Workshop on Gear Innovations and Practices to Reduce Whale Interactions
Day 1 Notes

A. Welcome and Workshop Goals (Randy Fisher, Executive Director, PSMFC)

- Commission meeting in September 2015 directed PSFMC to work with stakeholders to identify gear innovations to address whale entanglement.
- Applied for and received a Bycatch Reduction Engineering Grant from NOAA with 3 goals:
  - Identify promising gear and other innovations to decrease whale interactions and entanglement in gear via a workshop.
  - Evaluate promising gear innovations, working with fishermen to test them as possible
  - Actively share results with agencies and fishermen
- Whale entanglement is an issue with growing public awareness.
- We are here to problem solve, not debate the existence or extent of a problem.
- Success in this workshop would be achieved if we come out with something we can test to reduce entanglement.

B. Introductions of Project Team (Fran Recht, Habitat Program Manager, PSMFC) (Attachment 1)

C. List of Workshop Participants (Attachment 2)

D. Handouts:

- **Best Management Practice Guide (CA) (Attachment 3)**
- **2016 NMFS Whale Entanglement Report (Attachment 4)**

E. Understanding the Issues: What we know; what we don't

1. Whales & fishing gear interactions – Lauren Saez (LS); contractor for NMFS West Coast Regional Office Protected Resources Division (Long Beach)

See Presentation 1:

Q&A

- How do you verify in some of the higher concentration areas of sitings? How do you verify they are not multiple sitings of the same animal?
  - LS: We review each record. Comparing photos and other descriptive information can identify repeat reports. All photos were recently sent to John Calambokidis to compare against his catalog. This past year we had up to 8 re-sights of a single whale – sometimes they were no longer entangled.
- You made the statement that emaciated whales sink quickly. When the ability of whales to feed is inhibited, how long does it take them to become emaciated?

    - LS: A mouth entanglement that limits feeding may impact a whale more than a tail entanglement, although that also makes them expend more energy.
    - JC: It would take months.
- How does the number of entanglements lead into mortality numbers?
    - LS: NMFS carefully analyzes the potential for entanglements to lead to serious injury mortality of entangled whales. We disentangled 5 in 2016, but disentanglement doesn't necessarily ensure survival.
    - Dan Lawson (DL, NMFS Protected Species): Most of the reports are live animals. It is rare for dead entangled whales to be reported. The ultimate outcomes of most entanglements are unknown. We do track whales that are disentangled or sited later and free from entanglement. The description of injuries are used by experts to estimate the potential for serious injury and mortality.
    - I live on Long Beach, WA and we see dead whales, but I don't recall entangled ones.
        - NMFS: We haven't seen a lot of it. We might see entangled animals offshore slowly dying and we may never see that animal again.
        - NMFS: A previous project looked at all of the humpbacks on the West Coast and they saw whale scarring. At least 30% had entanglement scars. It [entanglement] may be more common than we know and they get out of it

(Also see Appendix 1 for entanglement photographs—not provided at workshop)

2. How crab gear is fished (survey) and gear testing being conducted—Pete Nelson (PN, HT Harvey and Associates).

See Presentation 2

Questions/Answers:

- Have you considered stationary buoys similar to what is being used in Puget Sound to see how that correlates with the research you are doing down here? Are factors between currents, both tidal and weather, influencing the lines?
    - PN: Yes, I don't have anything nailed down yet. People at NMFS and I are working on pulling something together. If anyone has access to the CTDs that would be great. What information we can pull off the NOAA database is great, but crude.
- There are animal tags out there that measure vertical velocity. Maybe someone has some on the shelf we can borrow? I'm intrigued by your record of difference between depths of the two parts of the lines. Correlating that with the tidal cycle might give some indications of top and bottom line behaviors. The difference between the orientation and tension of the line is important when determining conditions whales can get tangled in.
    - PN: Good point.
- Do you have a TDR at the top of the buoy? It would be interesting to see how often the buoy is underwater. Gear that is underwater is not often lost, just unattainable.
    - PN I did not. I only had a limited number of sensors. I want to put a buoy tag on for sure, but I also want input on where these sensors should be put.
    - Gear might not be lost, but just might not be able to be saved at that time.
    - Occasionally the only time we can pull our gear is during certain tides. Buoys don't pop up during a flood tide. A slack tide allows the buoys to pop up where they can be

recovered again. Crabbers have to wait for the slack tide to recover their gear, and this correlates with the data that PN showed.

- There is a presumption that the line profile will have an impact in how likely whales get tangled. What kind of evidence do you have that would indicate that slack line would cause more entanglements than a tight line? Intuitively it seems that it would make a difference, but is there fact?
    - NMFS: no, we cannot empirically say this. It is just more of a common-sense place to start.
    - PN: There are some people working on this on the east coast.
    - Are the devices neutral buoyancy?
        - PN: good question, I believe so?
    - Where you put the lead on the line is vital. Any slack lines with currents will have a roller coaster effect, and can be bad for causing entanglement. Lead placement is essential.
        - PN: For "simple" gear, there are a lot of factors, definitely.

3. What we know about whales and how that relates to entanglement (John Calambokidis, JC, Cascadia Research Collaborative)

See Presentation 3.

Q/A:

- Can you explain why the high density feeding area off the coast of Washington has had relatively fewer entanglements documented in the past 16 years?

  JC :
    - Reporting limitations have a strong influence on the apparent fewer number of entanglements.
    - The density of humpbacks is not as high in N. Washington and S. British Columbia as the population unit off California.
    - The offshore banks where there is high feeding density are 20-30 miles offshore, and there has not been as much whale presence in nearshore coastal waters. This spatial separation makes the amount of sightings significantly less, but it's changing dramatically with whales entering Salish Sea (Puget Sound). They are seeing an increase in whale sightings in WA, but it's not the same scale as in California.
    - It's a challenge to respond to a whale entanglement off the coast of WA. The entanglement response team will get a report of entanglement, but it's hard to track the whale and find it again.
- Is there a connection between feeding activity/breeding activity and entanglement?
    - JC responded that they have not as good a handle on how exploration and play behavior is different in feeding vs. breeding grounds. He hazarded a guess that play is more likely in feeding grounds, but juveniles might be more active in breeding grounds.
    - The CRC plotted their whale tag data in 1-m increments and found that whales spend 1/3 of their time in first 3 meters of water column.

- What is the global status of whale hunting programs?

JC:

  - Japanese hunting targets minke and fin whales, but they have expressed a potential interest in whaling humpbacks also
  - Commercial whaling is banned under the regulations of the International Whaling Commission (IWC), but aboriginal and research hunts have been excepted.
  - IWC meets every year, and there's a constant negotiation/stalemate between conservation and hunting.
  - The Makah Tribe has proposed hunting grays and possibly humpbacks, but this would only involve a small number of animals.
  - Overall, I do not predict a population impact risk from whaling activities in the future.
- Do tagging activities or disentanglement efforts trigger a response from a whale?
  - JC: Tagging an entangled animal is an option if you can't free them, allowing you to track the whale's movements and try again later. The tagging revealed an impressive range of movement for entangled animals, but unclear if entanglement itself is affecting movement range. However, subjectively speaking, JC observed that gear encumbered animals seem to move more.
  - From audience: Movement can vary. Some stay in same feeding ground, while others can move long distances while entangled.

- How hard is it to deploy a tag?
  - JC: 50% success rate for tagging. Getting better over time.
- Is there observable variation in feeding behaviors between different populations?
  - JC: Some interesting differences: From SE Alaska into BC we see cooperative bubble net feeding, but West Coast populations aren't seen doing this. This difference in behavior may be related to prey type (more herring are present in the north), or it may be a question of social strategies that have evolved over time in one place that have not transferred to another population. In Monterey Bay for example they're seeing signs of competition between humpbacks. Bubble netting has spread from Alaska to British Columbia, but it's not clear if the strategy itself is spreading or whether the population is changing distribution.
- What attracts them? Color, sound, shape?
  - JC: Unknown. That's why we are doing current data collection, to look for answers. Can't help strategize deterrence options with the current information unfortunately.

F. <u>What is being done on the West Coast?</u>

Short (5 minute) presentations

Jim Anderson, Fisherman on CA Whale Entanglement Working Group (See Attachment 5.1)

Q/A: Focused on location of Derelict Gear

- During derelict gear retrieval, the U.S. Coast Guard (USCG) offered to collect aerial information.
    - USCG agreed in SF to do the flyovers and have been very helpful, especially doing flyovers during rough weather times.
    - With The Nature Conservancy (TNC) developed an app to allow logging of sightings of pots from people on boats.
    - Member of USCG is on the working group. The challenge is that they are very active and it's difficult to conduct organized research if it conflicts with their other priorities.
    - USCG interested in partnering in Central CA, but opportunistic data is of a different quality. Task force studies are focused on being structured similar to biological surveys.
- What about using a logbook program?
    - Concern is the time requirement to implement the logbook program both for implementers and respondents.
    - TNC has an electronic e-catch app for the iPhone. If you can make it easy for people (no mailing required), maybe the response rate will be higher.
- Use of drones?
    - Asked for it in the beginning, but permit process and drone driving requirements are onerous.
- Use airplane videos with computer vision software to identify pots?
    - Crab organization working with US Army Corp of Engineers (USACE) to develop species identification software.
    - Would take time to develop algorithms for software-based identification, plus many seabirds look like buoys from altitude.
    - Within the realm of exploring, but it's a funding issue.
- Pete Nelson was involved in building an app with the lobster industry similar to the one described.
    - Easy to add pots to a chart, but how do you remove the picture from the charts once the pot has been recovered?
    - Helpful to have a fresh chart every day when looking for lost pots.

(For more information see: http://www.opc.ca.gov/whale-entanglement-working-group/)

Dan Ayers, WA Department of Fish and Wildlife: gear retrieval

(See Attachment 5.2), also Appendix 2

Amanda Gladics (AG), Oregon State University/ Oregon Sea Grant re OR Cetacean Entanglement Working Group

(See Attachment 5.3)

Questions/Answers:

- Anything in place for a WA group? Ilwaco and Chinook are so close to OR that it might be useful?

    - AG: I have been talking with Sara Fisken from WA Sea Grant, she is really open to having a WA group as well. There is not anything in place for things to kick off right away, but there is some interest.
- Kelly Sayce (KS) Coordinator, CA Dungeness Crab Working Group: Glad to hear that you're working with other fixed gear fisheries. Wanted to check in on decision on bringing in other fixed gear fisheries. Thoughts on bringing others in?
    - AG: Interested in having at least one other fixed gear group in. Focus on crab gear, but want to be inclusive.
- NMFS: When do you anticipate coming out with information? Our office is interested in helping out in whatever way we can.
    - AG: We want to get the whole group's input on a good schedule.
        - KS: CA group wants to help out with any scheduling that they can as well.

Justin Yeager, OR fisherman (Also, see Attachment 5.4)

Presentation:

- Speak to efficiency of crab fishery overall. More efficient now than in years past and will be more in future.
- Where we fish crabs changing over time. Becoming more mobile with better technology, boats, and gear.
- When looking for solutions, keep efficiency in mind and don't cripple ourselves.
- Sustainability important to the fishery. They want a really solid label.
- We can't do enough with changing our gear. Might need to look at some timing changes for the fishery as well.

No questions.

Kortney Opshaugh (KO), Blue Ocean Gear

Presentation:

- Developing a solution to immediately locate lost or entangled gear.
    - Problem is that if boat doesn't stay with a sighted entangled whale, often never seen again.
    - Timing/location of sighting not indicative of where entanglement happened.
    - Facilitate rescue efforts.
    - Device can be used to locate lost gear as well
- Device goes on float buoy and includes GPS and other sensors to show distance wandered, acceleration, etc. that can send a warning to the owner of the pot via cell networks or possibly satellite/VHF transmission.
- Still in prototype development.

Q/A:

- Whale expert: What does it cost? What is the mechanism for transmitting?
    - KO: The cost is too high right now. The goal is to get it down to the $50 range. Right now communications are cellular but I've been looking at other communication devices. For example, networking buoys all of the buoys talk to a central buoy that talks to shore.

Kyle Antonelis (KA), Natural Resource Consultants (NRC)

(See images of pump and line cutter in Appendix X)

Presentation:

- Kyle Antonelis – Natural Resources Consultants, Inc. has worked with the Quinault Tribe and The Nature Conservancy on lost gear recovery since 2011 in the Chehalis River, Grays Harbor, and on the Washington Coast.

- In 2014, TNC, QIN, and NRC began a project funded by the NOAA Marine Debris Program to develop a tribe-specific lost crab pot removal project in the QIN Usual and Accustomed (U&A) fishing grounds, with an emphasis on the QIN Special Management Area

- Goals of the project were
    - Remove crab pots and reduce the impacts of lost crab pots on the Dungeness crab resource
    - Remove pots and vertical lines to allow access to prime salmon grounds for the salmon trolling fleet
    - Reduce potential for whale entanglement in vertical lines left from lost pots
    - Reduce hazards to navigation

- The plan was to remove all QIN pots and/or buoyed lines from the U&A during each post-fishing season gear recovery operation
    - Using the standard crab block to pull stray pots
    - Using pot pump to remove sanded in pots (Figure 1)
    - For pots that were extensively sanded-in, or otherwise stuck, we developed the line cutter tool to send down a buoyed crab line and sever the line at the seafloor. The line cutter is a heavy metal box with a hinged door and one-way cutting blade (Figure 2). The line cutter was used after 5, 10, or 15 minutes of unsuccessful pumping, depending on the location, sea conditions, and number of pots in the vicinity. Line is recovered onto vessel.
        - Pot remains, but buried in sand; line is out of water no longer posing risk to navigation, gear conflict, or whales.

- QIN crab vessels were chartered with captain and crew to remove gear during three field seasons from August through October in 2014, 2015, and 2016.
    - A total of 1,247 pots and lines were addressed
        - 51% removed by crab block alone
        - 16% removed by crab block with pump
        - 21% lines removed with line cutter
        - 12% lines broke during removal attempt

- Thoughts:
    - After a few iterations the line cutter proved to be a very successful tool to use when pumping does not work, or when pumping is inefficient considering time available.
    - Leaving buried pots is not ideal, but considering that they are buried and recovery is sometimes improbable or impossible, the removal of the buoyed line is good alternative to complete pot removal.
    - We are currently working with managers and crab fishers to identify options for incorporating the line cutter into the fishery when appropriate.

Questions/Answers:

- Line cutter is a very clever device. Did you find a way to broaden the opening to better get past blockings on the line?
    - KA: The example here is a bigger model than the original. The current size has a 2in modified chisel. One issue was if it got to a section right next to the pot, the line is much bigger, but it works otherwise.
    - Fisheries co-managed between tribes and federal managers: there are areas that tribal fishers fish and others don't. You can't collect across tribal lost gear and non-tribal lost gear. Glad that the Quinault are taking incentive to collect lost gear. What did you think of your success overall with your recover?
        - KA: We are very pleased with our results. In beginning, we went straight for well-known lost pot areas. Later we went through and tried to pinpoint areas that we had missed. We are not getting the density that we had seen earlier in our recovery. We had to work with the complications of the aerial surveys. By end of 2015 season, saw diminishing returns because we weren't finding the buoys anymore. Cleaned up quickly and effectively.
    - Any issues on cutting the pot off and leaving it in the ocean?
        - KA: Yes. Justified by saying pot was buried significantly enough that an attempt at pumping it out was still unsuccessful. Issue was the vertical lines was the subject of the project to begin with, not the pots
    - How many of the cutters have been developed, and what is the cost?
        - KA: Currently have 8 of the box tools that cut line. We are not a manufacturing front, so there are liability issues. We are trying to figure out how to get this into the hands of people.
    - Our area is not tribal area, but everyone seems to get their pots out of the water. If there is a way to pump the pots, we get them out. We seem to get a lot of the pots out. I would think that by a certain date if there are any visible pots that people would try to retrieve them.
        - KA: I just want to reiterate: we don't believe this (cutting line) is the answer, just a tool.
        - KA: Management issues to get through: If we are cutting the line, we are leaving a pot, which is someone's pot. There is a term of forfeit, any gear left out after this time is forfeit.
    - Quileute Tribe now shuts down their fishery earlier than normal. We give them time to get their gear out. After time, the gear is forfeited and property of the tribe.

- In CA, we modeled our recovery program off of WA recovery project. We have worked with the fleet out of Eureka. We are working to make the program less dependent on funding, and helped fishermen to raise funding needed to keep the program going.
    - In Bodega Bay, they are putting areas in to store and protect the gear so that they can contact the gear owners to pick up their gear.
    - Dungeness fleet wanted to propose legislation that requires there to be a state-managed program that monitors gear recovery. How this will play out remains to be seen. The fishermen themselves crafted the legislation and pushed for its eventual signing. They wanted to do something about the entanglement issue.
    - NMFS: Reality is that we have very few entanglements that we can associate with derelict gear. Our sense is that the problem lies with active gear that has been deployed. There is room for innovations regarding those questions with gear. One whale had tags from two different fishing seasons on it. So we are thrilled at efforts that are going on to retrieve gear, but this is likely not be the heart of the problem of whale entanglements.
        - Assumption that entanglements occur outside of fishing season are lost gear that are not actively fished.
        - NMFS: No we don't assume that; we don't actually know.

10 Minute OPEN DISCUSSION

- CA Fisherman: The California Task Force wanted to be proactive and get involved with creating a derelict crab gear removal program and worked with the California Dept. of Fish and Wildlife (CDFW)on laws related to removal. We also worked with TNC to pull together information to develop a pot removal program, including costs, required staff, and logistics. CDFW has given the Task Force time to pull all of the information together. The hope is working collaboratively will give the Task Force power to convince people to participate. In the past, people brought lost/derelict gear in and left it on the dock for the original owner to pick up at no cost. Last year, we charged a fee for fishermen to pick up their pots. The fee was small compared to the cost of a pot. Once the Task Force explained why the pots are being removed, they were receptive because it was for doing good. This year, we're looking at how to recover stuck pots. Do we hire a boat to pump the gear or put a pump on fishing boats? What is fair compensation for someone to pump it? Fishermen want to have a say in how this works. There is a law that says if you don't take care of your gear (if it's a whole string) that the CDFW can come after you. This idea that someone is going to bring in your gear for nothing has gone away.
- Dungeness Crab Task Force: Senate Bill 1287 signed in September 2016 regards removal of lost gear. CDFW is looking to implement the Bill in the 2018/2019 fishing season. We are working with fishermen to develop port by port synergy to put this in place. The Task Force helped get teeth in the Bill and included letting folks know that they have the potential risk of losing their permit if they keep leaving gear in the water.
- Oregon Department of Fish and Wildlife: ODFW has a derelict gear program that started a couple of years behind Washington. Since 2013 we've had a season permitted for derelict gear collection as well.
- OR Fishermen: I am supportive of the ideas of getting derelict gear out of the water. There are other ideas. There is an elephant in the room. If we were in the insurance business, we might

look at this information differently. We'd want to limit the exposure – pots in the water over time. We should at least consider looking for the intersection of not losing efficiency and not losing the most valuable time – is there a time we can sacrifice that intersects with the most whale entanglements.

G. What Innovations are Being Tried Throughout the World, East Coast?

Tim Werner, TW (New England Aquarium, bycatch.org

See Presentation 4:

Presentation notes:

- Fish less
    - Spatio-temporal conflict reduction
    - Closures with payments
- Fish better
    - Multiple pots on same lateral line for fewer verticals (called "trawling up" on east coast)
        - Heavier line- more harm for whales if entangled
        - More lost/damaged gear?
    - Sinking groundline (if you "trawl" up)
        - Bottom feeding marine mammal species still affected
        - Increased degradation, danger, difficulty to grapple
    - Ropeless fishing
        - Used in SE Australia with acoustic releases
        - More expensive
        - No surface expression, gear harder to find, increases potential for trawl conflict or overlapping pot gear
        - Completely eliminates risk of entanglement
        - WHOI design – engineered for extreme environments
            - 130 lbs empty, 340 lbs loaded
            - Pokemon Go idea of virtual buoys
    - Reduce rope or net length
    - Grappling of strings of 2 or more pots
    - Sound emitting device
        - Instigates behavioral avoidance – whales known to surface, so you can't use it to avoid ship strikes. 3khz pinger showed no response in humpbacks.
        - High density gear areas can cause confusion
        - Habitat exclusion?
    - Visual cues
        - Right whales can see red and orange rope from 4m, green rope from 2m. Enough to avoid collision? Work at depth or only photic zone?
        - Whales monochromats, but see contrast (red shows up)
        - "whiskers" on ropes increased visual profile.
    - Fleet communication
    - Materially stiffened rope.
        - Can still entangle whales

        - Harder to splice, tend to be knotted which is worse for entanglement hypothetically
    - High tension rope with counter weight and floatation
        - Much uncertainty regarding effectiveness, feasibility
        - Can cause more damage to whale tissue
    - Slippery rope
    - Whale free buoy
        - Can get caught in baleen
    - Post entanglement release
        - Weak links; e.g. with 1100 lb breaking strength at buoy
        - Mandated on east coast, but don't know if they work (whales have been found entangled w/ weak links)
    - Reduced breaking strength rope
        - Study showed fewer adults caught in smaller ropes.
    - "Chinese finger traps" – whale release rope
        - Braided sheath acts like weak link (1700 lb est. breaking strength)
- Switch gear type
- Post-entanglement mitigation
    - Expensive, dangerous, stressful to whale
    - 10% seen entangled, small fraction disentangled

Comments (no time for Q&A)

- Gear modification good way to go, but doesn't deal with the idea of efficient fishing: Reality is 80-90% of prime crab catch time is when the whales are not present. Perhaps consider different gear types when whales present.
- Industry has already made many upgrades to gear (gear better than 20 years ago). Limited entry already, pot limits; Faster pot retrieval (faster blocks), better equipment; tougher boats allow retrieval in bad weather (80% harvested in first 3 weeks).

H. East coast fishing industry perspective. Patrice McCarron (PC), Maine Lobstermen Association—

See Presentation 5

- Q/A Deferred, no time

I. Range of Potential Options for Reducing Whale Entanglement. Dan Lawson (DL), NMFS West Coast Region, Protected Species.

See Presentation 6

- One overarching goal is to avoid the need for creation of a Take Reduction Team, which entails a more formal way to address impacts and entanglement risk under the MMPA. The issue is complicated. For humpbacks, potential biological removal of 11 individuals per year on a

~5 year average.. “We are on our way there”. NMFS will look at which fisheries are most involved when assessing how to achieve entanglement reduction, but individual fisheries that may be involved “probably wouldn’t be left behind”. Even despite population rebound, they are an endangered species, and one entanglement of an endangered species is a potential problem/vulnerability under the Endangered Species Act (ESA).

- What can we do?
    - Reduce exposure of whales to gear
        - Minimize line in water
        - Focus on time/place when need to be most effective
        - Multiple traps, buoyless fishing, seasonal/regional limits
        - Reduce lost gear
    - Improve the gear to make less likely to entangle
    - Improve the gear to make entanglements less severe or allow escape
    - Avoidance and deterrence
        - What would the crabbers do if NOAA brought scientific predictions about where the whales were going to be?
    - Fill knowledge gaps
        - Gear marking
        - Spatio-temporal analysis of co-occurrence, environmental factors
        - Document current fishing practices and look for improvement opportunities

Q/A: Deferred, no time

BREAK OUT GROUPS: The group was broken into three sub-groups, each of which had a mix of people from each state, and include the various expertise: fishermen, gear, lost gear removal, marine mammal, and agency to stimulate initial discussions. Then the group got back together as a whole to continue their discussions. The notes from the 3 Break Out group discussions are presented below, followed by the whole group discussions that started on day 1 of the workshop and continued on day 2.

It is important to note that these were individual comments and no consensus was sought. Important to take back ideas to working groups, fishing groups, etc. for more discussion and consideration

Break Out Discussion – Group 1

Season Changes

- Industry Considerations:
    - Some members of the fishing industry in Oregon has in the past asked the state for shorter seasons given the risk of entanglement to their regulatory requirements and a desire to maintain a good reputation for sustainability in their labeling scheme.

Proposed dates Jun 1 or May 1. It was acknowledged that the industry may want to take a proactive approach to managing their risks.
    - Industry developed bio-economic model for the fishery to determine optimal harvest times.
    - The crab season is 8.5 months long, but 80% caught in the first 3 weeks.
    - A shorter harvest season would allow more time for derelict gear retrieval, less conflict with other fisheries, less exposure to gear loss and whale interaction.
    - Fishing effort is from the same boats as the early harvest (note: this was later disputed in the group discussion, as some boats have a small spring/summer market).
    - Boats from AK – very few for crab
    - In Oregon there were 423 permits last year, with only 306 active.
    - In June, the catch limit reduces to 1,200 lbs. This causes longer soak times as boats put out all their pots and harvest fewer pots per trip to stay to the limit. Proposal to change to 100 pots or whatever minimum amount of gear to catch limit out at a time?
    - Shrimp starts April 1, so some boats shift over then.

- Domoic acid risk: potential to start earlier (e.g., November) if crab meet biological/market size criteria and close the season on the molt as per bioeconomic model.
- Effect of multi-year cycles in prey availability?
    - Change depth lines for pots depending on what kind of prey/whale year it is?
    - Essential input: Is there a depth that would be better to avoid whale entanglements?
    - Spatial area restrictions depend on stability of whale presence.
- Reduce pot limit starting during May whale migration time when risk is highest?
    - Compare 250 pots with quick return vs. 500 pots?
    - Boat capacity requires a certain scale of pots to be worth the fishing effort.
    - 2,500 lbs limit after July 1 already implemented in WA
- Dynamic pot location depending on known/predicted whale presence? Not as reactive as the Maine system
- Combined strategy for spring whale entanglement risk? (contour lines, trawling up multiple pots, season shifts, pot limits after a certain date, etc.)
- It was noted that some people might prefer a gear solution (e.g., pool noodle) over season changes.
- Different states may have different situations that lead to different timing strategies. May be a 3 state solution.
    - How does that affect boats with multi-state licenses?

<u>Gear Modifications</u>

- Time release line cutter
    - “cutting burr” that activates when line is horizontal(?)
        - Concern is that pots are sometimes dragging behind the boat as they’re hauled and might be triggered unintentionally
    - The existing device starts the clock – 15-30 minutes under X lbs. of strain (as whale swims) before the cutter begins work.

        - Timer is adjustable depending on hauling needs. Can be 24 hours for example.
        - For safety issue, run a jumper line to address risk of running cutter through block?
        - The device won't cut immediately when load limit is exceeded. Will only start the timer.
        - What powers the timer and cutter? Batteries or mechanical? Information need
        - Does the cutter system become more difficult to manage if you have one on every string rather than the test scenario that was tried in Maine?
    - Probably not needed in the first 3 months of the season.
- "Pool noodle" in the top few meters below the buoy to encourage line rolling off after encounter with whale.
    - Could be difficult to remove the sleeve in difficult seas.
- Colored lines
    - All manner of colors have been seen on entangled whales. How does it change the overall risk at fishery-wide scale?
    - Response time an issue even if the line is more noticeable – may cause panic in a whale if it encounters line farther back on its body while trying to evade.
- Reduction of trailer line length
    - Boats with different freeboard need different trailer lengths
    - Uncertain how much it would help
    - Put lead in middle of trailer? Tangles become a possible problem.
    - Fisherman described a 3-buoy system (1-2-3) and grab between buoys 2-3. How does this relate to entanglement risk and operational efficiency?
- Samson line (stronger and thinner)
    - Currently used in British Columbia (compare entanglement risks?)
    - Expensive by comparison to lines used in the US
- Multiple traps
    - In Maine they set directional guidelines (N-S, E-W)
    - Enforcement boats won't pull up a string of pots to check tags for pot limits
    - Potential increased injuries
    - Whale won't escape so potentially easier to free it
    - Look at feasibility of small strings?
    - Long lining in the deeper water – after April competition increases with the other fisheries, so there is less likelihood that people would be doing it when the whales are at greatest risk.
    - Can be done in any weather.
    - 3 pots less efficient than 1 pot because you can't just drive down the string at 5 knots.
    - Long line with multiple pots (10 lines w/ 100 pots?)
- Weaker lines
    - Non-starter for industry due to safety concerns

Lost gear reduction

- One estimate is 8-10% loss, but this is not certain/disputed and loss can occur for several reasons. The reality was acknowledged however that there is always derelict gear found at the start of the next year's season.
- WA system changes property right after the season ends. This creates incentive to clean up gear before the season ends.
- Important to consider earlier gear retrieval programs.
    - Aug 15 to start recovery program may be too late to recover derelict gear due to ocean conditions deteriorating in the fall.
    - Quinault tribe shortened season one year when conditions were expected to worsen to allow time for gear retrieval.
    - OR allows in-season derelict gear retrieval (25 pots per day; 50 pots in summer) and retrievers are allowed to keep the crab in the pot to incentivize the effort of returning someone else's pot.
    - WA allows only out-of-season gear retrieval.

Expectations from workshop output

1. Research agenda for identified viable options
2. Potential for industry to adopt strategies proactively given risk of TRT
3. Goal in Oregon (and potentially others) is to preempt regulations and allow experimentation in a non-regulatory setting

Break-Out Discussion – Group 2

Main points:

- DISCUSS/adapt best management practices for coast-wide practices
- Very little support for longlining pots and weak links into the gear. The industry wouldn't support it. There is the potential for new technology for weak links? However, fishermen raised concerns that they don't work for pots embedded in sediment.
- Seasonal/Spatial restrictions? We would need data, how will we get the data? Could this be a potential starting place?
    - It would be useful if we can determine if whales have been in an area historically.
    - Fishermen suggest we proceed with caution, as decisions could potentially change the entire fishery.
    - Spring has the greatest entanglement risk. If the fishing was coupled at that time with experiments in gear, then this might be when we need to focus our efforts.
- Data gaps are important to address potential problems. Discussing data gaps is essential.
- There is a desire to be more clear about state/regional differences.
- Central CA area can be very important for testing/gathering data, etc. because of their "unique" conditions.

Expanded Comments/Concerns/Questions:

- What do we need to know re whale behavior. We don't necessarily know what we are up against, so how are we going to do something about it? Whales are known for "playing" in kelp, what does this mean for potential crab gear caught in kelp?
    - Previously, this has been thought of as a parallel behavior. Reductions in kelp entanglement with crab gear could be a means of reducing whale entanglements?
    - Kelp can pull buoys away. Could be prime entanglement area. Can gear be changed so that it is more kelp resistant?
    - Whales will behave differently in different areas. There is not always kelp involved, but could be a contributing factor. There are a variety of entanglement causes, so potentially a variety of entanglement solutions exist. Not a one-size-fits-all solution depending on the region. This is a complex problem with multiple aspects.
    - Things to focus on:
        - Reducing number of vertical lines
        - Reducing slack
        - Increased whale populations increases the possibility of entanglement problems
    - Behavior: various breeds behave differently. Guarding against one breed in particular could cause more problems with other breeds.
        - Does behavior alter with various food sources?
            - Would expect so. There is data from tags to suggest so. Ex: Bubble net foraging vs. individual foraging
        - Does the food source itself impact the whale behavior like it does in salmon?
        - What they are feeding does impact where they are. Krill=surface, although the whales are usually down deeper. Prey drives behavior more than anything. Integrating prey helps to explain both whale behavior and location.
            - Humpbacks can become so focused on feeding that they bump into things. They will be more focused on what they are doing to catch their prey than where they are going.
- No fishermen wants to entangle whales, so the industry is interested in ways for mitigating problems. But, they don't want to rush to reengineer the fisheries until we better know what the impacts are. WA, OR, CA comprise approx. 1260 miles of coast. Regional differences in how the fishing gear behaves, in spatial and temporal sense are important to consider. Variation in whales and their populations are important as well. Humpback entanglements, in comparison to gray whale could result in more severe fisheries restrictions. Does the WA coast humpback equate to the populations off CA and elsewhere? They want to be cautious of approaches to resolve this that incorporate wide-spread approaches until we know more. They want to avoid a situation where they are wrapped up in something that doesn't apply to that particular region.
    - Fishermen are trying to get in front of the problem and be proactive. We do have a known problem area for this, is there a way to utilize/focus on the problem areas to find out behaviors? How much value do you get out of looking at just one entanglement like in WA?
    - Lauren Saez had published work previously that made it clear that the central CA stood out. There is a spatial and a temporal aspect. Central CA is important foraging area for humpbacks. Recently, there has been more gear in the water there. The crab fishery has

changed slightly as well. People are working on getting more data for that region because that is where a lot of the confirmed entanglements are occurring.

- As an industry, it is everyone's problem. But CA seems to have the perfect storm situation where they can collect data faster
  - There are, however, more whale watching boats and people out on the water, more reports in Monterey Bay, more people who know how to report, etc.
- There is different "low hanging fruit" in CA than in WA. But, get beyond the easy targets, then might need to address how the regions are different, and how there is a potential to be treating the coast in a regional way.
  - Which of the humpback groups, if asked, would have the greatest impact if entanglement occurred?
    - The Central American DPS migrates to central CA, so the proportion of whales that are endangered in CA will therefore be higher than in WA or BC. This area will end up being different because of that link between CA and Central America.
    - Central CA is important because the most endangered populations go to that area. It is a small area for surveying, you can see where the gear and the whales are. You can easily observe whale behavior around traps as a result. This area provides the greatest potential to learn what we need to know to make a difference.
  - We don't see that any solution will fit everyone. It depends on what time of the year as well. There might be a solution for a short period of time for a single area. Everyone equally accountable.
  - If a Take Reduction Team process occurs, everyone will all be in the same spot. Categories of "take" are important. But not like a quota, where a hammer that comes down and says "you're done". If you start to take too many whales, then could suggest that a TRT is needed. Can implement innovations to help prior to starting the TRT process.
    - If put all the species and states in one hat, you won't get anywhere. The TRT should go where the biggest problem is and try to get a handle on that. Very deliberative process.
- For the smaller area in CA, you could apply things/tests and get results sooner than perhaps other areas. Is it good for public awareness that we are proactive? Finding interactions off OR and WA might take longer.

- The west coast is a big area with a lot of people, trying something on your own will make it difficult to measure any success. CA would be good testing area, because you could see if you reduce the entanglements over a season. There needs to be measurable success.
  - How do we quantify the results? How many things can we try at once? Science/Scientists can help to apply the statistical knowledge that will satisfy the regulators.
  - There are many pots out there, and the number of whales per pots is small, so it is very hard to quantify results from testing and innovations. Getting numbers down in general can be good, and we can figure out why later.

- There wasn't any major change in gear usage in CA to explain the increase in whale entanglements. What else can explain the differences?
    - 2015-16, the whales were distributed in a way that hadn't been seen in decades.
    - Last few years has seen increase in whale entanglements. These coincide with the warm blob, HAB (harmful algal blooms); are these things/environmental factors having an influence on the recent whale behavior? Can we alter the fishery in advance if we know these conditions occur in the future?
        - Looking at these solutions. What is the right one?
        - **Doing away with leads/splices in the ropes to help reduce the damage** to the whales in spite of inevitable interactions with whales.
    - It will be hard to get data to demonstrate an effect of the differences. Entanglements are so infrequent in the scheme of things, so you can't really say "this solution is the one that works".
        - **Behavioral metric for evaluating whale response to gear/gear model**. Is there something we can measure reasonably reliably with high frequency so that we can at least test some aspects of gear to learn more about whale behavior?
            - Proxy of whale behavior? Ex: two types of gear, and you could have whales turn one direction in response to one type of gear versus going straight with the other, might give an idea of how these whales interact specifically with gear types. It is possible to put some heavily modified gear out there, test and see how the whales respond.
            - Seasonal patterns are clear, and geography does matter. Whale density varies dramatically along the coast. Late season effort, and location can have immediate impact. **Suggestions are**: rules that apply during winter and spring that don't restrict efficiency of the fishery at all. Late season can have rules, areas off-limits based on location. Additional restrictions can be tied to research efforts.
            - For gear: Physical model tests like back east did (whale fin experiments with tension, etc.)—**can we get the results of those tests?**
            - Starting place?—Can start with best practices from CA, and look and see if they make sense for those fisheries outside of CA.
- Longline pots? Multi-pots per one rope
    - West coast crabbers are fishing close together, at night, and this can cause problems. Fishermen would have to rebuild the hydraulics on a lot of the boats. The entire industry change, and this would be expensive.
    - Also whale mortality increases with multiple traps. How much gear can a whale still move with?
    - There are potential concerns over increasing ground line, depending on what type of whale is feeding.
    - This could lead to situation with lots of pots left on the bottom.
- Crab fishermen should focus on making the gear that they have work better, with current efforts.
    - CA best-practices is a good place to start.

    - Educating the industry with implementing best-practices and see where we go from there. What is success? How do we measure it? Simply implementing best-practices could be a simple solution we are looking for without risking health, excess financial input, etc. Simple changes in gear structure, like shortening buoys, tightening slack, etc.
        - This would potentially take many years to see a difference. This information can't be quantified in a short time period.
        - Best-practices has given CA time to get some research, and gather data so that they can make a judgement before writing a law, etc.
- Would reducing fishermen access in certain time of year (if it would reduce like 50% mortality in whales), create industry agreement?
    - CA area is talking about that. They are already looking to gather data about where the whales are, so that they can best approach which areas to look at potentially for this method. They are trying to compile the data so they can have honest answers for who will be impacted.
    - Need buy in from the fishermen, and people need to agree that this is in everyone's best interests.

Breakout Discussion – Group 3

- How much gear is lost per year? ~4-8% per year
- Considering 80% of the catch is in the first few weeks after the opener, should there be some time area closures? The restrictions would come online when crab is getting less productive.
    - What would fishermen do during that time? We need to make money.
- We lack consistent information about where the whales are. If they are further off shore, there could be a depth restriction in summer months.
- Description of spring fishery in CA:
    - Crabs mate in spring so the catch is typically slow. After mating, they are hungry and there's a bit of a bite. Then they start getting soft.
    - Is there a difference in the boats or fishermen for the spring fishery? Not necessarily. You can let the gear soak longer. The price gets a lot higher in spring.
- The pattern of value in OR is similar. It's going up now. However, in the second or third week of May, it starts to decline due to other openers and deteriorating quality.
- Crab is managed through size, sex, and season. An adjustment that's closer to avoiding the major molt makes some sense since that's the most vulnerable time for crab.
    - There is cannibalization, but they are protected from other predators if they're in the pot.
    - There were some observations that there is a high level of cannibalism in the pots.
    - When they're in a trap, they can't bury up to protect themselves.
- We saw heat maps of where whales are and and the fishing effort through the year. If we develop that on the West Coast, it can help inform the decisions and think about risk factors and safety.
    - Lauren Saez published information on this previously.
    - It would be very useful for us to see that during the discussions about innovations.

- Even though there are less people fishing in Spring, do you still use the same amount of gear? Yes, unless some gear was lost earlier in the year.
- Even though Washington's season might look like it lasts longer, it closes outside of 4 miles on July 1.
    - Is there less effort then? About 10-15% of the fleet fishes after that.
- Can you overlay current maps with the whale maps? Karen has the latest data. One caveat – the data is on a large scale and we might need a finer scale.
- In OR, there's gentlemen's agreement to try to get the gear inside of 30 fathoms to reduce interactions with trawlers who are starting up in Feb/March
- There is no data about Dungeness fishing effort in some places (number or location of traps)
- A lot of people have mentioned "weird years." We have a lot of weird years lately. When we look at historical data, we need to keep this in mind.
- Co-occurrence models are dangerous because having a lot of gear doesn't mean there will be a lot of entanglements.
- A heat map will inform us today about what is happening today. If we start collecting information now to help us understand variability, it will help in the future.
- CA doesn't keep log books. Do we have a lot more information for OR because they keep the logbooks? Yes. The logbook program is about 7 years old. It started with about a 60% compliance rate and that has now increased.
- Fishing out of the Columbia river, we'll lose a fair amount of gear. WA Fisherman Steve and his son drag a lot to recover gear. Since OR and WA started the "recovery" season, gear is only recovered during those times. The state said after Sept 15, you can go out and find gear and keep it. We don't do this anymore because we have to wait until September and hardly anyone drags anymore. If you want to get the ropes out of the water, let guys drag in April and keep it (or trade it). Currently, you can drag outside of September but you have to return the pots. Now there's a limit of how many pots you can have on your boat that belong to someone else (6 in OR and CA; 25 in WA).
    - Enforcement doesn't want us dragging for gear.
    - "I don't buy stolen gear – let alone my own stolen gear."
    - The fleet is willing to live with some "legal theft" to avoid other issues.
- Some of the things that were tried on the East Coast that didn't cost a lot of money, we could try on the West Coast. Just because it didn't work there doesn't mean it won't work here. There will be an inconvenience, but time and area closures impact people in different ways.
- You need a lot of weight if you are dragging in deep water. Steve is putting a cutting edge on the heavy drag – this might be something to keep on every crab boat. If an entangled whale is observed, you can use the cutter to cut the line off.
- We might not ever be able to have the answer of where the whales are in real time. The fishermen are the ones really seeing where the whales are. How can we take that info and put it in a forum where it can be immediately available? What is the minimum amount of information we need to do some things? What are the costly things we can do? What do we want to do? What do we want to avoid? What do you need to know so something can be done? Create a matrix of high/low cost and high/low effort.
    - It would be difficult to use that data to direct gear movement because it takes so long to move it. It would be useful if you had a correlation between where the whales were and environmental and temporal conditions. Then fishermen can plan around those conditions. I don't know if you could do a real time order to move crab gear.
    - If we do know where the whales are, what does that mean for this fishery?

    - Fishermen would be afraid to report entanglements during the season because it would be costly to move all of their gear.
- Right now we need to raise awareness among fishermen and let them know to tighten up their gear when fishing in areas of high co-occurrence.
- There's no uniformity in what gear people use.
- We've gotta police each other. If someone's rope is floating, you've gotta call them and tell them to put some lead on it.
- Where the whales are today, they won't be around there the day after tomorrow. It can take weeks to move gear. Moving the gear might put it in a place where the whales will be.
- The mitigation should focus on a certain depth potentially. Do the entanglements occur at a certain depth?
- Rather than making conclusions on anecdotal evidence, why not use these times of high interaction to actually test ideas? It's dangerous to draw conclusions on anecdotal evidence. You run the risk of constantly changing actions.
    - With Pete Nelson's study, fishermen are helping with the research. We're already learning. Neutrally buoyant rope makes the bottom rope act different.
    - Test this stuff where there might be interactions.
- What metric do we use for success? How much time?
    - There are different ways to do this. Controlled experiments, behavioral studies, long term studies…
    - One of the best practices discussed was reducing the distance between the main buoy and trailer buoy. Maybe we can come up with a different way of measuring success since we can't throw the line around the whale.
- How often are whales entangled between the buoy? In general, the whale gets entangled in the line connecting to the pot.
    - Why does the trailer buoy matter? It's the force that wraps around the whale. The extra buoy wraps around the whale.
    - We've seen the humpbacks spiral up around the line. If there is a trailer buoy, there's a higher probability of the whale getting entangled.
    - Having extra buoys might cause extra wraps around the whales.
    - Some guys do shorter trailer rope but put a third buoy on. Sometimes that works better than the longer trailer rope.
- Do disentanglement teams draw the entanglement? Do they collect the gear? Do they do breaking strength on it? Now they are starting to collect more information including video of the whale. If possible, the gear is retrieved after freeing a whale.
- We brought gear that had been removed and presented the case to fishermen. It was like a diagnostic exercise that generated interesting ideas of how/why the whale got entangled and then ideas of what could be done to prevent it.
    - That's a good idea since we can't actually test this with whales. What we can test is if these innovations impact fishing. Can we do something with simulated whales (computer or mechanical simulations)?
    - We're working with an engineer at Duke University who developed a model on the behavior of right whales. You can also put ropes in the model and the ropes respond to the physical properties of ropes. You can put many parameters in the model.
- I'm assuming when a whale is entangled, it's towing a crab pot. When you encounter these entangled whales, how often do they have the trap?

    - With Dungeness, we're seeing the traps still connected. Some whales have even been anchored by the traps.
        - That's why it would be good to have rope cutter devices so you can at least cut the pot off. You'd need to get within 50 fathoms (300 ft) to cut the pot.
        - From an entanglement perspective it is best to keep all of the gear in place. Sometimes the gear slowing them down allows the rescuers to get to it and help it.
- Populations of whales on the West Coast are doing well. They can live up to about 60 years.
- Thoughts on breakaway gear?
    - One of my crew is a lobster guy and he was adamant that we do not want that. He said it would not work out well for us because of how we run our line.
    - The whale free buoy isn't a bad idea.
        - The issue with the buoy is more that entanglement events don't always manifest in their head, the initial contact might be in the front of the animal. Mouth entanglements are disastrous and almost always lead to death. With the whale free buoys if the entanglement is in the mouth, it would be terrible.
- The reaction of humpbacks is to push really hard – they'll blow a hole through a net. So, a whale free buoy might work.
    - The whale free buoy was a trombone shape. Maybe it could be more like the old Portuguese style buoys.
    - On the East Coast, mouth entanglements are more predominant on the Right whales than humpbacks. If mouth entanglements were less of an issue, the buoy might work.
        - We have everything – the entanglements are on all parts of the whale.

FULL GROUP Discussion and Questions

WEAK LINKS AND GEAR INFORMATION

- Weak links from east coast are at the top, not the bottom of the gear.
- Question re West Coast retrieval: Do fishermen yank on the traps to get them out?
    - Yes, they go back and forth over the gear to get it out.
- Diameter of rope used:
    - 7/16, ½ inch, 3/8.
    - Traditionally, bottom shot is floating, used to have all floating lines with leads.
    - At least 4000 lb breaking. Get stuck whenever there's a storm. More frequently within 24 fathoms
    - We have control of the pressure we develop, will turn pressure down to 1500. Doing that will stop the block until boat more over the gear. Don't get it then, then it's stuck.
        - The muddy spots on the bottom move around. Bottom moves around. Dungeness targets soft bottom, because the crabs prefer that. Some shallow 9/16 line in WA. Sometimes can't pull pots in the muck, have to pump. Indicates the regional differences in the fisheries along the coast.

        - WA, your gear stuck to bottom up to 12 miles off. Shallow slope. Storms disturb bottom up to 180 feet down.

- A storm is relative, guys will fish 25-30 knots for days, high seas. Fishery fishes through a lot of weather. Because of the derby fishery, people rush to get the limited number in the quota.

LOG BOOKS

- Regarding log books. In a fishery where trying to save seconds, putting a plotmark on the plotter for every pot would be very time consuming; Wastes a lot of time for the fishermen, especially if running by themselves. Lot of time, costly with lots of pots. Need to consider that if trying to change the fishery

LOST GEAR/GEAR RETRIEVAL

- WA Derelict gear If had more time to get more gear, then they would. August 14th when the program starts, depends on state?
  - Every year when the season starts we still see a lot of lost gear out there. October can be bad weather. Summer has better weather with more people able to get the gear.
- In CA, can have 6 pots from other people onboard. Someone can pick up another person's gear, but it can take people time to get out there. If weather is good, why not let people take up all the pots in the area rather than getting the limit and then leaving
- OR has an in-season derelict gear recovery program. Up to 25 pots. 50 pots in the summer. Made rules so that they can keep the crab in the pot if it's in season to provide more of an incentive.
  - End of season, don't need to have a permit to pick-up gear, just need to let that person know you have their pot.
  - Get gear out before end of season, you won't lose it. Extra incentive to get pots out of there
- Efforts of both WA and OR to retrieve gear. End of season, go out and get it. No one goes out later in the season, state extended it until September. This time of year, pots starting to come in shallower from the deep water. Since five years ago, no one pulls in the pots that they used to. If we're worried about getting stray ropes out of water, have to do it in April and May when there is no NW wind. By September, it is too late because fishermen are working on getting their own gear prepared for the season. Would be important for both states to consider.
- Definition of derelict gear, because perceptions can change. His definition: gear left in ocean that causes havoc on ecosystems. Dungeness gear have biodegradable cords, so eventually degrades and can let crab's get out. "Lost gear" sounds better, otherwise derelict gives bad opinion to the public
  - Other programs have changed term to lost gear to lose the negative perception.
  - Lost gear possibly not major cause of entanglement, but could save a few, and the fishery benefits by getting these pots back. Other methods are going to cost the industry more potentially. Is like a win-win almost?
  - West coast fishes crab for short period of time, but the lost gear tangles all year long. Catches troll gear, etc.

DISENTANGLEMENT

- Does OR have a disentanglement team?

- Have a modest team. Limited capacity out of Newport. Very difficult to access the whale within a few hours. But retrieve a lot of calls about entanglements. Get 2-4 confirmed entanglements per year
    - Run programs about teaching people how to properly report whale entanglements? CA has program to teach fishermen about proper procedures, spread knowledge of protocol
    - OR doesn't have that, but NOAA has taken initiative to spread SOS hotline around
    - OR and WA desperately need additional capabilities compared to other areas. Want to get industry better engaged. Better for PR as well
- WA starting to get WDFW involved, getting more responders in the area. Better response gearing up

SEASON CHANGES

- Need to determine short-term goal and long-term goals. Since gear innovations will take time and their usefulness uncertain, the best thing we can do is reduce interaction time between the fishery and the whales.
- Early in season most crabs are caught in a short time period. Only a few boats fishing into the late spring and summer when whales are more prevalent. Need to consider this. If people fish during this time perhaps need additional limits on pots, gear, etc.

OTHER

- Should consider that there may be different solutions in different states, even different areas.

Workshop on Gear Innovations and Practices to Reduce Whale Interactions
Day 2 Notes

J. Co-occurrence model: whales and fishing effort. Lauren Saez (LS) (contractor, NMFS West Coast Regional Office, Protected Resources Division).

(See Presentation 7)

(Also see poster on same topic in Appendix 4 (Not shared at workshop) and http://www.westcoast.fisheries.noaa.gov/protected_species/marine_mammals/fisheries_interactions_assess_risk.html)

- Questions/Comments
  - We do not have gear models for CA Dungeness crab for our work done previously. We had to use common denominator across the coast- landings data. In many instances that is all we have. We would like to look at how this compares with some actual information.
  - In some ways, co-occurrence can get you away from the information you are after. Also, it is important to be identifying the areas that are most valuable to fishing. We would like to see where is the problem with the least fishing effort. Where can we have greatest impact with fewest detrimental fishing reductions. How do we get to that? We are looking at the seasonal picture, not just breaking into quarters. What are the hottest spots seasonally, even just by month? How do we break that into areas that would be least valuable to the fisheries with maximized benefits for the whales.? The goal is to have the most bang for the buck.
    - Also for sake of entanglement, do we think about amount of gear? But for fishermen, do we think about the amount of catch? We should be thinking about both spatial and time scale.
    - It will be a dichotomy of finding areas where gear fix would have limited impacts on whale populations. Look at where do we catch the least/poorest quality crab, etc. There are different ways in which we can use this data. Maps can tell us where to focus two different types of strategies.
  - If we are looking at monthly, I would rather look at weekly or bi-weekly.

K. Full group discussion:

Gear Innovations

- Gear expert: These four potential innovations: sinking or neutral lines; length of trailer lines; keep gear tighter; breakaway gear-- are appealing because they're the kind of innovations we can evaluate

- Some of the stuff that's been tried on the East Coast that doesn't seem like it will work here, we shouldn't waste time on.
- We don't even know how whales are getting entangled. If we don't know how and where whales are getting entangled, we don't know if innovations will work. Look at the East Coast ideas and think about if a modification to those ideas could make it work for the West Coast. With new technology, there are electronic switches that we can trigger if a whale is entangled – are there things like this we can develop – new things that haven't been done before?
- Has there been any evidence that breakaway gear works?
    - Maine Lobsterman's Association: If they're working, we wouldn't see them. There have been instances where the weak link was still attached to an entangled whale. If the weak link breaks, we wouldn't know it. The disentanglement team thinks the rope jams up in the baleen.
- WA Fisherman: It's hard to imagine a breakaway rope that will work for us. We run our gear at 2,500 lbs. of pressure. A lot of our would-be-interaction isn't when the whales are around. We've done things in the past few years to try to eliminate this. Where I fish, a lot of guys fish in Alaska in the winter. We've worked hard to eliminate the allure of spring crabbing – by decreasing the limits (weight) on catch. We're about getting it done and getting it done safely. I'd like to see a list of what we as an industry has done already to address whale entanglements.
- Gear expert: You have your best practices and already put that out there – that is an accomplishment. Eventually, you're going to run into something we all run into. Some of these things you say are common sense and eventually you might realize common sense wasn't so common. Research priorities would be valuable to inform what we can do.
- Fisherman: I think there are some things we can take off the list. Colored lines – we already use a bunch of different colors. There have been some studies – do we really want to go there? The Samson line is a good idea, but it is extremely costly and might cause more problems. On the breakaway gear – in itself it's not a very good concept. I don't know if something can be evolved – it seems like it would be very costly. Sinking/neutral lines – the majority of the industry has already embraced that very much. Mostly because they're stronger, eliminate a lot of the line off the surface, and they help with gear loss.
- WA Fisherman: In Alaska, floating line on the surface is already illegal and it seems to work.
- OR Fisherman: There's good reason to do further research on line profiles just so we understand more what will be the best set up for less entanglement. We fish four fathoms of floating line the rest is sinking weight. Most seasons, I don't use floating line. I think it's worth of research especially if we're going to entertain having a fishery in spring and summer. We can make that list a lot shorter than it is.
- When we think about gear innovations, we shouldn't think about it in winter time. There are different conditions in the winter than the summer. Maybe we need to think about things we can do in conditions when the whales are there. We need to get away from thinking about these changes when the ocean conditions are the worst.
- OR Fisherman: There has been a lot of effort from the East Coast. I don't know that I'm ready to drop colored lines. We heard yesterday they can't perceive color but they can see shadows. Is there a way to amplify that perception by a light under the buoy? What distance is it that a whale takes to turn? What is that reaction? There may be something yet. We've had incredible success in the shrimp industry using LEDs to keep smelt away.
- We need to think about these in the context of the summer fishery. These options might become more palatable when thinking about closures.
- Think about research – not necessarily solutions.

- The colored line is something we could have further conversations or research about. It sounds like the floating line used at the bottom is usually blue. In some of the entanglements in the past 2 years, the trap was very close to the whale. Is there floating line that's red or orange? Maybe that bottom section is the section to change to address what we've seen.
    - Sheila G (Gear expert): Yes
- WA Fisherman: We could consider dropping the multiple traps/trawling up concept. That doesn't marry up well with our West Coast fishery. It wouldn't play well with other fisheries. If we're going to drop any from the spreadsheet, it would be that one. The research ideas would be different from what might be a practical consideration in this fishery. Breakaway gear isn't a solution now, but with research there could be some benefit in the future. We do have some high areas of interaction where we could do that research.
- CA Fisherman: It's important to look at what happened in Monterey Bay because that's where most of these entanglements were. For you folks here [Oregon] this is more preemptive. So, the way they fish there, they're fishing on contour lines, not North-South lines. Do whales get more stuck in clumps of gear or lines of gear? The more we can focus on Monterey Bay where the actual problem has occurred…
- Fisherman: If you look at that list, the one that we probably could defend – that we know could change something – would be less vertical lines coming to the surface. In some areas, putting two traps on one vertical line might not work, but it might work for other areas. We could make some of these work, especially if the alternative is the season closing earlier.
- DL: Clarification about where the problem is. We've had a ton of reports in central CA. We don't actually know where those entanglements occurred. Most of the entanglements in Monterey Bay did not happen there. This is bigger than Monterey Bay.
- One category missing is better data collection. If people could get photos of entanglements and we could gather more information, we could inform other things. A separate category of something this group can do is a better job on data collection.
- OR Fisherman: We talked about marking the lines for our crab gear and we were supportive of that. It wouldn't take a lot of effort. That's not a big deal and it will help you guys.
- I want to go back to talking about seasonal adaptation of the gear. In the winter time, having the gear in a different way. That's a pretty valid point.
- I like the idea of seasonal gear adjustments. Has that been done in another fishery? How is that enforced?
    - Just like everything else is enforced…
    - The Atlantic coast has a seasonal management component to it. When they knew the whales were coming, there was a date that gear had to change – markings, sinking line, etc. The downfall was it was inflexible so they couldn't change the date based on when the whales were coming or leaving. Those methods work but the key is to have some flexibility.
- LS: If we were marking the lines and gear better, that might really help us identify the fishery the gear belongs to – especially because there is often only line. We have a lot of unknown gear.
- Trawling up concept – if you reduce the number of vertical lines by half, you aren't necessarily reducing the risk to whales by half. It might lead to entangled whales dragging multiple traps, which can lead to them becoming anchored. Given a lot of fishermen are not supportive and it could be bad for the whales, we might want to take that off the table.
- Whale Expert: One recurring theme is our lack of knowledge about how whales respond to the traps or line. I've been using drones to fly over whales and we'll see them go right past crab

pots. I have 10 instances of this from the past summer. They go right past it or sometimes veer away. It might be a good tool to look at their response.

- Monterey Bay is the perfect storm conditions because warm water was closer to the beach and the krill was off deeper. In this day and age with the mobility of the fleet, the traps can get concentrated.
    - I fish in Monterey Bay and they don't set them in clumps.
    - When gear is set so close together it might be difficult to navigate
- We're talking about vertical lines and other things. One of the things that's lacking is a very good description of our fisheries occurring later in the season during the time where interactions can be higher. In WA, we have times where we shut the fishery down outside of 4 miles so there are things that are currently being done that could coincidentally help lower the number of entanglements. Understanding how the fishery dynamics change during the season might already be getting us towards some solutions. We should better understand this so the people looking at it appreciate that these things are already occurring.
- Breakaway gear – Don't write it off. The standard weak links might not work for a lot of cases. Maybe the solution doesn't exist yet, but the concept might work with more development. It might be one of the tools. The other thing – acoustic deterrents are something that may need more research. There are devices that listen for marine mammals and can send a signal when they are detected. Maybe we need more research on this. We wouldn't need them on every single line.
- If it's vertical lines we're worried about and when whales are there. I think you need to see a map of our industry. In WA, we fish to close to 100k pots. By the time we get to April and May there's considerably less pots (less than 25k). In June, there are even less. We should look at reducing pot limits. For multiple traps on a line, we wouldn't know where the other end was and we what it actually accomplished? If we do something, how much did it really help us?
- You have to realize the reason that [conditions in Monterey Bay] happened was demoic acid last year. That could easily happen up on the North coast.
- We have this list of things and we have a problem. We don't know if the solution is on this list because we don't know if they'll help. We can look at that stuff but is it going to solve this problem? For research, we need to be able to come up with new ideas.
- As we go forward, I would like to make sure academia/scientists include fishermen and include the practical end of things. Work with the fishermen to test things. Work parallel with the industry so it's realistic. Talk to the fishermen about the cost of the solutions.
- Maine Lobstermen Assoc: In terms of the evaluation, it's almost mission impossible. If you're going to take gear out of the water, you're reducing the risk of entanglements. We can test anything for operational feasibility but we'll still never know how it's going to act when a whale gets entangled. That's never going to change. "In the end, you have to fish. You have no choice." There are now scientists who say they don't know if sinking rope works. The industry has put a lot of money into that and it causes safety concerns. We can try all of these things that seem like they'll help, but you can't measure it.
- WA Fisherman: You've got your major players here – the crab industry. Demoic acid is a very serious thing. What do we do as an industry? We get together and try to figure out what to do. We, as an industry, come to the tri state meetings. We don't want the whale situation tying in with the demoic acid.
- OR Fisherman: The industry in OR wants a tool to make the fishery continue on.
- Whale expert: I've got a lot of ideas on research. It seems like it boils down to perception – what whales can see – and where they get entangled. In terms of how whales react and how they get

entangled, we really have to rely on the disentanglement data. Has anyone tried to do a cross region study focused on humpback whales? An in depth focus on the live and dead entangled whales could help. We need to know where that occurs, where on the whale the entanglement is, how the whale reacted.
    - DL: No, that hasn't been done. The West Coast is relatively new to this.
    - JC: It seems there are a number of situations that could inform our discussion and our research.
    - TW: There are at least three people in this room that say they're sitting on a lot of information where they observe people interacting with gear. In the Atlantic we have maybe two reports of the behavior when they interacted with gear. You have a huge dataset that can help us understand this behavior. We can plug this into some whale behavior models. I would encourage you to share that information and work with other regions.
- OR Fisherman: I thought I heard that virtually every whale has the marks of being entangled.
    - JC: It's about 1/3 to ½ of whales
    - OR Fisherman: Do we know the markings are from fishing gear and not from kelp or competition? Or from other objects? If it is from fishing gear, then that answers one of Randy's questions – we likely have a high survival rate.
    - JC: A substantial percent has encountered crab gear.
- NMFS (KF): We do have to be careful because we can't tell how serious an injury is and what is the actual outcome. The Working Group looked at all of the cases where there were known outcomes – that's mostly data from the Atlantic. There are different types of entanglements. We have data on known outcomes for certain kinds of entanglements. Almost all of the non-constricting (loose) entangled whales survived. Often we don't have data on the entanglement or the outcome. It would be great to take another look at necropsy reports or entanglement reports to tell how many are getting entangled. Would knowing when they make contact with the line and don't get entangled help? Do you think your tag studies would help with drone data – could that fill some of those gaps about how they are getting entangled and what part of the gear?
    - JC: There are things that can be done with operational studies and we have intention to do that. I've spent a lot of time trying to collect this data about whales. This kind of data would be very difficult to collect. In a place like Monterey where you have 20-30 boats at any time monitoring the whales…following a whale around is akin to sitting and watching a crab pot. When I think about perception – are there some non-threatening and non-lethal ways to test perception?
    - This could be the focus of a proper scientific study. All we have is anecdotal information.
    - JC: We have a tag data gives you 3D information. We have plans to do this.
    - LT: In coastal OR in one summer, we saw whales interact with gear (not get entangled). It [researching/observing] can work, but we shouldn't over promise the research we can do.
    - It [observational studies] would be very opportunistic. If there are a lot of whales swimming around the gear, we can go out and tag some of the whales.
    - We've identified a big data gap.
    - PN: There are some options that may involve working with fishermen to coordinate efforts. Maybe the fishermen can target areas with whales so we can get some more information. It gets tricky with permits. The last thing we want to do is catch a whale.

There may be some ways to improve our odds of getting good information on this stuff. It's going to require some input from agencies.

Lost Gear Innovations

- Lost gear changes will be better when we make the necessary changes.
- OR Fisherman: I had conversations early on for the guys who wanted to still crab to pick up lost gear. There has been a good Samaritan attitude so far. But it is a pain to pull up gear that has been down there for a long time. In the past, we have discussed a way to create a pool of funds to have a retrieval reward system, but it didn't go anywhere.
    - 1$ per pot to something for everyone that had a pot, would be $30,000ish. If things got to a certain level, we could initiate a tariff on floats. This would maybe initiate a desire for the skipper and crew to pick up the pots. They could split the reward, and splitting between deck hands could better motivate people to get gear out of the water while they are already out there. Would this be something for OR folks to consider?
    - OR Fisherman: Around 2007, we had some funding to hire people to go out of season and collect the pots. This was successful, as the pots that they gathered still had buoys on them, so it would be beneficial for the whales as well. This helped with late season lost pots.
    - OR Fisherman: A lot of efforts worked better with the salmon and the shrimp seasons, it allowed them to pick up the gear in season, rather than out of season.
    - Humboldt fishermen market association had a similar program that was very successful. They paid some people to bring the pots in. There were monetary benefits, and the fishermen made some money to bring the pots in, and the pots would then belong to them. There was a little bit of a loss, but the association was able to bank some money on selling gear back to owners.
- The system that we have had for recovery isn't bad (WA?), it's just late in the season. We have had people doing this for 30+ years, but it is better to have it running in April/May when have good wind blowing through to make it easier when there are actually people out there already.
    - You need to have good crew, otherwise it's not worth it for little money when spending a lot on fuel costs. People haven't really recovered pots in five years because of that.
- Is there a tool to locate the lost gear? Can we put it on a chart of some sort?
    - ODFW: Have done a similar thing in the past, but we don't have a mechanism right now. Occasionally we will get reports (ODFW).
    - OR Dungeness Crab Association: You can have a permit program and they start marking where the gear is, but they don't tell anyone where it is because they want to collect the gear and make the money off it.

Seasonal Changes

- This is what we have that we know will help. If we want to entangle fewer whales, this is all we have as a tool right now. This is how we make it better, and we should continue with research and then maybe we can return to where we were in the past once we have a silver bullet solution. In OR, the fishermen are here to represent their industry. They feel it is important, and

want to make the problem better. There is a lot of support from the industry to see some change.

- WA Fisherman: Important to recognize that we (WA crabbers) already have a reduction in the gear in the ocean as we move into the spring/summer. Some states close very soon in spring/summer. WA has had summer management in some years. I am concerned that we are not connecting the impacts of our current fishery practices on whales. It seems like the metrics as to whether or not radical changes to the fisheries need to occur are not there. Looking at the impacts that the present fishery practices are having, we may need to look at the regional way and not a coast-wide approach. However, we shouldn't re-engineer our fisheries based on a small impact from present practices or by the benefits that we do not know will occur from changes. I caution radical restructuring of fisheries practices. Long term, I understand that changing our seasons can help with the whales, but I don't think we are there yet for OR and WA. We want to see what the truth of our fisheries are. There were only 20 boats in WA fishing in August, while there were probably 200 boats at the start of the season. Reduction is already happening, so we just need to be cautious.
    - Sounds like we are creating a business plan. Scientists seem to be leaning towards changing gear. Industry seems to want to change time of year. Changing the seasons is a legislative effort, and we as a community can't just decide that we want to change the seasons. There is already an effort in changing that in WA.
    - OR would do Fish and Wildlife Commission, CA and WA would be federal. It would be a contentious issue to tackle.
    - Does CA also have a decrease in effort later in the season?
        - Yes, quite reduced, but there is a new facet of guys who have new permits with no other fisheries, so there has been a recent increase in spring fisheries. But lot of gear taken out of the water in the spring still.
        - There is no regulation in reducing for catches for soft shells or to lower quotas for weaker months. It is left up to the fisher and the buyer as to the prices for quality.
    - OR Fisherman: We are here today because our fisheries aren't doing well enough. This is the tool, and we feel that we are being proactive if we experiment with some gear changes. We don't have much confidence with them. Recent headlines with CA crab fisheries and whales are giving us a negative public image. Our brand has been damaged from demoic acid, and this is damaging the PR of our good product. Headlines like this are similar to dolphins in tuna nets and the ruining of that industry. With modern technology moving fast, we need to be proactive on this front, or we may find consequences with things that have nothing to do with regulations or lawsuits, or we are simply ruining our brand past the point of return.
        - I agree. If we wait too long. It will be far greater of an impact than the little bit we will lose from limiting our seasons slightly.
        - We have season-managed fisheries, so subtracting time is a little more doable than somewhere like with lobsters.
        - WA Fisherman: I am not against closures, it is just hard to deal with things like fishing for soft crab. It's not about me, it's not about you, it's about our constituents that we represent. We don't want to come out of here feeling like

we need to do something right now, there are a lot of families relying on this. It will be a slow process, but this is a great start.
        - Departments need to handle press better. When information is released, you need to think about how you release it. We need to have thoughts as to how we put out our information.
    - Gear expert: OR and WA are okay right now. CA has to do something. Ultimately, it is a Dungeness crab fishery as a unit. CA is not quite with their back against the wall, but they are close.
    - DL: All fixed fisheries are part of the problem, any gear that is on the west coast and sitting and entangling whales is a risk. Everyone needs to think about reducing entanglement problems. Don't wait until you're under the gun, because it is hard to get out from under it. The situation in CA is a little more elevated, but the "gun" of public perception across the coast might be better than regulatory gun. There is a large proportion of entanglements that are of unknown gear. But no fishery that puts gear in the water can think that they are not a part of the problem.
- For seasonal changes in the gear itself, if we have identified gear changes that might be beneficial. It is not worth using less efficient gear in winter when whales aren't around.
- WA Fisherman: There is a place for us to endorse gear and season innovations. But we need to be cautionary of more radical solution at this junction. I am not saying that I overlook the problem. Need to recognize that there are regional differences between the coastline of the west coast. Management should recognize and look into these regional differences
    - OR Fisherman: There were demoic acid delayed fisheries a few years past in CA. Could be a factor
    - DL: I don't disagree that it could be a factor, but there are a lot of factors. There is a regional acknowledgement that crab fishing and entanglement risk may vary. But as a whole, it is recognized that the industry has a problem. Everyone wants to focus on a regional/local method of approaching solutions.
- OR Fisherman: I'm assuming there isn't reduction management later in the season for CA. In this era of climate change, every year is different. The consequences of climate change will be felt from now on. I worry that with limitations on salmon trawling, there could be more people clinging to late-season crabbing since it is their only option for income.
    - WA Fisherman: News releases like gear reductions later in the season are what should be released rather than "another whale entangled". Where are the humpback whales? Out at 80 fathoms, we have almost zero gear in the water there and during that time. That is huge, and people should know about it.
    - We can't control the media, and we never can.
    - Tribal fishers tried to fish in WA during a demoic acid outbreak further south, and they couldn't sell their crab because of the bad press from the CA crab even though the bad crab were from a different state. From a public perception, it is a west coast problem, and it is the coast as a whole that needs to cut down on the problems.
- OR Fisherman: Have you seen (fishermen) areas over the spring and summer where there are more/less whales where there could be potential for depth area closures?
    - We do in WA, WA does depth closure, but not always.
    - OR sees so few whales during crab season, so it is hard to pick.

- OR Fisherman: I see more and more gray whales every year, and I see them at all depths, even out to 40-50 fathoms. I hadn't observed humpback whales for most of my career, but 3-4 years ago I began to see them on my fishing grounds. This is a new thing, and I'm on the central coast.
- OR Fisherman: I haven't seen them in areas central to our fishing. I see them when they are migrating. They do seem to travel a highway of open area at times, sometimes we are crabbing on the other side in shallower areas and they pass just outside of me. They seem to have a sense of where the gear is, and they go in between it. I've had to turn my boat off and let a few whales by, and they seem to know where the gear is and where to go through. Gray's seem astute to where things are, humpbacks seem so busy on feeding that they really don't know where they are.

<u>Research Questions</u>

- We should be separating things that we might do under best practices that are different than things that might be good to investigate under further research. Are there benefits to research developing breakaway apparatuses? There are some areas that might benefit from this research since there are high interactions with whales.
- There is a need to Identify which fishery, and where the gear is getting tangled.
  - Need to do a better job on data collection.
  - We don't have good data of our fisheries occurring later in the season when there is the most risk of entanglement. 2/3 vertical lines are removed before whales are migrating through. There is soft-shell management in WA, and there are months in summer when the fishery is shut down. There should be a better understanding of how fishery dynamics change during the season. We might already be getting towards the goal of some of these innovations.
    - Good impacts of management decisions might already be occurring, just under a different umbrella.
- Look at whale behavior with crab pots. Using drones and aerial surveys to see their responses to gear and lines in the water
  - How respond to color, etc. gather more data to use in decision making
  - Saw some whales interact—not get entangled
- How to quantify results, show that it is making a difference and helping? Need to be able to interject new ideas as ideas come up.
  - Very hard to measure this. You can make a lot of innovations, but you will never really know how/if things are working.
- Lot of questions boil down to how whales perceive the gear, and where and when they get entangled.
  - For where/when, we really need to rely on the entanglement data from NOAA. This is probably species dependent. Has anyone tried to do a cross-region analysis (humpback and lobster in Atlantic?), as this could yield some useful insights as to where on the string the entanglement occurs. We haven't seen a multi-region, species specific approach.
  - It could be helpful to us to understand where specifically the break-aways should be, for example.

        - We haven't done that yet. West coast is essentially a brand-new data source.
        - There are people who have data about whale interactions with gear. It could be useful to allow us to plug behavior into whale-swimming models, and allow us to see how whales might interact with gear depending on various scenarios. Those with this behavior data should share it so that it can be applied widely.
    - What part of the gear are they getting tangled in? Could diver observational studies be useful?
- Are there non-invasive non-lethal ways to experiment with whales and gear?
    - Probably would never get the permit to do this, but would be a good way to see exactly how everything works together
    - Things like aerial surveys and drones have their limitations.
    - Can't overpromise the benefit that these methods would bring. Everything is dependent on conditions, but could help to close the data gap.
- Working with fishermen as a coordinated effort is important.
    - Are there areas with lots of whales that are not good fishing grounds? Can we make efforts to fish there when whales are there to get some interaction data?
        - Things are tricky there with permitting. The last thing that someone wants is to actually catch a whale. But this would require cooperation from both fishermen and the agencies distributing permits.
- Map of lost/abandoned gear

<u>Discussion about Research</u>

- Consequences of doing nothing are a lot more than losing a few pots. There is a risk of losing pots, but less of a loss than a portion of their season
    - Enforcement can tell if you have recovered pots
- Working on combining overlapping categories
- Need to understand where whales are, and oceanographic conditions. If we had that, then we would be way ahead.
- Data gap
    - In WA and OR we have the number of pots in a string and their location. I know CA is working on setting up on some kind of log book. Might be a good data gap to address. If there is anything we can incorporate into OR and WA logbooks to make it easier to consolidate all the coast's data, then a system could be accessible by all.
- If you remove gear from a whale, you will be able to use a tag, brand of gear, etc. to find the owner. If you have the size of the rope, then it can tell us more about where and how the gear was placed.
- Do you document where on the whale the entanglement is?
    - DL: We put everything reported to us in the notes.
    - Try to mark on the gear, where it is on the whale.
    - DL: It's rare we can recover all of the gear. We've been trying to recreate the entanglements based on the information provided so we can think more about how it happened. It's a lot of information that is difficult to record. We need to encourage the reporters to collect more information

    - Whale expert: This is something we're going to communicate - the information we need from reporters. We will be capturing more information up front.
    - OR Fisherman: Be careful when determining the actual position of contact. The rope is going to slide through the mouth. It's hard to know if we're going to be working away from entanglement or creating more because we don't know where they are becoming entangled.
    - DL: We've had some whales that were sighted multiple times during their entanglement so we now have some of the first data points on how the entanglements change.
    - Do whales tend to swim with their mouth open? Whale expert: Humpbacks are lunge feeders so the tend to open and close.
- Are we all on board with marking our gear? How frequently do we need to mark the line?
    - Maine Loberstermen's Association: It's a difficult question. We thought about making it visible from the air. We went with 12" at the top, middle, and bottom. Defined segments were onerous for the industry. There might be a tracer that can be put into the rope. We started developing a microtag that can be embedded in the rope. When we had the 4" mark in the center of the line it was never recovered from a whale but with the 12" mark, that has been recovered. They tend to lose the top of the rope and they tend to lose the trap so we need to get the middle.
- OR Fisherman: I'm guessing there is enough of a market for lines, you can't keep lines forever
    - We were told that too. If you come up with a color that works, people will go for it.
    - Gear expert: changing the color of the rope, putting a tracer in more doable; the tag thing might be something more difficult to adapt
    - OR Fisherman: painting ropes, when we have coils in the rope, we can dip sections so that every 3-6 ft can have markings. Wouldn't be a huge cost or time consuming. Another thing: Doubts as to how far whales can see. We also have surveyor marks that are very bright, might do some testing in areas where you can put them on the lines. Could experiment.
- WA Fisherman: Do whales look, or do they use sonar
- Whale expert:
    - Toothed whales echolocate, so don't use sonar
    - Do whales see forward, or on the side. Whales I've seen suggest see on side
    - We don't fully understand
    - Whale expert: They are able to perceive something is in front of them but they have to turn to the side to actually see what it is
- JC: In terms of survivability, we'd need some follow up and scar studies of live whales.
- RF (PSMFC): What happens if you could go fishing earlier? This may be worth a discussion. If you can start earlier you can quit earlier. Might be a tri-state discussion
    - I think a lot of people who are crabbing are crabbing because they don't have anything else to do. Would still have people out there
    - Not as many, however.
- WA Fisherman: In WA, the fishery is co managed with Tribes. The likelihood of us being able to move an opening earlier across the entire state of WA, probably can't be done. We haven't been starting before January, by agreement, for many years.

- Notes, presentations, etc. from the conference will be emailed out or put online for everyone to have access to
- Fran will work to get a press release out about this workshop and what kind of work has been done.
- Gear Expert: If you want to look more into what has been done, look at Tim Werner's website: bycatch.org and the Maine lobstermen's website.
- CA whale working group is meeting in May. Think of things individually to put on the agenda.

L. Participant survey of potential approaches

A survey was handed out after the discussion. Participants individually filled out the survey to note their thoughts on the practicality, acceptability, and cost of potential gear ideas and other solutions. 36 people returned the survey. The results have been transcribed in full onto a summary form and organized by state or region and are in Attachment 6.

Two additional presentations were given, since time remained after the surveys were completed.

M. Whale behavior videos: John Calambokidis, Cascade Research Cooperative, showed videos from their group's placing forward and backward looking cameras of whales (mostly humpbacks) and showing the whales' behaviors, including as they interact with each other.

A few videos: https://www.youtube.com/watch?v=aaS02X4EdV0

https://www.youtube.com/user/CascadiaResearch

N. Review of Marine Mammal Protection Act: Dan Lawson, NMFS West Coast Region, Protected Species

Dan provided information on the provisions of the Marine Mammal Protection Act; how the number is calculated that determines the level of take that triggers action (from all causes) and how fisheries are classified, based on their interactions. (Additional regulations would come into play with the Endangered Species Act, but there was no time to discuss that.)

NOAA does marine mammal stock assessments. It's an evaluation of what we know about the abundance of the stocks of whales. Stocks are determined and evaluated under the Marine Mammal Protection Act (MMPA). The stock assessment reports are updated every year– but in reality, each stock

gets updated every few years. They are all available on the NMFS site. The assessments go through a Scientific Review Group. The draft is put out to the public for comment then a final version is put out.

Karin Forney (NMFS, SW Science Center): Potential Biological Removal (PBR) – A concept that takes into account we'll never have all of the information for the stock assessment. It captures uncertainty to allow managers to make decisions. As your information gets better, the limits get higher. It is a calculation of the minimum number of animals times ½ the estimated population growth times a recovery factor (this includes the growth rate of the animal). With humpbacks, there is an added uncertainty because the whales are only in US waters half of the time. So, the PBR is halved.

- DL: It's the actual removal from the population aspect that we're actually tracking under PBR– serious injury and mortality from these entanglements.
- As our whale populations reach capacity, are we adjusting that growth rate?
  - Karin: The number in the formula is the maximum growth rate when the whales are at about 50% of their maximum population.
- WA Fisherman: What is this "stock" of humpback whales?
  - DL: CA, OR, and WA stock. In the future, there will probably be changes to these stocks based on how we are now seeing populations of humpback whales. This WA, OR, and CA stock is under the MMPA. Under the ESA, whale populations are identified differently. We now have the endangered Central American population of humpback whale and the threatened Mexican population. Further north, there are unlisted populations of whales coming from Hawaii. We're going to have some very complicated issues to deal with under the ESA. The estimates going into the PBR assessment are estimates of how many animals are here along our coast, not how many are down in the breeding grounds.
  - KF: The ESA versus MMPA… The language in the laws are not completely compatible. The ESA is really looking at breeding populations. The MMPA requires we retain them throughout their range. The ways we think about managing stocks under the MMPA has to be different since we have to manage for their entire habitat area. We will be reviewing the stocks over the coming year with the new information that just came out under the ESA.
    (See Appendix 5)
  - JC: Defining these stocks is very difficult.
  - WA Fisherman: Have you considered the rate of what goes forward and the PBR rate of fishermen is? When you keep putting a pinch on fishermen it puts a certain degree of insanity in the fishery where fishermen don't look at their personal safety because fishermen have a responsibility to feed their family. There's a potential for takes on fishermen when you push them too hard. We should have a PBR listing and an ESA listing for crab fishermen. The fishing deaths don't seem to matter.
    - DL: The PBR doesn't take into account fishermen. I have taken into account the fishermen. I've been talking to you about being proactive before regulation comes down.
- Once you've developed a PBR for a species, how do you determine how that number gets divvied up for all of the different human uses? Dan: I'll get to that.
- KF: This PBR number was designed to not be the ax that comes down. The PBR is a number that tells us we need to start taking a closer look. It was designed to be a flexible process that includes industry.
- How do you document the PBR?

        - DL: There are a variety of information sources used on the abundance side of the house. Resources have gotten slimmer so we can't do abundance surveys as often. We look at other whale research. We take the best information available to construct that. We try to calculate what will be a biological removal without impacting the population.
        - WA Fisherman: How do you document 11 removals?
- DL: Based on information from fisheries observer data, entanglement reports, etc. the marine mammal stock assessment shows data from the last five years. There is a very formal process, laid out in national guidelines, to assess if entanglements or injuries would lead to mortalities.
    - This particular table is looking at fisheries. Looking at specific fisheries is important when considering the management side of things. We have information on ship strikes, as well as other sources of information
    - Stock assessment is about this is what we know about the animals, this is what we have
        - KF: Data type: tells us where the information is coming from. So an observer comes from an observer program sighting. We try to document precisely exactly what those data sources are. We compile all the data sources, and when the summed total is compared to the PBR, then we can know if there is something we should be concerned about.
        - Where are we today as far as our total of 11?
- DL: On the fisheries side, we're currently at 5.3 per year. So, we're under. This is the draft 2016 report. This is fishery entanglement data through 2014. We know we have a large pile of humpback whale entanglements in 2015 and 2016. The average over the next few years is going to creep up. We are not sure yet how these big numbers of entanglements will be added ti the average until the data are vetted.
    - JC: It seems pretty inevitable once you include 2015 and 2016 that the average will go above PBR. For fisheries that have observers, the observed number is adjusted. These numbers are being documented in a way that benefits the fishery.
    - What about the base stock of humpback whales?
    - JC: Some of these problems have increased because we have more humpback whales. Some of this is the result of them reaching carrying capacity. It still surprises everyone how dramatic the number of entanglements has been.
    - From what you've seen now, do you see the base population dropping?
    - JC: I think it will stay stable. In the 90s, gray whales reached their carrying capacity and there was a large die off so the population dropped then stabilized.
- DL: The MMPA has a regimented way of monitoring called the list of fisheries. Category III is the lowest level. This is all an evaluation relative to those PBR levels. These levels are fishery-specific. We're relying on what we know. This information about the List of Fisheries and Fishery Categorization is on the web at: http://www.nmfs.noaa.gov/pr/interactions/fisheries/lof.html (Also see Appendix 6).
- The level takes into account the average of annual mortality and serious injury. Category III is less than or equal to 1% of the PBR level; category II is between 1 and 50%; category III is greater than or equal to 50%. The MMPA generally prohibits the take of marine mammals, but there is an exception for commercial fisheries (outlined on the website).
    - Reporting requirements for Category I & II:
        - All vessels must be registered with NMFS.
        - Each vessel must have a decal
        - Observers can be deployed

        - Take Reduction Planning – If a take reduction team is convened, you must comply with the reduction plans.
            - Once the team is convened, the plan must be developed in 6 months. The main goal is to get the fishery to a category III.
    - There isn't an explicit trigger for creating a take reduction team (TRT). The team provides recommendations to NMFS to make regulations, where necessary. We will be faced with decisions if any of these crab fisheries become Category I. The best defense against a take reduction team is probably what we're doing now – being proactive and working on this.
- How does this being a state management fishery play into this?
    - DL: The list of fisheries covers all commercial fisheries. The TRT is a federal process, but can cover state mandated fisheries. Any regulations made under the take reduction plan will be federal regulations. There wouldn't be a need to wait for states to change management laws. Decisions by the TRT are consensus based. The teams are made of fishermen, scientific community, state managers, NMFS…It's a very challenging process. It is in our best interest to try and avoid this process if we can.
- DL: Every year, usually in the summer, we put out the proposed changes to the list of fisheries. We are currently thinking about what we want to change for the 2018 season. The process includes opportunity for public comment.

Other websites for more information:

http://www.fisheries.noaa.gov/pr/interactions/	(Links/info for protected species interactions)
http://www.fisheries.noaa.gov/pr/sars/	(Marine Mammal Stock Assessments)

The Taylor et al. 2000 paper (in Attachment 7) provides an overview of the MMPA management framework and PBR approach. (This paper was provided as background AFTER the workshop and not reviewed).

APPENDICES: Additional information

(relevant information, but not provided or discussed at workshop)

Appendix 1: Lauren Saez, NMFS Protected Species, Entanglement Photographs
Appendix 2: Dan Ayers, WDFW, gear retrieval
Appendix 3: Kyle Antonelis, NRC, photos pump, line cutter
Appendix 4: Lauren Saez, NMFS Protected Species, poster: co-occurence
Appendix 5: Federal Register: Humpback Whale Endangered Species Act changes
Appendix 6: List of Fisheries: classifies commercial fisheries based on level of interaction with marine mammals.
Appendix 7: Taylor et al. 2000, scientific paper on Marine Mammal Protection Act
Appendix 8: Blue whale feeding video
Appendix 9: Press release about workshop