

Variability in precipitation drives early recruitment of the eastern oyster *Crassostrea virginica* in Mississippi

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Division of Coastal Sciences

School of Ocean Science and Engineering

The University of Southern Mississippi



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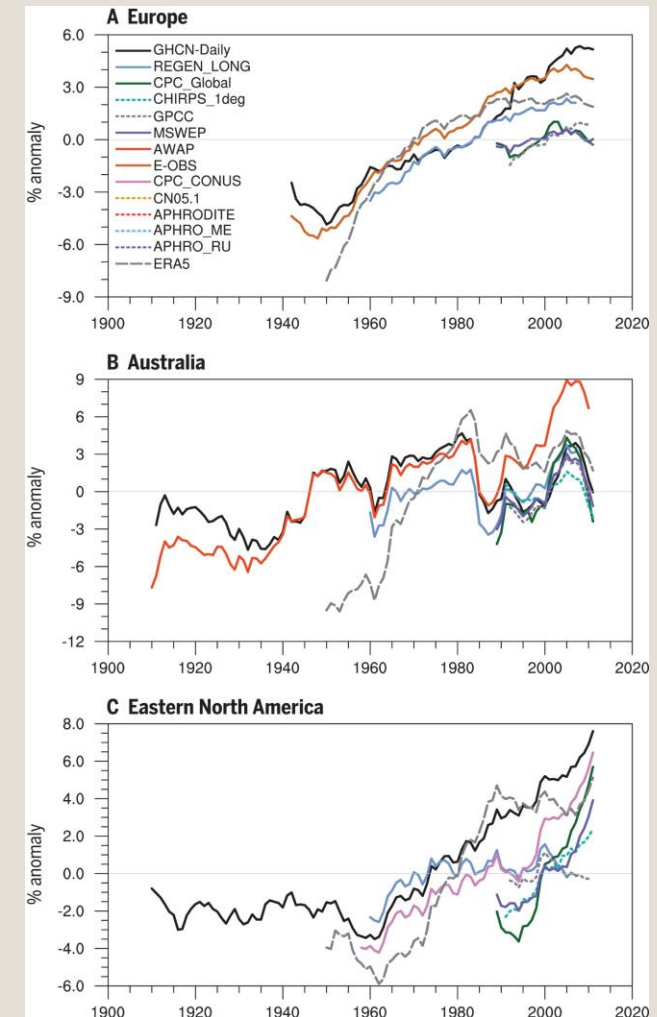
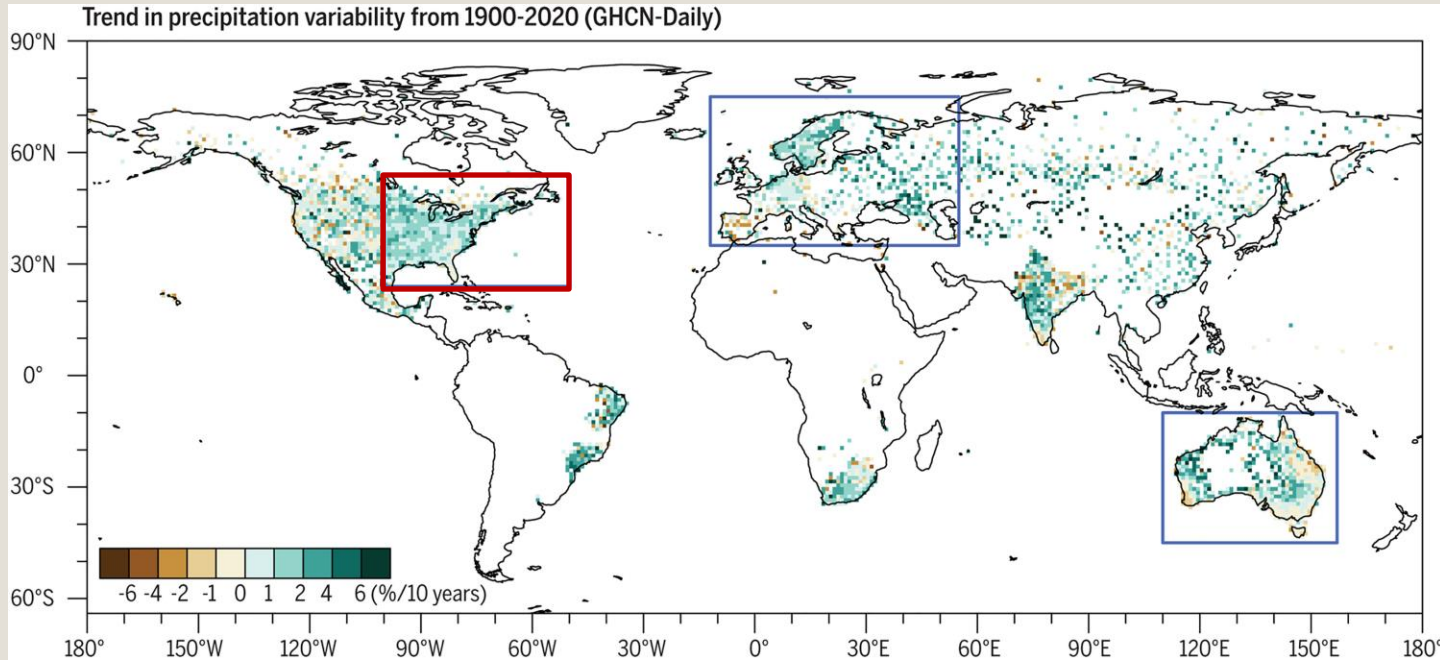
Precipitation Variability from 1900 - 2020

CLIMATE

Anthropogenic amplification of precipitation variability over the past century

Wenxia Zhang¹, Tianjun Zhou^{1,2*}, Peili Wu³

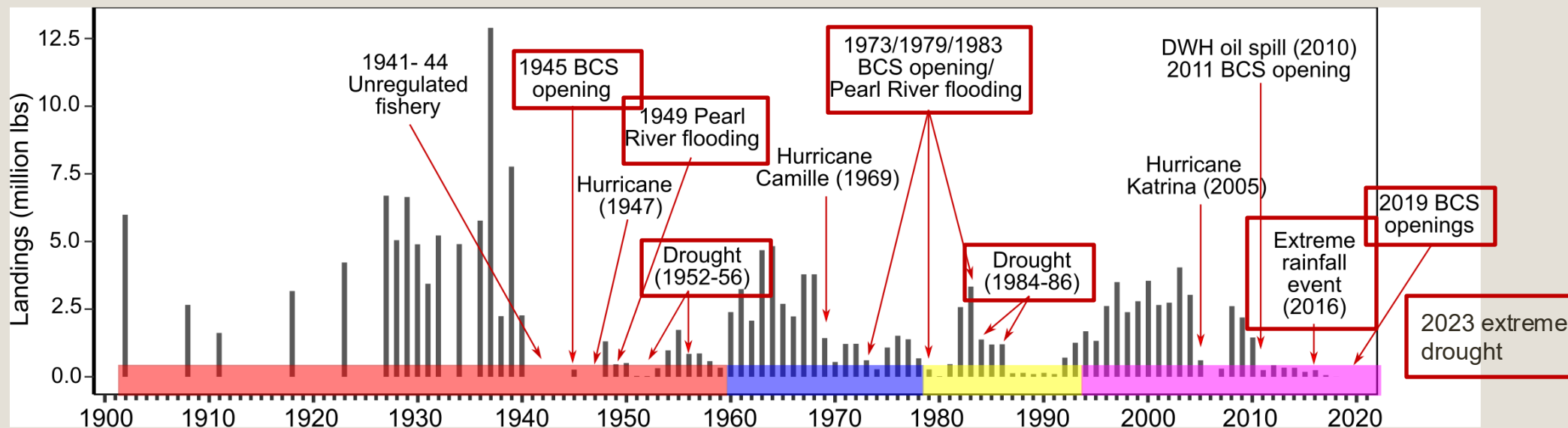
Zhang *et al. Science* 385, 2024, 427-432.



- Warming elevates atmospheric moisture which in turn causes extreme precipitation
- Concomitant variability in precipitation produces wider swings in wet-dry periods
- Daily variability has increased globally by 1.2% per 10 years
- Heightened variability occurs most notably over Europe, Australia, and **eastern North America**

Timeline of Oyster Harvest vs Environmental Events in Mississippi

Pruett et al. 2024. Journal of Shellfish Research 43: 1-13.



Journal of Shellfish Research, Vol. 43, No. 1, 1-13, 2024.

A PAST, PRESENT, AND FUTURE OUTLOOK ON THE MISSISSIPPI OYSTER FISHERY

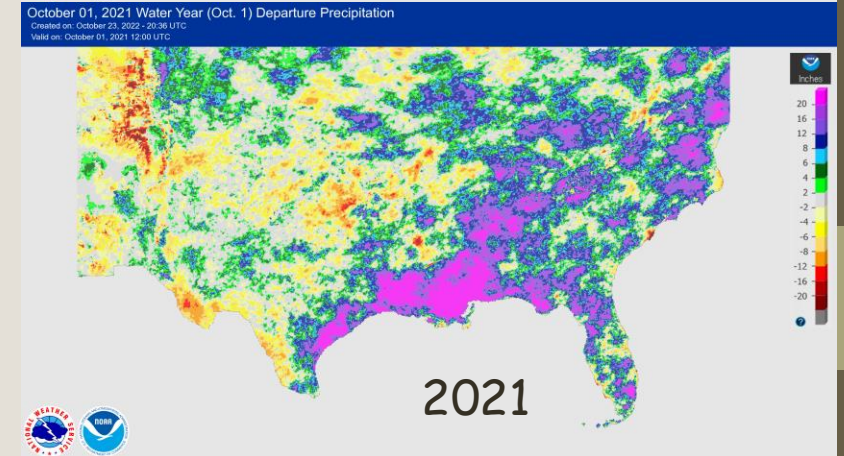
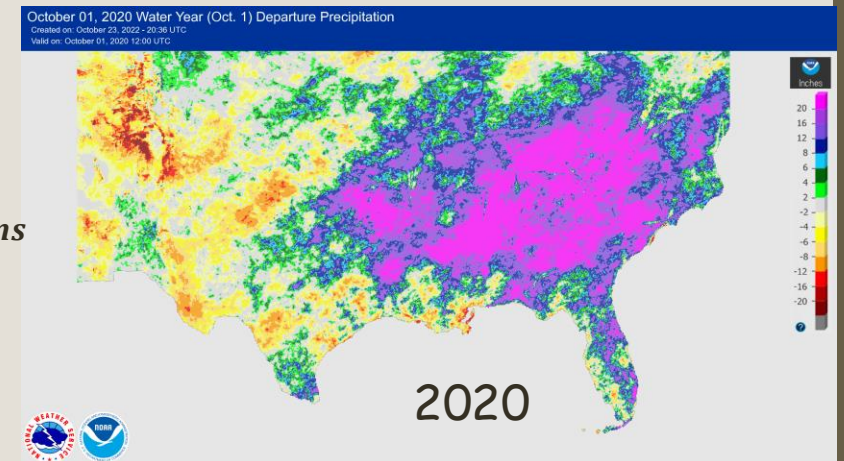
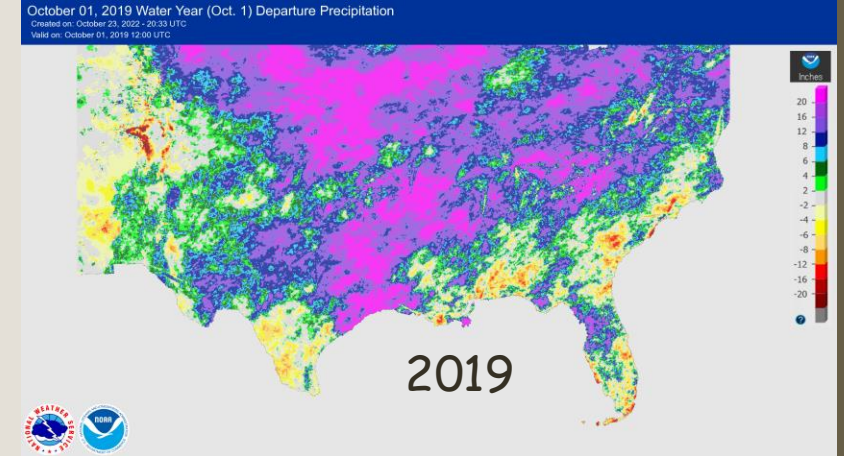
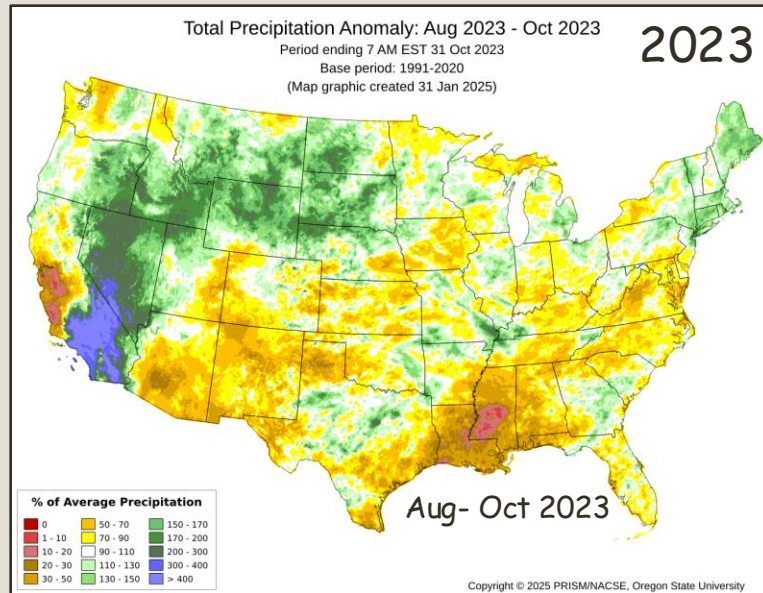
JESSICA L. PRUETT,^{1,2*} STEPHANIE SHOWALTER OTTS,³ KRISTINE L. WILLETT,⁴
LUKE FAIRBANKS,^{1,5} KELLY M. DARNELL¹ AND DEBORAH J. GOCHFELD^{2,4}

- Like other regions, oyster stocks are declining in Mississippi
- The timeline shows how major environmental events intersperse with oyster landings in Mississippi
- **Cycles** of excessive discharge and drought occur in the record
- Effects of discharge on the Mississippi Sound ecosystem were exacerbated by the construction of the Bonnet Carré Spillway in 1931

Interannual Regional Rainfall Patterns

NOAA Departure precipitation maps

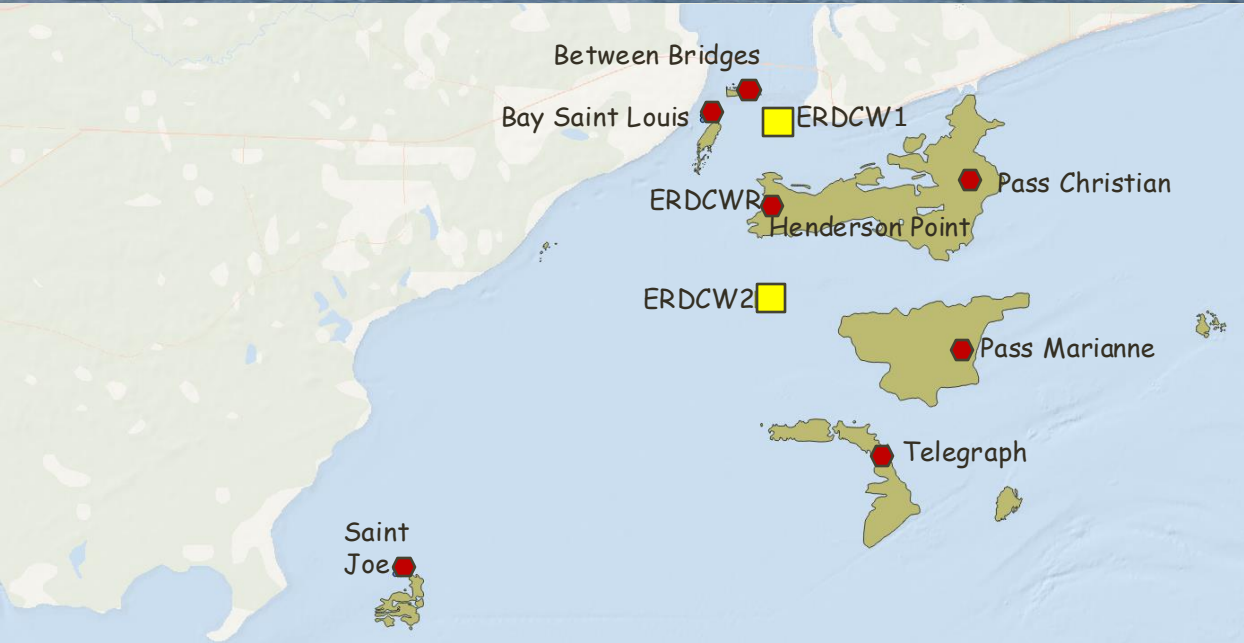
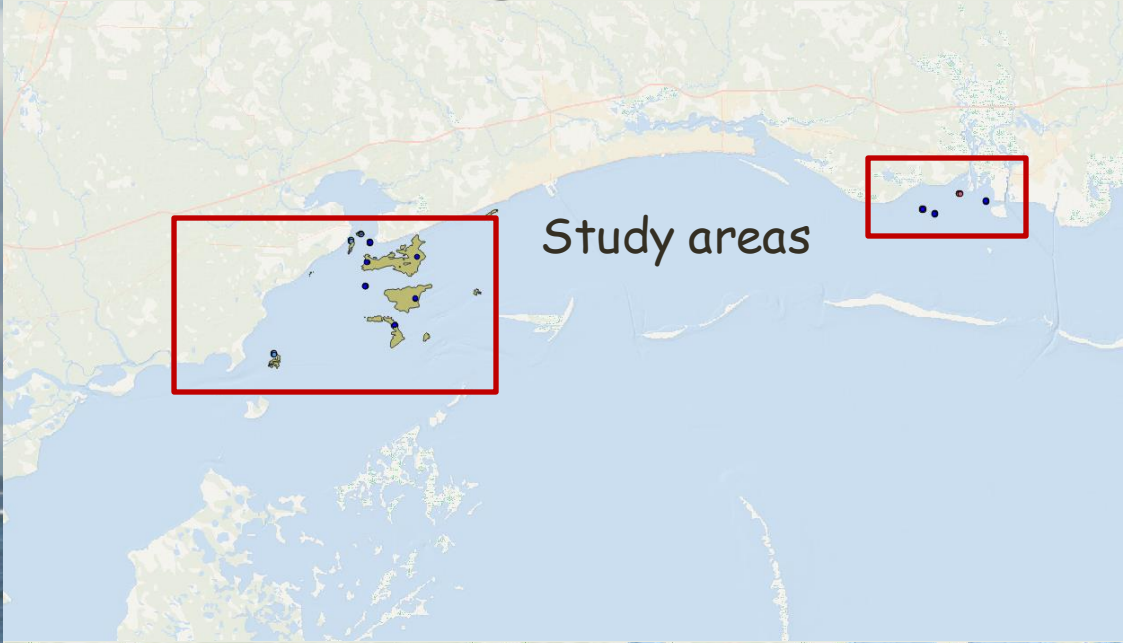
- Water year: from October 1 to September 30
- 2019 anomalous high inland rainfall
- 2020 inland rainfall higher than usual
- 2021 record regional rainfall
- Effects of excessive variability?
 - Repeated **discharge impacts** on oyster recruitment from 2019-2022
 - ***In 2023, El Niño induced unprecedented drought caused uniformly polyhaline conditions within our study area!***



Objectives

- Do early oyster recruitment metrics reflect the 2019-2023 discharge/drought cycle?
 - Interannually – between years
 - Spatially - among sites

Study Areas



Methods - Spat settlement

- Spat settlement was sampled at the same seven sites in western Mississippi Sound from 2019 - 2023
- Four settlement samplers were deployed for four weeks in early fall of all four years



Side view of settlement sampler with settlement plates



Oyster spat on lower surface

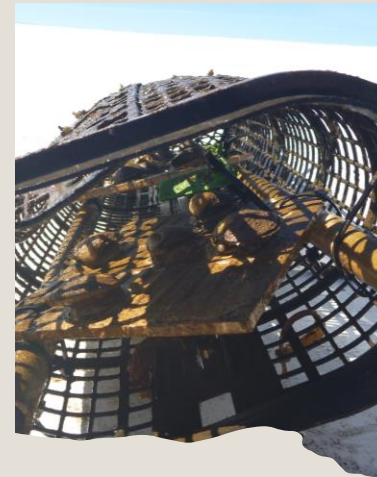


Recovering sampler

Methods - Growth

Transplanted Reared Juvenile Oysters

- Growth samplers set out for one month at 4 sites in 2020 and at 8 in 2021, 2022 and 2023
 - 2 samplers per site
 - 3 plates per basket
 - 5 juvenile oysters per plate



Growth sampler

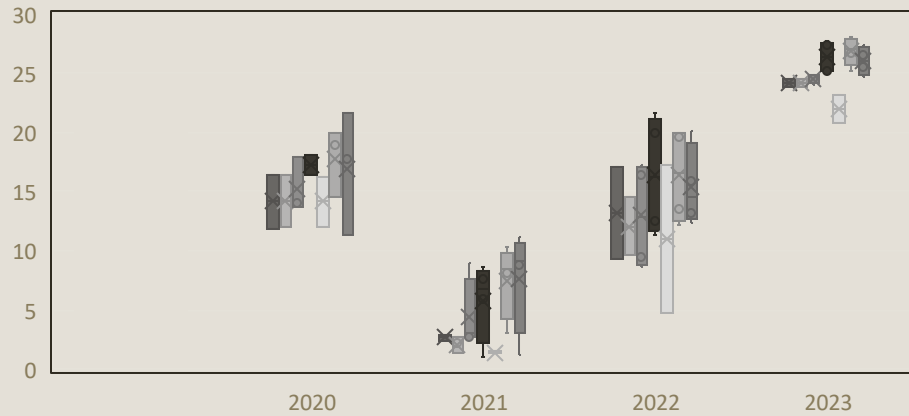


Juvenile oysters

Juvenile Oyster Growth

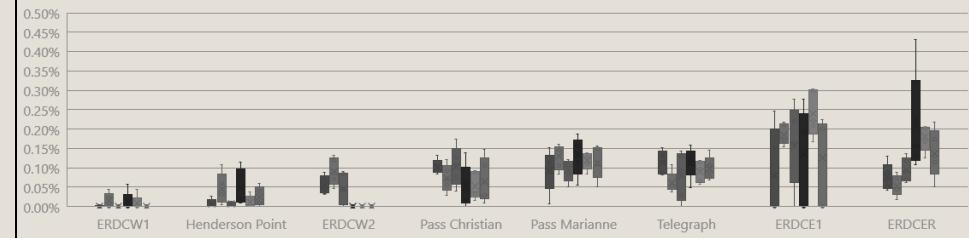
Bottom Salinity

BB BSL HP PC SJ PM TG

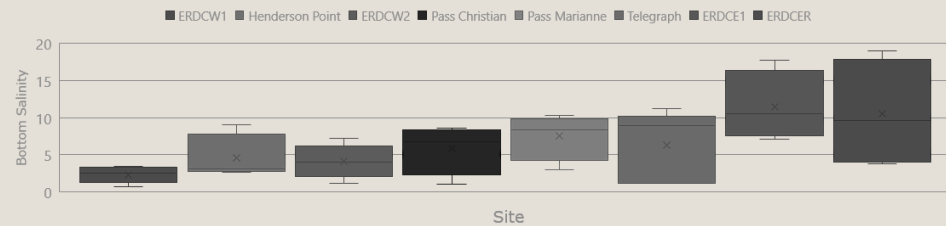


- Spatial variability in growth was commensurate with salinity when discharge was high in 2021
- Nested spatial scales of variation in growth are apparent

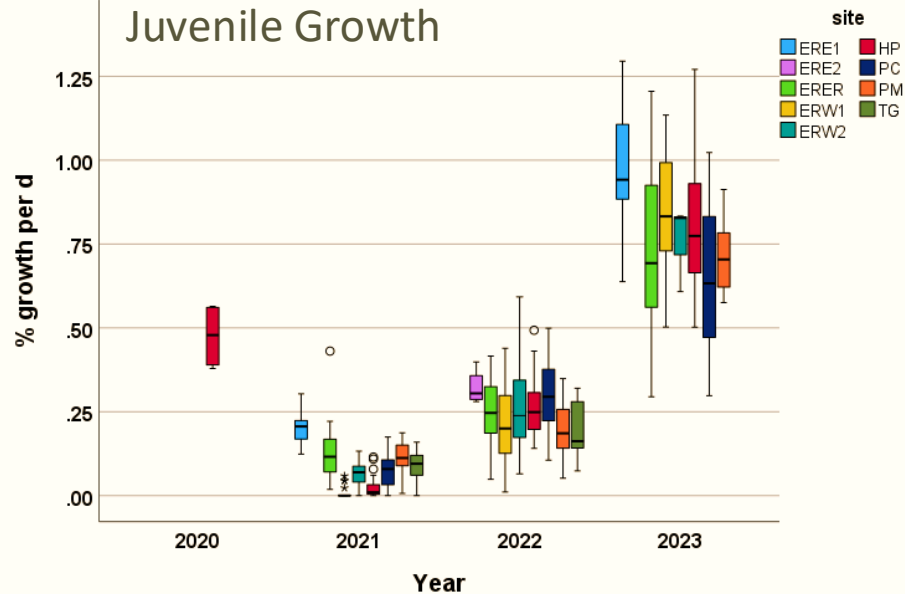
Transplanted Juvenile Oyster Growth 2021



Bottom Salinity 2021

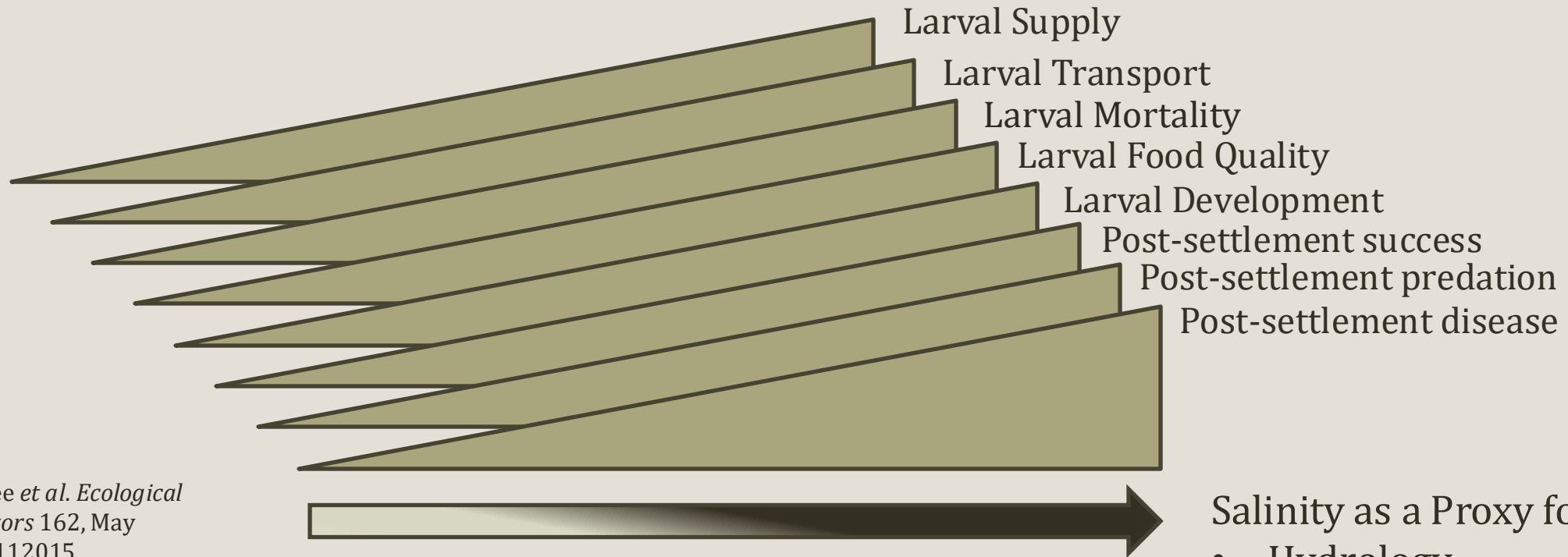


Juvenile Growth



- Growth rates varied interannually and spatially
- Lowest growth rates occurred in 2021 during low salinity regime
- Relatively low growth rates occurred inshore in 2021
- Relative growth differences among sites consistent between years
- At Henderson Point growth rates were high in 2020, lowest in 2021, intermediate and variable in 2022, and highest and most variable in 2023

Salinity as a Proxy for Secondary Ecological Drivers

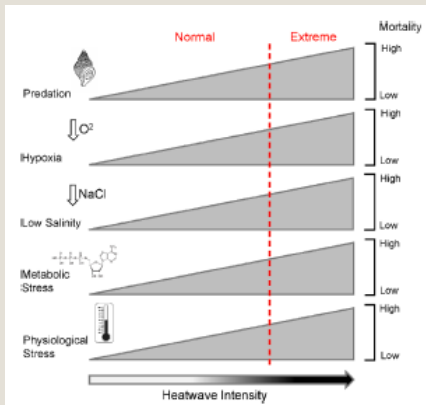


Salinity Gradient

Salinity as a Proxy for:

- Hydrology
- Temperature
- pH
- Hypoxia
- Physiology
- Plankton composition
- HABS

Plumlee *et al. Ecological Indicators* 162, May 2024, 112015



Questions



Disclaimer

This project was paid for with federal funding from the U.S. Army Core of Engineers and the U.S. Department of the Treasury, the Mississippi Department of Environmental Quality, and the Mississippi Based RESTORE Act Center of Excellence under the Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States Act of 2012 (RESTORE Act). The statements, findings, conclusions, and recommendations are those of the author(s) and do not necessarily reflect the views of the U.S. Army Core of Engineers, the Department of the Treasury, the Mississippi Department of Environmental Quality, or the Mississippi Based RESTORE Act Center of Excellence.

