Lost Fishing Gear in British Columbia

Engaging Commercial Fishermen

Megan Eadie, Director of Innovation
T Buck Suzuki Foundation
Contact: Megan@bucksuzuki.org
About the Authors
The T Buck Suzuki Environmental Foundation (TBSEF), a registered charity based in Victoria, was founded in 1981 by coastal activists and commercial fishermen to protect habitat, prevent pollution, and promote sustainable fisheries. The environmental and social justice values of our namesake, long-time fisherman Buck Suzuki, guide the foundation. TBSEF is a longstanding member of the Global Ghost Gear Initiative and has been involved in a number of Ghost Gear related projects, including supporting the Area A Crab Association’s gear removal, participating in the coordination of the BC Lost Gear Workshop, and hosting a Lost Gear discussion at the BC Young Fishermen’s Gathering.

Acknowledgments
The authors acknowledge and thank Fisheries and Oceans Canada (DFO) for the generous support. We thank all 350 workshop and survey participants for their valuable input on the fisheries they work within. We thank Caitie Frenkel UVic Masters student for her work on developing and conducting the surveys that were part of this project. We recognize and thank our staff who reviewed this report and offered feedback.
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Introduction

For the past three years TBSEF has engaged with BC commercial fishermen on lost gear. We have worked to gather local knowledge on what, where, why, and how much fishing gear is lost regionally. Though many fishermen have been working to remove lost gear from BC waters, the scope of lost gear in the region is not yet fully understood. Data in the form of local knowledge was gathered through a series of workshops across the coast in 2020. In 2021 we followed up with dialogues one on one and in larger fishery specific groups, and through surveys conducted on the docks and online. This builds on our previous work which is outlined in our report Ghost Busting: Lost Fishing Gear Along the British Columbia Coastline.

By engaging harvesters we hoped to:
• Expand our understanding of lost fishing gear in BC
• Identify lost fishing gear hotspots in BC
• Understand the causes of gear loss unique to fisheries in BC
• Identify gear retrieval priorities

In this report, we will present our findings in two parts:
• Part One: Scope and Causes of Gear Loss
• Part Two: Gear Loss Mapping
• Part Three: Retrieval Site Prioritization

Background

Abandoned, Lost, or Otherwise Discarded Fishing Gear (ALDFG) is also known as lost gear. Throughout this report the term lost gear will be used. The term fishermen is used in favor of fishers, as support is given to the local preference for the term women fishing (Branch & Kleiber, 2017; Loomis, 2015).

Ghost fishing rates in BC were explored in the 1980s in crab (Breen, 1987, 1989) and sablefish fisheries (Scarsbrook, MacFarlane, & Shaw, 1988), however, gear restrictions have since changed and there are few recent studies exploring these regional rates since. Much of the regional ghost fishing and gear loss research has come from American organizations, working in Canadian waters and/or through inferences that can be drawn from similar bodies of water; such as the Salish Sea (Antonelis, 2013; Antonelis, Huppert, Velasquez, & June, 2011; Gilardi et al., 2010; Good et al., 2007, 2009, 2010) or Alaska (Long, Cummiskey, & Munk, 2014; Maselko, Bishop, & Murphy, 2013). Washington state, in the Salish Sea, estimated ghost fishing rates in the Salish Sea account for an around 4.5% annual loss in the Dungeness crab fishery, equating to harvest losses of over $744,000 (Antonelis, Huppert, Velasquez, & June, 2011). Similar estimates have not yet been established in modern BC fisheries, nor have gear loss rates (Drinkwin et al., 2019).

In BC commercial, FSC, and recreational fisheries, incidental and unintended gear loss may occur due to inclement weather, gear failure, or entanglement with underwater obstacles;
including other gears (Huntington, 2019; Richardson, Gunn, Wilcox, & Hardesty, 2018). Non-incidental loss may also occur, due to theft, gear conflict or illegal, unreported, and unregulated (IUU) fishing (Gilman, 2015; Richardson, Hardesty, & Wilcox, 2019; World Animal Protection, 2018). Lost gear impacts our marine environment in several ways, it can continue to capture marine animals, including commercially valuable species that become enmeshed; it can damage the underwater habitat when entangled and exposed to abrasive qualities; it can pose undetectable marine hazards to mariners, fouling boat propellers and anchors; and it can similarly endanger humans, especially SCUBA divers (Huntington, 2019; Laist & Wray, 1995; Macfadyen, Huntington, & Cappell, 2009; World Animal Protection, 2018).

Engagement

Our engagement with fishermen took on many different forms, primarily due to Covid-19 preventing travel across BC. As described in our previous report, we held workshops throughout January 2020 in key fishing communities: Steveston Harbour, Pender Harbour, Prince Rupert, Nanaimo, and Port Hardy. Since then we pivoted towards online workshops, but found that interest and attendance was low, and that fishermen were less willing to share information in a less personable environment. Fishermen are, as a group, are less interested in email and online exchanges, and we found this particularly true over the past two years.

As a result, we moved towards individual phone or zoom meetings. These were more time consuming, but we were able to engage on a deeper level with individuals in this manner and developed strong relationships. This process enabled us to map gear loss, and also build a better understanding on why gear gets lost in specific locations.

We also worked with key members of the fishing community to expand our outreach. One individual reached out to over 30 members of the black cod and halibut fisheries to identify general locations and specific coordinates of gear loss events. This tactic proved much faster and more successful than sending out emails through our networks. Learning from this we had a prawn harvester, who had been selected to conduct gear retrievals, reach out to 15 of his contacts within the fishery to identify gear loss coordinates.

We have reached out to a number of other organizations that have identified lost fishing gear, including the Hakai Institute, the Malahat Nation, and Ocean Networks Canada. These groups have conducted dive and ROV surveys across BC and incidentally noted lost fishing gear. We have gathered these reports where possible to compile along with our data.

As a central component of our engagement with harvesters, TBSEF and the University of Victoria collaborated on a project to better understand the causes and interactions of gear loss across fisheries on the BC coast. The survey can be found here and has engaged harvesters at docks across BC.
The survey was developed to gather primary information from BC fishermen regarding the cause of gear loss, the types of gear lost, and what other gear types they have come into contact with. The survey included questions on the fishery(s) the participant engaged with and the number of years they had spent in the fishery. Questions related to human and environmental gear loss factors were offered on a scale of 1 (least important) to 5 (most important) to determine the level of ranking among potential factors.

Surveys were conducted in Victoria, Sooke, Sidney, Cowichan Bay, Ladysmith, Nanaimo, French Creek, Campbell River, False Creek, Steveston, Port McNeil, Port Hardy, Tofino, and Ucluelet. In addition to in-person visits, an online version of the survey was made available.

In total across all of our methods, over 350 fishermen participated from a wide range of fisheries. This included commercial salmon troll, seine, and gillnet; herring seine and gillnet; crab by trap; prawn by trap; shrimp by trawl; sablefish by trap and longline; groundfish trawl; tuna longline; halibut longline; as well as sports/recreational and First Nations Food, Social, and Ceremonial (FSC) fishermen (Figure 1). Prawn and Halibut were by far the most represented fisheries, and while there were many Salmon fishermen participating in the initial workshops, we found fewer were interested in participating over the following year.

Figure 1. Fisheries distributions reported by participants. Not all participants reported a fishery.
We also tracked interactions with fishing associations, and have included the list of associations below:

- BC Young Fishermen’s Network
- West Coast Prawn Harvesters Council
- Pacific Prawn Association
- Northern Troller’s Association
- Canadian Sablefish Association
- Deep Sea Trawlers Association
- Groundfish Trawl Advisory Committee
- Halibut Advisory Board
- Area A Crab Association
- BC Crab Association

1. Scope and Causes of Gear Loss

1.1 Gear Loss Estimates by Fishery

In our previous work, we attempted to quantify the amount of gear lost per fishery and found rates of gear loss in BC differ by fishery, gear type, and location.

We have since updated our estimates based on additional research and surveys with fishermen (Table 1). Many fishermen suggested that though they could share their estimated rates of loss over the previous few seasons, their experience may not be reflective of the entire fishery. Many recommended gear loss rates to be determined using existing electronic monitoring equipment.

<table>
<thead>
<tr>
<th>Gear Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crab traps</td>
<td>5-15% of traps; higher loss in Area A, and areas with high theft</td>
</tr>
<tr>
<td>Prawn traps</td>
<td>2%-10% of traps, very rare to lose entire string</td>
</tr>
<tr>
<td>Troll gear</td>
<td>10-25% of hooks, flashers, cannonballs for troll gear</td>
</tr>
<tr>
<td>Seine nets</td>
<td>Rare to lose an entire seine net, more typically a portion of web or leadline is lost or torn</td>
</tr>
<tr>
<td>Gillnets</td>
<td>Rare to lose an entire gillnet, more typically a portion of web or leadline is lost. (Approximately 5% of gillnet is average when loss occurs)</td>
</tr>
<tr>
<td>Longline</td>
<td>3 skate lengths per season</td>
</tr>
<tr>
<td>Trawl</td>
<td>Rare to lose entire net, more typically a portion of web is lost</td>
</tr>
</tbody>
</table>
1.2 Causes of Gear Loss
A variety of factors can lead to gear loss and while many of them are similar across fisheries, they seem to vary in importance both across fisheries and region fished.

In our 2020 workshops we offered participants a checklist of items for potential gear loss reasons designed based on knowledge developed by Richardson, Gunn, Wilcox, and Hardesty (2018). The most commonly selected reason for loss was overcrowding and gear conflict, where a total of 14 workshop participants selected this reason (Figure 2). Working near reefs or rough ground was the second highest selected reason for gear loss, stated by 13 participants. Seven participants selected gear caught in propellers causing loss. Five participants selected poor weather during retrieval causing loss, as well as gear damage during retrieval. Equipment and/or machine failure was selected by four participants. Finally, stowed gear washing overboard was selected by two participants. Two additional checklist items were provided on the workbook that were not selected by any participants, this included “worn out equipment breaking during retrieval” along with “gear loss during operation”.

![Figure 2. Gear loss reasons selected by participants who completed the workbook checklist activity. Overcrowding and gear conflict was the highest selected reason for loss, selected by 14 participants.](image)

In our subsequent survey, we asked fishermen to rank reasons for gear loss from least to most important. The reasons were more specific in this survey. According to the survey, snagging on rough ground, seafloor type (rocky especially), and ocean currents are the most important reasons for gear loss. Interacting with other gear types and vessels seem to be the least important (Figure 3). Fishermen were also asked if there were other key reasons for gear loss and the most common responses were gear maintenance, experience, human error, and theft. Interactions with marine mammals and sharks, underwater debris, and gear conflict were also listed.
Figure 3. Survey responses (n = 33) for ranking questions, where fishers were asked to rank different reasons for gear loss from least to most important. Percentages of responses for least to slightly important (yellow), important (grey), and fairly to most important (teal) are indicated on the left, middle, and right of the plot respectively.

We believe that the difference in responses between the workshops and the survey lies primarily in the fisheries represented. Our workshops had a large number of salmon trollers in attendance, who spoke of gear conflict with crab gear. Whereas our survey had a large number of prawn and halibut fishermen, fisheries which have less overlap with other fisheries, and where more gear loss is attributed to snags, seafloor type, and ocean current. Both snags and seafloor type are represented in working near reefs or rough ground, the second most selected cause of gear loss in our workshops, which is consistent with our survey findings.

It is worth noting that lost gear was listed as important, fairly important, or most important by 48% of respondents, confirming that lost gear begets lost gear and highlighting the need for lost gear retrievals.

We further identified which seafloor types that gear comes into contact with lead to loss, and nearly 60% of participants stated rocky seafloor (Figure 4).
Figure 4. Seafloor types that fishers’ gear comes into contact with for their most (blue) and second most (orange) economically important fisheries.

Survey participants were asked what vessel types gear comes into contact with, with the most common response being other fishing vessels, followed by recreational vessels (Figure 5). Log tows and ferries were the least frequently encountered, which surprised us given the frequency of lost gear reports we received due to log tows dragging gear.

Figure 5. Vessel types that fishers’ gear comes into contact with from their most (blue) and second most (orange) economically important fisheries.
Survey participants were asked which types of active fishing gear their gear comes into contact with most often. Though roughly a third of respondents said none, a large number also responded with crab traps, prawn traps, longline, and bottom trawls (Figure 6).

Figure 6. Types of other actively fishing gear that respondents’ gear from their most (blue) and 2nd most (orange) important fisheries come into contact with while fishing.

We next asked participants which types of lost fishing gear their gear encounters while fishing. Crab traps, prawn traps, and longline gear were all selected by a third of participants, followed by bottom trawls (Figure 7). Many fewer participants responded with not applicable for lost gear than active gear. This is consistent with our other work interviewing fishermen on gear loss, who also consistently stated these three gear types as the most commonly found lost gear.

Figure 7. Types of lost fishing gear that respondents’ gear from their most (blue) and 2nd most (orange) important fisheries come into contact with while fishing.
Trap Gear

Crab
Our work suggests that crab gear is unlikely to be lost due to weather or rough ground, as crab is often fished in shallow water with sandy seafloor using heavy traps that are not likely to drift substantially. However, crab gear faces high rates of loss due to gear conflict either with other crab gear in areas with overcrowding or with gear from other fisheries, such as groundfish trawls and salmon trolls. Gear theft came up repeatedly as a concern from crab fishermen when asked about lost gear.

In Area A, where crab traps are fished individually, they are more likely to be lost due to weather. Several fishermen reported that though they lose a larger amount of gear in Area A than in other areas, the Area A crab retrievals result in much of that gear being returned.

Prawn
Prawn gear seems to have slightly lower rates of loss than crab gear across BC, likely due to the short soaking time and the timing of the fishing season when gear conflict with other fisheries is low and weather is better. Prawn fishermen consistently reported several traps lost per season, and very rarely an entire string if caught by another vessel or a log boom. Reasons for loss were typically attributed to rough seafloor and bottom snags. Gear conflict within the fishery is high in certain regions with overcrowding, which can lead to loss. Gear theft was also mentioned in regards to prawn gear, but less commonly than crab gear.

Because of the relatively light weight of prawn traps, fishermen believe that if the gear is lost and it is not caught on a snag or rock, then it will likely be dragged away from the location of loss.

Sablefish
Sablefish traps were rarely mentioned as lost, but we believe this is likely due to a lack of respondents from the sablefish trap fishery. Given what we know about loss in the other trap fisheries, it is likely that weather and tide is the highest cause of loss in the sablefish trap fishery.

Longline gear

Halibut and Sablefish
The most common causes for loss in the longline fisheries appear to be weather, snags, and ocean currents. Halibut fishermen in particular reported frequently losing gear to lost gear in the marine environment, particularly in highly fished areas.

Salmon and Tuna troll
Salmon trollers often cited gear loss as caused by interactions with marine mammals or sharks taking hoochies, flashers, and spoons. Interactions with other gear types, particularly crab gear, caused loss of line and cannonballs. These gear types rarely interact with the bottom and therefore are rarely lost.
Nets
Gillnets
Multiple fishermen mentioned that salmon gillnet loss was low due to a reduced fishing effort for salmon. During in person dock surveys, many salmon fishermen opted not to take the survey stating that they no longer have the opportunity to fish and therefore have no gear loss. Those who did respond stated that loss was more common during the in-river fisheries, typically due to snags in the river on logs or on navigation buoys in The Fraser River (particularly during sockeye season). When nets are snagged, the leadline is usually left behind. Herring gillnet loss is rare, though tearing a portion of the net is relatively common as the fishery occurs in shallow water where snags are possible. Over the two herring seasons that occurred during the timeline of this project, no one interviewed knew of any gillnets lost.

Seines
Both salmon and herring seine loss was reported as very rare, except in cases of particular danger for the crew. This is less common now with the reduced scale of these fisheries. As is common across all net fisheries, tearing a portion of the net and leaving a small amount of web or leadline is more likely than total loss.

Trawls
Trawl loss is considered catastrophic for fishermen, so when they are lost, fishermen work hard to retrieve them. Trawl loss can happen due to poorly maintained gear, including cables, from extreme weather, or from debris such as sunken wrecks on the seafloor. It is much more common for a small amount of web to be lost than an entire net.

1.3 Recommendations for reducing gear loss
Fishermen made a number of recommendations for reducing gear loss. They spoke about how they reduced their gear loss, then made recommendations to the industry and to government. Their recommendations have been listed here.

General changes that have reduced gear loss:
- Better knowledge of the area being fished
- Better ocean floor mapping technology to learn better where snags may happen
- Better gear maintenance
- Better/more clear gear marking
- Reduced proximity to other fishers
- Less overlap with other fishing industries in an area
- Better quality, stronger gear
- Better technology
- Longer season leads to less competition on grounds, cameras
- More fishing experience
- Less opportunity and fishing time means less gear is set
- More prevention techniques
- Cameras have had a huge impact. There are fewer irresponsible fishermen.
- Need to be mindful of weather- especially winter. Gear loss happens during storms because it isn’t anchored down properly.
Many of these reductions in gear loss have come from better technology and gear quality, more knowledge either from experience or technology, and changes to reduce competition on fishing grounds.

**Recommendations to fishermen:**
- Try to not set in high snag areas
- When fishing in high traffic areas, use “breaking strands” where the buoy connects to the string so that if a large vessel runs over it, the strand breaks instead of towing the whole string. Then you can haul from the other end or drag for the string which is easy because it will be fully intact and we know exactly where it is.
- Use good anchors, replace ground line, maintenance
- Gear maintenance every year is crucial
- Figure out why gear hangs up in a particular spot so as to not do it again
- Better knot maintenance
- Avoid bad areas with lots of crab traps (McIntrye bay)
- Stronger gear, smart fishing - avoid known bad spots and rocky bottom
- Bigger traps, heavier gear and more weights
- Moved crab pots to local knowledge area that’s not as stormy in the winter. Moved to safer fishing areas. Fish less pots in the winter to avoid getting stuck in bad weather. Keep within fishing boundaries.
- Respecting and moving locations when water levels rise/lower
- Changed how I set up my ground lines 20 plus years ago
- Had to stop fishing many areas due to extreme crab loss
- Stay away from fish farm anchors, breakaway lines on scotchmen when fishing around log booming/towing operations
- Better gear, Low drag scotchmen, experience and knowledge

**Specific gear modification suggestions**
- Breaking strands as explained in answer to previous question
- Bridle gear from trap to string instead of using snaps, Dog vs crab snaps don’t change loss much
- File smooth any burrs inside weighted jig to reduce how much it wears on line
- Funnel on bottom on top of cannonball, can pull off crab trap when caught
- Option to go to American style with larger individually set traps, would allow to set trap exactly where needed. Would lose one trap at a time value a whole string.
- Using beackets (a portion of twine or rope) to attach each trap has greatly reduced gear loss. If there is a hang-up, the becket will in theory break or allow slack for the hang-up to work itself out before the web/gear or structural line is harmed.
- Boats should have a gear retrieval device onboard.
- Strong buoy lines and proper floats/scotchmen for all weather tide and other vessel traffic.
What can the industry do to prevent gear loss?
- Share their knowledge! Record in log where loss happens.
- More knowledge for younger skippers
- Buy back the same percentage of fleet as percentage of area is taken away for parks to prevent crowding
- Educating fisheries management
- Less pots and more accountability. Crab industry.
- Less crab pots per boat. These vessels have so many pots they have to take 3 to 4 boat loads of pots to get all their gear out
- Gear loss is unpredictable. Inexperienced captains or crews hauling are probably the greatest cause.

What can the government do to prevent gear loss?
- Reduce short openings in small areas
- Make it easier and less scary to report gear - this is more of a response rather than prevention.
- Increase opening area to prevent crowding
- More enforcement regulating everyone’s 6 took strings and 12 to 20 scotch a (markers)
- Reduce risk adverse management, broad brush approaches don’t account for individual contexts of smaller areas
- Keep trawlers out of crab fishing grounds
- More flexibility in management for salmon & herring industries. Some stocks could be fished, but because others are not doing well everything is shut down without the context. Commercial fishing areas keep being closed, condensing them into smaller areas.
- Make a policy for crab industry to be able to manage gear loss
- Educate fishermen and reporting of lost gear (which is in most fishery’s like prawn and ground fish is mandatory already)

2. Gear Loss Mapping

2.1 Gear Loss Data Sources
A number of sources have been identified in the gathering of gear loss data. We primarily relied on Local Fishing Knowledge directly from fishermen. Oceans Network Canada provided insight to the use of their Annotations Search platform, the Department of Fisheries and Oceans shared data on submission reports, and a survey conducted between TBSEF and UVic had fishermen identify gear loss locations along the BC Coast.

Verbal Reports of Gear Loss
Interviews with fishermen provided key local knowledge regarding experience with gear loss, retrieval, and interactions. The discussions revealed commonly identified locations including Langara (long line gear), Moresby Gully, Frederick Head, Quatsino (sunken infrastructure, fish
farm anchors, prawn gear), Stuart Channel (prawn gear), and Tofino (crab and prawn).

**ONC**
The Oceans 3.0 Data Portal is a product from Ocean Networks Canada. It is a tool to search, preview, download, and visualize data from cabled observatories, mobile platforms, and autonomous instruments. Within this, the Annotations Search platform offers the ability to filter data by collection type, resource, comments or key words, and date.

*A search of dive video annotations* that reported trash or waste in the imagery was conducted. This provided thirty-five location names, the coordinates of which were determined by an internet search. The gear types identified in the Annotations search include long line, tackle parts, rope, weights, anchors, trap, fishing line, net and grate. There were also reports of undefined waste, as well as metal.

**Department of Fisheries and Oceans**
In 2021, the Department of Fisheries and Oceans shared locations of lost gear submitted to their program. The data included twenty-three reports of prawn gear, with the coordinate points located around Broughton Island.

**Ghost Gear Survey 2022**
TBSEF and the University of Victoria engaged in a collaborative project to better understand the causes and interactions of gear loss across fisheries on the BC coast.

The highest ranked causes for gear loss were identified as bottom snags, seafloor type, and ocean current. Dozens of locations were also mapped, indicating where fishermen have come into contact with lost gear. This will be added to the TBSEF Lost Gear Database and be used to help inform future lost gear work. Data analysis on the gear loss factors is presently being conducted, and once complete will be used to inform the predictive mapping analysis.

**2.2 Reported Gear Loss Maps Methodology**
Interview notes were scanned for details including location, gear type, fishery, depth, certainty of the reporting, and who reported the information. These details were copied into an excel file to list the data more clearly. As noted above, most reports for lost gear locations included the likely fishery(ies) involved. To gain a better understanding of the potential extent of the gear loss, datasets from the online portal ‘SeaSketch’ and the BC Commercial Fishing Association were used to identify the footprint of the relevant fishery at each specified location. The perimeter for gear loss in each area was drawn based on the reported fishery footprint information.

In cases where the fishery was not specified and/or the gear type was unknown, all available fishery footprint data was cross-referenced with the location to determine which, if any,
fisheries overlapped. This was done to provide a rough idea of what fishery could be associated with that gear loss.

Using the software ArcMap, gear loss perimeters were linked to the summary data in the excel file so that each location had the proper associated metadata (location name, gear type, fishery, depth, certainty, who reported).

A limitation to this process is that fishermen themselves did not have the opportunity to draw the gear loss location boundaries themselves. While it was helpful to hear from fishermen about gear loss reports in areas such as Sooke or the Fraser River, the area boundaries that were set for these locations were based on fishery footprint data from 2007-2016.

In the future, it would increase the precision of the reports if fishermen could mark their local knowledge on paper or digital maps, or provide coordinates for locations, rather than use the last recorded footprint data for a fishery. Some fishermen have already offered coordinate points for gear loss - this information is useful to overlay on top of perimeters drawn as a way to focus further on target locations.

### 2.3 Reported Gear Loss Mapping Results

The results of the gear loss mapping process show that gear loss is spread across BC, but that there are certain areas with very high numbers of reports. Figure 8 shows fishing gear loss reports from the LFK gear loss reports, DFO gear loss reports, ONC gear reports, and the general reported areas for gear loss. Areas were separated from LFK gear loss locations to show the difference between where specific coordinates or map locations were given, versus a location shared verbally. The reported gear loss areas are therefore less accurate, but often came up repeatedly. Many locations have multiple forms of reports, suggesting that the data is likely accurate.
Below, Figure 9 shows the overlap of reported gear loss areas drawn by fishermen at the 2020 Gear Loss Workshop hosted by TBSEF. The colour gradient of the figure changes from blue to red - the greater the number of fishermen to report gear loss in a particular area, the closer to red the colouring becomes - for example, MacIntyre Bay and the Mouth of the Fraser River are the highest-reported areas for interaction with lost gear by fishermen. The black points on the map reference the broader areas mentioned in interviews.
Certain locations showed up as clear loss hotspots, including McIntyre Bay, Hecate Strait, Langara Island, Cape St James, Clayoquot Sound, Knight’s Inlet, Boundary Bay, and along the south-east coast of Vancouver Island. Some of these locations have reports of only one type of gear loss, but most have several types. We opted not to include the type of gear reported on this map as it quickly became difficult to interpret.

2.4 Predictive Mapping Methodology
TBSEF is currently in the process of creating predictive ALDFG maps based on influencing factors that increase the likelihood of gear loss. This project is being supported by Caitie Frenkel, a graduate student at the University of Victoria, as well as fishermen across the coast of BC.

Preliminary influencing factors have been identified via a literature review on gear loss. While this list is useful, it can be strengthened by gathering local fishing knowledge (LFK) to inform which factors have the greatest (or least) impact on BC fishermen. To understand this better, a survey has been shared with fishermen to gather information within fisheries regarding gear type used, harvest areas, identification and ranking of reasons for gear loss (ie. ocean currents, interactions with other fishing vessels, seafloor composition etc.), gear loss solutions, as well as provide the opportunity to include any additional information that might be relevant.
The influencing factors identified in local knowledge surveys will be statistically analyzed to weight their importance and be used to conduct a suitability analysis. This analysis will use the combination of weighted factors to determine high vs low risk gear loss areas and produce a final product in the form of a heat map. As the surveys are collected, this process will be run for the main fisheries identified in the 2020 TBSEF Gear Loss Workshop. This includes: crab, prawn, salmon, halibut, and herring.

The following image (Figure 10) is a comparison of this methodology used in the crab fishery with known gear loss data. The map on the left is the rough process of weighting the influencing factors without LFK input, and the right map shows the known gear loss density of crab traps in McIntyre Bay. The correlation of known vs. expected gear loss between the images can be seen in the datasets. Incorporating LFK in the process will increase the precision of this analysis.

![Figure 10. Predictive map vs Local Fisheries Knowledge map of crab gear in McIntyre Bay, BC](image)

### 2.5 Predictive Mapping Results

Below, Figure 11 shows a heat map of likely areas for crab gear loss based on factors including depth, current, marine traffic, and the crab fishery footprint from 2016. The crab fishery data
was provided by the BC Commercial Fishing Association, and the rest was downloaded from the BC Marine Conservation Analysis website.

A weighted analysis was conducted to determine the predictive gear loss heat map. This process applied a percentage weight value to each dataset based on their importance and were then combined to produce the final output raster. The following weights were assigned to each dataset: crab fishery footprint (40%), depth (20%), marine activity (20%), and current (20%). The analysis was processed using ArcMap software. Note, the classified ‘Low Risk’ of gear loss in Saanich Inlet is influenced by the absence of crab fishery data in the area.

![Predictive Gear Loss Map for Crab Fishery - Saanich Inlet, Cadboro Bay. Source: BC Commercial Fishing Association, BC Marine Conservation Analysis](image)

Figure 11. Predictive Gear Loss Map for Crab Fishery - Saanich Inlet, Cadboro Bay. Source: BC Commercial Fishing Association, BC Marine Conservation Analysis

The blue points in Figure 11 represent gear retrieval locations that were submitted to TBSEF in between July 2021 and February 2022. Most of the crab gear found was in an area classified as medium to high risk of gear loss, suggesting that the predictive maps as currently prepared are likely to be beneficial in identifying priority locations for gear retrieval.

Figures 12 and 13 are heat maps of likely areas for prawn gear loss based on the factors of depth, current, marine traffic, and the prawn fishery footprint from 2016. The prawn fishery data was provided by the BC Commercial Fishing Association, and the rest was downloaded from the BC Marine Conservation Analysis website. A weighted analysis was conducted to
determine the predictive gear loss heat map. This process applied a percentage weight value to each dataset based on their importance and were then combined to produce the final output raster. The following weights were assigned to each dataset: prawn fishery footprint (40%), depth (20%), marine activity (20%), and current (20%). The analysis was processed using ArcMap software.

Figure 12. Predictive Gear Loss Map for Prawn Fishery - Nanaimo, Crofton. Source: BC Commercial Fishing Association, BC Marine Conservation Analysis
The blue points in Figure 12 and 13 represent gear retrieval locations submitted to TBSEF between July 2021 and February 2022. The predictive map for the prawn fishery appears to be slightly less accurate than the predictive crab fishery map, but still shows that the majority of the gear found was in an area classified as medium to high risk of gear loss. We believe that if the prawn fishery map also incorporated seafloor type into the analysis that its accuracy would improve.

3. Retrieval Site Prioritization
Following this engagement process, we identified priority areas for retrieval. These locations are based on the rate of gear loss, the likelihood of lost gear creating additional loss in the future, the value of these locations to fishermen, the cultural and ecological importance of the regions, and the feasibility and accessibility of sites. We know that gear gets lost more often when there is high fishing intensity, and these high value sites get stronger buy-in from a fleet when they are targeted for retrieval.
Unfortunately, timing of fishery closures in many regions coincides with the poor weather windows, high likelihood of storms, and increased tidal flow. This has made it necessary for us to pivot away from many of the high value sites towards safer retrieval options.

We also decided to target a variety of gear types in our retrieval prioritization plan. The sites, and their confirmed gear types are listed below.

- Stuart Channel, prawn traps
- Quatsino Sound, prawn traps
- Satellite Channel, prawn traps
- Cordova Bay, crab traps
- Cordova Channel, crab traps
- Hecate Strait, halibut longline

The results of these retrievals are documented in our Racer X and Star Wars II retrieval reports.

The following sites were determined to be high value, but not feasible this year either due to the above considerations or because they were targeted by other retrieval groups. We will be searching for further funding to conduct retrievals at the sites should they still need it.

- Sooke Inlet, crab traps
- Boundary Bay, crab traps
- Nelson Island, fish farm net
- Clayoquot Sound, crab gear
- Saanich Inlet, prawn traps
- Fraser River, salmon gillnet
- Moresby Gully, halibut longline, black cod longline and traps
- McIntyre Bay, crab traps and troll cannonballs
- Frederick Hump, halibut longline
- West Coast Haida Gwaii, Black cod traps

**Discussion**

The collective local knowledge of commercial fishermen is extensive. Fishermen were easily able to share rough estimates of the gear lost within a season, and identify areas with high rates of gear loss. The data collected to date provides an initial summary of gear loss in BC. We developed a better understanding of the causes and rates of gear loss across the different fisheries, have identified best practice recommendations to reduce gear loss, and learned which active and lost gear types are most frequently encountered. Fishermen are a wealth of knowledge on both gear loss and gear retrieval, and should be considered key partners in work on ADLFG in Canada.

Through our engagement we were able to develop detailed lost gear maps that identified many hotspot locations that helped inform our gear retrieval efforts. While we were able to target some of these locations for retrieval this year, many were determined to be impractical at the time.
The understanding of the causes of gear loss developed through engagement allowed us to develop predictive gear loss maps. By comparing precise gear loss and gear retrieval locations with the predictive maps, we are able to assess their effectiveness. These maps could be expanded to include the entire BC coast.

Though we have learned a great deal about the lost gear ecosystem in BC through this project, it is clear that more coordinated work is needed to eliminate lost gear. For instance, to develop a more complete understanding of current rates of gear loss, it should be made as easy as possible for fishermen to report through their existing log books and electronic monitoring. The potential for fines and other penalties for losing gear were commonly brought up as a concern around this topic. We recommend reviewing existing logbook and electronic monitoring data, in addition to gear loss reports to compile a more complete understanding of current rates of gear loss.

Our work on gear loss thus far has primarily focused on current rates and locations of loss. This is as a result of the difficulty in participants to remember their gear loss upwards of 20-50 years ago. While we were able to ascertain that gear loss has decreased over time, we still don’t know how much gear loss used to happen. We are also less confident in where gear loss used to happen, as our maps are based on fishery footprints from the last decade. Legacy gear is certainly still in our marine environment causing harm, and is likely in many locations that have been closed to fishing. We know of some such areas, like many of the seamounts in Canadian waters and offshore such as Cobb Seamount, studies have been conducted assessing the impact of fishing on vulnerable marine ecosystems and found that derelict gear is causing an ongoing threat to biological structures (Du Preez et al., 2020). We recommend conducting a desktop review of all available data from the past 100 years referring to gear loss in BC, as well as reviewing ROV and video footage collected of the seafloor, to further identify gear loss hotspots.

Though it may be hard to acquire permissions to retrieve gear in protected areas such as seamounts, those locations are likely to be the ones with the most ecological benefits from retrieving gear. Areas with high rates of gear loss due to existing lost gear should also be considered as priorities.

Throughout this project we determined how critical a whole ecosystem approach is when it comes to eliminating lost gear from our ocean. Commercial fishermen and their organizations are central to the issue, but regulators and fisheries managers, gear manufacturers and suppliers, service providers, processors, distributors, and end consumers should all be engaged. TBSEF will continue to work with commercial fishermen, industry associations, First Nations, ENGOs, governments, and more to address the issue of lost fishing gear in BC.
References


