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

2022-06-30

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 June 2022

0.1 General statement of project status and implementation.

This report includes work accomplished from April through June 2022. We have attached an Appendix that provides a proposed sampling framework for winter 2022-2023.

Implementation continues to be mostly smooth, and our project's monitoring phase is progressing in a timely fashion.

To date, this project is on track both in budget and within the 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 currently have no existing or anticipated problems with completion of Task 1 and consider this part of the project completed.

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

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

An updated version of the Adaptive Management Plan, and Biological Sampling Plan, were completed in June 2020. The elevation and biological sampling plans continue to evolve as we have completed the fourth winter season of post-construction oyster sampling, and ongoing water quality sampling. For example, the variability in oyster counts observed in each strata (substrate, harvest status, location) collected in each winter sampling period is incorporated into our estimate of number of samples required to achieve a known power of detecting change of particular magnitude for each sampling period. This sampling effort is then updated mid-winter sampling season based on observed count data collected during the first half of the winter sampling. Details of this adaptive approach are included in a peer-reviewed publication.

Moore JF, Pine III WE. 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.

Following of the adaptive management plan, biological sampling plan, and elevation data.

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

Task 2 appears to be well within the timeline and budget as 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
Work performed on Task 5.

A. We have continued the water quality sampling program, collecting continuous information and downloading sondes approximately every two weeks (see Sections 2 - 5). We have a relational database to track these data and 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 maintain a Zenodo repository and posted a copy of all oyster count data to this repository as described in our data management plan.

https://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.

We have made progress completing the post-construction elevation analyses and hope to complete a manuscript for peer-review soon.

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 winter 2021-2022 sampling period have been entered, summarized, and preliminary analyses complete. Draft preliminary report was provided last quarter.

. We are working on a draft manuscript of the post-construction survey data.

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. We are starting to see an increase in the errors in the water quality sensors. This may be due to the sensors starting to reach the end of their service life resulting in malfunctions or erratic recordings. These errors are not easily reproducible because the sensor may report as normal, but erratic data would have been recorded during the ~14 day deployment. We are working to address and may need to update several water quality sensors. We are working to complete an analyses that will help us to determine whether we should focus water quality monitoring efforts on a subset of sensors instead of replacing multiple sensors. This preliminary analyses will be completed by late summer 2022.

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 A paper brochure about the project continues to be distributed to the public via the local hardware and tackle shops, marinas, the Cedar Key Chamber of Commerce, and UF/IFAS Nature Coast Biological Station during the reporting period.

We maintain two public educational displays about the Lone Cabbage restoration project at high traffic boat ramps in Cedar Key and Suwannee.

We continue to update public information about the project primarily through the various electronic and social media produced by the Nature Coast Biological Station in Cedar Key https://ncbs.ifas.ufl.edu/. The public can view data for water quality, oyster landings, and river discharge via the project Shiny App available here https://lcroysterproject.github.io/oysterproject/

We presented post-construction results at two meetings. At the FWC Oyster Integrated Mapping and Monitoring Project meeting in St. Petersburg, Florida, Jamie Casteel presented work from her thesis ccharacterizing the relationship between shell biomass and live oyster counts. At the same meeting, Bill Pine presented an update on the oyster population response to the Lone Cabbage Reef restoration. Bill Pine also presented results from the Lone Cabbage Reef restoration as a case history of a restoration project successfully using an adaptive management framework at the Gulf of Mexico Conference in Baton Rouge. Finally, Bill Pine participated in a two-day NFWF-led workshop on oyster reef restoration projects in Milton, Florida where he presented an overview of the restoration of Lone Cabbage Reef.

A. Progress made towards Task 6 milestones.

Regular posting of information on NCBS website, social media outlets, and presentations to practitioners.

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.

We continue to work with the UF Library Academic Resource Computing (LARC) team for technical assistance related to data storage for water quality, oyster count, and elevation data. By maintaining modern data collection and storage systems this facilitates our ability to rapidly analyze data and inform project decision making. This was demonstrated to NFWF staff during their site visit in December 2021.

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 survey information from GF Young and others (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
Generally, the budget is within the calendar schedule and on track for completion of all tasks. We reconcile budget vs. expenditure every six months and review project status and progress.

Subtask 8.2. Managing staff Two graduate students (Jamie Casteel and Matthew Richardson) are supported in full or part by this award. Jamie Casteel successfully defended her MS thesis this quarter and will graduate in August 2022. The Research Coordinator position remains vacant. Bill Pine has expanded his project duties to include responsibilities previously completed by Peter Frederick. Bill Pine, Matt Richardson, Jamie Casteel, and Jennifer Moore will increase project responsibilities to cover the Research Coordinator's responsibilities. Dylan Sinnickson is working for approximately two months as a post-doc to improve the framework for summarizing and comparing oyster height data. Several hourly technicians assist with the project on an as-needed basis primarily with field sampling efforts.

Subtask 8.3. Coordination Coordination has been carried out through as-needed meetings and communications among the three principal investigators, graduate students, research coordinator, student OPS workers, and the UF Libraries data management group (LARC).

Previous and continuing coordination activities with projects external to this one have included coordination with county plans for additional oyster restoration activities (Sturmer, Pine), coordination with research planned for the Lower Suwannee National Wildlife Refuge hydrological restoration project (Allen), antipoaching actvities and oyster management by the Florida Fish and Wildlife Conservation Commission (Frederick, Pine, Sturmer), coordination with sampling of fishes on the Lone Cabbage Reef by Nature Coast Biological Station and the Florida Fish and Wildlife Conservation Commission (Allen), coordination with aquaculture activities in the area (Sturmer), coordination with Florida's Oyster Integrated Mapping and Monitoring Project (OIMMP, Pine and Ennis), participation in oyster research and restoration planning efforts by other entities in the region (FWC, TNC, UF, Sturmer, Pine, Allen).

Subtask 8.4. Reporting During this period we have submitted requests for reimbursement for the June 2022 reporting period, and have completed the quarterly report for the June reporting period.

B. Progress made towards Task 8 milestones.

. Fiscal reports and requests for reimbursement completed. . Quarterly report completed through June 2022. . Management and training graduate students and OPS student workers. . Internal coordination of this project among staff and PI's, four UF departments, Nature Coast Biological Station.

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, efforts are continuing as planned.

0.2 Submission schedule for payment requests.

UF has submitted payment requests quarterly and we plan 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.

We do not have any other information that might help NFWF evaluate the project's progress. We met in person with NFWF wtaff while attending meetings in Baton Rouge and Milton. We are very engaged with agency partners who are completing similar restoration efforts in Apalachicola in cooperation with NFWF.

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

None.

1 Water Quality Quarterly Figures

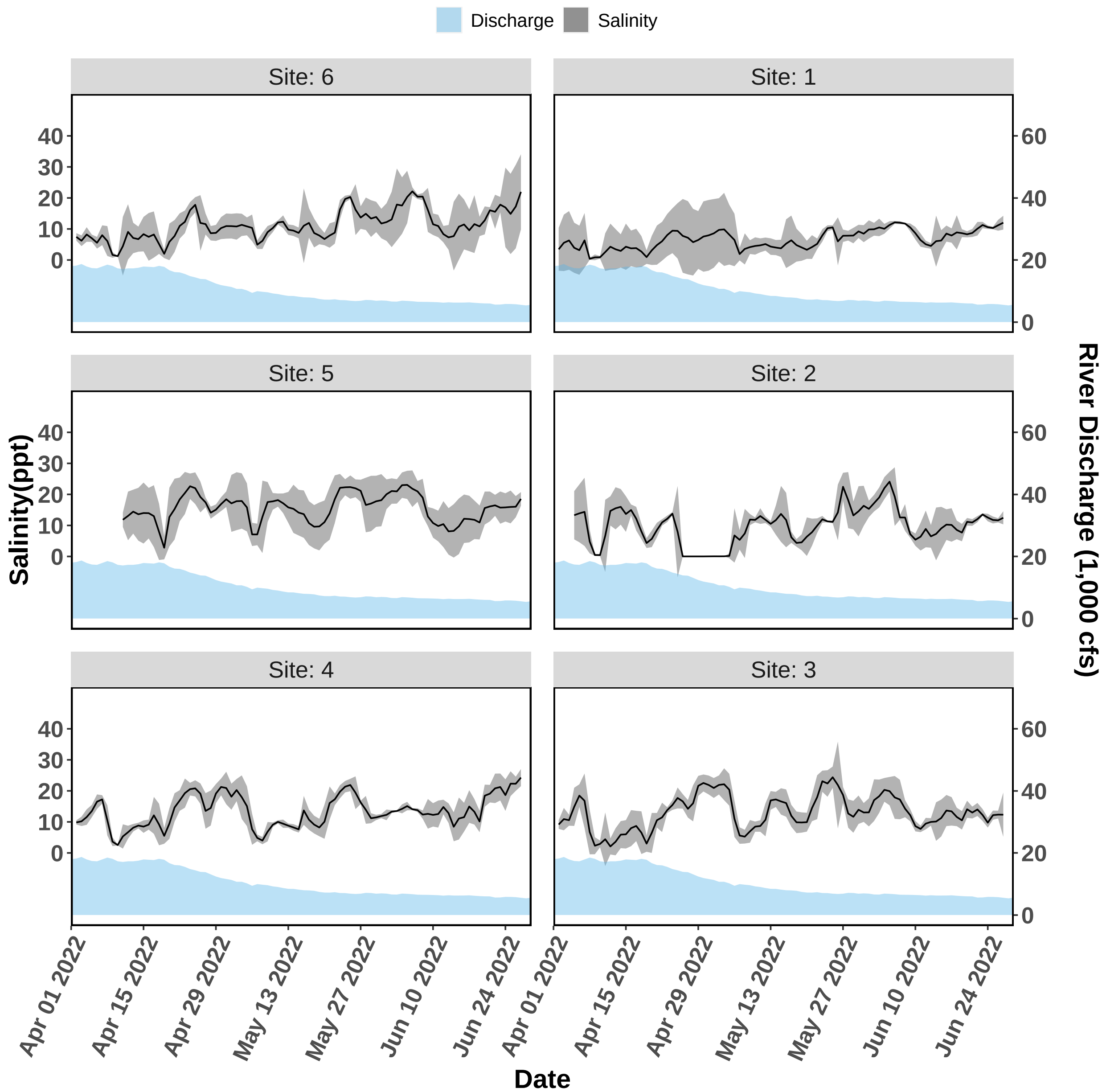


Figure 1-1. Salinity and river discharge data collected from autonomous sensors from the Lone Cabbage Reef restoration site near Suwannee, FL. Each graph represents a sensor location, with top of page as north, and right of page as east. The right column of figures (Sites 1-3) represent the eastern side 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.

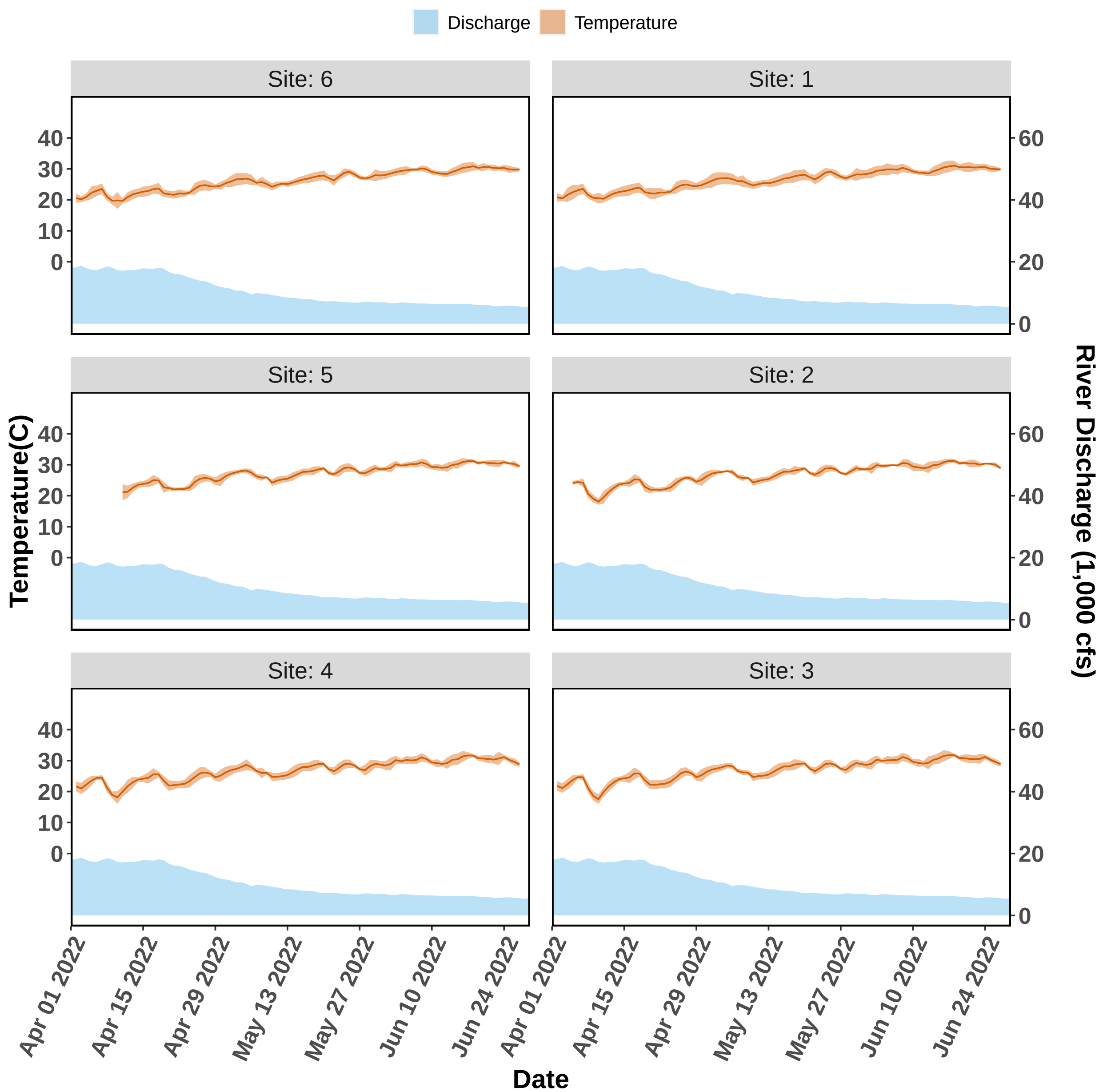


Figure 1-2. Temperature and discharge data collected from autonomous sensors from the Lone Cabbage Reef restoration site near Suwannee, FL. Each graph represents a sensor location, with top of page as north, and right of page as east. The right column of figures (Sites 1-3) represent the eastern side 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.

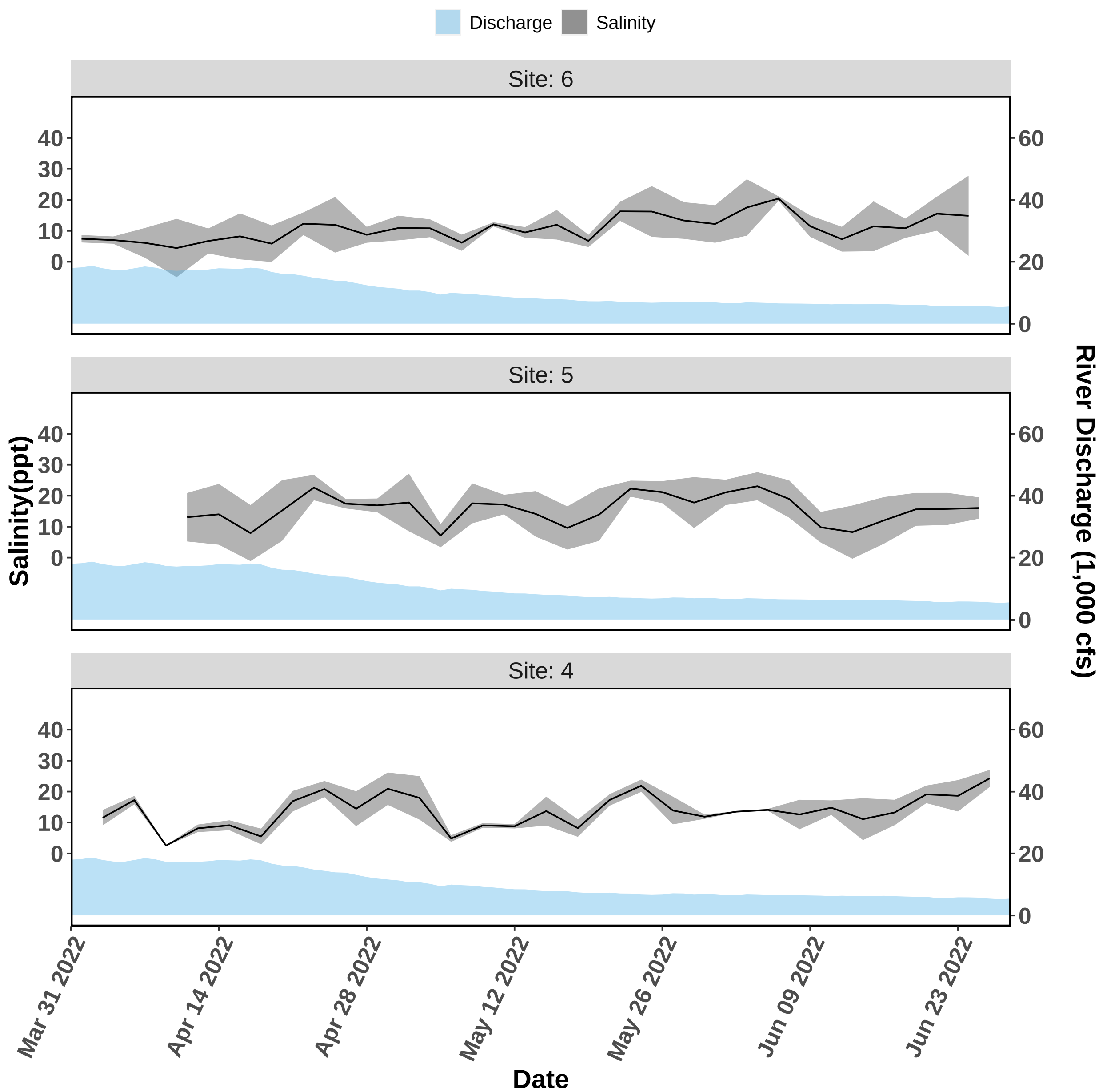


Figure 1-3. Salinity and discharge data collected from autonomous sensors from the Lone Cabbage Reef restoration site near Suwannee, FL. Each graph represents a sensor location, with top of page as north, and right of page as east. The figures (Sites 4-6) represent the western side of the Lone Cabbage 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.

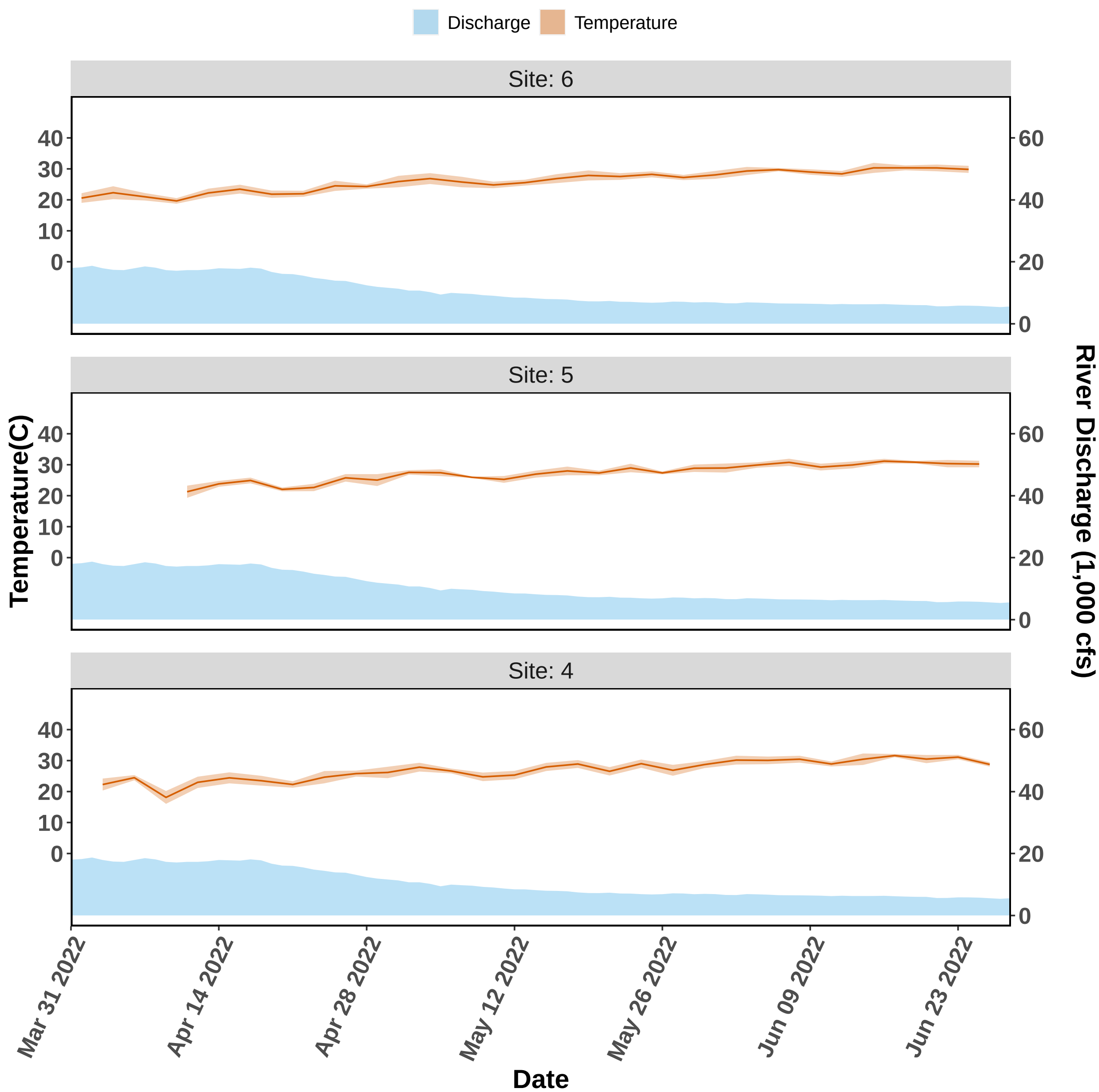


Figure 1-4. Temperature and discharge data collected from autonomous sensors from the Lone Cabbage Reef restoration site near Suwannee, FL. Each graph represents a sensor location, with top of page as north, and right of page as east. The figures (Sites 4-6) represent the western side of the Lone Cabbage 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.

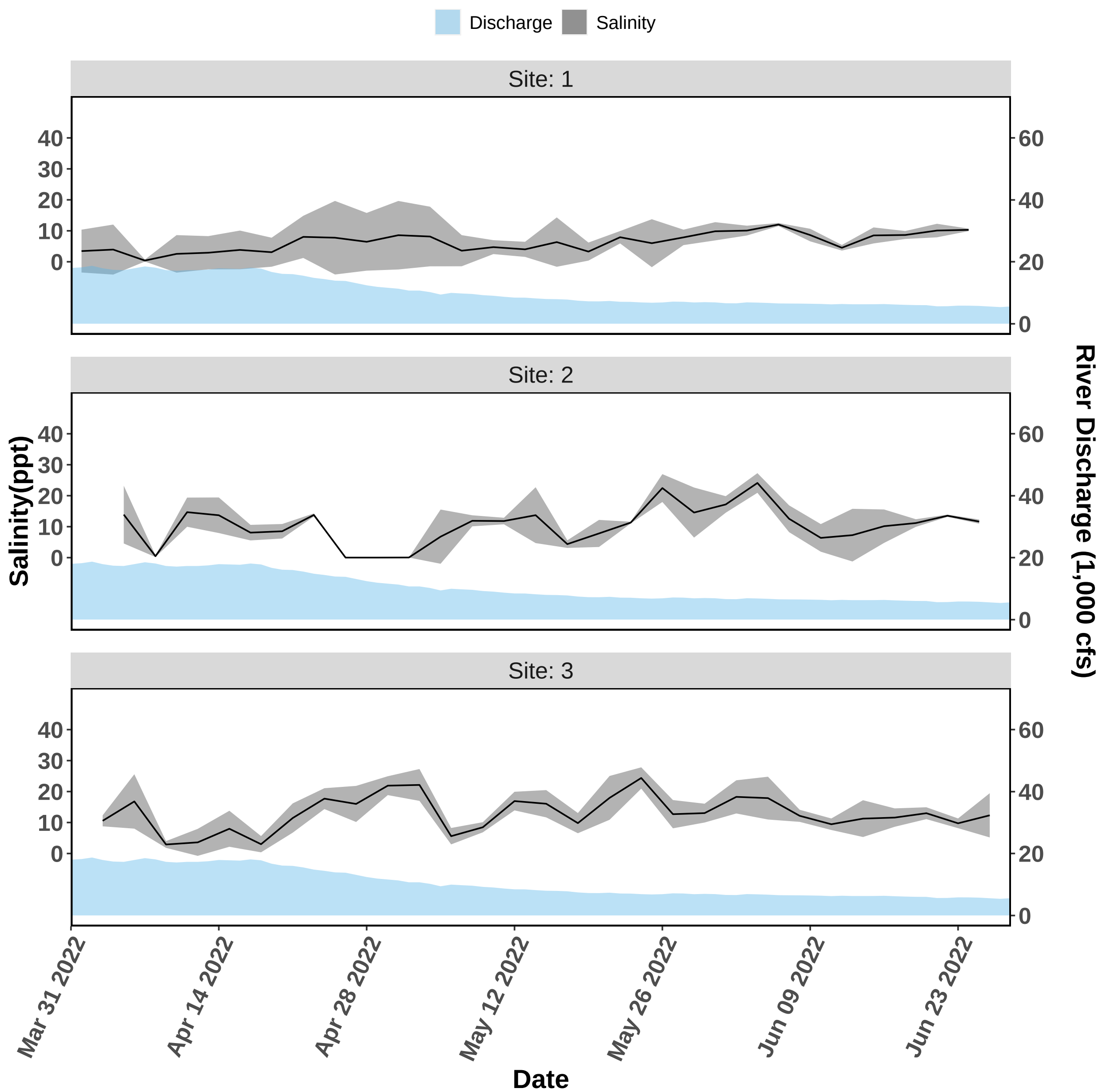


Figure 1-5. Salinity and discharge data collected from autonomous sensors from the Lone Cabbage Reef restoration site near Suwannee, FL. The figures (Sites 1-3) represent the eastern side of the Lone Cabbage Reef restoration site. The primary y-axis is Salinity (ppt, parts per thousand), and the secondary 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.

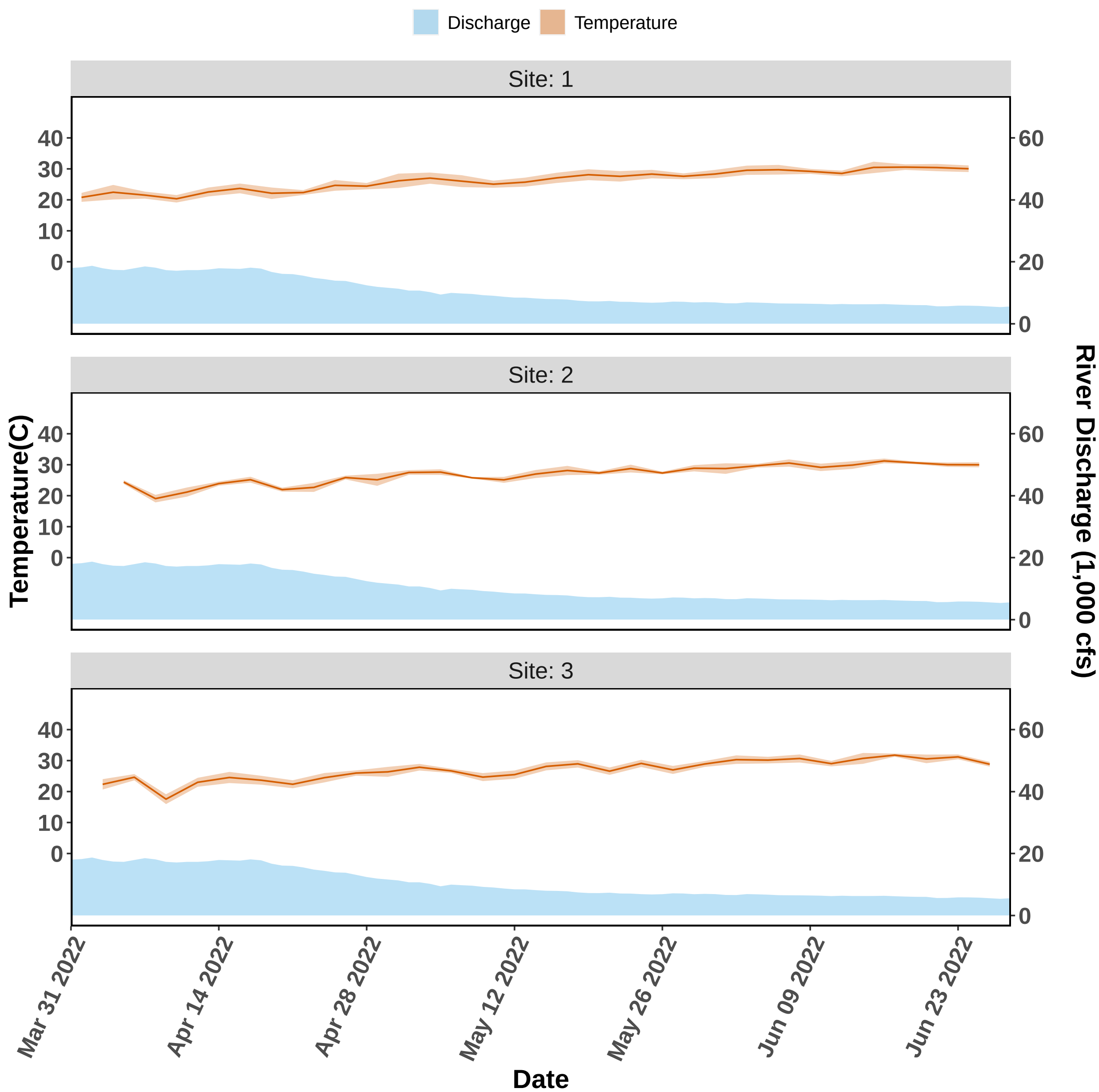


Figure 1-6. Temperature and discharge data collected from autonomous sensors from the Lone Cabbage Reef restoration site near Suwannee, FL. The figures (Sites 1-3) represent the eastern side of the Lone Cabbage Reef restoration site. The primary y-axis is Temperature (C, Celsius), and the secondary y-axis 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).

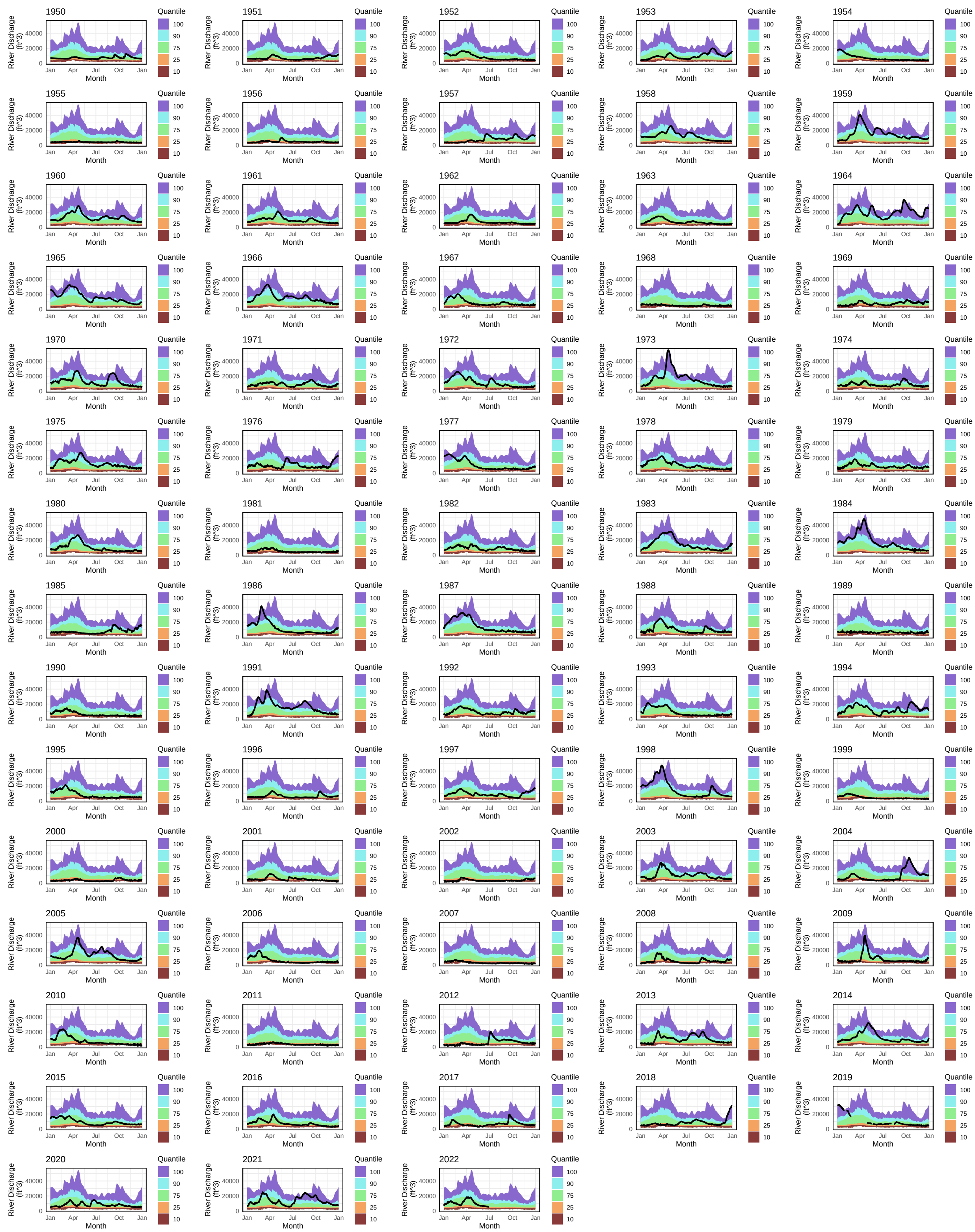


Figure 2-1. River discharge (by convention CFS, y axis) from the USGS Wilcox, Florida gauge (USGS 02322500) for the years 1950-2022 (solid black line).

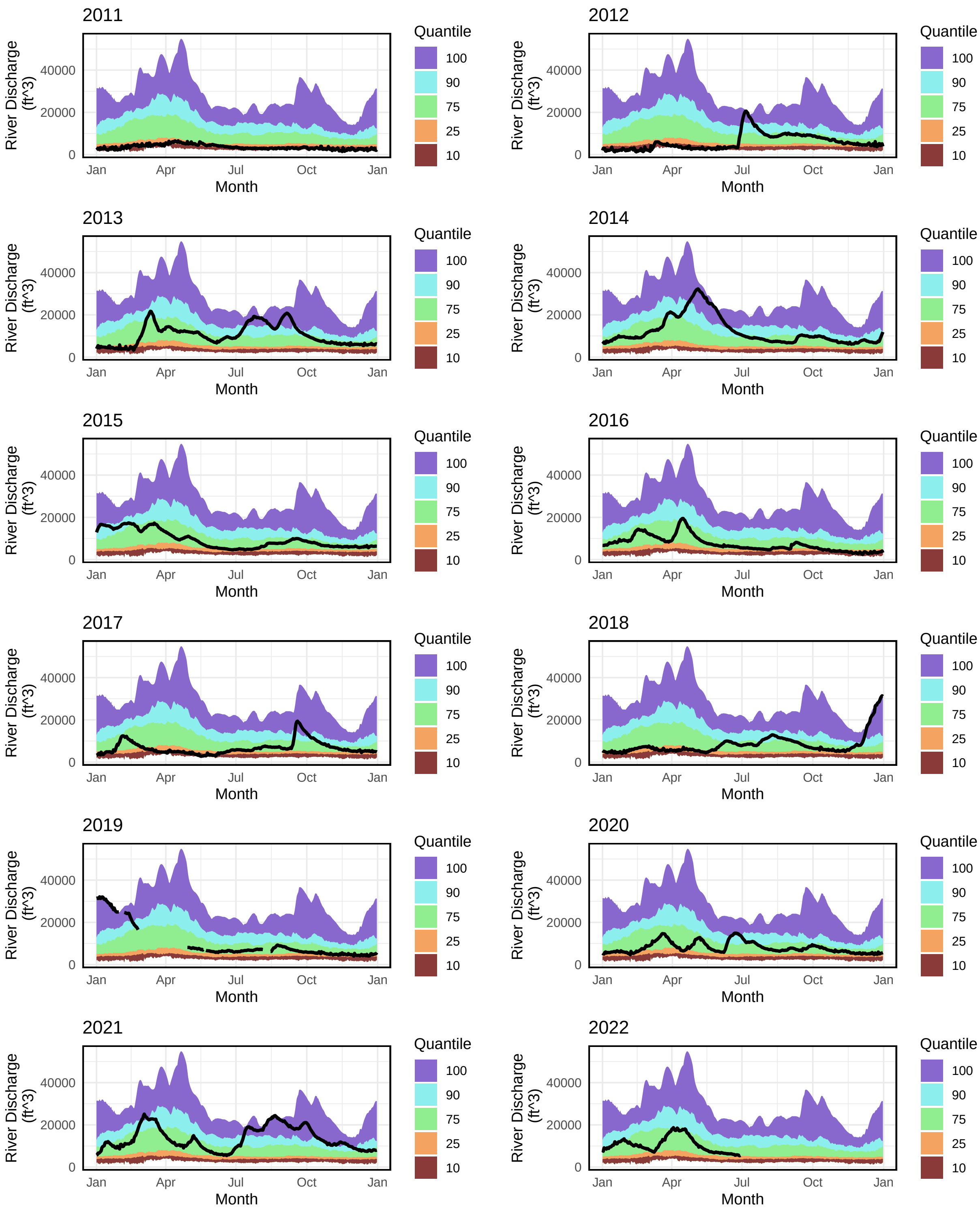


Figure 2-2. River discharge (by convention CFS, y axis) from the USGS Wilcox, Florida gauge (USGS 02322500) for the years 2011-2022 (solid black line).

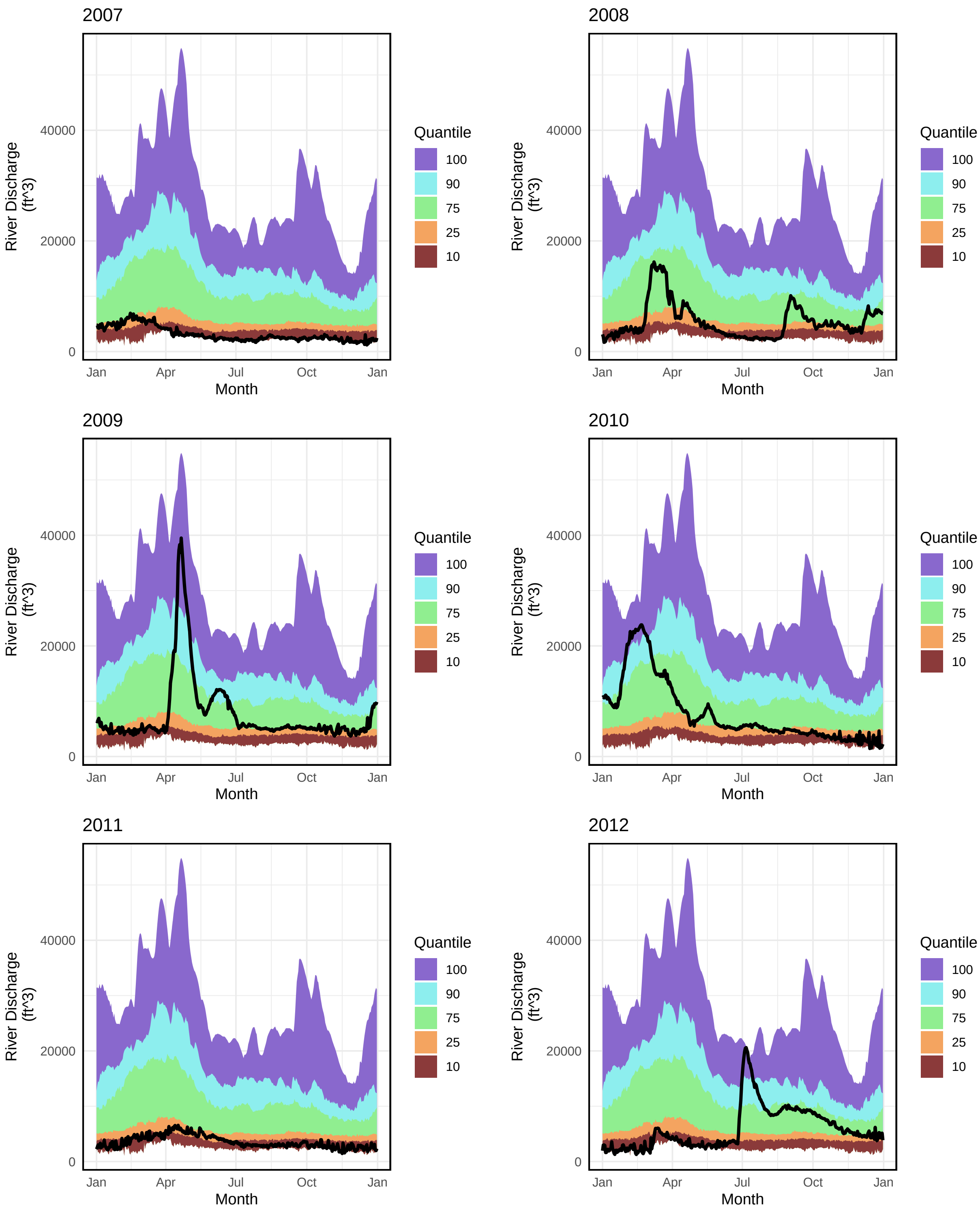


Figure 2-3. River discharge (by convention CFS, y axis) from the USGS Wilcox, Florida gauge (USGS 02322500) for the years 2007-2012 (solid black line) representing the years preceding observed extreme low discharge conditions 2010-2012.

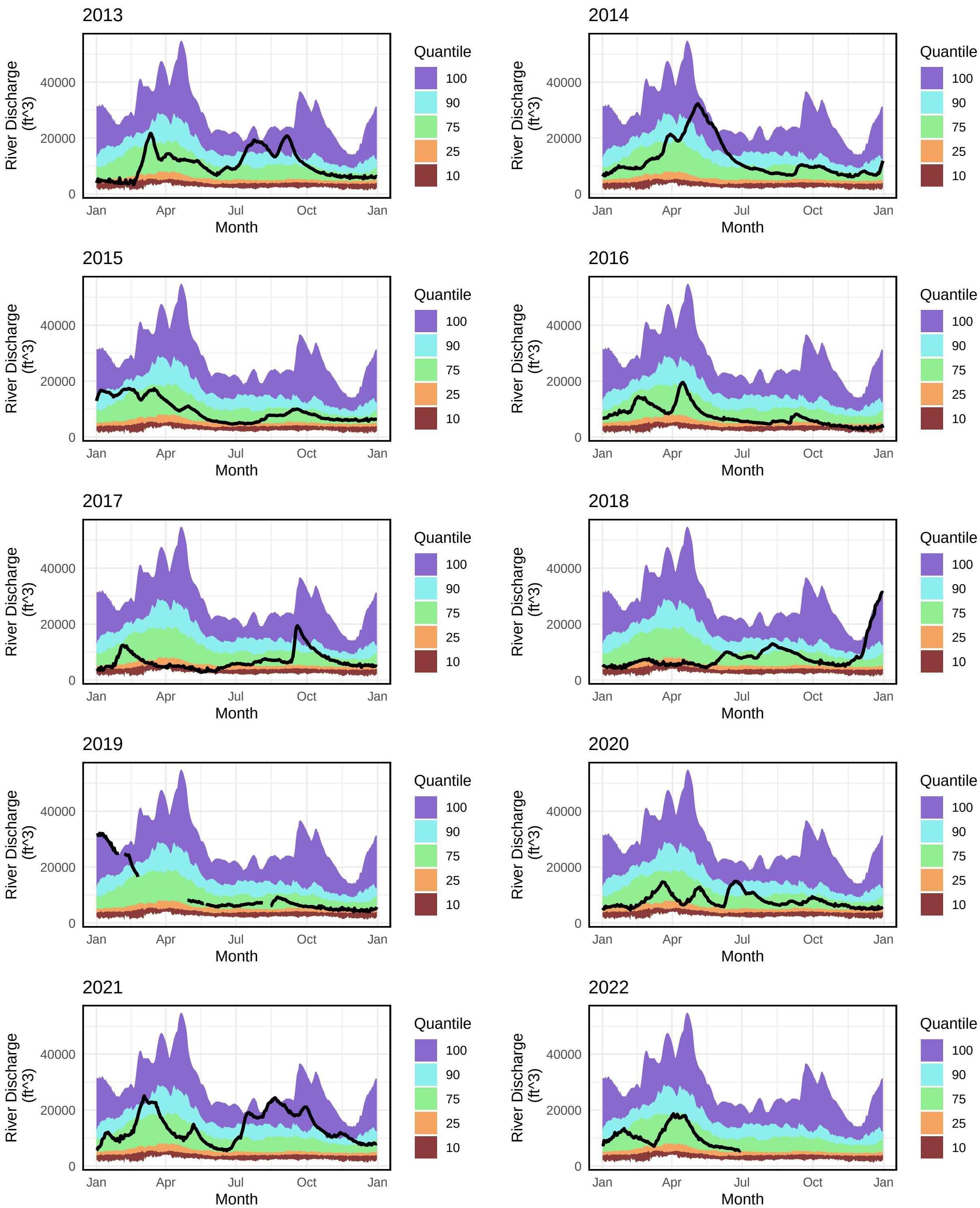


Figure 2-4. River discharge (by convention CFS, y axis) from the USGS Wilcox, Florida gauge (USGS 02322500) for the years 2013-2022 (solid black line) representing the years since 2010-2012 low flow conditions including the initiation of the Lone Cabbage Reef restoration project.

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 2021-2022) and how the collected data compare to last year's sampling (Winter 2020-2021). So far 35 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 (5/27/2010). In total, 145 days have been sampled over this entire project.

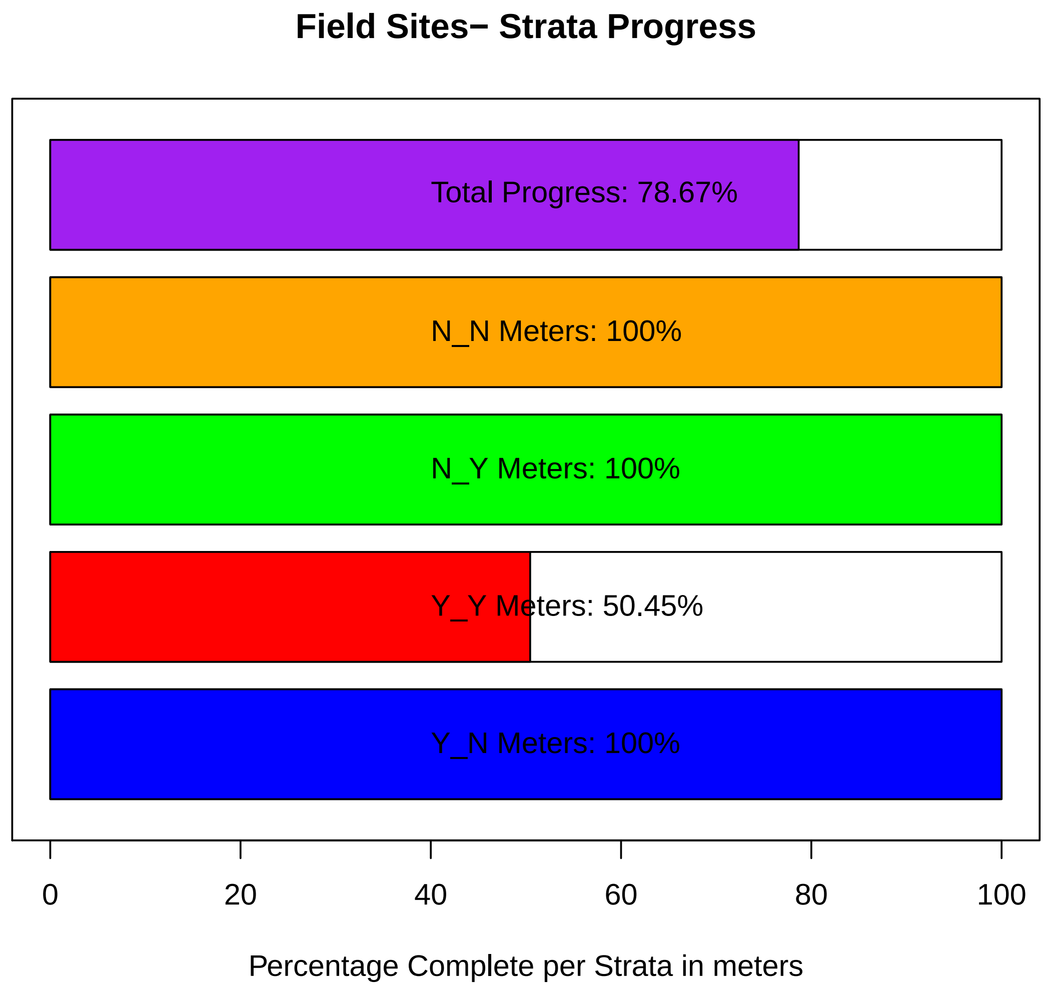
3.1.1 Definition of Localities and Strata

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 24, and last year's sampling period is period 22.**



STRATA	Meters Completed
Y_N	411.9
Y_Y	700.2
N_N	521.2
N_Y	1174

Table 4-1. - Displaying the total meters surveyed during period 24 per strata.

3.2.1 Summary Plots for Periods 18, 20, 22, and 24

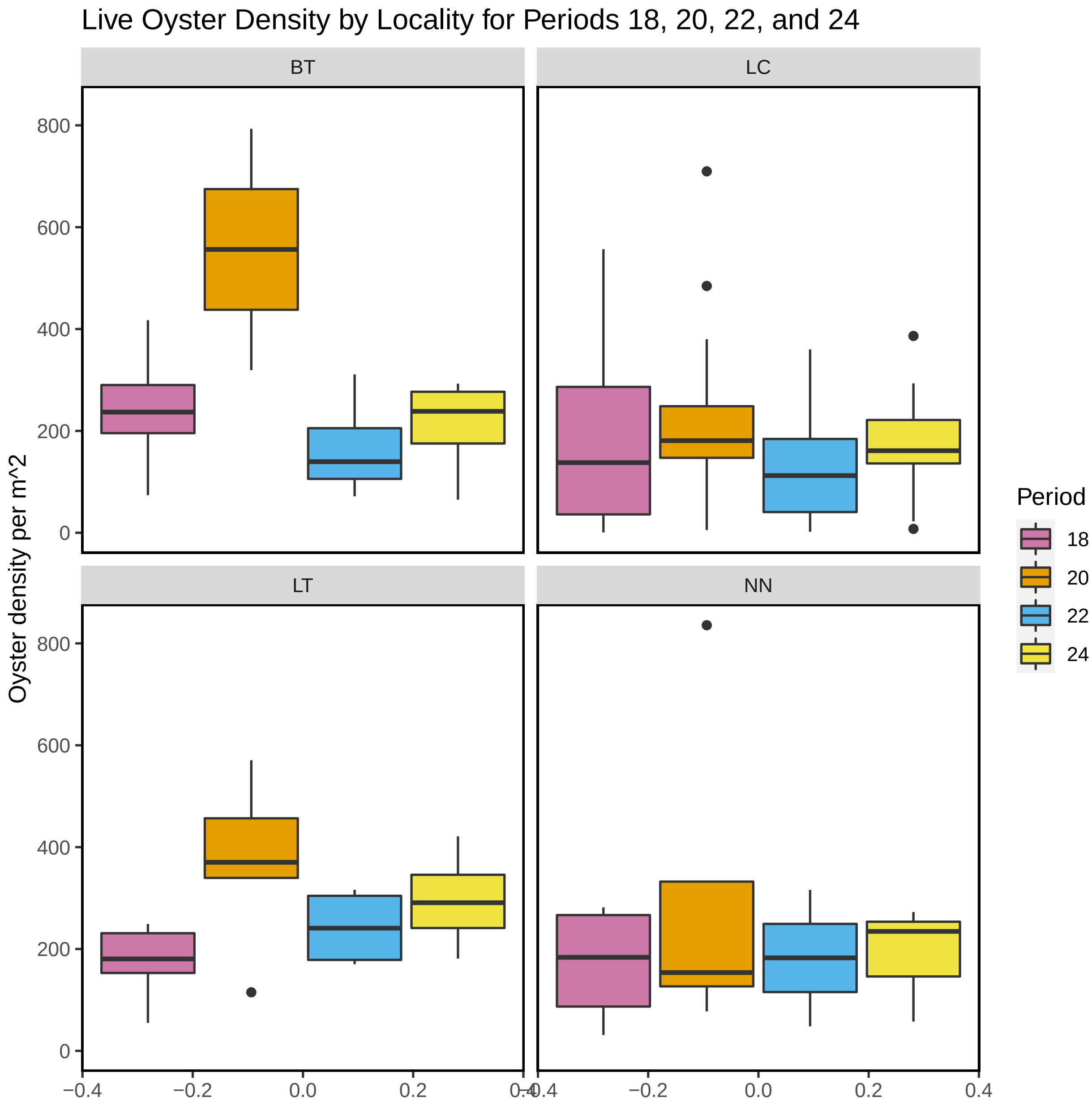


Figure 4-1.- Calculated live oyster density by locality for periods 18 (Winter 2018-2019), 20 (Winter 2019-2020), 22 (Winter 2020-2021), and 24 (Winter 2021-2022) with the last sample date of period 24 as 2/1/2022.

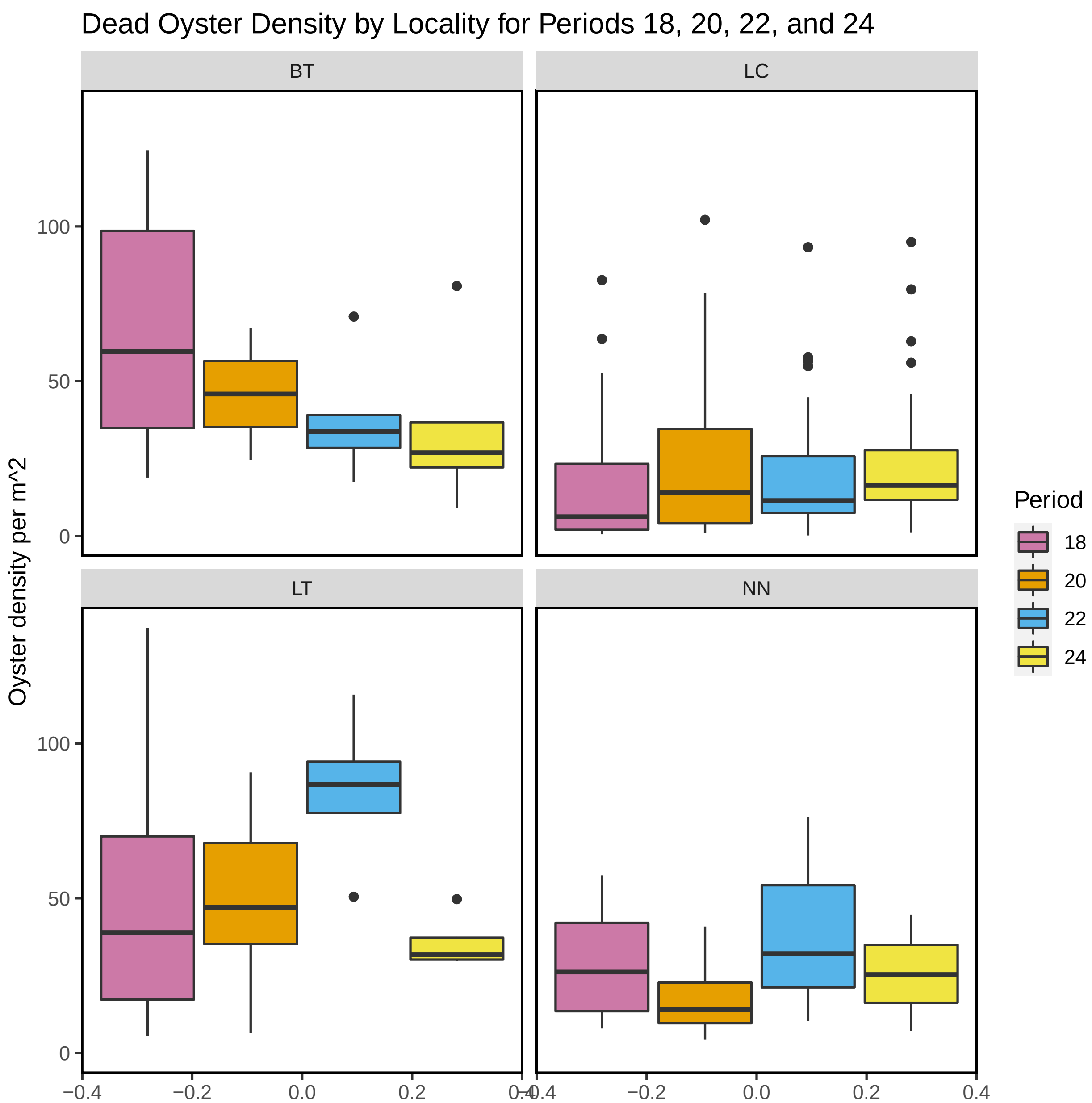


Figure 4-2.- Calculated dead oyster density by locality for periods 18 (Winter 2018-2019), 20 (Winter 2019-2020), 22 (Winter 2020-2021), and 24 (Winter 2021-2022) with the last sample date of period 24 as 2/1/2022.

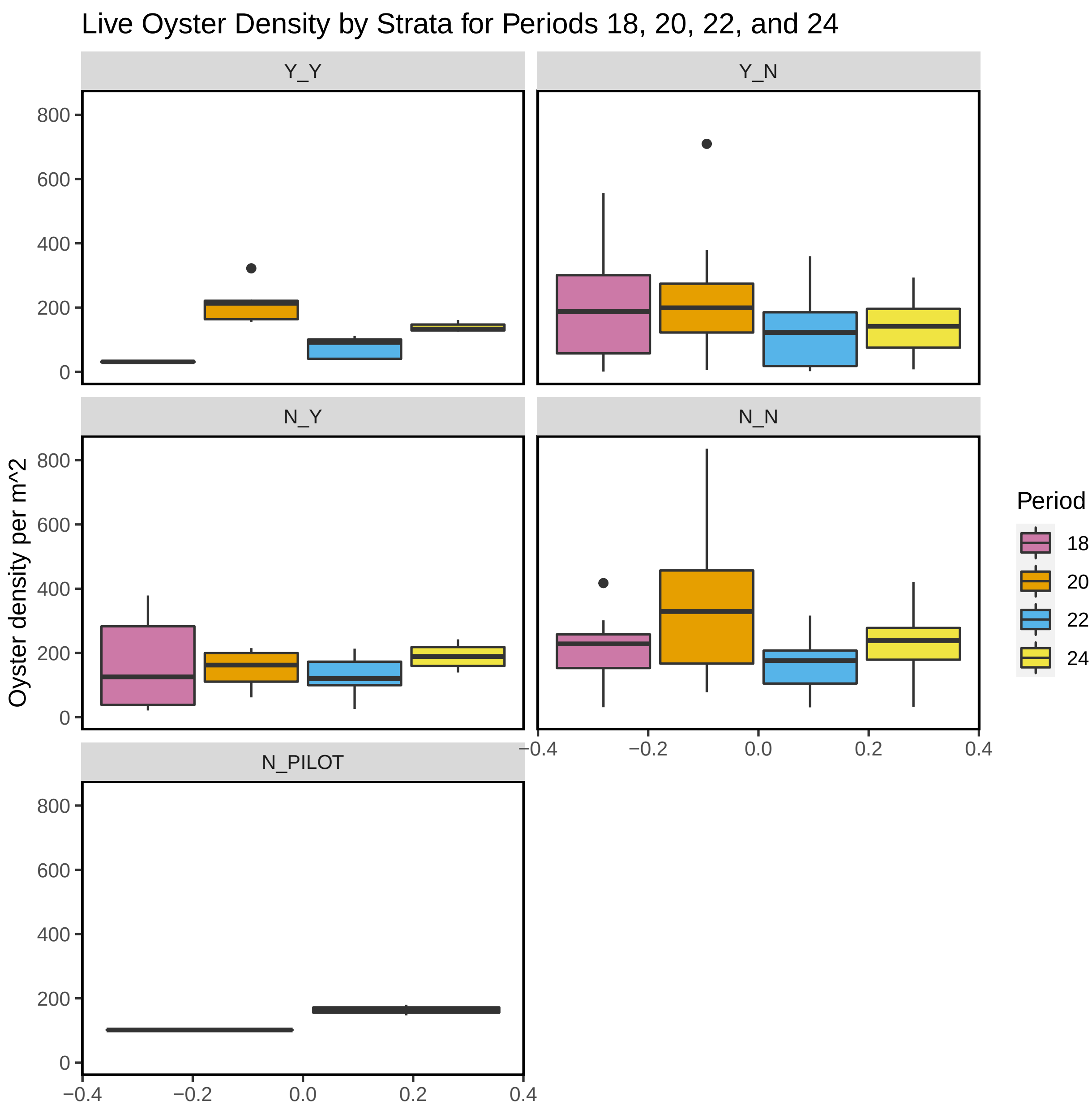


Figure 4-3.- Calculated live oyster density by strata for periods 18 (Winter 2018-2019), 20 (Winter 2019-2020), 22 (Winter 2020-2021), and 24 (Winter 2021-2022) with the last sample date of period 24 as 2/1/2022.

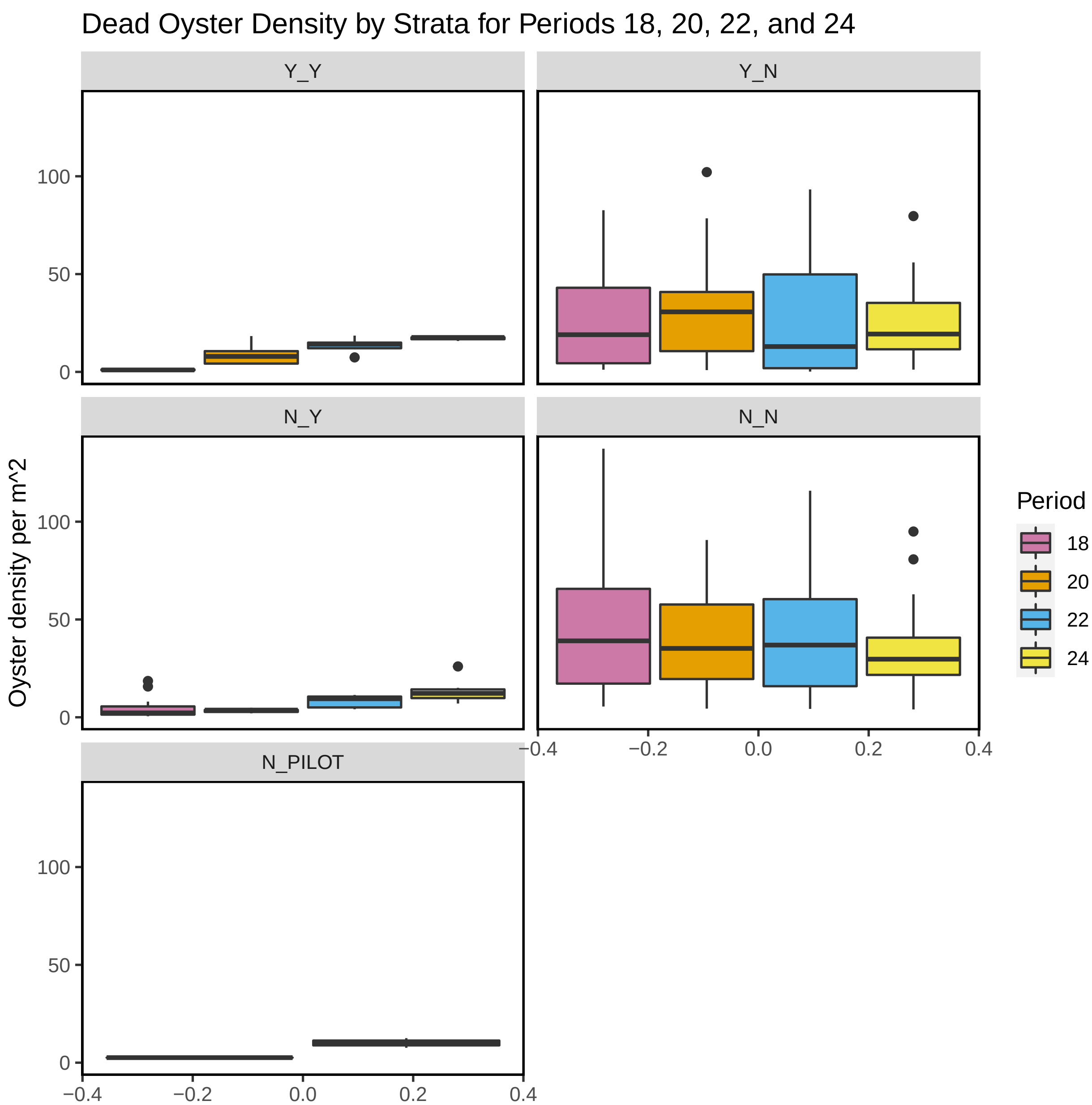


Figure 4-4.- Calculated dead oyster density by strata for periods 18 (Winter 2018-2019), 20 (Winter 2019-2020), 22 (Winter 2020-2021), and 24 (Winter 2021-2022) with the last sample date of period 24 as 2/1/2022.

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.

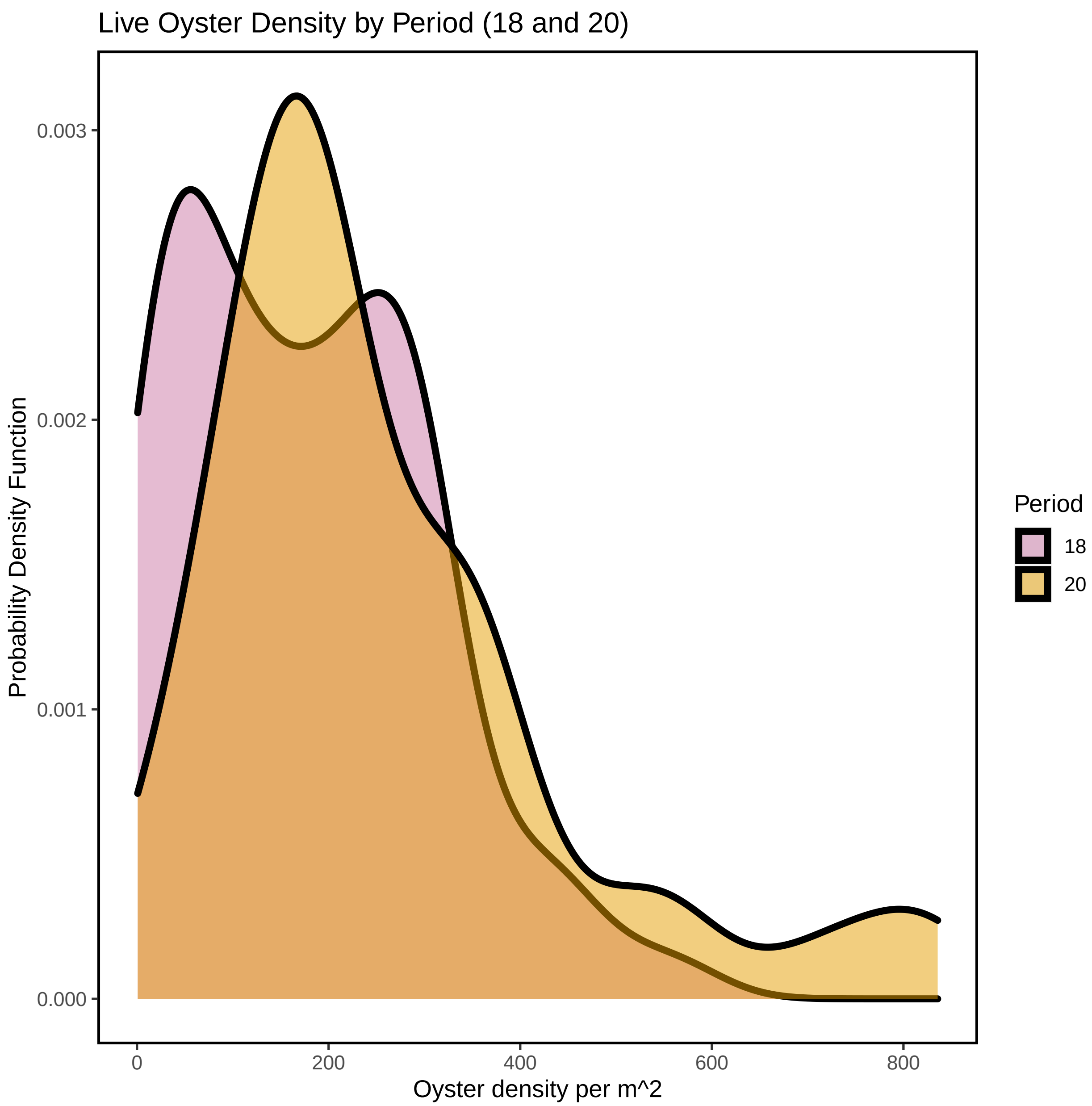


Figure 4-5.- Calculated live oyster density by periods 18 (Winter 2018-2019) and 20 (Winter 2019-2020) using a probability density function.

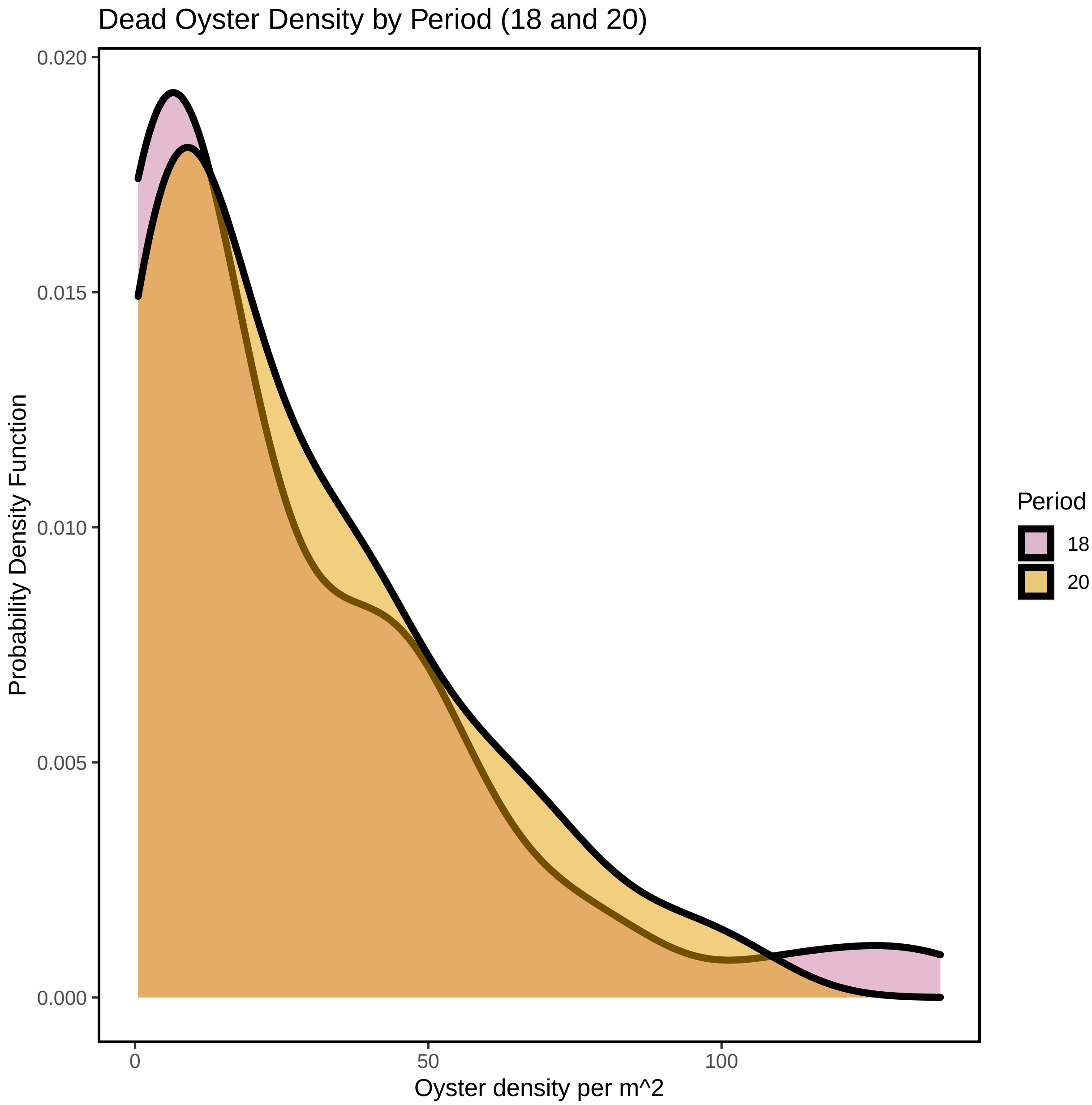


Figure 4-6.- Calculated dead oyster density by periods 18 (Winter 2018-2019) and 20 (Winter 2019-2020) using a probability density function.

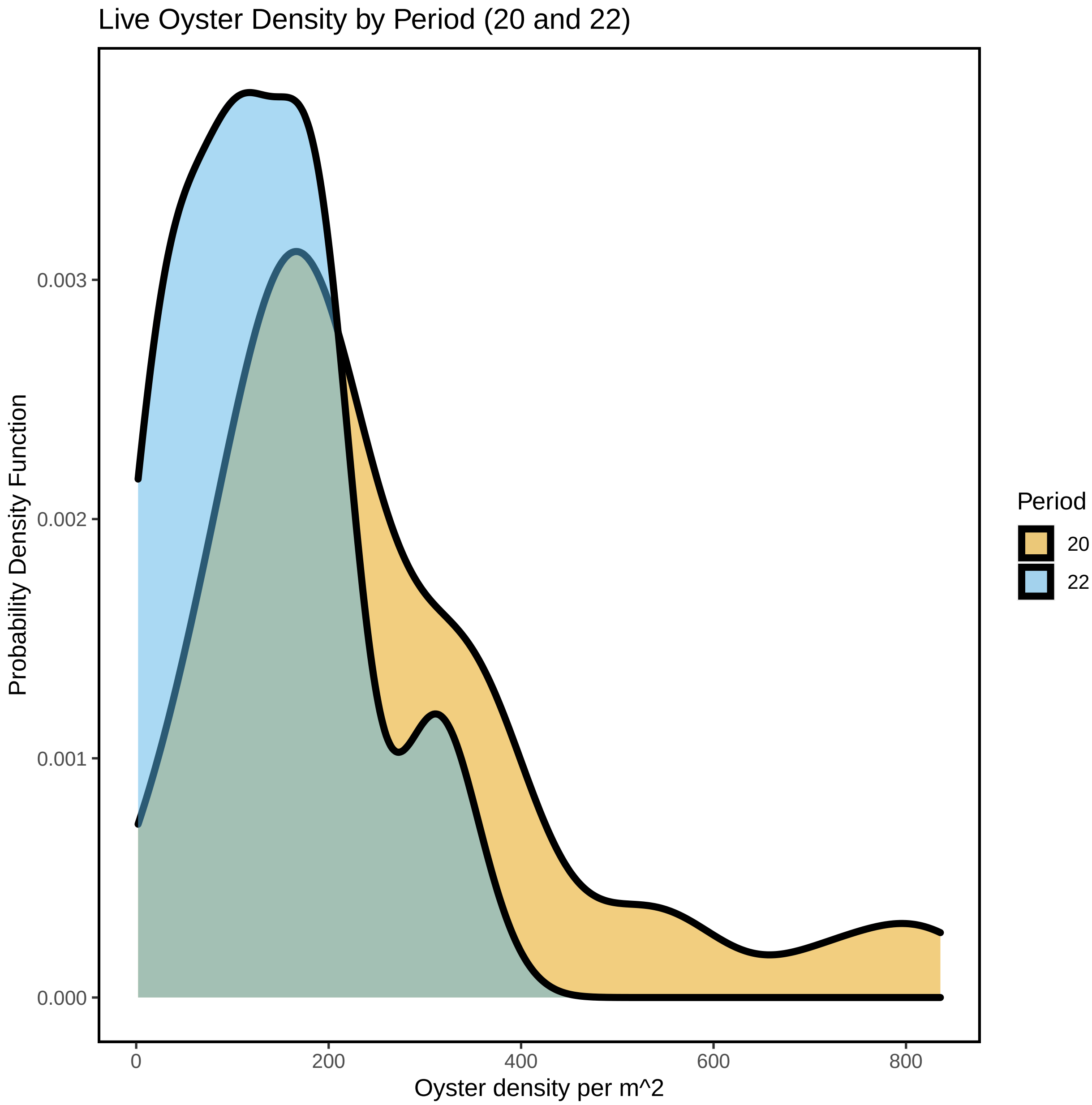


Figure 4-7.- Calculated live oyster density by periods 20 (Winter 2019-2020) and 22 (Winter 2020-2021) using a probability density function.

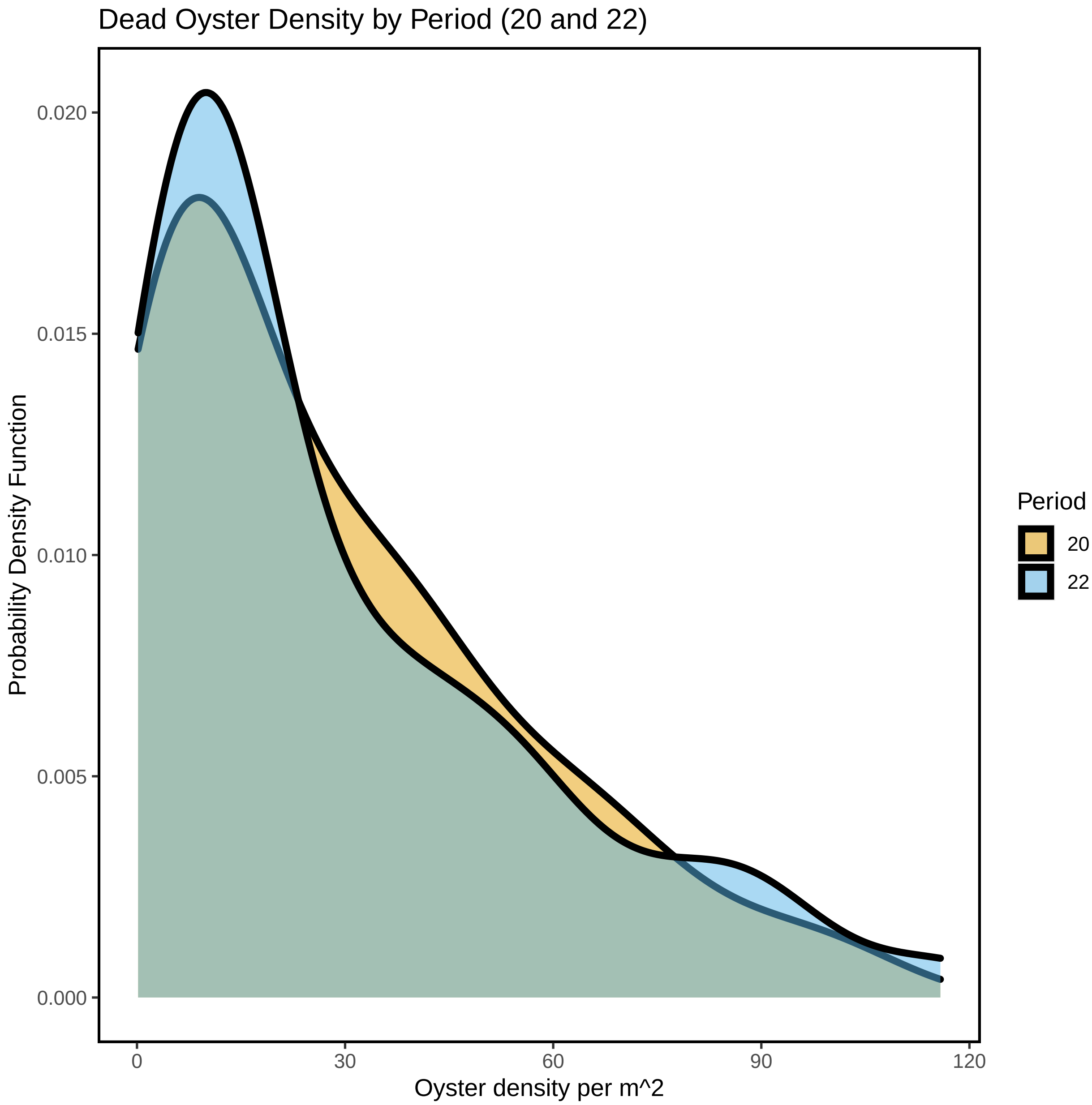


Figure 4-8.- Calculated dead oyster density by periods 20 (Winter 2019-2020) and 22 (Winter 2020-2021) using a probability density function.

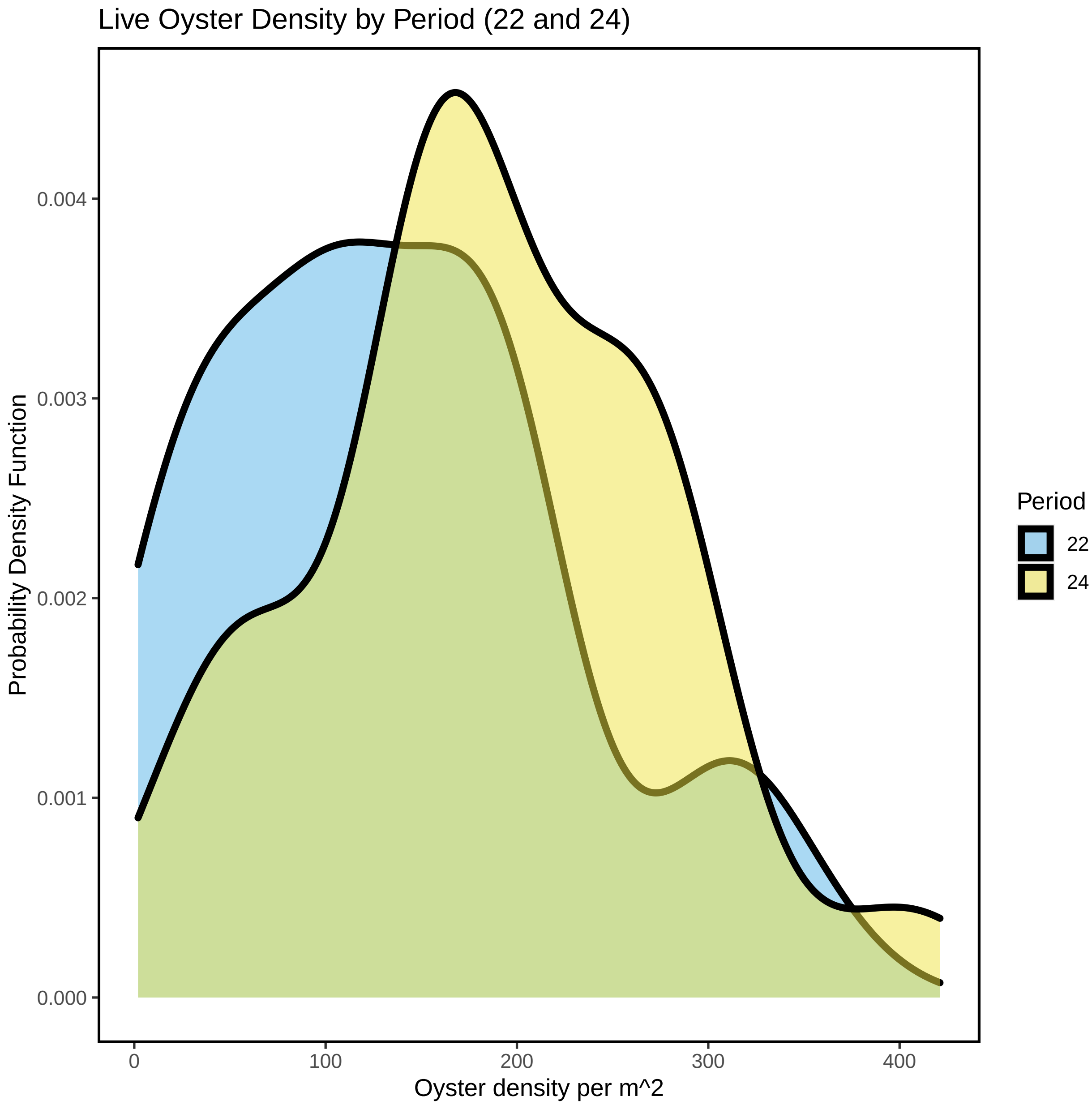


Figure 4-9.- Calculated live oyster density by periods 22 (Winter 2020-2021) and 24 (Winter 2021-2022) using a probability density function with the last sample date of period 24 as 2/1/2022.

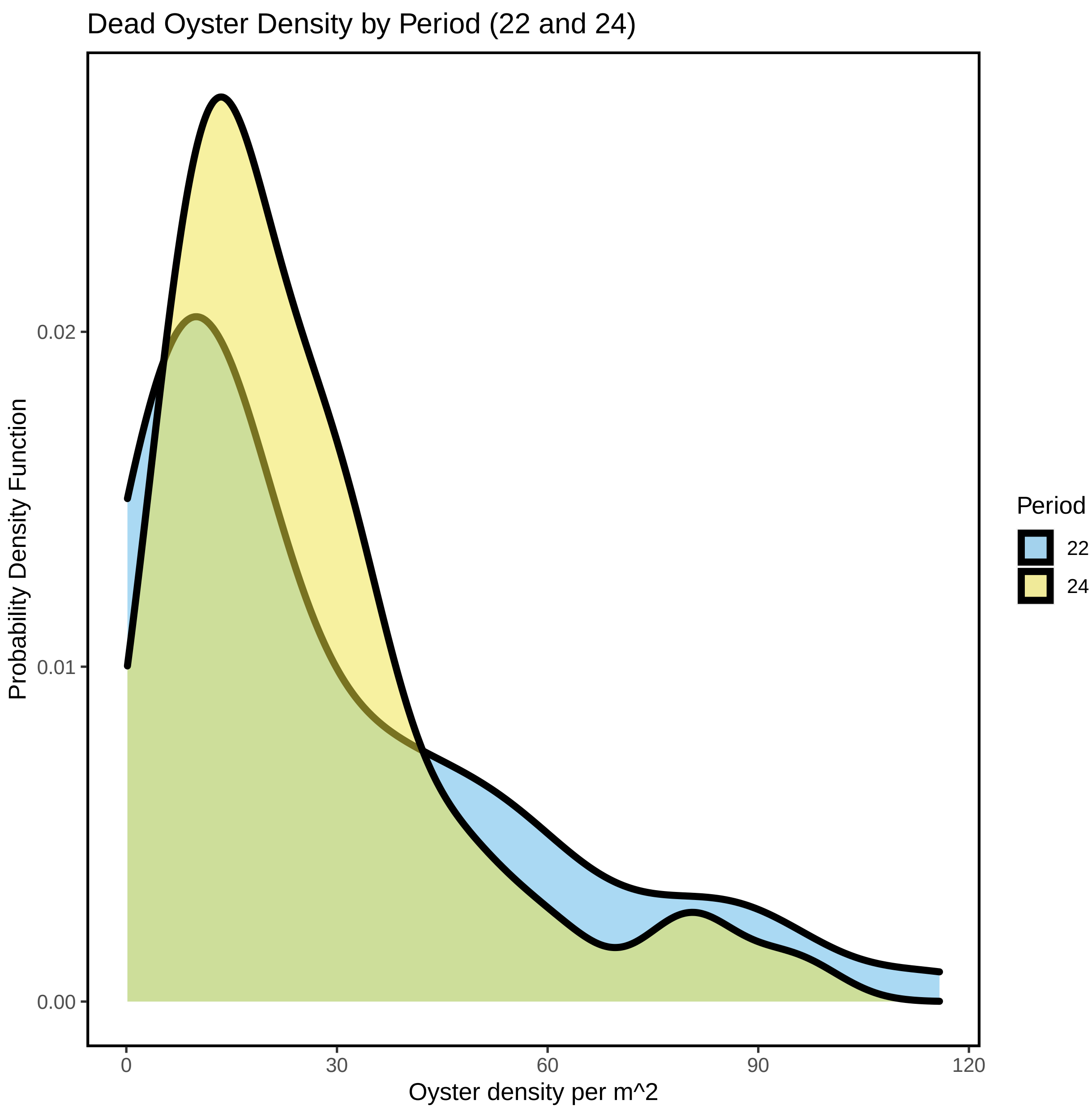


Figure 4-10- Calculated dead oyster density by periods 22 (Winter 2020-2021) and 24 (Winter 2021-2022) using a probability density function with the last sample date of period 24 as 2/1/2022.

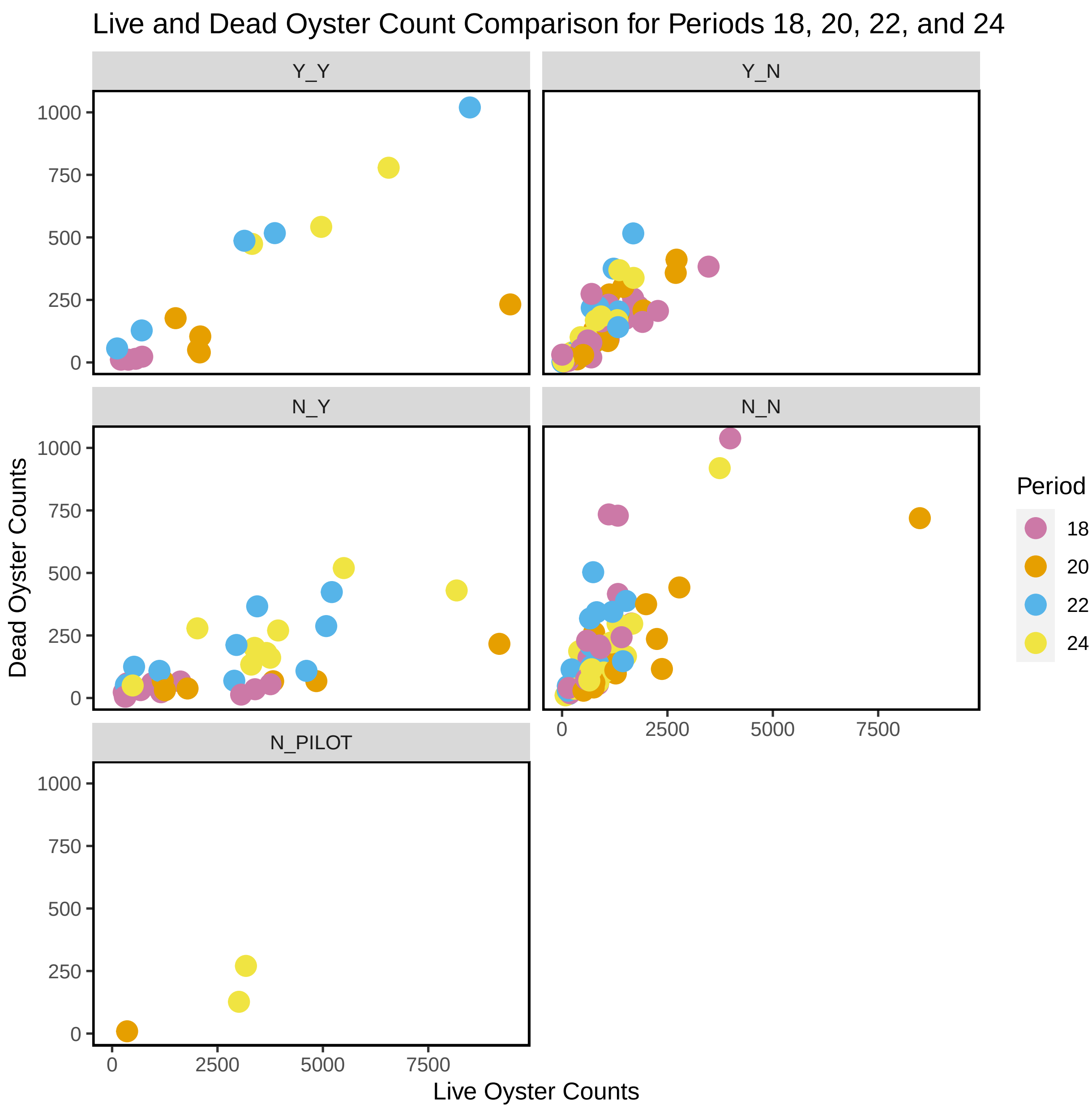


Figure 4-11.- Live and dead oyster count comparison by periods 18 (Winter 2018- 2019), 20 (Winter 2019-2020), 22 (Winter 2020-2021), and 24 (Winter 2021-2022), last sample date of period 24 as 2/1/2022.

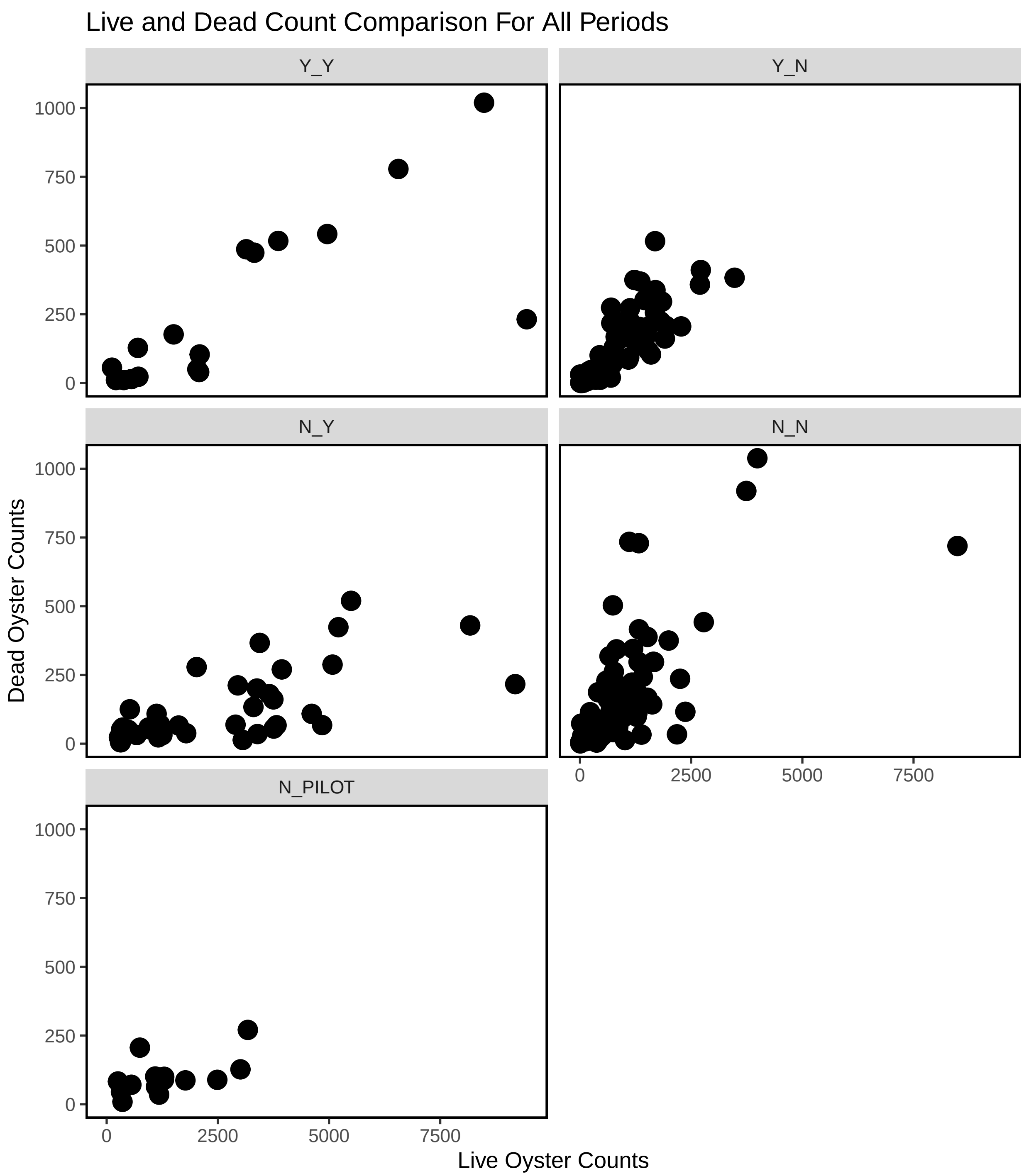


Figure 4-12.- Live and dead oyster comparison for all periods, last sample date of period 24 is 2/1/2022.

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.

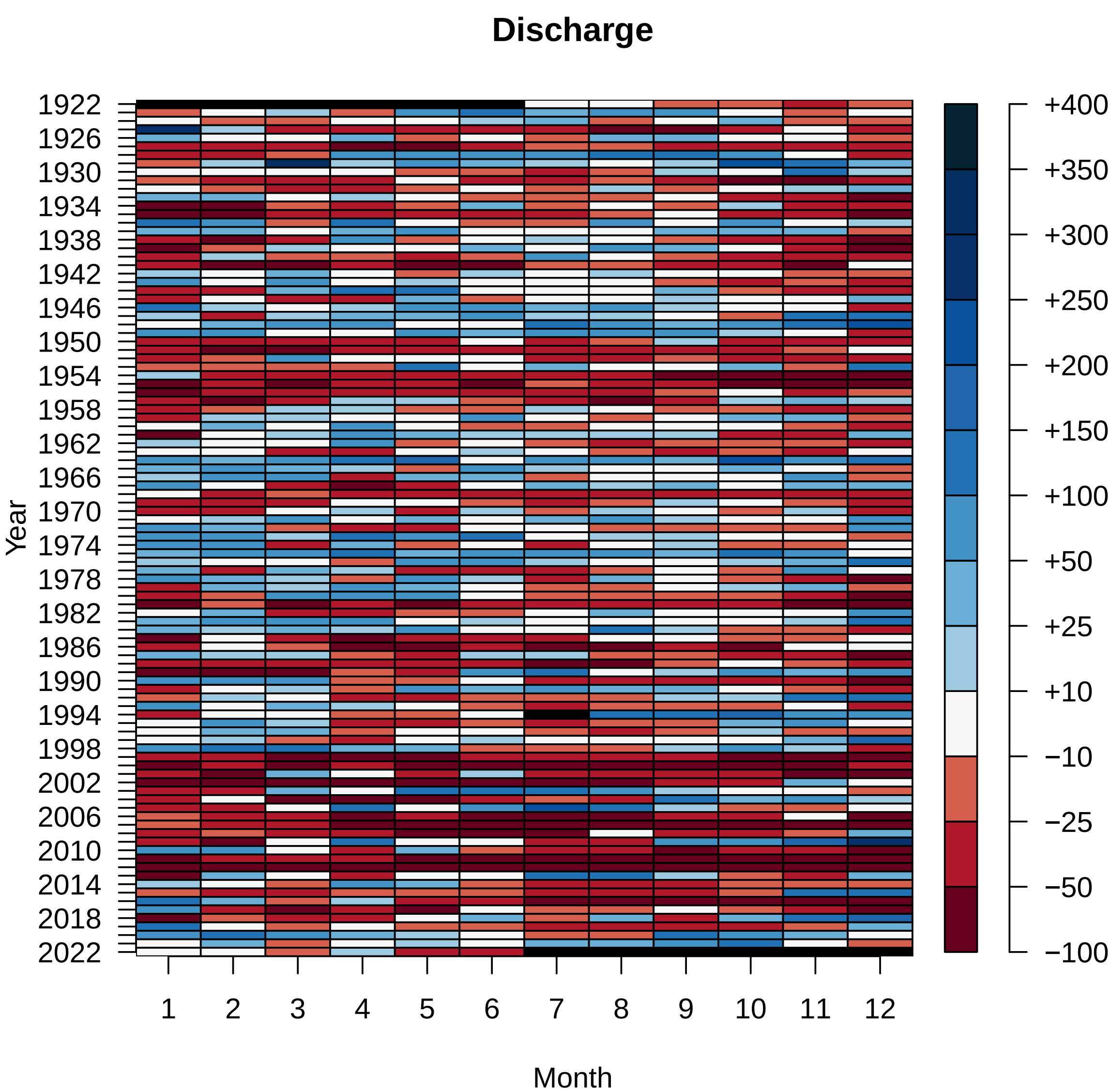


Figure 3-1. Heat map of Suwannee River deviations in mean daily discharge by year and month from USGS Wilcox gauge (02322500) for the period of record measured as deviation from the average by month

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.

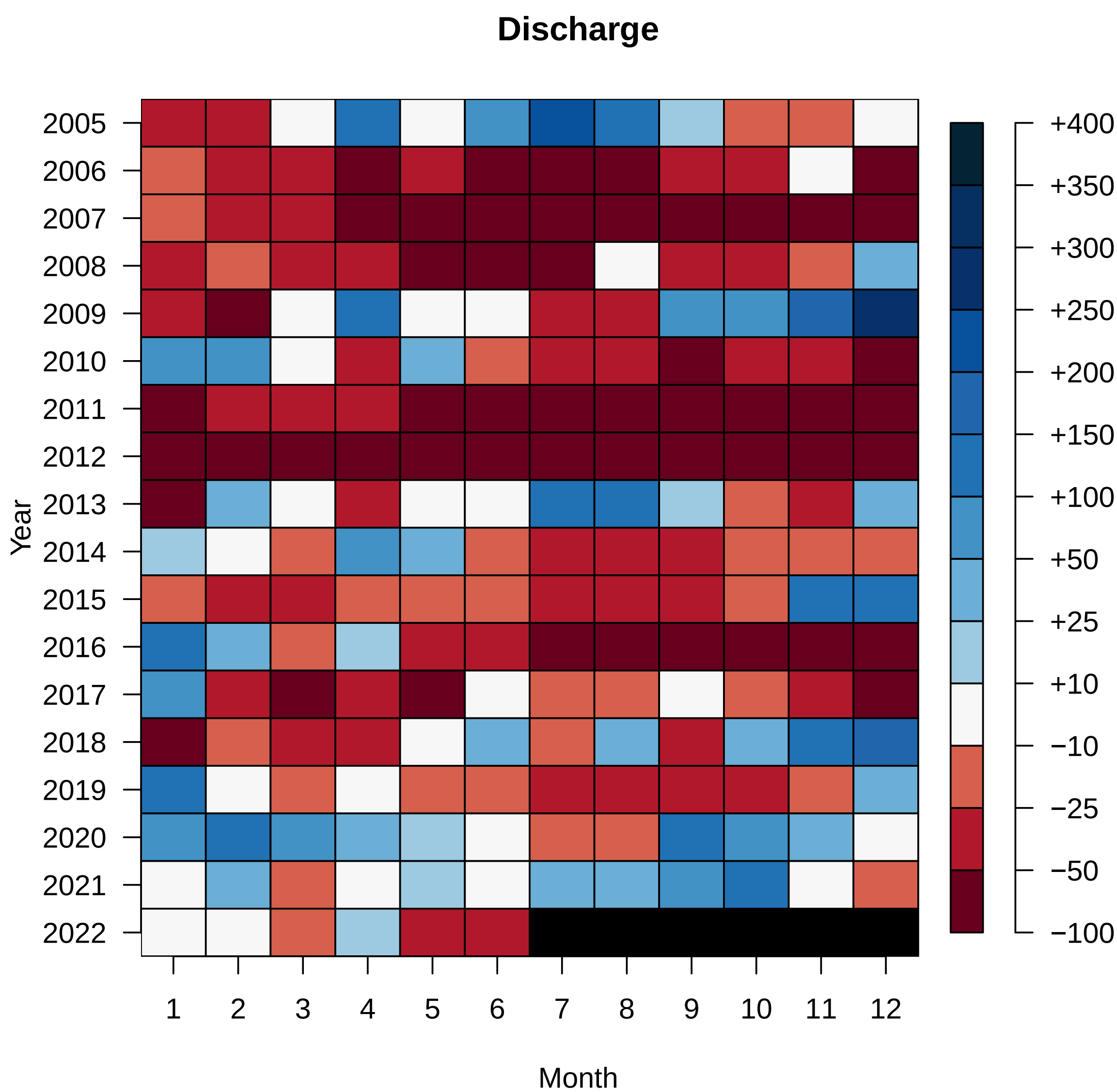


Figure 3-2. Heat map of Suwannee River deviations in mean daily discharge by year and month from USGS Wilcox gauge (02323500) for 2005-2021 measured as deviation from the average by month for period of record. White color for a given month and year is a month when river discharge is similar (with +/- 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.

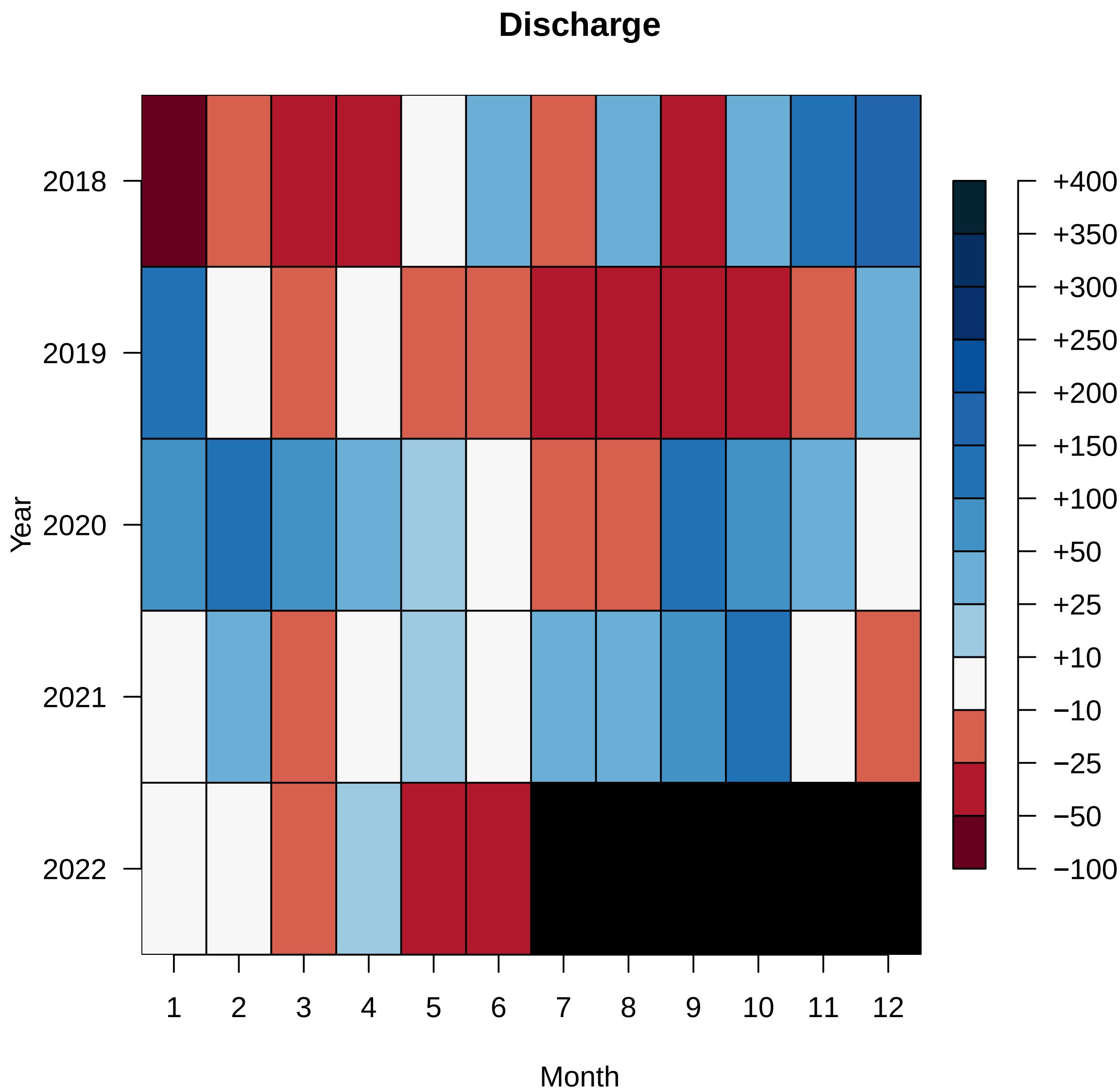


Figure 3-3. Heat map of Suwannee River deviations in mean daily discharge by year and month from USGS Wilcox gauge (02323500) for 2018-2021 measured as deviation from the average by month for period of record. White color for a given month and year is a month when river discharge is similar (with +/- 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.

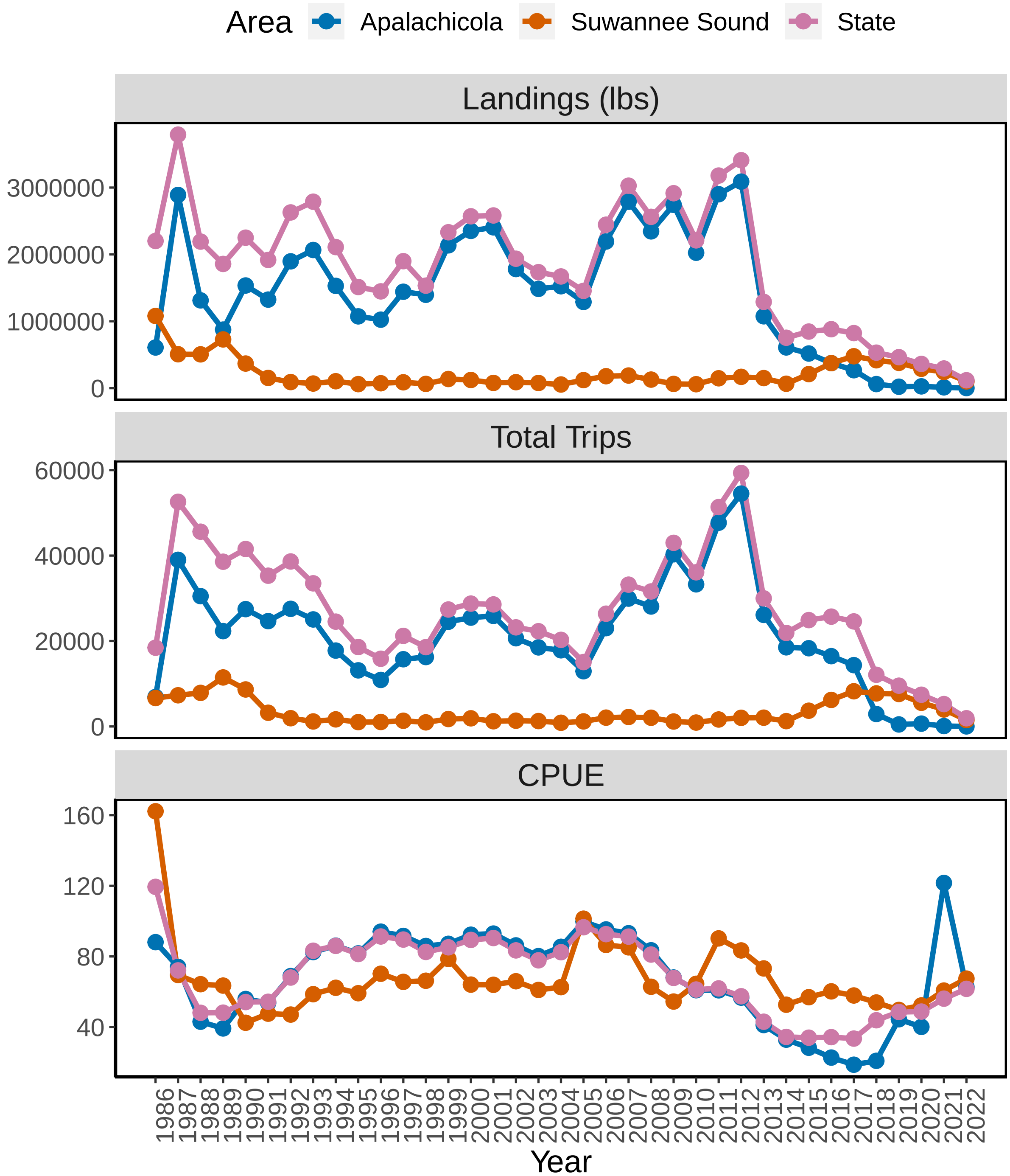


Figure 4-1. Figure of oyster landings (lbs), total trips, and cost per unit effort (CPUE) for Apalachicola (blue line), Suwannee Sound (orange), and the State of Florida (pink) for years 1986 to 2022.

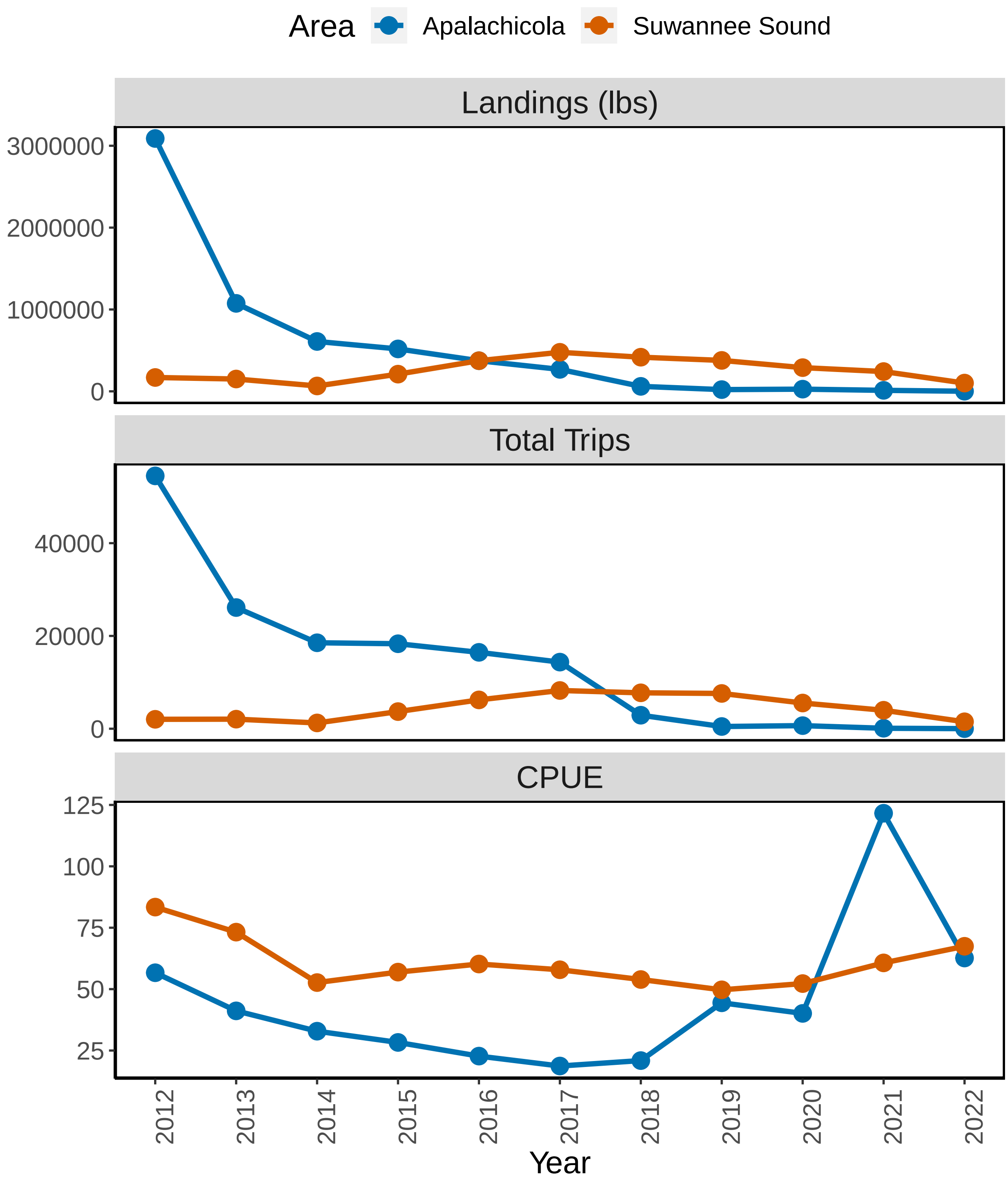


Figure 4-2. Figure of oyster landings (lbs), total trips, and cost per unit effort (CPUE) for Apalachicola (blue line), Suwannee Sound (orange) for years 2012 to 2022.

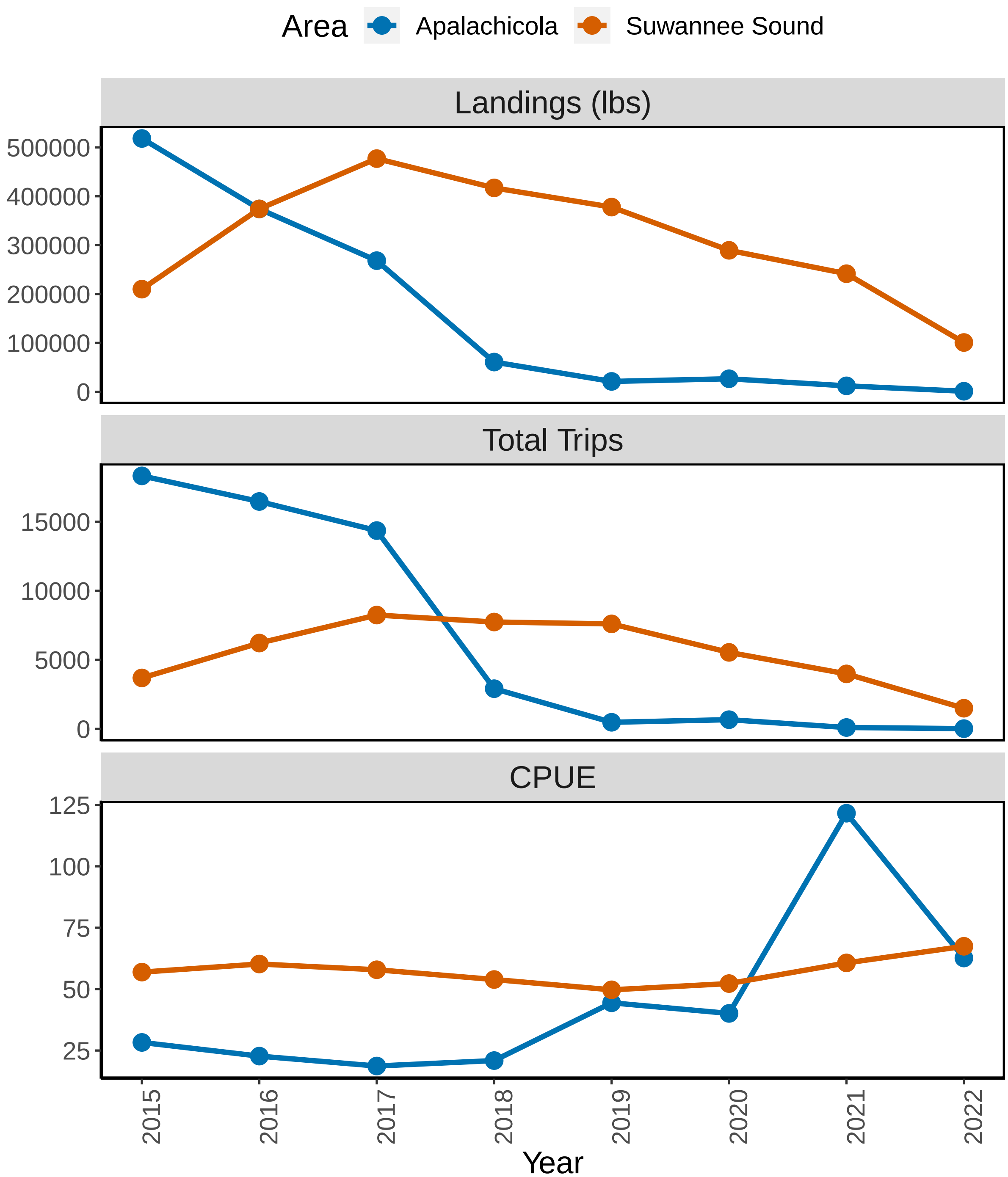


Figure 4-3. Figure of oyster landings (lbs), total trips, and cost per unit effort (CPUE) for Apalachicola (blue line), Suwannee Sound (orange) for years 2015 to 2022.

6 Quarterly Windrose

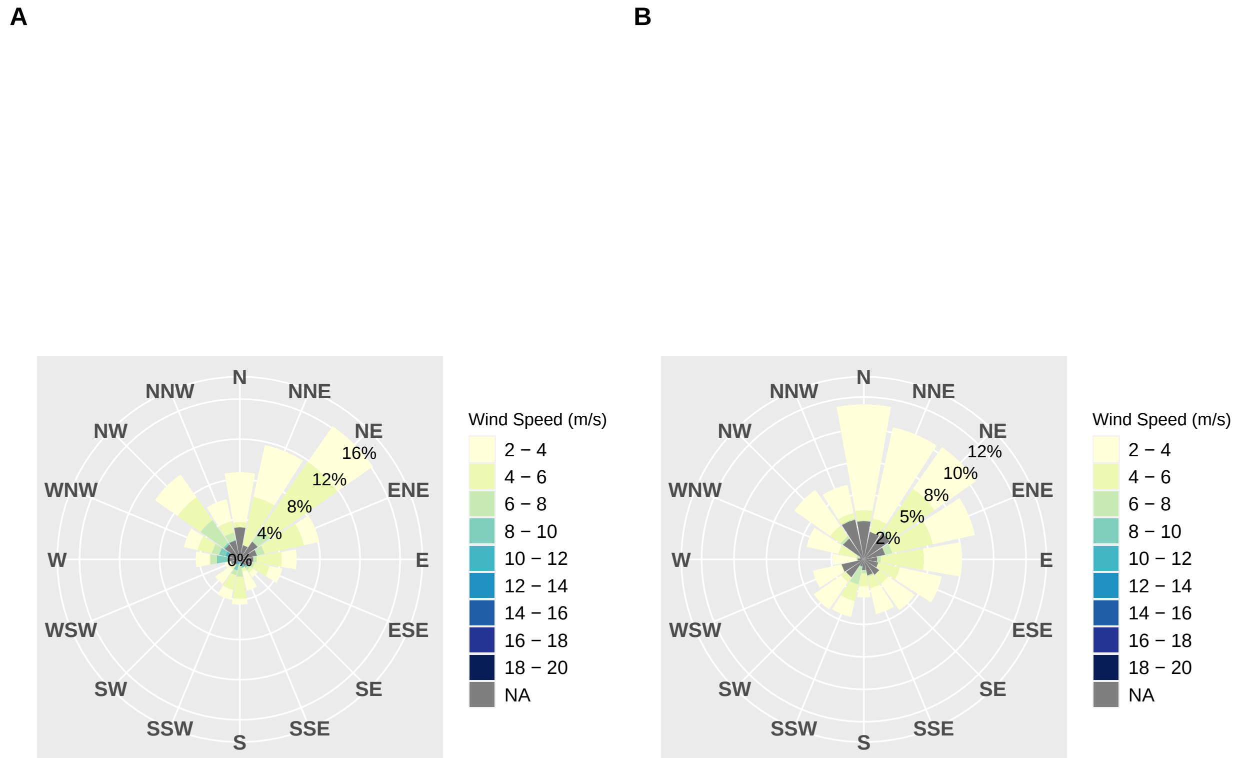


Figure 5-1. A wind rose visualizes the frequency of winds blowing from a specific direction of a desired Date Range. The data used for this figure were collected via the `rnoaa` R Package at station CDRF1 (Cedar Key, Florida). The legend represents the wind speed ranging from low (2-4 m/s) to high (18-20 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 January 1, 2022 to January 31, 2022, B) Windrose from February 1, 2022 to February 28, 2022, C) Windrose from March 1, 2022 to March 31, 2022.