WESTERN PACIFIC REGIONAL FISHERY MANAGEMENT COUNCIL

Options Paper
Inclusion of Tori Lines in the Hawaii Longline Fishery
Seabird Interaction Mitigation Measures

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1 INTRODUCTION

Seabird interactions in the Hawaii longline fishery, composed mostly of black-footed albatross (BFAL) and Laysan albatross (LAAL), have been monitored through the NMFS Pacific Islands Regional Office Observer Program since 1994. Starting in 2001, implementation of seabird mitigation measures including night-setting, blue-dyed bait, and weighted branchlines resulted in reductions in interactions by 70-90% (Van Fossen 2007; Gilman et al. 2008). LAAL and BFAL interactions in the Hawaii deep-set longline (DSLL) fishery have gradually risen in subsequent years with significant increases since 2015 for BFAL.

The increase in albatross interactions in the DSLL fishery appear to be driven by a combination of factors including oceanographic changes (Gilman et al 2016). In 2017, the Western Pacific Regional Fishery Management Council (Council) held a workshop exploring the causes of higher BFAL interactions observed in the Hawaii longline fishery in 2015-2016. Potential drivers identified included positive Pacific Decadal Oscillation, strong westerly winds, and cooler sea surface temperatures, which may increase the overlap of DSLL effort and BFAL foraging grounds (Wren et al. 2019).

In 2018, the Council held a second workshop to review seabird mitigation requirements and the best scientific information available for the Hawaii longline fishery. The workshop resulted in the identification of priority mitigation measures suitable for the Hawaii longline fishery, potential changes to seabird measures, and research needs to inform future changes to seabird measures (Gilman and Ishizaki 2018). Specifically, workshop participants identified blue-dyed bait as a candidate for removal from the existing suite of seabird mitigation measures because of concerns with efficacy and practicality, and identified deterrents such as tori lines (also called streamers) to be a high priority for further research and development due to its potential to provide an effective alternative to blue-dyed bait. Participants discussed that the requirement for using blue-dyed bait was intended to be used for squid bait but currently only fish are used for bait[1] in both Hawaii longline fisheries, and that blue-dyed fish bait may also be less effective at mitigating seabird catch risk than blue-dyed squid bait. Industry members who participated in the workshop indicated that blue-dyed bait is not favored by fishermen as the dye is messy and thawing of bait reduces retention on hooks. Additionally, recent analysis of observer data

[1] SSLL vessels are required to use mackerel-type fish bait and DSLL vessels use fish bait by preference. Squid bait is also more expensive than fish bait.

indicate that side-setting is more effective than blue-dyed bait in the DSLL fishery (Gilman et al. 2016).

Tori lines were previously tested in the Hawaii longline fishery in the late 1990s, which showed that the deterrents were effective in reducing seabird contact rates with bait and gear (McNamara et al. 1999, Boggs 2001). However, these early studies also identified issues with practicality and crew safety resulting from tori line entanglement with gear. The Council considered inclusion of tori lines in the seabird mitigation measures in 1999 and again in 2004, but to date tori lines have not been included as an option for the Hawaii longline fishery.[2]

Following the 2018 workshop, the Council at its 174th Meeting in October 2018 recommended 1) enhancing outreach and training efforts to ensure proper application of existing seabird mitigation measure requirements; 2) NMFS provide support for research and development for alternative measures with potential to replace blue-dyed bait, with high priority placed on identifying suitable designs for tori lines; and 3) encourage submission of Experimental Fishing Permit applications for testing alternative measures without the use of blue-dyed bait to allow comparison of measure effectiveness with and without blue-dyed bait. The Council additionally directed staff to prepare a discussion paper for the March 2019 Council Meeting to evaluate the effect of potential removal of blue-dyed bait without additional replacement measures on seabird interaction rates.

The Council at its 176th Meeting in March 2019 reviewed the discussion paper and determined that removal of blue-dyed bait without replacement measures would likely increase seabird interactions. The Council additionally endorsed strategies for identifying alternative mitigation measures and improving seabird measure effectiveness for the Hawaii longline fishery, including addressing captain effects through strategic outreach, identifying tori line designs suitable for the Hawaii fishery, encouraging trials for making minor modifications to existing required measures, and progressing international bycatch assessments for North Pacific albatross species. To further address the priority for identifying suitable tori line designs, the Council directed staff to work with industry, NMFS, Pelagic Plan Team and other expertise as appropriate to identify draft minimum standards for tori lines, taking into consideration existing standards established for other fisheries, designs currently used voluntarily by Hawaii longline vessel operators, and diversity of vessel size and configuration in the Hawaii longline fishery.

In 2019, a joint Cooperative Research Project by the Council, Hawaii Longline Association (HLA), NMFS Pacific Islands Fisheries Science Center (PIFSC) and Pacific Islands Regional Office (PIRO) was initiated to conduct 1) demonstration and trial of tori lines in the Hawaii longline fishery to inform minimum standards specific to this fishery, 2) field trials of tori lines to collect data on operational practicality and effectiveness in using tori lines under commercial

[2] The Council initially recommended including towed deterrents such as tori lines and towed buoys as part of its original seabird mitigation action in 1999 in which vessels would have been required to use two out of six mitigation measures. However, tori lines were not part of the seabird mitigation measures implemented in 2001 because the measure was not included in the Terms and Conditions in the 2000 Biological Opinion developed by USFWS. The Council again recommended requiring the use of tori lines as part of stern-setting measures when it developed the side-setting option in 2004, but later modified its recommendation in 2005 to remove tori lines from the proposed modifications in part due to the limited number of studies to inform construction and operating performance standards of using tori line systems in the Hawaii longline fishery.

fishing operations. Preliminary results from the Phase 2 data analysis presented at the 183rd Council Meeting in September 2020 indicate that tori lines are effective in reducing albatross contacts on baited hooks when used in conjunction with existing seabird bycatch mitigation measures. Specifically, the results indicate that albatrosses are at least 2 times less likely to interact (attempt or make contact) with longline gear or bait when tori lines are used (WPRFMC 2020).

The Council at its 183rd Meeting in September 2020 directed staff to develop an options paper to consider inclusion of tori lines in the seabird mitigation measures, including an option to allow the use of tori lines without blue-dyed bait.

2 PURPOSE OF THE OPTIONS PAPER

This paper explores options for inclusion of tori lines in the seabird mitigation measures in the Hawaii longline fishery, including specific considerations for allowing the use of tori lines without blue-dyed bait. Additionally, the paper presents options to define the scope of the Council action, such as the applicability of the action to the Hawaii shallow-set longline (SSLL) sector, modification of strategic offal discard requirement, conversion of requirements to mirror RFMO measures, and addressing cross-taxa impacts associated with weighted branchlines.

3 BACKGROUND INFORMATION

3.1 Seabird Mitigation Measures in the Hawaii Longline Fishery

Current gear-based seabird mitigation measures required in the Hawaii DSLL and SSLL fisheries are summarized in Table 1. This set of seabird measures were implemented in 2006, which amended earlier requirements implemented in 2001 for DSLL and in 2004 for SSLL. These measures apply to DSLL vessels when fishing north of 23°N, and SSLL vessels wherever they fish.

For both components of the longline fishery, vessels have the option to side-set or stern set, with each option having additional required measures. For both DSLL and SSLL fisheries, if vessels choose to side-set, they are also required to use weighted branch lines (i.e., attach weights equal to or greater than 45 grams to branch lines within one meter of each hook). DSLL vessels that stern set are required to use blue-dyed thawed bait, weighted branch lines, line shooter, and strategic offal discards. SSLL vessels that choose to stern set are required to night set, use blue-dyed thawed bait, and use strategic offal discards.

In addition to the gear-based measures, the Hawaii longline fishery is required to handle live seabirds in a manner that maximizes the chances of long-term survival after release and to annually attend a protected species workshop conducted by NMFS.

Table 1. Summary of current seabird mitigation measures required in the Hawaii DSLL and SSLL fisheries (50 CFR 665.815).

DSLL	
When side-setting north of 23°N, also use:	**When stern-setting north of 23°N, use:**
Bird curtain >45g weight within 1m of hook	Blue-dyed bait (thawed) >45g weight within 1m of hooks Line shooter Strategic offal discards (when seabirds present)
SSLL	
When side-setting, also use:	**When stern-setting, use:**
Bird curtain >45g weight within 1m of hook	Blue-dyed bait (thawed) Strategic offal discards (when seabirds present) Night set

3.2 Timeline of Seabird Mitigation Measure Implementation

The Council began addressing seabird interactions in the Hawaii longline fishery in the mid-1990s, with a series of workshops conducted in conjunction with the US Fish and Wildlife Service (USFWS) to inform fishermen of seabird interaction issues and provide information on mitigation measures. The Council and NMFS in 1998-1999 conducted at-sea trials of various mitigation measures, including blue-dyed bait, thawed bait, towed deterrents, night setting, weighted branch lines, and offal discharge (McNamara et al. 1999; Boggs 2001).

The Council took action in October 1999 recommending that Hawaii longline vessel operators when fishing north of 25°N employ two or more of the following seabird deterrent techniques: 1) blue-dyed bait; 2) strategic offal discards; 3) towed deterrents (e.g., tori lines or towed buoy); 4) line-setting machine with weighted branch lines; 5) weighted branch lines; and 6) night setting. The Council's recommendation was intended to allow fishermen to select a combination of methods to use and find the most effective combination so that seabird measures may be amended based on their operational experience and data. At the time, blue-dyed bait had been primarily tested on squid bait used in the SSLL fishery, and minimal testing had been done on fish bait used in the DSLL fishery.

After NMFS published a proposed rule in July 2000 based on the October 1999 Council recommendation, USFWS issued a Biological Opinion (BiOp) in November 2000 analyzing the impacts of the Hawaii longline fishery on ESA-listed short-tailed albatrosses (STAL). The BiOp concluded that the fishery was not likely to jeopardize the STAL, but estimated that the fishery would take 15 STALs during a 7-year period (for the purpose of the BiOp, USFWS defined "take" to include injury, mortalities, and any STAL striking at baited hooks or gear). Based on this assessment the 2000 BiOp included Reasonable and Prudent Measures (RPMs) and Terms and Conditions that required 1) all Hawaii longline vessels to use thawed blue-dyed bait and strategic offal discards when operating north of 23°N; and 2) DSLL vessels to additionally use line-setting machine with weighted branch lines when operating north of 23°N. The Terms and Conditions of the 2000 BiOp was implemented in June 2001 through an Emergency Interim Rule, and later through a Framework Amendment to the Pelagic Fishery Management Plan (FMP) in June 2002. A Regulatory Amendment to the Pelagic FMP implemented in April 2004

additionally required that SSLL vessels use night-setting (no earlier than one hour after local sunset and no later than local sunrise) when fishing north of 23°N.

The USFWS issued a revised BiOp in November 2002 in response to the court-ordered SSLL fishery closure in 2001 that modified the federal action subject to ESA Section 7 consultation. In reinitiating the consultation, NMFS included as part of the proposed action an experiment to test the efficacy of blue-dyed fish bait. The revised BiOp recognized the limited data available on the effectiveness of blue-dye on fish bait, and required interim and final reports of the experiments to be submitted to USFWS.

Following a series of cooperative research trials that tested blue-dyed fish bait along with side-setting and underwater setting chutes, the Council took initial action in June 2004 for a regulatory amendment to the seabird measure. In October 2004, the Council took final action to recommend the addition of side-setting as an alternative seabird mitigation measure to blue-dyed bait, the addition of tori lines to the existing blue-dyed bait measure, and modification of the SSLL seabird requirements to apply wherever they fish. The Council additionally indicated in its action that it would use the period of the regulatory process to collect supplementary data on bird behavior and coordinate with the USFWS to remove the requirement for blue dyed thawed bait and offal discards, if appropriate. A letter from the US Department of Interior (DOI) to NMFS dated October 15, 2004, received after the Council Meeting, stated that blue-dyed thawed bait and strategic offal discards should be retained as mitigation measures. DOI agreed that there is limited data on effectiveness of blue-dyed fish bait and acknowledged that trials in New Zealand show that mackerel-type bait hold dye less well than squid. However, DOI argued that blue-dyed thawed bait should be retained in the mitigation measures unless replaced by a demonstrably more effective deterrent, given that thawed bait has some deterrent effect due to its faster sink rate compared to frozen bait and that the blue dye has unclear but “perhaps neutral or positive deterrent effect”. The letter further suggested that strategic offal discards should be used only when seabirds were present. DOI also recommended that tori lines not be included as an optional seabird deterrent unless they are used in addition to more effective deterrents, as results of Hawaii-based studies using tori lines indicated tori lines were not as effective as other deterrent measures.

Following the publication of the proposed rule, the Council in November 2005 modified its recommendation to remove tori lines from the regulatory amendment. The decision was due to information that seabird interactions had already been reduced significantly, construction and operating performance standards of using tori line systems in the Hawaii longline fishery had not been thoroughly studied, and tori lines were originally included in the recommendations as an incentive to convert to side-setting whereas as of 2005, 40 vessels had converted to side setting with more on the way given NMFS financial assistance. The regulatory amendment adding the side-setting option and modifying SSLL requirements to apply wherever they fish was implemented in January 2006.

3.3 Seabird Interactions Trends

Seabird interactions in the Hawaii longline fishery have been monitored through the PIRO Observer Program since 1994. The observer coverage rate was initially low at around 5% from 1994 to 1999. The bigeye tuna-targeting DSLL fishery has been consistently monitored at a

minimum of 20% coverage since 2001, and the swordfish-targeting SSLL fishery has been monitored at 100% coverage since 2004.

Most seabird interactions in the Hawaii longline fishery are with BFAL and LAAL. Between 1994 and 1999, fleet-wide BFAL interactions were estimated to range from 1,134 to 1,830 annually, and LAAL interactions were estimated to range from 844 to 2,067 annually (McCracken 2000). Implementation of seabird mitigation measures in 2001 resulted in reductions in interactions by 70-90% (Van Fossen 2007; Gilman et al. 2008).

In the decade since the successful implementation of seabird mitigation measures, the DSLL fishery has seen a gradual increasing trend in LAAL and BFAL interactions (Gilman et al. 2016), with higher rates of BFAL interactions seen since 2015 (WPRFMC 2018; Figure 1). In contrast, LAAL interactions have remained relatively stable in recent years. A similar, but less pronounced pattern has been observed in the SSLL fishery. To date, STAL interactions have not been observed in the DSLL and SSLL fisheries. In both fisheries, interactions are highest in the first and second quarters of the calendar year (January-June) due to fishing effort overlapping with the BFAL and LAAL foraging distribution during breeding season in the northwestern Hawaiian Islands. Albatross interactions in the SSLL fishery have a single peak in March and April, while those in the DSLL fishery have two peaks, in February and May. Most interactions on DSLL vessels occur during the set, while majority of interactions occur during the haul on SSLL vessels.

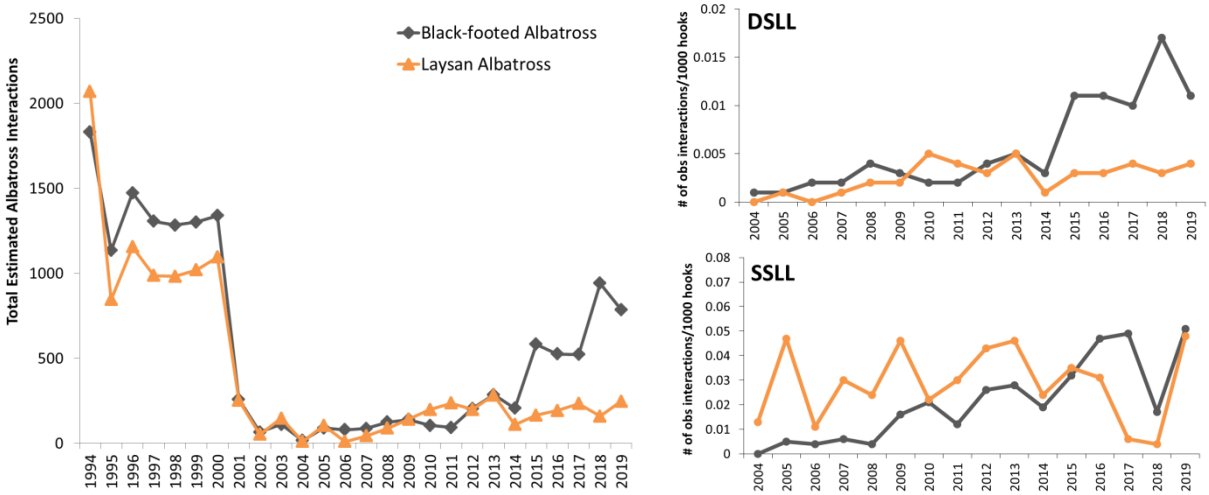

Figure 1. BFAL and LAAL interactions in the Hawaii longline fishery. Left panel shows total estimated BFAL and LAAL interactions in the DSLL and SSLL fishery combined, 1994-2019. Right panels show BFAL and LAAL interaction rates in the DSLL (top) and SSLL (bottom) fisheries. SSLL data for 2006 and 2018-2019 are primarily first quarter data due to fishery closures related to sea turtle interactions.

The gradual increase of albatross interactions over time and recent elevated levels of interactions in the DSLL appear to be driven by a combination of factors. An analysis conducted by Gilman and colleagues (2016) using data from October 2004 to May 2014, indicated that albatross interaction rates significantly increased during years of higher annual mean multivariate El Niño

index (MEI), suggesting that oceanographic changes may have contributed to the increasing trend in albatross catch rates. This analysis also showed a significant increasing trend in the number of albatrosses observed around fishing vessels, which may have contributed to the increasing catch rates. Council's 2017 Workshop further examined the potential environmental factors affecting higher BFAL interactions observed in the Hawaii longline fishery in 2015-2016. Analysis conducted for the 2017 Workshop suggested that while fleet dynamics (month, latitude and longitude of fishing) explained much of the variation over the years, positive Pacific Decadal Oscillation (PDO), strong westerly winds, and cooler sea surface temperatures explained the increase in BFAL sightings in recent years (Wren and Polovina 2018; Wren et al. 2019). Stronger westerly winds may drive productive surface waters to the south, increasing the overlap of DSLL fishing effort and BFAL foraging grounds, and more birds may also transit through the fishing grounds when westerly winds move south during positive PDO years.

Additionally, analysis prepared for the Council's 2018 Workshop suggested that a unique captain effect (i.e., probability of albatross interactions differed by individual vessel operators) may also be contributing to the higher interactions in recent years (Fitchett and Ishizaki 2018). Mean annual captain effects (calculated as odds ratios) increased significantly from 2010 to 2012 and again from 2016 to 2018, commensurate with the recent increase in seabird interactions. Increased albatross attraction to vessels through albatross learning behavior over time was speculated as a factor contributing to larger abundance around vessels in the 2017 Workshop discussions, although data are lacking to test this hypothesis.

BFAL population modeling updated for the 2017 Workshop indicated that the increased interactions in 2015-2016 in the Hawaii longline fishery, if it is temporary or stabilized at the higher level, is likely to have an imperceptible difference on the population growth (Bakker and Finkelstein 2017). If the elevated interaction rates are applied consistently throughout North Pacific fisheries (U.S. and international fleets) with BFAL bycatch, the population is projected to decline. However, data on BFAL interactions in non-U.S. fisheries are limited, and the total BFAL interactions in the North Pacific are unknown.

3.4 Summary of the Tori Line Cooperative Research Project

In 2019, a joint Cooperative Research Project by the Council, HLA, PIFSC, and PIRO was initiated to conduct 1) demonstration and trial of tori lines in the Hawaii longline fishery to inform minimum standards specific to this fishery, 2) field trials of tori lines to collect data on operational practicality and effectiveness in using tori lines under commercial fishing operations.

The project was divided into two phases. Phase 1 goals were to identify potential tori line designs based on industry input, expert advice, existing international standards and guidelines for tori lines, land trials, and sea trials. Five different tori line prototype designs were tested during at-sea demonstrations with the goal of determining operational practicality and design preferences based on interviews with vessel operators. A short streamer design with a 50 meter aerial extent using a light material (dyneema) backbone and 55 meter drag section was selected for Phase 2 field trials under commercial fishing operations in the DSLL. The short streamer design was most favored by captain and crew due to their ease of deployment and retrieval, and having sufficient amount of streamers to deter seabirds from sinking baited hooks. The 50 meter

aerial extent provides sufficient distance to cover the area with sinking baited hooks in the DSLL (approximately 40 m from vessel stern[3]), and allowed the design to meet existing tori line specifications for the Western and Central Pacific Fisheries Commission (WCPFC) and the Inter-American Tropical Tuna Commission (IATTC). During Phase 2 field trials, data on seabird strike attempts and contacts were collected throughout each setting operation using stern video cameras connected to the vessel's Electronic Monitoring (EM) system to evaluate the tori line's practicality and effectiveness.

Preliminary results from the Phase 2 data analysis presented at the 183rd Council Meeting in September 2020 indicate that tori lines are effective in reducing albatross contacts on baited hooks when used in conjunction with existing seabird bycatch mitigation measures. Specifically, the results indicate that albatrosses are at least 2 times less likely to interact (attempt or make contact) with longline gear or bait when tori lines are used.

The Council at its 183rd Meeting recommended additional at-sea trials for winter 2020/spring 2021 to test tori line efficacy without the use of blue-dyed bait when fishing north of 23N under an Experimental Fishing Permit (EFP) to inform development of options for revising mitigation measures. The Council is expected to review an EFP application at the 184th Meeting.

3.5 Seabird Mitigation Measures under the Regional Fishery Management Organizations

The Western and Central Pacific Fisheries Commission (WCPFC) and the Inter-American Tropical Tuna Commission (IATTC) have adopted measures to mitigate seabird bycatch in longline fisheries. Both commissions have adopted a "menu approach" whereby vessels may choose measures from two columns, and in the North Pacific, both commissions require measures to be applied north of 23°N.

WCPFC's Conservation and Management Measure (CMM) 2018-03 have separate requirements by the overall length of vessels. Vessels equal to or greater than 24 meters are required to use at least two mitigation methods from Table 2 with at least one from column A, and vessels that are less than 24 m in length are required to use at least one mitigation method from column A in Table 2. IATTC's Resolution C-11-02 applies to longline vessels greater than 20 m in overall length. The resolution requires longline vessels to use at least two mitigation methods listed in Table 3, with at least one coming from column A, but not using the same measure from Column A and Column B.

[3] BFAL and LAAL, the primary species that have incidental interactions with the Hawaii longline fishery are not diving birds, thus the project team determined that aerial extent to cover the area with sinking baited hooks would be sufficient to prevent primary attacks on baited hooks from these species. Secondary attacks by deeper diving seabirds that bring bait to the surface and making them available to other seabirds are not common in the Hawaii longline fishery.

Table 2. Seabird Mitigation Measure Table in WCPFC CMM 2018-03.

Column A	Column B
Side setting with a bird curtain and weighted branch lines[1]	Tori line[2]
Night setting	Blue-dyed bait
Tori line	Deep setting line shooter
Weighted branch lines	Management of offal discharge
Hook-shielding devices[3]	

[1] If using side setting with a bird curtain and weighted branch lines from Column A, this will be counted as two mitigation measures
[2] If a tori line is selected from both Column A and Column B, this equates to simultaneously using two (i.e. paired) tori lines.
[3] Hook-shielding devices can be used as a stand-alone measure.

Table 3. Seabird Mitigation Measure Table in IATTC Resolution C-11-02.

Column A	Column B
Side-setting with bird curtains and weighted branch lines[1]	Tori line[2]
Night setting with minimum deck lighting	Weighted branch lines
Tori line	Blue-dyed bait
Weighted branch lines	Deep-setting line shooter
	Underwater setting chute
	Management of offal discharge

[1] This measure can only be applied in the area north of 23° N until research establishes the utility of this measure in waters south of 30° S. If using side setting with a bird curtain and weighted branch lines from Column A, this will be counted as two mitigation measures.
[2] If a tori line is selected from both Column A and Column B, this equates to simultaneously using two (i.e. paired) tori lines.

4 OPTIONS

This section describes the preliminary range of options for Council consideration at its 184th Meeting. These options are in development and are subject to change in response to Council discussions. The Council may consider options including, but not limited to, the following:

1) Option 1: Status Quo/No Action – Continue managing the Hawaii longline fishery under existing seabird interaction mitigation measures

Under the No Action option, the Council would not recommend changes to management measures intended to mitigate seabird interactions in the Hawaii longline fishery. All existing measures to mitigate interactions with seabirds, including blue-dyed bait would be maintained. If vessel operators in the Hawaii longline fishery prefer to use tori lines as a seabird mitigation

measure, they would need to use it in addition to the existing suite of required measures. While some vessels may voluntarily add another mitigation measure, tori line is not likely to be widely adopted in the fleet without additional incentives. Additionally, voluntary adoption of tori lines by the fleet would lack the implementation of minimum standards, and effectiveness of tori lines would likely vary significantly between vessels.

Table 4. Comparison of pros and cons of option 1.

Pros	Cons
• Fishermen are familiar with the existing suite of measures	• Fishery participants will continue to be required to use blue-dyed bait when stern-setting north of 23N for DSLL vessels, and anywhere they fish for SSLL vessels • Tori lines would need to be used in conjunction with all existing required measures, including blue-dyed bait • Wide adoption of tori line among the fleet not likely without additional incentives • Lack of tori line minimum standards would result in varying level of effectiveness

2) Option 2: Allow use of tori lines as a third option

Under Option 2, the Council would create a third suite of seabird mitigation measures in addition to the existing side-setting and blue-dyed bait suite of measures for the DSLL fishery. Under the new third suite, vessels may replace the use of blue-dyed bait with tori lines, but would otherwise be required to follow the same set of requirements as the existing blue-dyed bait suite of measures (i.e., weighted branchlines, line shooter, and strategic offal discards when seabirds are present). As part of Option 2, the Council would specify minimum specifications for tori lines.

This option would provide flexibility for vessels interested in trying out tori lines to switch from blue-dyed bait to tori lines, while allowing other vessels to continue using blue-dyed bait. This option would also allow collection of operational data to further evaluate efficacy of the existing side-setting and blue-dyed bait measures against the tori line measure.

Table 5. DSLL seabird mitigation measures under option 2.

When side-setting north of 23°N, also use:	When stern-setting north of 23°N, use:	
Bird curtain >45g weight within 1m of hook	Blue-dyed bait (thawed) >45g weight within 1m of hooks Line shooter Strategic offal discards (when seabirds present)	**Tori line** >45g weight within 1m of hooks Line shooter Strategic offal discards (when seabirds present)

Table 6. Comparison of pros and cons of option 2.

Pros	Cons
• Provides fishery participants with flexibility for trying out tori lines in place of blue-dyed bait • Allow collection of operational data to evaluate efficacy of side-setting, blue-dyed bait, and tori line measures • Allows fishery participants to use tori lines without blue-dyed bait	• Some vessels likely to continue using blue-dyed bait, which is likely to be less effective than tori lines

3) Option 3: Replace blue-dyed bait with tori line

Under Option 3, the Council would replace blue-dyed bait with tori lines in the existing suite of blue-dyed bait measure for the DSLL fishery, and thus vessels would be required to choose between the side-setting and tori line suite of options when seabird measures are applicable. Under the tori line suite, vessels would also be required to use weighted branchlines, line shooter, and strategic offal discards when seabirds are present. As part of Option 3, the Council would specify minimum specifications for tori lines.

This option may have a greater effect in reducing seabird interactions in the fleet compared to Option 2, as the less effective blue-dyed bait would be removed from the required suite of measures. The results from the EFP study scheduled for the winter 2020/spring 2021 season is expected to inform analysis of this option. If vessels prefer to use blue-dyed bait, they would be required to use it in conjunction with the tori line suite of measures.

Table 7. DSLL seabird mitigation measures under option 3.

When side-setting north of 23°N, also use:	When stern-setting north of 23°N, use:
Bird curtain >45g weight within 1m of hook	**Tori line** >45g weight within 1m of hooks Line shooter Strategic offal discards (when seabirds present)

Table 8. Comparison of pros and cons of option 3.

Pros	Cons
• Allows fishery participants to use tori lines without blue-dyed bait • Blue-dyed bait would be replaced with a more effective mitigation measure	• Does not provide opportunity to collect operational data to evaluate effectiveness of blue-dyed bait against tori lines under broader commercial application • Does not provide flexibility for vessels that prefer to use blue-dyed bait over tori lines

4) Option 4: Inclusion of shallow-set longline sector in the scope of action

Under Option 4, the Council may consider the applicability of tori lines for the SSLL fishery, and whether modifications to requirements may also be needed for this sector.

In recent years, all SSLL vessels have been stern-setting and using the blue-dyed bait measure under the existing regulations, as side-setting is considered to be impractical for this sector. Shallow-set longline vessels are also required to night set in conjunction with blue-dyed bait when stern-setting. Majority of the seabird interactions in the SSLL fishery result in the seabirds released alive, indicating that they are more frequently caught on hauling operations than on setting operations and that the combination of blue-dyed bait, strategic offal discharge and night setting are effective in minimizing seabird captures during setting operations. The 2018 Workshop did not identify tori lines as a priority measure for the SSLL sector due to sufficiency of the night-setting requirement, but noted that tori lines may provide some benefit when setting during full moon, or if setting before sunset was allowed. Anecdotal information provided from SSLL fishery participants to Council staff indicate that allowing setting before sunset would be beneficial for operational flexibility. Additional research is needed to evaluate the effectiveness of tori lines in the SSLL fishery.

Development of suitable tori line designs under the Cooperative Research Project focused on its application in the DSLL sector due to the recent increase in black-footed albatross interactions observed in the DSLL sector but not in the SSLL sector, and the lower priority identified for the SSLL sector in the 2018 Workshop. If the Council considers inclusion of tori lines for the SSLL sector, separate tori line specifications may be needed, or alternatively, specifications would need to ensure sufficient aerial extent for both sectors. Shallow-set longline gear sink slower than DSLL gear, and thus greater aerial coverage is likely needed.

The 2018 Workshop identified bird curtain and towed bouy as additional seabird mitigation measures that hold potential for reducing interactions on hauling operations in the SSLL sector. However, additional research and development are warranted.

The Council may consider sub-options for the SSLL sector, including:

a) Modify SSLL requirements as part of this action, which may include:
    i. Removal of blue-dyed bait from the stern-setting option
    ii. Replacement of blue-dyed bait with tori lines for the stern-setting option
    iii. Removal or modification of the side-setting option
    iv. Addition of mitigation measures for hauling operations
b) Consider modification of SSLL seabird mitigation measures under a separate action, following further research and development.

5) Option 5: Modify strategic offal discard requirement

Under Option 5, the Council would modify the strategic offal discard requirement in conjunction with including tori lines as part of the seabird mitigation measures (Options 2–4). The preliminary results of the Tori Line Cooperative Research Project showed that seabird attempts and contacts were more likely to occur when offal discharge was used during the set; however,

the results were inconclusive due the strategic offal discharge procedure not being standardized during the field trials and the potential that crew utilized strategic offal discharge when attacks and contacts were actively observed.

Hawaii longline vessels are currently required to discharge fish, fish parts, or spent bait while setting or hauling, on the opposite side of the vessel from where the longline gear is being set or hauled, when seabirds are present. Vessels are also required to retain sufficient quantities of offal and spent bait between setting operations, and cut swordfish heads in half for the purpose of strategic offal discharge. The regulations do not specify the amount or frequency of offal discharge, thus a small amount of offal or bait discarded during setting or hauling would meet the requirement. Additionally, as described in McNamara et al. (1999), effective use of strategic offal discard would require a dedicated crew to observe seabirds and discharge offal accordingly. This measure therefore creates compliance and enforcement challenges, and it is likely that the strategic offal discard is not being utilized in a manner that is effective.

The use of strategic discards in the Hawaii fishery was a practice that started with SSLL vessels by using halved swordfish heads to attract seabirds away from fishing gear and bait. The large swordfish heads provide a large floating attractant that stayed afloat until seabirds were well astern of the vessel and less likely to resume pursuit of the baited hooks. The measure also requires vessels to retain offal and spent bait during hauling operations so that discharge material is available during setting operations, which create practicality and safety issues for crew. A controlled experiment conducted in the Hawaii longline fishery found that strategic offal discharge during setting operations was effective in reducing seabird attempts and contacts (tested on swordfish-targeting vessels only), whereas retention of offal during hauling operations resulted in higher seabird attempts and contacts than if offal was discarded (McNamara et al. 1999).

Empirical data evaluating effectiveness of strategic offal discard in other fisheries are limited and inconclusive. Discussions from the 2018 Workshop noted that offal discard practices may attract more birds around the vessels over the long term. Studies based on trawl fisheries in New Zealand showed that vessels that retain offal and other organic matter have been found to reduce the number of birds attending the vessels (Pierre et al. 2012).

WCPFC and IATTC seabird measures include strategic offal discharge as one of the measures that may be selected from the list. Both WCPFC and IATTC define management of offal discharge as either 1) no offal discharge during setting or hauling; or 2) strategic offal discharge from the opposite side of the boat to setting/hauling to actively encourage birds away from baited hooks. The Agreement on the Conservation of Albatrosses and Petrels (ACAP) discourages discharge during line setting, and recommends retention or strategic discharge during hauling (from opposite side of the vessel from where hauling operation is taking place).

Based on the above information, the Council may consider sub-options for modifying the strategic offal discharge under Option 5, including:

a) Removal of the requirement for strategic offal discards (make the measure optional): this will likely minimize the discharge of offal during setting operations;

b) Clarification of the existing regulations to improve effectiveness: this could include specifying amount and frequency of discharge, adding specificity for SSLL vs. DSLL vessels and setting vs. hauling;
c) Prohibition of offal discharge during setting and/or hauling operations: blanket prohibition of offal discharge or requirement to retain all offal throughout an entire trip would not be practical.

6) Option 6: Convert requirements to mirror RFMO measures

Under Option 6, the Council would restructure its seabird mitigation measures for consistency with WCPFC and IATTC measures. As described in Section 3.5, both commissions use a menu approach whereby vessels may choose measures from two lists of mitigation measures. The menu approach is similar to the Council's original seabird mitigation measure recommendation in 1999, which would have required vessel operators to use two or more of six deterrent methods. The WCPFC and IATTC measures divides the list of measures into two lists or columns, which ensures that vessels use at least one primary measure known to be most effective (e.g., tori lines, night setting, side setting, weighted branchlines).

The menu approach provides more flexibility for vessel operators to select mitigation methods that work best for their fishery. However, this approach may also allow vessel operators to use combination of methods that may not be as effective as others. For example, under the WCPFC measures, a Hawaii DSLL vessel could either side-set with a bird curtain and weighted branchlines, or use weighted branchlines and deep-setting line shooter, and be both compliant. However, since all Hawaii DSLL vessels use a line shooter for the gear to reach depths needed to target bigeye tuna, the addition of side-setting is likely to be more effective than only using weighted branchlines. Therefore, applying the WCPFC and IATTC menu approach may reduce the fleet-wide effectiveness of seabird mitigation measures in the Hawaii longline fishery. Additionally, mirroring domestic regulations consistent with WCPFC and IATTC measures may require regulatory changes each time the international measures are modified.

Table 9. Comparison of pros and cons of option 6.

Pros	Cons
• Provides more flexibility for fishery participants to choose mitigation measures • Provides consistency with WCPFC and IATTC measures	• Fleet-wide effectiveness of seabird mitigation measures may be reduced if vessels use less effective measures from the list • Would require amendment to domestic regulations each time changes to WCPFC or IATTC measures are modified

7) Option 7: Address cross-taxa impacts associated with weighted branchlines

Under Option 7, the Council may also consider whether a broader scope of action may be necessary or appropriate to address potential cross-taxa effects of seabird mitigation measures. In particular, the requirement to use weighted branchlines in the DSLL sector when fishing north of 23N, regardless of side-setting or stern-setting, has led to most vessels in the DSLL sector using

wire leaders to reduce risk of gear flyback. Wire leaders may make it difficult to cut trailing gear from protected species and sharks when attempting to release the animal, and branchlines are often cut above the wire leader and animals released with the wire leader attached. Wire leaders also prevent sharks from biting off the leader line and releasing itself compared to when monofilament leaders are used, although the effect of wire leaders on shark mortality is likely to be less on circle hooks compared to J-hooks (DSLL uses wire leaders and circle hooks) (Gilman et al. 2019). Circle hooks increase the likelihood that sharks are hooked in the mouth and jaw, making bite-offs less likely on monofilament leaders compared to when deeply hooked on a J-hook.

Alternative branchline weighting techniques such as sliding weights and double-weight branchlines have been shown to reduce risk of flyback, but have not been tested in the Hawaii longline fishery. A flyback prevention device developed by Hawaii longline crew members may also provide a low-cost solution.

5 COUNCIL ACTION

At its 184th Meeting in December 2020, the Council will consider the options for including tori lines in the seabird mitigation measures for the Hawaii longline fishery, and for defining the scope of the Council action. The Council may recommend a preliminary preferred option for further analysis, recommend further development of the range of options, recommend inclusion of additional options, or recommend no action be taken at this time.

6 REFERENCES

Boggs, C. 2001. Deterring albatrosses from contacting baits during swordfish longline sets. In: Seabird Bycatch: Trends, Roadblocks, and Solutions (eds E. Melvin, K. Parrish). University of Alaska, Fairbanks, AK, pp. 79–94, University of Alaska Sea Grant AK-SG-01-01.

Gilman, E., Chaloupka, M., Peschon, J., Ellgen, S. 2016. Risk factors for seabird bycatch in a pelagic longline tuna fishery. PLoS ONE 11(5): e0155477.

Gilman E, Chaloupka M, Dagorn L, Hall M, Hobday A, Musyl M, Pitcher T, Poisson F, Restrepo V, Suuronen P. 2019. Robbing Peter to pay Paul: Replacing unintended cross-taxa conflicts with intentional tradeoffs by moving from piecemeal to integrated fisheries bycatch management. Reviews in Fish Biology and Fisheries 29: 93-123

Gilman E, Kobayashi D, Chaloupka M. 2008. Reducing seabird bycatch in the Hawaii longline tuna fishery. Endangered Species Research 5(2-3): 309–323.

Gilman, E., Ishizaki, A. (Eds.) 2018. Report of the Workshop to Review Seabird Bycatch Mitigation Measures for Hawaii's Pelagic Longline Fisheries, September 18-19, 2018. Western Pacific Regional Fishery Management Council, Honolulu. Available online at:

http://www.wpcouncil.org/wp-content/uploads/2018/11/WPRFMC_2018-Seabird-bycatch-mgmt-workshop_FinalReport.pdf

McNamara, B., Torre, L., Kaaialii, G. 1999. Hawaii Longline Seabird Mortality Mitigation Project. Western Pacific Regional Fishery Management Council, Honolulu.

Pierre, J.P., Abraham, E.R., Richard, Y., Cleal, J. and Middleton, D.A., 2012. Controlling trawler waste discharge to reduce seabird mortality. Fisheries Research, 131, pp.30-38.

Van Fossen L. 2007. Annual report on seabird interactions and mitigation efforts in the Hawaii longline fishery for 2006. Honolulu: National Marine Fisheries Service, Pacific Islands Regional Office.

Western Pacific Regional Fishery Management Council (WPRFMC). 2020. Demonstration and field trials to evaluate operational practicality and efficacy of tori lines for mitigating black-footed albatross interactions in the Hawaii deep-set longline fishery utilizing electronic monitoring technology. Preliminary Report to the 137th SSC and 183rd Council Meetings.

Wren, J., Polovina, J. 2018. Fleet dynamics and oceanographic drivers behind variations in black-footed albatross sightings in the Hawaii longline fishery. Abstract in Gilman, E., Ishizaki, A. (Eds.) 2018. Report of the Workshop to Review Seabird Bycatch Mitigation Measures for Hawaii's Pelagic Longline Fisheries, September 18-19, 2018. Western Pacific Regional Fishery Management Council, Honolulu.

Wren, J.L.K, Shaffer, S.A., and J.J. Polovina, 2019. Variations in black-footed albatross sightings in a North Pacific transitional area due to changes in fleet dynamics and oceanography 2006–2017. Deep Sea Research Part II: Topical Studies in Oceanography, 169, 104605.