

## Isopods (Isopoda: Aegidae, Cymothoidae, Gnathiidae) associated with Venezuelan marine fishes (Elasmobranchii, Actinopterygii)

Lucy Bunkley-Williams,<sup>1</sup> Ernest H. Williams, Jr.<sup>2</sup> & Abul K.M. Bashirullah<sup>3</sup>

1 Caribbean Aquatic Animal Health Project, Department of Biology, University of Puerto Rico, P.O. Box 9012, Mayagüez, PR 00861, USA; lwilliams@uprm.edu

2 Department of Marine Sciences, University of Puerto Rico, P.O. Box 908, Lajas, Puerto Rico 00667, USA; ewilliams@uprm.edu

3 Instituto Oceanográfico de Venezuela, Universidad de Oriente, Cumaná, Venezuela.

Author for Correspondence: LBW, address as above. Telephone: 1 (787) 832-4040 x 3900 or 265-3837 (Administrative Office), x 3936, 3937 (Research Labs), x 3929 (Office); Fax: 1-787-834-3673; lwilliams@uprm.edu

Received 01-VI-2006. Corrected 02-X-2006. Accepted 13-X-2006.

**Abstract:** The parasitic isopod fauna of fishes in the southern Caribbean is poorly known. In examinations of 12 639 specimens of 187 species of Venezuelan fishes, the authors found 10 species in three families of isopods (Gnathiids, *Gnathia* spp. from *Diplectrum radiale*\*, *Heteropriacanthus cruentatus*\*, *Orthopristis ruber*\* and *Trachinotus carolinus*\*; two aegids, *Rocinela signata* from *Dasyatis guttata*\*, *H. cruentatus*\*, *Haemulon aurolineatum*\*, *H. steindachneri*\* and *O. ruber*; and *Rocinela* sp. from *Epinephelus flavolimbatus*\*; five cymothoids: *Anilocra haemuli* from *Haemulon boschmae*\*, *H. flavolineatum*\* and *H. steindachneri*\*; *Anilocra* cf. *haemuli* from *Heteropriacanthus cruentatus*\*; *Haemulon bonariense*\*, *O. ruber*\*, *Cymothoa excisa* in *H. cruentatus*\*; *Cymothoa oestrum* in *Chloroscombrus chrysurus*, *H. cruentatus*\* and *Priacanthus arenatus*; *Cymothoa* sp. in *O. ruber*; *Livoneca* sp. from *H. cruentatus*\*; and *Nerocila fluviatilis* from *H. cruentatus*\* and *P. arenatus*\*). The *Rocinela* sp. and *A. cf. haemuli* in the southern Caribbean could represent new species. The abundance of *A. cf. haemuli* appears to have drastically reduced from 1994 to 1999 in the Gulf of Cariaco. The *Cymothoa* sp. represents an undescribed species that is apparently host specific to *O. ruber*. It does not occur in the Gulf of Cariaco, but is relatively abundant on the Caribbean coast of Sucre State, Venezuela. The *Livoneca* sp. is an undescribed species host specific to *Diapterus rhombeus*, *Cymothoa excisa* and *C. oestrum* were thought to have distinct host preferences, but both infected the *Heteropriacanthus cruentatus* in the present study. *Gnathia* spp. are reported from Venezuelan waters for the first time. Twenty new host records\* are noted. The fish-associated isopod fauna is much more extensive and important than has previously been suspected. Rev. Biol. Trop. 54 (Suppl. 3): 175-188. Epub 2007 Jan. 15.

**Key words:** fish-parasitic isopods, Venezuela, new species, new host, new locality records.

Isopods associate with many species of commercially important fishes around the world and cause significant economic losses to fisheries by killing, stunting, or damaging these fishes. They can also kill or impair immature fishes so that they do not survive. At least one species often and quite painfully bites human swimmers and divers in the Caribbean: sometimes in alarming mass attacks. However, folklore endows these isopods with positive qualities. The presence of

isopods on Caribbean fishes is supposed to indicate that the host is free of ciguatera (fish poisoning) toxins [not tested] and dried isopods are used as folk medicines around the world. Despite their importance, isopods associated with fishes are relatively poorly studied or even surveyed in many parts of the world (Williams and Bunkley-Williams 1996, Bunkley-Williams and Williams 1998).

Few reports of fish-associated isopods have been made in the southern Caribbean

(Fig. 1): only 17 species of isopods have been recorded from 39 species of fishes (Table 1). The authors use the term “fish-associated” because some aegids and corallanids on fishes may be minipredators instead of parasites, and few of them are known well enough to be certain. Bashirullah (1991) examined the attachment positions of *Anilocra laticauda* H. Milne Edwards in Venezuela. Delaney (1989) noted *Alcirona* spp., isopods that sometimes associate with fishes, from Colombia. Garzon-Ferreira (1990) noted an isopod, which often associates with fishes, attacking humans in Colombia.

A collection of isopods taken from marine fishes in Venezuela (Fig. 2), July 1999, is reported below including four undescribed species, a new geographic record for Venezuela, and 20 new host records. Kensley and Schotte (1989) provided keys, diagnostic characters, and biological information about all of the species the authors discuss.

#### MATERIALS AND METHODS

Fishes were obtained from fish markets after having been captured by trawl, traps, trammel nets, spearing, and hook and line. The external surfaces, mouth and gill chambers of



Fig. 1. Southern Caribbean countries: (1) Panamá, (2) Colombia, (3) Venezuela, (4) Aruba, Netherlands Antilles islands of (5) Curaçao and (6) Bonaire, Trinidad and Tobago islands of Trinidad (7) and Tobago (8).

Fig. 1. Países del Sur del Caribe: (1) Panamá, (2) Colombia, (3) Venezuela, (4) Aruba; (5) Curaçao y (6) Bonaire, islas de las Antillas holandesas; (7) Trinidad y (8) Tobago, islas de Trinidad y Tobago.

each fish were examined grossly without the aid of magnification at the markets (Fig. 3). Some specimens were purchased and transported to the laboratory for microscopic examination. Gnathiid isopods were only found on those hosts examined microscopically. Isopods were preserved in 70% ethanol in individual vials for each host specimen. All isopod specimens were deposited in the U.S. National Parasite Collection (USNPC). The authors were familiar with all of the isopod and fish host species

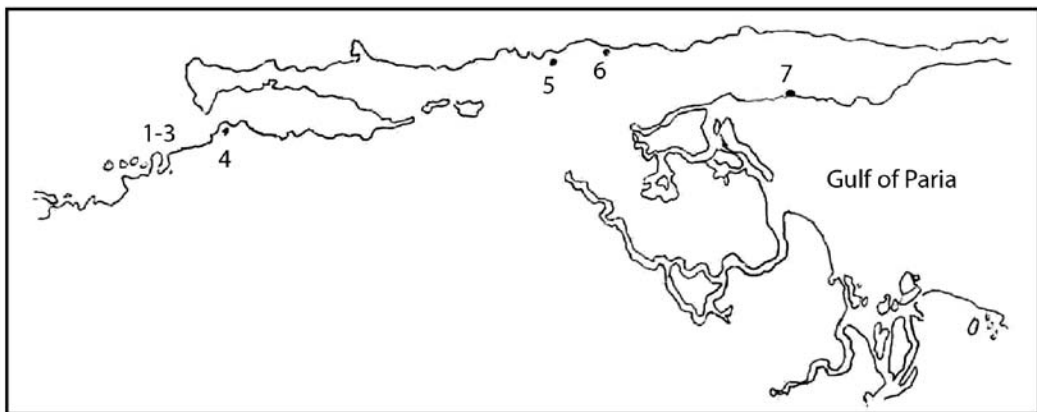


Fig. 2. Northeast Venezuela. Dots indicate localities of snorkeling observations: (1) Playa Blanco, (2) Playa Catuario, and (3) Las Maritas, all in Bahía de Mochima; or markets where fishes were examined for isopods: (4) Cumaná, (5) Carúpano, (6) Río Caribe, (7) Irapa.

Fig. 2. Venezuela. Los puntos indican las localidades de observación con esnórquel: (1) Playa Blanco, (2) Playa Catuario y (3) Las Maritas, todas en Bahía de Mochima; o en mercados donde se examinaba si los peces tenían isópodos: (4) Cumaná, (5) Carúpano, (6) Río Caribe, (7) Irapa.

TABLE 1  
*Isopods associated with southern Caribbean fishes*

CUADRO 1  
*Isópodos asociados con peces del Caribe sur*

Family	Isopod	Host	Country	Reference
<b>Family Gnathiidae</b>				
	<b><i>Gnathia</i> sp.</b>			
		<i>Apogon quadrisquamatus</i> Longley, Sawcheek Cardinalfish	Colombia	Bunkley-W. <i>et al.</i> 1999
		<i>Epinephelus niveatus</i> (Valenciennes), Snowy Grouper	Colombia	Bunkley-W. <i>et al.</i> 1999
		<i>Scorpaenodes tredecimspinosus</i> (Metzelaar), Deepreef Scorpionfish	Colombia	Bunkley-W. <i>et al.</i> 1999
<b>Family Corallanidae</b>				
	<b><i>Alcirona krebsii</i> (Hansen)</b>			
		<i>Apogon binotatus</i> (Poey), Barred Cardinalfish	Colombia	Bunkley-W. <i>et al.</i> 1999
		<i>Scorpaena bergi</i> Evermann & Marsh, Goosehead Scorpionfish	Colombia	Bunkley-W. <i>et al.</i> 1999
	<b><i>Excorallana costata</i> Lemos and Castro</b>			
		<i>Mycteroperca bonaci</i> (Poey), Black Grouper	Colombia	Bunkley-W. <i>et al.</i> 1999
	<b><i>Excorallana tricornis</i> (Hansen)</b>			
		<i>Anisotremus virginicus</i> (Linnaeus), Porkfish	Colombia	Williams <i>et al.</i> 1994
		<i>Dasyatis americana</i> Hildebrand & Schroeder, Southern Stingray	Colombia	Williams <i>et al.</i> 1994
		<i>Dasyatis guttata</i> (Bloch), Longnose Stingray	Colombia	Williams <i>et al.</i> 1994
		<i>Prionotus ophryas</i> Jordan & Swain, Bandtail Searobin	Colombia	Williams <i>et al.</i> 1994
		<i>Scorpaena plumieri</i> Bloch, Spotted Scorpionfish	Colombia	Williams <i>et al.</i> 1994
		<i>Selene vomer</i> (Linnaeus), Lookdown	Colombia	Williams <i>et al.</i> 1994
<b>Family Aegidae</b>				
	<b><i>Rocinela signata</i> Schøedte and Meinert</b>			
		<i>Dasyatis americana</i> Hildebrand & Schroeder, Southern Stingray	Colombia	Williams <i>et al.</i> 1994
		<i>Dasyatis guttata</i> (Bloch), Longnose Stingray	Colombia	Williams <i>et al.</i> 1994
		<i>Haemulon steindachneri</i> (Jordan and Gilbert), Chere-chere Grunt	Venezuela	Kensley and Schotte 1989
		<i>Lutjanus analis</i> (Cuvier), Lane Snapper	Venezuela	Bunkley-W. <i>et al.</i> 1998
		<i>Micropogonias furnieri</i> (Desmarest), Roncador	Venezuela	Bunkley-W. <i>et al.</i> 1998
		<i>Orthopristis ruber</i> (Cuvier), Corocoro	Venezuela	Kensley and Schotte 1989
<b>Family Cymothoidae</b>				
	<b><i>Anilocra abudufdufi</i> Williams and Williams</b>			
		<i>Abudufdufi saxatilis</i> (Linnaeus), Sergeant Major	Panama	Williams and Williams 1981
			Colombia	Williams and Williams 1981
	<b><i>Anilocra haemuli</i> Williams and Williams</b>			
		<i>Mycteroperca rubra</i> (Bloch), Comb Grouper	Colombia	Bunkley-W. <i>et al.</i> 1999
		<i>Mycteroperca bonaci</i> (Poey), Black Grouper	Colombia	Bunkley-W. <i>et al.</i> 1999
		<i>Orthopristis ruber</i> (Cuvier), Corocoro	Venezuela	Williams and Williams 1981
			Venezuela	Bunkley-W. <i>et al.</i> 1998
		<i>Paranthias furcifer</i> (Valenciennes), Creolefish	Colombia	Williams and Williams 1981
			Colombia	Bunkley-W. <i>et al.</i> 1999
		no host indicated	Venezuela	Williams and Williams 1981
	<b><i>Cymothoa excisa</i> Perty</b>			
		<i>Diapterus auratus</i> Ranzani, Irish Mojarra	Colombia	Bunkley-W. <i>et al.</i> 1999
		<i>Diapterus rhombeus</i> (Cuvier), Caitipa Mojarra	Colombia	Bunkley-W. <i>et al.</i> 1999
		<i>Lutjanus analis</i> (Cuvier), Lane Snapper	Panama	Weinstein and Heck 1977
			Venezuela	Bunkley-W. <i>et al.</i> 1998
			Colombia	Bunkley-W. <i>et al.</i> 1999

TABLE 1 (Continued)  
*Isopods associated with southern Caribbean fishes*

CUADRO 1 (Continúa)  
*Isópodos asociados con peces del Caribe sur*

Family	Isopod	Host	Country	Reference
		<i>Lutjanus griseus</i> (Linnaeus), Gray Snapper	Venezuela	Bunkley-W. <i>et al.</i> 1998
		<i>Lutjanus mahogoni</i> (Cuvier), Mahogany Snapper	Panama	Kensley and Schotte 1989
		<i>Lutjanus synagris</i> (Linnaeus), Lane Snapper	Panama	Weinstein and Heck 1977
			Colombia	Williams <i>et al.</i> 1994
		<i>Micropogonius furnieri</i> (Desmarte), Whitemouth Croaker	Colombia	Bunkley-W. <i>et al.</i> 1999
		<i>Ocyurus chrysurus</i> (Bloch), Yellowtail Snapper	Venezuela	Bowman and Diaz-Ungria 1957
			Panama	Weinstein and Heck 1977
			Colombia	Williams <i>et al.</i> 1994
		<i>Stellifer venezuelae</i> (Schultz), Venezuelan Stardrum	Colombia	Bunkley-W. <i>et al.</i> 1999
		no host	Trinidad	Kensley and Schotte 1989
	<b><i>Cymothoa oestrum</i> (Linnaeus)</b>			
		<i>Caranx hippos</i> (Linnaeus), Crevalle Jack	Venezuela	Kensley and Schotte 1989
				Bunkley-W. <i>et al.</i> 1998
		<i>Caranx</i> sp., jack	Curaçao	Kensley and Schotte 1989
		<i>Caranx latus</i> Agassiz, Horse-eye Jack	Colombia	Bunkley-W. <i>et al.</i> 1999
		<i>Chloroscombrus chrysurus</i> (Linnaeus), Atlantic Bumper	Colombia	Bunkley-W. <i>et al.</i> 1999
		<i>Cynoscion</i> sp.	Panama	Kensley and Schotte 1989
		<i>Cynoscion leiarchus</i> (Cuvier), Smooth Weakfish	Panama	Bunkley-W. and Williams 2003
		<i>Elagatis bipinnulatus</i> (Quoy & Gaimard), Rainbow Runner	Colombia	Bunkley-W. <i>et al.</i> 1999
		<i>Selar crumenophthalmus</i> (Bloch), Bigeye Scad	Venezuela	Bowman and Diaz-Ungria 1957
	<b><i>Cymothoa</i> sp. of Bowman and Diaz-Ungria</b>			
		<i>Orthopristis ruber</i> (Cuvier), Corocoro	Venezuela	Bowman and Diaz-Ungria 1957
	<b><i>Glossobius hemiramphi</i> Williams and Williams</b>			
		<i>Hemiramphus brasiliensis</i> (Linnaeus), Ballyhoo	Venezuela	Bunkley-W. <i>et al.</i> 1998
	<b><i>Kuna insularis</i> Williams and Williams</b>			
		<i>Abudefduf saxatilis</i> (Linnaeus), Sergeant Major	Panama	Williams and Williams 1985
			Curaçao	Williams and Williams 1985
			Venezuela	Bunkley-W. <i>et al.</i> 1998
	<b><i>Livoneca redmanii</i> Leach</b>			
		<i>Scomberomorus cavalla</i> (Cuvier), King Mackerel	Colombia	Kensley and Schotte 1989
		<i>Scomberomorus brasiliensis</i> Colette <i>et al.</i> , Serra Spanish Mackerel	Colombia	Williams and Bunkley-W. 1996
			Venezuela	Bunkley-W. <i>et al.</i> 1998
				Bunkley-W. <i>et al.</i> 1999
			Trinidad	Williams and Bunkley-W. 1996
	<b><i>Livoneca</i> sp.</b>			
		<i>Diapterus rhombeus</i> (Cuvier), Caitipa Mojarra	Venezuela	Bunkley-W. <i>et al.</i> 1998
		<i>Haemulon bonariense</i> Cuvier, Black Grunt	Colombia	Bunkley-W. <i>et al.</i> 1999
	<b><i>Mothocya xenobranchia</i> Bruce</b>			
		<i>Tylosurus crocodilis</i> (Peron and Lesueur), Houndfish	Venezuela	Bunkley-W. <i>et al.</i> 1998
	<b><i>Mothocya nana</i> (Schjödte and Meinert)</b>			
		<i>Hyporhamphus unifasciatus</i> (Ranzani), Silverstripe Halfbeak	Panama	Kensley and Schotte 1989
	<b><i>Nerocila fluviatilis</i> Schjödte and Meinert</b>			
		No hosts noted	Trinidad	Bunkley-W. and Williams 1999



Fig. 3. E.H. Williams examining Roncador, *Micropogonias furnieri* (Desmarest), at a fish market in Carúpano, Venezuela, 12 July 1999. Photograph taken by Lucy Bunkley-Williams.

Fig. 3. E.H. Williams examinando un roncador, *Micropogonias furnieri* (Desmarest), en un mercado de Carúpano, Venezuela, 12 de julio de 1999. Fotografía tomada por Lucy Bunkley-Williams.

reported. The keys and diagnostic characters provided in Kensley and Schotte (1989) can be used to identify all of these isopods. The authors carried a copy of Cervigón *et al.* (1993) in the field with them during examinations, which was useful in identifying some fishes on site (Appendix 1). Not all fish hosts were preserved. Tumors and other parasites collected from some of these hosts will be reported elsewhere. Using snorkeling equipment, the authors observed external isopods at three localities in Mochina National Park (Table 2, Fig. 2). This article was submitted for publication in the 29<sup>th</sup> AMLC Proceedings in 1999 (Anonymous 2000) immediately after the study was conducted, but the manuscript was misplaced at some point in the process. It was updated and resubmitted in 2005.

## RESULTS AND DISCUSSION

Eighty-seven isopods representing 10 species (or more because of the unknown number of gnathid species) were collected from 12 639 specimens representing 187 species of fishes (Table 2, Appendix 1). The use of fish markets for obtaining hosts certainly limited the

diversity and abundance of parasites collected. However, it did focus our efforts on the more economically important fishes in the region. Length of fish storage; use of ice, refrigeration or freezing; rough and frequent handling; and rinsing in salt or freshwater caused the loss or diminished the numbers of available parasites.

***Anilocra cf haemuli* Williams and Williams (Fig. 4):** *Anilocra haemuli* infects a variety of grunts (Haemulidae) and groupers (Serranidae) throughout the West Indies (Williams and Williams 1981). One form in the southern Caribbean infects different fish species than those individuals found further north and also differs by occurring on off-reef habitats (Bunkley-Williams *et al.* 2000). This form also possesses some minor morphological differences from *A. haemuli*. The authors are in the process of genetically evaluating this and other forms in this possible species complex (Bunkley-Williams and Williams, unpubl. data). This southern form could represent a distinct species (Fig. 4). This isopod was called *Anilocra laticauda* H. Milne Edwards by Bashirulla (1991), a name the present authors declared *nomen dubium* in 1981.

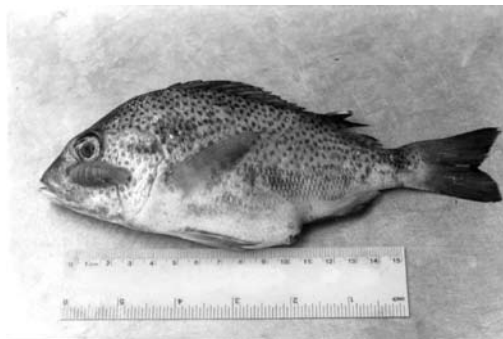


Fig. 4. Female *Anilocra cf haemuli* Williams and Williams attached under the eye of a Corocoro, *Orthopristis ruber* (Cuvier), collected at a fish market in Carúpano, Venezuela, 12 July 1999. Photograph taken by Lucy Bunkley-Williams.

Fig. 4. Hembra de *Anilocra cf haemuli* Williams and Williams adherida bajo el ojo de un Corocoro, *Orthopristis ruber* (Cuvier), recolectado en un mercado de Carúpano, Venezuela, 12 de julio de 1999. Fotografía tomada por Lucy Bunkley-Williams.

TABLE 2  
Isopods collected or observed in marine fishes in Sucre State, Venezuela, July 1999

CUADRO 2  
Isópodos recolectados u observados en peces marinos del Estado Sucre, Venezuela, julio 1999

Isopod Family Isopod Species	Locality	# Infected/ Examined	Isopods	Location	Host Species USNPC
<b>Family Gnathiidae</b>					
<b>Gnathia sp.**</b>					
<i>Diplectrum radiale</i> (Quoy & Gaimard), Pond Perch*	Cumaná	1/32	1J	gills	98505
<i>Heteropriacanthus cruentatus</i> (Lacepède), Glasseye*	Cumaná	2/5	2J	gills	---
<i>Orthopristis ruber</i> (Cuvier), Corocoro*	Carúpano	3/5	5J	gills	98524
<i>Trachinotus carolinus</i> (Linnaeus), Pompano*	Rio Caribe	1/1	1J	gills	98533
<b>Family Aegidae</b>					
<b>Rocinela signata Schöedte and Meinert</b>					
<i>Dasyatis guttata</i> (Bloch), Longnose Stingray*	Irapa	1/1	1	gills	98508
<i>Haemulon aurolineatum</i> Cuvier, Tomtate*	Catuaro	1/220	1	body	obs.
<i>Haemulon steindachneri</i> (Jordan & Gilbert), Chere-chere Grunt*	Rio Caribe	2/10	2	gills	98507
<i>Orthopristis ruber</i> (Cuvier), Corocoro	Carúpano	1/203	1	gills	98514
<i>Heteropriacanthus cruentatus</i> (Lacepède), Glasseye*	Cumaná	2/914	2	gills	98501
<b>Rocinela sp.**</b>					
<i>Epinephelus flavolimbatu</i> s Poey, Yellowedge Grouper*	Cumaná	2/4	2	gills	98532
<b>Family Cymothoidae</b>					
<b>Anilocra haemuli Williams and Williams</b>					
<i>Haemulon boschmae</i> (Metzelaar), Bronzestripe Grunt*	Blanca	2/120	2♀	cheek	obs.
<i>Haemulon flavolineatum</i> (Desmarest), French Grunt***	Maritas	2/250	1♀	cheek	obs.
<i>Haemulon steindachneri</i> (Jordan & Gilbert), Chere-chere Grunt*	Catuaro	1/150	1♀	cheek	obs.
<b>Anilocra cf haemuli Williams and Williams</b>					
<i>Haemulon bonariense</i> Cuvier, Black Grunt*	Carúpano	1/5	1♀	cheek	98516
<i>Heteropriacanthus cruentatus</i> (Lacepède), Glasseye*	Cumaná	28/914	30♂	cheek	98504,98506, 98513,98527
<i>Orthopristis ruber</i> (Cuvier), Corocoro*	Carúpano	2/203	3♀	cheek	98529
	Cumaná	3/1001	3♀	cheek	98530-31
<b>Cymothoa excisa Perty</b>					
<i>Heteropriacanthus cruentatus</i> (Lacepède), Glasseye*	Cumaná	1/914	1♀	mouth	98525
<b>Cymothoa oestrum (Linnaeus)</b>					
<i>Chloroscombrus chrysurus</i> (L.), Atlantic Bumper	Carúpano	1/25	1♀	mouth	98515
<i>Heteropriacanthus cruentatus</i> (Lacepède), Glasseye*	Cumaná	7/914	2♀,5♂	mouth	98500 98502,98509
<i>Priacanthus arenatus</i> (Cuvier), Atlantic Bigeye*	Cumaná	1/570	1♀	mouth	98510
<b>Cymothoa sp.</b>					
<i>Orthopristis ruber</i> (Cuvier), Corocoro	Carúpano	11/203	7♀,4♂	mouth	98517-23
<b>Livoneca sp.</b>					
<i>Heteropriacanthus cruentatus</i> (Lacepède), Glasseye*	Cumaná	1/914	1♀	gills	98498
<b>Nerocila fluviatilis Schöedte and Meinert</b>					
<i>Priacanthus arenatus</i> (Cuvier), Atlantic Bigeye*	Cumaná	1/570	1♂	body	98512
<i>Heteropriacanthus cruentatus</i> (Lacepède), Glasseye*	Cumaná	10/914	4♀, 6♂	body	98499,98503, 98511,98526

\*New host record; \*\*New country locality record, \*\*\*New record of this host in the southern Caribbean

LOCALITIES: Blanco = Playa Blanco, Bahía de Mochima; Catuaro = Playa Catuaro, Bahía de Mochima; Maritas = Las Maritas, Bahía de Mochima.

ABBREVIATIONS: Bunkley-W. = Bunkley-Williams; J = juvenile isopod; obs. = underwater observation; USNPC = U.S. National parasite Collection.

The authors found this isopod on only three of 1001 *Orthopristis ruber* examined from the Gulf of Cariaco (Table 2). This scarcity was not merely the result of losses due to handling because the typical and obvious external wounds caused by this isopod were also absent. Three years prior to this study this isopod was abundant in the Gulf of Cariaco and parasitized 3-6% of the *Orthopristis ruber* (Bashirulla, unpubl. data). Bunkley-Williams *et al.* (1998) found five of 30 (16.7%) *O. ruber* examined around Cumaná prior to 1992 infected with this isopod. The authors were unable to determine the cause for the reduction in prevalence of this isopod in the Gulf. Fishermen told us that this isopod also occurs on the Chere-chere Grunt, *Haemulon steindachneri* (Jordan and Gilbert), but the authors were unable to find specimens of this isopod on this fish.

*Heteropriacanthus cruentatus* appear to be acting as intermediate hosts for this isopod. The juveniles or males of this isopods occurred abundantly on the body of this host in the Gulf of Cariaco, but no adult females were found on this host.

***Cymothoa excisa* Party:** This is an important isopod due to its preference for members of the commercially important snapper family (Lutjanidae). This mouth-dwelling isopod stunts or reduces growth in infected snappers thus causing significant economic losses in snapper fisheries (Bunkley-Williams *et al.* 1998, 1999, Kensley and Schotte 1989, Weinstein and Heck 1977).

It is similar to *C. oestrum* in size, geographic range, and location in the host, but that isopod prefers jacks. *Cymothoa excisa* and *C. oestrum* were thought to have distinct host preferences, but both infected the Glasseye in the present study. However, both infections were very rare (Table 2) and may have represented little more than accidental infections. The Glasseye appears to be so abundant that it was available as a host for 8 of the 10 species of isopods we collected.

***Cymothoa oestrum* (Linnaeus):** This isopod typically infects jacks throughout the tropical and subtropical western Atlantic (Williams

and Bunkley-Williams 1996, Bunkley-Williams *et al.* 1998). The authors examined 235 specimens of seven species of jacks, but only found this isopod once (Table 2). This unusual scarcity may be due to losses during the handling of hosts. Williams and Bunkley-Williams (1994) described its early juvenile stages. Bunkley-Williams and Williams (2003) recently documented the plasticity of the morphology of this isopod as it becomes larger. Thatcher *et al.* (2003) redescribed this species on the basis of one specimen from Brazil without comparison with the original type material. This isopod causes some stunting and losses of jacks, which are becoming more commercially important in the Caribbean region as other fish species become over exploited.

***Cymothoa* sp. of Bowman and Diaz-Ungria (Figs. 5-6):** Bowman and Diaz-Ungria



Fig. 5. Anterior view of a female *Cymothoa* sp. of Bowman and Diaz-Ungria attached to the tongue of a Corocoro, *Orthopristis ruber* (Cuvier), collected at a fish market in Carúpano, Venezuela, 12 July 1999. Photograph taken by Lucy Bunkley-Williams.

Fig. 5. Vista anterior de una hembra de *Cymothoa* sp. de Bowman y Diaz-Ungria adherida a la lengua de un Corocoro, *Orthopristis ruber* (Cuvier), recolectado en un mercado de Carúpano, Venezuela, 12 de julio de 1999. Fotografía tomada por Lucy Bunkley-Williams.



Fig. 6. Lateral view of a female *Cymothoa* sp. of Bowman and Diaz-Ungria attached to the tongue, and a male attached on top of the left gill rakers, of a Corocoro, *Orthopristis ruber* (Cuvier) collected at a fish market in Carúpano, Venezuela, 12 July 1999. Left operculum and left side of mouth were excised to expose the attachment positions. Photograph taken by Lucy Bunkley-Williams.

Fig. 6. Vista lateral de una hembra de *Cymothoa* sp. de Bowman y Diaz-Ungria adherida a la lengua, y de un macho adherido en la parte superior de las branquias de un Corocoro, *Orthopristis ruber* (Cuvier), recolectado en un mercado de Carúpano, Venezuela, 12 de julio de 1999. El opérculo izquierdo y el lado izquierdo de la boca fueron extirpados para exponer las posiciones de adhesión. Fotografía tomada por Lucy Bunkley-Williams.

(1957) found a female and male pair of this isopod in *Orthopristis ruber* from "Paria (Estado Sucre)" Venezuela. This apparently referred to the Gulf of Paria, since there is no town in the Sucre State by that name. They suggested that this isopod represented a new species, but declined to describe it with only two specimens. The authors attempted to find additional specimens of this isopod in the Gulf of Cariaco in 1992 (Bunkley-Williams *et al.* 1998), but it apparently does not occur there (Table 2; Bashirulla, unpubl. data). It was relatively abundant in the *O. ruber* on the Caribbean coast of Sucre (Table 2).

The female isopod occurs on the tongue of the host (Figs. 5, 6) and the male on the gill rakers of one gill chamber (Fig. 6), which is typical for many species of the genus. It occupies almost the entire oral cavity (Fig. 5) and probably modifies the diet of the host since the size of items swallowed must be less. Kimmel and Arneson (1978) studied the food habits of jacks infected with *C. oestrum* in Puerto Rico

and found that the volume of the food was the same as in uninfected jacks, but the sizes and types of food items differed.

The externally-attaching isopods, *Anilocra abudehdufi* Williams and Williams and *A. acanthuri* Williams and Williams, infect the Sergeant Major, *Abudefduf saxatilis* (Linnaeus) and the Doctorfish, *Acanthurus chirurgus* (Bloch), respectively. These hosts are more likely to be infected with gill-dwelling isopods *Kuna insularis* Williams and Williams and *Agarna cumulus* (Haller), respectively (Williams and Williams 1981, 1985). The authors have not been able to determine the basis of this interesting interspecific cooperation. In the case of the externally-attaching *Anilocra cf haemuli* and the mouth-dwelling *Cymothoa* sp. both infecting *O. ruber*, the authors have not found both species on the same host specimen. Interspecific antagonism could be occurring; however, more hosts must be examined to determine the relationship between these two isopod species.

This isopod is apparently host specific to *O. ruber* and represents an undescribed species. The authors are preparing a description of this isopod.

***Gnathia* spp.:** These isopods were found on four new hosts (Table 2), and are reported for the first time in Venezuela. Müller (1988) noted *Gnathia* spp. in the southern Caribbean, but was concerned only with the adult males, which do not occur on fishes. They are very numerous and ubiquitous throughout the Caribbean. Their blood feeding takes an enormous amount of energy and resources away from coral-reef fishes and they have caused mortalities in aquaculture fishes (Bunkley-Williams and Williams 1998).

***Livoneca* sp. of Bunkley-Williams *et al.*:** This isopod is found in the gill chambers of the Caitipa mojarra, *Diapterus rhombeus* (Cuvier), throughout the southern Caribbean (Bunkley-Williams *et al.* 1998). A record in *Haemulon bonariense* could have represented an accidental infection (Bunkley-Williams *et al.* 2000), as is probably the case with the present record



in one of 914 *Heteropriacanthus cruentatus* (Table 2). Its occasional accidental parasitism is interesting, but it seems largely host specific to the Caitipa mojarra. The authors are preparing a description of this isopod. It causes extreme damage to the opercular flap of the host, but since this is not a commercially important host, the economic damage is slight.

***Nerocila fluviatilis* Schioedte and Meinert:** The authors found this isopod on fishes in Trinidad and Tobago (Bunkley-Williams and Williams 1999, unpubl. data), which represented a new locality record. In the present study, the authors only found this isopod on *Heteropriacanthus cruentatus* and rarely on *Priacanthus arenatus* and only in the Gulf of Cariaco (Table 2). This is a new locality and host record. This isopod can cause considerable damage to its host and occurs on a great variety of hosts including some of commercial importance. It was previously thought to be restricted to the eastern coast of South America. The authors' records in Venezuela and Trinidad and Tobago, extend its range into the northern coast of South America and the Caribbean Sea, although it may not extend much further since the authors did not find it in Bonaire and Curaçao (Bunkley-Williams and Williams 1981, unpubl. data), Colombia (Williams *et al.* 1994, Bunkley-Williams *et al.* 1999) or Panama (Williams and Bunkley-Williams 1985), or northern Tobago (Williams, unpubl. data).

***Rocinela signata* Schøedte and Meinert:** The authors found this isopod on five new fish hosts. It occurs throughout the Caribbean on a great variety of fishes. This isopod is particularly abundant in the gill chambers of larger commercially important hosts (e.g., hogfish, snappers, groupers). Thus it is responsible for reducing the growth rate of many of these important fishes. This is also the only fish-associated isopod that treats humans like a routine food source. The bite of this isopod is painful, bloody, and particularly terrifying in mass attacks. The authors gave this isopod the

common name of "Monogram Isopod" because of the inverted W-shaped mark on its pleotelson (tail) (Garzon-Ferreira 1990, Bunkley-Williams and Williams 1998, unpubl. data).

***Rocinela* sp.:** These specimens appear to represent a new species of *Rocinela*. They do not conform to any species of this genus known from the Caribbean. Only *R. signata* has been noted to associate with fishes in the Atlantic. The new species may represent another fish-associated isopod.

**Distributions:** Too little is known about isopods associated with fishes in the southern Caribbean to adequately discuss their zoogeography. One large-scale division of the Caribbean into continental and insular regions, first noted in fish distributions by Erdman (1963) and later refined by Robins (1971); however, seems to also occur in some fish-parasitic isopods of the southern Caribbean. *Anilocra abudedefdufi*, *Cymothoa excisa*, *Cymothoa* sp., *Kuna insularis*, *Livoneca* sp., and *Nerocila fluviatilis* appear to have a continental distribution in the Caribbean. *Alcirona krebsii*, *Anilocra haemuli*, *Excorallana tricornis*, *Cymothoa oestrum*, *Glossobius hemiramphi*, *Livoneca redmanii*, *Mothocya nana*, *M. xenobranchia*, and *Rocinela signata* occur in both Caribbean continental and insular areas (Bowman and Diaz-Ungria 1957, Weinstein and Heck 1977, Williams and Bunkley-Williams 1981, 1985, 1996, Delaney 1989, Kensley and Schotte 1989, Bashirullah 1991, Williams *et al.* 1994, Bunkley-Williams *et al.* 1998, 1999, Bunkley-Williams and Williams 1999, 2003 unpubl. data).

#### ACKNOWLEDGMENTS

The authors thank J. Ralph Lichtenfels, U.S. National Parasite Collection, Biosystematic Parasitology Laboratory, for depositing the specimens and providing museum numbers. Partial support was provided by Sportfish Restoration Funds, Wallop-Braux Project F-28-13.

## RESUMEN

Se conoce muy poco acerca de la fauna de isópodos parásitos de peces en el Caribe Sur. Tras examinar 12 639 especímenes de 187 especies de peces de Venezuela, los autores encontraron 10 especies de isópodos distribuidos en tres familias. Los asteriscos indican nuevos registros (*Gnátidos*, *Gnathia* spp. en *Diplectrum radiale\**, *Heteropriacanthus cruentatus\**; *Orthopristis ruber\** y *Trachinotus carolinus\**; dos aégidos, *Rocinela signata* en *Dasyatis guttata\**, *H. cruentatus\**, *Haemulon aurolineatum\**, *H. steindachneri\** y *O. ruber*; y *Rocinela* sp. en *Epinephelus flavolimbatus\**; cinco cimotoidos: *Anilocra haemuli* en *Haemulon boschmae\**, *H. flavolineatum\** y *H. steindachneri\**; *Anilocra* cf. *haemuli* en *Heteropriacanthus cruentatus\**; *Haemulon bonariense\**, *O. ruber\**; *Cymothoa excisa* in *H. cruentatus\**; *Cymothoa oestrum* en *Chloroscombrus chrysurus*, *H. cruentatus\** y *Priacanthus arenatus*; *Cymothoa* sp. en *O. ruber*; *Livoneca* sp. en *H. cruentatus\**; y *Nerocila fluviatilis* en *H. cruentatus\** y *P. arenatus\**). Las especies *Rocinela* sp. y *A. cf. haemuli* en el Caribe sur podrían representar especies distintas. La abundancia de *A. cf. haemuli* en el Golfo de Cariaco parece haberse reducido drásticamente entre 1994 a 1999. *Cymothoa* sp. es una especie no descrita que aparentemente parasita específicamente a *O. ruber*. No se le encuentra en el Golfo de Cariaco, pero es relativamente abundante en la costa Caribe del Estado de Sucre, Venezuela. *Livoneca* sp. (especie sin describir) parasita específicamente a *Diapterus rhombeus*. Anteriormente se pensaba que *Cymothoa excisa* y *C. oestrum* tenían distintas preferencias de hospedero, pero ambas infectan a *Heteropriacanthus cruentatus*. *Gnathia* spp. Son además primer registro en aguas venezolanas. Se informan en total 20 nuevos registros. La fauna de isópodos asociados a peces es mucho más extensa e importante de lo que se sospechaba.

**Palabras clave:** isópodos parásitos de peces, Venezuela, nuevas especies, nuevos hospederos, nuevos registros de localidad.

## REFERENCES

Anonymous. 2000. Proceedings of the 29<sup>th</sup> Scientific Meeting, Association of Marine Laboratories of the Caribbean, Cumaná, Venezuela. Rev. Biol. Trop. 48(Suppl. 1): 1-279.

Bashirullah, A.K.M. 1991. Occurrence and site specificity of an isopod *Anilocra laticauda* H. Milne Edwards, 1840 (Isopoda, Cymothoidae) parasitic on the grunt, *Orthopristis ruber* (Cuvier) in eastern Venezuela. Crustaceana 61: 38-42.

Bowman, T.E. & C. Diaz-Ungria. 1957. Isopodos quimotoides parásitos de peces de las aguas Venezolanas. Mem. Soc. Cienc. Nat. "La Salle" 17: 112-124.

Bunkley-Williams, L. & E.H. Williams, Jr. 1998. Isopods associated with fishes: A synopsis and corrections. J. Parasit. 84: 893-896.

Bunkley-Williams, L. & E.H. Williams, Jr. 1999. *Nerocila benrosei* n. sp. (Isopoda: Cymothoidae) an external parasite of hogfishes from the northern Bahamas. J. Parasit. 85: 1036-1040.

Bunkley-Williams, L. & E.H. Williams, Jr. 2003. The identity of the seldom found Caribbean and Gulf of Mexico fish-parasitic isopod, *Cymothoa caraibica* Bovallius, resolved: A neoteric synonym of *C. oestrum* (L.). Caribbean J. Sci. 39: 245-248. (Also available on line: [http://caribjsci.org/aug03/39\\_245\\_248.pdf](http://caribjsci.org/aug03/39_245_248.pdf)).

Bunkley-Williams, L., E.H. Williams, Jr., & A.K.M. Bashirulla. 1998. Some isopods associated with Venezuelan fishes. Carib. Mar. Stud. 6: 27-30.

Bunkley-Williams, L., E.H. Williams, Jr. & J. Garzon-Ferreira. 1999. Some isopod and copepod parasites (Crustacea) of Colombian marine fishes. Carib. J. Sci. 35: 311-314.

Cervigón, F., R. Ciprani, W. Fischer, L. Garibaldi, M. Hendrickx, A.J. Lemus, R. Márquez, J.M. Poutiers, G. Robaina & B. Rodríguez. 1993. Field guide to the commercial marine and brackish-water resources of the northern coast of South America. Food and Agriculture Organization of the United Nations, Rome, Italy. 513 p.

Delaney, P.M. 1989. Phylogeny and biogeography of the marine isopod family Corallanidae (Crustacea, Isopoda, Flabellifera). Natural History Museum of Los Angeles County, Contributions in Science 409: 1-75.

Erdman, D.S. 1963. Discontinuity in marine fish distribution in the Caribbean. Carib. Agricult. 1: 127-131.

Garzon-Ferreira, J. 1990. An isopod, *Rocinela signata* (Crustacea: Isopoda: Aegidae), that attacks humans. Bull. Mar. Sci. 46: 813-815.

Kensley, B. & M. Schotte. 1989. Marine isopod crustaceans of the Caribbean. Smithsonian Institution Press, Washington, D.C. 308 p.

Kimmel, J.J. & D.W. Arneson. 1978. The response of two species of jacks, *C. latus* and *C. hippos* to the isopod ectoparasite, *Cymothoa oestrum*. Proc. Assoc. Isl. Mar. Labs. Carib. 14: 27 (abstract).

Müller, H.-G. 1988. The genus *Gnathia* Leach (Isopoda) from Santa Marta area, northern Colombia, with a review of Gnathiidea from the Caribbean Sea and Gulf of Mexico. Bijdragen Tot de Dierkunde 58: 88-104.

Robins, C.R. 1971. Distribution patterns of fishes from coastal and shelf waters of the tropical western

- Atlantic. Symposium on Investigations and Resources of the Caribbean Sea and Adjacent Regions. Papers on Fisheries Resources, FAO United Nations, Rome, Italy. Pp. 249-255.
- Thatcher, V.E., J. de Loyola e Silva, G.F. Jost & J.M. Souza-Conceição. 2003. Comparative morphology of *Cymothoa* spp. (Isopoda, Cymothoidae) from Brazilian fishes, with the description of *Cymothoa catarinensis* sp. nov. and redescription of *C. excisa* Perty and *C. oestrum* (Linnaeus). Rev. Bras. Zool. 20: 541-552.
- Weinstein, M.P. & K.L. Heck. 1977. Biology and host-parasite relationships of *Cymothoa excisa* (Isopoda, Cymothoidae) with three species of snappers (Lutjanidae) on the Caribbean coast of Panama. Fish. Bull. 75: 875-877.
- Williams, E.H., Jr. & L. Bunkley-Williams. 1994. Four cases of unusual crustacean-fish associations and comments on parasitic processes. J. Aquatic Animal Health 6: 202-208.
- Williams, E.H., Jr. & L. Bunkley-Williams. 1996. Parasites of off shore, big game sport fishes of Puerto Rico and the Western North Atlantic. Puerto Rico Department of Natural and Environmental Resources, San Juan, Puerto Rico, and Department of Biology, University of Puerto Rico, Mayagüez, Puerto Rico. 384 p.
- Williams, E.H., Jr., L. Bunkley-Williams & C.J. Sanner. 1994. New host and locality records for copepod and isopod parasites of Colombian marine fishes. J. Aquatic Animal Health 6: 362-364.
- Williams, E.H., Jr. & L.B. Williams. 1985. *Cuna insularis* n. gen. and n. sp. (Isopoda: Cymothoidae) from the gill chamber of the sergeant major, *Abedufduf saxatilis* (Linnaeus), (Osteichthyes) in the West Indies. J. Parasit. 71: 209-214.
- Williams, L.B. & E.H. Williams, Jr. 1981. Nine new species of *Anilocra* (Crustacea: Isopoda: Cymothoidae) external parasites of West Indian coral reef fishes. Proc. Biol. Soc. Wash. 94: 1005-1047.

#### APPENDIX 1

##### *Host fishes examined for isopod parasites*

#### ANEXO 1

##### *Peces hospederos examinados para detección de isópodos parásitos*

Class, Order, Family Scientific-common name, scientific name, author, common name, and number of specimens examined are noted in phylogenetic order. Number examined in fish markets for macroparasites on the body, fins, gills, and mouth are in (parenthesis), number examined underwater for macroparasites on the body and fins in [brackets], and number examined for total metazoan parasites in detail in the laboratory in {curly brackets}. Numbers do not necessarily represent all of the specimens available, but the number that the authors had time to examine. Most of the fish species were identified in the field without benefit of detailed laboratory examinations. The authors feel confident in our identifications, but in the process of quickly examining large numbers of fish, a few specimens of similar species may have been occasionally confused. Fish specimens infected with isopods were individually and carefully identified. All fish specimens were adults, but only those with isopod para-

sites were measured. Cervigón *et al.* (1993) was used as a field guide.

**Class Elasmobranchii**-sharks and rays, **Order Carcharhiniformes**-ground sharks, **Family Carcharhinidae**-requiem sharks, Blacknose Shark, *Carcharhinus acronotus* (Poey) (6); Bullshark, *C. leucas* (Müller & Henle) (3); Blacktip Shark, *C. limbatus* (Müller & Henle) (22); Dusky Shark, *C. obscurus* (Leseuer) (6); Lemon Shark, *Negaprion brevirostris* (Poey) (1); Brazilian Sharpnose Shark, *Rhizoprionodon lalandii* (Müller & Henle) (35); Caribbean Sharpnose Shark, *R. porosus* (Poey) (50); **Family Triakidae**-houndsharks, Dusky Smooth-hound, *Mustelus canis* (Mitchill) (25); **Family Sphyrnidae**-hammerhead etc. sharks, Bonnethead, *Sphyrna tiburo* (L.) (30); **Order Squaliformes**-dogfish etc. sharks, **Family Squalidae**-dogfish sharks, Cuban Dogfish, *Squalus cubensis* Rivero (100); **Order Rajiformes**-skates and rays, **Family**

**Dasyatidae**-stingrays, Southern Stingray, *Dasyatis americana* Hildebrand & Schroeder (35); Sharpshout Stingray, *D. geijkesi* Boeseman (2); **Class Actinopterygii**-ray-finned fishes, **Order Elopiformes**-tarpons and tenpounders, **Family Megalopidae**-tarpons, Tarpon, *Megalops atlanticus* Valenciennes (16); **Order Abuliformes**-bonefishes, **Family Albulidae**-bonefishes, Threadfin Bonefish, *Albula nemoptera* (Fowler) (2); **Order Clupeiformes**-herrings etc., **Family Clupeidae**-herrings etc., Atlantic Thread Herring, *Opisthonema oglinum* (Lesueur) (300), Round Sardinella, *Sardinella aurita* Valenciennes (100), Brazilian Sardinella, *S. janeiro* (Egenmann) (100); **Family Engraulididae**-anchovies, Broadband Anchovy, *Anchoviella lepidentostole* (Fowler) (100); **Order Siluriformes**-catfishes, **Family Ariidae**-sea catfishes, Couma Sea Catfish, *Hexanematichthys couma* (Valenciennes) (6); Gillbacker Sea Catfish, *H. parkeri* (Trail) (25); Passany Sea Catfish, *H. passany* (Valenciennes) (32); Thomas Sea Catfish, *Notarius grandicassis* (Valenciennes) (10); Coco Sea Catfish, *Bagre bagre* (Linnaeus) (20), Gafftopsail Sea Catfish, *Bagre marinus* (Mitchell) (100); **Family Auchenipteridae**-driftwood catfishes, Cocosoda Catfish, *Pseudauchenipterus nodosus* (Bloch) (10); **Family Pimelodidae**-long-whiskered catfishes, Kumakuma, *Brachyplatystoma filamentosum* (Lichtenstein) (5); Highwaterman Catfish, *Hypophthalmus edentatus* Spix & Agassiz (13); **Order Ophidiiformes**-cusk eels, **Family Ophidiidae**-cusk-eels, Shortbeard Cusk-eel, *Lepophidium brevibarbe* (Cuvier) (20); Bank Cusk-eel, *Ophidion holbrookii* (Putnam) (16); **Order Batrachoidiformes**-toadfishes, **Family Batrachoididae**-toadfishes, Bocon Toadfish, *Amphichthys cryptocentrus* (Valenciennes) (66); Pacuma Toadfish, *Batrachoides surinamensis* (Bloch & Schneider) (20); **Order Beryciformes**-sawbellies, **Family Holocentridae**-squirrelfishes & soldierfishes, Squirrelfish, *Holocentrus adscensionis* (Osbeck) (6) [35]; Blackbar Soldierfish, *Myripristis jacobus* Cuvier [51]; **Order Scorpaeniformes**-scorpionfishes & flatheads,

**Family Sebastidae**-rockfishes etc., Blackbelly Rosefish, *Helicolenus dactylopterus dactylopterus* (Delaroche) (25); **Order Perciformes**-perch-like fishes, **Family Centropomidae**-snooks, Fat Snook, *Centropomus parallelus* Poey (5); Tarpon Snook, *C. pectinatus* Poey (6); Snook, *C. undecimalis* (Bloch) (15); **Family Serranidae**-sea basses etc., Pound Perch, *Diplectrum radiale* (Quoy & Gaimard) (65); Coney, *Epinephelus fulva* (Linnaeus) (25) [36]; Rock Hind, *E. adscensionis* (Osbeck) (16) {1}; Yellowedge Grouper, *E. flavolimbatus* Poey (50) {1}; Red Hind, *E. guttatus* (Linnaeus) (50) [19]; Snowy Grouper, *E. niveatus* (Valenciennes) (10); Venezuelan Grouper, *Mycteroperca cidi* Cervigón (60); Yellowmouth Grouper, *M. interstitialis* (Poey) (20); Mottled Grouper, *M. rubra* (Bloch) (20); Yellowfin Grouper, *M. venenosa* (Linnaeus) (10); **Family Priacanthidae**-bigeyes, Glasseye, *Heteropriacanthus cruentatus* (Lacepède) (300) [37] {4}; Atlantic Bigeye, *Priacanthus arena-tus* Cuvier (200) {2}; **Family Malacanthidae**-tilefishes, Atlantic Goldeye Tilefish, *Caulolatilus chrysops* (Valenciennes) (16); **Family Pomatomidae**-bluefishes, Bluefish, *Pomatomus saltatrix* (Linnaeus) (7); **Family Rachycentridae**-cobias, Cobia, *Rachycentron canadum* (Linnaeus) (3); **Family Carangidae**-jacks & pompanos, Yellow Jack, *Carangoides bartholomaei* (Cuvier) (35); Bar Jack, *C. ruber* (Bloch) (200); Blue Runner, *Caranx crysos* (Mitchill) (157) {1}; Crevalle Jack, *C. hippos* (Linnaeus) (45); Horse-eye Jack, *C. latus* Agassiz (35); Atlantic Bumper, *Chloroscombrus chrysurus* (Linnaeus) (100) {1}; Mackerel Scad, *Decapterus macarellus* (Cuvier) (120); Round Scad, *D. punctatus* (Cuvier) (30); Roughear Scad, *D. tabl* Berry (25); Rainbow Runner, *Elagatis bipinnulata* (Quoy & Gaimard) (5); Bluntnose Jack, *Hemicaranx amblyrhynchus* (Cuvier) (4); Maracaibo Leatherjacket, *Oligoplites palometa* (Cuvier) (50); Castin Leatherjacket, *O. saliens* (Bloch) (40); Atlantic Leatherjacket, *O. saurus* (Bloch & Schneider) (100); Bigeye Scad, *Selar crumenophthalmus* (Bloch) (250); Atlantic Moonfish, *Selene setapinnis* (Mitchill) (10); Lookdown, *S. vomer*

(Linnaeus) (30); Greater Amberjack, *Seriola dumerili* (Risso) (1); Pompano, *Trachinotus carolinus* (Linnaeus) (25) {1}; Cayenne Pompano, *T. cayennensis* Cuvier (10); Permit, *T. falcatus* (Linnaeus) (25); Palometa, *T. goodei* Jordan & Everman (6); Rough Scad, *Trachurus lathami* Nichols (220); **Family Coryphaenidae**-dolphinfishes, Dolphinfish, *Coryphaena hippurus* Linnaeus (16); **Family Lutjanidae**-snappers, Mutton Snapper, *Lutjanus analis* (Cuvier) (26); Schoolmaster Snapper, *L. apodus* (Walbaum) (120); Blackfin Snapper, *L. buccanella* (Cuvier) (6); Cubera Snapper, *L. cyanopterus* (Cuvier) (10); Gray Snapper, *L. griseus* (Linnaeus) (275); Dog Snapper, *L. jocu* (Bloch & Schneider) (32); Mahogany Snapper, *L. mahogoni* (Cuvier) (56); Southern Red Snapper, *L. purpureus* Poey (270); Lane Snapper, *L. synagris* (Linnaeus) (27); Silk Snapper, *L. vivanus* (Cuvier) (51); Yellowtail Snapper, *Ocyurus chrysurus* (Bloch) (160); Wenchman, *Pristipomoides aquilonaris* (Goode & Bean) (12); Cardinal Snapper, *P. macrophthalmus* (Müller & Troschel) (6); Vermilion Snapper, *Rhomboplites aurorubens* (Cuvier) (22); **Family Lobotidae**-triple-tails, Atlantic Tripletail, *Lobotes surinamensis* (Bloch) (2); **Family Gerreidae**-mojarra, Brazilian Mojarra, *Eugerres brasiliensis* (Cuvier) (55); Striped Mojarra, *E. plumieri* (Cuvier) (110); Yellowfin Mojarra, *Gerres cinereus* (Walbaum) (20); **Family Haemulonidae**-grunts, Black Margate, *Anisotremus surinamensis* (Bloch) (35); Banded Grunt, *Conodon nobilis* (Linnaeus) (220); White Margate, *Haemulon album* Cuvier (15); Tomtate, *H. aurolineatum* Cuvier [575]; Black Grunt, *H. bonariense* Cuvier (35) [26] {1}; Bronzestriped Grunt, *H. boschmae* (Metzelaar) [325]; Caesar Grunt, *H. carbonarium* Poey [87]; Smallmouth grunt, *H. chrysargyreum* Günther [260]; French Grunt, *H. flavolineatum* (Desmarest) (5) [275]; Spanish Grunt, *H. macrostomum* Günther (3) [6]; Cottonwick Grunt, *H. melanurum* (Linnaeus) (25) [210]; Sailor's Grunt, *H. parra* (Desmarest) (12); White Grunt, *H. plumieri* (Lacepède) (23) [16]; Bluestriped Grunt, *H. sciurus* (Shaw) (20) [36]; Cherechere Grunt, *H. steindachneri* (Jordan and

Gilbert) (50) [415] {2}; Corocoro Grunt, *Orthopristis ruber* (Cuvier) (250) {9}; Roughneck Grunt, *Pomadasys corvinaeformis* (Steindachner) (10); **Family Inermiidae**-bonnetmouths, Boga, *Inermia vittata* Poey (35); **Family Sparidae**-porgies, Western Atlantic Seabream, *Archosargus rhomboidalis* (Linnaeus) (16); Jolthead Porgy, *Calamus bajonado* (Bloch & Schneider) (35); Saucereye Porgy, *C. calamus* (Valenciennes) (70); Sheepshead Porgy, *C. penna* (Valenciennes) (15); Pluma Porgy, *C. pennatula* Guichenot (80); **Family Sciaenidae**-drums, Ground Croaker, *Bairdiella rhonchus* (Cuvier) (25); Striped Croaker, *B. sanctaeluciae* (Jordan) (10); Acoupa Weakfish, *Cynoscion acoupa* (Lacepède) (20); Smooth Weakfish, *C. leiarchus* (Cuvier) (10); Smallscale Weakfish, *C. microlepidotus* (Cuvier) (25); Tonkin Weakfish, *C. similis* Randall & Cervigon (30); Green Weakfish, *C. virescens* (Cuvier) (50); Shorthead Drum, *Larimus breviceps* (Cuvier) (10); King Weakfish, *Macrodon ancylodon* (Bloch & Schneider) (120); Gulf King Croaker, *Menticirrhus littoralis* (Holbrook) (22); Whitemouth Croaker, *Micropogonias furnieri* (Desmarest) (200); Smalleye Croaker, *Nebris microps* Cuvier (50); Spotted Croaker, *Ophioscion punctatissimus* Meek & Hildebrand (1); Sand Drum, *Umbrina coroides* Cuvier (200); **Family Mullidae**-goatfishes, Yellow Goatfish, *Mulloidichthys martinicus* (Cuvier) (25); Spotted Goatfish, *Pseudupeneus maculatus* (Bloch) (12); **Family Kyphosidae**-sea chubs, Yellow Sea Chub, *Kyphosus incisor* (Cuvier) (66); Bermuda Sea Chub, *K. sectator* (Linnaeus) (25); **Family Ehippidae**-spadefishes, Atlantic Spadefish, *Chaetodipterus faber* (Broussonet) (15); **Family Chaetodontidae**-butterflyfishes, Four-eye Butterflyfish, *Chaetodon capistratus* Linnaeus [41]; Spotfin Butterflyfish, *C. ocellatus* Bloch [2]; Banded Butterflyfish, *C. striatus* Linnaeus [9]; **Family Pomacanthidae**-angelfishes, Rock Beauty, *Holacanthus tricolor* (Bloch) [16]; Gray Angelfish, *Pomacanthus arcuatus* (Linnaeus) (10); **Family Pomacentridae**-damselfishes, Blue Chromis, *Chromis cyanea*

(Poey) [75]; Brown Chromis, *C. multilineata* (Guichenot) [223]; **Family Mugilidae**-mulletts, White Mullet, *Mugil curema* Valenciennes (120); Redeye Mullet, *M. gaimardianus* Desmarest (10); Lebranche Mullet, *M. liza* Valenciennes (23); **Family Sphyraenidae**-barracudas, Great Barracuda, *Sphyraena barracuda* (Walbaum) (40); Guaguanche, *S. guachancho* Cuvier (15); **Family Polynemidae**-threadfins, Littlescale Threadfin, *Polydactylus oligodon* (Günther) (20); **Family Labridae**-wrasses, Spanish Hogfish, *Bodianus rufus* (Linnaeus) (7); Hogfish, *Lachnolaimus maximus* (Walbaum) (3); **Family Scaridae**-parrotfishes, Blue Parrotfish, *Scarus coeruleus* (Bloch) (20); Striped Parrotfish, *S. iseri* (Bloch) (25); Princess Parrotfish, *S. taeniopterus* Desmarest (5); Queen Parrotfish, *S. vetula* Bloch & Schneider (30); Redtail Parrotfish, *Sparisoma chrysopteron* (Bloch & Schneider) (10); Redfin Parrotfish, *S. rubripinne* (Valenciennes) (200); Stoplight Parrotfish, *S. viride* (Bonnaterre) (100); **Family Acanthuridae**-surgeonfishes etc., Ocean Surgeon, *Acanthurus bahianus* Castelnau [330]; Blue Tang, *A. coeruleus* Bloch & Schneider [125]; Doctorfish, *A. chirurgus* (Bloch) [38]; **Family Trichiuridae**-cutlassfishes, Longhead Hairtail, *Trichiurus lepturus* Linnaeus (257) {5}; **Family Scombridae**-mackerels, Wahoo, *Acanthocybium solandri* (Cuvier) (26); Bullet Tuna, *Auxis rochei* (Risso) (25); Frigate Tuna, *A. thazard thazard* (Lacepède) (50); Little Tuny, *Euthynnus alletteratus* (Rafinesque) (60);

Skipjack Tuna, *Katsuwonus pelamis* (Linnaeus) (100); Atlantic Bonito, *Sarda sarda* (Bloch) (30); Chub Mackerel, *Scomber japonicus* Houttuyn (100); Serra Spanish Mackerel, *Scomberomorus brasiliensis* Collette, Russo, and Zavala-Camin (120); King Mackerel, *S. cavalla* (Cuvier) (70); Cero, *S. regalis* (Bloch) (20); Yellowfin Tuna, *Thunnus albacares* (Bonnaterre) (6); Blackfin Tuna, *T. atlanticus* (Lesson) (25); **Family Istiophoridae**-billfishes, Atlantic Sailfish, *Istiophorus albicans* (Latreille) (1); Atlantic Blue Marlin, *Makaira nigricans* Lacepède (3); **Order Pleuronectiformes**-flatfishes, **Family Paralichthyidae**-large-tooth flounders, Cyclope Flounder, *Ancylosetta cycloidea* Tyler (10); Mexican Flounder, *Cyclosetta chittendeni* Bean (12); Tropical Flounder, *Paralichthys tropicus* Ginsburg (120); **Family Cynoglossidae**-tonguefishes, Duskycheek Tonguefish, *Symphurus plagusia* (Bloch & Schneider) (12); **Order Tetraodontiformes**-puffers & filefishes, **Family Ostraciidae**-boxfishes, Spotted Trunkfish, *Lactophrys bicaudalis* (Linnaeus) (50); Buffalo Trunkfish, *L. trigonus* (Linnaeus) (5); **Family Balistidae**-triggerfishes, Gray Triggerfish, *Balistes capricus* Gmelin (25); Queen Triggerfish, *B. vetula* Linnaeus (100); **Family Tetradontidae**-puffers, Green Puffer, *Sphoeroides greeleyi* (Gilbert) (100); **Family Diodontidae**-porcupinefishes & burrfishes, Striped Burrfish, *C. schoepfii* (Walbaum) (1); Spot-fin Porcupinefish, *Diodon hystrix* Linnaeus (16).