

New risk assessment methods to understand vulnerability of marine mammals and sea turtles to offshore sustainable energy development

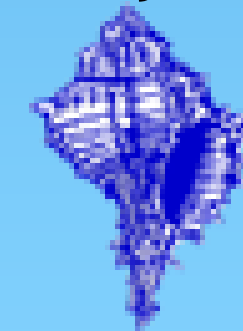
Brandon L. Southall, Ph.D.

Southall Environmental Associates, Inc.



UC Santa Cruz – Long Marine Laboratory

Duke University Marine Laboratory



California Ocean Alliance



MARINE MAMMAL AND SEA TURTLE VULNERABILITY RISK ASSESSMENT

Lead Organizations

Southall Environmental Associates (SEA)
Brandon Southall (PI)

California Marine Sanctuary Foundation (CMSF)
Robert Mazurek
Rikki Eriksen

Funding Provided by BOEM

Marine Mammal & Sea Turtle Experts

Elizabeth Becker (ManTech; NOAA affiliate)

Karin Forney (NOAA)

Elliott Hazen (NOAA)

Scott Benson (NOAA)

Desray Reeb (BOEM)

Dominic Tollit (SMRU, Consulting)

Jenn Amaral (Marine Acoustics Inc (MAI))

Kristin Reed (Upwell)

George Shillinger (Upwell)

Megan McKenna (SEA, Stanford University)

Daniel Pelacios (Oregon State University)

John Calambokidis (Cascadia Research)

Jeff Moore (NOAA)

Shannon Rankin (NOAA)

William Ellison (MAI)

Chris Clark (Cornell University; MAI)

OVERVIEW

Objective: Adapt elements of earlier risk assessment methods to evaluate potential vulnerability of marine mammal and sea turtles to development in a spatially, temporally explicit manner

— What this is:

- First step in a continuing process informed by other parallel efforts
- Relativistic, simple, consistent
- Very broad spatial and taxonomic scales
- Common assumptions and treatment of uncertainty
- Gap analysis based on uncertainty
- Intended to provide **guidance** for baseline **monitoring**, strategic **research**, impact assessment, mitigation

OVERVIEW

— What this isn't:

- Presumed to be a 'final' or full assessment
- Fully parameterized quantitative impact assessment
- Entire risk assessment
- Focused on a specific lease area or type and pattern of development/operation

ECOLOGICAL RISK ASSESSMENT METHODS FOR EVALUATING MARINE MAMMAL NOISE IMPACTS

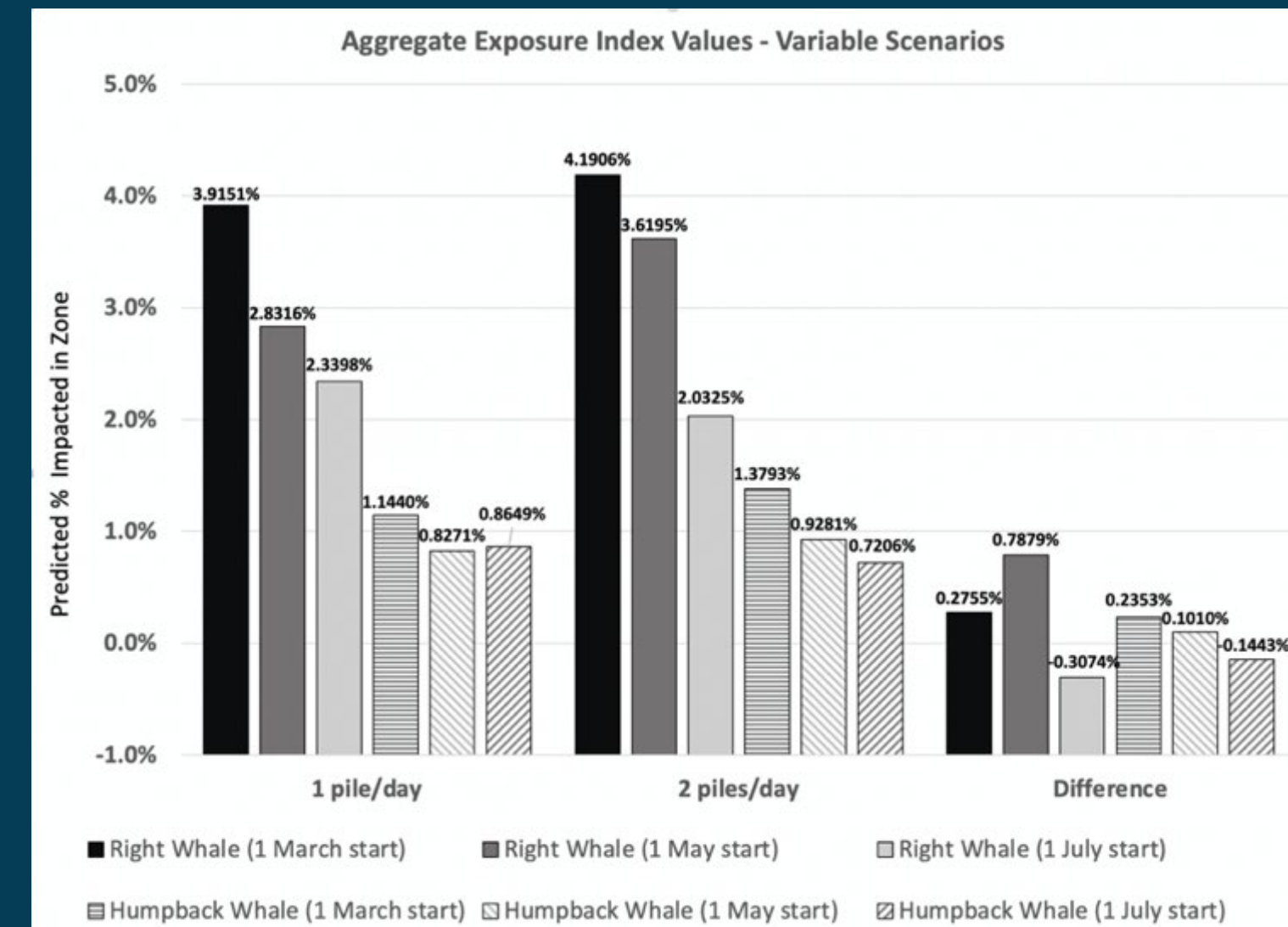
Wood, J., Southall, B.L. and Tollit, D.J. (2012). PG&E offshore 3-D Seismic Survey Project EIR – Marine Mammal Technical Report. SMRU Ltd.

Ellison, W.T., Clark, C.W., Mann, D.A., Southall, B., and Tollit, D.J. (2015). A risk assessment framework to assess the biological significance of noise exposure on marine mammals. 21st Biennial Conference on the Biology of Marine Mammals



Disturbance Severity	5					
	4					
	3					
	2					
	1					
	Rating	1	2	3	4	5
Species Vulnerability						

- Spatial-temporal-spectral calculation of severity: “exposure index”
- Multiple sources and cumulative effects
- Quantitative markers for species vulnerability
- Applied to seismic surveys offshore wind development
- Scalable, adaptable to different industrial scenarios



VULNERABILITY RISK ASSESSMENT SCORING METHODS

OVERALL APPROACH:

Spatially-temporally-taxonomically
explicit risk assessment

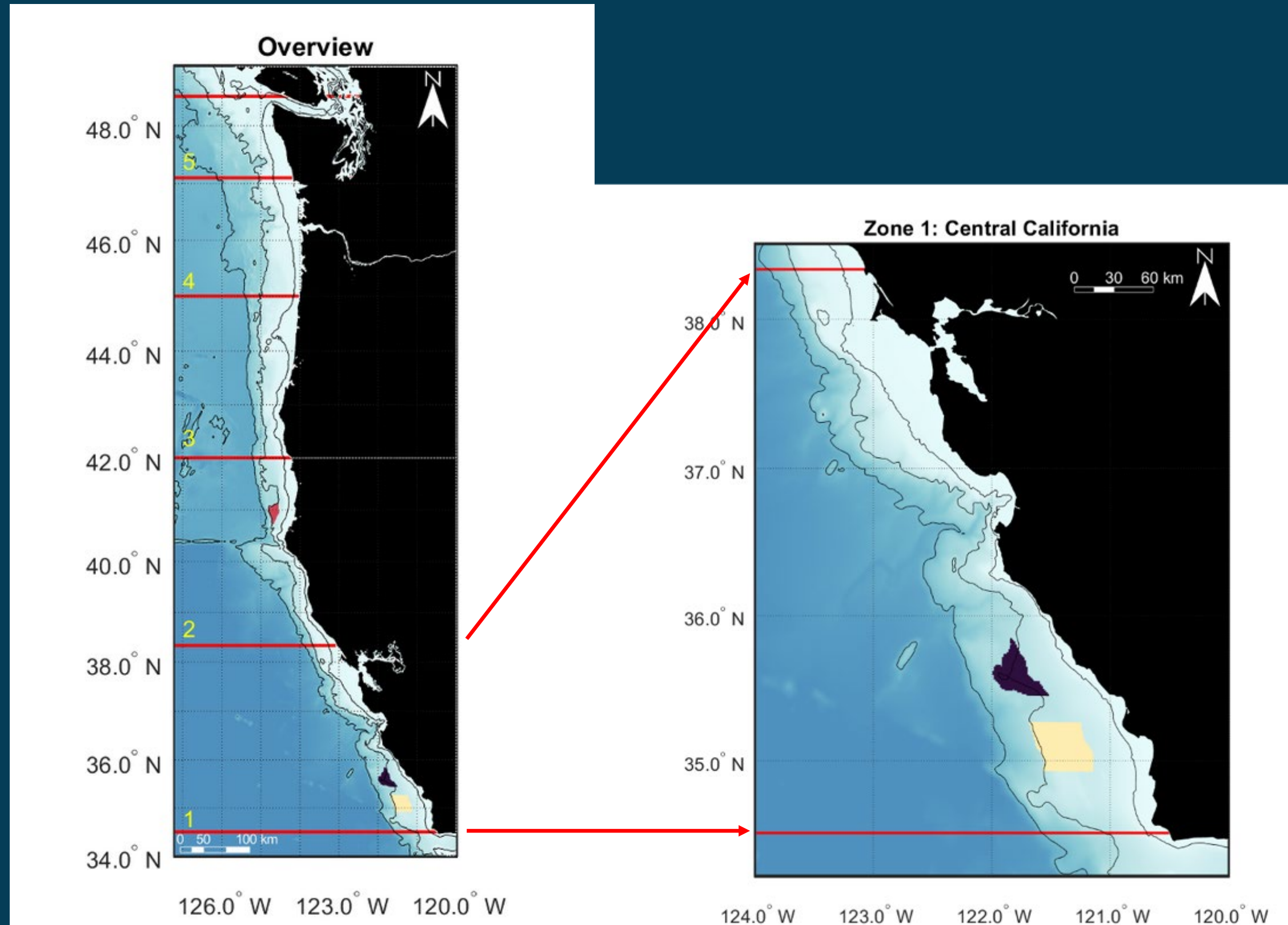
Semi-quantitative, expert elicitation
approach tuned to west-coast context

- Spatial Segregation: Focal Areas
- Temporal Windows: Oceanographic “Seasons”
- Vulnerability Scoring Criteria: Factors, Ratings
- Species and Groups Evaluated (42)

METHODS:

SPATIAL SEGREGATION (FOCAL AREAS)

- 5 latitudinal regions defined based on human-based boundaries and ecological considerations
- 3 depth regimes defined based on ecological considerations
 - Shelf (<100m)
 - Slope (100-1000m)
 - Oceanic (1000-2500m)
- 15 total “zones”



METHODS: VULNERABILITY SCORING CRITERIA

Total Vulnerability Score (from factors 1-4)	Total Risk Probability (% of total possible)	Relative Vulnerability Rating
29–36	80–100%	Highest
22–28	60–79%	High
15–21	40–59%	Moderate
8–14	20–39%	Low
1–7	0–19%	Lowest

Four Vulnerability Factors:
Equally Weighted (9 points each = 36
point total)

a. Population Factor

b. Species Habitat and Temporal Factor

c. Physical Interactions Factor

-> masking, entanglement, vessel-
strike, electromagnetic

d. Other Stressors Factor

-> existing human and biological risks

METHODS: VULNERABILITY SCORING CRITERIA

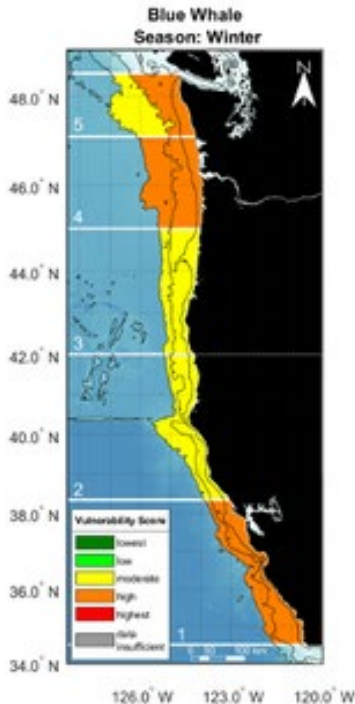
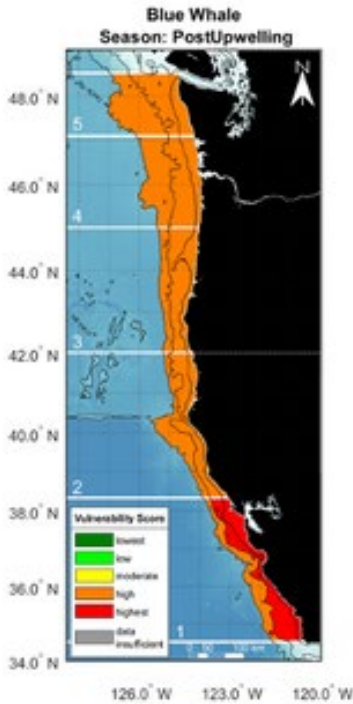
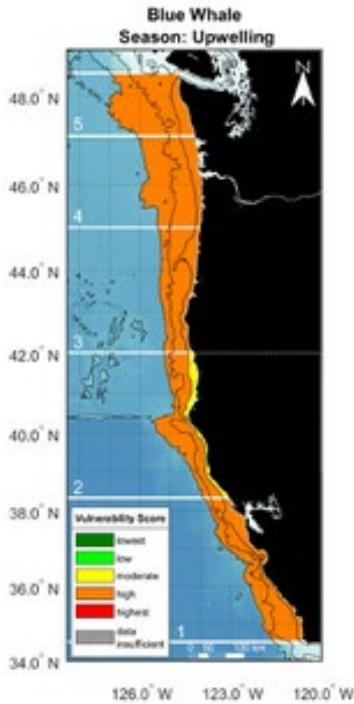
Species, Species Group, DPS/stock distinctions: **Example Mysticete Cetaceans (10)**

<i>SPECIES</i>	<i>STOCK</i>	<i>CONSERVATION STATUS</i>
BLUE WHALE	Eastern N Pacific	ESA-listed (endangered)
FIN WHALE	CA/OR/WA	ESA-listed (endangered)
SEI WHALE	Eastern N Pacific	ESA-listed (endangered)
N. PACIFIC RIGHT WHALE	Not specified (AK., W coast)	ESA-listed (endangered)
GRAY WHALE	Western N Pacific	ESA-listed (endangered)
GRAY WHALE	Eastern N Pacific	MMPA-listed
HUMPBACK WHALE	Central American DPS	ESA-listed (endangered)
HUMPBACK WHALE	Mexico DPS	ESA-listed (threatened)
HUMPBACK WHALE	Hawaii DPS	MMPA-listed
BRYDE'S WHALE	Eastern Tropical Pacific	MMPA-listed
MINKE WHALE	CA/OR/WA	MMPA-listed

RESULTS: VULNERABILITY SCORES (BY SPECIES)

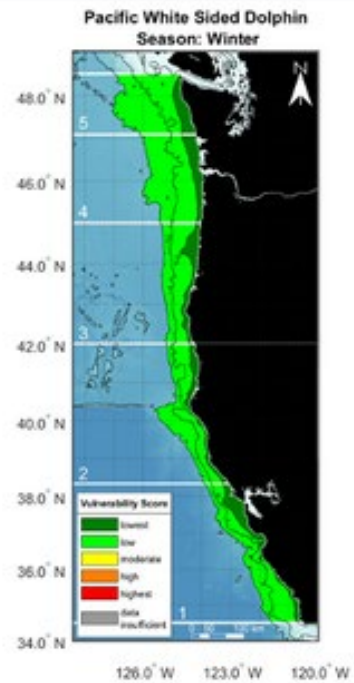
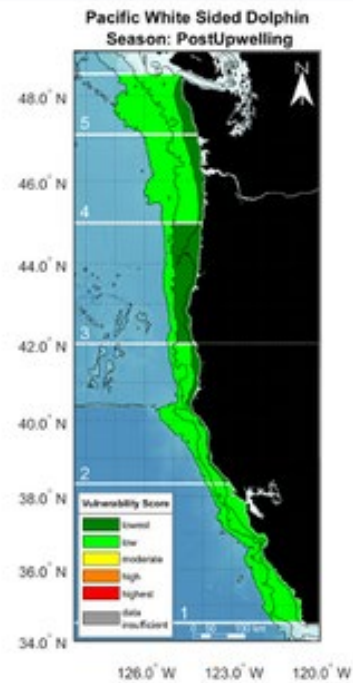
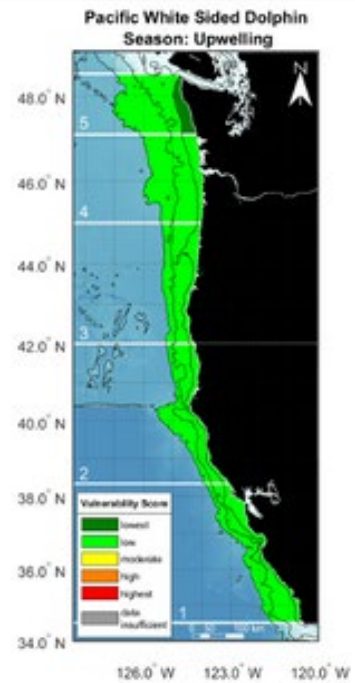
All Zones, All Seasons: **Blue Whale**

Oceanographic Season	ZONE 1			ZONE 2			ZONE 3			ZONE 4			ZONE 5		
	1a	1b	1c	2a	2b	2c	3a	3b	3c	4a	4b	4c	5a	5b	5c
Upwelling	25	25	23	21	23	23	24	25	23	22	24	23	22	23	22
Post-Upwelling	29	32	27	27	27	27	24	28	23	24	24	23	22	23	22
Winter	24	24	23	21	21	21	21	21	21	22	22	22	22	22	21

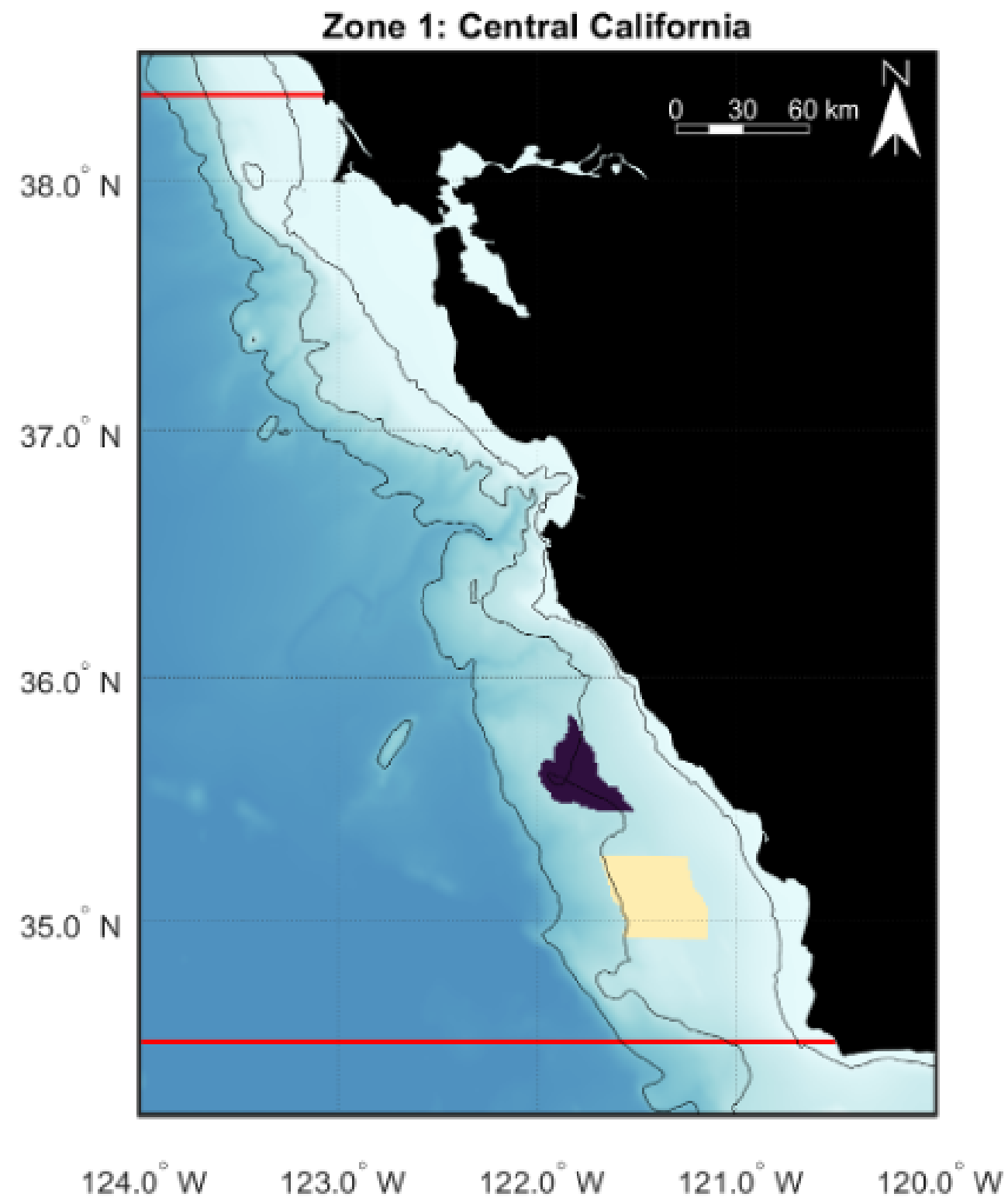


All Zones, All Seasons: **Pacific white-sided dolphin**

<i>Oceanographic Season</i>	ZONE 1			ZONE 2			ZONE 3			ZONE 4			ZONE 5		
	1a	1b	1c	2a	2b	2c	3a	3b	3c	4a	4b	4c	5a	5b	5c
<i>Upwelling</i>	10	13	11	8	8	11	9	13	11	9	12	11	6	10	12
<i>Post-Upwelling</i>	10	10	11	5	8	8	6	6	8	6	9	11	6	10	9
<i>Winter</i>	7	13	11	5	11	11	6	12	11	6	12	11	6	10	12



RESULTS: VULNERABILITY SCORES (ZONE 1A)



ZONE 1A					
UPWELLING		POST-UPWELLING		WINTER	
Gray whale (Western N. Pacific)	31	Leatherback sea turtle	34	Killer whale (S. Resident)	31
Humpback whale (Central American DPS)	31	Humpback whale (Central American DPS)	30	Gray whale (Western N. Pacific)	30
Killer whale (S. Resident)	29	Killer whale (S. Resident)	29	Humpback whale (Central American DPS)	29
Leatherback sea turtle	29	Blue whale	29	Blue whale	24
Humpback whale (Mexican DPS)	26	Humpback whale (Mexican DPS)	25	Coastal bottlenose dolphin	24
Blue whale	25	Gray whale (Western N. Pacific)	24	Humpback whale (Mexican DPS)	24
Bottlenose dolphin	22	Bottlenose dolphin	22	Leatherback sea turtle	23
Gray whale (Eastern N. Pacific)	21	Loggerhead sea turtle	21	Gray whale (Eastern N. Pacific)	20
Loggerhead sea turtle	21	Minke whale	20	Harbor Porpoise (Morro Bay)	20
Harbor Porpoise (Morro Bay)	20	Harbor Porpoise (Morro Bay)	20	Harbor Porpoise (Monterey Bay)	20
Harbor Porpoise (Monterey Bay)	20	Harbor Porpoise (Monterey Bay)	20	Loggerhead sea turtle	20
Harbor Porpoise (SF/Russian River)	19	Fin whale	20	Harbor Porpoise (SF/Russian River)	19
Fin whale	18	Harbor Porpoise (SF/Russian River)	19	Fin whale	17
Harbor seal (CA)	18	Green sea turtle	18	Olive Ridley sea turtle	16
Humpback whale (Hawaii DPS)	18	Sei whale	17	Humpback whale (Hawaii DPS)	16
Olive Ridley sea turtle	17	Olive Ridley sea turtle	17	Bryde's whale	15
Bryde's whale	16	Humpback whale (Hawaii DPS)	17	Minke whale	15
Minke whale	16	Sperm whale	17	Sperm whale	16
Sperm whale	17	Northern fur seal (CA)	16	Killer whale (Offshore)	15
Killer whale (Offshore)	16	Killer whale (Offshore)	16	Northern elephant seal	15
California sea lion	16	California sea lion	16	Green sea turtle	15
Green sea turtle	16	Bryde's whale	16	Killer Whale (Transient)	13
Killer Whale (Transient)	15	Stellar sea lion	15	Risso's dolphin	13
Stellar sea lion	15	Killer Whale (Transient)	14	Long-beaked common dolphin	13
Risso's dolphin	14	Harbor seal (CA)	14	Northern fur seal (CA)	13
Northern fur seal (CA)	14	Gray whale (Eastern N. Pacific)	14	Harbor seal (CA)	13
Long-beaked common dolphin	13	Short-beaked common dolphin	13	Harbor seal (OR/WA)	13
Harbor seal (OR/WA)	13	Risso's dolphin	13	Short-finned pilot whale	11
Short-finned pilot whale	12	Long-beaked common dolphin	13	Baird's beaked whale	11
Baird's beaked whale	12	Harbor seal (OR/WA)	13	Other beaked whales	11
Other beaked whales	12	Short-finned pilot whale	12	California sea lion	11
Northern elephant seal	12	Northern elephant seal	12	Stellar sea lion	10
Pacific White-sided dolphin	10	Baird's beaked whale	12	Dall's Porpoise	8
Northern fur seal (Eastern N. Pacific)	10	Other beaked whales	11	Northern fur seal (Eastern N. Pacific)	8
Dall's Porpoise	9	Pacific White-sided dolphin	10	Pacific White-sided dolphin	7
Guadalupe fur seal	8	Northern fur seal (Eastern N. Pacific)	9	Northern right whale dolphin	7
Pygmy and dwarf sperm whale	7	Dall's Porpoise	9	Guadalupe fur seal	7
Northern right whale dolphin	7	Guadalupe fur seal	8	Pygmy and dwarf sperm whale	6
Short-beaked common dolphin	7	Pygmy and dwarf sperm whale	7	Short-beaked common dolphin	6
Sei whale	n/a	Northern right whale dolphin	7	Sei whale	n/a
N. Pacific right whale	n/a	N. Pacific right whale	n/a	N. Pacific right whale	n/a
Harbor Porpoise (N CA/S OR)	n/a	Harbor Porpoise (N OR/WA Coast)	n/a	Harbor Porpoise (N CA/S OR)	n/a
Harbor Porpoise (N OR/WA Coast)	n/a	Harbor Porpoise (N CA/S OR)	n/a	Harbor Porpoise (N OR/WA Coast)	n/a

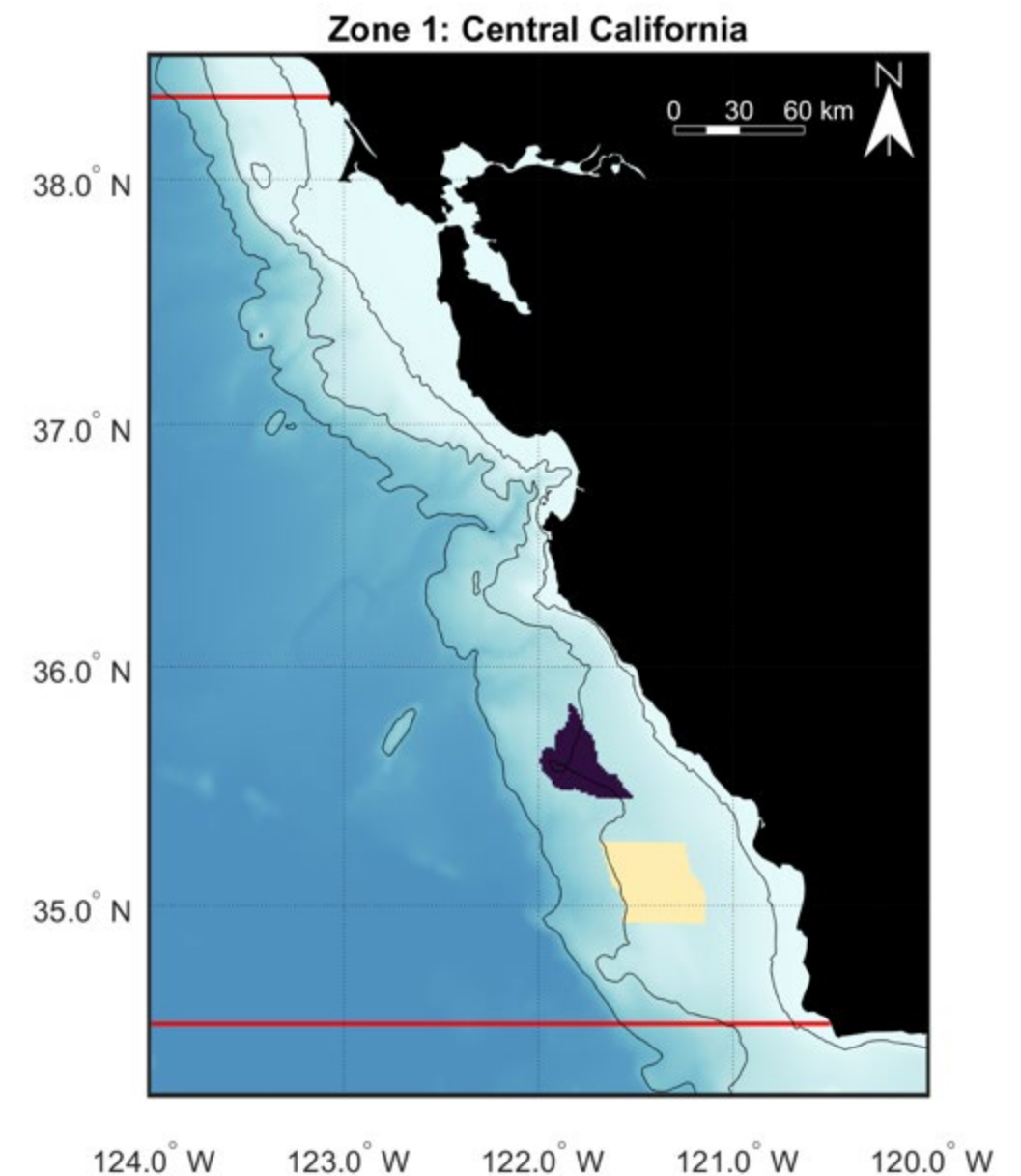
RESULTS: VULNERABILITY SCORES

(ZONE 1)

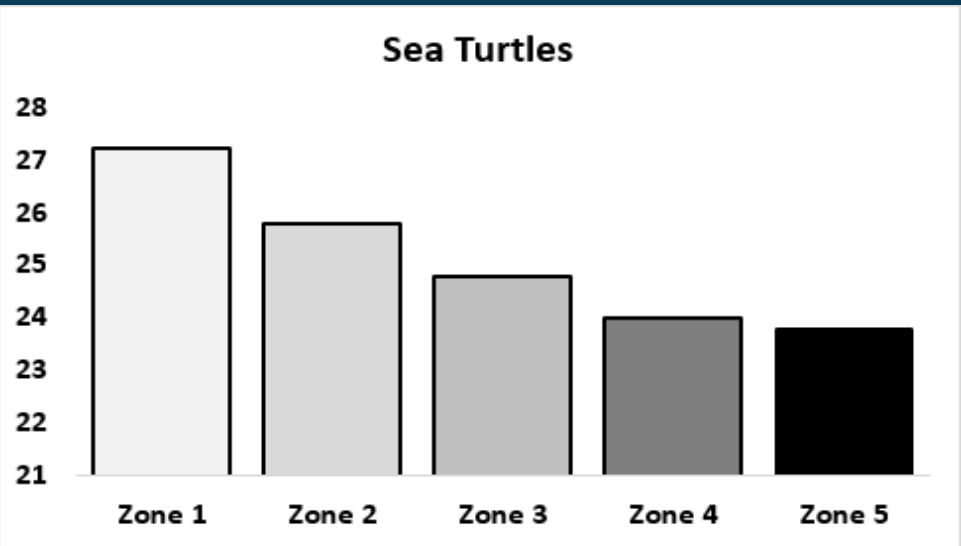
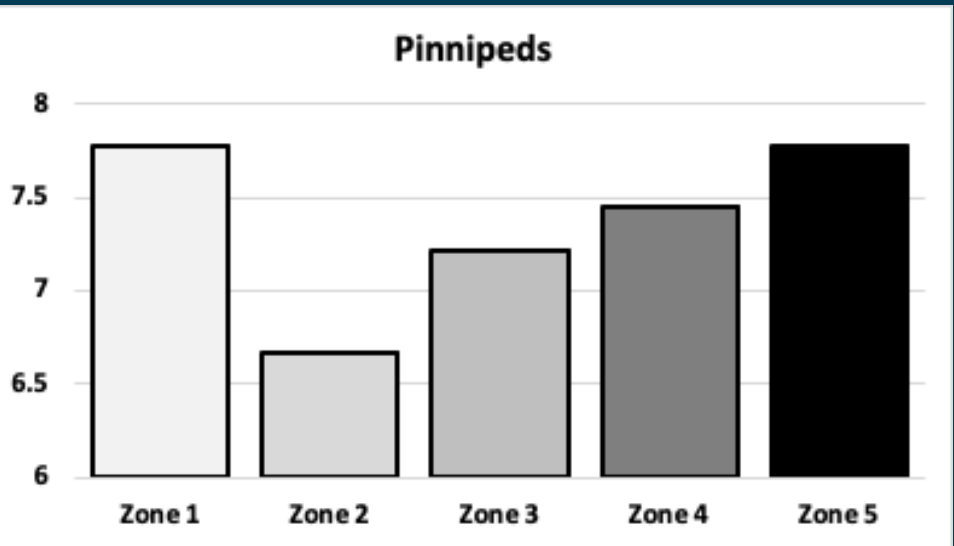
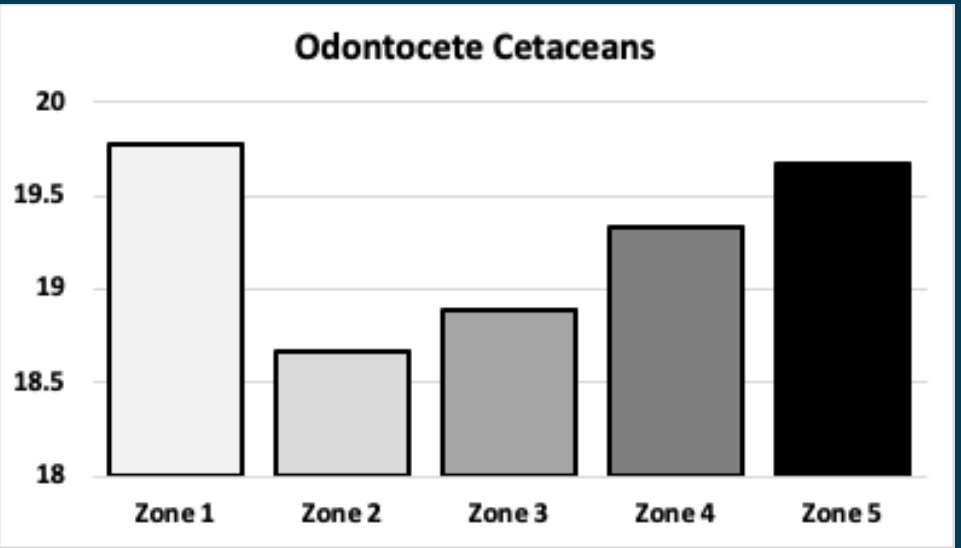
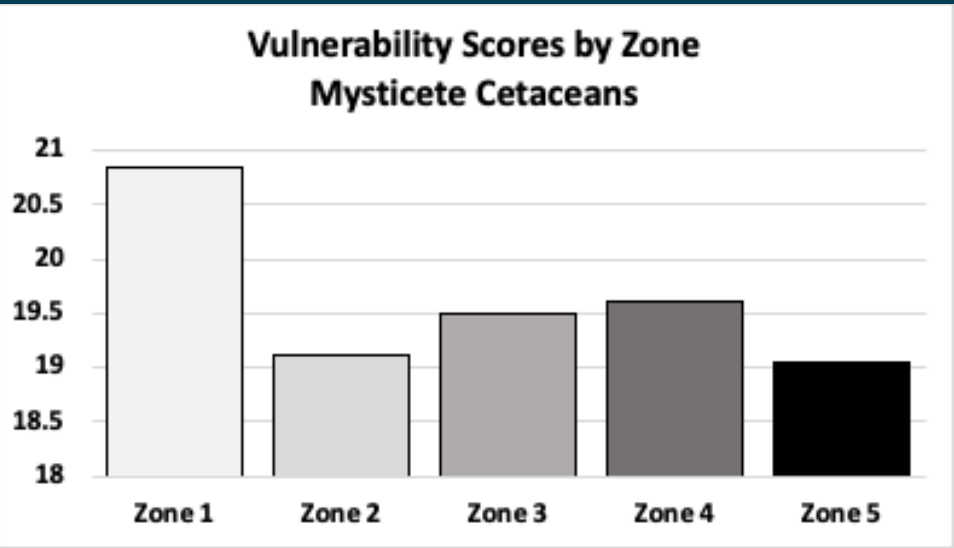
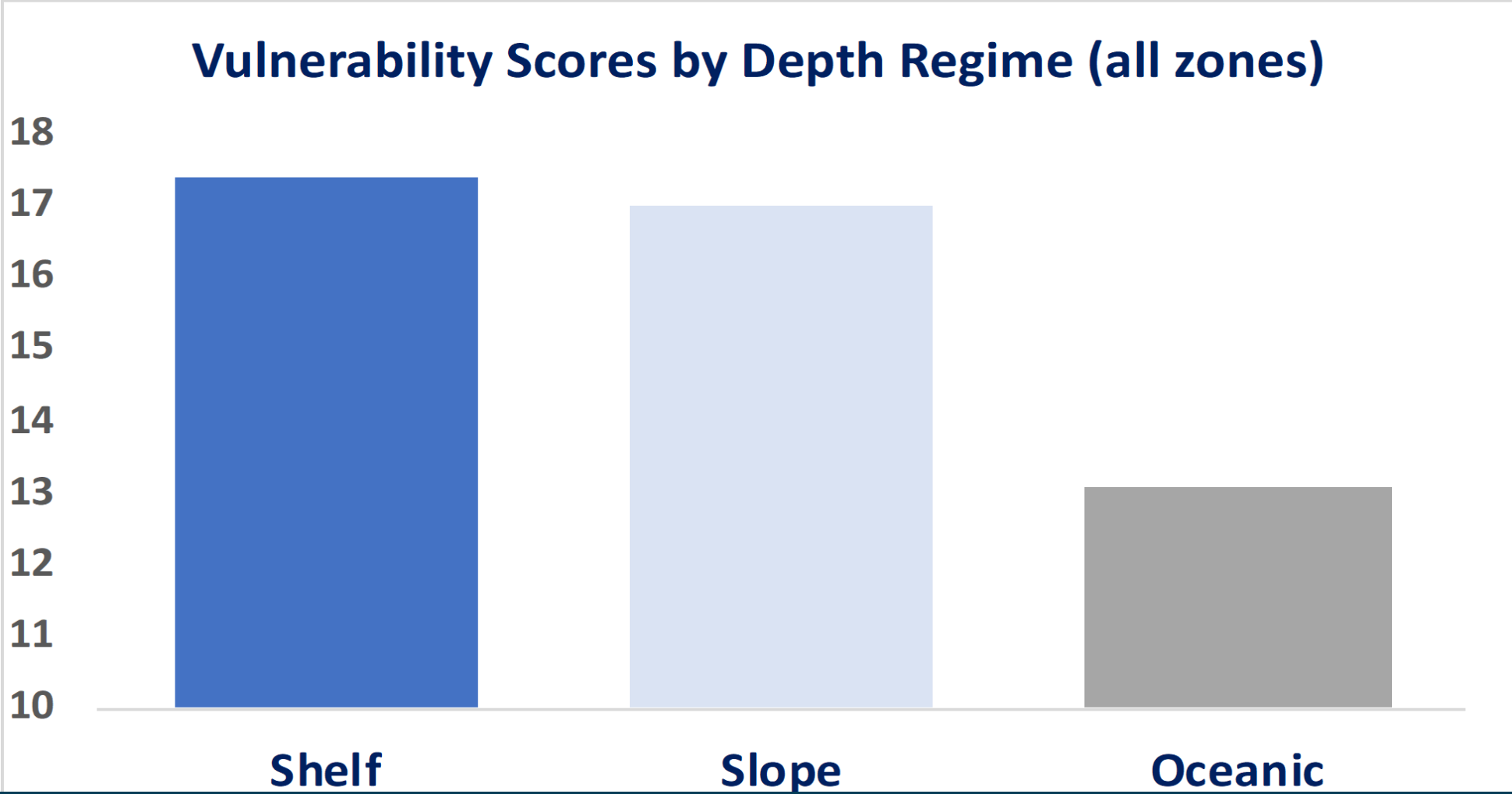
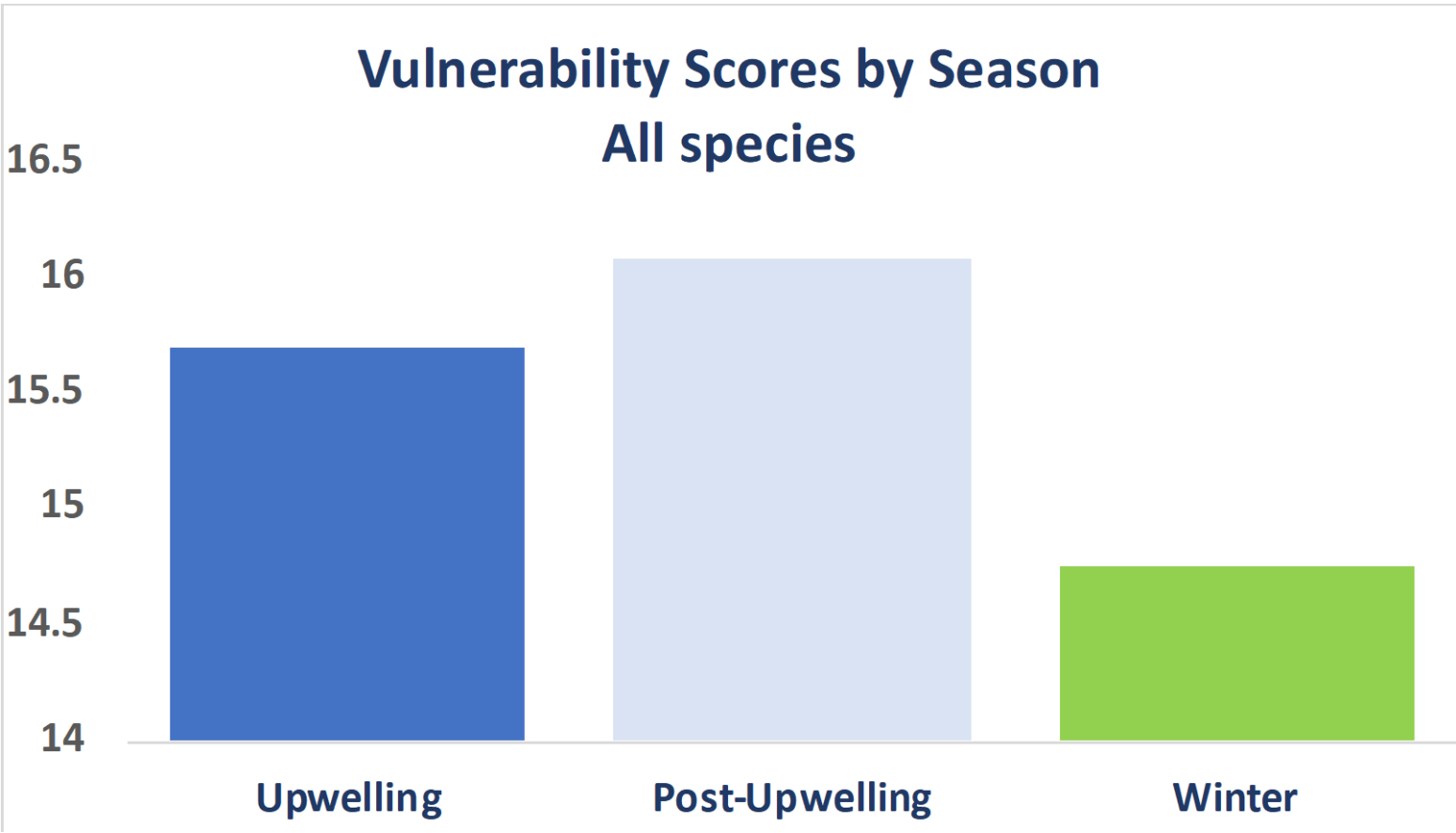
ZONE 1A						ZONE 1B						ZONE 1C					
UPWELLING		POST-UPWELLING		WINTER		UPWELLING		POST-UPWELLING		WINTER		UPWELLING		POST-UPWELLING		WINTER	
Gray whale (Western N. Pacific)	31	Leatherback sea turtle	34	Killer whale (S. Resident)	31	Humpback whale (Central American DPS)	31	Blue whale	32	Killer whale (S. Resident)	31	Leatherback sea turtle	27	Leatherback sea turtle	29	Humpback whale (Central American DPS)	25
Humpback whale (Central American DPS)	31	Humpback whale (Central American DPS)	30	Gray whale (Western N. Pacific)	30	Killer whale (S. Resident)	29	Leatherback sea turtle	31	Humpback whale (Central American DPS)	29	Humpback whale (Mexican DPS)	26	Blue whale	27	Humpback whale (Mexican DPS)	24
Killer whale (S. Resident)	29	Killer whale (S. Resident)	29	Humpback whale (Central American DPS)	29	Humpback whale (Mexican DPS)	29	Humpback whale (Central American DPS)	30	Humpback whale (Mexican DPS)	27	Humpback whale (Central American DPS)	26	Fin whale	25	Blue whale	23
Leatherback sea turtle	29	Blue whale	29	Blue whale	24	Leatherback sea turtle	29	Killer whale (S. Resident)	29	Blue whale	24	Killer whale (S. Resident)	23	Humpback whale (Central American DPS)	25	Killer whale (S. Resident)	21
Humpback whale (Mexican DPS)	26	Humpback whale (Mexican DPS)	25	Coastal bottlenose dolphin	24	Gray whale (Western N. Pacific)	28	Humpback whale (Mexican DPS)	28	Gray whale (Western N. Pacific)	23	Blue whale	23	Humpback whale (Mexican DPS)	25	Leatherback sea turtle	21
Blue whale	25	Gray whale (Western N. Pacific)	24	Humpback whale (Mexican DPS)	24	Blue whale	25	Fin whale	27	Leatherback sea turtle	22	Fin whale	22	Killer whale (S. Resident)	23	Gray whale (Western N. Pacific)	20
Bottlenose dolphin	22	Bottlenose dolphin	22	Leatherback sea turtle	23	Sperm whale	23	Sperm whale	23	Sperm whale	22	Sperm whale	21	Loggerhead sea turtle	21	Loggerhead sea turtle	19
Gray whale (Eastern N. Pacific)	21	Loggerhead sea turtle	21	Gray whale (Eastern N. Pacific)	20	Loggerhead sea turtle	21	Gray whale (Western N. Pacific)	22	Harbor Porpoise (Monterey Bay)	20	Gray whale (Western N. Pacific)	20	Sperm whale	21	Fin whale	18
Loggerhead sea turtle	21	Minke whale	20	Harbor Porpoise (Morro Bay)	20	Harbor Porpoise (Monterey Bay)	20	Loggerhead sea turtle	22	Loggerhead sea turtle	20	Loggerhead sea turtle	20	Gray whale (Western N. Pacific)	20	Minke whale	18
Harbor Porpoise (Morro Bay)	20	Harbor Porpoise (Morro Bay)	20	Harbor Porpoise (Monterey Bay)	20	Fin whale	20	Minke whale	20	Fin whale	19	Minke whale	18	Minke whale	18	Sperm whale	18
Harbor Porpoise (Monterey Bay)	20	Harbor Porpoise (Monterey Bay)	20	Loggerhead sea turtle	20	Minke whale	20	Harbor Porpoise (Monterey Bay)	20	Minke whale	19	Baird's beaked whale	17	Olive Ridley sea turtle	17	Baird's beaked whale	17
Harbor Porpoise (SF/Russian River)	19	Fin whale	20	Harbor Porpoise (SF/Russian River)	19	Gray whale (Eastern N. Pacific)	18	Harbor Porpoise (Morro Bay)	17	Harbor Porpoise (Morro Bay)	17	Olive Ridley sea turtle	16	Baird's beaked whale	17	Olive Ridley sea turtle	16
Fin whale	18	Harbor Porpoise (SF/Russian River)	19	Fin whale	17	Humpback whale (Hawaii DPS)	18	Olive Ridley sea turtle	17	Coastal bottlenose dolphin	16	Humpback whale (Hawaii DPS)	16	Humpback whale (Hawaii DPS)	15	Humpback whale (Hawaii DPS)	15
Harbor seal (CA)	18	Green sea turtle	18	Olive Ridley sea turtle	16	Harbor Porpoise (Morro Bay)	17	Humpback whale (Hawaii DPS)	17	Harbor Porpoise (SF/Russian River)	16	Bryde's whale	14	Green sea turtle	14	Bryde's whale	14
Humpback whale (Hawaii DPS)	18	Sei whale	17	Humpback whale (Hawaii DPS)	16	Olive Ridley sea turtle	17	Harbor Porpoise (SF/Russian River)	16	Olive Ridley sea turtle	16	Killer whale (Offshore)	14	Northern fur seal (CA)	14	Killer whale (Offshore)	14
Olive Ridley sea turtle	17	Olive Ridley sea turtle	17	Bryde's whale	15	Harbor Porpoise (SF/Russian River)	16	Green sea turtle	16	Long-beaked common dolphin	16	Green sea turtle	14	Killer whale (Offshore)	14	Green sea turtle	14
Bryde's whale	16	Humpback whale (Hawaii DPS)	17	Minke whale	15	Bryde's whale	16	Northern fur seal (CA)	16	Humpback whale (Hawaii DPS)	16	Other beaked whales	14	Bryde's whale	14	Other beaked whales	14
Minke whale	16	Sperm whale	17	Sperm whale	16	Killer whale (Offshore)	16	Killer whale (Offshore)	16	Bryde's whale	15	Killer Whale (Transient)	13	Short-beaked common dolphin	14	Short-finned pilot whale	13
Sperm whale	17	Northern fur seal (CA)	16	Killer whale (Offshore)	15	California sea lion	16	California sea lion	16	Killer whale (Offshore)	15	Short-finned pilot whale	13	Short-finned pilot whale	13	Northern fur seal (CA)	13
Killer whale (Offshore)	16	Killer whale (Offshore)	16	Northern elephant seal	15	Green sea turtle	16	Bryde's whale	15	Bryde's whale	15	Northern fur seal (CA)	13	Other beaked whales	13	Harbor seal (OR/WA)	13
California sea lion	16	California sea lion	16	Green sea turtle	15	Long-beaked common dolphin	16	Short-beaked common dolphin	16	Baird's beaked whale	15	Harbor seal (OR/WA)	13	Harbor seal (OR/WA)	13	Coastal bottlenose dolphin	12
Green sea turtle	16	Bryde's whale	16	Killer Whale (Transient)	13	Baird's beaked whale	16	Long-beaked common dolphin	16	Other beaked whales	15	Northern fur seal (Eastern N. Pacific)	13	Killer Whale (Transient)	12	Killer Whale (Transient)	12
Killer Whale (Transient)	15	Stellar sea lion	15	Risso's dolphin	13	Other beaked whales	16	Baird's beaked whale	16	Short-finned pilot whale	14	Risso's dolphin	12	Long-beaked common dolphin	11	Risso's dolphin	12
Stellar sea lion	15	Killer Whale (Transient)	14	Long-beaked common dolphin	13	Bottlenose dolphin	15	Bottlenose dolphin	15	Gray whale (Eastern N. Pacific)	13	Long-beaked common dolphin	11	Bottlenose dolphin	11	Long-beaked common dolphin	11
Risso's dolphin	14	Harbor seal (CA)	14	Northern fur seal (CA)	13	Harbor seal (CA)	15	Short-finned pilot whale	15	Killer Whale (Transient)	13	Bottlenose dolphin	11	Risso's dolphin	11	Pacific White-sided dolphin	11
Northern fur seal (CA)	14	Gray whale (Eastern N. Pacific)	14	Harbor seal (CA)	13	Killer Whale (Transient)	15	Other beaked whales	15	Risso's dolphin	13	Pacific White-sided dolphin	11	Pacific White-sided dolphin	11	Short-beaked common dolphin	11
Long-beaked common dolphin	13	Short-beaked common dolphin	13	Harbor seal (OR/WA)	13	Short-finned pilot whale	15	Killer Whale (Transient)	14	Northern fur seal (CA)	13	Northern right whale dolphin	11	Gray whale (Eastern N. Pacific)	10	Gray whale (Eastern N. Pacific)	10
Harbor seal (OR/WA)	13	Risso's dolphin	13	Short-finned pilot whale	11	Risso's dolphin	14	Harbor seal (CA)	14	Harbor seal (CA)	13	Gray whale (Eastern N. Pacific)	10	Harbor seal (CA)	9	Northern elephant seal	10
Short-finned pilot whale	12	Long-beaked common dolphin	13	Baird's beaked whale	11	Northern fur seal (CA)	14	Risso's dolphin	13	Harbor seal (OR/WA)	13	Harbor seal (CA)	10	Stellar sea lion	9	Dall's Porpoise	10
Baird's beaked whale	12	Harbor seal (OR/WA)	13	Other beaked whales	11	Harbor seal (OR/WA)	13	Harbor seal (OR/WA)	13	Pacific White-sided dolphin	13	Dall's Porpoise	10	Northern fur seal (Eastern N. Pacific)	8	Harbor seal (CA)	9
Other beaked whales	12	Short-finned pilot whale	12	California sea lion	11	Pacific White-sided dolphin	13	Gray whale (Eastern N. Pacific)	12	Northern elephant seal	11	Northern elephant seal	10	Guadalupe fur seal	8	Stellar sea lion	9
Northern elephant seal	12	Northern elephant seal	12	Stellar sea lion	10	Northern fur seal (Eastern N. Pacific)	12	Stellar sea lion	11	California sea lion	11	Stellar sea lion	9	Pygmy and dwarf sperm whale	8	Northern right whale dolphin	8
Pacific White-sided dolphin	10	Baird's beaked whale	12	Dall's Porpoise	8	Dall's Porpoise	12	Pacific White-sided dolphin	10	Dall's Porpoise	11	Short-beaked common dolphin	8	Northern right whale dolphin	8	Guadalupe fur seal	8
Northern fur seal (Eastern N. Pacific)	10	Other beaked whales	11	Northern fur seal (Eastern N. Pacific)	8	Stellar sea lion	11	Northern elephant seal	9	Stellar sea lion	10	Guadalupe fur seal	8	California sea lion	7	Pygmy and dwarf sperm whale	8
Dall's Porpoise	9	Pacific White-sided dolphin	10	Pacific White-sided dolphin	7	Northern right whale dolphin	10	Northern fur seal (Eastern N. Pacific)	9	Short-beaked common dolphin	9	Pygmy and dwarf sperm whale	8	Northern elephant seal	7	California sea lion	7
Guadalupe fur seal	8	Northern fur seal (Eastern N. Pacific)	9	Northern right whale dolphin	7	Short-beaked common dolphin	10	Dall's Porpoise	9	Northern fur seal (Eastern N. Pacific)	8	California sea lion	7	Dall's Porpoise	7	Northern fur seal (Eastern N. Pacific)	7
Pygmy and dwarf sperm whale	7	Dall's Porpoise	9	Guadalupe fur seal	7	Northern elephant seal	9	Guadalupe fur seal	8	Northern right whale dolphin	7	Sei whale	n/a	Sei whale	n/a	Sei whale	n/a
Northern right whale dolphin	7	Guadalupe fur seal	8	Pygmy and dwarf sperm whale	6	Guadalupe fur seal	8	Pygmy and dwarf sperm whale	7	Guadalupe fur seal	7	N. Pacific rightwhale	n/a	N. Pacific right whale	n/a	N. Pacific right whale	n/a
Short-beaked common dolphin	7	Pygmy and dwarf sperm whale	7	Short-beaked common dolphin	6	Pygmy and dwarf sperm whale	7	Northern right whale dolphin	7	Pygmy and dwarf sperm whale	6	Harbor Porpoise (N CA/S OR)	n/a	Harbor Porpoise (N OR/WA Coast)	n/a	Harbor Porpoise (N CA/S OR)	n/a
Sei whale	n/a	Northern right whale dolphin	7	Sei whale	n/a	Sei whale	n/a	Sei whale	n/a	Sei whale	n/a	Harbor Porpoise (N OR/WA Coast)	n/a	Harbor Porpoise (N CA/S OR)	n/a	Harbor Porpoise (N OR/WA Coast)	n/a
N. Pacific right whale	n/a	N. Pacific right whale	n/a	N. Pacific rightwhale	n/a	N. Pacific rightwhale	n/a	Harbor Porpoise (N OR/WA Coast)	n/a	N. Pacific right whale	n/a	Harbor Porpoise (Monterey Bay)	n/a	Harbor Porpoise (Monterey Bay)	n/a	Harbor Porpoise (Monterey Bay)	n/a
Harbor Porpoise (N CA/S OR)	n/a	Harbor Porpoise (N OR/WA Coast)	n/a	Harbor Porpoise (N CA/S OR)	n/a	Harbor Porpoise (N CA/S OR)	n/a	Harbor Porpoise (N CA/S OR)	n/a	Harbor Porpoise (N CA/S OR)	n/a	Harbor Porpoise (Morro Bay)	n/a	Harbor Porpoise (Morro Bay)	n/a	Harbor Porpoise (Morro Bay)	n/a
Harbor Porpoise (N OR/WA Coast)	n/a	Harbor Porpoise (N CA/S OR)	n/a	Harbor Porpoise (N OR/WA Coast)	n/a	Harbor Porpoise (N OR/WA Coast)	n/a	N. Pacific right whale	n/a	Harbor Porpoise (N OR/WA Coast)	n/a	Harbor Porpoise (SF/Russian River)	n/a	Harbor Porpoise (SF/Russian River)	n/a	Harbor Porpoise (SF/Russian River)	n/a

MORRO BAY LEASE AREA EXAMPLE

How should assessed vulnerability be interpreted relative to baseline data collection, evaluation of impacts, monitoring and mitigation?



Synthesis Comparisons: Seasonal and Spatial Differences



SYNTHESIS

*Results intended to provide:
gap analyses, guide strategic baseline
data collection, impact assessments,
and inform effective monitoring and
mitigation*

DIFFERENCES IN RELATIVE VULNERABILITY DUE TO:

- Species-specific population, life history factors
- Spatial (depth and latitude) context
- Temporal (seasonal) context
- Existing stressors already in environment

SOURCES OF UNCERTAINTY (DATA GAPS):

- Systematic, reliable distribution and density
- Susceptibility to specific impacts (vessel strike, entanglement, electromagnetic)
- Variable data in SARs (marine mammals)

DISCUSSION

- VERY BROAD spatial scale initial comparison across many species
 - Finer-scale strategic monitoring and full risk assessment
- Don't necessarily focus on most common – balance w/ highest risk
- "Constant" factors (population, human impact) can keep overall scores high even where very low probability of species occurring.
 - Finer-scale data needed; decide where occurrence low enough for n/a (0 score)

Monitoring and Research to
Smartly Prepare for Offshore Wind
Energy Development in California:

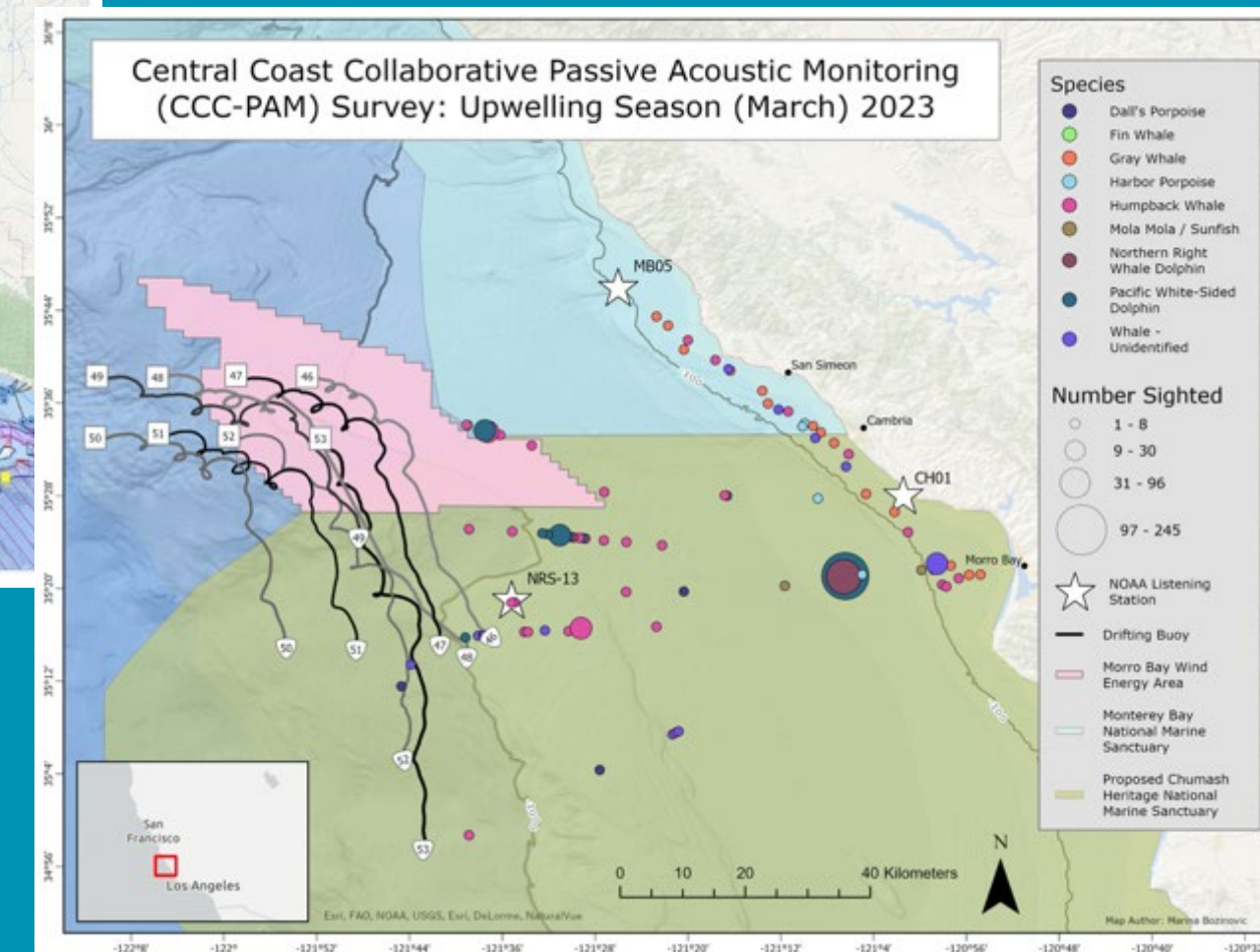
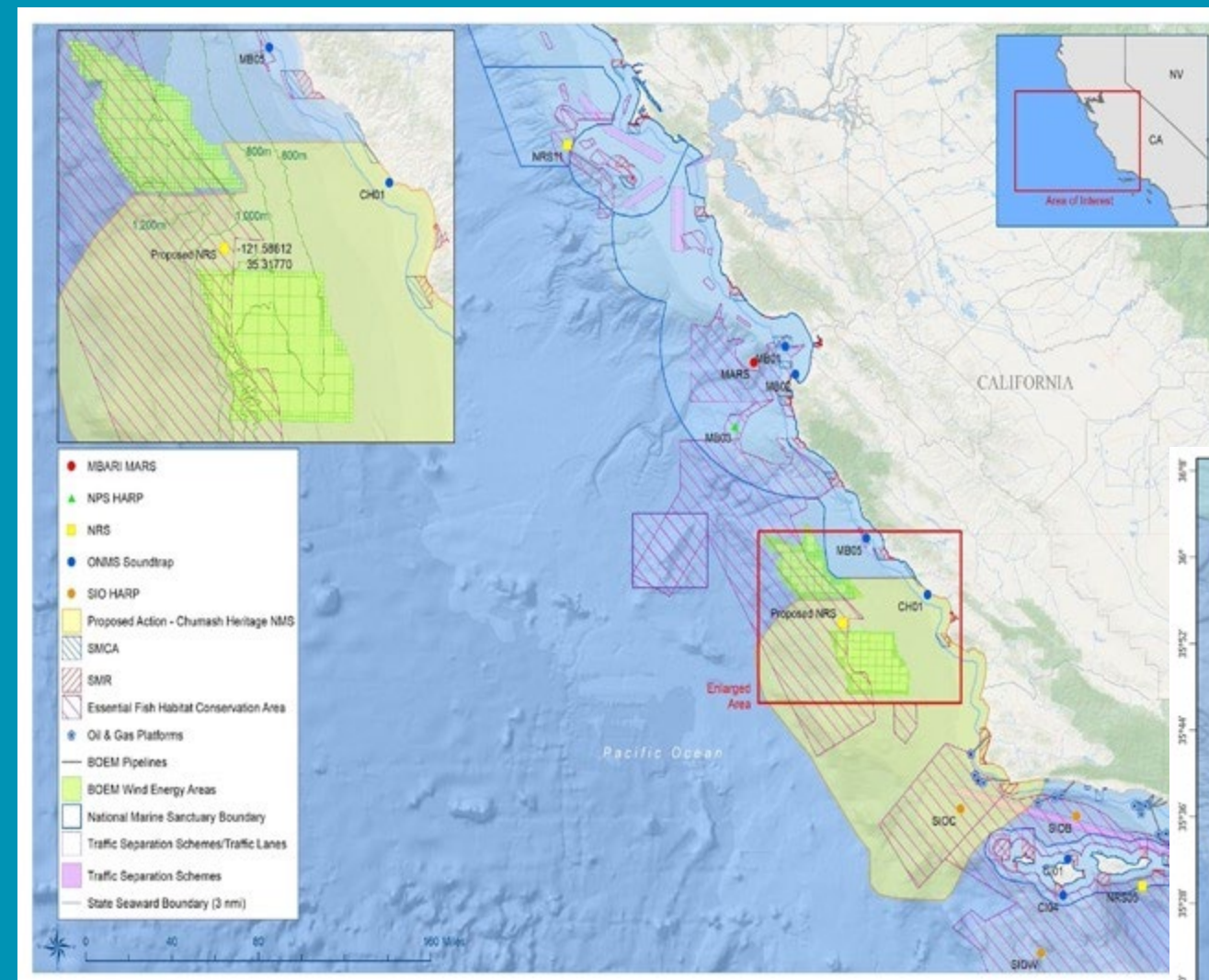
What Should We Be Doing?

Passive Acoustic Monitoring Collaborations



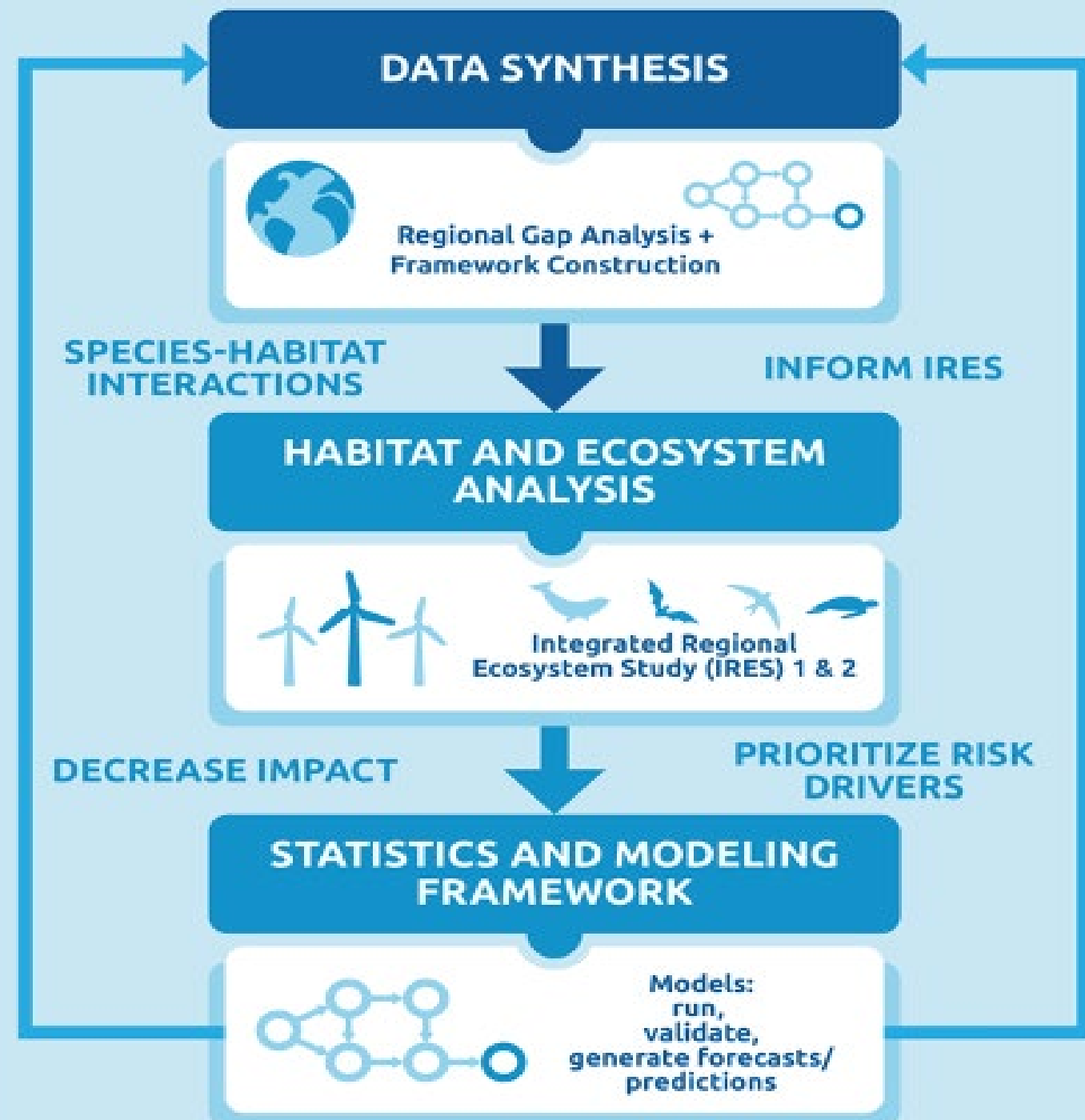
SanctSound

<https://sanctsound.ioos.us>



Coordinating biological monitoring and behavioral response studies with full-scale industrial operations

WILDLIFE AND OFFSHORE WIND: A Systems Approach to Research and Risk Assessment for Offshore Wind Development from Maine to North Carolina



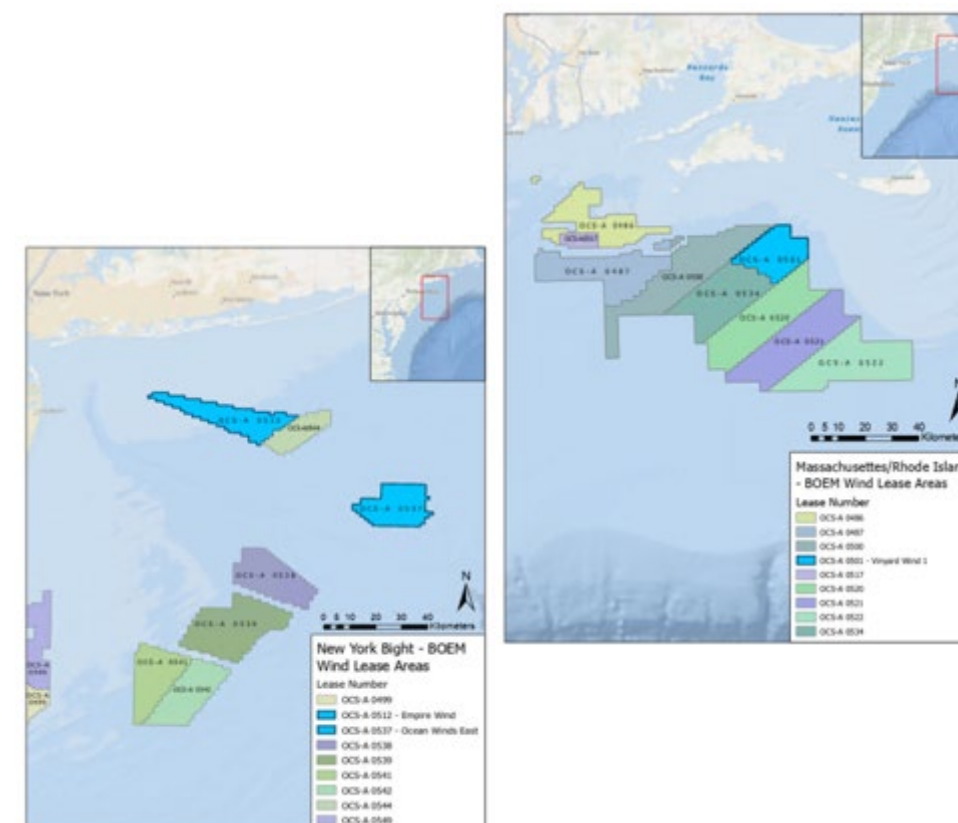
<https://offshorewind.env.duke.edu/>



Project WOW Research Team



External Advisory Board



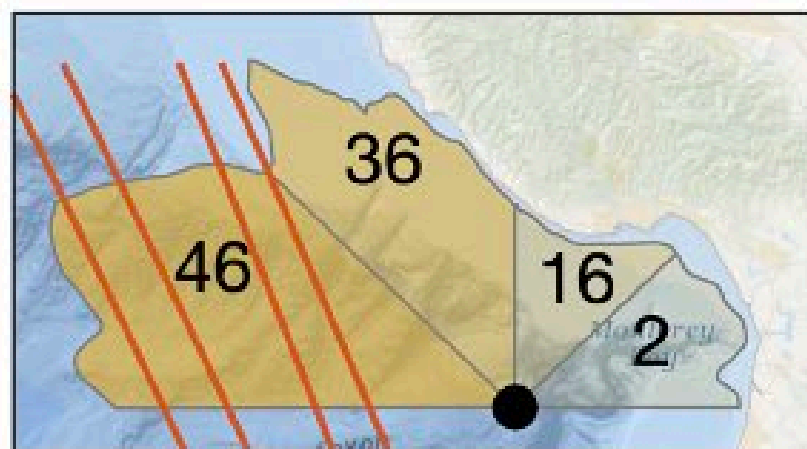
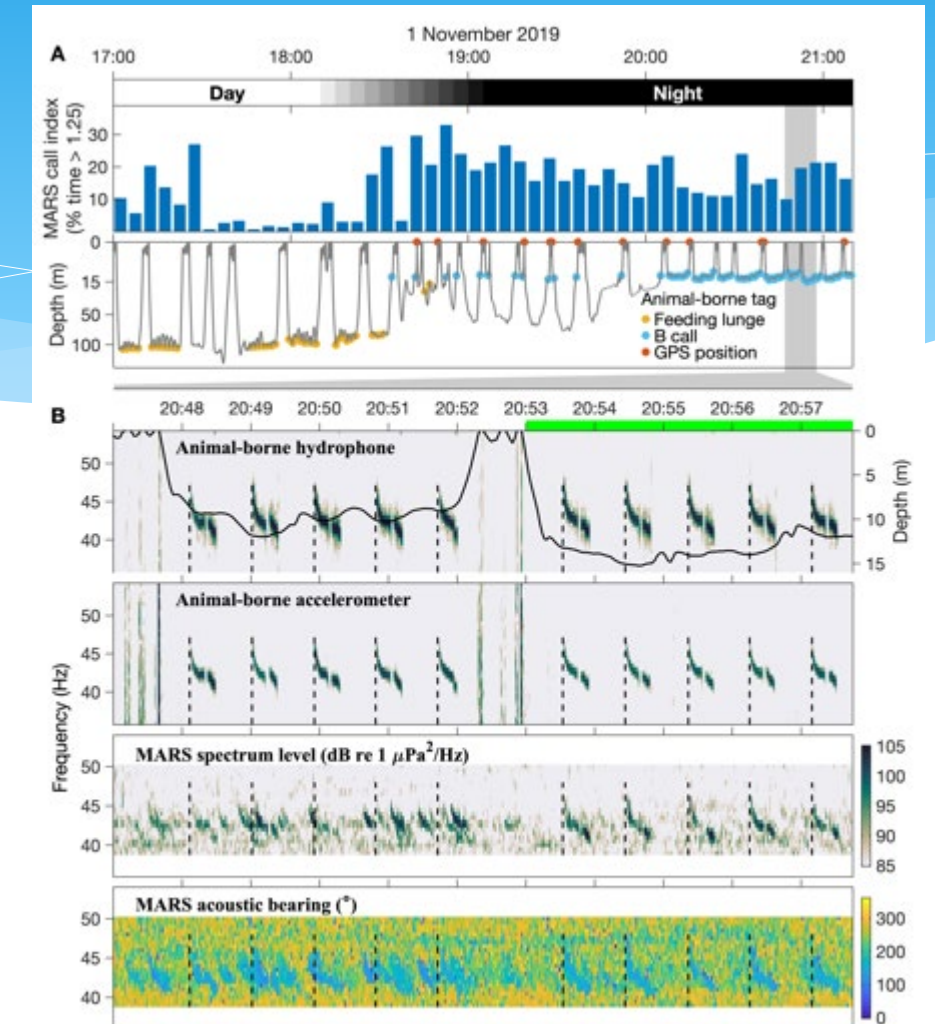
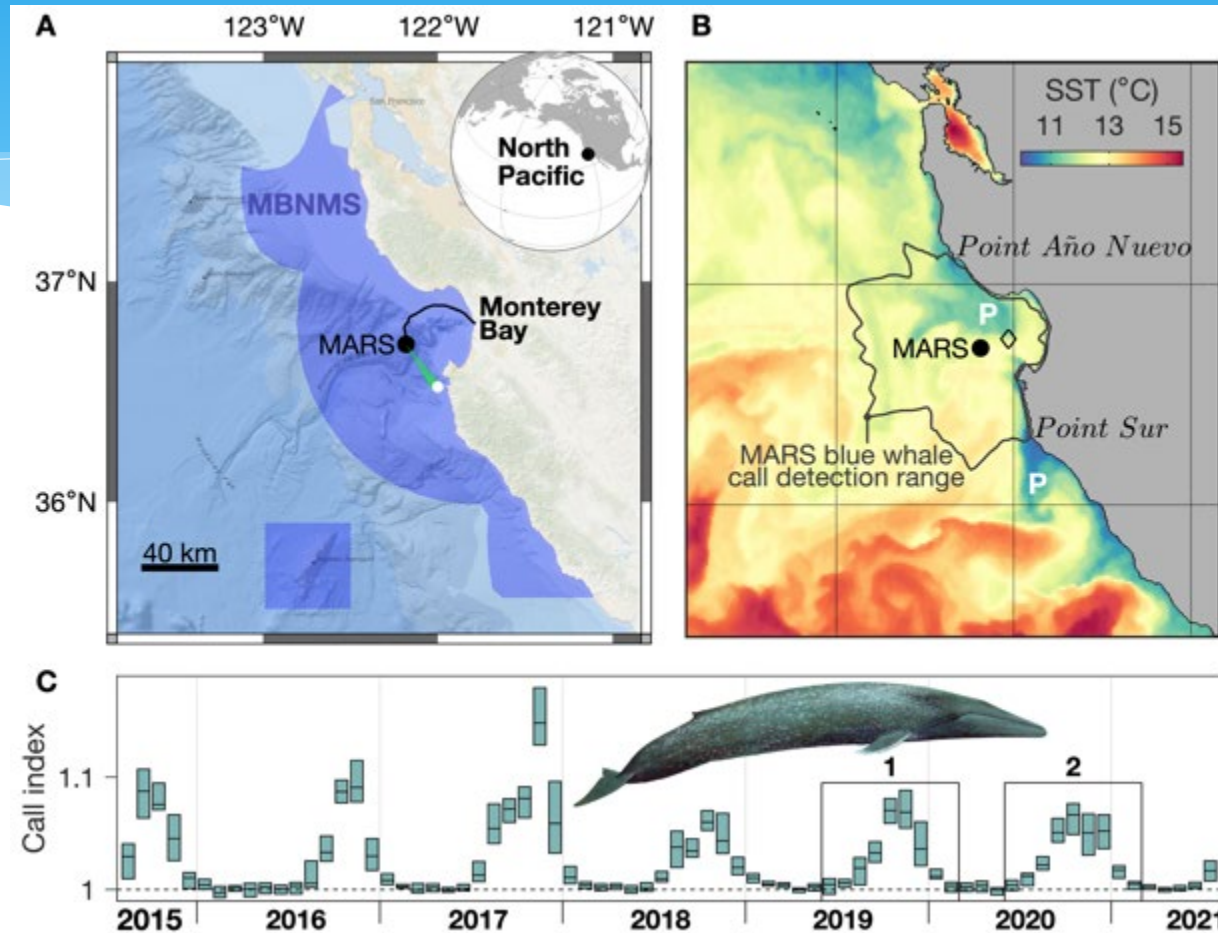
IRES locations chosen for progress of **construction timelines**, different **oceanographic qualities**, and the **taxa** present

Cross-disciplinary partnerships in acoustics and ecology to monitor marine mammals and predict occurrence

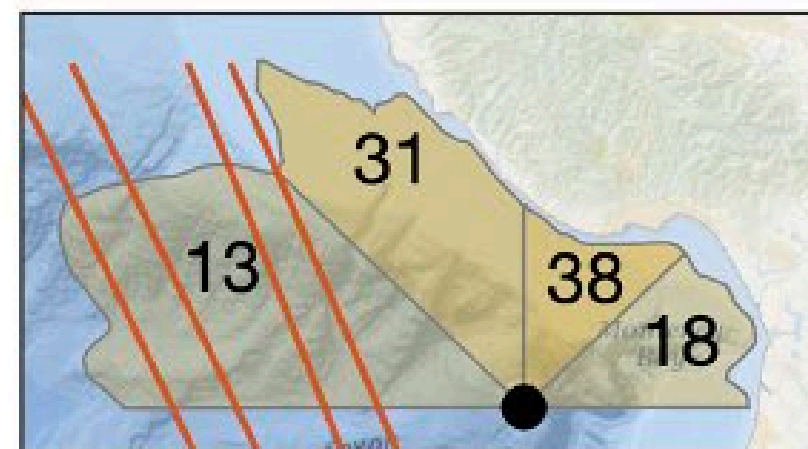
LETTER **MBARI** Monterey Bay Aquarium Research Institute **ECOLOGY LETTERS** WILEY

Oceanic giants dance to atmospheric rhythms: Ephemeral wind-driven resource tracking by blue whales

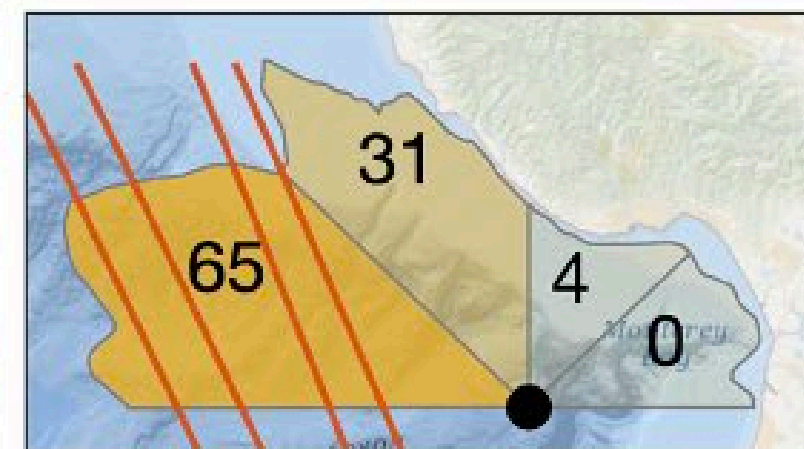
John P. Ryan¹ | Kelly J. Benoit-Bird¹ | William K. Oestreich^{1,2} | Paul Leary³ | Kevin B. Smith³ | Chad M. Waluk¹ | David E. Cade² | James A. Fahlbusch^{2,4} | Brandon L. Southall^{5,6} | John E. Joseph³ | Tetyana Margolina³ | John Calambokidis⁴ | Andrew DeVogelaere⁷ | Jeremy A. Goldbogen²



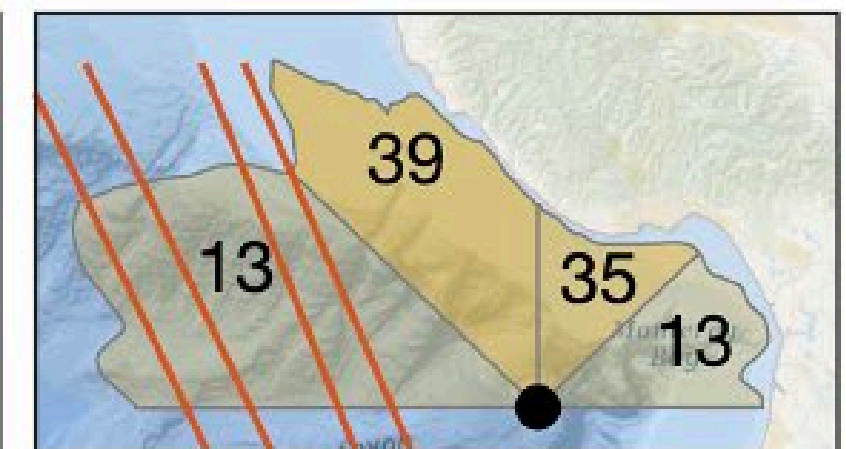
R1: relaxation
22-Oct to 06-Nov



U1: upwelling
06-Nov to 13-Nov



R2: relaxation
13-Nov to 25-Nov



U2: upwelling
25-Nov to 15-Dec

Monitoring and Research to Smartly Prepare for Offshore Wind Energy Development in California:

What Should We Be Doing?

- Recognize there are (manageable) risks and there are data gaps
 - Strategic risk assessment can guide effective planning
 - Most urgent data needs are fine-scale, multi-annual habitat use and behavior for key species
 - DON'T just focus on the construction phases – survey and operations pose different question
 - DON'T let mitigation objectives to prevent something rare make worse something common

Monitoring and Research to Smartly Prepare for Offshore Wind Energy Development in California:

What Should We Be Doing?

- Multi-disciplinary, synoptic environmental & biological data collection
 - Cross-sectoral collaborations building on existing capabilities
 - SYSTEMS approaches
- Appreciate the scale and scope of the issues and questions
 - Need appropriately scaled (time, \$\$, and people) responses -> qualified people supply
 - LISTEN and incorporate traditional knowledge
 - LEARN from Europe, East coast, Gulf of Mexico

WEBINAR:
**IMPACTS OF
OFFSHORE WIND
ON MARINE
MAMMALS AND
SEABIRDS:**
**THE KNOWN
& UNKNOWN**

SPEAKER LINEUP

David Pereksta

Avian Biologist, BOEM, Pacific Outer
Continental Shelf (OCS) Region

Tyler Studds

Chief Executive Officer, Golden State
Wind

Brandon Southall

Co-Founder and Chief Scientist,
Southall Environmental Associates;
Research Associate, UC Santa Cruz
Institute of Marine Science;
Senior Scientist, California Ocean
Alliance

Garry George

Director, Clean Energy Initiative of the
Climate Strategy, National Audubon
Society

**PANEL DISCUSSION TO
FOLLOW**

- ADAM CANTER, WIYOT
TRIBE,
- YI-LUI OPC,
- ELI HARDING CEC,
- DESRAY REEB BOEM

Wednesday, May 17th, 2023
10.00 am - 12.00 pm Pacific Time

[Click here to register](#)

<https://www.globalallianceoceannoise.org/>

OFFSHORE RENEWABLE ENERGY

Workshop One

Workshop One: 'Practical Approaches for Reducing Ocean Noise Associated with Offshore Renewable Energy Development' intends to foster a productive setting for stakeholders across international governing bodies, industry leaders, non- governmental organizations, and academia to debate, break down barriers, and ultimately develop data-informed and technologically advanced solutions that fit within a realistic business model and continue to benefit a sustainable blue economy. The focal topics of this workshop will include lessons learned from different projects and experiences and pairing monitoring and mitigation requirements for ongoing developments in science and research. This workshop will culminate by identifying and proposing opportunities for actionable next step.

WATCH THE RECORDING

Spring 2023 Newsletter

Thank you for being engaged with the [Global Alliance for Managing Ocean Noise \(GAMEON\)](#). The GAMEON Sounding Board is thrilled to share the first edition of the GAMEON Newsletter, which will include upcoming events, recent publications, and opportunities to get involved.

[The Quieting Workshop Series](#) continues to foster collaborative conversations between strategically-invited, multi-sectoral attendees. In November 2022, GAMEON hosted its [second quieting workshop](#) on practical approaches to reduce ocean noise associated with seismic exploration and will be releasing the subsequent report soon.

The third workshop will focus on three key topics around the theme of practical approaches for reducing ocean noise associated with shipping. In the interim before the IMO guidelines are released, we would like to provide information on the status of ocean noise associated with human activity in the ocean and opportunities to engage further. See below for upcoming events.

