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Distribution and Abundance of Nearshore Fishes in the Anclote River Estuary, West-Central Florida

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DISTRIBUTION AND ABUNDANCE OF NEARSHORE FISHES IN THE ANCLOTE RIVER ESTUARY, WEST-CENTRAL FLORIDA

Fish species use estuarine areas as nurseries for their young (Gunter 1967). This facet of west Florida estuaries has long been suggested (Reid 1954; Kilby 1955; Springer and Woodburn 1960; Sykes and Finucane 1966), and subsequent trawl surveys have supported this phenomenon (Livingston *et al.* 1976; Weinstein *et al.* 1977). Previous studies have concentrated efforts in more coastal or open bay waters of the west Florida coast. West Florida shallow estuarine habitats accessible only to seining or block nets have received less attention (Subrahmanyam and Drake 1975; Livingston 1975; Naughton and Saloman 1978; Subrahmanyam and Coultas 1980; Price and Schlueter 1985; Thayer *et al.* 1987; Sogard *et al.* 1987; Sogard *et al.* 1989). In addition, in littoral waters where one would expect the smallest size distributions, few studies in west Florida estuaries used small (<4 mm) mesh sizes (Price and Schlueter 1985; Thayer *et al.* 1987).

The present study examines a previously unsampled "nearshore" fish community along the salinity gradient of the Anclote River estuary on the west-central coast of Florida. Sampling was designed to capture the smallest nursery recruits and resident fishes through the use of a fine (1.5 mm) mesh seine.

MATERIALS AND METHODS

The Anclote River estuary is located on the west-central coast of Florida between latitudes 28°09′-28°13′N and longitudes 82°47′-82°51′W. Three stations were sampled in the Anclote River estuary (Fig. 1). Station 1, was a polyhaline habitat located at the mouth of the Anclote River. This station was characterized by extensive patches of seagrasses (*Thalassia testudinum, Syringodium filiforme, Halodule wrightii, Halophila engelmannii, Ruppia maritima*), mangroves, and oyster bars. Station 2, was a mesohaline habitat located 6.5 km from the mouth of the Anclote River. This station was characterized by lack of rooted aquatic vegetation and a shoreline with extensive stands of black rush, *Juncus roemerianus*. Station 3, was an oligohaline habitat located 9.6 km from the river mouth. This station was also characterized by lack of rooted aquatic vegetation, but shoreline vegetation was more typical of fresh waters, including cattails *Typha* spp., and bald cypress *Taxodium distichum*.

Surface salinity and temperature measurements were made with a temperature compensated refractometer and mercury thermometer. Specimens were collected with a 1.5 mm mesh, 6.3×1.8 m seine net. A preliminary sample of 13 seine hauls per station in February 1980 revealed that species accumulation curves leveled off at eight seine hauls, and this number per station was used throughout the study. Collections were made every two weeks, from 26 March to 24 October, 1980, for a total of 361 seine hauls (23 missing due to weather). Seine locations were chosen to maximize variation in substrate and were repeated at the same locations throughout the study period, except that distance from mean high water level varied according to tidal stage. The seine was stretched parallel to the shore, 9.0 m from the water's edge, and the ends were simultaneously pulled to shore. The length of the seine was 6.3 m with an effective sampling length of 4.5 m, thus, approximately 40 m^2 were sampled per seine.

Fish were preserved in the field with 10% seawater-formalin and changed to 70% isopropyl alcohol after 24 hours. Individuals were identified, counted, and standard lengths measured in the labora-

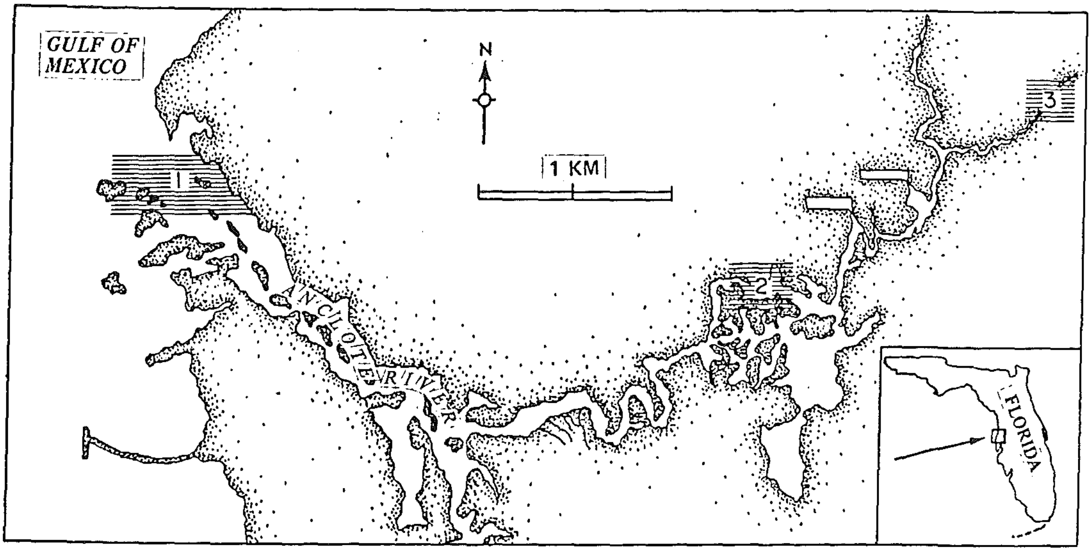

Figure 1. Anclote River estuary sampling sites, Tarpon Springs, Florida.

tory. Transient species were defined as those that complete their life cycle outside the estuary, and were assigned juvenile or adult status from published lengths (Jones *et al.* 1978; Johnson 1978).

Total and species abundances (numbers + 1) / seine were transformed by base-10 logarithm. When assumptions of normality (Kolmogorov-Smirnov test) and homogeneity (Bartlett-Box F-test) were met, parametric two-way analysis of variance (2-way ANOVA) was used to test for station, date, and interaction effects. After significance was determined (0.05 level), a Tukey multicomparison test was used to identify particular differences. If conditions of normality and homogeneity were not met after transformations, a nonparametric Kruskal-Wallis analysis of variance (KW-2-way ANOVA) was used to test for significance (0.05 level; Zar 1984). Multispecies distribution patterns were examined by multidimensional scaling (Schiffman *et al.* 1981; Field *et al.* 1982). Species abundance data were root-root transformed and Manhattan-metric distance used in the analysis. Iterations were stopped when Young's stress for successive iterations did not show improvement greater than 0.000001 (Schiffman *et al.* 1981).

RESULTS

Salinity averaged 30±2.7 Sd ppt and ranged 22–34 ppt at station 1, 18±5.4 Sd ppt and 6–25 ppt at station 2, and 7±4.3 Sd ppt and 2–15 ppt at station 3. During the sampling period from March to October, 1980, the salinity gradient between stations always exceeded 4 ppt. At all three stations water temperature increased from 23°C in March to 35°C in July, then decreased to 25°C in October. There was little difference (<2°C) in temperature among stations during any one sampling.

Station 1 yielded the highest number of species (37) and mean total abundance of fishes (447±1006 Sd/40 m^2); station 2 yielded the lowest species (24) and abundance values (60±193 Sd/40 m^2); and station 3 yielded intermediate species (30) and abundance values (176±561 Sd/40 m^2). Abundance estimates were significantly different among stations (Fig. 2). Seasonally, only the highest abundance collection date (791.4/40 m^2, 17 Jul), was significantly different from the two lowest collection dates (86.7/40 m^2, 13 Aug;

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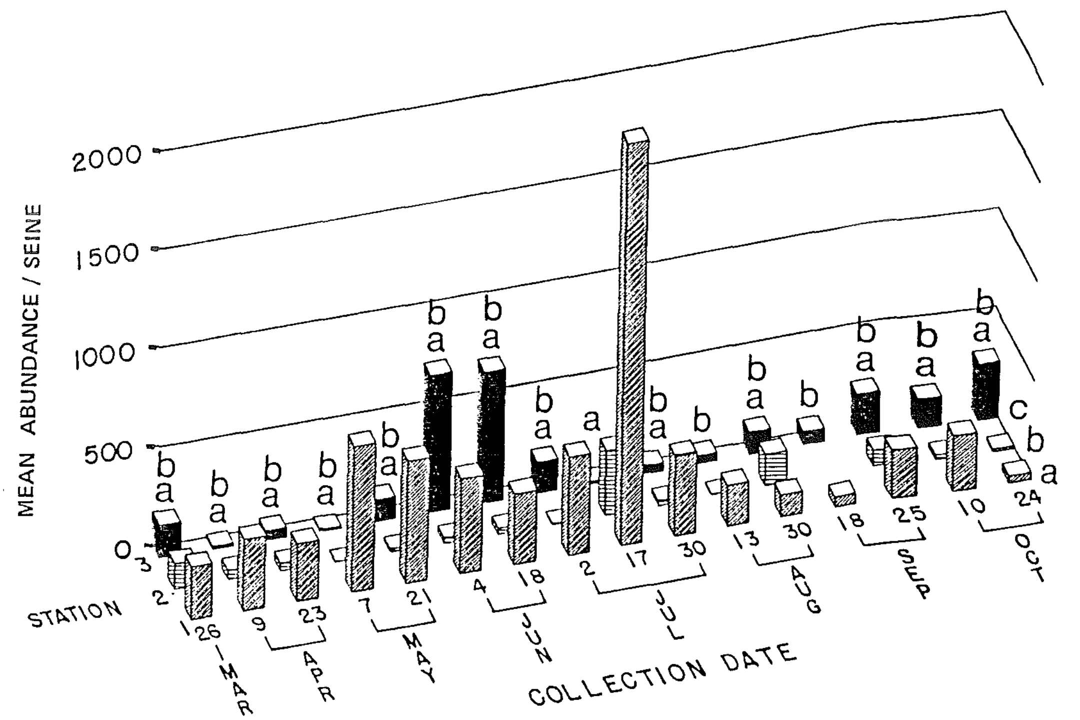

Figure 2. Mean total abundance/40 m² by station and date of nearshore fish species from the Anclote River estuary, Florida. Different letters denote significant differences among stations and among dates. There was also a significant interaction effect, not depicted (2-way ANOVA; 0.05 level).

61.7/40 m², 18 Sep; Fig. 2). In addition, there was a significant interaction effect on mean total abundance between station and date (2-way ANOVA).

The estimated abundances of *Menidia beryllina*[1], *Lagodon rhomboides, Leiostomus xanthurus, Cyprinodon variegatus*, and *Eucinostomus argenteus*, showed significant station, date, and interaction effects (KW-2-way ANOVA; Table 1, date and interaction effects not shown). There were also several other patterns: station effect (*Strongylura marina, Fundulus similis*, and *Poecilia latipinna*), date effect (*F. grandis*), interaction effect (*Anchoa mitchilli*), date and interaction effects (*Mugil cephalus*), and station and date effects (*Syngnathus scovelli*). During the sampling period of this study (spring-summer-fall) the Anclote nearshore system was dominated by those species identified as residents: *M. beryllina* (78.1% of total number), *A. mitchilli* (10.5%), *C. variegatus* (1.0%), *Gobiosoma bosci* (0.8%), *Gambusia affinis* (0.6%), and *Microgobius gulosus* (0.6%). Eight species identified as transients, made up less than 7% of the total abundance. Common (>0.5%) transients included: *L. rhomboides* (2.1%), *L. xanthurus* (1.8%), *Brevoortia patronus* (1.0%), *E. gula* (0.9%), and *E. argenteus* (0.7%). Also, juvenile stages of all species were collected, confirming the nursery role of the Anclote River estuary (Table 1).

Changes in dominance occurred by station and date. *Menidia beryllina*, dominated all months at station 1; April, May, and June, at station 2; and May through October at station 3 (Fig. 3). *Leiostomus xanthurus* dominated stations 2 and 3 in March. *Anchoa mitchilli* domi-

[1]Silversides were the most abundant taxon and identified as *Menidia beryllina*, but may be a complex of *M. beryllina* and *M. peninsulae* (Chernoff *et al.* 1981).

Table 1. Species abundance pooled by date /40 m² at stations 1, 2, and 3 Anclote River estuary, Florida. Different letters denote significant difference among stations for particular species (KW-2-way ANOVA, 0.05 level), R = resident, T = transient species, J = juvenile, and A = adult. S = significant date effect, * = significant interaction effect.

SPECIES	LIFE HISTORY	STATION			TOTAL %
		1	2	3	
Menidia beryllina S*	RJA	382.2a	9.1b	142.4a	78.6
Anchoa mitchilli *	RJA	25.7a	35.6a	10.7a	10.5
Lagodon rhomboides S*	TJ	13.2a	1.0b	0.1c	2.1
Leiostomus xanthurus S*	TJ	3.5a	5.0a	3.7b	1.8
Cyprinodon variegatus S*	TJA	7.0a	<0.1b	<0.1b	1.0
Brevoortia patronus	TJ	3.4a		3.2a	0.9
Eucinostomus gula S*	TJ	5.7a	0.3b		0.8
Gobiosoma bosci *	RJA	<0.1a	1.5b	4.0c	0.8
E. argenteus S*	TJ	0.8a	2.2b	1.6ab	0.7
Microgobius gulosus *	RJA	<0.1a	3.2b	1.1b	0.6
Gambusia affinis *	RJA			3.9	0.6
Lucania parva *	RJA	0.8a		2.5b	0.5
Eucinostomus sp. *	J	<0.1a	0.5a	1.0b	0.2
Mugil cephalus *	J	0.1a	1.0a	0.2a	0.2
Strongylura notata *	J	0.8a	0.1b	0.2b	0.2
Strongylura spp. *	J	0.9a	<0.1b	<0.1b	0.1
Fundulus grandis	RJA	0.4a	0.4a	0.1a	0.1
Poecilia latipinna	RJA		<0.1a	0.6b	0.1
Oligoplites saurus *	J	0.5a	0.1b	0.1b	0.1
Syngnathus scovelli	JA	0.3a	0.2ab	<0.1b	0.1
S. marina	J	0.3a	0.1ab	0.1b	0.1
F. similis	RJA	0.3a	0.1b	<0.1b	0.1
MEAN TOTAL/40 m²		446.59	60.50	176.01	

Other species <0.1% of the total abundance/40 m²:
Micropterus salmoides, Sphoeroides spengleri, Achirus lineatus, Trachinotus falcatus, Orthopristis chrysoptera, Synodus foetens, Cynoscion nebulosus, Lepomis spp., *Opisthonema oglinum, Centropomus undecimalis, Symphurus plagiusa, S. louisianae, Bairdiella chrysoura, Hippocampus zosterae, Hyporhamphus unifasciatus, Lepisosteus* sp., *Paralichthys lethostigma, Chilomycterus schoepfi, P. albigutta, Opsanus beta, A. hepsetus, S. nephelus, Lepomis macrochirus, Elops saurus, Anguilla rostrata.*

nated station 2 from July to October. *Brevoortia patronus* dominated station 3 in April. Salinity and temperature were associated with multispecies fish distributions as detected by the multidimensional scaling analysis (Fig. 4).

DISCUSSION

The Anclote River estuary of west-central Florida showed similarities to other nearshore fish communities, as detected in north-west Florida (Naughton and Saloman 1978), south-west Florida (Sogard *et al.* 1987), and other areas (Weinstein 1979; Bozeman and Dean 1980; Rogers *et al.* 1984; Stoner 1986): juveniles of many species were found in this nearshore estuarine habitat, confirming its importance as a fish nursery. Abundance estimates in the Anclote River estuary were an order of magnitude higher compared to north-west Florida (8–36 fish/40 m², Naughton and Saloman 1978), but dominant species were similar (*Menidia beryllina, Lagodon rhomboides, Leiostomus xanthurus,* and *Eucinostomus argenteus*, comprised 69% of the total abundance in the north-west Florida estuary; Naughton and Saloman 1978). In contrast, present abundance estimates of polyhaline station 1 (447/40 m²) were almost exactly the same compared to similar habitat in south-west Florida (440 fish/40 m², Sogard *et al.* 1987), but showed differences in dominant species (*Flori-*

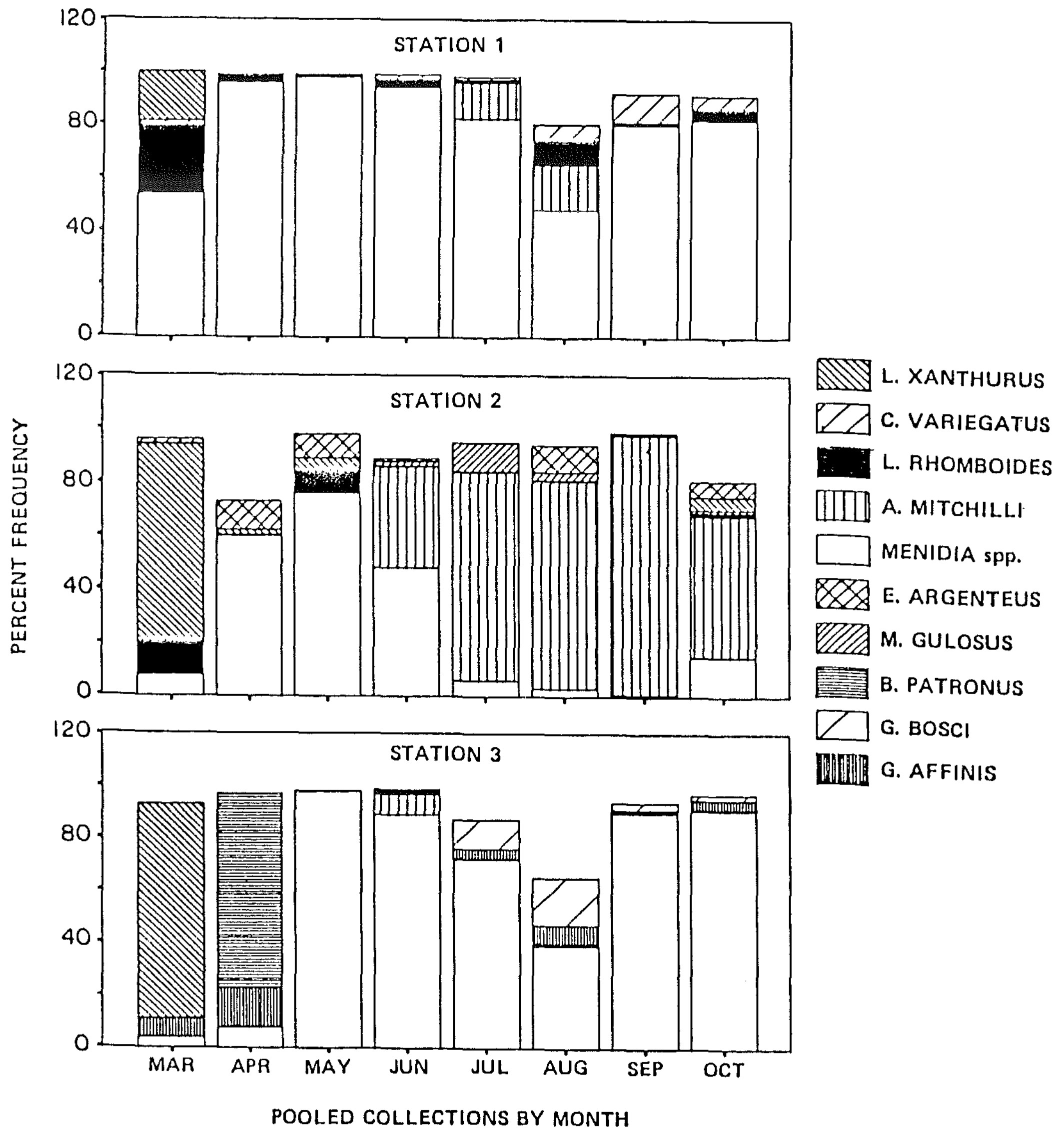

Figure 3. Percent frequency of dominant species, pooled for two consecutive sampling dates for each station.

dichthys carpio, Lucania parva, Opsanus beta, and *Gobiosoma robustum*, comprised 76% of the total abundance, Sogard *et al.* 1987; *Atherinomorus stipes, E. gula, A. mitchilli, Lucania parva*, comprised 64% of the total abundance, Thayer *et al.* 1987).

The Anclote nearshore area was dominated by residents rather than transients, in contrast with other Anclote studies where effort was more concentrated in slightly deeper waters (Baird *et al.* 1971; Fable 1973; Thorhaug *et al.* 1977). This difference may be due to gear bias and seasonal factors, since trawls, fyke nets, large mesh seines, and winter months were sampled in other Anclote studies. However, the suggestion that nearshore Anclote habitats are dominated by residents and adjacent deeper habitats are dominated by transients is probably a real reflection of the fish community. In other west Florida studies where all seasons were sampled, and a variety of

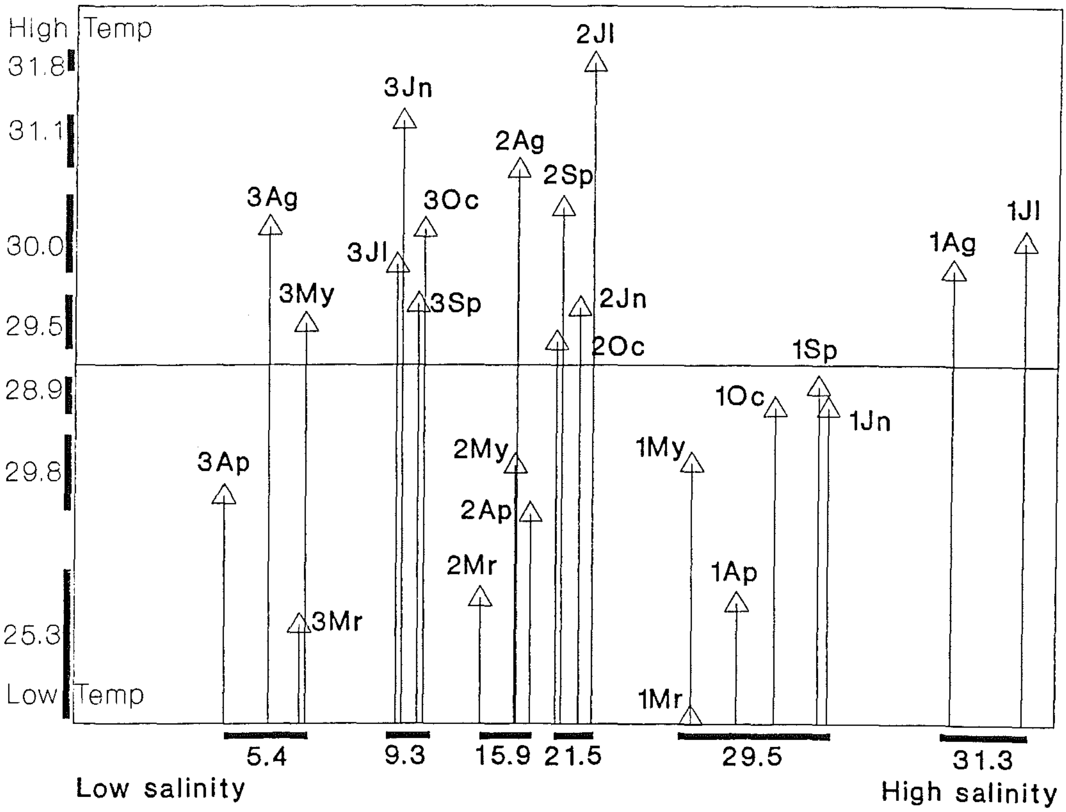

Figure 4. Multidimensional scaling of species abundances. Axes are unitless. Shown are numbers which stand for station, along with month of collection, *e.g.*, 3 Jn = station 3, month of June. The abscissa was associated with salinity and the ordinant associated with temperature. Bold lines depict clusters and each associated number is the mean salinity or temperature value for that particular cluster.

gear used, residents also dominated the shallow nearshore waters (Kilby 1955; Springer and Woodburn 1960; Livingston 1975; Subrahmanyam and Drake 1975; Naughton and Saloman 1978; Price and Schlueter 1985; Naughton and Saloman 1978; Thayer *et al.* 1987; Sogard *et al.* 1987), and transients dominated adjacent deeper waters (Reid 1954; Baird *et al.* 1971; Livingston *et al.* 1976; Weinstein *et al.* 1977).

Lowest abundances and species richness occurred at the mesohaline site (station 2). Two mechanisms probably influenced this distribution (in addition to the temperature and salinity effects detected in the multidimensional scaling). First, increased spatial heterogeneity due to the presence of extensive seagrass beds at station 1 has resulted in greater abundance and number of species compared to other stations (Martin and Cooper 1981; Stoner 1983; Heck *et al.* 1989). Second, a greater range of salinity encountered at station 2 may have created a more stressful habitat that resulted in reduced abundance and richness per unit area (Kinne 1967; Weinstein *et al.* 1980).

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