WESTERN PACIFIC REGIONAL FISHERY MANAGEMENT COUNCIL

Considerations for Developing Reasonable and Prudent Measures and/or Reasonable and Prudent Alternatives in the Hawaii Deep-set and American Samoa Longline Fisheries

136th Meeting of the Scientific and Statistical Committee
182nd Meeting of the Western Pacific Regional Fishery Management Council

1 BACKGROUND

The Hawaii deep-set longline fishery (DSLL) and the American Samoa longline fishery (ASLL) are currently undergoing Section 7 Consultations pursuant to the Endangered Species Act (ESA). The Western Pacific Regional Fishery Management Council at its 181st Meeting in March 2020 reiterated its recommendation to NMFS that they work with the Council to develop any necessary reasonable and prudent measures (RPMs) or reasonable and prudent alternatives (RPAs) under the ongoing ESA Section 7 Consultations to ensure that such measures are appropriate and practicable to ensure the sustainability of the fisheries. NMFS Pacific Island Regional Office (PIRO) Protected Resources Division (PRD) has indicated to Council staff that they are not yet in a position to discuss, but encouraged the Council to work with PIRO Sustainable Fisheries Division (SFD) to:

- Consider any actions that the fishery could take to:
    - Avoid adversely impacting listed species; and
    - If impacts cannot be avoided, work to minimize impacts of incidental take
- Start with applicability of RPMs included in the 2019 Biological Opinion (BiOp) for the Hawaii shallow-set longline fishery (SSLL), and consider new measures
- Focus on the following species:
    - Leatherback turtle (concern with species status);
    - Oceanic whitetip shark (taken in large numbers); and
    - Giant manta ray (demographic units poorly understood).

When NMFS determines that a federal action is not likely to jeopardize the continued existence of listed species, the resulting BiOp includes an Incidental Take Statement (ITS) with RPMs and Terms and Conditions exempting a certain amount of “take” of listed species. RPMs refer to those actions NMFS believes necessary or appropriate to minimize the impacts, i.e., amount or extent, of incidental take (50 CFR §402.02). When preparing the ITS, NMFS must specify RPMs and their implementing terms and conditions to minimize the impacts of incidental take that do not alter the basic design, location, scope, duration, or timing of the action, and that involve only minor changes, i.e., “Minor Change Rule”. (50 CFR §402.14(i)(2)).

If NMFS determines that a federal action is likely to jeopardize the continued existence of listed species, then an RPA will also be issued as part of the BiOp. RPAs refer to alternative actions identified during formal consultation that can be implemented in a manner consistent with the intended purpose of the action, that can be implemented consistent with the scope of the Federal agency's legal authority and jurisdiction, that is economically and technologically feasible, and that NMFS believes would avoid the likelihood of jeopardizing the continued existence of listed species or resulting in the destruction or adverse modification of critical habitat (50 CFR §402.02).

The SSC and Council at their meetings in June 2020 will discuss and consider providing direction on the development of potential RPMs and/or RPAs for the DSLL and ASLL fisheries. This document provides a summary of available information and initial considerations identified through discussions amongst Council and PIRO SFD staff, as well as the Pelagic Plan Team.

2 SUMMARY OF AVAILABLE INFORMATION

This section summarizes available observer data on leatherback turtle, giant manta ray, and oceanic whitetip shark interactions in the Hawaii deep-set and American Samoa longline fisheries, and other relevant information for the consideration of RPMs/RPAs.

The Hawaii longline fishery has been required to carry federal observers since 1994, and American Samoa longline fishery since 2006. The DSLL fishery has had approximately 20% observer coverage since 2001. In ASLL, observer coverage ranged between 6 and 8 percent from 2006-2009, increased to 25 percent in 2010 and 33 percent in 2011, and a target of 20 percent since 2012.

2.1 Leatherback Turtle

2.1.1 Interactions in the Hawaii Deep-set Longline Fishery

Leatherback turtle interactions in DSLL are rare occurrences, with observed interactions ranging between 0-7 annually for the 2002-2019 period (Table 1). Estimated total interactions based on the observer coverage (approximately 20%) ranges between 0-38 leatherback turtles. Of the 40 observed leatherback turtle interactions in the 2002-2019 period, 29 were release alive and 11 were observed dead.

Based on a recommendation from the Protected Species Advisory Committee, the Council at its 163rd Meeting directed staff to evaluate further spatial and environmental information regarding leatherback turtle interaction trends in the Hawaii deep-set longline fishery to assess if there are any significant correlations that should be considered in analyzing impacts and developing proposed fishery actions. The recommendation was based on slightly higher observed leatherback interactions in the fishery in 2014 and the first two quarters of 2015.

Following the 163rd Council Meeting, PIRO Sustainable Fishery Division (SFD), in coordination with Council staff and PIRO Protected Resources Division (PRD), convened an informal working group to review leatherback turtle interactions in the longline fishery. The working group included staff from the Council, SFD, PRD, PIRO Observer Program and the Pacific Islands Fisheries Science Center (PIFSC). Council staff presented a preliminary analysis of interaction patterns based on observer data at a working group meeting held in August 2015.

Table 1. Annual summary of observed and estimated total leatherback turtle interactions in the Hawaii deep-set longline fishery, 2002-2019.

Year	Observed					Estimated Total Interactions[1]
	Coverage (%)	Sets	Hooks	Interactions (Obs. mortalities)	Interactions/ 1,000 hooks	
2002	24.6	3,523	6,786,303	2	0.0003	5
2003	22.2	3,204	6,442,221	1(1)	0.0002	4
2004	24.6	3,958	7,900,681	3	0.0004	15
2005	26.1	4,602	9,360,671	1	0.0001	4
2006	21.2	3,605	7,540,286	2(2)	0.0003	9
2007	20.1	3,506	7,620,083	2	0.0003	4
2008	21.7	3,915	8,775,951	1	0.0001	11
2009	20.6	3,520	7,877,861	1(1)	0.0001	4
2010	21.1	3,580	8,184,127	1(1)	0.0001	6
2011	20.3	3,540	8,260,092	3	0.0004	14
2012	20.4	3,659	8,768,728	1(1)	0.0001	6
2013	20.4	3,830	9,278,133	3	0.0003	15
2014	20.8	3,831	9,608,244	7(2)	0.0007	38
2015	20.6	3,728	9,393,234	4(2)	0.0004	18
2016	20.1	3,880	9,872,439	3(1)	0.0003	15
2017	20.4	3,832	10,148,195	0	0.0000	0
2018	20.4	4,332	11,751,144	2	0.0002	12
2019	20.5	4,697	12,948,077	3	0.0002	15

Source: Draft 2019 Annual Stock Assessment and Fishery Evaluation (SAFE) Report (in prep).
[1]See WPRFMC (2019) and draft 2019 SAFE Report for details on source and method for estimating total interactions.

Preliminary analysis using observer data associated with observed leatherback interactions were conducted to assess potential patterns in the higher observed interactions seen in 2014 and 2015 that may warrant further analysis. The analysis included all years of available data, 1994-June 2015. Main findings and potential patterns emerging from the preliminary analysis include the following:

- Potential shift in take location: The range of latitude and longitude do not appear to have shifted, except for a narrower longitudinal range for the observed interactions in 2014. The preliminary analysis did not examine observed leatherback interaction in relation to fishing effort.
- Potential changes in observed leatherback size: A portion of the interactions over the years include juvenile leatherback turtles, but difficult to discern any trends in size class due to small sample sizes. Most of observed interactions in 2014 and 2015 are with large (>100 cm straight carapace length) animals.
- Potential impacts from the weak circle hook requirement under the False Killer Whale Take Reduction Plan: Difficult to discern any meaningful pattern due to small sample size. Available literature suggests change to circle hooks may result in change in hooking location, but no significant changes were found based on the preliminary analysis.

- Notable patterns:
    - The higher observed interactions in 2014 can be attributed primarily to a high concentration of takes in Dec 2013-Feb 2014 (5 takes in 2 month period) observed in relatively narrow longitudinal band (160-168W), all of which were large animals that are likely to be adults and were released alive.
    - In all years of data, a seasonal pattern in observed takes is emerging, with low numbers of interactions in May-November, higher numbers in December-April. Based on available satellite tag data of adult and sub-adult leatherback turtles, the higher numbers of interactions in December-April appear to overlap with migratory patterns. However, interactions are also observed during months that do not overlap with migratory patterns, and seasonal distributions of juvenile leatherbacks are unknown. The seasonal pattern does not appear to be correlated with the total number of hooks observed by month.

Based on the working group meeting and additional follow-up discussions, PIFSC conducted an analysis to evaluate whether the higher number of observed interactions recorded in the Hawaii deep-set longline fishery in 2014 are within anticipated levels or an anomaly. Results from the analysis presented to the Scientific and Statistical Committee at its 122nd Meeting in March 2016 showed that leatherback interactions in 2014 were significantly higher than levels expected from previous years (2007-2013). The higher level of interactions in 2014 was considered in the 2014 Biological Opinion, which concluded that the fishery is not likely to jeopardize leatherback turtles. Leatherback interactions, since the 2014 Biological Opinion, remain below the ITS of 72 interactions over three years. The Council at its 165th Meeting in March 2016 recommended continued monitoring of the interactions and further analysis to evaluate patterns of leatherback interactions in the Hawai`i deep-set longline fishery.

More recent review of available observer data on leatherback turtle interactions through 2019 show the following:

- April remains the month with the highest cumulative number of interactions (9 out of 40 interactions for the 2002-2019 period). Of the 9 interactions in April, 3 were smaller animals less than 100 cm carapace length; the remaining 6 are larger animals that have lower mortality rates (Figure 1).
- Between 2002-2019, 9 (22.5%) of the 40 observed leatherback turtle interactions occurred south of 10N, whereas 2.1% of the observed effort over the period have occurred south of 10N.
    - Most of the years in which interactions south of 10N has been observed have been with one interaction, and 2015 was the only year with 2 observed interactions south of 10N.
    - April has had the highest cumulative effort south of 10N over time, with 8.4% of the cumulative effort in April from 2002-2019. Of the 9 interactions observed south of 10N, 6 have occurred in April.
    - However, little to no observed DSLL effort has taken place south of 10N since 2015 (0-0.5% of the effort annually), with no leatherback interactions observed south of 10N since 2016.

- Between 2002-2019, 10 of the 40 (25%) of the 40 observed leatherback turtle interactions occurred between the latitudes of 10-15N, whereas 10.3% of the observed effort over the period occurred in those latitudes.
    - In all but one year, the observers recorded 0-1 annual leatherback turtle interactions between 10-15N. In 2014, 3 interactions were observed.
    - Most of the years in which interactions between 10-15N has been observed have been with one interaction, and 2014 was the only year with 3 observed interactions in these latitudes.
- Mortality rate estimates differ substantially between small (<100cm) and large leatherback turtles. Large turtle are more likely to be released alive and have an average post-hooking mortality rate of 0.281, while smaller turtles are more frequently observed dead and have an average post-hooking mortality rate of 0.711 (Table 2).

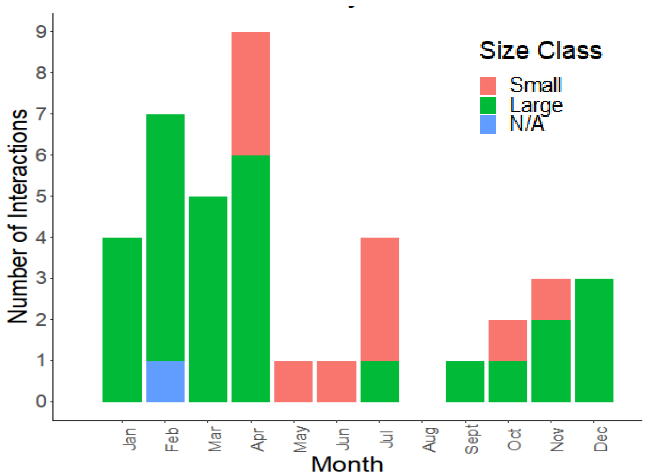

Figure 1. Cumulative number of observed leatherback turtle interactions per month, 2002-2019. Small size class refers to animals less than 100cm in carapace length. Observed interactions without size data were categorized as N/A.

Table 2. Proportion of large and small size classes of DSLL LB interactions (2004-2018) and average post-hooking mortality rate for each size class. Post-hooking mortality rate for leatherback turtles released alive are estimated based on injury category and release condition in Ryder et al. (2006).

Size class	Proportion of interactions (number observed)	Average post-hooking mortality rate estimate
Large (≥100cm SCL)	72.7% (n = 24)	0.281
Small (<100cm SCL)	27.3% (n = 9)	0.711
Overall	**100% (n= 33)**	**0.398**

2.1.2 Interactions in the American Samoa Longline Fishery

Similar to the DSLL, leatherback turtle interactions in ASLL are rare occurrences, with observed interactions ranging between 0-3 annually for the 2006-2019 period (Table 3). Estimated total interactions based on the observer coverage ranges between 0-22 leatherback turtles. Of the 11 observed leatherback turtle interactions in the 2006-2019 period, 5 were release alive and 6 were observed dead.

Table 3. Annual summary of observed and estimated total leatherback turtle interactions in the American Samoa longline fishery, 2006-2019.

Year	Observed					Estimated Total Interactions[1]
	Coverage (%)	Sets	Hooks	Interactions (Obs. mortalities)	Interactions/ 1,000 hooks	
2006	8.1	287	797,221	0	0.0000	0
2007	7.1	410	1,255,329	0	0.0000	0
2008	6.4	379	1,194,096	0	0.0000	0
2009	7.7	306	880,612	0	0.0000	0
2010	25.0	798	2,301,396	0	0.0000	0
2011	33.3	1,257	3,605,897	2(1)	0.0006	4
2012	19.8	662	1,880,525	1	0.0005	6
2013	19.4	585	1,690,962	2(1)	0.0012	13
2014	19.4	565	1,490,416	0	0.0000	4
2015	22.0	504	1,441,706	3(3)	0.0021	22
2016	19.4	424	1,179,532	1(1)	0.0008	3
2017	20.0	447	1,271,803	1	0.0008	3
2018	17.5	276	732,476	1	0.0014	6
2019	15.7	380	1,087,860	0	0.0000	0

Source: Draft 2019 Annual Stock Assessment and Fishery Evaluation (SAFE) Report (in prep).
[1]See WPRFMC (2019) and draft 2019 SAFE Report for details on source and method for estimating total interactions.

2.1.3 Other Relevant Information

Population Status and Impact Assessment for DSLL and ASLL

The Western Pacific leatherback turtle population is declining at an estimated rate of 6.1% annually (Martin et al. 2020). A recent population assessment led by NMFS Pacific Islands Fisheries Science Center (PIFSC) show that impacts of the DSLL and ASLL have minimal effects on the population projections. The modeling results indicate that there were almost no changes to the probabilities of the population falling below abundance thresholds (50%, 25%, and 12.5% of current abundance) under scenarios comparing the population projection with and without DSLL and ASLL interaction impacts (Martin et al. 2020).

Post-hooking Survival

Species-specific post-hooking mortality estimates based on tagging data are not available for leatherback turtles due to the difficulty in boarding and tagging them. Current post-hooking mortality estimates for leatherback turtles add 5-10% mortality risk to the risk levels for hardshell turtles due to friable skin, softer tissue, bone structure and increased susceptibility to entanglement and anoxia (Ryder et al. 2006). Leatherback turtles are typically foul hooked on the body or the flipper rather than being mouth hooked. The post-hooking mortality estimate of a leatherback turtle that is foul hooked or entangled, and released with the hook and entangled is 65%. If the leatherback turtle is released with the hook and with trailing gear less than half the length of the carapace, the post-hooking mortality rate is reduced to 15%, and if all gear are removed, the mortality rate is reduced to 10%.

To improve the information base for a more robust post-hooking mortality estimate for leatherback turtles, PIFSC, Council and Hawaii longline industry members are implementing a project to develop a tag head design that would allow deployment of tags from vessel side without having to board the turtle. The project is anticipated to be completed by 2021, with tag deployments to follow.

Additionally, NMFS is funding a project through the Bycatch Reduction Engineering Program to design and test a cost-effective line cutter prototype that would provide a tool to remove trailing gear in an efficient and safe manner. The project aims to design a tool that can be used on multiple incidental species including leatherback turtles and sharks.

2.2 Giant Manta Ray

2.2.1 Interactions in the Hawaii Deep-set Longline Fishery

Giant manta ray interactions in DSLL are rare occurrences, with observed interactions typically ranging from 0-4 observed interactions per year at approximately 20 percent coverage, with the exception of 2010 when 17 interactions were observed (Table 4). Estimated total interactions typically range from 0-23, with the exception of 2010 with 95 interactions. Of the 55 observed giant manta ray interactions in the 2002-2019 period, 42 were release alive and 2 were observed dead or retained.

A review of spatial and temporal characteristics of the interactions shows the following:

- Interaction patterns are driven largely by the 17 interactions observed in 2010, 12 of which were observed south of 10N in April
- Between 2002-2019, 18 out of 44 observed interactions were south of 10N, 12 of which were observed in 2010.
- Between 2002-2019, 18 out of 44 observed interactions occurred in April, 12 of which were observed in 2010.
- As previously described, April has had the highest cumulative effort south of 10N over time, with 8.4% of the cumulative effort in April from 2002-2019, compared to 2.1% of the overall effort during that period. However, little to no observed DSLL effort has taken place south of 10N since 2015 (0-0.5% of the effort annually), and no giant manta ray interactions have been observed since 2015.

Table 4. Annual summary of observed and estimated total giant manta ray interactions in the Hawaii deep-set longline fishery, 2004-2019.

Year	Observed					Estimated Total Interactions[1]
	Coverage (%)	Sets	Hooks	Interactions (Obs. mortalities)	Interactions/ 1,000 hooks	
2004	24.6	3,958	7,900,681	1	0.0001	3
2005	26.1	4,602	9,360,671	2	0.0002	7
2006	21.2	3,605	7,540,286	2(1)	0.0003	11
2007	20.1	3,506	7,620,083	2	0.0003	5
2008	21.7	3,915	8,775,951	2	0.0002	10
2009	20.6	3,520	7,877,861	4	0.0005	23
2010	21.1	3,580	8,184,127	17(1)	0.0021	95
2011	20.3	3,540	8,260,092	1	0.0001	5
2012	20.4	3,659	8,768,728	2	0.0002	11
2013	20.4	3,830	9,278,133	1	0.0001	5
2014	20.8	3,831	9,608,244	3	0.0003	11
2015	20.6	3,728	9,393,234	2	0.0002	10
2016	20.1	3,880	9,872,439	4	0.0004	22
2017	20.4	3,832	10,148,195	0	0.0000	0
2018	20.4	4,332	11,751,144	1	0.0001	5
2019	20.5	4,697	12,948,077	0	0.0000	0

Source: Draft 2019 Annual Stock Assessment and Fishery Evaluation (SAFE) Report (in prep).
[1]See WPRFMC (2019) and draft 2019 SAFE Report for details on source and method for estimating total interactions.

2.2.2 Interactions in the American Samoa Longline Fishery

Giant manta ray interactions in ASLL are rare occurrences, with observed interactions typically ranging from 0-3 observed interactions per year (Table 5). Estimated total interactions range between 0-29. All giant manta rays observed in the ASLL have been released alive. The lack of observed giant manta ray interactions in the ASLL since 2015 may be attributed to improvements in species identification between giant manta ray and other rays such as mobulas, changes in observer protocol to only attribute interactions to giant manta ray when positive identification is made with photographs (otherwise categorized as “manta/mobula”), and difficulty in identifying mantas and mobulas.

Table 5. Annual summary of observed and estimated total giant manta ray interactions in the American Samoa longline fishery, 2006-2019.

Year	Observed					Estimated Total Interactions[1]
	Coverage (%)	Sets	Hooks	Interactions (Obs. mortalities)	Interactions/ 1,000 hooks	
2006	8.1	287	797,221	0	0.0000	0
2007	7.1	410	1,255,329	0	0.0000	0
2008	6.4	379	1,194,096	0	0.0000	0
2009	7.7	306	880,612	1	0.0011	13
2010	25.0	798	2,301,396	3	0.0013	11
2011	33.3	1,257	3,605,897	3	0.0008	11
2012	19.8	662	1,880,525	3	0.0016	29
2013	19.4	585	1,690,962	2	0.0012	8
2014	19.4	565	1,490,416	1	0.0007	2
2015	22.0	504	1,441,706	0	0.0000	3
2016	19.4	424	1,179,532	0	0.0000	0
2017	20.0	447	1,271,803	0	0.0000	0
2018	17.5	276	732,476	0	0.0000	0
2019	15.7	380	1,087,860	0	0.0000	0

Source: Draft 2019 Annual Stock Assessment and Fishery Evaluation (SAFE) Report (in prep).
[1]See WPRFMC (2019) and draft 2019 SAFE Report for details on source and method for estimating total interactions.

2.2.3 Other Relevant Information

No information is available on the abundance of giant manta rays around the main Hawaiian Islands, American Samoa or the high seas where DSLL and ASLL operate. The NMFS status review for the giant manta ray does not identify any subpopulations of giant mantas near American Samoa (Miller and Klimovich 2016). There are no current or historical estimates of the global abundance of giant mantas. Most estimates of subpopulations are based on anecdotal diver or fisherman observations, which are subject to bias. These populations seem to potentially range from around 100-1,500 individuals (Miller and Klimovich 2016). The NMFS status review concluded that the incidental catch of giant manta rays in U.S. longline fisheries is likely to have minimal effects on the population (Miller and Klimovich 2016).

A review of all observed information for giant manta rays in the Western and Central Pacific Ocean (WCPO) purse seine and longline fisheries indicate that this species is widely distributed throughout the region (Tremblay-Boyer and Brouwer 2016; Figure 2).

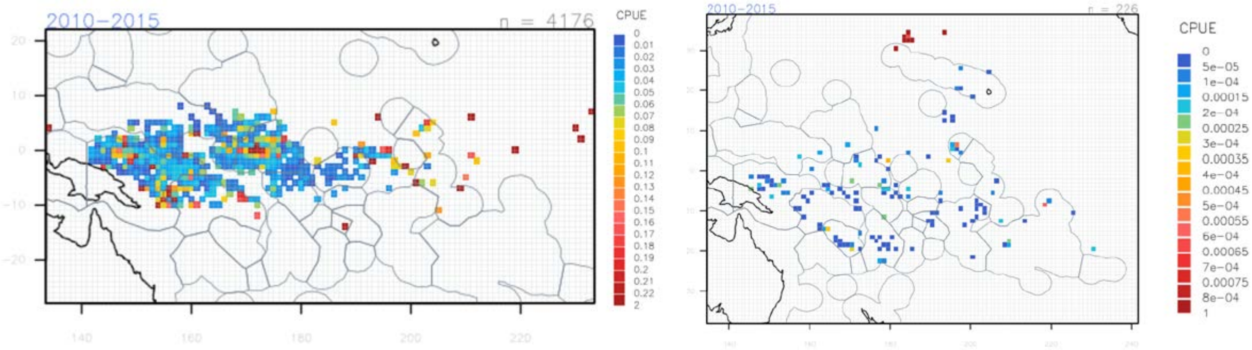

Figure 2. Distribution of giant manta rays observed in purse seine (left) and longline (right) sets in 2010-2015 within the Western and Pacific Ocean. Observations have been standardized to observed fish per observed hook using the 95th percentile. Source: Tremblay-Boyer and Brouwer (2016)

2.3 Oceanic Whitetip Shark

2.3.1 Interactions in the Hawaii Deep-set Longline Fishery

Oceanic whitetip sharks are observed more frequently in the DSLL fishery than leatherback turtles or giant manta rays, ranging between 144-531 observed interactions (741-2,654 estimated total interactions) per year for the 2004-2019 period (Table 6). Majority of the interactions result in the animal being released alive (Figure 1).

Table 6. Annual summary of observed and estimated total oceanic whitetip shark interactions in the Hawaii deep-set longline fishery, 2004-2019.

	Observed					Estimated
Year	**Coverage (%)**	**Sets**	**Hooks**	**Interactions (Obs. mortalities)**	**Interactions/ 1,000 hooks**	**Total Interactions[1]**
2004	24.6	3,958	7,900,681	434(101)	0.0549	2,938
2005	26.1	4,602	9,360,671	341(80)	0.0364	1,282
2006	21.2	3,605	7,540,286	331(78)	0.0439	1,346
2007	20.1	3,506	7,620,083	262(72)	0.0344	1,341
2008	21.7	3,915	8,775,951	144(36)	0.0164	741
2009	20.6	3,520	7,877,861	244(55)	0.0310	1,236
2010	21.1	3,580	8,184,127	253(44)	0.0309	1,198
2011	20.3	3,540	8,260,092	225(43)	0.0272	1,176
2012	20.4	3,659	8,768,728	172(38)	0.0196	878
2013	20.4	3,830	9,278,133	196(36)	0.0211	973
2014	20.8	3,831	9,608,244	374(68)	0.0389	1,670
2015	20.6	3,728	9,393,234	531(139)	0.0565	2,654
2016	20.1	3,880	9,872,439	423(123)	0.0428	2,188
2017	20.4	3,832	10,148,195	242(57)	0.0238	1,257
2018	20.4	4,332	11,751,144	224(62)	0.0191	1,098
2019	20.5	4,697	12,948,077	435(99)	0.0336	2,122

Source: Draft 2019 Annual Stock Assessment and Fishery Evaluation (SAFE) Report (in prep).
[1]See WPRFMC (2019) and draft 2019 SAFE Report for details on source and method for estimating total interactions.

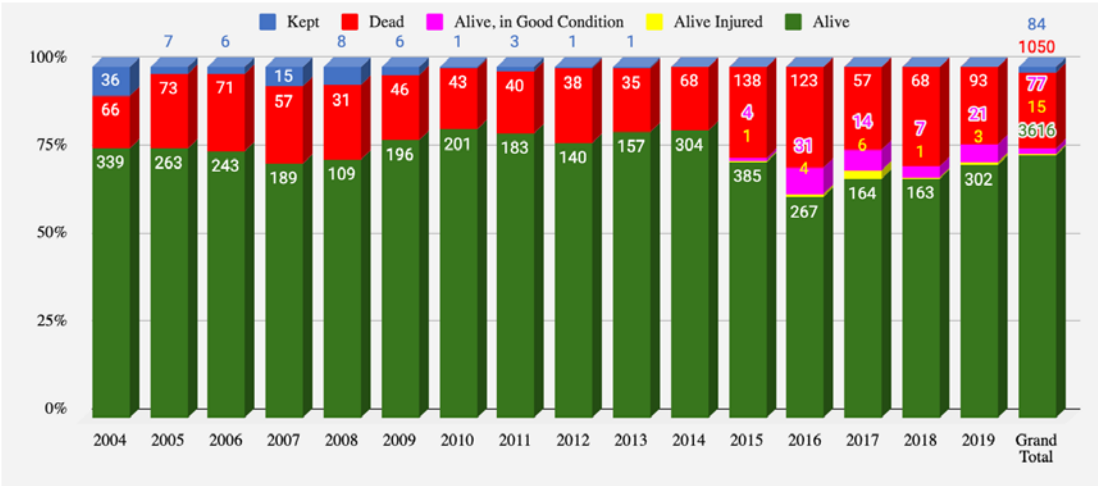

Figure 1. Disposition proportion of observed oceanic whitetip shark interactions in the Deep-set longline fishery, 2004-2019

2.3.2 Interactions in the American Samoa Longline Fishery

Oceanic whitetip sharks are observed more frequently in the ASLL fishery than leatherback turtles or giant manta rays, ranging between 46-197 observed interactions (319-1,176) per year for the 2004-2019 period (Table 7). Majority of the interactions result in the animal being released alive (Figure 1).

Table 7. Annual summary of observed and estimated total oceanic whitetip shark interactions in the American Samoa longline fishery, 2006-2019.

Year	Observed					Estimated Total Interactions[1]
	Coverage (%)	Sets	Hooks	Interactions (Obs. mortalities)	Interactions/ 1,000 hooks	
2006	8.1	287	797,221	46(11)	0.0577	568
2007	7.1	410	1,255,329	62(18)	0.0494	873
2008	6.4	379	1,194,096	48(17)	0.0402	750
2009	7.7	306	880,612	45(13)	0.0511	584
2010	25.0	798	2,301,396	130(37)	0.0565	1,176
2011	33.3	1,257	3,605,897	116(44)	0.0322	319
2012	19.8	662	1,880,525	71(26)	0.0378	470
2013	19.4	585	1,690,962	88(15)	0.0520	407
2014	19.4	565	1,490,416	104(37)	0.0698	464
2015	22.0	504	1,441,706	168(59)	0.1165	827
2016	19.4	424	1,179,532	197(70)	0.1670	899
2017	20.0	447	1,271,803	63(22)	0.0495	458
2018	17.5	276	732,476	108(39)	0.1474	617
2019	15.7	380	1,087,860	140(51)	0.1287	892

Source: Draft 2019 Annual Stock Assessment and Fishery Evaluation (SAFE) Report (in prep).
[1]See WPRFMC (2019) and draft 2019 SAFE Report for details on source and method for estimating total interactions.

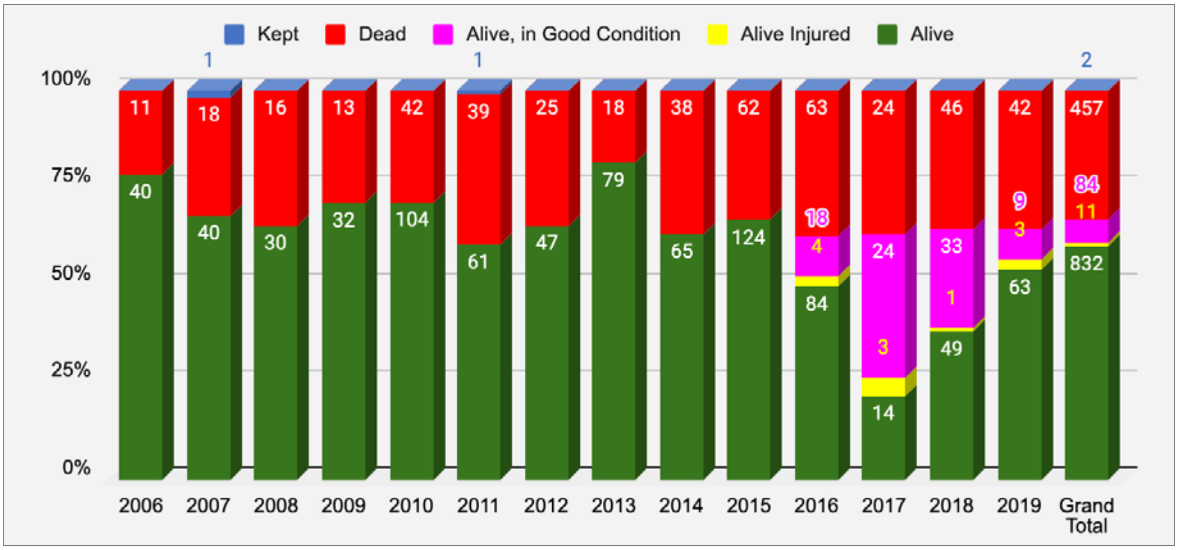

Figure 3. Disposition proportion of observed oceanic whitetip shark interactions in the American Samoa longline fishery, 2006-2019.

2.3.3 Other Relevant Information

State/Territory, Federal and International Shark Regulations

State of Hawaii and Federal regulations prohibiting shark finning were implemented between 1999-2002, resulting in most sharks species caught in the DSLL fishery to be released alive since 2001. In 2012, American Samoa banned shark fishing, including the trade, sale, and distribution of sharks or shark parts, including fins, within 3 nm of the coastline.

To mitigate impacts to the oceanic whitetip shark, conservation measures recommended by regional fishery management organizations and implemented by regulations in the U.S. domestic fisheries have prohibited retention of oceanic whitetip sharks since 2011 in the Inter-American Tropical Tuna Commission (IATTC) convention area and since 2015 in the Western and Central Pacific Fisheries Commission (WCPFC) convention area. Specifically, these conservation measures for the WCPFC (50 CFR 300.226) prohibit U.S. fishing vessels from retaining any part or carcass of an oceanic whitetip shark, except to assist WCPFC observers in collection of samples. The regulations also require vessel operators to release any oceanic whitetip shark as soon as possible and take reasonable steps for safely releasing oceanic whitetip sharks. Similar conservation measures prohibiting retention and safe release of oceanic whitetip sharks are implemented in the IATTC convention area (50 CFR 300.24).

Stock Assessment and Stock Status

A new stock assessment for the oceanic whitetip shark in the WCPO was completed in 2019 (Tremblay-Boyer et al. 2019). This was the first stock assessment since WCPFC adopted the oceanic whitetip shark non-retention measure (CMM 2011-04) that went into effect in 2013 and applied to WCPFC Members, Cooperating Non-Members and Participating Territories. The 2019 stock assessment found that fishing mortality reference points for WCPO oceanic whitetip shark improved by nearly half in the period since CMM 2011-04 became active, which covers the last four years of the assessment's time-span (2013–2016), and a slight increase in spawning biomass since 2013. The assessment also indicates that the WCPO population of oceanic whitetip shark continues to decline due to overfishing, and that current catch in the WCPO (all fisheries and gear types combined) is estimated at about 3,000 t annually. Because the 2019 assessment assumes that oceanic whitetip sharks mature at 6-8 years, increases in biomass from CPUE in the final four years are attributed to recruitment, thus resultant spawning biomass and fishing mortality may not reflect expected stock recovery by the terminal year in the assessment.

The assessment was presented at the WCPFC 15th Science Committee (SC15) for review. SC15 noted the increase in biomass and CPUE since implementation of CMM 2011-04 and the maturation of the species may not allow the stock assessment model to indicate the efficacy of the measure in the terminal years of the assessment. The SC15 recommended that stock projections be conducted clarify whether the stock status will continue to improve. The Council will be supporting a project to carry out these stock projections to determine likely future biomass and spawning stock levels.

Final indicators of stock status and key management quantities contained in the 2019 assessment are determined from summary statistics over 648 model runs accounting for assumptions about life-history parameters and impact[s] of fishing underpinning the assessment. Using the underlying data over the 648 models in the structural uncertainty grid described in Tremblay-Boyer et al. (2019), and provided to NMFS from the assessment authors, the median value of the current total number of individuals in the WCPO is 775,214 (NMFS 2020).

On May 1, 2020, NMFS notified the Council that the WCPO stock of oceanic whitetip shark is subject to overfishing and is overfished, based on the 2019 stock assessment, PIFSC's April 10, 2020, determination that the assessment meets requirements under National Standard 2 of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) as the best scientific information available, and the status determination criteria in the Pelagic Fishery Ecosystem Plan. Pursuant to MSA Section 304(i), the Council is obligated to respond to this determination because the overfishing of the oceanic whitetip shark in the WCPO is due largely to excessive international fishing pressure, and because it has not been determined that management measures adopted by the WCPFC will end overfishing and rebuild the stock. Consistent with Magnuson-Stevens Act section 304(i), the Council is required to:

1. Within one year, develop and submit recommendations to the Secretary of Commerce for domestic regulations to address the relative impact of fishing vessels of the United States on the WCPO oceanic whitetip shark stock; and
2. Develop and submit recommendations to the Secretary of State and to Congress for international actions that will end overfishing and rebuild the WCPO oceanic whitetip shark stock, taking into account the relative impact of vessels of other nations and vessels of the United States on the stock.

Tagging Study to Assess Post-hooking Survival Rates

PIFSC is conducting a study to assess the post-release survival rates of oceanic whitetip sharks released alive in the Hawaii deep-set and American Samoa longline fisheries (Hutchinson and Bigelow 2019). In this ongoing study, Hutchinson and Bigelow (2019) has found that the condition of bycatch sharks at release ("good" versus "injured") and the amount trailing gear left on the animals were the two factors that had the largest effect on post release mortality. PIFSC researchers have been working with observer programs and fishermen to quantify post release mortality rates of blue, bigeye thresher, oceanic whitetip, and silky sharks that are incidentally captured in DSLL and ASLL, using pop-off archival satellite tags (PAT). This study also assessed the effects that standard shark bycatch handling and discard practices utilized in these fisheries may have on the post release fate of discarded sharks that are alive at haul back of the longline gear.

Observers collected shark condition and handling data on 19,572 incidental elasmobranchs captured during 148 fishing trips that occurred between January 2016 and June 2019 on 76 different vessels. During 111 of these trips, 148 sharks were tagged by observers and fishers with PAT. The handling and damage data recorded by trained observers indicated that most sharks (93.22%) were released by cutting the branchline. In the DSLL this means that most sharks were released with an average of 9.02 meters of trailing gear, typically composed of a stainless-steel hook, 0.5 m of braided wire leader, a 45-gram weighted swivel, and monofilament branchline ranging in length from 1.0–25.0 m. Sharks released by cutting the line in ASLL were released with an average of 3.038 m of trailing gear which is composed of a stainless-steel hook to an all monofilament line ranging in length from 1.0–9.0 m. Results from the PAT deployments showed that survivorship to 30 days is relatively high (0.891 ± 0.03 S.E.) for sharks when captured in good condition. Survival rates are also higher for all species when they are left in the water and released by fishers cut the line versus removing the gear. Gear removal requires additional handling, and animals are sometimes brought on deck (sometimes using a gaff) and exposed to air which may impact release condition. The effects of the trailing gear was assessed in a subset (n=12) of blue sharks captured in the DSLL using tags programmed for longer deployments (180 and 360 days). Long term survival rates to 300 days were remarkably lower for this dataset (0.356 ± 0.18 S.E.). Additional details regarding the preliminary results of this study are available in Hutchinson and Bigelow (2019).

Simulation modeling of possible measures to reduce impacts

Harley et al (2015) conducted Monte Carlo simulation testing to evaluate how oceanic whitetip and silky sharks interact with longline gear and using it to quantify potential sources of fishing-related mortality. The model evaluated four potential management measures: (1) removal of shallow hooks; (2) removal of shark lines; (3) requirement for circle hooks; and (4) requirement for mono lament leaders. The key conclusions of the analyses included the following (Harley et al. 2015):

- The initial interaction of silky shark and oceanic whitetip shark with longline gear can be reduced by both the banning of shark lines or the removal of “shallow-hooks", which was defined as the three hooks closest to the start/end of the basket;
- Banning shark lines has the potential to reduce fishing mortality by 14.7% and 23.3% for silky shark and oceanic whitetip shark respectively, and removing shallow hooks has the potential to reduce fishing mortality by 11.7% and 6.7% respectively;
- Banning wire trace, while unlikely to influence initial interaction, lead to increased bite-offs which resulted in the greatest reductions in fishing mortality of the measures considered –17.6% and 23.3% for silky shark and oceanic whitetip shark respectively;
- Prohibiting both shark lines and wire trace is predicted to reduce mortality by 29.4% and 40% for silky shark and oceanic whitetip shark respectively; and
- The tendency for greater lip-hooking with circle hooks and therefore fewer bite-offs meant little predicted benefit from requiring circle hooks.

DSLL and ASLL do not use shark lines, both fisheries use circle hooks, and ASLL does not use wire leaders. DSLL uses wire leaders as a safety measure to prevent fly-back of weights required as part of the seabird mitigation measures.

2.4 Other Relevant Research Initiatives Applicable to All Species

Ecosystem-based Fisheries Management Project

Following a Council recommendation in March 2017, the Council and NMFS implemented the ecosystem-based fisheries management (EBFM) project for protected species impacts assessment for the Hawaii and American Samoa longline fisheries. The project is a collaboration between PIFSC, Council, PIRO and University of Florida. In the first year of the initiative, the team developed methodologies to associate the spatiotemporal patterns of olive ridley turtle interactions with the DSLL fishery with static and dynamic environmental characteristics. However, the project quickly expanded looking not only across marine turtle species within the fisheries but also across taxa. The project resulted in the development of a data compilation workflow linking the observer dataset with NOAA and other related oceanographic data products for the DSLL observer data set as well as the shallow-set observer data. The resulting data sets were used to develop an Ensemble Random Forest model to (i) predict the probability of fishery interactions with protected species including target and non-target catch; (ii) defining critical areas of interaction using quantile contouring over a range of temporal time frames; (iii) assessed the number of sets and interactions within the contours; and (iv) developing covariate response curves using Accumulated Local Effects.

The EBFM project is currently in year 2, during which the Ensemble Random Forest approach will be expanded to investigate risk contours for a suite of species of interest. Datasets will be updated to incorporate recent years of data as well as explore model refinement to include derived products on weekly temporal frames. The relative importance of environmental covariates resulting from the Ensemble Random Forest approach can be used to establish recommendations similar in implementation to the existing TurtleWatch product for avoiding species of interest. The analysis will explore the potential benefit and impact of closures or voluntary avoidance of interaction hotspots on protected species bycatch of interest as well as on catch rates of primary and secondary target species in the fishery. The goal is to model how the redistribution of displaced effort may affect primary and secondary target catch rates as well as protected species interactions.

3 POTENTIAL MITIGATION MEASURES TO FURTHER MINIMIZE IMPACTS

3.1 RPMs in the Shallow-set Longline Fishery BiOp

The 2019 SSLL BiOp (NMFS 2019) concluded that the continued operation of the fishery is not likely to jeopardize ESA-listed species, and included a range of RPMs with a focus on immediately reducing impacts to leatherback and loggerhead turtles, and requiring consideration for additional measures for oceanic whitetip shark and giant manta rays. These RPMs included:

1. Hard caps for leatherback turtles;
2. Trip limits for leatherback and loggerhead turtles with additional restrictions upon reaching trip limit twice in a year;
3. Updating data collection;
4. Updating reporting;

5. Exploring spatial and temporal patterns to develop new mitigation measures (time-area closures, move on rules, etc.) for leatherback and loggerhead turtles, giant manta ray, and oceanic whitetip shark; and
6. Researching/innovating handling and release practices to increase post-interaction survivability.

3.2 Considerations for Evaluating Applicability of SSLL RPMs and Developing New Measures

Considerations for evaluating applicability of SSLL RPMs to DSLL and ASLL fisheries, and for developing new measures include, but are not limited to, the following:

- Observer coverage for DSLL and ASLL fisheries are approximately 20%, compared to 100% in the SSLL fishery. Less than 100% coverage would require developing methodologies to generate estimated total interactions in real-time for tracking any fleet-wide interaction limits. Additional monitoring mechanisms would also be needed if individual trip or vessel interaction limits are considered.
- Leatherback turtle interaction rates are an order or two magnitudes lower in the DSLL and ASLL compared to the SSLL.
- Due to the small number of observed leatherback turtle and giant manta ray interactions, any potential patterns or trends in interactions are difficult to interpret.

The Pelagic Plan Team meeting at its meeting convened May 6-8, 2020, reviewed the draft 2019 Stock Assessment and Fisheries Evaluation (SAFE) report, considerations for RPMs, and other related fishery issues, and noted the following:

- Shark tagging studies suggest improving handling practices likely to be beneficial in improving post-hooking survivorship;
- Improving handling practices to reduce post-hooking mortality likely to provide “best bang for the buck” for many protected species including leatherback turtles;
- Difficulties with giant manta ray identification; and
- EBFM project building method to explore potential impacts of effort removal/redistribution from closed areas on fishery performance
- Recommended convening interdisciplinary working group to develop roadmap for generating analyses and/or potential measures for oceanic whitetip sharks regarding emerging requirements under the MSA and ESA.

4 SSC AND COUNCIL DISCUSSION

The SSC and Council at their respective June 2020 meetings will provide direction on the following:

- Considerations for mitigation measures based on interaction characteristics (e.g., known spatiotemporal patterns; frequency of interactions; mortality rates; potential for conservation benefit)
- Identify high and low priority measures for each species, with justifications
- Recommended analyses to inform considerations for mitigation measures (taking into account timing and available resources)

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