

Stories of Conservation Success: Results of Interviews with Hawai'i Longliners

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November 2020

NOAA Administrative Report H-20-11
<https://doi.org/10.25923/6bnn-m598>

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Recommended citation

Ayers AL, Leong K. 2020. Stories of conservation success: results of interviews with Hawai‘i longliners. NOAA Admin Rep. H-20-11, 43 p. doi:10.25923/6bnn-m598

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Executive Summary

This NOAA Administrative Report presents findings from fieldwork with the Hawai‘i longline fleet conducted in summer/fall 2019. It reveals how Hawai‘i longline fishers are affected by, respond to, and attempt to mitigate protected species bycatch. The purpose of our research was to better understand protected species interactions from the perspective of Hawai‘i longline fishers and learn how solutions devised by industry can potentially further reduce bycatch. Although Hawai‘i longliners have significantly lowered protected species bycatch, there is continual pressure on the fleet to further reduce interactions.

We conducted 38 unstructured interviews with Hawai‘i longline fishers, including 30 captains or owner-operators and 8 crewmembers. We received informed consent from fishers and conducted interviews with them in their primary language, with translation assistance provided by the Hawai‘i Language Bank. A combination of non-probabilistic sampling approaches (intercept and network sampling) guided initial data collection, followed later with a purposive stratified design to ensure different groups or strata were not oversampled. Although our interviews were not statistically representative of the entire labor population in the Hawai‘i fleet, it does closely reflect the composition of many industry subgroups. Detailed interview notes were analyzed and separated by theme using a grounded theory approach and are reported anonymously or in aggregate. Four key themes emerged that repeatedly arose during interviews:

- vessels have major incentives to avoid protected species,
- vessels relocate to avoid protected species,
- captains communicate to avoid protected species, and
- fishers have innovative ideas to avoid protected species and improve release handling.

These themes consistently came up, regardless of the questions being asked, and they demonstrate how Hawai‘i longline fishers proactively attempt to reduce protected species interactions in the fishery. Hawai‘i longline fishers reported that they go to great lengths to avoid protected species interactions. Primarily, they avoid protected species because they have significant financial incentives to do so. Inadvertently catching a protected species can result in fishery closures, loss of fish or bait via depredation, and losses in valuable fishing time. Fishers often relocate to avoid protected species, travelling 60–100 miles or more to avoid animals and share information about protected species aggregations within their trusted networks. Fishers also shared several innovative ideas to avoid protected species, some of which were simple, such as homemade tori lines or the translation of workshop materials into other languages, while others were much more technologically complex and need to be tested before brought to scale.

In summary, our findings demonstrate what Hawai‘i longliners do in addition to existing guidelines and regulations to avoid interacting with protected species and to improve handling if caught. These findings may also challenge notions that fishers do not care about these rare animals. To the contrary, many interviewees indicated that they revered animals such as false killer whales (FKWs) for their intelligence and skill. There are many reasons to avoid protected species; however, regardless of those reasons, communication and fisher-developed solutions present some promising ways to meet demands to further reduce interactions in the fishery.

Introduction

The Western Pacific Regional Fishery Management Council (Council or WPRFMC) and the National Marine Fisheries Service (NMFS) manage fishing for pelagic management unit species (PMUS) in the U.S. Exclusive Economic Zone (EEZ) (or federal waters, generally 3–200 nautical miles (nm) from shore) and the high seas through the Fishery Ecosystem Plan for Pelagic Fisheries of the Western Pacific Region (Pelagics FEP) as authorized by the Magnuson-Stevens Fishery Conservation and Management Act (Dept. of Commerce et al. 2007). This area includes federal waters around the state of Hawai‘i, American Samoa, Guam, The Commonwealth of the Northern Mariana Islands, and the Pacific Remote Island Areas. The Hawai‘i longline fishery is managed via a limited entry permit system (WPRFMC 1994; WPRFMC 2009; Ayers and Chan 2020), which includes a deep-set fishery predominantly targeting bigeye tuna (*Thunnus obesus*), and a smaller shallow-set fishery targeting swordfish (*Xiphias gladius*).

The Hawai‘i longline fishery is the largest commercial fishery in the state of Hawai‘i and is the reason the port of Honolulu ranked 6th in the United States in 2018 in landed value (NMFS 2020). Most fish caught by Hawai‘i longliners and delivered fresh to local markets around Hawai‘i contribute to local food security. But, like many commercial fisheries, the Hawai‘i longline fishery also catches some non-target species with no economic value as bycatch, including some protected species. Protected species covered in this report include sea turtles, seabirds, marine mammals, and sharks. Most of these species are protected under the Endangered Species Act (ESA), the Marine Mammal Protection Act (MMPA), and the Migratory Bird Treaty Act (MBTA). A list of protected species found in or near waters where fisheries managed under the Pelagics FEP and a list of critical habitat designations in the Pacific Ocean are included in Annual Stock Assessment and Fishery Evaluation Report for the U.S. Pacific Island Pelagic Fisheries Ecosystem Plan (WPRFMC 2019).

The Hawai‘i longline industry, NMFS, and the Council have worked together to significantly reduce protected species bycatch. Despite tremendous strides and efforts, protected species interactions have resulted in multiple fishery closures over the past two decades.

As a result of the industry’s economic importance, particularly its contribution to domestic seafood production and reduced U.S. seafood trade deficits, it is vitally important to develop creative solutions to keep the Hawai‘i longline fishery open and viable each year. Further reducing bycatch may require ‘sociotechnical’ bycatch solutions that consider complex social and technological practices embedded within the fishery and its linkages to society and markets (Smith et al. 2005). Sociotechnical bycatch solutions in this fishery may entail finding innovative ways to efficiently communicate information and share effective interventions across the industry to reduce bycatch, streamline complex guidelines and regulations, limit protected species interactions, and improve survivability of animals incidentally caught. Anecdotal information and published research allude to the potential role of communication—and not more regulation—to further reduce interactions and improve best handling practices (Barnes et al. 2016). Finding ways to further reduce protected species interactions and improve post hook survivability can help ensure a sustainable, thriving, economically important commercial fishery that continues well into the future.

Therefore, the purpose of this research was to work with Hawai‘i longline fishers to understand how they mitigate protected species interactions. These stories can assist scientists, managers, and the general public better understand what fishers do to mitigate protected species bycatch, increase awareness of industry efforts, and discover if any industry-led communication or innovation can further reduce protected species interactions.

Background on Hawai‘i longline fishing

Longline fishing in Hawai‘i has occurred in some form since the early 1900s. The first longliners targeted yellowfin tuna (*Thunnus albacares*) and bigeye tuna within 2–20 nautical miles of the main Hawaiian Islands using lengths of ropes strung together or basket gear (June 1950; WPRFMC 1986). Fish caught on these trips were canned in Honolulu and were primarily shipped to the U.S. mainland (Dollar and Yoshimoto 1991). Longline fishing in this era was colloquially known as “Flaglining” because of the flagpoles attached to floats that separated lengths of attached rope (Boggs and Ito 1993). Contemporary longline fishing in Hawai‘i commenced in the late 1980s when monofilament gear replaced rope-based gear.

By 1990, most vessels targeted swordfish using shallow-set gear and delivered their catch fresh to fish dealers in Honolulu, before shipping most fish to markets on the U.S. mainland. Most of these trips occurred far offshore, at least 75 nm from the Hawaiian Islands. In the early 2000s following a court-ordered closure of the swordfish fishery, most vessels switched to deep-set gear full-time to target bigeye tuna, which is also delivered fresh to, and where most remain in, Hawai‘i markets.

In response to greater catches and increased effort in the late 1980s and early 1990s, NMFS and the Council began working with the industry to develop progressive conservation and management measures. Over time, these measures became more complex as science, data collection, and innovative solutions became more available. Table 1 provides a synopsis of current regulations applicable to the Hawai‘i longline fishery.

Table 1. Summary of current regulatory requirements applicable to the Hawai‘i longline fishery.

Requirements¹
Fishing Permits and Certificates Required
- Hawai‘i Longline Limited Entry Permit.
- Marine Mammal Authorization Program Certificate.
- High Seas Fishing Compliance Act Permit for fishing on the high seas.
- Western and Central Pacific Fisheries Convention (WCPFC) Area Endorsement for fishing on the high seas in the convention area.
- Protected Species Workshop (PSW) Certificate.
- Western Pacific Receiving Vessel Permit, if applicable.
- State of Hawai‘i Commercial Marine License.
Reporting, Monitoring, and Gear Identification
- Logbook for recording effort, catch, and other data.
- Transshipping Logbook, if applicable.
- Marine Mammal Authorization Program Mortality/Injury Reporting Form.
- Vessel monitoring system (VMS).

Requirements¹

- Vessel and fishing gear identification.

Notification Requirement and Observer Placement

- Notify NMFS before departure on a fishing trip to declare the trip type (shallow-set or deep-set).
- Each fishing trip is required to have a fishery observer on board if requested by NMFS; NMFS places observers on every shallow-set longline trip, resulting in 100% coverage, and approximately 20% coverage on deep-set trips.
- Fisheries observer guidelines are used.

Prohibited Areas in Hawaii

- NWHI Longline Protected Species Zone.
- MHI Longline Fishing Prohibited Area.
- Papahānaumokuākea Marine National Monument (PMNM): Prohibited commercial in the Monument, which has boundaries that align with the Northwest Hawaiian Islands (NWHI) Longline Protected Species Zone.
- Southern Exclusion Zone (annually if fleet interacts with two Insular false killer whales)

Protected Species Workshop (PSW)

- Each year, longline vessel owners and operators must complete a PSW and receive a certificate.
- The vessel owner must have a valid PSW certificate to renew a Hawai‘i longline limited entry permit.
- The vessel operator must have a valid PSW certificate on board the vessel while fishing.

Sea Turtle, Seabird, and Shark Handling and Mitigation Measures

- Vessel owners and operators are required to adhere to regulations for safe handling and release of sea turtles and seabirds.
- Vessel owners and operators must have on board the vessel all required turtle handling/de-hooking gear specified in regulations.
- Vessel owners and operators can choose between side setting and stern setting, with additional requirements to reduce seabird interactions when fishing north of 23 degrees north.
- When shallow-set longline fishing north of the Equator:
 - o Use 18/0 or larger circle hooks with no more than 10 degrees offset.
 - o Use mackerel-type bait.
 - o Set at night (at least 1 hour after sunset) for stern set vessels.
- Vessel owners, operators, and crew are required to release any oceanic whitetip (*Carcharhinus longimanus*) or silky shark (*Carcharhinus falciformis*) and take reasonable steps for its safe release.
- Sea turtle annual take limits for both loggerhead and leatherbacks.
- Weak hook and branch line width regulations under the false killer whale take recovery plan.
- Branch line length, thickness, and weight requirements.

Marine Mammal Handling and Release

- Vessel owners and operators must follow the marine mammal handling guidelines provided at the PSW.
-

Requirements¹

- Vessel owners or operator must submit the Marine Mammal Authorization Program (MMAP) Mortality/Injury Reporting Form within 48 hours after the end of the fishing trip to NMFS to report injuries or mortalities of marine mammals (50 CFR 229.6).
-

¹Unless otherwise noted, the above regulations can be found at 50 CFR Part 665. A summary of regulations for Hawai‘i longline fisheries (shallow-set and deep-set combined) is provided by the Summary of Hawai‘i Longline Fishing Regulations, which can be found here: <https://www.fisheries.noaa.gov/resource/document/hawaii-pelagic-longline-regulation-summary>.

With greater information on the population status of sea turtles, marine mammals, elasmobranchs, and seabirds in the Pacific, NMFS, WPRFMC and the Hawai‘i longline industry worked together to address fishery impacts on protected species and reduce interactions. With this report, we share some of these ongoing efforts made by the fishing industry, NMFS, and WPRFMC to further reduce protected species interactions with longline fishing operations in Hawai‘i. We believe that it can also help inform future dialogue between the industry, scientists, and fishery managers.

Fishing gear

Longline gear is defined as a mainline longer than one nautical mile, which is deployed as the fishing vessel moves across the water. Longline deployment is typically referred to as “setting,” and the gear, once deployed, is typically referred to as a “set.” Sets normally drift separated from the vessel for several hours before they are retrieved, known as the “haul” or “hauling,” along with any catch.

Deep-set longline gear typically targets bigeye tuna and consists of a continuous mainline set below the surface and supported in the water column horizontally by floats with branch lines attached at intervals on the mainline. The mainline is 3.2–4.0 mm diameter monofilament and is stored on large hydraulic reels. Radio buoys are used to keep track of the mainline as it drifts at sea. A line shooter is used on deep-sets to deploy the mainline faster than the speed of the vessel, which allows the longline gear to sink to its target depth (target depth for bigeye tuna is approximately 400 m). The mainline is typically 25 to 45 nm long. A minimum of 15, but typically 25 to 30, weighted branch lines (gangions) are clipped to the mainline at regular intervals between the floats. All float lines must be at least 20 m in length. Each branch line terminates with a single baited hook. The branch lines are typically 11 to 15 m (25 to 50 ft) long. Sanma (saury) or sardines are used for bait. The use of light sticks (or any light-emitting device) is prohibited on deep-set trips. Unlike the shallow-set fishery, there are no regulations that regulate when deep-set gear may be set. But fishermen typically set their gear in the morning at dawn and haul in the afternoon to maximize target catch rates. Vessel operators are also required to take a NMFS contracted observer if requested by NMFS. Observer coverage in the deep-set fishery has been around 20% since 2004.

By contrast, shallow-set longline gear typically targets swordfish and consists of a continuous mainline set much closer to the surface, and bait is set at depths of 30–90 m. The portion of the mainline with branch lines attached is suspended between floats at about 20–75 m depth, and the branch lines hang off the mainline another 10–15 m. Only 4–5 branch lines are clipped to the mainline between floats, and a typical set for swordfish uses between 700 and 1,000 hooks.

Shallow-set fishers (swordfish targeted trips) are required to use size 18/0 circle hooks with a 10-degree offset and mackerel bait (squid bait is prohibited). Seabird mitigation regulations require bait to be dyed blue and gear to be set 1 hour after sunset, which also coincides with the swordfish nocturnal feeding behaviors, and hauling typically commences at dawn. If they do not set at night with blue-dyed bait, Hawai‘i longliners must side-set (deploy their gear off the side of their vessel) in order to mitigate seabird interactions. Unlike the deep-set fishery, and largely due to interactions with sea turtles, NMFS requires an observer on all shallow-set trips (100% observer coverage). See Table 1 for regulations applicable to Hawai‘i longline fishing and see Table 2 for more details on key events and regulatory interventions affecting Hawai‘i longline fishing.

Table 2. Timeline of major protected species regulatory interventions in the Hawai‘i longline fishery.

Date	Event
1985	NFMS issues first of many biological opinions on the U.S. pelagic longline fishery in the Western and Central Pacific Ocean. The initial opinion concludes that the Hawai‘i longline fleet does not jeopardize the continued survival of sea turtle populations.
1987	The WPRFMC establishes the first Pelagics Fishery Management Plan (FMP).
1991	Amendment 2 of the Pelagic Fishery Management Plan establishes 50 nm longline exclusion zone around the Northwestern Hawaiian Islands to limit protected species interactions.
1992	Amendment 5 of the Pelagic Fishery Management Plan established a 50–75 nm longline exclusion zone around the main Hawaiian islands to limit interactions with the Hawai‘i small boat fleet.
1994	Satellite (VMS) tracking initiated for all longline vessels; limited entry permits capped at 164.
-	NMFS establishes a federal fishing observer program for the Hawai‘i longline fleet.
1999	Litigation over sea turtle take begins; Center for Marine Conservation and Turtle Island Restoration Network files a suit against NMFS in federal district court in Honolulu.
2000–2004	Court orders closure of the shallow-set longline fishery over incidental sea turtle take; closure lasts nearly 3 years.
2001	NMFS began teaching a mandatory, in-person, protected species workshop for all Hawai‘i-based longline vessel owners and captains. Workshop teaches captains and owners the latest guidance and regulations pertaining to protected species identification and handling. Seabird regulations first put in place.
2002	NMFS PIRO established a 20% minimum observer coverage requirement for all deep-set trips.
2004	Shallow-set fishery reopened with 100% federal observer coverage and other mitigation measures such as circle hooks, set limits, banned use of squid as bait; deep-set observer coverage increased to 20% of all trips; Amendment 10 of the Pelagic Fishery Management Plan established a hard cap on turtle take that resulted in a fishery closure if loggerhead (<i>Caretta caretta</i>) and leatherback (<i>Dermochelys coriacea</i>) turtle interactions are met.

Date	Event
2006	Hawai'i shallow-set longline fishery closed on March 20, 2006, when the fishery reached its maximum interaction limit for loggerhead sea turtles.
2010	In January 2010, a Take Reduction Team (TRT) is established to help reduce incidental mortality and injury of false killer whales (FKW) (<i>Pseudorca crassidens</i>).
2011	Shallow-set fishery closed for the remainder of the year on November 18, 2011, when the fishery reached the maximum interaction limit of leatherback sea turtles.
2012	TRT mandates industry use circle hooks to improve survivability of accidentally caught endangered species; a final rule establishes other gear requirements and creates the Southern Exclusion Zone (SEZ) south of the main Hawaiian Islands in order to minimize interactions with the endangered main Hawaiian Islands Insular FKW stock.
2018	On May 4, 2018, as part of terms of a settlement with Turtle Island Restoration Network and interactions with North Pacific Loggerhead turtles in the fishery, the U.S. District court decision required NMFS to close the Hawai'i shallow-set longline fishery for the remainder of the year.
-	On July 18, 2018, NMFS closed the SEZ to Hawai'i deep-set longline fishing when the interaction limit for FKW was met.
-	On October 2, 2018, NMFS complied with a court order to reduce annual interaction limits for loggerhead turtles from 34 to 17.
2019	The SEZ closed for deep-set longline gear February 22, 2019, when the fishery reached two interactions with FKWs.
-	Shallow-set fishery closed for the remainder of the year on March 19, 2019, when fishery reached interaction limit for North Pacific loggerhead sea turtles.
-	On June 27, 2019, a new biological opinion sets reasonable and prudent measures and terms and conditions for the Hawai'i shallow-set fishery to further reduce protected species interactions.

Methods

Research design and sampling frame

We employed a qualitative research approach and primarily used unstructured, open-ended interviews to gather data. To identify fishers for interviews, we employed a non-probabilistic sampling approach, which combined two different sampling methods: intercept sampling and snowball or network sampling (Bernard 2013). Initial individuals willing to be interviewed were asked to provide names of other individuals in their network that may also participate. This is often called ‘chain referral’ sampling. The strength of this approach is that it is effective at identifying and interviewing willing participants since our interview topics (protected species) could be sensitive to some fishers who may not be comfortable speaking about their experiences. The limitation of this approach is that results may not statistically represent the subject population. Given these reasons, a random sample or population-level data collection effort was not the best fit. Our goal was to learn from fishers, take a proactive approach, and share solutions that they may have to further reduce protected species interactions and encounters with the industry.

To address potential issues related to oversampling, we followed up our early non-probabilistic sampling effort with a purposive, stratified sampling design (Creswell 2003). This is akin to research designs previously used during fieldwork with the Hawai‘i longline fleet (Allen and Gough 2006; Allen and Gough 2007). This approach was used to gain additional targeted representation from different subgroups or strata. Interviews conducted with these subgroups included individuals from groups that may not have been interviewed, including different ethnicities, vessel sizes, gear types (shallow versus deep-set), permit types, experience levels, etc. The stratified sampling design did not yield a probabilistic sample, but it does reflect current participation levels in the fishery among several different strata (see Table 3).

Data collection and analysis

The initial interview guide was shared with industry leaders, policymakers, and scientists for their review and was subsequently revised based on their input. But the interests and experiences of interviewees drove the direction and focus of the conversations. All 38 interviews were conducted in person between August and December 2019, with fishermen at Pier 38 and Pier 17 in Honolulu, Hawai‘i. We interviewed 30 captains or owner-operators and 8 crewmembers (including 2 American crew and 6 foreign crew: 3 Indonesian, 2 Filipino, and 1 Vietnamese). Interviewees included vessels that targeted bigeye tuna via deep-set gear, swordfish via shallow-set gear, and some that switched between both gear types. Attributes of our interview set approximated the composition of several industry strata (see Table 3).

Fishermen were interviewed on fishing vessels voluntarily with informed consent. Interviews were not audio recorded due to the sensitivity of interview questions. Many interviews were conducted with interpretation and translation assistance from the Hawai‘i Language Bank so that fishermen could be interviewed in their primary languages. Data provided in this report were documented via detailed handwritten interview notes in interviewees’ primary languages, translated if necessary, then digitized. Data were then coded or binned into thematic areas (Miles and Huberman 1994) using a grounded theory approach (Corbin and Strauss 2008). All data are

reported anonymously and no personally identifiable information is included in this report. Given the number of interviews conducted (38) and the cross section of industry strata, we are confident that we have achieved thematic saturation (Weller et al. 2018). In other words, we believe that we interviewed enough individuals across the fleet that we heard many of the same themes repeated over and over again. For more aggregated information on interview respondents, see Table 3.

Table 3. Aggregated information about Hawai‘i longline (HI LL) Captains or Owner-operators (N=30).

Category	Sub-Category	Number of individuals interviewed (%)	Active vessels/ permit holders in Hawai‘i longline fleet (%)
Vessel ownership ¹	Single vessel owner-operator or captain	25 (83)	96 (85)
	Multiple vessel owner-operator or captain	5 (17)	17 (15)
Ethnicity ²	Vietnamese American	22 (73)	111 (68)
	European American	6 (20)	48 (29)
	Korean American	2 (7)	5 (3)
Vessel length ²	Vessels less than or equal to 24 m in length	24 (80)	110 (76)
	Vessels greater than 24 m in length	6 (20)	35 (24)
Vessel permit ³	Single-permitted vessels	25 (83)	122 (84)
	Dual-permitted vessels (Hawai‘i longline limited entry and American Samoa longline limited entry	5 (17)	24 (16)

¹Hawai‘i Longline Limited Entry Permit Database, March 2019

²Hawai‘i Longline Limited Entry Permit Database, December 2019

³Hawai‘i Longline Limited Entry Permit Database, June 2020

Results

This section provides analysis of unstructured interviews with Hawai‘i longline fishers. Tables 4–13 present summary thematic findings from interviews with Hawai‘i longline fishers. Findings in the tables were analyzed and separated by theme, with the most frequently mentioned themes at the top of each table. We reported the total mentions for each theme along with the number of unique mentions. In other words, we reported the number of interviewees that mentioned a theme regardless of how many times it was referenced.

For more information on the interview guide, see Appendix A Interview Guide. Captains and crewmembers were asked many of the same questions, but crewmembers were not asked some questions, such as location choice, since those decisions are made by captains or owner-operators. In these instances, the number of reported interviewees in the table is 30, rather than 38. When both captains and crew were asked a question, the number of interviewees is 38.

The median interviewee had been longlining for 25 years (standard deviation 12.9 years) and fishing commercially for 30 years (standard deviation 13.7 years). Their estimated median age was 55 years old (standard deviation 13.7). We interviewed 12 owner-operators and 18 captains. For more summary aggregate information about interviewees, see Table 3.

Interviewees differed in their thoughts about which protected species guidelines or regulations were most effective (see Table 4). Several fishers cited the protected species workshop as most effective, followed by seabird and FKW regulations. Many interviewees were unsure about which regulations or guidelines were most effective. Although the topic was effectiveness, some interviewees were very dissatisfied with regulations and guidelines and thus their comments are still included here.

Table 4. Most effective Hawai‘i longline protected species regulations (N=30).

Theme/subtheme	Total mentions	Total individuals mentioning each theme
Protected species workshop	13	13
Seabird regulations	10	5
- Seabird regulations in general; (5)		
- Side setting; (2)		
- Tori lines; (2)		
- Bird curtain;		
N/A or Unsure	6	6
FKW regulations	5	3
- FKW regulations; (3)		
- Weak hook, straighten hook; (2)		
Very dissatisfied with them	4	4
- Dissatisfied with all of them;		
- Regulations are unacceptable;		
- Do not see how regulations are effective;		
- Past regulations were better;		

Theme/subtheme	Total mentions	Total individuals mentioning each theme
Turtle regulations	4	4
- Turtle regulations in general; (3)		
- All regulations make sense except turtle ones;		
Other	3	3
- Regulations that recommend cutting the line close to the animals;		
- Flexible guidelines;		
- I follow the regulations;		

Interviewees reflected on which guidelines or regulations were most challenging or difficult to follow (see Table 5), which provided an opportunity for fishers to explain which guidelines or regulations they feel are burdensome or ineffective. Nearly every regulation was mentioned at least once by interviews, but FKW and shark restrictions came up most frequently, followed by observer interactions and closures. One commonality among most of these comments was the issue of crew safety. For FKWs, this was related to gear flybacks when attempting to straighten weak hooks, while shark safety comments had more to do with removing hooks or trailing gear from sharks, or being asked by observers to land sharks so that they could obtain biological samples. “Flybacks” can occur when the monofilament line breaks under high line tension, sending the weighted lead leader flying back towards the crewmember aboard the vessel. Captains and crew told detailed stories about these flybacks, including near misses and injuries. Interviewees felt that this unnecessarily jeopardized crew safety. In sum, handling these animals according to existing guidance comes with risks, which may make them challenging or difficult to follow. Four fishers stated that they did not find any guidelines or regulations to be challenging.

Table 5. Most challenging or difficult to follow Hawai‘i longline protected species regulations (N=38).

Theme/Subtheme(s)	Total mentions	Total individuals mentioning theme
FKWs	9	7
- FKW avoidance (3)		
- FKW cause crew safety concerns (2)		
- Difficulty avoiding whales		
- Weak hook FKW regulations		
- Whale regulations		
- Avoiding whales on tuna fishing trips		
Shark regulations	8	6
- Shark handling regulations (4)		
- Shark handling regulations jeopardize crew safety (4)		
Observers	7	7
- Interactions/communication with observers (6)		

Theme/Subtheme(s)	Total mentions	Total individuals mentioning theme
- Some observers make things difficult		
Closures	7	7
- PMNM closure (2)		
- FKW and SEZ closures (2)		
- Time-area closures (2)		
- Closing Johnston & Palmyra Atolls		
Shallow-set regulations	4	4
- Shallow-set regulations in general (2)		
- Turtle caps (2)		
No challenges	4	4
- All regulations are easy to follow (2)		
- Nothing, would let protected species workshop instructor know		
- No burden		
N/A or don't know	4	4
Seabird regulations	3	3
- Blue-dyed bait (2)		
- Bird curtains don't work		
Gear restrictions	2	2
- Barrel swivels with too long leaders		
- Not being able to use lead sinkers		
Regulations (in general)	2	1
- Language in regulations is difficult to interpret		
- Regulations are too strict		
Other	2	2
- If fishers had to pay for observers		
- Turtle injury/mortality determinations		

Fishers also discussed how protected species guidelines and regulations affect their fishing trips (see Table 6 for themes that came up during interviews). Most frequently, fishers cited some aspect of added time and added financial costs associated with protected species encounters. Here, we differentiate between an encounter, in which an animal is not caught but may cause significant costs from depredation, or potentially, an interaction, which is incidental bycatch. Such encounters could entail costly depredation events, so the mere presence of protected species in a fishing area may force vessels to retrieve their gear and relocate 75–100 miles or more away to get away from them. Others mentioned that such encounters can endanger crew safety, particularly when observers ask them to land sharks to gather samples or when trying to straighten a weak hook if a FKW is on the line. At times, this guidance may result in dangerous gear flybacks. But overall, the main message that came through was that **encounters or interactions** with protected species are costly and time-consuming, and Hawai‘i longline fishers go to great lengths to avoid them.

Table 6. How do protected species regulations and guidelines affect fishing trips? (N=38).

Theme/Subtheme	Total mentions	Total individuals mentioning theme
Costly, time-consuming protected species encounters	20	15
- Complicates location choice (2)		
- Whales take bait, running away takes time, is costly (2)		
- Whale encounters are costly		
- Whale encounters are very costly — lost five sets [of fish and/or bait to depredation] on the last trip		
- Encountering whales increases travel time, increases costs		
- Running away from whales takes time		
- We run away if we see any protected species		
- When encounter FKWs, have to travel a long ways to get away from them		
- No way to avoid sharks		
- Always run away when you see a whale		
- Hurt to lose seasonally productive bigeye area north-northwest of Kaua‘i due to FKW interactions		
- Whale encounters are very costly		
- Whale encounters lengthen trips		
- Whale encounters (of any type) cost time and money		
- Whales force you to move		
- Whales sometimes eat the entire set		
- Whales steal catch		
- Have to watch out for whales		
Affects crew safety	17	13
- Endangers, affects crew safety (4)		
- Observer guidance about shark handling endangers crew safety (2)		
- Safety concerns with shark handling (2)		
- Lead weight snapbacks are dangerous if/when sharks/whales are on the line		
- Handling sharks endangers crew safety		
- Cut the line if crew safety is in question		
- Dangerous to pull up sharks, can cause gear flybacks		
- Lancetfish are dangerous due to gear flybacks		
- Some crew lack experience to handle sharks safely		
- Observers always ask him to pull in sharks		
- Some guidelines are a liability		
- Always cut the line with sharks		

Theme/Subtheme	Total mentions	Total individuals mentioning theme
Increases costs, affects profitability	12	10
- Increased costs (6)		
- Affects profitability (2)		
- Protected species (PS) handling increases crew stress, burden		
- Harder to make a living		
- Fish are lower quality		
- Affected when forced to change gear		
Longer trips	9	7
- Longer trips (3)		
- Longer trips equal lower quality fish and less revenue		
- Trips above 23 degrees North are longer, less profitable		
- Lengthens travel time		
- Longer travel time		
- Longer trips are financially risky		
- Lower prices		
Increases time	8	8
- Time-consuming (2)		
- Slows you down (2)		
- Accidental PS interactions take time, but aren't costly		
- Slows us down, may catch less fish		
- Takes time to deal with sharks		
- Have to be careful handling turtles		
Causes Stress	8	7
- Increase stress (2)		
- Handling protected species causes stress and anxiety (2)		
- Captain stress causes crew stress		
- Adds additional stress		
- Handling bycatch increases crew stress, less time for them to eat		
- Stress over crew handling competence		
- Regulations increase stress		
Blue-dyed bait	7	6
- Blue dye bait above 23 degrees north increases time (2)		
- Blue-dyed bait is ineffective (2)		
- Blue-dyed bait is useless and time-consuming		
- Tori lines work better than blue-dyed bait		
- Tori lines are mostly effective		
Closures	6	5
- Closed areas make trips longer, more expensive		
- Closures increase competition with international fleets		
- SEZ closure increases competition, wipes fish out fishing areas		
- Trips outside the Exclusive Economic Zone (EEZ) are time-consuming and costly (gas, food, supplies, wages)		

Theme/Subtheme	Total mentions	Total individuals mentioning theme
- Sometimes fish [just outside] the boundaries of closed areas		
- Affected by the expanded PMNM		
Ineffective, dangerous SS regulations	5	5
- No way to avoid turtle encounters other than stop shallow-set (SS) trips		
- SS regulations have a greater impact than deep-set (DS) trips		
- Regulations make SS trips too costly		
- Swordfish fishing is very dangerous		
- Makes SS fishing too costly		
Side-setting ineffective, unsafe	2	2
- Side-setting is ineffective		
- Side-setting unsafe, not worth it		
Miscellaneous	2	2
- Have to follow the guidelines		
- N/A		

Due to their special work status¹, Hawai‘i longline crewmembers are not allowed to attend protected species workshops in person at Federal office facilities. So it is left to captains to teach crewmembers handling guidelines and regulations. The Hawai‘i Longline Association, NMFS, and WPRFMC are keenly aware of this challenge and are working to devise ways to improve crew education and training. Hawai‘i longline fishers offered ideas to improve crew training and their responses coded by theme are presented below in Table 7. Ideas to improve crew training were varied and diverse. Several ideas referenced improvements to at-sea handling, finding creative ways to present training materials to crew, translating materials into primary languages, and using incentives or positive reinforcement to improve handling. Many of the ideas referenced the importance of hands-on training for crewmembers, which can be difficult to practice given the rare nature of such events. Others felt that teaching captains was a waste of time, since crew handle setting and hauling and would be the first responder if a protected species is accidentally hooked.

Table 7. Ideas to improve crew training (N=38).

Theme/Subtheme	Total mentions	Total individuals mentioning each theme
Improving at-sea handling	12	12
- Captains must be more directly involved in handling and crew instruction (2)		
- Return to sea alive if accidentally caught (2)		
- Best crew training is hands-on		
- Captains should take the lead in handling		
- Crew mainly learn from handling the animals		
- Crew observes how captain handles		
- Difficult for captains to be involved with handling at sea		
- Disconnect between class trainings and at-sea handling		
- Make inexperienced crew check with captains first before handling		
- Rotate crew responsibilities		
Protected Species Workshop	11	10
- Provide trainings for crew (2)		
- Attend PSW		
- Continue PSW		
- Keep providing annual PSW trainings		
- Must teach crew		
- Teaching captains is a waste of time		
- Video training on the docks for crew		
- Share ideas with crew to safely handle whales		
- Train captains		
- Education is important		

¹ <https://www.govinfo.gov/content/pkg/USCODE-2011-title46/pdf/USCODE-2011-title46-subtitleII-partF-chap81-sec8103.pdf>

Theme/Subtheme	Total mentions	Total individuals mentioning each theme
Captain-crew instruction	11	11
- Crew only follow captain instructions (3)		
- Captains share new handling guidelines with crew (3)		
- Captain reminders about handling (2)		
- Crew follow PSW guidelines via captain instructions		
- Crew turnover means captains have to teach one-on-one		
- Captains have to teach crew		
Translation	8	6
- Provide trainings in primary languages (3)		
- Create a training video in different languages		
- Language barriers complicate captain-crew teaching		
- Translate training materials into crew languages		
- Translate vessel signage		
- Provide vessel signage in different languages		
Other solutions	6	6
- Research to improve handling safety (2)		
- Give bonuses to crew that handle PS properly		
- Get the United Nations (UN) to pay for a crew training course		
- Need captains to care about marine mammals		
- Commercial fisher behavior won't change without financial penalties		
Observers	3	2
- Observers actions can jeopardize animals and crew		
- Observers shouldn't be so demanding		
- Sometimes observers are threatened		
Communication materials	2	2
- Post a communication board at the pier		
- Posted training info on vessel walls is enough		

Captains also described what happens at sea after a protected species interaction (see Table 8 for all responses summarized by theme). Their most frequently mentioned response was communication with other fishers at sea. Fishers shared information about an interaction with their networks so that others can potentially avoid **encounters or interactions**. Fishers frequently retrieve their gear and leave an area, explaining that they had no choice but to pick up and go somewhere else, particularly if there is intense depredation from sharks or FKWs. Others mentioned financial losses, again due to loss of bait or fish via depredation. Some reported never interacting with protected species, an indication that conservation measures are effective, that at-sea communication works, or the rare nature of such events.

Table 8. What happens after a protected species interaction? (N=30).

Theme/Subtheme	Total mentions	Total individuals mentioning theme
Share information with other fishers	25	19
<i>At sea (18)</i>		
- If protected species are around, call each other to avoid the area		
- Share information about protected species locations via satellite phone or radio		
- If protected species are encountered, talk on the radio		
- Share information with friends in the community		
- If whales are encounter, talk with other captains to find where to go next		
- Easier to avoid whales if fishing with other vessels (because share info)		
- Communicate at-sea over the radio		
- Stay in contact with other captains via satellite phone		
- Contact each other when things settle down		
- Talk with friends on the radio		
- Keep in contact via phone, radio		
- Share information with just one other vessel		
- One captain friend knows everything that is going on		
- Communicate with other captains at sea		
- Inform each other if birds are around		
- Talk to other captains to avoid whales		
- Talk on the radio to avoid whales		
- Talk to each other on the radio		
<i>At Port (4)</i>		
- Share protected species stories at port with other captains		
- Talk about it back at port		
- Get info from other captains at port		
- Share information with other captains at port		
<i>Communication (3)</i>		
- Communicate (2)		
- Talk, share information with each other		
Relocate to avoid protected species	14	10
- Try to get away from them		
- Can't run too far south because of long-tailed sharks [thresher sharks]		
- If birds are around, go somewhere else		
- Move the opposite way		
- If lose a lot of baits (from depredation), move to another spot		

Theme/Subtheme	Total mentions	Total individuals mentioning theme
<ul style="list-style-type: none"> - If lots of sharks, sometimes move 20 miles away - Move to another location - Move at least 75 miles away - Move far away from protected species - When whales are seen, turn the lights off and move - Sometimes travel a whole day and night away - Cut the set short and move if whales are seen - If whales are around, you have to move - Doesn't like to get close to protected species 		
Financial loss	5	5
<ul style="list-style-type: none"> - Encounter whale, lose profit - Lose a lot of money if whales are encountered - If whales or sharks are around, best to not waste your time - Stop fishing when whales around - Sometimes depredation is intense (seasonally) 		
No interactions or N/A	5	5
<ul style="list-style-type: none"> - No interactions (2) - Never interact with seabirds if you use mitigation measures - New to fishery, haven't encountered any - N/A 		
Other ideas	3	3
<ul style="list-style-type: none"> - Sometimes turn off the engine for an entire day until whales swim away - Whales see the lights when boats go together - Only go out in small groups 		
Follow the rules	2	2
<ul style="list-style-type: none"> - If small turtle or bird is dead, put it in the freezer for observer - Keep training materials 		

Fishers also discussed how protected species affect where they choose to fish. Many of their answers, presented below in Table 9, were similar to those reported in Table 8. Most often, fishers mentioned that they relocate to avoid protected species. If they arrive at a fishing spot and notice that protected species are around, fishers frequently reported that they pick up their gear—or won't even set their gear—and motor away a minimum of 6–7 hours, sometimes as much as 1–2 days away in order to avoid them. They relocate because encounters with protected species such as FKWs can mean the difference between a profitable trip and one where they lose money. FKWs are notorious for eating the bait off hooks or picking a hooked fish clean, leaving only fish heads when gear is hauled back up. Fishers described such encounters as getting “whaled” and shared their frustration with these events, but they also revealed an admiration for the highly intelligent animals. Fishers also thought that reducing cues associated with fishing vessels could help prevent protected species interactions. One fisher suggested that a hydraulic suppressor

might reduce or eliminate auditory cues while another suggested that turning off the radar or emitting colored smoke could keep birds away.

Avoiding these **encounters or interactions** is important because of the financial implications. One interviewee quantified their effect, noting that if FKWs eat five of their sets, then they will lose money for the trip. Although relocating or motoring away from protected species appeared to be the best option to avoid them, environmental variability and climate change have significantly affected fishers' knowledge of fishing spots. It has become increasingly difficult to find the ideal water temperature for bigeye tuna fishing and fish can no longer be expected to be in areas where they were known to aggregate. This adds an additional element of uncertainty or risk when facing the decision to relocate to a different fishing spot.

Table 9. How do protected species affect where you go? (N=30).

Theme/Subtheme	Total mentions	Total individuals mentioning theme
Relocate away from protected species	24	17
<i>Travel a day or further to get away (12)</i>		
- Sometimes run a day away		
- You travel a day, they're there the next day. 180 miles away, they're there		
- Have to travel 60–80 miles to get away from whales		
- Sometimes drive 6–7 hours, if whales still around, drive a whole day and night further		
- When encounter whales, sometimes move 75 miles or more to get away from them		
- Sometimes move 1–2 days because whales will follow		
- Move 100 miles away		
- Run away, sometimes a whole day		
- Sometimes travel a day to get away from whales		
- Sometimes run a whole day to get away from whales		
- Whales are smart. If you set already, no choice but to motor a day away		
- Have to travel a whole day to a new location		
<i>Change locations (12)</i>		
- Go somewhere else if we get whaled or catch sharks		
- Sometimes move at least 10 miles away when we see them		
- No other way than to move somewhere else		
- If we encounter whales, we stay away from them		
- Try to get away from whales		
- Move to stay away from whales		
- No choice but to move away from them		
- Yes you move		
- Move to new location		
- We try to stay away from them		

Theme/Subtheme	Total mentions	Total individuals mentioning theme
- Just move away from the area with protected species		
- Just run away from whales		
Other solutions or ideas	12	12
- Colder the water, higher likelihood of sharks		
- If whales are seen, wait to set lines, turn off the lights		
- The whales are so smart, they will let us know and keep us in check		
- Less likely to encounter whales on deep-set trips		
- Whales staying in same places to get free food		
- Less whales to the northeast		
- More whales to the south		
- Less likely to encounter whales more than a day from the island		
- Whales are habituated to sounds, so we use a hydraulic suppressor		
- Closures (SEZ) squeeze boats into smaller areas and increase interactions		
- Many of the notorious areas (for FKW encounters) are now shutdown		
- The protected areas are closer to the island, I often go long distance fishing		
Financial impacts of protected species encounters, depredation	10	8
- If a whale eats more than five sets, we lose money		
- When lots of whales are around, they will eat all your baits		
- Encounter whales, we lose tuna		
- Where there are lots of tuna, there are lots of whales		
- When you encounter the whale, you lose profit		
- If they eat our tuna, we pick up and move		
- FKWs eat tuna all the way to the head		
- Last trip was 15 sets, whale ate 10 of them		
- Have to stop fishing when whales are around		
- Get away or lose fish		
Environmental change, variability complicate location choice	8	4
- [Fish] are all mixed up now with warmer water		
- Climate change is a real thing		
- Charts not working		
- Very hard to predict where fish will be		
- Use satellite data, use your best guess		
- Water temperature is really warm this year		
- Move and still get whaled right away. Didn't used to be like that		
- Almost impossible to get away these days		

Theme/Subtheme	Total mentions	Total individuals mentioning theme
N/A (4)	4	4
Communicate species aggregations or depredation	2	2
- Avoid areas where someone got whaled (depredated)		
- Some captains let people know when whales are around		

Regulations or guidelines typically represent the best way to avoid protected species or handle them safely. But fishers spend more time at sea than anyone and may have unique ideas on how to avoid such encounters or interactions. Not every fisher took on extra work to develop innovative gear or participate in pilot projects with the WPRFMC, but several did (see Table 10). Most often, fishers mentioned that they did extra work outside of existing guidelines or regulations to avoid seabirds. They frequently trialed homemade tori lines, which some claim reduce seabird interactions to nearly zero. Fishers again mentioned relocation to avoid FKWs, often travelling a day or more away to avoid them. Some felt that they did not have enough experience to comment, others mentioned new gear such as lighter hooks and heavier monofilament. Still others referenced improved crew education and communication.

Table 10. Do you do anything outside existing guidelines or regulations to avoid protected species? (N=30).

Theme/Subtheme	Total mentions	Total individuals mentioning theme
Bird guidelines or regulations	10	7
- 3–4 friends voluntarily use tori lines		
- Tori lines		
- Created my own tori line. It doesn't get stuck in the prop and the birds won't get near it		
- Use a tori line and strategic floating offal to keep birds away		
- Can't use lazy lines		
- Blue-dyed bait doesn't work		
- If we go above 23 degrees, we have to dye the bait		
- Don't do anything other than dye the bait		
- Turn off your satellite to get away from birds		
- Used to use blue smoke device before it was banned		
FKW guidelines or regulations	8	6
- No choice but to run away from whales (3)		
- Everyone runs away from whales		
- No choice but to run away for a day		
- If we see a whale, we travel a day away and try to set the next morning		
- Try to get away from the whales		

Theme/Subtheme	Total mentions	Total individuals mentioning theme
- Understand relationship between water temps and whale migration		
N/A or not enough experience	5	5
- N/A (3)		
- Not much experience (2)		
Gear guidelines or regulations	5	4
- Japanese gear is higher quality, but too expensive		
- Have used basically the same gear for 40 years		
- Lighter hooks, heavier monofilament		
- Side set with big circle hooks		
- Developed bycatch mitigation tech, but NMFS won't issue permits		
Miscellaneous	4	4
- Everyone does things differently		
- If it's going to happen, it's going to happen		
- Don't see turtles when tuna fishing		
- Try to avoid bycatch, it only causes trouble		
Shark guidelines or regulations	4	3
- Colder water north of 45 degrees, more sharks		
- Find sharks in colder water, no way to avoid them		
- Loud noises may scare sharks		
- Beyond 300 miles, whale and shark encounters are more likely		
Crew education and handling instruction	4	2
- Educating the crew goes a long way		
- Crew should wear safety glasses		
- Have a good first-aid kit		
- Cameras are good for captains		
Follow existing regulations	3	3
- Just what regulations say		
- Have to follow the guidelines		
- Only follow NOAA guidelines		
Communicate, share information	3	2
- Communicate to avoid sharks		
- Captain-to-captain communication		
- When we fish together, if we see whales, we move to another location		

Fishers also revealed which information might be useful to avoid protected species interactions or encounters. Their responses were widespread, with many referencing how additional data, for example, acoustic or environmental data, could be useful to avoid particular species such as seabirds, sharks, or whales (see Table 11). Some of this data could be provided by NMFS,

similar to existing products such as TurtleWatch. Others posited theories about why protected species might be found in particular areas or near bigeye tuna that they target on fishing trips. Relocating away from protected species came up again as well as the futility of avoiding animals that inhabit the same ocean space and depths as bigeye tuna.

Table 11. What additional information, if available, could be useful to avoid protected species interactions or encounters? (N=30).

Theme/Subtheme	Total mentions	Total individuals mentioning theme
Innovative industry ideas	9	8
<ul style="list-style-type: none"> - Tired of trying. NMFS won't give me permits to try things - Some [Republic of] Korea boats use radio frequency signals to keep FKWs away - Use tori lines if birds are around - Use acoustics to listen for FKWs before setting gear - Check water temp, current, winds - Pay for an app to get frequently updated water temp data - If you see birds, don't throw bait too far - Use an app to measure water temp - Avoid the restricted zone (SEZ) 		
Industry theories	7	7
<ul style="list-style-type: none"> - Where the whales are, the bigeye tuna are - The further you travel, the less likely you encounter whales - Streamers, tori lines work better than blue dyed bait - Colder water, higher likelihood of sharks - More whales in the Big Island water - Whales are seasonal - If you find birds and whales, you will find tuna 		
NMFS products or research	5	5
<ul style="list-style-type: none"> - Tag and track FKWs, share data with industry (2) - Eco-cast works pretty well to avoid leatherbacks on the west coast - TurtleWatch useful to avoid turtles when swordfishing - Research depredation events across time and space 		
None or N/A	5	5
Share more information, learn from other captains	3	3
<ul style="list-style-type: none"> - Learning from more experienced captains is the best way - Talk story and share location of encounters - I'm new, there's a lot to learn 		
Avoiding protected species is futile	3	2
<ul style="list-style-type: none"> - Cannot predict where fish or FKWs will be anymore - No way to avoid them - Hard to know whale location 		

Fishers were also given an opportunity to share anything they would like people to know about the Hawai‘i longline industry and protected species. Most interviewees had nothing to add, but some suggested changes to regulations and guidelines and others called for greater regulatory flexibility (see Table 12). Some fishers wanted people to know that the industry follows regulations and that the industry does more to avoid protected species than any other longline fleet in the Pacific. Additional comments questioned FKW population assessments and posited that they are far more abundant than current estimates suggest.

Table 12. Anything else you want people to know about the HI LL industry and protected species? (N=30).

Theme/Subtheme	Total mentions	Total individuals mentioning theme
No or N/A	14	14
- No (9)		
- N/A (5)		
Suggested changes to regulations or guidelines	7	6
- Close the areas where swordfish (shallow-set folks) catch turtles		
- Fines for PS violations are unfair		
- Let captain make PS handling decisions		
- Improve observer-captain communication, especially when crew may be in danger		
- The United States Coast Guard (USCG) needs to do something about inexperienced captains		
- Start the swordfish season later, at the end of February		
- Should not count turtles that are released alive		
Hawai‘i longline industry follows the regulations	7	6
- PS shouldn’t be a big deal because the rest of the Pacific fleets don’t have to follow our regulations		
- We just follow the rules		
- I follow the regulations, but I'm not happy about turtle regulations		
- HI LLers have done more than anyone in the world to address protected species		
- We’ve covered it. Over and over and over and over. Stop beating the dead horse. We need to move on		
- Everyone wants to preserve protected species, no one wants to kill them		
- Greater industry awareness of protected species than ever before		
More regulatory flexibility and innovation	7	5
- Stop arguing and start solving problems		
- Need more flexible regulations		

Theme/Subtheme	Total mentions	Total individuals mentioning theme
<ul style="list-style-type: none"> - Use technology to reduce interactions - Need website with real-time data to help avoid protected species - Need more leeway from NMFS - Local tackle vendors wouldn't bring in thicker branch line to try because it wasn't required by NMFS - Litigation doesn't solve anything 		
FKWs	6	4
<ul style="list-style-type: none"> - Longliners make it easy for FKWs to eat - Less likely to encounter whales down south - Whales are closer to the islands - More whales and turtles to the south - There seem to be so many FKWs, I don't understand how they are endangered - Only encountered a whale one time 		

Fishers were given a final opportunity to add any additional comments. Most had nothing else to add, but some felt that better communication system between NMFS and industry would be beneficial. Others used the opportunity to question the utility of fishery closures, protected species injury determinations, and turtle interaction limits (see Table 13). Comments about closures referenced having to compete with foreign longline fleets for fish on the high seas outside the U.S. EEZ.

Table 13. Anything else that you would like to add? (N=30).

Theme/Subtheme	Total mentions	Total individuals mentioning theme
No or N/A	18	18
Communication;	4	2
<ul style="list-style-type: none"> - Need a better communication system - Doesn't know who to talk to when you have a question - Hard to communicate with NMFS sometimes because of their M-F workday availability - Would call the NMFS Protected Species Coordinator if had ideas 		
Miscellaneous	4	4
<ul style="list-style-type: none"> - Need a device to keep sharks or FKWs away - Translate regulations and guidelines into Vietnamese - Fishing and interacting with protected species is all luck - U.S. it the land of the free, but there are so many rules here. All the freedom in the world, but you can't do anything 		

Closures	3	2
- Don't understand the 200 mile closure [closing most of the U.S. EEZ around Hawai'i to longline fishing – 200 miles around the PMNM, the MHI longline prohibited area, and when in effect, the southern exclusion zone]		
- Have to compete with foreign vessels beyond 200 miles		
- SEZ or 200 miles closures do not make sense		
Protected Species handling	2	2
- Counting interactions as deaths is unfair		
- Unclear about where to cut the line on big sharks		
Turtle caps	2	2
- Regulations discourage swordfishing; If turtle cap was 50 it would make sense; I see the dead end future of this business, its only getting worse and worse		
- Turtle caps for shallow-set fishery are unreasonable		

Discussion

Over the past few decades, the Hawai‘i longline fleet, NMFS, and WPRFMC have made significant strides to reduce protected species interactions. Fishing gear has been modified or changed, animal handling protocols have become refined and routinized based on years of evidence, and avoidance through informal at-sea communication appears to be industry standard. These strides have been successful in reducing interactions with many protected species, making the Hawai‘i longline fleet a global leader in bycatch reduction (Gilman et al. 2007). But, there is continual pressure on NMFS, WPRFMC, and the Hawai‘i longline fleet to further reduce these rare and accidental interactions. A byproduct of conservation success is that it can be difficult to learn from rare interactions in the fishery.

Four key themes continually came up during the interviews related to further reducing interactions: vessels have major incentives to avoid protected species, vessels relocate to avoid protected species, captains communicate to avoid protected species, and fishers have innovative ideas to avoid protected species and improve handling. Therefore, in the spirit of being proactive and further reducing these interactions, we will discuss these themes below in greater detail. These topics consistently came up across our main discussion topics and warrant more attention and analysis.

Vessels have major incentives to avoid protected species

Captains and owner-operators were unequivocal about their desire to avoid protected species during fishing trips, because if they encounter the animals, they frequently incur significant financial costs in terms of lost bait, catch, and gear. These losses may be compounded when they result in regulatory closures and/or lost fishing time and profits. When vessels that target swordfish with shallow-set gear reach a cap of leatherback or loggerhead sea turtles, the fishery closes for the remainder of the calendar year. Reaching this cap causes vessels currently at sea to stop fishing and immediately return to port. Additionally, financial investments in specialized shallow-set gear cannot be reused on deep-set trips.

In addition to costs associated with gear, closures, and trip costs, Hawai‘i longline fishers also incur significant financial loss due to depredation. Much of this depredation occurs via encounters with FKWs, which can quickly turn a vessel’s profit into a loss. Some fishers reported losing money for the trip if they encountered FKWs and could not get away from them. Regardless of the cause, Hawai‘i longliners may lose revenue – and often their profits – when they encounter FKWs during fishing trips. Collectively, the potential costs of protected species interactions provide significant financial incentives to minimize or avoid them altogether.

Vessels relocate to avoid protected species

Interactions with protected species can add up and trigger area closures, but fishing vessels do not need to interact with protected species or sharks to significantly affect their fishing trips. When certain protected species are encountered during fishing trips, Hawai‘i longliners often travel great distances to get away from them. There seemed to be strong agreement that if they come across an aggregation of protected species, for example, sea turtles or FKWs, then there is

no choice but to leave the area. But, there was less agreement about the threshold for when to leave and the distance necessary to travel in order to safely avoid them.

For some fishers, the threshold to relocate was very low. If they see FKWs or sharks when they begin to set their gear, they will immediately haul it up and motor to another location. For these fishers, the mere possibility of depredation and accompanying financial loss of bait or target catch—or worse, an accidental foul hook or take of a FKW—is enough to leave the area. The risk outweighs any potential reward in terms of catch. But for others, the threshold to leave the area might be greater, depending on which animals are around. When captains decide to relocate to avoid protected species like FKWs, there was not a clear consensus about how far they need to move. The decision about how far they need to travel may depend on the species that they encounter. For sharks, the distance may not be too far, but vessels may need to motor further away to get away from FKWs, because the distance they are able to travel to follow vessels may be greater than other species.

Many captains reported travelling 60–80 miles, sometimes 100 miles or more after encountering a FKW to ensure that they have safely distanced their vessel from the animals. Regardless of the animals they are trying to avoid, the decision to leave an area where fish are abundant can be difficult. They may lose some of their bait or catch, but the potential reward could be enticing enough to stay in an area where they know sharks are around. Shark depredation was described as an important issue. Fishers did not differentiate between protected sharks (silky and oceanic whitetips) and other non-protected shark species with which they encounter or interact.

Captains communicate to avoid protected species

To further avoid protected species interactions, Hawai‘i longline fishers frequently share location information of protected species sightings, interactions, encounters, and depredation events within their social networks via radio or satellite phones. Communicating this information not only helps animals from being caught accidentally, it could save their friends in the fleet valuable time and money by avoiding these areas. Since letting other captains know the location of protected species aggregations inadvertently shares confidential fishing information, many captains are only comfortable circulating this information with friends or other vessels that they work with closely, because this information is essentially a trade secret. Although fishers can be notoriously secretive about fishing spots, information about protected species still gets around. So even if one individual may not widely share their information, someone in their network likely communicates with other segments of the fleet. Word usually travels fast if depredation is intense or if an area has a high concentration of sharks, whales, turtles, or seabirds.

Fishers have innovative ideas to avoid protected species and improve handling

Fishing captains and owner-operators spend upwards of 300 days a year at sea, so it is not surprising that they would have some innovative ideas to avoid protected species or further improve handling if they are accidentally caught. Their ideas were widespread, from simple, elegant, homemade fixes that they believe could reduce certain interactions to nearly zero, to others that involved advanced technology to further avoid protected species interactions and encounters. All of these innovations were developed at their own cost and go beyond existing NMFS handling guidelines and regulations. These ideas came directly from the fishers.

Many of the ideas to improve handling dealt with communication, hands-on training, or translation of existing regulatory guidelines and materials. Since protected species interactions (in other words, hookings and/or entanglements) are rare events, it can be challenging to provide crewmembers with enough handling experience. There were no negative comments about the protected species workshop or the educational material taught therein. Hawai'i longline crewmembers, most of which are foreign, speak little English. Likewise, some captains whether Vietnamese American or Korean American, may not speak the primary languages spoken by the crew that work for them and they may not speak a common, shared language such as English to share important protected species handling instructions. Therefore, many captains highlighted the importance of captains handling protected species and leading by example

Other respondents highlighted the importance of communication and translation of workshop materials and signage into primary languages. Language barriers exist for many fishers in the Hawai'i longline fleet and one way to improve the situation involves technology. One captain suggested making a training video available that crew can view aboard their vessels. Video content could include subtitles in primary languages spoken by captains and crew in the fleet.

In terms of simple solutions, homemade tori lines were some of the simplest solutions that came up during interviews. Fishers explained that it is not profitable to catch birds, nor to feed them their bait, further highlighting the financial incentives not to catch protected species referenced earlier. There is an ongoing WPRFMC tori line pilot project with industry and NMFS that helps facilitate this. Another fisher had a very simple idea to keep birds away: turn off the satellite. More evidence may be needed to substantiate the claim, but if effective, it could offer another simple solution to avoid "birdy" areas. Another fisher referenced opening some of the closed areas. As one fisher mentioned, concentrating fishers into other remaining productive fishing areas may have the unintended consequence of actually increasing protected species interactions.

Fishers also described several other innovative technologies to avoid protected species. These ideas may not be as simple as running a tori line to avoid seabird interactions, but they could also be effective at reducing interactions. One fisher explained that there are no easy solutions, but new gear and solutions such as lighter hooks and heavier monofilament are being tested. Heavier line and lighter hooks (i.e., weaker hooks and thicker branch lines) could make it easier to straighten hooks if a FKW is accidentally hooked while fishing, thus releasing the animal without any trailing gear or a fishing hook. Unfortunately, this new gear comes at a cost and those costs are incurred by the industry.

Another fisher explained that their hydraulic gear makes a lot of noise and marine mammals such as FKWs are able to hear this noise underwater from long distances when vessels set or haul their gear. If FKWs associate the noises made by hydraulics with a meal, then a suppressor could silence the proverbial dinner bell that attracts them to fishing boats, and potentially limit or eliminate costly depredation events.

Conclusion

The Hawai‘i longline fleet, NMFS, and WPRFMC have been successful at reducing interactions with protected species, but there is continual pressure to further reduce these interactions. Our research sought to learn how fishers have been addressing this need on the water and whether proactive, fisher-developed solutions could help accomplish this goal. Our fieldwork with Hawai‘i longline fishers and the data we gathered indicate the lengths that fishers go to avoid protected species, because interacting with them does not make financial sense and could significantly harm their industry. Thus the industry has significant financial incentives to avoid them. Fishers also travel great distances at sea to avoid aggregations of protected species and share information among their networks so that other vessels can also avoid them. Fishers also shared several innovative solutions that, if effective and brought to scale, have the potential to reduce industry interactions with protected species to increasingly lower levels. It is our hope that this report can demonstrate actions by longline fishery participants to avoid endangered and threatened species and share fisher-developed solutions to a wider audience of scientists, regulators, and the general public.

Acknowledgments

Thank you to the Hawai‘i longline fishers for their participation and candor. We would also like to acknowledge Asuka Ishizaki, Eric Kingma, Chelsea Tran, Colby Brady, Josh Lee, Justin Hospital, Russell Ito, Krista Graham, Keith Bigelow, and many others who reviewed earlier versions of this report and provided input on the interview guide.

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Appendix A. Interview guide

Stories of Conservation Success

We invite you to participate in a social science research project with The Joint Institute of Marine and Atmospheric Research (JIMAR)/University of Hawai‘i at Mānoa and NOAA’s Pacific Islands Fisheries Science Center. The purpose of this research is to collect stories from fishermen to increase awareness of industry efforts to avoid protected species interactions. Your *stories of conservation success* can help scientists, managers, and the general public better understand what fishermen go through to mitigate protected species interactions. Your participation in this study is voluntary and your responses will not be tied to you or your business in any way. Findings from this study will be presented anonymously or in the aggregate and may be used to improve safety while handling protected species, and improve communication about them by fishery managers (The Western Pacific Regional Fishery Management Council and NMFS). Interviews should take 20–30 minutes. If you have any questions please contact Adam Ayers (adam.ayers@noaa.gov, 808-725-5347) or Kirsten Leong (kirsten.leong@noaa.gov, 808-725-5398).

Interview Guide (Captains)

Background

1. Before we begin, do you have any questions?
2. Where are you from and how did you get into longlining in Hawai‘i? *Probes:*
 - a. How long have you been fishing? How long have you been longlining in Hawai‘i?

Effectiveness of protected species guidelines and regulations

3. Which guidelines or regulations are most effective at preventing the catch of protected species or ensuring their survival after they were caught? Which make the most sense?

Probes:

- a. Gear modifications?
 - b. Regulations?
 - c. Trainings?
 - d. Scientific information?
 - e. Innovative avoidance/mitigation measures developed by industry?
 - f. Other – please describe.
4. Which protected species regulations are the most challenging to follow or the most burdensome? How would you change them?
 5. Before you start fishing, how do protected species regulations and guidelines affect fishing trips (for example, side-setting, blue dyed bait, regulations that restrict where and when you fish)?

Probes:

- a. Do they slow you down?
- b. Increase costs?

- c. Affect profitability?
- d. Endanger crew safety?
- e. Add additional stress?
- f. Other – please describe.

Ideas to Improve Training

- 6. How could captain and/or crew training on protected species be improved?

Communication to avoid protected species interactions

- 7. How do you obtain fishing information that might affect protected species interactions and handling while at sea, at port, and face-to-face.

Probes:

- a. What types of fishing information do you share or ask about?
- b. How is that information shared?
- c. Do you share fishing information with others while at sea so that they can avoid protected species? Why or why not?

Other protected species solutions

- 8. If you hear that protected species are concentrated in a particular area, you encounter them, or interact with them, what, if anything do you do to avoid them?

Probes:

- a. Do you move somewhere else? If so, how do you decide where to go and how far?
- 9. What additional scientific or fishing information would be useful to avoid or mitigate protected species interactions? If available, what is the best way to get you that information?

Innovative gear developed or tested by industry

- 10. What have you tried outside of existing guidelines/regulations to improve handling or mitigate interactions? What about other captains?
 - a. Do you have any other ideas for mitigation measures that are more practical or would enhance safety?

Concluding remarks

- 11. Is there anything else that you would like people to know about protected species and the Hawai'i longline industry?
- 12. Is there anything else that you would like add or do you have any questions for us?
- 13. Who else should we talk to about these topics?

Thank you for your time and thoughtful responses. If you share your email address, we will send you the study results when we are finished. If not, we will also distribute our findings to the industry when the study is completed.

Appendix B. Informed Consent Form

Agreement to Participate in Stories of Conservation Success

Adam Ayers
Kirsten Leong

This research is a cooperative study between the University of Hawai‘i’s Joint Institute of Marine and Atmospheric Research (JIMAR) and the National Marine Fisheries Service (NMFS) Pacific Islands Fisheries Science Center. The purpose of the project is to collect stories of conservation success in order to help scientists, managers, and the general public better understand what Hawai‘i longline fishermen do to avoid protected species. We need to hear your ideas to improve regulations, enhance safety, and better understand the challenges you face out on the water.

Your responses will remain confidential and anonymous. No personal identifying information will be included with the research results. The interview should take about 30 minutes to complete. Findings from this study will be presented anonymously or in the aggregate and used to understand fishers’ concerns and increase awareness of industry efforts and innovations to avoid protected species interactions.

The investigators believe there is little or no risk to participate in this research project. Participation in this research project is completely voluntary. You are free to withdraw from participation at any time during the duration of the project with no penalty, or loss of benefit to which you would otherwise be entitled. Participating in this research may be of no direct benefit to you. However, we believe that the results from this project may improve safety while handling protected species and improve communication about them by fishery managers: The Western Pacific Regional Fishery Management Council and NMFS.

Research data will be confidential to the extent allowed by law. Agencies with research oversight, such as the UH Committee on Human Studies, have the authority to review research data. All research records will be stored in locked file in the investigators’ office for the duration of the research project.

If you have any questions regarding this research project, please contact Adam Ayers adam.ayers@noaa.gov (808)-725-5347 or Kirsten Leong kirsten.leong@noaa.gov (808) 725-5398.

If you have any questions regarding your rights as a research participant, please contact the UH Committee on Human Studies at (808)956-5007 or by email: uhirb@hawaii.edu.

Agreement to Participate in
Fisher Behavior and Protected Species Interactions in the Hawai‘i Longline Fishery

Adam Ayers
Kirsten Leong

Participant:

I have read and understand the above information, and agree to participate in this research project.

Name (printed)

Signature

Date