Northwest Straits FOUNDATION

partners in marine conservation

Puget Sound Lost Crab Pot Prevention Plan





Prepared for
Northwest Straits Foundation

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Acronyms

ALDFG	Abandoned, lost, and discarded fishing gear
MRC	Marine Resources Committee
NWIFC	Northwest Indian Fisheries Commission
NOAA	National Oceanic and Atmospheric Administration
NRC	Natural Resources Consultants, Inc.
NWSC	Northwest Straits Marine Conservation Commission
NWSF	Northwest Straits Marine Conservation Foundation
NWSI	Northwest Straits Marine Conservation Initiative
PSA	Puget Sound Anglers
PSCA	Puget Sound Crab Association
PSP	Puget Sound Pilots
UNEP	United Nations Environmental Program
USCG	United States Coast Guard
WDFW	Washington Department of Fish and Wildlife

1.0 Introduction

In this document, the term 'lost fishing gear' is any fishing gear, such as nets, lines, and shellfish pots, that is lost, discarded, or abandoned in the marine environment. In many intergovernmental organizations, such as the United Nations Environmental Program (UNEP), derelict fishing gear is referred to as abandoned, lost, or discarded fishing gear, or ALDFG. In marine conservation management forums, ALDFG is considered under the larger umbrella of marine debris. It is recognized as a global problem (UNEP, n.d.). In Puget Sound*, lost fishing gear mostly consists of gillnets and shellfish pots, but does include trawl and purse seine nets, aquaculture nets, other traps and recreational fishing line and lures. Globally, ALDFG often includes fish aggregation devices, which are deployed by fishers to attract fish. Such devices can include balls of fishing nets tied into knots and other kinds of items suspended in the water column or floating on the ocean surface.

The problem of lost fishing gear in Puget Sound was identified as a priority by the Northwest Straits Marine Conservation Initiative in 1999. The Northwest Straits Initiative (NWSI) is a nationally recognized model for marine conservation. Authorized by Congress in 1998 to restore and protect marine resources of the Northwest Straits region of Puget Sound, the work of the NWSI is driven by sound science, local priorities and community-based decisions. The NWSI encompasses seven county-based Marine Resources Committees (MRCs), volunteers who are appointed by local elected officials; the Northwest Straits Commission (NWSC), which includes representatives of each MRC as well as appointees from the Governor's office and the Secretary of Interior; and the non-profit Northwest Straits Foundation (NWSF). Together, the NWSI partners identify marine conservation needs at the local and regional level and work toward solutions. Lost fishing gear is one of many marine conservation issues currently being addressed by the NWSI.

When lost fishing gear was identified as a priority, the NWSC worked cooperatively with the Washington Department of Fish and Wildlife (WDFW), tribes, and other partners to pass state legislation establishing a WDFW approval process for lost fishing gear removal operations. Protocols for lost fishing gear removals and a no-fault reporting system were established. These collaborative actions set in motion the successful Northwest Straits Initiative Derelict Fishing Gear Program run today by the Northwest Straits Foundation.

This Lost Crab Pot Prevention Plan builds on years of efforts by the partners of the NWSI and many other parties to stem the loss of crab pots in Puget Sound and to reduce the negative impacts of lost crab pots. It identifies the known causes of crab pot loss and the negative impacts of these lost crab pots on the marine environment, species, fishing, and other beneficial uses. It identifies ways to both reduce crab pot loss and negative impacts of lost pots.

* In this document the term Puget Sound is used to refer to the portion of the Salish Sea that falls within Washington State's borders, including the Strait of Juan de Fuca to and including Neah Bay.

1.1 Purpose of the Lost Crab Pot Prevention Plan

The purpose of the Lost Crab Pot Prevention Plan is to guide strategic action to both prevent the accumulation of and minimize the negative impacts of lost crab pots in Puget Sound. The plan is designed to be implemented within a three-year timeframe, with periodic reviews.

It is designed to be used by any organization, business, or agency that is affected by the problem of lost crab pots and that can take action to reduce the problem. It is not a guide to best crabbing practices nor is it intended to be an educational manual to avoid crab pot loss.

1.2 Development of the Lost Crab Pot Prevention Plan

The Lost Crab Pot Prevention Plan was developed through a collaborative process, bringing together an Advisory Committee of individuals from the fishing industry, recreational fishers, fisheries resource managers, vessel traffic authorities, maritime industry, MRCs, non-governmental organizations, and government agencies (see Acknowledgements).

The process was begun by gathering advice from Advisory Committee members over many months prior to launching the formal plan development process in April 2016. Two in-person workshops with Advisory Committee members were held in April and May. Before the first workshop, a series of fact sheets and other background information, including published literature, was provided to the Advisory Committee to ensure equal understanding of the issues around lost crab pots prior to meeting. One-on-one phone calls were also made to select advisors to ensure availability and familiarity with the issues and the work of the NWSF. Between the first and second workshop, an online survey was conducted to gather recommended actions to be discussed at the second workshop and included in the final plan.

The plan development was informed by the following key considerations agreed to by the Advisory Committee:

- Respect for tribal treaty rights
- Support for sustainable commercial and recreational crab fishing
- Protection of marine habitats
- Cost effectiveness
- Feasibility
- Scientific justification

At the first Advisory Committee workshop, agreement was reached concerning the impacts of lost crab pots and the causes of crab pot loss in Puget Sound. The subsequent online survey solicited action recommendations related to the identified causes of crab pot loss and identified impacts of lost pots. At the second Advisory Committee workshop, agreement was reached on a set of goals,

strategies, and actions recommended to prevent and reduce impacts of lost crab pots. Lead action implementers and partners were identified for each recommended action. See Section 5.

The NWSF led development of this Lost Crab Pot Prevention Plan. It was informed by the experience and expertise of members of the Advisory Committee as well as other advisors who were unable to participate on the Advisory Committee. The plan was developed and designed to be used by any and all stakeholders affected by this problem. No single organization can solve this problem in Puget Sound. It will take many collaborators to eliminate the problem of lost crab pots in Puget Sound.

1.3 Implementation and Monitoring of the Lost Crab Pot Prevention Plan

Implementation of the Lost Crab Pot Prevention Plan will be accomplished over the next three years by a variety of partners. The plan recommends actions (see Section 5) and identifies leaders and potential collaborating partners. The NWSF is committed to assist with all identified actions to the extent possible with existing funding and capacity and to assist partners in building the funding and capacity needed for implementation. NWSF will coordinate any needed working groups required to move identified actions from concept to conclusion.

The NWSF will monitor the progress of action implementation over the next three years. NWSF will reconvene the Advisory Committee after the three-year implementation period to revisit the plan and update it as needed.

2.0 Negative Impacts of Lost Crab Pots in Puget Sound

In Puget Sound, the crab fishery is a multimillion-dollar business, with the share of crab harvest split between tribal commercial and subsistence fishermen and non-tribal commercial and recreational fishermen. The harvest quotas are determined annually by the fisheries co-managers: WDFW and Puget Sound treaty tribes. Annually more than 200,000 recreational fishermen purchase crab endorsements so they can fish for crab.

A 2010 research study estimated 12,193 pots are lost annually in Puget Sound: 3,601 commercial and 8,592 recreational pots (Antonelis et al. 2011). When crab pots are lost, they often do not stop attracting and capturing crabs. Because the pots are lost and no one is retrieving them, crabs that are captured will die in the pots, unless they can escape. Dead crabs continue to attract crabs to the lost pot and the pot continues to capture crabs in a cycle of self-baiting. This cycle is often called ‘ghost-fishing.’ The regulation requiring biodegradable escape cord on crab pot escape hatches is designed to eliminate this problem. If proper escape cord is used, it degrades before captured crabs die, and if the crab pot’s escape hatch works correctly, ghost-fishing can be eliminated. However,

if escape cord is not used properly or takes too long to degrade or if the escape hatch on a pot does not work properly, this cycle of ghost-fishing can continue until the crab pot is too dilapidated to capture any crab.

Mapping of locations of pots reported lost to the NWSF and to WDFW shows that pot loss is widespread, with some areas of defined concentration. See Figure 1. This is consistent with findings from targeted lost crab pot removal operations conducted by the NWSF.

The NWSC started removing lost fishing gear in 2002, and since then, NWSI partners (including NWSF) have removed 4,130 lost crab pots (30 metric tons), using sidescan sonar to locate concentrations of pots and divers to remove them. Operations have targeted suspected concentrations of lost pots based on known crab fishing activity. Every location surveyed contained some level of lost crab pot concentrations, leading to the conclusion that no area where crabbing occurs is free from impacts of lost crab pots.

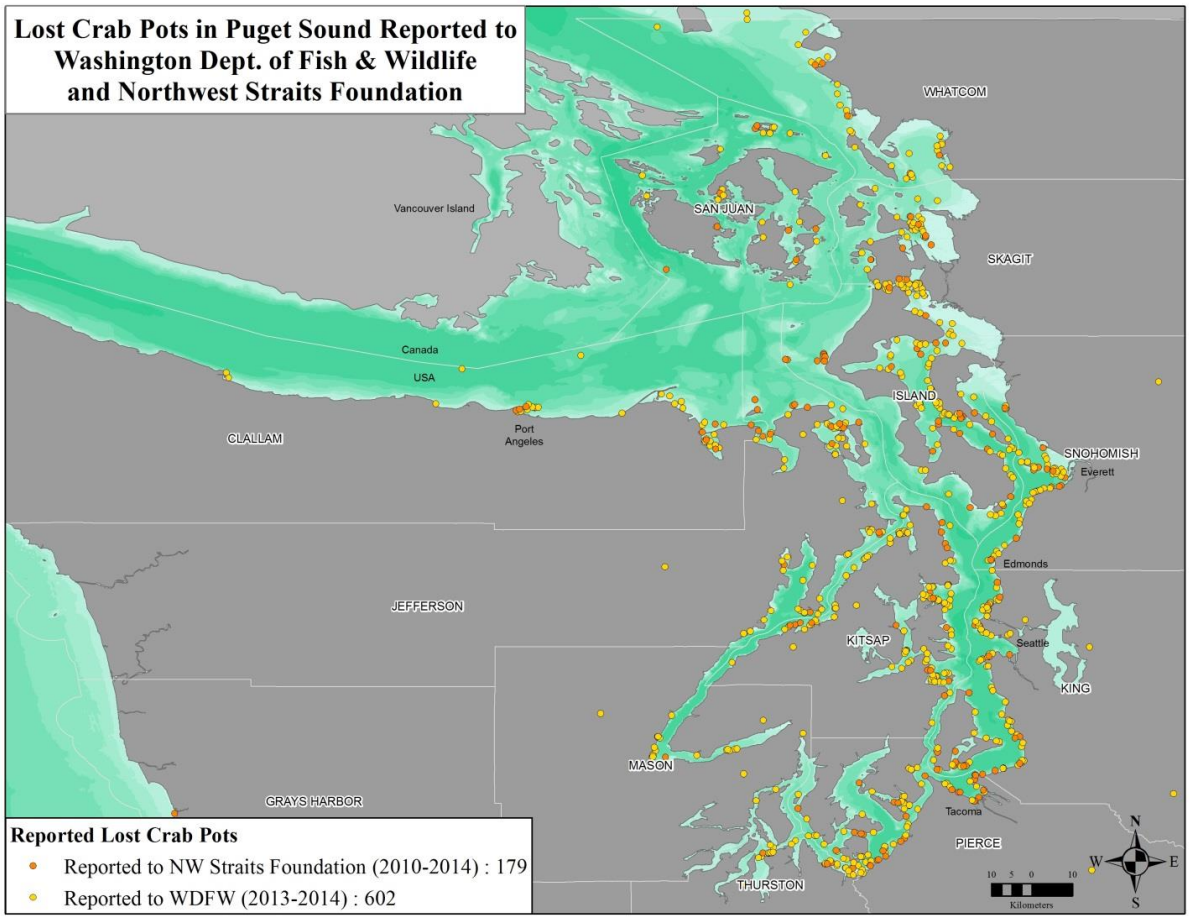

Figure 1. Locations of lost crab pots reported to WDFW and NWSF 2010-2014

Harm from lost crab pots takes a number of forms, the most damaging of which are crab mortality in lost pots, lost harvest revenue, and degraded marine habitat. The estimated loss of 12,193 crab pots results in the annual mortality of 178,874 legal-sized male Dungeness crab valued at $744,296 in 2010. Other key findings of the 2010 study: lost pots with escape cord fish for 126 days; pots without escape cord fish for 2.2 years; and crab mortality occurs within 51.5 days after initial capture (Antonelis et al., 2011). Longer (up to 7 years) fishing times have been documented in other similar marine areas (Maselko et al., 2013). New analysis of updated data from 2015 suggests that total pot loss has risen to 14,235 annually: 2,193 commercial and 12,043 recreational. This represents approximately 103 metric tons of debris. Applying updated estimates of pot loss and ex-vessel value, annual mortality increases to 207,098 crab with a value of $1.385 million.

Lost crab pot survey and removal operations conducted by NWSI have focused on locations with high fishing effort and covered approximately 110 km^2, with some locations being covered multiple times. A total of 4,471 Dungeness crab and 604 red rock crab have been found in removed lost pots. Of the Dungeness crab found, males accounted for 75% of all Dungeness crab encountered, while females made up 13%, and the gender of 12% was unknown. These observed impacts represent only a snapshot of the long term impacts of lost crab pots. Ninety percent of all pots were removed from a substrate type dominated by mud, sand and gravel, with an average depth of 46.5 feet.

During removal operations, even crab pots that were equipped with escape cord that had disintegrated prior to removal were observed to have newly entrapped crabs. This suggests that the problem of ghost-fishing is not solved with current strategies, which rely on the timely disintegration of escape cord and on the ability of trapped crabs to escape through pot escape hatches. A recent study conducted by NWSF and Natural Resources Consultants (NRC) showed that a number of commonly used recreational crab pots employ escape hatch designs that do not effectively allow crabs to escape (NRC, unpublished report).

The negative impacts to the marine food web of crab mortality in lost pots are unknown. What is known is that Dungeness crab play an important role in the food chain as predator and prey in estuarine and marine environments. Nemerteans (marine worms) feed on Dungeness crab eggs and Dungeness crab larvae are important food for herring, rockfish, and salmon. Juvenile Dungeness crabs are eaten by starry flounder, English and rock sole, lingcod, rockfish, sharks, and skates (ODFW 2015). In some cases salmon may feed selectively on Dungeness crab megalopae, which represent a significant component of their diet (Thomas, 2015; Orcutt, 1977).

Vessel entanglement with crab pot buoy line poses a hazard to vessel operation and human safety. Buoy lines may become entangled in a vessel's propeller or rudder resulting in loss of control of the vessel until the line has been removed. Vessel operators may be forced to shut down their

engine and work to untangle the crab line while drifting with the currents without the ability to steer the direction of the vessel. Entanglement may additionally cause damage to props and drive-shafts, requiring costly repair. Entanglement with crab lines by towboats can occur up to twice weekly in the Anacortes, Bellingham, and Ferndale areas during crabbing season (Jack Sanford, pers.com. May 10, 2016). This can require mobilizing a diver to remove the lines from the vessel, costing from $200 to $500 per occurrence. More serious propeller entanglements require vessels to be hauled out of the water for repair.

In general, maritime vessel entanglements with crab pots involve actively fishing crab pots, rather than lost pots that still retain buoys and lines. Therefore, vessel entanglements and their resultant costs to the vessel cannot be considered a direct impact of lost crab pots. However, the interactions cause pots to become lost, often resulting in the impacts noted. Therefore, vessel interactions will be addressed in the following section related to causes of crab pot loss.

3.0 Causes of Crab Pot Loss

Crab pots are lost for a variety of reasons. Causes for loss generally fall into three categories: vessel interaction (both recreational and commercial vessels); improperly configured gear, including improperly tied knots; and improperly placed gear. All these categories usually include a degree of user error, either on the part of the crabber, or on the part of the boater or vessel operator.

Vessel interactions cause pot loss by severing buoy lines, by moving the pot so that the owner cannot find it, and by carrying the pot away. This is a problem both for the crabber and for the boater or commercial vessel owner. Commercial vessel interactions can be caused by placing pots in vessel transit zones or by vessels operating outside vessel transit zones. Recreational vessel interactions can be caused by floating line, low visibility buoys, and submerged buoys (line length too short).

Improperly configured pots include improperly tied knots, use of floating line, inadequate length of line, use of inappropriate buoys that are difficult to see, and failure to weight the crab pot, especially in areas with strong tidal or current action.

Improper placement of pots includes placing pots in known vessel transit zones such as ferry lanes or placing pots too close to other pots or other obstructions, such as docks or marker buoys. Also, pots are placed inappropriately because of general lack of knowledge about water depth, tidal action, and currents. Generally, this lack of knowledge results in the use of too short line and failure to properly weight pots to prevent them from being carried away by the tides and currents.

The NWSF has investigated causes for pot loss through several means. Enhanced data collection on board lost crab pot removal operations began in 2013 to discern why recovered pots were lost,

if possible. In 2014, NWSF interviewed crabbers whose pots were retrieved by WDFW during closed crabbing days. In addition, reports of lost pots provided to the NWSF reporting system and to the WDFW reporting system have been analyzed. Also, in 2015, NWSF commissioned 20 intercept interviews with recreational crabbers at the Seattle Boat Show to better understand the extent of and reasons for pot loss.

Of the 947 crab pots for which loss information was reported or inferred during removal operations, 56% were determined to have been lost due to some reason associated with user error: loose knots, incorrect gear set up, line length too short, unweighted line or pot, or improper placement (too close to other gear, etc.). Twenty-six per cent were determined to have been lost due to vessel interactions. Ten percent of pots were determined to have been lost due to sabotage. Figure 2 illustrates the breakdown of reasons for crab pot loss from the various data sources.

Unfortunately, many crabbers who have lost their pots mistakenly think that their pots have been stolen. This misunderstanding was evident in interviews conducted with crabbers whose pots were collected by WDFW during off days in the 2014 summer crabbing season. Most of the forty people interviewed about their pots thought they had been stolen. Their pots were all collected by WDFW from locations very close to where they had been deployed, suggesting that they had not been

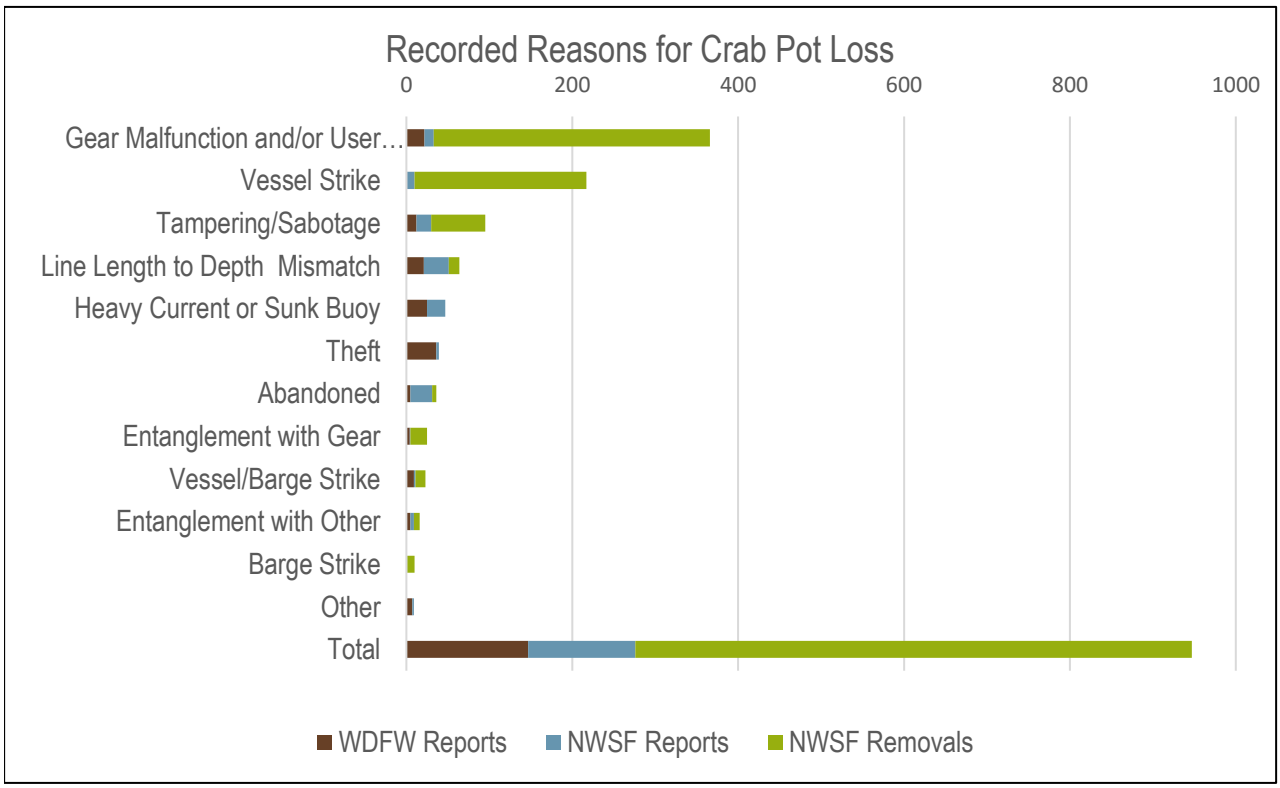

Figure 2. Reasons for crab pot loss

stolen. Instead, it is likely that the owners were unable to locate their pots because their pots were not clearly marked/visible, the buoy was submerged at the time they were trying to locate the pots, or the pots had been moved by the wind, tides, or currents.

4.0 Goals, Strategies, and Actions to Prevent Impacts from Lost Crab Pots

Solving the problem of lost crab pots will involve regulatory and non-regulatory actions. Solutions identified in this document are aimed at preventing crab pot loss and, recognizing that some loss is inevitable, at minimizing impacts of pots after they are lost.

To prevent crab pot loss, certain fishing regulations requiring visible buoys and tags and a variety of education programs are currently in place. To reduce impacts of crab pots that are already lost, regulations requiring biodegradable escape cord and escape hatches, as well as undersize egress routes serve to minimize 'ghost fishing' of lost pots. In addition, prompt removal of lost pots (Figure 3), through enforcement sweeps and diver removals also serve to minimize impacts of lost pots. Dissemination of recent research assessing the effectiveness of various crab pot escapement designs is being pursued to encourage use of pots with more effective escapement designs.

Figure 3. WDFW enforcement sweeps during closed crabbing days are effective at reducing impacts of lost crab pots.

Many of these existing actions are effective and should be continued and, where possible, increased and enhanced. The goals, strategies, and actions recommended herein are intended to augment current actions, rather than to replace them.

The following goals for the Lost Crab Pot Prevention Plan were agreed upon by the Advisory Committee. Each goal directly relates to an impact of lost crab pots or to a cause of crab pot loss. Overarching goals agreed upon are as follows:

1. Reduce crab pots lost from vessel interactions in the commercial sector
2. Reduce crab pots lost due to tampering and sabotage in the commercial sector
3. Reduce crab pot loss by improving regulations in the recreational sector

4. Reduce crab pot loss resulting from user error (improperly configured gear and improperly placed gear) in the recreational sector
5. Reduce crab pot loss from vessel interaction in the recreational sector
6. Prevent impacts to species, habitat, and harvest after pots are lost

To achieve each goal, broad strategies were developed with specific actions recommended. Lead implementers of those actions and potential partners and collaborators are identified. Action completion dates are identified.

Goal 1: Reduce crab pot lost from vessel interactions in the commercial sector

Major strategies identified under this goal include maintaining separation between the crab fleet and other vessels and revising regulatory pot configuration requirements to reduce the risk of lines being cut or carried away by vessels.

Maintaining separation between the crab fleet and other vessels, particularly towing barges, will be facilitated by promoting existing tools available to crab fishermen, such as VHF (very high frequency) frequencies and smartphone applications such as mareintraffic.com that show when and where large vessels are transiting.

Another recommendation is to investigate the successful, voluntary system of vessel traffic lanes for towing barges and tugboats that is in place on the West Coast.

Successful implementation of these recommended actions improving communications will take concerted cooperation between major commercial vessel organizations and companies and participation from the crabbing fleet.

Prohibition of the use of floating line except for some length at the pot end is recommended to ensure that line sinks below the surface in as vertical an alignment as currents allow to avoid being cut or carried away by vessels. This regulatory change is the first of several in this plan. Lead implementers will be WDFW and Tribes and it is anticipated that this and other regulatory changes will be phased in over three years.

Goal 2: Reduce crab pot loss due to tampering and sabotage

Tampering and sabotage was determined to be a high priority cause of pot loss in the commercial sector. Therefore, its reduction is seen as a high priority to prevent continued pot loss. The recommended action under this goal is increased enforcement of current laws. Current enforcement patrols are recognized as effective, so the recommendation is to increase those patrols.

The best approach to increase enforcement patrols is through increased cooperation between enforcement agencies of WDFW and Tribes. This action is ongoing.

Goal 3: Reduce crab pot loss by improving regulations in the recreational sector

Two main strategies are identified under this goal: improving the crab fishing license process to ensure a minimum level of knowledge for all crab license holders, and requiring and encouraging pot configurations that will reduce pot loss from vessel interaction, pot drifting, and buoy submersion.

The current WDFW fishing license program allows crabbers to purchase their crabbing endorsements with their fishing license online or at any number of vendors, such as sporting goods stores and grocery stores around Puget Sound. Neither of these options requires the person purchasing a crab endorsement to show any level of understanding of best crabbing practices. The WDFW recreational fishing pamphlet prepared and distributed annually by WDFW is available at all license vendors and is a comprehensive resource for crabbing regulations and for techniques as well.

Converting to an all online fishing license purchase process is recommended. This recommendation includes the inclusion of a compulsory education mechanism associated with the purchase of a crab fishing endorsement, perhaps a quiz or instructional video. This will ensure at least a minimal exposure to information about how to crab and avoid losing crab pots. This recommended action is intended to be phased in over three years. Development of the educational tool is part of the recommendation.

Incorrect pot configurations are known to cause pot loss. It is recommended to require a minimum weight of crab pot to ensure that pots are not carried away by currents or floated away on high tides. The weight required will be determined in subsequent working groups convened to facilitate the recommended regulatory changes.

Also, prohibition of the use of floating line except for some length at the pot end is recommended to ensure that line sinks below the surface in as vertical an alignment as currents allow to avoid being cut or carried away by vessels. The length of floating line allowed (if any) at the pot end of the configuration will be determined in subsequent working groups.

There are several configurations of buoys that recreational crabbers can use to make their pots more visible. This helps crabbers to relocate their pots and also helps prevent boaters from running over buoys and lines. Various high visibility buoy configurations will be illustrated in the WDFW fishing pamphlet and on the WDFW website and their use will be encouraged.

As stated above, all recommended regulatory changes are planned to be phased in over three years.

Goal 4: Reduce crab pot loss resulting from user error in the recreational sector

Education is called out as an important tool to prevent crab pot loss. A number of recommended actions under other goals involve elements of dissemination, outreach, or public education. In particular, achieving Goal 4 will require effective education and outreach aimed at changing the behavior of recreational crabbers. Strategies under this goal focus on executing new programs and improving existing education outlets, such as the WDFW website.

The first recommended action to change crabber behavior is for the NWSF to implement a comprehensive, social science-based education program designed to improve crabbing practices and reduce the loss of crab pots in the recreational crabbing fleet. The program was under development in spring 2016 using established social marketing frameworks developed by Nancy Lee (Kotler, 2008). Using social marketing strategies moves education and outreach work beyond awareness toward real behavior change. Barriers to behavior change are identified as are incentives (monetary or non-monetary) to influence behavior change. For the NWSF project, initial intercept interviews and surveys of crabbers informed the messaging. The program will use social media predominantly to reach the target audience. The program will launch in the 2016 crabbing season and includes a robust evaluation component.

Other recommended education actions include those planned by other organizations using social media. The Snohomish MRC developed an Instagram contest encouraging best fishing practices in 2015. The NWSC is expanding this program throughout the region in 2016. Point of sale education is recognized as an important opportunity to reach crabbers when they purchase crabbing gear. One-on-one education at events is also recommended. Additionally, publicizing existing tools that many smartphones have to log location information when pots are set is also recommended, so crabbers can return to the exact pot location.

The WDFW website is known to be a primary internet site where crabbers go to learn where, when, and how to catch crab in Puget Sound. The site has a tremendous amount of valuable information. Unfortunately, it has not been reorganized comprehensively in some time; many navigation links are broken and some information is outdated. It is recommended to update this website, making it more engaging and accessible. Also recommended is to include on the site links related to vessel transit information (see Goal 1).

Goal 5: Reduce crab pot loss from vessel interaction in the recreational sector

The strategies to prevent recreational crabbers from losing their pots due to vessel interactions are divided based on whether interactions are with recreational or commercial vessels.

To prevent loss of pots from interactions with recreational boaters, it is recommended to include avoiding crab pots in boater education programs. The implementing organizations for this recommendation include organizations that regularly educate recreational boaters, such as Power Squadrons and BoatUS, an organization serving recreational boaters. During the development of this plan, BoatUS was developing an education program for recreational boaters designed to prevent interactions with crabbing gear. The program will be launched in 2016 or 2017 and the NWSF is in contact with BoatUS to follow the program's progress.

To reduce interactions between recreational crabbers and commercial vessels, recommendations mirror those provided for Goal 1: promoting existing tools available to crabbers, such as VHF (very high frequency) frequencies and smartphone applications such as mareintraffic.com that show when and where large vessels are transiting. It is recommended that information about these communications tools be included on the WDFW website and be incorporated into other education programs under Goal 4.

Goal 6: Prevent impacts to species, habitat, and harvest after pots are lost

This goal addresses impacts of crab pots after they are lost. Two strategies will achieve this goal: removing lost pots and configuring pots in such a way as to allow crabs to escape the pot before they die.

Removing pots immediately after they are lost is currently done through sweeps of crabbing areas during days when recreational crabbing is closed. In Puget Sound, summer crabbing is allowed five days a week, with no crabbing allowed on Tuesdays and Wednesdays. WDFW enforcement officers regularly pick up crab pots with buoys floating on the surface of the water during these closed days. These efforts are effective at removing lost crab pots quickly after loss. However, sweeps are not done in every crabbing area and are not comprehensive. Because of limited capacity, the number of days spent on sweeps varies between crabbing areas and between years. From 2013 through 2015 an average of 25 days or crab sweeps were conducted per crab season. It is recommended to increase these sweeps.

It is recommended to investigate the potential for allowing third parties to conduct these sweeps to increase this activity. This recommendation will be reviewed collaboratively with WDFW and Tribes along with other regulatory changes recommended in this plan.

Removal of lost crab pots at other times of the year is accomplished by divers after pots are located using sidescan sonar. This removal method is equally as effective as enforcement sweeps, but more expensive. Also, it removes lost pots a considerable time after they are lost, after crab mortality and habitat degradation have occurred. A portion of the crab pot fishing endorsement paid by recreational crabbers is allocated to removal of lost crab pots. The NWSF regularly works with WDFW to identify and remove lost crab pots under this program. It is recommended to continue these removal operations and focus on areas with high crab fishing effort.

To reduce crab mortality in lost pots, crabs that are trapped in the pot when it is lost must be able to escape within about 50 days. To ensure that trapped crabs escape, all crab pots in Puget Sound are required to have an escape mechanism or 'hatch.' The escape hatch is secured closed during fishing, but must be secured with biodegradable cotton cord (120 thread count) or other biodegradable material that will disintegrate over time so the hatch opens if the pot is lost. Because of evidence that 120 thread count cord does not disintegrate before trapped crabs die in the pots, it is recommended to decrease the required thread count of escape cord. Like other regulatory recommendations, exact details of the new thread count required will be determined by a working group after this plan is finalized. The regulatory change will be phased in over three years.

Evidence also shows that some crab pot escape mechanisms are ineffective at allowing crabs to escape. Either crabs cannot access the escape hatch, or it is too difficult to open. Recent research conducted by the NWSF and NRC identified pot designs with the most effective escape mechanisms and retrofits of less effective escape mechanisms that can improve their effectiveness. It is recommended to encourage the use and the manufacture of crab pots with more effective escape mechanisms, based on these research findings. See Figure 4.

Figure 4. Research showed that and pots with open wall escape routes and square Danielson pots with escape rings that fall off are most effective at letting crab escape. Photo credit: NOAA

5.0 Lost Crab Pot Prevention Recommended Actions Table

Goals	Action #	Strategies & Recommended Actions	Lead implementers and partners	Completion Date
Goal 1: Reduce pots lost from vessel interactions in the commercial sector	**Strategy 1.1: Maintain separation between commercial crab fleet and vessels – voluntary actions**			
	1.1.1	Publicize use of existing app showing large vessel traffic: marinetraffic.com	TBD	June 2019
	1.1.2	Systematize communications between major towing companies and commercial crabbers to give notice when vessels will be transiting; publicize VHS frequencies	Towing companies; WDFW; Tribes	June 2019
	1.1.3	Investigate replicating in the Puget Sound the non-mandatory system of vessel traffic lanes for towboats that is in place on the West Coast	Ports; WSDOT; refineries	June 2019
	Strategy 1.2: Revise required pot configuration			
	1.2.1	Prohibit use of floating line except for a length TBD at pot end	WDFW; Tribes	phase in over 3 years
Goal 2: Reduce commercial pots lost due to tampering and sabotage	**Strategy 2.1: Increase enforcement of current laws prohibiting tampering and sabotage**			
	2.1.1	Increase cooperative state/tribal patrols	WDFW; Tribes	ongoing
Goal 3: Reduce crab pot loss by improving regulations in the recreational sector	**Strategy 3.1: Improve crab fishing endorsement licensing process**			
	3.1.1	Convert to all online licensing and provide incentives to crabbers to learn about crabbing best practices	WDFW	phase in over 3 years
	Strategy 3.2: Improve pot configuration requirements			
	3.2.1	Add language in fishing pamphlet encouraging more visible, customized buoy configurations	WDFW	2017 pamphlet
	3.2.2	Require weighted line except for a length TBD at pot end.	WDFW; Tribes	phase in over 3 years
	3.2.3	Require minimum weight per pot in recreational fishery	WDFW	phase in over 3 years

Goals	Action #	Strategies & Recommended Actions	Lead implementers and partners	Completion Date
Goal 4: Reduce crab pot loss resulting from user error (improperly configured gear and improperly placed gear) in the recreational sector	**Strategy 4.1: Implement a comprehensive, social science-based education program designed to improve crabbing practices and reduce the loss of crab pots in the recreational crabbing fleet**			
	4.1.1	Implement currently planned social science-based education program involving social media, videos, and website advertisements	NWSF; NWSC; MRCs; WDFW; NWIFC	start 2016; ongoing thereafter
	4.1.2	Implement point of gear sale and point of licensing education	WDFW; NWSF; MRCs; WDFW	June 2019
	4.1.3	Increase crabber education events	NWSC; partners; NWSF; MRCs; PSA; WDFW	June 2019
	4.1.4	Publicize location plotting (GPS) capabilities of smartphones	NWSC	Jul-16
	Strategy 4.2: Improve WDFW crabbing webpage			
	4.2.1	Make WDFW crabbing webpage more engaging and accessible	WDFW; other partners	June 2019
	4.2.2	Include links to educational videos, vessel traffic websites and include information about vessel transit notification system on WDFW crabbing webpage	NWSF; WDFW: NWSC; MRCs	June 2019
Goal 5: Reduce crab pot loss from vessel interaction in the recreational sector	**Strategy 5.1: Reduce recreational boater interactions**			
	5.1.1	Include avoidance of crab pots in boater education	NWSF; MRCs; Power Squadron; USCG auxiliary	2017
	Strategy 5.2: Reduce interactions with commercial vessel traffic			
	5.2.1	Publicize current vessel traffic maps and smartphone applications: marinetraffic.com, shipfinder, etc.	TBD	June 2019
	5.2.2	Publicize existing (or create new) communication system to alert crabbers when towing vessels and tugs are scheduled to transit	TBD	June 2019

Goals	Action #	Strategies & Recommended Actions	Lead implementers and partners	Completion Date
Goal 6: Prevent impacts to species, habitat, and harvest after pots are lost	**Strategy 6.1: Remove lost crab pots from the marine environment within the same season they are lost**			
	6.1.1	Increase sweeps of remaining crab pots from crabbing areas during off-crabbing days	WDFW; Tribes	2017
	6.1.2	Develop program to permit others to assist with sweeping crab pots from crabbing areas during off-crabbing days	WDFW; Tribes	2017
	6.1.3	Conduct removal of lost crab pots in areas of high crabbing concentration.	NWSF; Tribes	ongoing
	Strategy 6. 2: Decrease numbers of crabs mortally trapped in lost crab pots			
	6.2.1	Decrease thread count of required biodegradable escape cord	WDFW; tribes	Phased in over 3 years
	6.2.2	Encourage use of crab pots with most effective escape routes	NWSF; WDFW	Start 2016
	6.2.3	Encourage manufacture of crab pots with most effective escape routes	NWSF; WDFW	Start 2016
	6.2.4	Encourage low-cost retrofits of crab pots to increase escapement effectiveness	NWSF; WDFW	Start 2016

6.0 Lost Crab Pot Prevention Plan Results Chain

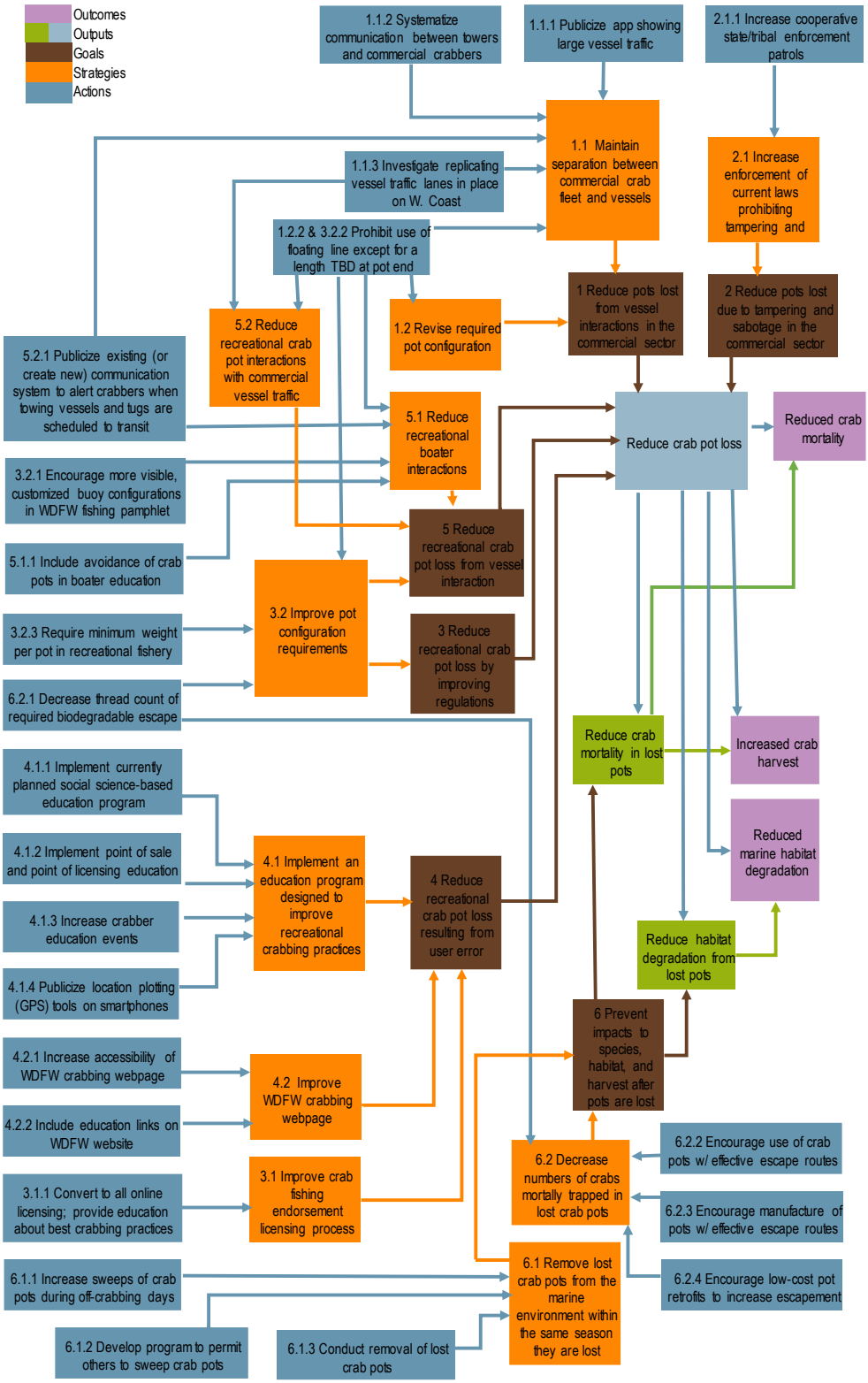

Figure 3. Results Chain for Puget Sound Lost Crab Pot Prevention Plan

The results chain in Figure 3 above is a schematic rendering of the recommended actions in this Lost Crab Pot Prevention Plan. It shows the relationship between the actions, strategies, and goals to the intended outcomes: improving marine habitat, reducing mortality of Dungeness crab, and increasing Dungeness crab harvest opportunities in Puget Sound.

References

Antonelis, K., Huppert, D., Velasquez, D., & June, J. (2011). Dungeness crab mortality due to lost traps and a cost–benefit analysis of trap removal in Washington State waters of the Salish Sea. *North American Journal of Fisheries Management*, *31*(5), 880-893.

Kotler, P. and N. Lee. (2008). *Social Marketing: Influencing Behaviors for Good*. Sage Publications.

Maselko, J., G. Bishop and P. Murphy. (2013). Ghost Fishing in the Southeast Alaska Commercial Dungeness Crab Fishery. *North American Journal of Fisheries Management*, 33:422-431.

ODFW. (2015). *The Life of a Dungeness Crab.* Accessed June 7, 2016. http://www.dfw.state.or.us/mrp/shellfish/crab/lifehistory.asp

Orcutt, H. G. (1977). *Dungeness crab research program; Report for the year 1977*. Menlo Park, CA, California Department of Fish and Game, Marine Resources Region, (Marine Resources Administrative Report, 77-21).

Thomas, D.H. (1985). *A possible link between coho (silver) salmon enhancement and a decline in central California Dungeness crab abundance.* Fish. Bull. U.S. 83: 682-691.

The United Nations Environment Programme and National Oceanic and Atmospheric Administration. Undated. The Honolulu Strategy: A Global Framework for Prevention and Management of Marine Debris.