Monitoring Ecosystem Indicators for Science-Based Restoration and Enhancement of Pelagic Habitats of Galveston Bay

Liu Lab

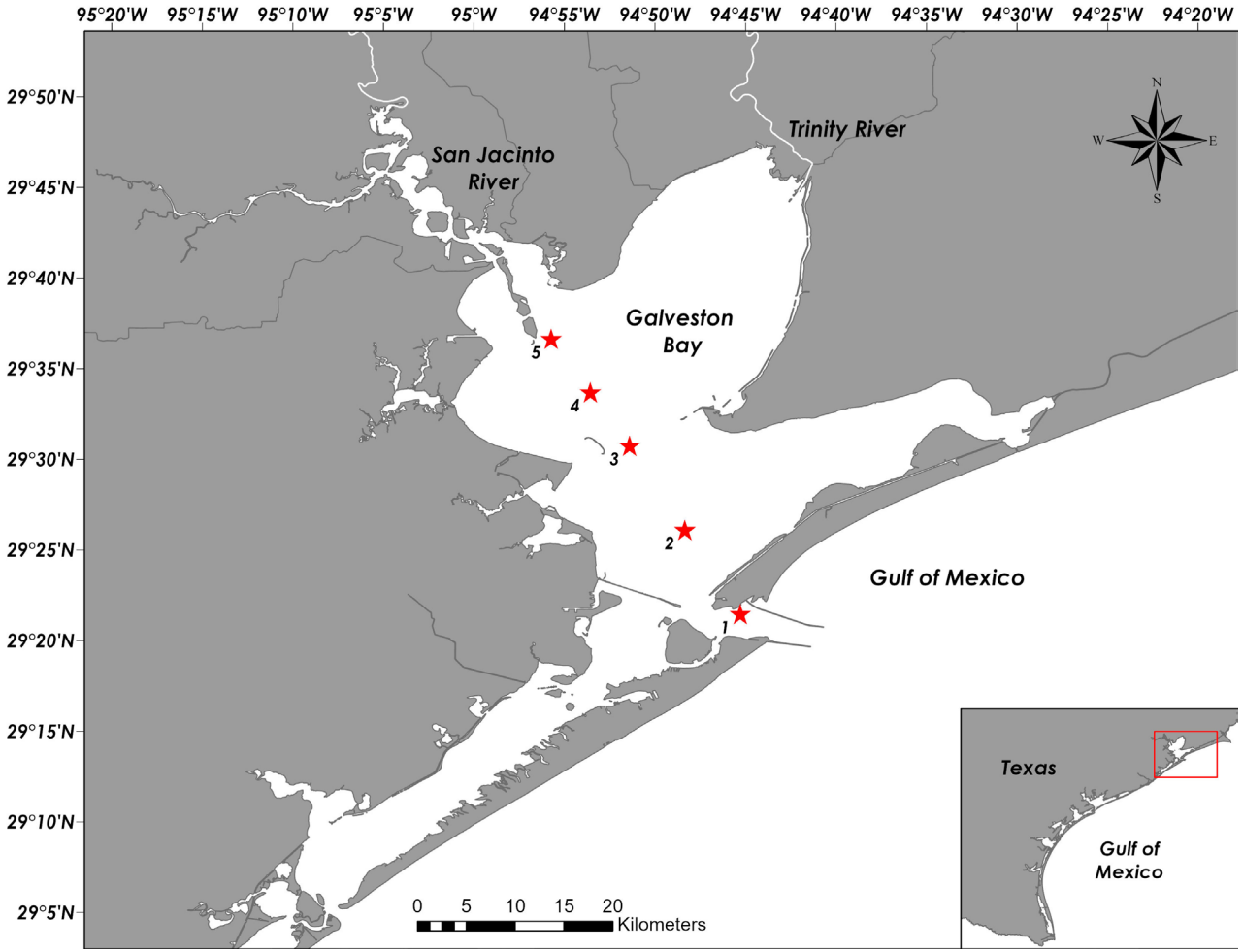
Background

- Estuaries are highly vulnerable to anthropogenic stressors and natural disasters, increased eutrophication, bottom-water hypoxia, invasive species, and hurricanes (Kemp et al., 2005; Kimmel et al., 2009; Liu et al., 2021).
- Zooplankton are often used as indicator species regarding climate change (Richardson, 2008).
- Galveston Bay (GB) in Texas has been subjected to extensive long-term human impacts and natural stressors for decades.
- Development of ecological indicators is highly needed for better management of the GB ecosystems.

Objectives

- Monitoring the long-term spatial and temporal variation in zooplankton dynamics along with environmental factors.
- Expanding previous efforts after Hurricane Harvey to extend the data collection on ecological indicators (e.g., zooplankton) in GB.
- Generating time series data for tracking ecosystem health in GB that can be used to inform science-based decisions relating to ecosystem services in GB.

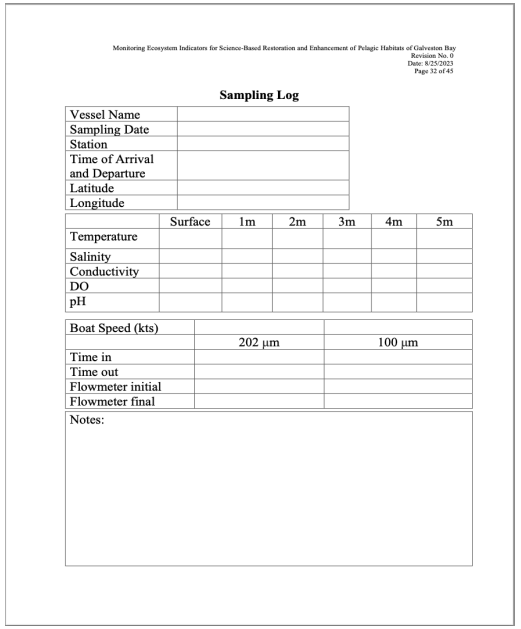
Galveston Bay Line (GBL)



Protocols

Pre Cruise	Onboard	Post Cruise
-Label jars and make 10% buffered formalin -Ensure YSI calibration -Account for log sheets -Check out Chl-a water bottles -Follow checklist and ensure proper procedure has been followed	-Record station information -Water Sample Collection -Environmental data measurement -Zooplankton and oyster sample collection	-Electronically backup sampling data -Chlorophyll-a measurement -Store zooplankton samples -Zooplankton sample processing -Oyster genetic analysis

ITEM	QUANTITY	Person 1	Person 2
Net (200mm)	1	☐	☐
Net (100mm)	1	☐	☐
Codend	2	☐	☐
Spare Net	1	☐	☐
Spare Flowmeter	1	☐	☐
Bucket	1	☐	☐
Water bottle	5	☐	☐
Chlorophyll sensor	1	☐	☐
Jars with formalin	10	☐	☐
Jars with ethanol	5	☐	☐
Wash bottle with ethanol	2	☐	☐
Spare jars	6	☐	☐
YSI	1	☐	☐
Cooler with ice	1	☐	☐
Gloves	1	☐	☐
Pens and notebook	1	☐	☐
Log sheets	10	☐	☐



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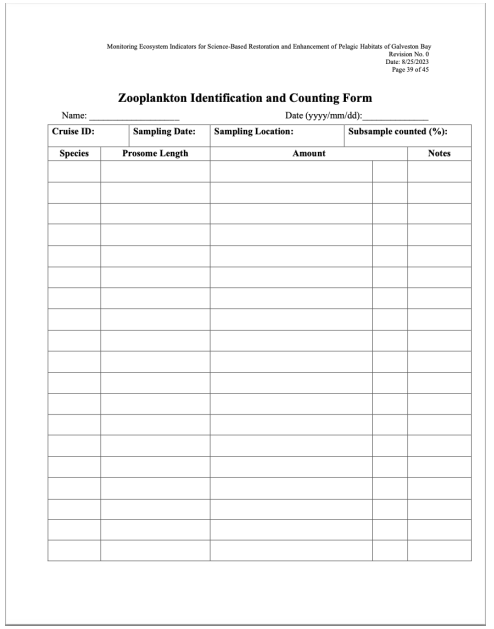
Sampling Log

Vessel Name	
Sampling Date	
Station	
Time of Arrival and Departure	
Latitude	
Longitude	

	Surface	1m	2m	3m	4m	5m
Temperature						
Salinity						
Conductivity						
DO						
pH						

Boat Speed (kts)		
	202 µm	100 µm
Time in		
Time out		
Flowmeter initial		
Flowmeter final		

Notes:



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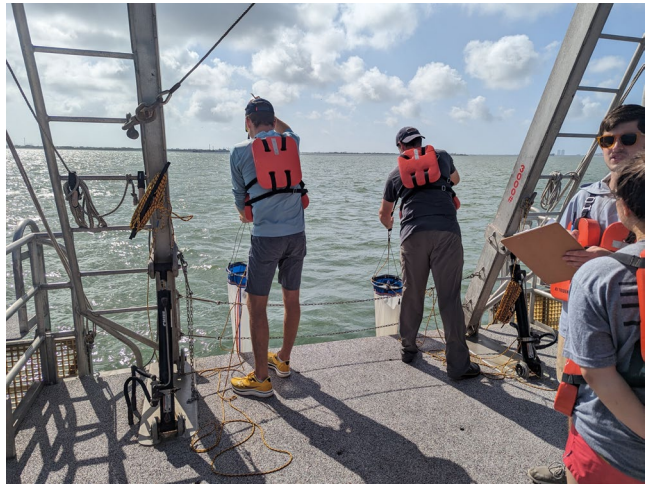
Zooplankton Identification and Counting Form

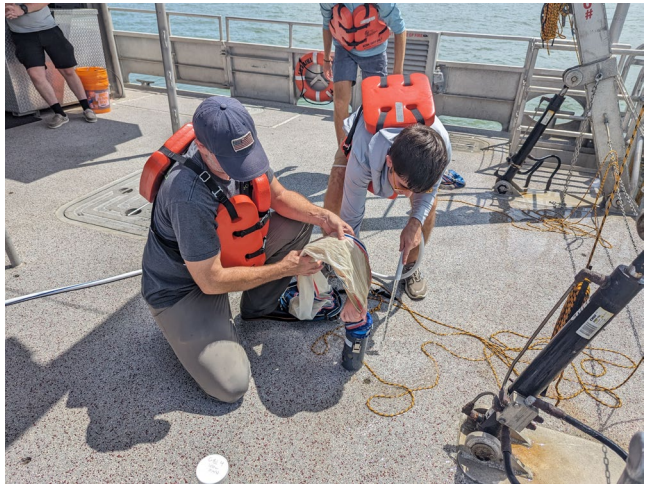
Name: _____ Date (yyyy/mm/dd): _____

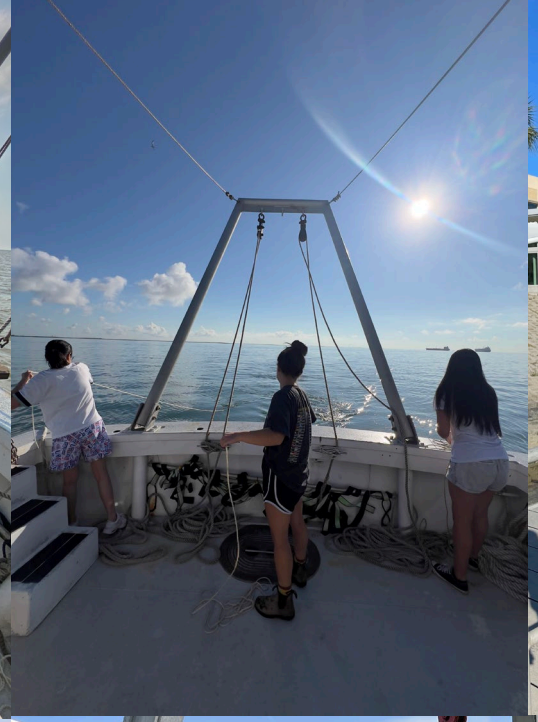
Cruise ID:	Sampling Date:	Sampling Location:	Subsample counted (%):

Species	Prosome Length	Amount		Notes

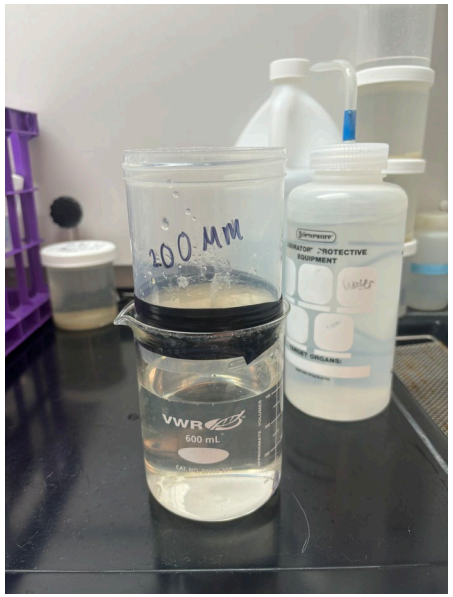
Monthly Sampling

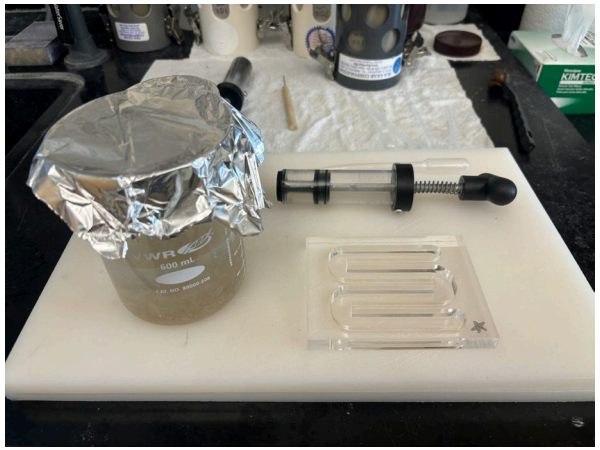


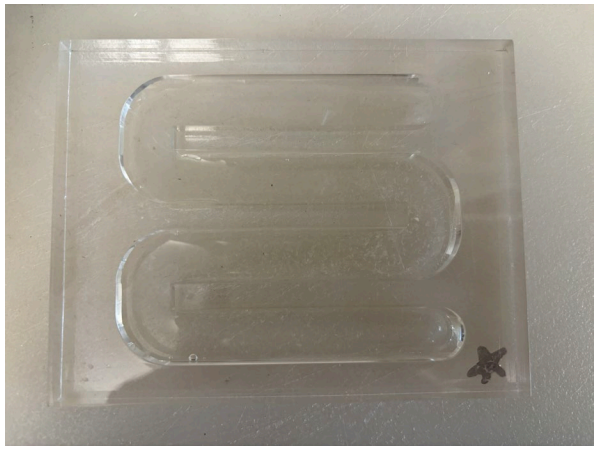



Sample Processing








Euterpina acutifrons


Acartia tonsa

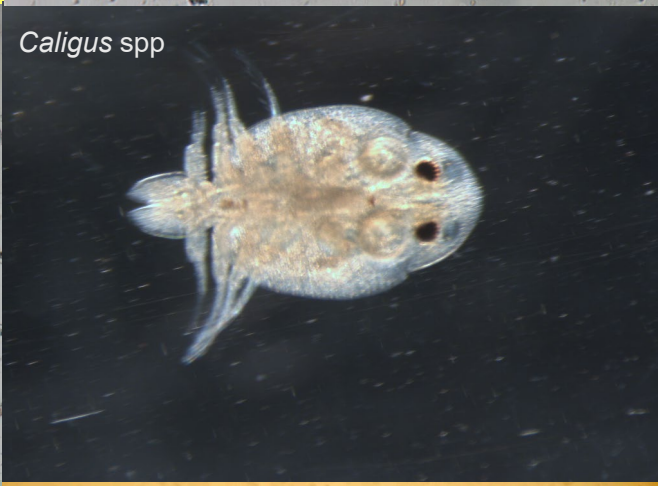

Argulus spp


Temora spp

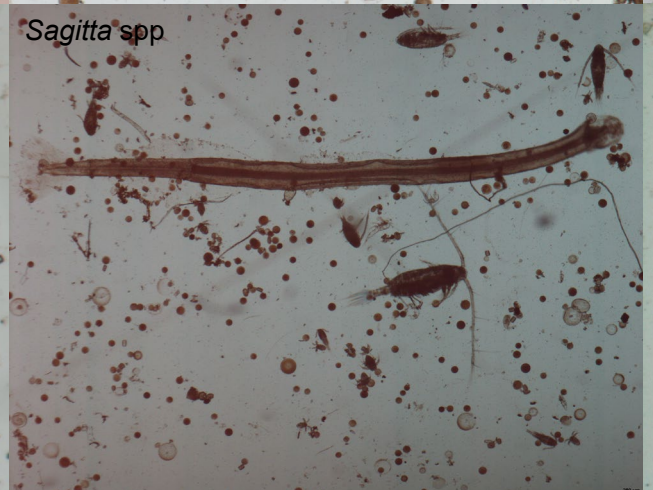

Labidocera spp


A. tonsa and *Oithona* spp


Centropages spp


Caligus spp


Oithona spp


Sagitta spp

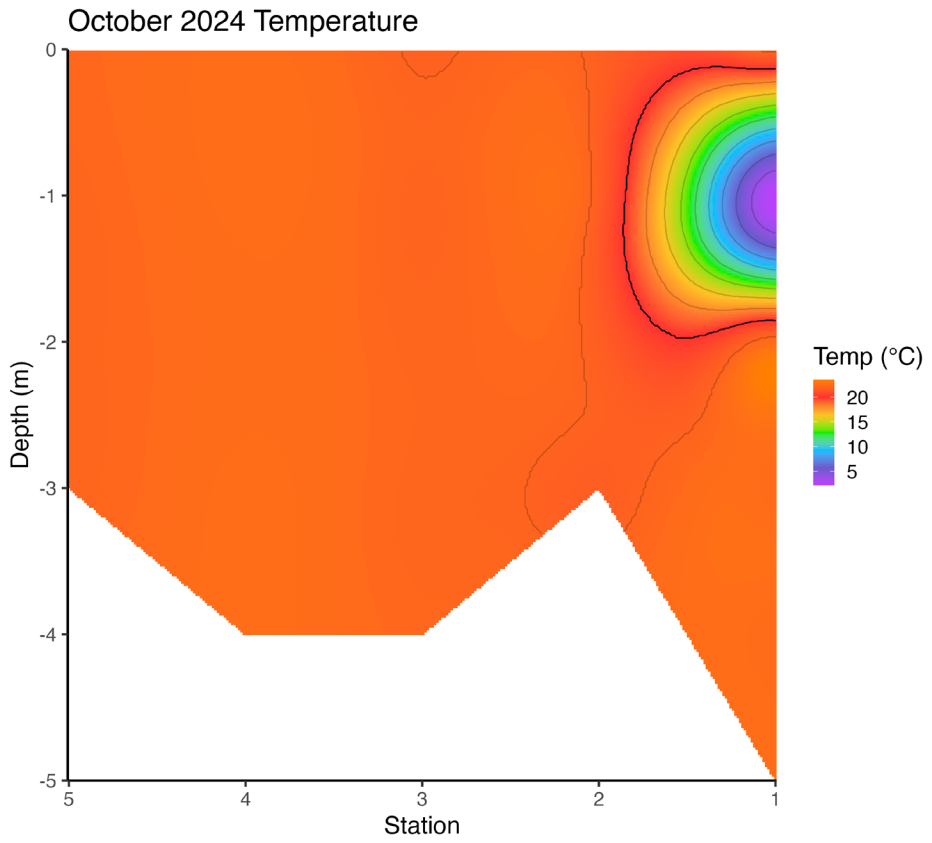

Paracalanus spp

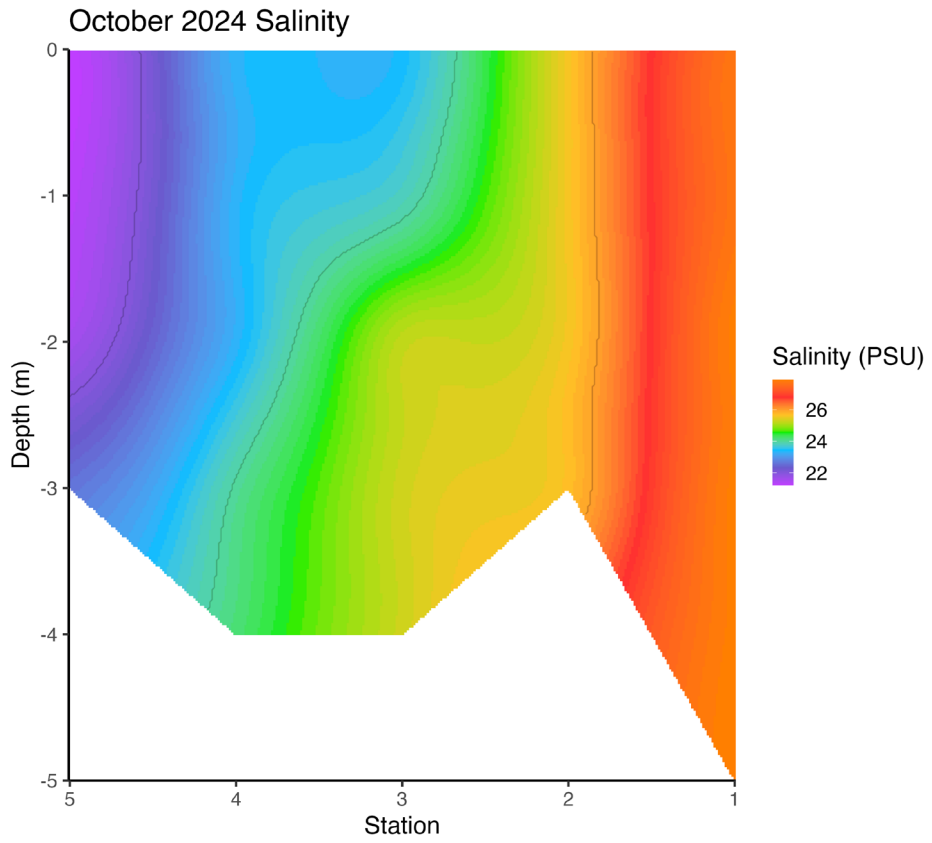

Pseudocalanus spp

Data Presentation:

Cruise-based hydrographic profiles

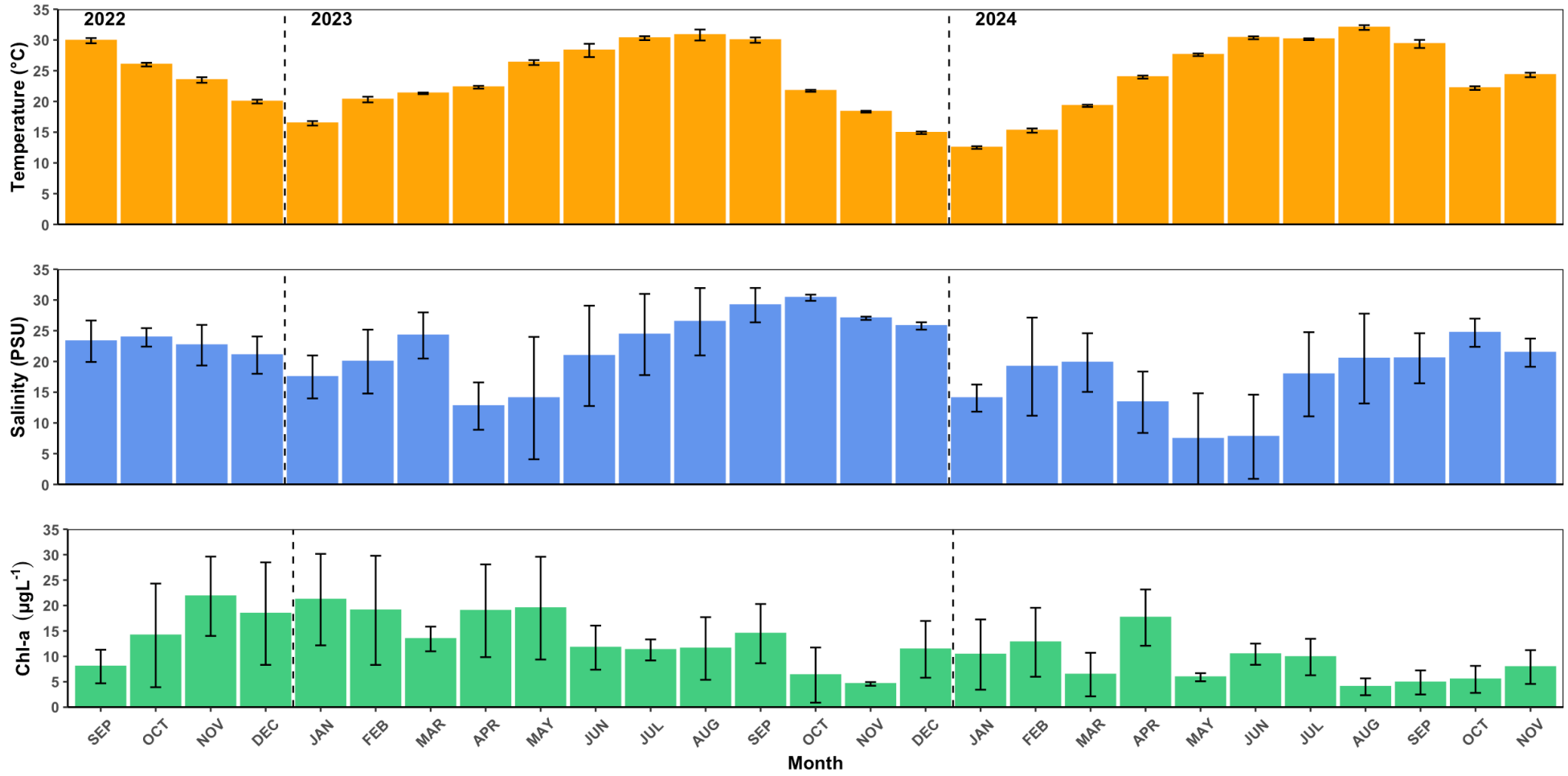
- Data taken using YSI Pro30.
  - From October 2024 cruise
- Surface to bottom





Data Presentation:

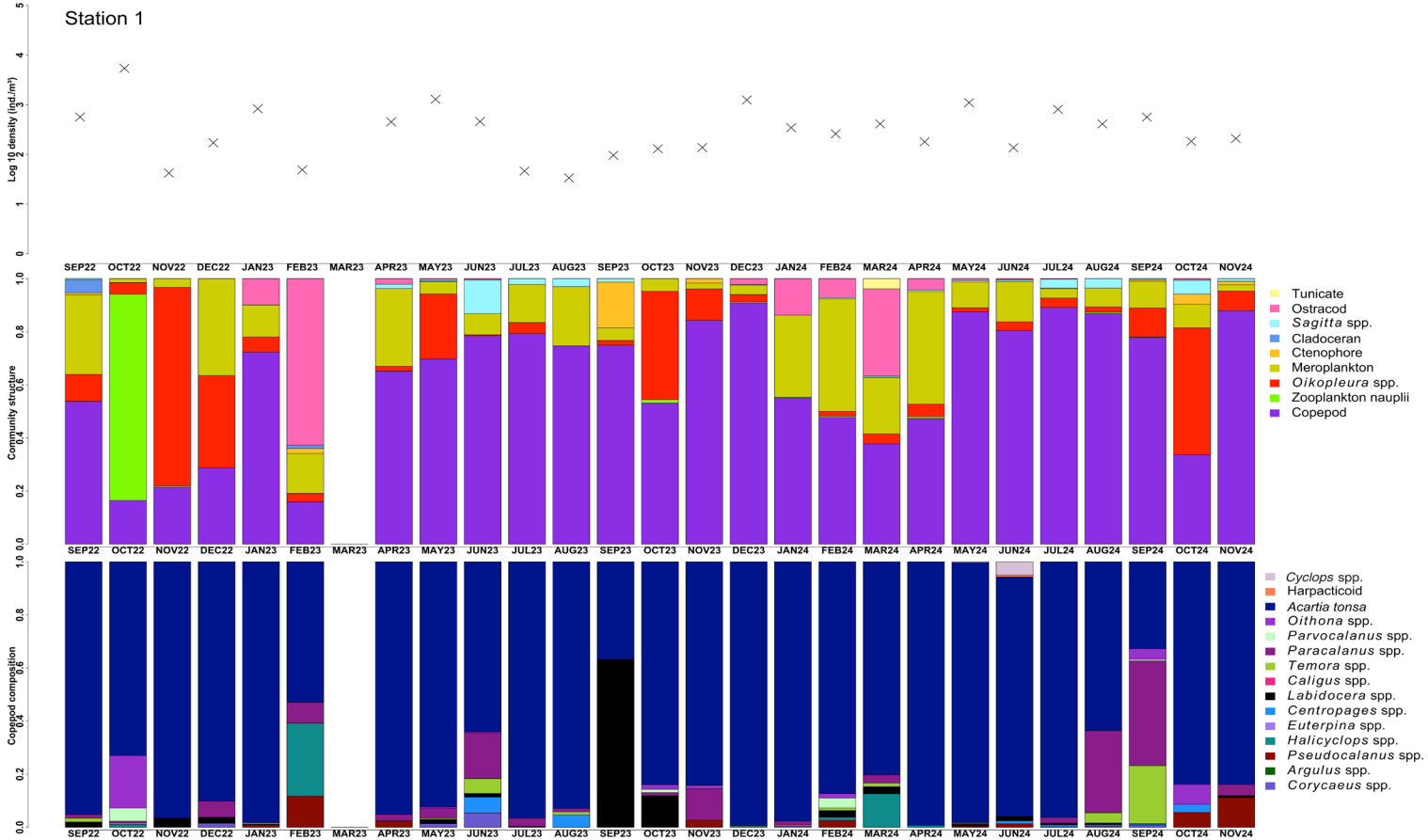
Bay-wide time series



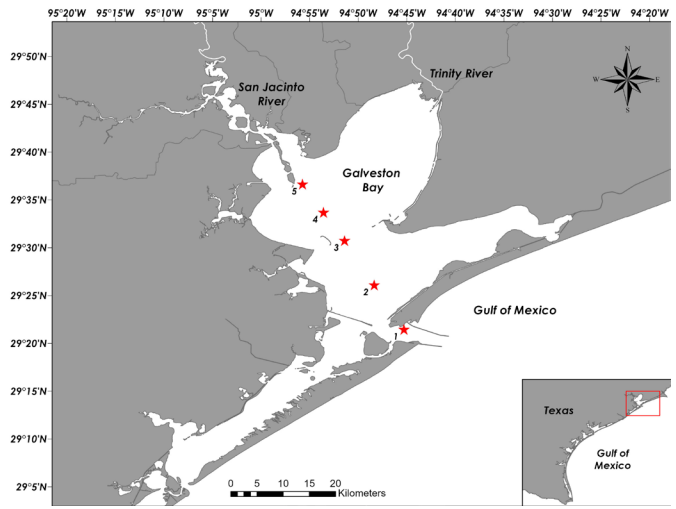
Average bay-wide environmental patterns from September 2022 to November 2024.

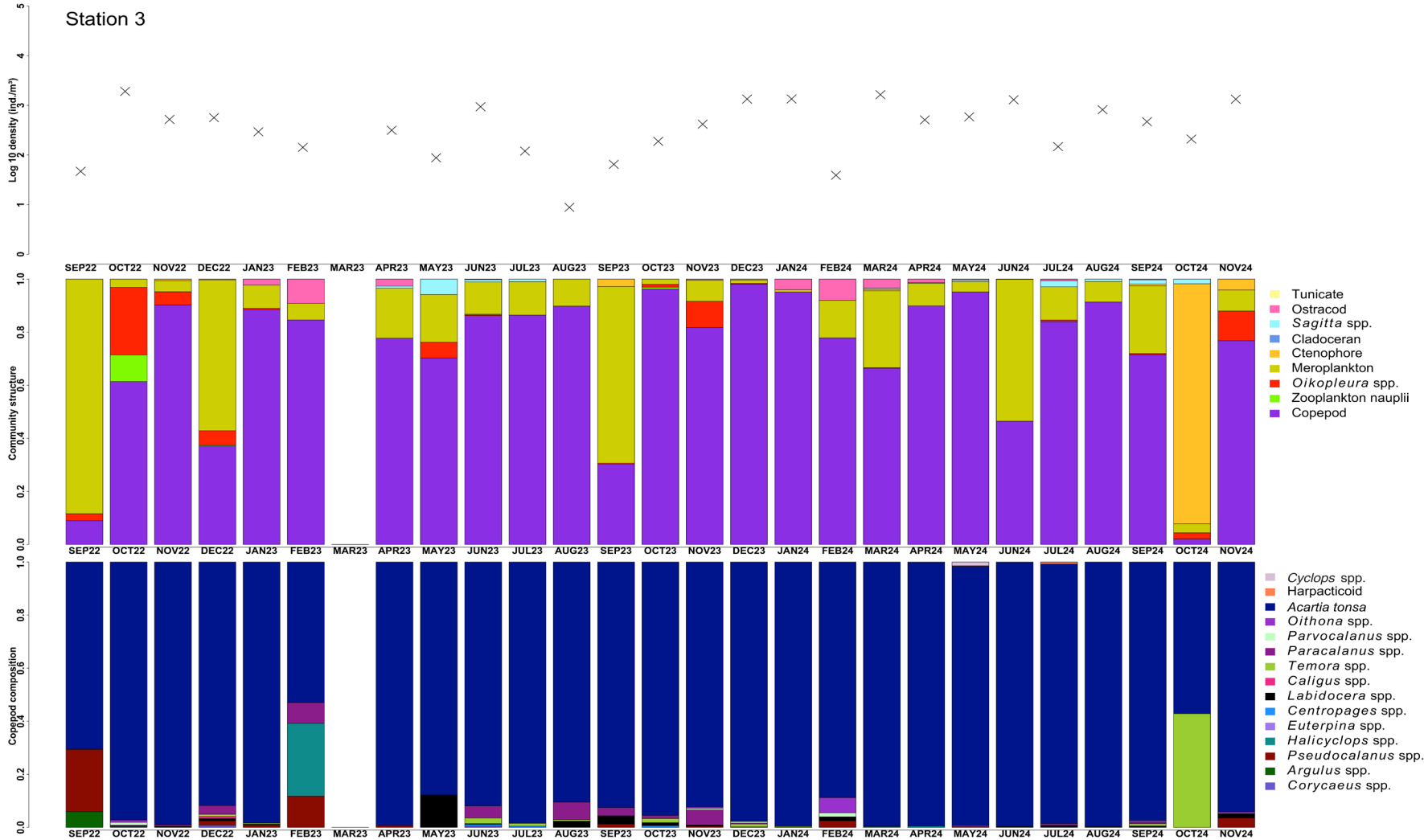
Data Presentation:

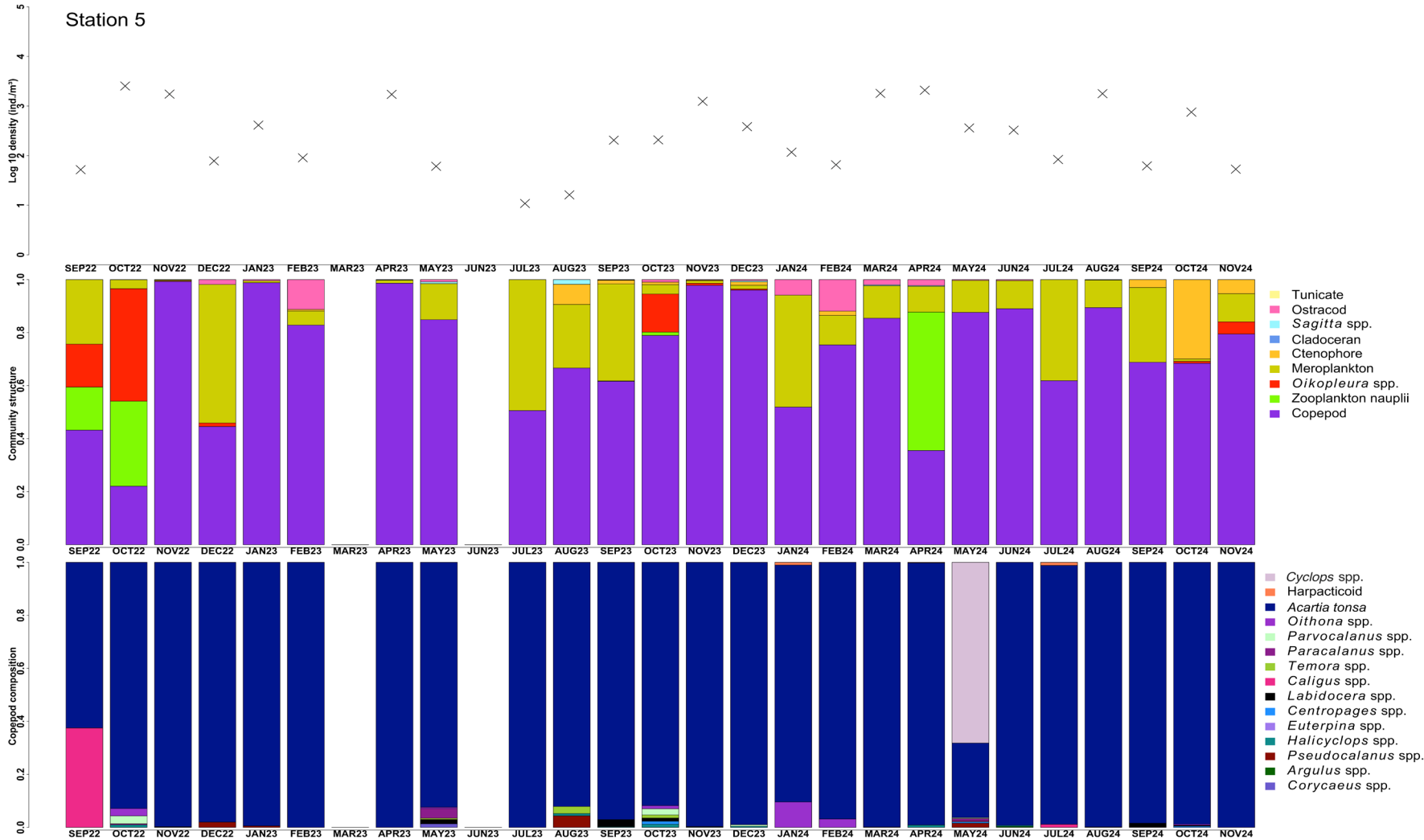
Site-based zooplankton data



1. Density
2. Community structure
3. Species composition




Station 3
Log 10 density (ind./m³)
0
1
2
3
4
5
SEP22 OCT22 NOV22 DEC22 JAN23 FEB23 MAR23 APR23 MAY23 JUN23 JUL23 AUG23 SEP23 OCT23 NOV23 DEC23 JAN24 FEB24 MAR24 APR24 MAY24 JUN24 JUL24 AUG24 SEP24 OCT24 NOV24
Community structure
0.0
0.2
0.4
0.6
0.8
1.0
Tunicate
Ostracod
Sagitta spp.
Cladoceran
Ctenophore
Meroplankton
Oikopleura spp.
Zooplankton nauplii
Copepod
Copepod composition
Cyclops spp.
Harpacticoid
Acartia tonsa
Oithona spp.
Parvocalanus spp.
Paracalanus spp.
Temora spp.
Caligus spp.
Labidocera spp.
Centropages spp.
Euterpina spp.
Halicyclops spp.
Pseudocalanus spp.
Argulus spp.
Corycaeus spp.


Station 5
Log 10 density (ind./m³)
0
1
2
3
4
5
SEP22
OCT22
NOV22
DEC22
JAN23
FEB23
MAR23
APR23
MAY23
JUN23
JUL23
AUG23
SEP23
OCT23
NOV23
DEC23
JAN24
FEB24
MAR24
APR24
MAY24
JUN24
JUL24
AUG24
SEP24
OCT24
NOV24
Community structure
0.0
0.2
0.4
0.6
0.8
1.0
Tunicate
Ostracod
Sagitta spp.
Cladoceran
Ctenophore
Meroplankton
Oikopleura spp.
Zooplankton nauplii
Copepod
Copepod composition
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Parvocalanus spp.
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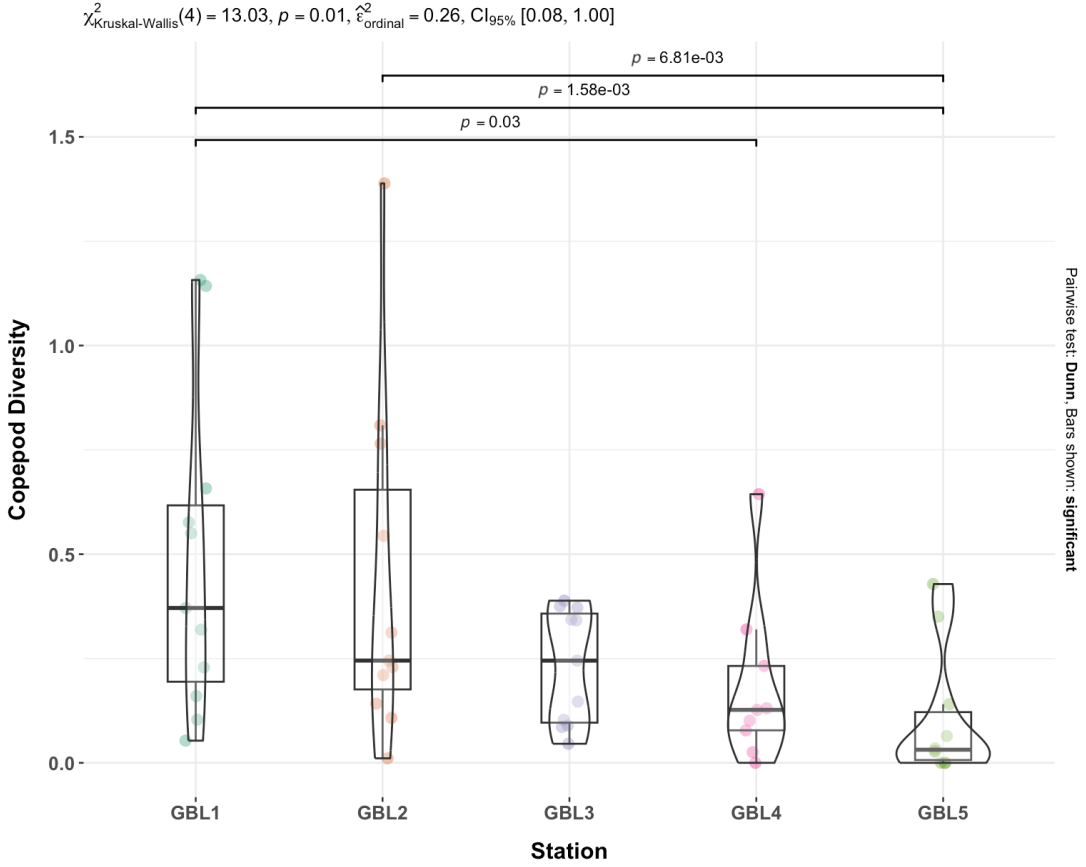
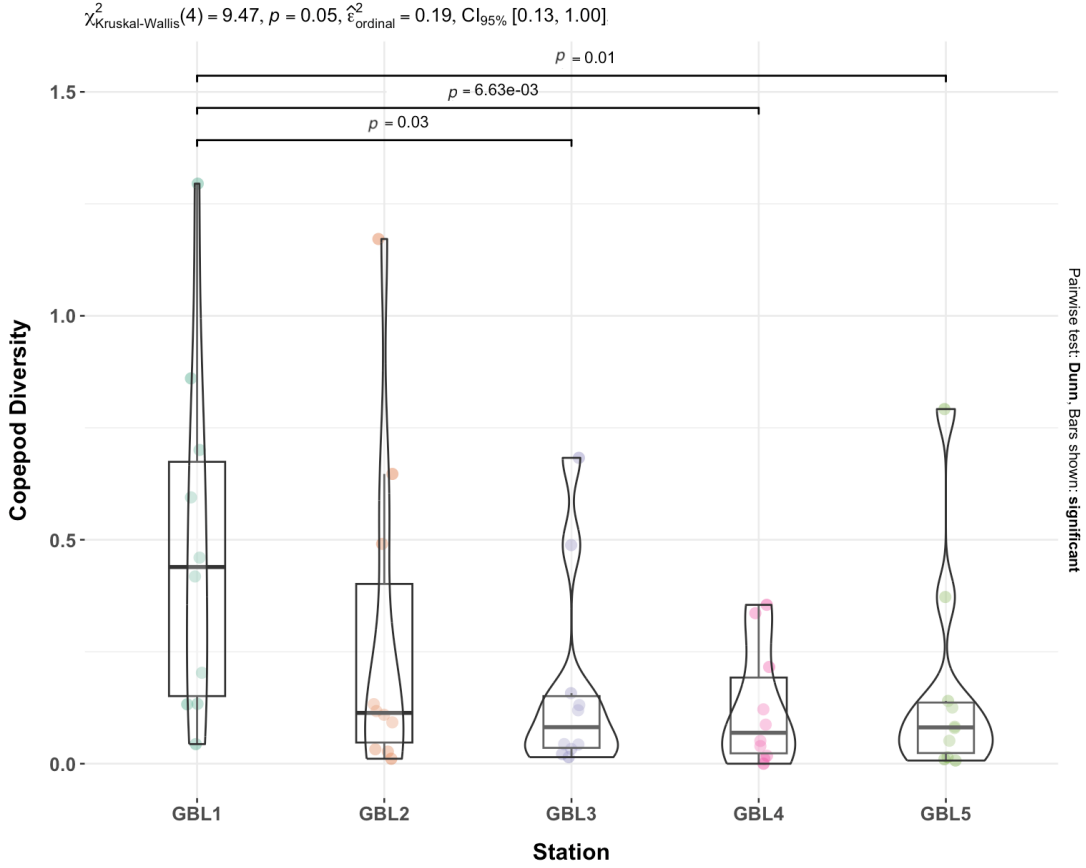
Temora spp.
Caligus spp.
Labidocera spp.
Centropages spp.
Euterpina spp.
Halicyclops spp.
Pseudocalanus spp.
Argulus spp.
Corycaeus spp.

Data Analysis:

Site-based comparisons

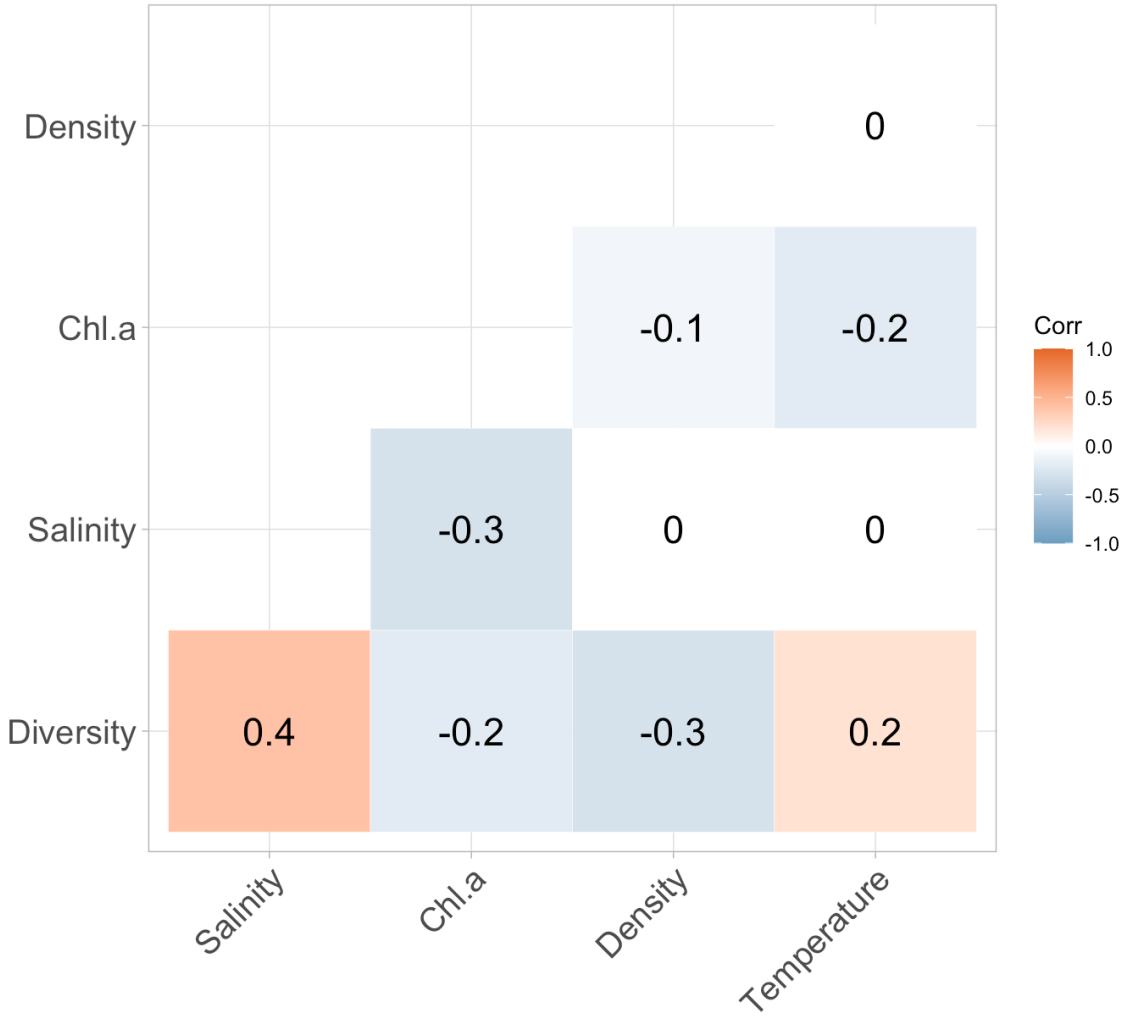




Comparison of the mean difference in copepod diversity by station between 2023 (left) and 2024 (right).

Data Analysis:

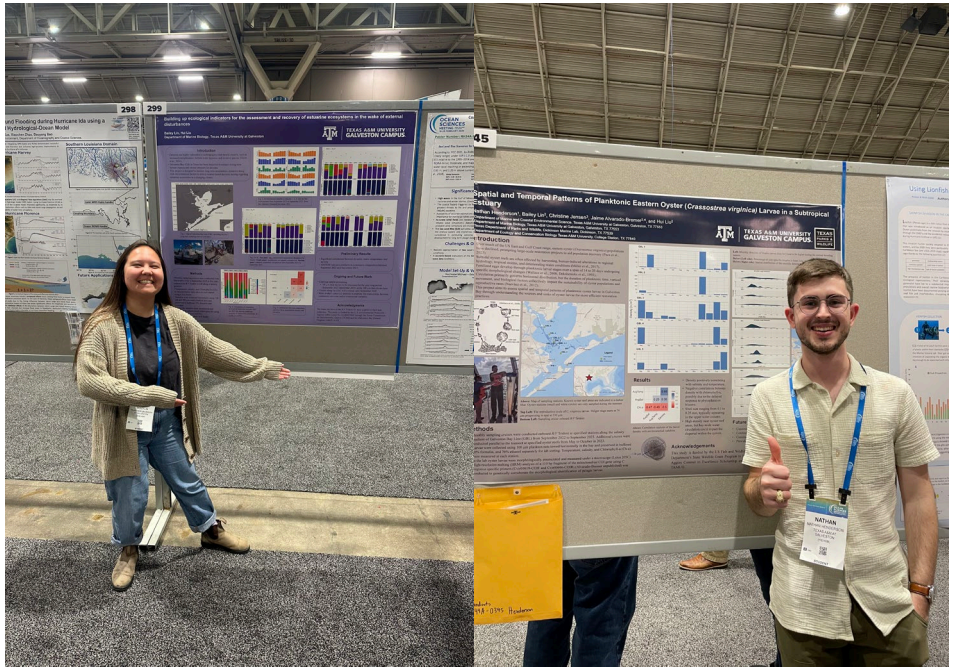
Lining environmental variables with zooplankton



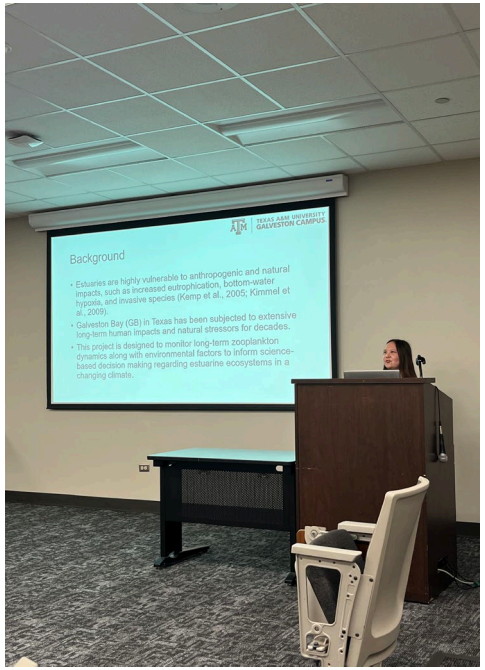
Progress Summary:
(September 2022-present)

- 26 monthly cruises completed
- 15 field volunteers
- 260 total samples collected
- 140 samples processed
- 120 samples yet to be processed
- 7 conference presentations
- 5 undergraduate students and 2 high-school students involved

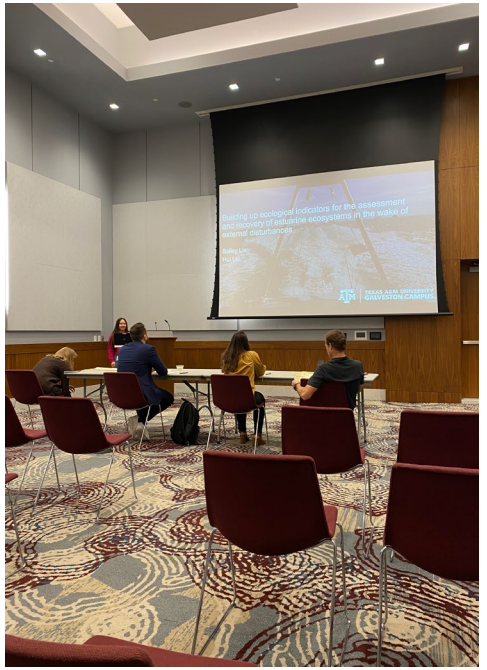
Fun Moments of Research!



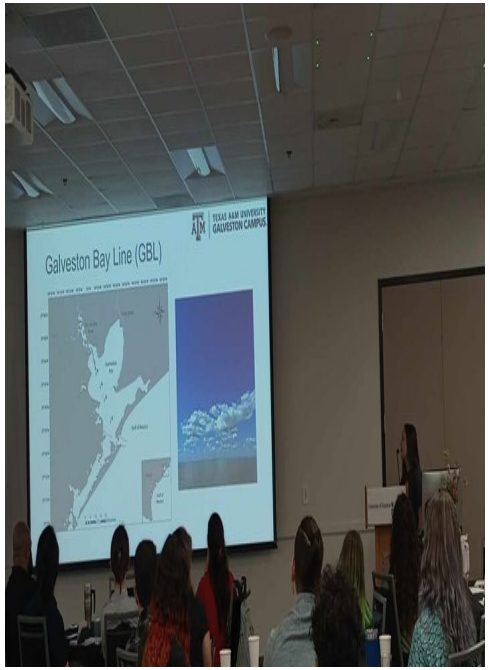
Ocean Science Meeting 2024



Ecological Integration Symposium 2024



TAMUG Symposium 2024



Houston Regional Ecology and Evolution Symposium 2024

Goals Ahead

- Sampling along the GBL will continue into May of 2025.
- Finish processing all remaining samples.
- More in-depth statistical analyses of data.

Thank You!