Metazoan Parasites of Snappers, Lutjanidae (Pisces) from Puerto Rico

By

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ABSTRACT

A total of 47 species of parasites were collected from 131 specimens of 13 species of fishes of the family Lutjanidae (Pisces). Host specificity was analyzed using the calculated mean intensity from each infection. Sixty-eight new host records, three new family host specificities, and eight new species of parasites are reported. The new species of parasites include one monogenean, three cestode larvae, one nematode and four copepods. Ten species of digenetic trematodes from seven families and eight genera were collected. Ten species of four genera of monogeneans were collected, which include: a new species of *Diplectanum*, three species of *Euryhaliotrema*, five species of *Haliotrema*, and one species of *Microcotyloides*. Three species of cestode larvae: *Bothriocephalus* sp., *Ceratobotrium* sp. and *Nybelina* sp. infected four different species of snappers. Three species of nematodes of three different genera were collected from seven different species of snappers. One nematode of the genus *Cucullanus* is proposed as a new species. One species of Acanthocephala, *Illiosentis ctenorhynchus,* was collected from *Etelis oculatus*. Four leeches of the species *Trachelobdella lubrica,* were collected on the gills of four *Lutjanus griseus* and one on one *Lutjanus jocu.* Sixteen species of copepods were collected including three new species of *Hatschekia* and one *Neobrachiella* sp. Three species of isopods of the genera *Rocinela* and *Gnathia* infected seven species of snappers.

RESUMEN

Un total de 47 especies de parásitos fueron colectados en 131 especimenes de 13 especies de peces de la familia Lutjanidae (Pisces). La especificidad de hospedero fue analizada calculando la intensidad media de cada infección. Sesenta y ocho nuevos registros de hospederidad, tres de hospederidad específica de familia y ocho nuevas especies son reportados. Las nuevas especies incluyen un monogéneo, tres larvas de céstodos, un nemátodo y cuatro copépodos. Diez especies de digéneos de siete familias y ocho géneros fueron coleccionados. Diez especies de cuatro géneros de monogéneos fueron coleccionados. Estos incluyen una nueva especie de *Diplectanum*, tres especies de *Euryhaliotrema*, cinco especies de *Haliotrema*, y una especies de *Microcotyloides*. Tres especies de larvas de céstodos: *Bothriocephalus* sp., *Ceratobotrium* sp. y *Nybelina* sp. infectaron cuatro especies diferentes de pargos. Tres especies de nemátodos de tres géneros fueron coleccionados en siete especies diferentes de pargos. Un nemátodo del género *Cucullanus* se propone como una especie nueva. Una especie de acantocéfalo, *Illiosentis ctenorhynchus* fue coleccionado en *Etelis oculatus*. Cuatro sanguijuelas de la especie *Trachelobdella lubrica*, fueron coleccionados en las agallas de cuatro *Lutjanus griseus* y en un *Lutjanus jocu*. Dieciséis especies de copépodos fueron coleccionados el cual incluye tres nuevas especies de *Hatschekia* y una especie de *Neobrachiella* sp. Tres especies de isópodos de dos géneros, *Rocinela* y *Gnathia* fueron coleccionados en siete especies de pargos.

DEDICATION

I dedicate this thesis to my mother, Rosalía Rodríguez Rivera; without her dedication and sacrifice during my school years and during college I would not had made it. Thank you “Mami”, you are the strongest woman I will ever meet, I hope I inherited your strength.

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INTRODUCTION

Lutjanidae is a family composed of 17 genera and 103 species of mostly reef – dwelling marine fishes known as snappers, and is divided into four subfamilies: *Etelinae,* with five genera: *Aphareus*, *Aprion*, *Etelis*, *Pristipomoides* and *Randallichthys*; *Apsilinae,* with four genera: *Apsilus*, *Lipocheilus*, *Paracaesio* and *Parapristipomoides*; *Paradicichthyinae* with two genera: *Symphorus* and *Symphorichthys*; and *Lutjaninae,* with six genera: *Haplopagrus*, *Macolor*, *Ocyurus*, *Pinjalo*, *Rhomboplite*s, and 65 known species in the genus *Lutjanus* (Allen, 1985). The family is divisible into four discrete geographical faunas: (1) eastern Pacific, (2) Indo-West Pacific, (3) eastern Atlantic and (4) western Atlantic.

The snappers are a large and diverse group of robust-bodied, carnivorous fishes. Most species possess relatively large mouths with stout canine teeth and bodies covered with relatively large coarse scales (Amesbury and Myers, 2001). Snappers, in general, feed heavily on crustaceans; the larger species eat mostly fishes. The lutjanids are usually benthic, and many are primarily noctural in habits (Randall, 1968).

Lutjanids are considered an important component of the local artisanal catch throughtout their geographical distribution. These fishes are captured by a variety of methods including handlines, traps, various types of nets, and trawling gear (Allen, 1985). Large snappers are popular eating, but are not caught in the same quantities as the smaller species because of their solitary habits and territorial behavior. In the western Atlantic and Australia, the larger species of snappers, mostly from the genus *Lutjanus,* are sought after by recreational anglers (Allen, 1885). The total commercial catch of

Lutjanidae reported from the western central Atlantic from 1995 to 1999 ranged from 10,588 to 16,413 t. (Carpenter, 2002). Some species of snapper of the genus *Lutjanus* are believed to cause ciguatera poisoning by feeding on herbivorous fishes that eat a dinoflagellate found in dead coral or benthic algae (Allen, 1985).

Parasites affect marine fishes by making them commercially less valuable and probably limiting their populations; some fish parasites may be transmitted to man (Rhode, 1982). Few studies of the community structure of parasites attacking fishes of the family Lutjanidae have been done, which include the grey snapper in the Florida Keys (Schroeder, 1971) and studies in Australia (Whitington and Kearn, 1993). Most previous works did not concentrate on parasites of snappers, but included them in surveys of marine fish parasites or in studies of specific groups of parasites.

The main purpose of this investigation was to identify the parasites of fishes of the family Lutjanidae from Puerto Rico; to compare the parasite fauna with that reported in the literature and to report possible new host and locality records. The groups of parasites included are: Digenea, Cestoda, Acanthocephala, Nematoda, and Crustacea. One hundred and thirty-one specimens of lutjanids were examined from different localities in Puerto Rico.

Table 1.- Species of Snappers reported from Puerto Rico.

Species of Snapper	FAO Common Names[1]
Apsilus dentatus Guichenot, 1853	Black snapper
Etelis oculatus (Valenciennes, 1828)	Queen snapper
Lutjanus analis (Cuvier, 1828)	Mutton snapper
Lutjanus apodus (Walbaum, 1792)	Schoolmaster snapper
Lutjanus buccanella (Cuvier, 1828)	Blackfin snapper
Lutjanus cyanopterus (Poey, 1860)	Cubera snapper
Lutjanus griseus (Linnaeus, 1758)	Gray snapper
Lutjanus jocu (Bloch and Schneider, 1801)	Dog snapper
Lutjanus mahogoni (Cuvier, 1828)	Mahogany snapper
Lutjanus purpureus (Poey, 1866)	Southern red snapper
Lutjanus synagris (Linnaeus, 1758)	Lane snapper
Lutjanus vivanus (Cuvier, 1828)	Silk snapper
Ocyurus chrysurus (Bloch, 1791)	Yellowtail snapper
Pristipomoides aquilonaris (Goode and Bean, 1896)	Wenchman
Pristipomoides macrophthalmus (Müller and Troschel, 1898)	Cardinal snapper
Rhomboplites aurorubens (Cuvier, 1829)	Vermilion snapper

[1] FAO Common Names are taken from Food and Agriculture Organization of the United Nations. Species Catalogue Vol.6 Snappers of the world.

Table 2.- Common names of Snappers used in Puerto Rico.

Species of Snapper	Common Names used in Puerto Rico
Apsilus dentatus Guichenot, 1853	Chopa negra
Etelis oculatus (Valenciennes, 1828)	Cartucho
	Cachucho
Lutjanus analis (Cuvier, 1828)	Sama
Lutjanus apodus (Walbaum, 1792)	Pargo rubio (La Parguera)
	Pargo amarillo
	Cají (Mayagüez)
Lutjanus buccanella (Cuvier, 1828)	Alinegra
	Negra
Lutjanus cyanopterus (Poey, 1860)	Pargo guacinuco (San Juan)
	Pargo mulato (La Parguera)
Lutjanus griseus (Linnaeus, 1758)	Pargo prieto
Lutjanus jocu (Bloch and Schneider, 1801)	Pargo colorado
	Pargo sama (La Parguera)
Lutjanus mahogoni (Cuvier, 1828)	Rayado de yerba
Lutjanus synagris (Linnaeus, 1758)	Arrayado
	Rayado (South coast)
	Manchego (North coast)
Lutjanus vivanus (Cuvier, 1828)	Chillo
	Colorado
Ocyurus chrysurus (Bloch, 1791)	Colirubia
	Rabirrubia
Pristipomoides aquilonaris (Goode and Bean, 1896)	Muniama
Pristipomoides macrophthalmus (Müller and Troschel, 1898)	Muniama de afuera
Rhomboplites aurorubens (Cuvier, 1829)	Tunaro (La Parguera)
	Besugo (San Juan)
	Buchona (Guayanilla)
	Rubí (Cabo Rojo-Aguadilla)
	Sardo (Quebradilla)
	Cagón de lo Alto (Cuba)

[1] Common Names are taken from Erdman 1987.

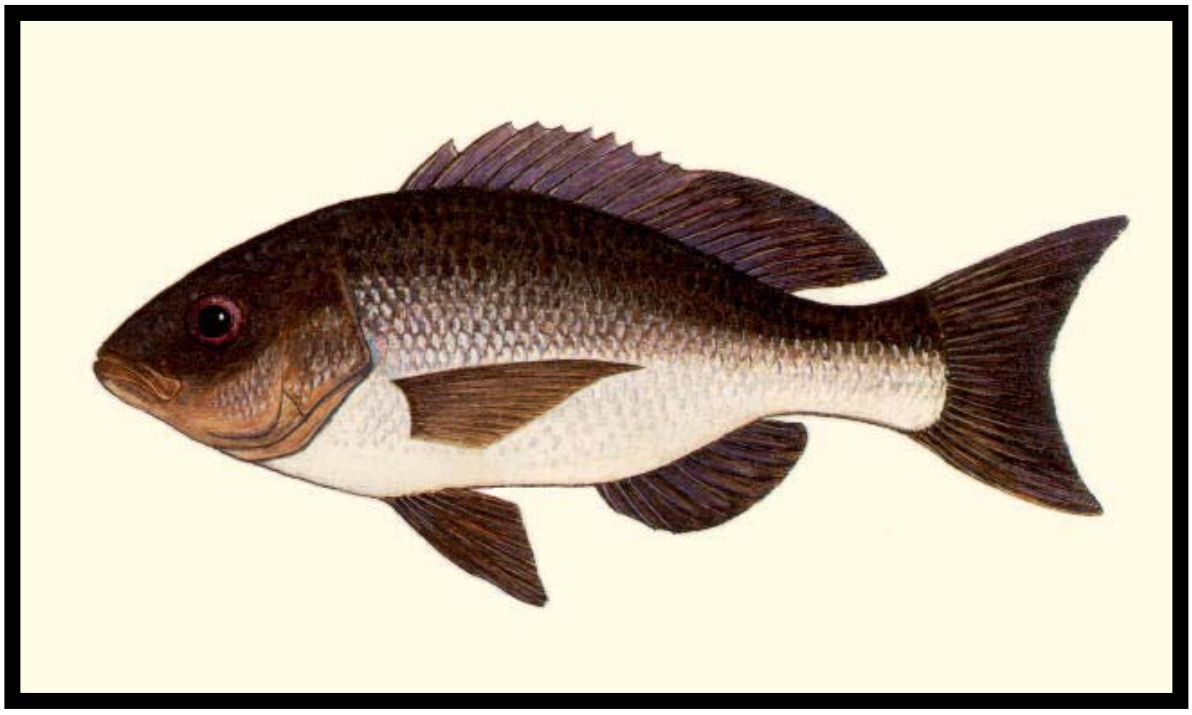
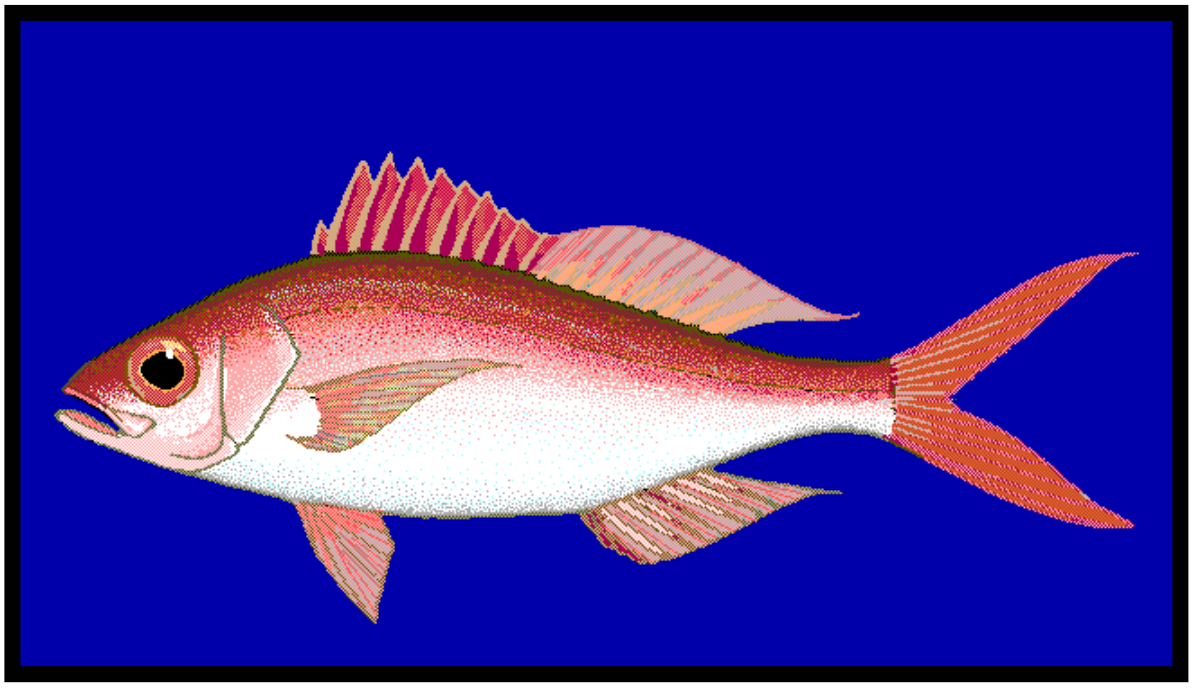


Figure 1. *Apsilus dentatus*. Froese and Pauly (2003)



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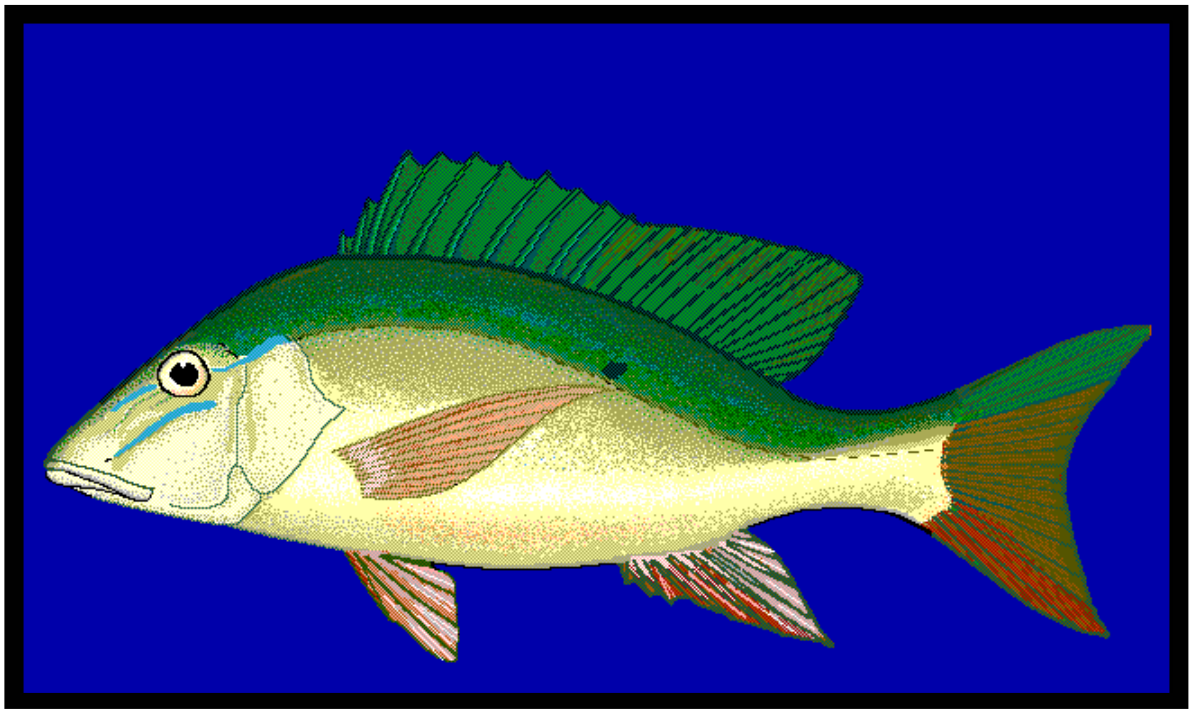
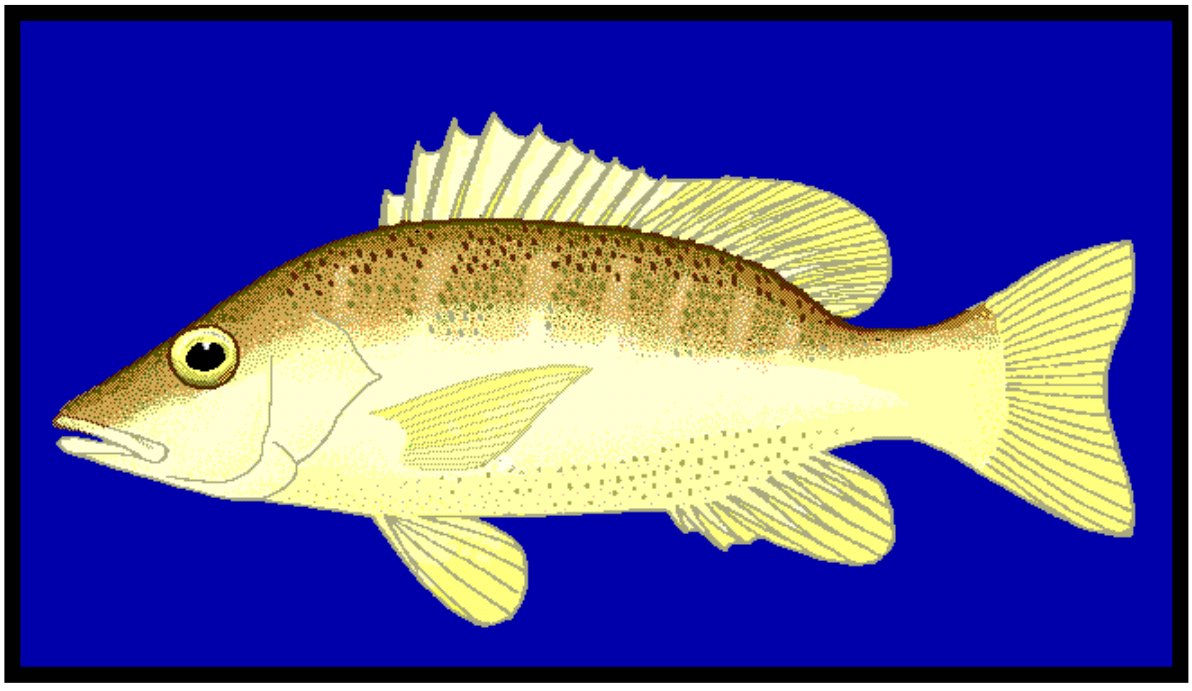


Figure 3. *Lutjanus analis*. Froese and Pauly (2003)



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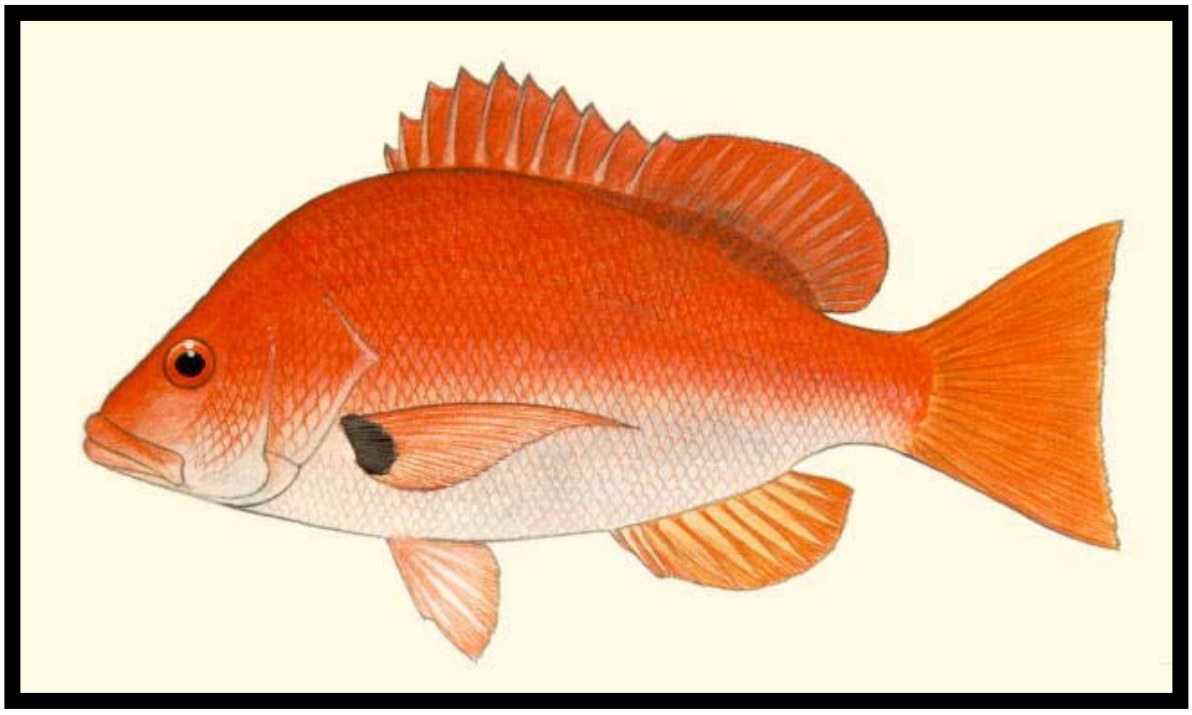

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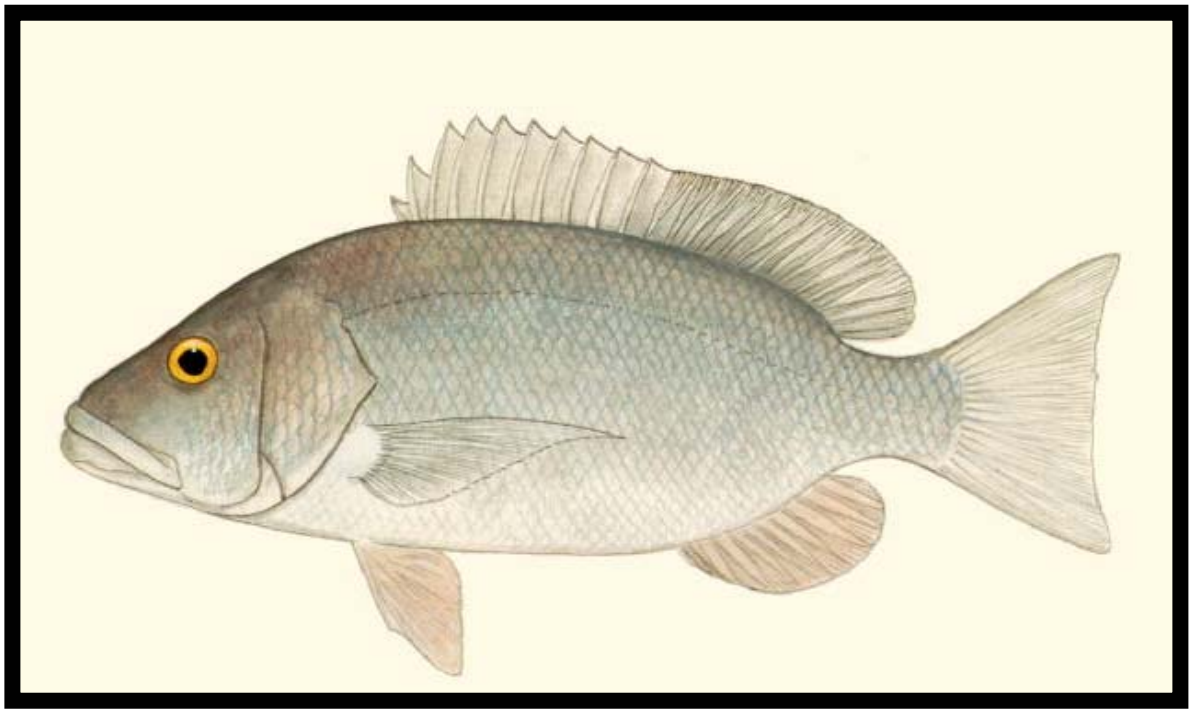


Figure 6. *Lutjanus cyanopterus***.** Froese and Pauly (2003)

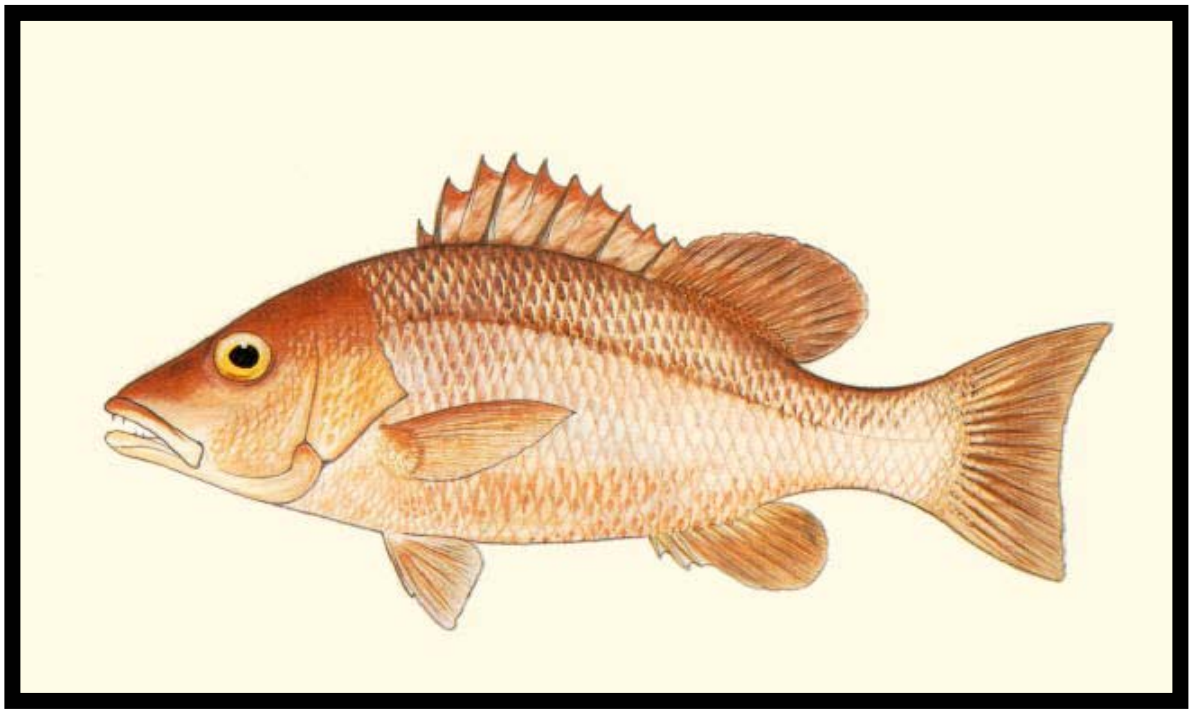
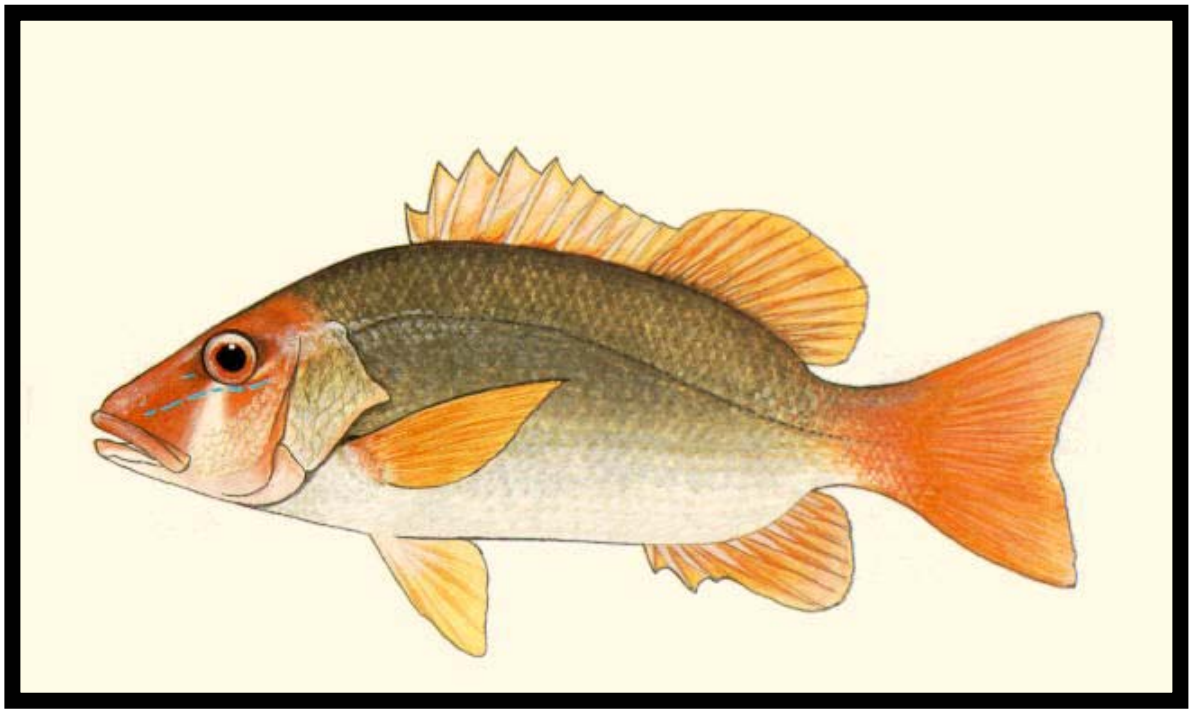


Figure 7. *Lutjanus griseus***.** Froese and Pauly (2003)



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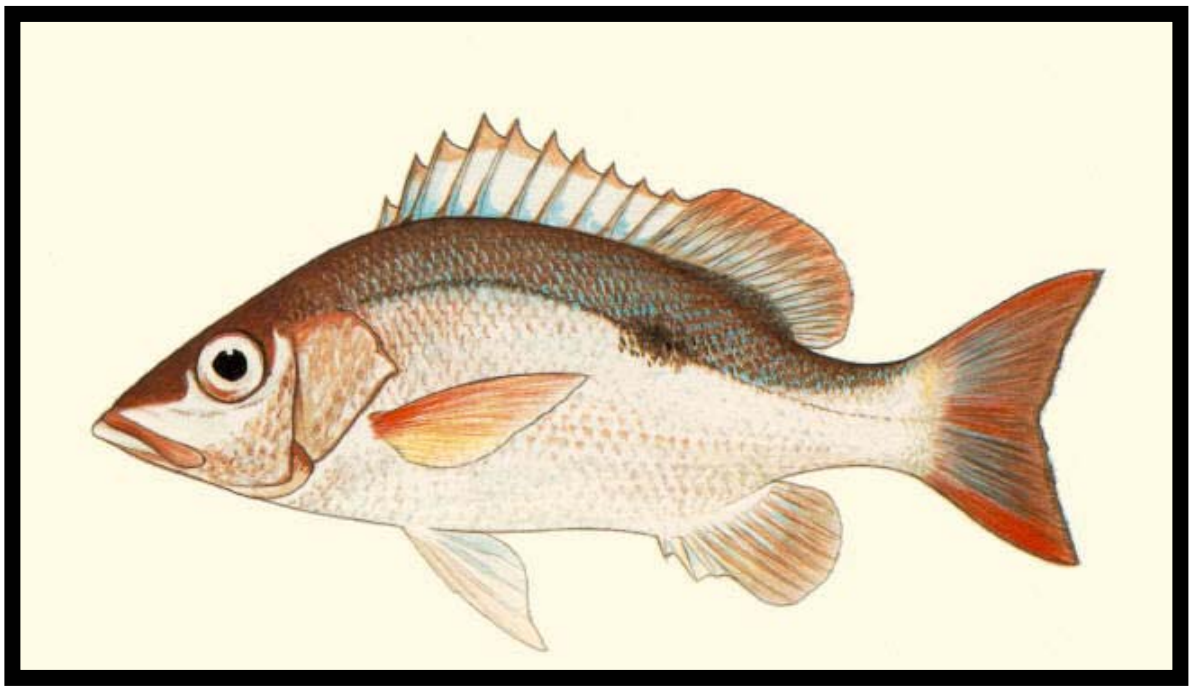

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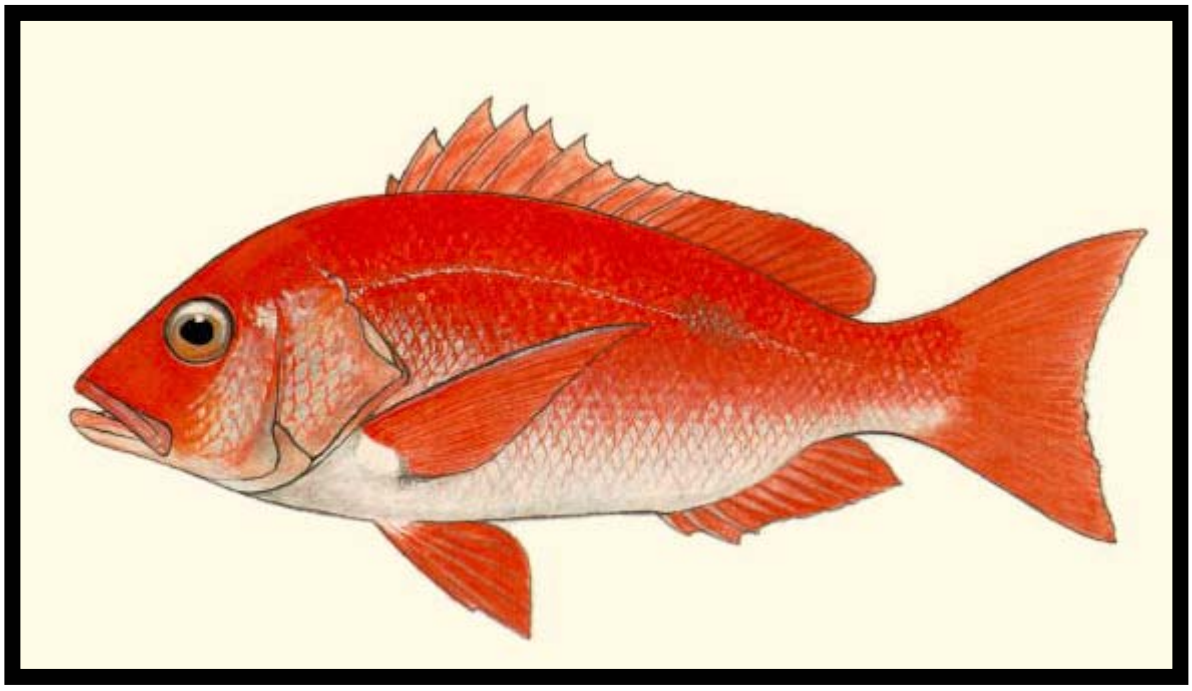


F**igure 10.** *Lutjanus purpureus***.** Froese and Pauly (2003)

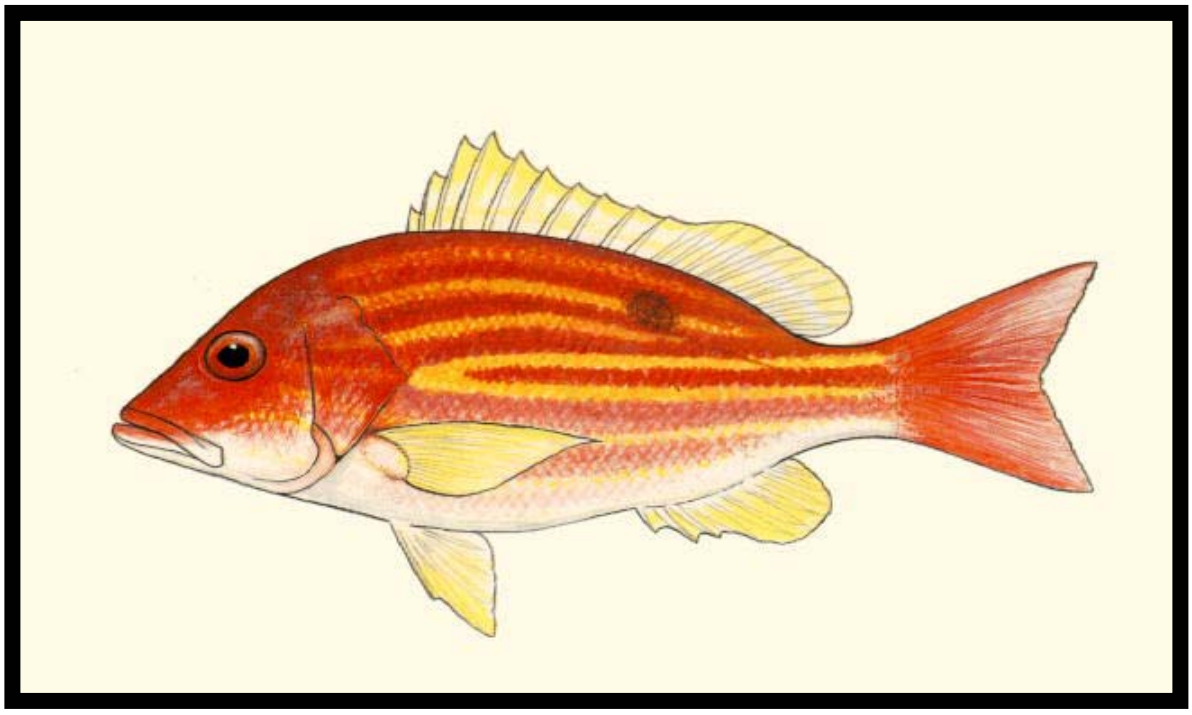
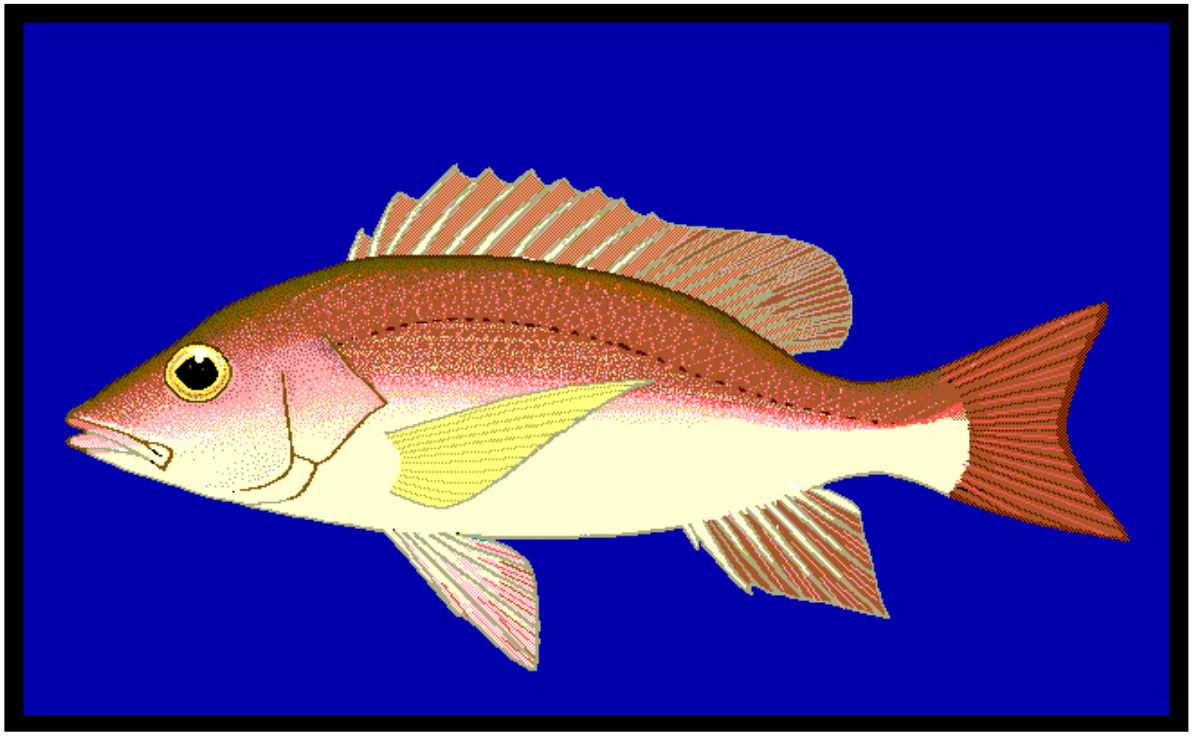


Figure 11. *Lutjanus synagris***.** Froese and Pauly (2003)



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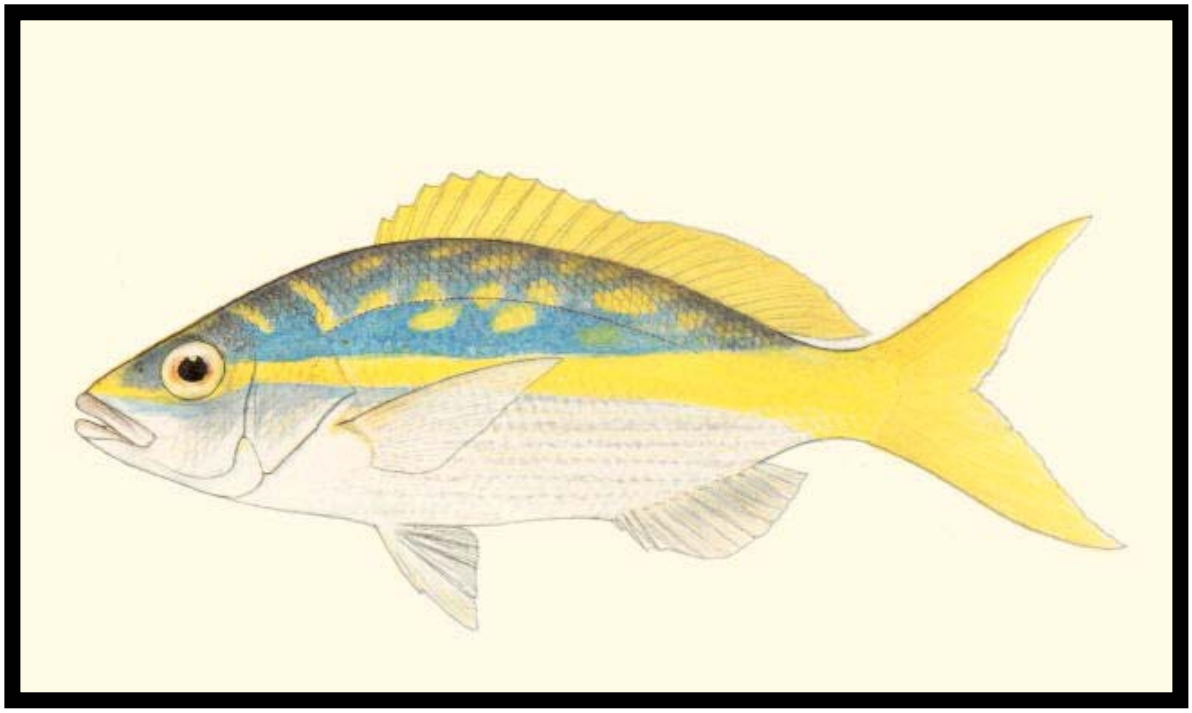

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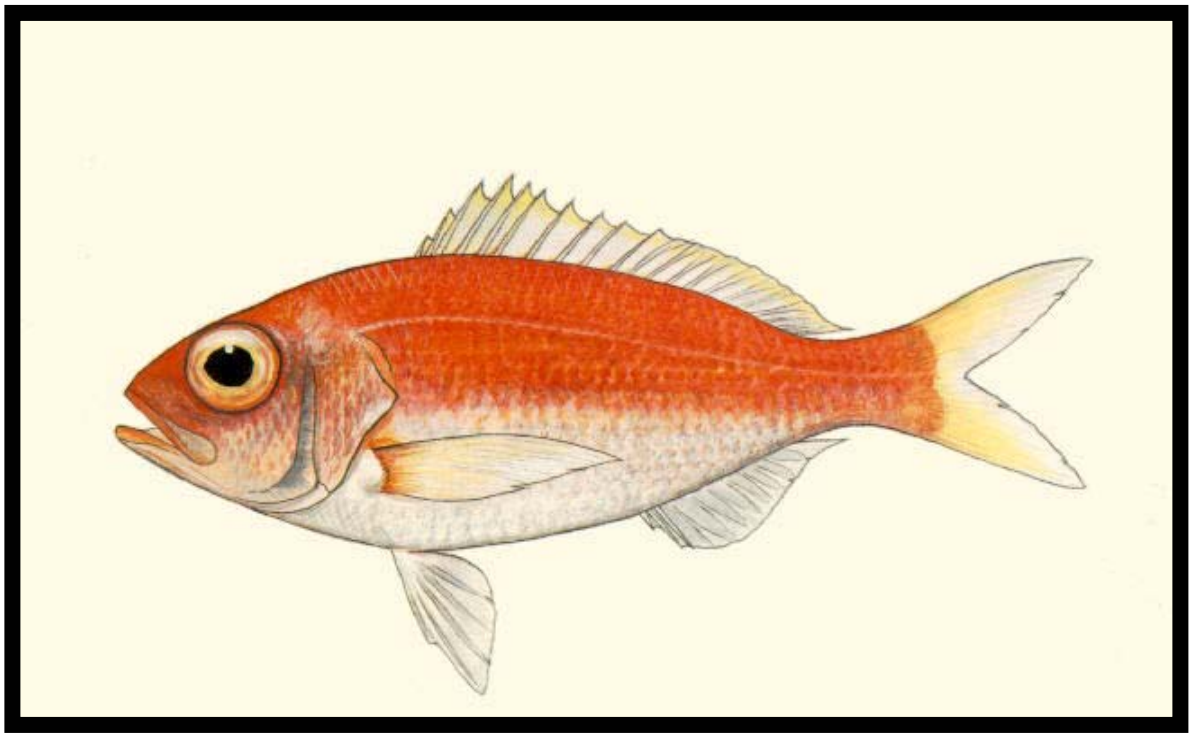

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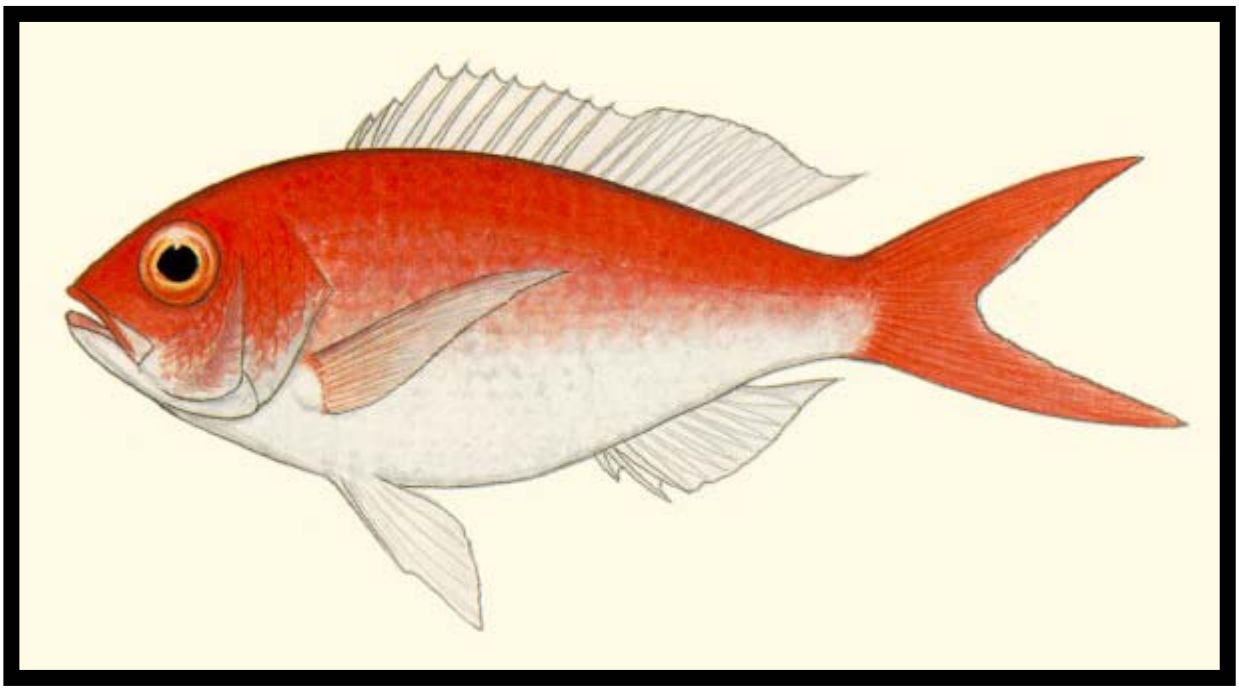

Figure 15. *Pristipomoides macrophthalmus***.** Froese and Pauly (2003)

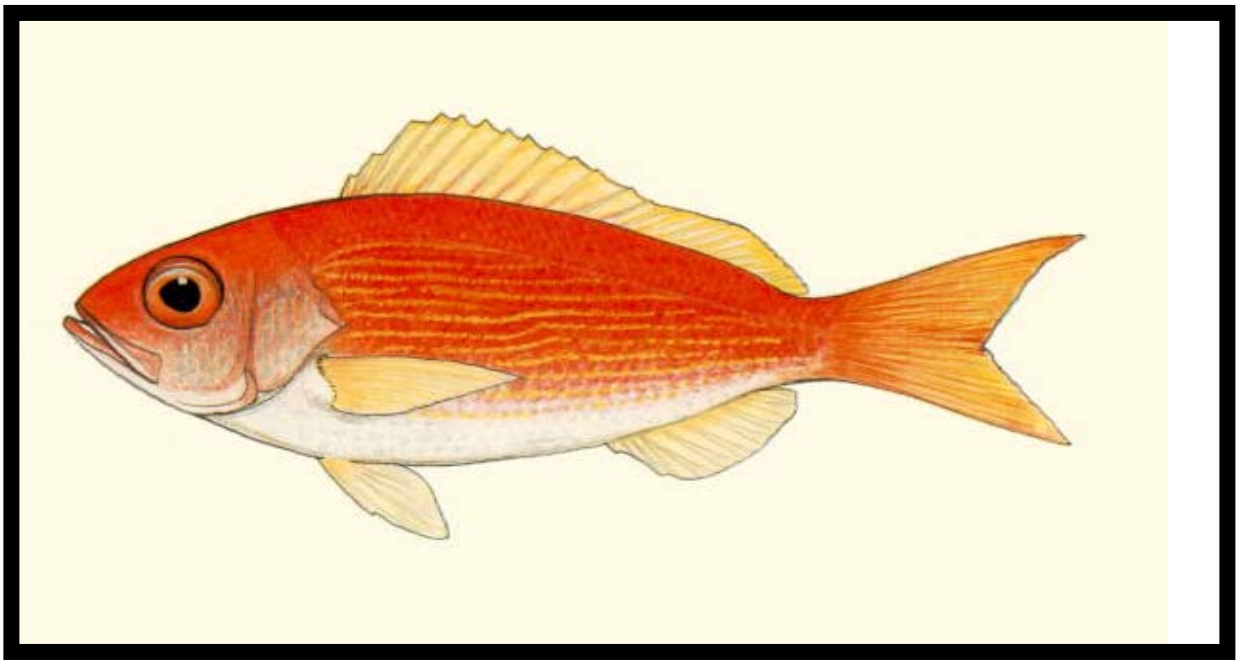

Figure 16. *Rhomboplites aurorubens***.** Froese and Pauly (2003)

LITERATURE REVIEW

Lutjanids have been reported with many species of metazoan parasites (Table 3). In this review, I will consider each group: monogeneans, digeneans, acanthocephalans, nematodes, cestodes, and crustaceans, separately.

Protozoa

Protozoa are complex, unicellular, microscopic organisms with lifestyles ranging from free-living through various forms of commensalism to parasites inhabiting animals, plants, and even other protozoans (Williams and Bunkley-Williams, 1996). Williams and Bunkley-Williams (1996) reported *Brooklynella hostilis* Lom and Nigrelli, 1970 infecting all lutjanids they examined. Saunders (1958a,b;1966) reported *Haemogregamia bigemina* Laveran and Mesnil, 1901 on snappers from Bahamas, Florida and Puerto Rico (Table 3).

Udonellidea

These represent a class of flatworms that parasitizes parasitic copepods, which in turn parasitizes fishes (Williams and Bunkley-Williams, 1996). The copepod worm, *Udonella caligorum* Johnson, 1835 was reported by Linton (1910) and Manter (1954) on *Lutjanus griseus* from Florida. Williams and Bunkley-Williams (1996) reported it on *L. jocu* from Puerto Rico.

Digenea

Digeneans, commonly known as flukes, are members of the Subclass Digenea, Class Trematoda, and Phylum Platyhelminthes. They are among the most common and abundant parasitic worms, second only to nematodes in their distribution (Roberts and

Janovy, 2000). Flukes are important fish parasites with fishes serving both as intermediate and final hosts (Williams and Bunkley-Williams, 1996). Because of their importance, the digeneans have stimulated vast amounts of research, and the literature on the group is immense (Roberts and Janovy, 2000).The digenetic trematodes of marine fishes constitute a large group of parasites that have been studied intensively in only a few regions (Siddiqi and Cable, 1960; Vélez, 1987).

Linton (1907; 1910) was the first to describe and report digenetic trematodes infecting snappers from Bermuda and Dry Tortugas, Florida (Table 3). McCoy (1929) infected experimentally with cysts of *Hamacreadium mutabile* specimens of the gray snapper, *Lutjanus griseus,* which then developed into adult worms in the intestine and pyloric caeca. The purpose of his investigation was to determine its life history. Pérez-Vigueras (1940) described *Prosogonotrema bilabiatum* collected on *Ocyurus chrysurus* from Cuba. Manter (1947) also reported digenetic trematodes of seven species of snappers (Table 3) from Dry Tortugas, Florida. His intention was to provide a complete list and a few corrections in the names of hosts from previeus works done on fish digenetic trematodes. Sogandares-Bernal (1959) described and reported digenetic trematodes infecting snappers from Bahamas and Panama (Table 3). Sogandares-Bernal and Hutton (1960) reported *Lepocreadium trulla* on *O. chrysurus* from Bahamas. Siddiqi and Cable (1960) reported and described digenetic trematodes found in marine fishes from Puerto Rico, including fishes in the family Lutjanidae (Table 3), where the fish trematodes had previously received no attention. Nahhas and Cable (1964) made additional reports on digenetic trematodes of the Caribbean examining and collecting flukes from 10 species of snappers from Jamaica and Curaçao (Table 3). Overstreet

(1969) reported 111 species of Digenea from 69 of 113 species of fishes including five species of snappers (Table 3) from Biscayne Bay, Florida. Schroeder (1971) collected nine species of trematodes (Table 3), representing three families, from the intestine and pyloric caeca of *L. griseus*, the gray snapper, collected near Lower Matecumbe Key, Florida. They concluded that fish moving from one habitat to another take parasites with them. In the new habitat, the original parasites are gradually lost and new ones, typical of the new habitat, are acquired. Fischthal and Nasir (1974) reported digenea infecting snappers from Venezuela and Fischthal (1977) from Belize (Table 3). Dyer *et al.* (1985) reported additional digenetic trematodes of Puerto Rican marine fishes (Table 3) and updated the work of Siddiqi and Cable (1960). This study was a follow-up, specially in an attempt to examine additional fishes reported earlier as negative (Dyer *et al*. 1992). Nahhas and Carlson (1994) reported *Lepocreadium trulla* and *Sterrhurus musculus* Looss, 1907 on *O. chrysurus* from Jamaica.

A recent paper by Dyer *et al*. (1998) reports the results of examination of 55 fishes of 24 species including five species of digenean (Table 3) from *L. apodus, L. griseus, L. synagris,* and *O. chrysurus*. Vélez (1987; 1999) reported 14 species of digenetic trematodes (Table 3), and made a comparison of the trematode fauna of snappers from the north coast of Colombia with the fauna of the Caribbean, finding similar species of trematodes in the two regions. Vélez (1999) described a new species of digenean in the genus *Pseudacaenodera* (Acanthocolpidae) from *L. synagris*. Bunkley-Williams *et al*. (1996) collected 37 digenean and aspidogastrid species (six identified only to genus) from 37 fish species in 16 families during surveys to determine fish health and the biology of Caribbean fish parasites. They studied three species of

snappers of the genus *Lutjanus,* and the parasites reported are listed in Table 3. Bray and Cribb (1996) worked with flukes from the genus *Preptetos* and *Neopreptetos* (Digenea: Lepocreadiidae) from Australian marine fishes. They compared their new genus with the trematode *Lepocreadium trulla* (Linton, 1907) from the yellowtail snapper, *O. chrysurus* and considered that features of *Lepocreadium trulla,* such as the excretory system and the three lobed ovary, are characteristic of the genus *Preptetos*, arguring that it should be reassigned to the genus *Preptetos.* Some specimens of digenetic trematodes collected on snappers were deposited in the US Parasite Collection and Manter's Museum and these records were not published.

Monogenea

Monogenea, commonly known as gill worms, is a class in the Phylum Platyhelminthes. Most species are ectoparasitic on the gill filaments of their fish hosts, but some are ectoparasitic on fins, body surfaces, in the nostrils, and buccal cavity. Others are endoparasitic in the esophagus, cloaca, urinary tract, and the heart (Hendrix, 1994). In heavy infections, they can kill captive fishes and occasionally wild ones (Williams and Bunkley-Williams, 1996). Because many host species have not yet been examined for these helminths, much remains to be done to expand both geographic ranges and host records for Monogenea (Hendrix, 1994).

Little work on snapper monogeneans had been done until recently. Even Yamaguti (1963b) only reports three species of monogeneans from snappers and none were from the species included in the present study. MacCallum (1917) reported *Echinopelma neomaenis* from *Lutjanus analis* and Manter (1954) collected it from *L. analis* and *L. griseus* from Florida. Pritchard deposited in the Manter Museum

specimens of *Epibdella* sp. collected on *Ocyurus chrysurus* from Bermuda. Zhukov (1976) described 10 new species of gill worms of the genus *Haliotrema* (Table 3) collected from the gills of eight species of snappers found in Cuba and the Gulf of Mexico. Kritsky and Boeger (2002) proposed a new genus, *Euryhaliotrema,* based on one common characteristic found in several species of *Haliotrema*. They relocated five species of *Haliotrema* (Table 3) described by Zhukov, 1976 to the genus *Euryhaliotrema* based on a bulbous base of the copulatory organ.

Linton (1910) described *Microcotyle incisa* collected from *L. griseus* from Dry Tortugas, Florida. Fujii (1944) relocated *Microcotyle incisa* to the genus *Microcotyloides* based on differences found on the position of the vaginal pore and male terminal organs in Linton's (1910) description. Hernández-Vale (2003) made comparison between Linton's (1910) description and Fujii's (1944) relocation of this species of monogenea and made her own observations finding three cephalic glands and four cuticular pieces in the cirrus pouch that were not mentioned in previous descriptions. Williams and Bunkley-Williams deposited in the US Parasite Collection Museum specimens of *M. incisa* collected from *L. apodus* from Puerto Rico. Wilson deposited *Microcotyle* sp. collected on *O. chrysurus* from Jamaica. Jahn and Kuhn (1932), Gallet de S. A. *et al.* (1990), and Müller and Watanabe (1994) reported *Neobenedenia melleni* (MacCallum, 1927) on different species of snappers from Bahamas, Florida and Puerto Rico (Table 3).

Cestoda

Tapeworms are parasites of the Class Cestoidea, Phylum Platyhelminthes. Nearly every species of vertebrate is a host to one or more species of tapeworms (Schmidt, 1986). Two life-cycle stages are represented in fishes: adults inhabit the intestine and pyloric caeca; and plerocercoids of the same or different species are found in the viscerae and musculature (Hoffman, 1999). Tapeworms can reduce growth and affect reproductive success of fishes (Williams and Bunkley-Williams, 1996).

Linton (1908) reported *Callotetrarhynchus gracilis* (Linton, 1899) from *Lutjanus griseus* and *Ocyurus chrysurus* from Florida; other specimens were collected and deposited in the US Parasite museum by MacCallum from *L. analis* and *O. chrysurus*. MacCallum also deposited specimens of *Otobotrium dipsacum* Linton, 1897 collected from *L. analis* and *O. chrysurus*. Linton (1908) described *Ryncobarium speciosum* on *L. griseus* from Dry Tortugas, Florida. MacCallum (1917) described *Rynchobothrium brevibothrium* collected on *L. analis* and *L. griseus* and *Tetrarhynchus brevibothria* collected on *L. analis* from Florida. MacCallum also deposited in the U S Parasite Collection museum several species of cestodes infecting snappers from Florida (Table 3). Brownell and Rainey (1971) reported pleurocercoid larvae from two snappers (Table 3). Recently, Campbell and Beveridge (1996) reported *Pterobothrium heteracanthum* Diesing, 1850 on *O. chrysurus* from Florida.

Nematoda

Nematodes are roundworms from the Phylum Nematoda and are found in marine, freshwater, and terrestrial habitats. Nematodes are among the most abundant

animals on earth (Roberts and Janovy, 2000). Most roundworms in fishes are similar in shape. None of the roundworms found in Puerto Rican fishes are known to normally infect humans (Williams and Bunkley-Williams, 1996).

Linton (1907) in his notes on parasites of Bermuda fishes reports three species of nematodes infecting only *Lutjanus griseus* (Table 3). Barreto (1922) described *Dichelyne lintoni* (Barreto, 1922) in *L. griseus* from North Carolina.Chandler (1935) described *Raphidascaris anchoviellae* collected on *Ocyurus chrysurus* from Texas. Olsen (1952) described *Raphidascaris anchoviellae* on *L. analis* from Florida. Ress (1970) reported *Phlometra* sp. in *L. griseus* from Bermuda. Williams (1983) reported new host records for some nematode parasites of fishes from Alabama and adjacent waters. He collected and reported new host records of *Spirocamallanus cricotus* Fusco and Overstreet from *L. griseus* and *L. apodus*. Recently, González-Solis *et al.* (2002) described *Dichelyne bonacii* on *L. griseus* from Mexico. Some specimens were deposited in the US Parasite Collection Museum by MacCallum. These collections are listed on Table 3.

Acanthocephala

Acanthocephala comprise a small phylum of parasites. These worms are commonly known as spiny-headed worms. Big game fishes are final hosts for a few spiny-headed worms and are sometimes infected by larval stages of marine mammal spiny headed worms (Williams and Bunkley-Williams, 1996). Compared with parasitic platyhelminthes or nematodes, they are fairly rare (Roberts and Janovy, 2000). Linton (1907) described *Gorgorhynchus medius* on *L. griseus* and *O. chrysurus* from Bermuda.

Linton (1908) reported it on *L. griseus* from Florida. Cable and Linderoth (1963) reported *Gorgorhynchus clavatus* Van Cleave, 1940 in *L. jocu* from Jamaica. Golvan (1969) described *Gorgorhynchus cablei* collected from *L. jocu* from Jamaica. Cable and Mafarachisi (1970) described *Gorgorhynchus bullocki* collected from *L. griseus* from Florida.

Hirudinea

Leeches form a class of segmented worms or annelids that can be found in aquatic or humid terrestrial habitats around the world except in Antarctica. The parasitic form feeds on the blood of crustaceans, fishes, amphibians, reptiles, and mammals (Williams and Bunkley-Williams, 1996). Williams (1982) reported *Tracelobdella lubrica* (Grube, 1840) on *Lutjanus cyanopterus* from Puerto Rico. Recently, Williams *et al.* (1994) reported it on *L. apodus* and *L. synagris* from Puerto Rico.

Crustacea

Copepoda

Copepods are members of the Phylum Arthropoda, Subphylum Crustacea. They are found in marine and fresh water habitats. Most are freeliving and are very important food items for a variety of aquatic life. As fish parasites, they frequently occur on the gills or skin, but highly specialized species burrow into the flesh or head sinuses, or crawl into the nose (nares or nasal fossae or lamellae) or eyes (orbits) (Williams and Bunkley-Williams, 1996).

Wilson (1913) described three species of parasitic copepods from *Lutjanus* sp., *L. synagris* and *Ocyurus chrysurus* from Jamaica (Table 3). Wilson (1935) also reported *Caligus irritans* on *L. griseus* from Florida. Bere (1936) reported *Caligus bonito* Wilson, *Lernanthropus spiculatus* Wilson, and *Lernanthropus kroyeri* Van Beneden, 1851 on *L. griseus* from the Gulf of Mexico. He also described *Caligus praetextus* from *L. synagris*. Pearse (1951) made additional reports of copepods of the genera *Hatschekia* and *Lernanthropus* infecting *L. griseus*, *L. apodus*, and *L. analis* from Bahamas (Table 3). Causey (1960) reported *Hatschekia oblonga* Wilson 1913 parasitizing the yellowtail snapper, *O. chrysurus*. Bashirullah (1975) examined 263 *L. griseus* from Cubagua Island, Venezuela. Fifty-four *L. griseus* were infected with a new species of the genus *Lernaeolophus.* The copepod reported resembles *Lernaeolophus recurvus* Wilson, 1913, and represents a new geographical distribution record. *Caligus* Müller 1785 is the largest genus of parasitic copepods, containing more than 250 species (Ho *et al*., 2000). Steele (1982) collected and reported the parasitic copepods that parasitized nine species of snappers from Puerto Rico and other adjacent areas of the Caribbean. Cressey and Nutter (1987) reported *Caligus atromaculatus* on *L. griseus*. Cressey (1991) worked with the parasitic copepods from the Gulf of Mexico and Caribbean Sea and revised the circumglobal genus *Caligus*. Most of the collections reported in the research were collected from the west coast of Florida and Carrie Bow Cay, Belize. The copepods reported by Cressey (1991) are listed in Table 3. Bunkley-Williams and Williams (1994; 1995) reported *Caligus irritans* Heller in *L. griseus* from Cabo Rojo, Puerto Rico, and made additional host records for the Caribbean. Williams and Bunkley-Williams (1996)

reported *Caligus bonito* on *L. griseus* and *L. jocu* from Puerto Rico. They also deposited specimens in the US Parasite Collection Museum, which are listed in Table 3.

Brachiura

Fish lices form a small subclass of crustaceans and can be very harmful to fishes. They are the only crustacean fish parasites known to infect humans (Williams and Bunkley-Williams, 1995). Linton (1910) reported *Argulus* sp. on *Lutjanus griseus* from Dry Tortugas, Florida. *Argulus* spp. can penetrate, survive in, and cause diseases in human (Williams and Bunkley-Williams, 1995).

Pentastoma

These strange animals form a small phylum which parasitized dinosaurs and can infect humans. They have five projections which resembles fingers that sustain their four legs and in some species a mouth (Bunkley-Williams and Williams, 1995). MacCallum deposited in the US Parasite Collection Museum the tongeworm *Linguatula* sp. collected on *L. griseus* from Florida.

Isopoda

Isopods are mostly free-living crustaceans, but also parasitize fishes, crabs, shrimp and other isopods, attaching in a variety of locations including the skin, gills, inside the mouth, on the fins and some even burrow under the skin to form a cyst in the flanks of fish (Williams and Bunkley-Williams, 1996). Approximately 4000 species of

isopods have been described. More than 450 species are known to be associated with fishes.

Yeatman (1957), in his redescription of two parasitic copepods from Bermuda, mentions the isopod *Exocirolana mayana* Ives infecting *Lutjanus griseus*. Williams and Bunkley-Williams (1977) reported six species of isopods from five species of snappers from Puerto Rico and adjacent waters (Table 3). An investigation by Weinstein and Heck (1977) demonstrated that the isopod *Cymothoa excisa* was found to occur on 4.7% of *L. synagris*, 10.5% of *L. analis*, and 2.1% of *Ocyurus chrysurus* collected from the Caribbean coast of Panama. Kensley and Schotte (1989) created a guide to the marine isopod crustaceans of the Caribbean. They reported *Rocinela signata* Schioedte and Meinert, 1879 from *L. analis,* and *L. buccanella*, and the isopod *Cymothoa excisa* Perty, 1833 from 4 species of snappers (Table 3). Williams *et al.* (1994) reported *Cymothoa excisa* located in the mouth of *L. synagris* and *O. chrysurus* from Cartagena, Colombia. Bunkley-Williams *et al.* (1998) reported *R. signata* located in the gills of *L. analis*, and *C. exsisa* in the mouth of *L. analis* and *L. griseus* from Venezuela.

Diseases

Fishes can be affected by other diseases caused by bacteria, virus and tumors. Lucké (1942) and Starck (1971) reported neurofibromas on *Lutjanus griseus* from Florida. Starck (1971) also found *L. griseus* infected with Black-spot Disease. Thouard *et al.* (1990) mentioned nutritional disease that affected five species of snappers from Martinique (Table, 3). Bunkley-Williams and Williams (1994) reported infection with *Vibrio* sp. affecting *L. griseus* of Puerto Rico. Recently, Williams *et al.* (2000) reported

neurofibromas on *L. griseus* from Bermuda and Williams and Bunkley-Williams (2000) reported Slime-botch Disease infecting all lutjanids from the West Indies.

Table 3. Parasites and diseases of Lutjanids occurring in the Caribbean.

Protozoa – single-celled organisms

	Brooklynella hostilis Lom & Nigrelli, 1970	
all lutjanids	West Indies	Williams & Bunkley-W. 2000
	Haemogregamia bigemina Laveran and Mesnil, 1901	
L. analis	Puerto Rico	Saunders 1966
L. griseus	Florida	Saunders 1958a
L. synagris	Bahamas	Saunders 1958b
	Florida	Saunders 1958a
O. chrysurus	Bahamas	Saunders 1958b
	Florida	Saunders 1958a
	Puerto Rico	Saunders 1966

Udonellidea – copepod worm

	Udonella caligorum Johnson, 1835	
L. griseus	Florida	Linton 1910; Manter 1954
L. jocu	Puerto Rico	Williams & Bunkley-W. 1996

Digenea – flukes

	Allogasolena atenuata Siddiqi & Cable, 1960	
L. apodus	Puerto Rico	Siddiqi & Cable 1960
	Apocreadium foliatum (Siddiqi & Cable, 1960)	
L. analis	Puerto Rico	Siddiqi & Cable 1960
L. apodus	Florida	Overstreet 1969
	Puerto Rico	Dyer *et al.* 1992
L. mahogani	Curaçao	Nahhas & Cable 1964
	Aponurus laguncula (Looss, 1907)	
L. purpureus	Colombia	Vélez 1987
L. synagris	Colombia	Vélez 1987
O. chrysurus	Florida	Manter 1947
	Brachyphallus parvus (Manter, 1947)	
L. apodus	Puerto Rico	Dyer *et al.* 1985
	Cainocreadium gulella (Linton, 1910)	
L. analis	Florida	Manter 1947; McCoy 1930
L. griseus	Florida	Linton 1910; Manter 1947; McCoy 1930; Schroeder 1971
O. chrysurus	Florida	McCoy 1930
L. synagris	Colombia	Vélez 1987
	***Cyclocoelum* sp**.	
L. apodus	Florida	McCollum (US 36248)
	***Deontacylix* sp.**	
L. synagris	Bahamas	Sogandares-B. (MM 44283)
	Deretrema fusillus Linton, 1910	
O. chrysurus	Florida	Linton, 1910; Manter, 1947
	Bermuda	Pritchard, M. L. (MM 1116)
	Diplangus anoplosus Siddiqi & Cable, 1960	
O. chrysurus	Puerto Rico	Siddiqi & Cable 1960
	***Distomum* sp.**	
O. chrysurus	Florida	MacCallum (US 36092)
L. jocu	Florida	MacCallum (US 036371)
L. synagris	Florida	MacCallum (US 35145)

	Distomum synagris	
L. synagris	Florida	MacCallum (US 36251, 036271)
	Echinostoma hispidum	
L. synagris	Florida	MacCallum (US 36275)
	Ectenurus virgule Linton, 1910	
L. synagris	Belize	Fischthal 1977
	Fasciola griseus	
L. griseus	Florida	MacCallum (US 36149)
	Fasciola neomensis	
L. jocu	Florida	MacCallum (US 36381)
	Hamacreadium confusum Overstreet, 1969	
O. chrysurus	Florida	Overstreet 1969
	Jamaica	Nahhas & Carlson 1994
	Hamacreadium mutabile Linton, 1910	
L. analis	Florida	Manter 1947; Manter 1954[sic]
	Puerto Rico	Siddiqi & Cable 1960
L. apodus	Belize	Fischthal 1977
	Florida	Linton 1910; Manter 1947
	Jamaica	Nahhas & Carlson 1994; Nahhas & Cable 1964
	Puerto Rico	Dyer *et al.* 1998
L. griseus	Bahamas	Sogandares-B. (MM 22519)
	Belize	Fischthal 1977
	Florida	Linton 1910; Manter 1947; McCoy 1929, 1930; Overstreet 1969; Schroeder 1971
	Jamaica	Nahhas & Cable 1964
	Puerto Rico	Siddiqi & Cable 1960; Dyer *et al.* 1985, 1992, 1998
L. jocu	Florida	Manter 1947
	Jamaica	Nahhas & Cable 1964
	Puerto Rico	Dyer *et al.* 1992; Siddiqi & Cable 1960
L. mahogoni	Puerto Rico	Bunkley-W. *et al.* 1996
L. synagris	Bahamas	Sogandares-B. 1959
	Belize	Fischthal 1977
	Florida	Manter 1947; Overstreet 1969
	Jamaica	Nahhas & Carlson 1994
	Puerto Rico	Bunkley-W. *et al.* 1996; Dyer *et al.* 1998
	Colombia	Vélez 1987
O. chrysurus	Belize	Fischthal 1977
	Florida	Linton 1910; Manter 1947; McCoy 1929, 1930
	Jamaica	Nahhas & Carlson 1994
	Panama	Sogandares-B. (MM 44337, 44338, 44372)
	Puerto Rico	Dyer *et al.* 1992; Siddiqi & Cable 1960
	***Hamacreadium* sp.**	
L. griseus	Puerto Rico	Siddiqi & Cable 1960; Dyer *et al.* 1985
	Helicometra exacta Linton, 1910	
L. griseus	Florida	Schroeder 1971
	Helicometra torta Linton, 1910	
L. apodus	Puerto Rico	Dyer *et al.* 1992
L. griseus	Florida	Schroeder 1971
	Puerto Rico	Dyer *et al.* 1992
	***Helicometra* sp.**	
L. synagris	Bahamas	Sogandares-B. [MM 44284, 44296]
	Helicometrina nimia Linton, 1910	
L. analis	Belize	Fischthal 1977
L. apodus	Belize	Fischthal 1977

	Colombia	Vélez 1987
	Florida	Manter 1947; Overstreet 1969
L. griseus	Belize	Fischthal 1977
	Colombia	Vélez 1987
	Florida	Linton 1910; Manter 1947; Schroeder 1971
L. jocu	Belize?	Fischthal 1977? [no]
	Jamaica	Nahhas & Cable 1964
L. mahogoni	Florida	Overstreet 1969
L. synagris	Bahamas	Sogandares-B. 1959
	Belize	Fischthal 1977
	Colombia	Vélez 1987
	Florida	Manter 1947
	Puerto Rico	Bunkley-W. *et al.* 1996?
O. chrysurus	Florida	Linton 1910; Manter 1947; Overstreet 1969
	Jamaica	Nahhas & Carlson 1994
Helicometrina varia		[sic, Fischthal, 1977:88]
L. synagris	Belize	Fischthal 1977
Hirundinella venricosa (Pallas, 1774)		
L. synagris	Colombia	Vélez 1987
Horatrema crassum		
L. synagris	Puerto Rico	Bunkley-W. *et al.* 1996?
Hymenocotta manteri Overstreet, 1969		
L. synagris	Puerto Rico	Bunkley-W. *et al.* 1996?
Lutjanus sp.	Puerto Rico	Bunkley-W. & Williams 1994
Lasiotocus truncates (Linton, 1910)		
L. mahogani	Curaçao	Nahhas & Cable 1964
Lecithochirium floridensis (Manter 1934)		
L. vivanus	Florida	Manter 1934
O. chrysurus	Bahamas	Sogandares-B. 1959; Sparks, 1957?
Lecithochirium microcercus (Manter, 1947)		
L. apodus	Puerto Rico	Dyer *et al.* 1998
Lecithochirium microstomum Chandler, 1935		
L. synagris	Florida	Overstreet 1969
Lecithochirium monticellii (Linton, 1898)		
L. griseus	Florida	Linton 1910
O. chrysurus	Florida	Linton 1910
	Puerto Rico	Siddiqi & Cable 1960
Lecithochirium parvum (Manter, 1947)		
L. apodus	Curaçao	Nahhas & Cable 1964
L. buccanella	Puerto Rico	Dyer *et al.* 1985, 1986
L. griseus	Jamaica	Nahhas & Cable 1964
	Florida	Manter 1934, 1947
L. synagris	Colombia	Vélez 1987
	Florida	Overstreet 1969
L. vivanus	Curaçao	Nahhas & Cable 1964
***Lecithochirium* sp.**		
L. apodus	Florida	Manter 1947
L. synagris	Florida	Manter 1947
L. vivanus	Florida	Manter 1947
Lepidapedon holocentri Siddiqi & Cable, 1960		
L. analis	Puerto Rico	Siddiqi & Cable 1960
L. apodus	Puerto Rico	Dyer *et al.* 1992
Lepocreadium trulla (Linton, 1907)		
L. apodus	Puerto Rico	Dyer *et al.* 1992

L. buccanella	Bahamas	Sogandares-B. 1959
L. griseus	Puerto Rico	Dyer *et al.* 1992
L. purpureus	Colombia	Vélez 1987
L. synagris	Colombia	Vélez 1987
O. chrysurus	Bahamas	Sogandares-B. & Hutton 1960
	Belize	Fischthal 1977
	Bermuda	Linton 1907; Pritchard, M. L. (MM 1117)
	Curaçao	Nahhas & Cable 1964
	Florida	Linton 1908, 1910; Manter 1947; Overstreet 1969
	Jamaica	Nahhas & Cable 1964; Nahhas & Carlson 1994
	Puerto Rico	Dyer *et al.* 1985, 1998, Siddiqi & Cable 1960
R. aurorubens	Puerto Rico	Siddiqi & Cable 1960
Lepocreadium truncatum Nahhas & Cable, 1964		
O. chrysurus	Bahamas	Sogandares-B. 1959
	Curaçao	Nahhas & Cable 1964
***Lepocreadium* sp.**		
L. apodus	Puerto Rico	Bunkley-W. *et al.* 1996
O. chrysurus	Puerto Rico	Siddiqi & Cable 1960
Leurodera decora Linton, 1910		
L. analis	Puerto Rico	Siddiqi & Cable 1960
L. apodus	Puerto Rico	Dyer *et al.* 1992
L. griseus	Florida	Linton 1910; Manter 1947
Mesocoelium monas (Rudolphi, 1819)		
L. cyanopterus	Venezuela	Fischthal & Nasir1974
Metadena adglobosa Manter, 1947		
L. apodus	Belize	Fischthal 1977
	Curaçao	Nahhas & Cable 1964
	Florida	Overstreet 1969
	Jamaica	Nahhas & Carlson 1994; Nahhas & Cable 1964
	Puerto Rico	Dyer *et al.* 1992; Siddiqi & Cable 1960
L. griseus	Belize	Fischthal 1977
	Curaçao	Nahhas & Cable 1964
	Jamaica	Nahhas & Cable 1964
	Bermuda	Hanson 1950; Pritchard, M. L. (MM 1121)
	Florida	Manter 1947; Overstreet 1969; Schroeder 1971
	Puerto Rico	Dyer *et al.* 1985, 1992; Siddiqi & Cable 1960
L. jocu	Jamaica	Nahhas & Cable 1964
L. synagris	Belize	Fischthal 1977
	Jamaica	Nahhas & Cable 1964
L. vivanus	Curaçao	Nahhas & Cable 1964
Metadena crassulata Linton, 1910		
L. analis	Florida	Linton 1910; Manter 1947
	Jamaica	Nahhas & Cable 1964
L. vivanus	Curaçao	Nahhas & Cable 1964
	Florida	Manter 1947
Metadena globosa (Linton, 1910)		
L. analis	Belize	Fischthal 1977
L. apodus	Belize	Fischthal 1977
	Jamaica	Nahhas & Cable 1964
L. griseus	Belize	Fischthal 1977
	Florida	Linton 1910; Manter 1947; Overstreet 1969; Schroeder 1971
L. mahogoni	Florida	Overstreet 1969
L. purpureus	Colombia	Vélez 1987
L. synagris	Belize	Fischthal 1977

	Colombia	Vélez 1987
	Florida	Overstreet 1969
L. vivanus	Curaçao	Nahhas & Cable 1964
O. chrysurus	Bahamas	Sogandares-B. 1959
	Belize	Fischthal 1977
	Florida	Overstreet 1969
	Jamaica	Nahhas & Cable 1964
Metadena obscura Schroeder, 1971		
L. griseus	Florida	Schroeder 1971
***Metadena* sp.**		
L. analis	Bahamas	Sogandares-B. (MM 44468)
L. apodus	Bahamas	Sogandares-B. (MM 44328)
L. griseus	Florida	Overstreet 1969
L. synagris	Bahamas	Sogandares-B. (MM 44314)
Paracryptogonimus americanus Manter, 1940		
L. analis	Belize	Fischthal 1977
L. griseus	Belize	Fischthal 1977
L. synagris	Belize	Fischthal 1977
	Florida	Overstreet 1969
O. chrysurus	Belize	Fischthal 1977
	Florida	Overstreet 1969
Paracryptogonimus neoamericanus Siddiqi and Cable, 1960		
L. buccanella	Colombia	Vélez 1987
L. griseus	Florida	Schroeder 1971
L. purpureus?	Puerto Rico	Siddiqi & Cable 1960
L. synagris	Colombia	Vélez 1987
L. vivanus	Curaçao	Nahhas & Cable 1964
O. chrysurus	Curaçao	Nahhas & Cable 1964
	Puerto Rico	Siddiqi & Cable 1960
Parahemiurus merus (Linton, 1910)		
O. chrysurus	Florida	Manter 1947
Pinguitrema lobatum Siddiqi & Cable 1960		
L. apodus	Puerto Rico	Dyer *et al.* 1998; Siddiqi & Cable 1960
Prosogonotrema bilabiatum Pérez-Vigueras 1940		
L. synagris	Colombia	Vélez 1987
O. chrysurus	Bahamas	Sogandares-B. 1959
	Cuba	Pérez-V. 1940
	Jamaica	Nahhas & Cable 1964
Pseudacaenodera samariensis Vélez, 1999		
L. synagris	Colombia	Vélez 1999
Pseudocreadium biminense Sogandares-Bernal, 1959		
L. griseus	Bahamas	Sogandares-B. (MM 44285, 44286, 44289)
L. synagris	Bahamas	Sogandares-B. (MM 44287, 44290)
***Pseudocreadium* sp.**		
Lutjanus sp.	Panama	Sogandares-B. (MM 44288)
Pseudopecoeloides tortugae (Linton, 1934)		
L. synagris	Colombia	Vélez 1987
***Pseudopecoeloides* sp.**		
L. analis	Panama	Sogandares-B. (MM 44469)
Schikhobalotrema acutum (Linton, 1910)		
L. analis	Venezuela	Fischthal & Nasir1974
Siphodera brotulae Manter, 1934		
O. chrysurus	Puerto Rico	Dyer *et al.* 1992

Siphodera vinaledwardsii (Linton, 1901)

L. analis	Belize	Fischthal 1977
	Curaçao	Nahhas & Cable 1964
	Florida	Fischthal (US 76746); Whittaker (US 76746)
	Jamaica	Nahhas & Cable 1964
	Puerto Rico	Siddiqi & Cable 1960
L. buccanella	Curaçao	Nahhas & Cable 1964
L. griseus	Colombia	Vélez 1987
L. mahogoni	Florida	Overstreet 1969
L. purpureus	Colombia	Vélez 1987
L. synagris	Bahamas	Macy, R. W. (MM 23289); Sogandares-B. 1959
	Belize	Fischthal 1977
	Colombia	Vélez 1987
	Florida	Fischthal (US 76747); Overstreet 1969; Whittaker (US76747)
	Jamaica	Nahhas & Cable 1964
	Puerto Rico	Dyer *et al.* 1998; Siddiqi & Cable 1960
	BVI	Dyer 1983
L. vivanus	Curaçao	Nahhas & Cable 1964
Lutjanus sp.	Bermuda	Hanson 1950
O. chrysurus	Belize	Fischthal 1977
	Curaçao	Nahhas & Cable 1964
	Florida	Linton 1910; Manter 1947
	Jamaica	Nahhas & Cable 1964
	Panama	Sogandares-B. [MM 22335, 22336]

Stephanostomum casum (Linton, 1910)

L. analis	Belize	Fischthal 1977
	Florida	Linton 1910; Manter 1947
	Puerto Rico	Siddiqi & Cable 1960
L. buccanella	Curaçao	Nahhas & Cable 1964
L. cyanopterus	Puerto Rico	Dyer *et al.* 1985
L. griseus	Colombia	Vélez 1987
	Florida	Linton 1910; Manter 1947; Overstreet 1969; Schroeder 1971
	Puerto Rico	Dyer *et al.* 1985
L. purpureus	Colombia	Vélez 1987
L. synagris	Belize	Fischthal 1977
	Florida	Overstreet 1969
	Colombia	Vélez 1987
	Jamaica	Nahhas & Cable 1964
L. vivanus	Curaçao	Nahhas & Cable 1964
O. chrysurus	Belize	Fischthal 1977
	Bermuda	Pritchard, M. L. (MM 1115)
	Florida	Linton 1910; Manter 1947; Overstreet 1969
	Jamaica	Nahhas & Carlson 1994

Stephanostomum sentum (Linton, 1910)

L. mahogoni	Puerto Rico	Bunkley-W. *et al.* 1996
Lutjanus sp.	Curaçao	Nahhas & Cable 1964

Stephanostomum tenue (Linton, 1898)

L. apodus	Florida	Overstreet 1969
L. mahogoni	Florida	Overstreet 1969

Sterrhurus microcercous Manter, 1947

L. jocu	Colombia	Vélez 1987

Sterrhurus musculus Looss, 1907

L. apodus	Curaçao	Nahhas & Cable 1964

	Florida	Overstreet 1969
	Jamaica	Nahhas & Cable 1964
L. griseus	Curaçao	Nahhas & Cable 1964
	Florida	Overstreet 1969
L. synagris	Belize	Fischthal 1977
L. vivanus	Curaçao	Nahhas & Cable 1964
O. chrysurus	Jamaica	Nahhas & Carlson 1994
***Sterrhurus* sp.**		
L. vivanus	Florida	Manter 1947
Unidentified		
O. chrysurus	Bahamas	Pearse (US 46410; 46412)
	Jamaica	Nahhas & Carlson 1994
Vitellibaculum spinosum (Nahhas and Cable, 1964)		
L. apodus	Jamaica	Nahhas & Cable, 1964

Monogenea – gillworms

Echinopelma neomaenis (MacCallum, 1917)		
L. analis	Florida	MacCallum 1917; Manter 1954
L. griseus[sic]	Florida	Manter 1954
***Epibdella* sp.**		
O. chrysurus	Bermuda	Pritchard, M. L. (MM 1118)
Euryhaliotrema fastigatum (Zhukov, 1976)		
L. apodus	Cuba	Kritsky & Boeger 2001; Zhukov 1976
L. jocu	Cuba	Kritsky & Boeger 2001; Zhukov 1976
Euryhaliotrema longibaculum (Zhukov, 1976)		
L. mahogoni	off Cuba	Kritsky & Boeger 2001; Zhukov 1976
L. synagris	off Cuba	Kritsky & Boeger 2001; Zhukov 1976
Euryhaliotrema paracanthi (Zhukov, 1976)		
L. apodus	Cuba	Kritsky & Boeger 2001; Zhukov 1976
Euryhaliotrema torquecirrus (Zhukov, 1976)		
L. synagris	Cuba	Kritsky & Boeger 2001; Zhukov 1976
O. chrysurus	Cuba	Kritsky & Boeger 2001; Zhukov 1976
Euryhaliotrema tubocirrus (Zhukov, 1976)		
L. analis	off Cuba	Kritsky & Boeger 2001; Zhukov 1976
L. apodus	off Cuba	Kritsky & Boeger 2001; Zhukov 1976
L. cyanopterus	off Cuba	Kritsky & Boeger 2001; Zhukov 1976
L. synagris	off Cuba	Kritsky & Boeger 2001; Zhukov 1976
O. chrysurus	off Cuba	Kritsky & Boeger 2001; Zhukov 1976
R. aurorubens	off Cuba	Kritsky & Boeger 2001; Zhukov 1976
Haliotrema cornigerum Zhukov, 1976		
L. mahogoni	Cuba	Zhukov 1976
L. synagris	Cuba	Zhukov 1976
Haliotrema gracilihamus Zhukov, 1976		
L. apodus	Cuba	Zhukov 1976
L. jocu	Cuba	Zhukov 1976
Haliotrema heteracantha Zhukov, 1976		
L. jocu	Cuba	Zhukov 1976
L. mahogoni	Cuba	Zhukov 1976
L. synagris	Cuba	Zhukov 1976
Lutjanus sp.	Cuba	Zhukov 1983
O. chrysurus	Cuba	Zhukov 1976, 1983
Haliotrema longihamus Zhukov, 1976		
L. analis	Cuba	Zhukov 1976

L. synagris	Cuba	Zhukov 1976
Haliotrema magnigastrohamus Zhukov, 1976		
L. analis	Cuba	Zhukov 1976
L. synagris	Cuba	Zhukov 1976
O. chrysurus	Cuba	Zhukov 1976
***Microcotyle* sp.**		
O. chrysurus	Jamaica	Wilson (MM 36862)
Microcotyloides incisa (Linton, 1910)		
L. apodus	Puerto Rico	Williams & Bunkley-W. (US 82592)
L. griseus	Bermuda	Fujii 1944
	Florida	Linton 1910
Neobenedenia melleni (MacCallum, 1927)		
L. analis	Bahamas	Müeller *et al.* 1994
	Florida?	Jahn & Kuhn 1932
L. apodus	Bahamas	Müeller *et al.* 1994
	Florida?	Jahn & Kuhn 1932
O. chrysurus	Bahamas	Müeller *et al.* 1994
	Guadeloupe	Gallet de S. A. *et al.* 1989

Cestoda – tapeworms

Callotetrarhynchus gracilis (Linton, 1899)		
L. analis	Florida	MacCallum (US 35853, 35912)
L. griseus	Florida	Linton 1908
O. chrysurus	Florida	Linton 1908; MacCallum (US 35789; 35792)
Otobothrium dipsacum Linton, 1897		
L. analis	Florida	MacCallum (US 35853)
O. chrysurus	Florida	MacCallum (US 35783)
Pterobothrium heteracanthum Diesing, 1850		
O. chrysurus	Florida	Campbell & Beveridge 1996
Rynchobothrium brevibothrium		
L. analis	Florida	MacCallum (US 35910, 35967)
Rynchobothrium *microbothrium* MacCallum, 1917		
L. analis	Florida	MacCallum 1917
L. griseus	Florida	MacCallum 1917
***Rynchobothrium* sp.**		
L. analis	Florida	MacCallum (US 35966)
O. chrysurus	Florida	MacCallum (US 35791)
Synbothrium filicolle		
O. chrysurus	Florida	MacCallum (US 35743)
Tetrarhynchus brevibothria MacCallum, 1917		
L. analis	Florida	MacCallum (US 35956)
Tetrarhynchus chrysuri		
O. chrysurus	Florida	MacCallum (US 35766)
Tetrarhynchus speciosum		
L. analis	Florida	MacCallum (US 35862)
***Tetrarhynchus* sp.**		
L. analis	Florida	MacCallum (US 35863, 36021)
L. griseus	Florida	MacCallum (US 35914)
Pleurocercoid larvae		
L. buccanella	USVI	Brownell & Rainey 1971
L. vivanus	USVI	Brownell & Rainey 1971
Unidentified		
O. chrysurus	Florida	MacCallum (US 35751)

Nematoda – roundworms

***Ascaris* sp.**

L. griseus	Bermuda	Linton 1907

Dichelyne bonacii González-Solis *et al.*, 2002

L. griseus	Mexico	González-Solis *et al.* 2002

Dichelyne lintoni (Barreto, 1922)

L. griseus	North Carolina	Barreto 1922

Heterakis foveolator Rudolphi

L. griseus	Bermuda	Linton 1907

***Heterakis* sp.**

L. griseus	Bermuda	Linton 1907

***Philometra* sp.**

L. griseus	Bermuda	Rees 1970
Lutjanus sp.	Bermuda	Linton 1907

Raphidascaris anchoviellae Chandler, 1935

O. chrysurus	Texas?	Chandler 1935?

Raphidascaris lutiani Olsen, 1952

L. analis	Florida	Olsen 1952

Spirocamallanus cricotus Fusco and Overstreet, 1978

L. apodus	Alabama	Williams 1983
L. griseus	Alabama	Williams 1983

Unidentified

L. analis	Florida	MacCallum (US 35524)

Acanthocephala – thorny-headed worms

Echinorhynchus gadi Zoega in Müller, 1776

O. chrysurus	Florida	MacCallum (US 35789)

Gorgorhynchus bullocki Cable and Mafarachisi, 1970

L. griseus	Florida	Cable & Mafarachisi 1970

Gorgorhynchus cablei Golvan, 1969

L. jocu	Jamaica	Golvan 1969

Gorgorhynchus clavatus Van Cleave, 1940

L. jocu	Jamaica	Cable & Linderoth 1963

Gorgorhynchus medius (Linton, 1907)

L. griseus	Bermuda	Linton 1907
	Florida	Linton 1908
L. vivanus	Bermuda	Linton 1907
O. chrysurus	Bermuda	Linton 1907

Hirundinella – Leeches

Trachelobdella lubrica (Grube, 1840)

L. apodus	Puerto Rico	Williams *et al.* 1994
L. cyanopterus	Puerto Rico	Williams 1982
L. synagris	Puerto Rico	Williams *et al.* 1994

Copepoda – copepods

Caligus asperimanus Pearse, 1951

L. analis	Bahamas	Pearse 1951
	Belize	Cressey 1991
L. apodus	Belize	Cressey 1991
L. jocu	Belize	Cressey 1991
L. synagris	Belize	Cressey 1991

	Caligus atromaculatus Wilson, 1913	
L. griseus	Florida	Cressey & Nutter 1987
	Caligus bonito Wilson, 1905	
L. buccanella	Puerto Rico	Steele 1982
L. griseus	Florida	Bere 1936
L. jocu	Puerto Rico	Steele 1982
	Caligus fallax Krøyer, 1863	
L. griseus	Puerto Rico	Steele 1982
O. chrysurus	Puerto Rico	Steele 1982
	Caligus irritans Heller, 1868	
L. analis	Puerto Rico	Williams & Bunkley-W. (US 87870)
L. griseus	Florida	Wilson 1935
	Puerto Rico	Bunkley-W. & Williams 1994, 1995
L. purpureus	Jamaica	Wilson 1913
L. synagris	Puerto Rico	Steele 1982; Williams & Bunkley-W. (US 87889)
	Caligus ocyurus Cressey, 1991	
O. chrysurus	Belize	Cressey 1991
	Caligus praetextus Bere, 1936	
L. synagris	Belize	Cressey 1991
	Florida	Bere 1936
	Caligus robustus Bassett-Smith, 1898	
L. apodus	Belize	Cressey 1991
	Caligus rufimaculatus Wilson, 1905	
L. synagris	Belize	Cressey 1991
	Caligus xystercus Cressey, 1991	
L. apodus	Belize	Cressey 1991
L. jocu	Puerto Rico	Williams & Bunkley-W. (US 87855)
	Caligus wilsoni Delamare Deboutteville and Nunes Ruivo, 1958	
L. griseus	Belize	Cressey 1991
	***Caligus* sp.**	
A. dentatus	Puerto Rico	Steele 1982
L. buccanella	Puerto Rico	Steele 1982
	Hatschekia albirubra Wilson, 1913	
L. griseus	Bahamas	Pearse 1951
L. synagris	Jamaica	Wilson 1913
	Puerto Rico	Williams & Bunkley-W. (US 87890)
O. chrysurus	Jamaica	Wilson 1913
	Puerto Rico	Steele 1982; Williams & Bunkley-W. (US 87238)
	Hatschekia linearis Wilson, 1913	
L. cyanopterus	Puerto Rico	Steele 1982
	Hatschekia oblonga Wilson, 1913	
L. analis	Puerto Rico	Steele 1982; Williams & Bunkley-W. (US 87880)
L. apodus	Bahamas	Pearse 1951
L. griseus	Bahamas	Pearse 1951
L. purpureus	Jamaica	Wilson 1913
O. chrysurus	Mexico	Causey 1960
	***Hatschekia* sp.**	
L. buccanella	Puerto Rico	Steele 1982
L. jocu	Puerto Rico	Steele 1982
L. synagris	Puerto Rico	Steele 1982
	Lernaeolophus recurvus Wilson, 1913	
L. griseus	Belize	Cressey 1991
	Lernaeolophus sultanus (Norman, 1864)	
O. chrysurus	Puerto Rico	Steele 1982

Lernanthropus bifidus Pearse, 1951

L. analis	Bahamas	Pearse 1951

Lernanthropus eddiwarneri Delamare-Deboutteville and Nunes-Ruivo, 1954

L. analis	Venezuela	González-C. *et al.* 1999

Lernanthropus frondeus Wilson, 1913

L. analis	Puerto Rico	Steele 1982
L. cyanopterus	Puerto Rico	Steele 1982
L. purpureus	Jamaica	Wilson 1913

Lernanthropus kroyeri Van Beneden, 1851

L. griseus	Florida	Bere 1936

Lernanthropus obscurus Wilson, 1913

O. chrysurus	Jamaica	Wilson 1913

Lernanthropus spiculatus Wilson, 1913

L. synagris	Florida	Bere 1936
	Bahamas	Pearse 1951
	Jamaica	Wilson 1913

***Lernanthropus* sp.**

L. apodus	Puerto Rico	Steele 1982
L. griseus	Venezuela	Bashirullah 1975; Steele 1982
L. jocu	Puerto Rico	Steele 1982
L. synagris	Puerto Rico	Steele 1982

Paralebrion curticaudis Wilson, 1913

L. purpureus	Jamaica	Wilson 1913

Thysanote longimana Wilson, 1913

L. jocu	Puerto Rico	Steele 1982
L. purpureus	Jamaica	Wilson 1913
O. chrysurus	Puerto Rico	Williams & Bunkley-W. (US 87242)

copepod[sic] = *Argulus* sp.

L. griseus[sic]	Florida	Manter 1954

Brachiura – fish lice

***Argulus* sp.**

L. griseus	Florida	Linton 1910

Pentastoma – tongueworms

***Linguatula* sp.**

L. griseus	Florida	MacCallum (US 36057)

Isopoda – isopods

Alcirona krebsii Hansen, 1890

L. analis	Puerto Rico	Williams & Williams 1977

Cymothoa excisa Perty, 1833

L. analis	Colombia	Williams *et al.*, 1994
	Mexico	Kensley & Schotte 1989
	Panama	Weinstein & Heck 1977
	Venezuela	Williams *et al.* 1998
L. griseus	Venezuela	Williams *et al.* 1998
L. mahogoni	Panama	Kensley & Schotte 1989
L. synagris	Colombia	Williams *et al.* 1994
	Panama	Kensley & Schotte 1989; Weinstein & Heck 1977
O. chrysurus	Colombia	Williams *et al.* 1994
	Mexico	Kensley & Schotte 1989

Excirolana mayana (Ives, 1891)

L. griseus	Bermuda	Yeatman 1957

Excorallana sexticornis (Richardson, 1901)

L. griseus	Puerto Rico	Williams & Williams 1977

Excorallana tricornis (Hansen, 1890)

L. apodus	Puerto Rico	Williams & Williams 1977

Gnathia puertoricensis Menzies and Glynn, 1968

L. cyanopterus	Puerto Rico	Williams & Williams 1977

***Gnathia* sp.**

L. analis	Puerto Rico	Williams & Bunkley-W. (US 87858)
L. buccanella	Puerto Rico	Williams & Williams 1977
O. chrysurus	Puerto Rico	Williams & Bunkley-W. (US 87242; 87859)

Rocinella signata Schiœdte and Meinert, 1879

L. analis	Florida	Kensley & Schotte 1989
	Puerto Rico	Williams & Williams 1977
	U.S. Virgin Islands	Kensley & Schotte 1989
	Venezuela	Williams *et al.* 1998
L. buccanella	Bahamas	Kensley & Schotte 1989
L. griseus	Puerto Rico	Williams & Williams 1977

Diseases

Black-spot Disease [encysted parasite?]

L. griseus	Florida	Starck 1971

Slime-blotch Disease

all lutjanids	West Indies	Williams & Bunkley-W. 2000

Neurofibromas

L. griseus	Florida	Lucké 1942; Starck 1971
	Bermuda	Williams *et al.* 2000

***Vibrio* sp.**

L. griseus	Puerto Rico	Bunkley-W. & Williams 1994

"Nutritional" Disease

L. analis	Martinique	Thouard *et al.* 1990
L. apodus	Martinique	Thouard *et al.* 1990
L. griseus	Martinique	Thouard *et al.* 1990
L. synagris	Martinique	Thouard *et al.* 1990
O. chrysurus	Martinique	Thouard *et al.* 1990

A. dentatus = Apsilus dentatus; *L. analis = Lutjanus analis*; *L. apodus = Lutjanus apodus*; *L. buccanella = Lutjanus buccanella*; *L. cyanopterus = Lutjanus cyanopterus*; *L. griseus = Lutjanus griseus*; *L. jocu = Lutjanus jocu*; *L. mahogoni = Lutjanus mahogoni*; *L. purpureus = Lutjanus purpureus*; *L. synagris = Lutjanus synagris*; *L. vivanus = Lutjanus vivanus*; *O. chrysurus = Ocyurus chrysurus*; *R. aurorubens = Rhomboplites aurorubens*

BVI = British Virgin Islands; MM = Manter Museum; US = U.S. National Parasite Collection; USVI = U.S. Virgin Islands

MATERIALS AND METHODS

Snappers were collected by fishermen using nets from Crashboat, Aguadilla; Puerto Real, Cabo Rojo; El Seco and El Maní, Mayagüez; and Villa Pargueras at Lajas, Puerto Rico. The guts and gills were placed in a plastic bag and transported in a cooler to the laboratory at the Biology Department. Some were examined immediately and others were frozen until examined from 1 to 30 days later.

Examinations

Fishes were measured and examined externally and internally for parasites. Each gill arch was separated and placed in Petri dishes with seawater. The gill arches and filaments were examined in a dissection microscope and wet mounts of gill filaments were prepared to observe with a light microscope. The removed digestive tract was examined internally. Each organ was separated, and examined with a dissecting microscope.

Fixing

For recovering small monogeneans, the frozen gills were put in a Beaker with sea water to let them thaw and then they were shaken vigorously. The liquid, with the freed parasites, was poured into a Petri dish and alternately diluted and decanted until clear enough for examination under a dissecting microscope. Monogeneans were then fixed and store in 10% phosphate-buffered formalin. Live digeneans were held for a few minutes in a Petri dish with fresh water, allowing them to expel their eggs. They were then fixed and stored in steaming 10% phosphate-buffered formalin. Cestodes were fixed and stored in 10% phosphate-buffered formalin. Small nematodes, larval stages of

nematodes, acanthocephalans, copepods and small isopods were fixed and stored in 70% alcohol. Isopods and copepods too large to mount were maintained in glass vials for further examination**.**

Staining and Mounting

Digenea, acanthocephala and cestoda were dehydrated with ascending proportions of alcohol. They were then stained with Semichon's Acetic–carmine from 70% alcohol and then de-stained with 1% acid alcohol. After the de-staining the dehydration continued until absolute ethyl alcohol. Xylene was then used as a clearing agent, and specimens were mounted in Kleermount ©. Monogenea, Nematoda, Copepoda and some Isopoda were mounted in glycerin jelly.

Photos

Photos were taken with a Nikon ® Cool Pix 995 digital camera with a photo tube microscope adapter.

Identification

Preliminary identification of helminthes and copepods were made using Yamaguti (1959, 1961, 1963a,b,c). Isopods were identified using Kensley and Schotte (1989). The primary literature was used for the final identification of the parasites and is detailed in the results and discussion. Voucher specimens of all parasites will be deposited in the U.S. National Parasite Collection at Beltsville, MD. Higher taxonomy follows Roberts and Janovy (2000).

Measurements

Measurements of parasites were made with an ocular micrometer.

RESULTS AND DISCUSSION

Forty three species of parasites (Table 13) were found in 131 fishes of 13 species (Table 4) including: 10 monogeneans, three cestode larvae, one blastocyst, one procercoid, 10 digeneans, three nematodes, eight nematode cyst, one acanthocephala, 13 copepods, three isopods and one leech. Comparisons among genera, intensity and mean intensity, and a host specificity analysis are presented. The mean intensities will be compared in order to indicate the degree of host specificity of the parasite and the susceptibility of each host.

Phylum **Platyhelminthes**

Class **Trematoda**

Subclass **Digenea**

Digenetic trematodes are very common parasites of marine fishes. They are most collected from the digestive tract as adults or encysted in the fish flesh as metacercaria.

Family **Cryptogonimidae** Ciurea, 1933

Genus ***Metadena*** Linton, 1910

Metadena adglobosa Manter, 1947 (Figure 17)

Linton (1910) described *Metadena globosa* from digenea he found in *Lutjanus griseus* from the Dry Tortugas. Unfortunately, he did not distinguish two species in his material. Manter (1947) described this fluke from *L. griseus* from Dry Tortugas, Florida. *Metadena adglobosa* is easily confused with *M. globosa* from the same type host, *L. griseus*. Linton (1910) included *M. adglobosa* in his description of *M. globosa*. Siddiqi and Cable (1960) collected *M. adglobosa* from *L. apodus* and *L. griseus* from Punta

Arenas, Puerto Rico. Overstreet (1969) reported the same parasite in *L. apodus* and *L. griseus* from Biscayne Bay, Florida. Overstreet (1969) also proposed a new species which had a large and a heavily-spined ventrogenital pouch. Schroeder (1971) found this parasite in *L. griseus* from every collecting station in their project, with higher incidences at Back Bay station.

The body of *Metadena adglobosa* is more elongate; the oral sucker is considerably less than half body width; the ovary has fewer lobes; the uterus does not extend anterior to the acetabulum; the seminal vesicle has coils anterior to the acetabulum; and the eggs are somewhat larger than those of *M. globosa*.

Dyer *et al.* (1985) collected *M. adglobosa* from *L. griseus* from Isla Magüeyes, La Parguera, Puerto Rico. In the present study, twenty-four *M. adglobosa* were collected from three *L. analis* and three were collected from three *Ocyurus chrysurus* (Table 5). *Lutjanus analis* and *O. chrysurus* are new host records for this parasite. The mean intensity from each infection ranged from 1 to 2.7 (Table 13). *Lutjanus analis* obtained the highest mean intensity presenting a higher degree of host specificity between the infected host. This parasite was not collected in the type host (Linton, 1910), *L. griseus*. Vélez (1982) reported *M. globosa* from *L. synagris* and *L. purpureus*. In the present study, no *M. globosa* were found.

Paracryptogonimus neoamericanus Siddiqi and Cable, 1960 (Figure 18)

Siddiqi and Cable (1960) described this parasite from *Ocyurus chrysurus* and "*Lutjanus aya"*(*L. aya* does not occur in Puerto Rico, they are probably referring to *L. purpureus*), from Cabo Rojo, Puerto Rico. The first species of its genus to be reported

outside the Pacific, *Paracryptogonimus neoamericanus* resembles *P. americanus* Manter, 1940 in sucker ratio, topography of the gonads and vitellaria, and extent of the uterus and form of the cecae. It differs from *P. americanus* in being a much smaller species and in having fewer circumoral spines, a terminal oral sucker and smaller eggs (Siddiqi and Cable, 1960). Overstreet (1969) reported *P. neoamericanus* in *Ocyurus chrysurus* from Biscayne Bay, Florida. Schroeder (1971) found *P. neoamericanus* in much higher incidences in *O. chrysurus* than in *L. griseus*. Vélez (1987) reported the same parasite from *L. synagris* and *L. buccanella* from Santa Marta and Cartagena, Colombia. In the present study, 85 *P. neoamericanus* were collected from two *O. chrysurus*, one was collected from one *L. vivanus*, and one was collected from one *L. mahogoni* (Table 5). *Lutjanus vivanus* and *L. mahogoni* are new host-parasite records for this parasite. The mean intensity from each infection ranged from 1 to 42.5 (Table 13). *Ocyurus chrysurus*, type host (Siddiqi and Cable, 1960), had the highest mean intensities indicating higher host specificity. These data agree with Schroeder (1971) who reported higher incidence on *O. chrysurus* and fewer on *L. griseus*. In fact, none was found at all on the *L. griseus* examined in the present study.

Family **Acanthocolpidae** Lühe, 1909

Stephanostomum casum (Linton, 1910), McFarlane, 1936 (Figure 19)

Syn. *Stephanochasmus casus* Linton 1910

Linton (1910) described this parasite from *Lutjanus griseus*, and collected the fluke in *L. analis*, and *Ocyurus chrysurus*. He also described *Lechradena edentula* the synonym of *Stephanostomum casum* from *L. griseus* (Linton, 1910b). The description of

Lechradena edentula was based on one specimen which he considered near to the genus *Stephanochasmus* (*Stephanostomum*), but without spines (Linton, 1910). The losses and replacement with increased number of spines could contribute to some of the confusion about the number of spines in each species (Williams and Bunkley Williams, 1996). Siddiqi and Cable (1960) collected this digenetic trematode from *L. analis* from Puerto Rico. Nahhas and Cable (1964) reported the same fluke parasitizing *L. aya (L. purpureus)*, *L. buccanella* and *L. synagris* from marine fishes of Curaçao and Jamaica. Recent reports of this parasite by Dyer *et. al* (1985) identify *S. casum* from *L. cyanopterus* and *L. griseus* from La Parguera, Puerto Rico. Vélez (1987) reported this fluke from *L. synagris*, *L. purpureus* and *L. griseus* from Santa Marta, Colombia.

In the present study, three *S. casum* were collected from two *L. analis*; one was collected in one *L. vivanus*, and three in one *O. chrysurus* (Table 5). *Lutjanus vivanus* is a new host record for this parasite. The mean intensity for each infection ranged from 1 to 3 (Table 13).

Family **Haploporidae** Nicoll, 1914

Allomegasolena attenuata Siddiqi and Cable, 1960 (Figure 20)

Siddiqi and Cable (1960) proposed the new genus *Allomegasolena* in which to place two new species: *Allomegasolena spinosa* (type) and *A. attenuata*. These two species had some characters of the genus *Magasolena.* The two species of flukes differ in the following characters: a suckerlike structure occupies the terminal end of the hermaphroditic sac near the genital pore, and the metraterm and ejaculatory duct remain separate until they approach the genital pore, which they unite well back in the sac in

Megasolena estrix (Siddiqi and Cable, 1960). They collected *A. attenuata* from *Lutjanus apodus* from Punta Arenas, Puerto Rico. *Allomegasolena attenuata* differs from *A. spinosa* in body shape, sucker ratio, and size of pharynx (Siddiqi and Cable, 1960).

In this project, one *A. attenuata* was collected from one *L. vivanus*, and three were collected from two *Ocyurus chrysurus* (Table 5), both of which are new host records. The mean intensities are very similar, thus are not useful in comparing the degree of host specificity.

Family **Opecoelidae** Ozaki, 1925

Hamacreadium lintoni Siddiqi and Cable, 1960 (Figure 21)

Siddiqi and Cable (1960) described this parasite from *Epinephelus striatus* and *Cephalopholis fulvus* from Mona Island, Puerto Rico. In the present study, eight *Hamacreadium lintoni* were collected from three *Lutjanus griseus*; five from three *L. vivanus*; two from one *L. synagris*, and three were collected from one *L. jocu* (Table 5). This is the first report of this fluke for these snappers. The mean intensity for each infection ranged from 1-3.5 (Table 13) with the highest mean intensity in *L. griseus*. This species of snapper had a higher degree of specificity for digeneans of the genus *Hamacreadium*. It had the highest mean intensities in both *Hamacreadium mutabile* and *H. lintoni*. It is interesting that both these species of *Hamacreadium* are also found in groupers.

Hamacreadium mutabile Linton, 1910 (Figure 22)

This is a well known fluke first described by Linton (1910) from *Lutjanus griseus.* McCoy (1930) studied its life history, and that of *Hamacreadium gulella* infecting *L. griseus* from Dry Tortugas, Florida. Manter (1947) reported *Hamacreadium mutabile* from *L. griseus*, *L. apodus*, *L. jocu*, *L. analis*, and *L. synagris*. An important characteristic of this parasite is that the position of the genital pore can vary from its usual location on the left of middle and to be median, to the right (Manter, 1947). Siddiqi and Cable (1960) reported this fluke from *L. analis*, *L. jocu*, *L. griseus*, *L. apodus*, and *Ocyurus chrysurus* caught in Parguera, Puerto Real, Punta Arenas, and Mayagüez, Puerto Rico. Nahhas and Cable (1964) collected the same fluke from *L. apodus*, *L. griseus* and *L. jocu* from Curaçao and Jamaica. Dyer *et al*. (1985) reported this parasite from *L. apodus* and *L. griseus*. Vélez (1987) reported *H. mutabile* infecting only *L. synagris* from Santa Marta, Colombia. This fluke was also reported by Caballero (1990) parasitizing *O. chrysurus* from Mexico. Bunkley-Williams *et al.* (1996) reported this digenean from *L. synagris*. In a recent report, Dyer *et al*. (1998) reported it from *L. griseus* from Puerto Rico. In the present study, 56 *Hamacreadium mutabile* were collected from a single *L. griseus*, and seven were collected from one *O. chrysurus* (Table 5). *Lutjanus griseus,* which was designated type host by Linton (1910) had the highest mean intensity. Reports made by Linton (1910), McCoy, (1930), Manter (1947), Siddiqi and Cable (1960), Nahhas and Cable (1964), Dyer *et al*. (1985, 1998), Velez (1987); Caballero (1990), Williams *et al.* (1996) and additional reports made in this study propose this species of *Hamacreadium* family host specific for members of the family Lutjanidae.

Family **Lepocreadiidae** Nicoll, 1934

Lepocreadium troncatum Nahhas and Cable, 1964 (Figure 23)

Siddiqi and Cable (1960) first collected this parasite from *Ocyurus chrysurus* from Cabo Rojo, Puerto Rico, but only placed it in the genus because they had a single specimen in poor condition. Nahhas and Cable (1964) described *Lepocreadium troncatum* based on one specimen from Curaçao and three from Puerto Rico from the intestine of *O. chrysurus*. Bunkley-Williams *et al*. (1996) reported this parasite from *Opisthonema oglinum* (Lesueur, 1818) and *Calamus pennatula* Guichenot, 1868. This species differs from *Lepocreadium trulla* and *L. maris* (Caballero, 1957) chiefly in sucker ratio and in having tandem rather than diagonal testes (Nahhas and Cable, 1964). In the present study, only one specimen was collected from one *O. chrysurus* (Table 5).

Lepocreadium trulla (Linton, 1907) Linton, 1910 (Figure 24)

Linton (1907) described this parasite as *Distomun trulla*. He relocated it to the genus *Lepocreadium* in 1910 from the type host, *Ocyurus chrysurus,* from Bermuda. Siddiqi and Cable (1960) collected *Lepocreadium trulla* from *Rhomboplites aurorubens* and *O. chrysurus*. Nahhas and Cable (1964) reported this parasite from *O. chrysurus* from Curaçao and Jamaica. Vélez (1987) reported *Lepocreadium trulla* from *Lutjanus synagris*, *L. jocu* and *L. purpureus*. Dyer *et al.* (1985, 1998) reported the same parasite from *O. chrysurus* from Puerto Rico. Other reports from Puerto Rico made by Bunkley-Williams *et al.* (1996) reported *Lepocreadium sp*. from *L. apodus*. In the present study, five *L. trulla* were collected from one *O. chrysurus* (Table 5). This parasite is also found

in other families of fishes, but the intensities suggest that *O. chrysurus* is the primary host (Yamaguti, 1971; Vélez 1978).

Family **Hemiuridae** (Loos, 1899) Luhe, 1901

Brachyphallus parvus (Manter, 1947) Skrjabin and Gushanskaja, 1955 (Figure 25)

Syn. ***Lecithochirium parvum*** Manter 1947

This parasite has been placed in the genera *Brachyphallus, Lecithochirium* and *Sterrhurrus*, but the worm does not appear to fit well into any described genus (Williams and Bunkley-Williams, 1996). Manter (1947) originally described this parasite as *Lecithochirium parvum* from *Epinephelus striatus*. Skrjabin and Gushanskaja (1955) placed it in the genus *Brachyphallus.* Overstreet (1969) put it back in the genus *Lecithochirium* because it lacks the deep striations on the sides of the body that are characteristic of *Brachyphallus*. Yamaguti (1971) stated that this parasite could not be placed in *Lecithochirim* because it lacks a prostatic vesicle characteristic of the genus, but still listed it under this genus. Williams and Bunkley-Williams (1996) reported it in the genus *Brachyphallus*.

It has been reported from a wide range of hosts. Overstreet (1969) reported the following genera of marine fishes as hosts of this parasite: *Archosargus, Bathygobius, Caranx, Elops, Eucinostomus, Haemulon, lagodon, Lutjanus, Mycteroperca, Scorpaena* and *Synodus*. Williams and Bunkley-Williams (1996) reported it from tunas, jacks and greater amberjack. Nahhas and Cable (1964) collected the same trematode in different species of marine fishes, including *Lutjanus apodus*, *L. aya* (*L. vivanus*) and *L. griseus* from Curaçao and Jamaica. Overstreet (1969) collected the worm from other marine

fishes including *L. synagris* from the east coast of Florida. Dyer et *al*. (1985) reported the fluke in several fishes including *L. buccanella* from the coastal waters of western and southwestern Puerto Rico. Vélez (1987) reported *Brachyphallus parvus* in *L. synagris* from the vicinity of Santa Marta, Colombia.

In the present study, two specimens were collected in the intestine and seven in the gills of *L. griseus* (Table 5). Some digenetic trematodes can be found in the gills of marine fishes when they are examined because in the process of capturing and handling the fish their stomach contents can be refluxed into the esophagus and mouth. Twenty nine specimens were collected from the pyloric cecae of *L. analis*; nine specimens were collected from the intestine; one from the stomach; and one from the gills of *L. vivanus*; one specimen was collected from the gills of *L. mahogoni*; one was collected from the stomach of *Pristipomoides aquilonaris*; and seven from the gut and ten on the gills of *Ocyurus chrysurus*. All are new host records for *Brachyphallus parvus*. The mean intensity calculated for each infection ranged from 2 to 5.7 (Table 13). *Ocyurus chrysurus* had the highest mean intensity indicating a high degree of host specificity among the snappers. Clearly, this parasite has little host specificity, or it might represent a complex of species that are difficult to distinguish.

Family **Prosogonatrematidae** Pérez Vigüeras, 1940

Syn**. Bhaleraoiidae** Srivastava, 1948

Prosogonotrema bilabiatum Pérez Vigüeras 1940 (Figure 26)

Pérez-Vigüeras (1940) proposed the genus *Prosogonotrema* using *Prosogonotrema bilabiatum* as the type species from *Ocyurus chrysurus* from Cuba and

Jamaica. Yamaguti (1971) reported another species of this genus, *Prosogonotrema symmetricum,* in three species of snappers: *Pristipomoides typus, P. microlepis* and *P. sieboldii* from Hawaii. Vélez (1987) collected the same worm in *Lutjanus synagris* from the vicinity of Santa Marta. Nahhas and Cable (1964) reported this trematode in *O. chrysurus* from Curaçao and Jamaica. Peña-Alvarado (2002) collected it from a Greater Amberjack representing new host and locality record or prey contamination.

Prosogonotrema bilabiatum is characterized by its robust plump body and covered with a thick cuticle making it very noticeable when examining the fish. In the present study three specimens were collected from one *O. chrysurus* (Table 5).

General analysis- The following analysis compares the present study with published reports for species of digenea found in snappers by other workers. In the present study, 10 species of digenetic trematodes were collected from 131 specimens of 11 species of snappers (Table 13). Siddiqi and Cable (1960) reported nine species of flukes from eight species of snappers (number of specimens examined from each species was not reported) from Puerto Rico, including *Lutjanus aya* = (*L. purpureus),* which was not examined in this study. In the present study, *Rhomboplites aurorubens* was negative for Digenea but Siddiqi and Cable (1960) found *Lepocreadium trulla* in this fish. They reported *Siphodera vinaledwardsii* in *L. analis*, and *Diplangus anoplosus* in *Ocyurus chrysurus* which were not found in the present study. All seven remaining species were found in the present study. Four species of flukes found in the present study were not reported by them.

Nahhas and Cable (1964) reported a total of 17 species of flukes from 10 species of snappers from Curaçao and Jamaica. Nine species of snappers from Curaçao, with a total of 45 specimens examined, had 12 species of flukes. Six species of snappers from Jamaica, with a total of 82 specimens, had 12 species of digeneans. They reported *Metadena globosa* in *L. purpureus* and *O. chrysurus*; *Metadena crassulata* in *L. apodus*; *Siphodera vinaledwardsii* in *L. purpureus*, *L. buccanella*, *L. synagris*, and *O. chrysurus*; *Helicometrina nimia* in *L. jocu*; *Homalometron foliatum* in *L. mahogoni*; and *Stephanostomum sentum* in *Lutjanus* sp. none of which was found in this study. The remaining 11 species of digenetics were found in the present study. They found six more species than the present study but they examined snappers from two distinct locations.

Overstreet (1969) reported 15 species of Digenea collected in five species of snappers (112 snappers examined with 77 infected) from Florida. He reported *Helicometrina nimia* in *L. analis*, *L. mahogoni*, and *O. chrysurus*; *Stephanostomum tenue* in *L. apodus*, and *L. mahogoni*; *Lecithochirium microstomum* in *L. synagris*; and *Hamacreadium confusum* and *Paracryptogonimus americanus* in *O. chrysurus,* of which none was collected in this study. The remaining 10 species were common to the present study, only *Hamacreadium lintoni* from the present study was not reported by Overstreet (1969).

Vélez (1987) studied the digenea of snappers of the Caribbean Colombia. She reported 14 species of digenea infecting six species of snappers. Vélez (1987) reported *Hamacreadium gullela* in *L. synagris* and *L. purpureus*; *Pseudopecuelus tortugae* in *L. synagris*; *Helicometrina nimia* in *L. synagris*, *L.griseus*, and *L. apodus*; *Siphodera vinaledwardsii* in *L. synagris*, *L. purpureus* and *L. griseus*; *Metadena globosa* in *L.*

synagris and *L. purpureus*; *Sterrhurus microcercous* in *L. jocu*; *Aponurus laguncula* in *L. purpureus* and *L. synagris*; and *Hirudinella ventricosa* in *L. synagris*, all these species of flukes were not found in this study. The remaining six species were common to both studies. Five species in the present study were not reported by her. Vélez (1987) reported a diverse digenean fauna in *L. synagris* compared with the other species she examined, but this is probably because she examined 313 *L. synagris* and only 31 specimens of the other five species of snappers. Probably, if Vélez (1987) have had examined equal numbers of each species of snappers she would have found a more diverse digentic fauna in all the species examined.

Recently, Nahhas and Carlson (1994) reported 13 species of Digenea in five species of snappers (a total of 82 specimens examined) from Jamaica They reported *Metadena crassulata* in *L. analis*; *Metadena globosa* in *L. apodus* and *O. chrysurus*; *Allomegasolena spinosa* in *L. apodus*, *Siphodera vinaledwardsii* in *L. analis*, *L. synagris* and *O. chrysurus*; *Sterrhurrus musculus* in *L. apodus*, and *O. chrysurus*; *Helicometrina nimia* in *L. jocu* and *O. chrysurus*, all of which were not found in the present study. The remaining seven species of Digenea were also found in the present study.

Both studies from Jamaica indicate a somewhat different fauna from the present study. Perhaps the influence of the Gulf of Mexico fauna is more pronounced in Jamaica, with Puerto Rico more similar to the Florida fauna.

Phylum **Platyhelminthes**

Class **Monogenea**

Monogeneans are small to medium sized flatworms that complete their life cycle on the host with immature worms usually morphologically similar to the mature forms (Hoffman, 1999). The Monogenea are diverse both in terms of morphology and numbers, they are generally host specific, and their phylogeny is well resolved, at least to the family level (Poulin, 2002).

Several structures are important for the identification of Monogenea including the posterior attachment organ, or haptor, and its associated hard (sclerotized) structures. In addition, the shape and nature of the anterior attachment structures, reproductive system, and digestive system are also important in keying these worms (Hendrix, 1994). Hendrix (1994) defined the haptor as the posterior attachment organ which usually carries additional components such as marginal hooks, hamuli, accessory sclerites, armed suckers, or clamps. The male reproductive system consists of one or more round, ovoid or lobated testes; a vas efferens, which expands or fuses into an ejaculatory duct; a genital atrium; a distal sclerotized ejaculatory duct and unicellular prostatic glands (Roberts and Janovy, 2000). In several families, the copulatory complex includes a sclerotized copulatory apparatus that joins with the ejaculatory duct. This apparatus commonly consists of a penis and an accessory piece. These components vary widely in structure among species but are similar within a species and, therefore, are important taxonomic characters (Roberts and Janovy, 2000). A single ovary is anterior to the testis and among species varies in shape from round or oval to elongated or lobated (Roberts

and Jonovy, 2000). The position and shape of the ovary, uterus, vagina, genital pore and egg are used as diagnostic characteristics (Hendrix, 1994).

Identification of the monogeneans to genus was made using Yamaguti (1963b). The monogeneans identified in the present project are members of the family *Microcotylinae* Monticelli, 1892; *Dactylogyridae* Bychowsky, 1933 and *Diplectanidae* Bychowsky, 1957.

In the present study, monogeneans were found in 11 of the 13 species examined. In the case of the three specimens of *Apsilus dentatus* and 14 *Etelis oculatus* examined including the gills, no gill worms were found.

Subclass **Polyonchoinea** Bychowsky, 1937

Order **Dactylogyridea**

Suborder **Dactylogyrinea**

Family **Dactylogyridae** Bychowsky, 1933

Subfamily **Acyrocephalinae** Bychowsky, 1937

Genus ***Haliotrema*** Johnston et. Tiegs, 1922

The Genus *Haliotrema* was erected by Johnston and Tiegs (1922) for the monogenean *Haliotrema australe*, from *Upeneus signatus* (Gunther, 1867). *Haliotrema* has since grown into a taxonomic "waste-basket" with 116 nominal species (Klassen, 1994) Klassen (1994) considers these species to have potential for uncovering unambiguous information about geographical distribution.

Species of *Haliotrema* can develop heavy infections in captive fishes and cause pathological changes to host gill tissues, and may contribute to mortality under culture

conditions. Infected fishes often are reported to display exophthalmia, bacterial septicemia, liver pathology or infestation with *Caligus* sp. (Kritsky and Stephens, 2001).

Zhukov's (1976) important work on this genus erected 10 new species from 8 species he examined from around Havana, Cuba. Of the 10 species of *Haliotrema* 5 still remain in the genus and these were found in the present study. The following species of *Haliotrema* were collected from different species of the family Lutjanidae (Pisces):

Haliotrema cornigerum Zhukov, 1976 (Figure 27)

Zhukov (1976) described this species from *Lutjanus synagris* and collected the same parasite from *L. mahogoni*. In the present study, a total of 20 *Haliotrema cornigerum* were collected from four *L. mahogoni.* The mean intensity (Table 13) was of five. The presence of this species of monogenean only on *L. mahogoni* may indicate that this snapper is more susceptible than the other snappers. There are no additional reports of this parasite infecting these species of snappers since Zhukov's (1976) description. This project examined eight *L. synagris* (Table 4) from different localities around the island and none was infected with this parasite.

Haliotrema gracilihamus Zhukov, 1976 (Figure 28)

Zhukov (1976) described this gillworm from *Lutjanus apodus*. He made additional reports of this parasite from *L. jocu*. In the present study, 35 *Haliotrema gracilihamus* were collected from 12 *L. griseus*; eight from three *L. mahogoni*; two were collected from two *L. apodus,* and two from one *L. jocu* (Table 6). *L. griseus* and *L. mahogoni* are new host records for this species of parasite. It is interesting that Zhukov

(1976) did not find this parasite on *L. mahogoni* even though he examined this host. The mean intensities ranged from 1 to 4. The highest mean intensities were obtained on *L. mahogoni* with 4 and *L. griseus* with 2.9 (Table 13). Zhukov used *L. apodus* as the type host for this species, but in the present collection *L. apodus* had the lowest mean intensity of the infected species.

Haliotrema heteracantha Zhukov, 1976 (Figure 29)

Zhukov (1976) described this gillworm from *Lutjanus synagris*. He also collected it from *L. mahogoni*, *L. apodus* and *O. chrysurus*. In the present study, 74 *Haliotrema heteracantha* were collected from seven *L. synagris*; 27 were collected from eight *L. analis*; three were collected from two *L. griseus*; six from *L. mahogoni* and three from one *O. chrysurus* (Table 6). *L. griseus* is a new host record for this parasite. The mean intensities for each infection ranged from 1.5 to 10.6 (Table 13). *L. synagris,* type host for this species, had the highest mean intensity (10.6). *L. griseus* had the lowest mean intensity (1.5), but this host was infected with 3 of the 4 species of *Haliotrema* collected in this study (Table 6).

Haliotrema longihamus Zhukov, 1976 (Figure 30)

Zhukov (1976) described this gillworm from *Lutjanus synagris*. He also found it on *L. analis* and *L. mahogoni*. In the present study, 19 *Haliotrema longihamus* were collected from six *L. synagris*; 34 from nine *L. analis*, two from two *L. griseus*, and one from one *L. mahogoni* (Table 6). Zhukov (1976) did not examine *L. griseus* during his research and there are no recent reports of the grey snapper as host of *H. longihamus*.

This represents a new host record for this parasite. No *H. longihamus* was found in *L. mahogoni,* in the present study. The mean intensity for each infection ranged from 1 to 3.4 (Table 13). *Lutjanus synagris* and *L. analis* had the highest mean intensity. Results suggest this species of parasite to have a higher degree of host specificity to *L. synagris* and *L. analis* compared with *L. griseus*.

Haliotrema magnigastrohamus Zhukov, 1976 (Figure 31)

Zhukov (1976) described this monogenean from *Lutjanus synagris*. He also reported this parasite on *L. mahogoni* and *Ocyurus chrysurus*. In the present study, seven *Haliotrema magnigastrohamus* were collected from four *L. synagris* and 12 were collected from eight *L. analis* (Table 6), however none were collected from *L. mahogoni* or *O. chrysurus*. *L. analis* is a new host record for this parasite. The mean intensity for each infection ranged from 1.5 to 2.3 (Table 13). *L. synagris,* type host, had the highest mean intensity suggesting that it had a higher susceptibility than *L. apodus*.

Genus ***Euryhaliotrema*** Kritsky and Boeger, 2002

Kritsky and Boeger (2002) erected this genus with *Euryhaliotrema chaoi* as type species from *Plagioscion sp*. and *P. squamosissimus* (Heckel, 1840). *Euryhaliotrema* is distinguished by one character, a bulbous base on the copulatory organ (Kritsky and Boeger, 2002). The name refers to the broad saline conditions, freshwater to marine, in which members of the genus occur (Kritsky and Boeger, 2002).

Zhukov (1976) described *Haliotrema longibaculum, H. tubocirrus, H. torquecirrus, H. paracanthi* and *H. fastigatum* from different species of snappers from

Havana, Cuba and the Gulf of Mexico. Kritsky and Boeger (2002) relocated these monogenean to the genus *Euryhaliotrema* because of the presence of a bulbous base on the copulatory organ.

Euryhaliotrema fastigatum (Zhukov, 1976) Kritsky and Boeger, 2002 (Figure 32)

Zhukov (1976) described this monogenean as *Haliotrema fastigatum* from *Lutjanus apodus*. He also reported it from *L. jocu*. In the present study, four *Euryhaliotrema fastigatum* were collected from two *L. analis*; 14 were from six *L. griseus,* and 11 from one *L. jocu* (Table 6). Zhukov (1976) did not find this parasite on *L. analis* and did not examine *L. griseus.* Both are new host records. The mean intensity for each infection ranged from 1.3 to 11 (Table 13), with *L. jocu* with the highest. It may have a higher degree of host specificity than the other infected hosts. No *E. fastigatum* were collected from the type host, *L. apodus.*

Euryhaliotrema torquecirrus (Zhukov, 1976) Kritsky and Boeger, 2002 (Figure 33)

Zhukov (1976) described this monogenean as *Haliotrema torquecirrus* from *Ocyurus chrysurus*. He also reported the same parasite on *Lutjanus mahogoni* and *L. synagris*. In the present, study five *Euryhaliotrema torquecirrus* were collected from three *L. synagris*; six from three *L. analis*; five from four *L. griseus*; one from one *L. mahogoni,* and 33 were collected from three *O. chrysurus* (Table 6). *L. analis* and *L. griseus* are new host records for *Euryhaliotrema torquecirrus*. The mean intensity for each infection ranged from 1.3 to 11.0 (Table 13) with *O. chrysurus,* type host of this

species, having the highest mean intensity. This result may indicate a higher degree of host specificity of this snapper compared with the other infected fishes.

Euryhaliotrema tubocirrus (Zhukov, 1976) Kritsky and Boeger, 2002 (Figure 34)

Zhukov (1976) described this species as *Haliotrema tubocirrus* and designated *Lutjanus synagris* as the type host species. He also reported it from *L. analis, L. apodus, L. cyanopterus, L. mahogoni* and *Rhomboplites aurorubens*. In the present study, five *Euryhaliotrema tubocirrus* were collected from three *L. synagris*; nine from five *L. analis*; 71 were from seven *L. vivanus*; seven from five *L. griseus*, three from one *L. mahogoni*, and 12 from three *L. buccanella* (Table 6). *L. vivanus, L. griseus* and *L. buccanella* are new host records for *Euryhaliotrema tubocirrus.* This species of *Euryhaliotrema* was the only monogenean collected from seven *L. vivanus* and three *L. buccanella*. The mean intensity for each infection (Table 13) ranged from 1.0 to 10.1. The three new hosts had the higher mean intensities. (*L. vivanus* 10.1, *L. buccanella* 4.0 and *L. griseus* 1.8) than the type host *L. synagris,* which had 1.7 (Table 13). Between the host species reported by Zhukov and the present work, there are seven species of hosts for the worm possibly indicating that this is the least host specific of the *Haliotrema-Euryhaliotrema* generic complex. It is interesting that Zhukov used *L. synagris* as the type host. In the present study, only three of eight *L. synagris* were parasitized with only 1-2 of these worms. The highest intensity found was in *L. vivanus*.

General discussion of *Haliotrema-Euryhaliotrema* Complex: Zhukov (1976) reported 10 species of the complex on eight species of snappers from the north coast of Cuba. In the present study, two of these species were not found, *Euryhaliotrema longibaculum*

from *Lutjanus synagris* and *Euryhaliotrema paracanthi* from *L. apodus*, even though eight and seven, respectively, of these hosts were examined.

Since Zhukov (1976) does not report intensities of infection it is difficult to compare host specificity between the two studies. However, if we assume that the type hosts had the highest infection rate, then we can make some observations. Two type hosts from the Zhukov (1976) study were not found to have their respective parasites in Puerto Rico. *Haliotrema cornigerum* was not found on *L. synagris* in Puerto Rico, even though eight specimens were examined and *Euryhaliotrema fastigatum* was not found in *L. apodus* even though seven specimens were examined. *Haliotrema cornigerum* was not found on *L. mahogoni* in Puerto Rico. *Euryhaliotrema fastigatum* was reported by Zhukov (1976) on the type host and also on *L. jocu*. In the present study, it was found also on *L. jocu*, *L. griseus* and *L. analis* with the highest mean intensity. In five cases where the type host was also parasitized in Puerto Rico, it had the highest mean intensity of all the Puerto Rico hosts. Only one case showed that the type host, when parasitized, had a lower mean intensity and the difference between the type host and the host with the highest intensity was slight (3.2 vs. 3.4).

Diversity of this group of parasites on hosts as fairly similar between the two studies, except for *L. analis* and *L. apodus,* where *L. apodus* had a higher diversity in Cuba and *L. analis* had a higher diversity in Puerto Rico. Number of host species infected by this group of parasites was also similar between the two studies, with *Euryhaliotrema tubocirrus* with six hosts in each study. *Haliotrema heteracantha* and *Euryhaliotrema torquecirrus* each were parasitizing five fish species in the present study. Two species of parasites shifted hosts between Cuba and Puerto Rico. *Haliotrema*

magnigastrohamus was not found on *O. chrysurus* and *L. mahogoni* in Puerto Rico. *Euryhaliotrema tubocirrus* was not found on *L. apodus* in Puerto Rico. These differences could indicate changes in host's specificity between the Gulf of Mexico and the Caribbean.

Family **Diplectanidae** Bychowsky, 1957

Genus ***Diplectanum*,** Diesing, 1858

Diplectanum sp. Yamaguti 1968 (Figure 35)

Yamaguti (1968) described *Diplectanum curvivagina* from *Pristipomoides sieboldii* (type host) and *Arnillo* (*Pristipomoides*) *auricilla* (Jordan *et al.*, 1927) from Hawaii. This species is characterized by the anterior position and peculiar shape of the vagina, and the C-shaped cirrus with poorly developed prostatic complex (Yamaguti, 1968). In the present study, 17 *Diplectanum* sp. were collected from two *Pristipomoides aquilonaris* (Table 6). The mean intensity for this infection was of 8.5 (Table 13). *Diplectanum* sp. found in this study is morphologically similar to *D. curvivagina*, but differs greatly in the measurements of the diagnosis characters. There are no reports of this parasite infecting this species of snappers in the Caribbean. *D. curvivagina* hosts are from the same genus, *Pristipomoides,* but are located in the Pacific. This is an example of how parasites can evolve with their hosts when the common ancestor of the host shifts to different geographical locations and becomes different species, but still withn the same genus. Their parasite also evolves and becomes two different species originating from a common ancestor. This study compares the differences between Yamaguti's (1968) description of *D. curvivagina* with the new species found in Puerto Rico.

Habitat: On the gills of two *Pristipomoides aquilonaris* (type host) from Puerto Rico.

Description: The description is based on three specimens from the type host. The body is elongate and fusiform, measuring 0.52- 0.66 mm long, much smaller than 0.76-1.2 mm from Yamaguti's (1968) description. It is 0.10-0.12 mm wide at a postequatorial level, not 0.18-0.34 mm (Yamaguti, 1968). The opisthohaptor measured 124-146 μm wide, not 60-220 μm (Yamaguti, 1968), and it is well constricted off from body proper. The squamodisc is circular and 26-30 μm in diameter, not 45-60 μm (Yamaguti, 1968), consisting of eight concetric rows of scale-like ridges which are in the same range of 8-10 of Yamaguti's description. The dorsal anchor is 34-38 μm long lineally from the tip of the longer root to the height of the curve of the blade, not 52-63 μm (Yamaguti, 1968). The ventral anchor is stouter than the dorsal anchor, measuring 40-42 μm long from the tip of the long ventral root to the height of the curve of the blade, not 62-73 μm (Yamaguti, 1968). The median bar is 30-34 μm long, not 52-65 μm (Yamaguti, 1968), and it is tapered at both ends. The submedian bar is gently simoid, with nodular dorsal projection near the rounded inner end, 82-96 μm long, much larger than 57-73 μm (Yamaguti, 1968). The marginal hooklets are 8 μm which are in the same range of 8-10 from Yamaguti's description. The head is trapezoidal, 46-70 μm wide at the base and not 90-130 μm (Yamaguti, 1968), with several pairs of marginal head organs. Two pairs of eyespots are anterior to the pharynx. The pharynx measures 20-32 x 24-40 μm, not 55-65 x 40-60 μm (Yamaguti, 1968). The esophagus was not observed. The cecae terminate separately at the posterior end of body.

Testis are small and measure 40-56 x 22-34 μm and are located equatorial to the body; they are longer than in Yamagiti's description, but are practically of the same

width; 30-45 x 20-35 µm. The cirrus is tubular and curved like a letter C, 84-90 µm long, not 100-120 µm (Yamaguti, 1968) The ovary is elongate, measuring 52-60 x 36 µm immediately pretesticular, not 40-64 x 15-45 µm as in Yamaguti's description. The vagina is tubular measuring 30-40 µm long and curved like a semicircle, not 40-45 µm. It opens ventral to the left cecum at the level of the cirrus. No eggs were observed. The vitellaria is co-extensive with intestine.

Family **Microcotylidae** Taschenberg, 1879

Genus ***Microcotyloides*** Fujii, 1944

Microcotyloides incisa (Linton, 1910) Fujii 1944 (Figure 36)

Linton (1910) described this monogenean and Fujii (1944) placed it in a new genus, *Microcotyloides,* collecting the gill worm on *Neomaenis griseus* (*Lutjanus griseus*) from Florida. Mendoza-Garfias and Pérez-Ponce de Léon (1998) reported *Microcotyloides incisa* from *L. argentiventris, L. guttatus, L. jordani* and *Umbrina xanti* from Camela Bay, Cuba. Two mature *Microcotyloides incisa* were collected from one *L. analis*, and two juveniles from another *L. analis*; five were collected from three *L. griseus*; three were collected from *L. apodus*, eleven were collected from *L. jocu* and five from *Rhomboplites aurorubens* (Table 6). There are no previous reports of *M. incisa* infecting *L. analis*, *L. apodus*, *L. jocu* or *R. aurorubens*. The mean intensity for each infection (Table 13) ranged from 2 to 11. *L. jocu* had the highest mean intensity (11) following *R. aurorubens* with a mean intensity of (5). These snappers presented a higher degree of host specificity compared with the other infected hosts (Table 13). This species of *Microcotyloides* had little host specificity among species of fishes of the

family *Lutjanidae* from Puerto Rico. Reports of infections of this parasite on different species of snappers [Linton (1910), Fujii (1944), Mendoza – Garfias and Pérez – Ponce de Léon (1998), Hernández-Vale (2003) and this project suggest] this species of *Microcotyloides* to be family specific for fishes of the family Lutjanidae.

Phylum **Platyhelminthes**

Class **Cestoidea**

Adult forms of tapeworms are not very common in bony fishes. Many species of larval tapeworms are found in the intestinal tract, often in large numbers, and few are encapsulated in the tissue of marine bony fishes including big game fishes (Williams and Bunkley, 1996). These larval forms of cestodes use bony fishes as intermediate host. The adult forms can be found in sharks.

Cohort **Eucestodea**

Subcohort **Eucestoda**

Infracohort **Saccouterina**

Order **Trypanorhyncha**

Family **Tentaculariidae**

Genus ***Nybelinia*** Poche 1926

Nybelina sp. (Figure 37)

Schmidt (1986) reported larval stages of *Nybelina* sp. from many species of marine fishes, most of them at different locations in the Far East. Williams and Bunkley (1996) reported *Nybelina bisulcata*, *N. lamontaeae*, *N. lingualis* and *Nybelina* sp from

bony fishes, sharks and rays in the Caribbean. These larvae can be found encysted as blastocysts in the mesenteries, and the postlarvae in the stomach and intestine of fishes. One *Nybelina* sp. was found in *Lutjanus synagris* and one in *Etelis oculatus* (Table 7). There are no reports of these larval cestodes infecting these two species of snappers, thus they are new host records.

Infracohort **Saccouterina**

Order **Tetraphyllidea**

Family **Oncobothriidae**

Genus ***Ceratobothrium*** Monticelli 1892

Ceratobothrium sp. (Figure 38)

This larval form is commonly found in swordfish (Williams and Bunkley, 1996). In the present study, five *Ceratobothrium* sp. were collected from one *Lutjanus vivanus* (Table 7) which represents a new host record.

Order **Pseudophyllidea**

Family **Bothriocephalidae**

Genus ***Bothriocephalus*** Rudolphi 1808

Bothriocephalus sp. (Figure 39)

Schmidt (1986) reported this cestode larva from many different species of marine fishes from, North America, Hawaii, Egypt and India. Linton (1908) reported *Bothriocephalus scorpii* in the Atlantic mackerel from Woods Hole, Massachusetts and *Bothriocephalus* sp. in the Atlantic bonito, Atlantic mackerel, Greater amberjack and

Chub mackerel also from Woods Hole, Massachusetts, USA (Williams and Bunkley-Williams, 1996). In the present study, one *Bothriocephalus* sp. was collected from the gill wash of one *L. analis* (Table 7), which represents a new host record.

Blastocyst: Most cestode larvae are encysted in a structure called the blastocyst. The shape, thickness, color location in the host, location of the blastocyst, and attachment of the capsule are to be recorded for a possible identification of the larvae (Williams and Bunkley, 1996). In the present study, one blastocyst (Figure 40) was collected from the intestine of one *L. analis.* This blastocyst was confused as a digenetic metacercaria and was stained. It is an oval structure; the contents inside the cyst are yellowish with a dark spot in the center of the cyst.

Procercoid: In the life cycle of cestodes a free swimming ciliated larva is liberated from the egg. This ciliated larva must then be eaten by the first intermediate host. In the first intermediated host this larva sheds its cilia and metamorphoses to the next larval stage called the procercoid. When the first intermediate host is eaten by a second intermediate host, the procercoid penetrates the digestive tract of the host, develops a scolex and turns to the next larval stage called the plerocercoid. In the present study, one procercoid (Figure 41) was collected from *Rhomboplites aurorubens*. This may indicate that this snapper can be an intermediate host for the adult form of this cestode. This larva is characterized by the posterior end structure called the cercomer (Roberts and Janovy, 2000).

Phylum **Nematoda**

Class **Rhabditea**

Order **Ascaridida**

Family **Anisakidae** Railliet and Henry, 1912

Genus ***Anisakis*** Dujardin, 1845

Anisakis simplex Rudolphi (Figure 42)

In its adult stage, *Anisakis simplex* parasitizes marine mammals; however it has several juveniles' intermediate stages in hosts (Moreno-Ancillo *et al*. 1997). *Anisakis* spp. juvenile can produce pathological condition in humans who eat them in raw, salted, or pickled fish. Symptoms generally begin when the juveniles start to penetrate the stomach or intestine of humans from 1 to 12 hours after ingestion or after up to 14 days in the case of intestinal penetration (Roberts and Janovy, 2000). Williams and Bunkley-Williams (1996) summarized the occurrence of *A. simplex* larvae in swordfish from the northwest Atlantic; and in the Atlantic bonito, Atlantic mackerel, shipjack tuna and yellowfin tuna off the northeast coast of the USA.

In the present study, six *A. simplex* were collected from the mesenteries and pyloric cecae, and one from inside the pyloric cecae in two *Lutjanus analis*; one was collected from the pyloric cecae and one from the gut of two *L. griseus*; one was collected from the intestine of *L. mahogoni*; eight were collected from the intestine, one from the pyloric cecae and two from the stomach of eleven *L. vivanus*; one was collected from the stomach of *Etelis oculatus*; and 13 were collected from the pyloric cecae, three in the intestine and one in the stomach of four *Ocyurus chrysurus* (Table 8). The mean intensity for each infection ranged from 1 to 7 (Table 13). *L. analis* had the highest mean

intensity (7), followed *O. chrysurus* (4.8). These results may indicate that these snappers have a higher degree of host specificity for the larvae of these nematodes. These snappers are very common in Puerto Rican waters and are also commercially important fishes. If fishermen are not careful handling these fishes, this parasite may cause serious gastric infections to the consumers of these snappers.

Family **Cucullanidae** Cobbold, 1864

Genus **Cucullanus** Müeller, 1777

Cucullanus **sp.** (Figure 43)

Williams and Bunkley-Williams (1996) reported *Cucullanus carangis* (MacCallum) from the intestine of a crevalle jack at the New York Aquarium which was described as *Dacnitis cangris*, and *Cucullanus pulcherrimus* Barreto from a Black jack in Brazil. In the present study, 24 *Cucullanus* sp. were collected from three species of snappers from three different genera (Table 8). These nematodes may be new species of the genus *Cucullanus*. The only report of this nematode infecting a snapper is by Bharathalakshmi and Sudha (1999), but their specimens do not resemble the nematodes collected in this study, although the nematodes collected in the present study have the general characteristic of the genus. In the present study, four *Cucullanus* sp. were collected from the gut of one *Lutjanus analis*; 14 were collected from the intestine, one from the stomach and one from the pyloric cecae in eight *Etelis oculatus*; two were collected from the intestine and two from the stomach of two *Pristipomoides aquilonaris*. The mean intensity of each infection ranged from 1.3 to 4 (Table 13). *L.*

analis had the highest mean intensity suggesting a higher degree of host specificity for this nematode compared with the other infected hosts.

Family **Camallanidae**

Oncophora melanocephala (Rudolphi) (Figure 44)

Williams and Bunkley-Williams (1996) reported this parasite from an albacore captured off Desecheo Island, Puerto Rico; Atlantic blue marlin, and yellowfin tuna from the southern Gulf of México; swordfish from the northwest Atlantic and in Atlantic bonito, Atlantic mackerel, Bluefin tuna, Bullet tuna and Frigate tuna from the North Sea and Mediterranean. In the present study, only one adult *Oncophora melanocephala* was collected from the intestine of one *Etelis oculatus*. This is a new host record.

Cysts in different location of the digestive tract (Figure 45)**:** Many nematode larvae encyst in the intermediate host mesenteries, stomach, intestine and pyloric cecae as a way to be transported to the definitive host. Other nematodes encyst in the host flesh after the fish is caught as a way of protection and survivor until it is eaten by a new host. These cysts are a way of infection of a gastric infection called anisakiasis caused by nematode members of the family Anisakidae. In the present study, two cysts were collected from the mesenteries and pyloric cecae of one *Lutjanus analis*; three were collected from the intestine of one *L. vivanus* and one was collected from the liver of another *L. vivanus*; one was collected from the pyloric cecae of one *Etelis oculatus*, and one was collected from the intestine of one *Ocyurus chrysurus* (Table 8).

Phylum **Acanthocephala**

Class **Palaeacanthocephalan**

Order **Echinorhynchida**

Family **Rhadinorhynchidae** (Figure 46)

Illiosentis ctenorhynchus Cable and Linderoth

Cable and Linderoth (1963) described this acanthocephalan from *Upeneus martinicus* Cuvier and Valenciennes from Jamaica. In the present study, two acanthocephalans were collected in the intestine of *Etelis oculatus* (Table 9). It posses a long invaginated proboscis, with numerous rows of hooks. At the end of one specimen two elongated cement glands were noticeable. This is a new host record for *Etelis oculatus*.

Phylum **Annelida**

Class **Clitelata**

Order **Hirudinea**

Family **Piscicolidae**

Genus ***Trachelobdella*** Diesing 1850

Trachelobdella lubrica (Grude) (Figure 47)

In the present study, one *Trachelobdella lubrica* was collected from the gills of each of four *Lutjanus griseus* and one on *L. jocu* (Table 10). Knight-Jones (1962) reported the occurrence of this leech on fishes of the Mediterranean, but does not report any species of snappers as host species. This report is a new host record for these two snappers.

Subclass **Copepoda**

Order **Siphonostomatoida**

Family **Caligadae**

Genus ***Caligus*** Müller, 1785

One of the most successful genus of parasitic copepods, *Caligus* consists of about 200 species, distributed throughout the oceans and seas of the world (Kabata, 1979). A *Caligus* was the second species of fish parasitic copepod ever mentioned in the scientific literature and the genus was established in 1785 (Williams and Bunkley-Williams, 1996). This genus is a common parasite of marine teleosts. They are large, and easily noticeable when examining the gills arches of fishes. They also swim very fast, making them hard to collect when alive.

Caligus asperimanus Pearse, 1951 (Figure 48)

Pearse (1951) described this species of *Caligus* from *Lutjanus analis* collected at the Bahamas. Cressey (1991) reported the same copepod from *L. analis*, *L. apodus, L. jocu* and *L. synagris* collected from the Gulf of Mexico and the Caribbean Sea. In the present study, six *Caligus asperimanus* were collected from three *L. analis*; and two from one *L. apodus*; six from three *L. vivanus*; seven from one *L. buccanella*, and thirteen from *Apsilus dentatus* (Table 11). All are new host records for this copepod. The mean intensity of each infection (Table 13) ranged from 1.8 to 13. *Apsilus dentatus* had the highest mean intensity (13) followed by the *L. buccanella* (7). Reports of this copepod infecting different species of snappers (Pearse, 1951; Cressy, 1991) and

additional reports from this study suggests that this copepod is specific of the family Lutjanidae.

Caligus irritans Heller, 1868 (Figure 49)

Wilson (1935) reported this *Caligus* in *Lutjanus griseus* from Dry Tortugas. Bunkley-Williams and Williams (1994) reported the same copepod in one *L. griseus* from Joyuda Lagoon, Puerto Rico. They commented that this copepod could be found in low intensities in *L. griseus* from the freshwaters around the coast of the island because this parasite may not survive in freshwater for a long time. The most recent study of parasitic copepods from Puerto Rico was performed by Steele, 1982. She collected *Caligus irritans* in *L. synagris* and *L. buccanella*.

In the present study, 21 *Caligus irritans* were collected from five *L. griseus*; two were collected from one *L. analis*; and three were collected from one *L. mahogoni*. *L. mahogoni* is a new host record for this parasite. The mean intensity for each infection ranged from 1 to 4.2 (Table 13). The highest mean intensity calculated was on *L. griseus*.

Caligus praetextus Bere, 1936 (Figure 50)

Bere (1936) described *Caligus praetextus* from several hosts from the west coast of Florida. He also collected this parasite from Charlotte Harbor, Florida, from *Lutjanus synagris* and the following hosts: *Bairdiella chrysura* (Lacepède, 1802), *Cynoscion nebulosus* (Cuvier), *Centropomus undecimalis* (Bloch), *Chilomycterus atinga* (Linnaeus), *Diplopodus holbrooki* (Bean), *Diapterus plumieri* (Cuvier), *Echineis naucrates* Linnaeus, *Lagodon rhomboids* (Linnaeus), *Mycteroperca microlepis* (Goode

and Bean), *Synodus foetens* (Linnaeus), *Spheroides nephalus* (Goode and Bean), and *Sciaenops ocellatus* (Linnaeus). Cressy (1991) collected this species of *Caligus* from different species of marine teleosts including *L. synagris*. In the present study, one *Caligus practextus* was collected from one *L. buccanella,* and four were collected from one *L. jocu* (Table 11). *L. buccanella* and *L. jocu* are new host records for this parasite, with the highest mean intensity in *L. jocu*. The mean intensity from each infection ranged from 1 to 4 (Table 13).

Caligus xystereus Cressy, 1991 (Figure 51)

Cressy (1991) described *Caligus xystereus* and reported it from several non – Lutjanids including *Ansisotremus virgnicus, Aulostomus maculates* Valenciennes, 1837*, Calamus calamus, Calamus pennatula, Pomacanthus arcuatus* (Linnaeus, 1758), and *Priacanthus cruenatus* collected at Carrie Bow Cay, Belize. In the present study, one *C. xystereus* was collected from *L. synagris* (Table11). This is a new host record for this opportunistic parasite.

Immature stages of copepods collected: *Caligus* sp. has two free swimming naupliar stages with the second stage molting to produce the first copepodid stage that must find a host or die. It clings to the host by its prehensile antennae and molts to a chalimus. Three or more instars follow attached to the host by the frontal filament, and then two pre- adults stages follow. The pre-adults are not attached by a frontal filament, but are able to move freely over the host's body (Roberts and Janovy, 2000). In the present study, one chalimus stage (Figure 52) was collected in the following snappers: *Lutjanus*

analis, L. synagris, L. mahogoni and *L. vivanus;* and four were collected in *L. jocu* (Table 11). Ten naupliar stages (Figure 53) were collected in *Etelis oculatus* (Table 11). The identification of the species of these copepods to species level was not possible. The identified adult stages collected from these snappers may give us an idea of which copepod corresponds to these chalimus and naupliar stages.

Family **Hatschekiidae**

Genus ***Hatschekia*** Poche, 1902

Hatschekia albirubia Wilson, 1913 (Figure 54)

Wilson (1913) described this copepod on *Lutjanus synagris* from Jamaica. Pearse (1951) reported it on *L. griseus* from the Bahamas. Steele (1983) reported it on *Ocyurus chrysurus* from Puerto Rico. Williams and Bunkley Williams deposited specimens in the US Parasite Collection museum collected from *L. synagris* and *O. chrysurus* from Puerto Rico. In the present study, 14 specimens were collected from four *O. chrysurus*. The mean intensity for this infection was 3.5.

Hatschekia linearis Wilson, 1913 (Figure 55)

Wilson (1913) described this copepod collected from *Bathystoma rimator* from Jamaica. Steele (1982) reported it from *Lutjanus cyanopterus* from Puerto Rico. In the present study, 38 specimens were collected from two *L. buccanella*. This represents a new host record. The mean intensity for this infection was 19.

Hatschekia oblonga Wilson, 1913 (Figure 56)

Wilson (1913) described this species of *Hatschekia* from *Neomoenis aya* (*Lutjanus aya = L. purpureus*) from Jamaica. Pearse (1951) reported this copepod on *L. griseus* and *L. apodus* from the Bahamas. Causey (1960) reported it on *Ocyurus chrysurus* from Mexico. Williams and Bunkley-Williams deposited specimens in the US Parasite Collection museum collected on *L. analis* from Puerto Rico. In the present study, four *Hatschekia oblonga* were collected from four *L. analis*. The mean intensity for this infection was 1.8.

New species of *Hatschekia* – In the present study, three new species of *Hatschekia* were found in *Apsilus dentatus*, *Lutjanus griseus*, *L. vivanus* and *Rhomboplites aurorubens*. These copepods differ from each other in the size of the second antenna and the length and width of the body. Steele (1982) reported new species of *Hatschekia* on *L. buccanella*, *L. griseus* and *L. synagris*. These copepods are in need of revision for the Caribbean region. There are up to 132 reported species in this genus and their small size and cryptic-species characters based on the morphology of the swimming legs makes them extremely difficult to work with. These specimens will be deposited in the US Parasite Collection museum so experts in this genus can work with them.

Hatschekia sp. 1 (Figure 57)

In the present study, seven *Hatschekia* sp. 1 were collected from three *Lutjanus griseus* (Table 11). All the morphological characteristics conform with the diagnosis characters of the genus, *Hatschekia*, but differ from *Hatschekia albirubia*, *H. linearis*

and *H. oblonga* in the size of the second antennae and body form, length and width. The present study agrees that this copepod is a new species. Steele (1982) reported it on the same snapper. The mean intensity for this infection was of 2.3.

Hatschekia sp. 2 (Figure 58)

In the present study, sixteen *Hatschekia* sp. 2 were collected from two *Apsilus dentatus*; and two were collected from *Rhomboplites aurorubens* (Table 11). All the morphological characteristics conform with the diagnostic characters of the genus *Hatschekia*, but differ from *Hatschekia albirubia*, *H. linearis* and *H. oblonga* in the size of the second antenna, body form, length and width. The mean intensity for each infection (Table 13) ranged from 2 to 8. *Apsilus dentatus* had the highest mean intensity possibly indicating a higher degree of host specificity among the infected snappers.

Hatschekia sp. 3 (Figure 59)

In the present study, two specimens were collected from two *Lutjanus vivanus*. All the morphological characteristics conform with the diagnostic characters of the genus, *Hatschekia*, but differ from *Hatschekia albirubia*, *H. linearis* and *H. oblonga* in the very elongate body form and narrow width. The mean intensity for this infection was 1.

Family **Lernanthropidae** Kabata, 1979

Kabata (1979) abolished the family *Anthosomatidae*, moving all its members to the family Lernanthropidae. He erected this new family based on body segmentation of and the presence of a dorsal plate on the segment bearing the fourth leg.

Genus ***Lernanthropus*** de Blainville, 1822

This genus is the most abundant representative of its family and contains the most common species of parasitic copepods (Kabata, 1979).

Lernanthropus eddiwarneri Delamare-Deboutteville et Nunes-Ruivo, 1954 (Figure 60)

Delamare-Deboutteville et Nunes-Ruivo (1954) described *Lernanthropus eddiwarneri* from *Chromis lineatus*, *Lutjanus fulgens*, *L. goreensi* from Senegal. In the present study, two species of this *Lernanthropus* were collected from two *Lutjanus analis*; and one from one *Ocyurus chrysurus* (Table 11). This is a new host record for *O. chrysurus.* Both species of snappers obtained a mean intensity of 1.

Lernanthropus frondeus Wilson, 1913 (Figure 61)

Wilson (1913) described *Lernanthropus frondeus* collected from *Neomaenis aya* (*Lutjanus. aya = L. purpureus*) at Jamaica. Steele (1982) reported this copepod from *L. analis* and *L. cyanopterus* from Puerto Rico. In the present study, five specimens of this copepod were collected from two *L. analis* (Table 11). This result coincides with the report made by Steele (1982).

Lernanthropus kroyeri Van Beneden, 1851 (Figure 62)

Van Beneden (1851) described *Lernanthropus kroyeri* from *Labrax lupus* (Linneaus, 1758) from European waters. Bere (1936) reported the same species from *Lutjanus griseus* at the Gulf of Mexico. Steele (1982) also reported it from *L. griseus* from Puerto Rico. In the present study, five *Lernanthropus kroyeri* were collected from

three *L. griseus* (Table 11). This parasite appears to be a characteristic parasite of *L. griseus*.

Lernanthropus spiculatus Wilson, 1913 (Figure 63)

Wilson (1913) described *Lernanthropus spiculatus* from *Neomaenis synagris* (*Lutjanus synagris*) from Jamaica. Bere (1936) and Pearse (1951) reported this parasite from *L. synagris* at the Gulf of Mexico. Steele (1982) reported it from *L. apodus* from the Caribbean. In the present study, only one *Lernanthropus spiculatus* was collected from a *L. synagris* (Table 11).

Immature stages of copepod of the genus *Lernanthropus:* Two immature stages (Figure 64) of copepods of the genus *Lernanthropus* were collected from a *Lutjanus griseus*.

Family **Lernaeopodidae**

Genus ***Neobrachiella*** Kabata, 1979

Neobrachiella sp. (Figure 65)

Kabata (1979) established the genus *Neobrachiella* to accommodate species previously placed in *Brachiella,* but differed from the type species, *B. thynni*. He also placed species of *Parabrachiella, Probrachiella, Epibrachiella* and *Brachiellina* in *Neobrachiella.* In the present study, one *Neobrachiella* sp. was collected from *L. vivanus*; and ten species were collected from *Pristipomoides aquilonaris* (Table 11). There are no reports of this genus of copepod infecting marine teleosts in the Caribbean.

Infection of fishes with this copepod in the Caribbean may indicate new geographical distribution of this copepod. Another reason for this copepod not to be reported in the Caribbean is that many of the copepods of this genus were originally located in those genera that were accommodated in *Neobrachiella*. Another possibility is that this copepod is a new species. The mean from each infection ranged from 1 to 10 (Table 13). *Pristipomoides aquilonaris* had the highest mean intensity among hosts examined, but only a single specimen was infected from the 29 examined (Table 4).

Class **Malacostraca**

Order **Isopoda**

Approximately 4000 species of isopods have been described, and more than 450 species are known to be associated with fishes (Williams and Bunkley-Williams, 1996). This group of parasites can cause damage at the infection site, which may cause the death of the host. Other groups of isopods are free living, forming part of the food resources of fishes and other animals.

Family **Gnathiidae**

Gnathia spp. (Figure 66)

Gnathia spp. are parasites only as larvae, known as the praniza. This parasite was originally described as a different genus before its true identity was recognized. This stage attaches to a fish host and feeds on blood until its gut is hugely distended, then leaves the host and molts to become an benthic adult that do not feed (Roberts and Janovy, 2000). These isopods are not host specific and can be found on almost any

species of fish. They have not been very well studied and careful work would probably reveal several new species. The presence of this parasite indicates that the fish spent time near the bottom of the ocean (Peña-Alvarado, 2002). When they are in this larval stage they do not possess the characters with which to distinguish the species.

Williams and Bunkley-Williams (1977) reported *Gnathia puertoricensis* from *Lutjanus cyanopterus* and *Gnathia sp*. from *L. bucannella* from Puerto Rico. Williams and Bunkley-Williams also deposited specimens from *Ocyurus chrysurus* and *L. analis* in the U.S. National Parasite Collection. In the present study, seven *Gnathia* spp. were collected from two *L. analis*; three from two *L. apodus*; two from one *L. jocu*, and one from *Pristipomoides aquilonaris* (Table 12). The mean intensity for each infection (Table 13) ranged from 1 to 3.5 with *L. analis* the highest. There are no reports of these larval isopods infecting these species of snappers, indicating new host records.

Family **Aegidae**

Rocinela oculata Harger, 1883 (Figure 67)

In the present study, only one juvenile *Rocinela oculata,* in poor condition, was collected from one *Lutjanus griseus* (Table 12). Kensley and Schotte (1989) reported this species of isopod as a free living species with occurrence in Puerto Rico. There are no reports of this isopod infecting any species of snappers. This may indicate new host parasite record or accidental parasitism.

Rocinela signata Schioedte and Meinert, 1879 (Figure 68)

Rocinela signata is an opportunistic parasite or could be considered a mini-predator. It swims in the water, attaches to a fish, sucks blood, and then leaves. It has even been reported to attack scuba divers at night (Garzón-Ferreira, 1990). In the present study, two *Rocinela signata* were collected from two *Lutjanus analis*; one was collected from one *L. apodus* and another from one *L. griseus* (Table 12). Williams and Bunkley-Williams (1977) reported this copepod on *L. analis* and *L. griseus*. Kensley and Schotte (1989) reported it on *L. analis* from Florida, Tortugas and the Virgin Islands, and in *L. buccanella* from Bahamas. Bunkley-Williams *et al.* (1998) reported the same isopod on *L. analis* from Venezuela.

Table 4.- Species of fishes of the family Lutjanidae examined.

Date of Capture	Species of snapper	Capture Locality	Range TL (cm) - SL (cm)
February 3, 2002	*Lutjanus analis*	Crashboat, Aguadilla	44-33.4
February 3, 2002	*Lutjanus synagris*	Crashboat, Aguadilla	23-17.5
February 3, 2002	*Ocyurus chrysurus*	Crashboat, Aguadilla	33.6-21.7
February 3, 2002	*Lutjanus vivanus*	Mayagüez, El Seco	28.1-20.4
February 3, 2002	*Lutjanus vivanus*	Mayagüez, El Seco	35.2-28.3
February 13, 2002	*Lutjanus vivanus*	Mayagüez, El Maní	
February 13, 2002	*Lutjanus vivanus*	Mayagüez, El Maní	
February 13, 2002	*Lutjanus vivanus*	Mayagüez, El Maní	
February 13, 2002	*Lutjanus vivanus*	Mayagüez, El Maní	
February 13, 2002	*Lutjanus griseus*	Pargueras, Lajas	37-25
February 13, 2002	*Lutjanus griseus*	Pargueras, Lajas	
February 13, 2002	*Lutjanus griseus*	Pargueras, Lajas	
February 13, 2002	*Lutjanus griseus*	Pargueras, Lajas	
February 13, 2002	*Lutjanus griseus*	Pargueras, Lajas	
February 13, 2002	*Lutjanus griseus*	Pargueras, Lajas	
February 13, 2002	*Lutjanus griseus*	Pargueras, Lajas	
February 13, 2002	*Lutjanus griseus*	Pargueras, Lajas	
February 13, 2002	*Lutjanus griseus*	Pargueras, Lajas	
February 13, 2002	*Lutjanus griseus*	Pargueras, Lajas	
February 13, 2002	*Lutjanus griseus*	Pargueras, Lajas	
February 13, 2002	*Lutjanus griseus*	Pargueras, Lajas	
February 13, 2002	*Lutjanus mahogoni*	Pargueras, Lajas	24-22
February 13, 2002	*Lutjanus mahogoni*	Pargueras, Lajas	
February 13, 2002	*Lutjanus synagris*	Pargueras, Lajas	23-*
February 26, 2002	*Lutjanus buccanella*	Pargueras, Lajas	*
February 27, 2002	*Ocyurus chrysurus*	Pargueras, Lajas	44-31
February 27, 2002	*Ocyurus chrysurus*	Pargueras, Lajas	
February 27, 2002	*Ocyurus chrysurus*	Pargueras, Lajas	
February 27, 2002	*Ocyurus chrysurus*	Pargueras, Lajas	
February 27, 2002	*Ocyurus chrysurus*	Pargueras, Lajas	
April 16, 2002	*Lutjanus jocu*	Puerto Real, Cabo Rojo	*
April 16, 2002	*Lutjanus synagris*	Puerto Real, Cabo Rojo	
April 16, 2002	*Lutjanus vivanus*	Puerto Real, Cabo Rojo	
July 10, 2002	*Lutjanus synagris*	Pargueras, Lajas	28-22
July 10, 2002	*Lutjanus synagris*	Pargueras, Lajas	
July 10, 2002	*Lutjanus synagris*	Pargueras, Lajas	
July 10, 2002	*Lutjanus synagris*	Pargueras, Lajas	
July 10, 2002	*Lutjanus analis*	Pargueras, Lajas	27.5-21.5
July 10, 2002	*Lutjanus analis*	Pargueras, Lajas	
July 10, 2002	*Lutjanus analis*	Pargueras, Lajas	
July 10, 2002	*Lutjanus analis*	Pargueras, Lajas	
July 10, 2002	*Lutjanus analis*	Pargueras, Lajas	
July 13, 2002	*Lutjanus apodus*	Pargueras, Lajas	51.5-39
July 13, 2002	*Lutjanus jocu*	Pargueras, Lajas	79-65
July 13, 2002	*Ocyurus chrysurus*	Pargueras, Lajas	44-30
July 13, 2002	*Ocyurus chrysurus*	Pargueras, Lajas	
July 13, 2002	*Ocyurus chrysurus*	Pargueras, Lajas	
July 13, 2002	*Ocyurus chrysurus*	Pargueras, Lajas	
July 13, 2002	*Ocyurus chrysurus*	Pargueras, Lajas	

July 13, 2002	*Ocyurus chrysurus*	Pargueras, Lajas	44-30
July 13, 2002	*Ocyurus chrysurus*	Pargueras, Lajas	
July 13, 2002	*Ocyurus chrysurus*	Pargueras, Lajas	
July 13, 2002	*Lutjanus analis*	Pargueras, Lajas	
July 18, 2002	*Lutjanus analis*	Pargueras, Lajas	
July 18, 2002	*Lutjanus analis*	Pargueras, Lajas	
July 18, 2002	*Lutjanus analis*	Pargueras, Lajas	58-46
July 18, 2002	*Lutjanus analis*	Pargueras, Lajas	
July 18, 2002	*Lutjanus analis*	Pargueras, Lajas	
July 18, 2002	*Lutjanus analis*	Pargueras, Lajas	
July 18, 2002	*Lutjanus analis*	Pargueras, Lajas	
July 18, 2002	*Lutjanus apodus*	Pargueras, Lajas	
July 18, 2002	*Lutjanus apodus*	Pargueras, Lajas	
July 18, 2002	*Lutjanus apodus*	Pargueras, Lajas	28-21.5
July 18, 2002	*Lutjanus apodus*	Pargueras, Lajas	
July 18, 2002	*Lutjanus apodus*	Pargueras, Lajas	
July 18, 2002	*Lutjanus apodus*	Pargueras, Lajas	
July 18, 2002	*Lutjanus griseus*	Pargueras, Lajas	
July 18, 2002	*Lutjanus griseus*	Pargueras, Lajas	
July 18, 2002	*Lutjanus griseus*	Pargueras, Lajas	36.6-28
July 18, 2002	*Lutjanus griseus*	Pargueras, Lajas	
July 18, 2002	*Lutjanus griseus*	Pargueras, Lajas	
July 18, 2002	*Lutjanus mahogoni*	Pargueras, Lajas	
July 18, 2002	*Lutjanus mahogoni*	Pargueras, Lajas	
July 18, 2002	*Lutjanus mahogoni*	Pargueras, Lajas	30.5-26
July 18, 2002	*Lutjanus mahogoni*	Pargueras, Lajas	
July 18, 2002	*Lutjanus mahogoni*	Pargueras, Lajas	
July 18, 2002	*Lutjanus synagris*	Pargueras, Lajas	
July 20, 2002	*Etelis oculatus*	Pargueras, Lajas	
July 20, 2002	*Etelis oculatus*	Pargueras, Lajas	
July 20, 2002	*Etelis oculatus*	Pargueras, Lajas	
July 20, 2002	*Etelis oculatus*	Pargueras, Lajas	
July 20, 2002	*Etelis oculatus*	Pargueras, Lajas	77-60
July 20, 2002	*Etelis oculatus*	Pargueras, Lajas	
July 20, 2002	*Etelis oculatus*	Pargueras, Lajas	
July 20, 2002	*Etelis oculatus*	Pargueras, Lajas	
July 20, 2002	*Etelis oculatus*	Pargueras, Lajas	
July 20, 2002	*Pristipomoides aquilonaris*	Pargueras, Lajas	
July 20, 2002	*Pristipomoides aquilonaris*	Pargueras, Lajas	37-30
July 20, 2002	*Pristipomoides aquilonaris*	Pargueras, Lajas	
July 20, 2002	*Pristipomoides aquilonaris*	Pargueras, Lajas	
August 1, 2002	*Rhomboplites aurorubens*	Pargueras, Lajas	
August 1, 2002	*Pristipomoides aquilonaris*	Pargueras, Lajas	
August 1, 2002	*Pristipomoides aquilonaris*	Pargueras, Lajas	
August 1, 2002	*Pristipomoides aquilonaris*	Pargueras, Lajas	
August 1, 2002	*Pristipomoides aquilonaris*	Pargueras, Lajas	48-31
August 1, 2002	*Pristipomoides aquilonaris*	Pargueras, Lajas	
August 1, 2002	*Pristipomoides aquilonaris*	Pargueras, Lajas	
August 1, 2002	*Pristipomoides aquilonaris*	Pargueras, Lajas	
August 1, 2002	*Pristipomoides aquilonaris*	Pargueras, Lajas	

August 1, 2002	*Pristipomoides aquilonaris*	Pargueras, Lajas	
August 1, 2002	*Pristipomoides aquilonaris*	Pargueras, Lajas	
August 1, 2002	*Pristipomoides aquilonaris*	Pargueras, Lajas	
August 1, 2002	*Pristipomoides aquilonaris*	Pargueras, Lajas	
August 1, 2002	*Pristipomoides aquilonaris*	Pargueras, Lajas	
August 1, 2002	*Pristipomoides aquilonaris*	Pargueras, Lajas	
August 1, 2002	*Pristipomoides aquilonaris*	Pargueras, Lajas	
August 1, 2002	*Pristipomoides aquilonaris*	Pargueras, Lajas	
August 1, 2002	*Pristipomoides aquilonaris*	Pargueras, Lajas	48-31
August 1, 2002	*Pristipomoides aquilonaris*	Pargueras, Lajas	
August 1, 2002	*Pristipomoides aquilonaris*	Pargueras, Lajas	
August 1, 2002	*Pristipomoides aquilonaris*	Pargueras, Lajas	
August 1, 2002	*Pristipomoides aquilonaris*	Pargueras, Lajas	
August 1, 2002	*Pristipomoides aquilonaris*	Pargueras, Lajas	
August 1, 2002	*Pristipomoides aquilonaris*	Pargueras, Lajas	
August 1, 2002	*Pristipomoides aquilonaris*	Pargueras, Lajas	
August 1, 2002	*Etelis oculatus*	Pargueras, Lajas	
August 1, 2002	*Etelis oculatus*	Pargueras, Lajas	
August 1, 2002	*Etelis oculatus*	Pargueras, Lajas	77-49
August 1, 2002	*Etelis oculatus*	Pargueras, Lajas	
August 1, 2002	*Etelis oculatus*	Pargueras, Lajas	
August 1, 2002	*Lutjanus vivanus*	Pargueras, Lajas	
August 1, 2002	*Lutjanus vivanus*	Pargueras, Lajas	45-34
August 1, 2002	*Lutjanus vivanus*	Pargueras, Lajas	
August 1, 2002	*Apsilus dentatus*	Pargueras, Lajas	35-27
August 1, 2002	*Apsilus dentatus*	Pargueras, Lajas	
August 7, 2002	*Lutjanus buccanella*	Pargueras, Lajas	*
October 10, 2002	*Pristipomoides aquilonaris*	Pargueras, Lajas	40-30
October 10, 2002	*Rhomboplites aurorubens*	Pargueras, Lajas	23-25
October 10, 2002	*Rhomboplites aurorubens*	Pargueras, Lajas	
October 10, 2002	*Apsilus dentatus*	Pargueras, Lajas	49-37
October 31, 2002	*Lutjanus buccanella*	Pargueras, Lajas	*
*	*Lutjanus mahogoni*	Pargueras, Lajas	24.5-17.5
September 17, 2003	*Lutjanus jocu*	Cabo Rojo	*

*** Data not recorded** **TL (Total length)** **SL (Standard length)**

Table 5. – Digenetic trematodes from fishes of the family Lutjanidae from Puerto Rico.

Host	Collection number	Parasite	Location found	♦Intensity
Lutjanus analis	980213-1	*Brachyphallus parvus*	Pyloric cecae	29
		Metadena adglobosa	Pyloric cecae	3
		Stephanostomum casum	Pyloric cecae	1
	990907-1	*Stephanostomum casum*	-	2
	020204-1	*Metadena adglobosa*	Intestine	19
	020807-1	*Metadena adglobosa*	Intestine	2
Lutjanus griseus	990913-1	*Hamacreadium mutabile*	Intestine	54
	020216-9	*Brachyphallus parvus*	Gills	1
	020216-10	*Brachyphallus parvus*	Gills	4
		Hamacreadium lintoni	Gills	1
	020216-13	*Brachyphallus parvus*	Gills	1
	020924-1	*Hamacreadium lintoni*	Intestine	1
	020316-1	*Hamacreadium lintoni*	Pyloric cecae	6
	020924-3	*Hamacreadium lintoni*	Intestine	6
		Brachyphallus parvus	Intestine	2
Lutjanus jocu	030917-2	*Hamacreadium lintoni*	Intestine	3
Lutjanus mahogany	020217-1	*Brachyphallus parvus*	*	1
		Paracryptogonimus neoamericanus	*	1
Lutjanus synagris	030128-3	*Hamacreadium lintoni*	Intestine	2
Lutjanus vivanus	020206-1	*Brachyphallus parvus*	Intestine	3
	020216-1	*Hamacreadium mutabile*	Stomach	1
	030106-1	*Brachyphallus parvus*	Intestine	6
		Brachyphallus parvus	Gills	1

		Hamacreadium lintoni	Intestine	3
		Hamacreadium lintoni	Gills	1
		Stephanostomum casum	Intestine	1
		Allomegasolena attenuata	Gills	1
	030128-1	*Brachyphallus parvus*	Stomach	1
		Paracryptogonimus neoamericanus	Stomach	1
		Hamacreadium lintoni	Stomach	1
Ocyurus chrysurus	970305-1	*Allomegasolena attenuata*	*	1
	971029-1	*Paracryptogonimus neoamericanus*	Intestine	22
		Metadena adglobosa	Intestine	1
	991025-1	*Paracryptogonimus neoamericanus*	Guts	63
		Lepocreadium trulla	Guts	5
		Hamacreadium mutabile	Guts	7
		Brachyphallus parvus	Guts	7
		Stephanostomum casum	Guts	3
		Metadena adglobosa	Guts	1
		Allomegasolena attenuata	Guts	2
		Lepocreadium troncatum	Intestine	1
	000831-1	*Prosogonotrema bilabiatum*	Stomach	1
	020317-1	*Brachyphallus parvus*	Gills	4
		Metadena adglobosa	Gills	1
	020317-2	*Prosogonotrema bilabiatum*	Stomach	3
	020317-3	*Brachyphallus parvus*	Gills	6
Pristipomoides aquilonaris	030108-4	*Brachyphallus parvus*	Stomach	1

* Data not recorded ♦ = number of parasites per infected fish

Table 6. – Monogenea from fishes of the family Lutjanidae from Puerto Rico.

Host	Collection Number	Parasite	♦Intensity
Lutjanus analis	020204-1	*Microcotyloides incisa*	2
		Euryhaliotrema fastigatum	3
	020717-1	*Haliotrema magnigastrohamus*	1
		Haliotrema longihamus	6
		Haliotrema heteracantha	1
	020717-2	*Haliotrema longihamus*	10
		Haliotrema heteracantha	2
	020717-3	*Euryhaliotrema fastigatum*	1
		Haliotrema longihamus	2
		Euryhaliotrema tubocirrus	1
		Haliotrema heteracantha	5
		Microcotyloides incisa (juveniles)	2
	020717-4	*Haliotrema longihamus*	3
		Haliotrema magnigastrohamus	3
		Haliotrema heteracantha	1
	020717-5	*Haliotrema heteracantha*	7
		Haliotrema longihamus	2
		Euryhaliotrema tubocirrus	2
		Haliotrema magnigastrohamus	1
	020805-1	*Haliotrema heteracantha*	8
		Haliotrema magnigastrohamus	1
		Haliotrema longihamus	1
	020805-2	*Euryhaliotrema torquecirrus*	2
		Haliotrema magnigastrohamus	1
		Euryhaliotrema tubocirrus	2
	020805-3	*Haliotrema longihamus*	3
		Euryhaliotrema torquecirrus	3
		Haliotrema heteracantha	2

		Haliotrema magnigastrohamus	1
		Euryhaliotrema tubocirrus	1
	020805-4	*Haliotrema longihamus*	3
		Haliotrema heteracantha	1
		Haliotrema magnigastrohamus	1
	020805-6	*Haliotrema longihamus*	2
		Haliotrema magnigastrohamus	3
	020808-1	*Haliotrema longihamus*	2
		Euryhaliotrema torquecirrus	1
		Euryhaliotrema tubocirrus	1
Lutjanus apodus	020730-3	*Haliotrema gracilihamus*	1
	020730-4	*Haliotrema gracilihamus*	1
	020713-1	*Microcotyloides incisa*	3
Lutjanus buccanella	020226-1	*Euryhaliotrema tubocirrus*	5
	020819-1	*Euryhaliotrema tubocirrus*	2
	021031-1	*Euryhaliotrema tubocirrus*	5
Lutjanus griseus	020216-5	*Microcotyloides incisa*	2
		Euryhaliotrema fastigatum	2
		Haliotrema gracilihamus	3
		Haliotrema heteracantha	2
		Euryhaliotrema torquecirrus	2
	020216-6	*Euryhaliotrema tubocirrus*	3
	020216-8	*Haliotrema gracilihamus*	3
		Euryhaliotrema tubocirrus	1
	020216-9	*Haliotrema gracilihamus*	1
		Euryhaliotrema fastigatum	3
	020216-10	*Haliotrema gracilihamus*	4

	020216-11	*Haliotrema gracilihamus*	9
		Euryhaliotrema tubocirrus	1
		Euryhaliotrema torquecirrus	1
	020216-12	*Euryhaliotrema tubocirrus*	3
		Euryhaliotrema fastigatum	1
		Microcotyloides incisa	1
	020216-13	*Euryhaliotrema fastigatum*	2
		Haliotrema gracilihamus	6
		Euryhaliotrema torquecirrus	1
	020216-14	*Euryhaliotrema torquecirrus*	1
		Haliotrema longihamus	1
		Haliotrema gracilihamus	1
		Haliotrema heteracantha	1
	020216-15	*Microcotyloides incisa*	2
		Euryhaliotrema fastigatum	2
		Haliotrema gracilihamus	1
	020216-16	*Haliotrema gracilihamus*	1
	020710-1	*Euryhaliotrema fastigatum*	4
		Haliotrema gracilihamus	3
		Haliotrema longihamus	1
	020917-3	*Haliotrema gracilihamus*	2
	020924-1	*Euryhaliotrema tubocirrus*	1
	020924-2	*Haliotrema gracilihamus*	1
Lutjanus jocu	030917-1	*Microcotyloides incisa*	11
		Euryhaliotrema fastigatum	11
		Haliotrema gracilihamus	2
Lutjanus mahogoni	020217-1	*Haliotrema gracilihamus*	2
		Haliotrema gracilihamus	4

		Euryhaliotrema tubocirrus	1
		Haliotrema longihamus	1
	020217-2	*Euryhaliotrema tubocirrus*	1
		Euryhaliotrema torquecirrus	1
	020728-1	*Haliotrema cornigerum*	5
	020728-2	*Haliotrema cornigerum*	6
	020728-3	*Haliotrema cornigerum*	3
		Haliotrema heteracantha	1
	020728-4	*Haliotrema cornigerum*	5
		Euryhaliotrema tubocirrus	1
	020728-5	*Haliotrema gracilihamus*	2
		Haliotrema heteracantha	2
	020730-1	*Haliotrema heteracantha*	3
Lutjanus synagris	020204-2	*Haliotrema heteracantha*	3
	020217-3	*Haliotrema heteracantha*	48
	020712-1	*Euryhaliotrema tubocirrus*	2
		Haliotrema heteracantha	13
	020714-1	*Haliotrema heteracantha*	4
		Euryhaliotrema torquecirrus	1
		Haliotrema magnigastrohamus	2
		Euryhaliotrema tubocirrus	1
		Haliotrema longihamus	1
	020714-2	*Haliotrema longihamus*	5
		Haliotrema magnigastrohamus	2
	020714-3	*Haliotrema longihamus*	2
		Haliotrema heteracantha	1
		Euryhaliotrema torquecirrus	2
	020714-4	*Haliotrema longihamus*	5
		Euryhaliotrema tubocirrus	2

	020715-1	*Euryhaliotrema magnigastrohamus*	3
		Haliotrema longihamus	3
		Haliotrema heteracantha	2
		Euryhaliotrema torquecirrus	2
	020917-2	*Haliotrema heteracantha*	3
		Haliotrema longihamus	3
Lutjanus vivanus	011116-1	*Euryhaliotrema tubocirrus*	2
	020206-1	*Euryhaliotrema tubocirrus*	19
	020216-2	*Euryhaliotrema tubocirrus*	3
	020216-3	*Euryhaliotrema tubocirrus*	19
	020216-4	*Euryhaliotrema tubocirrus*	18
	020805-8	*Euryhaliotrema tubocirrus*	3
	020919-2	*Euryhaliotrema tubocirrus*	7
Ocyurus chrysurus	020204-3	*Euryhaliotrema torquecirrus*	16
		Haliotrema heteracantha	3
	020917-1	*Euryhaliotrema torquecirrus*	8
	L-6-1	*Euryhaliotrema torquecirrus*	9
Pristipomoides aquilonaris	020401-1	*Diplectanum curvivagina*	5
	020722-1	*Diplectanum curvivagina*	12
Rhomboplites aurorubens	030216-1	*Microcotyloides incisa*	5

♦ = number of parasites per infected fish

Table 7. -Cestoda larvae from fishes of the family Lutjanidae from Puerto Rico.

Host	Collection Number	Parasite	♦Intensity
Etelis oculatus	030108-6	*Nybelina sp.*	1
Lutjanus analis	020204-1	Blastocyst	1
		Bothriocephalus sp.	1
Lutjanus synagris	020118-1	*Nybelina sp.*	1
Lutjanus vivanus	020206-1	*Ceratobotrium sp.*	5
Rhomboplites aurorubens	030216-2	Procercoid	1

♦ = number of parasites per infected fish

Table 8. – Parasitic nematodes from fishes of the family Lutjanidae from Puerto Rico.

Host	Collection number	Parasite	Location found	♦Intensity
Etelis oculatus	030104-4	*Cucullanus* sp.	Intestine	1
	030108-5	*Cucullanus* sp.	Intestine	4
		Cyst	Pyloric cecae	1
		Cucullanus sp.	Pyloric cecae	1
		Oncophora melanocephala	Pyloric cecae	1
	030108-7	*Cucullanus* sp.	Intestine	3
	030109-1	*Anisakis simplex*	Stomach	1
	030109-2	*Cucullanus* sp.	Intestine	3
	030109-3	*Cucullanus* sp.	Intestine	1
	030109-5	*Cucullanus* sp.	Intestine	1
	030204-1	*Cucullanus* sp.	Intestine	1
Lutjanus analis	980213-1	*Anisakis simplex*	Mesenteries/Pyloric cecae	6
		Cyst in tissue	Mesenteries/Pyloric cecae	2
		Cucullanus sp.	Gut	4
		Anisakis simplex	Pyloric cecae	1
Lutjanus griseus	020316-1	*Anisakis simplex*	Pyloric cecae	1
	020924-3	*Anisakis simplex*	*	1
Lutjanus mahogoni	030106-2	*Anisakis simplex*	Intestine	1
Lutjanus vivanus	020216-1	*Anisakis simplex*	Intestine	2
		Cyst in tissue	Intestine	3
	020206-1	*Anisakis simplex*	Intestine	1
	020216-3	Cyst in tissue	Liver tissue	1

	020216-4	*Anisakis simplex*	Intestine	2
	030106-1	*Anisakis simplex*	Pyloric cecae	1
		Anisakis simplex	Intestine	1
		Anisakis simplex	Stomach	1
	030128-1	*Anisakis simplex*	Intestine	1
	030128-2	*Anisakis simplex*	Stomach	1
		Anisakis simplex	Intestine	2
Ocyurus chrysurus	000831-1	*Anisakis simplex*	Pyloric cecae	13
		Anisakis simplex	Intestine	3
	020317-1	*Anisakis simplex*	Pyloric cecae	2
	020317-3	*Anisakis simplex*	Stomach	1
	020317-4	Cyst in tissue	Intestine	1
Pristipomoides aquilonaris	030108-1	*Cucullanus* sp.	Intestine	1
	030108-2	*Cucullanus* sp.	Intestine	1
	030108-4	*Cucullanus* sp.	Stomach	2

* Data not recorded ♦ = number of parasites per infected fish

Table 9 – Acanthocephalan from one fish of the family Lutjanidae from Puerto Rico.

Host	Collection number	Parasite	♦Intensity
Etelis oculatus	020304-2	***Illiosentis ctenorhynchus***	1
	030108-5	***Illiosentis ctenorhynchus***	1

♦ = number of parasites per infected fish

Table 10. – Leeches collected on fishes of the family Lutjanidae from Puerto Rico.

Host	Collection number	Parasite	♦Intensity
Lutjanus griseus	020216-6	*Trachelobdella lubrica*	1
	020216-9	*Trachelobdella lubrica*	1
	020216-15	*Trachelobdella lubrica*	1
	020216-16	*Trachelobdella lubrica*	1
Lutjanus jocu	030917-1	*Trachelobdella lubrica*	1

♦ = number of parasites per infected fish

Table 11. – Parasitic copepods from fishes of the family Lutjanidae from Puerto Rico.

Host	Collection number	Parasite	♦Intensity
Apsilus dentatus	020915-1	*Caligus asperimanus*	13
		Hatschekia sp.2	7
	021028-1	*Hatschekia* sp.2	9
Etelis oculatus	020724-1	Immature nauplius	10
Lutjanus analis	980213-1	*Hatschekia oblonga*	1
	020204-1	*Caligus irritans*	2
	020717-1	*Caligus asperimanus*	1
	020717-3	Immature chalimus stage	1
	020717-4	*Caligus asperimanus*	1
	020805-1	*Hatschekia oblonga*	4
	020805-3	*Lernanthropus eddiwarneri*	1
	020805-4	*Hatschekia oblonga*	1
	020808-1	*Hatschekia oblonga*	1
		Lernanthropus frondeus	3
	020915-2	*Lernanthropus frondeus*	2
	unknown	*Caligus asperimanus*	4
Lutjanus apodus	020713-1	*Caligus asperimanus*	2
Lutjanus buccanella	020819-2	*Hatschekia linearis*	9
	021031-1	*Hatschekia linearis*	20
		Caligus asperimanus	7
		Caligus practextus	1

Lutjanus griseus	020216-1	*Hatschekia* sp.1	4
	020216-5	*Caligus irritans*	1
		Lernanthropus kroyeri	1
	020216-8	*Caligus irritans*	15
	020216-9	*Lernanthropus* sp. (immature)	2
	020216-11	*Lernanthropus kroyeri*	2
	020216-13	*Caligus irritans*	3
	020216-14	*Lernanthropus kroyeri*	2
	020216-16	*Hatschekia* sp.1	1
	020216-17	*Caligus irritans*	1
	020424-2	*Caligus irritans*	1
	020316-1	*Hatschekia* sp.1	2
Lutjanus jocu	030917-1	*Caligus practextus*	4
		Copepod stage	4
Lutjanus mahogoni	020217-1	Immature chalimus stage	1
		Caligus irritans	3
Lutjanus synagris	020714-4	*Caligus xystereus*	1
	020714-2	Immature chalimus stage	1
	O20217-3	*Lernanthropus spiculatus*	1
		Lernanthropus eddiwarneri	1
Lutjanus vivanus	020216-3	Immature chalimus stage	1
		Hatschekia sp. 3	1
	020216-4	*Caligus asperimanus*	1
		Hatschekia sp. 3	1
	020219-2	*Caligus asperimanus*	4
	020219-4	*Caligus asperimanus*	1

		Lernanthropus sp. immature	1
	020216-1	*Caligus asperimanus*	1
	020919-4	*Neobrachiella* sp.	1
Ocyurus chrysurus	020204-3	*Hatschekia albirubia*	1
	020713-1	*Hatschekia albirubia*	2
	020317-1	*Hatschekia albirubia*	9
		Lernanthropus eddiwarneri	1
	020312-2	*Hatschekia albirubia*	2
Pristipomoides aquilonaris	021010-1	*Hatschekia* sp. 1 *Neobrachiella*	2
Rhomboplites aurorubens	030216-2	*Hatschekia* sp.2	2

♦ = number of parasites per infected fish

Table 12. - Parasitic isopods from fishes of the family Lutjanidae from Puerto Rico.

Host	Collection number	Parasite	♦Intensity
Lutjanus analis	020204-1	*Gnathia* sp.	5
	020717-1	*Gnathia* sp.	2
	020808-1	*Rocinela signata*	1
	unknown	*Rocinela signata*	1
Lutjanus apodus	unknown	*Rocinela signata*	1
	020730-2	*Gnathia* sp.	1
	020730-6	*Gnathia* sp.	2
Lutjanus buccanella	021031-1	*Gnathia* sp.	2
Lutjanus griseus	020316-1	*Rocinela oculata*	1
	020216-7	*Rocinela signata*	1
Lutjanus synagris	020714-2	*Gnathia* sp.	1
	020917-2	*Gnathia* sp.	4
Lutjanus jocu	030917-1	*Gnathia* sp.	2
Pristipomoides aquilonaris	021011-1	*Gnathia* sp.	1

♦ = number of parasites per infected fish

Table 13. – Metazoan parasite of fishes of the family Lutjanidae (Pisces) host parasite list and quantitative descriptors.

Host	Group of parasite	Parasite	No. E	No. I	♦I	+MI
Apsilus dentatus						
	Copepoda	*Caligus asperimanus*	3	1	13	13
		Hatschekia sp. 2		2	7-9	8
Etelis oculatus						
	Cestode	*Nybelina* sp.		1	1	1
	Nematode	*Anisakis simplex*		1	1	1
		Cucullanus sp.		8	1-4	1.9
		Cyst		1	1	1
		Oncophora melanocephala	14	1	1	1
	Acanthocephala	Family Rhadinorhynchidae		2	1	1
	Copepoda	Immature nauplius		1	10	10
Lutjanus analis						
	Monogenea	*Euryhaliotrema fastigatum*		2	1-3	2
		Euryhaliotrema torquecirrus		3	1-3	2
		Euryhaliotrema tubocirrus		5	1-2	1.4
		Haliotrema heteracantha		8	1-8	3.4
		Haliotrema longihamus		10	1-10	3.4
		Haliotrema magnigastrohamus	13	8	1-3	1.5
		Microcotyloides incisa		2	4	2
	Digenea	*Brachyphallus parvus*		1	29	29
		Metadena adglobosa		3	2-3	2.7
		Stephanostomum casum		2	1-2	1.5

	Cestode	Blastocyst		1	1	1
		Bothriocephalus sp.		1	1	1
	Nematode	*Anisakis simplex*		1	6	6
		Cucullanus sp.		1	4	4
		Cyst		1	2	2
	Copepod	*Caligus asperimanus*	13	3	1-4	2
		Caligus irritans		1	2	2
		Chalimus stage		1	1	1
		Hatschekia oblonga		4	1-4	1.8
		Lernanthropus eddiwarneri		1	1	1
		Lernanthropus frondeus		2	2-3	2.5
	Isopod	*Gnathia* sp.		2	2-5	3.5
		Rocinela signata		2	1	1
Lutjanus apodus						
	Monogenea	*Haliotrema gracilihamus*		2	1	1
		Microcotyloides incisa		1	3	3
	Copepod	*Caligus asperimanus*	7	1	2	2
	Isopod	*Gnathia* sp.		1	2	2
Lutjanus buccanella						
	Monogenea	*Euryhaliotrema tubocirrus*		3	2-5	4
	Copepod	*Caligus asperimanus*	3	1	7	7
		Caligus practextus		1	1	1
		Hatschekia linearis		2	9-29	19
	Isopod	*Gnathia* sp.		1	2	2

Lutjanus griseus						
	Monogenea	*Euryhaliotrema fastigatum*		6	1-4	2.3
		Euryhaliotrema tubocirrus		5	1-3	1.8
		Euryhaliotrema torquecirrus		4	1-2	1.3
		Haliotrema gracilihamus		12	1-9	2.9
		Haliotrema heteracantha		2	1-2	1.5
		Haliotrema longihamus		2	1	1
		Microcotyloides incisa		2	2	2
	Digenea	*Brachyphallus parvus*		4	1-4	2
		Hamacreadium mutabile		1	54	54
		Hamacreadium lintoni	17	4	1-6	3.5
	Nematodes	*Anisakis simplex*		2	1	1
	Copepod	*Caligus irritans*		5	1-15	4.2
		Hatschekia sp. 1		3	1-4	2.3
		Lernanthropus sp. (immature)		1	2	2
		Lernanthropus kroyeri		3	1-2	1.7
	Isopod	*Rocinela oculata*		1	1	1
		Rocinela signata		1	1	1
	Annelida	*Trachelobdella lubrica*		4	1	1
Lutjanus jocu						
	Monogenea	*Euryhaliotrema fastigatum*		1	11	11
		Haliotrema gracilihamus		1	2	2
		Microcotyloides incisa	3	1	11	11
	Digenea	*Hamacreadium lintoni*		1	3	3

	Copepod	*Caligus practextus*		1	4	4
		Chalimus stage		1	4	4
	Isopod	*Gnathia* sp.	3	1	2	2
		Rocinela signata		1	1	1
	Annelida	*Trachelobdella lubrica*		1	1	1
Lutjanus mahogoni						
	Monogenea	*Euryhaliotrema torquecirrus*		1	1	1
		Euryhaliotrema tubocirrus		3	1	1
		Haliotrema cornigerum		4	3-6	5
		Haliotrema gracilihamus		2	2-6	4
		Haliotrema heteracantha		3	1-3	2
		Haliotrema longihamus		1	1	1
	Digenea	*Brachyphallus parvus*	8	1	1	1
		Paracryptogonimus neoamericanus		1	1	1
	Nematodes	*Anisakis simplex*		1	1	1
	Copepod	*Caligus irritans*		1	3	3
		Chalimus stage		1	1	1
Lutjanus synagris						
	Monogenea	*Euryhaliotrema torquecirrus*		3	1-2	1.7
		Euryhaliotrema tubocirrus		3	1-2	1.7
		Haliotrema heteracantha	8	7	1-48	10.6
		Haliotrema longihamus		6	1-5	3.2
		Haliotrema magnigastrohamus		3	2-3	2.3
	Digenea	*Hamacreadium lintoni*		2	2	2

	Cestode	*Nybelina* sp.		1	1	1
	Copepod	*Caligus xystereus*	8	1	1	1
		Chalimus stage		1	1	1
		Lernanthropus eddiwarneri		1	1	1
		Lernanthropus spiculatus		1	1	1
	Isopod	*Gnathia* sp.		2	1-4	2.5
Lutjanus vivanus						
	Monogenea	*Euryhaliotrema tubocirrus*		7	2-19	10.1
	Digenea	*Allomegasolena attenuata*		1	1	1
		Brachyphallus parvus		4	1-6	2.8
		Hamacreadium mutabile		1	1	1
		Hamacreadium lintoni		3	1-3	1.7
		Paracryptogonimus neoamericanus		1	1	1
		Stephanostomum casum		1	1	1
	Cestode	*Ceratobotrium* sp.	8	1	5	5
	Nematode	*Anisakis simplex*		6	1-2	2
		Cyst in tissue		2	1-3	2
	Copepod	*Caligus asperimanus*		4	1-4	1.8
		Chalimus stage		1	1	1
		Hatschekia sp. 3		2	1	1
		Lernanthropus sp. (immature)		1	1	1
		Neobrachiella sp.		1	1	1
Ocyurus chrysurus						
	Monogenea	*Euryhaliotrema torquecirrus*	14	3	8-16	11

		Haliotrema heteracantha		1	3	3
	Digenea	*Allomegasolena attenuata*		2	1-2	1.5
		Brachyphallus parvus		3	4-7	5.7
		Hamacreadium mutabile		1	7	7
		Lepocreadium troncatum		1	1	1
		Lepocreadium trulla		1	5	5
		Metadena adglobosa		3	1	1
		Paracryptogonimus neoamericanus	14	2	22-63	42.5
		Prosogonotrema bilabiatum		2	1-3	2
		Stephanostomum casum		1	3	3
	Nematode	*Anisakis simplex*		4	1-13	4.8
		Cyst in tissue		1	1	1
	Copepod	*Hatschekia albirubia*		4	1-9	3.5
		Lernanthropus eddiwarneri		1	1	1
Pristipomoides aquilonaris						
	Monogenea	*Diplectanum* sp.		2	5-12	8.5
	Digenea	*Brachyphallus parvus*		1	1	1
	Nematode	*Cucullanus* sp.	29	3	1-2	1.3
	Copepod	*Hatschekia* sp. 1		1	2	2
		Neobrachiella sp.		1	10	10
	Isopod	*Gnathia* sp.		1	1	1

Rhomboplites aurorubens					
	Monogenea	*Microcotyloides incisa*	1	5	5
			3		
	Copepod	*Hatschekia* sp.2	1	2	2
	Cestoda	Procercoid	1	1	1

No. E (Number examined) No. I (Number infected) I (Intensity) ♦ = number of parasites per infected fish
MI (Mean intensity) + = average number of parasites per infected fish

Table 14. Parasite – Host list of fishes of the family Lutjanidae from Puerto Rico.

Group of Parasite	Parasite	Host
Digenea		
	Allomegasolena attenuata	*Lutjanus vivanus*[*] *Ocyurus chrysurus*[*]
	Brachyphallus parvus	*Lutjanus analis*[*] *Lutjanus griseus* *Lutjanus mahogoni*[*] *Lutjanus vivanus* *Ocyurus chrysurus*[*] *Pristipomoides aquilonaris*[*]
	[+]*Hamacreadium mutabile*	*Lutjanus griseus* *Lutjanus vivanus* *Ocyurus chrysurus*
	Hamacreadium lintoni	*Lutjanus griseus*[*] *Lutjanus jocu*[*] *Lutjanus synagris*[*] *Lutjanus vivanus*[*]
	Lepocreadium troncatum	*Ocyurus chrysurus*
	Lepocreadium trulla	*Ocyurus chrysurus*
	Metadena adglobosa	*Lutjanus analis*[*] *Ocyurus chrysurus*[*]
	Paracryptogonimus neoamericanus	*Lutjanus mahogoni*[*] *Lutjanus vivanus* *Ocyurus chrysurus*
	Prosogonotrema bilabiatum	*Ocyurus chrysurus*
	Stephanostomum casum	*Lutjanus analis* *Lutjanus vivanus* *Ocyurus chrysurus*
Monogenea		
	[-]*Diplectanum* sp.	*Pristipomoides aquilonaris*[*]
	Euryhaliotrema fastigatum	*Lutjanus analis*[*] *Lutjanus griseus*[*] *Lutjanus jocu*
	Euryhaliotrema torquecirrus	*Lutjanus analis*[*] *Lutjanus griseus*[*] *Lutjanus mahogoni* *Lutjanus synagris* *Ocyurus chrysurus*

	Euryhaliotrema tubocirrus	*Lutjanus analis* *Lutjanus buccanella*[*] *Lutjanus griseus*[*] *Lutjanus mahogoni* *Lutjanus synagris* *Lutjanus vivanus*[*]
	Haliotrema cornigerum	*Lutjanus mahogoni*
	Haliotrema gracilihamus	*Lutjanus apodus* *Lutjanus griseus*[*] *Lutjanus jocu* *Lutjanus mahogoni*[*]
	Haliotrema heteracantha	*Lutjanus analis* *Lutjanus griseus*[*] *Lutjanus mahogoni* *Lutjanus synagris* *Ocyurus chrysurus*
	Haliotrema longihamus	*Lutjanus analis* *Lutjanus griseus*[*] *Lutjanus mahogoni* *Lutjanus synagris*
	Haliotrema magnigastrohamus	*Lutjanus analis* *Lutjanus mahogoni* *Lutjanus synagris*
	[+]*Microcotyloides incisa*	*Lutjanus analis*[*] *Lutjanus apodus*[*] *Lutjanus griseus* *Lutjanus jocu*[*] *Rhomboplites aurorubens*[*]
Cestoda		
	Blastocyst	*Lutjanus analis*
	[-]*Bothriocephalus* sp.	*Lutjanus analis*[*]
	[-]*Ceratobotrium* sp.	*Lutjanus vivanus*[*]
	[-]*Nybelina* sp.	*Etelis oculatus*[*] *Lutjanus synagris*[*]
	Procercoid	*Rhomboplites aurorubens*[*]
Nematoda		
	Anisakis simplex	*Etelis oculatus*[*] *Lutjanus analis*[*] *Lutjanus griseus*[*] *Lutjanus mahogoni*[*]

		Lutjanus vivanus[*] *Ocyurus chrysurus*[*]
	[-]*Cucullanus* sp.	*Etelis oculatus*[*] *Lutjanus analis*[*] *Pristipomoides aquilonaris*[*]
	Cyst	*Etelis oculatus* *Lutjanus analis* *Lutjanus vivanus* *Ocyurus chrysurus*
	Oncophora melanocephala	*Etelis oculatus*[*]
Acanthocephala		
	Illiosentis ctenorhynchus	*Etelis oculatus*[*]
Annelida		
	Trachelobdella lubrica	*Lutjanus griseus*[*] *Lutjanus jocu*[*]
Copepoda		
	[+]*Caligus asperimanus*	*Apsilus dentatus*[*] *Lutjanus analis* *Lutjanus apodus* *Lutjanus buccanella*[*] *Lutjanus vivanus*[*]
	Caligus irritans	*Lutjanus analis* *Lutjanus griseus* *Lutjanus mahogoni*[*]
	Caligus practextus	*Lutjanus buccanella*[*] *Lutjanus jocu*[*]
	Caligus xystereus	*Lutjanus synagris*[*]
	chalimus stage	*Lutjanus analis* *Lutjanus jocu* *Lutjanus mahogoni* *Lutjanus synagris* *Lutjanus vivanus*
	Hatschekia albirubia	*Ocyurus chrysurus*
	Hatschekia linearis	*Lutjanus buccanella*[*]
	Hatschekia oblonga	*Lutjanus analis*
	[-]*Hatschekia* sp. 1	*Lutjanus griseus*[*] *Pristipomoides aquilonaris*[*]

	-*Hatschekia* sp. 2	*Apsilus dentatus** *Rhomboplites aurorubens**
	-*Hatschekia* sp. 3	*Lutjanus vivanus**
	Lernanthropus eddiwarneri	*Lutjanus analis* *Lutjanus synagris* *Ocyurus chrysurus**
	Lernanthropus frondeus	*Lutjanus analis*
	Lernanthropus kroyeri	*Lutjanus griseus*
	Lernanthropus spiculatus	*Lutjanus synagris*
	Lernanthropus sp. (immature)	*Lutjanus griseus* *Lutjanus vivanus*
	Naupliar stage	*Etelis oculatus*
	-*Neobrachiella* sp.	*Lutjanus vivanus** *Pristipomoides aquilonaris**
Isopoda		
	Gnathia spp.	*Lutjanus analis* *Lutjanus apodus** *Lutjanus buccanella* *Lutjanus jocu** *Lutjanus synagris* *Pristipomoides aquilonaris**
	Rocinela oculata	*Lutjanus griseus**
	Rocinela signata	*Lutjanus analis* *Lutjanus griseus* *Lutjanus jocu* *Lutjanus apodus**

* new host record - new species + family specific

CONCLUSIONS

The aim of this project was to determine the parasite fauna of snappers found in the waters of Puerto Rico, including reporting of new host records, and new species of parasites. In addition, a host specificity analysis was also included. A total of 47 species of parasites were collected in 131 specimens of 13 species of snappers collected from Puerto Rico. A total of 68 new host records, three new family specificities and eight new species of parasites are reported in this study.

Ten species of digenetic trematodes from seven families and eight genera were collected from different species of snapper examined (Table 5). In this study, a total of 13 new host records and one family specificity record are reported in this group of parasites. Snappers and their flukes new host records are listed in (Table 14). This study confirms *O. chrysurus* as the primary host for *Lepocreadium trulla*, *Lepocreadium troncatum* and *Prosogonotrema bilabiatum*. *Ocyurus chrysurus* also had the highest mean intensity for snappers infected with *Paracryptogonimus neoamericanus*, *Stephanostomum casum*, and *Brachyphallus parvus*. *Lutjanus griseus* had the highest mean intensity for *Hamacreadium mutabile* and *H. lintoni,* and *L. analis* for *Metadena adglobosa*. These data suggest that these snappers are more susceptible to these flukes. Comparison of this study was made with others. The parasite fauna appear to be like those found in Florida and differ from those of Jamaica and Curaçao.

Ten species of four different genera of gillworms were collected, including five species of *Haliotrema*, three species of *Euryhaliotrema*, one new species of *Diplectanum* and one species of *Microcotyloides*. In this study, a total of 16 new host records, one

family specificity and one new species of gillworms are reported for this group. Zhukov (1976) did not examine *Lutjanus griseus* in his descriptions of species of the genus *Haliotrema*. This study collected *Euryhaliotrema fastigatum*, *E. torquecirrus, E. tubocirrus*, *Haliotrema gracilihamus*, *H. heteracantha,* and *H. longihamus* on the gills filaments of *L. griseus,* which are six new host records. Snappers and additional new host record of gillworms list in (Table 14). *Pristipomoides aquilonaris* is proposed as the type host for a new species of parasite of the genus *Diplectanum*. This species of *Diplectanum* was compared with *Diplectanum curvivagina* which was described by Yamaguti (1968) from two snappers from the genus *Pristipomoides.* The morphological characteristic of these two species of *Diplectanum* seem similar, but the measurements of the key characteristics differ immensely. These species of *Diplectanum* are an example of speciation the hosts from the same genus are separated geographically and become two separate species of parasites. The monogenean, *Microcotyloides incisa* is proposed as host family specific, since it has been reported on fishes of different genera of the family Lutjanidae. The following snappers had the highest mean intensity for infection with gillworms (Table 13): *Lutjanus analis* for *H. longihamus*; *L. buccanella* and *L. vivanus* for *E. tubocirrus*; *L. griseus* for *H. gracilihamus* and *E. tubocirrus*; *L. jocu* for *E. fastigatum* and *M. incisa*; *Lutjanus mahogoni* for *H. gracilihamus; L. synagris* for *H. longihamus*, *H. heteracantha*, and *H. magnigastrohamus;* and *Ocyurus chrysurus* for *E. torquecirrus*.

Three new host records and three new species are reported for the following cestode larvae: *Bothriocephalus* sp. for *L. analis*; *Nybelina* sp. for *L. synagris* and *E.*

oculatus; and *Ceratobotrium* sp for *L. vivanus*. In this study, one procercoid was found in *R. aurorubens* indicating it as an intermediate host for the adult stage of this cestode.

Three species of nematodes of three different genera were collected from seven different species of snappers. In the present study, ten new host records and one new species of parasitic nematodes were found (Table 14). Six species of snappers including: *L. analis*, *L. griseus*, *L. mahogoni*, *L. vivanus*, *Etelis oculatus* and *O. chrysurus* were infected with *Anisakis simplex*. This nematode has been known to cause a gastric infection when humans are infected eating encysted worms form the raw flesh of these fishes. *L. analis*, *Etelis oculatus* and *Pristipomoides aquilonaris* are new host record for one new species of nematode of the genus *Cucullanus* sp. *Etelis oculatus* is also new host record for the nematode *Oncophora melanocephala*. *Lutjanus analis* and *O. chrysurus* had the highest mean intensity for *Anisakis simplex*. This information is very important because these two snappers are commercially important in Puerto Rico. *Lutjanus analis* also had the highest mean intensity for the new species of the genus *Cucullanus*, and is the type host of this new species.

One acanthocephalan, *Illiosentis ctenorhynchus,* was collected from *Etelis oculatus*. This is also a new host record. One species of leech was collected on two species of snappers. Four *Trachelobdella lubrica* were found on the gills of four *L. griseus* and one on one *L. jocu*. Both reports are new host records.

Sixteen species of copepods were collected from all species of snappers examined. Sixteen new host records, one family specificity record and four new species of parasitic copepods are reported (Table 14). Five new species and host records are proposed for *Neobrachiella* sp. from *L. vivanus* and *Pristipomoides aquilonaris*;

Hatschekia sp. 1 from *L. griseus, Hatschekia* sp 2 from *Apsilus dentatus* and *Rhomboplites aurorubens*; and *Hatschekia* sp. 3 from *L. vivanus*. This study proposes *Caligus asperimanus* as family specific since it infected different genera of the family Lutjanidae. *Apsilus dentatus* and *L. buccanella* had the highest mean intensity for fishes infected with *Caligus asperimanus*; *L. buccanella* for *Caligus practextus*; *L. griseus* for *Caligus irritans*; and *Ocyurus chrysurus* for *Hatschekia albirubia*. *Apsilus dentatus* had the highest mean intensity for the new species *Hatschekia* sp. 2. ,and is the type host for this parasite. *Pristipomoides aquilonaris* had the highest mean intensity for the new species *Neobrachiella* sp. These data can also be used to propose this fish as the type host for this parasite.

Three species of two genera of parasitic isopods were collected. Seven new host records are reported for parasitic isopods infecting snappers examined (Table 14) from Puerto Rico. *L. apodus*, *L. jocu* and *Pristipomoides aquilonaris* are new host records for *Gnathia* sp. *L. apodus* is a new host record for *Rocinela signata* and *L. griseus* for *Rocinela oculata*. *Lutjanus analis* obtained the highest mean intensity for *Gnathia* sp. All the mean intensities for the isopods of the genus *Rocinela* were the same indicating the same degree of host specificity or lack of host specificity.

This study extends the knowledge of the parasite fauna of fishes of the family Lutjanidae from Puerto Rico, and the western Atlantic. It included the broadest study of the parasite of these fishes since Linton (1908, 1910). No other study of snappers includes all the groups of parasites.

RECOMMENDATIONS

This study intended to study the parasite fauna of all the snappers found in the waters of Puerto Rico. Only 13 species of snappers were examined from the 16 reported to be found in Puerto Rico. Extended work to determine the parasite fauna should be done to include those snappers not examined during this study.

Some genera of parasites including *Haliotrema, Hamacreadium*, *Metadena*, *Hatschekia* and *Lernanthropus* should be revised. Most of the previous works on these genera are old and some key characteristics used to identify these organisms are confusing or ambiguous. *Haliotrema* is an interesting genus which needs lots of work since it is consider as a "waste basket" genus. Many species in this genus are misallocated and new genera had to be erected based on different characteristics shared by some species. An example of this problem was demonstrated with the erection of the new genus *Euryhaliotrema* by Kritsky and Boeger (2001), of which species of this new genus share a bulbous base on the copulatory organ. Molecular systematics should provide useful information on how far apart each species is in the evolutionary line.

Redescription of Zhukov (1976)'s species of *Haliotrema* from the original Russian descriptions are in Russian and the redrawing of the parasites with all the key characteristics of the species would aid in their study. Other species of *Haliotrema* should be analyzed to determine if they may also be placed in the genus *Euryhaliotrema*.

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Plate I

Figure 17 *Metadena adglobosa* Manter, 1947

Figure 18 *Paracryptogonimus neoamericanus* Siddiqi & Cable, 1960

Figure 19 *Stephanostomum casum* (Linton, 1910)

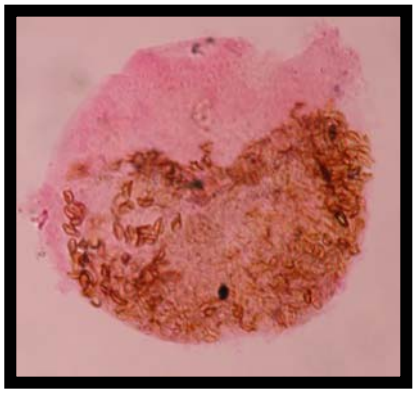

Figure 17

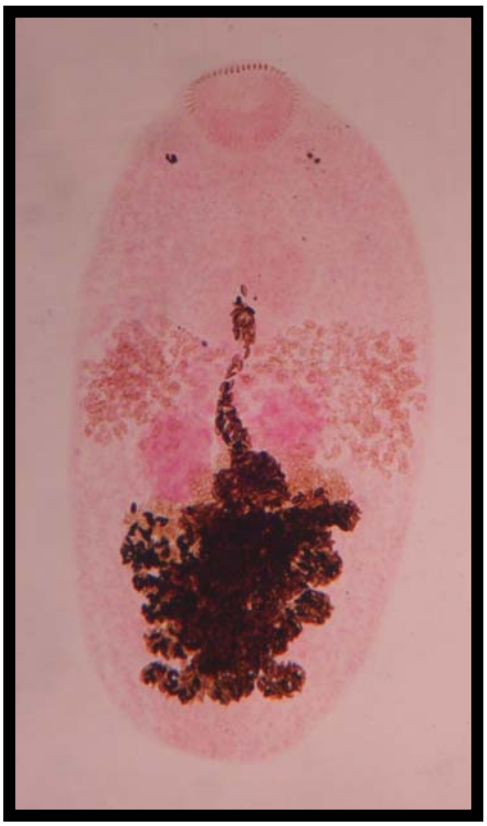

Figure 18

Figure 19

Plate II

Figure 20 *Allomegasolena attenuata* Siddiqi & Cable, 1960

Figure 21 *Hamacreadium lintoni* Siddiqi & Cable, 1960

Figure 22 *Hamacreadium mutabile* Linton, 1910

Figure 20

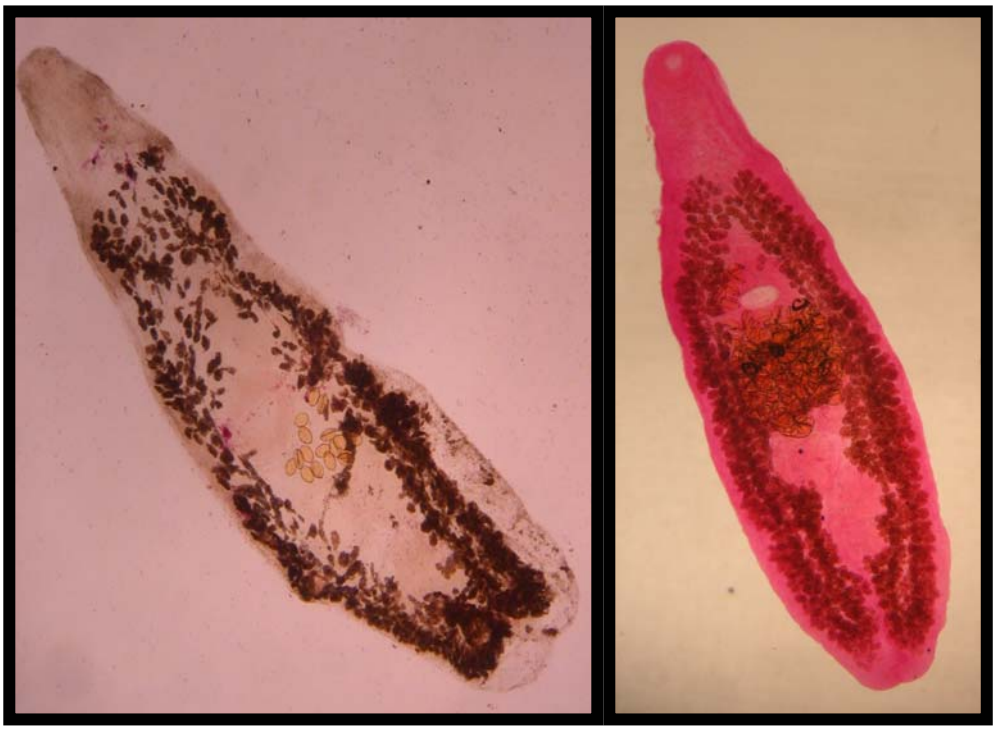

Figure 21

Figure 22

Plate III

Figure 23 *Lepocreadium troncatum* Nahhas & Cable, 1964

Figure 24 *Lepocreadium trulla* (Linton, 1907)

Figure 25 *Brachyphallus parvus* (Manter, 1947)

Figure 26 *Prosogonotrema bilabiatum* Pérez Vigüeras 1940

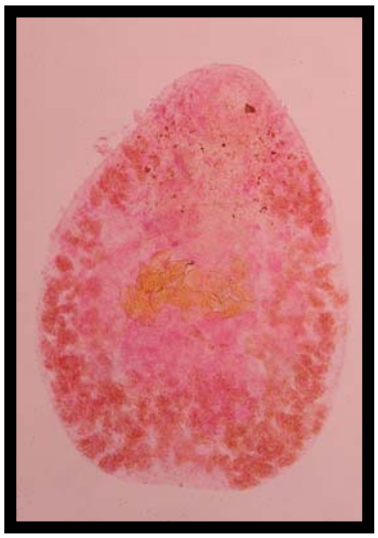

Figure 23

Figure 24

Figure 25

Figure 26

Plate IV

Figure 27 *Haliotrema cornigerum* Zhukov, 1976
(a) Whole worm
(b) Haptor
(c) Copulatory complex

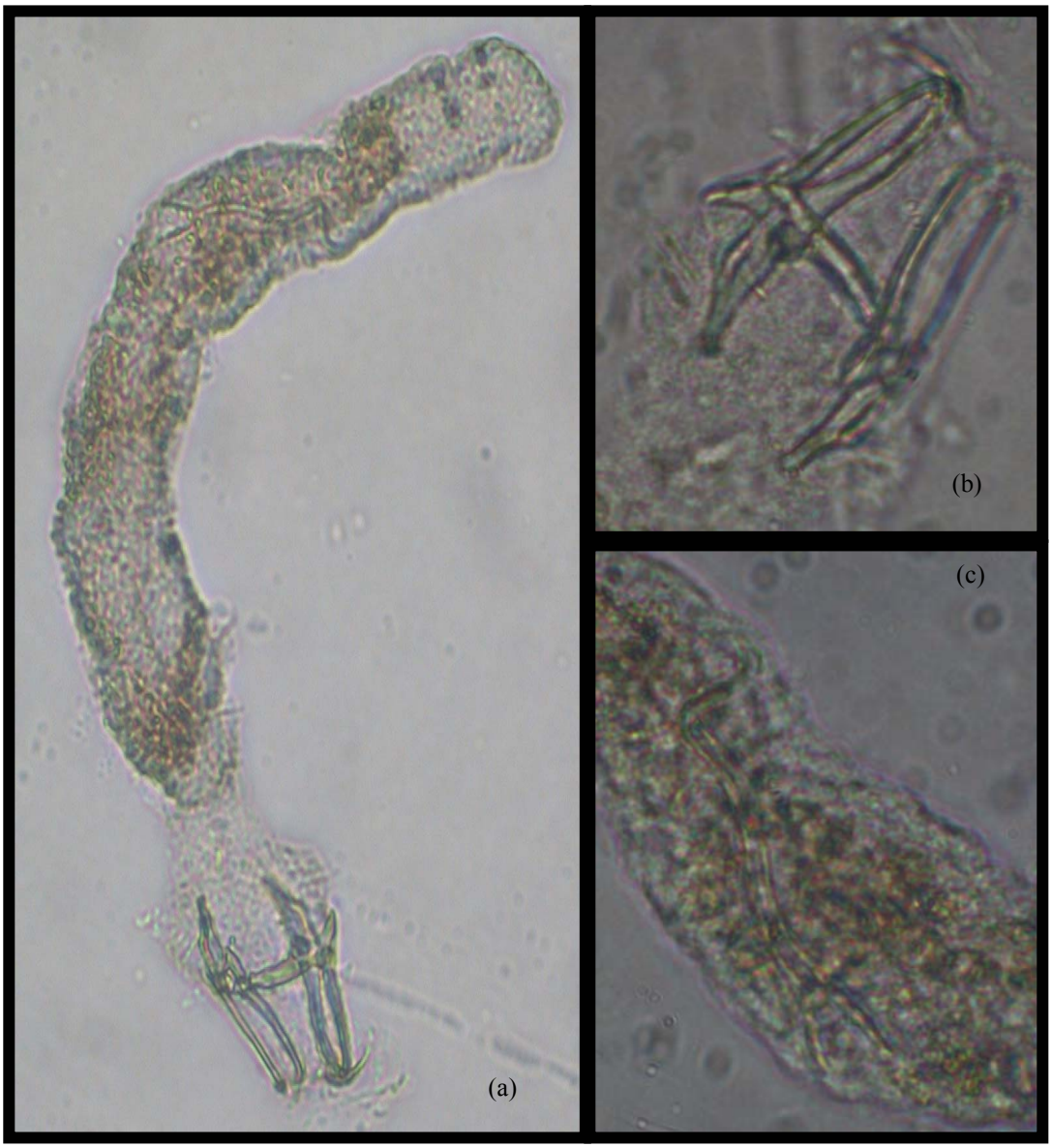

Figure 27

Plate V

Figure 28 *Haliotrema gracilihamus* Zhukov, 1976
(a) Whole worm
(b) Haptor
(c) Copulatory complex

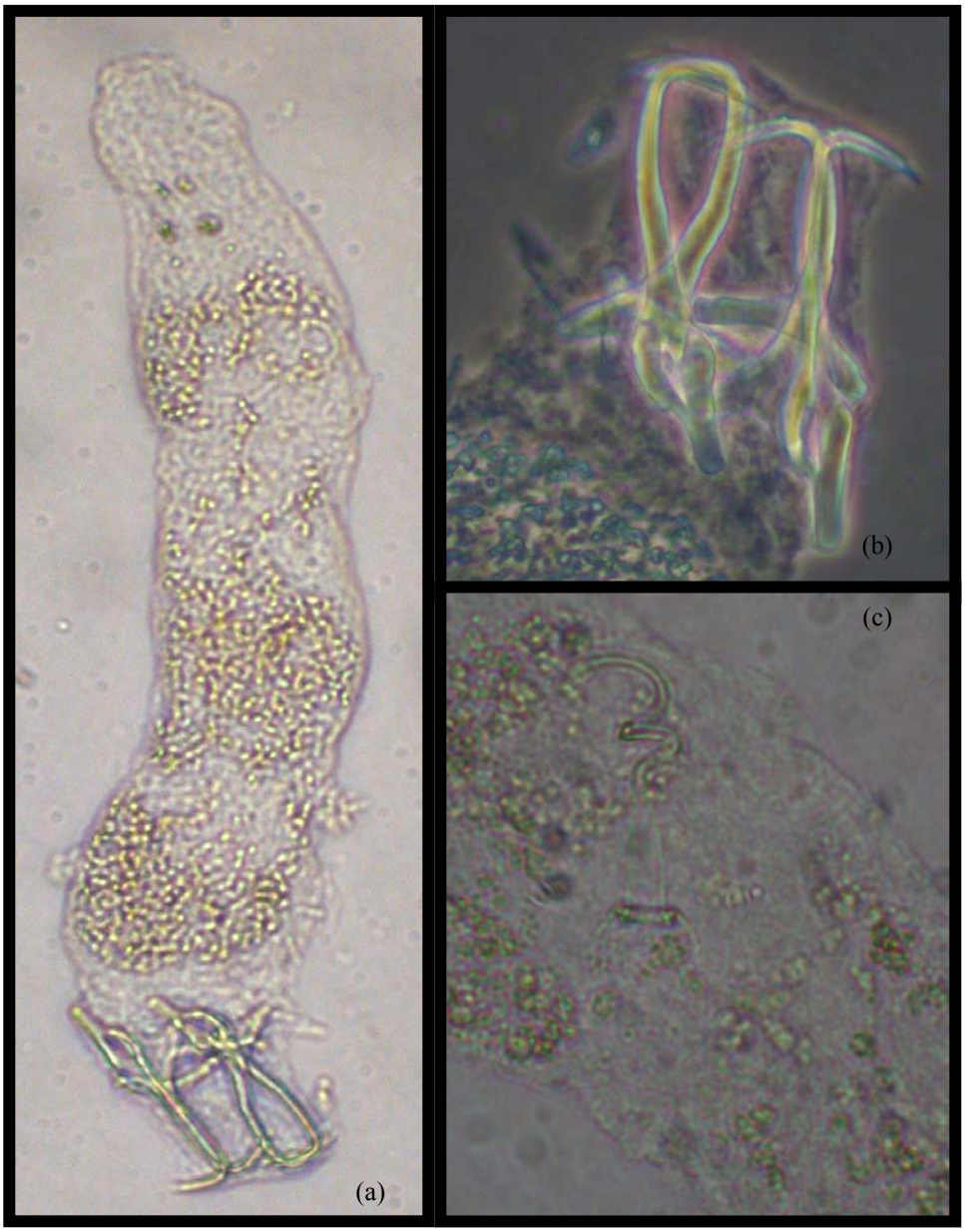

Figure 28

Plate VI

Figure 29 *Haliotrema heteracantha* Zhukov, 1976
(a) Whole worm
(b) Haptor
(c) Copulatory complex

Figure 29

Plate VII

Figure 30 *Haliotrema longihamus* Zhukov, 1976
(a) Whole worm
(b) Haptor
(c) Copulatory complex

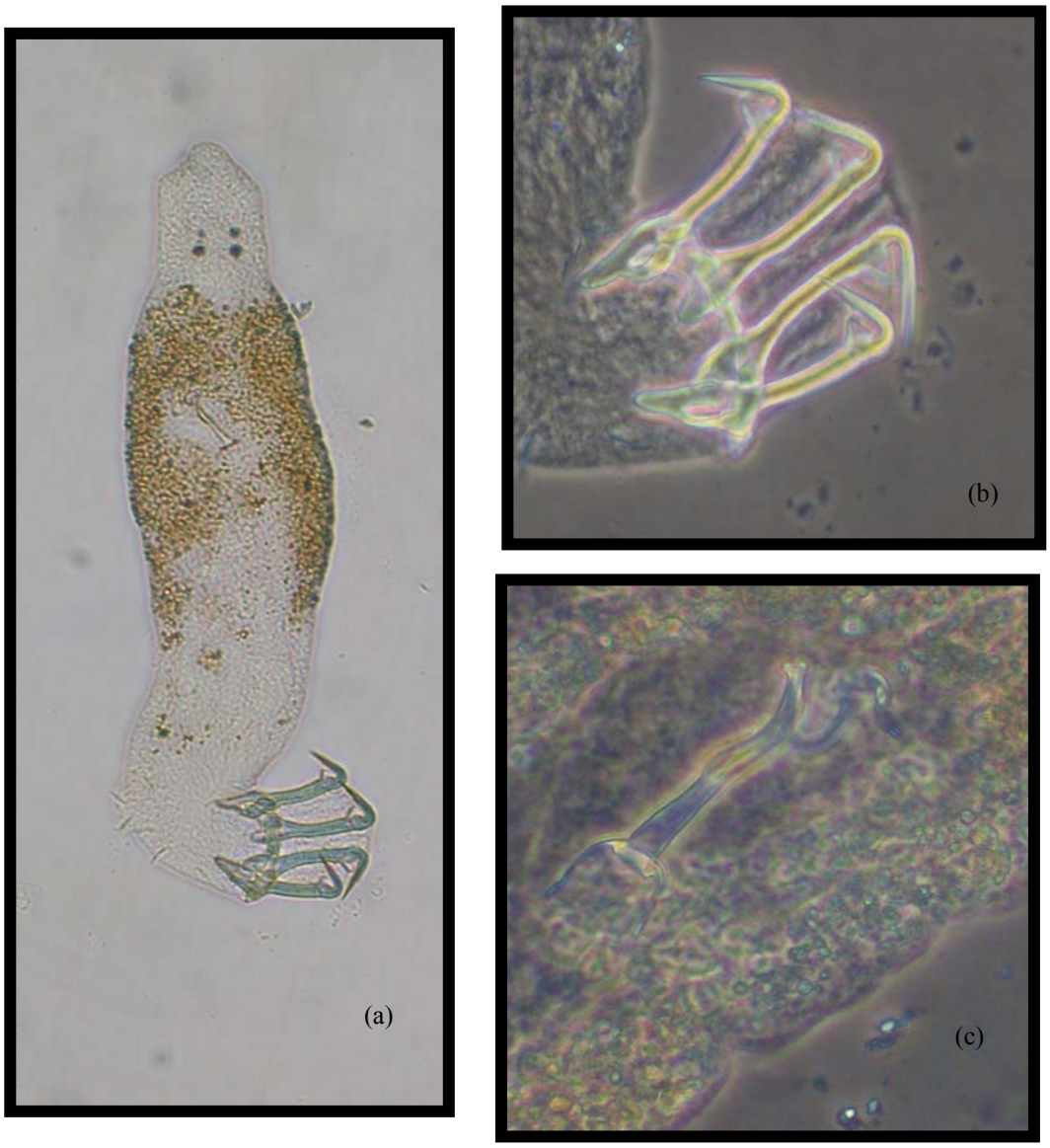

Figure 30

Plate VIII

Figure 31 *Haliotrema magnigastrohamus* Zhukov, 1976
(a) Whole worm
(b) Haptor
(c) Copulatory complex

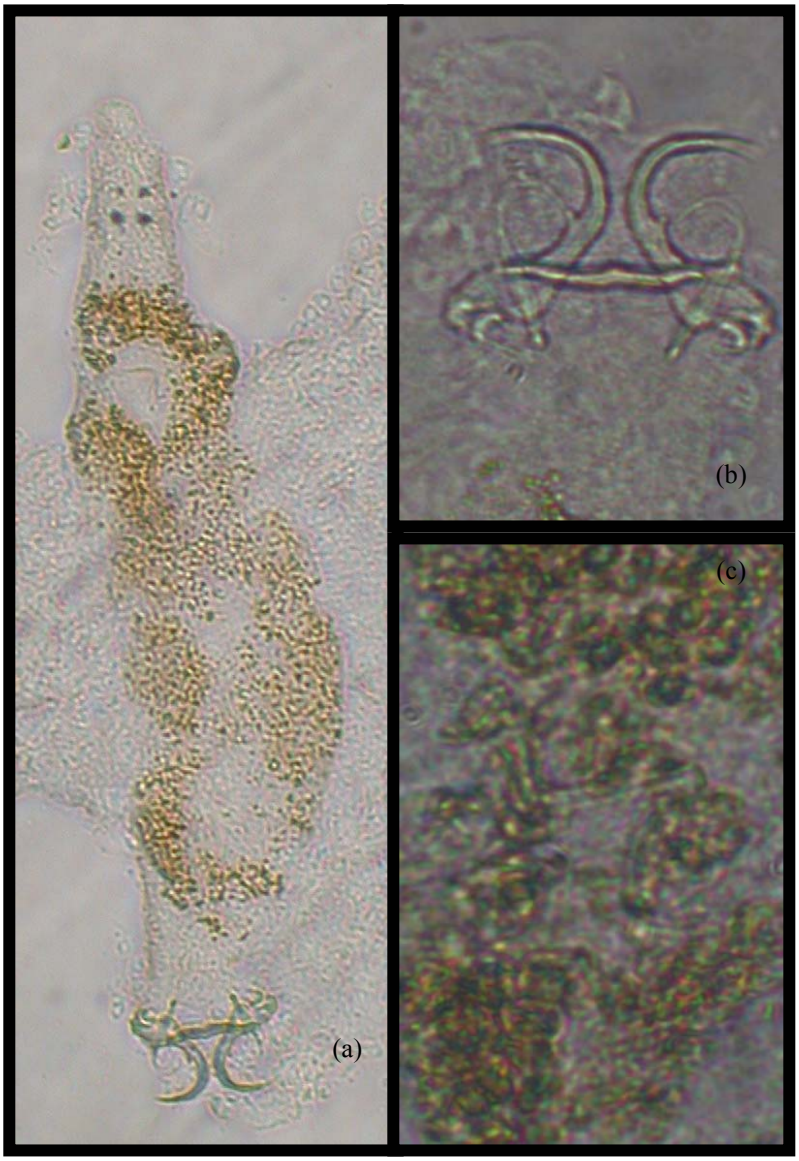

Figure 31

Plate IX

Figure 32 *Euryhaliotrema fastigatum* (Zhukov, 1976)
(a) Whole worm
(b) Haptor
(c) Copulatory complex

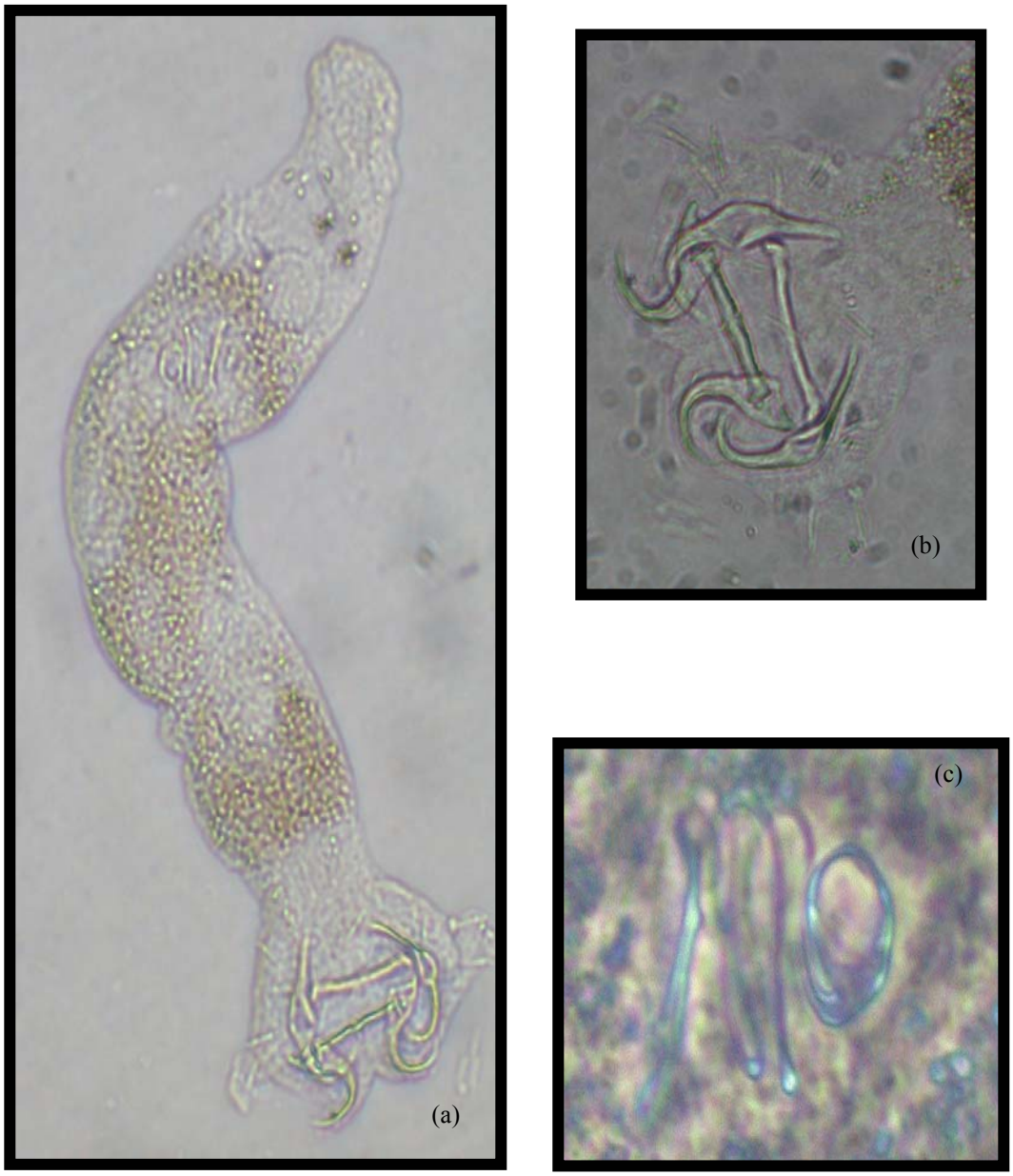

Figure 32

Plate X

Figure 33 *Euryhaliotrema torquecirrus* (Zhukov, 1976)
(a) Whole worm
(b) Haptor
(c) Copulatory complex

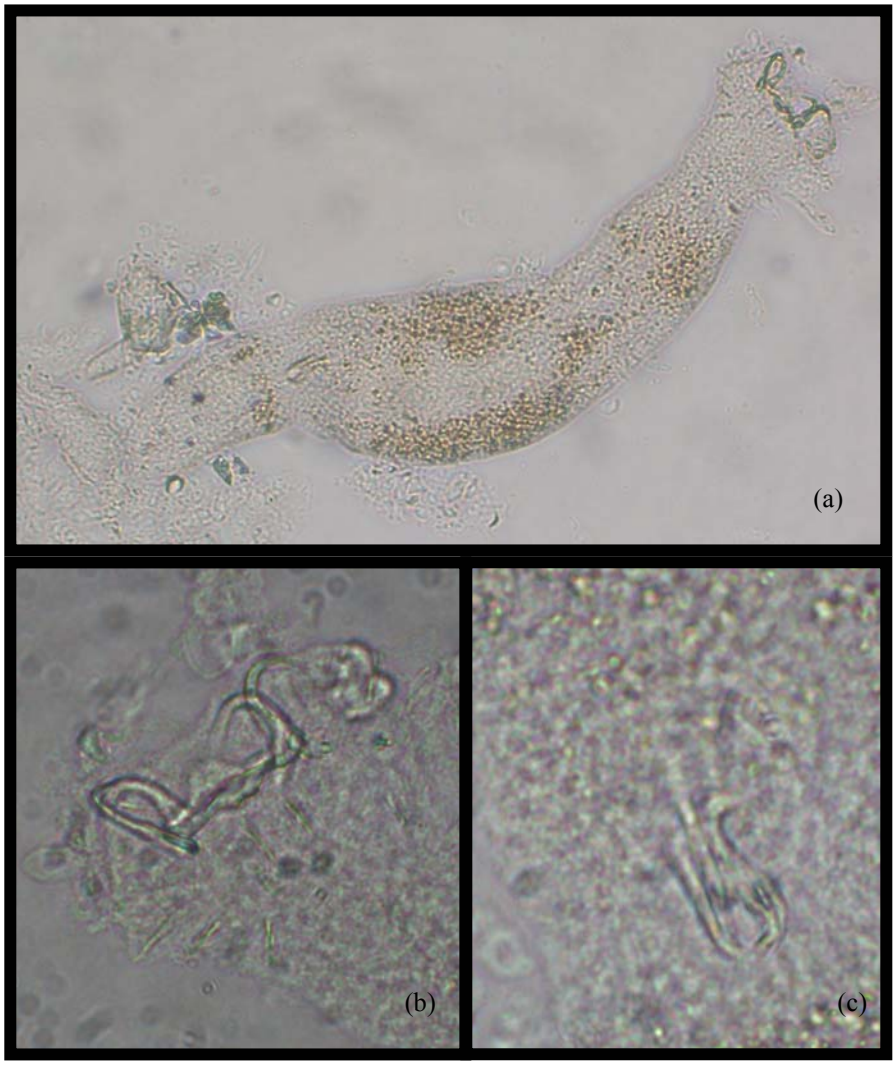

Figure 33

Plate XI

Figure 34 *Euryhaliotrema tubocirrus* (Zhukov, 1976)
(a) Whole worm
(b) Haptor
(c) Copulatory complex
(d) Egg

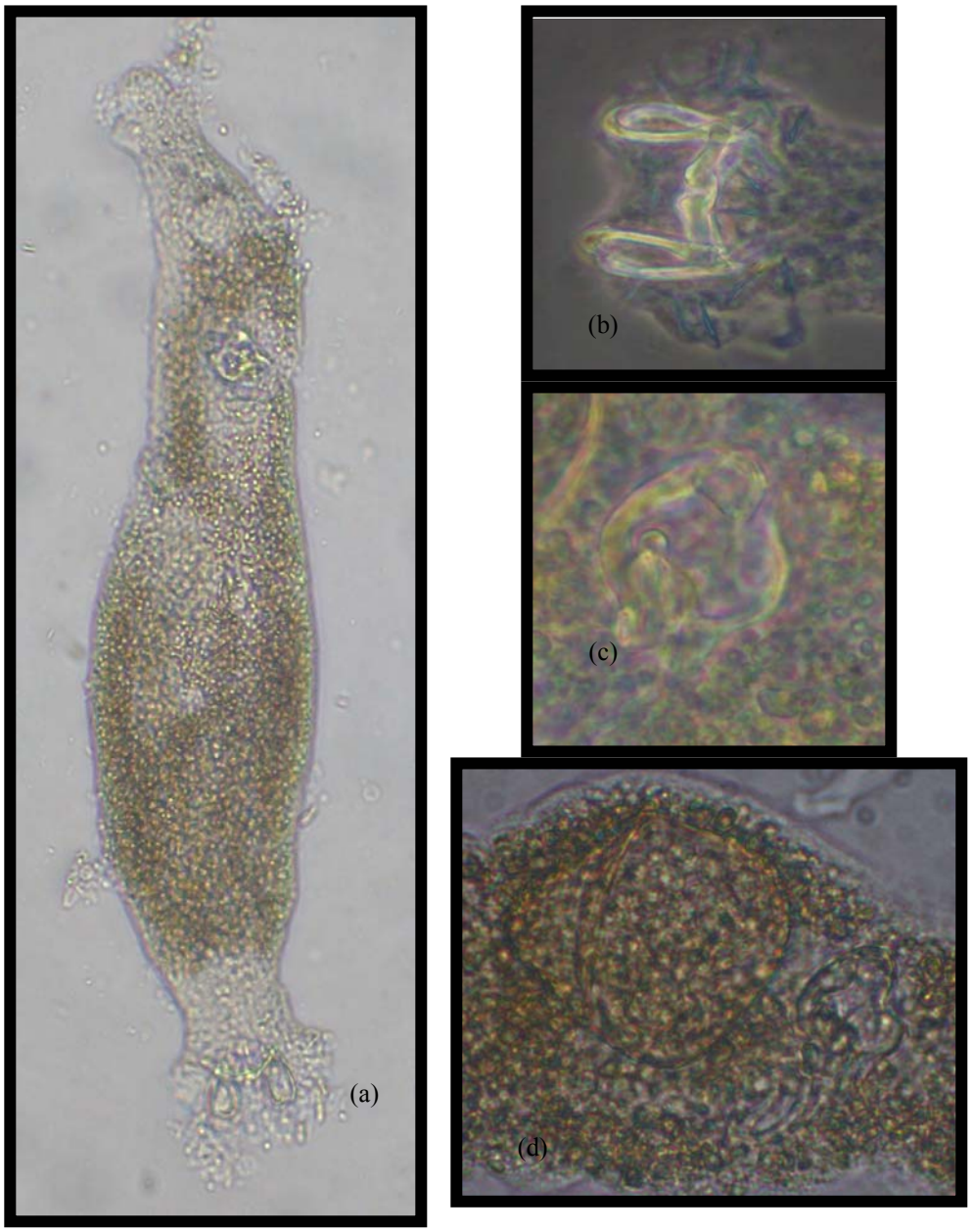

Figure 34

Plate XII

Figure 35 *Diplectanum curvivagina* Yamaguti 1968
(a) Whole worm
(b) Haptor
(c) Copulatory complex

Figure 35

Plate XIII

Figure 36 *Microcotyloides incisa* (Linton, 1910)
(a) Anterior portion of the worm
(b) Haptor
(c) Clamp
(d) Four cuticular pieces in the cirrus pouch
(e) Egg

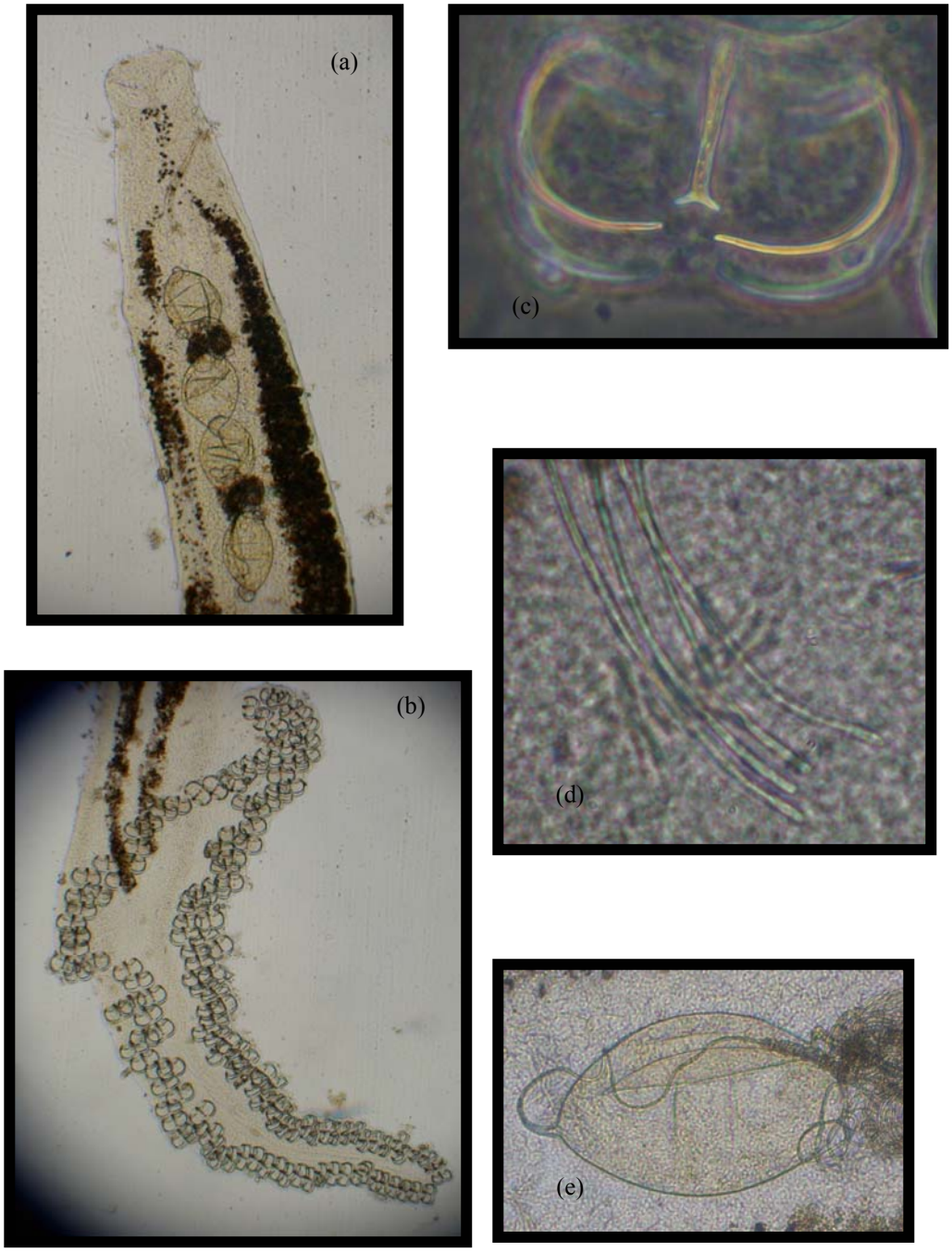

Figure 36

Plate XIV

Figure 37 *Bothriocephalus* sp

Figure 38 *Ceratobotrium* sp

Figure 39 *Nybelina* sp

Figure 40 Blastocyst

Figure 41 Procercoid

Figure 37

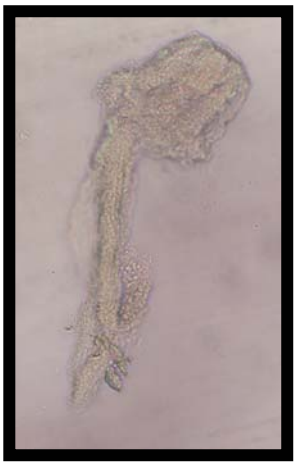

Figure 38

Figure 39

Figure 40

Figure 41

Plate XV

Figure 42 *Anisakis simplex* Rudolphi
(a) Anterior portion of the worm
(b) Posterior portion of the worm

Figure 42

Plate XVI

Figure 43 *Cucullanus* sp.
(a) Female anterior portion of the worm
(b) Female posterior portion of the worm
(c) Male anterior portion of the worm
(d) Male posterior portion of the worm

Figure 43

Plate XVII

Figure 44 *Oncophora melanocephala* (Rudolphi)
(a) Anterior portion of the worm
(b) Posterior portion of the worm

Figure 45 Cysts in different location of the digestive tract

Figure 44

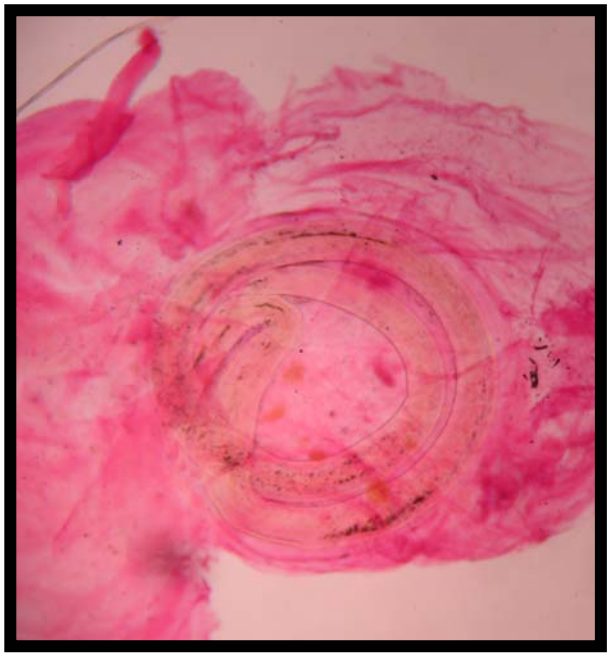

Figure 45

Plate XVIII

Figure 46 *Illiosentis ctenorhynchus* Cable and Linderot
(a) Anterior portion of the worm
(b) Probosis

Figure 47 *Trachelobdella lubrica* (Grude)
(a) Anterior portion of the worm
(b) Posterior portion of the worm

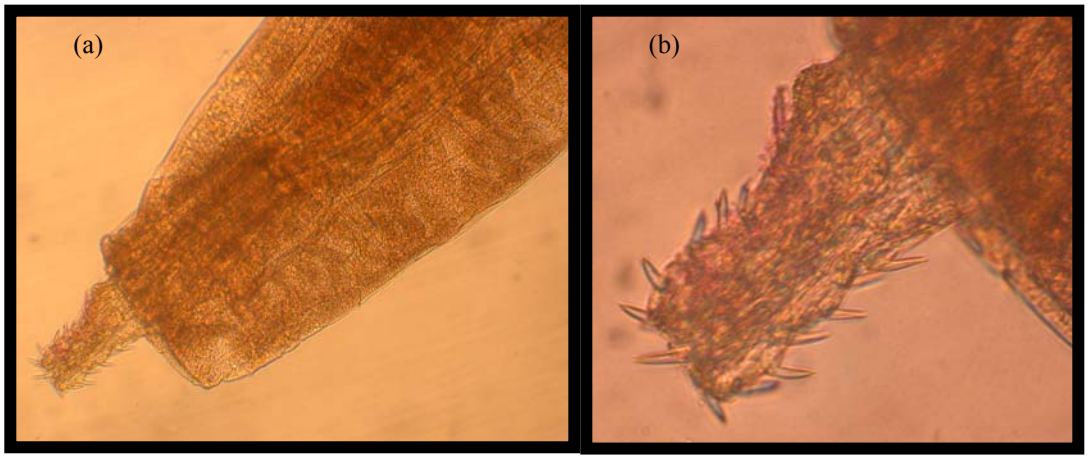

Figure 46

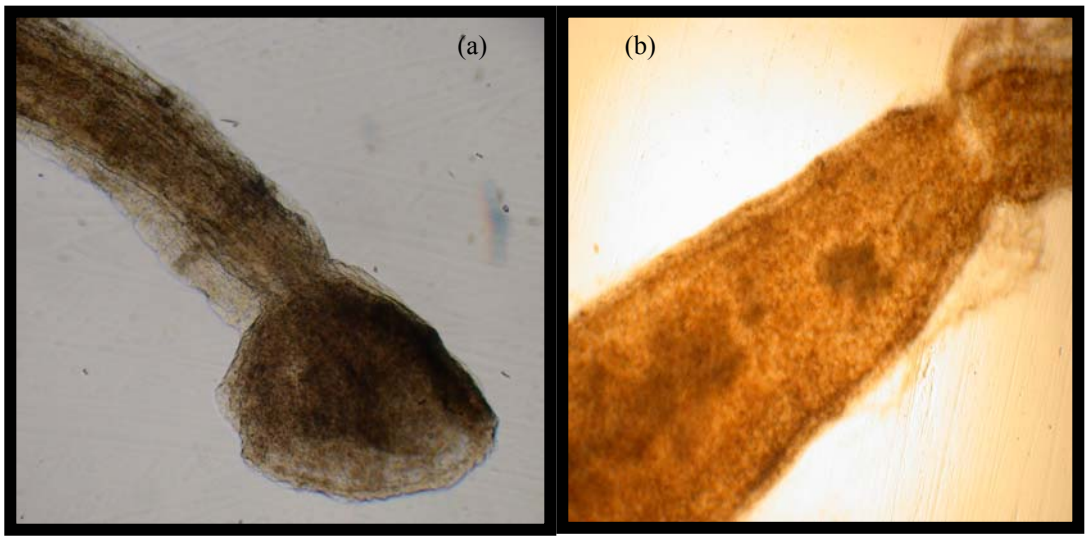

Figure 47

Plate XIX

Figure 48 *Caligus asperimanus* Pearse, 1951
(a) Copepod
(b) Sternal furca

Figure 49 *Caligus irritans* Heller, 1868
(a) Copepod
(b) Sternal furca

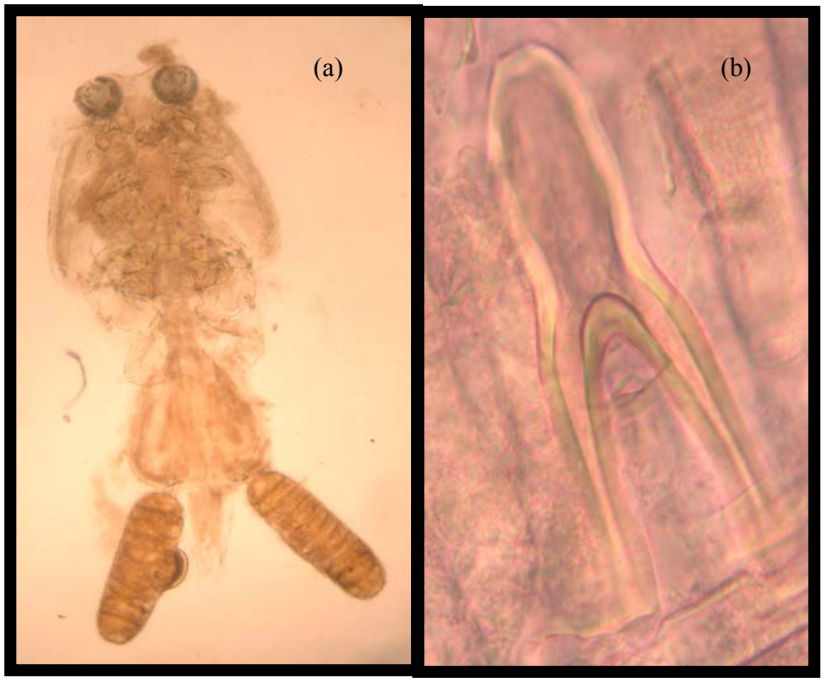

Figure 48

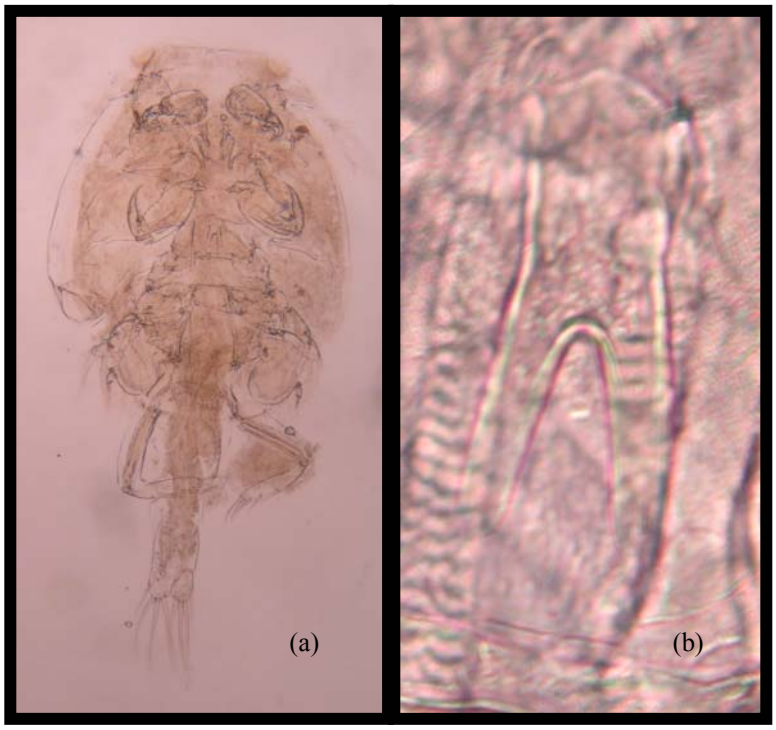

Figure 49

Plate XX

Figure 50 *Caligus practextus* Bere, 1936
(a) Copepod
(b) Sternal furca

Figure 51 *Caligus xystereus* Cressy, 1991
(a) Copepod
(b) Sternal furca

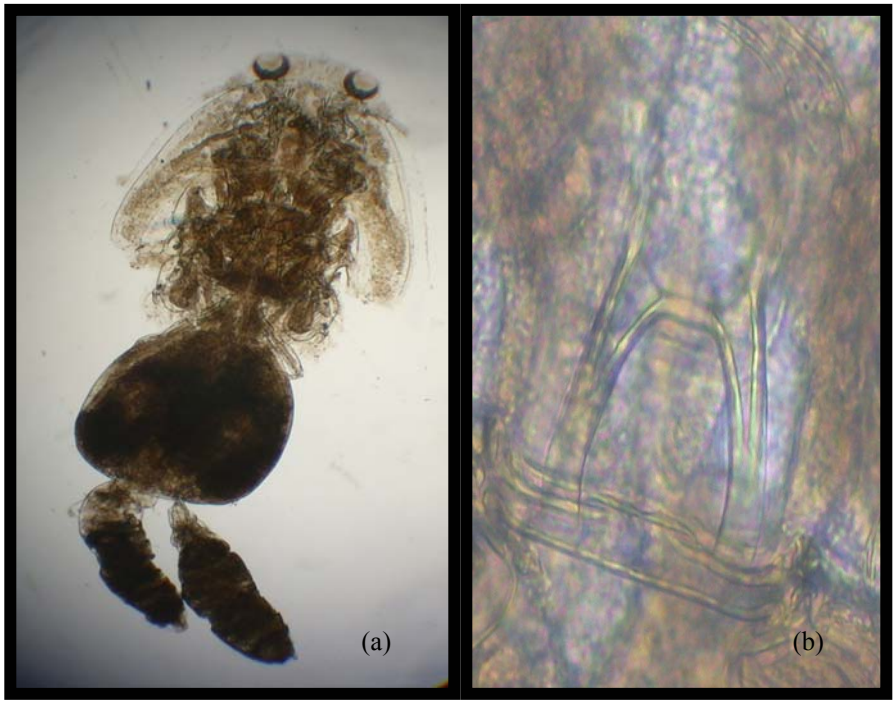

Figure 50

Figure 51

Plate XX

Figure 52 Chalimus stage copepod

Figure 53 Nauplius stage copepod

Figure 52

Figure 53

Plate XXI

Figure 54 *Hatschekia albirubia* Wilson, 1913
(a) Copepod
(b) Anterior portion of the copepod

Figure 55 *Hatschekia linearis* Wilson, 1913
(a) Copepod
(b) Anterior portion of the copepod

Figure 54

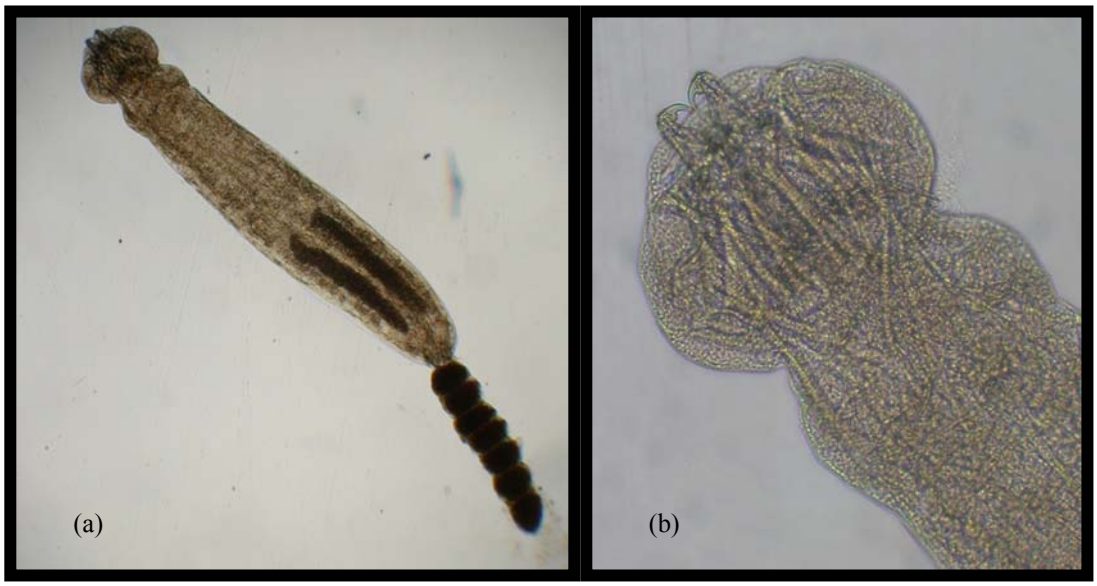

Figure 55

Plate XXII

Figure 56 *Hatschekia oblonga* Wilson, 1913
(a) Copepod
(b) Anterior portion of the copepod

Figure 57 *Hatschekia* sp. 1
(a) Copepod
(b) Anterior portion of the copepod

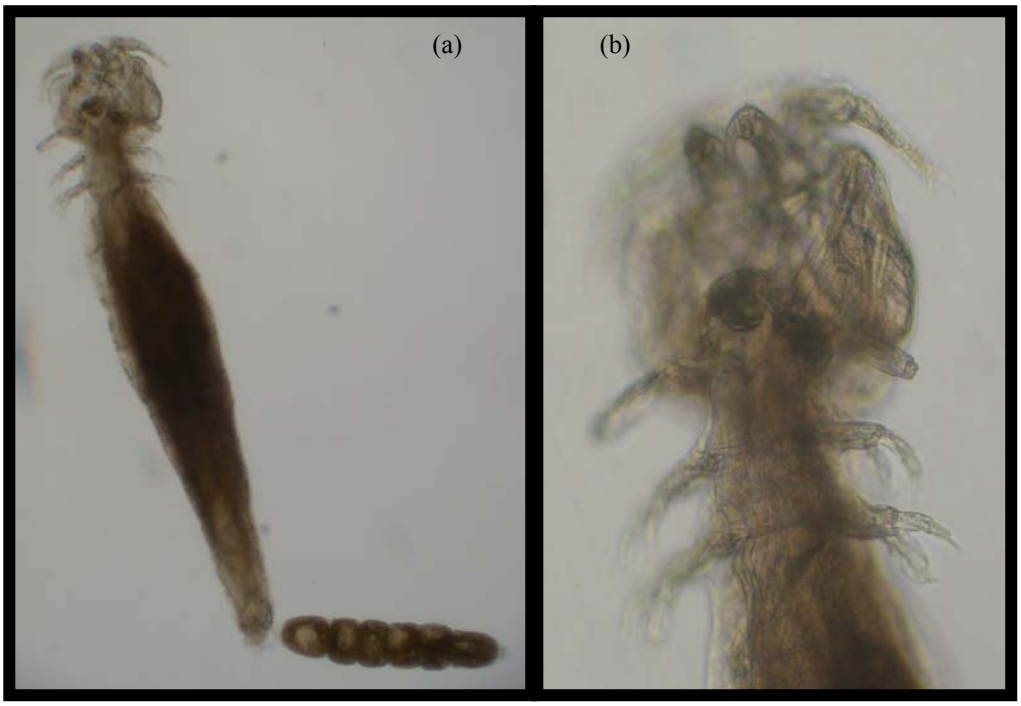

Figure 56

Figure 57

Plate XXIII

Figure 58 *Hatschekia* sp. 2
(a) Copepod
(b) Anterior portion of the copepod

Figure 59 *Hatschekia* sp. 3
(a) Copepod
(b) Anterior portion of the copepod

Figure 58

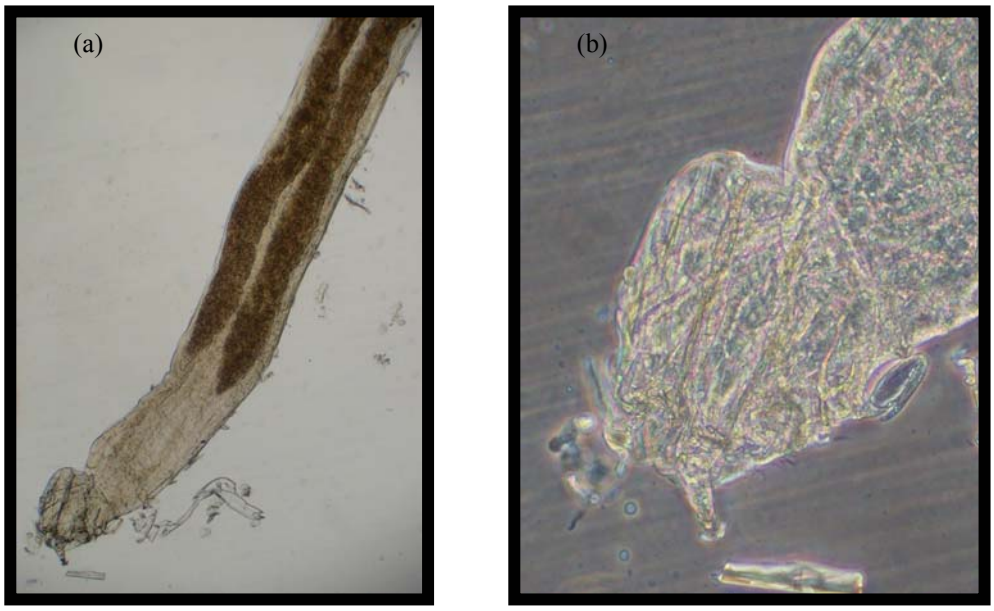

Figure 59

Plate XXIV

Figure 60 *Lernanthropus eddiwarneri* Delamare-Deboutteville et Nunes-Ruivo1954
(a) Front view of the copepod
(b) Back view of the copepod

Figure 61 *Lernanthropus frondeus* Wilson, 1913
(a) Front view of the copepod
(b) Back view of the copepod

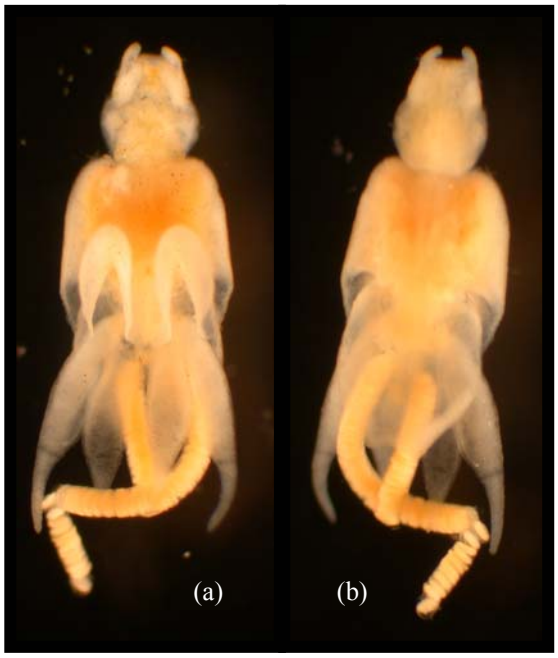

Figure 60

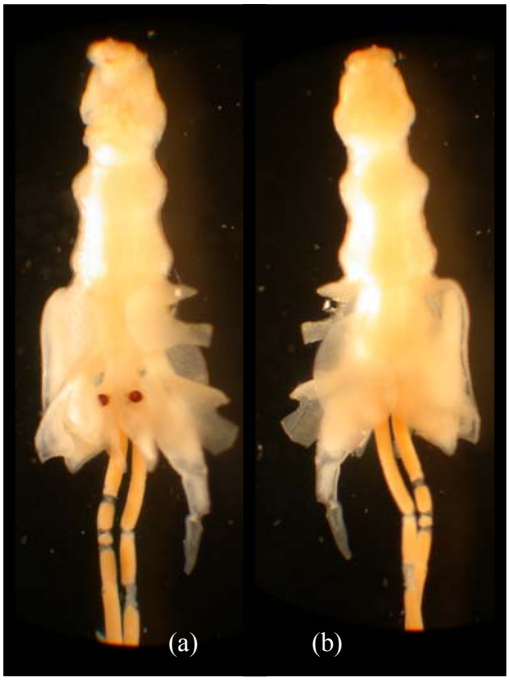

Figure 61

Plate XXV

Figure 62 *Lernanthropus kroyeri* v. Beneden, 1851

Figure 63 *Lernanthropus spiculatus* Wilson, 1913
(a) Front view of the copepod
(b) Back view of the copepod

Figure 62

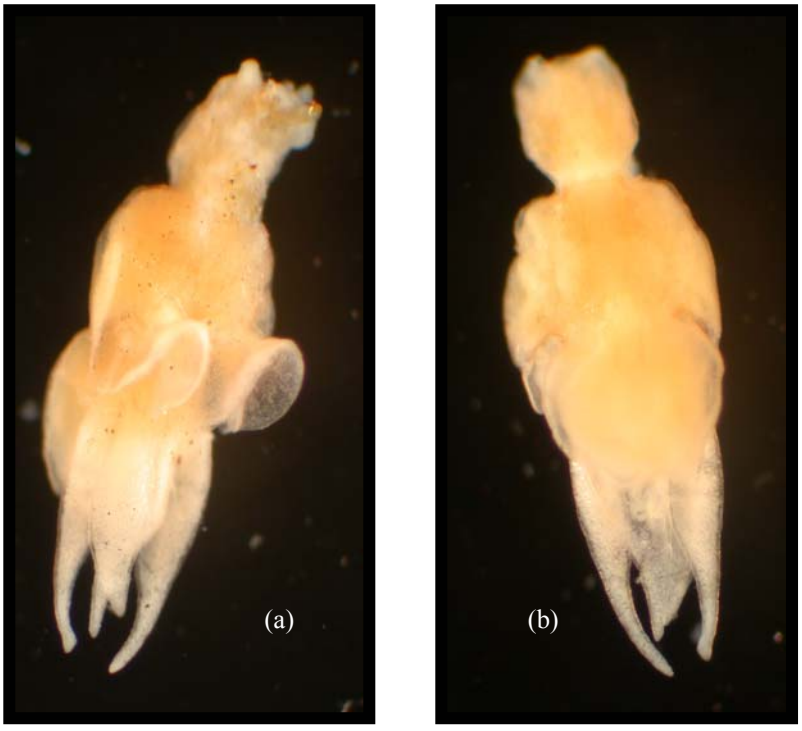

Figure 63

Plate XXVI

Figure 64 Immature stages of copepod of the genus *Lernanthropus*

Figure 65 *Neobrachiella* sp.

Figure 64

Figure 65

Plate XXVII

Figure 66 *Gnathia* spp.

Figure 67 *Rocinela oculata* Harger, 1883

Figure 68 *Rocinela signata* Schioedte and Meinert, 1879

Figure 66

Figure 67

Figure 68