

a. Project Summary

(1) Organization title: International Pacific Halibut Commission (IPHC)

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Collaborating partners: **Industry Representatives**: Kenny Down (industry representative and voting member NPFMC), James Johnson (Deep Sea Fishermen's Union), **NOAA Alaska Fisheries Science Center (AFSC)**: Dr. Noëlle Yochum

(4) Area of interest: This study addresses program priorities 2, and 1(a) in Section I.B.

(5) Project title: Gear-based approaches to catch protection as a means for minimizing whale depredation in longline fisheries.

(6) Project objective: This study seeks to identify potential methods for protecting hook captured fish from whale depredation and to develop and field-test several simple low-cost catch-protection designs that can be deployed effectively using current longline fishing techniques.

(7) Summary of work: Proposed work entails conducting a workshop with industry (affected fishers, gear researchers, scientists) to identify methods to protect fishery catches from depredation. The top two or three catch protection design outcomes from the workshop will be incorporated into functional prototypes and field tested in longline sea trials targeting flatfish.

(8) Budget Information: A total of \$99,700 of FY21 BREP funding is requested for this project.

b) Project Narrative

(1) Identification of problem: Whale depredation of captured fish is a growing problem among many hook-and-line fisheries worldwide (Tixier 2020). In the north Pacific, both Killer (*Orcinus orca*) and Sperm (*Physeter macrocephalus*) whales are involved in depredation behavior in Pacific halibut (*Hippoglossus stenolepis*), sablefish (*Anoplopoma fimbria*), and Greenland turbot (*Reinhardtius hippoglossoides*) longline fisheries. In 2011 and 2012 fisheries observers estimated that 21.4% of sablefish sets, 9.9% of Greenland turbot sets, and 6.9% of Pacific halibut sets were affected by whale depredation in the Bering Sea (Peterson et al. 2014). Reductions in catch per unit effort (CPUE) when whales were present ranged across geographic regions from 55%-69% for sablefish, 54%-67% for Greenland turbot, and 15-57% for Pacific halibut (Peterson et al., 2014). These impacts also incur significant time, fuel, and personnel costs to fishing operations. From a fisheries management perspective, depredation creates an additional and highly uncertain source of mortality, loss of data (e.g. compromised survey activity), and reduces fishery efficiency. Stock assessments of both Pacific halibut (Stewart et al., 2020) and sablefish (Goethel et al., 2020) have adjusted their analysis of fishery independent data to account for the effects of whale depredation on catch rates. In the sablefish assessment, fishery limits are also adjusted downward to reflect expected depredation during the commercial fishery. In recent years, whale depredation has been limiting fishers' ability to harvest their Greenland turbot allocations (Kenny Down, personal communication) and they have been well below (35-78% in the last 5 years) the total allowable catch (TAC, Table 5.1. Bryan et al., 2020) for that fishery. Meanwhile, potential risks to the whales include physical injury due to being near vessels and gear, disruption of social structure (e.g., Chilvers and Corkeron, 2001), and developing an artificial reliance on food items that can be affected by fishery dynamics.

Many efforts have been made over the years to mitigate this problem, with fishers generally limited to simple methods that can be constructed, deployed, or enacted without significantly disrupting normal fishing operations, or without violating gear regulations. Existing approaches include catch protection, physical and auditory deterrents, and spatial or temporal avoidance. These approaches have had variable degrees of success and ease of adoption in each fishery (Werner et al. 2015) but none have solved the problem. Participants of the “International Marine Mammal – Longline Bycatch Mitigation Workshop” held in 2013 at Woods Hole Oceanographic Institution (Werner 2015) identified ‘terminal gear modification’ and catch protection as the avenue with the highest likelihood of ‘breaking the reward cycle’ in depredation behaviors.

Pacific halibut and Greenland turbot are prohibited in trawl fisheries, are difficult to capture efficiently in pots, and therefore new approaches to protection of longline catch are necessary. This proposal follows up on the aforementioned workshop’s findings, with a narrow and tactical focus on protecting longline-caught fish, through low cost, easy to adopt gear modifications. Recent developments in physical catch protection methods include: the development of underwater shuttles that unhook and transport catch to the surface (e.g., Patagonian toothfish: [Sago Solutions](#)), light and expandable spring coils (e.g., the underlying mechanism of ‘slinky’ pots used in the Alaska sablefish fishery: [Cod Coil](#)), and triggerable spokes or mesh panels attached to the gear to obscure catches of tuna (e.g., Rabeiroso et al. 2012). Some of these approaches may have elements that are suitable to be adapted for the protection of longline captured flatfish.

Relevance to the FY21 BREP priorities: This proposal aims to address 2021 BREP program priority Section I.B.2: Improving understanding and reduction of indirect mortality on target

catch due to marine mammal depredation in commercial longline fisheries (in particular: Pacific halibut, sablefish, and Greenland turbot) and Section I.B.1(a): facilitating fuller utilization of quotas (particularly Greenland turbot).

It also addresses North Pacific Fishery Management Council (NPFMC) Research Priority [#615](#): Evaluate the interactions between fisheries and killer whales and sperm whales. Both the Council and Scientific and Statistical Committee (SSC) categorize this priority as “Important” and specify a desire to “evaluate methods of avoidance and deterrence” within their priority description.

(2) Project objectives: The objectives of this study are to:

- a) Work with fishermen and gear manufacturers to identify effective methods for protecting hook captured fish from depredation; and
- b) develop and pilot several simple low-cost catch-protection designs that can be deployed effectively using current longline fishing techniques.

(3) Project description: This project is framed in a two-step format:

A) Virtual Workshop: An electronic format (in light of the pandemic) two-day workshop focused on identifying methods to protect fishery catches from depredation is proposed. The objective will be to document the current state of knowledge and identify specific catch-protection principles and devices for field testing. Participants will include fishers affected by depredation, researchers involved in depredation mitigation, and private companies developing solutions to depredation (Table 1). Key target workshop participants have been identified and are detailed in Appendix 1.

Table 1. Participant estimates by sector.

Sector	Participant Estimate
Fishers	37
International Researchers	12
Industry / Private Gear Developers	12
Governmental Researchers	15
Other	2
Grand Total	78

Prior to the workshop participants will be tasked with providing input summarizing their work and experiences (in written, pre-recorded videos, creation of small prototypes, video demonstrations of prototypes and how they are expected to function). Organizers will work actively to create an agenda and environment fostering active participation and engagement, bounded brainstorming, and elements to prevent online fatigue. The virtual format (IPHC is well versed in Adobe Connect, Webinar meeting production) will enable international participation, creatively integrating pre-recorded videos outlining and demonstrating current research and gear performance (participants to view prior to live interactive sessions), online polls for active interaction, regional breakout sessions (to accommodate time zones), and combined sessions to brainstorm and build on key attributes of successful solutions. The PIs will act as facilitators prior to and during the meeting to ensure efficient and timely execution of the agenda, accomplishment of deliverables and coordinating and drafting a meeting report that will include a list of final conclusions and recommendations as well as a ranked list of catch protection designs. Facilitators will engage participants prior to the workshop to contribute conceptual models or prototypes to better facilitate targeted discussion. Funding for the creation of scale models is included in the budgeting. This could include but is not limited to: a mini-shuttle (“mini-Sago”), an open-ended slinky pot to shroud the catch, and plastic or metal streamers triggered during the catch process. Workshop scheduling would be in the fall of 2021 (November/December) when affected north Pacific fishers are available. It

may be possible to target the dates around the Pacific Marine Expo (commercial fishing tradeshow) when many fishing industry participants are in the Seattle area.

B) Field Trials: The top two or three (determined by production costs) catch protection design outcomes from the workshop will be incorporated into functional concept prototypes to be tested in longline sea trials targeting flatfish (Pacific halibut and/or Greenland turbot) in Alaska. These will be field tested over a five-day period aboard a contracted commercial longline operation during the summer of 2022. Testing of the prototypes aboard a commercial vessel with working fishers will allow for evaluation of functionality of the prototypes under typical fishing conditions, allow for knowledgeable adjustments of the prototypes on site, and lend credibility of the outcomes of the tests. These field trials will serve as a pilot study for future efforts. Specifically, the primary objective will be to evaluate whether each device is easily integrated into standard fishing operations, and whether catch rates are comparable to those experienced generally in the fishery (via logbook reporting). All field trials will be conducted at known fishing areas in the Gulf of Alaska or Bering Sea and will include as many deployments of each device (on independent skates of gear) as can be completed with a minimum of 5 hours of fishing time to ensure reasonable catch rates of the target species. If whales are encountered during trial fishing operations, a tertiary objective will be to document the degree of whale depredation (if any) observed with each device.

These pilot trials will also allow us to test the technology required (e.g. cameras) to observe these trial devices in situ and to address management questions regarding their performance. Camera recording equipment will be utilized to better understand the performance dynamics

of the gear, animal behavior around the gear (both the target fish species and whales if present), and to document losses and/or injuries to fish lost from the gear underwater. This is anticipated to be a collaborative effort between the IPHC, partner agencies, and the fishing industry.

Project timelines and deliverables for this two part proposal are provided in Table 2.

Table 2. Milestone work to be performed and project timeline for the proposed study.

Month	Work Performed
1-3	Identification of key participants, dates, times of day (to maximize participation) for the workshop. Draft invitations. Selection and production of scale models. Request pre-recorded videos. Draft poll questions and trial the software. Identify meeting delivery team and roles (facilitator, support team).
3-4	Conduct workshop. Summarize results in collaboration with industry partners, and provide reports to BREP and participants.
5-7	Identify key prototypes to trial, and partners to develop field ready prototypes. Work with partners on study design. Provide progress report to BREP.
8-11	Physical prototype development. Draft and post vessel tender specifications for chartering a vessel to conduct field trials. Select and contract with the vessel. Request and secure all necessary permits.
12-14	Conduct sea trials. Expected to be 5 days of fishing, but timing will depend on vessel availability and weather conditions.
15-16	Analyze data. Write a project report for public dissemination and a manuscript for a peer review.
17-18	Outreach and education. Present project findings to industry, management, and scientific workshops, and meetings. Work with industry partners to select the most promising design for further development and evaluation. Final project report to BREP.

The success of this project will rely on inter-disciplinary and multi-stakeholder participation for both the workshop and the field trials. Official collaborators include Dr. Noëlle Yochum (AFSC) and several fishery representatives: Mr. James Johnson (Executive Director - Deep Sea Fishermen’s Union of the Pacific), and Mr. Kenny Down (Industry representative and voting member of NPFMC). Dr. Yochum brings expertise with gear design, industry engagement, and field-testing equipment, including underwater video cameras, and lighting. Additionally, several private industry researchers and trade groups (Sago International, Cod Coil, Southeast Alaska

Sperm Whale Avoidance Project (SEASWAP)) have shown an interest in being involved in the workshop and field trials of initial design concepts in Alaska flatfish fisheries.

(4) Permitting: The workshop component requires no permit. IPHC field work would require a NMFS Letter of Acknowledgement (LOA), as well as an IPHC scientific sampling permit. Permits will be applied for after notice of successful project funding is received and after completion of the scientific design phase.

(5) Impacts, benefits, and results expected: This project will further define and develop previously identified (Werner et al. 2015) high priority work that can break the reward cycle of depredation behavior and thereby suppress its prevalence. It will identify strategies to protect already captured fish in cost effective manners that are compatible with currently employed hook and line fishing practices. Ease of deployment and cost effectiveness will be critical to adoption by fishing fleets to mitigate this developing challenge. Successful development of depredation mitigation strategies will save the industry money, reduce wastage in the fishery, and assure managers that catch records are accurately capturing removals. The international nature of depredation will ensure that successful deliverables can be leveraged/applied into other fisheries around the world.

(6) Need for Government Assistance: The research budget at the IPHC does not include funds for studies on mitigating depredation of longline catch, therefore external financial support of the proposed project is required. The FY21 BREP FFO is currently the only funding source identified to support this project proposal.

(7) Federal, state and local government activities: This project will not adversely affect any federal, state, or local government activities described in the FFO.

(8) Project Management: This project will be jointly managed by principal investigators Mr. Claude Dykstra and Dr. Ian Stewart (IPHC) with collaboration from Dr. Noëlle Yochum (AFSC), Mr. Jim Johnson (DSFU), and Mr. Kenny Down.

Mr. Dykstra will be responsible for managing the project budget, planning and scheduling of the workshop, co-facilitating the workshop, acquiring project permits, generating an RFP to contract a commercial vessel for gear trials, collection and overall analysis of the data, and providing interim and final reporting functions to BREP. Dr. Stewart will be responsible for co-facilitating the workshop, overseeing study design of field trials, and review of the analytical products. Dr. Yochum will be closely involved in workshop structural planning and topic flow and will provide expertise and equipment (video cameras, lighting) for collecting imagery and footage of deployed field equipment to inform interactions with the prototype catch protection devices during deployment, in-situ, and during recovery. Collaborators James Johnson (Deep Sea Fishermen's Union of the Pacific) and Kenny Down (Industry representative and voting member of the NPFMC) will be involved in outreach activities for the workshop, advising and communicating to various fleets as part of the recruitment process for securing a vessel to conduct field trials, as well as in public outreach and education of outcomes of both aspects of this project. Several fishing and trade groups have shown interest in participating in the workshop (see Appendix 2 for a letter of support), as have several private gear development companies (Sago International, Cod Coil). Together this team will be cooperatively engaged in all aspects of the workshop planning and design, field study design, data collection and analysis,

review of imagery outputs, contributions to project summaries and manuscripts, and participating in public outreach and education. IPHC Finance and Administration staff will be responsible for interacting with the NOAA grants office staff during the study period and in execution of a contract agreement with project tender vessel. Curriculum vitae of the principal investigators are included in Appendix 3. A written agreement of Dr. Yochum's (AKFSC) involvement on this study is provided in Appendix 4.

(9) Results from prior NOAA/NMFS support: A summary of recent federal funding that Claude Dykstra (PI) has been involved with are listed in Appendix 5. Dr. Stewart has not received direct federal funding in the last 5 years.

(10) Project impacts: This research will identify cost effective prospective terminal gear modifications designed to protect longline catch from whale depredation, and thereby break the reward cycle contributing to this behavior. Field trials will demonstrate the functionality of these proof-of-concept ideas and provide direction for further modifications and larger scale experimental testing. The collaborators, in consultation with fishermen, will evaluate the designs trialed and will select one for further development and evaluation. Successful gear development will enable fishers to access fish and fishing grounds in areas currently unavailable due to depredation challenges. The outcomes of this project address the desire of NPFMC and their SSC to “evaluate methods of avoidance and deterrence” within Research Priority [#615](#): Evaluate the interactions between fisheries and killer whales and sperm whales.

(11) Education and outreach: The principal investigators and collaborators on this project have extensive experience presenting scientific research results to industry and stakeholders through formal meetings (Council Meetings, IPHC Research Advisory Board meetings, IPHC annual

meetings) as well as less formal settings (Pacific Marine Expo, Kodiak Marine Science Symposium, Western Groundfish Conference) and venues (community meetings during fishing season). Members of industry will be directly involved in contributions to, and outcomes of the workshop, and will disseminate these results to their membership groups. In addition, key outcomes and publications arising from this study will be made available through the IPHC website.

(12) *Evaluation of project:* Upon notice of project funding, work will commence on planning the workshop. Workshop agenda, schedule, platform, and dates will be communicated during normal reporting timelines. Workshop attendance, and outcomes will be reported in the month following the workshop. Field study design will be completed prior to a request for vessel contract tenders is announced and be shared with BREP. Progress will be reported on required timelines, and final analysis of the outcomes and data outputs will be provided in the final report.

(13) *Data Sharing Plan:* This project will not generate any environmental data as defined in Federal Fund Office (FFO) regulations. Data used in analyses to generate results will be made freely available after analyses are completed. Data and metadata will be made available in .csv files or equivalent. The final report from this project will be made freely available on the IPHC website (<https://iphc.int/management/science-and-research/biological-and-ecosystem-science-research-program-bandesrp/bandesrp-other/whale-depredation>). Further, research metadata will be publicly available on the IPHC's website. Please see Appendix 6 for full data sharing plan.

C. Total project costs and Budget Narrative

A total of \$99,700 of FY21 BREP funds is requested for the completion of this project. This is broken down by the two components of the project, \$10,950 for the workshop and \$88,750 for

the completion of field trials. These funds include financial support for Mr. Dykstra (4 weeks total ~8% annual salary) and Dr. Stewart (1 week total ~2% annual salary), with ¼ of their time focused on the workshop and ¾ attributable to field trials.

Workshop: The funds for the workshop include costs for the virtual meeting software license, as well as for supplies to create three to four working prototypes or models of example gear devices.

Field Trials: The funds for field trials cover the contracting of a commercial vessel to complete five (5) days of fishing, field sampler costs (salary, benefits, travel) for data collection, supplies and equipment costs for the creation of testable devices and cameras for monitoring performance, and PI costs for the design, execution, and evaluation of the trials. Requested funds are for one year of project support. However, an 18-month award period is requested to allow sufficient time to complete the project (workshop in first year, and development and scheduling of field trials over the following summer), including conducting the at-sea gear trials, writing summaries, reports and a peer reviewed paper where appropriate, and conducting education and outreach. Please refer to Appendix 7 for a Budget Narrative for a detailed explanation of requested funds.

Citations.

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