Parasites from the Red Lionfish, *Pterois volitans* from the Gulf of Mexico

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TABLE OF CONTENTS

SAND BOTTOM MICROALGAL PRODUCTION AND BENTHIC NUTRIENT FLUXES ON THE NORTHEASTERN GULF OF MEXICO NEARSHORE SHELF
Jeffrey G. Allison, M. E. Wagner, M. McAllister, A. K. J. Box, and R. A. Smale
1—8

WHAT IS KNOWN ABOUT SPECIES RICHNESS AND DISTRIBUTION ON THE OUTER—SHELF SOUTH TEXAS BANKS?
Hannah L. Nix, Sharon J. Furiness, and John W. Tunnell, Jr.
9—18

ASSESSMENT OF SEAGRASS FLORAL COMMUNITY STRUCTURE FROM TWO CARIBBEAN MARINE PROTECTED AREAS
Paul A. X. Belanger and Anthony J. Salek
19—27

SPATIAL AND SIZE DISTRIBUTION OF RED DRUM CAUGHT AND RELEASED IN TAMPA BAY, FLORIDA, AND FACTORS ASSOCIATED WITH POST—RELEASE HOOKING MORTALITY
Kerry R. Hobbs, Brett L. Wims, Julia L. Voelker, and Theodore S. Satter
29—41

CHARACTERIZATION OF ICHTHYOPLANKTON IN THE NORTHEASTERN GULF OF MEXICO FROM SEAMAP PLANKTON SURVEYS, 1982—1999
Joanne Lyczkowski-Shultz, David S. Hanske, Kenneth J. Salek, Madhura Ratnayake Koniszczen, and Pamela J. Bond
43—98

Short Communications

DEPURATION OF MACONDA (MC—252) OIL FOUND IN HETEROTROPHIC SCLERACTINIAN CORALS (TUBASTREA COCCINEA AND TUBASTREA MICRANTHUS) ON OFFSHORE OIL/GAS PLATFORMS IN THE GULF
Steve R. Kolb, Scott Porter, Paul W. Sammarco, and Edwin W. Cake Jr.
99—103

EFFECTS OF CLOSURE OF THE MISSISSIPPI RIVER GULF OUTLET ON SALTWATER INTRUSION AND BOTTOM WATER HYPOXIA IN LAKE PONCHARTRAIN
Michael A. Poirier
105—109

DISTRIBUTION AND LENGTH FREQUENCY OF INVASIVE LIONFISH (PTEROIS SP.) IN THE NORTHERN GULF OF MEXICO
111—115

NOTES ON THE BIOLOGY OF INVASIVE LIONFISH (PTEROIS SP.) FROM THE NORTHCENTRAL GULF OF MEXICO
William Stein III, Nancy J. Brown—Peterson, James S. Franks, and Martin T. O’Connell
117—120

RECORD BODY SIZE FOR THE RED LIONFISH, PTEROIS VOLITANS (SCORPAENIFORMES), IN THE SOUTHERN GULF OF MEXICO
Alfonso Aguilar—Perera, Leidy Perera—Chan, and Luis Quijano—Puerto
121—123

EFFECTS OF BLACK MANGROVE (AVICENNIA GERMINANS) EXPANSION ON SALTMARSH (SPARTEM ALTERNIFLORA) BENTHIC COMMUNITIES OF THE SOUTH TEXAS COAST
Inessa Lutz, Kimberly McClain, and Elizabeth M. Robinson
125—129

TIME—ACTIVITY BUDGETS OF STOPLIGHT PARROT FISH (SCARIDAE: SPARISOMA VIREIDE) IN BELIZE: CLEANING INVITATION AND DIURNAL PATTERNS
Wesley A. Dent and Gary R. Gaston
131—135

FIRST RECORD OF A NURSE SHARK, Ginglymostoma Cirratus, Within the Mississippi Sound
Jill M. Hendon, Eric R. Hoffmayer, and William B. Driggers III
137—139

REVIEWS

141

INSTRUCTION TO AUTHORS

142—143

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INTRODUCTION

Invasion of lionfish from the Indo–Pacific Ocean into the western Atlantic Ocean has recently become the subject for ecological investigation directed at exploring concepts pertaining to host–parasite ecology (Sikkel et al. 2014, Sellers et al. 2015). The potential impact that host–parasite interactions may have on the relative success of lionfish in their new habitat is of particular interest. The value of data analyzed in such ecological investigations is dependent on accurate identification of parasite species, which in turn is dependent on the ability to verify parasite identification with vouched museum specimens and sequence data. Studies identifying parasites of invasive lionfish in the western Atlantic Ocean that are supported by museum vouched specimens or published sequence data are limited to 4 reports (Ruiz–Carus et al. 2006, Bullard et al. 2011, Ramos–Ascherl et al. 2015, Claxton et al. 2017), so there is a need to improve the current state of knowledge of parasites of invasive lionfish. This study reports and vouchers some parasites from invasive Red Lionfish from the northern Gulf of Mexico.

MATERIALS AND METHODS

Red Lionfish (Pterois volitans [Linnaeus, 1758]) were collected from the Gulf of Mexico between 29 March 2013 and 13 October 2014 (see Table 1). Fish were collected and identified following methods described in Fogg et al. (2013, 2014). Forty-nine fish from a separate life history study of Red Lionfish were opportunistically examined for external parasites (skin, fins, mouth and gills). Twenty-four of the 49 fish were placed on ice after initial external examination and further examined for internal parasites (from the heart and digestive tract) between 12 and 24 h after capture.

Leeches were cold-shocked or recently dead and therefore not relaxed prior to preservation in 70% ethanol. Arthropods were preserved in 70% ethanol. Digeneans and a nematode were removed, fixed using hot water, and preserved in 70% ethanol. Digeneans were stained using aqueous Meyer’s hematoxylin, dehydrated through an alcohol series, cleared in methyl salicylate, and mounted in Damar gum.

<table>
<thead>
<tr>
<th>Collection date</th>
<th>Latitude</th>
<th>Longitude</th>
<th>Bottom habitat</th>
<th>Depth (m)</th>
<th>Number of fish examined</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>External only (n=25) Internal and external (n=24)</td>
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<tr>
<td>3/29/2013</td>
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<tr>
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<tr>
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<tr>
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<td>61</td>
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<tr>
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<td>3</td>
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<tr>
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<tr>
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<td>-86.86</td>
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<td>1 5</td>
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<tr>
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<td>-83.27</td>
<td>Artificial</td>
<td>34</td>
<td>5</td>
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<tr>
<td>4/22/2014</td>
<td>30.04</td>
<td>-87.56</td>
<td>Artificial</td>
<td>32</td>
<td>1 8</td>
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<td>-88.05</td>
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<td>1</td>
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<tr>
<td>5/2/2014</td>
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<td>-87.20</td>
<td>Artificial</td>
<td>27</td>
<td>1</td>
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<tr>
<td>6/10/2014</td>
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<td>-87.25</td>
<td>Artificial</td>
<td>34</td>
<td>3</td>
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<tr>
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<td>-83.31</td>
<td>Natural</td>
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<tr>
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<td>-88.10</td>
<td>Artificial</td>
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<td>-86.04</td>
<td>Natural</td>
<td>28</td>
<td>1</td>
</tr>
</tbody>
</table>
The nematode was cleared and mounted in warm glycerin jelly for microscopic examination. Arthropods and leeches were directly examined in ethanol and temporarily cleared and examined using lactic acid. Identification of leeches was based on Ingram (1957) and Meyer (1965). Identification of arthropods was based on Richardson (1905), Wilson (1911, 1917), Brusca (1981), Kensley and Schotte (1989), and Williams and Bunkley–Williams (1996).

Two ecological parameters, prevalence and mean intensity of infection (with standard deviation), were calculated for each species of parasite when appropriate. Parasite prevalence is the percentage of fish examined that are infected with a particular parasite species; mean intensity is the mean number of a particular parasite species per individual infected host (Bush et al. 1997). Ecological data were pooled for the entire study area due to the small number of fish examined. Reef habitat type was noted as natural or artificial for each captured fish and its associated parasites. Representative voucher specimens of each species of parasite are deposited in the United States National Museum in the Smithsonian Institution, Washington, D.C., and in the Gulf Coast Research Laboratory Museum, Ocean Springs, Mississippi (Table 2).

### Results and Discussion

We collected 9 species of parasites during the study. Four of the 9 taxa are reported from the Red Lionfish for the first time (Table 2).

#### Annelida

A single species of marine leech, Trachelobdella lubrica (Grube, 1840) Ingram, 1957, infested the mouth or inner operculum of 10 of 49 fish (Prevalence = 20.4%, Mean intensity = 1.2 ± 0.63). The leech occurred at both natural and artificial reefs. Trachelobdella lubrica is known to occur in clear, high–salinity habitats, and infests a wide variety of teleosts over much of the warm Atlantic Ocean, Mediterranean Sea, and Red Sea (Sawyer, 1986). Meyer (1965) redescribed the species based on material from an unidentified serranid fish from western Africa, providing the best available taxonomic description for the species. Williams et al. (1994) reported T. lubrica from fishes from the orders Elopiformes, Myctophiformes and Perciformes in the Caribbean Sea, and Saglam et al. (2003) and Sanver–Celik and Aydin (2006) reported T. lubrica from the Black Scorpionfish, Scorpaena porcus Linnaeus, 1758, and the Red Scorpionfish, Scorpaena scrofa Linnaeus, 1758, in the Dardanelles of the Aegean Sea. Trachelobdella lubrica was reported from lionfish from near Jackson ville, Florida (see Ruiz–Carus et al. 2006, Bullard et al. 2011), and Puerto Rico (Ramos–Ascherl et al. 2015). Trachelobdella lubrica is known to infest P. volitans in the Red Sea (see Paperna, 1976); consequently, T. lubrica is the only known parasite that invasive lionfish share with fish from their native range.

#### Arthropoda

Three isopod species and 2 copepod species were collected. In all cases, infested fish had a single arthropod parasite. The isopods Rocinela signata Schiodte and Meinert, 1879 and Nerocila acuminata Schiodte and Meinert, 1881 each infested 4 of 49 fish examined (Prevalences = 8.2%). Rocinela signata occurred only on natural reefs (near Sarasota and Pensacola, Florida) while N. acuminata occurred in the northern Gulf of Mexico.

<table>
<thead>
<tr>
<th>Parasite Phylum</th>
<th>Class/Subclass</th>
<th>Order</th>
<th>Family</th>
<th>Site on/in host</th>
<th>Museum accession #</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Annelida</strong></td>
<td>Clitellata/Hirudinea</td>
<td>Piscicolidae</td>
<td>Trachelobdella lubrica</td>
<td>Gill chamber, operculum</td>
<td>USNM 1420607-1420614</td>
</tr>
<tr>
<td><strong>Arthropoda</strong></td>
<td>Malacostraca/Eumalacostraca</td>
<td>Isopoda</td>
<td>Aegidae</td>
<td>Rocinela signata</td>
<td>Mouth, gills, pectoral fin</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Corallaniidae</td>
<td>Alcirona krebsi*</td>
<td>External surface, gills</td>
<td>GCRLM 06581-2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cymothoidea</td>
<td>Nerocila acuminata*</td>
<td>Fins, external surface</td>
<td>GCRLM 06573-6</td>
</tr>
<tr>
<td></td>
<td>Maxillipoda/Copepoda</td>
<td>Caligidae</td>
<td>Caligus lobodes*</td>
<td>External surface</td>
<td>USNM 1420615</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pennellidae</td>
<td>Lernaenecus cf. polycerus*</td>
<td>Tongue, operculum, mandible muscles</td>
<td>USNM 1420616-7, GCRLM 06583</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Siphonostomatoida</td>
<td>Pennellia</td>
<td>Intestine</td>
<td>Not deposited</td>
</tr>
<tr>
<td><strong>Nematoda</strong></td>
<td>Chromadorea/Chromadoria</td>
<td>Rhabditida</td>
<td>Raphidascarididae</td>
<td>Intestine</td>
<td>Not deposited</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Didymozoidae</td>
<td>Raphidascaris sp.</td>
<td>Intestine</td>
<td>Not deposited</td>
</tr>
</tbody>
</table>

Lionfish parasites in the Gulf of Mexico

on a natural reef (near Sarasota, Florida) and artificial reefs (near Mississippi and Alabama). Both of these isopod species are known to be generalist parasites of various fishes in the Gulf of Mexico (Kensley and Schotte 1989). A third isopod species, *Alcirona krebsii* Hansen, 1890, infested the gills of a fish and the external surface of another, both at natural reef sites (near Destin, Florida and near Sarasota, Florida; Prevalence = 4.0%). *Alcirona krebsii* is typically a free-living associate of sponges and corals and is not normally a parasite on fishes; however, Richardson (1905) reported that 2 individuals infested a “Hamlet Grouper” in the Atlantic. The infestation we observed on the Red Lionfish may or may not represent an accidental association. Similarly, Poole (2011) reported that another corallanid isopod specimen belonging in *Excorallana* Stebbing, 1904 infested the gills of *P. volitans* from the Caribbean Sea but members of that genus are also free-living and not normally parasites on fish. Of the 3 isopod species collected, only *R. signata* had been previously reported to infest *P. volitans* in Puerto Rico (Ramos—Ascherl et al. 2015) and Panama (Sellers et al. 2015).

A single adult specimen of the copepod *Caligus lobodes* (Wilson, 1911) Kabata, 1979 infested the skin of a fish from a natural reef near Sarasota, Florida. This copepod was originally described from an infestation from the head of the Great Barracuda, *Sphyraena barracuda* Walbaum, 1792, from the Dry Tortugas, Florida. *Caligus lobodes* is well-known from Great Barracuda in the Caribbean Sea and Gulf of Mexico (see Williams and Bunkley—Williams 1996), and was also reported from *Sphyraena* sp. from the Indian Ocean (Lewis et al. 1969). This represents the first global report of *C. lobodes* from a Red Lionfish. Five specimens of the copepod *Lernaeenicus cf. polyceraus* Wilson, 1917 were found infected in the tongue or musculature associated with the dentary on 5 fish (Prevalence = 10.2%) collected from both natural and artificial reefs (Figure 1). The specimens conform closely to the description of *L. polyceraus* by Wilson (1917), but certain elements of the cephalothorax of each specimen were damaged or removed during collection. Observation of number and size of all swimming legs, which represent key generic features for *Lernaeenicus* Le Sueur, 1824, was not possible, rendering the identification of this species reasonable but tentative. *Lernaeenicus polyceraus* is infrequently reported but known to occur on a variety of fishes in the western Atlantic Ocean. Wilson (1917) described the species on the basis of the holotype from the Atlantic Tomcod, *Microgadus tomcod* (Walbaum, 1792) at Woods Hole, Massachusetts and two paratypes from Red Goatfish (as *Upeneus maculatus*, a junior subjective synonym of the Spotted Goatfish, *Pseudupeneus maculatus* (Bloch, 1793), (see page 992 of Eschmeyer 1998, Eschmeyer and Fong 2016) at Beaufort, North Carolina. Pearse (1947) reported *L. polyceraus* from the Vermilion Snapper, *Rhomboplites aurorubens* (Cuvier, 1829), from near Panama City, Florida. This represents the first global report of *L. polyceraus* from a Red Lionfish.

**Nematoda**

A single mature female specimen of *Raphidascaris* sp. infected the intestine of 1 fish from a natural reef near Destin, Florida; however, after preliminary identification the specimen was lost. Observed features consistent with *Raphidascaris* Railliet and Henry, 1915 according to Hartwich (1974) were: spines absent on cuticular rings, and an appendix emanated from a ventriculus. The position of the excretory pore was not noted. Ramos—Ascherl et al. (2015) reported adult *Raphidascaris* sp. from the stomach of *P. volitans* in the vicinity of Puerto Rico.

**Platyhelminthes**

Two species of Platyhelminthes, both adult digeneans,
were collected. One was represented by a single specimen belonging in the Didymozoidae Monticelli, 1888 that was embedded beneath the epidermis of the inner opercle of a fish from a natural reef near Sarasota, Florida. The anterior extremity was not intact preventing further identification. Neotorticaecum-type didymozoid metacercaria were reported from the stomach of *P. volitans* in Puerto Rico (see Ramos—Ascherl et al. 2015), but it is not clear if the adult reported herein is conspecific with the larval stage from Puerto Rico. The other digenean species, *Lecithochirium floridense* (Manter, 1934) Crowcroft, 1946, was the most common parasite encountered during the present study. *Lecithochirium floridense* infected the stomachs of 13 of 24 fish (Prevalence = 54.2%, Mean intensity = 7.7 ± 5.92), from both natural and artificial reefs. *Lecithochirium floridense* is a common generalist stomach parasite of teleosts in the western Atlantic Ocean, where it is known to infect perhaps as many as 60 species of pelagic and reef-oriented fishes, including the Red Lionfish (Bullard et al. 2011). Based on high prevalence of *L. floridense* reported in this and recent studies of invasive lionfish parasites, *L. floridense* represents the most successful parasite colonizer of Red Lionfish in the western Atlantic Ocean (Bullard et al. 2011; Ramos—Ascherl et al. 2015; Sellers et al. 2015; Claxton et al. 2017). The present study confirms what common sense would predict: only generalist parasites are found in invasive Red Lionfish in the Gulf of Mexico and no exotic parasites have been detected thus far.

**ACKNOWLEDGEMENTS**

We thank: Coast Watch Alliance, Perdido Key Chamber of Commerce, Mississippi Gulf Fishing Backs Inc., Mississippi Chapter of American Fisheries Society, National Oceanic and Atmospheric Administration, Florida Fish and Wildlife Conservation Commission, Alabama Department of Marine Resources, Gulf Coast Lionfish Coalition, Dauphin Island Sea Lab, Zookeeper LLC, Lytle Scholarship, Tom McIlwain Scholarship, Reef Pirate Emerald Coast Reef Association, Florida Skin Divers Association, Sarasota Underwater Club, Tampa Bay Spearfishing Club, Louisiana Council of Underwater Dive Clubs, and Canyon Coolers for their generous financial and logistical support in the acquisition of lionfish samples. We also thank the undergraduate interns at GCRL (Charles Duffie, Cody Jones, Jennifer Gross, Eileen Gibson, Judith Gonnello, Alicia Monroe, Megan McKenzie, and Aimee Rust) for laboratory assistance in processing lionfish.

**LITERATURE CITED**


