NORTHWEST STRAITS
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Preventing the Loss of Gillnets in Puget Sound Salmon Fisheries

Prepared for

NOAA Protected Resources Division

Prepared by

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SUMMARY

The 2010 federal listing of three rockfish species in Puget Sound under the Endangered Species Act (ESA) was the impetus for this project. Under the subsequent NOAA review in the Biological Opinion (BiOp) accompanying the 4(d) evaluation of the Puget Sound Chinook harvest plan, the ESA and derelict fishing gear were explicitly linked. The impacts of derelict fishing gear on Puget Sound marine habitats have been documented (Good et al., 2010), and the agency is required to make every effort to reduce the loss of gear, and to encourage recovery of gear that is lost. The informal approach used to gather information presented in this report - through personal interviews, email, and an anonymous online survey - proved an appropriate means of soliciting input from commercial fishermen and fishing gear experts, given the sensitive nature of the issue. The overarching goal of this work is to help ensure that salmon fisheries in Puget Sound are sustainable.

INTRODUCTON

This report is the result of a cooperative effort between the Northwest Straits Marine Conservation Initiative (Northwest Straits Initiative) and the Northwest Indian Fisheries Commission (NWIFC), in consultation with NOAA[1], commercial fishermen in Puget Sound, and Natural Resources Consultants (NRC). The primary goals of the project were to: 1) evaluate best practices to prevent the loss of commercial gillnets in marine waters of Puget Sound; and 2) evaluate systems and technologies to improve tracking of derelict nets and enable their quick retrieval.

It is estimated that 16-45 nets are lost annually in the Puget Sound salmon drift gillnet fisheries, dependent on the level of fishery participation in a given year (Table 1). Derelict nets from the purse seine and set-gillnet fisheries have also been identified and removed through the Northwest Straits Initiative derelict gear program, however there are currently no loss rate estimates for these gear types.

For the purposes of this document, the term ‘ net’ refers to portions of any component of net gear (webbing, leadline, corkline, or any combination thereof); and does not necessarily infer a full or complete net. The majority of derelict nets found in Puget Sound marine waters are from gillnet fisheries (Good et al. 2010), and consist of a combination of leadline and webbing, where length

[1] In 2011 NMFS reviewed the Puget Sound Chinook harvest plan (under limit 6 of the PS Chinook 4(d) rule). The harvest plan is developed by the Washington State Department of Fish and Wildlife and Puget Sound Tribes. NMFS has identified derelict nets as an indirect effect of the fisheries considered in the harvest plan.

and depth are usually a fraction of the full extent of the net. Surveys to quantify these losses have been conducted using sidescan sonar, drop camera and divers.

Table 1. Yearly totals of drift gillnet participants and the estimated number of lost net portions at 3% and 5%. Data source: WDFW Fish Ticket Database (NRC).

		Estimated Lost Nets	
YEAR	*Number of Gillnet Fishernen Producing Fish Tickets	Low (3%)	High (5%)
2003	565	17	28
2004	623	19	31
2005	530	16	27
2006	678	20	34
2007	669	20	33
2008	831	25	42
2009	678	20	34
2010	894	27	45
2011	787	24	39

**Actual number of participants is estimated as the number of non-Treaty vessels and Treaty individuals generating salmon gillnet fish tickets; this is considered the best method of estimating fleet size between sectors.*

Net fishing effort has been correlated with salmon catch, and – with some exceptions - effort also appears to correlate with net loss. Gillnets are lost more frequently in areas with obstructions that can entangle nets, proximity of effort to shore, areas of high and variable currents and areas subject to changes in wind and wave direction.

While derelict nets have been documented in some of the rivers systems in the Puget Sound Basin, this project focused on gillnets in Puget Sound marine waters as defined by the outer boundaries of Puget Sound Salmon Management and Catch Reporting Areas (SMCRA) (WAC 220-22-030). The project addresses the Terms and Conditions 2(c) in the 2011 Biological Opinion, "Derelict Gear Prevention: The Bureau of Indian Affairs (BIA), U.S. Fish and Wildlife Service (USFWS), and National Marine Fisheries Service (NMFS), in collaboration with the state and tribes, shall continue to conduct outreach and evaluate technologies and practices to prevent the loss of commercial fishing nets, and systems to track nets upon their loss, to better aid their retrieval and other measure(s) necessary to prevent and track lost gear".

Monofilament gillnets in Puget Sound are used primarily in salmon fisheries, and also in herring fisheries. The monofilament line is of variable mesh size depending upon the target species. In the non-tribal salmon fishery, buoys at the ends of the net must be labeled for ownership

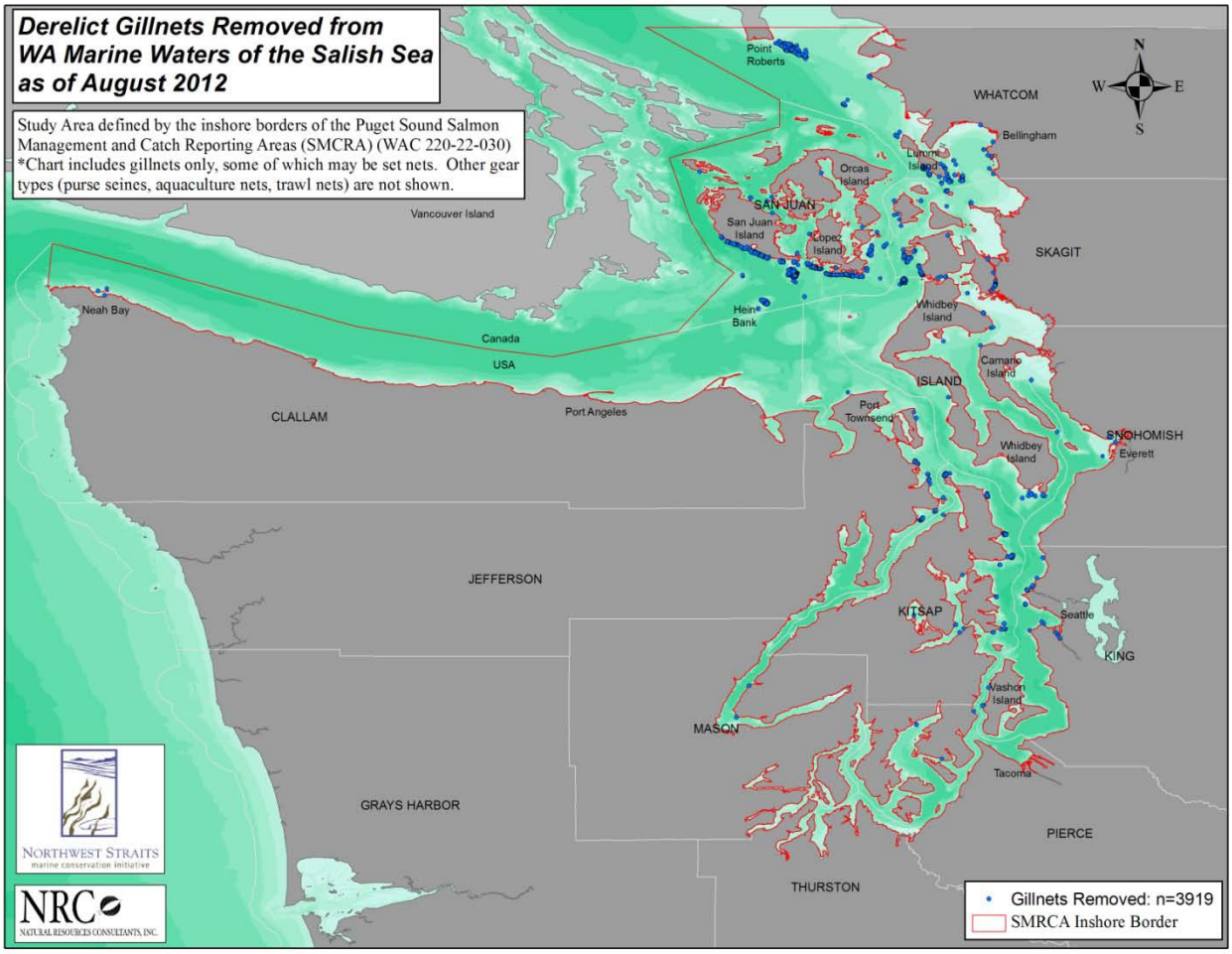

Figure 1. Derelict gillnets removed from WA marine waters of the Salish Sea, as f August 2012.

(WDFW 2003). Per Washington state law, non-treaty drift gillnets cannot exceed 1,800 feet in length, with no restriction on net depth. These nets are commonly up to 100 ft deep; some have been reported approaching 200 ft deep. Set nets used in tribal fisheries are 25-30 ft deep, and skiff gillnet fisheries – operating in a few specific locations – are limited to a net length of 600 feet, and a maximum depth of 90 meshes (WAC 220-47-302).

Derelict nets can entangle and kill rockfish (Good et al., 2010) and alter their habitats. Most nets hang on bottom structure that is also attractive to rockfish. This structure consists of high-relief rocky substrates or boulders located on sand, mud or gravel bottoms (Good et al., 2010). The combination of complex structure and currents tends to stretch derelict nets open and suspend them within the water column, in turn making them more deadly for marine biota (Akiyama et al., 2007; Good et al., 2010). Derelict nets also alter habitat suitability, by trapping fine sediments out of the water column. This makes a layer of soft sediment over rocky areas, changing habitat quality and suitability for benthic organisms (Good et al., 2010). Nets can cover habitats used by rockfish for shelter and pursuit of food, rendering the habitat unavailable; and can reduce the abundance and availability of rockfish prey that include invertebrates and fish (Good et al., 2010).

Derelict fishing nets are among several factors that affect rockfish populations in the Puget Sound. Other stressors include historic fishery removal, bycatch in contemporary bottom fish and salmon fisheries, habitat disruption from invasive species and nearshore degradation, hypoxia, bioaccumulative toxins and potential food web interactions (Palsson et al., 2009, Williams et al., 2010).

This project was designed to generate practical recommendations from tribal and non-tribal fishermen, fisheries managers and other experts, focusing on the following questions:

- What recommendation(s) do you have to reduce the likelihood of losing gear when gillnetting in Puget Sound?

- Can you think of potential modifications to gillnets used in Puget Sound that would reduce the likelihood of losing gear?

- In the event that a gillnet snags or is lost, are there technologies or gear modifications that could improve tracking in order to enable quick retrieval?

We hope that our methodology and findings catalyze further discussion among the fishing industry around the prevention and tracking of lost gear.

BACKGROUND AND JUSTIFICATION

New legislation passed in 2012 (SB 5661) mandated the reporting of lost gear to the Washington Department of Fish and Wildlife (WDFW) within twenty four hours of the loss. Commercial net fishermen must report lost net fishing gear by telephone (1-855-542-3935) or online (http://www.derelictgear.org/reportgear.aspx); and tribal fishermen must participate in the same reporting system through tribal fisheries co-managers. This legislation builds on law passed a decade earlier (SB 6313), establishing the Derelict Fishing Gear removal Program, and mandating that WDFW submit a report[2] on ways to prevent derelict fishing gear.

Derelict fishing nets were linked to the ESA for the first time as a result of the NOAA review of the joint Resource Management Plan (RMP) for harvest of Puget Sound Chinook salmon, provided by the Puget Sound Treaty Tribes and WDFW. In 2011, terms and conditions for listed rockfish in the Biological Opinion included a technical evaluation of methods for reducing loss and improving recovery. It was determined that reducing loss of gillnet gear used in salmon fisheries would help to minimize adverse affects to the U.S. portions of the Puget Sound/Georgia Basin Distinct Population Segments (DPSs) of three species of rockfish: canary rockfish (*Sebastes pinniger*) and yelloweye rockfish (*Sebastes ruberrimus*), listed as threatened; and endangered boccaccio (*Sebastes paucispinis*). The agency also recognized that the prevention or reduction of newly lost nets would reduce the incidental entanglement of ESA-listed salmon, green sturgeon, marine mammals, and numerous non-listed marine biota, and minimize impacts to marine habitats particularly those associated with ESA- listed rockfish species.

[2] Reduction of Future Fishing Gear Losses, submitted to Washington State Legislature by WDFW in January 2003.

The NOAA contract awarded for this project stipulated "(1) evaluation of best practices, technologies or additional gear to prevent the loss of commercial salmon-fishing nets. Background work will include literature reviews and interviews of fishers and other experts regarding net fisheries within the Puget Sound and elsewhere (as applicable), (2) evaluate systems/technologies to track nets upon their loss to enable quick retrieval, and (3) summarize key findings within a report used to enable implementation of gear loss prevention measures by fishers."

The Northwest Straits Initiative was contracted based on its successful track record in derelict fishing gear removal, research and education efforts since 2001, in collaboration with state and federal agencies, tribes, local organizations, and fishermen. The Northwest Straits Initiative maintains an online, fax, and telephone no-fault reporting system, through which derelict gear removal teams are alerted for quick retrieval of newly lost nets.

The Northwest Indian Fisheries Commission (NWIFC) is a support service organization for 20 treaty Indian tribes in western Washington and was created following the U.S. v. Washington ruling (Boldt Decision) that re-affirmed the tribes' treaty-reserved fishing rights and established them as natural resources co-managers with the State of Washington. The role of the NWIFC is to provide technical and policy support to assist member tribes in their role as natural resources co-managers.

METHODS

In 2011, approximately 787 tribal and non-treaty fishermen participated in gillnet fisheries in Puget Sound (pers. comm. NRC and NWIFC staff). In order to expedite the process of gathering information for this project, we contacted individual fishermen and other experts familiar with ongoing derelict gear outreach and removal efforts, and invited their assistance in identifying people with relevant knowledge and expertise.

Direct contact was made with fifteen Washington state residents who hold decades of commercial fishing experience, and are currently engaged in the Puget Sound, Bristol Bay, and Cordova, Alaska salmon net fisheries; two marine supply companies, one local net maker, state and federal fishery managers, and fishing gear technology experts in Seattle, Bellingham, San Diego, New England, Canada, Australia, and Italy. A letter describing the project was sent to treaty fishermen and fisheries co-managers; followed by an email from NWIFC staff inviting response. Natural resources staff with Tulalip Tribes, Suquamish Tribe, Puyallup Tribe, Lummi Nation, Makah Nation, Swinomish Tribe, Lower Elwha Klallam Tribe, Jamestown S'Klallam, and Port Gamble S'Klallam Tribe provided useful input on derelict gear reporting processes.

It was determined that casual conversation by telephone, and dockside following initial introduction by telephone, was the most productive means of eliciting input from fishermen for this project. This process contributes to an established means of gathering Local Ecological Knowledge (LEK); a methodology in the field of ethnoecology that is accepted and used by NOAA Fisheries and many natural resources agencies. LEK can include knowledge of local distributions of fishes and habitats, ecological interactions, local fishing businesses, social

dynamics of fishing, fishing communities' territories of use, local economics and networks of regional economies of which communities are a part, and local fishing culture (Hall-Arber et al., 2002).

In cooperation with NOAA Fisheries staff, the Northwest Straits Initiative created a simple online survey for fishermen, with an option to provide personal contact information. During the period December 2011- June 2012, the following methods were used to collect and elucidate information on derelict net prevention and tracking:

- In-person and telephone conversations about the project with more than 50 individuals
- Letter from NOAA to Puget Sound treaty fishermen and fishery managers
- Online survey (Survey Monkey) open for 30 days
- Email correspondence with fishermen, fishery managers, and gear technology experts
- Literature review
- Web-based research
- Announcement to Alaska Independent Fishermen's Marketing Association Newsletter (many recipients of which fish in Puget Sound)
- Solicitation of ideas from tribal fishery management programs and individual fishery management biologists.

DERELICT NET PREVENTION EFFORTS IN OTHER REGIONS

Recent European and New England studies led by gear technology experts Petri Suuronen and Christopher Glass demonstrate that "There is concern about impacts of ghost fishing by lost and abandoned gillnets which may continue to fish for several weeks, months or even years, depending on their construction, the depth, and prevailing environmental conditions (Humborstad et al., 2003; Hareide et al., 2005; Brown and Macfadyen, 2007). This problem can be partially addressed by the use of biodegradable materials or other means to disable unattended gillnets (Matsushita et al., 2008). However, commercially viable solutions are few if any. Better results might be obtained by increasing efforts to avoid loss of gillnets, or by facilitating the quick recovery of lost nets. In some areas, gillnet fishing grounds are periodically "swept" for lost nets."

In the Maldives, the Seychelles, and other parts of the world, a variety of economic incentives to reduce the loss of nets are being explored. In Australia, an alliance of indigenous communities administers a government program which supports local Indigenous Rangers to remove monofilament nets from local beaches and nearshore waters; (pers. communication, Martin Hall).

In Virginia, unemployed fishermen were provided the equipment, procedural instructions and pay to successfully remove over 18,000 items of derelict fishing gear, most of it blue crab pots (Havens et al., 2011). In the Gulf of Maine, captains and crew in the lobster fishery were hired to retrieve derelict traps during the slow season of their fishery (Ludwig et al., 2011). However, these two examples required the use of grappling for removal, rather than divers, and therefore would not be allowed in Puget Sound.

In Bristol Bay, Alaska, actively fishing drift gillnet gear must have at each end (except the end attached to the vessel) a red keg, buoy or cluster of floats plainly and legibly marked with the permanent vessel license plate (Alaska Department of Fish and Game/ADF&G) number of the vessel operating the gear. Marking must be in permanent symbols at least four inches high with lines at least one-half inch wide, in a color that contrasts with the background and; at least one cork every 10 fathoms along the corkline that is plainly and legibly marked with the vessel license plate (ADF&G) number of the vessel operating the gear[3]. Additionally, a permit holder fishing in the Bristol Bay Area must report the loss of a gillnet, or portion of a gillnet, to the local department office in Dillingham or King Salmon within 15 hours of the loss of the gillnet, or portion of the gillnet. This report must be made directly to a local representative of the department in person or by radio or telephone[4].

SOLICITED INPUT/ FEEDBACK

The information hereby outlined is intended to be practical and applicable to gillnet fisheries in Puget Sound, and to the extent possible was generated by commercial fishermen. We outlined three general categories of recommendations in support for gear prevention/retrieval. The first consists of actions that could be implemented without gear modifications or major changes to fisheries practices. The second category contains elements that may require gear modifications, and/ or education or materials in order to implement. The third category consists of methods that would require additional gear modifications and applied field research prior to implementation.

Category 1: Does not require significant change to existing practices
Provide local bathymetry information to fishermen on areas of highest accumulation, easily available to sectors of the fleet lacking electronics on board.
Produce a comprehensive best practices guide for newcomers to the fishery. Make it widely available through port offices and fishing gear supply stores in Bellingham, Anacortes, Seattle, Friday Harbor and elsewhere. Include information on known 'hotspots' for snagging gillnet gear, tips for hauling gear that tangles or snags, and basic mechanical and gear maintenance toward minimizing the likelihood of getting hung up.

[3] A few individuals have stated that this cork-ID is also required in Puget Sound, however no supporting documentation was found for this report. Few end buoys or corks have been found in derelict gear removal operations by the Northwest Straits Initiative, so current methods of net identification in Puget Sound do not aid derelict gear recovery.

[3] Similar to the legislation implemented in Washington state on July 1, 2012 (SB 5661)

Category 1: Does not require significant change to existing practices (continued)
Understand the tidal fluctuation and current patterns prior to setting gear—anticipate the drift and location where you will haul in the gear.
Know the topography of the area before fishing; Use a Global Positioning System (GPS) to avoid areas of complex bathymetry.
In the event of a snag on the bottom, wait out the tide if possible. Be patient, haul the tangled gear only on a slack tide and begin haul from the opposite end as set.
Attend to the gear. This will reduce the chances of pleasure craft or drift logs fouling gear, and currents moving gear to areas with potential snags.
Avoid reef edges, rocky shorelines, and rock piles unless you really know what you're doing. An experienced fisherman can find sets against the shore, but knows to haul as soon as the tide starts running.
Provide free, annual two-hour training on 'trade secrets' for newcomers to the fishery. For example, new non-treaty gillnetters in Puget Sound are required to take a "Fish Friendly" class provided by WDFW if they fish in areas 7/7A. There are more newcomers to the treaty fisheries; perhaps training could be offered in concert with a community event.
Suggest to all ports/marinas hosting commercial fishing fleet members that they provide an easily-accessible net recycling container/bin; giving fishermen a simple, inexpensive and environmentally safe option for discarding compromised gear.
Work with supplier gear manufacturer/ supplier to hold an open competition for innovation around derelict net prevention.

Category 2: Could require some change to existing practices
Explore practical ways for fishermen to monitor set net gear that would otherwise be left unattended. For example, establish in-fleet procedures for routine gear checks, particularly in areas with high tidal exchange and where floating driftwood and other debris are common.
Use longitudinal suspender lines (i.e., Chehalis and Columbia river fisheries), which are heavier and allow more force to be applied from the surface to the leadline during the recovery of an entangled net[5].
Secure a standby vessel during fishery openers, from which fishermen in a discrete area can request rapid assistance in freeing up and retrieving tangled gear. This could be particularly beneficial during the sockeye opener, when the window of fishing opportunity is very short.

[5] If suspenders were allowed by WDFW in the Puget Sound drift gillnet fishery, the length and hanging ratio would have to be monitored (i.e., length of suspenders can be no less than 1.1 times the depth of the net from float line to leadline.)

Category 3: Would require changes to existing practices, and applied research
Use a breakaway leadline per Alaska and Columbia River fisheries. This enables a net to drift over a snag without hanging up the entire net, although does not provide a fisherman the solid pull that can help free leadline from a snag - and thus beyond the spot where another portion of gear might get hung up.
Low frequency pingers (eg. Fumunda) attached elsewhere than the corkline[6] could assist in locating lost gear with hydrophones; a lower frequency carries farther distance for tracking purposes.
Use a corrosive link to attach sections of leadline to a recovery float. For example, a line rolled inside a tube with a trigger mechanism attached to a corrosive link, whereby a tube opens and float inflates with gas capsules.
Use biodegradable webbing to avoid the long-term persistence of derelict nets. Provide weather resistant charts to fishermen showing benthic areas with potential to snag gear.
Explore the efficacy of mesh depth restrictions as in the salmon gillnet fisheries in British Columbia and Alaska (i.e. Change net gear depth limit such that the vertical mesh count is restricted, limiting the extended distance between corkline and leadline.- 60 or 90 meshes deep). Such restrictions do not eliminate all probability of net gear loss, but may merit experimentation in Puget Sound as a means of significantly reducing the probability of snagging gear on shallow reefs. In many of the Puget Sound salmon fisheries, a gear restriction of this type would reduce Catch Per Unit Effort (CPUE), and would certainly require uniformity across gear types (purse seine and gillnet) in order to maintain level competition.
Improve tracking of lost gear through coordination between co-managers and the Northwest Straits Initiative, ensuring that the Derelict Gear Removal Program has the most current information possible on active net fishing.

DISCUSSION

One important outcome of discussions with fishermen during the course of this project was the increase in awareness about the problems associated with derelict gear. Several people interviewed agreed that preparation of this report provided them a simple means of asking questions, sharing opinions, and generally engaging in problem-solving.

[6] Most fishermen who lose gillnet gear in Puget Sound recover their end buoys and float lines, only leaving leadline and lower net panels behind.

Three common themes emerged:

Industry perception: "That's not the way we do it!" Several people remarked that although they do not think derelict gear is an important issue within the broader context of fisheries problems, they do know *other* fishermen who should be making a better effort to prevent the loss of gear.

Distinction between industry profiles: The gillnet and purse seine fisheries in Puget Sound are very different. Several gillnet fishermen interviewed feel that they are an artisanal industry and "get the short end of the stick" with regard to the derelict gear issue. An observation was made by authors of this report that purse seine fishermen have a much larger initial financial investment in gear, and tend to either hire divers or use grapple gear to recover nets. Purse seines also target fish in deeper water (~200' ft), and therefore are less likely to snag on shallow rocky reefs.

Fear of further regulation: Participants unanimously commented that any ideas offered in the course of discussion for the project were bound to result in further regulation of the gillnet fisheries. Authors recognize that this is a valid concern, and continued outreach about the economic and ecological impacts of derelict fishing gear, toward its prevention, will no doubt help address this concern.

This project was not intended or designed to assess, or to elicit recommendations for, enforcement tools or fishery regulations relating to derelict fishing gear. It is important to note that the voluntary, no-fault reporting system has existed since 2003 and few members of the fishing industry have used it, yet newly lost nets continue to be found and retrieved.

RECOMMENDATIONS

A concerted effort was made to solicit input on how to prevent future loss of gillnets in Puget Sound salmon fisheries, and it is clear that there is no magic bullet. Solutions need to be developed that align with the economics of the industry, and that do not infringe on Treaty Rights. The recommendations in common, and which were provided by participants in this project, are:

1. Prepare a comprehensive guide to best fishing practices that is tailored to each gillnet fishery, and, where possible, include bathymetric information specific to local areas of high relief.

2. Conduct a collaborative fisheries research project that is designed to test the efficacy of mesh limits/ net depth restrictions in local gillnet fisheries.

3. Establish a peer-based incentive system to monitor gillnet gear that would otherwise be left unattended, prioritizing areas where the likelihood of net entanglement and/ or loss is high.

ACKNOWLEDGEMENTS

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ONLINE RESOURCES AND REFERENCED LITERATURE

- Fumunda Marine http://www.fumunda.com/

- GhostNet Australia, an Indigenous Derelict Fishing Gear Programme http://www.ghostnets.com.au/

- Northwest Straits Initiative Derelict Fishing Gear Removal Program www.derelictgear.org

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