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FISHES OF THE INDIAN RIVER LAGOON AND ADJACENT WATERS, FLORIDA

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FISHES OF THE INDIAN RIVER LAGOON AND ADJACENT WATERS, FLORIDA

R. GRANT GILMORE, JR.[1]

SYNOPSIS: A qualitative analysis of the ichthyofauna of east central Florida including the Indian River lagoon, its tributaries, and the adjacent continental shelf has accumulated records for 609 species. These species are listed in tabular form, including biotopic distribution and relative abundance. It is predicted that 704 species should eventually be collected from this area. The transitional nature of the Indian River ichthyofauna is emphasized, as tropical Caribbean and warm temperate Carolinian faunas overlap considerably within the Cape Canaveral area. Recorded as new range extensions into this area are 135 fishes, mostly of tropical origin.

A physical description of the region is also given with a brief discussion of geology, water salinities, and temperature.

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INTRODUCTION

Although the fishes of the Indian River region of east central Florida (Fig. 1) belong to the relatively well known Western Atlantic shore fish fauna, the marine and estuarine species of the Indian River have never been studied in detail. No comprehensive list, based on actual capture records, of the fishes that occur here has been published.

The Indian River is a narrow estuarine lagoon system extending from Ponce de Leon Inlet in Volusia County south to Jupiter Inlet in Palm Beach County (Fig. 1). It lies within the zone of overlap between two well known faunal regimes (*i.e.* the warm temperate Carolinian and the tropical Caribbean). To the north of the region, Hildebrand and Schroeder (1928), Fowler (1945), Struhsaker (1969), Dahlberg (1971), and others have made major

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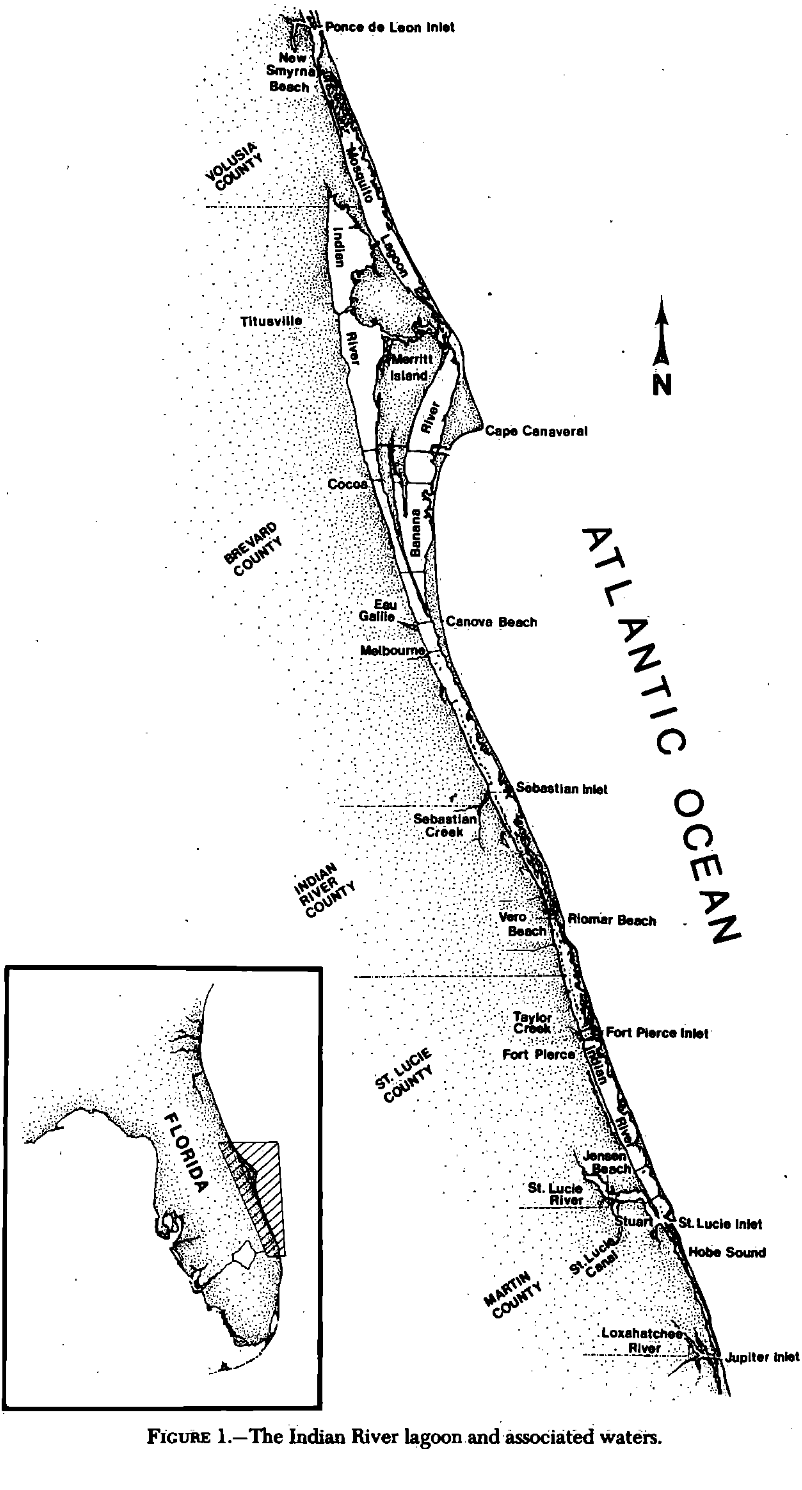

FIGURE 1.—The Indian River lagoon and associated waters.

ichthyofaunal reviews of the coastal waters of the southeastern United States. McLane (1955) and Tagatz (1967) have made extensive surveys of the fishes of the St. Johns River, including the estuarine portions. Southeast of the Indian River region, Böhlke and Chaplin (1968) surveyed the fishes of the Bahamas. The tropical fish fauna south of the Indian River lagoon has been thoroughly reported on by Herrema (1974), Starck (1968), and Longley and Hildebrand (1941). These workers made extensive fish surveys in Palm Beach and Broward counties, the Florida Keys, and Dry Tortugas, respectively.

The first major study of the fishes in the Indian River lagoon was conducted by Evermann and Bean (1897). They listed 106 species found in the Indian River lagoon and its inlets, but their report concentrated on species of commercial value and they procured most of their records in local fish houses where precise locality data are frequently lacking.

Not until 1957-1959 was another ichthyological study made within the Indian River lagoon. During this time V.G. Springer (1960) made several collections in the St. Lucie Inlet area (Fig. 1). His report contains a list of 62 species as well as temperature and salinity data. Gunter and Hall (1963) also made fish collections in the St. Lucie River estuary during the same time period, primarily to assess the effect of freshwater release from the St. Lucie Canal on the local fish fauna. They took seasonal temperature and salinity data with the 83 fish species they collected. From 1960 to 1965 Christensen (1965) made a qualitative seasonal survey of the fishes found in the Jupiter Inlet area and associated freshwater tributaries at the extreme southern end of the Indian River (Fig. 1). This was the most extensive survey to date in the Indian River region and presents data on 276 species, a number of which are tropical fishes not previously recorded as far north as Jupiter.

All of the Indian River regional collections above combine to give a total of 286 species for the lagoon system.

From 1933 to 1935 the trawler R/V LAUNCH 58 made offshore collections on the continental shelf adjacent to the Indian River lagoon (Anderson and Gehringer 1965). Their less than 94 trawling hours produced quantitative trawl data on 64 species. From 1956 to 1957 and 1961 to 1964 the R/V SILVER BAY, R/V COMBAT, and R/V PELICAN made 421 trawl stations in this region. The 105 species these three vessels collected here were compiled in a publication by Bullis and Thompson (1965). Anderson and Gehringer (1965) published a report covering 134 species in both the offshore and inshore fishery in the Cape Canaveral area and reviewed the previous continental shelf collections made by the aforementioned research vessels. Stewart Springer (1963) published an account of sharks from data taken in an offshore shark fishery based in Salerno, near Stuart, Martin County (17 species). Futch and Dwinell (1977) recently completed a nearshore ichthyofauna survey off Hutchinson Island including seasonality notes for 75 fish species.

All of the continental shelf collections recorded approximately 210 fish species for the area.

The combined total of fishes reported in the literature from the Indian River lagoon and adjacent continental shelf is 454 species. Although Briggs (1958) did not collect here, he lists some 453 species that should range through the region. The 453 species Briggs reported is coincidental and are not necessarily the same reported by previous authors.

The intent of the current investigation is to fill in the gaps left by the above papers and make an updated assessment of the Indian River region ichthyofauna together with a regional physical description.

Acknowledgements

This study was initiated under the direction of Robert Gore who helped in various aspects of the fish survey. During this period (1971 to 1975) LaVergne Williams, George Kulczycki, Wayne Magley, and many others at Harbor Branch Foundation, Inc., helped with field collections. Williams and Jon Dodrill collected most of the sharks, remoras, mackerels, and billfishes. Robert Avent collected many continental shelf fishes during the R/V GOSNOLD cruises. Robert Jones made several invaluable observations and collections during lock-out dives from the JOHNSON-SEA-LINK submersible.

The State Department of Natural Resources and the captain and crew of the R/V HERNAN CORTEZ kindly donated fishes collected from that vessel. George Kulczycki and David Mook made a number of these cruises for the Harbor Branch Foundation.

Carter R. Gilbert of the Florida State Museum, Gainesville, aided with specimen identifications, recent taxonomic changes, and kindly accepted the Harbor Branch Foundation collections. Richard Robins of the Rosenstiel School of Marine and Atmospheric Sciences made helpful taxonomic suggestions on the initial faunal lists and reviewed the final manuscript. Stephen Ross, Victor Springer, C.E. Dawson, Andrew Leslie, Walter Courtenay, Hector Harima, and Labbish Chao verified fish identifications in their respective areas of interest.

The late Robert Harrington of the Florida State Department of Health Entomological Research Laboratory at Vero Beach kindly discussed new records of fishes he had collected in this region and gave insight into past ecological conditions here. David Kirtley, Nat Eiseman, and David K. Young of the Foundation read and made suggestions on descriptive portions of the manuscript. Robert Jones painstakingly reviewed the manuscript in its entirety and made helpful suggestions.

Materials and Methods

In November 1971 fish collections began in the Indian River lagoon for the Harbor Branch Foundation as part of a field study program to assess qualitatively the estuarine and marine fauna. By the end of 1975 over 1,000 collections had been made at 376 stations in the Indian River lagoon, its freshwater tributaries, and nearshore Atlantic reefs along 157 coastal miles extending from New Smyrna Beach to Jupiter Inlet (Fig. 2).

During the fall of 1973 offshore trawl stations, using the R/V GOSNOLD, were established as part of the Indian River study. Beginning in April 1974 fishes were also taken by a Florida State Department of Natural Resources vessel, the R/V HERNAN CORTEZ, operating in the Atlantic off Cape Canaveral. The DNR kindly made these specimens available to the Indian River study. The two vessels together accounted for 129 offshore stations (Fig. 2).

As collecting techniques centered around juvenile fish populations in shallow water grass flats and mangrove habitats, small mesh (3 to 6.4 mm) beach seines 3 to 67 m in length were used extensively. We also used 2-m cast nets, crab traps, wire fish traps, SCUBA gear, dip nets, 185-m gill nets, 3′ and 7′ otter trawls, and fish toxicants.

Fishes collected on the inshore Atlantic reefs and in Jupiter Inlet were all collected with the aid of diving gear, dip nets, spear guns, and quinaldine, rotenone, or Chemfish.

The sharks were collected principally from the surf zone or waters less than 600 m from the beach with either a surface or bottom set longline or conventional fishing gear. Because of the relatively large hook size employed, the longline was selective for larger species of sharks. Most of the smaller specimens were taken with conventional fishing gear.

Offshore surface collections of pelagic bony fish species were made with dip nets and conventional fishing gear. LaVergne Williams made a relatively concentrated fishing effort (10

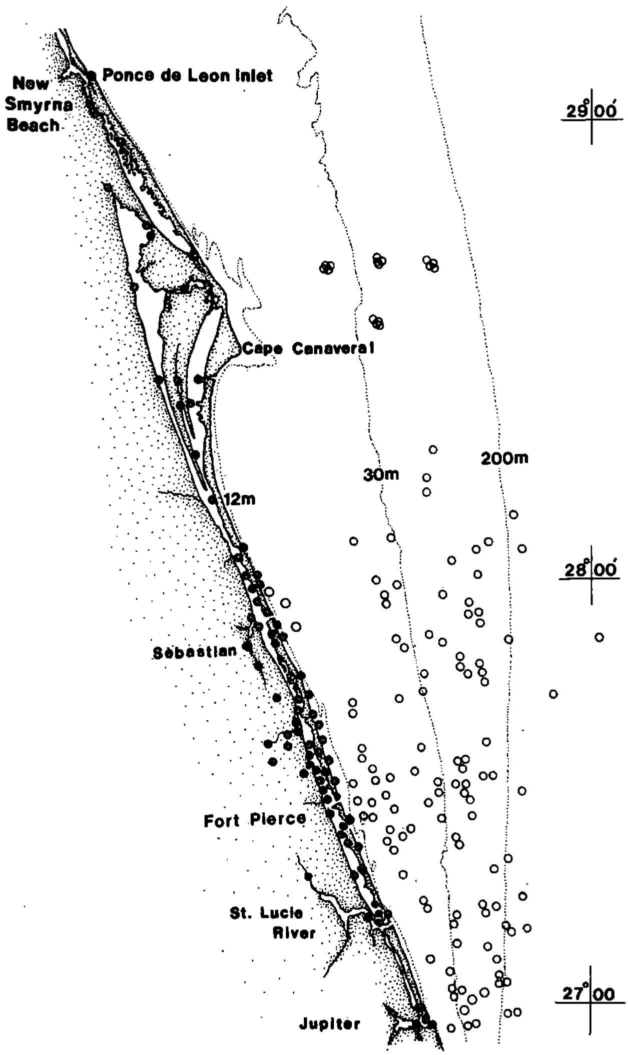

FIGURE 2.—Collecting stations in the Indian River lagoon (solid dots), and continental shelf (open circles). The northern most grouping represents the R/V HERNAN CORTEZ cruises and the remainder are R/V GOSNOLD collections. Of the 129 continental shelf stations, 76% are otter trawls and the other dip nets and dredges (Nov. 1973 to Sept. 1974).

fishing hours per week) from 1970 to 1973 by surface trolling east of Sebastian Inlet in depths of 50 to 200 m. He kept accurate records of size and location of offshore catches of game fish that were included in this survey.

Salinities were recorded with a temperature compensated Goldberg refractometer that can be read to 0.5 ppt. Bottom type (dominant vegetation, etc.), shore type, tidal state, weather conditions, water visibility, and sea state were also noted at each station.

Description of the Indian River Lagoon and Vicinity

Geography.—As Evermann and Bean (1897) noted, the term "river" is a misnomer. The Indian River region encompasses a shallow estuarine lagoon extending for 253 km (157 mi) from latitude 29°05′N to 26°58′N (Fig. 2). The northern terminus for this region is at Ponce de Leon Inlet in Volusia County and the southern at Jupiter Inlet in Palm Beach County (Fig. 1). The width of the lagoon varies from a few meters at the Jupiter Narrows and the south bridge at New Smyrna Beach to 8.9 km (5.5 mi) north of Titusville. The narrow strip of land east of the lagoon is a barrier island cut by five artificial inlets of varying size and depth, all maintained by the Army Corps of Engineers: Ponce de Leon (previously known as Mosquito Inlet), Sebastian, Fort Pierce, St. Lucie, and Jupiter. The land on the east bank at Cape Canaveral is the most extensive with a large peninsula, Merritt Island, dividing the Indian River lagoon on the west from the Banana River lagoon to the east (Fig. 1). The average depth is approximately 1.5 m with the maximum occurring in dredged channels and harbors. The Intracoastal Waterway is dredged to an average depth of 3.7 m north of Ft. Pierce and to 3.1 m from Ft. Pierce south to Jupiter. This dredged channel has an average width of 30 m. A ship lock at Cape Canaveral connects the Banana River lagoon with the Atlantic Ocean, but the locks opening depends on daily boat traffic.

The Indian River lagoon north of Titusville is separated on the east bank from the Mosquito Lagoon by a narrow strip of land that is dissected by an open canal (*i.e.* the Haulover Canal). The northern end of the Banana River is separated from the Mosquito Lagoon only by a shallow marsh with waters coming within 0.8 km of a direct connection between the two.

Along the west bank of the Indian River lagoon a system of relict sand dunes rises up to 24 m in height. Beyond these dunes, coastal lowlands and marshes extend up to 96.7 km inland.

Drainage—A number of small, low-gradient rivers, creeks, and canals flow into the Indian River lagoon (Fig. 1). The most extensive proximate watershed is the St. Johns marsh 11 to 16 km west of the lagoon. The surface waters of this marsh flow north into the St. Johns River rather than into the Indian River lagoon. The St. Lucie River drains 1165 sq km (450 sq mi) in St. Lucie and Martin counties (Gunter and Hall 1963). This river and associated canal system discharge freshwater overflow from Lake Okeechobee and marshes between the lake and the coast to St. Lucie Inlet. According to Christensen (1965) the extensive marshes east of Lake Okeechobee feed into the Loxahatchee River (draining 855 sq km or 330 sq mi) which opens at Jupiter Inlet. The rivers and freshwater canals all have locks that are opened or closed depending on climatic conditions and associated water levels farther inland. The times of opening and amounts of fresh water released from these canals vary.

GEOLOGY.—The barrier island on the east bank and the lowlands and marshes of the west bank for several kilometers inland are of Pleistocene age, primarily the Anastasia Formation, which consists of coquina shell marl with varying amounts of quartz sand (Cook 1945). The formation was deposited by multiple marine invasions over the St. Johns drainage basin west of the Indian River region. Farther south and out of the study area, the Anastasia Formation intergrades into the more calcareous Miami Oolite Formation.

The lithified Anastasia coquina forms rock bluffs at the river's edge at Melbourne, Eau Gallie, and at the south end of Merritt Island on both sides of the Indian River lagoon in Brevard County. These same rock formations occur in the intertidal zone on the Atlantic side at various locations from Palm Beach County northward to central Brevard County. Extensive submerged Atlantic reef formations run from north of Sebastian Inlet south to Jupiter Inlet, both near shore and out to the 110 m isobath. The deeper reef ledges may have reliefs as high as 10 m, but are more commonly in the 0.5 to 1.5 m range, at least on the inshore reefs. In the lagoon itself, either by dredging or by natural erosion, the coquina rock in the Intracoastal Waterway in northern St. Lucie County has been undercut along the edge of the waterway to form a small, 0.5 to 1.0 m high ledge that shelters numerous invertebrate and fish species.

SALINITY—The salinity of the Indian River lagoon, because of its estuarine nature, varies up and down the coast, depending on rainfall, freshwater drainage systems (*i.e.* how often canal locks are opened), evaporation, and access to the Atlantic Ocean (Table 1).

The natural system of fresh and marine water exchange within the northern half of the Indian River has undergone many recent changes. The canal connecting Mosquito Lagoon and the Indian River lagoon north of Titusville, the Canaveral Locks (completed 1965), Sebastian Inlet (dredged in 1921), Ft. Pierce Inlet (dredged in 1921), numerous mosquito impoundments (see mosquito impoundment section below), 19 bridges and causeways, and many artificial freshwater flood canals draining marshes and agricultural land west of the lagoon have caused major changes in the lagoon hydrography and, quite likely, species distribution. Prior to these changes in the northern section of the lagoon, the only inlet south of Ponce de Leon was a small shallow ephemeral inlet (Indian River Inlet) 3.5 km north of the present Ft. Pierce Inlet. Because of its shallow depths (Evermann and Bean 1897) the water exchange that did take place must have been localized. This inlet was 154 km south of the northern end of the lagoon (Sebastian Inlet is now 111 km south).

TABLE 1.—SALINITY AND TEMPERATURE RANGES FOR THE INDIAN AND BANANA RIVER LAGOONAL SYSTEMS.

Stations	Date	N	Salinity Range o/oo	R	x̄	N	Temp. Range (°C.)	R	x̄
Brevard Co.									
Haulover Canal[1]	Jan. 1968-May 1975	?	27.0-38.0	(11.0)	32.5	?	11.0-30.0	(19.0)	22.7
Haulover Canal[6]	Jan. 1974-May 1975	?	22.0-42.0	(20.0)	20.0	?	11.0-32.5	(21.5)	21.5
Indian R. Titusville[1]	Jan. 1968-May 1971	?	20.0-37.5	(17.5)	30.2	?	11.0-30.0	(19.0)	22.7
Indian R. Titusville[2]	Nov. 1971-Aug. 1972	?	21.0-34.0	(13.0)	29.1	?	17.0-37.9	(20.9)	25.7
Indian R. Cocoa[1]	Jan. 1968-May 1971	?	18.8-36.6	(17.8)	25.8	?	12.0-30.0	(18.0)	22.7
Banana R. S.R. 520[1]	Jan. 1968-May 1971	?	9.3-34.5	(25.2)	21.8	?	?-30.0		22.2
Indian R. Melbourne[1]	Jan. 1968-May 1971	?	11.6-34.0	(22.4)	22.3	?	12.0-30.0	(18.0)	23.3
Indian R. 12.9 km N. of Sebastian Inlet[1]	Jan. 1968-May 1971	?	11.6-37.2	(25.6)	25.1	?	14.0-29.0	(15.0)	22.2
Indian R. 1.6 km N. of Sebastian Inlet[3]	Dec. 1971-Nov. 1972	(138)	16.0-35.0	(19.0)	28.6	(137)	15.0-29.0	(14.0)	24.0
Indian River Co.									
Indian R. Wabasso[3]	Dec. 1971	(140)	4.0-36.0	(32.0)	22.9	(137)	13.0-29.0	(16.0)	23.5
Indian R. Vero Beach[3]	Dec. 1971-Nov. 1972	(137)	6.0-32.0	(26.0)	22.5	(137)	16.0-30.0	(14.0)	24.1

St. Lucie Co.									
Indian R. HBF Lab[3]	Dec. 1971- Sept. 1973	(704)	18.5-37.0	(18.5)	29.8	(704)	13.0-31.0	(18.0)	24.3
Indian R. N. Bridge Rt. AIA[3]	Dec. 1971- Aug. 1972	(100)	16.0-36.0	(20.0)	31.0	(98)	17.0-30.0	(13.0)	24.7
Indian R. S. Bridge Ft. Pierce[3]	Dec. 1971- Jan. 1973	(122)	29.0-36.0	(7.0)	25.1	(122)	17.0-30.0	(13.0)	22.1
Indian R. 3-6 km S. of S. Bridge. Ft. Pierce[3]	Jan. 1971- Feb. 1973	(142)	18.0-36.0	(18.0)	30.0	(137)	14.0-29.5	(15.5)	23.4
Martin Co.									
Mouth of St. Lucie River & Indian R. at Sewall Pt.[4]	Jan. 1957- Jan. 1959	(55)	0.15-32.8	(30.6)	10.7	(112)	14.4-30.9	(16.5)	23.3
Palm Beach Co.									
Jupiter Inlet[5]	July 1960- Jan. 1965	(29)	16.5-37.5	(21.0)	31.8	(31)	20.5-36.0	(15.5)	27.5
Mouth of C-18 Canal S. Fork Loxahatchee R.[5]	July 1960	(4)	1.5-30.2	(28.7)	15.5	(4)	22.0-32.5	(10.5)	27.5

[1]Grizzel (1968-1971)
[2]Neven and Lasater (1971), Lasater and Carey (1972)
[3]Gore *et al.* (1971-1973), Wilcox and Mook (1972-1973)
[4]Gunter and Hall (1963)
[5]Christensen (1965)
[6]Young (1975)

Even after inlets were dug, Ponce de Leon, Sebastian, Ft. Pierce, St. Lucie, and Jupiter inlets were not dredged regularly, and all were frequently closed by sand deposition from parallel (southerly) inshore ocean currents. Christensen (1965) notes that from 1942 to 1947 Jupiter Inlet was closed and the Indian River lagoon in this area became fresh. During this same period Sebastian Inlet also closed. By comparison the salinity range in Jupiter Inlet from 1960 to 1965 was 16.5 to 37.5 o/oo with a mean of 31.8 o/oo (see Table 1). Thus when the inlets were closed little estuarine discharge was possible. When this occurs salinities can change considerably depending on the weather. Turbulent fall and winter storms that send ocean waters across the barrier islands forming small temporary inlets often counter this situation. It may therefore be presumed that these changing conditions led to extremes of salinity range that, when combined with a greater variation in temperature in the northern section of the lagoon, might have a profound influence on faunal diversity, at least seasonally.

In comparison the regular maintenance of seven inlets and locks and the active control of freshwater runoff today has allowed tidal influence to moderate the annual salinity range of the Indian River in the vicinity of the inlets. The average mean annual salinity for the entire river is 25.6 o/oo (based on data from Table 1). This value is relatively high but is not surprising, as tides apparently influence much of the lagoon south of Sebastian Inlet. North of Sebastian Inlet evaporation and freshwater runoff begin to affect salinity to a greater degree with wind-driven water movements becoming more predominant. Major freshwater influence occurs locally near the mouths of the St. Lucie and Loxahatchee rivers. The mean annual salinity for much of the river, excluding the two major river mouths, should be closer to 27 o/oo. The recorded annual salinity range is least at the Haulover Canal and in the lagoon at Ft. Pierce Inlet where higher salinities are normally found. The mean annual salinity range for all stations combined is 20.9 o/oo (19.6 o/oo excluding the mouths of the St. Lucie and Loxahatchee Rivers).

Table 1 shows that major freshwater sources may lower wet season (May - October) lagoon salinities considerably at Wabasso, Vero Beach, North Bridge at Ft. Pierce, and at St. Lucie Inlet. At Stuart in Martin County, the St. Lucie River and the St. Lucie Flood Control Canal empty into the Atlantic through St. Lucie Inlet. Here, especially when the locks of the St. Lucie Canal are opened, salinity may drop markedly, for example from 23.0 to 0.2 o/oo in less than 24 hours (seasonal range of 0.15 to 32.8 o/oo; Gunter and Hall 1963 V. Springer 1960).

TEMPERATURE—Because of the shallow average depth of the Indian River lagoon, air temperature variations appear to be most effective in controlling water temperature and, therefore, the fish distribution within the lagoon. The mean annual air temperature at New Smyrna Beach is 1.6°C lower than at Jupiter (Thomas 1970). The range in annual air temperatures is greater in the New Smyrna Beach Ponce de Leon Inlet area than at Cape Canaveral and so on as one proceeds farther south, although summer air temperatures (June-August) are relatively homogeneous for the entire lagoon. The fish fauna must therefore adjust its distribution according to the resultant river water temperatures (Table 1).

The lowest water temperature recorded for this region was 8.0°C from the lagoon in northern Brevard County, whereas Christensen (1965) never recorded a water temperature below 20.0°C in the lagoon at Jupiter Narrows. Occasional periods of very low air temperatures (*e.g.* January to February, 1957-1958) to 0.0°C as far south as Stuart bring water temperatures down to a lethal low (14.4°C) for fishes of tropical and subtropical affinities (*e.g. Megalops atlantica, Elops saurus, Centropomus undecimalis* and several gerreids; Gunter and Hall 1963).

Atlantic Ocean surface and bottom water temperatures taken adjacent to the coast over the 3 to 10 m isobaths show a trend similar to the air temperatures (Table 2). The low winter temperatures ranged lower in the northern section increasing the annual temperature range substantially over that for the Jupiter Inlet area.

Taylor and Stewart (1958) described an interesting temperature phenomenon caused by upwellings in this part of Florida. During the summer months, July and August specifically, an annual inshore decrease in water temperatures often occurs along the east coast from Fernandina Beach to West Palm Beach, with the most dramatic drop occurring around Daytona Beach and Cape Canaveral. Readings made in the Canova Beach area, Brevard County, 34 km north of Sebastian Inlet, during 1946-57 showed a temperature drop that persisted through July and August, from 26.7° in June to 22.3°C in July, well below the average surface temperatures taken there in 1956. Summer upwellings are also common in the St. Lucie area (S. Springer 1963). Harbor Branch personnel observed an unusually low surface seawater temperature of 22.0°C in August 1972 at Sebastian Inlet (flood tide, salinity of 35.5 o/oo).

Table 2 reveals that at a bottom depth between 30 and 150 m the water temperature is lower during July and August than during the other months of the year.

The seaward influence of these cold water upwellings is uncertain, but a decline in the fishing associated with this phenomenon has been reported by commercial and sport fishermen. The associated decline in fishing has been observed out to a depth of 40 m (6.4 to 33.6 km offshore) and has been blamed for fish kills (S. Springer 1963).

Studies have not yet been conducted to see what effect this upwelling of cold water might have on the inshore reef fish fauna, which has definite tropical affinities (see Atlantic reef biotope section below). Christensen (1965) noted this cold water upwelling in June and August at Jupiter and saw

TABLE 2.—REGIONAL SURFACE (S) AND BOTTOM (B) SEAWATER TEMPERATURE (°C) FOR THE CONTINENTAL SHELF (FROM CLARK *et al.* 1970).

Latitude and Date	Longitude 80°40′ (s)	80°40′ (b)	80°30′ (s)	80°30′ (b)	80°20′ (s)	80°20′ (b)	80°10′ (s)	80°10′ (b)	80°00′ (s)	80°00′ (b)	79°50′ (s)	79°50′ (b)
29°00′												
Depth (m)		(20)		(21)		(32)						
May	23.5	23.0	23.0	22.0	24.0	19.0						
July-August	26.5	23.0	27.0	22.0	27.5	20.0						
October	23.5	24.0	24.0	24.0	26.0	25.0						
Jan.-Feb.	15.0	14.0	18.0	15.0	21.0	17.0						
28°30′												
Depth (m)				(15)		(22)		(60)		(150)		
May			24.5	23.0	24.5	22.0	25.0	19.0	26.0	16.0		
July-August			27.0	23.0	26.0	18.0	26.5	15.0	27.0	11.0		
October			25.0	24.0	26.5	25.0	27.0	25.0	27.0	19.0		
Jan.-Feb.			16.0	15.5	20.0	17.0	22.0	18.0	22.0	16.0		
28°00′												
Depth (m)				(17)		(23)		(33)		(66)		
May			23.4	23.0	24.0	22.0	24.5	20.0	25.0	17.0		
July-August			26.0	24.0	27.0	22.0	27.5	17.0	28.0	13.0		
October			24.5	24.0	26.0	25.0	26.5	25.0	27.0	16.0		
Jan.-Feb.			17.0	17.0	19.0	17.0	21.0	18.0	22.0	18.5		

27°30′						
Depth (m)		(31)		(72)		(310)
May	24.0	21.0	25.0	18.0	26.0	16.0
July-August	28.0	21.0	29.0	14.0	29.0	13.0
October	25.5	25.0	26.0	18.0	27.0	11.0
Jan.-Feb.	21.0	20.0	23.0	20.5	24.0	21.0
27°00′						
Depth (m)				(40)		(340)
May			26.0	20.0	26.0	16.0
July-August			29.0	16.0	29.0	13.0
October			26.0	24.0	27.0	11.0
Jan.-Feb.			23.0	22.0	24.0	22.0

indications of "temporary distress in some shore fishes," but he did not see "winter kill" as Gunter and Hall (1963) noted for low winter temperatures in the St. Lucie area.

Regional Biotopes and Associated Fishes

Freshwater Tributaries and Canals.—The major freshwater rivers, streams, and canals that feed into the Indian River lagoon fall into this biotope. Where stream vegetation has not been disturbed by man, such plants as *Panicum*, and *Typha* form a dense shore cover. A variable quantity of submerged plants such as *Elodea densa* and *Hydrilla verticillata* and a surface cover of *Eichhornia crassipes, Pistia straitioites* or *Pontederia lanceolata* also occur. The dominant plant depends on stream flow, substratum, and other physical variables. All streams in this part of Florida have shallow gradients and currents are generally moderate to sluggish, depending on rainfall or floodgate manipulation. The water level and flow rate may increase when a lock holding back significant amounts of stored water is opened.

Table 3 shows that 110 fish species have been collected from this biotope. Of these fishes 59 (54%) are euryhaline and are also found in brackish to marine waters either in the Indian River lagoon or in the Atlantic Ocean (*e.g.* gerreids, cyprinodontids, poeciliids, and centropomids). Therefore primary freshwater fishes form a minority of the freshwater fauna. Kushlan and Lodge (1974) found this to be the predominate characteristic of the South Florida freshwater ichthyofauna. Several less common euryhaline tropical forms have also been collected in this biotope (*e.g. Gobiomorus dormitor, Awaous tajasica, Oostethus lineatus,* and *Pomadasys crocro*).

Canal and River Mouths.—This biotope is characterized by a wide salinity range (0.0—33.0 o/oo; mean salinity 15.0 o/oo) relative to adjacent marine and fresh-water biotopes (Table 1). The predominant bottom type is sand-mud. Halophilic species are lacking, and where natural shore vegetation has not been destroyed *Rhizophora* and *Spartina* are gradually replaced by *Taxodium* and*Typha*. The water quality varies considerably with tide cycles, but is generally turbid with organic detrital material, tannin, and suspended sediments.

These waters are truly estuarine and the fish fauna consists of a euryhaline species group (109 species) with marine affinities (Table 3).

Local commercial and sport fishing interests claim that a large drop in salinity within a short period of time, such as occurs periodically when locks are opened in the St. Lucie Estuary, may limit the number of marine invaders into the estuary and reduce their fish catches. Contrary to the opinion of local sport fishermen, Gunter and Hall (1963) stated that the "St. Lucie Estuary is characterized as an area of high production of a wide variety of sport and food fishes, a condition which has developed and been enhanced by periodic discharges of fresh water and nutrient materials" (from the St. Lucie Canal). They found that the largest collections of *Mugil, Brevoortia, Micropogon, Menidia,* and *Anchoa mitchilli* occurred during or after freshwater releases from the St. Lucie canal. On the other hand, they noted that *Trachinotus* and small lutjanids left the estuary when very low salinities were prevalent. Stenohaline marine fishes would be those most likely to be affected by freshwater discharge. In the sport fishing category this would include most of the lutjanids, serranids, and scombrids; the latter two are predominantly fished on the continental shelf. Many of the inshore sport and game fishes (*i.e.* centropomids, elopids, sparids, and sciaenids) in this area are euryhaline and would theoretically be little affected by salinity changes.

MOSQUITO IMPOUNDMENTS.—The mangroves *Rhizophora mangle, Avicennia nitida, Laguncularia racemosa,* and *Conocarpus erectus* are the most dominant and conspicuous shoreline vegetation throughout the Indian River lagoon. A recent development in this region that has greatly affected the mangrove community is the extensive impoundment of many acres of tidal mangrove stands (Provost 1959, 1967). Dikes were built around high marsh vegetation to stop tidal movement of water from the lagoon to the intertidal zone. This prevented the salt marsh mosquitos (*i.e. Aedes sollicitans* and *A. taeniorhynchus*) from laying their eggs in the intertidal sediments. In most instances an effort was made to impound only high marsh vegetation (*i.e. Avicennia* rather than *Rhizophora*). Tidal movement of detrital material from the impounded vegetation to lagoon waters has been precluded over thousands of acres throughout the Indian River region. In some cases water levels in the impoundments covered the pneumatophores of *Avicennia nitida* and the prop root lenticles of *Rhizophora mangle,* thus killing many acres of mature trees in St. Lucie and Indian River counties. The ecological value of the mangrove community to an estuary has been the subject of many recent studies. Odum and Heald (1972) showed a significant contribution from mangroves to the primary productivity of the estuary. Remnant and recent mangrove growth can be found on the lagoon side of the impoundments, but their contribution to the lagoon ecosystem is undetermined.

In general the impoundment ichthyofauna consists of only 26 species, but large numbers of individuals. This response is considered typical of ecosystems such as the impoundments that are under stress. The salinity regime and the amount and type of vegetative growth, of each impoundment can be very different, and the capacity to support a diverse fish fauna will depend on such variables. In some impoundments salinity varies considerably (0-41 o/oo) depending on rainfall, evaporation, ground water, artesian flooding, and the salinity of the water pumped into the impoundment from the lagoon. The fishes found consistently in these areas are generally euryhaline and capable of living on the food resources available (*e.g. Gambusia affinis, Poecilia latipinna, Lucania parva,* and *Cyprinodon variegatus*).

Although the total ecological effect of impounding is unknown, the current fish faunas of both the impoundments and the Indian River lagoon can be compared (Table 3). All the 26 species collected from mosquito impoundments also occur in the Indian River lagoon, but this is only 7.3% of the 359 species recorded from the unimpounded waters of the Indian River lagoon (Table 3).

Harrington and Harrington (1961) gave an account of the feeding habits of 16 larvivorous fish species in the salt marsh-mangrove community before impoundment in St. Lucie and Indian River counties. Of these species 12 still occur in the impoundments while 4 have been found only in the lagoon. Provost (1967), in referring to unpublished data taken by Harrington, noted a decrease after impounding in fish species that prior to impounding lived in the mangrove community but spawned elsewhere (*e.g. Megalops, Centropomus, Eucinostomus*, and *Diapterus*). A similar decrease was noted in herbivorous fishes. Nonlarvivorous species were reduced from 34% of the total mangrove fish community to 5% after impoundment, while predators on mosquito larvae comprised the remaining 95%.

OPEN SAND BOTTOM.—Most of the lagoon bottom is fine sand-shell mixture. Generally a fine anaerobic mud ooze lies next to the inshore mangroves and a very fine silt layer over the exposed bottom in the Intracoastal Waterway. The salinities over these sand flats away from freshwater tributaries range between 18.0 and 37.0 o/oo (mean approximately 30 o/oo, Table 1).

On or over this bottom type 121 fishes commonly occur. Of these the bothids, triglids, dactyloscopids, and synodontids have been found here consistently. The other fishes recorded here make feeding forays or migrations that bring them out over an open bottom from a more sheltered lagoon habitat (*i.e.* lagoon reefs and grass flats).

MANGROVE MARSH.—Where mangroves have not been impounded (see above) or where recent intertidal mangrove growth has occurred, a prominent vegetative shore cover has formed. The prop root system of *Rhizophora* and adjacent waters have been observed to have an associate fish fauna. Of the 84 species recorded from this biotope, many species appear to be resident (*e.g. Blennius nicholsi, Gobiesox strumosus*, and *Bathygobius soporator*) while others seek refuge among the prop roots as larvae and juveniles (*e.g. Centropristes philadelphica* and *Epinephelus itjara*).

SPERMATOPHYTE GRASS FLATS.—Lagoon flats (depths of less than 2 m) near shore support heavy to moderate growths of the marine spermatophytes *Syringodium filiforme, Haldoule wrightii, Ruppia maritima*, and *Thalassia testudinum*. The *Thalassia* beds are generally isolated and are apparently not found north of Melbourne. *Syringodium* is dominant in the lagoon as far north as Mosquito Lagoon. *Halodule* is found throughout the lagoon and is the next most abundant grass. *Ruppia* is relatively uncommon in the lagoon compared to the other seagrasses, but it has been found at Sebastian Inlet and the mouth of the St. Lucie River near St. Lucie Inlet. It has also been noted in several freshwater lakes in the vicinity and as far north as the Haulover Canal. *Halophyla baillonis* is found in the lagoon but is rare and associates with the more common spermatophyte species (*Halodule* and *Thalassia*).

During late summer and fall large amounts of fleshy algae (*e.g. Gracilaria foliifera* and *Acanthophora spicifera*) accumulate in the grass beds. During this period filamentous epiphytic algal growth on the spermatophyte grasses can be considerable. The actual contribution of algae to the primary productivity of this biotope is undetermined.

Salinities here are identical to those discussed in the previous open sand bottom biotope.

In the grass flats 208 fish species have been collected (Table 3). This biotope harbors the richest fish fauna in the Indian River lagoon. Of these species, 181 (87%) are found here primarily as juveniles (*e.g.* serranids, lutjanids, sciaenids, and pomadasyids). The prominent role the grass flat biotope plays as a nursery for the local fishes is obvious.

LAGOON REEFS.—This biotope may consist of artificial (wrecks, pilings) or natural relief above the lagoon bottom. The submerged rock ledges cut in the Intracoastal Waterway (depths 3 to 5 m) show a relief up to 1.5 m and support a gorgonian coral growth.

In this biotope 90 fishes have been collected, of which 51 (67%) are considered primary reef fishes (*e.g.* chaetodontids, pomacentrids, pomadasyids).

INLETS.—All five inlets and Port Canaveral have granite rock jetties extending seaward. The inlets are kept open to boat traffic by periodic maintenance dredging. Prior to dredging, the inlets were ephemeral and when open were very shallow. All typically have a shallow (2-4.5 m depth) sand bottom. Tidal currents are generally swift with a 3.1 kt average ebb tide velocity recorded from midstream in Ft. Pierce Inlet. The salinity range in the inlets is generally not so great as that further up or down the river or in the back estuary (Table 1). This obviously depends on the amount of freshwater input from the hinterland plus the fact that those inlets associated with substantial river systems such as St. Lucie and Jupiter inlets have the larger salinity ranges.

Of the 275 fish species recorded from the inlets (Table 3) 129 (47%) are normally associated with the inshore Atlantic reefs and occur around inlet jetties from Sebastian Inlet south. Those fishes that make periodic migrations from the lagoon to the Atlantic or vice versa are also occasionally found associated with the jetties. These fishes are either maturing and leaving the lagoon nursery grounds for adult feeding grounds offshore (*e.g.* serranids) or are making temporary offshore spawning migrations (*e.g.* sciaenids). Many larval and juvenile fishes enter the lagoon through these inlets.

CONTINENTAL SHELF

SURF-ZONE-SAND/SHELL BOTTOM.—This biotope is characterized by a sand shell bottom and is continuously under the influence of wave turbulence. The shallow sub-littoral (less than 2 m depth) and littoral zones are included in this region. Besides the surf, a major limiting factor is the lack of cover over the sand substratum. This becomes apparent when the surf zone reef fauna is compared with this open sand bottom fauna (see below). Little or no macroscopic attached vegetation grows here, but many burrowing invertebrates do occur (*e.g. Emertia, Donax*).

Because of the limiting nature of this biotope only 78 fish species have been found here to date (Table 3). Although roving carnivores (jacks, mackerels, ladyfish, bluefish) and planktivores (herrings, anchovies) may occur in the surf zone, the dominant fishes are bottom feeding carnivores (catfishes, lizardfishes, croakers, threadfins, and pompanos) that feed on the burrowing invertebrate fauna.

SURF ZONE REEF.—Coquina rock forms a protective littoral and sublittoral surf zone reef at the various localities given in the regional physical description section of this paper. This rock structure may support the growth of sabellariid worm colonies and the protection afforded may result in an increase in fish species in the surf zone. Although some of these inshore rock ledges just south of Cape Canaveral disappear from year to year with the shifting of sand masses along the surf zone, the larger reefs appear to be permanent.

The predominant sabellariid reef builder in this area is *Phragmatopoma lapidosa*, which may settle on old worm colonies, pier pilings, and other manmade structures, or on the coquina rock formations. All of these reefs are exposed to some extent at low tide and all give a 1 to 2.5 m relief above the bottom, providing cover for fishes.

The surf zone reef fish fauna is dominated by individuals capable of thriving in this turbulent high energy zone (Table 3). Although 105 fish species have been found to associate with these reefs, they are numerically dominated by two demersal species, *Labrisomus nuchipinnis* and *Blennius cristatus* and three semi-demersal species, *Diplodus holbrooki, Anisotremus virginicus*, and *Haemulon parrai*. Most of the other fishes that occasionally occur on the surf zone reef are primary reef fishes that are commoner on the deeper (over 2 m) coquina reefs offshore.

OFFSHORE REEFS.—Extensive lithified coquina and other types of organic reefs parallel the shore beginning on the average 100 to 300 m out. These inshore reefs run north of Sebastian Inlet for at least 48 km and south beyond Jupiter Inlet. The shallow water reefs show a relief from 0.5 to 3 m above the bottom and are in 2 to 7 m of water. Similar formations occur in 10-13 m, 20-23 m, 33-40 m, 60-80 m, and 100-110 m depths. A maximum relief of 10 to 20 m has been recorded on the deeper reefs. The inshore reefs have a definite seaward slope to the reef top with the low end seaward, and they may have multiple ledges running parallel to shore. The reef ledges are eroded extensively into elaborate interconnecting caves. This provides abundant shelter for many primary reef fishes (*i.e.*, pomadasyids, chaetodontids, pomacentrids, serranids, labrids) and supports a popular and highly productive commercial/sports fishery (Moe 1963) for snappers (mostly *Lutjanus campechanus* and *Rhomboplites aurorubens*) and groupers (mostly *Epinephelus morio* and *Mycteroperca microlepis*).

Very little coral grows on these shallow reefs, except for small coralla of *Oculina* and isolated spots of siderastraeid and montastraeid corals. Deeper reefs in depths around 30 m have a more proliferous growth of *Oculina* corals. The shallow reefs south of Sebastian Inlet support an abundant algal growth (*Sargassum*, etc.) throughout the year. Many of the juvenile fishes associated with the reef school or hide amid this prolific algal growth (*e.g. Bairdiella sanctaeluciae* and many pomadasyid juveniles). Gorgonians, sponges, and ascidians also live amid the algae.

The water clarity in summer gives 5 to 6 m visibility on a good day. The rest of the year periodic northeast or southeast strong winds (10-25 kts) keep the water over the reefs turbid and turbulent, and observations or collections are difficult. Nearshore water turbidity decreases farther south as the continental shelf narrows, water depths increase, and the axis of the Florida Current comes closer to the coast. During calm weather the water visibility in Jupiter Inlet at flood tide is between 5 and 10 m.

From the nearshore reefs (3 to 7 m depth; Table 3) 223 fish species have been recorded, of which 191 (86%) are Caribbean reef fishes. Because of collecting difficulties, this reef fauna has not been assessed completely and is probably richer than indicated.

The seasonality of the tropical representatives of this nearshore reef fish fauna is speculative. Several dives made on the Pepper Park reef (3.2 km north of Ft. Pierce Inlet) in January and February indicated that at least 46 of these tropical fishes may remain on the reef throughout the year. Farther north the tropicals might well make a seaward migration to deeper reefs where the seasonal temperature change is not so dramatic (see Table 2), but the offshore reef fish fauna (depths over 10 m) has not been investigated on a seasonal basis.

BENTHIC-OPEN SHELF.—This biotope is an open plain of sand and shell extending several meters or kilometers between reef lines. The predominance of shell or sand varies. Dredges have occasionally brought up large bottom samples consisting of the scallop *Aquipecten irradians*. In certain locations the clam *Chione* also made up a large portion of the shell hash bottom. Near the seaward edge of the shelf (to depths of 200 m) a fine sand-mud bottom predominates. The temperature patterns for this biotope are given in Table 2. The current patterns are basically unknown for this shelf zone, but apparently variable eddies leaving the Florida Current may change with season and wind direction.

The fish fauna of the open shelf collected to date consists of 171 species (Table 3). Pleuronectiform fishes, ophidids, and triglids dominate this biotope. Other species adapted to an open bottom existence such as ogcocephalids and rajiids are commonly found here. Several groups appear on the open shelf in seasonal spawning aggregations (*e.g.* sciaenids). Some families characteristic of the reef environment have representatives on the open bottom as well (*e.g. Hemipteronotus novacula*, Labridae; *Diplectrum formosum, D. radiale, Centropristis ocyurus*, Serranidae).

NERITIC ZONE.—This biotope consists of the open waters above the benthic habitats. The Florida Current plays an important role in determining the physical character of this biotope. Occasional weed lines of floating *Sargassum* sp. may be seen at the interface between the Florida Current and coastal waters. Many fishes (*e.g.* coryphaenids and carangids) associate with this weed line and other floating debris that may afford food and shelter.

Of the 177 species that occur here the sharks, mackerels, tunas, jacks, billfishes, herrings, and anchovies dominate this biotope. Large north-south seasonal migrations of dolphin (*Coryphaena*), mackerels (*Scomberomorous*), tunas (*Euthynnus*), and billfishes occur in the neritic shelf region adjacent to the Indian River lagoon. A population of sailfish, *Istiophorus platypterus*, overwinters annually off Jupiter Island from St. Lucie Inlet south. *Mugil cephalus, M. curema, Brevoortia smithi, B. tyrannus*, and numerous sciaenids make seasonal migrations from the lagoon out into neritic waters to spawn.

Many juvenile fishes are transported by the Florida Current into the neritic zone of this region from South Florida and the Caribbean. This is a continual source of recruitment for the local representatives of the tropical fish fauna.

DISCUSSION

Briggs (1958) estimates that the total fish population of Florida consists of 1,120 species, including those found at depths below 200 m. Of these 453 are considered to range over the Indian River region (continental shelf and estuary). Harbor Branch Foundation collections and the combined records of other collections from the Indian River region have established that at least 609 species of fishes occur in the Indian River lagoon, its freshwater tributaries, and the adjacent continental shelf at depths less than 200 m. Of these 135 were not previously recorded from this region (Table 3). Of the species in Briggs' list 95 have not yet been collected in the Indian River region but are known to range both north and south of here. If the 95 additional species from Briggs' list are added to the current regional total, at least 704 species should eventually be collected or identified.

The richness of this fauna appears to be directly affected by water temperature moderation and recruitment via the Florida Current, moderate inshore salinities, and the transitional zoogeographic setting of the study area. The Indian River region encompasses several biotopes, all of which affect the distribution and composition of the local fish fauna. The study area is broad (latitude 27°00'-29°00'N) and includes nearly all of the aquatic fish communities in east Florida (lacustrine biotopes were omitted). The fish distribution is further complicated by its transitional nature, as the warm-temperate Carolinian and the tropical Caribbean fish faunas overlap considerably here; 28% of the fish fauna is considered tropical, 22% are warm-temperate, and 50% are eurythermic tropicals and continental species having a wide distribution both north and south of this region. Nine fishes (1.8%) are endemic to Florida and 10 (2%) are exotic freshwater tropicals introduced and breeding here.

Tropical Caribbean fishes on inshore reefs are apparently not found throughout the year north of Sebastian Inlet, yet observations indicate a permanent population from Sebastian south. Of the 39 tropical species that Christensen (1965:248) lists as new to the Jupiter area 35 (90%) are found throughout the year on shallow nearshore reefs (depths under 10 m) or in the Indian River lagoon at least as far north as Sebastian Inlet, 109.7 km north of Jupiter Inlet. A total of 152 tropical fishes (27% of the total fauna) range at least to latitude 28°00'N and apparently have a permanent population within this region either on shallow reefs or farther out on the continental shelf and in the Indian River lagoon. This extends the northern limit of permanent shallow water tropical fish populations northward 100 km from Jupiter Inlet.

The current continental shelf and the lagoon collections show that water depth has much to do with northerly distribution of permanent tropical fish populations. North of Sebastian this warm water fish fauna is found farther out on the shelf in deeper waters. At depths between 20 and 70 m the bottom temperature range is narrow (less than 8.0°C, see Table 2). The Florida Current apparently has much to do with this temperature moderation and the rock reefs in these areas should act as a haven for tropical and eurythermic tropical fish faunas. The open shelf fauna within this depth range was sampled during this survey and is heterogenous in it faunal affinities, but euythermic tropicals and tropical fishes (*i.e. Gymnothorax nigromarginatus, Centropristis philadelphicus, Syacium papillosum, Otophidium omostigmum,* and *Lepophidium jeannae*) are common in these samples. The reef fish fauna in these deeper waters needs to be investigated.

Many benthic, Carolinian, continental shelf species penetrate into the Indian River region, and a few Carolinian estuarine species are found at New Smyrna Beach and occasionally stray to the southern reaches of the lagoon (*e.g. Alosa sapidissima* and *Brevoortia tyrannus*). The successful penetration of either Carolinian or Caribbean species may depend on recruitment occurring during successive or alternating cold and warm winters. The transitional character of the lagoon fish fauna is obvious as fishes found in grass beds adjacent to St. Lucie Inlet are never qualitatively or quantitatively representative of a similar grass bed (both dominated by *Syringodium*) over 160 km north in Mosquito Lagoon or the Indian River lagoon.

Of the 110 fishes recorded from freshwater tributaries, 59 (54%) were euryhaline, secondary freshwater species or marine invaders from tropical families or genera; 51 (46%) primary freshwater species were mostly warm-temperate fishes that have migrated down the peninsula (Kushlan and Lodge 1974).

It may be concluded that the fish fauna of the Indian River region is a diverse assemblage dominated by tropicals and eurythermic tropicals. These fishes originated in the Caribbean faunal province and apparently came into the region via the Florida Current. Warm-temperate Carolinian fishes are more commonly found in the open bottom continental shelf biotope and in the primary freshwater fish families. Distribution of the Carolinian species must be explained by adult migration, with some aid from larval fishes transported via southbound counter-currents of the Florida Current and other inshore water mass movements.

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TABLE 3.—BIOTOPE DISTRIBUTION OF THE SHALLOW WATER FISH FAUNA (DEPTHS LESS THAN 200 M) FROM THE INDIAN RIVER LAGOON AND ADJACENT WATERS. FISH RECORDS BASED ON OBSERVATIONS ONLY AND THOSE THAT HAVE NOT BEEN COLLECTED NOR OBSERVED ARE FOLLOWED WITH 0, AND NC RESPECTIVELY. QUESTIONABLE RECORDS ARE FOLLOWED BY ?. PREVIOUS SURVEYS ARE CODED NUMERICALLY. BIOTOPE KEY: N = NERITIC; B = BENTHIC-OPEN SHELF; R = OFFSHORE REEFS; SR = SURF ZONE REEF; SS = SURF ZONE-SAND/SHELL BOTTOM; I = INLETS; GF = GRASSFLATS; MAN = MANGROVES; SB = OPEN SAND BOTTOM; LR = LAGOON REEFS; CRM = CANAL AND RIVER MOUTHS; FTC = FRESHWATER TRIBUTARIES AND CANALS; MI = MOSQUITO IMPOUNDMENTS. FISH ABUNDANCE CATEGORIES (STARCK 1968): U = UNKNOWN; R = RARE; O = OCCASIONAL; F = FREQUENT; C = COMMON; A = ABUNDANT.

SPECIES	PREVIOUS* SURVEYS	N	B	R	SR	SS	I	GF	MAN	SB	LR	CRM	FTC	MI
Branchiostomidae														
Branchiostoma virginiae	13		U							O				
B. sp.	NR		U											
Orectolobidae														
Ginglymostoma cirratum	6	O	O	F	O	O	R			R				
Rhincodontidae														
Rhincodon typus O	NR	R												
Odontaspididae														
Odontaspis taurus	7,6	O		O										
Alopiidae														
Alopias superciliosus NC	11	R												
Lamnidae														
Carcharodon carcharias NC	6	O												
Isurus oxyrinchus	6	O												
Scyliorhinidae														
Galeus arae NC	8,7	U	U											
Scyliorhinus retifer O	6	U	U											

*Previous surveys and new records: NR = a fish not previously recorded from the study area, 1 = Evermann and Bean (1897), 2 = V. Springer (1960), 3 = Gunter and Hall (1963), 4 = Christensen (1965), 5 = Powell *et al.*, 1972), 6 = S. Springer (1960, 63, 66), 7 = Anderson and Gehringer (1965), 8 = Bullis and Thompson (1965), 9 = Harrington and Harrington (1961), 10 = Courtenay (1972), 11 = Bigelow and Schroeder (1948), 12 = Daly (1970), 13 = Cory and Pierce (1967), 14 = Briggs (1958), 15 = Harrington, R. H., ichthyological collection, Florida State Entomological Research Laboratory, Vero Beach, Florida, 16 = Dahlberg (1970), 17 = Moe (1963), 18 = Bailey *et al.*, (1970), 19 = Stewart Springer, pers. comm., 20 = Unpublished R/V Silver Bay station data compiled by Paul Struhsaker of the National Marine Fisheries Service, 21 = Relyea (1975).

TABLE 3 (CONTINUED).

SPECIES	PREVIOUS* SURVEYS	N	B	R	SR	SS	I	GF	MAN	SB	LR	CRM	FTC	MI
Carcharhinidae														
Aprionodon isodon	6	O				O								
Carcharhinus acronotus	6	F		O		O								
C. altimus	6	O		O										
C. falciformis	7,6	F												
C. leucas	6	F		U	O	U	F	F	F	F	U	F	F	
C. limbatus	4	C		C	O	F	C	U		U	U	U	U	
C. longimanus	NR	F												
C. maculipinnis	12	O		U										
C. milberti	7,6,1	C		U	U	F	O							
C. obscurus	6	F		U										
C. springeri	19	U		U										
Galeocerdo curvieri	6	F		F		O								
Mustelus canis	4	O				O	O			U				
M. norrisi NC	8	U												
Negaprion brevirostris	8,7,6	C		O		O	O	O				O		
Rhizoprionodon terraenovae	7,1	F				O								
Sphyrnidae														
Sphyrna lewini	6	F				O	O							
S. mokarran	6	F					O							
S. tiburo	7,4,1	O				F	F	O						
S. zygaena NC	7,6,1	R												
Squalidae														
Squalis acanthias NC,?	1	U												
S. sp. NC	7	U												
Pristidae														
Pristis pectinata	4,1		R					R		R				
P. perotteti NC,?	11							R		R				
Rhinobatidae														
Rhinobatos lentiginosus	4		R			R	R							

Torpedinidae											
Narcine brasiliensis	8,5,4		F	C	F						
Torpedo nobiliana NC	8,7		U								
Rajidae											
Raja eglanteria	8,7		C	O							
R. garmani NC	8		R								
R. texana NC	8		U								
Dasyatidae											
Dasyatis americana	7		R								
D. sayi	8,7,1		F					F			
D. sabina	7,4,3,2,1		C			C	F	C	F	F	
D. centroura	7		F	F				O			
Gymnura micrura	8,7,1		R			R		R			
Myliobatidae											
Aetobatus narinari	8,7,4	O			F	F		F			
Myliobatis freminvillei	7,4	R		O	U						
Rhinoptera bonasus	7	U									
Mobulidae											
Manta birostris O	NR	O									
Mobula hypostoma NC	11	U									
Acipenseridae											
Acipenser brevirostrum NC	1				U				U		
Lepisosteidae											
Lepisosteus osseus	NR					O	O		O	C	
L. platyrhincus	4,3								O	A	
L. spatula NC,?	1								U	U	
Amiidae											
Amia calva	4									C	
Elopidae											
Elops saurus	9,5,4,3,2,1	O		O	O	F	F	F	F	O	
Megalops atlantica	9,5,4,1	F		O	O	O	F	O	F	F	C
Albulidae											
Albula vulpes	5,4				O	O	O	O			

TABLE 3 (CONTINUED).

SPECIES	PREVIOUS* SURVEYS	N	B	R	SR	SS	I	GF	MAN	SB	LR	CRM	FTC	MI
Anguillidae														
Anguilla rostrata	5,4,2,1	U					O					O	F	
Xenocongridae														
Chlopsis bicolor			U											
Muraenidae														
Anarchias yoshiae	8		O	O										
Enchelycore nigricans	5		U	U										
Gymnothorax funebris	5,4			F	F		F							
G. moringa	5,4			C	C		C							
G. nigromarginatus	NR		C											
G. vicinus	4			F			O							
Muraena miliaris	NR			O										
Muraena retifera	5		O	O			O							
Muraenesocidae														
Hoplunnis macrurus	8		O											
Congridae														
Ariosoma impressa	NR		U					U	U					
Congrina flava	NR		U											
Paraconger caudilimbatus	NR		U											
Ophichthidae														
Ahlia egmontis	5,4			U			U							
Bascanichthys scuticaris NC	4			U			U	U						
B. teres	4			U			U							
Letharchus velifer	4		U	U										
Myrichthys acuminatus	5,4		U	U			U				U			
Myrophis punctatus	5,4,2		O	O			F	F	F	F	F			
Mystriophis intertinctus NC	8		U											
Ophichthus ocellatus	8,7,5		F											
Gordiichthys springeri NC	14							U						

Clupeidae											
Alosa sapidissima NC,?	1	U				U	U		U	U	U
Brevoortia smithi	16,8,7,5, 4,3,2,	A				A	A		A	A	O
B. tyrannus	16,7,5,4,2,1	O				O	O		O	O	O
B. smithi × *B. tyrannus*	16	O				O	O		O	O	O
Dorosoma cepedianum	4,3						O			O	C
D. petenense NC	5,4,3,2									U	U
Etrumeus teres NC	8,7	U									
Harengula clupeola	4	U		U		U					
H. humeralis	5,4	U		U		U	U				
H. jaguana	8,7,5,4,3	A		A	A	A	A	A	A		
Jenkinsia sp. NC	4	U				U	U				
Opisthonema oglinum	8,7,5,4,1	A		A	A	A	A	A	A		
Sardinella anchovia	8,7,5,4	A		A	A	A	A	A	A		
Engraulidae											
Anchoa cubana	4	C		C	C	C	C	C	C		
A. hepsetus	7,4,3	A		A	A	A	A	A	A	O	
A. lamprotaenia	4	O			O	O	O		O		
A. lyolepis	5,4,2	O				O					
A. mitchilli	7,5,4,3,2,1	A			A	A	A	A	A	A	O
A. nasuta	12	A		A	A	A	A	A			
Anchoviella perfasciata NC	12	U									
Engraulis estauquae NC	12	U									
E. eurystole NC	12	U			U						
Argentinidae											
Argentina silus NC,?	8	U	U								
A. stewarti	NR	U	U								
Glossanodon pygmaeus	NR	U	U								
Synodontidae											
Saurida normani	8		U								
S. caribbaea	NR		O								
Synodus intermedius	7		O								
S. foetens	7,5,4,3,2		C		C	C		C	C	O	
S. poeyi	NR		U								
S. saurus	NR		U								
Trachinocephalus myops	8,7		C		O	O					

TABLE 3 (CONTINUED).

SPECIES	PREVIOUS* SURVEYS	N	B	R	SR	SS	I	GF	MAN	SB	LR	CRM	FTC	MI
Chlorophthalmidae														
Chlorophthalmus agassizi	7		U											
Cyprinidae														
Notemigonus crysoleucas	4,3												C	
Notropis maculatus	4,3												C	
N. petersoni NC	4												O	
Catostomidae														
Erimyzon sucetta	4,1												C	
Ictaluridae														
Ictalurus catus NC	3,2												U	
I. natalis NC	4												U	
I. nebulosus	4											O	C	
I. punctatus NC	3												U	
Noturus gyrinus NC	4												U	
Clariidae														
Clarias batrachus	NR												C	
Ariidae														
Arius felis	8,7,5,4,3,2,1		C			C	C	C	C	C		C	C	
Bagre marinus	8,7,5,4,3,1		C			C	C	C		C		C	C	
Batrachoididae														
Opsanus tau	NR		U					C			C			
Porichthys plectrodon	7		C											
Gobiesocidae														
Gobiesox strumosus	5,4,2,1				C				C		C			
Antennariidae														
Antennarius pauciradiatus	NR			U					U					
A. scaber	4		O	O			O		O		O			
A. radiosus NC	8,7			U										
Histrio histrio	8,7,4	F					O		O					

Chaunacidae									
Chaunax pictus NC	8	U							
Ogcocephalidae									
Halieutichthys aculeatus	8,7		C						
Ogcocephalus nasutus	8		F						
O. radiatus	8		F						
O. vespertilio	7		O						
O. sp.	NR		C						
O. sp.	NR		C						
Gadidae									
Enchelyopus cimbrius	NR		U						
Urophycis floridanus	8		O						
U. regius	8,7		C						
U. tenuis	NR		C						
Ophidiidae									
Lepophidium cervinum	8		F						
L. jeannae	NR		F						
L. sp.	7		U						
Ophidion holbrooki	8,7		C						
O. grayi	8,7		F						
O. sp. nov.	8		U						
O. selenops	NR		R						
Ogilbia cayorum	5,4			C	C		C		C
Otophidium omostigmum	NR		C						
Parophidion schmidti NC	4		U						
Rissola marginata NC	7		U						
Carapidae									
Carapus bermudensis	NR		R						
Exocoetidae									
Cypselurus heterurus	7,5	C			O	O		O	
Parexocoetus brachypterus	7	C							
Prognichthys gibbifrons NC	7,5,4	O							
Hemiramphidae									
Euleptorhamphus velox	NR	O							

TABLE 3 (CONTINUED).

SPECIES	PREVIOUS* SURVEYS	N	B	R	SR	SS	I	GF	MAN	SB	LR	CRM	FTC	MI
E. viridis NC	8	U												
Hemiramphus brasiliensis	7	C												
H. balao NC	8,7	U												
Hyporhamphus unifasciatus	7,5,4,1	C			C		C	C						
H. sp.	NR	C			C		C	C						
Belonidae														
Ablennes hians	7	O												
Platybelone argalus	NR	R												
Strongylura marina	5,4,1	O					O	R		R		R	R	
S. notata	5,4	A					A	A	A	A		A	A	
S. timucu	2	A					A	A	A	A		A		
Tylosurus acus	7	O					O	O	O	O				
T. crocodilus	4	F					F	F	F	F				
Cyprinodontidae														
Cyprinodon variegatus	15,9,5,3,1						O	O	O	O		O	O	A
Floridichthys carpio	21,5						C	F	F	F		R		
Fundulus chrysotus	5,4,1												U	
F. cingulatus NC	4												U	
F. confluentus	15,9,4,3									O		O	O	O
F. grandis	9,5,4,1						C	C		C		C	O	O
F. heteroclitus NC	21											U		
F. lineolatus NC	4,1												U	
F. seminolis NC	4,3												U	
F. similis	9,5,1					O	F	C		C		C	O	F
Jordanella floridae	4,3,1											R	C	
Leptolucania ommata NC	15,1												U	
Lucania goodei	4,3												C	
L. parva	9,5,1						C	C		C		F	O	C
Rivulus marmoratus NC	15,9								R				R	R

Poeciliidae														
Gambusia affinis	15,9,5,4 3,2,1							O	O			C	A	A
Heterandria formosa	15,5,4,3,2												C	
Poecilia latipinna	15,9,4,2,1							C	C	C		C	A	A
Poecilia (latipinna x velifera) NC	10												U	
Xiphophorus variatus NC	10												U	
X. helleri x X. variatus NC	10												U	
X. maculatus NC	10												U	
X. maculatus x X. helleri NC	10												U	
X. maculatus x X. variatus NC	10												U	
Atherinidae														
Allanetta harringtonensis	5,4							R	R					
Labidesthes sicculus	5,4,1												C	
Membras martinica	7,5,3	O			O	O	F	C	C	C				
Menidia beryllina	9,5,4,3,2,1							O	O	O		F	C	
M. peninsulae	9,5,4,3,2,1	O			O	C	C	C	C	C		O		C
Polymixiidae														
Polymixia lowei NC	8,7		U											
Fistulariidae														
Fistularia tabacaria	8,7,5,4,2	U		R			R	R						
Centriscidae														
Macrorhamphosus scolopax	8	U												
Syngnathidae														
Corythoichthys albirostris	NR	R	R											
C. brachycephalus	NR	R												
Hippocampus erectus	8,4,3	C					C	C			C	C		
H. reidi	4	R						R						
H. zosterae	4							C				O		
Oostethus lineatus	4							O					O	
Syngnathus dunckeri	4	R					R	R						
Syngnathus floridae	4,3,2	U					O	O						
S. fuscus	4	U					R	R						
S. louisianae	5,4,3,2,1	F					C	C				C	C	
S. pelagicus	NR	F												

TABLE 3 (CONTINUED).

SPECIES	PREVIOUS* SURVEYS	N	B	R	SR	SS	I	GF	MAN	SB	LR	CRM	FTC	MI
S. scovelli	5,4,3,2,1	O				O	C	C				C	C	
S. springeri	NR	O												
Scorpaenidae														
Neomerinthe hemingwayi	NR		R											
Pontinus longispinis	7		U											
Scorpaena agassizi	NR		F											
S. brasiliensis	8,7,5,4,1			C			C	C	O		C			
S. calcarata	8,7		C											
S. dispar	NR							R						
S. grandicornis	4,3			F			F	F			F			
S. plumieri	5,4			C	C		C	C			C			
Setarches guentheri NC	8		U											
Triglidae														
Bellator brachychir	5		R				R	R		R				
B. egretta NC	8		U											
B. militaris	8,7		C											
Peristedion miniatum	NR		U											
Peristedion sp.	7		U											
Prionotus alatus	NR		O											
P. carolinus NC	8,7		U											
P. evolans NC	8,7,1		U							U	U	U		
P. martis	NR		O											
P. ophryas	NR		O											
P. roseus	8,7		C											
P. scitulus	8,5,4		C				C			C		U		
P. salmonicolor	8,7,5		F				U					U		
P. tribulus	4,3,1		C				C			C		U		
Centropomidae														
Centropomus pectinatus	5,4,2							O	O			C	C	
C. undecimalis	9,5,4,3,2,1	O		O			C	C	C	C	C	C	C	C

Serranidae									
Anthias sp. NC	7		U						
Centropristis ocyurus	8,7,5	C	C		O				
C. philadelphica	8,7,5,4	C	C		O	O	O		
C. striata	8,7,5,4		C	C	C	O			
Diplectrum bivittatum	4	O	O			R			
D. formosum	8,7,4	C	C		O	O		O	O
Epinephelus drummondhayi	NR		U						
E. fulvus NC	5	U			U				
E. itajara	5,4,2,1		C	C	C	C	F		C
E. morio	4		C	C	C	C	F		C
E. nigritus	NR		C		O	O			
E. niveatus	7		C						
E. striatus	NR		F		O	O			
Hemanthias vivanus	8	F	F						
H. sp. NC	7	U							
Hypoplectrus gemma	NR		O						
H. nigricans	NR		O						
H. puella	NR		O						
H. unicolor	4		O		O	O			O
Liopropoma eukrines	NR		C						
Mycteroperca bonaci	5,4		C		O	O			O
M. microlepis	5,4		C	C	C	C	O		C
M. phenax	NR		C		O	O			O
Pikea mexicana	NR	R							
Plectranthias garrupellus	NR	U							
Pronotogrammus aureorubens	NR	U							
Serraniculus pumilio NC	8	U	U						
Serranus baldwini	4		U		U	U			
S. notospilus	8	U	U						
S. phoebe	8,7	C	C						
S. subligarius	5		C	C	O	O			
Grammistidae									
Rypticus bistrispinus	NR	C	C						
R. maculatus	4		C	C	O	O			
R. saponaceus	5		O		U				
R. subbifrenatus	NR		F						

TABLE 3 (CONTINUED).

SPECIES	PREVIOUS* SURVEYS	N	B	R	SR	SS	I	GF	MAN	SB	LR	CRM	FTC	MI
Centrarchidae														
Elassoma evergladei	4,1												U	
Enneacanthus gloriosus	4,3												F	
E. obesus NC, ?	1												U	
Lepomis gulosus	4,1												C	
L. macrochirus	5,4,3,2,1												C	C
L. marginatus	4,3												O	
L. microlophus	4,3												C	
L. punctatus	4,1												C	
Micropterus salmoides	4,1												C	C
Pomoxis nigromaculatus	3,2												U	U
Percidae														
Etheostoma fusiforme	4,1												C	
Priacanthidae														
Priacanthus arenatus	NR			C										
Pristigenys alta	8			O										
Apogonidae														
Apogon binotatus	NR			O	O		O				O			
A. maculatus	5,4			C	C		C				O			
A. planifrons	NR			O										
A. pseudomaculatus	5,4			C	C		C				O			
Astropogon puncticulatus	NR							C						
A. stellatus	5,4						O	C						
Phaeoptyx conklini	5						C	O						
P. pigmentaria NC	5						U	U						
Branchiostegidae														
Caulolatilus cyanops	NR		C											
Lopholatilus chamaeleonticeps	NR		C											
Pomatomidae														
Pomatomus saltatrix	8,7,5,4,2,1	C			C	C	O	O		O				

Rachycentridae												
Rachycentron canadum	7,5	F										
Echeneidae												
Echeneis naucrates	7,5	C	C			C						
E. neucratoides	NR	C	C			C						
Remora brachyptera	NR	R										
R. osteochir	NR	R										
R. remora	1	O										
Remorina albescens	NR	R										
Carangidae												
Alectis crinitus NC	8,5	O				O						
Caranx bartholomaei	7,4	C	C	C	C	C						
C. crysos	8,7,4,1	C	C	C	C	C						
C. hippos	8,7,5,4,3, 2,1	C	C	C	C	C	C	C	C	C	C	F
C. latus	4,3	C	C	C	C	C	O		O	O	O	U
C. ruber	8,5,4	C	C	C	C	F	R		R	R		
Chloroscombrus chrysurus	8,7,5,4,3,1	C	C	C	C	C	C		C		C	
Decapterus punctatus	7,4	C			C							
Elagatis bipinnulata	4	R										
Oligoplites saurus	4,3,1	C	C	C	C	C	C		C	C	C	C
Selar crumenopthalmus NC	8,7,4	U				U						
Selene setapinnis	8,7,3,1	F	F	F	F	F	F		F	F	F	
S. vomer	8,5,4,3,2,1	C	C	C	C	C	C		C	C	C	
Seriola dumerili	7	C			O							
S. rivoliana	4	U										
Trachinotus carolinus	8,7,5,4,3,1				C	C	O				R	
T. falcatus	5,4,3,1				C	C	C	C	C		O	
T. goodei	5,4,1				F							
Trachurus lathami	8,7	U										
Coryphaenidae												
Coryphaena equisetis	NR	R										
C. hippurus	8,7,5,4	C	C	O	O	R						
Lutjanidae												
Lutjanus analis	4,2		C	C		C	C	C		C		
L. apodus	5,4,2,1		C	C		C	C	C		C		

TABLE 3 (CONTINUED).

SPECIES	PREVIOUS* SURVEYS	N	B	R	SR	SS	I	GF	MAN	SB	LR	CRM	FTC	MI
L. campechanus	17	F		C										
L. cyanopterus	4			F			F	F						
L. griseus	5,4,3,2,1			C	C		C	C	C		C	C	C	F
L. jocu	4			C	C		C	C	C		C			
L. mahogoni	NR			F	F		F							
L. synagris	5,4,3,2,1			C	C		C	C	O		C			
Ocyurus chrysurus	4	C		C	F		F	C						
Pristipomoides aquilonaris	NR		U											
Rhomboplites aurorubens	8,7	C	C	C										
Lobotidae														
Lobotes surinamensis	7,4,1	O		O			O	O			O			
Gerreidae														
Diapterus auratus	5,4,3,2,1						O	A	C	A		A	A	C
D. plumieri	9,5,4,2						F	F	C	F		F	F	F
Eucinostomus argenteus	8,5,4,2	C	C	C	C	C	C	A	C	A		A	C	C
E. gula	5,4,3,2,1	C	C	C	C	C	C	A	C	A		A	C	
E. havana	4					U	U	U						
E. lefroyi	4						U	U						
E. pseudogula	4						C	O						
Gerres cinereus	4	C	C	C	C	C	C	O	O	O				
Pomadasyidae														
Anisotremus surinamensis	5,4,1			A	A		C							
A. virginicus	5,4			A	A		C	F			F			
Haemulon album	NR						O							
H. aurolineatum	8,5,4	C		C	C		F	F						
H. carbonarium	NR			O	O		O							
H. chrysargyreum	4			C	C		R		R					
H. flavolineatum	4			O	O		R	R						
H. macrostomum	4,1			C			R							
H. melanurum	NR			R	R		R							

Haemulon parrai	5,4,2			C	C		C	C	C					
H. plumieri	7,4			C	C		C	C	O		O			
H. sciurus	4			O			O	O						
Orthopristis chrysoptera	7,5,4,3,2,1	C	C	C				C				O		
Pomadasys crocro	NR (15)												R	
Sparidae														
Archosargus probatocephalus	5,4,3,2,1		C	C	C		C	C	O	C	C	C	C	C
A. rhomboidalis	5,4						O	O	O					
Calamus arctifrons	4			O			O	O						
C. bajonado	NR			C	C		C							
Diplodus argenteus	4			O	O		O							
D. holbrooki	5,1			C	A		A	O	O		O			
Lagodon rhomboides	8,7,5,4 3,2,1		O	O			C	A	O	A	A	C	F	O
Stenotomus chrysops	7	O	O	O			O	O						
Sciaenidae														
Bairdiella chrysura	7,5,4,3,2		O					C	O	C		O	O	
B. sanctaeluciae	18			C										
Cynoscion nebulosus	8,7,5,4,		R				O	C	O	C				
C. nothus	7,5		O				O	O		O				
C. regalis	8,7,5,4 3,2	O	O			O	O			O		O	O	
Equetus acuminatus	8,5,4			C	C		C				O			
E. lanceolatus	7			U										
E. umbrosus	5,4			C	C		O							
Larimus fasciatus	8,7		U											
Leiostomus xanthurus	8,7,5,4, 3,2,1		F				F	O		F		O	O	
Menticirrhus americanus	7,5,3,1		C			C	O			O				
M. littoralis	5,4		C			C	O			O				
M. saxatilis	8,7,5,4,2		C			C	O			O				
Micropogon undulatus	8,7,5,4 3,2,1		O			O	O	R		O				
Odontoscion dentex	NR			C	C									
Pogonias cromis	8,7,5,4 3,2,1		O	O			F	F	O	O	O	O		

TABLE 3 (CONTINUED).

SPECIES	PREVIOUS* SURVEYS	N	B	R	SR	SS	I	GF	MAN	SB	LR	CRM	FTC	MI
Sciaenops ocellata	5,4,3,2,1		C			F	F	F	F	F	F	F		
Stellifer lanceolatus	7,5,4,3,2	R	R				R	R		R				
Umbrina coroides	5,4		F			F	F							
Mullidae														
Mullus auratus	7		C	U										
Pseudupeneus maculatus	8,7,5,4			C	O		O	O		O				
Pempheridae														
Pempheris schomburgki	NR			O	O									
Kyphosidae														
Kyphosus incisor	8,7,4	F		F	O		F	R						
K. sectatrix	8,7,5,4	F		F	O		F	R						
Ephippidae														
Chaetodipterus faber	8,7,5,4,3,2,1	O		F	F		C	O	O	O	C	O		
Chaetodontidae														
Chaetodon aya	8			C										
C. capistratus	4			R			R							
C. ocellatus	4			R			R							
C. sedentarius	NR			R										
Holacanthus bermudensis	NR			C	C		C				O			
H. ciliaris	5,4			F			F				O			
H. tricolor O	NR			R			R							
Pomacanthus arcuatus	4			C	C		C				O			
P. paru	5			C			C				O			
Cichlidae (all introduced)														
Hemichromis bimaculatus NC	10												U	
Tilapia melanopleura NC	10												U	
T. mossambica NC	10												U	
Pomacentridae														
Abudefduf saxatilis	8,5,4,3,2			F	C		C				F			

A. taurus	4			O	F		F							
Chromis enchrysurus	NR		O	A										
Microspathodon chrysurus	NR			R										
Pomacentrus dorsopunicans	4			C	F		C				O			
P. leucostictus	5,4			O			O				O			
P. partitus	5			C			O				O			
P. variabilis	5,4			A	C		C				C			
Labridae														
Bodianus rufus	NR			O			O	O						
Doratonotus megalepis	5,4			O	O		O	O			O			
Halichoeres bethyphilus	8			U										
H. bivittatus	5,4			A	C		C	O			F			
H. caudalis	NR			O										
H. maculipinna	5			C	C		C	O			O			
H. poeyi	8,5			F	F		F							
H. radiatus	NR			F	F		F							
Hemipteronotus novacula	NR		C	O				R						
Lachnolaimus maximus	NR		O	C			O	O			O			
Thalassoma bifasciatum	NR			C	C		O							
Scaridae														
Cryptotomus roseus	4			O			O	O			O			
Nicholsina usta	5,4,1			O			O	C			O	R		
Scarus coelestinus	NR			F	F									
S. coeruleus	NR						R							
S. croicensis NC	4			U			U	U						
S. guacamaia	4			C	F		C							
S. taeniopterus	NR			U			U	U						
Sparisoma chrysopterum	4			F	F		F	F						
S. radians	4			O			O							
S. rubripinne	4			C	C		C	C						
Mugilidae														
Agonostomus monticola	NR	R					R					R	R	
Mugil cephalus	9,5,4 3,2,1	F	F			F	A	A	A	A		A	A	A
M. curema	7,5,4, 3,2,1	F	F			F	A	A	A	A		A	A	A

TABLE 3 (CONTINUED).

SPECIES	PREVIOUS* SURVEYS	N	B	R	SR	SS	I	GF	MAN	SB	LR	CRM	FTC	MI
Sphyraenidae														
Sphyraena barracuda	8,5,4,3	A		C	C		C	C	C	C	C	C		
S. borealis	8,4	F		F			F	F	F	F	F			
S. guachancho	NR	F		F	F	F	O							
Polynemidae														
Polydactylus octonemus NC	5,2					U	U							
P. oligodon	NR					U	U							
P. virginicus NC	5					U	U							
Opistognathidae														
Opistognathus macrognathus NC	15, NR			U	U									
O. whitehursti	NR			F										
O. sp.	5,2										U			
O. sp.	NR			U										
Percophididae														
Bembrops anatirostris	NR		U											
B. gobioides	NR		U											
Dactyloscopidae														
Dactyloscopus crossotus	4				F	F	F			U				
D. tridigitatus	4						F			F				
D. sp.	NR		U											
D. sp.	NR		U											
Gillellus greyae	5,4			F			U			U				
G. rubrocinctus	4			F			U			U				
G. sp.	2						U			U				
Uranoscopidae														
Astroscopus y-graeum	7,5,4		O		O	O	O			O	O			
Kathetostoma albigutta	8,7		O											
Clinidae														
Enneanectes altivelis	NR			O										
E. pectoralis	NR			O										

Labrisomus gobio	NR		O	O					R		
L. nuchipinnis	5,4		C	A	A	R			C		
Malacoctenus macropus	5		O	O	O				C		
M. triangulatus	5		C	O	O	O			O		
Paraclinus fasciatus	4					R		R	R		
P. nigripinnis	5,4			R	R						
Starksia ocellata	NR		O	C	O						
Blenniidae											
Blennius cristatus	5,4		C	A	A						
Blennius marmoreus	5,4				O		O				
B. nicholsi	5,4,2					O	F		O	O	
Chasmodes bosquianus	NR					O	O				
C. saburrae	5,1					O	O		O		
Entomacrodus nigricans	NR		R	R		R			R		
Hypleurochilus aequipinnis	4		O		O	O					
H. bermudensis	5				O					O	
H. geminatus	5				O						
Hypsoblennius sp. NC	7	U	U								
Callionymidae											
Callionymus pauciradiatus NC	4				U	U					
Eleotridae											
Dormitator maculatus	9,5,4,2									C	C
Eleotris pisonis	5				O	O		O	O	O	O
Erotelis smaragdus	4	O		O	O	O		O	O	O	O
Gobiomorus dormitor	4										C
Gobiidae											
Awaous tajasica	15										R
Bathygobius curacao	5									O	O
B. soporator	5,4,3,2,1				C	C	C		C	C	
Coryphopterus dicrus	NR		O								
C. glaucofraenum	4		C			O					
Evermannichthys spongicola	NR	R									
Evorthodus lyricus	9,5,4,1					U	U	U		U	
Gnatholepis thompsoni	NR		U								
Gobioides broussoneti	5,4,3					U	U			U	U

TABLE 3 (CONTINUED).

SPECIES	PREVIOUS* SURVEYS	N	B	R	SR	SS	I	GF	MAN	SB	LR	CRM	FTC	MI
Gobionellus boleosoma	5,4,3,2,1							C	O			C	O	
G. gracillimus NC	5,3							U	U			U		
G. hastatus NC	5,3							U	U			U	U	
G. oceanicus	2							F	F	F				
G. schufeldti	NR												U	
G. smaragdus	5,4,2							C	F			C		
G. stigmaturus	4,1							F						
Gobiosoma bosci	5,4,3,2,1							R				C	F	
G. ginsburgi NC	4							U				U		
G. macrodon	NR			O				U			U			
G. oceanops	NR			C										
G. robustum	5,4,2							A		F	O	O		
Lophogobius cyprinoides	5,4,2							F	F	O	O	F	F	C
Lythrypnus nesiotes	NR			O										
Microgobius gulosus	5,4,2,1							C	O	C	C	C	F	
M. microlepis NC	4							U						
M. thalassinus	NR							O						
Risor ruber														
Varicus n.sp.														
Microdesmidae														
Cerdale floridana	4							U						
Acanthuridae														
Acanthurus bahianus	5,4			C	C		F	O						
A. chirurgus	5,4			C	C		F	O						
A. coeruleus	NR			O	O		F							
Trichiuridae														
Trichiurus lepturus	8,7,4,3	O	O	O		O	F	C	F	C	C	F		
Scombridae														
Acanthocybium solanderi	7	O												
Auxis thazard	NR	O												

Euthynnus alletteratus	7	C		C	F	F				
E. pelamis	NR	O								
Scomber japonicus NC	7	U								
Scomberomorus cavalla	7	C		F	F	O				
S. maculatus	8,7,5,1	C		F	F	F	F	F	O	
S. regalis	5	O								
Thunnus albacares	NR	O								
T. atlanticus	NR	O								
Xiphiidae										
Xiphias gladius	7	O								
Istiophoridae										
Istiophorus platypterus	NR	F								
Makaira nigricans	NR	R								
Tetrapterus albidus	NR	R								
Stromateidae										
Nomeus gronovii	4	C				C				
Peprilus alepidotus NC	8,7	O				O				
P. triacanthus NC	8,7,5	O				O				
Psenes cyanophrys	8,4	O								
Bothidae										
Anclopsetta quadrocellata NC	8,7		U							
Bothus ocellatus	8,4		C			O		O		
B. robinsi	NR		C			O		O		
Citharichthys arctifrons	8,7		O				R	R		
C. arenaceus	4							U		
C. macrops	8,7,5,4,3		C			O	O	O		
C. spilopterus	7,5,4,3,2,1						C	C	C	O
Cyclopsetta chittendeni NC	8		U							
C. fimbriata	8		O							
Engyophrys senta	NR		U							
Etropus crossotus	7,5,3		C			O		O		
E. rimosus	8		F							
Monolene antillarum	NR		O							
M. sessilicauda	NR		O							
Paralichthys albigutta	8,7,5,4,2		C		C	C		C	C	

TABLE 3 (CONTINUED).

SPECIES	PREVIOUS* SURVEYS	N	B	R	SR	SS	I	GF	MAN	SB	LR	CRM	FTC	MI
P. dentatus	7,5		F			F	F			F		F		
P. lethostigma	8,7,4,1		F			F	F			F		F		
P. oblongus NC	7		U											
P. squamilentus	8,7,5,4		F			F	F			F		F		
Scophthalmus aquosus NC	7		U											
Syacium gunteri	NR		O											
S. micrurum NC	4		O				U			U				
S. papillosum	8		A											
Pleuronectidae														
Poeciliopsetta beani	NR		O											
Soleidae														
Achirus lineatus	5,4,3,2,1		O				O			C		C	C	C
Gymnachirus melas	7		C											
Trinectes maculatus	7,5,3,2		O							O		O	O	O
Cynoglossidae														
Symphurus civitatus	NR		O											
S. diomedianus	8		C											
S. minor	NR		O											
S. plagiusa	8,7,5,4,3,2,1		C				C			C		C		
S. urospilus	NR		O											
Balistidae														
Aluterus heudeloti NC	4	U					U							
A. schoepfi	7,4	O		O			O							
A. scriptus	4	R		R			R	R						
Balistes capriscus	8,5,4	F		F			O							
B. vetula	NR	O												
Canthidermis maculatus	NR	O												
C. sufflamen	4	O					R							
Cantherhines pullus	NR			R										
Monacanthus ciliatus	8,5,4	F		F			F	F			F			

M. hispidus	8,7,5,4	C		C	F		C	C			C	C		
M. setifer	8,4	O												
M. tuckeri	NR	R												
Ostraciidae														
Lactophrys quadricornis	8,7,4			R			R	R			R			
L. trigonus	7,5,4,2			O			O	O			O			
L. triqueter	NR			C	O		C	C			C			
Tetraondontidae														
Canthigaster rostrata	NR			R										
Lagocephalus laevigatus	NR	R		R			R							
Sphoeroides dorsalis	8	C												
S. maculatus NC	3,1						U	U		U	U	U		
S. nephelus	5,4,3,2	O		O			C	C	O		C	C		
S. spengleri	8,5,4,1	O		O			C	C	O		C	C		
S. testudineus	5,4,3,2,1						C	C	C		C	C		
Diodontidae														
Chilomycterus antennatus NC	5			U			U							
C. schoepfi	8,7,5,4,3,2,1			C			C	C		C	C	C		
Diodon histrix NC	1			F			O							
D. holacanthus	4			U			U							
Molidae														
Mola mola	NR	R												
TOTAL SPECIES		177	171	223	105	78	275	208	84	121	90	109	110	26
Total Continental Shelf	478													
Total Indian River Lagoon and Tributaries	381													
Combined Species	609													
New Records	135													

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