Attachment 5
PPBEP COMMUNITY GRANT FINAL RESEARCH REPORT FORM

Agreement No.:	FY2023-06		
Grantee Name:	Northwest Florida State College		
Grantee Address:	100 College Blvd E, Niceville, FL 32579		
Grantee's Representative:	Geoffrey Smith	**Telephone No.:**	850-729-5242
Project Title:	Fish Community Analysis of Santa Rosa Sound Tidal Tributaries		
Please submit any high-resolution photos related to the project (include photo credit for possible use by PPBEP for use in our e-newsletter, annual report, social media, or website) with your report as image files to lmcdonald@ppbep.org.			

ABSTRACT: Limit to 250 words. The abstract should include background and a statement of the problem or issue, followed by a description of the research method(s) and design, the major findings, and the conclusions reached.

Tidal tributaries, including small tidal creeks and tidal ponds, serve as critical habitat to numerous marine fish and invertebrate species including many important forage species and juveniles of many commercially and recreationally important species. There is a general lack of either short term or long term assessment and monitoring of juvenile fish and decapod crustacean species in the Pensacola Bay system including Santa Rosa Sound and its tributaries. This study worked to fill some of these gaps by gathering baseline data on fish and decapod crustacean communities on a subset of 7 creeks systems draining into Santa Rosa Sound. These creeks were sampled monthly from January through June with small bag seines and cast nets to assess the species composition and abundance of fish and decapods. Ambient water conditions were collected at each sampling location, and water quality samples were taken at each creek. All of the creek systems housed large numbers of fish, especially small tidal creek residents (e.g., killifishes and livebearers) and juvenile forage fish (e.g., Spot, Pinfish, mojarras). Juvenile sportfish, including Red Drum, Sheepshead, Spotted Seatrout, and Atlantic Tarpon, were collected in all but two of the creek systems. The Shoreline Park complex of creeks and Liza Jackson Creek are very small and sporadically connected to the sound which may have reduced their sportfish recruitment. Additionally, Liza Jackson Creek is highly modified with no intact marsh vegetation. Generally, creeks with more intact natural marsh shoreline yielded the highest abundances of juvenile sportfish, Blue Crab, and penaeid shrimp.

INTRODUCTION: Provide necessary background information, describe the purpose of the project, and state the key objectives.

Tidal tributaries, including small tidal creeks and tidal ponds, serve as critical habitat to numerous marine fish and invertebrate species. This includes many important forage species and the juveniles of many commercially and recreationally important species. In many cases, abundances in these backwater tributary systems are orders of magnitude greater than surrounding main-stem river shorelines or open bay/sound shorelines. There is a general lack of either short term or long term assessment and monitoring of juvenile fish and decapod crustacean species in the Pensacola Bay system including Santa Rosa Sound and its tributaries. The data that are available are focused primarily on seagrass beds with little to no sampling of marsh habitats or tidal creeks. This project aimed to fill some of these gaps in sampling within the Santa Rosa

Sound system by providing some baseline data on fish and decapod communities within tidal tributaries of the sound. Key objectives were to sample a subset of creeks distributed along the length of Santa Rosa Sound to assess the relative abundance and composition of fish and decapod species in each creek system on a monthly basis. Ambient water parameters (temperature, salinity, dissolved oxygen, pH) and water quality samples (analyzed for TSS, dissolved nutrients, and chlorophyll) were collected during each sampling event that could be paired with future analysis of the fish and decapod data or longer term monitoring of these systems.

METHODS: Provide sufficient detail for how the project was conducted and data were collected, including specific materials and methodologies/protocols.

Seven creek systems were selected along the length of Santa Rosa Sound. Creeks systems were located on the northern (mainland) side of the sound as there are few creeks on the southern (island) side of the sound. Selected creeks included: Shoreline Park Creeks, Soundside Preserve Creek, Lands End Creek, Lighthouse Point Creek, Marsh Harbor Creek, Coral Drive Creek and Liza Jackson Creek (Figure 1). These are not official creek names as many (if not all) of these systems do not official designations denoted on maps. The names reflect general location of the system (park name, neighborhood/community name, street name). Each creek system was sampled monthly from January through June. Lighthouse Point Creek was not sampled until February as a replacement for Williams Creek, which could not easily be accessed during this study. Marsh Harbor Creek was not sampled until February due to initial delays in gaining access to the creek. Coral Drive Creek was not sampled until February when cast net sampling was initiated, this creek was deemed potentially to hazardous to sample with bag seines due to various debris in the creek. Based on the size of the creek system 2-6 bag seines (30 ft (9.1 m) in length, 6 ft (1.8 m) in depth, 1/8" (3.1 mm) mesh) were be hauled at creek stretches that are approximately 50-60 m in length. A cast net (7 ft radius (2.13 m) with ¼" (6.4 mm) mesh) was deployed at each sampling location as well (cast net sampling did not begin until February). Bag seines were not utilized in Coral Drive Creek due to safety issues and cast nets were not deployed in Liza Jackson Creek to the the small size of the creek. The bag seines were deployed from shore in a semi-circle encompassing the length of the net. The length and width of the net deployment was measured to estimate the area sampled. Based on several previous studies, the sampling area of the cast net was estimated as 42% of the theoretical maximum area based on the radius of the net. All fish and decapod crustaceans captured during a seine haul or cast net throw were identified and enumerated prior to release. Target species (sportfish, species of special concern, etc. including but not limited to Red Drum, Spotted Seatrout, penaeid shrimp, Blue Crab, etc.) were measured to the nearest mm prior to release. A subset of individuals of each species was retained as a reference collections: placed on ice in field, frozen, defrosted and preserved in 10% buffered formalin prior to transfer and long-term storage in 70% ethanol.

At each sampling location tidal cycle, shoreline composition (vegetation, seawall, etc.), and bottom type (mud, sand, presence of submerged aquatic vegetation) was recorded. Ambient water parameters (temperature, dissolved oxygen (mg/L and % saturation), salinity, conductivity, and pH) were measured before net deployment (to avoid disturbing the water/sediment) with a YSI or Hydrolab multi-meter probe. A surface water sample was collected within each creek system (every creek within the Shoreline Park system and approximately midway between the most upstream and downstream site in all other creeks) during each sampling month and

processed by staff at the University of West Florida (using standard procedures, Table 1) for the following parameters: total suspended solids (TSS), color, ammonium, nitrate + nitrite, dissolved organic phosphorus (DIN), and chlorophyll-*a*.

Community composition between creek systems was analyzed for the entire sampling period and each month (for both gear types) with the mvabund package in R. Post-hoc tests (corrected for multiple comparisons) were performed to identify species that contributed to the differences in community composition. Boxplots of sportfish (Spotted Seatrout, Red Drum, etc.) and species contributing to creek composition differences were created to illustrate which creeks differed from one another.

RESULTS: Present and describe key results from your research project. This section should accurately describe all data collected, including data summaries, significant observations, and trends (if applicable). Please attach a separate file with map(s), tables, and figures.

Water Parameters

Water depth at the sampling locations within the creek systems was almost always less than 1 m, thus only surface measurements were collected with the YSI/Hydrolab probes. On a few occasions, bottom conditions were examined and showed stark differences from the surface, even when the depth was much less than 1 m. This would suggest that in the future, both surface and bottom measurements should be collected regardless of depth, this may be of particular importance after rain/storm events.

Salinity varied widely among the creek and within individual creeks system (Figure 2). Generally, differences could be attributed to tidal cycle (high vs low tide) or rain events. Overall, Lighthouse Point, Lands End, and Shoreline Park Creeks tended to have higher salinities. Liza Jackson and Marsh Harbor Creeks saw a generally shift to higher salinities in many of their sampling sites after a storm surge event in late April/early May (based on salinity, shoreline disturbance, vegetation disturbance, etc.).

Temperature was relatively consistence within creeks and between creeks for a particular month. The temperatures of the creeks generally increased from the winter through early summer as expected (Figure 3).

Dissolved oxygen was general adequate to support healthy fish communities, especially given the tolerance of many estuarine species for lower oxygen levels. Oxygen levels dropped below 5 mg/L in about half of the sampled locations and rarely dropped below 2 mg/L (Figure 4). As temperatures increase (later spring/early summer), DO levels generally dropped, especially in Lighthouse Point Creek. The driving cause for the more substantial drop in DO in this creek

compared to the others is not known. The restricted connections with the sound for some of the creeks (e.g. Soundside Preserve and some of the Shoreline Park creeks may contribute to their lower DO values during some of the sampling periods.

The pH of all of the creek system generally fell within the expected range for an estuarine system with variable salinity (6-8) (Figure 5). A few values below 6 were documented. Possible drivers of these low values are rain events, decaying seagrass noted in a few of the systems (Shoreline Park and Lands End), or upstream (more fresh) location of a particular sampling site.

Total suspended solid (TSS) values varied widely both among and within creeks over time (Figure 6). The variability in these measurements likely reflect weather conditions (rain events and wind) and tidal cycle (lower water clarity was often noted on higher tides, especially on windy days).

There were no clear trends in dissolved inorganic phosphorus (DIP) concentrations (Figure 7). Higher values in some of the Shoreline Park creeks may be the result of large amounts of decaying seagrass on the bottom and/or large rain events (May and June). Liza Jackson Creek consistently had some of the highest dissolved inorganic nitrogen (DIN) concentrations (Figure 8). This creek drains a urban area and is directly adjacent to a dog park, both of which could contribute to the nitrogen enrichment of this system. Coral Drive Creek also had some higher nitrogen values. This creek also drains a large urban area. Chlorophyll values were relatively low, with the exception of one of the Shoreline Park creeks in June, and did not necessarily tract nutrient levels (Figure 9). This is not unexpected, as primary production in small tidal backwaters is often dominated by benthic microalgae rather than phytoplankton in the water column. Food webs in these systems can also be driven by detrital inputs from both terrestrial (decaying shoreline vegetation) and open bay sources (decaying seagrass/macroalgae deposited during high tides).

Sampling of all of the creek systems yielded large numbers of fish and some decapods (most notably grass shrimp *Palaemonetes spp*. in a few of the creeks). Significant differences in the community composition were noted overall and for each month for both sampling gears (Tables 2 and 3). However, in many of the cases the species driving the differences were schooling transient species (Tidewater Silverside and mullet species) or cyprinodontiform species (e.g., Gulf Killifish Sailfin Molly, and Sheepshead Minnow) that often retreat to flooded marsh habitats in all but the lowest tidal conditions (i.e., large numbers collected could simply be indicative of a low tide rather than a greater abundance). With this in mind, the creek systems had relatively similar species compositions. Juvenile sportfish (Red Drum, Spotted Seatrout, Sheepshead, and Atlantic Tarpon) were generally in greater abundance within the larger creek systems, that had intact marsh vegetation along most of their length, and had a consistent connection to the sound, Lands End and Lighthouse Point Creeks in particular (Figures 10-12, 40-43). However, these species did not contribute to community level differences due to their overall low numbers compared to many of the estuarine residents. Generally the species contributing to the overall differences also contributed to one or more of the monthly differences. Eastern Mosquitofish contributed to differences on several occasions, with abundances generally being higher in Liza Jackson, Shoreline Park, Coral Drive, and Soundside Preserve Creeks (Figures 14,21, 24, 29, 31, 37, 47, 57, 63). This a salt tolerant freshwater species, and the creeks

with the highest abundances of these species often had some of the lowest salinities and had greater connection to upstream freshwater sources (or were sampled further upstream). Grass Shrimp species were consistently more abundant in Lands End Creek, some of this was due to particularly high catches on very low tides (Figures 15, 25). Green Swordtail, an nonnative, species was regularly collected in Liza Jackson Creek in high numbers and contributed to its difference from other creek systems (Figures 16 26). Marsh Killifish contributed to difference in Liza Jackson and Shoreline Creeks from the other systems (higher numbers) (Figures 17, 38, 50, 58, 60). This was in part due to the sampling conditions at these sites (no intact Marsh at Liza Jackson and low tides at Shoreline Park). This could also be in part due to their restricted entrances and lack of potential predators. The large numbers of Marsh Killifish in Liza Jackson, which lacks any typical saltmarsh vegetation like *Spartina* or *Juncus*, is surprising given that this is a species that is often noted as an indicator of intact, healthy saltmarsh systems. Spot, Pinfish, and mojarra (*Eucinostomus spp.*) contributed to creek differences on several instances, with abundances generally being lower in Liza Jackson, Coral Drive, and Shoreline creeks (Figures 17, 19, 22, 27, 28, 51, 52, 55, 64). Liza Jackson Creek and the Shoreline Park creeks are some of the smallest creek systems sampled and often had minimal connection to the sound (increased towards the end of the study after several storm events). As noted before, both Liza Jackson and Coral Drive Creeks are located in more urban areas. And although, they do not have large stretches of hardened shoreline (i.e., mostly vegetated shores), they also do not have much if any intact marsh habitat. The large numbers of centrachids (Bluegill, Spotted Sunfish, Largemout/Florida Bass, etc.) noted in cast net samples from Soundside Preserve Creek are almost entirely due to sampling a connected upstream, freshwater pond (Figures 13, 44, 45, 56). Largemouth/Florida Bass were also caught on several occasions at the most upstream site of Marsh Harbor Creek. After several major rain events, this species was also noted in downstream portions of these two creek system.

DISCUSSION AND CONCLUSION: Present, interpret, and discuss the results, project outcomes, future research needs, and how this research connects back to the CCMP.

All of the creek systems sampled during this study provided habitat for large numbers of fish, especially small tidal creek residents (such as killifishes and livebearers) and juvenile forage fish (such as Spot, Pinfish, and mojarras). Juvenile sportfish, including Red Drum, Sheepshead, Spotted Seatrout, and Atlantic Tarpon, were collected in all but two of the creek systems. The complex of creeks at Shoreline Park and Liza Jackson Creek are very small and sporadically connected to the sound which may have reduced their recruitment of sportfish. Additionally, Liza Jackson Creek is highly modified with no intact marsh vegetation. Generally, creeks that had a more intact natural marsh shoreline yielded the highest abundances of juvenile sportfish, Blue Crab, and penaeid shrimp. Ideally, more thorough sampling of not only tidal tributaries, but also surrounding shorelines and bay/river systems on a year round basis (peak recruitment of some sportfish species not captured in this study) would better reveal what areas are providing the greatest nursery habitat to juvenile sportfish. However, this study has revealed that these creeks are at least contributing some to local sportfish populations both as nursery habitat and a supply source for some forage fish species. These creeks also likely play a role in reducing nutrient loading and sedimentation entering the sound. In both cases, this may be particularly true for the creeks with more intact shoreline vegetation. This would suggest that these intact creeks should

be protected from further development if possible and that restoration of the more disturbed creeks may be warranted and beneficial to the overall health of the Santa Rosa Sound system.

REFERENCES: Please list references cited throughout this report. Additionally, if there are key references that PPBEP needs copies of to fully understand your methods and overall research, please attach references as individual PDFs.

SUCCESSES AND CHALLENGES: Describe the significant successes and challenges the organization experienced related to the funded grant.

We were successfully able to sample a subset of tidal creeks draining into Santa Rosa Sound through the granting period. These sampled demonstrated that these creeks are functioning as primary habitat for a number of shallow/backwater resident species and as nursery areas for several commercial and recreational species. Several challenges arose during the onset of the study. The most notable were significant delays in permit approval to initiate sampling followed by a series of low temperatures (possible death of fish as a result of sampling) in early January. There were also some issues in access to sampling sites that delayed initial sampling or resulted in the relocation of some of the initially proposed sampling locations. These delays not only resulted in the peak of Red Drum recruitment (a target species for this study) be missed but also necessitated an extension of the grant to complete the contracted sampling and analysis.

LESSONS LEARNED: Describe what the organization learned based upon the results, successes, and challenges reported. Address programmatic, evaluative, or organizational changes that will be made based upon these lessons learned.

PI had prior experience submitting Special Activity Licenses applications with FWC and turnaround was typically less than a month. Staffing issues (loss of positions and staff changing positions) at FWC led to much longer than anticipated turnaround and approval of the sampling permit. In the future, for grants with a short time frame, permit applications will be submitted as soon as PI is aware of the grant being awarded (possibly once it makes it through the initial recommendation stage). For this grant, the permit application was not submitted until after the public announcement of the awards. There was an also a further delay in the application submission while awaiting a response from FWC about sub-awards/contracts and their listing on

the permit application. Based on the information gained through this process, permit applications will be submitted as soon as possible (even if contracts aren't finalized) as the permit can later be amended to reflect the finalized contract. The PI also now has knowledge on the formal procedures for developing a sub-award contract to avoid delays in approval of any future sub-award contracts.

In the future, sampling should start earlier in the Fall if possible (not done in this study due to the challenges noted above) to better capture the recruitment of early-juvenile Red Drum (<100 mm). Year-round sampling would also be beneficial to capture peak recruitment of species such as Spotted Seatrout and Mangrove Snapper that primarily spawn in the summer and recruit to nurseries through the summer and early Fall.

The bag seine utilized in this study was reflective of a similar study in tidal creeks of Tampa Bay conducted by FWC staff, however, it proved too small to efficiently sample some of the more mobile fish species and larger juveniles of some of the sportfish species. Future studies may incorporate a larger bag seine (21.3 m seine used by FWC in the bay and river sampling) to more efficiently sample some of the larger taxa observed on site but rarely collected during this study.

This report is submitted in accordance with the reporting requirements of Agreement No. FY2023-06 and accurately reflects the activities associated with the project.

7/18/2024

X Geoffrey Smith

Geoffrey Smith
Biology Instructor
Signed by: Geoffrey Smith

Signature of Grantee's Representative | Date

Geoffrey Smith, Biology Instructor

Print Name and Title