Ontogeny & marsh restoration status influence the trophic ecology of Gulf Killifish (*Fundulus grandis*) in coastal Louisiana

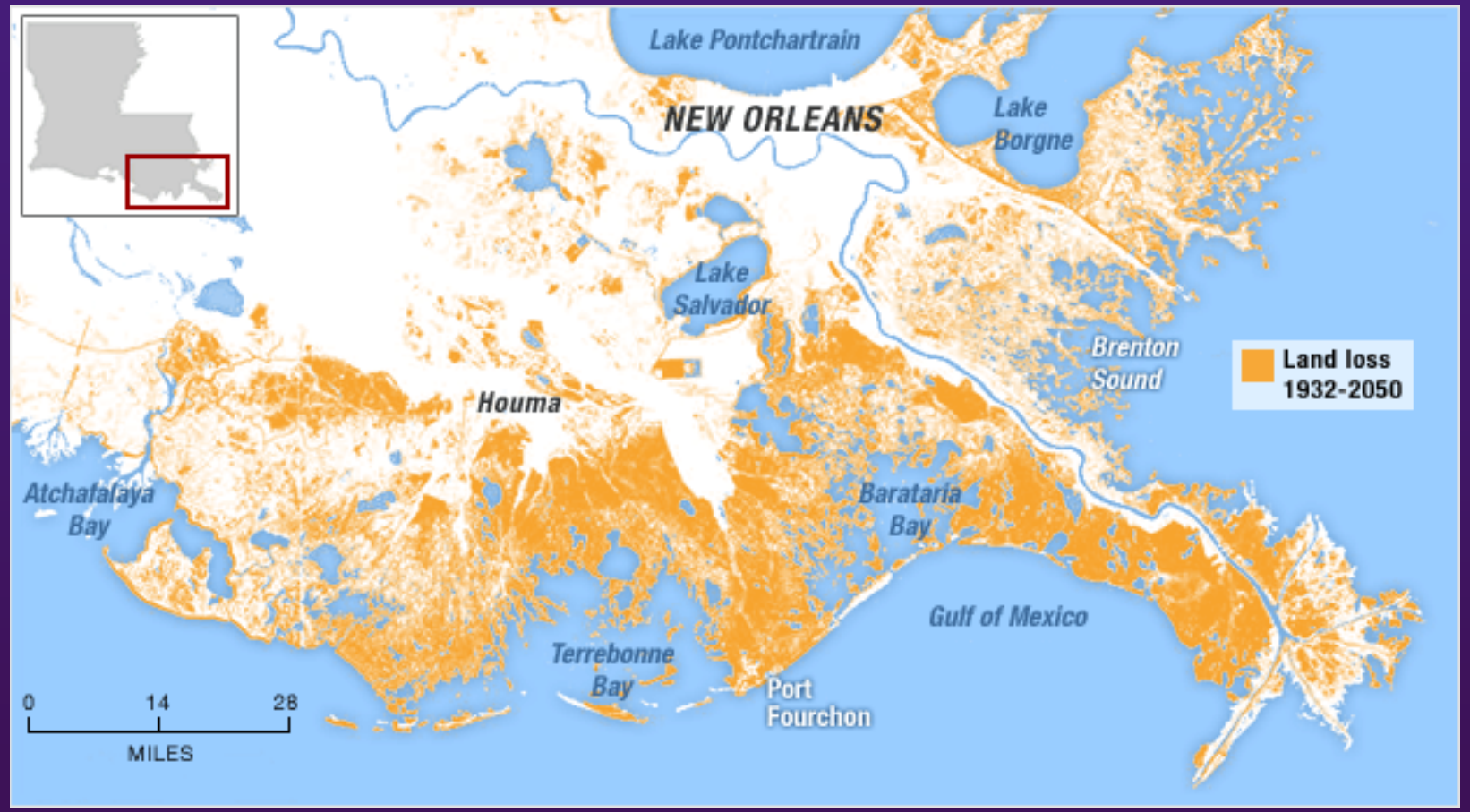
M. Polito[1], P. Brahana[1], K. Lamb[1], P. Lopez-Duarte[2], J. Olin[3], B. Roberts[4], E. Swenson[1]. Moyo[1,5]

[1]Louisiana State University, [2]University of North Carolina Charlotte , [3]Michigan Technological University, [4]Louisiana Universities Marine Consortium, [5]Rhodes College

LSU

The Gulf of Mexico Conference, Apr 27, 2022 10:30 - 10:45 AM

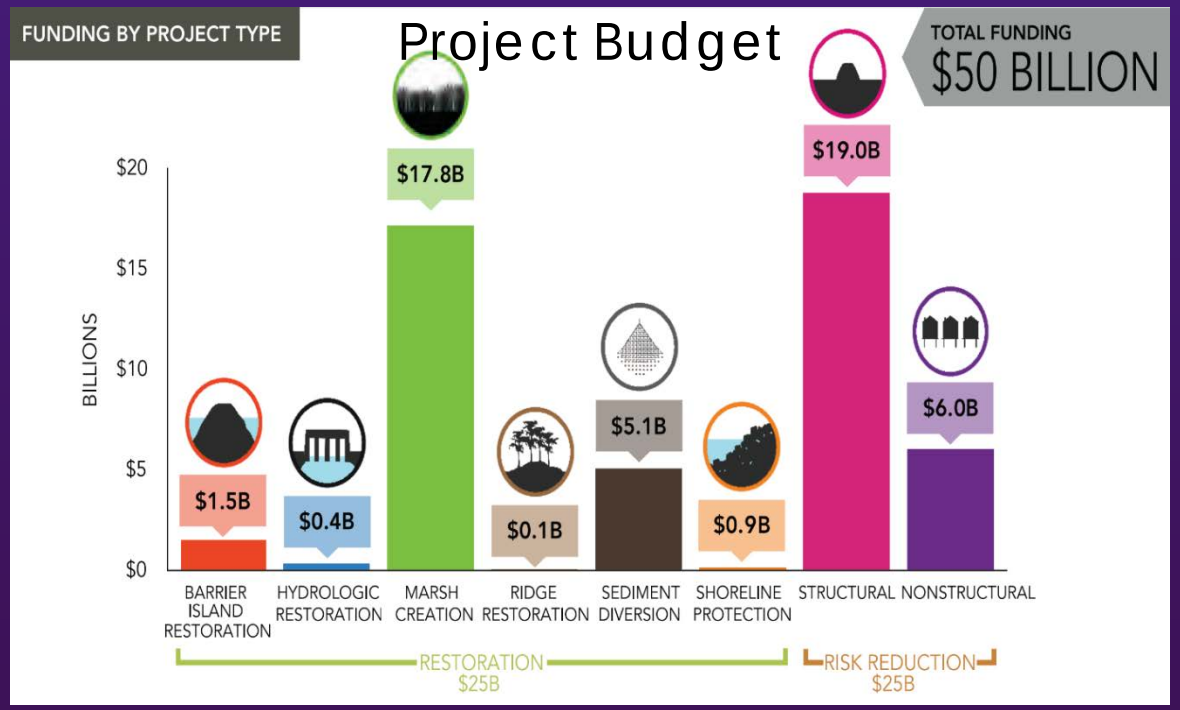
Coastal land loss in Louisiana



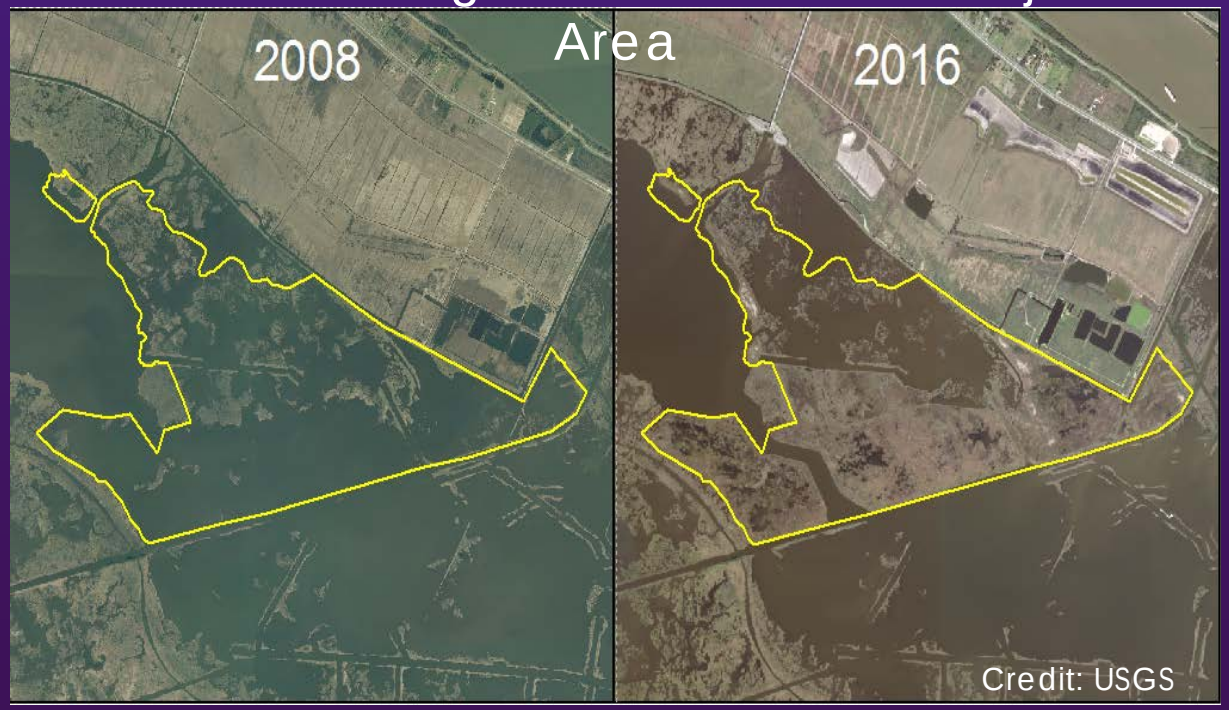
- From the early 1930s to 2000, Louisiana lost an area close to the size of Delaware.

Marsh creation is a key restoration strategy

2017 Louisiana Coastal Master Plan Project Budget



Lake Hermitage Marsh Creation Project Area



It looks like a marsh & it smells like a marsh, but does it function like a marsh?

- Post construction monitoring efforts commonly evaluate structural characteristics & species abundance.
- However, these do not provide an evaluation of functional qualities like species diets * food web structure.

Gulf Killifish (*Fundulus grandis*) as an indicator apecies

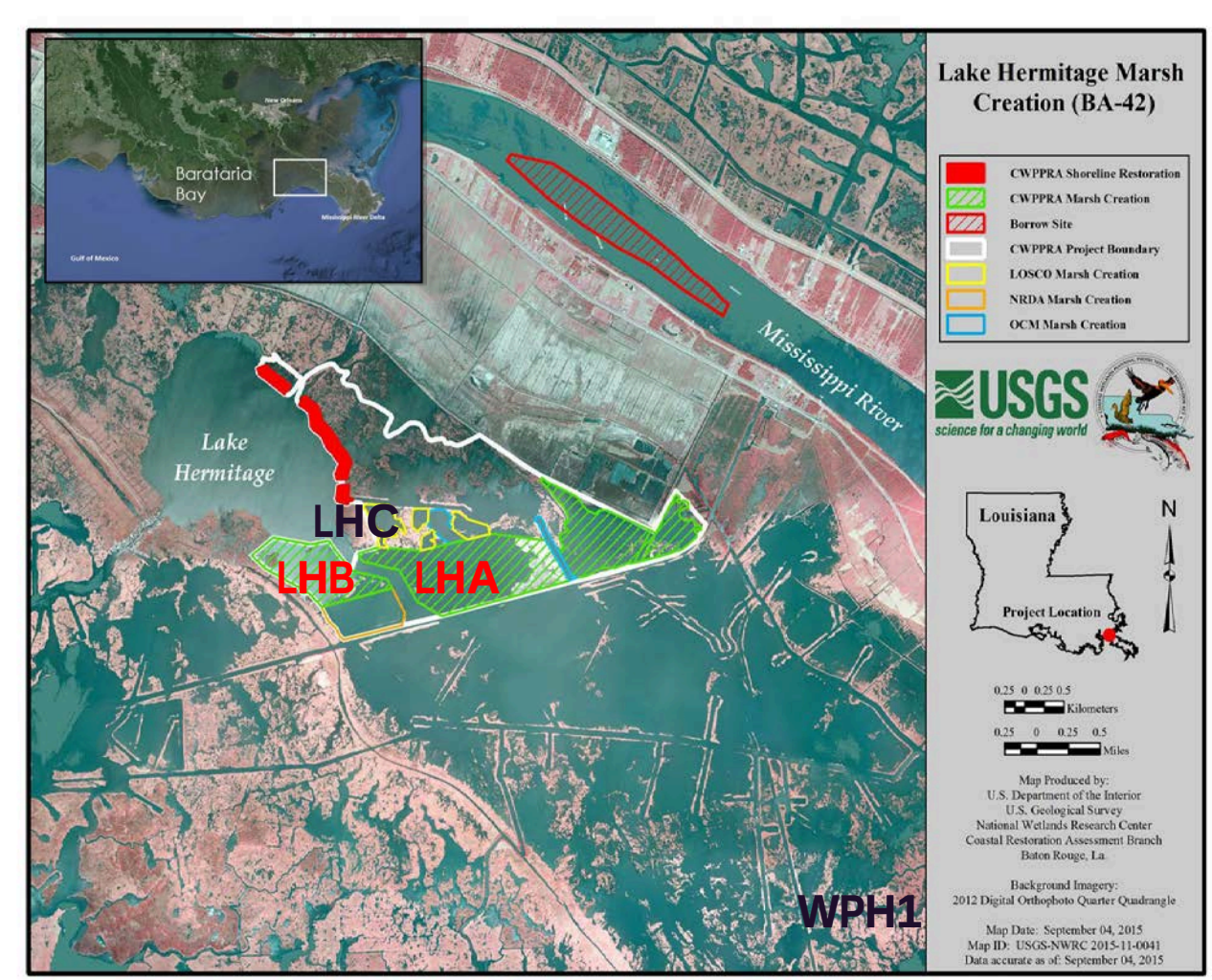
- Widely used to examine the effects of oils spills, coastal habitat degradation, & restoration activities.
- However, using a species for biomonitoring requires a solid understanding of their trophic ecology, habitat use, & life-history.

Photo by Zachary Randall

Study Goal:

Use stable isotope analysis to determine if the trophic position and the relative importance of aquatic vs. terrestrial carbon sources in Gulf Killifish differ with ontogeny, sex, & among created & reference brackish marshes.

Study Area



- Lake Hermitage Marsh Creation Project Area
- West Point a la Hache Plaquemines Parish, LA
- 4 Sampling Sites
  - Created marshes
    - LHA, LHB
  - Reference Marshes
    - LHC, WPH1

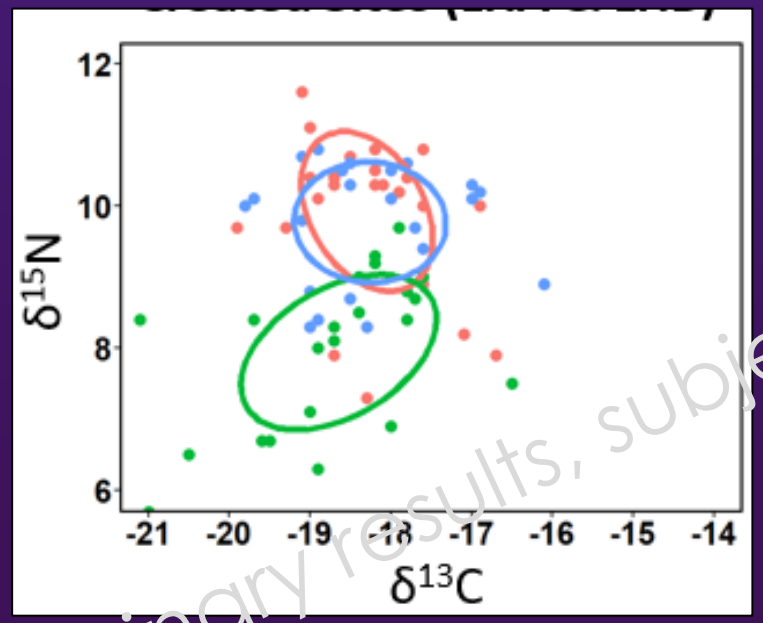
Methods

Sample Collection & Analysis

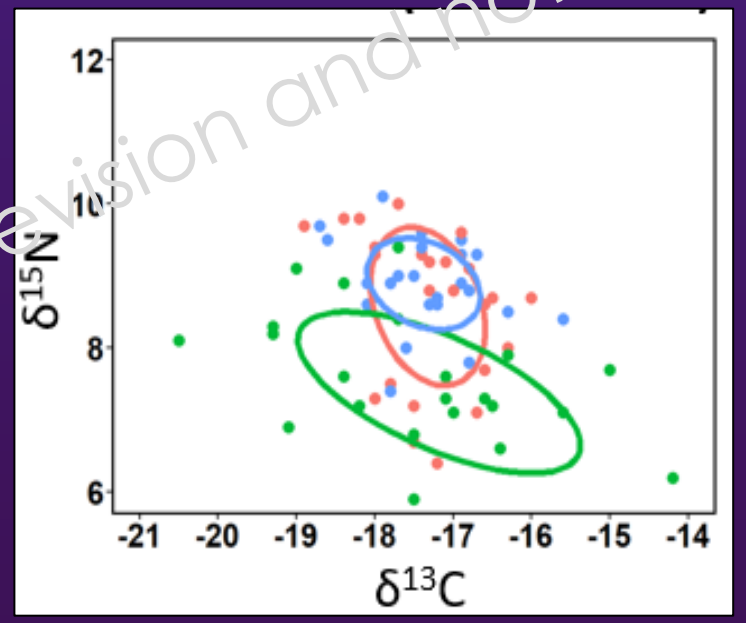
- May 2018 (~6 years post creation)
- Killifish
  - 12 fish per site, per sex (juv., male, female)
- Basal carbon sources
  - Aquatic: POM, BMA, Epiphytic Algae
  - Terrestrial: *Spartina alterniflora, S. patens, Distichlis spicata, Paspalum sp.*
- Stable Isotope Analysis
  - $\delta^{13}C$ and $\delta^{15}N$ values
  - Isotopic niche position, area, & overlap
  - Trophic position & use of aquatic vs. terrestrial carbon sources

Little isotopic overlap among juveniles & adults

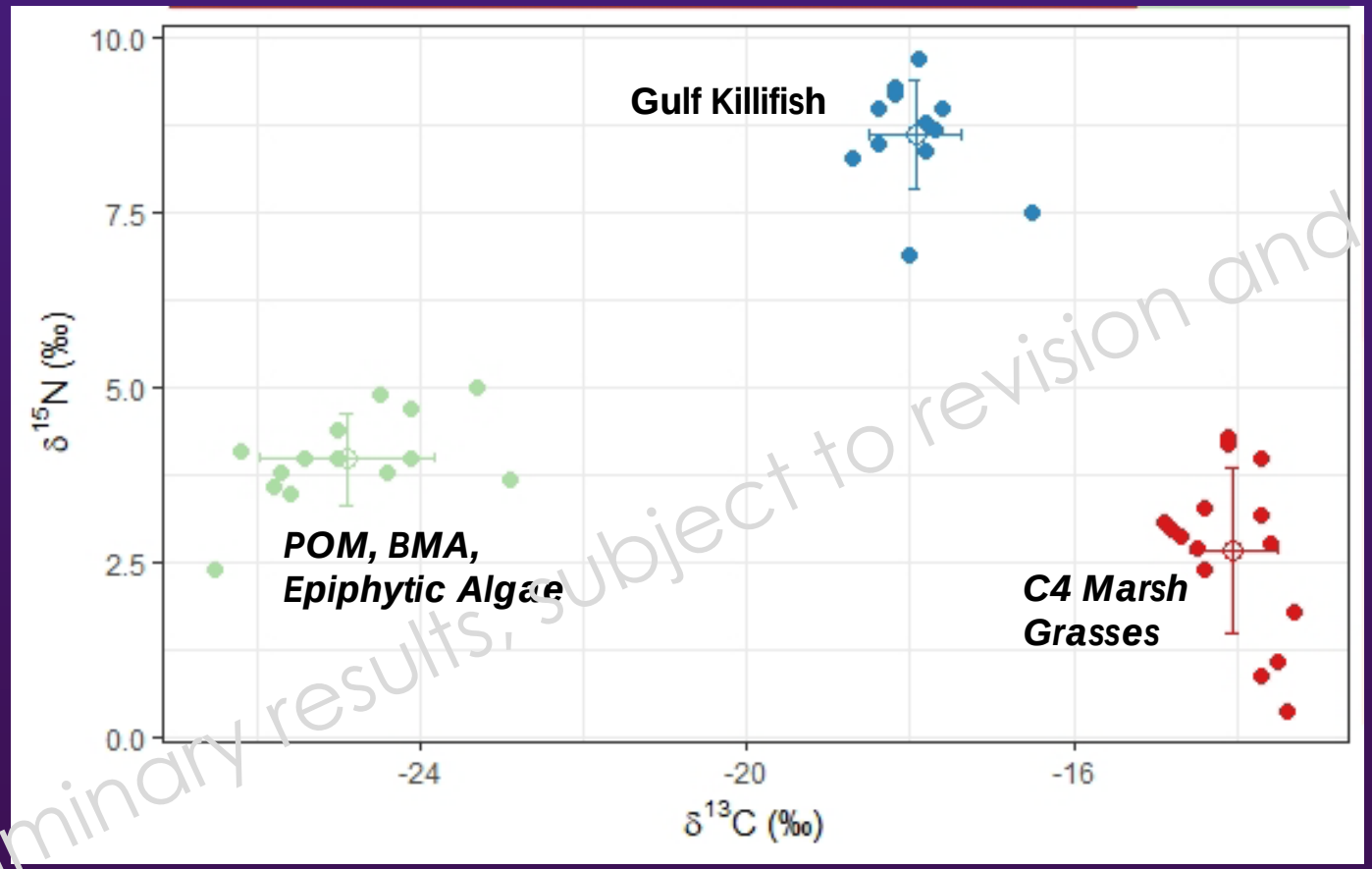
Created Marshes
(LHA &LHB)



Reference Marshes
(LHC & WPH2)



Comparing Gulf Killifish to aquatic & terrestrial baselines

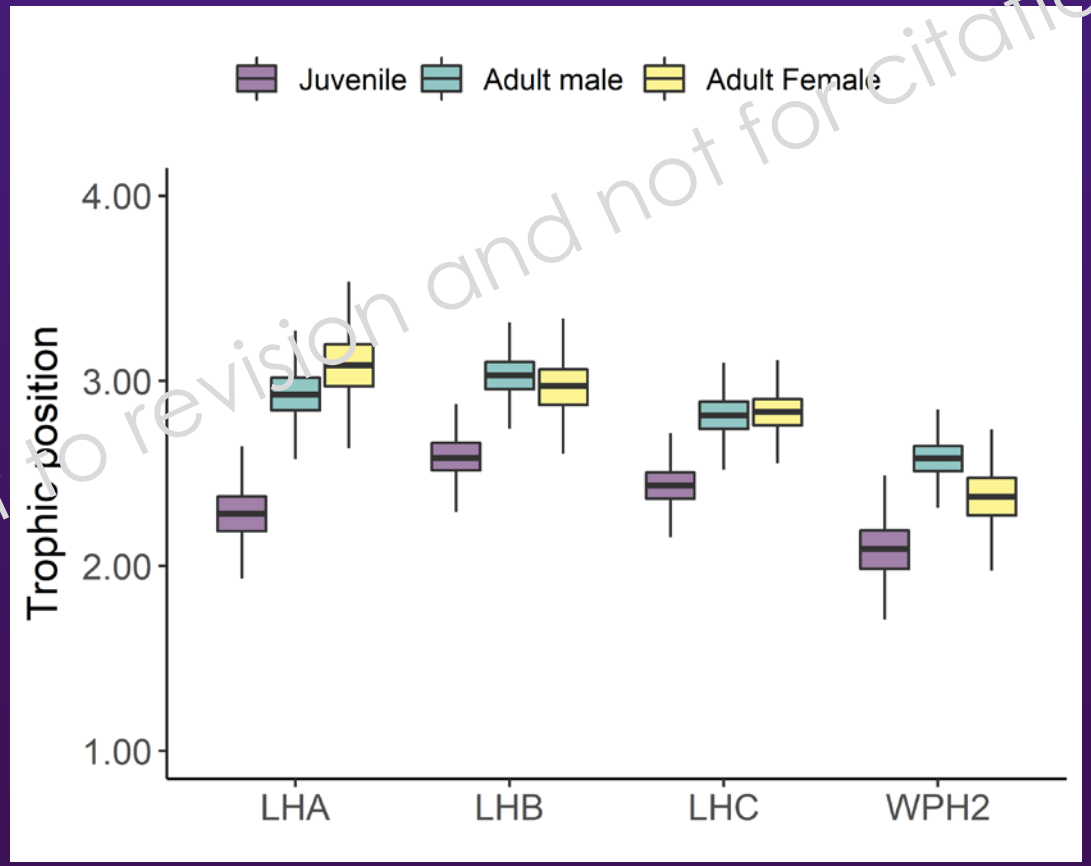


- tRophicPosition R package (Ver. 0.7.7)
- Trophic position
- Relative use of aquatic vs. terrestrial carbon sources (α)

Quezada-Romegialli et al. (2018). Methods in Ecology and Evolution, 9(6), 1592-1599.

Juveniles have lower trophic positions relative to adults

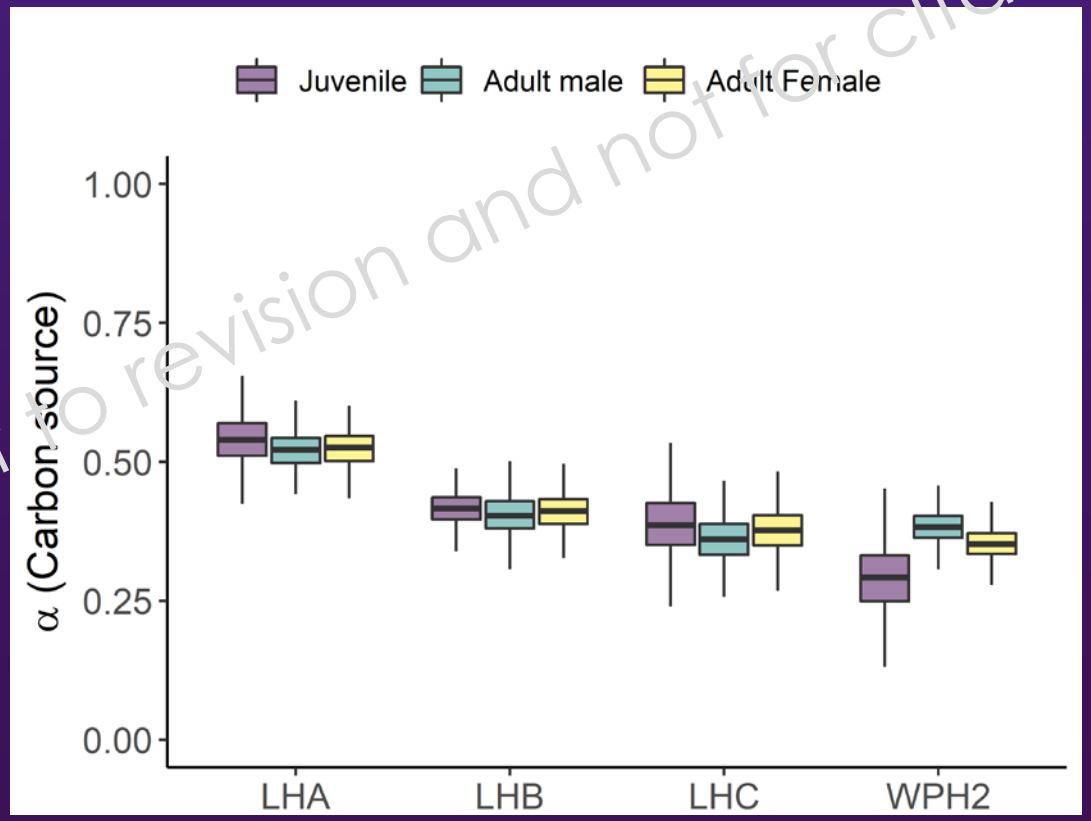
- No differences between adult male & females
- Trends are consistent among all created & reference marshes



Created Marshes | Reference Marshes

Killifish at created marshes use relatively more aquatic carbon (61-70%) than fish at reference marshes (46-59%)

- This trend is most pronounced at LHA
- Even so terrestrial carbon sources are relatively important at all sites

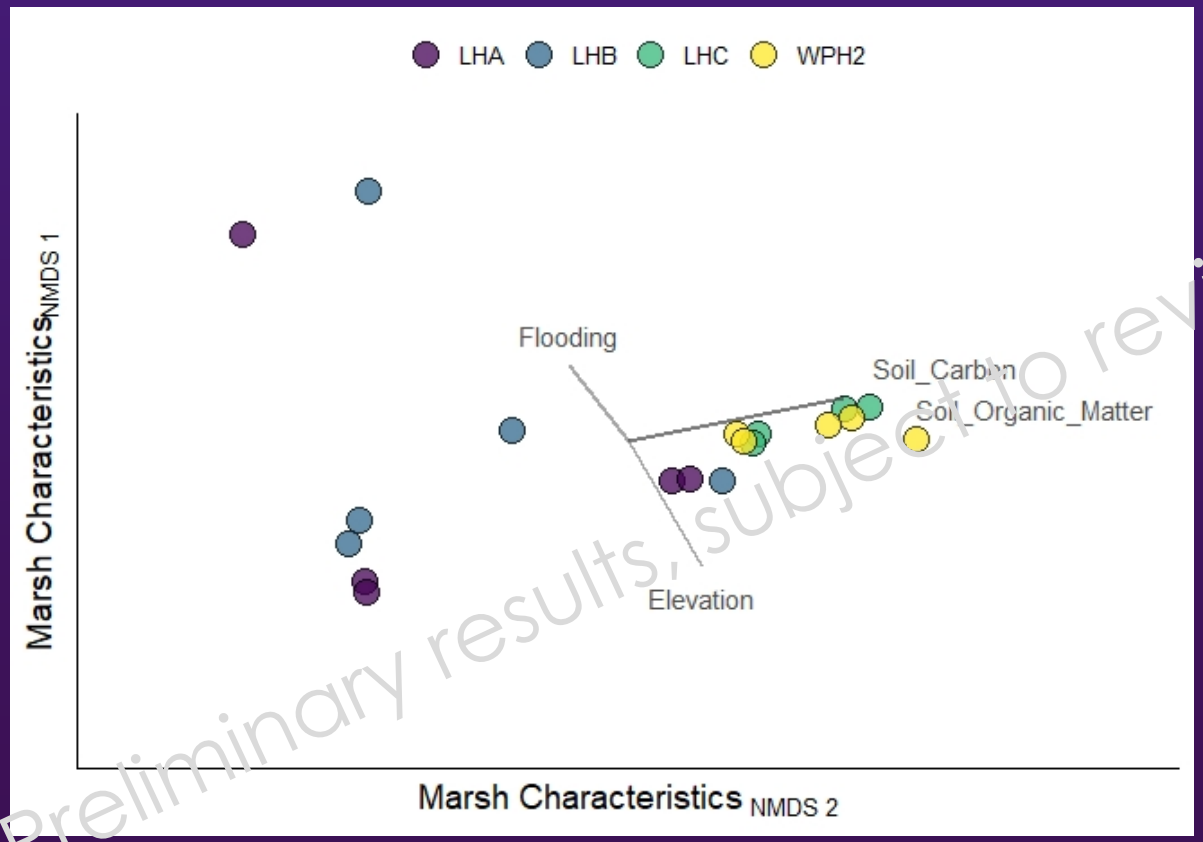


Summary:

- Adult male & females consume higher trophic level prey relative to juveniles
- The use of aquatic vs. terrestrial carbon sources did not differ with ontogeny &/or sex.
- Instead, fish at reference marshes used a relatively higher proportion of terrestrial carbon to those at created marshes.

Conclusions

Lower terrestrial carbon use at created marshes mirrored these sites lower soil organic matter content & inundation

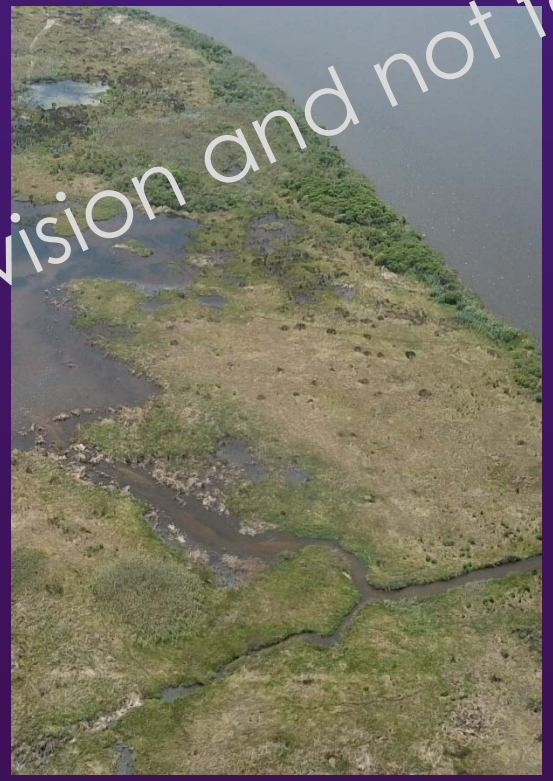


- Marshes characterics differ
  - Measured at 1,10,50,100m
    - ANOSIM statistic R: 0.2481
    - Significance: 0.0079
- LHA (Created Site) has higher elevation & lower inundation
- Created sites (LHA & LHB) have lower soil organic matter & carbon content

Lower terrestrial carbon use at created marshes mirrored these sites lower soil organic matter content & inundation

Why?

- Less access to the marsh platform in created marshes due to infrequent inundation.
- Less “terrestrial” carbon in created marsh soils due to river sediment source & young age of these “new” marshes.



LHA (created)

WPH2 (reference)

Implications

- Ontogeny must be considered when using Gulf killifish indicators of the post-construction recovery of marsh food web dynamics.
- Differences in food web energy pathways of created and reference marshes in coastal Louisiana are likely a result of differing elevation, inundation, and soil characteristic.

Implications

- Ontogeny must be considered when using Gulf killifish indicators of the post-construction recovery of marsh food web dynamics.

- Differences in food web energy pathways of created and reference marshes in coastal Louisiana are likely a result of differing elevation, inundation, and soil characteristic.

Thank you!

- GoMCon Organizing Committee & Session Chairs
- Marsh Food Webs Project:
  - *Linda Bui (LSU), Annette Engel (UT), Olaf Jenson (UWM), Charlie Martin (UF), Nancy Rabalais (LSU), Wendy Morrison (LUMCON), Leslie Smith (Ocean Consulting)*
- Project Advisory Board Members:
  - *Jim Pahl, CPRA; Sharon Osowski, EPA; Kevin Roy, USFWS; Robert Spears, Plaquemines Parish; Pat Williams, NOAA*
- Program Officer & Technical Monitors
  - *Frank Parker, NOAA Restore; Melissa Carle, NOAA Restoration Center; Ian Zink, NOAA Fisheries*
- Field & Laboratory Assistance
  - *Mario Hernandez, Rohit "Ro" Kalvakalvaa, Allison Benelli, Maggie Shaw, Whitney Scheffel, Scott Alford, Eddie Weeks*
  - *Hayat Bennadji, Thinh Huynh, Joseph Daigle, Katerine Kjos, Noah Jeffers, Madalyn Mouton*

Questions?

Funding:

NOAA RESTORE SCIENCE PROGRAM