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## FINAL REPORT

# SNOHOMISH COUNTY 2012 DERELICT FISHING GEAR PROJECT

PREPARED FOR:

SNOHOMISH COUNTY MARINE RESOURCES COMMITTEE

PREPARED BY:

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## **Introduction**

Abandoned, lost and discarded crab pots can present economic and environmental impact issues in marine waters. Every year pot gear is lost due to entanglement with debris, vessel hits and vandalism. Identification, location and safe removal of derelict crab pots can reduce these destructive impacts of derelict fishing gear, as has been demonstrated in derelict gear removal projects previously conducted in Washington waters of the Salish Sea.

The goals of the 2012 Snohomish County Marine Resources Committee (MRC) derelict gear project were to locate and remove derelict fishing gear from a specific study area in the commonly fished commercial, Tribal and recreational crab fishing area of Port Gardner and to continue using this area for crab pot loss rate measurements by comparing results from past and future surveys and removal operations. Beginning in 2005, the Snohomish County MRC initiated a pilot education program designed to inform the public of the importance of using escape cord (rot cord) on crab pots and encourage these practices. In 2006, the MRC began partnering with Washington State University (WSU) Extension Beach Watchers with a primary focus on using outreach/education to improve escape cord compliance. In 2008, the Recreational Crabber Education Program focus shifted toward pot loss prevention with less emphasis on escape cord compliance. This report and future derelict gear surveys and removals in the area could be used to evaluate the effectiveness of such educational programs.

In addition to reporting the outcome of the 2012 derelict gear removal operations at Port Gardner, cumulative results from previous removal projects in 2004/05, 2008, 2009 and 2011 are included. Results for each year are analyzed and compared for changes in rate of pot loss, number of derelict pots removed or disabled, crab mortality and escape cord usage for both commercial and recreational crab fishers. These findings help to identify trends and/or anomalies in the characteristics of the lost gear in the area and the fishing practices of the recreational and commercial fishers utilizing these fishing grounds.

The Snohomish County MRC secured funding from Snohomish County for derelict crab pot survey and removal operations. Snohomish County then contracted with Natural Resources Consultants, Inc. (NRC) to manage the project. The removal operations were coordinated with the WDFW, Snohomish County, 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 one day of sidescan sonar pot survey fieldwork and 0.25 days of post-survey processing, followed by 4.5 days of dive removal operations for derelict crab pot targets. Dive removal operations were conducted in the commonly fished area immediately west of Jetty Island in Port Gardner. Previous surveys and derelict crab pot removal projects conducted in 2004/05, 2008, 2009 and 2011 cleared a specific study

area of nearly all derelict pots providing a baseline from which future derelict gear surveys of the same area would allow estimation of the loss rate of derelict pots in these fisheries and changes in compliance with escape cord requirements over time. This information is valuable to WDFW and Tribal fishery managers in assessing the overall impact of derelict fishing gear in the area and provides additional information on the effectiveness of public information programs aimed at reducing fishing gear loss and compliance with escape cord regulations.

A portion of this project entailed re-surveying the “Study Area” with sidescan sonar and removing newly lost derelict crab pots to ascertain the number of pots lost during the 2012 crab fishing season. During derelict crab pot removal, an onboard biologist recorded pot characteristics, along with the use and decomposition status of escape cord and the number of live and dead crab in pots. Similar data has been collected during removal projects in Port Gardner before and after outreach/education activities related to the Recreational Crabber Education Program conducted by WSU Extension Beach Watchers and the Snohomish County MRC allowing an assessment of the success of this program.

## **Methodology**

### *Sidescan Sonar Survey*

Fenn Enterprises performed the sidescan sonar surveys on December 21, 2012, in Port Gardner followed by 0.25 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 stern of a 40-foot 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 survey was conducted at an average speed of 4.63 km/hr (2.5 knots) with a sonar signal range of 40 m on both sides of the vessel for an approximate path width of 80 m (262 ft). Survey depths in Port Gardner 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 2012 sidescan sonar survey in Port Gardner was to locate derelict crab pots to be removed from the previously cleaned “Study 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 (Figure 1).

### *Derelict Fishing Gear Removal*

Fenn Enterprises was contracted to conduct the dive recovery operations of crab pots in the Port Gardner area. Two divers equipped with SCUBA operated off a 40-foot dive support and gear recovery vessel, the R/V *Surveyor II*. A list of the precise locations of derelict crab pots detected during the sidescan sonar survey was used by the onboard biologist and dive team to locate derelict pots using a wide area augmentation (WAAS) GPS and electronic navigation software (Nobeltec®). Derelict gear target locations derived from the sidescan sonar survey were transferred into the Nobeltec software as waypoints and plotted over navigation charts of the Port Gardner area.

Using the WAASGPS system, the 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 was then anchored in the vicinity of the clump weight or drifted nearby and a single diver was deployed. A second, 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 and the depth and type of seabed where the gear was located. The onboard biologist further inspected the gear at the surface and looked for owner identification information.

During removal operations at Port Gardner, the derelict fishing gear was stored in a locked secure waste container in the parking lot of the 10<sup>th</sup> Street public boat ramp in the Port of Everett until disposal at the Snohomish County solid waste facility. 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.

### *Comparing Results from Derelict Pot Removals in Port Gardner*

In 2008, the derelict fishing gear survey and removal project in Port Gardner successfully surveyed and cleaned a specific area of heavily concentrated Dungeness crab pot fishing

effort just West of Jetty Island outside the Port of Everett. The 2008 operations overlapped an area where derelict crab pot surveys were conducted in 2004 with subsequent removals in 2004 and 2005. This area has been identified as the Port Gardner “Study Area” and repeated surveys and removal in the “Study Area” have been completed in 2009, 2011 and now in 2012. Along with the goals of removing derelict crab pots that impact the local resource and marine ecosystem, multiple years of completed surveys and removals within the same area provide an opportunity to analyze gear loss over time, changes in the rate of compliance by fishers regarding use of legally mandated escape cord for both commercial and recreational crab fishers. These are important factors in the impacts of derelict gear on the valuable Dungeness crab resource.

To calculate pot loss rates over time we identified how many seasons occurred between derelict gear operations, which part of the year those seasons occurred (summer or winter) and how many days of fishing were available for sport fishers during those seasons. Sport fishing effort expended during winter seasons are significantly less than summer seasons and estimates from WDFW biologists estimate winter effort at 12% to 13% that of summer effort (D. Velasquez, personal communication). Therefore, a correction factor of 0.125 was applied to winter season days available to account for the difference in effort, standardizing the unit of effort measurement to summer day equivalent. To remain within the scope of the project, this analysis was only performed on sport pot data and excludes commercial pot data.

Spatial analysis of the sidescan sonar survey areas and derelict gear targets investigated per project was conducted using ArcGIS®. While the bounds of the study area were defined in 2008, several variable factors such as weather and sea conditions (i.e., wind, waves, currents, haloclines, thermoclines, etc.), GPS satellite coverage and obstacles within the survey grounds contribute to deviations in total survey coverage for a given survey. Therefore, the efforts of subsequent survey and removal operations have resulted in finding several derelict crab pots outside the “Study Area” as well as some gaps in the survey data within the “Study Area”. In order to accurately assess the amount of gear loss between projects in the “Study Area”, data from each project was compared to the data from the previous projects and gaps identified in survey area coverage were not included in the analysis unless the pots found within those gaps were identified as “New” pots in “Good” condition. Additionally, derelict gear items that were adjacent to previously surveyed targets that had not been removed were identified as duplicates and not used in analysis. Some investigated targets exhibiting dilapidated characteristics as the result of likely being derelict for longer than the amount of time since the previous project were identified as such and not used in the analysis.

Data from operations conducted in 2004 and 2005 are reported together in this document (2004/2005) since the targets addressed during those years were the results of surveys conducted in 2004 only (i.e., no surveys conducted in 2005). While data from derelict crab pot removals in 2004/2005 and 2008 are presented here for comparison, it should be noted that the loss of pots identified during projects prior to 2009 cannot be attributed to a

specific year or series of fishing seasons since neither in 2004/2005 or 2008 was the “Study Area” cleared of derelict pots prior to subsequent surveys and removal as was the case in 2009, 2011 and 2012. Therefore, pot loss rates were not calculated or reported for 2004/2005 and 2008 data. Additionally, because the vast majority of animals immediately impacted are Dungeness crab from crab pots, other species such as red rock crab (*Cancer productus*) were not included, nor were other gear types such as shrimp pots or crab rings. Crab pots that were beyond maximum diver depth (BMDD), defined as greater than a depth of 32 meters (105 feet) were not included in the analysis.

## **Results**

### *Sidescan Sonar Survey and Pot Removals*

In the one day of sidescan sonar surveys conducted in Port Gardner on December 21, 2012, 2.25 km<sup>2</sup> were covered and 121 potential derelict crab pot targets were detected or 53.8 targets/km<sup>2</sup>. Two targets identified in the survey were in close proximity to actively fishing recreational crab pot buoys observed by the surveyors and upon later dive investigation one of these targets was not found having probably been retrieved by the owner, and the other was identified as actively fishing and was left in place. One crab pot target proved to be an automobile tire and was removed, one target was identified as a duplicate of a removed pot and upon investigation one target was identified as beyond the safe maximum diver depth (BMDD) of 32 m (105 feet). A total of 116 targets were found to be derelict fishing gear (115 crab pots, 1 crab ring) that were removed by divers and six additional pots were found within close proximity to sidescan targets and removed during dive operations for a total of 121 derelict crab pots removed or disabled (Table 1). Eliminating the known debris item (tire), duplicated target, actively fishing pots (present and not present), the crab ring and the BMDD target, a total of 121 derelict crab pot targets were identified or 53.8 targets/ km<sup>2</sup> (Figure 2). Table 1 provides the characteristics of pots removed in Port Gardner.

### *Derelict Crab Pot Removal*

Derelict fishing gear was removed from Port Gardner on December 22, 23, 26, 27 and 28, 2012. A total of 121 crab pots and one crab ring were removed. A total of 115 of the derelict crab pots and one crab ring removed were identified in the sidescan sonar surveys and six derelict pots not identified in the survey were found adjacent to surveyed pots and removed. Derelict crab pots were removed from water depths ranging from 4.9 m (16 ft) to 30.5 m (100 ft) from mud and mixed sand/mud substrate.

Of the 121 derelict pots removed, 33 (27%) were commercial pots and 88 (73%) were sport pots (Table 1). Thirty-nine (32%) pots were determined to be actively fishing and 82 (68%) were no longer fishing. Of the 121 pots removed, 20 (16%) were not equipped with legal escape cord, 87 (72%) had legal escape cord and 14 (12%) pots were too

deteriorated to determine whether escape cord was used or not. Of the 87 pots equipped with legal escape cord, the escape cord had disintegrated on 63 (72%) and was still intact on 24 (28%) pots.

Of the 33 commercial pots recovered, 4 (12%) were not equipped with proper escape cord, 27 (82%) were equipped with escape cord and on two pots (6%) escape cord use could not be determined. Sixteen (18%) of the 88 sport derelict pots were not equipped with legal escape cord, 60 (68%) did have legal escape cord and on 12 (14%) sport pots escape cord use could not be determined. Of the 39 crab pots found to still be fishing, 18 (46%) were not equipped with proper escape cord and 21 (54%) had legal escape cord that had either yet to deteriorate.

Of the 121 derelict pots recovered, 37 (31%) pots contained a total of 152 Dungeness crab (Table 1). Of the 152 crab recovered, 110 (72%) were live and 42 (28%) were dead. Twelve (8%) of the Dungeness crab recovered were females (seven live and five dead), 107 (70%) were males (92 live and 15 dead) and the sex was not determined for 33 (22%) of the crab due to either poor shell condition or the crab was observed in the pot by divers but were lost during pot recovery. Derelict pots determined to be still actively fishing contained 107 (70%) Dungeness crab (84 live and 23 dead). Pots determined to be no longer actively fishing contained 45 (30%) Dungeness crab (22 live and 23 dead). Crab pots without legal escape cord contained 24 (16%) Dungeness crab (11 live and 13 dead). Crab pots with legal escape cord contained 125 (82%) Dungeness crab (95 live and 30 dead).

Other animals found in the crab pots removed included 61 ochre stars (*Pisaster ochraceus*), 20 live sunflower stars (*Pycnopodia helianthoides*) and one live northern kelp crab (*Pugettia producta*).

A total of 14 crab pots recovered were returned to owners. Five commercial pots with owner identification were returned to commercial crab fishers. Tulalip Tribal marine enforcement personnel retrieved nine Tulalip Tribal pots to be returned to owners. A total of 16 sport pots not exhibiting owner identification were given to interested recreational crab fishers upon inquiry during the transfer of pots from the vessel to the dumpster/trailer. Pots removed from Port Gardner that were not returned to owners or taken by recreational crabbers were placed in a dumpster/trailer provided by Eastside Hauling®. Pots were transported and disposed of at the Waste Management Seattle facility where the total weight of gear disposed was approximately 1,480 lbs.

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 Dungeness crab observed in Port Gardner during the Snohomish County MRC 2012 derelict fishing gear project. Source: NRC.

Fishable/Not Fishable		Fishable			Not Fishable				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	7	3	10	20	1	2	23	27	4	2	33
	# Dungeness Crab Dead	11	7	18	0	0	0	0	11	7	0	18
	# Dungeness Crab Alive	62	5	67	12	0	0	12	74	5	0	79
Sport	# Pots Recovered	14	15	29	46	1	12	59	60	16	12	88
	# Dungeness Crab Dead	0	5	5	19	1	3	23	19	6	3	28
	# Dungeness Crab Alive	11	6	17	10	0	0	10	21	6	0	27
All Pots	# Pots Recovered	21	18	39	66	2	14	82	87	20	14	121
	# Dungeness Crab Dead	11	12	23	19	1	3	23	30	13	3	46
	# Dungeness Crab Alive	73	11	84	22	0	0	22	95	11	0	106
# Total Crab		84	23	107	41	1	3	45	125	24	3	152

*Comparing Results from Derelict Pot Removals in Port Gardner*

Derelict pot density (pots/km<sup>2</sup>) and analysis of escape cord compliance for the 2004/2005 and 2008 projects are reported here. Pot loss rates were calculated within the “Study Area” for 2009, 2011 and 2012 based on the survey area covered, number of available fishing day opportunities and number of confirmed derelict crab pots present (total and newly lost) and are summarized in Tables 2 and 3. For the 2009 loss rates per km<sup>2</sup>, the 2009 and 2008 survey area overlap within the “Study Area” was used to calculate newly lost pots since all pots removed outside the overlap area but within the “Study Area” were considered old and/or dilapidated. Derelict pots removed within the “Study Area” but outside the overlap areas in both 2011 and 2012 were considered to be newly lost and therefore, the entire survey area within the “Study Area” was used to calculate pot loss for 2011 and 2012.

Surveys in 2004 within the later defined “Study Area” covered 1.59 km<sup>2</sup> and identified 457 crab pot targets (287.42 targets/km<sup>2</sup>). Of the 457 targets, 166 were removed or disabled (68 commercial and 98 sport) in 2004 and 2005 (Table 2 and Figure 3) and it is assumed that the remainder have become dilapidated, some of which were found and removed during subsequent operations. Of the 68 commercial pots, the use of escape cord could be determined on 41 and of those 28 (68%) had been equipped with legal escape cord. Of the 98 sport pots removed in 2004/2005, the use of escape cord was determined on 71, of which 56 (79%) were equipped with legal escape cord (Table 4).

The 2008 survey covered 2.25 km<sup>2</sup>, of which 1.87 km<sup>2</sup> is inside what is now considered the bounds of the “Study Area.” A total of 153 targets were identified (81.82 targets/km<sup>2</sup>) and 142 derelict crab pots (71 commercial and 71 sport) were removed during 2008, 139 (69 commercial and 70 sport) of which were within the “Study Area” bounds (Table 2 and Figure 4). In the 2008 removals, 70 of 71 commercial pots were determined to have either used escape cord or not, and of those 54 (77%) used legal escape cord. Seventy-one of 71 (100%) sport pots removed in the “Study Area” in 2008 were equipped with legal escape cord (Table 4).

In 2009, the entire survey area covered 2.67 km<sup>2</sup>, including a large survey portion to the north of the “Study Area”, 1.72 km<sup>2</sup> landed within the “Study Area” bounds and the amount of overlap between 2008 and 2009 surveys was 1.62 km<sup>2</sup>. A total of 154 confirmed derelict crab pots (48 commercial and 106 sport) were removed within the “Study Area” in 2009, with a derelict pot density of 89.53 pots/ km<sup>2</sup> (27.91 pots/ km<sup>2</sup> commercial and 61.63 pots/ km<sup>2</sup> sport). Twenty-four of these pots were determined not to be newly lost pots based on their dilapidated condition and/or proximity to un-removed targets from surveys in previous years, leaving 130 removed derelict crab pots (39 commercial and 91 sport) within the “Study Area” determined to be newly lost within the period since prior derelict gear removal operations (Table 2 and Figure 5), yielding a pot density of 80.25 pots/ km<sup>2</sup> (24.07 pots/ km<sup>2</sup> commercial and 56.17 pots/ km<sup>2</sup> sport). Recreational crab fishing opportunities in the Port Gardner area between 2008 and 2009 derelict gear operations included only the summer 2008 season, consisting of 37 days available for fishing. This provides a sport pot loss rate of 2.46 pots lost/day (1.52 pots lost/km<sup>2</sup>/day) between 2008 and 2009 (Table 3). Of the 39 newly lost derelict commercial pots removed in the “Study Area”, 36 were determined to have used legal escape cord or not, 27 (75%) of which had been properly equipped with legal escape cord. Of the 91 newly lost sport pots removed, the use of escape cord could be determined on 88, and 68 (77%) of those exhibited proper use of legal escape cord (Table 4).

The 2011 sidescan sonar surveys covered 2.22 km<sup>2</sup> with 1.81 km<sup>2</sup> inside the “Study Area”. The amount of overlap between 2009 and 2011 survey coverage within the “Study Area” was 1.58 km<sup>2</sup>. A total of 111 confirmed derelict crab pots (40 commercial and 71 sport) or 61.33 pots/ km<sup>2</sup> (22.10 pots/ km<sup>2</sup> commercial and 39.23 pots/ km<sup>2</sup> sport) were removed during 2011 operations, 21 of which were not used in this analysis based on their condition and estimated time of loss, leaving 90 removed derelict crab pots (33 commercial and 57 sport) within the “Study Area” determined to be newly lost (Table 2 and Figure 6), yielding a newly lost pot density of 49.72 pots/ km<sup>2</sup> (18.23 pots/ km<sup>2</sup> commercial and 31.49 pots/ km<sup>2</sup> sport). Recreational crab fishing opportunities in the Port Gardner area between 2009 and 2011 derelict gear operations included the summer 2009 and summer 2010 seasons consisting of 83 total available fishing days (42 days in 2009 and 41 days in 2010). This provides a sport pot loss rate of 0.69 pots lost/day (0.38 pots lost/km<sup>2</sup>/day) between 2009 and 2011 (Table 3). In 2011, all 33 newly lost commercial pots removed were determined to have either used proper escape cord or not,

and 29 (88%) of those were equipped with legal escape cord. Escape cord usage could also be determined on all 57 newly lost sport pots with 54 pots (95%) having been equipped with legal escape cord (Table 4).

In 2012, 1.92 km<sup>2</sup> of the entire 2.25 km<sup>2</sup> survey area was within the bounds of the “Study Area” and 1.78 km<sup>2</sup> overlapped the 2011 survey area. A total of 121 confirmed derelict crab pots (33 commercial and 88 sport) or 63.02 pots/ km<sup>2</sup> (17.19 pots/ km<sup>2</sup> commercial and 45.83 pots/ km<sup>2</sup> sport) were removed in 2012, 25 of which were considered not to be newly lost based on their age and condition, leaving 96 removed derelict crab pots (22 commercial and 74 sport) within the “Study Area” determined to be newly lost (Table 2 and Figure 7), yielding a newly lost pot density of 50.00 pots/ km<sup>2</sup> (11.46 pots/ km<sup>2</sup> commercial and 38.54 pots/ km<sup>2</sup> sport). Recreational crab fishing opportunities in the Port Gardner area between 2011 and 2012 derelict gear operations included the summer 2011, winter 2011, summer 2012 seasons and the majority portion (87.5%) of the winter 2012 season. Combined, these seasons totaled 251 available fishing days (96 days in summer and 155 days in winter). To account for the significant difference in effort between summer and winter seasons we standardized the amount of available days to summer day equivalents by applying a correction factor of 0.125 to the amount of winter days available resulting in a total of 115 days available for recreational crab fishing during the period. This provides a sport pot loss rate of 0.64 pots lost/day (0.34 pots/km<sup>2</sup>/day) between 2011 and 2012 derelict gear operations (Table 3). The use of escape cord could be discerned on all 22 newly lost commercial pots removed within the “Study Area” in 2012, 18 (82%) of which were properly equipped with legal escape cord. Seventy-two of the 74 newly lost sport pots removed in 2012 were determined to either be using escape cord or not, and 57 (79%) of those were equipped with legal escape cord (Table 4).

Table 2. Area surveyed, number of derelict pots recovered and average derelict pot density between operational periods 2009, 2011 and 2012 within the Port Gardner “Study Area”. Source: NRC.

Year	Survey Area within 'Study Area' (square km)	Total # Pots Removed/Disabled			Pot Density (per square km)			Area w/in 'Study Area' used for New Pot Loss Analysis (square km)	# Newly Lost Pots			Pot Density (per square km)		
		Comm	Sport	Total	Comm	Sport	Total		Comm	Sport	Total	Comm	Sport	Total
2004/2005	1.59	68	98	166	42.77	61.64	104.40	NA	NA	NA	NA	NA	NA	NA
2008	1.87	69	70	139	36.90	37.43	74.33	NA	NA	NA	NA	NA	NA	NA
2009	1.72	48	106	154	27.91	61.63	89.53	1.62	39	91	130	24.07	56.17	80.25
2011	1.81	40	71	111	22.10	39.23	61.33	1.81	33	57	90	18.23	31.49	49.72
2012	1.92	33	88	121	17.19	45.83	63.02	1.92	22	74	96	11.46	38.54	50.00

The overall number and density (pots per area) of lost crab pots lost within the “Study Area” has shown a downward trend over time since derelict gear survey and removals began in 2004, especially within the commercial fishery (Table 2 and Figure 8). The sport pot loss rate decreased from 2.46 pots/day (1.52 pots/km<sup>2</sup>/day) during the 2008 summer crab season to 0.69 pots/day (0.38 pots/ pots/km<sup>2</sup>/day) during the 2009 and 2010 summer crab seasons or a 72% decrease of pots lost per day and a 75% decrease in pots lost per km<sup>2</sup> per day. Over the course of the 2011 and 2012 summer and winter seasons, the sport pot loss rate dropped further to 0.64 pots/day (0.33 pots/km<sup>2</sup>/day), a decrease of 7% pots lost per day and 13% pots lost per km<sup>2</sup> per day from the previous period. Overall, this equates to a 74% decline in pots lost per day (78% decline in pots lost per km<sup>2</sup> per day) within the recreational fishery inside the Port Gardner “Study Area” after the 2008 summer season (Table 3, Figure 9 and 10).

Table 3. Area surveyed, number of derelict pots recovered and average derelict pot density between operational periods 2009, 2011 and 2012 within the Port Gardner “Study Area”. Source: NRC.

Year	Sport Crab Seasons since Prior Removal	Summer Season Days since Prior Removal	Winter Season Days since Prior Removal	Total Summer Day Equivalent (SDE)	# Newly Lost Sport Pots	Sport Pots Lost per km <sup>2</sup>	Sport Pots Lost per SDE	Sport Pots Lost per km <sup>2</sup> per SDE
2009	S'08	37	0	37	91	56.17	2.46	1.52
2011	S'09, S'10	83	0	83	57	31.49	0.69	0.38
2012	S'11, W'11, S'12, W'12	96	155	115	74	38.54	0.64	0.33

Escape cord compliance observed in derelict commercial pots within the “Study Area” has shown an increasing trend from 68% pot compliance (excluding “Unknown”) in 2004/2005 observations to 82% pot compliance in 2012, and peaked at 88% pot compliance in 2011 (Table 4, Figures 11 and 12). Within the sport fishery, the observed escape cord compliance went from 79% pot compliance in 2004/2005 to 100% pot compliance in 2008, reached a low of 77% pot compliance in 2009 followed by an increase to 95% pot compliance in 2011 and then returned to 79% pot compliance in 2012 (Table 4, Figures 13 and 14).

Dungeness crab catch and mortality in derelict crab pots removed from the Port Gardner “Study Area” and nearby have been thoroughly reported in the previous section of this document, as well as in previous reports from 2008, 2009 and 2011. Therefore, the findings of Dungeness crab catch and mortality are not included in this analysis of newly-lost pots within the “Study Area”. A full summary of newly lost pots by sector (commercial and sport) and the associated catch and mortality of Dungeness crab is provided in Appendix A.

Table 4. Escape cord compliance observed in derelict pots recovered between operational periods 2009, 2011 and 2012 within the Port Gardner “Study Area”. Source: NRC.

Year	Newly Lost Pots Inside "Study Area"		Escape Cord: Used		Escape Cord: Not Used		Escape Cord: Unknown		% of Total Pots Equipped with Legal Escape Cord		% of Pots Equipped with Legal Escape Cord: Excluding Unknown	
	Comm	Sport	Comm	Sport	Comm	Sport	Comm	Sport	Comm	Sport	Comm	Sport
2004/2005*	68	98	28	56	13	15	27	27	41%	57%	68%	79%
2008*	69	70	52	70	16	0	1	0	75%	100%	76%	100%
2009	39	91	27	68	9	20	3	3	69%	75%	75%	77%
2011	33	57	29	54	4	3	0	0	88%	95%	88%	95%
2012	22	74	18	57	4	15	0	2	82%	77%	82%	79%
*Pots removed were not determined to be newly lost or old Only data within 'Study Area' used in this analysis												

**Conclusions**

This project successfully investigated 100% of original 121 side scan sonar survey targets. Divers removed 115 (95%) of the 121 derelict fishing gear targets found during the sidescan sonar surveys along with six others that were not identified in the surveys.

Results show that the number of pots lost per fishing day opportunity within the recreational crab fishery in the Port Gardner “Study Area” has decreased significantly (74% to 78%) since the 2008 summer season, a change that coincides with the recreational crabber education program’s shift in focus from proper escape cord use to preventing pot loss. The number of recreational pots within the “Study Area” found during the 2008 project was closer to that found in the 2012 project, giving reason to speculate that the high sport pot loss rate in the 2009 observations may have been an anomaly, however, sufficient data does not exist to calculate sport pot loss rates prior to 2008. While there have been signs of increasing escape cord compliance within the observed derelict sport pots (100% compliance in 2008 and 95% compliance in 2011), the compliance in 2012 of 79% was the same as that from the 2004/2005 observations indicating that the percentage of sport fisher compliance with WDFW escape cord regulations is variable year to year. The Port Gardner study site is ideal for continuing research to determine further loss rate of derelict crab pots and the effectiveness of ongoing recreational crabber education programs in the area.

Without full investigation of commercial fishing effort between derelict gear projects in the Port Gardner “Study Area”, a pot loss by effort rate is not available however; decreasing numbers of derelict commercial pots identified from 39 in 2009 to 33 in 2011 to 22 pots in 2012 indicates a general decreasing trend in pot loss over time. This may be attributed to both a change in fisher behavior as well as a decrease in available fishing opportunities. Additionally, the observed use of legal escape cord on commercial derelict pots indicates an increasing trend in escape cord compliance within the commercial fishers utilizing the Port Gardner fishing grounds.

The Snohomish County MRC and WSU Extension Beach Watchers have been conducting crabber education programs directed at sport crab fishers in Port Gardner. The initial objective of the program was to educate crab fishers on the importance of complying with the WDFW escape cord regulations. In 2008, the educational focus shifted to preventing the loss of crab pots with a continued but lower profile emphasis on escape cord compliance. The results of the analysis of pot loss and observed escape cord compliance from 2004/2005 through 2012 removal projects suggest that the rate of pot loss amongst sport fishers has decreased; however, despite educational programs the percentage of sport fisher compliance with WDFW escape cord regulations is variable year to year.

## **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.

- **Education programs focused on crab pot loss prevention should continue in Snohomish County and elsewhere in Puget Sound where recreational crab fishing is prevalent. The following is a list of practices that can reduce pot loss, many of which are already included in the Snohomish County MRC and WSU Extension Beach Watchers education curriculums:**
  - 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
  - Avoid high vessel traffic areas, ferry, barge and log tow routes
  - Remain near pots during soak time
  - 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

- **The use of legal escape cord on crab pots should continue to be enforced. Escape cord education programs should continue in Snohomish County, as well as other counties throughout the Puget Sound.**
- **Escape cord education should continue to focus on 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, bridles, etc., that can prevent the opening of a crab pot door despite the deterioration of escape cord.**
- **Consider regulatory changes related to the construction of crab pots and the effectiveness of their disabling components. In many instances, the deterioration of escape cord does not effectively disable the fishing capabilities of a crab pot, nor does it ensure the successful escape of an entrapped crab.**
- **The “Study Area” should be surveyed and gear removed annually for the next two to three years to further determine crab pot loss rates and gain greater information on the effectiveness of crab pot fishing education programs being conducted by the Snohomish County MRC.**

### **Acknowledgements**

The Port of Everett kindly provided free moorage for the dive support vessel during the Port Gardner portion of the project and allowed storage of a waste container at the 10<sup>th</sup> Street public boat ramp. Their assistance is greatly appreciated. We also wish to thank the Snohomish County MRC for their cooperation during the project, with a special thanks to Brent Hackney for providing assistance in coordinating amongst the different stakeholder groups. Don Velasquez of WDFW, Cathy Stanley and Mike McHugh of Tulalip Fisheries assisted in planning by providing valuable fisheries updates and information prior to derelict gear operations, helping ensure that the completion of operations prior to December 31, 2012.

Figure 1. Sidescan sonar survey effort and derelict crab pot targets found in Port Gardner during the Snohomish County MRC 2012 derelict fishing gear project. Source: NRC, Inc. and Fenn Enterprises.

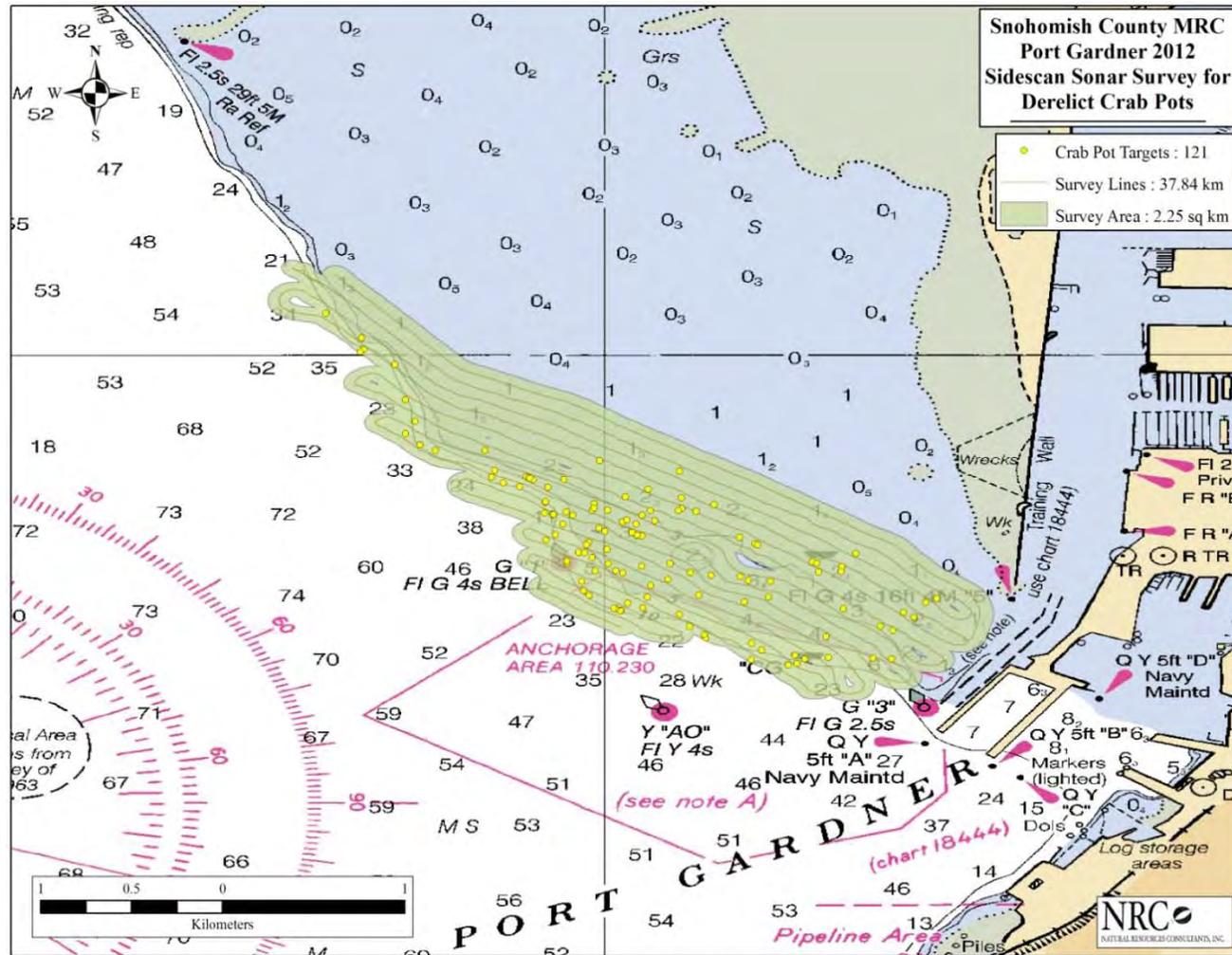


Figure 2. Sidescan sonar survey effort and disposition of derelict crab pot targets found in Port Gardner during the Snohomish County MRC 2012 derelict fishing gear project. Source: NRC, Inc. and Fenn Enterprises.

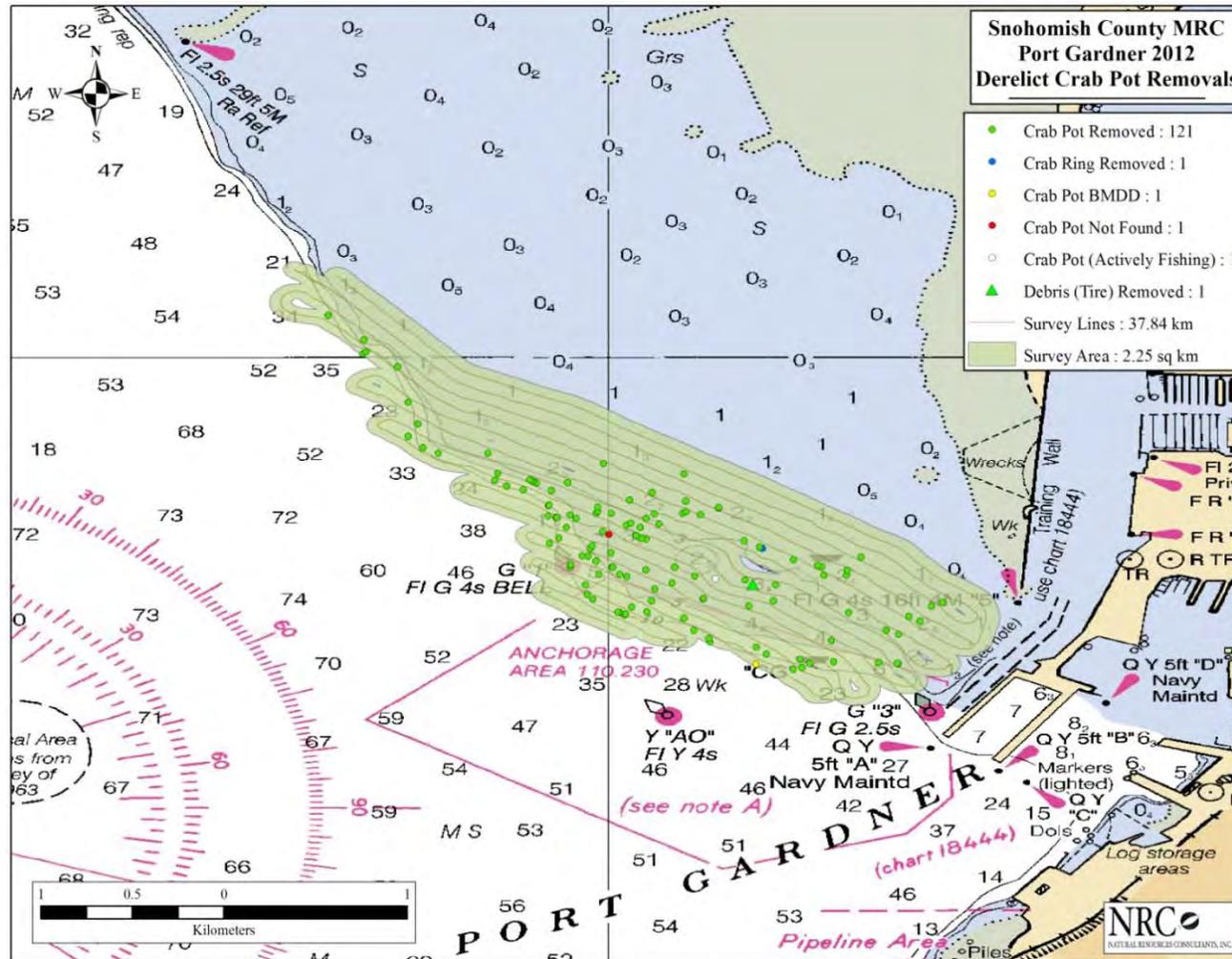


Figure 3. Derelict crab pot targets removed or disabled during the 2004/2005 operations within the Port Gardner “Study Area”. Source: NRC, Inc. and Fenn Enterprises.

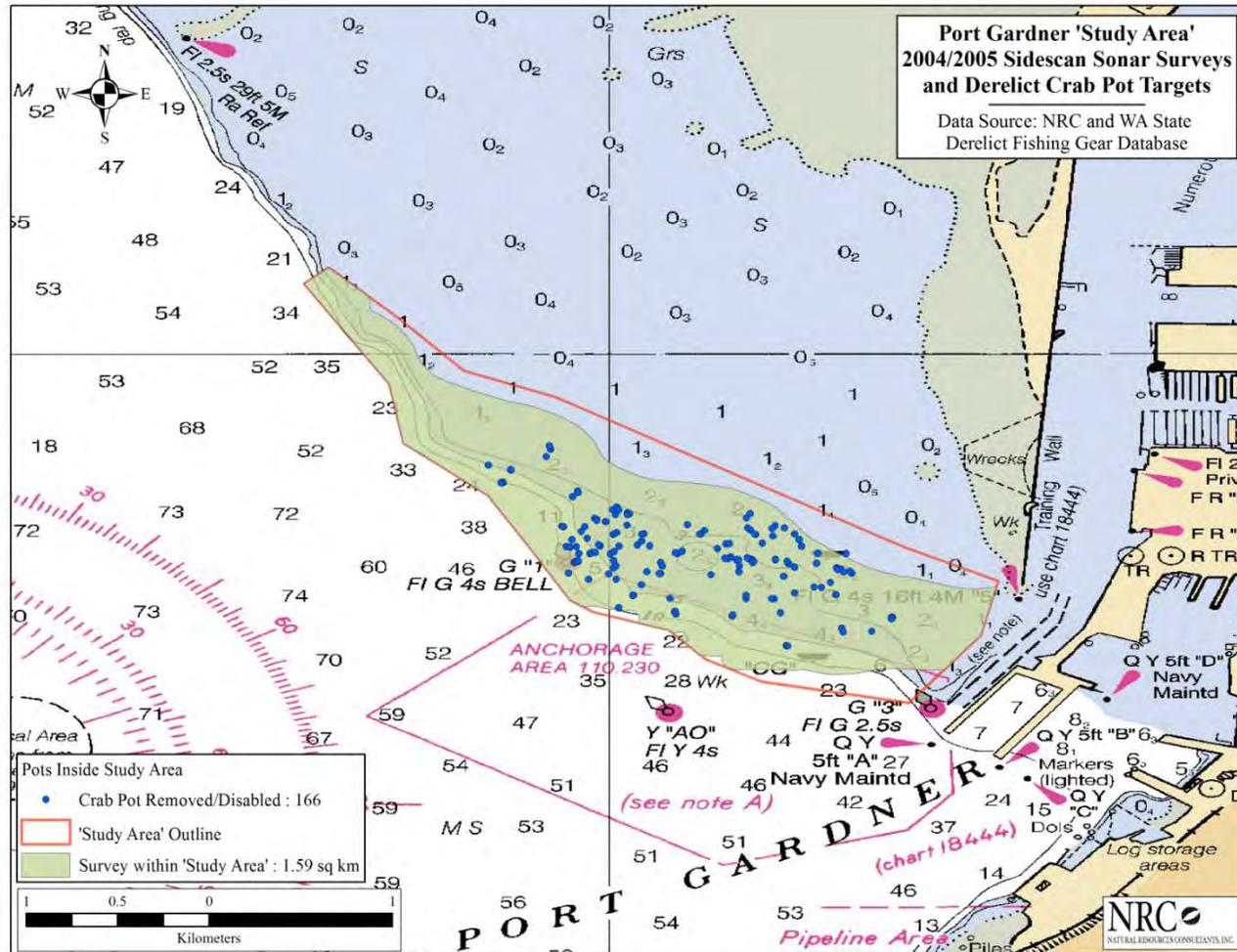


Figure 4. Derelict crab pot targets removed or disabled during the 2008 operations within the Port Gardner “Study Area”.  
 Source: NRC, Inc. and Fenn Enterprises.

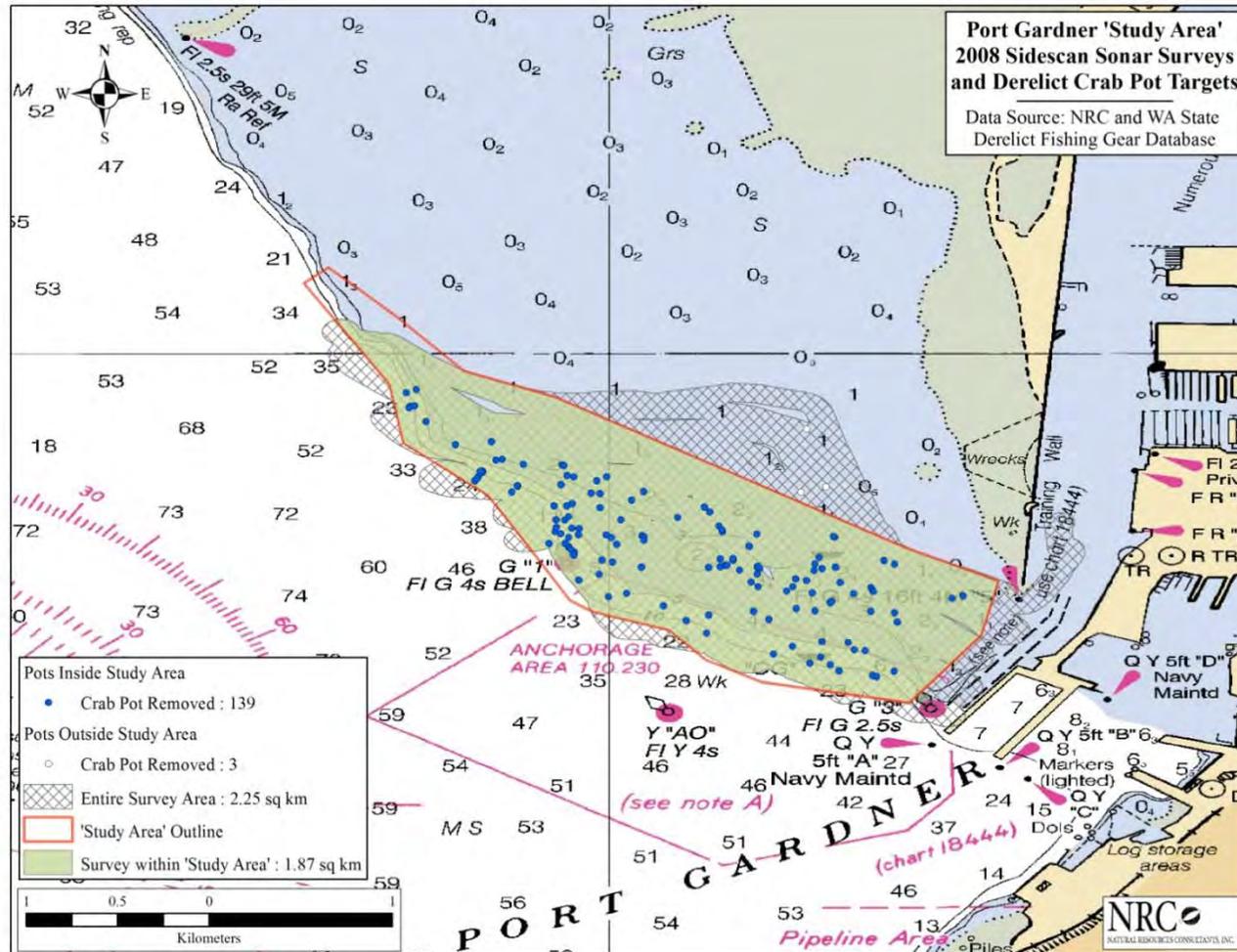








Figure 8. Number of derelict crab pots removed/disabled within the Port Gardner “Study Area” by project. Source: NRC, Inc.

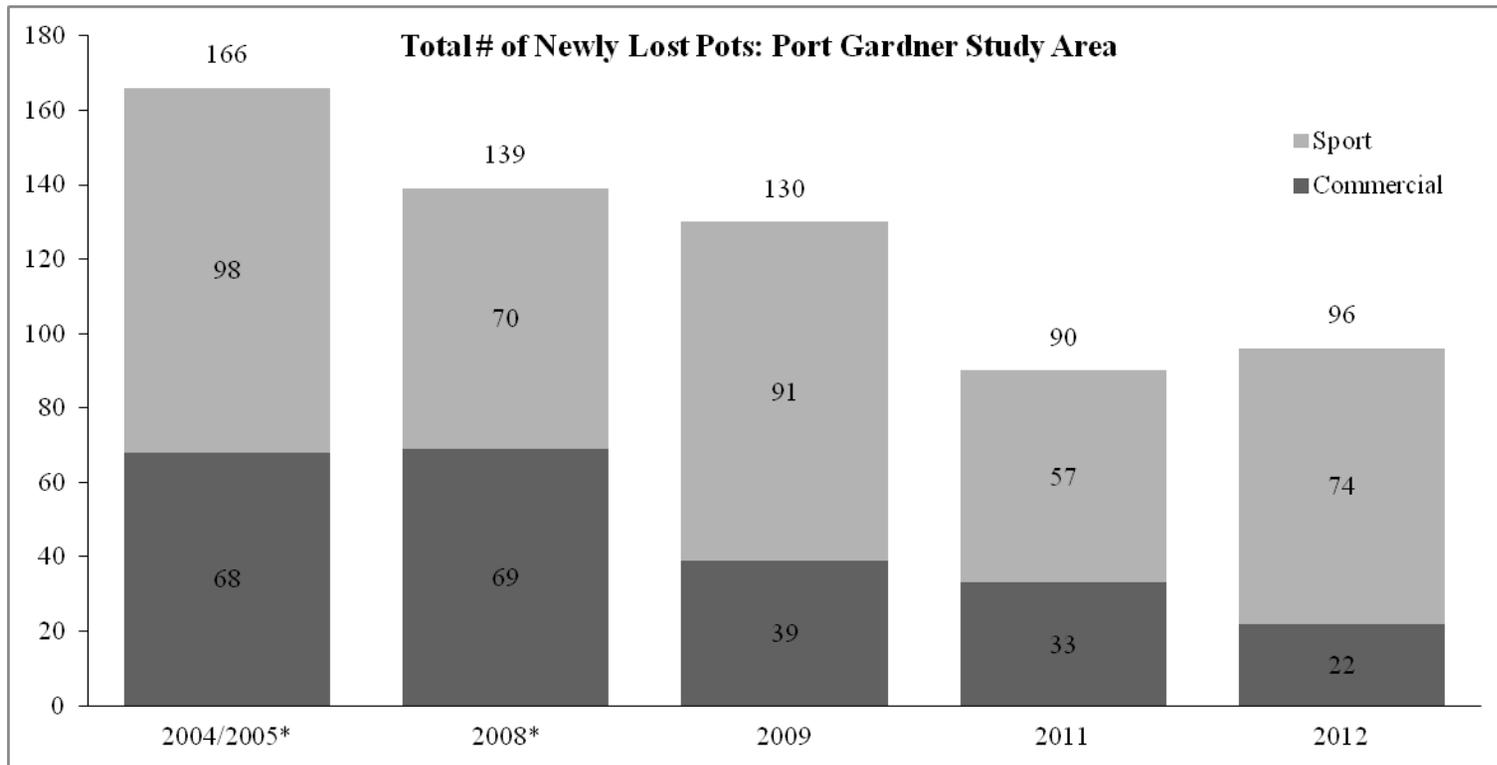


Figure 9. Number of derelict sport pots removed/disabled within the Port Gardner “Study Area” by project and number of recreational crab fishing days available between projects Source: NRC, Inc. and WDFW.

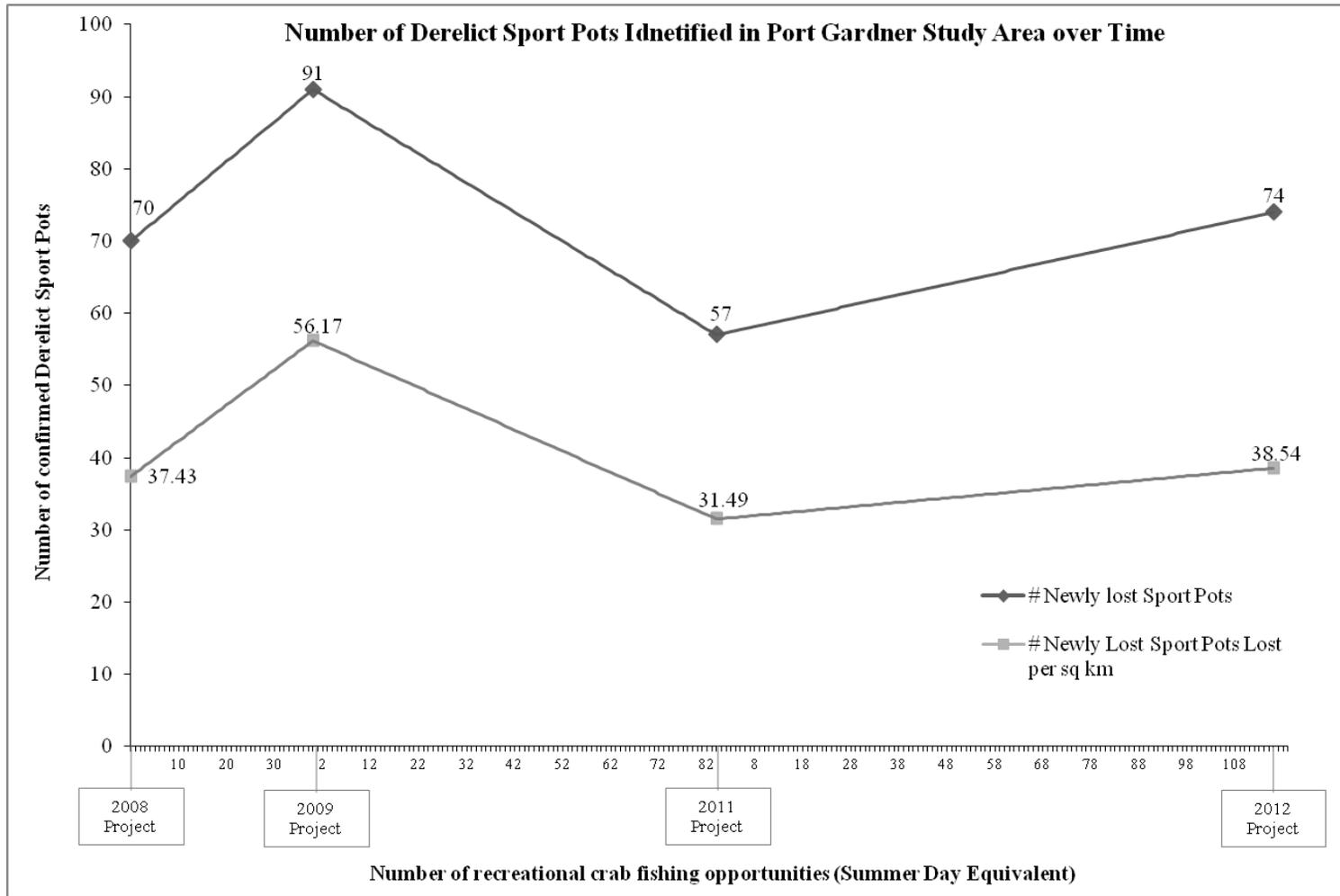


Figure 10. Observed sport pot loss per available fishing day within the Port Gardner “Study Area” by year. Source: NRC, Inc. and WDFW.

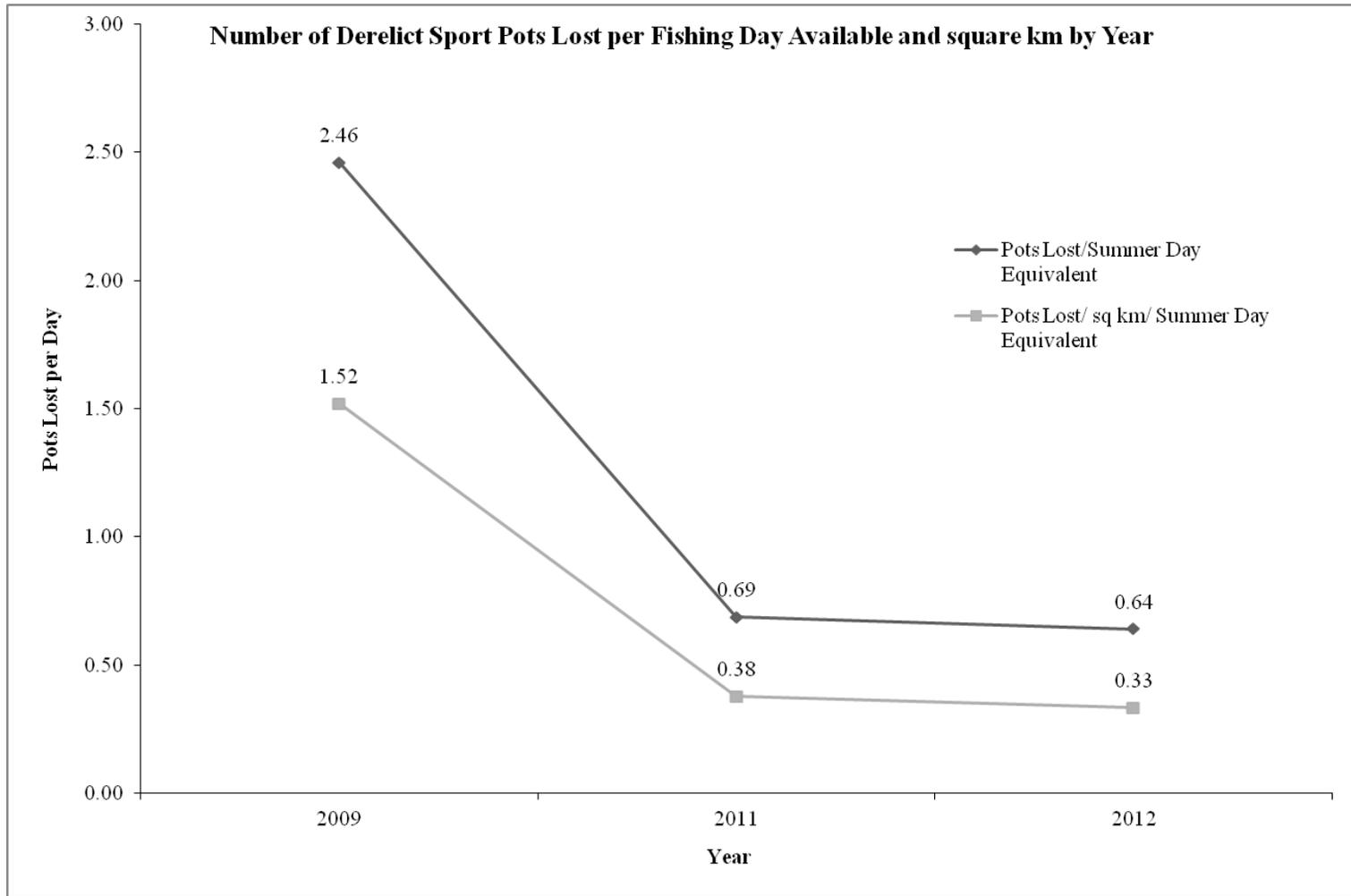


Figure 11. Summary of escape cord compliance observed on commercial derelict crab pots removed in the Port Gardner “Study Area” from 2004/2005 to 2012. Source: NRC, Inc.

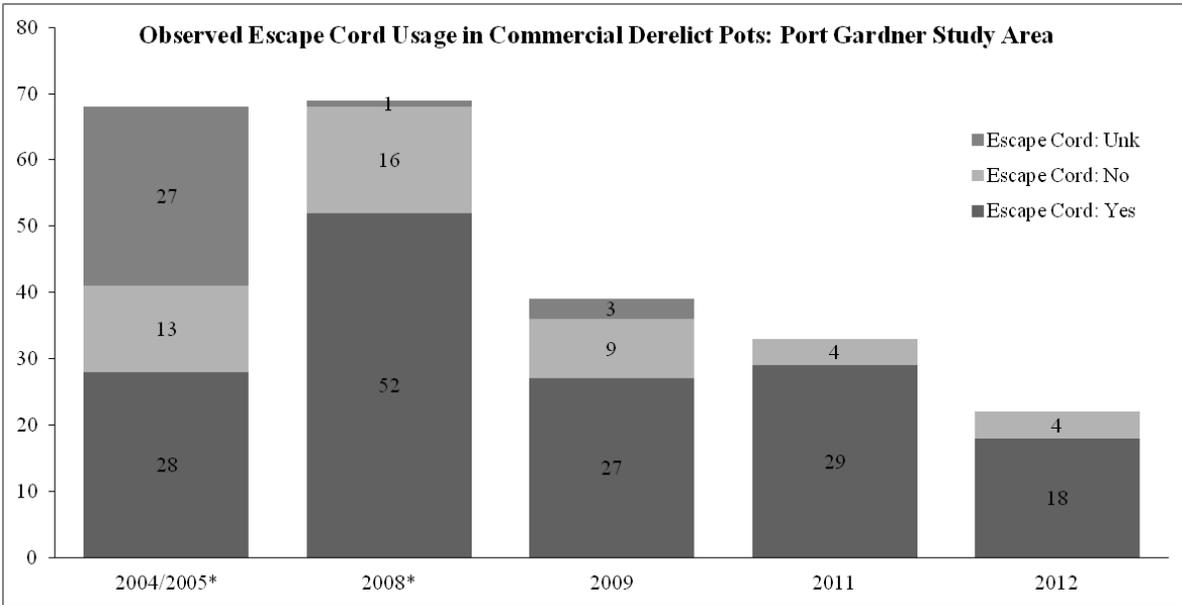


Figure 12. Percentage of legal escape cord compliance exhibited in derelict commercial pots removed exhibiting legal escape cord in the Port Gardner “Study Area” from 2004/2005 to 2012. Source: NRC, Inc.

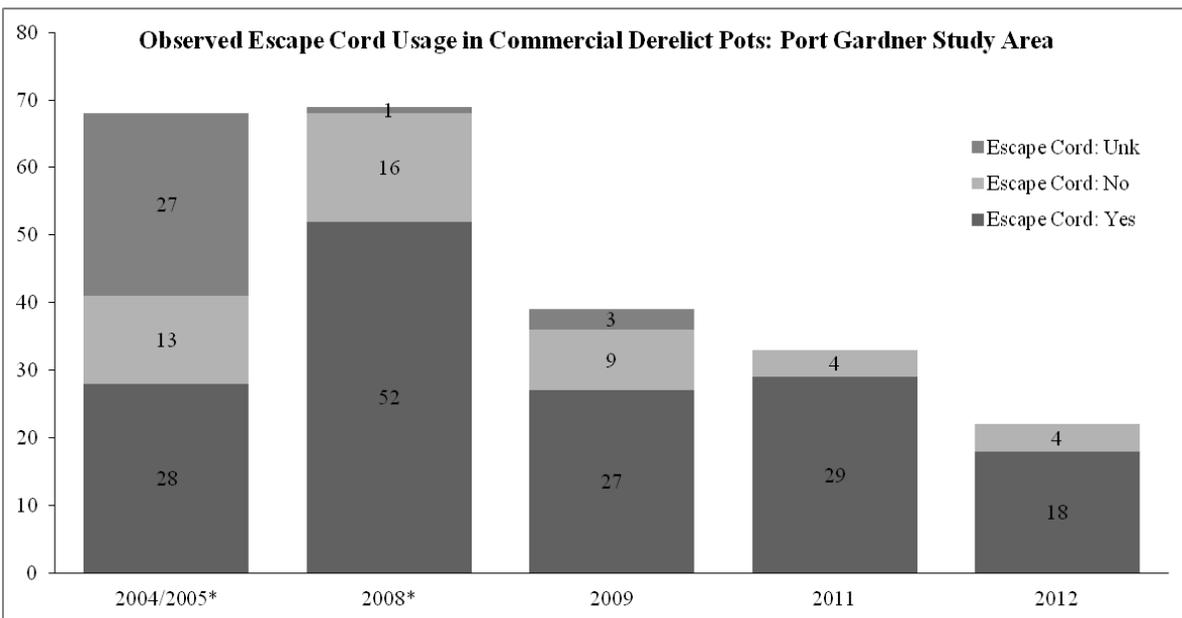


Figure 13. Summary of escape cord compliance observed on commercial derelict crab pots removed in the Port Gardner “Study Area” from 2004/2005 to 2012. Source: NRC, Inc.

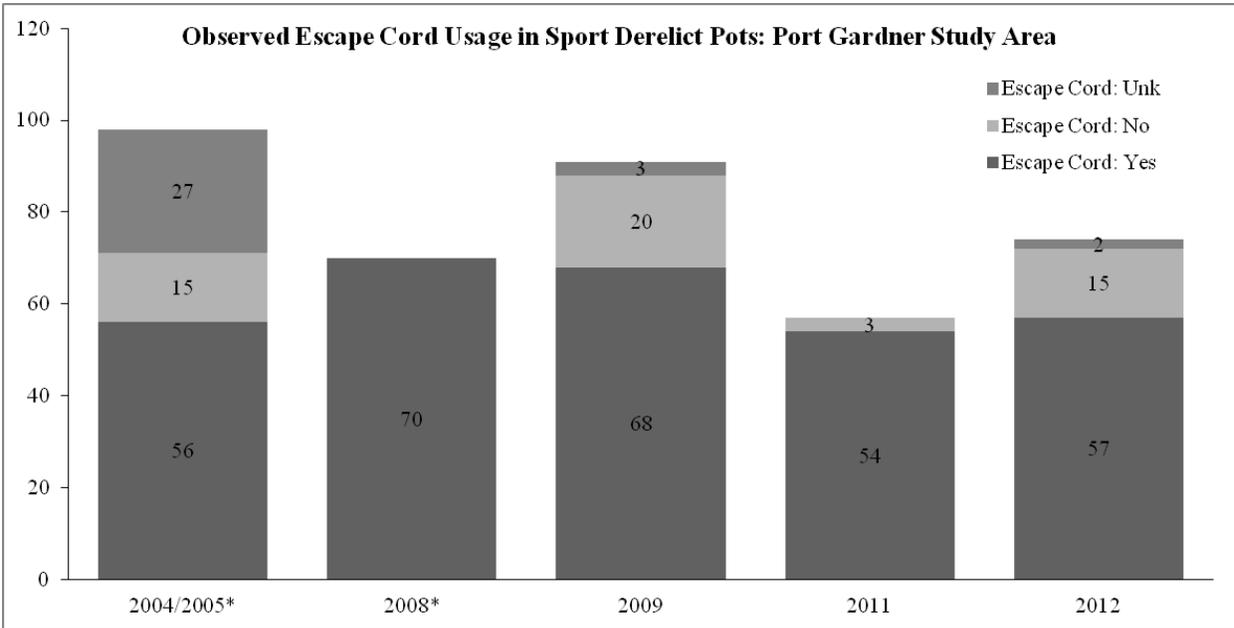
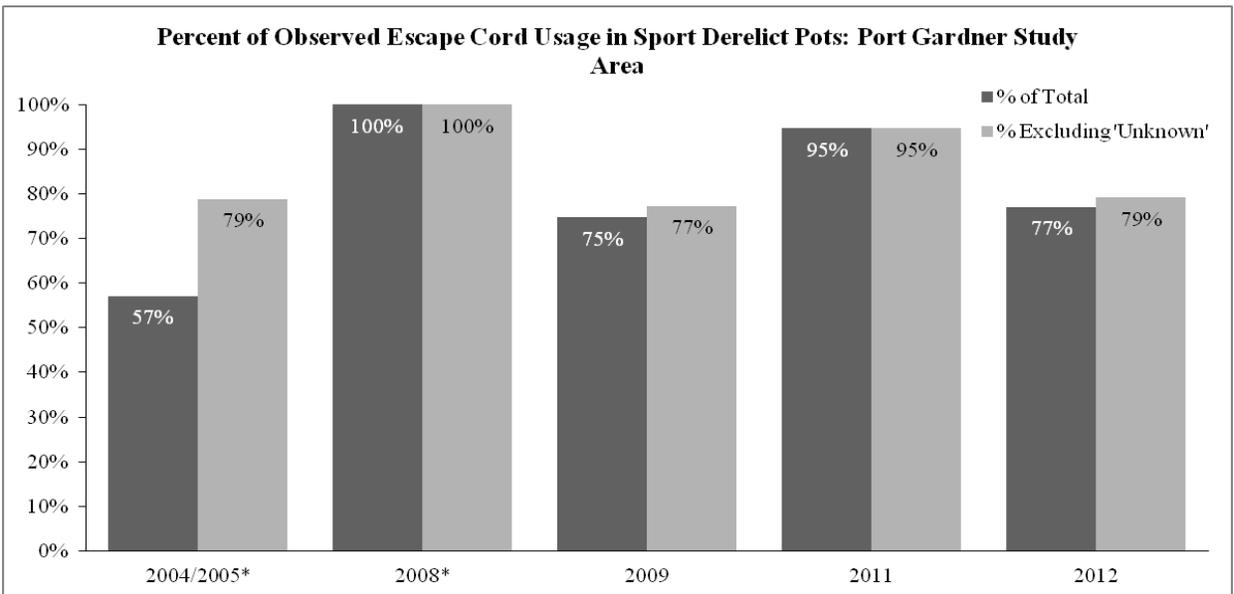


Figure 14. Percentage of legal escape cord compliance exhibited in derelict commercial pots removed exhibiting legal escape cord in the Port Gardner “Study Area” from 2004/2005 to 2012. Source: NRC, Inc.



Appendix A. Summary of characteristics and Dungeness crab impacts from removed derelict crab pots removed in the Port Gardner “Study Area” from 2008 to 2012

Targets within 'Study Area' Only		Year	Targets Removed / Disabled	Fishable	# Fishable Pot with D. Crab	Non - Fishable	# NF with D.Crab	Rot Cord Used	Rot Cord Not Used	Rot Cord Unk	Rot Cord Intact	Rot Cord Not Intact	Rot Cord NA
Comm	Pots	pre-2008	68	15	11	53	7	28	13	27	4	24	40
		2008	69	35	26	34	6	52	16	1	1	51	17
		2009	39	10	7	29	3	27	9	3	0	27	12
		2011	33	4	2	29	12	29	4	0	0	29	4
		2012	22	10	8	12	3	18	4	0	7	11	4
	Alive D. Crab	pre-2008	69	57		12		44	25	0	41	3	25
		2008	57	49		8		23	34	0	1	22	34
		2009	11	8		3		5	6	0	0	5	6
		2011	18	3		15		15	3	0	0	15	3
		2012	79	67		12		74	5	0	62	12	5
	Dead D. Crab	pre-2008	33	26		7		19	13	1	13	6	14
		2008	26	24		2		19	7	0	0	19	7
		2009	3	3		0		1	2	0	0	1	2
		2011	6	0		6		6	0	0	0	6	0
		2012	18	18		0		11	7	0	11	0	7
	Total D. Crab	pre-2008	102	83		19		63	38	1	54	9	39
		2008	86	76		10		45	41	0	1	44	41
		2009	14	11		3		6	8	0	0	6	8
		2011	24	3		21		21	3	0	0	21	3
		2012	97	85		12		85	12	0	73	12	12
Sport	Pots	pre-2008	98	19	11	79	5	56	15	27	10	46	42
		2008	70	16	10	54	1	70	0	0	7	63	0
		2009	91	24	13	67	16	68	20	3	4	64	23
		2011	57	12	4	45	12	54	3	0	8	46	3
		2012	74	29	8	45	15	57	15	2	17	40	17
	Alive D. Crab	pre-2008	19	17		2		12	7	0	7	5	7
		2008	12	9		3		12	0	0	4	8	0
		2009	90	65		25		45	44	1	5	40	45
		2011	39	13		26		38	1	0	12	26	1
		2012	27	17		10		21	6	0	11	10	6
	Dead D. Crab	pre-2008	11	4		7		8	1	2	2	6	3
		2008	14	14		0		14	0	0	2	12	0
		2009	10	4		6		8	2	0	0	8	2
		2011	3	1		2		3	0	0	1	2	0
		2012	24	5		19		19	5	0	0	19	5
	Total D. Crab	pre-2008	30	21		9		20	8	2	9	11	10
		2008	26	23		3		26	0	0	6	20	0
		2009	100	69		31		53	46	1	5	48	47
		2011	42	14		28		41	1	0	13	28	1
		2012	51	22		29		40	11	0	11	29	11
Total	Pots	pre-2008	166	54	22	132	12	84	28	54	14	70	82
		2008	139	51	36	88	7	122	16	1	8	114	17
		2009	130	34	20	96	19	95	29	6	4	91	35
		2011	90	16	6	74	24	83	7	0	8	75	7
		2012	96	39	16	57	18	75	19	2	24	51	21
	Alive D. Crab	pre-2008	88	74		14		56	32	0	48	8	32
		2008	69	58		11		35	34	0	5	30	34
		2009	101	73		28		50	50	1	5	45	51
		2011	57	16		41		53	4	0	12	41	4
		2012	106	84		22		95	11	0	73	22	11
	Dead D. Crab	pre-2008	44	30		14		27	14	3	15	12	17
		2008	40	38		2		33	7	0	2	31	7
		2009	13	7		6		9	4	0	0	9	4
		2011	9	1		8		9	0	0	1	8	0
		2012	42	23		19		30	12	0	11	19	12
	Total D. Crab	pre-2008	132	104		28		83	46	3	63	20	49
		2008	112	99		13		26	41	0	7	20	41
		2009	114	80		34		59	54	1	5	54	55
		2011	66	17		49		62	4	0	13	49	4
		2012	148	107		41		125	23	0	84	41	23