

NOAA Technical Memorandum NMFS-NWFSC-142



U.S. West Coast and Alaska Trawl Fisheries Seabird Cable Strike Mitigation Workshop, November 2017: Summary Report

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U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
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Northwest Fisheries Science Center



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Executive Summary

The U.S. West Coast and Alaska Trawl Fisheries Seabird Cable Strike Mitigation Workshop was held on 7–8 November 2017 at the NOAA Fisheries West Coast Region in Seattle, Washington. The workshop was hosted by a Steering Committee consisting of members from NOAA's Northwest Fisheries Science Center (NWFSC), Alaska Fisheries Center (AFSC), and the Alaska Regional Office (AKR). In early 2017, the Steering Committee scoped goals and objectives for the meeting; these formed the basis for the overall vision of the workshop. Members of the Steering Committee are listed in [Appendix A](#). Workshop planning, organization, and facilitation services were provided by Veda Environmental, under contract to the Pacific States Marine Fisheries Commission (PSMFC).

Thirty-nine workshop attendees from Alaska, Washington, and Oregon—representatives of the groundfish trawl fishing industry, seafood associations, non-governmental organizations (NGOs), and federal agencies—participated in the 1.5-day workshop. [Appendix A](#) lists the participants' names and affiliations.

Day one (a full day) of the workshop included presentations from subject-matter experts on the scope and scale of the seabird cable strike issue in the North Pacific, as well as mitigation strategies utilized elsewhere in the world. The presentations were followed by breakout group discussions of mitigation strategies and designs. Day two (a half day) was devoted to prioritizing mitigation measures for seabird cable strikes and brainstorming implementation hurdles and next steps for the priority mitigation measures. The workshop agenda is provided in [Appendix B](#).

Workshop participants agreed to five priority physical mitigation measures. They include, in priority order:

1. Snatch block.
2. Water deterrents.
3. Improved visibility of the third wire.
4. Combined streamer lines and warp booms.
5. Third wire float device.

See [Appendix E](#) for full descriptions, including illustrations, of each of these mitigation measures.

Behavioral measures used in global fisheries were considered for the west coast hake and Alaska trawl fleets. A number of these measures were deemed unfeasible (e.g., batching) without major changes to vessels. Other behavioral methods were noted as worth considering for these fisheries, but upon examination and feedback from industry, are already being employed where feasible.

The participants agreed that more research is needed. Studies being conducted in the west coast hake and Alaska trawl fisheries should continue to be refined as appropriate. NOAA Fisheries, industry, Sea Grant, and other interested entities should partner to fund research for improving data collection as well as testing and development of mitigation strategies for trawlers in Alaska and the U.S. West Coast. Funding sources should be found to support dedicated seabird observers

to add to the data currently being collected, given appropriate protocols are adopted. Participants all agree that this will be a long-term, slow, deliberative, collaborative process. Voluntary measures could be adopted before regulations, as happened in the longline industry. Industry and NOAA Fisheries agreed to be proactive. Fishing companies pledged to engage their fleets.

At the conclusion of the workshop, the following next steps were proposed:

1. Collaboratively explore and apply for funding to move forward with improved data collection and testing and implementation of mitigation measures.
2. Distribute the PowerPoint slides for each workshop presentation, upon request via email to Jason Jannot.¹
3. Provide a written summary of the workshop process and outcomes, including links to documents and other resources that were made available to workshop participants.²

¹ jason.jannot@noaa.gov

² This Technical Memorandum serves as the written summary.

Acknowledgments

This workshop would not have been possible without a grant to the workshop Steering Committee from the National Seabird Program, Office of Science and Technology, National Marine Fisheries Service, NOAA. We also thank the Northwest Fisheries Science Center Observer Program for providing additional financial support for this workshop, and the Pacific States Marine Fisheries Commission for administering and managing the workshop funds.

The workshop objectives were successfully met in part due to the assistance of Sara Brace and Hilary Wilkinson of Veda Environmental both prior to and during the workshop. Their expertise, professionalism, and flexibility were important factors in the realization of positive workshop outcomes. The workshop summary prepared by Veda Environmental served as the basis for writing this Technical Memorandum.

The Steering Committee appreciates the contributions from each of the presenters and participants. Their time and effort in offering scientific information and personal and professional experience and expertise at sea added valuable context to the issue, as well as realism to potential solutions. The workshop was a success because of the input and participation of all attendees.

Workshop Overview

The U.S. West Coast and Alaska Trawl Fisheries Seabird Cable Strike Mitigation Workshop was held on 7–8 November 2017 at the NOAA Fisheries West Coast Region in Seattle, Washington. The workshop was hosted by a Steering Committee consisting of members from NOAA's Northwest Fisheries Science Center (NWFSC), Alaska Fisheries Center (AFSC), and the Alaska Regional Office (AKR). In early 2017, the Steering Committee scoped goals and objectives for the meeting; these formed the basis for the overall vision of the workshop. Members of the Steering Committee are listed in [Appendix A](#). Workshop planning, organization, and facilitation services were provided by Veda Environmental, under contract to the Pacific States Marine Fisheries Commission (PSMFC).

Thirty-nine workshop attendees from Alaska, Washington, and Oregon—representatives of the groundfish trawl fishing industry, seafood associations, non-governmental organizations (NGOs), and federal agencies—participated in the 1.5-day workshop. [Appendix A](#) lists the participants' names and affiliations.

Day one (a full day) of the workshop included presentations from subject-matter experts on the scope and scale of the seabird cable strike issue in the North Pacific, as well as mitigation strategies utilized elsewhere in the world. After the presentations, breakout groups were formed to facilitate discussions of physical and behavioral mitigation strategies and designs. Breakout groups reconvened to the plenary to review and screen mitigation measures for potential adoption. Day two (a half day) was devoted to prioritizing mitigation measures for seabird cable strikes and brainstorming implementation hurdles and next steps for the priority mitigation measures. The plenary voted on eight priority physical seabird strike mitigation measures, and the top five were forwarded for further discussion of implementation. Five breakout groups were formed, one for each physical mitigation measure. Breakout groups discussed opportunities and challenges to implementation of each physical mitigation measure. The plenary reconvened to discuss implementation and next steps. The workshop agenda is provided in [Appendix B](#).

This document provides a high-level summary of the workshop process and outcomes. It also includes links to documents and other resources that were made available to workshop participants.

Workshop Goals and Objectives

The goals of the workshop were to bring together industry, government, and NGO representatives to share information on the scope and scale of seabird interactions and to identify effective, practical mitigation measures to reduce seabird cable strike mortality in the catcher-processor west coast hake and Alaska trawl fisheries. In the longer term, the workshop strove to develop collaborative relationships between the participants for testing and implementing proposed mitigation measures.

1. Contextualize and scope the problem by providing information on:
 - a. The scale of the seabird cable strike problem.
 - b. Existing mitigation measures being used effectively elsewhere.

2. Discuss operational feasibility in the context of ensuring crew safety while minimizing disruption to fishing operations.
3. Discuss existing mitigation measures for catcher-processor west coast hake and Alaska trawl fisheries.
4. Generate new ideas for mitigation measures in two categories: physical and behavioral.
5. Prioritize mitigation measures for each category.
6. Identify needs for testing and implementation of priority measures.
7. Identify and share resources that participants could use to develop collaborative mechanisms for testing and implementing priority mitigation measures (e.g., the Bycatch Reduction Engineering Program, BREP).

Workshop Design

The workshop was designed to provide participants with context of the issue of seabird cable strikes through a series of presentations, followed by an opportunity to discuss and agree to priority measures and strategies to reduce the risk of strikes. The overall workshop design included the following stages.

Current understanding of seabird bycatch on west coast and Alaskan trawlers

A series of presentations given by subject-matter experts described the current level of knowledge about seabird mortality on at-sea catcher-processor vessels using midwater trawl gear in both the U.S. West Coast and Alaska fisheries, and the underlying causes of seabird mortality. Presentations also included an overview of strategies for cable strike prevention that are being tested or are currently in use in trawl fisheries around the globe. [Workshop Outcomes](#) summarizes the presentations and subsequent discussion of each presentation.

Breakout and group review of mitigation measures

Participants were assigned to one of three breakout groups, with the goal that each group contain a representative mix of government, industry, and NGO participants. Each breakout group discussed each of the physical and behavioral mitigation measures (see Tables 1 and 2) that could be tested and adopted in this fleet to reduce seabird cable strikes. After reconvening to the plenary, groups discussed their results, and all participants were invited to comment on and prioritize measures to develop a unified consensus. Specifically, the breakouts and plenary sessions were planned to achieve the following tasks (see [Appendix C](#) for breakout group assignment, including screening criteria):

1. Refine the language of each physical and behavioral seabird cable strike mitigation measure.
2. Screen the physical and behavioral seabird cable strike mitigation measures, first for crew safety as a priority, and then using these agreed-upon screening criteria: a) feasible, b) practical, c) testable, d) effective, and e) applicable across west coast and Alaska trawl fisheries.

3. Propose and describe *new* physical and behavioral seabird cable strike mitigation measures, i.e., new measures not specifically identified in Tables 1 and 2.
4. Screen the proposed *new* seabird cable strike mitigation measures (using the screening criteria in step 2, above).
5. Prioritize all seabird strike mitigation measures, both proposed (Tables 1 and 2) and new (step 3, above).
6. Draft implementation recommendations for the five seabird cable strike mitigation measures that were of the highest priority for testing and implementation.

Workshop Context and Scope

The incidental catch of seabirds during the prosecution of fisheries is a global phenomenon that highlights challenges inherent in natural resource management and conservation. The spatial and temporal overlap of wide-ranging seabirds with commercial fisheries in the U.S. Exclusive Economic Zone (EEZ) makes interactions between seabirds and vessels unavoidable, resulting in at least some incidental seabird mortality. The first documented take of an Endangered Species Act (ESA)-listed short-tailed albatross (*Phoebastria albatrus*)—in April 2011, off the Oregon coast in the west coast sablefish longline fishery—focused attention on seabird–fisheries interactions and bycatch mitigation efforts in U.S. West Coast groundfish fisheries. This mortality triggered extensive collaborative research and outreach to west coast longline sablefish fisheries to reduce seabird interactions in this fleet (Guy et al. 2013, Gladics et al. 2017).

In addition to endangered short-tailed albatross, large numbers of near-threatened (IUCN 2017) black-footed albatross (*Phoebastria nigripes*) interact with west coast groundfish fisheries. NOAA Fisheries and the U.S. Fish and Wildlife Service (USFWS) are charged with reducing bycatch of seabirds listed under the ESA or protected under the Migratory Bird Treaty Act. Fishing-induced mortality of ESA-listed species or other species of concern could have negative impacts on both seabird populations and the fisheries responsible. Short-tailed albatross and black-footed albatross both spatially overlap the fishing grounds of the U.S. West Coast midwater trawl catcher-processor vessels in the U.S. Exclusive Economic Zone (Guy et al. 2013). Thus, reducing the risk of fishing mortality for black-footed albatross is likely to have the additional benefit of reducing the risk of fishing mortality for endangered short-tailed albatross and many other seabird species that interact with this fishery. Seabird mortality on trawl fishing vessels is often unreported and undetected, because when a bird strikes a cable and is seriously injured or killed, the resulting carcass is not likely to be recovered and counted, resulting in cryptic mortality. Cryptic seabird mortality on trawl vessels was recently highlighted in Alaska fisheries (Eich et al. 2016).

Bycatch of black-footed albatross is highly variable among fisheries but has been extensively documented in west coast, Alaskan, and Hawaiian longline fisheries (Eich et al. 2016, J. Jannot and coworkers, NWFSC, unpublished data). The cumulative impact of bycatch from these fisheries, as well as from foreign and unobserved fisheries, on the breeding population is unknown but of concern. Bycatch levels on black-footed albatross are nearing the maximum Potential Biological Removal level; in addition, the potential risk to nesting habitat from sea-level rise on the site of the world's largest breeding colony (Midway Atoll) portends potential future population declines in the next half-century (Arata et al. 2009, IUCN 2017).

Streamer lines³ are a standard method of reducing seabird bycatch worldwide, especially in hook-and-line fisheries. However, they can be difficult to use in trawl fisheries and can produce safety hazards. As seabirds congregate around trawlers to feed on offal, they heighten their risk of colliding with the trawl warps and data cables (a.k.a., the “third wire”) that run aft of trawlers, collectively referred to here as cables. Cable strikes are a known source of cryptic seabird mortality, particularly on at-sea factory trawlers (Sullivan et al. 2006, Melvin et al. 2011, Maree et al. 2014).

Quantifying mortality from cable strikes is difficult because dead birds often go unobserved and are rarely entangled by cables and recorded by fisheries observers. In fall and spring 2016 and spring 2017, at-sea fisheries observers monitored cables for seabird strikes on at-sea hake (*Merluccius productus*) pelagic trawlers off the continental U.S. West Coast. Estimates of seabird cable strikes, based on extrapolating from observed to unobserved tow hours, indicate that several hundred cable strikes went unobserved and that therefore, seabird mortalities were underreported. Not all cable strikes will lead to death; however, a mortality rate from cable strikes for black-footed albatross in U.S. West Coast fisheries has not been calculated. Therefore, we estimated a 12% mortality rate based on black-browed albatross (*Thalassarche melanophris*) cable strikes in a similar pelagic trawl fishery in Argentina (Tamini et al. 2015). Applying the 12% mortality rate to the extrapolated estimate of cable strikes indicated a total of 49 potential black-footed albatross mortalities in 2016 and nine in spring 2017. Fisheries observers counted two black-footed albatross mortalities in 2016, and zero in spring 2017.

While streamer lines have been shown to mitigate seabird cable strikes on trawl vessels in Alaska (Melvin et al. 2011), the unsafety and difficulty of using streamers, especially in high winds, have deterred adoption of these mitigation devices in at-sea factory trawlers off Alaska and the U.S. West Coast. Developing new, practical, and effective seabird mitigation measures has the potential to significantly reduce seabird mortality in much of the northeastern Pacific, because many factory vessels fish in both Alaskan and west coast waters.

Seabird Cable Strike Mitigation Measures

The workshop planning process included initial research into existing physical and behavioral seabird cable strike mitigation measures. These were compiled from research studies and tests carried out in fisheries activities on the west coast, in Alaska, and in international trawl fisheries. A complete list of the existing mitigation measures, with sources and notation by the Steering Committee, is contained in [Appendix C](#).

The tables below include the two categories of mitigation measures discussed during the workshop. Table 1 includes physical mitigation measures in the categories of cable strikes and net entanglement, and Table 2 includes behavioral mitigation measures in the categories of bird attraction to vessels,⁴ net engagement, and fishing behavior).

³ Streamer lines are also referred to as tori lines or bird scaring lines. We use “streamer lines” throughout for consistency.

⁴ During the workshop, this category was called Offal Discharge and Management. It has been modified here to make it consistent with the other categories.

Table 1. Physical seabird cable strike mitigation measures discussed for potential implementation in west coast and Alaska at-sea midwater trawl catcher-processor vessels. All physical mitigation measure codes begin with the letter “P.” Definitions and descriptions of these measures are provided in [Appendix D](#).

Mitigation Measure	Category	Physical Mitigation Measures
P1	Cable strike	Deploy bird streamer lines to avoid warp cables.
P2	Cable strike	Warp scarers
P3	Cable strike	Deploy bird streamer lines to avoid net monitoring cables.
P4	Cable strike	Net monitoring cables should not be used.
P5	Cable strike	Snatch block
P6	Cable strike	Bird baffler
P7	Cable strike	Cones
P8	Cable strike	Buoys
P9	Cable strike	Warp boom
P10	Cable strike	Sleeves with streamers
P11	Net entanglement	Net binding

Table 2. Behavioral seabird cable strike mitigation measures discussed for potential implementation in west coast and Alaska at-sea midwater trawl catcher-processor vessels. All behavioral mitigation measure codes begin with the letter “B.” Definitions and descriptions of these measures are provided in [Appendix D](#).

Mitigation Measure	Category	Behavioral Mitigation Measures
B1	Attraction to vessel	Avoid any discharge during shooting and hauling.
B2	Attraction to vessel	Convert offal into fishmeal and retain all waste material.
B3	Attraction to vessel	Batch waste.
B4	Attraction to vessel	Mince waste.
B7	Attraction to vessel	Avoid peak areas and periods of seabird foraging activity.
B5	Net entanglement	Clean nets.
B6	Net entanglement	Minimize the time the net is on the water surface.

The existing mitigation measures served as the launching point for breakout discussions exploring appropriate mitigation strategies for application in the west coast hake and Alaska trawl fisheries, including an assessment of those already in practice. The workshop was designed to evaluate and prioritize existing and new mitigation measures for use on the U.S. West Coast and Alaska.

Facilitated Workshop Activities

Day One

Participants were split into three breakout groups, each consisting of approximately 12 participants. The composition of the groups was adjusted to ensure all perspectives were represented in each breakout group. Each group spent time discussing the existing physical and behavioral seabird cable strike mitigation measures and then screened them for their feasibility, practicality, testability, efficacy, and applicability to Alaska and the west coast. Through this process, some mitigation measures were removed from further discussion because they did not meet one or more of the screening criteria outlined in [Workshop Design](#). Those mitigation

measures that met the screening criteria were adopted for further discussion and prioritization by the breakout group. The breakout groups also brainstormed new measures that could be viable options to reduce seabird cable strikes.

Next, the plenary reconvened and reviewed the screening results of the three breakout groups. The plenary also screened any new mitigation measures presented by the breakout groups using the same five screening criteria. Through this process, new mitigation measures were identified as having potential; they were either kept for final review and prioritization, or deemed inappropriate or unfeasible via the screening criteria, and thus removed from further consideration.

A subset of participants gathered for an evening social and continued discussing potential problems and solutions to seabird cable strikes, evaluating potential mitigation ideas, discussing constraints due to vessel or maritime conditions, and in general preparing for the next day's discussion.

Day Two

Day two began with the entire group reviewing the mitigation measures identified on Day One as having potential for future field testing. A voting process was used to prioritize the potential mitigation measures. The entire group agreed that all behavioral mitigation measures (Table 2) were either unfeasible or were already in practice in west coast and Alaska trawl fisheries. Therefore, behavioral mitigation measures were not prioritized. Thus, the prioritization exercise only focused on the physical mitigation measures.

Each participant semianonymously voted for their top three choices of the eight screened physical mitigation measures. The final five priority measures were then moved forward for discussion of implementation challenges and opportunities. These discussions took place in small breakout groups, with participants self-selecting to whichever of the five mitigation strategies they had the most interest or expertise in. Each breakout group filled out a worksheet on their mitigation measure. Each breakout group collaboratively answered five questions on the worksheets; the results from these worksheets are presented in [Appendix E](#).

Workshop Outcomes

Presentations

The presentations given in the opening of the workshop provided context for the seabird cable strike issue and an overview of the mitigation measures that have been tested. Below is a summary of the information shared, comments provided, and discussion offered during the session.⁵ Copies of the presentation slides are available upon request from [Jason Jannot](mailto:jason.jannot@noaa.gov).⁶

Alaska Groundfish Seabird Interactions

Shannon Fitzgerald, NOAA

With Kim Dietrich as co-author, Shannon provided an overview of the status of seabird interactions in the Alaska trawl fisheries and noted efforts to address additional seabird mortalities.

Presentation highlights

- Beginning in 1993, we have been reporting estimated seabird bycatch in Alaska Trawl fisheries based on observer sampling.
- Observer data and data from southern hemisphere studies indicate that seabird interactions occur outside standard sampling methods and cannot account for mortalities, resulting in underestimates of seabird mortality.
- In 2004–06 and 2009, we conducted a special project where experienced observers completed standard sampling and protocols for supplemental seabird sampling. Data reflect 9,000 tows, collected during haul-backs. During these periods, observers noted 638 bird mortalities, 143 from cable strikes and 481 from gear interactions.
- Comparisons of supplemental and standard samples were made for area, gear, offal, short-wiring, processing mode, and other factors.
- Results indicated a bycatch level 3.5 times that of the standard sample, but this was variable among species, with Procellariidae spp. (shearwater) bycatch ten times higher than standard sampling. Standard sampling did not capture albatross bycatch, where supplemental sampling did. The challenge is to extrapolate from vessels to the fleet.
- Study led to implementation of protocols for all observers in 2010. These data are currently being analyzed, and recommendations on improved protocols and possible extrapolation algorithms or approaches should result, improving our bycatch reporting.
- Results should also allow us to analyze where a conservation concern exists, indicating the need to use appropriate mitigation measures.

⁵ The summaries of the presentations are not verbatim transcripts, but rather represent a combination of what was understood by the notetaker (Veda Environmental) and post-workshop edits and contributions from the presenters.

⁶ jason.jannot@noaa.gov

Question or Comment	Response
1. Did data reflect mortality or interaction?	Data reflected mortality only.
2. Were you looking at vessels with or without a fishmeal plant on board?	Both. For the current study we are still trying to get vessel specifications.
3. What is the fulmar (<i>Fulmarus glacialis</i>) population? What is the status of take?	Fulmar population is several million, so based solely on that species this might not warrant the use of mitigation gear. USFWS: Once we have a good handle on how many birds are being taken, then we can look into the conservation needs/options/mitigation measures. If there's a problem, is it fleet wide (e.g., processors) or only in Alaska? Probably more an albatross issue than a fulmar issue.
4. Short-tailed albatross? How many are there?	To date we have not had a short-tailed albatross bycatch event in the Alaska trawl fishery, but other albatross have been caught. A biological opinion looks at overall population, evaluates whether take has an impact, and sets expected level of incidental take. Current biological opinion allowable take level for Alaska groundfish (longline and trawl) is six birds per two-year period.

West Coast Hake Fishery Seabird Cable Interactions

Jason Jannot, NOAA

Jason provided an overview of a special project that aims to quantify seabird cable interactions on U.S. West Coast at-sea hake midwater trawl catcher-processor vessels.

Presentation highlights

- Observers watched for cable strikes on all nine at-sea hake vessels; eight vessels experienced at least one hard strike.
- Observed 2,200 tow hours over three fishing seasons: spring and fall 2016, and spring 2017.
- An estimated 468 hard strikes of black-footed albatross occurred in the at-sea hake fishery in 2016 and spring 2017. This estimate was calculated by using a ratio estimator to extrapolate from the observed hours of monitoring cables to the total hours of daylight fishing. Using a 12% mortality rate estimated from a southern hemisphere hake fishery, this potentially results in 58 black-footed albatross mortalities: 40 in spring 2016, nine in fall 2016, and nine in spring 2017. The 12% mortality rate was calculated from black-browed albatross cable strikes in a similar at-sea hake pelagic trawl fishery in Argentina (Tamini et al. 2015). A mortality rate for black-footed albatross cable strikes in U.S. West Coast fisheries has not yet been determined.
- Estimates differ among seasons and years. For black-footed albatross, in spring 2016, there were an estimated 332 hard strikes; in fall 2016, an estimated 69 hard strikes; and in spring 2017, an estimated 68 hard strikes.
- Strikes only occur when an offal plume is present, never when it is absent.
- More strikes occur on vessels with fishmeal plant on board, despite fewer birds near fishmeal plant vessels.
- More data are necessary to understand the seasonal component of seabird cable strike mortalities in this fishery.
- Current biological opinion for short-tailed albatross does require monitoring.

Question or Comment	Response
1. Bird changing course is reported as a heavy strike. Why?	Observer would have to determine that the bird changed direction because of the strike. This is the standard used by Melvin et al. 2011, which this study used as a model for data collection.
2. Is data collected during haul-back only?	Data is collected only during tow times or when vessel is short-wiring. All times for observation are randomly chosen based on a random number table.
3. Are these third-wire or warps strikes? (Black-footed albatross data results.)	The estimates include both third-wire and warp hard strikes. However, for black-footed albatross, the majority of hard strikes are third-wire strikes (16/19).
4. When you extrapolate, what percent accuracy do you apply to the data?	I have not yet calculated the error for these estimates. This will be done in the future.
5. Are hard strikes when birds are airborne?	Hard strikes can occur while the bird sits on the water surface or while flying. Black-footed albatross appear to be more at risk while flying.
6. For the 2016 number that was higher, did you look at the distribution? Was it one or two tows, or across several vessel tows?	One particular tow had 6–7 heavy strikes. May have been a few tows that had higher numbers.
7. Will you go back and look at other factors associated with the higher-count tow?	Yes.
8. Does confirmed mortality mean that a body was found?	Yes. In 2016, observers confirmed two black-footed albatross mortalities likely attributable to cable interactions.
9. Distance off-shore when strikes happen?	The data are available, but that has not been investigated yet.
10. What were these birds eating before catcher-processors? What did they live off of? Are we actually feeding them a buffet from our fishing activities?	Don't have an answer for this. Not sure if we can figure out what the birds were eating before fishing, but could be important for understanding short-tail or other species responses to fishing. However, this is outside the scope of the problem and not likely to impact mitigation strategies.
11. During port-side offal release, are bird strikes occurring more on warp on port side, starboard, or on third wire?	Jason has a slide that did address these operational factors. Indicates that incidents were third-wire and both port and starboard warp strikes from both air and water.
12. Will the trawl interactions study continue into the future?	Yes. ⁷
13. Do you know why more birds hit the fishmeal vessels?	Further study is needed to explain this. Some participants noted that fishmeal production could actually contribute to this problem. Fishmeal vessels discharge very small amounts of fish parts that birds could consume. The hypothesis is that because very little offal is discharged, birds spend more time searching from the air for consumable parts, increasing their risk of a cable strike. This hypothesis has not been tested, but a similar phenomenon has been observed on these vessels fishing in Alaskan waters.

⁷ During the workshop, the At-Sea Hake Observer Program (A-SHOP) had not yet determined to continue the study. After hearing industry's desire to continue data collection, A-SHOP decided to continue data collection into 2018 and 2019.

Seabird Conservation and Management

Laura Todd, USFWS

Laura's presentation focused on the west coast biological opinion and on the take process with regard to seabirds, with an emphasis on black-footed and short-tailed albatross. She also discussed legal and policy rulings related to these species in the Alaskan fisheries.

Presentation highlights

- Short-tailed albatross: 4,995 individuals, 69% of young birds (1–3 yrs. old) occur on the U.S. West Coast.
- One take of short-tailed albatross in the sablefish fishery off Oregon coast in 2011.
- Incidental Take Statement (ITS) for the U.S. West Coast fisheries focused mainly on effects from hook-and-line vessels.
- Current ITS for west coast allows for one *actual* bird every two years, or an *estimated* five birds every two years. This estimate has been exceeded every year since the biological opinion was written. In response, USFWS and NOAA Fisheries are refining estimation methods.
- Current biological opinion for the west coast requires investigating and minimizing interactions between trawl cables and seabirds.
- Since 1990, 11 short-tailed albatross mortalities have occurred, all in hook-and-line fisheries.
- Alaska ITS and biological opinion allows for six birds in a two-year period, including both hook-and-line and trawl fisheries.
- USFWS wants to know what works, to know enough to make a reasonable change, if necessary.

Question or Comment	Response
1. Regarding offal management, what is Environmental Protection Agency (EPA) requirement for size of offal pieces?	USFWS advised EPA on this, but EPA comes up with what's reasonable/feasible for industry.
2. What are the requirements for longline reporting?	They are required to note the number of streamers, hooks, floating gear, etc.
3. What is the status of the black-footed albatross?	A proxy for short-tailed albatross. Stable or declining, as of 2009, when it was petitioned for listing.
4. What is the status of the short-tailed albatross?	Doing well. 8% increase per year; current population is 4,497. Used to be tens of thousands. Industry efforts have really helped.
5. If we've been fishing this way for 30 years and the bird takes are low, what are we looking for?	If we weren't doing the current efforts (streamers, etc.), then we would probably lose more. Also an indicator of the effects of fishing on all birds—not just endangered. This is not just about a listed species.
6. Are there efforts to protect these birds on the Japanese side?	Not entirely familiar with international fishing rules, but there are a number of approaches that Japanese fishermen are taking to protect these birds (and in Russia, too).
7. If the short-tailed albatross are increasing at 8% year per, when might they be delisted?	Projected to meet delisting criteria in 2047. But there is a contested island in China/Japan where a large population of birds live. If something happens to that group of birds, this could be a problem for the entire population.

Alaska Study and Mitigation Trials

Ed Melvin, Washington Sea Grant (WSG) and University of Washington (UW)

Ed's presentation focused on the seabird cable strike study he conducted on two vessels fishing for pollock (*Gadus chalcogrammus*) in the Bering Sea.

Presentation highlights

- Two Alaskan vessels fishing for pollock in the Bering Sea were studied.
- One vessel minced its offal and the other vessel produced fishmeal.
- Differences among vessels made comparisons difficult.
- Details of this work were published in Melvin et al. (2011).
- Attempts to put sleeves on streamer lines not effective, potentially dangerous to manage.
- Streamer lines and snatch blocks reduced seabird cable strikes, but results varied by vessel and trawl activity.
- Warp boom mitigation was variable; success depended on good placement.
- Only streamer lines effectively reduced seabird strikes on warp cables.
- Using a combination of mitigation measures is probably the most effective means of reducing bird strikes (e.g., streamers on warps, snatch block for the third wire).

Question or Comment	Response
1. Did data reflect mortality or interaction?	Data reflected mortality only.
2. Were there different-color cable streamers/flags, etc.?	Streamers were orange during research. Hoping to work with Purdue University to explore what birds can actually see.
3. What is the definition of a hard hit?	On water: struck and pulled under water. In air: changed course, hooked a wing, and "corkscrewed" down the wire and under water, or visibly injured a wing crashing into a wire.
4. In terms of making counts of interactions, would you recommend using video or human observers?	Human observers. If you are already out there making the video, might as well make the count.

International Trawl Fisheries Mitigation Measures

Mark Lomeli, PSMFC

Mark gave an overview of the various mitigation strategies used or tested in the trawl fisheries globally.

Presentation highlights

- Streamer lines, cones on warps, and a snatch block for the third wire all have been shown to effectively reduce seabird cables strikes in international trawl fisheries.
- Warp scarers, bird bafflers, warp deflectors, and offal discharge methods had variable success in reducing bird strikes, depending on the testing conditions. More work needs to be done on the effectiveness of these devices.
- Streamer lines have reduced effectiveness, or cannot be used, in high winds.

- Cones on warps have only been tested in one fishery, and need more testing in other fisheries to determine their true efficacy.
- Snatch blocks for the third wire not as effective in reducing bird strikes as streamer lines.
- Net monitoring cables have been banned from many southern hemisphere trawl fisheries, and their tests are specific to trawl warps.

Question or Comment	Response
1. Cones were used on warps, not the third wire?	This was not a third-wire fishery (so no third-wire application).

ACAP Best Practices

Ed Melvin, WSG and UW

Presentation highlights

- Agreement on the Conservation of Albatrosses and Petrels (ACAP) is an international convention signed by 13 nations. The United States is not a signatory.
- Trawl mortality categories addressed by ACAP:
 - ◆ Net mortality.
 - ◆ Cable-related mortality: cable strikes are mainly warp strikes, because third wires are banned in southern-ocean fisheries.
- ACAP is focusing on offal discharge as a key priority.
- Offal is the driver of incidents; if you take away the offal discard, the interactions go away.
- Offal management/batching: This is what the international community is talking about most.
- Early research indicated the need to hold discharge for two hours or more. Recent research shows that holding discharge for ~20 minutes reduces cable strike incidents by 80%. However, batching discard requires retrofitting vessels or increasing sump-pump power, both of which might be difficult or expensive to implement.
- Alaska and west coast groundfish fisheries attempt to minimize offal discharge to the greatest extent possible.
- Cable strikes are an issue with many large-winged birds (albatrosses). Smaller birds get killed too, but the strikes are deadlier for larger-winged birds.
- Fulmars forage aggressively behind vessels; albatrosses tend to hang back or off to the side.

Question or Comment	Response
1. Is batching done regardless of whether you are towing? Or how about when you are returning?	Mostly when you are towing. Best to not discharge anything during towing. Hold the material for a period, then discharge quickly. This breaks up aggregation birds during the quick release.
2. Is batching done in combination with mincing?	Batching and mincing are separate. Batching requires a large storage tank and reconfiguring the vessel.
3. Zero offal is better for industry; anything that goes over the side is lost revenue.	Some birds will still be there even with little offal coming off the boat. If we could reduce it to zero, we would.
4. ACAP focusing on offal discharge as a key priority: Is that something we're heading?	To be determined; more work needs to be done.

- | | |
|---|--|
| 5. Acoustic: Has anyone tried acoustics around ropes and cables? | Used an L-Rad system (not written up yet). Has high-power, targeted acoustic sound. Tried this with fishing line (elephants trumpeting, dogs barking, etc.). Supposed to scare the birds, but they habituate easily. |
| 6. Standardized random sampling approach: Would you be receptive to this approach to get additional information? Dedicated seabird monitoring person on vessel. | The more information, the better. Waiting for this to start. 100% support from industry of this idea. Data would probably show that there's more cryptic mortality. ⁸ |

Overall Comments Following Presentations⁹

General discussion

- The fishing industry indicated multiple times that they appreciated NOAA Fisheries' early efforts to include industry in the entire process. NOAA Fisheries indicated that it is absolutely crucial for industry to participate and collaborate to help understand the problem and develop solutions. Turning research into regulation is a long process. All agreed that having the fleets involved is vitally important. Industry stressed the importance of keeping them engaged throughout the process, including research, regulations, and working through the two Fisheries Management Councils.
- In the southern hemisphere, the third wire was banned. Outside groups have asked why NOAA Fisheries hasn't banned the third wire. Industry is planning on developing a paper on why third wires are necessary in this fishery. NOAA Fisheries has not determined that eliminating the third wire is what's needed. Rather, this workshop is aimed at developing alternatives to eliminating the third wire.
- Potential research questions that need to be addressed by industry, NOAA Fisheries, and NGO partners:
 - ◆ Are third wires needed? How important are they to industry and effective/efficient fishery practices?
 - ◆ Are there viable alternatives to third wires? If so, could they be effectively implemented in west coast and Alaskan at-sea catcher-processor fisheries?
 - ◆ What type of third wire is being used?
 - ◆ Some can be covered in different-colored plastics. New options are available, but there are practical issues with the wire getting fouled with grease/lubricant.
 - ◆ Third wire and telemetry: Acoustics.

Industry comments

- Third wires are becoming more and more critical to this fleet due to regulations for avoiding salmon, rockfish, and other species. The fleet needs the information obtained from third-wire systems. The "fourth wire" is a data cable just like the third wire,

⁸ This comment reflects the notes from the third-party notetaker. However, agency and industry participants disagree about exactly what was said and by whom.

⁹ This is not a verbatim transcript, but rather reflects the notes captured by the notetaker as well as edits and comments from participants. Attribution to industry or to NOAA Fisheries is presented for transparency, when known.

connected to a camera system used in some trawl fleets. It has been a useful tool in providing real-time catch and bycatch information. There is a myriad of other things that we're looking at through video.

- Tweaks to the color of wire can make a difference.
- There have been 60 years of work on attempting to develop an acoustic information transfer (i.e., wireless) system. However, physical limitations (of water) prevent high-quality information from being effectively transmitted.
- It would be helpful to invite researchers/industry representatives from the Falklands and other southern hemisphere fisheries to engage in discussions of third wires and their alternatives.
- The scope and scale of this issue still needs more data and study. Is this really a problem?

NOAA Fisheries comments

- The Steering Committee is trying to be proactive and think ahead. Some species of birds may not yet be listed as currently of concern, but could be a problem in the future. A good example of this is the black-footed albatross, which has been of concern in the past. Alternatively, as short-tailed albatross populations begin to recover, takes of this species could start to occur. Field-testing mitigation devices and practices is good precautionary practice for industry to mitigate risk. Industry, NGOs, and Fishery Management Councils will need to participate to make mitigation successful.

Screening and Prioritization of Seabird Cable Strike Mitigation Measures

Table 3 summarizes the screening and prioritization process that took place during the breakout sessions on Day One. The letter “K” denotes that the measure was kept for prioritization and further discussion. The letter “D” denotes that the measure was dropped from further consideration. The “Votes” column denotes the number of votes each “Keep” mitigation measure received. The five mitigation measures that received the highest number of votes (the top five) are indicated in the “Rank” column.

Converting offal into fishmeal and retaining all waste material is only feasible on vessels fitted with the necessary processing equipment. Industry generally minimizes the time the net is on the water surface. However, holding the net at the surface cannot be avoided during short-wiring of haul-backs.

Priority Mitigation Approaches

Table 4 summarizes the top five mitigation measures, as determined from voting. These five mitigation measures were moved forward for the final step in the workshop: Identifying challenges and opportunities to implementing these mitigation measures.

Table 3. Final screening and prioritization summary table. *MM* = mitigation measure number.

MM	Category	Mitigation Measure	Keep/ Drop	Votes	Rank
Physical					
P1	Cable strike	Deploy streamer lines to avoid warp cables.	D		
P2	Cable strike	Warp scarers	K	2	
P3	Cable strike	Deploy streamer lines to avoid net monitoring cables.	D		
P4	Cable strike	Net monitoring cables should not be used.	D		
P5	Cable strike	Snatch block	K	28	1
P6	Cable strike	Bird baffler	D		
P7	Cable strike	Cones	K		
P8	Cable strike	Buoys	K		
P9	Cable strike	Warp boom	K	1	
P10	Cable strike	Sleeves with streamers	D		
P11	Net entanglement	Net binding	D		
New	Cable strike	Visibility of third wire	K	12	3
New	Cable strike	Third wire float device	K	6	5
New	Cable strike	Submerge snatch block.	D		
New	Cable strike	Water deterrent	K	16	2
New	Cable strike	Combination warp booms	K	10	4
Behavioral*					
B1	Attraction to vessel	Avoid any discharge during shooting and hauling.	D		
B2	Attraction to vessel	Convert offal into fishmeal, retain all waste material.	K		
B3	Attraction to vessel	Batch waste.	D		
B4	Attraction to vessel	Mince waste	K		
B5	Net entanglement	Clean nets	D		
B6	Net entanglement	Minimize the time the net is on the water surface	K		
B7	Behavioral	Avoid peak areas and periods of seabird foraging activity	D		
New	Attraction to vessel	Super-filter cutter pump	D		
New	Attraction to vessel	Underwater discharge	D		
New	Attraction to vessel	Towed bladder	D		

* Behavioral seabird strike mitigation measures were not prioritized as all are already in practice, where feasible.

Table 4. Final priority seabird cable strike mitigation measures moved forward for implementation discussion.

Mitigation Measure	Description
1. Snatch block	A block to get the third wire pulled down so that it enters the water much closer to the stern of the vessel, fore of the trawl warps.
2. Water deterrent	A water cannon off the stern, on both sides of the vessel.
3. Visibility of third wire	Improving the visibility of the third wire with colored cable, a sleeve, or lighting.
4. Combination warp booms	Combination of warp boom on the side plus streamer lines positioned to the end of the boom, ending with a float.
5. Third wire float device	A collapsible device that runs the entire aerial length of the third wire, terminating at the surface of the water.

Implementation Recommendations

The final step of the workshop involved the breakout groups to discuss implementation strategies and hurdles for the five priority seabird cable strike mitigation measures. Each breakout group filled out a worksheet on a single specific mitigation measure. Each breakout group collaboratively answered five questions on the worksheets (see below); results from these worksheets are presented in [Appendix E](#).

Worksheet Questions for Priority Mitigation Measures

1. On a separate sheet, please sketch a basic design for the proposed mitigation measure. Include as much detail as you deem necessary to adequately convey the basic concept.
2. Please describe this mitigation measure in one paragraph or less, including (at a minimum):
 - a. Physical description.
 - b. Materials needed.
 - c. Location/placement on or near fishing vessel.
 - d. Installation instructions and training needs for installing.
 - e. Anything else you think is important!
3. Who are the key individuals or entities that need to be involved in advancing this mitigation measure? What suggested approaches do you have to get them involved and on board with the concept?
4. What hurdles or impediments do you foresee in broad adoption of this mitigation measure across the industry?
5. Please add anything else you can think of that might help advance this mitigation measure.

The drawings and responses of each of the five breakout groups are captured in [Appendix E](#). For all groups, there were some commonalities, as they settled on measures that were:

- Fairly easy to implement.
- Not a significant safety risk to the vessel operators.
- Not requiring a large reconfiguration of their vessels.
- Easy to test for efficacy.

In addition, all groups stressed that funding was needed to support research to a) refine the approaches, and b) measure the effectiveness of seabird cable strike mitigation measures.

Workshop Results and Next Steps

Workshop Results

Physical mitigation measures

Workshop participants agreed to five priority physical mitigation measures, as shown in Table 4. See [Appendix E](#) for full descriptions, including illustrations, of each of these mitigation measures.

Behavioral mitigation measures

- Behavioral measures used elsewhere were considered for the west coast hake and Alaska trawl fleets.
- A number of these measures were considered unfeasible (e.g., batching) without major changes to vessels.
- Other behavioral methods were noted as worth considering for these fisheries, but upon examination and feedback from industry, are already being employed where feasible.

Information sharing and education

- Share information across the industry.
- According to industry, NOAA Fisheries and agency partners need to fill data gaps, clarify the problem (especially as it relates to albatross populations and the differences between west coast and Alaska), and do broader outreach and education.

Research needs

- NOAA Fisheries, industry, Sea Grant, and other interested entities should partner to fund research for testing and development of mitigation strategies for trawlers in Alaska and the west coast.
- Studies being conducted in the west coast hake and Alaska trawl fisheries should continue to be refined as appropriate.
- Funding sources should be found to support some dedicated seabird observers to add to the data currently being collected, given appropriate protocols are adopted.
- Population levels of bycatch species should be established, and the sum of bycatch evaluated, to determine if there is a conservation cause for concern.

Other

- Some measures might be more effective in reducing cable strikes when used in combination versus as standalone, single strategies.
- This will be a long-term, slow, deliberative, collaborative process.
- Voluntary measures are often initiated before regulations. This has happened in the longline industry.
- Industry wants to be proactive.
- All participants expressed appreciation for being included in the opportunity to participate, be heard, and provide feedback.
- Fishing companies will engage their fleets.
- Vessel operators are encouraged to explore potential solutions early, even if funding has not yet been secured and a research program to test feasibility is not yet established. Try out potential promising solutions in the field, especially if they are on the prioritization list.
- Appreciation from industry to NOAA Fisheries for reaching out and giving the fleet a chance to be involved with mitigation measures.

Next Steps

At the conclusion of the workshop, the following next steps were proposed:

1. Explore funding opportunities.
 - The Bycatch Reduction Engineering Program (BREP) was announced in January 2018. Application is a two-step process: a) a short initial proposal, then b) panelists will review and invite complete proposals from selected candidates. NOAA Fisheries and federal employees can't apply, but can support and help pull together the proposals. Contact [Erin Wilkinson](#) for details.¹⁰
 - ♦ BREP supports the development of technological solutions and changes in fishing practices designed to minimize bycatch. Our mission is to find creative approaches and strategies for reducing bycatch, seabird interactions, and post-release mortality in federally managed fisheries. This opportunity will be published on [grants.gov](#). Projects should produce outcomes that can directly influence management needs of federally managed living marine resources. As in the past, there will be four priority areas:
 1. Developing innovative and effective technologies, gear modifications, avoidance programs, and/or improved fishing practices in commercial and recreational fisheries to reduce bycatch impacts.
 2. Improving understanding and reducing post-release and other indirect mortality (including barotrauma, predation, and unaccounted mortality) associated with commercial and recreational fisheries (including target and nontarget species).
 3. Developing techniques to reduce interactions between fishing gears and corals, sponges, and other structure-forming invertebrates.
 4. Conducting comprehensive international bycatch analyses or research which will inform conservation engineering in U.S. fisheries.

¹⁰ erin.wilkinson@noaa.gov

- ESA Section 6 funding. Contact [Leah Kenney](mailto:leah_kenney@fws.gov) regarding funding available for Alaska.¹¹ Contact [Laura Todd](mailto:laura_todd@fws.gov) regarding funding available for Washington and Oregon.¹² Amount varies year by year, and funding has to go through the state.
 - Other potential sources of funding:
 - ◆ NOAA Fisheries [National Cooperative Research Program](https://www.st.nmfs.noaa.gov/cooperative-research/index)¹³
(Note that in January 2018, NOAA Fisheries, in conjunction with Oregon Sea Grant and the west coast at-sea hake catcher-processor fleet, submitted a grant proposal to this program to improve data collection about seabird cable strikes and begin the early stages of exploring mitigation strategies. At the time of publication, the results from this submission had not yet been announced.)
 - ◆ [National Fish and Wildlife Foundation Funding](http://www.nfwf.org/whatwedo/grants/Pages/home.aspx)¹⁴
 - ◆ [Packard Foundation Funding](https://www.packard.org/what-we-fund/ocean/)¹⁵
 - ◆ NOAA Fisheries [Saltonstall-Kennedy Grant Program](https://www.fisheries.noaa.gov/grant/saltonstall-kennedy-grant-program)¹⁶
2. PowerPoint slides for each workshop presentation will be made available upon request, and this report will be forwarded to workshop participants. Other interested parties can email [Jason Jannot](mailto:jason.jannot@noaa.gov) to obtain copies of this report and the presentations.¹⁷
3. On the U.S. West Coast:
- The At-Sea Hake Observer Program (A-SHOP) plans to continue data collection on seabird cable strikes and seabird mortalities in the at-sea hake catcher-processor sector in 2018.
 - Seabird cable strike data and analyses will be summarized and presented to industry each year on an ad hoc basis, when requested by industry.
 - The NWFSC Observer Program will develop methods to estimate seabird mortality from cable strikes using A-SHOP data.
 - The NWFSC Observer Program will continue to identify funding sources for mitigation testing and implementation, and will notify industry and other partners of funding sources as they are identified.
 - Recognize that the west coast hake fishery is currently the best option for testing potential seabird cable strike mitigation measures.
4. In Alaska:
- The North Pacific Groundfish and Halibut Observer Program will continue to collect data on seabird mortalities in 2018 using both standard and seabird supplemental sampling protocols.
 - Seabird cable strike data and analyses (from studies conducted by the AFSC in 2004–06 and 2009) will be summarized and published sometime in 2018.
 - All seabird bycatch in federal fisheries off Alaska is reported out in an annual report and is also available when requested by interested parties. These reports to date do not include the additional mortalities from gear (cable and net) entanglements.

¹¹ leah_kenney@fws.gov

¹² laura_todd@fws.gov

¹³ <https://www.st.nmfs.noaa.gov/cooperative-research/index>

¹⁴ <http://www.nfwf.org/whatwedo/grants/Pages/home.aspx>

¹⁵ <https://www.packard.org/what-we-fund/ocean/>

¹⁶ <https://www.fisheries.noaa.gov/grant/saltonstall-kennedy-grant-program>

¹⁷ jason.jannot@noaa.gov

- The current analysis of 2010–16 data will be completed in 2018, and will provide information on the scope of this bycatch problem for a variety of Alaska trawl sectors.
- Based on both studies, we will engage specialists on how supplemental seabird data collection can be extrapolated to a fleetwide estimate, to be used in conjunction with Catch Accounting System extrapolation of standard seabird sampling for an improved, but still biased, estimate of seabird mortality for Alaska trawl fisheries.

5. Industry

- The fishing industry, with assistance from agency or Sea Grant biologists, will produce a technical paper on the importance and application of hard-wired (cable) net monitoring devices as compared to acoustic systems. This paper should be submitted as an Information Paper to the ACAP Seabird Bycatch Working Group and provided to the U.S. Delegation to ACAP for the 11th meeting of the Advisory Committee, to be scheduled in 2019.
- Begin fabricating and testing various options as soon as possible, so that when funding does become available, we are running tests on measures where we have gained some experience on the constraints at sea.

6. Others

- With assistance and/or coordination from agency staff, within the parameters allowed by BREP, a nonfederal governmental or industry group should strongly consider applying for BREP funding.



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APPENDIX A

Workshop Participants

The following organizations and individuals attended the workshop:

Steering Committee

Jason Jannot, Northwest Fisheries Science Center
Tom Good, Northwest Fisheries Science Center
Vanessa Tuttle, Northwest Fisheries Science Center
Anne Marie Eich, NOAA Fisheries Alaska Regional Office
Shannon Fitzgerald, Alaska Fisheries Science Center

Government Representatives

Mark Lomeli, Pacific States Marine Fisheries Commission
Laura Todd, U.S. Fish and Wildlife Service, West Coast
Leah Kenney, U.S. Fish and Wildlife Service, Alaska
Cassandra Donovan, Pacific States Marine Fisheries Commission
Tom Holland, Pacific States Marine Fisheries Commission
Jon McVeigh, Northwest Fisheries Science Center
Yvonne deRenier, NOAA Fisheries West Coast Region
Andy Kingham, Alaska Fisheries Science Center
Jennifer Cahalan, Pacific States Marine Fisheries Commission
Ryan Shama, Northwest Fisheries Science Center
Wayne Palsson, Alaska Fisheries Science Center
Keeley Kent, NOAA Fisheries West Coast Region
Frank Lockhart, NOAA Fisheries West Coast Region
Ashley Grompe, U.S. Environmental Protection Agency
Amanda Miller, U.S. Environmental Protection Agency

Industry Representatives

Dan Waldeck, PWCC
Arne Fuglvog, Iquique U.S./Glacier Fish Company
Jan Jacobs, American Seafoods Company
Mike Luchino, Trident Seafoods
Austin Estabrooks, At-Sea Processors Association
Anne Vanderhoeven, Arctic Storm Seafoods
David Barbee, SIMRAD
Chris Oliver, Jr., Alaska Seafoods Cooperative
Chip Dodge, American Seafoods Company
Denney Amundsen, Trident Seafoods
Eduardo Diaz, Trident Seafoods

Industry Representatives, continued

Dan Dietrich, Trident Seafoods

Tim Thomas, American Seafoods Company

Jens Johnsen, American Seafoods Company

Rick Palmby, Trident Seafoods

Oddvin Josok, American Seafoods Company

Other Collaborators

Amanda Gladics, Oregon Sea Grant

Ed Melvin, Washington Sea Grant

Craig Rose, FishNext, Inc.

Facilitation Team

Hilary Wilkinson, Veda Environmental

Lead Facilitator

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Support

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APPENDIX B

Workshop Agenda

Seabird Cable Strike Mitigation Workshop

NOAA Fisheries West Coast Region

Building 9 (Kelly C. Sandy III Auditorium)

7600 Sand Point Way, NE, Seattle, WA 98115

November 7, 2017, from 8:30 a.m. to 4:30 p.m., and

November 8, 2017, from 8:30 a.m. to 12:30 p.m., Pacific Standard Time

Goal

Bring together industry and government representatives to identify effective, practical mitigation measures to reduce seabird cable strike mortality in the catcher-processor west coast hake and Alaska trawl fisheries.

Objectives

1. Participants have an opportunity to learn about
 - a. the scope and scale of the seabird cable strike problem.
 - b. existing mitigation measures being used effectively elsewhere.
2. Discuss relevance of existing measures for catcher-processor west coast hake and Alaska trawl fisheries.
3. Generate new ideas for mitigation measures in two categories: physical and behavioral.
4. Prioritize mitigation measures for each category.
5. Identify/agree to critical next steps/actions needed for implementation of priority measures.
6. Share available resources for implementing priority mitigation measures (e.g., BREP).

DAY 1: Tuesday, November 7, 8:30 am - 4:30 pm

Opening (35 min)

- Introductions, Purpose, History, Goals Kevin Werner, Facilitator
- Review Agenda Facilitator

Seabird Cable Strikes on Trawlers: Problem and Scope (1 hr. 25 min)

- Alaska Groundfish Seabird Interactions Shannon Fitzgerald, K. Dietrich
- West Coast Hake Fishery Seabird Interactions Jason Jannot, V. Tuttle, T. Good
- Seabird Conservation and Management Laura Todd, L. Kenney
- Questions and Discussion

Break - 10:30 am (15 min)

Mitigation Strategies and Designs: History (1 hr. 45 min)

- Alaska Pollock Fisheries Mitigation Measures Ed Melvin
- Other International Trawl Fisheries Mark Lomeli
- Agreement on the Conservation of Albatrosses and Petrels (ACAP) Best Practices Ed Melvin
- Industry Experiences, Challenges and Concerns Industry Representatives
- Discussion

Lunch - 12:30 - 1:30 pm (1 hr.)

Mitigation Strategies and Designs (3 hrs.)

- Identify and Discuss Mitigation Measures Facilitators
- Finalize List of Mitigation Measures, Screen and Report Out Breakout Group
- Prioritize Mitigation Measures Facilitators

Informal Evening Social

DAY 2: Wednesday, November 8, 8:30 am - 12:30 pm

Mitigation Strategies and Designs (4 hrs.)

- Review Day One Results Facilitator
- Identify Implementation Steps Breakout Groups
- Policy and Regulatory Issues USFWS, NOAA Staff
- Wrap-up for Workshop Facilitator

Invited Speaker Information

Shannon Fitzgerald is a research fishery biologist for NOAA Fisheries in the Resource Ecology and Ecosystem Modeling Program at the Alaska Fisheries Science Center in Seattle, Washington. He serves as the seabird/fishery interaction lead for AFSC. While in the North Pacific Groundfish Observer Program, he coordinated with the U.S. Fish and Wildlife Service and the U.S. Geological Survey to implement the seabird bycatch monitoring component, and was involved in several bycatch reduction studies, working collaboratively with industry, academia, and NGOs. He continues to improve seabird bycatch monitoring and reporting, and works on a variety of seabird bycatch improvement and demographics issues. He serves as AFSC and the National Seabird Program's representative to various regional and national seabird bycatch committees.

Jason Jannot is a research fishery biologist for NOAA Fisheries in the Fisheries Observation Sciences Program at the Northwest Fisheries Science Center in Seattle, Washington. He works on a variety of analyses related to West Coast Groundfish Observer Program data, including groundfish stock assessments, marine mammal and seabird monitoring, and developing models for the Pacific Fishery Management Council's Groundfish Management Team. He has worked on projects to understand the spatial, temporal, environmental, and social aspects of trawl fishery bycatch, and the ecological and economic consequences of Individual Fishing Quota fisheries. He serves as a member of the Pacific Fishery Management Council's Groundfish Endangered Species Workgroup and has experience as a groundfish fisheries observer in the Bering Sea and the Gulf of Alaska.

Vanessa Tuttle is a research fishery biologist for NOAA Fisheries in the Fisheries Observation Sciences Program at the Northwest Fisheries Science Center in Seattle, Washington. There she oversees the At-Sea Hake Observer Program. Her current focus is on ensuring data quality, filling data requests, developing sampling protocols, and biological data collection. As time allows, she also assists with the Groundfish Survey Team, collecting data at sea. She has experience as a fisheries observer in Alaska, off the west coast, and in the Gulf of Mexico.

Tom Good is a research fishery biologist for NOAA Fisheries in the Ecosystem Science Program at the Northwest Fisheries Science Center in Seattle, Washington. There he conducts research on a variety of seabird/fishery interactions, including avian predation on juvenile salmonids, seabird ecology in Puget Sound and the northern California Current, and seabird bycatch in the west coast groundfish fisheries. He has conducted risk assessments for NOAA Fisheries' biological assessments of west coast groundfish fisheries as part of an Endangered Species Act Section 7 consultation for the short-tailed albatross (*Phoebastria albatrus*). He serves as the Seabird Team Lead for, and is a member of, the Pacific Fishery Management Council's Groundfish Endangered Species Workgroup.

Laura Todd is a Field Supervisor at the U.S. Fish and Wildlife Service's Field Office in Newport, Oregon. There she administers the Coastal Program to address natural resource issues in priority bays, estuaries, and watersheds; habitat restoration projects; coastwide mapping of natural resources; working to recover threatened coastal species (e.g., the western snowy plover [*Charadrius nivosus*], Oregon silverspot butterfly [*Speyeria zerene hippolyta*], and western lily [*Lilium occidentale*]); and working with watershed councils and the State of Oregon to restore declining salmon runs. She serves on the Seabird Team of the Pacific Fishery Management Council's Groundfish Endangered Species Workgroup.

Leah Kenney is a Fish and Wildlife Biologist at the U.S. Fish and Wildlife Service's Field Office in Anchorage, Alaska. She serves on the NOAA Fisheries Alaska Groundfish and Halibut Seabird Working Group. Leah works on a variety of ESA-related projects and has recently taken over as the lead biologist for the endangered short-tailed albatross. Leah is currently working on the biological opinion for the Alaska halibut fisheries and any potential effects to the short-tailed albatross. Leah is the Anchorage office contact for all contaminant-related projects and issues. She also works on numerous conservation planning and mitigation work projects.

Ed Melvin is the Marine Fisheries Senior Scientist for Washington Sea Grant and an Affiliate Professor at the University of Washington in Seattle, WA. He maintains a program of collaborative research blended with directed outreach education to help solve conservation-related problems in the North Pacific commercial fishing industry. For the past 20 years, his work has focused on developing methods to reduce seabird bycatch. Ed is a member of the U.S. Endangered Species Act Short-tailed Albatross Recovery Team, serves on the Seabird Bycatch Working Group of the Agreement for the Conservation of Albatrosses and Petrels, and serves as a judge of the World Wildlife Fund Smart Gear competitions, which seek innovative, practical, cost-effective solutions that can reduce fisheries bycatch.

Mark Lomeli is the project manager of the Pacific Fisheries Bycatch Program at Pacific States Marine Fisheries Commission. Since 2008, Mark has been conducting collaborative trawl selectivity studies in west coast fisheries. Recent projects have evaluated methods to minimize catches of Pacific halibut (*Hippoglossus stenolepis*) in the groundfish fishery, Chinook salmon (*Oncorhynchus tshawytscha*) in the Pacific hake fishery, and eulachon (*Thaleichthys pacificus*) in the ocean shrimp fishery.

Anne Marie Eich is a Fishery Management Specialist at NOAA Fisheries' Alaska Regional Office in Juneau, Alaska. She serves as the regional office lead for seabird/fishery interactions off Alaska. She was the primary author of the biological assessments on Alaska groundfish (2015) and halibut (2017) fisheries to assess any potential interactions with the endangered short-tailed albatross. NOAA fisheries provided these biological assessments to the U.S. Fish and Wildlife Service as part of Endangered Species Act Section 7 consultations. Anne Marie leads the NOAA Fisheries Alaska Groundfish and Halibut Seabird Working Group.

APPENDIX C

Breakout Group Assignments and Screening Criteria

SEABIRD CABLE STRIKE MITIGATION WORKSHOP

BREAKOUT GROUPS – ASSIGNMENT

For each category of mitigation measures, **physical** and **behavioral**, complete the following tasks.

1. Review the entire list of existing mitigation measures, one by one, and make sure it makes sense. Any clarifying questions? Any needed language changes to make it clearer?
2. Cross-walk each mitigation measure with the screening criteria. In order to remain on the list, a mitigation measure should “pass” each of the first four* criteria – e.g.:
 - a. Feasible – yes, this mitigation measure is feasible
 - b. Practical – yes, it is practical (not cost-prohibitive, implementation likely not onerous)
 - c. Testable – yes, it can be tested in the field for effectiveness
 - d. Effective – yes, we know it has been effective elsewhere or we suspect it will also be effective here.

*For the fifth “bonus” criteria (broadly applicable across the West Coast and Alaska) – if the answer is no, the mitigation criteria still remains on the list. Ideally, though, mitigation measures are broadly applicable.

3. Are there any additional mitigation measures that should be added?
 - a. Brainstorm list (very short description)
 - b. Discuss and clarify
 - c. Get group to agree to a maximum of two to advance to the larger group.

The resulting additional seabird cable strike mitigation measures were screened using the criteria above in 2a–d.

APPENDIX D

Mitigation Measures from Research and Studies

The tables on the following pages provide detailed descriptions of the physical and behavioral seabird cable strike mitigation measures discussed for potential implementation in west coast and Alaska at-sea midwater trawl catcher-processor vessels.

Text in blue represents best practices advice from the Agreement on the Conservation of Albatrosses and Petrels (ACAP).

Table D-1. Detailed descriptions of proposed physical seabird cable strike mitigation measures. *MM* = mitigation measure number.

MM	Category	Mitigation Measure	Description	Where used?	ACAP Best Practice?	Field tested?
P1	Cable strike	Bird streamer lines (BSL)	BSL are streamer lines that extend aft above and outside of the trawl warps. Deploy BSL while fishing to deter birds away from warp cables. Results: significantly lowered seabird–warp contact rates compared to the control. Pros: effectively reduces seabird–warp interactions when weather conditions are favorable; suitable for pelagic trawling. Con: effectiveness is reduced in strong cross-winds and rough seas where BSL can be deflected away from the warps, tangling materials.	Australian and New Zealand trawl fisheries and many others.	Y	Y*
P2	Cable strike	Warp scarers	Warp scarers: devices attached to warp with clips or hooks that can slide up and down the warp freely. Results: Sullivan et al. (2006) showed warp scarers significantly reduced seabird–warp strikes compared to the control. Other research has shown warp scarers to reduce seabird–warp strikes, but not at significant levels. Pro: eliminates problems associated with cross-winds. Cons: cannot be deployed while the warps are being set or hauled, leaving periods of time when the warps are not protected; concerns over practicality and safety issues; not as effective as BSLs.	Falkland trawl fishery on 66-m factory trawler.	N	Y*
P3	Cable strike	Bird streamer lines (BSL)	Deploy BSL while fishing to deter birds away from net monitoring cables.		Y	N
P4	Cable strike	Avoid net monitoring cables	Net monitoring cables should not be used.		Y	N
P5	Cable strike	Snatch block	Install a snatch block at the stern of a vessel to draw the net monitoring cable close to the water to reduce its aerial extent. Snatch block: block placed on stern of vessel to draw the third wire closer to the water and reduce its aerial extent (Melvin et al. 2011). Results: Reduced the aerial extent of the third wire and seabird strikes. Pro: reduced seabird strikes. Cons: performance varied across vessel; increased third-wire cable wear; pulling upward through water/surface under rough weather; less effective than BSLs. Should be used in combination with other mitigation methods.	Walleye pollock in Alaska on catcher-processor vessels.	Y	Y†

* Sullivan et al. 2006.

† Melvin et al. 2004.

Table D-1, continued. Detailed descriptions of proposed physical seabird cable strike mitigation measures. *MM* = mitigation measure number.

MM	Category	Mitigation Measure	Description	Where used?	ACAP Best Practice?	Field tested?
P6	Cable strike	Bird baffler	Bird baffler: consists of booms attached to the vessel stern that extend outward (aft and port–starboard) that have drop lines coming off with plastic cones occurring towards the lower end of the lines. Results: seabird warp cable strikes were reduced, however, the reduction didn't differ significantly from the control. Pros: after deployment it doesn't require retrieval until the end of the fishing trip; reduces seabird warp strikes to some degree. Con: generally not as effective as BSLs or warp scarers.	Falkland trawl fishery on 66-m factory trawler.	N	N
P7	Cable strike	Cones	The cones are designed to open and attach over the trawl warps. A rope is then used to lower each cone to the water line. Results: tests occurred under normal fish operations. Seabird contact with warps was reduced by 89%. Pro: applicable for small-to-mid-sized vessels; size and color of the cones are believed to increase seabird detection of the warps. Con: needs further testing in other fisheries to determine their true efficacy.	Argentine hake (<i>Merluccius hubbsi</i>) fishery (Argentina, South America). Vessels are 26.4 ± 2.4 m; 458.1 ± 65 hp; tow at 3 knots.	N	Y [*]
P8	Cable strike	Buoys	The buoys are designed to hang from the warp cable and hang forward of where the warp enters the water and act as a physical and visual deterrent to seabirds at the warp–water interface. Results: Scalefish and shark fishery: reduced “heavy interactions” of shy-type albatross by 75%. Falkland Island Fishery: unsuccessful results; pinkie system was found unsuitable as a stand-alone seabird mitigation device. Most of the fleet is using mitigation devices other than the pinkie deflector. Pros: further gear refinement (riggings, vessel attachment locations, etc.) could improve effectiveness of the pinkie system. Cons: buoy placement along the warp is critical; buoy line entanglement occurs; deployment in rough weather is difficult.		N	Y [†]
P9	Cable strike	Warp boom	Warp boom: boom with streamers extending to the water forward off the stern to divert birds away from offal and thus warps. Results: warp booms failed to reduce seabird warp strikes (Melvin et al. 2011). Pro: further research and development could improve gear performance. Con: failed to significantly reduce seabird strikes with trawl warps.	Walleye pollock (<i>Gadus chalcogrammus</i>) in Alaska on catcher-processor vessels.	N	Y [‡]

* Tested the efficacy of placing a cone (orange traffic cone, 1 m × 10–20 cm diameter) over each trawl warp.

† Australian scalefish and shark fishery (2012–13), and Falkland Islands trawl fishery (2015): Tested the efficacy of placing a buoy near the trawl warps.

‡ Warp booms failed to reduce seabird warp strikes (Melvin et al. 2011).

Table D-1, continued. Detailed descriptions of proposed physical seabird cable strike mitigation measures. *MM* = mitigation measure number.

MM	Category	Mitigation Measure	Description	Where used?	ACAP Best Practice?	Field tested?
P10	Cable strike	Sleeves with streamers	Streamer lines attached to sleeves that slip over cables. Results: Not effective as they became tangled and were dangerous and difficult to use.	Walleye pollock in Alaska on catcher-processor vessels.		Y*
P11	Net entanglement	Net binding	For pelagic trawl gear, apply net binding to large meshes in the wings (120–800 mm), together with a minimum of 400-kg weight incorporated into the net belly prior to setting.		Y	N

* Melvin et al. 2004.

Table D-2. Detailed descriptions of proposed behavioral seabird cable strike mitigation measures. *MM* = mitigation measure number.

MM	Category	Mitigation Measure	Description	Where used?	ACAP Best Practice?	Field tested?
B1	Attraction to vessel	Avoid any discharge during shooting and hauling.	Avoid any discharge during shooting and hauling. Full retention: repeated studies have shown discharge of offal when cables are not deployed can significantly reduce the attendance of all groups of seabirds evaluated.		Y	Y*
B2	Attraction to vessel	Convert offal into fishmeal and retain all waste material.	Where practicable, convert offal into fishmeal and retain all waste material with any discharge restricted to liquid discharge/sump water to reduce the number of birds attracted to a minimum. Evidence in global fisheries that reducing discharge to stick/sump water is highly effective at reducing seabird interactions vs. unprocessed fish waste.		Y	Y*
B3	Attraction to vessel	Batch waste.	Where meal production from offal and full retention are impracticable, batching waste (preferably for two hours or longer) has been shown to reduce seabird attendance at the stern of the vessel. Shown to be effective in New Zealand. However, relies on how fast batch discards are.		Y	Y*
B4	Attraction to vessel	Mince waste.	Mincing of waste has also been shown to reduce the attendance of large albatross species. Effective on large albatrosses, but not other seabirds.		Y	Y*
B5	Net entanglement	Clean nets.	Clean nets after every shot to remove entangled fish (“stickers”) and benthic material to discourage bird attendance during gear shooting.		Y	N
B6	Net entanglement	Minimize the time the net is on the water surface.	Minimize the time the net is on the water surface during hauling through proper maintenance of winches and good deck practices.		Y	N
B7	Attraction to vessel	Avoid peak areas/ periods of seabird foraging activity.			Y	N

* Kuepfer and Pompert 2017.

References

- Kuepfer, A., and J. Pompert. 2017. The warp deflector (pinkie system): Practical implications of a physical seabird bycatch mitigation device trialled in the Falkland Islands trawl fishery. Eighth Meeting of the Seabird Bycatch Working Group of the Agreement on the Conservation of Albatross and Petrels. Available: www.acap.aq/en/working-groups/seabird-bycatch-working-group/seabird-bycatch-wg-meeting-8/sbwg8-information-papers/2921-sbwg8-inf-16-discard-management-as-a-seabird-bycatch-mitigation-tool-results-from-further-batch-discard-trials/file (May 2018).
- Melvin, E. F., K. S. Dietrich, and T. Thomas. 2004. Pilot tests of techniques to mitigate seabird interactions with catch processor vessels in the Bering Sea pollock trawl fishery: Final report. Washington Sea Grant, Seattle, Washington.
- Melvin, E. F., K. S. Dietrich, S. Fitzgerald, and T. Cardoso. 2011. Reducing seabird strikes with trawl cables in the pollock catcher-processor fleet in the eastern Bering Sea. *Polar Biology* 34:215–226.
- Sullivan, B. J., P. Brickle, T. A. Reid, D. G. Bone, and D. A. J. Middleton. 2006. Mitigation of seabird mortality on factory trawlers: Trials of three devices to reduce warp cable strikes. *Polar Biology* 29:745–753.

APPENDIX E

Implementation Worksheets for Physical Seabird Cable Strike Mitigation Measures

1. Snatch Block

1. On a separate sheet, please sketch a basic design for the proposed mitigation measure. Include as much detail as you deem necessary to adequately convey the basic concept of this mitigation measure.

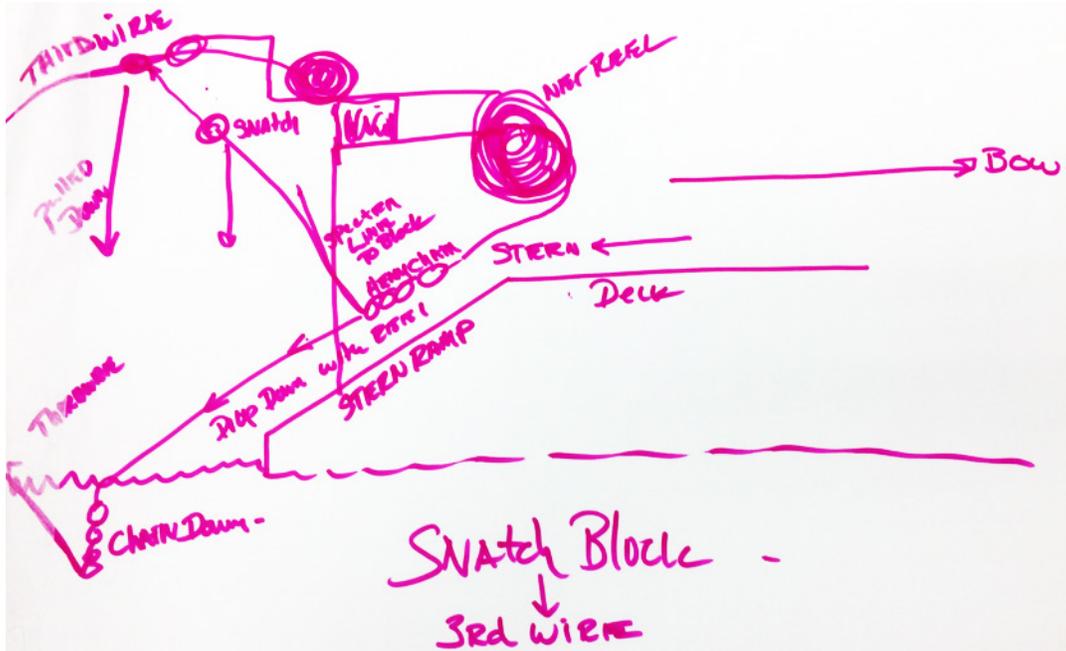


Figure E-1. Drawing of a snatch block coming off the aft of the vessel and entering the water. The third wire comes aft off the upper block and is threaded through a block held lower and fore of the upper block; this is the snatch block. The snatch block draws the third wire down and back toward the vessel so that the third wire enters the water very close to the aft of the boat. In this manner, the snatch block decreases the aerial extent of the third wire, thus reducing the risk of birds striking the wire.

2. Please describe this mitigation measure in one paragraph or less, including (at a minimum):
 - a. **Physical description**

A block to get the third wire pulled down so that it enters the water much closer to the stern of the vessel. The snatch block is a removable block that you can attached to third wire. A standard snatch block could be used or and articulated crane or boom can be used to move the wire.
 - b. **Materials needed**

Larger radius reel but lighter material (so that crew can move it more easily) will reduce wear on the wire.

c. **Location/placement on or near fishing vessel**

Possible to build an articulating arm on the third-wire reel

3. Who are the key individuals and/or entities that need to be involved in advancing this mitigation measure? What suggested approaches do you have to get them involved and on board with the concept?
 - Vessels with snatch block experience (e.g. those that already use them for ice deflection)
 - Pacific Whiting Conservation Cooperative
 - Oregon Sea Grant
 - Pacific States Marine Fisheries Commission
 - At-Sea Hake Observer Program
 - Equipment manufacturers
 - Ed Melvin (Potential PI?)
 - At-Sea Processors Association
 - Alaska Pollock Conservation Cooperative
 - Amendment 80 AK Seafood Cooperative
4. What hurdles or impediments do you foresee in broad adoption of this mitigation measure across the industry?

Industry needs to be convinced that there is truly an issue and a need to broadly adopt

Feasibility phase + effectiveness phase

Sequence:

1. Develop a proposal to get funding to do a pilot project. Third-wire observer on one or two vessels or monitoring camera.
 2. Experimental design: control + experiment. Access different performance standard with the goal of determining the farthest point that is effective. How close to the stern of the vessel does the third wire need to enter the water to reduce or eliminate interactions?
5. Please add anything else you can think of that might help advance this mitigation measure.
 1. Develop performance standards – e.g. amount of third wire allowed to be exposed, etc. and allow vessels to retrofit accordingly.
 2. Need some research to establish performance standards e.g. Length of third wire and link to bird strikes, etc.
 3. Funding: USFWS, NFWC, BREP

2. Water Deterrent

1. On a separate sheet, please sketch a basic design for the proposed mitigation measure. Include as much detail as you deem necessary to adequately convey the basic concept of this mitigation measure.

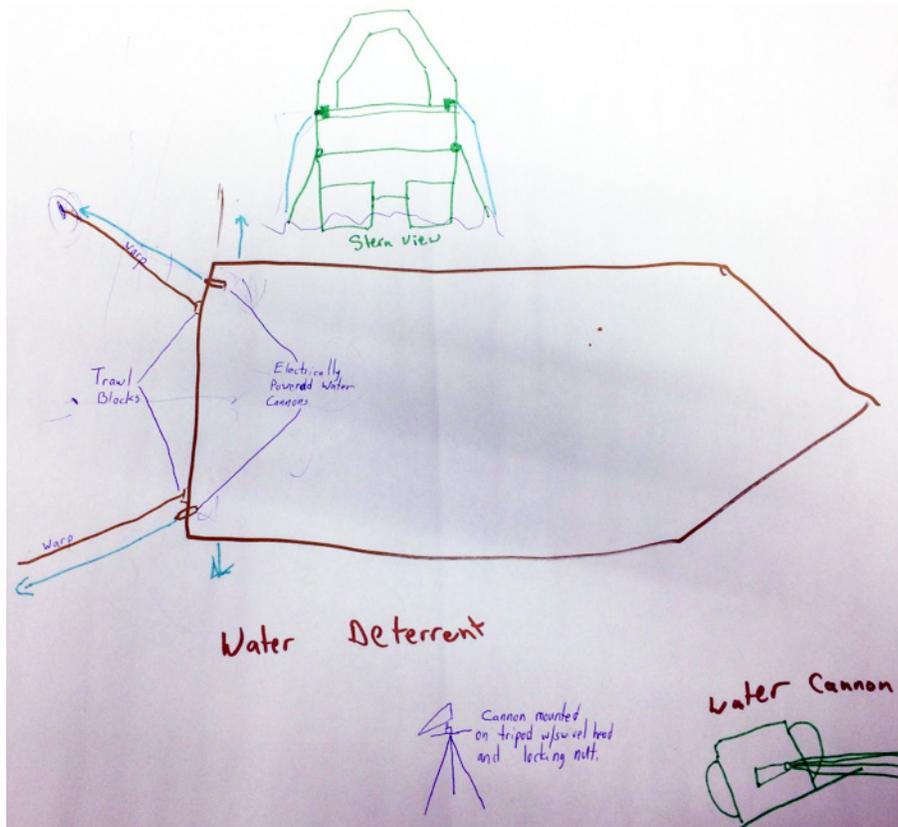


Figure E-2. Drawing of a device that uses water to prevent birds from striking the trawl warps. The figure shows the position of two water sprinkler systems, a.k.a. water cannons, mounted on the aft port and aft starboard sides of the vessel, very close to, but outboard of, the blocks that control the trawl warps. Each electrically powered cannon is mounted on a tripod with a swivel and a locking nut. Cannons would spray water on and near each of the warps to deter seabirds from striking the trawl warps.

2. Please describe this mitigation measure in one paragraph or less, including (at a minimum):
 - a. **Physical description**
Water cannon (fire hose) off the stern on both sides of vessel. Set with clamps that pivot. This device would be mounted on the helo deck.
 - b. **Materials needed**
 - Water cannon with substantial flow - enough to reach at least 30 feet.
 - Pump for each side
 - Locking pivot and stanchion on dedicated tripod
 - Hard piped (see diagram)

- Instructions not to intentionally hit birds
 - Could also be used as warp booms
 - Combine with snatch block
- c. **Location/placement on or near fishing vessel**
Off the stern on both sides of vessel.
3. Who are the key individuals and/or entities that need to be involved in advancing this mitigation measure? What suggested approaches do you have to get them involved and on board with the concept? (Note: This group did not include important personnel that would be necessary to help test and implement this device. The following reflects only the engineering and operation of the device.)
- Boat captain – design to fit boat
 - Boatswain – maintain and train
 - Chief engineer – design and installation and maintenance
 - Crew – trained to operate
4. What hurdles or impediments do you foresee in broad adoption of this mitigation measure across the industry?
- Weather conditions will impact effectiveness (wind).
5. Please add anything else you can think of that might help advance this mitigation measure.
- Pre-experimental testing and development
 - Ensure ease of use

3. Visibility of Third Wire

1. On a separate sheet, please sketch a basic design for the proposed mitigation measure. Include as much detail as you deem necessary to adequately convey the basic concept of this mitigation measure.

[NO DRAWING PROVIDED]

2. Please describe this mitigation measure in one paragraph or less, including (at a minimum):
- a. **Physical description**
The third wire is modified with cable fairing or other colors of the sleeve/jacket.
 - b. **Materials needed**
A new wire needs to be manufactured and installed
 - c. **Location/placement on or near fishing vessel**
Standard third wire location

d. **Installation instructions and training needs for installing**

See manufacture and vessel personnel. Basic standard replacement of a third wire.

e. **Anything else you think is important!**

- Cost is consideration
- How to field test – two boats may be needed, although some vessels have backup third wire reels so a test and a control reel are available on a single ship (ideal).
- Further research needs: a) to work with the industry to understand the constraints or capabilities of the third wire mechanics, b) also work with third wire manufacturers to determine if other colors can be used, and c) better understand bird vision.

3. Who are the key individuals and/or entities that need to be involved in advancing this mitigation measure? What suggested approaches do you have to get them involved and on board with the concept?

- Cable manufacturers
- Volunteer vessel
- Someone to do the 3 research fronts identified in 3.e above.
- US Fish and Wildlife and state representatives
- Must first show that this is an identified conservation issue

4. What hurdles or impediments do you foresee in broad adoption of this mitigation measure across the industry?

- Cost
- How does it affect third wire winches, etc.
- Durability
- If it's possible, would solve basic safety issue

5. Please add anything else you can think of that might help advance this mitigation measure.

- Grants would pay for experimental third wire
- More work on attaching to the third wire –inexpensive way to light the wire, from drum to water. Snap clips to attach new LED.

4. Combination Streamer Line and Warp Booms

1. On a separate sheet, please sketch a basic design for the proposed mitigation measure. Include as much detail as you deem necessary to adequately convey the basic concept of this mitigation measure.

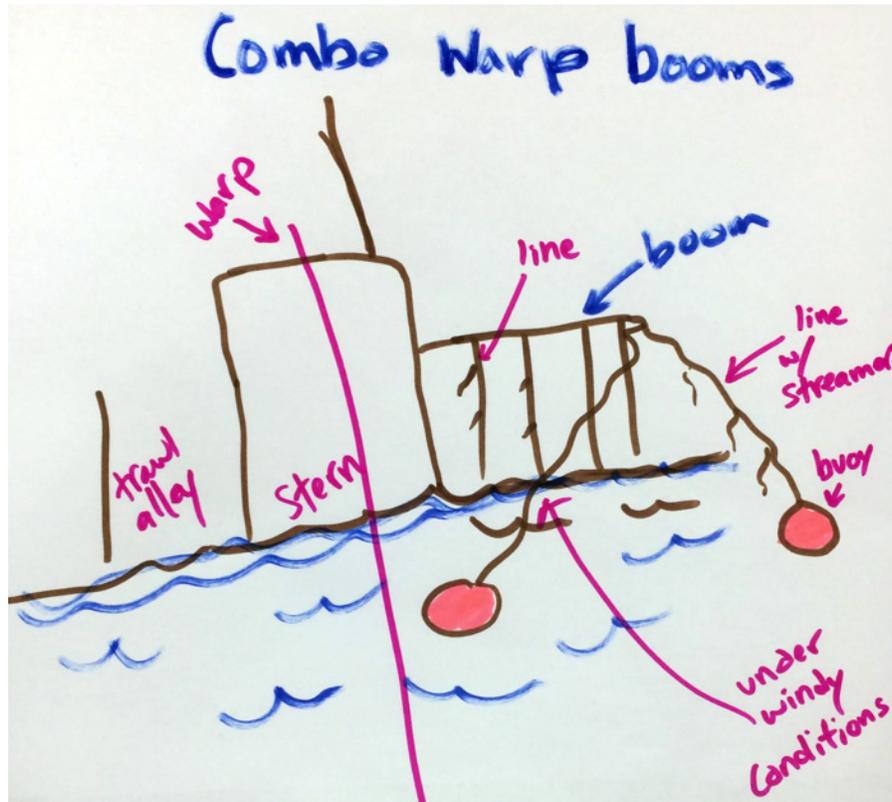


Figure E-3. Drawing of a warp boom combination device to deter seabirds from striking trawl warp cables. Warp booms are booms protruding on both the port and starboard side of the boat near the aft of the vessel. Each boom contains streamers or lines hanging down to and touching the water surface. The most-outboard streamer or line contains a buoy or a float.

2. Please describe this mitigation measure in one paragraph or less, including (at a minimum):
 - a. **Physical description**

Warp boom deployed out to the side plus streamer lines positioned on to the end of the boom, ending with a float. Float and streamers could be retractable to adjust to windy conditions.
 - b. **Materials needed**
 - Boom, and stabilizing cables
 - Streamers or lines hanging down (creating curtain)
 - Streamer line positioned at the end of the boom
 - Bloat or buoy

- c. **Location/placement on or near fishing vessel**
Within seven meters of stern (at or near stern)
 - d. **Installation instructions and training needs for installing**
Tie boom to gantry (or other) near stern. Should be higher than the warp bock and be at least 7 meters based on ACAP guidelines (depends on vessel and gantry placement).
3. Who are the key individuals and/or entities that need to be involved in advancing this mitigation measure? What suggested approaches do you have to get them involved and on board with the concept?
 - Trade associations
 - Pollock CP companies
 - Amendment 80 CP companies
 - Pacific Whiting Conservation Coop
 - Vessel captains/engineers
4. What hurdles or impediments do you foresee in broad adoption of this mitigation measure across the industry?
 - Not a one-size-fits-all, so very vessel-specific needs at design
 - Getting buy-in needs outreach
5. Please add anything else you can think of that might help advance this mitigation measure.
 - Very testable and refine-able for individual vessels
 - Adaptable to windy conditions by adjusting

5. Third Wire Float Device

1. On a separate sheet, please sketch a basic design for the proposed mitigation measure. Include as much detail as you deem necessary to adequately convey the basic concept of this mitigation measure.

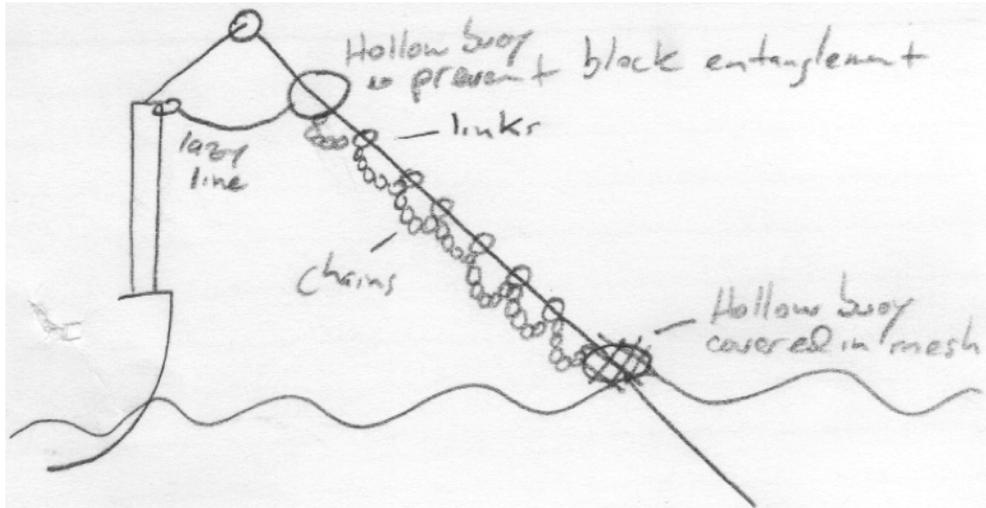


Figure E-4. Drawing of a third wire float device to deter seabirds from striking the third wire. This device has a lazy line attached to the vessel on one end and attached to hollow buoy on the opposite end. The hollow buoy is attached to the third wire and a chain which runs the length of the third wire. The chain is attached to a second hollow buoy covered in mesh that floats on the water surface. The first buoy prevents chain entanglement in the third wire block. The lazy line ensures the chain device is attached to the vessel and the chain allows the entire device to be retracted when the third wire is retrieved upon haul-back.

2. Please describe this mitigation measure in one paragraph or less, including (at a minimum):
 - a. **Physical description**
 - b. **Materials needed**
 - c. **Location/placement on or near fishing vessel**
 - d. **Installation instructions and training needs for installing**

} see below

This collapsible device runs the entire aerial length of the third wire, terminating at the surface of the water. It will address both air and surface strikes. The device consists of a hole-through buoy, wrapped in netting (keeps it at the surface) which the third wire is fed through, followed by a series of stainless rings connected by lengths of chain. Streamer could be attached to the chain or the chain could be painted to increase visibility. Not certain whether or not this would be necessary. One or more lazy lines would be needed to adjust the deployment length and keep it in place. The device would remain on the third wire for the duration of the trip, collapsing and secured during retrieval. During deployment, it is lowered until the buoy touches the water. Using the lazy line, attached to opposite end, rings and chain are pulled up close to stern and line is secured. Hollow buoy at top to prevent being sucked through third line block.

3. Who are the key individuals and/or entities that need to be involved in advancing this mitigation measure? What suggested approaches do you have to get them involved and on board with the concept?
 - F/T Boatswain or Captain (design and implementation)
 - Researcher to arrange effectiveness testing -- trials to establish and improve design, identify and resolve problems

4. What hurdles or impediments do you foresee in broad adoption of this mitigation measure across the industry?
 - Entanglement with block and cable
 - Chain handling hazards
 - Training of deck crew
 - Effects of icing
 - Wear on cable
 - Deck crew handling during haul-back.

5. Please add anything else you can think of that might help advance this mitigation measure.
 - Industry participation and buy-in
 - Potential for simple/inexpensive implementation
 - Good for fishing season potential (don't have to take it off each haul)
 - Can be used in conjunction with warp deterrents.

Recently published by the Northwest Fisheries Science Center

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