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U.S. Geological Survey

Wetland and Aquatic Research Center

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U.S. Department of the Interior
U.S. Geological Survey

Photo courtesy of Canva

Wetland and Aquatic Research Center

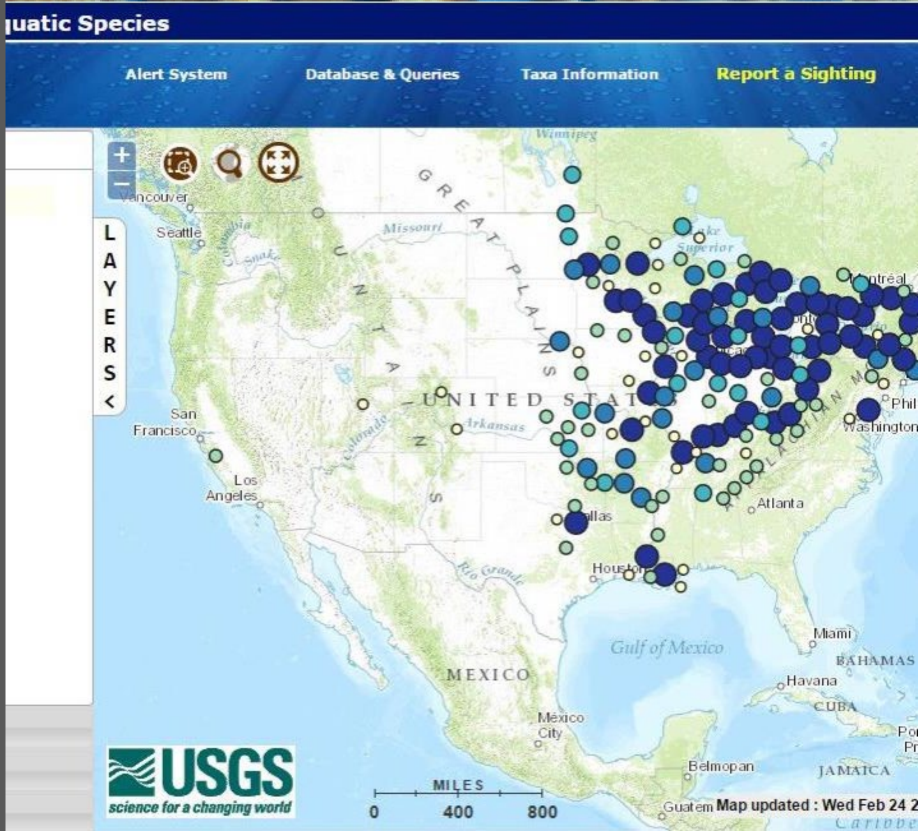
RESEARCH AREAS

- INVASIVE SPECIES
- IMPERILED SPECIES
- ECOLOGICAL STRESSORS
- RESTORATION

Invasive Species

Invasive Species: NAS Database

- Publicly accessible database of spatially referenced introduced aquatic plant and animal species
- Sighting records from land managers, historical records, citizen scientists
- Alert function announces new sightings to users
- FaST maps describe potential species spread due to storm-related flooding



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Imperiled Species

Ecological Stressors

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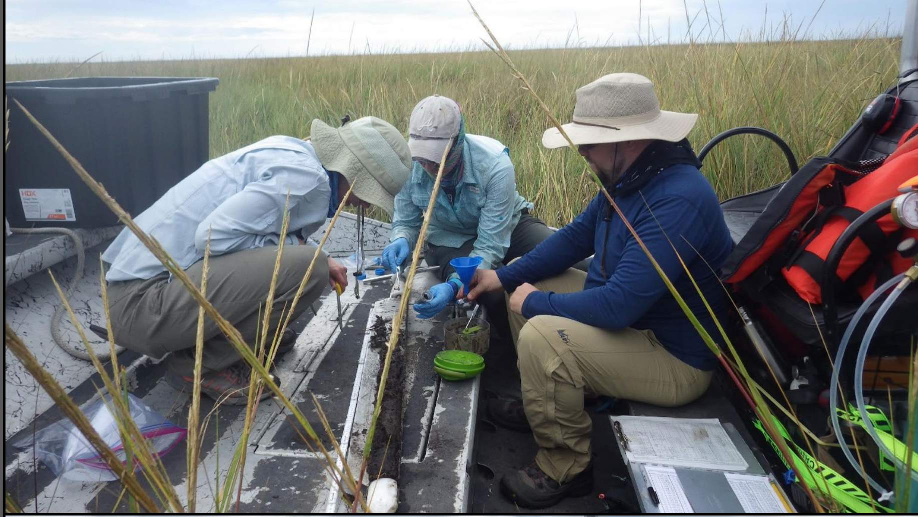
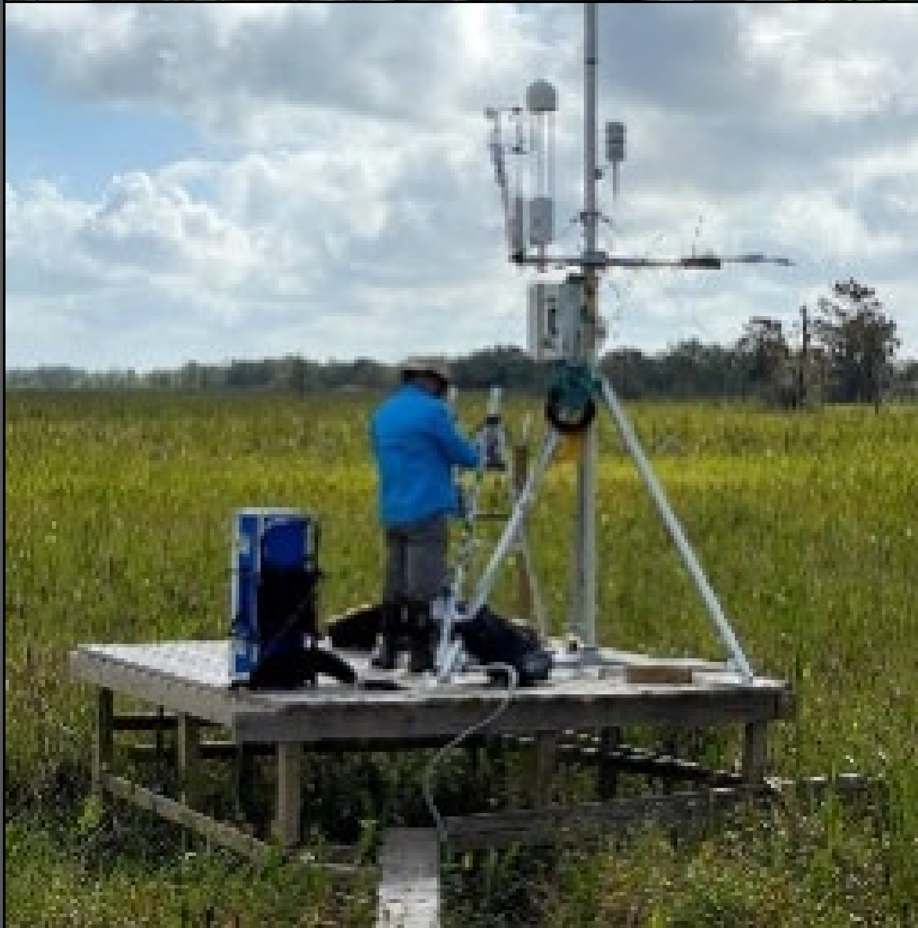
Ecological Stressors: Climate Change

- Investigating climate change on coastal ecosystems, with focus on:
    - Drivers: Sea-level rise, warming winters, precipitation, hurricanes
    - Results: Marsh migration, land loss, coastal tropicalization
- Modeling climate impacts to help inform coastal ecosystem management
- Enhancing the adaptive capacity of coastal wetlands in the face of sea-level rise and coastal development
- Assessing coastal wetland creation/restoration to provide nature-based solutions for mitigating climate change impacts through carbon sequestration





Oyster reefs in dynamic environments

Simeon Yurek
syurek@usgs.gov

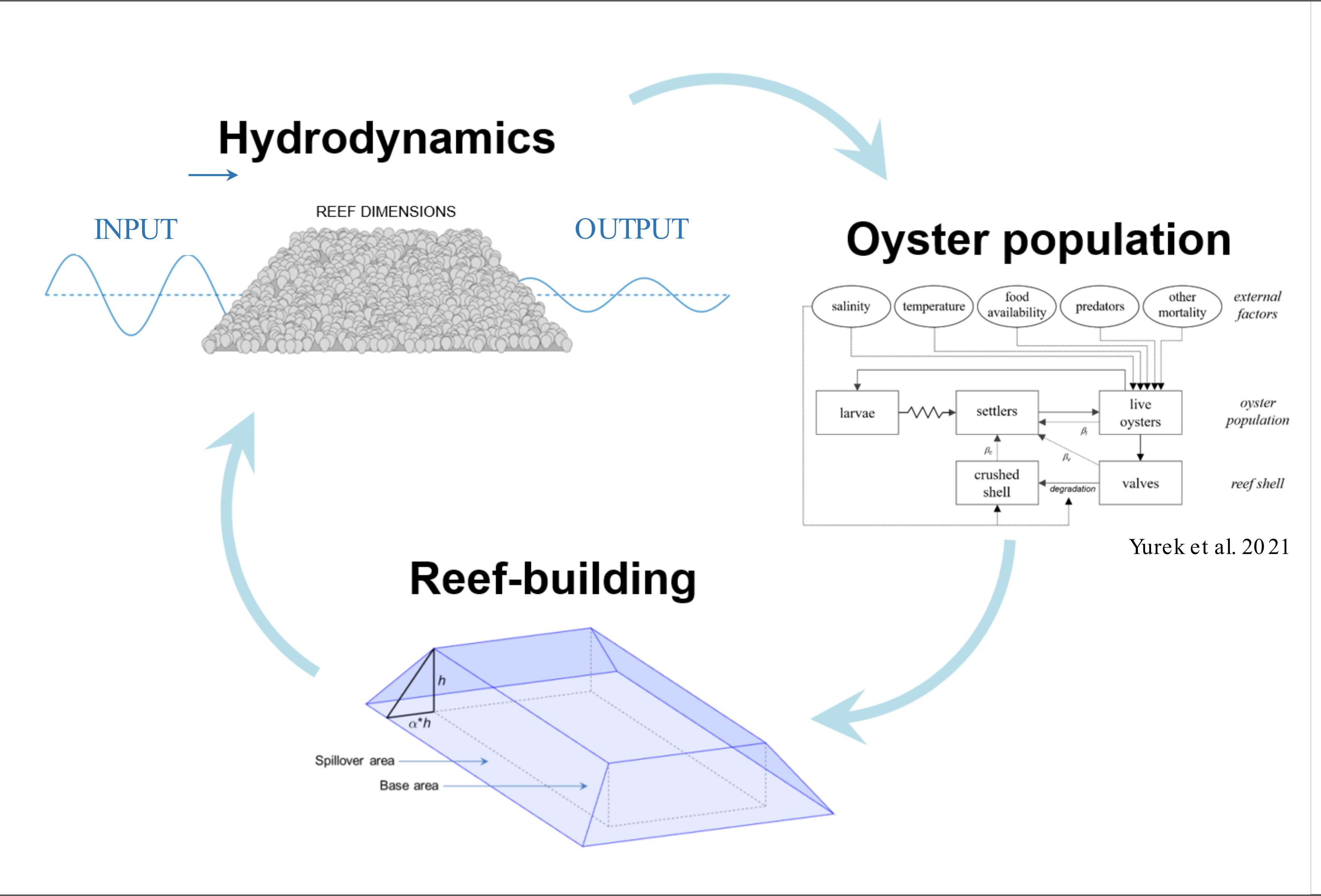


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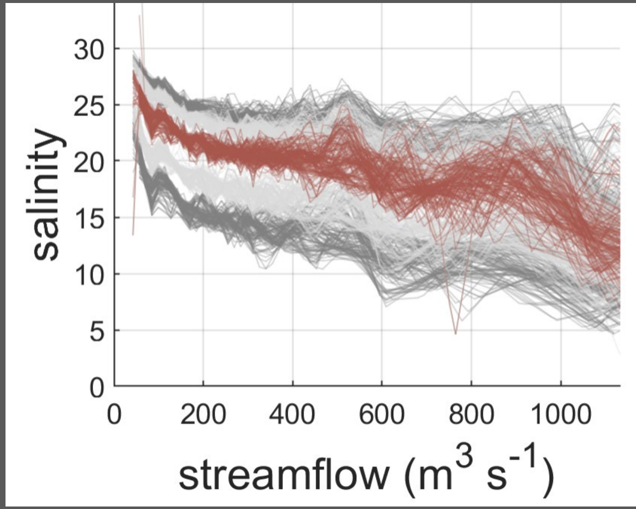
photo: VA Soil and Water Conservation District

Preliminary Information- Subject to Revision. Not for Citation or Distribution.

Hydrology and coastal salinity regime

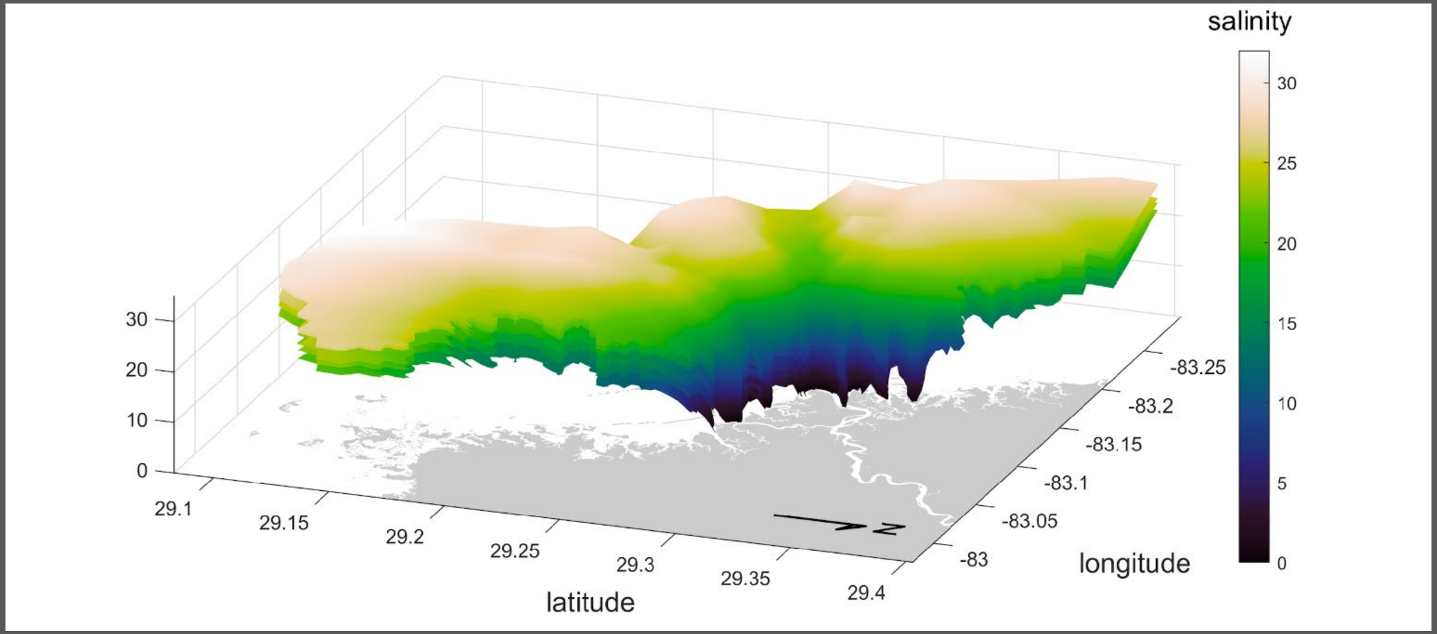


Quantile regression:

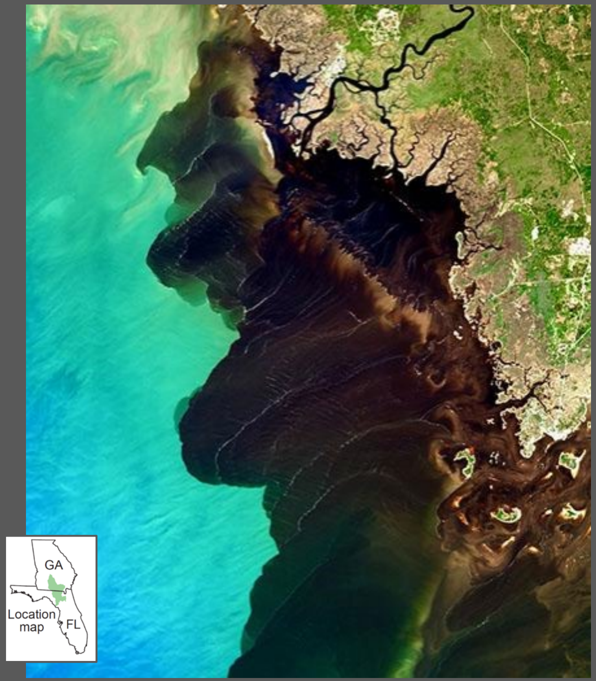
Salinity quantile = location coordinates
+ freshwater input (streamflow metrics)
+ marine input (tide stage)
+ wind direction and velocity

Streamflow and watershed dynamics represented:

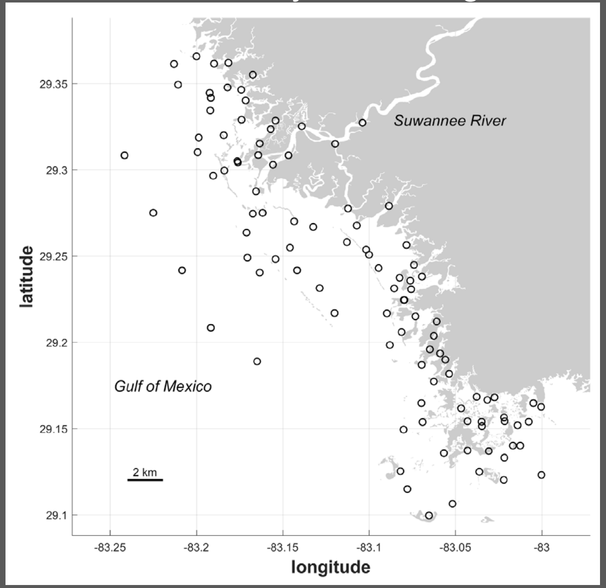
- varying time scales
- lags between salinity and streamflow



Suwannee River Streamflow



Salinity Monitoring



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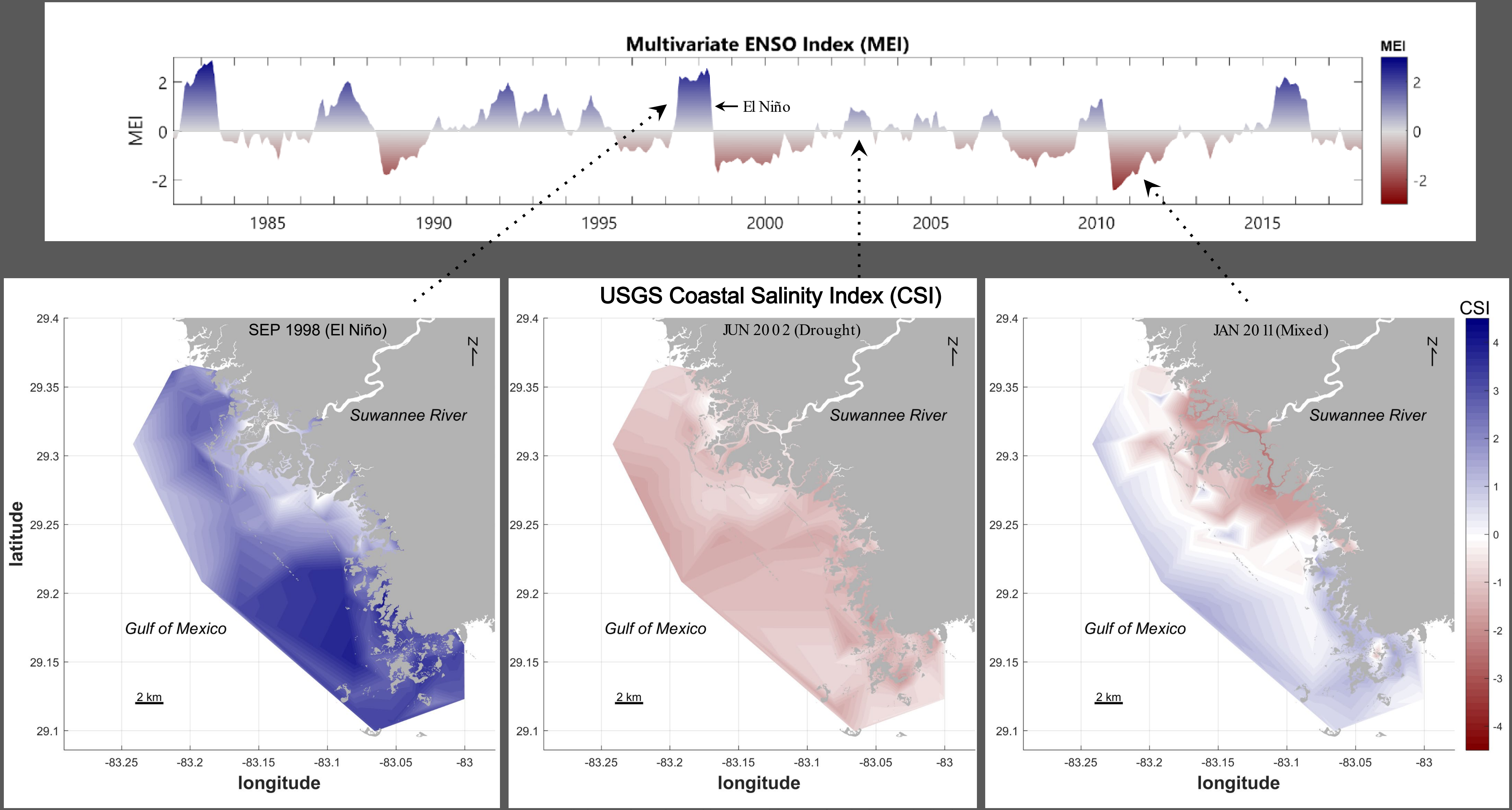
Climate change & USGS Coastal Salinity Index (CSI)



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Management applications

Supports decision making for:

- Coastal fisheries
- Shell habitat restoration
- Fish & wildlife management (T&E species)
- Spatial reserve design with constraints (budget, material)
- Reservoir / spillway / diversion management
- Watershed planning and development
- Economic incentives and policy
- Also relevant to coral reefs, barrier islands

Advantages:

- Modular (cross-applied Gulf and Atlantic coast)
- Integrated
- Provides platform for cooperative management & adaptation planning

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Case study areas

Chincoteague Bay, VA

- Barataria Bay, LA
- Breton Sound Bay, LA
- Grand Bay, AL/MS
- Galveston Bay, TX
- Apalachicola Bay, FL
- Suwannee Sound, FL
- Winyah Bay, North Inlet, SC
- Chincoteague Bay, VA
- Delaware Bay, NJ

Delaware Bay, DE/NJ

Lone Cabbage Reef, FL

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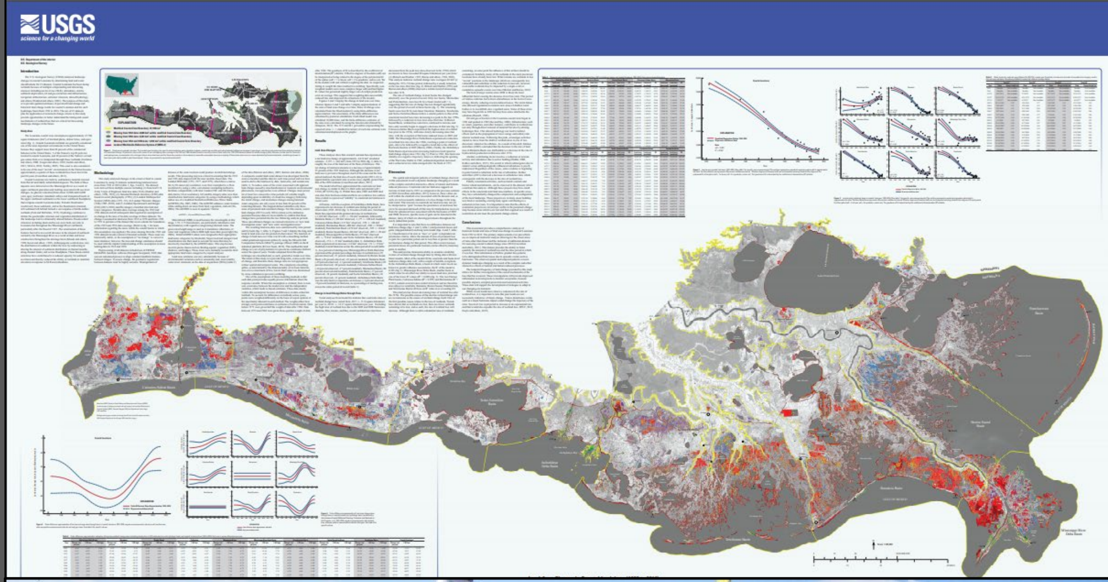
Restoration

Restoration: Gulf of Mexico

- Conduct ecological research following events like oil spills and hurricanes, including post-storm assessments characterizing degree and extent of damage to ecosystem structure
- Working with other agencies to help inform restoration/management activities (e.g., sediment diversions, state-wide monitoring)
  - Coastwide Reference Monitoring System (CRMS) through the Coastal Wetlands Planning Protecting and Restoration Act (CWPPRA) for 20+ years



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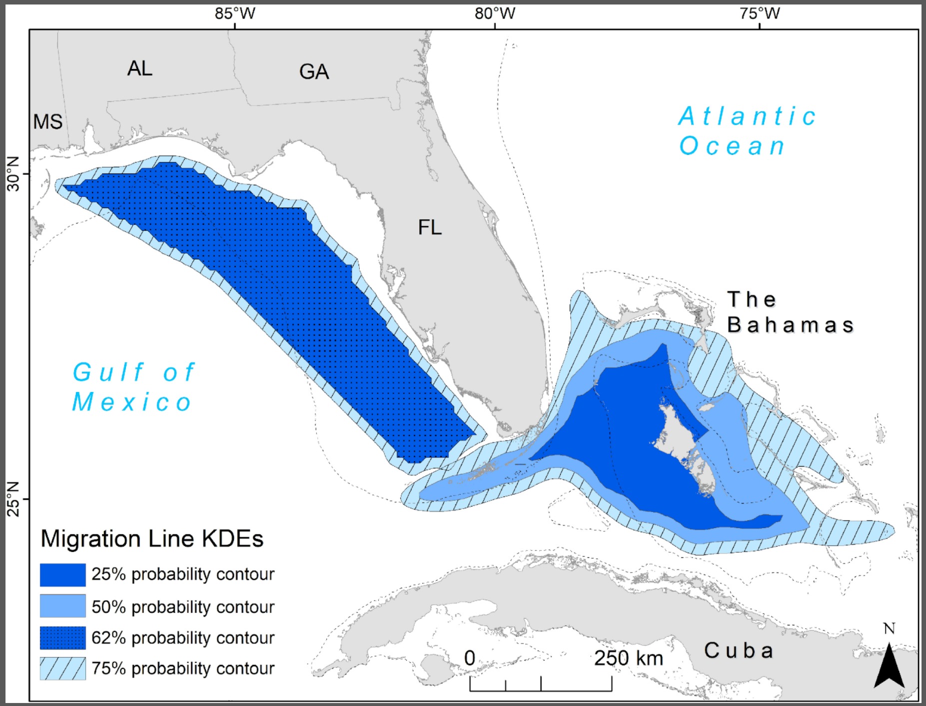
Animal Movements

Margaret Lamont, Ph.D. mlamont@usgs.gov
U.S. Geological Survey
Wetland and Aquatic Research Center



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Different methods to collect movement (and distribution) data:

1. Telemetry
2. eDNA: invasive species but also imperiled and species of interest.

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eDNA: species detections using water samples

1. monitoring species use of oil/gas platforms or wind turbines
2. range expansion

Pairing eDNA with telemetry

Dr. Margaret Hunter - WARC

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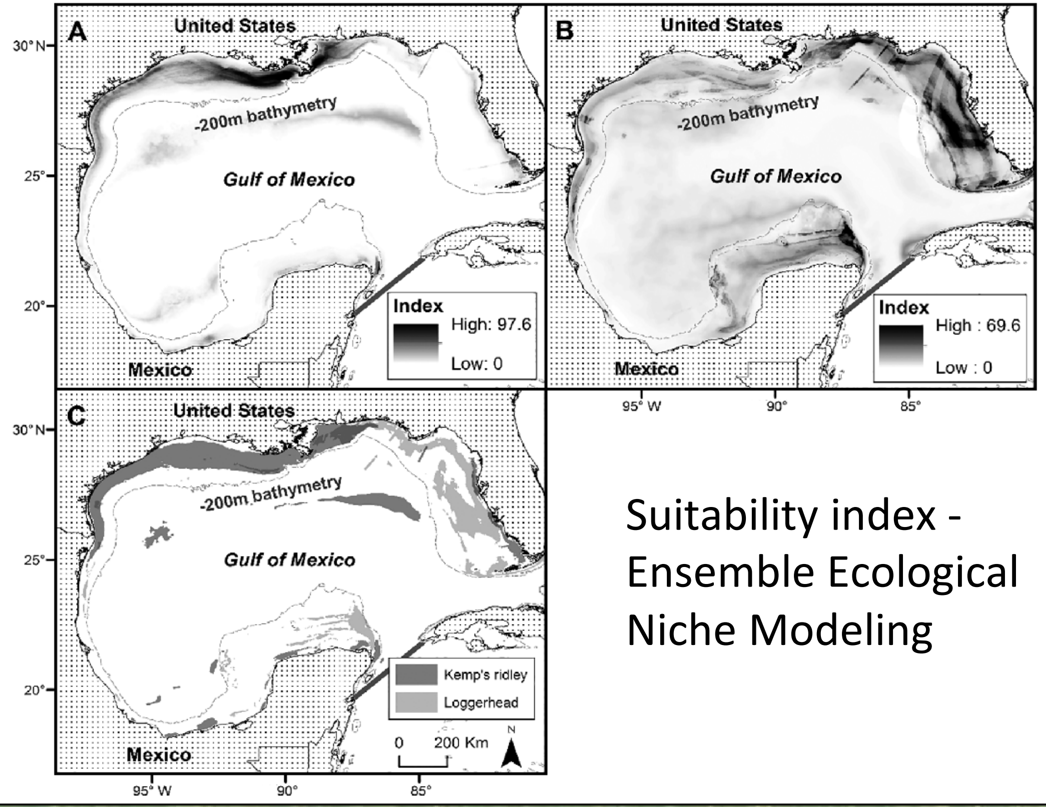
Telemetry

Tells us where animals are and how they are behaving at those sites. Coupled with habitat data we can address why they are at those sites.



Suitability index - Ensemble Ecological Niche Modeling

Dr. Simeon Yurek
Dr. Gregg Sneddon
and others at the WARC

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Telemetry

1. Pop-off Archival Tags (PSATs)
2. Acoustic telemetry

Pop-off Archival Tags (PSATs)

External tags that typically trail behind the animal. Pops off and then transmits data. Provides data where receivers are not available.

Examples:
Gulf sturgeon: acoustic telemetry array in the river and estuary but extremely limited data on offshore movements.

Tiger sharks: expanding range impacting prey species (i.e. landscape of fear).

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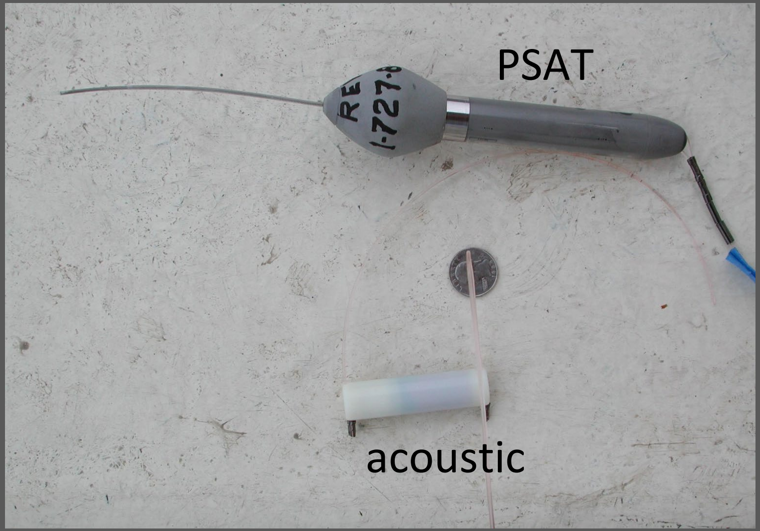
Acoustic telemetry

Small tag that transmits a unique code. Tags can be attached externally or internally. Relatively long-life.

Receiver that listens for those transmissions and records time of each detection. Can detect transmissions from any compatible tag.



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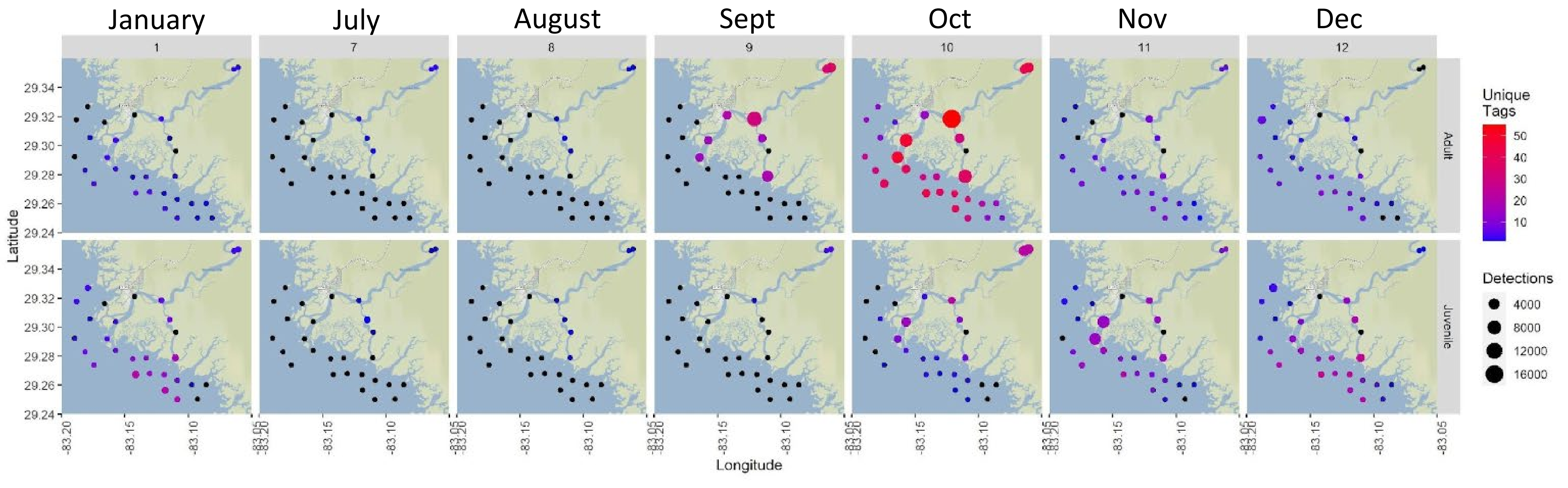
Acoustic telemetry

Provides data for:
1. Single species and site-specific questions
Example: long-term array in the Suwannee River and estuary for Gulf sturgeon.



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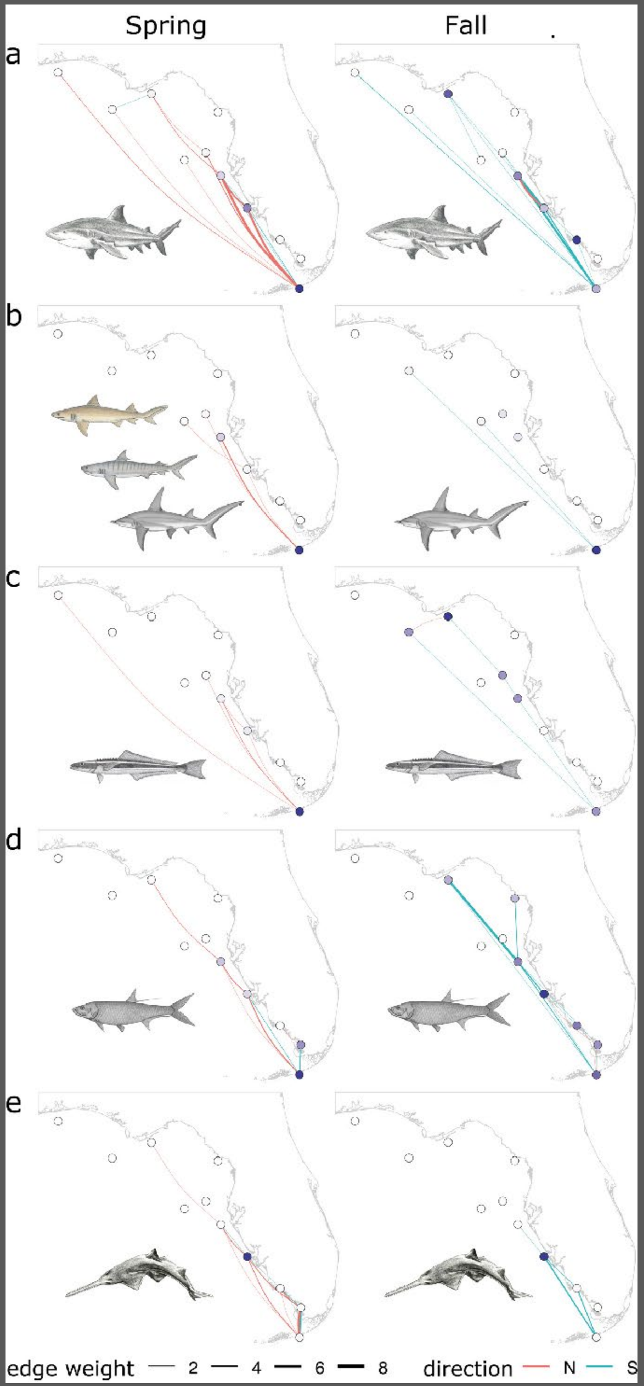
Acoustic telemetry

Provides data for:
2. Multi-species, broad-scale studies
Example: Collaborative acoustic array programs (GOM = iTAG).

Freiss et al. (2021): Regional-scale variability in the movement ecology of marine fishes revealed by an integrative acoustic tracking network.
21 arrays
29 species (WARC Gulf sturgeon)

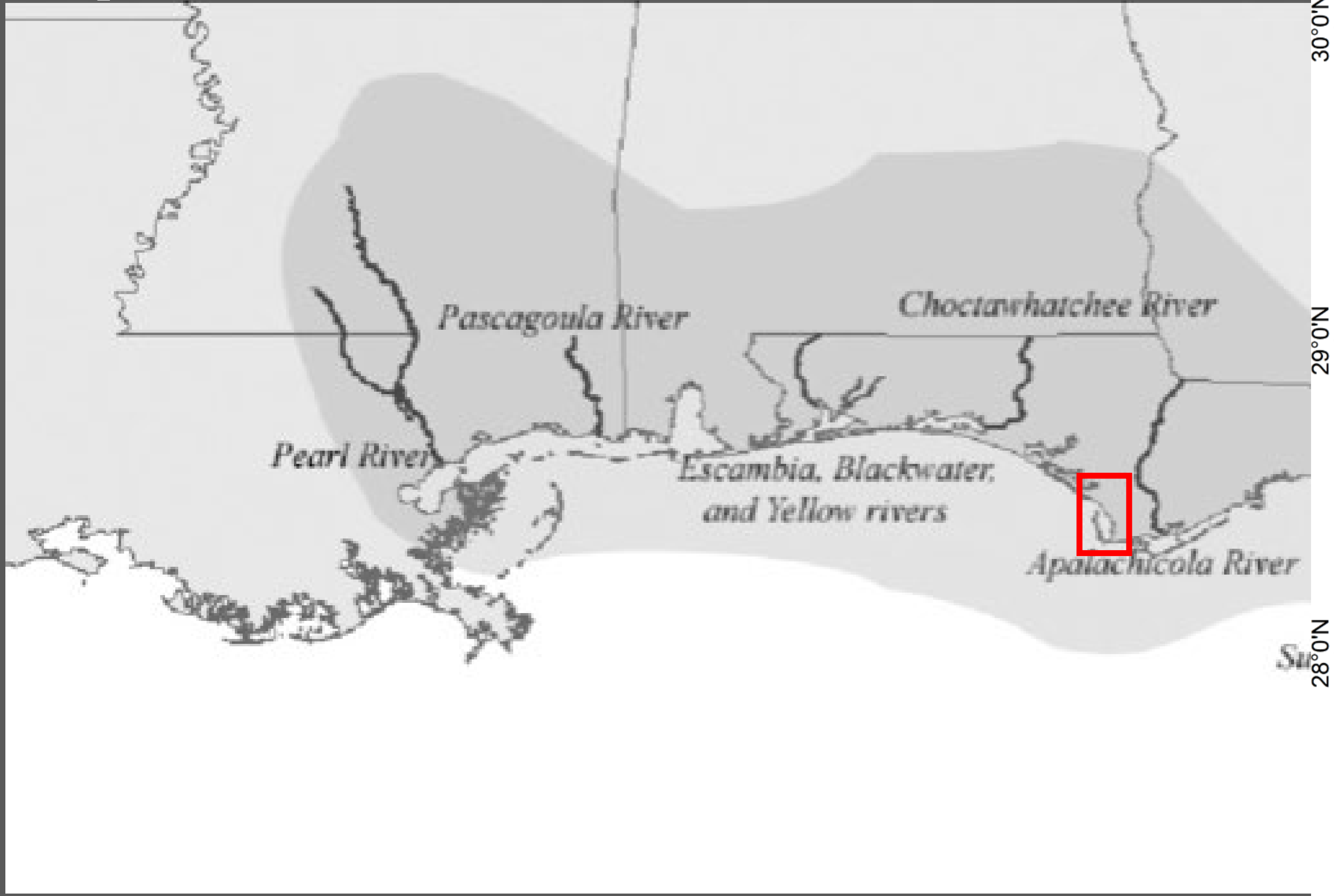
Included only fish tagged by authors (37)

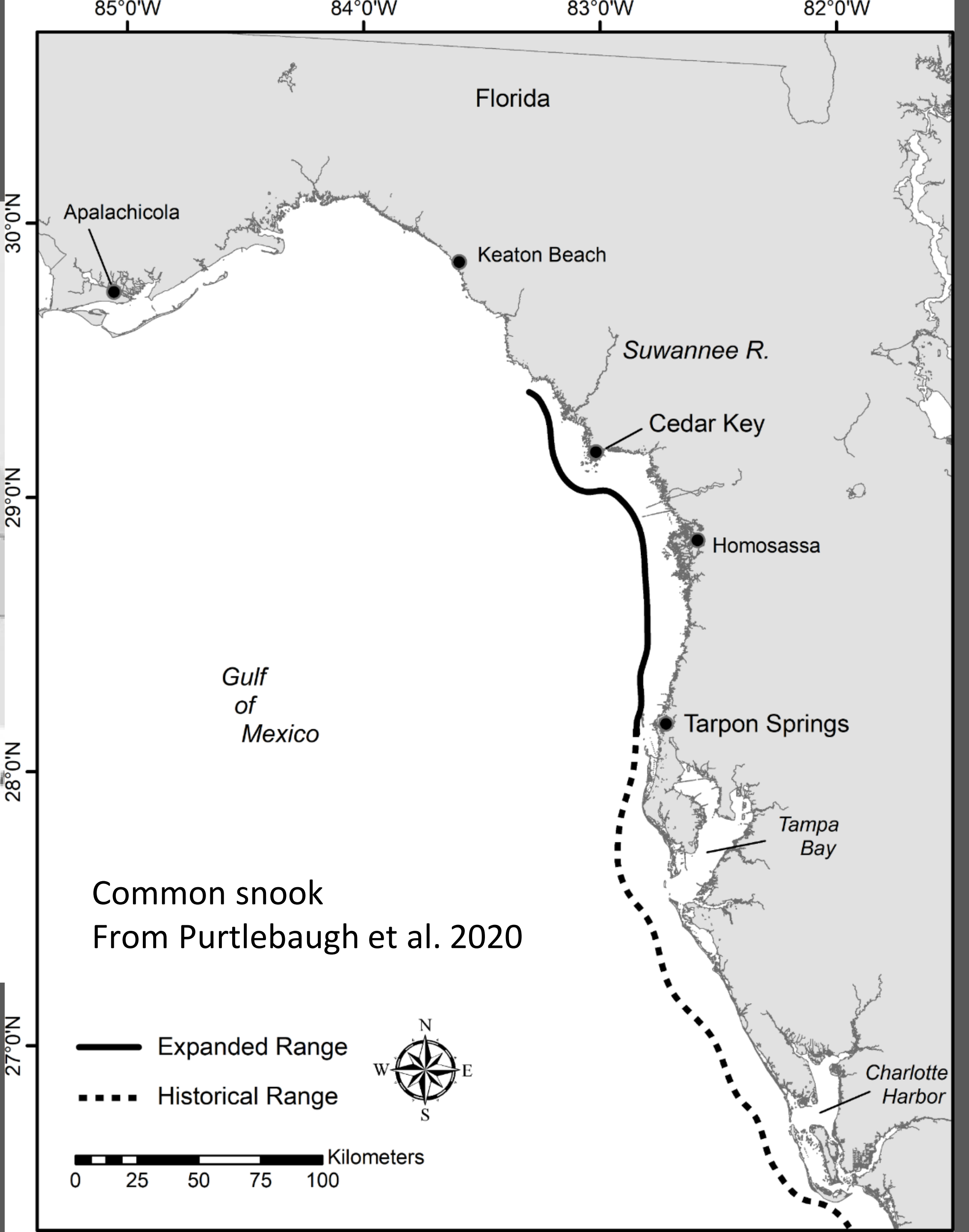
Common name	Scientific name
Atlantic tarpon	*Megalops atlanticus*
Blacktip shark	*Carcharhinus limbatus*
Bonnethead	*Sphyrna tiburo*
Bull shark	*Carcharhinus leucas*
Cobia	*Rachycentron canadum*
Common snook	*Centropomus undecimalis*
Gafftopsail catfish	*Bagre marinus*
Gag grouper	*Mycteroperca microlepis*
Goliath grouper	*Epinephelus itajara*
Gray snapper	*Lutjanus griseus*
Great hammerhead	*Sphyrna mokarran*
Greater amberjack	*Seriola dumerili*
Grey triggerfish	*Balistes capriscus*
Gulf sturgeon	*Acipenser oxyrinchus desotoi*
Hardhead catfish	*Ariopsis felis*
Largemouth bass	*Micropterus salmoides*
Lemon shark	*Negaprion brevirostris*
Nurse shark	*Ginglymostoma cirratum*
Red drum	*Sciaenops ocellatus*
Red grouper	*Epinephelus morio*
Red snapper	*Lutjanus campechanus*
Sandbar shark	*Carcharhinus plumbeus*
Scamp	*Mycteroperca phenax*
Sheepshead	*Archosargus probatocephalus*
Smalltooth sawfish	*Pristis pectinata*
Southern kingfish	*Menticirrhus americanus*
Tiger shark	*Galeocerdo cuvier*
White shark	*Carcharodon carcharias*
Whitespotted eagle ray	*Aetobatus narinari*



Spring/fall movement networks

Detect all compatible





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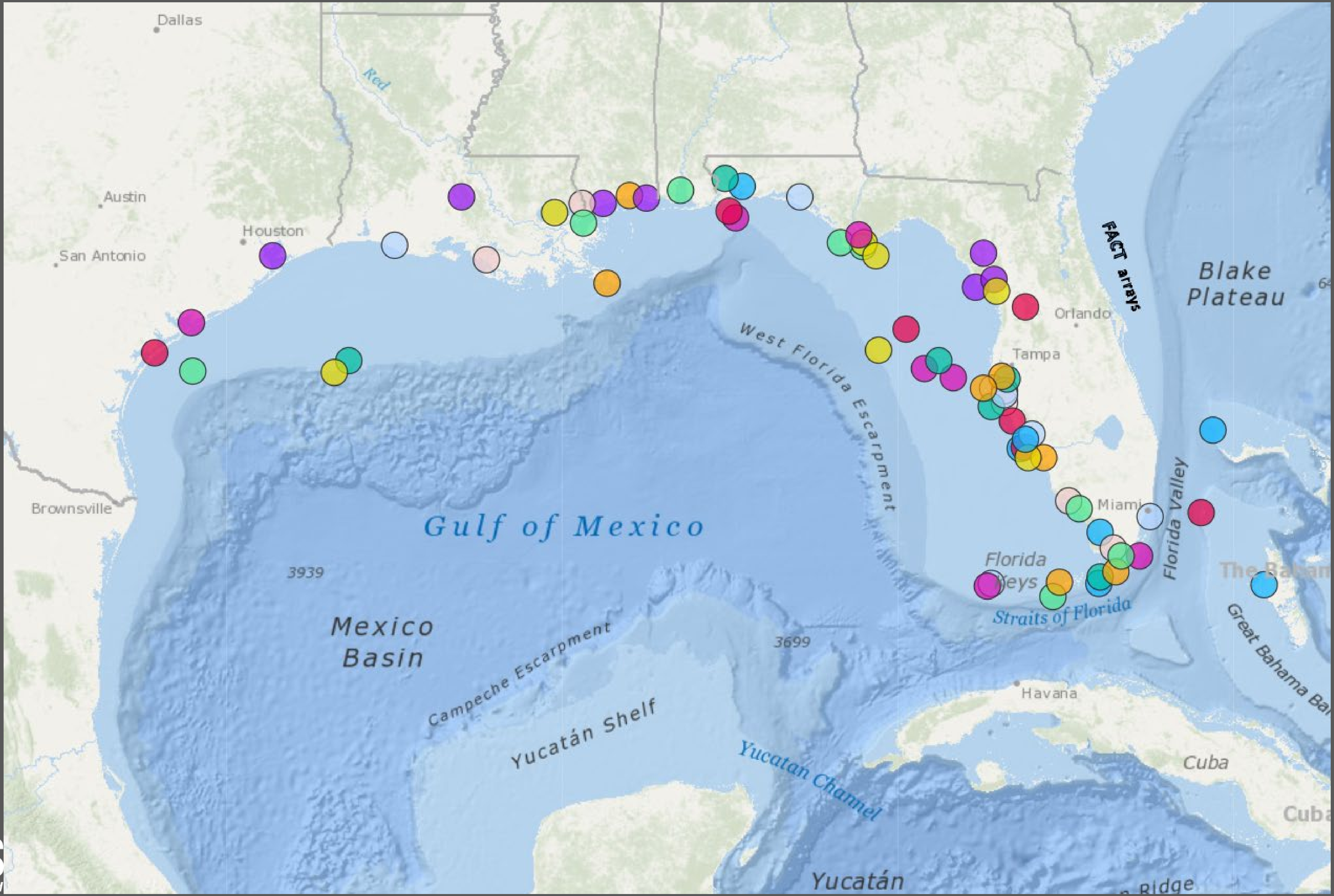

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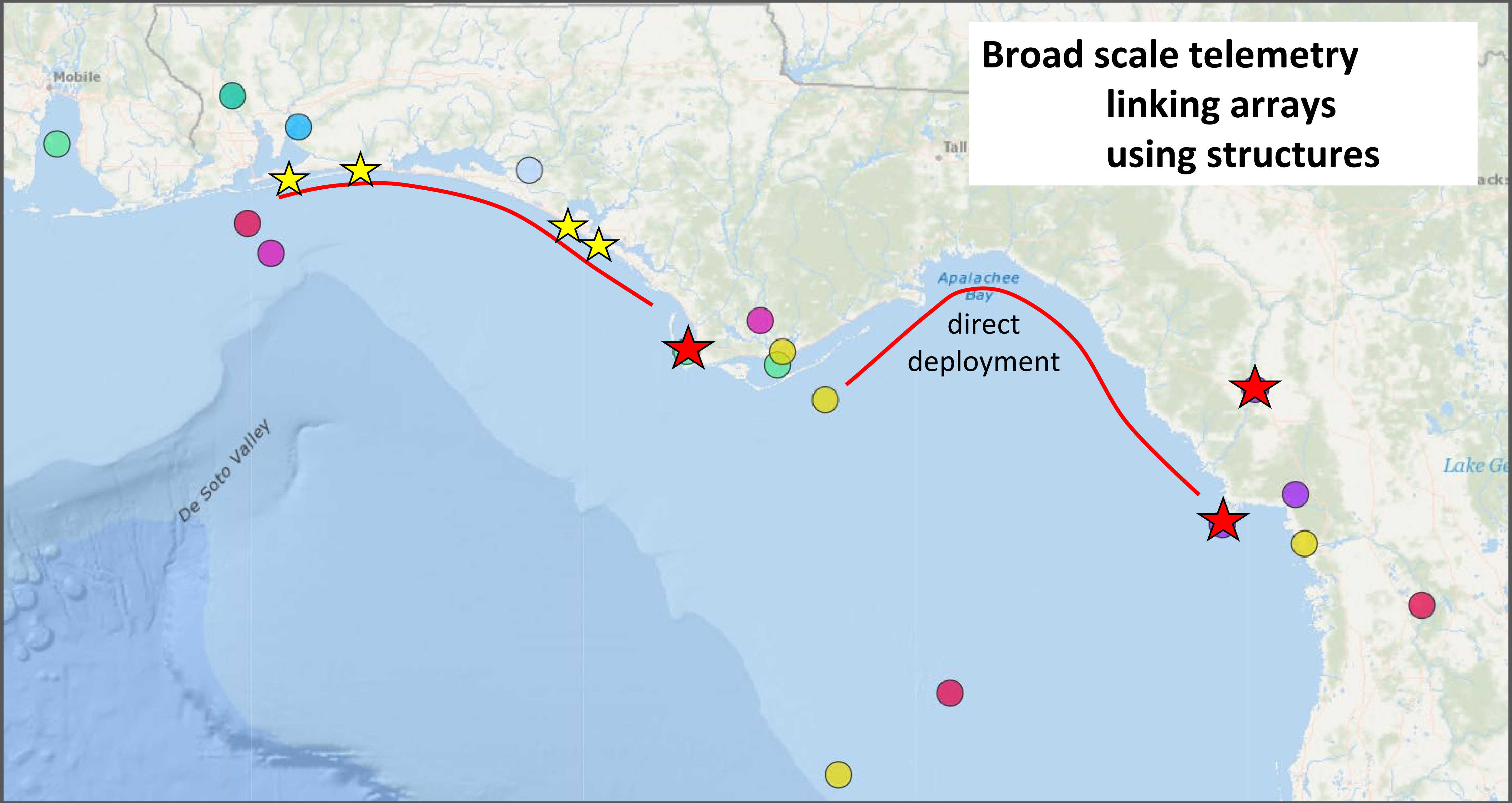
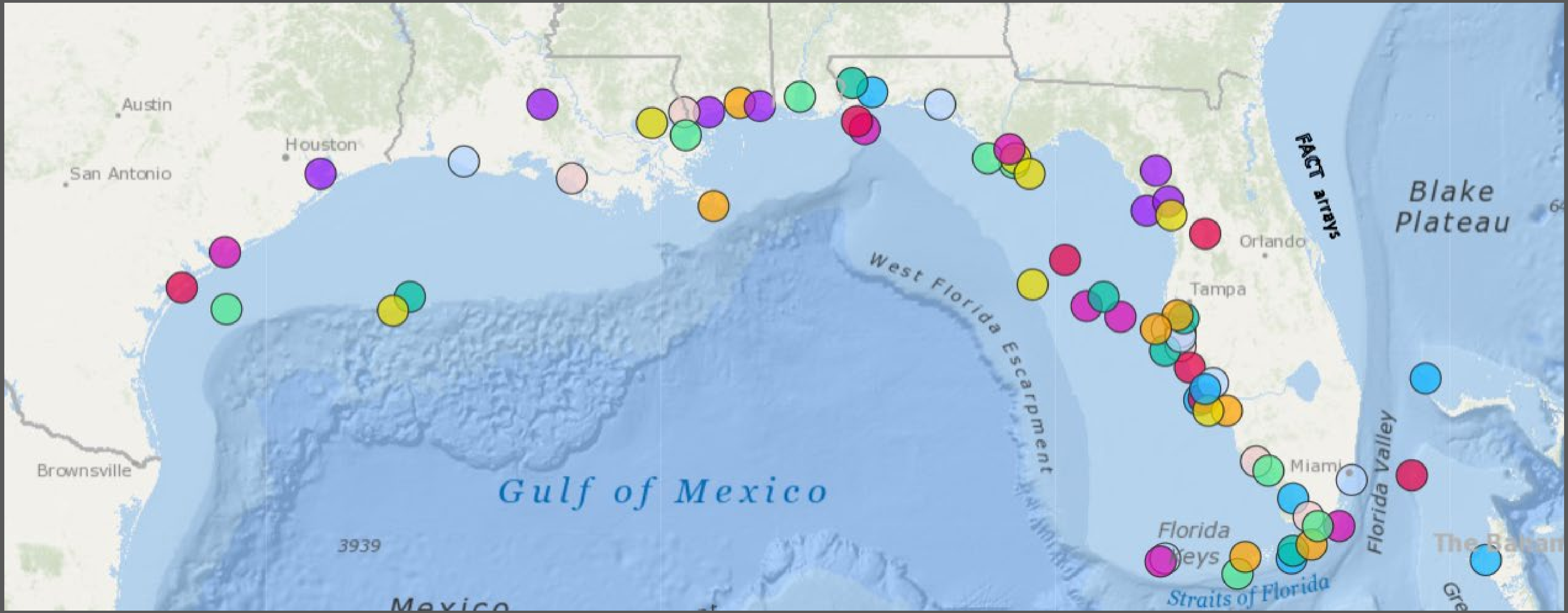
Broad scale telemetry linking arrays using structures





1. Address specific project objectives
2. Ease of access

Deployed, anchored (well), maintained, downloaded

Utilize fixed structures – piers, reefs, platforms, etc.

Reduces need for anchor

These structures are often visited for other reasons (e.g. reef clean up events)

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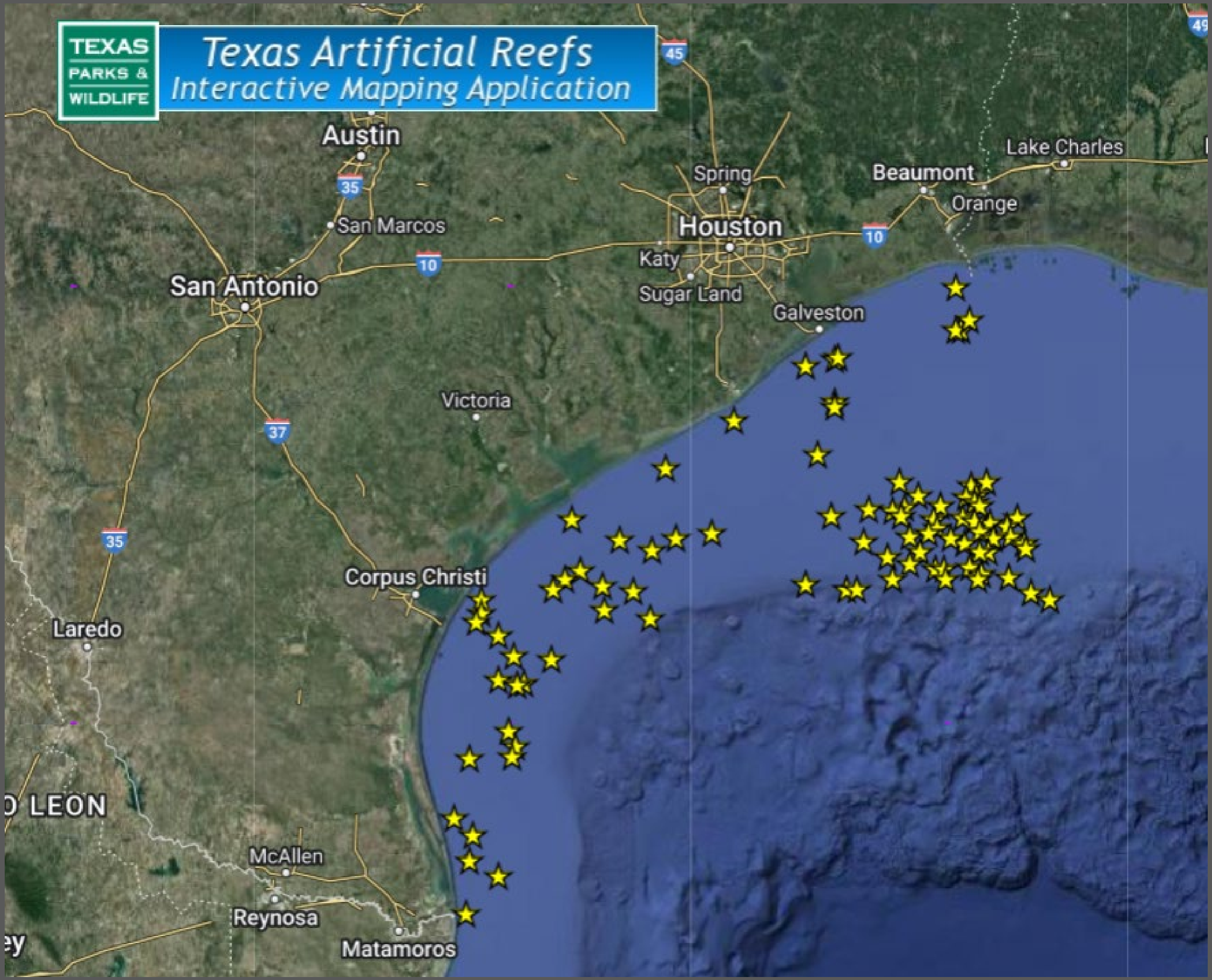
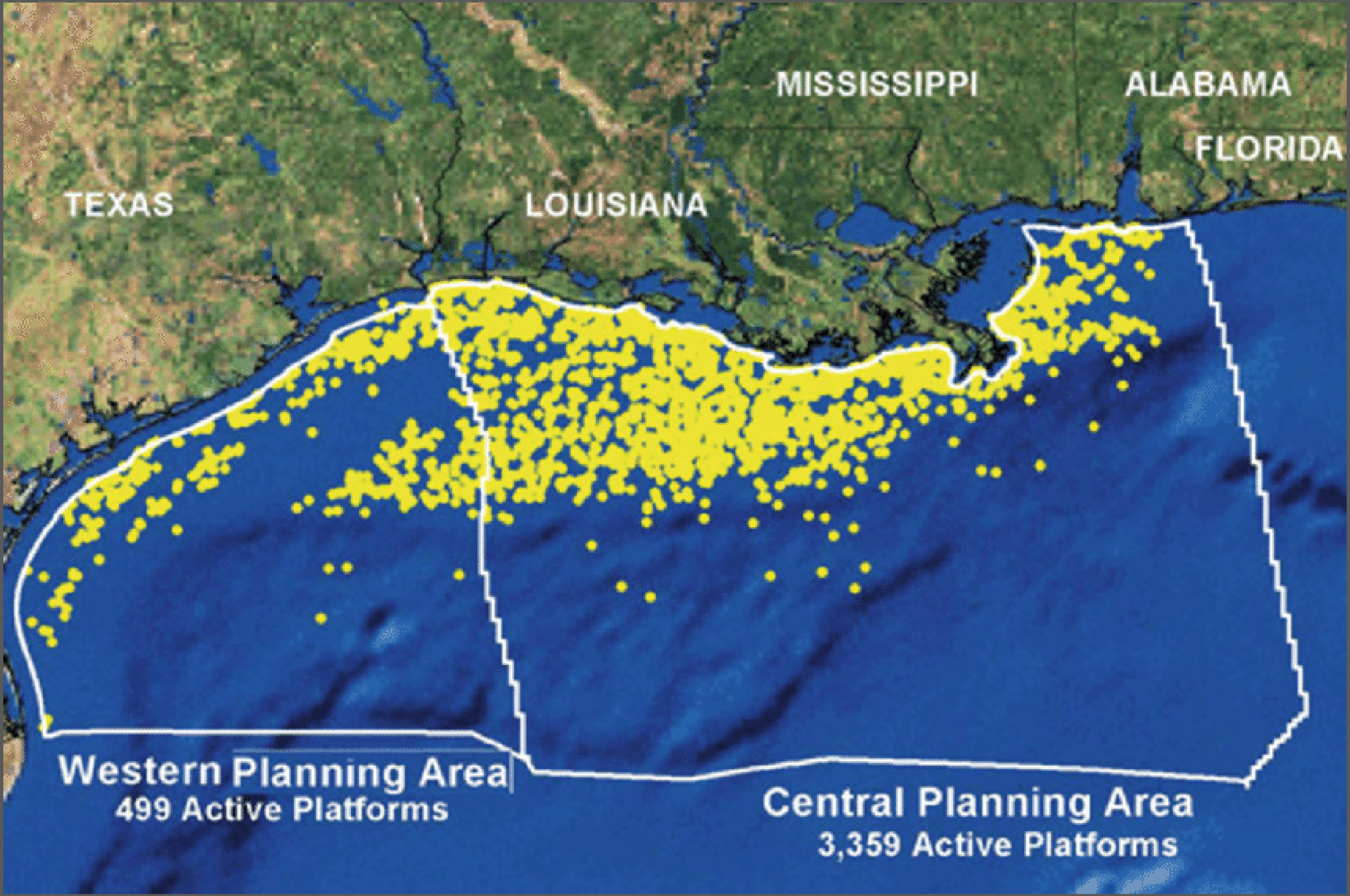
STATE	GOM SHORELINE (Miles)	NUMBER OF REEFS	Acres (est.)
Florida	1,350	3,100 reefs (2,100 in Gulf)	457,676
Alabama	53	1,030 sq miles permitted	872,974
Mississippi	44	15 reefs	16,000
Louisiana	397	9 offshore planning areas (3,600 sq nm)	3,051,172
Texas	367	78 reefs (10 nearshore)	5,000





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Temporal and spatial relationships of Yellowfin Tuna to deep water petroleum platforms in the northern Gulf of Mexico.

Price et al. (*in press*) Journal of Marine and Coastal Fisheries

Deployed receivers on 6 deep water platforms; tagged Yellowfin Tuna at platforms.

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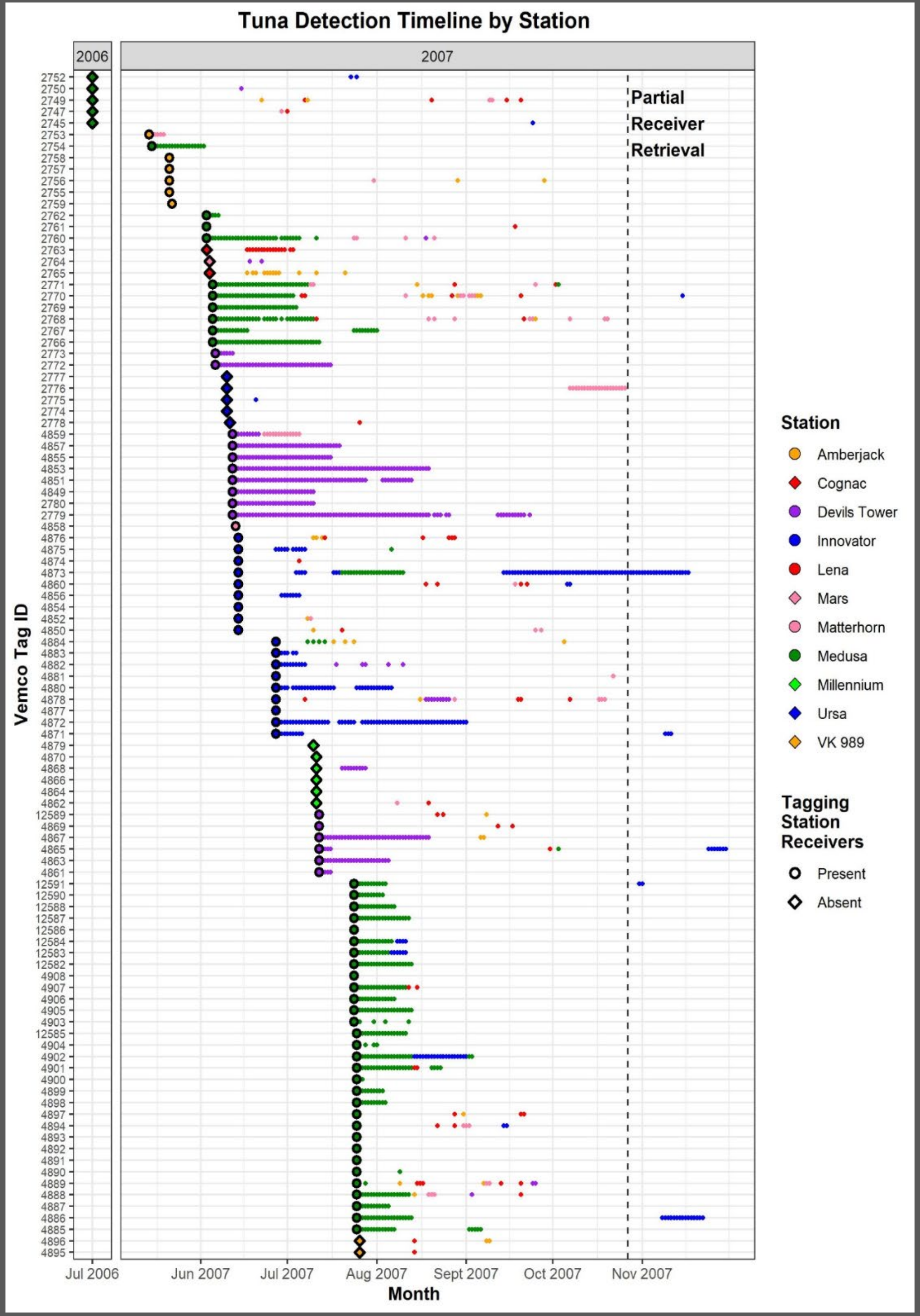

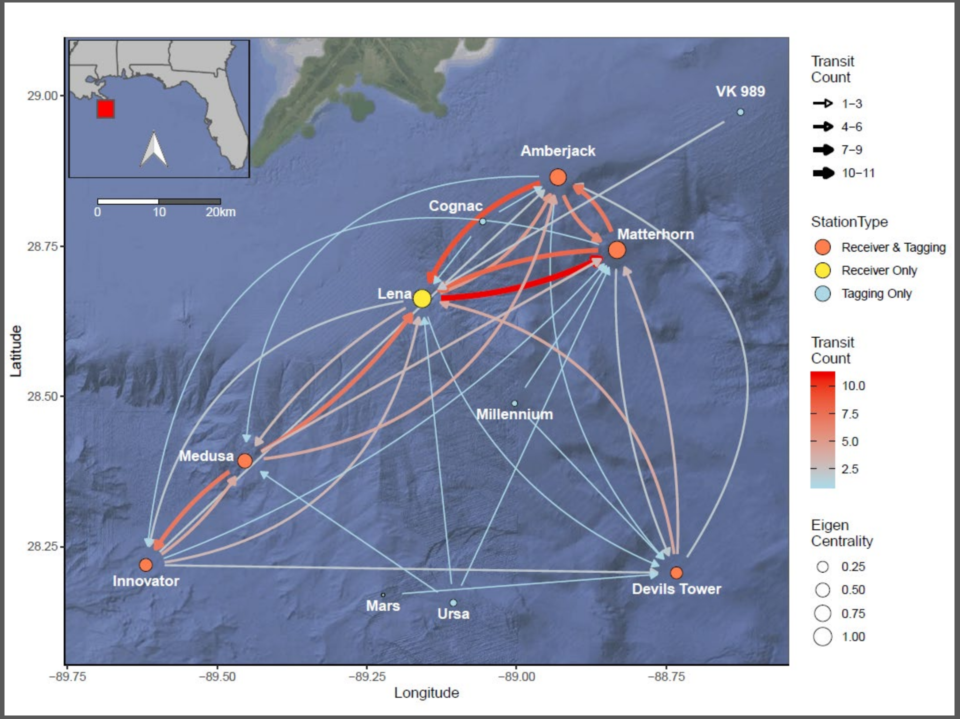

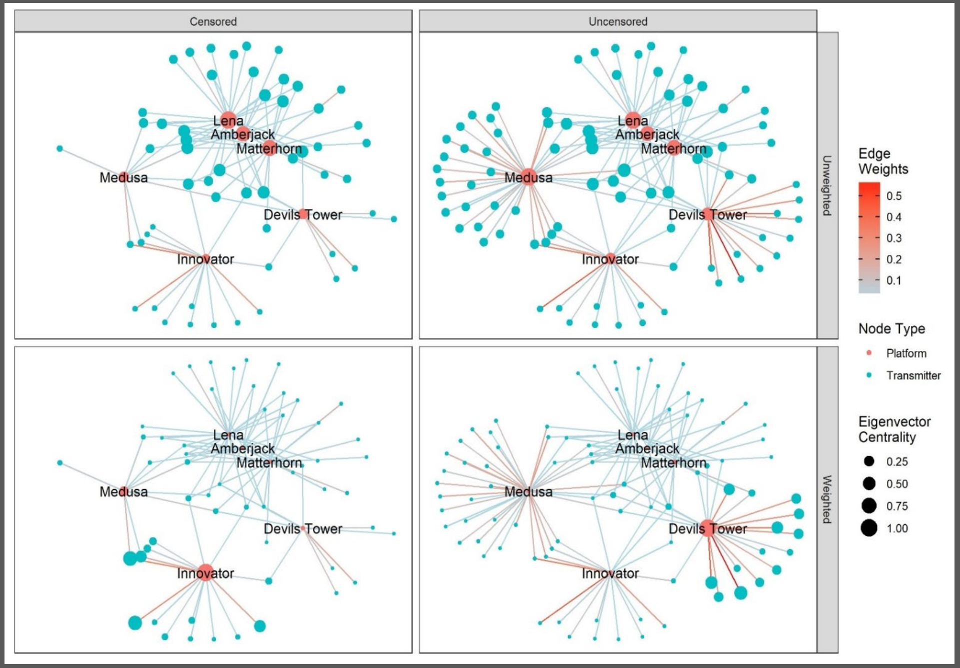

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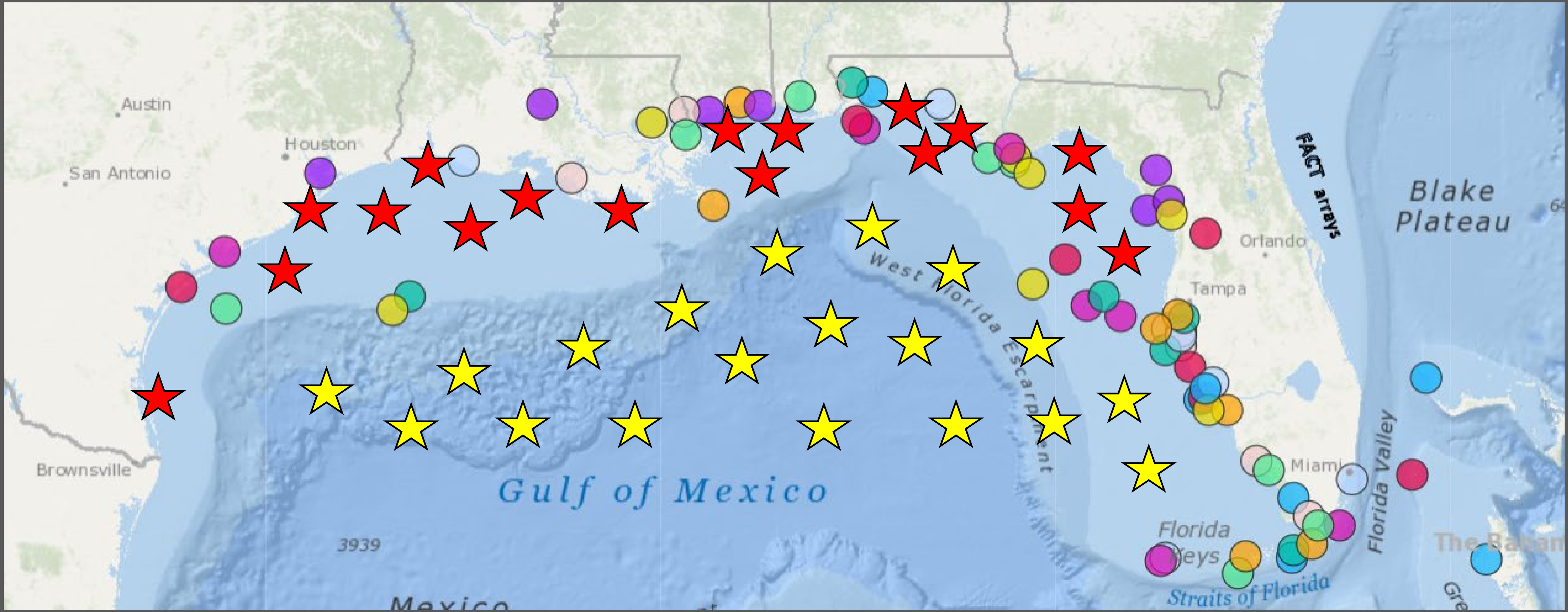


Natural Resource Damage Assessment: Animal movement patterns in, out, and around the Gulf of Mexico, including the identification of migratory pathways, sites of spawning aggregations, and the co-location of animals with existing or future threats

Habitat and water quality monitoring: marine species as platforms for environmental monitoring (e.g. temperature, chlorophyll, light levels)

examples:

Real-time monitoring of water quality using fish and crayfish as bio-indicators: a review

Iryna Kuklina, Antonín Kouba & Pavel Kozák

Animal-Borne Telemetry: An Integral Component of the Ocean Observing Toolkit

Rob Harcourt[1*], Ana M. M. Sequeira[2], Xuelei Zhang[3], Fabien Roquet[4], Kosei Komatsu[5,6], Michelle Heupel[7], Clive McMahon[8], Fred Whoriskey[9], Mark Meekan[10], Gemma Carroll[11], Stephanie Brodie[11], Colin Simpfendorfer[12], Mark Hindell[13], Ian Jonsen[1], Daniel P. Costa[14], Barbara Block[15], Mônica Muelbert[16,17], Bill Woodward[18], Mike Weise[19], Kim Aarestrup[20], Martin Biuw[21,22], Lars Boehme[23], Steven J. Bograd[11], Dorian Cazau[24], Jean-Benoit Charrassin[25], Steven J. Cooke[26], Paul Cowley[27], P. J. Nico de Bruyn[28], Tiphaine Jeanniard du Dot[29], Carlos Duarte[30], Víctor M. Eguíluz[31], Luciana C. Ferreira[10], Juan Fernández-Gracia[31], Kimberly Goetz[32], Yusuke Goto[6], Christophe Guinet[33], Mike Hammill[29], Graeme C. Hays[34], Elliott L. Hazen[11], Luis A. Hückstädt[14], Charlie Huveneers[35], Sara Iverson[36], Saifullah Arifin Jaaman[37], Kongkiat Kittiwattanawong[38], Kit M. Kovacs[21], Christian Lydersen[21], Tim Moltmann[39], Masaru Naruoka[40], Lachlan Phillips[1], Baptiste Picard[33], Nuno Queiroz[41], Gilles Reverdin[42], Katsufumi Sato[6], David W. Sims[43,44], Eva B. Thorstad[45], Michele Thums[10], Anne M. Treasure[28,46], Andrew W. Trites[47], Guy D. Williams[48], Yoshinari Yonehara[6] and Mike A. Fedak[23]

A Correction for the Thermal Mass–Induced Errors of CTD Tags Mounted on Marine Mammals

VIGAN MENSAH,[a] FABIEN ROQUET,[b,c] LIA SIEGELMAN-CHARBIT,[d,e] BAPTISTE PICARD,[f] ETIENNE PAUTHENET,[b] AND CHRISTOPHE GUINET[f]

Marine animals as platforms for oceanographic sampling: a "win/win" situation for biology and operational oceanography

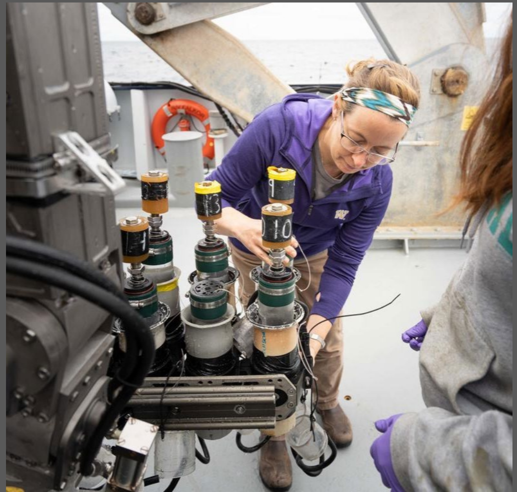
Mike Fedak

NERC Sea Mammal Research Unit (SMRU), Gatty Marine Laboratory, School of Biology, University of St. Andrews, Fife KY16 8LB, Scotland (maf3@st-and.ac.uk)

Calibration procedures and first dataset of Southern Ocean chlorophyll *a* profiles collected by elephant seals equipped with a newly developed CTD-fluorescence tags

C. Guinet[1], X. Xing[2,3,4], E. Walker[5], P. Monestiez[5], S. Marchand[6], B. Picard[1], T. Jaud[1], M. Authier[1], C. Cotté[1,7], A. C. Dragon[1], E. Diamond[2,3], D. Antoine[2,3], P. Lovell[8], S. Blain[9,10], F. D'Ortenzio[2,3], and H. Claustre[2,3]

QUESTIONS?



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