



Understanding Potential Effects of West Coast Offshore Renewable Energy Development on Marine Mammals

BOEM Pacific Region
May 13, 2020

Desray Reeb, Ph.D. | West Coast Renewable Energy Science Exchange

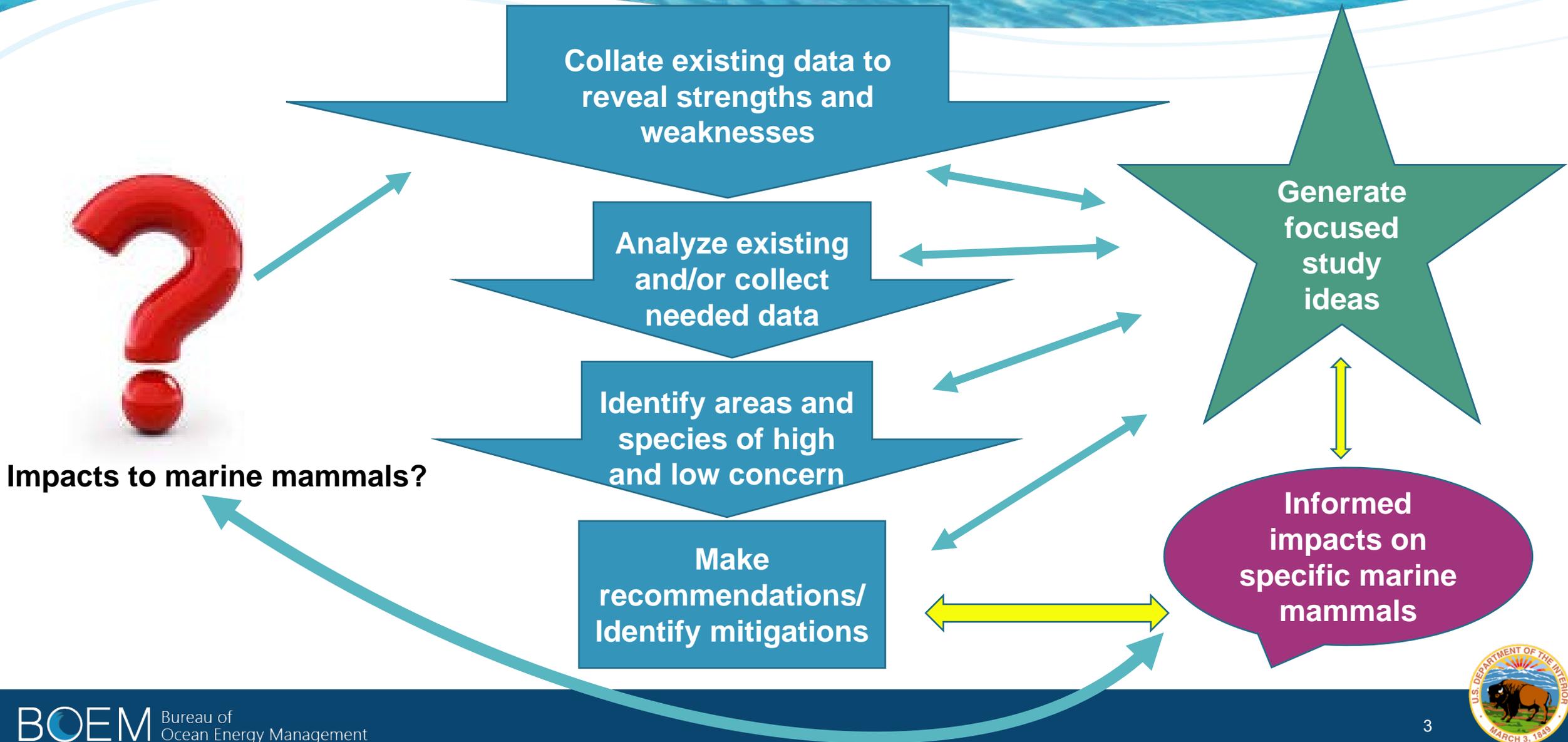


Your presenter for today.....



Dr. Desray Reeb

Strategic Science



Effects versus Impacts

Effects – “something happened”

Impacts – describe changes in intensity, spatial extent, duration (time)

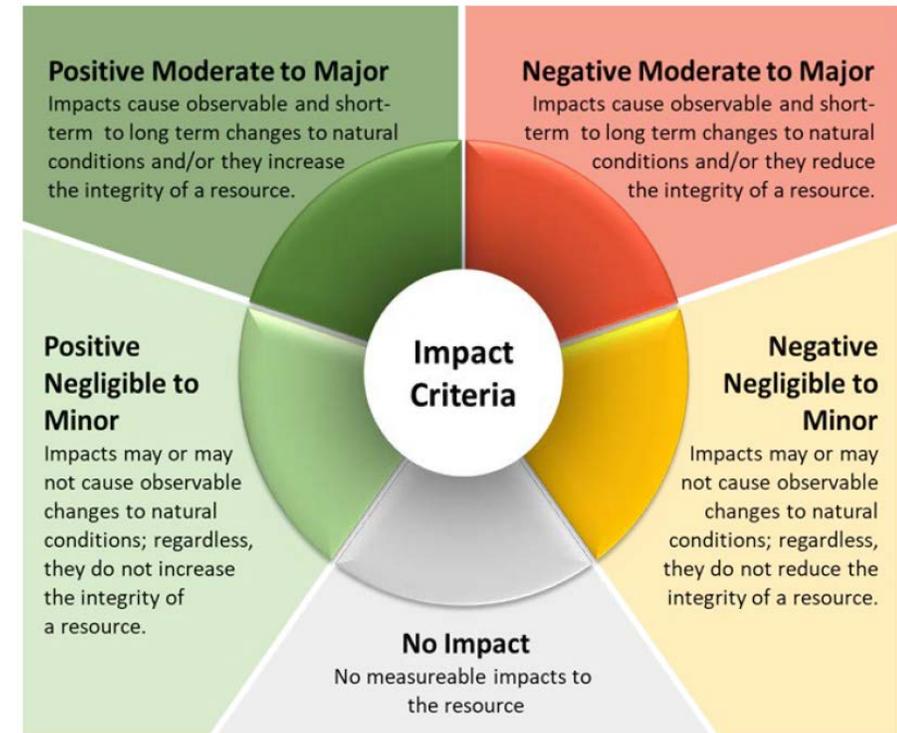
Hypothetical scenarios:

e.g. Space-Use Conflicts during Cable Installation

Negligible to Minor negative impact to harbor porpoise for duration of cable installation phase

e.g. Artificial Marine Protected Area Effect

Moderate/Major positive impacts to marine mammals at a regional scale for operational phase



Slide idea credit: Donna Schroeder



Potential Impacts to Whales from Offshore Floating Wind

- **Displacement**

- Noise (vessels, operations)
- Prey availability
- Electromagnetic Fields (EMF)

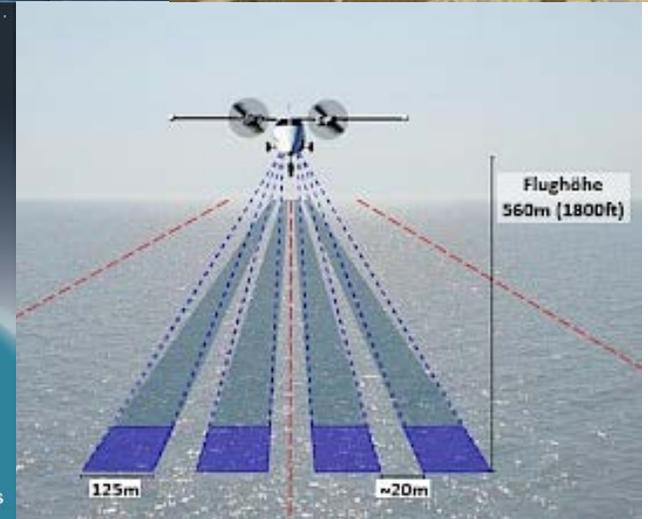
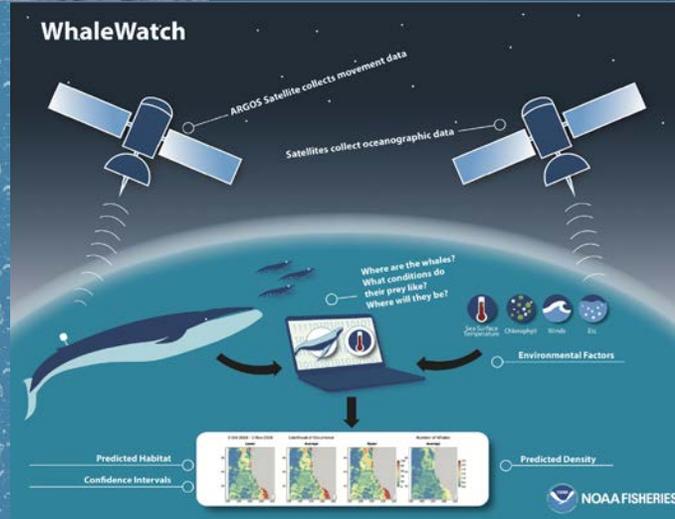
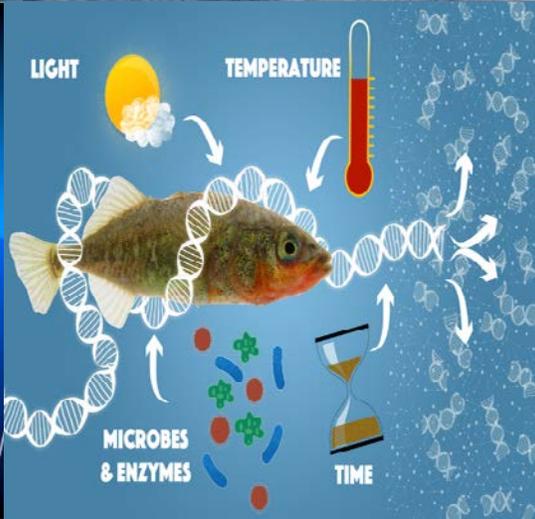
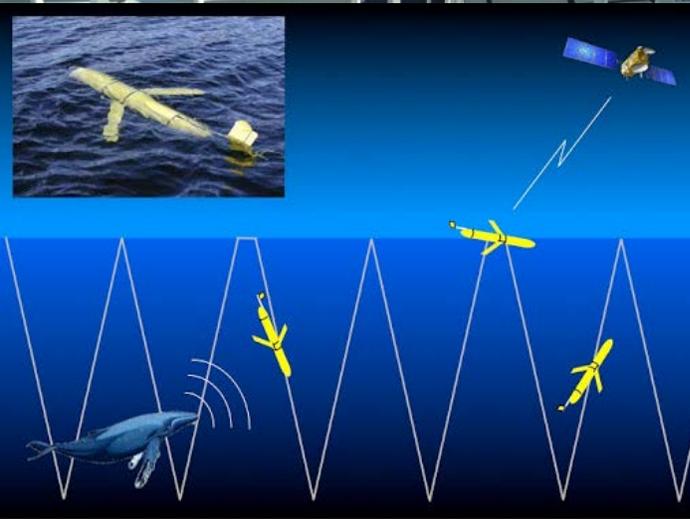
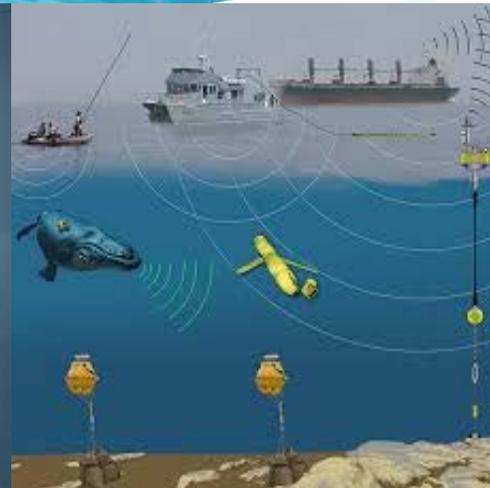
- **Entanglement**

- Floating wind mooring systems and cables
- Associated derelict fishing gear

- **Vessel strikes**



The Toolbox Approach



Types of Studies in Relation to Project Life Cycle

↓ *We are here!*



Planning Site Characterization Construction Operations Decommissioning
(or Repowering)

Synthesis and Current Condition Studies



Impact Studies

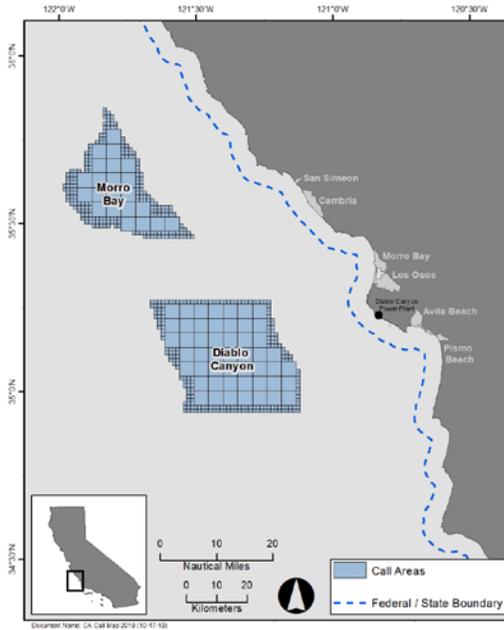
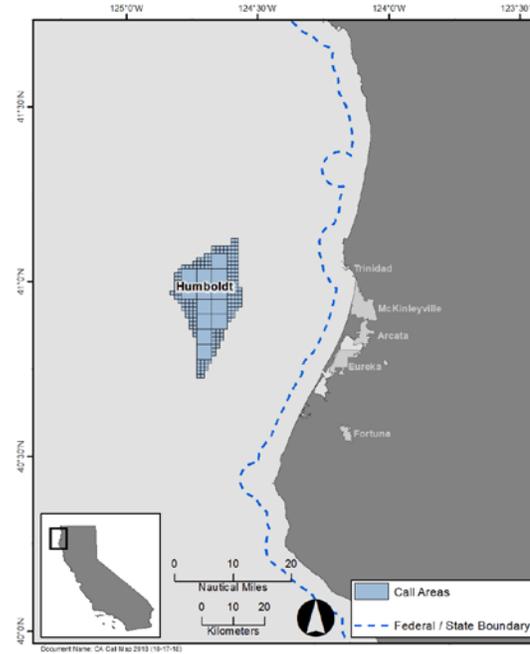
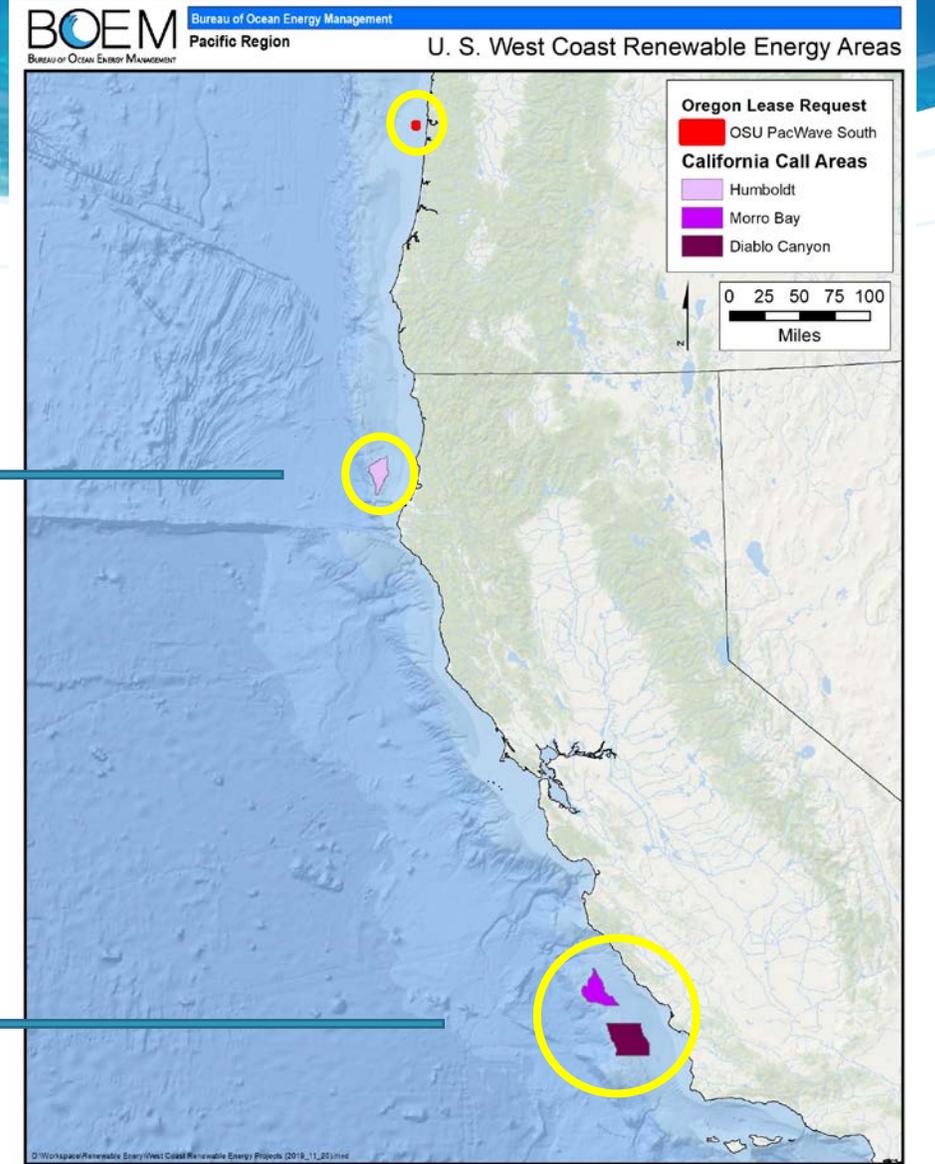


Monitoring Studies

Slide credit: Donna Schroeder



U.S. West Coast Renewable Energy Areas



Synopsis of Research Programs that can Provide Baseline and Monitoring Information for Offshore Energy Activities in the Pacific Region: Seabird and Marine Mammal Surveys in the Pacific Region



US Department of the Interior
Bureau of Ocean Energy Management
Pacific OCS Region



<https://www.boem.gov/2019-042/>

Database of Marine Mammal and Seabird Research Activity in the Pacific (US) View ▾

Dates

Publication Date : 2019-09-09
Start Date : 1960
End Date : 2018

Citation

Lafferty, K.D., Adams, J., Johnston, C.A., and Kelsey, E.C., 2019, Database of marine mammal and seabird research activity in the Pacific (US): U.S. Geological Survey data release, <https://doi.org/10.5066/F7X0669S>.

Summary

This database is a compilation of marine mammal and seabird information collected along the Pacific coast of the United States and U.S. territories in the Pacific from surveys that were solicited among regional research communities and persons. Information from standardized surveys was gathered from 2015 to 2018 and includes programs and researchers who collected information regarding seabirds since 1960.

These data support the following publication:

Adams, J., Lafferty, K.D., Kelsey, E.C., and Johnston, C.A. 2019. Synopsis of Research Programs that can Provide Baseline and Monitoring Information for Offshore Energy Activities in the Pacific Region: Seabird and Marine Mammal Surveys in the Pacific Region. U.S. Department of the Interior, Bureau of Ocean Energy Management, Pacific OCS Region, Camarillo, CA. OCS Study BOEM 2019-042. 14 Figures, 20 Tables, 54 p.

Contacts

Point of Contact : U.S. Geological Survey, Western Ecological Research Center
Originator : Kevin D Lafferty, Josh Adams, Cora A Johnston, Emily (Emma) C. Kelsey
Metadata Contact : Western Ecological Research Center
USGS Mission Area : Ecosystems
SDC Data Owner : Western Ecological Research Center
Distributor : U.S. Geological Survey - ScienceBase

Attached Files

Click on title to download individual files attached to this item or [download all files listed below as a compressed file.](#)

Database of Marine Mammal and Seabird Research Activity in the Pacific.xml <i>Original FGDC Metadata</i>	View	55.3 KB
Extent.jpg		2.52 MB
BOEMmonitoringDatabase1.7.2.csv		1.21 MB

Related External Resources

Type: Related Primary Publication

To download a PDF file of this report, go to the U.S. Department of the Interior, Bureau of Ocean Energy Management's Recently Completed Environmental Studies webpage and click on the link for 2019-042.

<https://www.boem.gov/Pacific-Completed-Studies/>



Map



Communities

- USGS Data Release Products
- USGS Western Ecological Research Center *

Tags

Categories : Data

Theme : Research, biodiversity, biological informatics, biota, birds, coastal zones, field methods, geographical information systems (GIS), inlandWaters, laboratory methods, location, mammals, marine ecosystem, marine mammals, oceans, seabirds

Place : Alaska, California, Hawaii, Oregon, Pacific Islands, Washington

Harvest Set : USGS Science Data Catalog (SDC)
USGS Scientific Topic Keyword : Ecology, Wildlife Biology

Provenance

Data source : Input directly

<https://www.sciencebase.gov/catalog/item/5a7c8fb1e4b00f54eb231ae6>



European Context – What can we learn?

Hywind Scotland

World's first commercial-scale floating wind farm



Each blade is similar in length to an Airbus A380 wingspan which is: **79.8m**

The turbines can be placed in water with depths of up to **800m**

Will provide electricity to approximately **20,000** UK homes

Will reduce carbon emissions by **63,000 tons**

Location: 25km off the coast of Peterhead, Scotland where the average wind speed is about 10m per second.

Total Height: **253m**

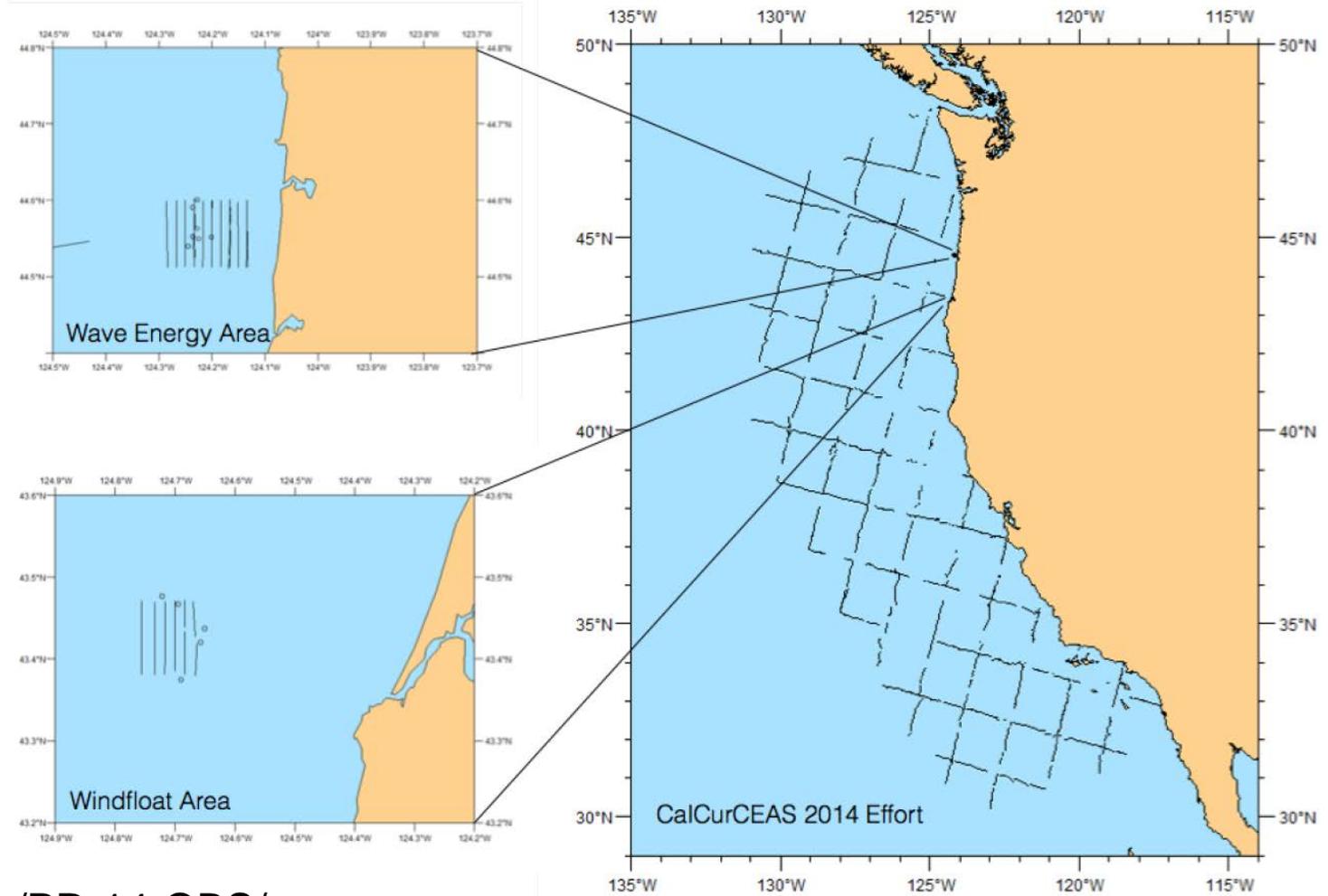
Hywind Scotland is a partnership between Masdar (25%) and Statoil (75%)

Masdar A MUBADALA COMPANY



<https://tethys.pnnl.gov/marine-renewable-energy>

California Current Cetacean and Ecosystem Assessment Survey



<https://www.boem.gov/PR-14-OBS/>

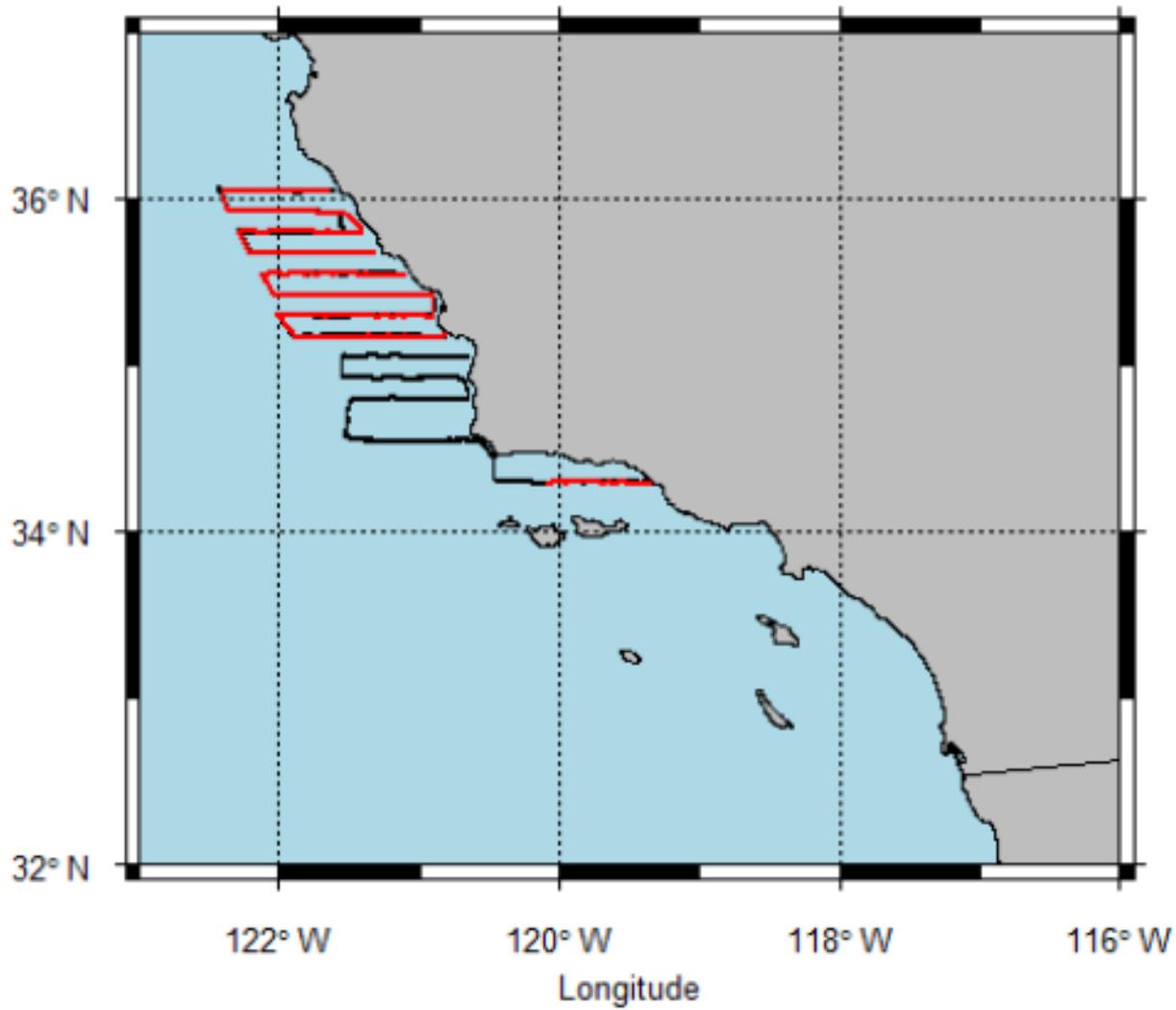
Study Title	Dates	Methodology	Online Information
Central and Northern California Marine Mammal and Seabird Study	1979-1983	Mostly aerial and some ship-based surveys	https://marinecadastre.gov/epis/#/search/study/20375
Oregon and Washington Marine Mammal and Seabird Studies	1988-1999	Aerial and ship-based surveys	https://marinecadastre.gov/epis/#/search/study/20204
Spatial Database for the At-Sea Distribution and Abundance of Seabirds and Marine Mammals off Southern California: 1999-2002	1999-2002	Aerial surveys	https://www.sciencebase.gov/catalog/item/57c75faae4b0f2f0cebed52e
Pacific Continental Shelf Environmental Assessment (PaCSEA): Aerial Seabird and Marine Mammal Surveys off Northern California, Oregon, and Washington, 2011-2012	2011-2012	Aerial surveys	https://epis.boem.gov/final%20reports/5427.pdf
2014 California Current Cetacean & Ecosystem Assessment Survey (CalCurCEAS): Final Report to Bureau of Ocean Energy Management regarding surveys of Windfloat and Wave Energy Areas	2014	Ship-based surveys	https://www.boem.gov/PR-14-OBS/
Pacific Marine Assessment Partnership for Protected Species (PacMAPPS)	2017-2021	Vessel-based surveys	https://www.boem.gov/pc-17-04/
Seabird and Marine Mammal Surveys Near Potential Renewable Energy Sites Offshore Central and Southern California	2017-2021	Aerial surveys	https://www.boem.gov/pc-17-01/

Pacific Continental Shelf Environmental Assessment (PaCSEA)

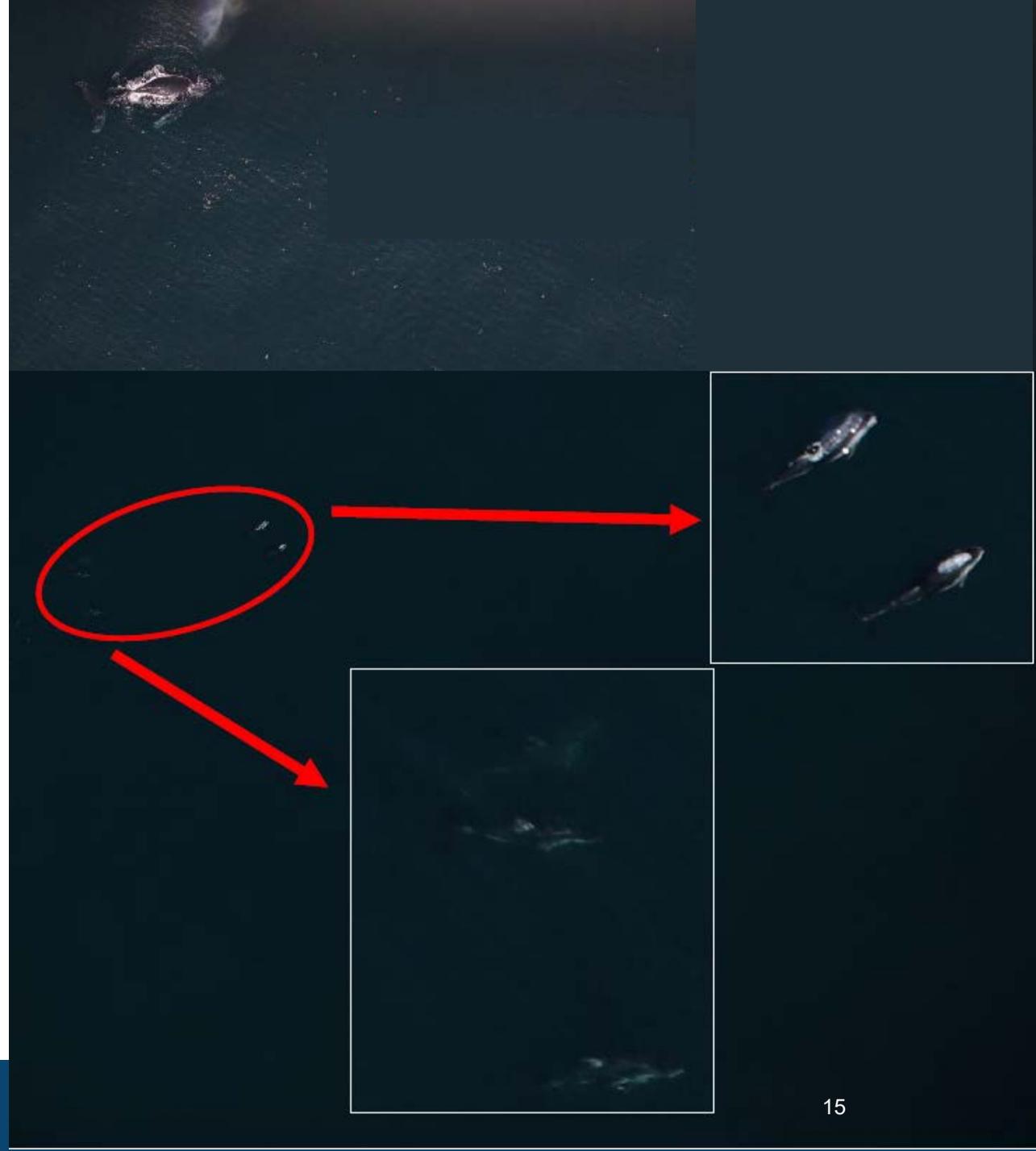


<https://espis.boem.gov/final%20reports/5427.pdf>

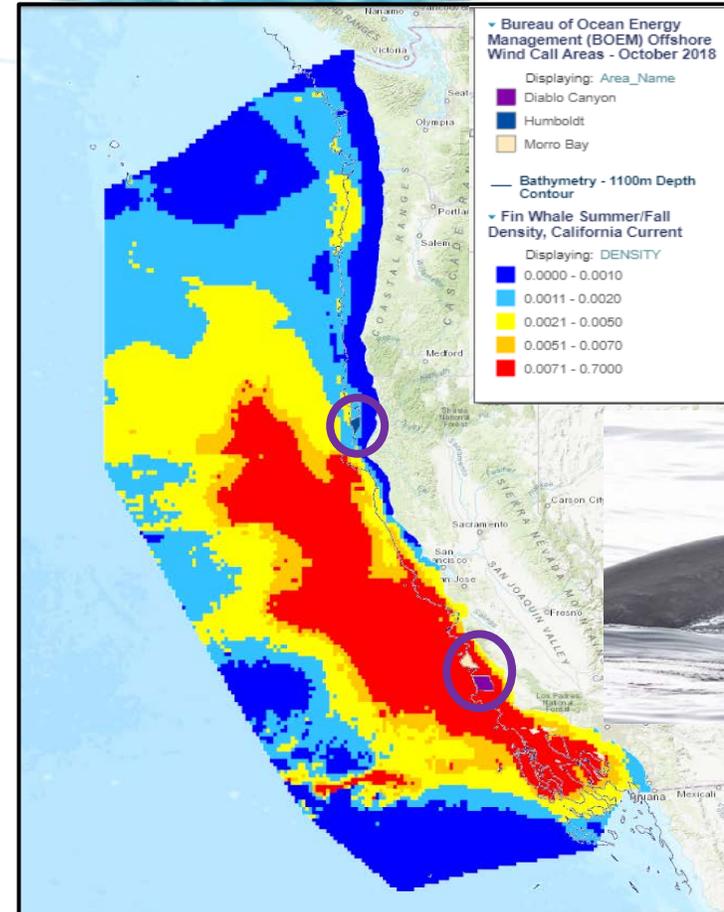
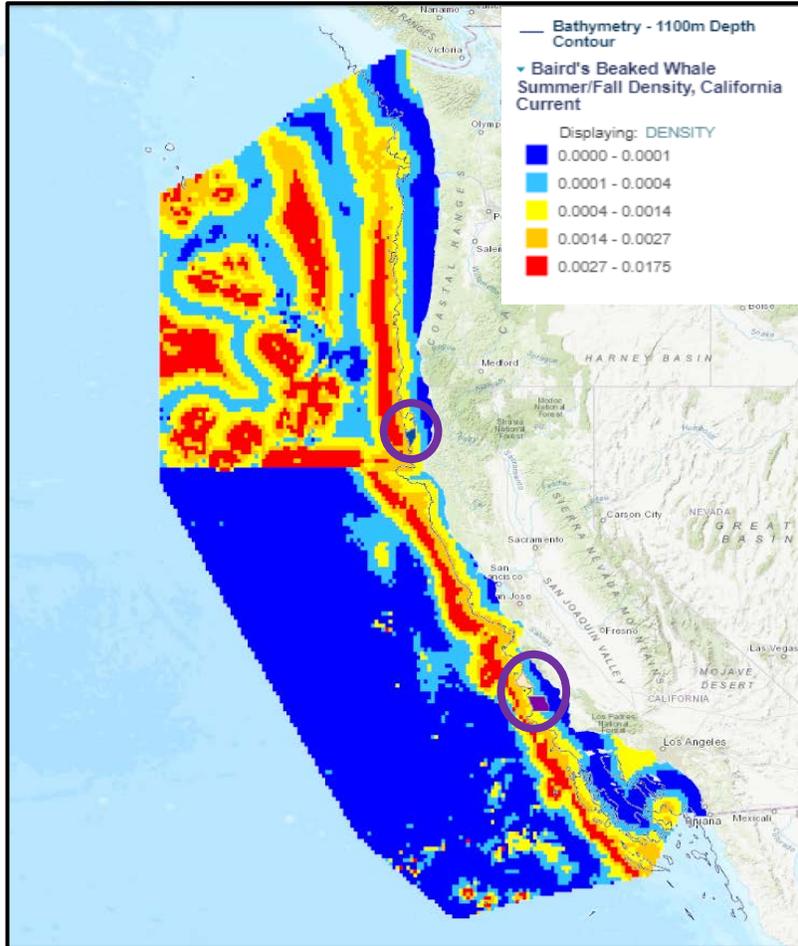
Fall Migration Survey 2019



<https://www.boem.gov/pc-17-01/>

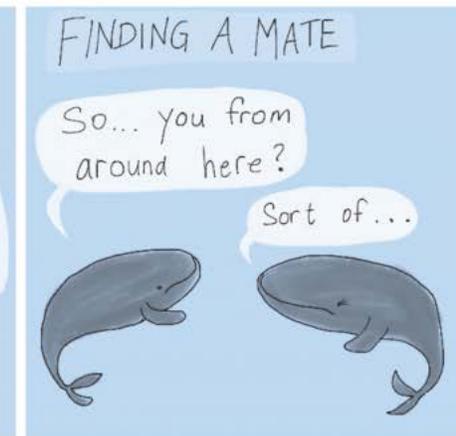
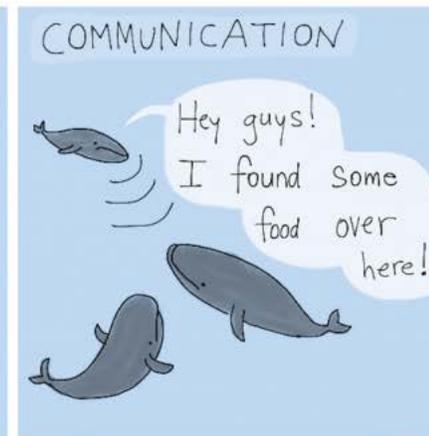
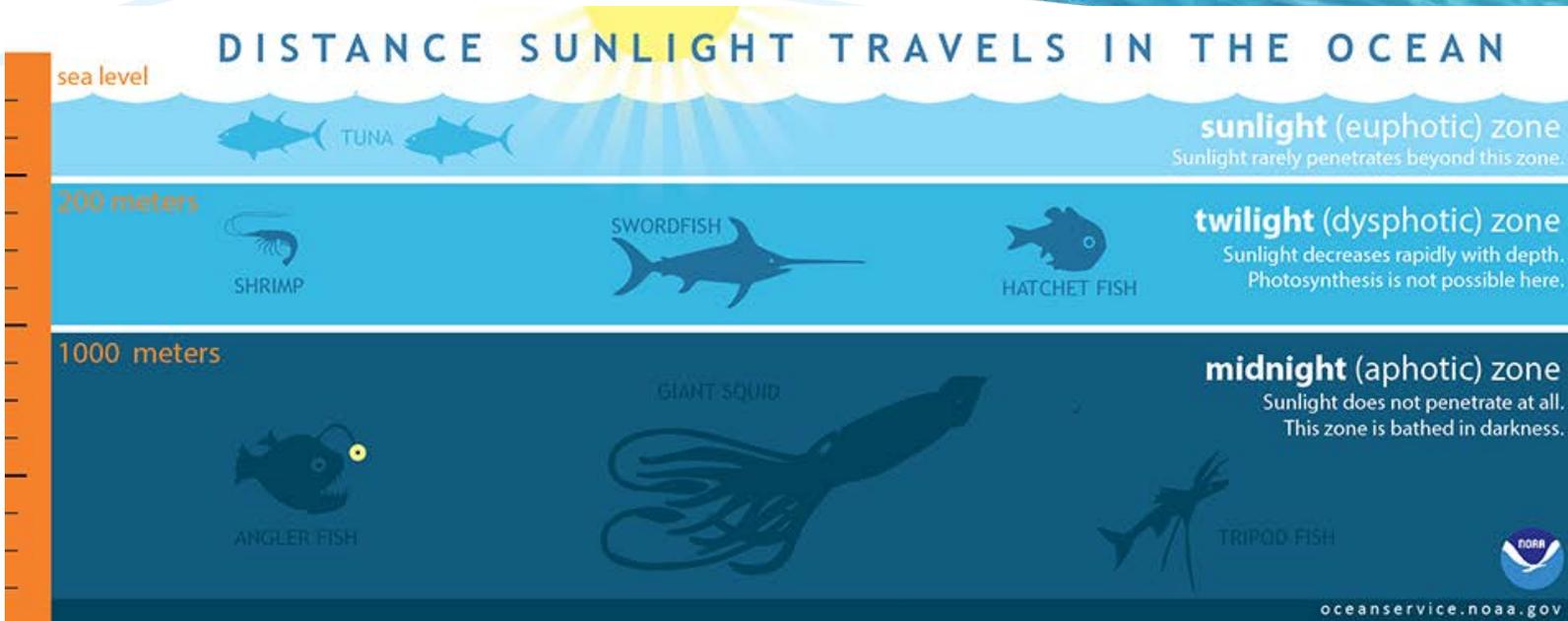


California Offshore Wind Energy Gateway

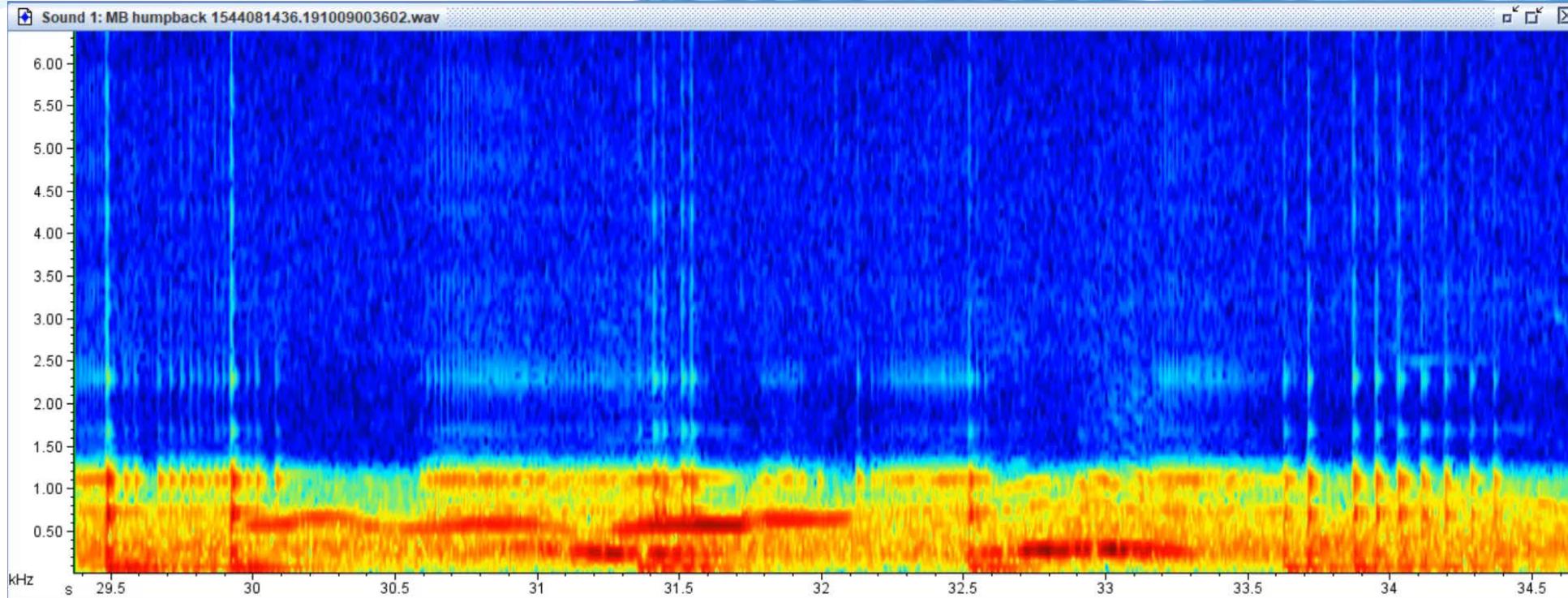


<https://caoffshorewind.databasin.org/galleries/e1e3eab6e86446e7905c824474f70428#expand=145364>

Heard but not often seen...



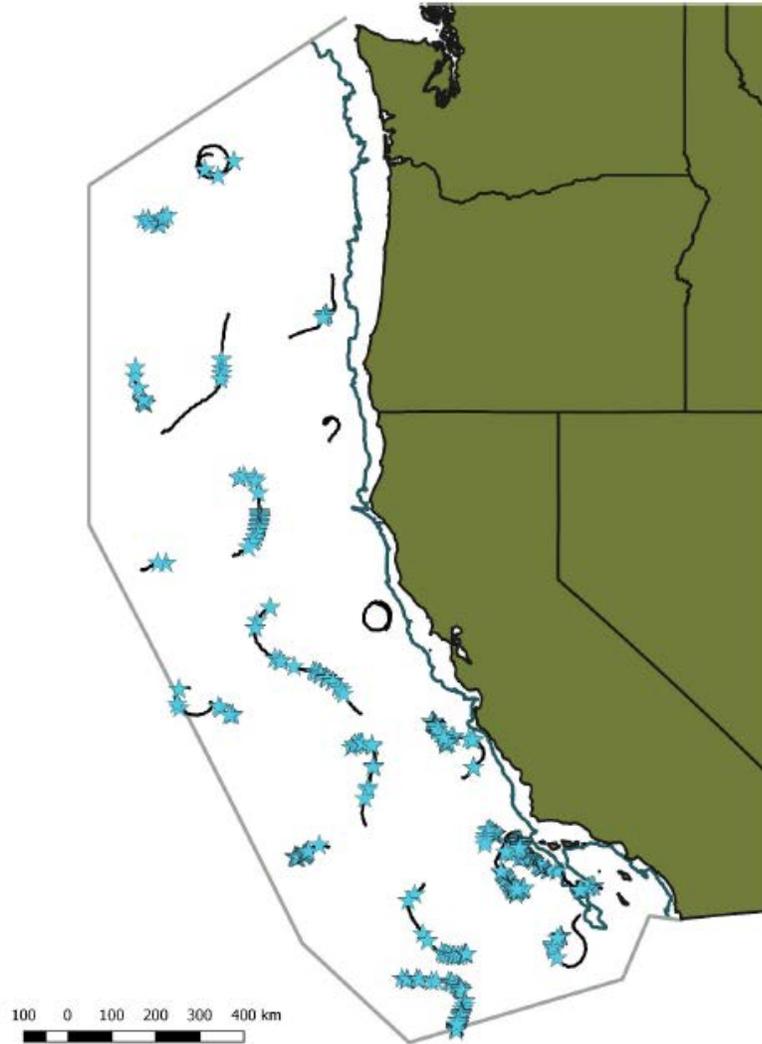
Humpback Whale Vocalizations in Morro Bay, California



Credit: Shannon Rankin, NOAA



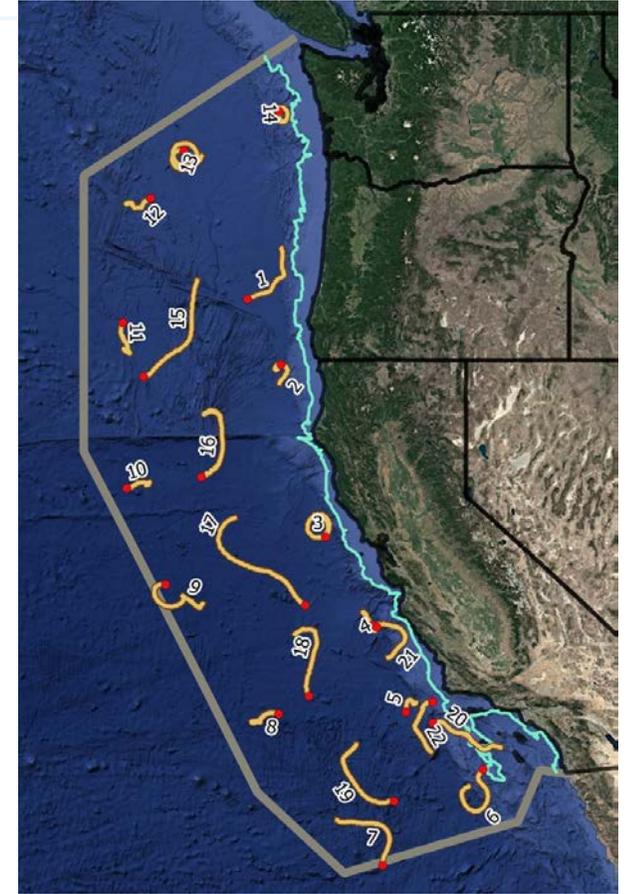
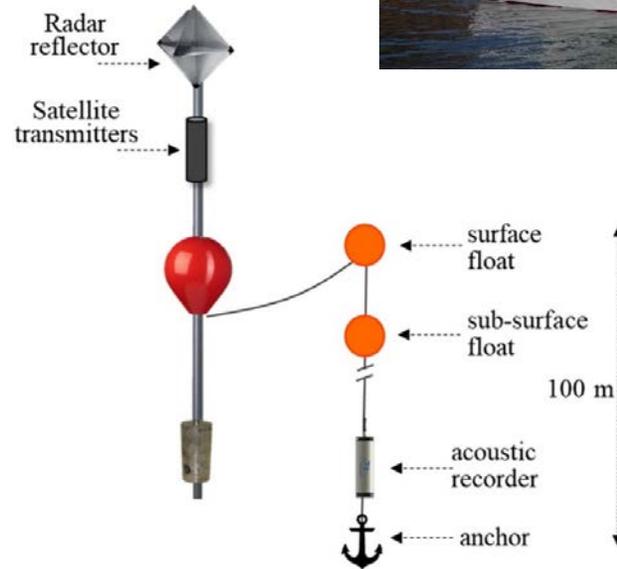
Passive Acoustic Survey of Cetacean Abundance Levels



<https://marinecadastre.gov/espis/#/search/study/100116>

ADRIFT:

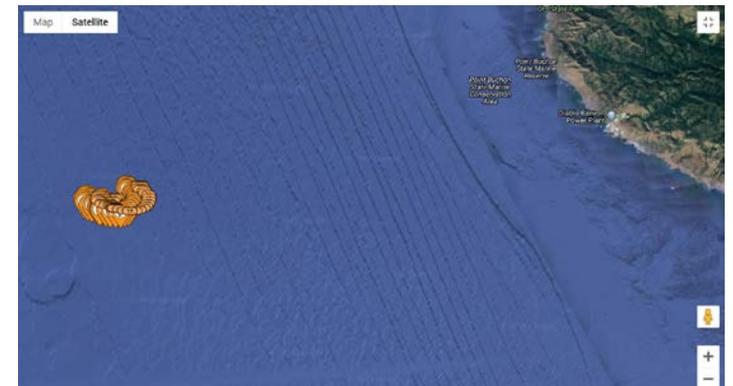
Spatial and Temporal Distribution of Cetaceans in the California Current Ecosystem Using Drifting Archival Passive Acoustic Monitoring



ADRIFT:

Spatial and Temporal Distribution of Cetaceans in the California Current Ecosystem Using Drifting Archival Passive Acoustic Monitoring

- Lower cost = more deployments
- Increased geographic & temporal resolution
- Deployment by local vessels
- Vessel time on NOAA research vessels
- Remote monitoring via satellite



ADRIFT:

Spatial and Temporal Distribution of Cetaceans in the California Current Ecosystem Using Drifting Archival Passive Acoustic Monitoring

- Open source computing for Artificial Intelligence
 - Streamlined data processing
 - Supervised machine learning acoustic ID
 - Standardized data for future development
 - Artificial Intelligence
 - Population assessment

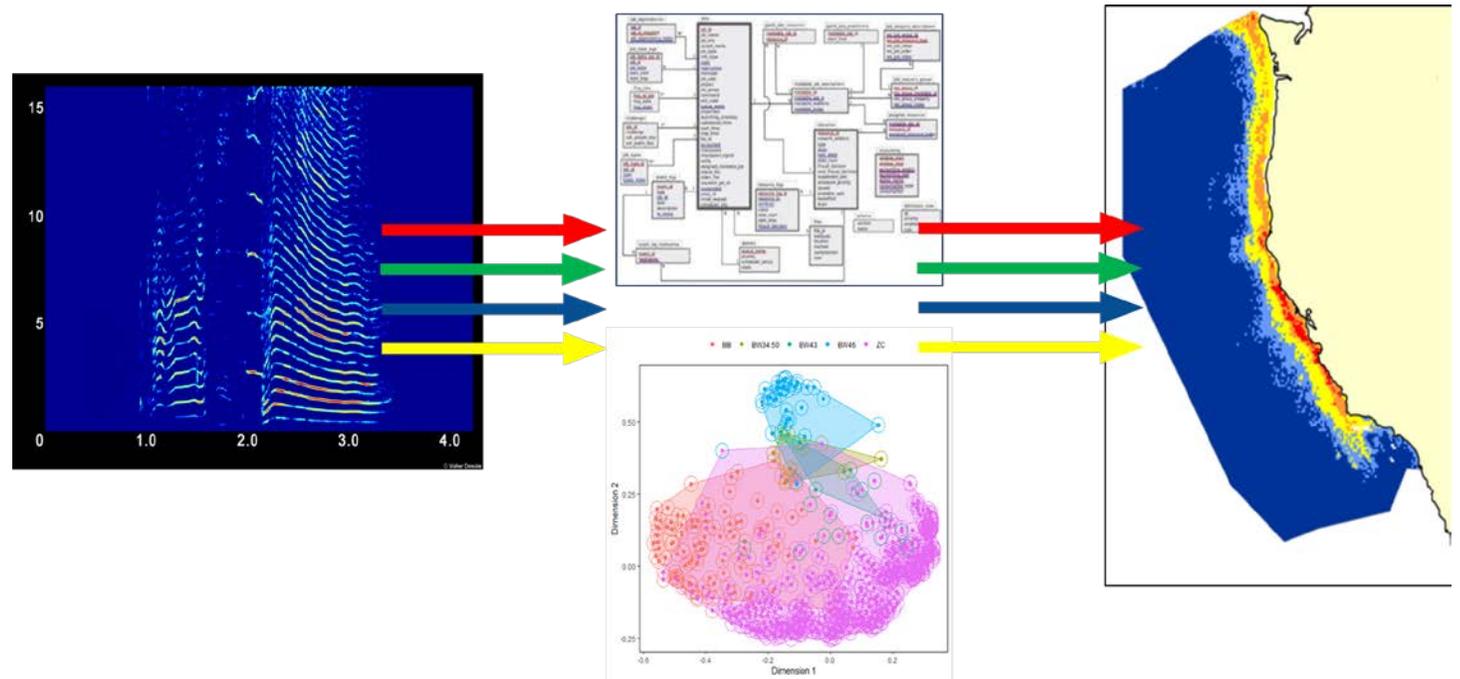


Image credit: Shannon Rankin, NOAA SWFSC

ADRIFT:

Spatial and Temporal Distribution of Cetaceans in the California Current Ecosystem Using Drifting Archival Passive Acoustic Monitoring



- Cost-effective partnerships
 - Additional sensors expand scope
- Academic research partnerships
- Education/Outreach
- Citizen Science
 - Vessels of opportunity
 - zooniverse.org



HUMBOLDT STATE UNIVERSITY



DEPARTMENT OF FISHERIES BIOLOGY



Characteristics of Sounds Emitted During High-Resolution Marine Geophysical Surveys

NUWC-NPT Technical Report 12,203
24 March 2016

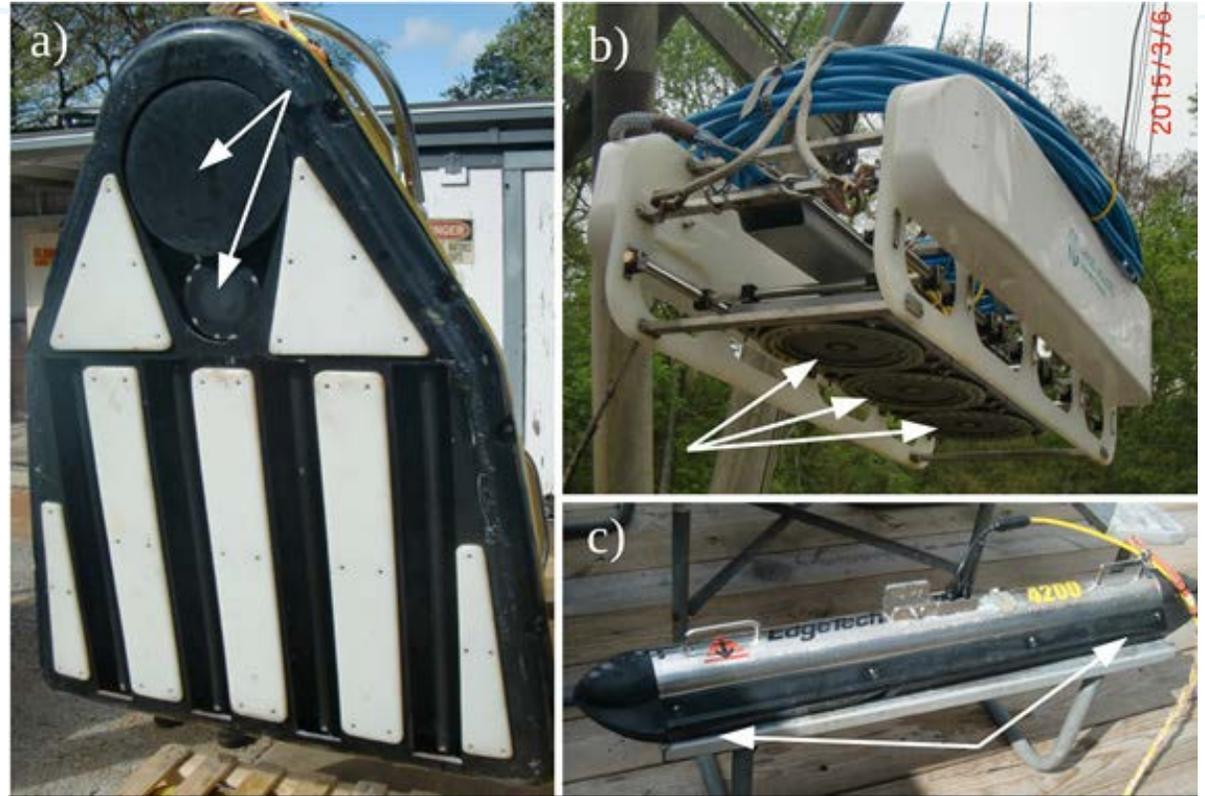
Characteristics of Sounds Emitted During High-Resolution Marine Geophysical Surveys

Steven E. Crocker
Frank D. Fratantonio
Sensors and Sonar Systems Department



Naval Undersea Warfare Center Division
Newport, Rhode Island

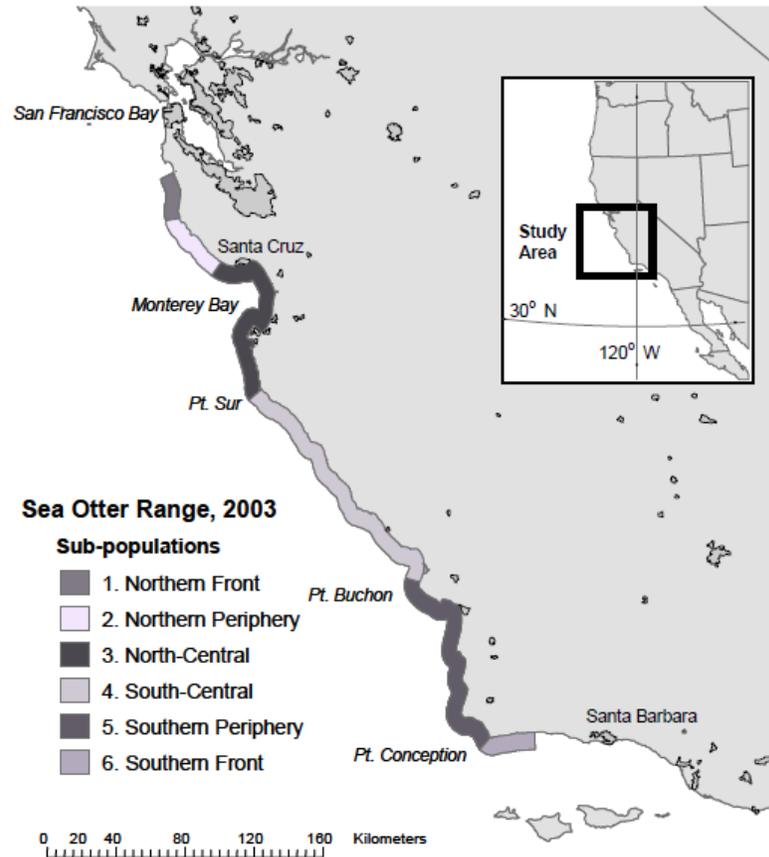
Approved for public release; distribution is unlimited.



- a) Edgetech sub-bottom profiling system
- b) S-Boom sub-bottom profiling system
- c) EdgeTech side scan sonar

<https://epis.boem.gov/final%20reports/5551.pdf>

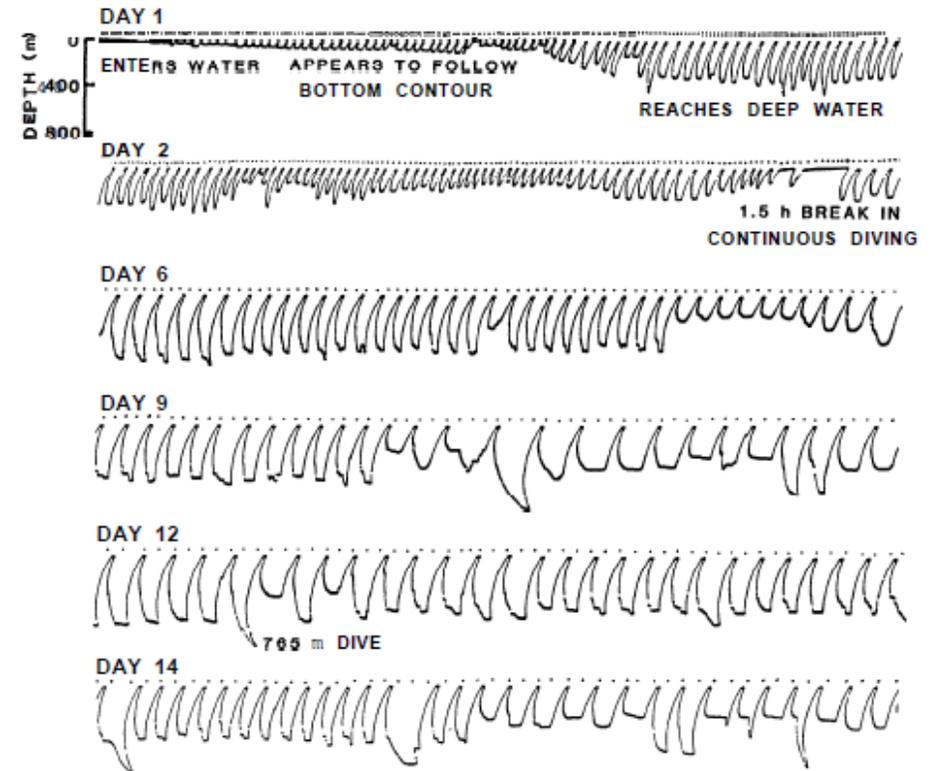
Population Dynamics and Biology of the California Sea Otter (*Enhydra lutris nereis*) at the Southern End of its Range: 2000-2003



- Female movement limited
- Males move throughout range – southern range periphery late winter and early spring
- Significant difference in behavior and demography between subgroups
- Female survival decreased since 1980s

<https://espis.boem.gov/final%20reports/4379.pdf>

Diving Behavior of Female Northern Elephant Seals (*Mirounga Angustirostris*): 1984-1987



<https://marinecadastre.gov/espis/#/search/study/20337>

Environmental Sensitivity and Associated Risk to Habitats and Species from Offshore Floating Wind Technologies

OCS Study
BOEM 2018-031

Environmental Sensitivity and Associated Risk to Habitats and Species Offshore Central California and Hawaii from Offshore Floating Wind Technologies

Volume 1: Final Report



US Department of the Interior
Bureau of Ocean Energy Management
Pacific OCS Region



Species	Region	All Phase AS	All Phase AL	All Phase CSE	All Phase HD	All Phase SN	All Phase VS	Impact Score	Recovery Score
Northern Fur Seal	CA	4.32	3.30	3.40	1.75	5.04	5.40	23.21	1.80
Killer Whale	CA	2.70	2.20	6.38	2.75	6.82	4.80	25.65	1.70
Blue Whale	CA	3.51	3.30	5.95	2.50	6.53	4.20	25.99	1.80
Harbor Porpoise	CA	2.97	2.57	6.80	2.00	6.53	5.40	26.26	1.50
Leatherback Turtle	CA	4.05	4.03	4.68	2.50	5.64	5.40	26.30	1.30
California Sea Lion	CA	5.67	2.57	5.10	2.75	5.64	6.60	28.32	1.80
Humpback Whale - CMX DPS	CA	4.32	3.67	5.95	3.00	6.82	6.00	29.76	2.00
Maximum Possible MT Scores:		8.10	5.50	8.50	5.00	8.90	9.00	45.00	2.50

Impact-causing factors:

- Accidental Spills (AS)
- Artificial Light (AL)
- Collisions with Subsurface Structures, Entanglement (CSE)
- Habitat Disturbance/Displacement (HD)
- Sound/Noise (S/N)
- Vessel Strikes (VS).

https://epis.boem.gov/final%20reports/BOEM_2018-031.pdf



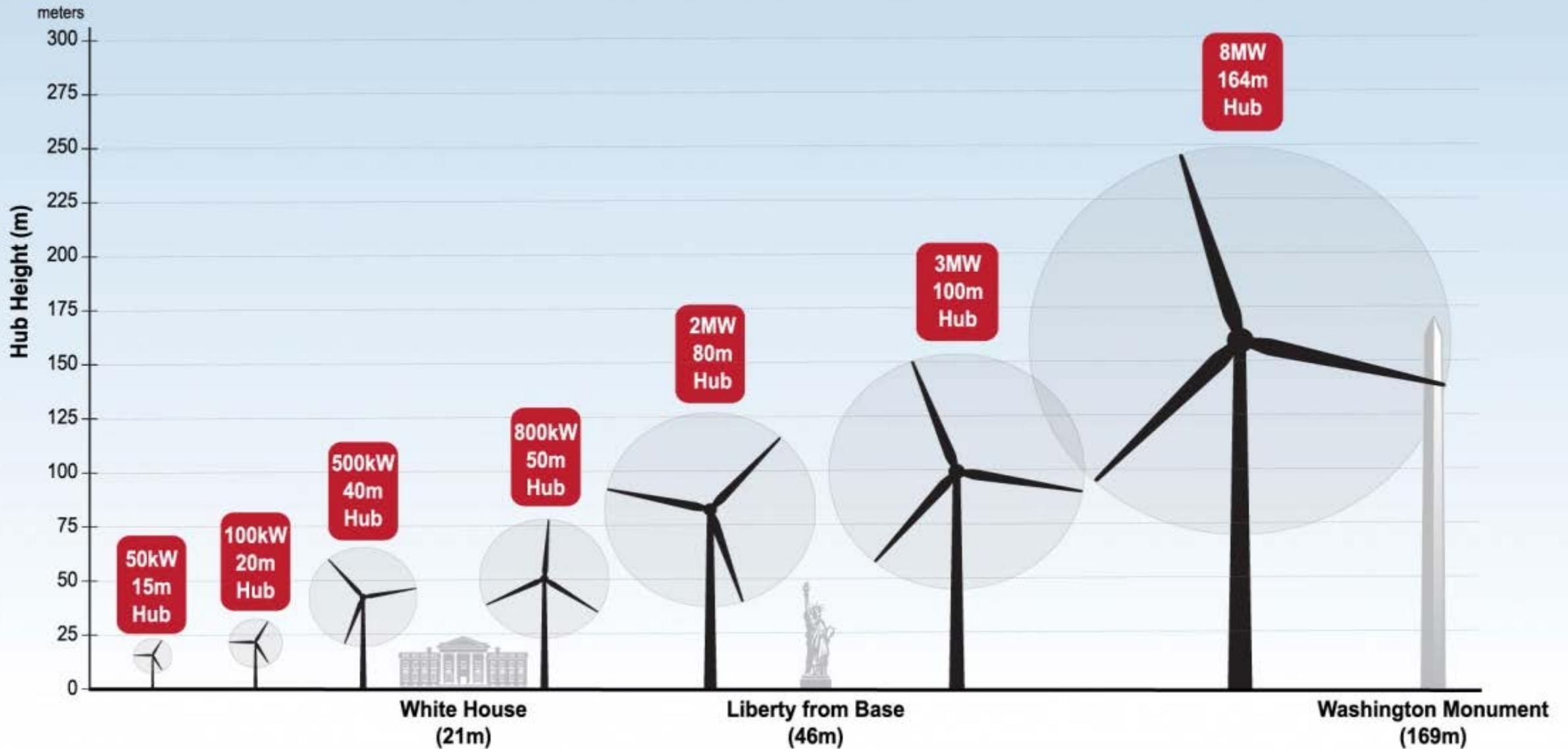


Illustration by Josh Bauer, NREL



Humpback Whales and Floating Offshore Wind Farms

Humpback Whales and Floating Offshore Wind Farms



Animation: <https://www.boem.gov/Humpback-Whales-Floating-Wind/>

Report: <https://www.boem.gov/BOEM-2018-065/>

This slide presented a full screen showing of the animation mentioned in the previous slide. To watch the animation, please go to: <https://www.boem.gov/Humpback-Whales-Floating-Wind/>

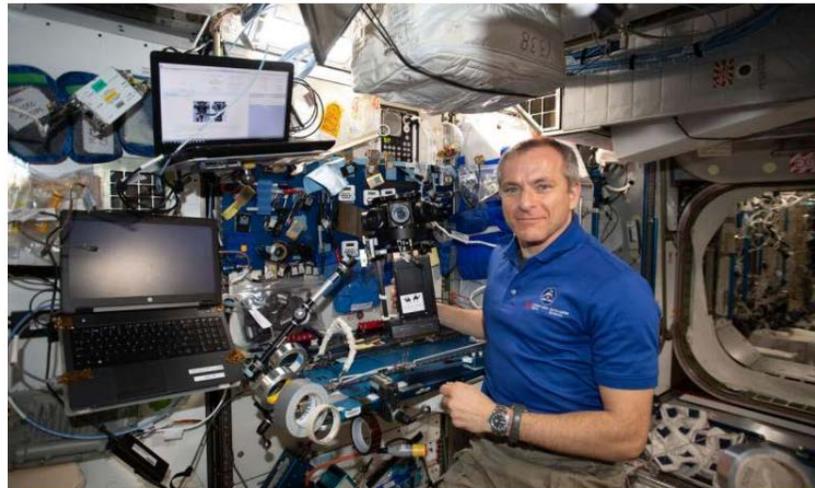
Virtual Reality in Science and Engineering



NOVEMBER 13, 2019

A virtual reality camera captures life and science aboard the space station

by Erin Winick, NASA



A view of Canadian Space Agency (CSA) astronaut David Saint-Jacques setting up the Z-CAM V1 Pro ...



Stanford Shows You the Horrors of Ocean Acidification in Virtual Reality

October 20, 2016 • by Dieter Holger

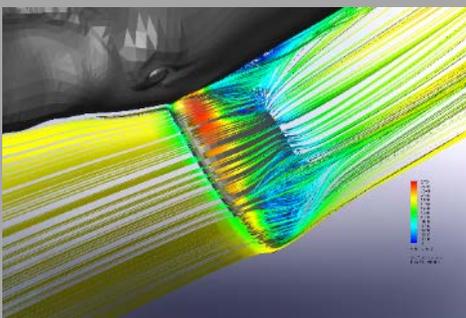


Physical Model

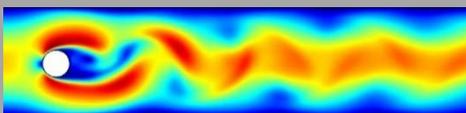


- Validation of forces and deflections in aquaculture gear

CFD Model



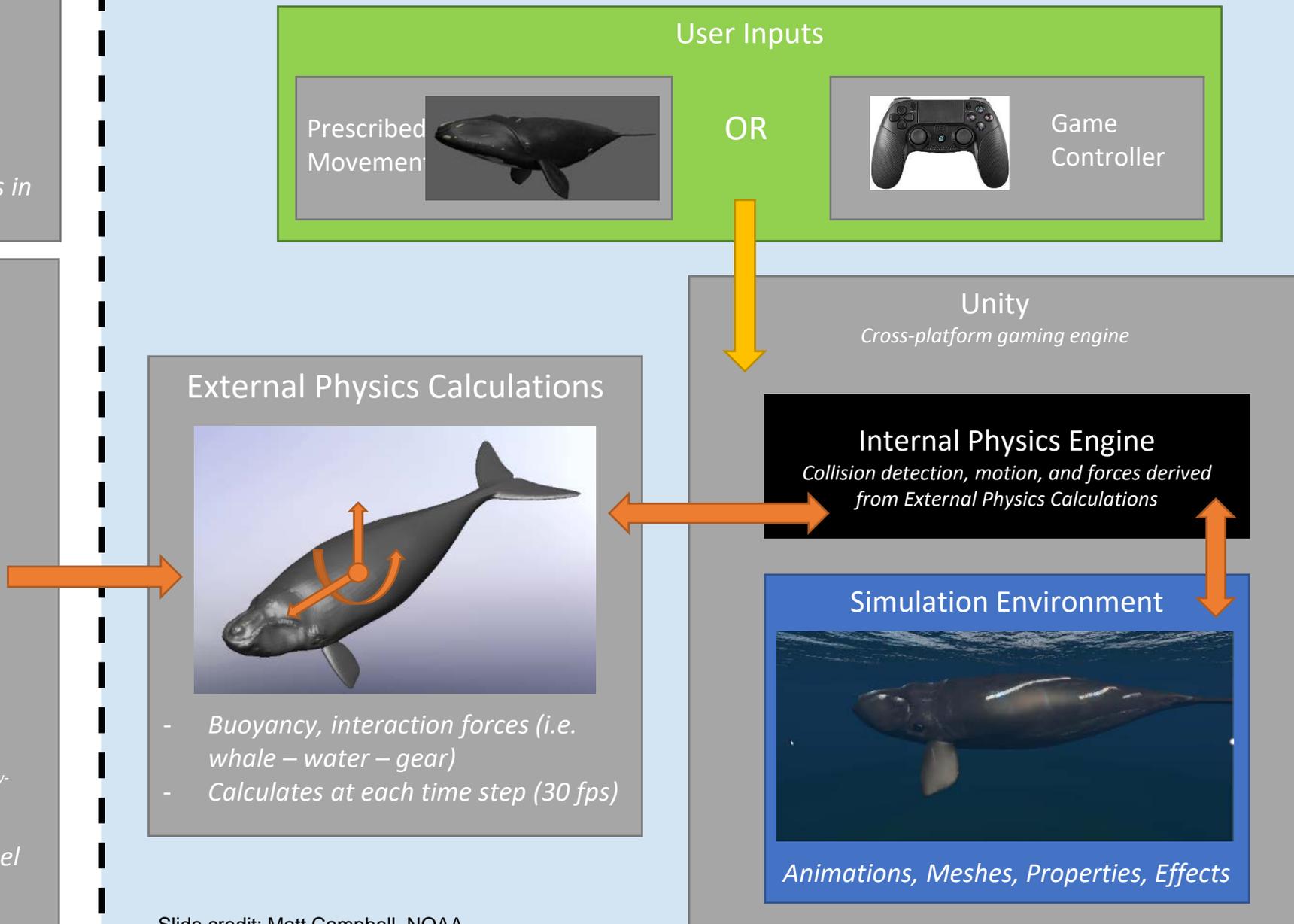
- Computes forces, moments, and coefficients for whale positions at various relative water currents



Wolfram Hage / CC BY-SA (<https://creativecommons.org/licenses/by-sa/4.0>)

- Compute forces on aquaculture components (i.e. lines, floats, mussel droppers, etc.)

Virtual Whale Entanglement Simulator (VWES)



Virtual Whale Entanglement Simulator



Systematic and science-based approach to analyzing Whale-Gear Interactions

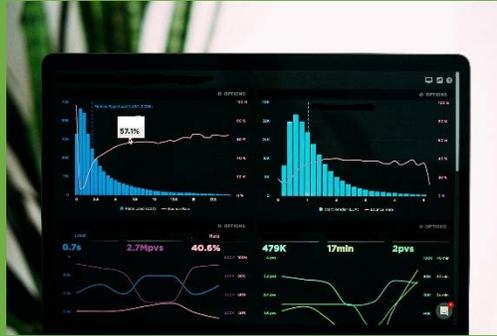
Configuration Analysis



Ocean Industries



Risk Assessment



Descriptive statistics



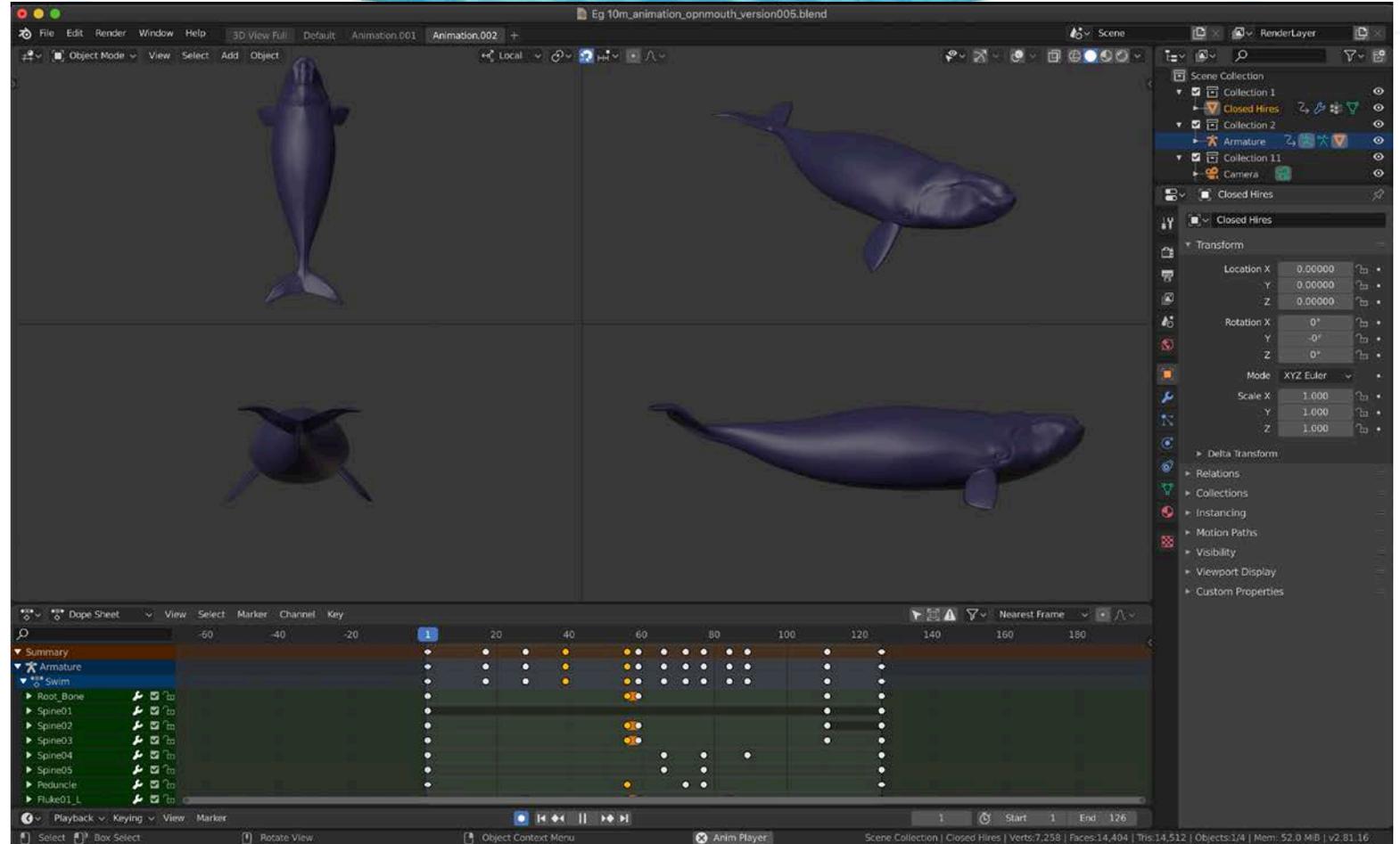
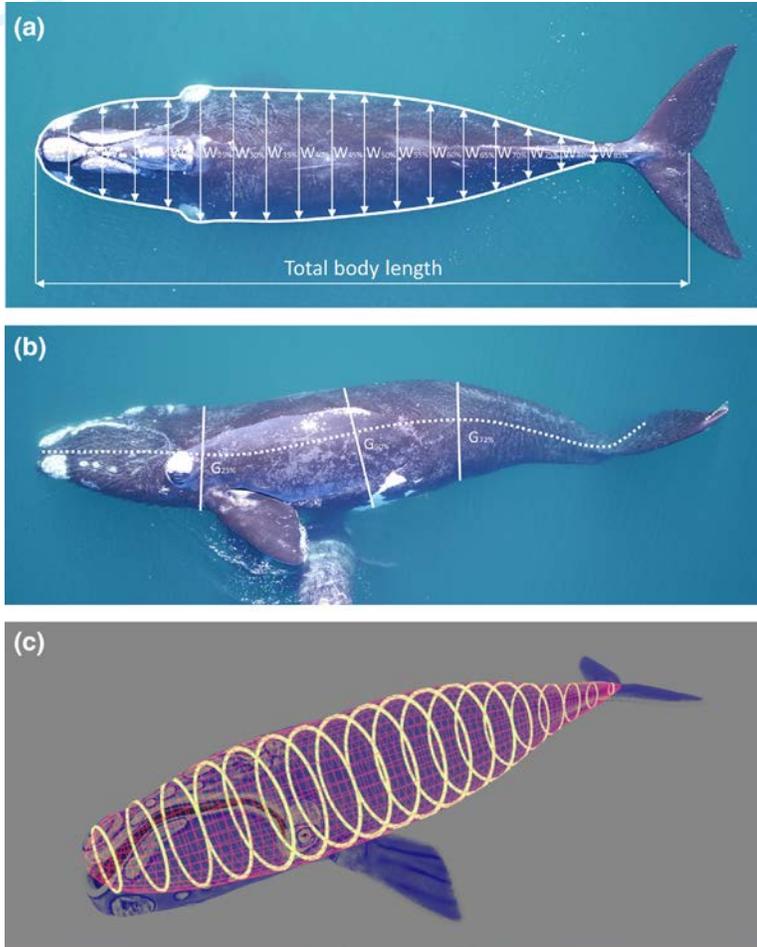
Planning tools



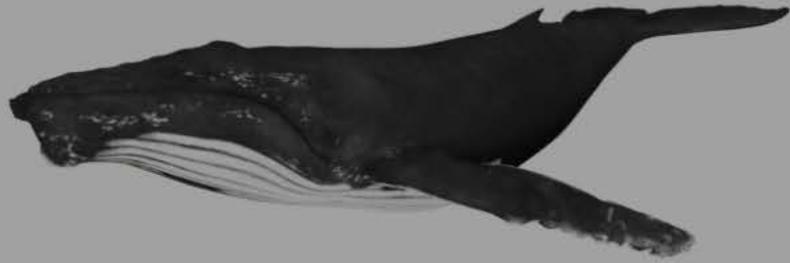
Sustainable Offshore Development Minimizing Entanglement Risk



Animal Model Development



Slide credit: Dr. Lars Howle, Bellequant Engineering





This slide presented a video of the simulated marine environment that is currently under development.

Development of Computer Simulations to Assess Entanglement Risk to Whales and Leatherback Sea Turtles in Offshore Floating Wind Turbine Moorings, Cables, and Associated Derelict Fishing Gear Offshore California



- We are also modeling fishing gear that may become snagged on moorings
- This is a proof of concept



<https://www.boem.gov/pr-19-ent-profile/>

Effects of EMF from Undersea Power Cables

OCS Study
BOEMRE 2011-09

EFFECTS OF EMFs FROM UNDERSEA POWER CABLES ON ELASMOBRANCHS AND OTHER MARINE SPECIES

Final Report



U.S. Department of the Interior
Bureau of Ocean Energy Management, Regulation and Enforcement
Pacific OCS Region



Photo credits: D. Pereksta

- Navigational miscue during migration is a possible effect
- Effect possible but unlikely to be significant
- May expect similar limited effects among other porpoises or dolphins
- Insufficient information to determine effect on whale species

<https://epis.boem.gov/final%20reports/5115.pdf>

Thank you!

BOEM Study Reports

- **Environmental Studies Program Information System (ESPIS)**

<https://marinecadastre.gov/espis/#/>

Data and Maps

- **California Offshore Wind Energy Gateway**

<https://caoffshorewind.databasin.org>

- **Oregon West Coast Data Portal**

(under development)

<https://portal.westcoastoceans.org>

- **Marine Cadastre**

<https://marinecadastre.gov>



Collaboration is key!

BOEM

Bureau of Ocean Energy
Management

BOEM.gov



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