

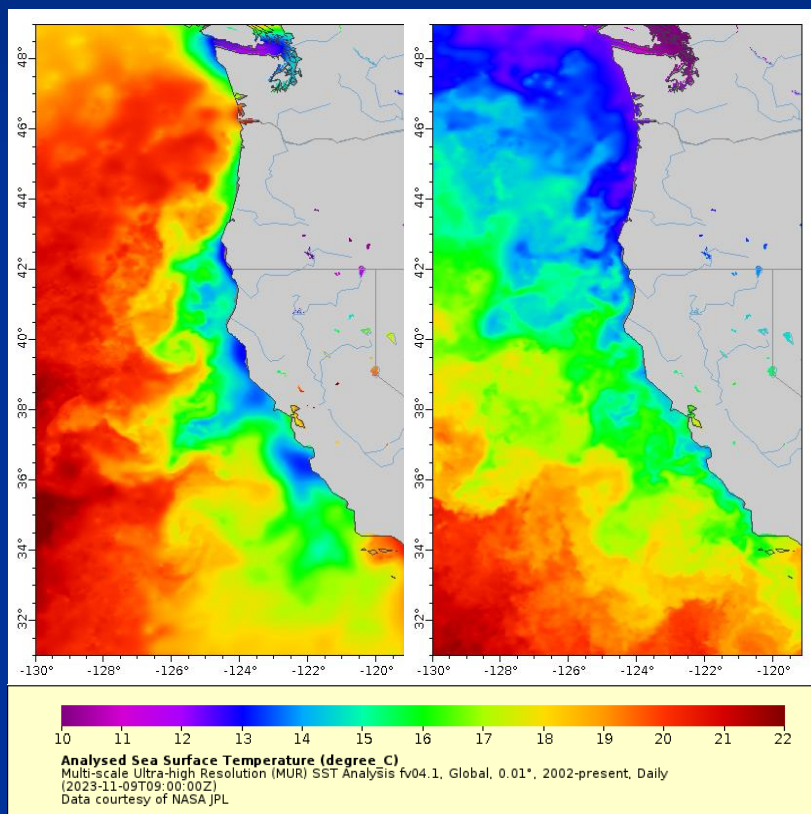


Assessing and mitigating entanglement risk of humpback whales in the dynamic California Current Ecosystem



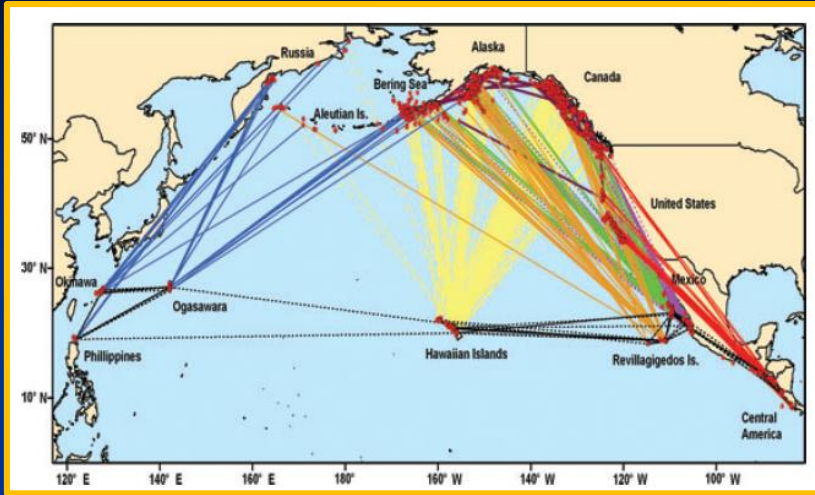
Karin A. Forney

NMFS Southwest Fisheries Science Center and Scientific Advisor, Marine Mammal Commission

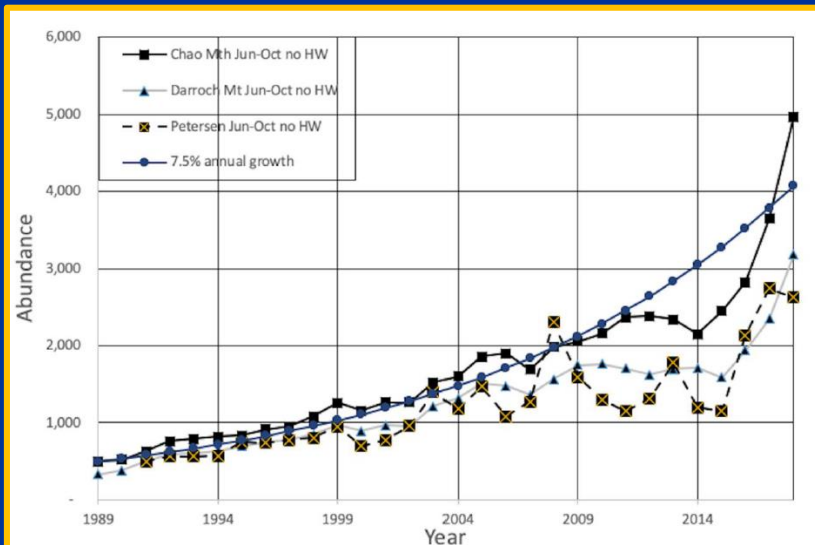


*Marine Mammal Commission Annual Meeting
14-15 November 2023*

Humpback whales in the CA Current

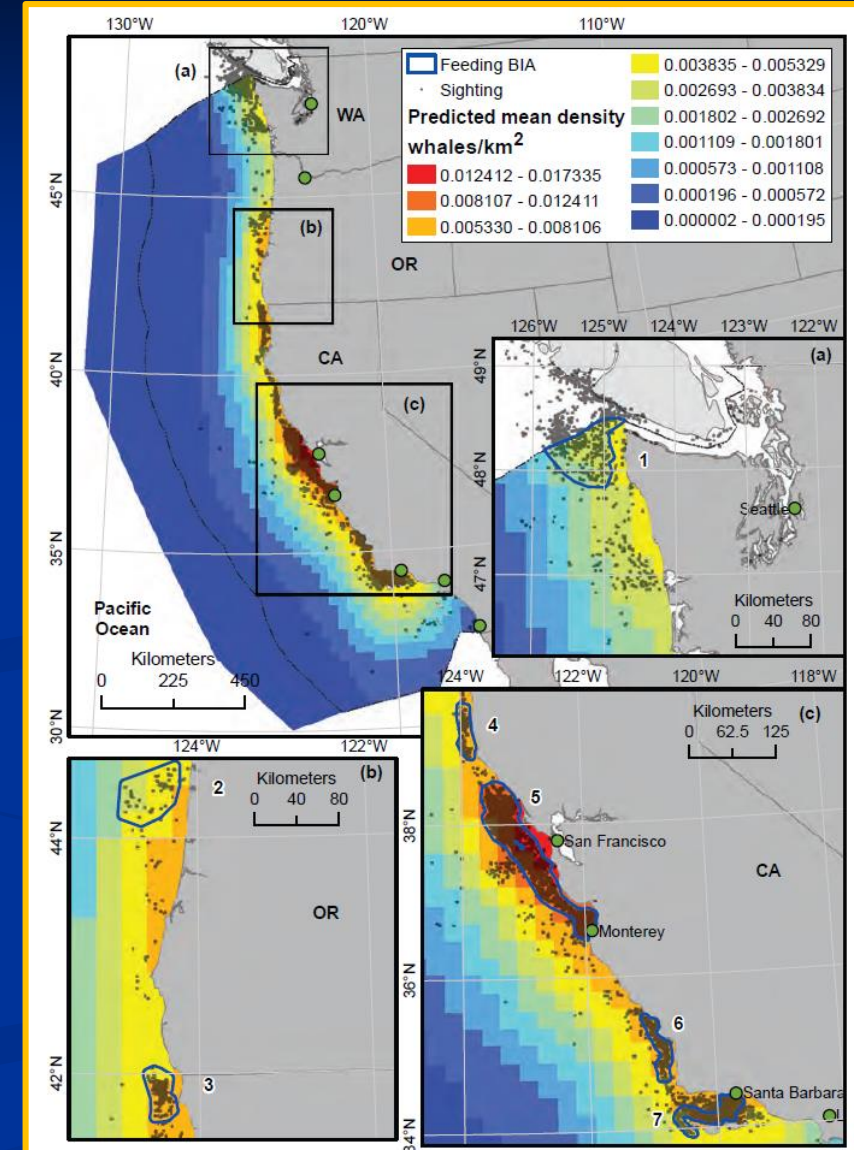


Barlow et al. 2011



Calambokidis and Barlow 2020

- Whales that forage off CA, OR, WA are mostly from two Distinct Population Segments (Central America, Mexico)
- Populations recovering from past whaling
- Biologically important areas (BIAs) have been identified off California, Oregon and Washington
- Mostly shelf/slope waters

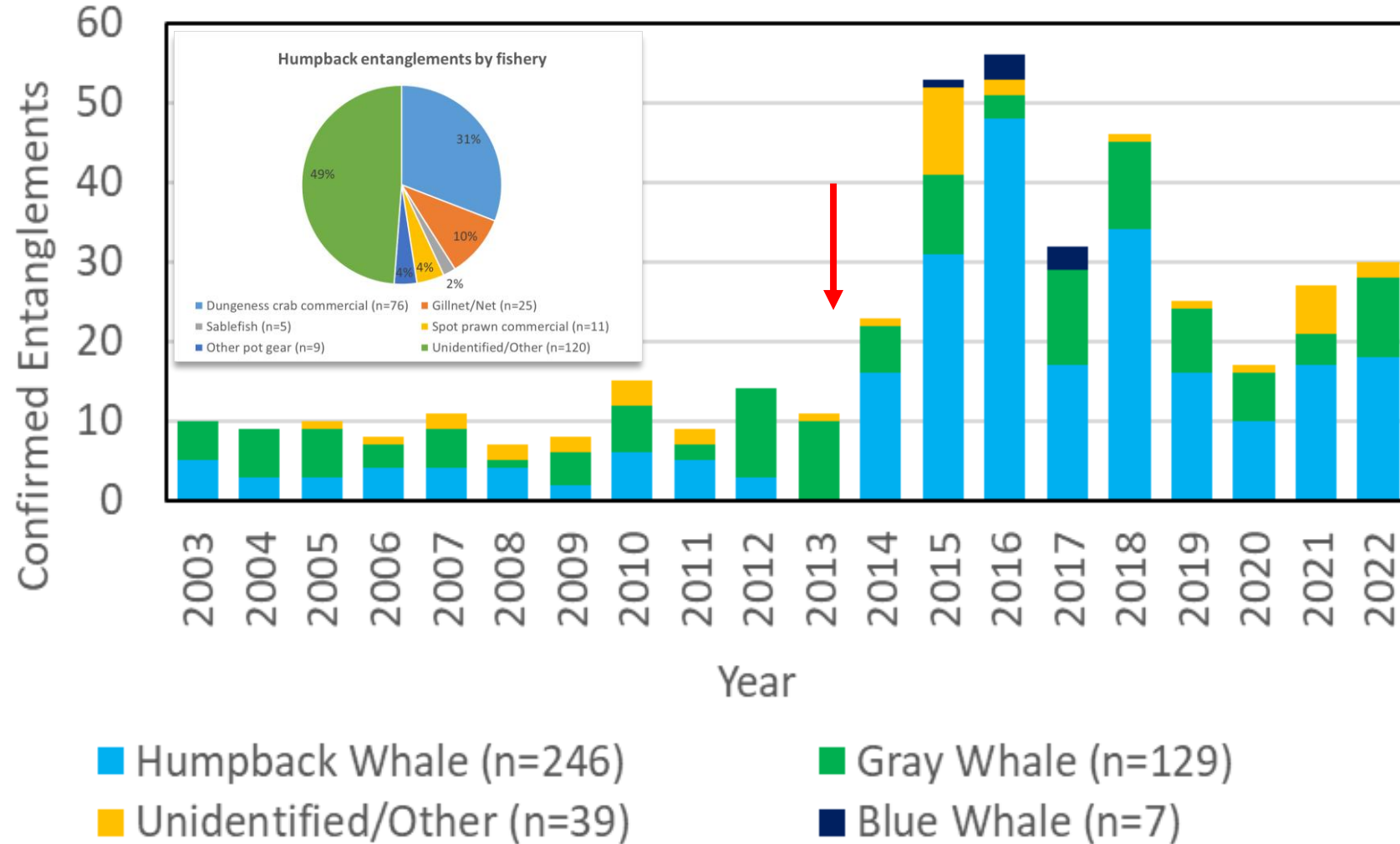


Calambokidis et al. 2015

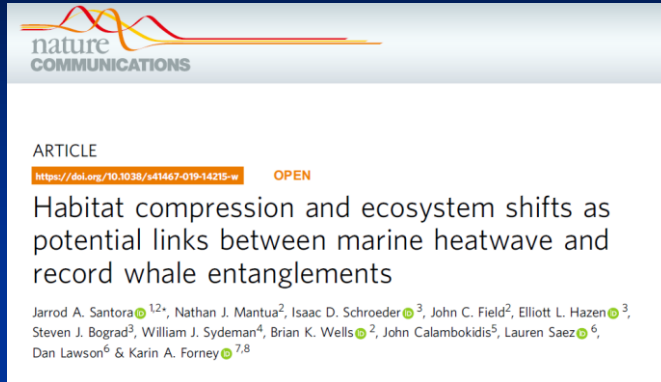
Confirmed Whale Entanglements, 2003 – 2022

Source: NOAA West Coast Region

Saez et al. 2013

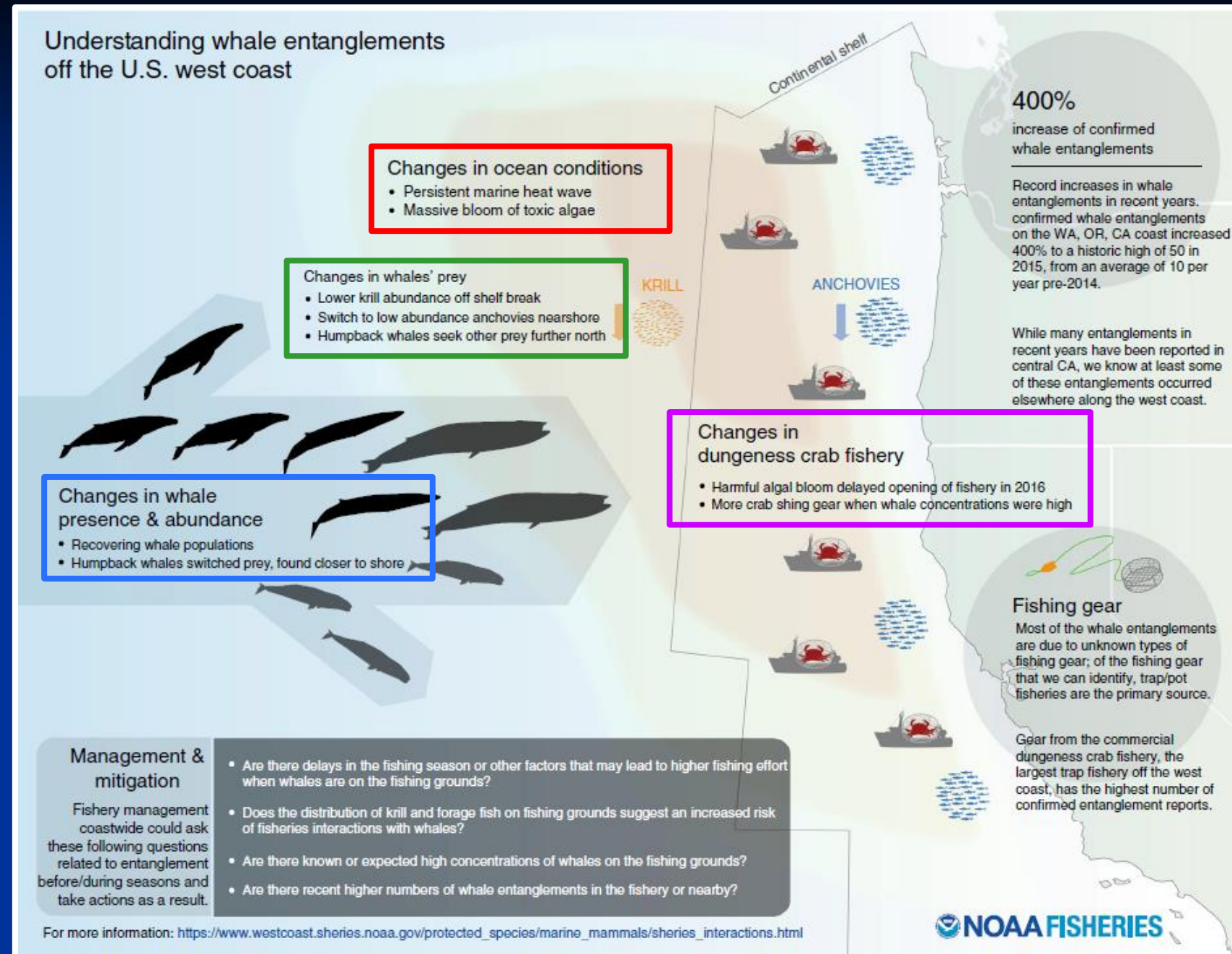


Complex causes of entanglement increase



Santora et al. 2020

- *Marine heatwave and habitat compression 2014-2016*
- *Prey changes (offshore krill vs. nearshore anchovies)*
- *Expanding populations, seasonal migration patterns*
- *Fishery delays / toxic algae*



Assessment and Mitigation Strategies: CALIFORNIA

BEST PRACTICES GUIDE
FOR AVOIDING MARINE LIFE ENTANGLEMENT
IN THE DUNGENESS CRAB FISHERY
Last updated: October 2023

Best Practices For All Crab Trap Fisheries

- Minimize knots, leads and scope
- Reduce slack surface line and keep vertical lines taut
- Avoid setting gear in the vicinity of whales and sea turtles
- Communicate locations of high whale activity to other fishing boats
- Promptly remove gear not being actively fished
- Maintain gear to ensure lines and buoys are in good condition so they do not break and get lost
- Frequently check traps and remove traps when whales are foraging in the area

Best Practices for the Commercial Trap Fishery

Water Depth	Best Practices Surface Gear Length
< 30 fathoms	Shortest possible - 3 to max (18 ft)
30-50 fathoms	Shortest possible - 4 to max (24 ft)
> 50 fathoms	Shortest possible - 5 to max (30 ft)

Commercial Trap Fishery Regulatory Requirements

- Up to two trailer buoys and one end marker buoy
- End marker buoy attached to ≤ 3 feet of line

Water Depth	Regulation Surface Gear Length
< 35 fathoms	≤ 4 fa (24 ft)
≥ 35 fathoms	≤ 6 fa (36 ft)

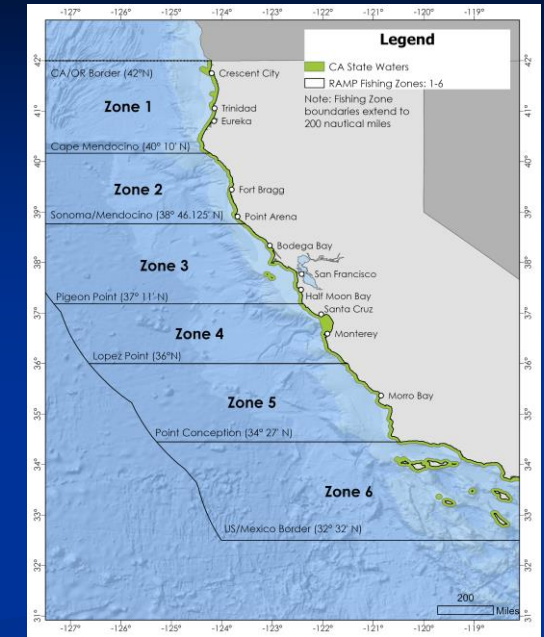
Recreational Trap Fishery Regulatory Requirements

- Purchase an annual trap validation if using crab traps
- Raise, clean, and empty (service) traps at least every nine days
- 10 trap limit

Initially developed by the California Department of Fish and Wildlife (CDFW) and National Marine Fisheries Service (NMFS) in collaboration with the California Dungeness Crab Fishing Gear Working Group and Ocean Protection Council.



- ✓ **Best Practices Guide** for fishing communities
- ✓ **Alternative Gear Development and Testing**
- ✓ **Derelict Gear Retrieval Program**
- ✓ **Recreational Crab Fishery Regulations**
- ✓ **Draft Conservation Plan (released 2021)**
- ✓ **RAMP: Risk Assessment and Mitigation Plan**
- ~Bi-weekly evaluation of risk (Oct-May):
 - Year-to-date entanglements
 - Marine life concentrations by zone
 - Ecosystem indicators (Prey, habitat compression)
 - Fishery dynamics
 - Working Group recommendations
 - CA Fish and Wildlife Director's Decision
- ✓ **Update to RAMP regulations planned in 2024**



<https://wildlife.ca.gov/Conservation/Marine/Whale-Safe-Fisheries>

Assessment and Mitigation Strategies: OREGON

Best Practices Guide

Oregon Commercial Dungeness Crab Fishing Directive to Minimize Marine Life Entanglement Risk

Recommended by the Oregon Entanglement Advisory Committee
Last updated November 2022



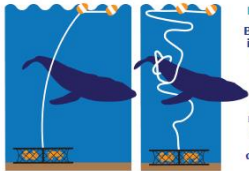
Reasons for Directive

Since 2014, there has been an elevated number of marine life entanglements in fixed fishing gear, particularly in commercial Dungeness crab gear, along the U.S. West Coast. This increase has been driven largely by interactions with humpback whales, including animals that are listed as threatened or endangered under the Endangered Species Act. This situation threatens the stability of the fishery and coastal fishing communities. These best practices are an important, proactive way that the Oregon crab fleet can help to reduce the risk of marine life entanglement and continue to harvest crab.

Best practices during the crab season

The best known way to reduce risk of marine life entanglement is to **reduce the amount of gear** and line in the water during the spring and summer months, when threatened species are in the area. To that end, **remove any gear that you are not actively tending** during the season, ensure you are meeting the 14-day landing requirement, and promptly remove all gear from the water when finished crabbing for the season.

- Use the **minimum amount of scope** required to compensate for tides, currents, and weather.
- When moving pots to shallower water, shorten the length of pot lines by adjusting shots to **maintain taut vertical lines**.
- **Minimize surface gear** and ensure no excess line is floating at the surface. Floating line should only be between the main buoy and trailer buoy(s).
- **Minimize knots, splices, and leads** when connecting buoys and lines, especially in the upper portion of the gear.
- **Avoid setting gear in the vicinity of large feeding aggregations** of whales, especially humpback whales.
- **Communicate the locations of unusually high whale activity** to other fishermen and ODFW.
- Ensure **all gear markings are clearly legible**, as required by regulations, to help identify the origins of lost gear and gear involved in entanglements.
- **Promptly report entangled animals** to the NMFS entanglement response hotline and follow all NMFS reporting guidelines (see back of Directive for more reporting information).

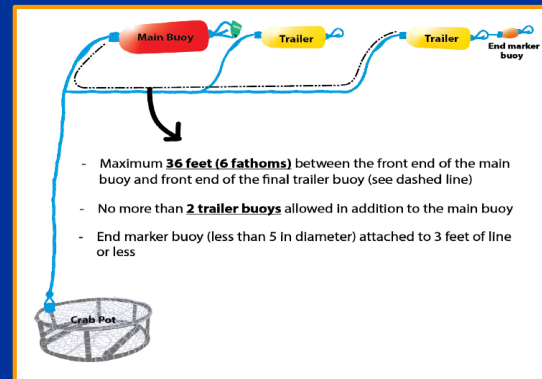


REMEMBER—
By regulation, it is unlawful to use crab gear with more line than is reasonably necessary to compensate for tides, currents, and weather.

https://www.dfw.state.or.us/MRP/shellfish/commercial/crab/whale_entanglement.asp

Regulations:

- ✓ Late-season reduction of pot limits by 20% effective May 1 each season, with:
 - Late-season tag
 - <40 fathom depth restriction
- ✓ Restriction amount of surface gear



- ✓ Allowance for retention of crab from derelict crab pots in Derelict Gear Recovery Program

Conservation Plan:

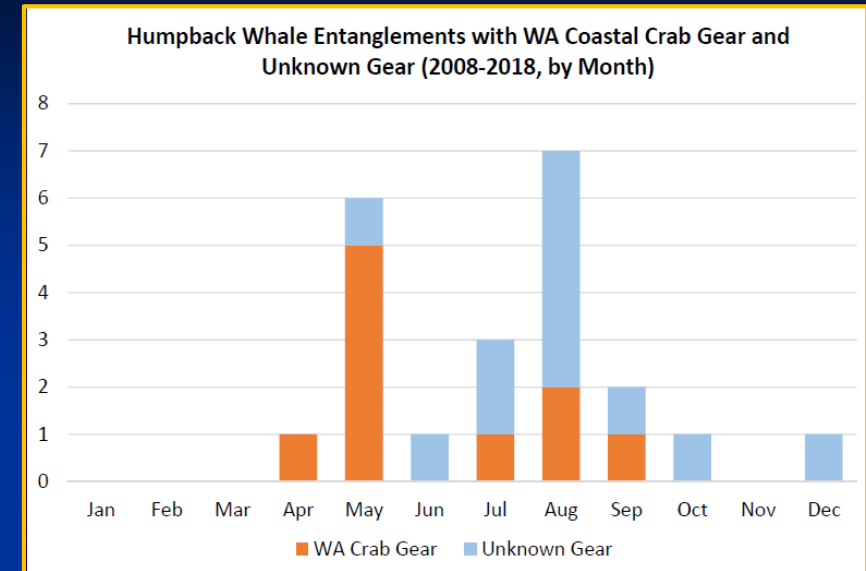
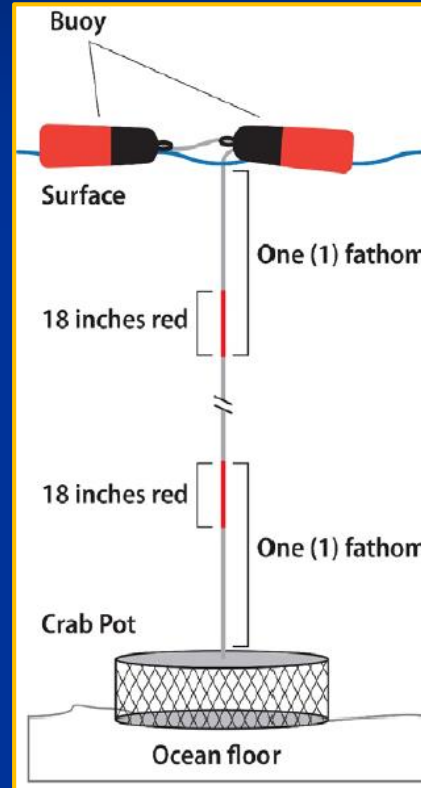
- ✓ Draft released in 2021

Goals:

- ✓ Reduce co-occurrence of ESA-listed species and Dungeness crab fisheries
- ✓ Reduce the amount of vertical lines
- ✓ Support alternative gear development

Assessment and Mitigation Strategies: WASHINGTON

- ✓ Best Practices Guide
- ✓ Late-season reduction of pot limits by 33%, effective May 1 – Sep 15 each season with requirement for late-season tag
- ✓ Line marking to help identify fisheries involved in entanglements
- ✓ Derelict gear recovery
- ✓ Draft Conservation Plan:
 - Conservation strategy
 - Electronic monitoring and reporting
 - Adaptive management measures:
 - *Entanglement Advisory Group*
 - *Pot Limits*
 - *Closed Areas*
 - *Gear modifications*
 - *Other*>



Washington Department of FISH & WILDLIFE

Home Species & Habitats **Fishing & Shellfishing** Hunting Licenses & Permits Places to go

Fishing & Shellfishing / Commercial fishing / Commercial Dungeness crab fishery / Coastal commercial Dungeness crab fishery / Marine life entanglement information and resources

Fishing & Shellfishing

- Fishing regulations
- Shellfishing regulations
- Places to go fishing
- Fishing and stocking reports
- Fishing and shellfishing basics
- Managing fish populations
- Tribal fishing
- Commercial fishing**

Marine life entanglement information and resources

An increase in marine life entanglements has occurred in recent years along the U.S. West Coast relative to rates recorded prior to 2013. Commercial Dungeness crab fishing gear collectively makes up the largest portion of identifiable gear found in West Coast entanglement cases (NOAA 2021). Large whale and marine turtle species are among those most impacted by fishing gear entanglements off the West Coast, and these animals are federally protected under the Marine Mammal Protection Act and/or the Endangered Species Act. To bring the fishery into compliance with federal regulations and reduce its impact on protected marine species moving forward, WDFW has committed to submitting an Incidental Take Permit application and working with the Washington Dungeness crab industry to develop an accompanying Conservation Plan (CP).

Humpback whale "spy hopping"

<https://wdfw.wa.gov/fishing/commercial/crab/coastal/marine-entanglements#resources>

Research on Potential Assessment and Mitigation Strategies

Feist et al. 2021

Fishing effort distribution and
timing, 2011-2016

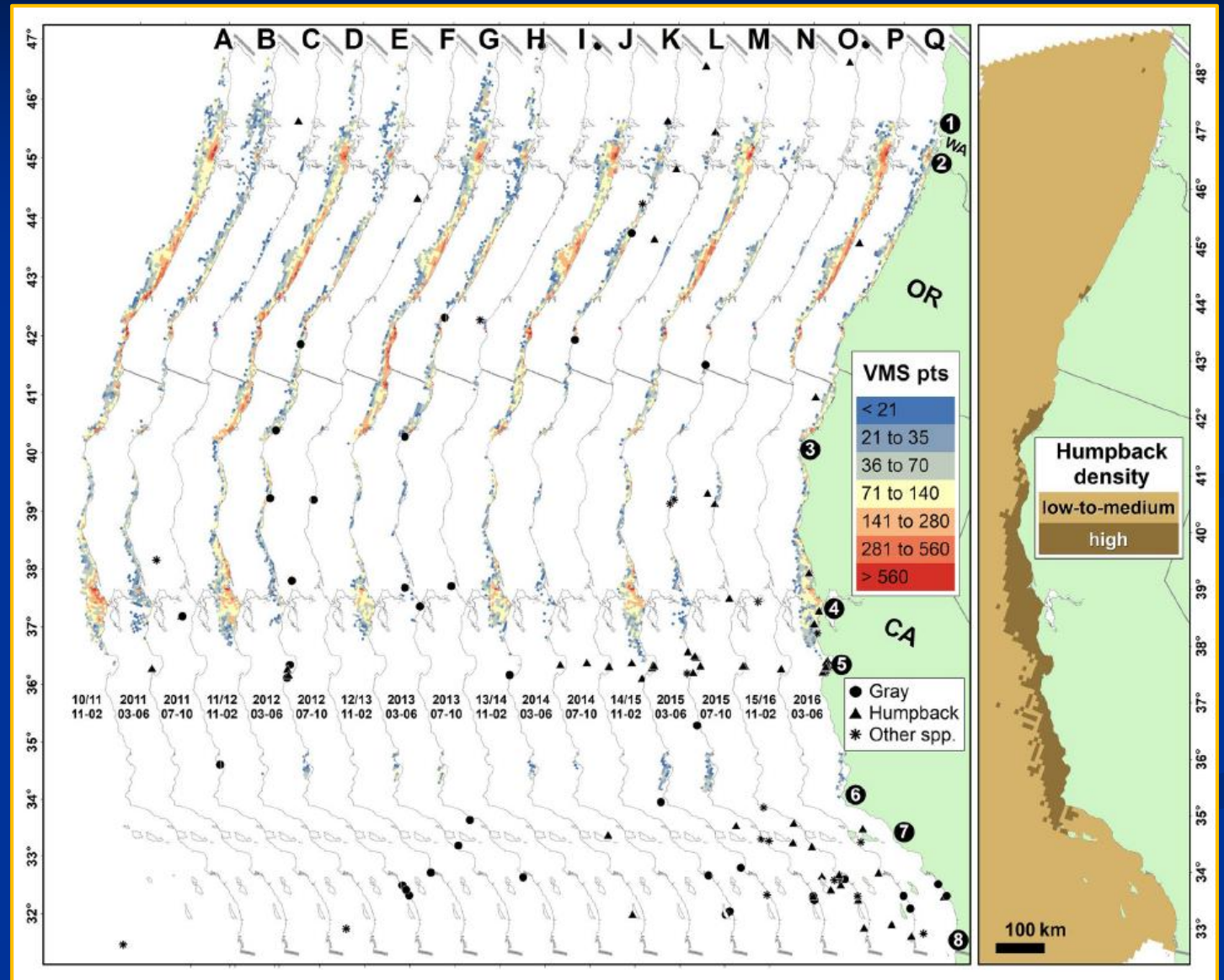
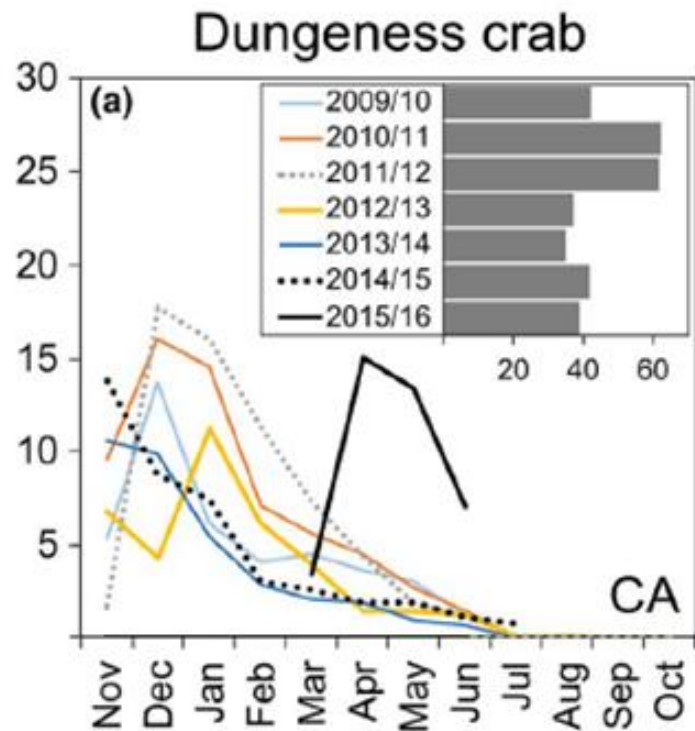
DOI: 10.1111/fme.12478

ORIGINAL ARTICLE

Fisheries Management
and Ecology WILEY

Footprints of fixed-gear fisheries in relation to rising whale
entanglements on the U.S. West Coast

Blake E. Feist¹ | Jameal F. Samhour¹ | Karin A. Forney^{2,3} | Lauren E. Saez⁴

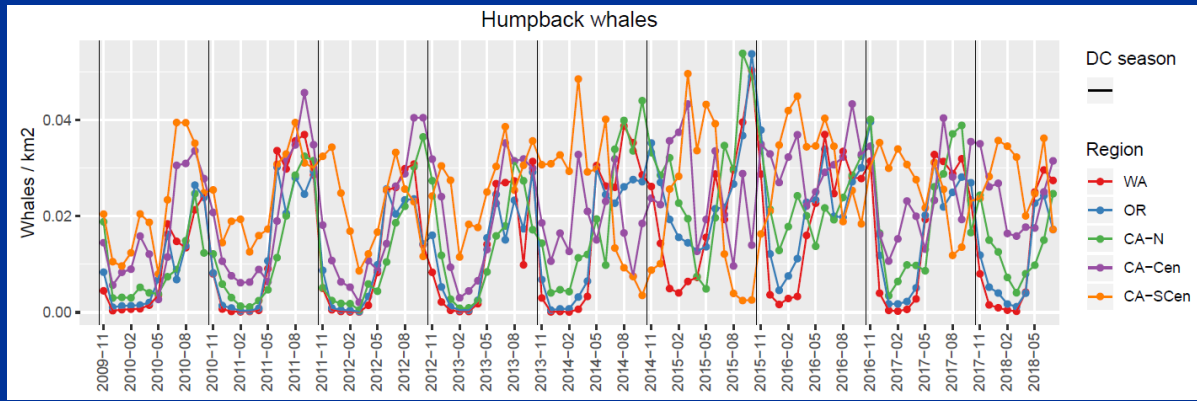


Research on Potential Assessment and Mitigation Strategies

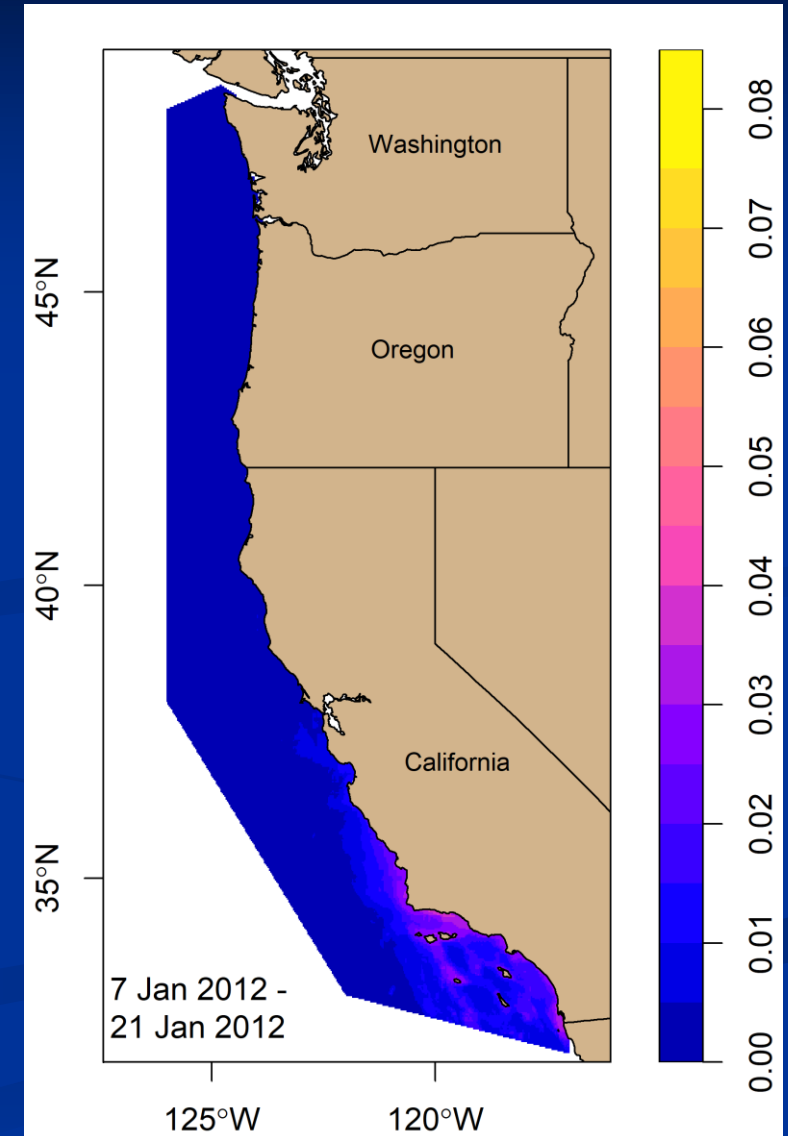
Forney et al., in prep

Dynamic, year-round humpback whale model

- Model developed using established methods (*Becker et al. 2018*)
- Fine-scale (3-km; bi-weekly and monthly density predictions)
- Validated using independent data
- Model successfully captured:
 - ✓ Seasonal north-south migration
 - ✓ Varying seasonal foraging hotspots
 - ✓ Interannual variability and marine heatwave impacts



← Seasonal migration 2011 - 2013 →
← Marine heatwave 2014-2016 →

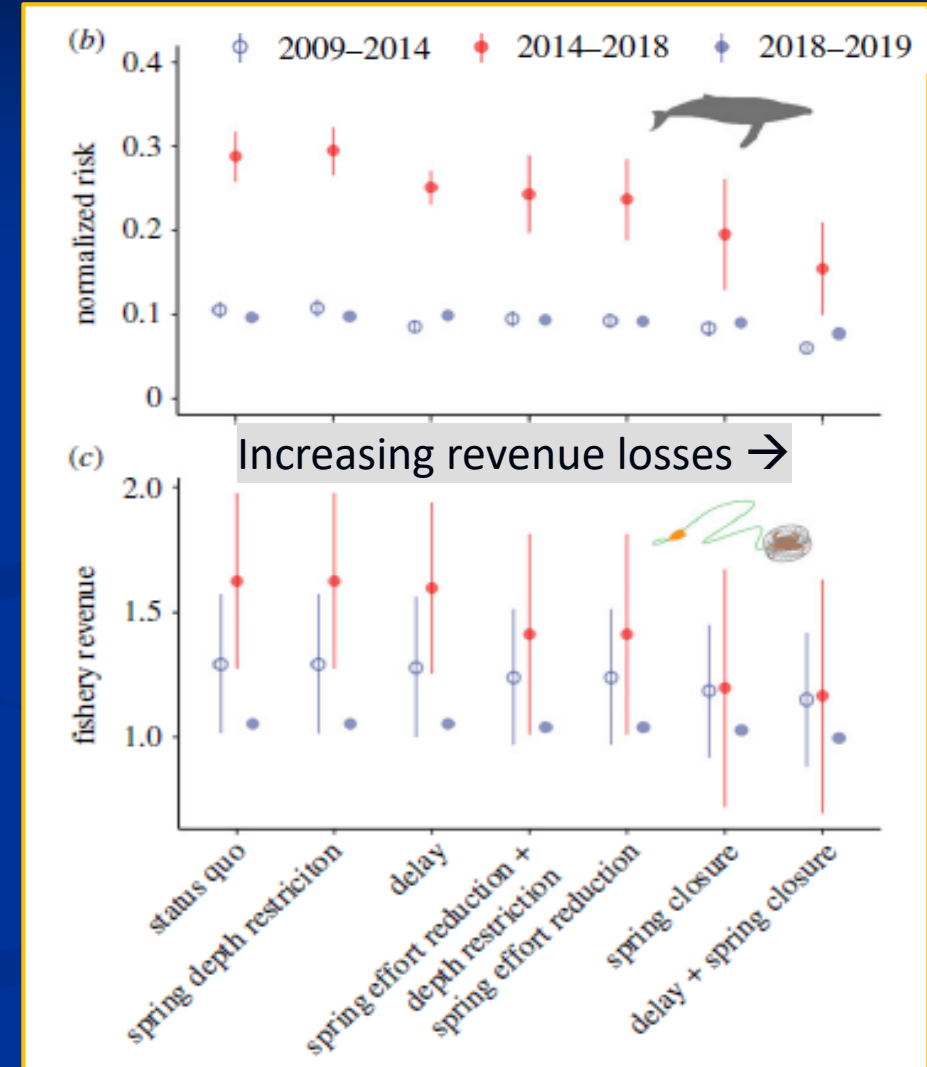


Evaluations of Potential Dynamic and Static Mitigation Strategies

Samhuri et al. 2021

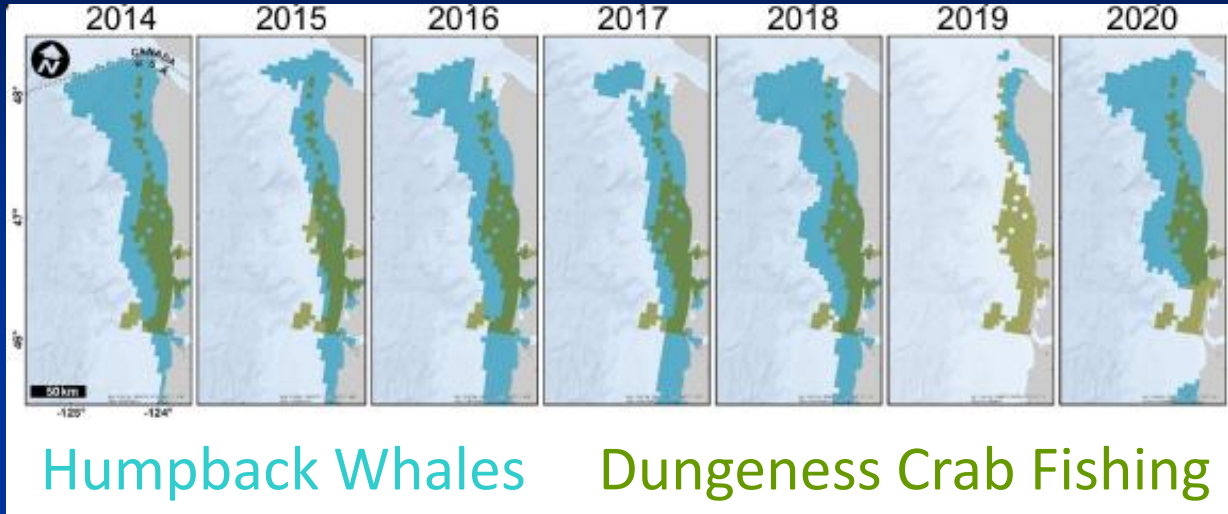


- Used *Feist et al.* Dungeness crab fishing data and *Forney et al.* humpback spatial model to evaluate a range of management options
- Risk reduction **varied by time period** (10-100%)
- During marine heatwave (2014-2018), risk remained elevated even with greatest fishing restrictions
- Delayed fall start and early spring closure of crab fishery reduced entanglement risk the most



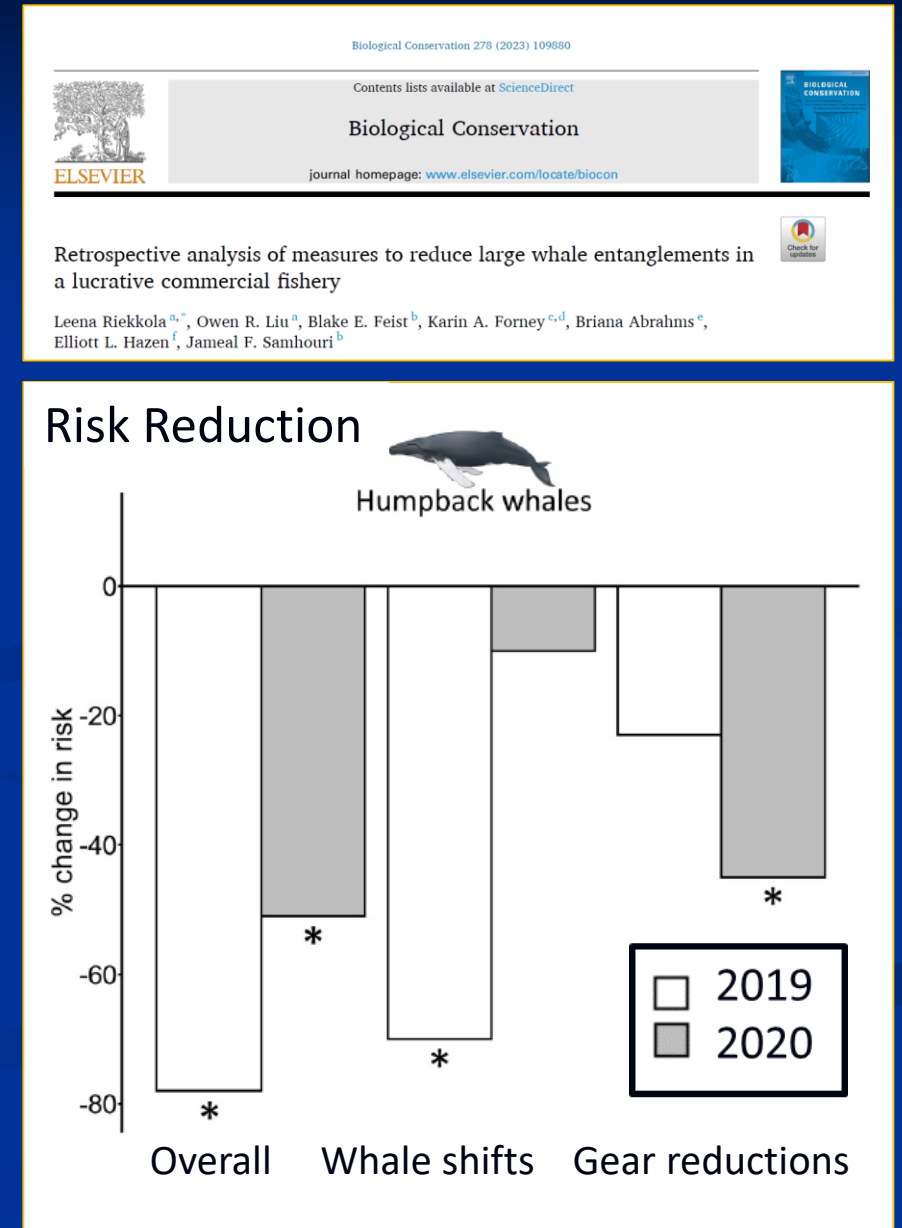
Evaluation of Washington State Management Measures

Riekkola et al. 2023



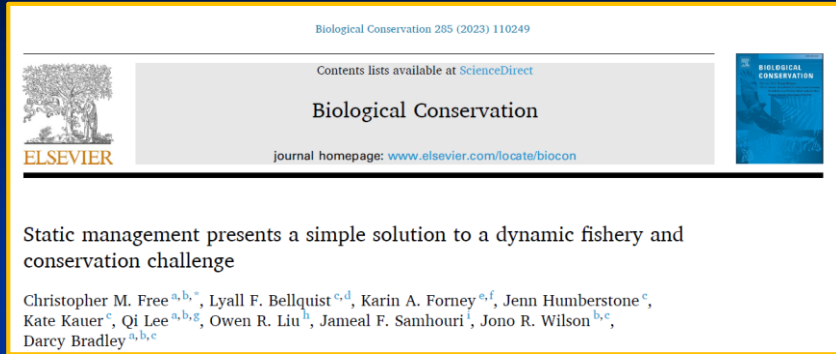
Evaluated spring/summer 33% gear reductions:

- Gear reductions during 2019-2020 reduced entanglement risk in both years
- 2019: Risk reduction from whale distribution shifts
- 2020: Risk reduction mostly from gear reductions
- Effectiveness **varies interannually**



Evaluations of Potential Dynamic and Static Mitigation Strategies

Free et al. 2023

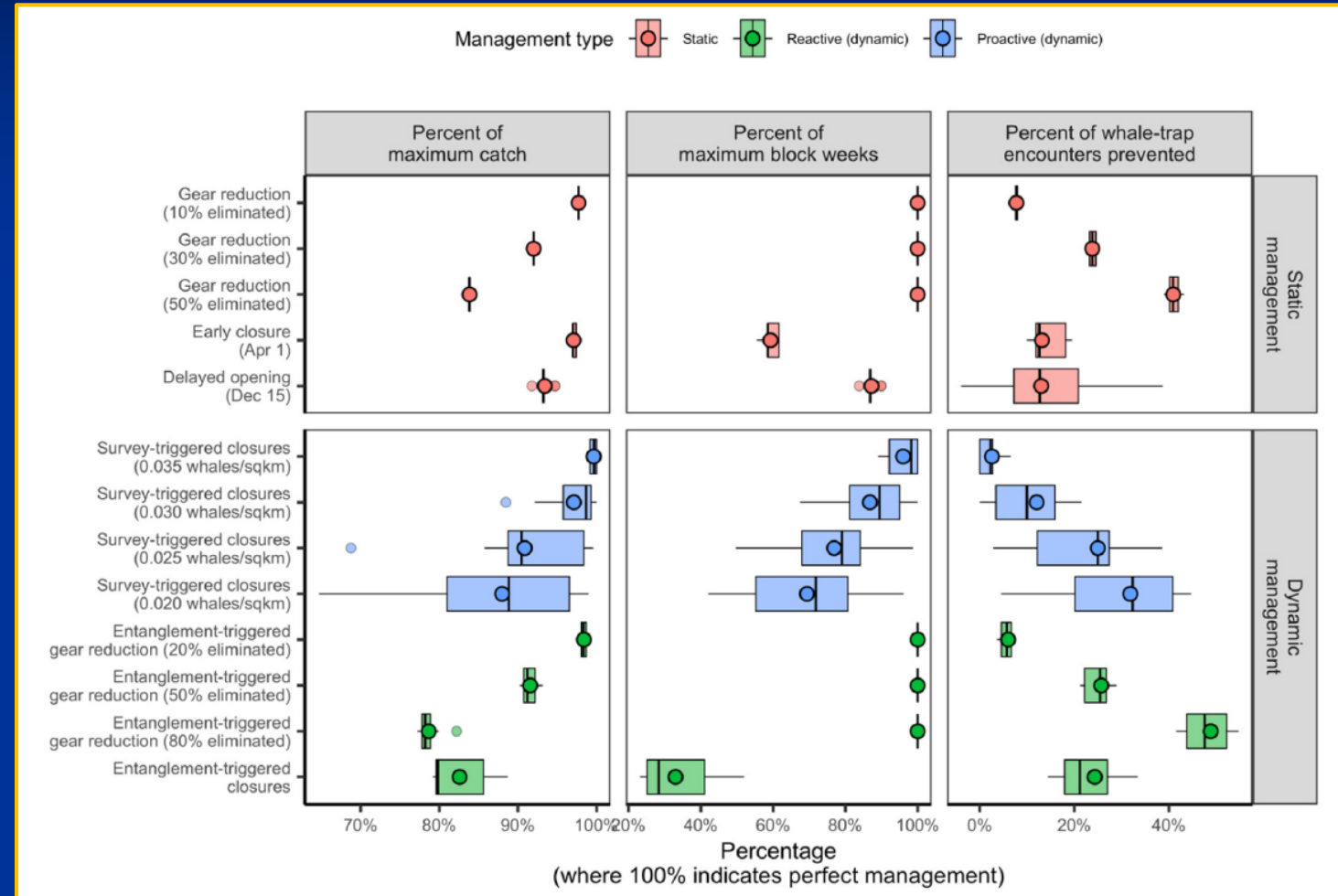


Simulated:

- Fishing effort from landing data
- Humpback whale/gear encounters

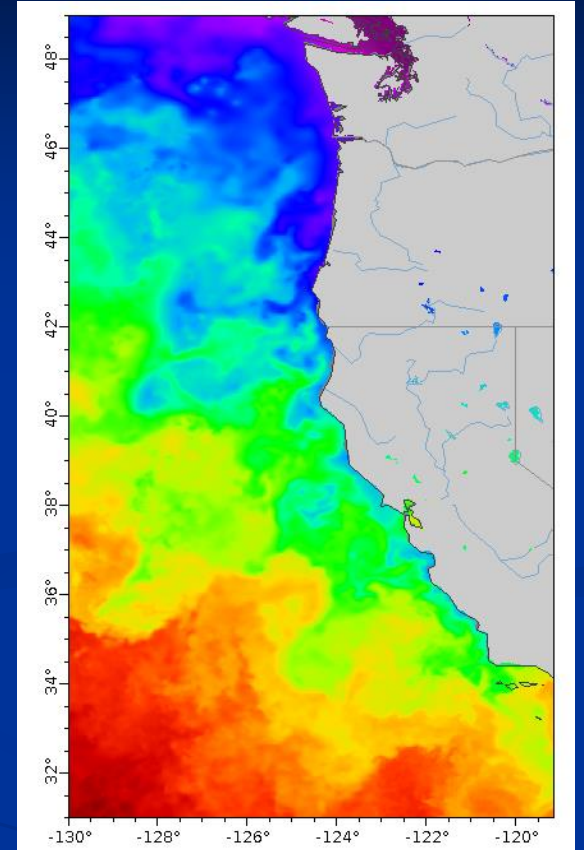
Results:

- 30-50% gear reductions minimized risk while maximizing crab catches (>80-90%)
- Dynamic (**reactive** and **proactive**) measures were less effective or more costly to the fishery than **static** measures



Summary and Conclusions

- Spatial and temporal shifts of prey, humpback whales, and fisheries have significantly impacted whale entanglement risk along the West Coast
- The marine heat wave of 2014-2016 contributed to the increase in entanglements, but levels remain elevated for complex reasons
- CA, OR, WA implemented different sets of static and/or dynamic management measures and are developing long-term Conservation Plans
- Static and dynamic management measures have been evaluated in several simulation studies, but there is no 'silver bullet'
- Mitigating entanglement risk to West Coast humpback whales will continue to be challenging in the dynamic California Current Ecosystem, especially in a changing climate and with increasing whale populations.



THANK YOU!



NMFS-SWFSC, Photo by Cornelia Oedekoven