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

Dr. Sarah Courbis
Marine Protected Species and Regulatory Specialist

2014 Smultea Sciences Team
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
Risk Assessment

Use statistics/models/best science to assess risk.

Data collection not practical.

Question

Data

No/few data

Data collection practical

Low

Mitigation/monitoring

High

Set triggers for adaptive management

Analyze monitoring data and take action if trigger is met.

Impact

Likelihood

High	
  Impact

Low	
  Likelihood

High	
  Impact

High	
  Likelihood

Low	
  Impact

Low	
  Likelihood

High Impact
Low Likelihood

Low Impact
High Likelihood

Low Impact
Low Likelihood

Low Impact
High Likelihood
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
Problem to be solved
Whale entanglement

Criteria
Factors measuring problem
Number of whales entangled on OSW via fishing

Triggers
Thresholds
X entanglements over X years (could break down by)

Proxies

Strategy

Warning

Actions

Stand in for criteria

Methods to measure proxies

Yellow light level

Add/Remove/Change Mitigation

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…
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
Knowledge from MRE

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

- As the scale of MRE development grows, concern is 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
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

- 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
Knowledge from Surrogate Industries

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  - Small animals entangled in derelict fishing gear and marine debris

- 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)
Knowledge from Surrogate Industries

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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)

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

The floating platform would be anchored to the sea floor using mooring lines.
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

1000 WHALES MIGRATING THROUGH WIND FARM

- Encounter 0.20%
- No Encounter 99.80%
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.
Understanding forces on mooring lines during whale encounter

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Thank you!

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Andrea Copping, Ph.D
andrea.copping@pnnl.gov
Dan Lawson
NOAA Fisheries West Coast Region, Protected Resources Division
Insight into Whale Entanglement Risks

• 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?

Dan Lawson
NOAA Fisheries West Coast Region
Protected Resources Division

MMHSRP 18786-04
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?
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
Aerial surveys of wind energy areas off Massachusetts

Risk Assessment

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

Traditionally we estimated the number of animals in large areas.

How many individuals are impacted?

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

How many individuals are impacted?

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
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
Marine Mammal Survey Data 1986-2014:
- Ship and aerial surveys
  
  *Southwest Fisheries Science Center*

Ecosystem Data 1986-2014:
- In situ oceanographic data
  - *Southwest Fisheries Science Center*
- Remotely sensed data
- Regional oceanographic models

Habitat Models to Estimate Marine Mammal Density
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

Extensive model validation and expert review

<table>
<thead>
<tr>
<th>YEAR</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>1991</td>
<td>1.621638</td>
</tr>
<tr>
<td>1993</td>
<td>0.354613</td>
</tr>
<tr>
<td>1996</td>
<td>1.32254</td>
</tr>
<tr>
<td>2001</td>
<td>0.853526</td>
</tr>
<tr>
<td>2005</td>
<td>0.740571</td>
</tr>
<tr>
<td>2008</td>
<td>0.71209</td>
</tr>
<tr>
<td>All Years</td>
<td>~1.00</td>
</tr>
</tbody>
</table>

1) Spatial prediction patterns across 8 geographic strata

2) Observed : predicted ratios across all survey years

3) CCE-wide abundance comparisons

<table>
<thead>
<tr>
<th>Habitat-based density models</th>
<th>Barlow (2010) line-transect estimates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pd</td>
<td>53,239</td>
</tr>
</tbody>
</table>

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

Blue Whale:
Mean and Confidence Intervals

Becker et al. 2016
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
Ship-Strike Risk Assessment

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Methods overview

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Fin Whales
Assessing Risk

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

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)
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
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
Cetacean Mitigation and Monitoring
Opportunities by Development Phase

**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

**Site Characterization** (G&G surveys)
- 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

**Construction**
- Platform constructed onshore – towed offshore
- Minimal noise – anchor setting
- “Take” unlikely
- Remote acoustic/visual monitoring?

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

**Decommissioning (or repowering)**
- Remove anchors/cables
- Tow platform to shore
- “Take” unlikely
- Real-time remote monitoring & integration

Mitigation/Monitoring addressed at every stage of process

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

For detailed summary, see 2020 BOEM webinar

http://seamap.env.duke.edu
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

http://seamap.env.duke.edu
**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 Mitigation & Monitoring – Floating Wind*
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*
  
- Potential effects appear mitigable with adaptive monitoring & mitigation

![Diagram showing known and needed data for cetacean studies](image-url)
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*
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

Cetacean Mitigation & Monitoring – Floating Wind
Solutions: New Technology -
The Future is Now

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

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

Remote Command Center
(www.thayermahan.com)
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

*Cetacean Mitigation & Monitoring – Floating Wind*
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

Cetacean Mitigation & Monitoring – Floating Wind
Integrated Real-time Technology

Example: *Outpost Mobile* Persistent Acoustic Surveillance System

Floating Wind Farm
PAM - Marine Mammals
*Outpost* Concept Schema

360° Panoramic Camera - IR/HD

Outpost Acoustic Monitoring Array

Integrated Monitoring Command Center

Remote Real-Time Monitoring of Acoustic and Visual Detections

Cetacean Mitigation & Monitoring – Floating Wind
Remote Visual Monitoring: Infra-red (IR) / High-definition (HD) / Night Vision Cameras

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

Cetacean Mitigation & Monitoring – Floating Wind

NOAA/SWFSC Drone

UAV – underwater autonomous vehicle

ASV – autonomous surface vehicle

NOAA/SWFSC
<table>
<thead>
<tr>
<th>Potential Concern</th>
<th>Risk, Monitoring, Mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct entanglement in mooring cables</td>
<td>Not predicted – cables large diameter/floating/stiff</td>
</tr>
<tr>
<td>Direct entanglement in bottom transmission cables</td>
<td>Cables can be buried in sea bottom to avoid risk</td>
</tr>
</tbody>
</table>
| 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? |

Cetacean Mitigation & Monitoring – Floating Wind
## Potential Risks/Concerns to Address

<table>
<thead>
<tr>
<th>Potential Concern</th>
<th>Risk, Monitoring, Mitigation</th>
</tr>
</thead>
</table>
| 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

*Cetacean Mitigation & Monitoring – Floating Wind*
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

Cetacean Mitigation & Monitoring – Floating Wind
Thank you

Dr. Mari Smultea / Smultea Sciences
www.Smultea.com
Cetacean Mitigation & Monitoring – Floating Wind

Risso’s dolphins – CA
Photo by M. Smultea
NMFS Permit 19289
Questions?

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