



FINAL REPORT

PUGET SOUND 2013/2014 DERELICT CRAB POT REMOVAL PROJECT

Prepared for:

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Prepared by:

Northwest Straits Foundation and
Natural Resources Consultants, Inc.

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Introduction

Abandoned, lost and discarded crab pots cause negative economic and environmental impacts in Puget Sound every year. Crab pots are lost for a variety of reasons: operator error, gear malfunctions, entanglement with debris, vessel strikes and vandalism. Negative impacts include reduced harvest and lost harvest revenue, entrapment and death of Dungeness crab (*Cancer magister*) and other non-target species, degradation of marine habitat, and hazards to navigation. Identification, location and safe removal of derelict crab pots eliminates impacts from lost gear.

The goals of the Puget Sound 2013/2014 derelict fishing gear project were to locate and remove derelict crab pots in commonly fished commercial, tribal and recreational Dungeness crab fishing areas where a relatively high concentration of derelict crab pots exist. Project personnel and WDFW shellfish managers chose Dungeness Bay, Boundary Bay and Port Townsend as the project worksites. In addition to the standard gear characteristic and impact (species entrapped) information collected and summarized; in the Port Townsend area, investigations consisting of in-water and out-of-water analysis of each derelict crab pot and their components were conducted to determine the most likely cause for pot loss. Additionally, derelict crab pot removal data summarizing number of derelict pots present and escape cord compliance in Dungeness Bay, Boundary Bay and Port Townsend has been provided here. Combined, these report components determine the extent of derelict pot gear and their associated impacts in the area, and identify the practices of the recreational and commercial fishers utilizing these fishing grounds.

Funding from the Washington Department of Fish and Wildlife (WDFW) was provided to the NWSF for derelict crab pot survey and removal operations. The NWSF contracted with Natural Resources Consultants, Inc. (NRC), to manage the project. The removal operations were coordinated with the WDFW, Tribal governments, NOAA, the U.S. Fish and Wildlife Service (USFWS) and the U.S. Coast Guard (USGC).

Scope of Work

The project consisted of eleven days of sidescan sonar survey fieldwork in the Dungeness Bay, Boundary Bay and Port Townsend Bay areas, with an associated 2.55 days of post-survey processing. Survey operations in each area were followed by dive removal operations equaling in total 24 days of dive removal for derelict crab pot targets, one day of transit, and 1.5 total days of offload. Dive removal operations were conducted in the commonly fished areas of Dungeness Bay, Boundary Bay and greater Port Townsend, from Point Hudson to Port Townsend Canal. During derelict gear removal operations for the Port Townsend portion of the project, project personnel increased data collection methods to include a visual analysis of the derelict gear removed to estimate the reason for pot loss for each target.

Methodology

Sidescan Sonar Survey

Fenn Enterprises performed the sidescan sonar surveys on June 14th and 15th, 2013 in Dungeness bay, followed by 0.3 days of post-survey processing. Sonar surveys in Boundary Bay were conducted on June 18th and 19th, 2013, followed by 0.5 days of post-survey processing, while surveys in Port Townsend were conducted May 28 – 31 and June 26 and 29, 2014, followed by 0.5 days of post-survey processing. A Marine Sonic sidescan sonar system operating at 600 kHz with a differential global positioning system (DGPS) was used during the survey to locate derelict fishing gear. The sonar system employed a heavy towfish, towed off the bow of an 8 m (26 ft) survey vessel. A hydraulic winch and cable controlled the depth of the towfish. The sidescan sonar image was projected on a monitor onboard the vessel and recorded onto a computer hard drive for later processing.

The sidescan sonar surveys were conducted at an average speed of 4.63 km/hr (2.5 knots) with a sonar signal range of 50 m on both sides of the vessel for an approximate path width of 100 m (328 ft). Survey depths generally ranged from about 3 m (10 ft) to 32 m (105 ft) in order to identify derelict fishing gear within the dive depth capabilities of the recovery team.

The intent of the 2013 and 2014 sidescan sonar surveys was to locate derelict crab pots to be removed from the Dungeness Bay, Boundary Bay and Port Townsend Bay areas and to determine derelict crab pot densities in the area. Counts and precise locations of derelict fishing gear were recorded during post-survey processing of the data. The products from the sidescan sonar survey included a trackline file of the area surveyed, calculation of the area covered and the positions (latitude and longitude) of likely derelict fishing gear targets found.



Diver Joe Chang of the F/V Bet-Sea with a stack of derelict crab pots removed from Dungeness Bay in June 2013.

Derelict Fishing Gear Removal

Doug Monk Diving was contracted to conduct all of the dive recovery operations of crab pots in Dungeness Bay and Port Townsend, and conducted two and a half of the eight days of removal in Boundary Bay. Two divers equipped with surface supplied air operated off a 12 m (40 ft) dive support and gear recovery vessel, the F/V *Bet-Sea*. Fenn Enterprises was contracted to conduct

the other 5.5 days of the dive recovery operations of crab pots in Boundary Bay. Two divers equipped with SCUBA operated off the 12 m (40 ft) dive support and gear recovery vessel, the R/V *Surveyor II*. Derelict gear target locations derived from the sidescan sonar survey were transferred into electronic navigation software (Nobeltec®) as waypoints and plotted over navigation charts of the Dungeness Bay, Boundary Bay and Port Townsend area.

Using the wide area augmentation (WAAS) GPS system with Nobeltec software, each dive support vessel was directed to the exact location of the potential derelict gear targets. When the vessel arrived at the target location, a clump weight with a line and float was deployed at the target location. The dive support vessel drifted nearby and a single diver was deployed, while a safety backup diver stood by on deck. A 30 m (100 ft) length of rope was passed through a loop on the rope near the clump weight and the diver held the other end. Typically the clump weight landed within two meters of the derelict gear target and the diver visually located the derelict pot. However, in poor water visibility conditions, 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. The derelict gear was freed by hand by the diver and a recovery line from the vessel was attached and it was hauled aboard the recovery vessel with a hydraulic winch.

A variety of information about the derelict crab pot was reported by the diver to the biologist or observed directly onboard the support vessel. Information collected included whether the derelict pot was commercial or sport, whether it was equipped with escape cord, whether the gear was actively fishing or not and the number of live and dead Dungeness crab and other crab and fish entrapped. Also reported was information about the overall condition of the gear, the depth and type of seabed where the gear was located, and in Port Townsend if there was any evidence that would elucidate the reason the pot was lost. The biologist also searched owner identification, and if present, recorded contact information that was later used to coordinate returning gear items to their owners.

During removal operations in Dungeness Bay, derelict fishing gear was stored on the recovery vessel in the John Wayne Marina until it was either returned to owners, transferred to a secure location for storage until being returned to owners, or disposed of at the Clallam County Regional Transfer Station. In Boundary Bay, derelict fishing gear was stored in a locked secure

Pots defined as “fishable” or “actively fishing” remain structurally viable and were either equipped with legal escape cord that had not yet deteriorated, were never equipped with legal escape cord, or were equipped with legal escape cord that had deteriorated, but for some reason was not disabled (i.e., biofouling keeping the escape door closed). Any pot that does not have an egress route for crab to escape entrapment through are considered “fishable” or “actively fishing”. Not all fishable pots contain crab in them at the time of removal, and some non-fishable pots do contain crab in them. To read about current research being conducted on “non-fishable” pots continuing to hold crab. [click here](#).

waste container in the parking lot of the Port of Bellingham - Blaine Harbor Marina until disposal at the Bellingham Recycling and Transfer Station. In Port Townsend, derelict fishing gear was stored on the recovery vessel in the Port Townsend Marina until it was either returned to owners, transferred to a secure location for storage until being returned to owners on a later day, or disposed of at Midway Metals recycling center. In all cases, if the owner of the pot could be determined, the owner was contacted and allowed the opportunity to recover their fishing gear at no cost. Pots that remained in good condition and were not claimed by owners were stored in a secure location for potential future use. Re-usable crab pots without any identification were given to members of the Jefferson County Marine Resource Committee as well as some members of the general public that inquired about the crab pots during off-loading procedures at the marinas.

Investigating Reasons for Pot Loss: Port Townsend

In order to successfully address the derelict crab pot issue in the Puget Sound region, it is important to understand why pots are being lost. The reasons for pot loss are many, and may vary depending on area, and typically the full story behind each lost pot cannot be found through inspecting a derelict crab pot. However, much information about the probable reasons for pot loss can be found by investigating the gear both underwater and out-of-water. Therefore, in addition to the standard data collection methods performed by NRC during derelict crab pot removal operations in Port Townsend, careful attention was given to investigating the reason for pot loss. The anticipated reasons for

pot loss were divided into eight categories: (1) line length to water depth mismatch, (2) vessel strike, (3) barge strike, (4) tampering / sabotage, (5) gear malfunction/user error, (6) entanglement with other gear, (7) entanglement with non-gear, and (8) unknown. Divers were instructed to report to the biologist any visual evidence they may witness underwater that would explain why the pot was lost. At the surface, the onboard biologist further inspected the pot and its components (i.e., harness, clips, buoy lines, etc.), looking for signs that could determine how each pot was lost; such as broken gear components, cut or tangled buoy lines, evidence of tampering or sabotage, significant structural damage and more. Photographs of most removed crab pot were taken for future reference and further investigations, if needed.



This pot, removed from Port Townsend in June 2014 was identified to have been lost by tampering or sabotage, evident by the coiled line and buoy found inside the pot.

Results

Sidescan Sonar Survey and Pot Removals: Dungeness Bay

In the two days of sidescan sonar surveys conducted in Dungeness Bay on June 14 and 15, 2013, 4.71 km² were covered and 103 potential derelict crab pot targets were detected or 21.88 targets/km². One debris item was identified, one target was investigated and nothing was found, and one target was identified as duplicates of adjacent targets detected on alternative survey transects. A total of 100 of the original targets were found to be derelict fishing gear (98 crab pots, 2 shrimp pots) that were removed by divers, and two additional shrimp pots were found within close proximity to sidescan targets and removed during dive operations for a total of 102 derelict pots removed (Table 1). Eliminating the known debris items, targets not found, and actively fishing pots not present at total of 102 derelict crab pot targets were identified or 21.65 targets/ km² (Figure 1). Table 1 provides the characteristics of pots removed in Dungeness Bay.

Sidescan Sonar Survey and Pot Removals: Boundary Bay

In the two days of sidescan sonar surveys conducted in Boundary Bay on June 18 and 19, 2013, 5.45km² were covered. A total of 780 derelict crab pot targets were detected during the surveys; 430 of which were found within 250 meters of the US – Canada Border, while the other 350 were found on the fishing grounds just west of Semiahmoo Spit. The derelict crab pot density in this area equaled 143.12 targets/km². Circumstantially, during surveys along the US – Canada border, the sonar survey path width extended into Canadian waters, where an additional 788 derelict pot targets were identified over an area of 0.63 km²; for a target density of 1,250.79 targets/km². Targets in Canadian waters were not investigated. Thirteen potential crab pot targets proved to be debris such as, anchors, bundles of line, concrete blocks, cables and chain. Eleven targets were investigated but nothing was found, two targets found buried in sediment were disabled and left in place, three targets were identified as duplicates of adjacent targets detected on alternative survey transects, and 536 targets were not investigated due to time limitations. A total of 230 targets were found to be derelict fishing gear (228 crab pots and 2 crab lines) that were removed or disabled by divers and three additional derelict pots were found within close proximity to sidescan targets and removed during dive operations (Figure 2). Table 2 provides the characteristics of the derelict pots removed in Boundary Bay.

A “disabled” pot is one that is no longer fishing. A pot typically becomes disabled at the point of escape cord degradation, when an egress route becomes available for entrapped crab to escape through. If a significant portion of a derelict pot is buried in the sediment, project divers will at times choose to disable the pot rather than removing it. This is done by cutting the escape cord or a portion of the pot’s mesh, ensuring that an escape route is available for crab that enter the pot.

It is worth noting that of the 231 crab pots removed in US waters of Boundary Bay, 67 (29%) of them were identified by DFO ID tags as pots originating from Canadian fisheries. These pots were all found within 200 meters of the US – Canada border. Based on the style of pots used in the Canadian fishery, several other recovered pots that did not contain DFO ID tags appeared to also be from the Canadian fishery rather than the US and Tribal fisheries.

Sidescan Sonar Survey and Pot Removals: Port Townsend

In the eight days of sidescan sonar surveys conducted in Port Townsend on May 28 – 31 and June 26 and 29, 2014, 16.59 km² were covered and 409 potential derelict crab pot targets and one other debris item were detected or 24.7 targets/km². Twenty of the investigated sidescan targets proved to be non-fishing gear related debris, 18 of which were left in place. These included five boulders of similar shape and size to a crab pot, four tires, two piles of multiple milk crates, two individual milk crates (removed), five small structures associated with mooring blocks, one large steel cage (10' x 4' x 3') and one steel cable with a loop in it. A total of 313 of the original targets were found to be derelict crab pots, one was a derelict crab ring, one was a coil of crab line, three were derelict shrimp pots and one was a mesh aquaculture bag; all of which were removed by divers. Sixteen additional pots were found within close proximity to sidescan targets and removed during dive operations, and three abandoned pots were identified by their buoys and removed for a total of 332 derelict crab pots removed (Figure 3). One large derelict aquaculture net was found at the target identified as debris, which was removed during a separate project. No derelict fishing gear items or other debris were found at 16 of the 356 investigated targets, and 54 targets were not investigated. Table 3 provides the characteristics of pots removed in Port Townsend.



This commercial style pot had not been equipped with legal escape cord. A total of 21 Dungeness crab were found entrapped inside this pot, without an escape route

Sidescan Sonar Survey and Pot Removals: Dungeness Bay, Boundary Bay and Port Townsend

In the 11 days of sidescan sonar surveys conducted in the Dungeness Bay, Boundary Bay and Port Townsend area, 26.75 km² were covered and 1,292 potential derelict crab pot targets were detected or 48.30 targets/km². Thirty-four potential crab pot targets proved to be non-fishing gear related debris. Twenty-eight targets were investigated but nothing was found, two targets found buried in sediment were disabled and left in place, four targets were identified as duplicates of adjacent targets, and 590 targets were not investigated due to time limitations and location. A total of 647 of the original targets were found to be derelict fishing gear (639 crab pots, 5 shrimp pot, 3 coils of crab line, 1 mesh aquaculture bag and 1 crab ring) that were removed or disabled by divers, and 19 additional crab pots and two shrimp pots were found within close proximity to sidescan targets and removed during dive operations. Table 4 provides

the characteristics of derelict pots removed in Dungeness Bay, Boundary Bay and Port Townsend combined.

Derelict Crab Pot Removal: Dungeness Bay, Boundary Bay and Port Townsend

Derelict fishing gear was removed from Dungeness Bay on June 17 through 20, 2013, from Boundary Bay June 21 through 23, 25 through 27, July 17 through 19, 2013, and in Port Townsend June 3, 10 through 13, 20, 21, 23 through 25, 30, July 1, 2, 2014. A total of 661 crab pots, seven shrimp pots, three crab lines, one crab ring and one aquaculture bag were removed. A total of 639 of the derelict crab pots, five shrimp pots, three crab lines, one aquaculture bag and one crab ring removed were identified in the sidescan sonar surveys, and 19 derelict pots and two shrimp pots, not identified in the survey were found adjacent to surveyed pots and removed. An additional three abandoned pots were identified by their buoys and removed as well. Derelict crab pots were removed from water depths ranging from 3 m (10 ft) to 23.5 m (86 ft) from mud and mixed sand/mud substrate.



This recreational style crab pot removed in Dungeness Bay had not been equipped with legal escape cord. A total of nine Dungeness crab were found entrapped in this pot

Dungeness Bay

A total of 98 derelict crab pots were removed in Dungeness Bay during the project including 47 (48%) commercial and 51 (52%) sport pots (Table 1). Twenty-seven (28%) pots were fishable and 71 (72%) were not fishable. A total of 67 (68%) pots were determined to be equipped with proper escape cord (rot cord), 23 (23%) were not equipped with proper escape cord and on eight (8%) the use of escape cord could not be determined. Of the 27 actively fishing pots removed, 18 (67%) were not equipped with escape cord and nine (33%) did have escape cord. Of the 71 disabled derelict pots removed, 58 (82%) were equipped with escape cord, five (7%) were found without escape cord and on eight (11%) of the pots escape cord use could not be determined due to the condition of the pot.

A total of 104 crabs were found in the 98 derelict pots removed from Dungeness Bay. Dungeness crab (*Cancer magister*) totaled 87 of which seven (8%) were dead and 80 (92%) were alive. Seventeen red rock crab (*Cancer productus*) were recovered with two (12%) dead and 15 (88%) alive (Table 1). Actively fishing pots contained 57 (66%) Dungeness crab, including 3 dead and

54 live crab. Derelict pots no longer fishing contained 30 (34%) Dungeness crab including 4 dead and 26 live crab.

Boundary Bay

A total of 231 derelict crab pots were removed or disabled in Boundary Bay during the project including 228 (99%) commercial and 3 (1%) sport pots (Table 2). A total of 46 (20%) pots were actively fishing and 185 (80%) were disabled. A total of 161 (70%) pots were determined to be equipped with proper escape cord (rot cord), 40 (17%) were not equipped with proper escape cord and on 30 (13%) the use of escape cord could not be determined. Of the 46 actively fishing pots removed, 34 (74%) were not equipped with escape cord and 12 (26%) did have escape cord. Of the 185 disabled derelict pots removed, 149 (81%) were equipped with escape cord, 6 (3%) had not been equipped with proper escape cord but the pot was otherwise disabled and on 30 (16%) escape cord use could not be determined due to the condition of the pots.



Diver Ken Woodside on the F/V Bet-Sea with a stack of commercial derelict crab pots removed from Boundary Bay. Several of the pots removed from near the US – Canada border were from the Canadian Fishery.

A total of 182 crabs were found in the 231 derelict pots removed from Boundary Bay. Dungeness crab totaled 154 crab of which 58 (38%) were dead and 96 (62%) were alive. Twenty-eight red rock crab were recovered with 11 (39%) dead and 17 (61%) alive (Table 2). Actively fishing pots contained 123 (80%) Dungeness crab including 43 dead and 80 live crab. Derelict pots no longer actively fishing contained 30 (20%) Dungeness crab including 14 dead and 16 live crab.

Port Townsend

A total of 332 derelict crab pots were removed or disabled in Port Townsend during the project including 73 (22%) commercial pots and 259 (78%) sport pots (Table 3). A total of 60 (18%) pots were actively fishing and 272 (82%) were disabled. A total of 214 pots were determined to be equipped with proper escape cord (rot cord), 76 (23%) were not equipped with proper escape cord and on 42 (13%) the use of escape cord could not be determined. Of the 60 actively fishing pots removed, 44 (73%) were not equipped with escape cord and 16 (27%) did have escape cord. Of the 272 disabled derelict pots removed, 198 (73%) were equipped with escape cord, 32 (12%) had not been equipped with proper escape cord but the pot was otherwise disabled and on 42 (15%) escape cord use could not be determined due to the condition of the pots.

A total of 170 crabs were found in the 331 derelict pots removed from Port Townsend. Dungeness crab totaled 121 crab of which 10 (8%) were dead and 111 (92%) were alive. Forty-nine red rock crab were recovered with 4 (8%) dead and 45 (92%) alive (Table 3). Actively fishing pots contained 104 (86%) Dungeness crab including 4 dead and 100 live crab. Derelict pots no longer actively fishing contained 17 (14%) Dungeness crab including 6 dead and 11 live crab.

Dungeness Bay, Boundary Bay and Port Townsend Combined

Of the 661 derelict pots removed, 348 (53%) were commercial pots and 313 (47%) were sport pots (Table 4). One hundred and thirty-three (20%) pots were determined to be still actively fishing and 528 (80%) were no longer fishing. Of the 661 pots removed, 139 (21%) were not equipped with legal escape cord, 442 (67%) had legal escape cord and 80 (12%) were too deteriorated to determine whether escape cord was used or not. Of the 442 pots equipped with legal escape cord, the escape cord had disintegrated on 405 (92%) and was still intact on 37 (8%) pots (Table 4).

Of the 348 commercial pots recovered, 74 (21%) were not equipped with proper escape cord, 217 (62%) were equipped with escape cord and on 57 (16%) escape cord use could not be determined. Sixty-five (21%) of the 313 sport derelict pots were not equipped with legal escape cord, 225 (72%) did have legal escape cord and on 23 (7%) sport pots escape cord use could not be determined. Of the 133 crab pots found to still be fishing, 96 (72%) were not equipped with proper escape cord and 37 (28%) had legal escape cord that either had yet to deteriorate or were still fishing even after the escape cord had disintegrated due to the pot lid being stuck closed (Figure 4).

Of the 661 derelict pots recovered, 165 (34%) pots contained a total of 362 Dungeness crab and 94 red rock crab (Table 4). Of the 362 Dungeness crab recovered, 287 (79%) were live and 75 (21%) were dead. Forty (11%) of the Dungeness crab recovered were females (26 live and 14 dead), 285 (79%) were males (249 live and 36 dead), and the sex was not determined for 37 (10%) of the Dungeness crab due to either poor shell condition of the crab was observed in the pot by divers but was lost during pot recovery. Seventy-seven (82%) of the 94 red rock crab recovered were live. Derelict pots determined to be still actively fishing contained 284 Dungeness crab (234 live and 50 dead), and 34 red rock crab (23 live and 11 dead). Pots determined to be no longer actively fishing contained 77 Dungeness crab (53 live and 24 dead), and 60 red rock crab (54 live and 6 dead). Crab pots without legal escape cord contained 223



Captain Doug Monk of the F/V Bet-Sea removing Dungeness crab from a recovered derelict pot in Port Townsend. All crab are gently returned to the sea.

(62%) Dungeness crab (183 live and 40 dead), and 31 (33%) of the red rock crab recovered (20 live and 11 dead). Crabs with legal escape cord contained 136 (38%) Dungeness crab (103 live and 33 dead), and 57 (61%) of the red rock crab recovered (53 live and 4 dead) (Table 4).

Other animals found in the crab pots removed or disabled included 13 live sunflower stars (*Pycnopodia helianthoides*), three ochre stars (*Pisaster ochraceus*), two great sculpins (*Myoxocephalus polyacanthocephalus*), two mottled stars (*Evasterias troschelii*) and one live Northern Kelp crab (*Pugettia producta*).



A recovered derelict commercial crab pot un-equipped with escape cord.

Twenty-seven commercial crab pots with owner identification recovered were returned to owners, as well as one recreational pot. Fifty-two recreational pots from Dungeness Bay and Port Townsend that were in good condition and did not have identification were given to members of the Jefferson County Marine Resources Committee (MRC) and other interested members of the public that were in port during the span of pot removal operations. Pots not returned to owners, along with crab rings and other fishing gear that were removed were disposed of or recycled at the Bellingham Clean Green Transfer Station or Midway Metals Recycling Center, where the total weight of gear disposed was approximately 8,835 lbs.

Investigating Reasons for Pot Loss: Port Townsend

Beginning in December 2013, project personnel began the process of investigating and estimating the reason for loss of each pot removed based on observations during removal operations. Based on the information provided by removal divers and inspection of recovered gear on the removal vessel deck, the estimated reason for gear loss was determined for 307 (91%) of the 336 shellfish gear items removed (including three shrimp pots and one crab ring). In cases where the evidence suggested multiple reasons for pot loss, the onboard biologist decided upon the one most likely reason given the evidence while also providing a potential alternate reason for the pot becoming derelict. Of the 336 derelict pots removed, 143 (43%), including three shrimp pots, were determined to have been lost by gear malfunction and/or user error (Table 5). This was often identified by broken gear components (i.e., clips, bridals, buoy sticks, etc.) or insufficient line capacity (too thin). Other evidence suggested that some buoy lines were not correctly attached to the pot, causing the line to release from the pot, and more evidence showed that buoys were released from buoy lines due to knots coming undone or knots being small enough to pass through the center hole of the buoy.

A distinction was made between vessel strikes and barge strikes based on the often mangled condition of relatively new pots, suggesting that their buoys had been snagged by a slow moving vessel (barge) and the pot was dragged across the seafloor until the line severed. Vessel strikes, on the other hand, often exhibit a clean cut of the buoy line from a fast moving propeller, or they leave an extremely wound-up buoy line with a much less clean cut after being wrapped multiple times in a slower-moving propeller and shaft. Vessel strikes were determined to be the cause of pot loss for 120 (36%) of the pots recovered, and were evident by buoy lines being severed and sometimes wound up, near the terminal end to the line. Barge strikes were found to be the cause for 10 (3%) of the recovered pots to be lost (Table 5).



A wound-up buoy line from a recovered derelict crab pot in Port Townsend. This provides evidence that the pot was lost by vessel strike when the buoy line became wrapped in a propeller prior to being cut.

Line length to water depth mismatch was determined to be the cause of loss in 10 (3%) of the 336 pots recovered. Gear lost for this reason were characterized by pot presence in usual crab fishing grounds, with all gear components intact and a buoy line attached that was shorter in length than the depth of the water it was found in.

Evidence of tampering and/or sabotage of other peoples gear was evident in 8 (2%) of the removed pots. The term “suitcased” is used to describe a pot that has been retrieved (probably emptied) and then returned to the water with buoy line coiled and secured with the buoy inside the pot. This was evident in two sport pots and one commercial pot removed, while two recreational pot and two commercial pots were found to have severed buoy lines. One sport crab pot was found with its buoy line removed, rather than severed, and the escape door was deliberately zip-tied open (Table 5).

Seven (2%) of the 336 removed pots seemed to have been lost by entanglement with other gear, as their lines were wrapped with that from another derelict pot. Five (2%) pots, including one crab ring, showed evidence of becoming entangled with debris and other obstructions on the seafloor (entanglement with non-gear) (Table 5). Three crab pots and one crab ring were found to have buoy lines wrapped around old mooring blocks that were no longer in use. One crab pot had a connected buoy at the sea-surface, with the buoy line entangled in remnants of a sunken vessel.

Evidence of crab pots being abandoned or forgotten by the user was evident in four (1%) of the 336 removed pots. Abandonment was characterized by the gear being present and fully functional in usual crab fishing grounds while crab fishing was closed.

Finally, 29 (9%) of the 336 pots removed did not exhibit enough evidence to determine a reason for pot loss, and were therefore categorized as ‘unknown’. Of those 29 pots, six were thought to potentially be lost by gear malfunction and/or user error, four were potentially entangled with other gear and one was potentially sabotaged (Table 5).

Conclusions

During this project we successfully investigated 702 (54%) of original 1,292 sidescan sonar survey targets. Divers removed 649 derelict fishing gear targets found during the sidescan sonar surveys along with 21 others that were not identified in the surveys. Additionally, one derelict aquaculture net identified during sidescan sonar surveys was verified during pot removals and removed during subsequent net removal operations related to a separate project. Escape cord compliance in crab pots where escape cord use could be discerned was 76%, and consistent with the average of 76% from all derelict pots removed during NWSF projects prior to this. Crab pots that were non-compliant with escape cord regulations totaled 139 (21%), yet these pots contained 254 (56%) of the crab found in all pots removed, indicating the importance of compliance with escape cord regulations. The remaining 202 (44%) of the total crab were found in pots that had initially been equipped with proper escape cord (442), or those where escape cord use could not be discerned (80). While the observed number of crabs in pots were considerably higher in those that had not been equipped with legal escape cord, these findings like others prior to this project, show that in many instances crab pots initially equipped with legal escape cord may not be successfully disabled after the escape cord deteriorates.

The Port Townsend portion of this project was the second crab pot removal project conducted by NWSF and NRC where the removal team made efforts to identify the reason for pot loss on each of the derelict pots removed. The first project including this analysis took place in December 2013 in Port Gardner, Snohomish County. Results from this analysis in Port Townsend showed that the two most common reasons for pot loss in the area are either gear malfunction and/or user error (43%) and vessel strikes (36%), similar to findings in Port Gardner 2013 of 33% and 29% , respectively. Other identified reasons for pot loss in Port Townsend were identified were barge strikes, line length to water depth mismatch, tampering or sabotage, entanglement with either other gear or non-gear items, and abandonment; none of which exceeded 3% of the total. Findings from this research can assist resource managers and other interested parties in education and outreach programs to reduce pot gear loss by focusing messages on the main reasons for pot loss.



Dungeness crab entrapped in a recovered derelict crab pot.

Recommendations

Based on the observations and results of the derelict gear removal project and analysis of data from previous years, the following are recommendations to further reduce the impacts of derelict fishing gear on the marine environment.

- Recreational crabbers should be educated on the best fishing practices that prevent crab pot loss. The following is a list of practices that can reduce pot loss:
 - Avoid high vessel traffic areas, ferry, barge and log tow routes
 - Remain near pots during soak time
 - Use weighted buoy lines to reduce potential vessel strikes
 - Use buoy lines of proper length (i.e., 1/3 longer than water depth)
 - Know the depth of water where pots are set

- Use multiple buoys in high current areas to avoid buoy submersion
 - Augment pot weight to avoid pot migration in high currents
 - Leave ample spacing between pot drops to avoid buoy entanglement
- Education programs should include suggestions to recreational fishers to test the durability and functionality of all gear components and knots prior to deploying crab pots, and replace items or re-tie knots if they seem to be compromised or faulty. This could reduce gear loss through gear malfunction and/or user error.
- Education programs should include information regarding proper installation of escape cord; the use of thin vs. thick strands of escape cord and that in order to comply with regulations, escape cord must be made of biodegradable material rather than synthetics such as nylon. In addition, special attention should be placed on the placement of bait clips, bait jars, bridles, etc., that can prevent the opening of a crab pot door despite the deterioration of escape cord.
- The use of legal escape cord on crab pots should continue to be enforced.
- Consider adjusting the definition of legal escape cord to be substantially thinner than what is currently considered legal. This would allow pots to become disabled in a shorter length of time, and therefore reducing the amount of Dungeness crab loss due to derelict pots.
- Pot loss by vessel strike can be reduced by making buoys more visible to vessel operators. In areas of heavy vessel traffic, such as Port Townsend, augmenting pot buoys with brightly colored poles (i.e., PVC pipe either painted bright or with flagging) extruding 16 to 28 inches vertically from the buoy, perpendicular to the sea-surface, would significantly increase the visibility of a buoy to vessel operators, and therefore reduce the amount of pots that are lost by vessel strikes. Such practices should be encouraged in educational programs and outreach opportunities, and could be considered as a potential regulatory requirement in specific locations where vessel strikes are a prominent reason for gear loss.

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Figure 1. Disposition after removal operations of derelict crab pot targets found at Dungeness Bay during the NWSF 2013 - 2014 derelict fishing gear project.

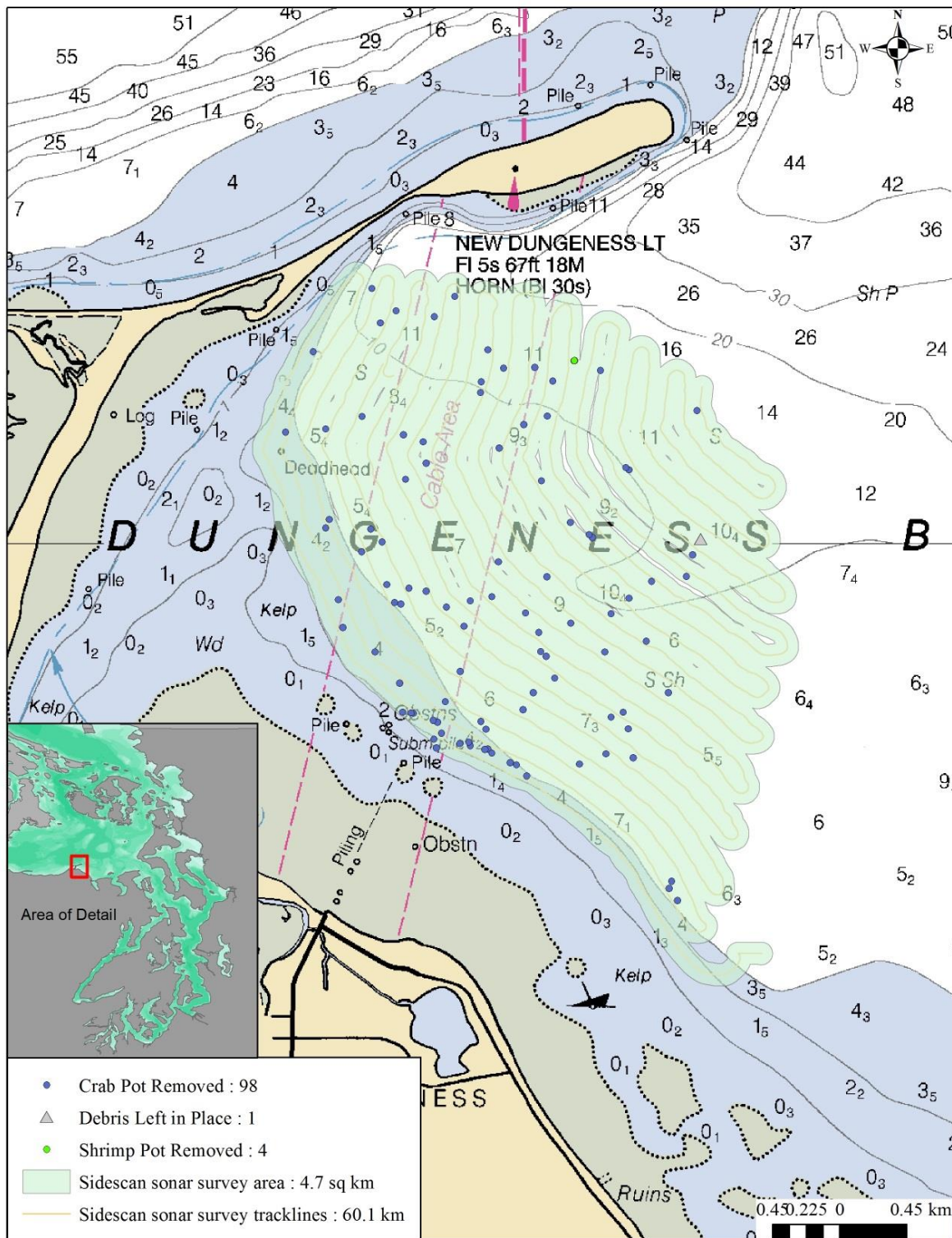


Figure 2. Disposition after removal operations of derelict crab pot targets found at Boundary Bay during the NWSF 2013 - 2014 derelict fishing gear project.

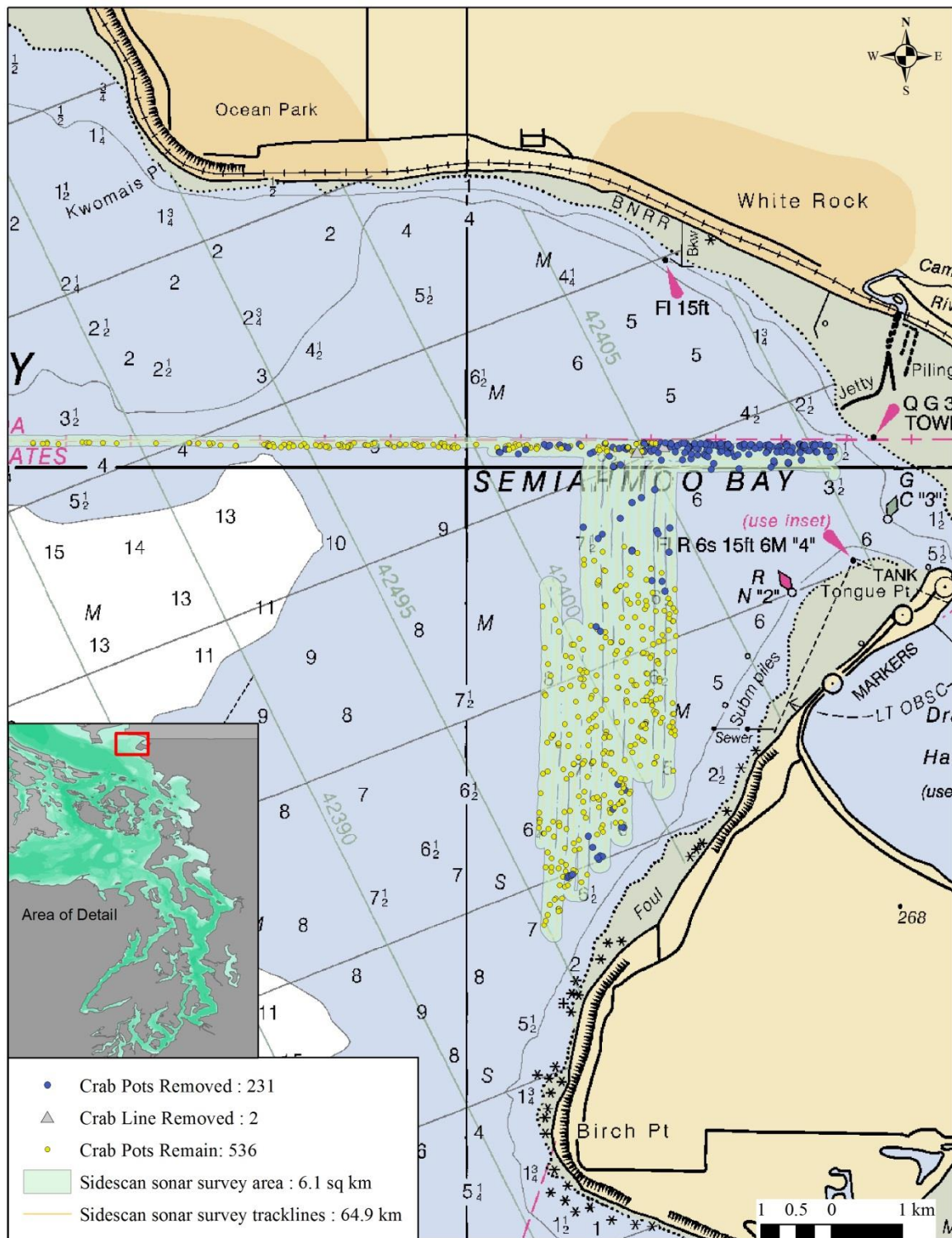


Figure 3. Disposition after removal operations of derelict crab pot targets found at Port Townsend during the NWSF 2013 - 2014 derelict fishing gear project.

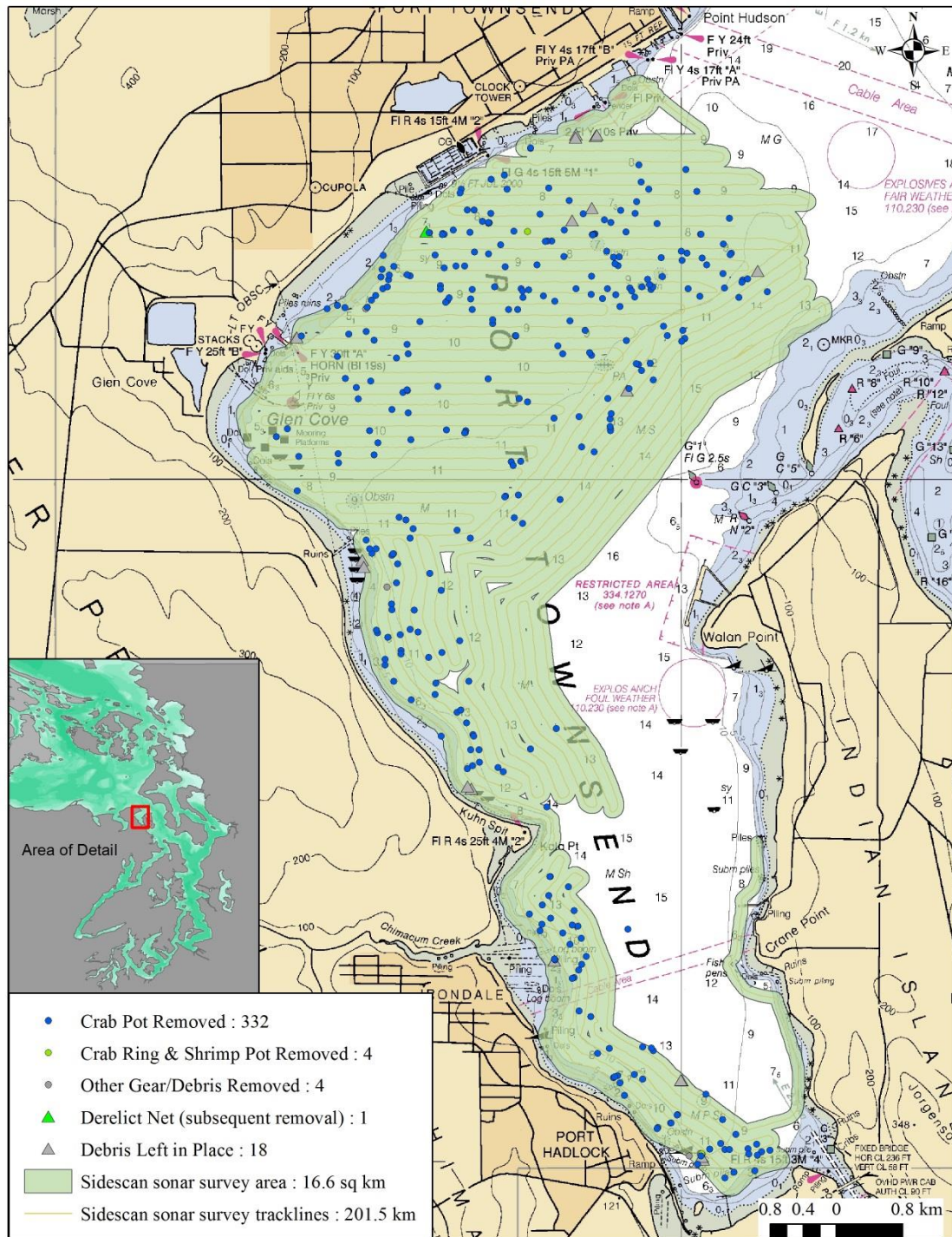


Figure 4. Characteristics of removed derelict crab pots during the NWSF 2013 - 2014 derelict fishing gear project.

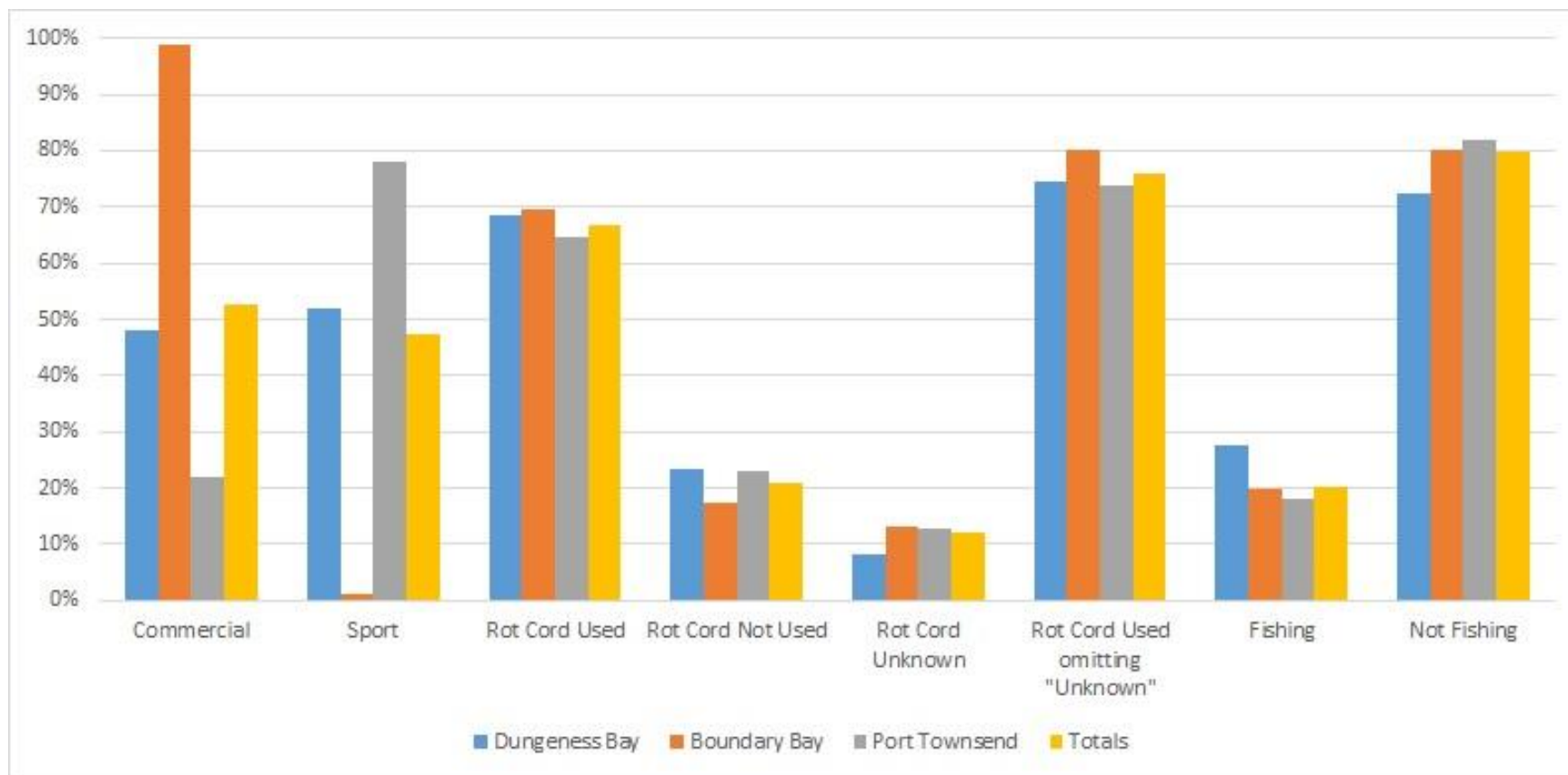


Table 1. Number of derelict pots recovered, type of pot (commercial or sport), fishing status (fishable or not), rot cord use and numbers of live and dead crab observed in Dungeness Bay during the NWSF 2013 - 2014 derelict fishing gear project.

Fishery	Fishing/Not Fishing	Actively Fishing			Not Fishing				All Pots			
		No Rot			No Rot				No Rot			
		Rot Cord	Cord	Total	Rot Cord	Cord	Unknown	Total	Rot Cord	Cord	Unknown	Total
Commercial	# Pots Recovered	4	7	11	26	4	6	36	30	11	6	47
	# Dungeness Crab Dead	0	1	1	2	0	0	2	2	1	0	3
	# Dungeness Crab Alive	19	15	34	15	0	1	16	34	15	1	50
	# Red Rock Crab Dead	0	0	0	0	0	1	1	0	0	1	1
	# Red Rock Crab Alive	1	0	1	5	0	0	5	6	0	0	6
	# Total Crab Dead	0	1	1	2	0	1	3	2	1	1	4
	# Total Crab Alive	20	15	35	20	0	1	21	40	15	1	56
Sport	# Pots Recovered	5	11	16	32	1	2	35	37	12	2	51
	# Dungeness Crab Dead	0	2	2	2	0	0	2	2	2	0	4
	# Dungeness Crab Alive	6	14	20	8	2	0	10	14	16	0	30
	# Red Rock Crab Dead	0	0	0	1	0	0	1	1	0	0	1
	# Red Rock Crab Alive	2	1	3	6	0	0	6	8	1	0	9
	# Total Crab Dead	0	2	2	3	0	0	3	3	2	0	5
	# Total Crab Alive	8	15	23	14	2	0	16	22	17	0	39
All Pots	# Pots Recovered	9	18	27	58	5	8	71	67	23	8	98
	# Dungeness Crab Dead	0	3	3	4	0	0	4	4	3	0	7
	# Dungeness Crab Alive	25	29	54	23	2	1	26	48	31	1	80
	# Red Rock Crab Dead	0	0	0	1	0	1	2	1	0	1	2
	# Red Rock Crab Alive	3	1	4	11	0	0	11	14	1	0	15
	# Total Crab Dead	0	3	3	5	0	1	6	5	3	1	9
	# Total Crab Alive	28	30	58	34	2	1	37	62	32	1	95
	# Total Crab	28	33	61	39	2	2	43	67	35	2	104

Table 2. Number of derelict pots recovered, type of pot (commercial or sport), fishing status (fishable or not), rot cord use and numbers of live and dead crab observed in Boundary Bay during the NWSF 2013 - 2014 derelict fishing gear project.

Fishery	Fishing/Not Fishing	Actively Fishing			Not Fishing				All Pots			
		No Rot			No Rot				No Rot			
		Rot Cord	Cord	Total	Rot Cord	Cord	Unknown	Total	Rot Cord	Cord	Unknown	Total
Commercial	# Pots Recovered	12	34	46	146	6	30	182	158	40	30	228
	# Dungeness Crab Dead	8	35	43	14	0	0	14	22	35	0	57
	# Dungeness Crab Alive	12	68	80	16	0	0	16	28	68	0	96
	# Red Rock Crab Dead	1	9	10	1	0	0	1	2	9	0	11
	# Red Rock Crab Alive	3	4	7	8	1	1	10	11	5	1	17
	# Total Crab Dead	9	44	53	15	0	0	15	24	44	0	68
	# Total Crab Alive	15	72	87	24	1	1	26	39	73	1	113
Sport	# Pots Recovered	0	0	0	3	0	0	3	3	0	0	3
	# Dungeness Crab Dead	0	0	0	1	0	0	0	1	0	0	1
	# 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	1	0	0	0	1	0	0	1
	# Total Crab Alive	0	0	0	0	0	0	0	0	0	0	0
All Pots	# Pots Recovered	12	34	46	149	6	30	185	161	40	30	231
	# Dungeness Crab Dead	8	35	43	15	0	0	14	23	35	0	58
	# Dungeness Crab Alive	12	68	80	16	0	0	16	28	68	0	96
	# Red Rock Crab Dead	1	9	10	1	0	0	1	2	9	0	11
	# Red Rock Crab Alive	3	4	7	8	1	1	10	11	5	1	17
	# Total Crab Dead	9	44	53	16	0	0	15	25	44	0	69
	# Total Crab Alive	15	72	87	24	1	1	26	39	73	1	113
	# Total Crab	24	116	140	40	1	1	41	64	117	1	182

Table 3. Number of derelict pots recovered, type of pot (commercial or sport), fishing status (fishable or not), rot cord use and numbers of live and dead crab observed in Port Townsend during the NWSF 2013 - 2014 derelict fishing gear project.

Fishery	Fishing/Not Fishing	Actively Fishing			Not Fishing				All Pots			
		No Rot			No Rot				No Rot			
		Rot Cord	Cord	Total	Rot Cord	Cord	Unknown	Total	Rot Cord	Cord	Unknown	Total
Commercial	# Pots Recovered	3	10	13	26	13	21	60	29	23	21	73
	# Dungeness Crab Dead	1	2	3	1	0	2	3	2	2	2	6
	# Dungeness Crab Alive	0	52	52	0	1	0	1	0	53	0	53
	# Red Rock Crab Dead	0	0	0	0	1	0	1	0	1	0	1
	# Red Rock Crab Alive	1	1	2	3	4	1	8	4	5	1	10
	# Total Crab Dead	1	2	3	1	1	2	4	2	3	2	7
	# Total Crab Alive	1	53	54	3	5	1	9	4	58	1	63
Sport	# Pots Recovered	13	34	47	172	19	21	212	185	53	21	259
	# Dungeness Crab Dead	1	0	1	3	0	0	3	4	0	0	4
	# Dungeness Crab Alive	17	31	48	10	0	0	10	27	31	0	58
	# Red Rock Crab Dead	1	0	1	0	1	1	2	1	1	1	3
	# Red Rock Crab Alive	3	7	10	21	2	2	25	24	9	2	35
	# Total Crab Dead	2	0	2	3	1	1	5	5	1	1	7
	# Total Crab Alive	20	38	58	31	2	2	35	51	40	2	93
All Pots	# Pots Recovered	16	44	60	198	32	42	272	214	76	42	332
	# Dungeness Crab Dead	2	2	4	4	0	2	6	6	2	2	10
	# Dungeness Crab Alive	17	83	100	10	1	0	11	27	84	0	111
	# Red Rock Crab Dead	1	0	1	0	2	1	3	1	2	1	4
	# Red Rock Crab Alive	4	8	12	24	6	3	33	28	14	3	45
	# Total Crab Dead	3	2	5	4	2	3	9	7	4	3	14
	# Total Crab Alive	21	91	112	34	7	3	44	55	98	3	156
	# Total Crab	24	93	117	38	9	6	53	62	102	6	170

Table 4. Number of derelict pots recovered, type of pot (commercial or sport), fishing status (fishable or not), rot cord use and numbers of live and dead crab observed in Dungeness Bay, Boundary Bay and Port Townsend during the NWSF 2013 - 2014 derelict fishing gear project.

Fishery	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
Commercial	# Pots Recovered	19	51	70	198	23	57	278	217	74	57	348
	# Dungeness Crab Dead	9	38	47	17	0	2	19	26	38	2	66
	# Dungeness Crab Alive	31	135	166	31	1	1	33	62	136	1	199
	# Red Rock Crab Dead	1	9	10	1	1	1	3	2	10	1	13
	# Red Rock Crab Alive	5	5	10	16	5	2	23	21	10	2	33
	# Total Crab Dead	10	47	57	18	1	3	22	28	48	3	79
	# Total Crab Alive	36	140	176	47	6	3	56	83	146	3	232
Sport	# Pots Recovered	18	45	63	207	20	23	250	225	65	23	313
	# Dungeness Crab Dead	1	2	3	6	0	0	5	7	2	0	9
	# Dungeness Crab Alive	23	45	68	18	2	0	20	41	47	0	88
	# Red Rock Crab Dead	1	0	1	1	1	1	3	2	1	1	4
	# Red Rock Crab Alive	5	8	13	27	2	2	31	32	10	2	44
	# Total Crab Dead	2	2	4	7	1	1	8	9	3	1	13
	# Total Crab Alive	28	53	81	45	4	2	51	73	57	2	132
All Pots	# Pots Recovered	37	96	133	405	43	80	528	442	139	80	661
	# Dungeness Crab Dead	10	40	50	23	0	2	24	33	40	2	75
	# Dungeness Crab Alive	54	180	234	49	3	1	53	103	183	1	287
	# Red Rock Crab Dead	2	9	11	2	2	2	6	4	11	2	17
	# Red Rock Crab Alive	10	13	23	43	7	4	54	53	20	4	77
	# Total Crab Dead	12	49	61	25	2	4	30	37	51	4	92
	# Total Crab Alive	64	193	257	92	10	5	107	156	203	5	364
	# Total Crab	76	242	318	117	12	9	137	193	254	9	456

Table 5. Number of derelict pots recovered by suspected reason for pot loss observed in Port Townsend during the NWSF 2013 - 2014 derelict fishing gear project.

Primary Reason for Pot Loss	Potential Other Reasons for Pot Loss	Number of Pots	% of Total
Gear Malfunction and/or User Error*	gear malfunction/user error	109	43%
	barge strike	5	
	vessel strike	3	
	entanglement w/ other gear	2	
	line length to water depth mismatch	1	
	tampering/sabotage	1	
	unknown	22	
	Total Gear Malfunction/User Error	143	
Vessel Strike	vessel strike	68	36%
	tampering/sabotage	47	
	gear malfunction/user error	3	
	barge strike	1	
	unknown	1	
	Total Vessel Strike	120	
Barge Strike	barge strike	6	3%
	vessel strike	2	
	gear malfunction/user error	2	
	Total Barge Strike	10	
Line Length to Water Depth Mismatch	line length to water depth mismatch	10	3%
	Total Line Length to Water Depth Mismatch	10	
Tampering / Sabotage	tampering/sabotage	6	2%
	vessel strike	2	
	Total Tampering/Sabotage	8	
Entanglement w/ Other Gear	entanglement w/ other gear	6	2%
	gear malfunction/user error	1	
	Total Entanglement w/ other gear	7	
Entanglement w/ non-gear**	entanglement w/ non-gear	5	1%
	Total Entanglement w/ non-gear	5	
Abandoned	abandoned	3	1%
	line length to water depth mismatch	1	
	Total Entanglement w/ other gear	4	
Unknown	Unknown	18	9%
	gear malfunction/user error	6	
	entanglement w/ other gear	4	
	tampering/sabotage	1	
	Total Unknown	29	
Total Pots Removed		336	100%

* includes three shrimp pots

** includes one crab ring