Risk Assessment: Temporal Risk Overview

Dr. Barbara L. Taylor
Leader, Marine Mammal Genetics Group,
Mammal & Turtle Research Division
NOAA Fisheries, Southwest Fisheries Science Center

Review of NOAA Fisheries' Science on Marine Mammals & Turtles
Southwest and Northwest Fisheries Science Centers
27-31 July 2015
La Jolla, CA

Links with Mandates, Needs of Regulatory Partners

- ESA
  - Status reviews, identifying threats to recovery, prioritization of mitigation actions, critical habitat
- MMPA
  - Human induced mortality for Stock Assessment Reports, ecosystem expertise
- NOAA
  - CetMap, Ocean Noise Strategy, CINMS shipping working group, processing shipping data
- IWC/IUCN
  - Human induced mortality, ship strike workshop
  - Parameters used in IUCN Red List criteria

Risk Assessment

- Temporal—cumulative risk of extinction
- Spatial—combine species distributions with the distributions, magnitudes, and consequences of threats

Biological Review Teams with MMTD participation

- Loggerhead Turtles
- Green Turtles
- Southern Resident Killer Whales
- Hawaiian Insular False Killer Whales
- Black Abalone
- Humpback Whales
- Ribbon Seals
- Bearded Seals
- Harbor Seals of Iliamna Lake
- White Sharks
- Gulf of Mexico Bryde's Whales

Endangered species: "any species which is in danger of extinction throughout all or a significant portion of its range ..."

Threatened species: "any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range."

The process of status reviews continually improves

Each team struggles with how to quantify risk for decision makers

DeMaster et al. 2004 Report by the Quantitative Listing Criteria Group

Post-doctoral research by Tracey Regan performance testing different types of decision rules

Post-doctoral research by Charlotte Boyd on a retrospective analysis

- Can we use past listing decisions to develop standards based on clear reference points that will help ensure that listing decisions are "transparent, consistent, and scientifically and legally defensible"?

- What is the probability of falling below
  Q mature individuals within Z years?

Endangered

Probability of < 50 mature individuals in 50 years:
17.2%

Threatened

Probability of < 50 mature individuals in 50 years:
12.5%

Not Warranted

Probability of < 50 mature individuals in 50 years:
1.8%

Endangered

Threatened

Not Warranted

Endangered

Threatened

Not Warranted

Endangered

Threatened

Not Warranted

- What is the probability of falling below
  Q mature individuals within Z years?

Critically-low population size or densities

50 mature individuals?

250 mature individuals?

500 mature individuals?

	< 50 mature individuals						< 250 mature individuals						500 mature individuals					
	5 generations			50 years			5 generations			50 years			5 generations			50 years		
	28%	20%	10%	28%	20%	10%	28%	20%	10%	28%	20%	10%	28%	20%	10%	28%	20%	10%
black abalone																		
SR killer whale																		
Fiji petrel																		
Hawaiian False Killer Whale																		
Short-tailed albatross	■	■	■	■	■	■	■	■	■	■	■	■	■	■		■	■	
S Pacific loggerhead	■	■		■	■	■				■	■	■				■	■	
Atlantic salmon, GoM	■	■	■	■	■		■	■	■				■	■				
W. Steller Sea lion	■	■	■	■	■	■	■			■								
Ozette Lake Sockeye	■	■	■	■	■		■	■		■			■	■				
U. Colombia River steelhead	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
Snake River sp/sr chinook	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
Puget Sound steelhead	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
NW Atlantic loggerhead	■	■	■	■	■	■	■			■	■	■				■	■	■
NE Pacific white shark	■	■	■	■	■	■	■	■	■	■	■	■	■	■		■	■	
Quinault Lake Sockeye	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Black-footed albatross, HI	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■

	< 50 mature individuals						< 250 mature individuals						500 mature individuals					
	5 generations			50 years			5 generations			50 years			5 generations			50 years		
	28%	20%	10%	28%	20%	10%	28%	20%	10%	28%	20%	10%	28%	20%	10%	28%	20%	10%
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From retrospective analysis: cases with < 250 mature

Marine mammals:
southern resident killer whale (EN)
MHI insular false killer whale (EN)
N Atlantic right whale (EN)
N Pacific right whale (EN)
Cook Inlet beluga (EN)
Saimaa seal (EN)
western gray whale (EN)
Mediterranean monk seal (EN)

Sharks and rays:
largetooth sawfish (US range)? (EN)

Salmonids:
Snake River sockeye (EN)

Other ray-finned fishes:
Puget Sound bocaccio? (EN)

Seabirds:
Amsterdam albatross (EN)
Mascerene black petrel (EN)
Bermuda petrel (EN)
Fiji petrel (EN)
freira (EN)
Magenta petrel (EN)

Molluscs:
white abalone (EN)
black abalone (EN)

Conclusions

- Standards based on past listing decisions could be used to guide future decisions to ensure that they are “transparent, consistent, and scientifically and legally defensible”.

Risk Assessment: Spatial Risk Overview

Dr. Jessica V. Redfern

Leader, Marine Mammal Spatial Habitat and Risk Program,

Mammal & Turtle Research Division

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How many individuals are impacted?

NOAA SWFSC

John Calambokidis, Cascadia Research

Alexa Kownacki, NOAA SWFSC

U.S. Navy photo by Paul Farley via Wikimedia Commons

Major Activities

Habitat

Predict species distributions

Quantify spatial and temporal variability

Identify critical habitat

Human Use

Quantify distribution and magnitude

Quantify spatial and temporal variability

Spatially Explicit Risk Assessment

Single and cumulative impacts

Examples: Shipping

Bycatch

Ocean noise

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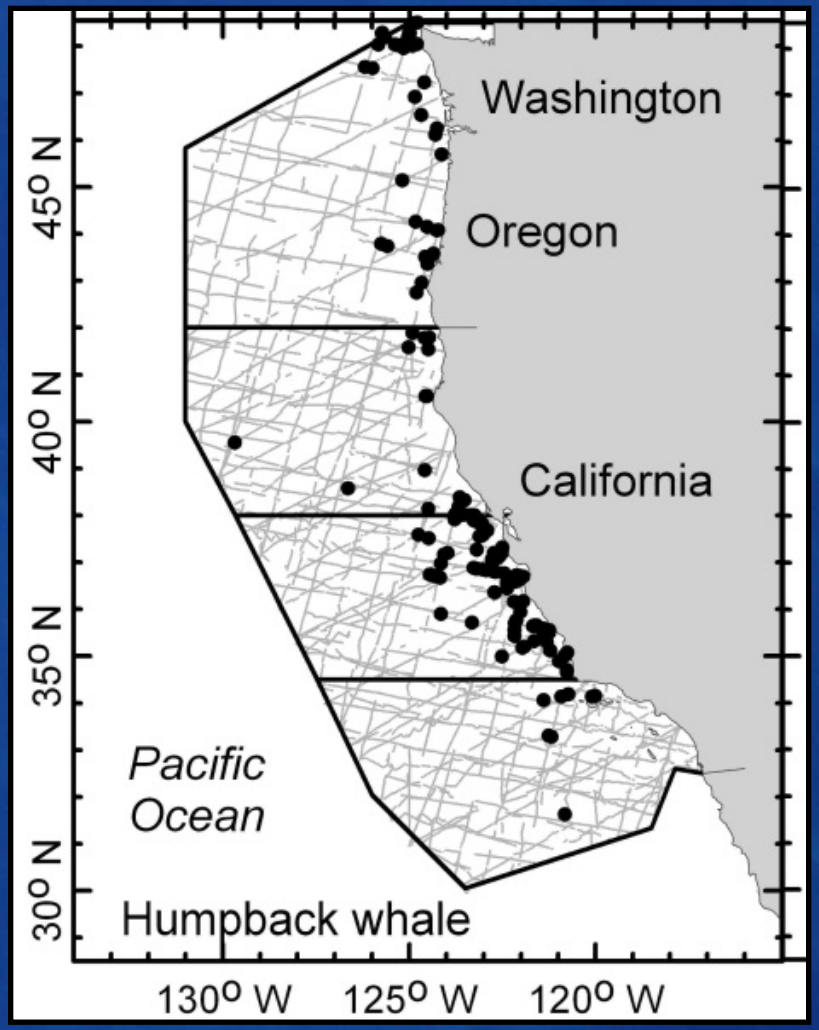
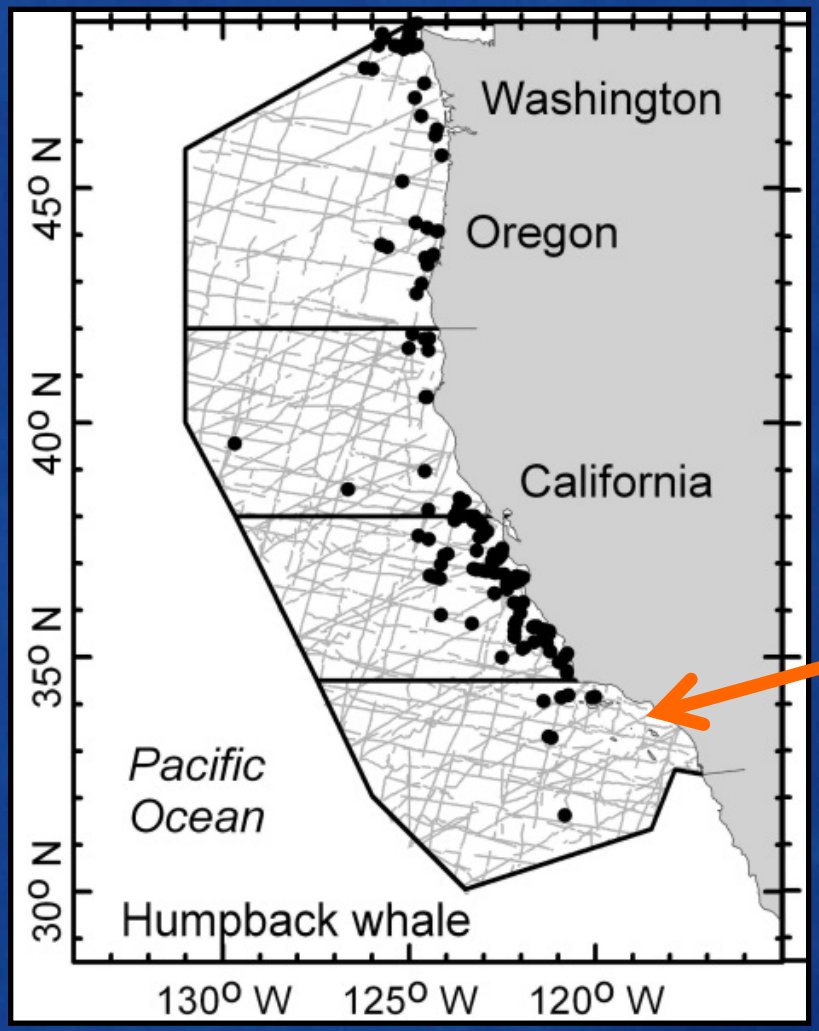
Predict Species Distributions



Starting point: low spatial and temporal resolution stratified density estimates

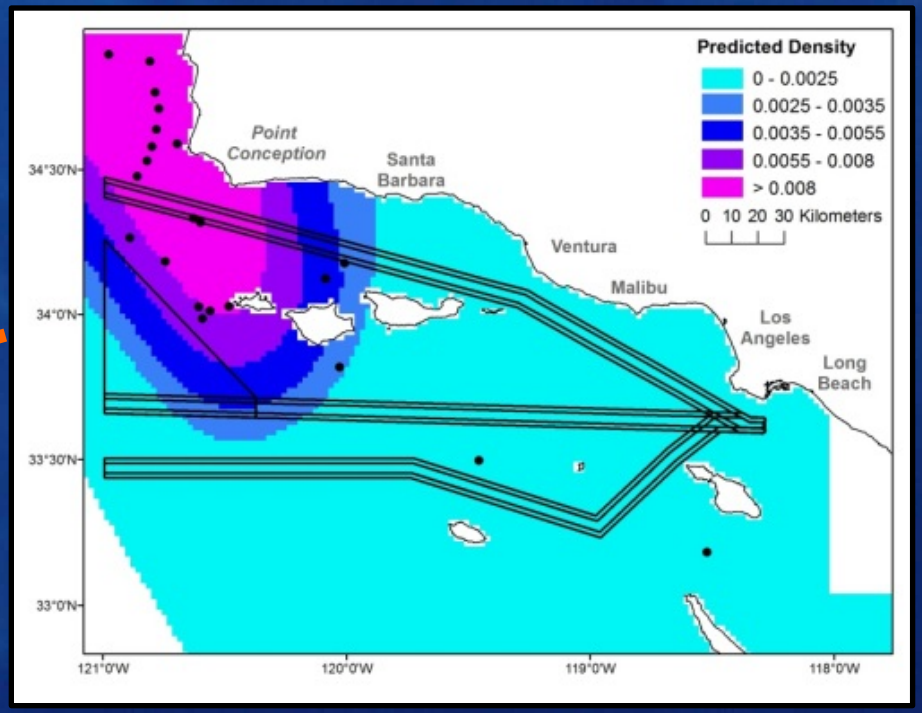
Finest stratification scale is two orders of magnitude too large

Predict Species Distributions



How many individuals are impacted?

- **Habitat modeling provides finer resolution predictions**



Quantify Variability

- Improve habitat variables
  - Quantify oceanographic variability
  - Use new data sources to enable forecasting, capture mechanisms that concentrate prey, and reflect upwelling locations and strength

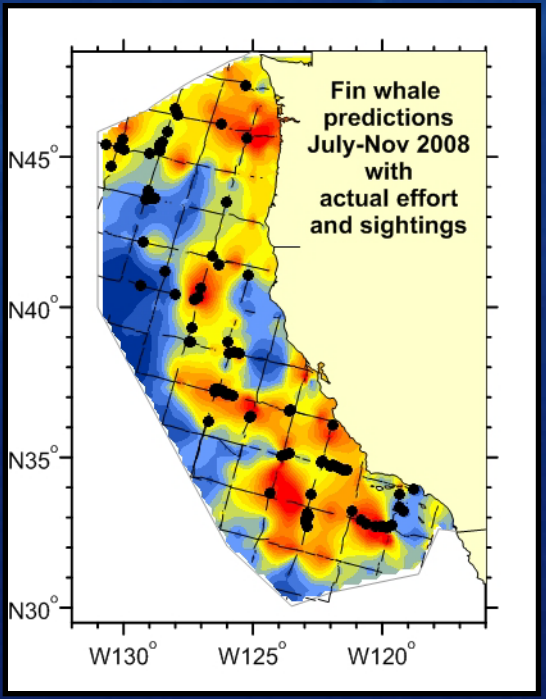
Selected Publications

Fiedler, P. C., R. Mendelssohn, D. M. Palacios, and S. J. Bograd. 2013. Pycnocline Variations in the Eastern Tropical and North Pacific, 1958–2008. Journal of Climate **26**:583-599.

Becker, E. A., D. G. Foley, K. A. Forney, J. Barlow, J. V. Redfern, and C. L. Gentemann. 2012. Forecasting cetacean abundance patterns to enhance management decisions. Endangered Species Research **16**:97-112.

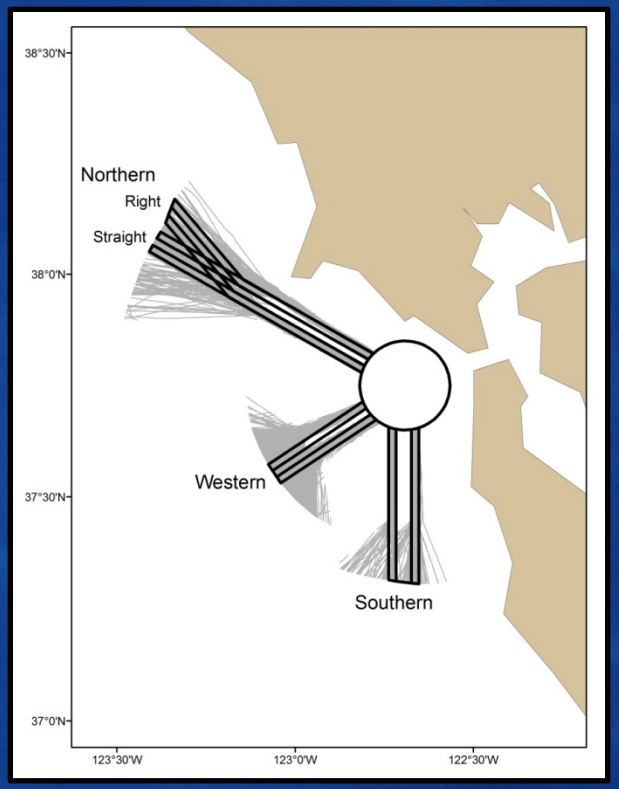
Becker, E. A., K. A. Forney, D. G. Foley, R. C. Smith, T. J. Moore, and J. Barlow. 2014. Predicting seasonal density patterns of California cetaceans based on habitat models. Endangered Species Research **23**:1-22.

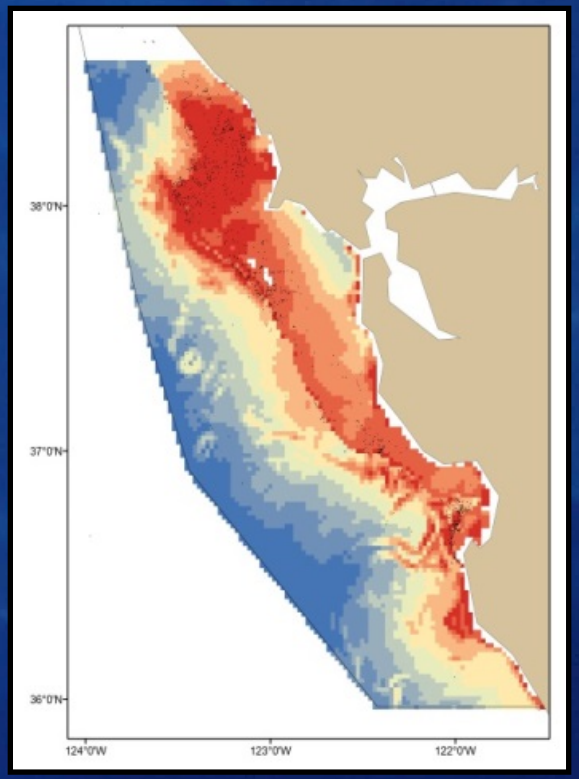
Near real-time forecast



Quantify Variability

- Merge multiple types of marine mammal data
  - Systematically and non-systematically collected data





Major Activities

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Quantify spatial and temporal variability

Identify critical habitat

Human Use

Quantify distribution and magnitude

Quantify spatial and temporal variability

Spatially Explicit Risk Assessment

Single and cumulative impacts

Examples: Shipping

Bycatch

Ocean noise

Human Use

Key questions

- What are the uses?
- Where do they occur?
- How does use change through time?
- What is the overlap among uses?

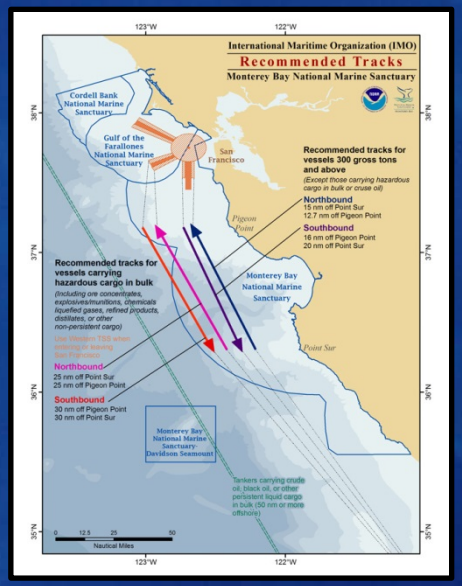
NOAA SWFSC

John Calambokidis, Cascadia Research

U.S. Navy photo by Paul Farley via Wikimedia Commons

Quantify Use and Variability

- Shipping traffic
  - Use AIS (Automatic identification systems) data (2008-present) to estimate cumulative distance traveled and speed in 1km x 1km grids
    - Ship-strike risk: effects of regulations on shipping traffic
    - Oil spill risk: Use of recommended shipping lanes between Monterey and San Francisco
    - Noise risk to acoustic habitats: Inputs to noise propagation models for southern California waters



Major Activities

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Spatially Explicit Risk Assessment

Single and cumulative impacts

Examples: Shipping

Bycatch

Ocean noise

Assessing the risk of ships striking large whales in marine spatial planning

Jessica V. Redfern, Megan F. McKenna, Thomas J. Moore, John Calambokidis, Monica L. DeAngelis, Elizabeth A. Becker, Paul C. Fiedler, Jay Barlow, Karin A. Forney, Susan J. Chivers

Redfern et al. 2013. Assessing the risk of ships striking large whales in marine spatial planning. Conservation Biology 27:292-302.

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NOAA
U.S. DEPARTMENT OF COMMERCE
SOUTHWEST FISHERIES SCIENCE CENTER

CARB Rule

California Air Resources Board
Ocean-going Vessel Fuel Rule

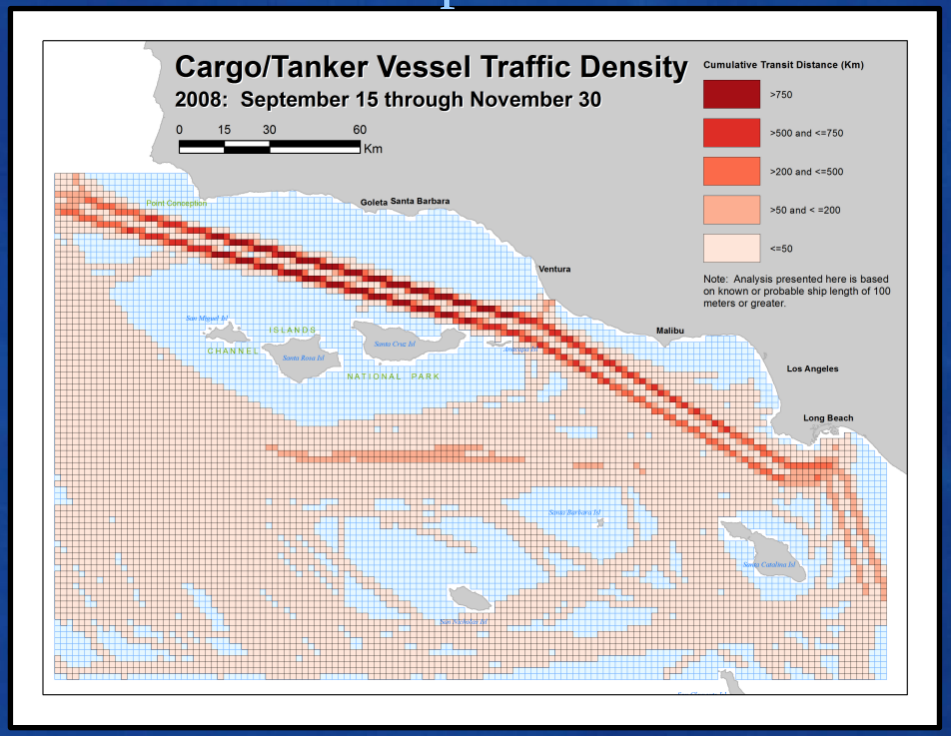
Goal: reduce air pollution by requiring large, commercial ships to use cleaner fuels when traveling within 24 nmi of the coast

Philip DiResta
http://mymaritimeblog.wordpress.com/2006/10/28/huge-cargo-ship

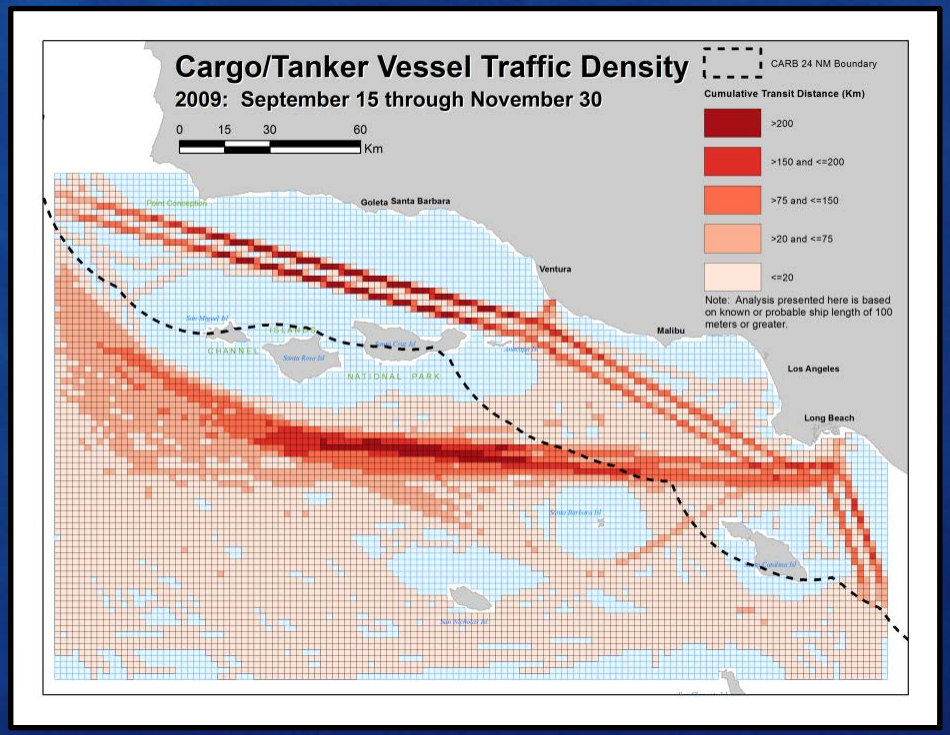
CARB Rule

Effects on shipping traffic

Before implementation



After implementation



McKenna, M. F., S. L. Katz, S. M.Wiggins, D. Ross, and J. A. Hildebrand. 2012. A quieting ocean: unintended consequence of a fluctuating economy. Journal of the Acoustical Society of America 132:EL169–EL175.

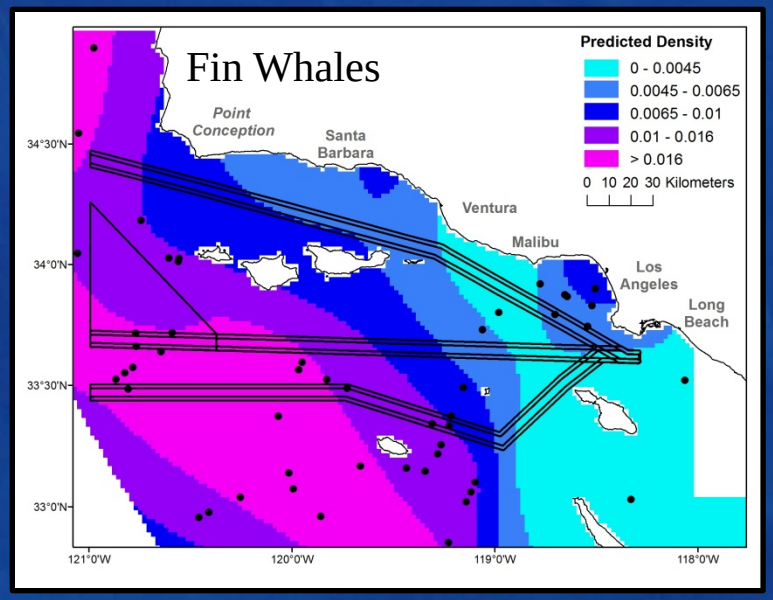
CARB Rule

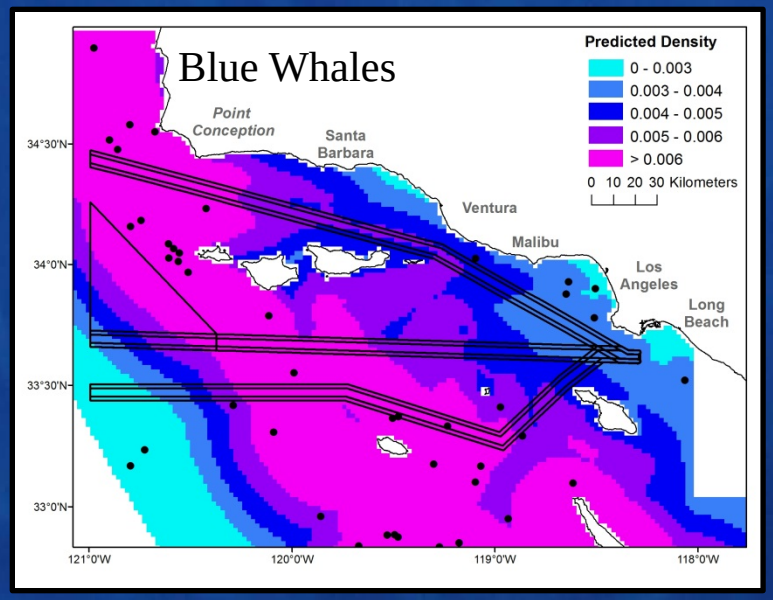
U.S. Coast Guard conducted a port access routing study for Los Angeles and Long Beach

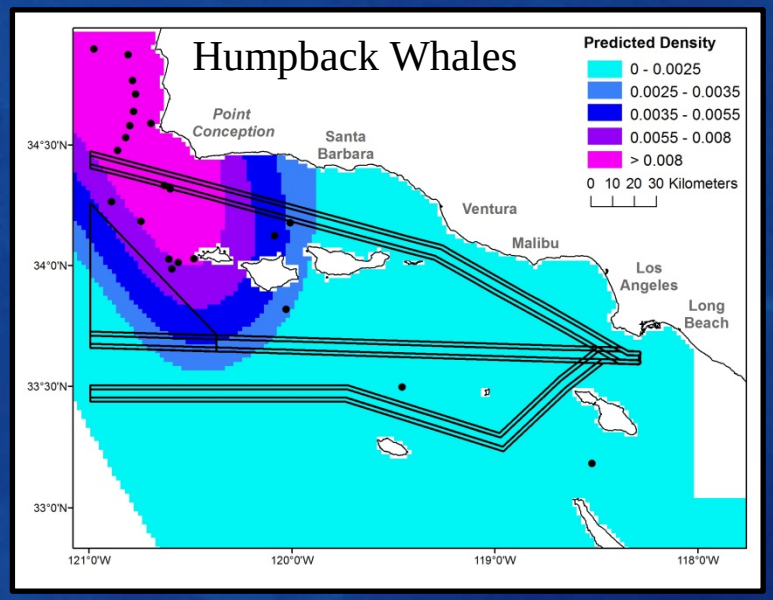
Primary concerns in public comments:

- amount of ship traffic through military ranges
- risk of ships striking large whales

Habitat Modeling







- Fin and humpback whales have opposing hot spots
- Blue whales are more evenly distributed throughout the area

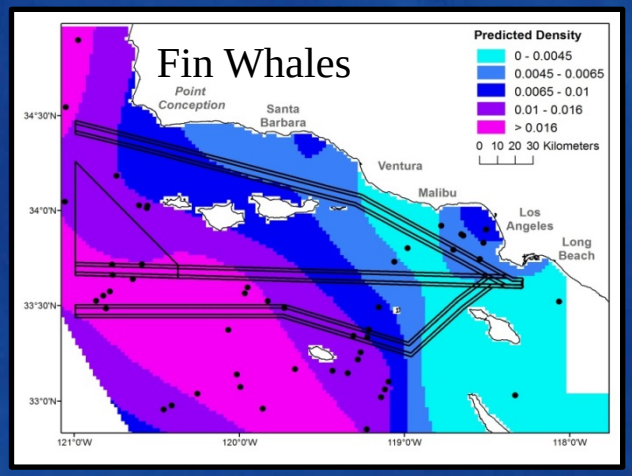
Assessing Risk

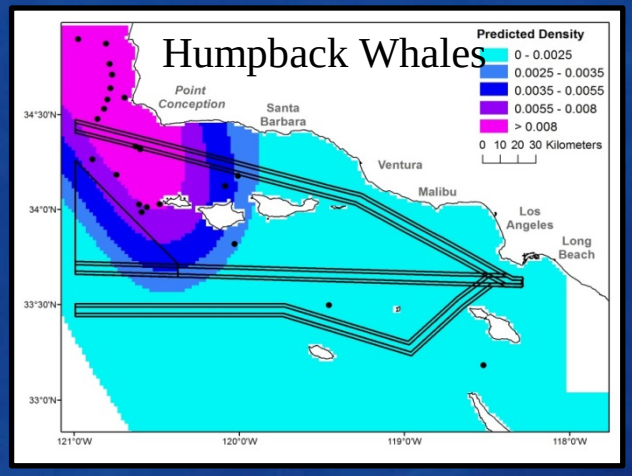
Assume risk is proportional to the number of whales in each route

→ Risk is highest in areas where the co-occurrence of whales and ships is high

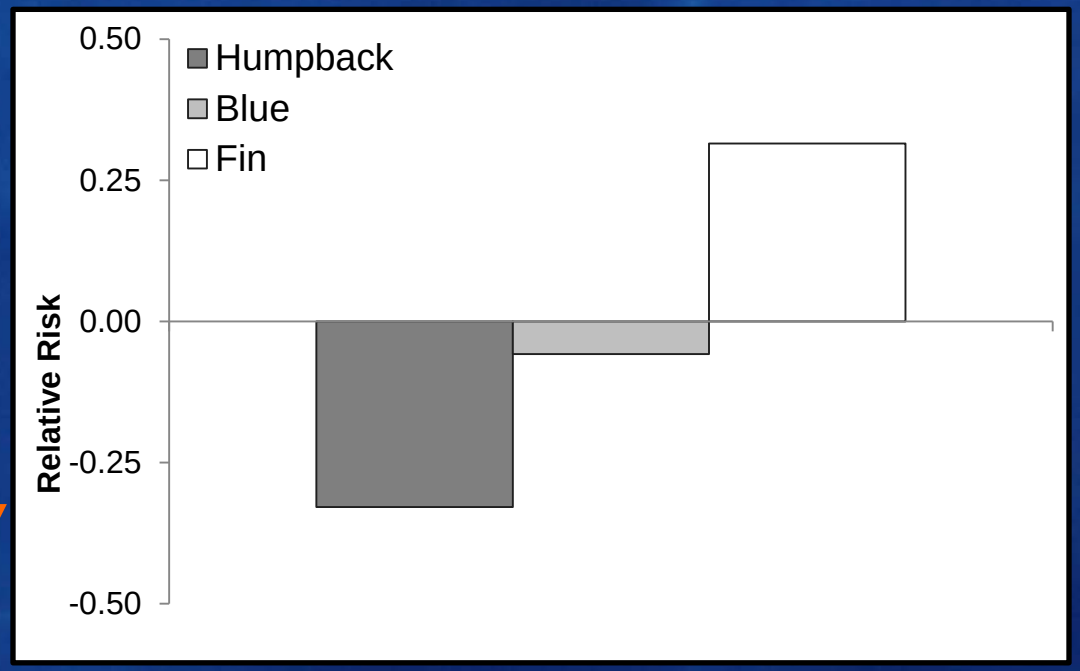
Assessing Risk

Percent change in risk before and after implementation of the CARB Rule





Decreasing Risk



Assessing Risk

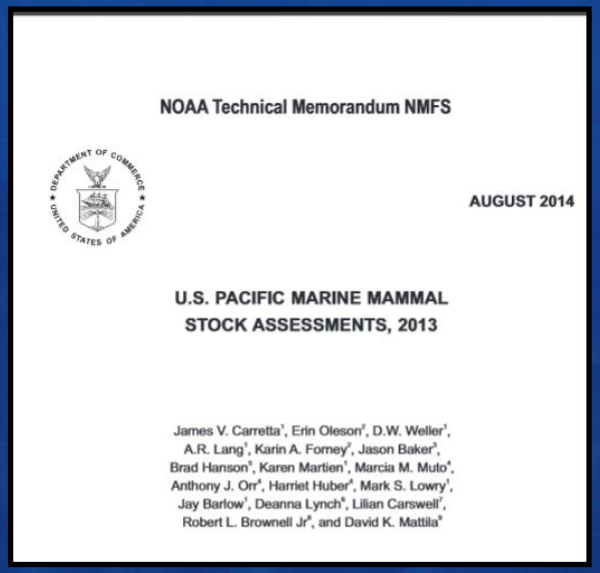
How did the CARB rule affect risk?

Risk for fin whales increased following implementation of the rule

- In 20 years of California stranding records, 2009 had the second highest number of fin whale ship strikes

Bycatch Risk

- Estimating bycatch
  - Mandates and methods
- Reducing bycatch
- Estimating bycatch limits



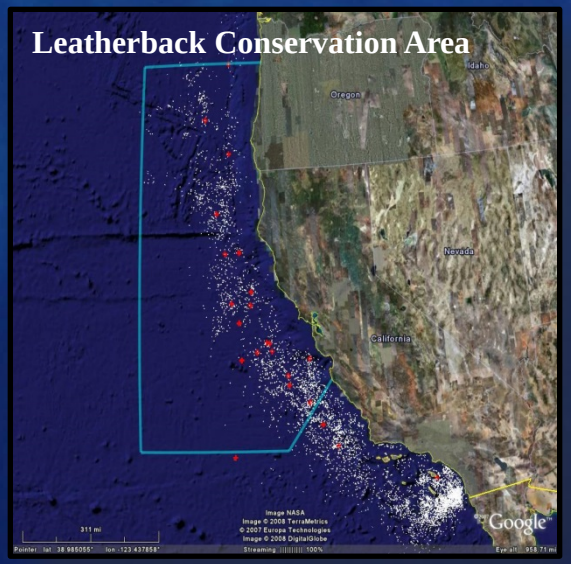
NOAA Technical Memorandum NMFS

AUGUST 2014

U.S. PACIFIC MARINE MAMMAL STOCK ASSESSMENTS, 2013

James V. Carretta[1], Erin Oleson[2], D.W. Weller[3], A.R. Lang[1], Karin A. Forney[2], Jason Baker[3], Brad Hanson[3], Karen Martien[1], Marcia M. Muto[4], Anthony J. Orr[3], Harriet Huber[4], Mark S. Lowry[1], Jay Barlow[1], Deanna Lynch[5], Lilian Carswell[2], Robert L. Brownell Jr[6], and David K. Mattila[5]

- Modeling interactions between species and fisheries
  - Spatial and temporal predictions of leatherback turtles on the U.S. West Coast



Strengths

- Leaders in developing the science needed to support ESA and MMPA mandates
- Expertise in Status Reviews for petitioned and listed ESA species
- Expertise in developing tools to assess the impacts of marine mammal and turtle bycatch on population dynamics
- Expertise in developing tools to assess spatial risks
  - Predicting cetacean distributions
  - Analyzing human use data
  - Spatially explicit risk assessment
- Collaboration with multiple stakeholders

Challenges

- Long-term support for staff recruitment and retention
  - Need new analytical tools to address management questions at the required spatial and temporal resolutions
  - Most work to predict species distributions has been funded by outside sources (e.g., Navy)
- Meeting mandates
  - Staffing shortages limit our ability to complete the analyses needed to meet core mandates
  - Partnering with managers to ensure science meets mandates
  - ESA status reviews require considerable time commitments with limited advance notice
    - ESA status reviews could be more efficient with standards for different risk levels (e.g. a species is at high risk if there are fewer than X mature individuals)
- Maintaining collaborations

Strategies

- Strategic thinking
  - Continued work on quantitative standards to improve efficiency, transparency and repeatability of risk categories in status reviews for listing petitions
  - Expand into high need areas
    - Spatially explicit risk assessment (ship strikes, renewable energy, noise, critical habitat, etc.)
- Coping
  - Repurposing existing PI's to the extent possible
    - Inefficient
    - Leaves previous duties unfulfilled
  - Bringing in outside funds
    - Funding streams are short-term and unpredictable, making it hard to build and sustain longer-term research programs
    - Meeting core mandates becomes a lower priority than meeting external deadlines