Gear-based approaches to catch protection as a means for minimizing whale depredation in longline fisheries

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PURPOSE

To provide the RAB with a description of an ongoing study designed to identify and test new tools to minimize marine mammal depredation of hook captured Pacific halibut.

BACKGROUND

Removal of captured fish from fishing gear (known as depredation) is a growing problem among many hook-and-line fisheries worldwide. In the north Pacific Ocean, 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. PLoS ONE 9(2): e88906). 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 and sablefish 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 and they have been well below (35-78% in the last 5 years) the total allowable catch for that fishery. Meanwhile, potential risks to the whales include physical injury due to being near vessels and gear, disruption of social structure 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, but none have solved the problem. Terminal gear modification and catch protection have been identified as an avenue with the highest likelihood of 'breaking the reward cycle' in depredation behaviors. Particularly for Pacific halibut and Greenland turbot, two species whose catches are prohibited and closely regulated, respectively, in trawl fisheries and that are difficult to capture efficiently in pots, novel approaches to protection of longline catch are necessary.

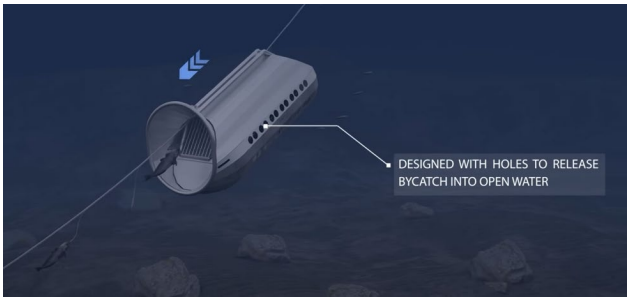
DISCUSSION

This project focuses on investigating strategies aimed at protecting longline-caught fish, through low cost, easy to adopt gear modifications that securely retain catch, while breaking the 'reward

cycle' in depredation. The project is structured in two parts. First, in early 2022 we conducted a virtual International Workshop on protecting fishery catches from whale depredation with industry (affected fishers, gear manufacturers), gear researchers and scientists to identify methods to protect fishery catches from depredation. Presentations were made from companies and researchers on a) underwater shuttles that unhook, and transport catch to the surface (e.g. Patagonian toothfish) by Sago Solutions from Norway, b) shrouding devices involving triggerable spokes or mesh panels attached to the gear to obscure catches of tuna by researchers from Paradep from France, and c) light weight expandable spring coil pots by Cod Coil from the U.S. Each presentation outlined what their product is, it's mode of action, method of interaction with the gear, functionality, costs (catch rates, money, time, safety, storage), modifications to consider, critical considerations, and ease of modification for flatfish fisheries. Common successes and failures of various iterations of these products, and general observations were discussed and summarized in the published report of the Workshop, with a particular focus on those elements that are suitable to be adapted for the protection of longline captured Pacific halibut.

Second, this project aims to incorporate the top catch protection design outcomes of the workshop into functional prototypes and conducting field-testing in longline sea trials. The two selected catch protection devices were: a) an underwater shuttle and b) a branch gear with a sliding shroud system.

The underwater shuttle design is a reduced size version of the Sago Extreme, consisting of an aluminum frame that is set with the gear, and which then slides down the gear near the seabed during haul-back, mechanically unhooking fish and securing the fish inside (Figure 1). After 100 hooks, the device encounters a stopper and is hauled to the surface with fish inside. At the surface the device must be hoisted aboard using a boom and winch.

A) 

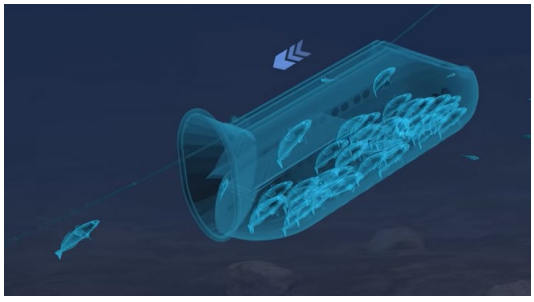
B) 

Figure 1. Schematic of Sago Extreme, as it slides down the groundline (A) and side view of fish released and contained in the device (B) (from Sago Solutions presentation).

The shrouded branchline design combines aspects of both the Paradep and Cod Coil concepts and consists of a main groundline, with several weighted side branches affixed to it, with the gangions and hooks affixed to the branchline (Figure 2). For this project, a set will consist of six (6) branchlines of 48' will be affixed on 100' spacing along the groundline. Ten (10) gangions and hooks (16/0) will be snapped to the branchlines on 4' spacing. Three branchlines will have a weighted spring coiled shroud attached, designed to slide over the 10 hooks/catch during haulback.

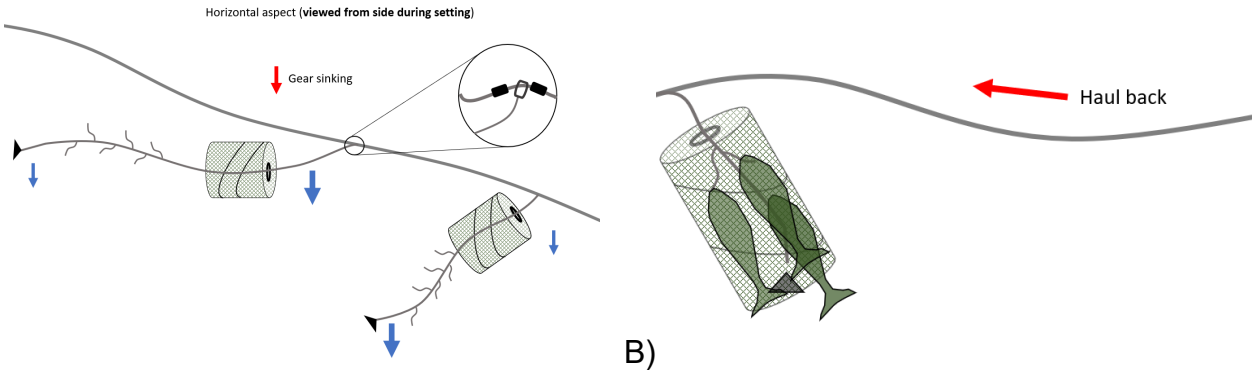


Figure 2. Schematic of shrouded branchline design during setting (A) and sliding over the catch during haulback (B).

The purpose of the field testing is to (1) investigate the logistics of setting, fishing, and hauling the two pilot catch protection devices, and (2) investigate the basic performance of the gear on catch rates and fish size compared to traditional gear. Successful field testing may lead to further proposals and development of the concept(s) moving forward.

RECOMMENDATION

That the RAB:

1) **NOTE** paper IPHC-2022-RAB023-11, which described studies designed to investigate whale depredation mitigation strategies through catch-protection in longline fisheries.