NOAA FISHERIES

U.S. west coast large whale entanglement information sharing workshop report

November 13-14, 2013
Portland, Oregon

Prepared by
The National Marine Fisheries Service
West Coast Regional Office
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1.0 Executive Summary

Addressing the serious injury and mortality of large whales due to entanglement in fishing gear is a national priority for the NOAA's National Marine Fisheries Service (NMFS). However, along the U.S. west coast, much is unknown about why, when, where, and how whales are seriously injured or killed due to entanglement, how this threat may be affecting their populations, and what can be done to minimize the risk. For some fisheries NMFS tracks entanglements along with other bycatch using onboard observers; however, for the majority of fisheries, entanglement information comes from opportunistic reports by the public or other agencies. Of the reports received, fixed gear (e.g., pot and trap gear) is the most commonly recognized and reported gear type causing entanglements since 2000 (Saez *et al.*, *In prep.*). Over the past four years, NMFS WCR has been compiling data on entanglements and large whale migratory movements to identify areas of overlap and increased risk of entanglement. The results of that effort are presented in a NOAA technical memorandum titled *Understanding the co-occurrence of larges whales and commercial fixed gear fisheries off the west coast of the United States* (Saez *et al.*, 2013). NMFS WCR hosted a two day workshop to review, share, and analyze the information from the Tech Memo along with results from similar analyses from other fisheries in the Pacific and Atlantic Oceans and other current research with interested stakeholders, promote feedback, and consider next steps in achieving the long-term goal of reducing large whale interactions with fixed gear fisheries (Appendix 1 – Agenda).

The three primary goals for this workshop were to:

1. Bring together experts in the fields of marine mammals, fisheries, modeling, bycatch, lost gear/marine debris, and management, to share information relevant to this issue;
2. Identify data gaps, data needs, and next steps;
3. If possible, begin to develop research and outreach priorities. These steps are necessary to better understand large whale entanglement and continue to build a strong science-based foundation for any actions that may be necessary to protect whales.

Workshop participants included scientists, managers, and experts with knowledge of large whales, large whale entanglement and fisheries (Appendix 2 – List of Participants). Presentations spanned several topics including: risk assessment models; large whale abundance, distribution and behavior; fishery characterizations and management regimes; and, gear reduction/recovery efforts. The workshop concluded that although the models presented provide direction on where whales are more likely to encounter commercial fishing gear, more research is needed to understand the conservation concern and mechanisms of large whale entanglement to help better inform future management actions aimed at reducing whale entanglement risks. In the interim, workshop participants identified action items that may be pursued such as gear marking and engagement with the commercial fishing industry through port-based meetings.

Participants identified four recommendations concerning reducing large whale entanglements off the U.S. west coast. The four recommendations are listed under the Workshop Recommendations/Action Items in Section 1.1 below.

1.1 Workshop recommendations/action items

1. Engage with commercial fishermen and commercial fishery managers to better understand the fisheries and what measures may be taken to fill existing data gaps
2. Address the unknowns surrounding large whale entanglements
    a. Conduct research which may be needed to encourage or support some fishery management actions or legislation changes, including:
    b. Identify and clarify the level of conservation concern surrounding population-level impacts from entanglement for different whales species;
    c. Conduct fine scale research on areas identified as having high co-occurrence of fishing gear and large whales;
    d. Research mechanisms by which whales become entangled in gear.
3. Evaluate the feasibility of gear modifications; for example, research could be conducted to increase the number of traps per line, which could lead to a reduction in entanglement risk by reducing the number of vertical lines in the ocean with which whales could interact.
4. Support lost gear and marine debris removal efforts to reduce the risk of whale entanglements.

1.2 List of Acronyms

AK	Alaska
ALWTRP	Atlantic Large Whale Take Reduction Plan
ALWTRT	Atlantic Large Whale Take Reduction Team
CA	California
CDFW	California Department of Fish and Wildlife
DCTF	Dungeness Crab Task Force
ESA	Endangered Species Act
FAQ	Frequently Asked Questions
HIHWNMS	Hawaiian Islands Humpback Whale National Marine Sanctuary
MMAP	Marine Mammal Authorization Program
MMC	Marine Mammal Commission
MMPA	Marine Mammal Protection Act
MOU	Memorandum of Understanding
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NRC	Natural Resources Consultants, Inc.
NWFSC	Northwest Fisheries Science Center
ODFW	Oregon Department of Fish and Wildlife
OR	Oregon
QIN	Quinault Indian Nation
QSMA	Quinault Special Management Area
SCUBA	Self-Contained Underwater Breathing Apparatus
SWFSC	Southwest Fisheries Science Center
TNC	The Nature Conservancy
TRT	Take Reduction Team
U&A	Usual & Accustomed
USCG	United States Coast Guard
WA	Washington
WCR	West Coast Region
WDFW	Washington Department of Fish and Wildlife

2.0 Workshop Proceedings

Large whale entanglement in commercial fishing gear off the U.S. west coast has been identified as an issue of concern by NOAA's National Marine Fisheries Service not only because of the potential impacts to these whale stocks but also because of statutory mandates, one of which clearly states that the agency shall reduce takes of marine mammals in commercial fisheries to insignificant levels. All marine mammals are protected under the Marine Mammal Protection Act (MMPA), and most large whales are also listed as endangered or threatened under the Endangered Species Act. The MMPA provides a mechanism for reducing serious injuries or mortalities in fishing gear through several means, including the categorization of fisheries based on their level of interactions, as well as the convening of "take reduction teams" to develop a "take reduction plan" to reduce interactions in short and long-term time frames. NMFS representatives from around the country meet fairly regularly to prioritize research related to commercial fisheries and marine mammal stocks of concern, determine whether a take reduction team should be formed, etc. The U.S. west coast has one take reduction team and plan, the Pacific Offshore Cetacean Take Reduction Team/Plan, which has been in place since the mid-1990s to address marine mammal bycatch in the CA large mesh drift gillnet fishery targeting swordfish and thresher shark.

NMFS has been monitoring and recording reports of entangled whales along the U.S. west coast since the early 1980's. While the specific patterns of entanglement may have changed over time, NMFS has been documenting an average of about 10 large whale entanglements along the U.S. west coast since 2000 (Saez *et al*., *In prep*.) Given that most reports are generated by opportunistic sightings, NMFS realizes that this number is represents only a minimum number and likely underestimates the actual total number of entanglements that occur. Recognizing the risk of large whales interacting with fixed gear off the U.S. west coast, but given limited funding to form a take reduction team, NMFS decided to take a step-wise approach for understanding and addressing this issue. As a first step, the NMFS Southwest Region (now the West Coast Region) researched commercial fixed gear fisheries and produced a "Fixed Gear Guide" published online December 2011. The Guide characterizes fisheries off the U.S. west coast, using a combination of written descriptions and diagrams of configuration of gear, geographic range of effort, and season/management structure. The next step was the creation of a co-occurrence model to assess the risk of 11 fixed gear fisheries to 5 different whale species, which was published as a Technical Memorandum in September 2013 (Saez *et al.* 2013). The co-occurrence model used landings data to account for commercial fishing effort and large whale habitat models to represent seasonal whale densities. Following these publications, NMFS planned a workshop (contents herein this report) to meet with stakeholders to share the results and start a discussion regarding next steps in reducing large whale entanglements off the U.S. west coast.

The U.S. west coast large whale entanglement information sharing workshop was held in Portland, Oregon over two days, November 13-14, 2013. The first day, November 13, consisted of presentations from various workshop participants. Summaries of the presentations were written by the presenter and are provided in the following section of the workshop report. The discussion section of this workshop report summarizes the discussions following presentations from Day 1 and facilitated discussions on Day 2, November 14.

The recommendations presented in this report reflect many of the participants' views but are not meant to be all-inclusive of all of the attendees. For example, a few participants were not able to attend/call-in to the second day of the workshop. In addition, while Oregon and Washington were well represented by industry and managers at the workshop, staff members from the California Department of Fish and Wildlife (CDFW) were not able to attend. NMFS plans to meet with CA managers and industry at a later date, but for this workshop report, their opinions were not considered in the development of any recommendations.

3.0 Summary of Workshop Presentations

November 13, 2013

3.1 Overview of MMPA and statutory mandates

3.1.1 CHRISTINA FAHY – NMFS West Coast Region, Protected Resources Division, Senior Fishery Biologist, Long Beach, California

Background to the 2013 Large Whale Entanglement Workshop

Under the 1994 amendments to the Marine Mammal Protection Act, NMFS is mandated to assess the status of all marine mammal stocks within the exclusive economic zone of the United States. This includes the preparation of annual stock assessment reports that are updated every 1-3 years, depending on the status of the stock or updated information. These stock assessments not only include summaries of abundance, trend and distribution of marine mammal stocks, they also include an estimate of the human-caused serious injury and mortality, including fisheries impacts to these stocks. Based on the incidental "take" estimates attributed to fisheries, NMFS annually categorizes commercial fisheries into one of three categories[1] according to their level of impact to a stock (*i.e.,* frequent (Category I), occasional (Category II), or rare/none (Category III)). Of 11 fixed gear fisheries off the U.S. west coast, 6 are currently (2013 List of Fisheries) classified as Category II, based on their interactions with humpback whales and Eastern North Pacific gray whales. These are: the California (CA) halibut/white sea bass set gillnet fishery, the CA spot prawn pot fishery, the CA, Oregon (OR) and Washington (WA) Dungeness crab fisheries, and the CA/OR/WA sablefish pot fishery. Current stock assessment reports[2] provide minimum population estimates of large whale stocks for which NMFS has identified as being at risk for entanglement in fixed gear fisheries. These include the non-Endangered Species Act (ESA)-listed Eastern North Pacific gray whale (18,017 animals), the ESA-listed as endangered Eastern North Pacific stock of blue whales (1,551 animals), the ESA-listed as endangered North Pacific stock of fin whales (2,598 animals), the ESA-listed as endangered CA/OR/WA stock of humpback whales (1,876 animals) and the ESA-listed as endangered CA/OR/WA stock of sperm whales (751 animals). Out of concern for the entanglement risk to these stocks and noting that most of the large whale recovery plans identified fishery bycatch reduction as a priority, NMFS undertook a series of steps to characterize fishery bycatch as a threat, given that any entanglement estimates based on observations were a minimum. Leading up to this November

[1] List of Fisheries is produced annually under the Marine Mammal Protection Act to categorize commercial fisheries according to their level of incidental mortality or serious injury of marine mammals. For more information, visit: http://www.nmfs.noaa.gov/pr/interactions/lof/

[2] Stock Assessment Reports can be accessed at: http://www.nmfs.noaa.gov/pr/sars/species.htm

2013 workshop, NMFS produced a "Fixed Gear Guide[3]," which characterizes fisheries off the west coast, including a description and configuration of gear, geographic range of effort, and season/management structure. Furthermore, using landings data to account for effort and area, and large whale habitat models, NMFS created a co-occurrence model to assess the risk of 11 fixed gear fisheries and 5 large whale species (listed above), which was published as a Technical Memorandum in September 2013 (Saez *et al.* 2013, and see Saez presentation in section 3.5.3). NMFS has also created extensive outreach materials to the boating community and has increased training and supplies to the U.S. west coast large whale disentanglement network (Appendix 3).

3.1.2 KRISTY LONG – NMFS Headquarters, Marine Mammal and Sea Turtle Conservation Division, Fishery Biologist, Silver Spring, Maryland
NOAA Take Reduction Team: process and lessons learned

An overview of the MMPA framework for addressing marine mammal bycatch in commercial fisheries was presented. NMFS convenes multi-stakeholder teams, called "take reduction teams," (TRT) to develop recommended measures by consensus that will reduce bycatch below specific levels. The MMPA prescribes a rigorous timeline for team negotiations as well as for NMFS to consider those recommendations and implement a take reduction plan through the Federal rulemaking process. These plans include both regulatory and voluntary measures, such as modifications to fishing gear or practices, bycatch limits, education and outreach, and prioritized research. NMFS currently manages 6 take reduction teams, which cover more than 25 marine mammal stocks and 22 commercial fisheries.

The success of the take reduction process is largely driven by the quantity and quality of available data as well as several other important factors such as a shared understanding of the problem, strong commitment to the process, team size and composition, and neutral-third party facilitation.

First and foremost, the TRT process relies on the best available data at any given time. For the Teams to be successful, we need several key pieces of information, such as abundance and mortality estimates. Additionally, certain basic data are critical for a team to be able to brainstorm options and ultimately recommend take reduction measures to NMFS.

Clearly defining the problem and ensuring that all team members agree with addressing that specific problem is also critical to successfully reducing bycatch. Individual team members will have varied underlying interests, which is inherent to any stakeholder-based process, but those interests should coalesce around achieving the specific goals of a given TRT.

[3] Fixed Gear Guide is available online at: http://www.westcoast.fisheries.noaa.gov/publications/protected_species/marine_mammals/fixed_gear_guide_final_12.14.11.pdf

Team size and composition can greatly affect the functionality of teams and subsequently their level of success. More focused teams of 15-20 members who are charged with addressing one or two closely related fisheries or marine mammal stocks tend to be more efficient and effective. The individuals chosen to represent various constituencies should be able to truly listen to all view points, engage constructively to create a solution everyone can live with, be respectful of others, articulate technical information to people with various backgrounds and expertise, etc.

Further, to achieve success, teams must fully commit to the take reduction process (Figure 1). TRTs have an opportunity to help create the solution in the form of a take reduction plan. TRTs can be challenging, and success can take time, but in most cases, having the opportunity to create a solution among stakeholders may engender more support and ultimately be more successful than a unilateral plan set by a court or by NMFS alone.

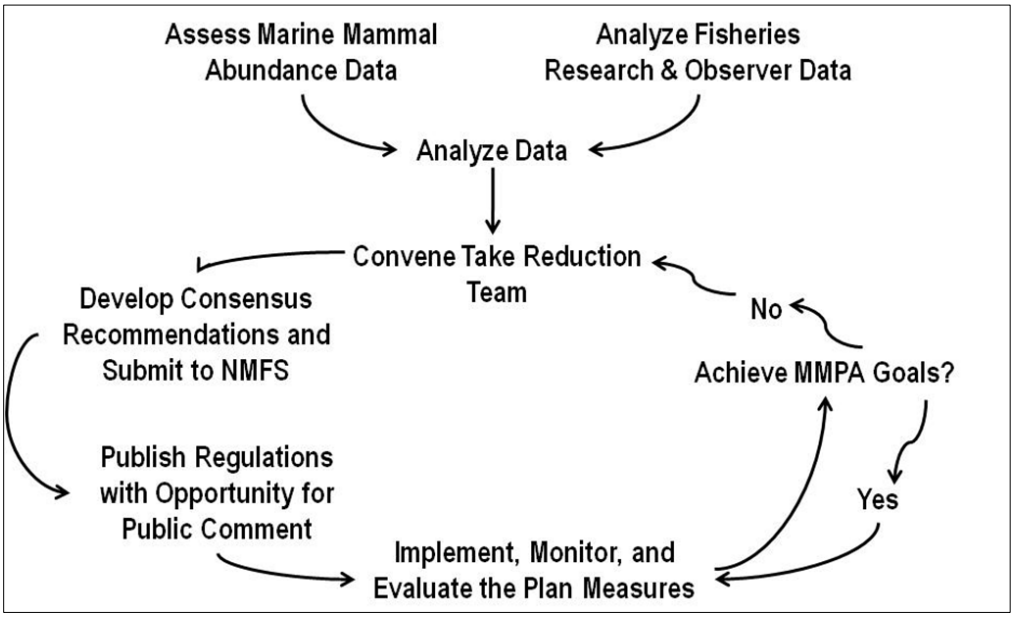

Figure 1. Take reduction process overview

3.2 Overview of U.S. west coast whales and entanglement history

3.2.1 JOHN CALAMBOKIDIS – Cascadia Research Collective, Senior Research Biologist, Olympia, Washington

Overview on status of large whales off the US West Coast and perspectives on entanglements

The status and trend of three species of whales that commonly feed or migrate in more coastal waters off the U.S. west coast were reviewed. Gray whales are a species that commonly occurs in shallow coastal waters and potentially vulnerable to entanglements. There has been considerable recent information on different subpopulations of gray whales in the north Pacific. A majority of the eastern north Pacific gray whale population migrates along the U.S. west coast annually moving between their primary winter breeding grounds off Mexico and their primary Spring-Fall feeding areas in Arctic waters. A small subpopulation, termed the Pacific Coast Feeding Group, spends from spring to fall feeding from northern California to southeast Alaska waters and shows small but significant differences in mitochondrial DNA from the overall eastern north Pacific gray whale populations. This subgroup numbers only a few hundred animals compared to the overall estimate of close to 20,000 gray whales. Additionally recent satellite tag and photo-ID data has shown that some of the gray whales feeding in the western north Pacific (an endangered subpopulation) also migrate east along the U.S. west coast to the Mexican breeding grounds.

Humpback whales have shown a steady recovery throughout the north Pacific including off the U.S. west coast where long term monitoring has revealed about a 7% annual increase (Figure 2). Humpback whales tend to be loyal to specific feeding grounds with one group consistently using the waters off California and Oregon and another feeding in areas extending from Washington to southern British Columbia.

Blue whales have not shown any sign of increasing in the last 20 years in contrast to some of the other hunted whale populations (Figure 3). Blue whale population size from mark-recapture of photo-IDed animals has stayed relatively unchanged and average density of animals from line-transect surveys off the U.S. west coast have declined from the 1990s to the 2000s.

Documented entangled animals and disentanglement efforts in the Pacific northwest have mostly involved gray whales and humpback whales and have involved both gill nets and crab gear. While not as common, both fin and blue whales are sometimes entangled based on a few stranded animals and scarring on live animals.

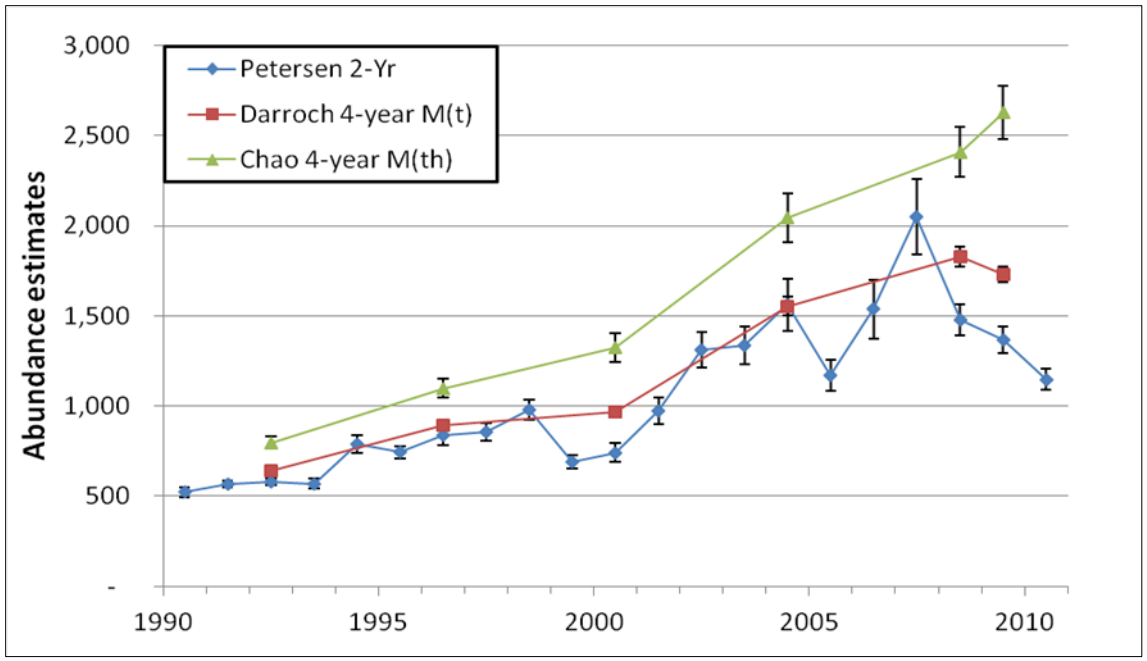

Figure 2. Humpback whale trends, U.S. west coast, various sources

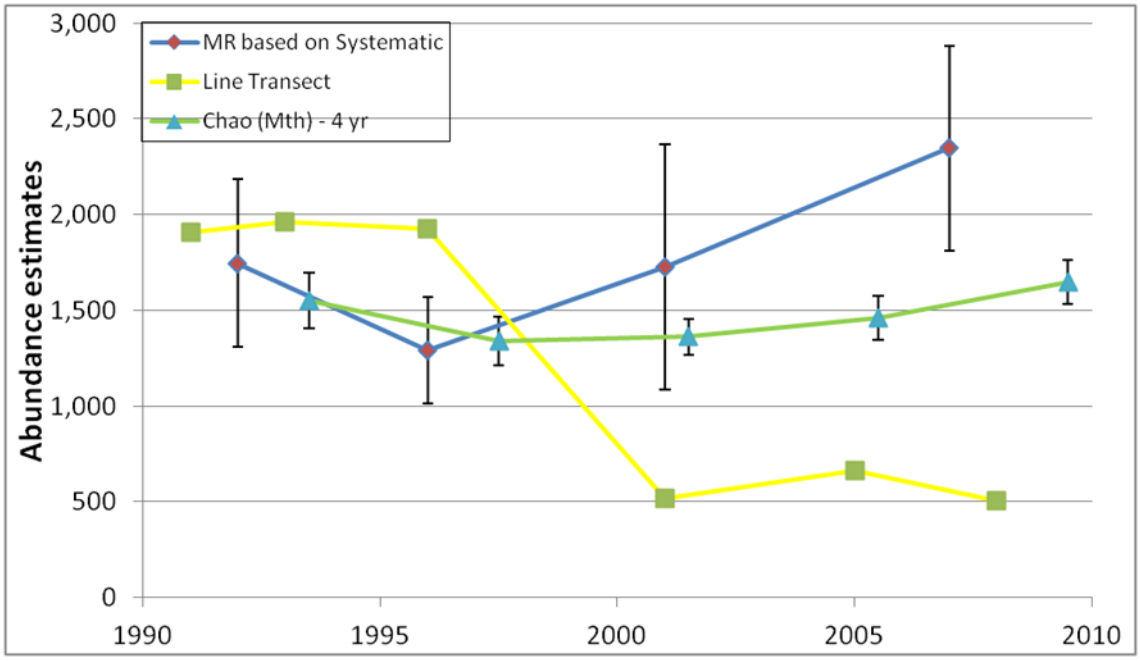

Figure 3. Blue whale trends, U.S. west coast, various sources

3.2.2 LAUREN SAEZ – Contractor with Ocean Associates for NMFS West Coast Region, Protected Resources Division, Fishery Biologist, Long Beach, California

California, Oregon, and Washington large whale entanglement trends

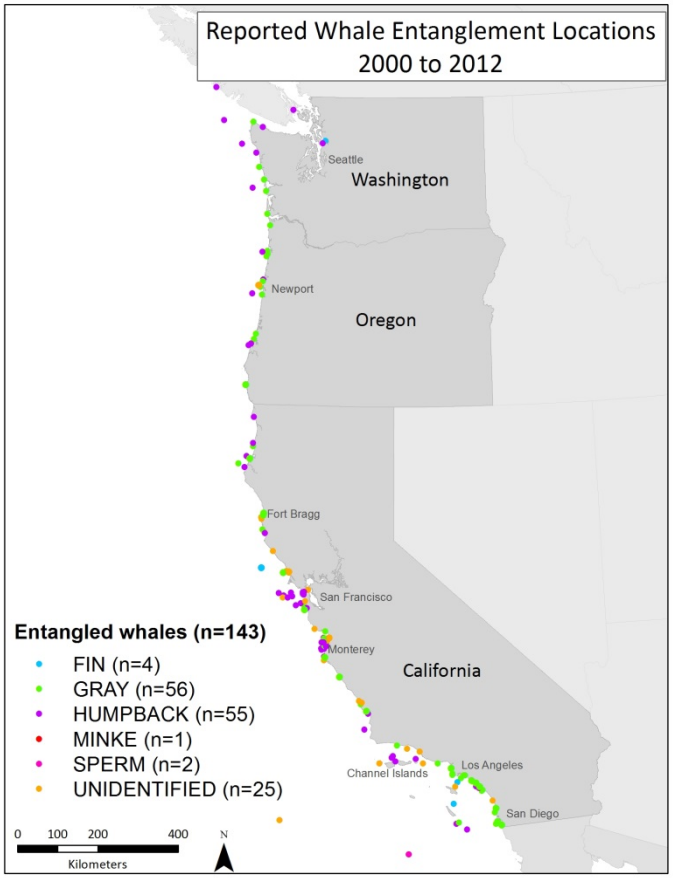

Figure 4. Whale entanglement locations from 2000 to 2012 (n=143). One dot represents a unique record, and does include re-sights. Source: Saez *et al.*, in prep

NOAA's National Marine Fisheries Service's West Coast Region tracks large whale entanglements through opportunistic sightings reported to the entanglement response networks, marine mammal stranding reports, Marine Mammal Authorization Program (fishermen self-reports), and NMFS commercial fishery observer records. Off the coasts of California, Oregon, and Washington, there have been 308 large whales documented as entangled from 1982 through December 31, 2012 (Saez *et al.*, 2013). From 2000 to 2012, 124 whales were reported as entangled: 56 gray, 55 humpback, 4 fin, 2 sperm, 1 minke, and 25 reports where the species was unidentified. The specific fishery associated with entangling gear from 2000 to 2012 was identified in 20 cases or in about 16% of the reports. The map, shown in Figure 4, shows whale entanglement reports by locations. Reports appear to be biased towards areas of higher human population, especially areas with active waterfronts.

The majority of whale entanglements reported off California, Oregon, and Washington from 2000 to 2012 (46%) were identified as trap/pot gear, 22% of reports identified the source as netting, and 32% of the reports identified the source of entangling gear was unidentified. This represents a shift from gillnet being reported as the primary source of whale entanglements in the 1990's. Since then, there have been confirmed entanglements with the Dungeness crab, sablefish, and spot prawn trap fisheries as well as the thresher/swordfish gillnet fishery.

3.2.3 ALERIA JENSEN – NMFS Alaska Region, Protected Resources Division, Fishery Resources Management Specialist, Juneau, Alaska

Alaska large whale entanglement trends

NMFS Alaska Region has focused significant effort over the past decade on capacity-building to respond to large whale entanglements. The Alaska Entanglement Response Network has grown since its inception in 1998 and now comprises over 180 participants with different levels of training statewide. NMFS Alaska Region maintains an ongoing partnership with the Hawaiian Humpback Whale National Marine Sanctuary to train personnel and respond to events in Alaska. Through this partnership, more than 40 trainings in over 16 communities have been performed to prepare personnel for various roles in addressing large whale entanglement. Nine caches of response equipment have been established throughout the state from Kodiak to Petersburg, AK. Since 1998, the network has received over 140 large whale entanglement reports and mounted more than 85 on-water responses which have totally or partially freed more than 45 large whales from life threatening entanglements. Between 1990 and 2013, the percentage of known gear types removed from, or documented on entangled whales in Alaska is as follows: pot gear (32%), gillnet (30%), other net (24%), seine (8%), mooring (4%), long line (1%), marine debris (1%) (Figure 5).

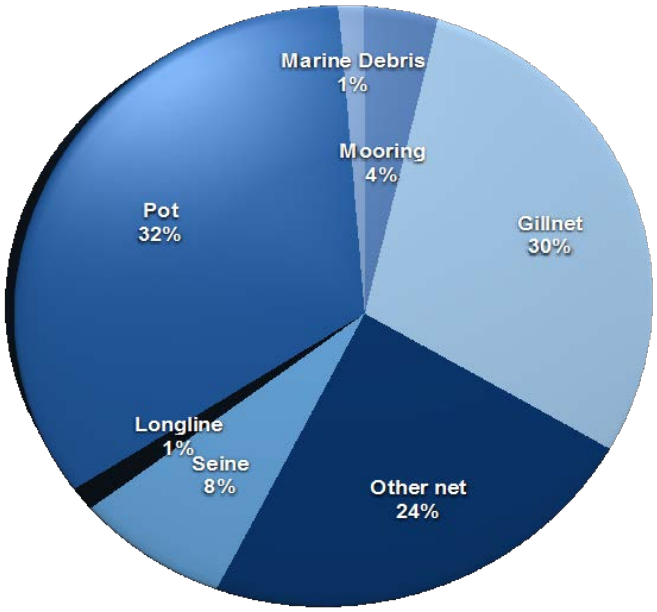

Figure 5 Percentage of known gear types removed from, or documented on entangled whales in Alaska between 1990 and 2013. Courtesy of Ed Lyman, HIHWNMS

Fishermen in AK are trying to reduce the rate and impact of large whale entanglement in their gear and assist in disentanglement efforts when appropriate. NMFS Alaska Region, in partnership of Alaska SeaGrant, have organized and conducted small community workshops with the fishing industry to better understand, prevent and respond to large whale entanglements. Eight fishermen workshops were held in AK between 2006-2013, providing a forum for discussing the threat, appropriate response protocols and measures to reduce impact. One outcome of these meetings was the creation of whale entanglement wheelhouse guide with information from fishermen to fishermen on ways to reduce the entanglement threat of your gear and information on how to respond to an entangled whale (Appendix 3). One emerging management issue in AK is the use of pingers by the fishing community as an acoustic deterrent for humpback whales. It is currently not well understood whether these work to deter humpbacks from gear, and further studies are needed to determine whether there are potential negative impacts to whales.

NMFS Alaska Region is committed to increasing awareness to address entanglement threat. In 2009, the agency instituted a hotline[4] for stranding and entanglement calls and also signed an MOU with USCG District 17 to establish communication procedures for USCG assistance in reporting and responding to entanglement events. In addition, to reduce the rate and severity of entanglement threat, the Alaska Region has instituted a practice of de-briefing events to learn from each incident and improve capabilities.

Despite challenges of geography, limited personnel and opportunistic reporting, future goals include continuing to develop collaborative relationships with fishing industry, developing a gear identification guide for Alaska, improving quality of reporting through outreach efforts, gear investigation for accurate fishery assignments, post-release monitoring, and greater overall emphasis on information-gathering for prevention.

3.3 U.S. west coast fishery management

3.3.1 DAN AYRES – Washington Department of Fish and Wildlife, Coastal Shellfish Lead Biologist, Montesano, Washington

Washington fixed gear fisheries

The states of Washington, Oregon and California are authorized to manage the coastal Dungeness crab fisheries adjacent to each state, in state (0-3 miles) and federal waters (3-200 miles) through the Magnuson Stevens Fishery Conservation and Management Act. The Washington Department of Fish and Wildlife (WDFW) manages the Dungeness crab fishery off the coast of Washington.

The coastal commercial Dungeness crab fishery has occurred in Washington's coastal waters for many decades and is the most important commercial fishery in Washington State. Since 1950, the Washington coastal crab fishery has produced between 2.6 and 25 million pounds per season. Coastal crab landings over the last five seasons average10.4 million pounds per season (2008-2012). The most recent 2012-13 season a total of 13.9 million pounds were landed in this state fishery.

The commercial fishery in Washington occurs in coastal waters extending approximately 140 miles from the U.S. Canadian Border to the Washington Oregon border and west from the shore to approximately 60 fathoms and at times deeper.

[4] AK Marine Mammal Stranding Network 24/7 Stranding Hotline: (877) 774-7325

There are 223 coastal Dungeness crab licenses under a limited license program; approximately 190-200 of those have been actively fished during the most recent seasons[5]. Under a two tiered pot limit of 300 or 500 pots per vessel, approximately 90,000 crab pots are deployed at the start of each commercial season, which typically starts in December or January. Pots may not be tethered to a ground line, with each required to have an individual surface buoy. The majority of the crabs are harvested in the first two to three months of the nine-month season.

A healthy Dungeness crab resource sustains a commercial fishery that has a strong socioeconomic impact on the small remote coastal communities of Westport, Ilwaco, Chinook, Neah Bay and LaPush, WA. The majority of the crabs harvested in the coastal fishery are delivered to buying facilities and processing plants located in these ports, which provides additional jobs and resources to these communities. The vast majority of the fishermen that participate in this fishery also make their homes and raise their families in these communities. A healthy Dungeness crab resource has provided these communities long term stability during years when salmon and groundfish resources could not support large commercial fisheries.

The coastal commercial Dungeness crab fishery is co-managed with three coastal tribal governments (Quinault, Quileute and Makah) within their different federally adjudicated Usual and Accustomed (U&A) fishing grounds. The state fishery is restricted by various regulations within these areas with a goal of reaching a final 50/50 sharing of harvest over the course of each season. In the most recent 2012-13 season the combined tribal total landings from within the U&A areas was 4.6 million pounds.

Starting in 2009 WDFW conducted a two-year NOAA funded stray and abandoned crab gear recovery project. This project resulted in the removal of 27 metric tons of commercial crab pots and lines from crab fishing areas along the Washington coast. In 2009 WDFW implemented a state supported Permitted Stray and Abandoned Gear Recovery Program. This program provides fishermen who hold a Washington State commercial crab fishing license the opportunity to request a permit from WDFW that allows them to recover and retain any pots remaining in the ocean following the close of the commercial fishing season. This permitted program required action by the state legislature to modify long-standing lost property statutes in Washington State law and provides some incentive for fishermen to recover abandoned pots by allowing them to keep the gear recovered. This permit, when issued by the WDFW to a coastal commercial Dungeness crab license owner, allows for the recovery and retention of commercial Dungeness crab gear owned by Washington State licensed fishermen in specific areas and time periods.

Three other smaller commercial fixed gear fisheries occur along the Washington coast (Figure 6).

[5] Although 223 licenses are sold, not all licenses are used to commercial landings.

- The spot shrimp pot fishery runs from March 15 to September 15 with the fishery occurring in off shore waters from 75 to 150 fathoms. Washington has eight limited entry licensed fishermen with between three to five active fishers each season. Fishermen are limited to 500 pots that can be tethered to a ground line. The average landings over the last five seasons are 87,000 pounds, with the majority taken in June, July and August.
- The hagfish pot fishery is open year round and has an average of 15 annual open access licenses. These fishermen land an average of 1.5 million pounds of hagfish annually. There is a 100 pot limit and these pots can be tethered to a ground line. Fishing is prohibited inside 50 fathoms and it generally occurs from 50 to 75 fathoms.
- The sablefish pot fishery off the Washington coast is managed by the Pacific Fishery Management Council. There is a combination of limited entry and open access licenses with approximately 20 fishers. With no pot limit most vessels use strings of 20 to 50 pots tethered to a ground line – with generally four strings per boat. The pots are set in 300 to 375 fathoms generating average landings over the last five seasons of 300,000 pounds.

Fishery	Primary Management	Permits (Active vessels)	5 yr. average pounds landed	2011 value
Dungeness crab pot	State	223 (200)	10.4 million* Non-tribal commercial	$47 million
Hagfish pot	State	15 (2-5)	1.5 million	n.a.
Sablefish pot	State	20 Limited Entry + Open Access (15)	300,000	$2.7 million* All groundfish fishery
Spot prawn pot	Federal	8 (3-5)	87,000	$407,000

Figure 6 Summary of fixed gear fisheries in Washington

3.3.2 KYLE ANTONELIS – Natural Resources Consultants, Inc., Seattle, Washington
Quinault Indian Nation and The Nature Conservancy efforts to address derelict crab pots on the Washington coast

The tribal Dungeness crab fisheries on the Washing (WA) coast employ approximately 30,000 pots per year in addition to the over 90,000 pots used by the non-tribal fleet (as reported by Dan Ayres - WDFW). In some years, estimates of pot loss on the WA Coast have reached 10%. The Quinault Indian Nation (QIN) has the largest of the three WA Coast tribal Dungeness crab fleets, and much of their crab effort is focused in a region along the coast called the Quinault Special Management Area (QSMA). The amount of derelict pots, both tribal and non-tribal, accumulating in this particular area have caused the QIN salmon troll fleet to lose an extensive amount of gear to the point where the grounds have become completely avoided for fishing.

Derelict crab pots also pose economic impacts to the Dungeness crabs themselves from 'ghost-fishing'. The vertical buoy lines associated with the derelict pots have caused additional concerns about marine mammal entanglements (especially large whales) and hazards to navigation for transiting vessels.

The derelict crab pot survey and removal project conducted by QIN and The Nature Conservancy (TNC) focused on the QSMA that covers a portion of the area between Grays Harbor and Point Grenville, WA, along the 15 fathom contour. In the summer of 2012, sidescan sonar surveys targeting derelict crab pots covered 5 km^2 and identified 84 derelict pots, with another 171 identified visually by their floats on the sea- surface (Figure 7). Removal methods using SCUBA divers and hydraulic pump hoses were separately utilized to remove 105 of the derelict pots and/or lines from the fishing grounds. More recently, a pot line cutter was developed and successfully tested by project partners (Natural Resources Consultants, Inc. (NRC) and Fenn Enterprises) to be used for removing buoy lines of "sanded-in" or buried pots (Figure 8). This device can be attached to a buoy line at the sea-surface and dropped to the seafloor where the pot is buried, and then with a quick exertion of upward pressure, the line is cut and can be recovered upon the work vessel. Project proposals have recently been submitted to continue derelict pot and vertical line removals along the WA Coast through three methods: (1) commercial grade hydraulic pot puller, (2) hydraulic pump hose with pot puller, and (3) the pot line cutter. Using these three methods, the project team has confidence that derelict pots and their associated vertical lines can be quickly and efficiently removed from the coastal waters, reducing the potential for whale entanglements, economic loss and hazards to navigation.

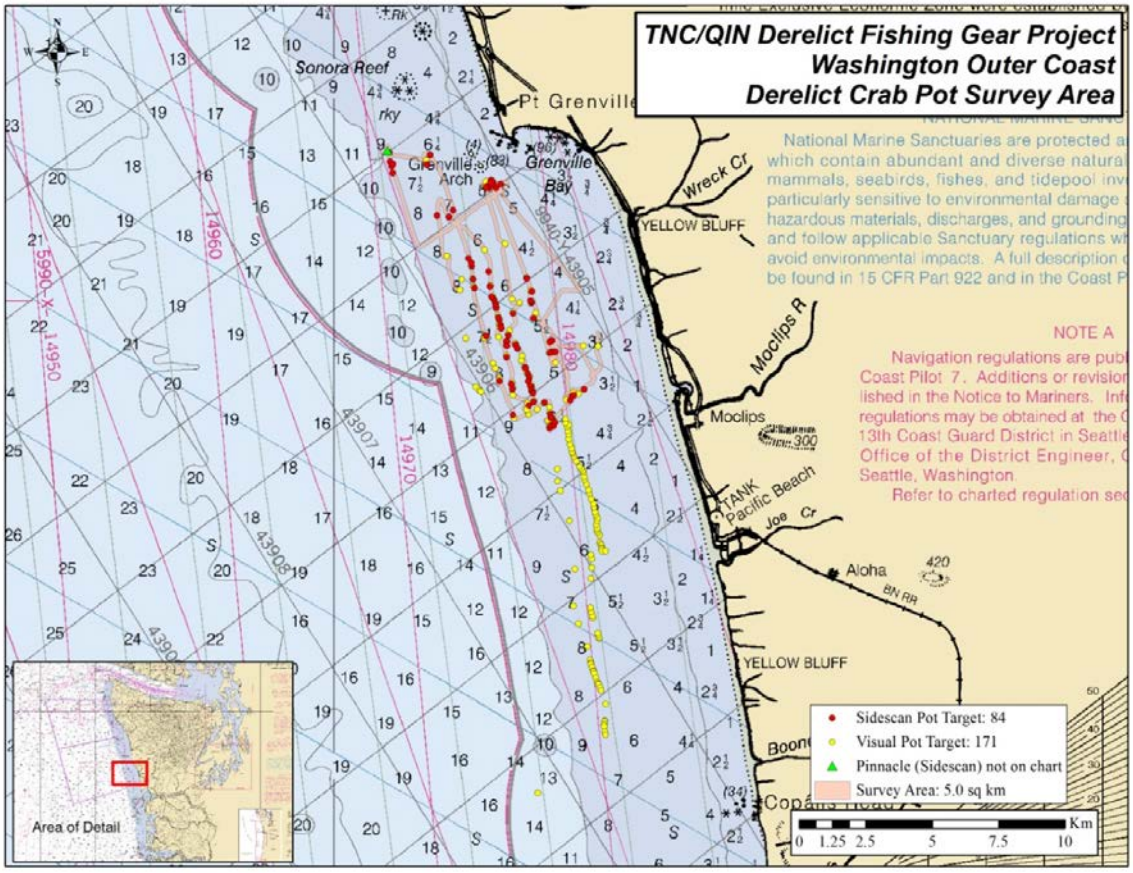

Figure 7. Sidescan sonar surveys and derelict fishing gear targets detected during the TNC/QIN 2012 Washington Coast Derelict Fishing Gear Project. Source: NRC.

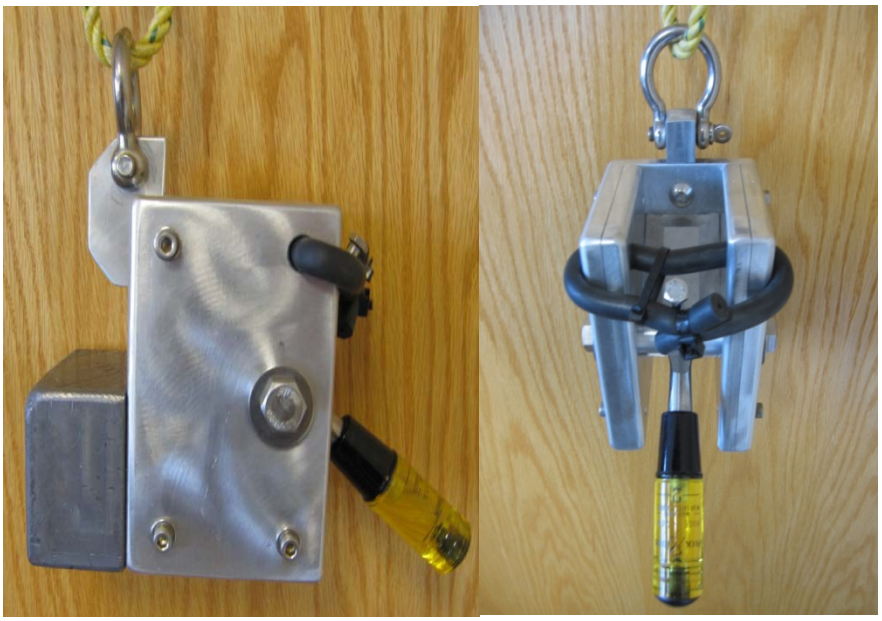

Figure 8. Derelict pot line cutter designed for TNC/QIN 2012 Washington Coast Derelict Fishing Gear Project. Source: NRC

3.3.3 TROY BUELL – Oregon Department of Fish and Wildlife, State Fisheries Management Program Leader, Newport, Oregon

Oregon's fixed gear fisheries

A number of fixed gear commercial fisheries that may interact with large whale species occur off the coast of Oregon, utilizing pot (trap) or demersal longline fishing gears. These include fisheries for Dungeness crab (pot), groundfish (pot and longline), Pacific halibut (longline), hagfish (pot), and spot shrimp (pot). This presentation provided information on the relative scale, management systems, data collection, gear regulations, effort limitations, and derelict gear recovery programs for each of these fisheries. Relative scale was provided in terms of number of vessels, number of trips, pounds landed, and ex-vessel value, averaged over the previous five years (Figure 9). The Dungeness crab fishery was the largest fishery in all categories, followed by groundfish, hagfish, halibut, and spot shrimp in that order.

Fishery	Primary Mgmt	Vessels	Trips	Pounds (x1,000)	Value (x1,000)
Dungeness crab pot	State	334 (322 - 360)	6,787 (6,389 – 7,419)	16,824 (12,342 - 23,196)	38,303 (26,065 – 48,951)
Groundfish hook and line	Federal/state	244 (229 – 266)	3,696 (3,293 – 4,319)	2,290 (1,895 – 2,563)	6,421 (4,431 – 8,501)
Groundfish pot	Federal	29 (25 – 34)	200 (182 – 237)	952 (743 – 1,123)	2,989 (2,257 – 4,820)
Hagfish pot	State	15 (12 – 17)	204 (150 – 261)	1,599 (780 – 2,020)	993 (417 – 1,139)
Spot shrimp pot	State	2 (1 – 3)	32 (24 – 46)	10 (5 – 19)	101 (48 – 181)

Figure 9. Summary of fixed gear fisheries in Oregon, 2008 – 2012 average (Min – Max)

3.3.4 RACHELLE FISHER- Strategic Earth Consulting, Senior Associate, Santa Barbara, California

California Dungeness crab task force

The California Dungeness Crab Task Force (DCTF) is a legislatively mandated advisory body responsible for reviewing and evaluating Dungeness crab fishery management measures. In 2010, the DCTF recommended a 7-tier trap limit program for California's commercial Dungeness crab fishery, which was subsequently put into law in 2013. In addition to limiting the amount of gear used in the commercial fishery, the program also allows for retrieval of an unlimited number of traps from July to October. The DCTF will continue to work with California fishery managers, including CDFW, to adaptively manage the trap limit program and

the fishery as a whole. More information on the trap limit system can be found at: http://www.dfg.ca.gov/marine/invertebrate/traplimit.asp. More information on the DCTF can be found at: http://www.opc.ca.gov/2009/04/dungeness-crab-task-force.

3.3.5 ALISON AGNESS – NMFS West Coast Region, Protected Resources Division, Fishery Biologist, Seattle, Washington
Pacific coast groundfish bycatch management

Alison provided an overview of NOAA Fisheries biological opinion on the continuing operation of the Pacific Coast groundfish fishery, and introduced the reasonable and prudent measures and terms and conditions for bycatch monitoring, reporting, and management planning and conservation recommendations to better characterize and minimize bycatch. In line with the workshop focus, the talk emphasized measures to specifically address humpback whales and their entanglement in pot gear of the WA/OR/CA sablefish pot fishery. Three of the identified conservation measures to minimize and better understand the entanglement risk of humpback whales include: (1) require or recommend unique, visual marking of sablefish pot/trap gear as identifiable to a specific fishery; (2) report, track, and retrieve pot/trap gear that becomes lost; and (3) assess and promote use of available technology to minimize loss of sablefish pot/trap gear. The NOAA Fisheries WCR is moving forward in joint partnership with NOAA Fisheries Northwest Fisheries Science Center, and the Pacific Fishery Management Council to deliver on all the reasonable and prudent measures of the biological opinion and are on track to meet specified timelines.

3.4 Mitigation

3.4.1 JEN RENZULLO – Sea Doc Society, Field Biologist, Eureka, California
California Lost Gear Recovery Project

The California Lost Fishing Gear Recovery Project works with fishing communities to recover fishing gear that has become lost or abandoned in marine waters (Figure 10). Priorities include gear that poses a direct entanglement risk to wildlife, navigation, or habitat. Since this project's inception in 2005, more than 60 tons of lost fishing gear has been recovered, including more than 1,200 nets, pots, and traps. More information on the Lost Gear Recovery Project can be found at: http://www.seadocsociety.org/california-lost-fishing-gear-removal-project.

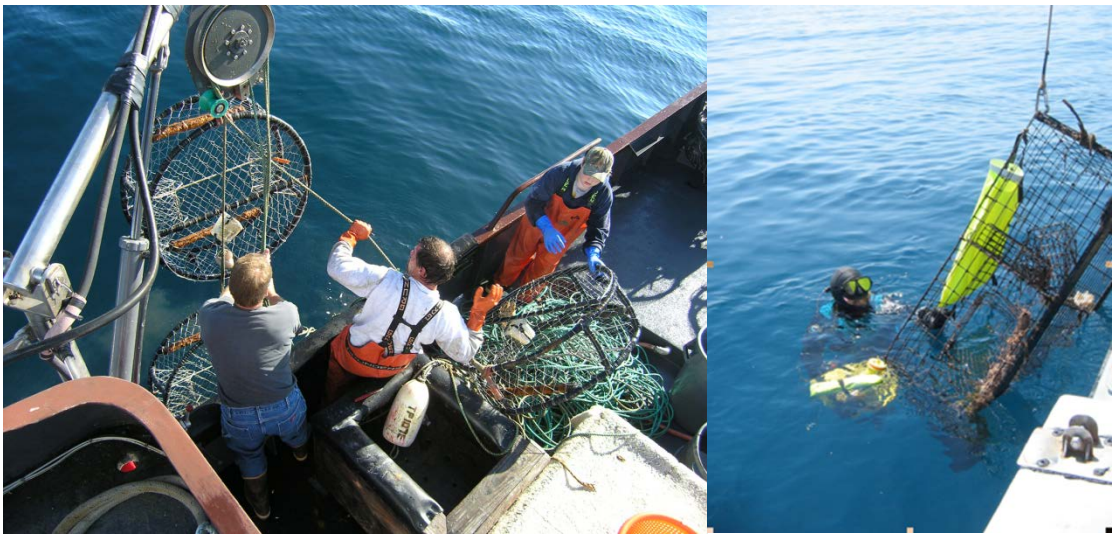

Figure 10. Gear removal efforts by the California Lost Gear Recovery Program

A cost-benefit analysis was performed in 2010 in partnership with the Northwest Straits Foundation's Derelict Fishing Gear Removal Program (Gilardi *et al*, 2010). Divers collected the following data at regular intervals over a 3-month period from 4 gillnets in Puget Sound, WA: the number of animals that became entangled, the state of decomposition of these animals, and the number of carcasses that fell out of the net upon recovery. The average cost to recover a net was determined to be $1,358. However, if the entrapment and decomposition rate information was conservatively extrapolated out to the lifetime of one derelict net persisting in the marine environment for 10 years, the potential loss in harvestable Dungeness crab could amount to $19,656 in lost revenue to the Dungeness crab industry. Going forward, we believe that getting gear that is not actively fishing out of the water in a timely manner will help to minimize impacts to not just harvestable species, but also other animals such as large cetaceans. Currently, we are focusing on working collaboratively with Dungeness crab fishers in the Eureka and Crescent City area to both revitalize a crab gear recovery effort piloted in 2008 in Crescent City and 2010 in Eureka, CA, and to research other potential methods of recovering gear that are both effective and financially sustainable. By reducing the amount of gear lost or abandoned after the close of the season, the potential co-occurrence between Dungeness crab lines and large cetaceans could be reduced.

3.4.2 KATE SWAILS – NMFS Northeast Region, Protected Resources Division, Marine Mammal Policy Analyst

Atlantic Large Whale Take Reduction Plan: History, management measures, challenges and lessons learned

The Team - The Atlantic Large Whale Take Reduction Team (Team) was established in 1996 to reduce the level of serious injury and mortality of large whales (fin, humpback, right, and minke)

as a result of commercial trap/pot and gillnet gear from Maine to Florida. The Team was one of the first TRTs and is a large team (60 people).

The Plan[6] - The Take Reduction Plan has been amended multiple times and is continuing to evolve as we learn more about both whales and fisheries. It is made up of both non-regulatory and regulatory measures:

- Non-Regulatory: A huge part of the success of the plan is our outreach efforts specifically those efforts of our fishery liaisons. The liaisons are employed by NMFS and are able to reach out to industry in a way that managers often can't. They spend a lot of time with industry listening to their concerns, they put a face to the government, and they're able to ground truth some of the things we hear at Team meetings with a larger portion of the industry. These liaisons also ID gear that is recovered from entanglements. The Plan also has a large research component. All of the gear modifications in the plan have gone through some type of research phase.
- Regulatory: The Plan consists of gear modifications based on where you fish, seasonal closures based on where the whales are, and gear marking (examples can be seen in Figures 11 and 12).

Challenges - It's difficult to determine where and when the entanglements took place. Observed interactions are not robust enough to develop bycatch estimates or bycatch rate patterns that we often use in other TRTs. Rulemaking is a slow process so it's sometimes difficult to keep Team members engaged throughout the entire process.

Lessons Learned - Working with large teams is challenging and achieving consensus is difficult. It helps to split the team into smaller subgroups. The Team works best when there are check-ins at every step of the process and NMFS provides some type of jumping off point for discussion during meetings. Timelines are extremely important. Having a timeline allows the team to know what's coming next, prepare their constituents, and NMFS is held accountable to follow the timeline the Team agrees to. Management measures that are constant and predictable work the best. It's difficult to manage fishing gear, especially fixed gear, in a dynamic nature. The earlier the public becomes involved in the process the better. Work with Team members to reach out to their constituents early and often.

As part of the Atlantic Large Whale Take Reduction Plan (ALWTRP) there is a federal requirement for the use of sinking ground line connecting multiple traps. The U.S. west coast has also seen a shift in purchasing and use of neutral buoyancy line, for vertical and ground line. This is the result of a few factors: 1) increasing price of lead, 2) weighting the line with lead weakens the line, 3) availability of neutral/sinking line, and 4) consistent strength and ease of use of neutral/sinking line. Sheila Garber, Englund Marine and Supply, noted that fishermen who do use it have also seen a reduction in gear loss from being cut by boat propellers and swell.

[6] http://www.nero.noaa.gov/Protected/whaletrp/

Figure 11. Gear modifications for fixed gear as part of the ALWTRP on the U.S. east coast to reduce whale entanglements: weak links and modified anchors.

Figure 12. Gear marking strategies as part of the ALWTRP on the U.S. east coast to help identify gear type

3.4.3 NEAL ETRE – Industrial Economics, Inc., Senior Associate, Cambridge, Massachusetts
Vertical line co-occurrence model for large whale entanglement risk planning on the U.S. east coast

For the NOAA's National Marine Fisheries Service (NMFS) and the Atlantic Large Whale Take Reduction Team (ALWTRT), IEc developed a dynamic GIS tool to analyze and illustrate spatial and temporal changes in trap/pot and gillnet fishing activity along the Atlantic coast. The Vertical Line Model draws on a variety of sources to provide the information that NMFS requires and to assist both NMFS and the ALWTRT in their efforts to improve the effectiveness of the ALWTRP (Figure 13). The model is designed to address the following types of questions:

- Where do the fisheries that are subject to the requirements of the ALWTRP operate?
- Where are concentrations of vertical line the greatest?
- Do whales frequent areas with high concentrations of vertical line?

The model contains information on a wide range of fixed gear fisheries, including a number of gillnet fisheries, the American lobster fishery, the blue crab fishery, and other trap/pot fisheries.

See Figure 14 for an example map of a monthly vertical line estimates created by the model. Through the integration of information on fishing activity and gear configurations, the model analyzes geographic and temporal variations in fishing effort and the distribution of fishing line in waters subject to the ALWTRP. The model also incorporates information on whale sightings and identifies areas and times at which whales and commercial fishing gear are likely to co-occur. The final product is a set of indicators that provide information on factors that contribute to the risk of entanglement at various locations and at different points in time. The model is currently being used to support an ongoing rulemaking, including the economic and social analysis, regulatory flexibility analysis, and Paperwork Reduction Act analysis associated with the Environmental Impact Statement. More information on the vertical line model can be found at: www.nero.noaa.gov/protected/whaletrp/eis2013/index.html.

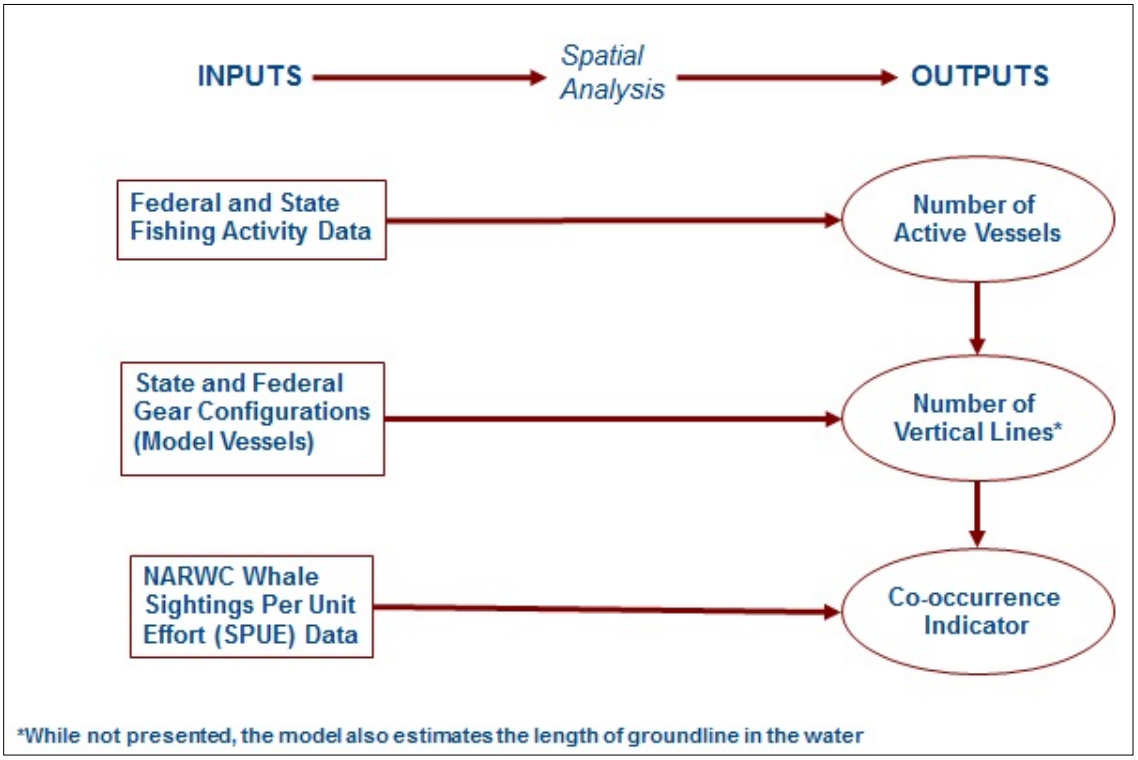

Figure 13. Conceptual overview of Industrial Economics Inc. co-occurrence model

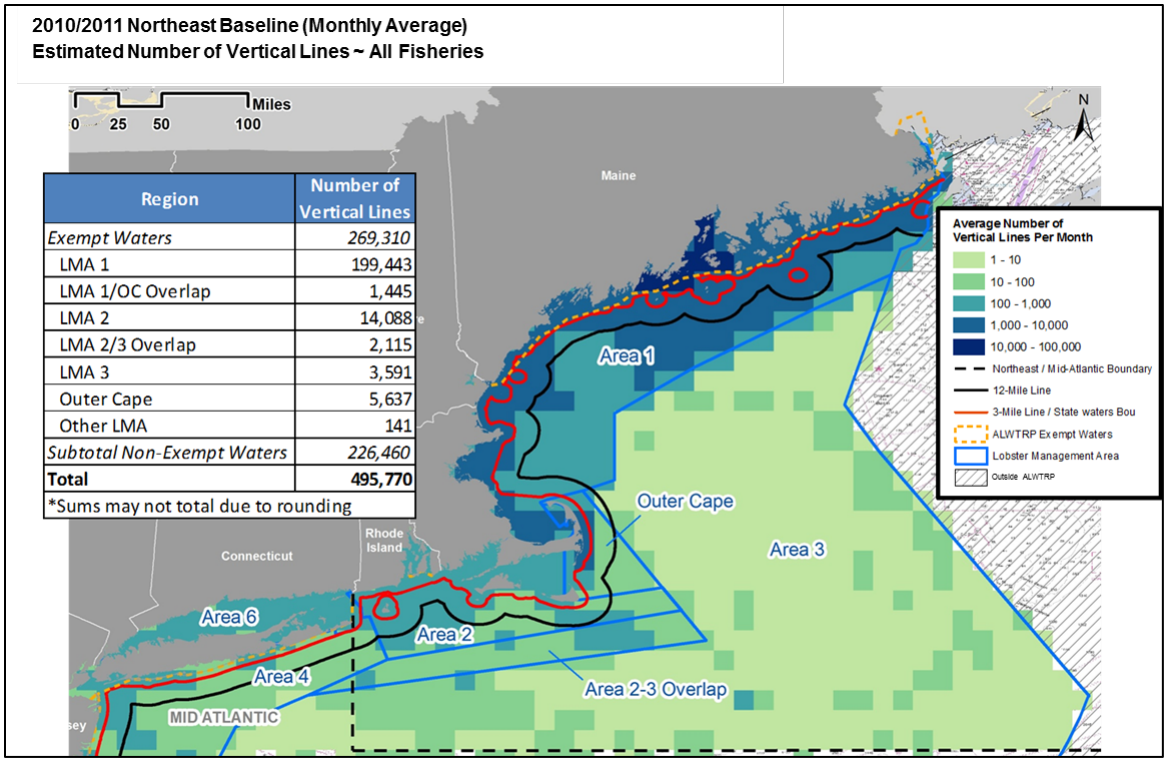

Figure 14. Example of monthly vertical line estimate map created by Industrial Economics, Inc.

3.5 Risk Assessment

3.5.1 JESSICA REDFERN – NMFS Southwest Fisheries Science Center, Protected Resources Division, Ecologist, La Jolla, California

Marine spatial planning and risk assessment along the U.S. west coast

Spatial planning provides a comprehensive framework for managing multiple uses of the marine environment and reducing environmental impacts. Spatial planning must be based on ecological principles to sustain ecosystem integrity, including maintaining the diversity of native species, habitat diversity and heterogeneity, and healthy populations of key species (Foley *et al.* 2010). Key species can be defined as top predators and prey species that affect the structure and stability of food webs and species that have strong effects on community structure and function. Spatially explicit risk assessments are a basic requirement of spatial planning because they link the distribution of key species and ecological features to the potential effects and distribution of human activities. These assessments require spatial representations of human activities (*e.g.*, shipping, military training, and fishing), valued ecological features, and the density of key species (Figure 15).

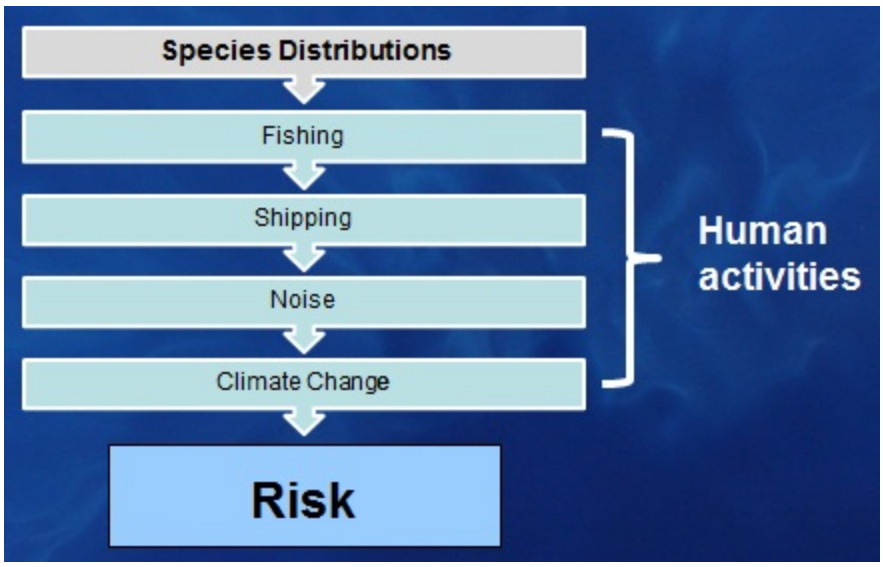

Figure 15. Summary of factors affecting risk that can be addressed through spatial planning

Previous estimates of marine mammal abundance were available at spatial scales that were typically much larger than the scale of human activities. To provide finer-scale estimates of species densities, researchers at NOAA Fisheries' Southwest Fisheries Science Center developed habitat models for 22 species or species groups using 15 cetacean and ecosystem assessment surveys conducted in the eastern Pacific Ocean between 1986 to 2006 (Barlow *et al.* 2009, Forney *et al.* 2012). During the development of these models, many methodological aspects of habitat modeling were investigated: modeling frameworks, data sources, error structures, model selection, spatial and temporal resolutions of input variables, and spatial interpolation techniques. Generalized additive models were used to relate species encounter rate and group size to bathymetry, distance to shore or selected isobaths, sea surface temperature, variance in sea surface temperature, salinity, chlorophyll, and mixed-layer depth. Model selection was performed using cross-validation on novel data. Smoothed maps of species density were created from the final models and are available with associated standard errors and 90% confidence intervals for the California Current Ecosystem (Figure 16).

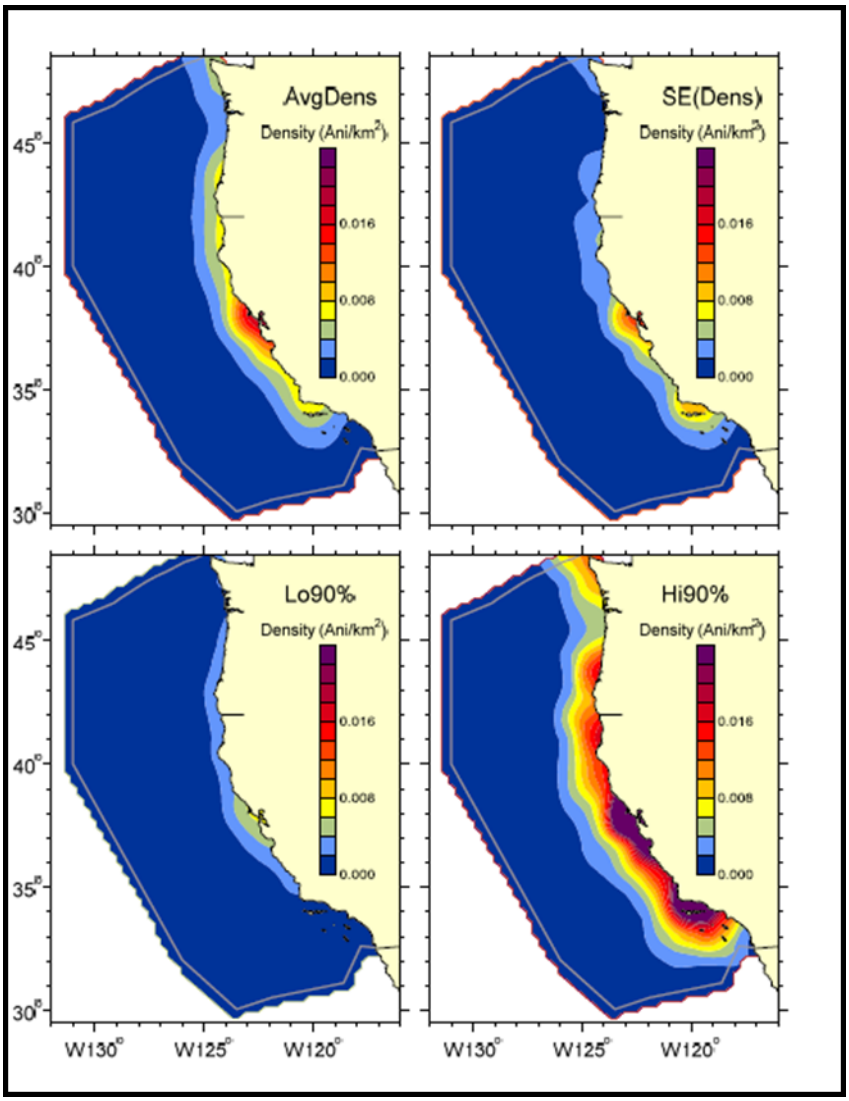

Figure 16. Example map (humpback whale) showing density, standard error, low estimate, and high estimate from Barlow *et al.*, 2009

These models have been used to assess the risk of ships striking large whales in a spatial planning framework (Redfern *et al.* 2013). In particular, an example of the connections between users of the marine environment and the possibility for conflict occurred in Southern California when the California Air Resources Board implemented the Ocean-Going Vessel Fuel Rule. The fuel rule required large, commercial ships to use cleaner-burning fuels when traveling close to the mainland coast. Before implementation of the rule, a majority of ships traveled through the traffic separation scheme adopted by the International Maritime Organization in the Santa Barbara Channel. Following implementation, a higher proportion of ships began traveling south of the northern Channel Islands. This shift resulted in increased shipping traffic in military ranges and raised concerns for maritime safety; it also raised concerns about the risk of ships striking large whales.

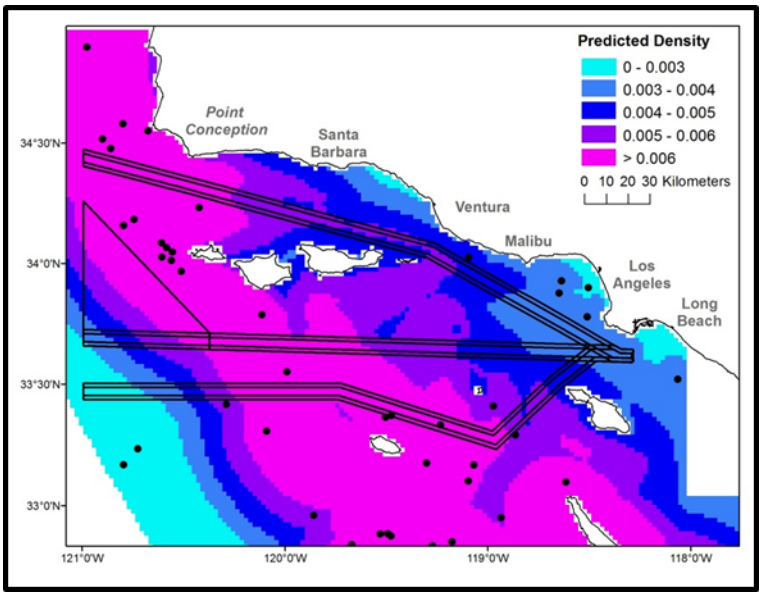

Figure 17. Example map of blue whale density with shipping lanes in southern California from Redfern *et al.*, 2013.

Habitat models were used to assess the risk of ships striking humpback (*Megaptera novaeangliae*), blue (*Balaenoptera musculus*), and fin (*B. physalus*) whales in alternative shipping routes derived from patterns of shipping traffic observed before and after implementation of the fuel rule (Figure 17). The route with the lowest risk for humpback whales had the highest risk for fin whales and vice versa. Risk to both species may be ameliorated by creating a new route south of the northern Channel Islands and spreading traffic between this new route and the existing route in the Santa Barbara Channel. The potential for conflict among users was estimated by the overlap between the alternative shipping routes and areas used for military training and fishing. These analyses represent a powerful tool for balancing user-user and user-environment conflicts when evaluating optimal shipping routes.

3.5.2 BLAKE FEIST – NMFS Northwest Fisheries Science Center, Conservation Biology Division, Statistician, Seattle Washington

Potential overlap between large whales and the groundfish fixed gear fleet operating in the California Current

Few studies have addressed the potential vulnerability of a given cetacean species to an entire fishing fleet operating over a large marine ecosystem. In this project, we overlaid spatially explicit multi-year mean predicted densities of four large cetacean species within the California Current Large Marine Ecosystem with West Coast Groundfish Fishery commercial fishing effort data for the fixed-gear fleet. The four species we analyzed included sperm whale (*Physeter macrocephalus*); fin whale (*Balaenoptera physalus*); blue whale (*B. musculus*); and, humpback whale (*Megaptera novaeangliae*). We quantified the exposure of each species to each fleet type by multiplying the predicted mean cetacean density by the measured fishing fleet effort. We created 25 km gridded maps of overlap for each of the species and we also generated species

summaries based on cumulative overlap over the entire study area. We found that there was large interspecific variability in the overlap between cetaceans and the fixed-gear fleet. While some of the species had relatively low overlap rates (esp. sperm whales), others had relatively higher exposure to the fishing fleet (esp. humpback whales), particularly those species with more nearshore distributions (Figure 18). While direct mortality from these fleets has been documented to be low, our results suggest there is opportunity for fisheries interactions with some large cetacean species. Our analyses are an important first step in generating formal risk assessments for quantifying the population impacts of various fishing fleets on large cetacean species that occur in the California Current.

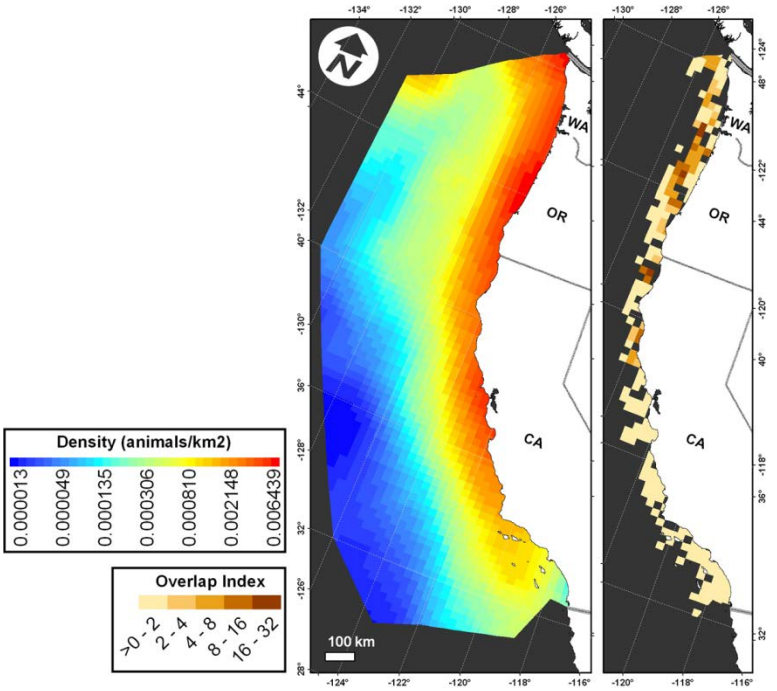

Figure 18. Humpback whale density and overlap index

3.5.3 LAUREN SAEZ – Contractor for Ocean Associates, Inc. for NMFS West Coast Region, Protected Resources Division, Fishery Biologist, Long Beach, California

Overview of co-occurrence of large whales and fixed gear commercial fisheries off the U.S. west coast

An average of 10 large whales were reported as entangled per year between 2000 and 2012 off California, Oregon, and Washington. Little information has been confirmed from entanglement reports about the origin of the entangling gear; therefore NOAA developed analytical tools as a first attempt to assess the potential entanglement risk associated with various fixed gear fisheries relative to their occurrence with large whale species.

A primary tool included the development of a fishery effort model that represents the spatial and temporal distributions of commercial fixed gear fisheries. Fixed gear fisheries were chosen because this type of gear that has been confirmed as entangling whales (based upon sightings and strandings of entangled animals) and/or has the potential for causing entanglement based on similarities in the general configuration of gear across the fisheries. Eleven fixed gear fisheries were included in the model: California halibut/white seabass set gillnet, California nearshore live finfish trap, coonstripe shrimp trap, Dungeness crab trap, hagfish trap, rock crab trap, Pacific halibut longline, sablefish longline, sablefish trap, spiny lobster trap, and spot prawn trap fisheries.

The other tool developed was a co-occurrence model overlaying the fishery effort maps with whale density maps. This model identified potential species-specific elevated risk areas where and when large whales are more likely to encounter fishing gear, which is a first step in assessment of whale entanglement risk associated with fixed gear fisheries (Figures 19 and 20). The whale species included in the co-occurrence model are: blue whales, fin whales, gray whales, humpback whales, and sperm whales.

Confirmed entanglement reports were compared with co-occurrence model results. Alignment of known entanglement locations with areas of higher co-occurrence, based upon the model, supported the use of the co-occurrence model for assessment of whale entanglement risk off the U.S. West coast.

Blue whales have similar co-occurrence results to humpback whales, yet there has not been an entanglement report or stranding with indications of entanglement of a blue whale on the U.S. west coast. Explanations for this suggested in the tech memo and also during workshop discussions include: the SWFSC model overestimating whale densities in nearshore waters, biological factors of whale morphology and behavior where blue whales may be less likely to become entangled because of body size, and the fact that blue whales are less likely to be regularly seen by humans because of their offshore distribution.

Research on the identified elevated risk areas, combined with the ability to trace gear, continued gear research, and strengthened outreach to improve reporting, should improve the ability to minimize or mitigate the risk of large whale entanglements.

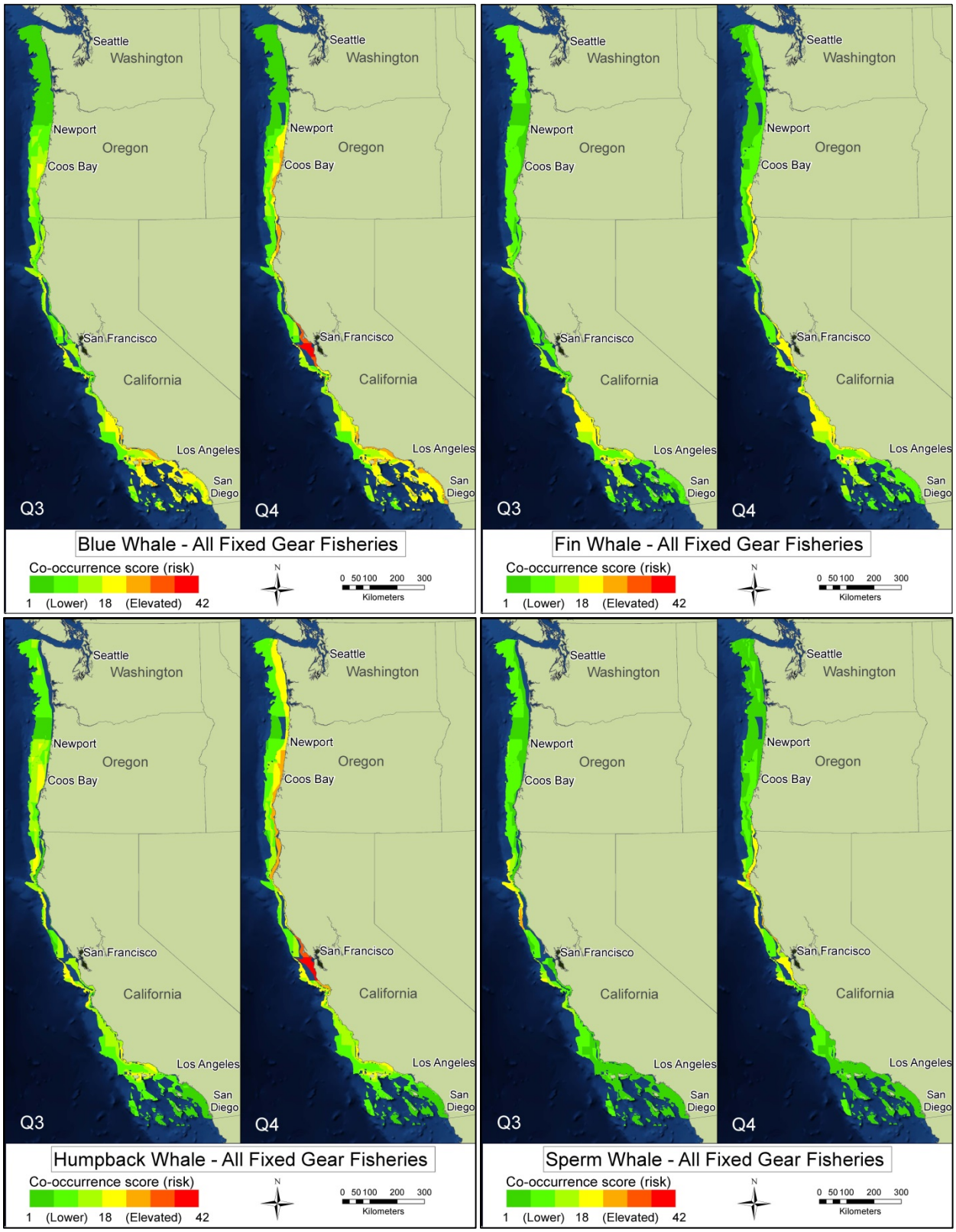

Figure 19. Co-occurrence of the multi-year average blue, fin, humpback and sperm whale densities and fishing effort for all 11 fisheries shown for quarter Three and Four. Source: Saez *et al.*, 2013.

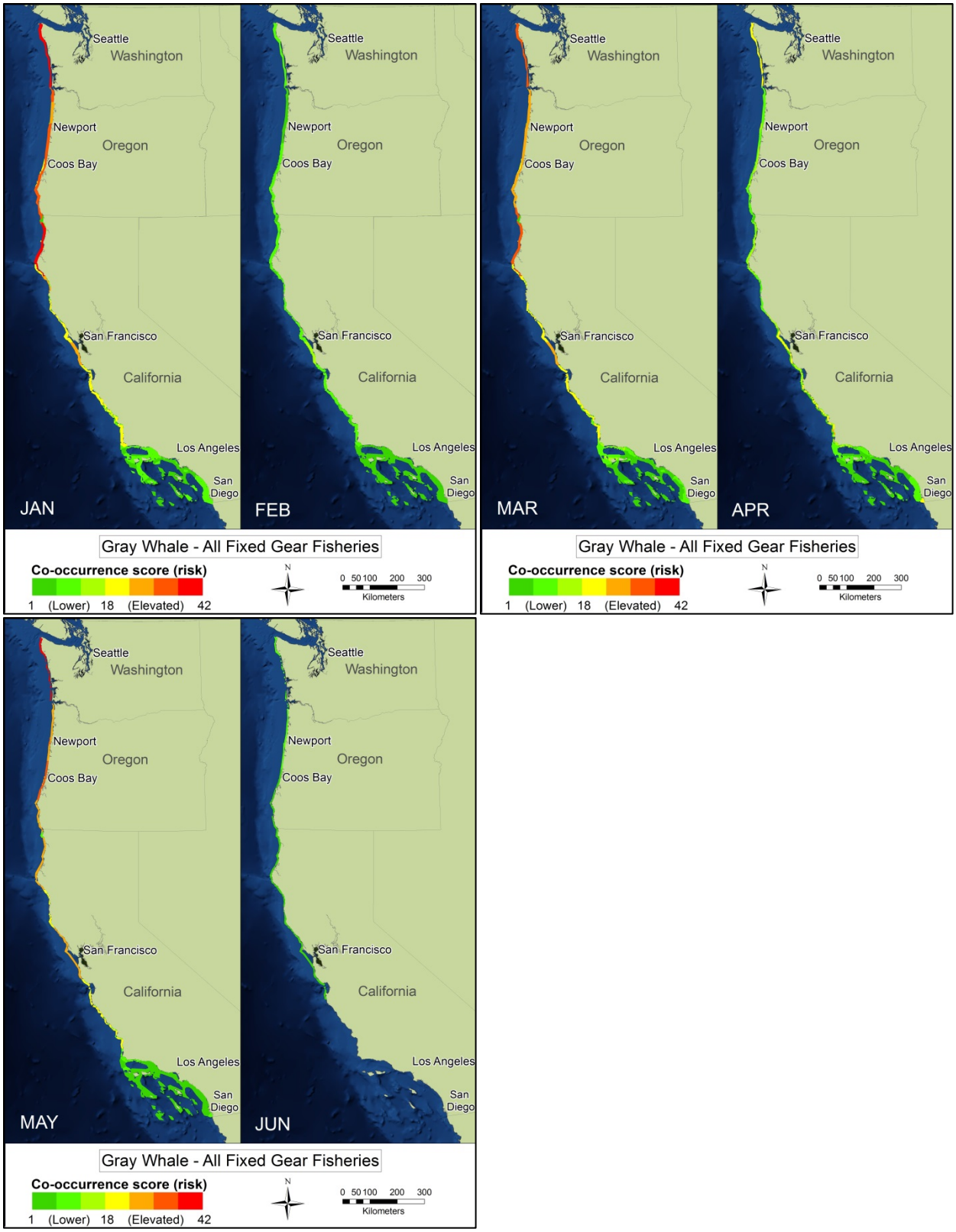

Figure 20. Co-occurrence of gray whale monthly densities and fishing effort for all 11 fisheries shown for January through June. Source: Saez *et al.*, 2013.

4.0 Workshop Discussions

Discussions following the presentations on Days 1 and 2 of the workshop covered a variety of topics but for ease of reporting, have been organized into three groups: data collection and research (section 4.1), outreach and education (section 4.2), and gear -based concepts (section 4.3). Topics of presentations are referred to below where relevant to discussions.

4.1 Data collection and Research

For the purpose of this report, data collection and research discussions and suggestions were subdivided into: limitations/uncertainty, model refinements, and research needs/questions.

4.1.1 Limitations/uncertainty

Workshop participants identified that there is uncertainty surrounding the conservation concern of large whale entanglements off the U.S. west coast. In response to this concern, Dennis Heinemann from the Marine Mammal Commission, in collaboration with NMFS, discussed their work to design a workshop that will address the methods available to estimate large whale "cryptic mortality" (the portion of mortality of large whales that is not detected by observers or stranding response programs; i.e., estimating the number of animals that are killed by entanglement or ship strikes but are never detected). The results of the cryptic mortality workshop can be combined with known records of entanglement to better assess the impact of entanglements on the populations of large whale species off the U.S. west coast.

There was a discussion of current population trends and the possible impacts of entanglements. Workshop participants noted that the general population trend for fin whales and humpback whales is increasing while the population trend for blue whales, gray whales, and sperm whales is stable and not increasing. It was noted that there is a high degree of inter-annual variability which is particularly important with respect to sperm whale population abundance estimates and distribution. It was noted that NMFS does not have documented blue whale entanglements or records of stranded blue whales with indications of interactions with fishing gear. However, workshop participants questioned if the threat of entanglement to the blue whale population may be greater than the reported interactions suggest and whether it may be high when compared to other threats, such as ship strikes. There was discussion about potential bias in the reporting of entangled whales. Blue whales have a more offshore distribution away from potential land-based or nearshore observers than humpback whales and gray whales. Coincidentally (or not) humpback and gray whales are the most commonly reported entangled large whales off the U.S. west coast. Given their offshore distribution, it was suggested that blue whales may become entangled and drown without being seen. Another theory was that blue whales may interact with gear to the point of leaving entanglement scars, but able to escape due to their size, power, and torpedo body shape. Participants agreed that while entanglements may pose a threat to blue

whales, it is not currently the highest priority for conservation although more research in this area is necessary to address the issue.

Participants discussed the types of gear that are reported to cause entanglements and uncertainties in the available information. Following the Saez presentation on entanglement trends (section 3.2.2.) it was noted that the identification of the gear source on an entangled whale was unidentified in 32% of reports in California, Oregon, and Washington. Even when gear is identified, some entanglement reports can only be classified to a general gear type, and few cases can be classified to a specific fishery. However, there are still a large percentage of reports where the gear is completely unidentifiable. In these reports, there is not enough detail in the report nor enough information that can be gathered from the gear itself to classify to any specific gear type. Aleria Jensen, NMFS Alaska Region, noted that the whales carrying gear from Alaska to Hawaii are typically seen entangled in trap gear but not in gillnets (section 3.2.3). This could be the result of many factors including: whales are entangled in gillnet gear but die in transit, they don't migrate, or overall there are relatively fewer gillnet entanglements compared to fixed gear entanglements. These findings could identify research needs to determine differences, if any, in serious injury/mortality risk of entangling gear types. Also, in response to Jensen's presentation, the workshop participants recommended a research question: Do trap entanglements have less of an impact on whales than gillnets?

4.1.2 Modeling

There were multiple suggestions to incorporate other data sets into the future co-occurrence modeling.

SWFSC Models-presented by Jessica Redfern

Participants discussed the data used in the models. John Calambokidis noted that whale density in coastal areas may be overestimated by the SWFSC models. Since the SWFSC survey effort is very coarse, John suggested incorporating less systematic data from smaller scale research, from different platforms, and different sightings per unit effort. Jessica Redfern, NMFS SWFSC, is working with more fine scale data in southern California for a ship strike paper by melding multiple data sources. For the San Francisco Bay area, SWFSC data is being combined with ACCESS[7] and small boat surveys[8]. This allows for refinement closer to shore where the large scale model may be skewed. She will be comparing it to other areas to determine where biases are with this new method and see how they can affect outcome. Neal Etre (Industrial Economics) noted that the east coast has been working through a similar set of issues with incorporation of multiple data sources and will work to find documentation to share. Participants determined that combining data sets will provide a better understanding of large whale presence with respect to large whale entanglements.

[7]The Applied California Current Ecosystem Studies: http://data.prbo.org/multimap-v3/aocean/index.php
[8] Cascadia Research Collective: http://www.cascadiaresearch.org/current_projects.htm

Risk Assessment Model-presented by Lauren Saez

Since the modeling described in the Saez *et al.* (2013) was the impetus for holding this workshop, participants were asked to evaluate the Saez *et al.* (2013) method and provide comment. Karin Forney, NOAA SWFSC, suggested that model simulations can inform assumptions of the Saez *et al.* (2013) co-occurrence model. The whale density/fishery overlap does not presently include uncertainty; however simulations could be performed to assess the sensitivity of the relative risk maps to variation and uncertainty. For example, fishery data and modeled cetacean densities for individual years could be randomly drawn and overlaid to see how the areas of greatest risk might vary from year to year. Participants agreed that there are limitations to the co-occurrence model and suggested that more work could be done to improve it, but it also suggested this avenue of effort may not be the highest priority moving forward.

Current/Future Modeling Efforts

Karin Forney and colleagues at the SWFSC are working on a Bayesian approach to observation data. Bayesian hierarchical modelling offers a tool for combining different data sets (collected using different methodologies), to estimate parameters such as the number of whales present in an area, or population trends. The method accounts for both sampling error in parameter estimates derived from each data set, and process variance (e.g. actual abundance through time). This type of approach has been used successfully to estimate trends in fin whale and beaked abundance (Moore and Barlow 2011, 2013).

There were a number of suggestions for future modeling efforts. For future co-occurrence modeling efforts, a gear based model using the Dungeness crab logbook data already collected by ODFW/WDFW could be analyzed with monthly gray whale density since both data sets cover a similar time period. Other whale species could be included if whale density data were available for the time period overlapping with Dungeness crab trap fishing effort, primarily December through March. Participants suggested that the surveys conducted by EcoTrust on commercial fisheries off California used for the Marine Life Protect Act Initiative may be applicable and suggested they be contacted to determine if the spatial data can be shared. Other future modeling exercises suggested by workshop participants include addressing the gray whale Pacific Coast Feeding Group, Western Pacific gray whales, year round humpback/blue/fin/sperm whale densities, and inclusion of lost gear recovery data. Each piece of recovered gear by the SeaDoc Society is spatially referenced and could be applicable, as well.

The current assumption for the east and west coast co-occurrence models (Vertical line action Draft EIS[9], Saez *et al*., 2013) is that all whales are equally likely to be entangled and all gear is equally likely to cause entanglement. Blake Feist, NOAA NWFSC, and Neal Etre, Industrial Economics, suggested that weighting may be a way to introduce variability and test the assumption that all whales have the same likelihood to become entangled and all types of gear

[9] www.nero.noaa.gov/protected/whaletrp/eis2013/index.html

have the same likelihood to cause entanglement. However, there is no current research underway that would inform and verify this type of modeling effort.

The workshop participants agreed that the clarification of the conservation concern of large whale entanglements and research on whale interactions with gear on the U.S. west coast should be conducted for the west coast to better inform future management actions or legislative actions aimed at reducing whale entanglement risks.

4.1.3 Research needs/questions

A research suggestion identified in Saez *et al.*, (2013) section 3.6 and also by the workshop participants was for more fine scale studies on gear density and whale density, especially in areas of higher co-occurrence identified in Saez *et al.* (2013). Augmenting aerial surveys to include gear counts was raised as a way to research areas of higher co-occurrence areas. Karin Forney, NOAA SWFSC, noted that including gear counts in aerial surveys can sometime be overwhelming in relation to the original mission of the flight, such as counting cetaceans, turtles, and pinnipeds. Currently in northern California, Dawn Goley, Humboldt State University, does weekly fly overs in her area with the Coast Guard and has included, as part of her research, looking for fishing gear. The information from smaller projects that are incorporated into other larger surveys could be used to inform management and refine co-occurrence models.

As noted above, there is a need to better understand the means by which whales are entangled. John Calambokidis reported to the group that he has observed whales rubbing on lines and feeding near lines during his small boat research. This led to a discussion among the workshop participants surrounding the mechanism of whale entanglements.

Workshop participants identified the following research questions:

- How do whales become entangled?
- How does whale behavior affect the entanglement risk of whales?
- Do health/forage issues increase an animal's susceptibility to entanglement?
- How would altering gear configurations influence risks for different whale species?
- How do different gear types affect the risks of serious injury and mortality from entanglement to whales?

Data Collection and Research Summary

- There is uncertainty surrounding the conservation concern of large whale entanglements off the U.S. west coast and workshop participants supported research to better quantify many uncertainties

- Workshop participants made suggestions for modifying current modeling efforts and presented ideas for future modeling efforts to better assess entanglement risk and address limitations of the current models
- A list of research needs and questions related to fine scale co-occurrence of whales/gear and better understanding the biological component of whale entanglement was produced by workshop participants

Key Points and Next Steps

1. Characterize the conservation concern of fishing gear entanglements for specific whale species off the U.S. west coast.
2. Facilitate small scale research on gear and whale density in co-occurrence hotspots.
3. Conduct research on mechanisms by which whales become entangled and how biological factors (such as behavior and body shape) affect entanglement.
4. Consider using gear density (or vertical line density) for fishery input in future co-occurrence models.
5. Integrate OR/WA Dungeness crab logbook data into co-occurrence model, possibly with Ecotrust data for California.
6. Include the following whales in future density estimates: Pacific coast feeding group of gray whales, year-round blue, fin, humpback, and sperm whales, nearshore blue, fin, humpback, and sperm whales, and Western North Pacific gray whales.
7. Identify agencies or research partners to conduct research.
8. Identify sources of funding for research.
9. Create incentives that may help reduce interactions with whales and consider the economic impacts to fishermen of any management decisions.

4.2 Outreach and Education

Workshop participants noted that more outreach and education is needed. Whale entanglements off the U.S. west coast are not typically considered an issue by many stakeholders, including state agencies, fishery councils, commercial fisheries, or the general public. Outreach and education should be directed at raising awareness of whale entanglements and encourage reporting to facilitate possible rescue. The MMPA requires that commercial fishermen report interactions with marine mammals. Participants representing state agencies, tribes, and commercial fisheries were not fully aware of requirements that commercial fishermen have to report an interaction with a marine mammal. John Corbin, an Oregon commercial fishermen, suggested that there should be some focused outreach with commercial fishermen, especially those that participate in fisheries listed under the List of Fisheries as Category I and II fisheries (50 CFR 229, 53336), and the mandatory reporting requirement under the Marine Mammal Authorization Program (MMAP). Information on how to report an entangled whale should also be shared during the fishery permit process and could be printed in logbooks.

Participants discussed Aleria Jensen's presentation about efforts in Alaska. There was particular interest in the work of Ed Lyman, from the Hawaiian Islands Humpback Whale National Marine Sanctuary (HIHWNMS), leading small workshops with fishermen to increase awareness of entanglements and also to teach them how to respond to entangled whales, in their own gear or if they encounter a free swimming whale trailing other gear. The small workshops in Alaska have been successful, especially since the monetary value of lost gear is a driving factor for the Alaskan fishermen. The NMFS Alaska Regional Office, in collaboration with multiple partners, has created a wheelhouse placard with information on how fishermen can reduce the risk of entangling whales in their own gear, who to contact if the fisherman encounters an entangled whale, and what do to if a whale is entangled in their gear (Appendix 3). Workshop participants strongly agreed that involving the fishing industry early and often in conservation and management measures are important. John Corbin had a positive response to the small meeting approach with fishermen, especially to develop potential entanglement solutions at the local level. Corbin suggested the meetings will be more successful if they take place at fishing ports and are mindful of timing of fishing seasons. Sheila Garber offered the Englund Marine and Supply stores in California, Oregon, and Washington as a starting point for the meetings since they are located close to major fishing ports.

Workshop participants agreed that meetings would be an important part of outreach and education and made the following suggestions:

- Focused meetings with commercial fishermen that could involve (depending on location) the following:
    - Commercial fishermen's associations
    - Commercial fishermen
    - State fishery agencies

    - NMFS representative
    - Tribal representatives
    - Other associations at ports
- Suggested topics for discussion:
    - Agency and local knowledge of whale presence in the area
    - Requirements for reporting interactions with marine mammals
    - What to do if an entangled whale is encountered
    - Ideas to reduce interactions with whales (e.g., tending gear more often, clean lines, neutral/sinking line)
    - Up-to-date information on west coast whale entanglement research
    - Possible engagement in gear research or data collection
    - Other concerns including ocean energy development, marine protected areas, etc.
- Suggested locations to hold events:
    - Harbors
    - Englund Marine & Supply stores
    - Sea Grant offices
    - Marine expos

Although fishermen are an excellent source of information, there is no incentive for a fisherman to report a whale sighting or an entangled whale. Workshop participants noted that there is a negative perception when reporting whales: more whales in an area could lead to regulations (i.e., closure) or changes in fishing practices (i.e., a higher categorization on List of Fisheries can lead to more requirements). Participants suggested researching a "no-fault situation" for reporting entangled whales. The regulatory framework surrounding entanglement and the MMPA and ESA is complicated, which underscores the need for NMFS to engage with fishermen and the public on this issue. In response to this discussion, NMFS is developing a west coast whale entanglement "Frequently Asked Questions" document to answer many of the questions and clarify the concerns that commercial fishermen and the general public may have regarding this issue.

NMFS discussed and shared visuals of the many whale entanglement outreach materials available, including a 24/7 reporting hotline (1-877-SOS-WHALe), a fixed gear guide to help people who report whales provide more details, a west coast whale entanglement fact sheet, whale entanglement DVD, reporting cards and stickers advertising the hotline. For ease of reference in this report, these outreach materials are available in Appendix 3 and also online at: http://www.westcoast.fisheries.noaa.gov/protected_species/marine_mammals/fisheries_interactions.html.

Outreach and Education Summary

- An outreach campaign aimed at communicating with commercial fishermen regarding large whale entanglements was highly recommended by the workshop participants, especially sharing information regarding reporting requirements and updates on research
- Many outreach materials regarding large whale entanglements and commercial fishing gear have been created by NMFS

Key Points and Next Steps

1. Determine feasibility of small meetings with commercial fishermen and attempt to have them in easily accessible locations (e.g., close to harbors)
2. Improve outreach and education with the public to increase knowledge of whale entanglements and how to respond/report if they encounter an entangled whale
3. NMFS should continue public outreach campaign: FAQ document development, increase sharing of SOS-WHALe hotline information, and whale entanglement DVD
4. Ensure state fishery agencies and tribes are involved with conservation and management process
5. Look into grants to support gear research, which could be discussed during small meetings

4.3 Gear-based concepts

There were many gear-based ideas brought up by workshop participants to reduce large whale entanglements off the U.S. west coast. These ideas were not directly related to one presentation, but were brought up in multiple discussions throughout the workshop and are captured here. For the purpose of this report, discussion topics are subdivided into: gear modifications/marking and gear recovery.

4.3.1 Gear modifications and marking

There was discussion on how gear modifications could reduce entanglement risk by helping a whale avoid the gear or reduce the severity of interaction should a whale encounter and subsequently become entangled in the gear. Discussions on this topic were very detailed ranging from recommendations on the type of gear to use, modifying gear, changing fishing styles, considering legislation that may alter the number of traps fished per string, to gear marking.

Since 1996, the Atlantic Large Whale Take Reduction team has researched many suggestions and management changes to reduce large whale entanglements for the U.S. east coast. Recent gear modification research included testing stiff or glowing ropes in addition to testing feasibility of ropeless fishing. A suggestion from a workshop participant was to consider keeping vertical lines free of knots so they would not get stuck in whale baleen. Workshop participants were

receptive to using the lessons learned and gear research findings from other areas as guidance for U.S. west coast whale entanglements, although no specific modifications were identified. Participants discussed the concept of ropeless fishing. Kate Swails, NMFS NER, mentioned that ropeless fishing was being investigated for use in the Northeast. Other opinions were expressed regarding the safety and economic concerns of ropeless fishing on the west coast, specifically regarding possible increases in gear handling time, potential increased danger to fishermen, and potential increases in lost gear. Concern of potential conflicts between unmarked gear and trawl fisheries in some areas was also noted.

Another gear modification from the ALWTRP that was discussed was weak links and the application on the west coast. Participants discussed their possible use on the west coast, similar to a strategy used by the east coast fishermen. One participant noted that weak links had not worked well in pilot research conducted off the west coast. It was also noted that different fishing styles, where east coast fishermen weigh their gear down with anchors, likely make the application of weak links more feasible compared to single trap system fisheries typical for the larger pot/trap fisheries on the west coast.

Another lengthy discussion regarding gear modifications was switching the gear configuration of single trap fisheries, primarily Dungeness crab, to multiple traps attached to a single vertical line (buoy line). This modification would reduce the number of vertical lines in the water with which whale may potentially interact. As part of the ALWTRP, NMFS is in the rulemaking process to reduce the number of vertical lines in the water by increasing the number of traps per string. The discussion included a quick overview of the history of single trap requirements in the Dungeness crab fishery off California, Oregon, and Washington

> *Dan Ayres, WDFW, and Troy Buell, ODFW, shared that the Dungeness crab trap fishery on the west coast historically would use 50 to 100 traps per string. There was spatial conflict when single trap fishermen set gear near multiple trap per line systems. John Corbin, commercial fishermen, noted that multi-trap stings could get tangled with other gear, increasing gear loss. California, Oregon, and Washington currently have regulations for the Dungeness crab trap fishery for single trap per line. The State fishery managers at the workshop noted that enforcement is currently the primary issue with strings of traps over the spatial conflict and gear loss.*

The conversation then moved to the topic of spatial conflict of commercial fisheries. On the U.S. west coast, spot prawn traps are fished with multiple traps per line and currently have some spatial conflicts with other fisheries however, the number of fishermen involved is much lower than the Dungeness crab trap fishery.

> *Kate Swails, NMFS NER, noted that on the east coast, using multiple traps per string is faster and more efficient than using single trap lines. John Corbin, commercial fisherman, noted that on the west coast, trap placement may be more important that*

efficiency of pulling. Conflict between single and strings of traps has been less of an issue on the east coast since they fish in different areas and have a much wider shelf and thus more overall area available to fish. On the west coast, the continental shelf is narrower so gear is concentrated in a less overall area, leading to a higher potential for multiple trap strings to overlap and become tangled.

Participants felt that legislative changes would also be a challenge with any proposed change in number of traps required per string (i.e., one string required per Dungeness crab trap in all three states, California, Oregon, and Washington trap fisheries). Fishery regulation changes require legislative action and negotiations between stakeholders can be lengthy. Therefore, participants recommended that research be conducted with States and fishermen to test gear configuration feasibility on the west coast before any legislative changes are proposed. These changes could potentially be brought up during the fishermen outreach meetings. For example, one idea for research could start with the feasibility of a two traps per string system which would reduce the number of vertical lines in an area by half. Research would initially focus on the feasibility of fishing using the modified gear configuration.

There was some discussion among participants on gear marking. Commercial fishing gear in California, Oregon, and Washington is currently required to be marked, however additional gear marking strategies applied to commercial fisheries across the whole coast could be used to help managers identify or exclude a fishery as the source of gear that entangled a whale. Gear marking could also be used to identify the area where gear was set and may also inform rescuers during disentanglement responses what type of gear they may be attempting to remove. NMFS is doing rule making requiring modification to gear on the U.S. east coast as part of the ALWTRP. The color coding requirements are a low cost and effective alternative to other strategies, such as electronic tags imbedded in fishing line. On the west coast, buoy tags, required in the Dungeness crab trap limit program, have proven effective and are easily visible by enforcement and also entanglement observers. There was not a general recommendation from workshop participants about gear marking; however, they suggested that should gear marking be pursued on the U.S. west coast, a low cost marking strategy such as the color coding requirement would be preferred.

Gear Modifications and Marking Summary

- Workshop participants were interested in gear modifications, such as increasing the number of traps per line, which would reduce the number of vertical lines in which a whale could become entangled.
- Enforcement and legislative changes were noted to be the biggest hurdles for gear modifications.
- Low cost gear marking strategies could assist in the information being collected from an entangled whale and shared with responders and managers.

Key Points and Next Steps

1. Test the efficacy of gear modifications to help whales avoid gear or reduce severity of interaction should entanglement occur
2. Legislative hurdles and enforcement may be significant with implementing gear modifications
3. Investigate the possibility of implementing gear marking strategies on the west coast to assist responders who disentangle whales and NMFS with identification of gear origins
4. Support research gear marking strategies in U.S. west coast commercial and recreational fisheries; consider gear modification and gear marking strategies already tested on the U.S. east coast

4.3.2 Gear recovery

There has not been any definitive research to estimate entanglement risk caused by lost/ghost/derelict gear. Lost gear may deteriorate over time and potentially be less of an entanglement threat. However, given the assumption that entanglement risk has a linear relationship to the amount of gear/fishing effort, any gear removed (active or derelict) should reduce the number of entangled whales. Lost gear recovery is a tangible action that can be promoted as a conservation measure, for multiple reasons such as reducing conflicts with other fisheries, mitigating impacts to ocean habitat, and not just for whale conservation.

The gear recovery programs in Washington have been driven in part by complaints from fishermen in the salmon troll fishery that their gear is getting caught on pots/lines. Traps can become lost in storms and get stuck closer to shore. This has led to removal of 27 metric tons of Dungeness crab trap and line removed since 2009 through WDFW and 105 trap removed in 2012 through the QIN/TNC collaboration (section 3.3). In Oregon, ODFW has worked to get a suspension of personal property law for their gear recovery program and cooperation from fishermen is a driving motivation. Jen Renzullo, Sea Doc Society, noted that lost gear varies year to year and can be very storm dependent. She also suggested a three year start up to any gear removal program, such as the Quinault gear removal program.

Gear Recovery Summary

- Lost gear and marine debris removal efforts are an accepted conservation measure that may help reduce the risk of whale entanglements by reducing the amount of gear in the water with which a whale could interact.

Key Points and Next Steps

1. Lost gear recovery is a tangible solution for reducing the amount of gear in the water in which whales could become entangled.
2. Lost gear recovery can reduce conflict between inactive gear and active fisheries.

3. It is unknown how or if lost gear is contributing to whale entanglements on the U.S. west coast.
4. Support lost gear recovery programs and coordinate data sharing.

5.0 Conclusions

The workshop was successful with meeting the outlined goals. Presenters shared information on a broad range of topics related to large whale entanglement which provided a baseline for discussions of data gaps and needs, research priorities, gear modifications, and outreach efforts. The main priorities identified during the workshop were: the need to engage with the commercial fishing industry through small, local meetings and continued research to provide a strong science foundation for any future actions to reduce large whale entanglements off the U.S. west coast in the future. Most stakeholder groups were represented, including experts in the fields of marine mammals, fisheries, modeling, bycatch, lost gear/marine debris, and management. As noted previously, staff from CDFW was not able to attend.

The location of the workshop was chosen to make it easier for the majority of invited workshop attendees to participate. Workshop participants did not include any state representatives from California, but this was only because they were not able to travel for this workshop that was held out of state. As a result, NMFS will be meeting with the CDFW to share the outcomes of the entanglement workshop and this workshop report. Much of the workshop discussions focused on the Dungeness crab fishery, but this is reflective of the area of expertise of workshop attendees. Thus, it is expected state of California representatives will augment the discussions that occurred during the workshop. The recommendations and next steps identified by California agency staff may be different than those in this report since California has more diversified fixed gear commercial fisheries than Oregon and Washington.

Key points

- Given the uncertainty surrounding the conservation concern associated with large whale entanglements, other fishery management agencies are looking for NMFS to clearly identify priorities to support potential actions to address entanglements.
- The workshop report, discussion, and recommendations are weighted toward the Northwest and the Dungeness crab fisheries, based on participant representation.
- A priority next step is to meet with the CDFW to discuss results of the entanglement workshop and determine level of interest in research, outreach, and whale entanglement related work in the future.

- Engagement with commercial fisheries and the general public was identified by workshop participants as a next step.
- There are still many unknowns surrounding large whale entanglements, and more research/baseline data will be needed to encourage and support some actions or changes in fisheries management.
- The workshop participants agreed with the six recommendations, listed below, from NOAA-TM-NMSF-SWR-044 (Saez *et al.*, 2013).

    1. Further investigate elevated risk areas and associated time periods identified by the co-occurrence model focused to understand and possibly mitigate large whale entanglements in the future.
    2. Filling in data gaps for future co-occurrence modeling: include to the extent possible year-round density data for all species and available information on the Western Pacific gray whales and the Pacific Feeding Group of gray whales.
    3. Continue gear research to understand mechanisms of large whale entanglements, and investigate the creation of a gear density-based fishery model.
    4. Consider the feasibility of new/improved gear marking to assist in the identification and traceability of entangling gear.
    5. Support future co-occurrence modeling efforts, especially with inclusion of research addressing the limitations of the co-occurrence model in this paper.
    6. Improve reporting through increased public awareness and outreach; expand geographic coverage; and improved documentation and information collected from each entanglement report.

Moving Forward

NMFS will be pursing the recommendations of the large whale entanglement information workshop as resources allow. The first priority is meeting with CDFW to review the outcomes of the workshop and determine their level of engagement in future activities relating to large whale entanglement. By the time this summary report was generated, initial discussions have occurred with CDFW although no outcomes are clear at this point. NMFS has also engaged with the California Dungeness Crab Task Force as a starting point regarding small port based meetings with commercial fishermen. If commercial fishermen are receptive, a more formal outreach plan can be created. The outreach plan should also include outreach to the general public to increase awareness of whale entanglements and how they can be reported; emphasizing that information

reported could potentially save the whale but can also help managers reduce future entanglement risk to whales. Also, NMFS will continue to be supportive of marine debris and lost gear removal efforts off the U.S. west coast.

To develop a strong science-based foundation for any future action to reduce large whale entanglements, NMFS is willing to collaborate with state fishery managers and marine mammal biologists to research the priorities listed in the workshop report such as: 1) fine-scale studies of gear and whale densities in areas predicted to have higher co-occurrence; 2) gear modifications that might reduce the probability of entanglements or mitigate the potential injuries caused from entanglement; and 3) whale behavior studies relating to entanglement risk.

6.0 References

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Appendix 1

U.S. west coast large whale entanglement information sharing workshop

November 13-14, 2013 Portland, Oregon

Goal/Objectives:

Addressing the serious injury and mortality of large whales attributed to entanglement in fishing gear is a priority issue for NOAA. However, along the U.S. west coast, much is unknown about why, when, and how many whales are seriously injured or killed due to entanglement, how this threat may be affecting their populations, and what can be done to minimize the risk. NOAA recognizes that there is a need to review, share, and analyze available data in order to address these questions. Therefore, NOAA Fisheries' West Coast Region is hosting a two day workshop that will bring together scientists, managers, and experts with knowledge applicable to large whale entanglement. Presentations will cover a broad spectrum of information including: risk assessment models; large whale abundance, distribution and behavior; fishery characterizations and management regimes; and, gear reduction/recovery. The workshop will provide a forum to stimulate discussion and collaboration among participating tribal, state and federal managers, scientists, and other stakeholders.

Some questions to consider related to this issue are:

a. Given the risk assessments and modeling exercises already undertaken, are there further improvements that can be made to refine or validate the models? Are there particular areas, fisheries, or whale species identified in the models that should be of primary focus?
b. What research and other strategies are of priority to reduce large whale entanglement? What suggested strategies will be most effective given limited resources in the short and long term?
c. What are some of the obstacles or challenges to reducing large whale entanglement in particular fisheries and areas off the U.S. west coast?
d. How can we improve reporting, outreach and education?

There are three primary goals for this workshop:

1. Bring together experts in the fields of marine mammals, fisheries, modeling, bycatch, lost gear/marine debris, and management, to share information relevant to this issue;
2. Continue to identify data gaps, data needs, and next steps;
3. If possible, begin to develop research and outreach priorities. These steps are necessary to better understand large whale entanglement and continue to build a strong science-based foundation for any actions that may be necessary to protect whales.

Agenda - U.S. west coast large whale entanglement information sharing workshop
November 13-14, 2013
NOAA Fisheries West Coast Regional Office, 1201 NE Lloyd Blvd, Suite 1100, Portland, OR 97232
Mt. St. Helen's Room, 10th floor; GoTo meeting information below

Goal: share information to better understand and quantify the interaction between commercial fishing gear and large whales off the U.S. west coast and improve ways to identify sources and characteristics of commercial fishing gear that contribute to entanglements.

Day 1 November 13

8:00-8:30am	Arrival and registration, check in on the 11th floor
8:30-8:50	Welcome and introductions
8:50-9:10	Overview of MMPA and Statutory Mandates
	1) Christina Fahy, NMFS West Coast Region (WCR) - Background to the workshop 2) Kristy Long, NMFS HQ- NOAA take reduction team: process and lessons learned
9:15-9:45	Overview of U.S. west coast whales and entanglement history
	1) John Calambokidis, Cascadia Research Collective – Large whales off the U.S. west coast 2) Lauren Saez, NMFS WCR – California, Oregon, Washington, and British Columbia large whale entanglements trends 3) Aleria Jensen, NMFS Alaska Region - Alaska large whale entanglement trends
9:45-10:30	U.S. west coast fishery management
	1) Joe Schumacker, Quinault tribe – Washington tribal Dungeness crab fishery* *not able to attend, Kyle Antonelis presented in his place* 2) Dan Ayres, WDFW- Washington fixed gear fisheries, gear reduction measures, and gear recovery programs 3) Troy Buell, ODFW- Oregon fixed gear fisheries, gear reductions measures, and gear recovery programs 4) Rachelle Fisher, Strategic Earth Consulting – California Dungeness Crab Task Force and trap limit program 5) Alison Agness, NMFS WCR - Pacific coast groundfish bycatch management
10:30-10:45	**Break**
10:45-12:00pm	Mitigation

	1) Jen Renzullo, SeaDoc Society – Lost gear recovery in California and a cost-benefit analysis for lost gear recovery in Puget Sound 2) Kate Swails, NMFS Northeast Region – Atlantic large whale take reduction team: history, reduction measures, lessons learned 3) Neal Etre, Industrial Economics – Vertical line co-occurrence model for large whale entanglement risk planning on the U.S. east coast
12:00-1:00pm	**Lunch**
1:00-2:15	Risk Assessment
	1) Jessica Redfern, NMFS Southwest Fisheries Science Center – Marine spatial planning and risk assessment along the U.S. west coast (20 minutes) 2) Blake Feist, NMFS NWFSC- U.S. west coast groundfish risk modeling (10 minutes) 3) Lauren Saez, NMFS WCR- Overview of co-occurrence of large whales and fixed gear commercial fisheries off the U.S. west coast, NOAA-TM-NMFS-SWR-044 (40 minutes)
2:15-2:30	**Break**
2:30-4:30	Break out discussion groups* *did not happen on day 1*
	Group A: Mt. St. Helen's room, call-in: +1 (213) 493-0605; Access Code: 856-263-216 (same as webinar) Group B: Willamette Room, call-in: 1-877-937-1682, passcode: 975470
4:30-5:00	Synthesis and wrap up in Mt. St. Helen's room

Day 2 November 14

8:00-8:30am	Welcome back
	Review of Day 1 and overview of Day 2
8:30-10:30	Group Discussions: Exploring next steps
	Identifying research and other strategies to reduce large whale entanglements off the west coast
10:30-10:45	**Break**
10:45-11:45	Continued facilitated discussions
	Key outcomes, new insights, and next steps
11:45-12:00pm	Wrap up and closing remarks

Appendix 2

List of attendees and affiliations

Name	Affiliation
Aleria Jensen*	NMFS Alaska Region
Alison Agness	NMFS West Coast Region
Blake Feist	NMFS Northwest Fisheries Science Center
Brent Norberg	NMFS West Coast Region
Chuck Tracy	Pacific Fishery Management Council
Christina Fahy	NMFS West Coast Region
Dan Ayres	Washington Department of Fish and Wildlife
Dan Lawson	NMFS West Coast Region
Dennis Heinemann	Marine Mammal Commission
Elizabeth Petras*	NMFS West Coast Region
Jen Renzullo	California Lost Gear Recover Program
Jessica Redfern	NMFS Southwest Fisheries Science Center
John Calambokidis	Cascadia Research Collective
John Corbin	Washington commercial fisherman
Karin Forney*	NMFS Southwest Fisheries Science Center
Kate Swails	NMFS Northeast Region
Kristin Wilkinson*	NMFS West Coast Region
Kristy Long	NMFS Headquarters
Kyle Antonelis	Natural Resources Consultants, Inc.
Lauren Saez	NMFS West Coast Region
Lynne Barre*	NMFS West Coast Region
Monica DeAngelis*	NMFS West Coast Region
Neal Etre	Industrial Economics, Inc.
Nir Barnea	NOAA Marine Debris Program
Rachelle Fisher	Strategic Earth Consulting
Sarah Wilkin*	NMFS West Coast Region/Headquarters
Sheila Garber	Englund Marine and Supply
Steve Jeffries	Washington Department of Fish and Wildlife
Troy Buell	Oregon Department of Fish and Wildlife

*participated by phone

Appendix 3

Outreach materials

- NOAA Fisheries West Coast Region's marine mammal fisheries interaction page: http://www.westcoast.fisheries.noaa.gov/protected_species/marine_mammals/fisheries_interactions.html
- Whale entanglements off the U.S. west coast fact sheet: http://www.westcoast.fisheries.noaa.gov/publications/protected_species/marine_mammals/cetaceans/entanglement_fact_sheet-final.pdf
- For information on the U.S. west coast marine mammal disentanglement network, 1-877-SOS-WHALe entanglement reporting hotline, and reporting cards: http://www.westcoast.fisheries.noaa.gov/protected_species/marine_mammals/disentanglement_network.html
- Identifying whales: http://www.westcoast.fisheries.noaa.gov/protected_species/marine_mammals/cetaceans/index.html
- NOAA Fisheries has a DVD entitled "Whale Rescue & Disentanglement: The Role You Can Play, A Guide for Ocean Users" available upon request. Contact Justin Viezbicke at: Justin.Viezbicke@noaa.gov
- Fixed Gear Guide: California, Oregon, and Washington commercial fisheries (44 pages): http://www.westcoast.fisheries.noaa.gov/publications/protected_species/marine_mammals/fixed_gear_guide_final_12.14.11.pdf

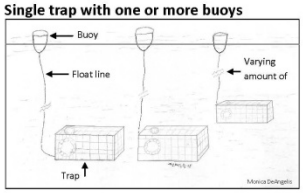
- Quick Reference Gear Guide:

U.S. West Coast Quick Reference Gear Guide

Fishery	Region	January	February	March	April	May	June	July	August	September	October	November	December
California Near-shore live fish	California north[1]												
	California south[1]												
Coonstripe Shrimp	Oregon												
	California												
Dungeness Crab	Washington												
	Oregon												
	California north[2]												
	California south[2]												
Hagfish	All regions												
Rock Crab	California												
Pacific Halibut	Commercial												
	Tribal												
Sablefish	All regions	Regulated by Federal Fishery Management Plan											
Spiny Lobster	California												
Spot Prawn	Washington												
	Oregon												
	California north[3]												
	California south[3]												
Set Gillnet	California												

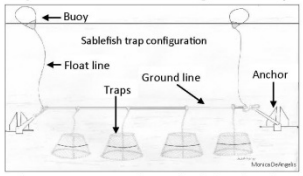
[1] North and south of 40°10'; [2] North and south of Sonoma County; [3] North and south of Point Arguello

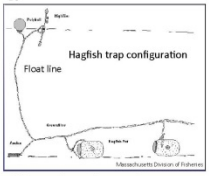
Single trap with one or more buoys



Fisheries: California nearshore live fish, Dungeness crab, sablefish caught with trap (open access), and spiny lobster

Traps attached to a common ground line (string)

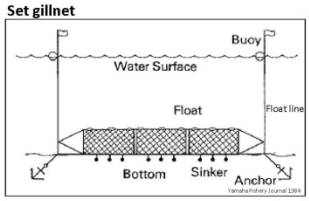




Fisheries: Coonstripe shrimp, hagfish, rock crab, sablefish caught with traps (open access and limited entry), and spot prawn

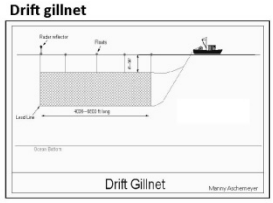
Gear Configuration Basics

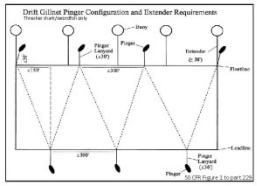
Set gillnet



Fisheries: California halibut/white seabass

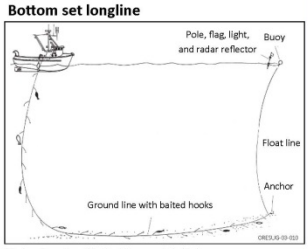
Drift gillnet





Fisheries: California thresher/swordfish (large mesh), and yellowtail/barracuda/white seabass (small mesh)

Bottom set longline



Fisheries: Pacific halibut, sablefish

U.S. West Coast Quick Reference Gear Guide

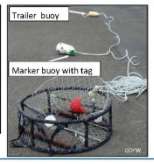
	Line		Buoy/Float			Trap				Net	
	Floating	Sinking	Bullet	Poly Ball	High Flyer	Round	Rectangle	Metal	Plastic	Twine	Mono-filament
Trap: California Nearshore Live Fish	X		X				X	X			
Trap: Coonstripe Shrimp	X		X	X	X	X		X			
Trap: Dungeness Crab	X		X			X		X			
Trap: Hagfish	X			X	X	X			X		
Trap: Rock Crab	X		X	X		X	X	X	X		
Trap/Set longline: Sablefish	X	X		X	X	X	X	X			
Trap: Spiny Lobster	X		X				X	X			
Trap: Spot Prawn	X			X	X	X	X	X			
Set longline: Pacific Halibut		X		X	X						
Set Gillnet: California Halibut/White Seabass	X	X		X	X					X	X
Drift Gillnet: Small mesh	X	X		X	X						X
Drift Gillnet: Large mesh	X	X		X	X					X	

Special Buoy Marking Requirements

California buoy marking	Fishery
License number + "B"	Sablefish
License number + "Z"	Other Finfish
License number + "P"	Lobster

Washington Indian tribes: Buoys branded with 2 digit number unique for each tribe followed by fishermen's unique ID number

Oregon & Washington Dungeness crab buoy tags
Implemented as part of a trap limit system. Tag is attached to the first buoy from the trap. (See photos)

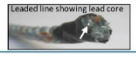


* Unless otherwise noted: photos taken by Lauren Saez, NMFS

Line types

Floating line
- Usually made of polypropelyne or other high strength fiber like Polysteel™, Blue Steel™

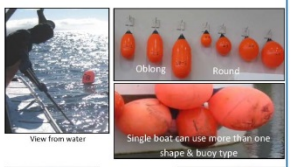
Sinking line
- Usually a combination of polypro-pelyne with nylon, polyester, or a lead core for negative buoyancy



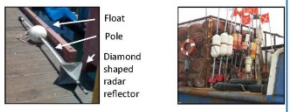
Buoy/Floats

Bullet Buoys
- Varying sizes (diameter x length): 5"x11", 6"x14", 7"x15" or 8"x15"
- Provides flotation to trap float line

Poly Ball (Polyform)
- Size range (diameter x length):
  - Round: 11" x 15" to 39" x 54"
  - Oblong: 8.6" x 19" to 15.5" x 37"
- Used as flotation of endline and for marking terminal end of strings of traps. Also as flotation for top of drift gillnet.
- Color: orange is most common, but a wide variety exists



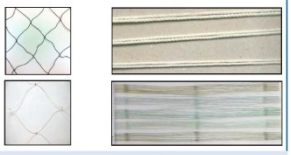
High Flyer with Float and Flag
- Attached, as a marker, to terminal end of a string of traps, longline, or gillnet
- Required in Washington and Oregon on all longlines and trap gear



Net mesh

Nylon twine mesh
- Color: brown, green, tan, or white
- Multifilament, three twisted strands

Monofilament mesh
- Color: many colors, including clear
- Single strand of material



Report injured, entangled, stranded or ship-struck whales to the 24/7 Hotline: (877) SOS-WHAL (877) 767-9425

This quick reference sheet was produced by NOAA's NMFS Southwest Regional Office's Marine Mammal/ Sea Turtle Team and is intended to be a supplement to the **Fixed Gear Guide: California, Oregon, and Washington Commercial Fisheries** available on the Southwest Region Office's website at: http://swr.nmfs.noaa.gov/psd/fixed_gear.htm

- Alaska Whale Entanglement Wheelhouse Guide:

Whale Entanglement Wheelhouse Guide

for Commercial Fishermen

Alaska Marine Mammal Stranding Network 24-hour hotline

(888) 774-7325

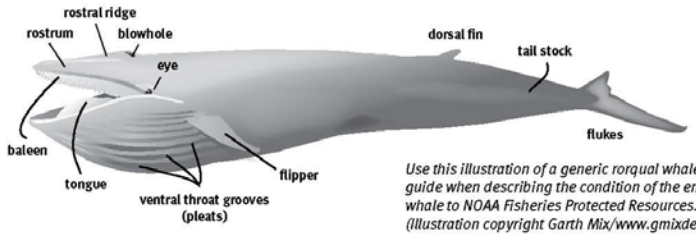
If you encounter a whale while fishing:

Avoid entanglement. See tips on reverse to prevent whales from becoming entangled in your fishing gear.

If a whale is entangled, assess the situation. First, determine if your situation is unsafe because the whale is too close. Maintain a safe distance. If your vessel is attached to the animal (e.g., seine or drift net fishing), determine if it is possible to safely help the whale free itself.

Free your vessel. Remember that entangled animals can be dangerous and unpredictable. Stay at least 25-50 feet away (one whale-body length). If you must free your vessel from the animal, and it is safe to do so, cut your fishing gear to leave 25-50 feet attached to the whale. Put a large buoy bag on the gear attached to the whale. This will make it easier for NOAA Fisheries to track the animal and possibly disentangle it later.

Call NOAA Fisheries Protected Resources at (907) 586-7235 (weekdays) or by using the Alaska Marine Mammal Stranding Network hotline above (nights and weekends) if you are unable to free the animal. Provide information on your exact location; sea conditions; species, size, and condition of the animal and its ability to surface to breathe; and type of gear and how the animal is entangled. This will help the agency determine whether or how to assist in disentanglement. Take pictures, if you have time and can do so safely, to help disentanglers later.



Use this illustration of a generic rorqual whale as a guide when describing the condition of the entangled whale to NOAA Fisheries Protected Resources. (Illustration copyright Garth Mix/www.gmixdesigns.com)

Report the incident to the NOAA Fisheries Marine Mammal Authorization Program. You can get the appropriate form from local enforcement or from the NOAA Fisheries website at http://alaskafisheries.noaa.gov/protectedresources/observers/mmapform.pdf. Your Marine Mammal Authorization allows for the legal "incidental take" of marine mammals in the course of commercial fishing. You must, however, report any incidental injuries or mortalities to marine mammals within 48 hours of the end of your fishing trip.

! Do not get in the water with the whale or approach a free-swimming entangled animal.

How to prevent whale entanglements

Tips from fishermen

Alaska Marine Mammal Stranding Network 24-hour hotline

(888) 774-7325

Make noise. Changing the speed or direction of your vessel (put vessel in and out of gear) can sometimes make whales aware of your presence and cause them to change course.

Put tension on the net or line by towing on the net. A whale is less likely to get entangled and more likely to go through a taut net than a loose one.

Towing the net may also help create bubbles or sound that could deter a whale.

Use sinking (rather than floating) line on pot gear whenever possible.

Stay aware of your gear so you can act quickly if you encounter a whale.

Use the radio. If you see a whale approaching, let others fishing in your area know so they can take steps to avoid it.

Report ghost gear. If you come across or know of lost gear, report it at www.mcafoundation.org/report.html/.

If you have your own tip you'd like to share, contact Sunny Rice, Alaska Sea Grant Marine Advisory Program in Petersburg, (907) 772-3381 or fnar@uaf.edu.

For detailed descriptions and illustrations of whales and other marine mammals, check out the *Guide to Marine Mammals of Alaska*, available through Alaska Sea Grant, alaskaseagrant.org.

Humpback whales (Megaptera novaeangliae) are less aware of their surroundings when they are feeding. (Photo by Barry Bracken, Petersburg Marine Mammal Center)

Petersburg Marine Mammal Center · Petersburg Vessel Owners Association · Sea Grant Alaska · NOAA · SEAFA · Gillnetters

This placard was produced with funds provided by the State of Alaska, with additional support from United Fishermen of Alaska, Alaska Independent Tenderman's Association, Southeast Alaska Seiners Association, Southeast Alaska Rainforest Wild, Marine Conservation Alliance, and Sitka Sound Seafoods.