Report of the 1st International Workshop on Protecting Fishery Catches from Whale Depredation (WS001)

Meeting held electronically, 9 February 2022

DISTRIBUTION:

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ACRONYMS

IPHC	International Pacific Halibut Commission
WS	Workshop

DEFINITIONS

A set of working definitions are provided in the IPHC Glossary of Terms and abbreviations: https://www.iphc.int/the-commission/glossary-of-terms-and-abbreviations

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Executive summary

The 1st International Workshop on Protecting Fishery Catches from Whale Depredation (WS001) was held electronically, on 9 February 2022. The meeting was opened by the Chairperson Mr. Claude Dykstra, who outlined the format and purpose and goals of the workshop.

1 Opening of the Session

1. The 1st International Workshop on Protecting Fishery Catches from Whale Depredation (WS001) was held electronically, on 9 February 2022. The meeting was opened by the Chairperson Mr Claude Dykstra, who outlined the format and purpose and goals of the workshop.

2 Adoption of the Agenda and arrangements for the Workshop

2. The Workshop Agenda is provided at Appendix I. The documents provided to the WS001 are listed in Appendix II. The list of participants is provided at Appendix III.

3 Workshop Goals

3. The focus of this Workshop was to explore opportunities in terminal gear modification and catch protection – an area previously identified as having the highest likelihood of ‘breaking the reward cycle’ in depredation. Rather than develop a new fishing gear or method, the goal was to generate ideas for the creation of additional low cost, easy to adopt gear modifications, to securely retain demersal longline catch of flatfish (e.g., Pacific halibut (*Hippoglossus stenolepis*) or Greenland turbot (*Reinhardtius hippoglossoides*)): essentially some additional tools for the fishermen’s toolbox.

4 Workshop Presentations

4. The Workshop received three invited presentations from the groups outlined below, each followed by a QA session.

5. The first presentation was provided by Linn Solveig Sørvik and Ingunn Elise Sørvik of Sago Solutions from Norway. They presented on their development of the Sago Extreme, a patented solution for longlines to secure catch (under water fish removal and transport shuttle) near the seabed.

   The device consists of a single large barrel shaped unit constructed of aluminum with stainless steel features that is threaded onto the groundline during setting (Figure 1). The device has a non-escape hatch door (prevents fish from swimming out after unhooking), a forward and a rear pulley (rear pulley with variable position feature which adjusts to optimal position for speed and angel of retrieval), groundline emergency exit feature (to mitigate groundline tangle issues), and holes for water flow and bycatch release (size could be customized to address fishery-specific bycatch reduction needs).

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 (from Sago Solutions presentation).

Rubber stoppers are affixed to the groundline prior to the next shuttle device being affixed to the gear, to aid in the retrieval of the unit. During hauling the device slides down the groundline via gravity, releasing hooked fish (in a manner similar to how fish are released (hook stripped) in fisheries using such devices) into the protection of the shuttle itself, and is brought up to the surface upon encountering a stopper fixed to the groundline, thereby protecting the catch from depredation on its trip to the surface. At the surface the device is hauled aboard via a crane, and emptied on the deck, before the device is stowed on a storage shelf.

Current devices are specifically designed for the Patagonia toothfish (*Dissostichus eleginoides*) fishery and individual units weigh approximately 130 kg (286 lb), having a capacity of 1.5 m^3 (52 ft^3) capable of hauling up to 2,000 kg (~4,400 lb) although they recommend using more units to reduce volume of catch to optimize speed of unloading. A company video of the mode of action of the unit can be located here [Sago Solutions | Sago Extreme | Catch Optimisation].

Sago Solutions highlighted several of their many testing efforts on the Sago Extreme. Early iterations of the device were tested on a 21.3 m (66 feet) autoline vessel on Atlantic halibut north of Norway. Twenty-one longline sets utilizing 9mm (11/32 inch) groundline with hooks (Hook E213) spaced at 1.3 m (4.3 feet) were fished in the presence of whales. This test was considered a partial success in that only the larger halibut where successfully unhooked and secured, while smaller halibut stayed on the hook passing through the device and were still susceptible to depredation. Underwater footage of the dynamics (release of fish, escape of small fish and bycatch) of the device was limited by the depth and waterproof constraints of the camera equipment.

More extensive studies have been done aboard a custom made autoline vessel (72 m (236 feet)) especially designed for ease of use of the Sago Extreme, and with a 12 m indoor setting and hauling “combi pool” to aid in safe deployment and retrieval of the gear and the device. This vessel conducted pilot work with 25 devices on trips out of Uruguay. The vessel has specific storage for the units, slides to launch the devices, and appropriate cranes for hauling filled devices back aboard the vessel. This testing has been successful with 90% of toothfish catch coming from gear with the devices employed.

Benefits:

- Straightforward deployment.
- Catch recovered unharmed from whale depredation.
- No physical or acoustic risk to depredators.
- Easy to empty design (return to hauling after 2 minutes to empty the device).

Challenges (not all of these are relevant to all fisheries, and units can be modified to address many):

- Large size and weight can create transportation and storage challenges.
- Initial cost is high (approx. $10,000 per prototype).
- Likely need 2-10 units per vessel depending on the amount of gear and vessel fishing behaviour.
- Appropriate crane device and stability and safety constraints need to be considered.
- Processes and facilities for bringing aboard, moving around, and stowing device need to be planned out.
- Devices are not currently stackable or collapsible.
- Possibly not a legal gear in the US/Canada due to automated hook stripping.
- Unclear level of damage (if any) to catch that might be released.
- Does not protect catch against depredation occurring before hauling while the gear is on the seafloor.

Potential modifications:

- Customization of the device to optimize flatfish fisheries.
    - Entry design, escape design, hook removal method.

- Modify design for stacking or collapsibility for ease of stowage and transport.
- Reduced size for deployment on smaller vessels.
- Ability to deploy on the gear during hauling if/when depredation occurs, rather than during gear deployment.
- Consider a different hook type (tensile strength) to mitigate damage to fish being forcibly removed from hook. Current hook strength is intended both for capture of the fish, and to retain it on the gear as it transits to the surface. A more pliable hook material may be suitable for the capture function alone if the animal is brought to the surface within the device, possibly reducing any damage to the fish during the dehooking process.
- Modification of the hook stripper device to twist the hook out of the mouth to minimize facial damage of fish that may be subject to regulatory discarding; or having the gangion unsnapped and leaving the hook in the fish to be removed at the surface as per current operations.
- Considerations to minimize damage to catch from fish with spines.

Sago Solutions is interested in expanding design and testing in other fisheries through collaborative efforts. Testing should include, if possible, underwater video of the device in action, including both fish entering and exiting the device (target and bycatch), as well as recording the extent of damage (if any) to the catch, and quantification of sizes and numbers of fish both with and without a device.

6. The second presentation included multiple devices developed and tested by researchers from France. Paul Tixier, Njaratiana Rabearisoa, and Pascal Bach presented on behalf of the French National Institute for Sustainable Development (IRD) – Marine Biodiversity, Exploitation, and Conservation Unit (MARBEC), University of Montpellier – CNRS-INFREMER-IRD. Tanguy Moreau (and Christophe Guinet – not present) presented on behalf of the French National Centre for Scientific Research, Centre d'Etudes Biologiques de Chisé.

   Paul Tixier provided an introduction to depredation challenges in seven southern toothfish fishery areas and efforts to use different shrouding devices to protect the catch on longlines. Both orca and sperm whales are involved in depredation in these fisheries. Fisheries in the area generally use one of two longline systems: 1) autoline – hooks attached to a main groundline via small branchlines or gangions 2) trotlines – which have a cluster of hooks coming off each branchline. Three (southern Chile, SW Atlantic, and Prince Edward/Marion Islands south of South Africa) of the seven fisheries have shifted from using autolines to using trotlines in combination with an 'umbrella' fish protection device known as a cachalotera (Chilean invention), consisting of a cone shaped net sleeve situated above the branchline, which slides down over the catch during the hauling phase (Figure 2). There appears to still be a large amount of depredation by whales in fisheries using cachaloteras, however a lack of experimental or detailed catch data makes it difficult to resolve performance differences between sets with and without cachaloteras. Referenced works from this presentation can be found in [Appendix IV](#)

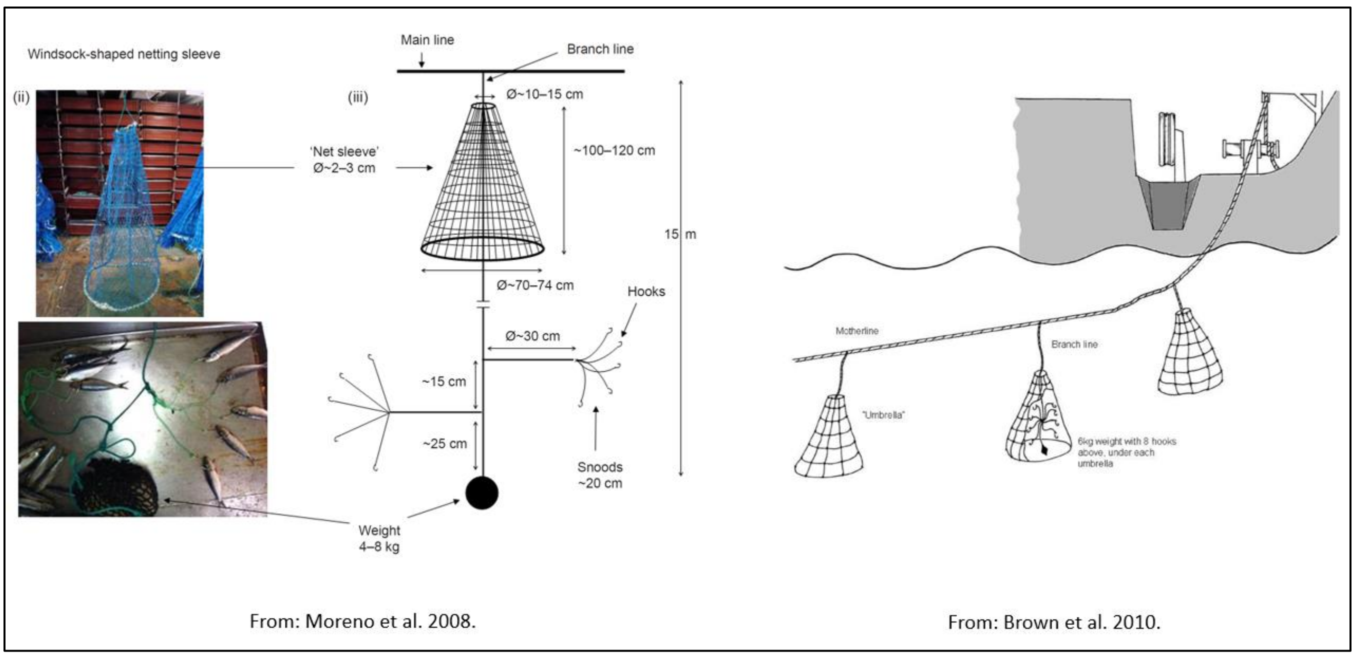


Figure 2. Schematic depictions of basic cachalotera design and retrieval dynamics.

Tanguy Moreau presented information from a larger project titled OrcaDepred (Home - OrcaDepred (cnrs.fr)). The OrcaDepred program had four main goals:

1. Study feeding behaviour and interaction with fisheries.
2. Evaluate the socio-economic consequences of depredation.
3. Study the practices and characteristics that influence cetacean and vessel interactions.
4. Technological approaches to eliminate depredation (Development of mitigation systems).

The presentation focused on a project focused on the last goal, utilizing filaments or 'spider-like' – umbrella shrouding devices (Figure 3) to mitigate depredation by orca whales in a vertical longline fishery for Blue-eye Trevalla (*Hyperoglyphe antarctica*) off Saint Paul and Amsterdam Islands in the Southern Indian Ocean. The project focused on a single vessel fishery using vertical longlines, each with 100 hooks, in an area with a high likelihood of interactions with toothed whales. Two factors were investigated: a) four 75cm rigid non-buoyant plastic filaments and b) shorter snoods (gangions). The expectation was that the filaments would reduce catch palatability and ease of biting (visual and physical deterrent effects) to the depredator. Paired experimental sets (52 sets with the spider filaments and 51 sets without) resulted in a 55% decrease in target catch, and a 56% reduction in depredation. When comparing shorter snoods (37 test treatments and 66 control) there was no effect on catch rates (i.e., catch rates were maintained) in the absence of toothed whales, and a 68% reduction in depredation in the presence of toothed whales. Combining the short snoods with the spider umbrellas resulted in no depredation by whales. Future work will focus on an enhanced umbrella device with positively buoyant filaments, which will drop down during hauling to protect the catch, with the hope that having the filaments out of the way will prevent reductions in target fishery yield. Additionally, combining floating filaments with shortened snoods may further mitigate depredation in future designs.

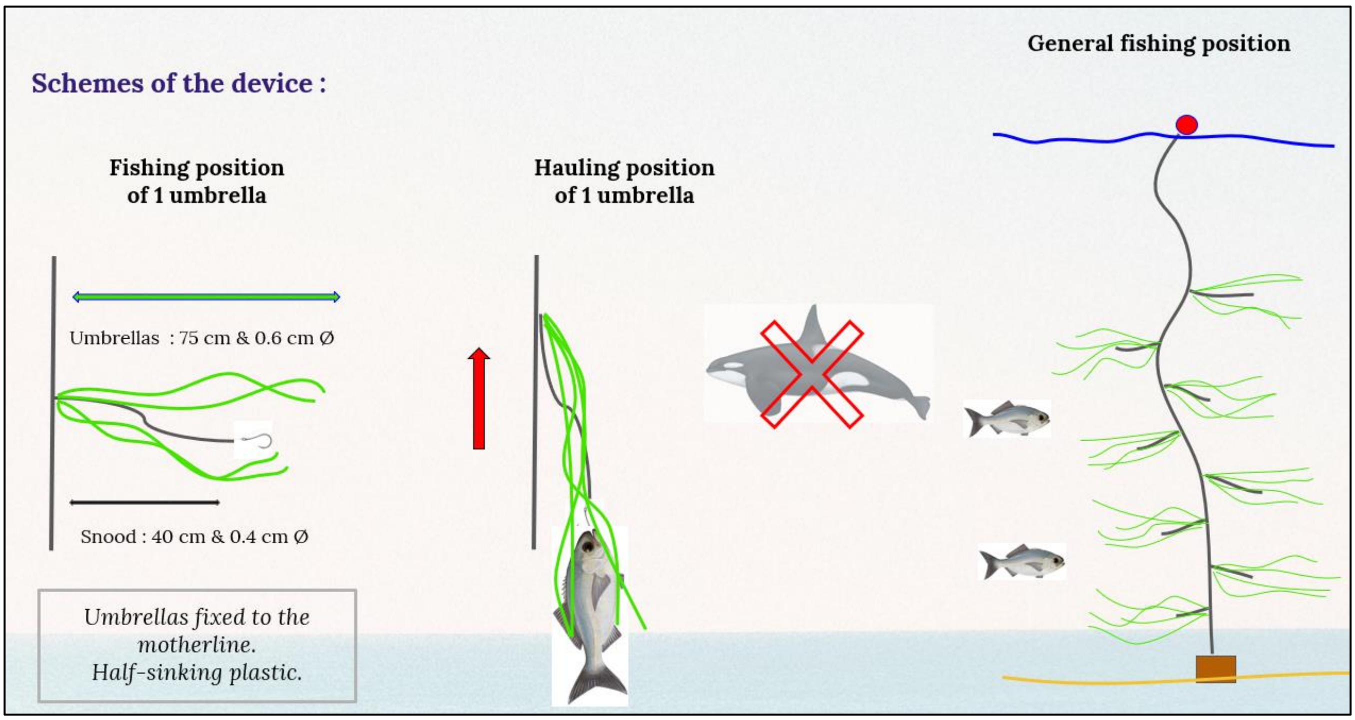
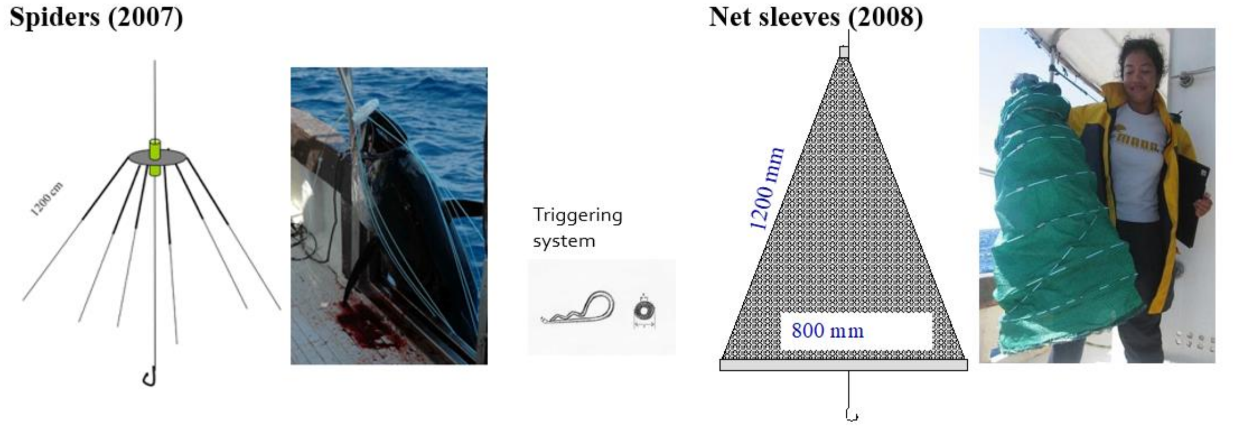


Figure 3. Umbrella style-shrouding device tested in Blue-eye Trevalla fishery (from T. Moreau presentation).

Njaratiana Rabearisoa presented information from a project entitled Paradep (Paradep Home - PARADEP - A depredation mitigation device for pelagic longline fisheries). This work is focused on mitigating depredation from swordfish (*Xiphias gladius*) and tuna (*Thunnus spp.*) midwater longline fisheries near the Reunion Islands that are subject to depredation by both sharks and toothed whales. These pelagic longlines range from 10-180 km (5-97 nmi) in length with 100-3,500 hooks and are set between 50 m and 500 m (27-273 fm) deep. This fishery has a need to protect fish as soon as they are hooked and through the hauling process. Observations suggest that entangled fish are less likely to be depredated (something seen in N. Pacific fisheries as well). The Paradep design approach is predicated on the principle that a tangle simulating device may deter toothed whales.

Early iterations: Beginning in 2007, experiments were initiated employing 8 polyester strands (spider device) with a triggering system, and in 2008 utilizing a net sleeve (sock) with a triggering system (fish pulling on a branch line triggers the net sleeve to drop down) as illustrated in Figure 4.



Deterrent device made up of 8 polyester strands covering the fish and a triggering system

Fiberglass mosquito netting device hiding the fish, equipped with metallic or plastic hoops and a triggering system

Figure 4. Early iterations of spider and net sleeve devices (from N. Rabearisoa presentation).

The spider devices provided good coverage of the catch but were not effective against depredation, likely because the fish are not protected when the branchline is hauled horizontally making the catch susceptible to depredation. Net sleeves did not provide good coverage of the catch, didn’t encounter marine mammal depredation, and where largely ruined by interactions with sharks.

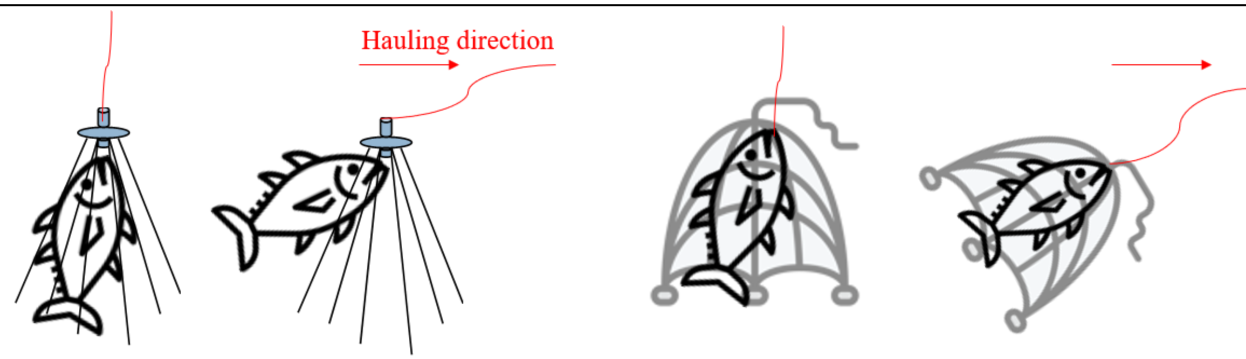
Benefits:

- Operationally user friendly deployment and retrieval.
- No deployment issues.
- Positive effects on catch rates.

Challenges:

- Entanglement with lines.
- Require reduced hauling speed.
- Bulky storage.
- Extra crewman required to handle the device.

The Paradep project looks to further develop this work, using protective netting/veil which sticks to the fish upon capture (Figure 5).



Spiders: the captured fish is not protected when the branchline is being hauled and can be depredated

PARADEP: the net sticks to the captured fish, simulating a tangled device, during the soaking and when the branchline is being hauled

Figure 5. Spider devices are not effective during hauling, whereas the new Paradep design relies on thin netting to stick on the fish after capture and throughout the hauling event. (from N. Rabearisoa presentation).

The netting is contained within a small case attached to the gangion/branchline during deployment, fish capture triggers the release of the netting from the case, the netting drifts down over the catch and sticks to it (Paradep video). The netting then acts as a physical barrier (non-palatable), visual barrier (hides or cloaks the catch), and passive acoustic barrier (altering the acoustic signature of the catch) reducing depredation. A variety of case designs (increasingly smaller, different release mechanisms), veil materials (linen, high density polyethylene (HDPE), etc.) and veil deployment methods (rectangular vs circular weighted carbineers, edge weights) have been tested to create a small, easy to reuse, form factor for the case and the netting. Testing has been conducted via SCUBA along with video to better understand the performance of the devices. New versions looking to balance the trade-off in volume (case and netting), coverage (netting volume) and netting material (nylon, polyester) characteristics of the device are being tested in real world fishery conditions off the Reunion Islands in 2022. This testing will assess catch protection, effect on catch rate, ease of use during setting/hauling, operational issues (e.g., entanglement, premature triggering, sink rate) and costs in terms of money, time, labor, and storage.

Benefits:

- Catch protection upon hooking and throughout haul.
- No physical or acoustic risk to depredators.
- Can be used with any type of hook and line fishery.
- Ease of deployment and no untimely triggering during hauling activity.

Challenges:

- Size and weight of the device needed at each gangion.
- Durability of the netting.
- Coverage level of protection (# of units required to effectively deter interest from depredators).
- Time budget to set all units (albeit if it allows the vessel to continue fishing, it may ultimately prove worthwhile).

7. The third presentation was provided by Alexander Stubbs of Fish Tech Inc. from the United States of America. Alexander's company manufactures a collapsible fish trap or 'pot' commonly known as a 'slinky pot' and marketed under the CodCoil brand, which has seen large increase in use in many non-flatfish hook and line fisheries as a means of avoiding depredation (i.e., sablefish (*Anaplopoma fimbria*) fisheries off the western coasts of North America). The inclusion of this presentation was to compare the underlying spring coil technology central to this products' design with other devices and to see if there were commonalities that might transfer over to the underwater transport and shrouding concepts provided in the two prior presentations or otherwise.

   Slinky pots are comprised of a helical coil spring, covered with rugged HDPE webbing, containing stainless steel entrance rings (typically 22 cm (9 in)) diameter, but any size and shape entrance can be used) sewn into each end of the trap (Figure 6). The ends can be opened to remove fish, and to manage the bait bag/canister. Escape rings can be sewn into the sides dependent on the fishery to allow undersize target fish and bycatch to escape. The pots are clipped to a main groundline (typically 3/8" (9 mm) for 20 pots, and 9/16" - ½" (13 mm) for 100 pots) via bridle and clip attachments at both ends of the pot. Pots can be made in any size, but currently are typically 68 cm x 127 cm (27 in x 50 in) weighing 6 kg (13 lb) fully rigged; or 81 cm x 152 cm (32 in x 60 in) weighing 11 kg (25 lb) fully rigged. The pots are stowed in a collapsed form and can be loaded and launched via aluminum launcher shelves (can hold 60-100 traps). Sash weights are clipped between pots as dictated by currents and depth, but generally weights are only needed every 5 or 10 pots.

A)  B) 

Figure 6. CodCoil slinky pots in collapsed storage format (A) and expanded fishable format (B). From A. Stubbs presentation.

   Design modifications to avoid ghost fishing for lost pots could include panels that are held in place with weaker quick rot cotton threading. Slinky pots provide a lightweight, safe, and affordable alternative for vessels currently rigged for longline fishing for species that enter pots readily. Compared to traditional heavy pots, slinky pots do not appreciably add to vessel stability concerns, nor do they require investment in higher capacity cranes and pullies. Catch rates for slinky pots in the sablefish fishery are high with minimal reported bycatch and no depredation, and therefore there has been a rapid increase in the use of this gear type in the heavily depredated sablefish fishery.

   Performance and catch rates of flatfish in slinky pots are poorly understood, and there are currently no reports of targeted flatfish fishing. Traditional pot designs do not capture flatfish efficiently compared to hook and line, however a lightweight alternative that could be used during heavy depredation events could be of interest.

A short video of Russian fishermen using a rigid steel device, similar to the umbrella design but apparently much heavier was presented (Figure 7). Catch-rates for this device are unknown, but it provided an illustration of the convergence in approaches (physical protection of catch) being explored in yet another demersal longline fishery.

Figure 7. Steel protection frame being used in a Russian fishery (from A. Stubbs presentation).

Benefits:

- Compact and light weight.
- Economical.
- Easy to adapt for small hook and line vessels.
- No physical or acoustic risk to depredators.
- No new hauling equipment investments.

Challenges:

- Not efficient at capturing flatfish under current design.
- Unknown if design modifications will allow for meaningful flatfish catch rates.
- A different fishing technique requiring new expertise and gear.

Potential modifications of the underlying spring coil technology that could be applied to hook and line captured fish might include:

- An open-ended covered coil frame with fishing hooks on the interior
- An open-ended covered coil frame with fishing hooks on the outside, and the open-ended frame slides over during haul back (analogous to the umbrella design).
- A collapsed covered coil frame that is triggered by the capture or hauling event to cover a fish or branch line with multiple fish (analogous to the umbrella design).

5 BRAINSTORMING SESSION

8. After the presentations the Workshop moved into a general brainstorming session, guided with several question prompts to get things moving. Participants were encouraged to explore ideas not constrained by current fishing regulations, fishing conditions, nor to restrict their thinking to the devices presented. Several questions were provided to encourage and stimulate participation, ranging from safety aspects that must be considered, ideas tried and failed, ideas that participants have conceived but not tried.

   Some general concepts and ideas emerging from the discussion are highlighted below:

- A device that that can be deployed during hauling, as needed when whales are present, rather than during the setting process. Currently the SAGO design requires units to be set out with the gear, but with modifications it might be possible to clip onto the gear and descend it during hauling operations.
- Slinky pot / SAGO hybrid: lighter, more stowable, and easier to manoeuvre on small vessels. This may require alternative material and design considerations. Something that is collapsible or modular on a space constrained vessel, and that is lighter and easier to haul with equipment found on smaller HL vessels. Aluminum is most appropriate for the toothfish fishery as it is rugged, corrosion resistant, and relatively light weight, and yet has sufficient weight to slide down the mainline (groundline) by force of gravity during hauling.
- Concerns were noted regarding damage to discarded catch (not a consideration in the toothfish fishery) from the underwater unhooking of fish via a *de facto* hook stripper. Suggestion to avoid this might include softer hooks (do not need the strength to retain the fish to the surface), a device to unclip the snap from the groundline with the fish then being unhooked carefully by hand at the surface). Another suggestion focused on using technology to view the type of catch before it enters the shuttle, allowing for pre-emptive unhooking/unclipping of fish prior to entering the shuttle. Yet another solution to this issue would be full retention of all captured fish.
- Slinky pot / cachalotera hybrid. Incorporating the coil into a device that shrouds fish or group of fish. The device could be triggered acoustically by the vessel (if the tech has the communication range and depth capability for the species being targeted), galvanically after a certain soak duration, or mechanically during hauling.
- General discussions about the advancement of automated hydroacoustic devices that listen for the sounds of depredating whales. Currently well developed for sperm whale depredation and spatial notification networks for fishers. Could that be used as a means for triggering catch protection devices on gear currently deployed? Could satellite infrared heat imagery be used to further provide vessels with spatial knowledge of whale presence/activity?
- General discussions pertaining to the need for good documentation of both the current scale of the problem, documentation of things that were tried and failed, and features of current tools currently being marketed. Sharing of experience across groups, through better documentation and through workshops like this one would be beneficial to all who are working on the challenge of depredation. Additionally, researchers indicated the importance of freedom to pivot on design parameters when they note something isn't working, to a different design plan, particularly when piloting gear, and when permits can be very limiting in their scope of work.
- Elements for documentation include costs (monetary for the device, time to set and haul, crew needs, stowage space needs), safety profiles, catch recovery (catch protection in comparison to without the protection, effects on catch rates for target and bycatch species, effects on size profiles of target and bycatch), discard condition (are discardable fish damaged more or less than the normal catch technique would impart). The discussion also acknowledged alternative approaches beyond catch protection (e.g., alternative gear such as cod coil pots, avoidance, and deterrence methods such as SaveWave Orca Saver). It is important to document failures and successes across all avenues for depredation reduction to propel the effort forward.

6 NEXT STEPS

9. Several presenters indicated a willingness to work with the organizing team to help prepare protype gear for testing under the funding elements of this project. Those ideas will be developed over the next several months with a goal of conducting some basic pilot studies of two or more promising devices in the 2022 field season.

10. Outreach to professionals tasked with managing marine mammals will be made to update them of the results of the Workshop, and the pilot plans moving forward.
11. Many participants expressed interest in additional workshops in the future. Funding sources and/or IPHC sponsorship for this will be investigated.
12. Acknowledgement and appreciation are of note to the funding support for this initiative by the IPHC and to the National Oceanic and Atmospheric Administration (NOAA)'s Bycatch Research and Engineering Program (BREP) funding (Grant NA21NMF4720534). The workshop would also like to acknowledge the collaborating support of partners: Kenny Down (industry representative and NPFMC member), James Johnson (Executive Director - Deep Sea Fishermen's Union), and Dr. Noëlle Yochum of NOAA Alaska Fisheries Science Center (AFSC).

APPENDIX I

AGENDA FOR THE 1ST INTERNATIONAL WORKSHOP ON PROTECTING FISHERY CATCHES FROM WHALE DEPREDATION (WS001)

Date: 9 February 2022
Location: Electronic
Venue: Adobe Connect
Time (PST): 9 February 09:00-12:00
Chairperson: Mr Claude Dykstra
Vice-Chairperson: Dr Ian Stewart

1. **OPENING OF THE SESSION** (Chairperson and Vice-Chairperson)

2. **CATCH PROTECTION DEVICE REVIEWS**
- 2.1 Underwater Removal and Transport Shuttle (Sago – Norway)
- 2.2 Shrouding Devices (Paradep (mid-water) and Umbrellas (deep-water) – France)
- 2.3 Spring Coil Technologies (Cod Coil – USA)

3. **BRAINSTORMING** (Chairperson and Vice-Chairperson)

4. **CONCLUSIONS** (Chairperson)

APPENDIX II
LIST OF DOCUMENTS FOR THE 1ST INTERNATIONAL WORKSHOP ON PROTECTING FISHERY CATCHES FROM WHALE DEPREDATION (WS001)

Document	Title	Availability
IPHC-2021-WS001-01	Agenda &Schedule of the 1st International Workshop on Protecting Fishery Catches from Whale Depredation (WS001)	✓ 1 Feb 2022
IPHC-2021-WS001-02	1st International Workshop on Protecting Fishery Catches from Whale Depredation (WS001) Introductory Video	✓ 3 Feb 2022

APPENDIX III
LIST OF PARTICIPANTS FOR THE 1ST INTERNATIONAL WORKSHOP ON PROTECTING FISHERY CATCHES FROM WHALE DEPREDATION (WS001)

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Mr Claude Dykstra	Dr Ian Stewart

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APPENDIX IV

SELECTED REFERENCES FOR THE 1ST INTERNATIONAL WORKSHOP ON PROTECTING FISHERY CATCHES FROM WHALE DEPREDATION (WS001)

Arangio, R. (2012). Minimising whale depredation on longline fishing. Nuffield Australia Project 1201. 43 p.

Brown, J., Brickle, P., Hearne, S., & French, G. (2010). An experimental investigation of the 'umbrella'and 'Spanish'system of longline fishing for the Patagonian toothfish in the Falkland Islands: Implications for stock assessment and seabird by-catch. Fisheries Research, 106(3), 404-412.

Moreno, C.A., Castro, R., Mujica, L.J., and Reyes, P. (2008). Significant conservation benefits obtained from the use of a new fishing gear in the Chilean Patagonian toothfish fishery. CCAMLR Science 15: 79-91.

O'Connell, V., Straley, J., Liddle, J., Wild, L., Behnken, L., Falvey, D., and Thode, A. (2015). Testing a passive deterrent on longlines to reduce sperm whale depredation in the Gulf of Alaska. ICES Journal of Marine Science. 72(5) 1667-1672. doi.10.1093/icesjms/fsv014

Rabearisoa N, Bach P, Tixier P, and Guinet C. (2012). Pelagic longline fishing trials to shape a mitigation device of the depredation by toothed whales. J Exp Mar Biol Ecol 432–433:55–63.

Rabearisoa N, Sabarros PS, Romanov EV, Lucas V, and Bach P. (2018) Toothed whale and shark depredation indicators: A case study from the Reunion Island and Seychelles pelagic longline fisheries. Plos One (2018) 13:e0202037.

Tixier, P., Burch, P., Richard, G., Olsson, K., Welsford, D., Lea, M.A., Hindell, M.A., Guinet, C., Janc, A., Gasco, N., Duhamel, G., Villanueva, M.Ch., Suberg, L., Arangio, R., Söffker, M., and Arnould, J.P.Y. (2019). Commercial fishing patterns influence odontocete whale – longline interactions in the Southern Ocean. Scientific Reports 9: 1904 (1-11). https://www.nature.com/articles/s41598-018-36389-x

Tixier, P., Lea, M.A., Hindell, M.A., Welsford, D., Mazé, C., Gourget, S., and Arnould, J.P.Y. (2020). When large marine predators feed on fisheries catches: Global patterns of the depredation conflict and directions for coexistence. Fish and Fisheries. 2020;00:1-23

Tixier, P., Burch, P., Massiot-Granier, F., Ziegler, P., Welsford, D., Lea, M.A., Hindell, M.A., Guinet, C., Wotherspon, S., Gasco, N., Péron, C., Duhamel, G., Arangio, R., Tascheri, R., Somhlaba, S., and Arnould, J.P.Y. (2020). Assessing the impact of toothed whale depredation on socio-ecosystems and fishery management in wide-ranging subantarctic fisheries. Reviews in Fish Biology and Fisheries. 30:203-217. https://doi.org/10.1007/s11160-020-09597-w

Werner, T.B., Northridge, S., Mclellan Press, K., and Young, N. (2015). Mitigating bycatch and depredation of marine mammals in longline fisheries. ICES Journal of Marine Science. 72(5):1576-1586. doi.10.1093/icesjms/fsv092