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Blood parasite biodiversity of reef-associated fishes of the eastern Caribbean

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SUPPLEMENT

Remarks

Haemohormidium-like infections

The *Haemohormidium*-like species reported here from the Caribbean fishes all had division stages alike to those described infecting fishes of the Red Sea and the GBR, Australia, by firstly Saunders (1960) and Burreson (1989), and later Smit et al. (2006), respectively. Saunders (1960) described these parasite stages as merozoite and pregamont stages of the haemogregarine *Desseria rubrimarensis* (syn. *Haemogregarina rubrimarensis*) (Saunders 1960). Smit et al. (2006) however, suggested that Saunders (1960) was likely observing a mixed infection of an unidentified *Haemohormidium*-like species and a haemogregarine, which we would agree with, particularly since we discovered pure infections of the former parasite with no haemogregarine stages present. Smit et al. (2006) described a *Haemohormidium*-like species parasitising both *Chlorurus sordidus* and *Scarus psittacus* (both Scaridae), the stages of their parasite all almost always in division. These stages were alike to the slender stages undergoing division described in the present study, those of Smit et al. (2006) measuring 7 x 1.9 µm and thus only slightly longer and wider than those described here. Furthermore, those of Smit et al. (2006) demonstrated the similar strip-like and elongate nuclei, however, authors described paired nuclei as compared to the triplicate nuclei observed in the present study. Additionally, Smit et al. (2006) did not record any separated "gamont" or "merozoite" like stages as seen in Fig. 1e.

Smit et al. (2006) proposed that the *Haemohormidium*-like parasites described by Saunders, Burreson and by them, very likely represented different species. In light of this, the parasite described here may be yet another unknown species in its own right. The main concern is that all four of these parasites described by the above authors as well the parasites of the present study do not show the morphological characteristics typical of the type species *Haemohormidium cotti* Henry, 1910 (see Smit et al. 2006). We also agree with Burreson (1989) and Smit et al. (2006) that this parasite equally cannot be readily identified as a haemogregarine either. However, as stated in Smit et al. (2006), light microscopy alone is not sufficient to determine the taxonomic placement of the above organisms, requiring most likely the clarification of ultrastructural and molecular analysis.

The *Haemohormidium*-like organism discovered in the *Selar crumenophthalmus* (Carangidae) from St Thomas, was comparable to that identified as perhaps *Haemohormidium terraenovae* So, 1972 by Davies et al. (2008) from the blood of estuarine Brazilian flounder *Paralichthys orbigynyanus* (Paralichthyidae) from southern Brazil. Similarly, parasitaemias were very low and leucocytes were not affected. The parasites described by Davies et al. (2008) were also rounded or oval, measuring 3.3 x 2.9 µm, comparable in size to those described in this study. It would appear that this parasite has a cosmopolitan distribution, having been described by So (1972) from a number of fishes from Newfoundland, the author noting that Laird and Bullock (1969) likely also recorded this species from fishes from New Brunswick, with further reports of this species infecting fishes from the east of Canada and the USA (see Davies et al. 2008). Davies et al. (2008) also mentioned the resemblance in morphology and size of *H. terraenovae* to *H. cotti* as well as to *Haemohormidium scombri* Henry, 1910. Khan et al. (1980) suggested that *H. terraenovae* species could represent a composite or number of cryptic species (see Davies et al. 2008). Unfortunately, the *Haemohormidium*-like species detected in the blood of the *Mugil curema* and *Stegastes adustus* in the present study could not be compared, as only small ring stages and no larger organisms were found. From the above, it is clear that species of *Haemohormidium* desperately require molecular analysis, as morphology alone is not proving adequate for clear species differentiation.

Viral-like infections

Intraerythrocytic cytoplasmic viral-like inclusions were found to be common, ranging from low to high intensity infections. Very little is known about the taxonomy and transmission of these organisms, some of these, such as the "bullet-hole viruses" appearing as small vacuoles within the erythrocyte cytoplasm (see Davies & Johnston 2000, Van As et al. 2013). One such viral infection, thought to be a subgroup of the icosahedral cytoplasmic deoxyriboviruses (ICDV's), the erythrocytic necrosis viruses (ENV), specifically Viral Erythrocytic Necrosis (VEN), is known to infect marine fishes. VEN has been reported to produce pathologies associated with anaemia (see Couch 1992, Davies & Johnston 2000). VEN is distinguishable by the characteristic appearance of acidophilic, intracytoplasmic inclusion bodies and may also produce discernable intraerythrocytic haloes, granules and comet-tails, cause erythroblastosis and may destroy the host cell nucleus. One such infection has been reported from tropical waters infecting a juvenile *Rhinecanthus aculeatus* (blackbar triggerfish) (Balistidae) collected off Lizard Island (GBR) (see Davies et al. 2009). Whether or not the cytoplasmic or intranuclear viral-like inclusions reported during this study are produced by one such virus may only be clarified with fluorescence microscopy, TEM and molecular analysis.

***Haemogregarina*-like infections**

As mentioned above, haemogregarines were not the most commonly encountered or abundant blood parasite group recorded during this study. However, in previous blood parasite surveys of fishes in the Caribbean, haemogregarines were reported to be the most prevalent or only blood parasite recorded (see Saunders 1966). Most of the reports of haemogregarines in this region were by Saunders, most of these being of *Haemogregarina bigemina* or an *H. bigemina*-like parasite, a parasite species described from fishes worldwide including an astonishing 96 species (see Davies et al. 2004). However, many of these *H. bigemina*-like stages reported by Saunders were from leucocytes (see Davies et al. 2004). These findings produced some concern, particularly since the characteristically paired gamont stages of *H. bigemina* were largely absent from Saunders' descriptions (see Davies et al. 2004). Besides the *H. bigemina*-like parasite described by Saunders on numerous occasions from Caribbean fishes, Saunders also described three other haemogregarine species including *Haemogregarina achiri* Saunders, 1955 and *Haemogregarina brevoortiae* Saunders, 1964, both from Florida (see Saunders 1955, 1964 respectively), as well as *Haemogregarina dasyatis* Saunders, 1958, from the Bahamas (see Saunders 1958). Gamont stages of a possible two different haemogregarine species were observed parasitising the erythrocytes of *Pomacanthus arcuatus* and *Lactophrys bicaudalis* respectively during this study, a possible third observed as trophozoite-like stages in a leucocyte of a *Sparisoma viride.* However, the intraerythrocytic gamonts of the above reported in this study do not conform morphologically to *H. bigemina* or to the other haemogregarines. Additionally, since the intraleucocytic trophozoite-like stages were only detected once in this study, it is impossible to compare these to the intraleucocytic stages described by Saunders as stages of *H. bigemina* or to the pregamont stages of the *H. bigemina*-like parasite described in this study.

The intraleucocytic parasite, however, did occur in what appeared to be a lymphocyte, similarly to that of the *H. bigemina*-like parasite described in this study, and to an undescribed intraleucocytic haemogregarine, as well as *Haemogregarina balistapi*, both discovered infecting fishes collected off Lizard Island (GBR). These fishes included a specimen of *Cephalopholis boenak* (Serranidae), as well as *Balistapus undulates* (Balistidae) and *Sufflamen chrysopternum* (Balistidae) respectively. Stages of the undescribed haemogregarine were all presumed to be merozoites, and those stages of *H. balistapi* did not include trophozoite descriptions, thus neither of these parasites could not be compared to those observed within this study (see Smit et al. 2006).

***Babesiosoma*-like infections**

Babesiosoma-like parasite stages were found in *Acanthurus bahianus* and *Stegastes adustus*. The young meront stages occurred in pairs similarly to *Babesiosoma mariae* from freshwater fishes, they were also oval and most characteristically were non-stained with the exception of the periphery, the nucleus not distinguishable (see Smit et al. 2003). Furthermore, the young meront stages in this study were close in size to those of *B. mariae*, which measured 3.8 x 2.4 µm. Such findings provide strong evidence that the parasite described here could very well be a species of *Babesiosoma*. Moreover, species of *Babesiosoma* are, according to current knowledge, leech transmitted (Davies &

Johnston 2000); observations of leeches on fishes in tropical waters being rare (see Smit et al. 2006). In the current study, only a single leech was collected off one *Ophioblennius macclurrei*. Unfortunately, however, these parasites in this study could not be further described, requiring additional stages, in particular mature stages, for description. *Babesiosoma* is not a commonly recorded genus parasitising fishes, all three recorded species recorded to date were described from freshwater fishes (see Smit et al. 2003), none from marine, making the above a significant find.

Thrombocytic infection

The parasite resembling an encapsulated haemogregarine, alike to a small *Hemolivia*, or anything similar, found parasitising several *Ocyurus chrysurus*, to our knowledge has not been reported before. An encapsulated haemogregarine has been described from an evileye pufferfish from South Africa, this haemogregarine demonstrating a cap-like structure, being intraerythrocytic and much larger than the organism described in this study (Smit & Davies 2001). However, whether this unidentified organism is a haemogregarine cannot be established as of yet. Only ultrastructural and molecular studies may be able to identify this peculiar parasite's taxonomic placement.

Gnathiid experiment

Evidence that the larvae of gnathiid isopods can sustain haemogregarine developmental stages has been documented from gnathiids collected feeding on intertidal fish, *Lipophrys pholis* (Blenniidae), infected with *H. bigemina* off the coasts of Wales and Portugal (see Davies & Smit 2001; Davies et al. 2004). Davies & Smit (2001) provided proof, describing the sustained development of *H. bigemina* in *Gnathia africana* collected feeding on the infected intertidal fish *Clinus superciliosus* (Clinidae) off the coast of South Africa. Similar work as described in the current study, involving the experimental transmission of haemogregarines, in particular *H. bigemina*, to the larvae of gnathiid isopods and these haemogregarines' further development in these vectors has been carried out before in fishes and gnathiids from tropical waters. Experimental transmission of *H. bigemina* by Smit et al. (2006) using laboratory reared gnathiid larvae provided proof that these isopods can act as vectors for at least *H. bigemina*, observing free gamont stages as well as possible oocyst stages in gnathiids one to three days post feeding on *H. bigemina* infected *Zebrasoma scopes* (Acanthuridae) collected off the coast of Lizard Island (GBR). Similarly, in the current study, free gamont stages were observed in the gnathiid squashes immediately to one to three days post feeding on *H. bigemina* infected fishes. Besides gnathiid isopod larvae acting as vectors for *H. bigemina*, they are confirmed definitive hosts for the haemogregarine *H. balstapi*, which infects *Gnathia aureamaculosa*, a natural ectoparasite of the type host *Rhinecanthus aculeatus* (Balistidae) caught off the coral reefs of the GBR (see Curtis et al. 2013). It is thus reasonably possible that gnathiid isopod larvae are the vectors of *H. bigemina* in Caribbean fishes and furthermore may be responsible for other unidentifiable haemogregarine and non-haemogregarine parasites reported during this study.

Then again, no developmental stages of the *Haemohormidium*-like parasite were detected in gnathiid isopods fed on infected fishes. It has been reported in the past that species of *Haemohormidium* are leech transmitted (see Davies et al. 2008), providing a very probable explanation for the above finding.

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Table S1: Families and species of fish collected from various islands in the eastern Caribbean and examined for blood parasites. Included are the common names of the fish, their diet and adult feeding ecology (BM: benthic microcarnivore, CC: crepuscular carnivore, DC: diurnal carnivore, DCC: diurnal/crepuscular carnivore, DD: diurnal detritivore, DH: diurnal herbivore, DM: diurnal microcarnivore, DS: diurnal spongivore, DZ: diurnal zooplanktivore, NC: nocturnal carnivore, NZ: nocturnal zooplanktivore, superscript letters I: of invertebrates, F: of fishes, IF: of invertebrates and fishes, SF: of small fishes, BI: of benthic invertebrates, number of fish collected, island of collection, blood parasite infection and prevalence, as well as intensity given as acute for high intensity infections and chronic for low intensity infections (B: *Babesiosoma*-like; HB: *Haemogregarina bigemina*-like; HL: *Haemogregarina*-like; H: *Haemohormidium*-like; V: viral-like inclusions; U: parasite of unknown identity). Also included are the fish species common to this study and those of Saunders' (1954, 1955, 1958a, 1958b, 1959a, 1959b, 1964, 1966), as well as other tropical water Indo-Pacific studies including Laird (1951), Smit et al. (2006), Curtis et al. (2013) (see footnotes).

Families and species of fish collected	**Common name**	**Ecology**	**No.**	**Culebra**	**Guana**	**Saba**	**St John**	**St Maarten**	**St Thomas**	**Haematozoa (intensity)**
Acanthuridae[4c]										
1. *Acanthurus bahianus* Castelnau, 1855[1b]	Ocean surgeon	DH	47		6	1/2*	1/20§		19	*B; §V (Both acute)
2. Acanthurus chirurgus (Bloch, 1787)[1a]	Doctorfish	DH	23	1	4		6		12	
3. Acanthurus coeruleus Bloch & Schneider, 1801[1a]	Blue tang surgeonfish	DH	77	21		2	20		34	
Balistidae[4c]										
4. Aluterus scriptus (Osbeck, 1765)[1a]	Scribbled leatherjacket filefish	DC^{I}	1						1	
5. Balistes capriscus Gmelin, 1789	Grey triggerfish	DC^{I}	3	1	1/2*					*V (Acute)
6. Balistes vetula Linnaeus, 1758[2]	Queen triggerfish	DC^{I}	20	15					5	
7. Cantherhines macrocerus (Hollard, 1853)	American whitespotted filefish	DC^{I}	1						1	
8. Canthidermis sufflamen Cope, 1871	Ocean triggerfish	DC^{I}	1	1						
9. Melichthys niger (Bloch, 1786)	Black triggerfish	DC^{I}	1	1						
Belonidae										
10. Ablennes hians (Valenciennes, 1846)	Flat needlefish	DC^{SF}	2						2	
Blenniidae[4c]										
11. Hypleurochilus bermudensis Beebe & Tee-Van, 1933	Barred blenny	DH	6						1/6*	*HB (Chronic)
12. Ophioblennius macclurei (Silvester, 1915)	Redlip blenny	DH	14						9/14§	§H (Chronic to acute)
Carangidae[4a]										
13. Carangoides bartholomaei Cuvier, 1833[2]	Yellow jack	DC^{IF}	1	1						
14. Caranx ruber (Bloch, 1793)[1a]	Bar jack	DC^{IF}	4	4						
15. Elagatis bipinnulata (Quoy & Gaimard, 1825)	Rainbow runner	DC^{IF}	1	1						
16. Selar crumenophthalmus (Bloch, 1793)	Bigeye scad	DC^{IF}	1						1/1*	*H (Chronic)
17. Seriola rivoliana Valenciennes, 1833	Longfin yellowtail	DC^{IF}	16	16						
18. Trachinotus falcatus (Linnaeus, 1758)[1a]	Permit	DC^{I}	3						3	
19. Trachinotus goodie Jordan & Evermann, 1896	Great pompano	DC^{IF}	2						2	

Chaetodontidae[4a]										
20. Chaetodon capistratus Linnaeus, 1758[1a]	Foureye butterflyfish	DC[BI]	2				2			
21. Chaetodon ocellatus Bloch, 1787[1a]	Spotfin butterflyfish	DC[BI]	1	1						
22. Chaetodon sedentarius Poey, 1860[1a]	Reef butterflyfish	DC[BI]	1			1				
23. Chaetodon striatus Linnaeus, 1758[1a]	Banded butterflyfish	DC[BI]	2			2				
Gerreidae[4d]										
24. Eucinostomus jonesii (Günther, 1879)	Slender mojarra	DC[BI]	17						17	
25. Ulaema lefroyi (Goode, 1874)	Mottled mojarra	DC[BI]	2				2			
26. Gerres cinereus (Walbaum, 1792)[1a]	Yellow fin mojarra	DC[BI]	17				8		9	
Haemulidae[4a]										
27. Haemulon aurolineatum Cuvier, 1830[2]	Tomtate grunt	NC[BI]	2						2	
28. Haemulon carbonarium Poey, 1860	Caesar grunt	NC[BI]	1				1			
29. Haemulon flavolineatum (Desmarest, 1823)[1b]	French grunt	NC[BI]	75	16	2/14*	13	15		17	*V (Acute)
30. Haemulon melanurum (Linnaeus, 1758)[1a]	Cottonwick grunt	NC[BI]	1	1						
31. Haemulon plumierii (Lacepède, 1801)[1b]	White grunt	NC[BI]	17	1/14§					3	§V (Acute)
32. Haemulon sciurus (Shaw, 1803)[2]	Bluestriped grunt	NC[BI]	19	10			4		5	
Holocentridae										
33. Holocentrus adscensionis (Osbeck, 1765)[1a]	Squirrelfish	NC[ISF]	15	2	6	2	1		4	
34. Holocentrus rufus (Walbaum, 1792)	Longspine squirrelfish	NC[ISF]	54	5	11		21		1/17*	*V (Chronic)
35. Myripristis jacobus Cuvier, 1829	Blackbar soldierfish	NC[ISF]	4				2		2	
36. Sargocentron coruscum (Poey, 1860)	Reef squirrelfish	NC[ISF]	11						11	
37. Sargocentron vexillarium (Poey, 1860)	Dusky squirrelfish	NC[ISF]	1						1	
Kyphosidae										
38. Kyphosus sectatrix (Linnaeus, 1758)[1a]	Bermuda sea chub	DH	1				1			
Labridae[4a]										
39. Halichoeres bivittatus (Bloch, 1791)[1b]	Slippery wrasse	DC[I]	45	8	4	1	1/15*		1/17*	*V (Chronic)
40. Halichoeres garnoti (Valenciennes, 1839)[1a]	Yellowhead wrasse	DC[I]	17				17			
41. Thalassoma bifasciatum (Bloch, 1791)[2]	Bluehead	DC[I]	19						19	
Labrisomidae										
42. Labrisomus kalisherae (Jordan, 1904)	Downy blenny	DM[BI]	1						1/1*	*H (Chronic)
43. Labrisomus bucciferus Poey, 1868	Puffcheek blenny	DM[BI]	1						1	
44. Labrisomas gobio (Valenciennes, 1836)	Palehead blenny	DM[BI]	1						1§	§HB (Acute)
45. Labrisomus nuchipinnis (Quoy & Gaimard, 1824)	Hairy blenny	DM[BI]	9						9	
46. Malacoctenus macropus (Poey, 1868)	Rosy blenny	DM[BI]	5						1/5¶	¶H (Chronic)

47. Malacoctenus triangulatus V. G. Springer, 1959	Saddled blenny	DM[BI]	2						1/2§	§H (Chronic)
Lutjanidae[4a]										
48. Lutjanus analis (Cuvier, 1828)[1a]	Mutton snapper	DC[IF]	3						3	
49. Lutjanus apodus (Walbaum, 1792)[2]	Schoolmaster snapper	DC[IF]	26				7		19	
50. Lutjanus campechanus (Poey, 1860)	Northern red snapper	DC[IF]	3	2					1	
51. Lutjanus griseus (Linnaeus, 1758)[1a]	Grey snapper	DC[IF]	3	3						
52. Lutjanus jocu (Bloch & Schneider, 1801)[1a]	Dog snapper	DC[IF]	1	1						
53. Lutjanus synagris (Linnaeus, 1758)[3]	Lane snapper	DC[IF]	22	6		7	9			
54. Lutjanus vivanus (Cuvier, 1828)[1a]	Silk snapper	DC[IF]	2			2				
55. Ocyurus chrysurus (Bloch, 1791)[2]	Yellowtail snapper	DC[IF]	31	6/7*			14		1/10§	*U; §V (Both acute)
Monacanthidae										
56. Aluterus schoepfii (Walbaum, 1792)	Orange filefish	DC[I]	2	2						
57. Aluterus scriptus (Osbeck, 1765)	Scribbled leatherjacket filefish	DC[I]	13	12			1			
58. Cantherhines macrocerus (Hollard, 1853)	American whitespotted filefish	DC[I]	10	10						
59. Cantherhines pullus (Ranzani, 1842)	Orangespotted filefish	DC[I]	11	1			10			
60. Stephanolepis setifer (Bennett, 1831)	Pygmy filefish	DC[I]	1	1						
Mugilidae										
61. Mugil cephalus Linnaeus, 1758[3]	Flathead grey mullet	DD	7						1/7§	§H (Chronic)
62. Mugil curema Valenciennes, 1836[1b]	White mullet	DD	2						1/2*	*H (Chronic)
Mullidae[4d]										
63. Mulloidichthys martinicus (Cuvier, 1829)[1a]	Yellow goatfish	DC[BI]	3			2	1			
64. Pseudupeneus maculates (Bloch, 1793)[1a]	Spotted goatfish	DC[BI]	3				3			
Ostraciidae[4a]										
65. Acanthostracion polygonius Poey, 1876[1a]	Honeycomb cowfish	DC[BI]	22	7		1	4		10	
66. Acanthostracion quadricornis (Linnaeus, 1758)[1a]	Scrawled cowfish	DC[BI]	6	2			2		2	
67. Lactophrys bicaudalis (Linnaeus, 1758)[1b]	Spotted trunkfish	DC[BI]	13	1/12*			1			*HL (Chronic)
68. Lactophrys trigonus (Linnaeus, 1758)[1a]	Buffalo trunkfish	DC[BI]	6	1			4		1	
69. Rhinesomus triqueter (Linnaeus, 1758)[1a]	Smooth trunkfish	DC[BI]	12	2		1	8		1	
Pempheridae										
70. Pempheris schomburgkii Müller & Troschel, 1848	Glassy sweeper	NZ	1						1	
Pomacanthidae										
71. Pomacanthus arcuatus (Linnaeus, 1758)	Gray angelfish	DS	10	2/8*					2	*HL (Chronic)
72. Pomacanthus paru (Bloch, 1787)	French angelfish	DS	5	1		3			1	

Pomacentridae[4a]										
73. Abudefduf saxatilis (Linnaeus, 1758)[2]	Sergeant-major	DZ	8				8			
74. Chromis cyanea (Poey, 1860)	Blue chromis	DZ	27			5			22	
75. Chromis multilineata (Guichenot, 1853)	Brown chromis	DZ	34			11			23	
76. Stegastes adustus (Troschel, 1865)	Dusky damselfish	DH	64					14/15*	1/49[§];25/49*	[§]B; *H (Chronic to acute)
77. Stegastes diencaeus (Jordan & Rutter, 1897)	Longfin damselfish	DH	80	3/7*	4/10*	6/20*	4/14*	7	7/22*	*H (Chronic)
78. Stegastes leucostictus (Müller & Troschel, 1848)[1b]	Beaugregory	DH	38			1			12/37*	*H (Chronic)
79. Stegastes partitus (Poey, 1868)	Bicolor damselfish	DZ	6					1/6*		*H (Chronic)
80. Stegastes planifrons (Cuvier, 1830)	Threespot damselfish	DH	12	3/3*			1/9*			*H (Chronic)
81. Stegastes variabilis (Castelnau, 1855)[1a]	Cocoa damselfish	DH+BM	10					10		
Priacanthidae										
82. Heteropriacanthus cruentatus (Lacepède, 1801)	Glasseye	NZ	6				6			
Scaridae[4c]										
83. Nicholsina usta usta (Valenciennes, 1840)	Emerald parrotfish	DH	4						1/4[§];2/4*	[§]HL ; *H (Chronic; acute)
84. Scarus taeniopterus Lesson, 1829[1b]	Princess parrotfish	DH	14		1/6*	4	3	1		*H (Chronic)
85. Sparisoma aurofrenatum (Valenciennes, 1840)[2]	Redband parrotfish	DH	26	1	8	1			16	
86. Sparisoma viride (Bonnaterre, 1788)[1b]	Stoplight parrotfish	DH	19				1/19*			*HL (Chronic)
Sciaenidae										
87. Equetus lanceolatus (Linnaeus, 1758)	Jack-knifefish	DC^{BI}	1	1						
88. Equetus punctatus (Bloch & Schneider, 1801)	Spotted drum	DC^{BI}	1				1			
Scorpaenidae[4d]										
89. Pterois volitans (Linnaeus, 1758)	Red lionfish	DC^{IF}	16						16	
90. Scorpaena plumieri Bloch, 1789[1a]	Spotted scorpionfish	CC^{IF}	4				2		2	
Serranidae[4c]										
91. Cephalopholis cruentata (Lacepède, 1802)[1a]	Graysby	DCC^{IF}	2	1					1	
92. Cephalopholis fulva (Linnaeus, 1758)[1a]	Coney	DCC^{IF}	11	4		6		1		
93. Epinephelus guttatus (Linnaeus, 1758)[1b]	Red hind	DCC^{IF}	29	1/12*	14				3	*V (Acute)
94. Epinephelus morio (Valenciennes, 1828)[1a]	Red grouper	DCC^{IF}	1				1			
95. Hypoplectrus sp.		DCC^{IF}	3						3	
96. Hypoplectrus nigricans (Poey, 1852)	Black hamlet	DCC^{IF}	29				23		6	
97. Hypoplectrus puella (Cuvier, 1828)	Barred hamlet	DCC^{IF}	3						3	
98. Hypoplectrus unicolor (Walbaum, 1792)[1a]	Butter hamlet	DCC^{IF}	1						1	
Sparidae										
99. Archosargus rhomboidalis (Linnaeus, 1758)[2]	Western Atlantic seabream	DC^{BI}	1				1			

100. Calamus calamus (Valenciennes, 1830)	Saucereye porgy	$\mathrm{DC}^{\mathrm{BI}}$	18	3			13		2	
101. Calamus penna (Valenciennes, 1830)[1a]	Sheepshead porgy	$\mathrm{DC}^{\mathrm{BI}}$	21				14		7	
102. Calamus proridens Jordan & Gilbert, 1884	Littlehead porgy	$\mathrm{DC}^{\mathrm{BI}}$	22	22						
Tetraodontidae[4d]										
103. Sphoeroides testudineus (Linnaeus, 1758)[1a]	Checkered puffer	$\mathrm{DC}^{\mathrm{BI}}$	2						2	
TOTAL			**123/1298 (9%)**	**17/251 (7%)**	**8/85 (9%)**	**7/87 (8%)**	**8/313 (3%)**	**15/40 (38%)**	**68/522 (13%)**	

[1a] Fishes common to this and Saunders' studies, no infections noted by the latter, nor during the present study
[1b] Fishes common to this and Saunders' studies, no infections noted by the latter, but present in this study
[2] Fishes common to this and Saunders' studies, infections of *Haemogregarina bigemina* noted by the latter, but not in this study
[3] Fishes common to this and Saunders' studies, infections of *Haemogregarina mugili* noted by the latter, but not in this study
[4a] Fish families common to this study and other tropical water studies of the Indo-Pacific including Laird (1951), Smit et al. 2006 and Curtis et al. 2013, with infections unique to this study
[4b] Fish families common to this study and other tropical water studies of the Indo-Pacific including Laird (1951), Smit et al. 2006 and Curtis et al. 2013, with infections unique to the other studies
[4c] Fish families common to this study and other tropical water studies of the Indo-Pacific including Laird (1951), Smit et al. 2006 and Curtis et al. 2013, with infections in the current study and at least one other study
[4d] Fish families common to this study and other tropical water studies of the Indo-Pacific including Laird (1951), Smit et al. 2006 and Curtis et al. 2013, with no infections found in any of the studies including the current study