



# The SECAS Third Thursday Web Forum

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The Gulf of Mexico Marine Assessment Program for Protected Species (GoMMAPPS): Developing spatial density models for marine mammals in the northern Gulf of Mexico

10-17-2024



# Agenda

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- Introduction
- Monthly topic
- Q&A and discussion
- Preview of next webinar
- Staff updates



# The Gulf of Mexico Marine Assessment Program for Protected Species (GoMMAPPS) - Developing spatial density models for marine mammals in the northern Gulf of Mexico

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Lance Garrison, NOAA Southeast Fisheries Science Center

10-17-2024





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# Gulf of Mexico Marine Assessment Program for Protected Species (GoMMAPPS)

Lance Garrison<sup>1</sup>, Jenny Litz<sup>1</sup>, Gina Rappucci<sup>2</sup>, Joel Ortega-Ortiz<sup>2</sup>, Laura Aichinger Dias<sup>2</sup>, Melissa Soldevilla<sup>1</sup>, Keith Mullin<sup>1</sup>, Anthony Martinez<sup>1</sup>, Kevin Barry<sup>1</sup>, Jonathan Reid<sup>2</sup>

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October 17, 2024

# Acknowledgements



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**All field staff and survey crews**



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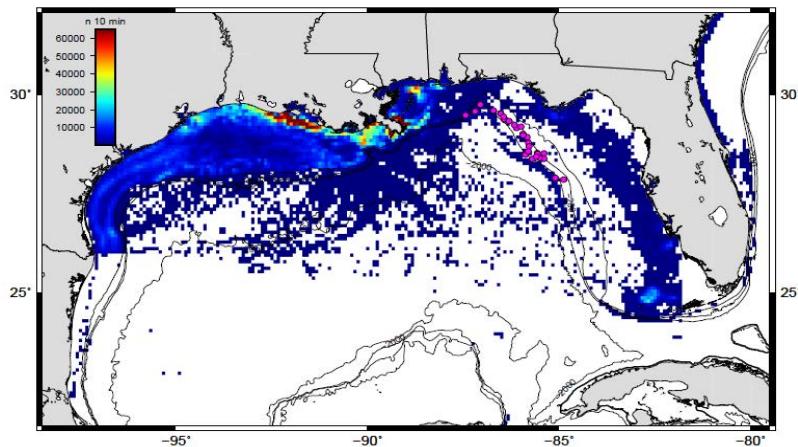


This research was carried out [in part] under the auspices of the Cooperative Institute for Marine and Atmospheric Studies (CIMAS), a Cooperative Institute of the University of Miami and the National Oceanic and Atmospheric Administration, cooperative agreement #NA15OAR4320064.

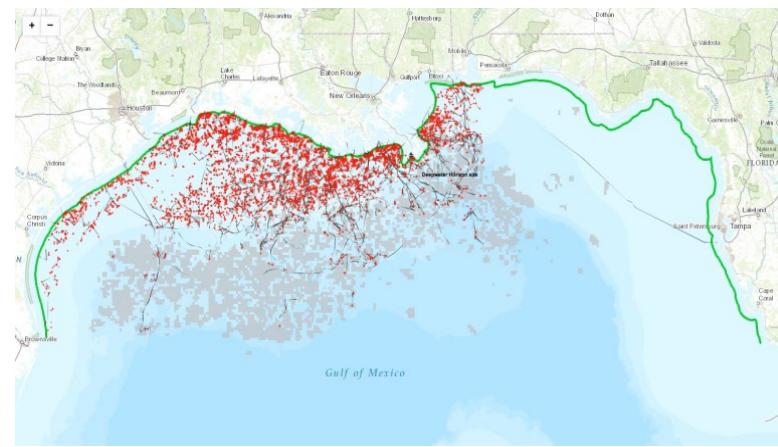


# Industrialization in the Gulf of Mexico

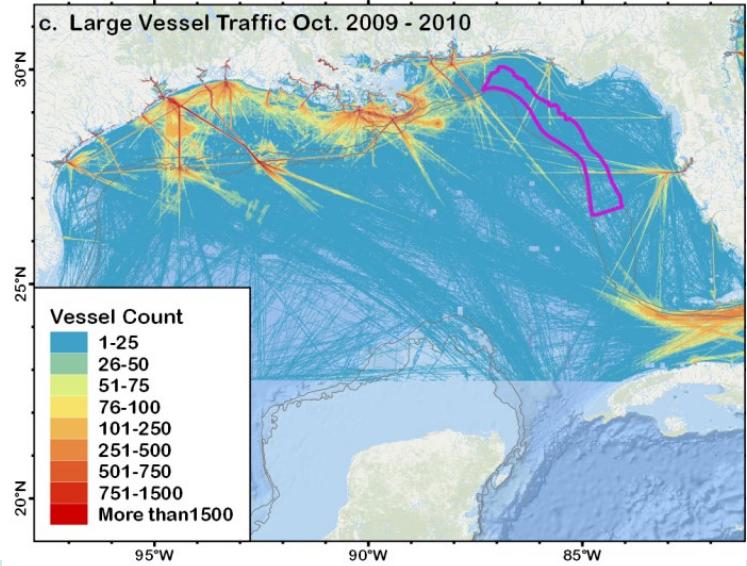
## High Levels of Fishing Activity



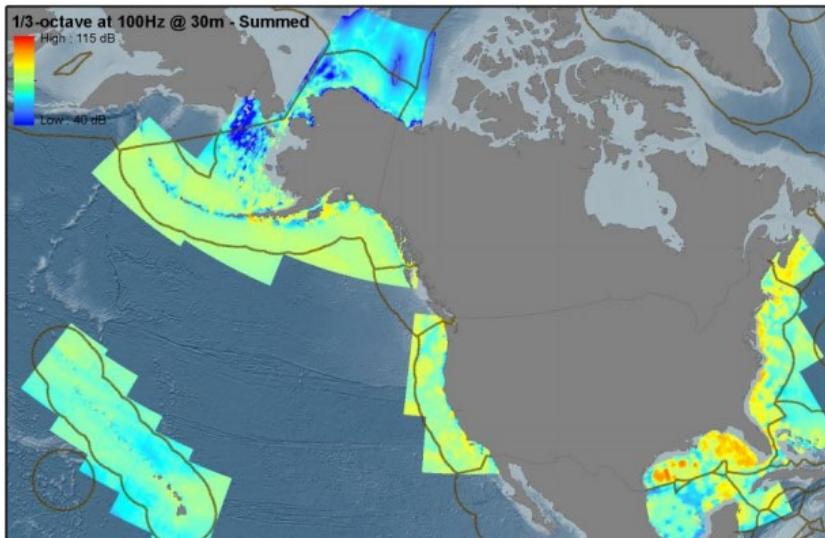
## Oil & Gas – Exploration and Extraction



## High Levels of Shipping Activity



## Chronic Industrial Noise



Rice's whale,



Clymene dolphin

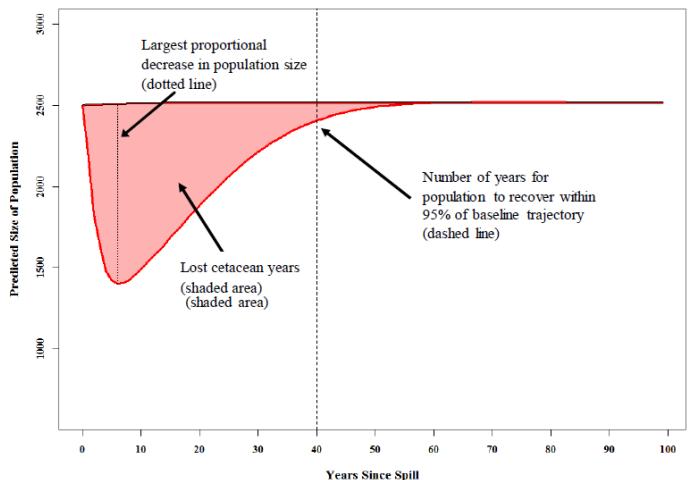
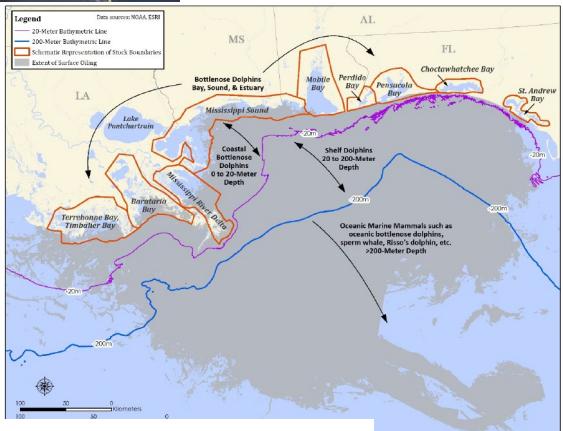


Gervais' beaked whale



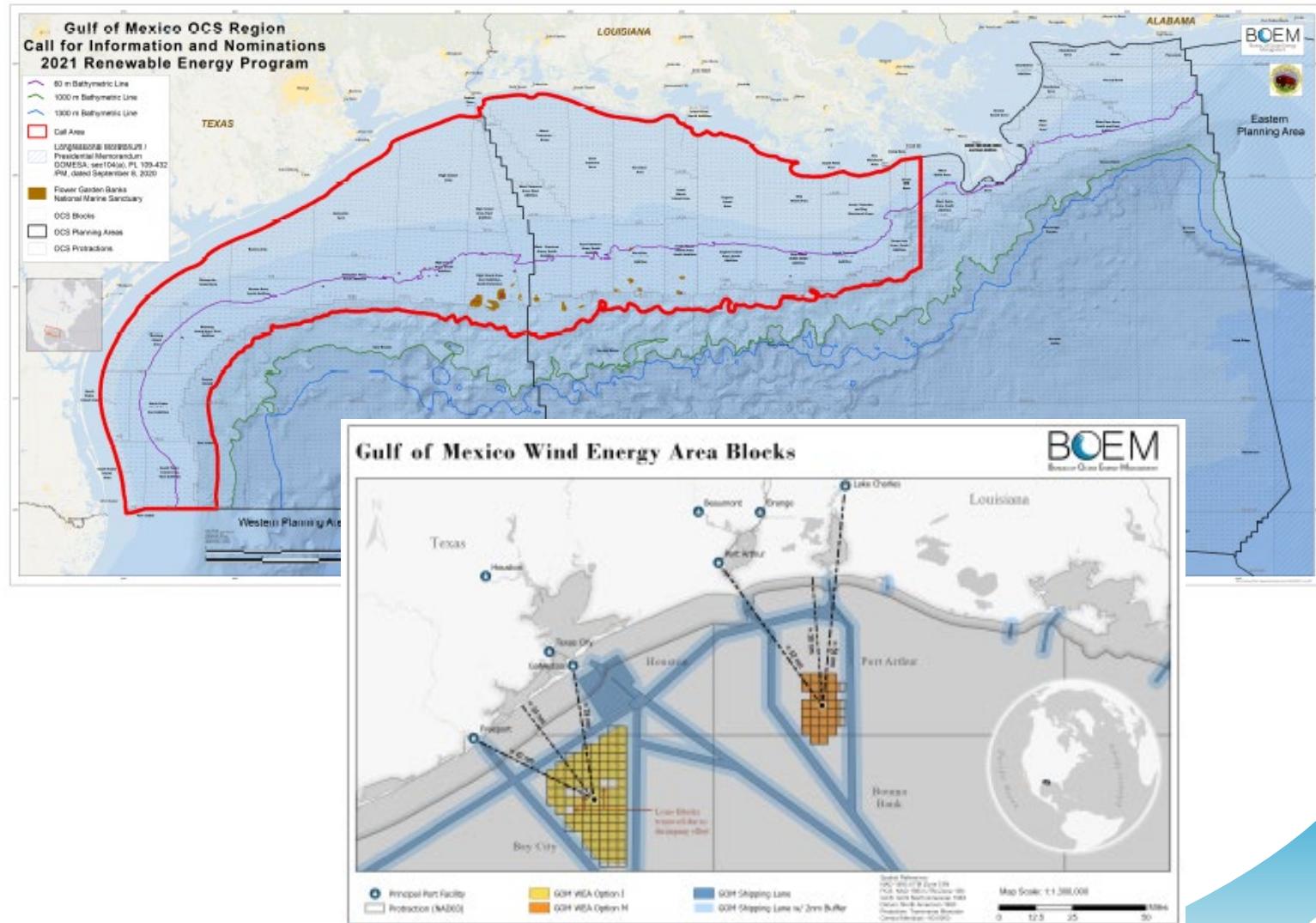
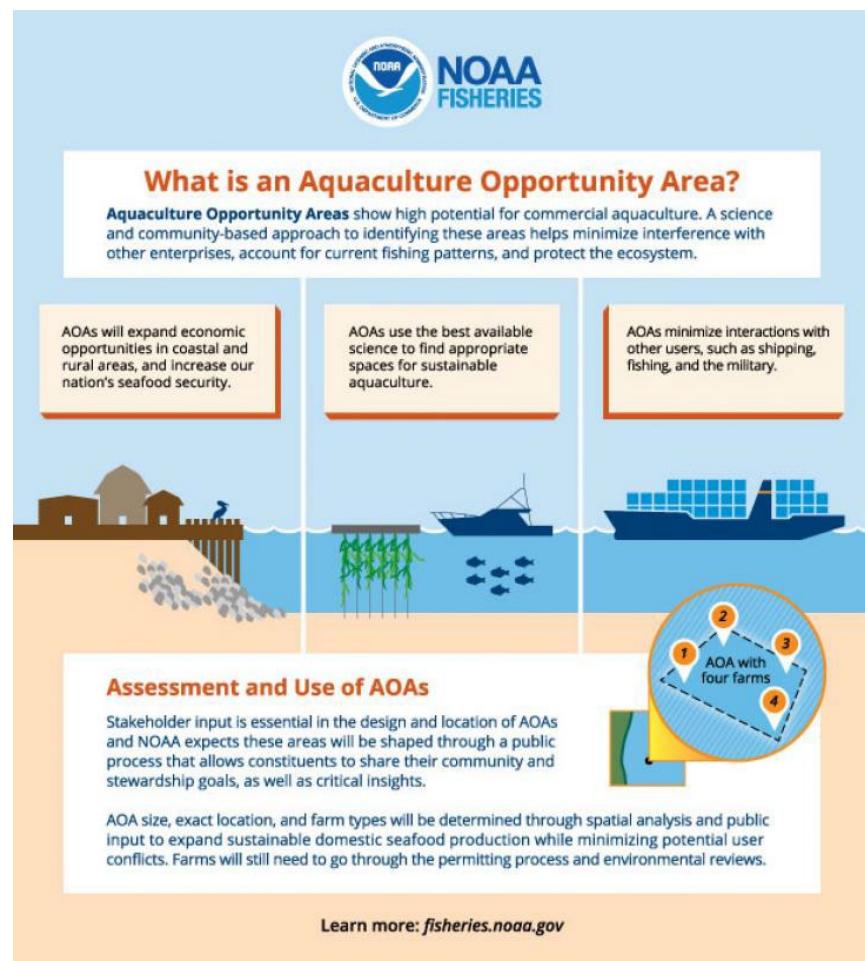
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# DWH Oil Spill Injury Assessment and Restoration



- On April 20, 2010, an explosion occurred on the *Deepwater Horizon* drilling platform in the Gulf of Mexico. Approximately 134 million gallons of oil had spilled into the Gulf
- Assessed Injury to estuarine and coastal dolphins and offshore species by evaluating exposure, examining health, survival, and reproduction effects, and integrating information into population models
- Recent studies are updating the injury assessment and evaluating ongoing effects
- Restoration projects are focused on evaluating and reducing anthropogenic impacts on populations

# Aquaculture and Wind Energy Development



# Gulf of Mexico Marine Mammal Species/Stocks



- Rice's whale (ESA-listed)
- Sperm whale (ESA-listed)
- Dwarf sperm whale
- Pygmy sperm whale
- Cuvier's beaked whale
- Blainville's beaked whale
- Gervais' beaked whale
- Short-finned pilot whale
- Killer whale
- Pygmy killer whale
- Melon-headed whale
- False killer whale
- Risso's dolphin
- Bottlenose dolphin
- Atlantic spotted dolphin
- Pantropical spotted dolphin
- Striped dolphin
- Clymene dolphin
- Spinner dolphin
- Rough-toothed dolphin
- Fraser's dolphin



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# Gulf of Mexico Marine Assessment Program for Protected Species (GoMMAPPS)



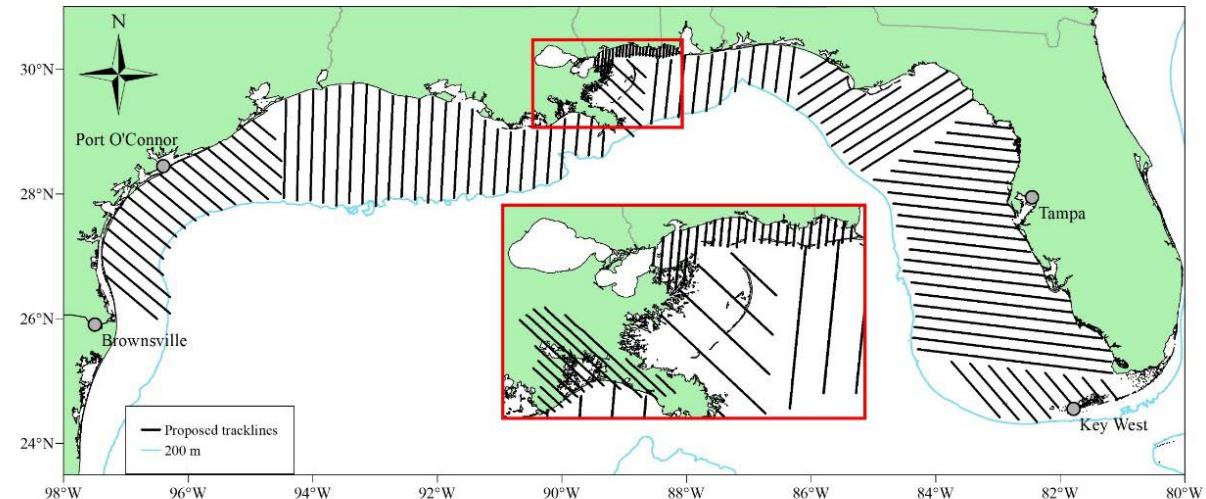
- Multi-agency, multi-species study: 2017 – 2022
- Goal: Provide improved information on abundance, distribution, habitat use, and behavior of **cetaceans, seabirds, and sea turtles** in the U.S. Gulf of Mexico
- NOAA's focus: Cetacean and sea turtle spatial density models derived from aerial and vessel survey data that incorporate environmental information



# Continental Shelf: Aerial Surveys



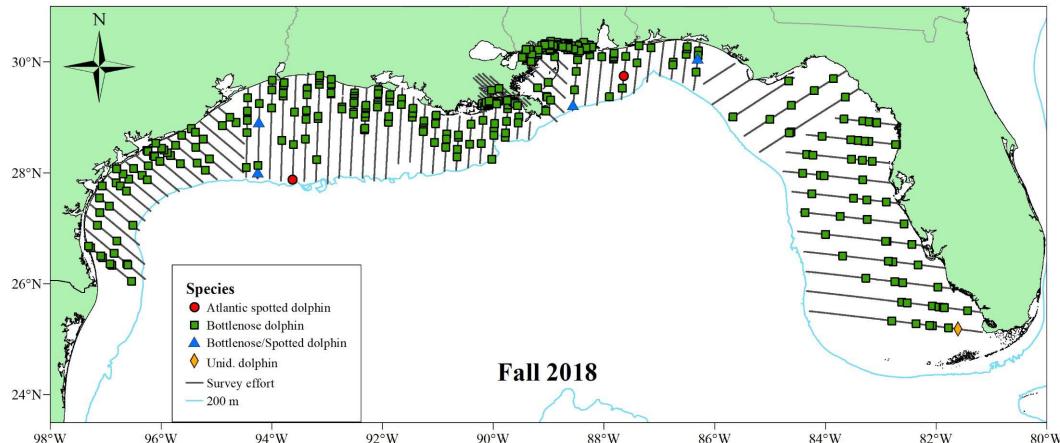
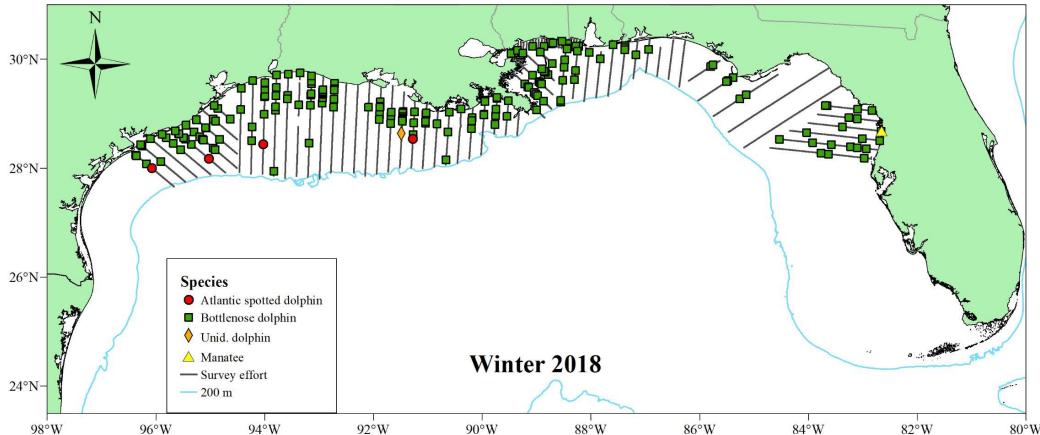
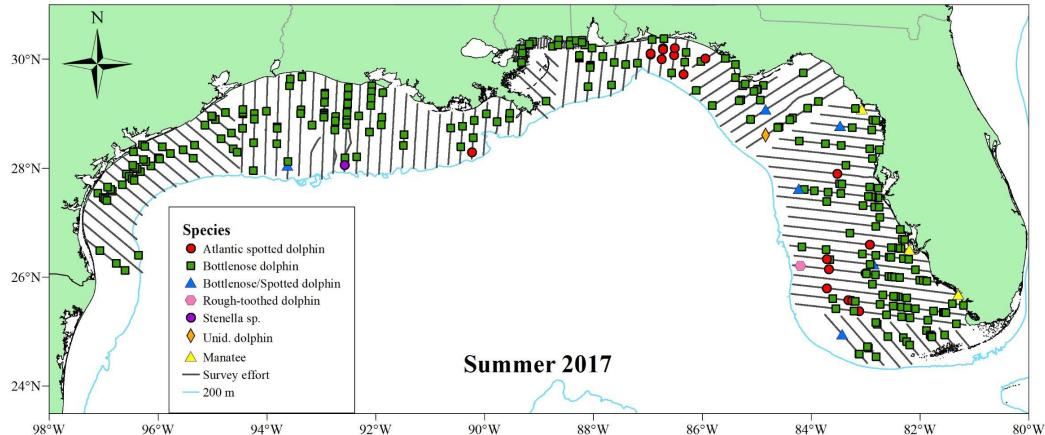
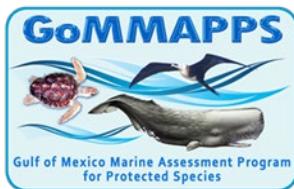
- 3 seasonal line-transect surveys conducted 2017-2018
- Higher density lines within MS Sound and Barataria Bay
- Two survey teams to estimate detection probability
- Recorded marine mammal and sea turtle sightings (and others such as manta rays)



Tracklines for aerial surveys

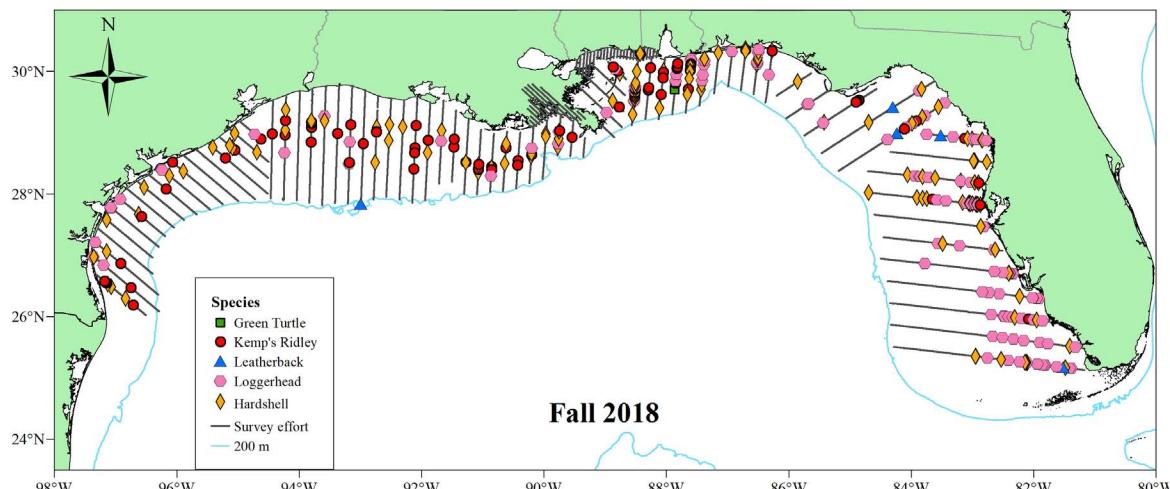
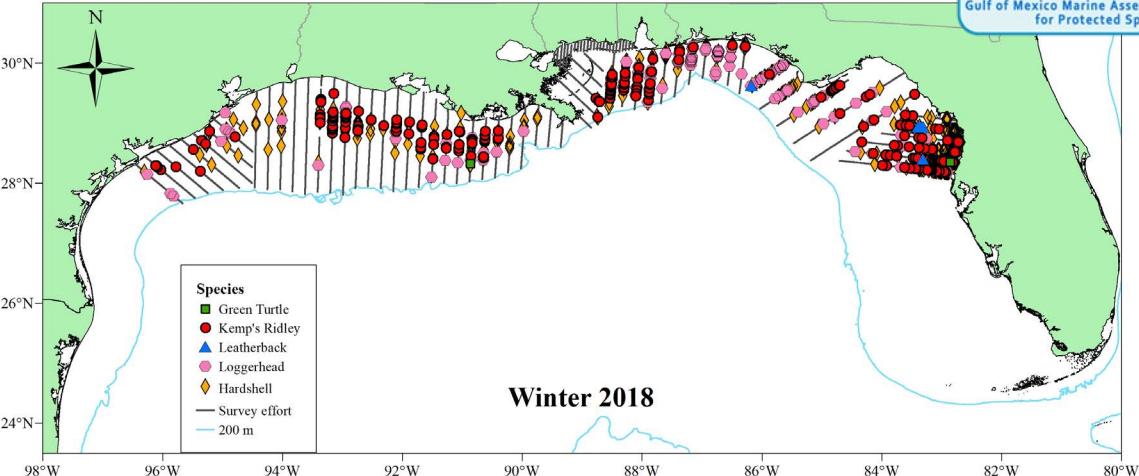
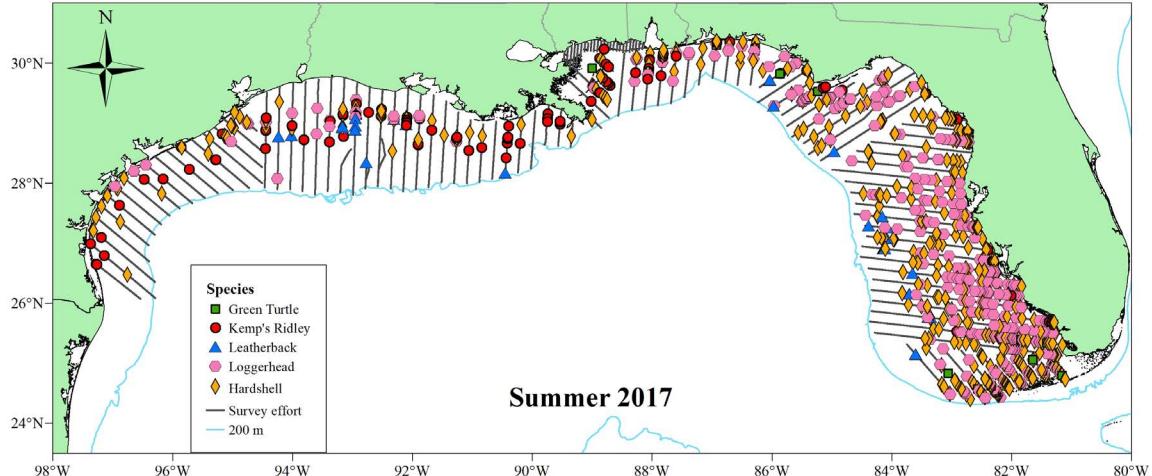


# Aerial Survey – Marine Mammal Sightings



- Incomplete winter 2018 survey
- Majority of sightings are common bottlenose dolphins
- Seasonal distribution changes

# Aerial Survey – Sea Turtle Sightings

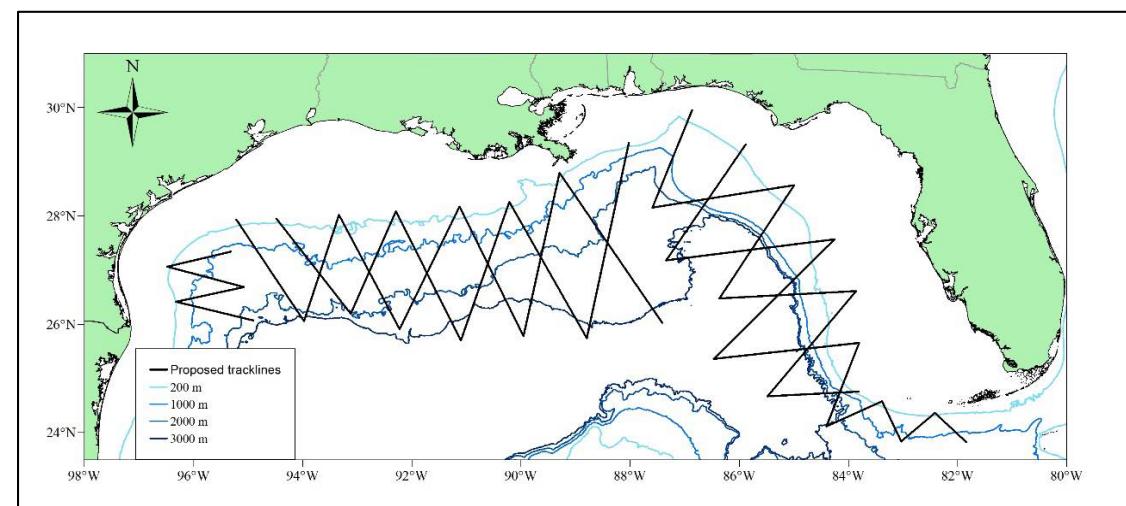


- Large number of unidentified hardshell sightings
- Turtles <30 cm likely not visible to the survey
- High densities in eastern Gulf and outer shelf in central Gulf

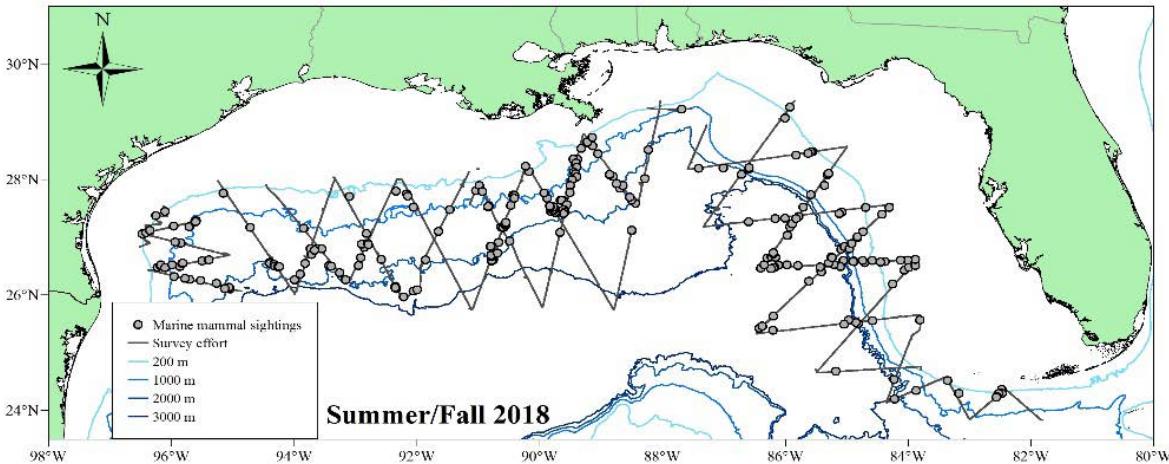
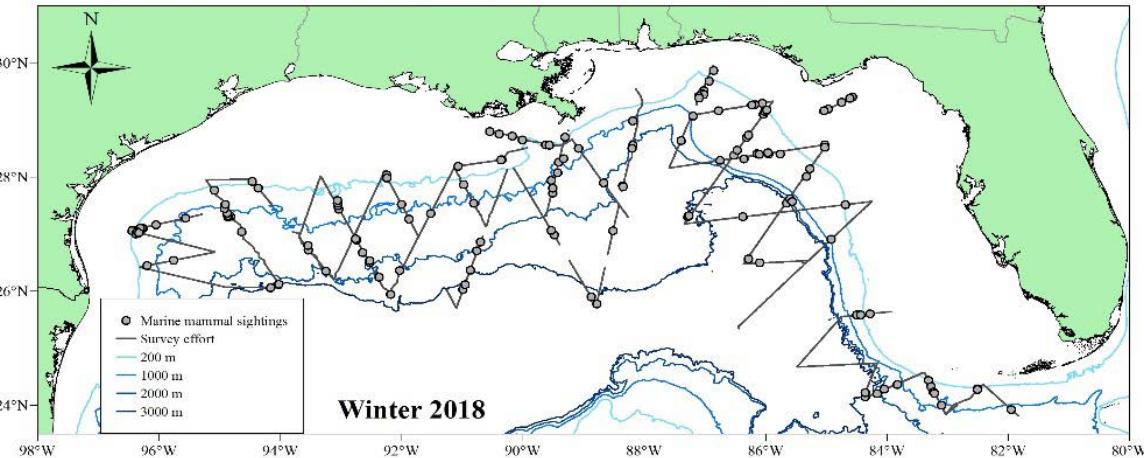
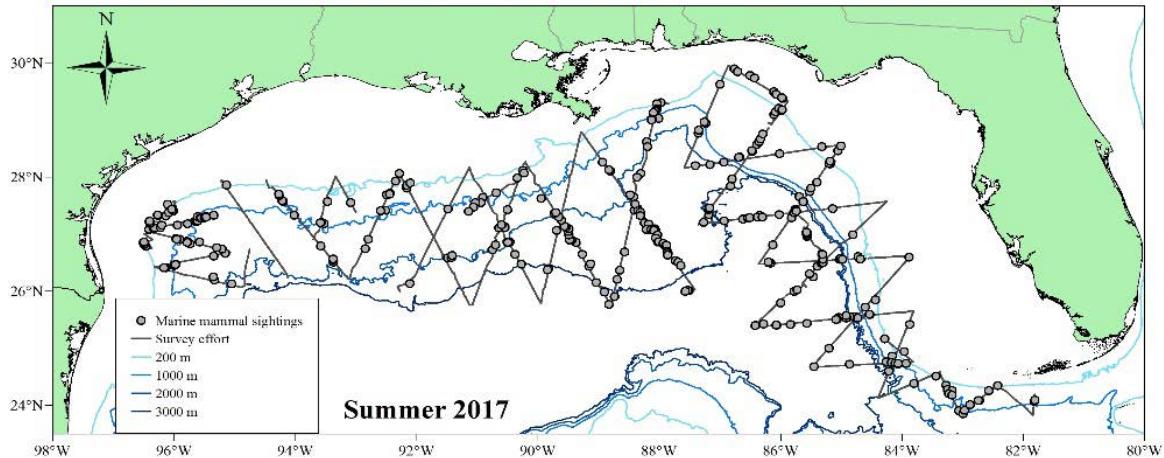
# Oceanic Waters: Vessel Surveys



- 3 seasonal line-transect surveys conducted 2017-2018
- Two visual teams to estimate detection probability
- Oceanographic data
  - Continuous surface sampling underway
  - Vertical profiles with CTD and XBT
  - Acoustic backscatter
- Passive acoustic sampling towed array and sonobuoys
- Seabird survey
- 19,576 km visually surveyed
- 709 marine mammal sightings
  - 19 species identified
- Over 1,360 hours of acoustic effort (towed array)
- Additional surveys from 2003, 2004, and 2009



# Vessel Survey - Field Results



- Generally poor conditions and low sighting rates during winter survey
- High encounter rates in western Gulf
- Inter-annual differences in distribution between 2017 and 2018

# GoMMAPPS Products

- Updated abundance estimates from visual surveys for 26 cetacean stocks and 4 sea turtle species
- Estimated sperm whale abundance from acoustic data
- Developed spatial density models for 15 cetacean species/stocks and 4 sea turtle species
- Developed new models that address uncertainty in abundance estimates
- Assessed inter-annual changes in distribution



QR Code for  
GoMMAPPS data  
collection archived  
on NCEI Geoportal



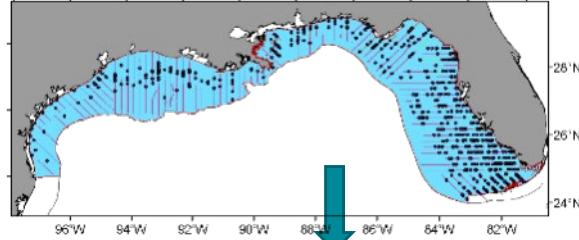
# Spatial Density Models



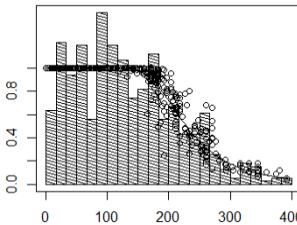
- “Two-stage” spatial density modeling
- Distance analysis including covariates and methods for estimating detection probability on the trackline, accounting for availability and observer detectability
- Generalized Additive Models to quantify species-environment relationships
- Monthly predictions on 40 km<sup>2</sup> hexagonal grid

## Analysis and Prediction

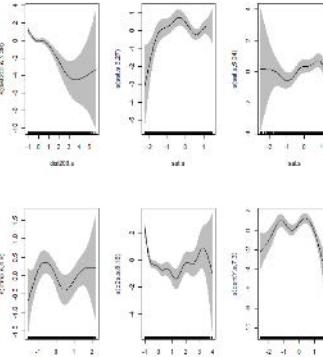
Effort Segments, Sightings, and Predictors



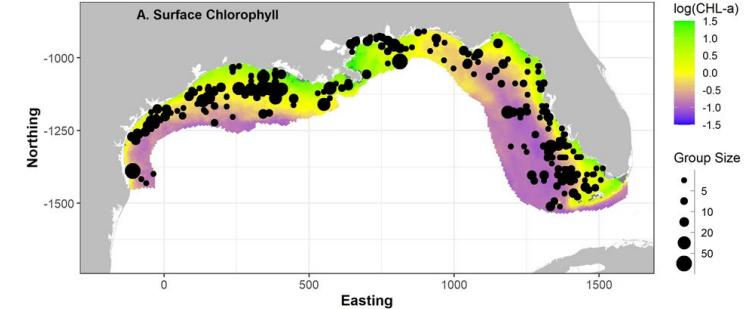
Detection Probability



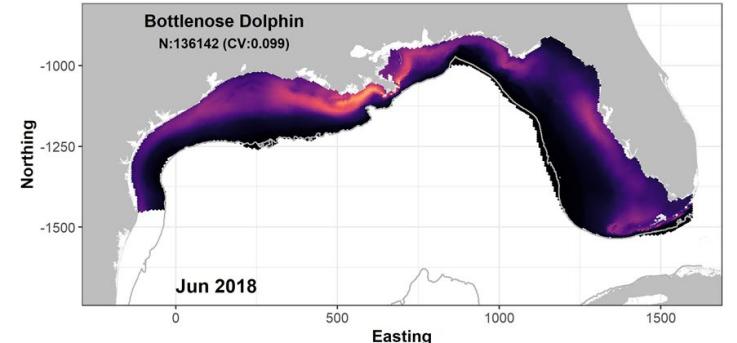
Habitat Relationships



Dynamic Predictor Variables



Density Prediction Maps



# Abundance Estimates

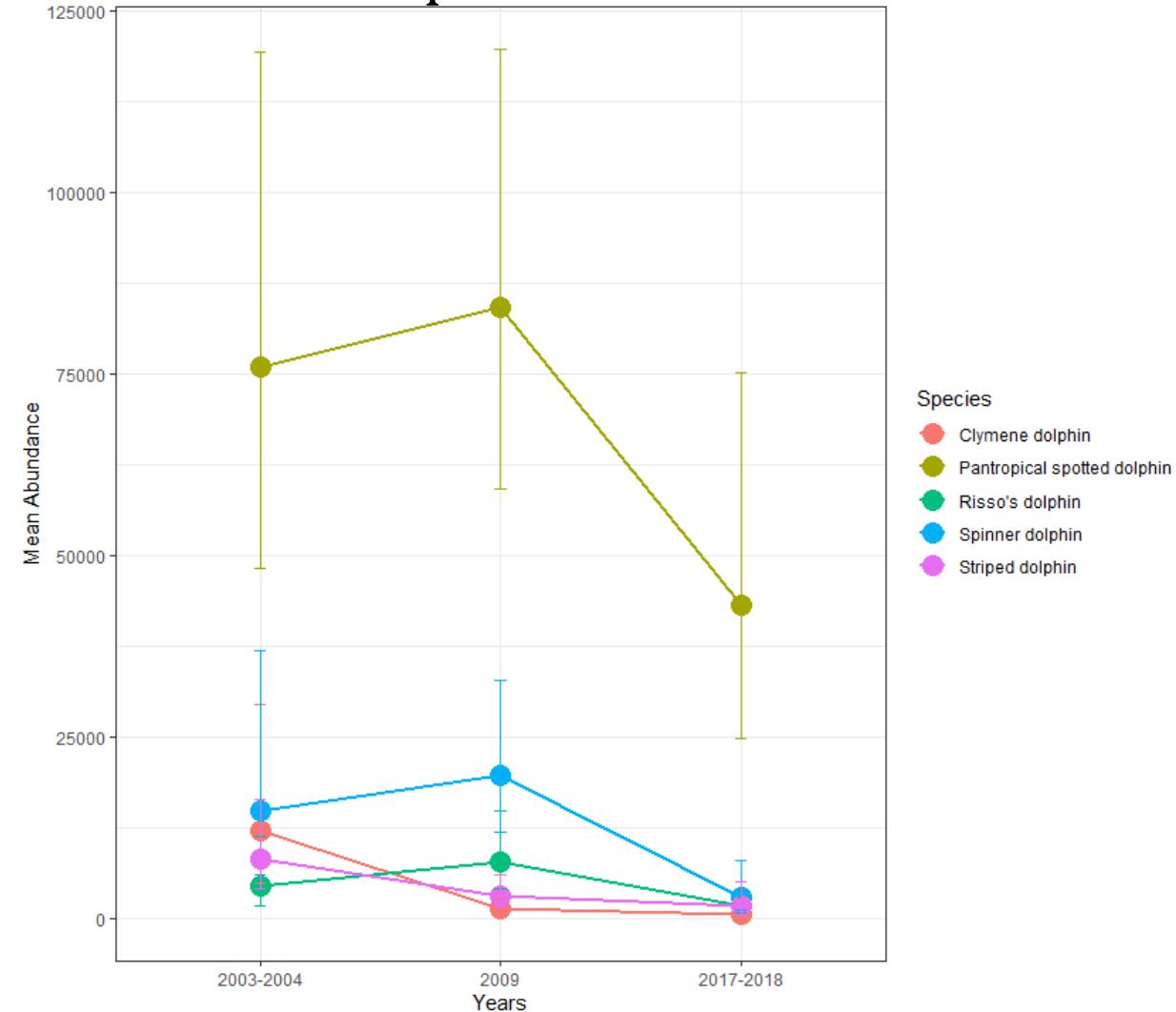


Species	2003	2004	2009	2017	2018
Sperm Whale	2542 (0.336)	1686 (0.405)	2096 (0.546)	1078 (0.293)	1307 (0.326)
Rice's Whale	0	63.9 (0.880)	100.1 (1.03)	84.2 (0.924)	39.8 (0.547)
Bottlenose dolphin	21350 (0.472)	8864 (0.504)	9640 (0.659)	8756 (0.412)	5832.7 (0.462)
Pantropical spotted dolphin	72901 (0.198)	78878 (0.41)	84047 (0.363)	27362 (0.274)	58725 (0.405)
Spinner dolphin	5160 (0.551)	24535 (0.584)	19678 (0.531)	5982 (0.540)	0
Striped dolphin	5494 (0.427)	10764 (0.510)	3060 (0.727)	0	3633.2 (0.558)
Atlantic spotted dolphin	0	0	1161 (1.021)	3267 (0.521)	8178 (0.553)
Fraser's dolphin	0	0	0	426.8 (1.028)	0
Clymene dolphin	10899 (0.415)	13257 (0.808)	1319 (0.782)	1026.3 (1.033)	0
Rough-toothed dolphin	9253 (0.785)	0	3509 (0.668)	0	0
Risso's dolphin	4471 (0.471)	4641 (0.856)	7788 (0.672)	2998 (0.521)	632.2 (0.596)
Short-finned Pilot whales	2740 (0.519)	586.7 (0.884)	4788 (0.738)	1274 (0.539)	1402.3 (0.711)
False killer whale	1293 (0.635)	0	0	1069 (0.973)	161.7 (0.741)
Killer whale	0	197.6 (1.002)	51.5 (0.968)	86.3 (0.874)	450.3 (0.878)
Melon-headed whale	1502 (0.957)	7351 (0.871)	4188 (0.757)	2694 (0.760)	453.9 (0.889)
Pygmy Killer Whale	501 (0.739)	490.0 (0.871)	359 (0.955)	1226.7 (1.149)	0
All Ziphids	573 (0.435)	55.1 (0.719)	276 (0.588)	316.0 (0.278)	192.8 (0.650)
Pygmy/Dwarf sperm whale	441 (0.424)	38.3 (0.711)	123.8 (0.604)	292.7 (0.593)	359.5 (0.424)

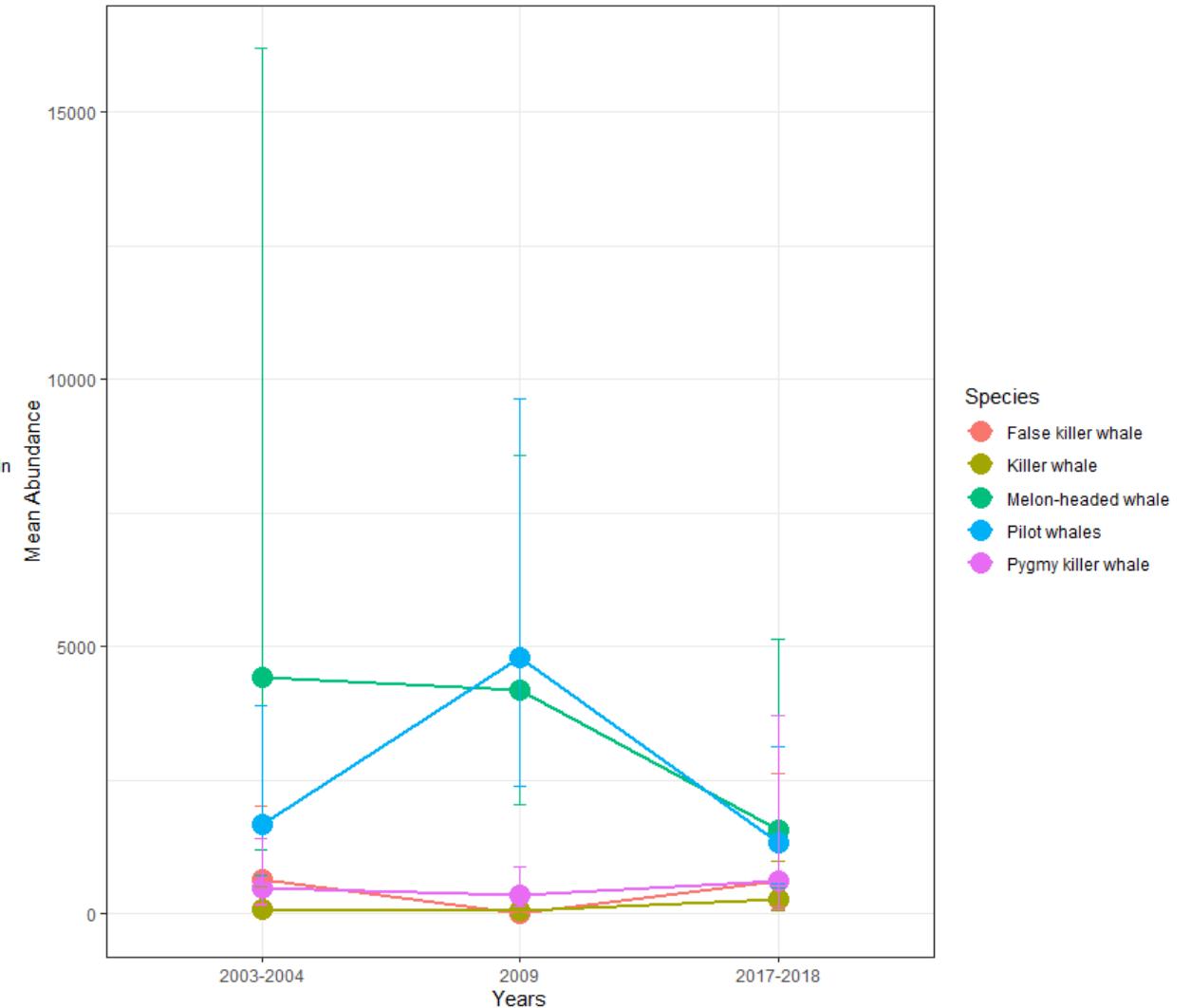
# Changes in Abundance



## Oceanic Dolphins



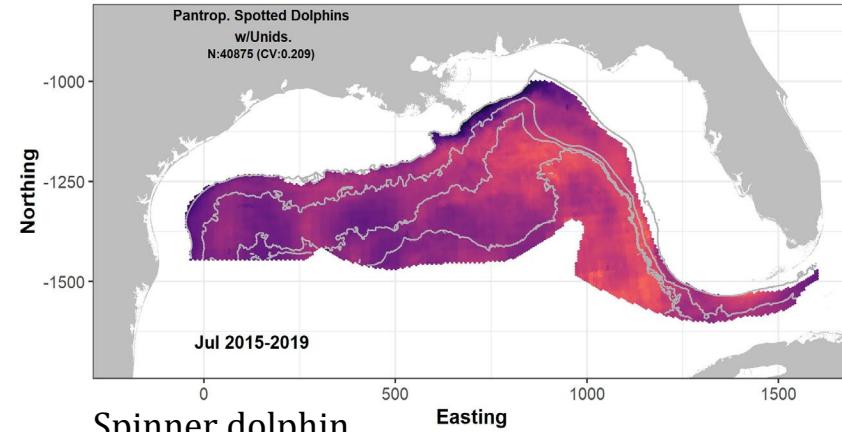
## Small Whales



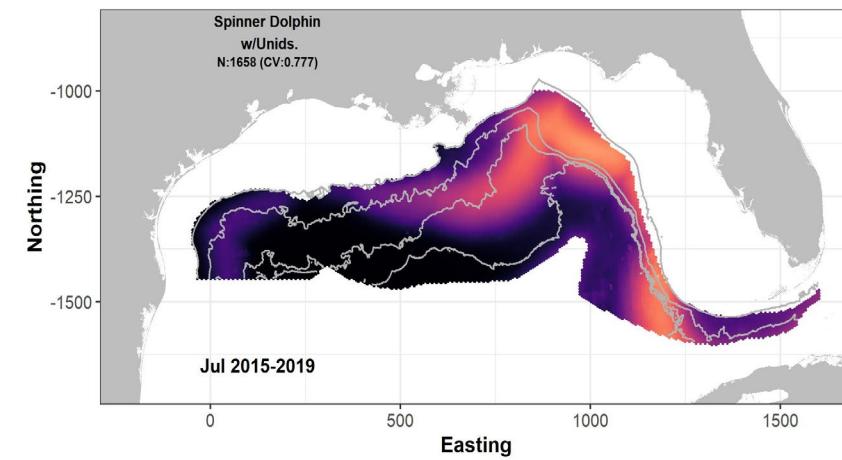
# Oceanic Dolphins



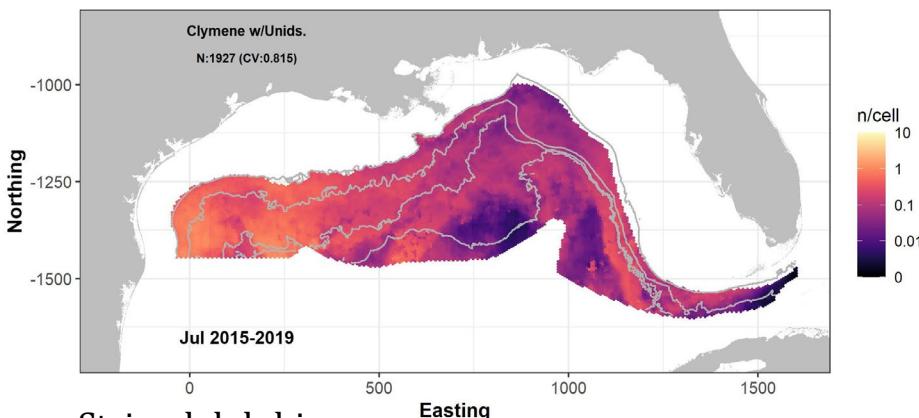
Pantropical spotted dolphin



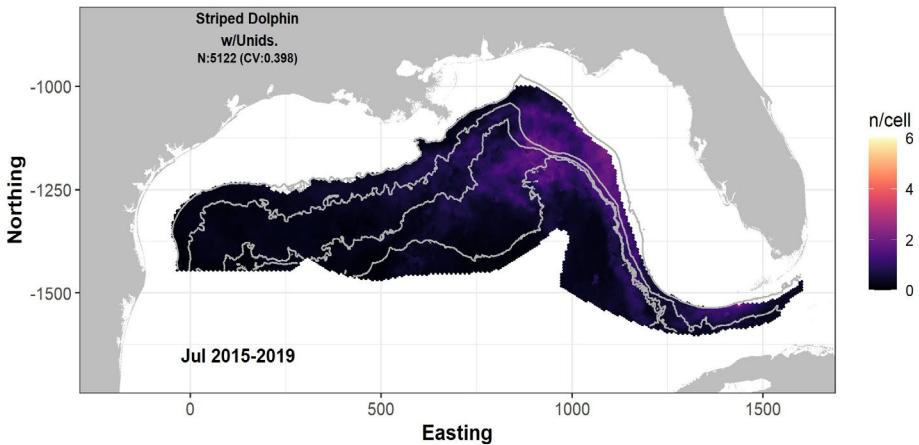
Spinner dolphin



Clymene dolphin

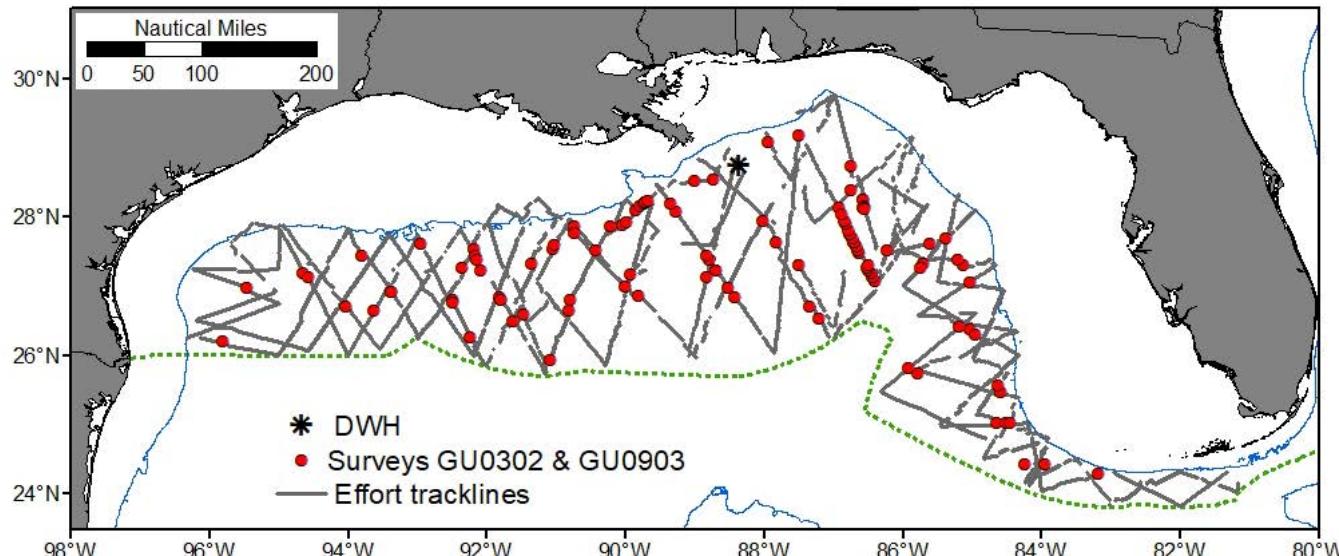


Striped dolphin

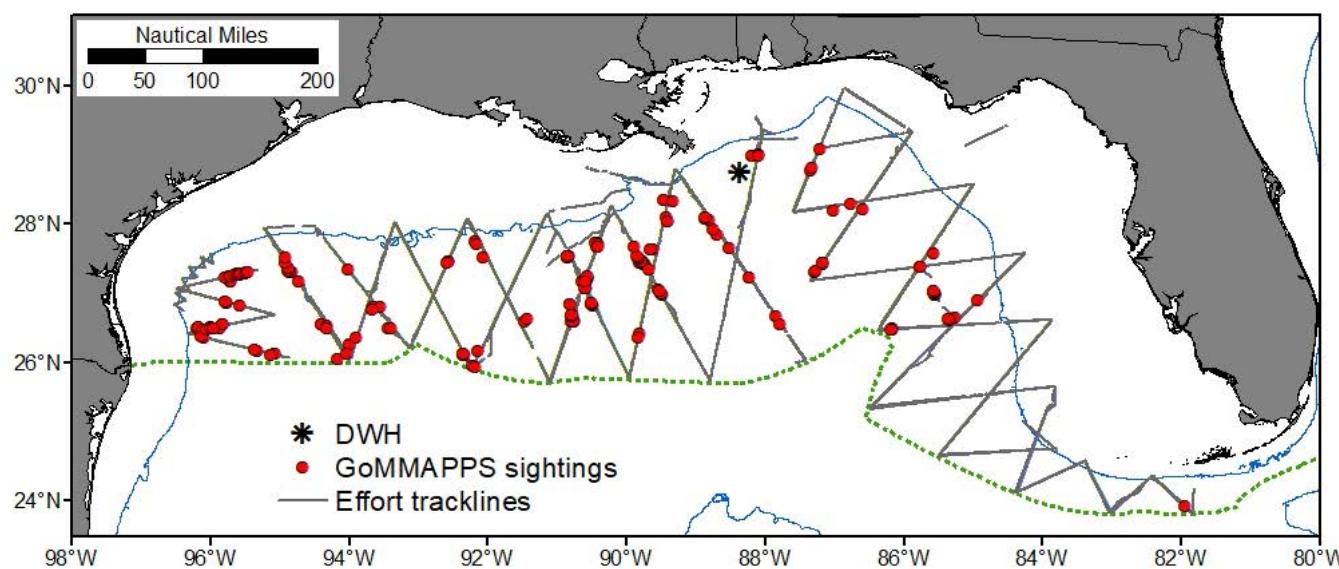


- Distribution of *Stenellid* dolphins closely related to surface productivity
- Lower densities of all species in recent surveys correlated with more positive SSH values
- Differential habitat use and spatial distribution among different taxa

# Sperm Whale Distribution Shift

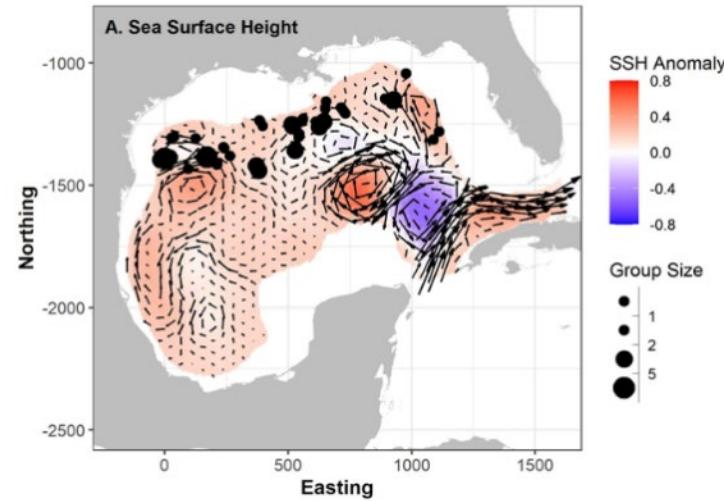
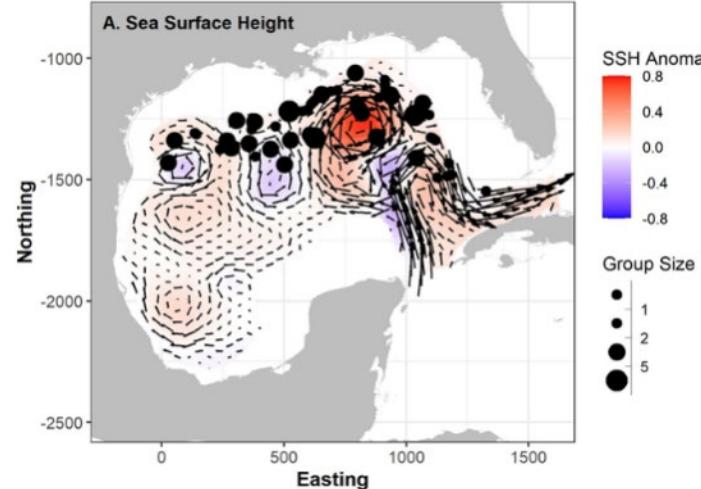


Sightings recorded  
in 2003 and 2009

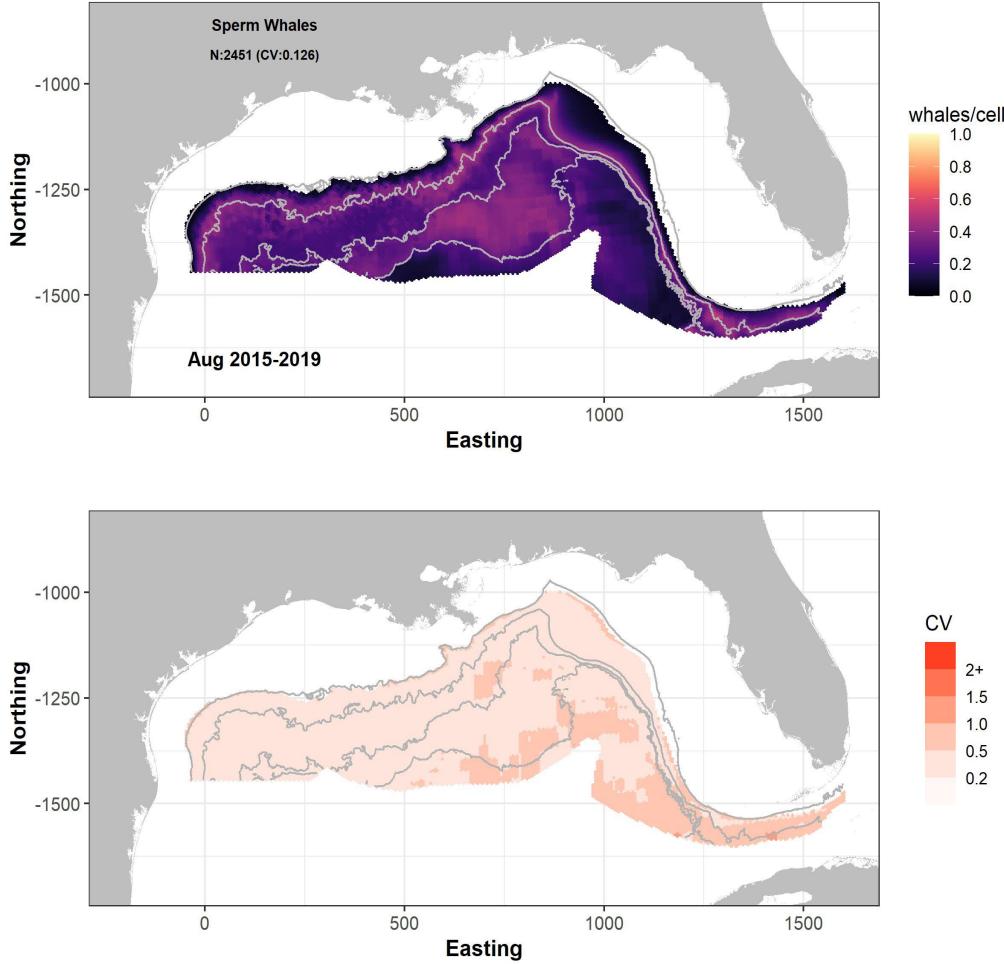


Sightings recorded  
during GoMMAPPS

# Oceanography and Sperm Whales



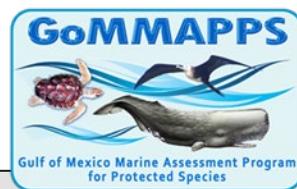
Sperm Whale sightings and sea surface height anomaly Summer 2003 (top) and summer 2018 (bottom)



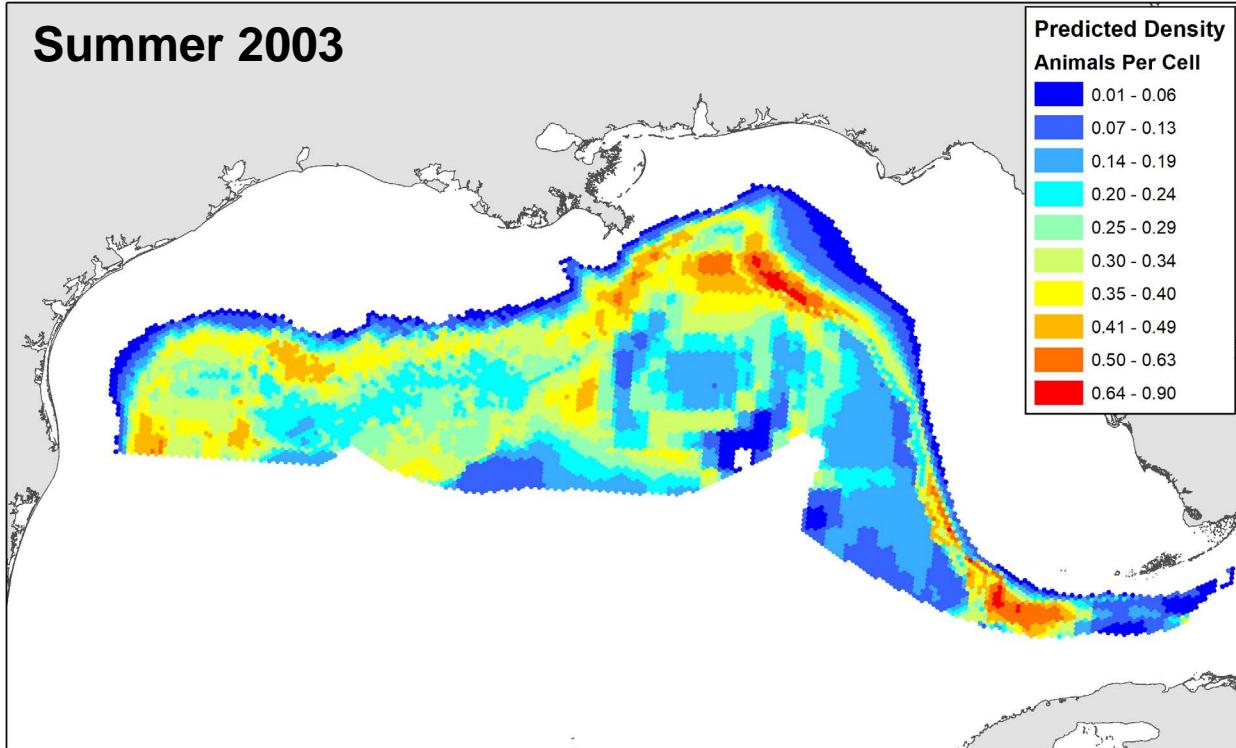
Sperm Whale prediction map and associated CV, monthly averaged oceanographic conditions during August 2015-2019



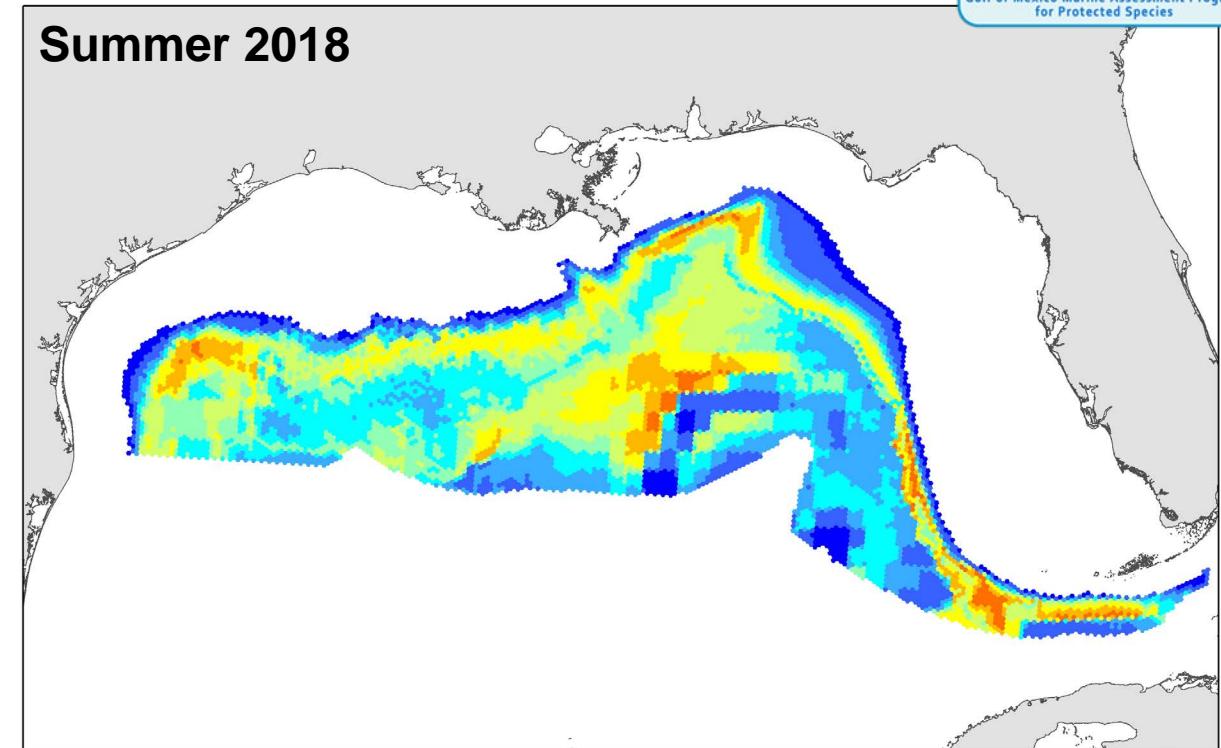
# Sperm Whale Distribution Shifts



Summer 2003



Summer 2018



- Habitat model captures distribution change across years, higher density in western Gulf and deep waters in recent years
- Does this reflect consistent changes or inter-annual variation?

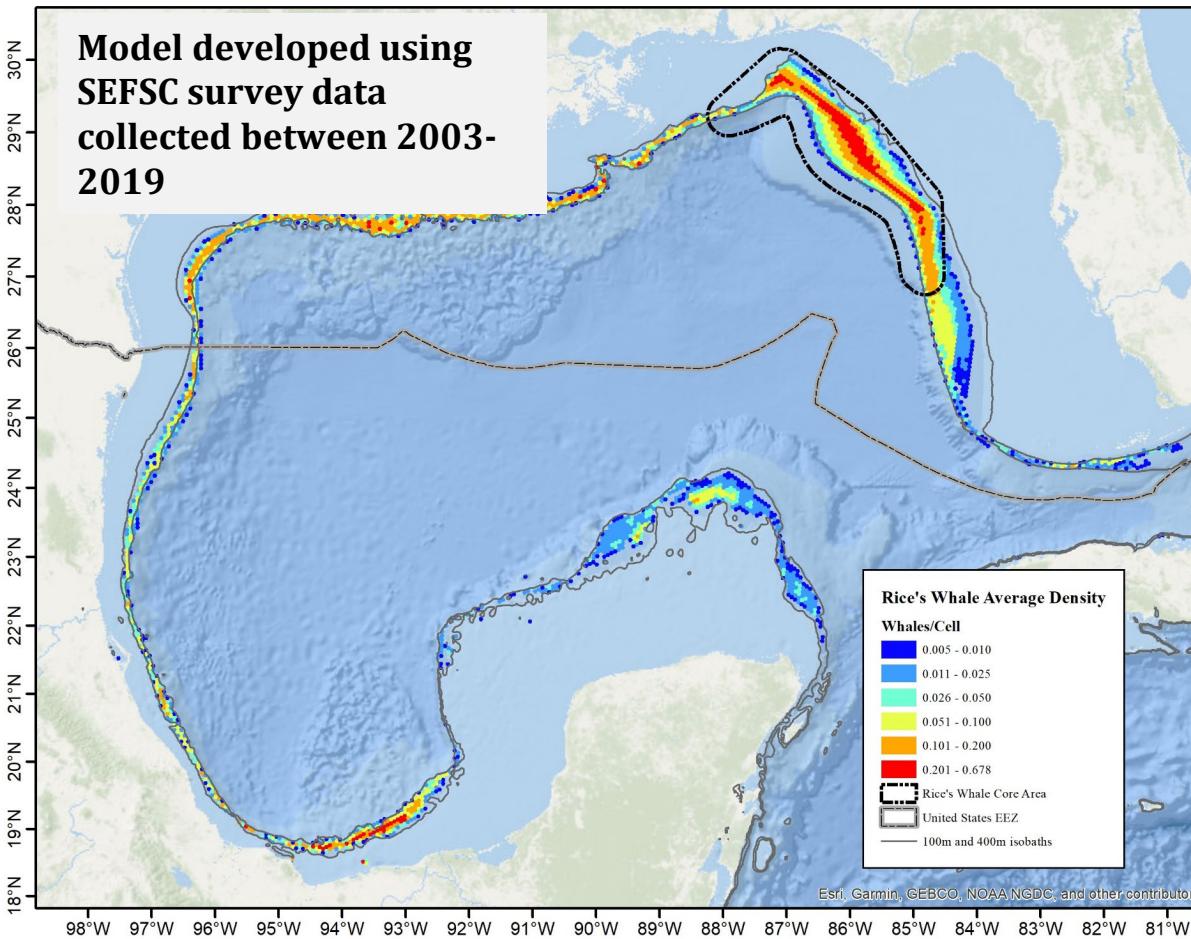
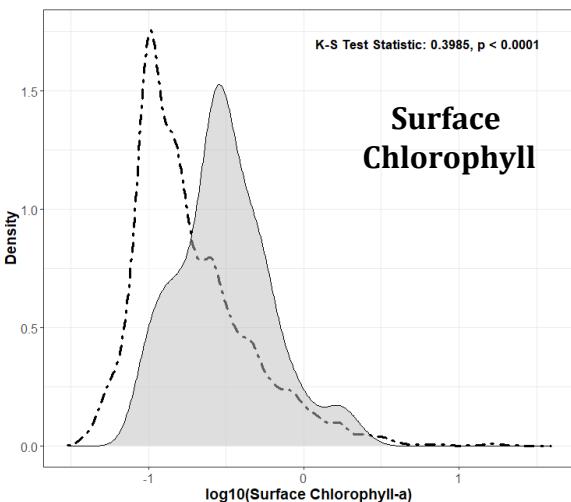
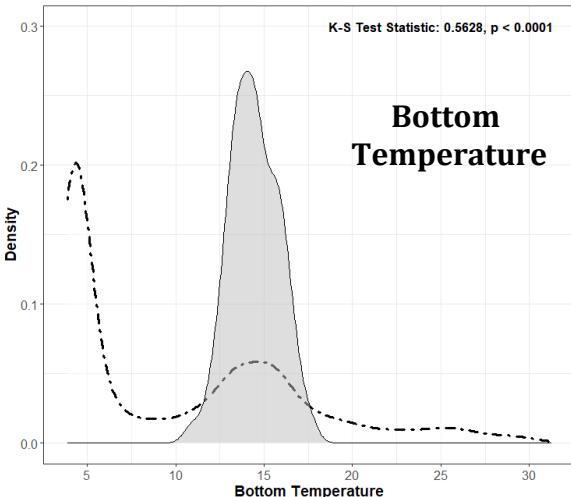
# Habitat Variables – Influence of Mesoscale Eddy Structure



Species	Chlorophyll	Sea Level Anomaly	Geostrophic Velocity	Sea Surface Temperature	Era Effect (pre vs. post 2010)
Pantropical spotted dolphin	X	X		X	X
Spinner dolphin					X
Clymene dolphin	X		X		X
Striped dolphin	X				
Atlantic spotted dolphin					
Bottlenose dolphin		X	X	X	
Risso's dolphin		X		X	X
Short-finned Pilot whales			X	X	
Other Small Whales	X		X		
Sperm Whale		X	X	X	
Beaked Whales		X	X	X	
Pygmy/Dwarf sperm whale	X	X	X		



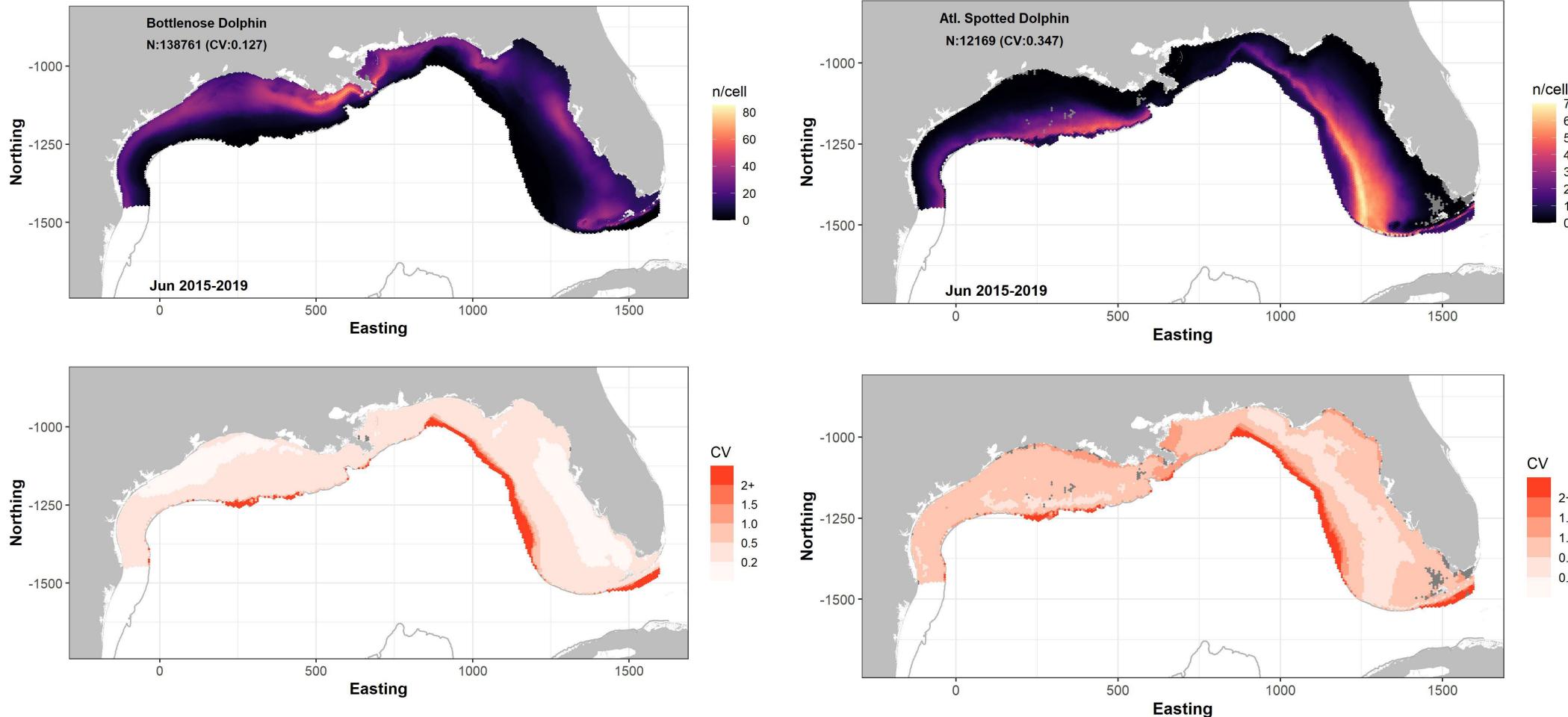
# Rice's Whales Abundance and Habitat



High predicted occurrence over inner shelf break, low bottom temperatures associated with upwelling, and intermediate surface chlorophyll

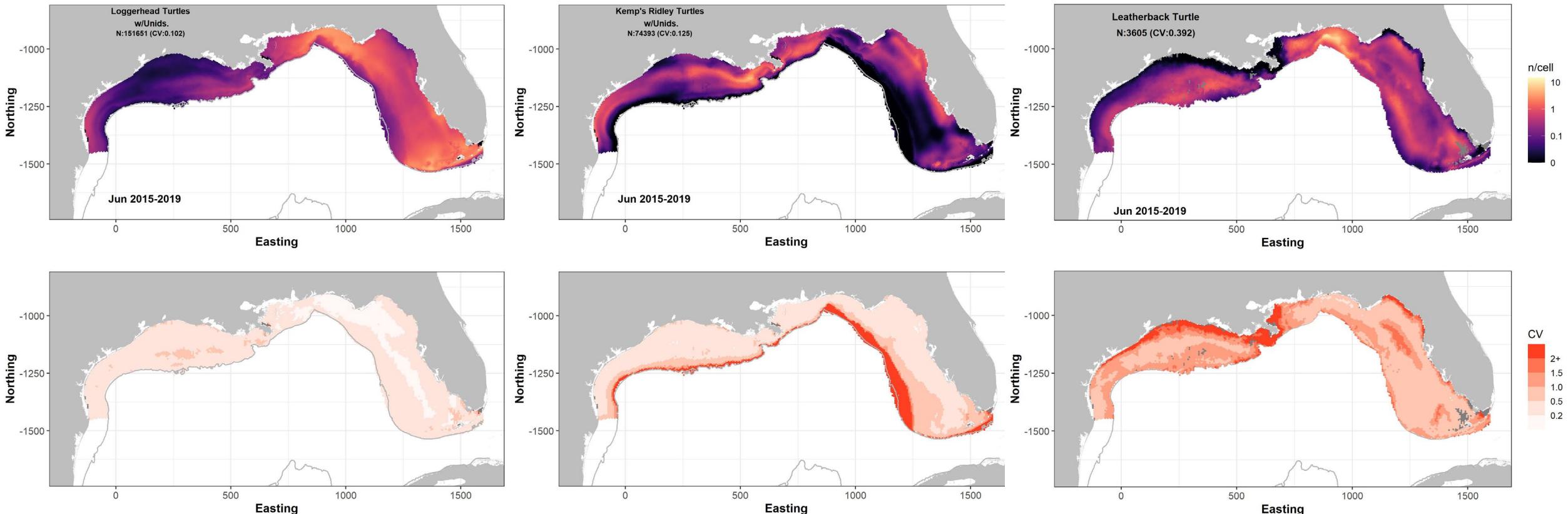
- Model expanded on GoMMAPPS methods and used survey data from 2003–2019
- Primary habitat in northeastern Gulf associated with upwelling and surface inputs of high productivity water
- Suitable habitat also in the western Gulf where acoustic detections have occurred

# Shelf Bottlenose and Atlantic Spotted Dolphins



Aerial survey data support SDM models for Common Bottlenose Dolphins and Atlantic Spotted Dolphins occupying continental shelf waters

# Sea Turtle Density Models and Abundance



SDM models for sea turtles capture seasonal variation in spatial distribution and abundance. Corrected abundance estimates for each species accounting for detection biases and time at surface



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# Data Products

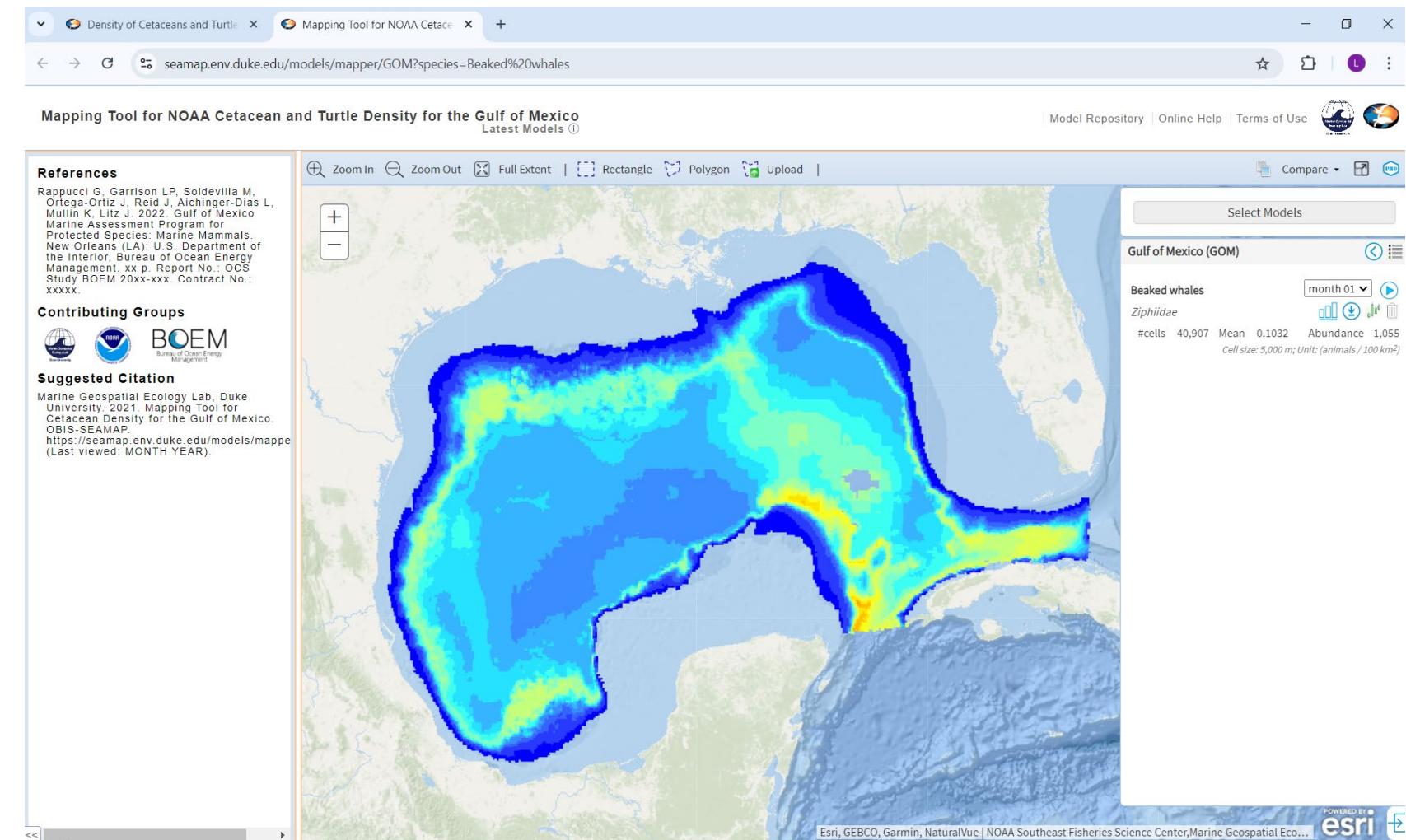
**Products available on the NCEI data portal include:**

- Visual sighting data from 3 aerial and 3 vessel surveys
- Density prediction map shapefiles for 15 cetaceans & 4 sea turtles based upon monthly averaged oceanographic conditions during 2015 – 2019
- Seabird survey data from our project partners at USFWS
- Environmental data collected during the surveys
- Photographs



QR Code for GoMMAPPS  
data collection archived on  
NCEI Geoportal

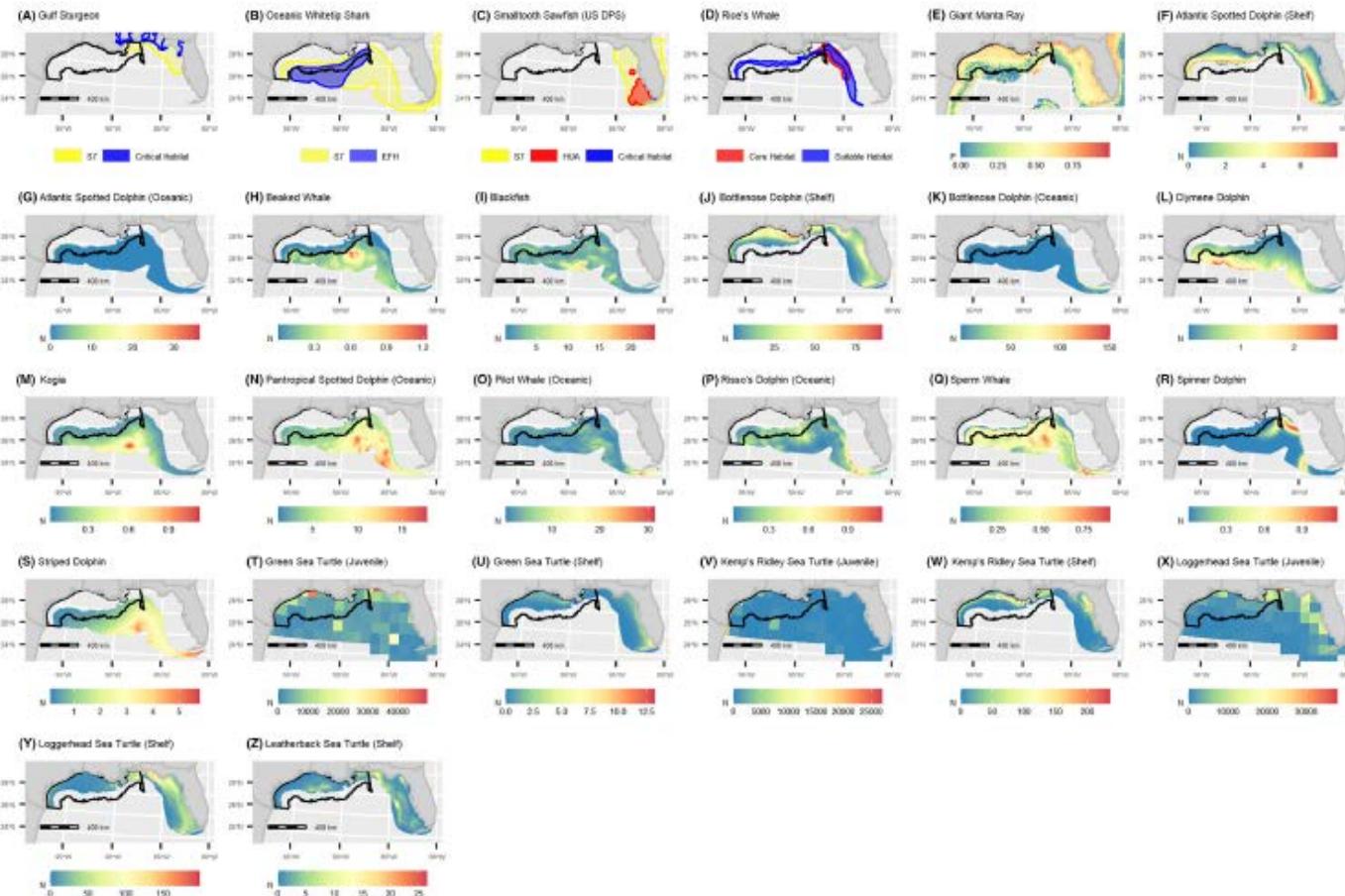
# Data Products – Cetacean Density Mapper



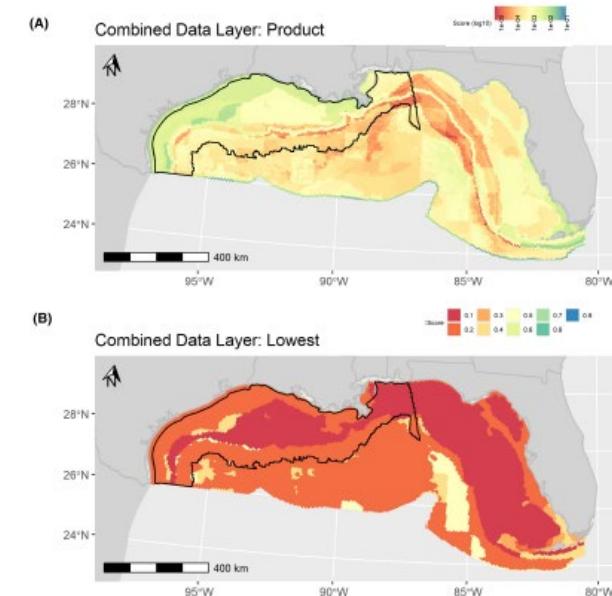
- Monthly spatial density maps for all marine mammals and sea turtles
- Extrapolated density into the southern Gulf
- Available for download at:

<https://seamap.env.duke.edu/models/SEFSC/GOM/>

# Application: Spatial Planning



**FIGURE 1** Distributions of all protected species considered for potential wind energy development spatial planning in the Gulf of Mexico: (A) Endangered Species Act Section 7 (S7) consultation layers and critical habitat for the Gulf Sturgeon; (B) S7 and essential fish habitat (EFH) layers for the Oceanic Whitetip Shark; (C) S7 consultation layer, high-use area (HUA) from 95% kernel density estimates around tag relocations, and critical habitat for the Smalltooth Sawfish (U.S. Distinct Population Segment [DPS]); (D) core habitat from sightings and suitable habitat from passive acoustic monitoring, sightings, and habitat suitability modeling for Rice's whale; (E) maximum probability of occurrence (January 2003–December 2019) for the Giant Manta (from Farmer et al. 2022a); and (F)–(Z) estimated abundance of other marine mammals and sea turtles in the Gulf of Mexico based on species distribution models fitted to distance-weighted aerial (shelf) and vessel (oceanic) surveys with environmental and bathymetric covariates. Panels T, V, and X depict modeled distributions of juvenile sea turtles from Putman et al. (2019). The black polygon denotes the Gulf of Mexico wind energy development call area.



**FIGURE 3** Final combined protected species data layers for the Gulf of Mexico. Spatial distribution of consultation risk for protected species was based on vulnerability and trend, with layers combined using two different approaches: (A) the product of risk scores across all 23 protected species data layers and (B) the lowest scoring layer within a given cell. Note that the latter approach does not consider the cumulative risk associated with overlapping protected species concerns.

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## THEMED ISSUE

### Offshore Wind Interactions with Fish and Fisheries



## Protected species considerations for ocean planning: A case study for offshore wind energy development in the U.S. Gulf of Mexico

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# Importance to Decision-makers

GoMMAPPS model products support diverse marine users

- Support regulatory needs of multiple federal agencies
- Planning for aquaculture & wind energy development and other blue economy sectors in the Gulf
- Continued surveys are critical to monitor populations/stocks and update and improve the predictive ability of models
- Just completed vessel surveys in summer 2023 and 2024 to provide data for updated density models and abundance estimates
- Anticipating additional BOEM funded aerial surveys during 2025 and 2026



Top: Offshore wind turbines. Credit: Ionna 22  
Bottom: Pilot whales near an oil platform.  
Credit: NOAA Fisheries



# Thank You!





Next Third Thursday  
Web Forum

11-21-2024

10:00 am ET

Rua Mordecai

Science Coordinator

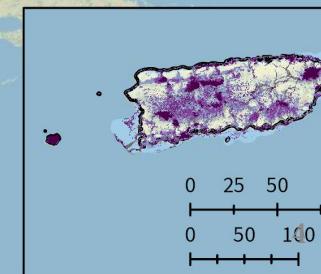
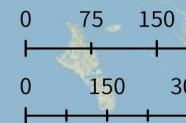
SECAS

[secassoutheast.org](http://secassoutheast.org)

## What's new in 2024: The latest updates to the Southeast Conservation Blueprint and SECAS Goal Report

Priorities for a connected  
network of lands and waters

- Highest priority
- High priority
- Medium priority
- Priority connections





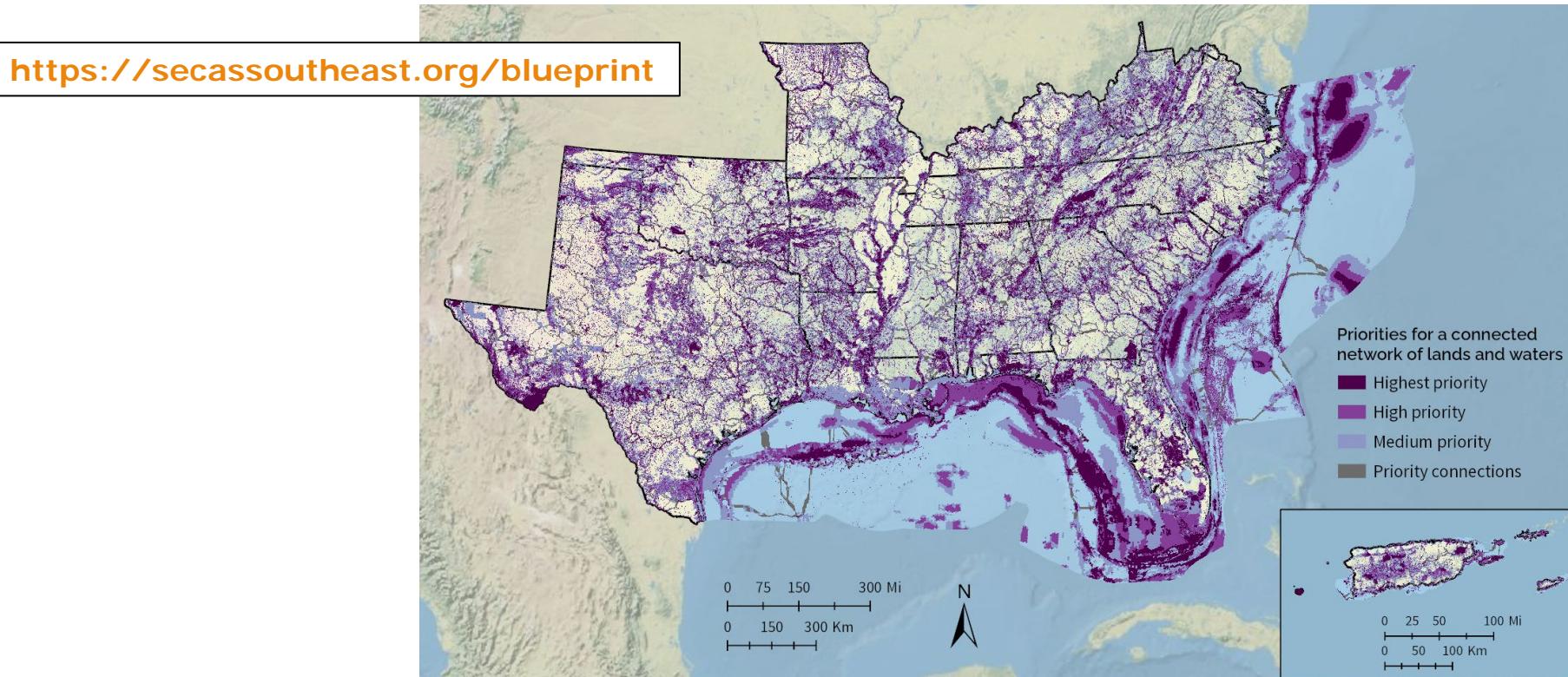
## Staff updates

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- Southeast Conservation Blueprint 2024 is now available!
- Blueprint 2024 workshops start next week

# Southeast Conservation Blueprint 2024 is now available!

- Blueprint Explorer, SECAS Atlas, and data download updated
- Please note Blueprint Explorer has a new web address:  
<https://apps.fws.gov/southeastblueprint/>



# Blueprint 2024 workshops start next week

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- By popular demand, moving workshops to after the Blueprint release so final indicator data and documentation is available to inform feedback
- October 22 – Nov 7 (first one is Tuesday!)
- 13 virtual workshops via Zoom, 1.5 hours long
- At least 2 workshops for every single part of the SECAS geography (inland continental, marine continental, U.S. Caribbean)
- Register here: <https://secassoutheast.org/workshops>

# How to get involved in SECAS

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- Sign up for the SECAS newsletter

[secassoutheast.org](http://secassoutheast.org)

- Connect with SECAS staff or partners

[secassoutheast.org/staff](http://secassoutheast.org/staff)

[secassoutheast.org/partners](http://secassoutheast.org/partners)

- Explore the Southeast Conservation Blueprint

[secassoutheast.org/blueprint](http://secassoutheast.org/blueprint)



**Southeast  
Conservation  
Adaptation  
Strategy**



# Questions?