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The fishes of Alligator Reef and environs in the Florida Keys: a half-century update

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Abstract

An update of the checklist of fishes of Alligator Reef and environs some fifty years after the first listing provides an unparalleled opportunity to evaluate the species richness for a limited reef area, as well as a unique opportunity to explore changes in diversity over a half-century time scale. We added 107 species and subtracted 5 from the original total of 516 species: thus the checklist is now totalling 618 species, of 122 families, the most recorded for any similarly sized area in the New World. The additional species records are made up of more recent identifications from the original sampling program (and a limited number of subsequent collections), as well as from a comprehensive effort by the junior authors to photograph the fishes of the study area. The latter project has provided 35 additional species for the checklist (plus 4 from others), from 318 total species photo-documented. The photographic records are presented and archived for reference. The checklist is analyzed in detail, taxonomic changes summarized and presented, and the list is compared to more recent compendia of fish lists for the Greater Caribbean region.

Key words: biogeography, zoogeography, species list, ichthyology, shorefishes, coral reefs, Florida Reef Tract.

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Introduction

From 1958–67, the senior author conducted various marine biological studies in the area of Alligator Reef, off Islamorada in the Florida Keys. These included extensive fish collecting employing line-fishing, nets, traps, spears, rotenone-based ichthyocides, and explosives. In 1968, he published *A list of fishes of Alligator Reef, Florida with comments on the nature of the Florida reef fish fauna* (Starck 1968). In that publication, a total of 516 fish species were recorded, of which 389 were considered to be coral-reef species (note that the 517 species reported in Starck [1969] was a miscount, the total was 516). Of the total number, 45 species were new records for U.S. waters and were previously known only from the Caribbean Sea and/or the Bahamas. Eight additional species were new to science and as yet undescribed. The 516 fish species recorded still remains as the highest from any comparable single area in the New World, and is now increased to 618 species in the current update.

The junior authors live in the area and have engaged in extensive recreational diving there for the past 35 years. In October 2013, they undertook a new census of the fishes of the area with a goal to photo-document as many of their sightings as possible. This effort has subsequently entailed 1039 combined dives devoted to either fish counts, photographic documentation, or both, and it presents a unique opportunity to assess the fauna for any apparent changes after a half century. During these surveys, they have photographed 278 of the species reported by Starck (1968) plus 35 additional and/or newly described or reclassified species not recorded in the earlier study, i.e. 314 species (plus 4 from other photographers/videographers), for a total of 318 photo-documented species.

In addition to the species added by the Estapés, there are an additional 66 species from Alligator Reef and environs that have been found in the reference collections of the Florida State Museum of Natural History (FLMNH) and three more confirmed species records from the database of visual fish surveys at the Reef Environmental Education Foundation (REEF) website (www.reef.org/), plus the recent documentation of the Great White Shark over Alligator Reef.

The fish fauna of Alligator Reef is unique for a coral-reef area in the extent to which it has been sampled and documented. Although ichthyologists have collected reef fishes far and wide around the world, very few locations have been extensively sampled and, while the recent popularization of fish watching is now providing a wealth of data from many areas, there is a significant portion of the fish fauna that is inaccessible to visual observation, either due to cryptic behavior or inaccessible depths. Probably the only other coral-reef areas for which a comparable long-term comparison of the fish fauna may be feasible would be the reef area around Nassau in the Bahamas (Ilves *et al.* 2011, 2013) and One Tree Island Reef near the southern end of the Great Barrier Reef in Australia (Russell 1983, Lowe & Russell 1990).

The Bio-physical Environment of Alligator Reef, Florida Keys.

Alligator Reef is situated at 24° 51’ N, about one-third of the way along the Florida Reef Tract from its northern end. The area in the vicinity of Alligator Reef included in this checklist extends from the inside shoreline on the Florida Bay side of the Matecumbe Keys to approximately 20 km offshore to the SE from Alligator Reef, at around the 200 m depth contour. Along the reef line, it includes the area up to and including the next named reefs to the NE and SW., i.e. Crocker Reef 11 km to the NE and Tennessee Reef 20 km to the SW.

The habitat on the ocean side of the islands in the study area is dominated by nearshore, shallow, sloping beaches of mixed reef sand, rubble, and finer sediments, with some smaller outcrops of eroded reef rock. On the bay side of the islands, mangroves and *Thalassia* beds on a calcareous silt substrate predominate at each end of the islands; between these ends, on the bay side of the middle portion of the islands, there are stretches of steep, highly eroded and undercut, reef rock with a water depth of about one meter at the shore, and extending to a similar height above the water.

On the ocean side of the islands, the shore slopes gently to a depth of about 3–4 m about a km offshore and continues to a depth of 5–6 m over most of the lagoon area between the islands and Alligator Reef itself, which is about 6 km offshore to the SE of the SW end of Upper Matecumbe Key. The lagoon of the Florida Reef Tract is known as Hawk Channel and, although it is a proper reef lagoon, it is not generally referred to as such. The predominant bottom habitats in the area are *Thalassia* beds, extensive areas of flat rocky bottom lightly covered

with reef sediments, and large areas of reef sand covering much of the seaward side of the lagoon. The areas of hard bottom support a diverse but scattered assemblage of attached life, with corals, alcyonarians, sponges, and *Sargassum* variously predominating in different locations. Near the middle of the lagoon in the study area are three well-developed areas of patch reefs. Each comprises several dozen coral patches scattered over an area of 10 to 15 ha in about 6 m depth. These patch reefs are known locally as Hen and Chickens, Cheeca Rocks and Tollgate Rocks or Anne's Rocks.

Along the outer edge of the reef tract, about 6 km offshore, the sea floor slopes more steeply into the Florida Strait. Over a distance of a few hundred meters, the depth increases from 6–10 m to 30 m or more. Along much of this outer slope are lengthy stretches of rocky substrate, supporting numerous areas of coral reef, interspersed with extensive areas of sand. In many areas, the reef takes the form of spur-and-groove formations that presumably developed during past periods of lower sea levels, when they would have formed as typical reef surge channels. At a depth of about 30 m, the coral bottom ends and beyond this the bottom is predominantly reef sand, coral rubble, and shell debris. Beyond the reef edge, the slope offshore is gentle, reaching 60 m depth about 1.5 km farther offshore and 200 m depth a further 3 km offshore. Rocky outcrops occur in scattered locations along the slope. A seamount with a depth of 90 m at the apex, and with surrounding depths of about 150–160 m, is located some 18 km ESE of the Alligator Reef Lighthouse.

Alligator Reef itself is a shallow knoll on the outer reef tract and is marked by a 41 m high lighthouse of iron-pile skeletal construction built in 1873. The reef is named after the U.S. Navy schooner USS *Alligator* that wrecked on the reef in 1822. The shallowest depth at low tide is 1.5 m at a point adjacent to the lighthouse on the east side. The most diverse fish habitat is a 1–2.5 m high, inward-facing, rocky ledge, which extends along the reef top for about one km to the SW, beginning from a point about 300 m south of the lighthouse. The depth over this ledge is generally about 5–6 m. A deep reef at about 20–30 m depth, with more extensive coral cover, parallels the ledge a few hundred meters offshore.

Shinn *et al.* (1989) state that core drilling of the ledge on Alligator Reef reveals it to be built by Elkhorn Coral (*Acropora palmata*) when the sea level was 4.5–6 m lower than at present around 4 ka. A layer of peat on the landward side of the ledge extends beneath the reef and would seem to indicate an earlier mangrove habitat on the landward side of what would then have been an island off the mainland shore.

The Florida Reef Tract is near the northern continental limit for coral growth and is subject to occasional lethal extremes of both heat and cold for reef organisms. Winter cold fronts can drop reef temperatures to 15°C and to as low as 9°C inshore around the islands. This can result in extensive kills of fishes, corals, and other marine life. The most recent such event was recorded in 2010 (Lirman *et al.* 2011). Such events are irregular on erratic multidecadal-scale frequencies. Summer temperatures in the area of Hawk Channel often reach 32°C and as high as 37°C inshore. Coral growth in the Hawk Channel lagoon tends to have a somewhat tattered appearance with dead colonies and dead patches on living colonies being frequent.

Alligator Reef is located offshore of four main tidal channels between Florida Bay and Hawk Channel. These can sometimes bring inshore extremes of turbidity and temperature to the outer reef area. However, the inner edge of the Gulf Stream washes the outer margin of the reef tract and moderates temperatures there, thus permitting healthier reef growth than in the lagoon. The Gulf Stream also provides an ongoing flow of both food for reef plankton feeders and fresh new larval and juvenile recruits of reef organisms from more tropical regions to the south. High variation in such recruitment results in considerable fluctuations in the populations of some organisms.

The Junior Authors

Carlos and Allison Estapé are avid recreational divers and underwater photographers with 35 years experience in the study area. In 2010, they began contributing data on species abundance to the REEF Volunteer Fish Survey Project's online database (http://www.REEF.org/). In October of 2013, they became aware of the 1968 checklist and embarked on a quest to find and photograph as many of the listed species as possible. To date, they have photographed 314 species, including 35 not listed in the 1968 study. In late 2013, they made contact with the senior author and in 2015 they all met in Florida and agreed there was a valuable opportunity to do an update on the Alligator Reef checklist and an assessment of any noticeable changes in the half-century since the original surveys.

Materials and Methods

The extensive fish collecting by the senior author between 1958 and 1968 included the use of line fishing of various types, including electric reels in depths down to 200 m, trawling in depths down to 100 m, traps, spears, rotenone-based fish poison, and explosives. State permits were obtained for all such usage. The most productive method for obtaining small reef species was the use of rotenone, which resulted in finding many cryptic and burrowing species that are otherwise rarely or never seen. Over 200 such collections were made throughout the study area and in depths down to 50 m. Small, multi-pronged, free spears propelled by a rubber sling also proved very effective in obtaining specimens of many small species. Trawling in grassbeds, sand areas, and in deeper water further yielded many species that are difficult to observe due to their low population density and/or their effective camouflage, especially amidst seagrass or seaweed.

In view of current day environmental sensitivities, it seems worthwhile to expand on the use of rotenone for scientific collecting. Rotenone is an extract from the roots of the *Derris* plant. It is widely used as an organic insecticide, and is toxic to fishes, and thus was commonly used by ichthyologists for making fish collections in the era of the earlier work at Alligator Reef. In the quantities typically used, it is effective over only a relatively small area before diluting to non-toxic levels. It also chemically degrades rapidly and its toxic effect in the environment is only brief. Its main advantage for scientific collecting is that it causes affected fish to emerge from cover and swim erratically up into mid-water, thus exposing many cryptic, burrowing, and camouflaged species otherwise rarely or never observed. Observations and subsequent collections in the same locations indicate that, in the amounts and frequencies used for scientific collecting, the effect on biological diversity and abundance from such collecting was minor and short lived. For a more detailed discussion on the use of rotenone in assessing marine fish diversity see Robertson & Smith-Vaniz (2008). However, it is also worth noting that repeated exposure to rotenone has been proposed as a possible risk factor for a serious peripheral neuropathy that has occurred in several ichthyologists (J.E. Randall, pers. comm.).

The extensive collections from the original Alligator Reef study were all placed in the research collection at the University of Miami Marine Laboratory (UMML). In 1961, the Laboratory was renamed as the Institute of Marine Science (IMS) and in 1969 it acquired its current name of the Rosenstiel School of Marine and Atmospheric Science (RSMAS). In 1996, the entire UMML fish collection was transferred to the University of Florida where it is housed today at the Florida State Museum of Natural History (FLMNH). Over the subsequent years, a portion of the original UMML material has been distributed to other institutions. Material from these collections have been cited in numerous systematic studies (no effort is made here to review these). The current study is an update to the 1968 checklist; it is not a bibliography of Alligator Reef research.

Since the original collections, there has been no significant collections conducted in the area. As permits for such extensive collecting are no longer possible to obtain, the original survey is impossible to replicate, making it a uniquely thorough assessment of the fish fauna of a coral reef.

The checklist presented here represents an updated assessment of the fish biodiversity of Alligator Reef and its environs, based on four sources: 1) the original 1968 checklist, 2) a review of specimens in the FLMNH database, 3) the photographic collection by the junior authors, and 4) the Reef Environmental Education Foundation (REEF) Volunteer Fish Survey Project database.

The database catalogue for specimens in the FLMNH fish collection (http://specifyportal.flmnh.ufl.edu/fishes/) was searched using six localities representing the Alligator Reef area: Alligator Reef, Lower Matacumbe, Upper Matecumbe, Islamorada, Indian Key, and Teatable Key.

The results of the FLMNH search yielded results as follows: the "Alligator Reef" locality search (Fig. 1) totals 2062 catalogue items, 1619 of which were collected by Starck. This includes 11 items without genus or species identification. The most recent collection by Starck is from August 1966. There are 26 later collections, 14 of these were made by R/V *Gerda*, a research vessel of the IMS; the last of these is 26 February 1969. There are only two subsequent records: *Hyperoglyphe perciformis* at 500 ft. depth in February1972 and *Haemulon parra* by W. Davis in July 2001. The "Lower Matecumbe" locality search totals 751 catalogue items with 453 collected by Starck. Four items are without genus or species identification. The most recent record is *Prognathodes aya* collected at 225 ft. depth by F. Young in 2004 (at FLMNH as "*P. guyanensis*"); all others are from 1966 or earlier. The "Upper

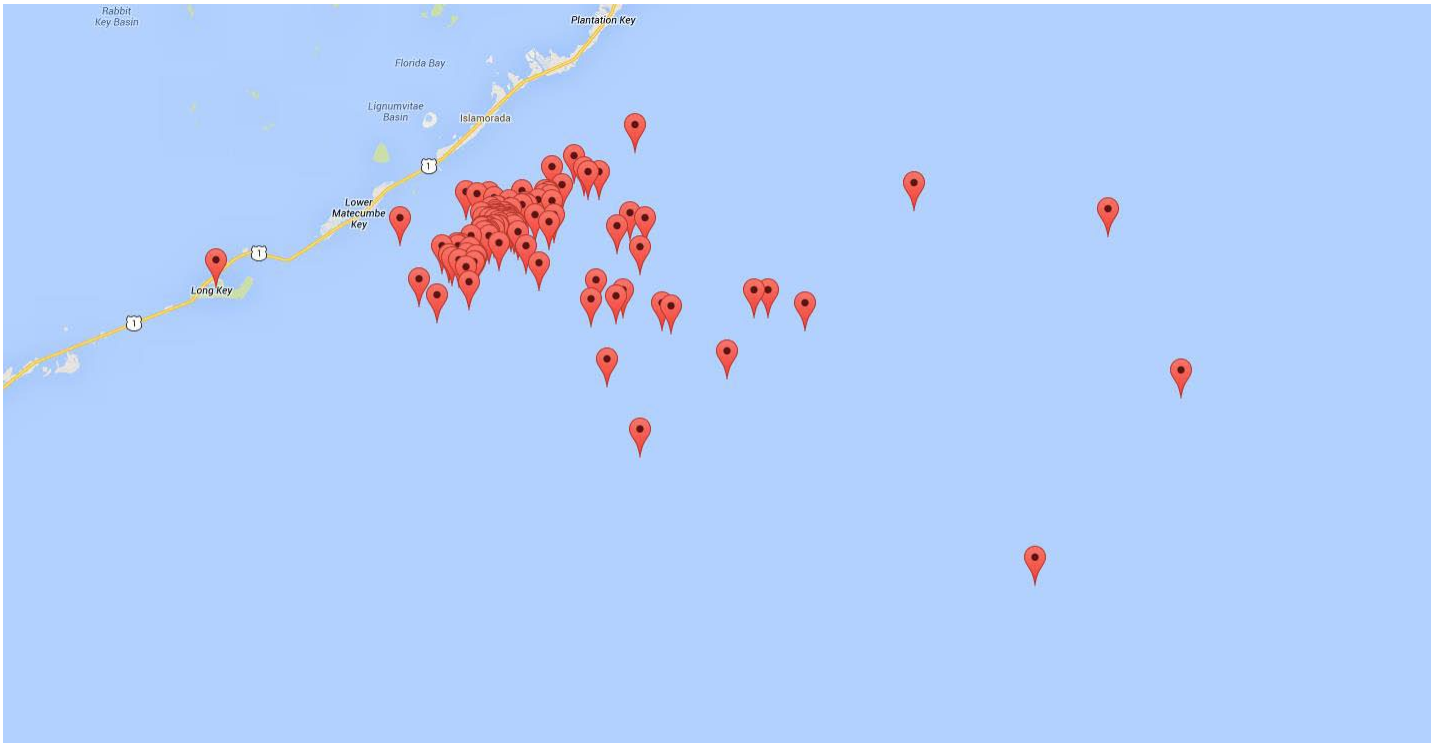

Figure 1. Locations for "Alligator Reef" collections in the FLMNH. Each marker represents one or more lots from a collection event. For a more detailed satellite image see pp.2-3 of AlligatorReefPhotos.pdf in Supplementary Material

Matecumbe" locality search totals 132 catalogue items, 25 collected by Starck. One record is without genus or species identification. The latest Upper Matecumbe record is from 1971. The "Islamorada" locality search totals 159 catalogue items, 50 collected by Starck. There are no items without genus or species identification. All are from 1977 or earlier, except for two records: *Regalecus glesne* collected in 2002 and *Centropristis fuscula* in 2009 (there are two more records from 2009 recently added to the FLMNH collection: *Bathygobius geminatus* and *Ctenogobius stigmaturus*, both "barcode" mtDNA-identified). The "Indian Key" locality search totals 342 catalogue items, but 42 of these are from a different Indian Key near Everglades City on the SW coast of Florida. The total for the Indian Key inshore of Alligator Reef is 300 catalogue items, 187 collected by Starck; 297 of the 300 items are from 1967 or earlier and 3 are from 1983–87. The "Teatable Key" locality search totals 6 catalogue items from 1967–68, none by Starck and none without genus or species identification.

Updating from the FLMNH database was undertaken because when the 1968 checklist was published there was still a backlog of unsorted material from Alligator Reef that had not been identified and catalogued. That material was subsequently transferred to FLMNH along with the entire UMML fish collection. This yielded a further 22 species for the present list. In addition, the UMML had been the preeminent institution engaged in ichthyological research in the area and the collection also contains most of the material collected by other researchers in the study area. This added another 43 species to the list, mostly offshore and deepwater species from a few trawls by the UMML research vessel, plus a few inshore species from land-based work around the islands. Importantly as well, this collection had been identified by workers with good knowledge of and familiarity with this fish fauna thus minimizing the level of misidentifications which plague most databases. (Author's note: From 1960–63 the senior author's office cubicle as a graduate student at UMML was in the fish collection. During this time and subsequently he also had the opportunity to visit a number of other major fish collections in the US and overseas thus providing the basis for this judgment.)

Among the numerous other databases of possible relevance to the study area, the Smithsonian Tropical Research Institute (STRI) Shorefishes of the Greater Caribbean online information system by D.R. Robertson & J. Van Tassell (2015) appears to be the most comprehensive and authoritative of these to date. It comprises a compilation of information for the region and the information it presents for the 0.5º square of latitude and longitude that covers the area of the Alligator Reef checklist is summarized and discussed in the Comparison with Other Caribbean Area Fish Lists section of this study (p. 109).

Identification, Nomenclature, and Classification

At the time of the 1968 checklist there were no comprehensive guides to reef fishes and available illustrations for many species were either not available or limited to line drawings of faded museum specimens. Species descriptions were scattered in numerous obscure scientific publications and identification of many species required examination of characteristics such as as scale and fin-ray counts, measurement of various body proportions, tooth patterns and other details only possible to obtain from physical specimens in hand. Visual identification in the field was not possible for many species.

The order in which families are presented has also changed. The 1968 list followed the order used by Bailey *et al.* (1960) and the current list follows that of van der Laan *et al.* (2014). The present list covers 122 families of shorefishes (Table 1). Although the order of family listing is intended to reflect our understanding of the order of evolutionary development from the earliest and most primitive to the most recent and advanced, it should be understood that the process of evolution is not linear in that respect. It often includes numerous branches on a similar level. Also, not every new development is necessarily an "advance", in the sense of being an improved design. Many are specializations that may afford an advantage for a particular limited circumstance, but may be restrictive for anything else. Then too, evolution may also proceed at different rates in different branches such that a more advanced species of a primitive group may be more advanced than a less "evolved" species of a more advanced group. It is thus arguable if the first species in this checklist, the Whale Shark, is really any less advanced than the last one, the Ocean Sunfish. The order presented by van der Laan *et al.* (2014) reflects a useful summary of recent understanding of the evolution of fishes. Although it entails considerable uncertainty, it is the best we have at this time and provides a useful standard to follow.

Checklist of the fish species from the Alligator Reef and environs, Florida Keys.

At present, we have confirmed 618 species of fishes collected, photographed, or observed in the environs of Alligator Reef, presented in Table 9. Over the half-century since the original Alligator Reef survey, there have been great advances in the taxonomy of Greater Caribbean reef fishes, with numerous changes in scientific names and classification. A number of families have been split, in particular the blennioid family Clinidae, as well as the Stromateidae, Bothidae and Balistidae (Table 2). A few species have also been moved from one family to another (Table 2). Many species (69) have been reassigned to different genera (Table 3). A relatively small number of species (22) were renamed, either due to synonymization of the old name or assigned new names (Table 4). A similar number (15) of species names were changed after species were split or reunited, many of these were the result of splitting Brazilian populations from Greater Caribbean populations, thus relegating the names previously used to Brazilian endemics (Table 5). Many genus and species names have changed in spelling, either due to a change in gender of the genus when reassigned to a different genus, taxonomic revisions of the spelling of species names, or due to typographic errors in the original paper (Table 6).

We have added 107 new records to the total of 516 in the Starck (1968) checklist, and removed 5 records, i.e. 3 are species now known to be from Brazil or the SE Caribbean and had been included in addition to their Florida counterparts and two records, of *Anthias* sp. and *Citharichthys* sp., have been removed since the specimens are now lost (Tables 4 & 5). The new records comprise 66 records from FLMNH collections, mostly fish collected before 1968 but not included in the Starck (1968) checklist, and another set from collections since the original checklist was finalized (Table 7). In addition, the Estapés have documented an additional 35 species, REEF and other observers have documented 5 more, and finally the presence of the Great White Shark, *Carcharodon carcharias,* on Alligator Reef was confirmed by photograph in April 2016 and reported in the local news (Goodhue 2016) (Table 8).

In total, the Estapés have photographed 314 species from the study area: 279 previously known and the 35 additional ones.

TABLE 1

List of 122 Fish Families occurring in Alligator Reef and environs, in order following van der Laan *et al.* (2014)

(*) indicate new additions to Starck (1968) based on FLMNH specimens

RHINCODONTIDAE
GINGLYMOSTOMATIDAE
LAMNIDAE
SCYLIORHINIDAE*
CARCHARINIDAE
SPHYRNIDAE
PRISTIDAE
NARCINIDAE
RHINOBATIDAE
RAJIDAE
DASYATIDAE
MYLIOBATIDAE
MOBULIDAE
UROTRYGONIDAE
ELOPIDAE
MEGALOPIDAE
ALBULIDAE
MORINGUIDAE
CHLOPSIDAE
MURAENIDAE
SYNAPHOBRANCHIDAE*
OPHICHTHIDAE
CONGRIDAE
CLUPEIDAE
ENGRAULIDAE
ARIIDAE
ARGENTINIDAE
STERNOPTYCHIDAE*
PHOSICHTHYIDAE*
CHLOROPHTHALMIDAE*
SYNODONTIDAE
RADIICEPHALIDAE*
REGALECIDAE*
MACROURIDAE*
MORIDAE
OPHIDIIDAE
CARAPIDAE
BYTHITIDAE
BATRACHOIDIDAE
LOPHIIDAE
ANTENNARIIDAE
OGCOCEPHALIDAE
GOBIESOCIDAE
ATHERINIDAE
FUNDULIIDAE
POECILIIDAE
CYPRINODONTIDAE
BELONIDAE
HEMIRAMPHIDAE
EXOCOETIDAE
HOLOCENTRIDAE
ZEIDAE*
AULOSTOMIDAE
FISTULARIIDAE
CENTRISCIDAE
SYNGNATHIDAE
SCORPAENIDAE
DACTYLOPTERIDAE
TRIGLIDAE
PERISTEDIIDAE
CENTROPOMIDAE
ACROPOMATIDAE
SERRANIDAE
OPISTOGNATHIDAE
PRIACANTHIDAE
APOGONIDAE
EPIGONIDAE*
MALACANTHIDAE
POMATOMIDAE
RACHYCENTRIDAE
ECHENEIDAE
CARANGIDAE
CORYPHAENIDAE
LUTJANIDAE
LOBOTIDAE
GERREIDAE
HAEMULIDAE
SPARIDAE
SCIAENIDAE
MULLIDAE
PEMPHERIDAE
KYPHOSIDAE
CHAETODONTIDAE
POMACANTHIDAE
CIRRHITIDAE
MUGILIDAE
POMACENTRIDAE
LABRIDAE
SCARIDAE
URANOSCOPIDAE
TRIPTERYGIIDAE
LABRISOMIDAE
CHAENOPSIDAE
DACTYLOSCOPIDAE
BLENNIIDAE
CALLIONYMIDAE
ELEOTRIDAE*
GOBIIDAE
MICRODESMIDAE
PTERELEOTRIDAE
EPHIPPIDAE
ACANTHURIDAE
SPHYRAENIDAE
GEMPYLIDAE
SCOMBRIDAE
XIPHIIDAE
ISTIOPHORIDAE
CENTROLOPHIDAE
NOMEIDAE
ARIOMMATIDAE
CAPROIDAE
PARALICHTHYIDAE
BOTHIDAE
ACHIRIDAE
CYNOGLOSSIDAE
TRIACANTHODIDAE
BALISTIDAE
MONACANTHIDAE
OSTRACIIDAE
TETRAODONTIDAE
DIODONTIDAE
MOLIDAE

TABLE 2

Changes in family-name placement from Starck (1968)

Narcine bancroftii to NARCINIDAE from *N. brasiliensis* in TORPEDINIDAE

Urobatis jamaicensis to UROTRYGONIDAE from *Urolophus jamaicensis* in DASYATIDAE

Synagrops bella to ACROPOMATIDAE from APOGONIDAE

Emmelichthyops atlanticus to HAEMULIDAE from EMMELICHTHYIDAE

Haemulon vittata to HAEMULIDAE from *Inermia vittata* in EMMELICHTHYIDAE

Enneanectes (3 spp.) to TRIPTERYGIIDAE from CLINIDAE

Labrisomus (7 spp.), *Malacoctenus* (3 spp.), *Paraclinus* (5 spp.) & *Starksia* to LABRISOMIDAE from CLINIDAE

Acanthemblemaria, Chaenopsis, Emblemaria, Emblemariopsis, Hemiemblemaria & *Stathmonotus* (9 spp.) to CHAENOPSIDAE from CLINIDAE

Ptereleotris calliura to PTERELEOTRIDAE from *Ioglossus calliurus* in ELEOTRIDAE

Hyperoglyphe perciformis to CENTROLOPHIDAE from STROMAETEIDAE [*sic*]

Nomeus gronovii, *Psenes cyanophrys* & *P. maculatus* to NOMEIDAE from STROMAETEIDAE [*sic*]

Ariomma regulus to ARIOMMATIDAE from STROMAETEIDAE [*sic*]

Ancylopsetta, *Citharichthys*, *Cyclopsetta* & *Syacium* (8 spp.) to PARALICHTHYIDAE from BOTHIDAE

Achirus lineatus & *Trinectes maculatus* to ACHIRIDAE from SOLEIDAE

Aluterus, Cantherhines, Monacanthus & *Stephanolepis* (9 spp.) to MONACANTHIDAE from BALISTIDAE

TABLE 3

Changes in genus placement from Starck (1968)

Starck (1968) name	Current name	Starck (1968) name	Current name
Raja garmani	*Leucoraja garmani*	*Vomer setapinnis*	*Selene setapinnis*
Urolophus jamaicensis	*Urobatis jamaicensis*	*Inermia vittata*	*Haemulon vittatum*
Muraena miliaris	*Gymnothorax miliaris*	*Bairdiella batabana*	*Corvula batabana*
Verma sp.	*Apterichtus ansp*	*Equetus acuminatus*	*Pareques acuminatus*
Verma sp.	*Apterichtus kendalli*	*Equetus umbrosus*	*Pareques umbrosus*
Sphagebranchus ophioneus	*Ichthyapus ophioneus*	*Pomacentrus fuscus*	*Stegastes adustus*
Nystactichthys halis	*Heteroconger longissimus*	*Eupomacentrus mellis*	*Stegastes diencaeus*
Galeichthys felis	*Ariopsis felis*	*Eupomacentrus leucostictus*	*Stegastes leucostictus*
Oligopus claudei	*Grammonus claudei*	*Eupomacentrus partitus*	*Stegastes partitus*
Antennarius ocellatus	*Fowlerichthys ocellatus*	*Eupomacentrus planifrons*	*Stegastes planifrons*
Allanetta harringtonensis	*Hypoatherina harringtonensis*	*Eupomacentrus variabilis*	*Stegastes xanthurus*
Cypselurus exsiliens	*Cheilopogon exsiliens*	*Hemipteronotus martinicensis*	*Xyrichtys martinicensis*
Cypselurus furcatus	*Cheilopogon furcatus*	*Hemipteronotus novacula*	*Xyrichtys novacula*
Cypselurus heterurus	*Cheilopogon heterurus*	*Hemipteronotus splendens*	*Xyrichtys splendens*
Adioryx coruscus	*Neoniphon coruscum*	*Heteristius rubrocintus*	*Platygillellus rubrocintus*
Adioryx vexillarius	*Neoniphon vexillarium*	*Blennius marmoreus*	*Parablennius marmoreus*
Adioryx bullisi	*Sargocentron bullisi*	*Blennius cristatus*	*Scartella cristata*
Micrognathus crinigerus	*Anarchopterus criniger*	*Callionymus pauciradiatus*	*Diplogrammus pauciradiatus*
Corythoichthys albirostris	*Cosmocampus albirostris*	*Callionymus agassizi*	*Foetorepus agassizii*
Corythoichthys brachycephalus	*Cosmocampus brachycephalus*	*Callionymus bairdi*	*Paradiplogrammus bairdi*
Syngnathus elucens	*Cosmocampus elucens*	*Gobionellus boleosoma*	*Ctenogobius boleosoma*
Micrognathus crinitus	*Halicampus crinitus*	*Gobionellus saepepallens*	*Ctenogobius saepepallens*
Petrometopon cruentatum	*Cephalopholis cruentata*	*Gobiosoma xanthiprora*	*Elacatinus xanthiprora*
Paranthias furcifer	*Cephalopholis furcifer*	*Garmannia grosvenori*	*Gobiosoma grosvenori*
Epinephelus flavolimbatus	*Hyporthodus flavolimbatus*	*Quisquilius hipoliti*	*Priolepis hipoliti*
Epinephelus mystacinus	*Hyporthodus mystacinus*	*Garmannia macrodon*	*Tigrigobius macrodon*
Epinephelus nigritus	*Hyporthodus nigritus*	*Microdesmus floridanus*	*Cerdale floridana*
Epinephelus niveatus	*Hyporthodus niveatus*	*Ioglossus calliurus*	*Ptereleotris calliura*
Cheilodipterus affinis	*Apogon affinis*	*Euthynnus pelamis*	*Katsuwonus pelamis*
Apogon conklini	*Phaeoptyx conklini*	*Tetrapturus albidus*	*Kajikia albida*
Apogon pigmentarius	*Phaeoptyx pigmentaria*	*Palinurichthys perciformis*	*Hyperoglyphe perciformis*
Apogon xenus	*Phaeoptyx xenus*	*Monocanthus hispidus*	*Stephanolepis hispida*
Caranx bartholomaei	*Carangoides bartholomaei*	*Monocanthus setifer*	*Stephanolepis setifer*
Caranx fusus	*Carangoides crysos*	*Mola lanceolata*	*Mastrurus lanceolatus*
Caranx ruber	*Carangoides ruber*		

TABLE 4

Taxonomic changes in species from Starck (1968), synonymized names or new species

Genus	Starck (1968) name	Current name
Apterichtus	*Verma* sp.	*Apterichtus ansp*
Apterichtus	*Verma* sp.	*Apterichtus kendalli*
Kaupichthys	*atlanticus*	*hyoproroides*
Enchelycore	sp.	*carychroa*
Uropterygius	*diopus*	*macularius*
Echiophis	*Echiopsis* [*sic*] *mordax*	*Echiophis punctifer*
Myrichthys	*acuminatus*	*breviceps*
Ariosoma	*impressa*	*balearicum*
Harengula	*pensacolae*	*jaguana*
Sardinella	*anchovia*	*aurita*
Lophiodes	undescribed genus and sp.	*Lophiodes reticulatus*
Peristedion	*platycephalum*	*brevirostre*
Anthias	*Anthias* sp.*	lost, removed from list
Lonchopisthus	*lindneri*	*micrognathus*
Alectis	*crinitus*	*ciliaris*
Carangoides	*Caranx fusus*	*Carangoides crysos*
Kyphosus	*Kyphosis* [*sic*] *incisor*	*Kyphosus vaigiensis***
Holacanthus	*isabelita*	*bermudensis*
Mugil	*gaimardiana*	*rubrioculus*
Stegastes	*Eupomacentrus mellis*	*Stegastes diencaeus*
Scarus	*croicensis*	*iseri*
Enneanectes	*pectoralis*	*jordani*
Citharichthys sp.	*Citharichthys* sp.*	lost, removed from list
Chilomycterus	*atinga* [*sic*]	*reticulatus*

* 2 species removed from Starck (1968) list without replacement.
**Knudson & Clements (2013) synonymized Atlantic *K. incisor* with pan-tropical *K. vaigiensis*.

note: six subspecies were not recognized in Starck (1968): *Platybelone argalus argalus, Tylosurus acus acus, Tylosurus crocodilus crocodilus, Strongylura notata forsythia, Oligoplites saurus saurus*, and *Auxis thazard thazard.*

TABLE 5

Taxonomic changes in species names from Starck (1968), species reassigned after splits

Genus	Starck (1968) listing	Current assignment	Reason for new assignment
Narcine	*brasilensis*	*bancroftii*	split from Brazilian species
Heteroconger	*Nystactichthys halis*	*Heteroconger longissimus*	E. and W. Atlantic spp. united
Porichthys	*porosissimus*	*plectrodon*	split from SW Atlantic
Ogcocephalus	*vespertilio**	*cubifrons*	split from Brazilian species
Parexocoetus	*brachypterus*	*hillianus*	split from Pacific species
Halicampus	*vittatus**	*crinitus*	split from Brazilian species
Prognichthys	*gibbifrons*	*occidentalis*	sympatric split
Opistognathus	*cuvierii*	*robinsi*	split from Brazilian species
Stegastes	*Eupomacentrus fuscus*	*Stegastes adustus*	split from Brazilian species
Stegastes	*Eupomacentrus variabilis*	*Stegastes xanthurus*	split from Brazilian species
Labrisomus	*nuchipinnis*	*conditus*	split-up species complex
Emblemariopsis	*bottomei**	*diaphana*	SE Caribbean/Florida split
Entomacrodus	*textilus*	*nigricans*	split from S. Atlantic
Ophioblennius	*atlanticus*	*macclurei*	split from E. Atlantic species
Acanthurus	*bahianus*	*tractus*	split from Brazilian species

* 3 species removed from Starck (1968) list without replacement.

TABLE 6

Changes in species and/or genus spelling from Starck (1968), including typographic errors

Genus	Starck (1968) name	Current name
Pristis	*pectinatus*	*pectinata*
Chilorhinus	*suensoni*	*suensonii*
Echiophis	*Echiopsis mordax*	*Echiophis punctifer*
Myrichthys	*oculatus*	*ocellatus*
Ophidion	*holbrooki*	*holbrookii*
Otophidium	*Otophidon dormitator*	*Otophidium dormitator*
Hirundichthys	*rondeleti*	*rondeletii*
Neoniphon	*Adioryx coruscus*	*Neoniphon coruscum*
Neoniphon	*Adioryx vexillarius*	*Neoniphon vexillarium*
Holocentrus	*ascensionis*	*adscensionis*
Anarchopterus	*Micrognathus crinigerus*	*Anarchopterus criniger*
Macroramphosus	*Macrorhamphosus gracilis*	*Macroramphosus gracilis*
Scorpaena	*agassizi*	*agassizii*
Scorpaena	*bergi*	*bergii*
Scorpaenodes	*tridecimspinosus*	*tredecimspinosus*
Synagrops	*bella*	*bellus*
Cephalopholis	*Petrometopon cruentatum*	*Cephalopholis cruentata*
Schultzea	*Schultzetta beta*	*Schultzea beta*
Pseudogramma	*Pseudogrammus gregoryi*	*Pseudogramma gregoryi*
Phaeoptyx	*Apogon pigmentarius*	*Phaeoptyx pigmentaria*
Elagatis	*bipinnulatus*	*bipinnulata*
Coryphaena	*equisetis*	*equiselis*
Haemulon	*parrai*	*parra*
Haemulon	*plumieri*	*plumierii*
Haemulon	*Inermia vittata*	*Haemulon vittatum*
Sciaenops	*ocellata*	*ocellatus*
Pempheris	*schomburgki*	*schomburgkii*

TABLE 6 cont.

Changes in species and/or genus spelling from Starck (1968), including typographic errors

Genus	Starck (1968) name	Current name
Kyphosus	*Kyphosis incisor*	*Kyphosus vaigiensis*
Kyphosus	*Kyphosis sectatrix*	*Kyphosus sectatrix*
Chromis	*enchrysurus*	*enchrysura*
Chromis	*insolatus*	*insolata*
Labrisomus	*hatiensis*	*haitiensis*
Stathmonotus	*hemphilli*	*hemphillii*
Scartella	*Blennius cristatus*	*Scartella cristata*
Foetorepus	*Callionymus agassizi*	*Foetorepus agassizii*
Coryphopterus	*punctipectorphorus*	*punctipectophorus*
Elacatinus	*Gobiosoma xanthipora*	*Elacatinus xanthiprora*
Cerdale	*Microdesmus floridanus*	*Cerdale floridana*
Ptereleotris	*Ioglossus calliurus*	*Ptereleotris calliura*
Kajikia	*Tetrapturus albidus*	*Kajikia albida*
Tetrapturus	*pflugeri*	*pfluegeri*
Nomeus	*Nomeus gronowi*	*Nomeus gronovii*
Symphurus	*diomedianus*	*diomedeanus*
Aluterus	*Alutera monoceros*	*Aluterus monoceros*
Aluterus	*Alutera schoefi*	*Aluterus schoepfii*
Aluterus	*Alutera scripta*	*Aluterus scriptus*
Cantherhines	*Cantherines macrocerus*	*Cantherhines macrocerus*
Cantherhines	*Cantherines pullus*	*Cantherhines pullus*
Stephanolepis	*Monacanthus hispidus*	*Stephanolepis hispida*
Chilomycterus	*schoepfi*	*schoepfii*
Diodon holacanthus	*holacanthus*	*holocanthus*
Mastrurus	*Mola lanceolata*	*Mastrurus lanceolatus*

TABLE 7

Additions to Starck's (1968) checklist of fish species occurring in Alligator Reef and environs, based on collections at FLMNH (66 spp.)

Species	Common Name	Species	Common Name
Galeus arae[2]	Roughtail catshark	*Cheilopogon melanurus*[1]	Atlantic flyingfish
Rhizoprionodon terraenovae[2]	Atlantic sharpnose shark	*Oxyporhamphus similis*[2]	Bigwing halfbeak
Breviraja spinosa[2]	Spinose skate	*Cypselurus comatus*[2]	Clearwing flyingfish
Fenestraja plutonia[2]	Pluto skate	*Zenopsis conchifera*[2]	Silvery john dory
Anarchias similis[1]	Pygmy moray	*Macroramphosus scolopax*[2]	Longspine snipefish
Synaphobranchus kaupii[2]	Kaup's arrowtooth eel	*Bryx dunckeri*[1]	Pugnose pipefish
Gnathophis bathytopos[2]	Blackgut conger	*Syngnathus floridae*[1]	Dusky pipefish
Pseudophichthys splendens[2]	Whiptail conger	*Syngnathus scovelli*[1]	Gulf pipefish
Rhynchoconger gracilior[1]	Purple-mouthed conger	*Scorpaena brasiliensis*[2]	Barbfish
Anchoa lamprotaenia[1]	Big-eye anchovy	*Peristedion greyae*[2]	Alligator searobin
Sternoptyx diaphana[1]	Diaphanous hatchet fish	*Peristedion thompsoni*[2]	Rimspine searobin
Yarrella blackfordi[2]	Lightfish	*Baldwinella vivanus*[2]	Red barbier
Chlorophthalmus agassizi[2]	Shortnose greeneye	*Centropristis fuscula*[3]	Twospot sea bass
Eumecichthys fiski[2]	Unicorn crestfish	*Rypticus carpenteri*[1]	Slope soapfish
Regalecus glesne[3]	Giant oarfish	*Apogon phenax*[1]	Mimic cardinalfish
Bathygadus macrops[2]	Bullseye grenadier	*Epigonus denticulatus*[2]	Pencil cardinal
Gadomus arcuatus[2]	Doublethread grenadier	*Rhomboplites aurorubens*[1]	Vermilion snapper
Hymenocephalus italicus[2]	Glasshead grenadier	*Eucinostomus harengulus*[2]	Tidewater mojarra
Malacocephalus occidentalis[2]	Western softhead grenadier	*Pagrus pagrus*[2]	Red porgy
Nezumia aequalis[2]	Common Atlantic grenadier	*Pogonias cromis*[2]	Black drum
Laemonema barbatulum[2]	Shortbeard codling	*Prognathodes aya*[3]*	Bank butterflyfish
Lepophidium crossotum[1]	Whitespot cusk-eel	*Hypleurochilus springeri*[2]	Orangespotted blenny
Lepophidium profundorum[2]	Blackrim cusk-eel	*Foetorepus goodenbeani*[1]	Palefin dragonet
Ophidion dromio[1]	Shorthead cusk-eel	*Dormitator maculatus*[1]	Fat sleeper
Ophidion josephi[2]	Crested cusk-eel	*Bathygobius geminatus*[3]	Twinspotted frillfin goby
Ogilbia suarezae[1]	Shy brotula	*Ctenogobius stigmaturus*[3]	Spottail goby
Lophius gastrophysus[2]	Angler	*Sarda sarda*[2]	Atlantic bonito
Dibranchus atlanticus[2]	Atlantic batfish	*Psenes pellucidus*[1]	Blue driftfish
Ogcocephalus corniger[1]	Longnose batfish	*Monolene antillarum*[2]	Slim flounder
Ogcocephalus rostellum[1]	Palefin batfish	*Monolene sessilicauda*[2]	Deepwater flounder
Lucania parva[2]	Rainwater killifish	*Symphurus minor*[2]	Largescale tonguefish
Cyprinodon variegatus[1]	Sheepshead minnow	*Symphurus parvus*[2]	Pygmy tonguefish
Cheilopogon cyanopterus[1]	Margined flyingfish	*Symphurus plagiusa*[1]	Blackcheek tonguefish

[1] Collected by Starck before 1967 (22 spp.); [2] Collected by others before 1970 (39 spp.); [3] Collected from 2000-2009 (5 spp.)
Note: 11 are inshore species, 7 reef species, 21 offshore species and 26 deepwater species (>100 m).
* at FLMNH as "*P. guyanenensis*", the Caribbean sibling species of *P. aya*,

TABLE 8

Additions to Starck's (1968) checklist of fish species
occurring in Alligator Reef and environs,
based on Estapé (35 spp.) and REEF documentation (3 spp.) & others (3 spp.)

Species	Common Name	Species	Common Name
*Carcharodon carcharias**	Great white shark	*Calamus penna*	Sheepshead porgy
*Carcharhinus perezii***	Caribbean reef shark	*Kyphosus bigibbus*	Gray sea-chub
*Dasyatis centroura***	Roughtail stingray	*Kyphosus cinerascens*	Topsail sea-chub
Heteroconger luteolus	Yellow garden eel	*Astroscopus y-graecum****	Southern stargazer
Anchoviella perfasciata	Flat anchovy	*Labrisomus conditus*	Masquerader blenny
Opsanus tau	Oyster toadfish	*Gillellus uranidae*	Warteye stargazer
Gambusia rhizophorae	Mangrove gambusia	*Hypsoblennius invemar*	Tessellated blenny
Pterois volitans	Common lionfish	*Bathygobius antilliensis*	Antilles frillfin goby
*Centropristis ocyurus****	Bank sea bass	*Coryphopterus kuna*	Kuna goby
Hypoplectrus aberrans	Yellowbelly hamlet	*Coryphopterus tortugae*	Patch-reef goby
Hypoplectrus floridae	Floridian hamlet	*Coryphopterus bol/venezuelae*	Sand-canyon goby
Hypoplectrus indigo	Indigo hamlet	*Lophogobius cyprinoides*	Crested goby
Hypoplectrus sp.	Bluelip hamlet	*Microgobius microlepis*	Banner goby
Caulolatilus microps	Blueline tilefish	*Risor ruber*	Tusked goby
Caranx lugubris	Black jack	*Tigrigobius gemmatus*	Frecklefin goby
Decapterus macarellus	Mackerel scad	*Sphyraena picudilla*	Southern sennet
Decapterus tabl	Redtail scad	*Paralichthys albigutta*	Gulf flounder
Trachinotus goodei	Palometa	*Bothus lunatus*	Peacock flounder
Diapterus sp.**	Irish or rhomboid mojarra	*Acanthostracion polygonius*	Honeycomb cowfish
Eucinostomus jonesii	Slender mojarra	*Canthigaster jamestyleri*	Goldface toby
Eucinostomus lefroyi	Mottled mojarra		

* from the press (Goodhue 2016).
** ID from REEF video or photograph.
*** ID from others' video or photograph.

TABLE 9

Checklist of fish species occurring in Alligator Reef and environs

Starck and Estapé

Starck only

Estapé additions

REEF surveyor additions

[1] Collected by Starck pre-1967

[2] From FLMNH, collected pre-1970

[3] From FLMNH, collected 2002–09

Species	Common Name	Species	Common Name
RHINCODONTIDAE	WHALE SHARKS	*Fenestraja plutonia*[2]	Pluto skate
Rhincodon typus	Whale shark	*Leucoraja garmani*	Rosette skate
GINGLYMOSTOMATIDAE	NURSE SHARKS	**DASYATIDAE**	STINGRAYS
Ginglymostoma cirratum	Nurse shark	*Dasyatis americana*	Southern stingray
LAMNIDAE	MACKEREL SHARKS	*Dasyatis centroura*	Roughtail stingray
*Carcharodon carcharias**	Great white shark	**MYLIOBATIDAE**	EAGLE RAYS
Isurus oxyrinchus	Shortfin mako	*Aetobatus narinari*	Spotted eagle ray
SCYLIORHINIDAE	CATSHARKS	**MOBULIDAE**	MANTAS
Galeus arae[2]	Roughtail catshark	*Manta birostris*	Giant manta
CARCHARINIDAE	REQUIEM SHARKS	**UROTRYGONIDAE**	ROUND STINGRAYS
Carcharhinus falciformis	Silky shark	*Urobatis jamaicensis*	Yellow stingray
Carcharhinus leucas	Bull shark	**ELOPIDAE**	TENPOUNDERS
Carcharhinus limbatus	Blacktip shark	*Elops saurus*	Ladyfish
Carcharhinus obscurus	Dusky shark	**MEGALOPIDAE**	TARPONS
Carcharhinus perezii	Caribbean reef shark	*Megalops atlanticus*	Tarpon
Galeocerdo cuvier	Tiger shark	**ALBULIDAE**	BONEFISH
Negaprion brevirostris	Lemon shark	*Albula vulpes*	Bonefish
Prionace glauca	Blue shark	**MORINGUIDAE**	SPAGHETTI EELS
Rhizoprionodon terraenovae[2]	Atlantic sharpnose shark	*Moringua edwardsi*	Spaghetti eel
SPHYRNIDAE	HAMMERHEAD SHARKS	**CHLOPSIDAE**	PENCIL EELS
Sphyrna mokarran	Great hammerhead	*Chilorhinus suensonii*	Seagrass eel
Sphyrna tiburo	Bonnethead	*Kaupichthys hyoproroides*	False moray
Sphyrna zygaena	Smooth hammerhead	**MURAENIDAE**	MORAYS
PRISTIDAE	SAWFISHES	*Anarchias similis*[1]	Pygmy moray
Pristis pectinata	Small tooth sawfish	*Echidna catenata*	Chain moray
NARCINIDAE	ELECTRIC RAYS	*Enchelycore carychroa*	Chestnut moray
Narcine bancroftii	Lesser electric ray	*Enchelycore nigricans*	Viper moray
RHINOBATIDAE	GUITARFISHES	*Gymnothorax funebris*	Green moray
Rhinobatos lentiginosus	Atlantic guitarfish	*Gymnothorax miliaris*	Goldentail moray
RAJIDAE	SKATES	*Gymnothorax moringa*	Spotted moray
Breviraja spinosa[2]	Spinose skate	*Gymnothorax nigromarginatus*	Blackedge moray

*** from a report in the press (Goodhue 2016).**

TABLE 9 page 2

Species	Common Name	Species	Common Name
Gymnothorax vicinus	Purplemouth moray	**ARIIDAE**	SEA CATFISHES
Uropterygius macularius	Marbled moray	*Ariopsis felis*	Hardhead sea catfish
SYNAPHOBRANCHIDAE	CUTTHROAT EELS	**ARGENTINIDAE**	ARGENTINES
Synaphobranchus kaupii[2]	Kaup's arrowtooth eel	*Glossanodon pygmaeus*	Pygmy argentine
OPHICHTHIDAE	SNAKE EELS	**STERNOPTYCHIDAE**	MARINE HATCHETFISHES
Ahlia egmontis	Key worm eel	*Sternoptyx diaphana*[1]	Diaphanous hatchet fish
Aprognathodon platyventris	Stripe eel	**PHOSICHTHYIDAE**	LIGHTFISHES
Apterichtus ansp	Academy eel	*Yarrella blackfordi*[2]	Lightfish
Apterichtus kendalli	Finless eel	**CHLOROPHTHALMIDAE**	GREENEYES
Bascanichthys scuticaris	Whip eel	*Chlorophthalmus agassizi*[2]	Shortnose greeneye
Caralophia loxochila	Slantlip eel	**SYNODONTIDAE**	LIZARDFISHES
Echiophis punctifer	Snapper eel	*Saurida normani*	Shortjaw lizardfish
Ichthyapus ophioneus	Surf eel	*Synodus foetens*	Largescale lizardfish
Myrichthys breviceps	Sharptail eel	*Synodus intermedius*	Sand diver
Myrichthys ocellatus	Goldspotted eel	*Synodus poeyi*	Offshore lizardfish
Myrophis punctatus	Speckled worm eel	*Synodus synodus*	Redbarred lizardfish
CONGRIDAE	CONGER EELS	*Trachinocephalus myops*	Snakefish
Ariosoma balearicum	Bandtooth conger	**RADIICEPHALIDAE**	TAPERTAILS
Conger triporiceps	Manytooth conger	*Eumecichthys fiski*[2]	Unicorn crestfish
Gnathophis bathytopos[2]	Blackgut conger	**REGALECIDAE**	OARFISHES
Heteroconger longissimus	Brown garden eel	*Regalecus glesne*[3]	Giant oarfish
Heteroconger luteolus	Yellow garden eel	**MACROURIDAE**	GRENADIERS
Paraconger caudilimbatus	Margin tail conger	*Bathygadus macrops*[2]	Bullseye grenadier
Pseudophichthys splendens[2]	Purple-mouthed conger	*Gadomus arcuatus*[2]	Doublethread grenadier
Rhynchoconger gracilior[1]	Whiptail conger	*Hymenocephalus italicus*[2]	Glasshead grenadier
CLUPEIDAE	HERRINGS	*Malacocephalus occidentalis*[2]	Western softhead grenadier
Harengula humeralis	Redear herring	*Nezumia aequalis*[2]	Common Atlantic grenadier
Harengula jaguana	Scaled herring	**MORIDAE**	MORID CODS
Jenkinsia lamprotaenia	Dwarf herring	*Laemonema barbatulum*[2]	Shortbeard codling
Jenkinsia majua	Little-eye dwarf herring	**OPHIDIIDAE**	CUSK-EELS
Jenkinsia stolifera	Shortband dwarf herring	*Brotula barbata*	Bearded brotula
Opisthonema oglinum	Thread herring	*Lepophidium crossotum*[1]	Whitespot cusk-eel
Sardinella aurita	Spanish sardine	*Lepophidium jeannae*	Mottled cusk-eel
ENGRAULIDAE	ANCHOVIES	*Lepophidium profundorum*[2]	Blackrim cusk-eel
Anchoa lamprotaenia[1]	Big-eye anchovy	*Ophidion dromio*[1]	Shorthead cusk-eel
Anchoa lyolepis	Shortfinger anchovy	*Ophidion holbrookii*	Bank cusk-eel
Anchoa mitchilli	Bay anchovy	*Ophidion josephi*[2]	Crested cusk eel
Anchoviella perfasciata	Flat anchovy	*Ophidion selenops*	Moon-eyed cusk eel

TABLE 9 page 3

Species	Common Name	Species	Common Name
Otophidium dormitator	Sleeper cusk-eel	**FUNDULIIDAE**	KILLIFISHES
Parophidion schmidti	Dusky cusk-eel	*Fundulus confluentus*	Marsh killifish
Petrotyx sanguineus	Redfin brotula	*Fundulus similis*	Longnose killifish
CARAPIDAE	PEARLFISHES	*Lucania parva*[2]	Rainwater killifish
Carapus bermudensis	Pearlfish	**POECILIIDAE**	LIVEBEARERS
BYTHITIDAE	VIVIPAROUS BROTULAS	*Gambusia affinis*	Mosquitofish
Grammonus claudei	Reef brotula	*Gambusia rhizophorae*	Mangrove gambusia
Ogilbia cayorum	Key brotula	*Poecilia latipinna*	Sailfin molly
Ogilbia suarezae[1]	Shy brotula	**CYPRINODONTIDAE**	PUPFISHES
Stygnobrotula latebricola	Black brotula	*Floridichthys carpio*	Goldspotted killifish
BATRACHOIDIDAE	TOADFISHES	*Cyprinodon variegatus*[1]	Sheepshead minnow
Opsanus beta	Gulf toadfish	**BELONIDAE**	NEEDLEFISHES
Opsanus tau	Oyster toadfish	*Ablennes hians*	Flat needlefish
Porichthys plectrodon	Midshipman	*Platybelone argalus argalus*	Keeltail needlefish
LOPHIIDAE	GOOSEFISHES	*Strongylura marina*	Atlantic needlefish
Lophiodes reticulatus	Reticulated goosefish	*Strongylura notata forsythia*	Redfin needlefish
Lophius americanus	Monkfish	*Tylosurus acus acus*	Agujon
Lophius gastrophysus[3]	Blackfin goosefish	*Tylosurus crocodilus crocodilus*	Houndfish
ANTENNARIIDAE	ANGLERFISHES	**HEMIRAMPHIDAE**	HALFBEAKS
Antennarius pauciradiatus	Dwarf frogfish	*Chriodorus atherinoides*	Hardhead halfbeak
*Antennarius scaber**	Striated frogfish	*Euleptorhamphus velox*	Flying halfbeak
Fowlerichthys ocellatus	Ocellated frogfish	*Hemiramphus balao*	Balao
Histrio histrio	Sargassumfish	*Hemiramphus brasiliensis*	Ballyhoo
OGCOCEPHALIDAE	BATFISHES	*Hyporhamphus unifasciatus*	Silverstripe halfbeak
Dibranchus atlanticus[2]	Atlantic batfish	*Oxyporhamphus similis*[2]	Bigwing halfbeak
Halieutichthys aculeatus	Pancake batfish	**EXOCOETIDAE**	FLYINGFISHES
Ogcocephalus corniger[1]	Longnose batfish	*Cheilopogon cyanopterus*[1]	Margined flyingfish
Ogcocephalus cubifrons	Polka-dot batfish	*Cheilopogon exsiliens*	Bandwing flyingfish
Ogcocephalus nasutus	Shortnose batfish	*Cheilopogon furcatus*	Spotfin flyingfish
Ogcocephalus parvus	Roughback batfish	*Cheilopogon heterurus*	Blotchwing flyingfish
Ogcocephalus rostellum[1]	Palefin batfish	*Cheilopogon melanurus*[1]	Atlantic flyingfish
Zalieutes mcgintyi	Tricorn batfish	*Cypselurus comatus*[2]	Clearwing flyingfish
GOBIESOCIDAE	CLINGFISHES	*Exocoetus obtusirostris*	Oceanic 2-wing flyingfish
Acyrtops beryllinus	Emerald clingfish	*Hirundichthys affinis*	Fourwing flyingfish
Gobiesox strumosus	Skilletfish	*Hirundichthys rondeletii*	Blackwing flyingfish
ATHERINIDAE	SILVERSIDES	*Parexocoetus brachypterus*	Sailfin flyingfish
Hypoatherina harringtonensis	Reef silverside	*Prognichthys occidentalis*	W. bluntnose flyingfish
Atherinomorus stipes	Hardhead silverside	**HOLOCENTRIDAE**	SQUIRRELFISHES

*** some authorities consider *A. scaber* as part of Indo-Pacific *A. striatus* (Robertson & Van Tassell 2015).**

TABLE 9 page 4

Species	Common Name	Species	Common Name
Holocentrus adscensionis	Squirrelfish	*Scorpaena calcarata*	Smoothhead scorpionfish
Holocentrus rufus	Longspine squirrelfish	*Scorpaena dispar*	Hunchback scorpionfish
Myripristis jacobus	Blackbar soldierfish	*Scorpaena elachys*	Dwarf scorpionfish
Neoniphon coruscum	Reef squirrelfish	*Scorpaena grandicornis*	Plumed scorpionfish
Neoniphon vexillarium	Dusky squirrelfish	*Scorpaena inermis*	Mushroom scorpionfish
Plectrypops retrospinis	Cardinal soldierfish	*Scorpaena plumieri*	Spotted scorpionfish
Sargocentron bullisi	Deepwater squirrelfish	*Scorpaenodes caribbaeus*	Reef scorpionfish
ZEIDAE	DORIES	*Scorpaenodes tredecimspinosus*	Deepreef scorpionfish
Zenopsis conchifera[2]	Buckler dory	**DACTYLOPTERIDAE**	FLYING GURNARDS
AULOSTOMIDAE	TRUMPETFISHES	*Dactylopterus volitans*	Flying gurnard
Aulostomus maculatus	Atlantic trumpetfish	**TRIGLIDAE**	SEAROBINS
FISTULARIIDAE	CORNETFISHES	*Bellator brachychir*	Shortfin searobin
Fistularia tabacaria	Bluespotted cornetfish	*Bellator egretta*	Streamer searobin
CENTRISCIDAE	SNIPEFISHES	*Bellator militaris*	Horned searobin
Macroramphosus gracilis	Slender snipefish	*Prionotus alatus*	Spiny searobin
Macroramphosus scolopax[2]	Longspine snipefish	**PERISTEDIIDAE**	ARMORED SEAROBINS
SYNGNATHIDAE	PIPEFISHES/SEAHORSES	*Peristedion gracile*	Slender searobin
Anarchopterus criniger	Fringed pipefish	*Peristedion greyae*[2]	Alligator searobin
Bryx dunckeri[1]	Pugnose pipefish	*Peristedion brevirostre*	Flathead searobin
Cosmocampus albirostris	Whitenose pipefish	*Peristedion thompsoni*[2]	Rimspine searobin
Cosmocampus brachycephalus	Crested pipefish	**CENTROPOMIDAE**	SNOOKS
Cosmocampus elucens	Shortfin pipefish	*Centropomus undecimalis*	Common snook
*Halicampus crinitus**	Banded pipefish	**ACROPOMATIDAE**	LANTERNBELLIES
Hippocampus erectus	Spotted seahorse	*Synagrops bellus*	Blackmouth bass
Hippocampus reidi	Longsnout seahorse	**SERRANIDAE**	GROUPERS/SEABASSES
Hippocampus zosterae	Dwarf seahorse	*Alphestes afer*	Mutton hamlet
Syngnathus floridae[1]	Dusky pipefish	*Baldwinella vivanus*[2]	Red barbier
Syngnathus louisianae	Chain pipefish	*Centropristis fuscula*[3]**	Twospot sea bass
Syngnathus pelagicus	Sargassum pipefish	*Centropristis ocyurus*	Bank sea bass
Syngnathus scovelli[1]	Gulf pipefish	*Cephalopholis cruentata*	Graysby
Syngnathus springeri	Bull pipefish	*Cephalopholis fulva*	Coney
SCORPAENIDAE	SCORPIONFISHES	*Cephalopholis furcifer*	Creole fish
Pontinus rathbuni	Highfin scorpionfish	*Dermatolepis inermis*	Marbled grouper
Pterois volitans	Common lionfish	*Diplectrum bivittatum*	Dwarf sand perch
Scorpaena agassizii	Longfin scorpionfish	*Diplectrum formosum*	Sand perch
Scorpaena albifimbria	Coral scorpionfish	*Epinephelus adscensionis*	Rock hind
Scorpaena bergii	Goosehead scorpionfish	*Epinephelus drummondhayi*	Speckled hind
Scorpaena brasiliensis[2]	Barbfish	*Epinephelus guttatus*	Red hind

*** most authorities consider *H. crinitus* and the strongly banded form *H. ensenadae* the same species; *H. vittatus* is considered a Brazilian sibling species (Robertson & Van Tassell 2015).**
**** some authorities place *C. fuscula* in *Serranus.***

TABLE 9 page 5

Species	Common Name	Species	Common Name
Epinephelus itajara	Goliath grouper	*Serranus tabacarius*	Tobaccofish
Epinephelus morio	Red grouper	*Serranus tigrinus*	Harlequin bass
Epinephelus striatus	Nassau grouper	*Serranus tortugarum*	Chalk bass
Hypoplectrus aberrans	Yellowbelly hamlet	**OPISTOGNATHIDAE**	JAWFISHES
Hypoplectrus floridae	Floridian hamlet	*Lonchopisthus micrognathus*	Swordtail jawfish
Hypoplectrus gemma	Blue hamlet	*Opistognathus aurifrons*	Yellowhead jawfish
Hypoplectrus guttavarius	Shy hamlet	*Opistognathus lonchurus*	Moustache jawfish
Hypoplectrus indigo	Indigo hamlet	*Opistognathus macrognathus*	Banded jawfish
Hypoplectrus nigricans	Black hamlet	*Opistognathus robinsi*	Spotfin jawfish
Hypoplectrus puella	Barred hamlet	*Opistognathus whitehursti*	Dusky jawfish
Hypoplectrus sp.	Bluelip hamlet	**PRIACANTHIDAE**	BIGEYES
Hypoplectrus unicolor	Butter hamlet	*Heteropriacanthus cruentatus*	Glasseye snapper
Hyporthodus flavolimbatus	Yellowedge grouper	*Priacanthus arenatus*	Bigeye
Hyporthodus mystacinus	Misty grouper	*Pristigenys alta*	Short bigeye
Hyporthodus nigritus	Warsaw grouper	**APOGONIDAE**	CARDINALFISHES
Hyporthodus niveatus	Snowy grouper	*Apogon affinis*	Bigtooth cardinalfish
Liopropoma eukrines	Wrasse bass	*Apogon aurolineatus*	Bridle cardinalfish
Liopropoma mowbrayi	Cave bass	*Apogon binotatus*	Barred cardinalfish
Liopropoma rubre	Peppermint bass	*Apogon lachneri*	Whitestar cardinalfish
Mycteroperca bonaci	Black grouper	*Apogon phenax*[1]	Mimic cardinalfish
Mycteroperca interstitialis	Yellowmouth grouper	*Apogon maculatus*	Flamefish
Mycteroperca microlepis	Gag	*Apogon pillionatus*	Broadsaddle cardinalfish
Mycteroperca phenax	Scamp	*Apogon planifrons*	Pale cardinalfish
Mycteroperca tigris	Tiger grouper	*Apogon pseudomaculatus*	Twospot cardinalfish
Mycteroperca venenosa	Yellowfin grouper	*Apogon quadrisquamatus*	Sawcheek cardinalfish
Pseudogramma gregoryi	Reef bass	*Apogon townsendi*	Belted cardinalfish
Rypticus bistrispinus	Freckled soapfish	*Astrapogon alutus*	Bronze cardinalfish
Rypticus carpenteri[1]	Slope soapfish	*Astrapogon puncticulatus*	Blackfin cardinalfish
Rypticus saponaceus	Greater soapfish	*Astrapogon stellatus*	Conchfish
Rypticus subbifrenatus	Spotted soapfish	*Phaeoptyx conklini*	Freckled cardinalfish
Schultzea beta	School bass	*Phaeoptyx pigmentaria*	Dusky cardinalfish
Serraniculus pumilio	Pygmy sea bass	*Phaeoptyx xenus*	Sponge cardinalfish
Serranus annularis	Orangeback bass	**EPIGONIDAE**	DEEPWATER CARDINALFISHES
Serranus atrobranchus	Blackear bass	*Epigonus denticulatus*[2]	Pencil cardinal
Serranus baldwini	Lantern bass	**MALACANTHIDAE**	TILEFISHES
Serranus chionaraia	Snow bass	*Caulolatilus cyanops*	Blackline tilefish
Serranus notospilus	Saddle bass	*Caulolatilus microps*	Blueline tilefish
Serranus phoebe	Tattler bass	*Lopholatilus chamaeleonticeps*	Tilefish

TABLE 9 page 6

Species	Common Name	Species	Common Name
Malacanthus plumieri	Sand tilefish	**LUTJANIDAE**	SNAPPERS
POMATOMIDAE	BLUEFISHES	*Apsilus dentatus*	Black snapper
Pomatomus saltatrix	Bluefish	*Lutjanus analis*	Mutton snapper
RACHYCENTRIDAE	COBIA	*Lutjanus apodus*	Schoolmaster
Rachycentron canadum	Cobia	*Lutjanus buccanella*	Blackfin snapper
ECHENEIDAE	REMORAS	*Lutjanus campechanus*	Red snapper
Echeneis naucrates	Sharksucker	*Lutjanus cyanopterus*	Cubera snapper
Echeneis neucratoides	Whitefin sharksucker	*Lutjanus griseus*	Gray snapper
Phtheirichthys lineatus	Slender suckerfish	*Lutjanus jocu*	Dog snapper
Remora brachyptera	Spearfish remora	*Lutjanus mahogoni*	Mahogany snapper
Remora osteochir	Marlinsucker	*Lutjanus synagris*	Lane snapper
CARANGIDAE	JACKS	*Lutjanus vivanus*	Silk snapper
Alectis ciliaris	African pompano	*Ocyurus chrysurus*	Yellowtail
Carangoides bartholomaei	Yellow jack	*Rhomboplites aurorubens*[1]	Vermilion snapper
Carangoides ruber	Bar jack	**LOBOTIDAE**	TRIPLETAILS
Caranx crysos	Blue runner	*Lobotes surinamensis*	Tripletail
Caranx hippos	Crevalle jack	**GERREIDAE**	MOJARRAS
Caranx latus	Horse-eye jack	*Diapterus* sp.*	Irish or rhombic mojarra
Caranx lugubris	Black jack	*Eucinostomus argenteus*	Silver mojarra
Chloroscombrus chrysurus	Atlantic bumper	*Eucinostomus gula*	Silver jenny
Decapterus macarellus	Mackerel scad	*Eucinostomus harengulus*[2]	Tidewater mojarra
Decapterus punctatus	Round scad	*Eucinostomus jonesii*	Slender mojarra
Decapterus tabl	Redtail scad	*Eucinostomus lefroyi*	Mottled mojarra
Elagatis bipinnulata	Rainbow runner	*Gerres cinereus*	Yellowfin mojarra
Oligoplites saurus saurus	Leatherjack	**HAEMULIDAE**	GRUNTS
Selar crumenophthalmus	Bigeye scad	*Anisotremus surinamensis*	Black margate
Selene setapinnis	Moonfish	*Anisotremus virginicus*	Porkfish
Selene vomer	Lookdown	*Emmelichthyops atlanticus*	Bonnetmouth
Seriola dumerili	Amberjack	*Haemulon album*	White margate
Seriola rivoliana	Almaco jack	*Haemulon aurolineatum*	Tomtate
Seriola zonata	Banded rudderfish	*Haemulon carbonarium*	Caesar grunt
Trachinotus carolinus	Pompano	*Haemulon chrysargyreum*	Smallmouth grunt
Trachinotus falcatus	Permit	*Haemulon flavolineatum*	French grunt
Trachinotus goodei	Palometa	*Haemulon macrostomum*	Spanish grunt
Trachurus lathami	Rough scad	*Haemulon melanurum*	Cottonwick
CORYPHAENIDAE	DOLPHINS	*Haemulon parra*	Sailors choice
Coryphaena equiselis	Pompano dolphin	*Haemulon plumierii*	White grunt
Coryphaena hippurus	Dolphin	*Haemulon sciurus*	Bluestriped grunt

*** represents either *D. aureus* or *D. rhombus.***

TABLE 9 page 7

Species	Common Name	Species	Common Name
Haemulon striatum	Striped grunt	*Prognathodes aculeatus*	Longsnout butterflyfish
Haemulon vittatum	Boga	*Prognathodes aya*[3]*	Bank butterflyfish
Orthopristis chrysoptera	Pigfish	**POMACANTHIDAE**	ANGELFISHES
SPARIDAE	PORGIES	*Centropyge argi*	Cherub fish
Archosargus probatocephalus	Sheepshead	*Holacanthus bermudensis*	Blue angelfish
Archosargus rhomboidalis	Seabream	*Holacanthus ciliaris*	Queen angelfish
Calamus arctifrons	Grass porgy	*Holacanthus tricolor*	Rock beauty
Calamus bajonado	Jolthead porgy	*Pomacanthus arcuatus*	Gray angelfish
Calamus calamus	Saucereye porgy	*Pomacanthus paru*	French angelfish
Calamus nodosus	Knobbed porgy	**CIRRHITIDAE**	HAWKFISHES
Calamus penna	Sheepshead porgy	*Amblycirrhitus pinos*	Redspotted hawkfish
Calamus proridens	Littlehead porgy	**MUGILIDAE**	MULLETS
Lagodon rhomboides	Pinfish	*Mugil cephalus*	Striped mullet
Pagrus pagrus[2]	Red porgy	*Mugil curema*	White mullet
SCIAENIDAE	DRUMS	*Mugil rubrioculus*	Redeye mullet
Corvula batabana	Blue croaker	*Mugil trichodon*	Fantail mullet
Equetus lanceolatus	Jack-knife fish	**POMACENTRIDAE**	DAMSELFISHES
Equetus punctatus	Spotted drum	*Abudefduf sexatilis*	Sergeant major
Odontoscion dentex	Reef croaker	*Abudefduf taurus*	Night sergeant
Pareques acuminatus	High-hat	*Chromis cyanea*	Blue chromis
Pareques umbrosus	Cubbyu	*Chromis enchrysura*	Yellowtail reeffish
Pogonias cromis[2]	Black drum	*Chromis insolata*	Sunshinefish
Sciaenops ocellatus	Red drum	*Chromis multilineata*	Brown chromis
MULLIDAE	GOATFISHES	*Chromis scotti*	Purple reeffish
Mulloidichthys martinicus	Yellow goatfish	*Microspathodon chrysurus*	Yellowtail damselfish
Pseudupeneus maculatus	Spotted goatfish	*Stegastes adustus*	Dusky damselfish
PEMPHERIDAE	SWEEPERS	*Stegastes diencaeus*	Longfin damselfish
Pempheris schomburgkii	Glassy sweeper	*Stegastes leucostictus*	Beaugregory
KYPHOSIDAE	SEA CHUBS	*Stegastes partitus*	Bicolor damselfish
Kyphosus bigibbus	Grey sea-chub	*Stegastes planifrons*	Threespot damselfish
Kyphosus cinerascens	Topsail sea-chub	*Stegastes xanthurus*	Cocoa damselfish
Kyphosus sectatrix	Bermuda chub	**LABRIDAE**	WRASSES
Kyphosus vaigiensis	Brassy sea-chub	*Bodianus pulchellus*	Spotfin hogfish
CHAETODONTIDAE	BUTTERFLYFISHES	*Bodianus rufus*	Spanish hogfish
Chaetodon capistratus	Foureye butterflyfish	*Clepticus parrae*	Creole wrasse
Chaetodon ocellatus	Spotfin butterflyfish	*Decodon puellaris*	Red hogfish
Chaetodon sedentarius	Reef butterflyfish	*Doratonotus megalepis*	Dwarf wrasse
Chaetodon striatus	Banded butterflyfish	*Halichoeres bathyphilus*	Greenband wrasse

*** *P. aya* is now considered the sibling species in US waters of the Caribbean *P. guyanensis.***

TABLE 9 page 8

Species	Common Name	Species	Common Name
Halichoeres bivittatus	Slippery dick	*Labrisomus guppyi*	Mimic blenny
Halichoeres caudalis	Painted wrasse	*Labrisomus haitiensis*	Longfin blenny
Halichoeres cyanocephalus	Yellowcheek wrasse	*Labrisomus kalisherae*	Downy blenny
Halichoeres garnoti	Yellowhead wrasse	*Labrisomus nigricinctus*	Spotcheek blenny
Halichoeres maculipinna	Clown wrasse	*Malacoctenus aurolineatus*	Goldline blenny
Halichoeres pictus	Rainbow wrasse	*Malacoctenus macropus*	Rosy blenny
Halichoeres poeyi	Blackear wrasse	*Malacoctenus triangulatus*	Saddled blenny
Halichoeres radiatus	Puddingwife	*Paraclinus fasciatus*	Banded blenny
Lachnolaimus maximus	Hogfish	*Paraclinus grandicomis*	Horned blenny
Thalassoma bifasciatum	Bluehead wrasse	*Paraclinus infrons*	Bald blenny
Xyrichtys martinicensis	Rosy razorfish	*Paraclinus marmoratus*	Marbled blenny
Xyrichtys novacula	Pearly razorfish	*Paraclinus nigripinnis*	Blackfin blenny
Xyrichtys splendens	Green razorfish	*Starksia ocellata*	Checkered blenny
SCARIDAE	PARROTFISHES	**CHAENOPSIDAE**	TUBE BLENNIES
Cryptotomus roseus	Bluelip parrotfish	*Acanthemblemaria aspera*	Roughhead blenny
Nicholsina usta	Emerald parrotfish	*Chaenopsis limbaughi****	Yellowface pikeblenny
Scarus coelestinus	Midnight parrotfish	*Chaenopsis ocellata*	Bluethroat pikeblenny
Scarus coeruleus	Blue parrotfish	*Emblemaria atlantica*	Banner blenny
Scarus guacamaia	Rainbow parrotfish	*Emblemaria pandionis*	Sailfin blenny
Scarus iseri	Striped parrotfish	*Emblemariopsis diaphana*	Glass blenny
Scarus taeniopterus	Princess parrotfish	*Hemiemblemaria simulus*	Wrasse blenny
Scarus vetula	Queen parrotfish	*Stathmonotus hemphillii*	Blackbelly blenny
Sparisoma atomarium	Greenblotch parrotfish	**DACTYLOSCOPIDAE**	SAND STARGAZERS
Sparisoma aurofrenatum	Redband parrotfish	*Dactyloscopus tridigitatus*	Sand stargazer
Sparisoma chrysopterum	Redtail parrotfish	*Gillellus greyae*	Arrow stargazer
Sparisoma radians	Bucktooth parrotfish	*Gillellus uranidea*	Warteye stargazer
Sparisoma rubripinne	Yellowtail parrotfish	*Platygillellus rubrocinctus*	Saddle stargazer
Sparisoma viride	Stoplight parrotfish	**BLENNIIDAE**	COMBTOOTH BLENNIES
URANOSCOPIDAE	STARGAZERS	*Entomacrodus nigricans*	Pearl blenny
Astroscopus y-graecum	Southern stargazer	*Hypleurochilus bermudensis*	Barred blenny
TRIPTERYGIIDAE	TRIPLEFIN BLENNIES	*Hypleurochilus springeri*[2]	Orangespotted blenny
Enneanectes altivelis	Lofty triplefin	*Hypsoblennius invemar*	Tessellated blenny
Enneanectes boehlkei	Roughhead triplefin	*Ophioblennius macclurei*	Redlip blenny
*Enneanectes jordani**	Redbelly triplefin	*Parablennius marmoreus*	Seaweed blenny
LABRISOMIDAE	SCALY BLENNIES	*Scartella cristata*	Molly miller
Labrisomus bucciferus	Puffcheek blenny	**CALLIONYMIDAE**	DRAGONETS
*Labrisomus conditus***	Masquerader blenny	*Diplogrammus pauciradiatus*	Spotted dragonet
Labrisomus gobio	Palehead blenny	*Foetorepus agassizii*	Spotfin dragonet

*** *E. pectoralis* is now a junior synonym of *E. jordani* (Victor 2017).**
**** *L. nuchipinnis* records in Florida are apparently *L. conditus* by mtDNA analysis (Victor, pers. comm.).**
***** mtDNA surveys indicate these records in FL may all represent *C. ocellata* (Victor, pers. comm.).**

TABLE 9 page 9

Species	Common Name	Species	Common Name
Foetorepus goodenbeani[1]	Palefin dragonet	*Priolepis hipoliti*	Rusty goby
Paradiplogrammus bairdi	Lancer dragonet	*Risor ruber*	Tusked goby
ELEOTRIDAE	SLEEPERS	*Tigrigobius gemmatus*	Frecklefin goby
Dormitator maculatus[1]	Fat sleeper	*Tigrigobius macrodon*	Tiger goby
GOBIIDAE	GOBIES	**MICRODESMIDAE**	WORMFISHES
Barbulifer ceuthoecus	Bearded goby	*Cerdale floridana*	Pugjaw wormfish
Bathygobius antilliensis	Antilles frillfin goby	**PTERELEOTRIDAE**	DARTFISHES
Bathygobius geminatus[3]	Twinspotted frillfin goby	*Ptereleotris calliura*	Blue dartfish
Bathygobius mystacium	Island frillfin goby	**EPHIPPIDAE**	SPADEFISHES
Bathygobius soporator	Frillfin goby	*Chaetodipterus faber*	Atlantic spadefish
Coryphopterus alloides	Barfin goby	**ACANTHURIDAE**	SURGEONFISHES
*Coryphopterus bol/venezuelae**	Sand-canyon goby	*Acanthurus chirurgus*	Doctorfish
Coryphopterus dicrus	Colon goby	*Acanthurus coeruleus*	Blue tang
Coryphopterus eidolon	Pallid goby	*Acanthurus tractus*	Ocean surgeonfish
Coryphopterus glaucofraenum	Bridled goby	**SPHYRAENIDAE**	BARRACUDAS
Coryphopterus hyalinus	Glass goby	*Sphyraena barracuda*	Great barracuda
Coryphopterus kuna	Kuna goby	*Sphyraena borealis*	Northern sennet
Coryphopterus lipernes	Peppermint goby	*Sphyraena picudilla***	Southern sennet
Coryphopterus personatus	Masked goby	**GEMPYLIDAE**	SNAKE MACKERELS
Coryphopterus punctipectophorus	Spotted goby	*Gempylus serpens*	Snake mackerel
Coryphopterus thrix	Bartail goby	**SCOMBRIDAE**	MACKERELS/TUNAS
Coryphopterus tortugae	Patch-reef goby	*Acanthocybium solandri*	Wahoo
Ctenogobius boleosoma	Darter goby	*Auxis thazard thazard*	Frigate mackerel
Ctenogobius saepepallens	Dash goby	*Euthynnus alletteratus*	Little tunny/Little tuna
Ctenogobius stigmaturus[3]	Spottail goby	*Katsuwonus pelamis*	Skipjack tuna
Elacatinus oceanops	Neon goby	*Sarda sarda*[2]	Atlantic bonito
Elacatinus xanthiprora	Yellowprow goby	*Scomberomorus cavalla*	King mackerel
Gnatholepis thompsoni	Goldspot goby	*Scomberomorus maculatus*	Spanish mackerel
Gobiosoma grosvenori	Rockcut goby	*Scomberomorus regalis*	Cero
Gobiosoma robustum	Code goby	*Thunnus albacares*	Yellowfin tuna
Lophogobius cyprinoides	Crested goby	*Thunnus atlanticus*	Blackfin tuna
Lythrypnus nesiotes	Island goby	*Thunnus thynnus*	Bluefin tuna
Lythrypnus phorellus	Convict goby	**XIPHIIDAE**	SWORDFISHES
Lythrypnus spilus	Bluegold goby	*Xiphias gladius*	Swordfish
Microgobius carri	Seminole goby	**ISTIOPHORIDAE**	BILLFISHES
Microgobius microlepis	Banner goby	*Istiophorus platypterus*	Sailfish
Nes longus	Orangespotted goby	*Kajikia albida*	White marlin
Oxyurichthys stigmalophius	Spotfin goby	*Makaira nigricans*	Blue marlin

*** *C. venezuelae* is likely an endemic species to NE Venezuela, if so the species is *Coryphopterus bol* Victor, 2008.**
**** some authorities consider *S. picudilla* to be a junior synonym of *S. borealis.***

TABLE 9 page 10

Species	Common Name	Species	Common Name
Tetrapturus pfluegeri	Longbill spearfish	**BALISTIDAE**	TRIGGERFISHES
CENTROLOPHIDAE	MEDUSAFISHES	*Balistes capriscus*	Gray triggerfish
Hyperoglyphe perciformis	Barrelfish	*Balistes vetula*	Queen triggerfish
NOMEIDAE	DRIFTFISHES	*Canthidermis sufflamen*	Ocean triggerfish
Nomeus gronovii	Man-of-war fish	**MONACANTHIDAE**	FILEFISHES
Psenes cyanophrys	Freckled driftfish	*Aluterus monoceros*	Unicorn filefish
Psenes maculatus	Silver driftfish	*Aluterus schoepfii*	Orange filefish
Psenes pellucidus[1]	Blue driftfish	*Aluterus scriptus*	Scrawled filefish
ARIOMMATIDAE	EYEBROWFISHES	*Cantherhines macrocerus*	White-spotted filefish
Ariomma regulus	Spotted driftfish	*Cantherhines pullus*	Orangespotted filefish
CAPROIDAE	BOARFISHES	*Monacanthus ciliatus*	Fringed filefish
Antigonia capros	Deepbody boarfish	*Monacanthus tuckeri*	Slender filefish
PARALICHTHYIDAE	LARGE-TOOTH FLOUNDERS	*Stephanolepis hispida*	Planehead filefish
Ancylopsetta dilecta	Three-eye flounder	*Stephanolepis setifer*	Pygmy filefish
Citharichthys arctifrons	Gulf stream flounder	**OSTRACIIDAE**	BOXFISHES/TRUNKFISHES
Citharichthys cornutus	Horned whiff	*Acanthostracion polygonius*	Honeycomb cowfish
Citharichthys macrops	Spotted whiff	*Acanthostracion quadricornis*	Scrawled cowfish
Cyclopsetta fimbriata	Spotfin flounder	*Lactophrys bicaudalis*	Spotted trunkfish
Paralichthys albigutta	Gulf flounder	*Lactophrys trigonus*	Buffalo trunkfish
Syacium gunteri	Shoal flounder	*Lactophrys triqueter*	Smooth trunkfish
Syacium papillosum	Dusky flounder	**TETRAODONTIDAE**	PUFFERFISHES
BOTHIDAE	LEFTEYE FLOUNDERS	*Canthigaster jamestyleri*	Goldface toby
Bothus lunatus	Peacock flounder	*Canthigaster rostrata*	Sharpnose puffer
Bothus ocellatus	Eyed flounder	*Sphoeroides spengleri*	Bandtail puffer
Monolene antillarum[2]	Slim flounder	**DIODONTIDAE**	PORCUPINEFISHES
Monolene sessilicauda[2]	Deepwater flounder	*Chilomycterus antennatus*	Bridled burrfish
ACHIRIDAE	AMERICAN SOLES	*Chilomycterus reticulatus*	Spotted burrfish
Achirus lineatus	Lined sole	*Chilomycterus schoepfii*	Striped burrfish
Trinectes maculatus	Hogchoker	*Diodon holocanthus*	Balloonfish
CYNOGLOSSIDAE	TONGUEFISHES	*Diodon hystrix*	Porcupinefish
Symphurus arawak	Caribbean tonguefish	**MOLIDAE**	MOLAS
Symphurus diomedeanus	Spottedfin tonguefish	*Masturus lanceolatus*	Sharptail mola
Symphurus minor[2]	Largescale tonguefish	*Mola mola*	Ocean sunfish
Symphurus parvus[2]	Pygmy tonguefish		
Symphurus plagiusa[1]	Blackcheek tonguefish		
TRIACANTHODIDAE	SPIKEFISHES		
Parahollardia lineata	Jambeau		

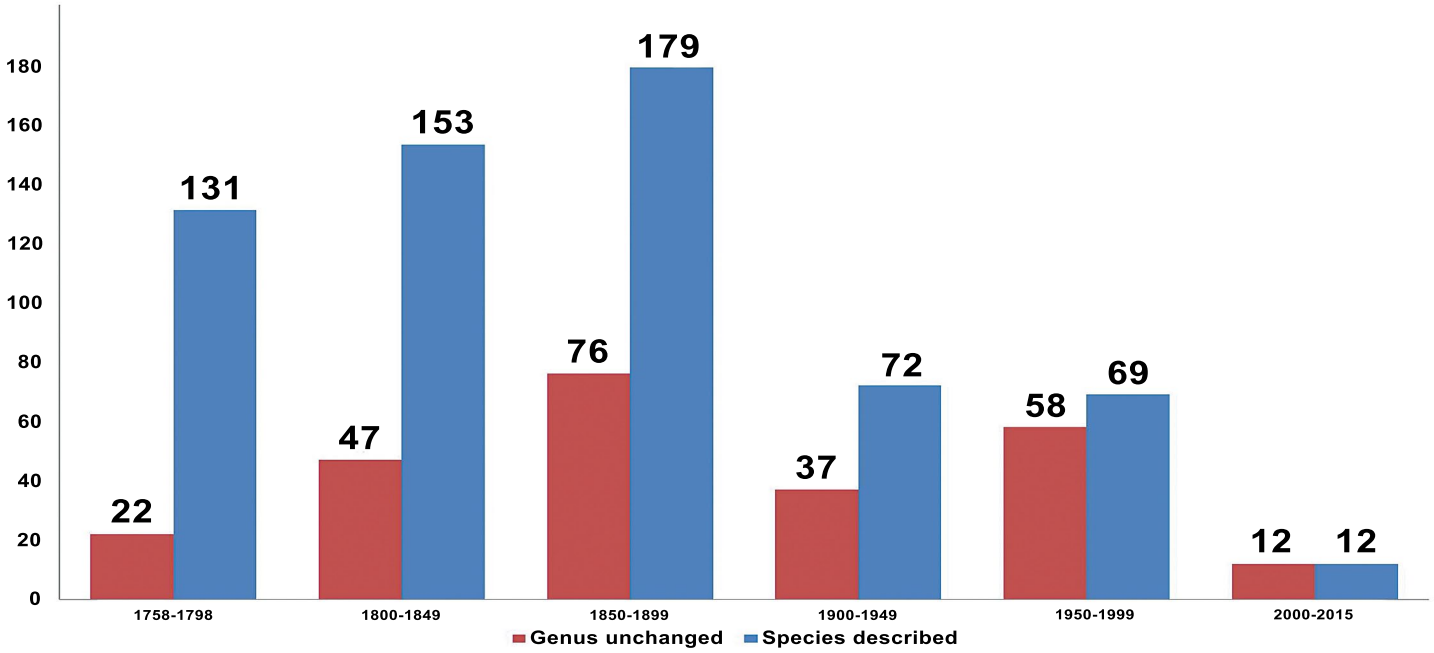

Figure 2. Species descriptions of fishes in the checklist by date (blue column) and whether genus is unchanged (red column).

Original descriptions of Alligator Reef fish fauna

From 1758–1771, the father of scientific nomenclature, the Swedish naturalist Carl Linnaeus, described the most species in this checklist, a total of 72 species; 13 of these are still recognized in their original genus. The Cuban naturalist Felipe Poey described the second-most number of the species in the list: from 1851–1876, he named 54 species, of which 17 remain in the original genus. The most species described in the 20th century was by James Böhlke of the Academy of Natural Sciences of Philadelphia who described 24 of the listed species from 1955–1976; 20 of these still occupy their original genus. Only 12 species have been described between 2000 and 2015; all remain in the genus in which they were originally described (Fig. 2). Only one species, the Bluelip hamlet *Hypoplectrus* sp., is as yet undescribed. A total of 239 species (38%) of the 616 identified species in this list are still assigned to the original genus in which they were first described.

Twelve species from the 1968 checklist were recorded as undescribed, six entries included the planned name. Other than the "*Anthias* sp." and "*Citharichthys* sp." that have been lost, all have since been described (Table 10).

TABLE 10

Status of undescribed species in Starck (1968)

Starck (1968) name	Current name	Common name
Verma sp.	*Apterichtus ansp*	Augernose worm eel
Verma sp.	*Apterichtus kendalli*	Bluntnose worm eel
Enchelycore sp.	*Enchelycore carychroa*	Chestnut moray
undescribed genus & sp.	*Lophiodes reticulatus*	Reticulated goosefish
Anthias sp.		
Apogon sp.	*Apogon pillionatus*	Broadsaddle cardinalfish
Apogon sp.	*Phaeoptyx xenus*	Sponge cardinalfish
Chromis sp.	*Chromis scotti*	Purple reeffish
Eupomacentrus sp.	*Stegastes diencaeus*	Longfin damselfish
Gobionellus sp.	*Ctenogobius saepepallens*	Dash goby
Gobiosoma sp.	*Elacatinus xanthiprora*	Yellowprow goby
Citharichthys sp.		

TABLE 11

Type specimens from Alligator Reef collections at FLMNH

Species name	type	collected by Starck	Species name	type	collected by Starck
Aprognathodon platyventris	P	+	*Apogon pillionatus*	P	+
Enchelycore carychroa	P	+	*Chromis scotti*	P	+
Gnathophis bathytopos	P	-	*Eupomacentrus mellis* (now invalid)	H	+
Lepophidium crossotum	P	+	*Foetorepus goodenbeani*	P	+
Ophidion dromio	P	+	*Coryphopterus dicrus*	P	+
Ctenogobius saepepallens	P	+	*Coryphopterus eidolon*	P	+
Ogilbia suarezae	P	+	*Coryphopterus hyalinus*	P	+
Liopropoma eukrines	H	+	*Coryphopterus lipernes*	P	+
Serranus chionaraia	P	+	*Elacatinus xanthiprora*	H	+
Apogon phenax	P	+	*Lythrypnus spilus*	P	+

Type specimens

Twenty of the species in the FLMNH collection include type specimens from Alligator Reef and environs on which the species description was based (Table 11). Of these, 19 include material collected by the senior author in his original survey. One described species has since been determined to be a junior synonym (*E. mellis*).

New Records for Continental U.S. Waters

The most definitive current list of fish species from continental U.S. waters is the American Fisheries Society listing by Page *et al*. (2013), i.e. *Common and Scientific Names of Fishes from the United States, Canada, and Mexico: 7th edition*. From the current Alligator Reef checklist, 13 deepwater and offshore species and 7 reef species are not listed by them (Table 12). Of the 7 reef species, all but two are recently revised genera and thus were not evaluated for the Page *et al*. listing.

TABLE 12

Alligator Reef fish species not listed by Page *et al*. (2013)

Deep water & offshore spp.		Reef species
Breviraja spinosa	*Gadomus arcuatus*[2]	*Hypoplectrus floridae*†
Fenestraja plutonia	*Hymenocephalus italicus*[2]	*Kyphosus bigibbus*†
Pseudophichthys splendens[2]	*Nezumia aequalis*[2]	*Kyphosus cinerascens*†
Sternoptyx diaphana[1]	*Lepophidium crossotum*[1]	*Labrisomus conditus*†
Yarrella blackfordi[2]	*Peristedion brevirostre*	*Coryphopterus bol/venezuelae*†
Eumecichthys fiski[2]	*Epigonus denticulatus*[2]	*Tigrigobius gemmatus*†
Bathygadus macrops[2]		*Sphyraena picudilla**

[1] Collected by Starck <1967, [2] From FLMNH collected <1970, [3] From FLMNH, collected 2002-2009.
† new records for U.S. waters.
* listed as *S. borealis*.
Note: *Hypoplectrus* sp. also not listed

TABLE 13

Alligator Reef fish families without a circumtropical distribution

Family	Distribution	Family	Distribution
UROTRYGONIDAE	W. Atlantic & E. Pacific	LABRISOMIDAE	Atlantic & E. Pacific
FUNDULIIDAE	freshwater North America (introduced widely elsewhere)	CHAENOPSIDAE	W. Atlantic & E. Pacific
POECILIIDAE	freshwater Americas & Africa (introduced widely elsewhere)	DACTYLOSCOPIDAE	W. Atlantic & E. Pacific
CENTROPOMIDAE	W. Atlantic & E. Pacific	ACHIRIDAE	Americas freshwater & W. Atlantic & E. Pacific

Zoogeographic Composition of Alligator Reef fish fauna

The families of fishes in the checklist are mostly cosmopolitan groups; only 8 of the 122 families of fishes from Alligator Reef do not have a circumtropical distribution (Table 13). None of the families are limited to the western Atlantic region, the six marine families are found on both sides of the continent.

Most genera in the checklist are circumtropical (203), but a large proportion are limited to the New World (56) or, specifically the Greater Caribbean region (30) (Table 14). Of the species in the checklist, the majority are limited to the Greater Caribbean region (382) and there are significant numbers of amphi-Atlantic species and circumtropical species (the latter mostly pelagic and deep-water species).

TABLE 14

Geographic distribution of genera of Alligator Reef fishes

Geographic Distribution	Genera	Geographic Distribution	Genera
Circumtropical	203	E. & W. Atlantic	11
New World (W. Atlantic & E. Pacific)	56	U.S. east coast & Gulf of Mexico	5
Tropical W. Atlantic (Greater Caribbean)	30	Temperate & Tropical W. Atlantic	1
E. & W. Atlantic & E. Pacific	15	Introduced from Indo-Pacific (lionfish)	1

Geographic distribution of species of Alligator Reef fishes

Geographic Distribution	Species	Geographic Distribution	Species
Tropical W. Atlantic (Greater Caribbean)	385	North America & Cuba	2
E. & W. Atlantic	88	Florida only (*Hypoplectrus floridae*)	1
Circumtropical	84	North America & Bermuda	1
U.S. east coast & Gulf of Mexico	45	E. & W. Atlantic & E. Pacific	1
Temperate & Tropical W. Atlantic	6	Introduced from Indo-Pacific (lionfish)	1
Tropical W. Atlantic & E. Pacific	4		

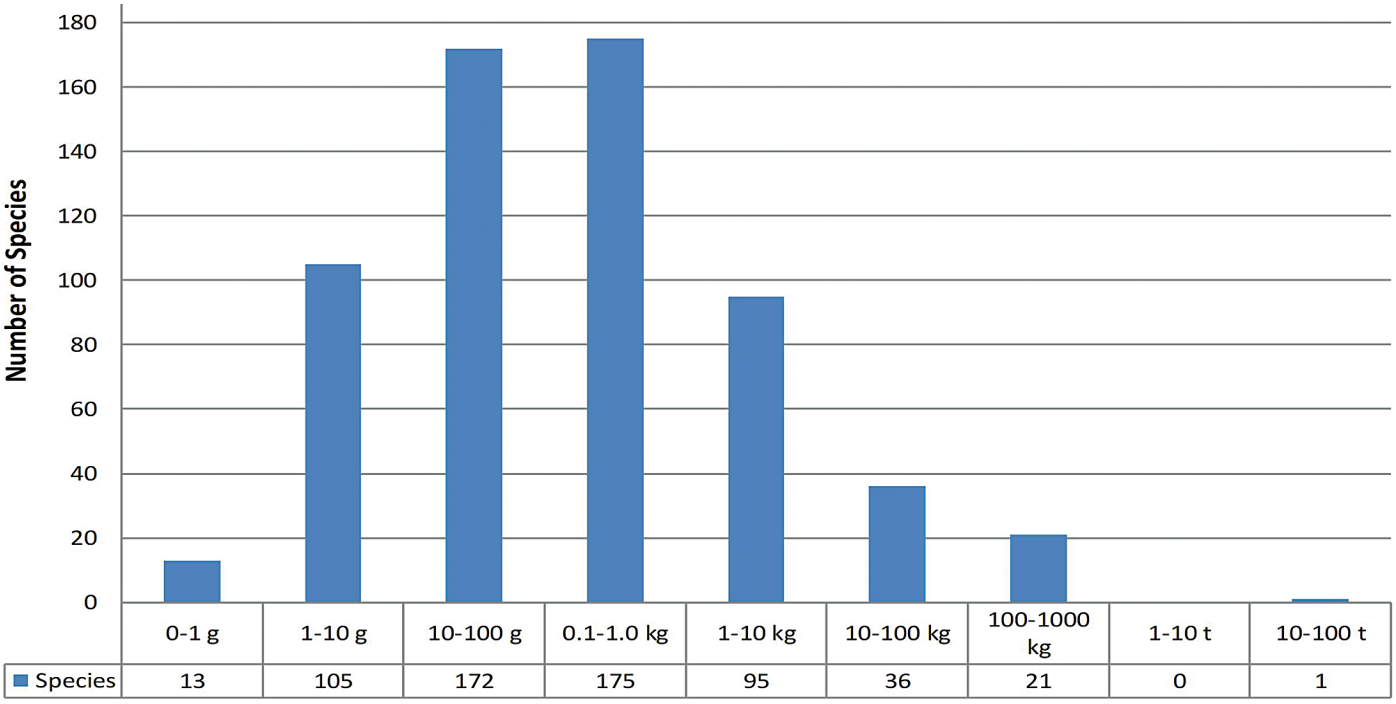

Figure 3. Size distribution of fish species in the checklist by weight category.

Size composition of Alligator Reef fish fauna

The composition of Alligator Reef fish species by body weight of typical large adults spans nine orders of magnitude from 0–1 gram up to 10–100 tons. They range in size from the convict goby (*Lythrypnus phorellus*) at a body length of 18 mm SL and a weight of less than a gram to the whale shark at a body length of over 10 m and a weight exceeding 10 tons. The weight distribution approximates a normal distribution with a peak for fishes weighing 0.1–1 kg (Fig. 3).

Abundance and habitat associations of Alligator Reef fish fauna

Starck (1968) used five qualitative categories to indicate the abundance of each species and these categories are followed here. Rare species are those of which 3 or fewer specimens have been seen or collected among a number of collections in their habitat. Occasional ones are species collected or observed at irregular intervals. Species listed as frequent have been seen or collected on numerous occasions or are taken in a large percentage of collections from their habitat. Common species are ones that may be found during virtually every dive or collection in the proper area. Abundant indicates a common species present in large numbers. It is important to note that these characterizations are relative to habitat and thus a species may be common but restricted to a limited habitat.

Overall, 36 species of the 618 in the checklist are considered to be abundant, 168 common, 117 frequent, 2 are frequent to occasional, 127 occasional, 48 occasional to rare, 100 rare and 20 are too uncertain to classify. The two frequent to occasional species (*Myripristis jacobus* & *Haemulon melanurum*) have been noted to vary greatly over time, presumably as a result of random variables of larval recruitment. The species considered to be frequent to occasional and occasional to rare are chiefly ones that appear to normally be found offshore in deeper water, but may sometimes be found on the reef.

Of the total of 618 species of fishes now recorded from Alligator Reef and environs, 420 are considered to be reef species, 275 of these are primarily found on reefs and 145 are secondary reef species which, while common on reefs, are also common or even more abundant elsewhere. An additional 69 species are normally restricted to inshore waters apart from the reef area. A further 102 species are epipelagic and demersal dwellers offshore in the Gulf Stream in depths down to 100 m. The remaining 27 species come from deep trawling by University of Miami and U.S. Fish and Wildlife Service research vessels farther offshore in depths down to 300 m. At least 10 of the inshore and 20 of the offshore species occasionally stray into the reef area.

TABLE 15

Species reported as common to abundant by Starck (1968) but rarely or not seen by the Estapés (59 spp.)

Galeocerdo cuvier[1]
Negaprion brevirostris[2]
Albula vulpes[3]
Moringua edwardsi[4]
Enchelycore carychroa[5]
Apterichtus ansp[4]
Apterichtus kendalli[4]
Ichthyapus ophioneus[4]
Harengula humeralis[6]
Anchoa mitchilli[7]
Saurida normani[8]
Synodus foetens[9]
Trachinocephalus myops[10]
Parophidion schmidti[11]
Petrotyx sanguineus[5]
Oglibia cayorum[11]
Halieutichthys aculeatus[12]
Ogcocephalus cubifrons[12]
Fundulus confluentus[13]
Fundulus similis[13]
Poecilia latipinna[13]
Floridichthys carpio[13]
Strongylura marina14
Strongylura notata forsythia[15]
Hemiramphus balao[14]
Hyporhamphus unifasciatus[15]
Anarchopterus criniger[11]
Cosmocampus brachycephalus[11]
Halicampus crinitus[11]
Hippocampus zosterae[11]
Scorpaena calcarata[16]
Scorpaenodes caribbaeus[16]
Liopropoma eukrines[17]
Serranus annularis[18]
Opistognathus lonchurus[19]
Apogon planifrons[20]
Phaeoptyx conklini[20]
Trachinotus carolinus[21]
Eucinostomus argenteus[22]
Archosargus rhomboidalis[11]
Lagodon rhomboides[11]
Mugil curema[22]
Doratonotus megalepis[11]
Nicholsina usta[11]
Enneanectes jordani[23]
Labrisomus guppyi[11]
Labrisomus hatiensis[11]
Paraclinus fasciatus[11]
Paraclinus nigripinnis[11]
Starksia ocellata[23]
Barbulifer ceuthoecus[23]
Bathygobius soporator[24]
Coryphopterus lipernes[25]

[1] primarily nocturnal, avoids divers, commonly caught on overnight setlines
[2] common on inshore *Thalassia* flats and in channels
[3] common on inshore *Thalassia* flats, very shy
[4] burrowing
[5] cryptic
[6] inshore, in areas not usually of interest to divers
[7] inshore, seasonal
[8] offshore, soft bottoms, camouflaged
[9] inshore, camouflaged
[10] on open sandy areas, often burrows
[11] hides in grass beds or algae
[12] offshore open bottom, beyond normal diving depths & camouflaged
[13] in ponds on the Matecumbe Keys, habitat largely destroyed by development
[14] fast moving surface dweller difficult to see while diving
[15] inshore surface dweller, difficult to see while diving
[16] in open rubbly bottom, camouflaged
[17] rocky outcrops beyond outer reef at 50 m depth
[18] rubble bottom beyond outer reef 30-45 m depth
[19] in open sandy rubble areas, hides in burrows
[20] cryptic in day, seen mostly at night
[21] in turbid inshore channels, seasonal
[22] in turbid inshore mud and sand areas
[23] small, camouflaged, hides in coral rubble and algae
[24] in tide pools on islands, not observed while diving
[25] conspicuous, perches on surface of coral heads of the outer reef

Of 420 total species considered here to be reef fish species, 262 were recorded by both Starck and the Estapés. A total of 130 reef species were recorded by Starck but not found by the Estapés or other REEF surveys. Almost all of these records were either rare sightings or species that are difficult to observe visually underwater and were found chiefly through the use of rotenone or by trawling. A few also live at depths greater than normal recreational diving limits. Of the 130, 6 are new additions to the Starck (1968) list based on museum specimens collected by Starck before 1968 (4) or collected by others more recently (2).

The junior authors have noted 59 species reported as common to abundant by Stark 1968 that they have not found or have seen only rarely (Table 15). All but 5 of these species were also rarely or never seen by Starck while diving, but were common to abundant in collections only. They are species whose habitats are not easily surveyed by diving or whose habits inhibit visual observation. *Liopropoma eukrines* and *Serranus annularis* are found at depths beyond the current recommended limits for recreational diving. Of the 3 remaining species frequently seen by Starck, *Apogon planifrons* and *Phaeoptyx conklini* were commonly found in rotenone collections (and can be observed during night diving). Finally, *Coryphopterus lipernes* was easily observed while diving on deeper reefs and appears to represent a genuine change in abundance, as it perches conspicuously on the surface of coral heads. Possible causes for its disappearance may be loss of habitat stemming from a significant recent reduction in live coral cover or the proliferation of predatory invasive lionfish, or both.

Comparison data on the Alligator Reef fish fauna

REEF Survey Data on Alligator Reef fishes fauna

The Reef Environmental Education Foundation (REEF) maintains an online database of worldwide visual fish-count surveys conducted by volunteer researchers and fish-count enthusiasts (http://www.REEF.org). REEF surveys are divided into novice and expert categories with the latter based on experience and passing a test of identification ability. While such surveys are biased toward easily observed species, they are indicative for a large portion of the reef fish fauna and comprise a valuable source of comparative information (Schmitt & Sullivan 1996, Pattengill-Semmens & Semmens 2003, Holt *et al*. 2013). The local REEF data includes that of the Estapés, who have conducted 185 roving-diver REEF surveys on Alligator Reef. An additional 1807 surveys at 94 sites in the study area have also been conducted by other REEF volunteers (as of July 3, 2016). The total of 1992 REEF surveys comprises 633 Expert SA (Species and Abundance) surveys, 12 Expert SO (Species Only) surveys, 1310 Novice SA surveys, and 37 Novice SO surveys.

REEF surveys report the highest diversity of fishes by region on Florida reefs (Table 16). For specific local

TABLE 16
REEF diversity report for the Tropical Western Atlantic Region (TWA)
(814 total potential fish species)

Region	Species	Families	Surveys	Sites
FLORIDA (East Coast and Keys)	623	98	37,721	1,877
CONTINENTAL CARIBBEAN & BRAZIL	617	88	28,662	853
NW CARIBBEAN	591	91	30,097	1,737
LESSER ANTILLES	525	80	7,986	692
BAHAMAS & TURKS & CAICOS	500	85	17,705	1,431
GULF OF MEXICO*	488	86	6,833	611
GREATER ANTILLES & VIRGIN ISLANDS	487	78	8,852	846
BERMUDA	269	57	3,145	270
		Total	141,001	

* Cape Sable, FL to Cabo Catoche, Yucatan, Mexico.

TABLE 17

Top 10 REEF sites for species richness in the Tropical Western Atlantic

(generated 2 January 2016)

Rank	Survey Site	No. of species
1	Bari Reef, Bonaire	403
2	Blue Heron Bridge (WPB), Phil Foster Park, Jupiter Inlet to Key Biscayne	385
3	Something Special, Bonaire	366
4	Tori's Reef, Bonaire	352
5	Front Porch Bonaire (Sunset Beach), Bonaire	346
6	Commercial Pier Reefs/Datura Ave., 1st and 2nd Reef, Jupiter Inlet to Key Biscayne	345
7	Green/Yellow Submarine, Bonaire	325
8	The Invisibles, Bonaire	310
9	Red Slave, Bonaire	302
10	Molasses Reef, Key Largo Oceanside (including Tavernier)	296

TABLE 18

10 most frequent species in TWA REEF surveys

(generated 7 February 2015)

Species	% of surveys	Species	% of surveys
Thalassoma bifasciatum	85.0	*Chaetodon capistratus*	72.6
Acanthurus coeruleus	84.8	*Abudefduf saxatilis*	70.0
Sparisoma viride	81.2	*Acanthurus tractus*	69.8
Stegastes partitus	79.9	*Halichoeres garnoti*	69.4
Haemulon flavolineatum	74.7	*Ocyurus chrysurus*	69.2

TABLE 19

10 most frequent species in Alligator Reef REEF surveys

(generated 7 February 2015)

Species	% of surveys	Species	% of surveys
Abudefduf saxatilis	91.6	*Stegastes partitus*	87.0
Acanthurus coeruleus	91.6	*Haemulon flavolineatum*	86.5
Ocyurus chrysurus	90.1	*Anisotremus virginicus*	84.7
Haemulon sciurus	89.1	*Chaetodon ocellatus*	84.7
Sparisoma viride	87.5	*Microspathodon chrysurus*	84.2

sites, Florida and Bonaire locations comprise the top 10 diversity reports (Table 17). The REEF data for REEF Zone Code area 3404 (Islamorada) corresponds roughly to the Alligator Reef area as included in Starck (1968) and in the current study. The REEF data for this area lists 406 species (as of 21 October 2015), including 14 entries for "turtles, presumed hybrids, and unidentified species". The Islamorada area comprises fish-count surveys from 139 specific locations. The "Alligator Reef" location (REEF Zone Code 34040002) is limited to the shallow ledge a few hundred meters south of the lighthouse. The area immediately around the lighthouse is a different location. With 94 expert and 278 novice REEF surveys (as of 13 February 2016), the 34040002 location has the most surveys and highest number of species in the REEF database of any location in the Islamorada area.

A comparison with Molasses Reef some 30 km to the NE of Alligator Reef is instructive. It is number 10 in the REEF list of sites for species richness for the TWA (Table 17). It has received 482 expert and 1845 novice surveys (as of 13 February 2016). The Molasses Reef locality (34030009) listed 239 species (as of 6 February 2016) and the Alligator Reef locality (34040002) listed 216 species (both excluding listings for turtles, presumed hybrids and unidentified species). (Note that the higher number of 296 species for Molasses Reef in the REEF top ten listing (Table16) likely derives from inclusion of additional locations in addition to the single locality (34030009) called "Molasses Reef" in the REEF database). Of the 239 Molasses species, 45 were not recorded for Alligator Reef and of the 216 Alligator Reef species, 25 were not listed for Molasses. However, 24 of the 45 Molasses species not recorded for Alligator Reef by REEF have been recorded for Alligator Reef in this study, leaving a total of 21 species recorded by REEF surveyors for Molasses that are absent from the current checklist. Of these 21, 10 records are solitary or rare sightings by novice observers and most or all of these may be misidentifications. Of the remaining species, all are of very low frequency or abundance, and, in view of the disparity in the number of surveys in the two locations, any difference in the fish fauna appears to be insignificant. A REEF Zone Report for Alligator Reef is included in the supplementary material for the current study.

The common reef fish species are comparable between the Greater Caribbean and Alligator Reef. Overall, 6 of the 10 most frequently sighted species in the TWA are shared between the entire TWA region and the Alligator Reef REEF surveys (Tables 18 & 19); 3 more are in the next 6 most frequently sighted species on Alligator Reef. The remaining species, the Bluehead Wrasse, *Thalassoma bifasciatum* is ubiquitous on well-developed coral reefs in the Caribbean Sea, but was not the most frequently sighted species on Alligator Reef surveys, perhaps due to the lower coral cover in the Florida Keys. The 3 unshared species in the most-frequent list for Alligator Reef are also common species in the Caribbean Sea.

The REEF Zone Report for Alligator Reef totals 277 "species", including 12 for turtles, unidentified species and presumed hybrid fishes (REEF 2016). Of the remaining 265 actual fish species, 49 are sightings reported only by novice observers. Six of the 216 species reported by expert category REEF observers have not been found in the current study. Due to various uncertainties in identification and the absence of confirmation by photos or specimens these have not been included in our own list. A full listing of the REEF Zone Report is in the Supplementary Material.

While the 420 reef fish species and 618 total species from Alligator Reef and environs in this checklist are impressive, it should be recognized that they are more the result of far more extensive collecting effort than of any unique biodiversity. It is important to note that the use of rotenone and trawls resulted in the collecting of numerous cryptic, burrowing, and highly camouflaged species that are rarely or never observed while diving.

All but two of the species from Alligator Reef have relatively broad distributions extending outside Florida, and the two exceptions are species of hamlets (*Hypoplectrus*), which comprise an exceptional genus made up of numerous morphs currently undergoing a species radiation (Puebla *et al*. 2014).

The actual comparative biodiversity in the different reef areas is probably better indicated by the REEF fish surveys in their expert category, as indicated in Table 16 above. It is also important to be aware that almost all reef species have a pelagic larval stage and relatively wide distributions. Florida reefs, in particular, receive a constant flow of larvae via the Gulf Stream from more tropical reefs further south. Among these there appear to be a number of reef species for which Florida conditions are marginal for their survival and they frequently are delivered to Florida by the prevailing currents but fail to establish permanent residence. As a result, extensive surveys or collecting over time results in a lengthening tail of such records, but these records reflect more the intensity and duration of sampling than they do any trend in biodiversity.

It should also be noted that the high REEF species counts for some Florida locations includes a significant portion of continental non-reef species. The relative richness of the Florida reef-fish fauna is probably best illustrated by the comparison of the 296 reef species from Molasses Reef, Florida vs. the 403 species from Bari Reef, Bonaire, a difference of about 25% (see Table 17 above). Unfortunately, no directly comparable surveys exist for comparison with our Alligator Reef survey, and permits for any similar intensive collecting effort, with rotenone especially, seem unlikely to be issued by government agencies in the future. The status of our survey recording the most species of fishes from any single locality in the New World appears likely to stand for some time into the future.

Comparisons to other publications and databases on the Greater Caribbean fish fauna

Floeter *et al*. (2008), Greater Caribbean Region

A comprehensive listing of 57 families of Caribbean reef-associated fishes was published in a biogeographic study by Floeter *et al*. (2008). A spreadsheet listing of the Greater Caribbean species from Floeter *et al*. 2008 and comparisons and tables are appended in the Supplementary Material section. A total of 58 families and 889 species (including 10 undescribed species) are listed for the Western Caribbean and Eastern Caribbean areas, and these can be combined here as the Greater Caribbean area. Only one of these families is not represented at Alligator Reef: the Grammatidae, which have only been found in Florida as rare strays, and none have been recorded in the Alligator Reef study area.

Of the 889 fish species in the Floeter *et al*. (2008) listing, 352 have been recorded as reef species at Alligator Reef; 257 of these were classified as primary reef species and 95 were secondary reef species. A further 50 species from the Alligator Reef list that are not considered to be reef species are in the listing, making a total of 402 species from Alligator Reef appearing in Floeter *et al*. An additional 68 reef species from Alligator Reef were not listed in Floeter *et al*. Of these, 27 were in families, but not species, listed and 41 were in 19 families not included in the listing. A total of 47 families and 88 species in the Alligator Reef list were considered to be non-reef species and, of these, only one family with 3 species appears in Floeter *et al*. (1980).

The families and species recognized as reef species at Alligator Reef but not listed by Floeter *et al*. (2008) include all the cartilaginous fishes, as well as the herring-like fishes and related groups, plus a scattering of various families which are predominantly not reef-dwellers but which do include some species which are largely or only found on reefs. Examples of the former group are the Caribbean reef shark (*Carcharhinus perezii*), Yellow stingray (*Urobatis jamaicensis*) and Dwarf herring (*Jenkinsia lamprotaenia*). Examples of the latter are Houndfish (*Tylosurus crocodilus*), Ballyhoo (*Hemiramphus brasiliensis*), Great barracuda (*Sphyraena barracuda*) and Cero (*Scomberomorus regalis*). The species listed by Floeter *et al*. (2008) but not considered to be reef species in the current study are ones which are predominantly found in non-reef habitats but may occur in some reef situations where their preferred habitat is immediately adjacent to or impinging on a reef area. Depending on the proximity of a reef to other coastal and continental shelf habitats, spill-over of species from adjacent biomes often occurs. A number of such species also have geographic ranges which extend far beyond the limits of reefs. Examples are the Gulf toadfish (*Opsanus beta*), Sargassumfish (*Histrio histrio*), Warsaw grouper (*Hyporthodus nigritus*), Lookdown (*Selene vomer*) and Red Snapper (*Lutjanus campechanus*).

In addition to the vexing matter of what is a reef species, attempting to make any comparison between a single reef locality and a partial listing from a major geographic region seems to be of limited utility. It is apparent that considerable future effort and cooperation is going to be required to develop a defined list of reef species. Many reef species also have restricted ranges and habitats thus a regional list only accords very generally with biodiversity in any given locality.

Anonymous (2008), Belize

This online list of the Marine Fish of Belize was compiled in 2008 from the Fishbase online database (www.fishbase.org/). It lists 547 species in 111 families. A list of these families and species, plus a comparison of families with 10 or more species at Alligator Reef, St. Croix, and Belize and a list of families from the Belize

list not recorded from Alligator Reef or St. Croix is appended in the Supplementary Material section. This latter list comprises 10 families and 18 species, all offshore and deepwater species with wide distribution, most of which are likely to be found at all three locations with more extensive offshore collecting effort. If these species and some 30 more obvious offshore species are discounted, the inshore and reef species in the Belize list totals about 500 species. While the available information makes any distinction between the reef and inshore species uncertain, the extensive inshore habitat in Belize would appear to make it likely that the reef component of this list would be similar in number to that of Alligator Reef and St. Croix. It also seems probable that with more extensive sampling the actual number of reef species would prove to be somewhat greater than Alligator Reef or St. Croix.

Ilves *et al*. (2011, 2013), Bahamas

This project is similar to our current study in involving an assment of 50-year change in reef-fish assemblages around New Providence Island in the Bahamas. In this effort, Ilves *et al*. compared the results of rotenone collections made in the 1950s to 1970s to similar collections made in the same locations in 2006 and 2010. Their key findings were that there had been no statistically significant change in overall species diversity but there had been a relative increase in herbivores (mainly parrotfishes) and a relative decrease in planktivores. There had also been an inverse trend between two nocturnal groups of fishes, in which the larger-bodied squirrelfishes increased while the smaller-bodied cardinalfishes decreased in relative abundance. These changes in trophic groups and families were considered to be consistent with the effects of a degraded reef habitat characterized by increased algal cover and fewer shelter spaces. Such degradation was suggested to result from the effects of local development combined with changes in ocean temperature and chemistry associated with climate change.

Three additional possible influences on the changes in trophic groups and reef conditions would also seem worthy of consideration. In this region, fish traps are the main method for catching parrotfishes and in the past traps were commonly used around New Providence. Any more recent reduction in trapping may have had a significant effect on parrotfish populations in the area. The size, habits and habitat of cardinalfishes would also seem to make them particularly susceptible to predation by invasive lionfish, and there is some indication of this at Alligator Reef as well. Severe hurricanes can also have a devastating effect on coral cover with a period of profuse algal growth taking place in the first few years of recovery.

It is interesting to note that the largest number of species recorded by Ilves *et al*. (2013; Table 2) for their rotenone collections were around 60, whereas the visual surveys at the ledge on Alligator Reef have often exceeded 100 species, with 116 being the highest number for a single observer on a single dive. However, a rotenone collection samples a much smaller area, but often yields a number of cryptic, burrowing, and camouflaged species rarely or never seen in visual surverys, thus making comparison between the two methods somewhat inconclusive.

A well-written and informative personal account of the earlier as well as this more recent fish-collecting activity around New Providence Island may be found in the book *Full Fathom Five* by Gordon Chaplin (2013).

Smith-Vaniz & Jelks (2014), St. Croix, U.S. Virgin Islands

This checklist of the fishes of St. Croix in the Virgin Islands is perhaps the most directly comparable to our list from Alligator Reef in that it covers a similar-sized reef area including adjacent inshore and oceanic habitats. A spreadsheet listing of the Alligator Reef and St. Croix fishes has been prepared and a set of three tables summarizing the similarities and differences is appended in the Supplementary Material section. Although the St. Croix list does not distinguish inshore, reef, and offshore species, we have made assumptions in this regard and the resulting total number of reef species for both areas is remarkably similar, i.e. 420 species for Alligator Reef and 428 for St. Croix.

The total species number reported by Smith-Vaniz & Jelks (2014) for St. Croix is 537, compared to the 618 we list for Alligator Reef. As one might expect of a continental area, the inshore species at Alligator Reef are more numerous, i.e. 69 species for Alligator Reef vs. 44 for St. Croix. A considerably larger number of offshore species at Alligator Reef than at St. Croix, i.e. 129 vs. 45 species is probably strongly influenced by differences in collecting effort. In the more speciose families of reef fishes, the smallest differences occur in the families with larger-sized species and the greatest differences are found among the small and especially speciose blennies and

gobies, many of which have restricted geographic ranges. As for families of fishes, 89 are common to both areas, with an additional 33 families from Alligator not found at St. Croix and 11 families from St. Croix not found at Alligator Reef. Only one reef family (Urotrygonidae, 1 sp.) is found at Alligator Reef but not St. Croix, and 2 reef families (Anomalopidae, 1 sp. & Grammatidae, 2 spp.) are found in St. Croix but not Alligator Reef.

Species numbers by country from www.fishbase.us online database

A compilation of numbers for total marine fish species and for reef-associated species for 22 countries from the West Indian region and 22 from the Indo-Pacific region was extracted from this extensive database on 20 May 2017. The highest number of reef species for the former region was 542 species for the contiguous United States and the second highest was 471 species for Cuba. The highest in the Indo-Pacific Ocean was Indonesia at 2061 reef species and Australia at 2046 species. This tabulation is included in the Supplementary Material section.

The contiguous United States figure presumably applies to Florida as it is the only reef area in the contiguous states. The high level for Florida undoubtedly reflects the more extensive ichthyological research conducted there as well as true diversity levels. It seems apparent from the numbers cited, fewer than our records for Alligator Reef alone, that this database is incomplete. Although not at all comprehensive, it is at least consistent in what is considered a reef associated species and appears broadly consistent in regard to general patterns of species diversity.

Robertson & Van Tassell (2015) Shorefishes of the Greater Caribbean: online information system

The Smithsonian Tropical Research Institute (STRI) Shorefishes of the Greater Caribbean online information system, Version 1.0, is the most extensive compilation of species listings and distributions for the region. It enables generation of species lists for 0.5º squares of latitude and longitude and larger. The 0.5º square that includes Alligator Reef is about five times larger than our study area, and it includes considerable additional reef areas as well as both inshore and offshore biomes not found in the study area. The species listed are indicated as being either "confirmed" or "probable", but the criteria for such determination is not documented (Table 20). Locality information more detailed than the 0.5º square was also not available for the STRI-confirmed species. A full list of these species is included in the Supplementary Material.

The STRI list of 469 probable fish species for the square includes 217 species in the current Alligator reef checklist that have been confirmed by specimens or photographs by us. Many of these are also documented in the primary ichthyological literature and by UMML specimens now in the Florida State Museum of Natural History collection and in their online database. In several instances, Alligator Reef is a type locality for the species. The 252 probable STRI species not in our checklist are predominantly wide-ranging oceanic species with a lesser number of shorefishes not recorded from this particular 0.5º square but known from other South Florida locations. Of the offshore species in this category, many additional species with similar ranges might arguably be added.

On the other hand, the 425 confirmed STRI species for the square contains 362 species in our checklist and 63

TABLE 20

STRI guide species list for the 0.5º square including Alligator Reef	
Total species listed	894
Confirmed species	425
Probable species	469
STRI confirmed species in the Alligator Reef checklist	363
STRI confirmed species not in the Alligator Reef checklist	63
STRI probable species in the Alligator Reef checklist	217
STRI probable species not in the Alligator Reef checklist	252
Alligator Reef checklist species not in the STRI list	38

not listed in our checklist. Of the unlisted species, only a few are reef species, a few more are inshore species, and the majority are offshore deepwater fishes. Most or all of these seem likely to be records from localities outside the Alligator Reef study area, either in other reef areas, in Florida Bay, or farther offshore in the Florida Straits.

Similarly, the converse, almost all of the species in our checklist that are not in the STRI listing for the square are offshore deepwater fishes. Those in our list are almost all based on FLMNH specimens collected by the U.S. Fish and Wildlife Service research vessel *Silver Bay* in some experimental trawls in the area in the early 1970s. The source of the STRI data for offshore deepwater fishes is unclear, but it may be from the same set of trawls, both in and out of our study area; USFWS material of this nature was often distributed to various museum collections including the U.S. National Museum.

The STRI information system is a large and very valuable undertaking. However, at this time, it is a work in progress (version 2.0 is being prepared at present), with considerable gaps in information yet to be filled. Because of the uncertainties and lack of precision in locality data used for the database, and the undocumented criteria for confirmed vs. probable, we have not included the data from the STRI list in our own list, which is directly based on vouchered specimens and photos.

General observations on coral-reef fishes

The large number of fish species on coral reefs provides a high degree of ecological redundancy with multiple species playing overlapping roles. This is further enhanced by considerable behavioral flexibility within individual species as well. The result is that reef communities are highly adaptable and exhibit a great deal of variability both from place to place and over time on the same reef and from one reef to another, both nearby and over large geographic areas. At Alligator Reef, there are marked seasonal changes in the presence and abundance of a number of species. There are also seemingly random fluctuations in the presence and abundance of some species from one year to another. This variation ranges from species that can occasionally become relatively numerous to those exhibiting an ongoing trickle of larval delivery from the south which appear only as occasional stray individuals.

The fish fauna of individual reefs varies from a maximum of about 100 species on reefs in the eastern Pacific Ocean to over 1000 on reefs in the Coral Triangle area of the southern Philippines and northern Indonesia. On reefs in regions with fewer species, the ecological niche of individual species appears to be wider, color patterns less distinctive, and the average species size somewhat larger.

The Florida Reefs are noteworthy for their abundance of fishes. The offshore Gulf Stream and the extensive inshore areas of Hawk Channel and Florida Bay provide especially favorable conditions for both food and recruitment. The record sighting of 116 species in a single dive on the ledge at Alligator Reef by Allison Estapé, with large numbers of individuals of many species, is testimony to such abundance.

Effects of reef protection

From 1958–67, about a dozen charterboats fished the outer reefs and Gulfstream in the wider Alligator Reef area. The area within about a 1 km radius of the Alligator Reef lighthouse was generally not fished, and only a few small private boats visited the outer reefs. A busy weekend might see a half-dozen boats within the 1 km radius and fewer still outside it. On weekdays, the typical number of boats was one, two, or none. In 1997, the senior author revisited Alligator Reef and over a dozen boats were present on the reef. The general impression was that there were fewer large predatory fishes and notably more shoals of juvenile grunts of *Haemulon* spp. along the shallow ledge. Large shoals of adult *Haemulon* and snappers of *Lutjanus* of several species were still conspicuous sheltering among the iron girders under the lighthouse, but the resident large barracuda that had normally been there appeared to be absent.

Shortly after the 1997 visit, the area of Alligator Reef was declared a Sanctuary Preservation Area (SPA) and fishing was prohibited. Observations and photos by the Estapés indicate that the large piscivorous lutjanids, serranids, carangids and barracuda are now present in larger numbers than in the 1958–67 era and the shoals of juvenile *Haemulon* spp. have been significantly reduced. These of course do vary seasonally in accord with

spawning time. It is the impression of the junior authors that larger predators are rarely seen outside the SPA, most likely because of increased fishing pressure. A noticeable exception has been a large increase in the population of the Goliath grouper (*Epinephelus itajara*) which has received individual species protection not limited to the SPA.

The tame nature of fishes inside the SPA where there is no spearfishing is also noticeable. Reef fishes live in an environment where they are surrounded by a numerous, diverse, and frequently changing collection of other species, only some of which are a threat. They are quite adept at learning which species to ignore and the different distances to allow for different threats. On reefs and areas where there is no spearing, many targeted gamefish species as well as the small reef fishes permit divers to approach as close as a meter or two, whereas on reefs where such species are regularly speared they may flee a diver from 10 m away.

Personal reflections on Alligator Reef by W. Starck

The 1950s and 1960s were a unique era in coral reef biology. The advent of self-contained diving equipment opened the way for direct personal exploration of what are the oldest and richest biological communities on Earth. This is something that might only be repeated if at some distant future time another planet rich in life is found and explored. This era of reef exploration was a time when diving where no one had ever been and discovering things we had never imagined were everyday occurrences.

The first rotenone collections at the ledge on Alligator Reef captured multiple species never before known from U.S. waters. The first night dives there completely changed our understanding of the fundamental nature of reef communities. That there was a huge change in species and activities between day and night was not expected. That the large shoals of haemulids and lutjanids seen on the reef in the day were only sheltering there and then left to forage widely at night, or that corals derived much of their nutrition from feeding on plankton at night, were remarkable revelations. That large areas of open sandy bottom supported a rich assemblage of burrowing creatures that emerged only at night was another surprise with important implications.

On a more personal level, some of the more memorable incidents include finding a small rotenone-affected fish with an almost surreal color pattern of alternating red-and-yellow stripes. I was unaware of anything like it and seeing it in my hand evoked a strange sense of contact with something of surprising beauty, yet also somewhat alien. It turned out to be what we now know as a Peppermint bass (*Liopropoma rubre*) that had been described by the Cuban naturalist Poey in 1861, but had only recently been rediscovered from two specimens collected in the Bahamas. It is now known to occur widely throughout the Greater Caribbean, but is cryptic in habits, never abundant, and only rarely seen.

The discovery of its relative, the Wrasse bass (*Liopropoma eukrines*) was a different story (see Fig. 4). It was found a few years later around some small rocky outcrops near Alligator Reef at a depth of 50 m. I was then familiar with the genus and immediately recognized it as a distinct species previously unknown to science. To

Figure 4. *Liopropoma eukrines*, Florida Middle Grounds, a species described from Alligator Reef by Starck & Courtenay (1962) (courtesy David B. Snyder).

recognize and capture a specimen of a unique and beautiful form of life that has existed for millions of years but never before seen by any human being is a very special experience. The legendary ichthyologist, Jack Randall, has described it as the next best thing to an orgasm. Certainly it invokes a sense of a deep connection with the mystery and beauty of life through vast spans of time.

Some experiences were also memorable for less-pleasant reasons. One such was having dive lights fail on a moonless night, being unable to find the boat and being forced to swim a kilometer to the lighthouse to ask the Coast Guard crew (which then manned it) if I could use their phone to call my father ashore to come out in the night to pick us up. On another occasion, on a late afternoon in winter with a howling northwester blowing, I was fishing in the Gulf Stream with my father not far from the reef when we came across an overturned outboard boat with three people clinging to it in a rough sea. When we came close, two men swam over and we pulled them aboard. However, a woman still clinging to the upturned hull was not able to swim to us and the waves made it too dangerous to closely approach. I jumped in with a line and was able to free her and be pulled back to my father's boat. It turned out they had been in the water for several hours, the woman was pregnant and another woman had also been with them but was lost when the boat turned over.

The most severe storm at Alligator Reef in the period I worked there was Hurricane Donna in September, 1960. Sand and coral rubble driven by the storm waves effectively scrubbed away all attached life on the reef down to a depth of 6–8 m with considerable damage and coral breakage down to at least 25 m depth. For a few weeks after the storm, the reef area was white with barren coral rock and rubble. It then turned a yellowish tan as gelatinous algae began to cover the bottom. After about a month, the color shifted to green as filamentous green algae became predominant. Over the next year, various sea fans and sea whips returned along with small colonies of reef corals starting to re-establish. On the deeper reefs, there was decreasing coral breakage down to about 30 m depth, however, the greatest impact was from siltation. For some weeks after the storm, this blanketed the channels of the spur-and-groove formations and much of the level bottom beyond the deep outer reef. In many places, this layer of loose silt was initially about 30 cm thick but with each period of windy weather over the next year it dispersed with wave action and became thinner.

One of the most notable casualties of the storm was the long-spined black sea urchins (*Diadema antillarum*), which had been abundant on the shallow ledge but were wiped out by the storm. Abundant nearshore colonies suffered similar devastation but both the reef and inshore populations experienced good recruitment and recovered to abundant levels within a year (Randall *et al*. 1964). Another major casualty of the storm was the mangroves. The wind stripped most trees and bushes on the islands of virtually all leaves. Immediately after the storm, glaring white coral rock, sand, and rubble prevailed, but within a few weeks most land vegetation, which was still standing, was covered in new green sprouts. Mangrove trees, however, must have their leaves to excrete the excess salt that comes with growing in seawater. When stripped of leaves they die and much of the mangroves around the islands were killed. However, their seedlings, growing in the understory of the mangrove forests were inundated by the storm surge and protected from the leaf-stripping wind and they survived. After the storm, they were no longer struggling to grow in the shade of older trees and over the next few years they grew into a new green understory from which protruded the bare skeletons of the old forest. Mangrove wood is not very rot resistant and in a few more years the growing new forest had engulfed the collapsing remains of the previous one. The extensive areas of sea grass both offshore and inshore were significantly battered and thinned out by the storm but recovered rapidly.

Another aspect of the earlier work at Alligator Reef involved the development of various equipment to carry out the work as commercially available equipment at that time was quite limited and simply not available for many purposes. One of the more important of such developments was the use of an optical-dome lens-port for use of wide-angle lenses in underwater photography. I had reasoned that an optical dome would enable this but inquiries to Corning Glass and Kodak both indicated a cost of about $20,000 to make such a dome. As this would buy a half-dozen new cars at that time, I shelved the idea for a while. Then one day I was in my cousin's living room in Islamorada and he had a marine compass sitting on the coffee table. I picked it up and closely examined the compass dome. It looked very good optically. I went home and called Bob Gilka, who was the Director of Photography at National Geographic Magazine. I told him I thought I could make the new Nikon 180° fisheye lens work underwater and asked to borrow one. He sent it with a Nikon-F body and motor drive. I ordered a

5-inch compass dome from a compass-repair shop in Miami and built a rough underwater housing from a piece of plastic sewer pipe using the machine shop in the Institute of Marine Science. It was first tested in the ocean at the ledge on Alligator Reef and produced excellent results. I then made a prototype adapter to use it with the Nikonos underwater camera. My friend Jerry Greenberg (the pioneer underwater photographer) had a machine shop make some copies for National Geographic and for us. Widespread adoption by others soon followed. Today dome ports are used universally for wide-angle underwater photography and Jerry, now near 90, lives on Key Largo and still dives and photographs the reefs he loves.

Like the era of the Wild West, the era of frontier excitement and discovery on coral reefs seemed to be the permanent nature of the place when it was happening, but actually lasted only a couple of decades. While new discoveries will continue to be made well into the future, the pace is slowing and the focus and funding of research has shifted away from basic understanding and discovery more towards investigation of environmental concerns.

Acknowledgments by W. A. Starck

The early work at Alligator Reef included the opportunity to collaborate and work with a number of outstanding ichthyologists. This included a number of dives with Jack Randall, who was an early mentor at the University of Miami and who encouraged the work at Alligator Reef as well as the study of the biology of the Grey snapper (*Lutjanus griseus*) for my doctoral dissertation. Jack described several of the new species from Alligator Reef and went on to describe more valid species of marine fishes than any other author. Now at 93 years of age, he is still describing more. Even more remarkable is the fact that of the total of well more than 700 new species he has described, almost all are ones he has collected himself and there are few reef areas anywhere in the world where he has not dived and collected fishes.

Jim Böhlke from the Academy of Natural Sciences of Philadelphia described more of the new species from Alligator Reef than anyone else and, though he never dived at Alligator Reef, I had the pleasure of visiting with him in Miami and Philadelphia and collecting with him in Yucatan and in the Seychelles and Almirante Islands in the Indian Ocean. Sadly, he died in 1982.

My major professor at Miami was Dick Robins who greatly supported my work at Alligator Reef, curated the specimens collected, and also described a number of the new species. The long list of graduate students he mentored went on to prominence in American ichthyology for a generation only now ending. These included Walt Courtenay, Bill Davis, Bill Eschmeyer, Alan Emery, Phil Heemstra, Pat Colin, Tom McKenney, Jon Baskin, Henry Feddern, Ray Birdsong, Tom Fraser, Jon Staiger, Bill Smith-Vaniz, and many more. Many of those mentioned here published on specimens from Alligator Reef and contributed to our understanding of these fishes

In addition to the people mentioned above, and those acknowledged in the 1968 checklist, several people have provided important assistance to the current update. Foremost among these, the senior author would like to thank the junior authors for their very capable and considerable effort, which made possible this study, and in adding 35 species to the list.

Nancy A. Voss, Research Professor Emeritus at the Rosenstiel School of Marine & Atmospheric Science of the University of Miami, assisted importantly in advising the whereabouts of the research collection of fishes from Alligator Reef which had been moved to the FLMNH.

Robert H. Robins, Senior Biologist/Collection Manager in the Division of Ichthyology at the FLMNH, turned out to be the son of my major professor, Dick Robins, so the collection had in effect stayed in the family and Rob helpfully provided me the information for access to the collection database.

Lad Akins was the Founding Executive Director of Reef Environmental Education Foundation (REEF) and is currently their Director of Special Projects. The authors are grateful for his bringing the Starck (1968) checklist to the attention of the junior authors, for his encouragement of their survey efforts, and for his key role in development of the REEF surveys and database. In addition to providing great enjoyment for thousands of recreational divers, this is now becoming an increasingly valuable resource for assessing, monitoring and comparing the fish faunas of coral reefs around the world.

Christy Pattengill-Semmens, Director of Science for REEF, has kindly provided detailed and much appreciated editorial advice on the manuscript for this study.

D. Ross Robertson is the lead contributor to the extensive online information system *Shorefishes of the Greater Caribbean* (http://biogeodb.stri.si.edu/caribbean/en/pages). It is maintained by the Smithsonian Tropical Research Institute with whom Ross is a Senior Scientist. He is now probably the most knowledgeable researcher on the fishes of this region and has provided valuable confirmation on various problematic species identifications for the Estapés, plus a number of additional suggestions in a review of the manuscript.

David B. Snyder kindly permitted use of his photograph of *Liopropoma eukrines*.

Finally, Benjamin Victor, the editor of this journal, has afforded much appreciated patience and assistance with numerous valuable corrections and suggestions in bringing this study to its final form.

Acknowledgments by C.J. Estapé & A. Morgan Estapé

The junior authors would like to thank the following persons for their help, guidance, and inspiration in the undertaking of this project.

The senior author, Walter Starck, whose seminal and comprehensive work during the 1960s captured a unique snapshot of fish biodiversity in the Florida Keys, specifically Alligator Reef, as well as our imagination. It is without a doubt that lacking the inspiration of his efforts nearly fifty years ago, we would not have embarked in our four-year undertaking to photo-document as many fish species as possible on Alligator Reef.

D. Ross Robertson from the Smithsonian Tropical Research Institute, who made himself available in helping us identify many of the fishes we photographed and provided thoughtful insights and much appreciated guidance. His website and app have been invaluable sources in helping us identify the fish we photographed. We are proud to say that in the course of this project he has deemed over 400 of our images worthy to be included in the online information system: Fishes: Greater Caribbean, A Guide to the Shorefishes of the Caribbean & adjacent areas (http://biogeodb.stri.si.edu/caribbean/en/pages).

Benjamin Victor, one of the leading researchers of the DNA barcoding program FISH-BOL, the Fish Barcode of Life Project, and founder of the Ocean Science Foundation and this journal. We had the great fortune of diving and collecting specimens with him when he came to visit us in Islamorada and this helped us lay to rest a few questions regarding local species and their ranges. We thought we knew how to look for small cryptic fish until we saw him in action.

Lad Akins, REEF Director of Special Projects, first alerted us to the Starck study. On several occasions Lad has brought to our attention species we would likely have missed or misidentified as a similar species; *Decapterus tabl* and *Lophogobius cyprinoides* come to mind.

We would be remiss of we didn't thank the entire REEF organization including Christy Pattengill-Semmens, Director of Science, and most especially Ned and Anna DeLoach and Paul Humann, for creating an organization that promotes conservation and encourages citizen-scientists like ourselves to more deeply explore the ocean world and the life within it. With over 200,000 fish surveys in its database, it is the largest of its kind in the world.

Ed Martin, dive buddy, REEF Advanced Assessment Team Member, USCG Captain, and fish enthusiast. It is a rare individual that is willing to go looking for uncommon species in poor conditions, especially in low visibility, mucky bottoms, and cold water where a two-hour dive might yield only ten fish. The only individuals of *Cosmocampus albirostris* and *Hippocampus reidi* we photographed were found by Ed and he was responsible for adding three new species to the general list, that of *Dasyatis centroura*, the Roughtail stingray; *Diapterus sp.*, the Irish or Rhombic mojarra; and *Caulolatilus microps*, the Blueline tilefish; the latter on the one day we went deep-sea fishing. Our endeavor has been considerably more fun because of his participation.

On a Personal Note by C. Estapé

I would especially like to thank Allison Estapé, REEF Level-5 Advanced Assessment Team Member, u/w photographer, USCG Captain, PADI dive instructor, dive buddy, and most importantly, my partner in life. I would have never undertaken this project without her enthusiasm and encouragement; she is responsible for finding and photographing many of the 313 species with which we are credited.

Allison and I have logged over 1,000 total dives within the geographical confines of the Starck study area

between October 2013 and August 2017. In our effort to duplicate Starck's results via photography, we spent many a dive not just on the reefs, but also over seagrass beds, sand, and rubble. On the inshore dives, the visibility was seldom over 10 feet, and, in many instances, we were in water so shallow that our SCUBA tanks could be seen sticking out of the water. On dives beyond the outer reef, we hovered over sandy bottoms in depths of 30 m or more looking for deep-water species and, when the *Sargassum* mats drifted in from the Gulf Stream, one of us would dive under them looking for pelagic juveniles and the species that make these floating islands their home, while the other followed with the boat. We also looked under the bridges, on the artificial wrecks, in Spanish galleon ballast piles, rocky shores, and open water, as well as the reefs; in other words, we have been as thorough and systematic as possible in our search.

Throughout the process we have become proficient at finding cryptic species and at taking diagnostic photographs of fish. These are profile images of the subject in all their life stages, boring if what you are looking for is a glamor shot, but absolutely crucial if you are trying to conclusively identify an individual from a photograph.

Our search was limited to the area encompassed between shoreline and the safe-diving limits, from Crocker Reef to Tennessee Reef in the Florida Keys, the same area that Starck spent nine years collecting specimens in the 1960s. Within this area lies what today is known as Alligator Ledge and Alligator SPA, a no-take zone as designated by NOAA within the National Marine Sanctuary that runs the length of the Florida Keys. Inside this half square mile of protected ocean is one of the most biodiverse underwater places we have ever dived in the tropical Western Atlantic. Finding and identifying 100 fish species on a two-hour dive has been done regularly (a "Century" dive) and has become the goal for many of the divers we take there, a badge of honor if you will. We challenge the readers to try it for themselves. For more information on "The Century Club" or to see the extensive photo galleries we have amassed from Alligator Reef and from around the world, we invite the reader to visit www.100fishid.com and www.carlosestape.photoshelter.com.

Supplementary material and archive doi:

AlligatorReefPhotos.pdf: a selection of images of various reef habitats from both the 1960s and today.
https://doi.org/10.5281/zenodo.848291

Alligator Reef checklist.xlsx: the spreadsheet version of the checklist.
https://doi.org/10.5281/zenodo.848294

Fishes of Alligator Reef-Starck68.pdf: the OCR-scanned and corrected text plus original images of Starck (1968).
https://doi.org/10.5281/zenodo.848296

Geographic Zone Report for AR.docx: a summary of REEF surveys for Alligator Reef from 1 January 1993 to 7 February 2016.
https://doi.org/10.5281/zenodo.848858

Species Photos.zip: a folder of 323 images of 318 fish species taken by Carlos Estapé and Allison Morgan Estapé in the study area.
https://doi.org/10.5281/zenodo.848289

plus video documentation of *Dasyatis centroura* by Ed Martin (Dasyatis_centroura_EdMartin.m2ts*)*
https://doi.org/10.5281/zenodo.846430

AR-St Croix comparison summary.docx: a summary of shorefish species-list differences between Alligator Reef and St. Croix, from Smith-Vaniz & Jelks (2014).
https://doi.org/10.5281/zenodo.850299

AR-St Croix comparison.xlsx: a table of shorefish species from Alligator Reef vs. St. Croix, from Smith-Vaniz & Jelks (2014).
https://doi.org/10.5281/zenodo.850341

Families w10+ spp at AR StC and Belize.docx: a summary of shorefish species-list differences between Alligator Reef vs. St. Croix, from Smith-Vaniz & Jelks (2014) and the Belize list from 2008.
https://doi.org/10.5281/zenodo.850369

GC-AR fishes summary tables.docx: a summary of shorefish species-list differences between Alligator Reef and the Greater Caribbean from Floeter *et al*. (2008).
https://doi.org/10.5281/zenodo.851611

GreaterCaribbeanSpeciesSpreadsheet.xlsx: a table of the shorefish species list of the Greater Caribbean from Floeter *et al*. (2008) compared to listing from Alligator Reef.
https://doi.org/10.5281/zenodo.851623

Marine fishes of Belize list.docx: a species list of shorefishes from Belize by Marine Fish of Belize (Anon. 2008).
https://doi.org/10.5281/zenodo.851625

Species numbers by country.pdf: a listing of total fish species numbers for locations compiled from http://www.fishbase.us online database.
https://doi.org/10.5281/zenodo.851637

STRI spp. for 0.5º Square for Alligator Reef.xls: a table of the shorefish species list for the square including Alligator Reef from Robertson & Van Tassell (2015) compared to listing from Alligator Reef.

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