



NORTHWEST STRAITS  
marine conservation initiative

## FINAL REPORT

# BRITISH COLUMBIA DERELICT FISHING GEAR SURVEY AND REMOVAL PROJECT

PREPARED FOR:

MINISTRY OF THE ENVIRONMENT

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## **Introduction**

Abandoned, lost and discarded fishing gear can present safety, liability, nuisance and environmental impact issues in marine waters. Identification, location and safe removal of derelict fishing gear can reduce these impacts. The Northwest Straits Initiative (NWSI) teamed with the National Oceanic and Atmospheric Administration (NOAA) and the Washington Department of Fish and Wildlife (WDFW) to address the issue of derelict fishing gear in Puget Sound and the Strait of Juan de Fuca. The result of this project is a comprehensive program to safely remove derelict fishing gear from the marine environment in an environmentally acceptable manner. WDFW published guidelines for derelict fishing gear removal in Washington marine waters based on the NOAA/NWSI project.

Funding from the Province of British Columbia, Canada, was provided to the Northwest Straits Foundation (NWSF) to conduct derelict fishing gear survey and removals in British Columbia waters. NWSI contracted with Natural Resources Consultants, Inc. (NRC), to survey and remove derelict fishing gear for this project. The removal operations were coordinated with the Department of Fisheries and Oceans Canada and the British Columbia Ministry of Environment.

The purposes of this project were to demonstrate that derelict fishing gear has negative impacts on the marine resources of British Columbia and to demonstrate that gear removal can be accomplished safely, efficiently, and with minimal negative environmental impacts. During removal operations, established derelict fishing gear removal protocols in place in Washington State were used to recover identified derelict gear. These guidelines can be accessed at <http://www.nwstraits.org/Uploads/pdf/DGGuidelines-final.pdf>.

## **Scope of Work**

The project focused on the removal of a known derelict net located off North Pender Island and the survey and removal of derelict crab pots in Canadian waters of Semiahmoo Bay. One day of sidescan sonar survey was conducted for derelict crab pots on January 27, 2011 and one-half day of post-survey processing of the sidescan sonar data was conducted on January 29, 2011. One day of derelict net removal work was completed on February 18, 2011, and four days of derelict pot removal work were completed between February 19 and 22, 2011. In addition to the survey and diver removal days, two days were expended in transit, offload and disposal of derelict fishing gear.

Derelict fishing gear retrieved during the course of this project was disposed of in the Whatcom County landfill.

## **Methodology**

### *Sidescan Sonar Survey*

The goal of the sidescan sonar survey was to locate derelict crab pots in Canadian waters of Semiahmoo Bay at water depths accessible by divers (< 32 meters). The sidescan sonar survey was conducted along the international border from the concrete border marker just offshore of Peace Arch Park west to approximately 122°54' West longitude (Figure 1).

Fenn Enterprises performed the sidescan sonar survey for the project using a Marine Sonics sidescan sonar system operating at 600 kHz with a differential global positioning system (DGPS). The sonar system employed a heavy towfish deployed off the bow of a 40-foot survey vessel. A hydraulic wench and cable controlled the depth of the towfish. The survey image was projected on a monitor onboard the vessel and recorded onto a computer hard drive for later processing.

Generally, the sidescan sonar survey was conducted at 4.63 km/hr (2.5 knots) with a path width of 50 m on either side of the boat for an approximate area swept of 90 m (295 ft). The survey path width was occasionally decreased to 10 to 20 m on either side of the boat in shallow water (less than 5 m deep) or when a more detailed image of an object was desired. Survey depths generally ranged from about -3 m (10 ft) to -14 m (146 ft) mean lower low water (MLLW).

The intent of the sidescan sonar survey was to obtain a sufficient number of derelict crab pot targets to provide four days of diver removal effort. Derelict crab pots were readily identified on the sidescan sonar images. Counts and precise locations of derelict fishing gear were recorded during post-survey processing of the data that allowed greater time to examine the images. The products from the sidescan sonar survey included a trackline file of the area surveyed, calculation of the amount of the seabed covered and the positions (latitude and longitude). The detailed sidescan sonar images allowed assessment of whether derelict crab pots were sitting on the seabed and partially or completely buried. The southern range of the sidescan sonar image also allowed the survey of derelict crab pots in U.S. waters.

### *Gear Recovery*

Doug Monk Diving was contracted to conduct the dive recovery operations on the derelict net and the derelict crab pots. Two divers equipped with surface supplied air operated off a 40-foot dive support and gear recovery vessel, the F/V *Bet-Sea*.

### *Derelict Crab Pot Removal*

The list of the precise locations of derelict crab pots detected during the sonar survey was used by the biologist and dive team to locate the derelict pots using a wide area augmented global positioning system (WAASGPS) and electronic chart software

(Nobeltec®). Derelict gear target locations derived from the sidescan sonar survey were transferred into the Nobeltec charting software as waypoints and plotted over a navigation chart of the project area.

Highest priority was given to unburied pots that were potentially actively fishing and locations with multiple derelict gear targets to maximize the number of derelict pots recovered during each dive operation. Using the WAASGPS system, the dive support vessel was directed to the exact location of the potential derelict gear target identified by the sidescan sonar survey. As the vessel arrived at the target location a clump weight with a line and float were deployed as near as possible to the derelict gear location. The dive support vessel was then anchored in the vicinity of the clump weight or drifted nearby and a single diver was deployed. The other diver stood by on deck as a safety backup diver. A 30 m (100 ft) length of rope was passed through a loop on the rope near the clump weight and the other end was held by the diver. When poor water visibility conditions were encountered, the diver would drag the 30 m rope around the clump weight in a circle until it tangled with the derelict fishing gear and then the diver worked back along the rope to the gear.

A variety of information was reported to the biologist on board the support vessel by the diver during recovery of the derelict pots. Information collected included whether the derelict pot was commercial or sport, whether it was fishing or disabled, whether it was equipped with rot cord (pots) and the number of live and dead Dungeness crab, other crab and fish entrapped. Also reported was information about the overall condition of the gear and the depth and type of seabed where the gear was located. Gear to be recovered was freed by hand by the diver, a recovery line from the vessel was attached and it was hauled aboard the recovery vessel by the aid of a hydraulic winch. Pots buried more than 1/2 of their height in the seabed were disabled and left in place. The onboard biologist further inspected the gear at the surface and looked for owner identification information. Tags found in many of the pots were removed and provided to the Ms. Bridget Ennevor, Department of Fisheries and Oceans Canada.

### *Derelict Net Removal*

The dive support and gear recovery vessel employed a WAASGPS to locate the reported position of the derelict net. Once the net was located, a variety of information was collected prior to, and after, removal. Divers were equipped with a two-way verbal communication system in order to communicate with a biologist on the dive vessel. The diver first walked the perimeter of the net and estimated the total length and width of the net covering the seabed and the number and height of any suspension of the net off the seabed. The diver reported the minimum and maximum water depth along the net and provided a general characterization of the habitat in the vicinity of the gear such as high relief rocky substrate, rock pinnacle, gravel/sand with boulders, reef edge, wreck, etc. The diver also identified and counted animals entangled in the net and indicated whether they were alive or dead. Additionally, other evidence of gear-induced mortality such as bones on the seabed in the vicinity of the net and impacts of the derelict net on the habitat were also reported. Only animals actually entangled in the net were counted as direct

impacts in this report. The biologist on the dive vessel estimated the location of the net relative to the vessel and derived the approximate latitude and longitude of the net location.

Once the required information was reported, the diver attempted to locate one end of the net or, if necessary, cut the net to make an end. The net was then removed from the seabed by hand and bundled or rolled into a tube. The diver then attached a strap and an airlift bag and partially filled the airlift bag with air to place an upward tension on the freed end of the net. This procedure was repeated down the length of the net until a manageable length of net was freed from the seabed. The diver then connected a "bag line" from the vessel's boom winch to the last airlift bag and instructed the vessel to place tension on the freed portion of the net. The diver then cut the freed portion of the net away from the remaining net on the seabed and the vessel hauled the freed end to the surface and aboard the vessel. The bag line and airlift bags were then sent back down to the diver via the air hose and the procedure was repeated until the diver reached the maximum allowable time-at-depth and returned to the vessel. The second diver then entered the water and continued dive removal operations. At the surface, a biologist and the deck hands laid the net on the deck and inspected it from one end to the other. The biologist recorded the general condition of the net.

All organisms alive or dead entangled in the net were identified and counted and immediately returned to the sea after identification. In most cases, entangled or entrapped animals were readily identified to species but for some specimens, such as or fish flesh, they were simply recorded as unidentified to the lowest possible taxonomic group such as "fish unidentified." For some species such as barnacles and bivalves, it was difficult to determine if the shells entangled in the net indicated mortality caused by the net or whether the shells had become caught in the net after the animals died. In many cases, the shells were too numerous to count by the diver and were lost in the retrieval process. However, their occurrence was noted on the data forms.

As much biological material as possible was removed from the net and returned to the sea. The net was then placed in heavy plastic bags and stored in the cargo hold of the vessel until offloaded. The weight of the disposed gear was measured at the landfill scale.

## **Results**

### *Sidescan Sonar Survey*

One day of sidescan sonar survey work was conducted in Semiahmoo Bay on January 27, 2011. Approximately 5.58 km<sup>2</sup> (1.63 nm<sup>2</sup>) of area was surveyed along 60.87 km (32.87 nm) of transects and 1,829 potential derelict gear targets were identified in Canadian waters and another 350 derelict crab pot targets were identified in U.S. waters for a total of 2,179 derelict crab pot targets (Figure 1). The observed derelict gear target density was 390.5 targets per square kilometer, the highest reported derelict crab pot density encountered by the NWSI in eight years of derelict fishing gear surveys. The survey was

conducted at depths ranging from -3 m (10 ft) to -14 m (-46 ft) MLLW. Of the 1,829 derelict crab pot targets identified in Canadian waters, 787 targets (43%) were identified as unburied pots sitting upright on the seabed and possibly actively fishing and 1,042 targets (57%) as partially or completely buried or degraded and probably not actively fishing. In Canadian waters, derelict crab pot targets were most abundant immediately north of the international border and less abundant farther north toward White Rock and Ocean Park.

### *Derelict Crab Pot Removal*

A total of four days of diving for derelict pot removal occurred between February 19 and 22, 2011, in Semiahmoo Bay. The dive recovery vessel operated out of Blaine, Washington. A total of 218 derelict crab pots were removed (214 pots) or disabled and left in place (4 pots) during the four removal days. Of the 218 derelict crab pots removed or disabled, 137 pots were identified as unburied pot targets and 6 pots were identified from the buried targets during the sidescan sonar survey. An additional 76 derelict pots were encountered and disabled or removed in addition to the sidescan sonar targets (Figure 2). The additional derelict crab pots found in addition to the sidescan sonar targets represented targets that had more than one derelict pot at a location. In some cases sidescan sonar targets represented up to three actual derelict pots entangled with each other. After removal operations, 650 unburied and 1,036 partially or completely buried derelict pot targets remained from the sidescan sonar survey. All of the derelict crab pots removed were commercial pots with the exception of one wire sport pot. All except two of the commercial pots removed or disabled were the typical British Columbia style pots with metal rebar frames and nylon netting. Two U.S.-style rebar frame and stainless steel wire mesh pots were also removed.

Twenty-one pots (10%) of the 218 derelict pots encountered were actively fishing and 197 (90%) pots were no longer actively fishing. Of the 21 derelict pots actively fishing, 12 pots (57%) were not equipped with proper rot cord (cotton escape cord), six pots (29%) had escape cord but the cord was still intact and on three pots (14%) the escape cord had deteriorated but the lids of pots were held shut by metridium anemones (*Metridium giganteum*) growing on the pot rims. Of the 197 pots not actively fishing 180 (91%) had been equipped with rot cord that was deteriorated and 17 pots (9%) were too deteriorated to determine if rot cord had been used or not.

Of the 218 derelict pots encountered, 14 pots (6%) contained a total of 64 Dungeness crab (*Cancer magister*) and 31 pots (14%) contained 36 red rock crab (*Cancer productus*) (Table 1). Of the 64 Dungeness crab recovered, 17 (27%) were dead and 47 (73%) were live. Five (14%) of the 36 red rock crab recovered were dead and 31 (86%) were live. A total of 59 (59%) of the Dungeness and red rock crabs recovered were from actively fishing pots and 41 (41%) were from pots considered to be no longer actively fishing. All of the twelve pots (6%) without rot cord were actively fishing and contained one live red rock crab and one dead Dungeness crab.

In addition to the 100 Dungeness and red rock crab recovered from the pots, 14 additional

live animals were encountered in the 218 pots including two staghorn sculpins (*Leptocottus armatus*), one starry flounder (*Platichthys stellatus*), four sunflower stars (*Pycnopodia helianthoides*), three California sea cucumbers (*Parastichopus californicus*), two graceful crabs (*Cancer gracilis*) and two mottled stars (*Evasterias troschelii*) (Table 2). Numerous metridium anemones (*Metridium giganteum*) were observed growing on many of the pots. See project photos below.

### *Derelict Net Removal*

Derelict net removal operations were conducted on February 18, 2011. Divers investigated a report of a large derelict net on a rock pinnacle off the south end of North Pender Island at 48°44.061' North latitude and 123°14.779' West longitude (Figure 3). The net was identified as a large salmon purse seine net by the netting material, the mesh size and the presence of brass seine rings and a heavy purse line. The net was estimated to cover 25,000 m<sup>2</sup> (6.2 acres) of seabed. The seabed was characterized as high relief rocky reef substrate. The net was located in water 23 m (76 ft) on the top of the pinnacle sloping down the western side to at depth of 32 m (105 ft). The net covered approximately 40% of the pinnacle that is approximately 65,000 m<sup>2</sup> (16 acres) in diameter. The net was suspended approximately 0.6 m (2 ft) off the seabed where it draped over rocks on the seabed. Approximately 50% or 12,500 m<sup>2</sup> (3.1 acres) of the derelict net was removed during the removal operations. The remaining net is approximately 68.5 m (225 ft) wide by 183 m (600 ft) long and is located on the southwestern side of the pinnacle at water depths of 26 m (85 ft) to 32 m (105 ft).

The derelict net had been first reported more than 20 years ago (personal communication Mr. Tomas Tomascik, Parks Canada). A subjective analysis of the relative condition of the net found it was in good condition and likely to remain lethal. The net also covered much of the high relief rocky substrate on the pinnacle preventing access to the underlying habitat. The derelict purse seine net encountered was still capable of entanglement and causing mortality of marine organisms. The derelict net also likely presented a hazard to divers, sport fishing gear and vessel anchoring. Both sport fishing gear and an anchor were found entangled in the net and were recovered.

A total of 1,799 live and dead animals were recovered from the portion of the derelict net removed during the project. Dead animals included two unidentified fish, one quillback rockfish (*Sebastes maliger*), 60 butter clams (*Saxidomus gigantea*) and ten smooth pink scallops (*Chlamys rubida*) (Table 3). Live animals included animals living on the net such as spiny sea squirts (*Halocynthia hilgendorfi igaboja*) and lamp shells (*Terebratalia transversa*) as well as animals recovered while grazing on the net such as California sea cucumbers (*Parastichopus californicus*), blood stars (*Henricia leviuscula*), sunflower stars (*Pycnopodia helianthoides*), green sea urchins (*Strongylocentrotus droebachiensis*) and Oregon tritons (*Fusitriton oregonensis*) (Table 3).

The derelict net was disposed of in the Whatcom County landfill. The total weight of the derelict net removed was estimated at 608 kg (1,340 lbs).

## **Conclusions**

### *Derelict Crab Pots*

The derelict crab pot target density of 390.5 targets/km<sup>2</sup> found during the project in the Canadian waters of Semiahmoo Bay is nearly three times higher than derelict crab pot densities ever recorded by the NWSI in US waters of the Salish Sea. The sidescan sonar survey underestimated the density of derelict pots in the area surveyed since in many cases individual sidescan sonar targets yielded more than one derelict pot. On average sidescan sonar targets yielded 1.5 derelict pots per target (143 targets investigated and 218 derelict pots removed or disabled). Therefore, the density of derelict crab pots in the area surveyed is more likely nearer 586 pots/km<sup>2</sup>.

The compliance with escape cord regulations based on pots observed during the removal operations was about 95% in Canadian waters compared with 80% compliance in U.S. waters of the Salish Sea based on previous crab pot removals. The high compliance with rot cord regulations accounts for the relatively low percentage (10%) of derelict pots that were actively fishing compared with 38% that were actively fishing in U.S. waters. Of the 218 derelict pots removed, 202 (93%) remained in relative good condition and may have continued to actively catch and kill crabs had they not been equipped with rot cord.

Actively fishing pots accounted for 59% of the total Dungeness and red rock crab found in the derelict pots. Inactive pots that were disabled due to rot cord deterioration accounted for 41% of the total crab encountered and 59% of the dead crab found, indicating crab entering a disabled pot may die before finding the escape panel.

Observations during derelict crab pot removal operations indicated one likely cause of crab pot loss was long float lines that entangled with other float lines in shallow water. In a number of instances float lines were in excess of 30 m (100 ft) long whereas the pots were fished in water less than 10 m (30 ft) deep. Tangled float lines can result in loss of floats and derelict pots.

Based on the average daily recovery rate of 54.5 derelict crab pots per day, it would require an additional 12 days of removal work to investigate the remaining 650 unburied derelict crab pot targets identified during the sidescan sonar survey.

### *Derelict Net*

A subjective analysis of the relative condition of the derelict purse seine net that was partially removed indicated it was in relatively good condition and the degree of suspension off the seabed (up to 0.6 m) has been generally correlated with the lethality of the nets from past removal operations. The derelict net was first reported more than 20 years ago (personal communication Mr. Tomas Tomascik, BC Parks). The data collection effort on board the removal vessel only recorded what was actually observed entangled in the net by the divers or what was removed from the nets onboard the vessel.

This methodology likely underestimated the overall entanglement and mortality rate associated with this gear. The presence of sunflower starfish (*Pycnopodia helianthoides*) on the derelict net indicates that animals were entrapped and killed and eaten by the starfish. Animals that become entangled in a derelict net and die are believed to either decompose rather rapidly or are eaten by other animals within ten days to two weeks after capture.<sup>1</sup> These observations are supported by recent derelict net tagging studies conducted by the NWSI. The derelict net removed during this project has likely killed large numbers of fish, invertebrates and possibly sea birds and marine mammals in the 20 years it has been in place. Although derelict nets can provide substrate for a number of sessile invertebrates, large nets block access to substantial amounts of important habitat for fish and other animals and may be a threat to divers, sport fishing gear and vessel anchoring.

The remaining derelict purse seine is likely to continue to entangle and kill marine animals until removed. It is estimated that 1 to 1.5 days of additional diver removal effort would be necessary to complete the net removal.

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<sup>1</sup> Gilardi, K.V.K., D. Carlson-Bremer, J.A. June, K. Antonelis, G. Broadhurst, and T. Cowan. 2009. Marine species mortality in derelict fishing nets in Puget Sound, WA and the cost/benefits of derelict net removal. *Marine Pollution Bulletin*. doi:10.1016/j.marpolbul.2009.10.016.

Table 1. Number of derelict pots recovered, type of pot (commercial or sport), fishing status (actively fishing or not), rot cord use and numbers of live and dead organisms observed during the 2011 British Columbia derelict fishing gear survey and removal project. Source: NRC.

Fishing/Not Fishing	Actively Fishing			Not Fishing				All Pots			
	Rot Cord	No Rot Cord	Total	Rot Cord	No Rot Cord	Unknown	Total	Rot Cord	No Rot Cord	Unknown	Total
<b>Commercial</b>											
# Pots Recovered	9	12	21	180	0	16	196	189	12	16	217
# Dungeness Crab Dead	8	1	9	8	0	0	8	16	1	0	17
# Dungeness Crab Alive	44	0	44	3	0	0	3	47	0	0	47
# Red Rock Crab Dead	0	0	0	5	0	0	5	5	0	0	5
# Red Rock Crab Alive	1	5	6	25	0	0	25	26	5	0	31
# Total Crab Dead	8	1	9	13	0	0	13	21	1	0	22
# Total Crab Alive	45	5	50	28	0	0	28	73	5	0	78
<b>Sport</b>											
# Pots Recovered	0	0	0	0	0	1	1	0	0	1	1
# Dungeness Crab Dead	0	0	0	0	0	0	0	0	0	0	0
# Dungeness Crab Alive	0	0	0	0	0	0	0	0	0	0	0
# Red Rock Crab Dead	0	0	0	0	0	0	0	0	0	0	0
# Red Rock Crab Alive	0	0	0	0	0	0	0	0	0	0	0
# Total Crab Dead	0	0	0	0	0	0	0	0	0	0	0
# Total Crab Alive	0	0	0	0	0	0	0	0	0	0	0
<b>All Pots</b>											
# Pots Recovered	9	12	21	180	0	17	197	189	12	17	218
# Dungeness Crab Dead	8	1	9	8	0	0	8	16	1	0	17
# Dungeness Crab Alive	44	0	44	3	0	0	3	47	0	0	47
# Red Rock Crab Dead	0	0	0	5	0	0	5	5	0	0	5
# Red Rock Crab Alive	1	5	6	25	0	0	25	26	5	0	31
# Total Crab Dead	8	1	9	13	0	0	13	21	1	0	22
# Total Crab Alive	45	5	50	28	0	0	28	73	5	0	78
# Total Crab	53	6	59	41	0	0	41	94	6	0	100

Table 2. Number of live and dead organisms encountered in a derelict crab pots removed or disabled during the 2011 British Columbia derelict fishing gear survey and removal project. Source: NRC, Inc.

<b>Group</b>	<b>Species Common</b>	<b>Species Scientific</b>	<b>Sum of # Alive</b>	<b>Sum of # Dead</b>	<b>Total</b>
<b>Fish</b>	staghorn sculpin	Leptocottus armatus	2	0	2
	starry flounder	Platichthys stellatus	1	0	1
	<b>Fish Total</b>		3	0	3
<b>Invertebrate</b>	California sea cucumber	Parastichopus californicus	3		3
	Dungeness crab	Cancer magister	47	17	64
	graceful crab	Cancer gracilis	2		2
	mottled star	Evasterias troschelii	2		2
	red rock crab	Cancer productus	31	5	36
	sunflower star	Pycnopodia helianthoides	4		4
<b>Invertebrate Total</b>		89	22	111	
<b>Grand Total</b>		92	22	114	

Table 3. Number of live and dead organisms encountered in a derelict purse seine net partially removed during the 2011 British Columbia derelict fishing gear survey and removal project. Source: NRC, Inc.

Group	Species Common	Species Scientific	Sum of # Alive	Sum of # Dead	Total
<b>Fish</b>	fish unid.		0	2	2
	quillback rockfish	Sebastes maliger	0	1	1
	<b>Fish Total</b>		0	3	3
<b>Invertebrate</b>	blood star	Henricia leviuscula	35	0	35
	butter clam	Saxidomus gigantea	0	60	60
	California sea cucumber	Parastichopus californicus	130	0	130
	green sea urchin	Strongylocentrotus droebachiensis	20	0	20
	lampshell	Terebratalia transversa	500	0	500
	Oregon triton	Fusitriton oregonensis	14	0	14
	smooth pink scallop	Chlamys rubida	25	10	35
	spiny sea squirt	Halocynthia hilgendorfi igaboja	1,000	0	1,000
	sunflower star	Pycnopodia helianthoides	2	0	2
<b>Invertebrate Total</b>		1,726	70	1,796	
<b>Coral</b>	hydroid coral	Abietinaria greenei	N/A	N/A	N/A
<b>Grand Total</b>		1,726	73	1,799	

Figure 1. The location in Semiahmoo Bay of sidescan sonar survey and derelict crab pot targets encountered during the 2011 British Columbia derelict fishing gear survey and removal project. Source: NRC, Inc.

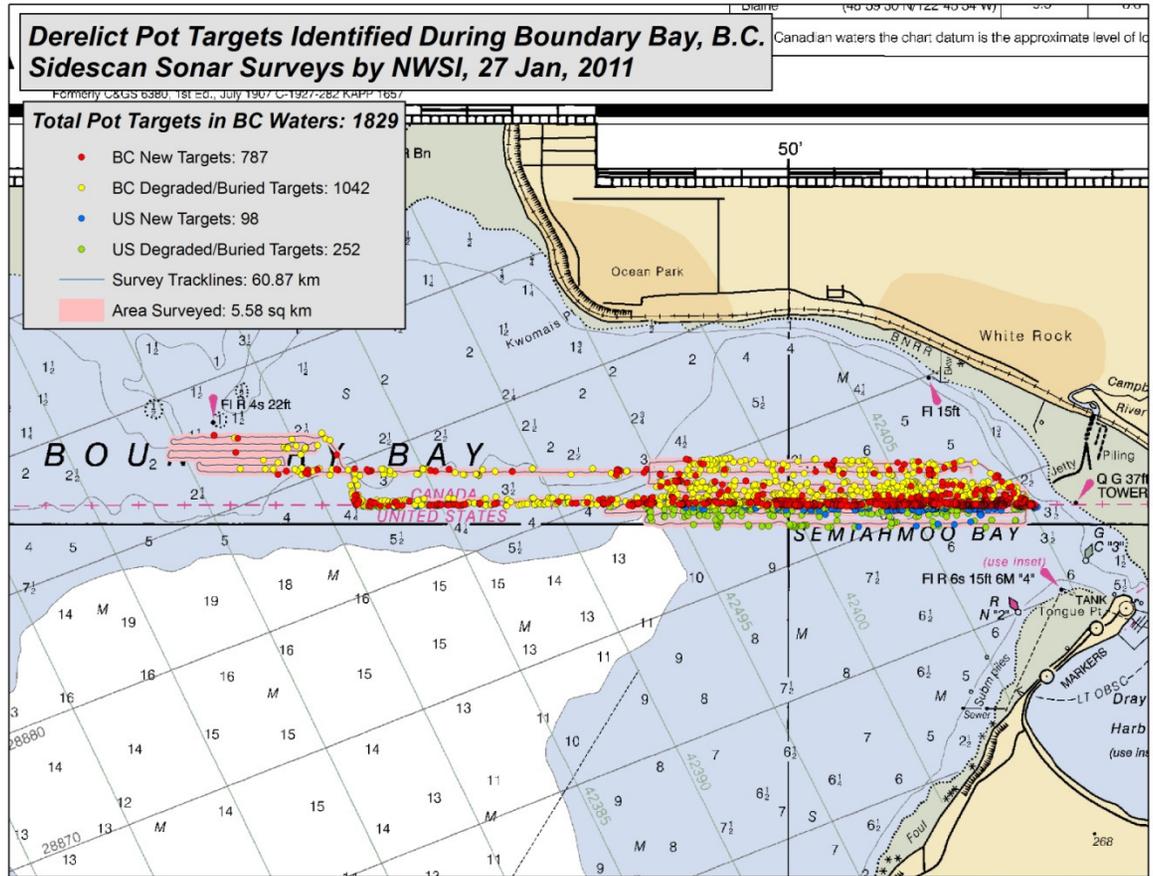


Figure 2. Derelict crab pots removed or disabled (red dot) and sidescan sonar targets remaining after removal operations in Semiahmoo Bay during the 2011 British Columbia derelict fishing gear survey and removal project. Source: NRC, Inc.

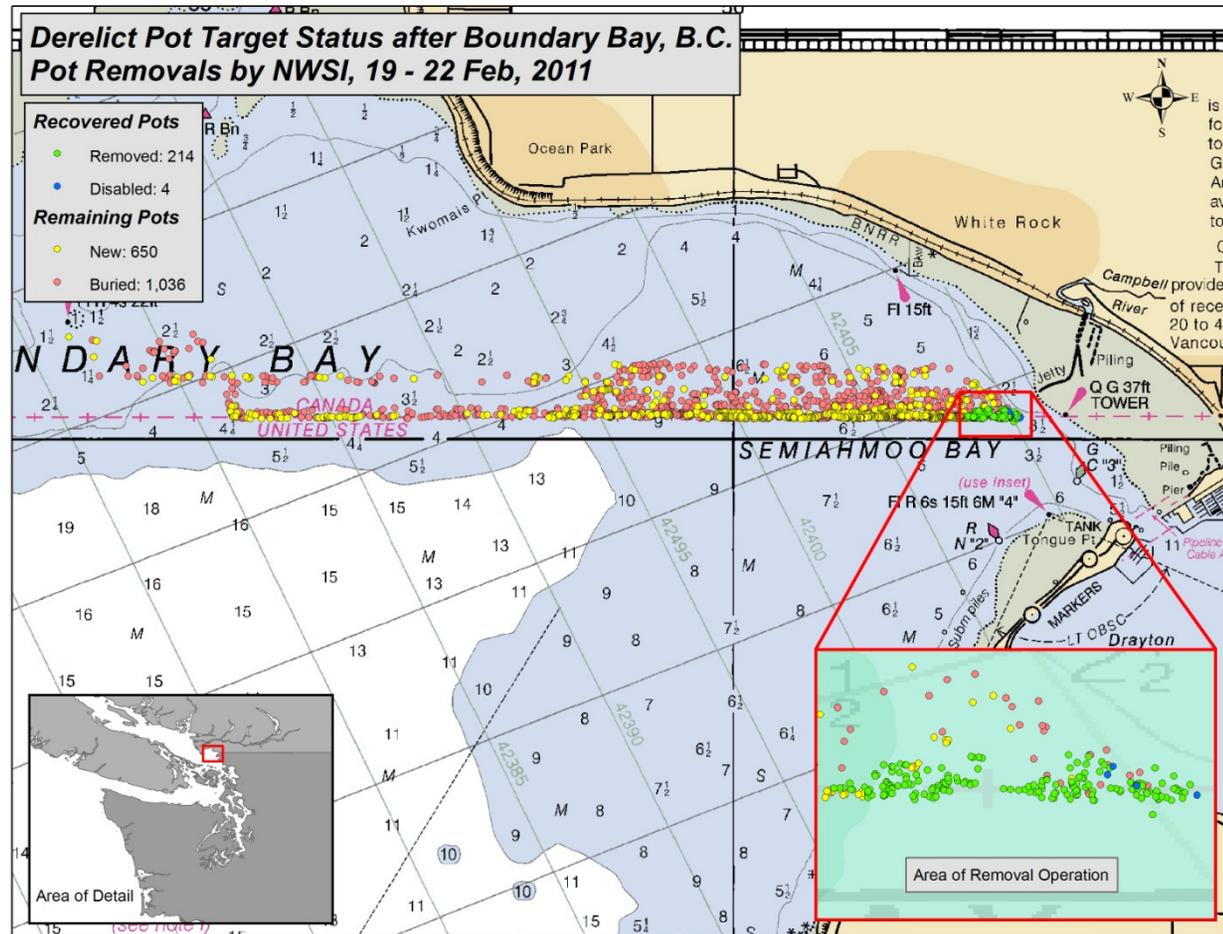


Figure 3. The location off North Pender Island of a derelict purse seine net partially removed during the 2011 British Columbia derelict fishing gear survey and removal project. Source: NRC, Inc.

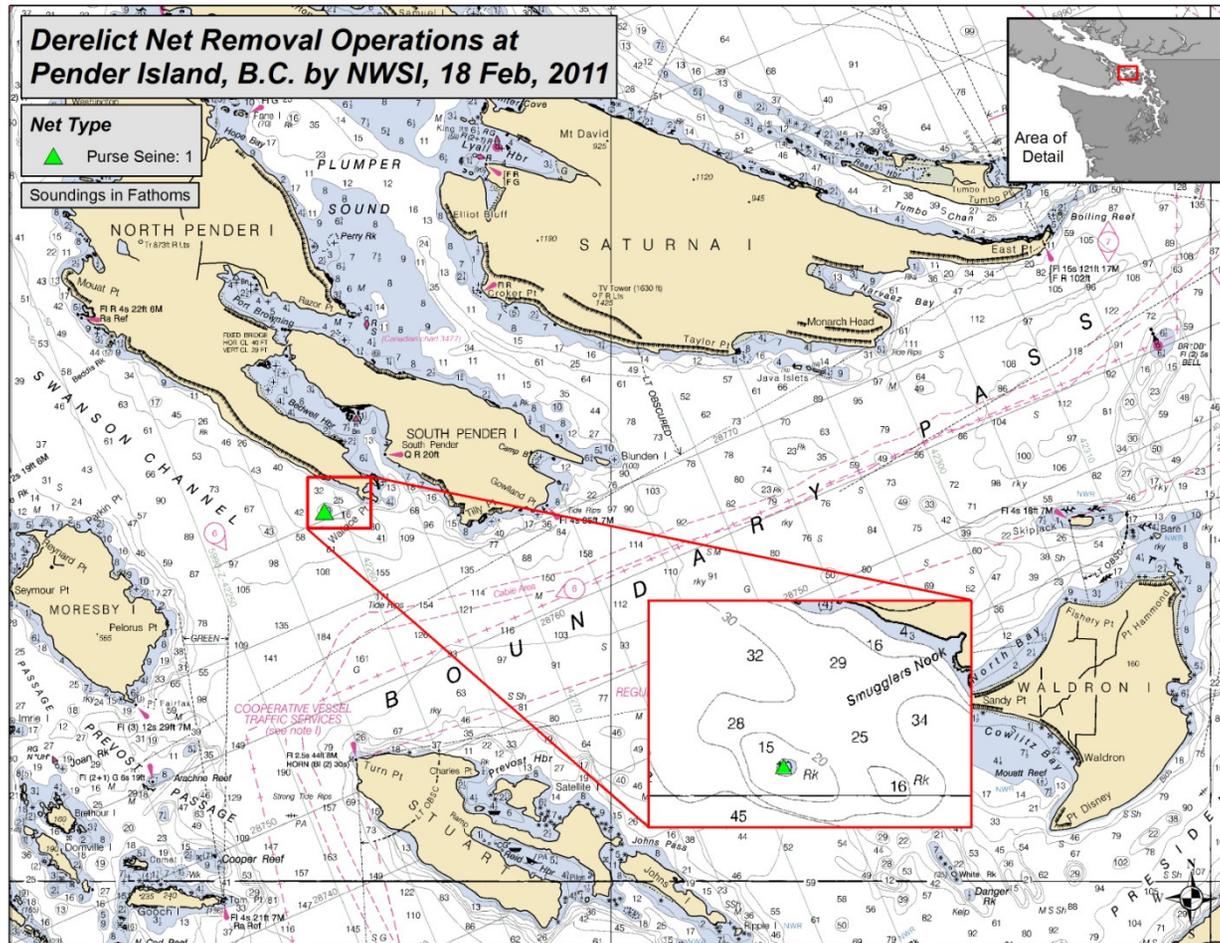


Photo 1. Removal diver prepares to enter the water to remove derelict crab pots in Semiahmoo Bay



Photo 2. A derelict pot that was still actively fishing crabs is hauled aboard the removal vessel.



Photo 3. Derelict crab pots are stacked on the vessel prior to offloading, transport and disposal

