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Use of Shallow Estuarine Habitats by Nekton in the Mobile-Tensaw River Delta, Alabama

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ABSTRACT

We compared nekton density, composition, and biomass in fall 2009 and spring 2010 among three major habitat types (marsh, SAV=submerged aquatic vegetation dominated by *Vallisneria americana*, SNB=shallow nonvegetated bottom) commonly found throughout the Mobile-Tensaw River Delta (MTD) using 1-m^2 drop samplers. In the sampling design, habitat selection was based on vegetation composition. Sample locations (TR=Tensaw River, CB=Chocolatta Bay, and BC=Below Causeway) were selected based on their degree of tidal connectivity with the wider estuary (BC > TR > CB). Nekton distributional patterns varied among both locations and habitat types. Species richness was greater at BC than CB. The young of most estuarine-dependant fishery species (e.g., white shrimp, blue crab, gulf menhaden) were more abundant, and had more biomass, at BC and TR than CB. Estuarine residents (e.g., riverine grass shrimp, rainwater killifish) dominated the nekton in CB. Within locations, mean densities and biomass of abundant species were concentrated in vegetated (marsh, SAV) habitat types, and most species associated with vegetation structure were more abundant in SAV than marsh. Tidally unrestricted areas of the MTD may provide an important nursery for fishery species such as white shrimp, blue crab, gulf menhaden, and southern flounder. Additional studies will be needed to determine if these fishery species represent strong conduits for cross ecosystem transfer of energy and nutrients between the MTD and northern Gulf of Mexico.

INTRODUCTION

Although tidal freshwater and oligohaline communities of river deltas have been studied over the last 25 years, quantitative comparisons of nekton habitat use in river deltas are uncommon. Moreover, the results are often inconsistent. In their study of blue crab populations in Mobile Bay, Heck et al. (2001) did not recognize the Mobile-Tensaw River Delta (MTD) as a primary nursery area based on relatively low blue crab densities there. Blue crab juveniles, however, are seasonally abundant (17 m^{-2}) in submerged aquatic vegetation (SAV) within the Atchafalaya River Delta (Castellanos and Rozas 2001).

Other than along the lower Mobile River, much of the MTD is free of human development. The U.S. Highway 90 Causeway crossing the lower delta, however, restricts tidal exchange to some areas of the MTD (Figure 1). Restricting the hydrological link to the wider estuary (i.e., reducing tidal connectivity) can influence habitat use, particularly for transient species that must recruit to estuarine nursery areas from spawning sites in the Gulf of Mexico (Rogers et al. 1994). Tidal connectivity influences habitat use through its affect on habitat flooding patterns, nekton recruitment, and nekton settlement patterns (Rozas and Minello 1999).

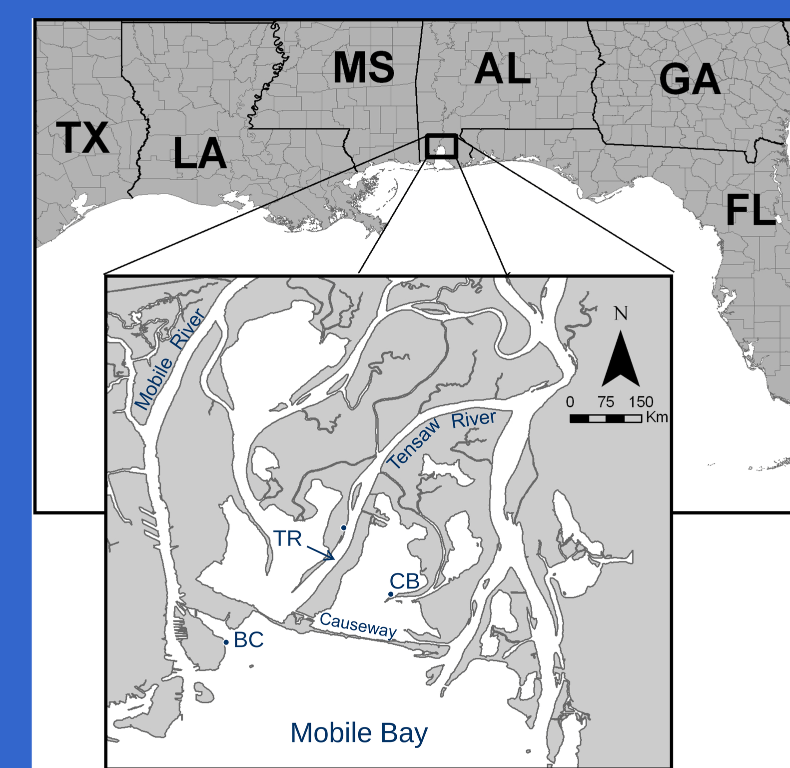
The objective of our study was to examine habitat-specific density and biomass patterns of juvenile fishery species and other nekton among three major habitat types (marsh, SAV, SNB) of the MTD. We also selected sample sites among three locations that varied in tidal connectivity to examine the effect of tidal connectivity on habitat use.

METHODS

At each location (Figure 1), we collected 8 nekton samples in each habitat type (marsh, SAV, SNB) using 1-m^2 drop samplers (Zimmerman et al. 1984). A total of 144 samples was collected during high tide at randomly selected sites over 2-3 days in fall (October 13-15) 2009 and spring (May 11-12) 2010. In the laboratory, animals were identified to lowest feasible taxon, enumerated, and measured (TL=total length for fishes and shrimps, CW=carapace width for crabs). Individuals of a species in each sample were pooled and weighed to determine wet weight (nearest 0.1 g).

A 2-way ANOVA was used test the null hypothesis that species richness, and density and biomass of individual species were similar among locations and habitat types (JMP, Version 9.0.0, SAS Institute, Inc., Cary, NC, 2010). Following a significant Location effect, comparisons among the three locations were made using Tukey's HSD post-hoc tests. We used *a priori* contrasts to compare marsh vs. SAV and the vegetated habitat types combined vs. SNB sites when the Habitat effect was significant.

Figure 1. Map showing the study area within the Mobile-Tensaw River Delta and its location in the northern Gulf of Mexico. Nekton sample locations are labeled as TR=Tensaw River, CB=Chocolatta Bay, and BC=Below (U.S. Highway 90) Causeway.



RESULTS

We collected totals of 2,431 individuals, 11 species, and 0.9 kg total biomass of crustaceans and 10,032 individuals, 40 species, and 2.1 kg total biomass of fishes during our study (Table 1). Daggerblade grass shrimp, blue crab, riverine grass shrimp, estuarine mud crab, marsh grass shrimp, and white shrimp were the most abundant crustaceans and contributed most of the crustacean biomass. Gulf menhaden, rainwater killifish, darter goby, naked goby, bay anchovy, gulf pipefish, and freshwater goby were the most abundant fishes identified from our samples. Most of the fish biomass in our samples was from gulf menhaden, redspotted/spotted sunfish, southern flounder (8 individuals), redear sunfish, sheepshead (2 individuals), rainwater killifish, and freshwater goby.

Table 1. List of most abundant species collected in fall (October 2009) and spring (May 2010) within the Mobile-Tensas River Delta. Species are grouped by major taxonic categories (decapod crustaceans, fishes) and listed in descending order of abundance. Life history strategy, total number, and total biomass are given for each species. Life history strategies are: T (transient) = use estuary primarily as young, R (resident) = use estuary in all life stages, C (catadromous) = use estuary primarily as corridor between marine spawning area and riverine nursery area, F (freshwater) = distribution primarily in freshwater environments.

Species	Common Name	Life History Strategy	Total Number	Total Biomass (g)	Relative Abundance (%)	Relative Biomass (%)
Crustaceans			2431	932.4		
Palaemonetes pugio	daggerblade grass shrimp	R	715	73.8	29.4%	7.9%
Callinectes sapidus	blue crab	T	476	719.6	19.6%	77.2%
Palaemonetes paludosus	riverine grass shrimp	R	260	30.5	10.7%	3.3%
Rhithropanopeus harrisii	estuarine mud crab	R	185	29.3	7.6%	3.1%
Palaemonetes vulgaris	marsh grass shrimp	R	176	15.7	7.2%	1.7%
Litopenaeus setiferus @	white shrimp	T	174	24.7	7.2%	2.6%
Fishes			10032	2099.1		
Brevoortia patronus *	gulf menhaden	T	8963	1309.6	89.3%	62.4%
Lucania parva	rainwater killifish	R	244	48.6	2.4%	2.3%
Ctenogobius boleosoma	darter goby	R	136	23.1	1.4%	1.1%
Gobiosoma bosc @	naked goby	R	130	20.6	1.3%	1.0%
Anchoa mitchilli	bay anchovy	T	92	18.9	0.9%	0.9%
Syngnathus scovelli	gulf pipefish	R	88	17.6	0.9%	0.8%
Ctenogobius shufeldti	freshwater goby	R	65	46.8	0.6%	2.2%
Microgobius gulosus	clown goby	R	56	15.2	0.6%	0.7%

* collected only in spring
@ collected only in fall

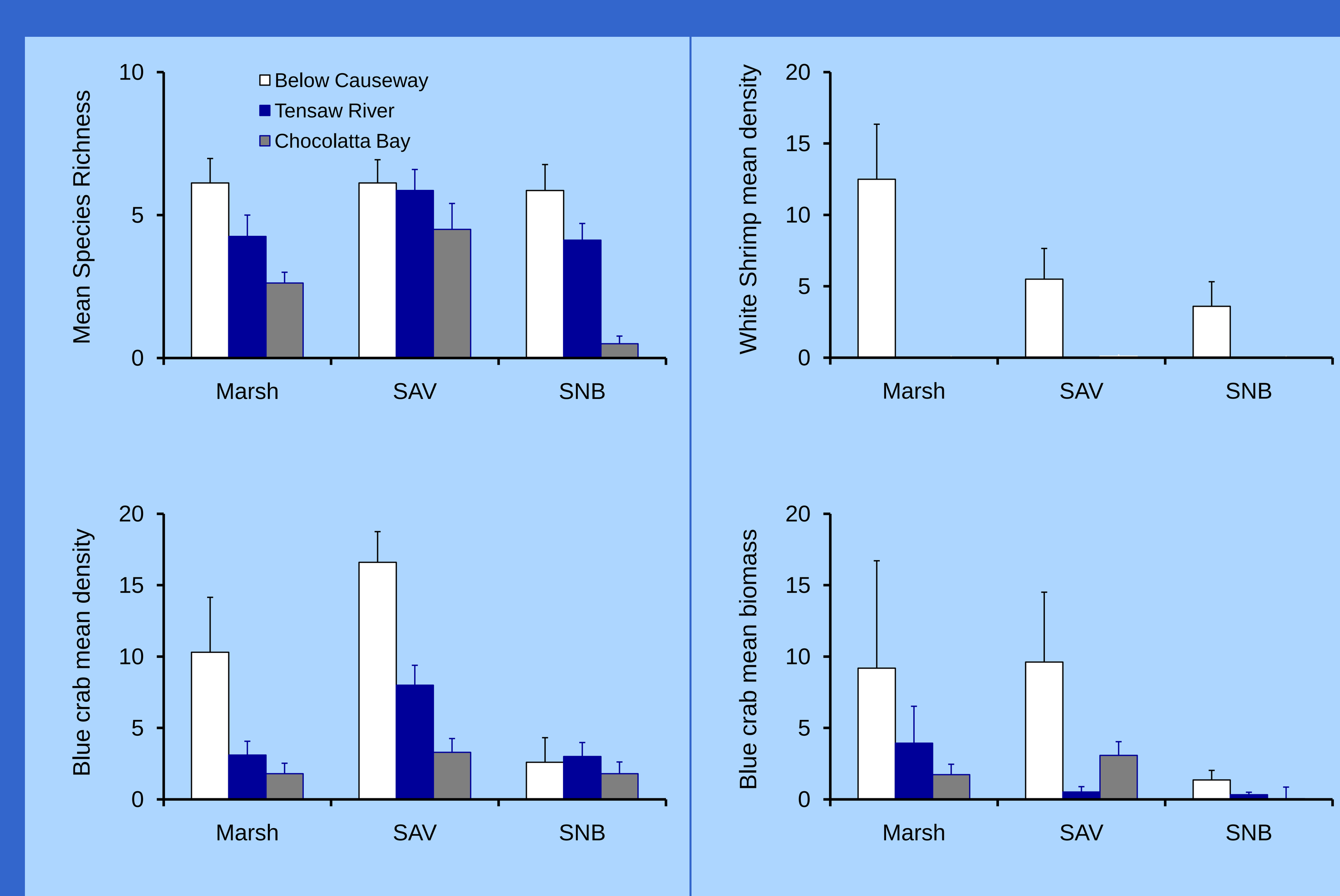


Figure 2. Comparison of species richness (spring), white shrimp and blue crab densities in fall, and blue crab biomass in spring among locations and habitat types (marsh, SAV=submerged aquatic vegetation, SNB=shallow nonvegetated bottom). Each mean and SE was calculated from 8 samples (except in fall: Tensaw River: SNB=7 and in spring: Tensaw River: SAV=7 and Below Causeway: SNB=7).

Patterns of nekton distribution (number and biomass) varied both among locations and habitat types. Species richness was significantly greater at BC than CB in fall and greater at both BC and TR than CB in spring (Figure 2). In fall, white shrimp and blue crab were most abundant at BC (Figure 2). White shrimp biomass was greatest at BC, and more blue crab (spring) biomass occurred at BC than TR. In spring, gulf menhaden occurred most abundantly at TR (Figure 3). Species most abundant at CB included riverine grass shrimp and rainwater killifish (Figure 3).

Densities of the most abundant taxa (e.g., white shrimp, blue crab, rainwater killifish) were concentrated in SAV beds and emergent vegetation (Figures 2 and 3). Of these species associated with vegetation structure, most also had higher densities in SAV than marsh. Densities and biomass of most species were relatively low over SNB, and no species was more abundant at SNB than vegetated sites. Spot was the only species that had more biomass over SNB than at vegetated sites.

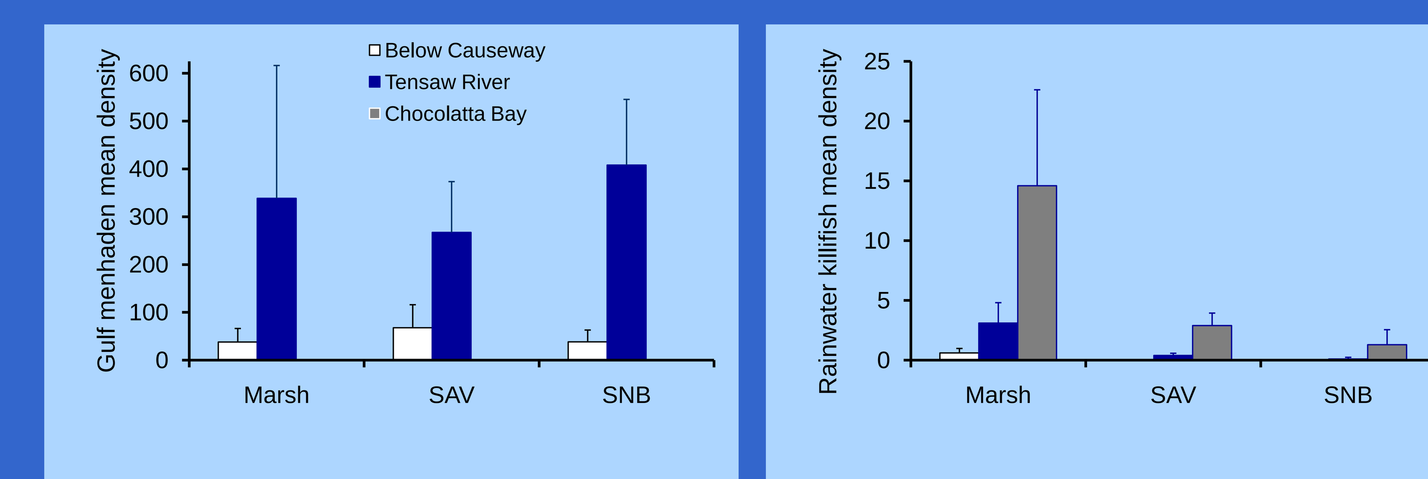


Figure 3. Comparison of gulf menhaden (spring) and rainwater killifish (fall) densities among locations and habitat types (marsh, SAV=submerged aquatic vegetation, SNB=shallow nonvegetated bottom). Each mean and SE was calculated from 8 samples (except in fall: Tensaw River: SNB=7 and in spring: Tensaw River: SAV=7 and Below Causeway: SNB=7).

CONCLUSIONS

1. Although freshwater conditions (salinity $\leq$ 1) prevailed during both sampling periods, populations of fishery species (e.g., gulf menhaden, white shrimp, blue crab) were relatively high at tidally unrestricted locations (BC and TR).
2. Populations of fishery species at CB were low or absent, likely because the U.S. Highway 90 Causeway restricts the access of young recruits to the area.
3. Most species of nekton within the MTD are concentrated in flooded vegetation, and most of those species associated with vegetation appear to select SAV over marsh.
4. The MTD may provide important nursery habitat for gulf menhaden, white shrimp, blue crab, and southern flounder.
5. Additional studies will be needed to determine whether these fishery species represent strong conduits for cross ecosystem transfer of energy and nutrients between the MTD and northern Gulf of Mexico.

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