible during nearshore surveys. Efforts can be incremental i.e., field time could be added on to field efforts funded for other projects	
FB.04	Examine call types and rates by different FKW populations to better understand the variability and nuances of the acoustic data, allowing for more precise and useful examination of existing and ongoing acoustic data	Allows alternative method for identifying individuals during surveys or interacting with fishing activities	Possible: some data already available, but additional data from all stocks would be needed	$25K-50K analysis cost. Some data collection required, particularly for pelagic stock FKWs. Equipment already available.	
FB.05	Develop real-time assessment capability for distinguishing between FKWs and other odontocetes using whistles and echolocation clicks	Allows alternative method for identifying individuals during surveys or interacting with fishing activities	Possible with existing data, better with more data, particularly from pilot whales	$25K-$50K+ analysis cost, can piggy-back with other projects. Some data collection may be required. Hardware readily available to researchers & analysis methods are defined.	
FB.06	Evaluate acoustic behavior near longlines using recorders on fishing gear	Understand the dynamics of how false killer whales are interacting with gear and how animals are attracted to the gear. Also provides acoustic ID following depredation.	Project to begin this year with specific vessels and through the observer program. Will take significant effort to adequately assess interactions given low interaction rate and length of sets	$100K-$200K start-up and/or charter costs. Scalable once audio recorders purchased. Can be piggybacked. Recorders >$10K each and will need several to assure recordings in a given set. May require chartering contracts.	
FB.07	Use acoustic tags to understand foraging and acoustic behavior	Understand how animals capture prey and how they communicate with conspecifics	Possible, but requires significant search effort as FKW densities are low, must get close to the animal to apply suction-cup tags.	$100K-$200K start up, lower once tags purchased. Scalable, can piggyback with other projects. Suction-cup acoustic tags cost ~$20K ea.	
FB.08	Carry out underwater observations of foraging behavior	Use audio & video to understand the mechanism of depredation- how are they removing fish, when are they near gear, what are the group dynamics (calm vs. frenzy)	Doable if targeted in areas with high rates of interactions	$100K-$200K start-up and/or charter costs. Scalable once video and audio recorders purchased. Video and audio recorders >$10K each and will need several to assure recordings in a given set. May require chartering contracts	
FB.09	Study adaptive learning in the FKW	-Evaluate whether loud sounds (at higher frequencies than those assumed to be heard by fish) presented on longlines cause reduction in depredation; conduct further analysis of whether the reduction remains a useful tool or if FKWs adapt to it	Feasible	$50-$100K	
FB.10	Conduct vessel sound playbacks	At what distance do false killer whale react to fishing vessels? Do insular animals react?	Possible, but need permits, which will take up to a year to obtain	$50K-$100K+, can be piggybacked to some extent, but requires specific equipment. Tags cost ~$4000 ea. Need several tags deployed, requiring significant search effort	

False Killer Whale Biology

Topic ID	Research Activity	Approach & Purpose/Benefit	Feasibility	Cost	Funding Opportunities or Partners?
FB.11	Determine the extent to which FADs attract FKWs.	Place acoustic monitors strategically to examine the impact of FADs on FKW distribution. Examine survey effort and sighting rates to evaluate whether higher encounter rates near FADs	Difficult given locations of most FADs are unknown. Analyses to date do not show higher encounter rates near State FADs, but private FADs may be more effective aggregators of fish and whales	Undetermined. Desktop study of existing sighting data $10K-$25K. Additional data collection near State FADs $50K-$100K.	
FB.12	Assess impact of hook density on FKW ability to follow line	Would help understand whether FKW are actively searching for fishing vessels, and could evaluate impact of moving fishing effort elsewhere	Two ways to assess: 1. Use logbook data, but limited info on interactions on trips without observers- initial evaluation feasible, 2. Use satellite tagged individuals versus VMS data- very difficult to locate pelagic animals for tagging	Observer data- <$10K. Satellite tagging- $50K-$100K. Tags cost ~$4000 ea. Requires significant effort to locate and tag individuals likely to encounter fishing gear. Can be piggy-backed to some extent.	
FB.13	Determine range at which a hook in a fish can be detected by FKW	Tank experiment with Kina to evaluate detection ability with different prey species. Will provide insight into depredation process, i.e. whether fish can be detected before whale is near gear.	Easy: Kina already trained to do echolocation experiments	$10-$50K	
FB.14	Test visual acuity of FKWs given different types of lights often found on longline vessels	Tank experiment with Kina. Evaluate whether use of certain types of lights may be a factor in probability of FKW depredation.	Possible, will require some retraining	Cost of re-training and acquiring testing objects $100-$200K	
FB.15	Evaluate FKW capability to see floats, as well as monofilament line of different colors and width	Tank experiment with Kina. Evaluate whether gear characteristics are related to probability of depredation.	Possible, will require some retraining	Cost of re-training and acquiring testing objects $100-$200K	
FB.16	Assess FKW response to compounds found in oil fish and other fish species that FKWs do not depredate from the line	Purpose is to determine if this is a potential deterrent with commercial applications; tank experiment with Kina	Possible, will require some retraining, may need to assess Kina's taste sensitivity relative to wild FKWs first	Cost of re-training >$200K. Kina not currently trained for taste studies so training could be significant.	
FB.17	Assess hormones to examine stress and reproductive rates	Collect skin/blubber samples from false killer whales to examine stress hormones and various demographics including sex ratio and pregnancy rates. Ultimate goal is to compare these rates from animals that depredate or are bycaught versus those that do not. May also provide insight into level of interaction for insular FKWs	Moderate- some samples available, but additional samples will be needed. May require specialized handling.	Data collection $25K-$50K scalable, may be piggybacked. Data analysis- $10K-$25K.	
FB.18	Examine physiological response of FKW and similar species during/following an interaction	Collect tissue, blood, or blubber samples from hooked FKWs. Ultimate goal is to understand whether the physiological response may be detrimental to health or reduce probability of healing following an interaction	Very difficult: not clear how this study would be done	Data collection $100K-$200K scalable, may be piggybacked. Data analysis- $25K-$50K.	
FB.19	Evaluate survival of FKWs and similar species following fisheries interactions.	May include literature research, assessment of archived and new photographs of injured FKWs, assessment of wound healing over time, evaluation of stranded animal injuries, etc.	Possible, but will take time to obtain time-series photographs of injured individuals. Literature search may be more quickly accomplished. Note types of injuries, frequency, severity (fatal vs. non-fatal)	Low to moderate.	
FB.20	Assess importance of fishery as a food source for FKWs.	What proportion of the FKW diet comes from depredating longlines. Are FKWs consuming species from longline gear not typically part of their diet?	May not be technically possible to get a signature for big eye vs. yellowfin given the likely mixed diet of FKWs. Some analyses and studies on other species may provide insight. May be able to use fatty acid signatures as a means of examining diet. Would need to differentiate samples for depredating animals versus those thought not to be depredating.	Assessment of existing studies <$10K New sample collection $50K-$100K+, scalable. Some portions may be piggybacked. Must sample across the population including some known to have been depredating.	
FB.21	Conduct hook-tissue interaction research to better understand the relationship between type of gear and where the animal is hooked and the severity of the injury.	Pursue research collaboration with B. McLellan	Feasible - contract being sought	Already funded. Future studies scalable depending on specific hooks available.	

Longline Gear

Topic ID	Research Activity	Approach & Purpose/Benefit	Feasibility	Cost	Funding Opportunities or Partners?
LL.01	Evaluate feasibility of using moored listening stations (FADs, NOAA weather buoys, etc.) to determine FKW occurrence before a fishing trip	Would provide advanced notice to the fleet on FKW presence in specific areas.	Set up possible but may be technically difficult and require regular maintenance. May not provide adequate information as buoys are few and far between.	$100K-$200K+, scalable depending on number of buoys monitored. On-going maintenance costs needs to be considered. Cost of data transmission unknown.	
LL.02	Develop new or test existing methods for fleet to use acoustic recorders to determine FKW presence prior to setting	Use radio buoys to alert to FKW presence prior to and during setting	Some development already underway (G. McPherson). Alternative systems could be designed and tested over the longer-term.	Unknown. Fisherman already purchase radio buoys so implementation likely low cost. Development costs may be significant.	
LL.03	Record acoustic profile of vessels and fishing gear across the fleet during transiting, setting, soaking, and hauling to assess potential cues to FKWs	Evaluate whether there are specific acoustic cues that may attract animals to the gear or may allow animals to follow or locate fishing vessels.	Project could be conducted as single instrument deployments on a voluntary basis through observer program or as a charter of a specific vessel(s) for multi-instrument deployments. Data collection will proceed more slowly when working with vessels on voluntary basis but will represent a more diverse cross-section of the fleet (geographically, temporally, gear configuration, etc.) Some deployments are underway with a small number of volunteer vessels. All deployments requires explicit participation of individual fisherman. Charters will be required to assess animal movement around gear or if animals target a specific area of the set.	Moderate- recorders exist for remote monitoring of gear. Many sets will need to be recorded to assess acoustic cues given diversity of vessels and gear configurations. Voluntary deployments through the observer program ~$50K/yr. Charter contracts for multiple instrument deployments $100-$200K for 2-3 trips.	
LL.04	Survey all longline vessels to identify commonalities among those with high depredation rates	Assess whether there a common feature of vessels that are commonly whaled or that have higher rates of bycatch	Difficult given confidentiality restrictions. May need to seek information from vessel owners on specific gear configurations.	Desktop study of known vessel characteristics <$10K.	
LL.05	Examine role of bait type, size, and manner of threading on bait depredation	Are certain bait characteristics more likely to be depredated or result in bycatch?	Could be done on voluntary basis or as charter.	Survey by observer program <10K. Requires survey of several boats. Charter for more detailed assessment $100K-$200K+.	
LL.06	Evaluate where animals are caught within a set and why	Initial analysis of observer data suggest higher interaction rate in the middle of a basket. Need to understand if this is an artifact of small sample size or if there is a higher probability of hooking in the middle of the set.	Difficult to evaluate given low interaction rates. The why could be assessed using other techniques already listed- acoustic and video recordings, etc.	Varies widely depending on method. Continued examination of observer data <$10K.	
LL.07	Evaluate potential to use killer whale/other playbacks as deterrents	Evaluate if killer whale sounds are a deterrent to FKWs. Would need to use tropical transient killer whale calls.	May be difficult to identify appropriate sounds as little is known on killer whale ecology in the tropics. Need research permits (up to 1 yr to obtain). Not clear how to implement experimental design.	Requires development for remote sound playbacks. Design and testing could be >$100K.	

Longline Gear

Topic ID	Research Activity	Approach & Purpose/Benefit	Feasibility	Cost	Funding Opportunities or Partners?
LL.08	Examine the ability of FADs to be used as decoys for false killer whales (to reduce depredation of active longlines).		Implement as charter to test depredation rates on trips with FADs and those without?	Charter costs expensive $200K+. Would need many replications given low probability of depredation within a given set.	
LL.09	Evaluate effectiveness of additions to terminal tackle or other items on the mainline as a method to reduce depredation on bait, catch and incidental takes of false killer whales	Is bait and/or catch depredation rate lower when other items are near hooks or on the mainline? Should be formally assessed using NMFS observer program.	Feasible, some experimentation already underway. May take considerable time to assess impact on false killer whale catch rates or deterrence, and would require large scale study with well-defined experimental methods.	Charter costs expensive $200K+. Would need many replications given low probability of depredation within a given set.	
LL.10	Assess potential for hooks to be modified (foam coating, etc.) to increase or decrease detection range	1. Are hooks easy to modify, 2. do modified hooks increase or decrease detection range, and 3. does this change in range reduce depredation or bycatch	Easy to test detection range with Kina	Hook modification costs may be high. Experimental cost is $50-$100K	
LL.11	Determine types of hooks and hook manufacturers used by Hawaii deep-set longline vessels (*see details in doc prepared by Laist and Bernard*)	Information request by observers, enforcement officers, and/or survey by PIRO or HLA of fishermen and/or gear suppliers	Feasible- likely most effectively surveyed through initiative of fishery	$10K-$25K to examine available gear in stores + some replacement costs for fisherman donating custom gear.	
LL.12	Evaluate performance of gear used in deep-set fishery (*see details in doc prepared by Laist and Bernard*)	Using gear voluntarily collected from fishermen or purchased, confirm breaking or bending strength and likely injury severity given performance; evaluate performance over time	Feasible- perhaps most effectively surveyed through initiative of fishery	$10K-$25K to examine available gear in stores + some replacement costs for fisherman donating custom gear.	
LL.13	Identify and evaluate other factors that may affect hook strength (and severity of FKW injuries)	Evaluate metallurgy, production methods, specific hooks shapes, etc,	Feasible- may take time for adequate sample of compliant available hooks for testing.	$25K-$50K if using already manufactured hooks. $100K+ if manufacturing hooks specifically for testing and evaluation.	
LL.14	Desktop study to assess size of false killer whales caught	May inform strength of weak hook needed to release FKWs.	Could be difficult given variability in observer interpretation of animal size.	<$10K	
LL.15	Follow-up weak hook study to understand impact on target catch.	Conduct experiment of catch rates testing hooks with smaller wire diameter than required by TRP (e.g., 4.3 mm, 4.2 mm, 4.0 mm) or with different properties (hook shape, metallurgy, etc.)	Very feasible- existing circle hooks may prove weak enough	$100K-$200K to test 2 hook types. >$200K to test 3 or more hooks or more sets than laid out in 2010 trials. Initial study cost $120K for 120 sets, did not include cost of hooks, observers, or NMFS time.	
LL.16	Evaluate impact of weak hooks on FKW bycatch rates	Long-term evaluation of bycatch rates using the observer data	Very feasible, but will take time	Low given gradual adoption of hooks by fisherman.	
LL.17	Collect straightened hooks for genetic sampling	Voluntary collection, potentially via observers, of straightened hooks for genetic analysis, to ID species that straightened the hook and possibly add to pelagic FKW sample size	Feasible, but may take some time to collect an adequate sample	Analysis already funded. Future studies scalable depending on availability of straightened hooks.	

State Fisheries

Topic ID	Research Activity	Approach & Purpose/Benefit	Feasibility	Cost	Funding Opportunities or Partners?
SF.01	Develop detailed descriptions of fishing practices including precise information on gear types used in the state fisheries (e.g., troll, dangler, handline, hybrid).	Work with the State to evaluate data for these fisheries, but unclear the extent to which individual vessel fishing reports submitted to the State include relevant data on fishing practices. Another approach would be to rely on interviews with fishermen.	May be feasible to use existing records, but more difficult to acquire new data. Possible confidentiality restriction associated with State data	Unknown	
SF.02	Institute observer coverage (possibly from an alternative platform) and/or video monitoring to better track state fisheries' practices and possible interactions.	Develop a program using independent vessels to assess fisheries interactions.	Unclear, unlikely to gain cooperation from fisherman being observed.	>$200K/yr to get adequate coverage	
SF.03	Cross-reference and otherwise examine existing data to assess consistency and QA/QC.	Reporting versus dealer records	Difficult due to limited ability to identify fishing gear in the dealer records, which do not identify type of fishing. PIFSC and HDAR have only been able to use vessel and captain names reported in the dealer data to determine longline fishing and bottomfish fishing in the dealer data with any accuracy. This is possible because the type of fishing by longline and bottomfish vessels/captains is highly consistent. This not typically the case for other types of fishing.	Low costs for longline and bottomfish because routine analysis only. Relatively higher costs to add more fishery types to such comparisons (additional analysts needed), as these other types of fishing are less-well defined by vessel or captain info, since a vessel or captain may undertake a variety of fishing types and is not required to state this in the dealer system.	Only PIFSC or State of Hawaii staff can have access to the personal information needed for such analyses.
SF.04	Better understand the distinctions and areas of commonality in federal and state reporting protocols.	For example, if shortline and longline on same trip, how is this reported?	Feasible to look into how multiple fishing types on one fishing trip are handled in the HDAR fishermen reporting system, but State and PIFSC staffing and workload are currently constrained. (From Chris Boggs: Does not appear to be an issue of federal versus state protocols, but a question of how state fishermen data are summarized. The federal longline logbook protocol applies only to longline fishing. I'm not 100% certain, but I believe if another type of fishing is conducted on a longline trip, only HDAR reporting is required for that other type of fishing, The high consistency of logbook catch kept and dealer sales data assigned to longline gear through forensic linkage of vessels/captains to logbook reports suggests very little catch by other fishing methods on longline trips.)	Approximately 150K a year for an additional federal or state employee to do the work	Only PIFSC or State of Hawaii staff can have access to the personal information needed for such analyses.
SF.05	Evaluate hook-and-line (shortline, kakaline, troll, handline, etc.) fishery effort and geographic distribution regionally and seasonally	Better understand total fishing effort and hotspots of effort by for evaluation of overlap with FKW stocks. Will also provide sense of which fisheries are most likely to interact and which are unlikely.	This is feasible. Mapping software for the HDAR data using State statistical areas is available. Thousands of permutations are possible, so some thought needs to be given as to what to ask for.	$15-30K for a month or two of mapping analysis	Uncertain due to software access constraints
SF.06	Model the potential for FKW interactions with state fisheries by calculating a FKW CPUE in the deep-set longline fishery and then extrapolating that to the state fishery (based on rates of tuna caught).	Understand contribution of potential total bycatch by each fishery	Per Chris Boggs: There are so many ways to model this with so little reason to choose a model that almost any result is possible. If one assumes the take per hook in another fishery would be the same as for longline, the take for the other fishery would be infinitesimal, given the much larger number of longline hooks set. If one assumed the take per tuna were the same in another fishery as for longline, the take would be way too high because of the role of soak time and chance gear encounter over long distance in longline compared to other fisheries. A third model might try to account for swept area of the gear, and would be more similar to the results of the first model. A simple illustration of the range in estimates between such models might further help to make clear the challenges in drawing meaningful inferences from such an exercise.	Cost limited to one week of staff time; availability of staff time may be serious constraint	Non-confidential data, so no partnering constraints

False Killer Whale Assessment

Topic ID	Research Activity	Approach & Purpose/Benefit	Feasibility	Cost	Funding Opportunities or Partners?
FA.01	Hawaiian EEZ survey (at least every 5 years)	Conduct large-scale (2 ships, 175 days-at-sea) covering the entire Hawaiian EEZ with visual and acoustic observing. Survey is intended to update abundance estimates for all cetaceans, but FKW will be priority for auxiliary projects.	Next survey may need to occur in collaboration with SWFSC	>$1M.	
FA.02	Continue research into FKW abundance using towed and stationary acoustics. Develop new towed systems that allow for real-time localization of vocal FKWs	Detection rates are higher acoustically than visually so this may provide an alternative means of estimating abundance. Many questions need to be addressed.	Research is ongoing	New development $50K-$100K+. Testing and additional research can be conducted as piggyback on survey projects.	
FA.03	Monitor abundance and trends of MHI insular stock	FKW TRP measures intended to protect insular stock animals from interactions. Continued monitoring may provide sense of degree of decline due to fisheries interactions and evaluate whether the decline continues.	Possible	$100K+, scalable, can piggyback. Cost depends on level of research effort, can add time/effort to already funded projects as well as fund independent field efforts	
FA.04	Survey windward side of Hawaiian Islands to assess differential FKW encounter rates	Cross-reference collected information with existing telemetry data	Feasible with large ship. Smaller vessel surveys will require larger time investment to insure adequate effort despite weather days.	$100K-$200K+ for large ship survey or small vessels given large time investment required. Geographic scope is scalable.	
FA.05	Develop predictive habitat models of FKW density	Incorporate *in situ* and remotely - sensed oceanographic data to develop models of FKW habitat which can be applied to unsurveyed areas or identify hotspots for further evaluation during a future survey	Currently under development, but will require more FKW data to build a robust model	Analysis and development $50K-$100K+ depending on variables used. Data collected as part of large-scale survey efforts.	
FA.06	Evaluate alternative methods for estimating abundance, with emphasis on improving precision	Consider alternatives that may provide a means for 1) surveying populations, and 2) modeling density. New methods for surveying may include fishery-dependant data evaluation, acoustic gliders, etc.	Survey and analysis methods must be developed. Long-term research goal.	Varies widely depending on methods.	

False Killer Whale Assessment

Topic ID	Research Activity	Approach & Purpose/Benefit	Feasibility	Cost	Funding Opportunities or Partners?
FA.07	Use Observer Program data (in combination with other fishery-dependent data where applicable) on FKW sightings, interactions, and depredation to develop abundance estimates, estimate depredation rates, and identify hot spots.	Should be comparable to models built from systematic surveys to allow for validation.	Fisheries confidentiality may be issue. Likely needs to be pursued within NMFS.	$50K+ depending on time investment.	
FA.08	Use mark/recapture studies to supplement info on abundance, demographics, stock structure, and injury categorization	Will provide most robust abundance estimate for MHI insular stock due to low density and high re-sighting rates.	Feasible for MHI insular population, for pelagic stock will require piggybacking with Hawaiian EEZ survey and sample sizes will be limited	$50K-$100K+, scalable, can be piggybacked. Field data collection can be funded incrementally with other studies to increase sample sizes.	
FA.09	Collect additional genetic samples from the pelagic, NWHI, and other distant FKWs to assess population structure	Collect biopsy samples using observers biopsying from bow of fishing boats, or during dedicated cetacean surveys	Feasible, but may not have many opportunities. May take years to collect adequate samples.	Collection $10K-$25K, scalable, may be piggybacked depending on collection methods. Analysis- $10K-$25K	
FA.10	Evaluate degree of genetic differentiation between insular and pelagic stocks	Requires additional effort to obtain samples to the west and north of Hawaii	Difficult to collect samples from remote areas. Will likely take years. Will take significant search effort.	Must be piggybacked to other studies.	
FA.11	Develop methods to pro-rate blackfish and unidentified cetacean bycatch	Bycatch is currently underestimated; several takes are identified only as unidentified cetacean. Alternative models (see SSC recommendations) may yield better assessment of FKW versus pilot whale allocation.	Several methods proposed, but require careful consideration.	<$10K	
FA.12	Re-analyze the proportion of SI vs. NSI for circle hooks vs. tuna and J-hooks		Feasible - analysis of existing observer data, but will take some time to amass enough interactions for robust result	<$10K	
FA.13	Evaluate detection probability for autonomous recorders in various locations	High or low rates of FKW detection at various recording sites may be due to instrument placement.	Easy with currently available data.	$50K-$100K given analysis time required. If deployments in additional areas needed, add $25K per deployment.	

Topic ID	Research Activity	Avg. Score	Overall Rank
FB.21	Conduct hook-tissue interaction research to better understand the relationship between type of gear and where the animal is hooked and the severity of the injury.	1.625	1
FB.19	Evaluate survival of FKWs and similar species following fisheries interactions.	1.444	2
FA.01	Hawaiian EEZ survey (at least every 5 years)	1.375	3
FA.04	Survey windward side of Hawaiian Islands to assess differential FKW encounter rates	1.375	3
LL.04	Survey all longline vessels to identify commonalities among those with high depredation rates	1.333	5
FA.02	Continue research into FKW abundance using towed and stationary acoustics. Develop new towed systems that allow for real-time localization of vocal FKWs	1.250	6
FA.06	Evaluate alternative methods for estimating abundance, with emphasis on improving precision	1.250	6
FB.05	Develop real-time assessment capability for distinguishing between FKWs and other odontocetes using whistles and echolocation clicks	1.222	8
FB.10	Conduct vessel sound playbacks	1.222	8
LL.02	Develop new or test existing methods for fleet to use acoustic recorders to determine FKW presence prior to setting	1.222	8
LL.12	Evaluate performance of gear used in deep-set fishery (*see details in doc prepared by Laist and Bernard*)	1.222	8
LL.16	Evaluate impact of weak hooks on FKW bycatch rates	1.222	8
FB.06	Evaluate acoustic behavior near longlines using recorders on fishing gear	1.111	13
FB.13	Determine range at which a hook in a fish can be detected by FKW	1.111	13
FA.03	Monitor abundance and trends of MHI insular stock	1.000	15
FA.07	Use Observer Program data (in combination with other fishery-dependent data where applicable) on FKW sightings, interactions, and depredation to develop abundance estimates, estimate depredation rates, and identify hot spots.	1.000	15
FA.08	Use mark/recapture studies to supplement info on abundance, demographics, stock structure, and injury categorization	1.000	15
FA.12	Re-analyze the proportion of SI vs. NSI for circle hooks vs. tuna and J-hooks	1.000	15
LL.11	Determine types of hooks and hook manufacturers used by Hawaii deep-set longline vessels (*see details in doc prepared by Laist and Bernard*)	1.000	15
LL.14	Desktop study to assess size of false killer whales caught	1.000	15
LL.17	Collect straightened hooks for genetic sampling	1.000	15

Color coded by category:
False killer whale biology
False killer whale assessment
Longline gear
State fisheries

Topic ID	Research Activity	Avg. Score	Overall Rank
FB.08	Carry out underwater observations of foraging behavior	0.889	22
FB.12	Assess impact of hook density on FKW ability to follow line	0.889	22
LL.05	Examine role of bait type, size, and manner of threading on bait depredation	0.889	22
LL.15	Follow-up weak hook study to understand impact on target catch.	0.889	22
SF.01	Develop detailed descriptions of fishing practices including precise information on gear types used in the state fisheries (e.g., troll, dangler, handline, hybrid).	0.889	22
FA.09	Collect additional genetic samples from the pelagic, NWHI, and other distant FKWs to assess population structure	0.875	27
SF.05	Evaluate hook-and-line (shortline, kakaline, troll, handline, etc.) fishery effort and geographic distribution regionally and seasonally	0.875	27
FB.03	Continue telemetry studies on the MHI insular stock FKWs	0.833	29
FB.01	Continue telemetry studies on the pelagic stock FKWs	0.778	30
FB.15	Evaluate FKW capability to see floats, as well as monofilament line of different colors and width	0.778	30
LL.03	Record acoustic profile of vessels and fishing gear across the fleet during transiting, setting, soaking, and hauling to assess potential cues to FKWs	0.778	30
LL.06	Evaluate where animals are caught within a set and why	0.778	30
LL.09	Evaluate effectiveness of additions to terminal tackle or other items on the mainline as a method to reduce depredation on bait, catch and incidental takes of false killer whales	0.778	30
FA.13	Evaluate detection probability for autonomous recorders in various locations	0.750	35
FB.04	Examine call types and rates by different FKW populations to better understand the variability and nuances of the acoustic data, allowing for more precise and useful examination of existing and ongoing acoustic data.	0.667	36
FB.11	Determine the extent to which FADs attract FKWs.	0.667	36
FB.14	Test visual acuity of FKWs given different types of lights often found on longline vessels	0.667	36
FB.16	Assess FKW response to compounds found in oil fish and other fish species that FKWs do not depredate from the line	0.667	36
FB.20	Assess importance of fishery as a food source for FKWs.	0.667	36
SF.02	Institute observer coverage (possibly from an alternative platform) and/or video monitoring to better track state fisheries' practices and possible interactions.	0.667	36

Topic ID	Research Activity	Avg. Score	Overall Rank
FA.05	Develop predictive habitat models of FKW density	0.625	42
FA.10	Evaluate degree of genetic differentiation between insular and pelagic stocks	0.625	42
FB.09	Study adaptive learning in the FKW	0.556	44
LL.10	Assess potential for hooks to be modified (foam coating, etc.) to increase or decrease detection range	0.556	44
LL.13	Identify and evaluate other factors that may affect hook strength (and severity of FKW injuries)	0.556	44
FA.11	Develop methods to pro-rate blackfish and unidentified cetacean bycatch	0.500	47
LL.01	Evaluate feasibility of using moored listening stations (FADs, NOAA weather buoys, etc.) to determine FKW occurrence before a fishing trip	0.444	48
SF.06	Model the potential for FKW interactions with state fisheries by calculating a FKW CPUE in the deep-set longline fishery and then extrapolating that to the state fishery (based on rates of tuna caught).	0.444	48
FB.07	Use acoustic tags to understand foraging and acoustic behavior	0.333	50
LL.07	Evaluate potential to use killer whale/other playbacks as deterrents	0.333	50
FB.17	Assess hormones to examine stress and reproductive rates	0.222	52
LL.08	Examine the ability of FADs to be used as decoys for false killer whales (to reduce depredation of active longlines).	0.222	52
SF.03	Cross-reference and otherwise examine existing data to assess consistency and QA/QC.	0.222	52
SF.04	Better understand the distinctions and areas of commonality in federal and state reporting protocols.	0.125	55
FB.02	Continue telemetry studies on the NWHI stock FKWs	0.111	56
FB.18	Examine physiological response of FKW and similar species during/following an interaction	0.111	56

Top Ranked Projects in Each Category

FKW Biology		
Topic ID	**Research Activity**	**Overall Rank**
FB.21	Conduct hook-tissue interaction research to better understand the relationship between type of gear and where the animal is hooked and the severity of the injury.	1
FB.19	Evaluate survival of FKWs and similar species following fisheries interactions.	2
FB.05	Develop real-time assessment capability for distinguishing between FKWs and other odontocetes using whistles and echolocation clicks	8 (tie)
FB.10	Conduct vessel sound playbacks	8 (tie)
FB.06	Evaluate acoustic behavior near longlines using recorders on fishing gear	13 (tie)
FB.13	Determine range at which a hook in a fish can be detected by FKW	13 (tie)

Longline Gear		
Topic ID	**Research Activity**	**Overall Rank**
LL.04	Survey all longline vessels to identify commonalities among those with high depredation rates	5
LL.02	Develop new or test existing methods for fleet to use acoustic recorders to determine FKW presence prior to setting	8 (tie)
LL.12	Evaluate performance of gear used in deep-set fishery (*see details in doc prepared by Laist and Bernard*)	8 (tie)
LL.16	Evaluate impact of weak hooks on FKW bycatch rates	8 (tie)
LL.11	Determine types of hooks and hook manufacturers used by Hawaii deep-set longline vessels (*see details in doc prepared by Laist and Bernard*)	15 (tie)
LL.14	Desktop study to assess size of false killer whales caught	15 (tie)
LL.17	Collect straightened hooks for genetic sampling	15 (tie)

State Fisheries		
Topic ID	**Research Activity**	**Overall Rank**
SF.01	Develop detailed descriptions of fishing practices including precise information on gear types used in the state fisheries (e.g., troll, dangler, handline, hybrid).	22
SF.05	Evaluate hook-and-line (shortline, kakaline, troll, handline, etc.) fishery effort and geographic distribution regionally and seasonally	27
SF.02	Institute observer coverage (possibly from an alternative platform) and/or video monitoring to better track state fisheries' practices and possible interactions.	36
SF.06	Model the potential for FKW interactions with state fisheries by calculating a FKW CPUE in the deep-set longline fishery and then extrapolating that to the state fishery (based on rates of tuna caught).	48
SF.03	Cross-reference and otherwise examine existing data to assess consistency and QA/QC.	52

FKW Assessment		
Topic ID	**Research Activity**	**Overall Rank**
FA.01	Hawaiian EEZ survey (at least every 5 years)	3 (tie)
FA.04	Survey windward side of Hawaiian Islands to assess differential FKW encounter rates	3 (tie)
FA.02	Continue research into FKW abundance using towed and stationary acoustics. Develop new towed systems that allow for real-time localization of vocal FKWs	6 (tie)
FA.06	Evaluate alternative methods for estimating abundance, with emphasis on improving precision	6 (tie)
FA.03	Monitor abundance and trends of MHI insular stock	15 (tie)
FA.07	Use Observer Program data (in combination with other fishery-dependent data where applicable) on FKW sightings, interactions, and depredation to develop abundance estimates, estimate depredation rates, and identify hot spots.	15 (tie)
FA.08	Use mark/recapture studies to supplement info on abundance, demographics, stock structure, and injury categorization	15 (tie)
FA.12	Re-analyze the proportion of SI vs. NSI for circle hooks vs. tuna and J-hooks	15 (tie)