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THE DISTRIBUTION AND ABUNDANCE OF FISHES CAUGHT WITH A TRAWL IN THE ST. ANDREW BAY SYSTEM, FLORIDA[1]

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ABSTRACT: Fish collections were made by trawling bi-weekly at 12 stations in the deeper portions (1.5-12.2 m) of the St. Andrew Bay system, Florida, from September 1972 through August 1973. In 312 trawl hauls, 207,447 fishes were caught, and 128 species (51 families) were identified from the collections.

The St. Andrew Bay system is characterized by high salinity and low turbidity waters similar to the coastal waters of the Gulf of Mexico. This permits the occurrence of many marine shore fishes in the bay and greatly increases the faunal diversity. In general, these shore species are more numerous in, but not restricted to, the higher salinity waters of the lower bay area.

One subarea, however, was more typical of other estuaries of the northern Gulf of Mexico due to its lower salinity waters and occurrence of significantly greater numbers of juveniles of estuarine dependent fishes such as the gulf menhaden (*Brevoortia patronus*), spot (*Leiostomus xanthurus*), and Atlantic croaker (*Micropogon undulatus*). This nursery area, North Bay, receives most of the fresh water that is discharged into the system.

An unusual abundance of Atlantic threadfin (*Polydactylus octonemus*) occurred during the latter half of the sampling period. This abundance was also observed over a widespread area in the northeastern Gulf of Mexico.

Marked seasonal abundance of the catches was observed. The numbers of fish that were caught during the winter declined to about 6% of the total catch. Movements out of the sampling area in response to low water temperature is inferred. Other movements into and within the bay system are discussed.

Size analysis for some of the more abundant species shows that smaller individuals were found in the lower salinity area and the larger were more frequently observed in the higher salinity water.

A large percent of the fauna in most bay systems along the northern Gulf of Mexico is composed of estuarine dependent forms. In general, these species during some stage of their life history tend to be geographically separated from the shore fauna by barrier islands and narrow tidal passes. The St. Andrew Bay system differs from other bays by the lack of large volumes of fresh water draining into the system, the presence of extensive sand substrates and submarine spermatophytes, and the existence of a relatively deep basin connected to the sea through two passes. Benthic fishes with substrate requirements for either coarse, sandy sediments or silty clay regimes, find suitable habitats in deeper portions of the bay system. These features most probably account for the occurrence of many marine shore fishes collected during this study. Earlier studies on the ichthyofauna of the bay

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were reported by Allison (1961) and Vick (1964). Hastings (1972) compared the jetty fauna of Choctawhatchee Bay, Florida, with that of the West Pass jetty, St. Andrew Bay. Records of tropical reef fishes occurring on the West Pass jetty were published by Briggs and Caldwell (1957), Caldwell and Briggs (1957), and Caldwell (1959). More recently, May, Trent and Pristas (1976), Nakamura (1976), Naughton and Saloman (personal communication) and Pristas and Trent (personal communication) have made extensive collections or have reported on the occurrence of demersal, pelagic and shallow-water fishes not normally encountered by trawling gear in St. Andrew Bay.

None of the above ichthyofaunal studies surveyed all of the bays within the system with the same sampling frequency or collected the variety of hydrological data as did this study. Our purpose was to determine the species composition, relative abundance, and distribution in this unusual estuarine system of northwest Florida.

STUDY AREA

The St. Andrew Bay system, located on the northwestern coast of Florida, is a complex of four bays situated along a NW-SE axis at latitude 30° 10′ N and longitude 85°40′W (Fig. 1). Physical and hydrological characteristics of this bay and nearshore environment have been reported by several authors (Ichiye and Jones 1961; Hopkins 1966; McNulty et al. 1972; Salsman et al. 1966; Tolbert

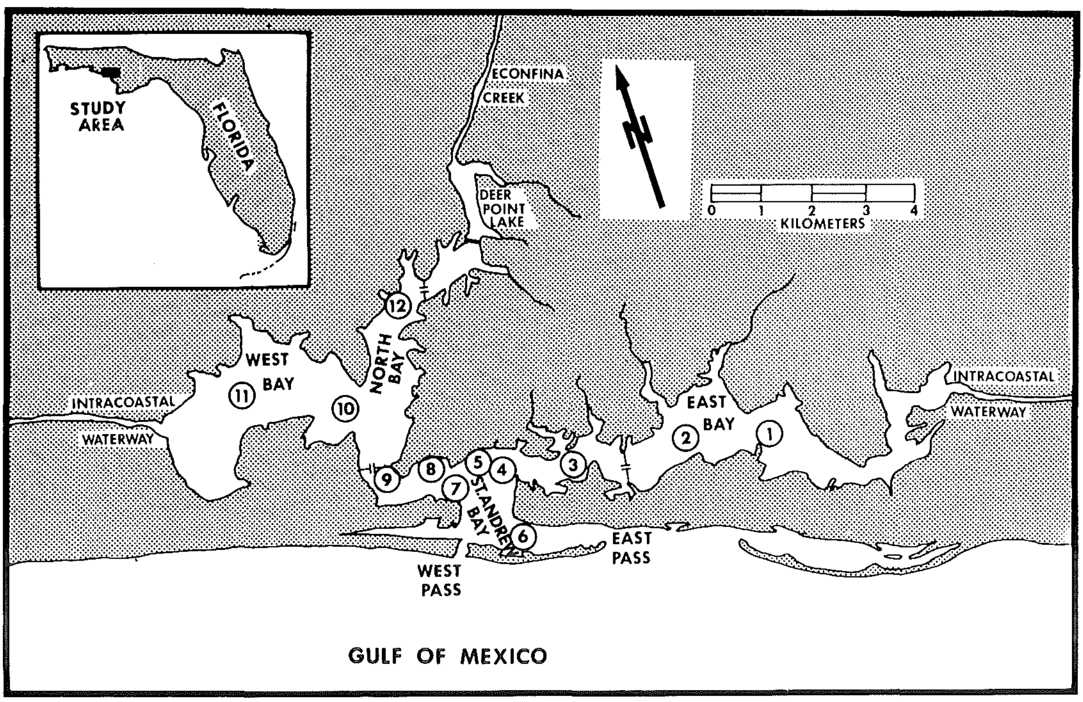

Figure 1. Location of sampling stations in the St. Andrew Bay system, Florida, 1972-1973 (from Brusher and Ogren 1976).

and Austin 1959; Waller 1961). These were summarized by Brusher and Ogren (1976). The salient environmental features discussed were low freshwater inflow, high salinity, low turbidity, extensive areas of sand flats and submerged spermatophytes, and a deep basin with both coarse and fine sediment regimes. In comparison with other estuaries located in the Gulf of Mexico from nothern Florida to Texas, water temperature fluctuations, freshwater inflow, and turbidities are lower, while water depths and salinities are greater for the St. Andrew Bay system (Brusher and Ogren 1976).

The stations in Figure 1 were grouped according to the following subareas: East Bay (Stations 1, 2); North Bay (Station 12); West Bay (Stations 10, 11); St. Andrew Bay (Stations 3-5, 7-9); and East Pass (Station 6). The upper bay area consisted of St. Andrew Bay and East Pass.

MATERIALS AND METHODS

Brusher and Ogren (1976) described the methods that were employed for this survey. Briefly, biological collections and hydrological measurements were taken bi-weekly from September 1972, through August 1973, at 12 stations. For convenience, Figure 1, which gives locations of the sampling stations from Brusher and Ogren (1976), is presented again.

The trawl that was used in this study has a 10.7-m headrope and a 2.5-cm stretched mesh in the cod end. It was towed at approximately 3.5 knots for 10 minutes at each station. Samples were taken on two consecutive nights between sunset and 2200-0200 hrs. Additional sampling was conducted on 23-24 August 1973, between 1000 and 1400 hrs at all of the stations for comparisons of the day and night catches.

Specimens in each sample were sorted to species, and the individuals of each species were counted and measured. A subsample of approximately 30 specimens was measured for each species, or, for some species numbering less than 100, all were measured. Lengths of fishes were measured horizontally from the most anterior projection of the jaw (either upper or lower) to the tip of the middle caudal ray. Sharks were measured horizontally across the maximum width of the disc. All measurements were made to the nearest 0.5 cm.

In the analysis of the catch regarding distribution and abundance, we recognize that the bias introduced by our collecting method (trawl selectivity and night collecting) does have an effect on catch, but that the catch per unit effort would provide us with the best method for comparisons. Differences in the mean catch per tow (MCPT) between subareas were tested with Tukey's *w*-procedure (Steel and Torrie 1960). Only those species numbering 25 or more individuals and occurring in four or more subareas were tested. In analyzing mean size distribution only those species numbering over 400 individuals were tested with Tukey's *w*-procedure. Abundance by collecting date was plotted for those species represented by 50 or more individuals.

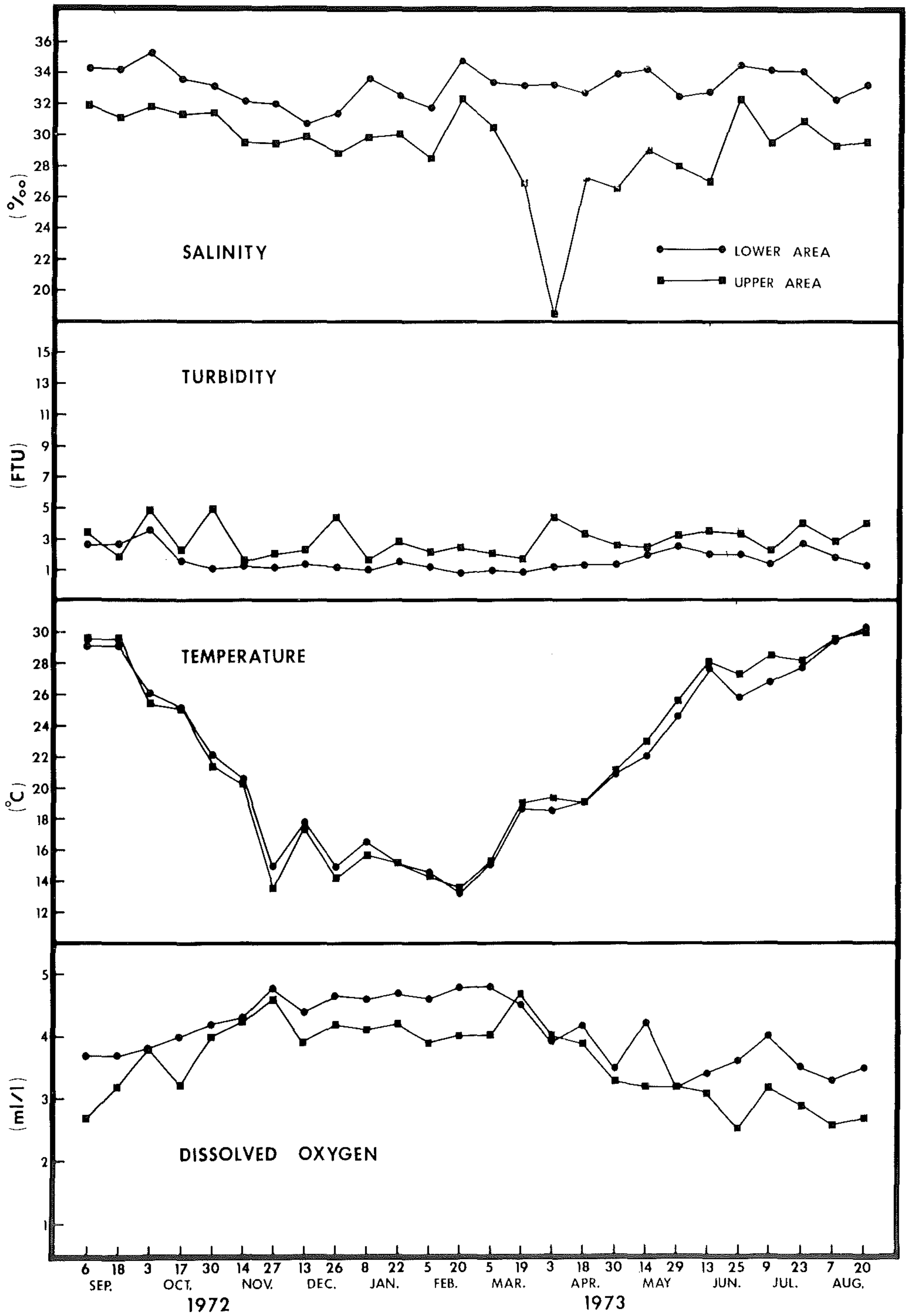

Figure 2. -- Mean values of environmental factors in the upper and lower areas of the St. Andrew Bay system, Florida, 1972-73 (From Brusher and Ogren 1976).

The terms estuarine and euryhaline are used in reference to species that are considered either to be estuarine dependent during some stage in their life history or to exhibit a broad salinity tolerance. Marine shore species are those that are more common in areas of higher salinity, but have been recorded from bays and estuaries when conditions are favorable. These terms are useful in describing the distribution patterns of fishes, as we interpret them in general terms.

Only the night trawl collections are discussed throughout the text and listed in the tables unless otherwise stated.

RESULTS

Environmental Factors

Brusher and Ogren (1976) summarized the hydrological data for the five subareas (Table 1) and presented the mean values for the sampling period for the combined upper and lower bay areas (Fig. 2). In general, the salinity and dissolved oxygen values were higher in the lower area, turbidity values were higher in the upper area, and temperatures were similar between the upper and lower areas. The average values for the upper and lower bay areas, respectively, were: temperature (°C), 21.8, 21.8; salinity (°/oo), 29.2, 33.2; turbidity (FTU), 3.0, 1.7; dissolved oxygen (ml/l), 3.6, 4.1).

During the study period, the mean annual rainfall for 1972 and 1973 for Bay County, Florida, was 135.89 cm and 199.85 cm, respectively (U. S. Department of Commerce, National Weather Service). Heavy spring rains in 1973 accounted for the drop in salinity recorded in the upper area for April (Fig. 2).

Table 1. - Means and ranges of environmental factors in subareas of the St. Andrew Bay systems, Florida, 1972-73 (from Brusher and Ogren 1976).

	SUBAREA				
Environmental factor	North Bay	West Bay	East Bay	East Pass	St. Andrew Bay
Salinity (°/oo)					
Mean	27.20	29.08	30.34	32.97	33.27
Range	13.1-32.5	20.5-34.1	25.3-33.9	30.3-35.2	30.6-35.6
Turbidity (FTU)					
Mean	2.69	3.40	2.63	1.09	1.75
Range	0.50-13.00	1.53-7.55	1.50-5.20	0.60-2.15	0.87-4.09
Temperature (°C)					
Mean	21.74	21.82	21.79	22.13	21.74
Range	13.1-31.1	13.6-30.2	13.8-29.9	13.0-30.2	13.2-30.0
Dissolved oxygen (ml/liter)					
Mean	3.87	3.77	3.27	4.43	4.01
Range	1.33-5.37	2.06-4.70	1.64-5.58	3.47-5.13	3.13-4.80
No. of samples	26	52	52	26	182

Table 2. - - Catches of fishes by trawling in the St. Andrew Bay system, Florida, 1972 - 1973.

Subarea	East Bay		St. Andrew			East Pass	St. Andrew			West Bay		North Bay	Total catch	% Total catch
Station No.	1	2	3	4	5	6	7	8	9	10	11	12		
Carcharhinidae (requiem sharks)														
Mustelus norrisi	0	0	0	0	1	5	1	0	0	0	0	0	7	0.003
Rhizoprionodon terraenovae	0	0	0	0	0	1	0	0	0	0	0	0	1	0.0005
Sphyrnidae (hammerhead sharks)														
Sphyrna lewini	0	0	0	0	0	0	0	0	1	0	0	0	1	0.0005
Sphyrna tiburo	0	0	0	1	0	0	0	0	0	0	0	0	1	0.0005
Rajidae (skates)														
Raja eglanteria	0	0	0	5	7	4	0	1	0	0	0	0	19	0.009
Dasyatidae (stingrays)														
Dasyatis sabina	9	0	0	2	12	5	1	2	0	2	3	20	56	0.03
Dasyatis sayi	1	1	0	0	2	6	0	2	0	3	2	1	18	0.009
Gymnura micrura	0	0	0	2	0	8	0	0	0	0	0	1	11	0.005
Lepisosteidae (gars)														
Lepisosteus osseus	1	0	0	0	0	0	0	0	0	0	0	7	8	0.004
Albulidae (bonefishes)														
Albula vulpes	1	0	0	0	0	0	0	0	0	0	0	0	1	0.0005
Muraenidae (morays)														
Gymnothorax nigromarginatus	0	0	0	1	4	4	3	0	0	0	0	0	12	0.006
Congridae (conger eels)														
Ariosoma impressa	0	0	0	1	0	0	0	0	0	0	0	0	1	0.0005
Ophichthidae (snake eels)														
Mystriophis intertinctus	0	0	0	0	0	1	0	0	0	0	0	0	1	0.0005
Ophichthus gomesi	8	13	13	12	7	10	20	22	9	14	17	3	148	0.07
Clupeidae (herrings)														
Alosa chrysochloris	0	1	0	0	0	0	0	0	0	1	0	0	2	0.001
Brevoortia patronus	18	0	0	0	11	0	1	1	0	5	107	2061	2204	1.1
Dorosoma petenense	7	0	0	0	0	0	0	0	0	1	2	8	18	0.009
Etrumeus teres	0	0	49	28	0	45	4	0	0	0	0	0	126	0.06
Harengula jaguana	164	34	184	236	328	9	1487	387	1184	33	38	127	4211	2.0
Opisthonema oglinum	51	44	212	53	15	26	34	18	231	31	69	172	956	0.5
Sardinella anchovia	5	10	17	62	3	2	20	4	169	11	4	12	319	0.2
Engraulidae (anchovies)														
Anchoa hepsetus	74	573	598	579	105	199	146	119	408	509	396	163	3869	1.9
Anchoa mitchilli	609	287	241	39	118	6	231	211	325	679	756	1180	4682	2.2
Anchoa nasuta	3	18	52	49	23	14	35	38	27	20	1	3	283	0.1
Synodontidae (lizardfishes)														
Synodus foetens	15	96	131	170	57	135	172	117	134	113	41	29	1210	0.6
Ariidae (sea catfishes)														
Arius felis	200	37	43	10	31	150	37	30	8	39	27	288	900	0.4
Bagre marinus	126	57	5	5	1	0	2	0	6	198	80	260	740	0.4
Batrachoididae (toadfishes)														
Opsanus beta	4	1	0	0	0	5	1	2	0	5	3	4	25	0.01
Porichthys porosissimus	110	145	89	45	7	27	53	57	54	128	61	27	803	0.4
Ogcocephalidae (batfishes)														
Ogcocephalus radiatus	0	0	0	1	4	1	3	0	0	0	0	0	9	0.004
Gadidae (codfishes)														
Urophycis floridanus	3	40	169	328	424	431	414	401	222	75	51	12	2570	1.2
Ophidiidae (cusk-eels, brotulas)														
Lepophidium brevibarbe	0	0	1	2	1	0	0	0	1	0	0	0	5	0.002
Ogilbia cayorum	0	1	1	0	0	0	0	0	0	0	0	0	2	0.001
Ophidion grayi	0	0	2	1	4	3	1	7	0	0	0	0	18	0.009
Ophidion welshi	0	2	12	18	26	8	24	26	15	4	1	0	136	0.06
Atherinidae (silversides)														
Membras martinica	0	0	0	0	0	0	0	0	0	0	0	1	1	0.0005
Syngnathidae (pipefishes, seahorses)*														
Hippocampus erectus	1	0	0	0	1	1	1	1	0	0	0	0	5	0.002
Syngnathus louisianae	1	1	1	0	1	1	0	0	1	2	1	0	9	0.004
Serranidae (sea basses)														
Centropristis melana	0	0	0	0	0	6	0	1	0	0	0	0	7	0.003
Centropristis ocyurus	0	0	1	1	2	0	2	0	1	0	0	0	7	0.003
Centropristis philadelphica	1	16	41	26	37	107	45	80	19	7	1	0	380	0.2
Diplectrum bivittatum	4	27	398	394	182	346	313	338	178	5	2	3	2190	1.0
Diplectrum formosum	8	10	53	45	251	39	264	135	46	3	2	9	865	0.4
Mycteroperca microlepis	0	0	0	0	0	1	0	0	0	0	0	0	1	0.0005

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Table 2. - (cont.)

Subarea	East Bay		St. Andrew			East Pass	St. Andrew			West Bay		North Bay	Total catch	% Total catch
Station No.	1	2	3	4	5	6	7	8	9	10	11	12		
Serraniculus pumilio	0	0	4	1	8	1	4	0	4	0	0	0	22	0.01
Serranus subligarius	0	0	0	0	0	2	0	1	0	0	0	0	3	0.001
Grammistidae (soapfishes)														
Rypticus maculatus	0	0	0	0	0	2	0	0	0	0	0	0	2	0.001
Priacanthidae (bigeyes)														
Priacanthus arenatus	0	0	1	5	2	1	0	0	1	0	0	0	10	0.005
Apogonidae (cardinalfishes)														
Apogon aurolineatus	0	0	2	10	1	0	12	1	0	0	0	0	26	0.01
Pomatomindae (bluefishes)														
Pomatomus saltatrix	1	0	0	0	0	0	0	0	0	0	2	1	4	0.002
Rachycentridae (cobias)														
Rachycentron canadum	0	0	0	0	0	1	0	0	0	0	0	0	1	0.0005
Echeneidae (remoras)														
Echeneis neucratoides	0	0	0	0	1	4	1	0	0	0	0	0	6	0.003
Carangidae (jacks, pompanos)														
Caranx crysos	0	0	1	0	0	0	0	0	0	0	0	0	1	0.0005
Caranx hippos	5	0	0	0	1	0	0	1	0	0	0	10	0	0.008
Chloroscombrus chrysurus	121	4	39	4	9	29	4	33	0	13	33	253	542	0.3
Oligoplites saurus	0	0	0	0	0	0	2	0	0	2	0	0	4	0.002
Selar crumenophthalmus	0	0	0	1	0	0	0	0	0	0	0	0	1	0.0005
Trachurus lathami	0	2	2	6	4	2	3	2	2	0	0	0	23	0.01
Vomer setapinnis	0	2	30	73	4	22	1	0	5	3	4	0	144	0.07
Lutjanidae (snappers)														
Lutjanus campechanus	0	0	4	14	3	1	22	16	2	0	0	0	62	0.03
Lutjanus griseus	1	0	0	0	0	0	0	0	0	0	0	1	2	0.001
Lutjanus synagris	0	0	4	0	8	1	3	34	1	0	0	0	51	0.02
Gerreidae (mojarras)														
Eucinostomus argenteus	39	30	173	264	526	852	269	740	126	22	15	29	3085	1.5
Eucinostomus gula	4	6	31	23	9	118	12	35	7	10	3	1	259	0.1
Pomadasyidae (grunts)														
Haemulon aurolineatum	0	0	18	3	5	1	13	0	1	0	0	0	41	0.2
Orthopristis chrysoptera	257	44	103	350	1425	1002	276	318	354	52	24	80	4285	2.1
Sparidae (porgies)														
Archosargus probatocephalus	2	0	0	0	0	0	0	0	0	0	0	0	2	0.001
Lagodon rhomboides	1269	20	52	285	281	139	69	191	53	36	51	3990	6436	3.1
Stenotomus caprinus	1	147	551	1241	6	323	590	125	189	100	0	0	3273	1.6
Sciaenidae (drums)														
Bairdiella chrysura	348	49	34	5	98	60	39	161	53	415	325	231	1818	0.9
Cynoscion arenarius	170	89	24	7	11	131	40	66	56	85	85	118	882	0.4
Cynoscion nebulosus	129	6	2	0	0	0	2	5	1	76	110	141	472	0.2
Equetus lanceolatus	0	0	0	0	1	1	1	0	0	0	0	0	3	0.001
Equetus umbrosus	0	0	0	0	0	7	1	0	0	0	0	0	8	0.004
Leiostomus xanthurus	2199	45	127	133	671	1219	56	245	39	693	3128	11223	19778	9.5
Menticirrhus americanus	88	19	1	1	2	1	1	3	9	12	2	18	157	0.08
Micropogon undulatus	10516	521	205	22	96	471	119	246	111	752	4519	13632	31210	15.0
Stellifer lanceolatus	0	1	0	0	0	0	0	0	1	0	0	0	2	0.001
Mullidae (goatfishes)														
Mullus auratus	0	0	0	3	0	0	0	0	0	0	0	0	3	0.001
Ephippidae (spadefishes)														
Chaetodipterus faber	6	1	0	2	1	1	0	0	0	1	12	5	29	0.01
Sphyraenidae (barracudas)														
Sphyraena borealis	0	0	0	0	0	0	3	0	0	0	0	0	3	0.001
Sphyraena guachancho	0	0	0	0	0	0	0	0	0	0	0	1	1	0.0005
Polynemidae (threadfins)														
Polydactylus octonemus	8204	9449	6110	9694	4380	6007	3320	7394	6847	7783	9265	17236	95689	46.1
Uranoscopidae (stargazers)														
Astroscopus y-graecum	1	0	0	0	0	0	0	0	0	0	3	0	4	0.002
Blenniidae (combtooth blennies)														
Chasmodes saburrae	0	0	0	0	0	0	0	0	0	1	0	0	2	0.0005
Hypsoblennius hentzi	3	0	0	0	0	0	0	0	0	2	0	0	5	0.002
Gobiidae (gobies)														
Bathygobius soporator	0	0	0	0	0	0	0	0	0	0	0	1	1	0.0005
Bollmannia communis	0	0	0	2	0	0	0	0	0	0	0	0	2	0.001

Table 2. - (cont.)

Subarea	East Bay		St. Andrew			East Pass	St. Andrew			West Bay		North Bay	Total catch	% Total catch
Station No.	1	2	3	4	5	6	7	8	9	10	11	12		
Gobioides broussonneti	1	0	0	0	0	0	0	0	0	1	0	0	2	0.001
Gobionellus boleosoma	1	1	4	24	0	5	0	7	2	2	0	0	46	0.02
Gobionellus hastatus	29	21	7	9	0	0	4	4	0	18	2	2	96	0.05
Trichiuridae (cutlassfishes)														
Trichiurus lepturus	1	1	1	0	1	1	0	1	0	0	0	0	6	0.003
Scombridae (mackerels, tunas)														
Scomber japonicus	0	0	0	0	0	0	1	0	0	0	0	0	1	0.0005
Scomberomorus cavalla	0	0	2	0	0	0	0	0	0	0	0	0	2	0.001
Scomberomorus maculatus	0	1	0	0	0	2	3	0	0	1	0	0	7	0.003
Stromateidae (butterfishes)														
Peprilus alepidotus	15	0	3	20	6	2	2	0	4	1	6	2	61	0.03
Peprilus burti	46	30	8	29	21	7	52	95	41	31	109	82	551	0.3
Scorpaenidae (scorpionfishes)														
Scorpaena brasiliensis	0	0	0	5	16	9	5	3	2	0	0	0	40	0.02
Triglidae (searobins)														
Prionotus ophryas	0	0	0	0	0	0	1	0	0	0	0	0	1	0.0005
Prionotus rubio	0	1	0	6	0	7	1	1	0	0	0	1	17	0.008
Prionotus salmonicolor	14	10	7	26	25	51	32	30	12	3	23	0	233	0.1
Prionotus scitulus	25	99	65	82	249	287	184	113	103	20	1	4	1232	0.6
Prionotus tribulus	55	97	36	17	12	25	13	32	30	29	44	101	491	0.2
Bothidae (lefteye flounders)														
Ancylopsetta quadrocellata	1	1	17	15	23	37	32	33	8	3	5	1	176	0.08
Bothus robinsi	0	0	0	0	0	2	0	0	0	0	0	0	2	0.001
Citharichthys macrops	0	1	4	4	34	15	25	11	2	1	0	0	97	0.05
Citharichthys spilopterus	1	2	8	8	1	3	5	3	0	3	0	3	37	0.02
Cyclopsetta chittendeni	0	0	0	2	1	7	3	1	0	0	0	0	14	0.007
Etropus crossotus	1	29	29	34	27	189	54	46	53	30	16	13	521	0.2
Etropus rimosus	2	13	20	131	170	253	87	90	34	1	0	0	801	0.4
Paralichthys albigutta	4	4	3	6	15	26	24	20	0	2	1	0	105	0.05
Syacium gunteri	0	0	5	31	65	23	23	12	6	1	0	0	166	0.08
*Syacium papillosum**														
Soleidae (soles)														
Achirus lineatus	0	2	1	1	5	7	11	3	2	3	1	2	38	0.02
Gymnachirus melas	0	0	0	0	1	0	1	0	0	0	0	0	2	0.001
Trinectes maculatus	47	9	1	4	0	1	8	7	0	0	3	1	81	0.04
Cynoglossidae (tonguefishes)														
Symphurus diomedianus	0	0	0	0	1	0	0	1	2	0	0	0	4	0.002
Symphurus plagiusa	306	496	618	699	474	443	1326	703	793	647	296	119	6920	3.3
Symphurus urospilus	0	0	0	0	1	0	0	0	0	0	0	0	1	0.0005
Balistidae (triggerfishes, filefishes)														
Aluterus schoepfi	0	0	0	0	3	0	1	0	0	0	0	0	4	0.002
Balistes capriscus	0	0	0	0	0	1	1	0	0	0	0	0	2	0.001
Monacanthus ciliatus	0	0	0	1	1	0	4	1	0	0	0	0	7	0.003
Monacanthus hispidus	1	4	0	0	7	9	7	2	1	0	1	9	41	0.02
Ostraciidae (boxfishes)														
Lactophrys quadricornis	17	5	2	1	35	9	24	18	7	5	4	25	152	0.07
Tetraodontidae (puffers)														
Lagocephalus laevigatus	0	0	0	0	1	0	0	0	0	0	0	0	1	0.0005
Sphoeroides nephelus	55	48	3	1	12	0	3	8	10	17	5	5	167	0.08
*Sphoeroides parvus**														
Diodontidae (porcupinefishes)														
Chilomycterus schoepfi	26	2	2	3	8	11	17	16	2	14	6	7	114	0.05
Total number	25436	12726	10677	15424	10433	13439	10132	12879	12014	12779	19769	51739	207447	
Total species	64	60	69	73	78	83	80	69	58	62	54	56	126**	
Mean catch per tow	978.3	489.5	410.7	593.2	401.3	516.9	389.7	495.3	462.1	491.5	760.3	199.0	664.9	
Depth range(m)	4.6-6.1	7.6-9.1	7.6-9.1	10.7-12.2	6.1-7.6	6.1-7.6	7.6-9.1	6.1-7.6	10.7-12.2	6.1-7.6	3.1-4.6	1.5-3.1		

**Syacium papillosum* catch data were combined with *S. gunteri,* and *Sphoeroides parvus* catch data were combined with *S. nephelus,* because of identification difficulties.

**Total species actually 128.

Catches

The total catch of fishes for the year's night trawl collections (312 samples) was 207,447 individuals. They represented 128 species and 51 families of primarily marine shore and estuarine fishes. The catches are summarized by station in Table 2. Catches varied greatly between subareas, and were highest at Station 12, North Bay subarea, where 25% of the total catch was obtained. Conversely, at Station 7, located adjacent to the navigation channel in St. Andrew Bay, only about 5% of the total year's catch was obtained. The MCPT for the upper bay area was 941.9, more than twice that of the lower bay area which was 467.0.

The 13 most abundant species made up 90.7% of the total catch. Of the 20 most abundant species that made up 95.5% of the total catch, 14 species were typically estuarine or euryhaline (*Brevoortia patronus, Anchoa mitchilli, Synodus foetens, Arius felis, Urophycis floridanus, Eucinostomus argenteus, Orthopristis chrysoptera, Lagodon rhomboides, Bairdiella chrysura, Cynoscion arenarius, Leiostomus xanthurus, Micropogon undulatus, Polydactylus octonemus, Symphurus plagiusa*). The large catches observed for some of these species were directly related to their abundance as juveniles in the North Bay subarea. The remaining six species (*Harengula jaguana, Opisthonema oglinum, Anchoa hepsetus, Diplectrum bivittatum, Stenotomus caprinus, Prionotus scitulus*) were primarily marine shore fishes.

In contrast, investigations of other estuarine systems located in the southern United States found that five to nine of the most abundant species made up 90-97% of the total catch (Christmas 1973; Livingston et al. 1975; Turner and Johnson 1973; Swingle 1971). If it were not for the unusual abundance of *Polydactlus octonemus* in the last half of our survey, which accounted for 46% of the total catch, the number of species comprising over 90% of our total catch would have been much greater. *Polydactylus* first appeared in our collections in the middle of March 1973; peak abundance occurred in late June when we recorded a MCPT of 1,326.1. None was collected in 1972. Recalculating the catch data minus *Polydactylus*, 19 and 26 of the most abundant species would have comprised 90% and 95% of our total catch, respectively.

Differences in catches between night and day, for a single sampling period at the conclusion of the survey, are shown in Table 3. These day catches were not included in the analysis of the regular night collections conducted for the one year period. The total (day: 21,053; night: 20,045) and number of species (day: 51; night: 56) were approximately the same; however, differences did exist in the species composition. Fifteen species were caught only during the day, whereas 20 species were caught only at night. Many of the small benthic species are apparently nocturnal and remain burrowed during daylight hours, and thus not encountered by the trawl. Some of the larger demersal species may be more active at night; they may have left their diurnal retreats in grass flats, reefs, and jetties to forage about the bay bottom.

Distribution and Abundance

The species composition from the upper and lower bay areas differed considerably. In the lower bay area, we recorded 114 species, of which 45 species were caught only in that area (Table 2). In comparison, 83 species were recorded from the upper bay area, but only 14 species (*Albula vulpes, Pomatomus saltatrix, Lutjanus griseus, Archosargus probatocephalus, Sphyraena guachancho, Astroscopus y-graecum*) are not generally restricted to low salinity waters, except when young, but range widely throughout the coastal zone, especially as adults. All of the 45 species recorded exclusively from the lower bay area generally are considered to be typical of shore or higher salinity habitats. Although this latter group of fishes represented 35% of the species recorded for the entire bay system it accounted for only 0.26% of the total catch.

Typically euryhaline forms, such as *Dasyatis sabina, Brevoortia patronus, Anchoa mitchilli, Cynoscion nebulosus, Leiostomus xanthurus, Menticirrhus americanus, Micropogon undulatus, Prionotus tribulus,* and *Trinectes maculatus,* were more abundant in one or more subareas of the upper bay as indicated by the significantly greater MCPTs in the upper bay subareas (North, West and East Bay) (Table 4). *Brevoortia patronus* and *Cynoscion nebulosus* were not collected by the trawl from the East Pass subarea, although they are common as adults in this subarea.

Conversely, *Anchoa nasuta, Synodus foetens, Urophycis floridanus, Ophidion welshi, Centropristis philadelphica, Diplectrum bivittatum, D. formosum, Eucinostomus argenteus, E. gula, Prionotus salmonicolor, P. scitulus, Ancylopsetta quadrocellata, Citharichthys macrops, Etropus crossotus, E. rimosus, Paralichthys albigutta,* and *Symphurus plagiusa* were more abundant in subareas of the lower bay (St. Andrew Bay and East Pass). Although these species occurred throughout the bay system, and some have been found commonly in other estuarine systems, their MCPTs were significantly greater in the higher salinity area (Table 4). *Ophidion welshi, Centropristis philadelphica, Prionotus salmonicolor, Citharichthys macrops, Etropus rimosus,* and *Paralichthys albigutta*, all typically marine shore species, were not collected in North Bay, the subarea with the lowest salinity. Fishes not listed in Table 4 showed no significant differences in their MCPTs between subareas.

Pronounced seasonal changes in abundance and composition of the fish fauna of the bay system occurred during the survey. The catches by season for all species are listed in Table 5, and the percent of the total catch of fishes and the total number of species are shown in Figure 3. With the onset of colder water temperatures in the fall and winter, catches declined to a low of 6.6% of the total during the winter months. In the summer months, when water temperatures reached their maxima for the year, catches were highest, 59.5% of the total. Only in winter season did we observe a notable change in the number of species in our collections. The number of species was 70 in the winter, while it ranged from 89 to 94 during the remaining seasons (Fig. 3).

Abundance by season for those species that were represented by 50 or more individuals (Table 5) was as

Table 3. — Day and Night catches of fishes caught by trawling in the St. Andrew Bay system, Florida, August 20-24, 1973.

Species	Catches	
	Day	Night
Rhizoprionodon terraenovae	1	
Dasyatis sabina		1
Dasyatis sayi		3
Gymnura micrura	2	1
Rhinoptera bonasus	1	
Lepisosteus osseus		5
Ophichthus gomesi	1	11
Alosa chrysochloris	6	
Brevoortia patronus	84	21
Brovoortia smithi	1	
Dorosoma petenense	5	
Harengula jaguana	67	2
Opisthonema oglinum	128	8
Sardinella anchovia	16	1
Anchoa hepsetus	308	151
Anchoa mitchilli	117	117
Anchoa nasuta	1	
Synodus foetens	208	45
Arius felis	48	59
Barge marinus	91	65
Porichthys porosissimus	3	63
Ogilbia cayorum		1
Ophidion welshi		4
Centropristis philadelphica		15
Diplectrum bivittatum	31	160
Diplectrum formosum	19	69
Apogon aurolineatus		1
Rachycentron canadum	1	
Caranx crysos		1
Caranx hippos	3	
Chloroscombrus chrysurus	203	139
Oligoplites saurus	1	
Selene vomer	1	
Trachinotus carolinus	1	
Vomer setapinnis	1	
Lutjanus campechanus	2	5
Lutjanus synagris		2
Eucinostomus argenteus	1,009	882
Eucinostomus gula	1	2
Orthopristis chrysoptera	540	1,341
Lagodon rhomboides	517	1,678
Stenotomus caprinus	10	14
Bairdiella chrysura	1	11
Cynoscion arenarius	365	74
Cynoscion nebulosus	6	17
Leiostomus xanthrus	1,946	3,140
Menticirrhus americanus		1
Micropogon undulatus	2,126	2,537
Polydactylus octonemus	13,138	9,049
Gobionellus hastatus	1	2
Trichiurus lepturus	2	
Scomberomorus maculatus		2
Peprilus alepidotus	1	
Peprilus burti	2	
Prionotus salmonicolor		22
Prionotus scitulus	2	38
Prionotus tribulus		3
Ancylopsetta quadrocellata	1	2
Citharichthys macrops		1
Citharichthys spilopterus		2
Cyclopsetta chittendeni		1
Etropus crossotus	4	58
Etropus rimosus	10	44
Paralichthys albigutta	1	
Syacium gunteri / papillosum	2	1
Achirus lineatus		1
Trinectes maculatus		2
Symphurus plagiusa	13	160
Monacanthus hispidus		5
Lactophrys quadricornis		1
Chilomycterus schoepfi	4	3
Total	21,053	20,045

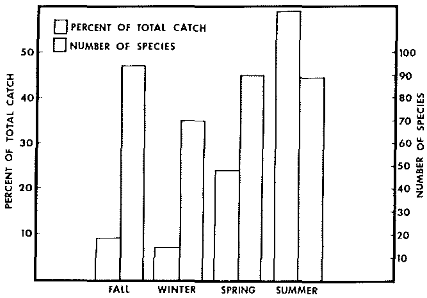

Figure 3. — Seasonal abundance (per cent of total catch) and species (number) of fishes caught by trawling in the St. Andrew Bay system, Florida, 1972 - 73.

follows. Most abundant in the fall were: *Opisthonema oglinum, Sardinella anchovia, Arius felis, Porichthys porosissimus, Diplectrum bivittatum, D. formosum, Chloroscombrus chrysurus, Vomer setapinnis, Lutjanus campechanus, L. synagris, Eucinostomus argenteus, E. gula, Bairdiella chrysura, Cynoscion arenarius, C. nebulosus, Peprilus alepidotus, Citharichthys macrops, Paralichthys albigutta, Trinectes maculatus,* and *Symphurus plagiusa.* Most abundant in the winter were: *Dasyatis sabina, Harengula jaguana, Anchoa hepsetus, A. nasuta, Synodus foetens, Menticirrhus americanus, Peprilus burti, Prionotus scitulus, P. tribulus, Lactophrys quadricornis,* and *Chilomycterus schoepfi.* Most abundant in the spring were: *Brevoortia patronus, Etrumeus teres, Anchoa mitchilli, Urophycis floridanus, Stenotomus caprinus, Gobionellus hastatus, Ancylopsetta quadrocellata,* and *Etropus rimosus.* And most abundant in the summer were: *Ophichthus gomesi, Bagre marinus, Ophidion welshi, Centropristis philadelphica, Orthopristis chrysoptera, Lagodon rhomboides, Leiostomus xanthurus, Micropogon undulatus, Polydactylus octonemus, Prionotus salmonicolor,* and *Etropus crossotus.* Variations in catches of these species by collecting date are depicted in Figure 4. We interpret declines in catches during the fall and winter months as movements out of the bay in response to low temperatures. Spring and summer abundance, conversely, is interpreted as movement into the bay. Other seasonal movements are suggested and will be discussed below.

Size

Comparisons of mean total lengths for some of the more abundant and widely distributed species were made between subareas. The smaller individuals of typically euryhaline species (*Brevoortia patronus, Bagre marinus, Chloroscombrus chrysurus, Cynoscion arenarius, C. nebulosus, Leiostomus xanthurus, Micropogon undulatus, Prionotus tribulus, Symphurus plagiusa*) were most frequently observed in the North Bay subarea. Statistically significant differences between the mean lengths for the above named species were found when these data were compared between subareas (Table 6). In general, the smaller individuals of other fishes were found in the lower salinity areas and the larger fishes were more frequently observed in the higher salinity water of the St. Andrew Bay and East Pass subareas. No significant differences in comparisons of mean total lengths between subareas were found for the other fishes.

DISCUSSION

The most salient feature of our catch was the great variety of fishes that occurred in the bay system. The faunal differences that we observed

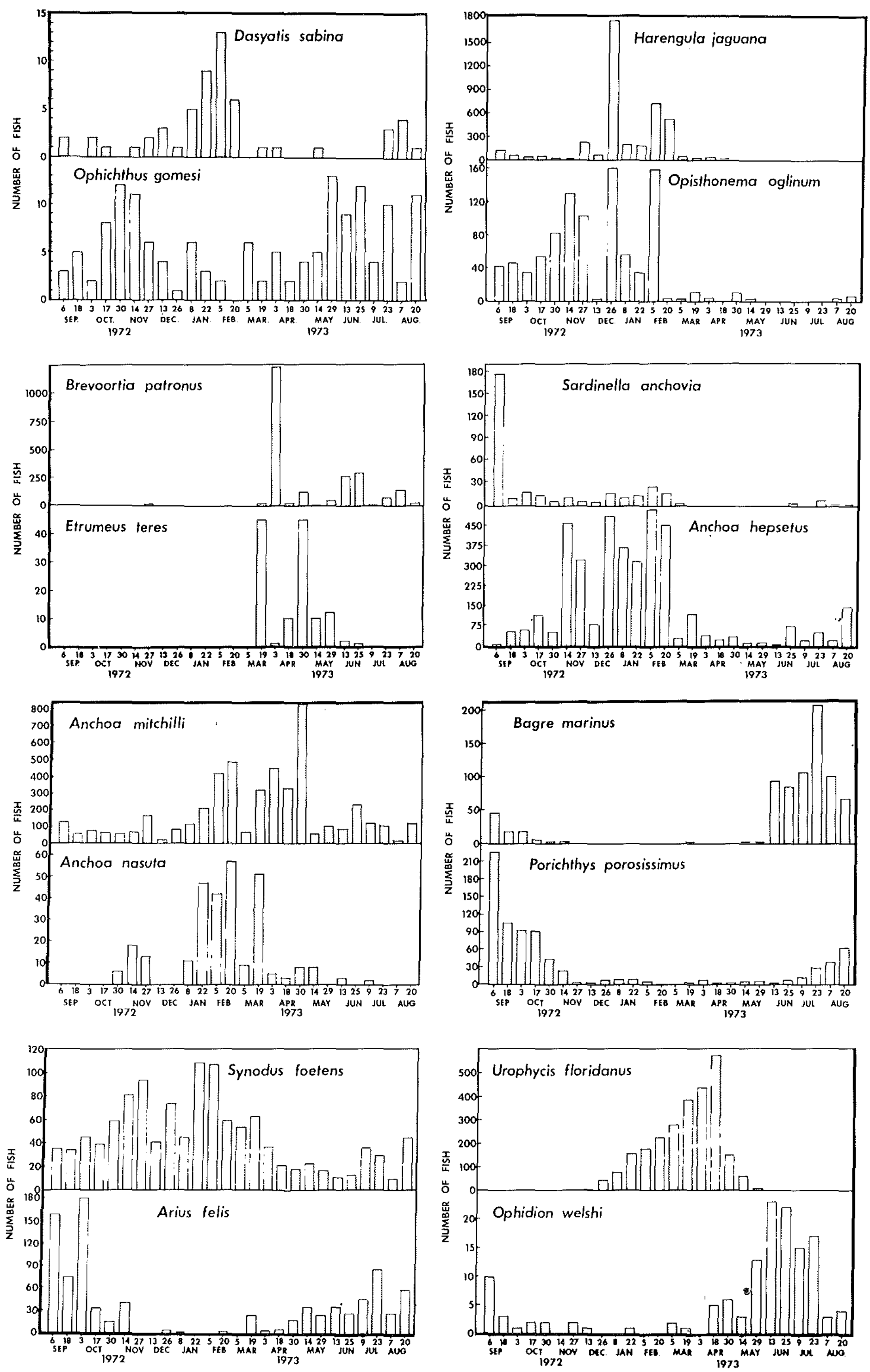

Figure 4. — Catches by sampling date of selected fishes (more than 50 individuals) caught by trawling in the St. Andrew Bay system, Florida, 1972-73.

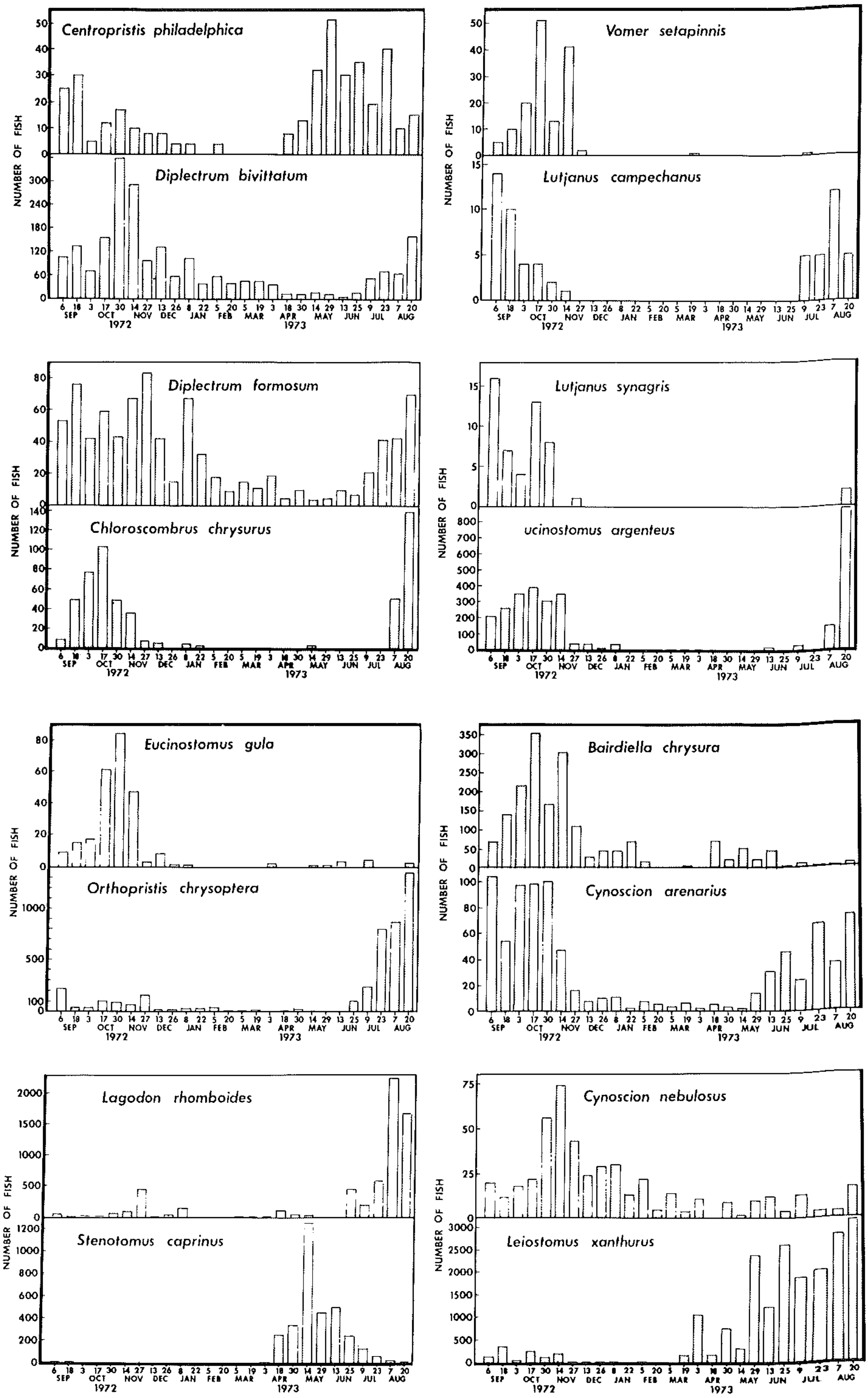

Figure 4. — (cont.)

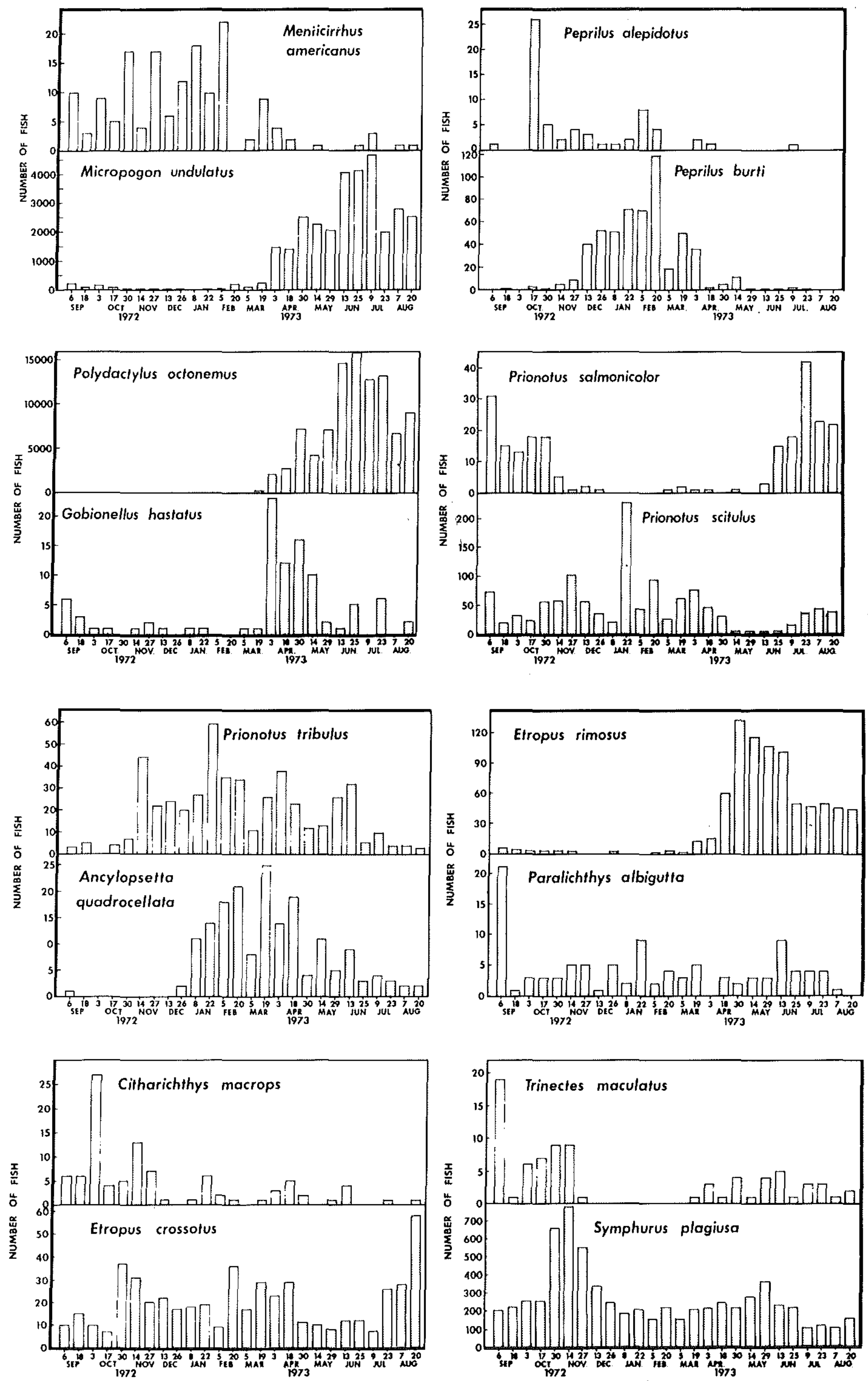

Figure 4. — (cont.)

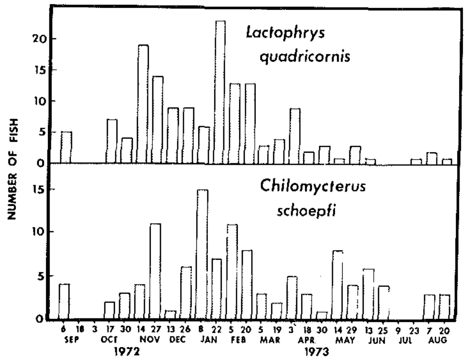

Figure 4. — (cont.)

when our data were compared to those of other estuaries in the northern Gulf of Mexico are most probably due to the low freshwater inflow into the system, greater depths, proximity to the clear oceanic gulf waters, and presence of extensive coarse, sandy sediments and marine grass beds.

More fishes were collected from the upper bay area than from the lower bay area despite more stations in the latter area. The MCPT of the former was almost twice that of the lower bay area. Some statistically significant differences of MCPTs between subareas were found for euryhaline and marine shore fishes. The former were more abundant in the lower bay subareas. Comparison of mean lengths between subareas showed smaller individuals occurring more frequently in areas of low salinity and shallow depth (i. e. the upper bay area).

Seasonality in the abundance and composition of our catch was evident (Fig. 4). Mean temperature (in Fig 2), the most varible observed environmental factor, was compared with the above catch data. Movements or migrations were suggested and were probably related to depth and temperature. For migratory species and some marine shore residents, the response to decreasing water temperature in fall and winter resulted in a seaward movement (*Arius felis, Bagre marinus, Centropristis philadelphica, Chloroscombrus chrysurus, Vomer setapinnis, Lutjanus campechanus, L. synagris, Eucinostomus argenteus, E. gula, Orthopristis chrysoptera, Lagodon rhomboides, Bairdiella chrysura, Cynoscion arenarius, C. nebulsus, Leiostomus xanthurus, Micropogon undulatus, Prionotus salmonicolor*). A corresponding increase in sightings or abundance was observed in the fall two miles offshore at a depth of 19 m for some of these species (*Arius felis, Centropristis philadelphica, Lutjanus campechanus, Orthopristis chrysoptera, Leiostomus xanthurus*) by Hastings et al. (1976). For some species, such as *Paralichthys albigutta*, part of the population remains in the bay throughout most of the year. However, large aggregations of this species occur offshore in the fall (Ogren, personal observation). Re-population of the bay by these species occurs in the spring and summer along with increasing water temperature. Movements of this kind have been reported for other estuarine systems. This migratory behavior of coastal fishes has long been recognized as a permanent feature of temperate estuarine communities. For many species, these migrations are considered to be related to reproduction, recruitment of young or feeding as well. Low catches for some benthic species that occurred during the colder months may be due to their burrowing habits and inactivity in response to cold water temperatures and not entirely to their migration out of the system (*Ophidion welshi, Diplectrum bivittatum, D. form-*

Table 4 - Comparisons of mean catch per tow of some fishes caught by trawling between subareas in the St Andrew Bay system, Florida, 1972-73.*

Species	Subarea, Mean ( ), and Significance lines*					Degrees of Freedom
Species Demonstrating A Mean Catch Per Tow Highest In Upper Bay Area						
Dasyatis sabina	West Bay (.10)	St. Andrew Bay (.11)	East Bay (.17)	East Pass (.19)	North Bay (.77)	125
Brevoortia patronus	St. Andrew Bay (0.08)	West Bay (0.10)	East Bay (0.35)	North Bay (79.27)		100
Anchoa mitchilli	East Pass (0.2)	St. Andrew Bay (7.4)	East Bay (17.2)	West Bay (27.6)	North Bay (45.4)	125
Cynoscion nebulosus	St. Andrew Bay (0.1)	East Bay (2.6)	West Bay (3.6)	North Bay (5.4)		100
Leiostomus xanthurus	St. Andrew Bay (8.4)	East Bay (43.1)	East Pass (46.9)	West Bay (73.5)	North Bay (431.6)	125
Menticirrhus americanus	East Pass (0.04)	St. Andrew Bay (0.11)	West Bay (0.27)	North Bay (0.69)	East Bay (2.06)	125
Micropogon undulatus	St. Andrew Bay (5.1)	East Pass (18.1)	West Bay (101.4)	East Bay (212.2)	North Bay (524.2)	125
Prionotus tribulus	St. Andrew Bay (0.90)	East Pass (0.96)	West Bay (1.38)	East Bay (2.92)	North Bay (3.88)	125
Trinectes maculatus	East Pass (0.04)	North Bay (0.04)	West Bay (0.06)	St. Andrew Bay (0.11)	East Bay (1.08)	125
Species Demonstrating A Mean Catch Per Tow Highest in Lower Bay Area						
Anchoa nasuta	North Bay (0.12)	West Bay (0.35)	East Bay (0.40)	East Pass (0.54)	St. Andrew Bay (1.43)	125
Synodus foetens	North Bay (1.1)	East Bay (2.1)	West Bay (3.0)	St. Andrew Bay (4.6)	East Pass (5.2)	125
Urophycis floridansu	North Bay (0.5)	East Bay (0.8)	West Bay (2.4)	St. Andrew Bay (12.5)	East Pass (16.6)	125
Ophidion welshi	East Bay (0.04)	West Bay (0.1)	East Pass (0.3)	St. Andrew Bay (0.8)		100
Centropristis philadelphica	West Bay (0.13)	East Bay (0.33)	St. Andrew Bay (1.58)	East Pass (4.12)		100
Diplectrum bivittatum	North Bay (0.1)	West Bay (0.1)	East Bay (0.6)	St. Andrew Bay (11.6)	East Pass (13.3)	125
Diplectrum formosum	West Bay (0.1)	East Bay (0.3)	North Bay (0.3)	East Pass (1.5)	St. Andrew Bay (5.1)	125
Eucinostomus argenteus	West Bay (0.7)	North Bay (1.1)	East Bay (1.3)	St. Andrew Bay (13.4)	East Pass (32.8)	125
Eucinostomus gula	North Bay (0.04)	East Bay (0.19)	West Bay (0.25)	St. Andrew Bay (0.75)	East Pass (4.54)	125
Prionotus salmonicolor	East Bay (0.5)	West Bay (0.5)	St. Andrew Bay (1.0)	East Pass (2.0)		100
Prionotus scitulus	North Bay (0.15)	West Bay (0.40)	East Bay (2.38)	St. Andrew Bay (5.08)	East Pass (11.04)	125
Ancylopsetta quadrocellata	North Bay (0.04)	East Bay (0.04)	West Bay (0.15)	St. Andrew Bay (0.82)	East Pass (1.42)	125
Citharichthys macrops	East Bay (0.02)	West Bay (0.02)	St. Andrew Bay (0.5)	East Pass (0.6)		100
Etropus crossotus	North Bay (0.50)	East Bay (0.58)	West Bay (0.88)	St. Andrew Bay (1.56)	East Pass (7.27)	125
Etropus rimosus	West Bay (0.02)	East Bay (0.29)	St. Andrew Bay (3.41)	East Pass (9.73)		100
Paralichthys albigutta	West Bay (0.06)	East Bay (0.15)	St. Andrew Bay (0.43)	East Pass (1.0)		100
Symphurus plagiusa	North Bay (4.6)	East Bay (15.4)	East Pass (17.0)	West Bay (18.1)	St. Andrew Bay (29.6)	125

*Any two means not underscored by the same line are significantly different at the 5% level (Tukey's -w procedure).

Table 5. — Seasonal catches of fishes by trawling in the St. Andrew Bay systems, Florida, 1972-73.

Species	Fall	Winter	Spring	Summer	Total
Mustelus norrisi	2	2	2	1	7
Rhizoprionodon terraenovae				1	1
Sphyrna lewini				1	1
Sphyrna tiburo			1		1
Raja eglanteria	8	9	2		19
Dasyatis sabina	8	37	3	8	56
Dasyatis sayi	5		5	8	18
Gymnura micrura	1	1	3	6	11
Lepisosteus osseus	1		1	6	8
Albula vulpes		1			1
Gymnothorax nigromarginatus	7		3	2	12
Ariosoma impressa			1		1
Mystriophis intertinctus		1			1
Ophichthus gomesi	47	16	37	48	148
Alosa chrysochloris	1		1		2
Brevoortia patronus	13	1	1,414	776	2,204
Dorosoma petenense	2	8	4	4	18
Etrumeus teres			123	3	126
Harengula jaguana	537	3,520	140	14	4,211
Opisthonema oglinum	492	416	35	13	956
Sardinella anchovia	230	78	1	10	319
Anchoa hepsetus	1,057	2,211	270	331	3,869
Anchoa mitchilli	600	1,314	2,114	654	4,682
Anchoa nasuta	37	157	84	5	283
Synodus foetens	387	445	233	145	1,210
Arius felis	500	6	111	283	900
Bagre marinus	88		3	649	740
Opsanus beta	4	1	18	2	25
Porichthys porosissimus	582	35	30	156	803
Ogcocephalus radiatus		4	5		9
Urophycis floridanus		679	1,891		2,570
Lepophidium brevibarbe	2		3		5
Ogilbia cayorum			1	1	2
Ophidion grayi	6	6	6		18
Ophidion welshi	20	2	30	84	136
Membras martinica		1			1
Hippocampus erectus	2	1	2		5
Synganthus louisianae	4	3		2	9
Centropristis melana			7		7
Centropristis ocyurus	3	1	1	2	7
Centropristis philadelphica	107	20	104	149	380
Diplectrum bivittatum	1,210	425	182	373	2,190
Diplectrum formosum	423	183	69	190	865
Mycteroperca microlepis				1	1
Serraniculus pumilio	9	13			22
Serranus subligarius	1		2		3
Rypticus maculatus			2		2
Priacanthus arenatus			7	3	10
Apogon aurolineatus	10		5	11	26
Pomatomus saltatrix		2	2		4
Rachycentron canadum				1	1
Echeneis neucratoides	6				6
Caranx crysos				1	1
Caranx hippos	10			7	17
Chloroscombrus chrysurus	332	14	5	191	542
Oligoplites saurus	1		2	1	4
Selar crumenophthalmus				1	1
Trachurus lathami			20	3	23
Vomer setapinnis	142		1	1	144
Lutjanus campechanus	35			27	62
Lutjanus griseus	2				2
Lutjanus synagris	49			2	51
Eucinostomus argenteus	1,900	86	5	1,094	3,085
Eucinostomus gula	236	10	4	9	259
Haemulon aurolineatum	37	1		3	41

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Table 5. — (cont.)

Species	Fall	Winter	Spring	Summer	Total
Orthopristis chrysoptera	714	139	76	3,356	4,285
Archosargus probatocephalus		2			2
Lagodon rhomboides	720	221	288	5,207	6,436
Stenotomus caprinus	3		2,303	967	3,273
Bairdiella chrysura	1,352	205	176	85	1,818
Cynoscion arenarius	516	46	41	279	882
Cynoscion nebulosus	245	123	50	54	472
Equetus lanceolatus	3				3
Equetus umbrosus	1	1	1	5	8
Leiostomus xanthurus	1,104	52	4,872	13,750	19,778
Menticirrhus americanus	65	68	18	6	157
Micropogon undulatus	609	204	10,085	20,276	31,210
Stellifer lanceolatus	2				2
Mullus auratus			3		3
Chaetodipterus faber	23			6	29
Sphyraena borealis				3	3
Sphyraena guachancho				1	1
Polydactylus octonemus			23,438	72,251	95,689
Astroscopus y-graecum	3		1		4
Chasmodes saburrae		1			1
Hypsoblennius hentzi		1	4		5
Bathygobius soporator	1				1
Bollmannia communis			2		2
Gobioides broussonneti			2		2
Gobionellus boleosoma	12	15	15	4	46
Gobionellus hastatus	14	3	65	14	96
Trichiurus lepturus	3			3	6
Scomber japonicus			1		1
Scomberomorus cavalla	2				2
Scomberomorus maculatus	4		1	2	7
Peprilus alepidotus	38	19	3	1	61
Peprilus burti	19	403	124	5	551
Scorpaena brasiliensis	22	7	8	3	40
Prionotus ophryas	1				1
Prionotus rubio	5		3	9	17
Prionotus salmonicolor	101	3	6	123	233
Prionotus scitulus	364	478	248	142	1,232
Prionotus tribulus	85	199	149	58	491
Ancylopsetta quadrocellata	1	66	86	23	176
Bothus robinsi	2				2
Citharichthys macrops	68	11	12	6	97
Citharichthys spilopterus	23	11		3	37
Cyclopsetta chittendeni	5			9	14
Etropus crossotus	130	121	127	143	521
Etropus rimosus	21	6	441	333	801
Paralichthys albigutta	41	23	19	22	105
Syacium gunteri / papillosum	81	60	22	3	166
Achirus lineatus	15	5	11	7	38
Gymnachirus melas	1	1			2
Trinectes maculatus	52		14	15	81
Symphurus diomedianus			2	2	4
Symphurus plagiusa	2,930	1,356	1,682	952	6,920
Symphurus urospilus	1				1
Aluterus schoepfi	4				4
Balistes capriscus	1		1		2
Monacanthus ciliatus	2			5	7
Monacanthus hispidus	19	2	5	15	41
Lactophrys quadricornis	49	73	25	5	152
Lagocephalus laevigatus				1	1
Sphoeroides nephelus / parvus	30	77	50	10	167
Chilomycterus schoepfi	24	48	26	16	114
Total catch	18,687	13,796	51,501	123,463	207,447
Percent of total catch	9.0%	6.6%	24.8%	59.5%	
No. of species	94	70	90	89	126
Percent of total species	75%	56%	71%	71%	

osum, Gobionellus hastatus, Citharichthys macrops, Etropus crossotus, E. rimosus, Trinectes maculatus).

Movement from shallow to deep water within the bay system in response to low water temperatures during the winter months is thought to have occurred with several typically temperate marine shore or euryhaline species (*Dasyatis sabina, Anchoa mitchilli, Synodus foetens, Cynoscion nebulosus, Menticirrhus americanus, Prionotus scitulus, P. tribulus, Paralichthys albigutta, Lactophrys quadricornis, Chilomycterus schoepfi*). These species are generally considered to be resident forms and are present year-round in the bay and nearshore environment (Allison 1961; Hastings 1972). They probably retreat in the winter from the more exposed sand and grass flat habitats into the deeper channels to escape low water temperatures. During intervening warming trends, they then move back to the shoal areas. This behavior may not be as evident in other estuaries which lack the depth and channels. Depth is the important factor and is necessary to provide some protection from the colder shallow water in winter. The fact that few, if any, winter kills of estuarine fishes, which are common in Louisiana and Texas, have been reported for this system supports this inference. Other fishes, not mentioned above, that were present in the bay system (marine shore and reef species) may be similarly affected by low water temperatures. These fishes normally are found on the sand and grass flats, oyster reefs and on various man-made structures near the littoral zone. However, this movement from shoal to deep water, inferred from our catches, probably continues out into the gulf for some of the fishes when the water temperature declines further or low temperatures persist.

Another movement or migration that is suggested by our data occurred during the colder months and involved and immigration from offshore. An abundance in the catches at this time was observed for six species of pelagic fishes or fishes that are pelagic in their juvenile stage. They were represented by two clupeids, two engraulids, and two stromateids. The young or small sized species of some marine shore or euryhaline fishes were also more frequently encountered during the colder months. Some were entirely absent from our catches during the summer when temperatures were highest. The pelagic forms, *Harengula jaguana, Opisthonema oglinum, Anchoa hepsetus, A. nasuta, Peprilus alepidotus,* and *P. burti,* were more abundant during the colder months. They may have descended to the bottom in response to the cold surface temperatures, thus becoming more vulnerable to the trawl. However, some pelagic species are known to descend to the bottom at night and can, therefore, be caught by trawls during other times of the year (Hoese et al. 1968). It is interesting to note that the two closely related species, *Peprilus alepidotus* and *P. burti*, were abundant at different times of the year, fall and winter, respectively. The latter two species' life history patterns are explained in detail by Horn (1970), who observed their association with medusae. We also observed this pelagic habit for the juveniles of these two species.

Some benthic shore species exhibited this inshore migration during the colder months also. *Urophycis floridanus* and *Stenotomus caprinus* were more a-

Table 6. —Comparisons of mean total lenth (cm) of some fishes caught by trawlings between subareas in the St. Andrew Bay system, Florida, 1972-73.

Species	Subarea, Mean Total Length ( ), and Significance Lines*					Degrees of Freedom
Brevoortia patronus	North Bay (8.98)	East Bay (10.21)	West Bay (10.32)	St. Andrew Bay (13.05)		100
Bagre marinus	West Bay (11.52)	North Bay (12.85)	East Bay (15.37)	St. Andrew Bay (37.22)		100
Chloroscombrus chrysurus	North Bay (5.21)	East Bay (5.70)	West Bay (5.91)	St. Andrew Bay (7.21)	East Pass (11.85)	125
Cynoscion arenarius	North Bay (10.62)	West Bay (13.84)	East Bay (14.71)	St. Andrew Bay (20.08)	East Pass (22.26)	125
Cynoscion nebulosus	North Bay (15.01)	West Bay (16.30)	East Bay (18.68)	St. Andrew Bay (22.85)		100
Leiostomus xanthurus	North Bay (10.18)	West Bay (10.97)	East Bay (11.77)	St. Andrew Bay (13.86)	East Pass (14.12)	125
Micropogon undulatus	North Bay (9.33)	West Bay (10.52)	East Bay (10.82)	St. Andrew Bay (14.46)	East Pass (16.22)	125
Prionotus tribulus	North Bay (5.99)	West Bay (6.10)	East Bay (7.31)	East Pass (7.90)	St. Andrew Bay (10.18)	125
Symphurus plagiusa	North Bay (9.08)	East Bay (9.68)	West Bay (9.82)	St. Andrew Bay (10.31)	East Pass (10.94)	125

*Any two means not underscored by the same line are significantly different at the 5% level (Tukey's *w*-procedure).

bundant in our catches during the winter and spring. This particular inshore migration for *Urophycis* has been well documented by Gunter (1967). No adults of either of the above species were present, suggesting that this inshore movement is restricted to the juveniles and occurs when abundance is low for other species. *Ancylopsetta quadrocellata*, another benthic shore species, was more abundant in the bay during the winter and spring. This species may move offshore during the warmer months according to Topp and Hoff (1972). Our data would appear to support this conclusion.

It is significant that juveniles of some shore and reef species collected in the bay (*Lutjanus campechanus, L. synagris,* and *Haemulon aurolineatum*) were restricted to the high salinity and deeper portion of the system. The notable occurrence of juvenile forms (2.5 - 13.5 cm) of *Lutjanus campechanus* in our trawl samples during the summer and fall during these seasons, suggests that the lower bay area provided a nursery for this species for part of the year. Most of the specimens were collected from a deep channel station or those stations immediately adjacent to the navigation channel in the lower bay area. The only other records of juvenile red snapper taken in St. Andrew Bay were from channel location in July and August (Allison 1961; Vick 1964). Hastings (1972) did not record this species from the West Pass jetties, although this area attracts many reef fishes. These observations support the belief that *Lutjanus campechanus* is not as reef specific in habits as are some other species of *Lutjanus*, although it is generally associated with rough bottom habitats (Bradley and Bryan 1975; Mosely 1966). It is believed to have been much more abundant in the bay ten years previously according to observation made by one of the authors (Ogren) while conducting studies on pink shrimp behavior in St. Andrew Bay.

Apogon aurolineatus (not depicted in Fig 4), a small deepwater reef species, may have migrated into deeper water offshore or perhaps was killed by colder temperatures in the bay during the winter months. If the latter is the case, recruitment of *Apogon* (and other reef species) may be an annual event made possible by the passive transport by ocean currents of eggs or larvae (Caldwell 1963).

The unusual occurrence in our catch of large numbers of *Polydactylus* occurred only during the latter half of the study. None was collected in our sampling prior to this time. This species has been reported from St. Andrew Bay, but no information was given on its relative abundance (Allison 1961). Hastings (1972) mentioned the occurrence of *Polydactylus* in the vicinity of the west jetties in April 1958, but he did not observe this species during the time of his survey in 1968 - 71. This species is not considered to be a reef fish, and therefore, would not be expected to occur on the jetties. However, large numbers of *Polydactylus* occurred in trawl samples taken in the summer of 1965 by one of the authors (Ogren) in conjunction with studies on pink shrimp. No data are available on their relative abundance from these catches. *Polydactylus* continued to appear in trawl catches from St. Andrew Bay and gradually diminished until November 7, 1974, after which none was collected as evidence in a subsequent study (data in files of the Panama City Laboratory). This relatively short-lived abundance of *Polydactylus* was not restricted to the St. Andrew Bay system. Personnel from the NMFS, Southeast Fisheries Center, Pascagoula, Mississippi, (personal communication) reported the occurrence of large numbers of this species in their trawl catches offshore of Alabama and as far west as Louisiana. The peak period of abundance recorded for this species by them coincided with our catches. A similar decline in abundance of *Polydactylus* was reported for the offshore area in 1973 - 74.

Data from surveys conducted for only one year cannot fully describe the complexity of the distribution and abundance of a species in a particular marine community. Longhurst et al. (1972), recognizing the instability of ocean populations, stressed the need for long term investigations in order to understand the natural phenomena of cyclic abundance. We can only report that this unusual abundance of *Polydactylus* occurred during a period of extremely heavy rainfall and subsequent freshwater discharges into the bay systems along the northern coast of the Gulf of Mexico.

In conclusion, the following points are made concerning the distribution and abundance of fishes in the St. Andrew Bay system: (1) the number of species of fishes is higher than other estuaries studied in the northern Gulf of Mexico; (2) this variety is most probably related to the similarity of the lower bay area to the nearshore environment in the Gulf; (3) North Bay, and not East or West Bay, is the primary nursery area for many species of estuarine dependents or euryhaline fishes in the upper bay area, and conversely, the lower bay provides a suitable nursery area for many species of marine shore fishes; (4) considerable shifting of abundances between species occurs throughout the bay during the different seasons of the year.

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