Pelagic Longline Gear and Operational Requirements in Pacific Island Fisheries to Improve Survivorship of Oceanic Whitetip Sharks

Final Environmental Assessment and Regulatory Impact Review

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Responsible Federal Agency:	Pacific Islands Regional Office (PIRO) National Marine Fisheries Service (NMFS) National Oceanic & Atmospheric Administration (NOAA)
Responsible Official:	Michael D. Tosatto Regional Administrator, PIRO 1845 Wasp Blvd., Bldg. 176 Honolulu, HI 96818 Tel (808) 725-5000
Responsible Council:	Kitty Simonds Executive Director Western Pacific Fishery Management Council (WPFMC) 1164 Bishop St., Ste. 1400 Honolulu, HI 96813 Tel (808) 522-8220

Abstract

In an effort to reduce impacts to oceanic whitetip sharks and other protected species, the National Marine Fisheries Service (NMFS) proposes rules for longline fisheries operating under the Fishery Ecosystem Plan for Pelagic Fisheries of the Western Pacific Region (FEP) to:

1. Prohibit wire leaders in the Hawaii deep-set longline fishery; and
2. Require fishermen, with limited exceptions, to remove fishing gear (trailing gear) from any oceanic whitetip shark caught in the Hawaii deep-set and shallow-set longline fisheries and the American Samoa longline fishery.

The Western Pacific Fishery Management Council (Council) recommended this rule change to improve survivorship of oceanic whitetip sharks and other species unintentionally caught in the longline fisheries that are managed under the FEP, which currently includes the Hawaii deep-set and shallow-set fisheries and the American Samoa fishery. This final environmental assessment (EA) evaluates the potential environmental effects of the following alternatives:

Alternative 1, the no action or status quo alternative, would not make any changes to existing fishing gear or handling requirements for longline fisheries operating under the FEP.

Alternative 2 would prohibit wire leaders in the Hawaii deep-set longline fishery only, and require removal of trailing gear from oceanic whitetip sharks under two sub-alternatives: A) removal of trailing gear only in the Hawaii deep-set fishery, or B) removal of trailing gear in

all the FEP fisheries, including Hawaii deep-set, shallow-set, and American Samoa fisheries. Alterative 2B is the Council’s preferred alternative.

Alternative 3 would apply the wire leader prohibition and trailing gear removal from oceanic whitetip sharks to all longline fisheries operating under the FEP.

All other existing gear and release requirements and fisheries observer coverage would remain in place under all three alternatives.

This EA is being prepared using the 2020 National Environmental Policy Act (NEPA) Regulations that became effective on September 14, 2020.

On January 19, 2022, NMFS published the proposed rule, draft EA, and request for public comments in the *Federal Register* (87 FR 2742). The comment period ended on February 18, 2022, and NMFS received comments from 46 individuals and 2 organizations all generally supporting the action. Comments included recommendations to expand the proposed rule to other fisheries, other species of sharks, and all bycatch species, as well as recommending additional gear and handing requirements to further reduce oceanic whitetip and other shark mortality. NMFS considered all comments in finalizing the EA. None of the comments resulted in a change to the alternatives or a substantive change to the environmental effects analysis.

If you need assistance with this document, please contact NMFS at 808-725-5000.

ACRONYMS AND ABBREVIATIONS

B	Biomass
BiOp	Biological Opinion
B_{MSY}	Biomass that Produces Maximum Sustainable Yield
CMM	Conservation and Management Measure
CNMI	Commonwealth of the Northern Mariana Islands
Council	Western Pacific Fishery Management Council
CPUE	Catch Per Unit Effort
DPS	Distinct Population Segment
EA	Environmental Assessment
EEZ	Exclusive Economic Zone
EPO	Eastern Pacific Ocean
ESA	Endangered Species Act
F	Fishing Mortality Rate
FKWTRP	False Killer Whale Take Reduction Plan
FEP	Fishery Ecosystem Plan
FMP	Fishery Management Plan
F_{MSY}	Mortality Rate that Produces Maximum Sustainable Yield
HLA	Hawaii Longline Association
IATTC	Inter-American Tropical Tuna Commission
ISC	International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean
ITS	Incidental Take Statement
LRP	Limit Reference Point
LVPA	Large Vessel Prohibited Area
M	Natural Mortality Rate
MBTA	Migratory Bird Treaty Act
MFMT	Maximum Fishing Mortality Threshold
MHI	Main Hawaiian Islands
MMPA	Marine Mammal Protection Act
M&SI	Mortality and Serious Injury
MSST	Minimum Stock Size Threshold
MSY	Maximum Sustainable Yield
MUS	Management Unit Species
NEPO	Northeastern Pacific Ocean
nm	Nautical Miles
NMFS	National Marine Fisheries Service
OLE	NOAA Office of Law Enforcement
NPO	North Pacific Ocean

NWHI	Northwestern Hawaiian Islands
PBR	Potential Biological Removal
PIFSC	Pacific Islands Fisheries Science Center
PIRO	Pacific Islands Regional Office
PIROP	Pacific Islands Regional Observer Program
PMUS	Pelagic Management Unit Species
PRIA	U.S. Pacific Remote Island Areas
PSW	Protected Species Workshop
RA	Regional Administrator
RFMO	Regional Fishery Management Organization
SAFE	Stock Assessment and Fishery Evaluation
SA_{MSY}	Spawning Abundance that Produces Maximum Sustainable Yield
SAR	Stock Assessment Report
SB	Spawning Biomass
SB_{MSY}	Spawning Biomass that Produces Maximum Sustainable Yield
SFD	Sustainable Fisheries Division
SPC	Secretariat of the Pacific Community
SSB	Spawning Stock Biomass
SSC	Scientific and Statistical Committee
t	Metric Ton(s)
USCG	U.S. Coast Guard
WCNPO	Western and Central North Pacific Ocean
WCPFC	Western and Central Pacific Fisheries Commission
WCPO	Western and Central Pacific Ocean

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1 INTRODUCTION

1.1 Background Information

The National Marine Fisheries Service (NMFS) and the Western Pacific Fishery Management Council (Council) manage fishing for pelagic management unit species (PMUS) in the Exclusive Economic Zone (EEZ or Federal waters, generally 3-200 nautical miles (nm) from shore) around American Samoa, Guam, the Commonwealth of the Northern Mariana Islands (CNMI), Hawaii, the U.S. Pacific Remote Island Areas (PRIA), and on the high seas through the Fishery Ecosystem Plan for Pelagic Fisheries of the Western Pacific Region (FEP) as authorized by the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act; 16 U.S.C. § 1801 et seq.).

Oceanic whitetip sharks were listed as threatened under the Endangered Species Act (ESA) in 2018 (83 FR 4153, January 30, 2018). NMFS is currently conducting ESA Section 7 consultations for the Hawaii deep-set and American Samoa longline fisheries to evaluate the potential effects of these fisheries on the survival and recovery of listed species, including oceanic whitetip sharks.

In May 2020, NMFS notified the Council that the Western and Central Pacific Ocean (WCPO) stock of oceanic whitetip shark is subject to overfishing and is overfished due to excessive international fishing pressure and that international management measures are not effective to end overfishing. Oceanic whitetip sharks are incidentally captured in the U.S. longline fisheries operating under the FEP, but the fisheries represent a small relative impact compared to the total catch by all fleets operating in the WCPO. Based on catch history from 2013-2017, the Hawaii deep-set longline and American Samoa longline fisheries are estimated to represent 4.8% and 1.7% of the total deep-set catch of oceanic whitetip sharks in the WCPO, respectively. The Hawaii shallow-set longline fishery is estimated to represent 0.15% of the total shallow-set catch of oceanic whitetip sharks in the WCPO (NMFS 2020a).

Prior to 2021, most vessels in the Hawaii deep-set longline fishery used steel wire line (leader) in the terminal portion of the fishing line between the fishing hook and a required weight that must be placed within 1 meter (m) of the hook. The required weight is generally in the form of a swivel and helps sink the hook and reduce interactions with seabirds.

The wire leader reduces the risk of crew injuries resulting from “fly back.” Fly backs may occur when retrieving fishing gear (hauling) if the line under tension between the hook and the weighted swivel breaks, is bitten off by sharks, or the hook is thrown from a fish and the weighted swivel flies back toward the vessel at high speed. The use of wire leaders between the hook and the weight reduces the chance that the leader will break or be bitten-off, thereby minimizing fly backs toward the vessel when crew are hauling fishing gear.

While they reduce fly backs, wire leaders make it difficult to remove fishing gear from sharks or other protected species that cannot be brought on board to facilitate gear removal. Due to the difficulty of cutting through the wire leader from deck height, the line is typically cut above the weighted swivel leaving, at minimum, the hook, wire leader, weighted swivel, and some amount of monofilament fishing line (collectively, trailing gear) attached to released animals. Long trailing gear is known to reduce post-hooking survival rates of sea turtles and sharks (Ryder et al. 2006, Hutchinson et al. 2021). Because monofilament nylon leaders are easier to cut from deck height, they can facilitate removal of trailing gear below the weighted swivel and close to the hook when releasing animals that cannot be brought on board to remove gear.

Sharks are also known to bite off of monofilament nylon leaders, resulting in early release of the animal (Afonso et al. 2012; Ward et al. 2008). Sharks that escape are more likely to be resilient, healthy sharks (Afonso et al. 2012), and early release from the longline gear would be expected to reduce capture stress and improve survival rates compared to sharks that are released after being brought to the vessel. For pelagic shark species including oceanic whitetip sharks, the leader material is not expected to change the initial interaction rate or hooking rate, but bite-offs are expected to result in reduced catchability (Afonso et al. 2012). With respect to other ESA-listed species, there is currently no experimental evidence for changes in catch or hooking rates across leader types.

In an effort to reduce impacts to oceanic whitetip sharks in the Hawaii deep-set longline fishery, the Hawaii Longline Association (HLA) announced in late 2020 that its members, comprising more than 90% of the Hawaii deep-set longline fleet of approximately 146 active vessels, would voluntarily switch from wire to monofilament leaders. The Hawaii shallow-set and American Samoa longline fisheries do not use wire leaders. At its 186th meeting in June 2021, the Council recommended that wire leaders be prohibited in the Hawaii deep-set fishery, along with the requirement to remove trailing gear in all FEP fisheries. This recommendation was to ensure that all fishermen in the FEP fisheries do not use wire leaders and to minimize the amount of trailing gear on oceanic whitetip sharks. To address the potential increased risk of fly back associated with monofilament leaders, the Council, NMFS, and HLA are working with longline fishermen to ensure best safety practices, including offering training on construction and use of a reusable fly back prevention device from materials readily available on longline vessels.

1.2 Proposed Action

The proposed action would amend the FEP implementing regulations to:

1. Prohibit wire leaders, specifically metal wire line within 1 m of the hook, in the Hawaii deep-set longline fishery; and
2. With limited exceptions, require all longline vessels operating under the FEP to release oceanic whitetip sharks with minimal trailing gear.

1.3 Purpose and Need for Action

The purpose of this action is to increase the post-hooking survival of oceanic whitetip sharks and potentially other protected species such as sea turtles while minimizing negative economic impacts to the affected fishery.

The action is needed because oceanic whitetip sharks are listed as threatened under the ESA, and the WCPO stock of the oceanic whitetip sharks is subject to overfishing an d is overfished. The use of wire leaders increases post-release mortality by reducing the chances that sharks may bite off or break free of the fishing line, and making it more difficult to remove trailing gear due to the difficulty of cutting through the wire. Longer trailing gear increases post-release mortality compared to when most of the gear is removed from sharks.

While HLA announced in December 2020 that all of its active Hawaii deep-set longline members will voluntarily eliminate wire leaders, not all Hawaii vessels are HLA members. A regulatory amendment is needed to ensure all deep-set vessels operating under the Hawaii longline limited entry permit transition away from wire leaders, and to facilitate trailing gear removal in all FEP longline fisheries.

1.4 Action Area

The action area where the longline vessels operate under the FEP includes portions of the U.S. EEZ around Hawaii, American Samoa, Guam, CNMI, and the PRIA that are open to commercial fishing and large longline vessels, and the adjacent high seas. There are currently no active longline vessels operating in the U.S. EEZ around Guam or CNMI under the Western Pacific general longline permit.

The Hawaii deep-set fishery operates around the main Hawaiian Islands primarily within 300-400 nm between the Equator and 35° N. In general, deep-set longline vessels operate out of Hawaii ports, with the vast majority based in Honolulu and a few in Hilo. Some deep-set trips originate from other ports such as Long Beach or San Francisco, California, or Pago Pago, American Samoa. Fishermen departing from California begin fishing on the high seas, outside the U.S. EEZ. Fishermen departing from American Samoa and landing in Hawaii usually begin fishing near the Equator or in the North Pacific where they expect higher catch rates of bigeye tuna.

The Hawaii shallow-set fishery operates in the U.S. EEZ around Hawaii and the high seas to the north and northeast of the main Hawaiian Islands (MHI). From 2004-2018, the fishery operated in an area between 180°- 125° W and 17°- 45° N., with longline fishing prohibited in the MHI area ranging from 50-75 nm from shore, the Northwestern Hawaiian Islands (NWHI) protected species zone, and the Papahanaumokuakea Marine National Monument.

The American Samoa longline fishery operates almost exclusively south of the Equator in the western Pacific. From 2008 through 2018, less than one percent of the American Samoa-based longline fishing effort occurred north of the Equator, and less than one percent in the eastern Pacific for vessels that either started or ended fishing trips in American Samoa (NMFS unpublished data). In recent years, the fishery has mostly been operating in the area between 175°- 165° W and 10°- 15° S.

1.5 Decision(s) to be made

This document will support a decision by the Regional Administrator (RA) of the NMFS Pacific Island Region, on behalf of the Secretary of Commerce, whether to approve, disapprove, or partially approve the Council's recommendation. The RA will use the information in this

Environmental Assessment (EA) to make a determination about whether the proposed action would constitute a major Federal action that has the potential to significantly affect the quality of the environment. If NMFS determines the action would *not* significantly affect the quality of the environment, NMFS will prepare a Finding of No Significant Impact (FONSI). If NMFS determines the proposed action is a major Federal action that would significantly affect the quality of the environment, NMFS would prepare an environmental impact statement before taking action.

1.6 List of Preparers

Preparers

Asuka Ishizaki, Protected Species Coordinator, Western Pacific Regional Fishery Management Council

Mark Fitchett, Pelagic Fisheries Ecosystem Scientist, Western Pacific Regional Fishery Management Council

David O'Brien, Fishery Management Specialist, NMFS PIRO Sustainable Fisheries Division (SFD)

Michelle McGregor, Economist, NMFS PIRO SFD

Reviewers

Phyllis Ha, Natural Resource Management Specialist, NMFS PIRO SFD

Mark Fox, Fish and Wildlife Administrator, NMFS PIRO SFD

Jarad Makaiau, Fish and Wildlife Administrator, NMFS PIRO SFD

1.7 NEPA compliance

This Environmental Assessment (EA) is being prepared using the 2020 Council on Environmental Quality (CEQ) National Environmental Policy Act (NEPA) Regulations. The effective date of the 2020 CEQ NEPA Regulations was September 14, 2020, and reviews begun after this date are required to apply the 2020 regulations unless there is a clear and fundamental conflict with an applicable statute. 85 Fed. Reg. at 43372-73 (§§ 1506.13, 1507.3(a)). This EA began after June 30, 2021 and accordingly proceeds under the 2020 regulations.

On November 6, 2021, NOAA's Senior Agency Official, Janet Coit (Assistant Secretary of Commerce for Conservation and Management / Deputy NOAA Administrator, Acting) granted a blanket waiver for time and page limits for a one-year period for all environmental assessments and environmental impact statements developed to support fishery management actions that are: developed by the regional fishery management councils pursuant to the requirements of the Magnuson-Stevens Act, or developed by the NMFS Atlantic Highly Migratory Species Management Division for actions taken under the requirements of the MSA. Because this EA was prepared to support a Council fishery management action and is expected to be completed before November 5, 2022, the page and time limits defined in CEQ regulations are waived.

1.8 Public Involvement

The development of the proposed action occurred in meetings of the Council and its advisory bodies, which are open to the public and are noticed in the Federal Register, local newspapers and publications, and on the Council's website (www.wpcouncil.org). Meeting agendas provide scheduled opportunities for public comment.

The Council and its Scientific and Statistical Committee (SSC) reviewed the HLA proposal to voluntary eliminate wire leaders among its membership at their December 2020 meetings (85 FR 73029; November 16, 2020). The Council directed staff to prepare a regulatory amendment to the FEP to prohibit wire leaders in the Hawaii deep-set longline fishery for Council action at its March 2021 meeting.

At its 185th meeting held on March 23-25, 2021 (86 FR 11505; February 25, 2021), the Council considered initial action on the regulatory amendment to prohibit wire leaders in the Hawaii deep-set longline fishery. The Council's Pelagic Plan Team, Fishing Industry Advisory Committee, Hawaii Archipelago FEP Advisory Panel, and the SSC also met on March 3-4, March 11, March 12, and March 16-18, 2021 (86 FR 12175; March 2, 2021), respectively, to advise on the initial action.

At its 186th meeting held on June 22-24, 2021, the Council took final action on the regulatory amendment (86 FR 29251; June 1, 2021). The Council's Pelagic Plan Team, Fishing Industry Advisory Committee, Hawaii Archipelago FEP Advisory Panel, and the SSC also met on May 11-13, June 10, June 11, and June 15-17, 2021 (86 FR 28080; May 25, 2021), respectively, to advise on the final action.

On January 19, 2022, NMFS published the proposed rule, draft EA, and request for public comments in the *Federal Register* (87 FR2742). The comment period ended on February 18, 2022 and NMFS received 46 comments from individuals and 2 comments from organizations all generally supporting the action. Comments included recommendations to expand the proposed rule to other fisheries, other species of sharks, and all bycatch species, as well as recommending additional gear and handing requirements to further reduce oceanic whitetip and other shark mortality. NMFS considered all comments in finalizing the EA. None of the comments resulted in a change to the alternatives or a substantive change to the environmental effects analysis.

2 DESCRIPTION OF THE ALTERNATIVES CONSIDERED

2.1 Development of the Alternatives

The SSC and Council, at their respective meetings held November 30-December 1, 2020, and December 2-4, 2020, reviewed the HLA proposal to voluntarily eliminate the use of wire leaders and use monofilament nylon leaders or other similar materials in its place. The SSC supported the proposal and recognized that the proactive steps by the industry should have significant positive effects on survival probabilities for protected species. The SSC recommended the

Council consider measures in the HLA proposal for further development under the FEP for Council action at a future meeting. The Council subsequently directed staff to prepare a regulatory amendment FEP to prohibit wire leaders in the Hawaii deep-set longline fishery for Council action at its March 2021 meeting.

The Council at the 185th meeting in March 2021 reviewed a range of alternatives, including the prohibition of wire leaders in the Hawaii deep-set longline fishery as well as in all longline fisheries operating under the FEP. The alternatives in the draft regulatory amendment considered existing scientific publications and reports, available observer data for the Hawaii deep-set longline fishery, and the findings from the Council's Oceanic Whitetip Shark Working Group. The Council heard recommendations from the Pelagic Plan Team, Fishing Industry Advisory Committee, Hawaii Archipelago FEP Advisory Panel, and the SSC, and selected a preliminary preferred alternative to prohibit wire leaders in the Hawaii deep-set longline fishery. The Council additionally recommended developing a regulatory requirement to remove trailing gear from oceanic whitetip shark as part of the alternative.

Following the March 2021 Council meeting, NMFS Pacific Islands Fisheries Science Center (PIFSC) analyzed the Hawaii deep-set longline fishery to model the effect of leader material on catchability and mortality of oceanic whitetip sharks and other target and non-target species (Bigelow and Carvalho 2021a). The SSC and the Council at their June 2021 meetings received a presentation on the analysis results, and considered additional new analysis including the effect of the alternatives on protected resources and socioeconomic factors. At that time, the Council also received recommendations from the Pelagic Plan Team, Fishing Industry Advisory Committee, American Samoa Archipelago FEP Advisory Panel, Hawaii Archipelago FEP Advisory Panel, and the SSC, and considered the recommendations analyzed in this document. As final action at its 186th meeting in June 2021, the Council recommended Alternative 2, Sub-Alternative 2B, prohibiting wire leaders in the Hawaii deep-set longline fishery, and requiring removal of trailing gear from oceanic whitetip sharks in all longline vessels operating under the FEP.

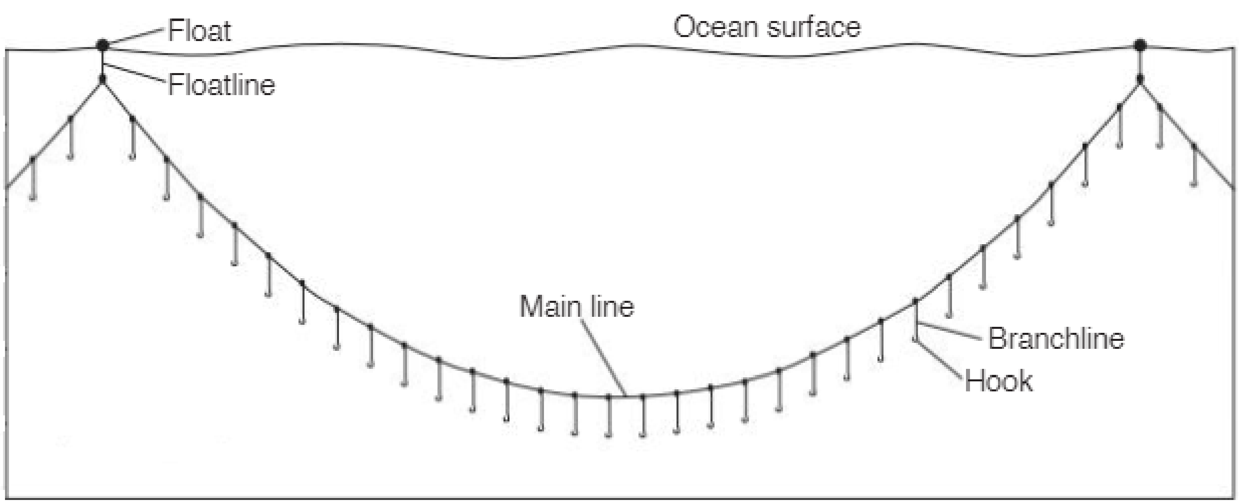
The Council's recommendation for Alternative 2, which would prohibit wire leaders in the Hawaii deep-set longline fishery but not in other longline fisheries operating under the FEP, was based on the determination that a regulatory prohibition for wire leaders is not necessary in other fisheries because wire leaders are only used in the Hawaii deep-set longline fishery. The Hawaii shallow-set and American Samoa longline fisheries already use monofilament nylon by preference, are expected to continue using that material for the foreseeable future, and the Council chose to minimize imposing unnecessary regulations on those fisheries. The Council recommended the requirement for removing trailing gear from oceanic whitetip sharks for all longline vessels operating under the FEP (Sub-Alternative 2B) because all active longline fisheries are known to release sharks with trailing gear.

At the 186th meeting, the Council also considered whether to specify a target length for trailing gear removal, and whether a target length should be required by regulations. The Council recommended that vessel owners and operators should leave the animal in the water, use a dehooker or line clipper or cutters to remove trailing gear from the animal as safely as practicable, and if using a line clipper or cutter, the line should be cut as close to the hook as possible. The Council also recommended that the target for removing trailing gear, if safe to do so, is less than 1 m from the hook on any longline vessel, or below the weighted swivel in the Hawaii deep-set longline fishery.

The Council's recommendation on the specification for trailing gear removal was based on safety considerations, noting that a requirement that line must be cut below a certain length could unnecessarily endanger crew and may also cause more harm to the animal. The length to cut trailing gear was therefore included in the recommendation as a target, rather than a requirement, to ensure that trailing gear removal is done as safely as practicable. The Council also considered existing sea turtle handling requirements, which provides a precedence for requiring gear removal as close as possible to the hook but not requiring a length (50 CFR 665.812(b)); available scientific information indicating minimal difference in survival when comparing between 1 m of trailing gear and none (Hutchinson et al. 2021); and the presence of a weighted swivel within 1 m of hook for the deep-set fishery.

2.2 Summary of Gear Types in the Hawaii and American Samoa Longline Fisheries

Longline gear used in the deep-set fishery is comprised of monofilament mainline stored on a hydraulically-operated drum. Typically, between 30-50 nm of mainline are deployed in a "set." This line is suspended by surface floats to form a series of curves in the water column to which the "branch" lines are attached and suspended (Figure 1). When targeting bigeye tuna, fishermen deploy 15-30 hooks between the line floats, with enough sag to reach as deep as 400 m.



Source: WPFMC 2021

Figure 1. Main components of a set longline.

Prior to 2021, most vessels in the Hawaii deep-set longline fishery used wire leaders in the section of the branch line between the hook and weighted swivel. The swivel is placed within 1 m of the hook due to a requirement to place a weight of at least 45 grams within 1 m of the hook to sink the hook and mitigate seabird interactions (50 CFR 665.815(a)(2)(viii)) (Figure 2). While the weighted branch lines are only required under regulations when fishing north of 23°N, this configuration is used as a standard design in the deep-set fishery regardless of fishing location. As such, the leader portion of the branch line used in the Hawaii deep-set longline fishery is less than 1 m in length. Monofilament nylon is the standard branch line material used above the swivel, and a wire line is not used in the branch line other than as a leader.

Between 2016 and 2020, approximately 97% of Hawaii deep-set longline fishing used wire leaders, with the remaining 3% using monofilament nylon leaders, based on observer data (Figure 3). Most of the observer records for "other" leader material occurred prior to 1997 when vessels may have used material such as twisted monofilament, rope, or braided line, which were more commonly used in the Hawaii longline fishery at the time. The two primary leader materials used in pelagic longline fisheries today are wire and monofilament nylon, and no "other" material has been recorded in the Hawaii deep-set longline fishery in the most recent five year period of 2016-2020. The proportion of vessels using wire leaders versus monofilament leaders has changed in 2021 as a result of the deep-set fishery's ongoing voluntary transition to monofilament leaders. As of November 2021, most of the Hawaii deep-set fishery is using monofilament leaders. Hawaii shallow-set and American Samoa longline fishermen use monofilament nylon leaders by choice.

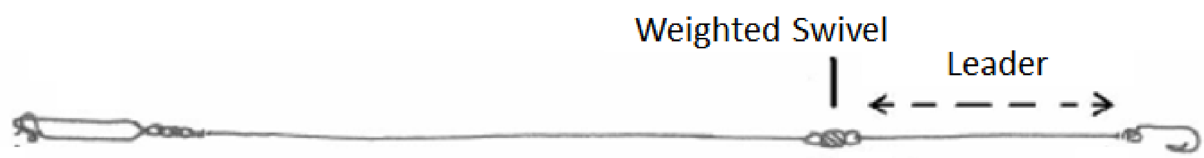


Figure 2. An illustration of a longline branch line with a leader at the terminal end of the gear between the weighted swivel and the hook. In the Hawaii deep-set longline fishery, the weighted swivel is placed within 1m of the hook. Not drawn to scale. Image source: NMFS Pacific Island Regional Office (2017)

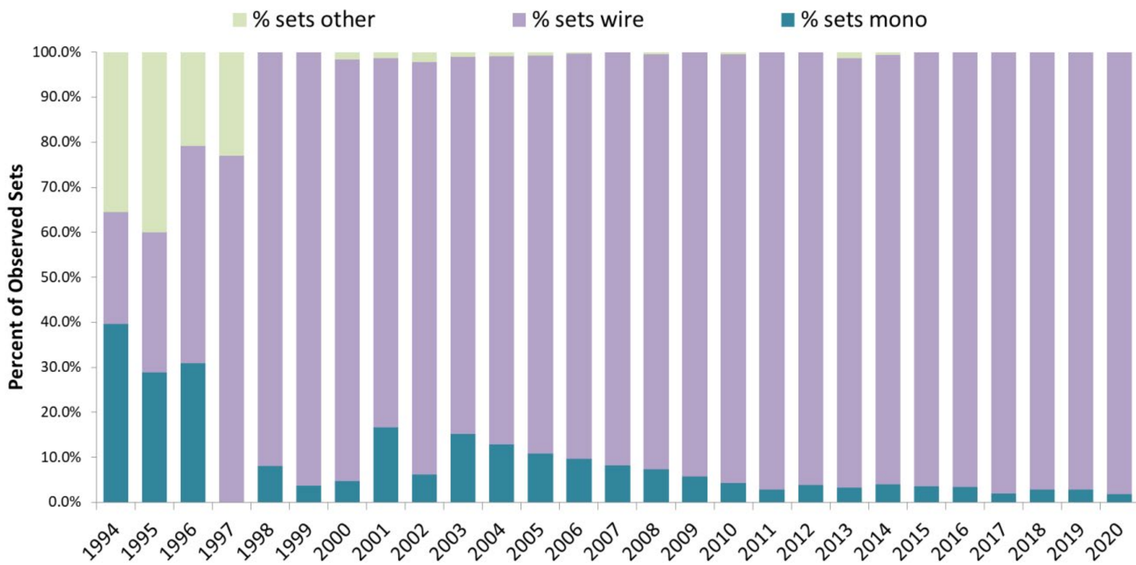


Figure 3. Proportion of observed sets by leader material in the Hawaii deep-set longline fishery, 1994-2020. Source: unpublished observer data.

2.3 Effect of Leader Material on Shark and Other Protected Species Interaction Rates and Survivorship

Analyses in this document are limited to wire and monofilament nylon because these are the primary leader materials used in pelagic longline fisheries today, and most Hawaii deep-set longline vessels are expected to transition to monofilament nylon leaders. Regardless of which alterative is selected, leader material used in the fishery will continue to be monitored through the observer data collection.

Due to the difficulty of cutting through the wire leader from deck height, the average length of trailing gear for shark interactions in the Hawaii deep-set longline fishery is 8.75 m (range: 0-30 m) for all shark species, and 5.44 m (range: 1-12 m) for oceanic whitetip sharks (Hutchinson et al. 2021). Tagging data from the Hawaii and American Samoa longline fisheries indicate that reducing the amount of trailing gear left on sharks increases post-release survivorship (Hutchinson and Bigelow 2019; Hutchinson et al. 2021). When trailing gear is reduced from 14 m to 0 m, the median post-release survival rate for oceanic whitetip sharks increases from 0.89 to 0.96 on wire leaders and from 0.91 to 0.97 on monofilament leaders, based on tagging data at 60-day post-release (Hutchinson et al. 2021). These tagging data indicate that the removal of trailing gear plays an important role in improving post-hooking survival of sharks, and that leaving sharks in the water and removing as much trailing gear as possible by either using a dehooker or cutting the line resulted in the best survival outcomes (Hutchinson et al. 2021).

Sharks may also bite off monofilament nylon leaders, resulting in early release of the animal (Afonso et al. 2012; Ward et al. 2008). Data are lacking on survivorship rates of sharks that escape longline gear after bite-offs, but sharks that escape are more likely to be resilient, healthy sharks (Afonso et al. 2012), and early release from the longline gear would be expected to reduce capture stress and increase survival rates compared to sharks that are released after being brought to the vessel. While speculative, the condition of sharks and fish caught and released using nylon materials may also be less detrimental to survivorship, given the abrasive nature of wire materials. Statistical analysis and modeling simulations conducted by PIFSC indicates oceanic whitetip shark catch may be reduced by approximately 32% and mortality by approximately 30% from bite-offs (Bigelow and Carvalho 2021a; see Section 4.2).

Leader material is not expected to change the initial interaction rate for sharks (Afonso et al. 2012). However, bite-offs with higher survival rates, as well as the ability to remove more gear from the remaining sharks that are brought to the vessel are likely to have a combined effect of reducing impacts to sharks when monofilament nylon leaders are used in place of wire leaders.

Monofilament nylon leaders are more susceptible to damage, abrasion, and bite-offs, which require more frequent repairs and replacement of longline gear. This cost may be offset by increase in target and other fish catch of market value. Studies comparing target catch per unit effort (CPUE) by leader material suggest that catch rates of bigeye tuna are higher on nylon leaders than wire leaders, likely due to some species of fish avoiding the more conspicuous wire leaders (Afonso et al. 2012; Ward et al. 2008, Bigelow and Carvalho 2021a).

Leader material is not known to impact interaction rates of other protected species such as sea turtles, seabirds and marine mammals. However, animals released with trailing gear are likely to have higher post-hooking mortality rate than when released with minimal trailing gear (Ryder et al. 2006). In the Hawaii deep-set longline fishery, larger animals such as leatherback turtles, giant manta rays, and false killer whales that cannot be brought on board are frequently released with trailing gear including the wire leader, weighted swivel, and the monofilament nylon branch line. Similar to sharks, nylon leaders would facilitate removal of trailing gear from these larger animals using long-handled line cutters.

2.4 Description of the Alternatives

This section describes the alternatives for gear and release requirements to improve post-hooking survivorship of oceanic whitetip sharks in the longline fisheries operating under the FEP.

Under all alternatives, all existing gear and release requirements, including weighted branch lines for the Hawaii deep-set longline fishery and sea turtle handling and release requirements for all longline vessels, would remain in place. Observer coverage would remain the same under all alternatives: 100% for Hawaii shallow-set longline fishery and approximately 20% for Hawaii deep-set and American Samoa longline fisheries. NMFS expects HLA members’ voluntary conversion from wire to monofilament leaders to continue under all alternatives.

2.4.1 Alternative 1: No Action (Status Quo/Current Management)

Under Alternative 1, there would be no changes to regulations, and the longline vessels operating under the FEP would not be prohibited from using wire leaders, and would not be required to remove trailing gear from oceanic whitetip sharks. The existing requirements to release any oceanic whitetip sharks as soon as possible in the Western and Central Pacific Fisheries

Commission (WCPFC) convention area under 50 CFR 300.226 and in the Inter-American Tropic Tuna Commission (IATTC) convention area under 50 CFR 300.24 would remain in place.

Expected Fishery Outcomes

For the purpose of analyzing the impacts of the alternatives in this regulatory amendment, the no action alternative assumes that most vessels in the Hawaii deep-set longline fishery would or could continue to use wire leaders as they have in past years. While most vessels in the Hawaii deep-set longline fishery are anticipated to voluntarily transition from wire leaders to monofilament leaders, observer data are not yet available on the extent of the voluntary conversion at this time. As of October 2021, HLA reports that approximately 90% of the deep-set fishery is using monofilament leaders. Without a regulatory requirement prohibiting the use of wire leaders, some vessels may revert to wire leaders over time or may not convert to monofilament nylon leaders, and it is unknown whether the small number of vessels that are not members of the HLA would also eliminate the use of wire leaders. Therefore, the no action alternative assumes a worst-case scenario for the Hawaii deep-set longline fishery in which the leader material would remain the same as the historical baseline. The no action alternative also assumes that the Hawaii shallow-set and American Samoa longline fisheries would continue to use monofilament nylon leaders consistent with the historical baseline.

Under Alternative 1, longline vessels would continue to be managed under existing management measures, which do not include gear or release requirements to improve post-hooking survivorship of oceanic whitetip sharks. In the Hawaii deep-set longline fishery, the continued use of wire leaders by most vessels would minimize the chances that oceanic whitetip sharks may bite or break free of the branch line, and make it more difficult to remove trailing gear when releasing animals due to the difficulty in cutting through wire.

Under Alternative 1, the longline fisheries would likely continue to release oceanic whitetip sharks with trailing gear. Based on observer data collected through a shark tagging study, the average length of the trailing gear left on released sharks in the Hawaii deep-set fishery was 8.75 m (range 0-30 m), 7.74 m (range 1-18 m) for the Hawaii shallow-set fishery, and 2.98 m (range 0-10 m) for the American Samoa fishery (Hutchinson et al. 2021). On average, oceanic whitetip sharks were released with less trailing gear than the amount left for all sharks combined, with an average of 5.44 m (range 1-12 m) left on oceanic whitetip sharks on the Hawaii deep-set fishery, 3 m (range 2-3 m) for the Hawaii shallow-set fishery, and 1.86 m (range 0-3 m) for American Samoa fishery (Hutchinson et al. 2021).

The longline fisheries' effort, target and non-target catch, and other protected species interactions would be expected to remain similar to the historical baseline under Alternative 1. This alternative would not improve post-hooking survival upon release.

2.4.2 Alternative 2: Prohibit Wire Leaders in the Hawaii Deep-set Longline Fishery and Require Removal of Trailing Gear from Oceanic Whitetip Sharks (Council Preferred Alternative)

Under Alternative 2, wire leaders would be prohibited, specifically metal wire line within 1 m of the hook, on vessels operating under a Hawaii longline limited entry permit that declare their trips as deep-set. Leader material information in the Hawaii deep-set fishery would continue to be collected through the observer program to allow monitoring of the proportion of vessels using monofilament nylon or other leader material.

In addition to the existing requirements to release any oceanic whitetip sharks as soon as possible under 50 CFR 300.226 and 50 CFR 300.24, Alternative 2 would require that vessel owners and operators remove trailing gear from oceanic whitetip sharks by leaving the animal in the water, using a dehooker or line clipper or cutters to remove trailing gear from the animal as safely as practicable, and if using a line clipper or cutter, cutting the line as close to the hook as possible. Recommendations on the target length for removing trailing gear (i.e., if safe to do so, cut the line at less than 1 m from the hook on any longline vessel, or below the weighted swivel for Hawaii deep-set vessels) would be included as a best practice in the NMFS Protected Species Workshop, which is an annual requirement for all owners and operators.

At its 186th meeting in June 2021, the Council considered the following sub-alternatives for removing trailing gear and selected Sub-Alternative 2B as preferred:

- **Sub-Alternative 2A:** Require removal of trailing gear only in the Hawaii deep-set longline fishery.
- **Sub-Alternative 2B:** Require removal of trailing gear in all Western Pacific pelagic longline fisheries operating under the FEP **(Council Preferred Sub-Alternative)**

Expected Fishery Outcomes: Sub-Alternative 2A

Under Sub-Alternative 2A, all vessels in the Hawaii deep-set longline fishery would be required to eliminate the use of wire leaders, and Hawaii deep-set longline vessels would also be required to remove trailing gear as safely as practicable. While other non-metal materials may be used for the leader, vessels are expected to transition to monofilament nylon as it is the most common alternative leader material in pelagic longline fisheries. Some or most vessels in the Hawaii deep-set longline fishery are anticipated to voluntarily transition from wire leaders to monofilament leaders in advance of the regulatory requirement. As of October 2021, HLA reported that approximately 90% of the Hawaii deep-set fishery is using monofilament leaders. Any vessels that do not transition voluntarily would be required to eliminate wire leaders from their branch lines when the regulatory requirement is implemented. Compared to Alternative 1, the regulatory amendment would ensure that all vessels in the fishery stop using wire leaders once the regulation is effective, and would help ensure that fishery participants do not revert to using wire leaders.

Leader material is not expected to change the initial interaction rate for sharks (Afonso et al. 2012). However, eliminating wire leaders and requiring removal of trailing gear in the Hawaii deep-set longline fishery are expected to result in higher bite-off rates of oceanic whitetip sharks and facilitate fishermen removing trailing gear closer to the hook. Both of these outcomes would reduce the mortality of oceanic whitetip sharks in the fishery. Based on the analysis and modeling conducted by PIFSC this year, oceanic whitetip shark catch at retrieval may be reduced by approximately 32% from bite-offs (median estimate of 1,708 individuals under status quo compared to 1,153 under monofilament nylon leaders) and mortality by approximately 30% from bite-offs and reduced post-release mortality (median estimate of 362 mortalities in the Hawaii deep-set longline fishery under status quo compared to 255 under monofilament nylon leaders) (Bigelow and Carvalho 2021a; see Section 4.2). The modeling assumed that the trailing gear would be reduced from an average of approximately 10 m to removal of all trailing gear (0 m). Tagging data indicate that post-release survivorship of sharks are similar (0-1% difference) when released with 1 m of trailing gear compared to no (0 m) trailing gear (Hutchinson et al. 2021), thus the simulation results for the Hawaii deep-set longline fishery provides a reasonable estimate of the best case expected outcomes under Sub-Alternative 2A.

The improved ability to cut monofilament leader is expected to also facilitate fishermen removing trailing gear closer to the hook, which is expected to have benefits for other large protected species incidentally captured in the fishery that cannot be brought on board the vessel, such as leatherback sea turtles, giant manta rays, and false killer whales. The extent of reduced impacts from trailing gear removal would depend on the effectiveness of NMFS, Council, and industry outreach and training efforts. The gear and release requirements under Sub-Alternative 2A are not expected to affect the interaction rates of any protected species, and are likely to have minimal effects on the removal of trailing gear for protected species small enough to be brought on board.

PIFSC estimated that the transition from wire to monofilament leaders in the Hawaii deep-set fishery would have a statistically significant effect on catchability for some retained species, but would have an overall negligible effect on fishery economic revenue (Bigelow and Carvalho 2021a). Specifically, albacore tuna, skipjack tuna, and mahimahi were estimated to have statistically lower catchability on monofilament leaders, whereas swordfish was estimated to have statistically higher catchability on monofilament leaders. Catchability of bigeye and yellowfin tunas are expected to be slightly higher on monofilament leaders, and striped marlin slightly lower, although the results for these species were not statistically significant. PIFSC estimated the economic impact in the Hawaii deep-set fishery from a transition to monofilament leaders based on these changes in catchability as a mean increase of $2.7 million annually, or about $18,000 per vessel. This estimate was based solely on the changes in target and non-target catch, and did not include the cost associated with gear replacement and repairs. Monofilament leaders are more susceptible to damage, abrasion, and bite-offs, which require more frequent repairs and replacement of longline gear. However, monofilament is less expensive than wire.

The extent to which changes in target and non-target CPUE resulting from the leader material conversion would affect overall effort of the deep-set longline fishery is unknown and has not been quantified. However, the Hawaii deep-set longline fishery operates under a bigeye tuna quota, and any increase in overall bigeye tuna catch would remain within approved catch and transfer limits.

Under Sub-Alternative 2A, the Hawaii shallow-set and American Samoa longline fisheries would not be prohibited from using wire leaders, but we anticipate these fisheries to continue using monofilament leaders consistent with the historical baseline due to their preference for monofilament and the absence of a weighted branch line requirement.

Expected Fishery Outcomes: Sub-Alternative 2B (Council Preferred Sub-Alternative)

Under Sub-Alternative 2B, all vessels in the Hawaii deep-set longline fishery would be required to eliminate wire leaders, and all Western Pacific pelagic longline fisheries operating under the FEP would be required to remove trailing gear as safely as practicable. Sub-Alternative 2B is expected to have similar outcomes as Sub-Alternative 2A because the American Samoa and Hawaii shallow-set longline fisheries are currently using monofilament nylon leaders.

Extending the requirement for removing trailing gear to all Western Pacific pelagic longline vessels, compared to Hawaii deep-set vessels only, is expected to have a relatively small effect on reducing post-hooking mortality of oceanic whitetip sharks (2-6%, Hutchinson et al. 2021). This is because the Hawaii shallow-set and American Samoa longline fisheries already use monofilament leaders and are not expected to see any additional reduction in mortality from bite-offs, and thus the reduction in mortality would only be expected from the changes to the amount of trailing gear removed. The application of such a requirement in all U.S. pelagic longline fisheries in the Western Pacific is expected to help promote adoption of internationally binding handling measures at the Regional Fishery Management Organizations (RFMOs) to appreciably reduce the mortality of oceanic whitetip sharks in international longline fisheries.

2.4.3 Alternative 3: Prohibit Wire Leaders and Require Removal of Trailing Gear from Oceanic Whitetip Sharks in All Western Pacific Pelagic Longline Fisheries

Under Alternative 3, regulations would prohibit wire leaders and require trailing gear removal from oceanic whitetip sharks for all vessels operating under the FEP.

Expected Fishery Outcomes

The expected outcomes for Alternative 3 would be similar to Alternative 2, Sub-Alternative 2B primarily because a regulation prohibiting wire leaders would not change gear use in the American Samoa deep-set and Hawaii shallow-set longline fisheries. Currently, the Hawaii deep-set longline fishery is the only longline fishery under the FEP that uses wire leaders, whereas the Hawaii shallow-set and American Samoa longline vessels use monofilament leaders. There are currently no active vessels operating under the Western Pacific general longline permit. Therefore, prohibition of wire leaders applicable to all longline fisheries under the FEP would not change the practice of the Hawaii shallow-set and American Samoa fisheries, and would not affect any Western Pacific general longline vessels, but could serve as a preventative measure to prohibit any wire leaders in the future. Costs to fishermen and changes to catch rates would also be the same as Alternative 2, Sub-Alternative 2A, because the only fishery that would change gear would be the Hawaii deep-set longline fishery.

Applying the requirement to remove gear to all Western Pacific longline fisheries would reduce fishery impacts to oceanic whitetip sharks comparable to Alt 2, Sub-Alt 2B, and could help promote adoption of handling measures to appreciably reduce the mortality of oceanic whitetip sharks in international longline fisheries.

2.5 Alternatives Considered, but Rejected from Further Analysis

Alternatives that were eliminated from further analysis are described below.

Removal of Shallow Hooks

This alternative would have considered the removal of one or more shallowest hooks from each basket (section between longline floats). Oceanic whitetip sharks tend to have higher catch rates on the shallowest hooks of longline gear. Recent PIFSC analysis (Bigelow and Carvalho 2021a) indicates that approximately 41% of oceanic whitetip shark catch in the Hawaii deep-set longline fishery occurs on the three shallowest hooks on each side of the basket (for a total of six hooks out of an average of 25 hooks per float) while approximately 20% of the effort occurs on those hooks. Removal of shallow hooks is difficult to operationalize and enforce, as the branch line positions depend in part on the amount of time elapsed between the deployment of the float and when the first branch line is clipped onto the mainline. Hook depth may also be affected by shoaling and other oceanographic factors. It is unknown if oceanic whitetip shark catch would move to the next shallowest hook.

The American Samoa longline fishery operates under a gear configuration requirement that was intended to reposition the shallowest branch lines to deeper depths by specifying the float line length, branch line length, and the distance between the float line and the closest branch lines. This measure was implemented in 2011 for the purpose of reducing sea turtle interactions. While a full evaluation of the measure has not yet been conducted due to the low sample size of sea turtle interactions, oceanic whitetip shark catch rates in the fishery did not decline following implementation.

Additionally, removal of shallow hooks may also affect catch rates of other economically important species. The PIFSC analysis indicated that potential changes in target and non-target catch rates may reduce revenue in the Hawaii deep-set longline fishery by $11-13 million. Such levels of economic impact would be inconsistent with the purpose and need of the action to increase the post-hooking survival of oceanic whitetip sharks while minimizing negative economic impacts to the affected fishery.

Non-stainless Steel or Corrodible Hooks

This alternative would have considered the use of corrodible or non-stainless steel hooks to facilitate earlier hook shedding by oceanic whitetip sharks. While non-stainless steel hooks are likely to degrade faster than stainless steel hooks, there is limited scientific information available to evaluate the effect of hook corrosion on the post-hooking survival rate of oceanic whitetip sharks. Available shark tagging data indicate that the post-hooking survival rate of oceanic whitetip shark is similar when released with 1 m of trailing gear and no trailing gear

(Hutchinson, et al. 2021), suggesting that the effect of a remaining hook in the mouth may be minimal compared to removing as much trailing gear as possible. Additionally, non-stainless steel hooks would need to be replaced more frequently compared to stainless steel hooks, which may result in negative economic impacts to the affected fisheries from increased gear replacement cost and potential reduction in catch. Therefore, this alternative was not considered further as it does not meet the purpose and need of the action.

Circle hooks for the American Samoa Longline Fishery

This alternative would have considered a regulatory requirement for circle hooks in the American Samoa longline fishery. The Hawaii shallow-set and deep-set longline fisheries are required under regulations to use circle hooks, but there is no hook type requirement for the American Samoa longline fishery. However, all vessels in the fishery use circle hooks by preference, and thus a regulatory requirement would not result in any additional improvements to oceanic whitetip shark survival rate in the American Samoa longline fishery.

Spatial and Temporal Management Measures

This alternative would have considered spatial and temporal management measures such as time-area closures or move-on rules. The Council at its 182nd meeting in June 2020 considered potential management measures to address impacts to several ESA-listed species of concern, including oceanic whitetip sharks, leatherback turtles, and giant manta rays. The Council recommended that priority be placed on improving handling and release methods to improve post-hooking survival rate over other measures including spatial and temporal measures. The Council also determined that development of time-area closures or move-on rules should consider tradeoffs of target catch and protected species interactions as well as potential impacts of effort displacement, but such an evaluation is premature until appropriate tools to evaluate those impacts are available. Several projects are underway (e.g., PIFSC Ecosystem-based Fishery Management (EBFM) project on longline bycatch covariates) to evaluate potential impacts of effort removal/redistribution from closed areas on fishery performance.

3 DESCRIPTION OF THE AFFECTED ENVIRONMENT

3.1 Target and Non-Target Stocks

This section identifies the pelagic management unit species (MUS) managed under the FEP that the two Hawaii and one American Samoa longline fisheries harvest. They include several species of tuna, billfish and sharks shown in Table 1. For a comprehensive discussion of the biology, life history, and factors which affect distribution and abundance of pelagic MUS, see the FEP (WPFMC 2009a). Recent catch data for these three longline fisheries is summarized in Section 3.1.13, with additional details available in the 2020 Annual Stock Assessment and Fishery Ecosystem (SAFE) Report (WPFMC 2021). The 2020 SAFE report contains a detailed summary of the environment affected by this action, and is incorporated here by reference.

The FEP (WPFMC 2009a) includes status determination criteria (SDC), also known as limit reference points (LRPs) for overfishing and overfished conditions. Specifically, overfishing occurs when the fishing mortality rate (F) for one or more years is greater than the maximum fishing mortality threshold (MFMT), which is the fishing mortality rate that produces maximum sustainable yield (F). Thus, if the F/F_{MSY} ratio is greater than 1.0, overfishing is occurring.

A stock is considered overfished when its total biomass (B) declines below the minimum stock size threshold (MSST), or the level that jeopardizes the capacity of the stock to produce MSY on a continuing basis (B_{MSY}). Specifically, the $B_{MMST} = (1\text{-}M)B_{MSY}$, where M is the natural mortality rate of the stock, or one half of B_{MSY}, whichever is greater. For example, if the natural mortality rate of a stock is 0.35, $B_{MSST} = 0.65*B_{MSY}$. Thus, if the B/B_{MSY} ratio for the stock falls below 0.65, the stock is overfished. If a stock has a natural mortality rate greater than 0.6, MSST is set at the default of $0.5*B_{MSY}$ (because 1- 0.6 = 0.4, and 0.5 is greater than 0.4). For such a stock, the stock is overfished when the B/B_{MSY} ratio falls below 0.5. It is important to note that NMFS National Standard 1 guidelines at 50 CFR 665.310(e)(1)(i)(C) defines B_{MSY} as the long-term average size of the stock measured in terms of spawning biomass (SB) or other appropriate measure of the stock's reproductive potential that would be achieved by fishing at B_{MSY}. Thus, whenever available, NMFS will use estimates of SB in determining the status of a stock. When estimates of SB are not available, NMFS may use estimates of B, or other reasonable proxies for determining stock status.

Table 1 shows the stock status of pelagic MUS measured against the SDCs of the FEP, based on the most recent stock assessment for the stock at the time of this publication. Section 3.5 describes the NMFS stock status determination process. The current status of the stock represents the best scientific information available regarding the effects of past and present actions on the target and non-target stocks.

For some pelagic MUS, the SDC specified in the FEP differs from the SDC or LRPs adopted by the WCPFC and IATTC. Additionally, in some cases, the LRPs adopted by the WCPFC for a particular stock of fish differs from the LRPs adopted by the IATTC. Finally, in other cases, no stock assessments are available and fishery management organizations must infer stock status from other indicators or not at all. For the purposes of stock status determinations, NMFS uses the SDCs specified in the FEP.

Table 1. Stock status of pelagic management unit species under the FEP.

Stock	Is overfishing occurring?	Is the stock overfished?	Assessment results
Skipjack Tuna (WCPO)	No	No	Vincent et al. (2019)
Skipjack Tuna (EPO)	No	No	Maunder (2018)
Yellowfin Tuna (WCPO)	No	No	Vincent, et al 2020
Yellowfin Tuna (EPO)	No	No	Minte-Vera et al. (2020)
Albacore (S. Pacific)	No	No	Tremblay-Boyer et al. (2018)
Albacore (N. Pacific)	No	No	ISC (2017b)
Bigeye Tuna (WCPO)	No	No	Ducharme-Barth et al. (2020)
Bigeye Tuna (EPO)	Yes	No	Aires-da-Silva et al (2018)
Pacific Bluefin Tuna	Yes	Yes	ISC (2018a)
Blue Marlin (Pacific)	No	No	ISC (2016)
Swordfish (WCNPO)	No	No	ISC (2018b)

Stock	Is overfishing occurring?	Is the stock overfished?	Assessment results
Swordfish (EPO)	Yes	No	ISC (2014)
Striped Marlin WC (N. Pacific)	Yes	Yes	ISC (2019)
Striped Marlin (NEPO)	No	No	Hinton and Maunder (2011)
Blue Shark (N. Pacific)	No	No	ISC (2017a)
Oceanic white-tip shark (WCPO)	Yes	Yes	Tremblay-Boyer et al. (2019)
Silky shark (WCPO)	Yes	No	Clarke et al. (2018)
Silky Shark (EPO)	Yes	No	Lennert-Cody et al. (2018)
Shortfin mako shark (N. Pacific)	No	No	ISC (2018c)
Common thresher shark (N. Pacific)	No	No	Teo et al. (2018)
Other Billfishes[1]	Unknown	Unknown	--
Other Pelagic Sharks[2]	Unknown	Unknown	--
Other PMUS[3]	Unknown	Unknown	--

[1]Black Marlin (Pacific), Shortbill Spearfish (Pacific), Sailfish (Pacific)
[2]Longfin Mako Shark (N. Pacific), Bigeye Thresher Shark (N. Pacific), Pelagic Thresher Shark (N. Pacific), Salmon Shark (N. Pacific)
[3]Dolphinfish (Pacific), Wahoo (Pacific), Opah (Pacific), Pomfret (family *Bramidae*, W. Pacific), Kawakawa (Pacific), Oilfish (family *Gempylidae*, Pacific), other tuna relatives *(Auxis* spp., *Allothunnus* spp., and *Scomber* spp, Pacific), Squids (Pacific)

3.1.1 Oceanic Whitetip Shark stock status overview

The 15th Science Committee of the WCPFC (SC15) reviewed the 2019 stock assessment of the Western and Central Pacific (WCPO) oceanic whitetip shark from an assessment using data from 1995 to 2016 (Tremblay-Boyer et al. 2019). The median values of relative 'recent' (2013-2016) spawning biomass ($SB_{recent}/SB_{F=0}$, SB_{recent}/SB_{MSY}) and relative recent fishing mortality (F_{recent}/F_{MSY}) over a series of model configurations were used to measure the central tendency of stock status. The span of the 'recent' time period was determined to only included years following the adoption of WCPFC CMM-2011-04; CMM-2011-04 was a binding measure prohibiting the retention of oceanic whitetip sharks, or associated parts (including fins) across all fisheries under WCPFC jurisdiction, effective January 1, 2013. The measure also required safe release of oceanic whitetip sharks and for observer programs to record the condition of sharks encountered in WCPFC fisheries. Tremblay-Boyer et al. (2019) was the first assessment since the adoption of CMM-2011-04. The 2019 stock assessment included an ensemble of model configurations, otherwise known as the uncertainty grid, which examined two scenarios of growth and fecundity, six catch history scenarios, three scenarios for initial fishing mortality, three scenarios for steepness in a spawner-recruit relationship, three scenarios of natural mortality, and two scenarios of recruitment, leading to 648 model runs.

Prior to the 2019 assessment, Rice and Harley (2012) assessed the stock using data from 1995 to 2009, noting uncertainty in historical catches and the initial condition of the stock prior to 1995 and the reliance on sparse observer data. Rice and Harley (2012) utilized an age-structured model, assuming a single aggregated regional structure, and accounted for both sexes. Rice and

Harley (2012) found the stock to be overfished relative to MSY, with spawning stock to be 15.3% of the spawning stock at MSY levels and overfished with relative fishing mortality to be 6.5 times fishing mortality at MSY levels. The assessment by Rice and Harley (2012) used three sources of data: historical catches (estimated and observed), time series of catch-per-unit-effort, and length frequencies. They assumed a four-fleet structure, splitting the longline fishery into bycatch and target fleets, and the purse seine fishery into fleets of associated (fish aggregating devices) and unassociated sets. US longline fisheries (American Samoa and the Hawaii-based deep-set, shallow-set sectors) are considered bycatch fleets.

Tremblay-Boyer et al. (2019) used similar model structures, data sources and fleet structures as the previous assessment, and found that the recent median level of SB depletion from the ensemble of stock assessment model configurations was $SB_{recent}/SB_0 = 0.04$ with a probable range of 0.03 to 0.05 (80% probability interval), with median values of SB to be well below commonly used WCPFC limit reference points. The median level of recent SB relative to that leading to MSY was $SB_{recent}/SB_{MSY} = 0.09$ (range: 0.05–0.17). The assessment found that overfishing is still occurring and the stock is still in an overfished state relative to MSY reference points (as prescribed by the FEP) and depletion-based reference points commonly used by the WCPFC. Like Harley and Rice (2012), Tremblay-Boyer et al. (2019) noted there was extinction risk if fishing mortality rates remain high. The most recent assessment estimated fishing mortality to be, on average, 4.2 times MSY levels, still much higher than sustainable, but a decrease in fishing mortality estimates since the last assessment (Rice and Harley 2012). Table 2 provides a summary of outputs and reference points from the 2019 stock assessment.

Table 2. Summary of reference points for oceanic whitetip shark from the most recent stock assessment.

	Mean	Median	Min	10%	90%	Max
C_{latest}	2464	2159	681	1002	4559	9233
C_{recent}	3007	2689	893	1311	5264	10348
MSY	7055	6052	1774	3036	11878	19122
SB_0	10387	8385	1510	3603	20148	34572
SB_{MSY}	4357	3433	523	1420	8524	15593
SB_{latest}	393	314	43	110	793	1217
SB_{recent}	404	324	36	106	795	1616
SB_{latest}/SB_0	0.04	0.04	0.02	0.03	0.05	0.07
SB_{recent}/SB_0	0.04	0.04	0.02	0.03	0.05	0.08
$SB_{latest}/SB_{\mathrm{MSY}}$	0.09	0.09	0.05	0.06	0.13	0.16
$SB_{recent}/SB_{\mathrm{MSY}}$	0.09	0.09	0.05	0.07	0.12	0.17
F_{MSY}	0.056	0.054	0.026	0.037	0.088	0.116
$F_{lim,\mathrm{AS}}$	0.089	0.083	0.041	0.058	0.137	0.183
$F_{crash,\mathrm{AS}}$	0.138	0.123	0.060	0.084	0.208	0.290
F_{latest}	0.194	0.171	0.096	0.116	0.335	0.473
F_{recent}	0.216	0.205	0.136	0.165	0.288	0.395
$F_{latest}/F_{\mathrm{MSY}}$	3.78	3.30	1.09	1.96	6.55	12.07
$F_{recent}/F_{\mathrm{MSY}}$	4.17	3.94	1.81	2.67	5.89	9.88
$F_{latest}/F_{lim,\mathrm{AS}}$	2.40	2.10	0.69	1.23	4.10	7.73
$F_{recent}/F_{lim,\mathrm{AS}}$	2.64	2.51	1.15	1.68	3.73	6.33
$F_{latest}/F_{crash,\mathrm{AS}}$	1.57	1.38	0.44	0.76	2.70	5.26
$F_{recent}/F_{crash,\mathrm{AS}}$	1.73	1.64	0.72	1.05	2.48	4.31

Source: (Tremblay-Boyer et al., 2019).

On May 4, 2020, the Council was notified by NMFS of the overfished and overfishing status based on the best scientific information available and of its obligations to take action within one year of that notice, pursuant to the MSA Section 304(e) and 304(i). This notification indicated the relative impact, based on catch history from 2013 to 2017 relative to estimates of total WCPO catch and effort from Peatman et al. (2018), estimated average annual catch over this period in the American Samoa longline fishery to be 617 individuals, or 1.7% of deep-set catch in the WCPO. In the Hawaii deep-set longline fishery, average annual catch from 2013 to 2017 was 1,725 individuals, or 4.8% of the estimated total deep-set catch in the WCPO. In the Hawaii shallow-set longline fishery, catch was 26 individuals, or 0.15% of estimated shallow-set longline catch in the WCPO.

Stock projections under future catch scenarios (up to 2032) were conducted by Rice et al. (2021) to estimate future biomass, spawning potential, and future US impacts on the stock based on possible catch scenarios. Stock projections considered a myriad of biological parameterization scenarios – including initial fishing mortality, natural mortality, steepness (recruitment response at low population size), and life history (age/growth and maturity) as utilized by Tremblay-Boyer et al. (2019). The projections also consider plausible catch histories and post-release mortality rates, with 43% of catch mortality being determined to be the most plausible per Hutchinson and Bigelow (2019). Future catch trajectories include 2016 ('status quo') catches, catches corresponding to 10% reduction from 2016 to 2020, catches corresponding to 20% reduction from 2016 to 2020, and no catch into the future (Figure 8). Catch trajectories corresponding to 10% and 20% reductions from 2016 catch levels correspond to independent estimates of catches for 2017 and 2018 (Peatman and Nicol, 2020; Table 3). Rice et al. (2021) indicated that projected biomass trajectories under scenarios of 10% and 20% catch reductions from 2016 are likely to lead to stock recovery (Figure 5).

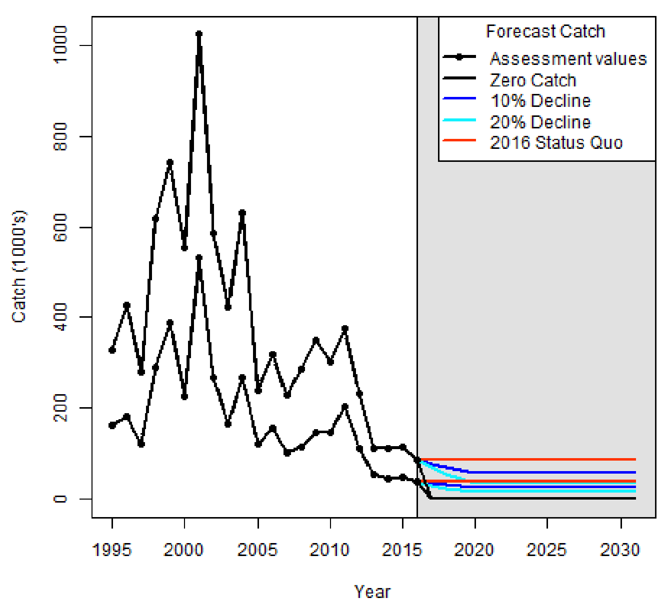


Figure 4. Assessment catch values (dotted line) under the high catch resulting from a higher assumed post-release mortality (upper line) and median catch from median post-release mortality assumptions with forecast catch under zero catch, the 10 %, 20% decline and 2016 status quo catch scenarios.

Table 3. Annual oceanic whitetip shark catch estimates ('000s individuals, 95% CIs in parentheses) for the WCPFC Convention area) and proportional difference in estimated catches relative to terminal year (2016) in 2019 assessment.

Year	Oceanic Whitetip Shark Catch	Proportional Difference Relative to 2016 Catch
2009	70.7 (50.7-100.0)	+88%
2010	68.8 (42.2-111.6)	+82%
2011	68.7 (46.6-103.2)	+82%
2012	69.2 (49.1-101.0)	+84%
2013	49.0 (37.6-65.4)	+30%
2014	42.8 (34.1-55.3)	+14%
2015	49.7 (39.1-65.4)	+32%
2016	37.7 (30.8-46.9)	--
2017	32.3 (27.2-38.9)	-14%
2018	27.6 (22.2-34.3)	-27%

Source: Peatman and Nicol (2020)

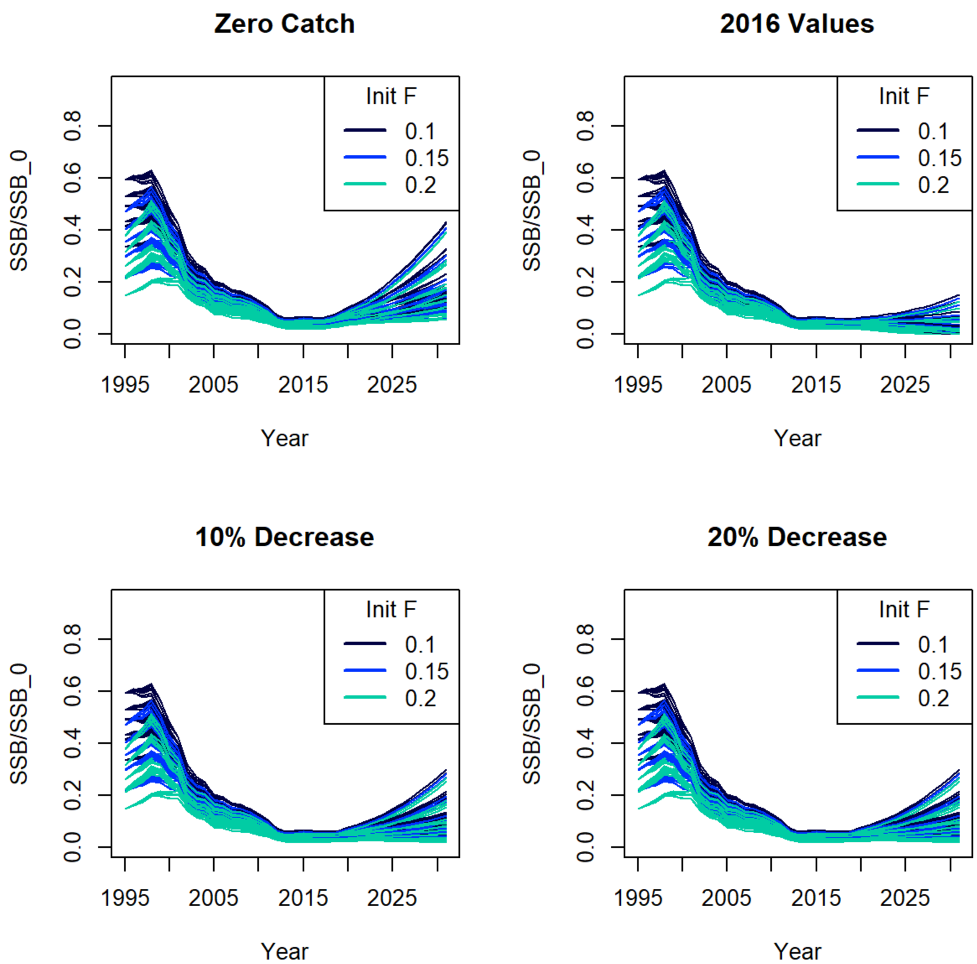


Figure 5. Projected biomass depletion under a zero catch scenario, the 2016 status quo catch, a 10% decline from 2016, and a 20% decline from 2016. Model runs are colored by the initial condition of fishing mortality assumed in 1995 (Rice et al. 2021).

Rice et al. (2021) also examined the impact of the U.S. longline fisheries, including the American Samoa longline fishery, the Hawaii deep-set fishery, and Hawaii shallow-set fishery into the future. The estimates of the U.S. total catches came from the PIFSC Data Reports (McCracken 2018, 2019a, 2019b) total approximately 2,400 individuals with significant interannual variability. These values are based on the total U.S. longline catches, and would be subject to a total mortality rate of 42.23%. The total estimate of the mortalities due to U.S. longline fisheries is therefore 1,014 (2,400 * 0.4223), of which 721 would be from the Hawaii deep-set longline fishery (Table 4). U.S. longline impacts on spawning potential in projections in the future to 2031 were about 1.2% with 0.8% attributed to the Hawaii deep-set fishery (Figure 6). Zero mortality of oceanic whitetip sharks in all U.S. fisheries for 17 years may lead to a 4% increase in stock biomass by 2034 (Figure 7). This underlines the small relative impact of the U.S. compared to other fisheries and relative to stock size.

Table 4. Estimates of the catch in different sectors of the US longline fishery (Rice et al., 2021)

Fishery	Estimated Catch	Estimated Mortality
DS - LL	1708	721
AS - LL	620	262
SH - LL	72	30
Total	2400	1014

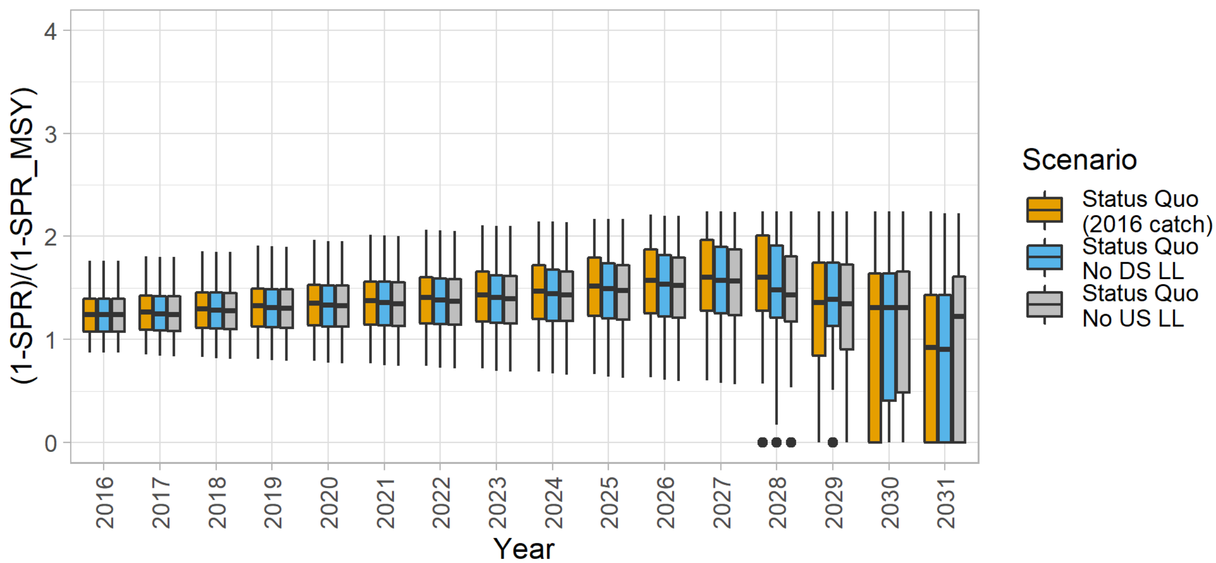


Figure 6. Ratios of spawning potential relative to spawning potential at MSY calculated as (1-SPR)/(1-SPR$_{MSY}$) projected using the status quo catch (2016 values carried forward, in orange) and assuming the 2016 catches without the US longline catches (in grey), and without the DS LL catches (in blue). Higher values indicate higher exploitation. From: Rice et al. (2021)

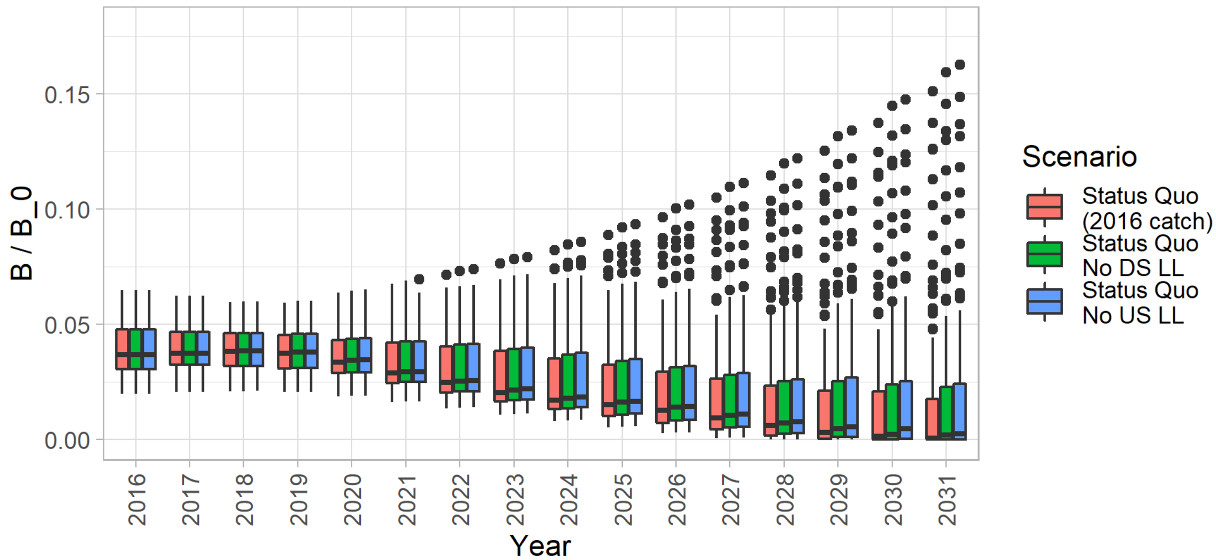


Figure 7. Biomass ratio (B/B_0) over time for the runs using the status quo catch (2016 values carried forward, in red) and assuming the 2016 catches without the US longline catches (in teal) and the 2016 catches without the DS LL catch (in green). From: Rice et al. (2021).

Rice et al. (2021) indicated the implementation of CMM-2011-04 has led to decreased fishing mortality, thus likely leading to future stock recovery based on probable catch scenarios. Rice et al. (2021) also concluded U.S. impacts, under more pessimistic scenarios of future catch, are projected to be 4% of total mortality.

In summary, U.S. Pacific longline fisheries under the FEP are fishing according to international conservation and management measures, but stock recovery has not yet been observed, and the outlook for the stock given by the most recent stock assessment is grave. There is some hope that past conservation and management efforts will improve the situation of the stock in the near term, but additional management measures to improve post hooking mortality would benefit the stock.

3.1.2 Striped Marlin

Internationally, striped marlin in the Pacific is comprised of three stocks: Southwest Pacific Ocean, Western and Central North Pacific Ocean (WCNPO), and North East Pacific Ocean (NEPO). Stock assessments are available for the WCNPO stock (ISC 2019) and the NEPO stock (Hinton and Maunder 2011).

Results of a 2019 stock assessment (ISC 2019) indicate the WCNPO stock of striped marlin continues to be subject to overfishing (F/F_{MSY} is =1.49) and is overfished (SB/SB_{MSY} = 0.39). The 2019 stock assessment estimated MSY at 4,946 tons (t). CMM 2010-01 for North Pacific striped marlin adopted by the WCPFC requires members and cooperating non-members to limit striped marlin landings by all gears from their highest catches from 2000-2003, and then further reduce catches by 10% in 2011, 15% in 2012, and 20% in 2013. The Small Island Developing States and Participating Territories are exempt from catch limits under the measure. The highest striped marlin catch by U.S. fisheries between 2000 and 2003 was 571 t. Thus, a 20% reduction from 571 t is 457 t. The Hawaii longline fishery accounts for more than 90% of the total U.S. catch of this stock, with the remainder made by Hawaii small-scale troll fisheries. The total landings of WCNPO striped marlin by all U.S. fisheries combined have never exceeded 425 t (WPFMC 2021).

In 2019, total WCNPO striped marlin (or striped marlin caught in the WCPO) landings by all U.S. fisheries was 336 t, with the Hawaii longline fisheries accounting for 286 t, the American Samoa longline fishery accounting for 48 t, and the Hawaii troll fisheries accounting for 8 t (WPFMC 2021) or about 6% of MSY for all U.S. fisheries. Thus, overfishing of the stock is due to excessive international fishing pressure and the IATTC and WCPFC have inadequate measures in place to address the issue. On June 4, 2020, the Council was notified by NMFS of the overfished and overfishing status of WCPO striped marlin based on best scientific information available and of its obligations to take action within one year of that notice, pursuant to the MSA Section 304(e) and 304(i). This notification indicated the average relative impact of U.S. fisheries, from 2011 to 2017, was 15% of total WCPFC catch. NMFS continues to work with the Pacific and Western Pacific Fishery Management Councils, and the State Department to ensure that the WCPFC and IATTC adopt effective management measures to end overfishing.

In the NEPO, results of the 2011 stock assessment (Hinton and Maunder 2011) indicate that the NEPO striped marlin stock is not overfished or experiencing overfishing. The stock biomass has increased from a low of about 2,600 t in 2003, and was estimated to be about 5,100 t in 2009. There has been an increasing trend in the estimated ratio of the observed annual SB to the SB in the unexploited stock, which has doubled from about 0.19 in 2003 to about 0.38 in 2009. The estimated ratio of SB in 2009 to that expected to provide catch at the level of MSY, SB_{2009}/SB_{MSY}, was about 1.5, which indicates that the SB biomass was above the level expected to support MSY. The estimated recent levels of fishing effort (average 2007-2009) were below those expected at MSY (Hinton and Maunder 2011). As this assessment is dated, the current status of the NEPO stock is unknown. Between 2013 and 2019, Hawaii longline catches of NEPO striped marlin (or striped marlin caught in the EPO) ranged between 63 and 77 t annually, which was no greater than 3% of the stock's biomass as of the previous assessment (WPFMC 2020).

3.1.3 Silky Shark

Silky sharks have a restricted habitat range compared to the other highly migratory species but within this range, they dominate both longline and purse seine catches (Rice and Harley 2013). Stock boundaries within the species are not clearly resolved, which complicates development of a pan-Pacific assessment model (Clarke et al. 2018a). Additionally, CPUE indices from WCPO and EPO fisheries show correlations with oceanographic conditions, so may not represent reliable indices of abundance and may bias indicators of stock status (Clarke et al. 2018a; Lennert-Cody et al. 2018). Based on apparent declines and in the absence of better scientific information, both the WCPFC and the IATTC implemented precautionary measures to prohibit vessels from retaining any part or carcass of a silky shark, except to assist WCPFC observers in collection of samples. A pan-Pacific assessment was completed in 2018, but the authors cautioned that estimates of stock status reference points for determining whether the stock is experiencing overfishing or is overfished are unreliable and should not be used as the basis for management advice (Clarke et al. 2018a), and a separate assessment for the WCPO stock only was developed and accepted at the 2018 WCPFC Science Committee meeting (Clarke et al. 2018b). That assessment (Clark et al 2018b) concluded that the WCPO silky shark stock is not currently overfished, but is experiencing overfishing.

On September 28, 2020, NMFS declared the WCPO-specific stock assessment (Clark et al. 2018b) as best scientific information available for WCPO silky shark. On October 20, 2020, NMFS notified Council to, within one year, to 1) develop and submit recommendations for domestic regulations to address the relative impact of U.S. fishing vessels on silky shark in the WCPO and 2) develop and submit recommendations for international actions that will end overfishing of WCPO silky shark, taking into account the relative impact of vessels of the United States and other nations. Domestic non-retention regulations have been in place since 2015 (80 FR 8807).

Estimates of total WCPO silky shark catch from observer data (Peatman et al. 2018) and market data (Clarke et al. 2018a) suggest that the proportion of WCPO catch attributable to U.S. longline fisheries is less than 1% (range 0.2 – 2.0%).

3.1.4 Bigeye Tuna

The Secretariat of the Pacific Community (SPC) prepared the most recent stock assessment for WCPO bigeye tuna in August 2020, which covers bigeye tuna from Indonesia in the far western Pacific, to the 150° W meridian in the central Pacific Ocean (Ducharme-Barth, 2020). The WCPFC Scientific Committee (SC) reviewed and endorsed the 2020 bigeye stock assessment at its Sixteenth Regular Session (SC16) as the most advanced and comprehensive assessment yet conducted for this species. SC16 also endorsed the use of the assessment model uncertainty grid as best available scientific information to characterize stock status and management advice. SC16 recommended retaining only model runs with newest growth information, comprising 24 model configurations and noted variance in the assessment results with respect to regional stock structure. The resulting uncertainty grid was used to characterize stock status, to summarize reference points and to calculate the probability of breaching the Commission-adopted SB limit reference point ($0.2*SB_{F=0}$) and the probability of F_{recent} being greater than F_{MSY}.

Based on the uncertainty grid adopted by SC16, recent WCPO bigeye tuna SB is likely above the MSST of the FEP and the WCPFC's biomass LRP. Recent SB was estimated to be $0.41*SB_{F=0}$. Additionally, recent F is likely below F_{MSY} (MFMT) with median F_{recent}/F_{MSY} estimated to be 0.72. The assessment suggests the WCPO bigeye stock is not experiencing overfishing (100% probability, 24 of 24 models) and is not overfished (100% probability) with respect to Commission-adopted LRP in 2015 (SB_{latest}/SB_{MSY}).

The majority of fishing effort by the U.S. longline fishery operating out of Hawaii occurs north of 20° N in stock assessment Region 2, where stock depletion is among the lowest in regional estimates (Ducharme-Barth 2020). Moreover, 98% of bigeye tuna caught by this fishery has occurred north of 10° N (WPFMC 2021), which is above the core equatorial zone of the heaviest purse seine and longline fishing (Ducharme-Barth 2020). SC16 noted that the region where the U.S. fishery operates has some of the lowest relative regional depletion and serves as a 'buffer' for the stock.

The IATTC assessed bigeye tuna in the eastern Pacific Ocean (EPO) in 2018 and the assessment results indicate F/F_{MSY} = 1.15 and $SB_{2014\text{-}2016}/SB_{MSY}$ = 1.02 (Xu et al. 2018). This substantial change in the reference points from the previous year's assessment, which were F/F_{MSY} = 0.87 and $SB_{2014\text{-}2016}/SB_{MSY}$ = 1.23 (Aires-da-Silva et al. 2017), triggered IATTC to investigate the cause of the change. The authors attribute the change in status to new data for the indices of relative abundance, based on longline CPUE, which resulted in lower estimates of recent biomass. There is substantial uncertainty in the estimate of current fishing mortality and in the model assumptions used (Xu et al. 2018) and the relative contribution of assessment uncertainty and variability in the relationship between fleet capacity and fishing mortality to the overfishing reference point are also unknown (Maunder et al. 2018). NMFS has not accepted the Xu et al. (2018) assessment as suitable for making stock status determinations for EPO bigeye tuna (NMFS 2018b). Because of this, the information required by the FEP for making a status determination is lacking (NMFS 2018b). In 2017, total bigeye tuna landings in the EPO by FEP longline fisheries was 2,690 t (WPFMC 2018a) or 2.8% of the estimated MSY of 95,491 t (Xu et al. 2018) and 2.8% of the total 2017 catch (IATTC 2018).

The U.S. deep-set longline fishery catch of bigeye tuna is limited by annual catch limits consistent with conservation and management measures of the WCPFC and IATTC. The fishery has additional opportunities for catching bigeye tuna under specified fishing agreements with U.S. territories (50 CFR 665.819(c)) that are managed to ensure catches of WCPO bigeye tuna remain sustainable. The Hawaii deep-set longline fishery is not harvesting its maximum catch under the current management and so there is room for catch to increase and not adversely affect the stock.

3.1.5 Yellowfin Tuna

Vincent et al. (2020) conducted the most recent stock assessment for yellowfin tuna in the WCPO. Yellowfin is neither subject to overfishing nor overfished. Similar to the bigeye assessment, the WCPFC SC endorsed a weighted assessment model uncertainty grid to characterize stock status. The SC, at its 16th regular session in 2020, noted that the central tendency of relative recent SB was median ($SB_{recent}t/SB_{F=0}$) = 0.53 with a probable range of 0.40 to 0.61 (80% probable range), and that there was a roughly 0% probability that the recent SB had breached the WCPFC limit reference point. The central tendency of relative recent fishing mortality was median (F_{recent}/F_{MSY}) = 0.74 with an 80% probability interval of 0.62 to 0.97, and there was a roughly 4% probability (2 out of 48 models) that the recent fishing mortality was above F_{MSY} (WCPFC 2017). In 2020, total yellowfin tuna landings by the longline fisheries in Hawaii and American Samoa was 2,531 t or less than 1% of the estimated MSY (WCPFC 2021). Of the 2,531 t of yellowfin tuna caught by U.S. longline fisheries in 2020, the longline fleet based in Hawaii accounted for 2,313 t with the remainder, 219 t or 8.7%, landed by the American Samoa longline fishery (WCPFC 2021).

3.1.6 Albacore

The International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean (ISC) in 2020 completed the most recent stock assessment of North Pacific albacore, which uses data through 2018 (ISC 2020a). The assessment indicates that: a) the stock is likely not overfished relative to the limit reference point adopted by the WCPFC (20%$SSB_{current}$, F=0), and b) no F-based reference points have been adopted to evaluate overfishing, but stock status was evaluated against seven potential LMRs and current fishing intensity ($F_{2012-2014}$) is below six of the seven reference points except for $F_{50\%}$. Total albacore tuna landings in the North Pacific by FEP longline fisheries was 90 t, or less than 1% of the estimated MSY. The Hawaii longline fishery made nearly all of the landings.

For South Pacific albacore, Tremblay-Boyer et al (2018) estimated that the median level of SB depletion from the uncertainty grid was SBrecent/$SB_{F=0}$ = 0.52 with a probable range of 0.37 to 0.63 (80% probability interval). Tremblay-Boyer et al (2018) indicated no individual model configurations estimated $SB_{recent}/SB_{F=0}) < 0.2$, breaching the limit reference point of the stock. The assessment indicated that the probability that recent SB being below the LRP was zero. However, U.S. longline fisheries operating out of American Samoa continue to experience a precipitous decline in catch: 1,050 t in 2019 and 507 t in 2020 (WPFMC 2021). Total catch of South Pacific albacore was estimated to be 86,706 t in 2019, with American Samoa longline fisheries contributing 1.2% of South Pacific catch in that year. In order to reduce the impacts of regional depletion on fishery performance of island-associated fisheries targeting South Pacific albacore, a target reference point was adopted by the WCPFC for SB of the stock to be 57% $SB_{F=0}$, with the intention of increasing fishery performance for small island states.

In summary, the U.S. longline fishery out of American Samoa is not depleting South Pacific albacore, and it is managed sustainably.

3.1.7 Skipjack

McKechnie et al. (2016) conducted the most recent assessment of skipjack tuna in the WCPO using data up to 2015. The median estimates of $F_{2015}/F_{MSY} = 0.48$ indicate that overfishing of skipjack is not occurring in the WCPO. Nor is the stock in an overfished state with $SB_{2015}/SB_{MSY} = 2.15$. Fishing pressure and recruitment variability (influenced by environmental conditions) will continue to be the primary influences on stock size and fishery performance (McKechnie et al. 2016). McKechnie et al. (2016) estimate MSY at 1,875,600 t. In 2020, total skipjack tuna landings by the longline fisheries in Hawaii and American Samoa was 311 t, or much less than 1% of the estimated MSY (WPFMC 2021). Of the 311 t, the Hawaii longline fishery accounted for 251 t with the remainder, 60 t or 19.3%, landed by the American Samoa longline fishery.

3.1.8 Swordfish

Based on the best scientific information available, the swordfish population in the North Pacific is comprised of two stocks, separated by a roughly diagonal boundary extending from Baja California, Mexico, to the Equator. These are the WCNPO stock, distributed in the western and central Pacific Ocean, and the EPO stock, distributed in the eastern Pacific Ocean.

Hawaii-permitted deep-set fishing operations north of the Equator may land no more than 25 swordfish per trip if only circle hooks are used and 10 swordfish per trip if any other type of hook is used. These limits do not apply if an observer is on board (50 CFR 665.813(j)).

The results of the most recent WCNPO assessment (ISC 2018b) support the conclusion that the WCNPO stock is not subject to overfishing as $F_{2013\text{-}2015}/F_{MSY} = 0.45$, and is not overfished as $SB_{2016}/SB_{MSY} = 1.87$. The 2018 stock assessment estimated MSY for the WCNPO stock at 14,941 t (ISC 2018b). In the terminal year of the stock assessment, total landings of swordfish by all U.S. longline fisheries in the North Pacific Ocean (NPO), which may include a small percentage of EPO swordfish, was 1,617 t (WPFMC 2018a) or approximately 11% of the estimated MSY. The Hawaii longline fishery made nearly all of the landings. In 2019, catch of North Pacific swordfish by Hawaii-based U.S. longline fisheries declined to 812.5 t, the lowest in over a decade (WPFMC, 2020). This can be attributed to closures of the shallow-set sector of the fishery due to reaching its limit on loggerhead sea turtle interactions, which was re-evaluated by FEP Amendment 10.

The results of the most recent EPO assessment (ISC 2014), using data through 2012, support a conclusion that the EPO stock is now subject to overfishing as $F_{2012}/F_{MSY} = 1.11$, but is not overfished as $B_{2012}/B_{MSY} = 1.87$. The 2014 stock assessment estimated MSY for the EPO stock at 5,490 t (ISC 2014). Based on logbook records, catch of swordfish by U.S. longline vessels operating within the boundary of the EPO stock is less than 5 t annually in years 2004-2018 (NMFS unpublished data). This amount is less than 1% of the estimated MSY; therefore, the relative impact of the U.S. longline fisheries on the stock is negligible.

3.1.9 Blue Marlin

The 2016 stock assessment by the ISC Billfish Working Group (ISC 2016) that uses data through 2014 indicates Pacific blue marlin is not experiencing overfishing ($F_{2014}/F_{MSY} = 0.88$), nor is it overfished ($SB_{2014}/SB_{MSY} = 1.25$). In 2020, total blue marlin landings by longline fisheries in Hawaii and American Samoa was 648 t, or approximately 3% of the estimated MSY. Of the 684 t, the Hawaii longline fishery accounted for 623 t with the remainder, 55 t or 3.8%, caught by the American Samoa longline fishery (WPFMC 2021).

3.1.10 Blue Shark

The results of the 2017 assessment (ISC 2017a) indicate the North Pacific blue shark is not subject to overfishing ($F_{2012\text{-}2014}/F_{MSY} = 0.37$) and is not overfished ($SB_{2012\text{-}2014}/SB_{MSY} = 1.71$). The 2017 stock assessment estimated SB_{MSY} at 179,539 t. In 2020, total blue shark landings by all U.S. longline fisheries was 0 t. Nearly all blue sharks caught in U.S. longline fisheries are returned to the sea alive.

3.1.11 Bluefin Tuna

Scientists consider Pacific bluefin tuna as a single North Pacific-wide stock (ISC 2018a). The most recent assessment of the status of Pacific bluefin tuna used data through 2016, and concluded that the stock is still experiencing overfishing and is overfished (ISC 2018a).

Spawning Potential Ratio (SPR), a preferred metric to estimate exploitation impacts on the stock, is the ratio of the cumulative SB that an average recruit is expected to produce over its lifetime when the stock is fished at the current fishing level to the cumulative SB that could be produced by an average recruit over its lifetime if the stock was unfished (ISC 2020b). The ISC assessment estimated that fishing mortality declined from a level producing about 1% of SPR in 2004-2009 to a level producing 14% of SPR in 2016- 2018. Current SB is estimated at 28,000 t in 2018, up significantly from near a historical low in 2010 (ISC 2020b). However, the ISC Bluefin Tuna Working Group noted that the stock has over a 75% probability of achieving its rebuilding target (6.7% $SSB_{F=0}$) by 2024 and over 80% probability of achieving a secondary target (20% $SSB_{F=0}$) ten years later. Spawning stock biomass has increased from 3.3% $SSB_{F=0}$ to 4.46% $SSB_{F=0}$ since the previous stock assessment.

The U.S. longline fleet seldom catches Pacific bluefin tuna (WPFMC 2021). From 2018 to 2020, the average total North Pacific bluefin tuna landings by all U.S. longline fisheries was 1.6 t (WPFMC 2021), about one percent of current SB. At such a low percentage of fishing mortality, the relative impact of the U.S. longline fisheries on the stock is negligible and therefore overfishing of the stock is due to excessive international fishing pressure. NMFS continues to work with the Pacific and Western Pacific Councils and the State Department to ensure that WCPFC and IATTC adopt effective management measures to end overfishing and rebuild the stock.

3.1.12 North Pacific Shortfin Mako Shark

In 2018, ISC concluded the first full stock assessment of shortfin mako shark in the NPO (ISC 2018c). Previous abundance indices showed conflicting trends from which stock status could not be determined (ISC 2015). The new assessment used data through 2016 and assumed a single stock in the NPO (ISC 2018c). Spawning abundance (SA) was used instead of SB because the size of mature female sharks does not appear to affect the number of pups produced (ISC 2018c). The results indicate that the stock is likely (>50%) not subject to overfishing because $F_{2013-2015}/F_{MSY} = 0.62$, and is likely (>50%) not overfished because $SA_{2016}/SA_{MSY} = 1.36$. ISC estimated the MSY at 3,127 t (ISC 2018c). In 2020, total mako shark landings by all U.S. fisheries in the NPO was 71 t, or 2.3% of the MSY.

On April 15, 2021 NMFS announced a 90-day ‘may be warranted’ finding on a petition to list the shortfin mako sharks as threatened or endangered under the ESA. This announcement means that NMFS is developing a detailed status review to determine whether short fin mako sharks should be listed under the ESA (86 FR 19863). As this status review is not yet complete, we will not include shortfin mako sharks in Section 3.2 “Protected Resources.”

3.1.13 Summary of Hawaii and American Samoa Longline Fisheries Catch Statistics

Released catch, retained catch, and total catch for the Hawaii deep-set longline, Hawaii shallow-set longline, and American Samoa longline fisheries in 2020 are summarized in Tables 7, 8 and 9. These and other catch statistics for these three longline fisheries can be found in the 2020 SAFE report (WPFMC 2021).

Table 5. Released catch, retained catch, and total catch for the Hawaii-permitted deep-set longline fishery, 2020.

	Deep-set longline fishery			
	Released catch	Percent released	Retained catch	Total Catch
Tuna				
Albacore	410	5.0	8,126	8,536
Bigeye tuna	4,542	2.2	202,596	207,138
Bluefin tuna	0	0.0	11	11
Skipjack tuna	165	0.8	20,544	20,709
Yellowfin tuna	1,164	2.2	53,231	54,395
Other tuna	0	0.0	0	0
Total tunas	**6,281**	**2.2**	**284,508**	**290,789**
Billfish				
Swordfish	147	4.0	3,716	3,863
Blue marlin	59	0.7	8,118	8,177
Striped marlin	157	1.2	12,621	12,778
Spearfish	279	2.9	9,696	9,975
Other marlin	10	2.1	469	479
Total billfish	652	1.9	34,620	35,272
Other PMUS				
Mahimahi	182	0.8	21,767	21,949
Wahoo	115	0.5	24,246	24,361
Moonfish	424	2.6	16,182	16,606
Oilfish	3,001	37.8	7,931	10,932
Pomfret	329	0.9	35,748	36,077
Total other PMUS	**4,051**	**3.8**	**105,874**	**109,925**
Non-PMUS fish	**6,414**	**97.3**	**175**	**6,589**
Total non-shark	**17,398**	**3.9**	**425,177**	**442,575**
PMUS Sharks				
Blue shark	104,427	100.0	1	104,428
Mako shark	4,422	99.1	39	4,461
Thresher shark	8,678	99.7	23	8,701
Oceanic Whitetip shark	463	100.0	0	463
Silky shark	234	100.0	0	234
Total PMUS sharks	**118,224**	**99.9**	**63**	**118,287**
Non-PMUS sharks	**257**	**99.6**	**1**	**258**
Grand Total	**135,879**	**24.2**	**425,241**	**561,120**

Source: WPRFMC (2021).

Table 6. Released catch, retained catch, and total catch for the Hawaii-permitted shallow-set longline fishery, 2020.

	Shallow-set longline fishery			
	Released catch	Percent released	Retained catch	Total Catch
Tuna				
Albacore	49	16.0	306	355
Bigeye tuna	57	5.6	1,015	1,072
Bluefin tuna	0	0.0	4	4
Skipjack tuna	0	0.0	7	7
Yellowfin tuna	34	7.5	454	488
Other tunas	0	0.0	0	0
Tuna PMUS Subtotal	**140**	**7.8**	**1,786**	**1,926**
Billfish				
Swordfish	128	2.9	4,418	4,546
Blue marlin	2	9.5	21	23
Striped marlin	8	38.1	21	29
Shortbill spearfish	4	18.2	22	26
Other billfishes	0	0.0	0	0
Billfish PMUS Subtotal	**142**	**3.2**	**4,482**	**4,624**
Other PMUS				
Mahimahi	5	2.9	171	176
Wahoo	1	9.1	11	12
Moonfish	24	9.0	267	291
Oilfish	95	44.0	121	216
Pomfret	0	0.0	12	12
Other PMUS Subtotal	**125**	**17.7**	**582**	**707**
Non-PMUS fish	**1**	**33.3**	**2**	**3**
Total non-shark	**408**	**5.6**	**6,852**	**7,260**
PMUS Sharks				
Blue shark	5,917	100.0	0	5,917
Mako sharks	712	81.2	165	877
Thresher sharks	33	80.5	8	41
Oceanic whitetip shark	1	100.0	0	1
Silky shark	0	0.0	0	0
Shark PMUS Subtotal	**6,663**	**97.5**	**173**	**6,836**
Non-PMUS sharks	2	100.0	0	2
Grand Total	7,073	50.2	7,025	14,098

Source: WPRFMC (2021).

Table 7. Number of fish kept, released, and percent released for all American Samoa longline vessels in 2020.

Species	Number Kept	Number Released	Total Caught	Percent Released
Skipjack tuna	8,832	143	8,975	1.6
Albacore tuna	28,504	305	28,809	1.1
Yellowfin tuna	9,083	127	9,210	1.4
Kawakawa	0	0	0	0.0
Bigeye tuna	974	12	986	1.2
Bluefin tuna	1	0	1	0.0
Tunas (unknown)	0	0	0	0.0
TUNAS TOTAL	**47,394**	**587**	**47,981**	**1.2**
Mahimahi	457	9	466	1.9
Black marlin	0	0	0	0.0
Blue marlin	419	28	447	6.3
Striped marlin	48	0	48	0.0
Wahoo	1,361	37	1,398	2.6
Swordfish	45	44	89	49.4
Sailfish	17	34	51	66.7
Spearfish	13	122	135	90.4
Moonfish	29	4	33	12.1
Oilfish	4	993	997	99.6
Pomfret	22	224	246	91.1
Pelagic thresher shark	0	0	0	0.0
Thresher shark	0	77	77	100.0
Shark (unknown pelagic)	0	2	2	100.0
Snake mackerel	0	0	0	0.0
Bigeye thresher shark	0	0	0	0.0
Silky shark	0	536	536	100.0
White tip oceanic shark	0	391	391	100.0
Blue shark	0	899	899	100.0
Shortfin mako shark	1	87	88	98.9
Longfin mako shark	0	0	0	0.0
Billfishes (unknown)	0	0	0	0.0
NON-TUNA PMUS TOTAL	**2,416**	**3,487**	**5,903**	**59.1**
Pelagic fishes (unknown)	0	0	0	0.0
Double-lined mackerel	0	0	0	0.0
Mackerel	0	0	0	0.0
Long-jawed Mackerel	0	0	0	0.0

Source: WPRFMC (2021).

3.2 Protected Resources

The Hawaii deep-set longline fishery has the potential to interact with a range of protected species (such as sea turtles, marine mammals, sharks and rays, and seabirds). This section provides background on protected species management authorities and associated monitoring, trends in species status, the recent annual estimated or observed interactions of the longline fisheries with protected species, and a summary of the effects of the standard operation of the FEP longline fisheries with a comparison to incidental take statements (ITS) where relevant. We will consider trends in species status and recent interaction levels to be the baseline condition for comparison of environmental effects of the alternatives in Section 4.

More detailed information on protected species interactions in the Hawaii and American Samoa longline fisheries are available in the 2020 Annual SAFE Report (WPRFMC 2021), incorporated here by reference.

3.2.1 Endangered Species Act

The purpose of the ESA (16 U.S.C. § 1531, et seq.) is to protect and recover imperiled species and the ecosystems upon which they depend. Section 7(a)(2) of the ESA requires each federal agency to insure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of designated critical habitat of such species. "Jeopardize" means to reduce appreciably the likelihood of survival and recovery of a species in the wild by reducing its numbers, reproduction, or distribution. When a federal agency's action "may affect" an ESA-listed species, that agency is required to consult formally with NMFS for marine species, some anadromous species, and their designated critical habitats, or with the U.S. Fish and Wildlife Service (FWS) for terrestrial and freshwater species or their designated critical habitat. The product of formal consultation is the relevant service's biological opinion (BiOp).

The ESA also prohibits the taking of listed species without a special exemption. Taking that is incidental to and not intended as part of a Federal action is not considered to be prohibited taking under the ESA, provided that such taking is in compliance with the reasonable and prudent measures and terms and conditions of an ITS. The reasonable and prudent measures are nondiscretionary, and must be undertaken by the Federal agency for the take exemption to apply. For BiOps reaching a jeopardy or adverse modification conclusion, NMFS develops reasonable and prudent alternatives that would avoid the likelihood of jeopardy or adverse modification of critical habitat. Western Pacific fisheries authorized under the FEP operate in accordance with ITSs set by ESA consultations, including applicable reasonable and prudent measures, and their associated terms and conditions, intended to minimize the potential effects of incidental take.

Table 8. ESA-listed species with the potential to interact with longline vessels permitted under the FEP

Species	ESA status
Sea Turtles	
Green turtle, Central North Pacific distinct population segment (DPS) (*Chelonia mydas*)	Threatened
Green turtle, East Pacific DPS (*Chelonia mydas*)	Threatened
Green turtle, Central South Pacific DPS (*Chelonia mydas*)	Endangered
Green turtle, Central West Pacific DPS (*Chelonia mydas*)	Endangered
Green turtle, East Indian-West Pacific DPS (*Chelonia mydas*)	Threatened
Green turtle, Southwest Pacific DPS (*Chelonia mydas*)	Threatened
Hawksbill turtle (*Eretmochelys imbricata*)	Endangered
Leatherback turtle (*Dermochelys coriacea*)	Endangered
Loggerhead turtle, North Pacific DPS (*Caretta caretta*)	Endangered
Loggerhead turtle, South Pacific DPS (*Caretta caretta*)	Endangered
Olive ridley turtle *(Lepidochelys olivacea*)	Threatened
Olive ridley turtle, Mexico Pacific nesting population (*Lepidochelys olivacea*)	Endangered
Marine Mammals	
Blue whale (*Balaenoptera musculus*)	Endangered
Fin whale (*Balaenoptera physalus*)	Endangered
Hawaiian monk seal (*Neomonachus schauinslandi*)	Endangered
False killer whale, Main Hawaiian Islands Isular DPS (*Pseudorca crassidens*)	Endangered
North Pacific right whale (*Eubalaena japonica*)	Endangered
Sei whale (*Balaenoptera borealis*)	Endangered
Sperm whale (*Physeter macrocephalus*)	Endangered
Guadalupe fur seal (*Arctocephalus townsendi*)	Threatened
Seabirds	
Hawaiian dark-rumped petrel (*Pterodroma phaeopygia sandwichensis*)	Endangered
Newell's shearwater (*Puffinus auricularis newelli*)	Threatened
Short-tailed albatross (*Phoebastria albatrus*)	Endangered
Sharks and Rays	
Scalloped hammerhead, Indo-West Pacific DPS (*Sphyrina lewini*)	Threatened
Scalloped hammerhead, Eastern Pacific DPS (*Sphyrina lewini*)	Endangered
Oceanic white tip (*Carcharhinus longimanus*)	Threatened
Giant manta ray (*Manta birostris*)	Threatened
Corals and Marine Invertebrates	
Acropora globiceps	Threatened
Acropora jacquelineae	Threatened
Acropora retusa	Threatened

Species	ESA status
Acropora speciose	Threatened
Euphyllia paradivisa	Threatened
Isopora crateriformis	Threatened
Seriatopora aculeata	Threatened
Chambered nautilus (*Nautilus pompilius*)	Threatened

Source: https://www.fisheries.noaa.gov/species-directory accessed October 13, 2021.

The following list identifies the valid BiOps under which the FEP longline fisheries currently operate. This section summarizes much of the information contained in these documents to describe baseline conditions. For further information, contact NMFS using the contact information at the beginning of the document.

FWS. 2012. Biological Opinion of the U.S. Fish and Wildlife Service for the Operation of Hawaii-based Pelagic Longline Fisheries, Shallow-Set and Deep-Set, Hawaii.

NMFS. 2014. Biological Opinion on Continued Operation of the Hawaii-based Deep-set Pelagic Longline Fishery.

NMFS. 2015. Biological Opinion and Conference Opinion on Continued Operation of the American Samoa Longline Fishery.

NMFS. 2017. Supplement to the 2014 Biological Opinion on Continued Operation of the Hawaii-based Deep-set Pelagic Longline Fishery.

NMFS. 2019. Biological Opinion on the Continued Authorization of the Hawaii Pelagic Shallow-set Longline Fishery.

NMFS reinitiated consultation for the Hawaii deep-set fishery on October 4, 2018, due to reaching several reinitiation triggers. The fishery exceeded the ITS for east Pacific green sea turtle distinct population segment (DPS) in mid-2018. Listing of the oceanic whitetip shark (83 FR 4153) and giant manta ray (83 FR 2916) as threatened species, and designation of MHI insular false killer whale critical habitat (83 FR 35062) also triggered the requirement for reinitiated consultation. On October 4, 2018, April 15, 2020 and again on December 18, 2020, NMFS determined that the conduct of the fishery during the period of consultation will not violate ESA Sections 7(a)(2) and 7(d).

NMFS reinitiated consultation for the American Samoa deep-set longline fishery on April 3, 2019, due to reaching several reinitiation triggers. The fishery exceeded the ITS for the east Indian West Pacific, Southwest Pacific, Central South Pacific, and East Pacific green sea turtle DPS; hawksbill; and olive ridley sea turtles in 2018. Listing of the oceanic whitetip shark (83 FR 4153), giant manta ray (83 FR 2916), and chambered nautilus (83 FR 48976) as threatened species also triggered the requirement for reinitiated consultation. On April 3, 2019, May 6, 2020, and most recently on July 13, 2021, NMFS determined that the conduct of the fishery during the period of consultation will not violate ESA Sections 7(a)(2) and 7(d).

3.2.2 Marine Mammal Protection Act

The Marine Mammal Protection Act (MMPA) prohibits, with certain exceptions, the take of marine mammals in the U.S. EEZ and by U.S. citizens on the high seas, and the importation of marine mammals and marine mammal products into the United States. The MMPA authorizes the Secretary of Commerce to protect and conserve all cetaceans (whales, dolphins, and porpoises) and pinnipeds (seals and sea lions, except walruses). The MMPA requires NMFS to prepare and periodically review marine mammal stock assessments. See 16 U.S.C. § 1361, et seq.

Pursuant to the MMPA, NMFS has promulgated specific regulations that govern the incidental take of marine mammals during fishing operations (50 CFR 229). Under Section 118 of the MMPA, NMFS must publish, at least annually, a List of Fisheries (LOF) that classifies U.S. commercial fisheries into three categories, based on relative frequency of incidental mortality and serious injury to marine mammals in each fishery:

- Category I designates fisheries with frequent serious injuries and mortalities incidental to commercial fishing.
- Category II designates fisheries with occasional serious injuries and mortalities incidental to commercial fishing.
- Category III designates fisheries with a remote likelihood or no known serious injuries or mortalities.

According to the 2021 LOF (86 FR 3028, January 14, 2021), the Hawaii deep-set longline fishery is a Category I fishery. Among other requirements, owners of vessels or gear engaging in a Category I fishery are required under 50 CFR 229.4 to obtain a marine mammal authorization to lawfully take incidentally marine mammals by registering with the NMFS marine mammal authorization program. The Hawaii shallow-set longline fishery and the American Samoa deep-set longline fishery are Category II fisheries. The proposed 2022 LOF (86 FR 43491, August 9, 2021) maintained these classifications, changed the Hawaii shallow-set longline fishery participation from 13 to 11 vessels/persons, and did not change the Hawaii deep-set and American Samoa participation levels.

Section 118 of the MMPA requires NMFS to prepare a take reduction plan for each strategic marine mammal stock that interacts with a Category I or Category II fishery. NMFS established the False Killer Whale Take Reduction Team in 2010 (75 FR 2853) and implemented the False killer whale take reduction plan (FKWTRP) in 2012 (72 FR 71260) to reduce mortalities and serious injuries (M&SI) of false killer whales in the Hawaii deep-set longline fishery.

Section 101(a)(5)(E) of the MMPA requires the Secretary of Commerce to allow the incidental, but not intentional, taking of individuals from marine mammal stocks that are designated as depleted because of a listing as threatened or endangered under the ESA in the course of commercial fishing operations if certain criteria are met.

On May 6, 2021, NMFS issued a permit under the MMPA section 101(a)(5)(E), addressing the Hawaii deep-set fishery’s interactions with ESA-listed species or depleted stocks of marine mammals (86 FR 24384). The permit authorizes the incidental, but not intentional, taking of ESA-listed humpback whales (Central North Pacific or CNP stock) and MHI insular false killer whales to vessels registered in the Hawaii deep-set fishery. In issuing the permit, NMFS determined that incidental taking by the deep-set fishery will have a negligible impact on the affected stocks of marine mammals. The humpback whale CNP stock delineation under the MMPA includes both ESA-listed and non-ESA-listed distinct population segments. However, any potential overlap of the deep-set fishery with humpback whales is with the Hawaii distinct population segment, which is no longer listed under the ESA (81 FR 62259, September 8, 2016).

Additional information on the marine mammals that interact with FEP fisheries are described in Section 3.2.4, below.

3.2.3 Migratory Bird Treaty Act

The Migratory Bird Treaty Act (MBTA) makes it illegal to intentionally take, possess, import, export, transport, sell, purchase, barter, or offer for sale, purchase, or barter, any migratory bird, or the parts, nests, or eggs of such a bird except under the terms of a valid Federal permit. In 2012, the FWS issued a special permit for the shallow-set fishery under the MBTA authorizing incidental take of certain seabirds in the Hawaii shallow-set fishery over a period of three years (USFWS 2012). On December 27, 2017, the U.S. Ninth Circuit Court of Appeals issued a split decision that reversed a lower district court decision upholding the MBTA permit. *Turtle Island Restoration Network v. NMFS & FWS*, 13-17123 (9th Cir. 2017). The Ninth Circuit Court majority opinion found that FWS improperly relied upon the special use permit to authorize the incidental take of sea birds by a commercial fishery. The permit expired on its own terms in March 2018 and NMFS determined that it would not reapply for the permit. On January 7, 2021, the FWS published a final rule (effective February 8, 2021) defining the scope of the MBTA as it applies to conduct resulting in the injury or death of migratory birds protected by the MBTA (86 FR 1134). In that January 2021 rule, FWS determined that the MBTA's prohibitions on pursuing, hunting, taking, capturing, killing, or attempting to do the same, apply only to actions directed at migratory birds, their nests, or their eggs. On October 4, 2021, FWS published a final rule (effective December 3, 2021) revoking the January 2021 rule, and returning the implementation of the MBTA as prohibiting incidental take and applying enforcement discretion consistent with judicial precedent and FWS practice prior to 2017 (86 FR 54642). NMFS and the Council continue to monitor interactions with seabirds and have implemented take mitigation measures.

Additional information on the seabirds that interact with FEP fisheries are described in Section 3.2.7 below.

3.2.4 Monitoring

NMFS monitors fishery interactions with protected species using at-sea observers, among other means. NMFS monitors interactions on approximately 20% of all Hawaii deep-set longline trips, 100% of Hawaii shallow-set longline trips, and approximately 20% of American Samoa longline trips. PIFSC generates fleetwide estimates of interactions for each longline fishery, when available (see WPFMC 2021). When these data are not available, NMFS estimates fleetwide interactions by expanding observed takes using an expansion factor based on the observer coverage rate. For example, because the Hawaii deep-set longline fishery was observed at a 20.4% coverage rate in 2017, NMFS multiplied each observed interaction by 4.9 to estimate interactions at a 100% coverage rate.

3.2.5 Sea Turtles

As air-breathers, sea turtles are typically found closer to the surface (0-100 m). Some are vulnerable to hooking and entanglement with longline fishing gear because of deeper foraging behaviors. Other pelagic fisheries effects are primarily limited to the potential for collisions with sea turtles.

In addition to the BiOps listed in the previous section, more detailed information, including the range, abundance, status, and threats of the listed sea turtles, can be found in the status reviews, 5-year reviews, and recovery plans for each species on the NMFS species pages found at the following website: http://www.fpir.noaa.gov/PRD/prd_esa_section_4.html. This section describes the baseline status of the sea turtle populations to facilitate an analysis of the effects of the alternatives under consideration.

Several measures implemented under the FEP mitigate the potential for turtle interactions and injury, including best practices and handling training to reduce the severity of interactions, requirements to carry observers, and an annual requirement for owners and operators to attend a protected species education workshop. Additionally, Federal regulations require closure of the Hawaii shallow-set fishery once the fishery reaches loggerhead or leatherback hard cap limits, and require the use of large circle hooks and mackerel-type fish bait when shallow-setting north of the Equator. Vessels in the American Samoa longline fleet that are longer than 40 m have specific requirements for gear configuration that result in setting gear at a minimum depth of about 100 m. As a non-regulatory measure, NMFS funds monitoring, conservation, and recovery projects for sea turtle populations with Pacific Islands Region connections due to commercial fishery interactions (NMFS 2014b).

After considering a range of potential effects to sea turtles, NMFS, in the 2014 as supplemented (2017), 2015, and 2019 BiOps listed above, determined that the pelagic fisheries of the western Pacific operating in accordance with the FEP and its implementing regulations would not jeopardize the survival or recovery of any listed sea turtles. Within each BiOp's ITS, NMFS has exempted the ESA prohibition on take for a certain level of interactions (incidental take) of species that the fishery may adversely affect for these fisheries.

Hawaii Deep-set Longline Fishery

Table 9 summarizes the fleetwide sea turtle interaction estimates for the Hawaii deep-set longline fishery from 2010 through 2020.

Table 9. Annual sea turtles interactions (takes) expanded from observed data to fleetwide estimates for the Hawaii deep-set longline fishery, 2010-2020.

Year	Sea Turtle Species				
	Green	**Leatherback**	**N. Pacific Loggerhead**	**Olive Ridley**	**Unidentified hardshell**
2010	1	6	6	10	0
2011	5	14	0	36	0
2012	0	6	0	34	0
2013	5	15	11	42	0
2014	16	38	0	50	0
2015	4	18	9	69	0
2016	5	15	7	162	5
2017	15	0	15	127	0
2018	15	10	5	88	0
2019	2	15	0	141	0
2020	2	26	20	72	0

Source: WPRFMC (2021).

On September 19, 2014, NMFS issued a no-jeopardy BiOp (2014 BiOp) for the deep-set longline fishery that authorizes, over a three-year period, the incidental take of green, leatherback, North Pacific loggerhead, and olive ridley sea turtles (NMFS 2014a). When the ITS were exceeded for green, loggerhead, and olive ridley sea turtles, NMFS reinitiated consultation and completed a supplemental BiOp (2017 Supplement) on March 24, 2017 (NMFS 2017). NMFS concluded in its 2017 Supplement that the Hawaii deep-set longline fishery as managed under the FEP is not likely to jeopardize the continued existence or recovery of any sea turtle species.

The new ITS for green turtle DPSs, olive ridley turtle populations, and North Pacific DPS of loggerhead turtles in the supplement (2017) to the 2014 BiOp has a monitoring period starting in July 1, 2016. From July 2017 through July 2018, NMFS observers reported seven fishery interactions with green sea turtles. These interactions, when expanded to the unobserved fishery and applying a genetic proration of 0.7% for the East Pacific DPS, exceeds the ITS of 12 interactions. NMFS reinitiated ESA Section 7 consultation for the Hawaii deep-set longline fishery on October 4, 2018 (NMFS 2018a). In the biological evaluation (BE) supporting reinitiation, NMFS found that the continued operation of the deep-set longline fleet is likely to adversely affect the East Pacific, Central North Pacific, East Indian-West Pacific, Southwest Pacific, Central West Pacific, and Central South Pacific DPS of the green turtle, Western Pacific population of the leatherback, North Pacific loggerhead DPS, and Eastern Pacific and Western Pacific populations of olive ridley sea turtles.

To estimate the potential effects of the operation of the Hawaii deep-set longline fleet on sea turtle species, NMFS estimated the annual interaction levels with 50, 80, and 95th percentile of the predicted distribution. NMFS conservatively used the 95th percentile value and estimated the Hawaii deep-set longline fishery could interact with up to 40 green, 43 leatherback, 28 loggerhead, and 179 olive ridley sea turtles in any given year. These predictions, generated by

PIFSC using Bayesian data analysis methods appropriate for count data (McCracken 2019a), used observed interactions in the fishery from 2002-2017. The unidentified hardshell interactions in 2016 (**Table 9**) are accounted for proportionately among the green, loggerhead, and olive ridley 2016 interaction estimates. In the 2018 BE, NMFS considered the number of green sea turtles likely to die from boat collisions and found the number of mortalities to be effectively zero (0.09) and therefore discountable (NMFS 2018a).

Using post-hooking mortality criteria described in Ryder et al. (2006), NMFS estimated that 91.6% of all green turtle, 40.7% of leatherback, 62.4% of loggerhead, and 93.9% of olive ridley interactions would result in mortality (NMFS 2018a). NMFS applied these post-hooking mortality rates to the interaction estimates to yield the annual number of mortalities that may occur for each affected sea turtle population from the continued operation of the deep-set longline fleet (**Table 10**). Because NMFS used the 95th percentile value, we would not expect this level of mortalities each year.

NMFS used methodologies appropriate for the available data to estimate interactions or mortalities for relevant populations of the sea turtle species. In order to estimate the interactions for each of the six green sea turtle DPSs, NMFS allocated a portion of the conservative take estimate to each DPS in the same proportion present in historical observer samples attributed to each DPS. NMFS used the upper 95% confidence interval for each proportion to account for a small sample size of 14 turtles (NMFS 2018a). The proportion attributed to each DPS was rounded up to the nearest whole number to calculate the anticipated interactions for each green sea turtle DPS. The estimated take is 32 in the East Pacific, 18 in the Central North Pacific, 12 in the East Indian-west Pacific, 10 each in the Southwest Pacific and Central South Pacific, and 8 in the Central West Pacific DPS (NMFS 2018a).

NMFS expects almost all (95%) leatherback turtles directly affected by the operation of the fishery to belong to the western Pacific population with the remaining 5% attributed to the eastern Pacific population, based on genetic samples from 21 leatherbacks (NMFS 2018a). The North Pacific DPS is the only loggerhead DPS that has the potential to interact with the deep-set longline fishery (NMFS 2018a), so NMFS attributes all interactions and mortalities to this DPS.

For olive ridley sea turtles, NMFS estimated from genetic samples that 73% of the take occurs from the eastern Pacific DPS and 27 percent from the Western Pacific. NMFS used these proportions to attribute mortalities to the eastern and western Pacific DPSs. NMFS used the ratio from a sample size of 153 olive ridley turtles, which was substantially larger than the green turtle sample size. NMFS did not adjust the olive ridley DPS mortality estimates based on the upper 95% confidence interval. Table 8 shows interaction and mortality estimates for sea turtles.

To analyze the effect of sea turtle interactions at the population level, NMFS compares the number of turtles that are predicted to die from the operation of the deep-set longline fleet that would have otherwise be expected to reach breeding age (adult nesting equivalency or ANE) to the total number of breeding females in each population. Counts of adult females on nesting beaches are the only abundance data available for sea turtles. In order to calculate the ANE, three adjustment factors are required: 1) adult equivalence of juveniles (probability of juveniles naturally surviving to become adults), 2) ratio of females in the population (female to male sex ratio), and 3) probability that a turtle will die if it interacts with the fishery. Risk to the population is also expressed in the number of years it takes to kill the equivalent of one adult female in each DPS. Where breeding female abundance is not available for a population, DPS or nesting population, NMFS determines the population effects for the purposes of this EA based on the frequency of expected adult nester mortality.

Table 10 also shows the ANE, number of breeding females, proportion of nesting population where available, and years to kill the equivalent of one female in each turtle species, population, breeding population, or DPS. For more details on the process and rationale used to develop population level impacts, please see the 2014 BiOp as supplemented (2017) (NMFS 2014a; 2017) and biological evaluation prepared for the reinitiation (NMFS 2018a).

NMFS estimates that the fishery may kill between 0.001% (East Indian-West Pacific, Southwest Pacific, and Central West Pacific green turtle DPS) to 0.1% (Western Pacific leatherback) of the population every year, with population impacts for the remaining nine sea turtle DPS falling in between. For context, a change in the population of 0.1% represents a change in the population growth rate (r) equivalent to 0.001; $r = 0.03$ is a typical growth rate for an increasing population. NMFS does not expect the fishery to cause more than a single adult female mortality ranging between every half year (for the north Pacific loggerhead DPS) to every 11 years (for the Central West Pacific DPS) for green and loggerhead species. When considered at the population level for leatherbacks, NMFS does not expect adult female mortalities to occur greater than between once every four months and 4.5 years. No more than 13 (Western Pacific DPS) and 35.7 (Eastern Pacific DPS) olive ridley adult female mortalities are expected as a result of the fishery's operation every year, and the proportion of nester abundance remains low. The information indicates that for each sea turtle species, adult female mortalities associated with the estimated annual level of interactions do not substantially affect the population growth rate.

Under the 2014 BiOp as supplemented (2017), the overall population for each sea turtle species was expected to remain large enough to maintain genetic heterogeneity, broad demographic representation, and successful reproduction, and to retain the potential for recovery. This conclusion remains valid for the impacts of the Hawaii deep-set longline fleet on all species and DPS of sea turtles. On October 4, 2018, when NMFS reinitiated consultation on the deep-set longline fishery, NMFS also determined that the conduct of the fishery during the period of consultation will not violate ESA Sections 7(a)(2) and 7(d)); that is, the operation of the fishery will not result in making irreversible or irretrievable commitments of resources during the period of consultation that would have the effect of foreclosing the formulation or implementation of any reasonable and prudent alternative.

NMFS develops mitigation measures to minimize the potential effects of incidental take on populations of ESA-listed species through the ESA Section 7 consultation process. Additionally, NMFS modifies the operation of the fishery to avoid the likelihood of jeopardizing listed species or adversely modifying critical habitat. There is a low likelihood (5%) that NMFS has underestimated the level of annual fleetwide interactions. There is also a low proportion of mortalities compared to the nesting population abundances that the conservation estimates represent for each year, and a low frequency of adult female mortalities expected from the conservative predictions. In addition, the management process designed to minimize adverse effects to listed species greatly reduces the annual effects of the operation of the Hawaii deep-set longline fishery on all sea turtle species.

Table 10. Sea turtle interactions, mortalities, and population level impacts in the Hawaii deep-set longline fleet.

DPS	Annual Interactions	Annual Mortalities	ANE	Nester abundance	Proportion of nesting population	Years to adult female mortality
Green	40	37				
East Pacific DPS	32	NA	0.4	20,112	0.00002	2.5
Central North Pacific DPS	18	NA	0.2	3,846	0.00005	5
East Indian-West Pacific DPS	12	NA	0.14	77,009	0.00001	7.14
Southwest Pacific DPS	10	NA	0.11	83,058	0.00001	9.09
Central West Pacific DPS	8	NA	0.09	6,518	0.00001	11.11
Central South Pacific DPS	10	NA	0.11	2,677	0.00004	9.09
Leatherback						
Western Pacific	41	17	3.04	2,750	0.00111	0.33
Eastern Pacific	3	1	0.22	1,000	NA	4.55
North Pacific Loggerhead DPS	28	18	1.77	8,632	0.00019	0.56
Olive Ridley						
Eastern Pacific DPS	132	124	35.7	1,000,000	0.00004	0.03
Western Pacific DPS	48	45	13.0	205,000	0.00006	0.08

Source: NMFS (2018a)

Hawaii Shallow-set Longline Fishery

Table 11 summarizes the fleetwide sea turtle interaction estimates for the Hawaii shallow-set longline fishery from 2004 to 2018.

Table 11. Annual number of observed sets (based on begin set date) and observed interactions (based on interaction date) of loggerhead, leatherback, green and olive ridley turtles in the Hawaii shallow-set longline fishery, 2004-2020.

Year	Annual number of observed sets	Observed Interactions (100% Coverage)			
		Loggerhead	Leatherback	Green	Olive ridley
2004	135	1	1	0	0
2005	1645	12	8	0	0
2006	850	17[a]	2	0	0
2007	1570	15	5	0	1
2008	1605	0	2	1	2
2009	1761	3	9	1	0
2010	1875	7	8	0	0
2011	1463	12	16[b]	4	0
2012	1369	5	7	0	0
2013	961	5	11	0	0
2014	1337	15	16	1	1
2015	1156	13	5	0	1
2016	727	15	5	0	0
2017	973	21	4	2	4
2018[c]	476	38	6	1	1
2019	312	20	0	0	2
2020	455	15	2	0	0
Average (2005-2020)[d]	1,204	11	6	0.6	0.7

[a] Fishery closed on March 20, 2006, as a result of reaching the loggerhead hard cap of 17.
[b] Fishery closed on November 18, 2011 as a result of reaching the leatherback hard cap of 16.
[c] Fishery closed on May 8, 2018, pursuant to the stipulated settlement agreement and court order.
[d] 2004 and 2018 data omitted from calculation of the long-term average due the fishery closures during peak season.
Source: WPFMC (2021) NMFS (2018e; 2019h)

On June 26, 2019, NMFS issued a BiOp concluding that the Hawaii shallow-set longline fishery as managed under the FEP is not likely to jeopardize the continued existence or recovery of any sea turtle species (NMFS 2019a). The continued operation of the Hawaii shallow-set longline fishery is likely to adversely affect the Central North Pacific DPS and East Pacific DPS of the green, Western Pacific population of the leatherback, North Pacific loggerhead DPS, and Eastern and Western Pacific populations of olive ridley sea turtles.

NMFS conservatively estimated that over a one year period, the shallow-set fishery could interact with up to (using the 95th percentile value of a predicted distribution) 5 green, 21 leatherback, 37 loggerhead, and five olive ridley sea turtles. These predictions, generated by PIFSC using Bayesian data analysis methods appropriate for count data (McCracken 2018), used observed interactions in the fishery from January 1, 2005 through December 31, 2017. For North Pacific loggerhead sea turtles, the predictions are based on observed interactions from January 1, 2005 through January 31, 2018, to account for loggerhead interactions observed in the first month of 2018.

The population-level effects of the anticipated level of sea turtle interactions in the Hawaii shallow-set longline fishery can be quantified as the number of adult females removed from the populations (ANE), using the same methods as NMFS used for the deep-set fishery. The resulting ANEs and proportion of nesting population are summarized in Table 12. This information indicates that for each sea turtle species, adult female mortalities associated with the conservatively estimated annual level of interactions do not substantially affect the population growth rate (NMFS 2018e).

Table 12. Population level effect metrics for ESA-listed sea turtle populations over a 1-year period, where ANE is Adult Nester Equivalents.

Species	Total Anticipated Annual Interactions	Annual Mortalities	ANE	Estimated Total Nesters	Proportion of Nesting Population	Years to adult female mortality*
Loggerhead turtle (North Pacific DPS)	37	6	0.676	8,632	0.000049	1.48
Leatherback turtle	21	5	1.502	2,750	0.00052	0.67
Olive ridley turtle (Eastern Pacific population)	4	1	0.118	>1 million (annual)	< 0.000001	8.47
Olive ridley turtle (Western Pacific population)	2	1	0.06	205,000	< 0.000001	16.67
Green turtle (Eastern Pacific DPS)	3	1	0.006	20,062	< 0.000001	166.67
Green turtle (Central North Pacific DPS)	3	1	0.006	3,846	0.000002	166.67

Source: NMFS (2018e).
*Calculated by the authors.

NMFS develops mitigation measures to minimize the potential effects of incidental take on populations of ESA-listed species through the ESA Section 7 consultation process. Additionally, NMFS modifies the operation of the fishery to avoid the likelihood of jeopardizing listed species or adversely modifying critical habitat. Based on the low likelihood (5%) that NMFS has underestimated the level of annual fleetwide interactions, the low proportion of mortalities compared to the nesting population abundances that the conservation estimates represent for each year, the low frequency of adult female mortalities expected from the conservative predictions, and NMFS management process designed to minimize adverse effects to listed species, NMFS expects the annual effect of the operation of the Hawaii shallow-set longline fishery will not jeopardize the continued existence of any sea turtle species.

American Samoa Longline Fishery

Table 13 summarizes the fleetwide sea turtle interaction estimates for the American Samoa longline fishery from 2006 through 2018.

Table 13. Annual sea turtle interactions expanded from observer data to fleetwide estimates for the American Samoa Longline Fishery, from 2006-2018.

	Sea Turtle Species			
Year	**Green**	**Leatherback**	**Olive Ridley**	**Hawksbill**
2006	37	0	0	0
2007	14	0	0	0
2008	16	0	0	0
2009	39	0	0	0
2010	50	0	0	0
2011	32	4	4	0
2012	0	6	6	0
2013	19	13	4	0
2014	17	4	5	0
2015	0	22	6	0
2016	21	5	15	5
2017[1]	20	5	10	0
2018[2]	23	6	11	11
2019	26	7	29	0
2020[3]	-	-	-	-

[1]2017 estimates expanded by multiplying observed interactions by 5 as there was 20% observer coverage in 2017. Fractional estimates rounded up to nearest whole number.
[2]2018 estimates expanded by multiplying observed interactions by 5.7 as there was 17.5% observer coverage in 2018. Fractional estimates rounded up to the nearest whole number. Because preliminary observed interactions are reported by date of trip arrival and observer coverage rates are reported by date of trip departure, interaction data may vary from other sources.
[3] Data confidentiality rules prevent publication of 2020 take numbers.
Source: WPFMC (2021)

On October 30, 2015, NMFS issued a no-jeopardy BiOp (2015 BiOp) for the American Samoa longline fishery that authorizes, over a three-year period, the incidental take of green, hawksbill, leatherback, loggerhead and olive ridley sea turtles (NMFS 2015). Based on observer data since the 2015 BiOp data cutoff of June 30, 2015, the fishery has not exceeded the ITS for leatherback, Central West Pacific DPS of green, or the South Pacific DPS of loggerhead sea turtles. The fishery exceeded the ITS for four DPS of green (East Indian West Pacific, Southwest Pacific, Central South Pacific, and East Pacific), hawksbill, and olive ridley sea turtles in 2018. ESA Section 7 consultation for the American Samoa deep-set longline fishery was reinitiated on April 3, 2019, in part based on exceeding these sea turtle ITS. On April 3, 2019, May 6, 2020, and July 13, 2021, NMFS determined that the conduct of the fishery during the period of consultation will not violate ESA Sections 7(a)(2) and 7(d); that is, the operation of the fishery is not likely to jeopardize the continued existence of species listed as threatened or endangered, result in the destruction or adverse modification of designated critical habitat, nor will it result in an irreversible or irretrievable commitment of resources that would foreclose the formulation or implementation of reasonable and prudent alternatives that would avoid jeopardy or adverse modification during the period of consultation. In the BE supporting reinitiation, NMFS found that the continued operation of the longline fleet is likely to adversely affect the East Indian West Pacific, Central West Pacific, Southwest Pacific, Central South Pacific, and East Pacific DPS of the green, Western Pacific population of the leatherback, South Pacific loggerhead DPS, and Eastern Pacific and Western Pacific populations of olive ridley sea turtles. NMFS conservatively estimated the American Samoa fishery could interact with up to 47 green, 8 hawksbill, 30 leatherback, two loggerhead, and 28 olive ridley sea turtles in any given year (NMFS 2019b). These predictions, generated by PIFSC using methods appropriate for count data (McCracken 2019b), used observed interactions in the fishery from January 1, 2012 through December 31, 2017, as not all relevant catch records and other modeling variables were available through the end of 2018. For the hawksbill, South Pacific loggerhead DPS, and unidentified hardshell sea turtles, the predictions are based on observed interactions from 2012 through 2018 to account for two interactions with hawksbills in 2018 and zero data points for loggerhead and unidentified sea turtle interactions. Interaction data prior to 2012 were not included in the predictions, because green sea turtle mitigation measures, under which the fishery currently operates, were implemented in the fishery in September of 2011.

PIFSC quantifies the population-level effects of the anticipated level of sea turtle interactions in the American Samoa longline fishery as ANE, where data are available, using the same methods as NMFS used for the Hawaii deep-set fishery (NMFS unpublished data). The resulting ANEs and proportion of nesting population are summarized in Table 14. This information indicates that for each sea turtle species, adult female mortalities associated with the estimated annual level of interactions do not substantially affect the population growth rate.

Table 14. Population level effect metrics for ESA-listed sea turtle populations over a 1-year period.

Species	Total Anticipated Annual Interactions	Annual Mortalities	ANE	Estimated Total Nesters	Proportion of Nesting Population	Years to adult female mortality
East Indian West Pacific green DPS	5.4	5	0.03	67,796	<0.000001	30.2
Central West Pacific green DPS	11.6	11	0.07	6,551	0.00001	15.1
Southwest Pacific green DPS	21.9	21	0.12	82,810	<0.000001	8.2
Central South Pacific green DPS	34.3	32	0.19	3,118	<0.00006	5.2
Eastern Pacific green DPS	10.9	10	0.06	19,744	0.000003	16.4
Hawksbill sea turtle	8	8	0.10	1,500	0.00006	10.3
Western Pacific leatherback	30	21	0.86	1,388	0.0006	1.2
Eastern Pacific olive ridley	12	8	1.59	>1,000,000	0.000008	0.68
Western Pacific olive ridley	17	12	2.26	205,000	0.000002	0.44
South Pacific loggerhead DPS	2	2	2	1,300	0.0015	0.5

Source: NMFS (2019c) and NMFS unpublished data.

Under the 2015 BiOp, the overall population for each sea turtle species was expected to remain large enough to maintain genetic heterogeneity, broad demographic representation, and successful reproduction, and to retain the potential for recovery. This conclusion remains valid for the impacts of the American Samoa deep-set longline fleet on all species and DPS of sea turtles.

NMFS develops mitigation measures to minimize the potential effects of incidental take on populations of ESA-listed species through the ESA Section 7 consultation process. Additionally, NMFS modifies the operation of the fishery to avoid the likelihood of jeopardizing listed species or adversely modifying critical habitat. There is a low likelihood (5%) that NMFS has underestimated the level of annual fleetwide interactions. There is also a low proportion of mortalities compared to the nesting population abundances that the conservation estimates represent for each year, and a low frequency of adult female mortalities expected from the conservative predictions. In addition, the management process designed to minimize adverse effects to listed species greatly reduces the annual effects of the operation of the American Samoa longline fishery on all sea turtle species.

3.2.6 Marine Mammals

ESA-listed marine mammals that have been observed or may occur in the area where FEP fisheries operate include:

Blue whale (*Balaenoptera musculus*)
Fin whale (*Balaenoptera physalus*)
Guadalupe fur seal (*Arctocephalus townsendi*)
Hawaiian monk seal (*Neomonachus schauinslandi*)
Humpback whale (*Megaptera novaeangliae*)
  Mexico DPS (threatened)
  Central America DPS (endangered)
  Western North Pacific DPS (endangered)
MHI insular false killer whale DPS (*Pseudorca crassidens*)
North Pacific right whale (*Eubalaena japonica*)
Sei whale (*Balaenoptera borealis*)
Sperm whale (*Physeter macrocephalus*)

Detailed information on these species' geographic range, abundance, bycatch estimates, and status can be found in the most recent stock assessment reports (SARs), available online at: https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessment-reports-region. Additional information is at: http://www.fpir.noaa.gov/PRD/prd_esa_section_4.html.

On September 8, 2016 (81 FR 62259), NMFS published a final rule to reclassify the humpback whale into 14 DPS under the ESA, of which four DPSs were listed as threatened or endangered. The remaining ten DPSs were not listed under the ESA, including the Hawaii DPS and the Oceania DPS, which occur in areas where the Hawaii and American Samoa longline fisheries operate, respectively. Based on research, observer, and logbook data, marine mammals not listed under the ESA that may occur in the region and that may be affected by the fisheries managed under the FEP include:

Blainville's beaked whale (*Mesoplodon densirostris*)
Bryde's whale (*Balaenoptera edeni*)
Bottlenose dolphin (*Tursiops truncatus*)
Common dolphin (*Delphinus delphis*)
Cuvier's beaked whale (*Ziphius cavirostris*)
Dwarf sperm whale (*Kogia sima*)
False killer whale (*Pseudorca crassidens*) other than the MHI Insular DPS
Fraser's dolphin (*Lagenodelphis hosei*)
Killer whale (*Orcinus orca*)
Longman's beaked whale (*Indopacetus pacificus*)
Melon-headed whale (*Peponocephala electra*)
Minke whale (*Balaenoptera acutorostrata*)
Northern fur seal (*Callorhinus ursinus*)
Pacific white-sided dolphin (*Lagenorhynchus obliquidens*)
Pantropical spotted dolphin (*Stenella attenuata*)
Pilot whale, short-finned (*Globicephala macrorhynchus*)
Pygmy killer whale (*Feresa attenuata*)
Pygmy sperm whale (*Kogia breviceps*)
Risso's dolphin (*Grampus griseus*)
Rough-toothed dolphin (*Steno bredanensis*)
Spinner dolphin (*Stenella longirostris*)
Striped dolphin (*Stenella coeruleoalba*)

Detailed information on these species' geographic range, abundance, bycatch estimates, and status can be found in the most recent SARs, available online at: https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessment-reports-region.

Marine mammals are primarily vulnerable to Hawaii and American Samoa longline fisheries through hooking and entanglement. Although blue whales, North Pacific right whales, and sei whales occur within the action area and could potentially interact with the FEP fisheries, fishermen and observers have not reported any incidental hooking or entanglements of these species. Other potential impacts to marine mammals from the operation of fisheries include vessel collisions, exposure to waste and discharge, and disturbance from human activity and equipment.

Several measures implemented under the FEP mitigate the potential for marine mammal interactions and injury, including the requirements to carry observers, and a requirement for owners and operators of longline vessels to attend a protected species education workshop annually on interaction mitigation techniques. Longline vessel owners and operators must post a NMFS-approved placard with marine mammal handling and/or release procedures in a conspicuous location on their vessels and crew must be supervised by the vessel operator during marine mammal handling and release. In the Hawaii deep-set longline fishery, circle hooks must have a wire diameter not exceeding 4.5 millimeters (mm) and leaders and branch lines must have a diameter of 2.0 mm or larger if made of monofilament nylon or, if another material, have a breaking strength of at least 400 lb. These Hawaii deep-set longline fishery gear requirements are meant to allow marine mammals to straighten the hook and release themselves if accidentally hooked. All incidental mortality and injury of marine mammals during commercial fishery operations must be reported within 48 hours after the end of a fishing trip where mortality or injury occurs. Additionally, longline closed areas generally within 30 to 75 nm of each U.S. island archipelago serve as de facto protection for island-associated stocks of marine mammals.

After considering a range of potential effects to marine mammals, NMFS, in the 2012 and 2014 BiOps as supplemented (2017) for the Hawaii longline fisheries, determined that the pelagic fisheries of the western Pacific operating in accordance with the FEP and its implementing regulations would not jeopardize the survival or recovery of any listed marine mammals. Within each BiOp, NMFS has authorized a certain level of interactions (ITS) of species that the fisheries may adversely affect. NMFS determined that incidental taking by the Hawaii longline fisheries will have a negligible impact on the affected stocks of marine mammals and subsequently issues its MMPA section 101(a)(5)(E) permit to fishermen. NMFS has determined that the American Samoa longline fishery is not likely to adversely affect the humpback or sperm whales, and will not affect blue, fin, or sei whales.

Hawaii Deep-set Longline Fishery

Table 15 shows the fleetwide marine mammal interaction estimates for the Hawaii deep-set longline fishery from 2009 through 2018.

Table 15. Estimated annual marine mammal interactions (including mortalities, and serious and non-serious injuries) with the Hawaii deep-set longline fishery from 2009-2018.

Species	2009	2010	2011	2012	2013	2014	2015	2016	2017[1]	2018[1]
Risso's dolphin	0	3	0	0	0	0	10	0	5	0
Short-finned pilot whale	0	0	0	0	4	0	4	0	0	0
False killer whale	55	19	10	15	22	55	21	35	39	59
Pantropical spotted dolphin	0	0	0	0	0	0	0	0	0	0
Striped dolphin	0	0	4	0	0	0	4	0	0	0
Bottlenose dolphin	5	4	0	0	11	0	0	5	5	5
Pigmy killer whale	0	0	0	0	5	0	0	0	0	0
Kogia species	0	0	0	0	0	10	0	0	0	0
Humpback whale	0	0	0	0	0	5	0	0	0	0
Sperm whale	0	0	6	0	0	0	0	0	0	0
Rough-toothed dolphin	0	0	0	0	5	0	0	5	0	0
Unidentified cetacean[2]	0	0	10	10	10	10	5	10	20	20
Unidentified whale[2]	15	14	0	0	0	0	0	0	0	0
Unidentified dolphin[2]	0	0	0	0	0	0	5	0	0	0

[1]2017 and 2018 estimates expanded by multiplying observed interactions by 4.9 as there was 20.4% observer coverage in 2017 and 2018. Fractional estimates are rounded up to nearest whole number. Because preliminary observed interactions are reported by date of trip arrival and observer coverage rates are reported by date of trip departure, interaction data may vary from other sources.
[2]Unidentified species identification based on Pacific Island Regional Office Observer Program (PIROP) classifications. Unidentified cetacean species refers to a marine mammal not including pinnipeds (seal or sea lion); unidentified whale refers to a large whale; and unidentified dolphin refers to a small cetacean with a visible beak. Further classifications based on observer description, sketches, photos and videos may be available from PIFSC.
Source: WPFMC (2018b), NMFS (2019g)

NMFS monitors the effects of the fishery on non-ESA listed marine mammals through comparison of the average level of interactions which result in M&SI to a stock's potential biological removal (PBR). For most marine mammal stocks where the PBR is available, the number of observed takes of marine mammal species in the deep-set longline fishery inside the U.S. EEZ around Hawaii is well below the PBR in the time period covered by the most current stock assessment report (Table 16).

Table 16. Mean estimated annual M&SI and PBR by marine mammal stocks with observed interactions in the Hawaii deep-set longline fishery.

Stock	Years Included in 2018 SAR	Outside EEZ[a]	Inside EEZ[b]	
		Mean Estimated Annual M&SI Outside EEZ[a]	Mean Estimated Annual M&SI	PBR (Inside EEZ only)
Bottlenose dolphin, HI Pelagic	2011-2015	2.2	0	140
Pantropical spotted dolphin, HI Pelagic	2011-2015	0	0	403
Rough-toothed dolphin, HI	2011-2015	0	1.1	423
Risso's dolphin, HI	2011-2015	1.9	0	82
Striped dolphin, HI	2011-2015	1.1	0	449
Blainville's beaked whale, HI	2011-2015	0	0	10
False killer whale, MHI Insular	2013-2015	N/A	0.0	0.3
False killer whale, HI Pelagic	2011-2015	15.2	7.5	9.3
False killer whale, NWHI	2011-2015	N/A	0.4	2.3
False killer whale, Palmyra Atoll	2006-2010	N/A	0.3	6.4
Kogia spp. whale (Pygmy or dwarf sperm whale), HI	2007-2011	Pygmy = 0 Dwarf = 0	Pygmy = 0 Dwarf = 0	undetermined

Pygmy killer whale, HI	2011-2015	0	1.1	56
Short-finned pilot whale, HI	2011-2015	1.4	0.9	106
Humpback whale, Central North Pacific	2013-2017[d]	0.9		83[c]
Sperm whale, HI	2011-2015	0	0.7	14

[a] PBR estimates are not available for portions of the stock outside of the U.S. EEZ around Hawai`i, except for the Central North Pacific stock of humpback whales for which PBR applies to the entire stock.
[b] PBR estimates are only available for portions of the stock within the U.S. EEZ around Hawai`i.
[c] PBR for the Central North Pacific stock for humpback whales apply to the entire stock.
[d] Draft 2019 SAR.
Source: WPRFMC (2020).

False killer whales have interacted with deep-set longline gear more than other marine mammal species and NMFS has implemented changes to the operations of the fishery based on the recommendations of the False Killer Whale Take Reduction Team to reduce incidental interactions. The mitigation requirements include the use of circle hooks, leader and branch lines of specific sizes or breaking strengths as described previously, a permanently closed area around the main Hawaiian Islands, and an EEZ interaction limit that, when reached, triggers a southern longline fishing exclusion zone (50 CFR 229.37). This interaction limit (two observed false killer whale serious injuries or mortalities within the EEZ around Hawaii in a calendar year) was reached in 2018, triggering a temporary closure of the Southern Exclusion zone (SEZ), an area in the EEZ south of Hawaii, to deep-set longline fishing for the remainder of 2018 (83 FR 33484, July 18, 2018). The SEZ was again opened on January 1, 2019, but two additional false killer whales were hooked in January 2019 (January 10 and January 15, 2019) and the SEZ was again closed effective February 22, 2019 (84 FR 5356) as this met the established trigger in the subsequent calendar year following an SEZ closure. The SEZ was reopened on August 25, 2020 because the criteria in the False Killer Whale Take Reduction Plan regulations at 50 CFR 229.37(e)(7)(iv) was met, i.e., the incidental M/SI within remaining open areas of the EEZ around Hawaii for the five most recent years was determined to be below the PBR level for the Hawaii Pelagic stock of false killer whales. Readers seeking more information may read the take reduction regulations (50 CFR 229.37).

We note that if vessels in the Hawaii deep-set longline fishery change to monofilament leaders as a result of this action, the monofilament would need to meet minimum diameter requirements, currently 2.0 mm or larger, established by regulation (50 CFR 229.37(c)(2)) and intended (along with weak circle hooks) to reduce the potential for mortality and serious injury of false killer whales by increasing the likelihood the whale can self-release from the hook. If a false killer whale is unable to self-release, vessel operators and crew will free the animal following protocols provided through the annual protected species education workshop trainings (50 CFR 229.37(f)). The prohibition of metal wire in leaders in this action is expected to facilitate gear removal and reduce trailing gear on false killer whales.

Hawaii Shallow-set Longline Fishery

Table 17 provides total marine mammal interactions observed in the shallow-set fishery from 2008 through 2018.

Table 17. Observed annual marine mammal interactions (including mortalities, serious injuries, and non-serious injuries) with the Hawaii shallow-set longline fishery from 2011-2020.

Species	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Blackfish*	1	0	0	0	0	0	0	0	0	0
Short-beaked Common dolphin	1	0	0	1	0	0	0	0	0	0
Risso's dolphin	4	0	3	6	3	2	2	2	0	0
Blainville’s beaked whale	1	0	0	0	0	0	0	0	0	0
Humpback whale	1	0	0	0	1	0	0	0	0	0
False killer whale	1	1	0	1	0	0	0	0	0	1
Striped dolphin	0	1	0	2	0	1	1	0	0	0
Bottlenose dolphin	2	1	2	4	2	1	0	1	0	0
Rough-toothed dolphin	0	0	1	0	0	0	0	0	0	0
Fin whale	0	0	0	0	1	0	0	0	0	0
Unidentified cetacean	0	1	0	0	1	0	0	0	0	0
Pygmy or dwarf sperm whale	0	0	0	0	0	0	0	0	0	0
Beaked whale, Mesoplodont	1	0	0	0	0	0	0	0	0	0
Ginkgo-toothed beaked whale	0	0	0	0	1	0	0	0	0	0
Unidentified beaked whale	1	0	2	0	1	0	0	0	0	0
Northern elephant seal	0	0	1	1	0	0	0	0	0	0
Guadalupe fur seal	0	0	0	0	0	1	3	0	0	7
Unidentified seal	0	0	0	0	0	0	0	0	1	0
Unidentified fur seal	0	0	0	0	0	0	0	0	0	2
Unidentified pinniped	0	0	0	0	3	0	0	0	0	0
Unidentified sea lion	0	0	0	1	2	0	0	0	0	0

Note: “Blackfish” include unidentified whales considered to be either false killer whales or short-finned pilot whales.
Source: WPFMC (2021)

NMFS monitors the effects of the fishery on non-ESA listed marine mammals through comparison of the average level of interactions which result in M&SI to a stock’s PBR. For marine mammal stocks where the PBR is available, the mean annual M&SI for the shallow-set longline fishery inside the EEZ around Hawaii is well below the corresponding PBR in the time period covered by the current stock assessment report (Table 18).

Table 18. Summary of mean annual M&SI and PBR by marine mammal stocks with observed interactions in the Hawaii shallow-set longline fishery.

Stock	Years Included in 2018 SARs	Outside EEZ[a]	Inside EEZ	
		Mean Annual M&SI	Mean Annual M&SI	PBR (Inside EEZ only)[c]
Bottlenose dolphin, HI Pelagic	2011-2015	2	0	140
Risso's dolphin, HI	2011-2015	3.2	0	82
Rough-toothed dolphin, HI	2011-2015	0	1	423
Striped dolphin, HI	2011-2015	0.6	0	449
Blainville's beaked whale, HI	2011-2015	0	0	10
False killer whale, HI Pelagic	2011-2015	0.1	0.1	9.3
Short-finned pilot whale, HI	2011-2015	0.1	0	106
Kogia spp. whale (Pygmy or dwarf sperm whale), HI	2007-2011	Pygmy = 0 Dwarf = 0	Pygmy = 0 Dwarf = 0	undetermined
Humpback whale, Central North Pacific	2013-2017[d]	0[b]		83[b]
Fin whale, HI	2011-2015	0	0	0.1
Guadalupe fur seal, CA	2013-2017[d]	0.4		1,062

[a] PBR estimates are not available for portions of the stock outside of the U.S EEZ around Hawai`i, except for the Central North Pacific stock of humpback whales for which PBR applies to the entire stock.
[b] PBR and M&SI for the Central North Pacific stock for humpback whales apply to the entire stock.
[c] PBR estimates for Hawai`i stocks are only available for portions of the stock within the U.S. EEZ around Hawai`i.
[d] Draft 2019 SAR.
Source: WPRFMC (2020).

The SEZ does not apply to the Hawaii shallow-set longline fishery. If a Hawaii shallow-set vessel interacts with a marine mammal, requirements for handling and release at 50 CFR 229.37(f) apply, with annual required vessel operator protected species education workshop trainings, posting of release methods in visible areas on the vessel, and required vessel operator supervision of marine mammal handling and release.

American Samoa Longline Fishery

Table 19 summarizes the fleetwide marine mammal interactions in the American Samoa longline fishery from 2009-2018.

The SEZ does not apply to the American Samoa longline fishery. If an American Samoa longline fishing vessel interacts with a marine mammal, requirements for handling and release at 50 CFR 229.37(f) apply, with annual required vessel operator protected species education workshop trainings, posting of release methods in visible areas on the vessel, and required vessel operator supervision of marine mammal handling and release.

Table 19. Number of marine mammal interactions (including mortalities, and serious and non-serious injuries) observed in the American Samoa longline fishery, 2011-2020.

Species	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020[3]
Rough-toothed dolphin	15	0	5	0	0	10	5	6	0	-
Cuvier's beaked whale	3	0	0	0	0	0	0	0	0	-
False killer whale	9	0	5	0	9	10	5	6	0	-
Short-finned pilot whale	0	0	0	5	0	0	0	0	0	-
Stiped dolphin	0	0	0	0	0	0	0	0	1	-
Unidentified cetacean	6	0	0	0	0	0	0	0	0	-

[1]2017 estimates expanded by multiplying observed interactions by 5 as there was 20% observer coverage in 2017. Fractional estimates rounded up to nearest whole number.
[2]2018 estimates expanded by multiplying observed interactions by 5.7 as there was 17.5% observer coverage in 2018. Fractional estimates rounded up to the nearest whole number. Because preliminary observed interactions are reported by date of trip arrival and observer coverage rates are reported by date of trip departure, interaction data may vary from other sources.
[3] 2020 data are not reported due to confidentiality rules
Source: WPFMC (2021) and NMFS (2019a)

3.2.7 Seabirds

The endangered short-tailed albatross, threatened Newell's shearwater, and endangered Hawaiian dark-rumped petrel have ranges that overlap the fishing grounds of the Hawaii longline fisheries. The short-tailed albatross has a range that overlaps the pelagic fisheries operating around the CNMI and Guam. In addition, three other seabirds in the South Pacific were determined to be endangered in 2009: the Chatham petrel (*Pterodroma axillaris*), Fiji petrel (*Pseudobulweria macgillivrayi*), and the magenta petrel (*Pterodroma magentae*). However, apart from Newell's shearwater, which was sighted on Tutuila only once in 1993 and considered an accidental visitor, the ranges of the other species are assumed not to overlap with that of the American Samoa longline fishery or other pelagic fisheries north of the Equator (see sources cited in WPFMC 2011). A comprehensive description of the species' distribution, population status, threats, and recovery strategy can be found in the species' recovery plans at: https://ecos.fws.gov/ecp0/reports/ad-hoc-species-report-input.

Seabirds are vulnerable to fisheries through hooking and entanglement, which may result in injury or mortality. Albatrosses that forage by diving are some of the most vulnerable species to bycatch in fisheries (Brothers et al. 1999). These species are long-lived, have delayed sexual maturity, small clutches and long generation times, resulting in populations that are highly sensitive to changes in adult mortality. Eighteen of the world's 22 albatross species are now at least near threatened with extinction according to the International Union for Conservation of Nature (IUCN 2017), and incidental catch in fisheries, especially longline fisheries, is considered one of the principal threats to many of these species (Veran et al. 2007).

Several measures mitigate the potential for seabird interactions and injury in the FEP fisheries, including requirements to carry observers, and a requirement for owners and operators of longline vessels to attend a protected species education workshop annually. Deep-set vessels operating north of 23º N latitude and all shallow-set vessels are required to comply with seabird mitigation measures codified at 50 CFR 665.815 that help deter birds from becoming hooked or entangled while attempting to feed on bait or catch. In 2008, the WCPFC implemented similar measures for longline vessels longer than 24 m when fishing north of 23° N (WCPFC 2007), and for vessels shorter than 24 m in 2017 (WCPFC 2017a).

Shallow-set vessels must begin setting one hour after local sunset and complete setting one hour before local sunrise. These measures resulted in a reduction of over 90% in total seabird interactions by 2006 in the deep-set and shallow-set fisheries combined (NMFS 2007). Seabirds likely drown if the interaction occurs during gear deployment (setting), but during gear retrieval (hauling), seabirds may be released alive when fishermen promptly apply seabird handling and release techniques as specified at 55 CFR 665.815(b) and 665.815(c).

Hawaii Deep-set Longline Fishery

Table 20 contains the numbers of albatross that have interacted with the Hawaii deep-set longline fisheries from 2009 through 2020 based on observed interactions by the NMFS Observer Program. In addition, from 2009 through 2020, the deep-set fishery has interacted with several species of boobies, shearwaters, and gulls (WPFMC 2021).

Table 20. Estimated total interactions with albatrosses in the Hawaii deep-set longline fisheries, 2009-2020.

Year	Laysan	Black-footed
2009	60	110
2010	155	65
2011	187	73
2012	136	167
2013	236	257
2014	77	175
2015	119	541
2016	166	485
2017*	186	475
2018*	162	951
2019	231	767
2020	387	630

*2017 and 2018 estimates expanded by multiplying observed interactions by 4.9 as there was 20.4% observer coverage levels in 2017 and 2018. Fractional estimates are rounded up to nearest whole number. Because preliminary observed interactions are reported by date of trip arrival and observer coverage rates are reported by date of trip departure, interaction data may vary from other sources.
Source: WPFMC (2021), NMFS (2019g)

In response to higher observed black-footed albatross interactions in the deep-set fishery since 2015, the Council has convened two workshops to explore the factors influencing the increase and to review seabird mitigation measures for the fishery. These efforts led to the trials of tori lines (bird-scaring streamers) in the deep-set longline fishery. The successful trials led the Council, at its 187th meeting in September 2021, to recommend that its staff and NMFS develop regulations to require tori lines in the Hawaii deep-set fishery along with other changes to further reduce the risk of seabird interactions. Those regulations are in development. Additional details on these recent developments are described in the 2020 Annual SAFE Report (WPFMC 2021).

Overall, seabird interactions are relatively rare in the Hawaii deep-set longline fishery. At this time, the Hawaii deep-set longline fleet is not having a substantial impact on seabird populations including black-footed or Laysan albatross populations (Arata et al. 2009, NMFS 2021a). International status of both black-footed and Laysan albatross is monitored by the Agreement on the Conservation of Albatrosses and Petrels (ACAP), and currently black-footed albatross populations trends continue to be positive (increasing from 1995-2019) and Laysan albatross populations are stable (1982-2019) (ACAP 2021).

Hawaii Shallow-set Longline Fishery

Table 21 contains the numbers of albatross that have interacted with the Hawaii shallow-set longline fisheries from 2008 through 2020 based on observed interactions by the NMFS Observer Program. In addition, from 2004 through 2020, the shallow-set fishery has interacted with two northern fulmars, four sooty shearwaters, and an unidentified gull (WPRFMC 2021). As described above for the Hawaii deep-set longline fishery, seabird interactions are relatively rare in the Hawaii shallow-set longline fishery, and the fishery is not having a substantial impact on seabird populations including black-footed or Laysan albatross populations (ACAP 2021).

Table 21. Number of albatross interactions observed in the Hawaii shallow-set longline fishery, 2008-2020.

Year	Laysan	Black-footed
2008	33	6
2009	81	29
2010	40	39
2011	49	19
2012	61	37
2013	46	28
2014	36	29
2015	45	41
2016	26	40
2017	6	51
2018	2	9
2019	15	19
2020	26	5

Source: WPFMC (2021), NMFS (2019h)

American Samoa Longline Fishery

Many seabird species that occur in the area of operation of the American Samoa longline fishery, are found around Hawaii, Guam, CNMI, and the remote atolls of the PRIA. These include albatross, boobies, frigatebirds, petrels, shearwaters and terns. Observers, with 20% coverage in the fishery, have recorded three interactions with unidentified shearwaters, one with an unidentified frigate bird, and 13 with black-footed albatross (in the NPO) in the American Samoa longline fishery from 2006-2020 (NMFS 2019a; WPFMC 2021), thus the fishery is not having a large effect on seabird populations.

3.2.8 Sharks and Rays

ESA-listed shark or ray (elasmobranch) species that have been observed or may occur in the area where the FEP fisheries operate include the scalloped hammerhead shark, oceanic whitetip shark, and giant manta ray. Sharks and rays are vulnerable to longline fisheries through hooking and entanglement. Additional information on oceanic whitetip sharks is in Section 3.1.1.

Hawaii Deep-set Longline Fishery

Table 22 shows the fleetwide interaction estimates for the Hawaii deep-set longline fishery with ESA-listed sharks and rays from 2010-2020.

Table 22. Estimated total ESA-listed shark and ray interactions with the Hawaii deep-set longline fishery for 2010-2019.

Year	Scalloped Hammerhead	Oceanic Whitetip	Giant Manta Ray
2010	0	1,198	95
2011	0	1,176	5
2012	0	878	11
2013	0	973	5
2014	0	1,670	11
2015	0	2,654	10
2016	0	2,188	22
2017	0	1,257	0
2018	0	1,092	3
2019	0	2,125	0
2020	0	1,980	7

Source: WPRFMC (2021)

Scalloped hammerhead shark interactions in the Hawaii deep-set fishery are rare, unpredictable events. Between 2004 and 2010, there were three observed interactions with scalloped hammerhead sharks in the Hawaii deep-set fishery in the area of the threatened Indo-West Pacific DPS (NMFS 2014a) with no observed interactions since 2010. NMFS has no records of any interactions with scalloped hammerhead sharks from the Eastern Pacific DPS (NMFS Observer Program, unpublished data). In its no-jeopardy 2014 BiOp, NMFS authorized the take of six Indo-West Pacific scalloped hammerhead sharks, with up to three mortalities over a three year period (NMFS 2014a).

In the request for reinitiation of ESA Section 7 consultation for the Hawaii deep-set longline fishery, NMFS estimated that there could be up to 5 interactions with scalloped hammerhead sharks annually in the fishery. At a 65.7% post-release survival rate, we anticipate that 4 (5 x 0.657 = 3.2, rounded to 4) of the 5 sharks would be released alive while one would be released dead (NMFS 2018a). Based on a population estimate of 11,280 adults, NMFS estimates one annual mortality represents 0.009% (1/11,280*100=0.00886) of the population. In the 2014 BiOp, NMFS determined the number of takes of scalloped hammerhead sharks associated with the operation of the fishery are not expected to cause an appreciable reduction in the likelihood of both the survival and recovery of the DPS (NMFS 2014a). In its 2018 BE, NMFS considered the fishery's the small level of take on the Indo-West Pacific scalloped hammerhead shark DPS from the Hawaii deep-set longline fishing operations to be negligible (NMFS 2018a).

Consultation for the oceanic whitetip shark and giant manta ray were included in the ongoing consultation reinitiated on October 4, 2018 (NMFS 2018a). In that reinitiation request, NMFS estimated the fishery could interact with a mean of 1,708 and up to 3,185 oceanic white tips sharks in any given year (NMFS 2018a).

The current stock assessment for the WCPO oceanic whitetip shark stock (Tremblay-Boyer et al. 2019) estimated median current SB biomass of oceanic whitetip sharks in the WCPO to be 393 t, about 4% of the unfished biomass, and current catch at 2,464 t annually. Based on the most recent assessment, the median estimate of the total size of the oceanic whitetip shark in the WCPO stock is about 775,000 individuals (NMFS 2020b). At an average 76.9% post-release survival rate, NMFS estimates that the anticipated level of interactions in any given year of equal to or less than 3,185 oceanic whitetip sharks represents 735 mortalities or about 0.09% (735/775,000*100) of the estimated number of individuals in the WCPO (NMFS 2020b). Population estimates of oceanic whitetip sharks in the EPO are unavailable, and thus this population-level impact is a conservative estimate. Given the current status of oceanic whitetip sharks (Tremblay-Boyer et al. 2019), and because the Hawaii deep-set longline fishery continues to adversely affect them, additional management is needed to alleviate the impacts of take in this fishery.

NMFS (2018a) estimates that the anticipated level of interactions for giant manta rays in any given year is equal to or less than 84 and would lead to 6 giant manta ray mortalities, based on a 92.7% post-release survival rate. The anticipated level of interactions include a proportion of rays identified as "unidentified ray" and "manta/mobula," and thus the anticipated annual number of giant manta ray interactions is potentially high. As described for oceanic whitetip shark, the upper bound values are based on the 95th percentile of the predicted distribution generated by PIFSC using Bayesian data analysis methods appropriate for count data (McCracken 2019a). From October 2018 to December 2020, there was one reported interaction, suggesting that fleet wide interactions with giant manta ray have been well under the anticipated level.

There are no historical or current global abundance estimates or stock assessments for giant manta rays. Most estimates of subpopulations are based on anecdotal observations, and range from around 100-1,500 (Miller and Klimovich 2016). Little information is available on the abundance of giant manta rays in the high seas area in the central north Pacific where the Hawaii deep-set longline fishery operates. Nevertheless, the 2016 NMFS Status Review Report for the giant manta ray concluded that the incidental catch of this species in U.S. longline fisheries are likely to be having minimal effects on the population (Miller and Klimovich 2016). Based on low recent interactions and the high likelihood that giant manta rays will be released alive when captured in this fishery, NMFS expects that the fishing may affect giant manta rays, but will not jeopardize the likelihood of both survival and recovery of the giant manta ray population.

Hawaii Shallow-set Longline Fishery

Table 23 shows the fleetwide observed interactions of ESA-listed sharks and rays for the Hawaii shallow-set longline fishery from 2010-2020.

Table 23. Total ESA-listed shark and ray interactions with the Hawaii shallow-set longline fishery for 2010-2020.

Year	Scalloped Hammerhead	Oceanic Whitetip	Giant Manta Ray
2010	0	90	6
2011	0	78	3
2012	0	24	0
2013	0	27	0
2014	0	21	1
2015	0	22	0
2016	0	32	0
2017	0	29	2
2018	0	1	0
2019	0	0	0
2020	0	13	0

Source: WPRFMC (2020).

A portion of the shallow-set fishery falls within the range of the Eastern Pacific scalloped hammerhead shark DPS. However, there have been no recorded or observed takes of hammerhead sharks in the shallow-set longline fishery in the area of the Eastern Pacific DPS. The NMFS 2019 BiOp has determined that the shallow-set fishery is not likely to adversely affect the Eastern Pacific scalloped hammerhead shark DPS (NMFS 2019a).

Of the three ESA-listed elasmobranchs the shallow-set fishery interacts with, oceanic whitetip sharks constitute the majority of the interactions (average takes/1,000 hooks = 0.0110) and the observed number of takes ranges between 1 and 348, although the observed number of takes have been less than 32 per year since 2012. Oceanic whitetip shark interactions have been observed throughout the time series, although substantially lower interactions occurred in 2006, 2018, and 2019. Spatial distribution of shallow-set fishing effort typically overlaps with oceanic whitetip shark distribution (south of 30° N) in the summer months. However, the fishery closed in March and early May in 2006 and 2018, respectively, thus likely minimizing the overlap and contributing to the lower number of interactions. Most of the oceanic whitetip sharks that are caught in the shallow-set fishery are released alive.

Giant manta ray are taken more rarely with takes ranging between 0 and 6 over the 2010 to 2020 period (Table 23).

After considering a range of potential effects to oceanic whitetip shark and giant manta ray, NMFS, in the 2019 BiOp, determined that the shallow-set fishery, operating in accordance with the FEP and implementing regulations, would not jeopardize the survival or recovery of oceanic whitetip shark and giant manta ray.

American Samoa Longline Fishery

Table 24 shows the fleetwide interaction estimates for the American Samoa longline fishery from 2010-2020.

Table 24. Estimated total ESA-listed shark and ray interactions with the American Samoa longline fishery for 2010-2019.

Year	Scalloped Hammerhead	Oceanic Whitetip	Giant Manta Ray
2010	17	1,176	11
2011	7	319	11
2012	0	470	29
2013	0	407	8
2014	6	464	2
2015	3	827	3
2016	6	899	0
2017	4	458	0
2018	17	617	0
2019	0	892	0
2020[1]	-	-	-

[1] 2020 catches not shown due to confidentiality requirements.

Source: WPRFMC (2020).

Scalloped hammerhead shark interactions in the American Samoa longline fishery are rare. All of the scalloped hammerhead sharks caught in this fishery are in the Indo-western Pacific DPS. Since the first full year of implementation of the sea turtle mitigation requirements in 2012 and through 2019, there were 36 interactions with Indo-West Pacific scalloped hammerhead sharks in the American Samoa longline fishery, based on expanded observer records (NMFS 2019b). In its no-jeopardy 2015 BiOp, NMFS authorized the take of up to 36 Indo-western Pacific scalloped hammerhead sharks annually, with up to 12 mortalities over a three year period (NMFS 2015a).

In the request for reinitiation of ESA Section 7 consultation for the American Samoa deep-set longline fishery, NMFS estimated that there could be up to 21 interactions with scalloped hammerhead sharks annually in the fishery. At a 77.8% post-release survival rate, we anticipate that 17 (21 x 0.778 = 16.3, rounded to 17) of the 21 sharks would be released alive while four would be released dead (NMFS 2019b).

Based on a population estimate of 11,280 adults (NMFS 2015b), NMFS estimates four annual mortalities represents 0.04% (4/11,280*100=0.04) of the population. Due to the small level of take NMFS considers the fishery's effects on the Indo-West Pacific scalloped hammerhead shark DPS from the American Samoa deep-set longline fishing operations to be small. NMFS in its 2015 BiOp concluded that the American Samoa longline fishery as managed under the FEP is not likely to jeopardize the continued existence or recovery of the Indo-West Pacific scalloped hammerhead DPS. There is no new information that would lead us to reconsider the conclusions reached in the no-jeopardy 2015 BiOp. Moreover, incidental take remains within levels estimated and authorized.

The ongoing consultation reinitiated on April 3, 2019 (NMFS 2019b) includes consultation for oceanic whitetip shark. In the request for reinitiation of consultation, NMFS estimated the fishery could interact with a mean of 613 and up to 1,110 oceanic whitetip sharks in any given year. The upper bound values are based on the 95th percentile of the predicted distribution generated by PIFSC using Bayesian data analysis methods appropriate for count data (McCracken 2019b). Based on the most recent stock assessment (Tremblay-Boyer et al. 2019), the median estimate of the total size of the oceanic whitetip shark in the WCPO stock is approximately 775,000 individuals (NMFS 2020b). At an average 66.6% post-release survival rate (NMFS unpublished data), NMFS estimates the anticipated level of interactions in any given year of equal to or less than 1,110 sharks represents 370 mortalities or about 0.05% (370/775,000*100) of the estimated number of individuals in the WCPO. Given the current status of oceanic whitetip sharks (Tremblay-Boyer et al. 2019), and because the American Samoa longline fishery continues to adversely affect them, additional management is needed to alleviate the impacts of take in this fishery.

The ongoing consultation also addresses giant manta ray. A mean of 9 and up to 28 giant manta ray interactions are expected in any given year (NMFS 2019b). For the giant manta ray, the anticipated level of interactions include a proportion of rays identified as "unidentified ray" and "manta/mobula," and thus the anticipated interactions for giant manta rays inclusive of these possible giant manta ray interactions is up to 38 in any given year. As described for oceanic whitetip shark, the upper bound values are based on the 95th percentile of the predicted distribution (McCracken 2019b). Based on an average post-release survival rate of 96.7%, NMFS expects up to one giant manta ray mortality annually (38 x 0.967 = 36.7, rounded to 37 alive leaves one mortality).

There is no historical or current global abundance estimate or stock assessment for giant manta rays. Most estimates of subpopulations are based on anecdotal diver or fisherman observations, which are subject to bias, and range from around 100-1,500 (Miller and Klimovich 2016). Little information is available on the abundance of giant manta rays in U.S. EEZ around American Samoa where the American Samoa longline fishery operates. Nevertheless, the 2016 NMFS

Status Review Report for the giant manta ray concluded that the incidental catch of this species in U.S. longline fisheries are likely to have minimal effects on the population (Miller and Klimovich 2016). As described in its in its 2019 BE, based on low recent interactions and the high likelihood that giant manta rays will be released alive when captured in this fishery, NMFS expects that the fishing may affect but will not jeopardize the continued survival of the giant manta ray population.

3.2.9 Marine Habitats and Protected Areas

Under the baseline, FEP longline fisheries are not known to have adverse effects on marine habitats. Fishing does not occur in any area designated as critical habitat, besides MHI insular false killer whale (MHI IFKW) habitat (83 FR 35062, effective August 28, 2018). MHI IFKW critical habitat is defined in areas within the action area and their prey species are an essential characteristic of that critical habitat. Longline fishing does not occur in marine protected areas (MPA), marine sanctuaries, or marine monuments so marine protected areas would not be affected.

Longline fishing involves suspending baited hooks in the upper surface layers of the water column, which does not materially affect benthic marine habitat under typical operations. Derelict longline gear may impact marine benthic habitats, especially substrate such as corals if carried by currents to shallow depths. When fishing, all longliners occasionally lose hooks, mainline, floats, float lines, and branch lines, which include lead weights in the deep-set fishery.

3.3 Socioeconomic Setting

The socioeconomic setting for the Hawaii and American Samoa longline fisheries is described below. A more detailed description of the fishery and the latest socio-economic statistics can be found in the FEP Annual SAFE Reports at: http://www.wpcouncil.org/annual-reports/.

U.S. and territorial longline fisheries comprise the Hawaii deep-set tuna longline fleet (including several vessels based on the U.S. West Coast), the Hawaii shallow-set swordfish longline fleet, and the American Samoa albacore longline fleet. In the past, several deep-set tuna longline vessels were based in Guam and the CNMI, but there has been no longline fishing in these locations since 2011.

3.3.1 Hawaii Longline Fisheries

Domestic longline fishing around Hawaii consists of the shallow-set sector and the deep-set sector, subject to separate mitigation measures based on the characteristics of the fishing activity. The deep-set fishery targets bigeye tuna in the EEZ around Hawaii and on the high seas at an average target depth of 167 m (WPFMC 2009a). The shallow-set fishery targets swordfish (*Xiphias gladius*) to the north of the Hawaiian Islands. NMFS and the Council manage the fisheries under a single limited-access permit program. Some Hawaii-permitted vessels also hold American Samoa longline permits. The number of dual-permitted vessels has ranged between 17 and 26 over the last five years (NMFS unpublished data). Dual-permitted vessels land their catch in Hawaii or American Samoa. In this section, we summarize the performance of the Hawaii deep-set and shallow-set longline sectors and incorporate Section 3.2.1 of NMFS and WPFMC (2019) by reference.

Fishing locations may vary seasonally based on oceanographic conditions, catch rates of target species, and management measures, among others. The deep-set fishery operates in the deep, pelagic waters around the Hawaiian archipelago and on the high seas throughout the year, mostly within 300-400 nm (556-741 km) of the MHI. However, Federal regulations and other applicable laws prohibit longline fishing inside the 200 nm U.S. EEZ around the Northwestern Hawaiian Islands. Longline fishing within 50 to 75 nm from the shoreline in the MHI is prohibited to minimize the potential for gear conflicts with small boat fisheries and interactions with protected species.

Federal regulations can temporarily prohibit longline fishing in the SEZ, an area in the EEZ south of Hawaii (see 50 CFR 229.37). An SEZ closure is triggered under regulations implementing the False Killer Whale Take Reduction Plan if there are two or more observed serious injuries or mortalities of false killer whales in the EEZ around Hawaii in a given year. See Section 3.2.6 above for more details SEZ closures and openings in recent years.

Figure 8 shows the distribution of fishing effort by the Hawaii deep-set longline fleet as the annual average number of hooks per 5 degree square in millions of hooks over 2019. The distribution of fishing operations over the fishing grounds varies seasonally and from year-to-year (Figure 8).

In general, deep-set longline vessels operate out of Hawaii ports, with the vast majority based in Honolulu. Infrequently, deep-set trips originate from other ports such as Long Beach or San Francisco, California, or Pago Pago, American Samoa, and then fishermen land their catches in Hawaii. Fishermen departing from California begin fishing on the high seas outside the EEZ. Fishermen departing from American Samoa usually begin fishing near the Equator or farther north where they expect higher catch rates of bigeye tuna. The shallow-set (swordfish-targeting) longline fishery operates in the U.S. EEZ around Hawaii and on the high seas to the north and northeast of the MHI seasonally.

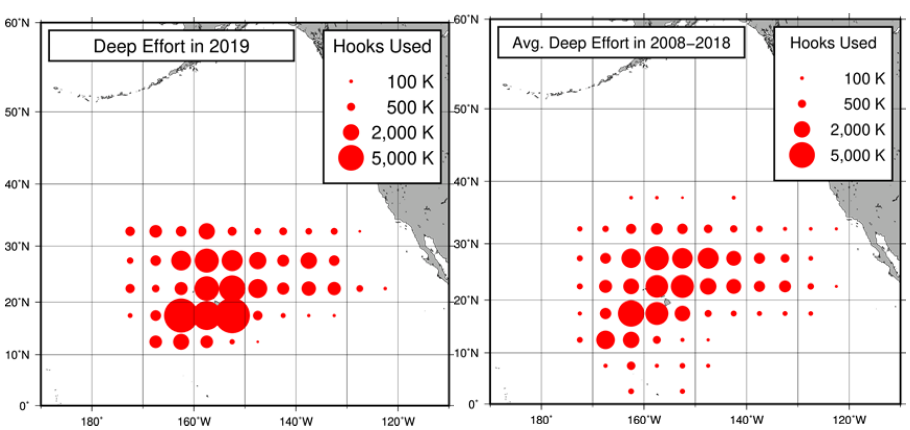


Figure 8. Distribution of deep-set fishing effort (hooks deployed) in 2019 (left panel) and for the 2008-2018 period (right panel). Source: R. Ito report to Council, March 2020.

Fishing effort in the Hawaii deep-set longline fishery has increased over the years. From 2004-2012, the annual number of vessels that participated in the deep-set fishery remained relatively stable, ranging from 124 to 129. The number of active vessels has increased since 2012, with an average of 145 vessels operating over the last five years (2016-2020). In 2020, 146 deep-set longline vessels made 1,644 trips with 20,785 sets and deployed 59.7 million hooks (Table 25).

Table 25. Number of active longline vessels and fishing effort in the Hawaii deep-set fishery, 2010-2020.

Year	Vessels making deep-sets	Deep-set fishing effort (millions of hooks)	Deep-set fishing effort (trips)	Deep-set fishing effort (sets)
2010	122	37.2	1,206	16,075
2011	129	40.8	1,308	17,192
2012	128	44.1	1,361	18,115
2013	135	46.9	1,383	18,754
2014	139	45.6	1,350	17,777
2015	142	47.5	1,447	18,470
2016	142	51.1	1,480	19,391
2017	145	53.6	1,539	19,674
2018	143	58.6	1,643	21,012
2019	150	63.2	1,724	22,513
2020	146	59.7	1,644	20,785

Source: WPFMC (2021)

The number of vessels participating in the shallow-set fishery has declined over time from a high of 35 vessels in 2006 to a low of 11 vessels in 2018 with 14 participants in 2019. The numbers of trips and hooks have been more variable, although well below amounts in years prior (Table 26). The shallow-set longline fishery is subject to an annual hard cap for the numbers of interactions with leatherback and loggerhead sea turtles. If the fishery reaches the hard cap, under current regulations, the fishery is subject to closure.

Table 26. Number of active longline vessels and fishing effort in the Hawaii shallow-set fishery, 2010-2020.

Year	Active Vessels	Number of Trips	Number of Sets	Number of Hooks (millions)
2010	28	114	1,871	1.8
2011	20	82	1,447	1.5
2012	18	83	1,352	1.4
2013	15	58	961	1.1
2014	20	81	1,329	1.5
2015	22	69	1,130	1.3
2016	13	46	727	0.8
2017	20	70	994	1.1
2018	11	30	420	0.5
2019	14	25	284	0.4

Year	Active Vessels	Number of Trips	Number of Sets	Number of Hooks (millions)
2020	14	34	450	0.6

Source: WPFMC (2021)

Revenue in the Hawaii Pelagic Fisheries

In 2020, Hawaii-based deep-set longline vessels landed approximately 27.1 million pounds of pelagic fish valued at $71.5 million, with revenue declining about 24% from $94.3 million in 2019 (Table 27). Average price per pound of pelagic species also declined by $0.14 from 2019 to 2020 while total pelagic fishery ex-vessel revenue declined from $107.2 million to $80.2 million. Given that 2020 had strong temporary economic impacts on prices and demand due to COVID-19 restrictions in Hawaii and elsewhere in the U.S. and worldwide, the decline in average price per pound of pelagic species on an annual basis masks short term price drops for bigeye tuna and other species of as much as 75% in the months following March 2020 (WCPFC 2021). The average catch of pelagic species in the Hawaii deep-set longline fishery over 2011-2020 was 28.51 million pounds valued at $94.4 million in inflation-adjusted dollars (WPFMC 2021).

Table 27. Hawaii commercial pelagic catch, revenue, and average price by fishery, 2019-2020.

	2019			2020		
Fishery	Catch (1,000 lbs)	Ex-vessel revenue ($1,000)	Average price ($/lb)	Catch (1,000 lbs)	Ex-vessel revenue ($1,000)	Average price ($/lb)
Deep-set longline	31,865	$94,322	$3.15	27,061	$71,503	$3.01
Shallow-set longline	829	$1,972	$3.07	838	$1,293	$3.68
MHI trolling	2,479	$7,331	$3.57	1,486	$4,245	$3.35
MHI handline	687	$2,196	$3.59	579	$1,882	$3.39
Offshore handline	477	$1,037	$2.57	326	$959	$2.56
Other gear	132	$352	$3.10	110	$121	$2.86
Total	**36,468**	**$107,210**	**$3.18**	**30,399**	**$80,221**	**$3.04**

Source: WPFMC (2021)

3.3.2 American Samoa Longline Fishery

The longline fishery based in American Samoa is a limited access fishery with a maximum of 60 vessels under the federal permit program. Vessels range in size from under 40 to over 70 ft long. The fishery primarily targets albacore for canning in the local Pago Pago cannery, although the fishery also catches and retains other tunas (e.g., bigeye, yellowfin, and skipjack), and other pelagic MUS (e.g., billfish, mahimahi, wahoo, oilfish, moonfish (opah), and sharks) for sale and home consumption. The target depth for albacore tuna is approximately 100-300 m (WPFMC 2009). Troll and handline fishing also occurs on a commercial and non-commercial basis in American Samoa, representing relatively small annual catches of yellowfin and skipjack tunas, and other pelagic MUS. Troll and handline fisheries in American Samoa do not catch bigeye tuna.

American Samoa longline fishing vessels operate in the EEZ around American Samoa, on the high seas in international waters, and occasionally in the EEZs of countries adjacent to American Samoa. Additionally, around 27 American Samoa longline limited access permit holders also hold Hawaii longline limited access permits, the latter of which allows them to fish in the EEZ around Hawaii and land fish in Hawaii. As previously noted, vessels possessing both an American Samoa and a Hawaii longline limited access permit have an exception to fishery restrictions on the retention on bigeye tuna in the WCPO and may continue to land fish in Hawaii, if NMFS prohibits catch and retention of bigeye tuna in the WCPO when the fishery reaches the U.S. WCPO limit. Federal regulations prohibit commercial fishing within marine national monuments. From early 2002 (67 FR 4369) until February 3, 2016 (81 FR 5619) and again from September 20, 2017 (82 FR 43908) until July 6, 2021 (86 FR 36239) fishing within the Large Vessel Prohibited Area (LVPA) for vessels greater than 50 feet in length (generally within 50 nm of emergent lands) was prohibited. Since July 6, 2021, U.S. large longline vessels that hold a Federal American Samoa longline limited entry permit may fish within the LVPA to approximately 12-17 nm from the shoreline around Swains Island, Tutuila, and the Manua Islands. Figure 9 shows the distribution of fishing effort by the American Samoa deep-set longline fleet in millions of hooks in years 2008-2017.

The American Samoa pelagic longline fishery is managed as a limited access fishery with a maximum of 60 vessel permits. Effort in the American Samoa deep-set longline fishery peaked in 2007, when 29 vessels participated and deployed 5,920 sets with approximately 17,554,000 hooks (NMFS 2015b). Since that time, fishery statistics across all categories have generally declined (Table 28). In 2020, 11 vessels made 90 trips and deployed 1,227 sets with 3.4 million hooks (WPFMC 2021).

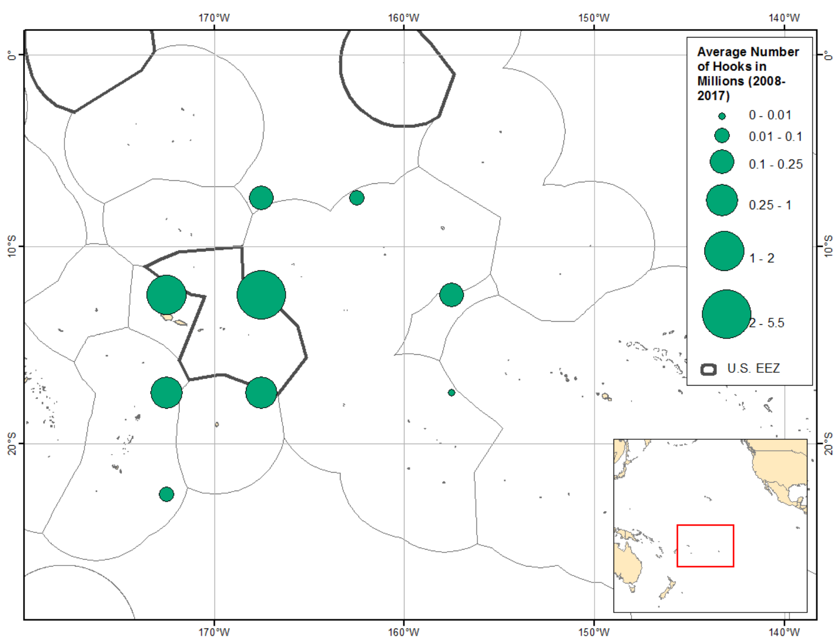


Figure 9. Operating area of the American Samoa longline fleet, shown in average number of hooks (millions) per five degree square for years 2008-2017.

Table 28. Fishing effort in the American Samoa longline fishery, 2009-2018.

Year	Vessels	Fishing effort (thousand hooks)	Fishing effort (trips)*	Fishing effort (sets)
2010	26	13,184	265	4,537
2011	24	11,074	276	3,891
2012	25	12,112	211	4,210
2013	22	10,184	104	3,411
2014	23	7,667	196	2,748
2015	21	7,806	169	2,786
2016	20	6,909	213	2,451
2017	15	6,623	135	2,333
2018	13	5,952	145	2,185
2019	17	4,769	114	1,695
2020	11	3,401	90	1,227

*Note: Trip and set numbers in years 2010-2014 are from NMFS (2015c), year 2015 trip and set numbers are from WPFMC (2017a), year 2016 trip and set numbers are from WPFMC (2017b), year 2017 trip and set numbers are from WPFMC (2018b), year 2018 trip and set numbers are from WPFMC (2019b), and year 2020 trip and set numbers are from WPFMC (2021).

Source: WPFMC (2019b) unless otherwise noted.

Revenue in the American Samoa Longline Fishery

In 2018, the American Samoa longline fleet landed approximately 4.1 million pounds of pelagic species with an estimated revenue of $4.3 million (WPFMC 2019). Landings and revenue have generally declined over the last ten years (Figure 10).

On October 7, 2021, NMFS published a final rule (FEP amendment 9) modifying the American Samoa longline permit size classes, requirements about minimum landings, and qualifications for obtaining a permit (86 FR 55743). The rule, effective November 8, 2021, is expected to reduce regulatory barriers that may be limiting small vessel participation in the fishery, and provide for sustained community and American Samoan participation in the fishery, but is not expected to expand the fishery substantially.

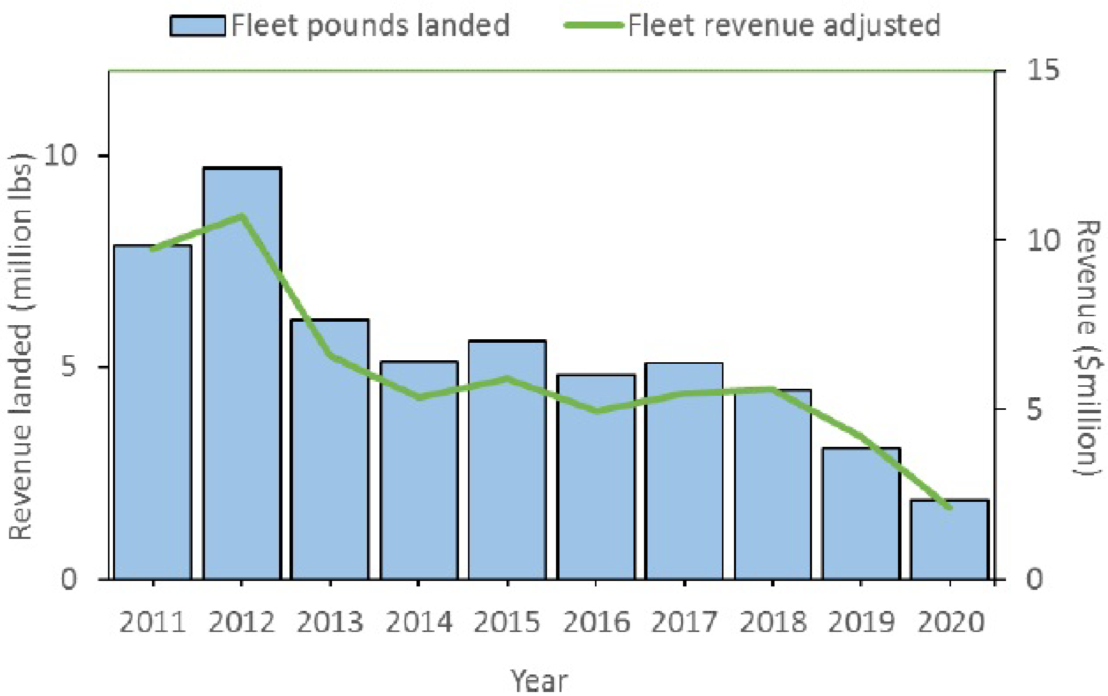


Figure 10. Landings, revenue, and price for American Samoa longline fishery from 2011-2020 adjusted to 2020 dollars.
Source: WPRFMC (2021),

3.4 Management Setting

The deep-set and shallow-set longline fisheries are managed under a single limited access fishery with a maximum of 164 vessel permits. The deep-set fishery is monitored at approximately 20% observer coverage. All Hawaii permitted vessels are required to provide 72-hour advance notification prior to leaving port on a fishing trip to declare trip type (shallow-setting or deep-setting) and to receive observer placement. Vessels may not switch gear type during a trip once a trip is declared and underway. NOAA Office of Law Enforcement (OLE) and U.S. Coast Guard (USCG) enforce these regulations for all Hawaii permitted vessels. A summary of current management requirements are as follows:

Fishing Permits and Certificates Required (on board each fishing vessel)

- Hawaii 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 Hawaii 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.
- 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.
- Papahanaumokuakea Marine National Monument: Prohibited commercial in the Monument, which has boundaries that align with the NWHI Longline Protected Species Zone.

Protected Species Workshop

- 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 Hawaii 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/dehooking gear specified in regulations.
- Vessel owners and operators can choose between side setting and stern setting, with additional requirements to reduce seabird interactions when deep-set longline fishing north of 23° North.
- When shallow-set longline fishing north of the Equator:
    - Use 18/0 or larger circle hooks with no more than 10° offset.
    - Use mackerel-type bait.
    - Set at night for stern set vessels.

- Vessel owners, operators, and crew are required to release any oceanic whitetip shark or silky shark and take reasonable steps for its safe release.

Marine Mammal Handling and Release

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

Unless otherwise noted, the above regulations are at 50 CFR Part 665. A summary of regulations for Hawaii longline fisheries (shallow-set and deep-set combined) is provided by the Summary of Hawaii Longline Fishing Regulations (WPFMC 2021). A detailed description of the management setting for the deep-set fishery can also be found in the FEP (WPFMC 2009a)

NMFS also conducts activities relevant to managing the longline fisheries as a whole. These include the ESA listing process, the ESA consultation process, and conducting status reviews and recovery planning under the ESA. NMFS also manages the Hawaii longline fishery through a take reduction team to reduce interactions with false killer whales. These management processes would continue under the proposed action without change.

NMFS and the Council administer the U.S. Pacific participating territories' use, assignment, allocation, and management of catch limits of pelagic MUS, or fishing effort limits, through agreements with U.S. vessels permitted under the FEP consistent with the Magnuson-Stevens Act and WCPFC management mandates. NMFS and the Council conduct several administrative processes relevant to managing territorial catch and effort limits, including but not limited to monitoring the effectiveness of catch or effort limits; in-season catch monitoring; enforcement; and publication of catch limits, specified fishing agreements, and closures.

NMFS determines the status of internationally managed stocks based on stock assessments produced by various scientific bodies. These bodies provide advice to the WCPFC in the WCPO and IATTC in the EPO. NMFS reviews the assessments and notifies the Council if overfishing is occurring or if a stock is overfished. If the Council and NMFS consider the stock is overfished due to international fishing pressure, they work with the State Department to put management measures into place internationally. If U.S. fisheries are responsible for the stock status, Councils and NMFS develop management measures to end overfishing. Additionally, the Council includes information from each newly assessed stock in its annual SAFE report. This work would not change under the alternatives.

Annually, the Council reviews whether territorial catch, effort, and allocation limits of bigeye tuna under the auspices of FEP Amendment 7 are consistent with the conservation needs of fish stocks, management objectives of the WCPFC and the FEP, and the needs of fishing communities. The Council has performed this review since the approval of the measure in 2014. This review typically includes preparation of the analysis that evaluates the potential effects of the bigeye tuna catch outcomes on the future status of WCPO bigeye tuna, and generally includes SPC evaluations of the tropical tuna measure if the range of limits the Council considers falls within the assumptions made in the SPC evaluation.

Regarding enforcement, the OLE and USCG monitor vessel compliance with applicable regulations and laws, including territorial catch/effort or allocation limits, through vessel monitoring systems and vessel boarding at sea.

Publication of catch, effort, and allocation limits occurs after the Council makes a recommendation regarding the limits. NMFS implements the recommendations through notice-and-comment rulemaking, which involves a review for consistency with the FEP, the Magnuson-Stevens Act, WCPFC decisions, and other applicable laws. NMFS has implemented Council-recommended territorial catch and allocation limits for bigeye tuna under the FEP every year since 2014.

Publication of specified fishing agreements occurs after receipt of the agreement from vessels party to the agreement and territorial governments. The Council and NMFS review each agreement for consistency with the FEP and implementing regulations, the Magnuson-Stevens Act, and other applicable laws. Then, NMFS authorizes the agreements through notice in the Federal Register. NMFS and the Council have reviewed and NMFS has authorized one or two specified fishing agreements under the FEP every year since 2014. The territorial catch, effort, and allocation limit measure's implementing regulations at 50 CFR 665.819 require that specified fishing agreements direct funds to the Western Pacific Sustainable Fisheries Fund (WP SFF) (Magnuson-Stevens Act Sec. 204(e)(7)) to support fisheries development projects identified in a U.S. participating territory's marine conservation plan (MCP) (Magnuson-Stevens Act Sec. 204(e)(4)), or that vessels operating under such agreements must land in the territory to which the agreement applies. Pursuant to Section 204(e) of the Magnuson-Stevens Act, the Council, in close coordination with a particular U.S. participating territory, would use the WP SFF to implement fishery development projects identified in that territory's MCP. The administration of this funding is not considered part of the proposed action, and is analyzed as project details become available. The requirements for fishing agreements, and the approval and notice process would not change under the alternatives.

NMFS publishes notice of closures of the WCPO in the Federal register seven days before we expect the fishery to reach the U.S. limit in the WCPO, territorial catch limits, or an allocation limit authorized through a specified fishing agreement. NMFS also sends letters to notify permit holders of impending closures. NMFS has closed the WCPO bigeye tuna fishery in 2015, 2016, and 2017 for 65, 48, and 39 days, respectively, (Ayers et al. 2018), through one *Federal Register* notice per year.

3.5 Resources Eliminated from Detailed Study

There are presently no known districts, sites, highways, cultural resources, structures or objects listed in or eligible for listing in the National Register of Historic Places in the EEZ around American Samoa, Guam, CNMI, and Hawaii, in the PRIA, or in adjacent areas of the high seas in international waters where pelagic longline fishing activities are conducted. Additionally, longline fishing activities are not known to result in adverse effects to scientific, historic, archeological or cultural resources because fishing activities occur generally miles offshore. Shipwrecks would be the only known cultural objects potentially within the affected environment. The location of most shipwrecks is unknown. However, longline fishing operations do not come into contact with the seafloor, so the deep-set fishery would not be expected to affect any material from shipwrecks, embedded in the ocean bottom. Therefore, the proposed action is not likely to affect historic resources.

Vessels fishing using deep-set longline gear and permitted under the FEP fish in portions of National Marine Monuments that are open to longline fishing. That fishing is not known to be causing adverse effects to the ecological, cultural or scientific resources protected within the Monuments, and a measure to change leader material and require removal of trailing gear from oceanic whitetip sharks would not change the conduct of the fishery in any way that would cause effects on Monument resources, so this topic will not be considered further.

The deep-set fishery does not operate within estuarine waters or have the potential to affect wetlands. Because pelagic longline fishing activities authorized occur offshore and in deep oceanic waters away from land, populated areas, and marine protected areas such as marine national monuments, the alternatives considered would not have an effect on air/water quality, coral reefs, or benthic marine habitats.

Longline fishing is not known to be a potential vector for spreading alien species as most vessels fish far away from coastal areas offshore. The proposed action would not increase the potential for the spread of alien species into or within nearshore waters in Hawaii or any of the U.S. participating territories.

NMFS is not aware of studies that show effects from pelagic longline fisheries to species fecundity or negative predator/prey relationships that result in adverse changes to food web dynamics. Without management to ensure fishing is sustainable, the removal of top predator pelagic species such as swordfish and other billfish, as well as tuna species above natural mortality rates has the potential to cause major imbalances or wide-ranging changes to ecosystem functions, biodiversity, and habitats. However, both international and domestic fishery managers are controlling catches throughout the Pacific. NMFS expects such control to improve stock status and prevent imbalances or wide-ranging changes to ecosystem function. Therefore, NMFS does not analyze effects on biodiversity and/or ecosystem function in this assessment.

4 ENVIRONMENTAL EFFECTS OF THE ALTERNATIVES

This chapter describes the potential environmental consequences that could result from the Alternatives considered. The analysis relies on the information described in Chapter 3 as the baseline to evaluate the impacts of the management alternatives considered herein. The environmental resources that are potentially affected include the following: target and non-target species (including bycatch), protected resources, socioeconomic setting and management setting. A summary of potential effects is presented in Table 39.

4.1 Potential Effects on Target and Non-target Stocks

This section describes the potential effects of the alternatives for gear and release requirements in the longline fisheries on target and non-target stocks identified in Section 3.1. Under all alternatives, NMFS, the Council, and RFMOs such as the WCPFC and IATTC would continue to adjust fishery management measures based on the best available information to prevent overfishing.

4.1.1 Alternative 1: No Action

Under Alternative 1, the Council would not recommend changes to the regulations implementing the FEP, and the longline vessels operating under the FEP would not be prohibited from using wire leaders, and would not be required to remove trailing gear from oceanic whitetip sharks. As described in Section 2.4.1, the no action alternative assumes that the Hawaii deep-set longline fishery would continue to use mostly wire leaders consistent with the historical baseline. Therefore, under Alternative 1, fishing effort and catch of longline vessels operating under the FEP are expected to remain at similar levels as described in Section 3.3. The longline fisheries are and will continue to be sustainably managed, and are not having negative effects on target and non-target stocks described in Section 3.1 under the status quo.

4.1.2 Alternative 2: Prohibit Wire Leaders in the Hawaii Deep-set Longline Fishery and Require Removal of Trailing Gear from Oceanic Whitetip Sharks (Council Preferred Alternative)

Under Alternative 2, the use of wire leaders would be prohibited in the Hawaii deep-set longline fishery under regulations implementing the FEP. Alternative 2 would also require that vessel owners and operators remove trailing gear from oceanic whitetip sharks as safely as practicable, with the applicability of this requirement to be considered under Sub-Alternative 2A (only applicable in the Hawaii deep-set longline fishery) and Sub-Alternative 2B (applicable to all Western Pacific pelagic longline fisheries operating under the FEP). The requirement to remove trailing gear would only apply to oceanic whitetip sharks, and would not apply to target and non-target catch, or other shark species. While the requirement to remove trailing gear from oceanic whitetip sharks may also lead to voluntary removal of trailing gear from other more common shark species in the long-term, the extent to which such voluntary behavior would be adopted by fishermen is unknown at this time. Therefore, we conclude that the requirement to remove trailing gear would have no effects on target and non-target stocks, and minor reductions in adverse effects on non-ESA-listed sharks, depending on the extent to which trailing gear is removed voluntarily. The remainder of the analysis for Alternative 2 focuses on the effects of the leader material.

Leader material is known to affect catch rates of certain fish species because material affects the visibility of the leader underwater. For example, wire leaders are visible to tuna at longer distances underwater than monofilament nylon leaders (4.2 m for wire and 1.2 m for nylon; Morinaga et al., 1993). Two experimental studies in pelagic longline fisheries have examined the effect of wire and monofilament nylon leaders on target and non-target catch rates (Afonso et al. 2012; Ward et al. 2008). These studies suggest that bigeye tuna catch rates are likely to be higher on monofilament nylon leaders than on wire leaders, whereas the effect of leader material on non-target species is less clear due to smaller sample sizes obtained in these studies (Table 29).

Recent analyses conducted by PIFSC using Hawaii longline observer data show that the effect of leader material on target and non-target species is likely to vary by species (Bigelow and Carvalho 2021a). For example, the analysis showed statistically higher swordfish catchability on monofilament leaders compared to wire leaders, and statistically lower catchability in albacore and skipjack tunas as well as mahimahi (Table 30). Statistically significant differences were not seen for bigeye, yellowfin tuna, and striped marlin (Table 30), although the direction of the effects was consistent with the aforementioned experimental studies (Afonso et al. 2012; Ward et al. 2008). Shark species generally had lower catchability on monofilament leaders, with blue shark and shortfin mako shark having statistically significant reductions, while differences in catchability of oceanic whitetip shark and bigeye thresher shark were not statistically significant. Results for the less common shark species should be interpreted with caution, as the Hawaii longline observer data have limited sample sizes for sets with monofilament nylon leaders.

Table 29. Summary of catch rates of target and non-target species by leader material type from two experimental studies (Ward et al. 2008; Afonso et al. 2012).

Species	Ward et al. 2008				Afonso et al. 2012		
	N	CPUE (per 1,000 hooks)		Relative catchability[a]	*N*[b]	CPUE (per 1,000 hooks)	
		Nylon	Wire			Nylon[c]	Wire[c]
Bigeye tuna	441	6.77	4.97	1.26	104	7.06	4.71
Yellowfin tuna	1,686	22.24	22.66	0.93	32	1.88	1.18
Striped marlin	30	0.29	0.51	0.55	--	--	--
Mahimahi	290	4.01	3.71	1.03	41	2.82	3.06
Ono	72	0.85	1.07	0.78	9	0.71	0.24
Blue shark	--	--	--	--	77	3.76	5.41
Silky shark	32	0.32	0.53	0.61	24	0.94	1.41
Oceanic whitetip shark	14	0.08	0.29	0.31	11	0	0.24

[a] The estimated parameter of the leader type variable from the conditional logistic regression.
[b] Includes captures on J-hooks.
[c] Circle hook captures only.

Based on the available data described above, the prohibition of wire leaders in the Hawaii deep-set longline fishery is expected to have a small effect on the catchability of some target and non-target species. A slight increase in bigeye tuna catch may be anticipated, although the difference was not statistically significant.

The extent to which changes in target and non-target CPUE resulting from the leader material conversion would affect overall effort of the deep-set longline fishery is unknown and has not been quantified. However, the Hawaii deep-set longline fishery operates under a bigeye tuna quota, and any increase in overall bigeye tuna catch would remain within approved catch and transfer limits.

Because catches would not change substantially and all of the pelagic MUS caught in the Hawaii and American Samoa longline fisheries are sustainable and have room for additional catch, the required change to monofilament leader would have negligible effects on target and non-target stocks. The change in catchability of certain target and non-target stocks is evaluated in terms of revenues in section 4.3.2 below.

Table 30. Generalized Linear Model (GLMs) coefficients for the Hawaii deep-set longline fishery (2005-2019) analysis.

Species	Branch line type (*P*-value)	Monofilament catch rate coefficient[a] (95% C.I.)	Statistically different ($P<0.05$)
Tuna PMUS			
Albacore	0.012	0.927 (0.874-0.983)	Yes
Bigeye tuna	0.163	1.028 (0.989-1.068)	No
Skipjack tuna	<0.001	0.856 (0.795-0.926)	Yes
Yellowfin tuna	0.144	1.054 (0.983-1.131)	No
Billfish PMUS			
Swordfish	<0.001	1.193 (1.101-1.291)	Yes
Blue marlin	0.287	0.945 (0.851-1.047)	No
Spearfish	0.081	0.939 (0.876-1.006)	No
Striped marlin	0.268	0.958 (0.889-1.032)	No
Other PMUS			
Mahimahi	0.019	0.930 (0.877-0.988)	Yes
Ono (wahoo)	0.237	1.038 (0.986-1.105)	No
Opah (moonfish)	0.195	0.964 (0.905-1.021)	No
Shark PMUS			
Oceanic whitetip shark	0.590	0.949 (0.783-1.143)	No
Blue shark	<0.001	0.905 (0.871-0.994)	Yes
Bigeye thresher shark	0.053	0.894 (0.797-1.002)	No
Shortfin mako shark	<0.001	0.675 (0.599-0.7589)	Yes

[a] GLM coefficients are estimates of relative catchability between monofilament and wire branch line types with inclusion of other explanatory variables. Coefficients less than 1.0 indicate lower catchability on monofilament branch lines.
Source: Bigelow and Carvalho (2021a)

4.1.3 Alternative 3: Prohibit Wire Leaders in the All Western Pacific Pelagic Longline Fisheries and Require Removal of Trailing Gear from Oceanic Whitetip Sharks

Under Alternative 3, use of wire leaders would be prohibited for all longline vessels operating under FEP under regulations implementing the FEP. Alternative 3 would also require that all longline vessel owners and operators fishing under the FEP remove trailing gear from oceanic whitetip sharks as safely as practicable by leaving the animal in the water and cutting as much trailing gear away from the animal as possible.

The effects of Alternative 3 on target and non-target stocks would be similar to that of Alternative 2 because all other longline fisheries currently operating under the FEP (Hawaii shallow-set and American Samoa fisheries) already use monofilament nylon leaders by preference, and thus a prohibition of wire leaders would not change the gear type used in these fisheries. There is currently no active Guam or CNMI longline fishery operating under the Western Pacific general longline permit.

Because catches would not change substantially and all of the pelagic MUS caught in the Hawaii and American Samoa longline fisheries are sustainable and have room for additional catch, the required change to monofilament leader would have negligible effects on target and non-target stocks. The change in catchability of certain target and non-target stocks is evaluated in terms of revenues in section 4.3.2 below.

4.2 Potential Effects on Protected Resources

This section describes the potential effects of the alternatives for gear and release measures in the longline fisheries on protected species identified in Section 3.2. Under all alternatives considered, the Hawaii and American Samoa longline fisheries will continue to operate under existing gear and handling measures for seabirds and sea turtles under the FEP, as well as the measures implemented under the FKWTRP (50 CFR 229.37). Under all alternatives considered, NMFS will continue to monitor the Hawaii and American Samoa longline fisheries under a Federal observer program.

Under all outcomes associated with the alternatives, the current and maximum foreseeable levels of fishing effort by longline fisheries managed under the FEP will continue to be subject to applicable biological opinions, including regulations implementing the terms and conditions required to mitigate impacts on protected species. As noted in Section 3.2, NMFS is required to re-initiate consultation under ESA Section 7 if the level of anticipated take in any ITS applicable to the shallow-set fishery is exceeded or another criterion for reinitiation is triggered. To meet management mandates, the Council, NMFS, and the RFMOs will continue to develop protected species mitigation measures as resource issues are identified through reporting and monitoring.

4.2.1 Alternative 1: No Action

Under Alternative 1, protected species interactions in the longline fisheries operating under the FEP would remain at levels similar to the baseline as described in Section 3.2. Continued use of wire leaders in Hawaii deep-set longline fishery would minimize chances that oceanic whitetip sharks may bite or break free of branch line, and make it difficult to remove trailing gear.

4.2.2 Alternative 2: Prohibit Wire Leaders in the Hawaii Deep-set Longline Fishery and Require Removal of Trailing Gear from Oceanic Whitetip Sharks (Council Preferred Alternative)

Alternative 2 does not have the potential to change any longline fishery in terms of location, effort, seasonality, intensity, or any other way except in terms of leader material and handling of oceanic whitetip sharks prior to release. Although the change in leader material in the Hawaii deep-set fishery is unlikely to change their interaction rates, it may facilitate removal of fishing gear from protected species other than oceanic whitetip sharks. Therefore, in this section, we will focus effects of the proposed action under Alternatives 2A and 2B on oceanic whitetip sharks and other protected species that may be meaningfully affected by a change in leader material.

Alternative 2 would not change leader material in the American Samoa or Hawaii shallow-set longline fisheries and, therefore, we will not focus on those fisheries.

Limited data are available from the Hawaii deep-set longline fishery on the effect of leader material on protected species interactions due to the vast majority (approximately 95%) of fishing effort observed since 2004 using wire leaders. The observed number of interactions and average interaction rates of ESA-listed species since 2004 by leader material is shown in Table 31. The low amount of effort with monofilament leaders means there are limited samples sizes for ESA-listed species caught on that leader type, making comparisons of catch rates across the two leader types difficult. Potential effects of Alternative 2 for oceanic whitetip sharks, leatherback turtles, giant manta rays, false killer whales, and other protected species considering all available information are discussed in further detail below.

Table 31. The number of ESA listed animals captured, the average annual catch per 1,000 hooks set (CPUE x 1,000), and the percent alive at capture on sets with wire and monofilament (mono) leaders and (a) all hook types and (b) only circle hooks in the Hawaii deep set longline fishery, 2004-2020.

		number captured		CPUE (x1000 hooks)		percent alive at capture	
species	total interactions	wire	mono	wire	mono	wire	mono
green turtle (TUG)	20	18	2	0.0001	0.0002	3.0%	0.0%
leatherback turtle (DKK)	41	39	2	0.0003	0.0003	74.3%	50.0%
loggerhead turtle (TTL)	15	15	0	0.0001	0.0000	27.1%	-
olive ridley turtle (LKV)	200	193	7	0.0012	0.0010	5.4%	16.7%
oceanic whitetip shark (OCS)	5362	5073	289	0.0390	0.0291	77.1%	76.0%
scalloped hammerhead shark (SPL)	32	31	1	0.0002	0.0001	72.8%	0.0%
giant manta (RMB)	43	41	2	0.0003	0.0004	96.3%	100.0%

Oceanic Whitetip Shark

The degree of impacts to oceanic whitetip sharks from the Hawaii deep-set longline fishery is expected to be reduced with the transition from wire to monofilament nylon leaders, primarily from increased bite-off potential and greater removal of trailing gear.

Catch rates of shark species including blue, silky, and oceanic whitetip sharks are likely to be higher on wire leaders (Table 29), which can be attributed to bite-offs on nylon leaders (Afonso et al. 2012; Ward et al. 2008). In a controlled experiment assessing the effects of hook type (J-hook and circle hook) and leader material (wire and nylon) on longline catch and mortality rates, Afonso et al. (2012) assumed that sharks are most likely to be responsible for most of the bite-offs, and that leader material would not affect the odds of sharks biting the bait. Based on the total number of sharks caught on wire (N = 86) and monofilament nylon (N = 56) leaders, the number of bite-offs observed for each leader material (wire = 1; monofilament = 36), and the assumption that the number of bite-off equals the number of sharks that escaped from the line (Afonso et al. 2012), the bite-off rate calculated from this study would be 1.1% for wire leaders and 39.1% for monofilament leaders for J-hooks and circle hooks combined. Shark bite-off on monofilament leaders is thought to be more frequent on J-hooks or tuna hooks due to their tendency of throat or gut hooking, compared to circle hooks which are more likely to result in mouth or jaw hooking (Afonso et al. 2012; Ward et al. 2008). Afonso et al. (2012) do not present data on bite-offs by hook type, and thus hook-specific bite-off rates cannot be calculated. However, the study reported that, of the 37 bite-offs included in the analysis of their controlled experiment, all but one occurred on monofilament leaders, and 68% (25 cases) occurred on J-hooks, while the remaining 32% (12 cases) occurred on circle hooks. The studies by Afonso et al. (2012) and Ward et al. (2008) involved fishing under limited scenarios of fishing operations and area with relatively low sample sizes. However, these studies provide corroborating evidence, using a controlled experimental design, to demonstrate the reduction in catch and retention for sharks and other non-target species.

Leader material is not expected to change the initial interaction rate for sharks (Afonso et al. 2012), and data are lacking on survivorship rates of sharks that escape longline gear after bite-offs. However, sharks that escape are more likely to be resilient, healthy sharks (Afonso et al. 2012), and early release from the longline gear would be expected to reduce capture stress. Thus, it is reasonably likely that sharks that bite-off the gear have higher survival rates compared to sharks that are released after being brought to the vessel.

Wire leaders also make it difficult for fishermen to remove the terminal portion of the branch line from sharks or other protected species that cannot be brought on board. Due to the difficulty of cutting through the wire leader from deck height, shark interactions in the Hawaii deep-set longline fishery typically result in the line being cut above the weighted swivel, leaving at minimum the hook, wire leader, weighted swivel, and some amount of monofilament nylon branch line trailing on the shark. The average length of trailing gear for sharks released in the Hawaii deep-set longline fishery is 8.75 m (range: 0-30 m), and varies by species (Hutchinson et al. 2021). Tagging data from the Hawaii and American Samoa longline fisheries indicate that reducing the amount of trailing gear (e.g., <1 body length, or 0.5 m) left on sharks increases post-release survivorship (Hutchinson and Bigelow 2019).

As described in section 1.1, shark catch rates are likely to be higher on wire leaders due to the material preventing bite-offs, although bite-off rates on circle hooks used in all of the U.S. Pacific longline fisheries are thought to be less than those of J-hooks. Species-specific bite-off data for oceanic whitetip sharks are not available. In the recent PIFSC analysis (Bigelow and Carvalho 2021a), the change in catchability with transition from wire to monofilament leaders for oceanic whitetip shark was not statistically significant (median catchability coefficient on monofilament = 0.949, 95% CI = 0.783-1.144, $p = 0.590$) likely due to the small sample size. Shortfin mako shark catchability was used as a proxy for oceanic whitetip sharks (median catchability coefficient on monofilament nylon leaders = 0.675, 95% CI = 0.599-0.759, $p < 0.001$) due to the larger sample size and similarities in morphology and behavior that are likely to affect bite-off rates (Bigelow and Carvalho 2021a). Note that catchability here refers to the rate at which sharks are retained on hooks until the gear is retrieved, not the number of sharks that initially interact with fishing gear. Gear interaction rates would be expected to be similar for these sharks across leader types (Afonso et al. 2012).

The average length of trailing gear for shark interactions in the Hawaii deep-set longline fishery is 8.75 m (range: 0-30 m) for all shark species, and 5.44 m (range: 1-12 m) for oceanic whitetip sharks (Hutchinson et al. 2021). Tagging data from the Hawaii and American Samoa longline fisheries indicate that reducing the amount of trailing gear left on sharks increases post-release survivorship (Hutchinson and Bigelow 2019; Hutchinson et al. 2021). Analysis of tagging data and Hawaii longline observer data show that switching from wire to monofilament leaders alone would increase the post-release survivorship of oceanic whitetip sharks by about 1%, while the leader material change combined with trailing gear removal would increase survivorship of oceanic whitetip sharks released alive by 5% (Hutchinson et al. 2021; Table 32). Tagging data indicate that post-release survivorship of sharks are similar (0-1% difference) when released with 1 m of trailing gear compared to 0 m of trailing gear (Hutchinson et al. 2021).

Table 32. Oceanic whitetip shark survival projections by gear type and remaining trailing gear based on the 60-day post-tagging data.

	Median Survivorship (90% CI)	
Trailing gear	Wire	Mono
10m	0.92 (0.81–0.97)	0.93 (0.77–0.98)
1.8m	0.95 (0.89–0.99)	0.96 (0.88–0.99)
Removed (0m)	0.96 (0.90–0.99)	0.97 (0.89–0.99)

Source: Hutchinson et al. (2021)

Bigelow and Carvalho (2021a) developed a detailed statistical analysis of anticipated change in mortality rates for oceanic whitetip sharks integrating data and assumptions about bite-off rates, survival of sharks after a bite-off (Hutchinson et al. 2021), and improvements in post release survival with removal of trailing gear to estimate mortality rates after hooking. Bigelow and Carvalho's analysis found a 30% reduction in expected oceanic whitetip shark mortality overall; accounting for bite-offs, mortality of sharks after bite-off, mortality at the vessel, and post release mortality (median estimate of 362 individuals under status quo wire leaders compared to 255 under monofilament leaders) (Bigelow and Carvalho 2021a; Table 33). The simulations assumed that the trailing gear would be reduced from an average of approximately 10 m to removal of all trailing gear (0 m). Tagging data indicate that post-release survivorship of oceanic whitetip sharks released with 1 m of trailing gear is the same as those released with zero trailing gear (Hutchinson et al. 2021).

As described in 3.1.1, the WCPO oceanic whitetip shark population is projected to increase. Therefore, the estimated interactions and mortalities may increase as a result of an increase in stock abundance, and the estimates provided here may become an underestimate in the future.

Bite-offs with higher survivorship rates, as well as the ability to remove more gear from the remaining sharks that are brought to the vessel are likely to have a combined effect of reducing impacts to sharks when monofilament leaders are used in place of wire leaders. Under the WCPFC CMM for Sharks (CMM 2019-04), flag states are required to comply with one of two options for longline fisheries targeting tuna and billfish: 1) do not use or carry wire trace as branch lines or leaders; or 2) do not use branch lines running directly off the longline floats or drop lines, known as shark lines. Harley and Pilling (2016) evaluated the potential impact of WCPFC member countries' choice among these two options and found that if flag states choose the option least used by their vessels, reductions to mortality were estimated to be 10% for oceanic whitetip sharks. They also found that if both options were required by all flag states, mortality reduction was 37% (Harley and Pilling 2016). A recent update of this analysis indicates that a ban of both shark lines and wire leaders would reduce fishing mortality by 40.5% for oceanic whitetip sharks (Bigelow and Carvalho 2021b).

In summary, the proposed action under Alternatives 2A and 2B (prohibiting wire leaders and requiring trailing gear removal) in the Hawaii deep-set longline fishery is expected to have moderate positive effects on survival of individual oceanic whitetip sharks, which, although positive, would contribute nominally to the conservation and improved status of the stock because of the limited contribution to the status of the stock the Hawaii longline fishery makes. Implementing the measure may serve as a model for management that could be adopted by other nations, so there could be unquantifiable benefits to the stock for implementing this measure.

Table 33. Annual anticipated oceanic whitetip shark interactions and mortality in the Hawaii deep-set longline fishery.

	Median catch and mortality (95% CI)		
Catch and Fate Components	Status Quo (Wire Leader)	Monofilament Leader	Percent change
Initial interactions at hook	1,708	1,708	0%
Catch at retrieval (from bite-offs)	1,708	1,153 (1,027-1,298)	-32%
Total mortality	**352** (326-417)	**255** (214-337)	**-30%**
Mortality at retrieval	328 (303-354)	222 (192-256)	*-32%*
Mortality at retrieval + handling mortality	333 (307-360)	225 (195-259)	*-32%*
Mortality at retrieval + handling mortality + post-release mortality	362 (326-417)	255 (214-337)	*-30%*

Source: Bigelow and Carvalho (2021a).

Extending the requirement for removing trailing gear to all Western Pacific pelagic longline vessels (Sub-Alternative 2B) is expected to have a relatively small effect on reducing post-hooking mortality of oceanic whitetip sharks (2-6%, Hutchinson et al. 2021), and we conclude that the effects of Sub-Alternative 2B would not be substantially different from those of 2A. However, the application of such a requirement in all U.S. pelagic longline fisheries in the Western Pacific is expected to help promote adoption of internationally binding handling measures at the RFMOs to appreciably reduce the mortality of oceanic whitetip sharks in international longline fisheries. Such a beneficial outcome is speculative, and unquantifiable, but is more likely to encourage adoption of international measures than Alternative 2A, which would only apply the gear removal requirement to the Hawaii deep-set longline fishery.

Leatherback Turtle

Leatherback turtle interaction rates are not known to be affected by leader material. Of the 53 observed leatherback turtle interactions in the Hawaii deep-set longline fishery for the 1994-2020 period, only 4 have been observed on monofilament nylon leaders, 48 on wire leaders, and one on other leader material. The proportion of leatherback turtles captured on monofilament nylon leaders during this period (7.5%) is not substantially different from the proportion of sets using monofilament nylon leaders during the same period (9%).

Of the 40 observed leatherback turtle interactions in the Hawaii deep-set longline fishery between 2004-2020, 18 interactions (45%) were released alive with some amount of trailing gear. Of these, seven interactions had trailing gear longer than half the carapace length, ten interactions had trailing gear less than half the carapace length, and one interaction was released with entanglement remaining. Most of the leatherback turtles that were released with trailing gear less than half the carapace length had the line cut above the wire leader. The overall post-hooking mortality rate for this period is 0.375, calculated based on the injury category and release condition described in Ryder et al. (2006). If observed interactions where animals were released alive with trailing gear had all gear except for the hook removed (i.e., assume line cut above hook), then the post-hooking mortality would be reduced to 0.365 (3% reduction). If all gear were removed from those observed individuals, then the post-hooking mortality rate would be reduced to 0.325 (13% reduction). Observed interactions in the deep-set fishery from 2004-2020 suggest that conversion of leader material to monofilament may have a minor positive effect in improving future post-hooking survival of leatherback turtles by facilitating removal of trailing gear, which would also promote greater compliance with existing regulations for sea turtle handling.

Table 34. Number of observed leatherback turtle interactions in the Hawaii deep-set longline fishery by leader material and entanglement, 1994-2020.

Entanglement	Total	Mono	Wire	Other
No	33	2	31	0
Yes	14	1	12	1
No data (unknown or blank field)	6	1	5	0
Total	53	4	48	1

Source: Unpublished observer data.

Table 35. Summary of leatherback turtle interaction outcomes for 2004-2020 in the Hawaii deep-set longline fishery by injury category and release condition described in Ryder et al. 2006.

	Release condition					
Injury category	A: Released with hook and trailing line ≥ ½ carapace length	B: Released with hook and trailing line ≤ ½ carapace length	C: Released with hook & entangled	D: Released with all gear removed	Dead	Total
I: Hooked externally with or	5	7	1	12	--	25

	Release condition					
Injury category	A: Released with hook and trailing line ≥ ½ carapace length	B: Released with hook and trailing line ≤ ½ carapace length	C: Released with hook & entangled	D: Released with all gear removed	Dead	Total
without entanglement						
I-III: Hooked internally or externally (unknown)	0	1	0	0	--	1
V: Entangled only, no hook involved	2	2	0	1	--	5
Dead	--	--	--	--	9	9
Total	7	10	1	13	9	40

Source: Unpublished observer data.

Giant Manta Rays

Giant manta ray interactions are not known to be affected by leader material. Of the 43 observed giant manta ray interactions in the Hawaii deep-set longline fishery since 2004, 42 were released alive, of which at least 14 were entangled. The majority of the observed interaction records do not have details on how the animal was hooked, entangled, or released. Available observer data suggest that giant manta rays tend to become entangled in multiple branch lines, making it difficult to safely disentangle the animal prior to release. Change in the leader material is not likely to change the ability to remove lines from such heavy entanglement cases. If some interactions result in hookings without entanglements, monofilament leaders may facilitate removal of trailing gear; however, data are not available to quantify the potential reductions in adverse effects of such interactions.

False Killer Whales

False killer whale interaction rates are not expected to be affected by leader material. The weak hook and minimum branch line strength requirement under the FKWTRP is intended to make the hook the weakest part of the branch line to allow the hook to straighten and false killer whales to pull free of the hook if tension is placed on the line. The FKWTRP regulations allow the use of monofilament nylon leaders that have a diameter of 2.0 mm or greater, and specifies a minimum breaking strength for other materials. Of the observed interactions between 2013 and 2020 in the Hawaii deep-set longline fishery, the hook has straightened approximately 10% of the interactions, and the line broke or was cut in most cases. When the hook does not straighten and crew cut the line, the animal is typically released with trailing gear that includes the wire leader. Prohibition of wire leaders in conjunction with crew training to prevent fly back is expected to facilitate more trailing gear removal of various species including false killer whales. Therefore, conversion of leader material to monofilament in the Hawaii deep-set longline fishery may have a minor positive effect in improving post-hooking survival of false killer whales by facilitating trailing gear removal as close to the hook as possible and additional removal of trailing gear.

Other Protected Species

Leader material is not known to impact interaction rates of other protected species, and a requirement to remove trailing gear is expected to have limited impact on mortality rates. While some loggerhead turtles have been released alive in the deep-set fishery, available observer data suggest that the manner in which this species is released is not likely to change with leader material as loggerhead turtles are typically small enough to be brought on board, which facilitates removal of any trailing gear. Of the 15 observed loggerhead interactions from 2007-2020 in the Hawaii deep-set longline fishery, six (40%) were released alive, of which five cases were brought on board, and one released with wire leader cut alongside vessel with hook remaining. Over 90% of the green and olive ridley turtle interactions in the Hawaii deep-set fishery are observed mortalities due to the depth of the gear, and leader material is not expected to affect the outcome of these interactions. Seabirds captured alive are required to be brought on board to disentangle or remove gear, and thus leader material is not expected to affect the outcome of these interactions.

4.2.3 Alternative 3: Prohibit Wire Leaders in the All Western Pacific Pelagic Longline Fisheries and Require Removal of Trailing Gear from Oceanic Whitetip Sharks

The effects of Alternative 3 on protected species would be similar to that of Sub-Alternative 2B because all other longline fisheries currently operating under the FEP (Hawaii shallow-set and American Samoa fisheries) use monofilament nylon leaders, and thus a prohibition of wire leaders would not change the gear type used in these fisheries. There is currently no active Guam or CNMI longline fishery operating under the Western Pacific general longline permit.

4.2.4 Marine Habitats and Protected Areas

Under all outcomes associated with the alternatives, NMFS does not anticipate any adverse effects to marine habitat, particularly critical habitat, essential fish habitat (EFH), habitat areas of particular concern (HAPC), marine protected areas (MPA), marine sanctuaries, or marine monuments. None of the FEP longline fisheries are known to have adverse effects on marine habitats, and none of the alternatives are likely to change the fishery in any way that would lead to substantial physical, chemical, or biological alterations to marine habitats. Fishing activity would not occur in any area designated as critical habitat besides MHI IFKW (described below). Fishing is either prohibited in the monuments, or conducted sustainably so as not to injure or destroy monument resources.

MHI IFKW prey species are considered a characteristic of the island-associated critical habitat for this DPS (83 FR 35062). For MHI IFKW prey species with estimated biomass, U.S. landings in the WCPO compared to each stock's total estimated biomass are generally less than one percent (NMFS 2021b), and international and domestic management aim to ensure the sustainability of these stocks. Additionally, the diversity in IFKW diet likely indicates the whales shift to available prey items to meet their energetic needs. The longline fisheries do not harvest MHI IFKW prey in the area designated as critical habitat. Based on this available information, NMFS does not expect the Hawaii longline fisheries to contribute to the long-term reduction in quantity, quality, or availability of MHI IFKW prey species over the range of the fish stocks that these whales encounter (NMFS 2018a, NMFS 2019a, NMFS 2020b).

Longline fishing involves suspending baited hooks in the upper surface layers of the water column, which does not materially affect benthic marine habitat under typical operations. Derelict longline gear may impact marine benthic habitats, especially substrate such as corals if carried by currents to shallow depths; however, the loss of longline gear during normal fishing operations is not believed to be at levels that result in substantial or adverse effects to EFH, HAPC, or the marine habitat (WPFMC 2014).

When fishing, all longliners occasionally lose hooks, mainline, floats, float lines, and branch lines, which include hooks, lead weights, and usually wire leaders in the deep-set fishery. Fishermen do try to recover gear, and are normally successful. The floats used in the fishery are marked to be visible from distance, even at night. Lost hooks are unlikely to have a major impact to the physical marine environment. Hooks do not continue to "ghost fish" indefinitely since baits decompose. Hooks are made of steel and decompose over time. Hooks lost on the deep seabed in water just above freezing will corrode more slowly, and stainless steel hooks will corrode at a slower rate than non-stainless steel hooks. In addition, Hawaii longline fishermen have participated in the Honolulu Harbor Derelict Fishing Gear Port Reception Program since 2006 where they voluntarily dispose of retrieved derelict nets and spent longline gear in a receptacle at Honolulu Harbor. Collected fishing gear is incinerated at Honolulu City and County's H-Power waste-to-energy plant to generate electricity.

4.3 Potential Effects on Socioeconomic Setting

There are effects on the socioeconomic setting in terms of changes in costs of fishing gear used in the Hawaii deep-set longline fishery, and anticipated changes in the catchability of target, non-target, and bycatch species that result from prohibition of wire leaders. This section reviews these changes relative to the three alternatives considered.

None of the alternatives have disproportionately high and adverse effects on the health or the environment of minority or low-income communities, compared to the impacts on other communities. The FEP longline fisheries are not known to have a large adverse environmental effect on stocks of fish that may be caught by subsistence fisherman, or on other marine resources that may be targeted for subsistence consumption. These fisheries are sustainably managed and do not pollute marine waters, and so do not have adverse effects to human health or on marine life. NMFS and the Council manage these fisheries through Federal regulations that are intended to maintain sustainable fisheries and conserve protected marine resources and habitats, while considering the economic and social well-being of fishing communities, including members of minority populations and low-income populations. The proposed rule would not change the fishery in any manner that would result in changes with respect to impacts on these populations. As a result, there would not be a disproportionately high and adverse impact to minority or low-income populations with respect to the availability of fish, other environmental effects, or health effects if NMFS implements the proposed action.

4.3.1 Alternative 1: No Action

Under Alternative 1, there would be no operational change required in any of the longline vessels operating under the FEP, and the socioeconomic setting, including the cost and revenue for each fishery, is expected to remain at similar levels as the baseline described in Section 3.3. As described in Section 2.4.1, the no action alternative assumes that the Hawaii deep-set longline fishery would continue to use mostly wire leaders consistent with the historical baseline (approximately 97% of effort using wire leaders, see Section 2.2), and that the Hawaii shallow-set and American Samoa longline fisheries would continue to use monofilament leaders consistent with the historical baseline.

The continued use of wire leaders in the Hawaii deep-set longline fishery would help to prevent gear fly back associated with the use of weighted swivels near the hook as part of the required seabird mitigation measures.

4.3.2 Alternative 2: Prohibit Wire Leaders in the Hawaii Deep-set Longline Fishery and Require Removal of Trailing Gear from Oceanic Whitetip Sharks (Council Preferred Alternative)

Under Alternative 2, the prohibition of wire leaders in the Hawaii deep-set longline fishery may affect the cost of gear replacement and repairs, as well as the revenue. Monofilament nylon leaders are more susceptible to damage, abrasion, and bite-offs, which require more frequent repairs and replacement of longline gear. The cost of additional repairs and replacements may in part be offset by the lower cost of monofilament nylon leaders compared to wire leaders. The cost of a monofilament nylon leader is $0.06-$0.17 per leader ($0.02-$0.03 for an 18 inch monofilament line and 2 sleeves at $0.02-$0.07 each depending on the brand used), and the cost of a wire leader is $0.41-$0.52 per leader ($0.17-$0.28 for an 18 inch monofilament line and 2 sleeves at $0.24 each) (N. Kanemoto, POP Fishing and Marine, Honolulu, Hawaii, pers. comm. May 2021).

On average, the Hawaii deep-set longline fishery deployed 2,876 hooks per set in 2020 (WPFMC 2021). The leaders for a single set would cost on average $173-$489 for monofilament nylon leaders and $1,179-$1,496 for wire leaders (Table 36). Longline vessels routinely replace some proportion of their branch lines and leader lines throughout their fishing operations. With HLA's announcement to voluntarily eliminate wire leaders, many Hawaii deep-set longline vessels that previously used wire leaders are transitioning to monofilament leaders as part of their routine replacement. As such, the cost of conversion is likely to be distributed over several months for most vessels. Vessels that do not voluntarily eliminate wire leaders may be required to transition their gear all at once when the regulatory amendment becomes effective; in such cases, the initial conversion cost would be on average $173-$489 per vessel.

Table 36. Estimated cost of one-time leader replacement by leader material in the Hawaii deep-set longline fishery.

Leader type	Cost[1]			Average hooks per set[2]	Cost of leaders for a full set
	Line segment	Crimp/sleeves	Total leader		
Monofilament nylon leaders	\$0.02-\$0.03	\$0.02-\$0.07 each (2 per leader)	\$0.06-\$0.17	2,876	\$173-\$489
Wire leaders	\$0.17-\$0.28	\$0.24 each (2 per leader)	\$0.41-\$0.52	2,876	\$1,179-\$1,496

1 Material cost provided by N. Kanemoto, POP Fishing and Marine, pers. comm. May 2021
2 Estimated based on 2020 total deep-set longline effort in hooks divided by total sets deployed (WPFMC 2021)

Data from research conducted in other fisheries suggest that bite-offs may represent approximately 0.3%-5% of the number of hooks deployed when using monofilament nylon leaders (Afonso et al. 2012; Ward et al. 2008). However, gear replacement and repair costs associated with bite-offs is likely to be negligible under Alternative 2 compared to Alternative 1 because over 80% of sharks captured in the Hawaii and American Samoa longline fisheries are released by cutting the line with some amount of trailing gear remaining on the shark, indicating that longline vessels routinely repair and replace branch lines after shark interactions under the status quo. Ward et al. (2008) found that the branch line repair rate (from bite-offs, damaged or abraded leaders) was 5.4% higher on monofilament nylon leaders (19.8%) than wire leaders (14.4%). The average number of hooks deployed per trip in the Hawaii deep-set longline fishery in 2020 was 36,314, and the average number of hooks deployed per vessel in 2020 was 408,904 (WPFMC 2021). Assuming that all other components of the branch line (e.g., hook, weighted swivel) would be the same between the two leader types, the cost of repairing 19.8% of monofilament leaders each trip would be on average \$431-\$1,222 per vessel, while the cost of repairing 14.4% of wire leaders would be on average \$2,144-\$2,719 per vessel (Table 37). Data on repair rates for the Hawaii deep-set longline fishery is not available, and thus the actual cost in the Hawaii deep-set longline fishery may vary from these estimates. However, these estimates suggest that while monofilament nylon leaders may require more frequent repairs, the replacement cost is likely to be less for monofilament than wire due to the lower material cost. Estimates of labor costs for the Hawaii deep-set longline fishery are not available, and thus are not included in these cost estimates.

Table 37. Estimated leader repair cost per trip in the Hawaii deep-set longline fishery.

	Monofilament nylon leaders	Wire leaders
Branch line repair rate[1]	19.8%	14.4%
Leader cost per branch line	\$0.06-\$0.17	\$0.41-\$0.52
Average number of hooks/trip[2]	36,314	36,314
Leader repair cost per trip	\$431-\$1,222	\$2,144-\$2,719

1 From Ward et al. (2008)
2 Estimated based on 2020 total deep-set longline effort in hooks divided by total trips (WPFMC 2021)

The cost may also be offset by increase in target and other fish catch of market value (Ward et al. 2008; Bigelow and Carvalho 2021a). As described in Section 4.1.2, the PIFSC analysis estimated that the transition from wire to monofilament leaders would have a statistically significant effect on catchability for some retained species, but an overall negligible effect on fishery economic revenue (Bigelow and Carvalho 2021a). Specifically, albacore tuna, skipjack tuna, and mahimahi were estimated to have statistically lower catchability on monofilament leaders, whereas swordfish was estimated to have statistically higher catchability on monofilament leaders. Catchability of bigeye and yellowfin tunas are expected to be slightly higher on monofilament leaders, and striped marlin slightly lower, although the results for these species were not statistically significant. The average (2015-2019) economic revenue in the deep-set fishery was $96,149,793 (Table 38; Bigelow and Carvalho 2021a). The actual revenue estimate for the Hawaii deep-set fleet is higher as the approximately $96 million pertains to only fish landed in Hawaii and does not incorporate Hawaii-permitted vessels landing in California where revenue is unknown. The economic impact for a transition from wire to monofilament leaders is estimated as a mean increase of $2,660,879 for the fishery (95% C.I. -1,750,655-7,333,064; Bigelow and Carvalho 2021a), or $17,739 per vessel. The increase of approximately $2.7 million is largely represented by the increase of $1,840,802 for bigeye tuna with a monofilament coefficient of 1.027 or 2.7% increase. The extent to which changes in target and non-target catchability resulting from the leader material conversion would affect overall effort or other operational factors of the Hawaii deep-set longline fishery is unknown and has not been quantified.

Table 38. Estimated change in revenue for the Hawaii deep-set longline fishery based on changes in catchability in target and non-target species.

	Deep-set longline									
	Average 2015-2019 Amount paid	Mean catchability	Mean revenue	Mean gain/Loss	2.5%	2.5% revenue	2.5% gain/Loss	97.5%	97.5% revenue	97.5% gain/Loss
Tuna PMUS										
Albacore	$ 580,781	0.927	$538,589	$ (42,192)	0.874	$507,683	$ (73,098)	0.983	$570,859	$ (9,922)
Bigeye tuna	$ 66,213,530	1.028	$68,054,332	$ 1,840,802	0.989	$65,500,344	$ (713,186)	1.068	$70,728,101	$ 4,514,571
Bluefin tuna	$ 16,964		$16,964	$ -		$16,964	$ -		$16,964	$ -
Skipjack tuna	$ 298,281	0.858	$255,781	$ (42,500)	0.795	$237,120	$ (61,161)	0.926	$276,124	$ (22,157)
Yellowfin tuna	$ 13,005,207	1.054	$13,707,865	$ 702,658	0.983	$12,783,557	$ (221,650)	1.131	$14,706,938	$ 1,701,731
Other tunas	$ 2		$2	$ -		$2	$ -		$2	$ -
Tuna PMUS Subtotal	$ 80,114,765		$82,573,534	$ 2,458,769		$79,045,670	$ (1,069,095)		$86,298,988	$ 6,184,223
Billfish PMUS										
Swordfish	$ 2,321,934	1.193	$2,769,654	$ 447,720	1.101	$2,556,682	$ 234,748	1.291	$2,997,910	$ 675,975
Blue marlin	$ 1,289,787	0.945	$1,218,906	$ (70,881)	0.851	$1,098,217	$ (191,570)	1.047	$1,350,579	$ 60,792
Spearfish	$ 609,071	0.939	$572,103	$ (36,968)	0.876	$533,734	$ (75,337)	1.007	$613,113	$ 4,042
Striped marlin	$ 1,516,730	0.959	$1,454,033	$ (62,697)	0.890	$1,349,853	$ (166,877)	1.033	$1,566,075	$ 49,345
Other marlins	$ 49,973		$49,973	$ -		$49,973	$ -		$49,973	$ -
Billfish PMUS Subtotal	$ 5,787,496		$6,064,670	$ 277,174		$5,588,458	$ (199,038)		$6,577,650	$ 790,154
Other PMUS										
Mahimahi	$ 1,674,951	0.930	$1,558,132	$ (116,818)	0.877	$1,468,313	$ (206,638)	0.988	$1,654,432	$ (20,519)
Ono (wahoo)	$ 2,091,870	0.961	$2,011,123	$ (80,747)	0.906	$1,894,232	$ (197,638)	1.021	$2,134,962	$ 43,093
Opah (moonfish)	$ 3,211,971	1.038	$3,334,472	$ 122,501	0.976	$ 3,133,723.30	$ (78,247)	1.105	$3,548,084	$ 336,113
Oilfish	$ 251,365		$251,365	$ -		$251,365	$ -		$251,365	$ -
Pomfrets (monchong)	$ 2,931,443		$2,931,443	$ -		$2,931,443	$ -		$2,931,443	$ -
PMUS sharks	$ 73,756		$73,756	$ -		$73,756	$ -		$73,756	$ -
Other PMUS Subtotal	$ 10,235,356		$10,160,292	$ (75,064)		$9,752,833	$ (482,523)		$10,594,043	$ 358,687
				$ -						
Non-PMUS pelagics	$ 12,176		$12,176	$ -		$12,176	$ -		$12,176	$ -
				$ -						
Total pelagics	$ 96,149,793		$98,810,672	$ 2,660,879		$94,399,137	$ (1,750,655)		$103,482,857	$ 7,333,064

Source: Bigelow and Carvalho 2021a.

Vessels in the Hawaii deep-set longline fishery use wire leaders to prevent potential gear fly backs and associated injury with the weighted branch lines that are required in the fishery as a seabird mitigation measure. A simple fly back prevention device constructed from material readily available on a longline vessel (floats, chain, monofilament branch line, and longline snap) has been shown to be a practical and safe method to prevent the weights from flying back toward crew. The cost of the materials for making one device is approximately $13, with one to two of these devices needed on board a vessel during any given fishing trip. The device is deployed by sliding it down the branch line during the haul when handling a line with a large animal at the end of the line. Information on this fly back prevention device is being disseminated to the Hawaii longline fishermen through HLA outreach and the required protected species workshop. The device is also likely to help prevent fly back in the other longline vessels operating under the FEP.

4.3.3 Alternative 3: Prohibit Wire Leaders in the All Western Pacific Pelagic Longline Fisheries and Require Removal of Trailing Gear from Oceanic Whitetip Sharks

The socioeconomic effects of Alternative 3 are expected to be similar to that of Alternative 2, Sub-Alternative 2B because the Hawaii shallow-set and American Samoa longline vessels are already using monofilament leaders by choice.

4.4 Potential Effects on Management Setting

The FEP fisheries are not known to have large adverse impacts to habitats, thus none of the Alternatives are likely to lead to substantial physical, chemical, or biological alterations to the habitat. Longline fishing does not occur in identified critical habitat, marine protected areas, marine sanctuaries, or marine monuments.

None of the alternatives are anticipated to substantially change administrative burden. Alternative 1 would not change any regulations for the fishery as the leader material conversion would remain voluntary. Regulatory changes under Alternatives 2 and 3 would not result in substantial changes to administrative burden, as the gear restriction could be monitored and enforced through existing mechanisms associated with current gear and handling requirements.

4.5 Additional Considerations

4.5.1 Public Health and Safety

Fishermen have used wire leaders in the Hawaii deep-set fishery to reduce the risk of crew injuries resulting from “fly back.” Fly backs can occur when retrieving fishing gear (hauling) if the line under tension between the hook and the weighted swivel breaks, is bitten off by sharks, or the hook is thrown from a fish and the weighted swivel flies back toward the vessel at high speed. The use of wire leaders between the hook and the weight reduced the chance that the leader will break or be bitten-off, thereby minimizing fly backs. To address the potential increased risk of fly backs associated with monofilament leaders, the Council, NMFS, and Hawaii Longline Association (HLA) are working with longline fishermen to ensure best safety practices, including offering training on construction and use of a reusable fly back prevention device from inexpensive materials readily available on longline vessels. Materials for each device cost approximately $13 and each vessel would likely carry two such devices. These safety training efforts are expected to minimize safety risks to fishermen of this action over the short- and long-term.

The longline fisheries operating under the FEP are not known to experience or cause other public health or safety-at-sea issues. The proposed rule would not change the operation of the fishery in any manner affecting safety beyond fly backs described previously. Therefore, there is no potential for other significant adverse effects to public health or safety.

4.5.2 Sensitive biological resources, biodiversity, and ecosystem function

There have been no identified impacts to sensitive biological resources, marine biodiversity, and/or ecosystem function from FEP longline fisheries. These fisheries operate away from coastlines and outside of marine sanctuaries or monuments and fishing gear does not contact the bottom or affect coral ecosystems. Because the proposed action would not substantially modify vessel operations or other aspects of these fisheries, NMFS does not anticipate the proposed action would result in changes in gear types beyond the use of wire leaders, areas fished, or fishing methods, as compared to baseline conditions. As such, NMFS expects no significant impacts on biodiversity or ecosystem function relative to baseline from the proposed action.

4.5.3 Cultural resources

Cultural or archeological resources or resources important to traditional cultural and religious practices are not known to exist within the action area. NMFS is not aware of any districts, sites, structures, or objects listed in or eligible for listing in the National Register of Historic Places within areas fished by FEP longline fisheries. Longline fisheries are not known to result in adverse impacts to scientific, historic, archeological, or cultural sites. The proposed action would not change the fishery in any manner that would result in effects to such sites; therefore, there is no potential for loss or destruction of significant scientific, cultural, or historical resources in the marine environment.

4.5.4 Invasive Species

These fisheries are not known to be introducing or spreading non-indigenous species. Because the proposed action would not substantially modify vessel operations or other aspects of these fisheries, NMFS does not anticipate it would result in the introduction or spread of non-indigenous species as compared to baseline conditions.

4.5.5 Climate Change

A climate change impact analysis is a difficult undertaking given its global nature and interrelationships among sources, causes, mechanisms of actions and impacts. We focus our analysis on whether climate change is expected to impact resources that are the focus of this analysis including target stocks, non-target stocks, and protected species. However, considerable uncertainty remains regarding the extent to which such climate change impacts may affect each target, non-target, and protected species. We note that the impacts of climate change on these resources may be positive if climate change impacts benefit a species' prey base or otherwise enhance the species' ability to survive and reproduce, or impacts may be negative if the impacts reduce a species' ability to survive and reproduce. Impacts may also be neutral. Potential effects of climate change are described in further detail in the EA for the Bigeye Tuna Catch Allocation Limits for Pelagic Longline Fisheries in U.S. Pacific Island Territories (NMFS and WPFMC 2019), Amendment 18 to the FEP (WPFMC 2009b), and the 2019 Hawaii shallow-set longline fishery BiOp (NMFS 2019a), and are incorporated here by reference.

Implication of Climate Change for the Environmental Effects of the Alternatives

Environmental changes associated with climate change are occurring within the action area and are expected to continue into the future. Marine populations that are already at risk due to other threats are particularly vulnerable to the direct and indirect effects of climate change. The 2019 BiOp on the continued authorization of the Hawaii shallow-set fishery considered potential effects of climate change on ESA listed species—including alterations in reproductive seasons and locations, shifts in migration patterns, reduced distribution and abundance of prey, and changes in the abundance of competitors or predators—which informed all analysis developed throughout the BiOp. These include the status of listed resources, population viability analyses for loggerhead and leatherback sea turtles, the environmental baseline, and the exposure, response, and risk analyses. Ongoing consultations for the Hawaii deep-set and American Samoa longline fisheries will also address the implications of climate change in those fisheries, although some of the information in the 2019 Hawaii shallow-set BiOp likely applies.

Because habitat for many shark and ray species is comprised of open ocean environments occurring over broad geographic ranges, large-scale impacts such as climate change may impact these species. Chin et al. (2010) conducted an integrated risk assessment to assess the vulnerability of several shark and ray species on the Great Barrier Reef to the effects of climate change. Scalloped hammerheads were ranked as having a low overall vulnerability to climate change, with low vulnerability to each of the assessed climate change factors (i.e., water and air temperature, ocean acidification, freshwater input, ocean circulation, sea level rise, severe weather, light, and ultraviolet radiation). In another study on potential effects of climate change to sharks, Hazen et al. (2012) used data derived from an electronic tagging project and output from a climate change model to predict shifts in habitat and diversity in top marine predators in the Pacific out to the year 2100. Results of the study showed significant differences in habitat change among species groups, but sharks as a whole had the greatest risk of pelagic habitat loss. We are not aware of information specific to the potential effects of climate change on oceanic whitetip sharks.

Because giant manta rays are migratory and considered ecologically flexible (e.g., low habitat specificity), they may be less vulnerable to the impacts of climate change compared to other sharks and rays (Chin et al. 2010). However, as giant manta rays frequently rely on coral reef habitat for important life history functions (e.g., feeding, cleaning) and depend on planktonic food resources for nourishment, both of which are highly sensitive to environmental changes (Brainard et al. 2011; Guinder and Molinero 2013), climate change is likely to have an impact on the distribution and behavior of these animals. Decreased access to cleaning stations may negatively impact the fitness of the giant mantas by hindering their ability to reduce parasitic loads and dead tissue, which could lead to increases in diseases and declines in reproductive fitness and survival rates.

The 2019 shallow-set longline BiOp describes the potential impacts of climate change on sea turtles to include alterations to foraging habitats and prey resources, changes in phenology and reproductive capacity that correlate with fluctuations in sea surface temperature and temperatures at nesting beaches, and potential changes in migratory pathways and range expansion, among others. Over the long-term, climate change-related impacts will likely influence biological trajectories in the future on a century scale (Paremsan and Yohe 2003). The study by Polovina et al. (2011), indicates that primary production in the southern biome and in the California current ecosystem are expected to increase by the end of the century (Rykaczewski and Dunne 2010), which may benefit leatherback sea turtles. Increases in their primary prey source, sea jellies, due to ocean warming and other factors are likely (Brodeur et al. 1999; Attrill et al. 2007; Richardson et al. 2009), although there is no evidence that any leatherback sea turtle populations are currently food-limited. Even though there may be a foraging benefit to leatherback sea turtles due to climate change influence on productivity, we do not know what impact other climate-related changes may have such as increasing sand temperatures, sea level rise, and increased storm events. However, a different picture is predicted for Eastern Pacific leatherback turtles. Modeling of climate projections and population dynamics resulted in an estimated 7% per decade decline in the Costa Rica nesting population over the twenty first century. Whereas changes in ocean conditions had a small effect on the population, the increase of 2.5º C warming of the nesting beach was the primary driver of the modeled decline through reduced hatching success and hatchling emergence rates (Saba et al. 2012). Furthermore, climate change may compound the effects of interannual climate variability, as governed by El Nino Southern Oscillation (ENSO). Saba et al. (2007) showed that nesting females in Costa Rica exhibited a strong sensitivity to ENSO whereas cool La Nina events correspond with a higher remigration probability and warm El Nino events correspond with a lower remigration probability. As a result, productivity at leatherback sea turtle foraging areas in the Eastern Pacific in response to El Nino/La Nina events result in variable remigration intervals and thus variable annual egg production. This phenomenon may render the Eastern Pacific leatherback sea turtle population more vulnerable to anthropogenic mortality due to longer exposure to fisheries than other populations (Saba et al. 2007). While NMFS cannot predict the exact impacts of climate change, sea level rise may present a more immediate challenge to the North Pacific loggerhead because of the proportion of beaches with shoreline armoring that prevents or interferes with the ability of nesting females to access suitable nesting habitat.

PIFSC modeled the effects of climate change on bigeye tuna and other pelagic MUS targeted by the Hawaii deep-set longline fishery, whose action area overlaps that of the shallow-set fishery (Woodworth-Jefcoats et al. 2019). This modeling effort used a size-based food web model that incorporates individual species and captures the metabolic effects of rising ocean temperatures. They found that, taken as individual stressors, climate change and increasing fishing mortality act to reduce fish biomass and size across all species. The effects of reduced fishing mortality are generally of the opposite sign. However, when modeled jointly, there were no scenarios in which yield increased. Results for the ecosystem supporting the fishery are slightly more optimistic, with reduced fishing mortality somewhat offsetting the negative effects of climate change. The findings of this study suggests that proactive fisheries management could be a particularly effective tool for mitigating anthropogenic stressors either by balancing or outweighing climate effects, albeit not completely offsetting those effects. The effect of climate change on the ecosystem depends primarily upon the intensity of fishing mortality. Management measures which take this into account can both minimize fishery decline and support at least some level of ecosystem resilience.

Climate change is expected to have similar impacts to the resources regardless of which Alternative is selected. In the coming years, the Council and NMFS will continue to monitor domestic catches of all pelagic MUS, and continue to consider information from scientifically-derived stock status reports as future catch and allocation limits are made, and as changes to fishery management are contemplated and implemented. Ongoing and future monitoring and research will allow fishery managers and scientists to consider impacts of climate change, fishing, and other environmental factors that are directly or indirectly affecting the resources.

Potential Effects on Climate Change in terms of Greenhouse Gas Emissions

The alternatives under consideration are not expected to substantially affect the level of fishing effort beyond the range observed since 2004. Neither NMFS, nor the Council controls where fishing vessels fish beyond existing restricted fishing areas, how long a fishing trip lasts, or other decisions that are made by individual fishermen. Some changes in fishing behavior may occur under all Alternatives if the leader material change results in changes to target and non-target catch rates; however, changes to fishing operations as a result of changes in catch rates are likely to be minor, and the overall effort level is not expected to be significantly affected because of the alternatives under consideration. For these reasons, none of the alternatives are expected to result in a noteworthy change to greenhouse gas emissions.

4.6 Potential Cumulative Effects of the Alternatives

Cumulative effects refer to the combined effects on the human environment that result from the incremental impact of the proposed action, and its alternatives, when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (Federal or non-federal) or person undertakes such other actions. Further, cumulative effects can result from individually minor but collectively significant actions taking place over a period of time. The cumulative effects analysis examines whether the direct and indirect effects of the alternatives considered on a given resource interacts with the direct and indirect effects of other past, present and reasonably foreseeable actions on that same resource to determine the overall, or cumulative effects on that resource.

The following cumulative effects analysis is organized by the following issues: target and non-target species, protected species, and fishery participants and communities. Because pelagic longline fishing activities authorized occur offshore and in deep oceanic waters away from land, populated areas, and marine protected areas such as marine national monuments, none of the alternatives considered would have an effect on air or water quality, coral reefs, and benthic marine habitats. As such, these resources ware not considered.

4.6.1 Cumulative Effects Related to Effects on Target and Non-Target Stocks

Past, Present and Reasonably Foreseeable Management Actions

The Council has recommended NMFS implement or authorize several actions, which are presently in various stages of development and/or review before approval by NMFS. These include the following actions:

- Modifications to the territorial catch and/or effort and allocation limits measure for bigeye tuna to allow for multi-year limits and establishing allocation limits without catch limits;
- Establishing a framework for domestic catch limits and specifying a striped marlin limit;
- Requiring tori lines (bird scaring streamers) in the Hawaii deep-set fishery; and
- Revising Pacific Islands region FEP management objectives and converting the FEPs to living documents.

In general, the alternatives considered here would not have interactive effects with the proposed actions listed above as they will result in no to negligible change to the fisheries, so there are no cumulative effects to consider from those actions. Territorial allocations will maintain the status quo, so there are no expected cumulative effects. The potential requirement for tori lines would, similar to this action, be expected to have costs for fishermen. We discuss cumulative economic considerations in section 4.6.3 below. One additional expected change would be a minor positive cumulative change to oceanic whitetip shark survival rates due to low impact of these fisheries on this species.

Regardless of which alternative is selected and which fishery outcome occurs, the WCPFC and IATTC, both of which the United States participates in, will continue to review fishery performance, stock status, and adopt management measures that are applicable to fisheries that catch pelagic MUS.

Potential Cumulative Effects on Target and Non-Target Species

None of the proposed actions under any of the three alternatives would change fishing intensity, locations, participation, or seasonality. The measure would be a minor gear change with nominal effects on catch and with no anticipated adverse effects on stock status of target and non-target stocks. Therefore, there are no anticipated cumulative effects on target or non-target stocks for any of the action alternatives.

4.6.2 Cumulative Effects Related to Effects on Protected Resources

Past, Present and Reasonably Foreseeable Management Actions

Through data collected from observer programs and other sources, the Council and NMFS will continue to monitor interactions between managed fisheries and protected species as well as monitoring the status of those populations. Consultations under the ESA have amounts of exempted take defined in their respective ITSs and the fisheries have either not exceeded those amounts, or when it has occurred, or other triggers have been reached, consultation has been reinitiated (see Section 3.2). The Council and NMFS will continue to conduct workshops with participation from fishermen to develop mitigation methods as appropriate, and NMFS will continue to conduct mandatory annual protected species workshops for all longline permit holders and vessel operators that teach how to identify marine mammals and how to reduce and mitigate interactions.

NMFS and the Council are supporting projects to address post-hooking mortality of oceanic whitetip sharks, leatherback turtles, and other protected species in the Hawaii longline fishery and to improve ecosystem-based fishery management. These include:

- Development of a line cutter that would allow for quick and safe removal of trailing gear on oceanic whitetip sharks, leatherback turtles, and other large protected species that cannot be brought on board. These species when observed in the longline fishery are frequently released with trailing gear in part due to the difficulty of handling animals vessel-side when they cannot be brought on board. Trailing gear remaining on the animals increase post-hooking mortality rates.

- Development of a tag head that would allow pole deployment of tags on leatherbacks from the vessel side without having to board the turtle using a direct attachment method. This project aims to improve species-specific post-hooking survivorship data for leatherback turtles observed in the shallow-set fishery, which are typically too large to board and do not allow for conventional method of tagging.

NMFS PIRO annually provides competitive Federal funding for sea turtle and fishery projects to understand, address, and mitigate threats to sea turtles and address the needs of fishing communities, while maintaining sustainability. These activities are included in the PIRO Federal Programs Office Annual Grant Reports at https://www.fisheries.noaa.gov/resource/document/pacific-islands-regional-office-federal-programs-office-annual-reports. CNMI, Guam and Hawaii are current recipients of ESA Section 6 grant awards, which provides funds to establish and implement state and territorial programs for the conservation of threatened and endangered species.

Other past and present management actions and factors affecting protected resources include:

- Interactions in U.S. and foreign fisheries;
- Sea turtle conservation projects;
- Human use and consumption of sea turtles;
- Marine debris;
- Fluctuations in the ocean environment; and
- Climate change (see also section 4.5.4).

The proposed action is not expected to interact with any of these past, present or reasonably foreseeable management actions.

Potential Cumulative Effects on Protected Resources

Under all alternatives, the Hawaii and American Samoa longline vessels will continue to be subject to mitigation measures to avoid and reduce protected species interactions and to reduce the severity of interactions when they do occur. The fisheries will be subject to terms and conditions described in ITSs for some listed species as defined in consultations under the ESA. The current ongoing consultation for the Hawaii deep-set longline fishery will consider the effects of this action and potential to reduce adverse effects to protected species, especially oceanic whitetip shark. NMFS anticipates no change in the number of interactions with protected species as a result of this action. The alternatives considered here would improve oceanic whitetip shark survival rates. There is some potential benefit to post-interaction survival rates for other protected species as well, specifically large animals that cannot be brought on board to facilitate hook or trailing gear removal. None of the proposed actions under any of the three alternatives would change fishing intensity, locations, participation or seasonality. The measure would be a minor gear change with nominal effects on catch and with no adverse effects on protected species Therefore, there are no anticipated cumulative effects on protected species for any of the action alternatives.

4.6.3 Cumulative Effects Related to Effects on the Socio-economic Setting

In accordance with the Magnuson-Stevens Act, the Council and NMFS will continue to assess the impact of management actions on fishery participants and fishing communities, and where possible, minimize negative effects while developing appropriate measures for the conservation and management of fishery resources.

The potential cumulative effects of this action on the socio-economic setting are expected to be minimal. Major factors affecting fishery participants and the fishing community include current and future costs of fishing supplies, fuel, and vessel maintenance as well as access to fishing grounds and competition with imported seafood. Besides costs associated with switching fishing gear from wire to monofilament leaders, none of these factors are expected to be influenced by any of the proposed alternatives. An analysis of costs for gear changes under this action suggests that costs for Hawaii deep-set longline fishery participants will be relatively small and potentially offset by minor increases in the catch rates of target species. The proposed action requiring tori lines would require an estimated $1,075 initial cost per vessel for purchasing the tori line materials, and ongoing costs for repair or replacement of materials estimated to be approximately $375 every few years. When considered together, the initial and ongoing costs of both actions would potentially be offset by increases in target species catch. The anticipated costs will not disproportionally impact fishery participants. These measures would be relatively minor gear changes with nominal effects on catch and with no adverse effects on socio-economic setting. Therefore, there are no anticipated cumulative effects on socio-economics for any of the action alternatives.

4.7 Summary of Expected Impacts

Table 39 shows the summary of expected impacts of the alternatives.

Table 39**. Summary of Effects of the Alternatives**

Resource	Alternative 1 (Status quo)	Alternative 2 (Council preferred alternative with Sub-Alternative 2B)	Alternative 3
Target and non-target stocks	Similar to baseline conditions described in Section 3.	**Sub-Alternatives 2A and 2B:** Small effect on some target and non-target catchability expected in the Hawaii deep-set longline fishery only, but no substantial change to stock status.	Small effect on some target and non-target catchability expected in the Hawaii deep-set longline fishery only, but no substantial change to stock status.
Protected species – oceanic whitetip sharks	Similar to baseline conditions described in Section 3.	**Sub-Alternative 2A:** Mortality of oceanic whitetip sharks likely to be reduced in the Hawaii deep-set longline fishery due to higher bite-offs and reduced trailing gear. **Sub-Alternative 2B:** Mortality of oceanic whitetip sharks likely to be reduced due to higher bite-offs in the Hawaii deep-set longline fishery and reduced trailing gear in all longline fisheries.	Mortality of oceanic whitetip sharks likely to be reduced due to higher bite-offs in the Hawaii deep-set longline fishery and reduced trailing gear in all longline fisheries.
Protected species – other species	Similar to baseline conditions described in Section 3.	**Sub-Alternatives 2A and 2B:** No change in interactions expected. Post-hooking mortality rate may be reduced for some species that are released alive and cannot be brought on board in the Hawaii deep-set longline fishery. May facilitate removal of more trailing gear in other FEP fisheries.	No change in interactions expected. Post-hooking mortality rate may be reduced for some species that are released alive and cannot be brought on board in the Hawaii deep-set longline fishery. May facilitate removal of more trailing gear in other FEP fisheries.

Resource	Alternative 1 (Status quo)	Alternative 2 (Council preferred alternative with Sub-Alternative 2B)	Alternative 3
Socio-economic setting	Similar to baseline conditions described in Section 3.	**Sub-Alternatives 2A and 2B:** More frequent gear repair and replacement expected in the Hawaii deep-set longline fishery, but cost expected to be offset by cheaper per unit replacement cost and slight increase in revenue.	More frequent gear repair and replacement expected in the Hawaii deep-set longline fishery, but cost expected to be offset by cheaper per unit replacement cost and slight increase in revenue. No change for all other longline fisheries.
Management setting	Similar to baseline conditions described in Section 3.	No substantial change.	No substantial change.

5 REFERENCES

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6 DRAFT PROPOSED REGULATIONS

For the reasons set out in the preamble, NMFS proposes to amend 50 CFR part 665 as follows:

PART 665 -- FISHERIES IN THE WESTERN PACIFIC

1. The authority citation for 50 CFR part 665 continues to read as follows:

Authority: 16 U.S.C. 1801 *et seq.*

2. In § 665.800 revise the definition of "*Deep-set* or *Deep-setting*" to read as follows:

§ 665.800 Definitions.

* * * * *

Deep-set or *Deep-setting* means the deployment of longline gear in a manner consistent with all the following criteria: All float lines are at least 20 meters in length; a minimum of 15 branch lines are attached between any two floats (except basket-style longline gear which may have as few as 10 branch lines between any two floats); no metal wire line within 1 meter of the hook; and no light sticks are used. As used in this definition, "float line" means a line used to suspend the main longline beneath a float, and "light stick" means any type of light emitting device, including any fluorescent "glow bead," chemical, or electrically-powered light that is affixed underwater to the longline gear.

* * * * *

3. In § 665.802 add paragraph (gg) and (hh) to read as follows:

§ 665.802 Prohibitions.

* * * * *

(gg) Use or have on board longline gear with metal wire line within 1 meter of the hook when operating a vessel registered for use under a longline permit issued under §665.801(b) at any time during a trip for which notification to NMFS under §665.803(a) indicated that deep-setting would be done, in violation of §665.813(d).

(hh) Fail to handle and release an oceanic whitetip shark in accordance with the requirements set forth at §665.811(a) when operating a vessel registered for use under any longline permit issued under §665.801, in violation of §665.811.

* * * * *

4. Add § 665.811 to read as follows:

§ 665.811 Handling and release of oceanic whitetip sharks.

(a) The owner and operator of a vessel registered for use under any longline permit issued under §665.801 must release any oceanic whitetip shark as soon as possible after the shark is caught and brought alongside the vessel, in accordance with §300.226 of this title, and must take the following actions:

(1) Leave the animal in the water;

(2) Use a dehooker, as defined in §665.812(a)(7), or line clippers, as defined in §665.812(a)(5), to remove trailing gear from the animal.

(3) When using line clippers, the branch line must be cut as close to the hook as possible.

(b) Paragraph (a) of this section does not apply if doing so would compromise the safety of any persons, or if a NMFS observer collects, or requests assistance collecting, samples of oceanic whitetip shark, or if a WCPFC observer collects, or requests assistance collecting, samples of oceanic whitetip shark in the Convention Area, as defined in §300.211 of this title and in accordance with §300.226 of this title.

5. In § 665.813 revise paragraph (d) to read as follows:

* * * * *

(d) Vessels registered for use under a Hawaii longline limited access permit may not have on board at any time during a trip for which notification to NMFS under §665.803(a) indicated that deep-setting would be done any float lines less than 20 meters in length, longline gear with metal wire line within 1 meter of the hook, or light sticks. As used in this paragraph "float line" means a line used to suspend the main longline beneath a float, and "light stick" means any type of light emitting device, including any fluorescent "glow bead," chemical, or electrically powered light that is affixed underwater to the longline gear.

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7 REGULATORY IMPACT REVIEW

1. Introduction

This is a regulatory impact review (RIR) prepared under Executive Order (E.O.) 12866, "Regulatory Planning and Review." The regulatory philosophy of E.O.12866 stresses that, in deciding whether and how to regulate, agencies should assess all costs and benefits of all regulatory alternatives and choose those approaches that maximize the net benefits to the society. To comply with E.O. 12866, the National Marine Fisheries Service (NMFS) prepares an RIR for regulatory actions that are of public interest. The RIR provides an overview of the problems, policy objectives, and anticipated impacts of regulatory actions. The regulatory philosophy of E.O. 12866 is reflected in the following statement:

> *In deciding whether and how to regulate, agencies should assess all costs and benefits of available regulatory alternatives, including the alternative of not regulating. Costs and benefits shall be understood to include both quantifiable measures (to the fullest extent that these can be usefully estimated) and qualitative measures of costs and benefits that are difficult to quantify, but nevertheless essential to consider. Further, in choosing among alternative regulatory approaches, agencies should select those approaches that maximize net benefits (including potential economic, environmental, public health and safety, and other advantages, distributive impacts; and equity), unless a statute requires another regulatory approach.*

This RIR is for a proposed Amendment to the Fishery Ecosystem Plan for the Pelagic Fisheries of the Western Pacific Region (FEP) developed by the Western Pacific Fishery Management Council (Council). The amendment includes an Environmental Assessment (EA) and proposed regulations.

2. Problem Statement and Management Objective

The regulatory amendment contains proposed management measures to improve post-hooking survival of oceanic whitetip sharks in longline fisheries. The action is needed because oceanic whitetip sharks are listed as threatened under the Endangered Species Act and the WCPO stock of the oceanic whitetip sharks is subject to overfishing and is overfished. The current use of wire leaders in the Hawaii deep-set longline fishery prevents sharks from biting off the line as well as making it difficult for fishermen to remove fishing gear, termed trailing gear, when releasing the animals. Reducing the amount of trailing gear on sharks would increase post-release survival. While the Hawaii Longline Association (HLA) announced that member deep-set longline vessels would voluntarily stop using wire leaders, this action would ensure all Hawaii longline vessels stop using wire leaders as well as ensure that fishermen take additional measures to help reduce the amount of trailing gear on released oceanic whitetip sharks.

3. Description of the Fisheries

The following section briefly describes the longline fisheries operating under the FEP potentially affected by this action. Detailed description of the socioeconomic environment can be found in Section 3.3 of the EA in support of this action and in the FEP annual reports available at http://www.wpcouncil.org/annual-reports/. Section 2.2 of the EA details the gear used in the longline fisheries, including information specific to the use of wire leaders in the Hawaii deep-set longline fishery.

Hawaii-based Longline Fishery

Domestic longline fishing around Hawaii consists of the shallow-set sector and the deep-set sector. Some Hawaii-permitted vessels also hold American Samoa longline permits with the number of these dual-permitted vessels ranging between 17 and 26 in recent years. Dual-permitted vessels land their catch in Hawaii or American Samoa, and these vessels can continue to fish in the western and central Pacific Ocean even when the U.S. longline fishery is closed as a result of reaching the U.S. bigeye tuna catch limit.

Fishing effort in the Hawaii deep-set longline fishery has increased over the years. From 2004-2012, the annual number of vessels that participated in the deep-set fishery remained relatively stable, ranging from 124 to 129. The number of active vessels has increased since 2012, with 146 vessels operating in 2020, slightly less than the number of active vessels in 2019 according to the 2020 Annual SAFE Report (WPFMC, 2021). The number of deep-set trips (1,644) and sets (20,758) in 2020 were also both below those measures of fishing effort in 2019.

The number of vessels participating in the shallow-set fishery has declined over time from a high of 35 vessels in 2006 to a low of 11 vessels in 2018 with 14 participants in 2019 and 2020 (WPFMC, 2021). The shallow-set longline fishery is subject to an annual hard cap for the numbers of interactions with leatherback and loggerhead sea turtles. If the fishery reaches either hard cap, the fishery is subject to closure.

Logbook data collected in 2020 indicated that Hawaii-based deep-set longline vessels caught approximately 27.1 million pounds of pelagic fish. Commercial receipts reported earnings on catch sold at $71.5 million (average price per pound $3.01). Revenue and landings in 2020 were low compared to those of recent years, largely due to the effects of the pandemic. In 2019, the fishery caught 31.0 million lb and earned $94.3 million in revenue on catch sold (average price per pound $3.15). The shallow-set fishery caught 838,000 pounds of pelagic fish and earned $1.3 million in revenue in 2020 (average price per pound $3.68) (Table 22, WPFMC, 2021).

American Samoa-based Longline Fishery

The longline fishery based in American Samoa is a limited access fishery with a maximum of 60 vessels under the federal permit program. Vessels range in size from under 40 ft to over 70 ft long. The fishery primarily targets albacore for canning in the local Pago Pago cannery, although the fishery also catches and retains other tunas, such as bigeye tuna and yellowfin tuna and other pelagic species for sale and personal consumption. American Samoa longline fishing vessels operate in the Exclusive Economic Zone (EEZ) around American Samoa, on the high seas in international waters, and occasionally in the EEZs of countries adjacent to American Samoa.

In 2020, the estimated revenue for the American Samoa longline fleet was $2.1 million, and albacore comprised more than 62% of the total landed value. Landings and revenue have generally declined over the last ten years (WPFMC, 2021).

4. Description of the Alternatives

Under all alternatives, all existing gear and release requirements under the FEP, including weighted branch lines for the Hawaii deep-set longline fishery and sea turtle handling and release requirements for all longline vessels, would remain in place. Also under all alternatives, non-regulatory efforts would remain, including HLA outreach efforts to enhance gear safety and assistance with gear configuration as well as promote protected species handling guidelines collaboratively with NMFS. The no-action alternative, the preferred alternative (proposed action), and other reasonable alternatives that could be implemented to improve post-hooking oceanic whitetip shark survival are identified below. Section 2.4 of the EA provides more details on each of the alternatives that were analyzed.

Alternative 1: No Action (Status Quo/Current Management)

Under Alternative 1, the Council would not recommend changes to the regulations implementing the FEP. The longline vessels operating under the FEP would not be prohibited from using wire leaders, nor would fishermen be required to take certain steps to remove trailing gear from oceanic whitetip sharks.

Alternative 2: Prohibit Wire Leaders in the Hawaii Deep-set Longline Fishery and Require Removal of Trailing Gear from Oceanic Whitetip Sharks (Council Preferred Alternative)

Under Alternative 2, the use of wire leaders would be prohibited on vessels operating under a Hawaii longline limited entry permit that declare their trip as deep-set.

In addition to the existing requirements to release any oceanic whitetip sharks as soon as possible under 50 CFR 300.226 and 50 CFR 300.24, Alternative 2 would require that vessel owners and operators remove trailing gear from oceanic whitetip sharks by leaving the animal in the water, using a dehooker or line clipper or cutters to remove trailing gear from the animal as safely as practicable, and if using a line clipper or cutter, cutting the line as close to the hook as possible. These requirements would not apply if doing so would compromise the safety of any persons, or a fisheries observer collects or requests assistance collecting, oceanic whitetip shark samples. Recommendations on the target length for removing trailing gear would be included as a best practice in the NMFS Protected Species Workshop, which is an annual requirement for all owners and operators.

At its 186th meeting in June 2021, the Council considered the following sub-alternatives for removing trailing gear and selected Sub-Alternative 2B as preferred:

- **Sub-Alternative 2A:** Require removal of trailing gear only in the Hawaii deep-set longline fishery.

- **Sub-Alternative 2B:** Require removal of trailing gear in all Western Pacific pelagic longline fisheries operating under the FEP **(Council Preferred Sub-Alternative)**

Alternative 3: Alternative 3: Prohibit Wire Leaders in All Western Pacific Pelagic Longline Fisheries and Require Removal of Trailing Gear from Oceanic Whitetip Sharks

Under Alternative 3, the use of wire leaders would be prohibited under regulations for all longline vessels operating under FEP. Alternative 3 would also require that all longline vessel owners and operators fishing under the FEP remove trailing gear from oceanic whitetip sharks in the same manner as described above for Alternative 2.

5. Analysis of Alternatives

Alternative 1: No Action

Under Alternative 1, longline vessels under the FEP would continue to be managed under existing management measures, which do not include gear or release requirements to improve post-hooking survivorship of oceanic whitetip sharks. In the Hawaii deep-set longline fishery, the continued use of wire leaders by most vessels would minimize the chances that oceanic whitetip sharks may bite or break free of the branch line, and make it more difficult to remove trailing gear when releasing animals due to the difficultly in cutting through wire.

Alternative 1 assumes that vessels in the Hawaii deep-set longline fishery would continue to use wire leaders as they generally have in recent years. Many Hawaii deep-set longline fishery participants are anticipated to voluntarily transition from wire leaders to monofilament leaders following HLA's announcement. As of November 2021, most of the deep-set fishery is using monofilament leaders with many others using a combination of wire and monofilament leaders as they replace wire leaders. Without a regulatory requirement prohibiting the use of wire leaders, some vessels may revert to wire leaders over time or may not convert to monofilament nylon leaders, and it is unknown at this time whether the small number of vessels that are not members of the HLA would also eliminate the use of wire leaders.

Under Alternative 1, the longline fisheries under the FEP would continue to release oceanic whitetip sharks with trailing gear. Based on observer data collected through a shark tagging study, the average length of the trailing gear left on oceanic whitetip sharks in the Hawaii deep-set fishery was 5.44 m (range 1-12 m), 3 m (range 2-3 m) for the Hawaii shallow-set fishery, and 1.86 m (range 0-3 m) for the American Samoa longline fishery.

The longline fisheries' effort, target and non-target catch, and other protected species interactions would be expected to remain similar to the historical baseline under Alternative 1. This alternative would not improve post-hooking survival rates for oceanic whitetip shark. The continued use of wire leaders in the Hawaii deep-set longline fishery would help to prevent gear fly back associated with the use of weighted swivels near the hook as part of the required seabird mitigation measures.

Under Alternative 1, there would be no operational change required in any of the longline vessels operating under the FEP, and the socioeconomic setting, including the cost and revenue for each fishery, is expected to remain at similar levels as the baseline described in Section 3.3 of the EA. As described in Section 2.4.1, the no action alternative assumes that the Hawaii deep-set longline fishery would continue to use mostly wire leaders consistent with the historical baseline (approximately 97% of effort using wire leaders), and that the Hawaii shallow-set and American Samoa longline fisheries would continue to use monofilament nylon leaders consistent with the historical baseline.

Alternative 2: Prohibit Wire Leaders in the Hawaii Deep-set Longline fishery and Require Removal of Trailing Gear from Oceanic Whitetip Sharks (Council Preferred)

Under Alternative 2 and Sub-Alternative 2A, all vessels in the Hawaii deep-set longline fishery would be required to eliminate the use of wire leaders and remove trailing gear from incidentally caught oceanic whitetip sharks as safely as practicable. Sub-Alternative 2B (Council Preferred Sub-Alternative) would extend the gear removal requirement to all longline vessels as explained below. Under Alternative 2, neither the Hawaii shallow-set nor American Samoa longline fisheries would be prohibited from using wire leaders -- participants in these fisheries are already using monofilament nylon leaders and are likely to continue doing so.

Regarding the prohibition on the use of wire leaders, longline vessels are most likely to transition to monofilament nylon as it is the most common alternative leader material in pelagic longline fisheries, although other non-metal leaders may be used. Some, if not most, vessels in the Hawaii deep-set longline fishery are anticipated to voluntarily transition from wire leaders to monofilament leaders prior to the regulatory requirement going into effect, and many have already transitioned or begun to transition to monofilament leaders. Under Alternative 2, any Hawaii deep-set longline vessel that does not fully transition to wire leaders voluntarily would be required to eliminate wire leaders from their branch lines when the regulatory requirement is implemented. Compared to Alternative 1, Alternative 2 would ensure that all Hawaii longline deep-set vessels in the fishery stop using wire leaders once the regulation is effective, and would also ensure that fishery participants do not revert back to using wire leaders.

While leader material is not expected to change the initial interaction rate for sharks, eliminating wire leaders and requiring removal of trailing gear in the Hawaii deep-set longline fishery are expected to result in higher survival rates for incidentally caught oceanic whitetip sharks. The leader material conversion is expected to also facilitate fishermen removing trailing gear closer to the hook. This could also reduce negative effects for other large protected species incidentally captured in the fishery that cannot easily be brought on board the vessel to facilitate gear removal, such as leatherback sea turtles, giant manta rays, and false killer whales, but not likely to affect outcomes for protected species small enough to be brought on board.

Analysis shows that transition from wire to monofilament nylon leaders would likely have a statistically significant effect on catchability for some species, such as swordfish, albacore tuna, skipjack tuna, and mahimahi, but the change in catchability of those species would have an overall negligible effect on revenue, as explained in greater detail in Section 1.3.2 of the EA. Change in catchability of other species such as bigeye tuna was expected to be slightly higher, although the results were not statistically significant. Based on the change in overall catchability of fish species due to the transition to monofilament leaders, the EA indicates a mean annual increase in revenue of $2.7 million for the Hawaii deep-set longline fishery.

Under Alternative 2, the prohibition of wire leaders in the Hawaii deep-set longline fishery will incur upfront costs associated with the transition of all remaining wire leaders to monofilament nylon leaders and may affect the ongoing cost of gear replacement and repairs. Section1.3.2 of the EA contains greater details, including the assumptions made in calculating the one-time initial cost in transitioning all leaders from wire to monofilament for the typical vessel as well as the trip-level leader replacement costs (due to bite-offs, abrasion, or some other damage to the leader) for the typical vessel. The calculations in the EA were based on 2020 deep-set longline data such as number of hooks, sets, and longline trips.

The estimated range in the initial costs of replacing an entire set of wire leaders with monofilament leaders can be found by multiplying the price of each monofilament leader ($0.06-$0.17) by the average number of hooks. This results in an estimated average one-time material cost to each vessel (averaging 2,876 hooks) of replacing wire leaders of $173-$489 for a full set of monofilament leaders; the range in leader prices depends on the brand of leader used. These initial conversion costs would apply to vessels that have not already begun to transition to monofilament leaders. As calculated in the EA, with 146 active Hawaii deep-set vessels in 2020, if all were to transition from a full set of wire leaders to a full set of monofilament nylon leaders as a result of this action, this would represent initial conversion costs of $25,194-$71,382 fleetwide. As noted earlier, Longline vessels routinely replace some branch lines and leader lines throughout their fishing operations and many participants of the Hawaii deep-set longline fleet have already begun to transition to monofilament nylon leaders as part of their routine replacement of leader lines. As a result, the upfront costs of transitioning to monofilament leaders upon the implementation of this Alternative will not be as high as presented here.

Monofilament leaders are more susceptible to damage, abrasion, and bite-offs, which would result in more frequent repairs and replacement of longline gear. However, monofilament is less expensive than wire, which may help offset the impacts of implementing Alternative 2. With regard to gear replacement and repair costs and the expected increase in replacement of monofilament leaders compared to wire leaders, the analyses provided in the EA used 2020 data and results from a research study that estimated branch line repair rates to be higher for monofilament leaders (19.8%) compared to wire leaders (14.4%). With the number of hooks deployed per trip averaging 36,314 and the number of hooks deployed throughout the year averaging 408,904 across all vessels, the cost of repairing 19.8% of monofilament leaders for each trip would on average range between $431-$1,222 per vessel, while the cost of repairing 14.4% of wire leaders per trip would be on average $2,144-$2,719 per vessel. These results suggest that the gear replacement costs are likely to be lower for monofilament leaders compared to wire leaders, even with the higher repair rate. Implementing the Council preferred alternative would result in an overall drop in leader repair material costs ranging from $922-$2,288 per trip or an annual drop in leader replacement costs ranging from $1,515,186-$3,761,100 fleetwide with 1,644 deep-set longline trips across the fishery in 2020.

Most vessels in the Hawaii deep-set longline fishery had used wire leaders in order to prevent potential gear fly backs and associated injury with the weighted branch lines that are required in the fishery as a seabird mitigation measure. This action would be implemented in conjunction with HLA outreach to fishery participants and NMFS protected species workshops on best practices for crew safety from fly back from the use of monofilament leaders while deep-set longline fishing. Some of these best practices include deploying fly back prevention devices. HLA will continue to work with NMFS and the Council to disseminate handling guidelines applicable to oceanic whitetip sharks (among other protected species) for safe release with as little trailing gear as possible. These initiatives, which are ongoing, are anticipated to address safety concerns associated with fly back in the Hawaii deep-set longline fishery. A simple reusable fly back prevention device constructed from material readily available on a longline vessel (floats, chain, monofilament branch line, and longline snap) has been shown to be a practical and safe method to prevent the weights from flying back toward the crew. The cost of the materials for making one device is approximately $13, with one to two of these devices needed on board the vessel during any given fishing trip. The device is deployed by sliding it down the branch line when a large animal is hooked. Information on this fly back prevention device is being disseminated to the Hawaii longline fishermen through the NMFS protected species workshop that vessel owners and operators are required to attend and also addressed through HLA's outreach with vessel owners under all alternatives.

Alternative 2A is not expected to increase costs related to fishing in other ways. Oceanic whitetip shark interactions are rare during longline fisheries, and while taking additional steps to carefully handle and minimize trailing gear could take slightly longer than simply cutting the line, handling requirement under Alternative 2A are not expected to increase overall fishing time appreciably.

Alternative 2 is expected to have a negligible to minor impact on fresh fish supplied by the Hawaii deep-set longline fishery as a result of the switch to monofilament leaders. Bigeye tuna catch may increase slightly, while mahimahi, skipjack, and albacore catch might decrease slightly. No change in terms of American Samoa or Hawaii shallow-set fishery catch is expected. U.S. seafood consumers would largely be unaffected by this alternative. Under Alternative 2, the survivability of oceanic whitetip sharks will increase compared to Alternative 1, with conservation benefits associated with the increased likelihood of recovery of oceanic whitetip sharks. The public cost associated with administration and enforcement under this alternative is expected to be minor, as the gear restriction and handling requirements could be monitored and enforced through existing mechanisms associated with current requirements.

Expected Fishery Outcomes: Sub-Alternative 2B **(Council Preferred Sub-Alternative)**

Under Sub-Alternative 2B, all vessels in the Hawaii deep-set longline fishery would be required to eliminate the use of wire leaders, and all Western Pacific pelagic longline fisheries operating under the FEP would be required to remove trailing gear as safely as practicable. Sub-Alternative 2B is expected to have similar outcomes as Sub-Alternative 2A because the American Samoa and Hawaii shallow-set longline fisheries are currently using monofilament leaders.

Extending the requirement for removing trailing gear to all Western Pacific pelagic longline vessels under Sub-Alternative 2B, compared to Hawaii deep-set longline fishery only under Sub-Alternative 2A, is expected to have a relatively small effect on reducing post-hooking mortality of oceanic whitetip sharks (2-6%, Hutchinson et al. 2021). This is because the Hawaii shallow-set and American Samoa longline fisheries already use monofilament nylon leaders and are not expected to see any additional reduction in mortality from bite-offs, and thus the reduction in mortality would only be expected from the changes to the amount of trailing gear removed.

***Alternative 3:* Prohibit Wire Leaders in All Western Pacific Pelagic Longline Fisheries and Require Removal of Trailing Gear from Oceanic Whitetip Sharks**

The expected outcomes for Alternative 3 would be similar to that of Alternative 2, primarily because a regulation prohibiting wire leaders would not change gear use in the and Hawaii shallow-set and American Samoa longline fisheries, neither of which use wire leaders. Therefore, prohibition of wire leaders applicable to all longline fisheries under the FEP would not change the practice of the Hawaii shallow-set or American Samoa longline fisheries, but could serve as a preventative measure to prohibit these and other longline fishing vessels operating under the FEP from using wire leaders in the future. Costs to fishermen and changes to catch rates would be similar as those described in Alternative 2, because the only fishery that would be required to change gear would be the Hawaii deep-set longline fishery. Applying the requirement to remove gear to all western Pacific longline fisheries would have the same benefits to oceanic whitetip sharks as under Alternative 2, Sub-Alternative 2B.

6. Determination of Significance Under Executive Order 12866

In accordance with E.O. 12866, NMFS has made the following determinations:

(1) This rule is not likely to have an annual effect on the economy of more than $100 million or adversely affect in a material way the economy, a sector of the economy, productivity, jobs, the environment, public health or safety, or state, local, or tribal governments or communities.

(2) This rule is not likely to create any serious inconsistencies or otherwise interfere with any action taken or planned by another agency.

(3) This rule is not likely to materially alter the budgetary impact of entitlements, grants, user fees or loan programs or the rights or obligations of recipients thereof.

(4) This rule is not likely to raise novel or policy issues arising out of legal mandates, the president's priorities, or the principles set forth in E.O. 12866.

Based on these findings, this rule is determined to not be significant regulatory action for the purposes of E.O. 12866.