Developing a Comprehensive Marine Debris Strategy for the West Coast Governors' Agreement on Ocean Health:

Findings from the Marine Debris Action Coordination Team Derelict Fishing Gear Workshop

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Introduction: WCGA MD-ACT Derelict Fishing Gear Workshop

This document represents the summary of comments and discussions from the West Coast Governors' Agreement on Ocean Health, Marine Debris Action Coordination Team's (MD-ACT) workshop 1, focusing on derelict fishing gear (DFG). The findings from this workshop should contribute to protocols for survey, removal, prevention, education, and prioritization of DFG along the West Coast. The majority of the information came from the workshop attendees and is therefore not referenced. The limited information that came from outside the workshop is referenced as footnotes throughout the document. Further information about DFG removal programs throughout the tri-state region can be found at a number of websites, including:

Washington: http://www.derelictgear.org

California: http://www.seadocsociety.org/lostfishinggear

Oregon: http://www.dfw.state.or.us/MRP/shellfish/commercial/crab/derelict_fishing_gear.asp

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Workshop participants in Seattle, WA, March 10, 2010

Background

Lost or abandoned commercial and recreational fishing nets, lines, pots, and traps are all categorized as derelict fishing gear (DFG). These items, whether discarded intentionally or lost accidentally, sit on the seafloor, get caught on rocky or coral reefs, or float on the ocean surface. The majority of fishing gear is made of synthetic materials that can remain in the marine environment for decades and negatively impact (1) the marine environment by entangling and trapping marine organisms and by damaging habitat upon which it snares and (2) human safety by posing a navigational hazard for mariners and by similarly endangering humans, especially divers.[1] DFG can also negatively impact the economy: designed to catch or trap available stock, it continues to do so after becoming abandoned and reduces the catch available to commercial and recreational fishers. The impacts of DFG are global, and Washington, Oregon, and California have been engaged in prevention, assessment, and removal of DFG from their marine environment for many years.

Washington

DFG in Washington State has posed significant problems, especially in the Puget Sound due to decades of heavy fishing effort combined with rocky substrate and shoreline and strong tidal currents. The Northwest Straits Initiative (NWSI), Stillaguamish and Nisqually tribes, and federal, state, and local entities, as well as nongovernmental organizations (NGOs) and industry, have been engaged in DFG survey and removal for a number of years. Since 2002, NWSI has managed the bulk of DFG survey and removal in the Puget Sound. Among the early initiatives of the NWSI were a no-fault reporting system; a database of reported and removed DFG with impact; state-approved protocols for removal, research, and training; and ongoing surveys and removal of DFG.

The vast majority of DFG in Washington State comes in the form of either gillnets or crab pots. Of these the issue of greatest concern is legacy gillnets, mostly in the Puget Sound, that were lost during the years of intensive salmon gillnetting efforts throughout the 1970s to 1990s. There are an estimated 4,000 derelict nets remaining in Puget Sound waters, many of which have been documented continuously entangling and killing marine life and obstructing, degrading, and limiting the functions of the habitat they are snared it on. By the end of December 2009, NWSI had removed over 2,000 nets, and since July 2009 has been operating with funding from the American Recovery and Reinvestment Act (ARRA) through the NOAA Office of Habitat Conservation. The NWSI plans to remove the vast majority of legacy derelict nets in Puget Sound with ARRA and other funding, and eliminate this hazard for good.

Commercial and recreational derelict crab pots also litter the floor of the Puget Sound, with annual pot loss estimated as high as 12,000. The majority of these pots are lost when vessels run over and cut the pots' lines and when the pots are placed in locations considered inappropriate due to weather, ocean conditions, and other activity. Between 2002 and December 2009, over 1,800 pots

[1] Gilardi, K., Brainard, R., Cowan, T., Donohue, M., June, J. 2006. Reducing Marine Debris: Derelict Fishing Gear Removal Programs in Hawaii, Washington, and California. Available at: http://conference.plasticdebris.org/whitepapers/Kirsten_Gilardi.doc

were removed from Puget Sound. These crab pot removal projects have been managed by Northwest Straits Commission (NWSC), which is part of the NWSI, and focus on areas of high fishing effort. Presence or absence of escape cord on recovered pots is documented, as are other characteristics. Overall, 20% of all pots recovered showed no signs of escape cord use.

Outside of the Puget Sound, the Olympic Coast National Marine Sanctuary performed several surveys and removals but did not find a high density of DFG in the region; this is because higher-energy waves move lost gear to the shoreline. There have been an increasing number of DFG reports in the Columbia River and Grays Harbor, which are yet to be investigated. Both of these areas may prove to have high quantities of DFG. In 2008, Washington State passed legislation that initiated a new state program allowing crab pots off the outer coast of Washington to be recovered by cleanup vessels after the end of the crab season. Legislation also mandated that fishermen report lost gear to Washington Department of Fish and Wildlife (WDFW). In the first year of this program, 331 state commercial crab pots were recovered; in addition, 30 tribal pots were inadvertently removed and were returned to their owners. Washington Department of Fish and Wildlife also has current grant funding for crab pot removal on the outer coast, which so far has removed 138 non-tribal and 37 tribal pots.

All DFG removal operations in Washington State include documentation of the dimensions, condition, and lethality of the DFG removed and all marine life found in the gear items. This documentation is housed within a centralized database, kept and managed by NWSI.

Oregon

New ways of finding and retrieving DFG have been designed and tested in Oregon through a joint project involving Oregon Sea Grant, the Oregon Fisherman's Cable Committee, and the Oregon Dungeness Crab Commission. This project coordinated a diverse group of fishermen, regulators, and agencies to use a modified "trawl/grapple" technique to retrieve DFG, including crab pots and bottom trawl nets. In 2006, efforts were made to retrieve three trawl nets sacrificed to protect submarine cables off the northern Oregon coast. These nets, plus six trawl doors and a considerable length of wire rope, weighing a total of 13.3 metric tons (mt), were successfully recovered and represent the deepest known recovery of DFG from the West Coast. The same year, a successful initial test to retrieve cut-off crab pots was conducted using two vessels out of Warrenton and Charleston. In one day, 59 crab pots, 600 feet of abandoned trawl cable, various old ropes, fishing hooks, and segments of fishing net were retrieved. Crab pots using escape cord made of cotton twine, intended to prevent "ghost fishing" by disintegrating quickly if the pot is lost, proved to work just as planned, and the only dead crab recovered was in a pot that did not use escape cord.

In partnership with this project, the Oregon Dungeness Crab Commission and Oregon Department of Fish and Wildlife (ODFW) chartered crab vessels to evaluate pulling and pumping techniques to retrieve lost pots during 2006 and 2007. During 11 chartered trips, 268 pots were retrieved from all along the Oregon coast. The condition of pots, including escape mechanisms and marine life retrieved with the pots, were recorded.

In 2009, ODFW received ARRA funding to execute a collaborative project with the Oregon fishing industry to restore marine habitat. The main thrust of the project, scheduled to continue through

2010, is to survey for and remove derelict pots along the entire Oregon Coast, and support industry efforts to put in place an ongoing voluntary effort to remove DFG.

In 2009, the first of two field seasons for this project, over 67mt of marine debris, including 1,359 commercial crab pots and nearly 4mt of lines, cables, and buoys, were removed from the coastal waters off Oregon. Over 98% of the retrieved crab pots were usable and returned to their owners. All remaining gear was unusable and recycled.

Little mortality of marine species was observed in the recovered gear. Data recorded on crab pot escape mechanisms show they functioned properly, with cotton escape cord disintegrated. Commercial crab pots are highly selective, and preliminary analyses indicate Dungeness crab was the main species recovered in the pots, averaging about four crabs per pot. Other marine species were recovered much less frequently and included mainly red rock crabs, starfish, anemones, sand dollars, and a few fish. All marine life was immediately returned to the sea.

The number of cut-off pots off the northern Oregon coast was assessed by side scan sonar. Sonar at two frequencies (300 kHz and 600 kHz) was used to simultaneously map 8 sqnm ; 474 targets, believed to be cut-off pots, were detected.

The commercial fishing industry began a voluntary cleanup effort, intended to grow into an annual program. In September 2009, seven vessels, with their captains and crew, each conducted a recovery trip and removed a total 40 derelict crab pots. The Oregon Dungeness Crab Commission, funded by crabbers, maintains a reporting hotline for derelict crab gear.

Escape cord and annual identification tags are required on all commercial crab gear in Oregon, and ODFW has implemented a free recycling program for the plastic identification tags. Further efforts to refine retrieval techniques, as well as ways to provide incentives for fishermen and their boats to take part in crab pot recovery, are being pursued by ODFW, the Oregon Dungeness Crab Commission, and Oregon Sea Grant.

ODFW also maintains a volunteer-based fishing line and tackle collection and recycling program. Containers are placed at many recreational fishing access points, including some coastal ports, for anglers, and volunteers periodically collect deposited line and tackle for recycling.

California

California's statewide effort to address DFG is administered by the UC Davis Wildlife Health Center's SeaDoc Society. The California Lost Fishing Gear Recovery Project, which began in 2005, was modeled on the Washington state program. It encourages ocean users to report lost fishing gear to a toll-free reporting hotline or via a reporting form on the project website (www.lostfishinggear.org). UC Davis has successfully obtained federal, state, and nongovernmental grants to support the project. DFG removal to date has largely been conducted in nearshore sites by contract scuba divers, all of whom are commercial urchin harvesters. To date, the program has largely focused its field efforts around the Channel Islands; nearly 11 metric tons of DFG has been removed from this area since May 2006. Collaborations with Cordell Bank and Monterey Bay national marine sanctuaries have led to the development of deepwater gear recovery techniques,

most recently applied to the removal of derelict crab pots and nets from state marine protected areas within Monterey Bay National Marine Sanctuary in September 2009.

The California Lost Fishing Gear Recovery Project has also organized volunteer American Association of Underwater Scientists (AAUS)-certified divers to remove monofilament line and other recreational gear from public fishing piers throughout the state, and has installed fishing line recycling bins on many of these piers and ramps to encourage proper disposal of unwanted gear. These bins are managed and monitored by local coastal stewardship organizations.

Involvement of the California Department of Fish and Game has been integral to the success of the UC Davis program, largely through its outreach to the fishing community via its website, facilitation of permitting, and advocacy on behalf of the program to other resource agencies.

The program has also conducted research on impacts of DFG on marine organisms, including collaboration with the NWSC in Washington State.

In November 2008 the California Ocean Protection Council approved an Ocean Litter Strategy with recommended actions to prevent and reduce marine debris. This plan recommends a deposit system on fishing gear to better manage DFG within the state, as well as improved outreach regarding SeaDoc Society's hotline. In 2009, legislation titled SB 21 was introduced to create a statewide program to manage DFG, including a lost-gear reporting hotline and associated database, the establishment of removal targets, and tagging of gear. While not enacted into law, this legislation represents a proactive approach to addressing DFG.

Ports and the Maritime Industry

Ports and the maritime industry have also recognized that DFG poses a severe threat to the marine environment. In 2008, for example, the Port of Seattle launched a trawl net recycling program through a grant received from the NOAA Marine Debris Program through the National Marine Fisheries Service (NMFS) Restoration Center. This grant allowed the Port of Seattle to develop a sustainable recycling program at little to no cost to the fishing industry. This program is supplemented by a gillnet recycling program already in place at the Port of Seattle. The Port of Seattle plans to continue its recycling program and hopes to expand its footprint to the Port of Seattle's Terminal 91 facility in the near future.

In Oregon, three ports—Warrenton, Garibaldi and Newport—participate in the Fishing for Energy program, with the Port of Astoria soon to join. Fishing for Energy is a partnership consisting of the Covanta Energy Corporation, the National Fish and Wildlife Foundation (NFWF), the National Oceanic and Atmospheric Administration (NOAA), and Schnitzer Steel Industries, Inc., which provides a no-cost solution to fishermen to dispose of old, derelict, or unusable fishing gear and works to reduce the amount of DFG in and around coastal waterways.

The partnership provides large bins at the port, where fishermen can easily dispose of gear. When these bins fill up, the gear is collected and transported to a nearby Schnitzer Steel facility where the metal (e.g., crab pots, gear rigging) is recovered for recycling and rope or nets are chopped for

easier disposal. From there it is brought to a nearby Covanta Energy-from-Waste facility, where the gear is converted into clean, renewable electricity for local communities.

Specific Activities

Database

A robust database containing all the important information regarding DFG reporting, surveying, investigation, and removal is an important part of any DFG program. With information about gear location, condition, size, habitat type, and marine life entangled, the users are able to gain insight into the extent of the problem in a given area or on a coast-wide scale. Data analysis can provide policy makers and agency managers with information about impact on critical habitat areas, endangered or threatened species, hazards to human health, and economic loss caused by mortality of commercially viable species. Additionally, because DFG is a relatively new focus for management agencies, there are few existing literature reports on the impact and extent of the DFG problem around the world.

Workshop participants suggested that development of a tri-state DFG database be considered, based on the Washington State DFG database originally established by WDFW. This database is now managed by NWSI and could be a model upon which to build a tri-state database. The tri-state DFG database should be managed by a single entity such the Pacific States Marine Fisheries Commission.

An effective database compiles data from a variety of reporting sources (described in a later section) and must have the flexibility to easily accommodate a variety of data that can be modified for specific projects. The two-table system (gear and impacts) used in Washington has proven very effective. These two tables are linked by the unique gear ID number associated with each gear item. The gear table describes each DFG item and its location and disposition (removed, remaining, disabled, etc.). The gear table consists of three types of gear: net, pot/trap, and other. These three categories should suffice for DFG along the entire West Coast, with the probable addition of longline, which is a common gear type in some locations. The majority of DFG reported and removed is nets and pots (usually crab pots). Higher resolution of gear type identification is important for analysis and identifying major problem sources. This would include distinguishing between different types of nets (gillnet, trawl net, purse seine, etc.) as well as for pots (crab, shrimp, lobster, etc.).

The impact table describes the impact each gear item has on the marine environment, specifically the marine life entangled and killed (mammals, birds, fish, and invertebrates). It includes the gear ID number of the associated gear item, common name of species, scientific name of species, and number of live and dead individuals of each species encountered. Bones, shells and partially decomposed specimens that cannot be identified during removal operations are collected, assigned specimen ID numbers, and later identified in an offsite laboratory. For unidentifiable live animals, photographs are taken to be later analyzed and identified. The bulk of this information is recorded during the removal process, by both diver reports and onboard observation, but sometimes is described in the reporting process (e.g., “this net is killing several crab and lingcod”); this information is helpful for prioritization and impact reporting.

The Washington database was recently transferred online and provides varying levels of access to database information. Onboard biologists can download an updated database in MS Access format prior to removal operations and can upload newly documented data. Database managers verify new data prior to incorporation into the database. The database remains confidential and access to specific data is authorized by the database administrator. Other than the agencies and companies managing the database, some researchers are authorized to analyze impact data, build models, etc. In such cases, certain pieces of information remain confidential, such as reporter contact information, owner of gear item (if known), and location of gear yet to be removed.

The reporting of lost or abandoned gear items is one of the most important and challenging parts of the DFG issue. Many projects use survey methods to locate and identify gear targets, yet reporting by fishers, boaters, divers, and the general public is an essential contributor to the process, especially when funding for surveys is minimal. The public reporting system must be a simple process, as the request for too much information can deter individuals from reporting. Online reporting forms request only that information required for investigation. Although some members of the public prefer anonymity in reporting, it is extremely beneficial to emphasize the importance of including contact information. Many times a gear item reported is never found because of overly general reporting, inaccurate location description (latitude, longitude), and inability to contact the person reporting for further description of the gear item and its location or depth. The main target groups for reporting DFG include commercial fishermen, recreational and commercial divers, sport fishermen, kayakers, boaters, and agencies conducting marine research such as dive, video, and sonar surveys. Often, reports from such groups provide DFG managers and personnel with information about newly lost gear items, as they are often seen on the water surface (e.g., floats, buoys). These reports enable quick removal response on such gear items, limiting their impact to the marine environment. Often when responding to a reported DFG item, the removal team will find several more in the same location or nearby, adding to the importance of engaging the public in accurate and prompt reporting. The majority of gear items added to the database are items found during removal of surveyed or reported items.

In order to produce and manage a successful tri-state database, the following must be included:

- Project name assigned to each reported, surveyed, and removed gear item.
- Unique gear ID number assigned to each gear item entered into database.
- All entities involved agree upon levels of access and confidentiality.
- Data dictionary is established so that vocabulary and terminology are consistent throughout states and projects.
- Online and telephone reporting methods are specific to regional project (e.g., California fishermen reporting to California entity), then submitted to the tri-state database.
- Each state has QA/QC staff person (could be data manager or database administrator) to verify data being entered.

- Additional data categories may be added when appropriate to account for issues such as ocean energy and likelihood of gear movement and drift.

It is important to acknowledge that the database is a tool to collect and organize data that is being entered; it is not an analysis tool. For data analysis, data can be extracted from the database and analyzed with other software.

Future Action

Objective 1

Determine the rules, parameters, guidelines, and data elements of the tri-state database.

Action 1: Develop agreed-upon principles for participation, such as expectations, use, and roles. This may include determination of who hosts and maintains the database, data acquisitions (e.g., survey, reporting), and ways to accommodate the needs of each state and its constituency (e.g., confidentiality concerns).

Action 2: Determine the content of the database. Content may include known gear locations, participants in gear removal, cost, funding sources, prioritization method, pounds removed, resource impact, and habitat impact. It would be helpful to have a database that not only documents what has been accomplished, but also can be used to select future DFG projects and prioritize limited funds for best possible use.

Objective 2

Set up, populate, and maintain the database.

Action 1: Solicit and select a vendor to develop an online tri-state database for DFG, with an option to expand it to land-based debris.

Action 2: Based on the information and guidelines in objective 1 and in consultation with MD-ACT and the host entity, the vendor will develop and populate the database.

Action 3: Update and maintain the database based on survey and reporting information.

After the database is operational for the U.S. West Coast, collaboration with Canada and Mexico should be explored and executed if possible.

Locations and Accumulation Rates

Locations and accumulation rates of DFG were identified as data gaps in the three states. While some survey methods can be used to gain perspective on the presence and extent of DFG in certain locations, it is important that data are not being collected for data's sake. Data collection is too expensive to perform it without an associated removal plan. In this section we identify where the data gaps exist and the actions needed to address these gaps.

The consensus of workshop attendees is that a major gap in all three states is that most fishermen are not fully engaged in the DFG reporting process. The reporting of lost nets and pots by treaty and non-treaty commercial fishermen could be improved, and better reporting could greatly contribute to better knowledge of DFG location and accumulation. To fill this gap, effort should focus on engaging commercial fishermen and treaty tribes, both of whom could play an important role in the identification of locations and amounts of fishing gear loss. Gillnets and crab pots are relatively inexpensive items; therefore, recovery of lost gear in these types of fisheries by the fishermen has been, in most cases, minimal. In Oregon and Northern California, crab fishermen have a long tradition of retrieving and returning gear to their colleagues or re-setting the gear for fishing. However, this behavior has not been observed on a coast-wide basis. Purse seine, longline, and trawl gear is expensive; therefore, fishers who have lost gear have much more incentive to recover it. Often, offshore gear is self-recovered unless it is too entangled or has moved since it was lost. Cable committees in Oregon and California are valuable partnerships between the underwater cable industry and the fishing industry to prevent damage to cables from fishing activities, primarily trawling. Trawlers avoid fishing near cables, but if they inadvertently snag a net, they sacrifice the net, report it to the Oregon Fisherman's Cable Committee, and are reimbursed for their losses. Knowing the locations of sacrificed nets, the committee pioneered methods to successfully retrieve them.

More can be done to engage fishermen in reporting and removing lost gear. Engaging fishermen's participation in no-fault reporting of lost gear items, identifying areas of accumulation, and surveying and removing of such items are essential for addressing lost gear. Working through entities fishermen are familiar with and trust will increase the likelihood of success. Encouraging fishermen to point out locations of underwater obstructions, snags, and hang-ups or areas where they have lost gear in the past would be an important and helpful knowledge-sharing activity. In addition, telephone surveys of all permit holders to gain further information could be administered by an agency they trust.

Information can also be gained through management mandates. Reporting of lost gear with no penalty to the fisherman could be made mandatory. Experience suggests that it would be more effective if tribal fishermen report to tribal management and non-tribal fishermen report to an entity they are familiar with.

State and federal agencies, as well as outside entities, can also provide important information to help gain understanding of the locations and extent of DFG. Past and present aerial survey or vessel monitoring systems (VMS) provide information on where boats have been fishing. For historical fishing effort this could involve data mining through years' worth of old paper documents. Observer data can also be used, although often only a limited percentage of vessel trips include observers. The locations of these trips are helpful in identifying the spatial distribution and accumulation of effort.

Seafloor mapping, when conducted by state, federal, and other agencies and at a resolution adequate for discerning gear-sized structures, can also provide useful data. The WCGA Seafloor Mapping Action Team could be helpful in identifying DFG items and locations of accumulation as a sub-product of their substrate mapping goals. This could also be done with data from other groups

or agencies such as U.S. Geological Survey, universities, and state departments of fish and wildlife, natural resources, and environment. Access to such data may be limited, and analysis of pre-existing data would be time-consuming, yet with agreement it is possible to have these groups record and report DFG items and locations during initial data collection and processing at little cost. Using satellite imagery to identify buoyed gear has been attempted, but so far limited resolution keeps this from being a useful tool.

Replacement trends, to some degree, can also be helpful in understanding accumulation rates. Crab tag replacement information from state agencies can be helpful, yet some fishers do not seek replacements, and some cross state boundaries when deploying gear, which would introduce discrepancy in data.

A geographic information system (GIS) is a very useful tool in analyzing spatial data and building a product from which to work. Overlaying various layers of available data such as fishing effort, bathymetry, and substrate characteristics in GIS software can accomplish this method of identifying potential areas prone to DFG presence and accumulation (e.g., 1,200 gillnets at Point Roberts last year + boulder field 60ft deep + surrounding water at 200ft deep + fishermen reports of lost gear = High likelihood of heavy DFG accumulation). If a variety of data sources is unavailable, heavy fishing effort alone in specific locations can be used as a proxy for identifying potentially DFG-rich areas. Accumulation rates for a specific location can be determined by removing all DFG in the area and re-surveying the same area after one or more fishing seasons. This method produced helpful and accurate crab pot accumulation rates in Port Gardner and Dungeness Bay, WA.

Future Action

Objective 1

Prioritize areas for assessment of DFG location and accumulation.

Action 1: Evaluate the distribution of fishing gear use by using a standardized gear identification system in conjunction with vessel logbook and information on fishing efforts.

Action 2: Prioritize areas to assess DFG accumulation rates based on DFG impact, quantity lost, gear type, and feasibility of removal.

Objective 2

Identify information sources for and collect information on DFG location and accumulation.

Action 1: Engage fishermen to provide DFG data.

Action 2: Collect DFG location and accumulation data from entities engaged in the field such as state, federal , tribal, and local agencies, NGOs, academia, and industry.

Action 3: Use information on heavy fishing locations, existing side scan sonar data, and seafloor mapping charts to identify areas where high loss of fishing gear occurs or is likely.

Action 4: Explore best means to track lost gear, such as tags on pots but also on nets.

Prevention

Preventing fishing gear from becoming lost is the first priority when dealing with DFG. Several methods can help prevent the loss of DFG, with varying viability depending on the region and type of fishery. For crab, shrimp, and lobster fisheries, pot loss can be reduced by limiting the number of pots fishermen can use, giving them incentive to avoid high-risk areas. Disseminating information to fishermen about locations of snag areas from survey data can also help them avoid fishing in high-risk areas.

Preventing heavy impact of lost gear is also important; this can be done by decreasing the response time—the time between loss and recovery of a DFG item—as well as altering gear in a way that minimizes its effect on the marine environment. An increase in fishermen's use of reporting hotlines and websites that provide incentives for gear reports, such as gear being returned to the owner at no fault, would be expected to increase the number of reports, and in turn increase recovery speed. In some states, regulatory restrictions make it illegal for fishing gear items belonging to one fisherman be held on another fisherman's vessel. Removing these restrictions would make it easier for fishermen to remove DFG they encounter while at sea. Mandatory use of rot cord on each pot does not reduce DFG accumulation, but it significantly reduces the impact that derelict pots have on the species they entrap. In addition, tracking devices on pots and nets could prove beneficial in locating DFG items as soon as they are lost. In the British Columbia "Area A" commercial crab fishery, GPS tracking devices have been placed on each crab pot buoy employed. Each tracking device is identified by a bar code that is scanned on board the vessel; the data from such scanning is linked to the vessel monitoring system (VMS). This technology was designed as part of a management and enforcement tool, in order to document gear deployment locations and gear ownership[2] but could also be employed as a useful tool in identifying and removing derelict pots. This has been proven in the industry-funded gear recovery charter currently taking place in the BC Area A crab fishery.

Fishing gear is often lost when placed in an area where other ocean uses, such as vessel traffic, damage the gear (for example, boat propellers cut the float lines) or drag it so it cannot be found easily. Incorporating fishing activities in marine spatial planning programs can help prevent such loses, and possibly identify areas to focus on for removal projects. Building incentives for the fishing industry to be involved in helping develop a program for them to retrieve gear or for others to retrieve gear for them is important in any DFG planning process. DFG removal can also be used as a mitigation tool for port expansion and other infrastructure-related projects where mitigation is mandated.

[2] Archipelago Marine Research Ltd. 2010. Electronic Monitoring, Project Summary: BC Area A Crab Fishery. Available at: http://www.archipelago.ca/highlight.aspx?ID=CF3EA83A-DB53-4F69-B787-3F7AEF432C2B

Future Action

Objective 1

Collaborate with the fishing industry to develop best DFG prevention measures.

Action 1: Identify stakeholders and develop a process for collaboration with the fishing industry.

Action 2: Work with fishermen to develop specific programs to reduce gear loss.

Action 3: Prioritize areas of implementation based on heavy accumulation and impact rates, and develop prevention measures specific to those areas.

Objective 2

Inform commercial and recreational fishermen and maritime entities about DFG and appropriate prevention measures.

Action 1: Survey existing educational efforts in California, Oregon, and Washington for effective programs.

Action 2: Survey stakeholder groups for appropriate messages/message deliverers and methods for disseminating educational messages.

Action 3: Develop/adapt educational messages.

Action 4: Work with entities responsible for outreach to stakeholder groups (e.g., permitting agencies like CA Department of Fish and Game) to disseminate educational messages.

Objective 3

Work with relevant constituencies to develop a recommended package of legislation and agency regulations for each state in order to maximize prevention measures.

Action 1: Survey all three states for existing regulations that assist or hamper prevention efforts.

Action 2: Work with fishing industry through process developed for Objective 1, Action 1 in this section to collect and evaluate legislative and regulatory ideas.

Outreach and Education

An effective outreach and education program is a critical requirement for any effort to reduce, prevent, and remove DFG. For an effective outreach and education program, determining the audience and the delivery vehicle is very important. Targeting groups and institutions that play significant roles in the marine environment and using a method that will engage their interest and galvanize their understanding of the situation are essential in gaining the support from these often influential entities. Such support from any particular group can cause a chain of information-sharing with other groups and individuals that could prove extremely beneficial when addressing DFG. For example, if commercial fishermen are wary of participating due to a lack of trust of the

government, they may be influenced otherwise by a group or individual they trust, such as a regional fishery management council or the editor of *Pacific Fishing Magazine*.

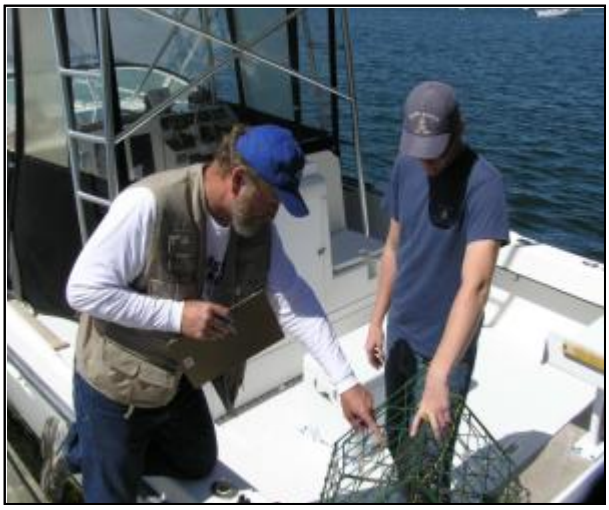
Appropriate target audiences for outreach include local, state, and federal government agencies, decision-makers, marine towing companies, the boating community, Pacific States Marine Fisheries Commission, commercial and recreational permit holders, tribal fishermen and government, recreational and commercial divers, zoos, and aquaria. The message to such targets can often be delivered on piers where fishing takes place or in supply stores by representatives from groups such as fishery advisory councils, neutral nongovernmental organizations, and marine resource committees. Another appropriate time and place for delivery would be when fishing permits are renewed, either through a message online or by a representative in a specific location. Public presentations in the form of videos, slide shows, and posters can often reach a significant number of people, who can then engage others in this effort. Another effective method of spreading the word is through media coverage of removal activity, as has been seen in all three West Coast states. It is important that the concepts of the message be as simple as possible while still conveying all the necessary information. Gaining interest from the target audience can be increased by using various tools such as humor, descriptive images and/or video, shock value, and word of mouth. Including "champions" or authentic people that are recognizable to the regional or local public is also a helpful tool, and making the message multilingual will ensure that most members of the audience are being reached.

However the outreach and education program looks, collaboration with the fishing industry, preferably in an informal setting, is vital. It should be understood that the industry is considered a collaborative partner when discussing with them the DFG issue, and when involving the public. It is also important to choose the target audience based on the DFG priorities.

Future Action

Objective 1

Survey the user groups associated with each DFG priority area in order to ascertain the most effective approach to outreach and education.



Action1: Survey the three states for existing outreach and education programs and the efficacy of those programs.

Action 2: Building on the industry collaboration cited in Prevention Objective 1, work with the fishing industry to test/refine existing outreach programs or develop new ones.

Objective 2

Incorporate user-group education and media/public outreach in each DFG program budget developed in conjunction with WCGA efforts.

Action 1: Designate at least one person on each WCGA DFG team to be responsible for assuring that outreach and education efforts are incorporated at the beginning and throughout planning for each new effort recommended by the team.

Action 2: In conjunction with fishing industry partners, develop a slate of potential outreach and education tools that could be used for any program.

Objective 3
Identify an outreach and education advisory group that can contribute to the effectiveness and applicability of outreach material to its target audience.

Action 1: Survey outreach and educational programs in the three states for staff who would be willing and able to serve as an advisory committee.

Derelict Fishing Gear Survey and Removal Practices

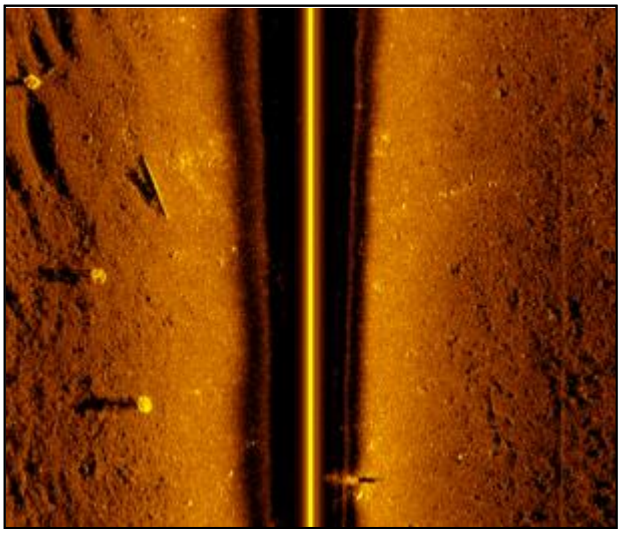
There are a variety of DFG survey and removal methods used along the West Coast. The methods depend on gear type, cost, state regulations, safety, depth of gear, location, weather and sea conditions, and availability of resources. Because addressing the DFG issue is a relatively recent priority, best methods for removal and survey continue to be adjusted and refined with experience and the application of new technologies. It is important to note that best methods are project-specific, as what works well for surveying and removing crab pots in the Puget Sound would not work for trawl gear off the Oregon coast. The varieties of methods used along the West Coast are discussed below.

Survey Methods

Dive Surveys: A diver or a group of divers are deployed from the vessel and swim or walk in equally spaced transects or a zigzag pattern between depths to locate DFG. This method is best applied in areas where presence of DFG has been reported or is suspected. Dive surveys can be done using surface- supplied air or scuba, and limitations depend on depth, visibility, and currents. If the diver is using a two-way radio system to the vessel, he or she reports each gear item verbally and the onboard crew records latitude and longitude coordinates that will later be entered into the database. If the item is to be removed immediately or within a short amount of time (one to three days), a line can be attached to the gear item with a small buoy that will appear at the water's surface for later removal. In California divers search an area based on seafloor topography and where they suspect they will find DFG.

Camera Surveys: A video camera feeding live visual footage to a monitor onboard the vessel is deployed with an attached weight to ensure the camera is directly under the boat while the vessel drifts through a specific area where DFG has been reported or is suspected. When a gear item is identified on the monitor, the vessel crew records latitude and longitude coordinates for future navigation to the site or deploys a diver to confirm or remove the item immediately. This method is limited in view and visibility, as it often covers only a small amount of seafloor below the camera.

Remotely Operated Vehicle (ROV) Surveys: An ROV survey operates much like a camera survey in that there is a camera on the unit with live video feed to an onboard monitor, yet it is different in that it is not limited to surveying only the seafloor below the vessel. The ROV can be maneuvered by the onboard crew in patterns similar to a diver survey and has the capability of surveying a much larger area than a camera survey. When a DFG item is identified, the latitude and longitude are recorded by the onboard crew for removal at a later time. ROVs are especially useful in deep water that is beyond maximum diver safety depths. ROV use is relatively expensive and may also be limited by poor visibility and areas with even minimal amounts of rough topography or other snagging features.



Sidescan Sonar Surveys: A towfish containing a transducer is deployed from the survey vessel to a depth just above the seafloor. The transducer sends a signal to both the port and starboard sides, which returns at different rates depending on the distance to the object the signal encounters. Equally spaced transect lines, depending on water depth, are conducted to gather complete coverage of the area to be surveyed. Data is logged into an onboard hard drive, and targets are identified and precisely located using the GPS signal that is synchronized to the sidescan sonar unit. Sidescan sonar is used for a variety of applications in mapping and visualizing the seafloor and underwater obstructions. It has proved very effective at identifying pot gear in multiple regions and is the standard method for crab pot surveys in the Puget Sound. Recent innovations in equipment and survey methods have found that sidescan sonar can also be used to locate derelict nets attached to the seafloor, usually by identifying seafloor obstructions where derelict nets are likely to be found. The extensive amount of coverage that sidescan sonar provides is its greatest advantage, along with the fact that it is not affected by poor underwater visibility. Sidescan sonar does not, however, see through gas-charged particles such as vegetation, and operations are limited to calm to fair sea and weather conditions and areas with minimal amounts of rough topography or other snagging features.

Aerial/Overflight Surveys: Aerial surveys have been used to identify floating buoys or gear that is very close to the surface. This is done through visual surveillance from an observer onboard the aircraft, or possibly with cameras. It can also be used to identify locations of high fishing effort that will help prioritize DFG areas. Other

methods use satellite, LIDAR, or video technology, yet to this point it has been difficult to gain the resolution needed for DFG identification. Possible future technologies may allow location of floating nets.

Grappling: Two types of grappling activities have been used to simultaneously locate and remove DFG. One technique sometimes used by commercial fishermen is to deploy a weighted grapple to the seafloor with a line attached to the vessel and drag it along the substrate. Another grappling technique is conducted from a vessel similarly to trawling, in which grapples are attached at intervals along a groundline hung between two trawl doors. The doors and groundline are lowered to the seafloor and towed along the bottom to snag line and other gear. Both these methods can be effective in finding DFG in areas where it is known to exist. To minimize the potential impact on seafloor habitat, this practice is advised only for sandy or muddy bottom areas that lack significant vegetation or other sedentary marine life.. In some areas such as Puget Sound, grappling for DFG is not permitted by WDFW regulations.

Removal Methods

The impact of DFG removal on seafloor habitat has been studied in a number of locations. Certain types of removal practices affect the habitat to varying degrees, yet in most cases the resulting recovery of habitat from the removal of DFG significantly outweighs the minimal damage caused by the removal itself.

A variety of removal methods are used along the West Coast. Because the bulk of nearshore removal operations include the use of divers, cost is often a limiting factor in implementing a DFG removal project.

Dive Removal: Divers can be utilized to remove DFG in all habitat types whether using surface-supplied air or scuba. Diver safety, depth, and cost are the key limitations when considering and planning for dive removal operations. This is the standard and most common method for DFG removal in the Puget Sound and in California, yet safety and cost limitations keep divers from removing gear from depths greater than 105ft. Methods for diver-based removal of gear beyond these safety depths are being developed and have been practiced by military divers who are not limited to such constraints, yet so far such projects have lacked efficiency. When dive operations take place at depths greater than 105ft, a hyperbaric chamber must be onboard the dive vessel. When conducting and planning any dive removal operations, extreme effort is expended toward avoiding entanglement, vessel traffic, and safety issues involving poor weather conditions and high tidal and wave energy.

In a dive removal operation, the diver is deployed from the vessel to the seafloor on a specific DFG target location. Once the item is found, the diver conducts a visual survey of the gear and reports a description of the gear and the surrounding habitat, including all marine life it has entangled, to the vessel. The diver then attaches a line connected to a hydraulic winch on the vessel to the gear item and assists the lifting of the item by disentangling it from the substrate and attaching float bags. The gear is lifted onboard the vessel with the winch, and the onboard biologist and crew record and remove all biological organisms entangled. Net removal in Washington and California can take place only with divers using surface-supplied air, as safety precautions such as entanglement prohibit

such operations to be done with scuba. However, scuba can and has been used to remove derelict crab pots in Washington and California.

The use of professional divers in DFG removal operations has advantages and disadvantages beyond just the cost. **Commercial harvest divers** (sea urchin, sea cucumber, abalone, etc.) are highly skilled, efficient, and very familiar with specific geographical locations, which proves very beneficial underwater. Unfortunately, this has been a shrinking profession, leaving the pool of available harvest divers for DFG operations small. There are also contractual complexities to utilizing harvest divers that can be disadvantageous. **Commercial salvage divers** can also be used to remove DFG, giving the project the advantage of highly skilled and fully equipped technical divers, with the disadvantage of time-intensive operations and high costs. As stated earlier, **military divers** have been used to perform DFG removal operations with limited effectiveness. Advantages to this option are that the divers are technically skilled and can work at deeper than 105ft. This work comes at no charge to the DFG project as it is designed as a training exercise for them, yet these projects still take on cost from planning and coordinating operations. Military dive operations are time-intensive due to their rules and regulations, and many military divers are not familiar with the regional terrain, which also cuts down on efficiency. Scheduling such operations with military takes a great deal of effort well ahead of the planned operation (i.e. months to years) as well, often leaving the project wondering if conducting such an operation is worth the trouble of planning and coordinating it.

Volunteer divers have rarely been used for DFG removal operations, as safety and liability concerns typically trump the interest in this low-cost approach. Commercial dive industry issues and concerns also play a part in keeping volunteer divers out of the DFG removal arena. In California, teams of volunteer AAUS-certified divers have been involved in recreational monofilament hook and line removal around public-access fishing piers. Potential removal operations for volunteer sport or scientific divers could also include uncomplicated removal work such as attaching small buoys to crab pots for later retrieval by a DFG removal vessel, or survey and data collection operations where safety concerns are low.

ROV Removal: ROVs have been used when confronting the challenge of removing DFG beyond maximum diver safety depths. In Port Susan, WA, derelict crab pots were effectively removed at a cost just 15% greater than that of divers removing gear at depths under 105 ft. DFG removals in shallow (<100ft) water with ROVs have not yet proven to be effective or cost-efficient but have been performed in deep water in California by Cordell Bank and Monterey Bay national marine sanctuaries. Continuing research and experiments may prove this to be a viable option in the future.

ROV removal operations are costly and are limited by weather and sea conditions, tidal and wave energy, and poor underwater visibility.

Grappling: Grappling for DFG removal is used in deep-water, sandy seafloor areas where neither divers nor ROV use would be feasible. The major concern associated with this method is that it does not allow for identification of what the gear is attached to or the habitat surrounding it. This is currently being addressed by assessing the impact of grappling on the sea floor by ROV and sidescan imaging. This method is feasible and cost-effective where seafloor conditions allow it and has been used successfully along the outer coast of Oregon and Washington to remove trawl gear and crab pots from water depths approaching 420ft.

Trawl Removal: The removal of marine debris with trawl nets was also discussed during the workshop, as it was utilized in the cleanup process following Hurricane Katrina. There has also been some effort to clean the Pacific Gyre garbage patch with trawl nets. The major concern with using trawl nets for such operations is the possible heavy impact it would have on marine life. At this time, given available and tested DFG removal strategies, use of trawl nets for DFG removal on the West Coast is not warranted.

Removal by Active Fishermen: For the most part, it is illegal for a fishing vessel to carry gear owned by another permit holder. If fishermen were to actively remove known or encountered DFG during their fishing operations they need to have both the legal authority and incentive to do so. Many Oregon and California commercial crab fishermen retrieve derelict pots they encounter while on the fishing grounds, but this activity is not well documented, quantified, or legally sanctioned. In recent years, Oregon crabbers have begun noting the number of lost and recovered pots in their logbooks. As it is, valuable time and vessel carrying capacity would be spent to remove and store gear, without a return on investment and in some cases at the risk of penalty. The UC Davis Wildlife Health Center has piloted an effort to give fishermen an incentive to recover derelict crab gear by reimbursing them for out-of-pocket expenses incurred while engaging in DFG recovery work.

Future Action

Objective 1

Working with the fishing industry and regulatory agencies, identify and address barriers for effective removal of DFG.

Action 1: Identify rules and regulations that bar fishermen and others from removing DFG. Working with state, tribal, and local agencies, address these barriers to the extent feasible, including potentially through a recommended package of legislation and/or regulatory changes.

Action 2: Identify and resolve technical challenges for effective survey and removal of DFG. These may include developing best survey techniques, addressing net removal from deep waters, experimenting with new techniques, and communicating and sharing these methods among the three states and fishing industry.

Objective 2

Refine and disseminate guidelines for DFG survey and removal.

Action 1: Continually refine and test best practices for DFG survey and removal, and disseminate them along the West Coast and nationwide.

Priorities

Setting DFG priorities for the West Coast is a complex process. The West Coast is not a uniform ecosystem; rather, it is diverse and variable. It has a number of impressive geographical and marine regions including the Puget Sound (and Salish Sea to the north, in Canada), the outer coast of Washington, Oregon and California, and a number of bays, river outfalls ,and islands, some of which fall within boundaries of designated national marine sanctuaries and state marine protected areas. These regions and ecosystems have different DFG challenges, and setting DFG priorities for the West Coast may best be done by tailoring priorities to each region or ecosystem.

A number of criteria may be used to prioritize DFG survey and removal on the West Coast. One such criterion would be **impact** on marine animals and environment, particularly when dealing with ESA-listed species or ESA-defined critical habitat. Impact on commercially viable species may also be considered for prioritization. **Funding** is also a major factor in setting priorities for DFG projects. Addressing DFG is rarely an inexpensive venture, and adequate funding is required to implement a successful project or program. This may be easier to accomplish if all regional DFG projects on the West Coast are part of a larger coast-wide plan that could be established through the WCGA. Projects that involve **collaborative partnerships** between fishermen, state agencies, tribes, and other groups such as NGOs and community organizations should also be considered in the prioritization process. It has been seen that honoring local passions and priorities of concerned groups working at a smaller scale is important and can produce very successful outcomes. Fishermen collaboration can be gained through communication with the Pacific Fishery Management Council; if these types of collaborations are built, then such relationships should also be considered when prioritizing projects. This however, would be based on the scale of the project.

Assessing whether a project is feasible is critical in the prioritizing process. Many projects arising from realistic ideas can become over-ambitious and virtually unachievable. On the other hand, well-planned and -conceived goals using a calculated approach can produce a project plan that can clearly be done in a timely and cost-effective manner.

Obtaining the necessary information for any proposed project must be done prior to evaluation for priority takes place. In many cases, the ecosystem type may best define the needs for DFG removal projects. It is important that experts are consulted for their knowledge of the topics pertaining to the ecosystem in any given area and the threat DFG poses to that ecosystem. Other information-gathering methods should be utilized to gain the knowledge needed to properly designate a priority level to any given project. Fishing industry experts' and fishermen's knowledge are essential in understanding gear loss rates and locations. Federal and state agencies have information on landing and on fishing areas where DFG may accumulate. The NOAA Marine Debris Program resources and nationwide experience addressing marine debris could be helpful. Information on the location of sensitive resources and the magnitude of impact DFG would have on their populations can be provided by government agencies and NGOs. Entanglement rates of coastal species from the Marine Mammal Stranding Network could provide information trends of mammal and gear interactions

and entanglements. As discussed in the survey section, sidescan sonar surveys for derelict pots and net surveys are methods to gain information on the abundance of DFG in specific locations. Aerial surveys could also possibly identify areas to be considered for high priority.

Future Action

Objective 1

Consult with the states and other stakeholders to determine priorities for addressing DFG based on geographic location, impact on humans and the environment, and feasibility of removal.

Action 1: Determine ecologically similar regions along the West Coast and the survey and removal methods best suited and most feasible for that region.

Action 2: Determine priorities for removal of DFG based on impact, feasibility of execution and funding.

Action 3: Consult with the states to set realistic target reduction levels.