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Determining Nursery Areas for Red Drum, *Sciaenops ocellatus*, in Florida Bay
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Allyn B. Powell, Michael Lacroix and Robin Cheshire
NOAA Beaufort Laboratory
Beaufort, NC 28516

Introduction

The red drum is one of the most popular species sought by anglers in Florida Bay (Schmidt et al. 1999), yet nursery areas for red drum residing in Florida Bay are unknown. Red drum spawn in coastal Gulf of Mexico waters in close proximity to Florida Bay and adjacent estuaries waters (Collins and Finucane 1984), and their spawning period is contracted (mid-September until mid-February with a peak in October) (Jannke 1971). Jannke sampled at one station in Everglades National Park (near the mouth of Little Shark River), and collected relatively large numbers of larval red drum entering the Little Shark River. It appears then that the Shark River system could be a nursery area for juvenile red drum, but these juvenile nursery areas have not been documented.

Postsettlement stage red drum utilize seagrass beds in Texas (Holt et al. 1983; Rooker and Holt 1997; Rooker et al. 1998), and this could be the case in Everglades National Park. Red drum in Texas, at sizes between 4 and 30 mm SL, mainly utilize *Halodule wrightii* beds. Nursery habitats for drum > approximately 40 mm SL were not determined in those studies. Studies in Tampa Bay identified the nursery habitats for red drum < approximately 50 mm SL (Peters and McMichael 1987). Red drum spawn near the mouth of Tampa Bay and settle out along the shore of the bay, move to backwaters then eventually disperse throughout the bay. These backwaters that supported the majority of juvenile red drum were located in a river at the head of the bay, in low energy environments, salinities averaging 7 ppt (range = 0-25 ppt), mud and sand/mud

bottoms and turbid waters. Ninety-eight percent of all the juveniles (8-300 mm SL) were collected (n = 7,536) in these backwater areas.

Juvenile red drum are rarely encountered in Florida Bay. The most notable collection (n = 10; size = 25-49 mm SL: salinity = 6ppt) was made at East Creek, Little Madeira Bay (Colvocoresses[1]) (Figure 1). In November, 1999, we collected red drum (5.2-10.8 mm SL) in Florida Bay at Johnson Key Basin (n = 18), Bradley Key (n = 6) and Whipray Basin (n = 1) using a bottom sled (1.0 x 0.5 m with 0.947 mesh). This was the first time we fished the sled when recently-settled late stage larvae and early stage juveniles would be available. To the best of our knowledge this is the first time recently-settled red drum have been collected in Florida Bay. Whether this is a sporadic or systematic event was one of the objectives of this study. The other objective was to sample backwaters of Florida Bay to determine if these low energy habitats are nursery areas for juvenile red drum.

Methods

Sampling was conducted monthly from November 2000 through February 2001. In November we sampled six sites (Table 1; Fig. 1) with an 1.0 m x 0.5 m epibenthic sled with 0.947 mm mesh for recently settled red drum. An additional epibenthic sled site (Bradley Key) was added from December through February. Because of tidal conditions we were unable to sample McCormick Creek (head of Terrapin Bay) from December through February. This station was moved to the mouth of Terrapin Bay, adjacent to Crocodile Point, during this period. A

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[1]Colvocoresses, James A. unpublished data (1995). Florida Marine Research Institute 2796 Overseas Highway, Marathon, FL 33050.

flowmeter was inserted in the frame of the sled to estimate the volume of water sampled. Replicate tows were taken at each station along with measures of water clarity (secchi disk), water depth, salinity, temperature, and sediment depth. Three $0.008m^2$ cores were taken along a transect adjacent to the towed area for seagrass short-shoot densities, seagrass composition, seagrass blade length, and seagrass standing crop. Fish were preserved in formalin and, in the laboratory, stored in alcohol.

In November, we surveyed potential sites to sample juvenile red drum. Our intention was to use a beach seine at as many sites as possible. However, because of deep sediments or narrow mangrove lined creeks, with few exceptions, cast nets could only be used. A total of 202 sites were sampled with a cast net (6.4mm square mesh) mainly in backwater areas from December through February to collect juvenile red drum (Fig. 2). Fewer sites were sampled in Florida Bay open waters for comparative purposes. In general, a six foot net was used, but at some sites where space was limited we used a five foot net. At each site three cast net samples were taken and fish were combined into one sample. Species and numbers were recorded and fishes released. Beach seine (12.2m x 1.2m x 1.6 mm mesh or 30.5m x 2.4m x 6.4mm square mesh) sites were sampled in December and February at Davis Cove, Deer Key, and the mouth of East Creek in Little Madeira Bay (Fig.3). The smaller seine was used only at East Creek. The latter site was the same site red drum juveniles had previously been collected (see above). Species were recorded and fishes released. Species were not counted as fish composition mirrored that of the cast nets. We did not analyze the limited beach seine collections. We used non-parametric Kruskal - Wallis tests with $\alpha = 0.10$ (Sokal and Rohlf 1981) and relied on Wilcoxon mean scores to infer patterns and trends in densities among stations and time periods.

Results and Discussion

Red Drum

We collected only one recently settled red drum (Johnson Key Basin; 7.2mm SL) with the epibenthic sled and no juvenile red drum with the other gear. This strongly suggested that recently settled red drum occur only sporadically, and Florida Bay and adjacent waters, we sampled, are not nursery areas for juvenile red drum. Given the reported red drum spawning area (Jannke 1971; Collins and Finucane 1984) and prevailing currents (Lee et al. 1999), it is puzzling that late stage larvae or early stage juveniles are not collected regularly in western Florida Bay. Collins and Finucane's collections of red drum larvae in coastal waters, and Jannke's collection of numerous red drum larvae at the entrance of Little Shark River indicates spawning in coastal waters, and some larvae do enter the Shark River system. Lee et al.'s observations of surface drifters deployed near the Shark River indicate that currents move southerly, and move through western Florida Bay toward the Florida Keys reef tract through Long Key Channel. Hence, the transport mechanism appears to be available for recruitment into the western portion of the bay.

We made a considerable number of cast net collections in mesohaline waters (Fig. 4) where red drum are commonly collected (Peters and McMichael 1987). However, the vast majority of these collections were in the Eastern Subdivision, a considerable distance from red drum spawning areas. Hence, recruitment limitations might be a major factor in the absence of red drum from these mesohaline waters.

Epi-benthic Sled Collections

Epi-benthic sled collections were made at stations that represented diverse habitat types (Tables 1 and 2). Johnson Key Basin had lush, mixed seagrass beds, and all seagrass species had

long blade lengths. As a result, this station had the largest seagrass standing crop (Table 2). Crocodile Point, which had the second largest seagrass standing crop, had the greatest densities of *Thalassia* short shoots (approximately seven times greater than Johnson Key Basin), but blade lengths were the shortest observed, resulting in a standing crop of *Thalassia* that was only similar to Johnson Key Basin. Similarly, East Creek had the highest densities of *Halodule* short shoots (approximately three times greater than observed at Johnson Key Basin), but blade length was the shortest observed for that species, resulting in a standing crop of *Halodule* that was one-half that observed at Johnson Key Basin. Low standing crops of seagrasses were observed at three stations (Bradley Key, McCormick Creek, and Roscoe Key) located in separate subdivisions (Table 2, Fig. 3).

Temperature and salinity patterns were similar among stations (Table1). Salinities were relatively low in January and February, while temperatures were relatively low in December and January. There were no significant differences in densities of the more commonly collected taxa (Fig. 5) among months despite differences in temperature and salinity (Table 1).

It appeared that the bay anchovy, *Anchoa mitchilli*, dominated epibenthic sled collections (Table 3), but densities are biased by one collection (508 bay anchovy 100 m^{-3}) that was made at McCormick Creek (north of Crocodile Point) in November. Differences in densities of bay anchovy among stations were significant (Table 4). Highest densitiy and Wilcoxon mean score was observed at Roscoe Key. Densities at McCormiickCreek/Crocodile Point were biased by one collection (see above) and this is reflected in the relatively low Wilcoxon mean score (Table 4). Bay anchovy were never collected at Johnson Key Basin (Fig. 5). Five other small resident species were among the dominant species and their densities were significantly different among

stations. Rainwater killifish, *Lucania parva*, was collected at high densities at Johnson Key Basin, but rare to absent at all other stations. Dusky pipefish, *Syngnathus floridae*, overall, was not collected in great densities, but was more commonly collected at Johnson Key Basin and Bradley Key. Pigmy pipefish, *Hippocampus zosterae*, were collected mainly at Bradley Key, and absent to rare in collections at Middle Ground, McCormick Creek/Crocodile Point, and East Creek. The clown goby, *Microgobius gulosus*, had the most restricted distribution. It was absent at four stations, rarely collected at two others and only was commonly collected at East Creek (Table 4, Fig. 5). Three species that spawn outside Florida Bay in Gulf of Mexico waters (Jannke 1971; Collins and Finucane 1984) were among the most commonly collected taxa. Pinfish, *Lagodon rhomboides*, pigfish, *Orthopritis chrysoptera*, and silver perch, *Bairdiella chrysoura*, exhibited similar patterns of distribution, in that they were collected at stations in close proximity to their spawning area (Fig. 5).

Cast Net Collections

Twenty-seven species were collected with the cast net (Table 5). Of the 202 stations sampled, 47 (23%) had no catches. The hardhead silversides, *Atherinomorus stipes*, was the dominant species collected, but occurred at only 12% of the sites sampled that had positive catches. Bay anchovy, spotfin mojarra (*Eucinostomus argenteus)*, silver jenny (*E. gula*), and goldspotted killifish (*Floridichthys carpio*) were among the most commonly collected species that occurred at relatively high frequencies (Table 5).

The least number of species occurred in oligohaline waters, the greatest in mesohaline waters (Table 6). Densities of five commonly collected species (Table 5; ≥100 total number collected) were significantly different among salinity regimes (Table 6). Although the hardhead

silverside appeared to be most abundant in mesohaline waters (Table 6), it's low frequency of occurrence (Table5) and Wilcoxon mean score (Table 7) indicated that this species had a restricted, contagious distribution. The bay anchovy was most abundant in polyhaline and euhaline waters; tidewater silversides, *Menidia peninsulae*, in polyhaline waters; and goldspotted killifish in mesohaline to euhaline waters. The two species of *Eucinostomus* appeared sympatric in their distribution with the spotfin mojarra occurring in more brackish waters than its congenera, the silver jenny (Table 6 and 7).

Densities of only one of the more commonly occurring species was significantly different among subdivisions, within the Central, Eastern and Gulf Transition Subdivisions (Tables 8 and 9). The silver jenny was not abundant in the Gulf Transition Subdivision, and although densities appeared relatively high in the Eastern Subdivision, Wilcoxon mean scores were similar to those observed for the Gulf Transition Subdivision, hence this species appeared to be more abundant in Central Subdivision waters. We observed very high densities of hardhead silversides in the Eastern Subdivision, but the majority of these fish ($n = 438$) were collected at one site (Deer Key).

In the Norther Transition Subdivision, densities of five of the more commonly occurring species were significantly different among sites (Tables 10 and 11). The hardhead silversides was collected at only three sites and appeared to be abundant at Trout Cove and Madeira Bay. The spotfin mojarra was most abundant at Joe Bay, while its congenera (silver jenny) was most commonly collected at Little Madeira Bay, Trout Cove and Mud Creek. The goldspotted killifish was commonly collected at Rankin Bight, and the sailfin molly, which appeared to be most abundant at Long Sound (Table 10), had the highest Wilcoxon mean score at Snake Bight Canal

(Table 11).

In conclusion, Florida Bay and adjacent waters we sampled are not nursery areas for juvenile red drum, and recruitment could be a major factor in inhibiting red drum juveniles from using mesohaline waters in the northeastern portion of Florida Bay. Future investigations to examine nursery areas for this valuable species should concentrate on mesohaline waters of the Shark River system where large numbers of larvae have been collected (Jannke 1971).

Although the red drum results are negative, we were able to: (1) identify mesohaline waters from our cast net sites to test our preliminary assessment that mesohaline habitat might be limited in Florida Bay, (2) document the distribution and abundance of fishes collected by cast net that should enhance our understanding of ichthyofauna in the Northern Subdivision and adjacent waters, and (3) from epibenthic sled collections, describe the habitats (temperature; salinity; water depth; sediment depth; seagrass composition, density and standing crop), abundance and distribution of recently settled larvae/small juveniles/small resident fishes during late fall and winter along an east west transect. This information should be useful to managers and future research.

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Table 1. Summary of epibenthic sled station data.

Station	Month	Salinity ‰	Temperature °C	Sediment depth (m)	Water depth (m)
Middle Ground	Nov	36	25	1.4	1.5
	Dec	35	20	2.3	0.8
	Jan	26	16	2.0	1.7
	Feb	28	26	2.2	0.9
Johnson Key Basin	Nov	37	25	2.1	1.1
	Dec	36	20	1.9	0.7
	Jan	26	17	1.3	1.4
	Feb	29	26	1.4	1.1
Snake Bight	Nov	37	25	1.5	1.0
	Dec	36	20	1.8	0.6
	Jan	27	16	1.6	0.8
	Feb	31	25	0.8	1.4
Roscoe Key	Nov	38	26	0.9	1.3
	Dec	37	22	0.9	1.1
	Jan	30	15	1.0	1.0
	Feb	30	25	1.0	0.9
McCormick Creek	Nov	27	26	1.3	1.3
Crocodile Point	Dec	36	21	1.0	1.0
	Jan	28	14	0.5	0.5
	Feb	27	22	0.3	0.3
East Creek	Nov	18	26	0.5	0.5
	Dec	14	21	1.0	1.0
	Jan	5	17	0.5	0.5
	Feb	8	25	0.7	0.7
Bradley Key	Dec	36	23	1.9	0.7
	Jan	28	16	1.5	1.2
	Feb	30	26	1.9	1.0

Table 2. Summary of seagrass data at epibenthic sled stations. HW=*Halodule wrightii*; RM=*Ruppia maritima*; SF=*Syringodium filiforme*; TT=*Thalassia testudinum*. Values are averaged across months. McCormick Creek was only sampled in November

Station	Species	Short shoots (no. m^{-2})	Blade length (mm)	Standing crop (g dry weight m^{-2})
Middle Ground	HW	157	102	2
	SF	24	158	1
	TT	105	181	18
Johnson Key Basin	HW	251	190	6
	SF	253	260	19
	TT	58	367	26
Snake Bight	HW	604	113	7
	TT	16	300	5
Roscoe Key	HW	139	108	2
	TT	58	143	7
McCormick Creek	HW	500	80	4
	RM	125	39	<1
Crocodile Point	TT	403	111	26
East Creek	HW	760	50	3
	RM	188	47	<1
	TT	170	119	11
Bradley Key	SF	238	172	8

Table 3. List of species collected at seven epibenthic sled sites in Florida Bay. Density (numbers 100 m^{-3}) is the mean density averaged over all stations and cruises. Species are listed in descending order of mean density.

Species	Mean density
Anchoa mitchilli	23.15
Lucania parva	7.77
Orthopristis chrysoptera	5.87
Hippocampus zosterae	5.85
Syngnathus scovelli	4.55
Microgobius gulosus	3.67
Lagodon rhomboides	3.39
Syngnathus floridae	2.31
Bairdiella chrysoura	2.16
Syngnathus sp.	0.98
Eucinostomus sp.	0.95
Eucinostomus gula	0.60
Syngnathus louisianae	0.30
Monacanthus hispidus	0.28
Chilomycterus schoepfi	0.10
Cynoscion nebulosus	0.09
Sphoeroides nephelus	0.09
Hippocampus erectus	0.08
Gobiosoma robustum	0.07
Symphurus plagiusa	0.05
Bairdiella batabana	0.05
Lutjanus synagris	0.05
Sphyraena barracuda	0.05
Synodus foetans	0.04
Anarchopterus criniger	0.04
Monacanthus ciliatus	0.03
Chasmodes saburrae	0.02
Gobiesox strumosus	0.02

Table 3. (Cont.)

Species	Mean density
Sciaenops ocellatus	0.02
Strongylura notata	0.02
Floridichthys carpio	0.02
Hypsoblennius ionthus	0.01
Lactophrys trigonis	0.01
Haemulon plumeri	0.01
Archosargus probatocephelus	0.01
Haemulon sp.	0.01

Table 4. Results of Kruskal-Wallis Test used to examine differences among selected taxa (density > 10.0 for, at least, one collection) densities and epi-benthic sled stations. Listed are the P-values and the Wilcoxon mean scores by station. MG = Middle Ground; JKB=Johnson Key Basin; SB=Snake Bight; RK=Roscoe Key; MC/CP=McCormick Creek/Crocodile Point; EC=East Creek; BK=Bradley Key.

Species	P-value	Station						
		MG	JKB	SB	RK	MC/CP	EC	BK
Anchoa mitchilli	0.0979	16.0	7.0	10.5	22.2	12.0	13.2	18.0
Bairdiella chrysoura	0.0110	13.8	18.5	24.0	9.0	9.0	9.0	15.0
Hippocampus zosterae	0.0012	7.5	17.2	20.5	18.5	7.5	4.5	25.0
Lagodon rhomboides	0.0257	12.5	17.5	16.2	10.0	10.0	10.0	24.3
Lucania parva	0.0035	6.0	25.5	15.8	9.2	16.5	17.0	6.0
Microgobius gulosus	0.0032	10.5	10.5	13.4	10.5	16.2	25.5	10.5
Orthopristis chrysoptera	0.0075	17.1	15.5	16.9	8.5	8.5	8.5	26.0
Syngnathus floridae	0.0026	14.9	24.0	15.1	8.4	6.5	8.1	23.3
Syngnathus scovelli	0.0056	7.0	22.0	22.8	9.2	6.5	13.0	18.7

Table 5. List of species collected at 202 cast net sites in Florida Bay and adjacent waters. Frequency of occurrence is the number of sites the species was collected; density is the mean number averaged over all stations and cruises. Species are listed in descending order.

Species	Frequency of occurrence	Total number collected	Density
Atherinomorus stipes	18	966	4.78
Anchoa mitchilli	33	308	1.52
Menidia peninsulae	5	237	1.17
Poecilia latipinna	14	175	0.87
Eucinostomus argenteus	39	173	0.86
Eucinostomus spp.	26	139	0.69
Sardinella aurita	11	120	0.59
Eucinostomus gula	41	117	0.58
Floridichthys carpio	37	100	0.50
Penaeus duorarum	13	53	0.26
Mugil curema	16	34	0.17
Diapterus plumeri	15	31	0.15
Syngnathus scovelli	10	18	0.09
Hippocampus zosterae	9	15	0.07
Strongylura notata	4	11	0.05
Fundulis grandis	5	9	0.04
Lucania parva	7	8	0.04
Cichlasoma urophthalmus	3	3	0.03
Elops saurus	6	6	0.03
Anchoa hepsetus	2	4	0.02
Centropomis undecimalis	3	3	0.01
Lutjanus griseus	3	3	0.01
Lepisosteus platyrhincus	1	2	0.01
Mugil cephalus	1	2	0.01
Micrgobius gulosus	2	2	0.01
Pristis pectinata	2	2	0.01
Sphyraena barracuda	2	2	0.01
Arius felis	1	1	<0.01

Table 5 (cont).

Species	Frequency of occurrence	Total number collected	Density
Caranx hippos	1	1	<0.01
Diplogrammus pauciradiatus	1	1	<0.01
Megalops atlanticus	1	1	<0.01
Sphoeroides nephalus	1	1	<0.01
Trinectes maculatus	1	1	<0.01

Table 6. Total number, and mean number per cast (in parenthesis) by salinity regime of selected taxa (total number collected >10) collected by cast net in Florida Bay and adjacent waters. Species are listed by alphabetical order.

Species	Salinity regime			
	Oligohaline	Mesohaline	Polyhaline	Euhaline
Anchoa mitchilli	2 (0.07)	56 (0.49)	115 (3.03)	135 (6.14)
Atherinomorus stipes	4 (0.15)	886 (7.70)	42 (1.11)	34 (1.55)
Diapterus plumeri	12 (0.44)	18 (0.16)	1 (0.03)	0
Eucinostomus argenteus	34 (1.26)	139 (1.21)	0	0
Eucinostomus gula	1 (0.04)	85 (0.74)	24 (0.63)	7 (0.32)
Eucinostomus spp.	0	56 (0.49)	18 (0.47)	65 (2.95)
Floridichthys carpio	0	67 (0.58)	21 (0.55)	12 (0.55)
Hippocampus zosterae	0	2 (0.02)	3 (0.08)	10 (0.45)
Menidia peninsulae	0	8 (0.07)	229 (6.03)	0
Mugil curema	0	22 (0.19)	6 (0.16)	6 (0.27)
Penaeus duorarum	0	1 (0.01)	31 (0.82)	21 (0.95)
Poecilia latipina	8 (0.30)	156 (1.36)	8 (0.21)	3 (0.14)
Sardinella aurita	0	58 (0.50)	6 (0.16)	56 (2.55)
Strongylura notata	0	10 (0.09)	0	1 (0.05)
Syngnathus scovelli	0	6 (0.05)	9 (0.24)	3 (0.14)

Table 7. Results of Kruskal-Wallis Test used to examine differences between selected taxa (total number collected >10) densities collected with a cast net and salinity regime. Listed are the P-values and the Wilcoxon mean scores by salinity regimes. Species are listed by alphabetical order.

Species	P-value	Salinity regime			
		Oligohaline	Mesohaline	Polyhaline	Euhaline
Anchoa mitchilli	0.0108	91.7	97.0	111.8	119.2
Atherinomorus stipes	0.6631	96.1	101.5	102.9	106.0
Diapterus plumeri	0.1225	109.6	102.7	96.5	94.0
Eucinostomus argenteus	0.0001	122.6	106.7	82.0	82.0
Eucinostomus gula	0.0564	84.3	102.5	112.3	98.8
Eucinostomus spp.	0.0001	88.5	98.3	101.7	134.0
Floridichthys carpio	0.0699	83.0	104.3	106.1	101.7
Hippocampus zosterae	0.0001	97.0	98.0	102.3	124.5
Menidia peninsulae	0.0056	99.0	99.9	109.6	99.0
Mugil curema	0.0700	93.5	99.8	106.4	111.7
Penaeus duorarum	0.0001	95.0	95.8	113.7	118.0
Poecilia latipina	0.2243	109.2	99.0	104.9	99.2
Sardinella aurita	0.1672	96.0	100.4	103.8	109.8
Strongylura notata	0.5180	99.5	102.1	99.5	104.1
Syngnathus scovelli	0.3866	96.5	100.9	104.5	105.8

Table 8. Total number, and mean number per cast (in parenthesis) by subdivision (Eastern, Central and Gulf Transition) of selected taxa (total number collected >10) collected by cast net in Florida Bay. Species are listed by alphabetical order. Data for the Northern Transition Subdivision are depicted in Table 10.

Species	Subdivision		
	Central	Eastern	Gulf Transition
Anchoa mitchilli	2 (0.15)	103 (6.87)	101 (7.77)
Atherinomorus stipes	47 (3.62)	439 (29.27)	0
Diapterus plumeri	0	0	0
Eucinostomus argenteus	0	3 (0.20)	0
Eucinostomus gula	19 (1.46)	27 (1.80)	8 (0.62)
Eucinostomus spp.	1 (0.08)	20 (1.33)	3 (0.23)
Floridichthys carpio	4 (0.31)	8 (0.53)	0
Hippocampus zosterae	1 (0.08)	0	0
Menidia peninsulae	0	1 (0.07)	0
Mugil curema	0	0	9 (0.69)
Penaeus duorarum	7 (0.54)	0	0
Poecilia latipina	5 (0.38)	0	0
Sardinella aurita	1 (0.08)	0	55 (4.23)
Strongylura notata	0	0	1 (0.08)
Syngnathus scovelli	0	0	0

Table 9. Results of Kruskal-Wallis Test used to examine differences among selected taxa (total number collected >10) densities and subdivisions collected by cast net. Listed are the P-values and the Wilcoxon mean scores by subdivision. Species are listed by alphabetical order. Data for the Northern Transition Subdivision are depicted in Table 11.

Species	P-value	Subdivision		
		Central	Eastern	Gulf Transition
Anchoa mitchilli	0.1789	17.9	20.9	24.2
Atherinomorus stipes	0.1702	23.2	22.6	17.0
Diapterus plumeri	1.0000	21.0	21.0	21.0
Eucinostomus argenteus	0.1692	20.0	22.7	20.0
Eucinostomus gula	0.0220	27.7	18.3	17.4
Eucinostomus spp.	0.4780	20.0	22.7	20.1
Floridichthys carpio	0.1289	23.5	21.9	17.5
Hippocampus zosterae	0.3406	22.1	20.5	20.5
Menidia peninsulae	0.4204	20.5	21.9	20.5
Mugil curema	0.0006	18.0	18.0	27.5
Penaeus duorarum	0.0335	24.2	19.5	19.5
Poecilia latipina	0.3406	22.1	20.5	20.5
Sardinella aurita	0.2888	21.0	19.5	22.7
Strongylura notata	0.3406	20.5	20.5	22.1
Syngnathus scovelli	1.0000	21.0	21.0	21.0

Table 10. Total number, and mean number per cast (in parenthesis) by subareas in the Northern Transition Subdivision of selected taxa (total number collected >10) collected by cast net in Florida Bay and adjacent waters. Species are listed by alphabetical order. CP=Crocodile Point; GB= Garfield Bight; JB=Joe Bay; LMB=Little Madeira Bay; LS=Long Sound; MB=Madeira Bay; MC=Mud Creek; RB=Rankin Bight; SBC=Snake Bight Canal; TC=Trout Cove; and WL=West Lake

Species	CP	GB	JB	LMB	LS	MB	MC	RB	SBC	TC	WL
Anchoa mitchilli	8 (4.00)	5 (0.45)	24 (1.20)	11 (0.32)	1 (0.03)	29 (7.25)	8 (0.62)	1 (0.50)	0	10 (0.91)	5 (0.18)
Atherinomorus stipes	0	0	0	64 (1.88)	0	22 (5.50)	0	0	0	394 (35.82)	0
Diapterus plumeri	0	0	6 (0.30)	14 (0.42)	5 (0.15)	0	0	0	0	0	6 (0.21)
Eucinostomus argenteus	0	0	59 (2.95)	19 (0.56)	53 (1.61)	0	7 (0.54)	0	0	1 (0.09)	31 (1.11)
Eucinostomus gula	0	3 (0.27)	0	33 (0.97)	8 (0.24)	0	5 (0.38)	0	0	14 (1.27)	0
Eucinostomus spp.	5 (2.50)	5 (0.45)	0	38 (1.12)	10 (0.30)	54 (13.50)	0	1 (0.50)	0	0	2 (0.07)
Floridichthys carpio	2 (1.00)	14 (1.27)	1 (0.05)	9 (0.26)	40 (1.21)	0	8 (0.62)	9 (4.50)	0	5 (0.45)	0
Hippocampus zosterae	2 (1.0)	3 (0.27)	0	2 (0.06)	0	3 (0.75)	0	4 (2.00)	0	0	0
Menidia peninsulae	0	0	0	8 (0.23)	201 (6.09)	0	0	0	0	27 (2.45)	0
Mugil curema	0	1 (0.09)	6 (0.30)	2 (0.06)	14 (0.42)	0	2 (0.15)	0	0	0	0
Penaeus duorarum	1 (0.50)	37 (3.36)	0	0	0	0	0	8 (4.0)	0	0	0
Poecilia latipina	0	3 (0.27)	0	0	154 (4.67)	0	0	0	3 (1.0)	2 (0.18)	8 (0.29)
Sardinella aurita	0	0	9 (0.45)	0	23 (0.70)	1 (0.25)	0	0	0	31 (2.82)	0
Strongylura notata	0	0	0	0	1 (0.03)	0	9 (0.69)	0	0	0	0
Syngnathus scovelli	1 (0.05)	10 (0.90)	0	2 (0.06)	2 (0.06)	0	0	2 (1.0)	0	1 (0.09)	0

Table 11. Results of Kruskal-Wallis Test used to examine differences among selected taxa (total number collected >10) densities and cast net stations. Listed are the P-values and the Wilcoxon mean scores Northern Transition Subdivision stations. Species are listed by alphabetical order. CP=Crocodile Point; GB= Garfield Bight; JB=Joe Bay; LMB=Little Madeira Bay; LS=Long Sound; MB=Madeira Bay; MC=Mud Creek; RB=Rankin Bight; SBC=Snake Bight Canal; TC=Trout Cove; and WL=West Lake

Species	P-value	Station										
		CP	GB	JB	LMB	LS	MB	MC	RB	SBC	TC	WL
Anchoa mitchilli	0.1132	113.2	90.6	81.4	80.8	71.2	114.0	87.1	106.0	69.0	77.2	79.9
Atherinomorus stipes	0.0001	76.0	76.0	76.0	85.5	76.0	115.6	76.0	76.0	76.0	105.5	76.0
Diapterus plumeri	0.6319	73.5	73.5	81.7	88.0	82.9	73.5	73.5	73.5	73.5	73.5	82.2
Eucinostomus argenteus	0.0633	62.5	62.5	100.9	75.8	80.8	62.5	90.6	62.5	62.5	68.8	88.2
Eucinostomus gula	0.0042	69.0	83.1	69.0	93.8	76.5	69.0	97.3	69.0	69.0	98.1	69.0
Eucinostomus spp.	0.0001	149.2	91.3	70.5	85.2	80.0	155.0	70.5	107.5	70.5	70.5	73.3
Floridichthys carpio	0.0001	108.5	88.0	69.7	75.5	100.1	66.0	73.1	149.2	66.0	93.9	66.0
Hippocampus zosterae	0.0001	117.8	91.5	77.0	79.4	77.0	116.8	77.0	158.5	77.0	77.0	77.0
Menidia peninsulae	0.8268	79.0	79.0	79.0	81.4	83.9	79.0	79.0	79.0	79.0	86.4	79.0
Mugil curema	0.5652	76.0	83.1	88.0	78.4	85.8	76.0	82.3	76.0	76.0	76.0	76.0
Penaeus duorarum	0.0001	114.5	134.6	76.0	76.0	76.0	76.0	76.0	117.8	76.0	76.0	76.0
Poecilia latipina	0.0899	74.5	95.6	74.5	74.5	84.6	74.5	74.5	74.5	102.0	81.9	85.8
Sardinella aurita	0.1130	77.0	77.0	81.1	77.0	86.8	96.4	77.0	77.0	77.0	91.7	77.0
Strongylura notata	0.1177	79.5	79.5	79.5	79.5	81.9	79.5	91.9	79.5	79.5	79.5	79.5
Syngnathus scovelli	0.0001	115.5	105.3	76.0	80.6	78.5	76.0	76.0	117.8	76.0	83.2	76.0

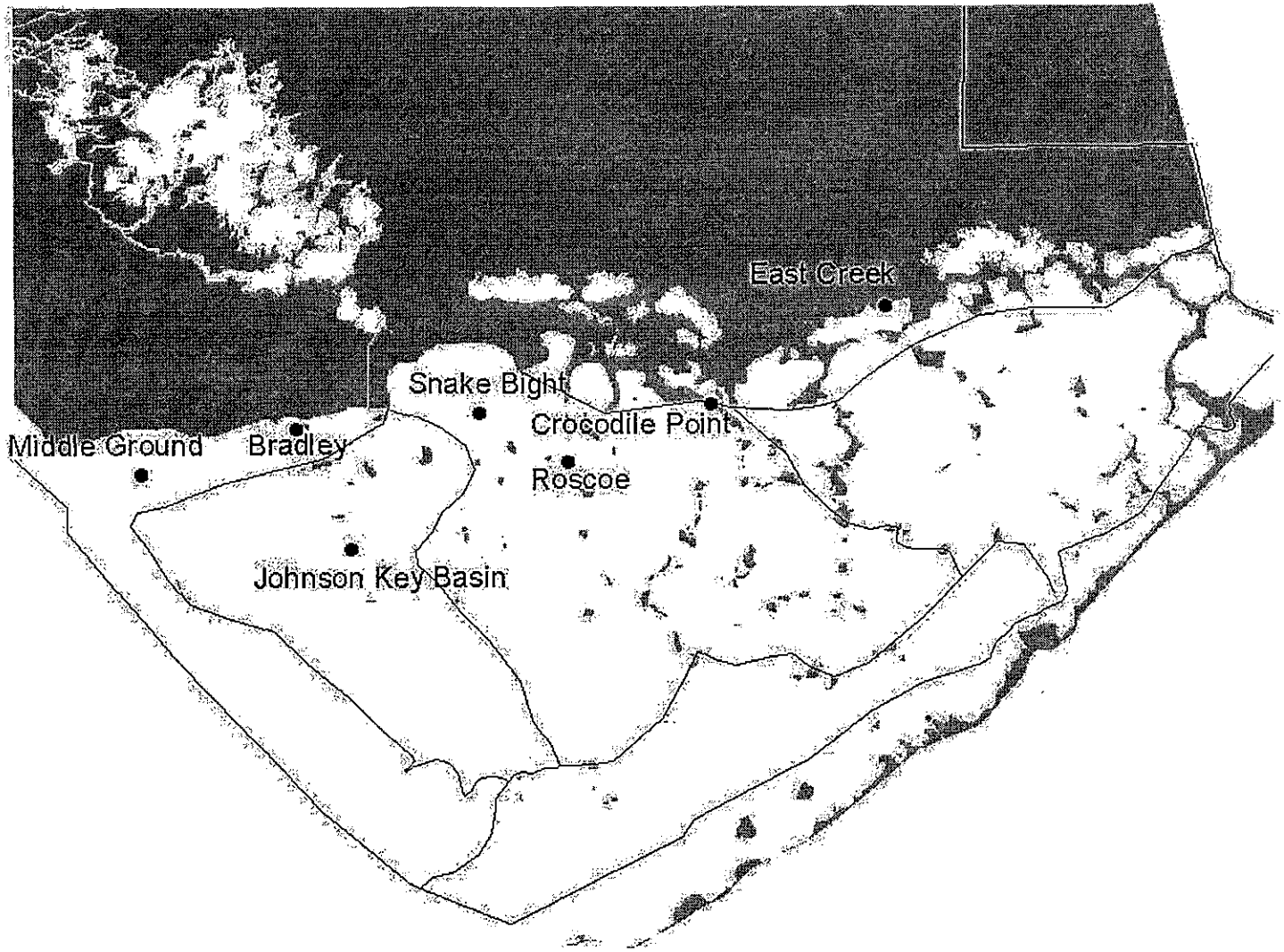

Figure 1. Epibenthic sled stations and Florida Bay Subdivisions.

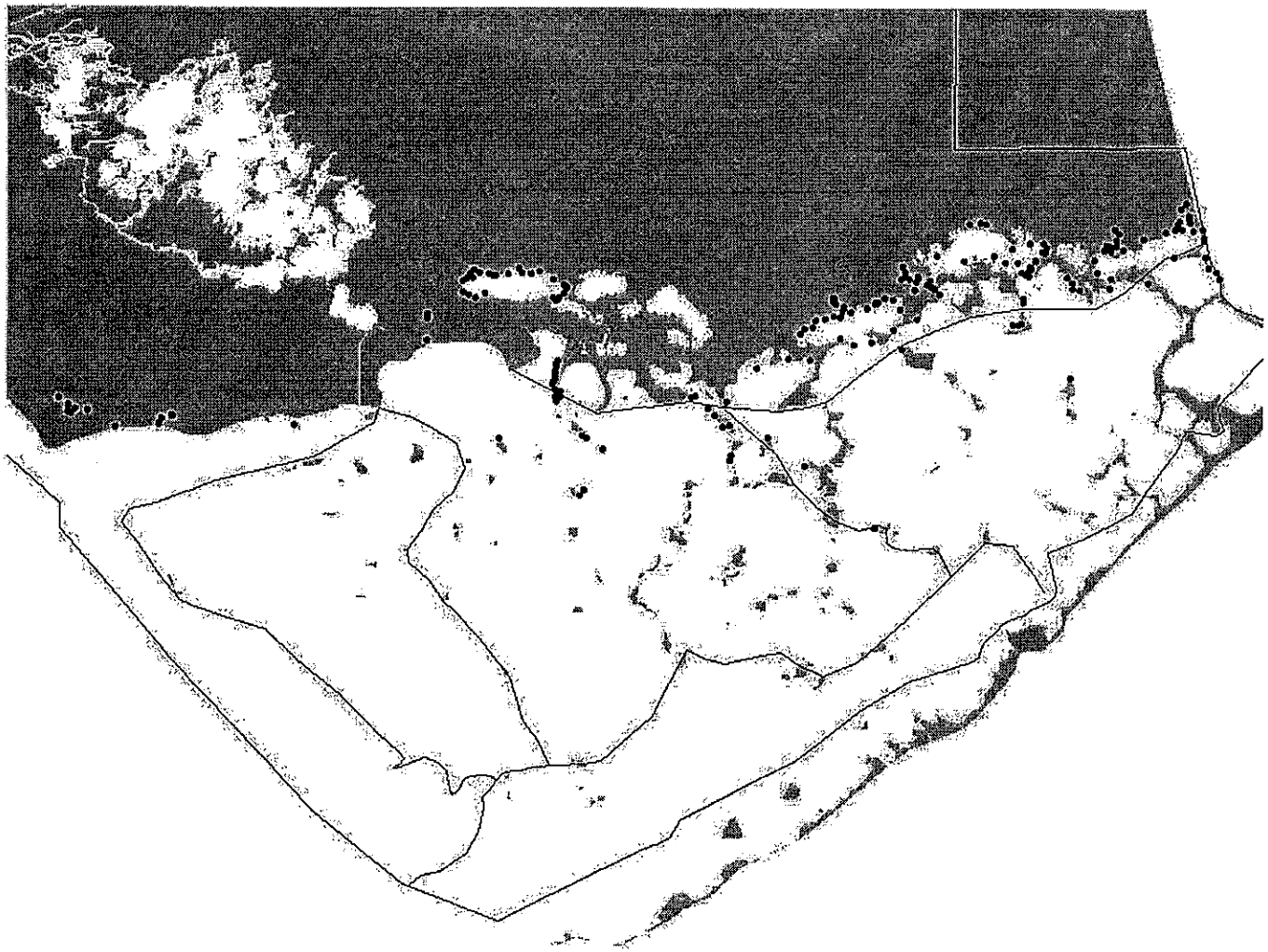

Figure 2. Cast net stations

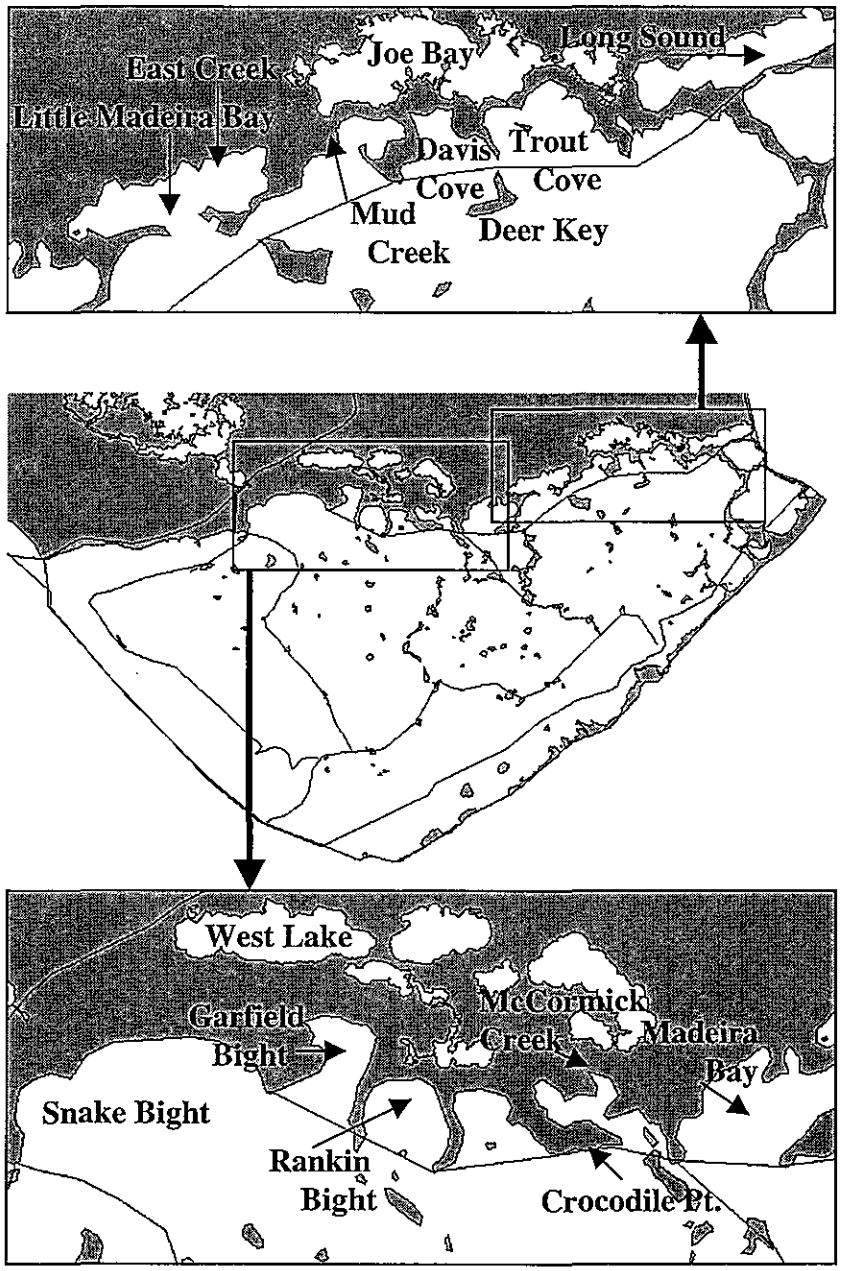

Figure 3. Geographic location referred to in the text.

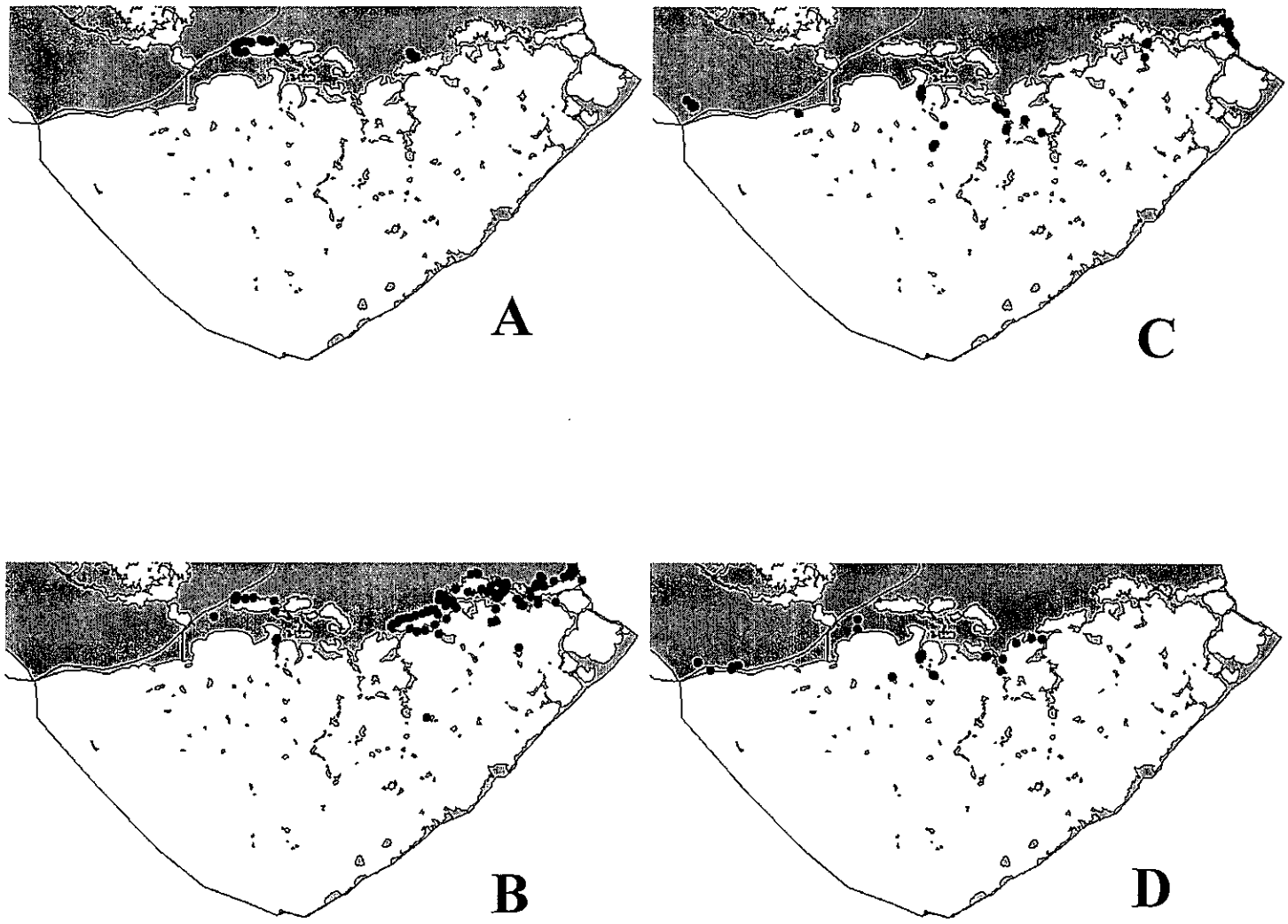

Figure 4. Cast net stations by salinity regime. A, Oligohaline; B, Mesohaline; C, Polyhaline; and D, Euhaline.

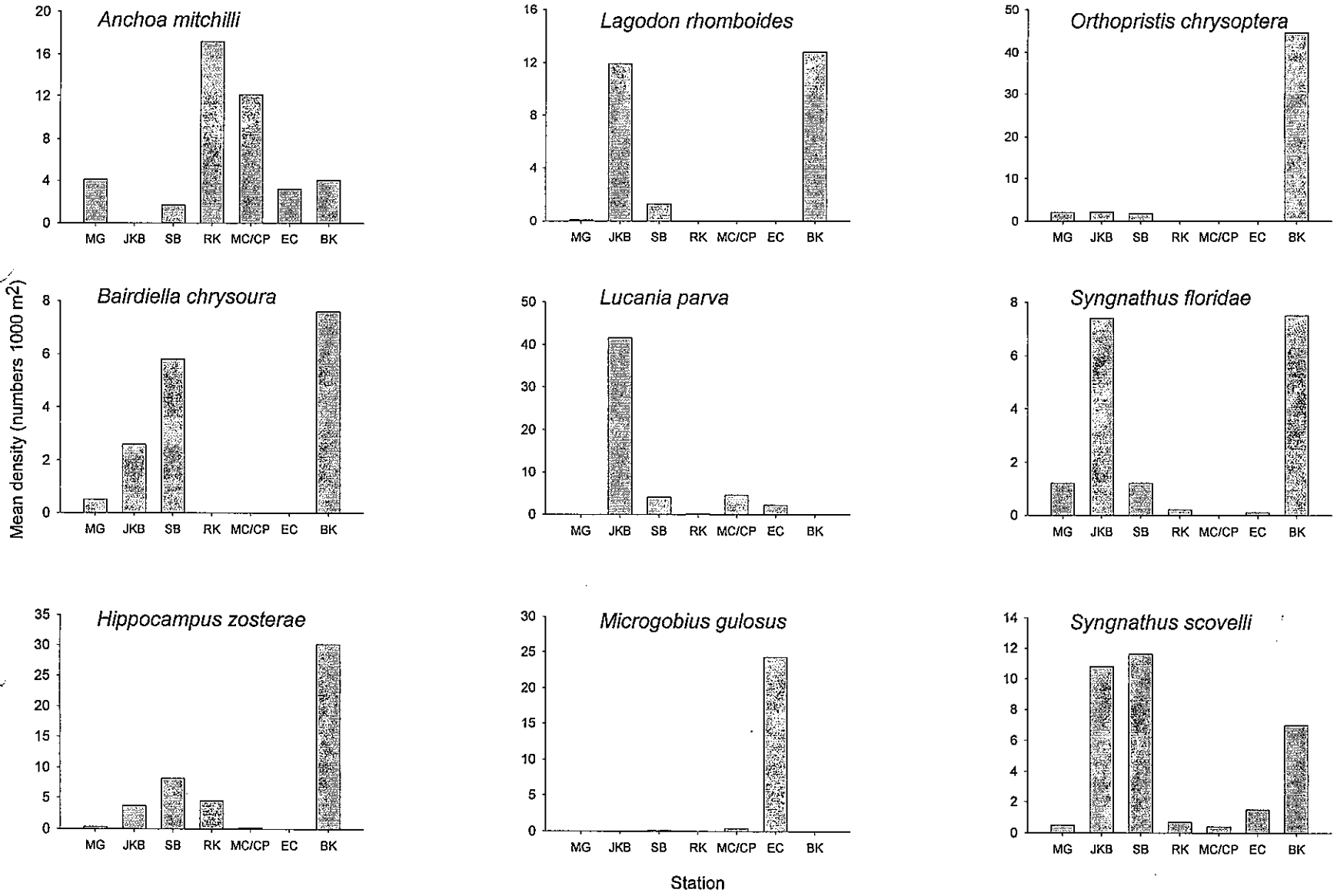

Figure 5. Density of nine commonly collected species by station. MG = Middle Ground; JKB = Johnson Key Basin; SB = Snake Bight; RK = Roscoe Key; MC/CP = McCormick Creek/Crocodile Point;EC = East Creek; BK = Bradley Key.