National Fish and Wildlife Foundation
Gulf Environmental Benefit Fund
Quarterly Progress Report

2023-10-31

Contents

Easygrants ID: 54029
Project Title: Recovery and Resilience of Oyster Reefs in the Big Bend of Florida
Organization: University of Florida
Project Term: 12/01/2016 - 11/30/2024
Reporting Quarter: Ending October 2023

0.1 General statement of project status and implementation.

This report includes work accomplished from August 2023 through October 2023. We are writing the final project report following the guidelines provided by NFWF.

To date, this project is within budget and timeline.

ii. Updates on individual tasks.

Task 1. Planning and Permitting
A. Work performed on Task 1.

All work on this task was completed by January of 2018.

B. Performance of Task 1 as against the Task 1 Budget.

All subtasks in Task 1 have been completed on schedule or ahead of schedule, and we remain within budget.

C. Existing or anticipated problems with implementation of Task 1.

We consider this part of the project completed.

Task 2. Develop Adaptive Monitoring Plan
A. Work performed on Task 2.

At a minimum, the Adaptive Management Plan for this project should be seen as a living document and an active, constant process.

We are using the Adaptive Management Plan as a guide for completing the final report.

We have followed an adaptive framework for all sampling. Details of this adaptive approach are included in a peer-reviewed publication. Moore JF and WE Pine III. 2021. Bootstrap methods can help evaluate monitoring program performance to inform restoration as part of an adaptive management program. PeerJ 9:e11378 https://doi.org/10.7717/peerj.11378

B. Progress made towards Task 2 milestones.

We are using the Adaptive Management Plan to guide completion of the final report.

C. Performance of Task 2 as against the Task 2 Budget.

Task 2 appears to be within the timeline and budget set out in the proposal.

D. Existing or anticipated problems with implementation of Task 2.

We do not anticipate any problems with implementation of Task 2.

Task 3. Preconstruction Monitoring
A. Work performed on Task 3.

All phases of preconstruction monitoring have been completed as of December 2018.

B. Progress made towards Task 3 milestones.

All subtasks within Task 3 have been completed.

C. Performance of Task 3 as against the Task 3 Budget.

This task appears to be well within budget and the schedule of spending as identified in the proposal.

D. Existing or anticipated problems with implementation of Task 3.

This task is completed.

Task 4. Construction
A. Work performed on Task 4.

All construction activities were completed by November of 2018, so no new work is reported here on construction activities.

B. Progress made towards Task 4 milestones.

All aspects of reef construction were completed as of November 30, 2018.

C. Performance of Task 4 as against the Task 4 Budget.

This task has been completed on schedule, and within budget.

D. Existing or anticipated problems with implementation of Task 4.

No problems are anticipated with the implementation of Task 4, which is complete.

Task 5. Post-Construction Monitoring
A.Work performed on Task 5.

We continued the water quality sampling program until March 9, 2023 and then discontinued the program by retrieving the array. The decommissioning of the water quality array occurred several weeks after the last winter monitoring sample. Data have been uploaded into the relational database used to track these data. We have been working through a final QA/QC of the water quality data and we have received the last samples from the LakeWatch lab. We continuously work to develop relationships between water quality data, survey information, and oyster populations (Task 7). Water quality information is publicly available and summarized on the website https://lcroysterproject.github.io/oysterproject/. We created a Zenodo repository and posted a copy of all oyster count data to this repository as described in our data management plan.

http://zenodo.org/communities/uf_ifas_oysterproject/?page=1%size=20

This repository will also store code used to complete analyses of various aspects of this project. This is an ongoing effort.

B. Progress made towards Task 5 milestones.
. Postconstruction biological sampling of oyster density and size on all study reefs completed for each winter sampling period. Data for the current (winter 2022-2023) sampling period have been entered and summarized, and preliminary results are included as an Appendix.

. GF Young Surveyors completed post-construction elevation sampling in winter/spring 2020-2021. We have received this data and are currently processing the survey results. While working on the survey data this quarter, we identified anomalies and incomplete records in some geospatial information. We worked extensively to identify and correct these anomalies, which necessitated hand-checking of spatial coordinates. Errors were corrected, and we can now resume working on the geospatial aspects of the project.

. Hurricane Idalia made landfall approximately 30-km north of Cedar Key adn less than 20-km from the Lone Cabbage Reef on August 30, 2023. Idalia produced the largest recorded storm surge during the period of instrument record for Cedar Key and led to widespread damage to public and private property and natural features. We have conducted basic bisual assessments of the Lone Cabbage Reef and found that the rocks appear to be in place as designed. It does appear that oyster clusters that were between the rocks during winter 2022-2023 have been displaced and may be concentrated on the landward side of the reef. There appears to have been some sedimentation of the reef on the lower 1/3 of reef elements. We are unsure whether permitting agencies or NFWF would like us to investigate this further.

. We have provided a draft manuscript on oyster reef heights as an appendix.

C. Performance of Task 5 as against the Task 5 Budget. This task is within schedule and budget.

D. Existing or anticipated problems with implementation of Task 5. Nathan Rogers has been on sick leave for most of the reporting period and unable to work. Bill Pine has transitioned to 50% employment with the University of Florida. He is committed to completing the project as agreed but is no longer able to meet workload demands to complete the project as he has done in recent years.

Task 6. Outreach and Education Work performed on Task 6.

Subtask 6.1. Preconstruction outreach and education
Since construction has been completed there is no new information to report.

Subtask 6.2. Post-construction education and outreach We are working with Florida SeaGrant to develop a story board for the Lone Cabbage Project.

Bill Pine met with the Cedar Key Aquaculture Association and Cedar Key community members on August 15 and 16 in Cedar Key. He presented an overview of the Lone Cabbage Reef project and had extensive discussions with the community related to concerns that have recently emerged within the community related to whether or not the restoration of Lone Cabbage Reef altered water quality in shellfish lease areas. This was motivated by large observed losses in farmed clam resources during summer 2023. Lone Cabbage Reef results do not suggest that the restoration led to any changes in water quality in the shellfish lease areas. This conclusion seems to be accepted by the Cedar Key Aquaculture Association leadership, but not some focal members. This led to further discussions about a deployment of the old, but operable, salinity sensors from the Lone Cabbage restoration project near the lease sites. However, these discussions were abandoned after the region was heavily damaged by Hurricane Idalia about two weeks later.

A. Progress made towards Task 6 milestones.

PI Pine presented public seminars to the general public in the town of Cedar Key and to the Cedar Key Oystermens Association.

B. Performance of Task 6 as against the Task 6 Budget.

This task appears to be within the budget proposed and on schedule.

C. Existing or anticipated problems with implementation of Task 6.

We do not anticipate any problems with the implementation of Task 6.

Task 7. Data Management

A. Work performed on Task 7.

With the help of the UF library team we corrected unexpected errors in the geospatial information collected in 2021-2022.

B. Progress made towards Task 7 milestones.

Database efforts for water quality and oyster count data are in place and operational. Effort continues to integrate GF Young's and others' survey information (pre and post-construction) into a common framework. We created a Zenodo repository for oyster count data.
https://zenodo.org/communities/uf_ifas_oysterproject/?page=1&size=20

C. Performance of Task 7 as against the Task 7 Budget.

We are currently proceeding as scheduled for Task 7 and are within budget.

D. Existing or anticipated problems with implementation of Task 7.

None anticipated.

Task 8. Project Administration

A. Work performed on Task 8.

Subtask 8.1. Tracking expenditures
The project is underspent. We have worked to close out financials related to the project.

Subtask 8.2. Managing staff Two graduate students (Nate Rogers and Matthew Richardson) are supported in whole or part by this award. Jennifer Moore (former post-doc) in now a contractor and was able to commit some hours in June and July to the project. Nate Rogers has been on medical leave most of the semester. Joe Aufmuth (UF library) worked extensively on the geospatial information and related report components. Staff continue to be supervised by PI Bill Pine, who is working on all aspects of the project but has reduced UF appointment.

Subtask 8.3. Coordination Coordinating meetings take place related to project completion as needed. PI Bill Pine meets with staff regularly via video conference, phone calls, and in-person.

Subtask 8.4. Reporting During this period, we have submitted requests for reimbursement for the October 2023 reporting period and have completed the quarterly report for the October 2023 reporting period. PI Pine is working on the project final report based on input from NFWF.

B. Progress made towards Task 8 milestones.

. Fiscal reports and requests for reimbursement completed.
. Quarterly report completed through October 2023.
. Management and training graduate students.
. Working on project final report.

C. Performance of Task 8 as against the Task 8 Budget.

This Task appears to be within the Task 8 budget, and on schedule.

D. Existing or anticipated problems with implementation of Task 8.

None.

0.2 Submission schedule for payment requests.

UF has submitted payment requests quarterly and UF plans to continue this schedule.

0.3 Any other information necessary for NFWF's evaluation of the Project's progress as measured against the Project Description, Budget, and Project schedule.

Project PI Bill Pine plans to separate from University of Florida employment. A solution was found for this separation.

0.4 Project products and deliverables produced during the applicable reporting period.

See the Appendix for draft manuscript on oyster heights.

1 Water Quality Quarterly Figures

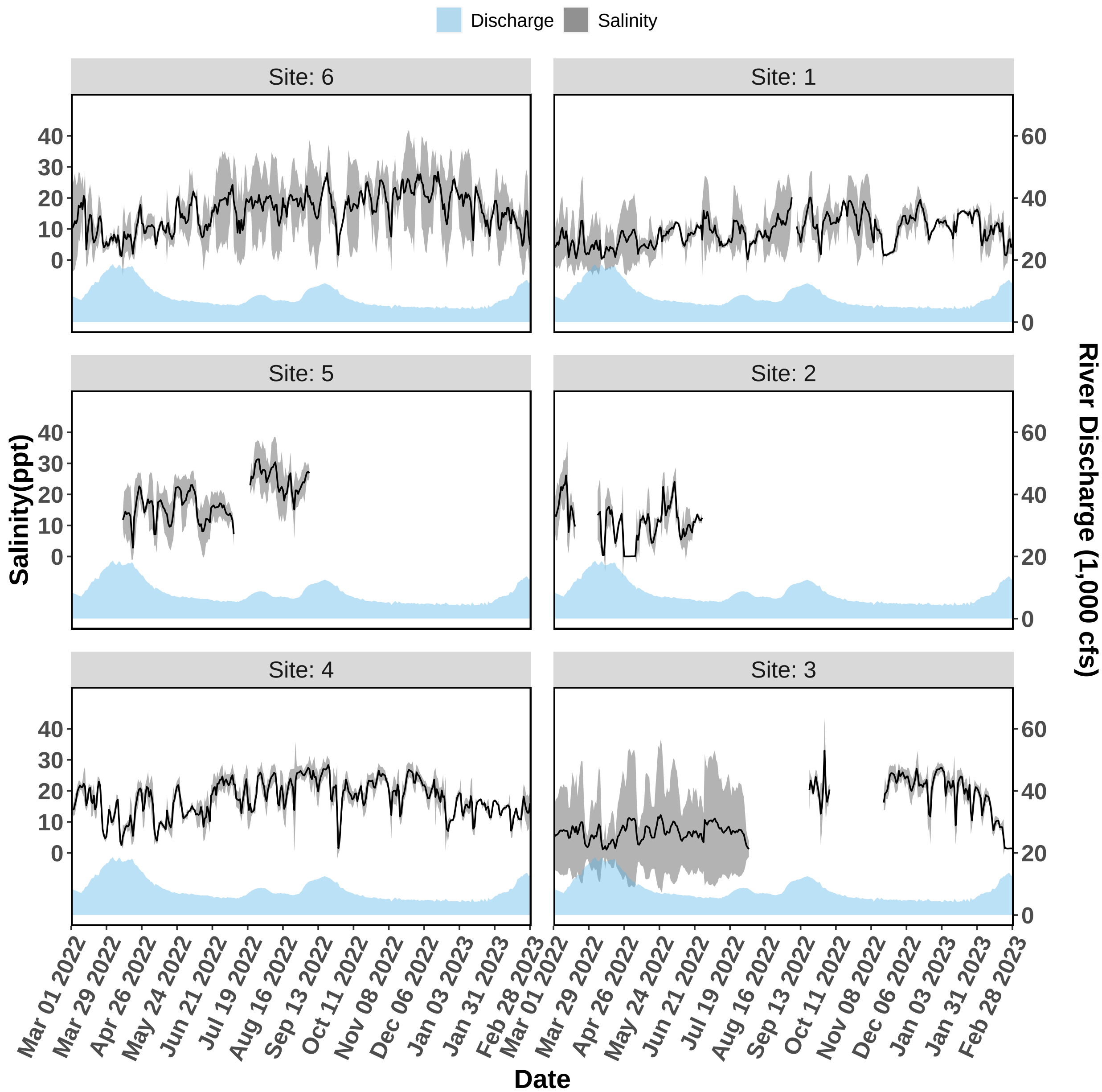


Figure 1-1. Salinity and river discharge data collected from autonomous sensors from the Lone Cabbage Reef restoration site near Suwannee, FL. Each graph represents a sensor location, with top of page as north, and right of page as east. The right column of figures (Sites 1-3) represent the eastern side of the Lone Cabbage Reef restoration site. The left column of figures (Sites 4-6) represent the western side of the Lone Cabbage Reef restoration site. The primary y-axis is Salinity (ppt, parts per thousand), and the secondary y-axis is Suwannee River discharge (CFS, cubic feet per second) measured at USGS Wilcox station 02323500 on the Suwannee River. River discharge is graphed as a daily mean in the light blue filled shape near the bottom of each graph. Daily mean salinity values (black line) are depicted using a 95% confidence interval (grey shaded region). Missing river discharge or salinity values are due to corrupt readings or missing equipment.

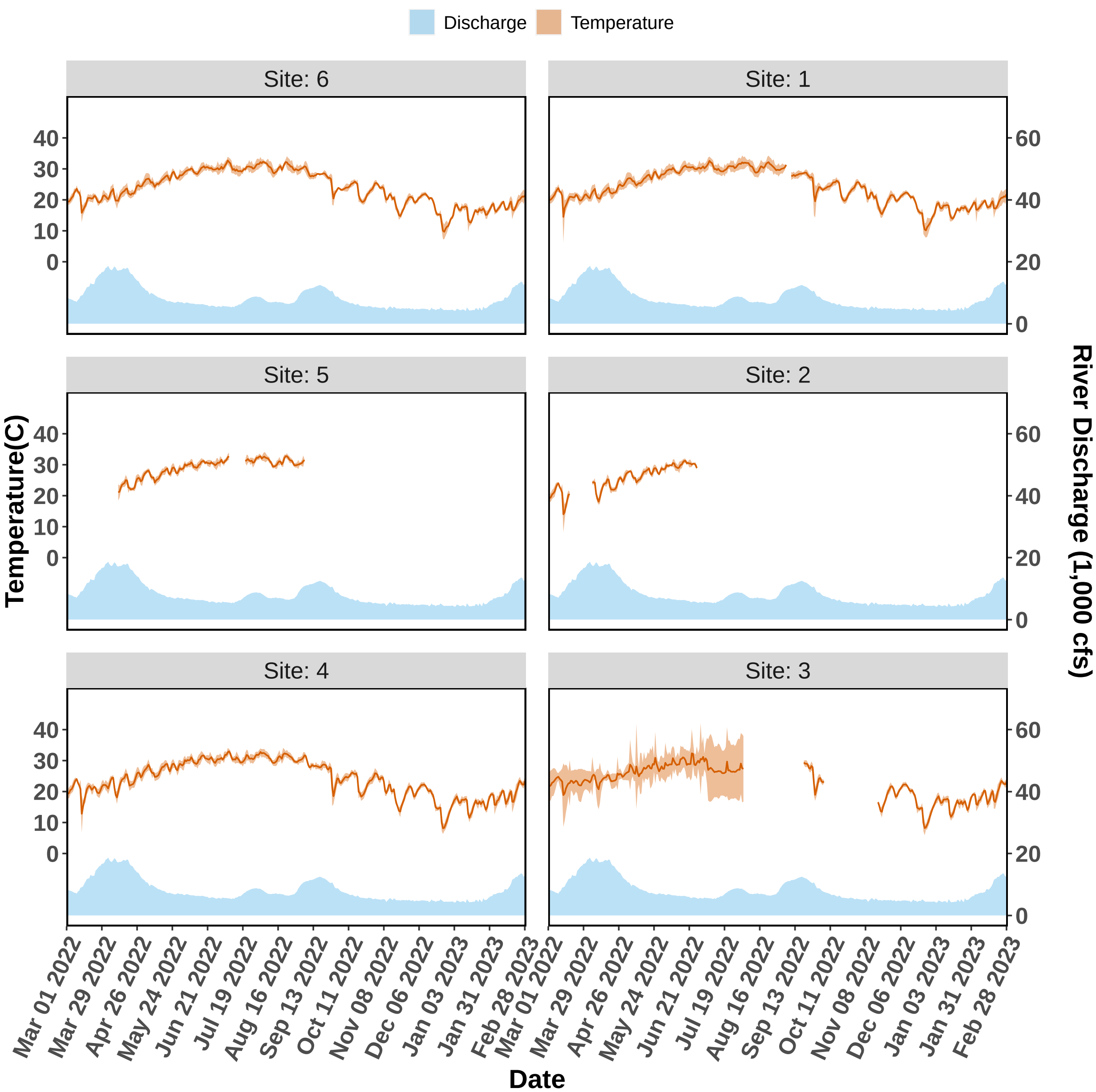


Figure 1-2. Temperature and discharge data collected from autonomous sensors from the Lone Cabbage Reef restoration site near Suwannee, FL. Each graph represents a sensor location, with top of page as north, and right of page as east. The right column of figures (Sites 1-3) represent the eastern side of the Lone Cabbage Reef restoration site. The left column of figures (Sites 4-6) represent the western side of the Lone Cabbage Reef restoration site. The primary y-axis is Temperature (C, Celsius), and the secondary y-axis is Suwannee River discharge (CFS, cubic feet per second) measured at USGS Wilcox station 02323500 on the Suwannee River. River discharge is graphed as a daily mean in the light blue filled shape near the bottom of each graph. Daily mean temperature values (orange line) are depicted with a 95% confidence interval (shaded orange region). Missing river discharge or temperature values are due to corrupt readings or missing equipment.

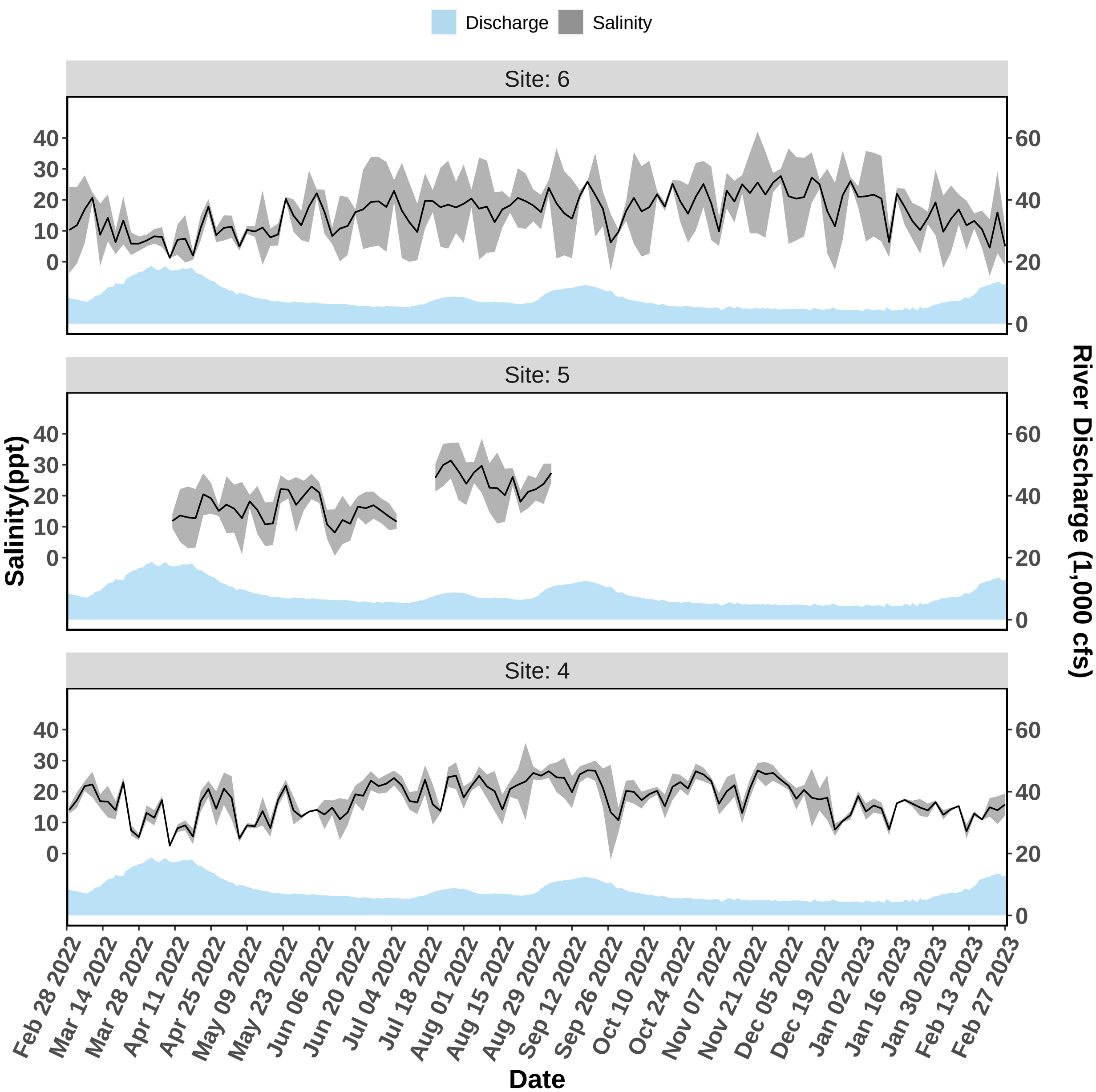


Figure 1-3. Salinity and discharge data collected from autonomous sensors from the Lone Cabbage Reef restoration site near Suwannee, FL. Each graph represents a sensor location, with top of page as north, and right of page as east. The figures (Sites 4-6) represent the western side of the Lone Cabbage Reef restoration site. The primary y-axis is Salinity (ppt, parts per thousand), and the secondary y-axis is Suwannee River discharge (CFS, cubic feet per second) measured at USGS Wilcox station 02323500 on the Suwannee River. River discharge is graphed as a daily mean in the light blue filled shape near the bottom of each graph. Daily mean salinity values (black line) are depicted using a 95% confidence interval (grey shaded region). Missing river discharge or salinity values are due to corrupt readings or missing equipment.

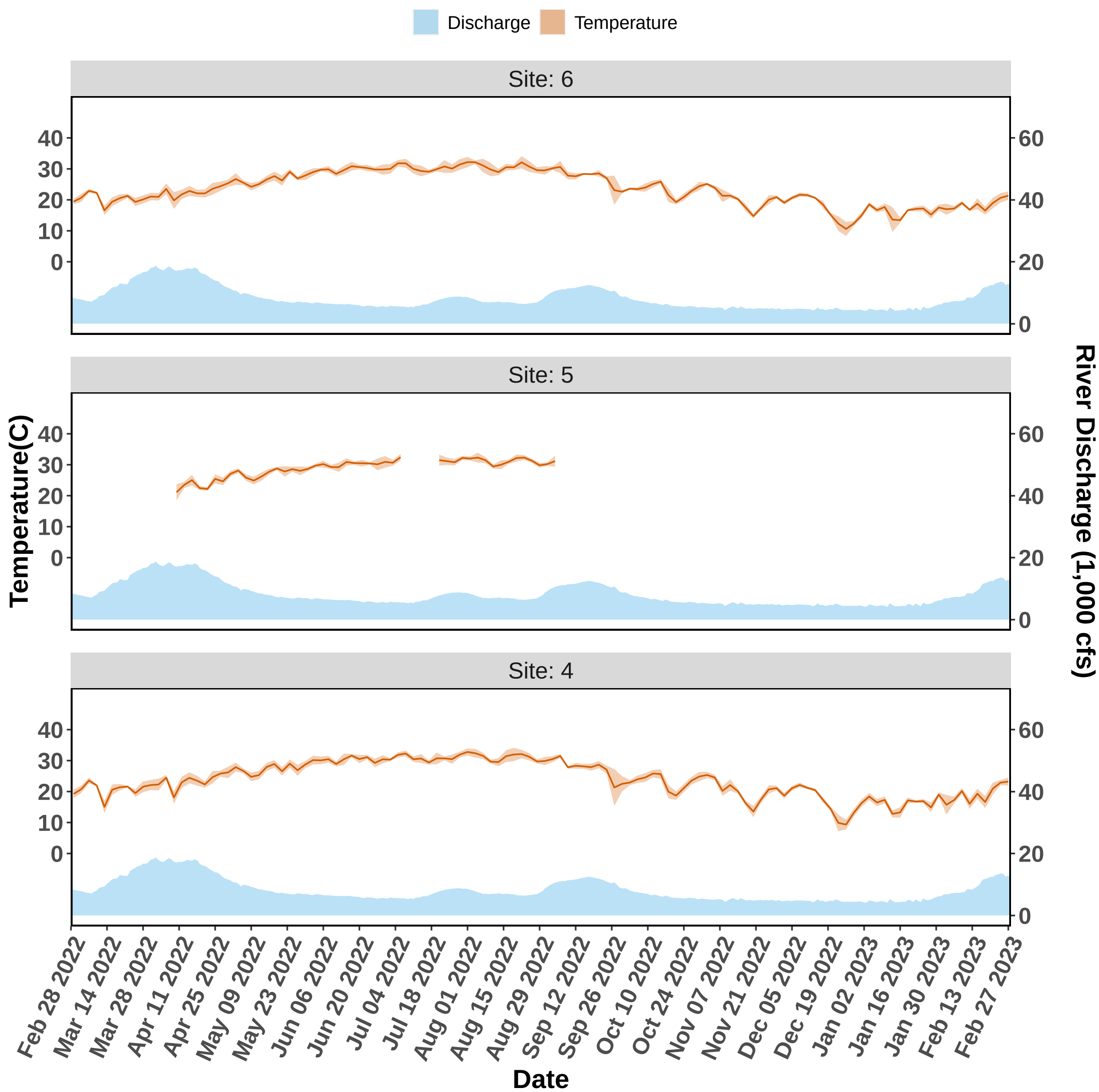


Figure 1-4. Temperature and discharge data collected from autonomous sensors from the Lone Cabbage Reef restoration site near Suwannee, FL. Each graph represents a sensor location, with top of page as north, and right of page as east. The figures (Sites 4-6) represent the western side of the Lone Cabbage Reef restoration site. The primary y-axis is Temperature (C, Celsius), and the secondary y-axis is Suwannee River discharge (CFS, cubic feet per second) measured at USGS Wilcox station 02323500 on the Suwannee River. River discharge is graphed as a daily mean in the light blue filled shape near the bottom of each graph. Daily mean temperature values (orange line) are depicted with a 95% confidence interval (shaded orange region). Missing river discharge or salinity values are due to corrupt readings or missing equipment.

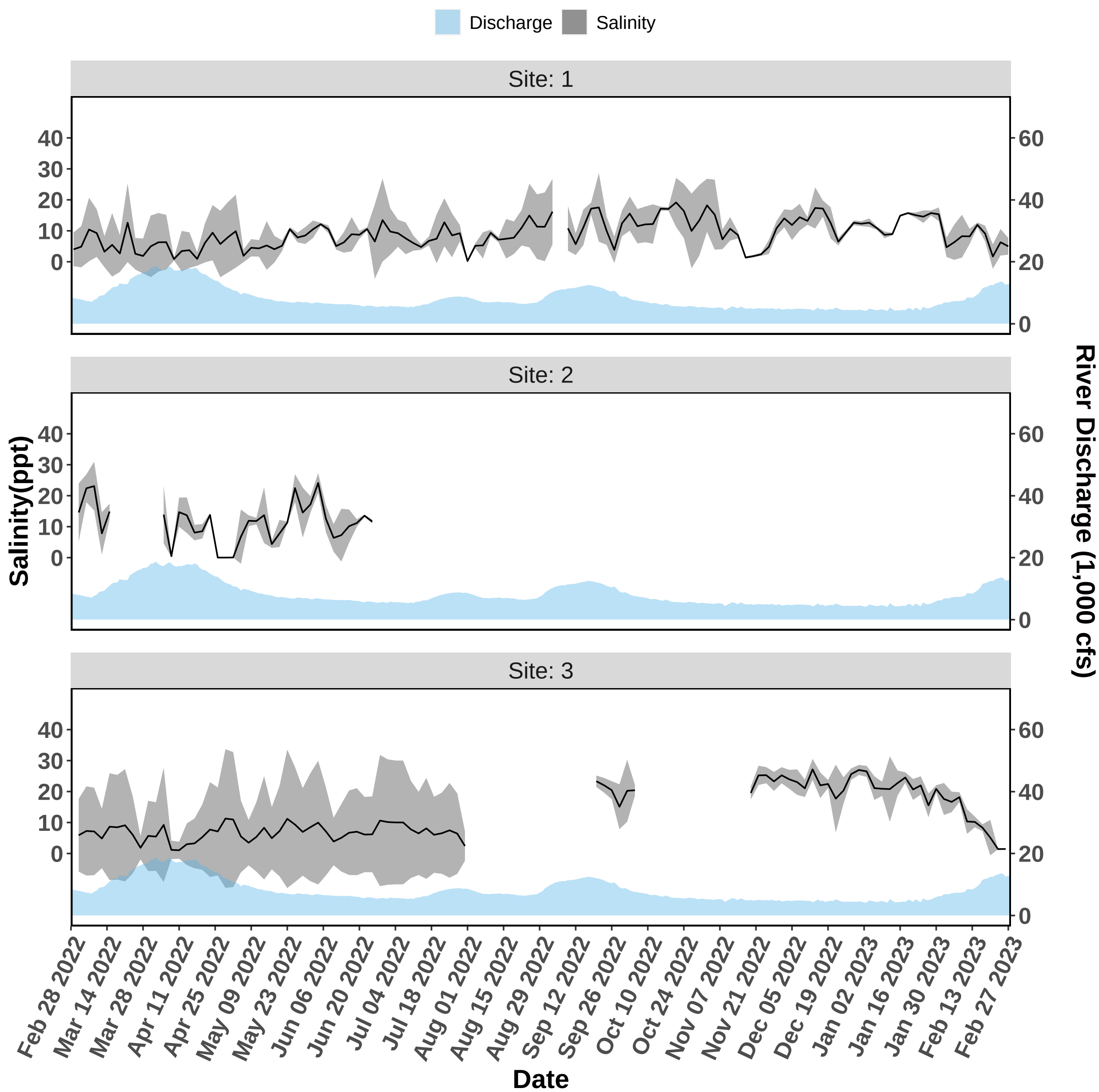


Figure 1-5. Salinity and discharge data collected from autonomous sensors from the Lone Cabbage Reef restoration site near Suwannee, FL. The figures (Sites 1-3) represent the eastern side of the Lone Cabbage Reef restoration site. The primary y-axis is Salinity (ppt, parts per thousand), and the secondary y-axis is Suwannee River discharge (CFS, cubic feet per second) measured at USGS Wilcox station 02323500 on the Suwannee River. River discharge is graphed as a daily mean in the light blue filled shape near the bottom of each graph. Daily mean salinity values (black line) are depicted using a 95% confidence interval (grey shaded region). Missing river discharge or salinity values are due to corrupt readings or missing equipment.

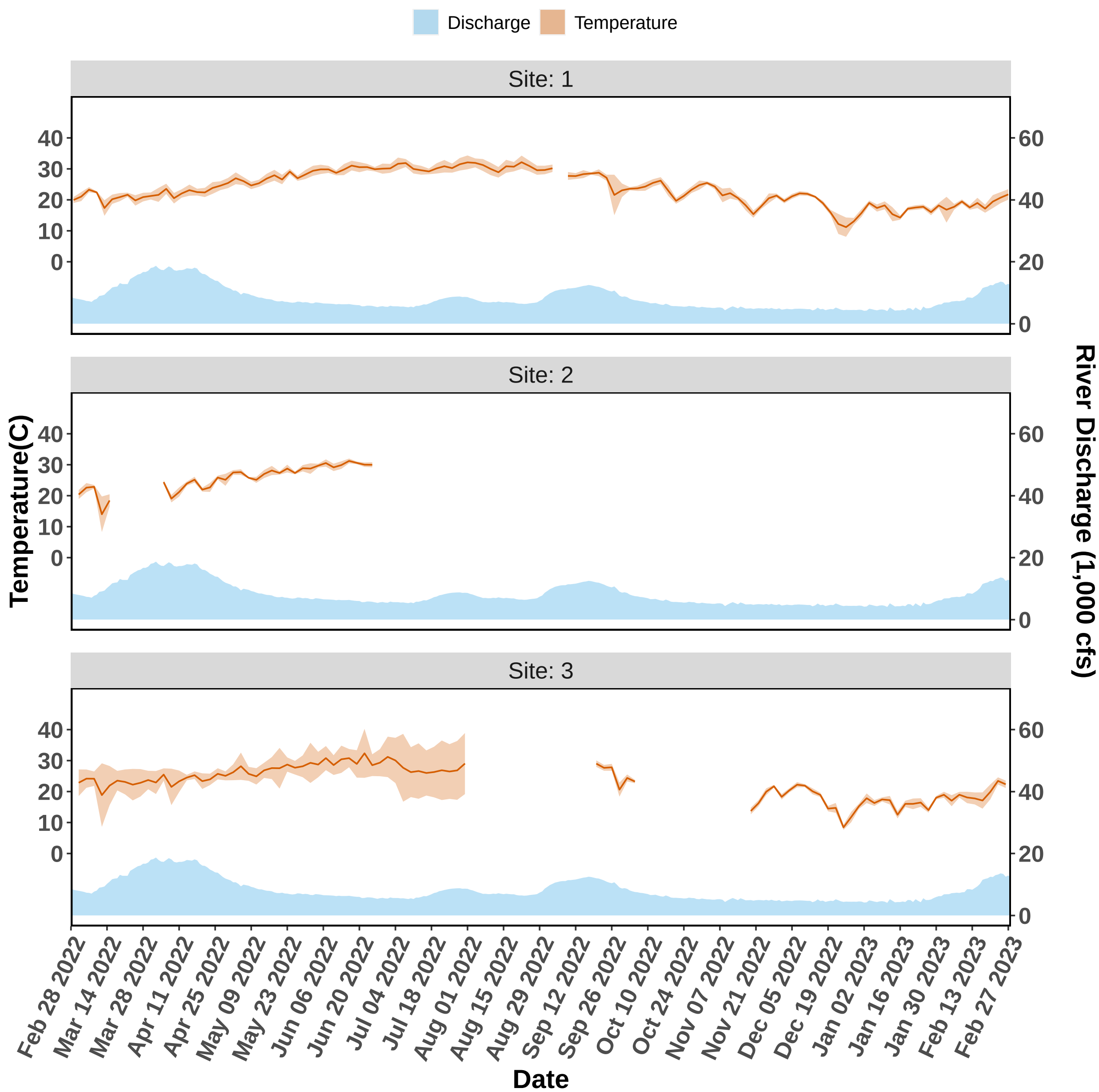


Figure 1-6. Temperature and discharge data collected from autonomous sensors from the Lone Cabbage Reef restoration site near Suwannee, FL. The figures (Sites 1-3) represent the eastern side of the Lone Cabbage Reef restoration site. The primary y-axis is Temperature (C, Celsius), and the secondary y-axis is Suwannee River discharge (CFS, cubic feet per second) measured at USGS Wilcox station 02323500 on the Suwannee River. River discharge is graphed as a daily mean in the light blue filled shape near the bottom of each graph. Daily mean temperature values (orange line) are depicted with a 95% confidence interval (shaded orange region).

2 River Discharge Figures

For all of the figures within this chapter, the areas of color represent percentiles where each percentile is a value on a scale of one hundred that indicates the percent of a distribution that is equal to or below it. For example, on the map of daily streamflow conditions a river discharge at the 90th percentile is equal to or greater than 90 percent of the discharge values recorded on this day of the year during all years that measurements have been made. In general, a percentile greater than 75 is considered above normal, a percentile between 25 and 75 is considered normal, and a percentile less than 25 is considered below normal. The percentiles are based on the period of record for this gauge station.

These data are retrieved via the `waterData` package in R made available by U.S. Geological Survey (USGS). These data are collected at the USGS 02323500 Suwannee River station near Wilcox, Florida. This site is located in Levy County, Florida (latitude 29.58968 and longitude -82.93651 in degrees).

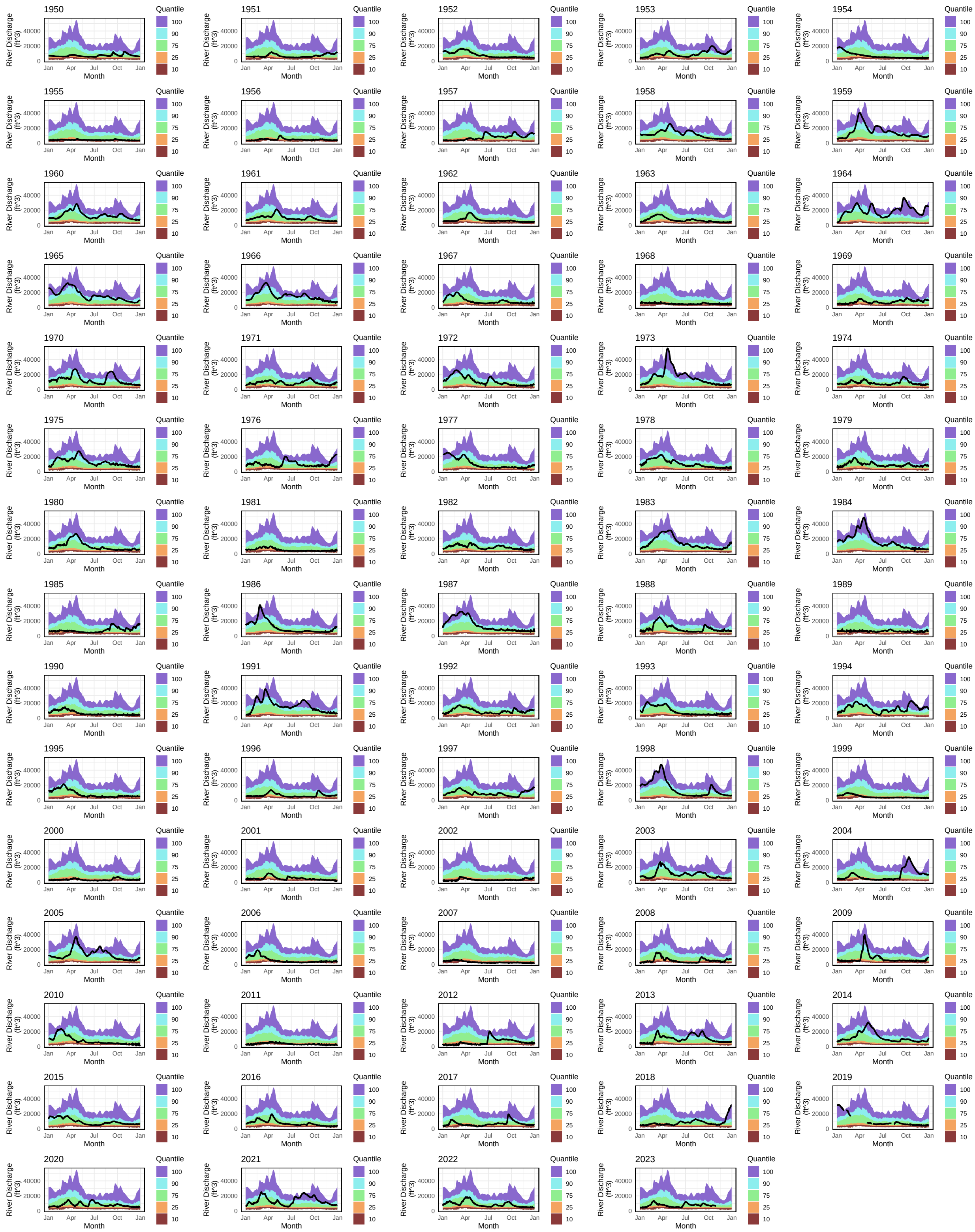


Figure 2-1. River discharge (by convention CFS, y axis) from the USGS Wilcox, Florida gauge (USGS 02322500) for the years 1950-2022 (solid black line).

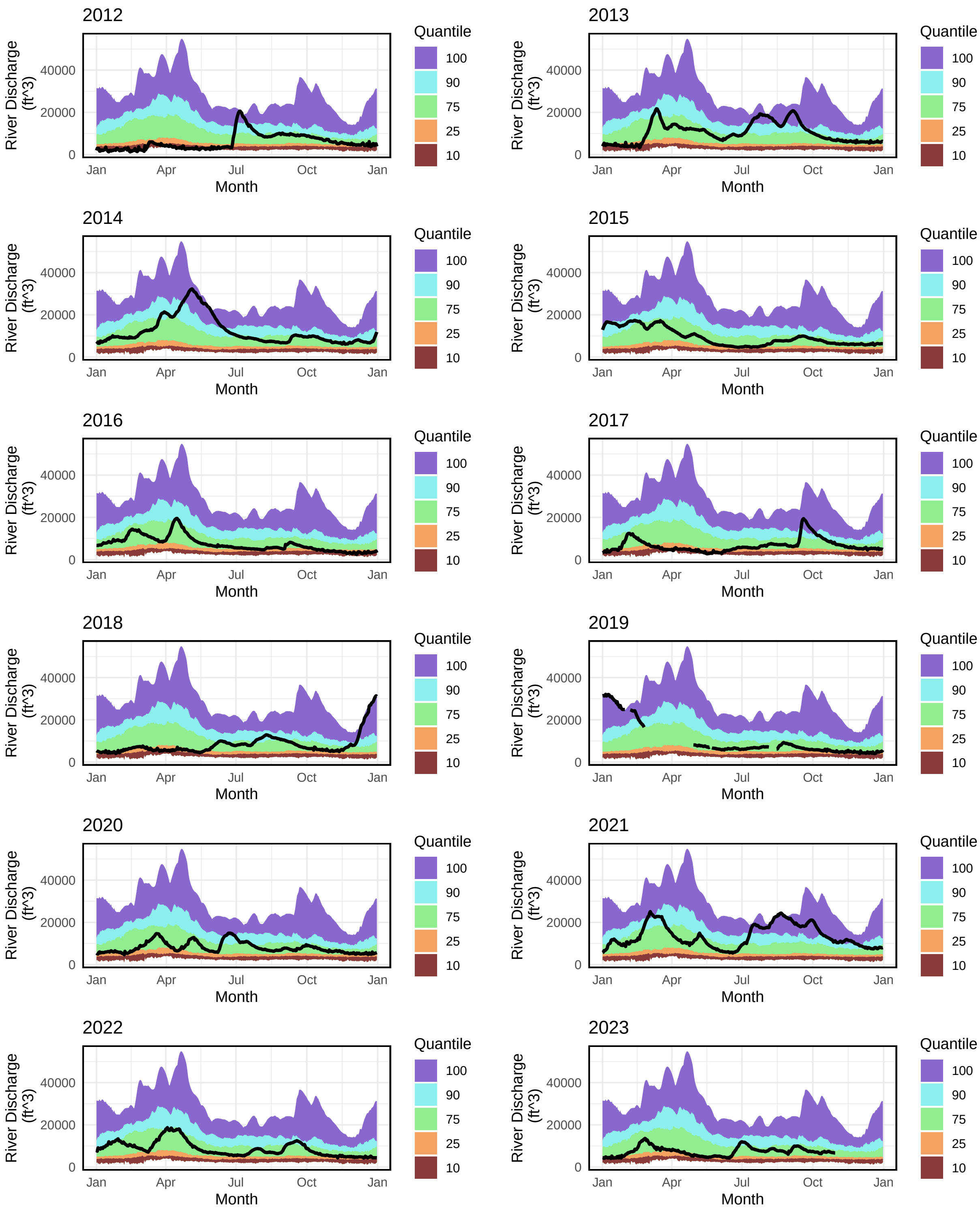


Figure 2-2. River discharge (by convention CFS, y axis) from the USGS Wilcox, Florida gauge (USGS 02322500) for the years 2012-2023 (solid black line).

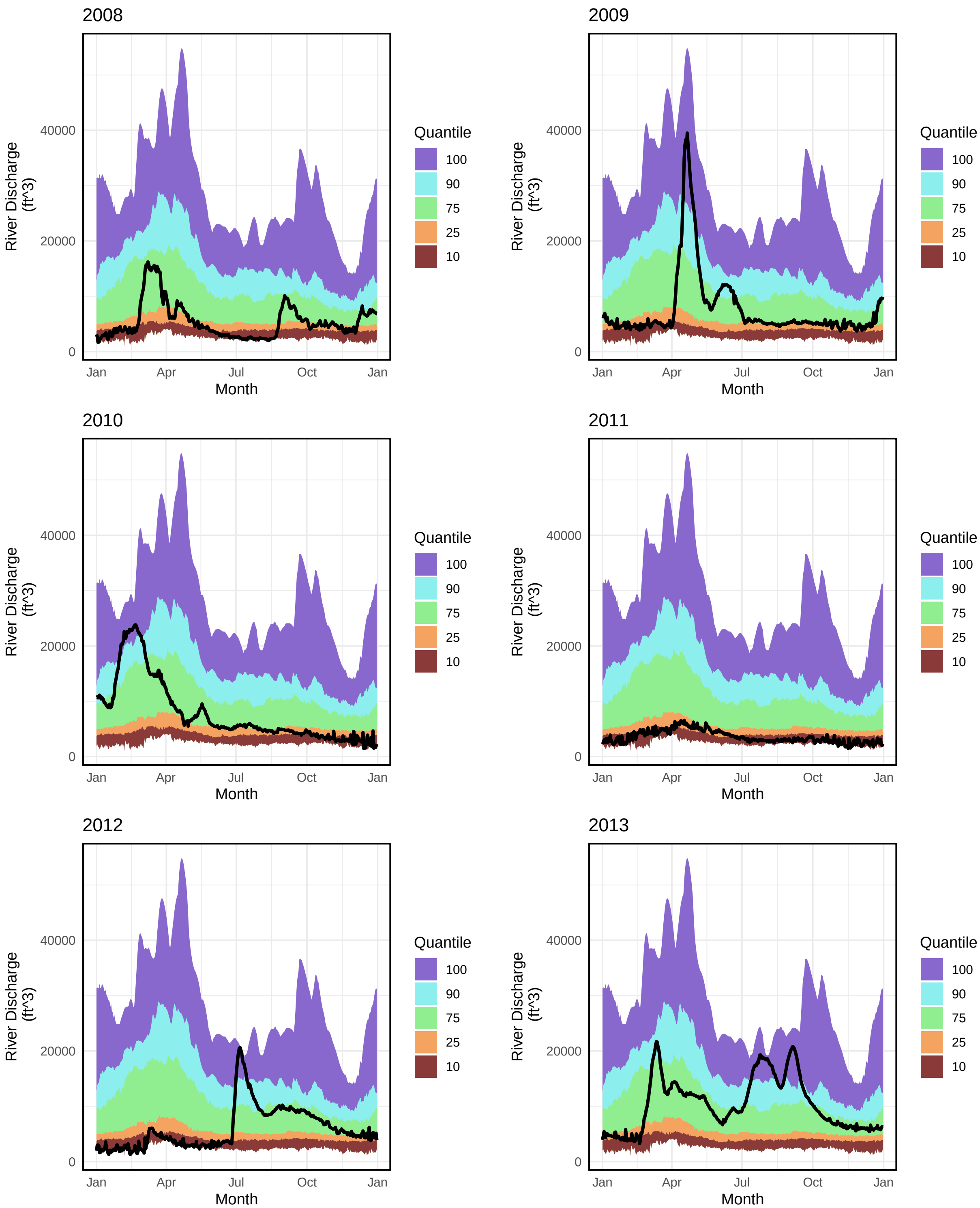


Figure 2-3. River discharge (by convention CFS, y axis) from the USGS Wilcox, Florida gauge (USGS 02322500) for the years 2008-2013 (solid black line) representing the years preceding observed extreme low discharge conditions 2010-2012.

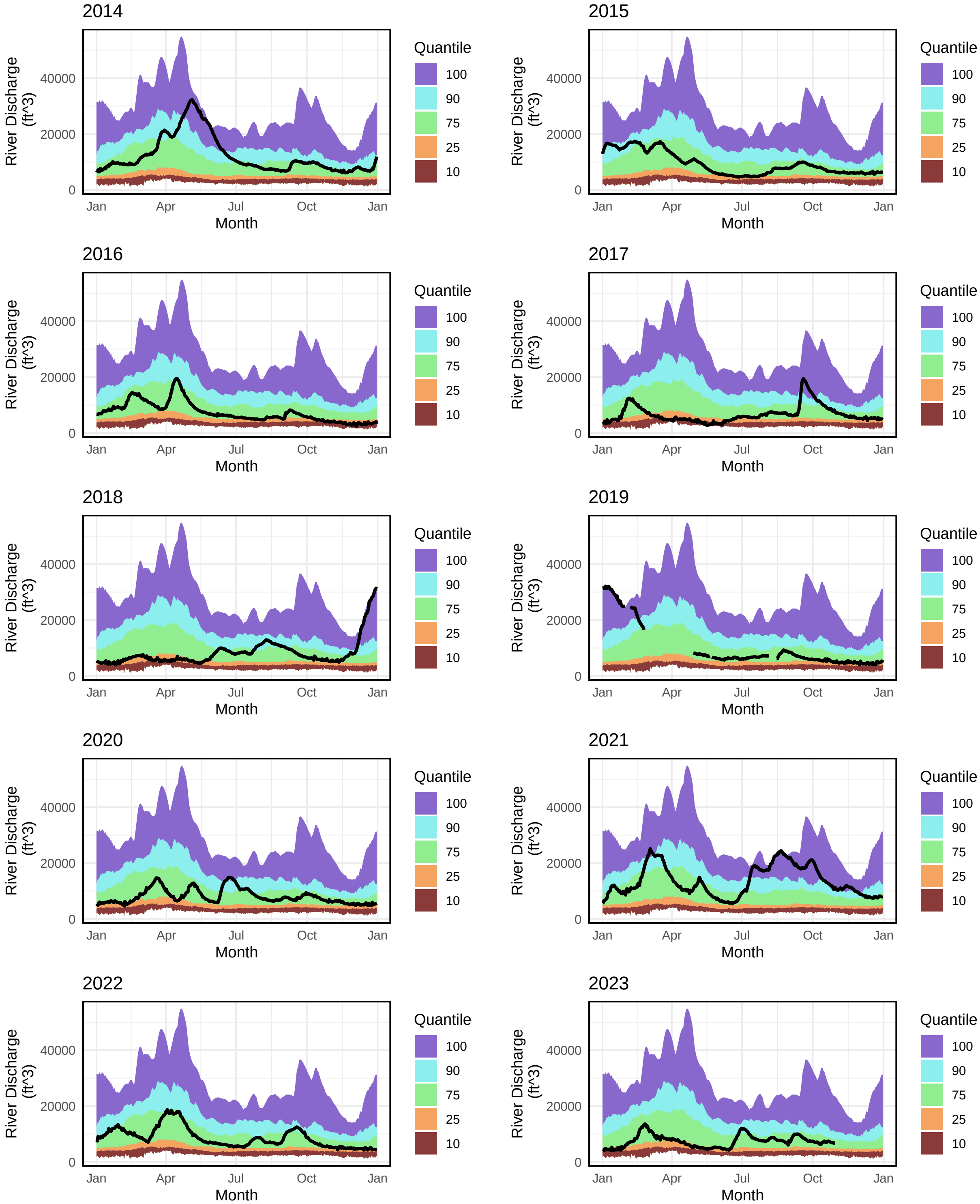


Figure 2-4. River discharge (by convention CFS, y axis) from the USGS Wilcox, Florida gauge (USGS 02322500) for the years 2014-2023 (solid black line) representing the years since 2010-2012 low flow conditions including the initiation of the Lone Cabbage Reef restoration project.

3 Transect Report

3.1 Overview

This report provides summary statistics and figures for ongoing transect sampling. The first section of the report focuses on the current sampling (Winter 2022-2023) and how the collected data compare to last year's sampling (Winter 2021-2022). So far 14 days have been sampled this season. The second half of the report gives summaries of all of the data that have been collected since the beginning of the project (2010-05-27). In total, 158 days have been sampled over this entire project.

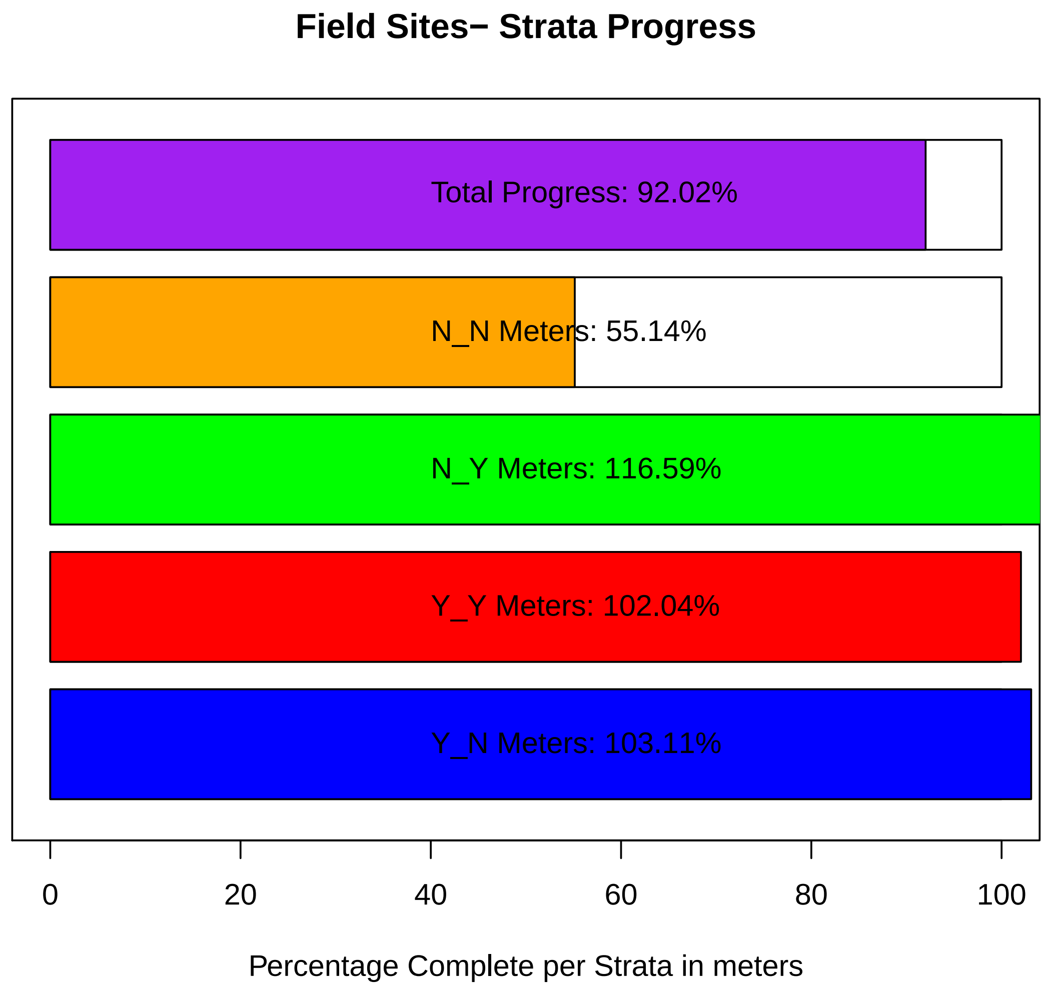
3.1.1 Definition of Localities and Strata

LOCALITY	LOCATION
BT	Big Trout
CK	Cedar Key
CR	Corrigan's Reef
HB	Horseshoe Beach
LC	Lone Cabbage
LT	Little Trout
NN	No Name

STRATA	DEFINITION
Y_N	Yes Harvest, No Rock
Y_Y	Yes Harvest, Yes Rock
N_N	No Harvest, No Rock
N_Y	No Harvest, Yes Rock
N_PILOT	No Harvest, Pilot Rocks

3.2 Current Sampling (progress)

Here, we provide a progress bar showing how much of the sampling has been completed for this season, plus summary tables and plots comparing live counts and density of oysters between this current season and last year. **The current sampling period is period 26, and last year's sampling period is period 24.**



STRATA	Meters Completed
Y_N	342.33
Y_Y	871.4
N_N	216.13
N_Y	728.66

Table 3-1. - Displaying the total meters surveyed during period 26 per strata.

3.2.1 Summary Plots for Periods 20, 22, 24, and 26

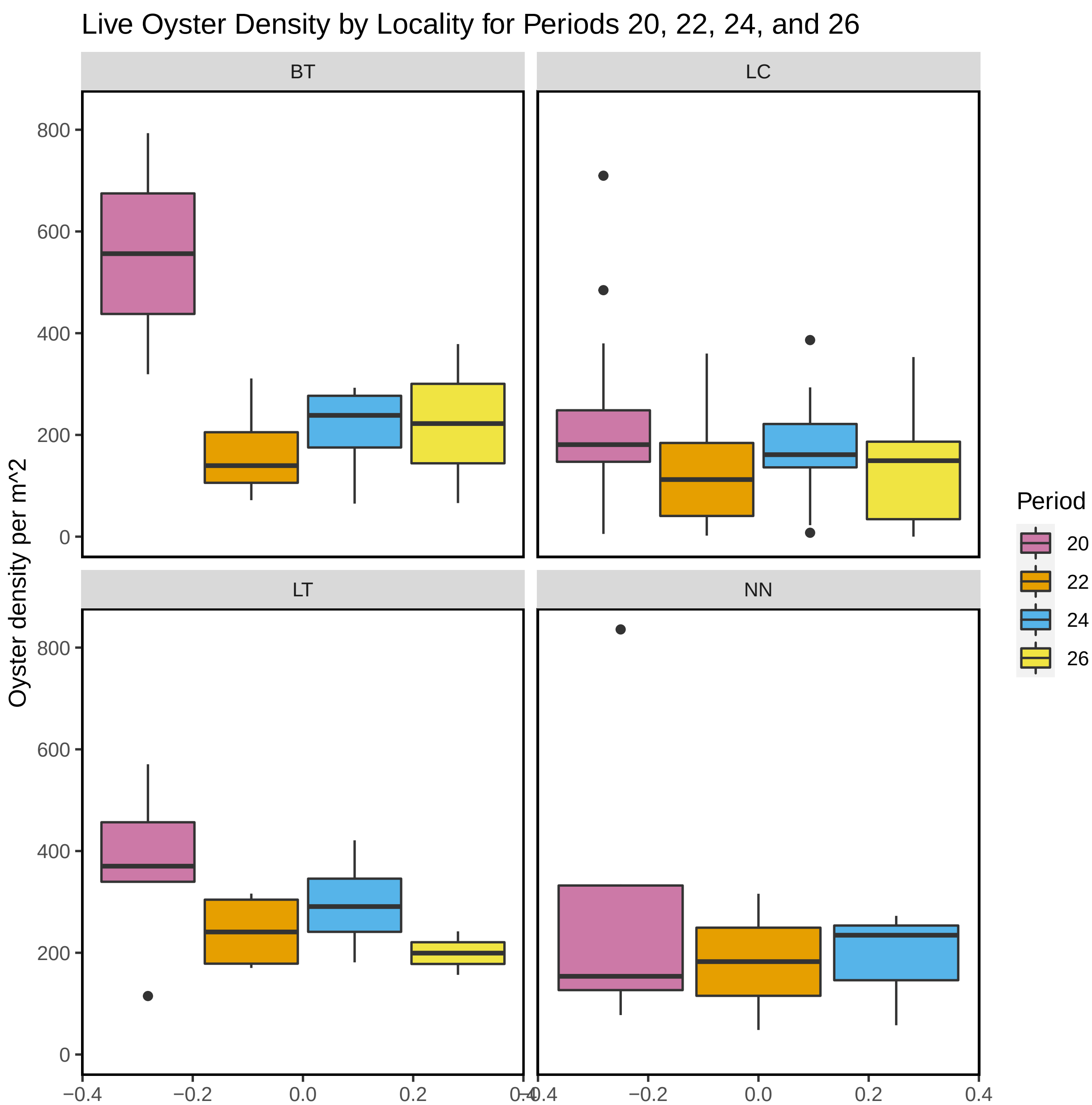


Figure 3-1.- Calculated live oyster density by locality for periods 20 (Winter 2019-2020), 22 (Winter 2020-2021), 24 (Winter 2021-2022), and 26 (Winter 2022-2023) with the last sample date of period 26 as 2023-02-06.

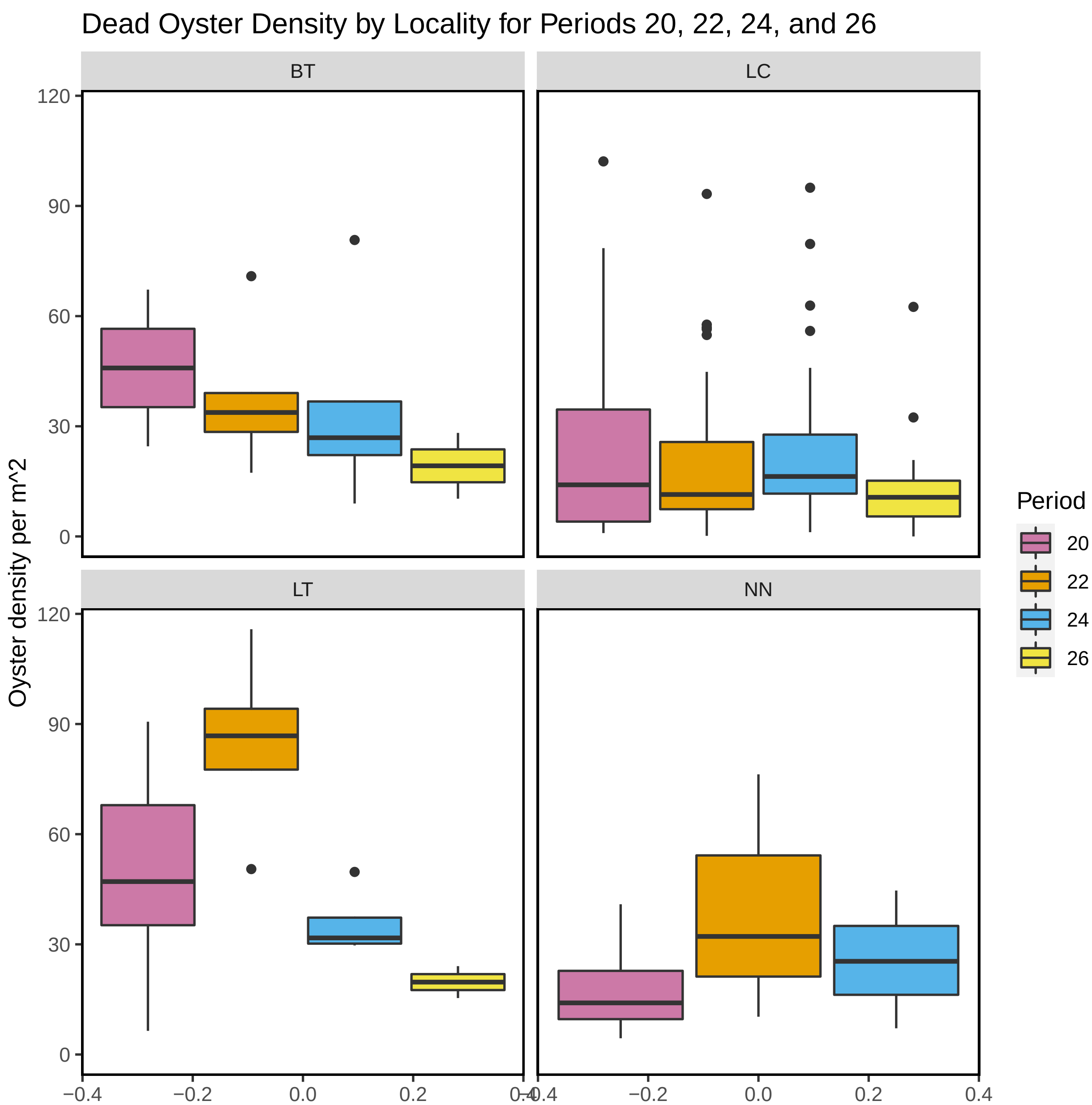


Figure 3-2.- Calculated dead oyster density by locality for periods 20 (Winter 2019-2020), 21 (Winter 2020-2021), 24 (Winter 2021-2022), and 26 (Winter 2022-2023) with the last sample date of period 26 as 2023-02-06.

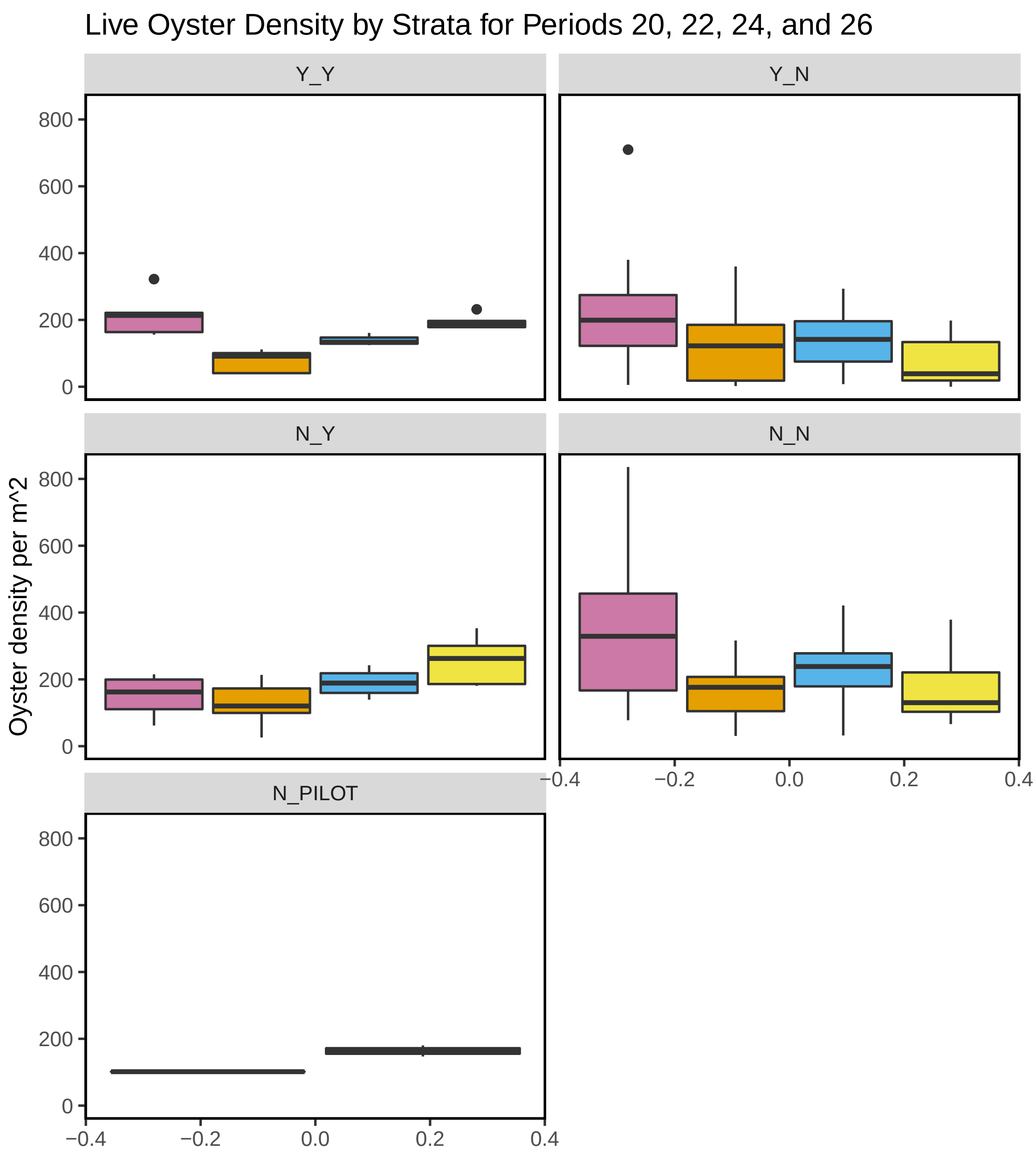


Figure 3-3.- Calculated live oyster density by strata for periods 20 (Winter 2019-2020), 22 (Winter 2020-2021), 24 (Winter 2021-2022), and 26 (Winter 2022-2023) with the last sample date of period 26 as 2023-02-06.

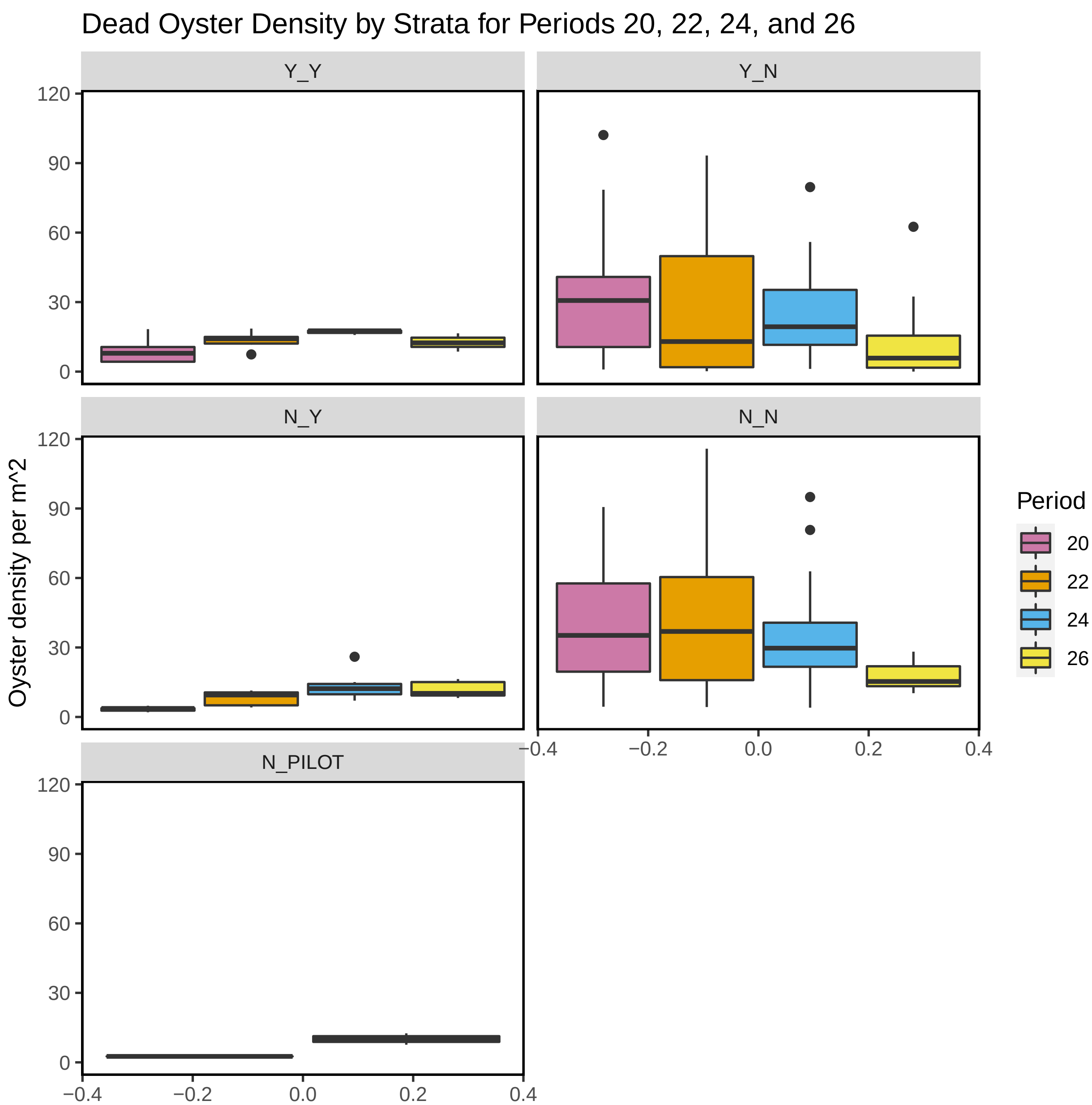


Figure 3-4.- Calculated dead oyster density by strata for periods 20 (Winter 2019-2020), 22 (Winter 2020-2021), 24 (Winter 2021-2022), and 26 (Winter 2022-2023) with the last sample date of period 26 as 2023-02-06.

The following summary plot is calculated in R using the `geom_density` (https://ggplot2.tidyverse.org/reference/geom_density.html) statistical function in `ggplot`. The `geom_density` function computes and draws kernel density estimates, which is then represented as a smoothed version of a histogram.

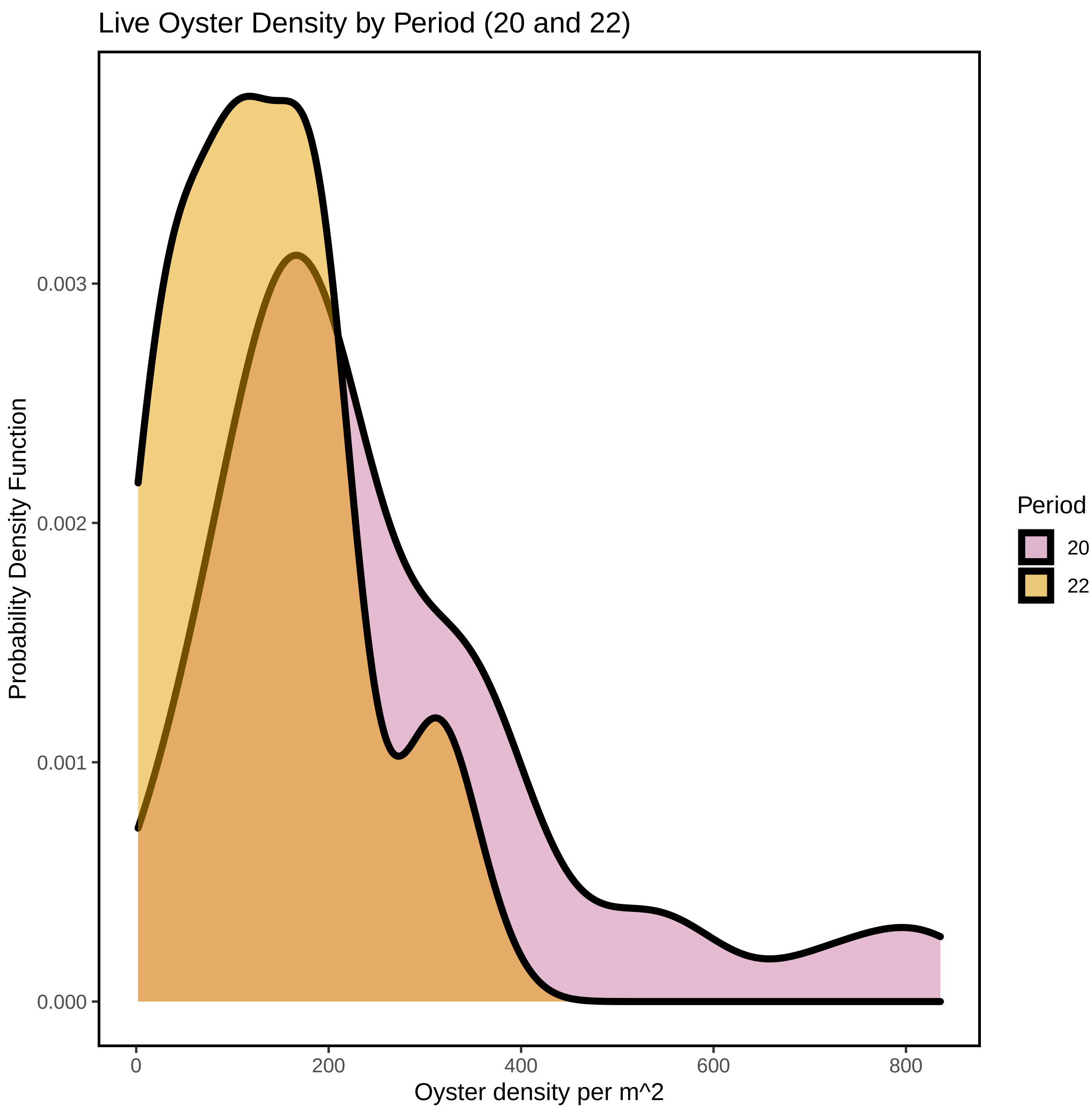


Figure 3-5.- Calculated live oyster density by periods 20 (Winter 2019-2020) and 22 (Winter 2020-2021) using a probability density function.

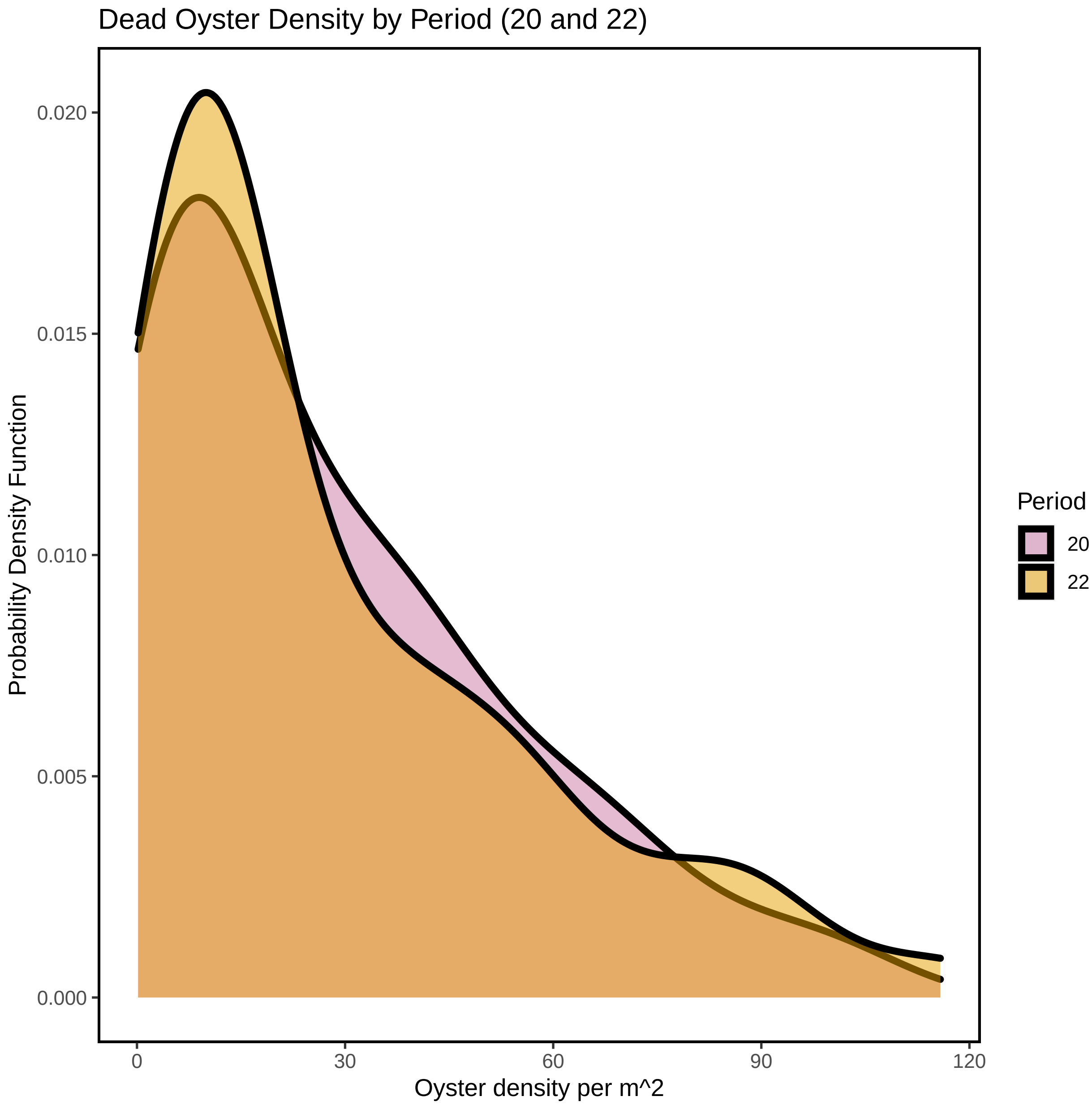


Figure 3-6.- Calculated dead oyster density by periods 20 (Winter 2019-2020) and 22 (Winter 2020-2021) using a probability density function.

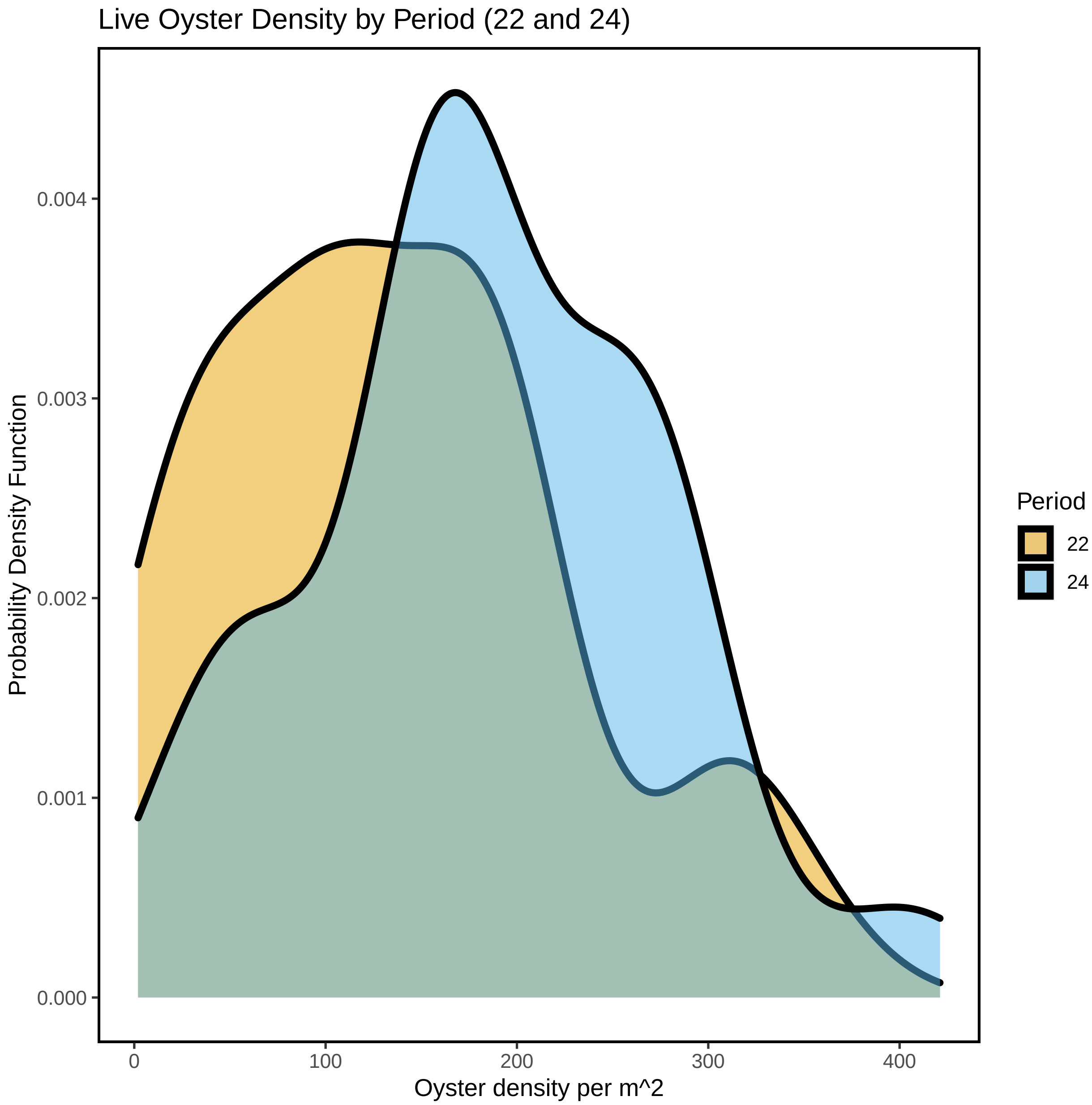


Figure 3-7.- Calculated live oyster density by periods 22 (Winter 2020-2021) and 24 (Winter 2021-2022) using a probability density function.

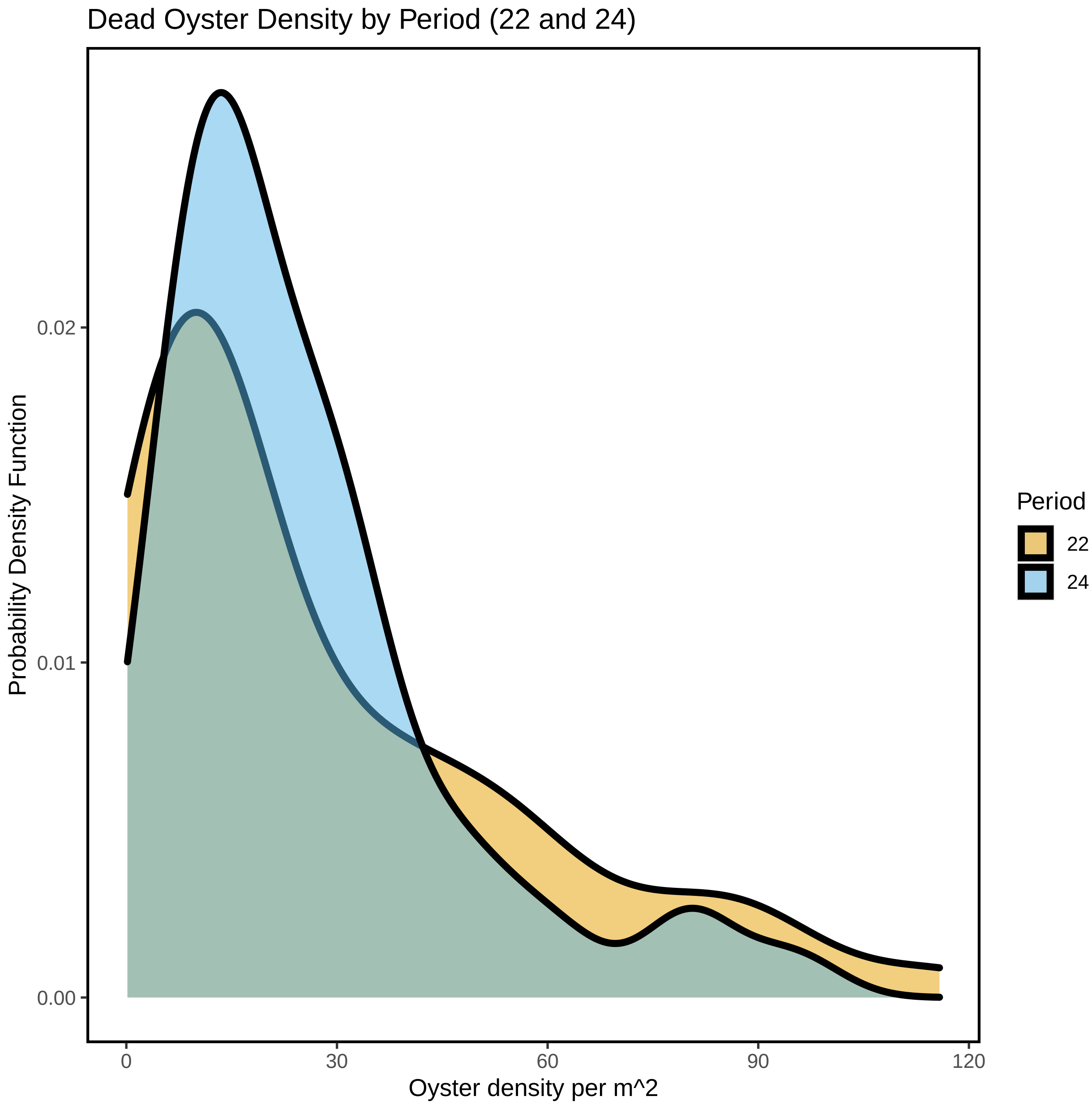


Figure 3-8.- Calculated dead oyster density by periods 22 (Winter 2020-2021) and 24 (Winter 2021-2022) using a probability density function.

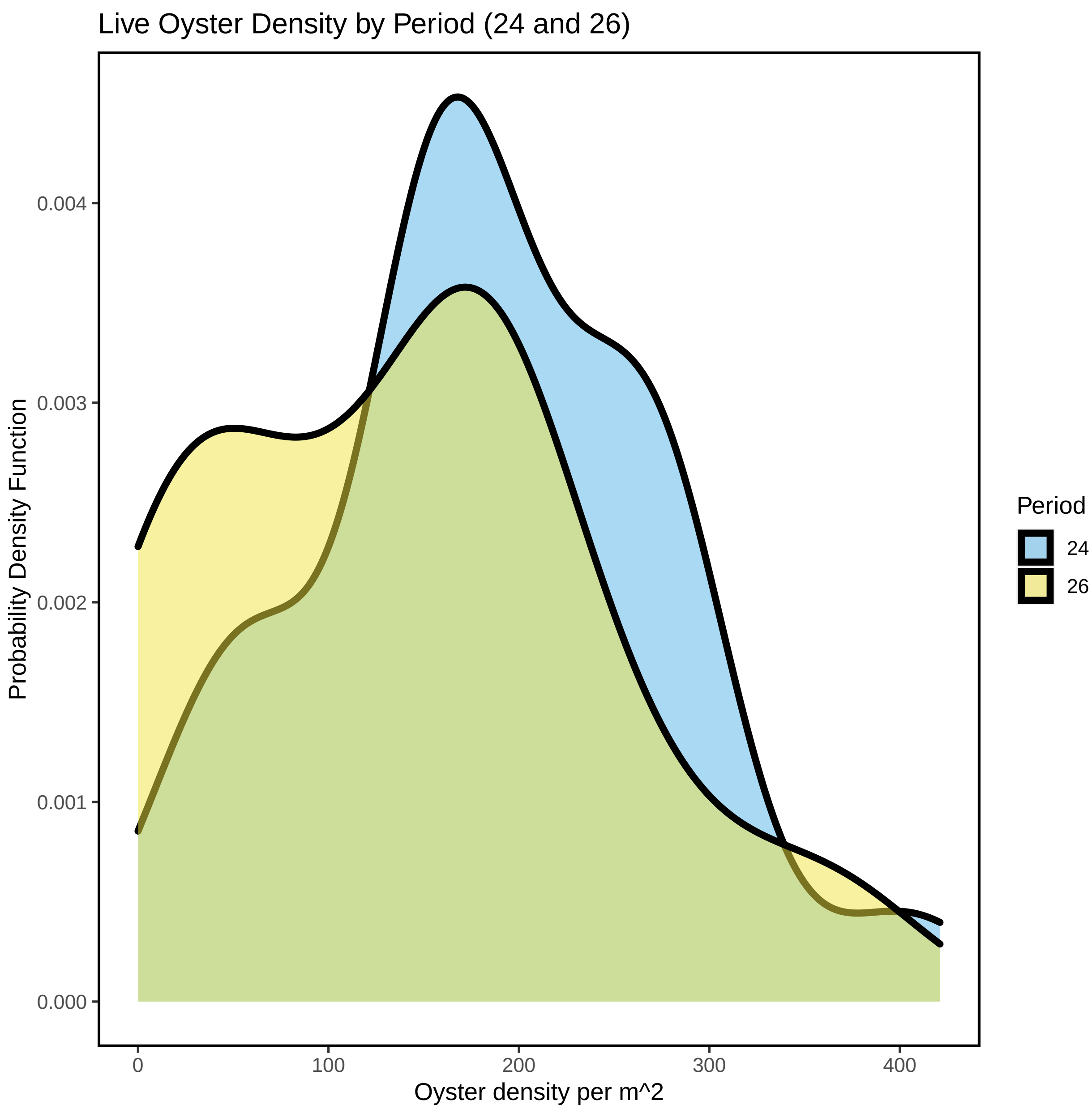


Figure 3-9.- Calculated live oyster density by periods 24 (Winter 2021-2022) and 26 (Winter 2022-2023) using a probability density function with the last sample date of period 26 as 2023-02-06.

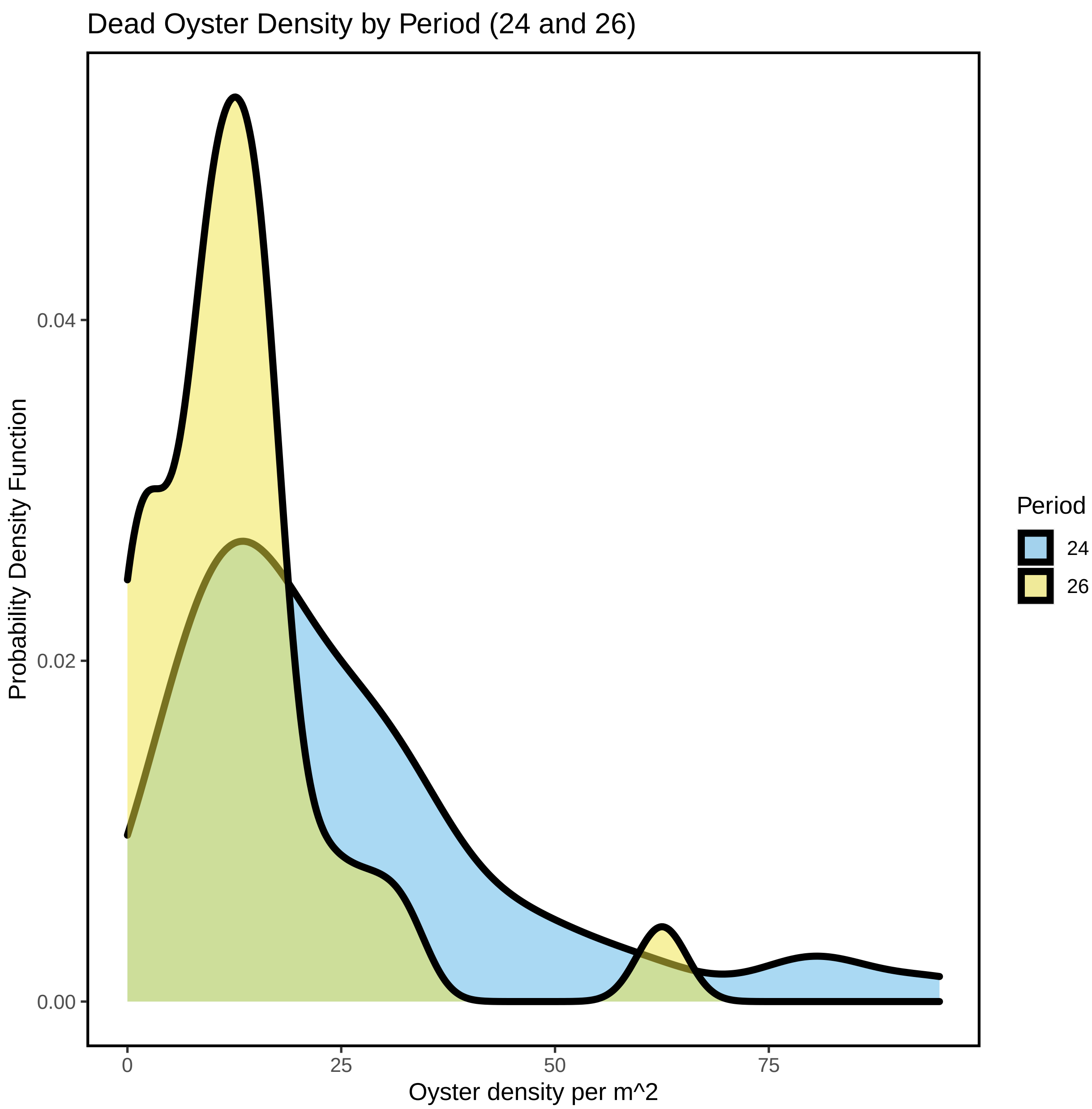


Figure 3-10- Calculated dead oyster density by periods 24 (Winter 2021-2022) and 26 (Winter 2022-2023) using a probability density function with the last sample date of period 26 as 2023-02-06.

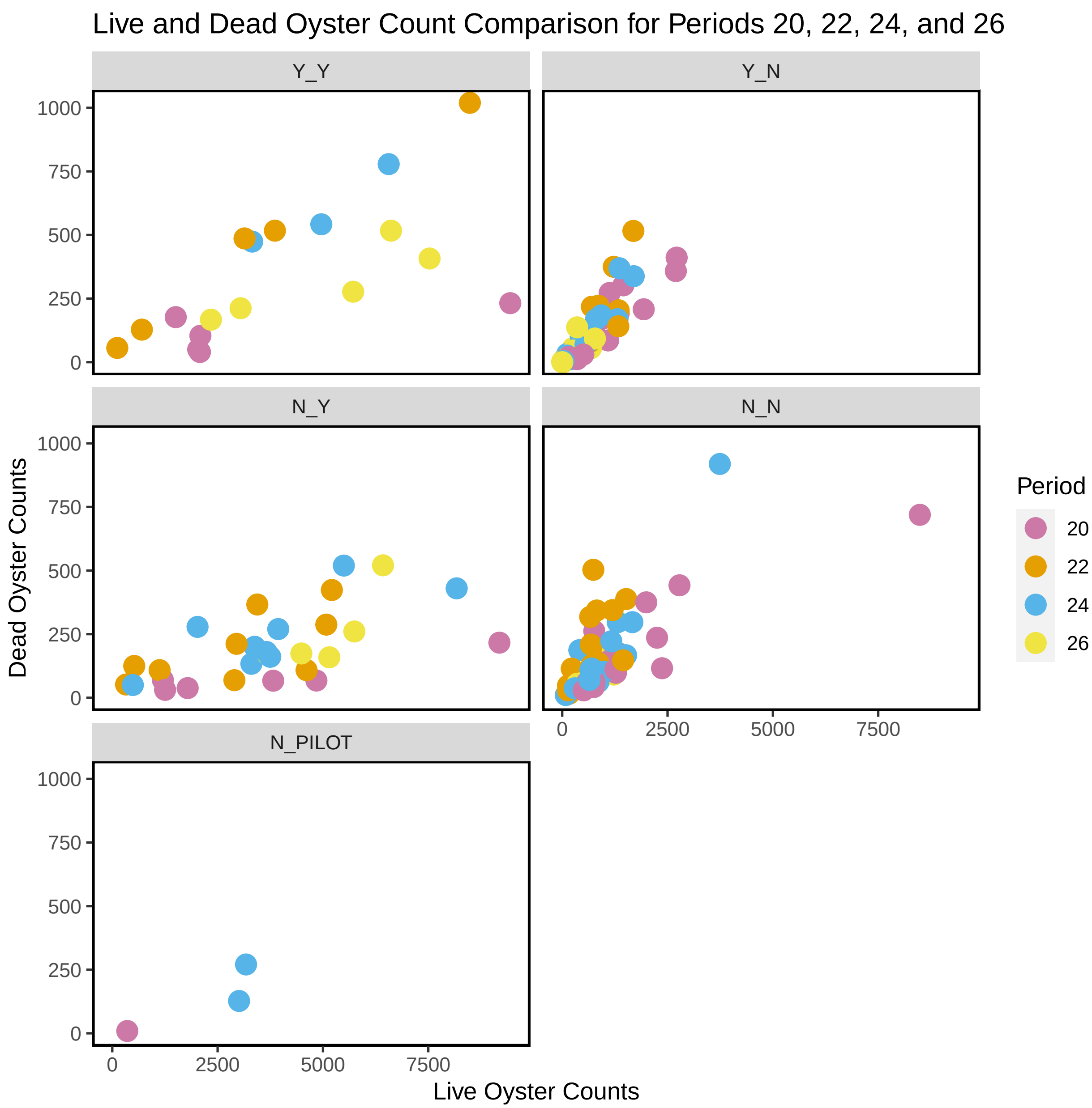


Figure 3-11.- Live and dead oyster count comparison by periods 20 (Winter 2019- 2020), 22 (Winter 2020-2021), 24 (Winter 2021-2022), and 26 (Winter 2022-2023), last sample date of period 26 as 2023-02-06.

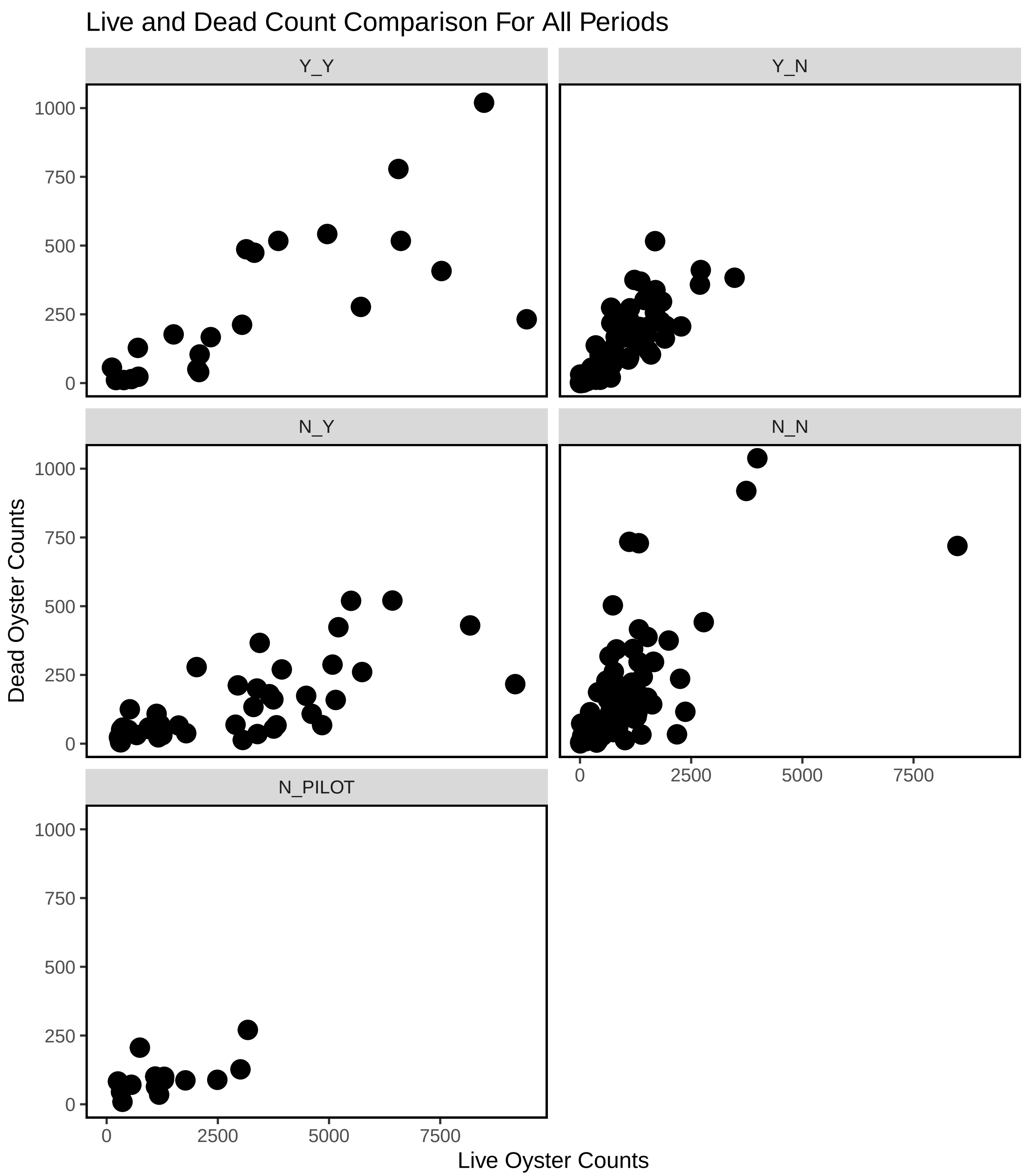


Figure 3-12.- Live and dead oyster comparison for all periods, last sample date of period 26 is 2023-02-06.

4 River Discharge Heatmaps

Suwannee River discharge is known to influence salinity in Suwannee Sound (Orlando et al. 1993) and lags between Suwannee River discharge and oyster counts have been observed (Moore et al. 2020). River discharge is essentially a second "treatment" in this restoration project (after the rebuilding of the reef) because it is the freshwater from the Suwannee River that Lone Cabbage Reef is thought to detain thus possibly promoting lower salinity. River discharge patterns in the Suwanee River basin may be changing over decadal scales due to changing climate, as is hypothesized for large rivers in the Gulf of Mexico (Neupane et al. 2019). For the period of record for the USGS Wilcox gauge (02323500) which begins in October 1930, we created a "heat map" that demonstrates for each month and year the deviation in river discharge (as a percentage) from the period of record average.

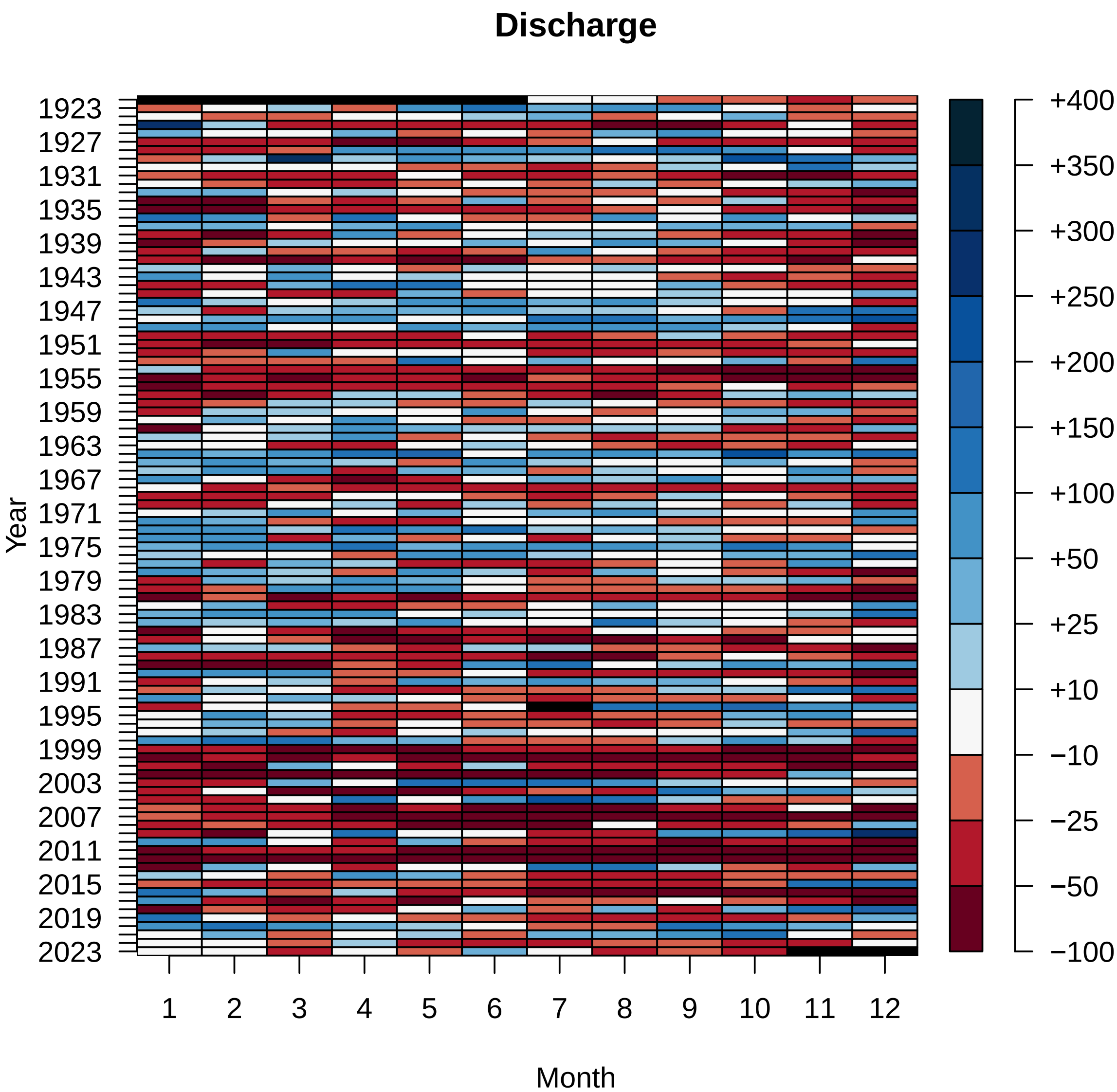


Figure 4-1. Heat map of Suwannee River deviations in mean daily discharge by year and month from USGS Wilcox gauge (02322500) for the period of record measured as deviation from the average by month

for period of record. White color for a given month and year is a month when river discharge is similar (with +/- 10%) to the period of record average, while blue to dark blue colors represent increasing discharge levels deviating as a percentage from the long-term average. Red to dark red colors conversely equal increasingly low discharge levels (below the period of record average). The black colors are months when data are not available.

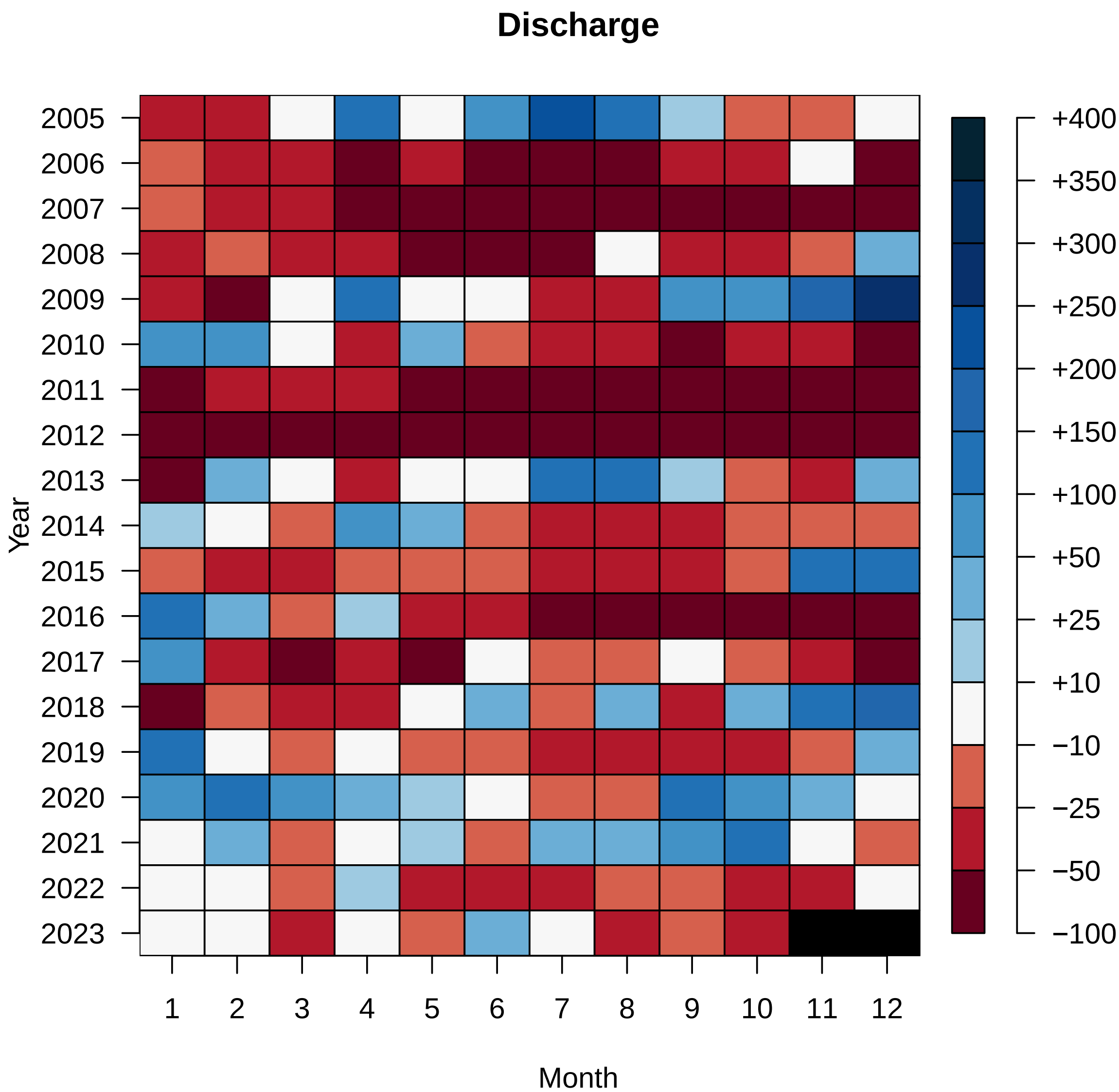


Figure 4-2. Heat map of Suwannee River deviations in mean daily discharge by year and month from USGS Wilcox gauge (02323500) for 2005-2023 measured as deviation from the average by month for period of record. White color for a given month and year is a month when river discharge is similar (with +/- 10%) to the period of record average, while blue to dark blue colors represent increasing discharge levels deviating as a percentage from the long-term average. Red to dark red colors conversely equal increasingly low discharge levels (below the period of record average). The black colors are months when data are not available.

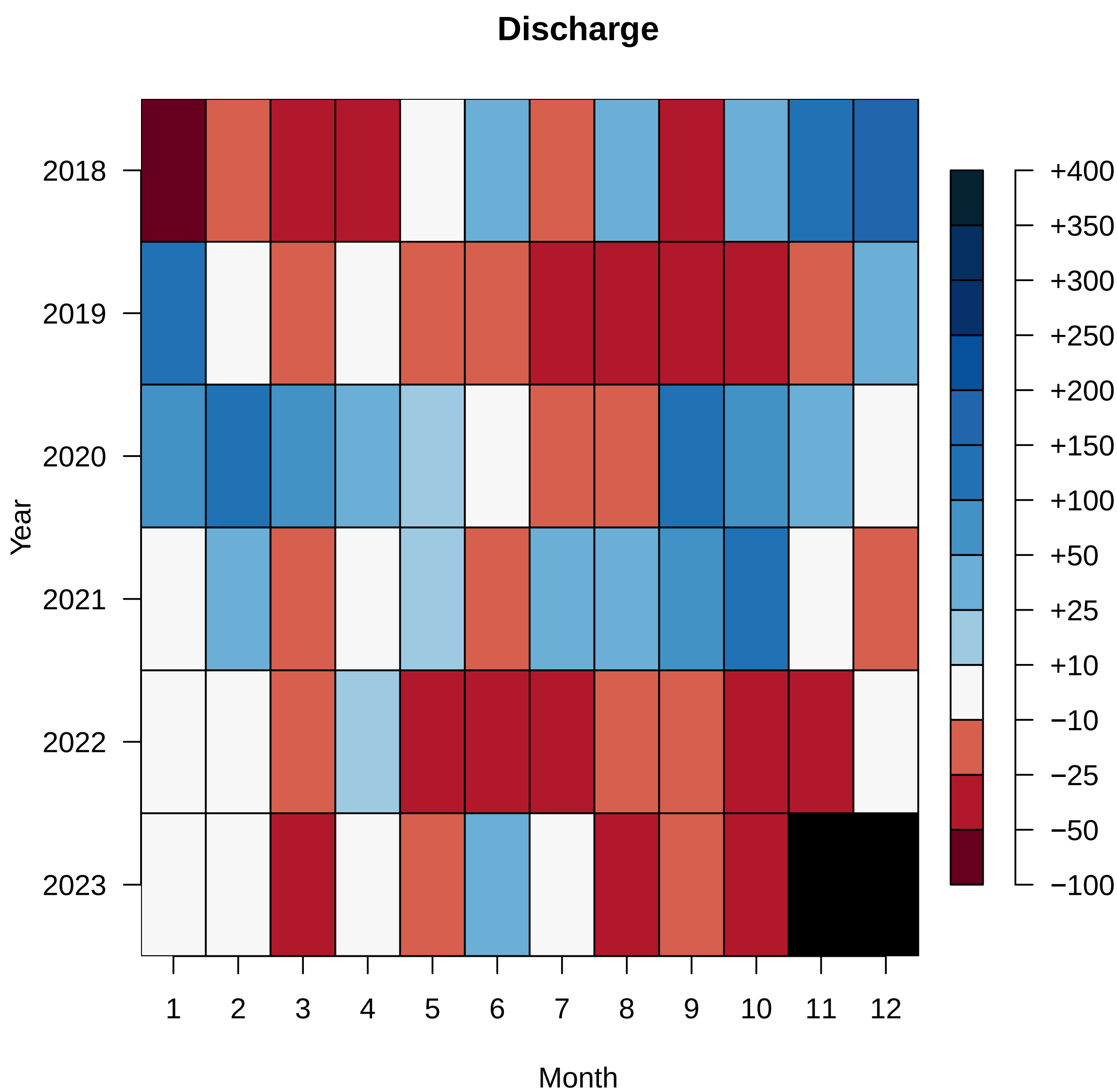


Figure 4-3. Heat map of Suwannee River deviations in mean daily discharge by year and month from USGS Wilcox gauge (02323500) for 2018-2023 measured as deviation from the average by month for period of record. White color for a given month and year is a month when river discharge is similar (with +/- 10%) to the period of record average, while blue to dark blue colors represent increasing discharge levels deviating as a percentage from the long-term average. Red to dark red colors conversely equal increasingly low discharge levels (below the period of record average). The black colors are months when data are not available.

5 Oyster Landings Figures

This data set is manually updated by the oyster landings data located here: https://public.myfwc.com/FWRI/PFDM/ReportCreator.aspx. The Commercial Fisheries Landings Summaries allows the user to select the date year range and oysters (as the Species).

The Suwannee counties used in these figures are TAYLOR, DIXIE, and LEVY.
The Apalachicola counties used iin these figures are FRANKLIN and WAKULLA.

The State of Florida data are all of the counties in Florida where oysters are landed, and this is selected in the FWC Commercial Fisheries Landings Summaries website.

Data shown in the plots from the current year are considered provisional and only contain reported data up until this point in the year.

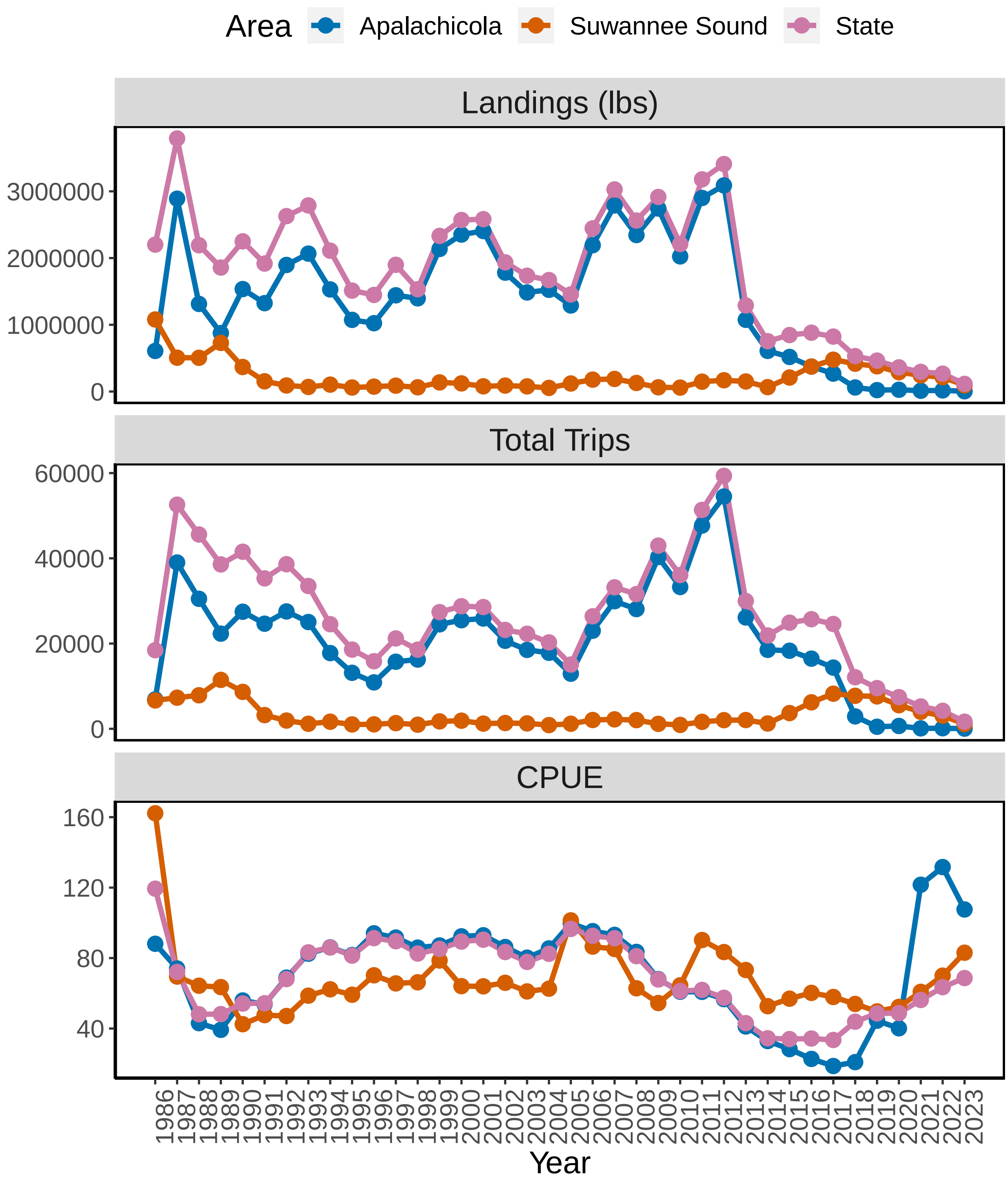


Figure 5-1. Figure of oyster landings (lbs), total trips, and cost per unit effort (CPUE) for Apalachicola (blue line), Suwannee Sound (orange), and the State of Florida (pink) for years 1986 to 2023.

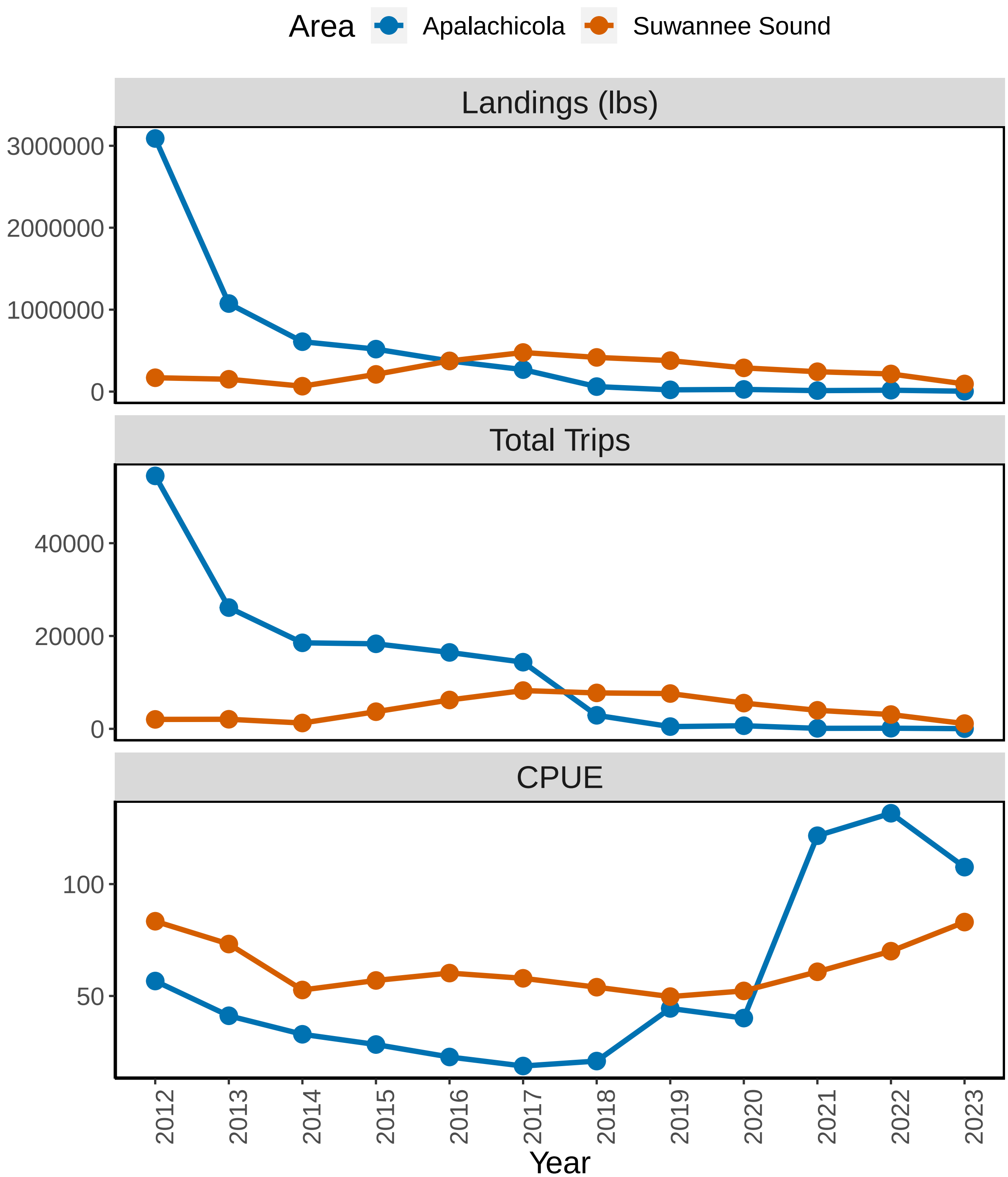


Figure 5-2. Figure of oyster landings (lbs), total trips, and cost per unit effort (CPUE) for Apalachicola (blue line), Suwannee Sound (orange) for years 2012 to 2023.

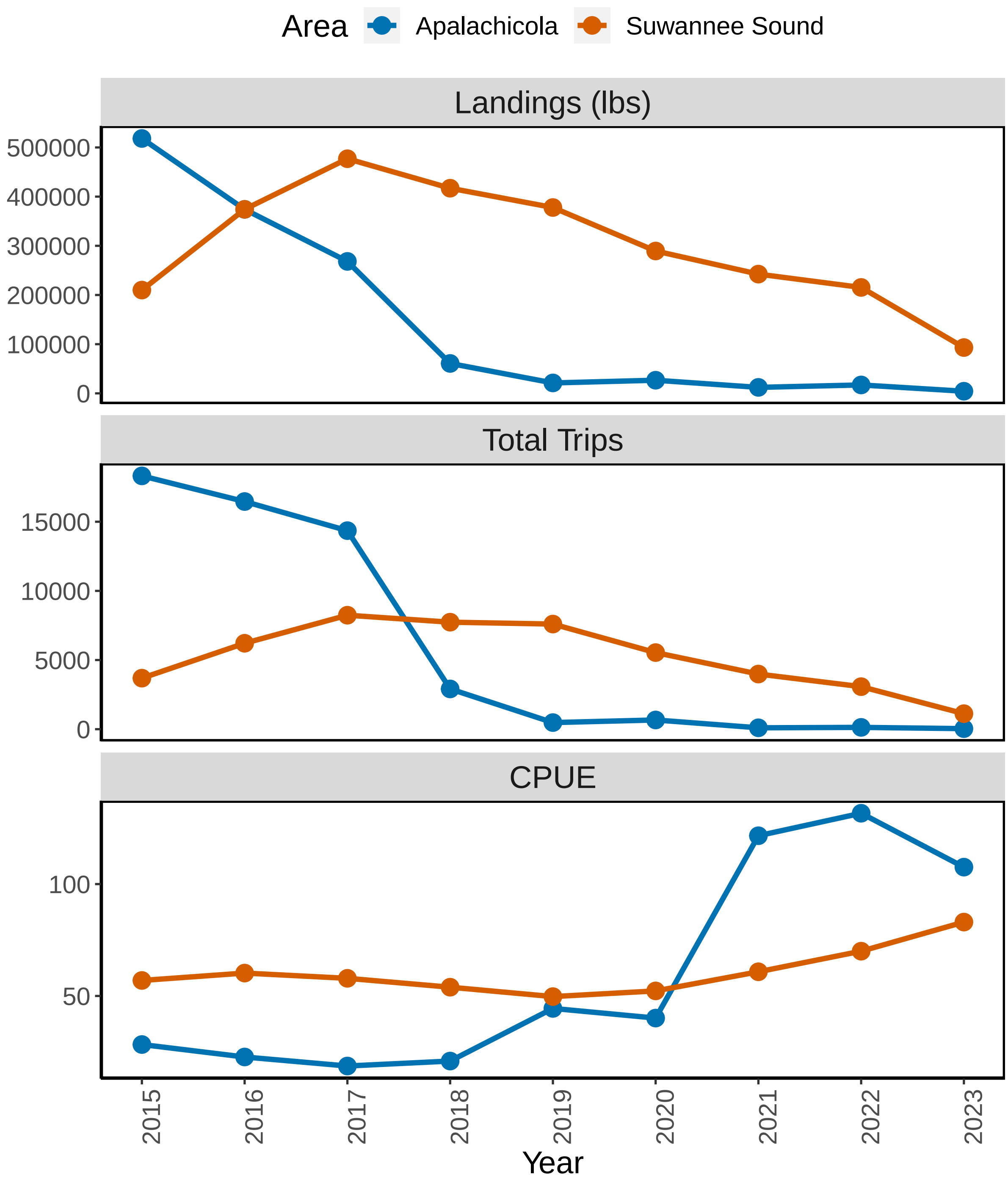


Figure 5-3. Figure of oyster landings (lbs), total trips, and cost per unit effort (CPUE) for Apalachicola (blue line), Suwannee Sound (orange) for years 2015 to 2023.

6 Quarterly Windrose

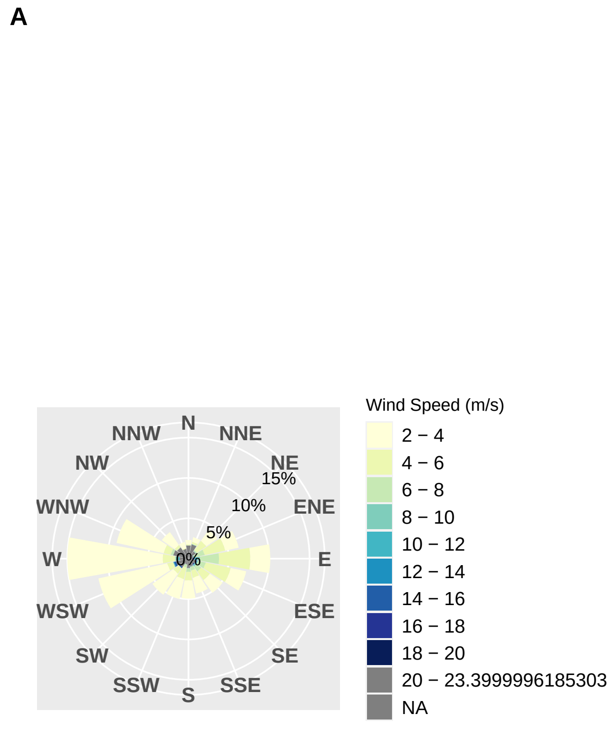


Figure 6-1. A wind rose visualizes the frequency of winds blowing from a specific direction of a desired Date Range. The data used for this figure were collected via the `rnoaa` R Package at station CDRF1 (Cedar Key, Florida). The legend represents the wind speed ranging from low (2-4 m/s) to high (18-20 m/s) wind speeds. The cardinal directions on the outer part of the wind rose indicate the direction of the wind. The Frequency is displayed as the lowest to highest percentage frequency of a wind speed occuring in a given direction, by the size of the wind magnitude polygon. Wind data are updated periodically through USGS (monthly basis).A) Windrose from August 1, 2023 to August 31, 2022, B) Windrose from September 1, 2023 to September 30, 2023.