Webinar Series

US West Coast Floating Wind and Cetaceans:

Baseline Data, Risks, and Moving Forward

July 2, 2020

Sarah Courbis, Ph.D.
Andrea Copping, Ph.D.
Lysel Garavelli, Ph.D.
Molly Grear, Ph.D.
Dan Lawson
Jessica Redfern, Ph.D.
Mari Smultea, Ph.D.

1998 Yaquina Bay Estuary, OR

2002 Kealakekua Bay, HI

2002 Honaunau Bay, HI

2006 Spotted dolphin, HI
Photo R.W. Baird

2007 Belize

2009 Sarasota Bay, FL

2014 Smultea Sciences Team

Advisian
Worley Group

Worley
energy | chemicals | resources

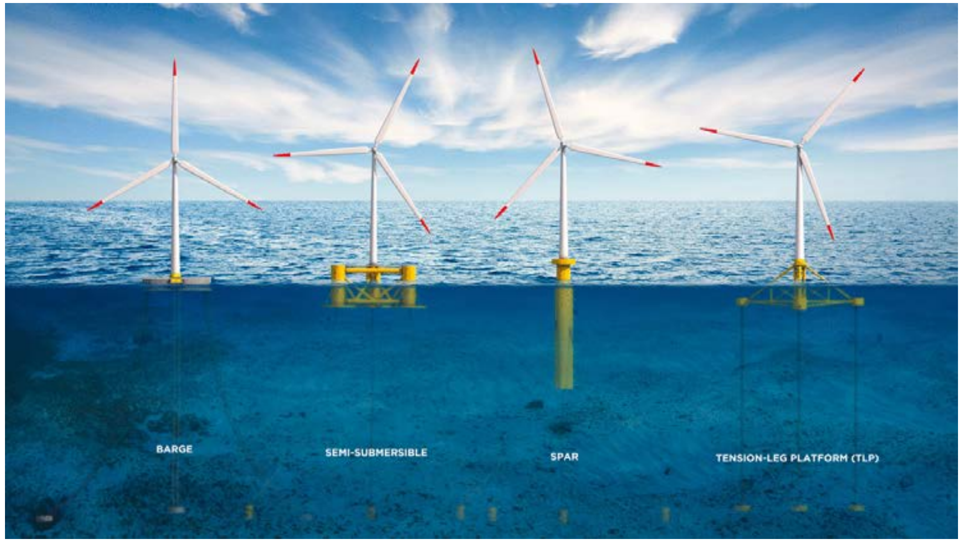
Dr. Sarah Courbis
Marine Protected Species and Regulatory Specialist

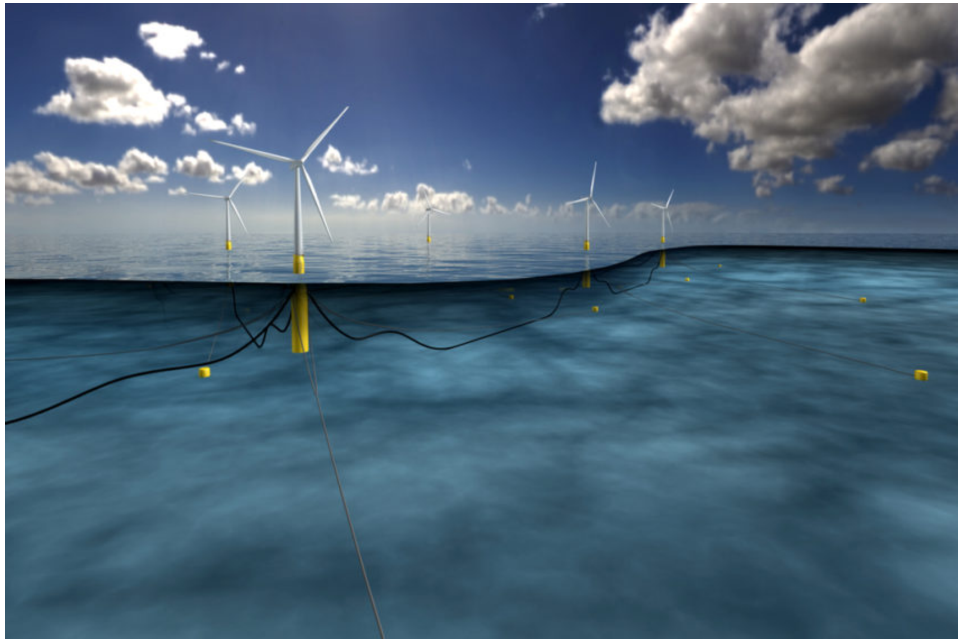
West Coast Cetaceans

- ~23 species
  - 6 baleen whales
  - 2 porpoises
  - 9 delphinids
  - 1 Sperm whale
  - 2 Kogia
  - 3 beaked whales
- ESA-listed: humpback, blue, fin, sei, sperm, southern resident killer whale

Effects of Offshore Wind

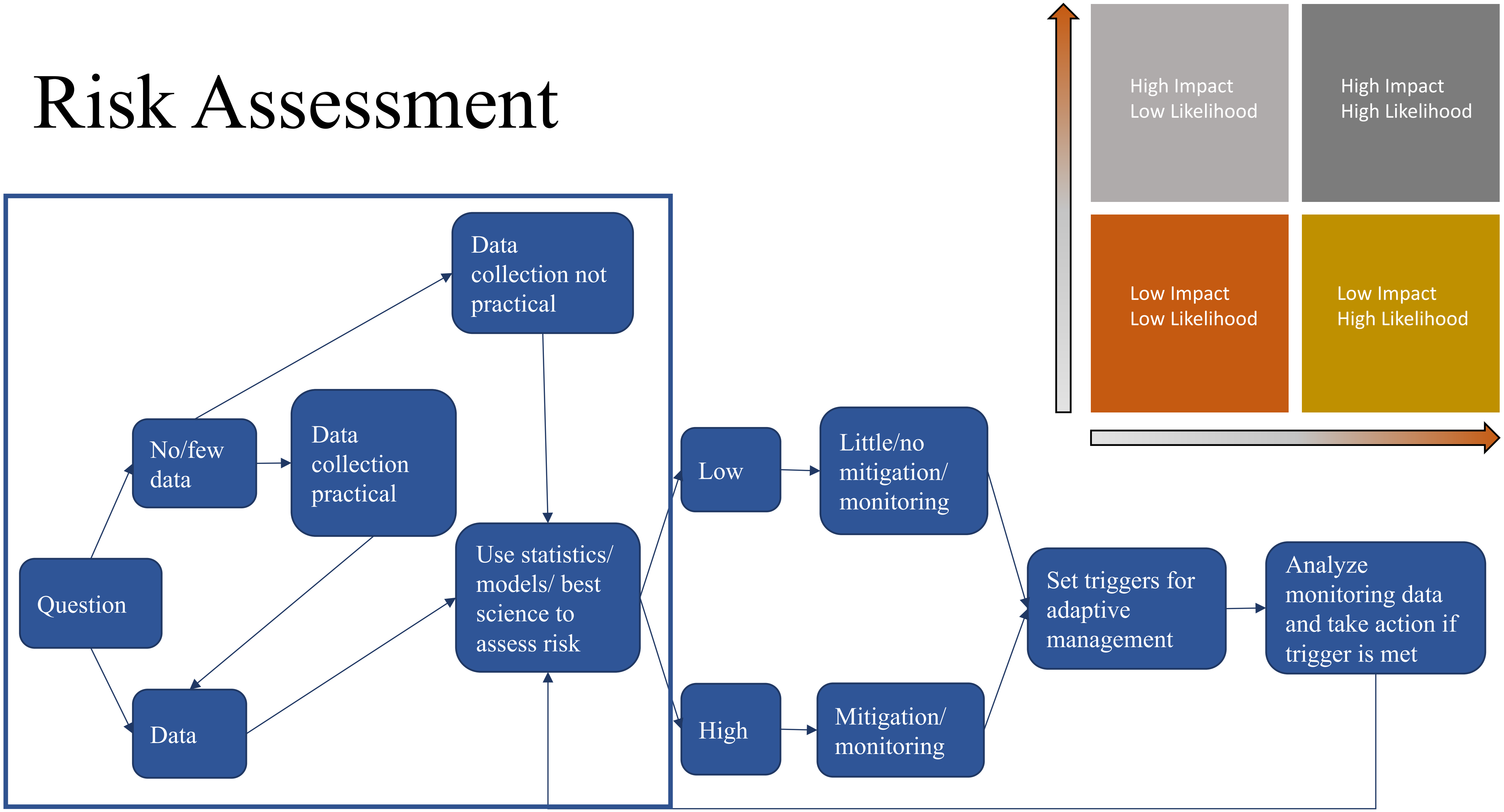
- Threats
  - Vessels (sound, collision)
  - Structure presence (displacement)
  - Moorings and sub-sea cables (secondary entanglement, EMF, collision)
- Benefits
  - Reduced emissions/climate change
  - Reef effects
  - Reduced traffic close to turbines





Advisian
Worley

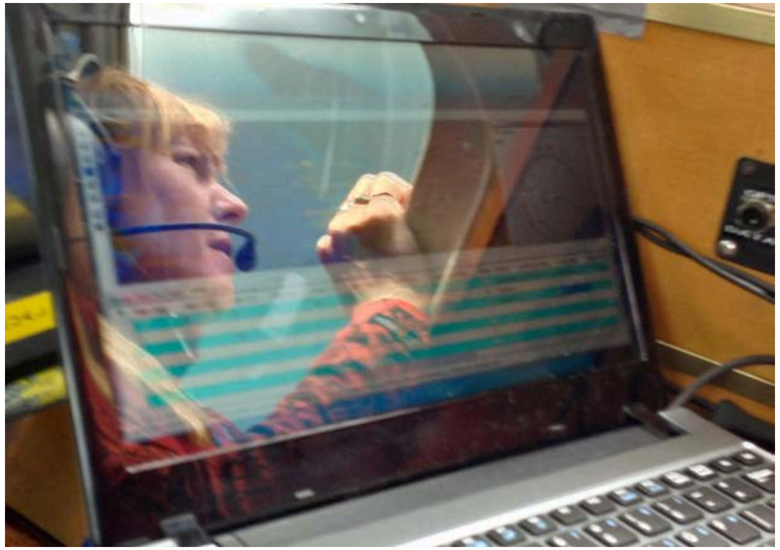
Risk Assessment



Advisian
Worley

Data Gaps/Data Collection

- Identify priorities
- Avoid DRIPy data collection
- Plan for the statistical analysis/models
- Plan for costs/time
- Plan for sharing data and outcomes
- Integrate into other studies

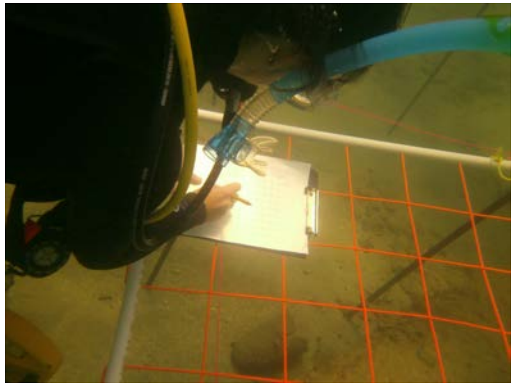


Adaptive Management

Focus	Criteria	Triggers	Proxies	Strategy	Warning	Actions
Problem to be solved	Factors measuring problem	Thresholds	Stand in for criteria	Methods to measure proxies	Yellow light level	Add/Remove/ Change Mitigation
Whale entanglement	Number of whales entangled on OSW via fishing	X entanglements over X years (could break down by	Detections of entangled gear (or animals)	ROV scanning cables, moorings X meters/mo; data relay 6 mo; statistical extrapolation	X% of trigger met	Increase gear removal efforts to X meters per quarter; increase ROV coverage with shorter delay

There are data and tools!

- PNNL State of the Science, whale collision risk modeling
- NMFS knowledge of derelict gear and entanglement
- 30+ years of NMFS, Navy, CalCOFI visual, acoustic, environment data
- Advances in modeling density, movements, important habitat
- Mitigation and monitoring technologies
- Regional partnerships
- Ongoing research: BOEM, DOE, PNNL, NREL, Sandia, CEC, OCEAN, Academia, Offshore Wind CA, AWEA, AWWI, POWER…



Pacific Northwest
NATIONAL LABORATORY

Dr. Andrea Copping
Senior Manager

Dr. Lysel Garavelli
Biological Oceanographer

Dr. Molly Grear
Ocean Engineer

US West Coast Floating Wind and Cetaceans: Baseline Data, Risks, and Moving Forward

Part 1: Entanglement and Collision Risk

POET Webinar
July 2, 2020

Lysel Garavelli, Ph.D.

Molly Grear, Ph.D.

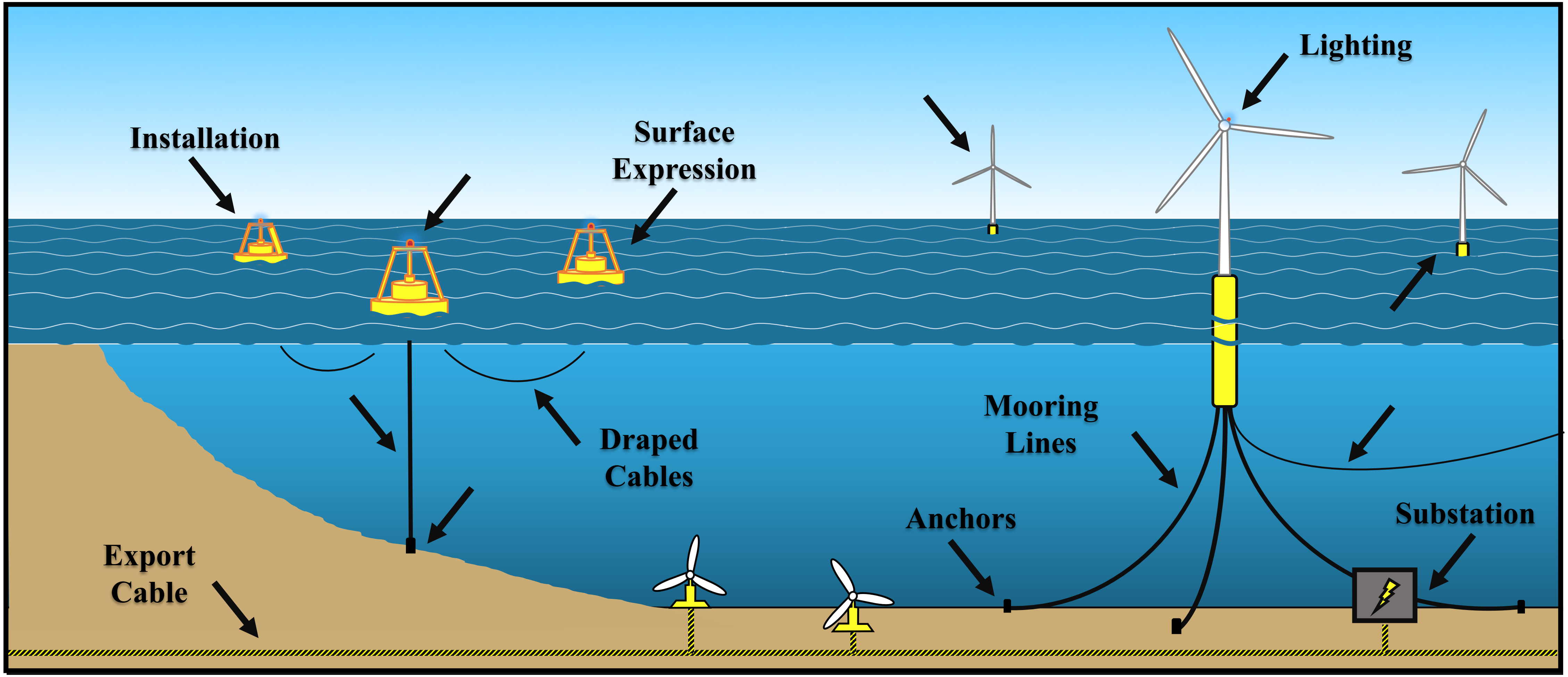
Andrea Copping, Ph.D.

Pacific Northwest National Laboratory

Effects that are similar between MRE and OSW

MRE = Marine Renewable Energy

OSW = Offshore Wind

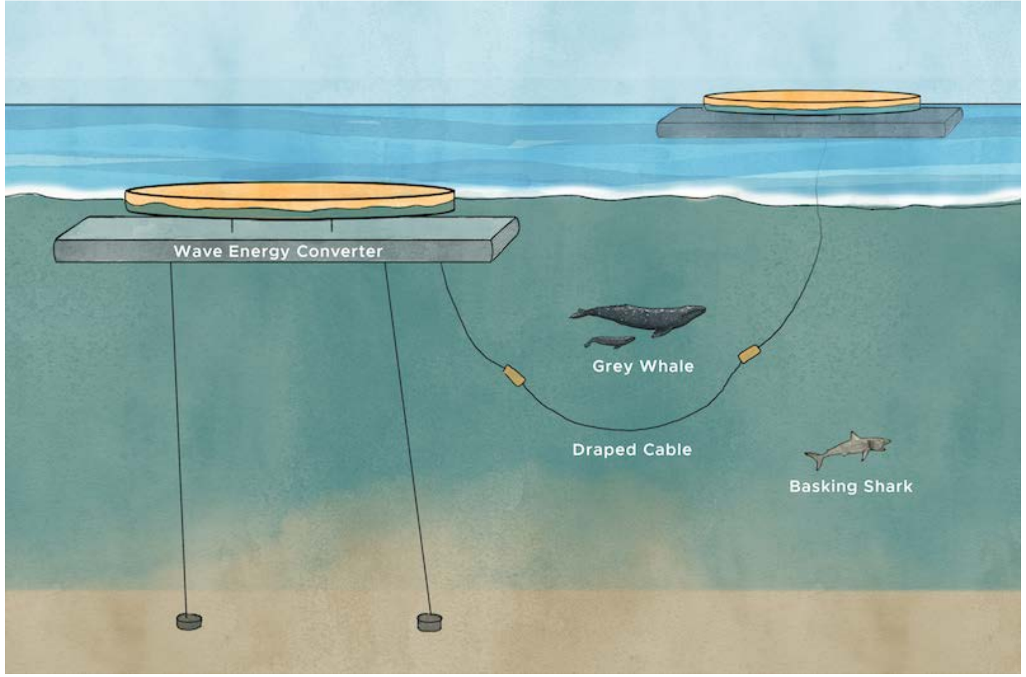


Entanglement: Relevance to MRE

➢ Potential for marine animals to encounter the mooring lines and cables

Entanglement?

Marine animal may become caught in a system without possibility of escaping



Garavelli (2020)
https://tethys.pnnl.gov/publications/state-of-the-science-2020-chapter-8-moorings

Knowledge from MRE

- Entanglement is currently not a significant issue of concern within MRE consenting processes

- As the scale of MRE development grows

  ➡ Concern likely to be more considered by regulatory bodies

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- Entanglement is currently not a significant issue of concern within MRE consenting processes

- As the scale of MRE development grows

  ➡ Concern likely to be more considered by regulatory bodies

- **Little information and no observations** of marine animals becoming entangled with MRE mooring lines or cables

- Greatest concern of entanglement for **large marine animals** (migratory whales)

Current Research: Modeling

- Risk of encounters and probability of entanglement

- Dependent on
    - Behavior and biological characteristics of marine animals (e.g., size)
    - Mooring line or cable configuration and depth

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- Mooring lines = **low risk** for entanglement
  (Benjamins et al. 2014, Harnois et al. 2015)

- Mooring tether and marine mammals (Minesto 2016)
  - No risk of encountering the mooring tether while device is operating
  - Even in the case of encounter, mooring lines would remain taut to avoid the risk of entanglement

Knowledge from Surrogate Industries

- Entanglement with fishing gear (e.g., nets, cables, traps)
  (Parton et al. 2019; Robbins et al. 2015; Wilcox et al. 2015)

  ➡ Large marine animals mainly entangled in loose end line / slack line

  ➡ Small animals entangled in derelict fishing gear and marine debris

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- Entanglement in submarine telecommunications cables prior to 1959
  - ➡ Whales entanglement in cables with excessive slack and in deep waters (118 m)
    (Wood and Carter 2008)

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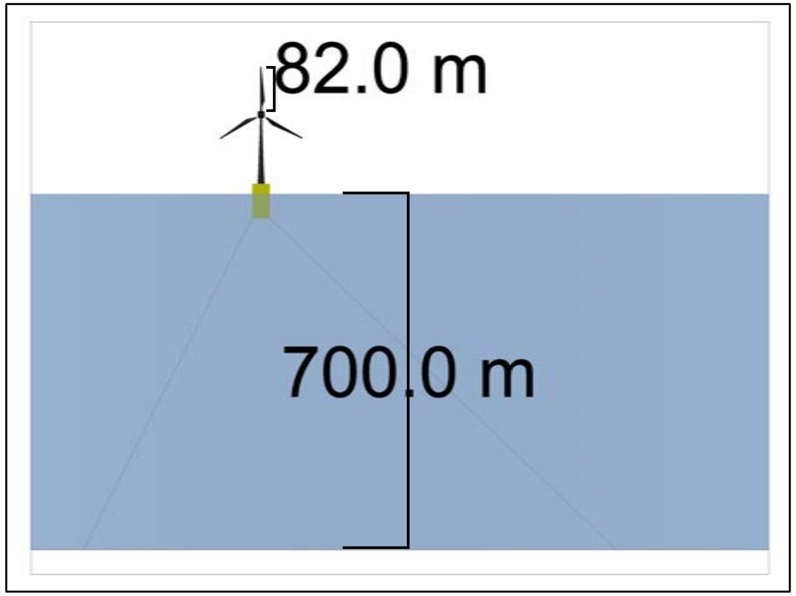
➡ **MRE systems: Mooring lines are never sufficiently slack to create a loop**
No part would be abandoned/discarded
Secondary entanglement could be a concern (Taormina et al. 2018)

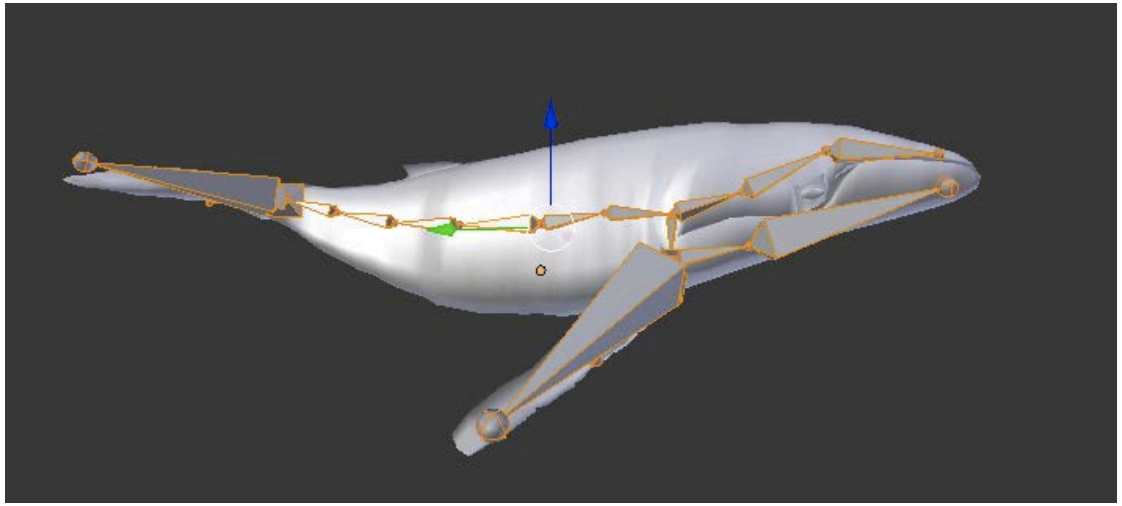
Entanglement
Application to Floating Wind

- Many MRE devices require only a single mooring line, while floating offshore wind platforms have 3 or 4
- Floating OSW more likely to be sited further offshore and in less biologically diverse and abundant marine areas
- Stakeholders remain concerned for direct interaction, or secondary risk from derelict fishing gear snagged on mooring lines

In collaboration with BOEM, PNNL created an animation to show the likely scale of wind farms

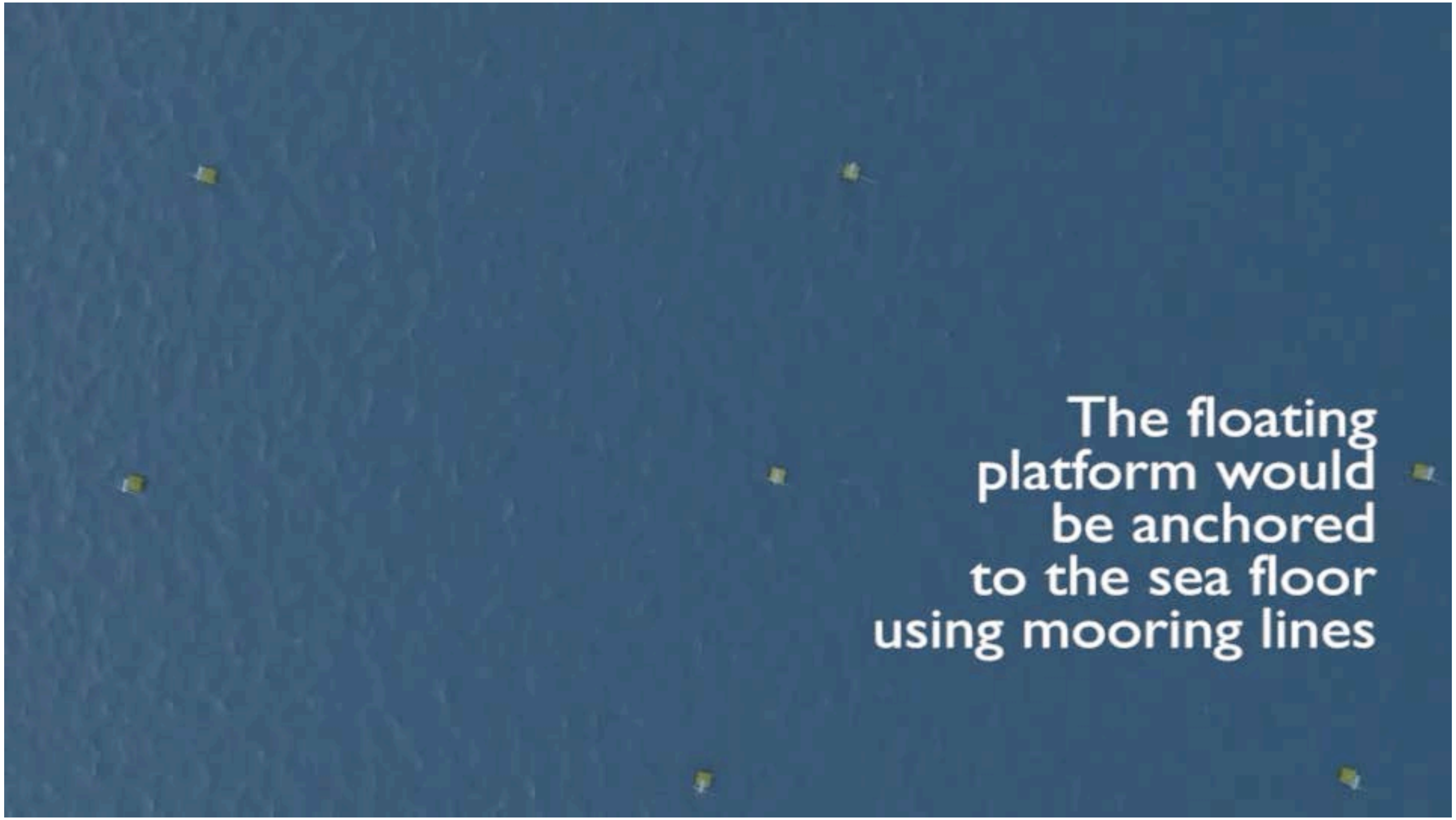
- Based on literature data of whale traveling speed, dive depth, and morphometric, we created a 3D animation of a whale swimming through a floating wind farm
- Floating wind farm dimensions and layouts were based on generalized dimensions from BOEM's lease applications





Model humpback whale has joints (in orange) so she can move and swim

In collaboration with BOEM, PNNL created an animation to show the likely scale of windfarms



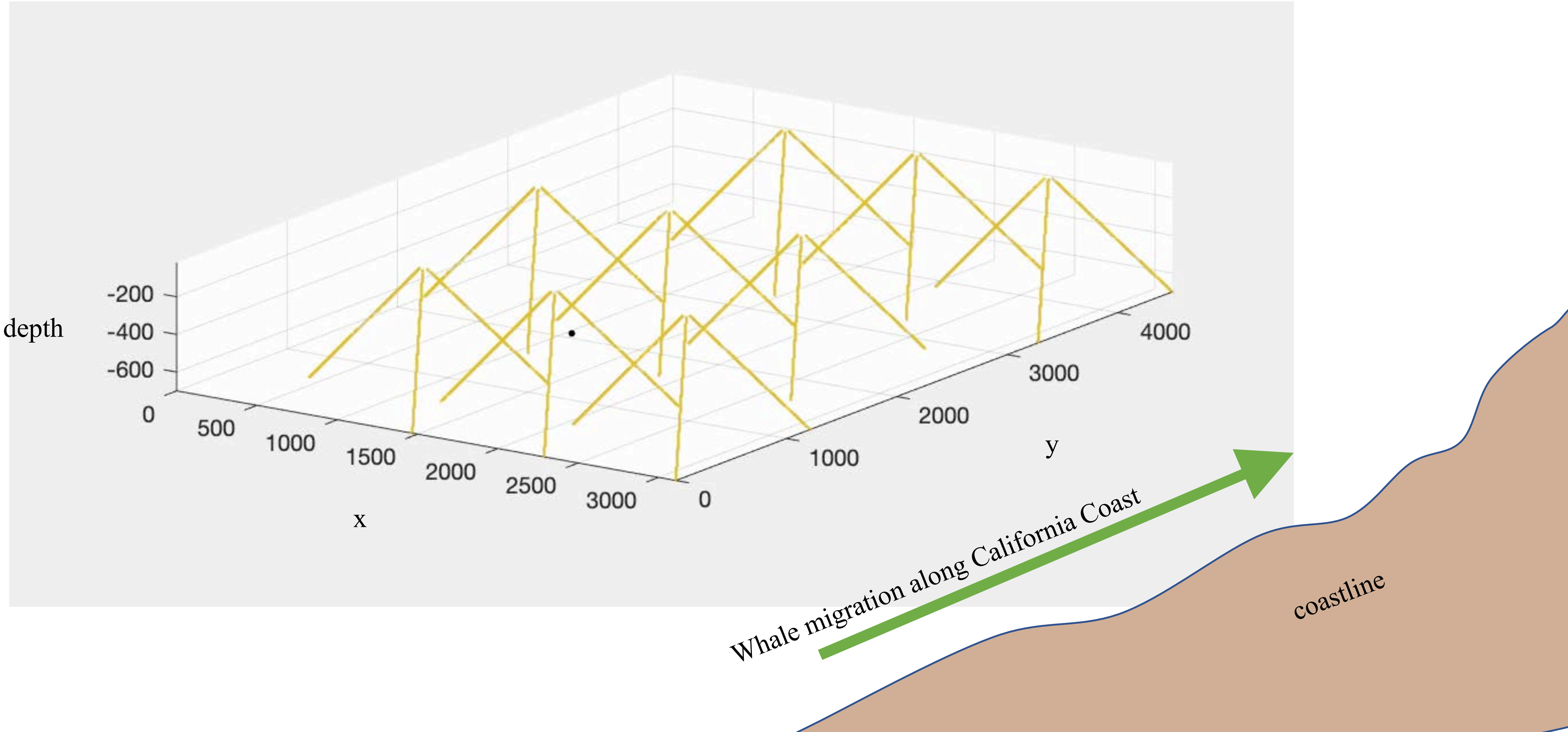
In collaboration with BOEM, PNNL created an animation to show the likely scale of windfarms

Full video at: https://www.youtube.com/watch?v=G8bKpuSNUZ0

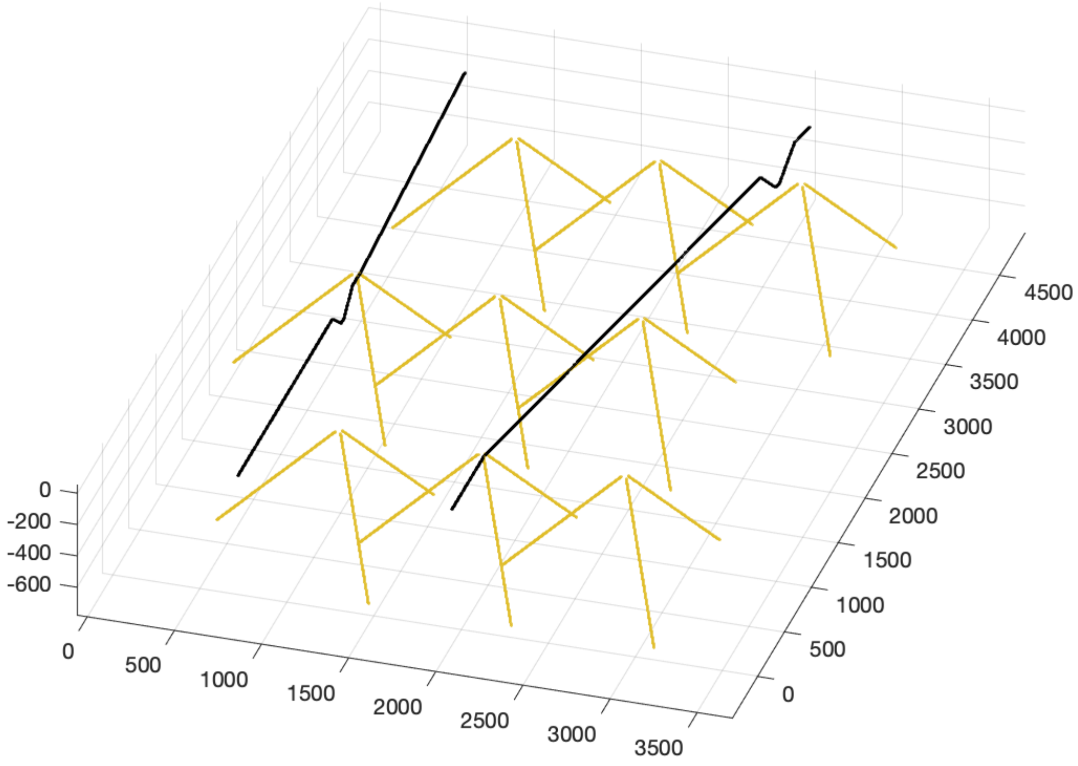
Collision Risk Models

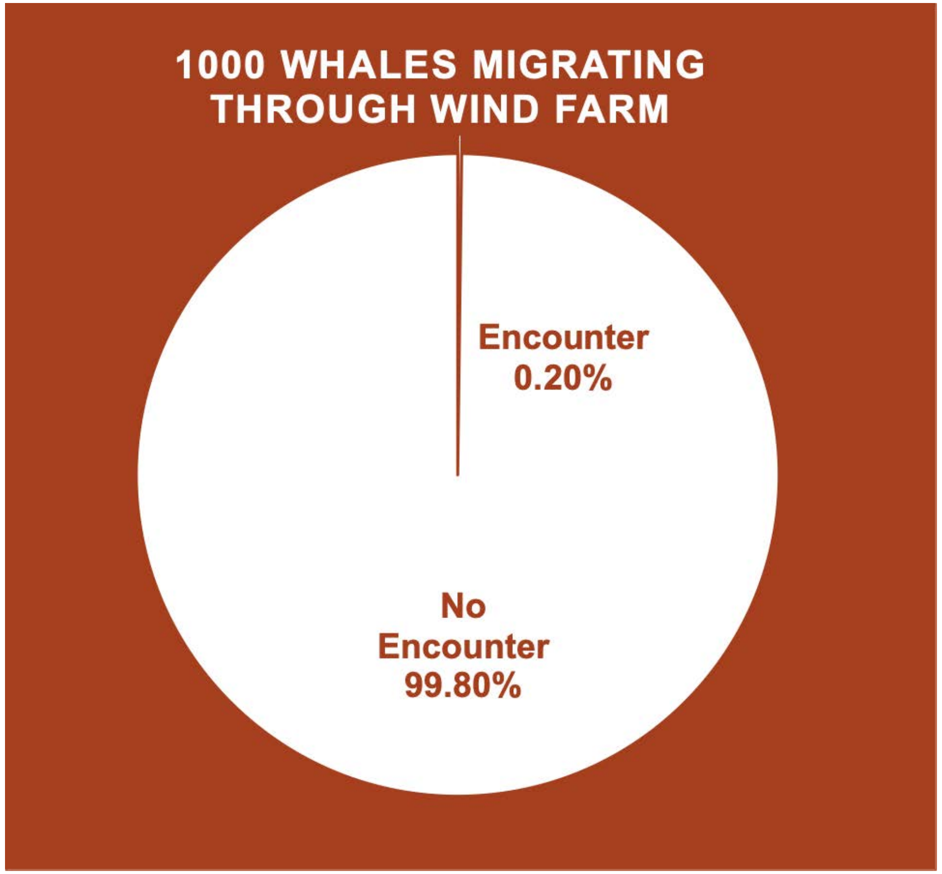
- Collision Risk Model was created based on similar inputs to animation work
- Whale is assumed to transit through the wind farm. Speed, dive depth, dive duration, and initial location are sampled from a distribution of potential values based on literature data.
- Whale is assumed to dive one time during the transit of the wind farm.
- If whale comes within one meter of mooring line, that results in an 'encounter' and the whale changes direction by up to 5 degrees to the left or right.
- Many assumptions in this model that could be changed with improved behavioral data.

Collision Risk Model (one dive)



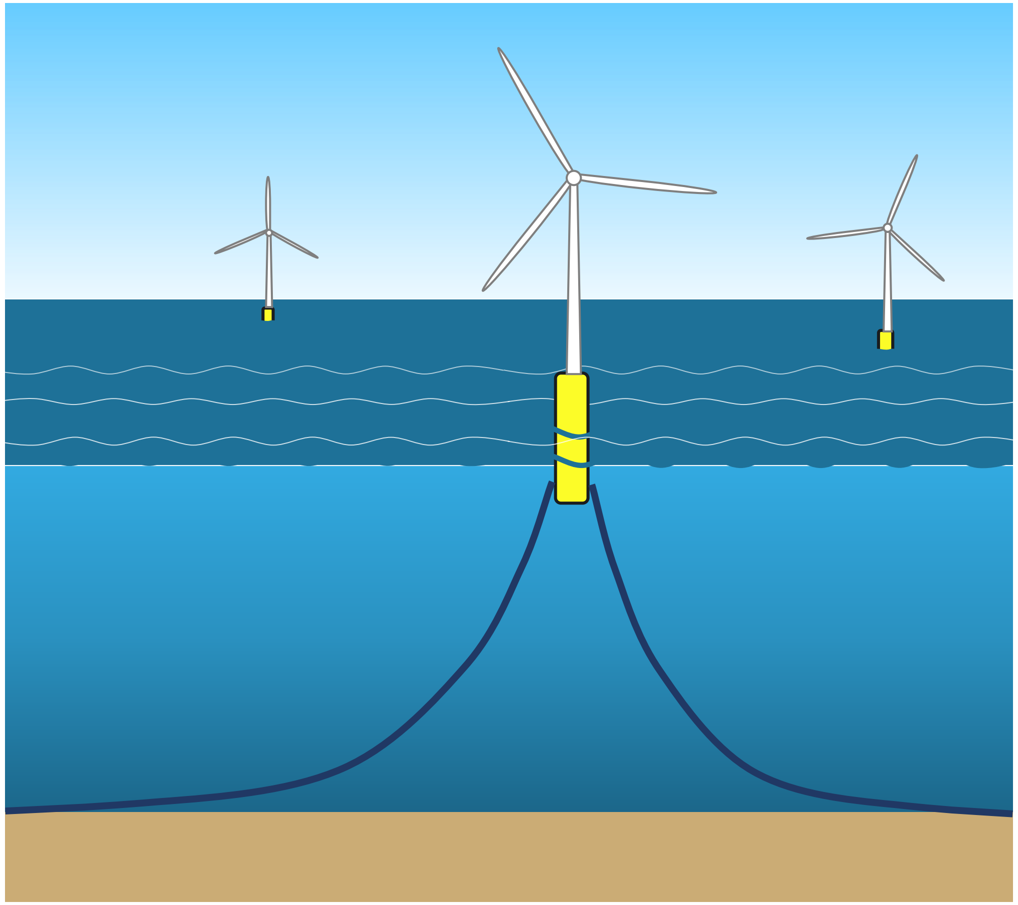
Collision risk model using 1000 whales





Understanding forces on mooring lines during whale encounter

- Calculating forces on the mooring lines during a potential encounter can also aid in understanding the risk



- Catenary moorings typically have several times the length of line in the water laying on the ground
- Large amount of mass on the ground means that there is amount of mass to move to pull the line off the sediment at the seafloor
- Even before the line becomes fully taut, the mooring line would weigh between 3000-4000 lbs, depending on where in the water column the movement was happening.

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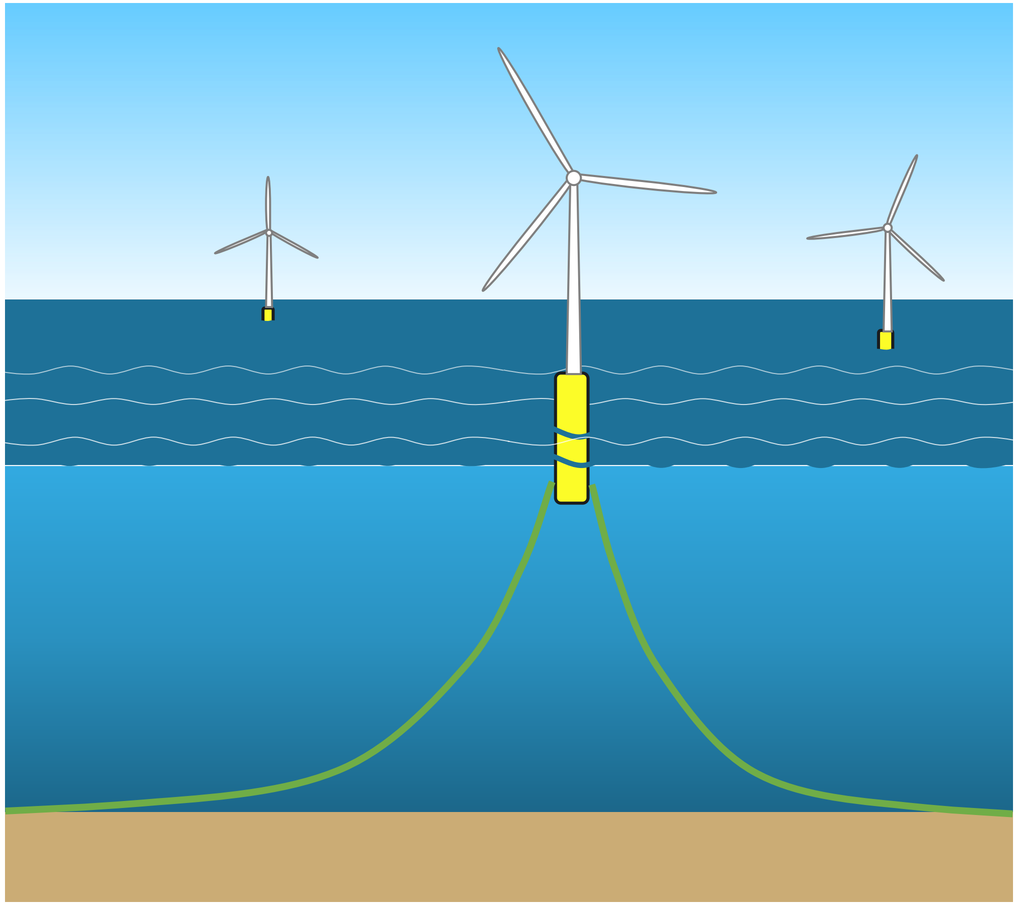

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Thank you!

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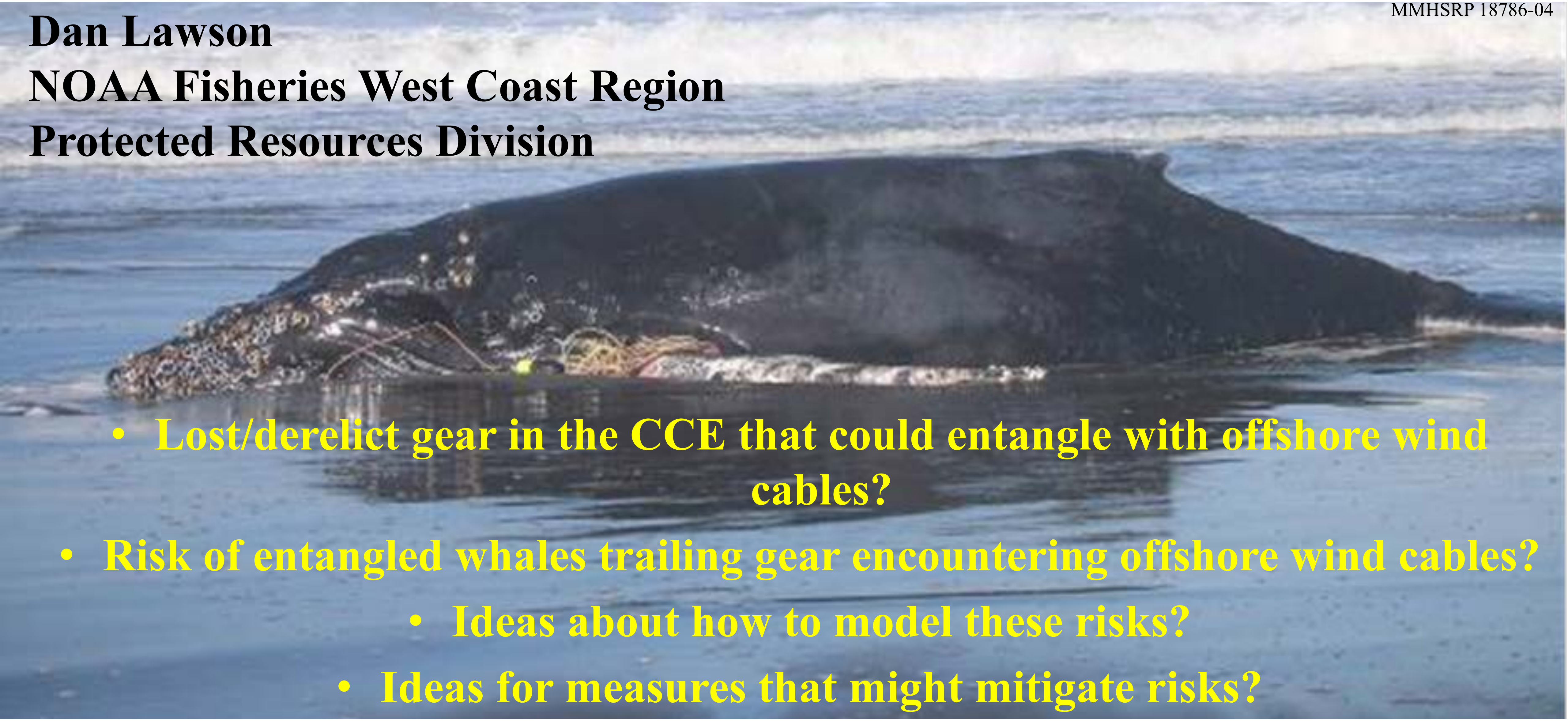
PNNL is operated by Battelle for the U.S. Department of Energy

Dan Lawson
NOAA Fisheries West Coast Region, Protected Resources Division

Insight into Whale Entanglement Risks

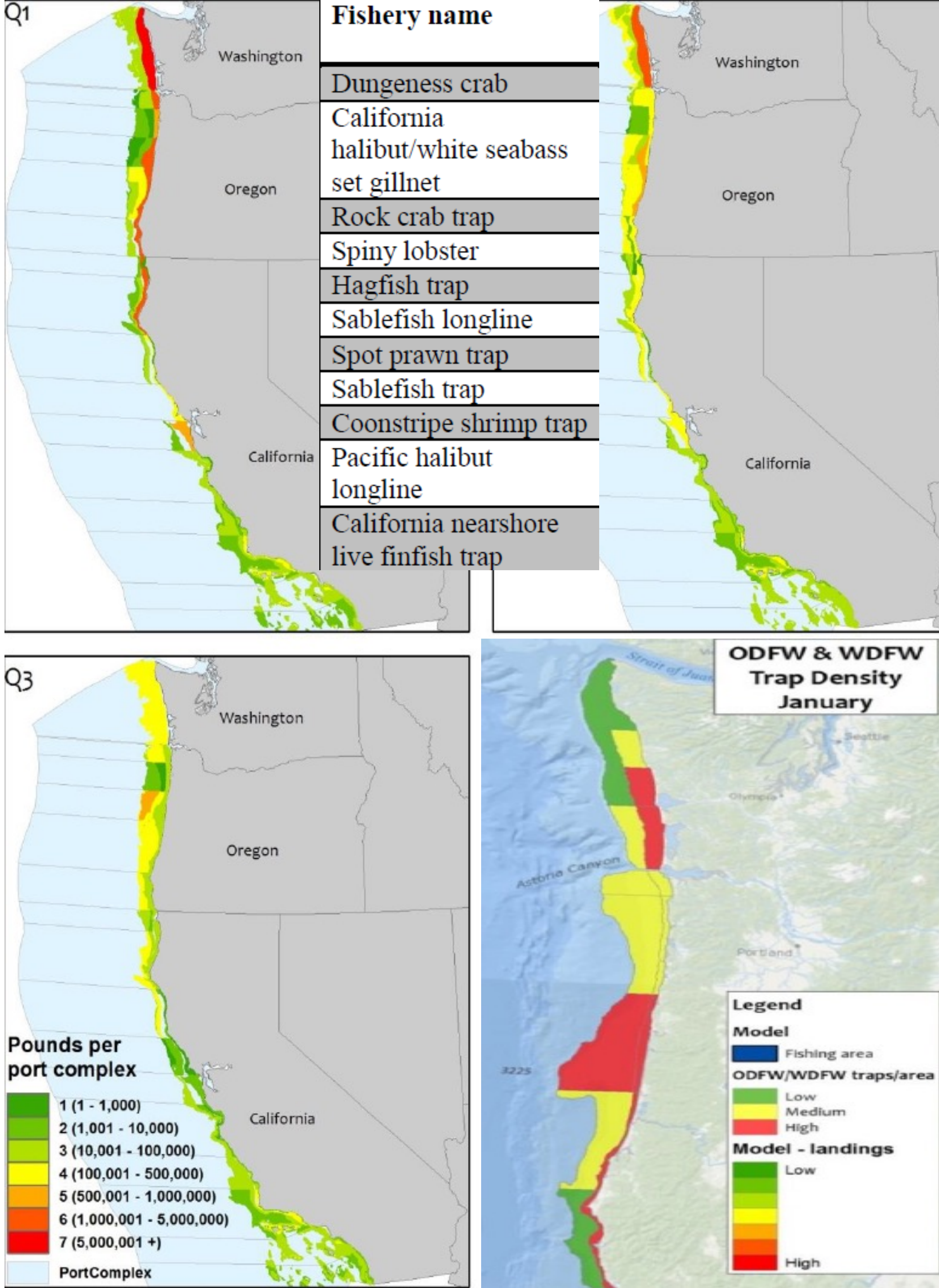


Dan Lawson
NOAA Fisheries West Coast Region
Protected Resources Division

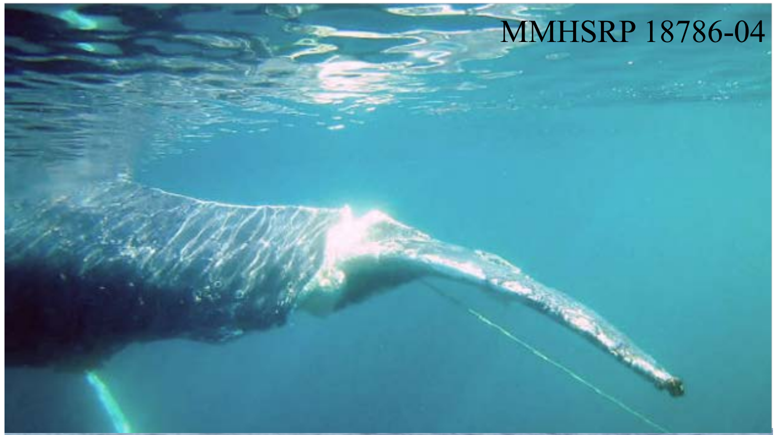
- **Lost/derelict gear in the CCE that could entangle with offshore wind cables?**
- **Risk of entangled whales trailing gear encountering offshore wind cables?**
- **Ideas about how to model these risks?**
- **Ideas for measures that might mitigate risks?**

What do we know about lost or derelict fishing gear?

- Active fixed gear - Saez et al. 2013 "Co-occurrence"
  - Depth considerations – cited on the shelf? slope?
- Info on lost gear not systematically collected
  - Information on replacement tags suggest loss up to 10% per season
- Order of mag - 500,000 lines/traps coastwide (80% are Dungeness crab)
  - 10,000s lost each year? – seems high
  - 1000s very possible
- Few entanglements known to have occurred with lost/derelict gear – 2019 D-crab entanglement



Entangled whales getting more entangled?



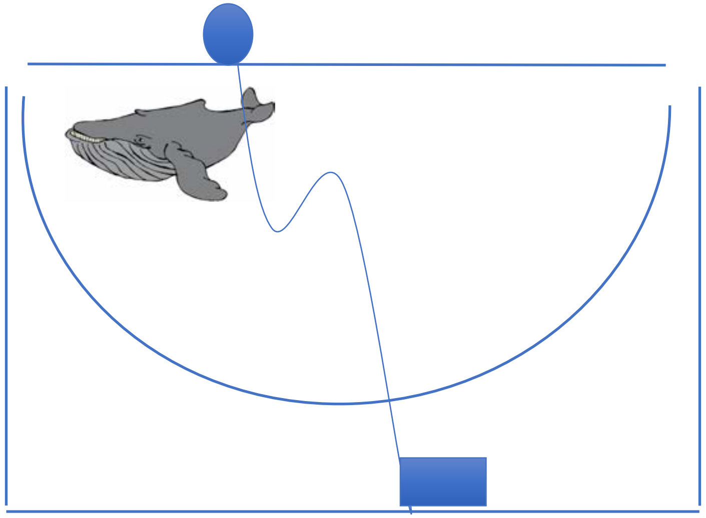
19 cases (that we know of) of more than one set of gear from 2010-19 out of ~280 confirmed entanglement reports

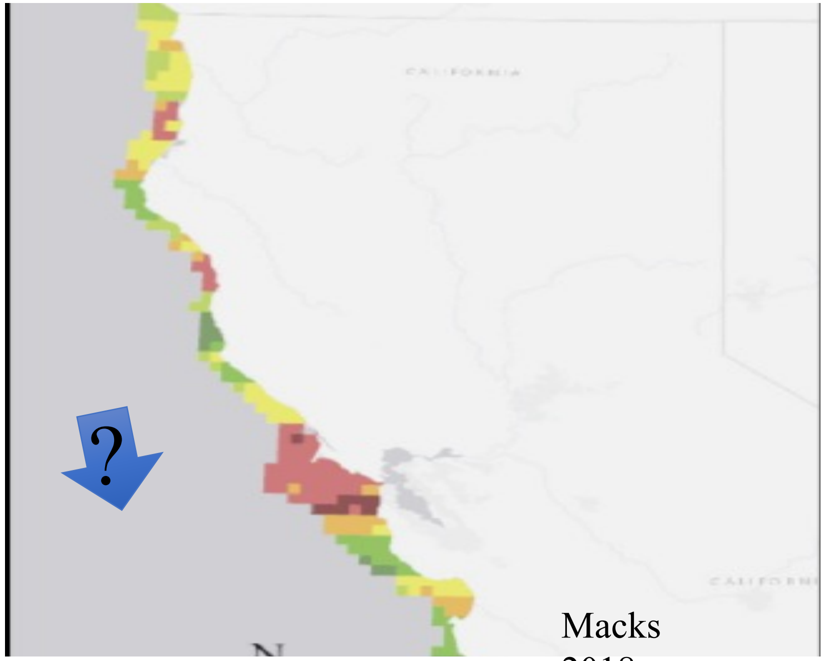
- Most are humpback whales – 4 gray whales
- 2019 entanglement with crab gear and weather buoy

- Extent of trailing gear – lots of surface gear
- Single traps vs strings
- Depth considerations
- Breaking strengths?

Modeling risk for entanglement risks for offshore wind?

- Qualitative models – Murphy's Law of Entanglements
  - Over time risks ≠ 0
- Quantitative model "estimates" will be difficult – high levels of uncertainty
  - Use reported entanglement rates (primary/secondary) and # of line-days from other sources of entanglement to compare to line-days of cables/mooring?
  - Calibration - length of lines and orientation?
  - Order of magnitude?
- Models weighing relative risks maybe easier to translate
  - Bring in whale, fishing effort, and citing information
- Generate expectations for movements of lost gear from current and wind models?



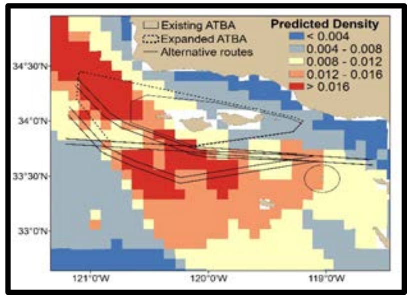


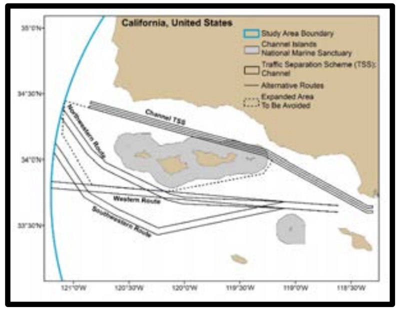
Macks 2018

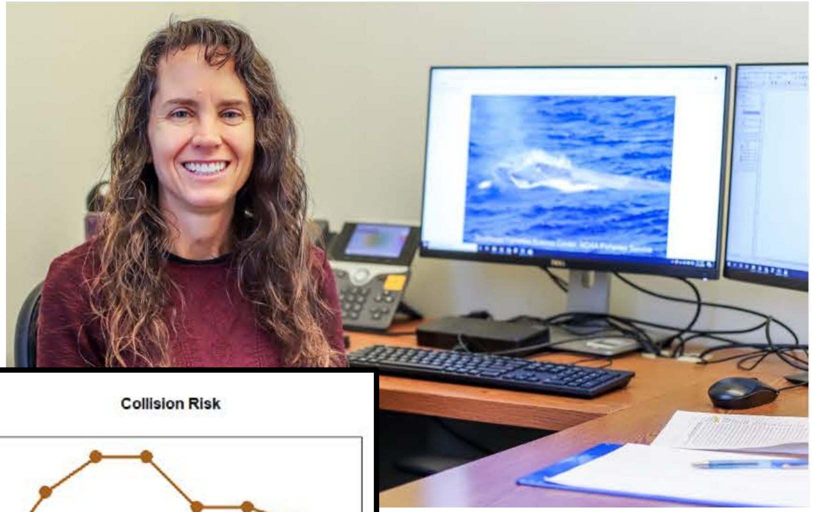
Ideas for measures to mitigate entanglement risk?

- Profile of cables/moorings – limit horizontal profile in "upper" column
- Citing – depth considerations and avoiding being within or "downstream" of gear/gear loss hotspots
- Work with States to facilitate lost gear retrieval
  - Learn where/when gear is lost
- NOAA Marine Debris Program
- Active effort to monitor infrastructure for gear/whales
  - Technology to monitor infrastructure to detect "variances" that may reflect gear and/or whale entanglements

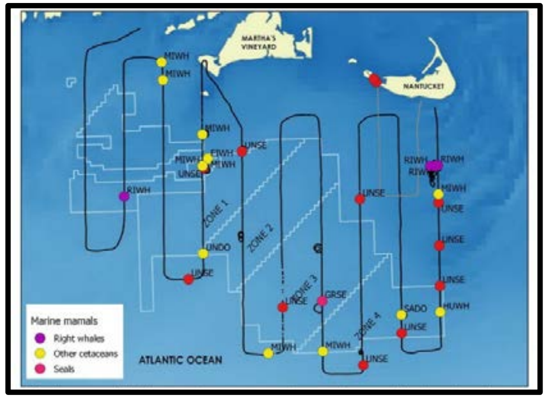
Fin Whales

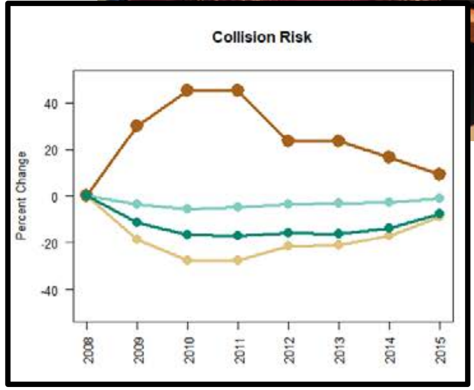






Aerial surveys of wind energy areas off Massachusetts





Risk Assessment

Anderson Cabot Center for Ocean Life at the New England Aquarium

New England Aquarium

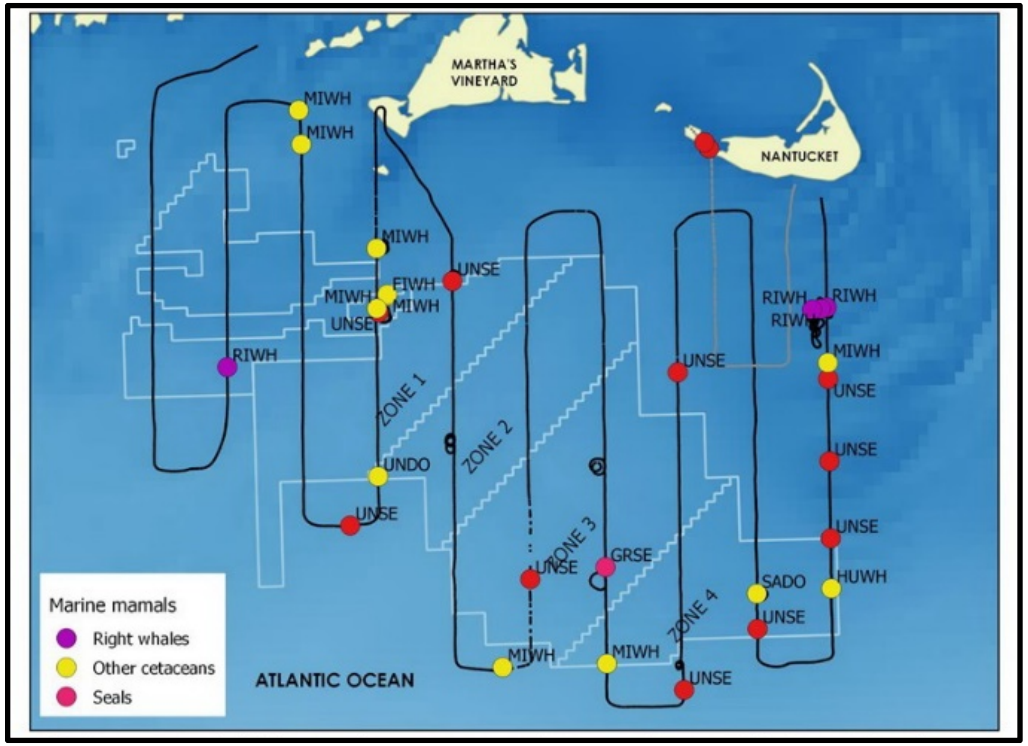
Protecting the blue planet

Dr. Jessica Redfern
Senior Scientist, EcoMap Chair, Spatial Ecology, Mapping, and Assessment Program

EcoMap

Mission:

- We assess risk to marine species from human use and climate change
- We use innovative monitoring and modeling techniques to provide a framework for stakeholders to develop solutions to marine conservation challenges

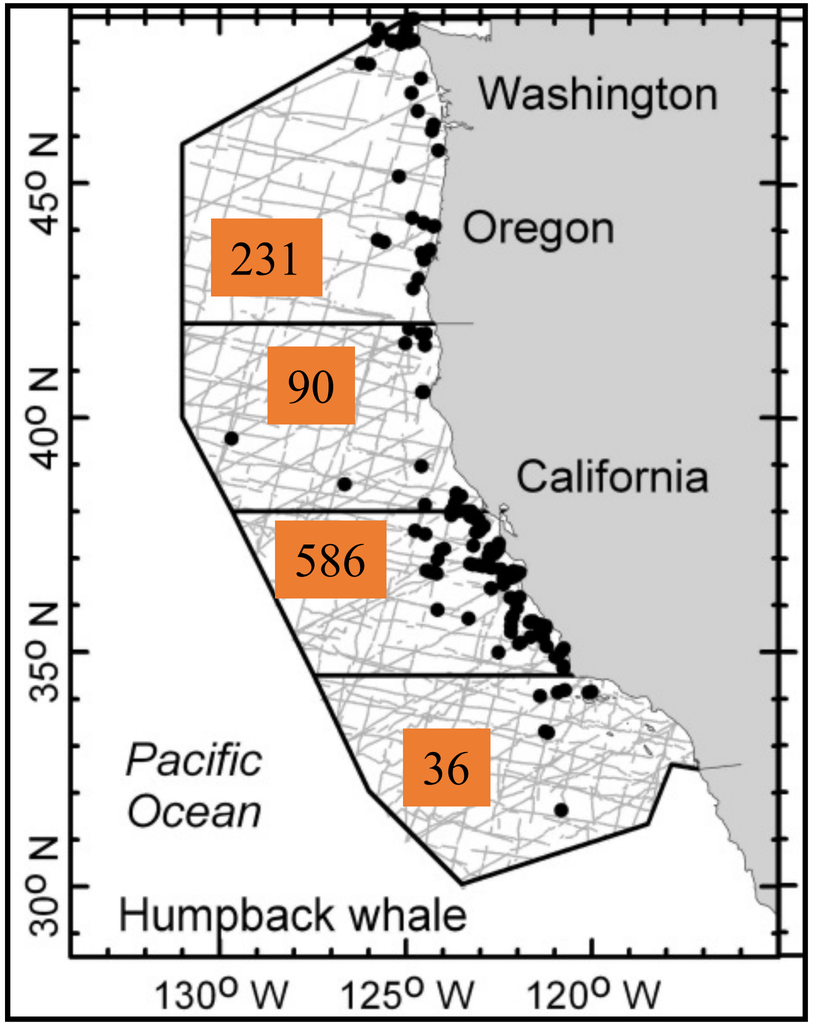


Aerial surveys of wind energy areas off Massachusetts

How many individuals are impacted?




How many individuals are impacted?

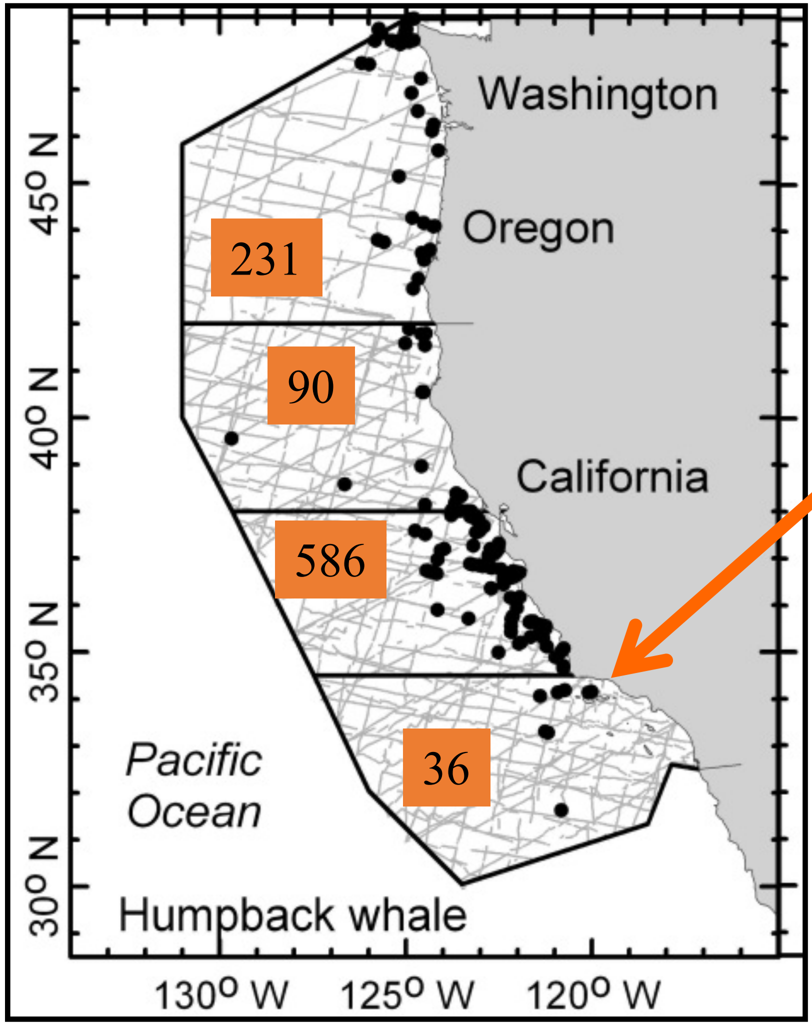


U.S. West Coast

Traditionally we estimated the number of animals in large areas

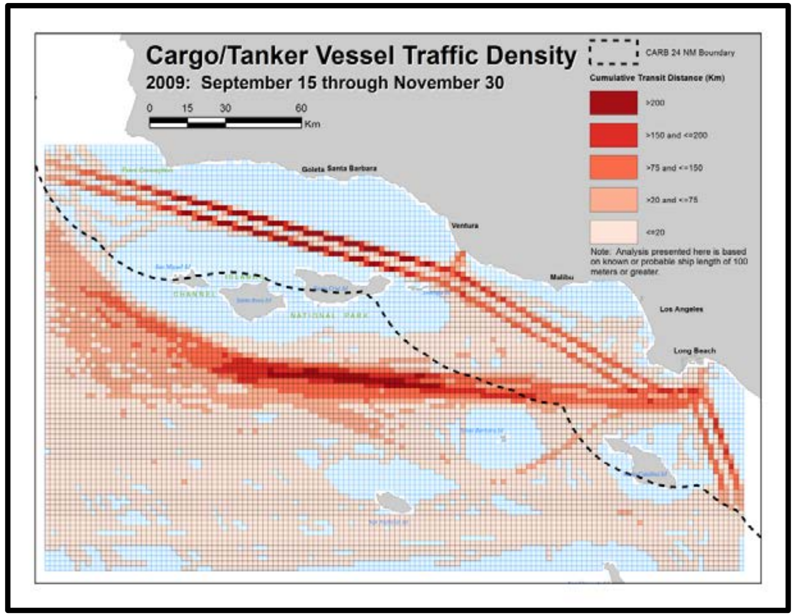
Barlow, J., and K. A. Forney. 2007. Abundance and population density of cetaceans in the California Current ecosystem. Fishery Bulletin **105**:509-526.

How many individuals are impacted?

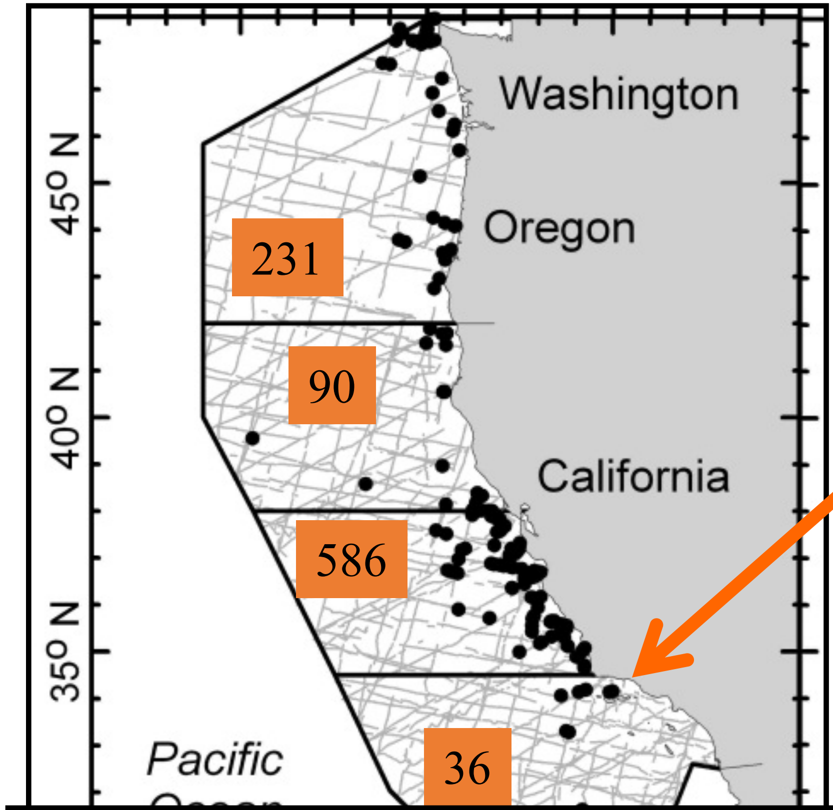


U.S. West Coast

What if we want to know the impact of an activity within one of these large areas?



How many individuals are impacted?



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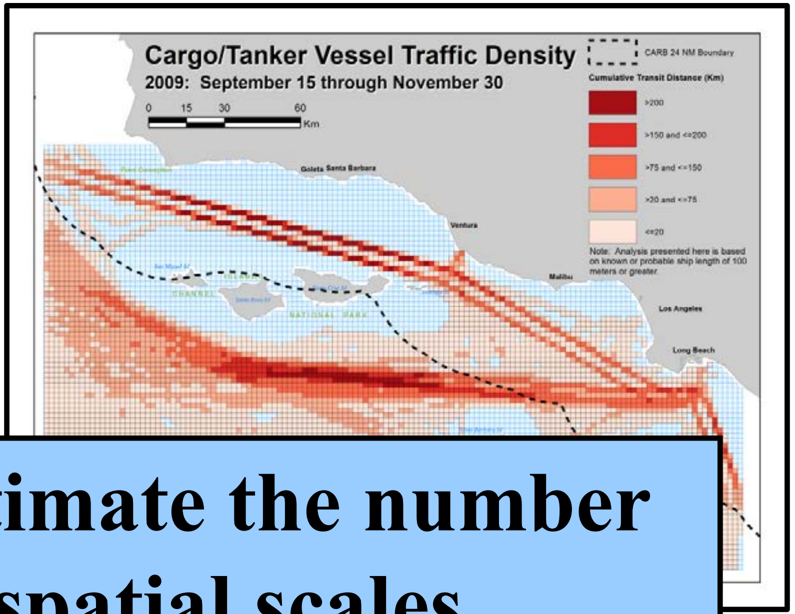


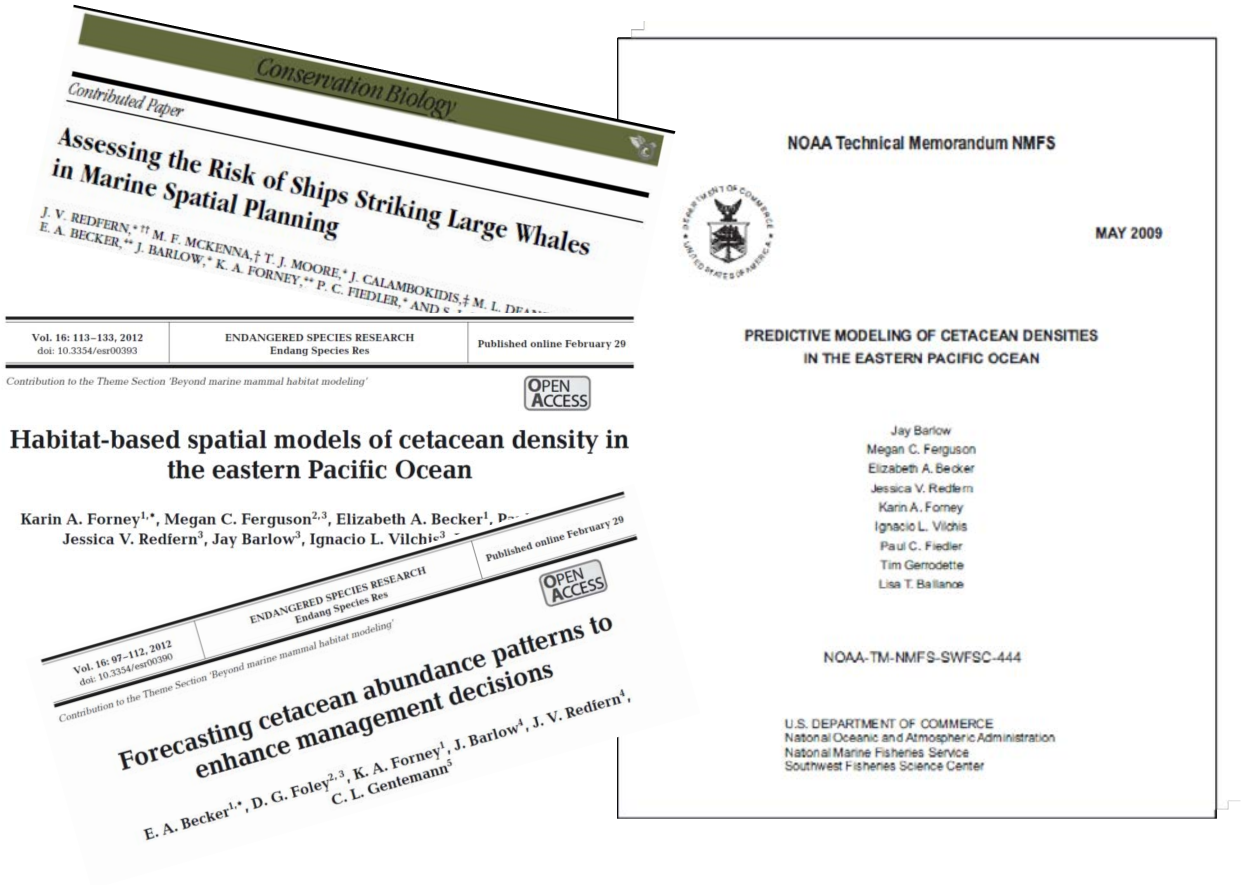
We developed tools to estimate the number of individuals at smaller spatial scales

U.S. West Coast

Multi-disciplinary studies -- drawing on collaborative research by MANY…

Primary Collaborators:

Elizabeth Becker
Karin Forney
Paul Fiedler
Jay Barlow
Lisa Ballance


Conservation Biology
Contributed Paper
Assessing the Risk of Ships Striking Large Whales in Marine Spatial Planning
J. V. REDFERN, M. F. MCKENNA, T. J. MOORE, J. CALAMBOKIDIS, M. L. DEAN…, E. A. BECKER, J. BARLOW, K. A. FORNEY, P. C. FIEDLER, AND S. …

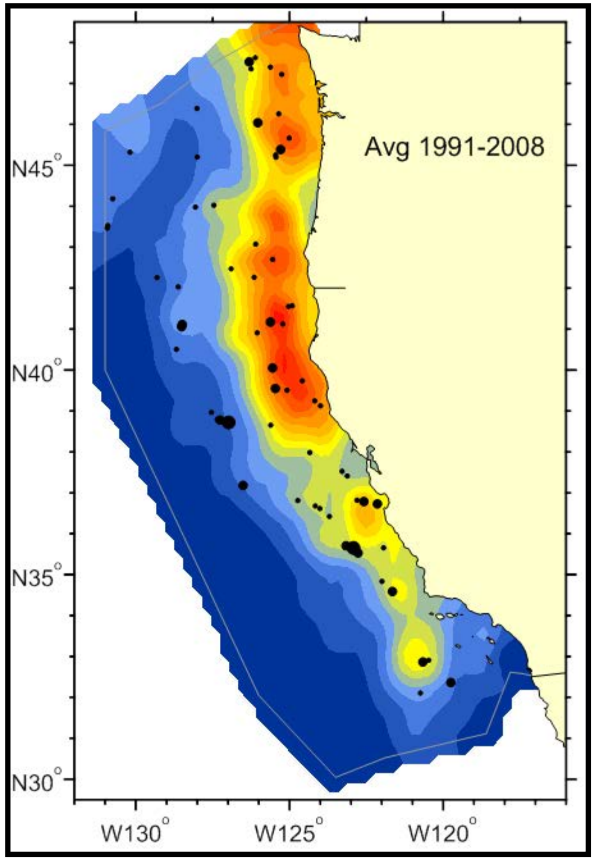
Vol. 16: 113–133, 2012 | ENDANGERED SPECIES RESEARCH Endang Species Res | Published online February 29
doi: 10.3354/esr00393
Contribution to the Theme Section 'Beyond marine mammal habitat modeling'
OPEN ACCESS
Habitat-based spatial models of cetacean density in the eastern Pacific Ocean
Karin A. Forney[1,*], Megan C. Ferguson[2,3], Elizabeth A. Becker[1], …
Jessica V. Redfern[3], Jay Barlow[3], Ignacio L. Vilchis…

Vol. 16: 97–112, 2012 | ENDANGERED SPECIES RESEARCH Endang Species Res | Published online February 29
doi: 10.3354/esr00390
Contribution to the Theme Section 'Beyond marine mammal habitat modeling'
OPEN ACCESS
Forecasting cetacean abundance patterns to enhance management decisions
E. A. Becker[1,*], D. G. Foley[2,3], K. A. Forney[1], J. Barlow[4], J. V. Redfern[4], C. L. Gentemann[5]

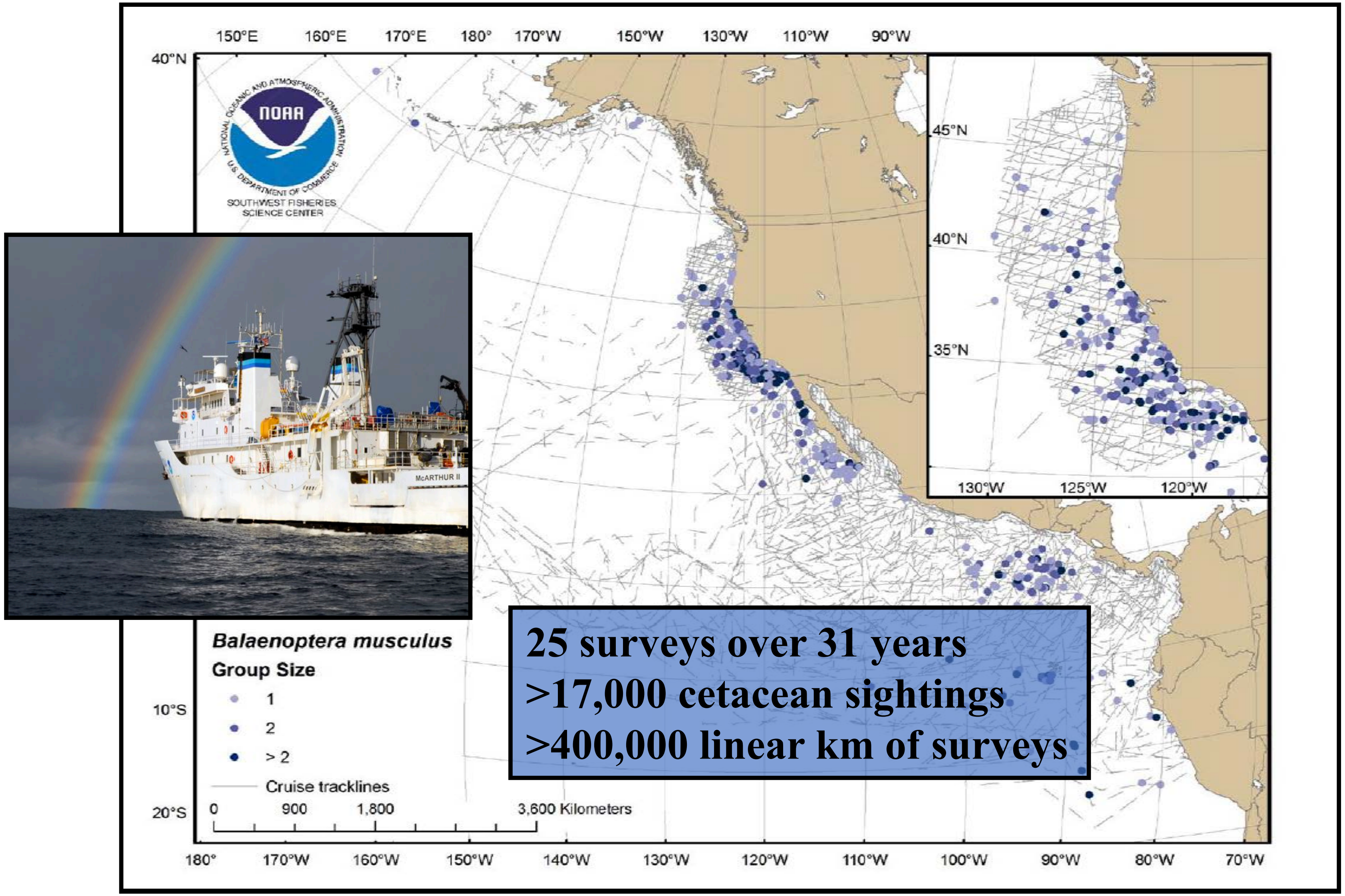
NOAA Technical Memorandum NMFS
MAY 2009
PREDICTIVE MODELING OF CETACEAN DENSITIES IN THE EASTERN PACIFIC OCEAN
Jay Barlow
Megan C. Ferguson
Elizabeth A. Becker
Jessica V. Redfern
Karin A. Forney
Ignacio L. Vilchis
Paul C. Fiedler
Tim Gerrodette
Lisa T. Ballance
NOAA-TM-NMFS-SWFSC-444
U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Southwest Fisheries Science Center

Publications

- Forney 2000 *Conservation Biology*
- Redfern et al. 2006 *MEPS*
- Redfern et al. 2008 *MEPS*
- Becker et al. 2010 *MEPS*
- Becker et al. 2012 *ESR Special Issue*
- Forney et al. 2012 *ESR Special Issue*
- Redfern et al. 2013 *Conservation Biology*
- Becker et al. 2014 ESR Special Issue
- Forney et al. 2015 ESR Special Issue
- Becker et al. 2016 Remote Sensing
- Redfern et al. 2017 ESR Special Issue
- Redfern et al. 2017 Diversity & Distributions
- Becker et al. 2017 Frontiers in Marine Science
- Becker et al. 2019 Diversity and Distributions
- Redfern et al. 2019 Diversity and Distributions
- Becker et al. 2020 Ecology and Evolution
- Redfern et al. 2020 Frontiers in Marine Science

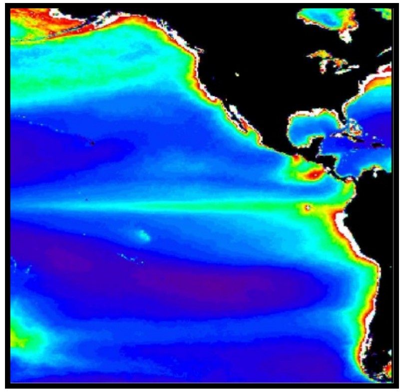


Southwest Fisheries Science Center
Marine Mammal Data Sets: 1986 - 2014



25 surveys over 31 years
>17,000 cetacean sightings
>400,000 linear km of surveys

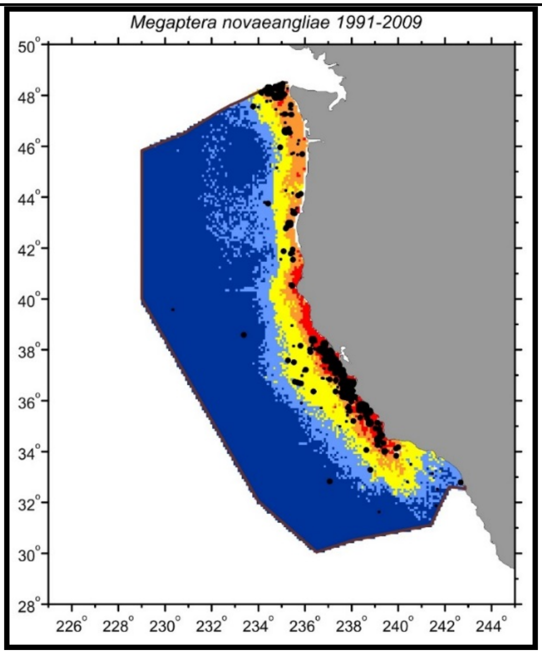
Survey data **Synthesis** → Density



Marine Mammal Survey Data

Ecosystem Data

Habitat Models to Estimate Marine Mammal Density



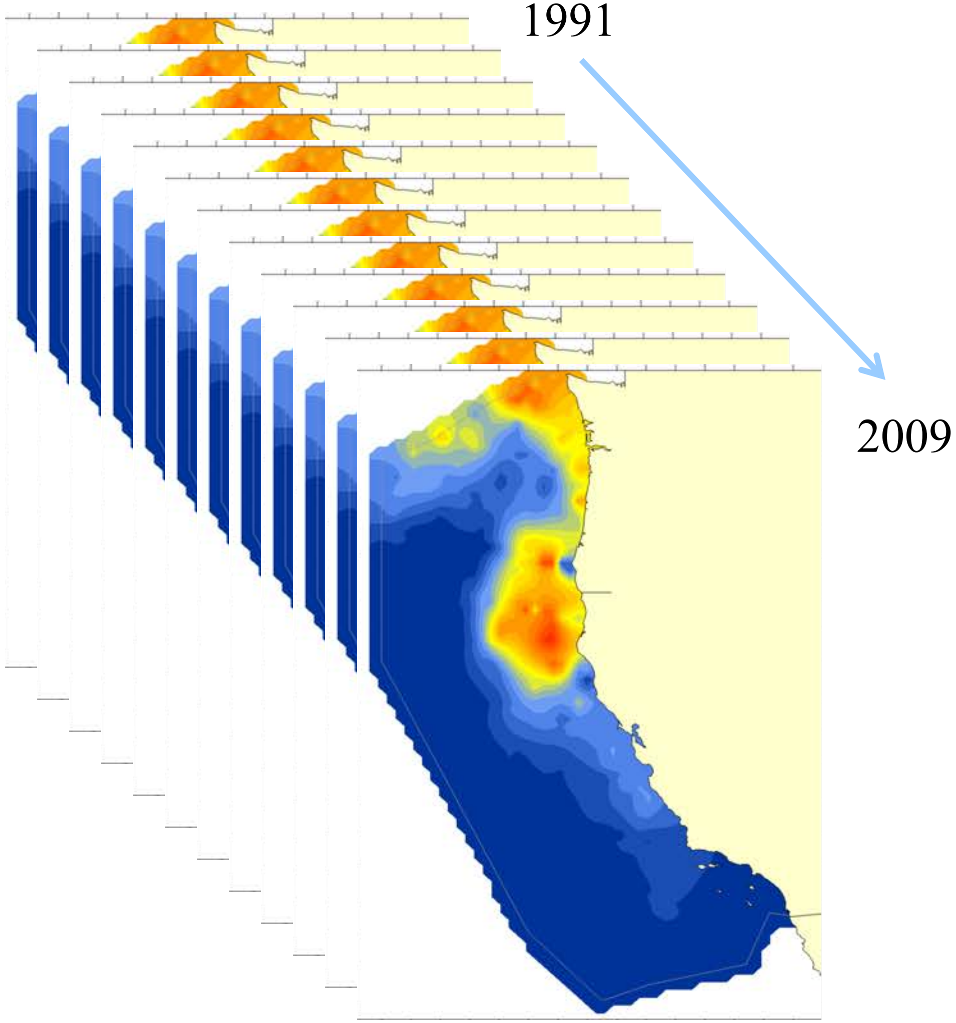
Marine Mammal Data 1986-2014:

- Ship and aerial surveys
  Southwest Fisheries Science Center

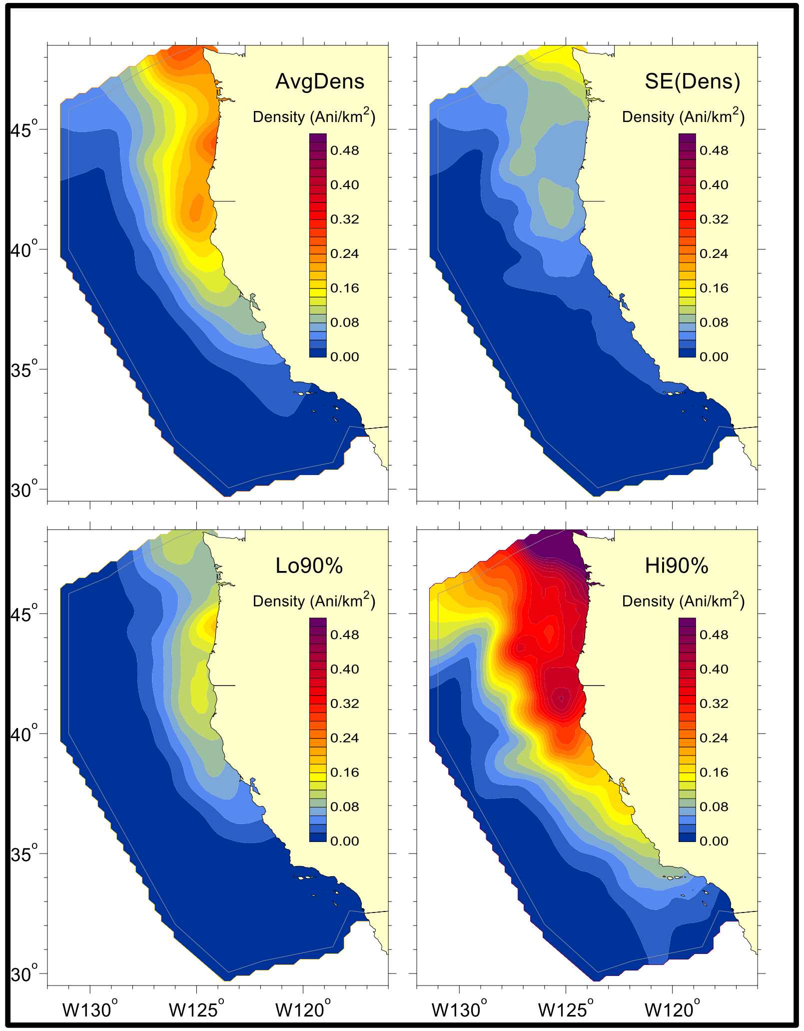
Ecosystem Data 1986-2014:

- In situ oceanographic and prey data
  Southwest Fisheries Science Center
- Remotely sensed data
- Regional oceanographic models

Average predictions

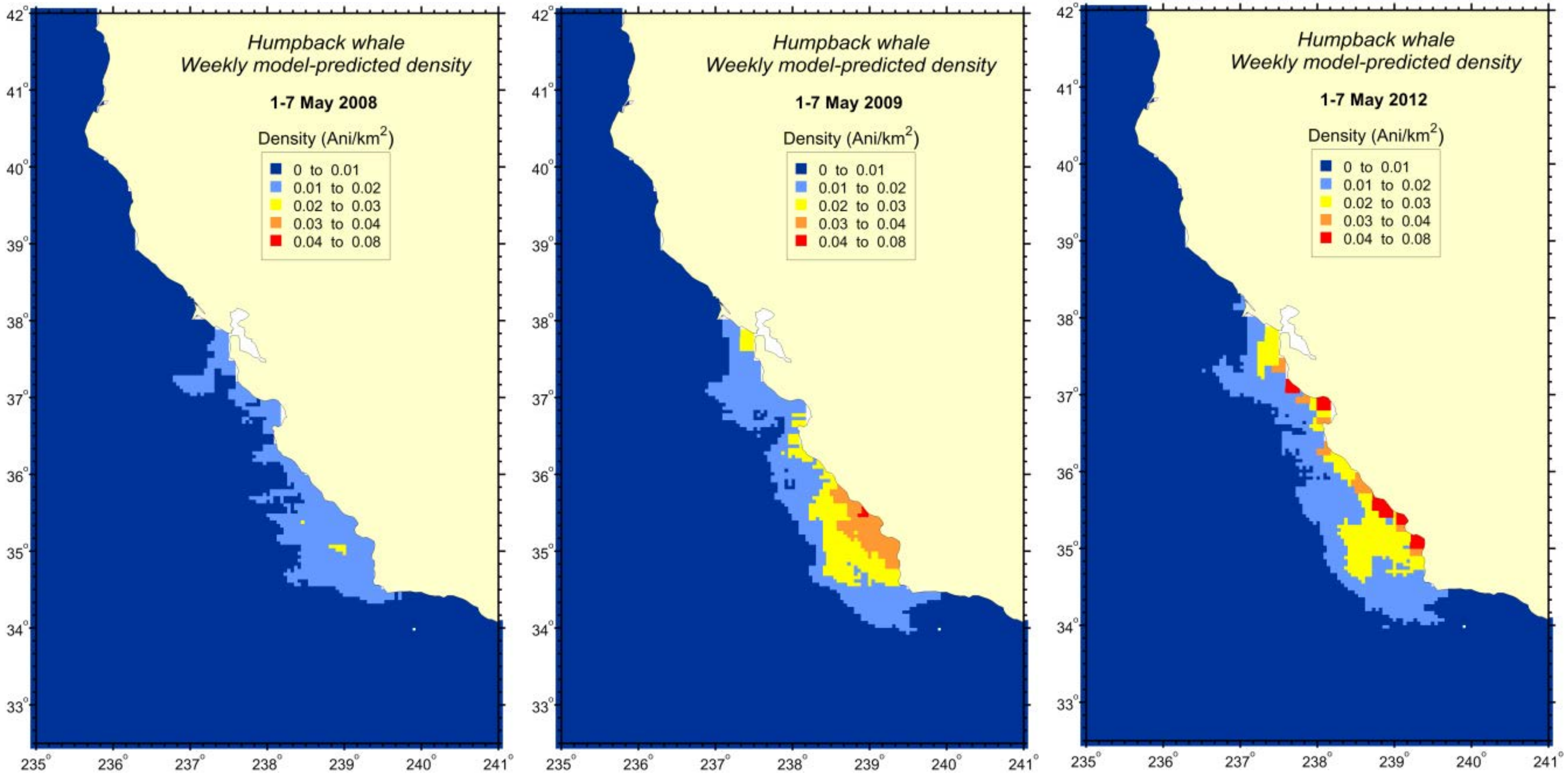


Seasonal, long-term predictions
Siting of wind energy areas



Weekly Predictions

Shorter-term predictions
Wind energy construction planning



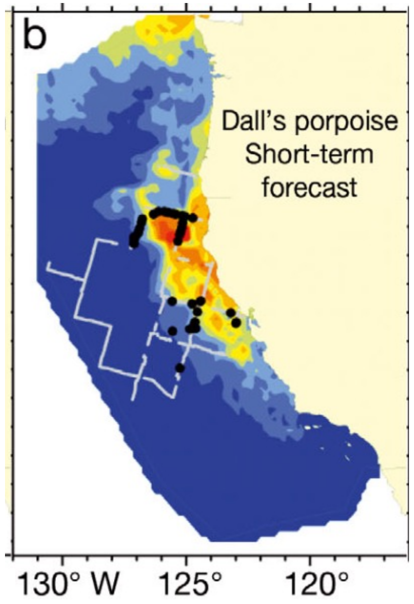
Forney et al. in prep.

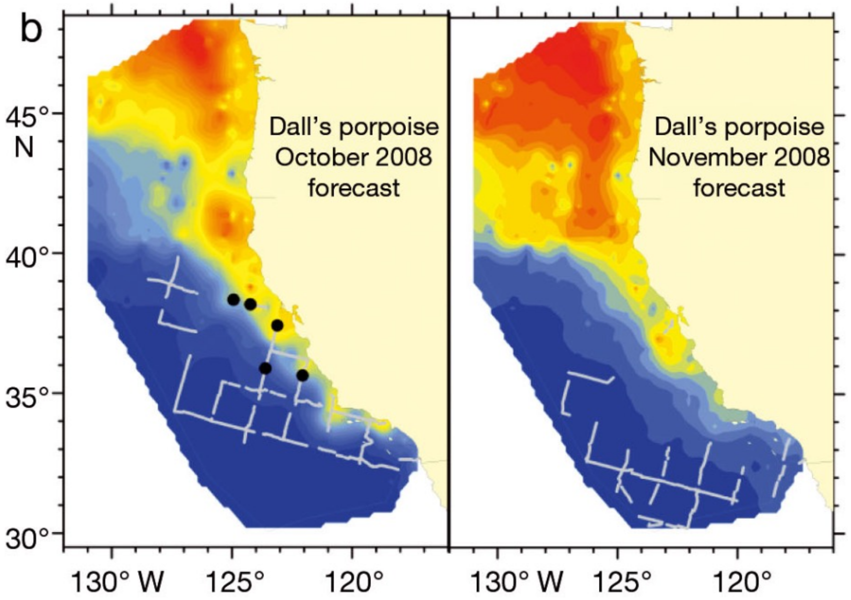
Forecast Predictions

Can we predict cetacean distributions weeks or months in advance?

Becker et al. (2012) found good concordance between:

- Sightings and forecasted daily predictions
- Sightings and forecasted monthly predictions





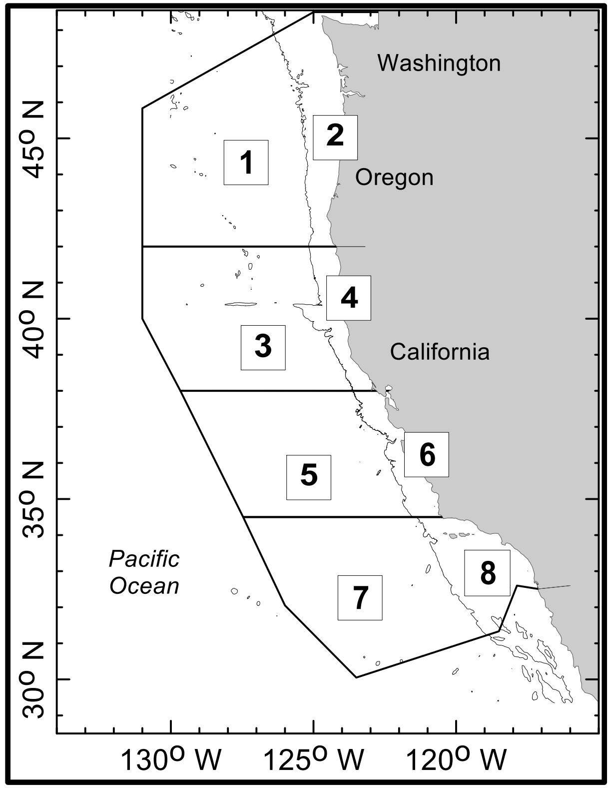
Wind energy construction

Becker et al. 2012. Forecasting cetacean abundance patterns to enhance management decisions. Endangered Species Research 16: 97-112.

Extensive model validation and expert review

YEAR	Ratio
1991	1.621638
1993	0.354613
1996	1.32254
2001	0.853526
2005	0.740571
2008	0.71209
All Years	~1.00

1) Spatial prediction patterns across 8 geographic strata



2) Observed : predicted ratios across all survey years

3) CCE-wide abundance comparisons

Habitat-based density models		Barlow (2010) line-transect estimates		
Species	**Abund**	**1991-2008**	**2005/2008**	**CV**
Pd	53,239	54,439	42,000	0.33

4) Modeled density patterns are reviewed by a panel of marine mammal experts…

5) Assess accuracy of predictions on novel years of survey data

Survey data → **Synthesis** → Density

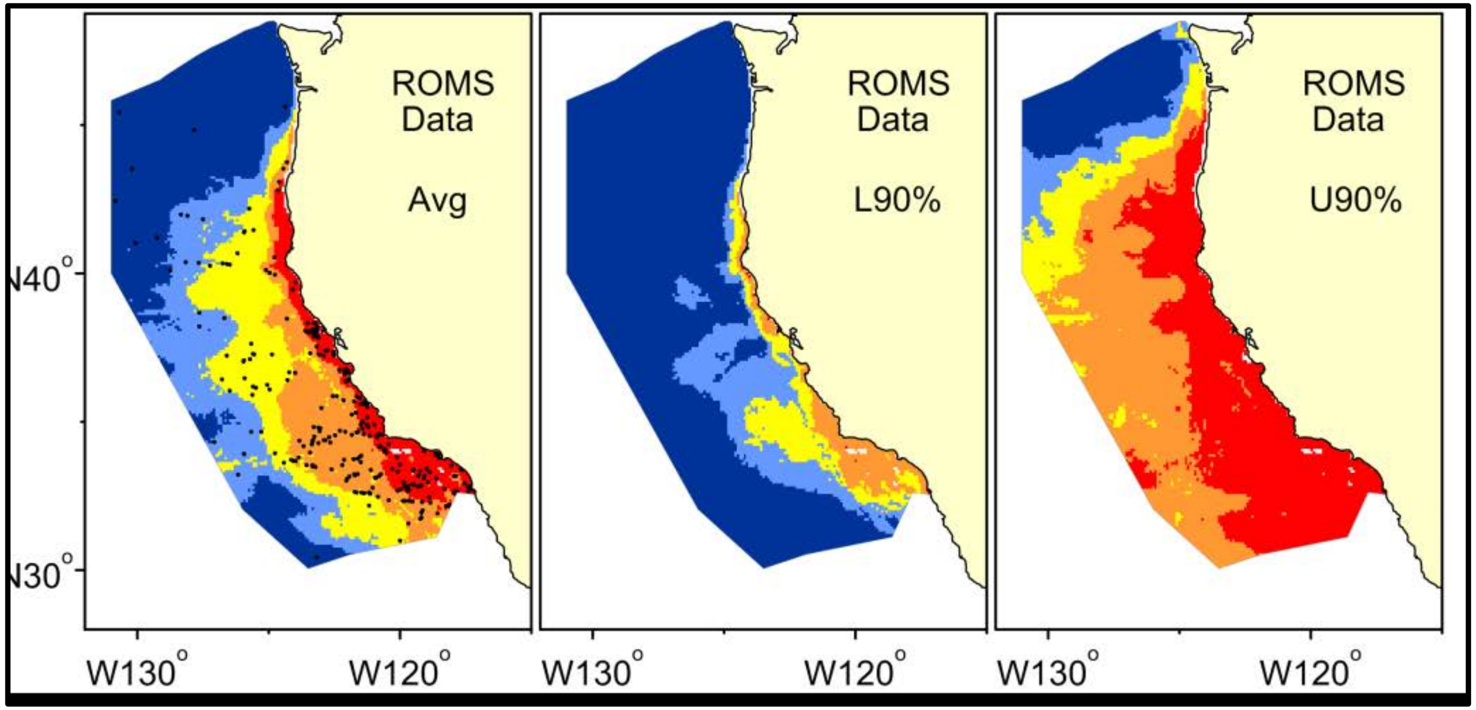
Models were developed for:

- **11 species in the California Current**

Becker et al. 2016

Blue Whale:

Mean and Confidence Intervals



Evaluating stakeholder-derived strategies to reduce the risk of ships striking whales

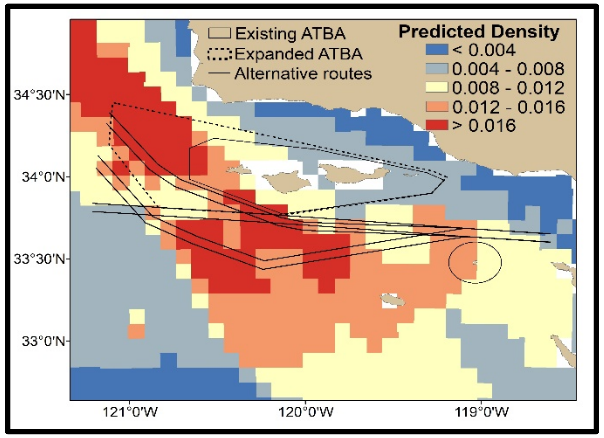
Redfern et al. 2019. Diversity and Distributions

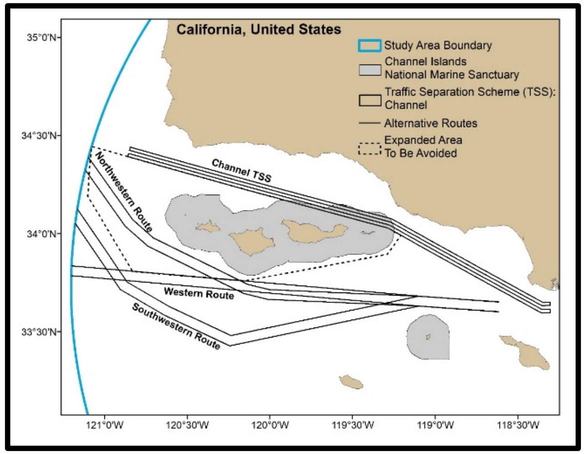
Ship-Strike Risk Assessment

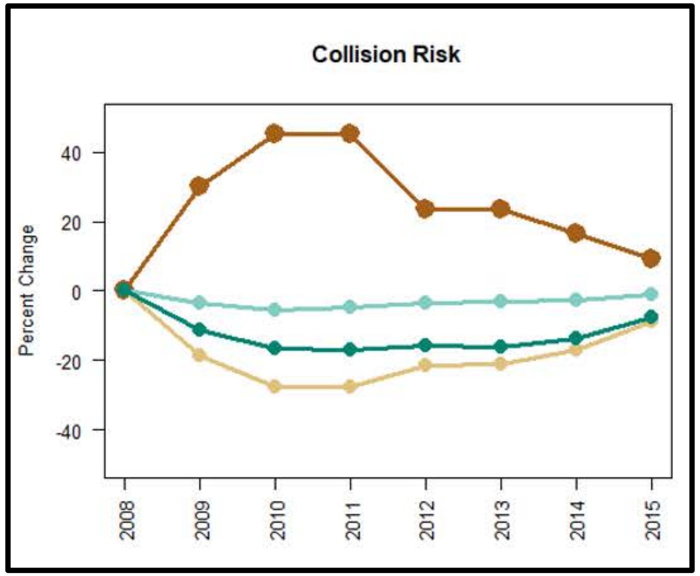
Methods overview

- Develop habitat models to predict whale densities
- Identify management options using shipping data
- Assess risk in the identified options

Fin Whales







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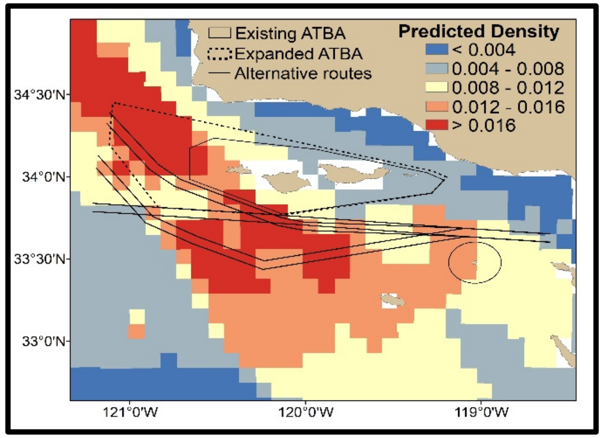

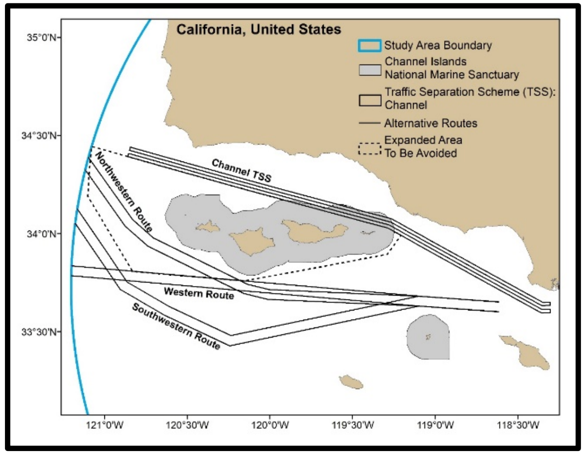

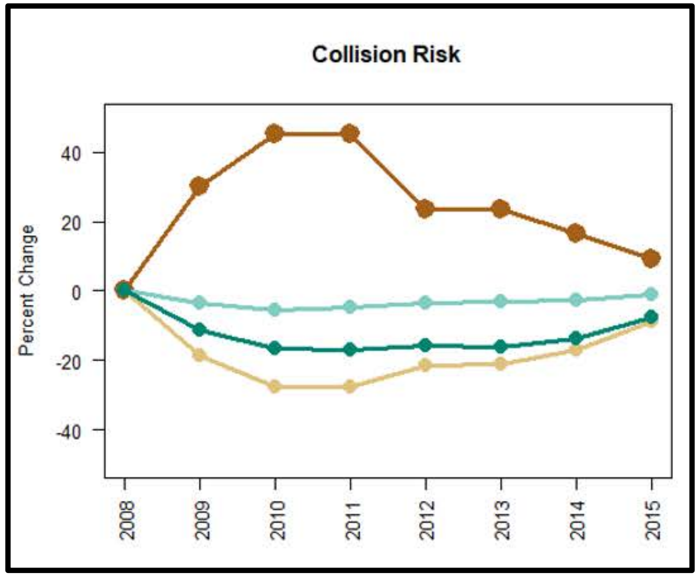

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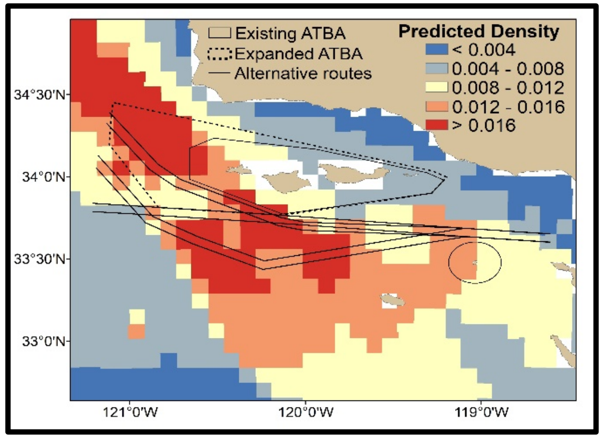

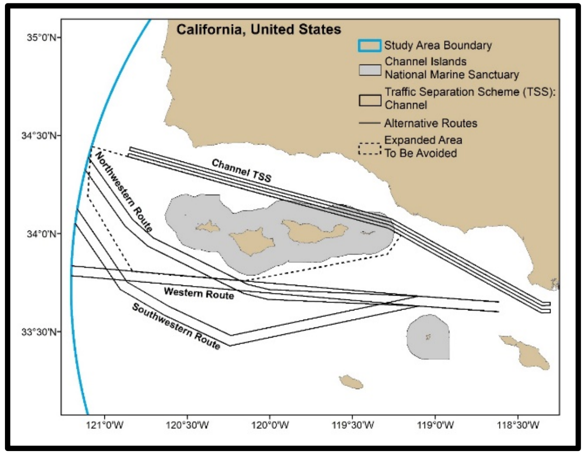

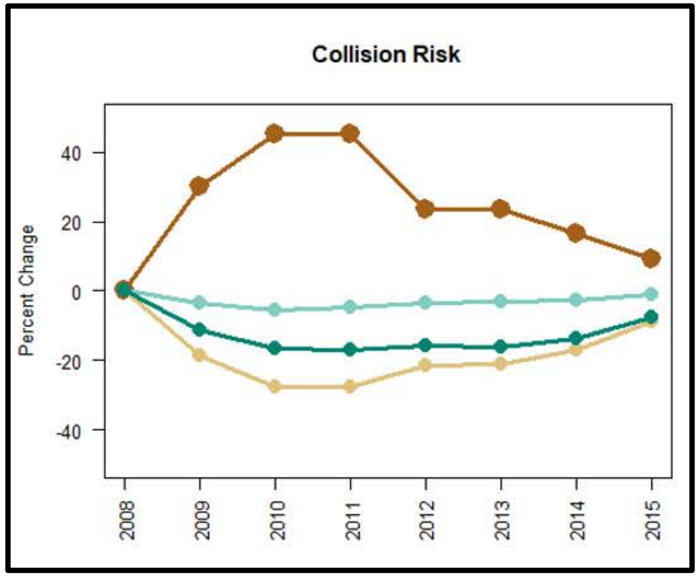

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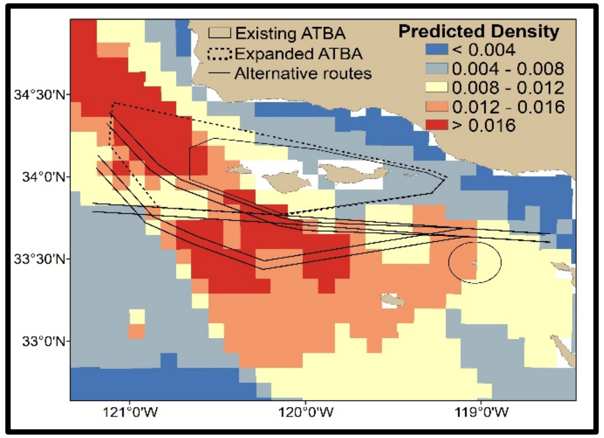
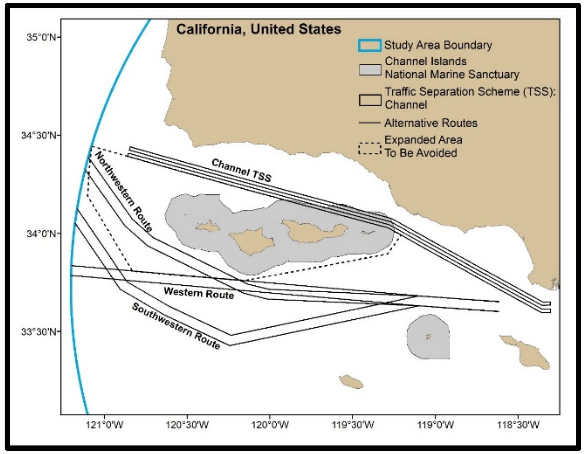
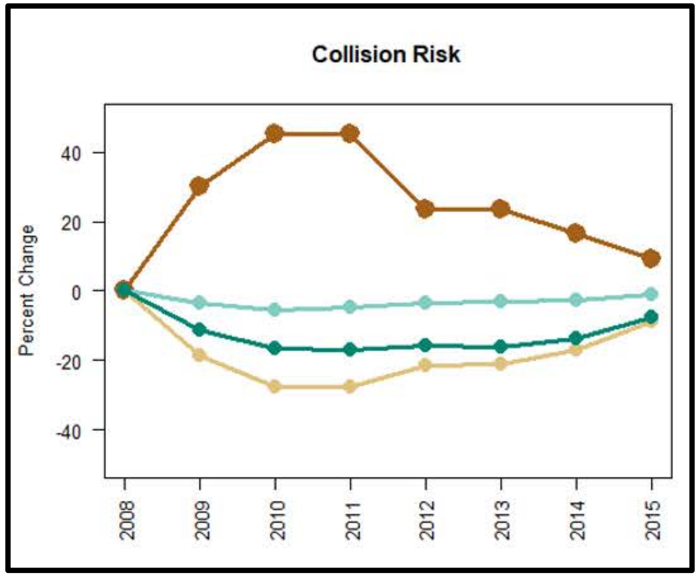
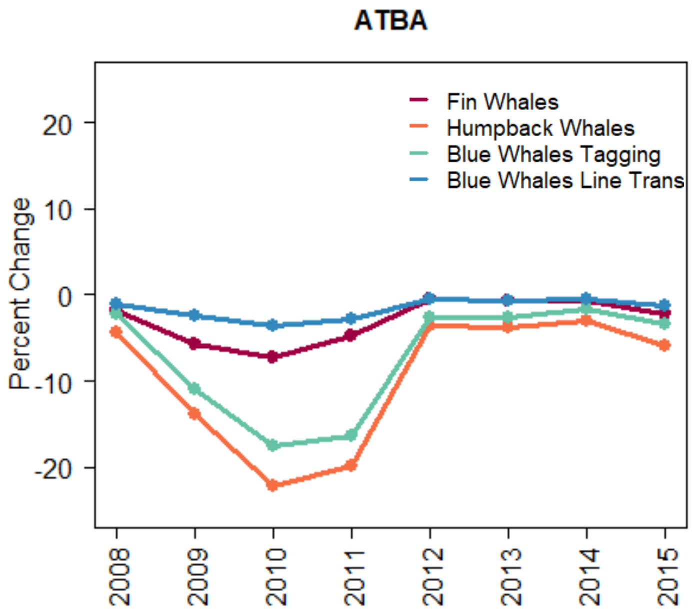




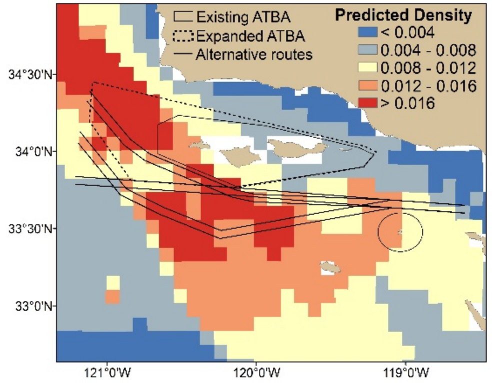


Assessing Risk

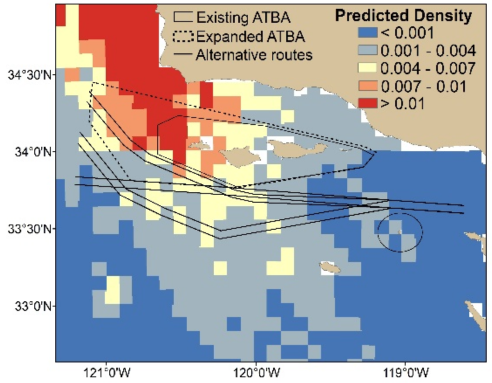
Negative percent change in risk = lower risk in the proposed management option



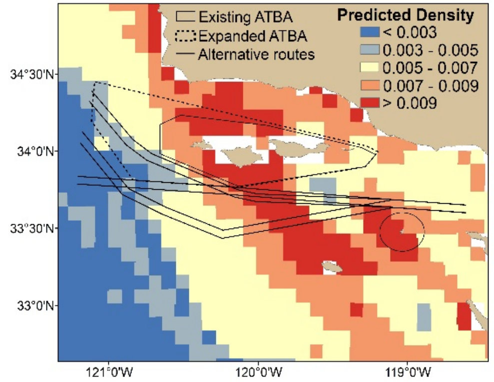
Fin Whales



Humpback Whales



Blue Whales



Expanding the ATBA reduced risk for all species

This management option was supported by all stakeholders

Identifying and minimizing risks to marine mammals

1. A time series of marine mammal data is needed to assess management actions

2. Habitat models allow us to predict where we expect high and low numbers of animals

3. Risk assessment combines predictions from habitat models with human activity data

4. Risk assessment is a valuable tool for balancing human use with the health of marine ecosystems

Acknowledgements

- NOAA Southwest Fisheries Science Center (mammal observers, cruise leaders, survey coordinators, oceanographers, plankton sorters, officers, crews)

DoD EPA DOE SERDP
Strategic Environmental Research and Development Program

US W Coast - Cetaceans & Offshore Floating Wind:

Baseline Studies, Mitigation & Monitoring, Recommendations

Mari Smultea, MS, PhD

Founder/Chief Scientist

Smultea Sciences

www.smulteasciences.com

Fin whale S CA
M. Smultea
NMFS permit 19289

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poet PACIFIC OCEAN ENERGY TRUST Webinar Series

Overview

- Existing US West Coast baseline studies

- Potential mitigation and monitoring to address risks—
  feasibility, practicality, need

- Recommendations from 30+ years engaged in research, mitigation, and monitoring for E/W Coast offshore wind & other development

Gray whales– S CA
B. Würsig
NMFS permit 19289

(Photo courtesy Principle Power, 2014)

Sperm whales – S CA
M. Smultea
NMFS permit 19289

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Cetacean Mitigation and Monitoring

Opportunities by Development Phase

Planning → Site Characterization (G&G surveys) → Construction → Operations → Decommissioning (or repowering)

Pre-planning

- Identify data gaps
- Prioritize risks by species/region/activity
- Focus on highest risk activity & most vulnerable species
- Early agency/stakeholder engagement
- Develop Practical Adaptive Approach

On-site Mitigation & Monitoring

- Minimize/avoid underwater noise exposure thresholds (sub-bottom profilers, coring, etc.)
- Real-time mitigation by Protected Species Observers (E coast example)
- Vessel strike avoidance
- PSOs collect **site-specific** baseline data

Integrated Remote Monitoring

- Platform constructed onshore – towed offshore
- Minimal noise – anchor setting
- "Take" unlikely
- Remote acoustic/visual monitoring?

Adaptive Monitoring

- Real-time remote monitoring & integration?
- Long-term acoustic array?
- Mounted IR/HD cameras?
- Data from project maintenance/inspections
- Adaptive management

Remote Monitoring

- Remove anchors/cables
- Tow platform to shore
- "Take" unlikely
- Real-time remote monitoring & integration

Adapted from BOEM West Coast Offshore Renewable Energy Development on Marine Mammals

Mitigation/Monitoring addressed at every stage of process

Existing Data – US Pacific West Coast

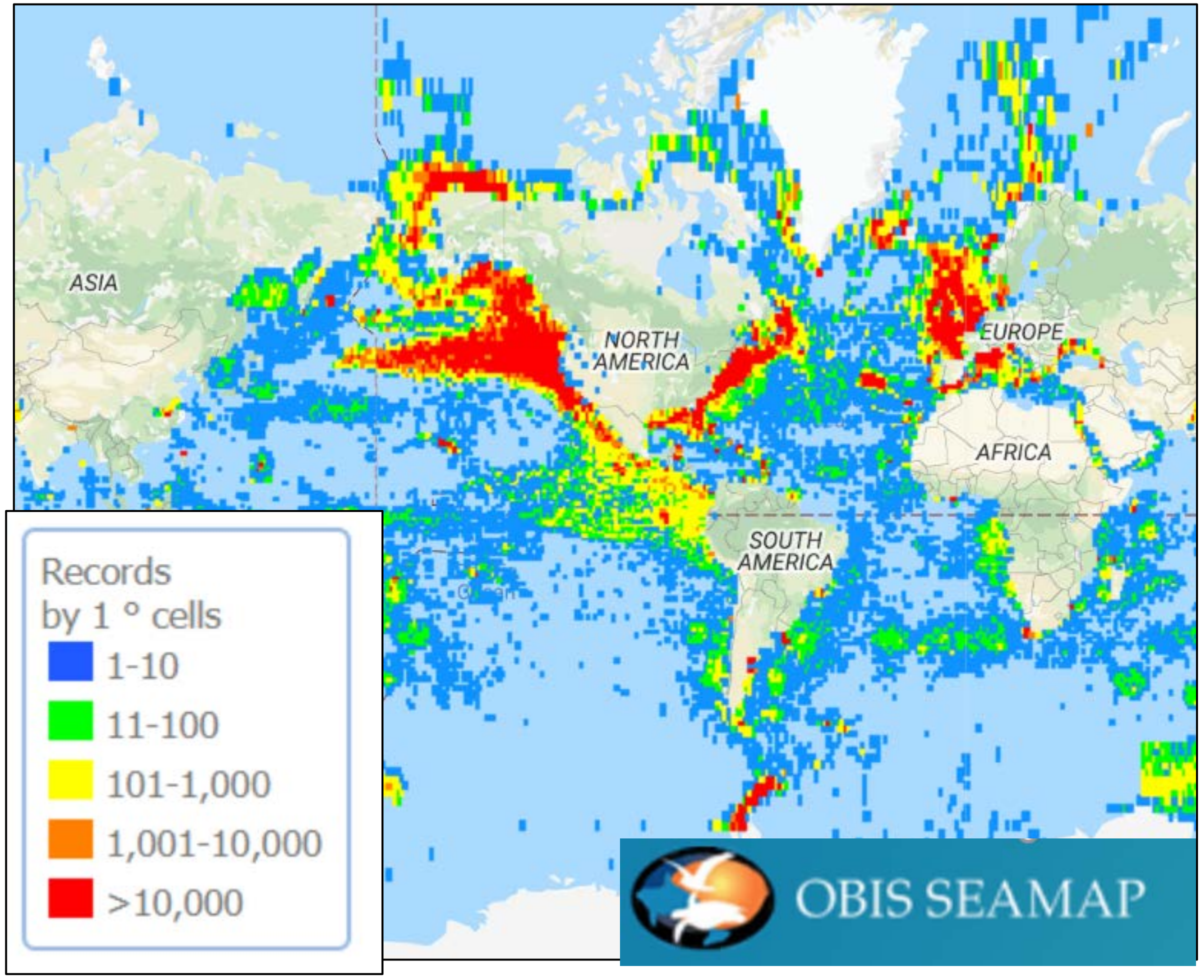
US Pacific W Coast :

Most extensive long-term, systematic databases in the world

Multiple interactive, searchable databases

- e.g., New California Energy Commission Offshore Wind R&D Database, OBIS SEAMAP, Tethys (green energy specific), CetMap, CetSound, CalCOFI, US Navy, etc.

Ongoing cooperative/ integrative research effort/ data contributions / summary reviews



OBIS-SEAMAP, Ocean Biodiversity Information System Spatial Ecological Analysis of Megavertebrate Populations, is a spatially referenced online database aggregating marine mammal, seabird, sea turtle and ray & shark observation data from across the globe.

Map Summary
#records: 6,556,482
#datasets:1,222 #species:735 / 926

For detailed summary, see 2020 BOEM webinar https://www.boem.gov/sites/default/files/documents//West-Coast-Science-Exchange-20200513.pdf

http://seamap.env.duke.edu

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Existing Marine Mammal Data – CA & OR

Primary data sources:

Agencies, industry mitigation & monitoring, univ/academics, researchers, non-profits, whale watches, citizen science, strandings, etc.

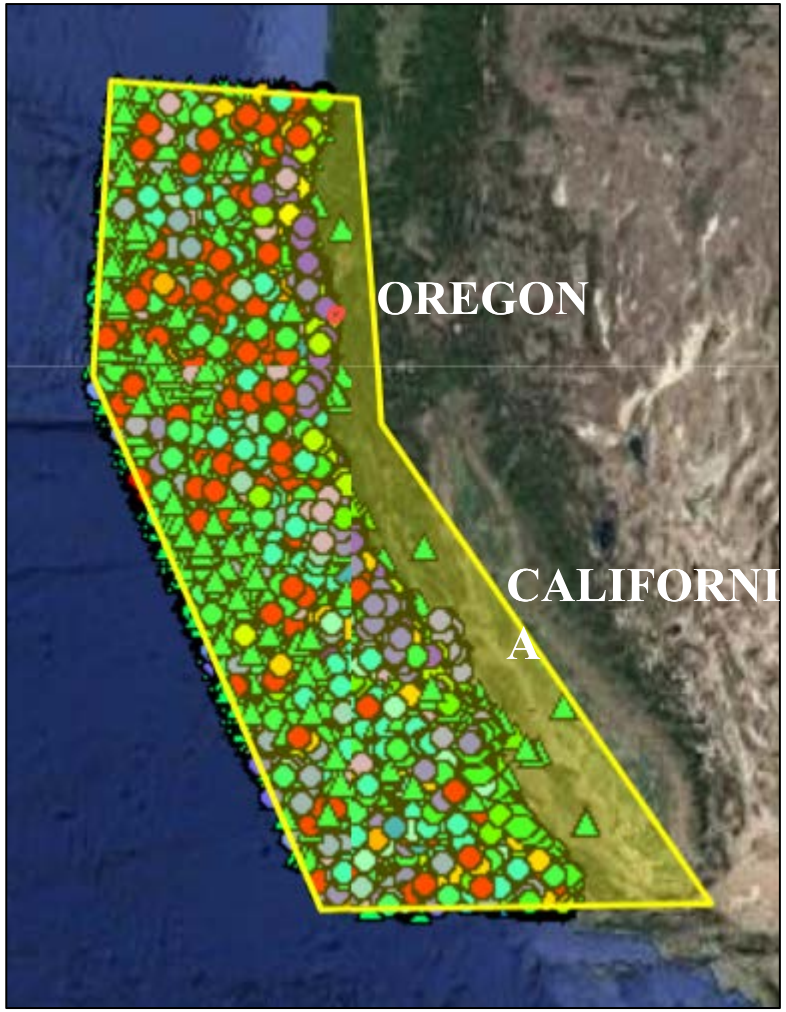
- Vessel/Aerial/Shore Surveys
- Photo ID
- Tagging
- Acoustic

Marine Mammal Sightings in OBIS SEAMAP database

OBIS SEAMAP

Map summary

Species / Taxa	31 / 43
Datasets	66
Records	77,490
Total of group size	207,776
Animals tagged/identified	2,990
Contributors	25



http://seamap.env.duke.edu

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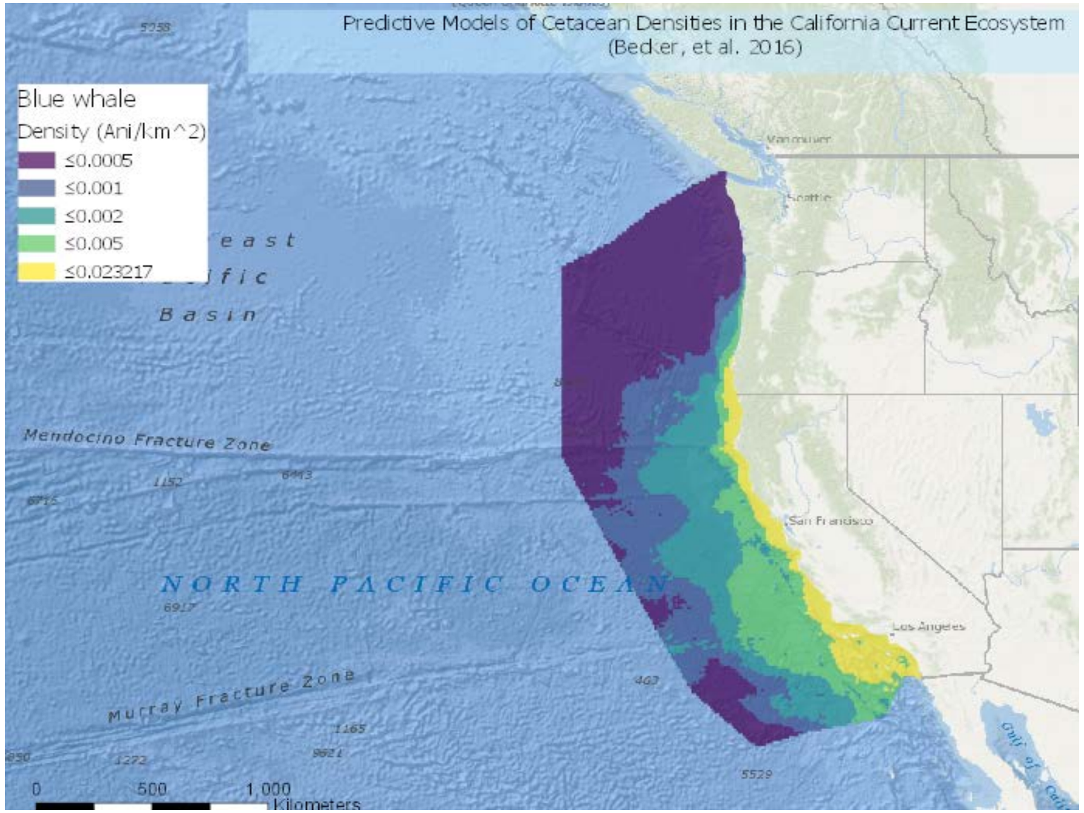
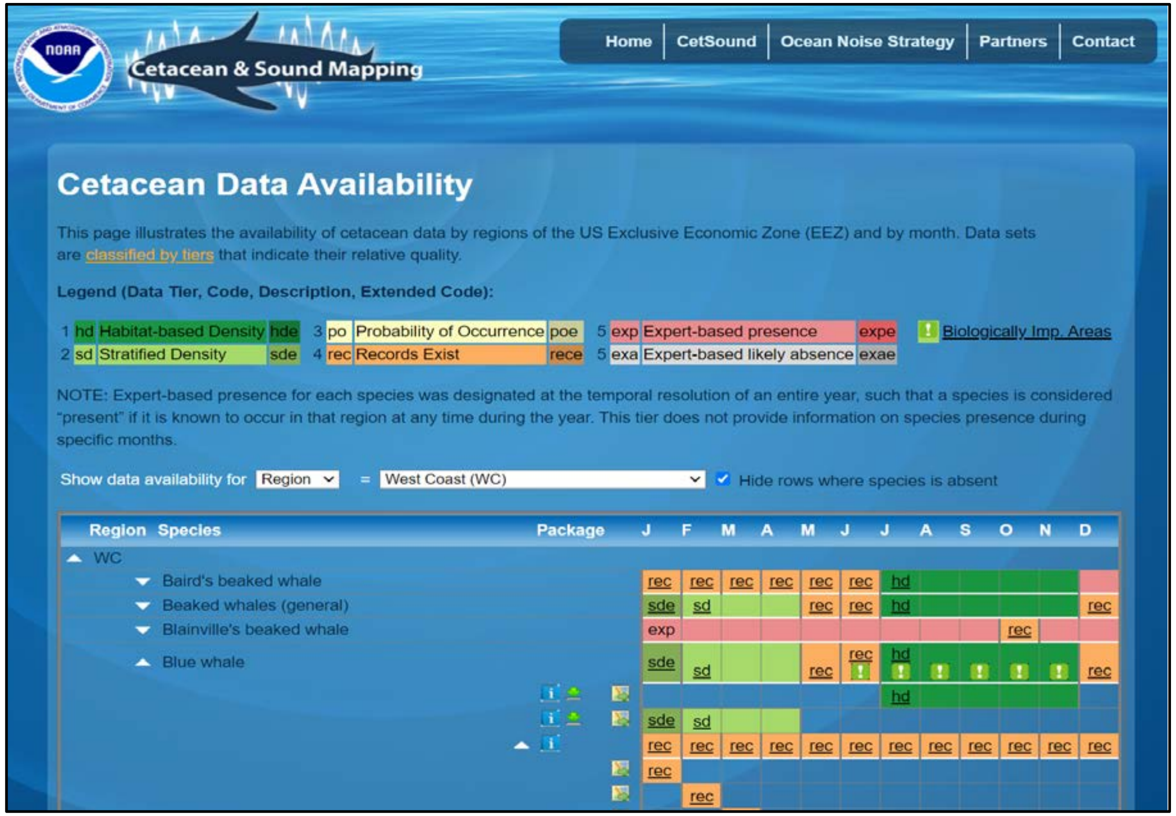
Example: Blue Whale Density

US W Coast NOAA CETMAP query

Predicted blue whale density <50 miles from CA/OR coast is low = <0.02 whales per km^2



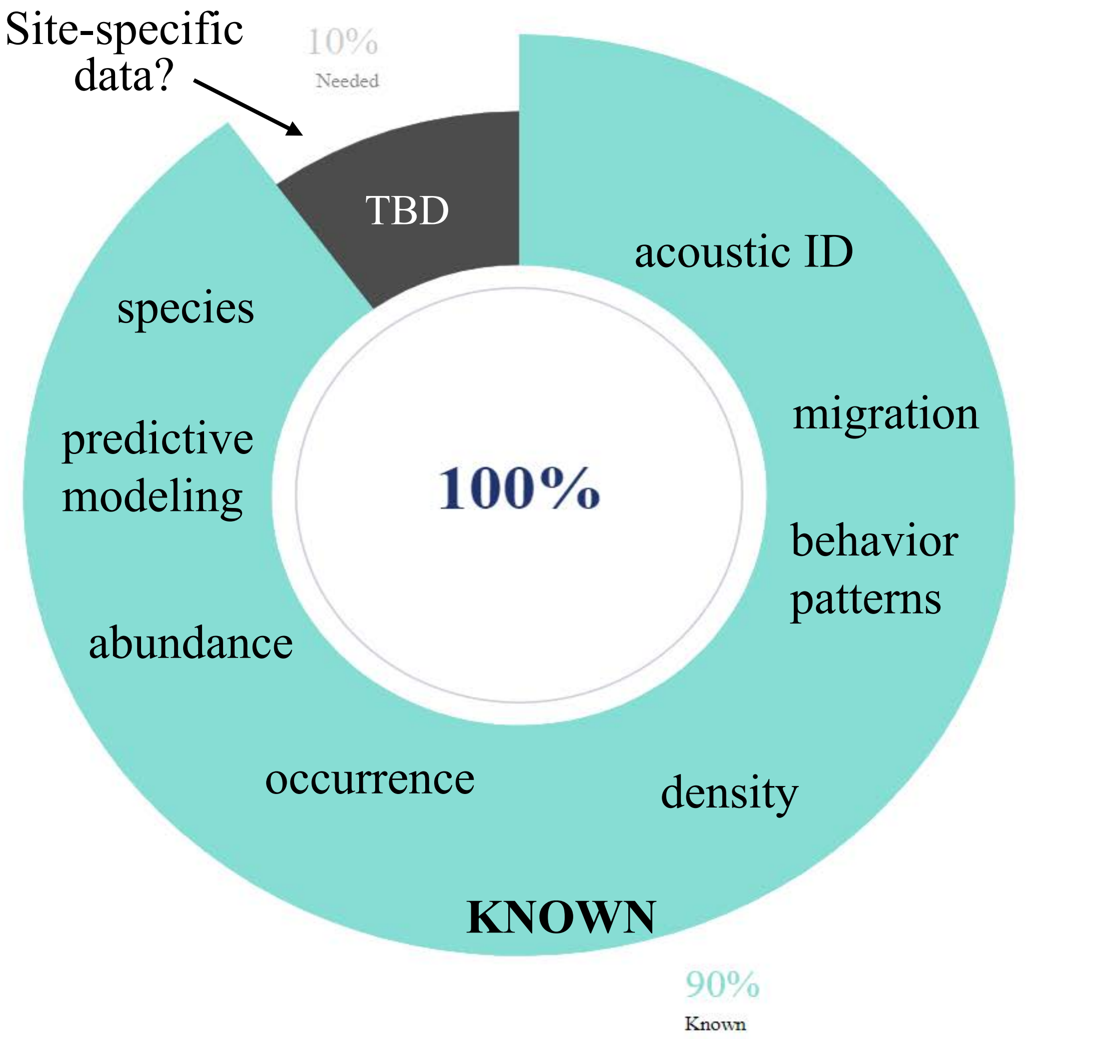


CETMAP - A NOAA website interface that organizes these datasets and maps to highlight the best available information type; makes them searchable by region, species, and month; and provides many of the GIS files for download.

Cetacean Studies – What May be Needed?

What is known vs. needed to address regulatory impact requirements?

- **General baseline data well-described for Pacific W Coast**
- **Potential risks appear low – *a priori***
  https://tethys.pnnl.gov/publications/state-of-the-science-2020
- **Potential effects appear mitigable with adaptive monitoring & mitigation**



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Cetacean Studies – Recommended Approach

1. Compile **existing data and know the regulations**
2. *Any data gaps* ? ***- proposed lease areas***
3. Focus limited resources relative to **species risk level**
4. Species density/status/season vs. risk of adverse effect
   - Risk probability modeling
5. **Pre-plan** integrated/coordinated systematic monitoring approach
6. Identify answerable questions re: effects
7. **Pool resources**: Integrate biological monitoring into windfarm sensors, site investigations, installment, operations/maintenance
8. Closely monitor initially, ***adapt as needed***
9. **Central data warehouse**: Share data, ongoing analysis/quantification – near real-time feedback for adaptive monitoring/mitigation


Blue whale and calf, S CA
M. Smultea NMFS Permit 19289

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Challenges – Opportunities – Solutions

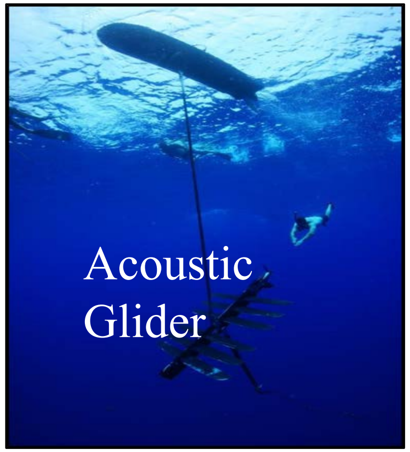
Challenges

- Platforms far offshore
  - Economically and logistically challenging access for studies

Opportunities/Solutions

- Seek mutually-beneficial collaboration with others whenever possible
- Take advantage of existing planned project platforms/ activities/ sensors
- Focus on remote, sustainable monitoring technologies with high data return
- Integrate/support existing ongoing studies & data
  - e.g., SWFSC, US Navy, BOEM, Science institutions
  - "*don't re-invent the wheel*"
- Maximize integration & feedback of complementary detection systems

Solutions: New Technology - *The Future is Now*



ThayerMahan

Remote, real-time:

- **Centralized integration/sharing display** of multi-platform detection systems
  - Acoustic, visual, tagged animals, buoy & glider data, oceanographic metadata/satellite data
- Graphic displays/mapping
- Command & Display Centers
- Data transmission – sea to shore for analysis

Automatic identification, classification, localization, analysis

- Acoustic detections
- Infra-red (IR)/High definition (HD) camera images
- Artificial intelligence & machine learning

Remote Command Center (www.thayermahan.com)

Current limitations – improving – at-sea internet bandwidth, device battery life, timely transmission of huge data streams, auto image/acoustic recognition

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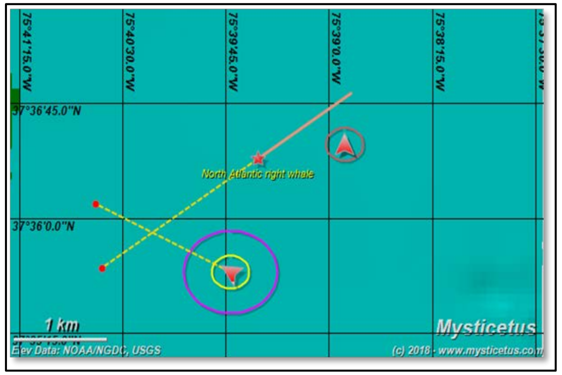
Real-time Remote Multi-platform Data Integration Example: ***Mysticetus***



"Whale Traffic Control"

- Realtime Command Center Display - Web Page
- Vessel Strike and shut-down avoidance

Integrate MULTIPLE Data Streams

- Whale Alert, research gliders, data/acoustic buoys, acoustic system detections, IR/HD video, AIS/vessel location, operations status, animal sightings, weather, tagged animal tracks
- Vessel-whale collision avoidance alerts

Instant, Secure, Data Sharing & Cloud Backup

Data Standardization

- Templates

Legal Non-Repudiation Environmental Compliance

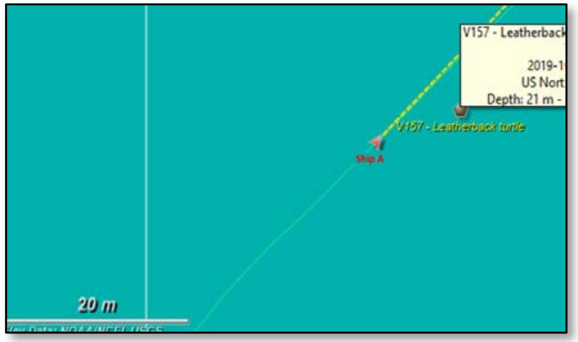
- DoD-approved encryption/audit
- Airplane-style "Black Box" & replay documentation of what happened

MYSTICETUS

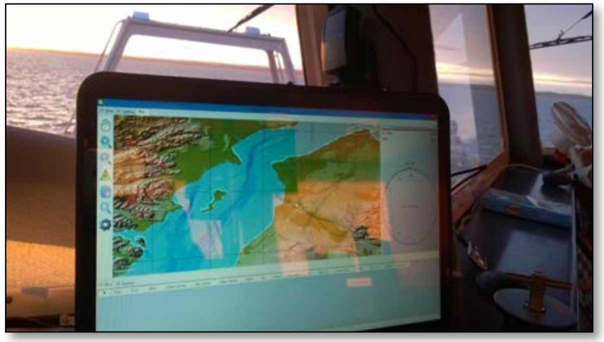
Automatic, Instant Prediction of Animal and Vessel Movement: Potential Collision Vectors are obvious on real-time map

1. Summer 2019 - Two vessels steaming NE, approx. 3km apart, running from a storm

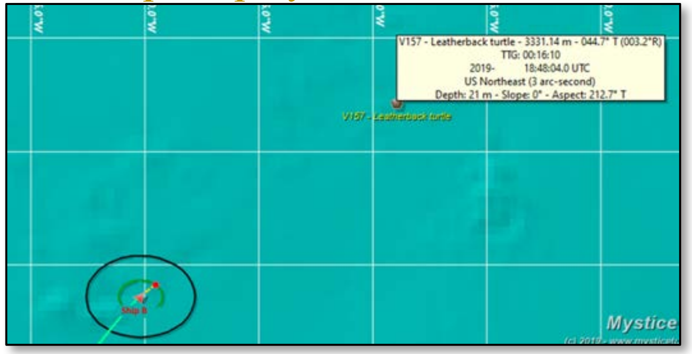
2. Lead vessel spots endangered leatherback turtle just to starboard as they pass



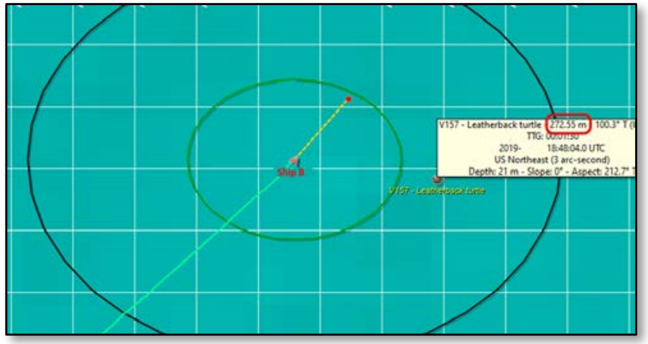
3. PSOs enter sighting data into Mysticetus



4. Sighting instantly shows up on trailing vessel's Heads-Up Display, Audible Alarm Sounds



5. Vessel B turns to port and uses Mysticetus to stay >250 m from turtle – avoids shut down & possible collision



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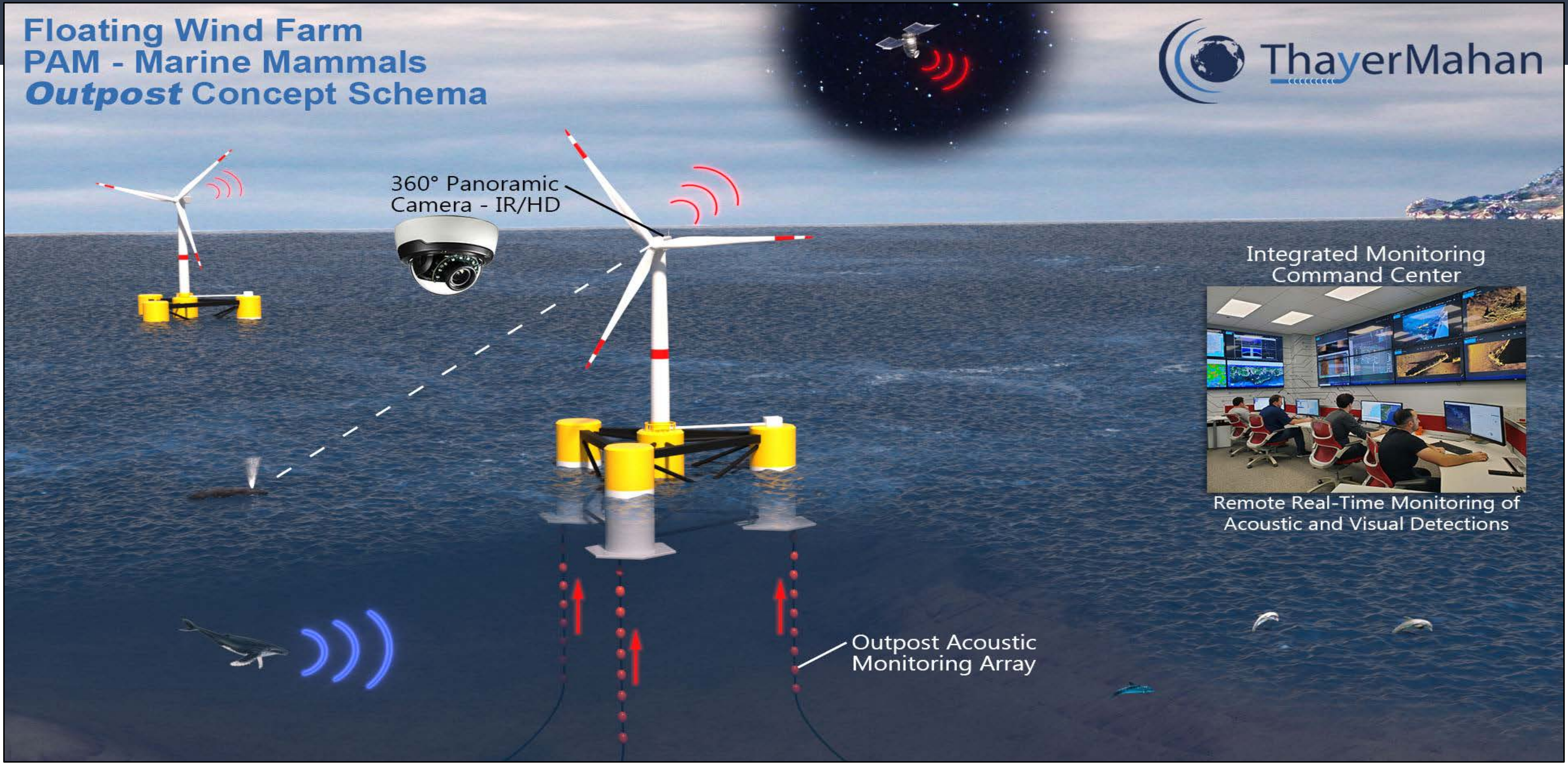
Integrated Real-time Technology
Example: *Outpost* **Mobile** Persistent Acoustic Surveillance System



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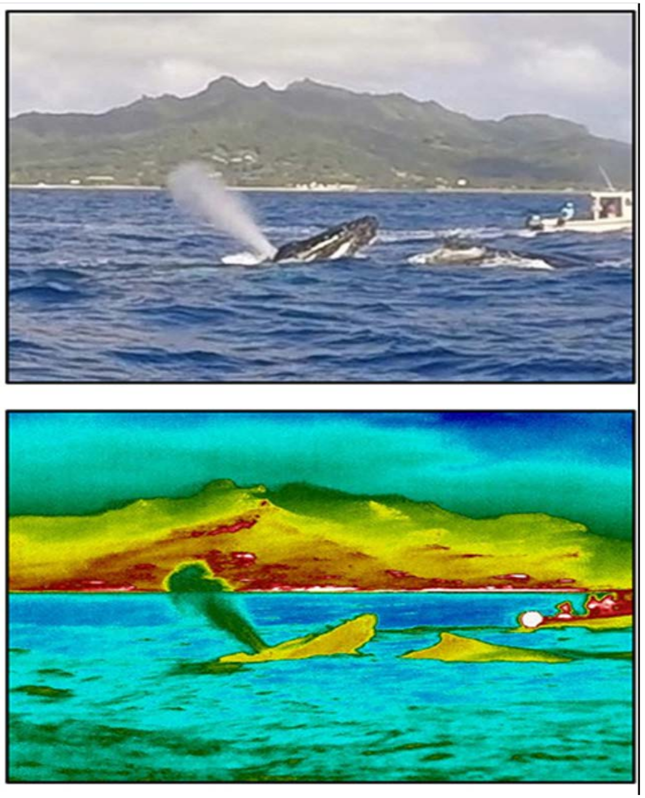
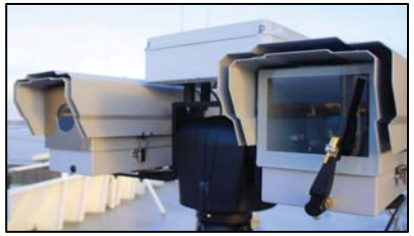
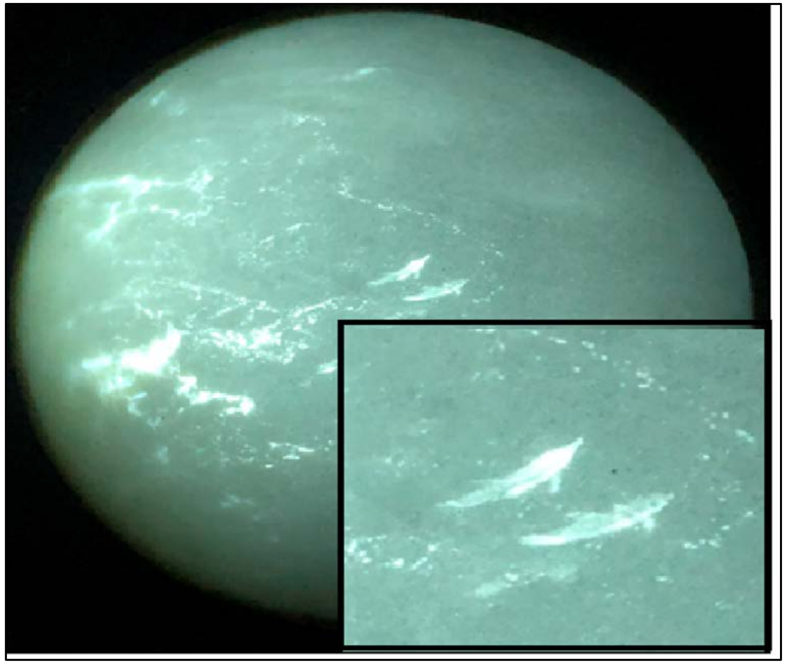
Remote Visual Monitoring: Infra-red (IR) / High-definition (HD) / Night Vision Cameras



Horton et al., 2017
https://doi.org/10.3389/fmars.2017.00424





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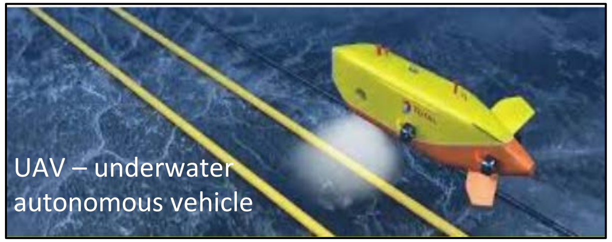
Parallel Technological Advancements - Examples

- Remote / mobile acoustic / visual / oceanographic detection systems
  - Sea gliders, drones, UAV, UAS, ASV, metadata buoys
- The Benioff Ocean Initiative (https://boi.ucsb.edu/)
  - Model/predict/monitor whale locations to avoid vessel strikes
- **Whale Alert** –info sharing via cell phone/software, citizen science, shared sighting info (real-time sharing on CA coast)



Potential Risks/Concerns to Address

Potential Concern	Risk, Monitoring, Mitigation
Direct entanglement in mooring cables	Not predicted – cables large diameter/floating/stiff
Direct entanglement in bottom transmission cables	Cables can be buried in sea bottom to avoid risk
Secondary entanglement in ghost fishing gear caught on cables ?	• Routine cable inspections during operations expected to regularly monitor/ remove/report debris on cables/platforms as part of maintenance • Limit horizontal orientation of cable in "upper" water column
Collision with cables or platform (e.g. during feeding?)	• Not likely due to large platform & cable size • Remotely monitor cable feedback to changes in tension? • Active pingers on cables activated when whale calls detected nearby?

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(Cont'd) Potential Risks/Concerns to Address

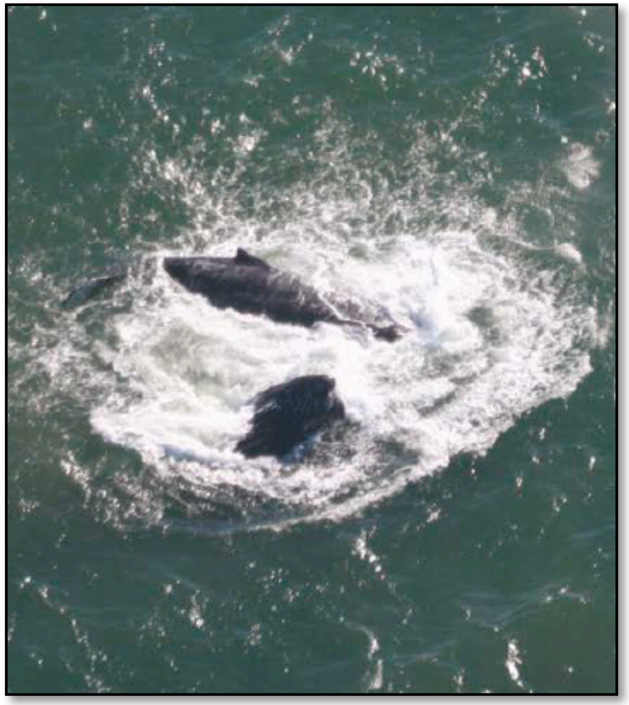
Potential Concern	Risk, Monitoring, Mitigation
Displacement/behavior change due to electromagnetic field (EMF) emitted from cables & devices	• EMF exposure effects expected to be weak or moderate – should be monitored • Remote visual & acoustic monitoring to identify potential changes
Displacement/behavior change due to underwater noise levels?	• Site Investigation: Protected Species Observers? (depends on noise level/frequency) • Operations: Remote visual & acoustic monitoring to identify potential changes • Onshore construction of turbines towed out to final location (no in-water pile driving noise) • Continued development of automated data processing algorithms & software to analyze data remotely gathered around operational devices
Project vessel strike?	• Vessel speed restrictions? • Visual observers use real-time map displays/alerts/software (e.g. Mysticetus sighting sharing, WhaleAlert). • Remote monitoring with IR cameras & PAM?

Recommendations

1. Rely on/incorporate existing data on cetacean seasonal occurrence, density, abundance
2. Identify practical monitoring questions /approaches –
   Start early identifying solutions with agencies & scientific experts
3. Plan and implement integrated remote sustainable monitoring technologies
4. Schedule timely data review/analysis
5. Apply **adaptive management** - develop mitigation if/as needed
6. Integrate monitoring into standard site investigations, construction, operations, maintenance/inspection, project platforms
7. Centralized shared database – maximize sample sizes

Summary

- Considerable existing baseline data already available – assess specific lease area gaps
- Know what mitigation and monitoring regulations apply
- Find solutions early – pre-planning coordination with agencies/scientific experts
- Risk is low for adverse impacts
- Focus on vulnerable species, greatest possible impacts (ship strike over noise), high density areas/seasons
- Collaborate/data share as much as possible
- Emphasize integrated/remote technologies
- Can monitor / mitigate anticipated low impacts
- Use adaptive management for unknown low risks/effects



Thank you

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www.Smultea.com
Cetacean Mitigation & Monitoring – Floating Wind

poet
PACIFIC OCEAN ENERGY TRUST
Webinar Series

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