Northwest Straits Foundation
Shallow Water Legacy Derelict Net Removal from High Priority Areas of Puget Sound
Final Report for Project #13-1791
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Project Scope and Objectives

In June 2013, the Washington State legislature provided $3.5 million to the Washington Department of Fish and Wildlife (WDFW) to work in partnership with the Northwest Straits Foundation (NWSF) to complete the removal of legacy derelict nets from shallow high priority areas of Puget Sound. Subsequent to receiving this appropriation, the WDFW executed a contract with the NWSF to complete the removal of shallow water (to 105') derelict nets from all high priority areas of Puget Sound. This entailed surveying some additional areas for nets, investigating all known targets and removing all nets from those locations. The NWSF was to mobilize one survey vessel, one target verification team and up to four removal vessels over the project period of twenty-three months. This final report satisfies the requirements of contract #13-1791 and details the NWSF's completion of this work.

This project was undertaken in July, 2013 with the goal of removing shallow water (to 105') legacy derelict nets from all high priority areas in the Puget Sound. Activities carried out which addressed this goal include coordination with resource managers, surveys of high priority areas, investigation of new and old net targets, net removals, and management of the statewide derelict fishing gear database.

The objectives of this project were to restore habitat and reduce marine species mortality due to derelict commercial nets in Puget Sound by:

a) Surveying remaining high priority areas for nets
b) Investigating all known targets
c) Removing verified nets
d) Quantifying the marine species mortality and marine habitat damage related to recovered derelict gear

The NWSF has a comprehensive derelict fishing gear program that addresses the problem of derelict fishing gear in Puget Sound with a three-pronged approach: removal, research, and prevention. The Northwest Straits Initiative began removing derelict fishing gear from shallow sub-tidal waters (down to 105 feet) of Puget Sound in 2002. The management of the program migrated gradually to the NWSF in 2006. Since then, the NWSF has completed significant research, removal and prevention projects focused on understanding the impacts of derelict fishing gear and eliminating this threat to Puget Sound and other areas of the Salish Sea.

At the inception of this contract, approximately 1000 derelict net targets were known to remain in shallow waters (to 105') of Puget Sound. Locations for these nets were obtained by sidescan sonar surveys, diver surveys, and through the statewide reporting system. Efforts involved with net removal have included investigating and removing known net targets, and collecting data on gear types and locations, and species and habitat impacts for input into the statewide derelict fishing gear database.

Regular outreach to policy-makers, media and user groups to raise awareness about the problem of marine debris and increase reporting of derelict fishing gear have been integrated into all project activities.

Tasks

Project Management

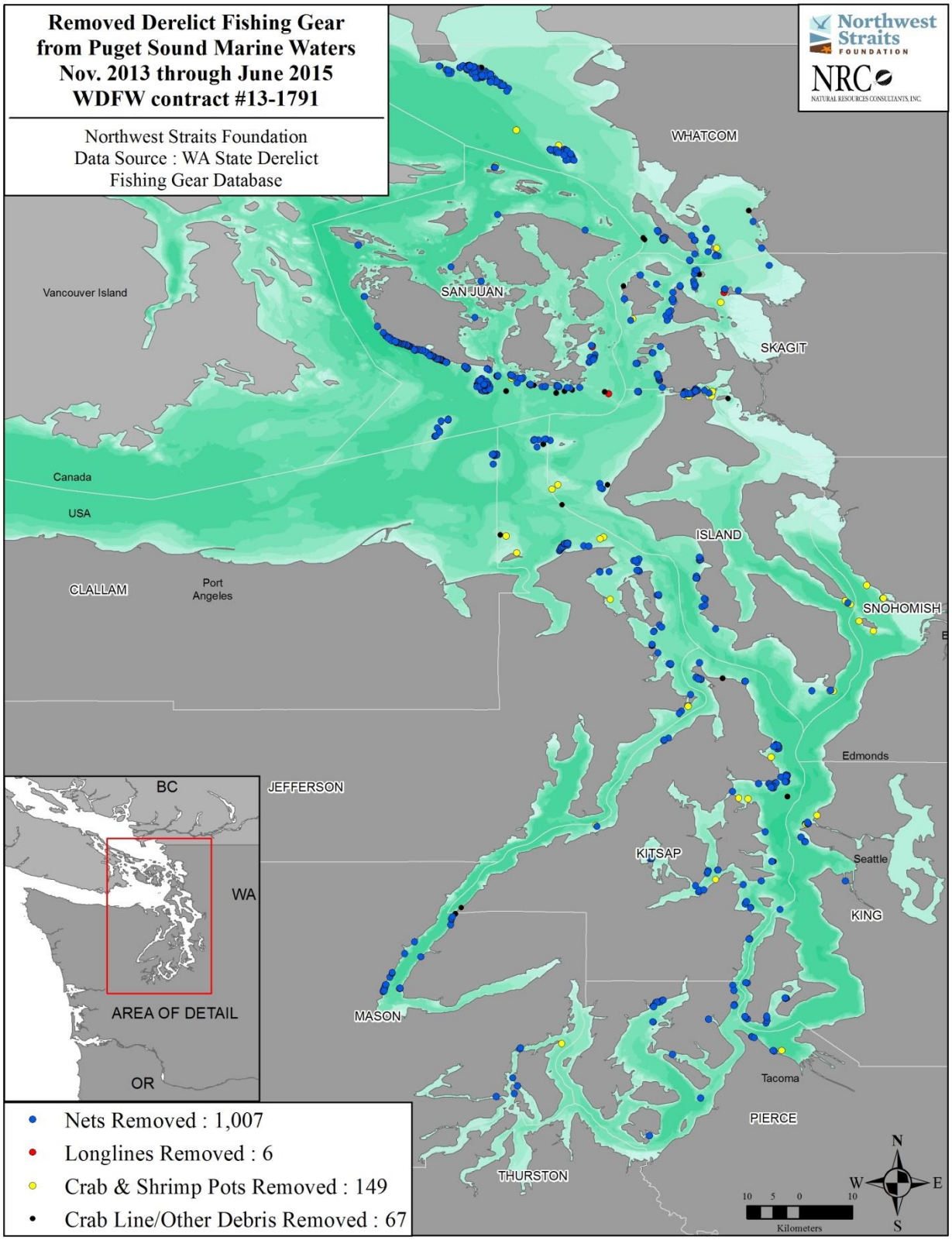
Project management has included executing the contract with WDFW, executing a subcontract with Natural Resources Consultants (NRC) for field operations management, developing schedule of surveys and removals by month, monitoring field operations against plans and schedules, meetings with WDFW contract managers in Olympia, reporting and fiscal management, and all press and public relations.

Field operations management was performed by NRC and included obtaining derelict fishing gear plan approval letters and specimen collection permit from WDFW, scheduling survey and removal vessels and onboard biologists; coordinating with vessels regarding where to survey and which targets to remove; notifications to the Coast Guard and tribes, etc.; entering all data collected into the statewide derelict fishing gear database after appropriate Quality Control; and coordinating specimen identification with subcontractor Applied Osteology.

Removal Operations

With funding from this contract, a total of 370 days of net removal operations were conducted throughout Puget Sound including waters within Kitsap, Jefferson, Clallam, Island, San Juan, Skagit and Whatcom Counties. Removal operations recovered 1,007 derelict nets, 87 crab pots, 8 shrimp pots, 6 longlines, 14 crab rings, and 67 various other gear and debris. Locations of gear removed are represented in Figure 1. Nets removed include 923 gillnets, 65 purse seines, 16 aquaculture nets and 3 trawl nets with a combined weight of 37 metric tons. Of that, 22.9 metric tons of mostly leadline were recycled. Gear removed measured approximately 6,203,460 square feet and was affecting 142.41 acres of marine habitat. Habitat recovered included boulders on

Figure 1. Locations of derelict gear removed through June 2015



sand/mud/gravel (59%), high-relief rocky substrate (19%), mud/sand/gravel/vegetation (13%), low-relief rocky substrate (5%), and underwater obstructions (pilings, bridges, etc.).

A total of 131,138 animals were observed entangled in the nets upon removal of which 33,272 were determined dead. Animals entangled in nets included 11 species of birds, 38 species of fish, and 107 invertebrate species. Species of concern included puffin, Copper rockfish, and Pinto (northern) abalone. A complete list of species encountered, habitats affected, and mortality estimates is included in the attached spreadsheet. Using a catch rate model developed by researchers at UC Davis, we can estimate the annual catch rate of these nets represented in Table 1 below.[1]

Table 1. Estimated annual catch rates of 1,007 nets removed

Mortality Rates (# animals/unit time)		
1,007 derelict nets removed between 11-21-13 and 6-30-15		
Animal Group	Daily	Annually
Marine Mammals	0.36	132
Birds	11.10	4,052
Fish	52.17	19,042
Invertebrates	2386.38	871,029
Total	2,450.01	894,255

Nine hundred ninety-seven (997) of the nets were removed by contracted vessels using surface supplied air diving operations. One diver equipped with surface supplied air located and retrieved the net while another backup diver stayed on deck managing the air supply line while also being ready to enter the water if needed. The dive support and gear recovery vessels employed a wide area augmented global positioning system to locate the reported position of the derelict gear. Once a derelict net was located, a variety of information was collected prior to, and after, removal. Divers were equipped with a two-way verbal communication system in order to communicate with a biologist on the dive vessel. The diver first visually surveyed the net and estimated the total length and width of the net covering the seabed and the height of any suspension of the net off the seabed. The diver reported the minimum and maximum water depth along the net and provided a general characterization of the habitat in the vicinity of the gear such as boulders on sand/mud and gravel, high relief rocky substrate, rock pinnacle, reef edge, wreck, etc. The diver also identified and counted animals entangled in the net and indicated whether they were alive or dead. Additionally, other evidence of gear induced mortality such as bones on the seabed in the vicinity of the net and impacts of the derelict net on the habitat were also reported. The biologist on the dive vessel estimated the location of the net relative to the vessel and derived the approximate latitude and longitude of the net location.

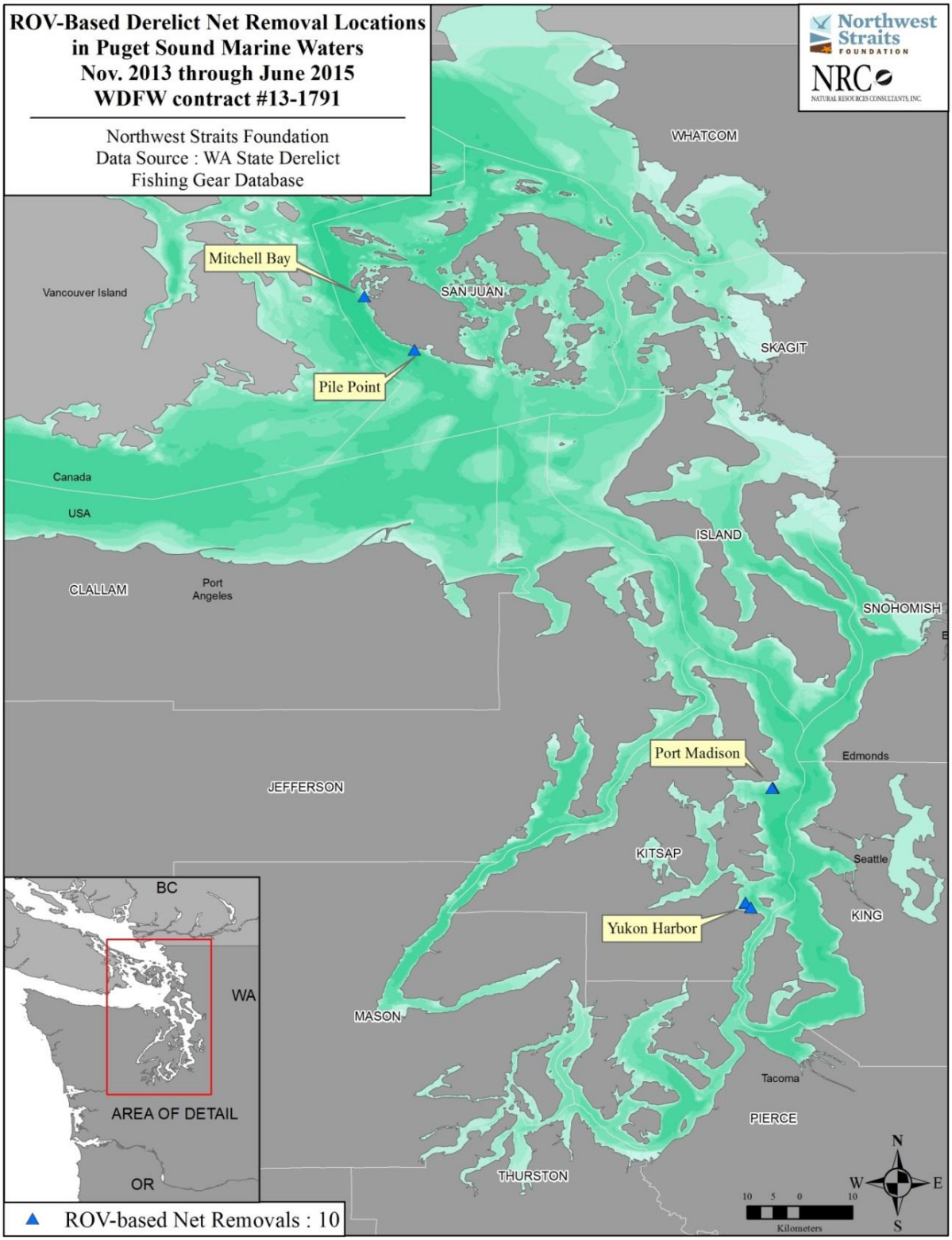
[1] Gilardi, K.V.K., D. Carlson-Bremer, J.A. June, K. Antonelis, G. Broadhurst, and T. Cowan. 2010. Marine species mortality in derelict fishing nets in Puget Sound, WA and the cost/benefits of derelict net removal. *Marine Pollution Bulletin*. doi: 10.1016/j.marpolbul.2009.10.016.

Once the required information was reported, the diver attempted to locate one end of the net or, if necessary, cut the net to make an end. The net was then removed from the seabed by hand and bundled or rolled into a tube. The diver then attached a strap and an airlift bag and partially filled the airlift bag with air to place an upward tension on the freed end of the net. This procedure was repeated down the length of the net until a manageable length of net was freed from the seabed. The diver then connected a "bag line" from the vessel's boom winch to the last airlift bag and instructed the vessel to place tension on the freed portion of the net. The diver then cut the freed portion of the net away from the remaining net on the seabed and the vessel hauled the freed end to the surface and aboard the vessel. The bag line and airlift bags were then sent back down to the diver via the air hose and the procedure was repeated until all of the nets and lead lines in an area were removed. In some cases, multiple nets were entangled on top of one another at the same location and the diver repeated the data reporting and removal operation as additional nets were revealed.

Ten (10) of the nets removed were removed by remotely operated vehicles (ROVs) during a pilot project to test ROV-based derelict net removal methods and protocol. See Figure 2. The nets removed were previously verified and specifically identified by an NWSF dive removal team as appropriate targets for this pilot project. In both Port Madison and Yukon Harbor, multiple derelict nets within a 1,000 foot radius defined the worksites, making it possible to address multiple net removals from a single anchoring location. The primary ROV used for net removals was a Seaeye Cougar XT, deployed from the 62 foot landing craft M/V *Prudhoe* Bay, both owned and operated by Global Diving and Salvage. After identifying the most ideal location for anchorage at each worksite, a two-point anchoring procedure was used to ensure vessel stability during operations. The ROV pilots and support team, along with an NRC biologist, conducted operations in a small Conex box on the deck of the vessel, housing all the necessary video monitors and electronic equipment. Equipped with video cameras, the primary ROV was deployed off the side of the vessel, piloted away from the vessel and then down to the seafloor to the target location. Prior to commencing any net removal operations, the ROV team surveyed each entire net, making notes and waypoints at each location of interest; especially locations where the net would need to be disentangled from snag locations such as a group of boulders, and other locations such as end points of each net. Following a full survey of the worksite, the primary ROV was recovered and equipped with a recovery line, and all the tools deemed necessary for net removal by the ROV team based on survey observations.

The ROV was then re-deployed and piloted to the net. The ROV operator disentangled the nets where they were snagged on boulders so that it would be free from strain when pulled on by the recovery line. Using a variety of tools, the ROV operator gathered the net at a chosen location and attached a choker to encircle the net. A snap-shackle at the terminal end of the recovery line was then attached to a loop at the end of the choker. Once the recovery line was secured to the choker, the ROV returned to the vessel, and the recovery line was attached to a hydraulically powered capstan. The net was then removed from the seafloor with the recovery line via the capstan. Once the net was at the vessel, the recovery line was detached from the choker and the net was placed in a Marco power-block (designed for purse seine fishing) and was fully recovered from the seafloor. At times either the primary ROV, or the secondary ROV (Seaeye

Figure 2. Locations of derelict gear removed by ROV through June 2015



Falcon) was deployed to observe the net being removed from the seafloor, and was available to detach the net from any snag location during removal. In situations where the ROV team decided that the net was too large for one single pull, it was cut prior to recovery and each portion was dealt with separately. The bulk of these operations were conducted in boulders on sand, mud and gravel, at Port Madison and Yukon Harbor. In two locations off the west coast of San Juan Island, operations were conducted in high relief rocky substrate where methods and protocol remained the same, except that the live-boat technique was used rather than the two-point anchor system.

At the surface, the net was laid on the deck and inspected from one end to the other. The onboard biologist recorded the general condition of the net and made a subjective determination of whether the net was newer or older based on the construction material, strength of the webbing and the amount of growth on the net. Newer nets were assumed to have been lost within the past two to three years, while older nets were assumed to have been lost for more than three years.

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

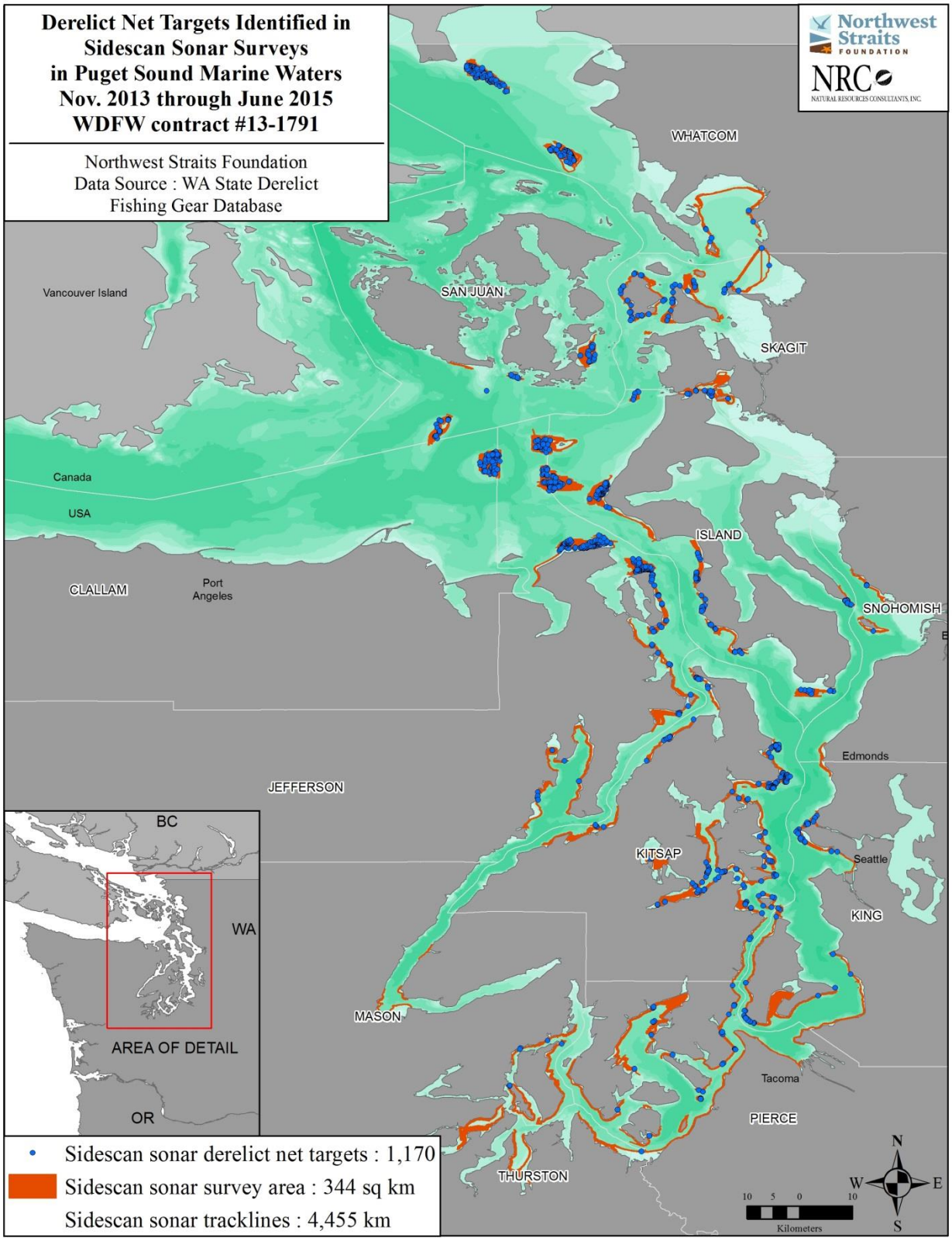
As much biological material as possible was removed from the nets and returned to the sea. The nets were then placed in heavy plastic bags and stored in the cargo hold of the vessel until offloaded. The weight of the disposed gear was measured at the landfill scale. Photograph documentation of net removal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

Surveys

A total of 257 days of survey operations included 169 days of sidescan sonar, 15 days of post survey processing, and 73 days of dive verification surveys at high priority areas throughout Puget Sound. Sidescan sonar surveys were conducted along 4,455 linear kilometers covering 344 square kilometers and identified 1,170 derelict net targets represented in Figure 3.

Sidescan sonar is completed using a Marine Sonic sonar system operating at 300 kHz or 600 kHz with a differential global positioning system (DGPS) to locate derelict fishing gear. The sonar system employed a heavy towfish deployed off the bow of a 26-foot survey vessel. A hydraulic wench and cable controlled the depth of the towfish. The survey image was projected on a monitor onboard the vessel and recorded onto a computer hard drive for later processing. Generally, the sidescan sonar survey was conducted at 4.63 km/hr (2.5 knots) with a path width of 50 m on either side of the boat for an approximate area swept of 90 m to 100 m (295 to 328

Figure 3. Area covered and net targets identified during sidescan sonar surveys



ft). The survey path width was occasionally decreased to 20 to 40 m on either side of the boat in shallow water (less than 5 m deep) or when a more detailed image of an object was desired.

Survey depths generally ranged from about 3 m (10 ft) to 32 m (105 ft) in order to identify derelict fishing gear within the dive depth capabilities of the recovery team. The intent of the sidescan sonar survey was to cover as much of the fishing grounds in the survey areas as possible and to provide locations of derelict fishing gear for recovery operations. Net or line targets were identified through careful analysis of sidescan sonar images. Counts and precise locations of derelict fishing gear targets were recorded during post-survey processing of the data that allowed greater time to examine the images. Targets were then categorized into categories based on confidence level.

Category 1 targets are obvious when observed by a technician or layman. Typically they are large targets that stand out on the image and are easily discerned from surrounding structure. Category 2 targets are not immediately obvious when looking at the sidescan image. However closer inspection reveals clear evidence of a net or line in the vicinity of the target coordinates. Category 2 targets are typically smaller than category 1 targets. Category 3 targets can be difficult to discern on the side-scan image even with given coordinates for the target. Further investigation and close inspection reveals some evidence of net or line. These targets are typically smaller then Category 1 and Category 2 targets and are possibly crab pot lines or other lines rather than gillnet leadline.

The products from the sidescan sonar survey included a trackline file of the area surveyed, calculation of the amount of the fishing grounds covered and the positions (latitude and longitude) of likely derelict fishing gear targets found.

There are also Category 1 targets in the statewide database that are assigned that category because they were reported with high level of accuracy and confidence. There are also Category 4 targets in the database. These are targets that were reported through the reporting system with questionable location information or targets that have remained in the database for several years without investigation.

It was more cost effective to first verify whether Category 2, 3, and 4 targets were nets before mobilizing a full removal crew to those targets. Verification involved mobilizing divers in smaller, faster boats to multiple targets. All divers were experienced in NWSF derelict fishing gear removal operations, and an onboard biologist recorded all observations reported by the divers.

Once in the vicinity of derelict net targets one diver utilizing surface supplied air was deployed and searched for the derelict net. After verifying the presence or non-presence of net at the target site, and reporting the findings to the vessel personnel, the team moved to the next nearest target and repeated the same procedure. NRC personnel accompanied this operation in order to ensure that the survey team collected proper and accurate information. The main goal of this survey technique was to eliminate dive removal time spent on ‘false positive’ targets, particularly those in remote areas with long transit times. Verified targets were either reclassified to Category 1 or removed from the target list.

Database Management

Database management has been continuous and Quality Control procedures were completed quarterly following the program's approved Quality Assurance Project Plan. During this project, we responded to a number of queries from multiple sources including NOAA protected species program and WDFW shellfish program. Several updates and upgrades have been completed and include the addition of new lookup tables, functions, and fields, and adjustments to the offline access database entry forms.

Outreach and Media Coverage

Outreach related to derelict gear is varied and ongoing. Of particular interest is the focused outreach to tribes. We contracted with Tom Cowan (using other funds) in 2014 to meet with tribal representatives and continue assistance to establish systems for reporting nets lost by tribal fishermen to the Northwest Straits Initiative. In addition, a direct mailing was sent to all licensed Puget Sound gillnetters in May, 2014 and another mailing is planned for late July, 2015. The mailings contain information on derelict fishing gear and how and when to report lost gear. This is the fifth year such a mailing will be completed.

In May, 2014, the NWSF was awarded the SeaDoc Society's Salish Sea Science prize at the Salish Sea Ecosystem Research Conference held in Seattle. Foundation staff accepted the prize during a plenary session during lunch on the second day of the conference. In addition to thanking SeaDoc Society for the prize, program funders and partners were recognized. WDFW was specifically thanked during the acceptance, which was attended by over 1,000 conference attendees.

A celebration of the culmination of removing shallow water legacy nets is planned for August 13, 2015. Senator Patty Murray is a featured speaker. We are coordinating the event with the office of state representative Norma Smith. The event is open to the public and invitations have already been sent out. We will also be creating a press release and working with various media outlets to highlight the work and the event.

Twenty-eight presentations and five removal observations occurred during the project. Audiences reached include local elected officials, tribal representatives, resource managers, researchers, national press corps, and general public.

A summary of outreach is listed in Tables 2, 3, and 4 in the Appendix.

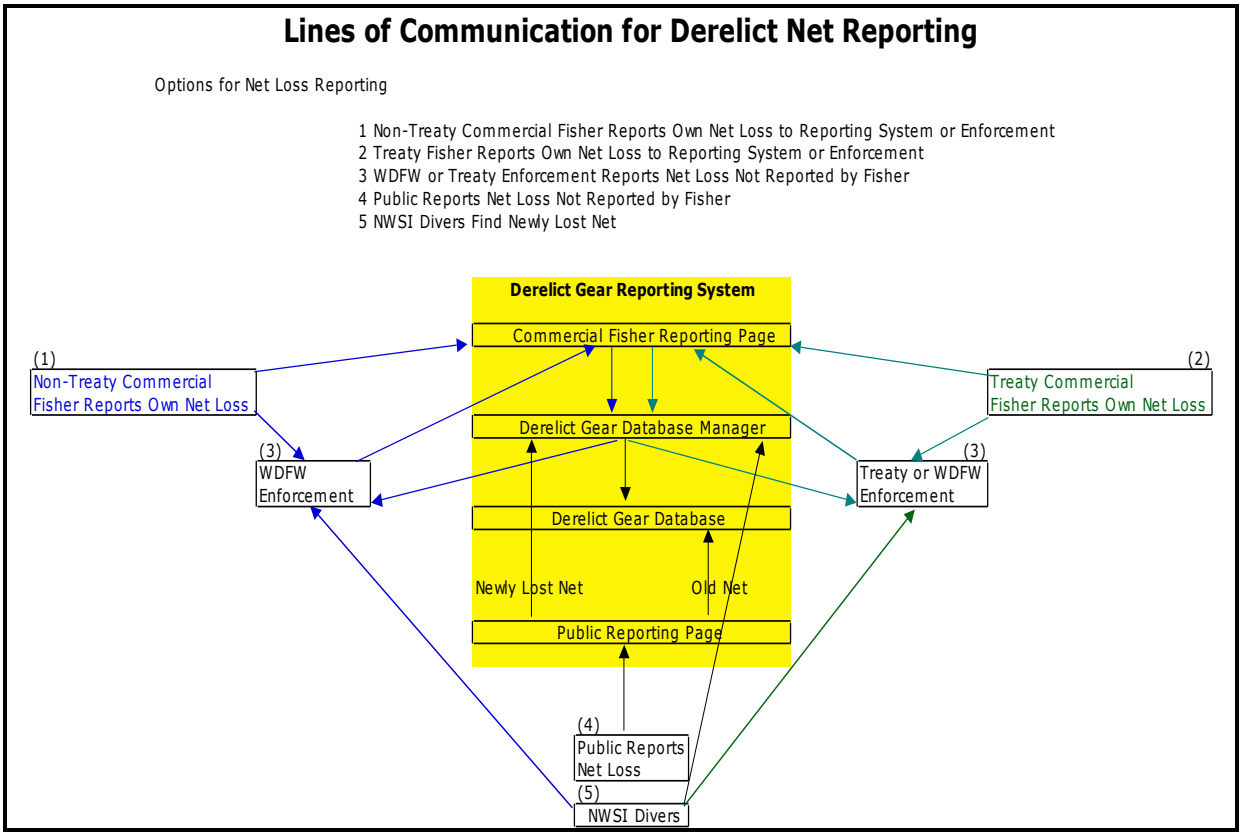
Preventing Re-accumulation of Newly Lost Nets

During this project period, the NWSF operated a newly lost net Reporting, Response, and Retrieval program designed to prevent newly lost nets from becoming derelict. This program was paid for with funds from the WDFW/DNR Marine and Nearshore Grant Program and through a sub-award from WDFW of NOAA Section 6 Protected Species Grant Program funds.

An effective line of communication and regulations for reporting requirements are essential components to providing rapid response to lost fishing nets. State law requires non-tribal fishermen to report lost nets within 24 hours to the reporting system or enforcement, and tribal agencies are required to report lost nets to the reporting system or enforcement under NOAA harvest rules. All reports are entered into the online reporting system which are then received, responded to within 24 hours, and entered into the derelict gear database. See Figure 4 for a flowchart detailing the lines of communication for derelict fishing net reporting.

Reports of lost nets are responded to within 24 hours of online reporting by first placing a call to the reporter to obtain details of the reported net and photos when possible. A site visit to the reported location is conducted to determine if the reported net is indeed derelict gear. Verified derelict nets are then evaluated for urgency of removal and a removal plan is established. Efforts are made to enlist assistance to retrieve the reported net if possible. For example, tribal fisheries personnel are often called first to give them the opportunity to retrieve tribal nets if they have time and capacity. If NWSF retrieval is necessary, a retrieval team is then dispatched to the location to remove the derelict net.

Figure 4. Lines of communication for derelict net reporting



All newly lost net retrieval operations conducted by the NWSF removal team follow the same state-approved derelict fishing gear removal protocols described above. However, not all newly lost nets reported were retrieved by NWSF removal teams. Some were removed by other

entities. Removal protocol varied but generally was accomplished by retrieving the nets from the water surface and pulling them into a boat. Some other nets were retrieved by hand from the beach or from intertidal locations at low tide.

Twenty-nine reports of derelict fishing nets were received during the grant project. Reports were received from a variety of sources including fishermen, private citizens, tribal Department of Natural Resources, public agencies such as Washington Department of Transportation, and Derelict Fishing Gear Program survey and removal teams. A comprehensive log detailing each report, response and removal effort is attached.

Of the 29 reports received, response efforts identified twenty-four (24) lost nets which were retrieved, one was determined to not be derelict fishing gear, two reported nets remain to be removed (these are on beaches), and two reports resulted in reported gear not found.

Table 5 below summarizes the source and method for reports received. Online reporting was the most prevalent method of reporting nets during this project with 11 (37%) reports received this way. Because a large number of nets were found by NWSF removal teams, direct phone reporting to NRC was also prevalent with 9 (31%) reports arriving this way. Since our program has developed strong relationships with several agencies, it is also not unusual for some personnel to report nets directly to NRC by email. Reports via tribal channels were not always readily discernable, since many tribal contacts use either the NWSF telephone or online method to report. No reports were received from fishermen who had lost a net. Two nets removed still had the identification buoys attached and belonged to non-tribal fishers who had failed to report them lost. Removal of these nets was coordinated with WDFW enforcement, who later took enforcement action against the fishers.

Response efforts and correspondence were facilitated by Tribal and WDFW Enforcement, Tribal Resource Managers, and NWSF. A breakdown of the response efforts is provided in Table 6 below.

Table 5. Source and method for all reports of lost nets received

Source	Reports	Method
Fishermen reported other's net	1	WDFW Phone
Private citizen	11	2 WDFW Phone
		8 Online
		1 NRC in person
Other agency (BLM, DNR, Port of Kingston)	8	1 WDFW Phone
		4 NRC Email
		3 Online
NWSF Removal team	9	NRC Phone
TOTAL	29	

Table 6. Summary of response efforts

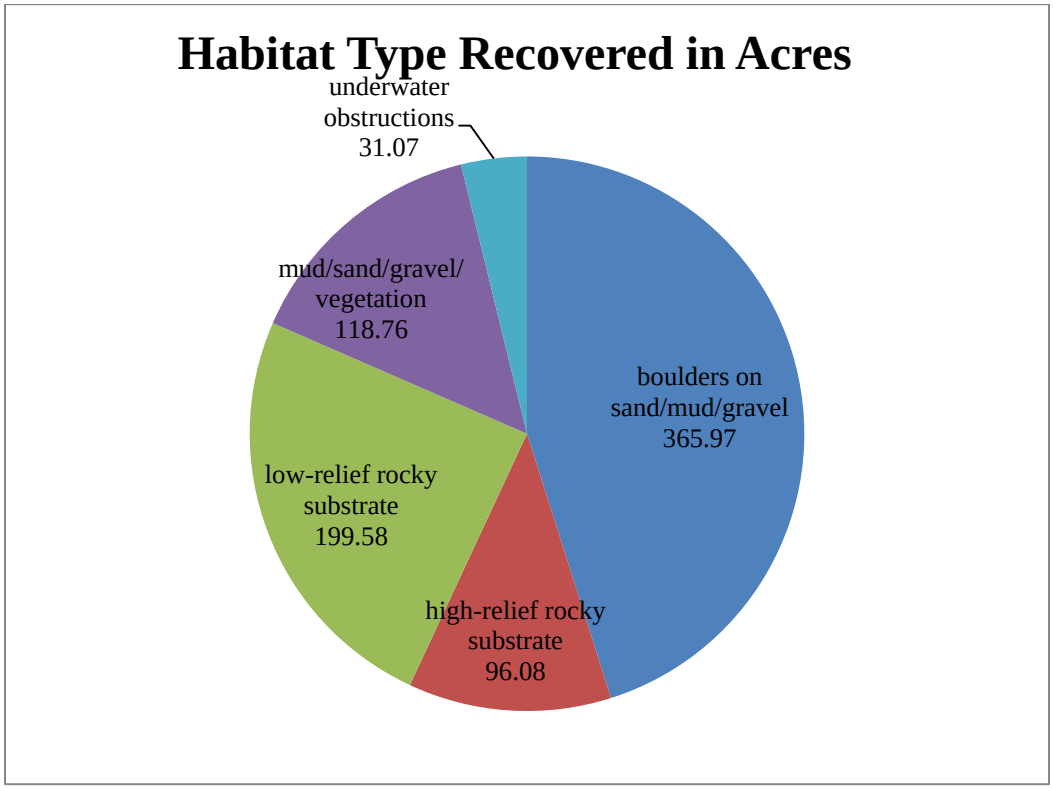
Efforts/Correspondence facilitated by	Number of Reports	Percent of Total
Tribal Enforcement	3	10%
WDFW Enforcement	7	24%
Tribal Resource Manager	4	14%
NWSF/Private Citizen/NA	15	52%
Total	29	100%

Discussion and Recommendations

Shallow Water Legacy Net Removal

This project marks the culmination of the NWSF's aggressive removal operations aimed at shallow water legacy derelict fishing nets in Puget Sound. As of June 30, 2015, 5,667 derelict fishing nets were removed from shallow, subtidal waters of Puget Sound (to 105'). Removing these nets recovered 812 acres of marine habitat. Figure 5 shows the acreage by type of habitats recovered through removal of 5,667 nets.

Figure 5 Acres of habitat recovered by type



Over 450,000 animals were observed in the removed nets, including 65 mammals, 1,092 birds, and 5,659 fish. Removing 5,667 nets has protected more than 1,700 mammals, 28,000 birds, 110,000 fish, and over 4.4 million marine organisms in total, from entanglement in derelict gear annually.[2] Projected impacts are estimated in Table 7.

Table 6. Estimated annual catch rates of 5,667 nets removed

Mortality Rates (# animals/unit time)		
5,667 derelict nets removed between 1-1-2002 and 6-30-15		
Animal Group	Daily	Annually
Marine Mammals	4.69	1,710
Birds	78.71	28,731
Fish	325.32	118,741
Invertebrates	11876.81	4,335,035
Total	12,285.53	4,484,217

WDFW identifies derelict gear as a likely stressor limiting populations of rockfishes in Puget Sound. Entanglement in derelict fishing gear is identified as a well-documented high intensity risk and a potentially major source of unreported mortality both for shallow- and deep water rockfish and is included in the *Puget Sound Rockfish Conservation Plan*.[3] Ninety-seven per cent (97%) of the derelict fishing nets removed from Puget Sound were removed from NOAA-proposed critical rockfish habitat areas.[4] Of the fish observed in the removed nets, approximately 5% were rockfish of varying species. See Table 7 for a breakdown of rockfish observed in removed nets.

Culmination of this work marks the successful completion of Near Term Action B3.2.1 in the *2014 Puget Sound Action Agenda*, the comprehensive plan designed to clean up Puget Sound by 2020.[5] This Near Term Action called for the completion of removal of shallow water legacy nets from Puget Sound.

Using data from fishing effort, the derelict gear reporting system, and qualitative estimates from fishermen, NWSF estimates that approximately 6,000 nets and remnants of nets were lost in Puget Sound by commercial fishers over several decades of intense fishing.[6] This project succeeded in removing 94% of estimated nets lost. While NWSF recognizes that there are

[2] Gilardi et al. 2010.

[3] Washington Department of Fish and Wildlife. 2011. *Puget Sound Rockfish Conservation Plan: Policies, Strategies, and Actions*. Olympia, WA. 28 pp.

[4] National Marine Fisheries Service. 2013. Endangered and threatened species: Designation of critical habitat for yelloweye rockfish, canary rockfish, and bocaccio of the Puget Sound/Georgia Basin. Federal Register 78:151 August 6, 2013. RIN 0648-BC76. 35 pp.

[5] Puget Sound Partnership. 2014. 2014/2015 Action Agenda for Puget Sound.

[6] Antonelis, K.L. 2013. Derelict *Gillnets in the Salish Sea: Causes of Gillnet Loss, Extent of Accumulation and Development of a Predictive Transboundary Model*. A thesis submitted in partial fulfillment of the requirements for the degree of Master of Marine Affairs University of Washington.

Table 7. Number of condition of rockfish observed in 5,667 removed derelict fishing nets

Group	Species Common	Species Scientific	Num Alive	Num Dead	Total
Fish	black rockfish	Sebastes melanops	5	59	64
	brown rockfish	Sebastes auriculatus	-	2	2
	canary rockfish	Sebastes pinniger	-	1	1
	China rockfish	Sebastes nebulosus	1	-	1
	copper rockfish	Sebastes caurinus	16	25	41
	Puget Sound rockfish	Sebastes emphaeus	11	4	15
	quillback rockfish	Sebastes maliger	15	28	43
	rockfish unid.	Scorpaenidae sp.	35	62	97
		Sebastes sp.	-	43	43
	yellowtail rockfish	Sebastes flavidus	1	2	3
Total			84	226	310

scattered remaining shallow water legacy nets, we have determined that the bulk of damaging nets have been removed. Further, NWSF recommends that efforts to combat impacts from derelict fishing nets be directed at preventing future lost nets from becoming derelict and at locating and removing deep water legacy derelict nets.

Reporting, Response, and Retrieval Program

It is imperative that the benefits of removing shallow water legacy nets are not compromised by further re-accumulation of derelict nets from current and future net fishing activity in Puget Sound. Current fishing effort in Puget Sound has declined precipitously from its heyday in the 1970s and 1980s. We currently estimate that 10-30 gillnets are lost each year.[7] The non-tribal commercial fleet included 155 fishermen in 2011 while the Treaty fleet included 632 fishermen (WDFW license database; NWIFC license database). Compare these numbers to the 3,357 total fishermen active in 1978, or the 2,857 active in 1988.

During 2011 and 2012, the NWSF conducted two separate research/interview projects aimed at understanding the rate of fishing net loss in Puget Sound and understanding why nets are lost. During those projects, fishermen provided first-hand information about why nets are lost and estimates of loss rates. More than 20 fishermen were interviewed at length and many more fisheries managers were interviewed. The results of those projects support the NWSF low annual net loss estimate. Results indicated that net loss is often not preventable and fishermen usually retrieve their own nets, either at the time of loss, or later after they return with assistance.

Until 2012, fishermen were encouraged to report lost fishing gear but were not required to report. The NWSF continued to find newly lost nets during removal operations and through reports by non-fishermen. Less than a handful of reports from 2002-2011 were from fishermen. The few

[7] Antonelis. 2013.

reports from fishermen were reporting nets lost by other fishermen. In 2012, the Washington State established requirements that non-tribal fishermen report the loss of fishing nets, along with a location, within 24 hours of loss (RCW 77-12-870), and efforts are ongoing to enhance net marking requirements to increase reporting accountability in the case that unreported nets are salvaged. Tribal fisheries are also required to report lost nets under the NMFS 4(d) review of the Chinook salmon harvest resource management plan. NWSF and WDFW have since worked cooperatively to ensure newly lost nets reported were responded to in a timely and efficient manner.

The Reporting, Response, and Retrieval Program is designed to ensure that any fishing nets lost during active fishing do not sink and become derelict. This program builds on the no-fault reporting system that has been in place for many years. The program was fully developed and initiated in 2012 using funds from the WDFW/DNR Marine and Nearshore Grant Program. It includes a number of options for reporting lost nets, a same day response system, and on-call vessels that can be activated to retrieve reported nets. It has been operating since June of that year: three years.

The reporting component of the Reporting, Response, and Retrieval Program is strong. The variety of methods to report lost nets appears to be adequate. All methods to receive reports are used regularly.

Annual and systematic outreach to tribal fisheries personnel, to WDFW fisheries personnel, and to commercial salmon fishermen has been an important factor in ensuring the reporting system works. Ongoing outreach will continue to be necessary to ensure continued reporting success. Currently, the NWSF has funding from WDFW through a sub-award of funding from the NOAA Protected Species grant program to continue this outreach. This funding runs through December, 2016.

While our outreach approach will remain constant for the most part, NWSF intends to increase its outreach to tribal enforcement personnel in addition to continued communication to tribal fisheries personnel. This strategy is a response to the effective response and retrieval cooperation the NWSF has been experiencing from the enforcement arm of tribal fisheries.

However, the goal of having fishermen report their own lost nets within 24 hours is not being achieved. Since June 2012, only three newly lost nets were reported by fishermen. None were reported by non-tribal fishermen. Two newly lost nets removed from the Hood Canal bridge in November and December 2014 were traced back to individual non-tribal fishermen. These fishermen received a small fine for failing to report a lost net within 24 hours.

To increase prompt reporting by fishers, NWSF recommends both increased positive reinforcement of the reporting system as well as increased penalties for failure to comply with reporting requirements.

The response component of the program is very efficient and effective. The established line of communication between fishers, enforcement, and NWSF and NRC staff has proven to be effective at ensuring that all lost net reports are responded to in a timely manner. Nevertheless,

even successful, timely reporting and response does not guaranty that a reported net can be found. Environmental factors, such as tides and currents and weather often move nets great distances in short time periods. Solutions to this problem could include greater accuracy in reporting locations as well as cooperation from fishermen. Such cooperation could include anchoring lost nets in place if possible, or placing marker buoys on the nets before they are left. Immediately reporting, even when a fisherman intends to return to the net to try to retrieve it within 24 hours, will assist in locating the net if the fisherman is unable to retrieve it.

Additionally, as in most efforts that involve effective communication, having consistent program staff responding to reports of lost nets from year to year is critical. Maintaining and building relationships with enforcement and fisheries personnel and with staff from other agencies, such as Washington Department of Transportation, and fishermen themselves is a long-term investment. The NWSF long-standing relationship with NRC allows our program to take advantage of NRC's expertise in fisheries and on-call availability to respond to reported lost nets without taking on staff. In other words, we only incur expenses when reports are received and responded to. This keeps program costs down, but allows us consistent personnel.

Several of the reported lost nets that could not be found were reported to us after several days. Response effectiveness could be bolstered by more immediate reporting from fishers and from both tribal and WDFW enforcement or fisheries personnel. Increasing our outreach to tribal enforcement personnel, as described above, will help build this cooperation. Improving cooperation and coordination with tribal and WDFW staff should help avoid reporting lags from those sources. This should help us be able to locate reported lost nets before they drift away.

The effectiveness of retrieval of located lost nets was very high, especially when NWSF removal teams were employed to retrieve the nets. During the first part of the Reporting, Response, and Retrieval project, NWSF intentionally attempted to encourage other entities, such as tribal and WDFW fisheries personnel to attempt to retrieve nets. This was done to keep costs down and to build ownership of the problem within the fishing community. Later, because there was some concern that portions of lost nets were left underwater to remain derelict, NWSF volunteered its teams to retrieve nets when working with other entities on response.

However, increasing the number and completeness of net retrieval by other entities is a goal for this program. Future retrieval efforts will be coordinated as much as possible with other entities. When underwater work is necessary, however, NWSF teams will be called on.

Costs for the program vary considerably over time. For example, from October 2014 through December 2014, an additional 12 reports of lost nets were received representing 25% of all reports received over an 18 month timeframe. Two factors contributed to this heavy reporting during these months: particularly severe winter weather in November and frequent incidental detection of newly lost net by NWSF removal teams working on removing legacy derelict nets.

From October 2014 through December 2014, more than $47,000 was spent from grant funds on this task. An additional $8,000.00 was spent from other funding to pay for December activities. It is wise to assume that reporting of lost nets will increase from fisheries personnel and fishers in the coming years. Reporting from NWSF removal teams, however, will decrease as we will no

longer have active removal crews focused on derelict nets. This creates even more urgency to improve reporting from other sources.

As the program gains recognition and partners increase coordination with us, the costs of the program may rise as well. It would be prudent to assume heavy winter weather each year, with commensurate heavy costs associated with response and retrieval. With this in mind, the NWSF is currently estimating the cost of the entire Reporting, Response, and Retrieval program at approximately $100,000/year. This estimate includes all necessary outreach, reporting system and database maintenance, response capabilities, and retrieval operations. We are currently funded at less than that amount through December 2016.

Appendix

Photo 1. Diver #1 locates and removes net while diver #2 manages air supply line and crew communicates via two-way diver equipped verbal communication system

Photo 2. One end of the net is hauled on board while the other end is suspended by an airlift bag

Photo 3. Biologist Jeff Cox hauls a net onboard R/V Bet Sea

Photo 4. Derelict net hanging from vessel's boom entangled with dogfish, sea stars and an abundance of other invertebrates

Photo 5. The Cougar is launched from the M/V Prudhoe Bay off of San Juan Island

Photo 6. Net is hauled onboard the M/V Prudhoe Bay

Photo 7. Net on board the deck of the M/V Prudhoe Bay is examined by biologists

Photo 8. Rockfish found in a net removed from False Bay, September 2014

Photo 9. Multiple mammals found in a newly lost net removed from Sares Head, March 2015

Table 2. Summary of Outreach Events

Date	Outreach Events Description	Location	Number attending
7/23/13	USFWS personnel	Aberdeen and Cosmopolis	6 USFWS staff
8/6/13	San Juan County Council	Friday Harbor	Elected officials
8/6/13	Alaska Tribal Staff	Webinar	20 representatives from Alaska tribes
11/12/13	North Snohomish County Chapter of the Coastal Conservation Association.	Bayside Marine, Everett	Approximately 30 people
12/3/13	Twin Harbors chapter of the Coastal Conservation Association.	Montesano Library	Approximately 30 people
1/16/14	WSU Island County Beach Watchers Annual Meeting	WSU Ag Research Center, Mount Vernon, WA	approximately 50 people
1/30/14	Western Washington University	Bellingham	20 university students
2/11/14	Seadoc Society Science Speaker Series	Orcas Island, WA	40 people, general public
3/12/14	Puget Sound Leadership Council	Olympia, WA	8 Leadership council, 40 people in audience
3/31/14	WDFW Resource Managers	Olympia, WA	3 WDFW Fisheries and Habitat resource managers
5/2/14	Salish Sea Ecosystem Conference: session on Protecting Species Associated with Rocky Reef Habitats	Seattle, WA	50 researchers and resource managers
05/06/14	UW Class on Recreational Fisheries	Seattle, WA UW – Fishery Science Bldg	40 University Fisheries students in attendance
05/07/14	San Juan County Marine Resources Committee	Friday Harbor, WA	San Juan MRC – 30 people
6/17/14	Fidalgo Island Chapter Puget Sound Anglers	Anacortes, WA	Approximately 50 people
8/6/14	International Whaling Commission Workshop: Impacts of Marine Debris	Honolulu, HI	40 Resource Managers and Scientists
9/24/14	WSU Skagit Beach Watchers	Anacortes, WA	15 Citizen volunteers
10/6/14	Olympic Peninsula Fly Fishers	Port Angeles, WA	25 people
10/8/14	Renton Puget Sound Anglers	Renton, WA	40 people
11/5/14	Restore America's Estuaries Conference, Derelict Fishing Gear Session	Washington D.C.	40 people
11/6/2014	Table display at NOAA Nite in Mukilteo	Mukilteo, WA	Approximately 50 people including researchers, resource managers and general public
11/13/14	Global Ghost Gear Initiative kickoff meeting, presentation on Derelict Fishing Gear Program	Lubjliana, Slovenia	50 people
12/5/14	United Nations Environmental Program Convention on Marine Biodiversity Workshop	Baltimore, MD	30 people
1/15/15	Sequim Puget Sound Anglers Chapter	Sequim, WA	40 people

Date	Outreach Events Description	Location	Number attending
1/25/15	Salish Sea Festival, Bellingham School District	Bellingham, WA	200 people
3/3/15	WWU Marine Conservation class	Bellingham, WA	15 people
5/31/15	Table Display at Flipper Fest	Seattle, WA	100 people
6/13/15	Table Display at Seattle Aquarium Ocean Weekend	Seattle, WA	200 people

Table 3. Summary of Removal Observations

Date	Observer (name and affiliation)	Boat
8/5/13	Miranda Plum, USFWS	Bet Sea
6/10/14	Manuel Valdes and Elaine Thompson, Associated Press	Bet Sea
6/20/14	Allison Arthur, Port Townsend Leader	Bet Sea
8/4/14	Roberta (Birdie) Davenport, WADNR Aquatic Reserves Program Manager and Betty Bookheim, WADNR Natural Resource Scientist toured Cornet Bay – Smith Island	Bet Sea
1/19/15	Chris Robertson, WADNR, Aquatic Restoration Program	Surveyor II

Table 4. Summary of Media Coverage

Date	Publication	Title/Link
7/8/13	PRI's The World	Ghost Net Busters Dive to Remove Deadly Lost Fishing Nets http://www.theworld.org/2013/07/ghost-net-busters/
9/3/13	San Juan Islander	Rounding Up Puget Sound's "Deadliest Catch" http://www.sanjuanislander.com/island-newshome/environment/7032-rounding-up-puget-sounds-qdeadliest-catchq
9/4/13	NOAA's Marine Debris Blog	NOAA MDP funds 11 marine debris removal projects http://marinedebrisblog.wordpress.com/2013/09/04/noaa-mdp-funds-11-marine-debris-removal-projects/
9/5/13	Press Release, Office of Rep. Rick Larsen	Larsen Announces Federal Funding to Remove Marine Debris from Puget Sound
9/9/13	KAFE 104.1	Derelict gear removal program featured
10/5/13	Daily World (Aberdeen)	Ghost nets haunt local waters no more http://thedailyworld.com/sections/news/local/ghost-nets-haunt-local-waters-no-more.html
11/8/13	Kitsap Sun	Abandoned fishing nets, creosote pilings on the way out (pdf copy in s/dg/outreach)
05/2014	YouTube, Vimeo	Marine debris video - interviews shot by Michael Monroe, produced by Joe Cone, Oregon Sea Grant. The video is viewable here: https://vimeo.com/92878422 and here: youtube.com/watch?v=_HoZX3qsYXQ Distribution intent is that each of the West Coast Sea Grant programs and NOAA would provide links from their web sites back to these.
05/14/14	Salishseanewsblogspot.com	Responding to the Risks of Marine Debris: Derelict Fishing http://salishseanews.blogspot.com/2014/05/514-climate-ghost-nets-steelhead-vandal.html

Date	Publication	Title/Link
7/2/14	PTLeader.com	**Fishing for Crab Pots** **http://www.ptleader.com/news/fishing-for-crab-pots/article_285e3f54-0168-11e4-a7ef-001a4bcf6878.html**
9/2/14	NOAA's Response and Restoration Blog	Diving for Debris: Washington's Success Story in Fishing Nets out of the Ocean- http://usresponserestoration.wordpress.com/2014/09/02/diving-for-debris-washingtons-success-story-in-fishing-nets-out-of-the-ocean/
9/4/14	Bellingham Herald	Divers Seek Lost Crab Pots in Washington Waters: http://www.bellinghamherald.com/2014/09/04/3838169_divers-seek-lost-crab-pots-in.html?sp=/99/100/&rh=1
9/5/14	MSN News	In Washington Waters, Diving for Lost Crab Pots: http://news.msn.com/videos?videoid=a8de48ef-4474-ddc5-33d4-5233d879b6a0&ap=True
9/7/14	Washington Post	Divers Seek Lost Crab Pots in Washington Waters: http://www.washingtonpost.com/national/divers-seek-lost-crab-pots-in-washington-waters/2014/09/05/2fc5888c-34c2-11e4-9f4d-24103cb8b742_story.html
9/7/14	ABC News	Divers Seek Lost Crab Pots in Washington Waters: http://abcnews.go.com/US/wireStory/divers-seek-lost-crab-pots-washington-waters-25257303
9/7/14	Washington Times	Divers Seek Lost Crab Pots in Washington Waters: http://www.washingtontimes.com/news/2014/sep/5/divers-seek-lost-crab-pots-in-washington-waters/
9/7/14	Fox Business	Divers Seek Lost Crab Pots in Washington Waters: http://www.foxbusiness.com/markets/2014/09/05/divers-search-for-lost-crab-pots-to-clean-up-washington-state-sea-floor/
9/7/14	Palm Beach Post	Divers Seek Lost Crab Pots in Washington Waters: http://www.palmbeachpost.com/ap/ap/business/divers-seek-lost-crab-pots-in-washington-waters/pCPDf3/
9/7/14	Journal News	Divers Seek Lost Crab Pots in Washington Waters: http://www.journal-news.com/ap/ap/business/divers-seek-lost-crab-pots-in-washington-waters/pCPDgJ/
9/7/14	Omaha.com	Divers Seek Lost Crab Pots in Washington Waters: http://www.omaha.com/news/nation/divers-seek-lost-crab-pots-in-washington-waters/article_ebfafac5-ad2b-58ea-b731-f6a396de637e.html
9/7/14	ABC6	Divers Seek Lost Crab Pots in Washington Waters: http://www.abc6.com/story/26458817/divers-seek-lost-crab-pots-in-washington-waters
9/7/14	Itemlive.com	Divers Seek Lost Crab Pots in Washington Waters: http://www.itemlive.com/news/national/divers-seek-lost-crab-pots-in-washington-waters/article_a186549e-5750-5477-ae94-d195736c8f29.html
9/7/14	News Times	Divers Seek Lost Crab Pots in Washington Waters: http://www.newstimes.com/news/us/article/Divers-seek-lost-crab-pots-in-Washington-waters-5735267.php
9/7/14	KSL.com	Divers Seek Lost Crab Pots in Washington Waters: http://www.ksl.com/?nid=151&sid=31431986
10/22/14	Goskagit.com	http://www.goskagit.com/all_access/derelict-net-removal-spares-wildlife-protects-rockfish/article_f0cb963e-548f-51ed-ae80-dda28e72528c.html
10/27/14	Millennial Magazine	http://millennialmagazine.com/ghost-fishing-when-lost-gear-keeps-fishing/
12/9/2014	The Planet Magazine	http://theplanetmagazine.net/issues/
12/1/2014	The Reel News	..\..\Press\Reel News Dec 2014.pdf
3/13/2015	The Fishing Wire	..\..\Press\FW The Fishing Wire for Friday March 13.msg
4/14/2015	The National	http://www.nationalfisherman.com/blogs/boats-gear/4899-projects-tackle-ghost-

Date	Publication	Title/Link
	Fisherman	trap-dilemma
4/1/2015	Global Diving and Salvage, Inc.	http://files.ctctcdn.com/de511b21101/b3d6b3e7-5281-456c-a803-0afbed5233dd.pdf?utm_source=March+2015+Newsletter+-+PDF&utm_campaign=April+Newsletter&utm_medium=email
5/14/2015	Bellingham Herald	http://www.bellinghamherald.com/2015/05/14/4294538_phillips-66-donates-166000-to.html?rh=1
5/28/2015	Bellingham Herald	http://www.bellinghamherald.com/2015/05/27/4316517_lost-nets-crab-pots-pulled-from.html?rh=1
6/3/2015	Marine Debris: NOAA	http://marinedebris.noaa.gov/research/crab-pot-escapement-study-underway-washington
6/3/2015	Marine Debris: NOAA	https://marinedebrisblog.wordpress.com/2015/06/03/spotlight-ghost-trap-recovery-and-research-ramped-up-across-the-country/
6/5/2015	Marine Debris: NOAA	https://marinedebrisblog.wordpress.com/2015/06/05/spotlight-how-our-partners-turn-net-loss-into-a-win-for-wildlife/
6/5/2015	Marine Debris: NOAA	http://marinedebris.noaa.gov/removal-projects/northwest-straits-initiative-puget-sound-derelict-net-removal
June, 2015	The Reel News	