Florida Fish and Wildlife Conservation Commission
Freshwater Fisheries

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Springs Coast Fish Community Assessment

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SPRINGS COAST FISH COMMUNITY ASSESSMENT

EXECUTIVE SUMMARY

Florida is home to the world's highest density of freshwater springs, which support diverse plant, animal, and fish communities, and many are located within the Southwest Florida Water Management District (District). The five Outstanding Florida Springs systems that occur within the District are the Crystal River/Kings Bay, Homosassa, Chassahowitzka, Rainbow, and Weeki Wachee River Systems. A study was initiated to better characterize the fish communities which utilize these spring-fed systems, while documenting associated habitat and water quality.

The four systems with direct connectivity to the Gulf of Mexico (GOM) were divided into zones that represented a decreasing salinity gradient from upstream (closest to the headspring) to downstream (closest to GOM). In these four systems, Zone 1 represented the lowest average salinity influence observed. The Rainbow River is not influenced by tidal activity or salinity, so it was divided into two zones based on differences in hydrology, water clarity, and vegetated habitat. A total of 1,104 transects were sampled between the five spring-fed river systems from November 2013 to February 2017. During this time period, 61,191 individual fish representing 37 freshwater and 39 marine species were collected.

Diversity and richness indices of fish species were higher in the four systems directly connected to the GOM when compared to the Rainbow River System, which was attributed to the presence of marine fishes. Trends in water quality and habitat parameters and how they relate to relative key species abundance were examined along the salinity gradient within systems directly influenced by salt water, as well as the water quality gradient in the Rainbow River System. Generally, we found less freshwater species in high salinity zones. Multivariate analysis of electrofishing data revealed seasonal patterns in fish assemblages across salinity

zones in all systems connected to the GOM. An influx of marine fish species was observed in low salinity zones during winter months from all systems when compared to the same zones during summer months (except for the Rainbow River System). The Chassahowitzka, Homosassa, and the Crystal River/Kings Bay System's fish assemblages differed by zone but exhibited the same seasonal pattern of more marine species present during winter months. We observed the same percentages of marine and freshwater fish for summer and winter in the Weeki Wachee River System. When comparing fish collections from previous studies conducted in these five systems, similar fish assemblages were observed in this study.

ACKNOWLEDMENTS

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INTRODUCTION

Florida is home to the world's highest density of springs and largest springs by volume (Force 2000). These systems are ecologically important as they support diverse plant and animal communities (Frazer et al. 2011). A key feature of Florida springs is their relatively stable year-round temperatures, which provide thermal refuge for many species of fish and wildlife, including the Florida Manatee (*Trichechus manatus latirostris).* Given their consistent temperature, crystal clear water, and unique wildlife viewing opportunities, the springs are an international attraction, beloved by tourists and residents alike. Measures to more fully understand and protect the Florida's springs systems have been initiated with recognition of their uniqueness and diversity.

The Spring-fed systems in this study are the Weeki Wachee River, Chassahowitzka River, Homosassa River, Crystal River/Kings Bay, and Rainbow River Systems (Figure 1). Despite their popularity and ecological significance, data that adequately characterize the fish communities found within these systems are relatively lacking. Previous studies have focused on specific parameters, such as inflow, nutrient loading, and submersed aquatic vegetation (SAV), on fish communities (Frazer et al. 2011, Pine et al. 2011). Fish specimens have also been collected from each river system for the Florida Museum of Natural History's (FLMNH's) Ichthyology collection. Previous regional fish community sampling has been conducted sporadically by the Florida Fish and Wildlife Conservation Commission (FWC) on the Rainbow, Weeki Wachee, and Crystal Rivers but without specific project goals or protocols. Between 2009 and 2011, the University of Florida conducted habitat and fish population interaction studies on the Chassahowitzka and Homosassa River Systems. Pine and Tetzlaff (2009) focused on habitat use and movement, while Pine et al. (2011) focused on the effects of different SAV species on

fish population structure. However, the fish communities in all of these river systems were not fully characterized during these studies, leaving a paucity of community assemblage data for comparisons.

The project objectives for this study included: 1) evaluation of seasonal and spatial differences in fish communities; 2) documentation of species abundance, diversity, richness, and composition; and 3) evaluation of species associations with quantified habitats and salinity levels within these water bodies during designated winter (November – February) and summer (May – August) months. The data collected during this study by the FWC's Division of Freshwater Fisheries Management (DFFM) represents the first comprehensive baseline dataset of fish community assemblages in these systems. Shifts in fish abundance, diversity, and distribution observed in this dataset can provide insight towards the status and long-term health of these rivers systems. Contemporaneous water quality, flow, and habitat data collected can be used to determine river condition at an ecosystem level. Only with this information can informed decisions be made related to the protection and restoration of these invaluable resources.

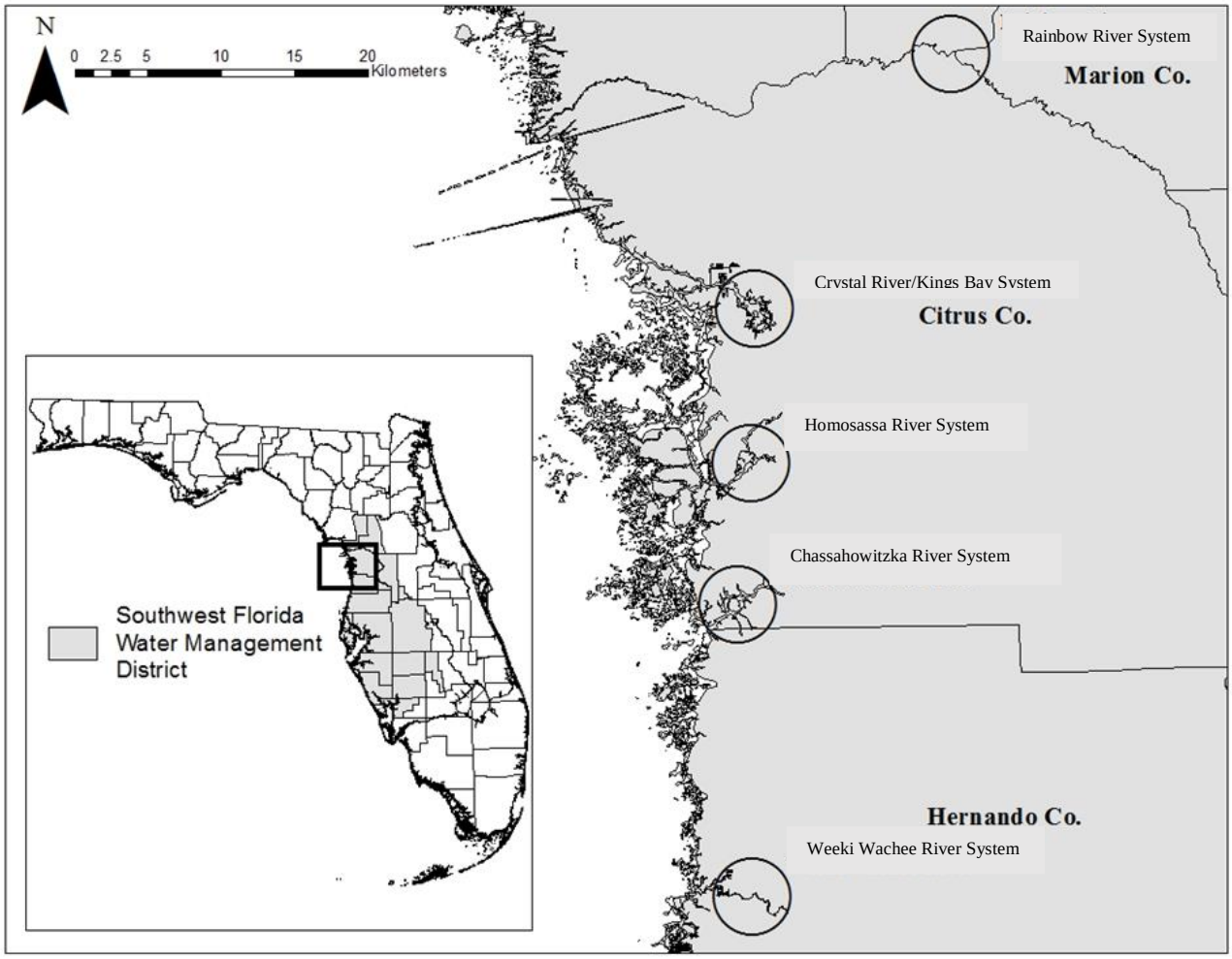

Figure 1. Map of all systems in this study, Rainbow River System, Crystal River/Kings Bay System, Homosassa River System, Chassahowitzka River System, and Weeki Wachee River System. Southwest Florida Water Management District's region is highlighted.

STUDY SYSTEMS

Chassahowitzka River System

The Chassahowitzka River System is a 9-km coastal river located in Citrus County (Figure 1). Classified as an Outstanding Florida Water (OFW) and Sovereign Submerged Lands (SSL), the Chassahowitzka River System is comprised of 12 headwater springs and spans roughly 5 km of forested wetlands from the headsprings to a coastal marsh complex. The coastal

marsh complex continues approximately 4 km before flowing into the GOM (SWFWMD 2012a). As with all coastal spring-fed rivers, water depth is tidally influenced. River depth being relatively shallow (averaging 1 m), coupled with 0.6 – 1.5 m tidal fluctuations, can make certain areas of the Chassahowitzka River System difficult to access or impassable by motorized boats (Wolfe et al. 1990, Pine and Tetzlaff 2009). The Chassahowitzka River Springshed is 492 sq. km; its 230-sq. km watershed is mostly forested land included in the Chassahowitzka National Wildlife Refuge (SWFWMD 2012a). While there are a few scattered houses and cabins, the shoreline and riparian zone is almost entirely natural. The river is roughly 50 m wide near the headsprings and increases in width to about 150 m as it flows toward the GOM. The average overall width of the river is 91 m (Pine and Tetzlaff 2009). The river's median flow value of 60 cubic feet per second (cfs) is derived from 1997-2015 measurements taken by the United States Geological Survey (USGS) at Chassahowitzka gage 02310650.

Homosassa River System

Also located in Citrus County, the Homosassa River System is a large spring-fed system, which is comprised of at least 22 springs (SWFWMD 2012b). The river is 12.8 km long and spans approximately 5 km from the headsprings to the coastal marsh system before continuing roughly 6.5 km until reaching the GOM. River depths range from 1.5 – 2 m at the headsprings, but reaches 4.5 – 6 m at the mouth of the river (Yobbi and Knochemus 1989). Daily tidal fluctuations are about 0.6 m at the river mouth and do not typically exceed 0.3 m in the upper portions of the river (SWFWMD 2012b). The Homosassa River Springshed is roughly 700 sq. km. Much of the upper river's shoreline is highly developed; consequently, it consists of mostly boat docks, seawalls, and lawns. The Halls River, a large 5.6-km-long tributary, converges with the Homosassa River about 0.3 km downstream of the headsprings (SWFWMD 2012b). The width of the river at the headsprings spans roughly 76 m and increases to approximately 305 m

as it flows towards the GOM (Yobbi and Knochemus 1989). The average width of the entire river from the headsprings to the salt marsh is 130 m (Pine and Tetzlaff 2009). Flow is moderate compared to the other spring-fed rivers; for example, the median flow from 2004 through 2015 was 211 cfs (SWFWMD 2017a).

Crystal River/Kings Bay System

The Crystal River/Kings Bay System is located in Citrus County and has over 70 springs. Kings Bay is the headwaters of the Crystal River, which travels 11.2 km to the GOM. The bay system is approximately 243 hectares in size and has typical depths from 0.9 to 3 m, with daily tidal fluctuations up to 1 m. Salinity varies with changing tide and location in the bay, but can be relatively low (0.3 ppt) in some of the northern portions. The most saline areas of the bay are found at the mouth of Crystal River and the salt marsh located at the southwestern corner of the bay, where salinity levels can reach around 2.0 ppt. The average flow of the Crystal River/Kings Bay System at Bagley Cove from 2002 through 2015 was 477 cfs (SWFWMD 2017b). The Kings Bay Springshed spans 803 sq. km, with a total watershed of 943 sq. km, (FSI 2016, Herrick et al. 2017).

Rainbow River System

The Rainbow River System, located in Marion County, is the largest tributary of the 227-km-long Withlacoochee River. Phosphate mining occurred in the lower portion of the Rainbow River in the late 1800s/early 1900s. In 1909, the Withlacoochee River was dammed nearly 20 km from the GOM, obstructing any tidal influence on the Rainbow River. The Rainbow River is roughly 9 km long and relatively narrow, ranging from 18 – 60 m wide (HSW Engineering, Inc. 2009). Depths range from 1 – 8 m, with minor fluctuations of <1 m (SWFWMD 2017d). The river's median flow from 1917 through 2015 was 678 cfs and is almost entirely derived from its 87 springs (PBS&J 2007, SWFWMD 2016). The Rainbow River Springshed is approximately

1,903 sq. km. Its crystal-clear waters and consistent temperatures have been known to attract up to 330,000 visitors annually (FSI 2013). In the interest of protecting this resource's natural beauty, it was designated as both an Aquatic Preserve (1986) and an OFW (1987) by the State of Florida (SWFWMD 2016).

Weeki Wachee River System

The Weeki Wachee River System is located in Hernando County. It is 12 km long, with a narrow, fast flowing and winding upper portion (maximum width of 18 m); wider sections in the lower portion (61 m maximum) consist of numerous homes with constructed canals, and seawalls. The freshwater portion of the river (<0.5 ppt salinity) spans just under 10 km until opening into a salt marsh (12 ppt salinity), which flows 2.4 km until meeting the GOM (SWFWMD 2008). The Weeki Wachee is a tidally influenced river with a downstream daily average tidal range of 1 m. The mean annual flow of the river from 1931 to 2015 was 171 cfs (SWFWMD 2017c). The headsprings and first few kilometers of river lie within Weeki Wachee State Park which is visited by hundreds of thousands of people each year. The Week Wachee Springshed is approximately 673 sq. km.

METHODS

Field Sampling

The four spring-fed systems with direct connectivity to the GOM were divided into a maximum of three zone segments to capture a salinity gradient experienced by tidal fluctuations. Salinity zones for the Homosassa (Zones 1-3), Chassahowitzka (Zones 1-3), and Weeki Wachee (Zones 1 and 2) River Systems were determined based on water quality data collected from previous studies (Frazer et. al. 2006; Frazer et. al. 2011). Salinity zones for the Crystal River/Kings Bay System (Zones 1-3) were determined by water quality data collected by the FWC's Southwest Region DFFM staff prior to sampling events. Zone delineation represented a gradient of salinity concentrations with upstream (closest to headsprings) zones being less influenced by tides than downstream (closest to GOM) zones. In these four systems, Zone 1 represents the lowest average salinity influence observed. The Rainbow River System is not influenced by tidal saltwater fluctuations and was divided into two zones based on differences in hydrology, water clarity, and vegetated habitat (SWFWMD 2016).

Lotic Sampling Protocol

The FWC standardized river sampling protocols were used to sample transects for the Chassahowitzka, Homosassa, Rainbow, and Weeki Wachee River Systems using the centerline technique for site selection developed by Strickland et al. (2011). Transect points were assigned at 25-m intervals throughout the center of each river. Before each sampling event, transect sites and river bank side (left or right) were randomly selected. For these rivers, between 20 to 30 transects, each measuring 100 m, were randomly selected before each sampling event. Once at the centerline point, we traveled to the selected bank and recorded a starting GPS point. After complete sampling of the transect, ending GPS points were then recorded.

The Chassahowitzka River System had a total of 123 transects throughout three salinity zones (Zone 1 = 102-123; Zone 2 = 51-101; Zone 3 = 1-50; Figure 2). There was a total of 168 transects throughout three salinity zones (Zone 1 = 130-168; Zone 2 = 62-129; Zone 3 = 1-61; Figure 3) for the Homosassa River System. The Weeki Wachee River System had a total of 403 transects throughout two salinity zones (Zone 1 = 76-403; Zone 2 = 1-75; Figure 4). There was a total of 307 transects throughout two water quality zones (Zone 1 = 143-307; Zone 2 = 1-142; Figure 5) for the Rainbow River System. The number of electrofishing sites sampled from each zone was proportional to the number of sites in each zone versus the total number of sites in the system.

Transect sampling was conducted using pulsed DC boat-mounted electrofishing equipment and small seines to characterize the fish communities and relative abundance in each spring-fed river system. Electrofishing surveys at each randomly selected, 100-m transect took place using 340 or 680 volts (adjusted for changes in salinity) discharged into the water at 60 pulses per second. Electrical amperage ranged from 6 – 16 amps during transects with low salinities and 25 – 37 amps throughout high salinity transects. Due to the lack of salt water influence, changes in amperage for the Rainbow River System were dependent on the specific conductivity of the water. Electrofishing transects were conducted in a zig-zag pattern along the shoreline, moving at a speed of 2.4 to 4 km/h, while one dipper collected all fish possible with a 6 mm mesh net and placed them into the boat's livewell. Due to the efficiency threshold of electrofishing gear, we aimed to not sample areas exceeding 2 m in depth. At the completion of each transect, fish were identified to species level, measured (nearest mm total length), weighed (wet weight to the nearest gram), and then released. Any unknown fish species collected were placed on ice and brought back to the lab for identification. A designated manatee spotter,

required by United States Fish and Wildlife Service regulations, was on board to warn of the presence of manatees during electrofishing. On occasions where manatees were located within 15 m of the boat, operations were immediately halted until the manatee moved beyond a safe distance (~ 15 m).

Additionally, ten randomly-selected seine hauls were pulled nearshore in each system using a 4.5-m long seine with 3 mm mesh to detect any small-bodied fish species (<50 mm) that may have been missed during electrofishing. Seine haul transects were 3- to 6-m long and pulled parallel to the shoreline. Captured fish were identified, enumerated, and weighed in batches by species. Small fish typically weigh less than a gram, so batch weights were used to get an average weight of each fish. Ultimately, if obstacles arose during sampling (i.e., inclement weather, obstructions in selected transect or tidally derived navigational restraints), the completion of a minimum of 20 electrofishing transects and five seine hauls was considered a successful sampling event.

Lentic Sampling Protocol

The FWC standardized sampling protocol for lentic systems developed by Bonvechio (2009) was used to sample transects within the Crystal River/Kings Bay System. Following this protocol, the entire shoreline within the designated study area (Figure 6) was divided into 29 transects, each measuring 750 m in length. Prior to each sampling event, 25 of the 29 transects were randomly selected for electrofishing surveys, while ten of the 29 transects were randomly selected for seining. However, if obstacles arose, the completion of a minimum of 20 electrofishing transects and five seine hauls was considered a successful sampling event. Electrofishing at each transect took place for 600 seconds using 340 or 680 volts (adjusted for changes in salinity) discharged into the water at 60 pulses per second. Electrical amperage

ranged from 6 – 16 amps for transects with low salinities and 25 – 37 amps throughout high salinity transects. Electrofishing transects were conducted in a zig-zag pattern along the shoreline, moving at a constant speed of 2.4 - 4 km/h, while one dipper collected all fish possible with a 6-mm mesh net and placed them into the boat's livewell. A designated manatee spotter was on board to warn of the presence of manatees during electrofishing. Fish were identified to the species level, measured (nearest mm total length), and weighed (wet weight to the nearest gram) prior to being released. Randomly selected seine hauls were also pulled using a 4.5m long seine to detect any small-bodied fish species that may have been missed during electrofishing.

The five spring-fed systems were sampled each year during winter (November – February) and summer (May – August) from November 2013 through February 2017 (Table 1). Each system was sampled eight times throughout the duration of the project. At the direction of the District, sampling was condensed into a two-and-a-half-year period instead of three years. Therefore, each system was sampled twice in one of the sampling seasons during the two-and-a-half-year period. The Weeki Wachee and Rainbow River Systems were sampled more in the winter seasons due to water traffic in the summer season.

Table 1. Dates of sampling events in this study.

	Crystal River/Kings Bay System	Homosassa River System	Chassahowitzka River System	Weeki Wachee River System	Rainbow River System
Winter 2013 - 2014	Nov 4 - 7	Dec 9 - 12	Jan 7 -10	Jan 28 - 30, Feb 5	Feb 10 - 13
Summer 2014	May 5 – 8, Aug 18 - 21	June 2 - 5	June 24 - 27	July 14 - 18	Aug 4 - 7
Winter 2014 - 2015	Nov 2 - 6	Nov 5 - 8	Nov 17 - 20	Jan 12 - 14 & 22	Dec 8 – 11, Jan 26 - 28
Summer 2015	May 11 - 14	June 1 – 4, Aug 17 - 20	June 15 - 18	July 13 - 16	Aug 3 - 6
Winter 2015 - 2016	Nov 2 - 5	Nov 16 - 19	Jan 4 - 7	Dec 14 - 16 & 18, Jan 25 - 26 & 29	Feb 1 - Feb 4
Summer 2016	May 16 - 19	June 13 - 16	June 27 – 30, Aug 8 - 11	July 11 - 14	July 25 - 28
Winter 2016 - 2017	Oct 31 - Nov 3	Nov 29 - Dec 2	Jan 23 - 26	Jan 10 - 13	Feb 6 - 9

Water Quality/Habitat Sampling Protocol

Dissolved oxygen (mg/l), salinity (ppt), specific conductivity (uS/cm), and temperature (°C) were recorded using a Yellow Springs Instrument (YSI) Pro2030 ® prior to each electrofishing transect. Water clarity was also measured using a 0.2-m diameter Secchi disk and instantaneous flow (m/s) was measured at a depth of 0.3 m using a Marsh-McBirney Flo-Mate 2000 ®. Shore type, bottom type, percent habitat (i.e., vegetation, woody debris, boat docks etc.) coverage sampled, depth range, time of day, weather conditions, starting/ending GPS points, and effort were recorded for each of the sampled transects. Any visible instream habitat (including bottom type) that was passed over directly by the boat was also recorded.

Habitat vegetation categories included emergent, submersed, floating and other. Emergent refers to any aquatic plants that emerged from the water's surface and continued their growth above the water (i.e., bullrush, sawgrass, maidencane, etc.). Submersed vegetation refers

to any aquatic plants that grew below the water's surface (i.e. eelgrass, hydrilla, filamentous algae, etc.). Floating vegetation refers to any aquatic plant that was not anchored to a substrate by a root attachment (i.e., water lettuce, duckweed, water lily, etc.). The classification "Other" included any trees, cypress knees, man-made structures (i.e., docks, seawall, boats, etc.), or debris within range of the electrofishing booms.

This habitat and water quality data collection is somewhat subjective and not able to be truly quantified. Plots and graphs, however, were made from averages of our collected data to make inferences and show possible trends between fish species and their habitat preferences.

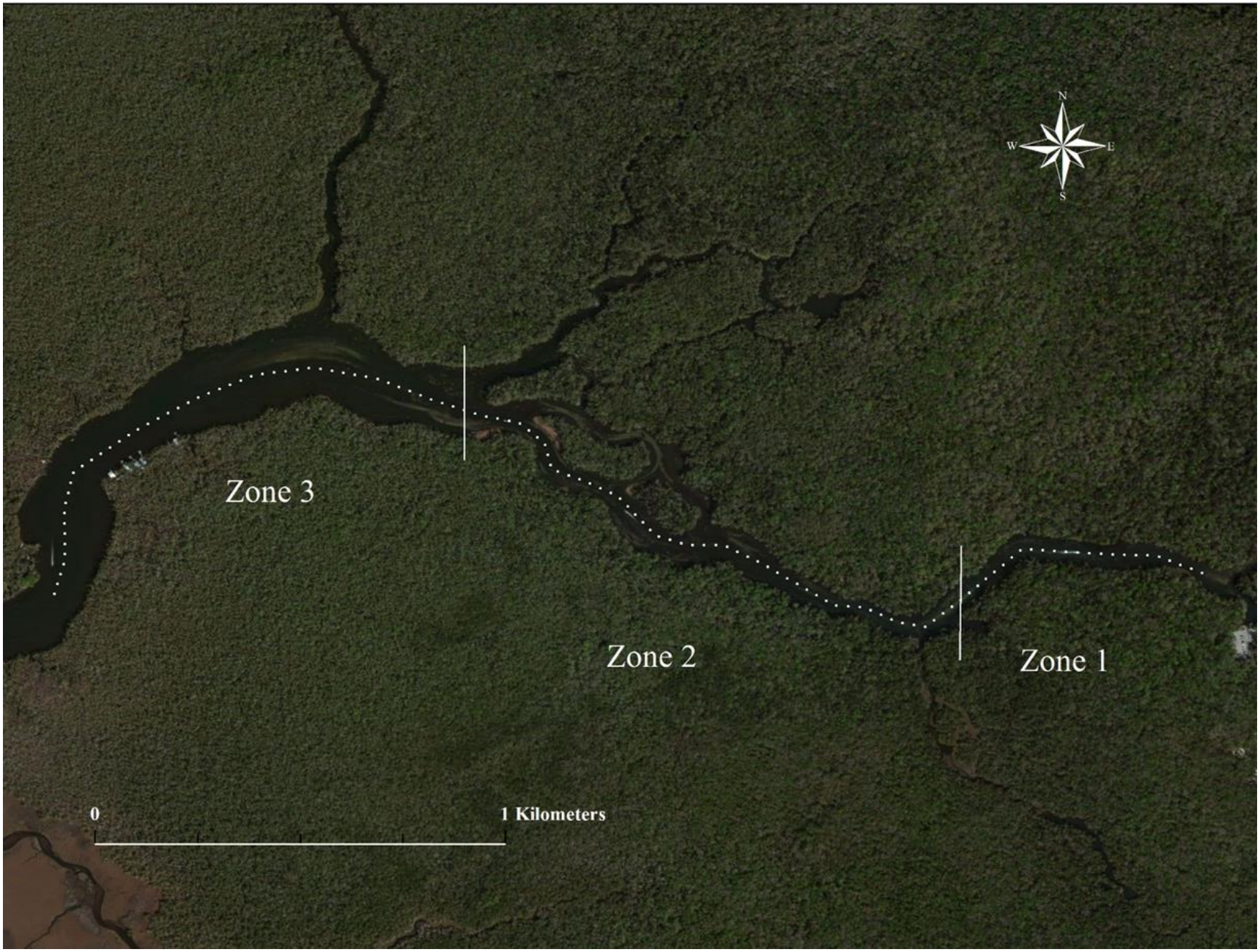

Figure 2. Chassahowitzka River System with sampling transects represented by white dots. Zone 1 = Transects 102-123, Zone 2 = Transects 51-101, Zone 3 = Transects 1-50.

Figure 3. Homosassa River System with sampling transects represented by white dots. Zone 1 = Transects 130-168; Zone 2 = Transects 62-129; Zone 3 = Transects 1-61.

Figure 4. Weeki Wachee River System with sampling transects represented by white dots. Zone 1 = Transects 76-403; Zone 2 = Transects 1-75.

Figure 5. Rainbow River System with sampling transects represented by white dots. Zone 1 = Transects 143-307, Zone 2 = Transects 1-142.

Figure 6. Crystal River/Kings Bay System with sampling transects represented by white dots. Zone 1= Transects 1-2 and 17-22; Zone 2 = Transects 3-8 and 27-29; Zone 3 = Transects 9-16 and 23-26.

Statistical Analyses

Spatial patterns of fish assemblages were analyzed using multivariate techniques with PRIMER v.6 (Clarke and Warwick 2001). Abundance indices for each species (fish per zone) were log (X+1) transformed to reduce the potential skew of highly abundant species and further standardized for relative abundance (Guy and Brown 2007). After calculating Bray-Curtis similarity matrices on data averaged by sampling event and system zone, the data were then bootstrapped to make similarity groupings more precise (Bray and Curtis 1957, Guy and Brown 2007;). Non-metric multidimensional scaling (MDS: Clarke and Warwick 2001) and analysis of similarity (ANOSIM) were used to determine if spatial patterns in fish assemblages varied between seasons (winter and summer) across the system zones. Similarity percentage analysis (SIMPER; Clarke and Warwick 2001) was used to determine which fish species contributed to greatest dissimilarity between seasons in each zone. The output was then used to create average abundance for the top five fish species that differed the most by season in each zone.

Relative fish abundance by species for the Homosassa, Weeki Wachee, Rainbow, and Chassahowitzka River Systems were estimated using catch-per-unit-distance (CPUD). Crystal River/Kings Bay System relative fish abundance was estimated as catch-per-unit-effort (CPUE) due to its classification as a lentic system, with differing analytical protocols. A catch-per-unit-effort or C/*f* index is defined mathematically as:

$$C/f = qN$$

where, C is the number of fish caught, *f* = the unit of effort expended (seconds in terms of this study) and *q* = the catchability coefficient or probability of catching an individual fish in one unit of effort. N = the absolute abundance of fish in the stock (Hubert and Fabrizio 2007). For this

study, CPUE (C/*f*) was calculated as the amount of fish caught per unit effort (600 seconds) of electrofishing, while the CPUD was calculated as amount of fish caught per relative unit of distance (~100 m) of electrofishing.

The CPUD values of the five most abundant freshwater and marine species were calculated seasonally within each year and split into salinity zones for the Chassahowitzka, Homosassa and Weeki Wachee River Systems. For the Rainbow River System, the ten most abundant freshwater fish were calculated seasonally within each year and split into zones. In the Crystal River/Kings Bay System, CPUE values were estimated seasonally within each year and split into salinity zones for the five most abundant freshwater and marine species (Appendix; Figure 54-73).

To evaluate fish community composition, we quantified species richness, evenness, and diversity for each system based on season (winter and summer) and zone. Winter, for the purpose of this study, was defined from November through February. Summer was defined from May through August. The sampling year started in the winter and ended in the summer (i.e., "W 14" refers to sampling performed in winter of the 2013-2014 calendar year and is grouped with "S 14" to complete a sampling event for the year 2014). Shannon's Diversity Index was used to characterize species diversity, and was calculated as follows:

Shannon Diversity Index *H'*

$$H' = -\sum_{i=1}^{S} (p_i)(log_e p_i)$$

where, s = the number of species and p_i = the proportion of the total sample represented by the *i*th species (Shannon and Weaver 1949). Evenness was based on the Shannon's Index *EH* calculated as follows:

$$E_H = \frac{H}{Hmax} = \frac{H}{\ln S}$$

where, *Hmax* = total species and *H* = the result of the Shannon Diversity Index. Evenness is a measure of the relative abundance of the different fish species making up the richness of an area. Evenness in this study is expressed as a proportion of estimated diversity relative to the corresponding maximum diversity for a specific number of fish species and sample size (Guy and Brown 2007). Species richness is a measure of the number of fish species found in a sample.

RESULTS

The total number of transects sampled are as follows: Chassahowitzka River System (224), Homosassa River System (235), Crystal River/Kings Bay System (198), Weeki Wachee River System (219) and Rainbow River System (228). The total freshwater and marine fish species count by river are as follows: Chassahowitzka River System (51), Homosassa River System (50), Crystal River/Kings Bay System (48), Rainbow River System (34), and Weeki Wachee River System (42).

For systems connected to the GOM, species richness within salinity zones ranged from 20-42 in the Chassahowitzka River System, 24-39 in the Homosassa River System, 20-36 in the Weeki Wachee River System, and 31- 38 in the Crystal River/Kings Bay System (Table 56, Appendix A). In the Rainbow River System, species richness ranged between 22 and 32. With the exception of the Crystal River/Kings Bay System, fish species diversity and evenness showed

an increase during winter months, when compared to summer months, for all systems connected to the GOM as a result of an increase in marine species (Table 54 and 55, Appendix A).

We found species evenness by zones in the Chassahowitzka River System to be greater toward the headsprings (Zone 1), while the Homosassa, Weeki Wachee, and Rainbow River Systems all showed species evenness to be greater towards the mouth of the river (Zone 3, Zone 2, Zone 2; respectively [Table 55, Appendix A]). The Crystal River/Kings Bay System also showed an increase in species evenness between Zones 1 and 2, followed by a decline in Zone 3 (Table 55, Appendix A).

Chassahowitzka River System

Previous Study Comparisons

We collected 20 freshwater species and 31 marine species from the Chassahowitzka River System (Table 8, Appendix A).

A study conducted by Pine et al. (2011) collected 40,170 small-bodied fish and macroinvertebrates from 32 taxa. Of the 32 taxa, 25 were comprised of fish species (14 freshwater, 11 marine), which were also present in the 51fish species we collected. Pine et al. (2011) collected the Swamp Darter (*Etheostoma fusiforme*) using throw traps during his sampling on the river, which was not collected during our study.

Frazer et al. (2011) studied the effects of nutrient loading on fish assemblages in this river. Frazer et al. (2011) collected 22 freshwater species using a combination of electrofishing and block-net seines, of which two were not found during this study: Brown Bullhead (*Ameiurus nebulosus)* and Warmouth (*Lepomis gulosus)*. We collected Ironcolor Shiners (*Notropis chalybaeus)* during our study, while Frazer et al. (2011) did not. Additionally, Frazer et al.

(2011) collected 30 marine species in their study, including three species that we did not collect in our study: Lizardfish (*Synodus saurus),* Silver Jenny (*Eucinostomus gula),* and Silver Perch (*Bairdiella chrysoura*).

Species Composition

The Chassahowitzka River had an overall marine fish species composition of 58%, as compared to 42% freshwater species. When divided by salinity zones, Zone 1 had the lowest percentage of marine species at 40%. With movement toward the GOM, marine species percent composition increased in Zones 2 and 3 (62% and 67%, respectively, Figure 103, Appendix B). Seasonal species composition showed marine species-dominant winter sampling events at 86%, and freshwater species-dominant summer sampling events at 60% (Figure 104, Appendix B).

Non-metric Multidimensional Scaling

All pairwise comparisons of fish assemblages between winter and summer months were significantly different (all $P \leq 0.001$). As distance from the headsprings increased, we found that fish assemblages became more homogenous from winter and summer months (Zone 1 $R^2 = 0.71$; Zone 2 $R^2 = 0.63$; Zone 3 $R^2 = 0.41$; Figure 135, Appendix B). Average abundance was generated from the five fish species that attributed the most variability between winter and summer months from each zone (Figure 136, Appendix B). Gray Snapper and Tidewater Mojarra contributed the most to the variability of fish assemblages between seasons, with high average abundances witnessed in winter months and low average abundances in summer months.

Seasonal & Temporal Relative Abundance v. Habitat & Water Quality
Winter Zone 1

Gray Snapper (*Lutjanus griseus)* had the highest average abundance for all years except for January 2016, which was dominated by Tidewater Mojarra (*Eucinostomus harengulus).* An

increase in Pinfish (*Lagodon rhomboids)* was observed from 2014-2016 (Figure 7). Largemouth Bass (*Micropterus salmoides)* biomass remained relatively consistent from 2014-2015 and increased thereafter through 2017. Gray Snapper biomass was consistent in the winter sampling events from 2014-2015 and decreased thereafter through January 2017 (Figure 8). Comparisons between relative abundance and average salinity showed Tidewater Mojarra and Spotted Sunfish (*Lepomis punctatus)* to have an inverse relationship with salinity (Figure 9). Conversely, Gray Snapper and Largemouth Bass abundance increased with salinity fluctuations (Figure 9). Largemouth Bass and Gray Snapper abundance increased with emergent vegetation habitat coverage. Spotted Sunfish and Tidewater Mojarra abundance were positively correlated with SAV habitat coverage (Figure 10).

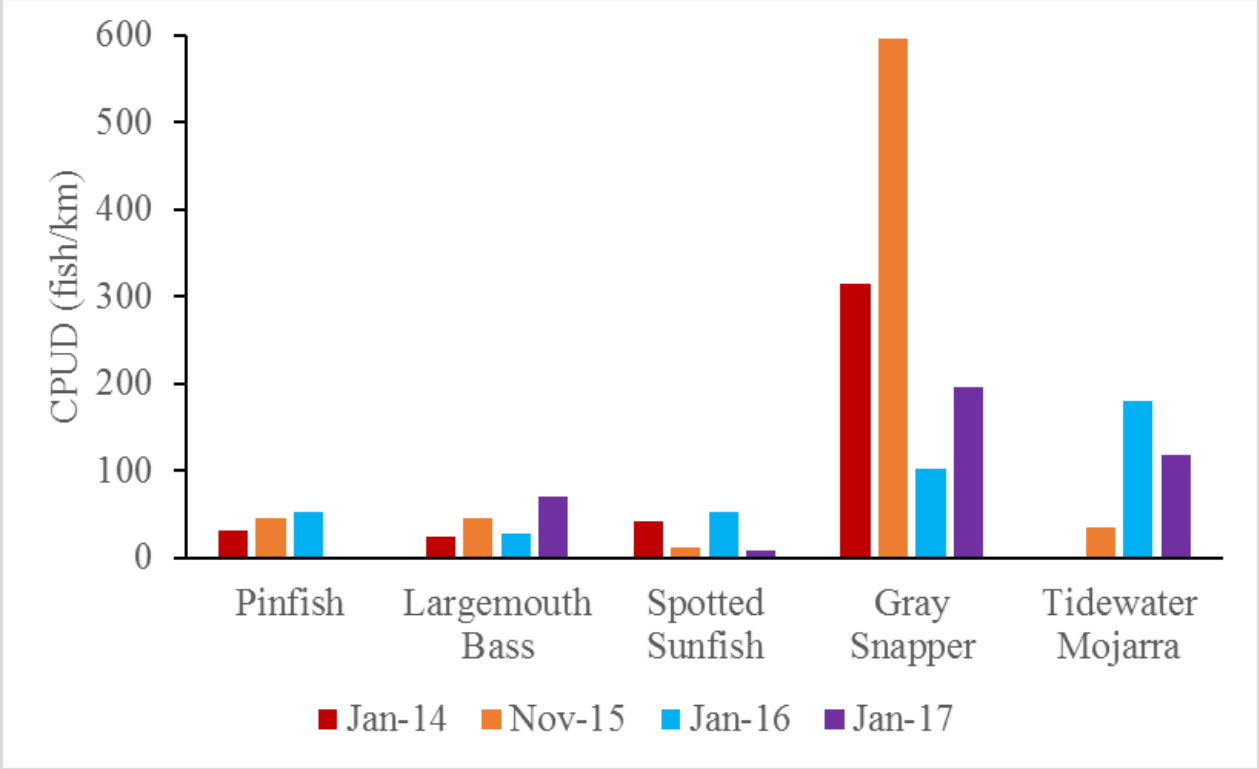

Figure 7. Winter relative abundance (CPUD) of key species in Zone 1 of the Chassahowitzka River System.

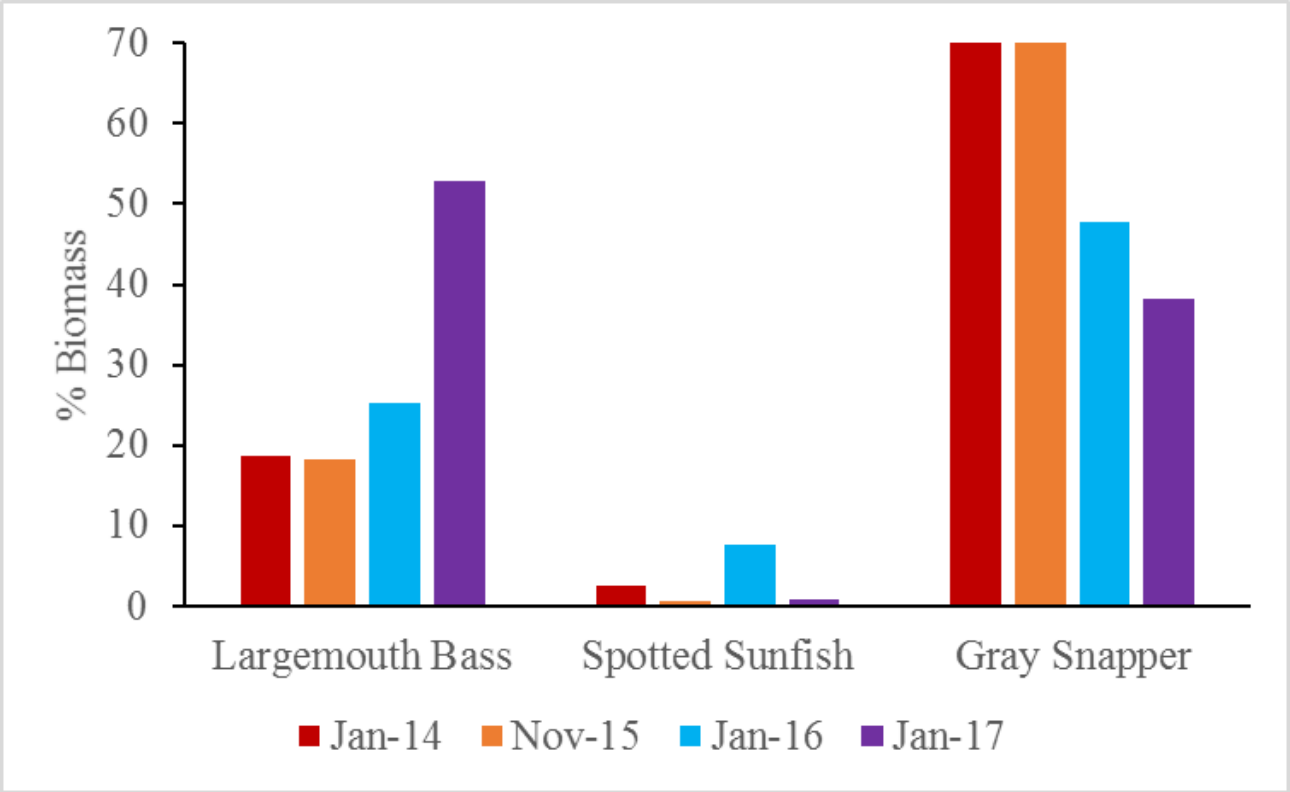

Figure 8. Winter biomass of key species in Zone 1 of the Chassahowitzka River System.

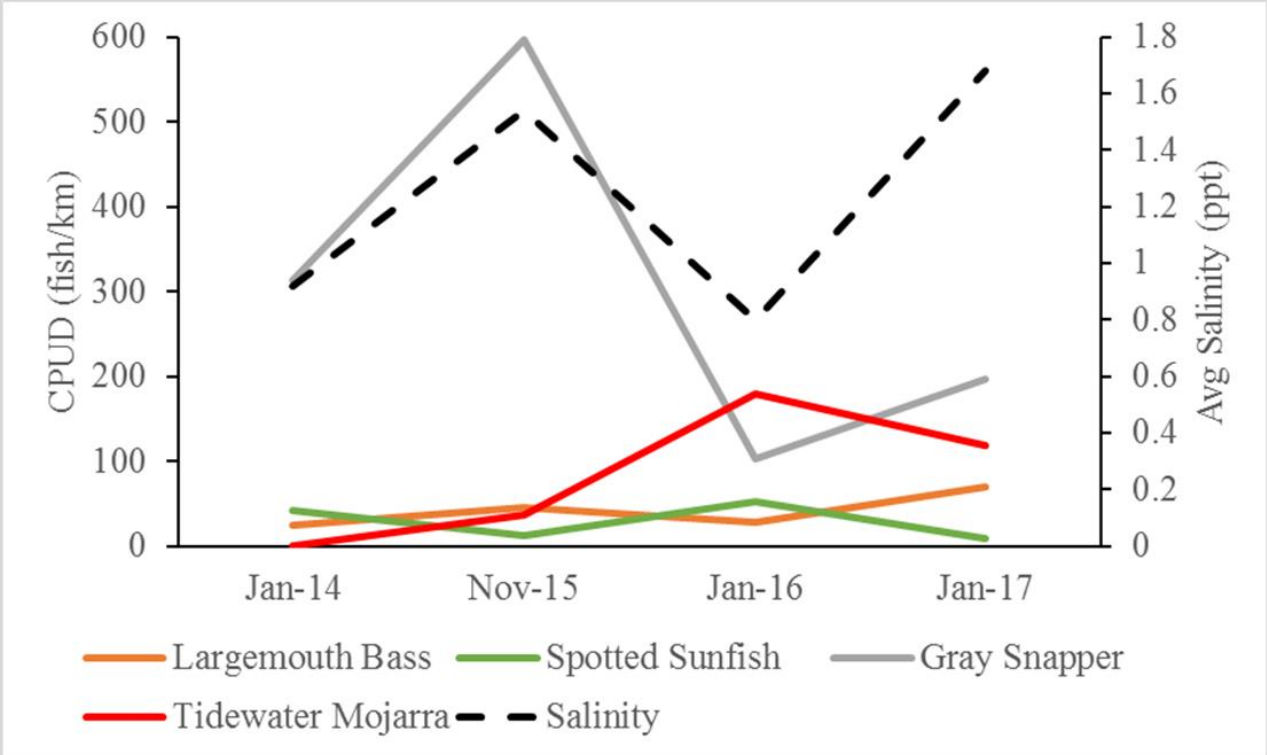

Figure 9. Winter relative abundance (CPUD) of key species in relation to salinity in Zone 1 of the Chassahowitzka River System.

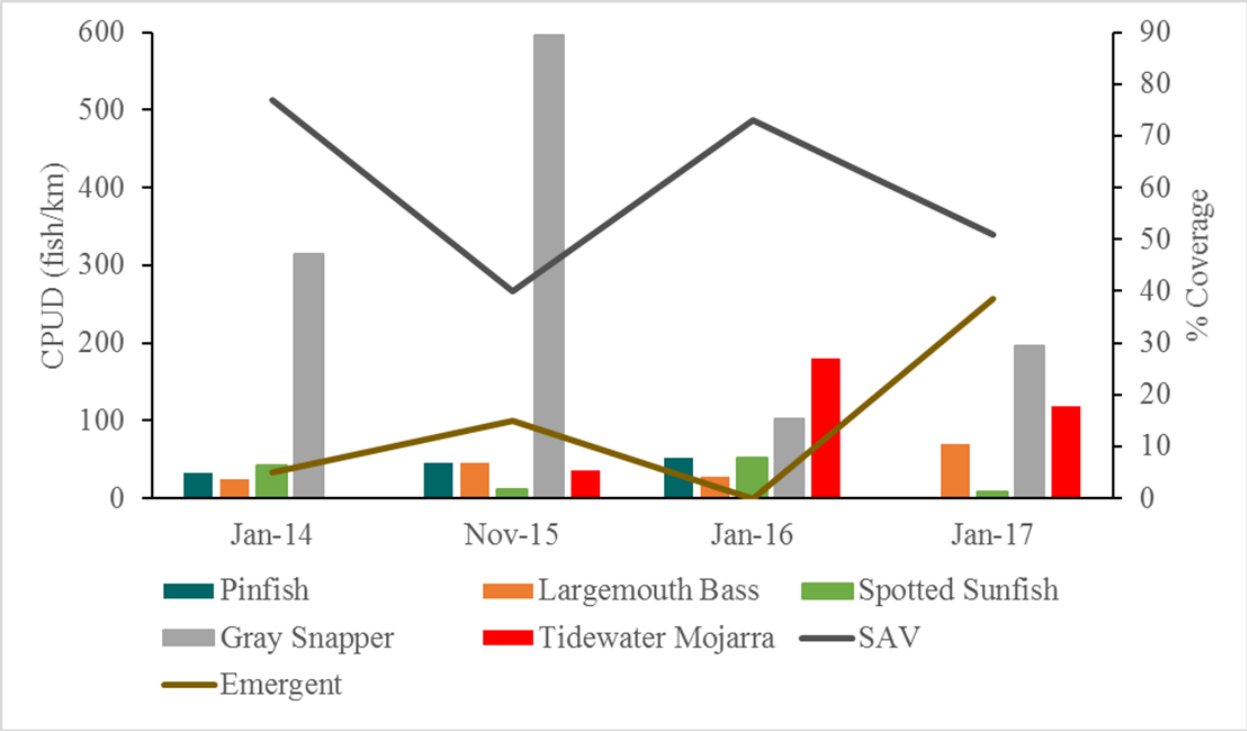

Figure 10. Winter relative abundance (CPUD) of key species in relation to percent habitat coverage in Zone 1 the Chassahowitzka River System. Emergent = emergent vegetation, SAV = submersed aquatic vegetation.

Winter Zone 2

Gray Snapper had the highest relative abundance in all winter sampling events except January 2016, when Tidewater Mojarra was the most dominant species (Figure 11). Of the three key species, Gray Snapper dominated biomass during all winter sampling events but decreased each year (Figure 12). Key species relative abundance comparisons with salinity and vegetation levels in Zone 2 exhibited no decipherable trends (Figure 13 and 14).

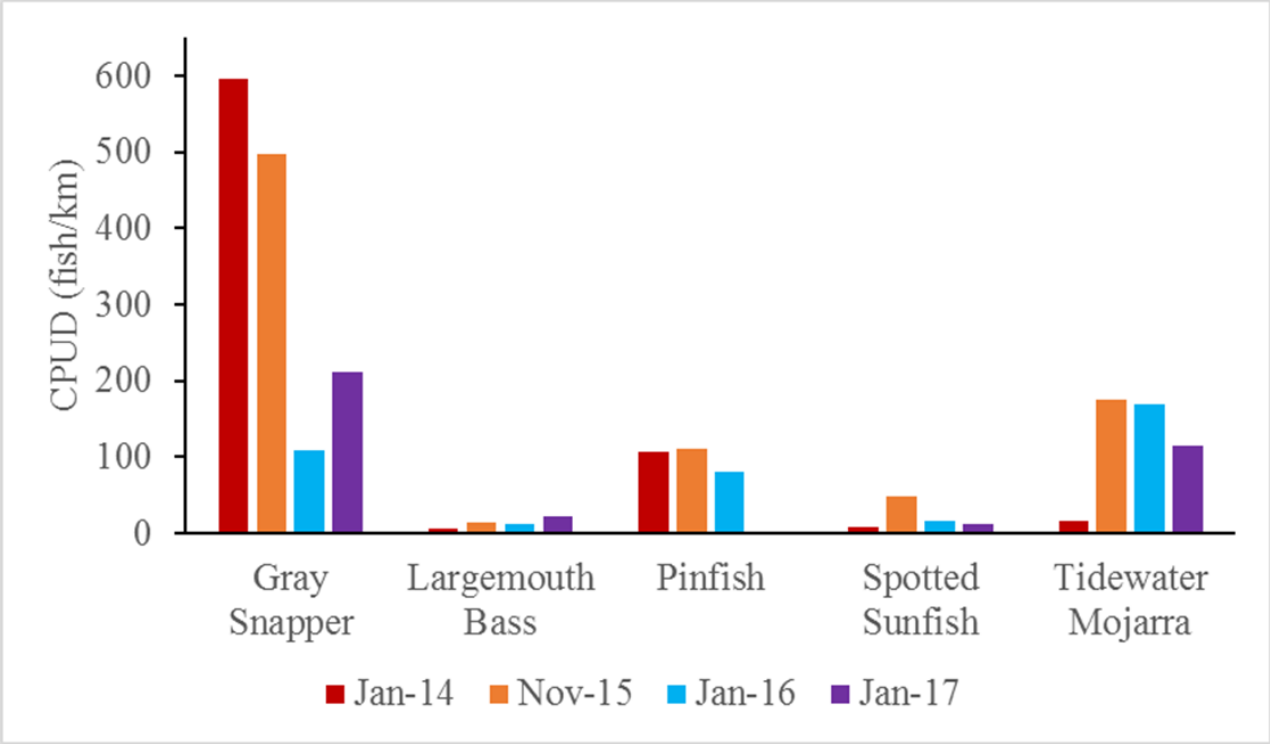

Figure 11. Winter relative abundance (CPUD) of key species in Zone 2 of the Chassahowitzka River System.

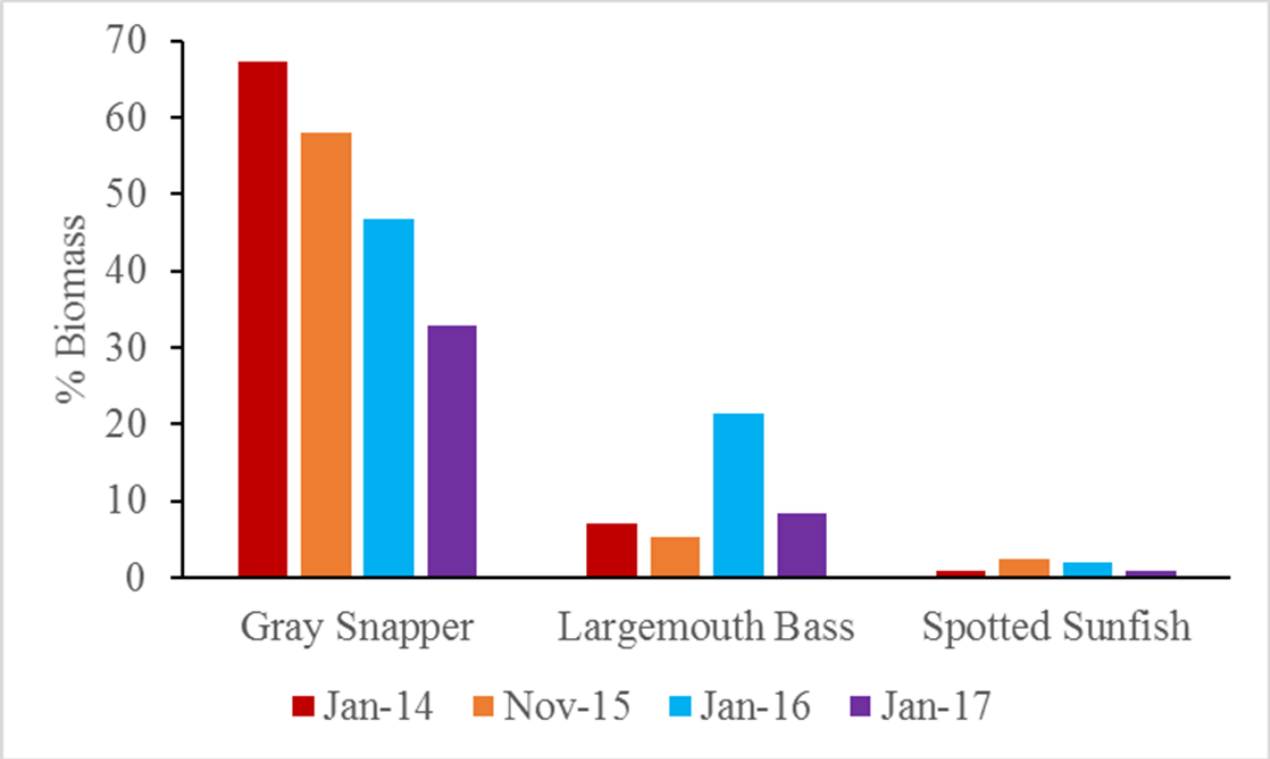

Figure 12. Winter biomass of key species in Zone 2 of the Chassahowitzka River System.

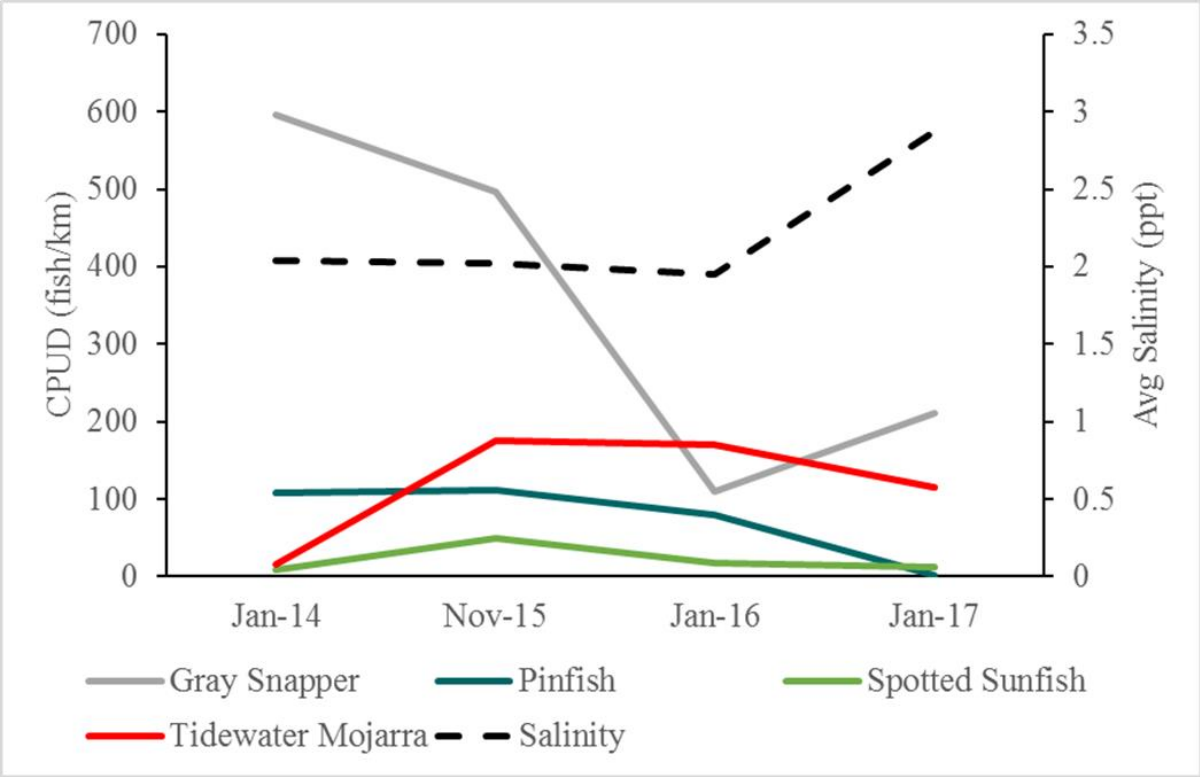

Figure 13. Winter relative abundance (CPUD) of key species in relation to salinity in Zone 2 Chassahowitzka River System.

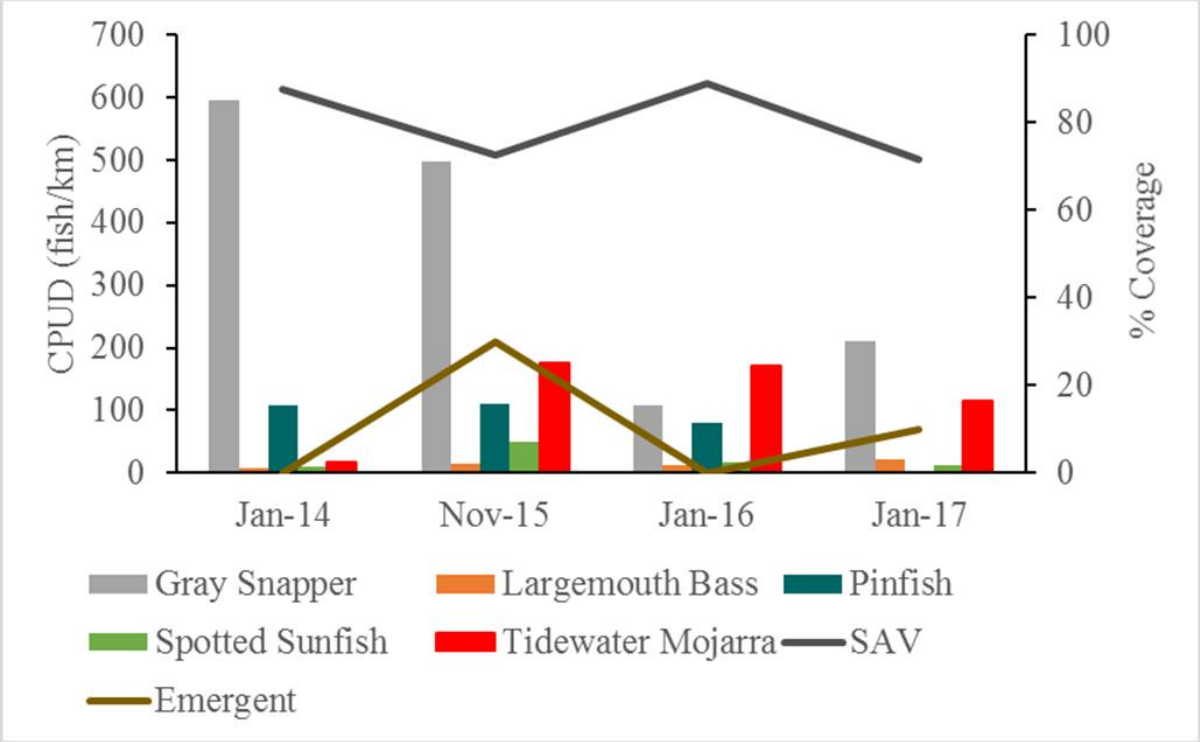

Figure 14. Winter relative abundance (CPUD) of key species in relation to percent habitat coverage in Zone 2 Chassahowitzka River System. Emergent = emergent vegetation, SAV = submersed aquatic vegetation.

Winter Zone 3

The relative abundance of Tidewater Mojarra and Rainwater Killifish (*Lucania parva)* and that of Gray Snapper exhibited opposite trends (Figure 15). Gray Snapper biomass decreased between Winter 2014 and Winter 2015 but remained stable in the following winter sampling events (Figure 16). Common Snook (*Centropomus undecimalis)* relative abundance increased with salinity (Figure 17). Tidewater Mojarra relative abundance increased when there was less SAV present (Figure 18).

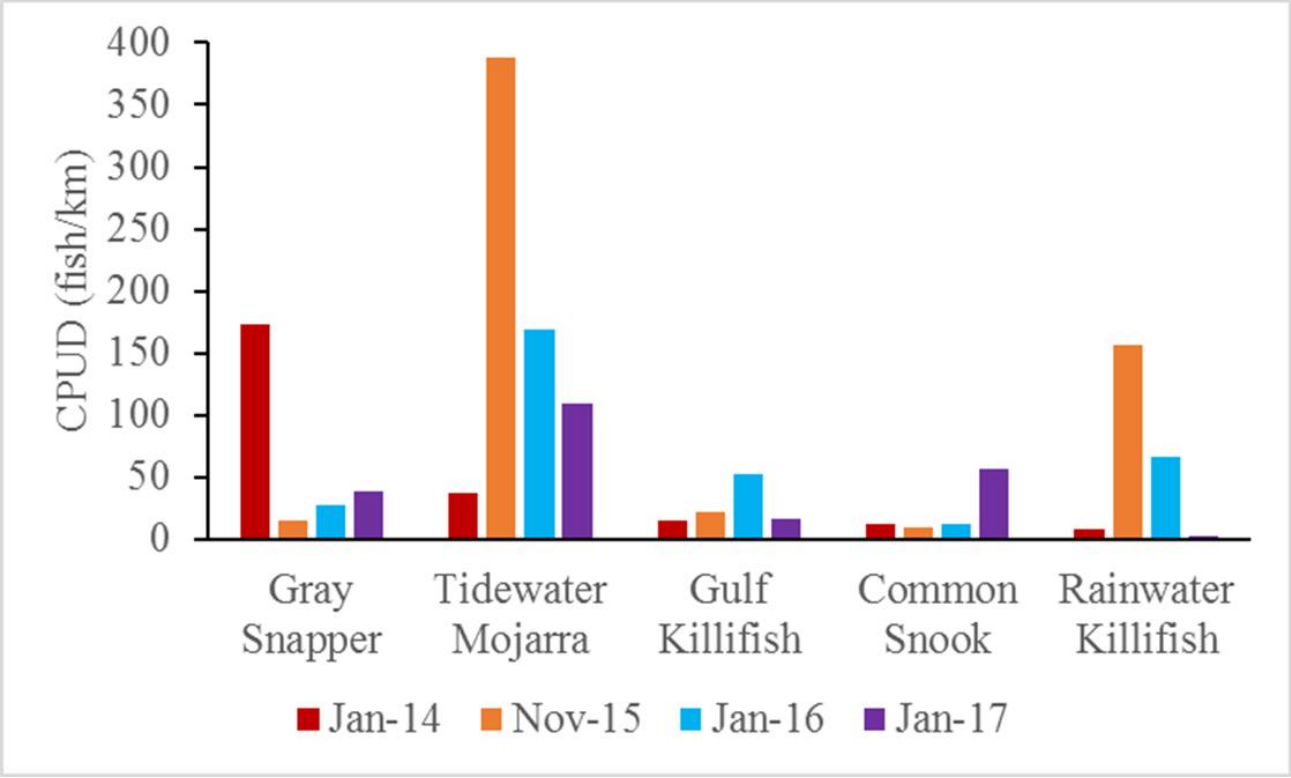

Figure 15. Winter relative abundance (CPUD) of key species in Zone 3 of Chassahowitzka River System.

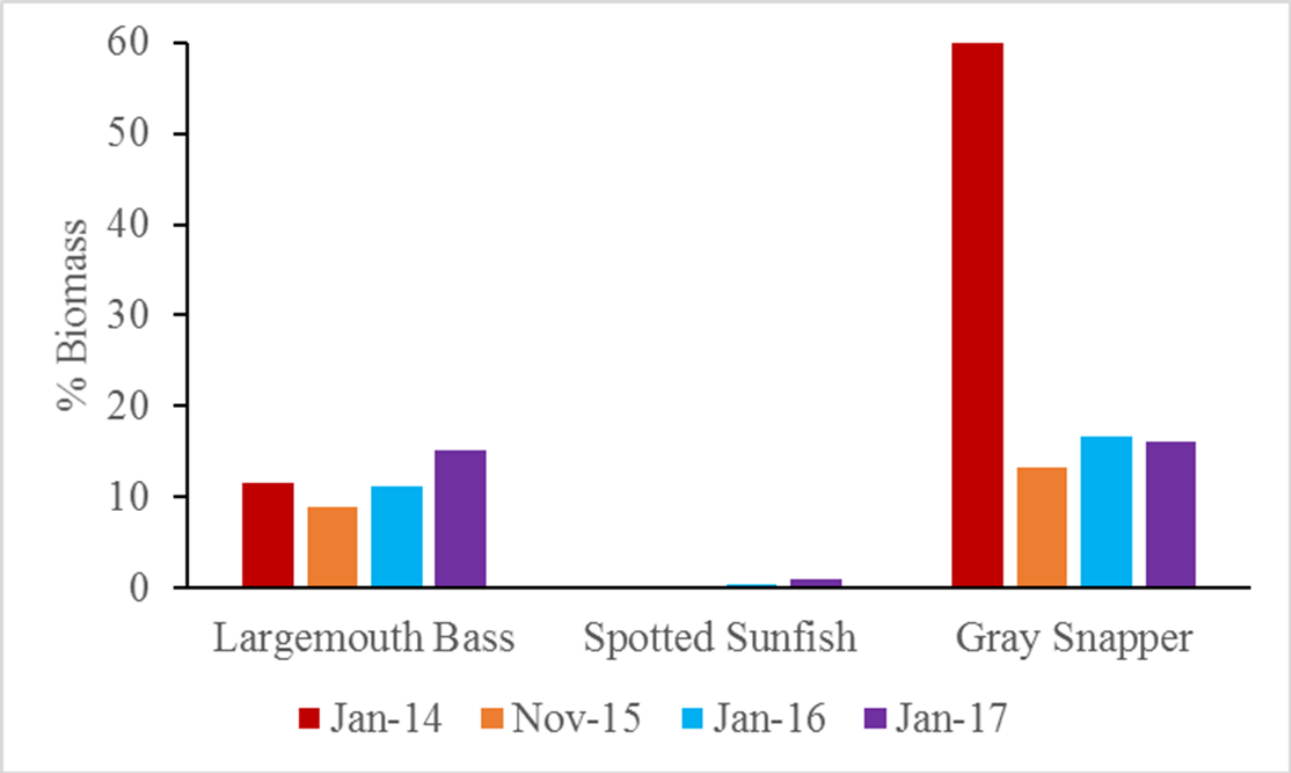

Figure 16. Winter biomass of key species in Zone 3 of Chassahowitzka River System.

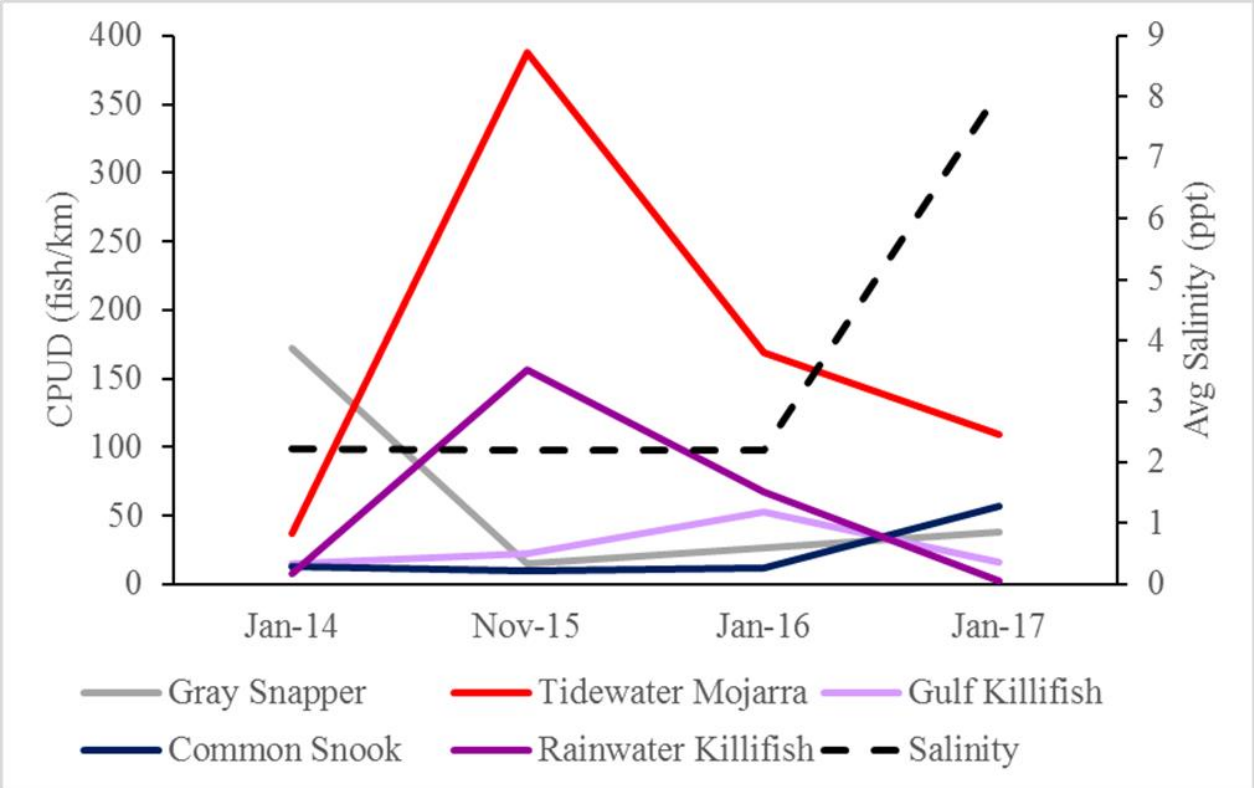

Figure 17. Winter relative abundance (CPUD) of key species in relation to salinity in Zone 3 of Chassahowitzka River System.

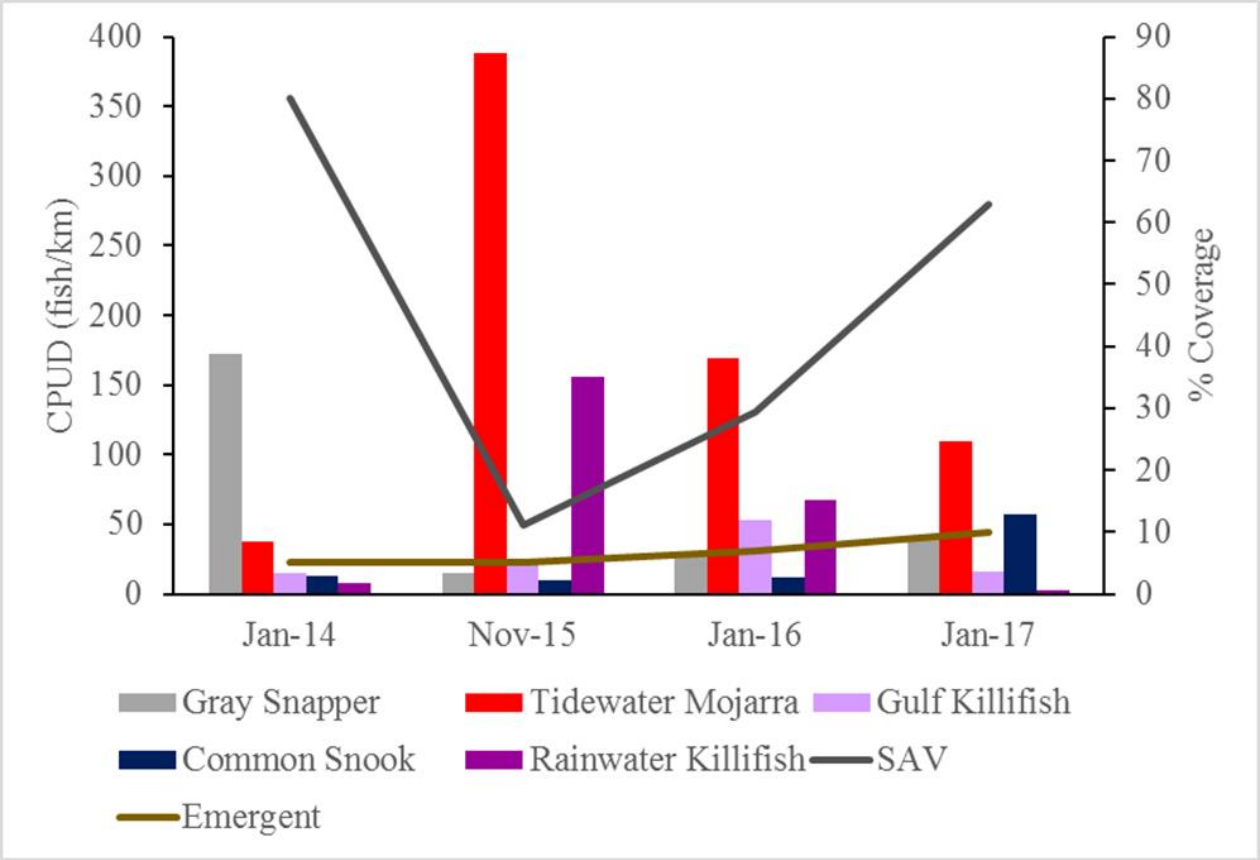

Figure 18. Winter relative abundance (CPUD) of key species in relation to percent habitat coverage in Zone 3 of the Chassahowitzka River System. Emergent = emergent vegetation, SAV = submersed aquatic vegetation.

Summer Zone 1

For all summer sampling events in Zone 1, Spotted Sunfish had the highest relative abundance, with the exception of the June 2016 event, which was dominated by Lake Chubsucker (*Erimyzon sucetta)* (Figure 19). An increase in Spotted Sunfish, Lake Chubsucker and Rainwater Killifish (*Lucania parva)* was observed from 2014-2016 (Figure 19). Largemouth Bass biomass remained relatively high from 2014-2016, but decreased in the second sampling event in August 2016 (Figure 20). Lake Chubsucker relative abundance followed the trends of salinity (Figure 21). The relative abundance of Spotted Sunfish in this zone, increased with emergent vegetation presence (Figure 22).

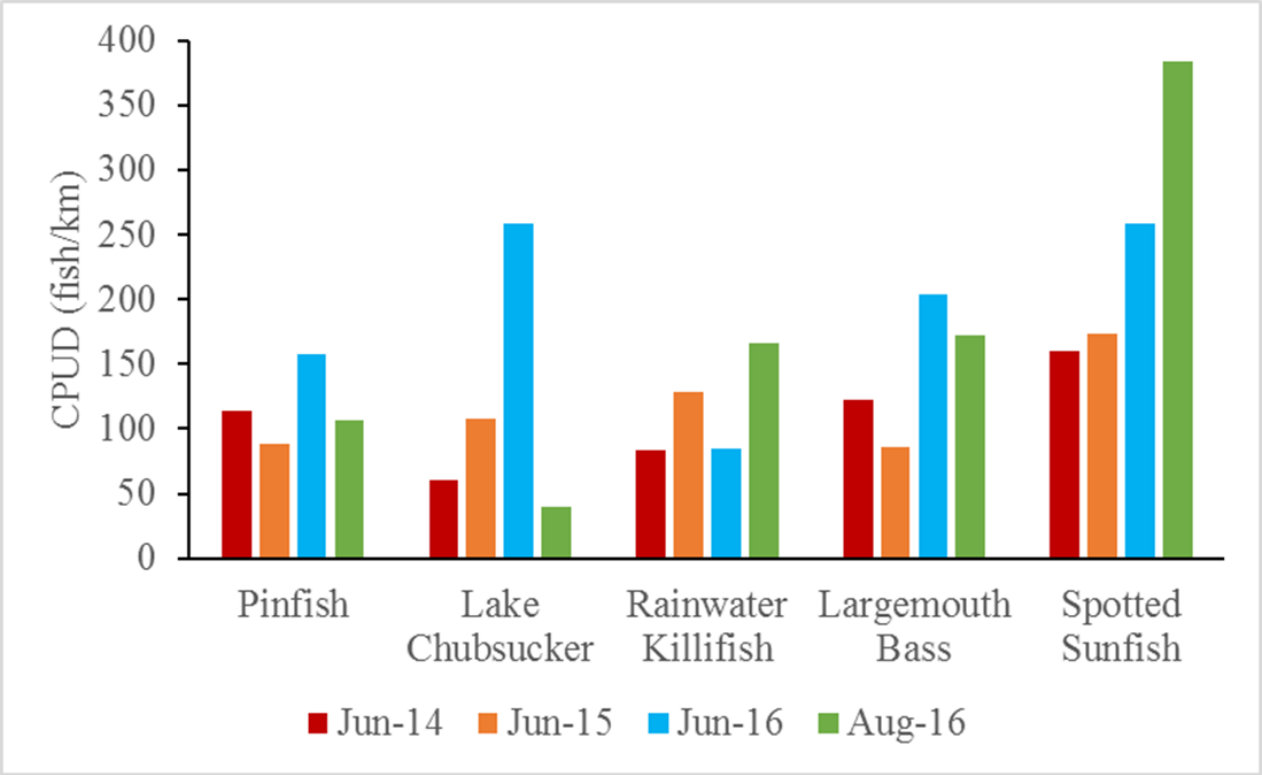

Figure 19. Summer relative abundance (CPUD) of key species in Zone 1 of the Chassahowitzka River System.

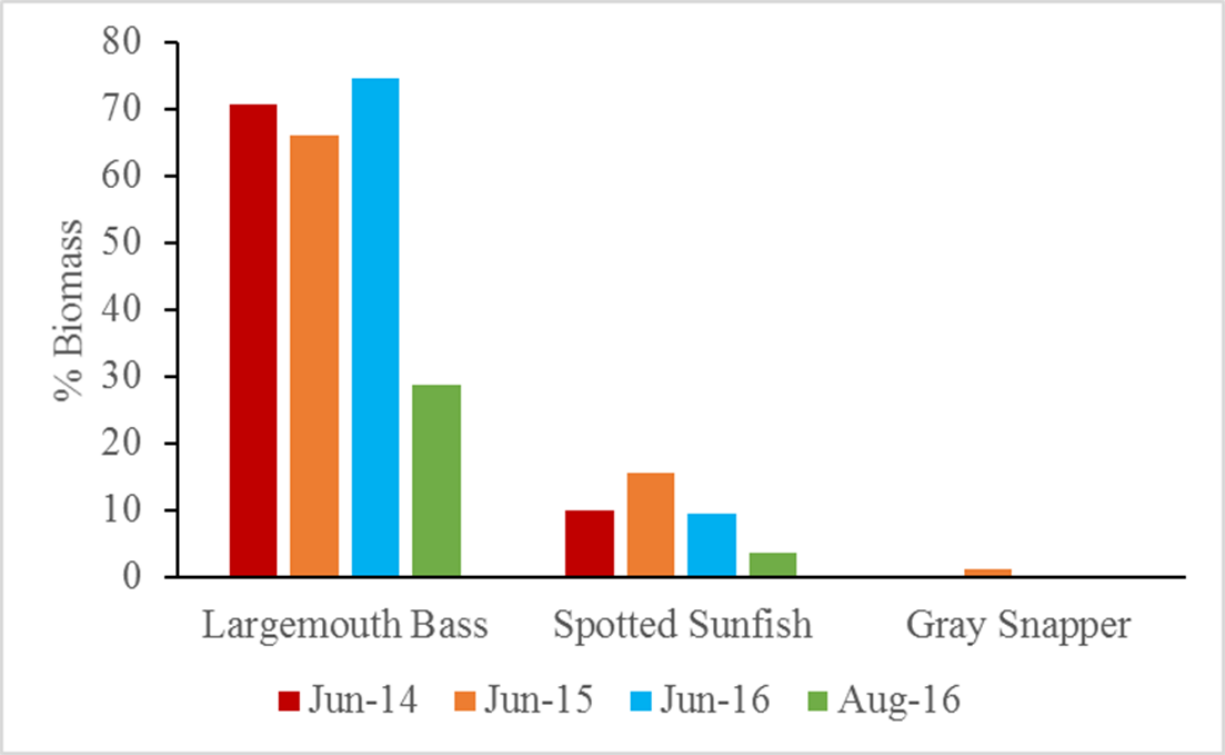

Figure 20. Summer biomass of key species in Zone 1 of the Chassahowitzka River System.

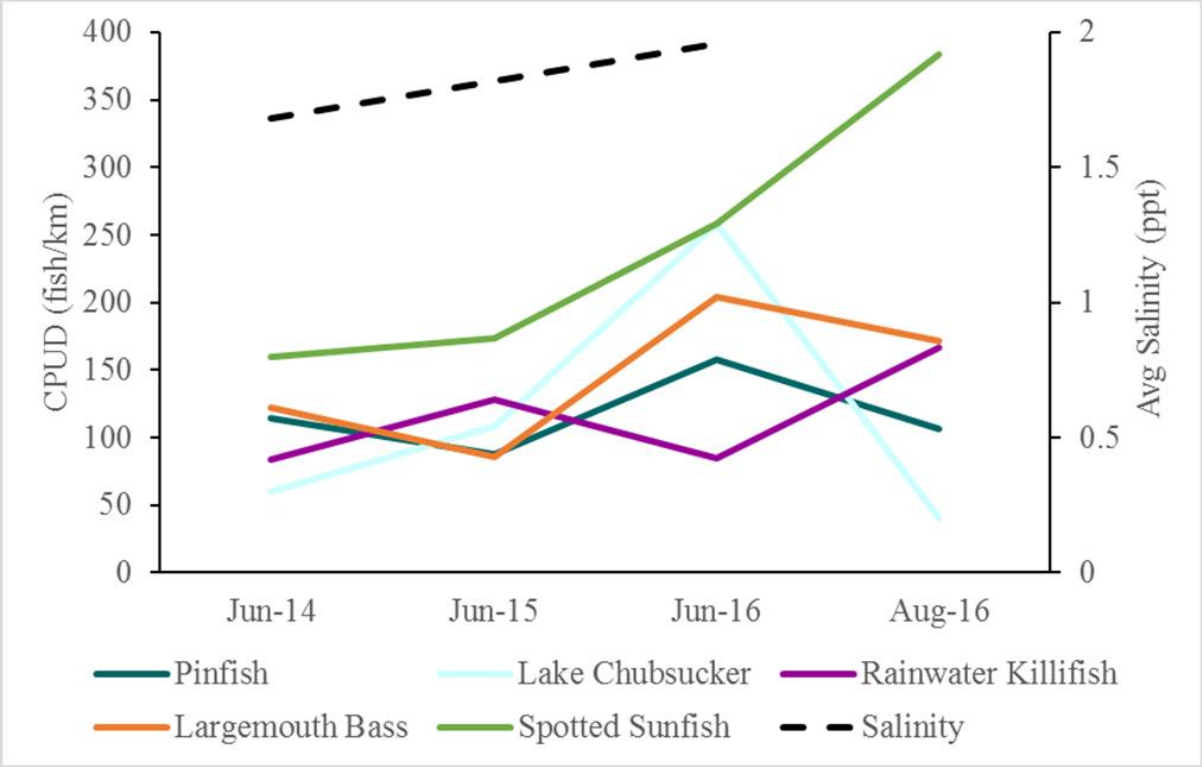

Figure 21. Summer relative abundance (CPUD) of key species in relation to average salinity in Zone 1 of the Chassahowitzka River System (August 2016 salinity data unavailable).

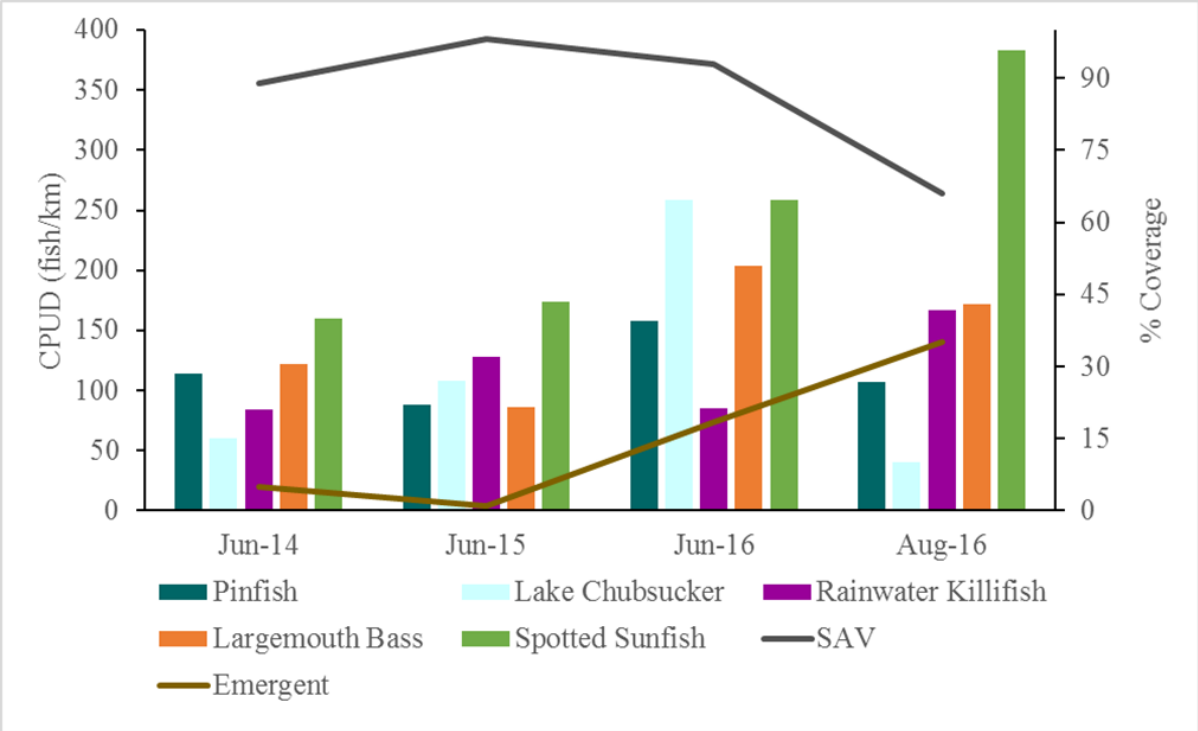

Figure 22. Summer relative abundance (CPUD) of key species in relation to percent habitat coverage in Zone 1 of the Chassahowitzka River System. Emergent = Emergent vegetation, SAV = submersed aquatic vegetation.

Summer Zone 2

Pinfish had the highest relative abundance for the first two summer sampling events followed by Rainwater Killifish in June 2016 and Spotted Sunfish in August 2016 (Figure 23). Largemouth Bass and Spotted Sunfish biomass were inversely related (Figure 24). Pinfish, Rainwater Killifish, and Lake Chubsucker trended positively with salinity (Figure 25). Pinfish and Rainwater Killifish relative abundance was inversely related to emergent vegetation coverage. Spotted Sunfish relative abundance trended with SAV presence (Figure 26).

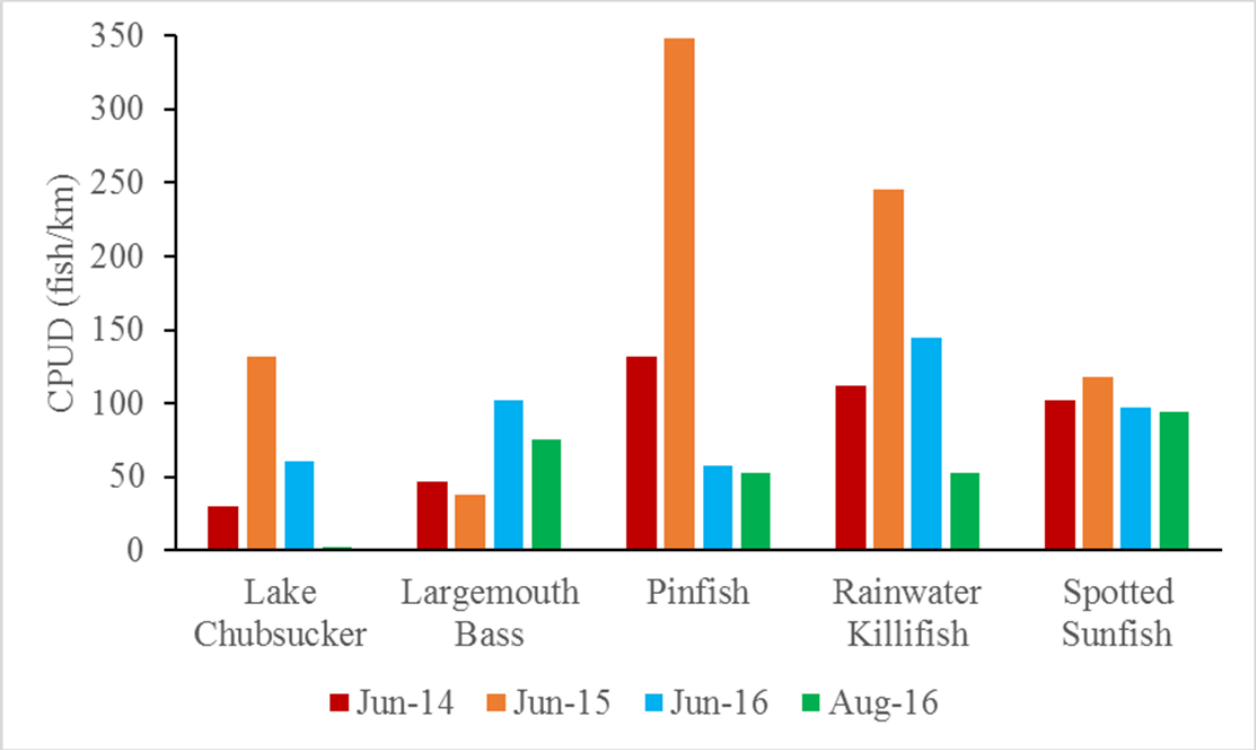

Figure 23. Summer relative abundance (CPUD) of key species in Zone 2 of the Chassahowitzka River System.

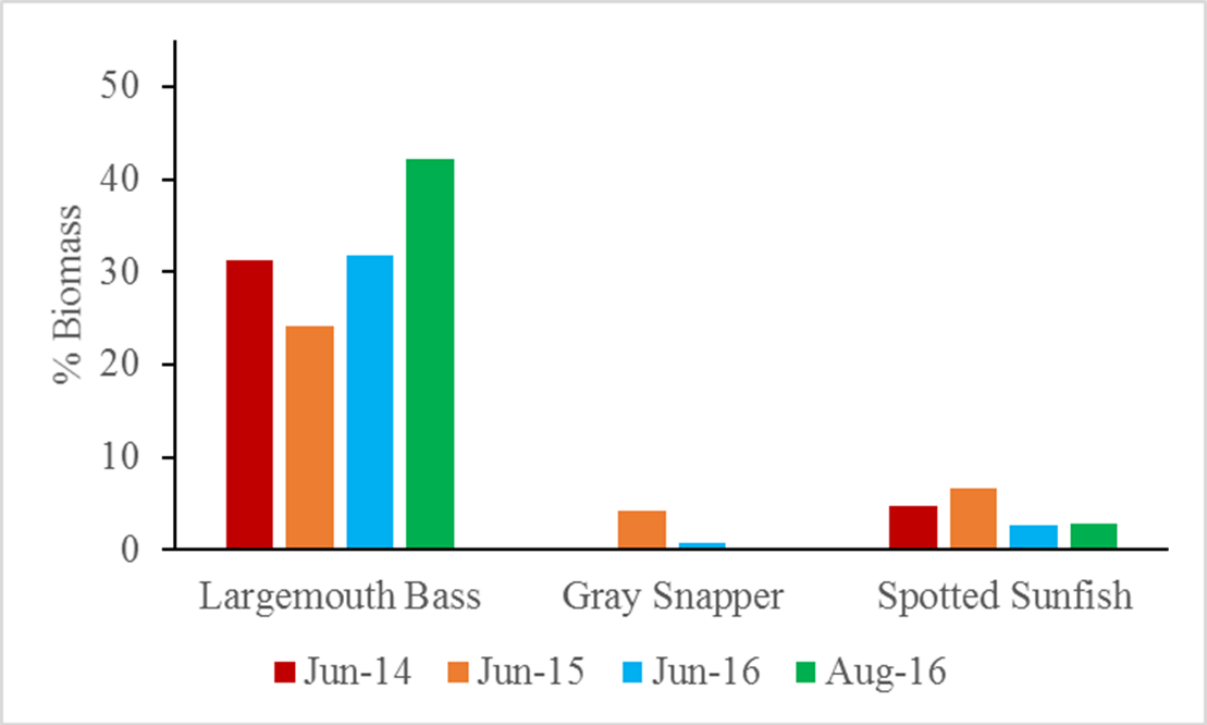

Figure 24. Summer biomass of key species in Zone 2 of the Chassahowitzka River System.

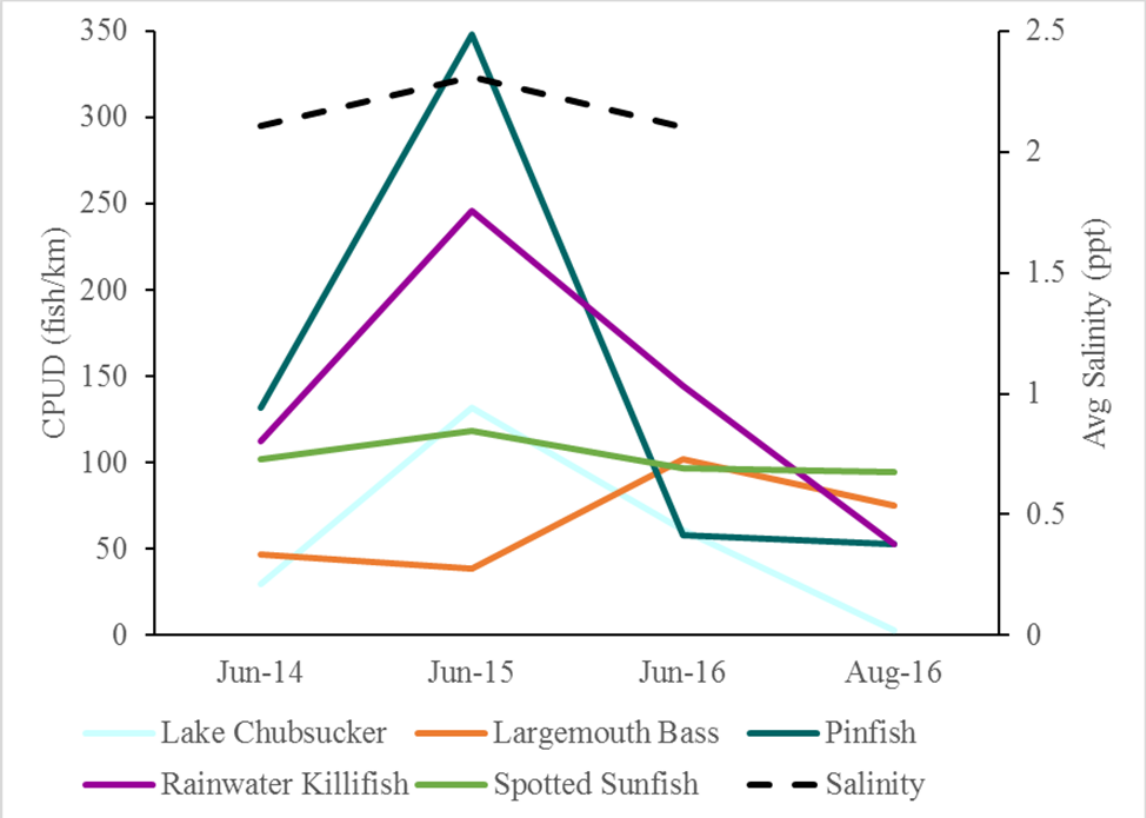

Figure 25. Summer relative abundance (CPUD) of key species in relation to salinity in Zone 2 of the Chassahowitzka River System (August 2016 salinity data unavailable).

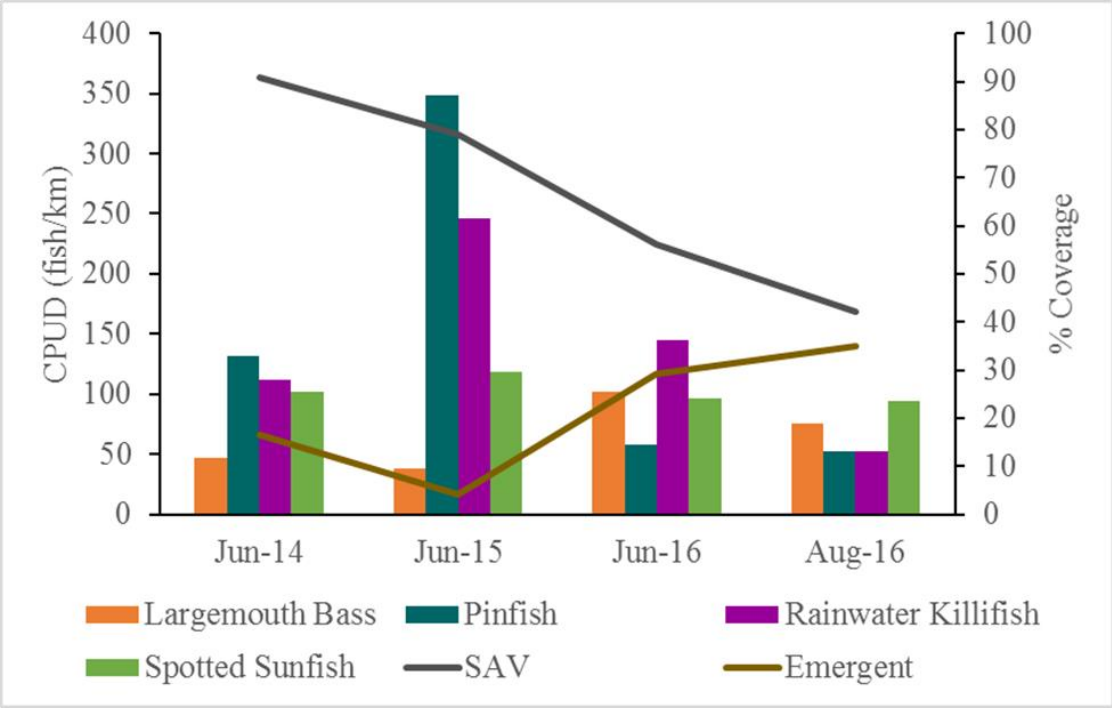

Figure 26. Summer relative abundance (CPUD) of key species in relation to percent habitat coverage in Zone 2 of the Chassahowitzka River System. Emergent = Emergent vegetation, SAV = submersed aquatic vegetation.

Summer Zone 3

Rainwater Killifish had the highest relative abundance in June 2014 before decreasing over the next three summer sampling events (Figure 27). Relative abundance of other key species (i.e., Pinfish, Largemouth Bass, Tidewater Mojarra) fluctuated over all sampling events. Largemouth Bass had spikes in biomass during June 2014 and August 2016 (Figure 28). Rainwater Killifish and Spotted Sunfish decreased in relative abundance as salinity increased (Figure 29). Spotted Sunfish and Rainwater Killifish were affected by the presence of SAV (Figure 30).

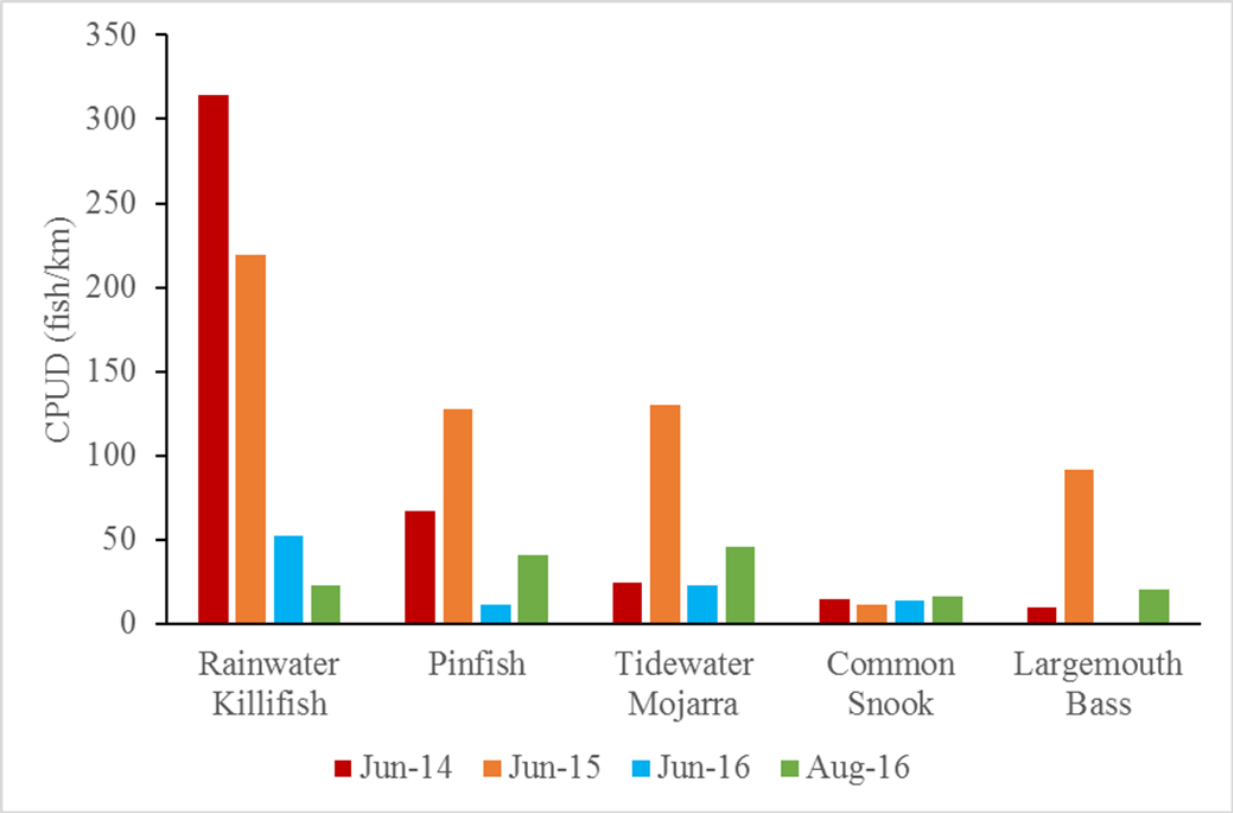

Figure 27. Summer relative abundance (CPUD) of key species in Zone 3 of the Chassahowitzka River System.

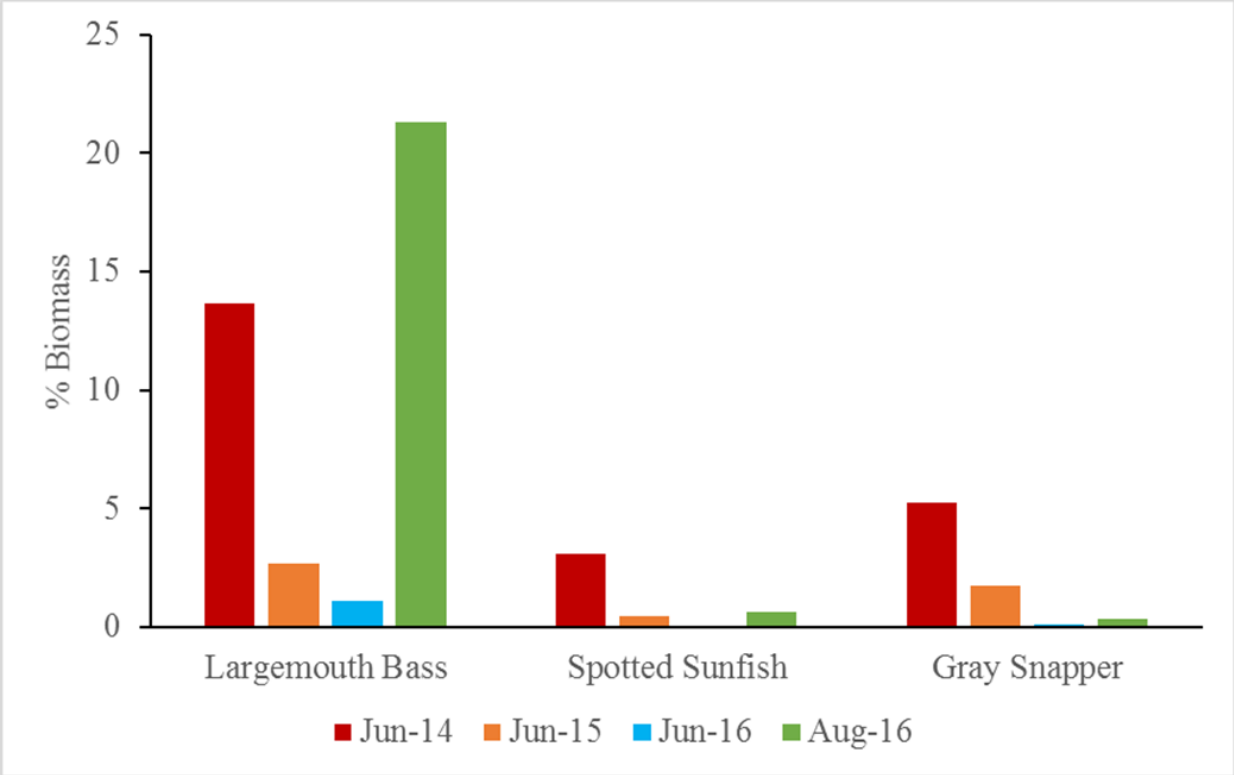

Figure 28. Summer biomass of key species in Zone 3 of the Chassahowitzka River System.

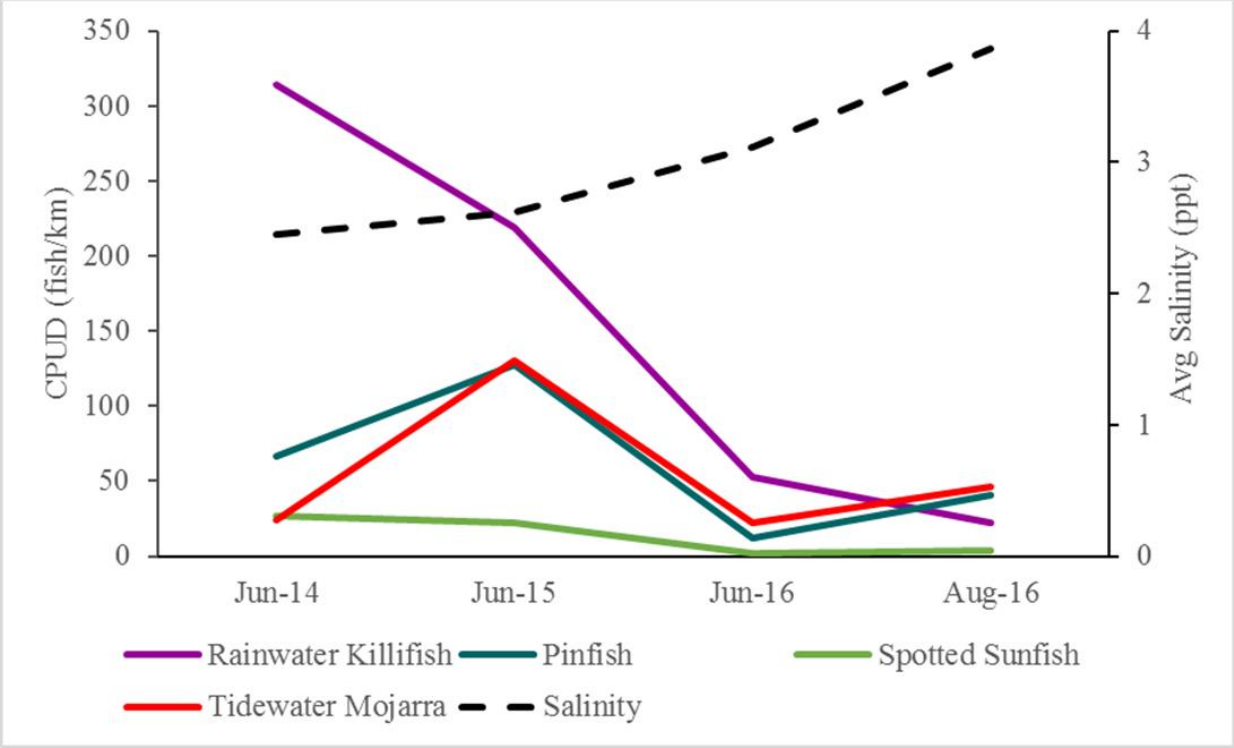

Figure 29. Summer relative abundance (CPUD) of key species in relation to salinity in Zone 3 of the Chassahowitzka River System.

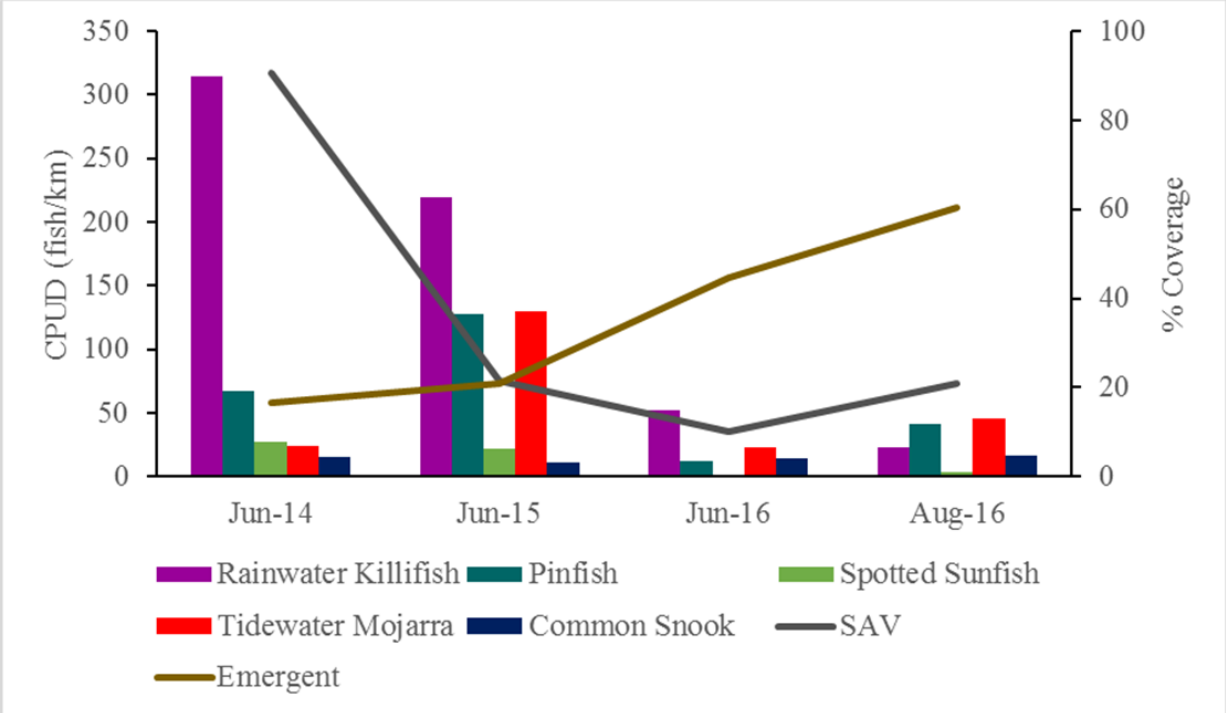

Figure 30. Summer relative abundance (CPUD) of key species in relation to percent habitat coverage in Zone 3 Chassahowitzka. Emergent = emergent vegetation, SAV = submerged aquatic vegetation.

Homosassa River System

Previous Study Comparisons

We collected 20 freshwater species and 30 marine species from the Homosassa River System (Table 18, Appendix A)

Herald and Strickland (1949) observed fish within and around the area commonly known as the "fish bowl" at the headsprings. Their visual counts documented one species that has not been collected to date; the Harper's Minnow (*Erimystax harperi)*, a freshwater cave dwelling minnow (Table 18, Appendix A).

The FLMNH has 28 fish specimens collected from the Homosassa River System in 1953 and 2001-2002 by various researchers [i.e., Largemouth Bass, Atlantic Needlefish (*Strongylura marina)*, Seminole Killifish (*Fundulus seminolis)*, etc.]. The FLMNH fish collections were comprised of 13 freshwater and 8 marine species similar to those collected during this study (Table 18, Appendix A).

Walsh and Williams (2003) collected fish and mussels from 16 springs in Florida for the Florida Park Service. They focused their efforts near the springheads area in the Homosassa River System. Using a combination of boat-mounted electrofishing, mask and snorkel observations, seining, and dip nets, Walsh and Williams (2003) collected 34 species; 20 freshwater and 14 marine (Table 18, Appendix A).

A study conducted on the Homosassa River by Pine et al. (2011) collected 3,690 fish and macroinvertebrates from 27 different taxa. Of the 27 taxa collected, 19 were comprised of fish species (9 freshwater, 10 marine), all of which were also collected during this study (21 freshwater, 30 marine) (Table 18, Appendix A). Pine et al. (2011) used throw traps for their fish

collection and collected the Atlantic Croaker (*Micropogonias undulatus*), which was not collected during our study.

Frazer et al. (2011) evaluated the effects of nutrient loading on fish assemblages in the Homosassa River System. The fish species they collected, 22 freshwater and 35 marine, were similar to those collected in our study (Table 18, Appendix A). However, differences were observed for four freshwater species when comparing our study to the Frazer et al. (2011) study. Black Crappie (*Pomoxis nigromaculatus)* and Warmouth were collected only in our study, while Brown Bullhead and Chain Pickerel (*Esox niger)* were only collected in their study (Table 18, Appendix A). The authors used a combination of boat-mounted electroshock fishing and block-net seins to collect their fish data.

Species Composition

The Homosassa River System was comprised of 84% marine fish species and 16% freshwater species. Marine species composition was lowest in Zone 1 at 69% and increased in Zones 2 and 3 (86% and 94% respectively; Figure 105, Appendix B). Marine species composition was consistently highest during the winter (93%), as compared to the summer (67%; Figure 106, Appendix B).

Non-metric Multidimensional Scaling

All pairwise comparisons of fish assemblages between winter and summer months revealed a significantly seasonal difference (all $P \leq 0.001$). As distance from the headsprings increased, fish assemblages appeared to become more similar ~~during~~ the winter and summer sampling sessions (Zone 1 $R^2 = 0.33$; Zone 2 $R^2 = 0.23$; Zone 3 $R^2 = 0.15$; Figure 137, Appendix B). Average abundance was generated from the five fish species that attributed the most variability between winter and summer months from each zone (Figure 138, Appendix B).

The MDS r-squared for comparisons between summer and winter sampling events are: Zone 1, 0.33; Zone 2, 0.23; Zone 3, 0.15. From this, the authors infer that the effect of season on fish assemblages is greatest upstream at zone 1, intermediate at zone 2, and weakest in zone 3.

Seasonal & Temporal Relative Abundance v. Habitat & Water Quality
Winter Zone 1

Gray Snapper had the highest relative abundance of all species for 2014 and 2015 (Figure 31). Tidewater Mojarra relative abundance was consistent from 2014-2015, followed by an increase from 2015-2017. Bluegill (*Lepomis macrochirus)* abundance showed a steady increase from 2014-2016 (Figure 31). Gray Snapper biomass was the highest of all species sampled in 2014 and 2015, while Largemouth Bass biomass was highest in 2016-2017 (Figure 32). Spotted Sunfish and Gray Snapper relative abundances were inversely related to average salinity (Figure 33). Key species abundance, when compared to percent habitat coverage, showed that Tidewater Mojarra were positively affected by the presence of emergent vegetation (Figure 34).

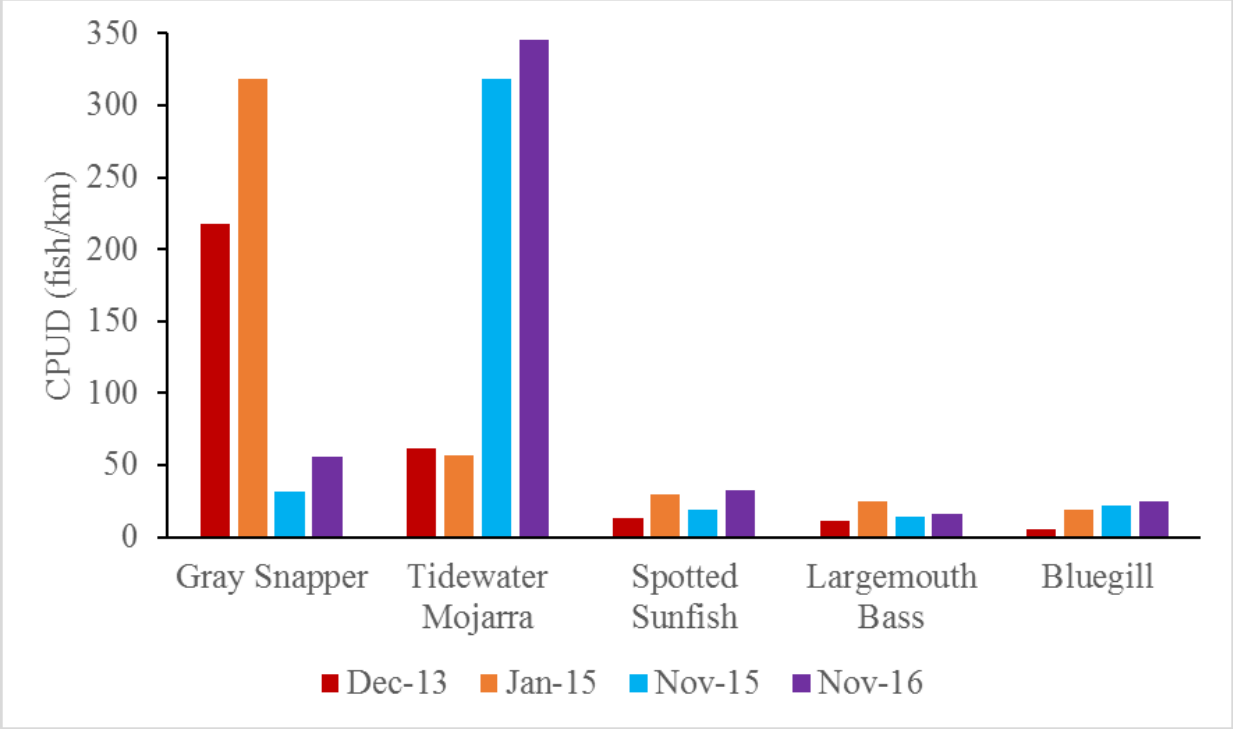

Figure 31. Winter relative abundance (CPUD) of key species in Zone 1 of the Homosassa River System.

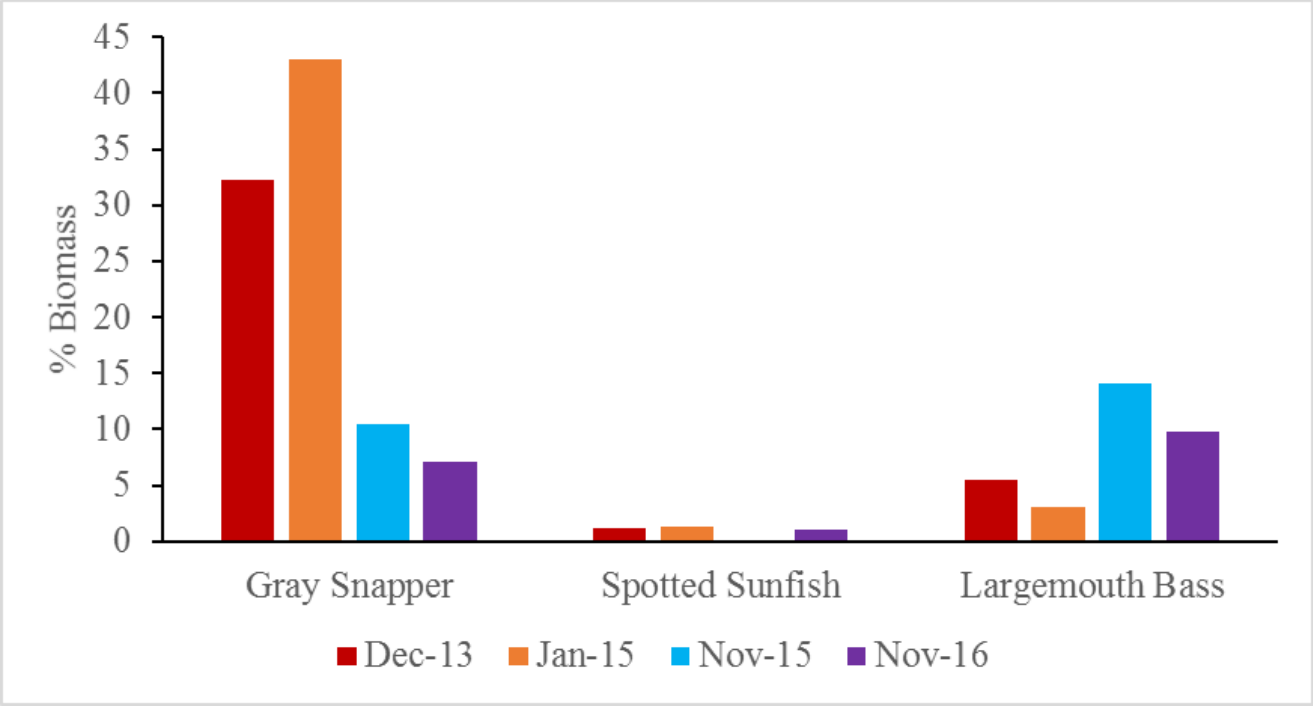

Figure 32. Winter biomass of key species in Zone 1 of the Homosassa River System.

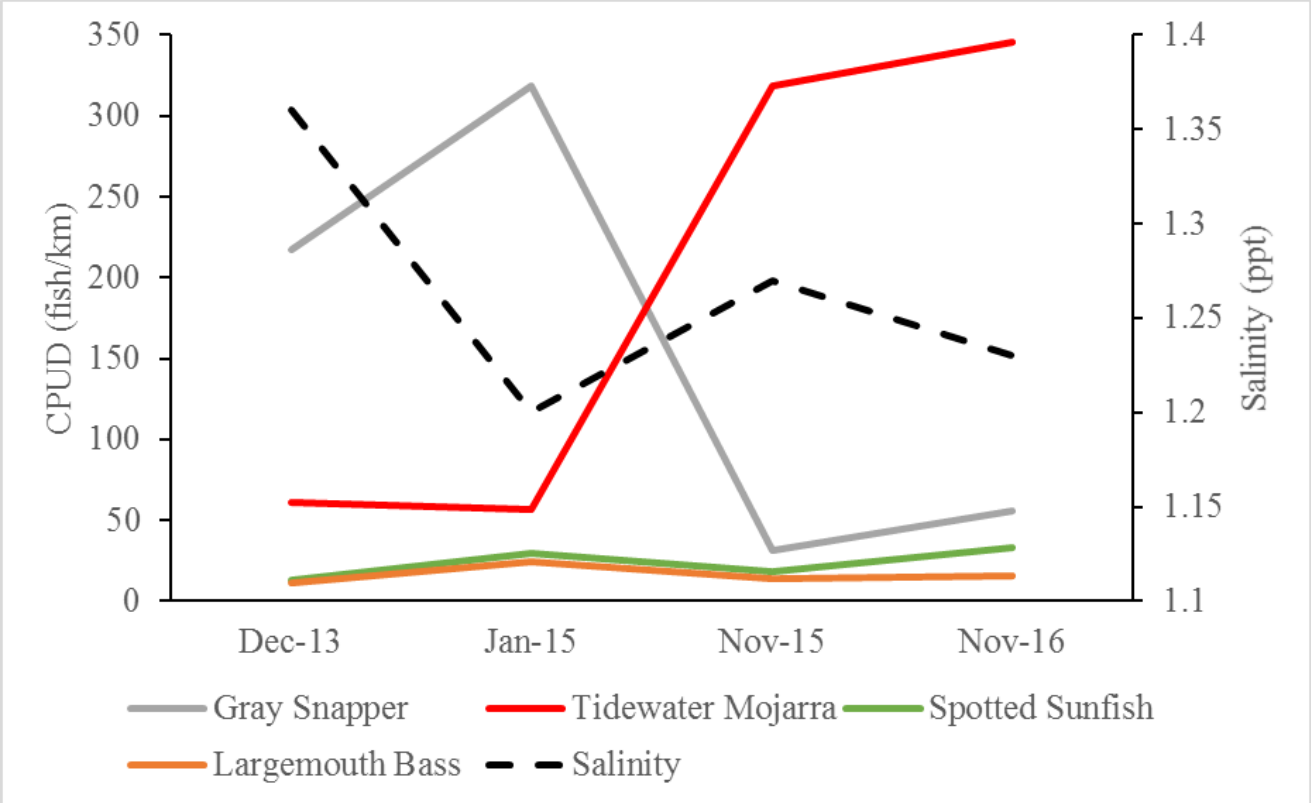

Figure 33. Winter relative abundance (CPUD) of key species in relation to salinity in Zone 1 of the Homosassa River System.

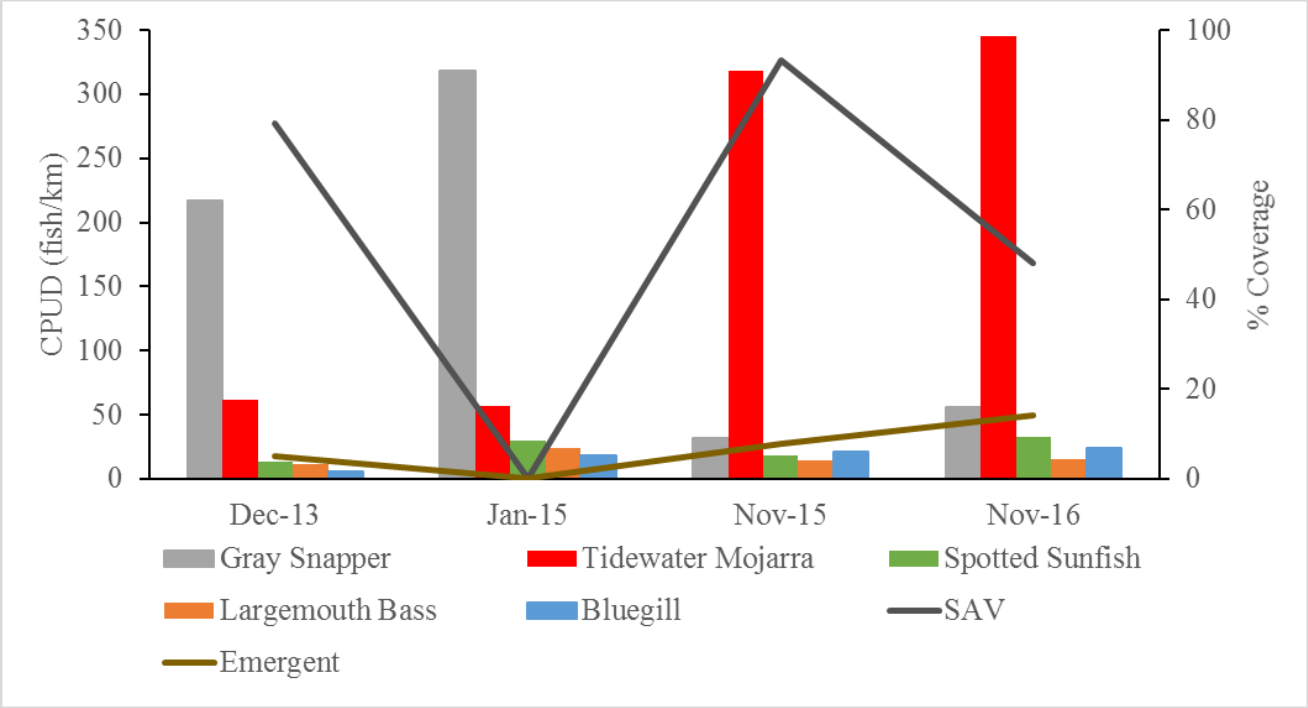

Figure 34. Winter relative abundance (CPUD) of key species in relation to percent habitat coverage in Zone 1 of the Homosassa River System. Emergent = emergent vegetation, SAV = submersed aquatic vegetation.

Winter Zone 2

Gray Snapper had the highest relative abundance in December 2013 before decreasing in 2015 and 2016; however, their biomass was greatest during the second sampling event in January 2015 (Figures 35 and 36). Tidewater Mojarra relative abundance exhibited an inverse relationship with salinity (Figure 35-37).

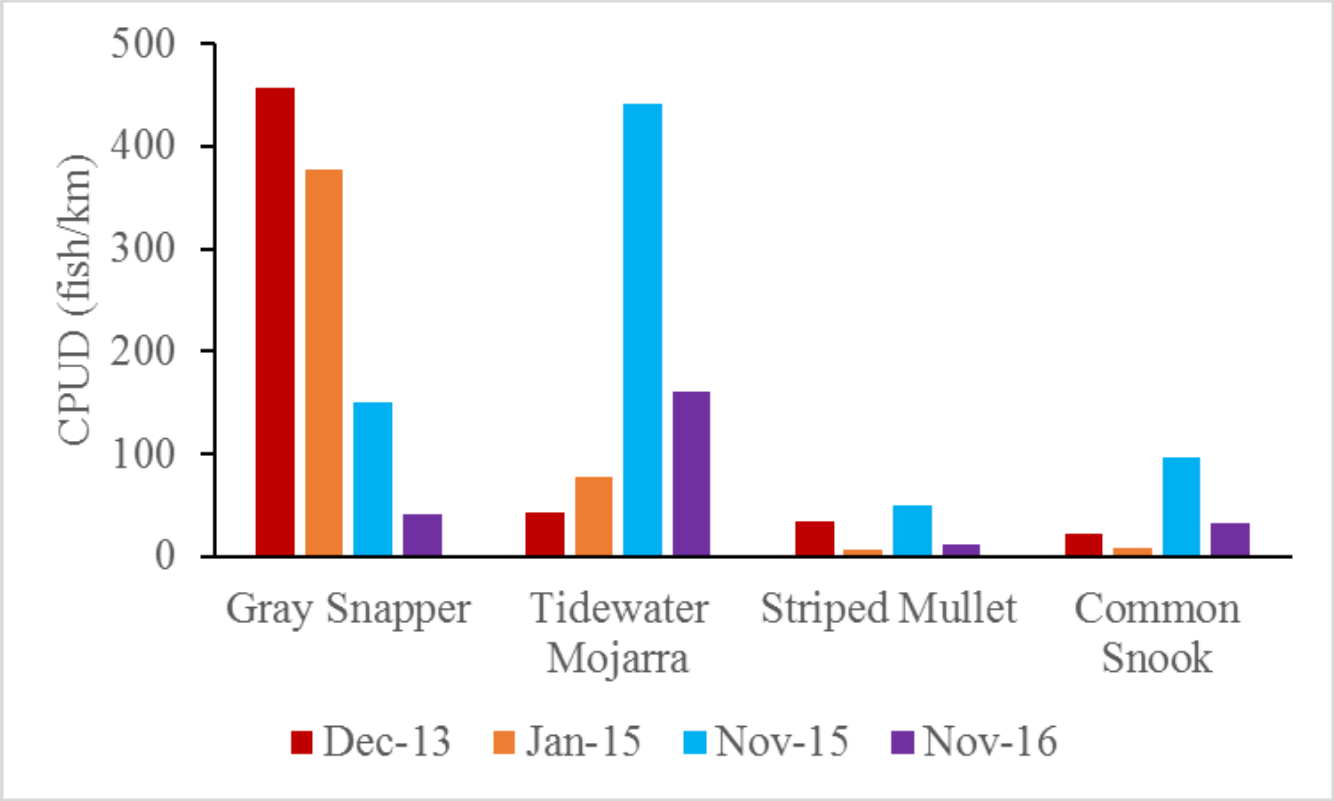

Figure 35. Winter relative abundance (CPUD) of key species in Zone 2 the of Homosassa River System.

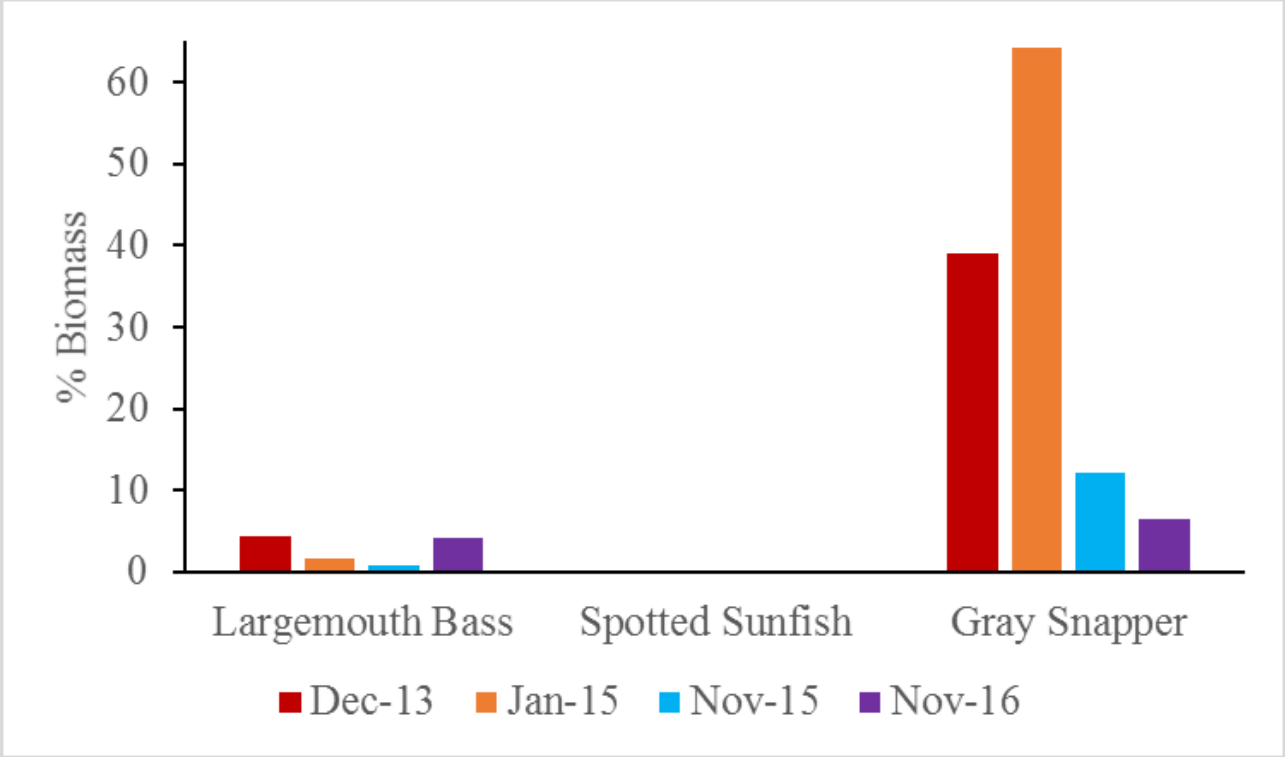

Figure 36. Winter biomass of key species in Zone 2 of the Homosassa River System.

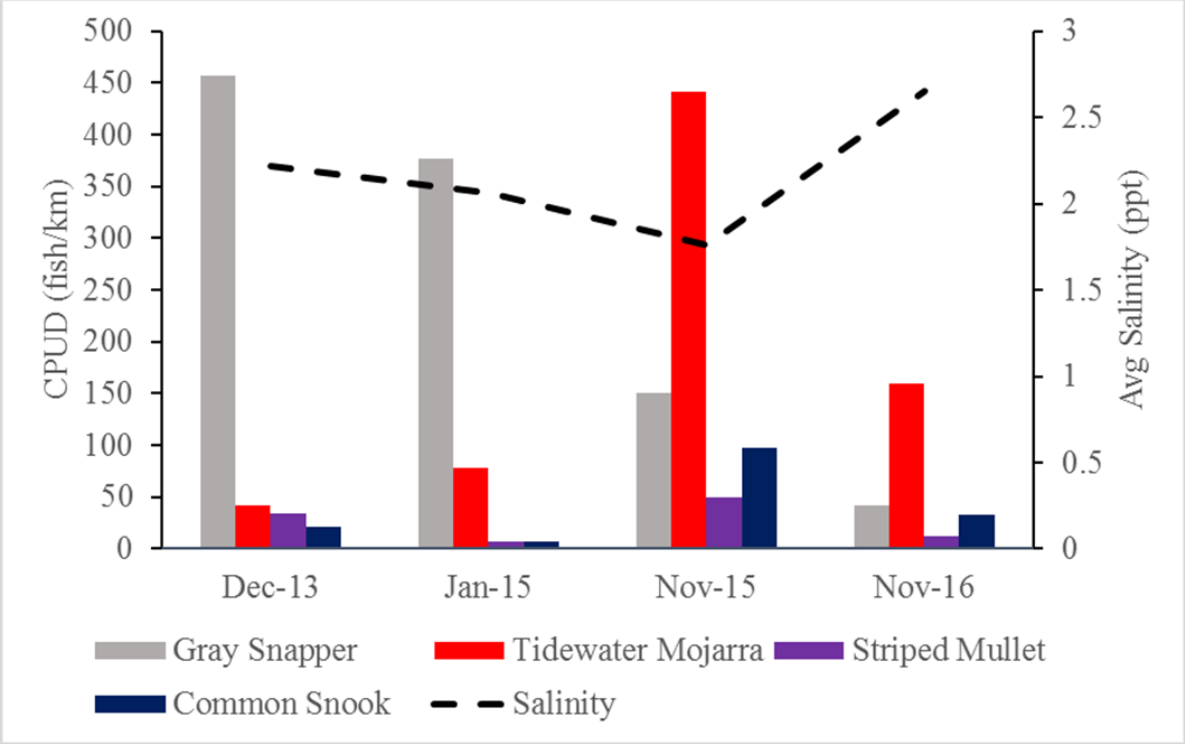

Figure 37. Winter relative abundance (CPUD) of key species in relation to salinity in Zone 2 of the Homosassa River System.

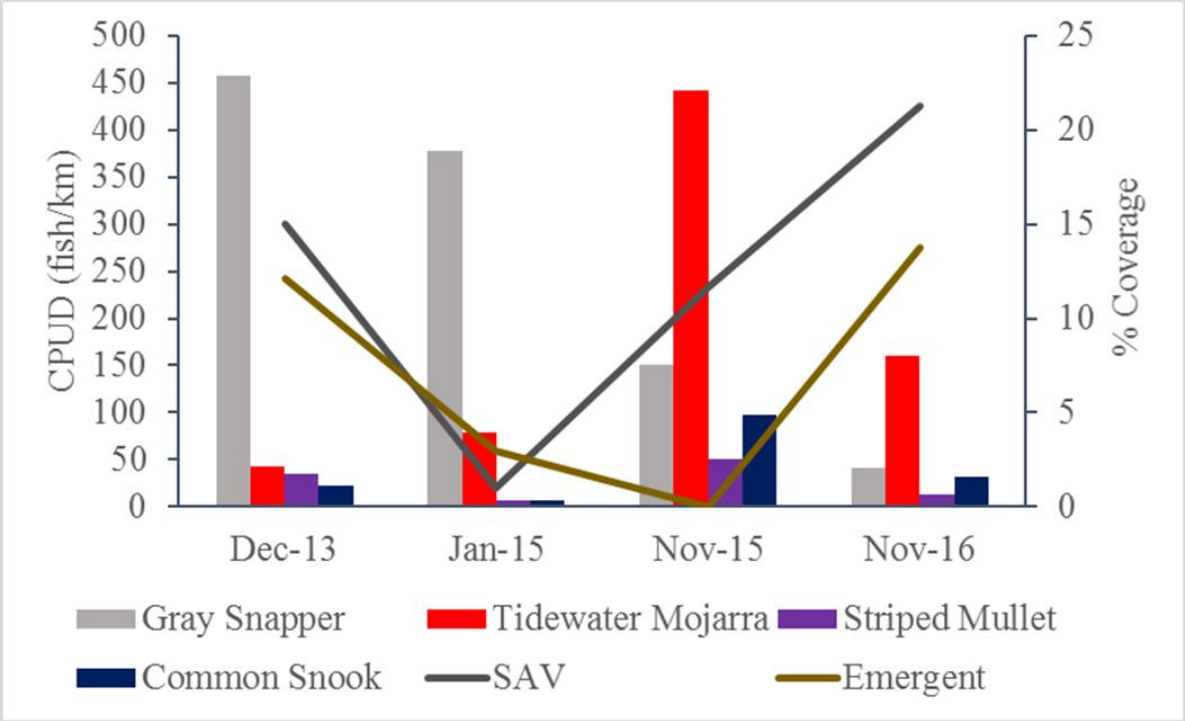

Figure 38. Winter relative abundance (CPUD) of key species in relation to percent habitat coverage in Zone 2 of the Homosassa River System. Emergent = emergent vegetation, SAV = submersed aquatic vegetation.

Winter Zone 3

As Gray Snapper relative abundance decreased in Zone 3 during the winter, the relative abundance of both Common Snook and Tidewater Mojarra increased (Figure 39). Gray Snapper had greater biomass in all winter sampling events (Figure 40). Striped Mullet (*Mullus surmuletus)* relative abundance remained consistent over time. Sheepshead (*Archosargus probatocephalus)* relative abundance most closely tracked average salinity levels, while other key species fluctuated independently (Figure 41). Tidewater Mojarra relative abundance was inversely related to the presence of SAV (Figure 42).

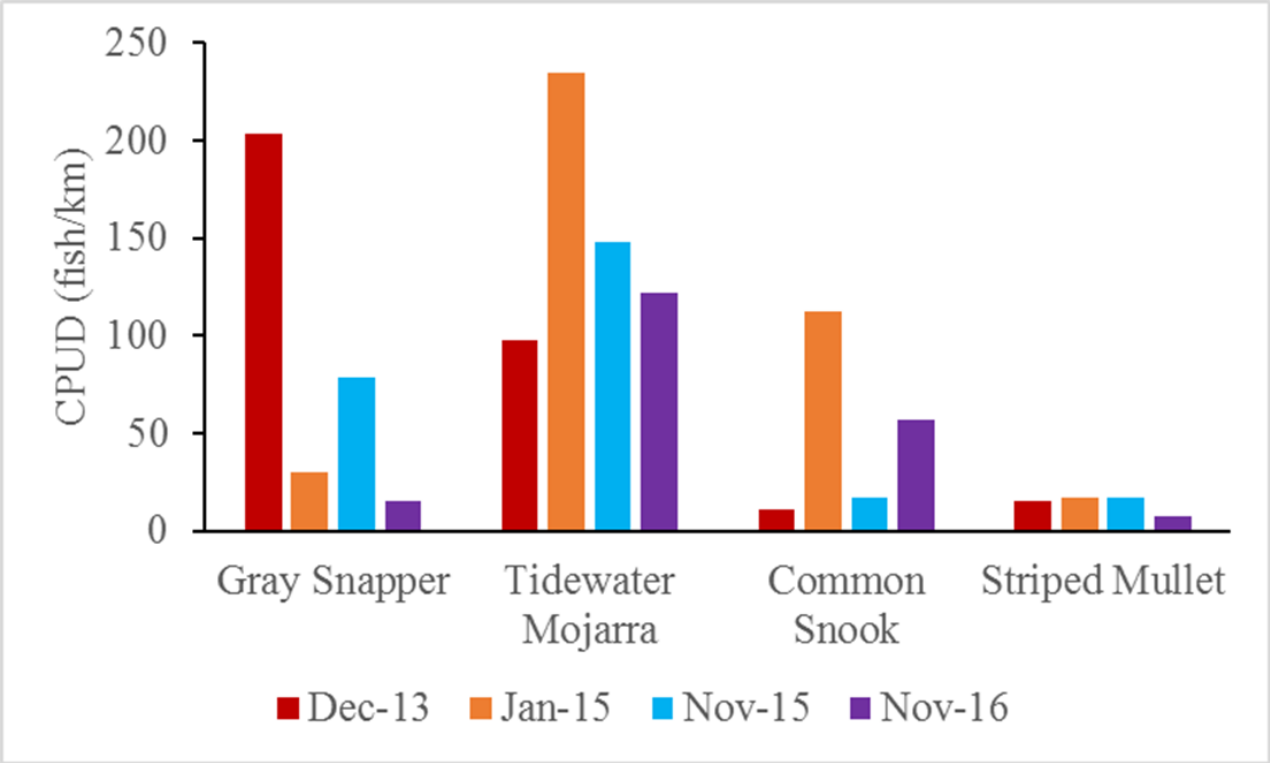

Figure 39. Winter relative abundance (CPUD) of key species in Zone 3 of the Homosassa River System.

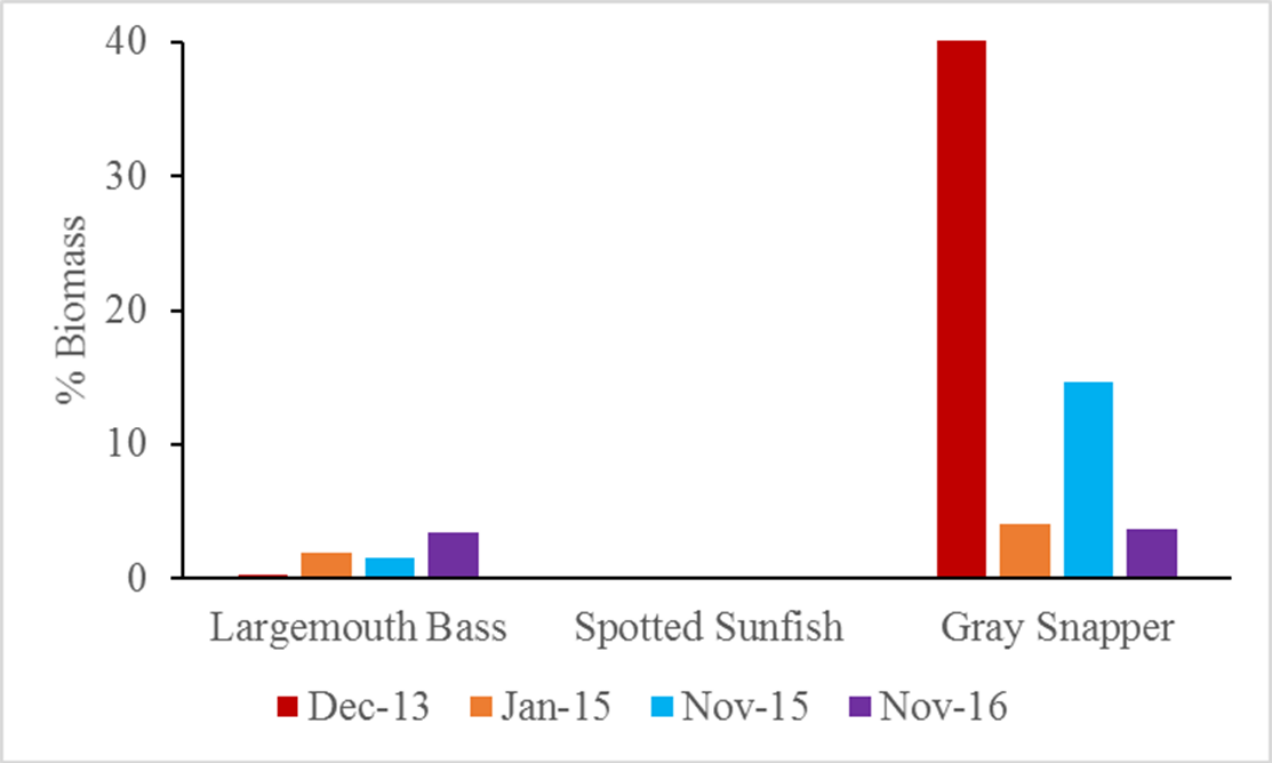

Figure 40. Winter biomass of key species in Zone 3 of the Homosassa River System.

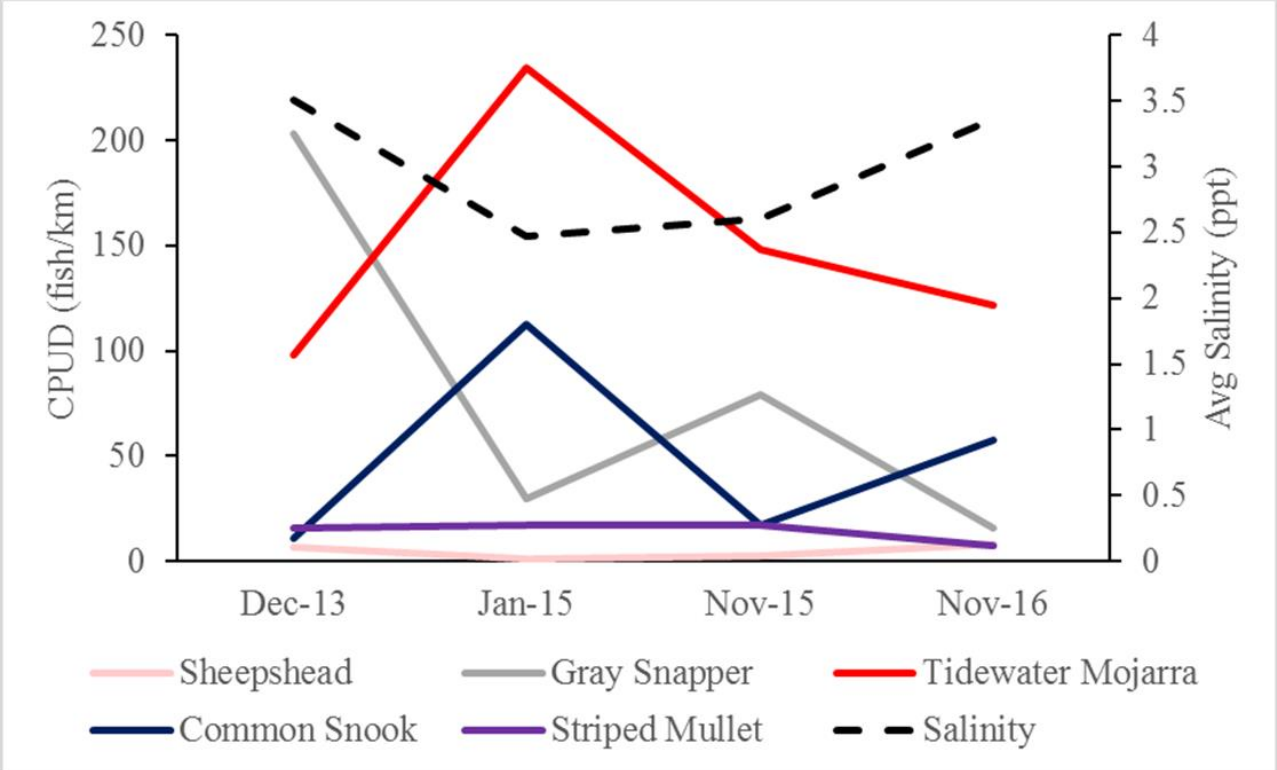

Figure 41. Winter relative abundance (CPUD) of key species in relation to salinity in Zone 3 of the Homosassa River System.

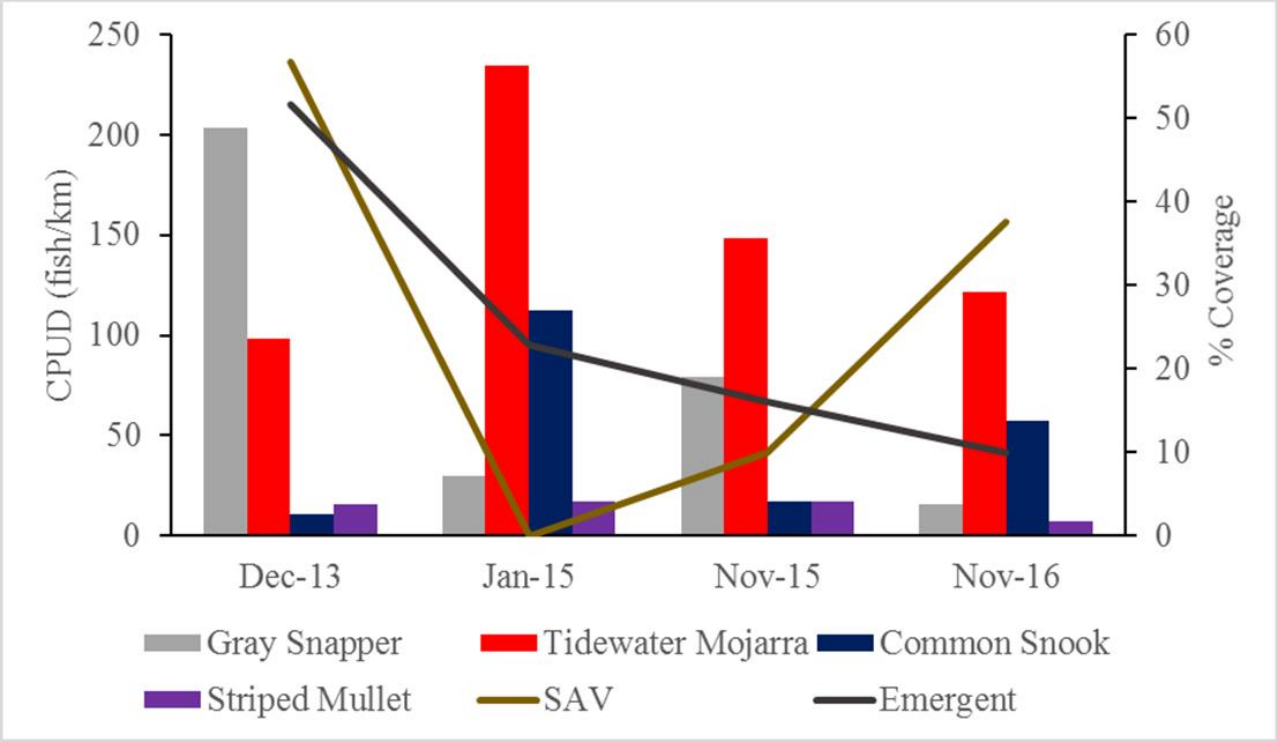

Figure 42. Winter relative abundance (CPUD) of key species in relation to percent habitat coverage in Zone 3 of the Homosassa River System. Emergent = emergent vegetation, SAV = submersed aquatic vegetation.

Summer Zone 1

Striped Mullet had the highest relative abundance in 2014, while relative abundance during June 2015 and 2016 was dominated by Largemouth Bass (Figure 43). Tidewater Mojarra had the highest relative abundance during the second sampling event of 2015 (Figure 43). Of the three key fish species, Largemouth Bass biomass was dominant during all summer events (Figure 44). A positive relationship between relative abundance and average salinity was observed for Striped Mullet, Bluegill, and Largemouth Bass (Figure 45). Conversely, Tidewater Mojarra relative abundance was inversely related to salinity from 2015 - 2016 (Figure 45). Largemouth Bass relative abundance was positively related to SAV. Bluegill exhibited a positive relationship with the presence of emergent vegetation (Figure 46).

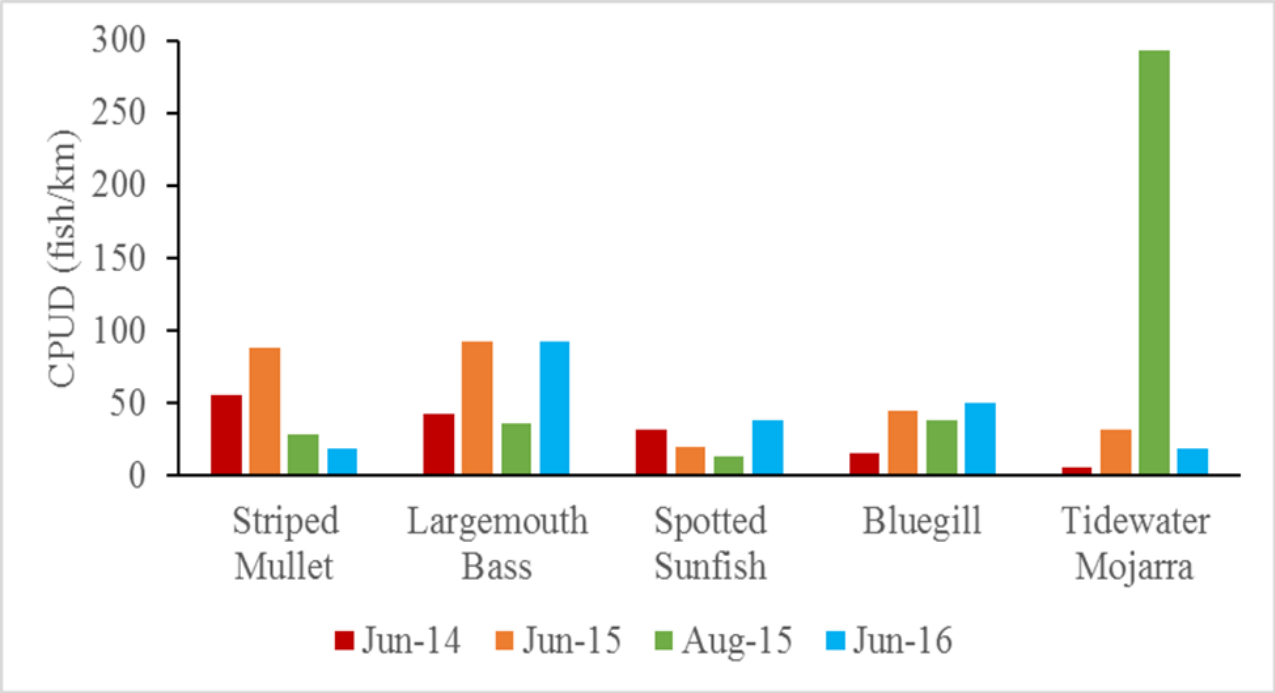

Figure 43. Summer relative abundance (CPUD) of key species in Zone 1 of the Homosassa River System.

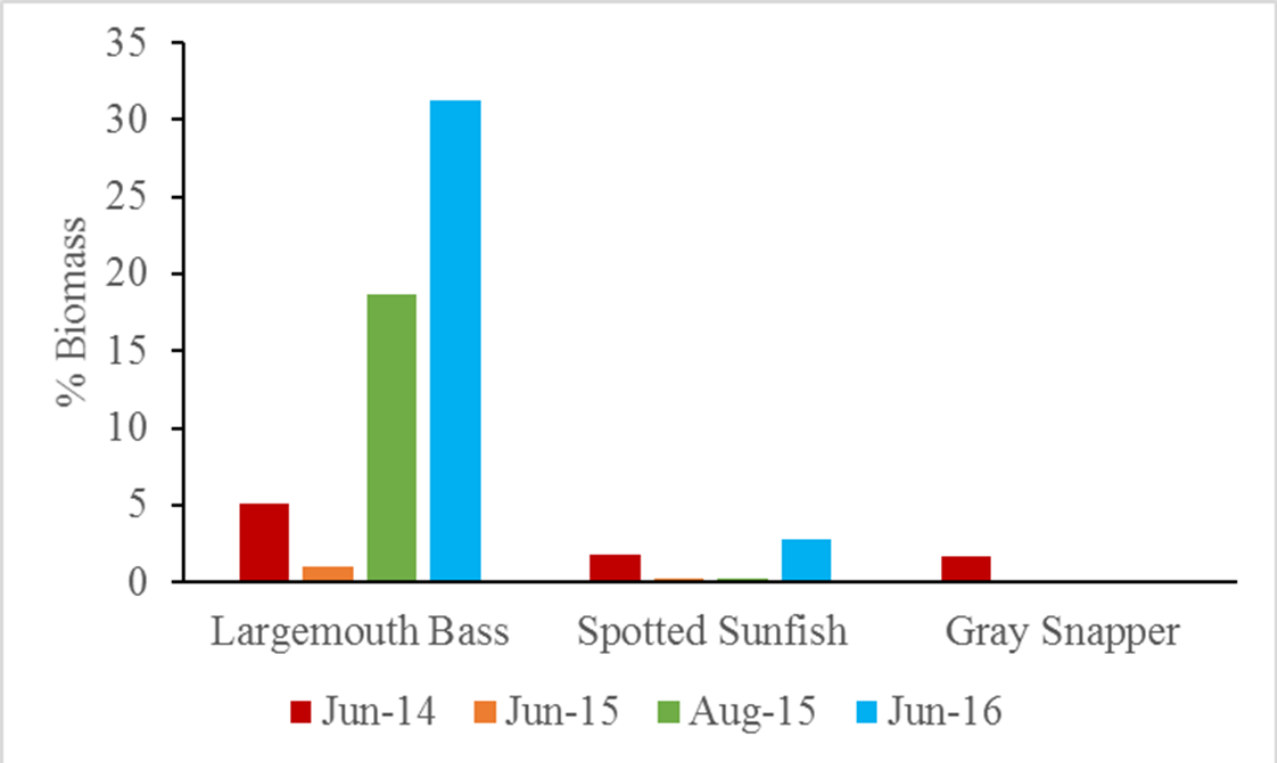

Figure 44. Summer biomass of key species in Zone 1 of the Homosassa River System.

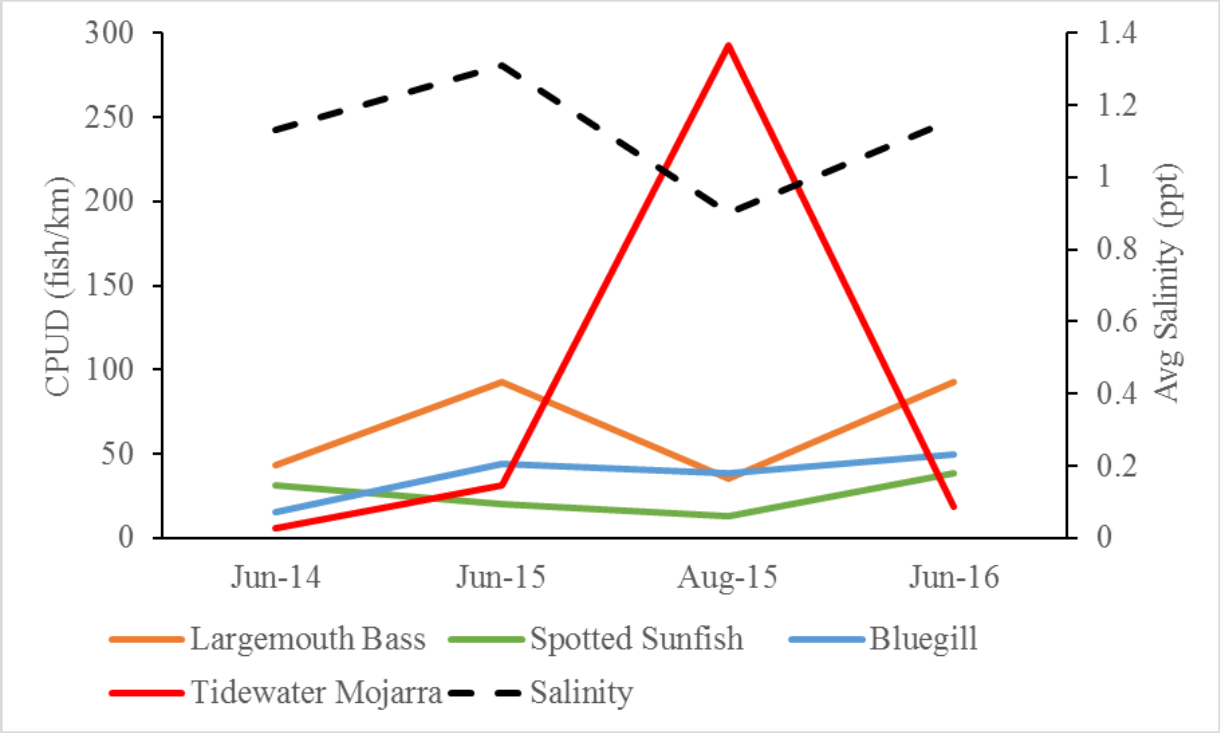

Figure 45. Summer relative abundance (CPUD) of key species in relation to salinity in Zone 1 of the Homosassa River System.

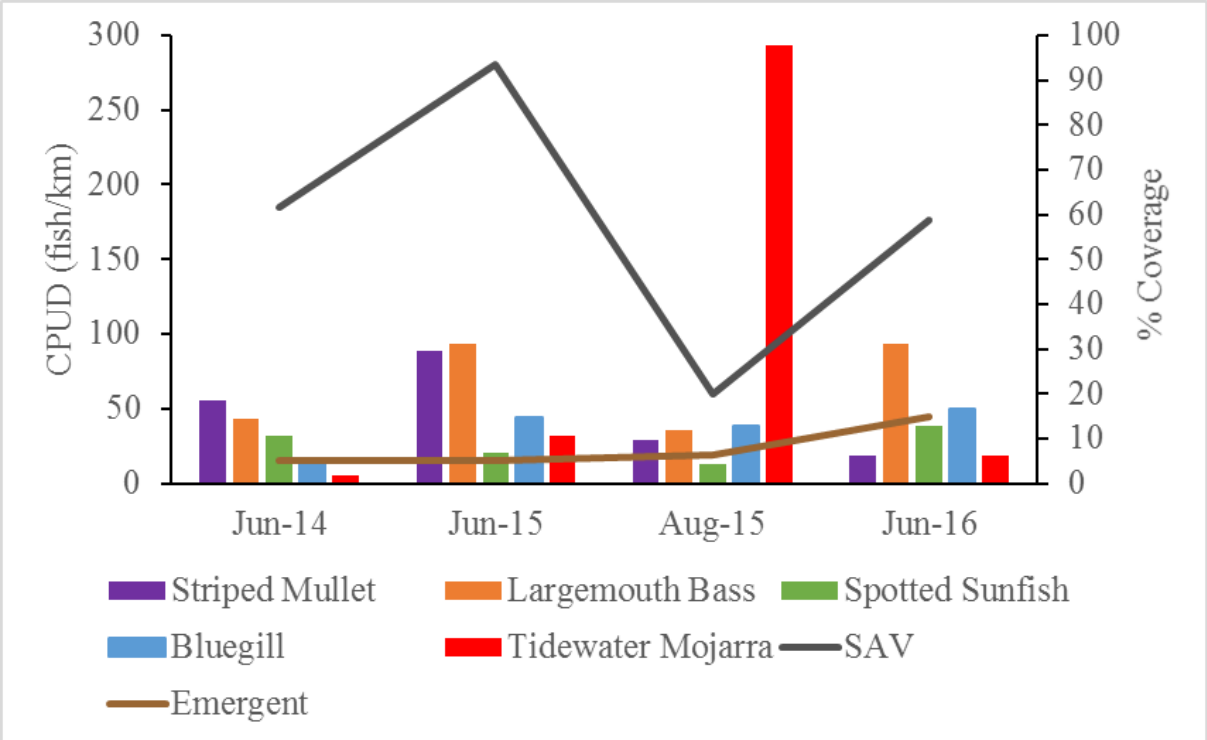

Figure 46. Summer relative abundance (CPUD) of key species in relation to percent habitat coverage in Zone 1 of the Homosassa River System. Emergent = emergent vegetation, SAV = submersed aquatic vegetation.

Summer Zone 2

The relative abundance in June 2014, June 2015, and August 2015 was dominated by Tidewater Mojarra; however, Largemouth Bass had the highest relative abundance in June 2016 (Figure 47). Gray Snapper dominated biomass percentages in June 2014 and June 2015, while Largemouth Bass dominated biomass percentage over Gray Snapper in August 2015 and June 2016 (Figure 48). Largemouth Bass and Spotted Sunfish had a positive relationship with submersed and emergent vegetation presence (Figure 49). Salinity levels were similar during summer sampling events; therefore, there were no relationships with species relative abundance (Figure 50).

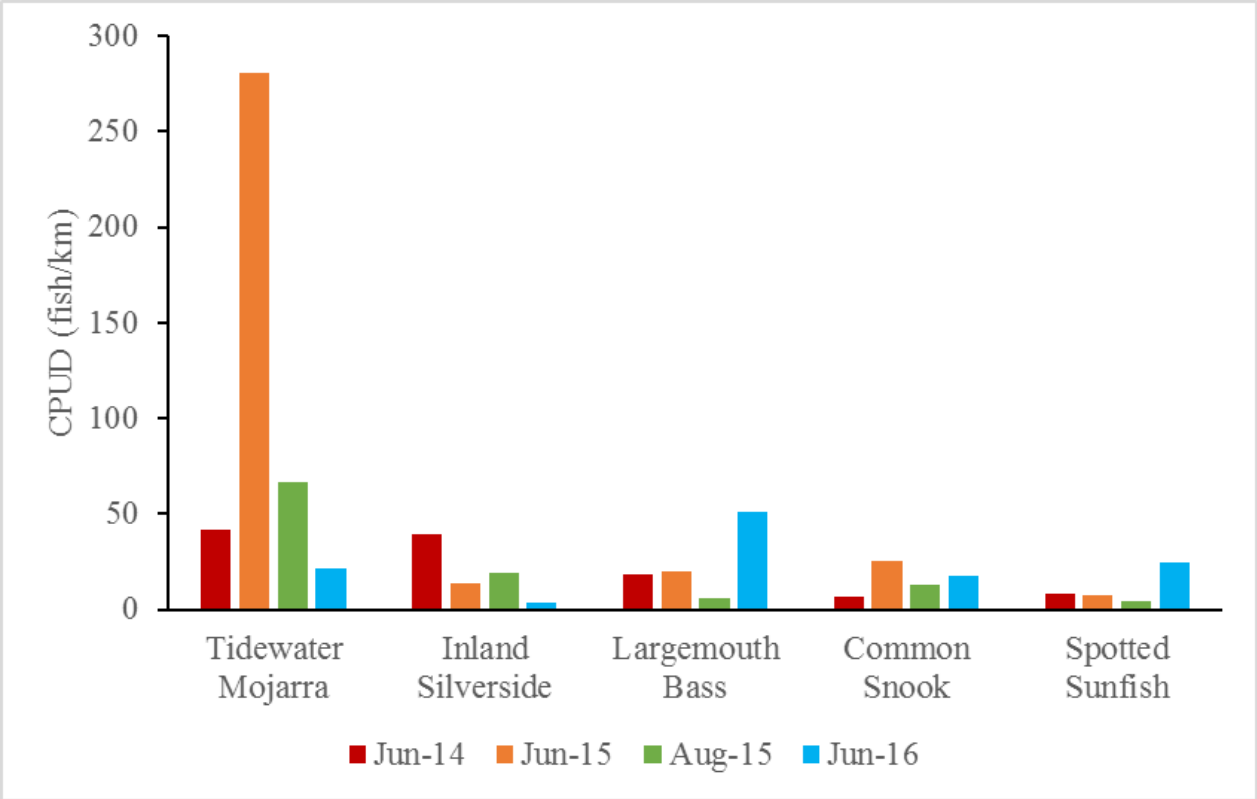

Figure 47. Summer relative abundance (CPUD) of key species in Zone 2 of the Homosassa River System.

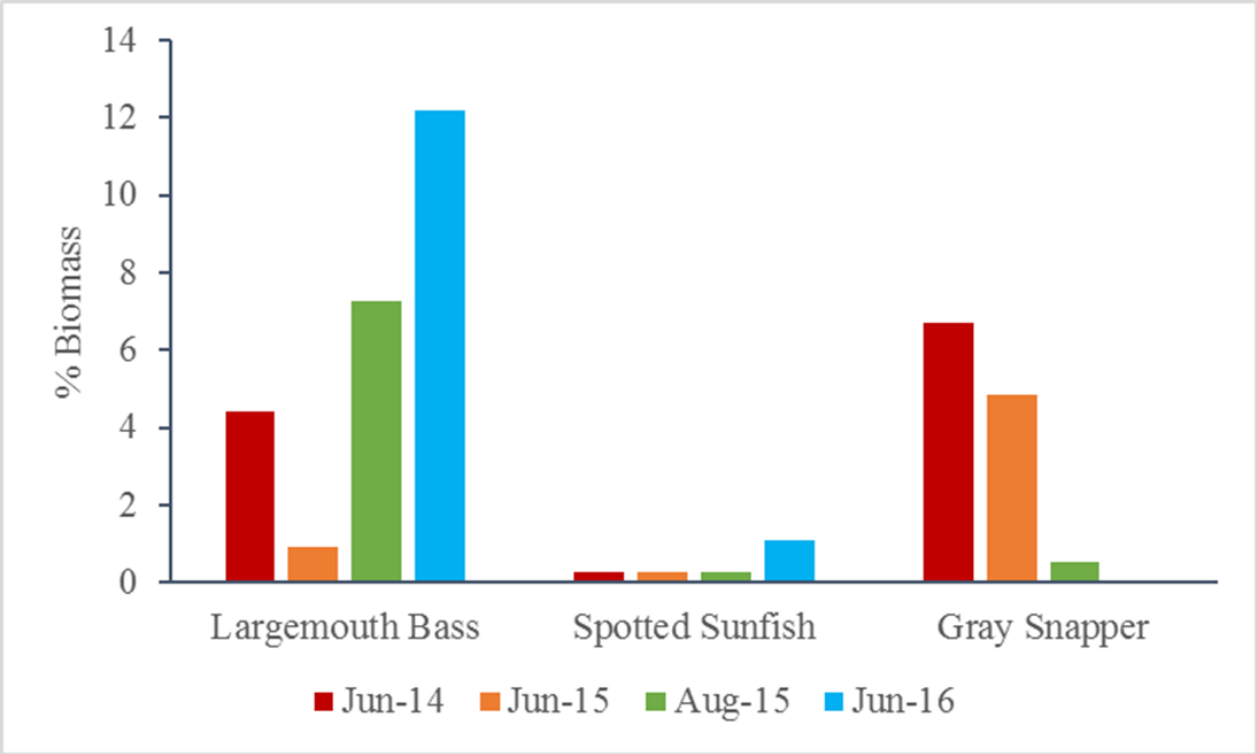

Figure 48. Summer biomass of key species in Zone 2 of the Homosassa River System.

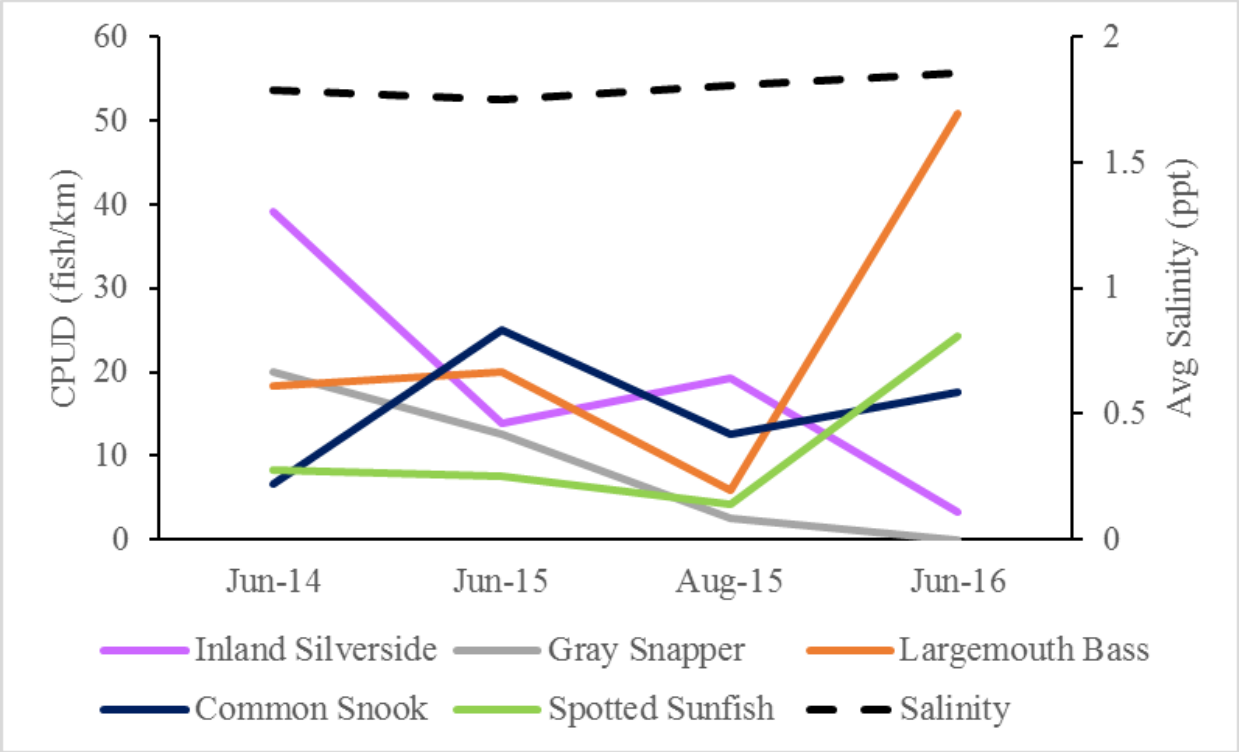

Figure 49. Summer relative abundance (CPUD) of key species in relation to salinity in Zone 2 of the Homosassa River System.

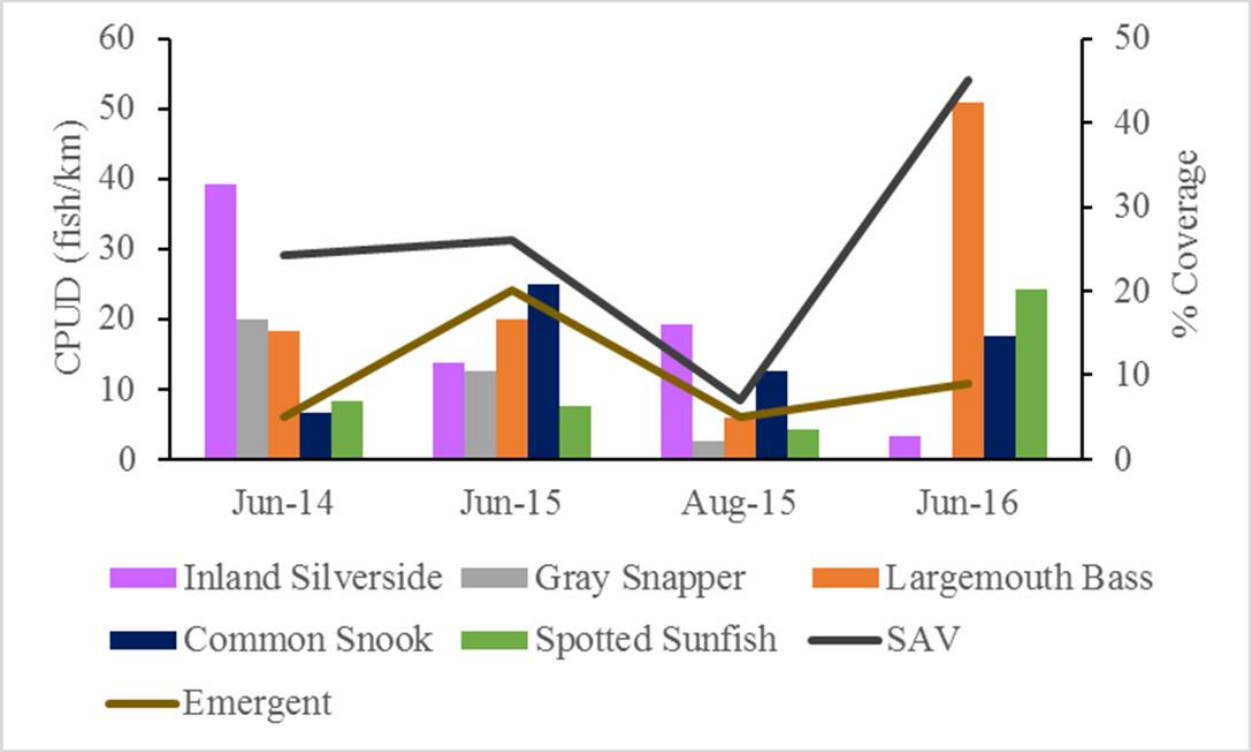

Figure 50. Summer relative abundance (CPUD) of key species in relation to percent habitat coverage in Zone 2 of the Homosassa River System. Emergent = emergent vegetation, SAV = submersed aquatic vegetation.

Summer Zone 3

Striped Mullet and Common Snook relative abundance had opposite trends (Figure 51). Striped Mullet held the highest relative abundance in June 2014, followed by Tidewater Mojarra in June 2015 and August 2015. In June 2016, Common Snook had the highest relative abundance (Figure 51). From 2014 through 2016, as Largemouth Bass biomass increased, Gray Snapper biomass decreased (Figure 52). Gray Snapper and Tidewater Mojarra relative abundance was positively related to salinity. Largemouth Bass relative abundance was positively affected by the presence of emergent vegetation (Figure 54).

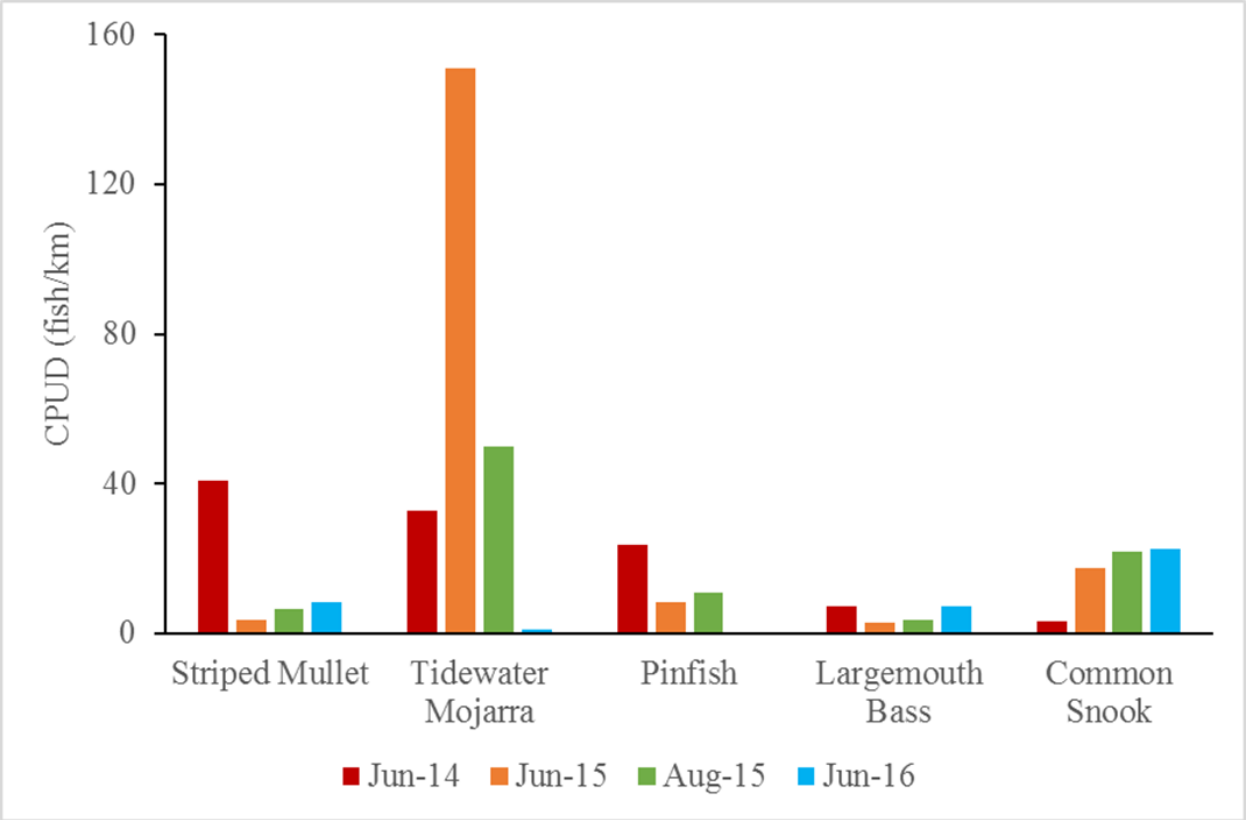

Figure 51. Summer relative abundance (CPUD) of key species in Zone 3 of the Homosassa River System.

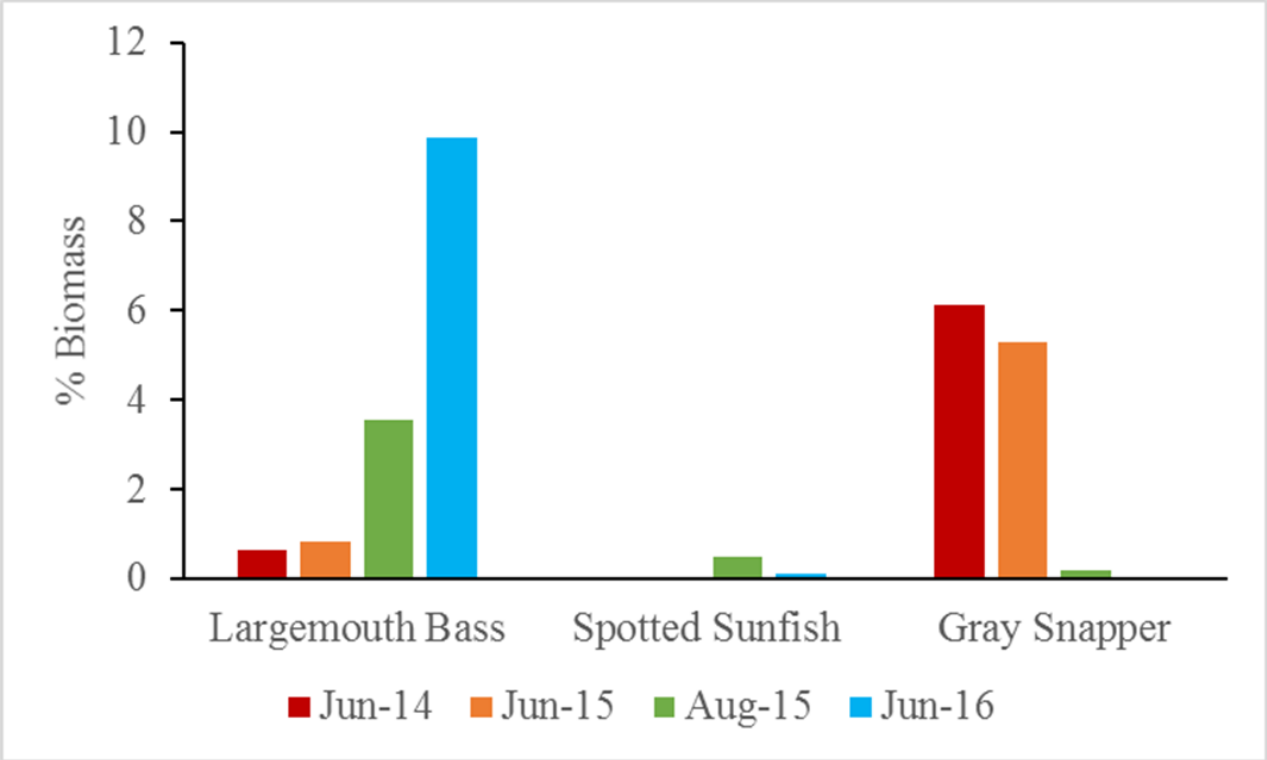

Figure 52. Summer biomass of key species in Zone 3 of the Homosassa River System.

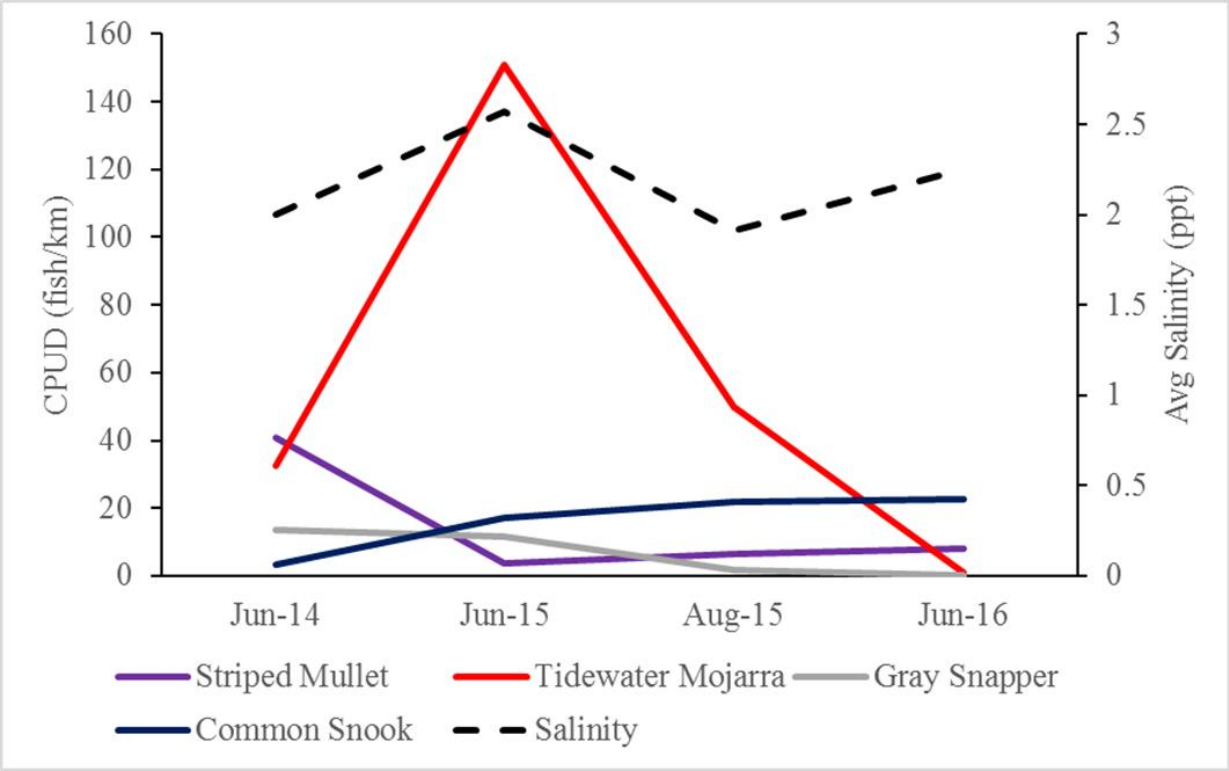

Figure 53. Summer relative abundance (CPUD) of key species in relation to salinity in Zone 3 of the Homosassa River System.

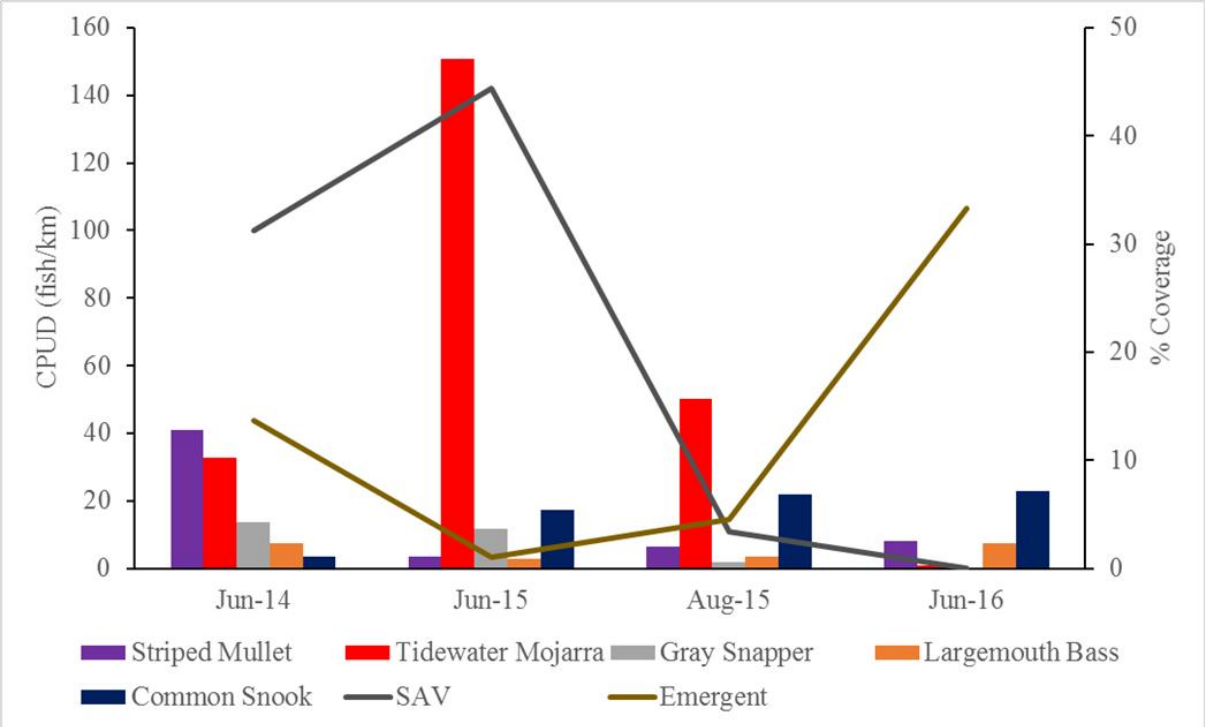

Figure 54. Summer relative abundance (CPUD) of key species in relation to percent habitat coverage in Zone 3 of the Homosassa River System. Emergent = emergent vegetation, SAV = submersed aquatic vegetation.

Crystal River/Kings Bay System

Previous Study Comparisons

We collected 18 freshwater species and 29 marine species from the Crystal River/Kings Bay System (Table 28, Appendix A).

Previous fish community surveys in the Crystal River/Kings Bay System are limited to regional sampling conducted by the FWC back in 1990-1992. While similar sampling methods and collection equipment were used, sampling was done infrequently, which resulted in fewer fish species being collected. The FWC collected 22 freshwater species and 19 marine species during the 1990-1992 surveys. They included nine more freshwater species and ten fewer marine species as compared to our study (Table 28, Appendix A).

Species Composition

The fish species composition of the Crystal River/Kings Bay System was comprised of 85% marine species. Zone 1 was identical to the system's overall composition with an 85% marine and 15% freshwater species. Zone 2 showed an increase to 87% marine species, and Zone 3 decreased to 84% marine species (Figure 107, Appendix B). In terms of season, winter sampling was comprised of 90% marine and 10% freshwater species. On average, there was a 79% marine species composition to 21% freshwater species composition in summer (Figure 108, Appendix B).

Non-metric Multidimensional Scaling

All pairwise comparisons of fish assemblages between winter and summer months were significantly different (all $P \leq 0.001$); though we found little variability in fish assemblages between seasons from this system (Zone 1 $R^2 = 0.15$; Zone 2 $R^2 = 0.12$; Zone 3 $R^2 = 0.18$; Figure

139). Average abundance was generated from the five fish species that contributed the most variability between winter and summer months from each zone (Figure 140, Appendix B). The low variability of species collected in the Crystal River/Kings Bay System may be attributed to the ease of access to all zones for marine species throughout the study area.

Seasonal & Temporal Relative Abundance v. Habitat & Water Quality

Winter Zone 1

In all winter sampling events for Zone 1, Tidewater Mojarra had the highest relative abundance (Figure 55). Largemouth Bass and Striped Mullet relative abundance had an inverse relationship during the study (Figure 55). Gray Snapper biomass was greatest during all sampling seasons, except for the first winter sampling event in November 2013, when Largemouth Bass biomass was highest (Figure 56). Tidewater Mojarra relative abundance had a negative relationship with salinity concentrations and SAV percentage (Figure 57). Largemouth Bass relative abundance had a negative relationship with salinity level and was positively affected by emergent vegetation (Figures 57 and 58).

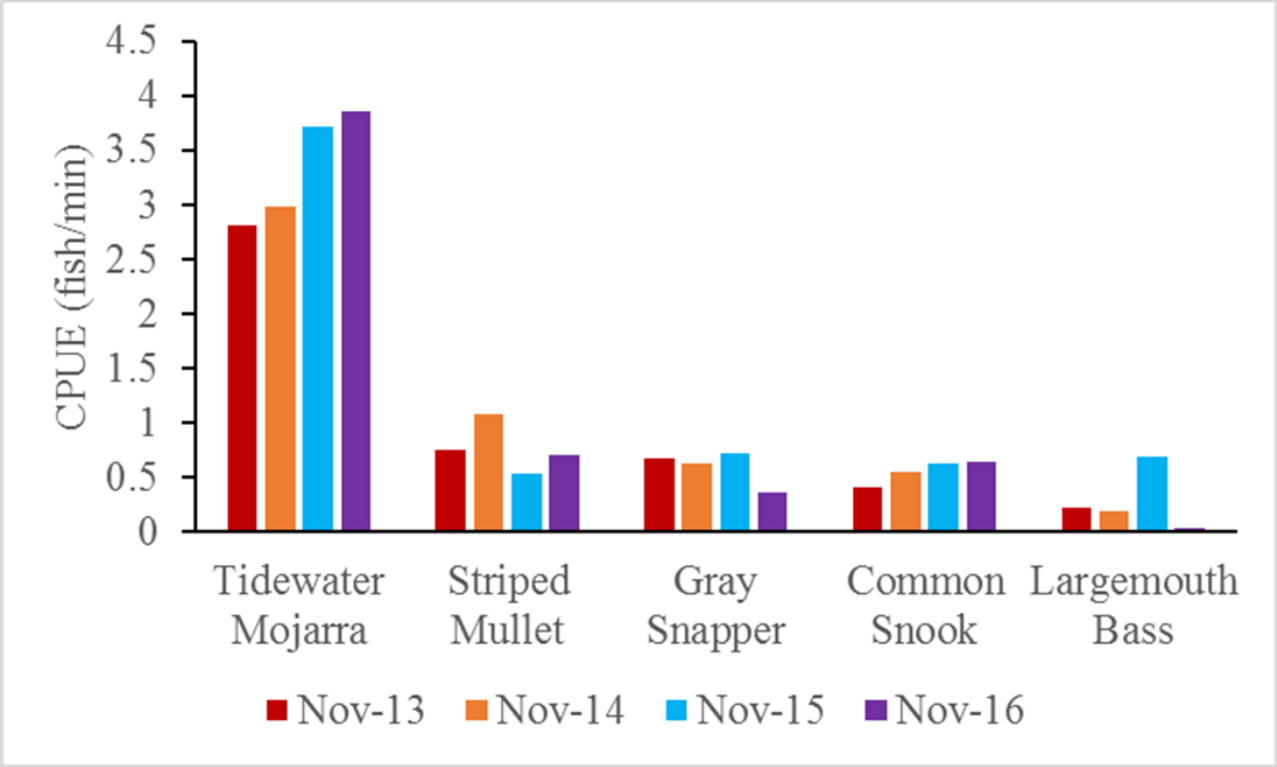

Figure 55. Winter relative abundance (CPUE) of key species in Zone 1 of the Crystal River/Kings Bay System.

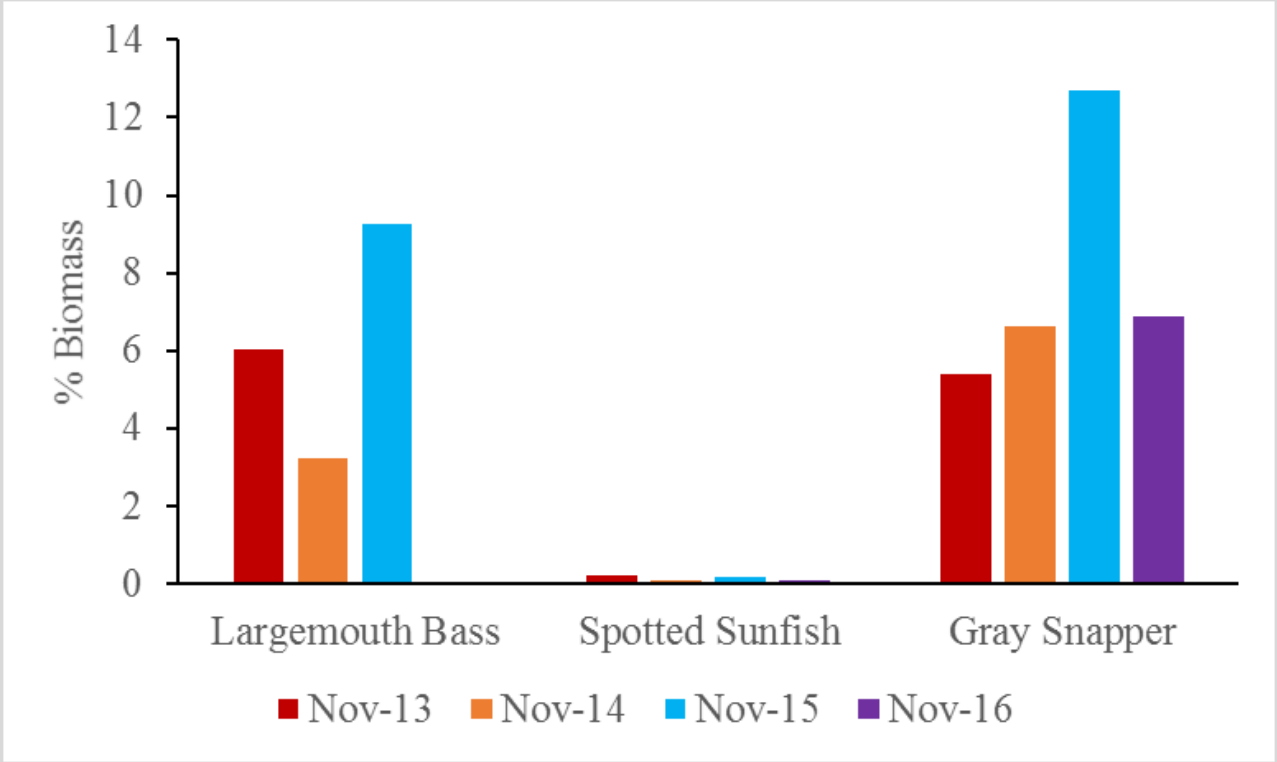

Figure 56. Winter biomass of key species in Zone 1 of the Crystal River/Kings Bay System.

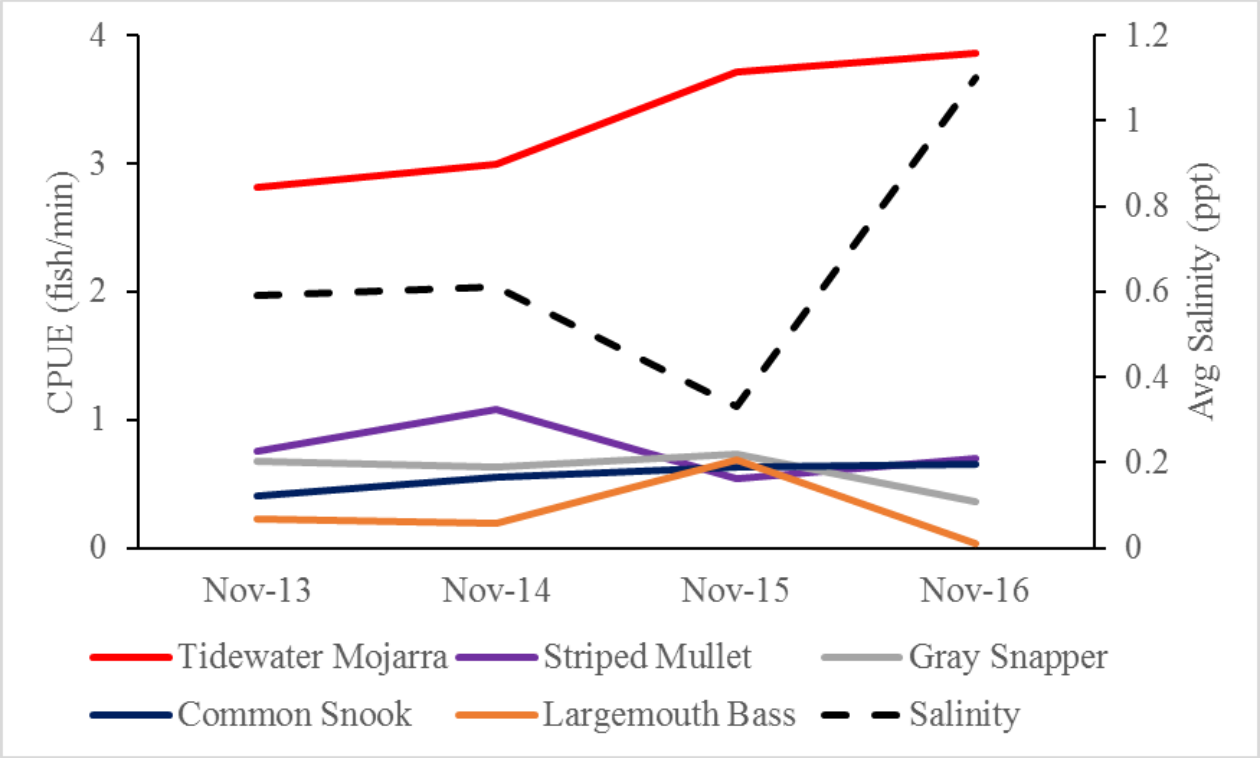

Figure 57. Winter relative abundance (CPUE) of key species in relation to salinity in Zone 1 of the Crystal River/Kings Bay System.

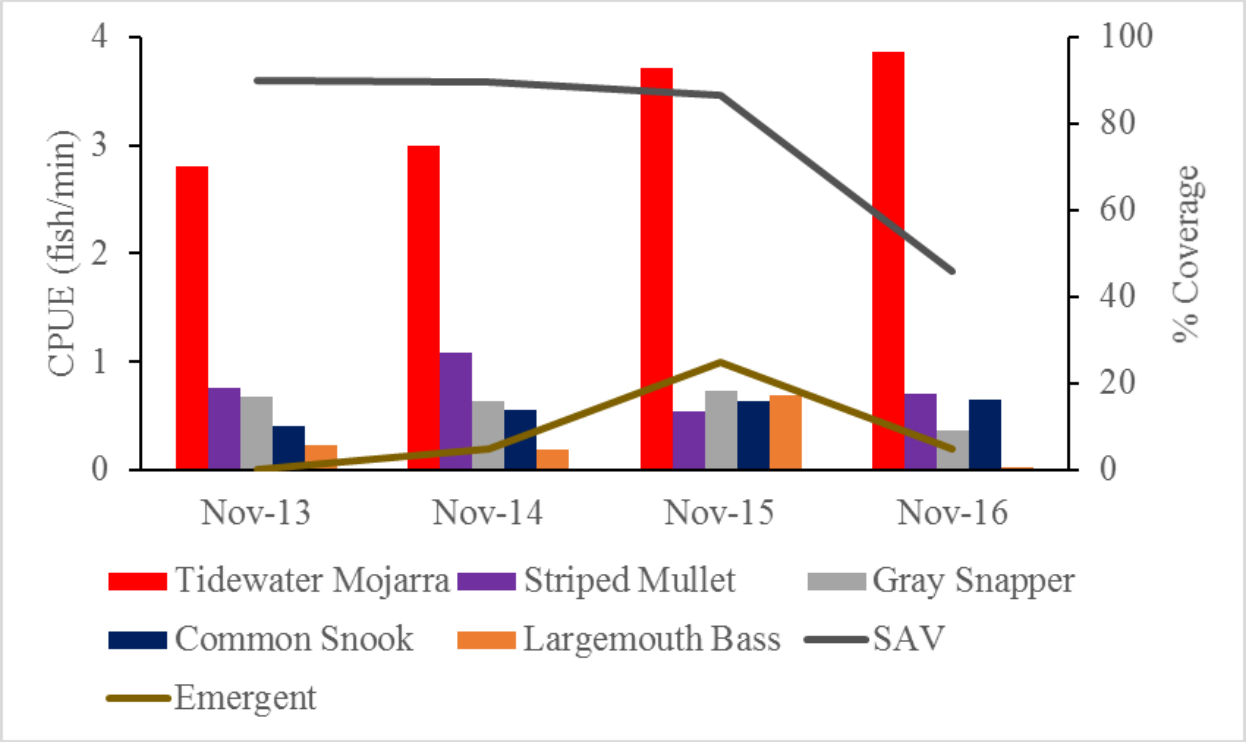

Figure 58. Winter relative abundance (CPUE) of key species in relation to percent habitat coverage in Zone 1 of the Crystal River/Kings Bay System. Emergent = emergent vegetation, SAV = submersed aquatic vegetation.

Winter Zone 2

For Zone 2, Tidewater Mojarra relative abundance dominated all winter sampling events (Figure 59). Of the three key species, Gray Snapper biomass was highest in November 2014 and November 2015, while Largemouth Bass biomass was highest in November 2013 and November 2016 (Figure 60). Tidewater Mojarra abundance was negatively related to salinity and followed a similar trend as SAV (Figures 61 and 62).

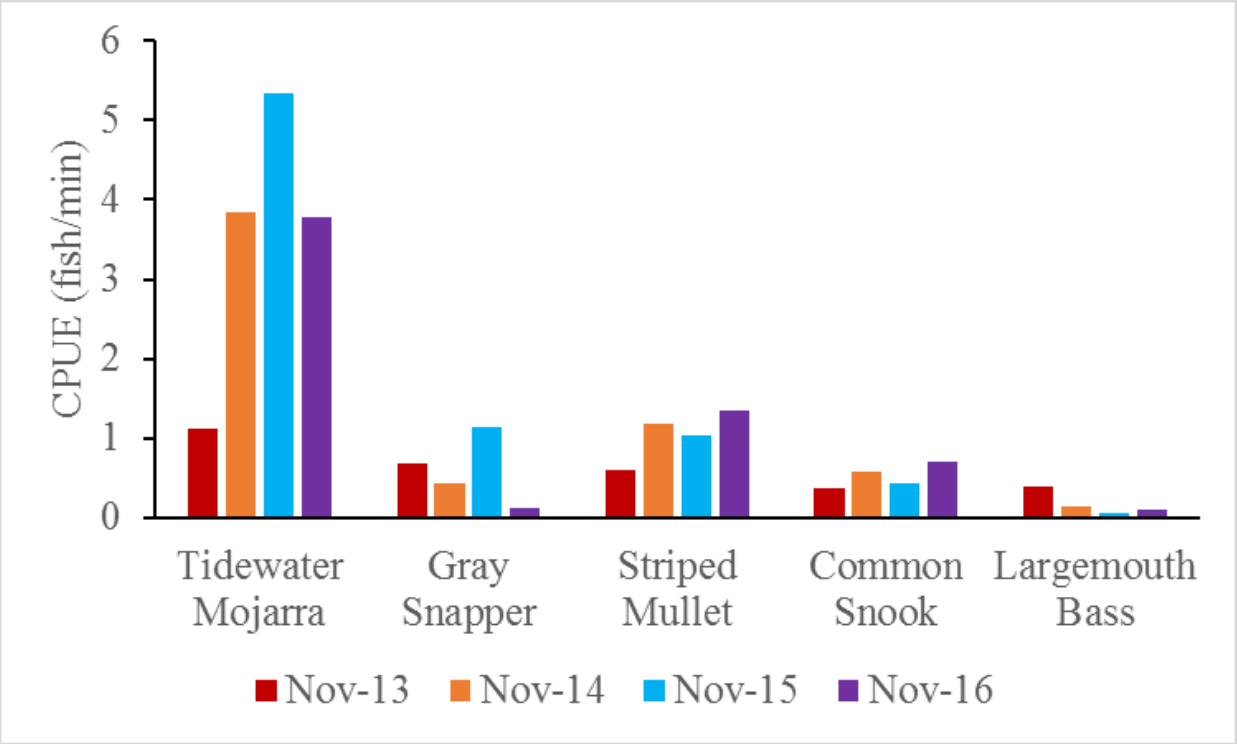

Figure 59. Winter relative abundance (CPUE) of key species in Zone 2 of the Crystal River/Kings Bay System.

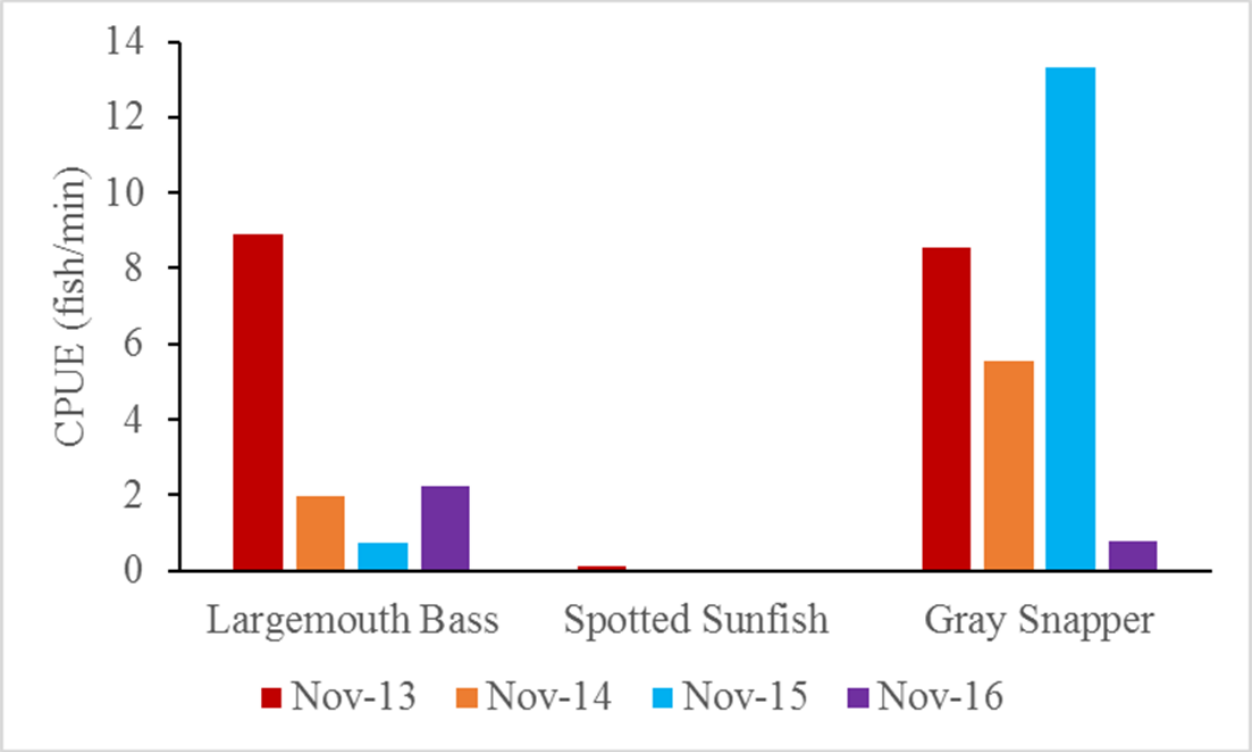

Figure 60. Winter biomass of key species in Zone 2 of the Crystal River/Kings Bay System.

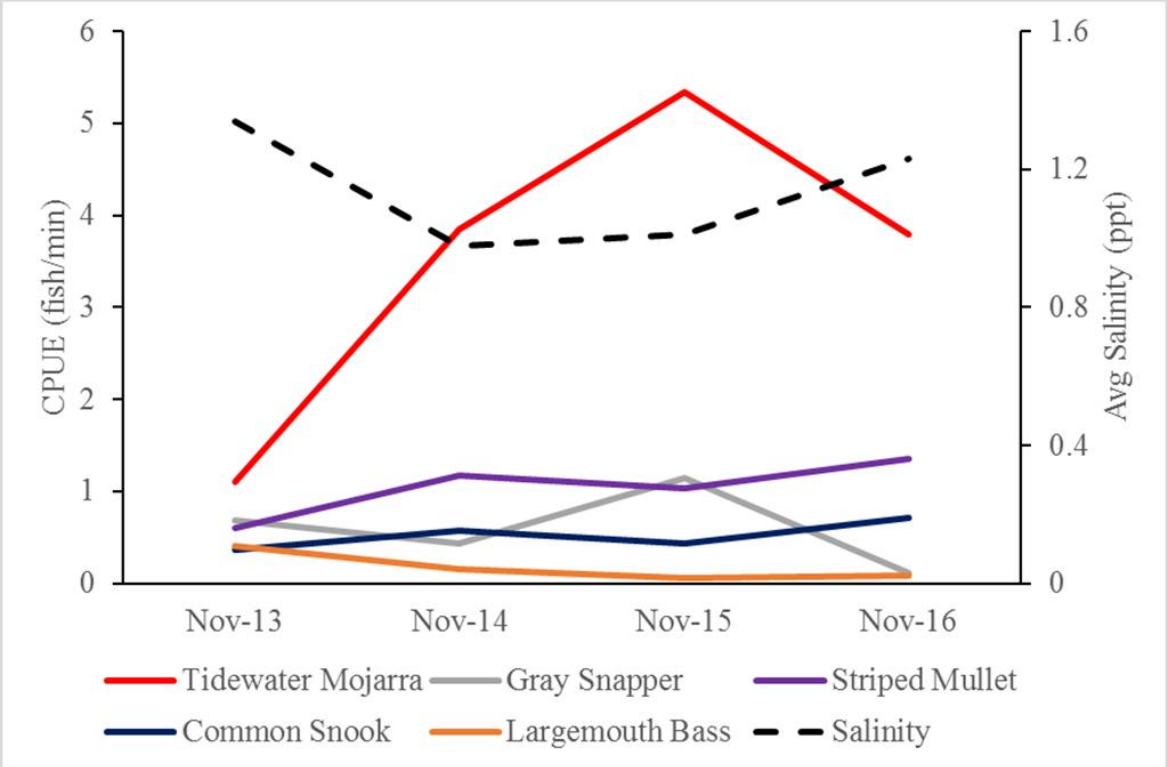

Figure 61. Winter relative abundance (CPUE) of key species in relation to salinity in Zone 2 of the Crystal River/Kings Bay System.

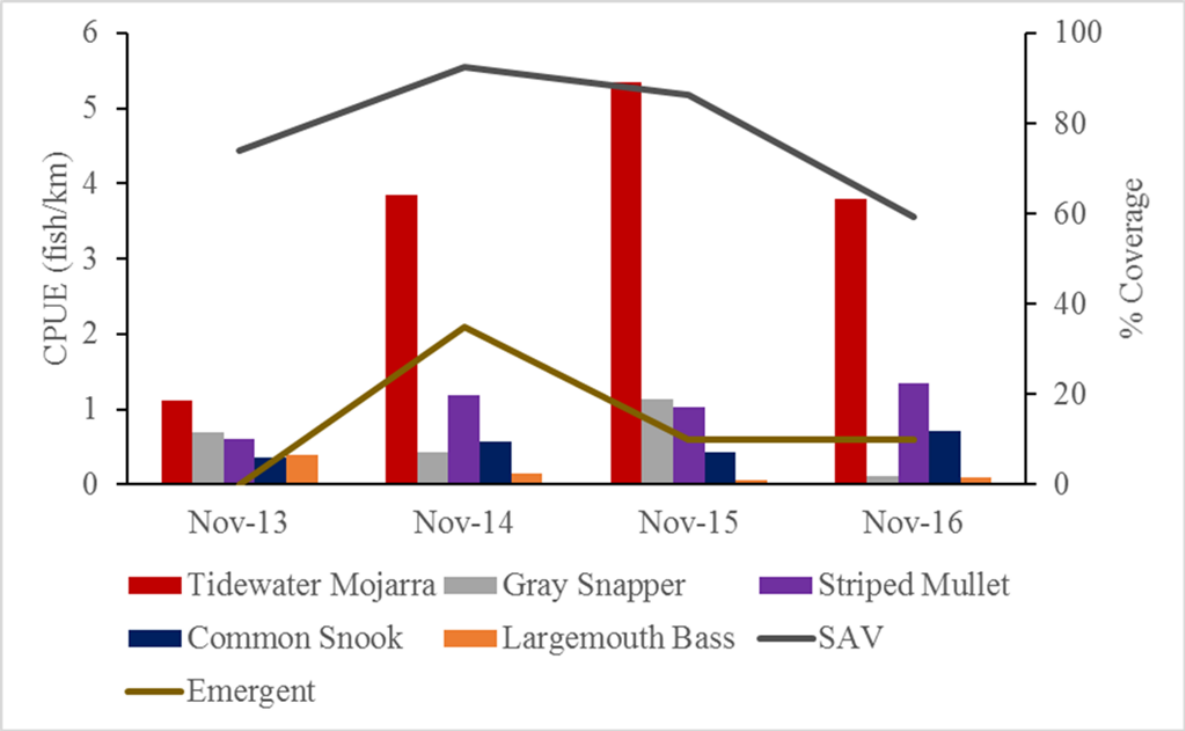

Figure 62. Winter relative abundance (CPUE) of key species in relation to percent habitat coverage in Zone 2 of the Crystal River/Kings Bay System. Emergent = emergent vegetation, SAV = submersed aquatic vegetation.

Winter Zone 3

Tidewater Mojarra had the highest relative abundance in all winter sampling events (Figure 63). Striped Mullet and Largemouth Bass relative abundance had opposite trends. Largemouth Bass biomass was dominant in all sampling events except November 2016, when Gray Snapper biomass was highest (Figure 64). Tidewater Mojarra and Red Drum (*Sciaenops ocellatus*) had an inverse relationship with salinity, while Gray Snapper relative abundance was positively affected (Figure 65). Tidewater Mojarra and Striped Mullet were similarly affected by the presence of emergent and submersed vegetation (Figure 66).

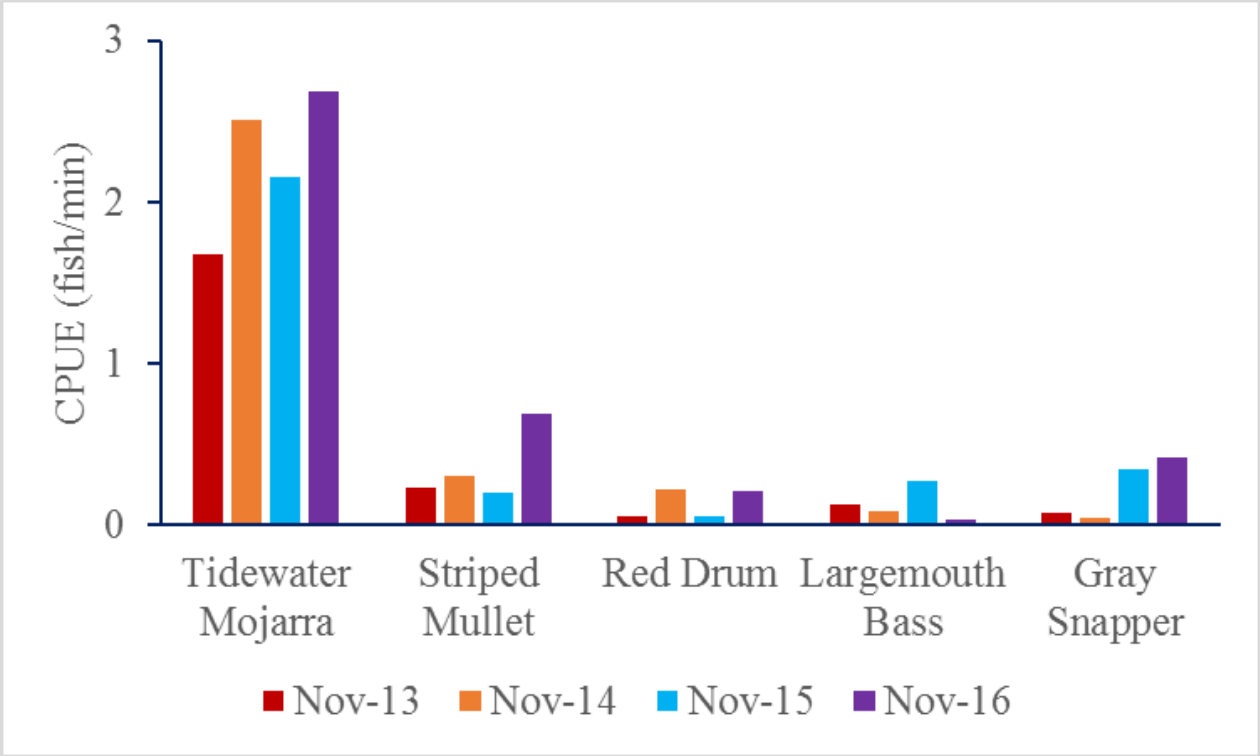

Figure 63. Winter relative abundance (CPUE) of key species in Zone 3 of the Crystal River/Kings Bay System.

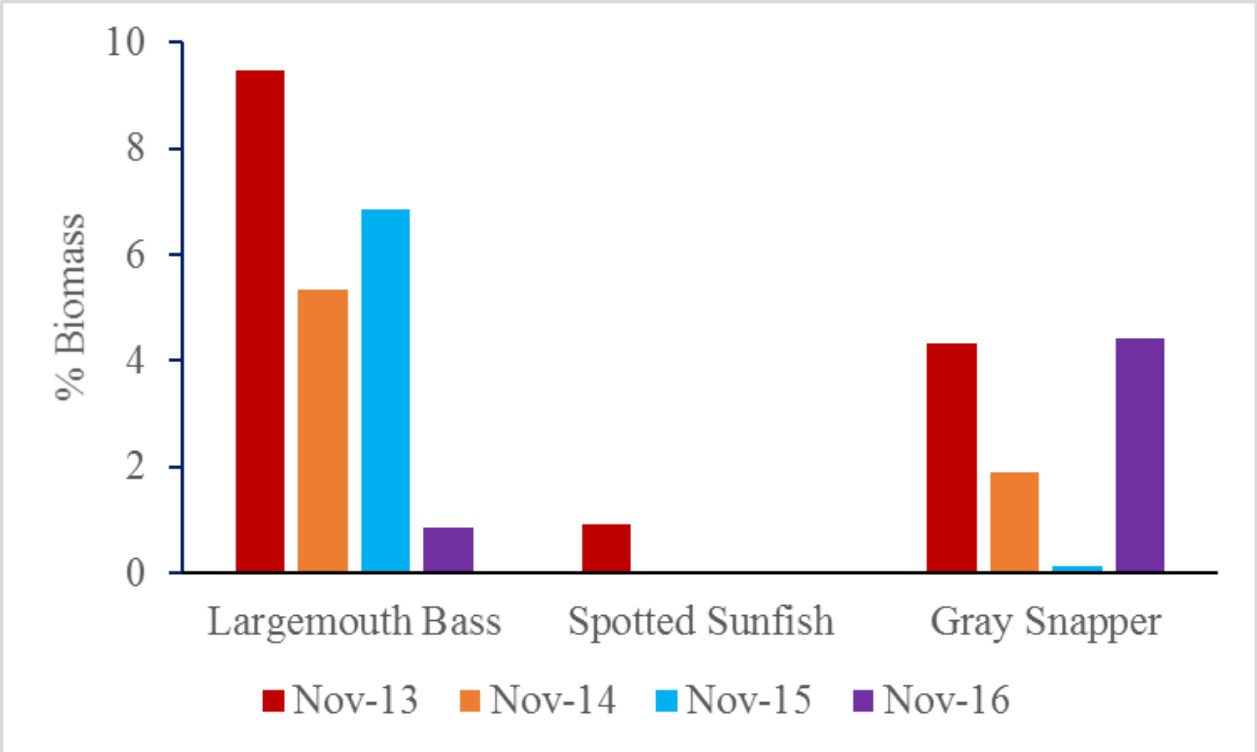

Figure 64. Winter biomass of key species in Zone 3 of the Crystal River/Kings Bay System.

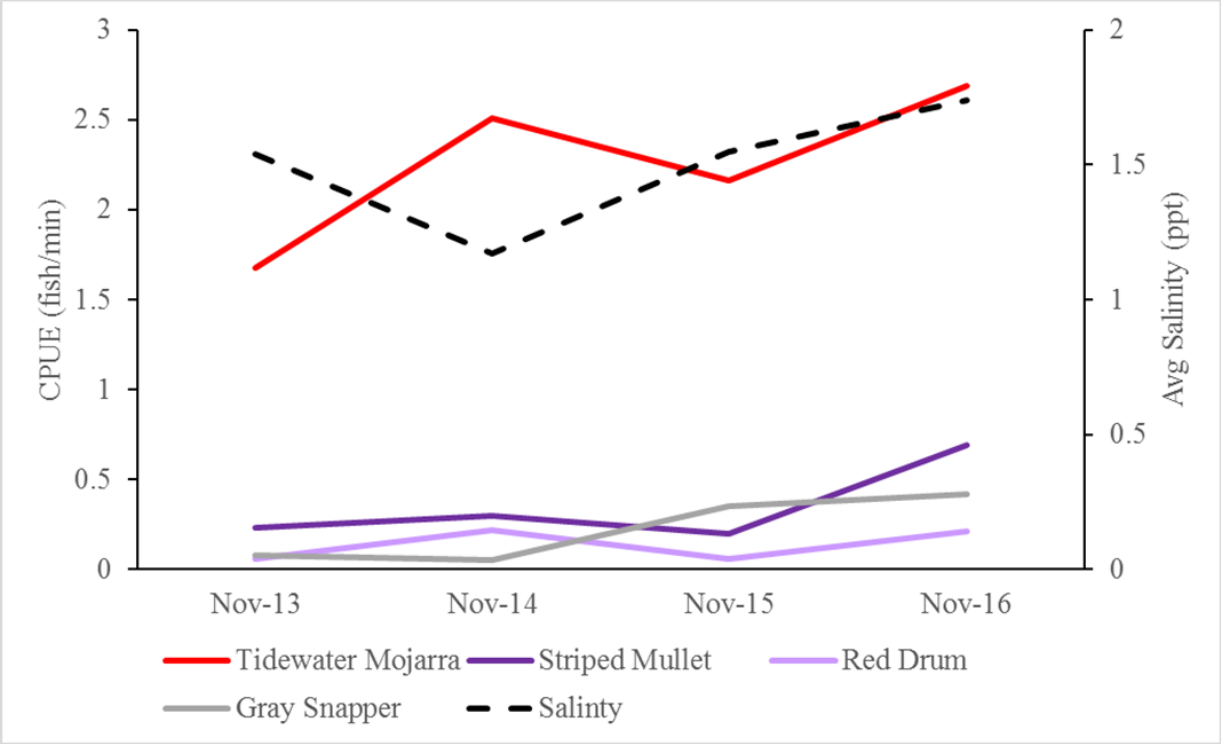

Figure 65. Winter relative abundance (CPUE) of key species in relation to salinity in Zone 3 of the Crystal River/Kings Bay System.

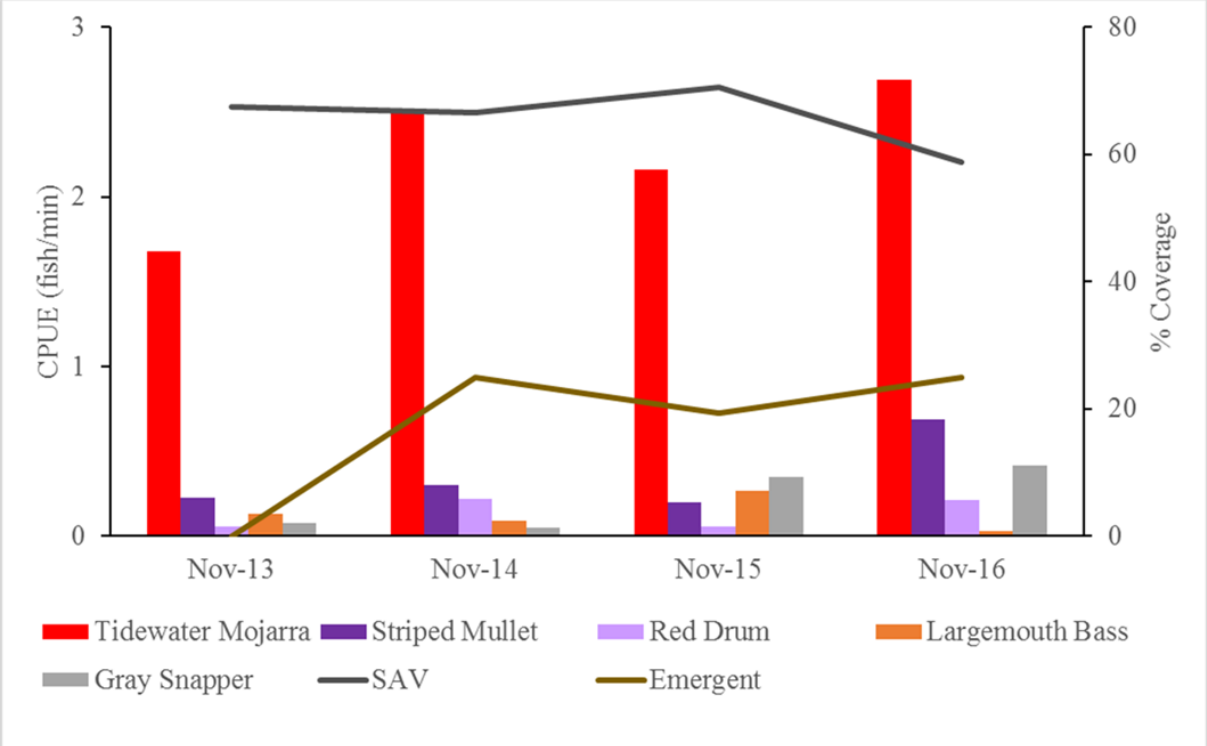

Figure 66. Winter relative abundance (CPUE) of key species in relation to percent habitat coverage in Zone 3 of the Crystal River/Kings Bay System. Emergent = emergent vegetation, SAV = submersed aquatic vegetation.

Summer Zone 1

Tidewater Mojarra relative abundance was highest during all summer sampling events in Zone 1, except for May 2016, when Striped Mullet were most dominant (Figure 67). Largemouth Bass and Gray Snapper biomass exhibited similar relationships over the summer sampling events (Figure 68). Striped Mullet, Common Snook, and Largemouth Bass relative abundance and trends in salinity levels were similar (Figure 69). Gray Snapper were positively affected by the presence of SAV (Figure 70).

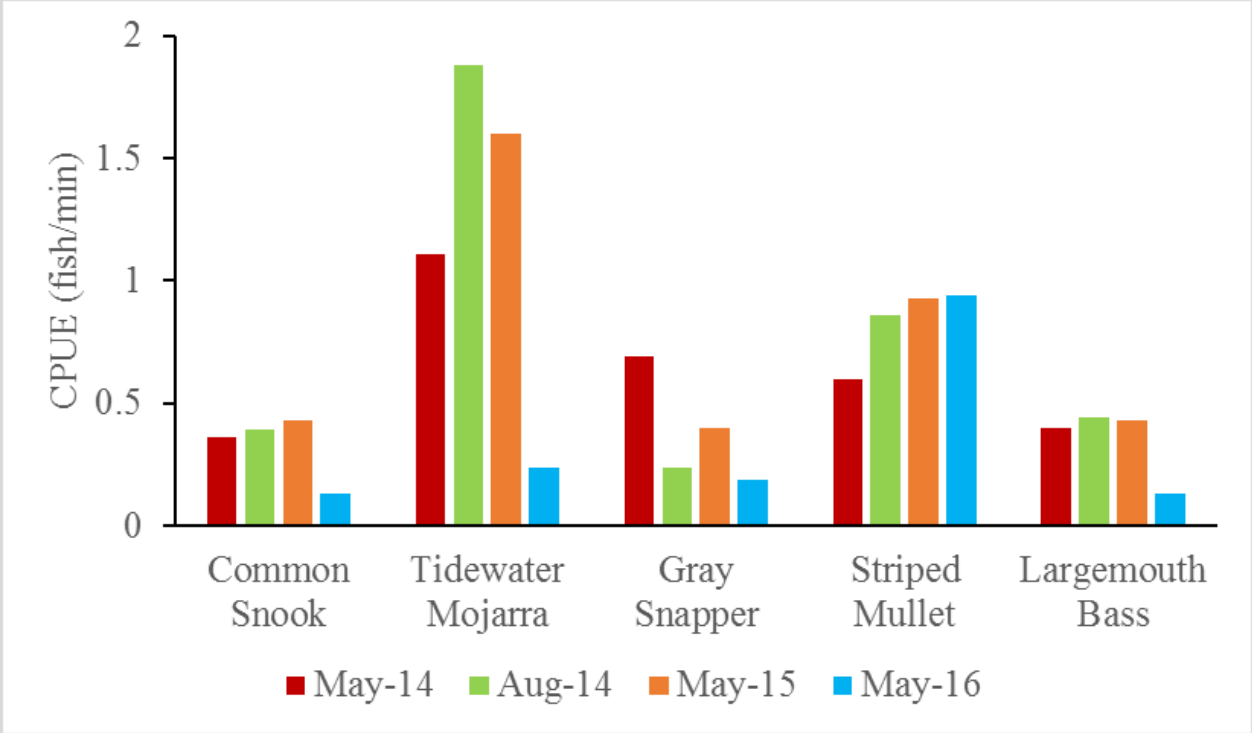

Figure 67. Summer relative abundance (CPUE) of key species in Zone 1 of the Crystal River/Kings Bay System.

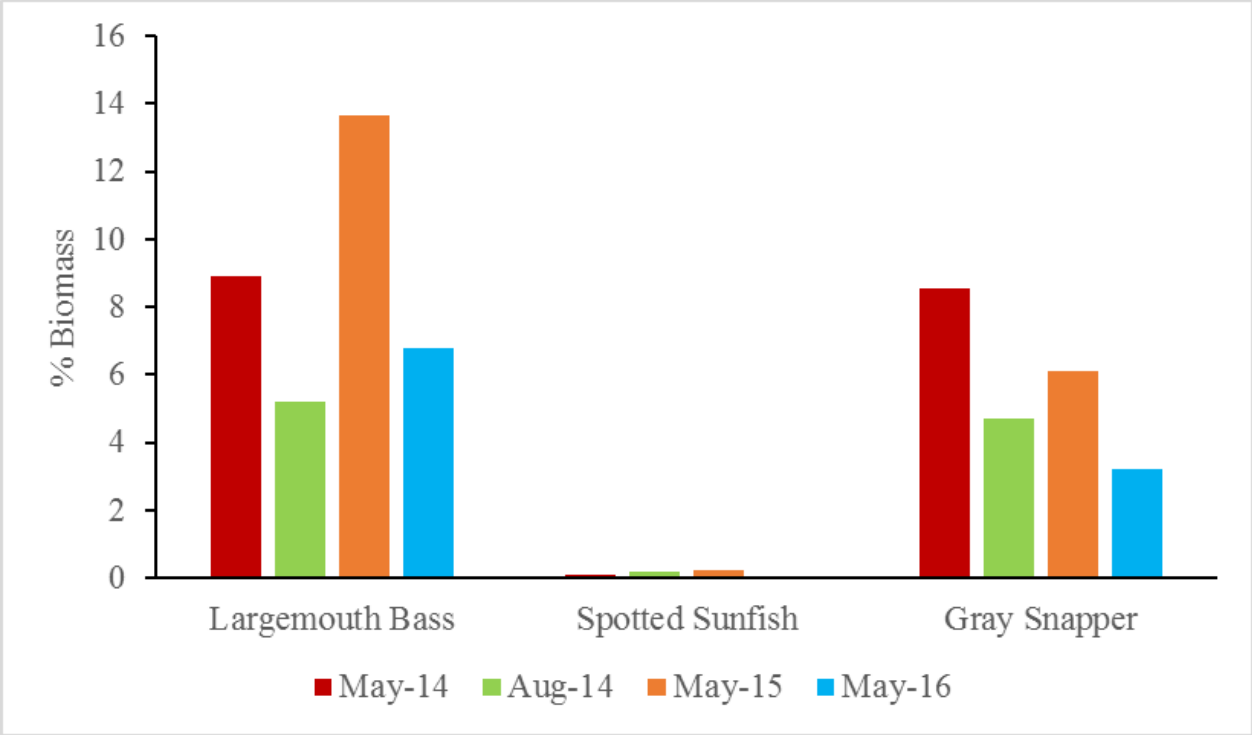

Figure 68. Summer biomass of key species in Zone 1 of the Crystal River/Kings Bay System.

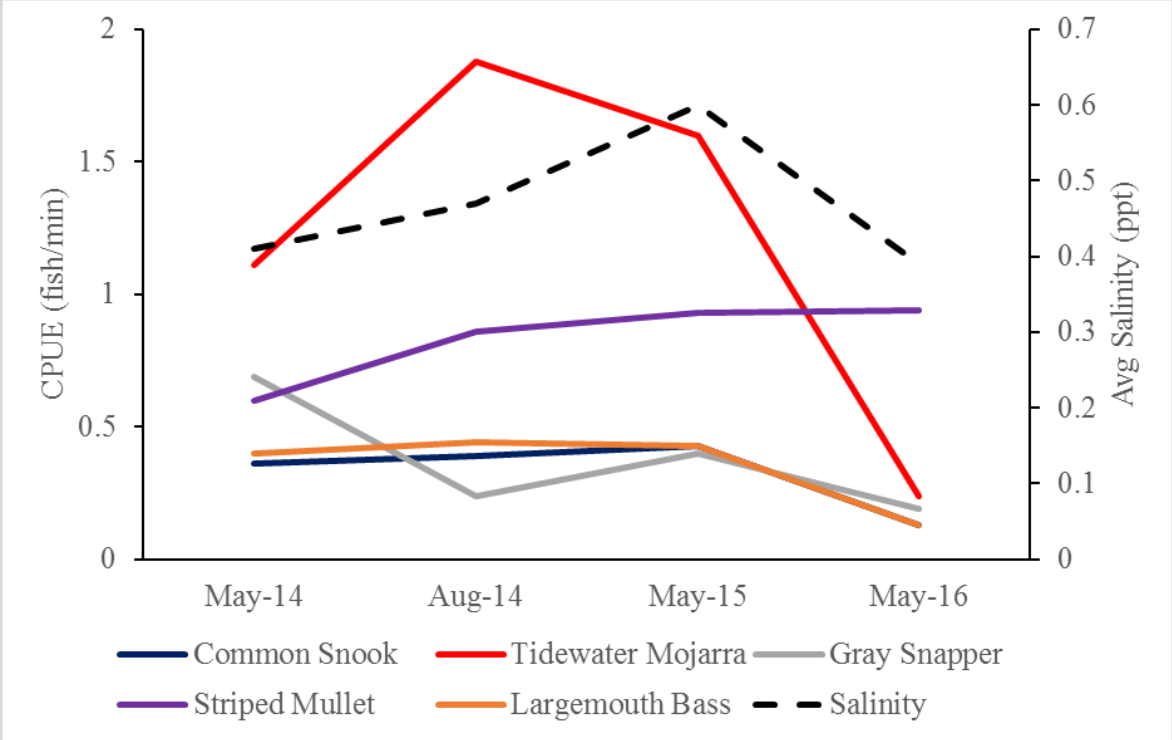

Figure 69. Summer relative abundance (CPUE) of key species in relation to salinity in Zone 1 of the Crystal River/Kings Bay System.

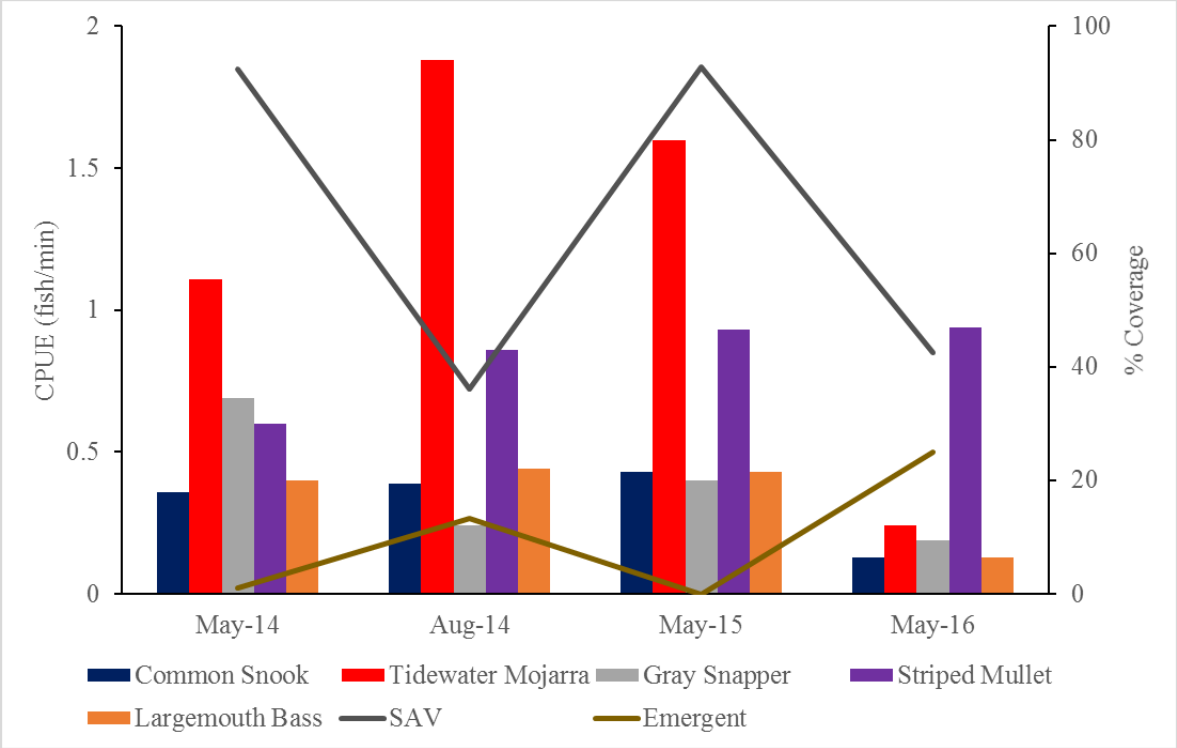

Figure 70. Summer relative abundance (CPUE) of key species in relation to percent habitat coverage in Zone 1 of the Crystal River/Kings Bay System. Emergent = emergent vegetation, SAV = submersed aquatic vegetation.

Summer Zone 2

For Zone 2, Gray Snapper had the highest relative abundance in May 2014, followed by Tidewater Mojarra in August 2014 (Figure 71). Striped Mullet relative abundance was highest in May 2015 and 2016. Largemouth Bass biomass dominated all summer sampling events, except for August 2014 (Figure 72). Striped Mullet and Largemouth Bass were negatively affected by salinity during all summer sampling events in Zone 2 (Figure 73). Tidewater Mojarra were positively affected by the presence of emergent vegetation (Figure 74).

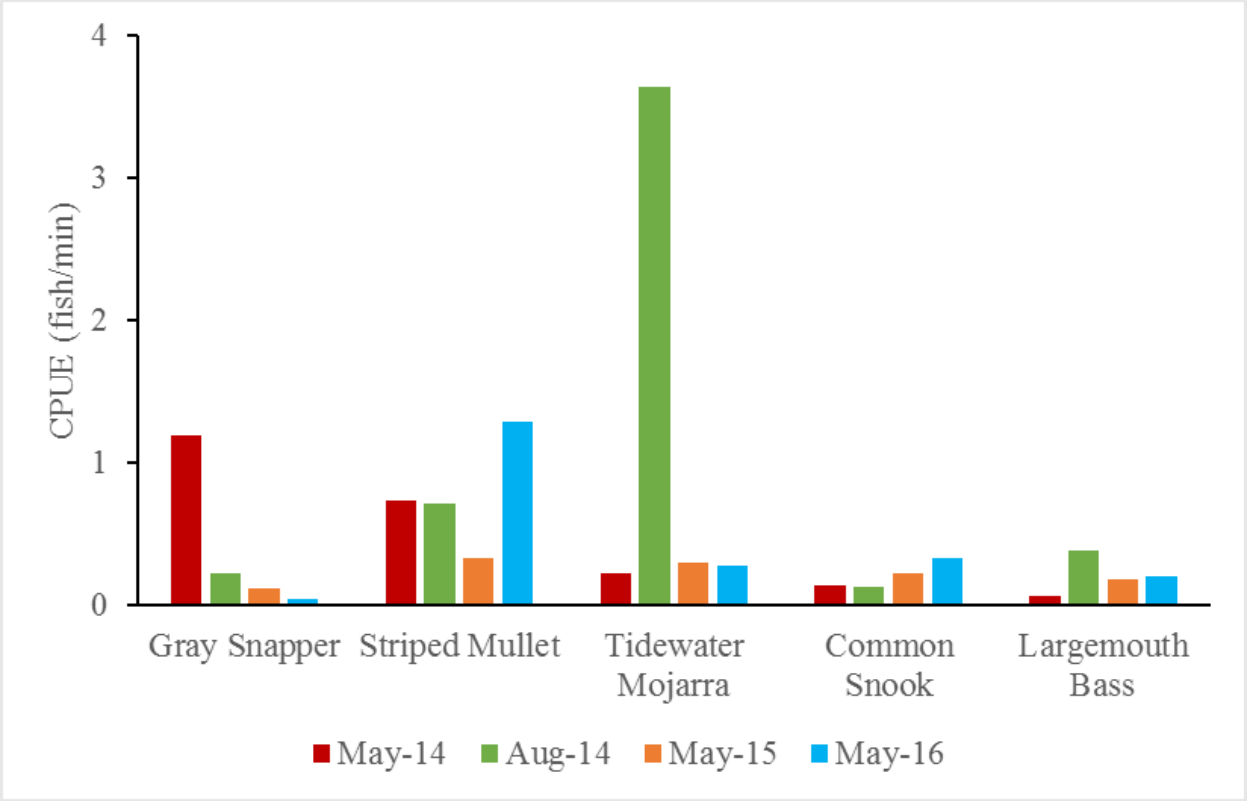

Figure 71. Summer relative abundance (CPUE) of key species in Zone 2 of the Crystal River/Kings Bay System.

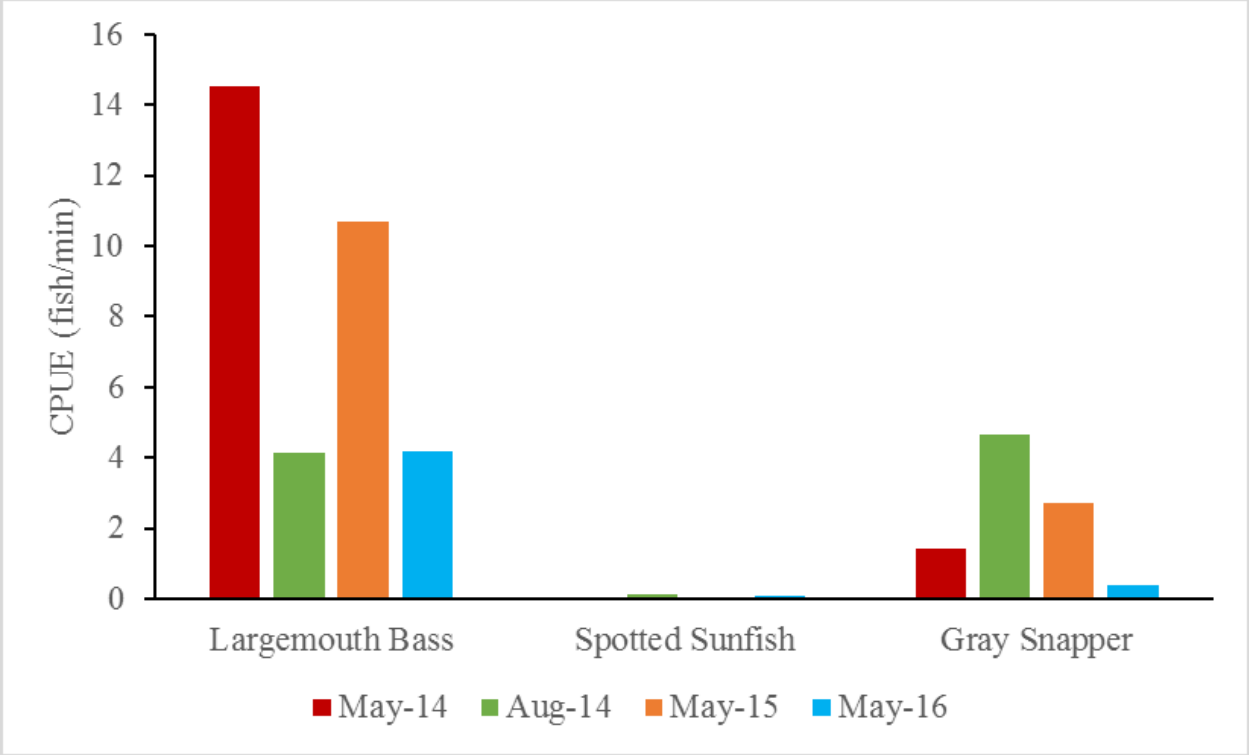

Figure 72. Summer biomass of key species in Zone 2 of the Crystal River/Kings Bay System.

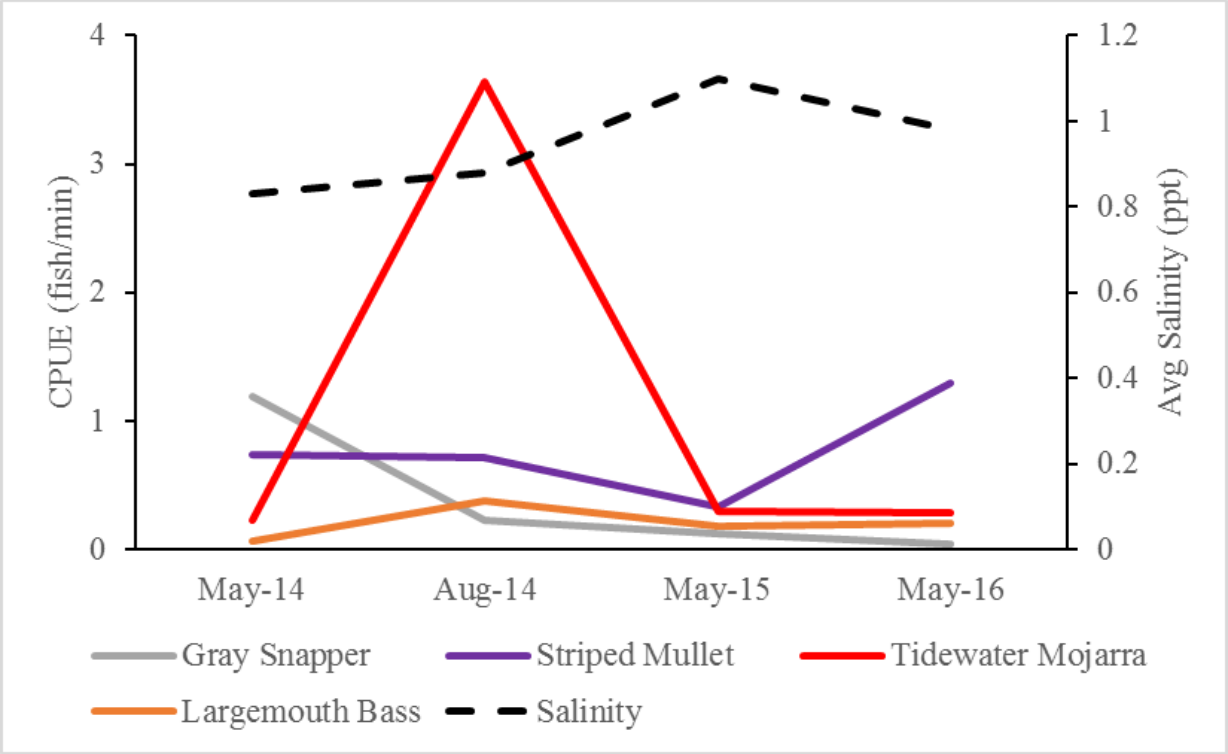

Figure 73. Summer relative abundance (CPUE) of key species in relation to salinity in Zone 2 of the Crystal River/Kings Bay System.

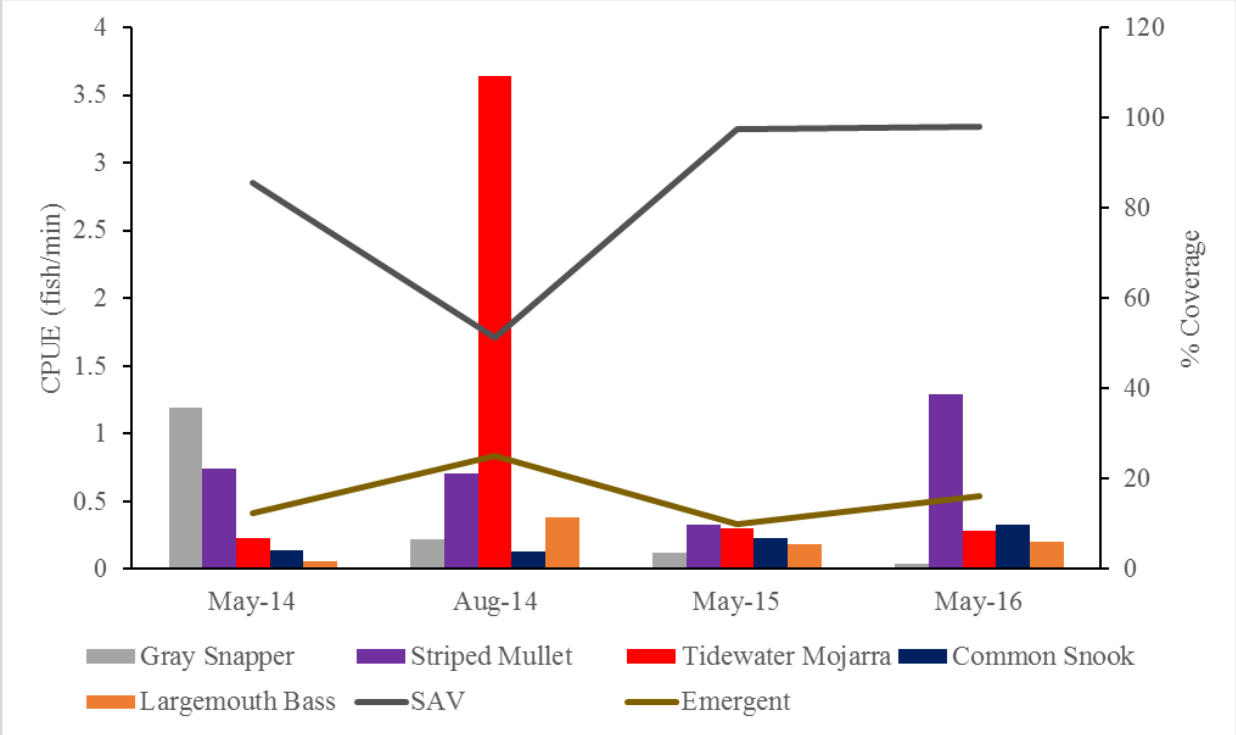

Figure 74. Summer relative abundance (CPUE) of key species in relation to percent habitat coverage in Zone 2 of the Crystal River/Kings Bay System. Emergent = emergent vegetation, SAV = submersed aquatic vegetation.

Summer Zone 3

Gray Snapper had the highest relative abundance in May 2014, followed by Tidewater Mojarra in August 2014 and May 2015; in May 2016, Striped Mullet relative abundance was the highest (Figure 75). Gray Snapper had more biomass during the three sampling events in which Gray Snapper and Largemouth Bass were present (Figure 76). Tidewater Mojarra relative abundance trended with salinity levels, while Gray Snapper trended oppositely (Figure 77). Gray Snapper was positively affected by SAV, while emergent vegetation positively affected Striped Mullet relative abundance (Figure 78).

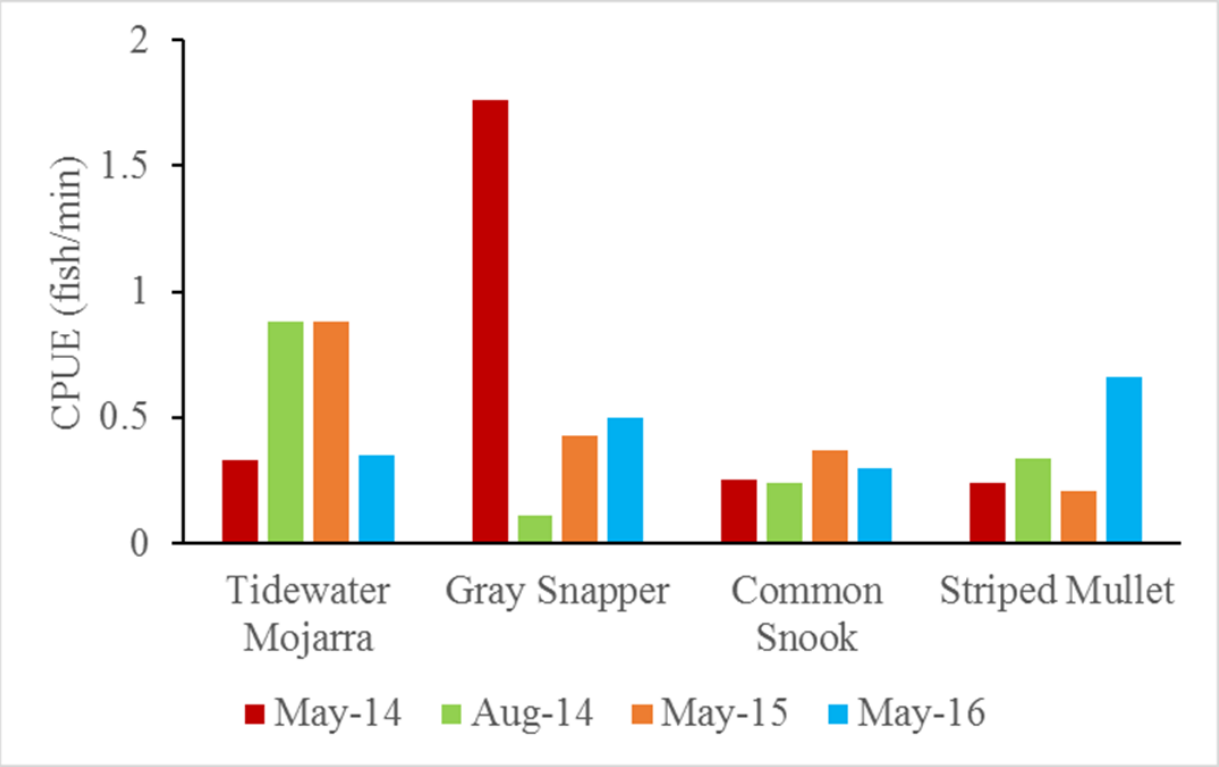

Figure 75. Summer relative abundance (CPUE) of key species in Zone 3 of the Crystal River/Kings Bay System.

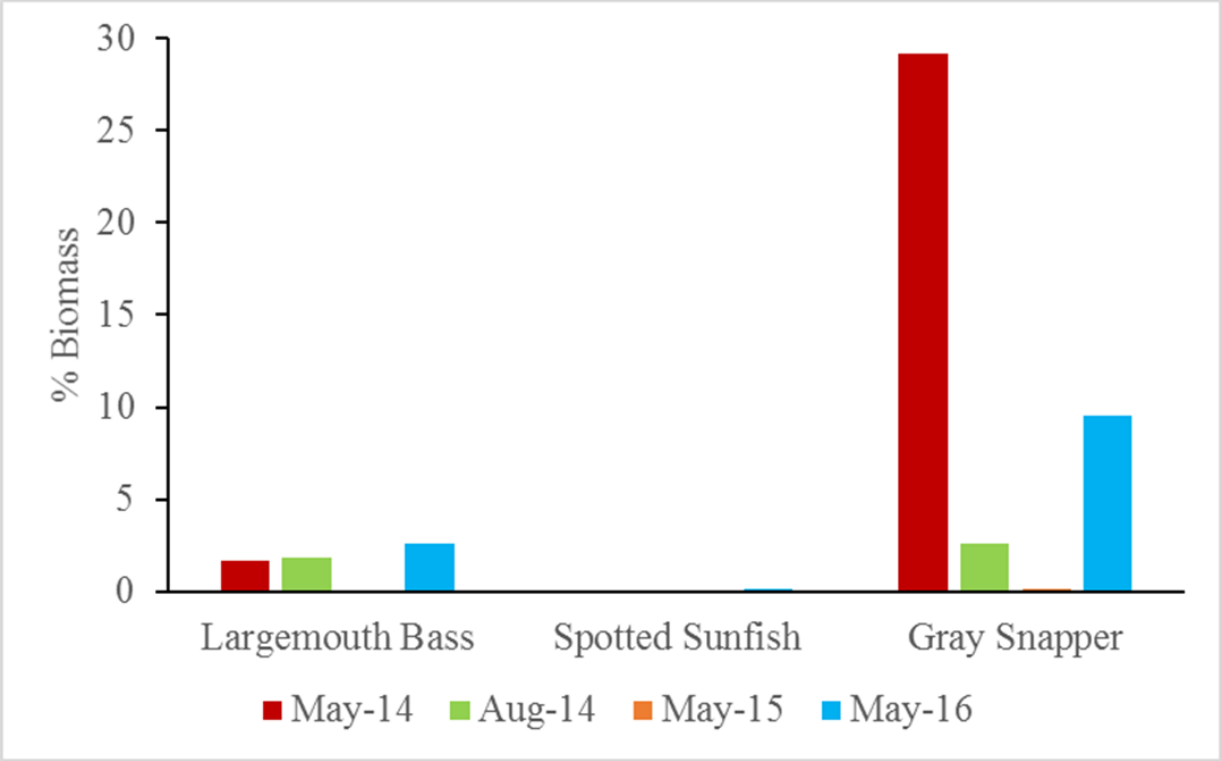

Figure 76. Summer biomass of key species in Zone 3 of the Crystal River/Kings Bay System.

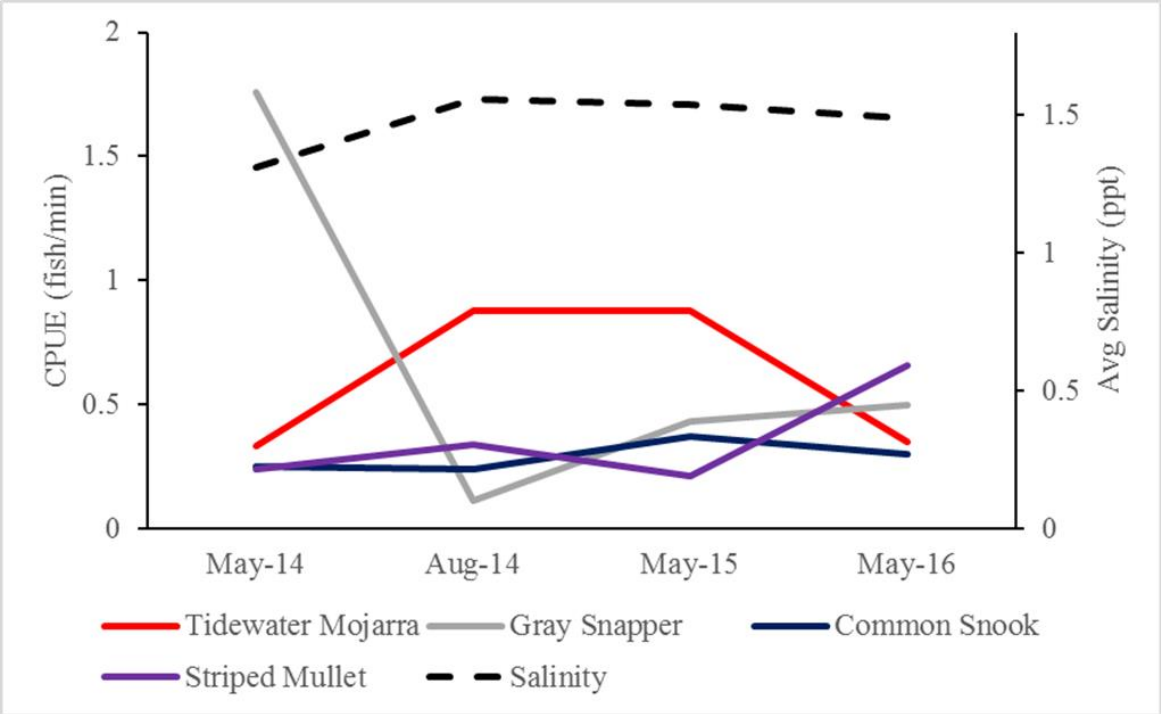

Figure 77. Summer relative abundance (CPUE) of key species in relation to salinity in Zone 3 of the Crystal River/Kings Bay System.

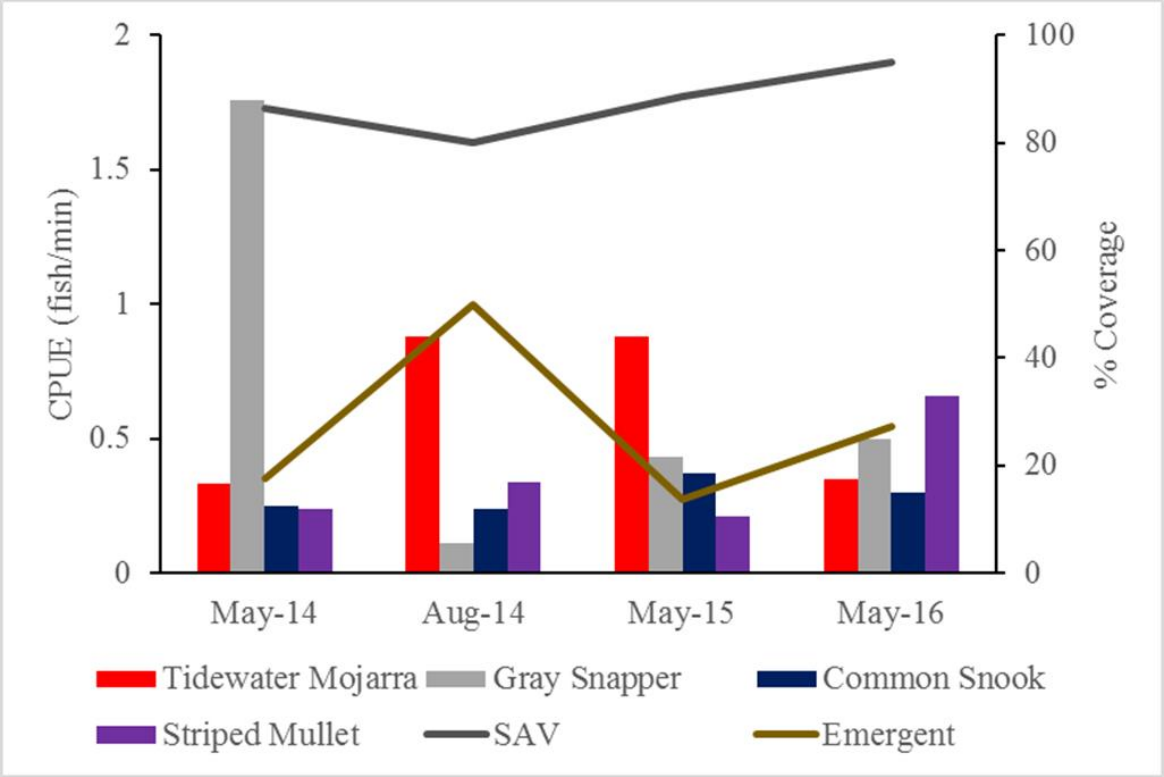

Figure 78. Summer relative abundance (CPUE) of key species in relation to percent habitat coverage in Zone 3 of the Crystal River/Kings Bay System. Emergent = emergent vegetation, SAV = submersed aquatic vegetation.

Rainbow River

Previous Study Comparisons

We collected 34 freshwater species and 1 marine species from the Rainbow River System (Table 38, Appendix A). The FLMNH collected 19 freshwater fish species in 1991, including the Flagfish (*Jordanella floridae*), which we did not collect in our study.

Previous fish community sampling was conducted by FWC Regional staff from 1989-1992. Staff used similar sampling methods and equipment, which resulted in the collection of most fish species that we found (Table 38, Appendix A). In the 1989-1992 collections, 29 fish species were collected, while 35 species of fish were collected in our study.

Walsh and Williams (2003) collected 20 freshwater fish species using a combination of boat-mounted electroshock fishing, snorkel and mask counts, seining, and dip nets. Collections were localized near the headsprings. All 20 fish species were collected in our study (Table 38, Appendix A).

Wetland Solutions, Inc. (2010) studied the ecology of 12 of Florida's spring-fed rivers. Their fish data were collected using mask and snorkel observations and/or Self Contained Underwater Breathing Apparatus (SCUBA) gear. Sampling was localized near the headsprings. They observed 17 fish species, all of which were collected in our study (Table 38, Appendix A).

Species Composition

The Rainbow River System differs from the other systems in this study, as it has no saltwater influence. With the exception of Atlantic Needlefish, all fish collected from this system during the study are considered freshwater species (Table X, Appendix A).

Non-metric Multidimensional Scaling

All pairwise comparisons of fish assemblages between winter and summer months were not significantly different (all $P > 0.05$).

Seasonal & Temporal Relative Abundance v. Habitat & Water Quality
Zone 1

Spotted Sunfish had the highest relative abundance for all sampling events in Zone 1 (Figure 79). Eastern Mosquitofish (*Gambusia holbrooki*) and Bluegill relative abundance decreased from 2014 through 2017. Of the three key species, biomass was highest for Largemouth Bass in Zone 1 (Figure 80). Eastern Mosquitofish displayed a positive relationship with flow levels (Figure 81). Largemouth Bass abundance trended with SAV presence (Figure 82).

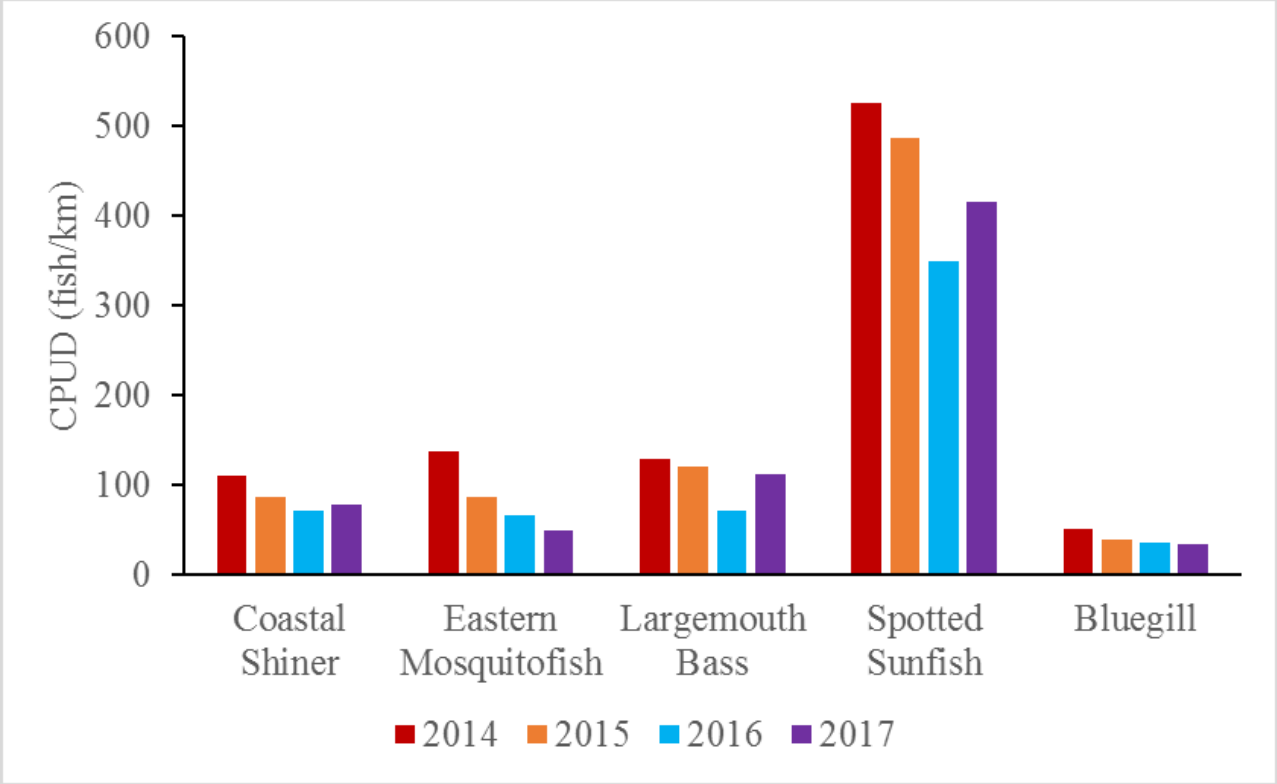

Figure 79. Relative abundance (CPUD) of key species in Zone 1 of the Rainbow River System.

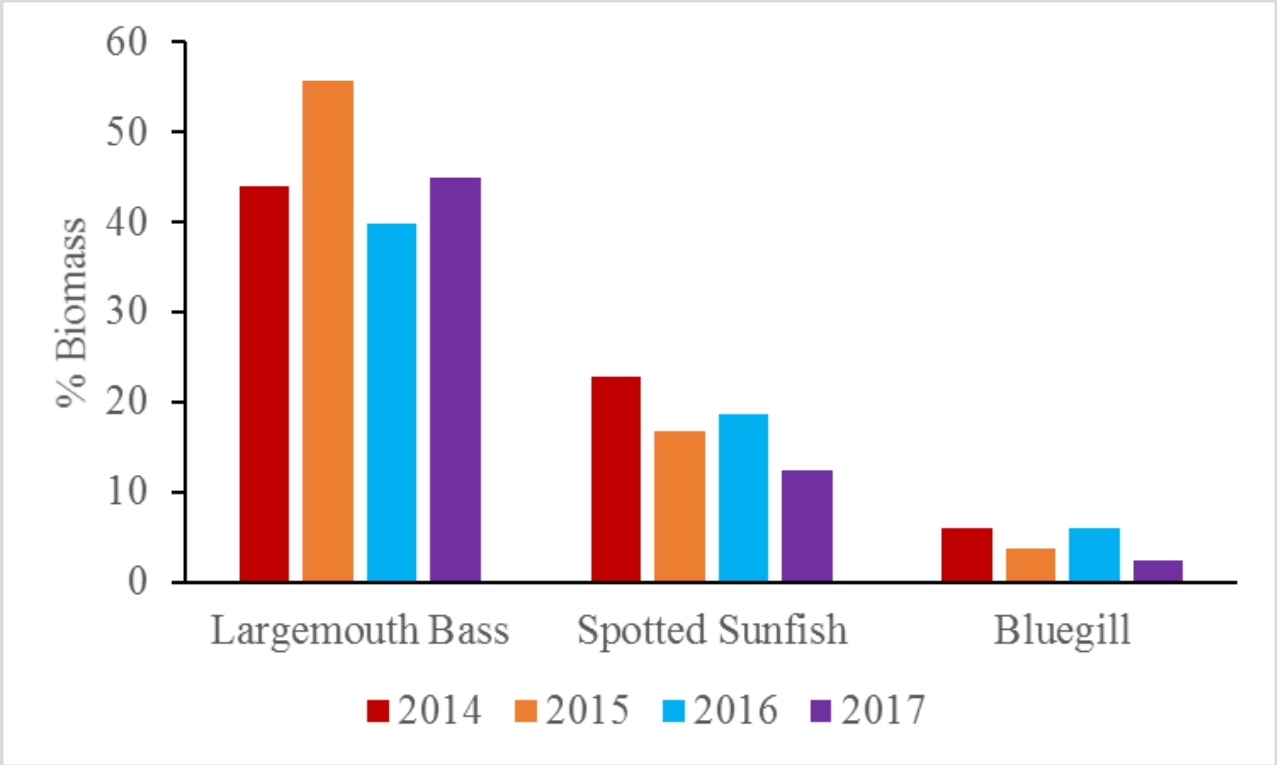

Figure 80. Biomass of key species in Zone 1 of the Rainbow River System.

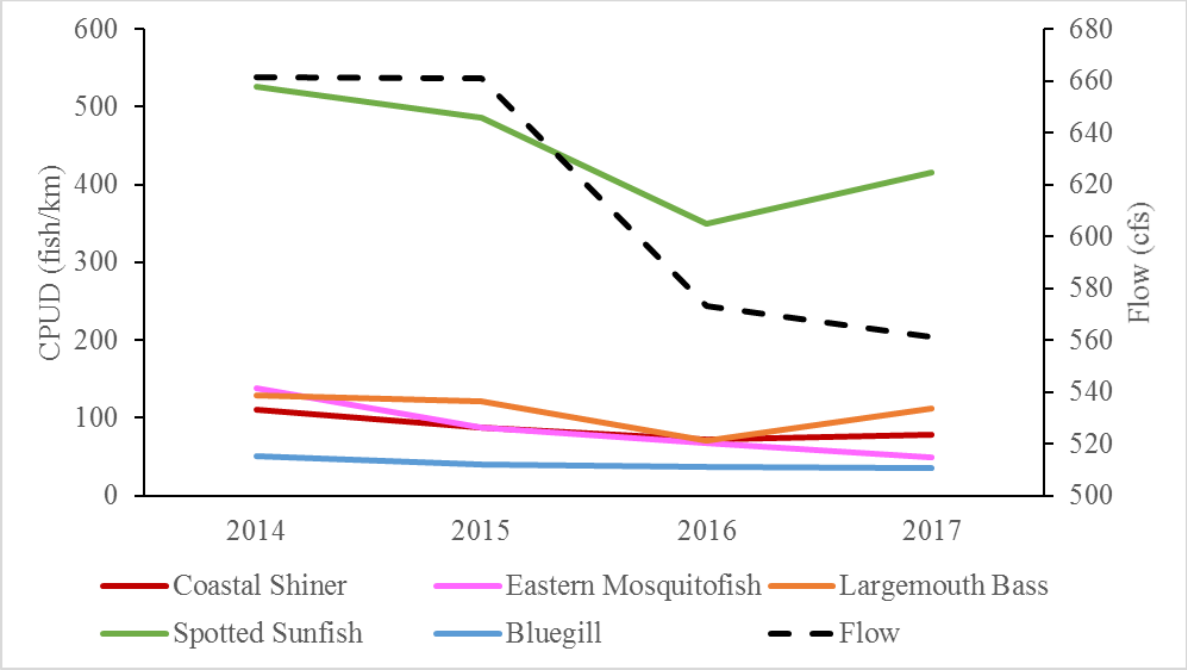

Figure 81. Relative abundance (CPUD) of key species in relation to average flow in Zone 1 of the Rainbow River System.

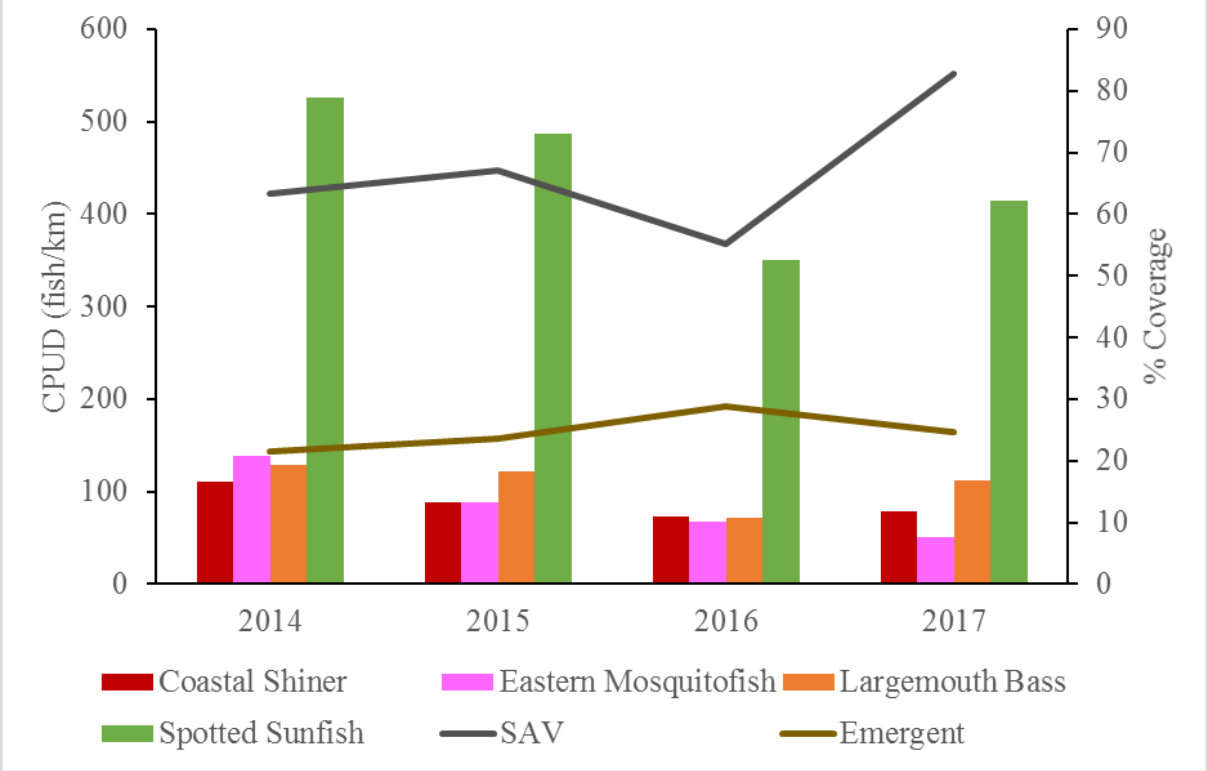

Figure 82. Relative abundance (CPUD) of key species in relation to percent habitat coverage in Zone 1 of the Rainbow River System. Emergent = emergent vegetation, SAV = submersed aquatic vegetation.

Zone 2

Similar to Zone 1, Spotted Sunfish had the highest relative abundance for all years in Zone 2 (Figure 83). Largemouth Bass relative abundance remained consistent throughout the study duration. Largemouth Bass biomass dominated throughout the study (Figure 84). Coastal Shiner (*Notropis petersoni*) relative abundance trended with flow (Figure 85). Largemouth Bass and Coastal Shiner relative abundance was affected by the presence of SAV(Figure 86).

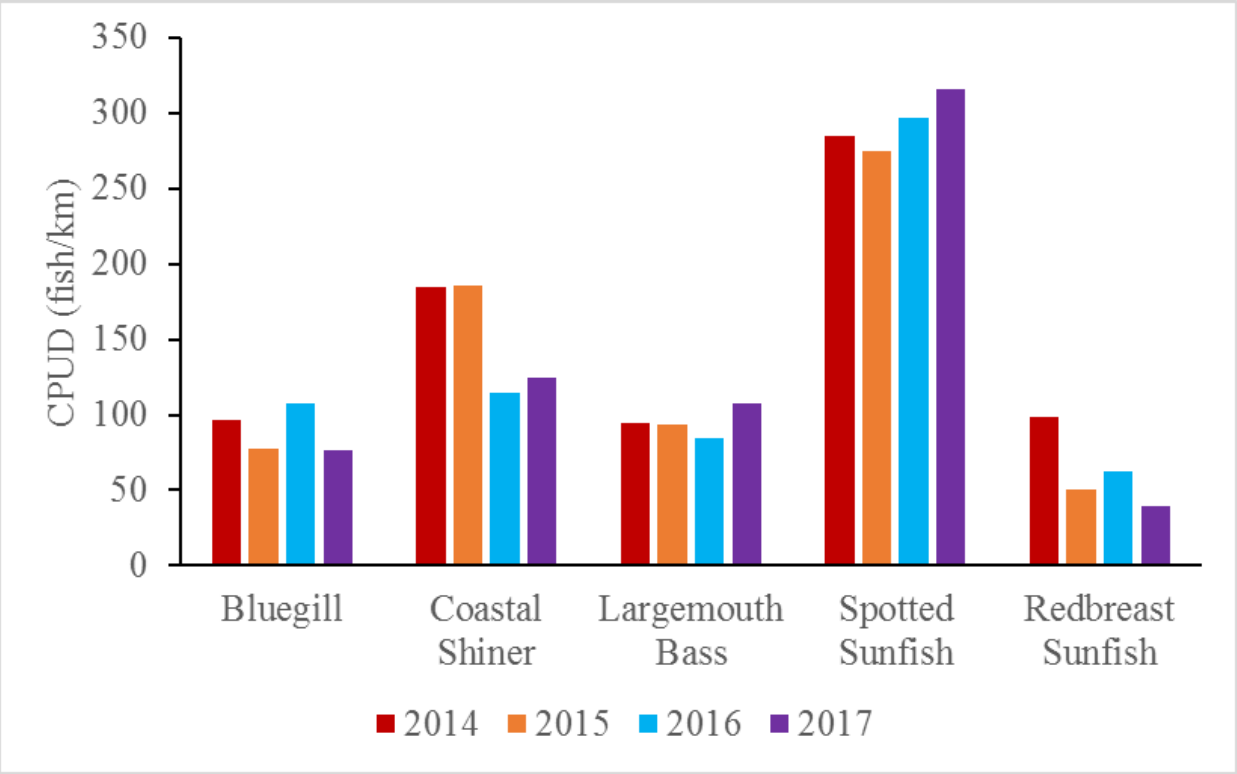

Figure 83. Relative abundance (CPUD) values for key species in Zone 2 of the Rainbow River System.

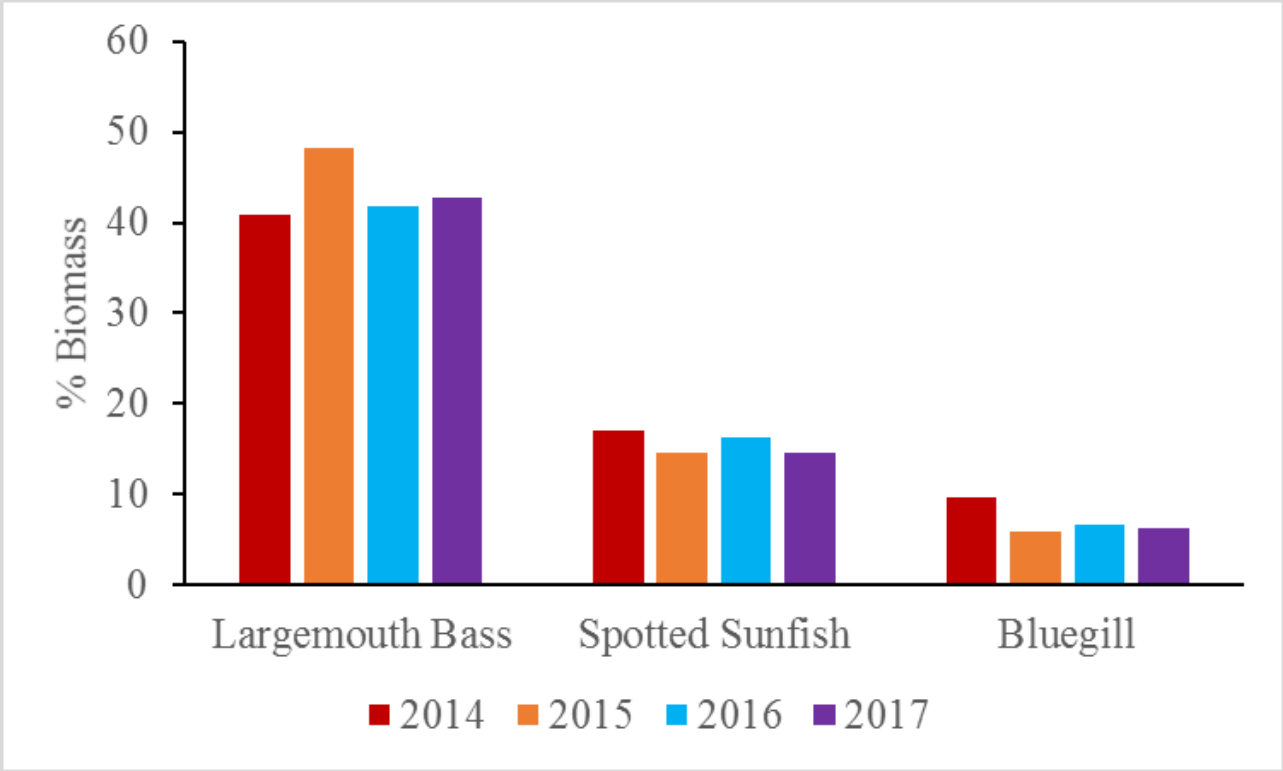

Figure 84. Biomass of key species in Zone 2 of the Rainbow River System.

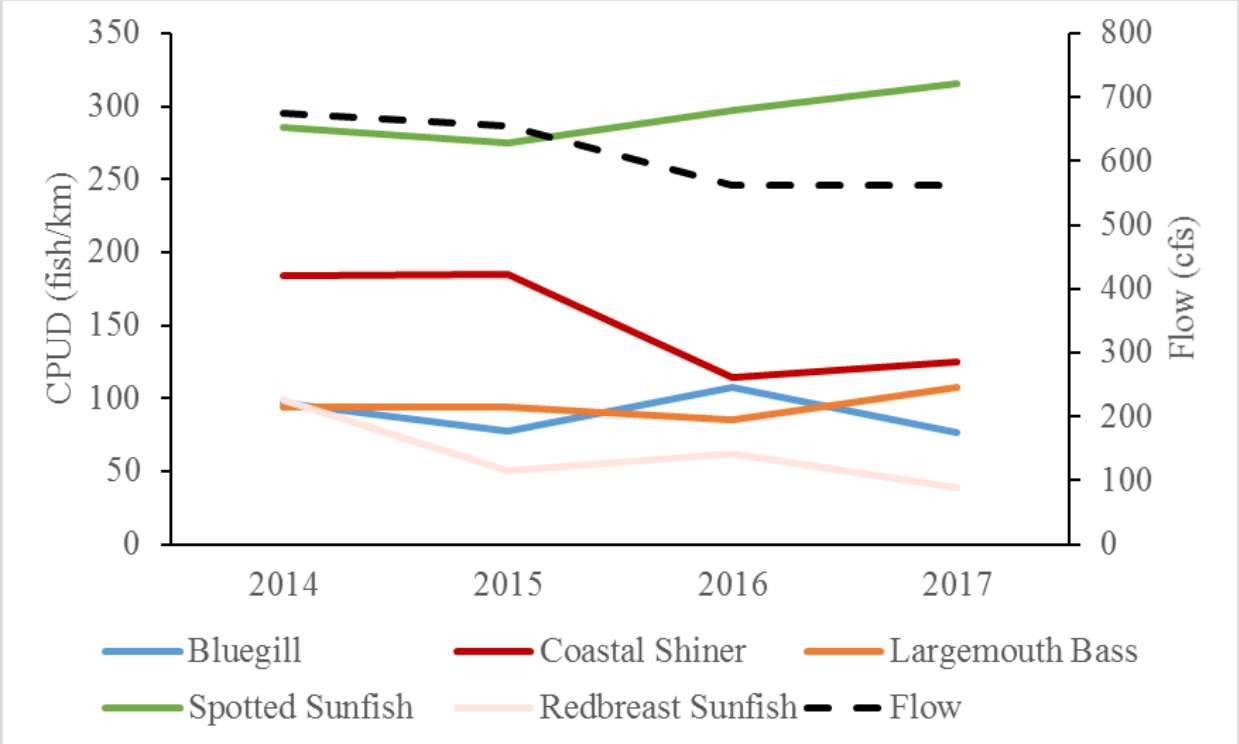

Figure 85. Relative abundance (CPUD) of key species in relation to average flow in Zone 2 of the Rainbow River System.

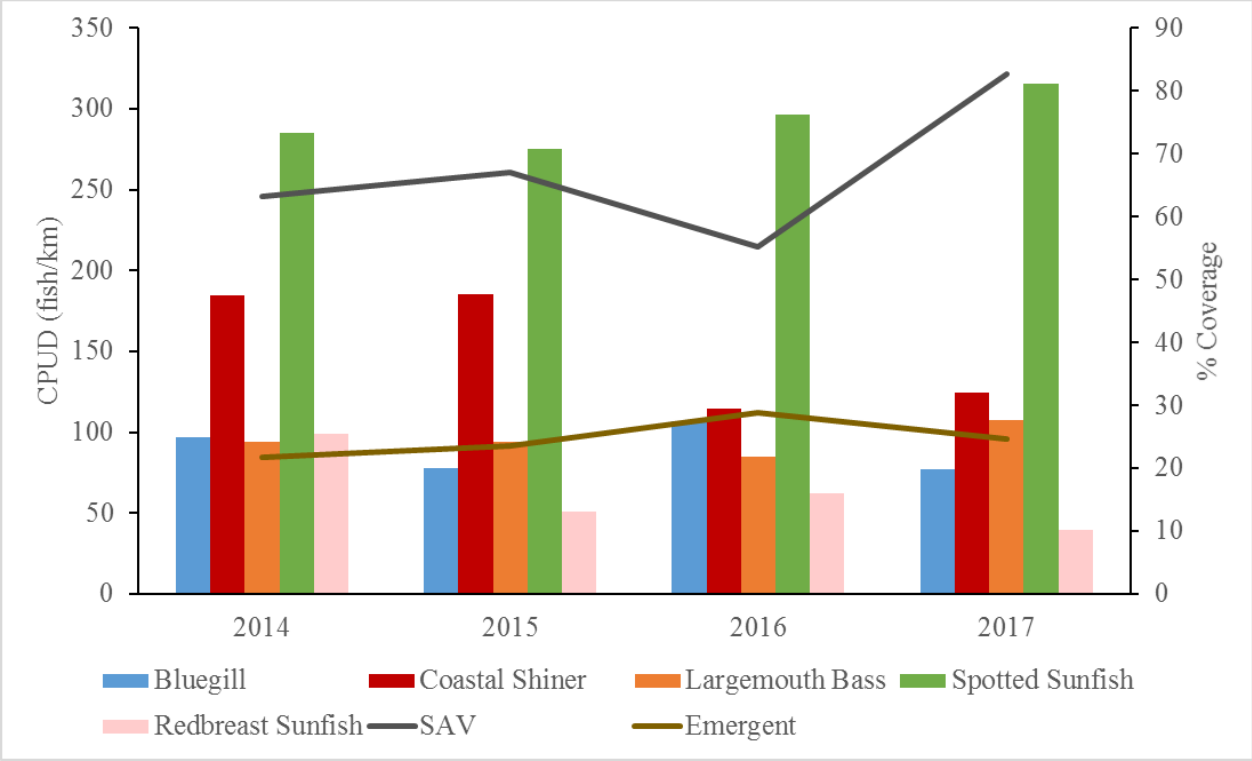

Figure 86. Relative abundance of key species in relation to percent habitat coverage in Zone 2 of the Rainbow River System. Emergent = emergent vegetation, SAV = submersed aquatic vegetation.

Weeki Wachee River

Previous Study Comparisons

We collected 21 freshwater species and 21 marine species from the Weeki Wachee River System (Table 46, Appendix A).

Previous fish community sampling on the Weeki Wachee River System was done by FWC Regional staff in 1984, 1991, and 2005. Sampling trips were completed in one day without a specific sampling protocol or study design. In 1984, 13 fish species were collected: 11 freshwater and two marine. In 1991, 13 species were collected: ten freshwater and three marine, while in 2005, 16 species were collected: 11 freshwater and five marine. Due to the non-systematic nature of the fish species surveys, many freshwater and marine species found in the

current study were not documented in previous regional sampling events (Table 46, Appendix A).

Using mask and snorkel and/or SCUBA equipment, Wetland Solutions, Inc. (2010) surveyed fish species presence near the headsprings of the Weeki Wachee River System. They observed 13 species: seven freshwater and six marine. All of these fish species were also collected in our study (Table 46, Appendix A).

Species Composition

The total fish species composition of the Weeki Wachee River System was 82% freshwater and 18% marine. The river system had a very clear divide, with a 76% freshwater species composition in Zone 1 versus 74% marine species composition in Zone 2 (Figure 109, Appendix B). Seasonally, Zones 1 and 2 had a 31% marine and 69% freshwater composition for both the winter and summer, despite their compositional differences zonally (Figure 109, Appendix B).

Non-metric Multidimensional Scaling

All pairwise comparisons of fish assemblages between winter and summer months were significantly different (all $P \leq 0.004$). Though statistically different, we found little variability in fish assemblages between seasons from this system (Zone 1 $R^2 = 0.1$; Zone 2 $R^2 = 0.2$; Figure 141, Appendix B). Average abundances were generated from the five fish species that attributed the most variability in each zone between winter and summer sampling events (Figure 142, Appendix B).

Seasonal & Temporal Relative Abundance v. Habitat & Water Quality
Winter Zone 1

Spotted Sunfish had the highest relative abundance for all years during the winter in Zone 1; however, decreases in their relative abundance and biomass were observed throughout the study (Figures 87 and 88). Coastal Shiners exhibited a negative relationship with salinity (Figure 89). Conversely, Tidewater Mojarra were positively affected by salinity, as well as emergent vegetation presence (Figure 89 and 90).

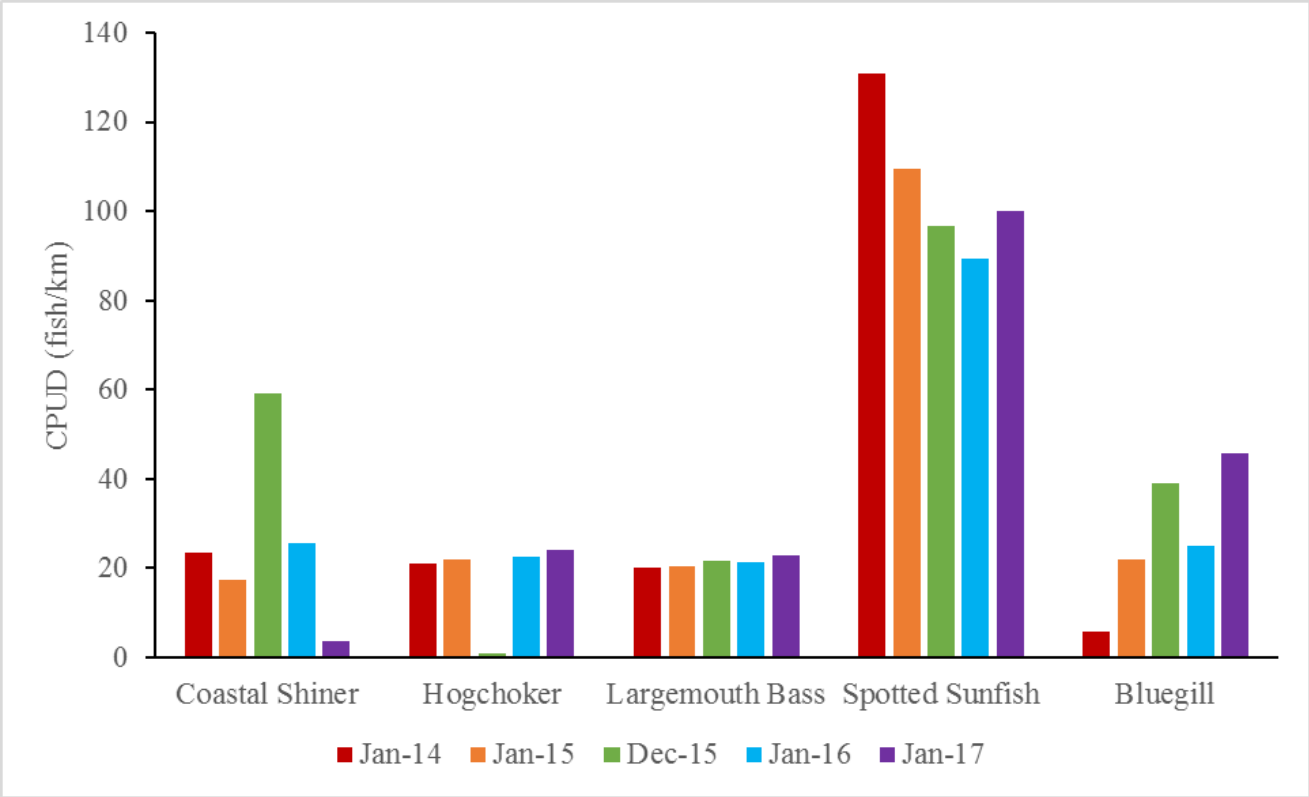

Figure 87. Winter relative abundance (CPUD) of key species in Zone 1 of the Weeki Wachee River System.

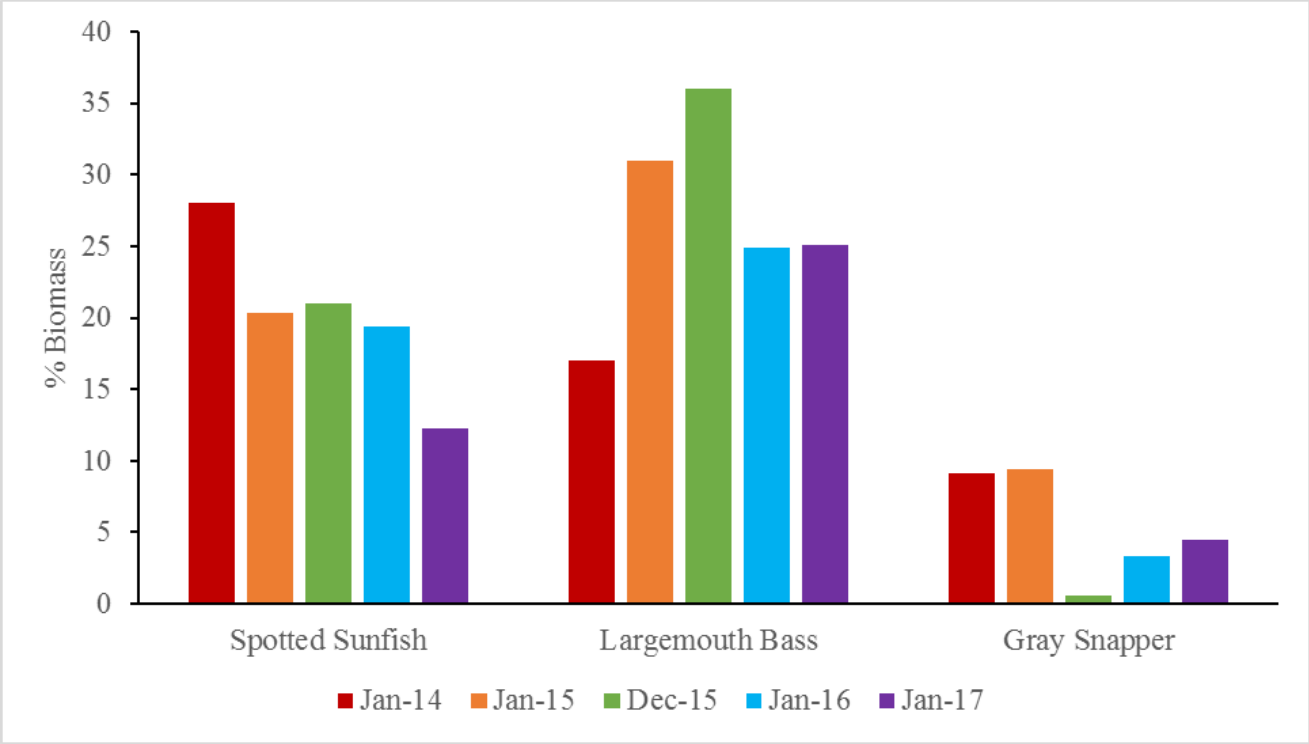

Figure 88. Winter biomass of key species in Zone 1 of the Weeki Wachee River System.

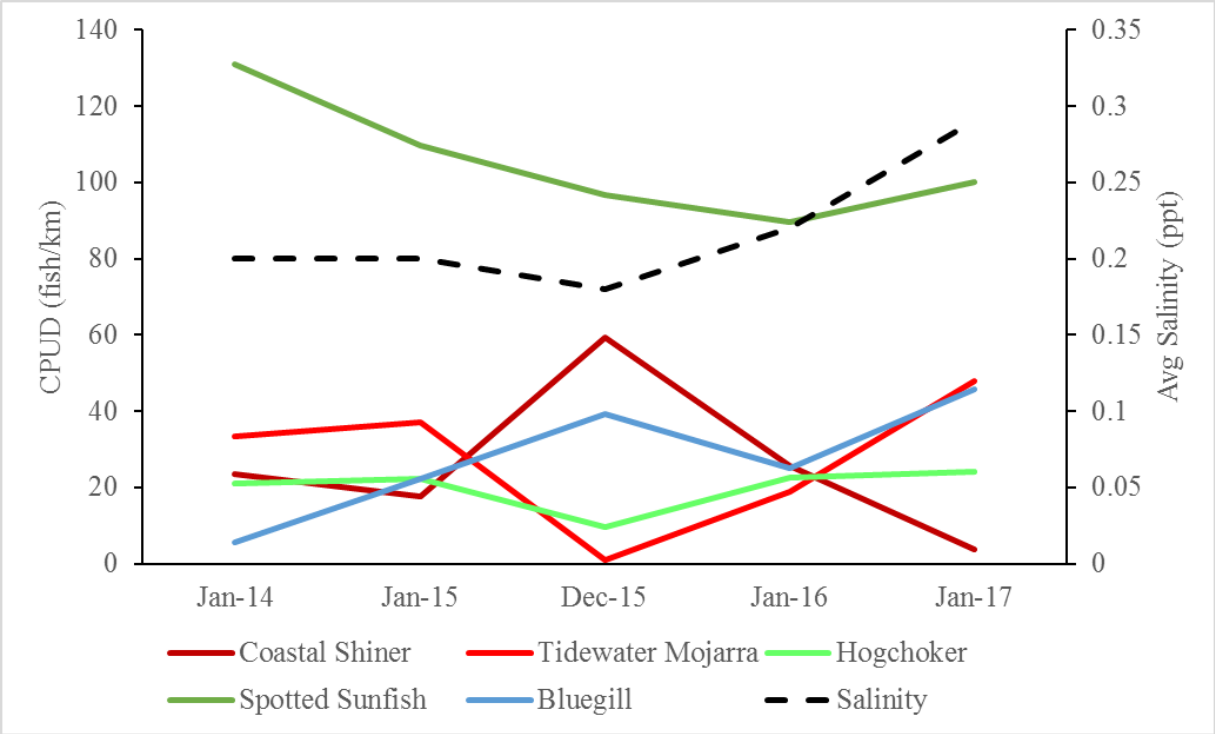

Figure 89. Winter relative abundance (CPUD) of key species in relation to salinity in Zone 1 of the Weeki Wachee River System.

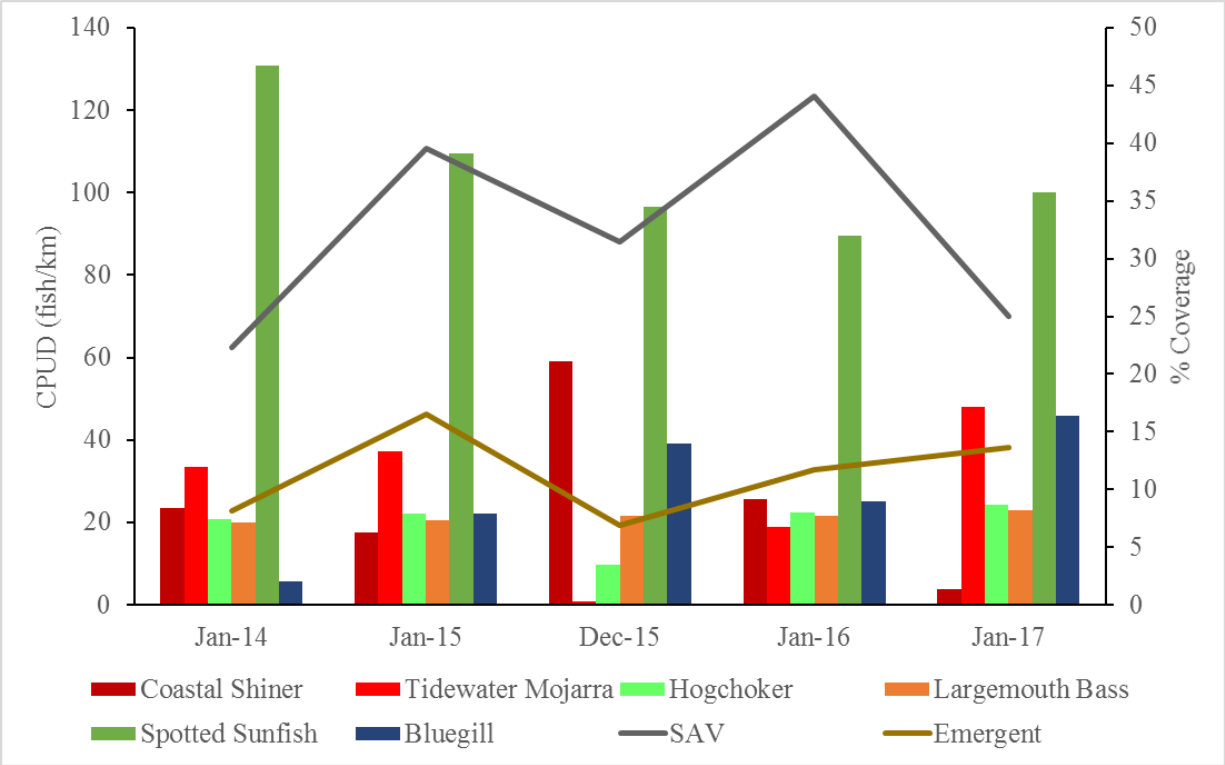

Figure 90. Winter relative abundance (CPUD) of key species in relation to percent habitat cover in Zone 1 of the Weeki Wachee River System. Emergent = emergent vegetation, SAV = submersed aquatic vegetation.

Winter Zone 2

Gray Snapper relative abundance dominated during January 2014, January 2015, and December 2015, while the relative abundance was dominated by Tidewater Mojarra in January 2016 and 2017 (Figure 91). Throughout the study, Tidewater Mojarra relative abundance increased. Gray Snapper abundance steadily declined, except for Winter 2017, and dominated biomass during 2014 and 2015 (Figures 91 and 92). Largemouth Bass biomass was highest in January 2016 and 2017. Overall, Gray Snapper experienced a steady decline in biomass (Figure 92). Conversely, except for Winter 2017, Largemouth Bass biomass steadily increased throughout the study (Figure 92). None of the key fish species seemed to be affected by the spike in average salinity in December 2015 (Figure 93). Largemouth Bass was positively affected by the presence of SAV (Figure 94).

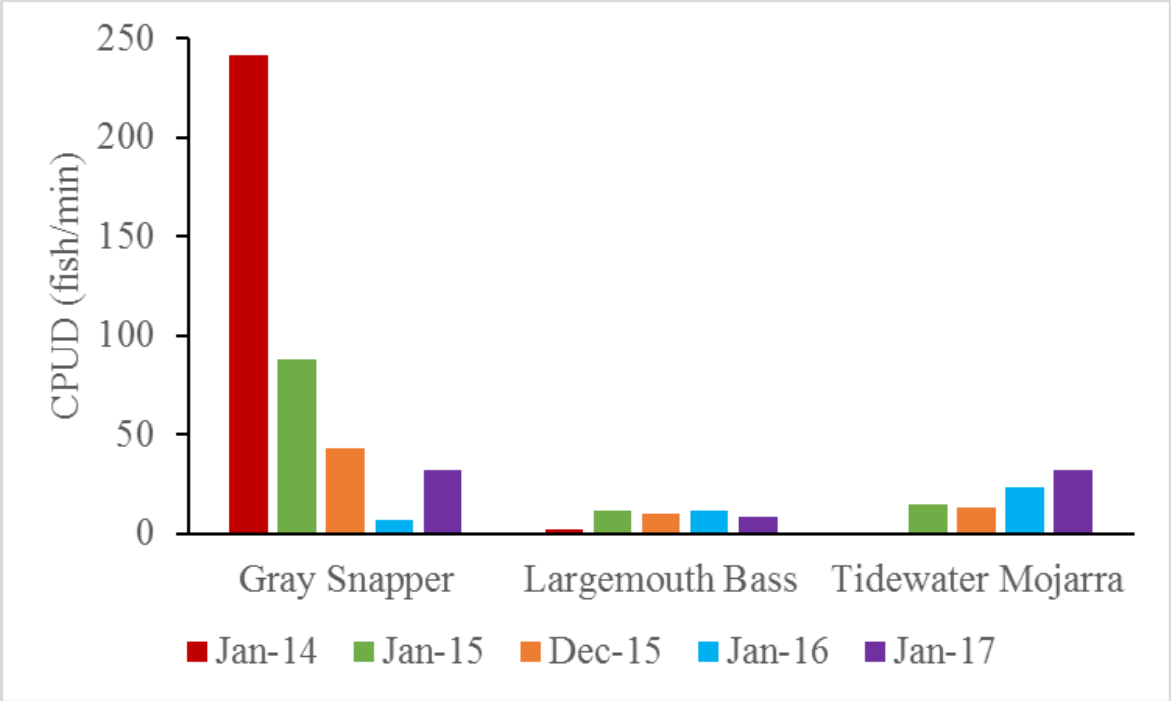

Figure 91. Winter relative abundance (CPUD) of key species in Zone 2 of the Weeki Wachee River System.

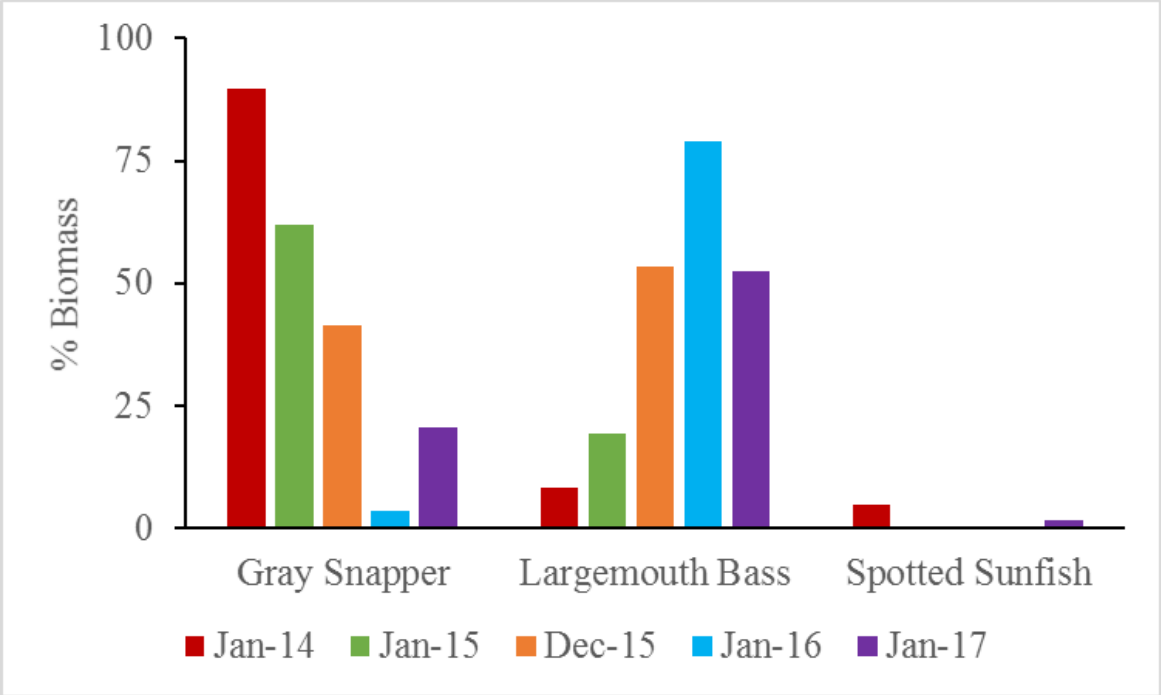

Figure 92. Winter biomass of key species in Zone 2 of the Weeki Wachee River System.

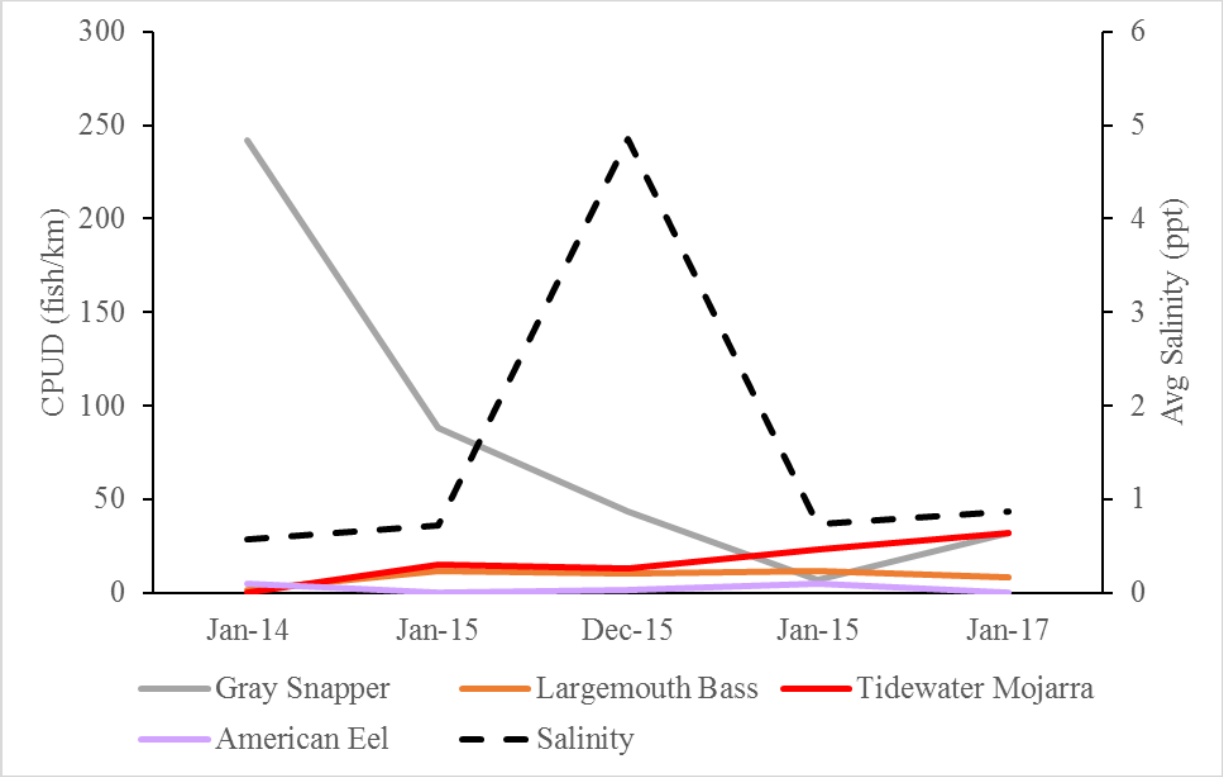

Figure 93. Winter relative abundance (CPUD) of key species in relation to salinity in Zone 2 of the Weeki Wachee River System.

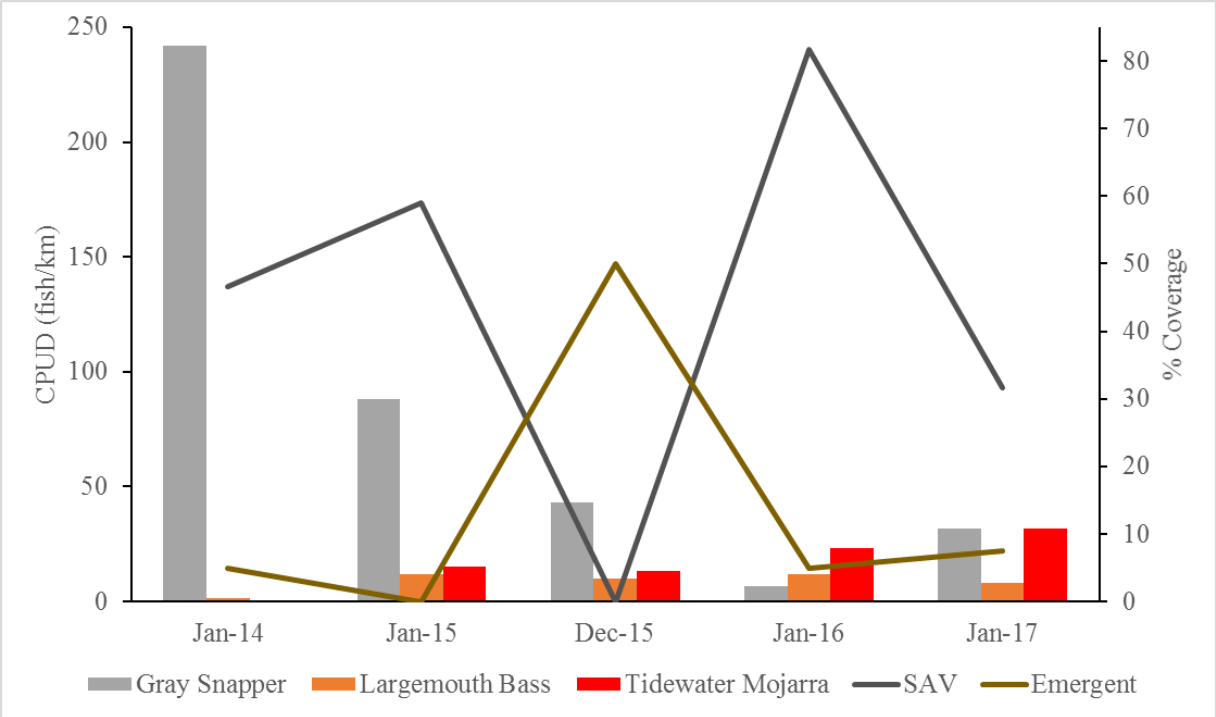

Figure 94. Winter relative abundance (CPUD) of key species in relation to percent habitat coverage in Zone 2 of the Weeki Wachee River System. Emergent = emergent vegetation, SAV = submersed aquatic vegetation.

Summer Zone 1

Coastal Shiners dominated the relative abundance in July 2014, while Spotted Sunfish were dominant in 2015 and 2016 in Zone 1 (Figure 95). For Zone 1 during the summer, we observed an increase in Bluegill relative abundance during the study. Spotted Sunfish biomass was highest in July 2014 (Figure 96). Bluegill was negatively affected by salinity (Figure 97). Conversely, Spotted Sunfish and Bluefin Killifish were positively affected by salinity concentrations. Spotted Sunfish was positively affected by emergent vegetation presence (Figure 98). Largemouth Bass and Bluefin Killifish similarly had positive relationships with the presence of SAV.

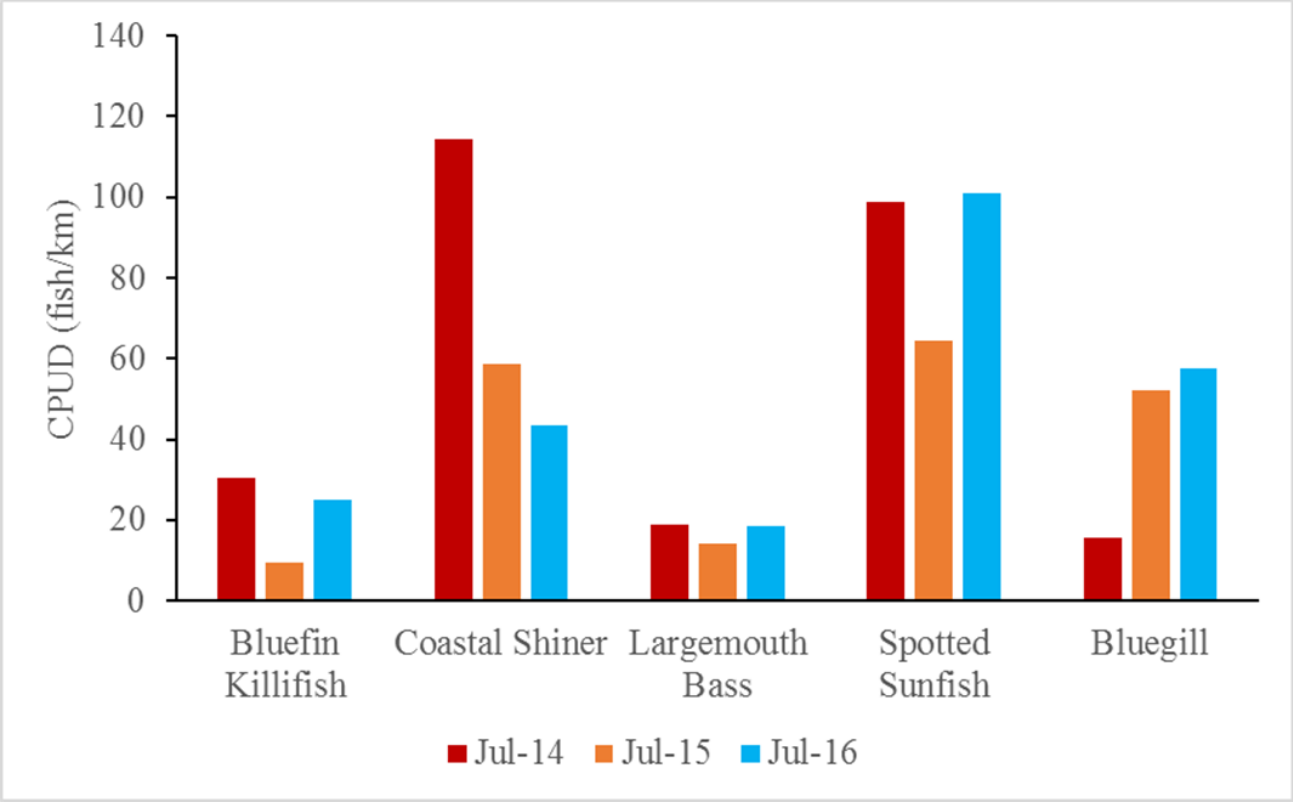

Figure 95. Summer relative abundance (CPUD) of key species in Zone 1 of the Weeki Wachee River System.

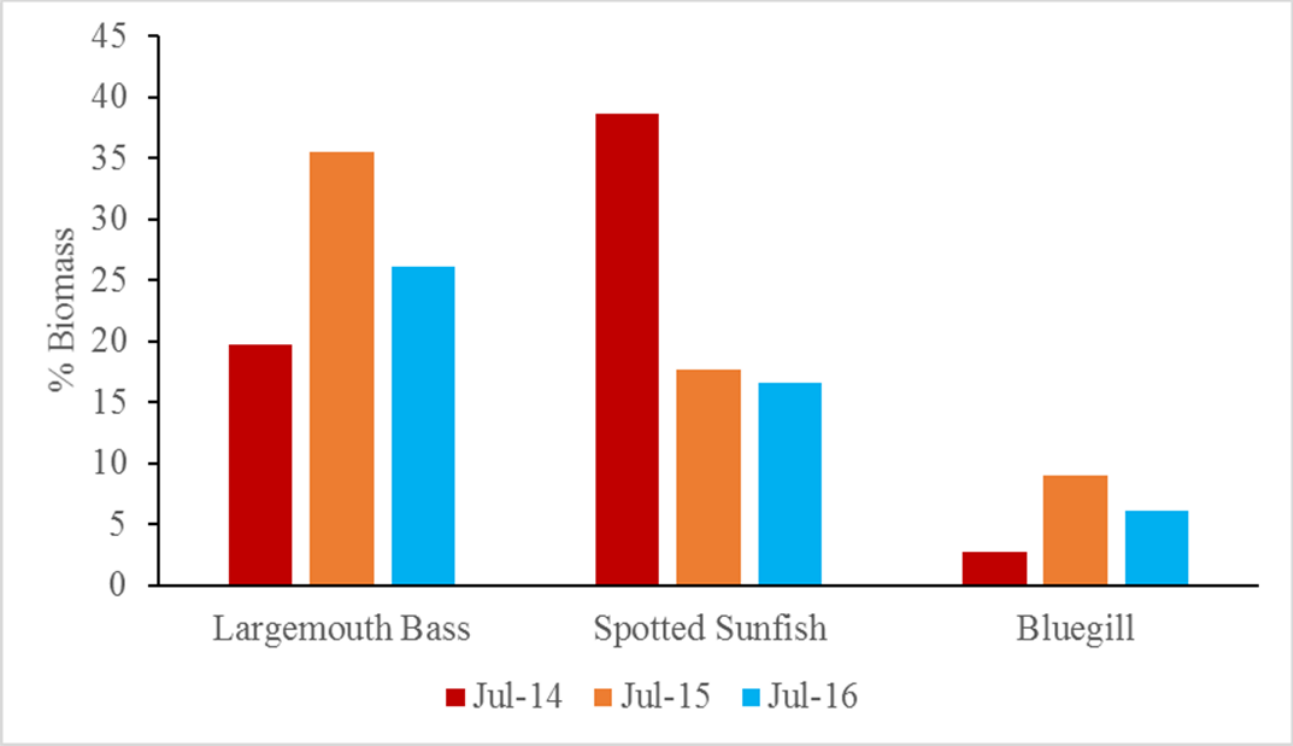

Figure 96. Summer biomass of key species in Zone 1 of the Weeki Wachee River System.

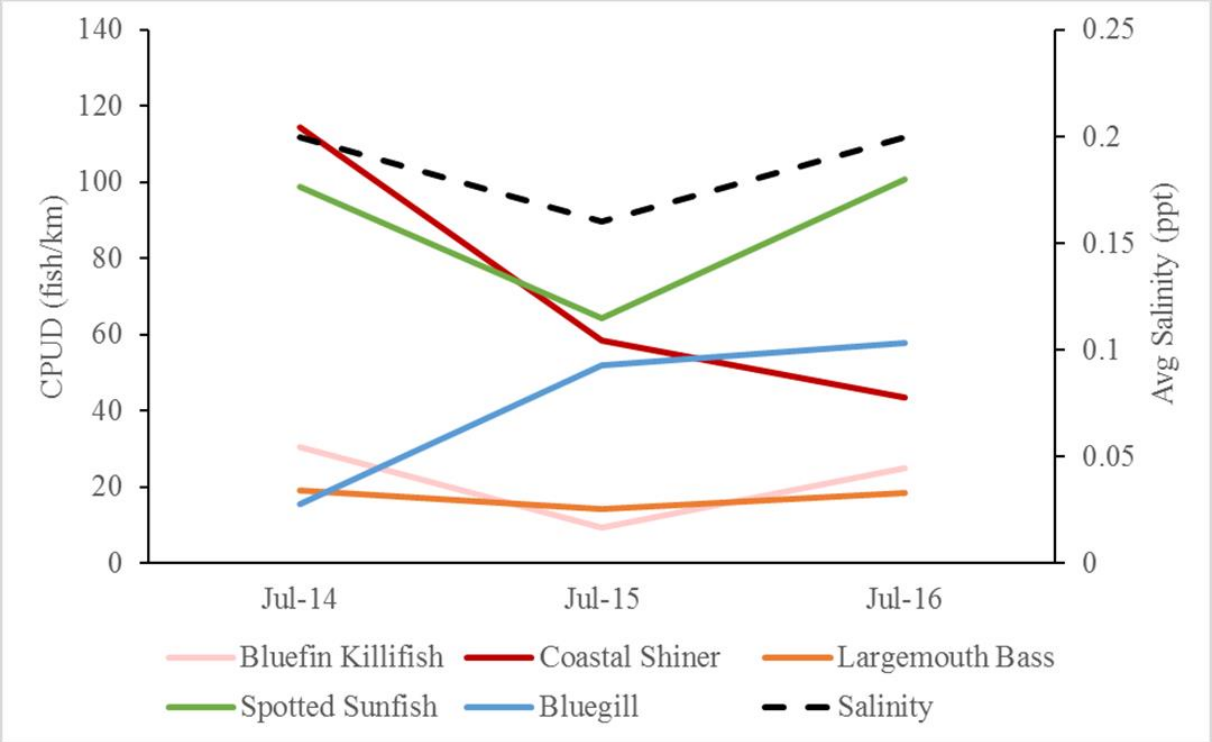

Figure 97. Summer relative abundance (CPUD) of key species in relation to salinity in Zone 1 of the Weeki Wachee River System.

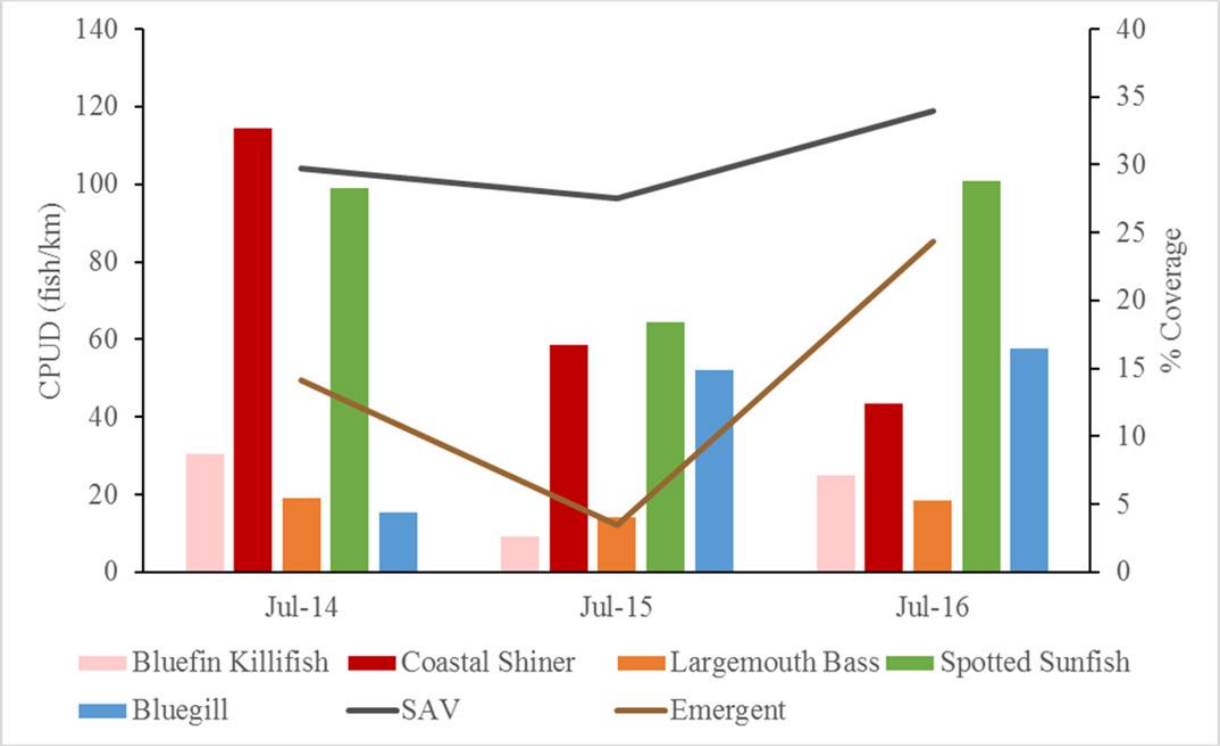

Figure 98. Summer relative abundance (CPUD) of key species in relation to percent habitat coverage in Zone 1 of the Weeki Wachee River System. Emergent = emergent vegetation, SAV = submersed aquatic vegetation.

Summer Zone 2

For Zone 2, Tidewater Mojarra relative abundance was highest during the summer (Figure 99). Largemouth Bass dominated the biomass, and a steady increase was observed from 2014 through 2016 (Figure 100). No trends between relative abundance and average salinity were observed in Zone 2 during the summer months (Figure 101). Tidewater Mojarra had a positive relationship with SAV presence (Figure 102). Similarly, Largemouth Bass was positively affected by the presence of emergent vegetation (Figure 102).

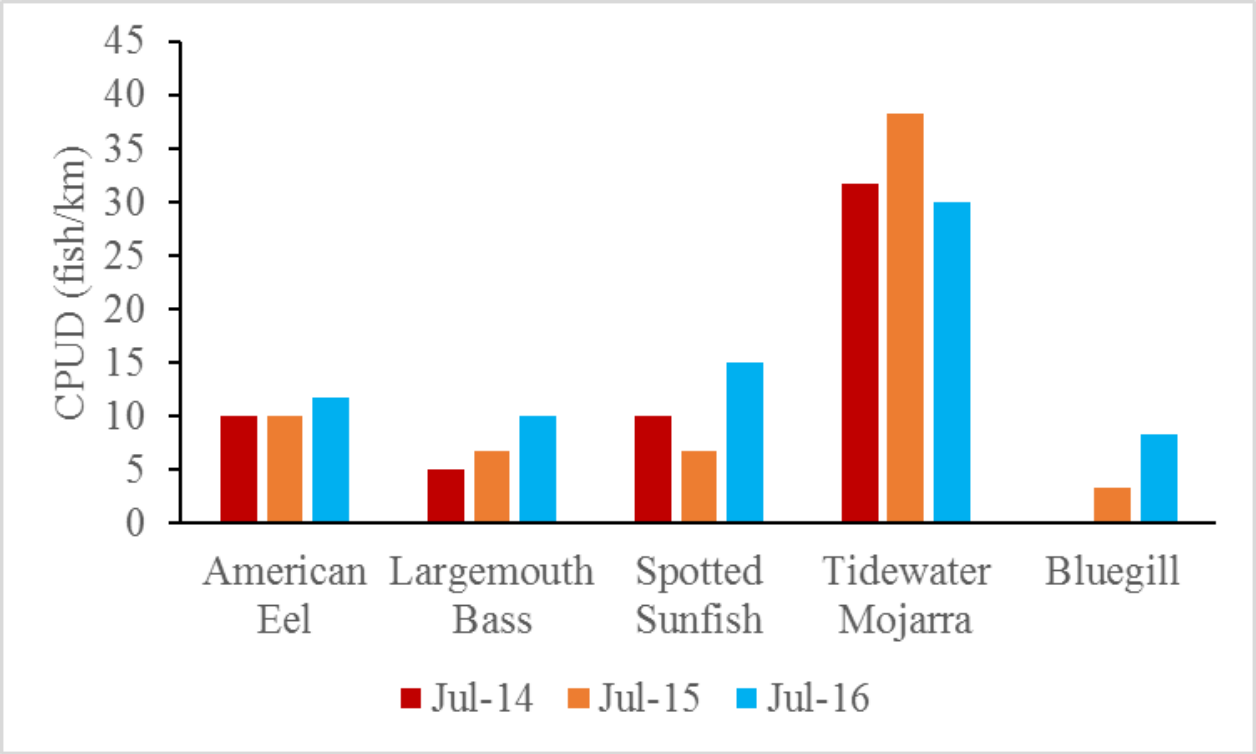

Figure 99. Summer relative abundance (CPUD) of key species in Zone 2 of the Weeki Wachee River System.

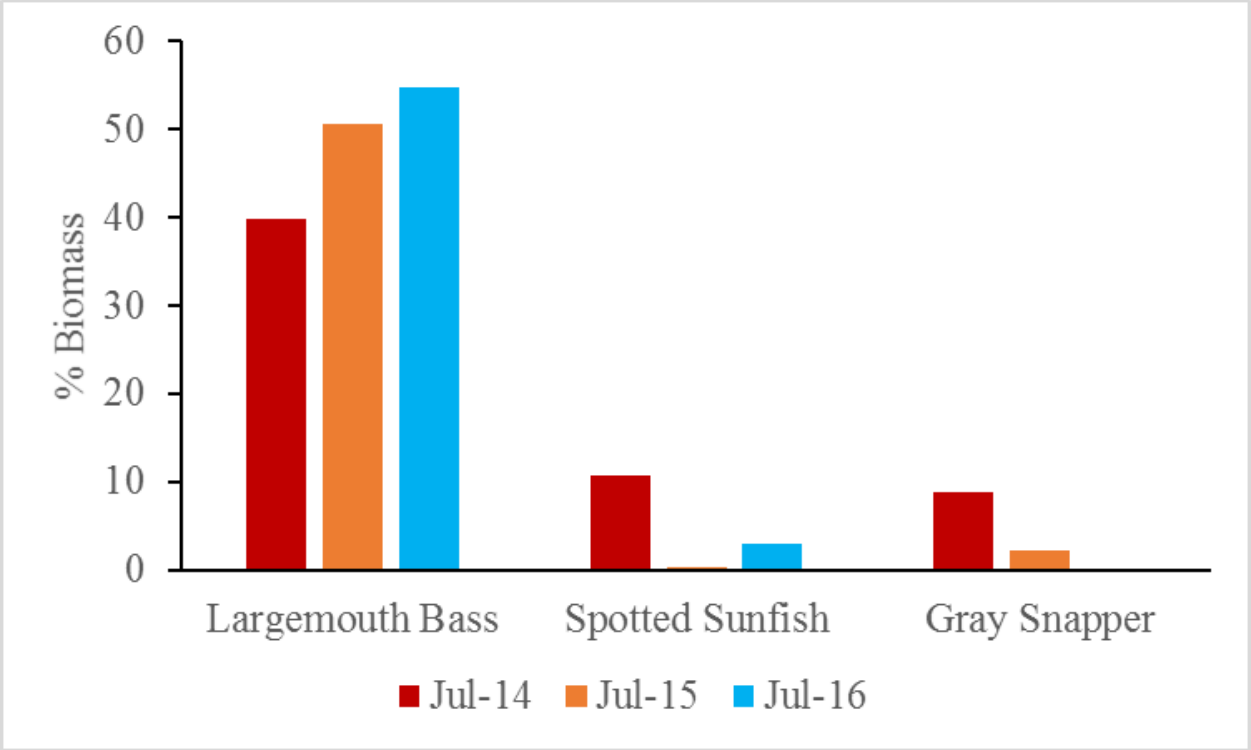

Figure 100. Summer biomass of key species in Zone 2 of the Weeki Wachee River System.

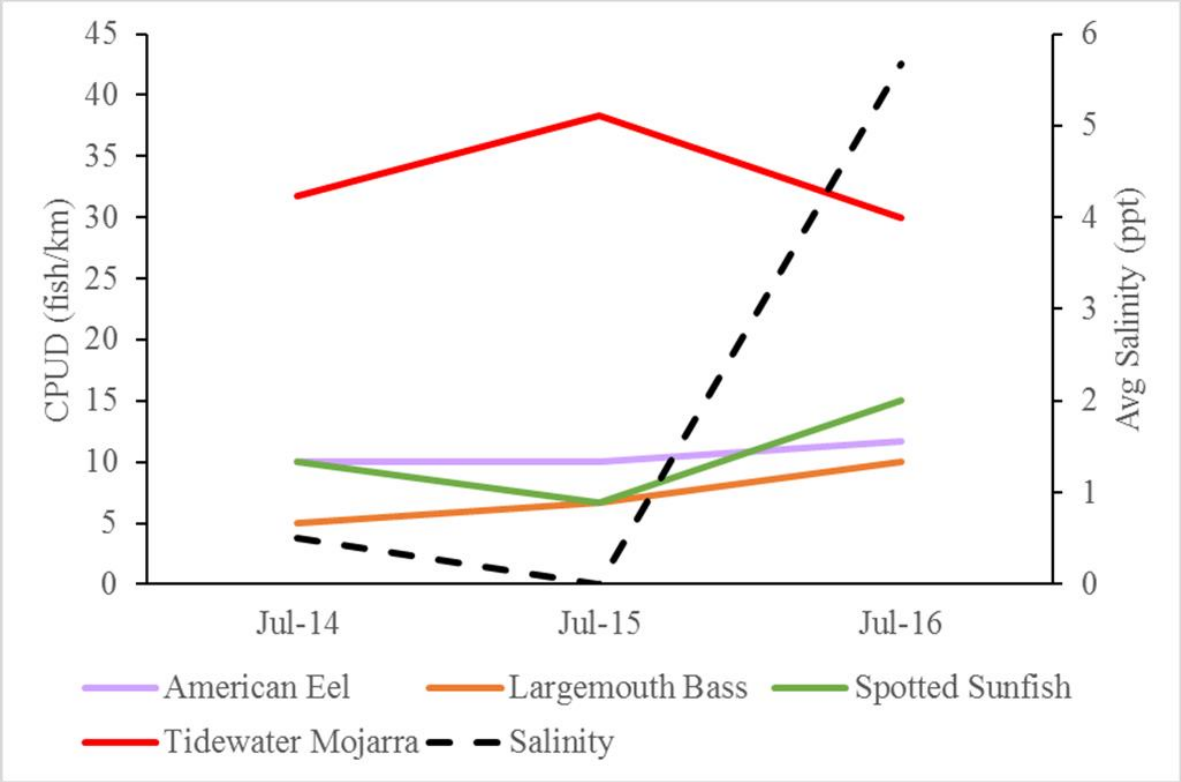

Figure 101. Summer relative abundance (CPUD) of key species in relation to salinity in Zone 2 of the Weeki Wachee River System.

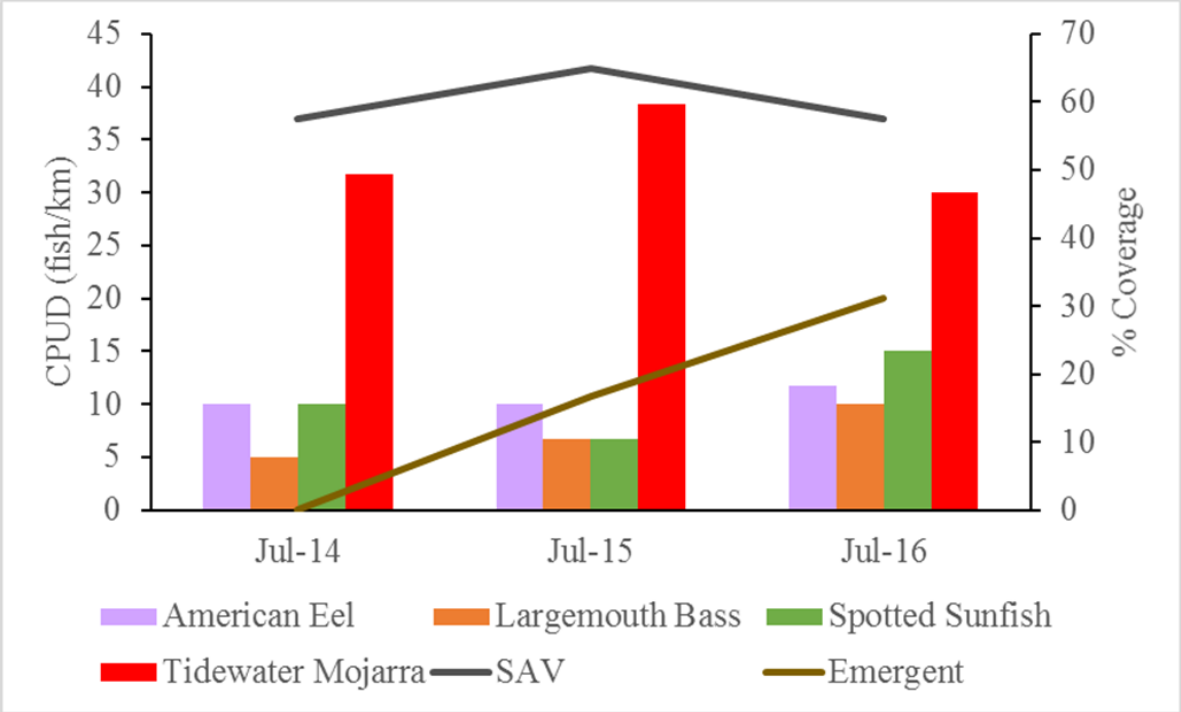

Figure 102. Summer relative abundance (CPUD) of key species in relation to percent habitat coverage in Zone 2 of the Weeki Wachee River System. Emergent = emergent vegetation, SAV = submersed aquatic vegetation.

DISCUSSION

Species richness and fish assemblage (species composition and relative abundance) are strongly dependent upon habitat (Meffe and Sheldon 1988). The diversity of aquatic species found within the springs coast systems sampled can in part be attributable to the dynamic freshwater, estuarine, and marine habitats. Fish assemblages at sample sites along the Chassahowitzka River, Homosassa River, Crystal River/Kings Bay, Rainbow River and Weeki Wachee River Systems overlapped between zones. However, each zone's key fish species, being the species with the greatest relative abundance, differed along the salinity gradient of those systems connected to the GOM.

In aquatic ecosystems, the structure of the physical environment has been shown to impact the dynamics of predator-prey interactions (Crowder and Cooper 1982). Both prey abundance and richness are often positively correlated with structural complexity of habitats (Heck and Crowder 1991, Pine and Tetzlaff 2008). Relative abundance data from this study appeared to indicate that species preferred habitat where submersed or emergent vegetation percent cover was high.

Chassahowitzka River System

The Chassahowitzka River System is a tidal system, which impacts the fish species composition both seasonally and by zone. During the summer, freshwater species increased in abundance as marine species seemingly migrated to the GOM. Decreases in freshwater species abundance observed during the winter months could be attributed to an influx of marine species seeking thermal refuges, causing resident freshwater species to become displaced while avoiding possible predation or increased resource competition. Similar declines of freshwater species during winter months were also observed by Frazer et al. (2011); they collected marine species,

such as Gray Snapper, Common Snook, and Red Drum, presumably seeking thermal refuge. In our study, marine species (i.e., Gray Snapper, Tidewater Mojarra, and Pinfish) were most abundant in Zone 2 during the winter.

Frazer et al. (2011) also observed a sharp decline in density of small bodied fishes (i.e., Pinfish and Bluegill) during the winter, which they attributed to be a result of increased predation by marine piscivores or migration out of the area. Due to these findings, it may be plausible to conclude that marine piscivorous fishes in the Chassahowitzka River System may be consuming and/or displacing small bodied marine and freshwater fishes in high densities during the winter months. During the summer months, we collected high numbers of Pinfish in all zones. This may be attributed to the emigration of marine predators to the GOM. Diet studies, as well as tributary sampling, would need to be conducted to know the interactions between marine and freshwater species for certain.

Homosassa River System

The Homosassa River System also has a salinity gradient, which impacts species composition both seasonally and by zone. Similarly, decreases in freshwater fish species abundance during the winter may be attributed to an influx of marine species and less freshwater habitat. In the winter months, Gray Snapper abundance increased, while Tidewater Mojarra decreased. This pattern was not observed in the other rivers surveyed in this study, but could be attributed to predation or the general schooling nature of Tidewater Mojarra. Frazer et al. (2011) found that small-bodied fish (i.e., Tidewater Mojarra) density and biomass declined between summer and winter sampling, which may be attributed in part to decreased density of freshwater species and the influx of marine species seeking refuge. In their diet study, Frazer et al. (2011) determined that a high proportion of small-bodied marine species were consumed by piscivorous

fishes during the winter. We found that decreases in river salinity, coupled with rising temperatures in the GOM during the summer, yielded a decline in marine fish species and an increase of freshwater fish species collected. These findings may be attributed to the dispersal of marine species back to the GOM.

Crystal River/Kings Bay System

Due to the lacustrine nature of the Crystal River/Kings Bay System, coupled with multiple spring vents throughout the bay, minimal differences in the fish assemblages were observed between zones. Statistical differences between seasonal fish assemblages were most likely due to temperature changes in the GOM, causing fluctuations in marine species presence and abundance. Typically, higher relative abundances of all fish species across all zones was observed during the winter sampling events as compared to summer events. We found higher concentrations of freshwater species in summer sampling events (21%), as opposed to winter sampling events (10%). In Zone 2, there was higher diversity than Zones 1 and 3, with mid-range salinity levels, allowing both freshwater and marine species to thrive. We also collected the only non-native species in our study; a singular Blue Tilapia (*Oreochromis aureus*) which was removed from the system.

Rainbow River System

The Rainbow River System had the lowest species diversity of all that river systems that we surveyed. This was most likely the result of the lack of a direct connection to the GOM, which prevents marine species from utilizing the river. Species evenness and diversity values were highest in Zone 2. The diversity values in Zone 1 were low due to five key fish species (Largemouth Bass, Eastern Mosquitofish, Spotted Sunfish, Coastal Shiner, and Bluegill), which comprised 77% of the fish collected in this zone. However, Zone 1 contained greater relative

abundance values, which may be attributed to its high levels of habitat complexity. Diversity indices in Zone 2, when compared to Zone 1, could be attributed to its proximity to the Withlacoochee River. Florida Gar and Pirate Perch (*Aphredoderus sayanus*) were collected in Zone 2 of the Rainbow River System and have been collected in the Withlacoochee River (Greg Knothe, Florida FWC, personal communication) but were not captured yet in Zone 1, suggesting they prefer less clear water. Further research exploring diversity indices and proximity impacts on the river may lead to better understanding of this relationship.

Weeki Wachee River System

The Weeki Wachee River System is also a tidally-influence system, though its influence is confined to the lower reach of the river. The salt water gradient impacts fish species composition both seasonally and by zone. Compared to Zone 1, Zone 2 contained sites with higher salinity and more moderate flows (Tables 61, Appendix A). These factors may have attributed to species evenness and diversity values being greatest in Zone 2. Largemouth Bass, Bluegill, Spotted Sunfish, Coastal, Shiner and Hogchoker comprised over 70% of the fishes collected in Zone 1, lowering its diversity. Zone 1 overall had higher species richness and greater relative abundance, which may be attributed to observed increased habitat complexity and depths when compared to Zone 2.

Conclusions and Future Work

Seasonal variations in the hydrology of a river system can directly impact fish assemblages. Although fish populations are generally resilient to short term hydrologic fluctuations, prolonged changes in flow can have an impact on community assemblages (Shearer and Berry 2003). Salinity changes, however, can have a great impact on vegetation and as a

result, fish communities. Through our MDS analyses of the four systems directly connected to the GOM, we found that fish assemblages from all zones were significantly different between winter and summer. Similar to our study, Frazer et al. 2011 found many small-bodied fish species exhibited strong seasonality in their density and biomass, with the greatest densities observed in late spring through summer and relatively lower densities observed during fall and winter. With the exception of the Weeki Wachee River and Crystal River/Kings Bay Systems, seasonal variation of fish assemblages was strongest at the headsprings (Zone 1). Seasonal variation in species weakens further from the headsprings, indicating that fish assemblages are more homogenous in zones closer to the confluence of the river and the GOM. This could be attributed to winter temperature decreases in the GOM, causing marine species to seek thermal refuge in the temperate spring-fed rivers. These conclusions were supported by the findings of seasonal migration patterns demonstrated by marine apex predators (Frazer et al. 2011).

Our findings, coupled with previous studies on tidally influenced systems, raise question as to where freshwater species are migrating during winter months. Frazer et al. (2011) theorized that declines in large-bodied freshwater species density are due, in part, to migration into tributaries, canals, and headwater areas, as evidenced by recapturing marked fish outside of the study reaches during subsequent months after sampling. Further exploratory sampling of connecting tributaries, coupled with acoustic tracking data, may reveal some insight as to additional habitats used seasonally by freshwater species in these systems.

Due to these important questions still unanswered, our sampling will continue through 2019. Discussions with the District have led us to add water quality readings at the end of transects and try to be more precise when quantifying habitat coverage. In conjunction with other projects currently being conducted on these systems, (i.e., Water and Air vegetation

mapping) we aim to create a Geographic Information System (GIS) spatial representation of fish abundance, habitat complexity and water quality parameters to hopefully better understand their relationships on these intricate systems.

It is important to identify, delineate, and protect critical freshwater habitats used by these species throughout these systems to increase recruitment and sustainability. It is also important to understand interactions of species habitat utilization, salinity and flow regimens, and fish communities in these systems when determining potential impacts. Our results provide a comprehensive baseline of fish community and habitat data that can be used in the future for evaluating the status and trends of the five Outstanding Florida Springs within the District.

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APPENDIX A

ADDITIONAL TABLES

Table 2. The Chassahowitzka River System relative abundance and percent composition by number and weight of fish species collected (n = 51). Catch per unit distance = (CPUD-km). Standard error = (SE).

			Fish/km		% Composition	
Common Name	**Scientific Name**	**Number**	**CPUD (SE)**	**Weight**	**Number**	**Weight**
American Eel	*Anguilla rostrata*	42	4 (0.83)	-	0.29	-
Atlantic Needlefish	*Strongylura marina*	31	2.95 (0.75)	1155	0.22	0.10
Bay Anchovy	*Anchoa mitchilli*	349	33.24 (18.44)	513	2.43	0.04
Bluefin Killfish	*Lucania goodei*	247	23.52 (6.60)	48	1.72	0.00
Bluegill Sunfish	*Lepomis macrochirus*	26	2.47 (0.84)	780	0.18	0.07
Clown Goby	*Microgobius gulosus*	41	3.90 (0.69)	49	0.29	0.00
Coastal Shiner	*Notropis petersoni*	44	4.19 (1.67)	30	0.31	0.00
Common Snook	*Centropomus undecimalis*	305	29.05 (8.04)	295549	2.12	24.71
Crevalle Jack	*Caranx caninus*	5	0.48 (0.31)	1664	0.03	0.14
Eastern Moquitofish	*Gambusia holbrooki*	69	6.57 (2.08)	13	0.48	0.00
Florida Gar	*Lepisosteus platyrhincus*	3	0.29 (0.21)	3713	0.02	0.31
Gafftopsail Catfish	*Bagre marinus*	1	0.1 (0.1)	1132	0.01	0.09
Golden Shiner	*Notemigonus crysoleucas*	49	4.67 (2.11)	146	0.34	0.01
Gray Snapper	*Lutjanus cyanopterus*	2506	238.67 (45.46)	265632	17.43	22.21
Gulf Killifish	*Fundulus grandis*	138	13.14 (3.78)	1638	0.96	0.14
Gulf Pipefish	*Syngnathus scovelli*	18	1.71 (0.41)	1	0.13	0.00
Gulf Toadfish	*Opsanus beta*	5	0.47 (0.21)	354	0.03	0.03
Hardhead Catfish	*Ariopsis felis*	46	4.38 (2.51)	9073	0.32	0.76
Hogchocker	*Trinectes maculatus*	58	5.52 (1.03)	476	0.40	0.04
Inland Silverside	*Menidia beryllina*	347	33.05 (7.70)	162	2.41	0.01
Ironcolor Shiner	*Notropis chalybaeus*	84	8 (3.12)	73	0.58	0.01
Ladyfish	*Elops affinis*	1	0.1 (0.1)	569	0.01	0.05
Lake Chubsucker	*Erimyzon sucetta*	680	64.76 (13.41)	14143	4.73	1.18
Largemouth Bass	*Micropterus salmoides*	857	81.61 (11.57)	286568	5.96	23.96
Least Killifish	*Heterandria formosa*	4	0.38 (0.23)	<1	0.03	<0.01
Leatherjacket	*Oligoplites saurus*	14	1.33 (0.8)	48	0.10	0.00
Longnose Gar	*Lepisosteus osseus*	5	0.47 (0.21)	1928	0.03	0.16
Marsh Killifish	*Fundulus confluentus*	10	0.95 (0.44)	28	0.07	0.00
Menhaden	*Ethmidium maculatum*	365	34.76 (9.94)	570	2.54	0.05
Naked Goby	*Gobiosoma bosc*	4	0.38 (0.23)	1	0.03	0.00
Pinfish	*Lagodon rhomboides*	1746	166.58 (22.04)	27355	12.15	2.29
Rainwater Killifish	*Lucania parva*	1994	189.90 (28.13)	721	13.87	0.06
Red Drum	*Sciaenops ocellatus*	3	0.28 (0.16)	397	0.02	0.03
Redear Sunfish	*Lepomis microlophus*	83	1.90 (1.34)	20131	0.58	1.68
Redeye Chub	*Notropis harperi*	53	5.04 (1.65)	17	0.37	0.00
Redfin Needlefish	*Strongylura notata*	2	0.19 (0.13)	194	0.01	0.02
Remora	*Echeneidae*	3	0.28 (0.16)	25	0.02	0.00
Sailfin Molly	*Poecilia latipinna*	30	2.85 (0.87)	110	0.21	0.01
Scaled Sardine	*Harengula jaguana*	68	6.47 (6.56)	172	0.47	0.01
Seminole Killifish	*Fundulus seminolis*	56	5.33 (1.21)	400	0.39	0.03
Sheepshead	*Archosargus probatocephalus*	83	7.90 (1.60)	23139	0.58	1.93
Sheepshead Minnow	*Cyprinodon variegatus*	52	4.95 (2.31)	121	0.36	0.01
Spot Croaker	*Leiostomus xanthurus*	186	17.71 (4.22)	2993	1.29	0.25
Spotted Seatrout	*Cynoscion nebulosus*	10	0.95 (0.45)	146	0.07	0.01
Spotted Sunfish	*Lepomis punctatus*	1285	122.38 (23.57)	33686	8.94	2.82
Striped Mullet	*Mugil cephalus*	165	15.71 (2.74)	184064	1.15	15.39
Sunfish sp.	*Lepomis sp.*	14	1.33 (0.36)	1	0.10	0.00
Tidewater Mojarra	*Eucinostomus harengulus*	2157	205.42 (21.16)	12891	15.01	1.08
Timucu	*Strongylura timucu*	12	1.14 (0.43)	384	0.08	0.03
White Mullet	*Mugil curema*	11	1.05 (0.43)	2688	0.08	0.22
Worm Eel	*Myrophis punctatus*	6	0.57 (0.32)	-	0.04	-
Yellow Bullhead	*Ameiurus natalis*	1	0.10 (0.10)	266	0.01	0.02

Table 3. The Homosassa River System relative abundance and percent composition by number and weight of fish species collected (n = 51). Catch per unit distance = (CPUD-km). Standard error = (SE).

			Fish/km		% Composition	
Common Name	**Scientific Name**	**Number**	**CPUD (SE)**	**Weight**	**Number**	**Weight**
American Eel	*Anguilla rostrata*	20	1.61 (0.52)	-	0.23	-
Atlantic Needlefish	*Strongylura marina*	36	2.90 (0.67)	1134	0.42	0.08
Atlantic Stingray	*Dasyatis sabina*	11	0.88 (0.30)	-	0.13	-
Bay Anchovy	*Anchoa mitchilli*	155	12.5 (6.35)	253	1.82	0.02
Black Crappie	*Pomoxis nigromaculatus*	1	0.08 (0.08)	<0.01	0.01	<0.01
Black Drum	*Pogonias cromis*	14	1.13 (0.49)	8368	0.16	0.55
Bluefin Killfish	*Lucania goodei*	17	1.37 (0.6)	4	0.20	0.00
Bluegill Sunfish	*Lepomis macrochirus*	294	23.7 (4.77)	7684	3.45	0.51
Clown Goby	*Microgobius gulosus*	18	1.45 (0.52)	10	0.21	0.00
Coastal Shiner	*Notropis petersoni*	5	0.4 (0.4)	11	0.06	0.00
Common Snook	*Centropomus undecimalis*	604	48.71 (10.3)	400068	7.09	26.53
Crevalle Jack	*Caranx caninus*	13	1.05 (0.37)	14980	0.15	0.99
Eastern mosquitofish	*Gambusia holbrooki*	40	3.20 (0.91)	8	0.47	<0.01
Florida Gar	*Lepisosteus platyrhincus*	67	5.40 (1.04)	63110	0.79	4.19
Golden Shiner	*Notemigonus crysoleucas*	12	0.97 (0.55)	69	0.14	<0.01
Gray Snapper	*Lutjanus cyanopterus*	2076	167.42 (26.82)	214275	24.37	14.21
Gulf Killifish	*Fundulus grandis*	1	0.08 (0.08)	13	0.01	<0.01
Gulf Pipefish	*Syngnathus scovelli*	7	0.56 (0.23)	3	0.08	<0.01
Gulf Toadfish	*Opsanus beta*	4	0.32 (0.16)	74	0.05	<0.01
Hardhead Catfish	*Ariopsis felis*	30	2.42 (0.72)	16455	0.35	1.09
Hogchocker	*Trinectes maculatus*	32	2.58 (0.70)	204	0.38	0.01
Inland Silverside	*Menidia beryllina*	163	13.15 (2.8)	73	1.91	<0.01
Ladyfish	*Elops affinis*	10	0.80 (0.4)	636	0.12	0.04
Lake Chubsucker	*Erimyzon sucetta*	1	0.08 (0.08)	2	0.01	<0.01
Largemouth Bass	*Micropterus salmoides*	412	33.23 (6.53)	74836	4.84	4.96
Least Killifish	*Heterandria formosa*	1	0.08 (0.08)	<0.01	0.01	<0.01
Longnose Gar	*Lepisosteus osseus*	6	0.48 (0.19)	5148	0.07	0.34
Marsh Killifish	*Fundulus confluentus*	1	0.08 (0.08)	3	0.01	<0.01
Menhaden	*Ethmidium maculatum*	81	6.53 (2.89)	231	0.95	0.02
Naked Goby	*Gobiosoma bosc*	7	0.56 (0.21)	3	0.08	<0.01
Pinfish	*Lagodon rhomboides*	193	15.56 (2.29)	4515	2.27	0.30
Rainwater Killifish	*Lucania parva*	81	6.53 (1.49)	17	0.95	<0.01
Red Drum	*Sciaenops ocellatus*	73	5.89 (1.44)	87712	0.86	5.82
Redear Sunfish	*Lepomis microlophus*	62	5 (1.25)	5399	0.73	0.36
Redeye Chub	*Notropis harperi*	1	0.08 (0.08)	<0.01	0.01	<0.01
Redfin Needlefish	*Strongylura notata*	1	0.08 (0.08)	84	0.01	0.01
Remora	*Echeneidae*	5	0.40 (0.17)	68	0.06	<0.01
Sailfin Molly	*Poecilia latipinna*	6	0.48 (0.41)	9	0.07	<0.01
Scaled Sardine	*Harengula jaguana*	103	8.31 ()5.6)	240	1.21	0.02
Seminole Killifish	*Fundulus seminolis*	6	0.48 (0.28)	49	0.07	0.00
Sheepshead	*Archosargus probatocephalus*	130	10.5 (1.44)	149094	1.53	9.89
Spot Croaker	*Leiostomus xanthurus*	20	1.61 (0.93)	188	0.23	0.01
Spotted Seatrout	*Cynoscion nebulosus*	6	0.48 (0.22)	125	0.07	0.01
Spotted Sunfish	*Lepomis punctatus*	210	16.94 (3.05)	6237	2.47	0.41
Striped Mojarra	*Eugerres plumieri*	1	0.08 (0.08)	634	0.01	0.04
Striped Mullet	*Mugil cephalus*	462	37.26 (6.16)	418433	5.42	27.75
Sunfish spp.	*Lepomis spp.*	5	0.40 (0.21)	1	0.06	<0.01
Tidewater Mojarra	*Eucinostomus harengulus*	2997	241.69 (29.76)	18405	35.18	1.22
Timucu	*Strongylura timucu*	29	2.34 (0.91)	752	0.34	0.05
Warmouth	*Lepomis gulosus*	1	0.08 (0.08)	6	0.01	<0.01
White Mullet	*Mugil curema*	25	2.02 (0.7)	8198	0.29	0.54
Worm Eel	*Myrophis punctatus*	3	0.24 (0.13)	-	0.04	-

Table 4. The Crystal River/Kings Bay System relative abundance and percent composition by number and weight of fish species collected (n = 50). Catch per unit effort = (CPUE-fish/min). Standard error = (SE).

			Fish/min		% Composition	
Common Name	**Scientific Name**	**Number**	**CPUE (SE)**	**Weight**	**Number**	**Weight**
American Eel	*Anguilla rostrata*	30	0.10 (0.03)	-	<0.01	-
Atlantic Croaker	*Micropogonias undulatus*	1	<0.01	26	<0.01	<0.01
Atlantic Needlefish	*Strongylura marina*	52	0.18 (0.06)	2399	<0.01	<0.01
Atlantic Stingray	*Dasyatis sabina*	17	0.06 (0.02)	-	<0.01	-
Bay Anchovy	*Anchoa mitchilli*	615	2.11 (1.36)	315	0.06	<0.01
Black Drum	*Pogonias cromis*	33	0.11 (0.05)	7178	<0.01	<0.01
Blue Tilapia	*Oreochromis aureus*	1	<0.01	2297	<0.01	<0.01
Bluefin Killifish	*Lucania goodei*	5	0.02 (0.01)	<1	<0.01	<0.01
Bluegill Sunfish	*Lepomis macrochirus*	114	0.39 (0.19)	1939	0.01	<0.01
Bowfin	*Amia calva*	4	0.01 (0.01)	6266	<0.01	<0.01
Brook Silverside	*Labidesthes sicculus*	7	0.02 (0.01)	11	<0.01	<0.01
Clown Goby	*Microgobius gulosus*	19	0.07 (0.02)	15	<0.01	<0.01
Common Snook	*Centropomus undecimalis*	724	2.48 (0.41)	725256	0.07	0.28
Crevalle Jack	*Caranx caninus*	30	0.10 (0.03)	29447	<0.01	0.01
Eastern Mosquitofish	*Gambusia holbrooki*	7	0.02 (0.01)	2	<0.01	<0.01
Florida Gar	*Lepisosteus platyrhincus*	85	0.29 (0.09)	62791	0.01	0.02
Golden Shiner	*Notemigonus crysoleucas*	1	<0.01	6	<0.01	<0.01
Gray Snapper	*Lutjanus cyanopterus*	996	3.43 (0.37)	186239	0.09	0.07
Gulf Killifish	*Fundulus grandis*	23	0.08 (0.05)	104	<0.01	<0.01
Hardhead Catfish	*Ariopsis felis*	34	0.12 (0.03)	18972	<0.01	0.01
Hogchoker	*Trinectes maculatus*	15	0.05 (0.02)	103	<0.01	<0.01
Inland Silverside	*Menidia beryllina*	576	1.98 (0.74)	490	0.05	<0.01
Ladyfish	*Elops affinis*	50	0.17 (0.04)	7412	<0.01	<0.01
Largemouth Bass	*Micropterus salmoides*	350	1.20 (0.24)	101262	0.03	0.04
Least Killifish	*Heterandria formosa*	1	<0.01	<1	<0.01	<0.01
Leatherjacket	*Oligoplites saurus*	6	0.02 (0.01)	4	<0.01	<0.01
Longnose Gar	*Lepisosteus osseus*	14	0.05 (0.02)	5947	<0.01	<0.01
Menhaden	*Ethmidium maculatum*	508	1.75 (0.90)	376	0.05	<0.01
Naked Goby	*Gobiosoma bosc*	5	0.02 (0.01)	0	<0.01	<0.01
Pinfish	*Lagodon rhomboides*	230	0.79 (0.15)	5823	0.02	<0.01
Rainwater Killifish	*Lucania parva*	180	0.62 (0.18)	59	0.02	<0.01
Red Drum	*Sciaenops ocellatus*	135	0.47 (0.08)	154860	0.01	0.06
Redear Sunfish	*Lepomis microlophus*	58	0.20 (0.06)	7785	0.01	<0.01
Refin Needlefish	*Strongylura notata*	4	0.01 (0.01)	116	<0.01	<0.01
Remora	*Echeneidae spp.*	3	0.01 (0.01)	34	<0.01	<0.01
Seminole Killifish	*Fundulus seminolis*	93	0.32 (0.08)	1498	0.01	<0.01
Sheepshead	*Archosargus probatocephalus*	91	0.31 (0.05)	43135	0.01	0.02
Sheepshead Minnow	*Cyprinodon variegatus*	3	0.01 (0.01)	2	<0.01	<0.01
Silver Perch	*Bidyanus bidyanus*	18	0.06 (0.03)	584	<0.01	<0.01
Southern Stingray	*Dasyatis americana*	2	0.01 (0.01)	-	<0.01	-
Spot Croaker	*Leiostomus xanthurus*	6	0.02 (0.01)	73	<0.01	<0.01
Spotted Seatrout	*Cynoscion nebulosus*	35	0.12 (0.03)	1408	<0.01	<0.01
Spotted Sunfish	*Lepomis punctatus*	70	0.24 (0.08)	2310	0.01	<0.01
Striped Mullet	*Mugil cephalus*	1410	4.84 (0.64)	1190328	0.13	0.46
Tarpon	*Megalops atlanticus*	1	<0.01	-	<0.01	-
Tidewater Mojarra	*Eucinostomus harengulus*	3982	13.72 (1.51)	26244	0.37	0.01
Timucu	*Strongylura timucu*	69	0.24 (0.07)	1532	0.01	<0.01
White Catfish	*Ameiurus catus*	1	<0.01	364	<0.01	<0.01
White Mullet	*Mugil curema*	57	0.20 (0.05)	13014	0.01	0.01
Worm Eel	*Myrophis punctatus*	8	0.03 (0.01)	-	<0.01	-

Table 5. The Rainbow River System relative abundance and percent composition by number and weight of fish species collected (n = 35) Catch per unit distance = (CPUD-km). Standard error = (SE).

			Fish/km		% Composition	
Common Name	**Scientific Name**	**Number**	**CPUD (SE)**	**Weight**	**Number**	**Weight**
American Eel	*Anguilla rostrata*	2	0.11 (0.08)	-	0.01	-
Atlantic needlefish	*Strongylura marina*	2	0.11 (0.08)	79	0.01	0.01
Bluefin Killifish	*Lucania goodei*	852	48.97 (4.85)	229	3.95	0.03
Bluegill	*Lepomis macrochirus*	1469	84.43 (6.48)	48712	6.80	5.47
Bowfin	*Amia calva*	30	1.72 (0.52)	81653	0.14	9.16
Brook Silverside	*Labidesthes sicculus*	82	4.71 (2.0)	78	0.38	0.01
Brown Bullhead	*Ameiurus nebulosus*	2	0.11 (0.08)	540	0.01	0.06
Coastal Shiner	*Notropis petersoni*	2632	151.26 (13.28)	4019	12.19	0.45
Dollar Sunfish	*Lepomis marginatus*	48	2.76 (0.59)	258	0.22	0.03
Eastern Mosquitofish	*Gambusia holbrooki*	1526	87.7 (10.76)	324	7.07	0.04
Florida gar	*Lepisosteus platyrhincus*	2	0.11 (0.08)	1369	0.01	0.15
Gizzard Shad	*Dorosoma cepedianum*	2	0.11 (0.08)	2015	0.01	0.23
Golden Shiner	*Notemigonus crysoleucas*	10	0.57 (0.32)	729	0.05	0.08
Inland Silverside	*Menidia beryllina*	815	46.84 (7.24)	560	3.77	0.06
Ironcolor shiner	*Notropis chalybaeus*	6	0.34 (0.25)	3	0.03	<0.01
Lake Chubsucker	*Erimyzon sucetta*	103	5.92 (1.24)	44528	0.48	5.00
Largemouth Bass	*Micropterus salmoides*	2208	126.9 (6.75)	413069	10.23	46.36
Least Killifish	*Heterandria formosa*	56	3.21 (0.52)	<0.01	0.26	<0.01
Longnose Gar	*Lepisosteus osseus*	3	0.17 (0.1)	4285	0.01	0.48
Metallic Shiner	*Pteronotropis metallicus*	29	1.67 (1.18)	3	0.13	<0.01
Pirate perch	*Aphredoderus sayanus*	1	0.06 (0.06)	6	0.00	<0.01
Pygmy Sunfish	*Elassoma spp.*	9	0.52 (0.20)	<0.01	0.04	<0.01
Redbreast Sunfish	*Lepomis auritus*	1077	61.9 (5.26)	38043	4.99	4.27
Redear Sunfish	*Lepomis microlophus*	751	43.16 (3.22)	38787	3.48	4.35
Redeye Chub	*Notropis harperi*	189	10.86 (2.01)	81	0.88	0.01
Sailfin Molly	*Poecilia latipinna*	79	5.54 (1.19)	45	0.37	0.01
Seminole Killifish	*Fundulus seminolis*	795	45.69 (3.85)	15616	3.68	1.75
Spotted Sunfish	*Lepomis punctatus*	8150	468.39 (23.9)	149810	37.74	16.81
Sunfish spp.	*Lepomis spp.*	18	1.03 (0.28)	2	0.08	<0.01
Swamp Darter	*Etheostoma fusiforme*	4	0.23 (0.11)	1	0.02	<0.01
Tadpole Madtom	*Noturus gyrinus*	24	1.38 (0.28)	49	0.11	0.01
Taillight Shiner	*Notropis maculatus*	11	0.63 (0.41)	1	0.05	<0.01
Warmouth	*Lepomis gulosus*	560	32.18 (3.71)	33990	2.59	3.81
White Catfish	*Ameiurus catus*	4	0.23 (0.11)	1547	0.02	0.17
Yellow Bullhead	*Ameiurus natalis*	42	2.41 (0.44)	10540	0.19	1.18

Table 6. The Weeki Wachee River System relative abundance and percent composition by number and weight of fish species collected (n = 44) Catch per unit distance = (CPUD-km). Standard error = (SE).

			Fish/km		% Composition	
Common Name	**Scientific Name**	**Number**	**CPUD (SE)**	**Weight**	**Number**	**Weight**
American Eel	*Anguilla rostrata*	38	2.13 (0.52)	-	0.65	-
Atlantic Needlefish	*Strongylura marina*	89	5 (0.95)	1467	1.51	0.45
Bluefin Killifish	*Lucania goodei*	225	12.64 (2.22)	32	3.83	0.01
Bluegill	*Lepomis macrochirus*	558	31.35 (4.24)	11430	9.50	3.54
Brown Bullhead	*Ameiurus nebulosus*	7	0.39 (0.16)	575	0.12	0.18
Clown Goby	*Microgobius gulosus*	12	0.67 (0.23)	7	0.20	<0.01
Coastal Shiner	*Notropis petersoni*	762	42.8 (11.0)	758	12.97	0.23
Common Snook	*Centropomus undecimalis*	6	0.34 (0.23)	5396	0.10	1.67
Crevalle Jack	*Caranx hippos*	9	0.51 (0.24)	5611	0.15	1.74
Eastern Mosquitofish	*Gambusia holbrooki*	112	6.29 (1.42)	25	1.91	0.01
Fat Sleeper	*Dormitator maculatus*	43	2.41 (1.02)	236	0.73	0.07
Florida Gar	*Lepisosteus platyrhincus*	1	0.06 (0.06)	44	0.02	0.01
Golden Shiner	*Notemigonus crysoleucas*	1	0.06 (0.06)	9	0.02	<0.01
Gray Snapper	*Lutjanus griseus*	344	19.33 (5.6)	30108	5.85	9.33
Gulf Killifish	*Fundulus grandis*	3	0.17 (0.12)	102	0.05	0.03
Gulf Toadfish	*Opsanus beta*	2	0.11 (0.08)	235	0.03	0.07
Hogchoker	*Trinectes maculatus*	306	17.19 (2.04)	3363	5.21	1.04
Inland Silverside	*Menidia beryllina*	17	0.96 (0.38)	8	0.29	<0.01
Lake Chubsucker	*Erimyzon sucetta*	97	5.45 (1.71)	11668	1.65	3.62
Largemouth Bass	*Micropterus salmoides*	383	21.52 (1.74)	89858	6.52	27.84
Least Killifish	*Heterandria formosa*	28	1.57 (0.51)	1	0.48	<0.01
Longnose Gar	*Lepisosteus osseus*	3	0.17 (0.1)	167	0.05	0.05
Mountain Mullet	*Agonostomus monticola*	3	0.17 (0.1)	1145	0.05	0.35
Naked Goby	*Gobiosoma bosci*	3	0.17 (0.1)	0	0.05	<0.01
Pinfish	*Lagodon rhomboides*	8	0.45 (0.17)	144	0.14	0.04
Rainwater Killifish	*Lucania parva*	51	2.87 (1.34)	2	0.87	<0.01
Redear Sunfish	*Lepomis microlophus*	203	11.4 (1.74)	13323	3.45	4.13
Remora	*Echeneidae spp.*	1	0.06 (0.06)	23	0.02	0.01
Sailfin Molly	*Poecilia latipinna*	41	2.30 (0.72)	145	0.70	0.04
Seminole Killifish	*Fundulus seminolis*	23	1.29 (0.35)	388	0.39	0.12
Sheepshead	*Archosargus probatocephalus*	31	1.74 (0.58)	5507	0.53	1.71
Silver Jenny	*Eucinostomus gula*	5	0.28 (0.18)	76	0.09	0.02
Skate	*Rajidae spp.*	1	0.06 (0.06)	-	0.02	-
Southern Flounder	*Paralichthys lethostigma*	1	0.06 (0.06)	64	0.02	0.02
Spotted Sunfish	*Lepomis punctatus*	1748	98.2 (7.34)	57706	29.75	17.88
Striped Mullet	*Mugil cephalus*	54	3.03 (0.56)	55250	0.92	17.12
Sunfish sp.	*Lepomis sp.*	6	0.34 (0.16)	1	0.10	<0.01
Tadpole Madtom	*Noturus gyrinus*	22	1.24 (0.26)	36	0.37	0.01
Tidewater Mojarra	*Eucinostomus harengulus*	435	24.44 (4.37)	6352	7.40	1.97
Timucu	*Strongylura timucu*	54	3.03 (0.69)	1027	0.92	0.32
Warmouth	*Lepomis gulosus*	45	2.53 (0.56)	1101	0.77	0.34
White Mullet	*Mugil curema*	13	0.73 (0.25)	5525	0.22	1.71
Worm Eel	*Myrophis punctatus*	4	0.22 (0.17)	-	0.07	-
Yellow Bullhead	*Ameiurus natalis*	88	4.94 (0.67)	13830	1.50	4.29

Table 7. Presence vs Absence of species across all five systems. Habitat preference F=freshwater M=marine.

Common Name	Scientific Name	Habitat	Chassahowitzka	Homosassa	King's Bay	Rainbow	Weeki Wachee
American Eel	*Anguilla rostrata*	F	X	X	X	X	X
Black Crappie	*Pomoxis nigromaculatus*	F	-	X	-	-	-
Bluefin Killifish	*Lucania goodei*	F	X	X	X	X	X
Bluegill Sunfish	*Lepomis macrochirus*	F	X	X	X	X	X
Blue Tilapia	*Oreochromis aureus*	F	-	-	X	-	-
Bowfin	*Amia calva*	F	-	-	X	X	-
Brook Silverside	*Labidesthes sicculus*	F	-	-	X	X	-
Brown Bullhead	*Ameiurus nebulosos*	F	-	-	-	X	X
Coastal Shiner	*Notropis petersoni*	F	X	X	-	X	X
Dollar Sunfish	*Lepomis marginatus*	F	-	-	-	X	-
Eastern Mosquitofish	*Gambusia holbrooki*	F	X	X	X	X	X
Florida Gar	*Lepisosteus platyrhincus*	F	X	X	X	X	X
Gizzard Shad	*Dorosoma cepedianum*	F	-	-	-	X	-
Golden Shiner	*Notemigonus crysoleucas*	F	X	X	X	X	X
Inland Silverside	*Menidia beryllina*	F	X	X	X	X	X
Ironcolor Shiner	*Notropis chalybaeus*	F	X	-	-	X	-
Lake Chubsucker	*Erimyzon sucetta*	F	X	X	-	X	X
Largemouth Bass	*Micropterus salmoides*	F	X	X	X	X	X
Least Killifish	*Heterandria formosa*	F	X	X	X	X	X
Longnose Gar	*Lepisosteus osseus*	F	X	X	X	X	X
Metallic Shiner	*Pteronotropis metallicus*	F	-	-	-	X	-
Pirate Perch	*Aphredoderus sayanus*	F	-	-	-	X	-
Pygmy Sunfish	*Elassoma spp.*	F	-	-	-	X	-
Rainwater Killifish	*Lucania parva*	F	X	X	X	-	X
Redbreast Sunfish	*Lepomis auritus*	F	-	-	-	X	-
Redear Sunfish	*Lepomis microlophus*	F	X	X	X	X	X
Redeye Chub	*Notropis harperi*	F	X	X	-	X	-
Sailfin Molly	*Poecilia latipinna*	F	X	X	-	X	X
Seminole Killifish	*Fundulus seminolis*	F	X	X	X	X	X
Silver Perch	*Bidyanus bidyanus*	F	-	-	X	-	-
Spotted Sunfish	*Lepomis punctatus*	F	X	X	X	X	X
Swamp Darter	*Etheostoma fusiforme*	F	-	-	-	X	-
Tadpole Madtom	*Noturus gyrinus*	F	-	-	-	X	X
Taillight Shiner	*Notropis maculatus*	F	-	-	-	X	-
Warmouth	*Lepomis gulosus*	F	-	X	-	X	X
White Catfish	*Ameiurus catus*	F	-	-	X	X	-
Yellow Bullhead	*Ameiurus natalis*	F	X	-	-	X	X
Atlantic Needlefish	*Strongylura marina*	M	X	X	X	X	X
Atlantic Stingray	*Dasyatis sabina*	M	-	X	X	-	-
Bay Anchovy	*Anchoa mitchilli*	M	X	X	X	-	-
Black Drum	*Pogonias cromis*	M	-	X	X	-	-
Clown Goby	*Gobiodon spp.*	M	X	X	X	-	X
Common Snook	*Centropomus undecimalis*	M	X	X	X	-	X
Crevalle Jack	*Caranx caninus*	M	X	X	X	-	X
Fat Sleeper	*Dormitator maculatus*	M	-	-	-	-	X
Gafftopsail Catfish	*Bagre marinus*	M	X	-	-	-	-
Gray Snapper	*Lutjanus cyanopterus*	M	X	X	X	-	X
Gulf Killifish	*Fundulus grandis*	M	X	X	X	-	X
Gulf Pipefish	*Syngnathus scovelli*	M	X	X	-	-	-
Gulf Toadfish	*Opsanus beta*	M	X	X	-	-	X
Hardhead Catfish	*Ariopsis felis*	M	X	X	X	-	-
Hogchoker	*Trinectes maculatus*	M	X	X	X	-	X
Ladyfish	*Elops affinis*	M	X	X	X	-	-
Leatherjacket	*Oligoplites saurus*	M	X	-	X	-	-
Marsh Killifish	*Fundulus confluentus*	M	X	X	-	-	-
Menhaden	*Ethmidium maculatum*	M	X	X	X	-	-
Mountain Mullet	*Agonostomus monticola*	M	-	-	-	-	X
Naked Goby	*Gobiosoma bosc*	M	X	X	X	-	X
Pinfish	*Lagodon rhomboides*	M	X	X	X	-	X
Red Drum	*Sciaenops ocellatus*	M	X	X	X	-	-
Redfin Needlefish	*Strongylura notata*	M	X	X	X	-	-
Remora	*Echeneidae spp.*	M	X	X	X	-	X
Scaled Sardine	*Harengula jaguana*	M	X	X	-	-	-
Sheepshead	*Archosargus probatocephalus*	M	X	X	X	-	X
Sheepshead Minnow	*Cyprinodon variegatus*	M	X	-	X	-	-
Silver Jenny	*Eucinostomus gula*	M	-	-	-	-	X
Skate	*Rajidae spp.*	M	-	-	-	-	X
Southern Flounder	*Paralichthys lethostigma*	M	-	-	-	-	X
Southern Stingray	*Dasyatis americana*	M	-	-	X	-	-
Spot Croaker	*Leiostomus xanthurus*	M	X	X	X	-	-
Spotted Seatrout	*Cynoscion nebulosus*	M	X	X	X	-	-
Striped Mullet	*Mugil cephalus*	M	X	X	X	-	X
Tidewater Mojarra	*Eucinostomus harengulus*	M	X	X	X	-	X
Timucu	*Strongylura timucu*	M	X	X	X	-	X
White Mullet	*Mugil curema*	M	X	X	X	-	X
Worm Eel	*Myrophis punctatus*	M	X	X	X	-	X
			n=51	n=50	n=48	n=34	n=42

Table 8. Historical species presence vs absence from the Chassahowitzka River System. Habitat preference; F=freshwater M=marine.

Chassahowitzka	Habitat	Frazer 2011 2007-2010	Pine 2011 2008-2011	FWC Springs 2013-2017
American Eel	F	X	X	X
Bluefin Killifish	F	X	X	X
Bluegill Sunfish	F	X	-	X
Brown Bullhead	F	X	-	-
Coastal Shiner	F	X	X	X
Eastern Mosquitofish	F	X	X	X
Florida Gar	F	X	-	X
Golden Shiner	F	X	-	X
Inland Silverside	F	X	X	X
Ironcolor Shiner	F	-	-	X
Lake Chubsucker	F	X	X	X
Largemouth Bass	F	X	X	X
Least Killifish	F	X	X	X
Longnose Gar	F	X	-	X
Rainwater Killifish	F	X	X	X
Redear Sunfish	F	X	X	X
Redeye Chub	F	X	-	X
Sailfin Molly	F	X	X	X
Seminole Killifish	F	X	X	X
Spotted Sunfish	F	X	X	X
Swamp Darter	F	-	X	-
Warmouth	F	X	-	-
Yellow Bullhead	F	X	-	X
Atlantic Needlefish	M	X	-	X
Bay Anchovy	M	X	-	X
Clown Goby	M	X	X	X
Common Snook	M	X	-	X
Crevalle Jack	M	X	-	X
Gafftopsail Catfish	M	-	-	X
Gray Snapper	M	X	X	X
Gulf Killifish	M	X	-	X
Gulf Pipefish	M	X	X	X
Gulf Toadfish	M	X	X	X
Hardhead Catfish	M	X	-	X
Hogchoker	M	X	X	X
Ladyfish	M	X	-	X
Leatherjacket	M	X	-	X
Lizardfish	M	X	-	-
Marsh Killifish	M	X	-	X
Menhaden	M	X	-	X
Naked Goby	M	X	X	X
Pinfish	M	X	X	X
Red Drum	M	X	-	X
Redfin Needlefish	M	X	-	X
Remora	M	-	-	X
Sheepshead	M	X	X	X
Sheepshead Minnow	M	X	X	X
Silver Jenny	M	X	-	-
Silver Perch	M	X	-	-
Spot Croaker	M	X	-	X
Spotted Seatrout	M	X	-	X
Stingray spp	M	X	-	X
Striped Mullet	M	X	-	X
Tidewater Mojarra	M	X	X	X
Timucu	M	X	-	X
White Mullet	M	X	-	X
Worm Eel	M	-	-	X

Table 9. Zone 1 species count from the Chassahowitzka River System for each sampling event (2014-2017). Habitat Preference F=freshwater M=marine; S=Summer W=Winter.

Species	Habitat	W 14	S 14	W 15	S 15	W 16	S 16 (1)	S16 (2)	W 17
American Eel	F	3	5	2	2	2	4	7	-
Bluefin Killifish	F	3	22	-	48	-	69	35	-
Bluegill Sunfish	F	-	4	-	1	-	2	7	-
Coastal Shiner	F	-	1	-	4	1	-	25	-
Eastern Moquitofish	F	-	15	-	2	-	-	-	-
Florida Gar	F	-	-	-	-	-	-	1	-
Golden Shiner	F	-	3	-	6	-	4	29	-
Inland Silverside	F	-	-	-	5	-	1	7	-
Ironcolor Shiner	F	2	20	-	-	-	44	-	-
Lake Chubsucker	F	3	30	4	54	5	129	28	-
Largemouth Bass	F	12	61	23	43	14	102	103	35
Least Killifish	F	-	3	-	-	-	-	-	-
Lepomis sp.	F	-	-	-	-	-	-	3	
Longnose Gar	F	-	1	-	-	-	1	-	-
Rainwater Killifish	F	11	42	1	64	3	51	100	1
Redear Sunfish	F	2	2	3	1	-	8	12	1
Redeye Chub	F	-	-	-	22	-	1	15	-
Sailfin Molly	F	-	1	-	-	-	1	-	-
Seminole Killifish	F	-	1	-	1	-	3	1	-
Spotted Sunfish	F	21	80	6	87	26	129	230	4
Yellow Bullhead	F	-	1	-	-	-	-	-	-
Atlantic Needlefish	M	6	-	-	-	2	5	-	1
Bay Anchovy	M	-	-	-	-	-	-	-	-
Clown Goby	M	2	-	-	2	1	1	2	-
Common Snook	M	-	-	-	-	-	-	11	1
Crevalle Jack	M	-	-	-	-	-	-	-	-
Gafftopsail Catfish	M	-	-	-	-	-	-	-	-
Gray Snapper	M	157	-	298	1	51	-	-	98
Gulf Killifish	M	-	-	-	-	-	-	-	-
Gulf Pipefish	M	-	-	-	2	-	-	1	-
Gulf Toadfish	M	-	-	-	-	-	-	-	-
Hardhead Catfish	M	-	-	-	-	-	-	-	-
Hogchoker	M	1	1	-	5	2	7	1	-
Ladyfish	M	-	-	-	-	-		-	-
Leatherjacket	M	-	-	-	-	-	-	-	-
Marsh Killifish	M	-	-	-	-	-	-	-	-
Menhaden	M	-	-	-	-	-	-	-	-
Naked Goby	M	-	-	-	-	-	1	-	-
Pinfish	M	16	57	23	44	38	79	64	1
Red Drum	M	-	-	-	-	-	-	-	-
Redfin Needlefish	M	-	-	-	-	-	-	-	-
Remora	M	-	-	-	-	-	-	1	1
Scaled Sardine	M	-	-	-	-	-	-	-	-
Sheepshead	M	-	-	-	-	-	-	5	14
Sheepshead Minnow	M	-	-	-	-	-	-	-	-
Spot Croaker	M	-	-	-	-	-	-	-	-
Spotted Seatrout	M	-	-	-	-	-	-	-	-
Striped Mullet	M	-	1	2	-	-	-	32	-
Tidewater Mojarra	M	-	-	18	-	90	3	92	59
Timucu	M	-	-	2	-	5	-	-	-
White Mullet	M	-	-	-	-	-	-	-	-
Worm Eel	M	-	-	-	-	-	-	-	-
		n =239	n =351	n =382	n =394	n =240	n =645	n =812	n =216

Table 10. Zone 2 species count from the Chassahowitzka River System for each sampling event (2014-2017). Habitat Preference F=freshwater M=marine; S=Summer W=Winter.

Species	Habitat	W 14	S 14	W 15	S 15	W 16	S 16 (1)	S16 (2)	W 17
American Eel	F	1	3	1	-	-	-	2	4
Bluefin Killifish	F	-	9	6	27	-	20	5	-
Bluegill Sunfish	F	-	7	-	-	-	1	2	-
Coastal Shiner	F	-	1	-	1	2	-	7	-
Eastern Moquitofish	F	-	25	-	20	-	6	1	-
Florida Gar	F	-	-	-	-	-	-	-	-
Golden Shiner	F	-	3	-	-	-	-	1	-
Inland Silverside	F	-	8	-	9	-	41	27	-
Ironcolor Shiner	F	3	5	-		-	10	-	-
Lake Chubsucker	F	-	39	36	158	1	79	3	-
Largemouth Bass	F	8	61	19	46	15	133	90	28
Least Killifish	F	-	-	-	-	-	-	-	-
Lepomis sp.	F	-	3	-	-	-	4	3	-
Longnose Gar	F	-	1	-	-	-	-	1	-
Rainwater Killifish	F	2	146	21	295	23	188	63	2
Redear Sunfish	F	2	10	2	2	2	19	8	2
Redeye Chub	F	-	-	-	12	-	-	1	2
Sailfin Molly	F	-	2	3	1	-	-	2	-
Seminole Killifish	F	-	5	2	15	-	13	6	1
Spotted Sunfish	F	10	133	64	142	22	126	113	16
Yellow Bullhead	F	-	-	-	-	-	-	-	-
Atlantic Needlefish	M	-	1		-	-	3	2	1
Bay Anchovy	M	-	-	-	-	-	-	-	-
Clown Goby	M	1	1	1	5	1	4	-	2
Common Snook	M	4	10	33	18	-	31	3	34
Crevalle Jack	M	-	-	-	-	-	-	-	2
Gafftopsail Catfish	M	-	-	-	-	-	-	-	-
Gray Snapper	M	656	-	646	5	142	1	-	274
Gulf Killifish	M	-	-	-	2	-	-	-	-
Gulf Pipefish	M	-	-	2	6	-	-	1	-
Gulf Toadfish	M	2	-	2	-	1	-	-	-
Hardhead Catfish	M	-	-	-	-	-	2	-	-
Hogchoker	M	-	1	2	1	1	7	11	-
Ladyfish	M	-	-	-	-	-	-	-	-
Leatherjacket	M	-	-	-	-	-	-	11	-
Marsh Killifish	M	-	-	-	-	-	1	-	-
Menhaden	M	-	-	-	-	-	80	5	-
Naked Goby	M	-	-	2	-	-	-	-	-
Pinfish	M	118	171	145	418	104	75	63	3
Red Drum	M	-	-	-	-	-	-	-	-
Redfin Needlefish	M	-	-	-	-	-	-	-	-
Remora	M	-	-	-	-	-	-	-	-
Scaled Sardine	M	-				-	-	-	-
Sheepshead	M	-	4	2	-	-	4	17	14
Sheepshead Minnow	M	-	-	-	-	-	6	1	-
Spot Croaker	M	-	-	-	-	-	39	10	-
Spotted Seatrout	M	-	-	-	-	-	-	-	-
Striped Mullet	M	-	9	4	2	4	19	32	10
Tidewater Mojarra	M	18	-	228	4	221	29	273	150
Timucu	M	-	-	-	-	3	-	-	-
White Mullet	M	2	-	8	-	-	-	-	-
Worm Eel	M	-	-	-	-	-	-	-	-
		n =827	n =658	n =1229	n =1189	n =542	n =941	n =764	n =545

Table 11. Zone 3 species count from the Chassahowitzka River System for each sampling event (2014-2017). Habitat Preference F=freshwater M=marine; S=Summer W=Winter.

Species	Habitat	W 14	S 14	W 15	S 15	W 16	S 16 (1)	S16 (2)	W 17
American Eel	F	-	3	-	1	-	-	2	-
Bluefin Killifish	F	-	-	-	3	-	-	-	-
Bluegill Sunfish	F	-	2	-	-	-	-	-	-
Coastal Shiner	F	-	-	-	-	-	-	2	-
Eastern Moquitofish	F	-	-	-	-	-	-	-	-
Florida Gar	F	-	-	-	-	-	-	2	-
Golden Shiner	F	-	-	-	3	-	-	-	-
Inland Silverside	F	-	61	5	42	1	11	129	-
Ironcolor Shiner	F	-	-	-	-	-	-	-	-
Lake Chubsucker	F	-	69	-	42	-	-	-	-
Largemouth Bass	F	1	12	1	12	3	1	25	9
Least Killifish	F	-	1	-	-	-	-	-	-
Lepomis spp.	F	-	1	-	-	-	-	-	-
Longnose Gar	F	-	-	-	1	-	-	-	-
Rainwater Killifish	F	3	377	156	285	67	63	27	3
Redear Sunfish	F	-	-	-	-	-	-	6	1
Redeye Chub	F	-	-	-	-	-	-	-	-
Sailfin Molly	F	-	3	3	1	10	-	-	3
Seminole Killifish	F	-	-	-	6	2	-	-	-
Spotted Sunfish	F	-	32	-	29	3	2	4	6
Yellow Bullhead	F	-	-	-	-	-	-	-	-
Atlantic Needlefish	M	-	3	-	-	-	1	4	2
Bay Anchovy	M	-	54	1	292	-	2	-	-
Clown Goby	M	1	2	8	2	3	-	-	2
Common Snook	M	5	18	10	15	12	17	20	63
Crevalle Jack	M	-	-	3	-	-	-	-	-
Gafftopsail Catfish	M	-	-	-	-	-	1	-	-
Gray Snapper	M	69	10	15	9	27	2	3	42
Gulf Killifish	M	6	21	22	3	53	11	-	18
Gulf Pipefish	M	-	-	2	2	-	-	1	1
Gulf Toadfish	M	-	-	-	2	-	-	-	-
Hardhead Catfish	M	-	3	1	9	-	30	1	-
Hogchoker	M	-	4	6	2	-	4	2	-
Ladyfish	M	-	-	-	-	-	1	-	-
Leatherjacket	M	-	-	-	-	-	-	3	-
Marsh Killifish	M	-	-	-	7	1	1	-	-
Menhaden	M	-	21	-	3	-	231	25	-
Naked Goby	M	-	-	1	-	-	-	-	-
Pinfish	M	-	80	9	166	6	14	49	3
Red Drum	M	-	-	-	-	1	1	1	-
Redfin Needlefish	M	-	-	-	-	-	1	1	-
Remora	M	-	-	-	-	1	-	-	-
Scaled Sardine	M	-	-	-	68	-	-	-	-
Sheepshead	M	-	3	-	1	2	3	4	10
Sheepshead Minnow	M	-	12	1	3	28	1	-	-
Spot Croaker	M	-	14	-	49	-	25	49	-
Spotted Seatrout	M	-	-	1	-	-	-	9	-
Striped Mullet	M	-	2	2	7	3	23	1	12
Tidewater Mojarra	M	15	29	388	169	169	27	55	120
Timucu	M	-	-	-	2	-	-	-	-
White Mullet	M	-	-	1	-	-	-	-	-
Worm Eel	M	-	-	-	5	-	1	-	-
		n =100	n =837	n =636	n =1241	n =392	n =474	n =425	n =295

Table 12. Total count and percent composition of marine and freshwater species from the Chassahowitzka River System based on respective habitat preference. Habitat Preference M= marine F= freshwater.

Total							
Species	**Count**	**Percent**	**Habitat**	**Species**	**Count**	**Percent**	**Habitat**
Atlantic Needlefish	31	0.37	M	American Eel	42	0.70	F
Bay Anchovy	349	4.15	M	Bluefin Killfish	247	4.14	F
Clown Goby	41	0.49	M	Bluegill Sunfish	26	0.44	F
Common Snook	305	3.63	M	Coastal Shiner	44	0.74	F
Crevalle Jack	5	0.06	M	Eastern Moquitofish	69	1.16	F
Gafftopsail Catfish	1	0.01	M	Florida Gar	3	0.05	F
Gray Snapper	2506	29.83	M	Golden Shiner	49	0.82	F
Gulf Killifish	138	1.64	M	Inland Silverside	347	5.81	F
Gulf Pipefish	18	0.21	M	Ironcolor Shiner	84	1.41	F
Gulf Toadfish	5	0.06	M	Lake Chubsucker	680	11.38	F
Hardhead Catfish	46	0.55	M	Largemouth Bass	857	14.35	F
Hogchocker	58	0.69	M	Least Killifish	4	0.07	F
Ladyfish	1	0.01	M	Lepomis sp.	14	0.23	F
Leatherjacket	14	0.17	M	Longnose Gar	5	0.08	F
Marsh Killifish	10	0.12	M	Rainwater Killifish	1994	33.38	F
Menhaden	365	4.34	M	Redear Sunfish	83	1.39	F
Naked Goby	4	0.05	M	Redeye Chub	53	0.89	F
Pinfish	1746	20.78	M	Sailfin Molly	30	0.50	F
Red Drum	3	0.04	M	Seminole Killifish	56	0.94	F
Redfin Needlefish	2	0.02	M	Spotted Sunfish	1285	21.51	F
Remora	3	0.04	M	Yellow Bullhead	1	0.02	F
Scaled Sardine	68	0.81	M				
Sheepshead	83	0.99	M				
Sheepshead Minnow	52	0.62	M				
Spot Croaker	186	2.21	M				
Spotted Seatrout	10	0.12	M				
Striped Mullet	165	1.96	M				
Tidewater Mojarra	2157	25.68	M				
Timucu	12	0.14	M				
White Mullet	11	0.13	M				
Worm Eel	6	0.07	M				

Table 13. Winter total count and percent composition of marine and freshwater species from the Chassahowitzka River System based on respective habitat preference. Habitat Preference M= marine F= freshwater.

Winter						
Species	**Count**	**Percent**	**Habitat**	**Species**	**Count**	**Percent**	**Habitat**
Atlantic Needlefish	12	0.25	M	American Eel	13	1.70	F
Bay Anchovy	1	0.02	M	Bluefin Killifish	9	1.18	F
Clown Goby	22	0.45	M	Coastal Shiner	3	0.39	F
Common Snook	162	3.32	M	Inland Silverside	6	0.78	F
Crevall Jack	5	0.10	M	Ironcolor Shiner	5	0.65	F
Gray Snapper	2475	50.74	M	Lake Chubsucker	49	6.41	F
Gulf Killifish	101	2.07	M	Largemouth Bass	168	21.96	F
Gulf Pipefish	5	0.10	M	Rainwater Killifish	293	38.30	F
Gulf Toadfish	3	0.06	M	Redear Sunfish	15	1.96	F
Hardhead Catfish	1	0.02	M	Redeye Chub	2	0.26	F
Hogchoker	12	0.25	M	Sailfin Molly	19	2.48	F
Marsh Kilifish	1	0.02	M	Seminole Killifish	5	0.65	F
Naked Goby	3	0.06	M	Spotted Sunfish	178	23.27	F
Pinfish	466	9.55	M				
Red Drum	1	0.02	M				
Remora	2	0.04	M				
Sheepshead	42	0.86	M				
Sheepshead Minnow	29	0.59	M				
Spotted Seatrout	1	0.02	M				
Striped Mullet	37	0.76	M				
Tidewater Mojarra	1476	30.26	M				
Timucu	10	0.21	M				
White Mullet	11	0.23	M				

Table 14. Summer total count and percent composition of marine and freshwater species from the Chassahowitzka River System based on respective habitat preference. Note: Habitat Preference M= marine F= freshwater.

Summer							
Species	**Count**	**Percent**	**Habitat**	**Species**	**Count**	**Percent**	**Habitat**
Atlantic Needlefish	19	0.54	M	American Eel	29	0.56	F
Bay Anchovy	348	9.88	M	Bluefin Killifish	238	4.57	F
Clown Goby	19	0.54	M	Bluegill	26	0.50	F
Common Snook	143	4.06	M	Coastal Shiner	41	0.79	F
Gafftopsail Catfish	1	0.03	M	Eastern Mosquitofish	69	1.32	F
Gray Snapper	31	0.88	M	Florida Gar	3	0.06	F
Gulf Killifish	37	1.05	M	Golden Shiner	49	0.94	F
Gulf Pipefish	13	0.37	M	Inland Silverside	341	6.55	F
Gulf Toadfish	2	0.06	M	Ironcolor Shiner	79	1.52	F
Hardhead Catfish	45	1.28	M	Lake Chubsucker	631	12.12	F
Hogchoker	46	1.31	M	Largemouth Bass	689	13.23	F
Ladyfish	1	0.03	M	Least Killifish	4	0.08	F
Leatherjack	14	0.40	M	Lepomis spp.	14	0.27	F
Marsh Killifish	9	0.26	M	Longnose Gar	5	0.10	F
Menhaden	365	10.36	M	Rainwater Killifish	1701	32.66	F
Naked Goby	1	0.03	M	Redear Sunfish	68	1.31	F
Pinfish	1280	36.33	M	Redeye Chub	51	0.98	F
Red Drum	2	0.06	M	Sailfin Molly	11	0.21	F
Redfin Needlefish	2	0.06	M	Seminole Killifish	51	0.98	F
Remora	1	0.03	M	Spotted Sunfish	1107	21.26	F
Scaled Sardine	68	1.93	M	Yellow Bullhead	1	0.02	F
Sheepshead	41	1.16	M				
Sheepshead Minnow	23	0.65	M				
Spot Croaker	186	5.28	M				
Spotted Seatrout	9	0.26	M				
Striped Mullet	128	3.63	M				
Tidewater Mojarra	681	19.33	M				
Timucu	2	0.06	M				
Worm Eel	6	0.17	M				

Table 15. The Chassahowitzka River System Zone 1 total count and percent composition of marine and freshwater species based on respective habitat preference. Habitat Preference M= marine F= freshwater.

Zone 1							
Species	**Count**	**Percent**	**Habitat**	**Species**	**Count**	**Percent**	**Habitat**
Atlantic Needlefish	14	1.07	M	American Eel	25	1.27	F
Clown Goby	8	0.61	M	Bluefin Killfish	177	8.98	F
Common Snook	12	0.92	M	Bluegill Sunfish	14	0.71	F
Gray Snapper	605	46.29	M	Coastal Shiner	31	1.57	F
Gulf Pipefish	3	0.23	M	Eastern Moquitofish	17	0.86	F
Hogchoker	17	1.30	M	Florida Gar	1	0.05	F
Naked Goby	1	0.08	M	Golden Shiner	42	2.13	F
Pinfish	322	24.64	M	Inland Silverside	13	0.66	F
Remora	2	0.15	M	Ironcolor Shiner	66	3.35	F
Sheepshead	19	1.45	M	Lake Chubsucker	253	12.83	F
Striped Mullet	35	2.68	M	Largemouth Bass	393	19.93	F
Tidewater Mojarra	262	20.05	M	Least Killifish	3	0.15	F
Timucu	7	0.54	M	Lepomis sp.	3	0.15	F
				Longnose Gar	2	0.10	F
				Rainwater Killifish	273	13.84	F
				Redear Sunfish	29	1.47	F
				Redeye Chub	38	1.93	F
				Sailfin Molly	2	0.10	F
				Seminole Killifish	6	0.30	F
				Spotted Sunfish	583	29.56	F
				Yellow Bullhead	1	0.05	F

Table 16. The Chassahowitzka River System Zone 2 total count and percent composition of marine and freshwater species based on respective habitat preference. Habitat Preference M= marine F= freshwater.

Zone 2							
Species	**Count**	**Percent**	**Habitat**	**Species**	**Count**	**Percent**	**Habitat**
Atlantic Needlefish	7	0.16	M	American Eel	11	0.42	F
Clown Goby	17	0.40	M	Bluefin Killfish	69	2.63	F
Common Snook	133	3.09	M	Bluegill Sunfish	10	0.38	F
Crevalle Jack	2	0.05	M	Coastal Shiner	11	0.42	F
Gray Snapper	1724	40.07	M	Eastern Moquitofish	52	1.99	F
Gulf Killifish	4	0.09	M	Golden Shiner	7	0.27	F
Gulf Pipefish	11	0.26	M	Inland Silverside	100	3.82	F
Gulf Toadfish	3	0.07	M	Ironcolor Shiner	18	0.69	F
Hogchoker	23	0.53	M	Lake Chubsucker	358	13.67	F
Hardhead Catfish	2	0.05	M	Largemouth Bass	407	15.54	F
Leatherjacket	11	0.26	M	Leopmis sp.	10	0.38	F
Marsh Killifish	1	0.02	M	Longnose Gar	2	0.08	F
Menhaden	85	1.98	M	Rainwater Killifish	804	30.70	F
Naked Goby	2	0.05	M	Redear Sunfish	47	1.79	F
Pinfish	1165	27.07	M	Redeye Chub	15	0.57	F
Sheepshead	41	0.95	M	Sailfin Molly	8	0.31	F
Sheepshead Minnow	7	0.16	M	Seminole Killifish	44	1.68	F
Spot Croaker	49	1.14	M	Spotted Sunfish	646	24.67	F
Striped Mullet	80	1.86	M				
Tidewater Mojarra	923	21.45	M				
Timucu	3	0.07	M				
White Mullet	10	0.23	M				

Table 17. The Chassahowitzka River System Zone 3 total count and percent composition of marine and freshwater species based on respective habitat preference. Habitat Preference M= marine F= freshwater.

Zone 3							
Species	**Count**	**Percent**	**Habitat**	**Species**	**Count**	**Percent**	**Habitat**
Atlantic Needlefish	10	0.36	M	American Eel	6	0.43	F
Bay Anchovy	349	12.50	M	Bluefin Killfish	1	0.07	F
Clown Goby	16	0.57	M	Bluegill Sunfish	2	0.14	F
Common Snook	160	5.73	M	Coastal Shiner	2	0.14	F
Crevalle Jack	3	0.11	M	Florida Gar	2	0.14	F
Gafftopsail Catfish	1	0.04	M	Inland Silverside	234	16.93	F
Gray Snapper	177	6.34	M	Lake Chubsucker	69	4.99	F
Gulf Killifish	134	4.80	M	Largemouth Bass	57	4.12	F
Gulf Pipefish	4	0.14	M	Least Killifish	1	0.07	F
Gulf Toadfish	2	0.07	M	Lepomis sp.	1	0.07	F
Hardhead Catfish	44	1.58	M	Longnose Gar	1	0.07	F
Hogchoker	18	0.64	M	Rainwater Killifish	917	66.35	F
Ladyfish	1	0.04	M	Redear Sunfish	7	0.51	F
Leatherjacket	3	0.11	M	Sailfin Molly	20	1.45	F
Marsh Killifish	9	0.32	M	Seminole Killifish	6	0.43	F
Menhaden	280	10.03	M	Spotted Sunfish	56	4.05	F
Naked Goby	1	0.04	M				
Pinfish	259	9.28	M				
Red Drum	3	0.11	M				
Redfin Needlefish	2	0.07	M				
Remora	1	0.04	M				
Scaled Sardine	68	2.44	M				
Sheepshead	23	0.82	M				
Sheepshead Minnow	45	1.61	M				
Spot Croaker	137	4.91	M				
Spotted Seatrout	10	0.36	M				
Striped Mullet	50	1.79	M				
Tidewater Mojarra	972	34.83	M				
Timucu	2	0.07	M				
White Mullet	1	0.04	M				
Worm Eel	6	0.21	M				

Table 18. Historical species presence vs absence from the Homosassa River System. Habitat preference; F=freshwater M=marine.

Common Name	Habitat	Herald et al 1949	FMNH 1953	FMNH 2001-2002	USGS 2003	Frazer 2011 2007-2010	WSI 2010	Pine 2011 2008-2011	FWC Springs 2013-2017
American Eel	F	-	-	X	X	X	-	X	X
Black Crappie	F	-	-	-	-	-	-	-	X
Bluefin Killifish	F	X	-	X	X	X	-	X	X
Bluegill Sunfish	F	X	X	X	X	X	X	-	X
Bowfin	F	-	-	-	-	-	X	-	-
Brown Bullhead	F	-	-	-	-	X	-	-	-
Chain Pickerel	F	-	-	-	-	X	-	-	-
Coastal Shiner	F	-	-	X	X	X	-	X	X
Eastern Mosquitofish	F	X	-	X	X	X	X	X	X
Florida Gar	F	-	-	-	X	X	X	X	X
Golden Shiner	F	X	-	-	-	X	-	-	X
Harper's Minnow	F	X	-	-	-	-	-	-	-
Inland Silverside	F	-	-	-	X	X	X	X	X
Lake Chubsucker	F	X	-	-	-	X	-	-	X
Largemouth Bass	F	X	X	X	X	X	X	-	X
Least Killifish	F	X	-	X	X	X	-	-	X
Longnose Gar	F	X	-	-	X	X	-	X	X
Okefenokee Pygmy Sunfish	F	-	-	-	X	-	-	-	-
Rainwater Killifish	F	X	-	X	X	X	X	X	X
Redbreast Sunfish	F	-	-	-	-	-	X	-	-
Redear Sunfish	F	X	-	X	X	X	-	-	X
Redeye Chub	F	-	-	-	X	X	-	-	X
Sailfin Molly	F	X	-	X	X	X	-	-	X
Seminole Killifish	F	-	-	X	X	X	-	-	X
Spotted Sunfish	F	X	-	X	X	X	-	X	X
Tadpole Madtom	F	-	-	-	X	-	-	-	-
Warmouth	F	X	X	X	X	-	X	-	X
Yellow Bullhead	F	X	-	-	X	X	-	-	-
Atlantic Croaker	M	-	-	-	-	-	-	X	-
Atlantic Needlefish	M	X	-	-	X	X	X	-	X
Barracuda	M	-	-	-	-	X	-	-	-
Bay Anchovy	M	-	-	-	-	X	-	X	X
Black Drum	M	-	-	-	X	X	X	-	X
Clown Goby	M	-	-	-	X	X	X	X	X
Common Snook	M	X	-	-	X	X	X	-	X
Crevalle Jack	M	X	-	-	X	X	X	-	X
Gafftopsail Catfish	M	X	-	-	-	X	X	-	-
Gray Snapper	M	X	-	X	X	X	X	-	X
Gulf Killifish	M	-	-	-	-	X	-	-	X
Gulf Pipefish	M	-	-	-	-	X	-	X	X
Gulf Toadfish	M	-	-	-	-	X	-	X	X
Hardhead Catfish	M	-	-	-	-	X	-	-	X
Hogchoker	M	-	-	X	X	X	-	X	X
Ladyfish	M	-	-	-	-	X	X	X	X
Leatherjacket	M	-	-	-	-	X	-	-	-
Lizardfish	M	-	-	-	-	X	-	-	-
Marsh Killifish	M	-	-	-	X	X	-	-	X
Menhaden	M	-	-	-	-	X	-	-	X
Naked Goby	M	-	-	-	-	X	-	X	X
Pinfish	M	X	X	-	X	X	-	X	X
Red Drum	M	X	-	-	-	X	X	-	X
Redfin Needlefish	M	-	-	-	-	X	-	-	X
Scaled Sardine	M	-	-	-	-	-	-	-	X
Schoolmaster Snapper	M	X	-	-	-	-	-	-	-
Sharksucker	M	X	-	X	X	X	X	-	X
Sheepshead	M	X	-	-	X	X	X	-	X
Sheepshead Minnow	M	X	-	-	-	X	-	-	-
Silver Jenny	M	-	-	-	-	X	-	-	-
Silver Perch	M	-	-	-	-	X	-	-	-
Spot Croaker	M	-	-	-	-	X	-	-	X
Spotfin Mojarra	M	X	-	-	-	-	-	-	-
Spotted Seatrout	M	X	-	-	-	X	-	-	X
Stingray spp	M	X	-	-	-	X	-	-	X
Striped Mojarra	M	-	-	-	-	X	X	-	-
Striped Mullet	M	X	-	X	X	X	X	-	X
Tarpon	M	X	-	-	-	-	-	-	-
Tidewater Mojarra	M	-	X	X	X	X	X	X	X
Timucu	M	-	-	X	-	X	-	-	X
White Mullet	M	X	-	X	-	X	-	-	X
Worm Eel	M	-	-	-	-	X	-	-	X

Table 19. Zone 1 species count from the Homosassa River System for each sampling event (2014-2017). Habitat Preference; F=freshwater M=marine; S=Summer W=Winter.

Species	Habitat	W 14	S 14	W 15	S 15 (1)	S 15 (2)	W 16	S 16	W 17
American Eel	F	-	1	2	4	4	4	-	-
Black Crappie	F	-	-	-	-	-	-	-	-
Bluefin Killifish	F	-	2	-	-	3	-	9	-
Bluegill Sunfish	F	1	11	13	31	27	15	35	17
Coastal Shiner	F	-	-	-	7	-	-	4	-
Eastern Mosqitofish	F	-	7	-	8	-	-	11	-
Florida Gar	F	9	4	3	2	1	6	3	3
Golden Shiner	F	-	1		3	6	-	-	-
Inland Silverside	F	-	1	-	-	17	-	2	-
Lake Chubsucker	F	-	1	-	-	-	-	-	-
Largemouth Bass	F	8	30	17	65	25	10	65	11
Least Killifish	F	-	-	-	-	-	-	1	-
Lepomis spp.	F	-	1	-	-	-	-	1	-
Longnose Gar	F	-	-	-	-	-	-	-	-
Rainwater Killifish	F	6	6	-	8	3	2	11	1
Redear Sunfish	F	4	2	5	3	3	3	8	10
Redeye Chub	F	-	-	-	-	-	-	1	-
Sailfin Molly	F	-	-	-	-	-	-	-	-
Seminole Killifish	F	-	-	-	-	-	-	-	3
Spotted Sunfish	F	9	22	21	16	9	13	27	23
Warmouth	F	-	-	-	-	1	-	-	-
Atlantic Needlefish	M	4	-	-	-	-	-	3	3
Atlantic Stingray	M	-	-	-	-	1	1	-	-
Bay Anchovy	M	-	-	-	-	-	-	-	-
Black Drum	M	-	-	-	-	-	-	-	1
Clown Goby	M	2	-	-	6	1	-	5	-
Common Snook	M	-	-	10	-	1	7	1	41
Crevalle Jack	M	-	-	-	-	-	-	-	-
Gray Snapper	M	152	4	223	-	-	22	-	39
Gulf Killifish	M	-	-	-	-	-	-	-	-
Gulf Pipefish	M	-	-	-	1	-	-	3	-
Gulf Toadfish	M	-	-	-	-	-	-	-	-
Hardhead Catfish	M	-	-	-	-	1	-	-	-
Hogchoker	M	-	-	2	2	3	-	3	4
Ladyfish	M	-	-	-	-	-	-	-	-
Marsh Killifish	M	-	-	-	1	-	-	-	-
Menhaden	M	-	-	-	-	-	-	-	-
Naked Goby	M	1	-	-	3	-	-	-	-
Pinfish	M	-	-	-	3	8	10	3	3
Red Drum	M	1	-	-	-	1	-	-	-
Redfin Needlefish	M	-	-	-	-	-	-	-	-
Remora	M	-	-	-	-	-	-	-	2
Scaled Sardine	M	-	-	-	34	-	-	-	-
Sheepshead	M	7	1	2	8	1	-	1	9
Spot Croaker	M	-	-	-	-	-	-	-	-
Spotted Seatrout	M	-	-	-	-	-	-	-	-
Striped Mullet	M	2	39	7	62	20	25	13	10
Striped Mojarra	M	-	-	-	-	-	-	-	-
Tidewater Mojarra	M	47	4	40	22	205	223	13	242
Timucu	M	-	-	1	-	2	-	-	-
White Mullet	M	-	-	-	-	1	2	3	-
Worm Eel	M	-	-	-	1	1	-	-	-
		n =253	n =137	n =346	n =290	n =345	n =343	n =226	n =422

Table 20. Zone 2 species count from the Homosassa River System for each sampling event (2014-2017). Habitat Preference F=freshwater M=marine; S=Summer W=Winter.

Species	Habitat	W 14	S 14	W 15	S 15 (1)	S 15 (2)	W 16	S 16	W 17
American Eel	F	-	2	-	2	-	-	1	-
Black Crappie	F	-	1	-	-	-	-	-	-
Bluefin Killifish	F	-	1	-	-	1	-	1	
Bluegill Sunfish	F	7	9	1	20	4	5	65	9
Coastal Shiner	F	-	-	-	-	-	-	-	-
Eastern Mosqitofish	F	-	4	-	4	-	-	3	-
Florida Gar	F	2	5	4	4	-	6	3	4
Golden Shiner	F		1	-	-	-	-	-	-
Inland Silverside	F	1	47	-	18	23	1	4	-
Lake Chubsucker	F	-	-	-	-	-	-	-	-
Largemouth Bass	F	12	22	5	24	7	3	61	8
Least Killifish	F	-	-	-	-	-	-	-	-
Lepomis sp.	F	-	1	-	-	-	-	2	-
Longnose Gar	F	-	-	-	1	-	-	-	-
Rainwater Killifish	F	2	2	3	10	1	2	14	-
Redear Sunfish	F	-	1	-	10	-	3	6	4
Redeye Chub	F	-	-	-	-	-	-	-	-
Sailfin Molly	F	-	-	-	-	-	-	6	-
Seminole Killifish	F	-	1	-	-	-	1	-	-
Spotted Sunfish	F	2	8	2	9	5	2	29	3
Warmouth	F	-	-	-	-	-	-	-	-
Atlantic Needlefish	M	6	1	2	-	-	-	2	4
Atlantic Stingray	M	-	-	-	1	1	-	-	-
Bay Anchovy	M	2	-	-	36	-	-	1	-
Black Drum	M	1	3	-	-	4	-	-	1
Clown Goby	M	-	-	-	-	1	-	2	-
Common Snook	M	26	10	9	30	15	97	21	39
Crevalle Jack	M	2	-	1	1	-	3	-	-
Gray Snapper	M	549	24	453	15	3	151	-	50
Gulf Killifish	M	-	-	-	-	-	-	1	-
Gulf Pipefish	M	-	1	-	-	-	-	-	-
Gulf Toadfish	M	-	-	-	-	-	-	-	-
Hardhead Catfish	M	-	-	-	-	-	-	6	-
Hogchoker	M	-	-	3	1	1	2	10	-
Ladyfish	M	-	-	-	-	1	-	-	-
Marsh Killifish	M	-	-	-		-	-	-	-
Menhaden	M	-	7	-		-	-	12	-
Naked Goby	M	-	2	-	1	-	-	-	-
Pinfish	M	-	6	2	2	11	21	14	4
Red Drum	M	11	3	1	9	6	6	7	3
Redfin Needlefish	M	-	-	-	-	-	-	-	-
Remora	M	-	-	-	-	-	1	-	2
Scaled Sardine	M	-	-	-	67	-	-	-	-
Sheepshead	M	5	17	2	11	1	2	4	23
Spot Croaker	M	-	-	-	-	-	-	-	-
Spotted Seatrout	M	-	-	-	-	1	-	-	-
Striped Mullet	M	41	29	8	3	5	50	5	15
Striped Mojarra	M	-	-	-	-	-	-	-	-
Tidewater Mojarra	M	59	50	94	337	80	442	26	192
Timucu	M	-	-	9	-	1	6	-	-
White Mullet	M	-	-	-	-	-	1	-	-
Worm Eel	M	-	-	-	-	-	-	-	-
		n =728	n =258	n =599	n =616	n =172	n =805	n =306	n =361

Table 21. Zone 3 species count from the Homosassa River System for each sampling event (2014-2017). Habitat Preference F=freshwater M=marine; S=Summer W=Winter.

Species	Habitat	W 14	S 14	W 15	S 15 (1)	S 15 (2)	W 16	S 16	W 17
American Eel	F	-	-	-	-	-	-	-	-
Black Crappie	F	-	-	-	-	-	-	-	-
Bluefin Killifish	F	-	-	-	-	-	-	-	-
Bluegill Sunfish	F	3	1	6	4	1	6	-	3
Coastal Shiner	F	-	-	-	-	-	-	-	-
Eastern Mosqitofish	F	-	2	-	1	-	-	-	-
Florida Gar	F	-	1	1	1	-	1	1	3
Golden Shiner	F	-	-	1	-	-	-	-	-
Inland Silverside	F	-	6	8	11	24	-	-	-
Lake Chubsucker	F	-	-	-	-	-	-	-	-
Largemouth Bass	F	1	8	9	3	4	2	8	4
Least Killifish	F	-	-	-	-	-	-	-	-
Lepomis spp.	F	-	-	-	-	-	-	-	-
Longnose Gar	F	-	1	1	2	1	-	-	-
Rainwater Killifish	F	2	1	4	-	2	1	-	-
Redear Sunfish	F	-	-	-	-	-	-	-	-
Redeye Chub	F	-	-	-	-	-	-	-	-
Sailfin Molly	F	-	-	-	-	-	-	-	-
Seminole Killifish	F	-	-	-	-	1	-	-	-
Spotted Sunfish	F	-	-	4	-	3	1	1	1
Warmouth	F	-	-	-	-	-	-	-	-
Atlantic Needlefish	M	5	-	-	1	-	2	2	1
Atlantic Stingray	M	-	2	-	3	-	2	1	-
Bay Anchovy	M	66	2	-	39	-	1	-	8
Black Drum	M	-	-	-	-	-	-	-	4
Clown Goby	M	-	-	-	-	1	-	-	-
Common Snook	M	12	4	124	19	24	19	25	63
Crevalle Jack	M	1	-	-	3	-	1	1	-
Gray Snapper	M	224	15	33	13	2	87	-	17
Gulf Killifish	M	-	-	-	-	-	1	-	-
Gulf Pipefish	M	-	-	-	-	-	-	1	-
Gulf Toadfish	M	-	3	-	-	-	1	-	-
Hardhead Catfish	M	-	-	-	7	2	-	14	-
Hogchoker	M	-	-	1	-	-	-	-	-
Ladyfish	M	-	3	-	4	2	-	-	-
Marsh Killifish	M	-	-	-	-	-	-	-	-
Menhaden	M	-	56	-	2	-	-	4	-
Naked Goby	M	-	-	-	-	-	-	-	-
Pinfish	M	2	26	6	9	12	50	-	1
Red Drum	M	1	1	11	5	1	2	2	2
Redfin Needlefish	M	-	-	1	-	-	-	-	-
Remora	M	-	-	-	-	-	-	-	-
Scaled Sardine	M	-	-	-	1	1	-	-	-
Sheepshead	M	7	4	1	5	6	3	1	9
Spot Croaker	M	-	-	-	18	-	-	2	-
Spotted Seatrout	M	2	-	-	1	-	2	-	-
Striped Mullet	M	17	45	19	4	7	19	9	8
Striped Mojarra	M	-	-	-	-	-	-	1	-
Tidewater Mojarra	M	108	36	258	166	55	163	1	134
Timucu	M	-	-	4	-	-	6	-	-
White Mullet	M	1	2	15	-	-	-	-	-
Worm Eel	M	-	-	-	1	-	-	-	-
		n =452	n =219	n =507	n =323	n =149	n =370	n =74	n =258

Table 22. Total count and percent composition of marine and freshwater species from the Homosassa River System based on respective habitat preference. Habitat Preference M= marine F= freshwater.

Total							
Species	**Count**	**Percent**	**Habitat**	**Species**	**Count**	**Percent**	**Habitat**
Atlantic Needlefish	36	0.50	M	American Eel	20	1.42	F
Atlantic Stingray	11	0.15	M	Black Crappie	1	0.07	F
Bay Anchovy	155	2.17	M	Bluefin Killfish	17	1.20	F
Black Drum	14	0.20	M	Bluegill Sunfish	294	20.84	F
Clown Goby	18	0.25	M	Coastal Shiner	5	0.35	F
Common Snook	604	8.45	M	Eastern mosquitofish	40	2.83	F
Crevalle Jack	13	0.18	M	Florida Gar	67	4.75	F
Gray Snapper	2076	29.04	M	Golden Shiner	12	0.85	F
Gulf Killifish	1	0.01	M	Inland Silverside	163	11.55	F
Gulf Pipefish	7	0.10	M	Lake Chubsucker	1	0.07	F
Gulf Toadfish	4	0.06	M	Largemouth Bass	412	29.20	F
Hardhead Catfish	30	0.42	M	Least Killifish	1	0.07	F
Hogchoker	32	0.45	M	Leopmis sp.	5	0.35	F
Ladyfish	10	0.14	M	Longnose Gar	6	0.43	F
Marsh Killifish	1	0.01	M	Rainwater Killifish	81	5.74	F
Menhaden	81	1.13	M	Redear Sunfish	62	4.39	F
Naked Goby	7	0.10	M	Redeye Chub	1	0.07	F
Pinfish	193	2.70	M	Sailfin Molly	6	0.43	F
Red Drum	73	1.02	M	Seminole Killifish	6	0.43	F
Redfin Needlefish	1	0.01	M	Spotted Sunfish	210	14.88	F
Remora	5	0.07	M	Warmouth	1	0.07	F
Scaled Sardine	103	1.44	M				
Sheepshead	130	1.82	M				
Spot Croaker	20	0.28	M				
Spotted Seatrout	6	0.08	M				
Striped Mojarra	1	0.01	M				
Striped Mullet	462	6.46	M				
Tidewater Mojarra	2997	41.93	M				
Timucu	29	0.41	M				
White Mullet	25	0.35	M				
Worm Eel	3	0.04	M				

Table 23. Winter total count and percent composition of marine and freshwater species from the Homosassa River System based on respective habitat preference. Habitat Preference M= marine F= freshwater.

Winter							
Species	**Count**	**Percent**	**Habitat**	**Species**	**Count**	**Percent**	**Habitat**
Atlantic Needlefish	27	0.53	M	American Eel	6	1.61	F
Atlantic Stingray	3	0.06	M	Bluegill	86	23.12	F
Bay Anchovy	77	1.52	M	Florida Gar	42	11.29	F
Black Drum	7	0.14	M	Golden Shiner	1	0.27	F
Clown Goby	2	0.04	M	Inland Silverside	10	2.69	F
Common Snook	447	8.81	M	Largemouth Bass	90	24.19	F
Crevalle Jack	8	0.16	M	Rainwater Killifish	23	6.18	F
Gray Snapper	2000	39.43	M	Redear Sunfish	29	7.80	F
Gulf Kilifish	1	0.02	M	Seminole Killifish	4	1.08	F
Gulf Toadfish	1	0.02	M	Spotted Sunfish	81	21.77	F
Hogchoker	12	0.24	M				
Longnose Gar	1	0.02	M				
Naked Goby	1	0.02	M				
Pinfish	99	1.95	M				
Red Drum	38	0.75	M				
Redfin Needlefish	1	0.02	M				
Remora	5	0.10	M				
Sheepshead	70	1.38	M				
Spotted Seatrout	4	0.08	M				
Striped Mullet	221	4.36	M				
Tidewater Mojarra	2002	39.47	M				
Timucu	26	0.51	M				
White Mullet	19	0.37	M				

Table 24. Summer total count and percent composition of marine and freshwater species from the Homosassa River System based on respective habitat preference. Habitat Preference M= marine F= freshwater.

Summer							
Species	**Count**	**Percent**	**Habitat**	**Species**	**Count**	**Percent**	**Habitat**
Atlantic Needlefish	9	0.43	M	American Eel	14	1.35	F
Atlantic Stingray	8	0.39	M	Black Crappie	1	0.10	F
Bay Anchovy	78	3.76	M	Bluefin Killifish	17	1.64	F
Black Drum	7	0.34	M	Bluegill	208	20.04	F
Clown Goby	16	0.77	M	Coastal Shiner	5	0.48	F
Common Snook	157	7.56	M	Eastern Mosquitofish	40	3.85	F
Crevalle Jack	5	0.24	M	Florida Gar	25	2.41	F
Gray Snapper	76	3.66	M	Golden Shiner	11	1.06	F
Gulf Pipefish	7	0.34	M	Inland silverside	153	14.74	F
Gulf Toadfish	3	0.14	M	Lake Chubsucker	1	0.10	F
Hardhead Catfish	30	1.44	M	Largemouth Bass	322	31.02	F
Hogchoker	20	0.96	M	Least Killifish	1	0.10	F
Ladyfish	10	0.48	M	Lepomis sp.	5	0.48	F
Marsh Killifish	1	0.05	M	Longnose Gar	5	0.48	F
Menhaden	81	3.90	M	Rainwater Killifish	58	5.59	F
Naked Goby	6	0.29	M	Redear Sunfish	33	3.18	F
Pinfish	94	4.53	M	Redeye Chub	1	0.10	F
Red Drum	35	1.69	M	Sailfin Molly	6	0.58	F
Scaled Sardine	103	4.96	M	Seminole Killifish	2	0.19	F
Sheepshead	60	2.89	M	Spotted sunfish	129	12.43	F
Spot Croaker	20	0.96	M	Warmouth	1	0.10	F
Spotted Seatrout	2	0.10	M				
Striped Mojarra	1	0.05	M				
Striped Mullet	241	11.60	M				
Tidewater Mojarra	995	47.91	M				
Timucu	3	0.14	M				
White Mullet	6	0.29	M				
Worm Eel	3	0.14	M				

Table 25. The Homosassa River System Zone 1 total count and percent composition of marine and freshwater species from on respective habitat preference. Habitat Preference M= marine F= freshwater.

Zone 1							
Species	**Count**	**Percent**	**Habitat**	**Species**	**Count**	**Percent**	**Habitat**
Atlantic Needlefish	10	0.61	M	American Eel	15	2.07	F
Atlantic Stingray	2	0.12	M	Bluefin Killfish	14	1.93	F
Black Drum	1	0.06	M	Bluegill Sunfish	150	20.66	F
Clown Goby	14	0.86	M	Coastal Shiner	5	0.69	F
Common Snook	67	4.09	M	Eastern Mosquitofish	26	3.58	F
Gray Snapper	440	26.88	M	Florida Gar	31	4.27	F
Gulf Pipefish	4	0.24	M	Golden Shiner	10	1.38	F
Hardhead Catfish	1	0.06	M	Inland Silverside	20	2.75	F
Hogchoker	14	0.86	M	Lake Chubsucker	1	0.14	F
Marsh Killifish	1	0.06	M	Largemouth Bass	231	31.82	F
Naked Goby	4	0.24	M	Least Killifish	1	0.14	F
Pinfish	27	1.65	M	Lepomis sp.	2	0.28	F
Red Drum	2	0.12	M	Rainwater Killifish	37	5.10	F
Remora	2	0.12	M	Redear Sunfish	38	5.23	F
Scaled Sardine	34	2.08	M	Redeye Chub	1	0.14	F
Sheepshead	29	1.77	M	Seminole Killifish	3	0.41	F
Striped Mullet	178	10.87	M	Spotted Sunfish	140	19.28	F
Tidewater Mojarra	796	48.63	M	Warmouth	1	0.14	F
Timucu	3	0.18	M				
White Mullet	6	0.37	M				
Worm Eel	2	0.12	M				

Table 26. The Homosassa River System Zone 2 total count and percent composition of marine and freshwater species based on respective habitat preference. Habitat Preference M= marine F= freshwater.

Zone 2							
Species	**Count**	**Percent**	**Habitat**	**Species**	**Count**	**Percent**	**Habitat**
Atlantic Needlefish	15	0.45	M	American Eel	5	0.93	F
Atlantic Stingray	2	0.06	M	Black Crappie	1	0.19	F
Bay Anchovy	39	1.18	M	Bluefin Killfish	3	0.56	F
Black Drum	9	0.27	M	Bluegill Sunfish	120	22.43	F
Clown Goby	3	0.09	M	Eastern Mosquitofish	11	2.06	F
Common Snook	247	7.46	M	Florida Gar	28	5.23	F
Crevalle Jack	7	0.21	M	Golden Shiner	1	0.19	F
Gray Snapper	1245	37.61	M	Inland Silverside	94	17.57	F
Gulf Pipefish	2	0.06	M	Largemouth Bass	142	26.54	F
Hardhead Catfish	6	0.18	M	Lepomis sp.	3	0.56	F
Hogchoker	17	0.51	M	Longnose Gar	1	0.19	F
Ladyfish	1	0.03	M	Rainwater Killifish	34	6.36	F
Menhaden	19	0.57	M	Redear Sunfish	24	4.49	F
Naked Goby	3	0.09	M	Sailfin Molly	6	1.12	F
Pinfish	60	1.81	M	Seminole Killifish	2	0.37	F
Red Drum	46	1.39	M	Spotted Sunfish	60	11.21	F
Remora	3	0.09	M				
Scaled Sardine	67	2.02	M				
Sheepshead	65	1.96	M				
Spotted Seatrout	1	0.03	M				
Striped Mullet	156	4.71	M				
Tidewater Mojarra	1280	38.67	M				
Timucu	16	0.48	M				
White Mullet	1	0.03	M				

Table 27. The Homosassa River System Zone 3 total count and percent composition of marine and freshwater species based on respective habitat preference. Habitat Preference M= marine F= freshwater.

Zone 3							
Species	**Count**	**Percent**	**Habitat**	**Species**	**Count**	**Percent**	**Habitat**
Atlantic Needlefish	11	0.50	M	Bluegill Sunfish	24	16.00	F
Atlantic Stingray	7	0.32	M	Eastern Mosquitofish	3	2.00	F
Bay Anchovy	116	5.27	M	Florida Gar	8	5.33	F
Black Drum	4	0.18	M	Golden Shiner	1	0.67	F
Clown Goby	1	0.05	M	Inland Silverside	49	32.67	F
Common Snook	290	13.18	M	Largemouth Bass	39	26.00	F
Crevalle Jack	6	0.27	M	Longnose Gar	5	3.33	F
Gray Snapper	391	17.76	M	Rainwater Killifish	10	6.67	F
Gulf Killifish	1	0.05	M	Seminole Killifish	1	0.67	F
Gulf Pipefish	1	0.05	M	Spotted Sunfish	10	6.67	F
Gulf Toadfish	4	0.18	M				
Hardhead Catfish	23	1.04	M				
Hogchoker	1	0.05	M				
Ladyfish	9	0.41	M				
Menhaden	62	2.82	M				
Pinfish	106	4.82	M				
Red Drum	25	1.14	M				
Redfin Needlefish	1	0.05	M				
Scaled Sardine	2	0.09	M				
Sheepshead	36	1.64	M				
Spot Croaker	20	0.91	M				
Spotted Seatrout	5	0.23	M				
Striped Mojarra	1	0.05	M				
Striped Mullet	128	5.82	M				
Tidewater Mojarra	921	41.84	M				
Timucu	10	0.45	M				
White Mullet	18	0.82	M				
Worm Eel	1	0.05	M				

Table 28. Historical species presence vs absence from the Crystal River/Kings Bay System. Habitat preference F=freshwater M=marine.

Common Name	Habitat	FWC 1990-1992	FWC Springs 2013-2017
American Eel	F	X	X
Bluefin Killifish	F	X	X
Bluegill Sunfish	F	X	X
Bluespotted Sunfish	F	X	-
Blue Tilapia	F	-	X
Bowfin	F	-	X
Brook Silverside	F	-	X
Brown Bullhead	F	X	-
Chain Pickerel	F	X	-
Dollar Sunfish	F	X	-
Eastern Moquitofish	F	X	X
Florida Gar	F	X	X
Golden Shiner	F	X	X
Inland Silverside	F	-	X
Lake Chubsucker	F	X	-
Largemouth Bass	F	X	X
Least Killifish	F	X	X
Longnose Gar	F	X	X
Rainwater Killifish	F	X	X
Redear Sunfish	F	X	X
Seminole Killifish	F	X	X
Spotted Sunfish	F	X	X
Swamp Darter	F	X	-
Taillight Shiner	F	X	-
Warmouth	F	X	-
White Catfish	F	-	X
Yellow Bullhead	F	X	-
Atlantic Needlefish	M	X	X
Atlantic Stingray	M	-	X
Bay Anchovy	M	-	X
Black Drum	M	-	X
Clown Goby	M	-	X
Common Snook	M	-	X
Crevalle Jack	M	-	X
Gray Snapper	M	X	X
Gulf Killifish	M	X	X
Gulf Toadfish	M	X	-
Hardhead Catfish	M	-	X
Hogchoker	M	X	X
Ladyfish	M	-	X
Leatherjacket	M	-	X
Marsh Killifish	M	-	X
Menhaden	M	-	X
Naked Goby	M	-	X
Pigfish	M	X	-
Pinfish	M	X	-
Pipefish spp.	M	X	
Red Drum	M	X	-
Redfin Needlefish	M	-	X
Remora	M	-	X
Sheepshead	M	X	
Sheepshead Minnow	M	-	X
Silver Perch	M	X	X
Southern Stingray	M	-	X
Spot Croaker	M	X	X
Spotfin Mojarra	M	X	-
Spotted Seatrout	M	X	X
Stingray spp.	M	X	X
Striped Anchovy	M	X	-
Striped Mullet	M	X	X
Tidewater Mojarra	M	-	X
Tidewater Silverside	M	X	-
Timucu	M	-	X
White Mullet	M	-	X
Worm Eel	M	X	X

Table 29. Zone 1 species count from the Crystal River/Kings Bay System for each sampling event (2014-2017). Habitat Preference F=freshwater M=marine; S=Summer W=Winter.

Common Name	Habitat	W 14	S 14 (1)	S 14 (2)	W 15	S 15	W 16	S 16	W 17
American Eel	F	1	2	3	1	2	-	-	-
Blue Tilapia	F	-	-	-	-	-	-	-	-
Bluefin Killifish	F	-	-	1	-	2	2	-	-
Bluegill Sunfish	F	-	8	40	5	-	14	-	-
Bowfin	F	1	1	1	-	-	1	-	-
Brook Silverside	F	-	-	-	-	-	-	-	2
Eastern Mosquitofish	F	-	-	3	-	-	-	-	-
Florida Gar	F	2	1	2	-	1	3	1	
Golden Shiner	F	-	-	-	-	-	-	-	-
Inland Silverside	F	2	2	264	3	46	5	1	-
Largemouth Bass	F	18	32	35	15	30	48	9	2
Least Killifish	F	-	-	-	-	-	-	-	-
Longnose Gar	F	-	-	-	-	-	-	-	1
Rainwater Killifish	F	8	2		5	2	2	-	1
Redear Sunfish	F	4	5	6	2	-	7	-	2
Seminole Killifish	F	1	-	4	1	-	8	-	1
Silver Perch	F	-	-	-	-	-	-	-	-
Spotted Sunfish	F	5	4	9	5	5	10	-	6
White Catfish	F	-	-	-	-	-	-	-	1
Atlantic Needlefish	M	28	-	-	1	-	1	-	5
Atlantic Stingray	M	-	1	-	-	-	-	-	-
Bay Anchovy	M	2	-	308	1	140	24	-	3
Black Drum	M	-	-	4	-	-	-	2	5
Clown Goby	M	2	1	-	-	1	2	-	-
Common Snook	M	33	29	31	44	30	44	9	52
Crevalle Jack	M	-	-	3	3	6	-	1	1
Gray Snapper	M	54	55	19	50	28	51	13	29
Gulf Killifish	M	-	-	-	-	-	-	-	-
Hardhead Catfish	M	2	1	1	-	1	-	-	3
Hogchoker	M	1	-	1	1	2	2	-	2
Ladyfish	M	6	-	3	2	-	8	-	9
Leatherjacket	M	-	-	3	-	-	-	-	-
Menhaden	M	-	185	-	-	-	-	187	-
Naked Goby	M	1	-	-	-	1	-	-	1
Pinfish	M	2	2	20	-	7	-	-	1
Red Drum	M	5	3	2		3	1	4	4
Redfin Needlefish	M	-	-	-	3	-	-	-	-
Remora	M	-	-	-	2	-	-	-	-
Sheepshead	M	6	5	6	1	-	1	-	6
Sheepshead Minnow	M	-	1	-	-	-	-	-	-
Southern Stingray	M	-	-	-	-	-	-	-	-
Spot Croaker	M	-	-	-	-	-	-	2	-
Spotted Seatrout	M	-	-	-	1	-	-	-	7
Striped Mullet	M	61	48	69	86	65	38	66	56
Tidewater Mojarra	M	225	89	150	239	112	260	17	309
Timucu	M	-	-	5	32	-	12	-	-
White Mullet	M	-	4	2	13	1	1	3	4
Worm Eel	M	-	-	-	-	-	2	-	-
		n=470	n=481	n=995	n=516	n=485	n=547	n=315	n=513

Table 30. Zone 2 species count from the Crystal River/Kings Bay System for each sampling event (2014-2017). Habitat Preference F=freshwater M=marine; S=Summer W=Winter.

Common Name	Habitat	W 14	S 14 (1)	S 14 (2)	W 15	S 15	W 16	S 16	W 17
American Eel	F	-	2	1	-	1	-	-	-
Blue Tilapia	F	-	-	-	-	-	-	-	-
Bluefin Killifish	F	-	-	-	-	-	-	-	-
Bluegill Sunfish	F	1	-	14	11	-	2	-	10
Bowfin	F	-	-	-	-	-	-	-	
Brook Silverside	F	-	-	-	-	-	-	-	1
Eastern Mosquitofish	F	-	-	-	-	-	-	1	-
Florida Gar	F	5	2	-	3	2		3	3
Golden Shiner	F	-	-	-	-	-	-	-	1
Inland Silverside	F	21	-	64	21	4	11	2	-
Largemouth Bass	F	8	4	30	9	11	4	17	7
Least Killifish	F	-	-	-	-	-	-	-	-
Longnose Gar	F	-	-	-	-	-	-	-	-
Rainwater Killifish	F	19	-	48	2	8	3	4	18
Redear Sunfish	F	5	-	4	-	-	-	-	3
Seminole Killifish	F	3	-	21	1		3	-	12
Silver Perch	F	-	-	6	2	-	-	-	-
Spotted Sunfish	F	-	-	2	2	-	-	2	-
White Catfish	F	-	-	-	6	-	-	-	-
Atlantic Croaker	M	-	-	-	-	-	-	-	1
Atlantic Needlefish	M	11	-	-	-	1	3	-	1
Atlantic Stingray	M	-	2	-	-	-	-	-	-
Bay Anchovy	M	52	-	-	3	-	6	-	1
Black Drum	M	1	-	-	-	-	-	-	6
Clown Goby	M	2	-	6	-	1	-	-	2
Common Snook	M	56	10	10	35	14	30	30	57
Crevalle Jack	M	1	-	-	4	-	-	-	1
Gray Snapper	M	96	83	16	26	7	80	5	9
Gulf Killifish	M	-	-	3	-	12	1	-	4
Hardhead Catfish	M	-	-	1	-	-	1	-	5
Hogchoker	M	-	-	1	-	-	-	-	1
Ladyfish	M	5	-	-	-	-	2	-	-
Leatherjacket	M	-	-	3	-	-	-	-	-
Menhaden	M	-	-	-	-	-	-	-	-
Naked Goby	M	2	-	-	-	-	-	-	-
Pinfish	M	11	-	40	5	7	7	15	46
Red Drum	M	1	8	5	2	1	1	7	2
Redfin Needlefish	M	-	-	-	-	-	-	-	-
Remora	M	-	-	-	-	-	-	-	-
Sheepshead	M	6	7	4	2	1	4	4	8
Sheepshead Minnow	M	-	-	-	-	1	-	-	-
Southern Stingray	M	-	-	-	-	-	-	-	-
Spot Croaker	M	-	-	-	-	-	-	1	-
Spotted Seatrout	M	4	-	-	3	-	-	-	5
Striped Mullet	M	146	52	57	71	20	72	114	108
Tarpon	M	-	-	1	-	-	-	-	-
Tidewater Mojarra	M	183	16	290	231	18	374	24	303
Timucu	M	-	-	4	8	-	2	-	-
White Mullet	M	-	2	-	-	-	2	4	9
Worm Eel	M	-	-	-	-	-	-	-	-
		n=639	n=481	n=631	n=447	n=113	n=608	n=233	n=624

Table 31. Zone 3 species count from the Crystal River/Kings Bay System for each sampling event (2014-2017). Habitat Preference F=freshwater M=marine; S=Summer W=Winter.

Common Name	Habitat	W 14	S 14 (1)	S 14 (2)	W 15	S 15	W 16	S 16	W 17
American Eel	F	4	-	7	2	2	-	2	-
Blue Tilapia	F	-	-	-	-	1	-	-	-
Bluefin Killifish	F	-	-	-	-	-	-	-	-
Bluegill Sunfish	F	2	-	1	-	-	5	-	1
Bowfin	F	-	-	-	-	-	-	-	-
Brook Silverside	F	-	-	-	-	-	-	-	4
Eastern Mosquitofish	F	-	3	-	-	-	-	-	-
Florida Gar	F	4	7	3	8	7	12	12	4
Golden Shiner	F	-	-	-	-	-	-	-	-
Inland Silverside	F	2	2	101	5	6	14	-	-
Largemouth Bass	F	10	6	7	10	-	30	5	3
Least Killifish	F	-	-	-	-	1	-	-	-
Longnose Gar	F	-	-	4	-	5	3	-	1
Rainwater Killifish	F	1	-	10	16	3	15	2	11
Redear Sunfish	F	5	-	3	2	-	8	1	1
Seminole Killifish	F	3	-	8	-	-	25	-	2
Silver Perch	F	6	-	3	-	-	1	-	-
Spotted Sunfish	F	8	-	-	2	6	2	1	1
White Catfish	F	-	-	-	-	-	-	-	-
Atlantic Croaker	M	-	-	-	-	-	-	-	-
Atlantic Needlefish	M	-	-	-	-	1	-	-	-
Atlantic Stingray	M	-	6	-	2	4	-	2	-
Bay Anchovy	M	1	-	3	51	1	13	-	6
Black Drum	M	-	-	-	-	-	-	-	15
Clown Goby	M	-	-	-	1	-	-	-	1
Common Snook	M	5	25	22	12	44	23	30	49
Crevalle Jack	M	-	-	5	4	1	-	-	-
Gray Snapper	M	6	176	10	6	51	38	50	38
Gulf Killifish	M	-	-	-	-	-	3	-	-
Hardhead Catfish	M	2	-	5	-	-	4	-	8
Hogchoker	M	-	-	-	1	1	-	-	2
Ladyfish	M	5	-	-	2	1	4	-	3
Leatherjacket	M	-	-	-	-	-	-	-	-
Menhaden	M	-	-	-	-	9	-	127	-
Naked Goby	M	-	-	-	-	-	-	-	-
Pinfish	M	-	1	10	3	7	14	14	18
Red Drum	M	5	11	5	24	5	7	10	19
Redfin Needlefish	M	-	-	-	1	-	-	-	-
Remora	M	-	-	-	-	-	1	-	-
Sheepshead	M	2	4	1	1	4	1	5	12
Sheepshead Minnow	M	-	-	-	-	-	1	-	-
Southern Stingray	M	-	-	-	-	-	-	2	-
Spot Croaker	M	-	-	-	-	3	-	-	-
Spotted Seatrout	M	1	-	-	10	-	3	-	1
Striped Mullet	M	18	24	31	33	25	22	66	62
Tarpon	M	-	-	-	-	-	-	-	-
Tidewater Mojarra	M	134	33	79	276	105	238	35	242
Timucu	M	-	-	1	2	-	3	-	-
White Mullet	M	-	-	1	2	-	-	-	3
Worm Eel	M	-	-	-	-	-	1	-	-
		n=224	n=298	n=320	n=476	n=293	n=491	n=364	n=507

Table 32. Total count and percent composition of marine and freshwater species from the Crystal River/Kings Bay System based on respective habitat preference. Note: Habitat Preference M= marine F= freshwater.

Total							
Species	**Count**	**Percent**	**Habitat**	**Species**	**Count**	**Percent**	**Habitat**
Atlantic Croaker	1	0.01	M	American Eel	30	1.88	F
Atlantic Needlefish	52	0.57	M	Blue Tilipia	1	0.06	F
Atlantic Stingray	17	0.19	M	Bluefin Kilifish	5	0.31	F
Bay Anchovy	615	6.70	M	Bluegill	114	7.14	F
Black Drum	33	0.36	M	Bowfin	4	0.25	F
Clown Goby	19	0.21	M	Brook Silverside	7	0.44	F
CommonSnook	724	7.88	M	Florida Gar	85	5.32	F
Creval Jack	30	0.33	M	Golden Shiner	1	0.06	F
Gray Snapper	996	10.85	M	Least Kilifish	1	0.06	F
Gulf Kilifish	23	0.25	M	Longnose Gar	14	0.88	F
Hardhead Catfish	34	0.37	M	Largemouth Bass	350	21.92	F
Hogchocker	15	0.16	M	Eastern Mosquitofish	7	0.44	F
Ladyfish	50	0.54	M	Rainwater Killifish	180	11.27	F
Leatherjacket	6	0.07	M	Redear Sunfish	58	3.63	F
Menhaden	508	5.53	M	Seminole Kilifish	93	5.82	F
Naked Goby	5	0.05	M	Spotted Sunfish	70	4.38	F
Pinfish	230	2.50	M	White Catfish	1	0.06	F
Red Drum	135	1.47	M	Inland Silverside	576	36.07	F
Redfin Needlefish	4	0.04	M				
Remora	3	0.03	M				
Sheapshead Minnow	3	0.03	M				
Sheepshead	91	0.99	M				
Silver Perch	18	0.20	M				
Southern Stingray	2	0.02	M				
Spot Croaker	6	0.07	M				
Spotted Seatrout	35	0.38	M				
Striped Mullet	1410	15.36	M				
Tarpon	1	0.01	M				
Tidewater Mojjara	3982	43.37	M				
Timucu	69	0.75	M				
White Mullet	57	0.62	M				
Worm Eel	8	0.09	M				

Table 33. Winter total count and percent composition of marine and freshwater species from the Crystal River/Kings Bay System based on respective habitat preference. Habitat Preference M= marine F= freshwater.

Winter							
Species	**Count**	**Percent**	**Habitat**	**Species**	**Count**	**Percent**	**Habitat**
Atlantic Croaker	1	0.02	M	American Eel	8	1.32	F
Atlantic	50	0.92	M	Bluefin Killifish	2	0.33	F
Atlantic Stingray	2	0.04	M	Bluegill	51	8.42	F
Bay Anchovy	163	2.99	M	Bowfin	2	0.33	F
Black Drum	27	0.49	M	Florida Gar	44	7.26	F
Brook Silverside	7	0.13	M	Inland Silverside	84	13.86	F
Clown Goby	10	0.18	M	Largemouth Bass	164	27.06	F
Common Snook	440	8.06	M	Longnose Gar	5	0.83	F
Crevalle Jack	14	0.26	M	Rainwater Killifish	101	16.67	F
Golden Shiner	1	0.02	M	Redear Sunfish	39	6.44	F
Gray Snapper	483	8.85	M	Seminole Killifish	60	9.90	F
Gulf Killifish	8	0.15	M	Spotted Sunfish	41	6.77	F
Hardhead	25	0.46	M	Striped Mullet	5	0.83	F
Hogchoker	10	0.18	M				
Ladyfish	46	0.84	M				
Naked Goby	4	0.07	M				
Pinfish	107	1.96	M				
Red Drum	71	1.30	M				
Needlefish	4	0.07	M				
Remora	3	0.05	M				
Sheepshead	50	0.92	M				
Minnow	1	0.02	M				
Silver Perch	9	0.16	M				
Spotted Seatrout	35	0.64	M				
Striped Mullet	768	14.08	M				
Tidewater	3014	55.24	M				
Timucu	59	1.08	M				
White Catfish	1	0.02	M				
White Mullet	40	0.73	M				
Worm Eel	3	0.05	M				

Table 34. Summer total count and percent composition of marine and freshwater species from the Crystal River/Kings Bay System based on respective habitat preference. Habitat Preference M= marine F= freshwater.

Summer							
Species	**Count**	**Percent**	**Habitat**	**Species**	**Count**	**Percent**	**Habitat**
Atlantic Needlefish	2	0.05	M	American eel	22	2.23	F
Atlantic Stingray	15	0.40	M	Bluefin Killifish	3	0.30	F
Bay Anchovy	452	12.12	M	Blue Tilapia	1	0.10	F
Black Drum	6	0.16	M	Bluegill	63	6.38	F
Clown Goby	9	0.24	M	Bowfin	2	0.20	F
Common Snook	284	7.61	M	Eastern Mosquitofish	7	0.71	F
Crevalle Jack	16	0.43	M	Florida Gar	41	4.15	F
Gray Snapper	513	13.75	M	Largemouth Bass	186	18.84	F
Gulf Killifish	15	0.40	M	Least Kilifish	1	0.10	F
Hardhead Catfish	9	0.24	M	Rainwater Killifish	79	8.00	F
Hogchoker	5	0.13	M	Redear Sunfish	19	1.93	F
Ladyfish	4	0.11	M	Seminole Killifish	33	3.34	F
Leatherjacket	6	0.16	M	Spotted Sunfish	29	2.94	F
Menhaden	508	13.62	M	Inland Silverside	492	49.85	F
Naked Goby	1	0.03	M	Longnose Gar	9	0.91	F
Pinfish	123	3.30	M				
Red Drum	64	1.72	M				
Sheepshead	41	1.10	M				
Sheepshead Minnow	2	0.05	M				
Silver Perch	9	0.24	M				
Southern Stingray	2	0.05	M				
Spot Croaker	6	0.16	M				
Striped Mullet	637	17.08	M				
Tarpon	1	0.03	M				
Tidewater Mojarra	968	25.95	M				
Timucu	10	0.27	M				
White Mullet	17	0.46	M				
Worm Eel	5	0.13	M				

Table 35. The Crystal River/Kings Bay System Zone 1 total count and percent composition of marine and freshwater species based on respective habitat preference. Habitat Preference M= marine F= freshwater.

Zone 1							
Species	**Count**	**Percent**	**Habitat**	**Species**	**Count**	**Percent**	**Habitat**
Atlantic Needlefish	28	1.98	M	American Eel	6	2.46	F
Atlantic Stingray	1	0.07	M	Bluefin Killifish	1	0.41	F
Bay Anchovy	310	21.97	M	Bluegill	47	19.26	F
Black Drum	4	0.28	M	Bowfin	3	1.23	F
Clown Goby	3	0.21	M	Eastern Mosquitofish	3	1.23	F
Common Snook	92	6.52	M	Florida Gar	5	2.05	F
Creval Jack	3	0.21	M	Largemouth Bass	74	30.33	F
Gray Snapper	128	9.07	M	Redear Sunfish	14	5.74	F
Hardhead Catfish	4	0.28	M	Seminole Killifish	5	2.05	F
Hogchoker	2	0.14	M	White Catfish	1	0.41	F
Ladyfish	9	0.64	M	Inland Silverside	58	23.77	F
Leatherjacket	3	0.21	M	Rainwater Killifish	10	4.10	F
Menhaden	185	13.11	M	Spotted Sunfish	17	6.97	F
Naked Goby	1	0.07	M				
Pinfish	17	1.20	M				
Red Drum	10	0.71	M				
Sheapshead	17	1.20	M				
Sheapshead Minnow	1	0.07	M				
Stripped Mullet	167	11.84	M				
Tidewater Mojarra	417	29.55	M				
Timucu	3	0.21	M				
White Mullet	6	0.40	M				

Table 36. The Crystal River/Kings Bay System Zone 2 total count and percent composition of marine and freshwater species based on respective habitat preference. Note: Habitat Preference M= marine F= freshwater.

Zone 2							
Species	**Count**	**Percent**	**Habitat**	**Species**	**Count**	**Percent**	**Habitat**
Atlantic Croaker	1	0.03	M	American Eel	4	0.90	F
Atlantic Needlefish	16	0.53	M	Bluegill	38	8.56	F
Atlantic Stingray	2	0.07	M	Brook Silverside	1	0.23	F
Bay Anchovy	62	2.04	M	Eastern Mosquitofish	1	0.23	F
Black Drum	7	0.23	M	Florida Gar	18	4.05	F
Clown Goby	11	0.36	M	Golden Shiner	1	0.23	F
Common Snook	242	7.96	M	Largemouth Bass	90	20.27	F
Creval Jack	6	0.20	M	Redear Sunfish	12	2.70	F
Gray Snapper	322	10.60	M	Seminole Killifish	40	9.01	F
Gulf Killifish	20	0.66	M	Silver Perch	8	1.80	F
Hardhead Catfish	7	0.23	M	Inland Silverside	123	27.70	F
Hogchoker	2	0.07	M	Rainwater Killifish	102	22.97	F
Ladyfish	7	0.23	M	Spotted Sunfish	6	1.35	F
Leatherjacket	3	0.10	M				
Naked Goby	2	0.07	M				
Pinfish	131	4.31	M				
Red Drum	27	0.89	M				
Sheepshead	36	1.18	M				
Sheapshead Minnow	1	0.03	M				
Spot Croaker	1	0.03	M				
Spotted Seatrout	12	0.39	M				
Striped Mullet	640	21.06	M				
Tarpon	1	0.03	M				
Tidewater Mojarra	1439	47.35	M				
Timucu	14	0.46	M				
White Mullet	23	0.76	M				
Worm Eel	4	0.13	M				

Table 37. The Crystal River/Kings Bay System Zone 3 total count and percent composition of marine and freshwater species based on respective habitat preference. Habitat Preference M= marine F= freshwater.

Zone 3							
Species	**Count**	**Percent**	**Habitat**	**Species**	**Count**	**Percent**	**Habitat**
Atlantic Needlefish	10	0.21	M	American Eel	20	2.16	F
Atlantic Stingray	12	0.25	M	Blue Tilipia	1	0.11	F
Bay Anchovy	243	5.15	M	Bluefin Killifish	4	0.43	F
Black Drum	22	0.47	M	Bluegill	29	3.13	F
Clown Goby	5	0.11	M	Bowfin	1	0.11	F
CommonSnook	390	8.27	M	Brook Silverside	6	0.65	F
Creval Jack	21	0.45	M	Eastern Mosquitofish	3	0.32	F
Gray Snapper	546	11.58	M	Florida Gar	62	6.69	F
Gulf Killifish	3	0.06	M	Largemouth Bass	186	20.06	F
Hardhead Catfish	23	0.49	M	Least Killifish	1	0.11	F
Hogchoker	11	0.23	M	Longnose Gar	14	1.51	F
Ladyfish	34	0.72	M	Redear Sunfish	32	3.45	F
Menhaden	323	6.85	M	Seminole Killifish	48	5.18	F
Naked Goby	2	0.04	M	Silver Perch	10	1.08	F
Pinfish	82	1.74	M	Inland Silverside	395	42.61	F
Red Drum	98	2.08	M	Rainwater Killifish	68	7.34	F
Redfin Needlefish	4	0.08	M	Spotted Sunfish	47	5.07	F
Remora	3	0.06	M				
Sheepshead	38	0.81	M				
Sheapshead Minnow	1	0.02	M				
Southern Stingray	2	0.04	M				
Spot Croaker	5	0.11	M				
Spotted Seatrout	23	0.49	M				
Striped Mullet	603	12.79	M				
Tidewater Mojarra	2126	45.10	M				
Timucu	52	1.10	M				
White Mullet	28	0.59	M				
Worm Eel	4	0.08	M				

Table 38. Historical species presence vs absence from the Rainbow River System. Habitat preference F=freshwater M=marine.

Common Name	Habitat	FLMNH 1991	FWC 1989-1992	USGS 2003	WSI 2010	FWC Springs 2013-2017
American Eel	F	-	-	-	-	X
Black Crappie	F	-	X	-	-	-
Bluefin Killifish	F	X	X	X	X	X
Bluegill Sunfish	F	X	X	X	X	X
Bluespotted Sunfish	F	-	X	-	-	-
Bowfin	F	-	X	X	X	X
Brook Silverside	F	X	X	X	X	X
Brown Bullhead	F	-	X	-	-	X
Coastal Shiner	F	X	X	X	-	X
Dollar Sunfish	F	-	X	-	-	X
Eastern Mosquitofish	F	X	X	X	X	X
Flagfish	F	X	-	-	-	-
Florida Gar	F	-	X	X	-	X
Gizzard Shad	F	-	X	X	X	X
Golden Shiner	F	X	X	-	X	X
Inland Silverside	F	X	X	X	-	X
Ironcolor Shiner	F	-	-	-	-	X
Lake Chubsucker	F	-	X	X	X	X
Largemouth Bass	F	X	X	X	X	X
Least Killifish	F	X	X	X	-	X
Longnose Gar	F	-	X	-	X	X
Metallic Shiner	F	-	-	-	-	X
Pirate Perch	F	-	X	-	-	X
Pygmy Sunfish	F	X	X	-	-	X
Rainwater Killifish	F	-	-	-	-	X
Redbreast Sunfish	F	X	X	X	X	X
Redear Sunfish	F	X	X	X	X	X
Redeye Chub	F	X	-	X	X	X
Sailfin Molly	F	X	X	X	-	X
Seminole Killifish	F	X	X	X	X	X
Spotted Sunfish	F	X	X	X	X	X
Swamp Darter	F	-	-	-	-	X
Tadpole Madtom	F	X	X	X	-	X
Tailight Shiner	F	-	-	-	-	X
Tidewater Silverside	F	-	X	-	-	-
Warmouth	F	-	X	-	X	X
White Catfish	F	-	-	-	-	X
Yellow Bullhead	F	X	X	X	-	X
Atlantic Needlefish	M	-	-	-	X	X

Table 39. Zone 1 species count from the Rainbow River System for each sampling event (2014-2017). Habitat Preference F=freshwater M=marine; S=Summer W=Winter.

Common Name	Habitat	W 14	S 14	W 15 (1)	W 15 (2)	S 15	W 16	S16	W 17
American Eel	F	-	-	-	-	-	-	-	1
Bluefin Killifish	F	89	130	54	71	51	35	31	35
Bluegill Sunfish	F	65	72	35	48	78	125	85	63
Bowfin	F	1	3	1	-	2	5	1	8
Brook Silverside	F	49	-	1	-	-	2	-	6
Brown Bullhead	F	-	-	-	-	-	-	1	-
Coastal Shiner	F	167	132	29	129	193	189	50	141
Dollar Sunfish	F	7	12		2	4	1	10	8
Eastern Mosquitofish	F	88	284	70	137	144	149	72	90
Florida Gar	F	-	-	-	-	-	-	-	-
Gizzard Shad	F	-	1	-	-	-	-	-	-
Golden Shiner	F	-	-	-	-	1	-	-	1
Inland Silverside	F	-	127	76	116	73	8	77	58
Ironcolor Shiner	F	-	-	-	-	-	-	-	6
Lake Chubsucker	F	2	2	4	6	17	14	2	12
Largemouth Bass	F	185	163	105	174	207	115	121	202
Least Killifish	F	-	8	-	6	6	5	3	-
Longnose Gar	F	-	-	-	-	1	-	1	-
Metallic Shiner	F	-	-	-	3	2	24	-	-
Pirate Perch	F	-	-	-	-	-	-	-	-
Pygmy Sunfish	F	-	1	-	-	-	-	-	-
Redbreast Sunfish	F	69	50	51	84	30	37	63	42
Redear Sunfish	F	24	41	28	41	30	19	48	46
Redeye Chub	F	-	-	15	52	27	38	19	28
Sailfin Molly	F	10	13	5	1	21	7	3	4
Seminole Killifish	F	47	40	56	49	34	38	36	74
Spotted Sunfish	F	644	776	434	813	698	435	720	747
Swamp Darter	F	-	-	-	-	-	-	-	-
Tadpole Madtom	F	1	2	1	2	-	1	1	-
Tailight Shiner	F	-	-	-	-	1	-	-	-
Warmouth	F	24	13	12	12	6	10	10	18
White Catfish	F	-	-	-	1	-	-	-	1
Yellow Bullhead	F	4	1	2	5	2	4	3	1
Atlantic Needlefish	M	-	-	-	-	-	-	-	-
		n =1476	n =1871	n =979	n =1752	n =1628	n =1262	n =1359	n =1592

Table 40. Zone 2 species count from the Rainbow River System for each sampling event (2014-2017). Habitat Preference F=freshwater M=marine; S=Summer W=Winter.

Common Name	Habitat	W 14	S 14	W 15 (1)	W 15 (2)	S 15	W 16	S16	W 17
American Eel	F	-	-	-	-	1	-	-	-
Bluefin Killifish	F	62	71	39	55	42	45	11	31
Bluegill Sunfish	F	150	111	59	50	171	85	172	100
Bowfin	F	1	-	-	1	1	1	3	2
Brook Silverside	F	14	2	-	-	8	-	-	-
Brown Bullhead	F	-	-	-	-	1	-	-	-
Coastal Shiner	F	292	206	182	171	314	160	115	162
Dollar Sunfish	F	-	-	1	-	1	-	-	2
Eastern Mosquitofish	F	38	187	79	48	47	40	29	24
Florida Gar	F	-	1	-	-	-	-	-	1
Gizzard Shad	F	-	-	-	-	-	-	1	-
Golden Shiner	F	1	-	-	5	2	-	-	-
Inland Silverside	F	-	39	86	53	87	3	6	6
Ironcolor Shiner	F	-	-	-	-	-	-	-	-
Lake Chubsucker	F	2	1	1	3	6	10	15	6
Largemouth Bass	F	159	95	138	62	138	75	129	140
Least Killifish	F	2	10	1	6	1	6	2	-
Longnose Gar	F	1	-	-	-	-	-	-	-
Metallic Shiner	F	-	-	-	-	-	-	-	-
Pirate Perch	F	-	1	-	-	-	-	-	-
Pygmy Sunfish	F	4	3	1	-	-	-	-	-
Redbreast Sunfish	F	163	104	64	57	62	41	109	51
Redear Sunfish	F	56	65	58	54	50	26	102	63
Redeye Chub	F	-	-	-	-	2	6	-	2
Sailfin Molly	F	2	5	1	-	3	3	-	1
Seminole Killifish	F	95	54	86	42	45	30	38	31
Spotted Sunfish	F	427	343	358	249	384	302	410	410
Swamp Darter	F	-	1	-	-	1	2	-	-
Tadpole Madtom	F	3	4	2	1	2	3	-	1
Tailight Shiner	F	-	-	1	-	-	1	7	1
Warmouth	F	87	44	42	31	44	38	59	110
White Catfish	F	-	-	-	1	1	-	-	-
Yellow Bullhead	F	3	2	3	3	5	2	-	2
Atlantic Needlefish	M	-	-	-	2	-	-	-	-
		n =1562	n =1354	n =1210	n =894	n =1419	n =879	n =1209	n =1147

Table 41. Total count and percent composition of marine and freshwater species from the Rainbow River System based on respective habitat preference. Habitat Preference M= marine F= freshwater.

Total							
Species	**Count**	**Percent**	**Habitat**	**Species**	**Count**	**Percent**	**Habitat**
Atlantic Needlefish	2	100.00	M	American Eel	2	0.01	F
				Bluefin Killifish	852	3.95	F
				Bluegill	1469	6.80	F
				Bowfin	30	0.14	F
				Brook Silverside	82	0.38	F
				Brown Bullhead	2	0.01	F
				Coastal Shiner	2632	12.19	F
				Dollar Sunfish	48	0.22	F
				Eastern Mosquitofish	1526	7.07	F
				Florida Gar	2	0.01	F
				Gizzard Shad	2	0.01	F
				Golden Shiner	10	0.05	F
				Inland Silverside	815	3.77	F
				Ironcolor Shiner	6	0.03	F
				Lake Chubsucker	103	0.48	F
				Largemouth Bass	2208	10.23	F
				Least Killifish	56	0.26	F
				Longnose Gar	3	0.01	F
				Metallic Shiner	29	0.13	F
				Pirate Perch	1	0.00	F
				Pygmy Sunfish	9	0.04	F
				Redbreast Sunfish	1077	4.99	F
				Redear Sunfish	751	3.48	F
				Redeye Chub	189	0.88	F
				Sailfin Molly	79	0.37	F
				Seminole Killifish	795	3.68	F
				Spotted Sunfish	8150	37.75	F
				Sunfish sp.	18	0.08	F
				Swamp Darter	4	0.02	F
				Tadpole Madtom	24	0.11	F
				Taillight Shiner	11	0.05	F
				Warmouth	560	2.59	F
				White Catfish	4	0.02	F
				Yellow Bullhead	42	0.19	F

Table 42. Winter total count and percent composition of marine and freshwater species from the Rainbow River System based on respective habitat preference. Habitat Preference M= marine F= freshwater.

Winter							
Species	**Count**	**Percent**	**Habitat**	**Species**	**Count**	**Percent**	**Habitat**
Atlantic Needlefish	2	100.00	M	American Eel	1	0.01	F
				Bluefin Killifish	516	4.05	F
				Bluegill	780	6.12	F
				Bowfin	20	0.16	F
				Brook Silverside	72	0.56	F
				Coastal Shiner	1622	12.72	F
				Dollar Sunfish	21	0.16	F
				Eastern Mosquitofish	763	5.98	F
				Florida Gar	1	0.01	F
				Golden Shiner	7	0.05	F
				Inland Silverside	406	3.18	F
				Ironcolor shiner	6	0.05	F
				Lake Chubsucker	60	0.47	F
				Largemouth Bass	1355	10.63	F
				Least Killifish	26	0.20	F
				Longnose Gar	1	0.01	F
				Metallic Shiner	27	0.21	F
				Pygmy Sunfish	5	0.04	F
				Redbreast Sunfish	659	5.17	F
				Redear Sunfish	415	3.25	F
				Redeye Chub	141	1.11	F
				Sailfin Molly	34	0.27	F
				Seminole Killifish	548	4.30	F
				Spotted Sunfish	4819	37.79	F
				Sunfish sp.	10	0.08	F
				Swamp Darter	2	0.02	F
				Tadpole Madtom	15	0.12	F
				Taillight Shiner	3	0.02	F
				Warmouth	384	3.01	F
				White Catfish	3	0.02	F
				Yellow Bullhead	29	0.23	F

Table 43. Summer total count and percent composition of marine and freshwater species from the Rainbow River System based on respective habitat preference. Habitat Preference M= marine F= freshwater.

Summer			
Species	**Count**	**Percent**	**Habitat**
American Eel	1	0.01	F
Bluefin Killifish	336	3.80	F
Bluegill	689	7.79	F
Bowfin	10	0.11	F
Brook Silverside	10	0.11	F
Brown Bullhead	2	0.02	F
Coastal Shiner	1010	11.43	F
Dollar Sunfish	27	0.31	F
Eastern Mosquitofish	763	8.63	F
Florida Gar	1	0.01	F
Gizzard Shad	2	0.02	F
Golden Shiner	3	0.03	F
Inland Silverside	409	4.63	F
Ironcolor Shiner		0.00	F
Lake Chubsucker	43	0.49	F
Largemouth Bass	853	9.65	F
Least Killifish	30	0.34	F
Longnose Gar	2	0.02	F
Metallic Shiner	2	0.02	F
Pirate Perch	1	0.01	F
Pygmy Sunfish	4	0.05	F
Redbreast Sunfish	418	4.73	F
Redear Sunfish	336	3.80	F
Redeye Chub	48	0.54	F
Sailfin Molly	45	0.51	F
Seminole Killifish	247	2.79	F
Spotted Sunfish	3331	37.68	F
Sunfish spp.	8	0.09	F
Swamp Darter	2	0.02	F
Tadpole Madtom	9	0.10	F
Taillight Shiner	8	0.09	F
Warmouth	176	1.99	F
White Catfish	1	0.01	F
Yellow Bullhead	13	0.15	F

Table 44. The Rainbow River System Zone 1 total count and percent composition of marine and freshwater species based on respective habitat preference. Habitat Preference M= marine F= freshwater.

Zone 1			
Species	**Count**	**Percent**	**Habitat**
American Eel	1	0.01	F
Bluefin Killifish	496	4.16	F
Bluegill	571	4.79	F
Bowfin	21	0.18	F
Brook Silverside	58	0.49	F
Brown Bullhead	1	0.01	F
Coastal Shiner	1030	8.64	F
Dollar Sunfish	44	0.37	F
Eastern Mosquitofish	1034	8.68	F
Gizzard Shad	1	0.01	F
Golden Shiner	2	0.02	F
Inland Silverside	535	4.49	F
Ironcolor Shiner	6	0.05	F
Lake Chubsucker	59	0.50	F
Largemouth Bass	1272	10.67	F
Least Killifish	28	0.23	F
Longnose Gar	2	0.02	F
Metallic Shiner	29	0.24	F
Pygmy Sunfish	1	0.01	F
Redbreast Sunfish	425	3.57	F
Redear Sunfish	277	2.32	F
Redeye Chub	179	1.50	F
Sailfin Molly	64	0.54	F
Seminole Killifish	374	3.14	F
Spotted Sunfish	5267	44.19	F
Lepomis sp.	3	0.03	F
Tadpole Madtom	8	0.07	F
Taillight Shiner	1	0.01	F
Warmouth	105	0.88	F
White Catfish	2	0.02	F
Yellow Bullhead	22	0.18	F

Table 45. The Rainbow River System Zone 2 total count and percent composition of marine and freshwater species based on respective habitat preference. Habitat Preference M= marine F= freshwater.

Zone 2							
Species	**Count**	**Percent**	**Habitat**	**Species**	**Count**	**Percent**	**Habitat**
Atlantic Needlefish	2	100.00	M	American Eel	1	0.01	F
				Bluefin Killifish	356	3.68	F
				Bluegill	898	9.28	F
				Bowfin	9	0.09	F
				Brook Silverside	24	0.25	F
				Brown Bullhead	1	0.01	F
				Coastal Shiner	1602	16.56	F
				Dollar Sunfish	4	0.04	F
				Eastern Mosquitofish	492	5.09	F
				Florida Gar	2	0.02	F
				Gizzard Shad	1	0.01	F
				Golden Shiner	8	0.08	F
				Inland Silverside	280	2.89	F
				Lake Chubsucker	44	0.45	F
				Largemouth Bass	936	9.67	F
				Least Killifish	28	0.29	F
				Longnose Gar	1	0.01	F
				Pirate Perch	1	0.01	F
				Pygmy Sunfish	8	0.08	F
				Redbreast Sunfish	652	6.74	F
				Redear Sunfish	474	4.90	F
				Redeye Chub	10	0.10	F
				Sailfin Molly	15	0.16	F
				Seminole Killifish	421	4.35	F
				Spotted Sunfish	2883	29.80	F
				Leopmis sp.	15	0.16	F
				Swamp Darter	4	0.04	F
				Tadpole Madtom	16	0.17	F
				Taillight Shiner	10	0.10	F
				Warmouth	455	4.70	F
				White Catfish	2	0.02	F
				Yellow Bullhead	20	0.21	F

Table 46. Historical species presence vs absence from the Weeki Wachee River System. Habitat preference F=freshwater M=marine.

Common Name	Habitat	FWC 1984	FWC 1991	FWC 2005	WSI 2010	FWC Springs 2013-2017
American Eel	F	X	-	X	-	X
Bluefin Killifish	F	-	-	X	-	X
Bluegill Sunfish	F	X	X	X	X	X
Brown Bullhead	F	X	X	-	-	X
Coastal Shiner	F	X	-	X	-	X
Eastern Mosquitofish	F	-	-	X	X	X
Florida Gar	F	-	X	X	-	X
Golden Shiner	F	-	-	-	-	X
Inland Silverside	F	-	-	-	-	X
Lake Chubsucker	F	X	X	-	-	X
Largemouth Bass	F	X	X	X	X	X
Least Killifish	F	-	-	X	-	X
Longnose Gar	F	-	-	-	-	X
Rainwater Killifish	F	-	-	-	X	X
Redear Sunfish	F	X	X	X	X	X
Sailfin Molly	F	-	-	-	X	X
Seminole Killifish	F	X	X	-	-	X
Spotted Sunfish	F	X	X	X	X	X
Tadpole Madtom	F	-	-	-	-	X
Warmouth	F	X	X	-	-	X
Yellow Bullhead	F	X	X	X	-	X
Atlantic Needlefish	M	-	X	X	X	X
Clown Goby	M	-	-	-	-	X
Common Snook	M	-	-	-	-	X
Crevalle Jack	M	-	-	X	X	X
Fat Sleeper	M	-	-	-	-	X
Gray Snapper	M	-	-	-	X	X
Gulf Killifish	M	-	-	-	-	X
Gulf Toadfish	M	-	-	-	-	X
Hogchoker	M	X	-	X	-	X
Mountain Mullet	M	-	-	-	-	X
Naked Goby	M	-	-	-	-	X
Pinfish	M	-	-	-	-	X
Sharksucker	M	-	-	-	-	X
Sheepshead	M	-	-	-	X	X
Silver Jenny	M	-	-	-	-	X
Skate	M	-	-	-	-	X
Southern Flounder	M	-	-	-	-	X
Striped Mojarra	M	-	X	X	-	-
Striped Mullet	M	X	X	X	X	X
Tidewater Mojarra	M	-	-	-	X	X
Timucu	M	-	-	-	-	X
White Mullet	M	-	-	-	-	X

Table 47. Zone 1 species count from the Weeki Wachee River System for each sampling event (2014-2017). Habitat Preference F=freshwater M=marine; S=Summer W=Winter.

Common Name	Habitat	W 14	S 14	W 15	S 15	W 16 (1)	W 16 (2)	S 16	W 17
American Eel	F	3	-	1	1	3	-	3	1
Bluefin Killifish	F	17	61	43	13	26	6	55	3
Bluegill Sunfish	F	13	31	53	73	94	50	127	110
Brown Bullhead	F	1	3	-	-	-	1	1	1
Coastal Shiner	F	54	229	99	82	142	51	96	9
Eastern Mosquitofish	F	4	28	22	4	6	6	37	-
Florida Gar	F	1	-	-	-	-	-	-	-
Golden Shiner	F	-	-	-	-	-	-	-	1
Inland Silverside	F	-	-	-	5	-	-	-	-
Lake Chubsucker	F	1	14	12	5	14	14	29	8
Largemouth Bass	F	46	38	49	20	52	43	41	55
Least Killifish	F	6	12	-	-	1	-	9	-
Longnose Gar	F	-	-	1	1	-	1	-	-
Rainwater Killifish	F	8	-	-	-	1	-	-	-
Redear Sunfish	F	7	25	16	16	31	27	32	47
Sailfin Molly	F	4	8	1	2	-	1	16	6
Seminole Killifish	F	6	4	4	-	3	-	4	2
Spotted Sunfish	F	301	198	263	90	232	179	222	240
Tadpole Madtom	F	3	1	4	-	3	2	3	6
Warmouth	F	3	3	1	5	2	7	18	6
Yellow Bullhead	F	15	5	21	3	19	12	7	6
Atlantic Needlefish	M	46	1	-	-	-	-	6	27
Clown Goby	M	-	1	-	2	-	-	2	-
Common Snook	M	-	-	-	4	2	-	-	-
Crevalle Jack	M	4	-	-	-	-	-	-	2
Fat Sleeper	M	-	-	-	9	-	-	-	1
Gray Snapper	M	28	-	31	-	3	12	-	18
Gulf Killifish	M	-	-	-	-	-	-	-	-
Gulf Toadfish	M	-	-	-	-	-	-	-	-
Hogchoker	M	48	35	53	17	23	45	25	58
Mountain Mullet	M	-	1	-	-	-	-	1	1
Naked Goby	M	-	-	-	-	-	-	-	-
Pinfish	M	-	-	-	-	-	-	-	1
Remora	M	-	-	-	-	-	-	-	-
Sheepshead	M	6	-	4	-	-	-	-	6
Silver Jenny	M	4	-	-	-	-	-	-	-
Skate	M	-	-	-	1	-	-	-	-
Southern Flounder	M	-	-	-	-	-	-	-	-
Striped Mullet	M	4	2	4	5	-	8	9	18
Tidewater Mojarra	M	77	1	89	1	2	38	2	115
Timucu	M	-	-	20	1	18	9	-	-
White Mullet	M	3	1	-	-	-	2	-	6
Worm Eel	M	-	-	-	-	-	-	-	-
		n=714	n=704	n=791	n=360	n=677	n=515	n=748	n=754

Table 48. Zone 2 species count from the Weeki Wachee River System for each sampling event (2014-2017). Habitat Preference F=freshwater M=marine; S=Summer W=Winter.

Common Name	Habitat	W 14	S 14	W 15	S 15	W 16 (1)	W 16 (2)	S 16	W 17
American Eel	F	3	6	-	6	1	3	7	-
Bluefin Killifish	F	-	1	-	-	-	-	-	-
Bluegill Sunfish	F	-	-	-	2	-	-	5	-
Brown Bullhead	F	-	-	-	-	-	-	-	-
Coastal Shiner	F	-	-	-	-	-	-	-	-
Eastern Mosquitofish	F	-	-	-	-	-	1	3	1
Florida Gar	F	-	-	-	-	-	-	-	-
Golden Shiner	F	-	-	-	-	-	-	-	-
Inland Silverside	F	-	4	-	8	-	-	-	-
Lake Chubsucker	F	-	-	-	-	-	-	-	-
Largemouth Bass	F	1	3	7	4	6	7	6	5
Least Killifish	F	-	-	-	-	-	-	-	-
Longnose Gar	F	-	-	-	-	-	-	-	-
Rainwater Killifish	F	-	39	-	-	-	1	-	2
Redear Sunfish	F	-	-	-	-	-	-	1	1
Sailfin Molly	F	-	-	-	-	-	-	-	3
Seminole Killifish	F	-	-	-	-	-	-	-	-
Spotted Sunfish	F	3	6	-	4	-	-	9	1
Tadpole Madtom	F	-	-	-	-	-	-	-	-
Warmouth	F	-	-	-	-	-	-	-	-
Yellow Bullhead	F	-	-	-	-	-	-	-	-
Atlantic Needlefish	M	3	-	-	1	-	4	1	-
Clown Goby	M	3	1	-	1	-	-	1	1
Common Snook	M	-	-	-	-	-	-	-	-
Crevalle Jack	M	-	-	-	-	-	-	3	-
Fat Sleeper	M	2	21	2	-	-	-	1	7
Gray Snapper	M	145	4	53	1	26	4	-	19
Gulf Killifish	M	-	-	-	-	-	3	-	-
Gulf Toadfish	M	-	-	-	1	-	-	-	1
Hogchoker	M	-	-	-	-	-	-	2	-
Mountain Mullet	M	-	-	-	-	-	-	-	-
Naked Goby	M	-	3	-	-	-	-	-	-
Pinfish	M	-	5	1	-	-	-	-	1
Remora	M	-	-	-	-	1	-	-	-
Sheepshead	M	1	1	1	-	-	-	-	11
Silver Jenny	M	-	-	-	-	-	1	-	-
Skate	M	-	-	-	-	-	-	-	-
Southern Flounder	M	-	-	-	-	1	-	-	-
Striped Mullet	M	-	1	2	1	-	-	-	-
Tidewater Mojarra	M	-	19	9	23	8	14	18	19
Timucu	M	-	-	-	-	5	1	-	-
White Mullet	M	-	-	-	1	-	-	-	-
Worm Eel	M	-	-	-	-	-	-	1	3
		n=161	n=114	n=75	n=53	n=48	n=39	n=58	n=75

Table 49. Total count and percent composition of marine and freshwater species from the Weeki Wachee River System based on respective habitat preference. Habitat Preference M= marine F= freshwater.

Total							
Species	**Count**	**Percent**	**Habitat**	**Species**	**Count**	**Percent**	**Habitat**
Atlantic Needlefish	89	6.23	M	American Eel	38	0.85	F
Clown Goby	12	0.84	M	Bluefin Killifish	225	5.05	F
Common Snook	6	0.42	M	Bluegill	558	12.52	F
Crevalle Jack	9	0.63	M	Brown Bullhead	7	0.16	F
Fat Sleeper	43	3.01	M	Coastal Shiner	762	17.09	F
Gray Snapper	344	24.09	M	Eastern Mosquitofish	112	2.51	F
Gulf Killifish	3	0.21	M	Florida Gar	1	0.02	F
Gulf Toadfish	2	0.14	M	Golden Shiner	1	0.02	F
Hogchoker	306	21.43	M	Inland Silverside	17	0.38	F
Mountain Mullet	3	0.21	M	Lake Chubsucker	97	2.18	F
Naked Goby	3	0.21	M	Largemouth Bass	383	8.59	F
Pinfish	8	0.56	M	Least Killifish	28	0.63	F
Remora	1	0.07	M	Lepomis sp.	5	0.11	F
Sheepshead	31	2.17	M	Longnose Gar	3	0.07	F
Silver Jenny	5	0.35	M	Rainwater Killifish	51	1.14	F
Skate	1	0.07	M	Redear Sunfish	203	4.55	F
Southern Flounder	1	0.07	M	Sailfin Molly	41	0.92	F
Striped Mullet	54	3.78	M	Seminole Killifish	23	0.52	F
Tidewater Mojarra	435	30.46	M	Spotted Sunfish	1748	39.21	F
Timucu	54	3.78	M	Tadpole Madtom	22	0.49	F
White Mullet	13	0.91	M	Warmouth	45	1.01	F
Worm Eel	4	0.28	M	Yellow Bullhead	88	1.97	F

Table 50. Winter total count and percent composition of marine and freshwater species from the Weeki Wachee River System based on respective habitat preference. Habitat Preference M= marine F= freshwater.

Winter							
Species	**Count**	**Percent**	**Habitat**	**Species**	**Count**	**Percent**	**Habitat**
Atlantic Needlefish	80	6.72	M	American Eel	14	0.53	F
Clown Goby	4	0.34	M	Bluefin Killifish	91	3.42	F
Common Snook	2	0.17	M	Bluegill	321	12.08	F
Crevalle Jack	6	0.50	M	Brown Bullhead	3	0.11	F
Fat Sleeper	12	1.01	M	Coastal Shiner	231	8.69	F
Gray Snapper	339	28.46	M	Eastern	39	1.47	F
Gulf Killifish	3	0.25	M	Florida Gar	1	0.04	F
Gulf Toadfish	1	0.08	M	Golden Shiner	1	0.04	F
Hogchoker	227	19.06	M	Lake Chubsucker	50	1.88	F
Mountain Mullet	1	0.08	M	Largemouth Bass	273	10.27	F
Pinfish	3	0.25	M	Least Killifish	7	0.26	F
Remora	1	0.08	M	Lepomis sp.	1	0.04	F
Sheepshead	30	2.52	M	Longnose Gar	2	0.08	F
Silver Jenny	5	0.42	M	Rainwater Killifish	12	0.45	F
Southern Flounder	4	0.34	M	Redear Sunfish	129	4.85	F
Striped Mullet	36	3.02	M	Sailfin Molly	15	0.56	F
Tidewater	369	30.98	M	Seminole Killifish	15	0.56	F
Timucu	54	4.53	M	Spotted Sunfish	1342	50.49	F
White Mullet	11	0.92	M	Tadpole Madtom	18	0.68	F
Worm Eel	3	0.25	M	Warmouth	19	0.71	F
				Yellow Bullhead	74	2.78	F

Table 51. Summer total count and percent composition of marine and freshwater species from the Weeki Wachee River System based on respective habitat preference. Note: Habitat Preference M= marine F= freshwater.

Summer							
Species	**Count**	**Percent**	**Habitat**	**Species**	**Count**	**Percent**	**Habitat**
Atlantic Needlefish	9	1.41	M	American Eel	23	1.64	F
Coastal Shiner	407	63.89	M	Bluefin Killifish	130	9.29	F
Common Snook	4	0.63	M	Bluegill	238	17.00	F
Crevalle Jack	3	0.47	M	Brown Bullhead	4	0.29	F
Fat Sleeper	31	4.87	M	Clown Goby	8	0.57	F
Gray Snapper	5	0.78	M	Eastern Mosquitofish	72	5.14	F
Gulf Toadfish	1	0.16	M	Inland Silverside	17	1.21	F
Hogchoker	79	12.40	M	Lake Chubsucker	48	3.43	F
Mountain Mullet	2	0.31	M	Largemouth Bass	112	8.00	F
Naked Goby	3	0.47	M	Least Killifish	21	1.50	F
Pinfish	5	0.78	M	Lepomis sp.	5	0.36	F
Sheepshead	1	0.16	M	Longnose Gar	1	0.07	F
Skate	1	0.16	M	Rainwater Killifish	39	2.79	F
Striped Mullet	18	2.83	M	Redear Sunfish	74	5.29	F
Tidewater Mojarra	64	10.05	M	Sailfin Molly	26	1.86	F
Timucu	1	0.16	M	Seminole Killifish	8	0.57	F
White Mullet	2	0.31	M	Spotted Sunfish	529	37.79	F
Worm Eel	1	0.16	M	Tadpole Madtom	4	0.29	F
				Warmouth	26	1.86	F
				Yellow Bullhead	15	1.07	F

Table 52. The Weeki Wachee River System Zone 1 total count and percent composition of marine and freshwater species based on respective habitat preference. Note: Habitat Preference M= marine F= freshwater.

Zone 1							
Species	**Count**	**Percent**	**Habitat**	**Species**	**Count**	**Percent**	**Habitat**
Atlantic Needlefish	80	8.29	M	American Eel	12	0.28	F
Clown Goby	5	0.52	M	Bluefin Killifish	224	5.21	F
Common Snook	6	0.62	M	Bluegill	551	12.82	F
Crevalle Jack	6	0.62	M	Brown Bullhead	7	0.16	F
Fat Sleeper	10	1.04	M	Coastal Shiner	762	17.73	F
Gray Snapper	92	9.53	M	Eastern Mosquitofish	107	2.49	F
Hogchoker	304	31.50	M	Florida Gar	1	0.02	F
Mountain Mullet	3	0.31	M	Golden Shiner	1	0.02	F
Pinfish	1	0.10	M	Inland Silverside	5	0.12	F
Sheepshead	17	1.76	M	Lake Chubsucker	97	2.26	F
Silver Jenny	4	0.41	M	Largemouth Bass	344	8.00	F
Skate	1	0.10	M	Least Killifish	28	0.65	F
Striped Mullet	50	5.18	M	Lepomis sp.	5	0.12	F
Tidewater Mojarra	325	33.68	M	Longnose Gar	3	0.07	F
Timucu	48	4.97	M	Rainwater Killifish	9	0.21	F
White Mullet	12	1.24	M	Redear Sunfish	201	4.68	F
				Sailfin Molly	38	0.88	F
				Seminole Killifish	23	0.54	F
				Spotted Sunfish	1725	40.13	F
				Tadpole Madtom	22	0.51	F
				Warmouth	45	1.05	F
				Yellow Bullhead	88	2.05	F

Table 53. The Weeki Wachee River System Zone 2 total count and percent composition of marine and freshwater species based on respective habitat preference. Note: Habitat Preference M= marine F= freshwater.

Zone 2							
Species	**Count**	**Percent**	**Habitat**	**Species**	**Count**	**Percent**	**Habitat**
Atlantic Needlefish	9	1.94	M	American Eel	26	16.25	F
Clown Goby	7	1.51	M	Bluefin Killifish	1	0.63	F
Crevalle Jack	3	0.65	M	Bluegill	7	4.38	F
Fat Sleeper	33	7.13	M	Eastern Mosquitofish	5	3.13	F
Gray Snapper	252	54.43	M	Inland Silverside	12	7.50	F
Gulf Killifish	3	0.65	M	Largemouth Bass	39	24.38	F
Gulf Toadfish	2	0.43	M	Rainwater Killifish	42	26.25	F
Hogchoker	2	0.43	M	Redear Sunfish	2	1.25	F
Naked Goby	3	0.65	M	Sailfin Molly	3	1.88	F
Pinfish	7	1.51	M	Spotted Sunfish	23	14.38	F
Remora	1	0.22	M				
Sheepshead	14	3.02	M				
Silver Jenny	1	0.22	M				
Southern Flounder	1	0.22	M				
Striped Mullet	4	0.86	M				
Tidewater Mojarra	110	23.76	M				
Timucu	6	1.30	M				
White Mullet	1	0.22	M				
Worm Eel	4	0.86	M				

Table 54. Species diversity for fish assemblages in all systems (2013-2017).

Zone	Season	Chassahowitzka	Homosassa	Weeki Wachee	Rainbow	Kings Bay
1	Summer	0.42	0.33	0.33	0.15	0.34
1	Winter	0.53	0.51	0.17	0.25	0.3
2	Summer	0.37	0.31	0.45	0.15	0.43
2	Winter	0.47	0.52	0.51	0.43	0.38
3	Summer	0.25	0.43	-	-	0.4
3	Winter	0.5	0.48	-	-	0.36

Table 55. Species evenness for fish assemblages in all systems (2013-2017).

Zone	Season	Chassahowitzka	Homosassa	Weeki Wachee	Rainbow	Kings Bay
1	Summer	0.07	0.06	0.06	0.03	0.06
1	Winter	0.09	0.09	0.03	0.04	0.05
2	Summer	0.06	0.06	0.08	0.03	0.08
2	Winter	0.08	0.09	0.09	0.08	0.07
3	Summer	0.04	0.08	-	-	0.07
3	Winter	0.09	0.08	-	-	0.06

Table 56. Species richness for fish assemblages in all systems (2013-2017).

Zone	Season	Chassahowitzka	Homosassa	Weeki Wachee	Rainbow	Kings Bay
1	Summer	33	38	30	32	36
1	Winter	20	25	36	29	38
2	Summer	36	39	24	32	31
2	Winter	29	24	20	22	34
3	Summer	42	32	-	-	33
3	Winter	27	28	-	-	35

Table 57. The Chassahowitzka River System mean water quality parameters (minimum, maximum).

River	Zone	Year	Dissolved Oxygen	Temperature	Conductivity	Salinity
Chassahowitzka	Zone 1	2014	8.15 (5.8, 10.6)	22.95 (20.2, 25.5)	2553.00 (1213, 3800)	1.3 (0.6,1.7)
		2015	7.05 (2.6, 13.7)	23.92 (21.8, 26.7)	3136.50 (2355, 4040)	1.68 (1.2, 2.2)
		2016	7.00 (4.3, 10.8)	23.38 (20.7, 24.9)	2789.06 (685, 6400)	1.38 (0.4, 2.5)
		2017	7.73 (1.1, 2.1)	23.12 (21.8, 24.2)	2730.60 (1161, 3984)	1.68 (1.1, 2.1)
	Zone 2	2014	9.56 (3.4, 15.4)	22.33 (16.4, 27.6)	3893.08 (2818, 4556)	2.08 (1.6, 2.3)
		2015	6.99 (3.1, 13.3)	23.05 (18.6, 27.1)	3925.58 (2365, 5028)	2.16 (1.3, 2.6)
		2016	10.75 (4.2, 20.0)	23.56 (19.4, 26.9)	4034.63 (1890, 8050)	2.02 (1.6, 2.5)
		2017	7.72 (3.95, 10.67)	21.77 (19.8, 23.6)	4963.46 (4072, 6896)	2.87 (2.2, 4.2)
	Zone 3	2014	5.84 (1.4, 10.6)	27.87 (19.0, 29.1)	4529.88 (3627, 5189)	2.39 (1.9, 2.8)
		2015	6.33 (3.4, 11.6)	24.07 (18.1, 30.5)	4477.18 (3138, 6213)	2.42 (1.8, 3.1)
		2016	6.99 (2.5, 16.1)	24.55 (18.5, 27.9)	5829.38 (3451, 11581)	3.07 (2.0, 6.7)
		2017	5.29 (4.6, 6.6)	20.82 (19.3, 21.5)	12749.00 (6088, 18348)	8.09 (3.6, 11.8)

Table 58. The Homosassa River System mean water quality parameters (minimum, maximum).

River	Zone	Year	Dissolved Oxygen	Temperature	Conductivity	Salinity
Homosassa	Zone 1	2014	6.01 (4.7, 9.2)	23.67 (21.7, 25.4)	2387.86 (1814, 2986)	1.24 (0.9, 1.6)
		2015	4.71 (3.3, 7.1	23.97 (21.9, 26.5)	2154.86 (1563, 2768)	1.14 (0.8, 1.5)
		2016	6.60 (5.4, 8.4)	24.94 (23.3, 27.1)	2342.57 (1994, 2740)	1.21 (1, 1.4)
		2017	4.63 (3.9, 6.9)	22.56 (20.6, 23.1)	2958.00 (1435, 7529)	1.65 (0.8, 4.6)
	Zone 2	2014	8.18 (5.0, 11.8)	24.47 (22.7, 26.1)	3805.79 (2172, 4694)	2.00 (1.2, 2.5)
		2015	6.87 (3.7, 11.1)	25.06 (19.0, 29.1)	3605.17 (2183, 5420)	1.89 (1.1, 2.7)
		2016	9.00 (4.3, 12.0)	25.70 (22.0, 30.2)	3508.71 (2153, 4766)	1.81 (1.1, 2.3)
		2017	6.18 (4.2, 8.1)	22.47 (21.3, 22.9)	4410.62 (1435, 6316)	2.51 (0.8, 3.8)
	Zone 3	2014	8.90 (6.2, 13.0)	25.20 (22.9, 28.1)	4953.73 (3715, 7920)	2.72 (1.9, 5.1)
		2015	7.50 (6.1, 10.4)	25.85 (18.8, 30.1)	4444.91 (3771, 6492)	2.32 (1.8, 3.2)
		2016	9.36 (7.4, 12.9)	26.06 (21.6, 30.5)	5586.82 (3715, 8604)	2.93 (1.9, 4.3)
		2017	7.50 (4.2, 8.9)	21.78 (20.6, 22.8)	5410.17 (1435, 7529)	3.15 (0.8, 4.6)

Table 59. The Crystal River/Kings Bay System mean water quality parameters (minimum, maximum).

River	Zone	Year	Dissolved Oxygen	Temperature	Conductivity	Salinity
Kings Bay	Zone 1	2014	7.70 (4.6, 11.6)	24.97 (22.3, 28.0)	949.95 (939, 2899)	0.40 (0.1, 1.1)
		2015	6.41 (3.0, 9.8)	23.52 (20.3, 26.5)	1186.95 (256.3, 2724)	0.53 (0.1, 1.0)
		2016	8.18 (6.0, 10.2)	25.53 (24.1, 26.6)	682.79 (259, 1082)	0.36 (0.1, 0.6)
		2017	6.45 (4.6, 8.7)	23.98 (23.4, 24.8)	2103.38 (534, 3577)	1.10 (0.3, 1.9)
	Zone 2	2014	7.27 (3.6, 10.2)	24.90 (22.3, 28.7)	2094.50 (956, 4638)	0.85 (0.1, 1.3)
		2015	4.72 (1.7, 9.0)	23.88 (20.3, 27.2)	2014.08 (921, 4248)	1.05 (0.5, 2.2)
		2016	6.99 (5.3, 10.1)	25.49 (24.3, 26.6)	1970.07 (956, 3584)	1.00 (0.5, 1.9)
		2017	7.27 (3.7, 12.9)	24.39 (23.2, 27.5)	2516.25 (1167, 3723)	1.31 (0.6, 1.9)
	Zone 3	2014	8.40 (5.0, 14.1)	25.29 (21.1, 29.5)	2743.63 (293, 3685)	1.41 (1.0, 1.8)
		2015	6.28 (2.6, 10.5)	24.38 (20, 28.8)	2593.83 (1366, 3359)	1.34 (0.7, 1.7)
		2016	7.77 (5.2, 10.9)	26.45 (23.9, 28.3)	2995.48 (1698, 3628)	1.53 (0.8, 1.8)
		2017	7.18 (5.3, 9.0)	24.47 (22.8, 25.6)	3538.56 (2974, 4666)	1.87 (1.6, 2.6)

Table 60. The Rainbow River System mean water quality parameters (minimum, maximum).

River	Zone	Year	Dissolved Oxygen	Temperature	Conductivity	Salinity
Rainbow	Zone 1	2014	7.87 (5.4, 10.2)	23.15 (21.8, 24.4)	248.04 (188, 271)	0.1
		2015	7.66 (5.6, 11.9)	22.94 (22.0, 25.0)	260.88 (209, 289)	0.1
		2016	7.42 (5.6, 10.5)	23.81 (22.9, 25.2)	273.89 (201, 307)	0.1
		2017	7.31 (5.7, 10.2)	23.15 (22.6, 23.7)	262.39 (194, 287)	0.1
	Zone 2	2014	8.06 (5.2, 11.3)	22.88 (21.3, 24.4)	257.09 (248, 268)	0.1
		2015	7.72 (5.4, 10.7)	22.61 (21.2, 23.9)	260.12 (105, 274)	0.1
		2016	8.00 (5.0, 10.9)	23.57 (22.2, 25.4)	278.50 (261, 293)	0.1
		2017	8.31 (3.6, 10.7)	22.78 (21.4, 23.8)	281.83 (272, 373)	0.1

Table 61. The Weeki Wachee River System mean water quality parameters (minimum, maximum).

River	Zone	Year	Dissolved Oxygen	Temperature	Conductivity	Salinity
Weeki Wachee	Zone 1	2014	5.15 (3.1, 7.1)	23.42 (22.0, 25.5)	315.15 (289, 363)	0.2 (0.2, 0.2)
		2015	5.63 (4.2, 6.9)	23.51 (22.5, 24.6)	330.12 (296, 610)	0.19 (0.1, 0.3)
		2016	6.79 (4.1, 9.9)	23.57 (19.5, 26.1)	351.34 (311, 789)	0.20 (0.1, 0.4)
		2017	6.29 (4.8, 7.5)	23.09 (20.7, 24.1)	361.46 (160, 787)	0.2 (0.0, 0.4)
	Zone 2	2014	6.69 (6.0, 7.6)	24.39 (23.1, 25.8)	1138.25 (605, 2207)	0.54 (0.04, 1.1)
		2015	6.27 (4.6, 7.3)	24.83 (20.9, 29.6)	1300.50 (720, 2630)	0.72 (0.4, 1.5)
		2016	6.18 (5.0, 7.9)	24.03 (19.2, 31.5)	6800.83 (844, 28695)	3.76 (0.5, 15.4)
		2017	7.40 (6.5, 9.1)	22.33 (21.9, 22.8)	1572.17 (784, 2521)	0.87 (0.4, 1.4)

Table 62. Mean habitat categories for all systems by Zone (2013-2017).

River	Zone	% Emergent	% Submersed	% Floating	% Other
Kings Bay	1	14.18	73.60	1.00	29.71
	2	16.77	79.30	7.00	25.11
	3	24.61	76.07	7.40	18.80
Rainbow	1	25.91	72.07	7.17	24.80
	2	22.93	66.23	6.31	26.66
Homosassa	1	10.05	72.30	7.67	47.46
	2	10.46	20.06	10.00	56.62
	3	20.97	31.12	1.00	42.10
Weeki Wachee	1	23.32	55.74	0.00	20.50
	2	12.61	31.89	7.92	34.18
Chassahowitzka	1	13.44	74.42	1.46	35.75
	2	23.86	74.02	0.10	40.11
	3	39.63	34.64	0.06	26.45

APPENDIX B
ADDITIONAL FIGURES

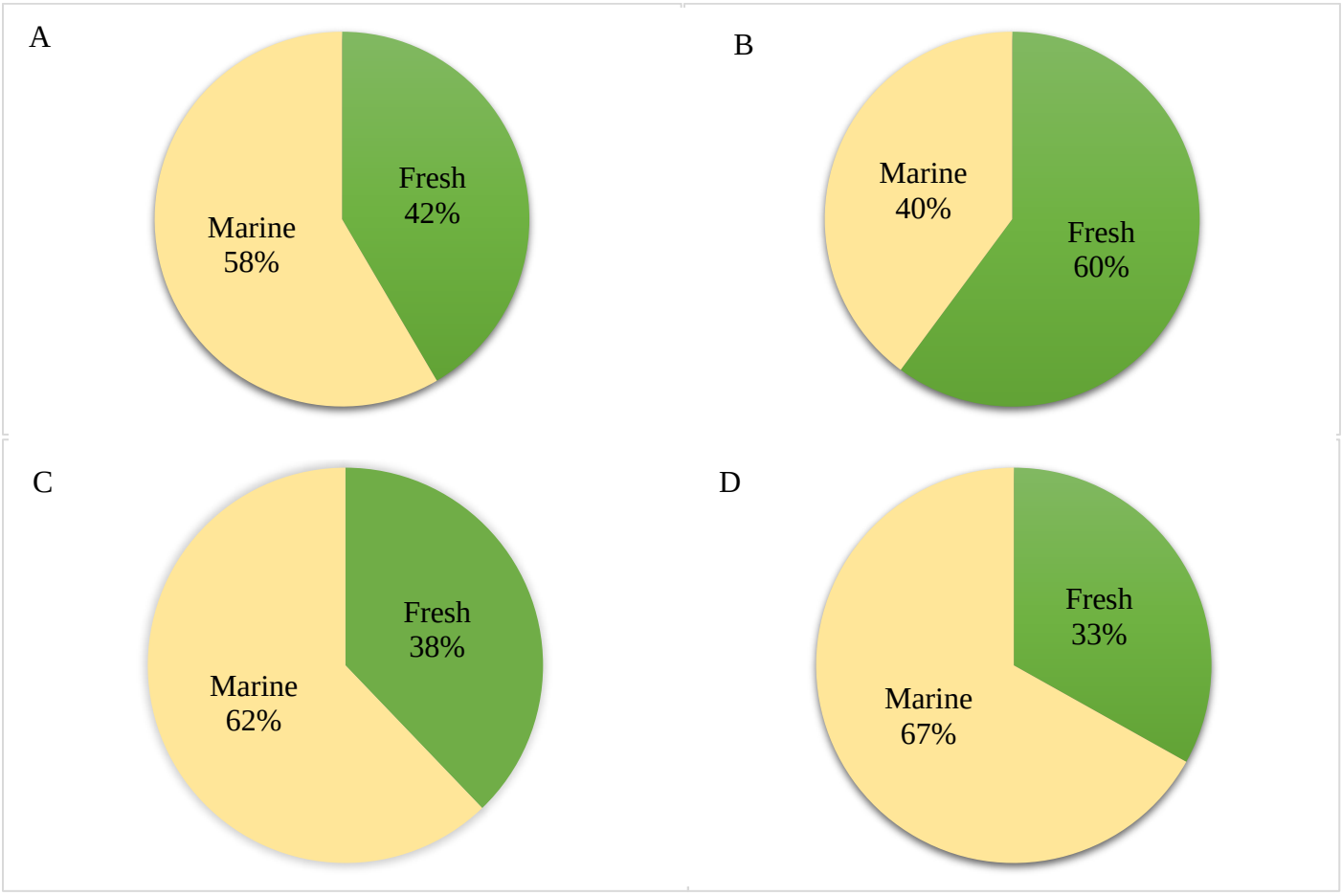


Figure 103. Species composition based on total count of marine and freshwater species for the Chassahowitzka River System (2013-2017). A = Total Composition, B = Zone 1, C = Zone 2, D = Zone 3.

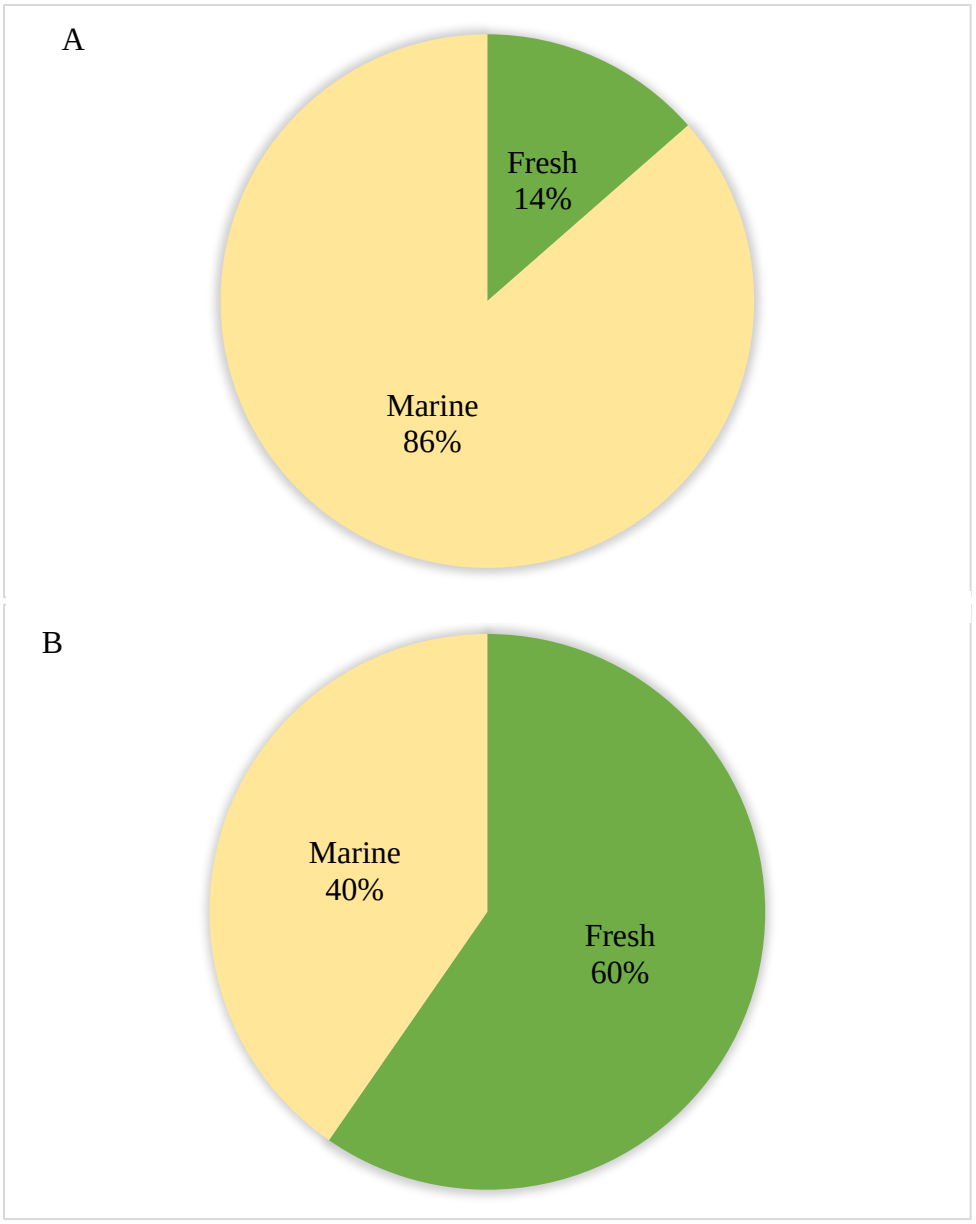


Figure 104. Seasonal species composition based on total count of marine and freshwater species for the Chassahowitzka River System (2013-2017). A = Winter, B = Summer.

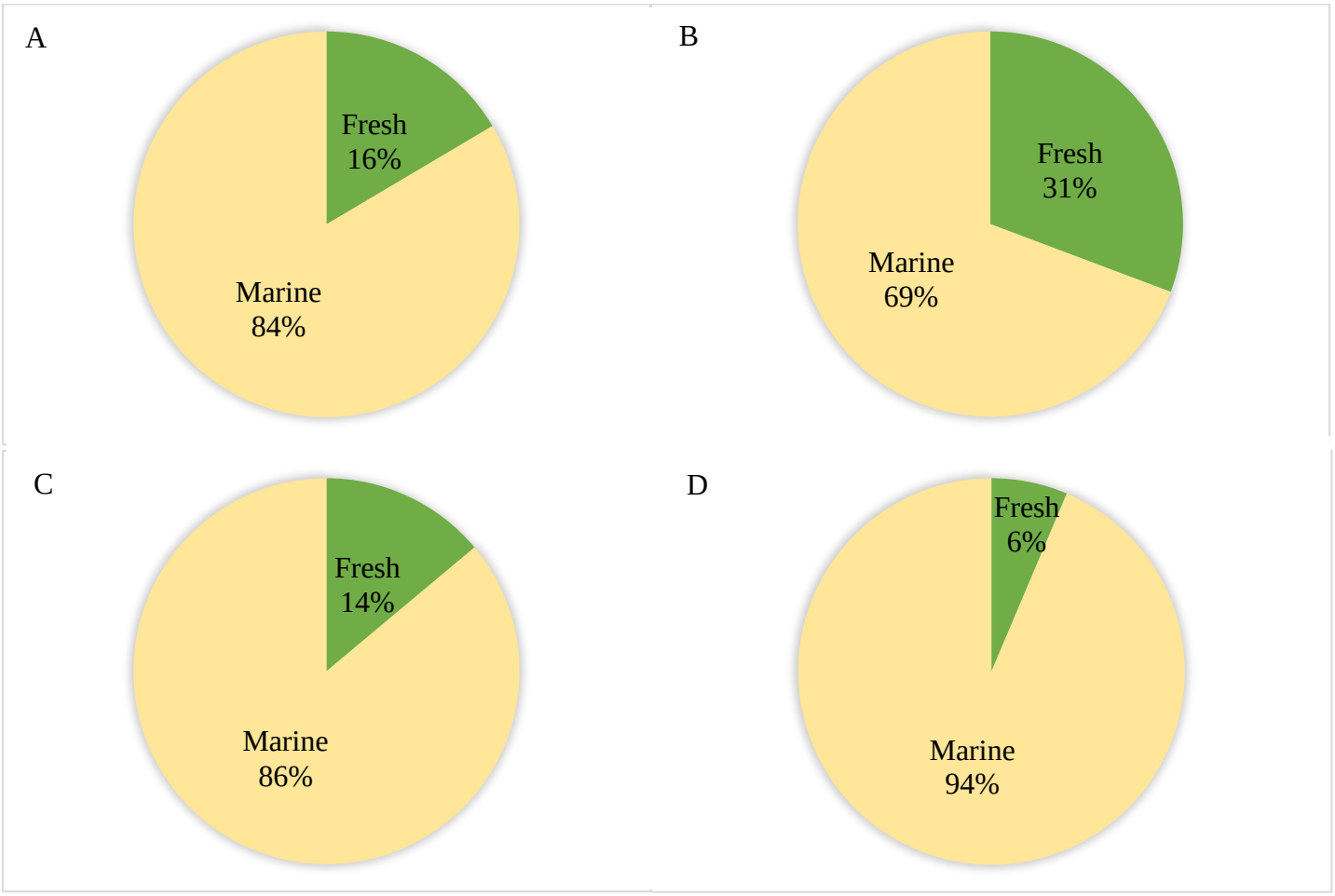


Figure 105. Species composition based on total count of marine and freshwater species for the Homosassa River System (2013-2017). A = Total Composition, B = Zone 1, C = Zone 2, D = Zone 3.

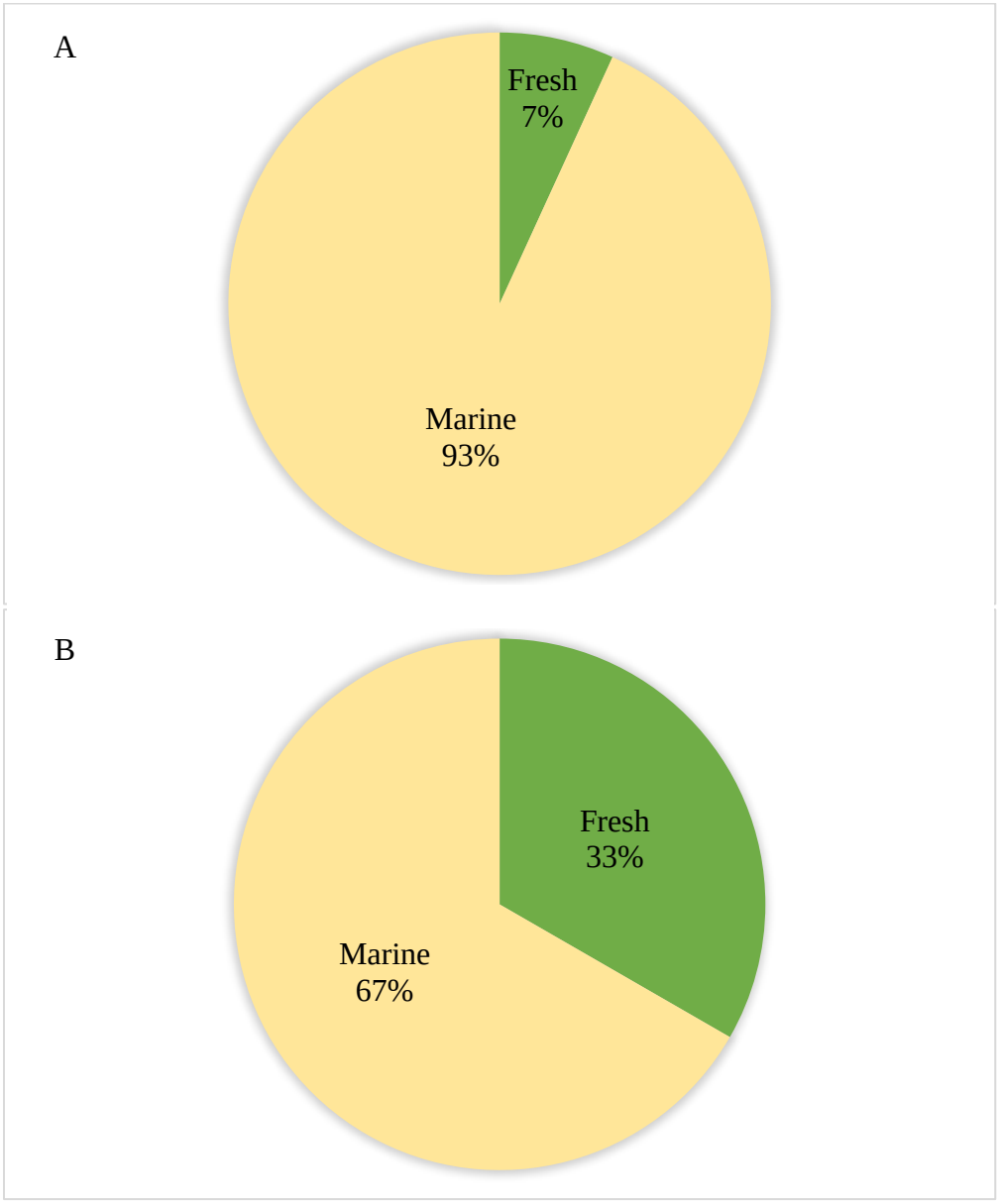


Figure 106. Seasonal species composition based on total count of marine and freshwater species for the Homosassa River System (2013-2017). A = Winter, B = Summer.

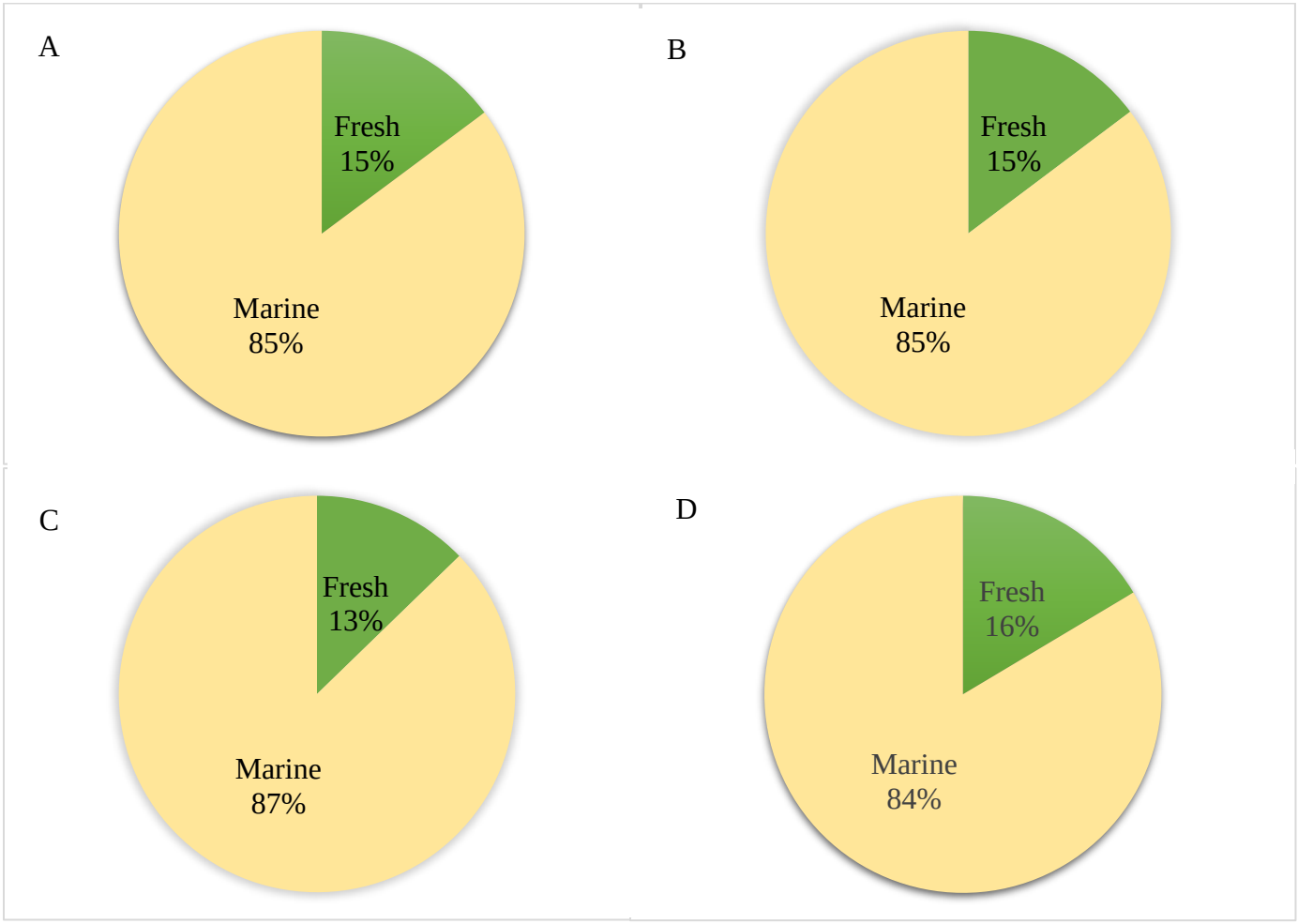


Figure 107. Species composition based on total count of marine and freshwater species for the Crystal River/Kings Bay System (2013-2017). A = Total Composition, B = Zone 1, C = Zone 2, D = Zone 3.

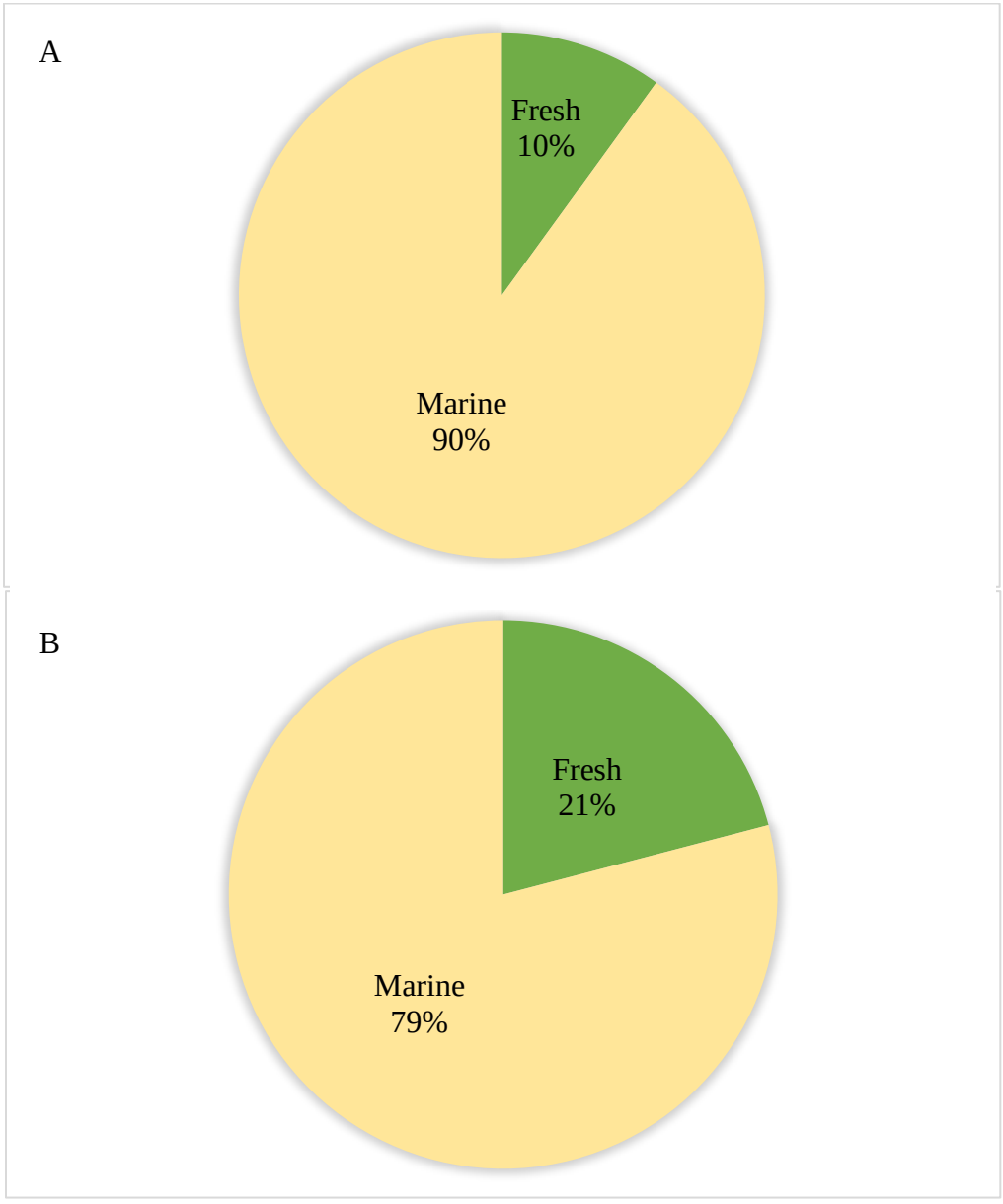


Figure 108. Seasonal species composition based on total count of marine and freshwater species for the Crystal River/Kings Bay System (2013-2017). A = Winter, B = Summer.

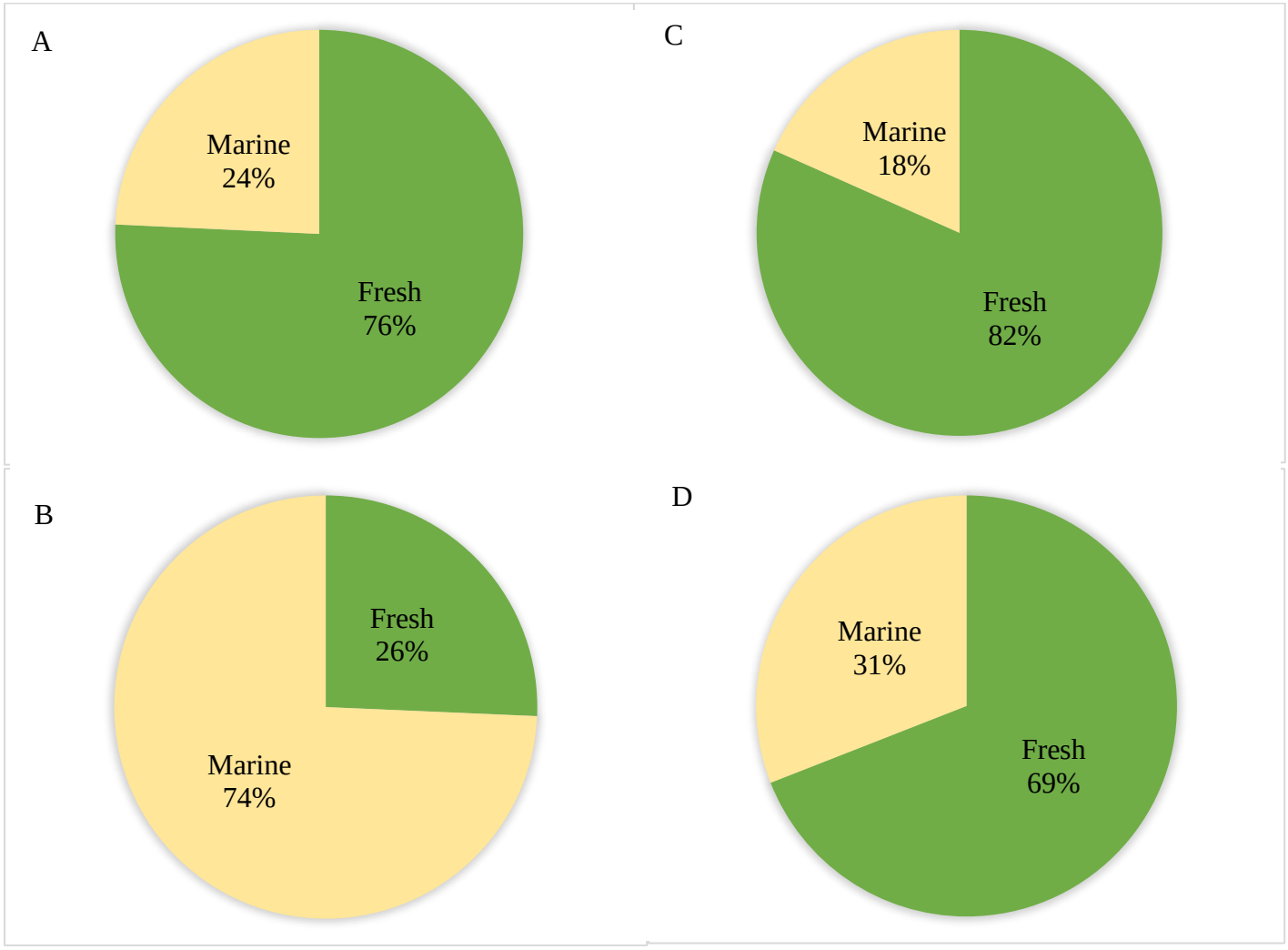


Figure 109. Species composition based on total count of marine and freshwater species for the Weeki Wachee River System from November 2013 to February 2017. A = Total composition, B = Zone 1, C = Zone 2, D = Seasonally.

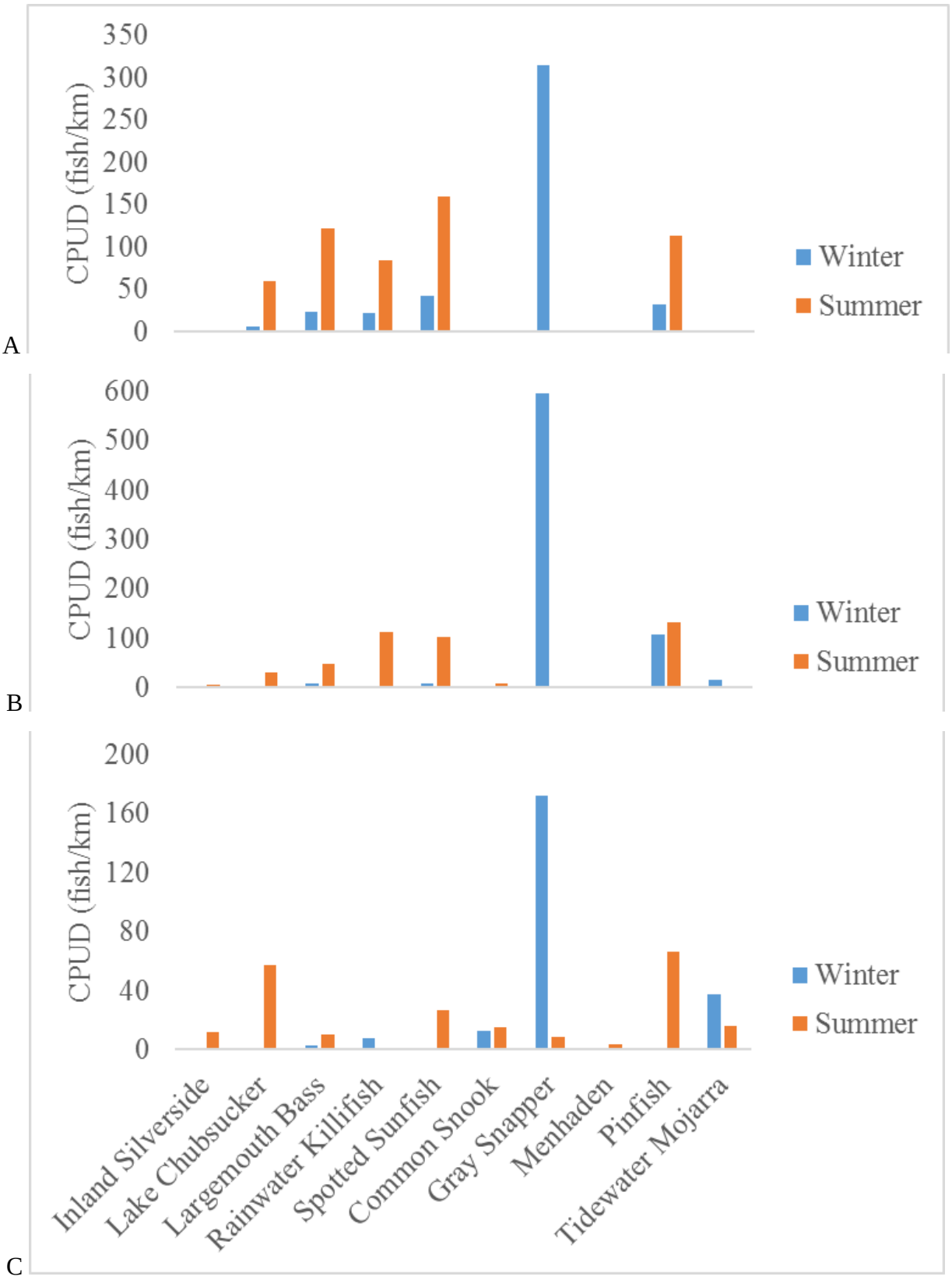


Figure 110. CPUD estimates for top five most abundant freshwater and marine species in the Chassahowitzka River System (2013–2014). A = Zone 1, B = Zone 2, C = Zone 3.

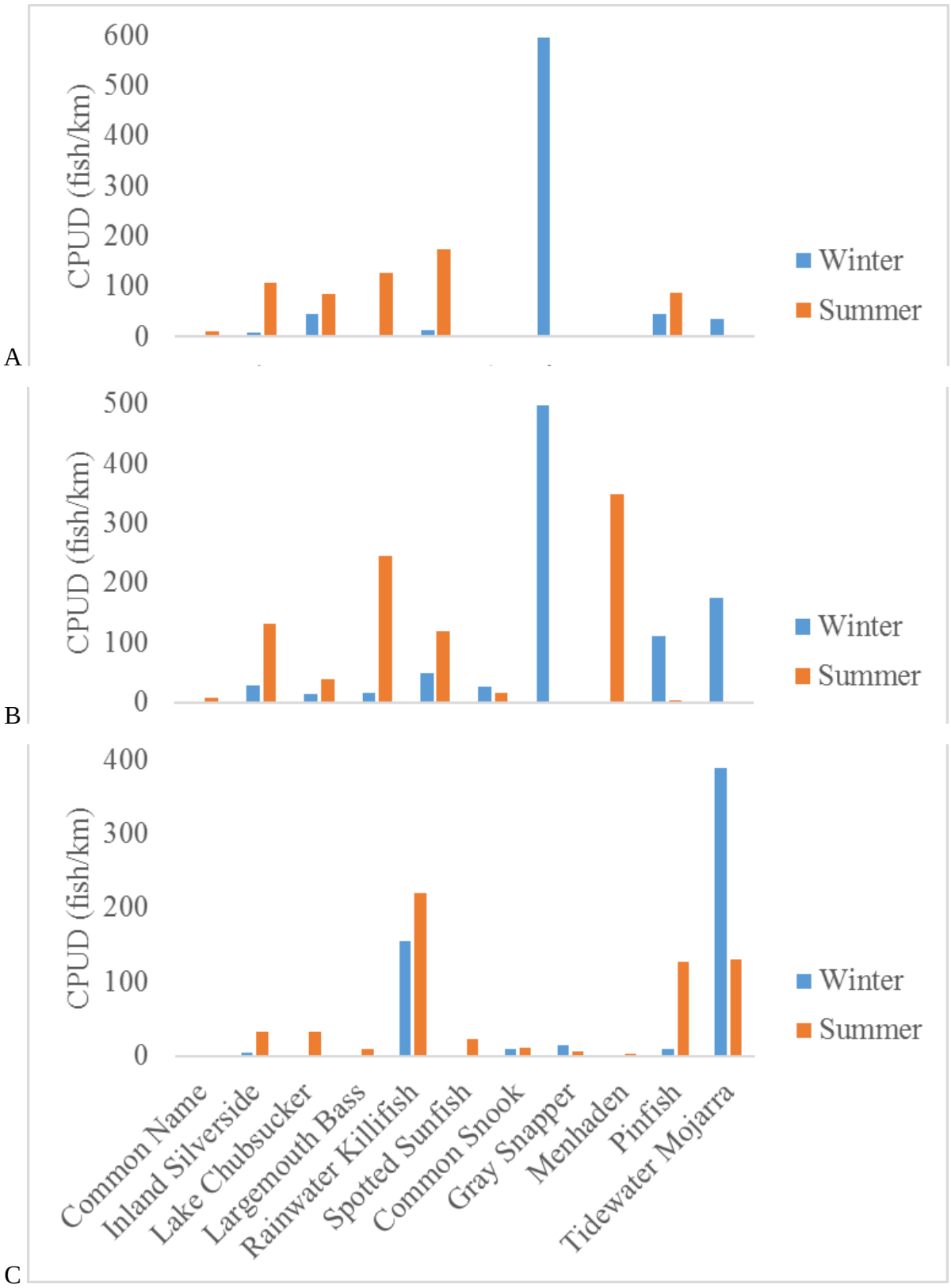


Figure 111. CPUD estimates for top five most abundant freshwater and marine species in the Chassahowitzka River System (2015). A = Zone 1, B = Zone 2, C = Zone 3.

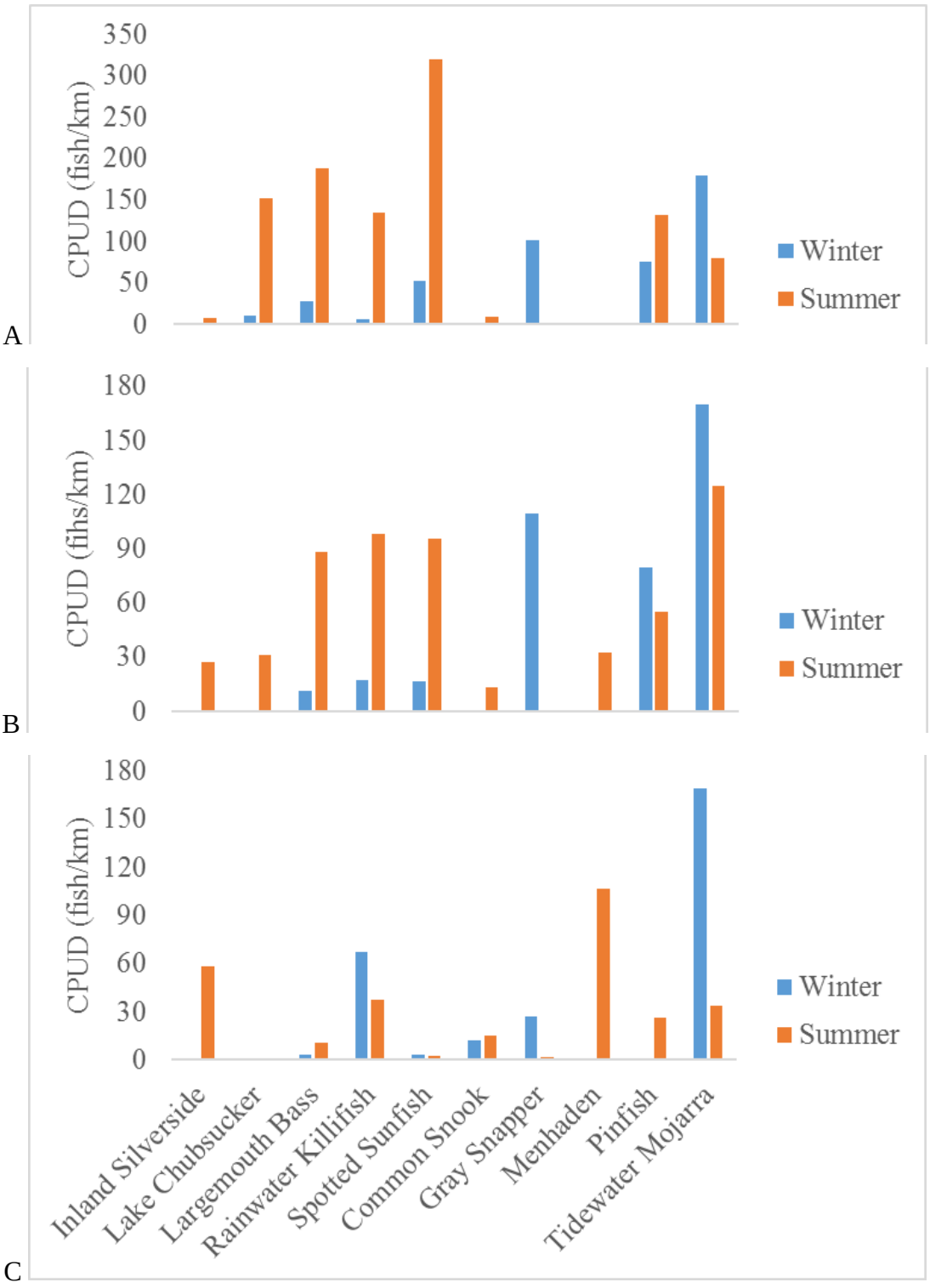


Figure 112. CPUD estimates for top five most abundant freshwater and marine species in the Chassahowitzka River System (2016). A = Zone 1, B = Zone 2, C = Zone 3. Note: Summer CPUD estimates were averaged.

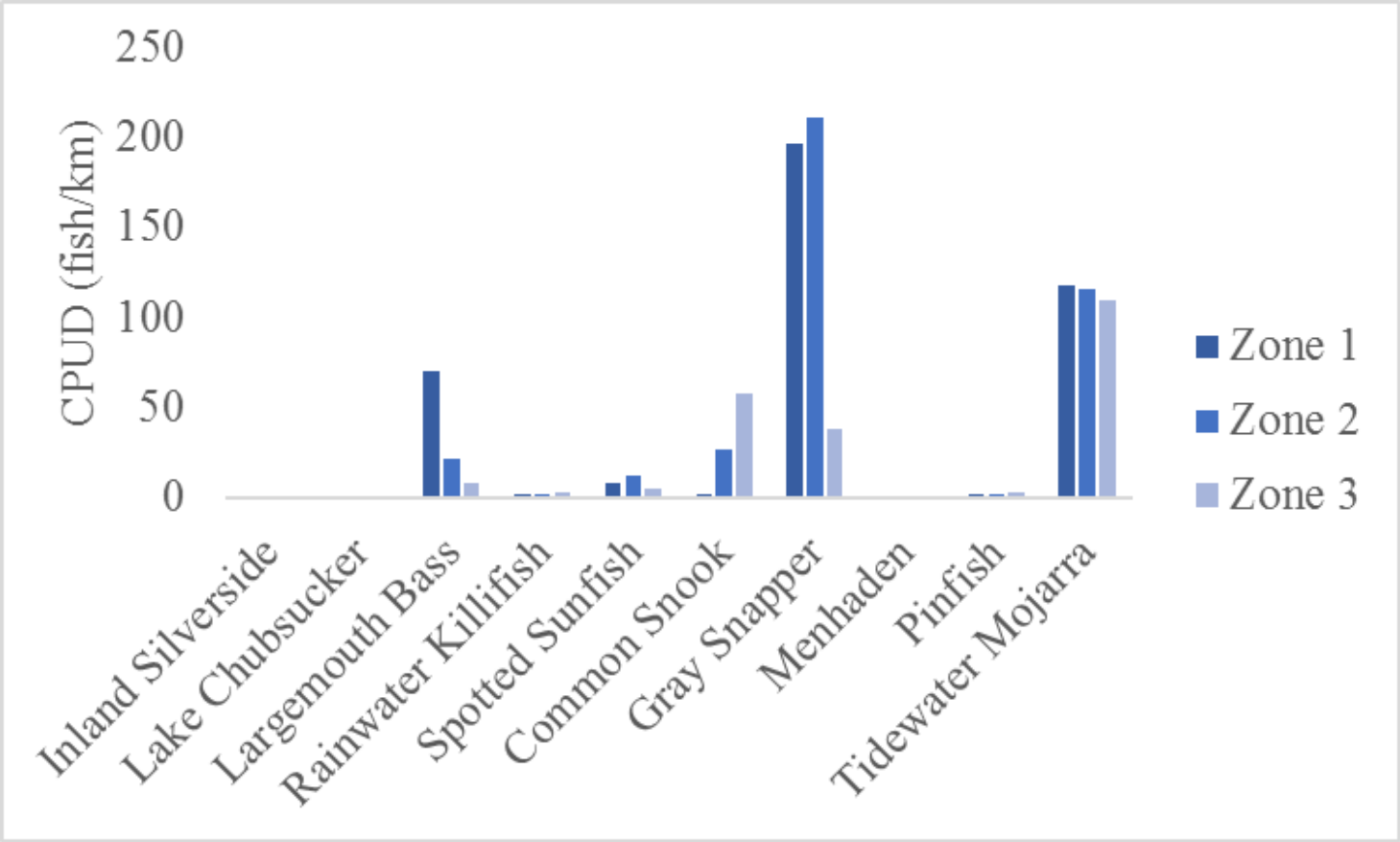


Figure 113. Winter 2017 CPUD estimates for top five most abundant freshwater and marine species from all zones in the Chassahowitzka River System.

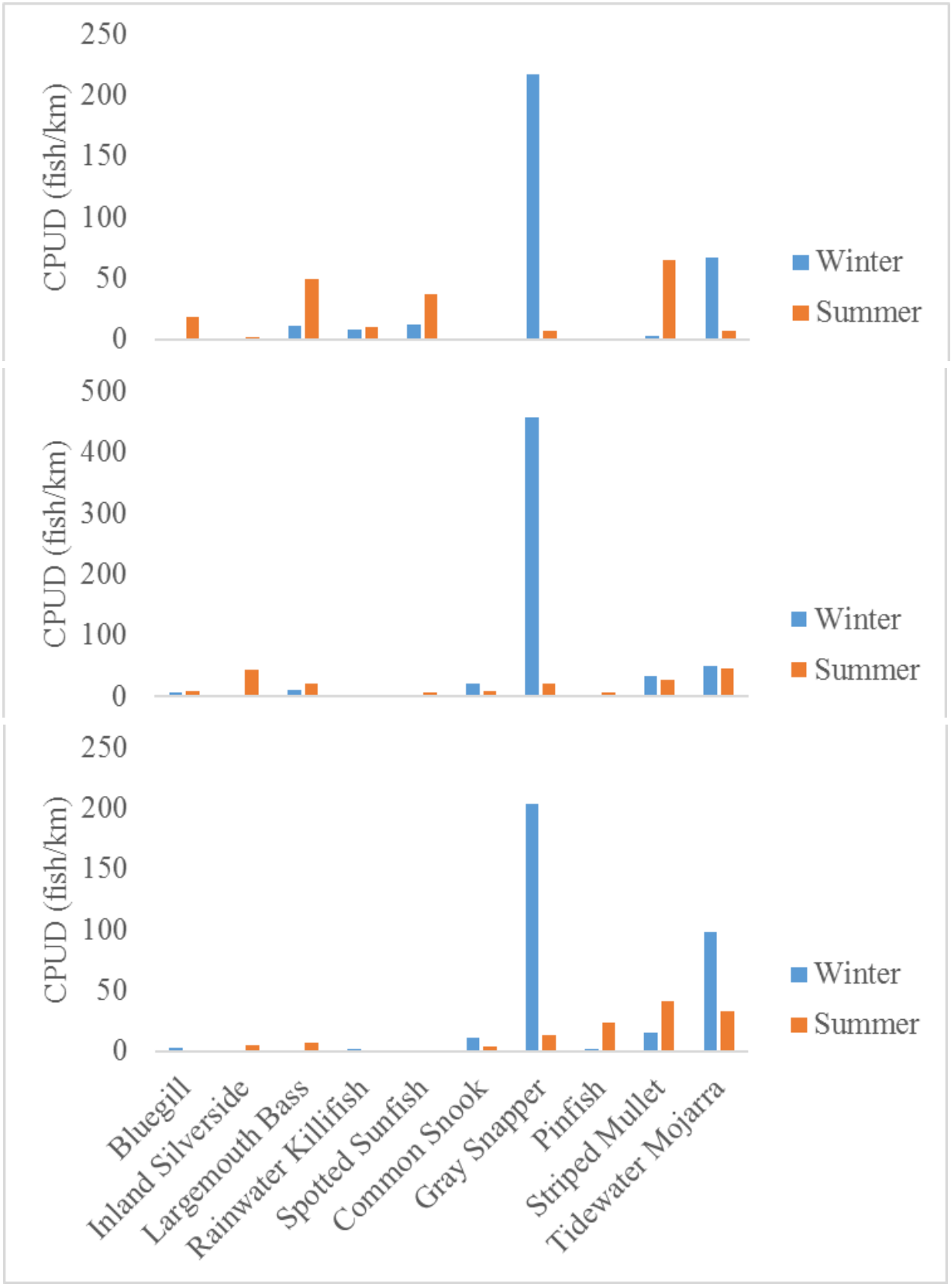


Figure 114. CPUD estimates for top five most abundant freshwater and marine species in the Homosassa River System (2013–2014). A = Zone 1, B = Zone 2, C = Zone 3.

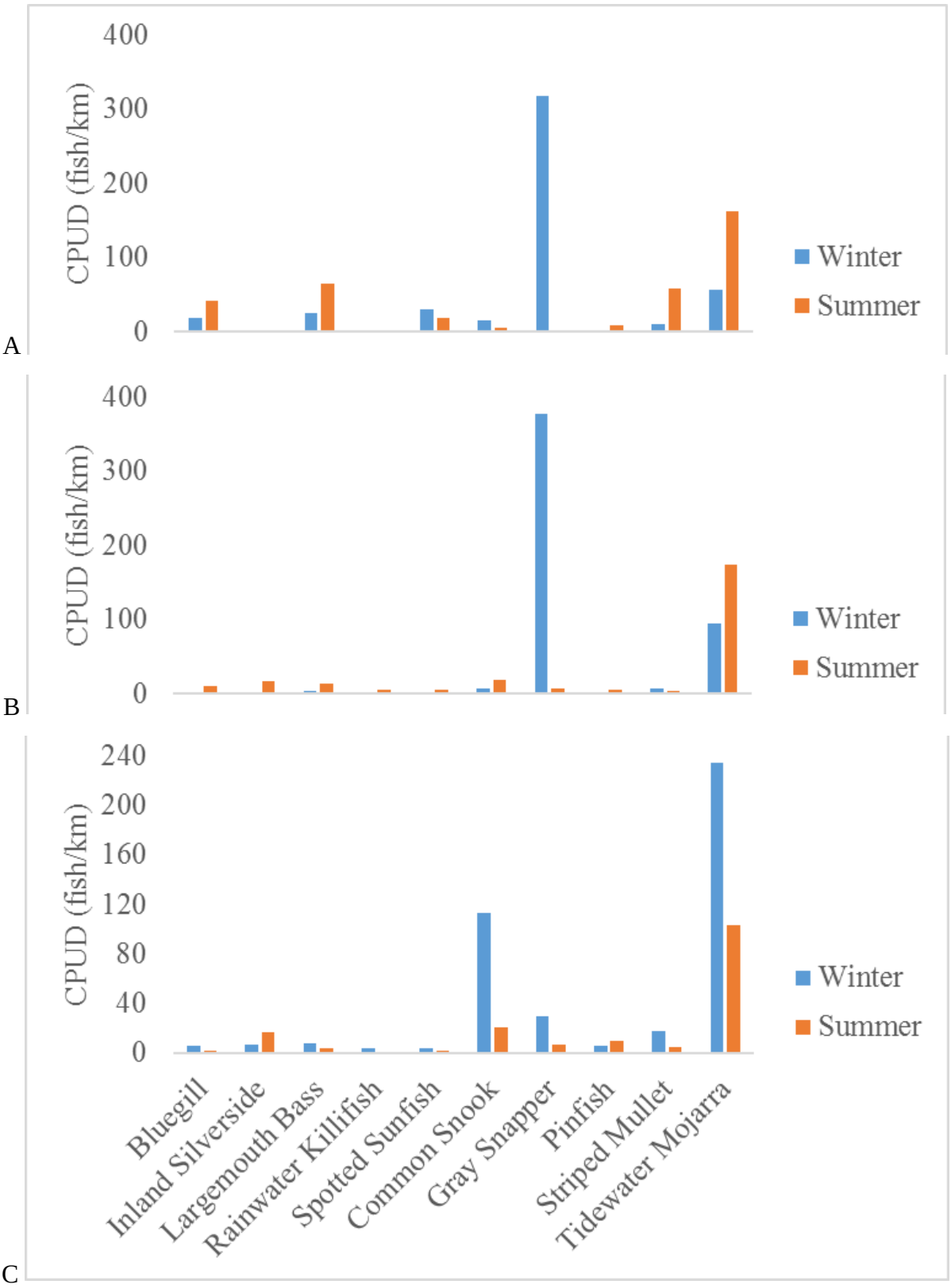


Figure 115. CPUD estimates for top five most abundant freshwater and marine species in the Homosassa River System (2015). A = Zone 1, B = Zone 2, C = Zone 3. Note: Summer CPUD estimates were averaged.

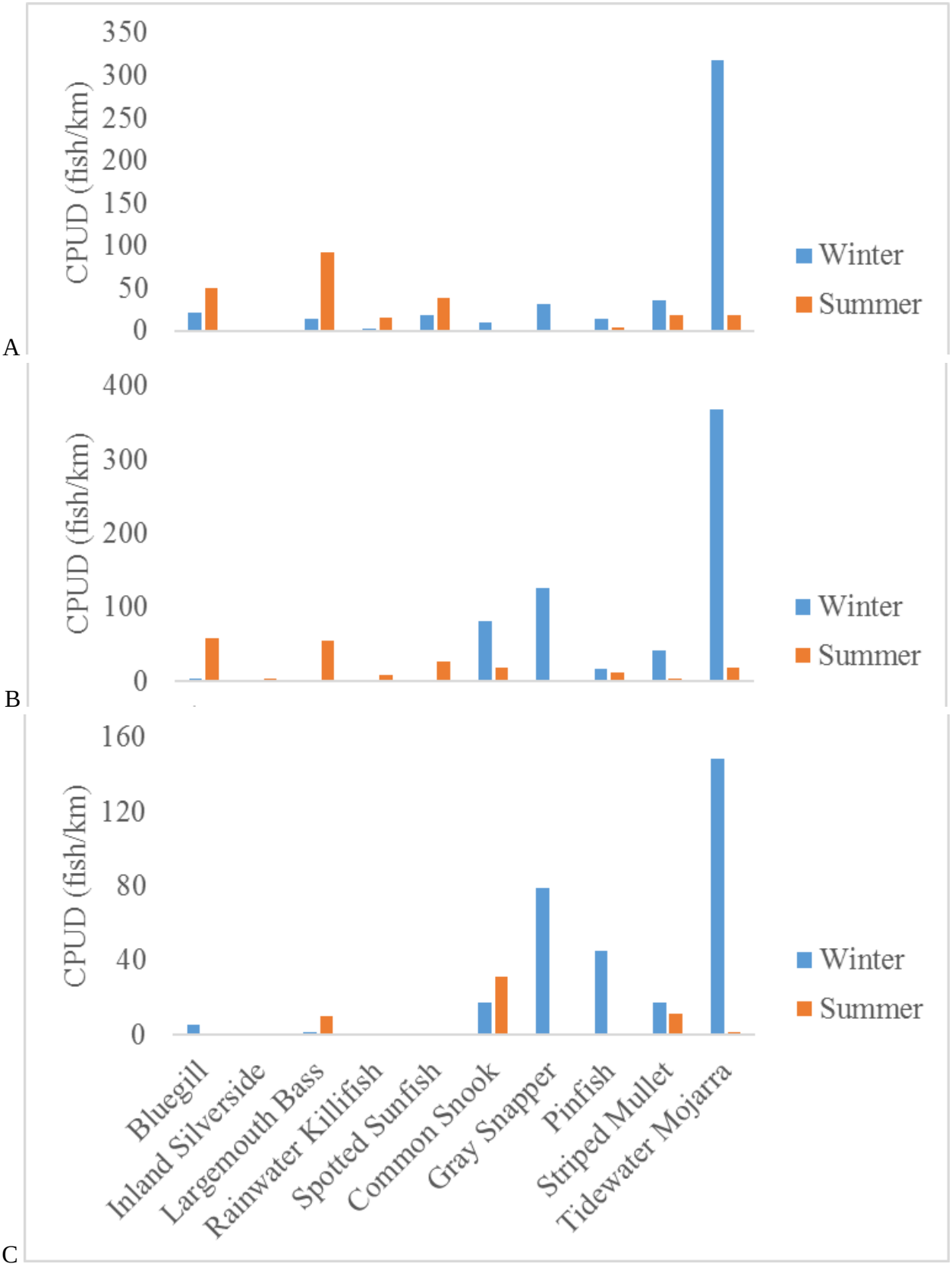


Figure 116. CPUD estimates for top five most abundant freshwater and marine species in the Homosassa River System (2016). A = Zone 1, B = Zone 2, C = Zone 3.

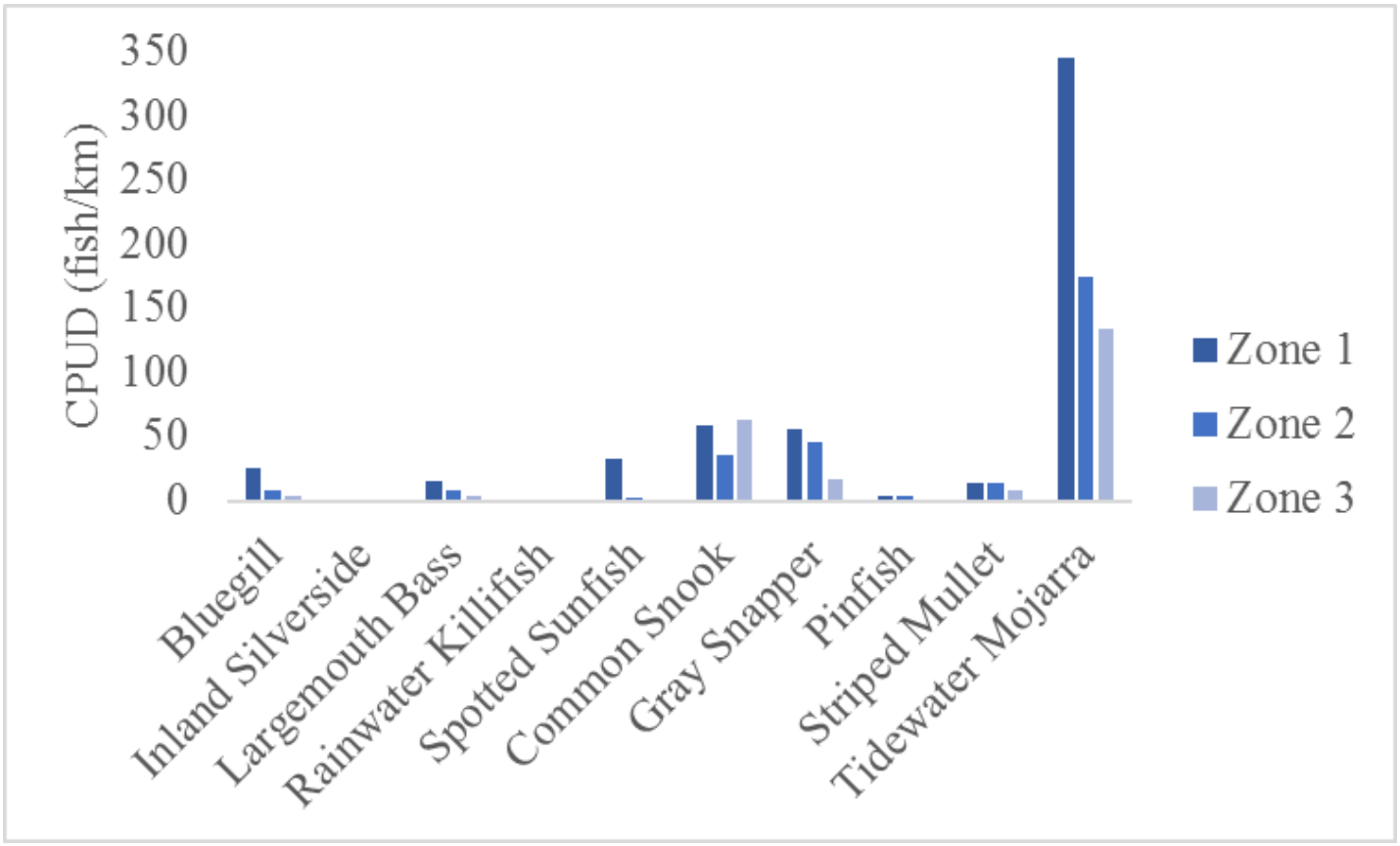


Figure 117. Winter 2017 CPUD estimates for top five most abundant freshwater and marine species from all zones in the Homosassa River System.

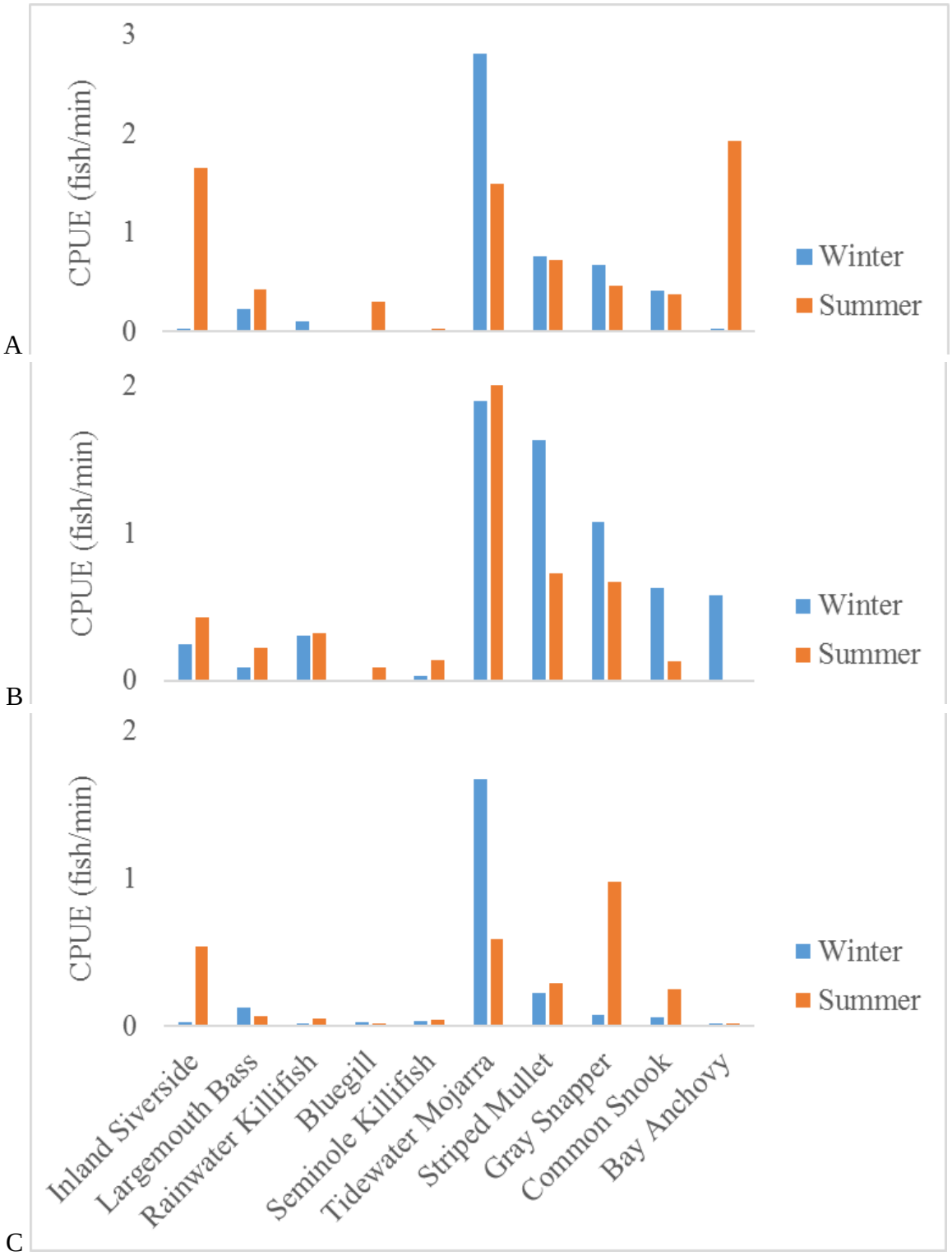


Figure 118. CPUD estimates for top five most abundant freshwater and marine species in the Crystal River/Kings Bay System (2014). A = Zone 1, B = Zone 2, C = Zone 3.

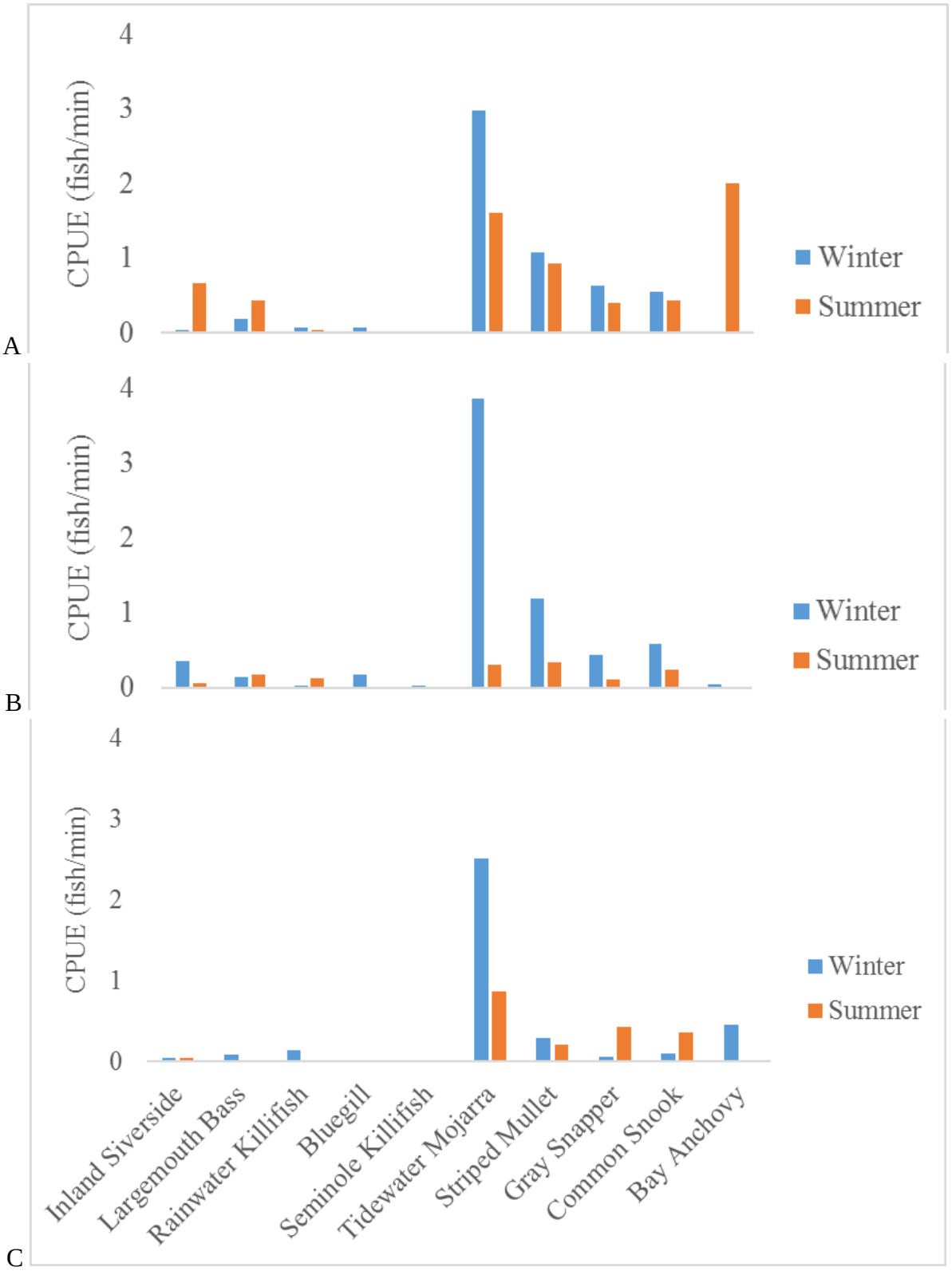


Figure 119. CPUD estimates for top five most abundant freshwater and marine species in the Crystal River/Kings Bay System (2015). A = Zone 1, B = Zone 2, C = Zone 3.

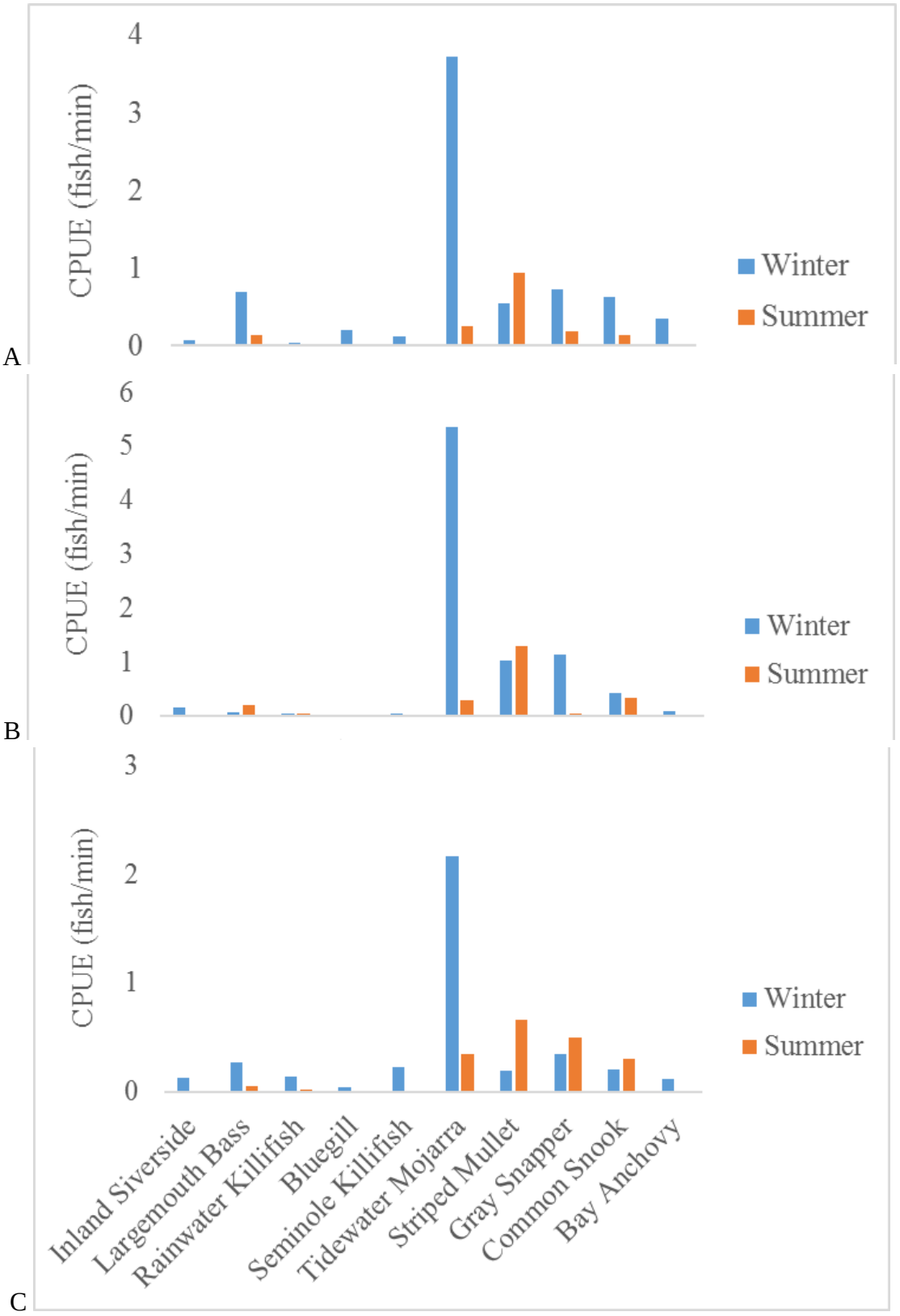


Figure 120. CPUD estimates for top five most abundant freshwater and marine species in the Crystal River/Kings Bay System (2016). A = Zone 1, B = Zone 2, C = Zone 3.

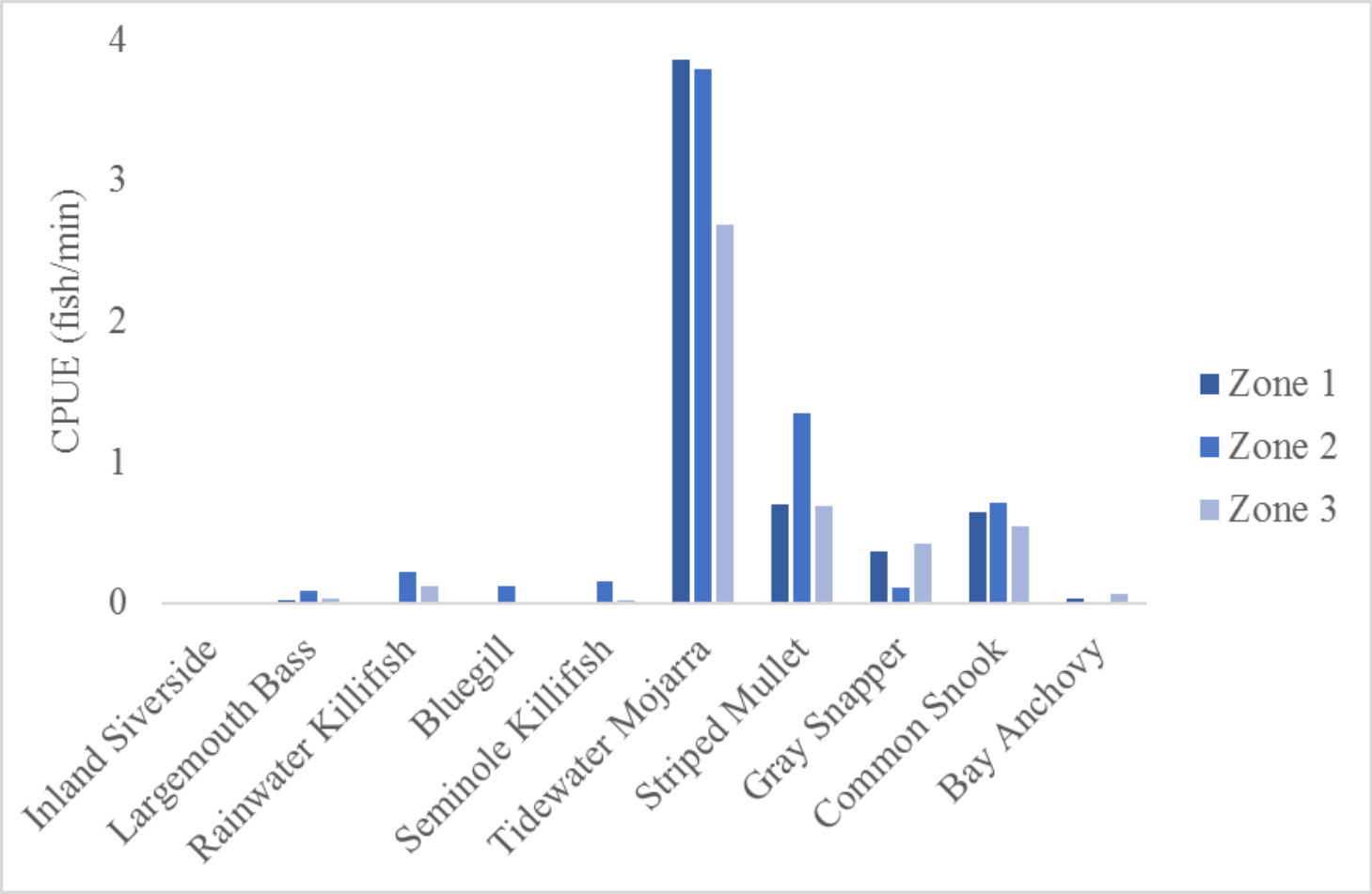


Figure 121. Winter 2017 CPUD estimates for top five most abundant freshwater and marine species from all zones in the Crystal River/Kings Bay System.

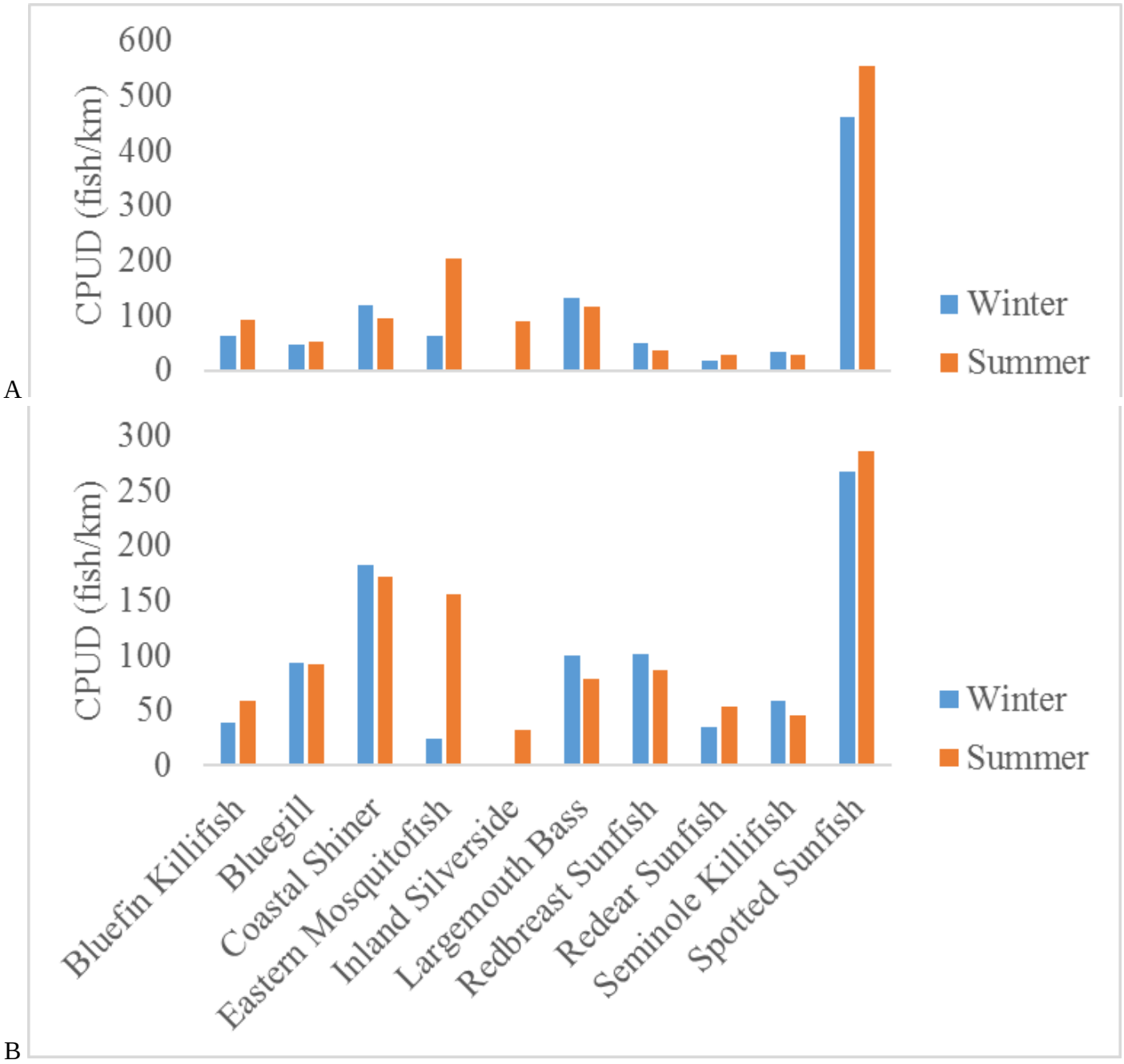


Figure 122. CPUD estimates for top five most abundant freshwater and marine species in the Rainbow River System (2014). A = Zone 1, B = Zone 2.

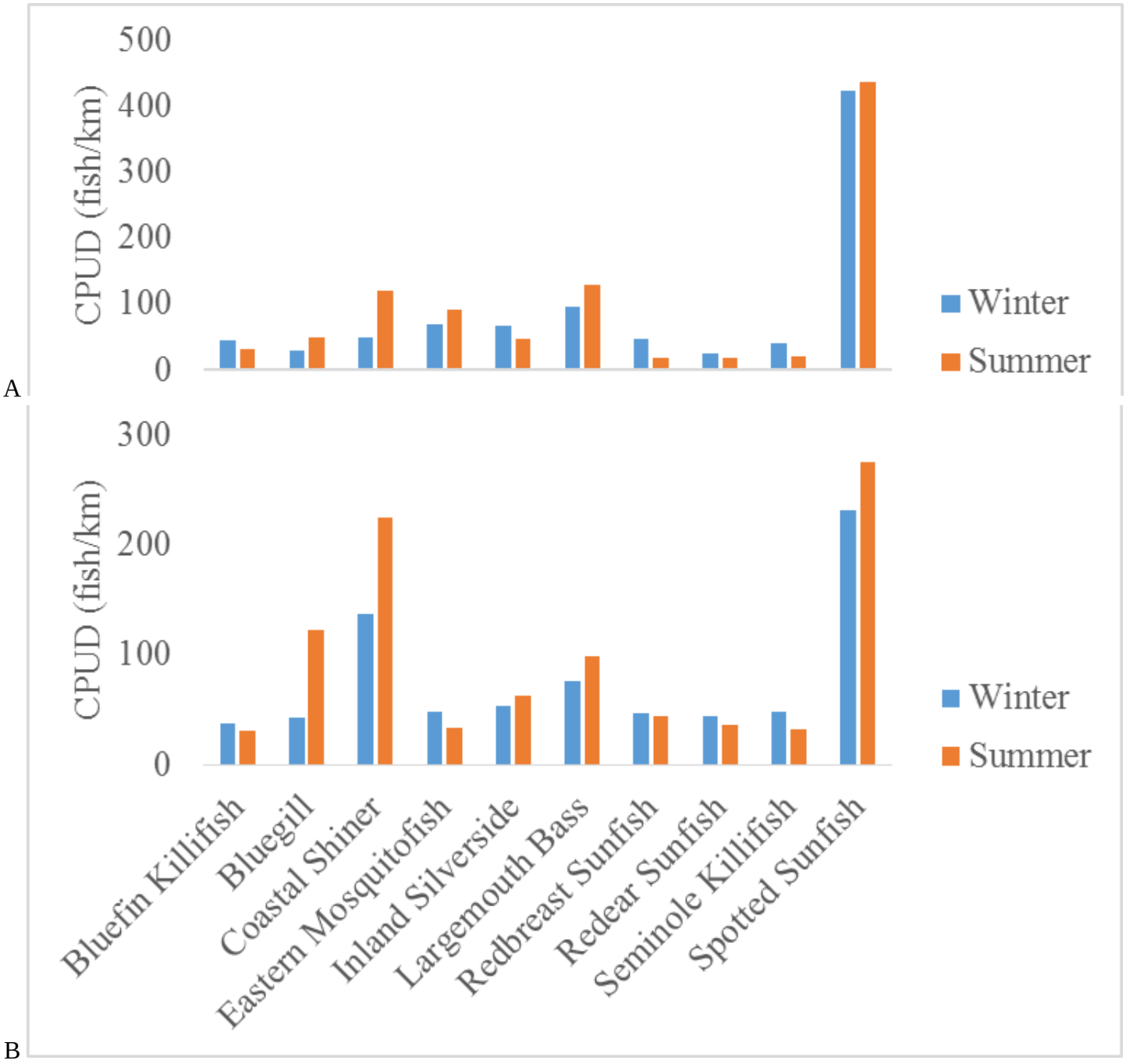


Figure 123. CPUD estimates for top five most abundant freshwater and marine species in the Rainbow River System (2015). A = Zone 1, B = Zone 2.

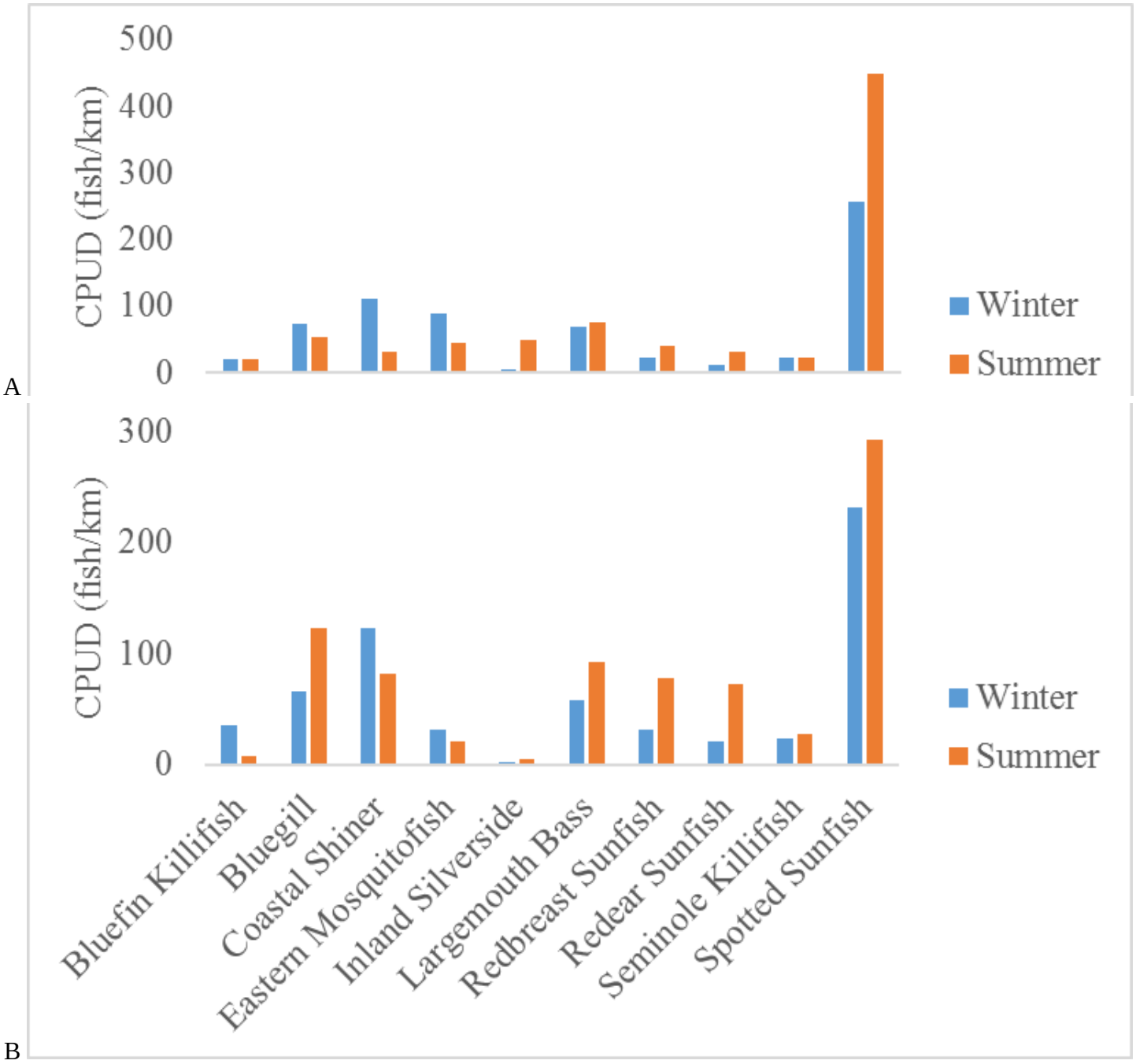


Figure 124. CPUD estimates for top five most abundant freshwater and marine species in the Rainbow River System (2016). A = Zone 1, B = Zone 2.

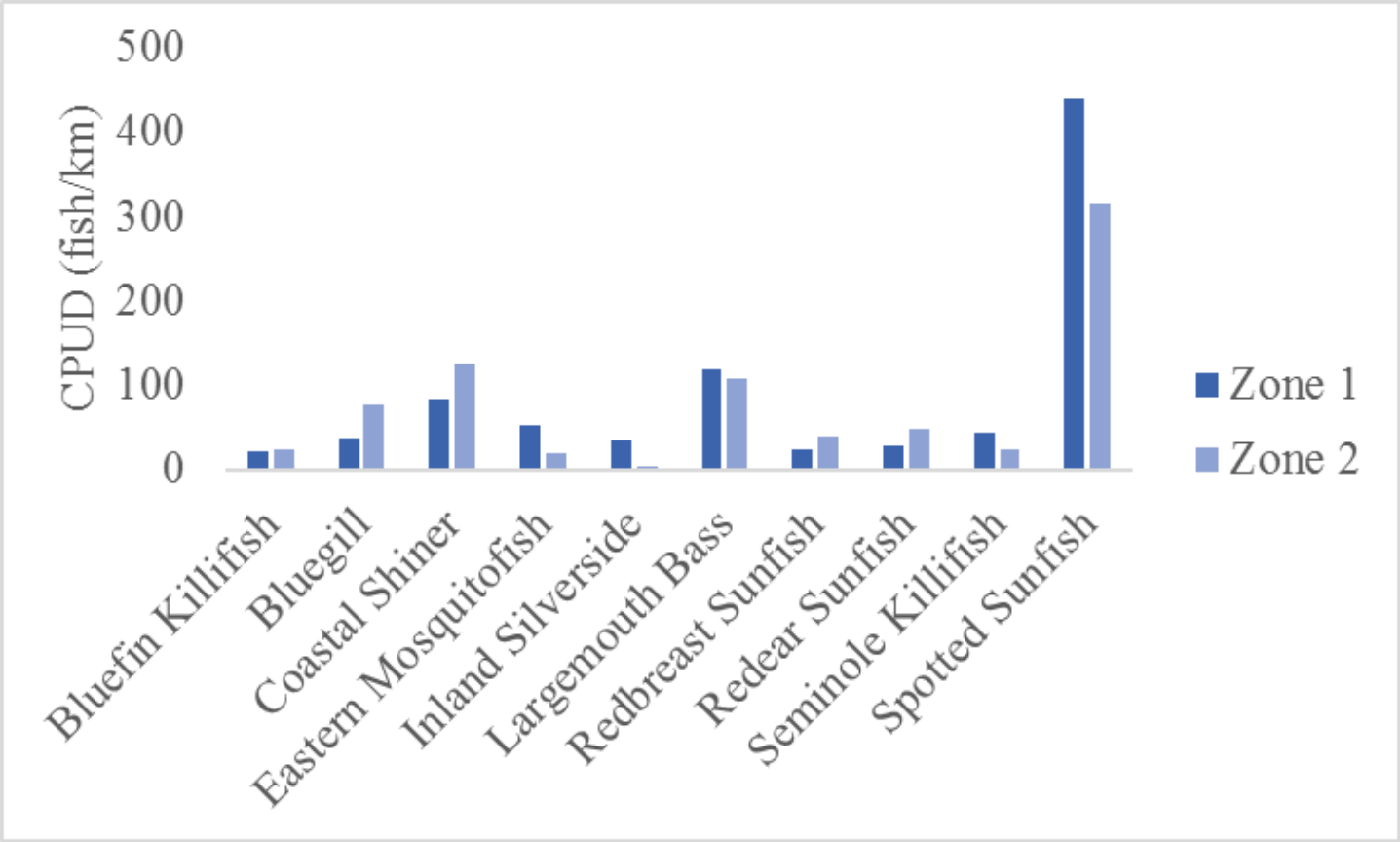


Figure 125. Winter 2017 CPUD estimates for top five most abundant freshwater and marine species from all zones in the Rainbow River System.

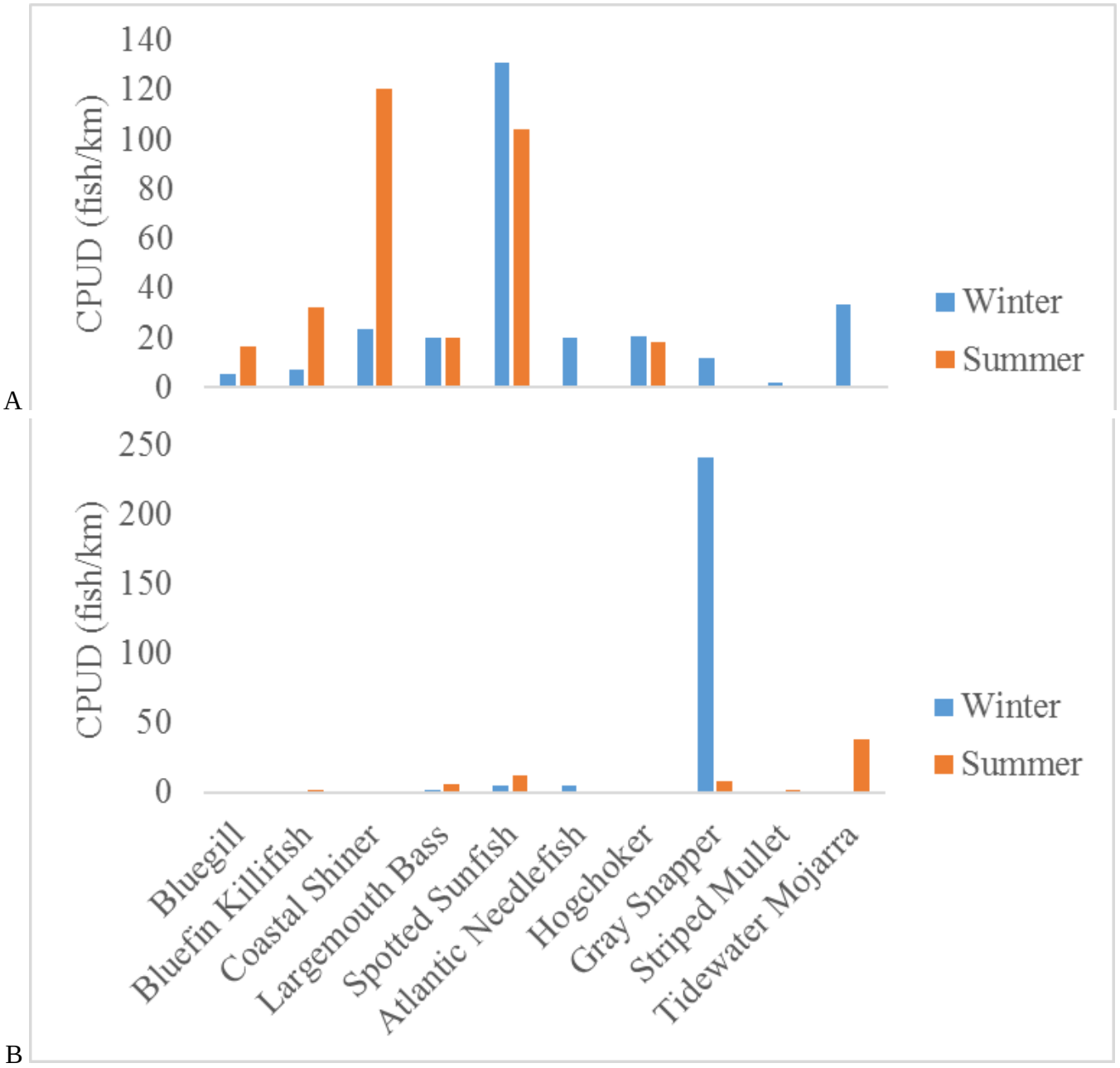


Figure 126. CPUD estimates for top five most abundant freshwater and marine species in the Weeki Wachee River System (2014). A = Zone 1, B = Zone 2.

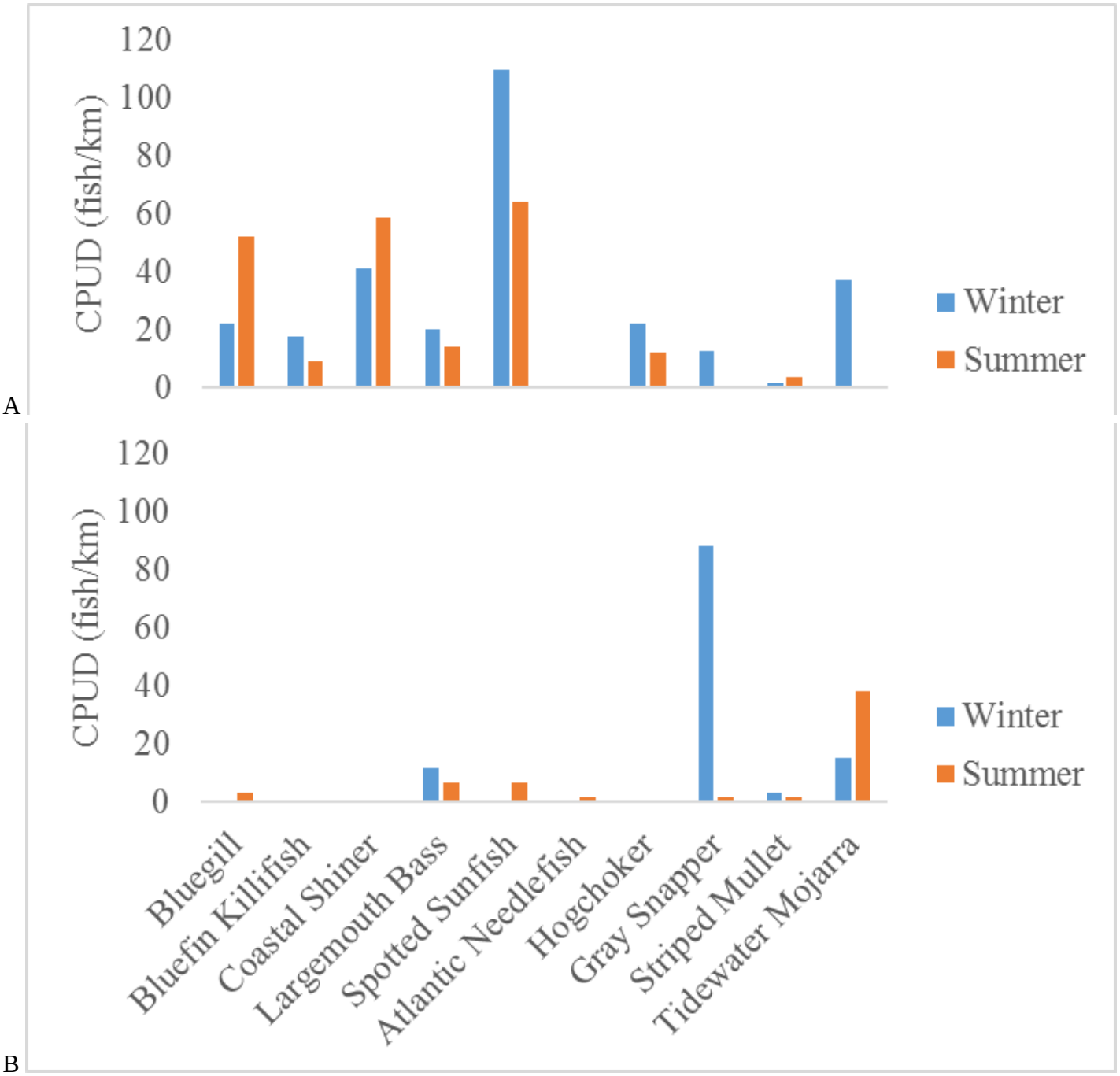


Figure 127. CPUD estimates for top five most abundant freshwater and marine species in the Weeki Wachee River System (2015). A = Zone 1, B = Zone 2.

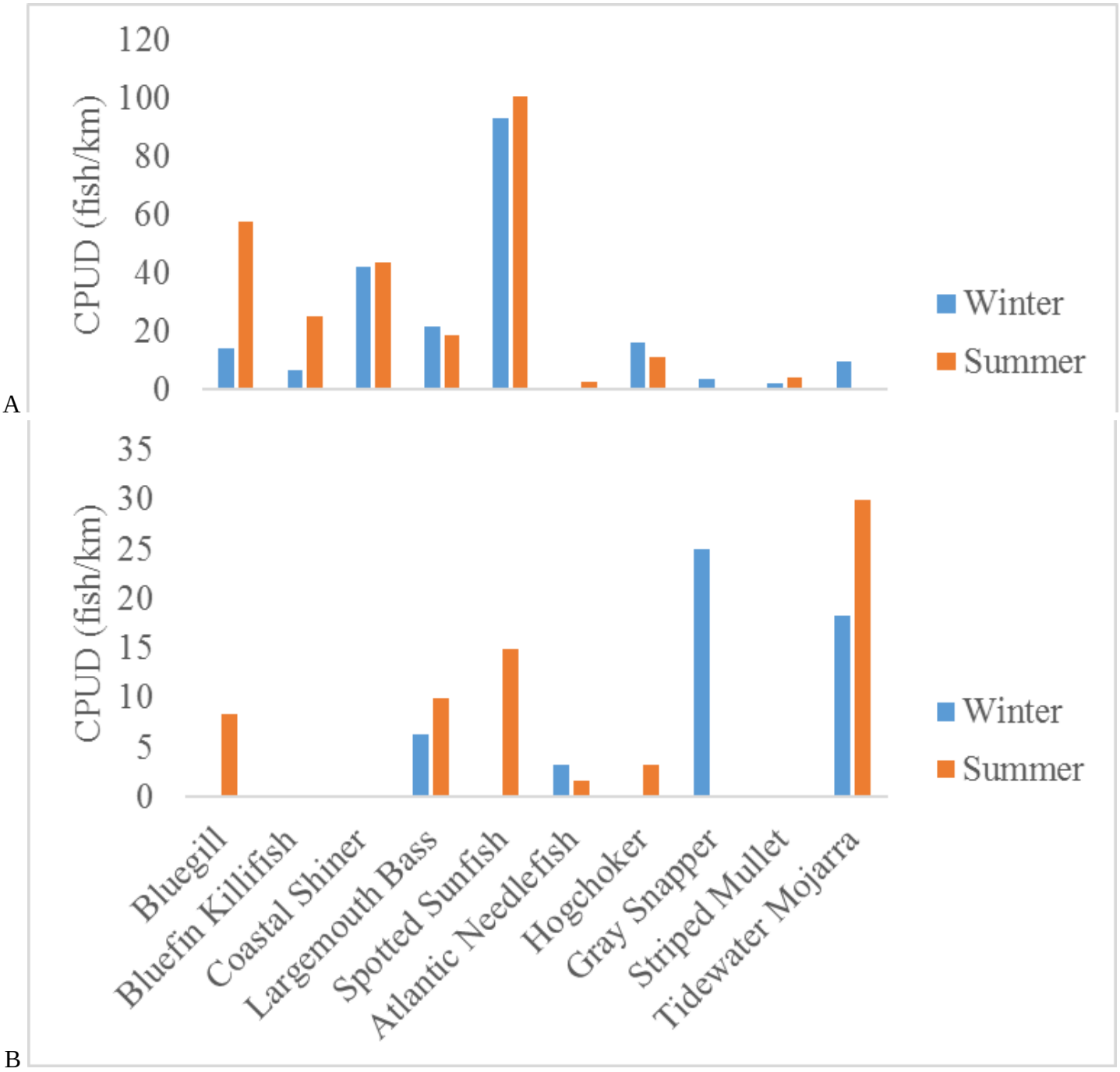


Figure 128. CPUD estimates for top five most abundant freshwater and marine species in the Weeki Wachee River System (2016). A = Zone 1, B = Zone 2.

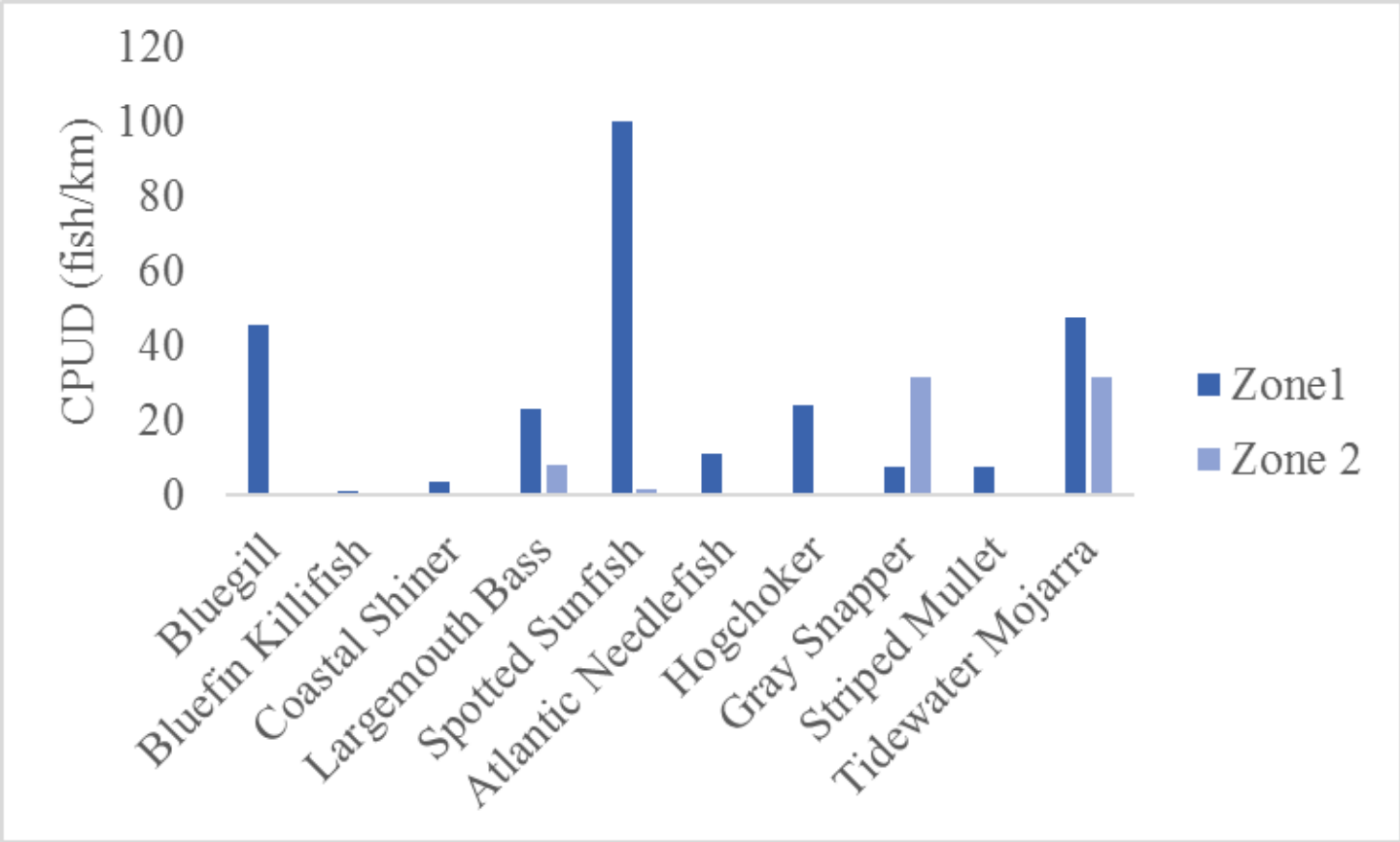


Figure 129. Winter 2017 CPUD estimates for top five most abundant freshwater and marine species from all zones in the Weeki Wachee River System.

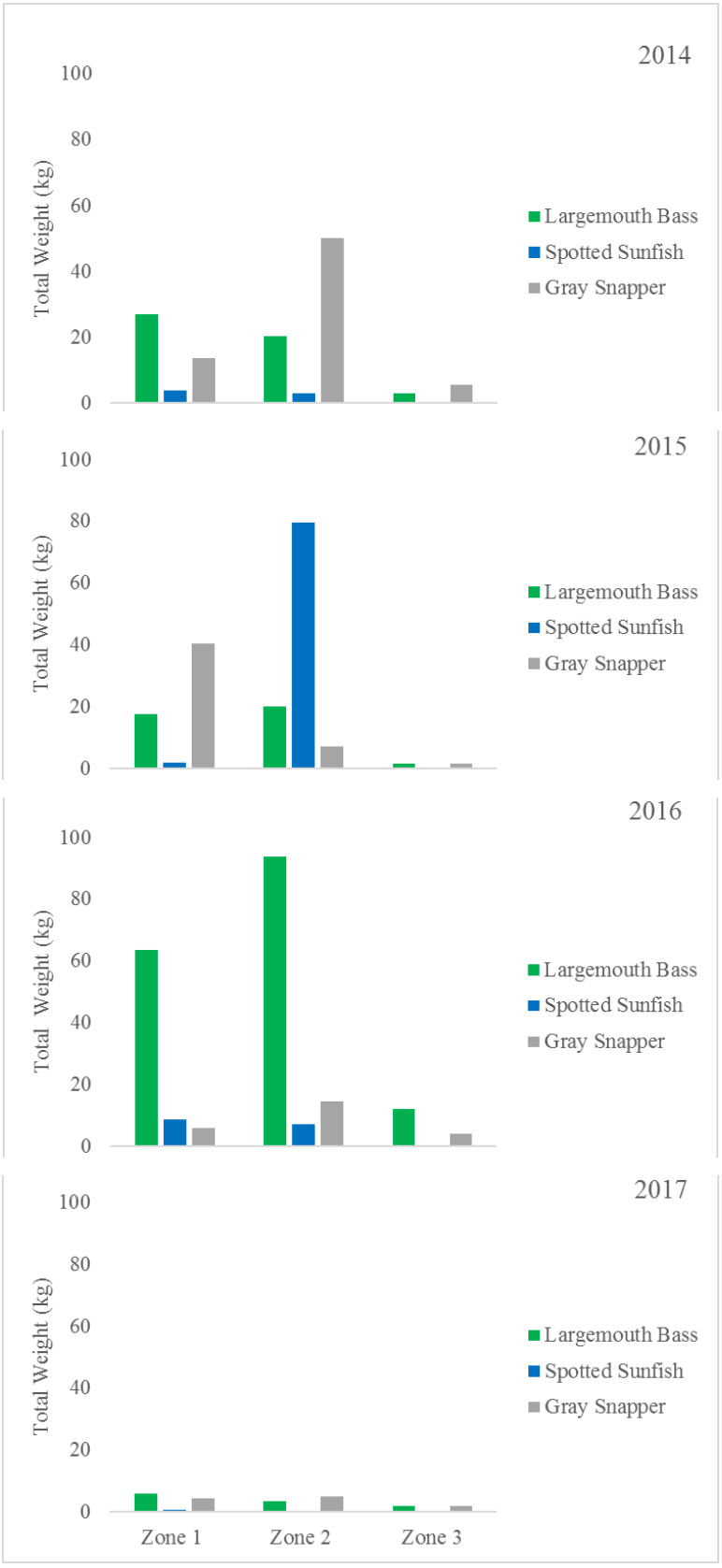


Figure 130. Biomass of the Chassahowitzka River System of Largemouth Bass, Spotted Sunfish and Gray Snapper by zone (2014-2017).

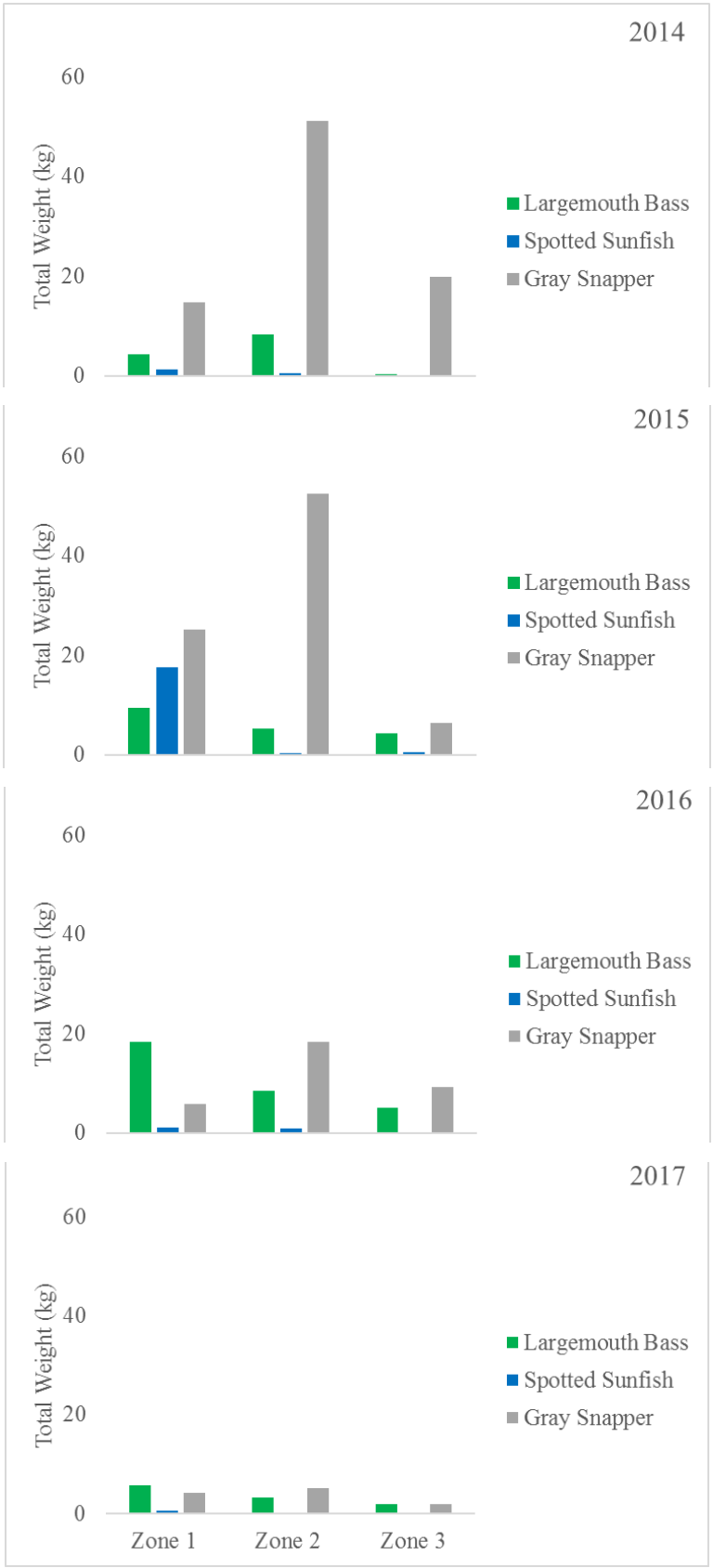


Figure 131. Biomass of the Homosassa River System of Largemouth Bass, Spotted Sunfish and Gray Snapper by zone (2014-2017).

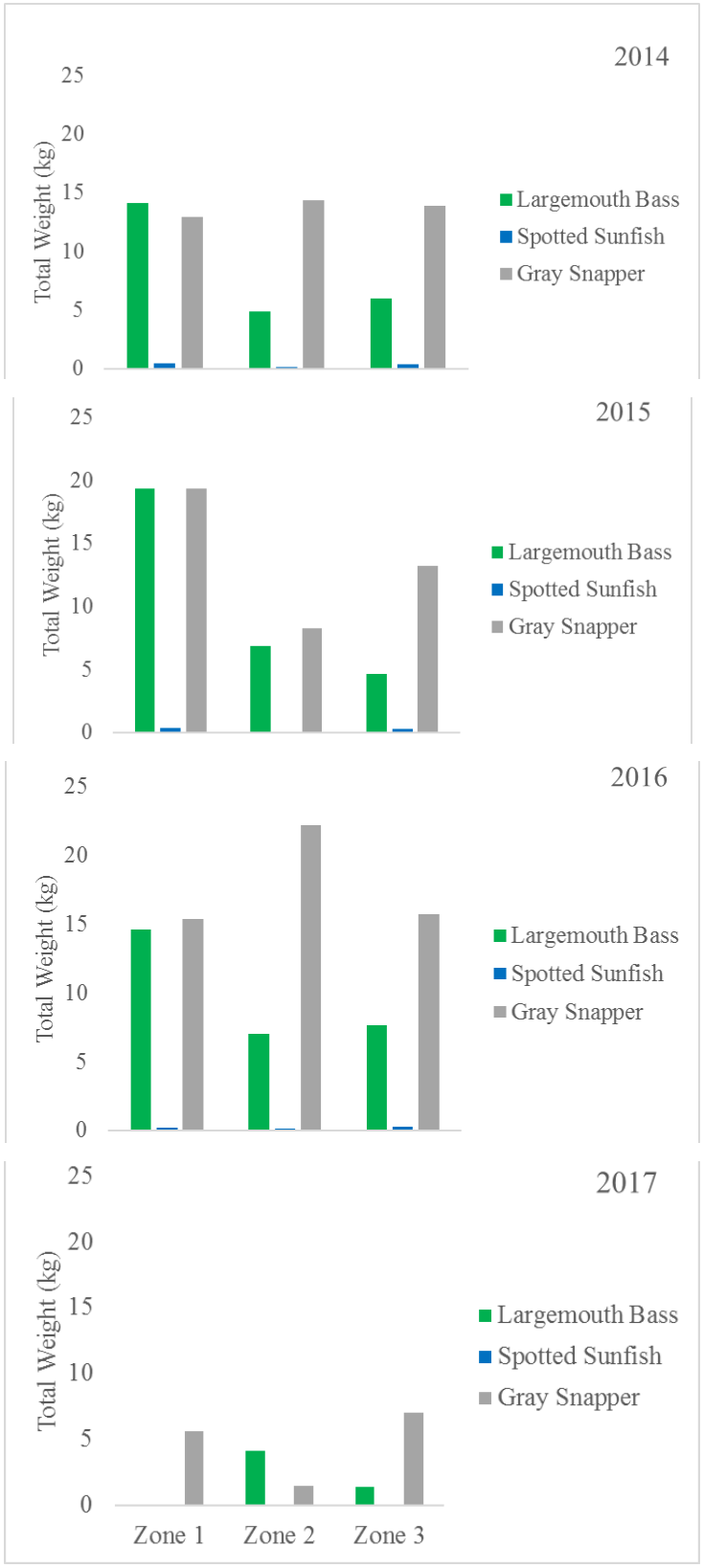


Figure 132. Biomass of the Crystal River/Kings Bay System of Largemouth Bass, Spotted Sunfish and Gray Snapper by zone (2014-2017).

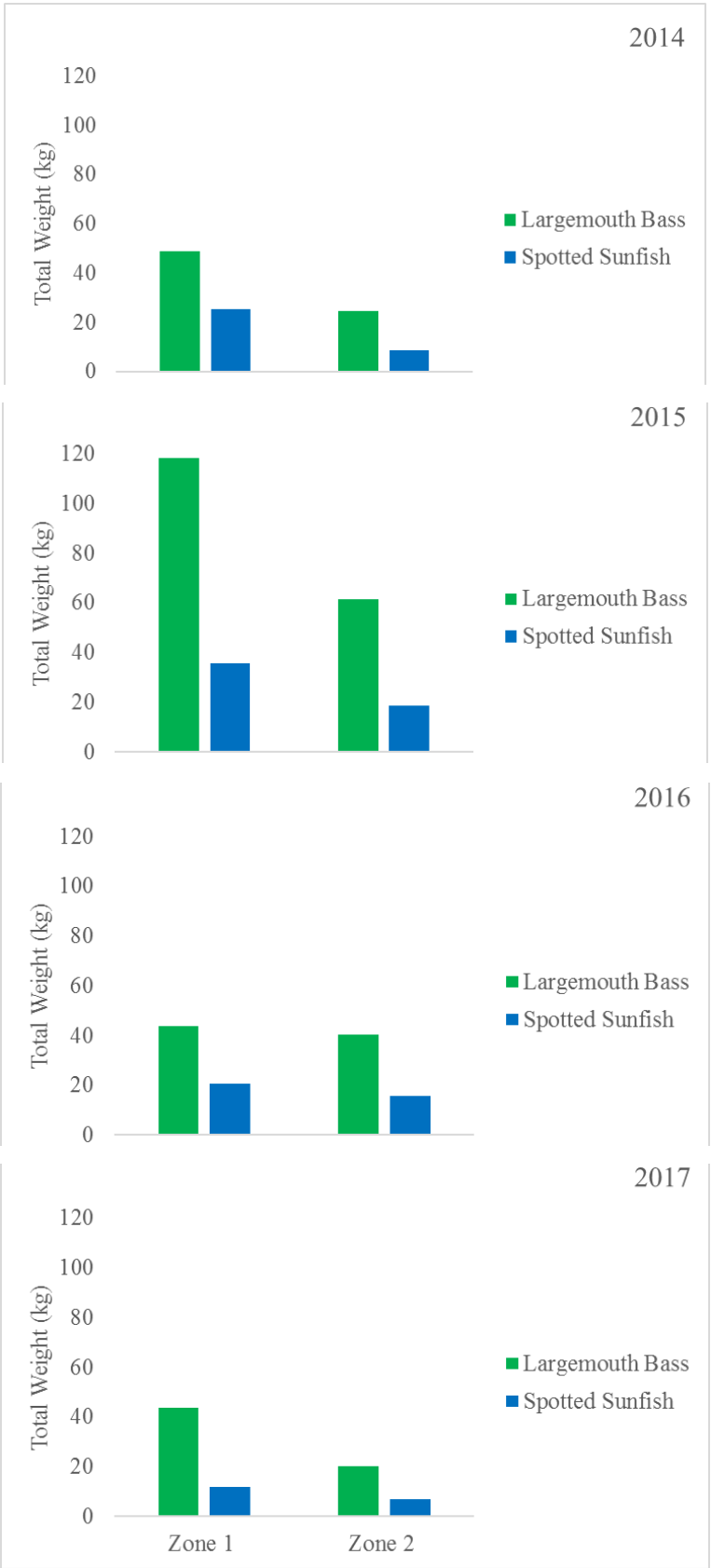


Figure 133. Biomass of the Rainbow River System of Largemouth Bass and Spotted Sunfish by zone (2014-2017).

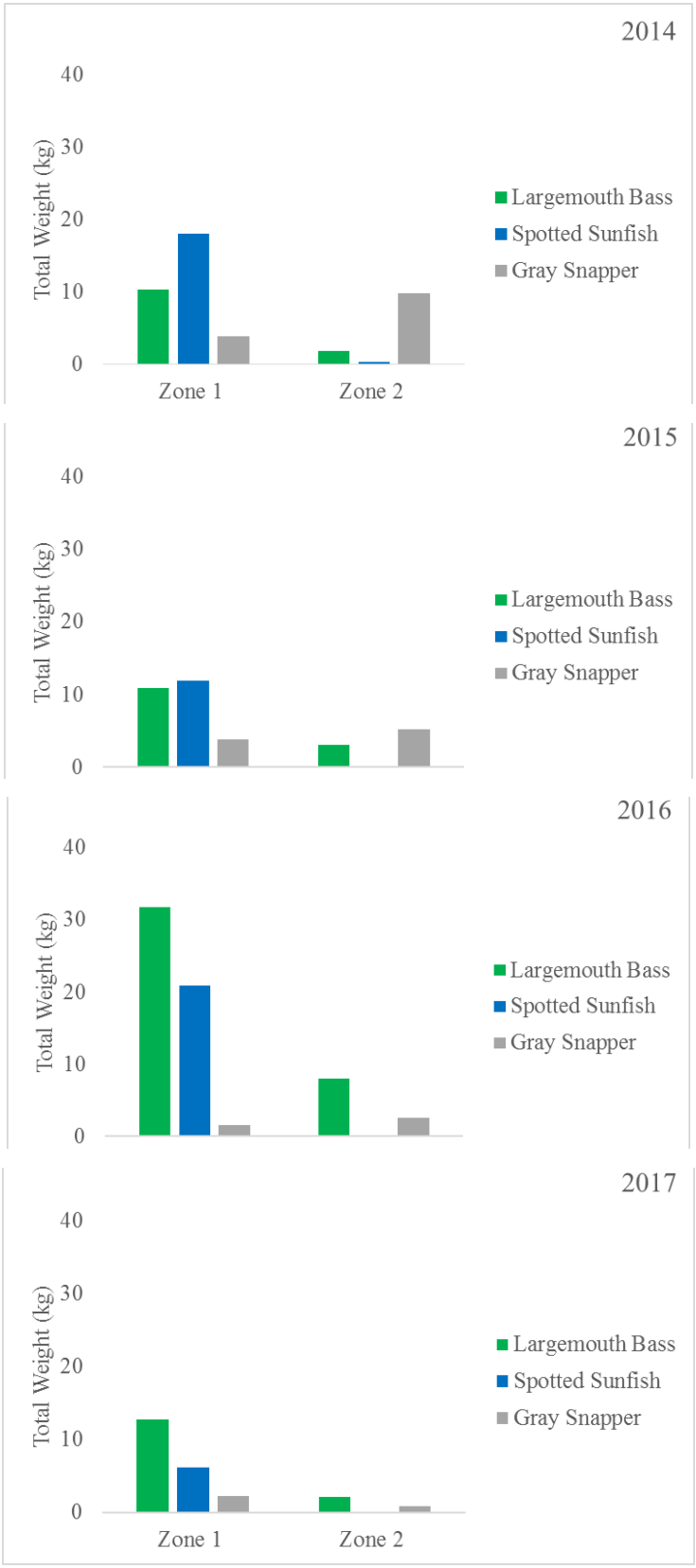


Figure 134. Biomass of the Weeki Wachee River System of Largemouth Bass, Spotted Sunfish and Gray Snapper by zone (2014-2017).

A

B

C

Figure 135. MDS scatter plots from the Chassahowitzka River System. A = Zone 1 ($R^2 = 0.71$), B = Zone 2 $R^2 = 0.63$, C = Zone 3 $R^2 = 0.41$ Note: av = Average.

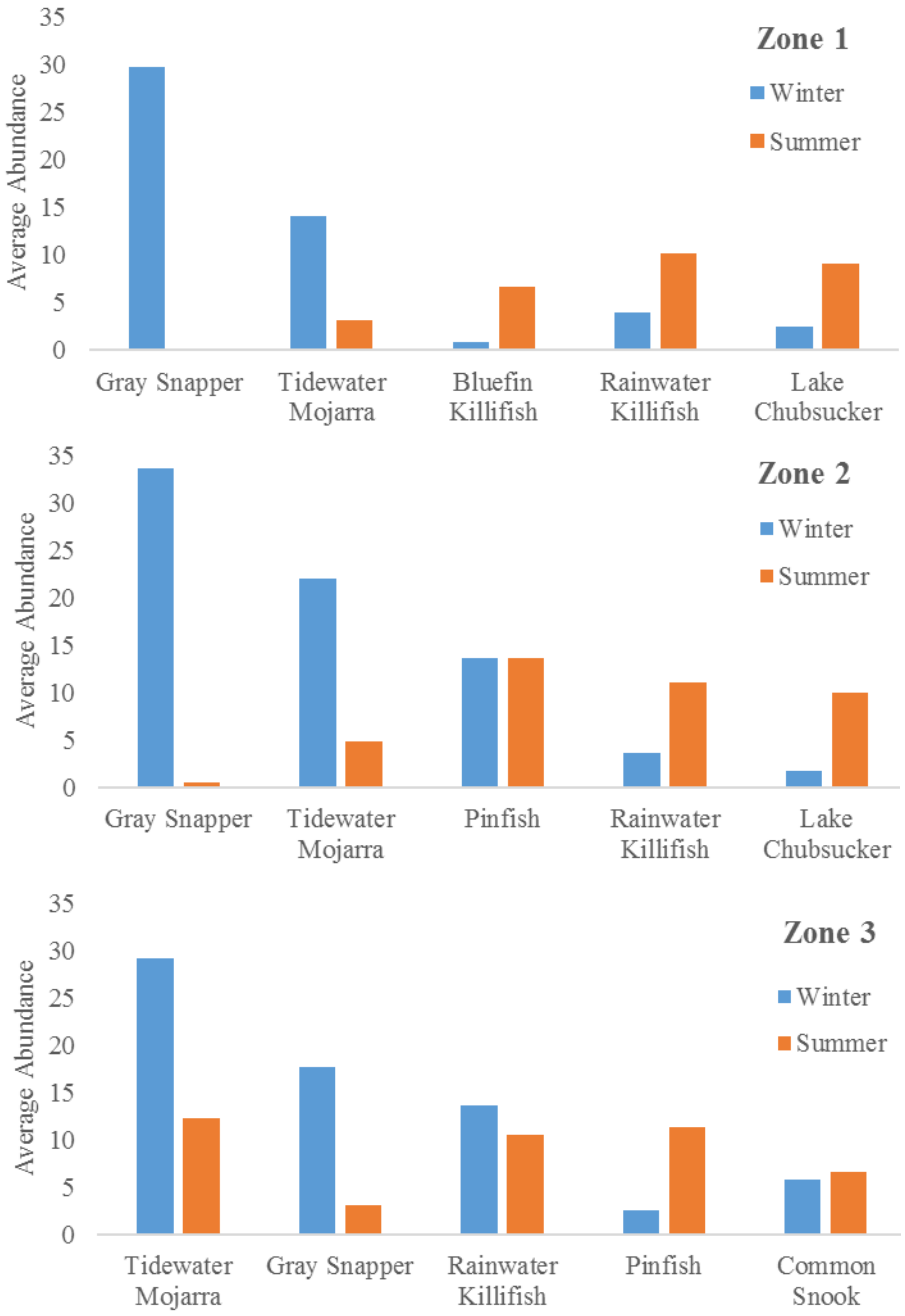
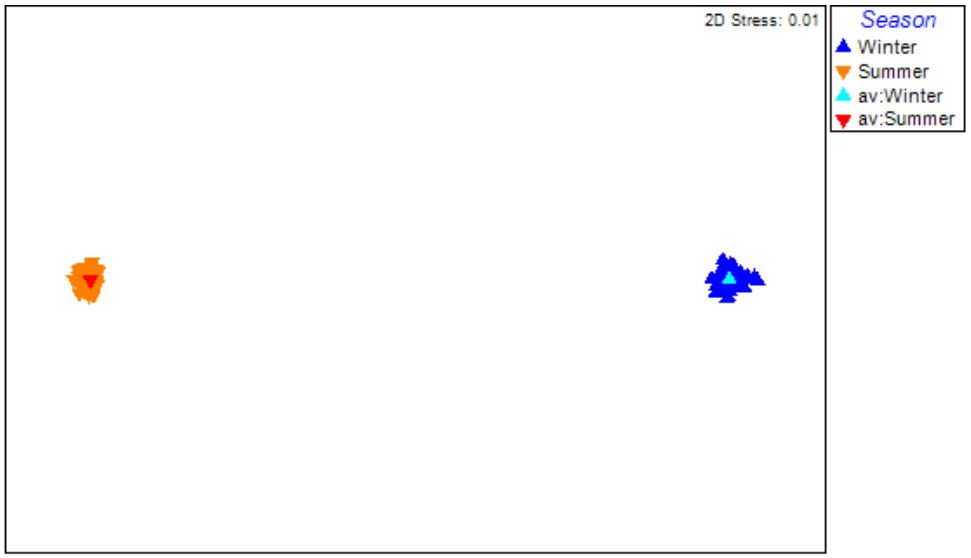
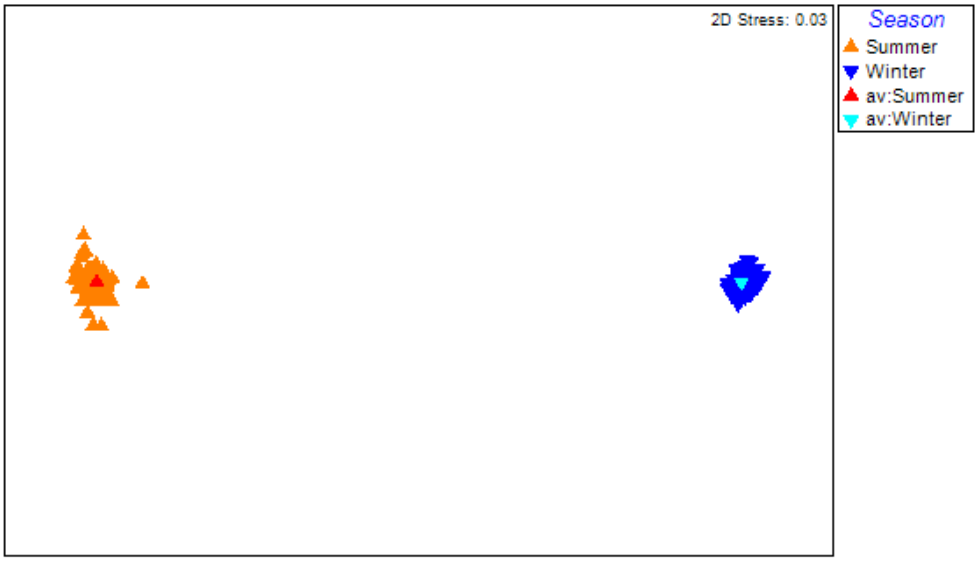


Figure 136. Average abundance of top five species that differed the most in the Chassahowitzka River System.



A

B



C

Figure 137. MDS scatter plots from the Homosassa River System. A = Zone 1 (R^2 = 0.33), B = Zone 2 (R^2 = 0.23), C = Zone 3 (R^2 = 0.15) Note: av = Average.

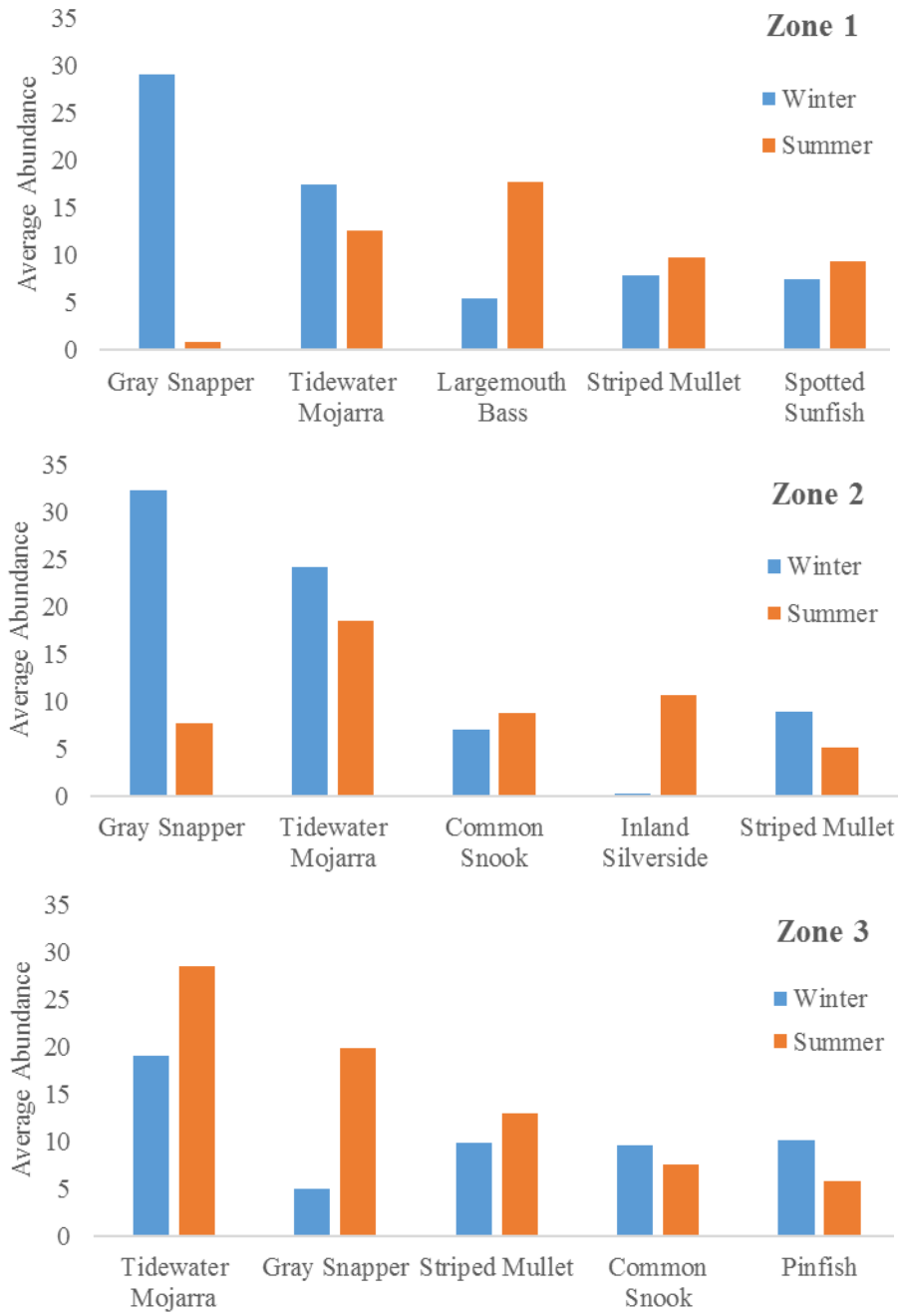


Figure 138. Average abundance of top five species that differed the most in the Homosassa River System.

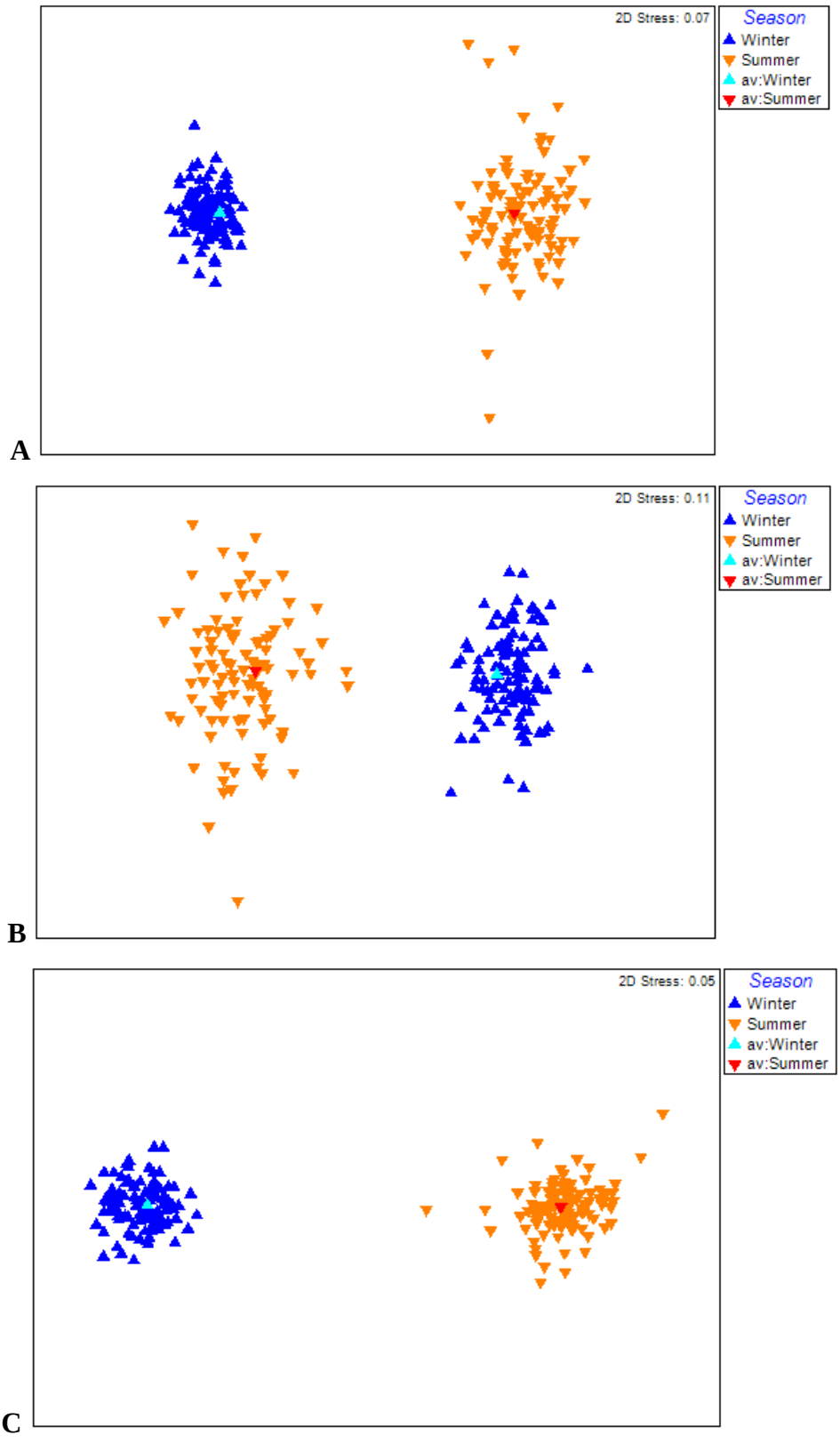


Figure 139. MDS scatter plots from the Crystal River/Kings Bay System. A = Zone 1 (R^2 = 0.15), B = Zone 2 (R^2 = 0.12), C = Zone 3 (R^2 = 0.18) Note: av = Average.

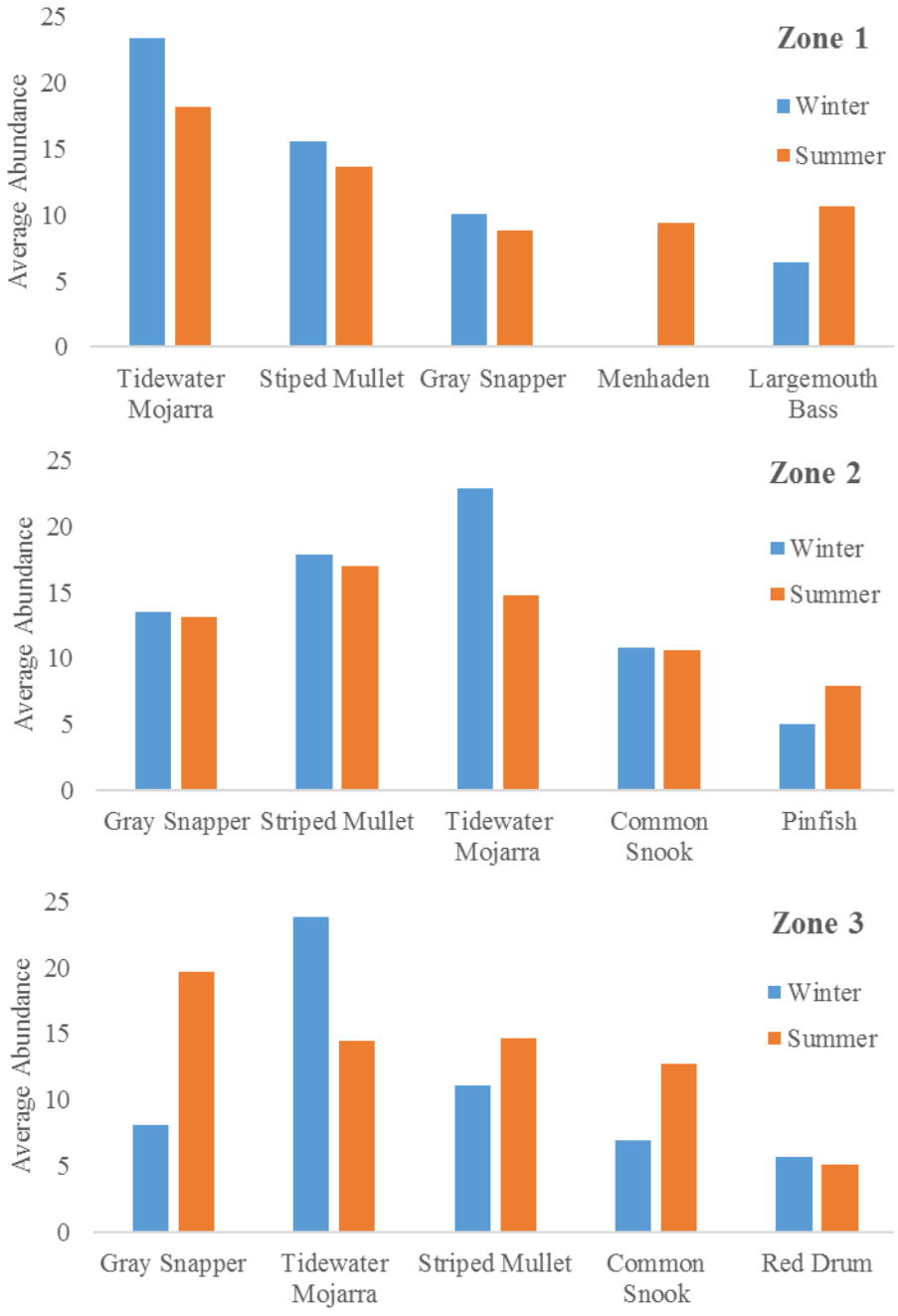


Figure 140. Average abundance of top five species that differed the most in the Crystal River/Kings Bay System.

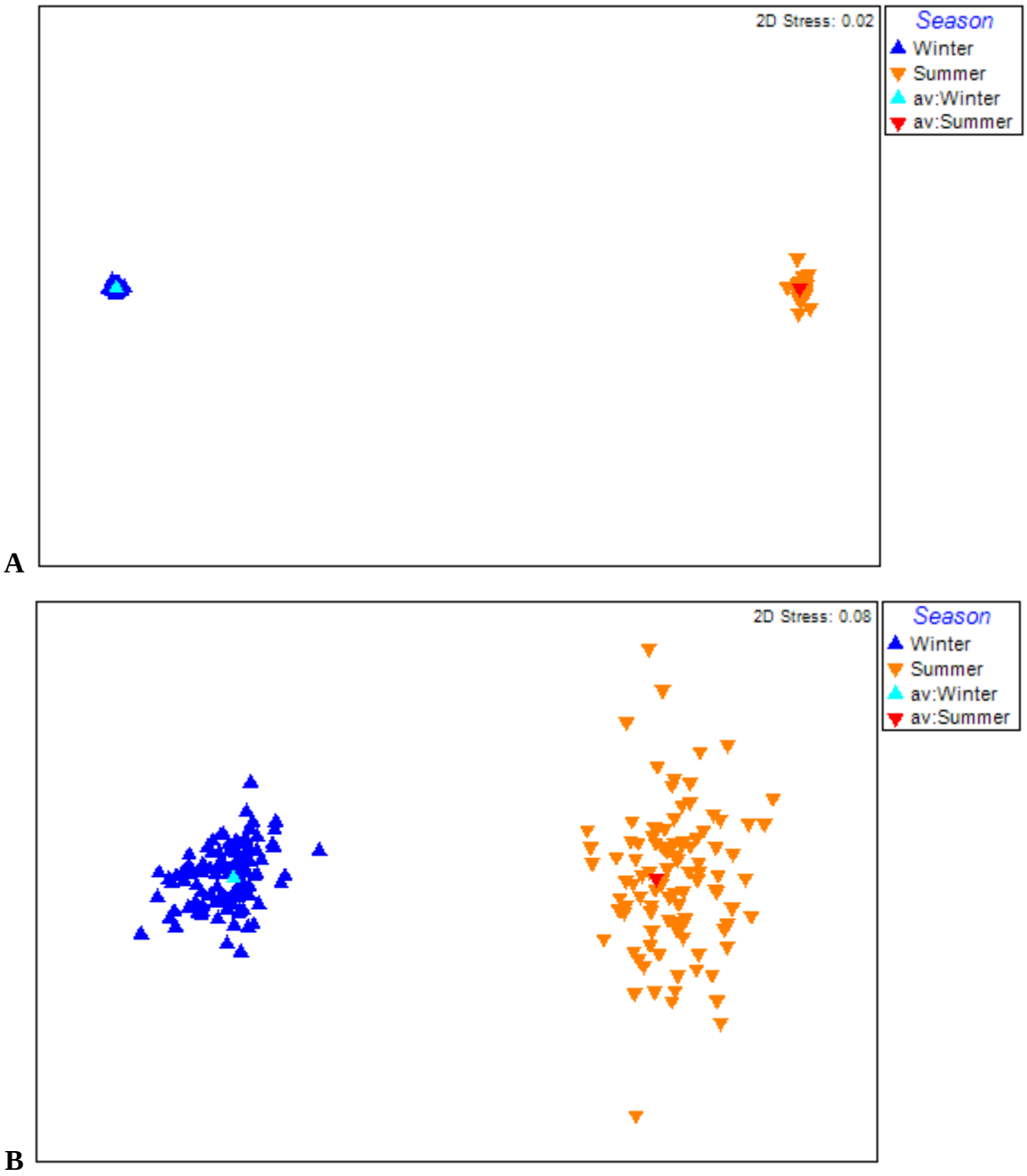


Figure 141. MDS scatter plots from the Weeki Wachee River System. A = Zone 1 ($R^2 = 0.09$), B = Zone 2 ($R^2 = 0.20$) Note: av = Average.

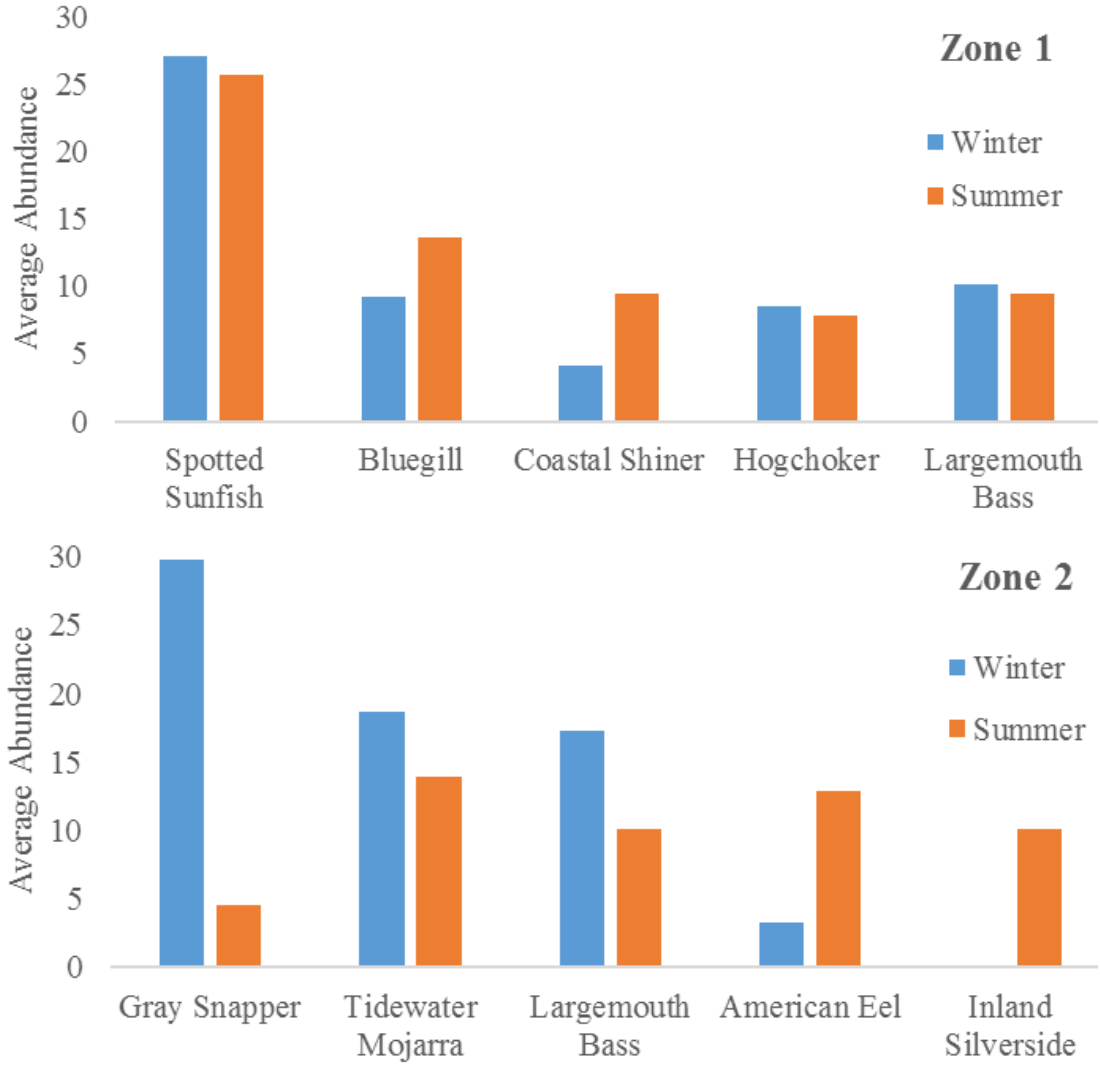


Figure 142. Average abundance of top five species that differed the most in the Weeki Wachee River System.