

ECOLOGICAL AND DISTRIBUTIONAL NOTES ON THE FRESHWATER FISH OF SOUTHERN FLORIDA

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ABSTRACT: The freshwater fish fauna is composed of 108 species in 34 families. Only 29% of the fauna belong to obligatory freshwater families. The Cyprinodontidae and Poeciliidae represent 19% of the native fauna. Eleven exotic species are established. The distribution and habitat of each species are described.

DESPITE recent interest in the wetlands of southern Florida, the freshwater fish fauna of the region is superficially known and poorly documented. The only published list of freshwater fish known to occur in this region (Kilby and Caldwell, 1955) is derived primarily from limited field collections in and near Everglades National Park. Studies of ecology and life history of southern Florida fish have been limited almost entirely to commercially important species and, with few exceptions such as Hunt (1953), Gunter and Hall (1963a, 1965), and Kushlan (1972a), published studies on the freshwater fish communities of southern Florida are almost nonexistent.

Ecological work has been hampered by the paucity of published distributional information. In addition, it is difficult for workers to judge the significance of new results because the pertinent literature is widely scattered. Information on southern Florida fish fauna is included in previous state lists starting with Evermann and Kendall (1900) and including the important works of Carr and Goin (1955) and Briggs (1958). The latter papers were based primarily on northern Florida specimens and reflected the paucity of information available on southern Florida fish.

The purpose of this paper is to summarize existing published information on the freshwater fishes of southern Florida with the addition of recent data collected by the authors. We have emphasized the gross distribution of each species and have added information on habitat preferences wherever possible. Detailed information on reproduction and other aspects of biology are too little known in most species for inclusion. The paper includes those native species of fish which have been collected in freshwater in Lake Okeechobee, the Caloosahatchee and St. Lucie Rivers, south to the southern tip of the peninsula. This region encompasses the vast freshwater swamps and marshes of the Everglades and Big Cypress Swamp (Fig. 1). The list also includes introduced species which have established populations in the region. Davis (1943) and Craighead (1971) described this region and the ecological communities found within it.

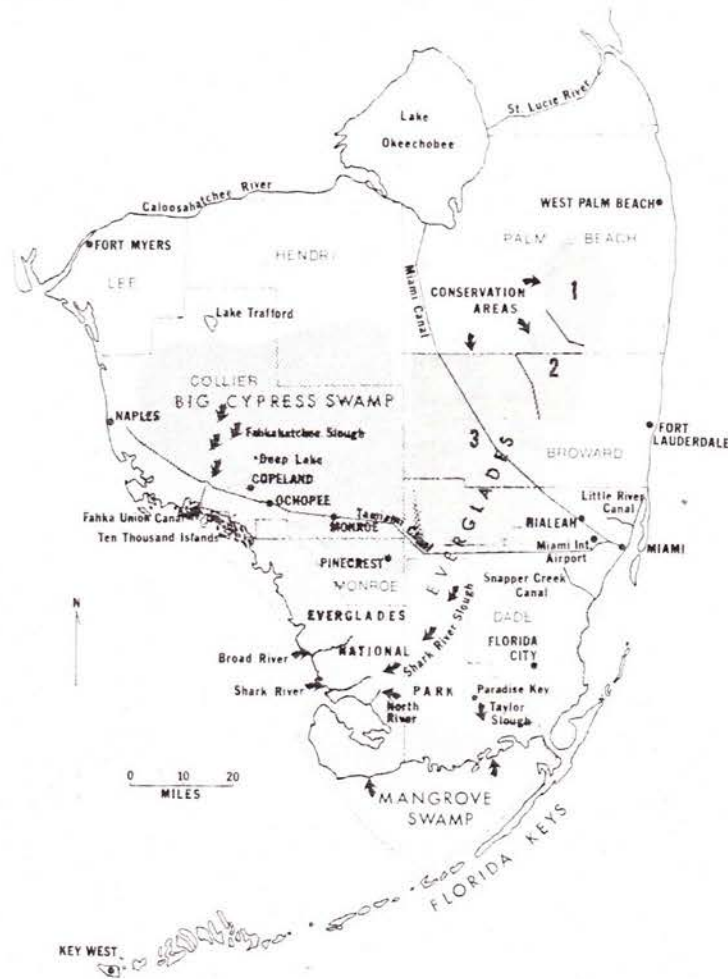


Fig. 1. Map of southern Florida.

FAUNA—The freshwater fish fauna of southern Florida is composed of 108 species listed in Table 1. The list is divided into two broad categories of "principally freshwater" and "principally marine" species. Each species is assigned to one of these categories based upon present information on whether or not the species carries out its life cycle in freshwater which we define as having a salinity of less than 0.30‰ (Gunter and Hall, 1963b). Distinguishing between the two categories becomes somewhat difficult because of the large number of marine species which occur in freshwater in Florida (Carr, 1937; Gunter, 1942; Hubbs and Allen, 1943; Herald and Stickland, 1949; Carr and Goin, 1955; Tagatz, 1968). Over half the species listed in Table 1 are marine. Possible reasons for this phenomenon have been discussed by Odum (1953), Hulet et al. (1967), Martin (1972) and others. Some species classified as principally marine, such as the

catadromous American eel (*Anguilla rostrata*) and the tarpon (*Megalops atlantica*), move far into the Everglades and Big Cypress Swamp. Other marine species move inland only short distances from the coast and are generally found in canals and rivers. Some families have both principally marine and principally freshwater members.

TABLE 1. List of the freshwater fishes of southern Florida.

<i>Principally Freshwater Species</i>		
Lepisosteus osseus	Noturus leptacanthus	Labidesthes sicculus
Lepisosteus platyrhincus	Clarius batrachus	Elassoma evergladei
Amia calva	Hyostomus sp.	Enneacanthus gloriosus
Dorosoma cepedianum	Aphredoderus sayanus	Lepomis gulosus
Dorosoma petenense	Cyprinodon variegatus	Lepomis macrochirus
Esox americanus	Fundulus chrysotus	Lepomis marginatus
Esox niger	Fundulus cingulatus	Lepomis microlophus
Notemigonus crysoleucas	Fundulus confluentus	Lepomis punctatus
Notropis chalybaeus	Fundulus seminolis	Micropterus salmoides
Notropis emiliae	Jordanella floridae	Pomoxis nigromaculatus
Notropis maculatus	Lucania goodei	Etheostoma fusiforme
Notropis petersoni	Belonesox belizanus ¹	Astronotus ocellatus ¹
Erimyzon sucetta	Gambusia affinis	Cichlasoma bimaculatum
Ictalurus catus	Heterandria formosa	Cichlasoma octofasciatum ¹
Ictalurus natalis	Poecilia latipinna	Cichlasoma nigrofasciatum ¹
Ictalurus nebulosus	Xiphophorus helleri ¹	Hemichromis bimaculatus
Ictalurus punctatus	Xiphophorus variatus ¹	Tilapia mossambica
Noturus gyrinus		
<i>Principally Marine Species</i>		
Carcharhinus leucas	Menidia beryllina	Sciaenops ocellata
Dasyatis sabina	Centropomus ensiferus	Mugil cephalus
Elops saurus	Centropomus parallelus	Mugil curema
Megalops atlantica	Centropomus pectinatus	Mugil trichodon
Anguilla rostrata	Centropomus undecimalis	Dormitor maculatus
Brevoortia smithi	Caranx hippos	Eleotris pisonis
Brevoortia tyrannus	Oligoplites saurus	Gobiomorus dormitor
Anchoa hepsetus	Lutjanus griseus	Gobioides broussoneti
Anchoa mitchilli	Diapterus olisthostomus	Gobionellus boleosoma
Arius felis	Diapterus plumieri	Gobionellus gracillimus
Bagre marinus	Eucinostomus argenteus	Gobionellus hastatus
Strongylura marina	Eucinostomus gula	Gobiosoma bosci
Strongylura notata	Archosargus probatocephalus	Gobiosoma robustum
Strongylura timucu	Lagodon rhomboides	Lophogobius cyprinoides
Adinia xenica	Cynoscion arenarius	Microgobius gulosus
Floridichthys carpio	Cynoscion regalis	Citharichthys spilopterus
Fundulus grandis	Leiostomus xanthurus	Achirus lineatus
Fundulus similis	Micropogon undulatus	Trinectes maculatus
Lucania parva	Pogonias cromis	

¹introduced species

An analysis of the freshwater fish fauna by families is presented in Table 2. Two of the 36 families listed are considered to be hypothetical because representatives have not been collected in freshwater in southern Florida

although they are expected to occur there. Three other families are represented only by introduced species. Each family is classified in Table 2 as belonging to the primary, secondary or peripheral division of fishes. These groupings, based upon the system of Myers (1938) and later authors, classify families as to their physiological adaptation to marine environments and therefore reflect their ability to invade new areas by marine routes.

TABLE 2. Families and number of species of freshwater fish in southern Florida.

Family ¹	Salinity class ²	Number of verified species	Number of principally freshwater species	Number of principally marine species	Number of established exotic species	Number of hypothetical species ³
Carcharhinidae	Per	1	0	1	0	0
[Pristidae]	Per	0				2*
Dasyatidae	Per	1	0	1	0	0
Lepisosteidae	Prim	2	2	0	0	0
Amiidae	Prim	1	1	0	0	0
Elopidae	Per	2	0	2	0	0
Anguillidae	Per	1	0	1	0	0
Clupeidae	Per	4	2	2	0	0
Engraulidae	Per	2	0	2	0	0
Esocidae	Prim	2	2	0	0	0
Cyprinidae	Prim	5	5	0	0	0
Catostomidae	Prim	1	1	0	0	0
Ictaluridae	Prim	6	6	0	0	0
Clariidae	Sec	1	0	0	1	0
Ariidae	Per	2	0	2	0	0
Loricariidae	Prim	1	0	0	1	0
Aphredoderidae	Prim	1	1	0	0	0
Belontiidae	Per	3	0	3	0	0
Cyprinodontidae	Sec	12	7	5	0	1*
Poeciliidae	Sec	6	3	0	3	1*
Atherinidae	Per	2	1	1	0	0
[Synnathidae]	Per	0				1*
Centropomidae	Per	4	0	4	0	0
Centrarchidae	Prim	9	9	0	0	0
Percidae	Prim	1	1	0	0	0
Carangidae	Per	2	0	2	0	1*
Lutjanidae	Per	1	0	1	0	1*
Gerreidae	Per	4	0	4	0	1*
Sparidae	Per	2	0	2	0	1*
Sciaenidae	Per	6	0	6	0	1*
Cichlidae	Sec	6	0	0	6	2
Mugilidae	Per	3	0	3	0	0
Eleotridae	Per	3	0	3	0	0
Gobiidae	Per	8	0	8	0	2*
Bothidae	Per	1	0	1	0	0
Soleidae	Per	2	0	2	0	0

¹ Brackets indicate family is based entirely on species of hypothetical occurrence.

² Classified as primary (Prim), secondary (Sec), or peripheral (Per) freshwater families. Peripheral families include those elsewhere classified as vicarious, complementary, and diadromous. Classification use follows Myers (1938) and Miller (1966) except for Lepisosteidae which is usually considered to be a secondary family and Clariidae which is usually considered to be a primary family. These follow the suggestion of C. R. Robins (personal communication).

³ Hypothetical status is due to either (*) euryhaline species of unproven occurrence in freshwater in southern Florida or (≠) freshwater species whose current breeding status is unknown.

Native Fauna: There are 97 species of native freshwater fishes in southern Florida. It is of biogeographic interest that only 9 of the 31 native families found in southern Florida belong to the primary (i.e., obligatory freshwater) division and represent only 29% of the entire native fauna. The affinities of these families are

decidedly temperate North American, all having ranges extending at least as far north as the Great Lakes region. Species of primary families occurring in southern Florida are derived from the coastal plain fauna of southeastern North America. Most of the primary families, especially the Catostomidae, Percidae and Cyprinidae experience a reduction in the number of species from north to south in Florida (see Briggs, 1958) despite the existence of continuous freshwater avenues for colonization. It seems most probable that the weak invasion of southern Florida by these families is due to a lack of proper habitat. The catostomids, percids and cyprinids are primarily fish of fast-flowing streams, a habitat missing from central and southern Florida. Species of these families that do occur in southern Florida are those which occupy slow-moving marsh and swamp habitats throughout their range. Two other families of primary freshwater fish, the Ictaluridae and Centrarchidae, are well-represented in southern Florida. While southern Florida ictalurids are found commonly in shallow habitats, the centrarchids are primarily fishes of stable habitats and are presently found in greatest abundance in canals, the most permanent of present-day habitats.

The native southern Florida freshwater fish fauna has two additional biogeographic components corresponding to the peripheral and secondary divisions. Only two native families are members of the secondary division. The Cyprinodontidae with 12 species makes the largest contribution of any family to the fauna. This family and the closely related Poeciliidae, together represent 19% of the total native fauna and one-quarter of the native species considered to be principally freshwater fish. These species, in addition, form the dominant component of the small fish fauna of the freshwater ecosystems of southern Florida. Although both of these families are derived from the neotropics, they have undoubtedly entered southern Florida from the north by both freshwater and marine routes.

Peripheral families comprise 20 of 41 native families and include the two hypothetical families of southern Florida fish. It is notable that peripheral families account for 56 of the 97 species of native fish verified to occur in southern Florida and that 3 of these are considered to be principally freshwater species.

Exotic Fauna: Eleven species of introduced fish are known to be established in freshwater in southern Florida. These comprise the families Clariidae, Loricariidae, Poeciliidae and Cichlidae (Table 2). This fauna has been recently reviewed by Lachner, Robins and Courtenay (1970) and Courtenay and Robins (1973).

Six of the species of exotic fish currently established in southern Florida are members of the tropical secondary freshwater family Cichlidae, a highly diversified group considered to be in many ways the ecological counterpart of the centrarchids. Members of this family are generally well adapted for survival in the Everglades and Big Cypress Swamp due to their ability to withstand drought, their highly developed system of parental care and their general aggressiveness. The Centrarchidae on the other hand comprise a primary freshwater family which reaches the extreme of its range in southern Florida in habitats characterized by seasonal drought to which the family is poorly adapted (Kushlan.

1974). It is anticipated that the spread of cichlids will be at the expense of the native centrarchids. The range expansion of *Cichlasoma bimaculatum*, already widespread throughout southern Florida, was aided by its tolerance of brackish water and its use of the extensive canal system of the interior. The future of both the exotic and native fish fauna of southern Florida should be a matter of concern.

FUTURE STUDY—It is hoped that this paper will serve to stimulate interest in and further research on the freshwater fish of southern Florida. The paucity of published information which compelled us to begin this work was even more apparent in its compilation. We have noted however some especially glaring gaps in current knowledge.

Due to the existence of canals, the correlation between the present distribution of fish and their historical distribution is not exact. It is anticipated that older collections might shed some light on this problem. This paper does not include data from any of the extensive collections of southern Florida fish which exist in various locations. The study of these collections might reveal interesting patterns of changing distribution.

Apparently biogeographic differences exist between the eastern and western parts of southern Florida, the one composed of the Lake Okeechobee-Everglades basin, the other composed of the Big Cypress Swamp, sandy flatwoods and Caloosahatchee river drainage. These patterns cannot be resolved without extensive sampling in and near the Big Cypress Swamp, where few data presently exist.

The extent of the penetration of marine fish into freshwater, especially in canals and rivers, deserves additional study. In this respect the Gobiidae and the Eleotridae present particularly interesting problems. Of all the families included in this paper we have been most hesitant and tentative in our accounts of the gobies. Study of the ecology, distribution and life history of species in both these families is much desired.

Finally we might take note that intensive ecological studies of southern Florida fish have only recently begun. Much additional work is necessary. The area presents abundant opportunity for significant and rewarding study.

SPECIES ACCOUNTS

The species accounts that follow describe the range and habitat of 108 verified and 14 hypothetical species of freshwater fish. Nomenclature and sequence follows Bailey et al. (1970) wherever possible. Names of introduced fishes follow Courtenay and Robins (1973). All information not credited to other sources are observations or generalizations attributable to the authors. It should be noted that the primary state work, Carr and Goin (1955) credits a number of species to southern Florida which apparently do not occur there. These species which have been excluded from the present paper include the following: Atlantic sharpnose shark, *Rhizoprionodon terraenovae* (Richardson); hickory shad, *Alosa mediocris* (Mitchill); skipjack herring, *Alosa chrysochloris* (Rafinesque); Alewife, *Alosa pseudoharengus* (Wilson); mummichog, *Fundulus heteroclitus* (Linnaeus);

mountain mullet, *Agonostomus monticola* (Bancroft); and frillfin goby, *Bathygobius soporator* (Valenciennes).

Order SQUALIFORMES, Family CARCHARINIDAE

Carcharhinus leucas (Valenciennes). The bull shark is a euryhaline species (Briggs, 1958) credited to the Florida freshwater fauna by Carr and Goin (1955) who stated that the specimens were recorded. Large rivers such as the Caloosahatchee, St. Lucie and the numerous smaller rivers of the southwest coast such as the Shark, Broad and North Rivers of Everglades National Park provide suitable habitat. Odum (1971) found juveniles in freshwater in North River in 1967.

Order RAJIFORMES, Family PRISTIDAE

Pristis pectinata Latham—hypothetical. The small tooth sawfish is a euryhaline species present along the southwest coast and may ascend the coastal rivers into freshwater.

Pristis perotteti Muller and Henle—hypothetical. The status of theargetooth sawfish is similar to that of the smalltooth sawfish.

Family DASYATIDAE

Dasyatis sabina (Lesueur). The Atlantic stingray ascends both the St. Lucie (Gunter and Hall, 1963a) and Caloosahatchee Rivers (Gunter and Hall, 1965) to freshwater.

Order SEMIONOTIFORMES, Family LEPISOSTEIDAE

Lepisosteus osseus (Linnaeus). Although Carr and Goin (1955) and Briggs (1958) considered the longnose gar to range throughout the state, the species apparently occurs in southern Florida only in Lake Okeechobee (Ager, 1971). The subspecies is *L. o. osseus* (Linnaeus).

Lepisosteus platyrhincus DeKay. The Florida gar is found in all habitats throughout the freshwater swamps and marshes of southern Florida. It is abundant in marsh-lined canals (Hunt, 1953, 1960), ponds, cypress sloughs, mangrove streams and other deep-water habitats. It is not common in canals in developed areas or along agricultural canals in southeast Dade County (Belshe, 1961). It occurs in cypress swamps and sawgrass marshes near canals during high water levels and apparently penetrates into the interior Everglades during prolonged high water. It moves into mangroves during the rainy season (Tabb and Manning, 1961; Odum, 1971).

Order AMIIFORMES, Family AMIIDAE

Amia calva Linnaeus. The bowfin (often called mudfish) is found throughout southern Florida. It is probably most common during high water in shallow communities but becomes abundant in ponds and canals during low water where it is well adapted for survival during drought.

Order ELOPIFORMES, Family ELOPIDAE

Elops saurus Linnaeus. The ladyfish occurs in freshwater in southern Florida in mangrove swamps (Tabb and Manning, 1961), in canals connected to salt water and in the St. Lucie (Gunter and Hall, 1963a) and Caloosahatchee Rivers (Gunter and Hall, 1965). It is pelagic in Lake Okeechobee (Ager, 1971).

Megalops atlantica Valenciennes. The tarpon is widespread in freshwater in southern Florida (Carr and Goin, 1955) as both juveniles (Wade, 1962) and adults. It occurs in airboat trails in the southern Everglades, in Taylor Slough during high water, and in canals in the conservation areas, the Big Cypress Swamp, and along both coasts. Large individuals are dependent upon such deep water habitats for dispersal as is shown by the fact that tarpons appeared in Deep Lake after the construction of a canal joining the lake to Barron River Canal (B. P. Hunt, personal communication).

Order ANGUILLIFORMES, Family ANGUILLIDAE

Anguilla rostrata (Lesueur). The American eel is a catadromous species found in most deeper water areas of southern Florida with connections to the ocean. These include mangrove streams, Lake Okeechobee (Ager, 1971) and many canals, including shallow ones, as far inland as the Big Cypress Swamp and Everglades.

Order CLUPEIFORMES, Family CLUPEIDAE

Brevoortia smithi Hildebrand. The yellowfin menhaden occurs in freshwater in Everglades National Park (C. R. Robins, personal communication) and in the St. Lucie River, where the presence of young is dependent upon low salinity (Gunter and Hall, 1963a).

Brevoortia tyrannus (Latrobe). The Atlantic menhaden occurs in freshwater in the Everglades National Park (C. R. Robins, personal communication) and in the St. Lucie River where it spawns (Gunter and Hall, 1963a).

Dorosoma cepedianum (Lesueur). The gizzard shad occurs in lakes and canals in southern Florida. It occurs in the St. Lucie River (Gunter and Hall, 1963a) and is plentiful in and around Lake Okeechobee (Ager, 1971). It is scarcer farther south but ranges through the conservation areas and into Everglades National Park (Phillips, 1971).

Dorosoma petenense (Gunter). The threadfin shad is abundant in Lake Okeechobee and nearby canals (Ager, 1971) and occurs in the St. Lucie (Gunter and Hall, 1963a) and Caloosahatchee Rivers (Gunter and Hall, 1965). It is apparently less common south of Lake Okeechobee but occurs in canals as far south as Everglades National Park (Phillips, 1971). The subspecies is *D. p. vanhyningi* (Weed).

Family ENGRAULIDAE

Anchoa hepsetus (Linnaeus). The striped anchovy apparently occurs in freshwater along both coasts (Carr and Goin, 1955) and has been recorded from southern Florida by Ogilvie (1969). However Gunter and Hall (1963a) stated that their record from a salinity of 1.0‰ in the St. Lucie River is the lowest salinity from which the species has been reported, and Odum (1971) noted it only occasionally strays into North River. The subspecies is *A. h. hepsetus* (Linnaeus).

Anchoa mitchilli (Valenciennes). The widespread and abundant bay anchovy invades freshwater rivers along both coasts (Carr and Goin, 1955) including the St. Lucie (Gunter and Hall, 1963a), Caloosahatchee (Gunter and Hall, 1965), and North Rivers (Odum, 1971). An unidentified species of *Anchoa* was taken in Lake Okeechobee (Florida Game and Fresh Water Fish Commission, 1956). The subspecies is *A. m. diaphana* Hildebrand.

Order SALMONIFORMES, Family ESOCIDAE

Esox americanus Gmelin. The redbfin pickerel occurs in marginal areas of Lake Okeechobee (Ager, 1971) and has been found in Conservation Area 3 (Dineen, 1972). It is primarily a fish of shallow marshes. The subspecies is *E. a. americanus* Gmelin.

Esox niger Lesueur. The chain pickerel occurs in vegetated areas of Lake Okeechobee (Ager, 1971), through the Everglades, and into Everglades National Park. Dineen (1968) stated that this species was established in Conservation Area 2 but not Area 3. However, it occurs commonly in Tamiami Canal south of Area 3. It is primarily a fish of canals and deep-water marshes and may have extended its range southward with the construction of the canal system.

Order CYPRINODONTIFORMES, Family CYPRINIDAE

Notemigonus crysoleucas (Mitchill). The golden shiner is widely distributed throughout southern Florida from Lake Okeechobee (Ager, 1971) to the limits of freshwater in the Everglades. It is especially common in ponds, sloughs and canals where it achieves its largest size. Juveniles have been collected in open dwarf cypress swamp and open marsh prairie in the Big Cypress Swamp and the Everglades. The subspecies is *N. c. bosci* (Valenciennes).

Notropis chalybaeus (Cope). The ironcolor shiner occurs in Lake Okeechobee (Ager, 1971) westward to Fort Myers (W. R. Courtenay, Jr., personal communication).

Notropis emiliae (Hay). The pugnose minnow is found in Lake Okeechobee (Ager, 1971; Gilbert and Bailey, 1972). The subspecies is *N. e. peninsularis* Gilbert and Bailey (1972).

Notropis maculatus (Hay). The taillight shiner has been recorded throughout much of southern Florida. It occurs in Lake Okeechobee (Ager, 1971), in the St. Lucie (Gunter and Hall, 1963a) and Caloosahatchee Rivers (Raney et al., 1953; Gunter and Hall, 1965), and in

several locations in the Big Cypress Swamp. It was collected in Shark River Slough several miles south of Tamiami Canal but has not yet been found further south. It seems to prefer slow-moving canals (W. R. Courtenay, Jr., personal communication).

Notropis petersoni Fowler. The coastal shiner seems to occur throughout much of southern Florida. It occurs in Lake Okeechobee (Ager, 1971) and the Caloosahatchee River (Raney et al., 1953; Gunter and Hall, 1965), but Gunter and Hall (1963a) did not report it from the St. Lucie River. It is the most abundant shiner (*Notropis*) in the southern Everglades although varying in abundance in different years. It has been collected as far south as the freshwater streams of lower Shark River Slough. It also has been collected in the Big Cypress Swamp near Copeland (C. R. Robins, personal communication) and Monroe.

Family CATOSTOMIDAE

Erimyzon succetta (Lacepede). The lake chubsucker is abundant and widespread throughout southern Florida from Lake Okeechobee (Ager, 1971) south throughout the Everglades and Big Cypress Swamp. It has been collected in the streams of the lower Everglades and in freshwater in mangrove swamps. It usually occurs in vegetated areas and is common in canals and ponds. Juveniles have been collected widely in sawgrass marsh, marsh prairie, cypress sloughs and ponds. The subspecies is *E. s. succetta* (Lacepede).
Order SILURIFORMES, Family ICTALURIDAE

Ictalurus catus (Linnaeus). The white catfish has been recorded from Lake Okeechobee where it is abundant in open water (Ager, 1971) and from the St. Lucie (Gunter and Hall, 1963a) and Caloosahatchee Rivers (Gunter and Hall, 1965) where it occurs only in low salinity.

Ictalurus natalis (Lesueur). The yellow bullhead ranges from Lake Okeechobee (Ager, 1971), throughout the Everglades and Big Cypress Swamp, and into mangrove swamps during periods of heavy rainfall. It is most abundant in close proximity to submerged vegetation in canals and ponds but has been collected in dwarf cypress swamp, marsh prairie and sawgrass marsh. The population has been referred to as *I. n. erebennus* Jordan (Hubbs and Allen, 1943).

Ictalurus nebulosus (Lesueur). The brown bullhead occurs throughout southern Florida being abundant in Lake Okeechobee (Ager, 1971) and common in the Big Cypress Swamp. It occurs in low salinity in the St. Lucie River (Gunter and Hall, 1963a). It apparently occurs in more open, muddy bottomed situations than does *I. natalis* and so is found in shallow ponds and sloughs as well as in the deeper water of canals and lakes. It seems generally less abundant than *I. natalis*. The subspecies is *I. n. marmoratus* (Holbrook).

Ictalurus punctatus (Rafinesque). The channel catfish occurs in open water in Lake Okeechobee (Ware, 1966; Ager, 1971) and in low salinities in the St. Lucie (Gunter and Hall, 1963a) and Caloosahatchee Rivers (Gunter and Hall, 1965). It ranges south through the conservation areas to Tamiami Canal (Hunt, 1953) and into Everglades National Park (Phillips, 1971) inhabiting deep canals almost exclusively.

Noturus gyrinus (Mitchill). The tadpole madtom ranges from Lake Okeechobee (Ager, 1971) throughout southern Florida to Taylor Slough, lower Shark River Slough of the Everglades, and into the mangrove swamps of the southern coast (Tabb and Manning, 1961).

Noturus leptacanthus Jordan. The speckled madtom has been recorded from the Caloosahatchee River (Gunter and Hall, 1965).

Family CLARIIDAE

Clarius batrachus (Linnaeus). The walking catfish was established near West Palm Beach in 1968 (Idvill, 1969). It now ranges from Ft. Lauderdale north to Lake Okeechobee and West Palm Beach with disjunct populations around Miami (Lachner, Robins and Courtenay, 1970).

Family ARIIDAE

Arius felis (Linnaeus). The sea catfish occurs in freshwater in the St. Lucie (Gunter and Hall, 1963a) and Caloosahatchee Rivers (Gunter and Hall, 1965) and in canals further south. It is abundant in freshwater throughout North River (Odum, 1971).

Bagre marinus (Mitchill). The gafftopsail catfish occurs in freshwater in the St. Lucie (Gunter and Hall, 1963a) and Caloosahatchee Rivers (Gunter and Hall, 1965).

Family LORICARIIDAE

Hypostomus sp. A mailed catfish identified as *Hypostomus plecostomus* (Linnaeus) has been reported from a borrow pit in west Miami by Rivas (1965). However, due to taxonomic uncertainty, identification of southern Florida specimens is not presently possible (C. R. Robins, personal communication). Mailed catfish have been taken from the Snapper Creek Canal system (Lachner, Robins, and Courtenay, 1970) and canals near Conservation Area 3 (C. R. Robins, personal communication).

Order PERCOPSIFORMES, Family APHREDODERIDAE

Aphredoderus sayanus (Gilliams). The pirate perch has been recorded to range to Lake Okeechobee (Florida Game and Fresh Water Fish Commission, 1956). Although Briggs (1958) and Carr and Goin (1955) stated that it ranges throughout southern Florida, the only specimen known from the area was near Florida City in 1930 (Kilby and Caldwell, 1955). In view of the lack of additional specimens, we assume that location data of the 1930 specimen is probably erroneous.

Order ATHERINIFORMES, Family BELONIDAE

Strongylura marina (Walbaum). The atlantic needlefish is found in many southern Florida canals even into the Everglades. It is common throughout open areas and bullrush marshes of Lake Okeechobee and has reproduced there (Ager, 1971).

Strongylura notata (Poey). The redfin needlefish has been recorded from freshwater in the St. Lucie River (Gunter and Hall, 1963a, b).

Strongylura timucu (Walbaum). The timucu has been found in canals in southeast Dade County (Belshe, 1961) and in freshwater near the northern Ten Thousand Islands area (T. Schmidt, personal communication).

Family CYPRINODONTIDAE

Adinia xenica (Jordan and Gilbert). The diamond killifish ranges along the Gulf Coast to the southern tip of the peninsula primarily in brackish water (Carr and Goin, 1955; Tabb and Manning, 1961). It has been collected in freshwater in North River (Odum, 1971), and it extends in some years into the freshwater of the southern Florida Everglades nearly as far north as Tamiami Canal.

Cyprinodon variegatus Lacepede. The sheepshead minnow occurs in brackish and freshwater from Lake Okeechobee (Ager, 1971) and the Caloosahatchee River (Raney et al., 1953) south to the mangroves and rivers of southern coast (Tabb and Manning, 1961; Odum, 1971). In some years it becomes very abundant in some localities in the Everglades and Big Cypress Swamp while in other years it is uncommon. This also appears to be the case in North River (Odum, 1971). Scattered individuals can be found in most open habitats. In the southern Everglades and Big Cypress the species is usually encountered near rocky culverts. It becomes more abundant and more regularly present in the southern Everglades near the mangrove coast. The subspecies is *C. v. variegatus* Lacepede.

Floridichthys carpio (Gunter). The goldspotted killifish is a euryhaline species occurring along both coasts (Briggs, 1958) in southern Florida. It has been recorded from freshwater in the North River (Odum, 1971). The subspecies is *F. c. carpio* (Gunter).

Fundulus chrysotus (Gunter). The golden topminnow ranges throughout southern Florida. It occurs in shallow spikerush marshes of Lake Okeechobee (Ager, 1971) and in all habitats southward to the limits of freshwater in lower Shark River Slough. It seems primarily a fish of relatively deeper water being common in ponds and along canal margins.

Fundulus ringulatus Valenciennes. The banded topminnow is apparently not common

in southern Florida but extends to at least Ft. Myers on the west coast according to Brown (1957) who also recorded it from the Tamiami Canal.

Fundulus confluentus Goode and Bean. The marsh killifish is a euryhaline species that ranges as far south as Key West (Miller, 1955). It occurs in freshwater in the Caloosahatchee River (Raney et al., 1953), in the Everglades, Big Cypress Swamp (Kushlan, 1973), and rivers and mangroves of the southern coast (Tabb and Manning, 1961; Odum, 1971). The subspecies is *F. c. confluentus* Goode and Bean.

Fundulus grandis Baird and Girard. The gulf killifish is a euryhaline and primarily brackish water species ranging along the Gulf (Miller, 1955) and Atlantic coasts (Briggs, 1958; Harrington and Harrington, 1961) and into the keys (Rivas, 1948). It occurs in freshwater in coastal canals, the Caloosahatchee River (Gunter and Hall, 1965) and mangroves (Tabb and Manning, 1961). The subspecies is *F. g. grandis* Baird and Girard.

Fundulus seminolis Girard. The seminole killifish occurs in Lake Okeechobee (Ager, 1971), the Caloosahatchee River (Raney et al., 1953; Gunter and Hall, 1965) and the Everglades to lower Shark River Slough. In the Big Cypress Swamp it has been collected in the Fakahatchee Strand.

Fundulus similis (Baird and Girard). The longnose killifish is a primarily brackish water species found along both coasts to Key West (Briggs, 1958). It ascends streams and canals into slightly brackish and freshwater (Tabb and Manning, 1961; Phillips, 1971; Carr and Goin, 1955).

Jordanella floridae Goode and Bean. The flagfish occurs throughout southern Florida. It is common in shallow marginal areas in Lake Okeechobee (Ager, 1971) and along canals. It occurs in marsh prairies and sawgrass marshes in the Everglades and especially in dwarf cypress in the Big Cypress Swamp. It becomes abundant in ponds during low water level (Kushlan, 1972a). It is primarily a bottom fish, common in dense, submerged vegetation and is also found in brackish water (Tabb and Manning, 1961).

Lucania goodei Jordan. The bluefin killifish is common throughout southern Florida into pools of the mangrove swamp where it occurs only during pulses of freshwater (Tabb and Manning, 1961; Odum, 1971). It is abundant in highly vegetated areas and especially along canal margins but is widespread in all habitats of the Big Cypress Swamp and Everglades. It occurs in the littoral zone of Lake Okeechobee (Ager, 1971).

Lucania parva (Baird). The rainwater killifish is a primarily brackish water species ranging to the Florida Keys (Hubbs and Miller, 1965). It occurs in freshwater in the Caloosahatchee River (Gunter and Hall, 1965), in mangrove swamps, rivers and canals along the coast (Carr and Goin, 1955; Raney et al., 1953; Belshe, 1961; Odum, 1971).

Rivulus marmoratus Poey—hypothetical. The rivulus is a brackish water species (Harrington and Rivas, 1958) which was found in canals in southeast Dade County by Belshe (1961), but the salinity was not reported.

Family POECILIIDAE

Belonesox belizanus Kner. The introduced pike killifish is abundant in canals in southeastern Dade County (Belshe, 1961; Lachner, Robins and Courtenay, 1970).

Gambusia affinis (Baird and Girard). The mosquitofish ranges throughout fresh and brackish water in southern Florida where it is the most ubiquitous species of fish (Kushlan, 1972a). It is found in habitats ranging from salt marshes (Harrington and Harrington, 1961) to Lake Okeechobee (Ager, 1971). It is usually the most abundant fish in canals, cypress sloughs, ponds, and dwarf cypress swamps. The subspecies is called the eastern mosquitofish, *G. a. holbrooki* Girard.

Gambusia rhizophorae Rivas—hypothetical. The mangrove gambusia is characteristically found in estuarine situations in association with mangrove swamps. Rivas (1969) however, stated that the original specimens were obtained near Paradise Key (Everglades National Park) which is surrounded by freshwater. We have no other records of its occurrence in freshwater. It is possible that the location data on the Paradise Key specimens was in error as it is doubtful that the species occurs even rarely in freshwater (C. R. Robins, personal communication).

Heterandria formosa Agassiz. The least killifish is found in freshwater throughout southern Florida. It is abundant in the littoral zone of Lake Okeechobee (Ager, 1971), in canals (Hunt, 1953), in the Big Cypress Swamp and in marsh prairies and sawgrass marshes of the Everglades where it is often one of the most abundant species. It also occurs in freshwater in mangrove swamps (Tabb and Manning, 1961) but rarely if ever moves into brackish water. It is usually associated with thick emergent and submerged vegetation where it remains close to submerged stems.

Poecilia latipinna (Lesneur). The sailfin molly is a euryhaline species occurring in freshwater throughout southern Florida. In freshwater habitats, it is probably most abundant and reaches its greatest size in canals but it occurs in most habitats including Lake Okeechobee (Ager, 1971).

Xiphophorus helleri Heckel. The green swordtail is established in canals in Palm Beach County (W. R. Courtenay, personal communication).

Xiphophorus variatus (Meek). The variable platyfish is established in canals in Palm Beach County (W. R. Courtenay, personal communication).

Family ATHERINIDAE

Labidesthes sicculus (Cope). The brook silverside occurs in freshwater throughout southern Florida from Lake Okeechobee (Ager, 1971) and the Caloosahatchee River (Raney et al., 1953) to the southern Everglades. It is common in open canals, clearwater ponds and deeper cypress sloughs. The subspecies is *L. s. vanhyningi* (Bean and Reid).

Menidia beryllina (Cope). The tidewater silverside is a euryhaline species which occurs in freshwater in the St. Lucie (Gunter and Hall, 1963a) and Caloosahatchee Rivers (Gunter and Hall, 1965), and in west coast mangroves (Raney et al., 1953) and canals. It is probably the most abundant fish in the North River (Odum, 1971) and other southern rivers from which it penetrates the southern Everglades. It also occurs in Lake Okeechobee (Ager, 1971).

Order GASTEROSTEIFORMES. Family SYNGNATHIDAE

Syngnathus scovelli (Evermann and Kendall)—hypothetical. The gulf pipefish enters freshwater in north Florida (Carr and Goin, 1955; Tagatz, 1968) and is a permanent resident in freshwater elsewhere (Whatley, 1969). Although it occurs in estuaries in southern Florida (Gunter and Hall, 1963a, 1965), we find no documented records for freshwater.

Order PERCIFORMES. Family CENTROPOMIDAE

Centropomus ensiferus Poey. The swordspine snook is known from the freshwater canals of southeastern Dade County (Rivas, 1962).

Centropomus parallelus Poey. The fat snook has been reported from Lake Okeechobee and canals of Dade County (Rivas, 1962).

Centropomus pectinatus Poey. The tarpon snook is known from the Caloosahatchee River and Dade County canals (Rivas, 1962).

Centropomus undecimalis (Bloch). The snook occurs in freshwater as both adult and juveniles. Ranging throughout southern Florida (Marshall, 1958), it occurs in freshwater canals in the Big Cypress Swamp, Conservation Area 3 (Dineen, 1972), Everglades National Park, and Lake Okeechobee (Ager, 1971; Rivas, 1962). Movement of snook between fresh and salt water has been shown by Volpe (1959). It enters the southern Everglades via air boat trails. Young occur in canals and freshwater ponds in mangroves (Tabb and Manning, 1961).

Family CENTRARCHIDAE

Elassoma evergladvi Jordan. The everglades pigmy sunfish ranges throughout southern Florida including Lake Okeechobee (Ager, 1971), the northern Everglades of Conservation Areas 2 and 3 (Clugston, 1966; Dineen, 1972), the southern Everglades and the Big Cypress Swamp (Kushlan, 1972a and unpubl. data). It is primarily a bottom fish commonly associated with submerged plants and fallen litter, especially in cypress sloughs. However, it is also found abundantly in stands of water hyacinth.

Enneacanthus gloriosus (Holbrook). The blue spotted sunfish occurs throughout the Everglades (Clugston, 1966; Dineen, 1972) and Big Cypress Swamp (Kushlan, 1972a and unpubl. data), in the eelgrass and pondweed communities of Lake Okeechobee (Ager, 1971) and in the St. Lucie (Gunter and Hall, 1963a) and Caloosahatchee Rivers (Gunter and Hall, 1965). It also occurs in canals but is apparently becoming rarer in that habitat along the urbanized east coast.

Lepomis gulosus (Cuvier). The warmouth is widespread and abundant throughout all of southern Florida. It is very abundant in canals (Hunt, 1953) and ponds (Kushlan, 1972a) and occurs in the littoral zone of Lake Okeechobee (Ager, 1971). It is the hardiest of the southern Florida centrarchids (Kushlan, 1974) and is one of the first invaders into excavated pits and canals (Ogilvie, 1969).

Lepomis macrochirus Rafinesque. The bluegill is probably the most common sunfish in southern Florida. It is very abundant in Lake Okeechobee (Ager, 1971) and in canals but has been found in all other freshwater habitats as well. The subspecies is *L. m. purpurescens* Cope.

Lepomis marginatus (Holbrook). The dollar sunfish occurs in Lake Okeechobee (Ager, 1971), the St. Lucie River (Gunter and Hall, 1963a), and the northern Everglades of the Conservation Areas (Clugston, 1966; Dineen, 1972) as far south as Tamiami Canal (Martin, 1963). However the southern extent of its range in the Everglades is not clear as it has not been reported from Everglades National Park (Phillips, 1971). It was collected on the east coast in Little River Canal in northeastern Dade County. It is apparently widely distributed in the Big Cypress Swamp, having been collected in Lake Trafford, Corkscrew (Martin, 1963), Deep Lake, Fakahatchee Slough, and north of Tamiami Canal near Monroe. However it has not been collected in six years of intensive sampling at an alligator pond near Pinecrest (Kushlan, 1972a and unpubl. data). It occurs primarily in ponds, lakes, and canals.

Lepomis microlophus (Gunther). The readear sunfish (also called shellcracker) ranges throughout southern Florida (Briggs, 1958) but seems to occur especially in such deeper-water habitats as ponds, lakes, canals, and cypress sloughs. The subspecies is *L. m. microlophus* (Gunther).

Lepomis punctatus (Valenciennes). The spotted sunfish (also called stumpknocker) ranges throughout southern Florida including Lake Okeechobee, where it occupies the littoral zone (Ager, 1971). It is found abundantly in canals, sloughs and ponds, but it ranges into dwarf cypress swamps. It is generally the most common sunfish in cypress sloughs and sawgrass marshes. The subspecies is *L. p. punctatus* (Valenciennes).

Micropterus salmoides (Lacepede). The largemouth bass ranges throughout southern Florida. It is found throughout Lake Okeechobee (Ager, 1971) and reaches its maximum abundance in canals during low water. It is also found in most other habitats including dwarf cypress and marsh prairie. The subspecies is *M. s. floridanus* (Lesueur) (Briggs, 1958).

Pomoxis nigromaculatus (Lesueur). The black crappie (also called speckled perch) ranges throughout southern Florida to the southern Everglades (Phillips, 1971). It is pelagic in Lake Okeechobee in winter moving into the littoral zone to breed (Ager, 1971). Further south it is primarily a fish of canals and is seldom found far from canal edge marshes. It is possible that this species may have extended its range into extreme southern Florida within historic times.

FAMILY PERCIDAE

Etheostoma fusiforme (Girard). The swamp darter is a common bottom-dwelling fish in Lake Okeechobee (Ager, 1971). It seems to be widespread in southern Florida and has been found in the Big Cypress Swamp, Conservation Area 3 (Dineen, 1972) and canals near Miami International Airport (C. R. Robins, personal communication).

FAMILY CARANGIDAE

Caranx hippos (Linnaeus). The crevalle jack is abundant throughout the Everglades

estuary region (Tabb and Manning, 1961) and was commonly collected by Odum (1971) throughout North River.

Caranx latus Agassiz—hypothetical. The horse-eye jack has been found in freshwater (Briggs, 1958), and Belshe (1961) found it in canals in southeast Dade County but the salinity was not reported.

Oligoplites saurus (Bloch and Schneider). The leatherjacket is a marine fish recorded from freshwater in the St. Lucie River by Gunter and Hall (1963a, b). The subspecies is *O. s. saurus* (Bloch and Schneider).

Family LUTJANIDAE

Lutjanus griseus (Linnaeus). The gray snapper occurs in freshwater in the St. Lucie River (Gunter and Hall, 1963a), coastal streams, and in canals in southeastern Dade County (Belshe, 1961) and near Naples (Gunter, 1942).

Lutjanus apodus (Walbaum)—hypothetical. The schoolmaster is a euryhaline species (Briggs, 1958) recorded from freshwater in Florida by Carr and Goin (1955). Whether it occurs in freshwater in southern Florida is not known.

Family GERREIDAE

Diapterus olisthostomus (Goode and Bean). The irish pompano enters freshwater along the canals of southern Florida and has been recorded from the St. Lucie River (Gunter and Hall, 1963a, b).

Diapterus plumieri (Cuvier). The striped mojarra is a species favoring brackish to freshwater (Waldinger, 1968) and is commonly found in freshwater in southern Florida. It occurs in the mangroves of the southern coast (Tabb and Manning, 1961), North River (Odum, 1971) and coastal canals.

Eucinostomus argenteus Baird and Girard. The spotfin mojarra, although favoring high salinities along the southwest coast (Waldinger, 1968), has been collected in freshwater in the St. Lucie (Gunter and Hall, 1963a, b), Caloosahatchee (Gunter and Hall, 1965) and North Rivers (Odum, 1971).

Eucinostomus gula (Quoy and Gaimard). The silver jenny is one of the most abundant species in the Everglades estuaries (Roessler, 1968; Odum, 1971) and has been collected in the southern Everglades in lower Shark River Slough. It also occurs in freshwater in the Caloosahatchee River (Gunter and Hall, 1963b, 1965).

Gerres cinereus (Walbaum)—hypothetical. The yellowfin mojarra was found in canals in southeastern Dade County by Belshe (1961), the salinity of which was not reported.

Family SPARIDAE

Archosargus probatocephalus (Walbaum). The sheephead was reported to be widely distributed in freshwater in southern Florida by A. F. Carr (Gunter, 1942) and was found in freshwater in the North River by Odum (1971).

Diplodus holbrookii (Bean)—hypothetical. The spottail pinfish is a euryhaline species (Briggs, 1958) stated to enter freshwater streams along both coasts by Carr and Goin (1955). We know of no southern Florida records.

Lagodon rhomboides (Linnaeus). The pinfish is a euryhaline species (Briggs, 1958) which enters freshwater streams along both coasts (Carr and Goin, 1965). Odum (1971) found only stray individuals near the mouth of the North River.

Family SCIAENIDAE

Cynoscion arenarius Ginsburg. The sand seatrout is recorded from freshwater in the Caloosahatchee River (Gunter and Hall, 1963b, 1965).

Cynoscion nebulosus (Cuvier)—hypothetical. The spotted seatrout occurs in freshwater streams along both coasts (Carr and Goin, 1955; Tagatz, 1968), but we have found no records from freshwater in southern Florida.

Cynoscion regalis (Bloch and Schneider). The weakfish has been collected in the St. Lucie River (Gunter and Hall, 1963a, b).

Leiostomus xanthurus Lacepede. The spot occurs in freshwater in the St. Lucie (Gunter and Hall, 1963a) and Caloosahatchee Rivers (Gunter and Hall, 1965). It has also been found in canals in southeastern Dade County by Belshe (1961) but salinity was not reported.

Micropogon undulatus (Linnaeus). The Atlantic croaker ascends freshwater streams along both coasts (Carr and Goin, 1955) and has been found in freshwater in the St. Lucie (Gunter and Hall, 1963a) and Caloosahatchee Rivers (Gunter and Hall, 1965).

Pogonias cromis (Linnaeus). The black drum is known to ascend freshwater streams in Florida (Carr and Goin, 1955) and has been found in freshwater near the northern Ten Thousand Islands (T. Schmidt, personal communication).

Sciaenops ocellata (Linnaeus). The red drum (also called redfish) occurs in freshwater in the St. Lucie (Gunter and Hall, 1963a) and Caloosahatchee Rivers (Gunter and Hall, 1965).

Family CICHLIDAE

Astronotus ocellatus (Agassiz). The oscar is well established in canals in Dade (Rivas, 1965) and Broward counties.

Cichla ocellaris Bloch and Schneider—hypothetical. The peacock cichlid was introduced in 1964 (Moe, 1964) but the population was apparently destroyed by a cold winter (Courtenay and Robins, 1973).

Cichlasoma bimaculatum Linnaeus. The black acara is well established in coastal canals in Palm Beach (Ogilvie, 1969) and Broward (Rivas, 1965) to southeastern Dade Counties. It has extended westward into the Everglades (Dineen, 1972) and Big Cypress Swamp (Kushlan, 1972b). (This is the species called *Aequidens portalegrensis* (Hansel) by Bailey et al. (1970) (W. R. Courtenay, personal communication).)

Cichlasoma octofasciatum (Regen). The jack dempsey is established in southern Florida canals (Ogilvie, 1969).

Cichlasoma nigrofasciatum (Günther). The convict cichlid is established in borrow pits in North Dade County (Rivas, 1965).

Cichlasoma meeki (Brind)—hypothetical. The firemouth was reported in a Northwest Miami rockpit (Rivas, 1965) but present information on reproduction is lacking (Lachner, Robins and Courtenay, 1970).

Hemichromis bimaculatus Gill. The jewelfish is established in several locations in Dade County (Bailey et al., 1970) including canals in Hialeah and near Miami International Airport (Rivas, 1965).

Tilapia mossambica (Peters). The mozambique mouthbrooder is established in a tributary canal of the Miami Canal near Miami (W. R. Courtenay, personal communication).

Family MUGILIDAE

Mugil cephalus Linnaeus. The striped mullet is a euryhaline fish abundant in Lake Okeechobee (Ager, 1971). It is found in the St. Lucie (Gunter and Hall, 1963a) and Caloosahatchee Rivers (Gunter and Hall, 1965). It is often common in freshwater canals of southern Florida and has been found in the Everglades, the Big Cypress Swamp, and in freshwater mangrove swamps (Tabb and Manning, 1961).

Mugil curema Valenciennes. The white mullet occurs in freshwater in the St. Lucie River (Gunter and Hall, 1963a). It was found in canals in Dade County by Belshe (1961) but the salinity was not reported.

Mugil trichodon Poey. The fantail mullet is a euryhaline species which occurs in freshwater canals in southern Florida (Carr and Goin, 1955).

Family ELEOTRIDAE

Dormitator maculatus (Bloch). The fat sleeper occurs in freshwater in southern mangrove swamps (Tabb and Manning, 1961) and probably in coastal canals of southeastern Dade County (Belshe, 1961).

Eleotris pisonis (Gmelin). The spinycheek sleeper is a euryhaline species collected in

freshwater near Palm Beach (C. R. Robins, personal communication) and was recorded from southeastern Dade County (Belshe, 1961).

Gobiomorus dormitor Lacepede. The bigmouth sleeper is a euryhaline species found in the canals of southeastern Florida (Carr and Goin, 1955; B. P. Hunt, personal communication).

Family GOBIIDAE

Exorthodus lyricus (Girard)—hypothetical. The lyre goby was found in canals in southeastern Dade County (Belshe, 1961) but salinity was not reported.

Gobionides broussoneti Lacepede. The violet goby has been reported from the St. Lucie River (Gunter and Hall, 1963a, b).

Gobionellus bolcosoma (Jordan and Gilbert). The darter goby has been found in freshwater in the St. Lucie (Gunter and Hall, 1963a) and Caloosahatchee Rivers (Gunter and Hall, 1965).

Gobionellus gracillimus Ginsburg. The slim goby has been reported from the St. Lucie River (Gunter and Hall, 1963a) although its identification may be uncertain (Gunter and Hall, 1963b).

Gobionellus shufeldti (Jordan and Eigenmann)—hypothetical. The freshwater goby has been found in the Fahka Union Canal but in brackish water (T. Schmidt, personal communication).

Gobionellus hastatus Girard. The sharptail goby was found in the St. Lucie River (Gunter and Hall, 1963a) and in canals in southeastern Dade County (Belshe, 1961), but salinity was not reported.

Gobiosoma bosci (Lacepede). The naked goby is a brackish water species which has been found in Lake Okeechobee (Ogilvie, 1969) and the Caloosahatchee River (Gunter and Hall, 1969). It has also been recorded from canals in southeast Dade County (Belshe, 1961), but salinity was not reported.

Gobiosoma robustum Ginsburg. The code goby occurs in freshwater in north Florida (Tagatz, 1968) and in canals of undetermined salinity in southeast Dade County. It is the most abundant goby in the Everglades estuary (Tabb and Manning, 1961) and North River (Odum, 1971) where it occurs in fresh water.

Lophogobius cyprinoides (Pallas). The crested goby is a euryhaline species which was recorded from freshwater in Lee County (Carr and Goin, 1955) and was found in canals in southeastern Dade County (Belshe, 1961), but salinity was not reported. It also occurs abundantly in North River (Odum, 1971).

Microgobius gulosus (Girard). The clown goby is a primarily brackish water species found in such habitats throughout southern Florida (Raney et al., 1953; Tabb and Manning, 1961; Belshe, 1961). It also occurs commonly in freshwater having been found in the Caloosahatchee (Gunter and Hall, 1963b, 1965) and North Rivers (Odum, 1971), in east and west coast canals, and in Lake Okeechobee where it breeds (Ager, 1971).

Order PLEURONECTIFORMES, Family BOTHIDAE

Citharichthys spilopterus Gunter. The bay whiff occurs in freshwater in the St. Lucie River (Gunter and Hall, 1963a).

Family SOLEIDAE

Achirus lineatus (Linnaeus). The lined sole has been recorded from the St. Lucie (Gunter and Hall, 1963a, b) and Caloosahatchee Rivers (Gunter and Hall, 1963b, 1965) and from streams in the southern Everglades.

Trinectes maculatus (Bloch and Schneider). The hogchoker is a euryhaline species recorded in Lake Okeechobee (Ager, 1971) and in the St. Lucie (Gunter and Hall, 1963a) and Caloosahatchee Rivers (Gunter and Hall, 1965). It occurs in canals and in streams of the southern Everglades. The subspecies is *T. m. fasciatus* (Lacepede).

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REVIEW

DAWES, CLINTON J. *Marine Algae of the West Coast of Florida*. i-xvi; 1-201; 2 maps; 82 figs. 6 × 9 inches. Univ. Miami Press, Coral Gables. Publication date: October 31, 1974. \$15.00. ISBN 0-87024-258-X.

From time to time a book is released which is potentially of considerable interest to Academy members. By taking advantage of the location of Tampa Bay at the northern and southern distributional limits of certain algal species, Dr. Dawes has given us such a book in the form of a handy manual based upon coastal habitats from Cedar Key to Cape Romano. However, the discussion of marine habitats and coastal plant communities are applicable beyond these limits. They contribute an extra dimension to the book of value to the "interested layman, as well as . . . high school and college students" to whom the book is addressed.

The user will find the keys well laid out with most dichotomies parallel and well drawn. However, some lapses can be found, for example: *Anacystis dimidiata* in the key has cells 8-50 μ m but the text says 10-16 μ m and thus it overlaps nearly the whole range of *A. aeruginosa* with which it is contrasted; a similar problem arises between *Calothrix crustacea* and *C. pilosa*; and "Plants partially embedded in soft mud, branching irregular" for *Vaucheria* is contrasted to "Erect branches bearing distichous, radial, or second ramuli" with no reference to habitat for *Bryopsis*.

The Linda Baumhardt illustrations stand out as most pleasing to the eye and they create a good visual image of the plant. The photographs of the bluegreen algae are less uniformly successful, e.g., fig. 17, and some line drawings would enhance the effectiveness of the treatment. Perhaps the 74 species illustrated are the most common of the 296 species treated in the text, but there is no indication of the reason for selection of the species figured.

The bibliography includes a broad coverage of algal literature applicable to Florida as well as publications on marine spermatophytes and ecology. Numerous M. A. and Ph. D. theses (some "in preparation") are cited as well as an extensive unpublished manuscript and an oral presentation to the Florida Academy in 1965. Citation of any but completed Ph. D. theses presents severe problems to other investigators. Even Ph. D. theses available through University Microfilms are not considered formally published although copies can be obtained if ordered by the microfilm number which was not given. We encourage the author to issue a supplement in a year or so citing places of publication for these manuscripts and theses as well as to list the microfilm catalog numbers for the Ph. D. dissertations.

All in all, the minor problems noted above do not diminish the immediate usefulness and value of the book. It should see wide usage in Florida and around the Gulf coast. I know of no better introduction to the study of Florida seaweeds.—HARVEY A. MILLER, Department of Biological Sciences, Florida Technological University, Orlando.