ABSTRACT

Rocinela signata (Isopoda: Aegidae) parasitizing Indo-Pacific lionfish *Pterois volitans* (Scorpaeniformes: Scorpaenidae) in the Southern Gulf of Mexico

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Indo-Pacific lionfish *Pterois volitans* (hereafter lionfish), introduced to the Western Atlantic, has shown a low susceptibility to parasitic infection in its invaded range. This study documented isopod *Rocinela signata* (Aegidae) parasitizing lionfish in two localities off the northern coast of the Yucatan Peninsula, Mexico. Out of 663 lionfish collected by fishermen in September and October 2017, 21 were infected with 31 isopods. In Cayo Arenas, *R. signata* showed a prevalence of 2.78%, mean abundance of 0.04, and a mean intensity of infection of 1.5 SD ± 0.6, varying from 1 to 3 isopods per host. In Alacranes Reef, it showed a prevalence of 3.88%, mean abundance of 0.05, and a mean intensity of infection of 1.4 SD ± 1.01, varying from 1 to 4 isopods per host. *Rocinella signata* showed a total prevalence, mean abundance, and mean intensity of infection of 3.16%, 0.03, 1.48 SD ± 0.81, respectively. It is remarkable that *R. signata* was the only isopod parasitizing lionfish examined during this work. This is the first record of prevalence, mean abundance, and mean intensity of infection of *R. signata* on lionfish from the southern Gulf of Mexico.

SUBJECT EDITOR: David Thieltges
KEYWORDS: Indo-Pacific lionfish, parasitic isopod, Gulf of Mexico, Alacranes Reef, Cayo Arenas

Introduction

Indo-Pacific lionfish *Pterois volitans* (hereafter lionfish), introduced to the Western Atlantic, threatens marine ecosystems due to its high predation on native fauna, where its population increased to become a biological invasion (Whitfield et al. 2002Whitfield PE, Gardner T, Vives SP, Gilligan MR, Courtenay WR, Jr, Ray GC, Hare JA. 2002. Biological invasion of the Indo-Pacific lionfish *Pterois volitans*along the Atlantic coast of North America. Marine Ecology Progress Series. 235:289–297. doi: 10.3354/meps235289[Crossref], [Web of Science ®],, [Google Scholar]). After its introduction in coral reefs of the Western Atlantic more than 30 years ago, only 25 taxa have been recorded parasitizing it. Among these taxa, digeneans, monogeneans, cestodes, nematodes, isopods, and copepods have been reported in lionfish from the Cayman Islands, Puerto Rico, The Bahamas, Cuba, USA, and Mexico (Bullard et al. 2011Bullard SA, Barse AM, Curan SS, Morris JA, Jr. 2011. First record of a digenean from invasive lionfish, *Pterois* cf. *volitans*(Scorpaeniformes: Scorpaenidae) in the northwestern Atlantic Ocean. Journal of Parasitology. 97:833–837. doi: 10.1645/GE-2746.1[Crossref], [PubMed], [Web of Science ®],, [Google Scholar]; Sikkel et al. 2014Sikkel PC, Tuttle LJ, Cure K, Coile AM, Hixon MA. 2014. Low susceptibility of invasive red lionfish (*Pterois volitans*) to a generalist ectoparasite in both its introduced and native ranges. PLoS One. 9:e95854. doi: 10.1371/journal.pone.0095854[Crossref], [PubMed], [Web of Science ®],, [Google Scholar]; Ramos-Ascherl et al. 2015Ramos-Ascherl Z, Williams EH, Jr, Bunkley-Williams L, Tuttle LJ, Sikkel PC, Hixon MA. 2015. Parasitism in *Pterois volitans*(Scorpaenidae) from Coastal Waters of Puerto Rico, the Cayman Islands, and the Bahamas. The Journal of Parasitology. 101:50–56. doi: 10.1645/13-422.1[Crossref], [PubMed], [Web of Science ®],, [Google Scholar]; Fogg et al. 2016Fogg AQ, Ruiz CF, Curran SS, Bullard SA. 2016. Parasites from the red lionfish, *Pterois volitans*from the Gulf of Mexico. Gulf and Caribbean Research. 27:SC1–SC5. doi: 10.18785/gcr.2701.07[Crossref],, [Google Scholar]; Aguilar-Perera et al. 2018Aguilar-Perera A, Quijano-Puerto L, Carrillo-Flota E, Williams EH, Bunkley-Williams L. 2018. First record

of the snapper-choking isopod *Cymothoa excisa* (Isopoda: Cymothoidae) parasitizing invasive lionfish *Pterois volitans* (Scorpaeniformes: Scorpaenidae). Journal of the Marine Biological Association of the United Kingdom. 1–3. doi: 10.1017/S0025315417001576[Crossref],, [Google Scholar]). In general, lionfish has shown a low susceptibility to parasite infection acquiring generalist parasites in low numbers (Ruiz-Carus et al. 2006Ruiz-Carus R, Matheson RE, Roberts DE, Whitfield PE.2006. The western Pacific red lionfish, *Pterois volitans* (Scorpaenidae), in Florida: evidence for reproduction and parasitism in the first exotic marine fish established in state waters. Biological Conservation. 128:384–390. doi: 10.1016/j.biocon.2005.10.012[Crossref], [Web of Science ®],, [Google Scholar]; Bullard et al. 2011Bullard SA, Barse AM, Curan SS, Morris JA, Jr. 2011. First record of a digenean from invasive lionfish, *Pterois* cf. *volitans*(Scorpaeniformes: Scorpaenidae) in the northwestern Atlantic Ocean. Journal of Parasitology. 97:833–837. doi: 10.1645/GE-2746.1[Crossref], [PubMed], [Web of Science ®],, [Google Scholar]; Sikkel et al. 2014Sikkel PC, Tuttle LJ, Cure K, Coile AM, Hixon MA. 2014. Low susceptibility of invasive red lionfish (*Pterois volitans*) to a generalist ectoparasite in both its introduced and native ranges. PLoS One. 9:e95854. doi: 10.1371/journal.pone.0095854[Crossref], [PubMed], [Web of Science ®],, [Google Scholar]; Ramos-Ascherl et al. 2015Ramos-Ascherl Z, Williams EH, Jr, Bunkley-Williams L, Tuttle LJ, Sikkel PC, Hixon MA. 2015. Parasitism in *Pterois volitans*(Scorpaenidae) from Coastal Waters of Puerto Rico, the Cayman Islands, and the Bahamas. The Journal of Parasitology. 101:50–56. doi: 10.1645/13-422.1[Crossref], [PubMed], [Web of Science ®],, [Google Scholar]; Sellers et al. 2015Sellers AJ, Ruiz GM, Leung B, Torchin ME. 2015. Regional variation in parasite species richness and abundance in the introduced range of the invasive lionfish, *Pterois volitans*. PLoS One. 10:e0131075. doi: 10.1371/journal.pone.0131075[Crossref], [PubMed], [Web of Science ®],, [Google Scholar]).

In the Western Atlantic, isopods (Isopoda) parasitizing lionfish include *Aegiochus tenuipes* (Aegidae), *Carpias serricaudus*(Janiridae) *Eurydice*

convexa (Cirolanidae) *Excorallana quadricornis* (Corallanidae) *Gnathia* sp., (Gnathidae), and *Rocinela signata* (Aegidae) in the Cayman Islands, Puerto Rico, The Bahamas (Ramos-Ascherl et al. 2015Ramos-Ascherl Z, Williams EH, Jr, Bunkley-Williams L, Tuttle LJ, Sikkel PC, Hixon MA. 2015. Parasitism in *Pterois volitans*(Scorpaenidae) from Coastal Waters of Puerto Rico, the Cayman Islands, and the Bahamas. The Journal of Parasitology. 101:50–56. doi: 10.1645/13-422.1[Crossref], [PubMed], [Web of Science ®],, [Google Scholar]). Recently, *Cymothoa excisa* (Cymothoidae) was recorded for the first time parasitizing lionfish (Aguilar-Perera et al. 2018Aguilar-Perera A, Quijano-Puerto L, Carrillo-Flota E, Williams EH, Bunkley-Williams L. 2018. First record of the snapper-choking isopod *Cymothoa excisa* (Isopoda: Cymothoidae) parasitizing invasive lionfish *Pterois volitans* (Scorpaeniformes: Scorpaenidae). Journal of the Marine Biological Association of the United Kingdom. 1–3. doi: 10.1017/S0025315417001576[Crossref],, [Google Scholar]).

Rocinela signata (Schiodte & Meinert 1879), a blood feeding isopod (Kensley and Shotte 1989Kensley B, Schotte M. 1989. Marine isopod crustaceans of the Caribbean. Washington (DC): Smithsonian Institution Press, 308 pp. [Google Scholar]; Brusca and France 1992Brusca RC, France SC.1992. The genus *Rocinela*(Crustacea: Isopoda: Aegidae) in the tropical eastern Pacific. Zoological Journal of Linnean Society London. 106:231–275. doi: 10.1111/j.1096-3642.1992.tb01248.x[Crossref], [Web of Science ®],, [Google Scholar]), is part of 40 species in the family Aegidae from the Pacific and Western Atlantic Oceans, with eight species occurring in the tropics (Brusca and France 1992Brusca RC, France SC.1992. The genus *Rocinela*(Crustacea: Isopoda: Aegidae) in the tropical eastern Pacific. Zoological Journal of Linnean Society London. 106:231–275. doi: 10.1111/j.1096-3642.1992.tb01248.x[Crossref], [Web of Science ®],, [Google Scholar]). While occasionally biting humans during its free-living phase (Garzón-Ferreira 1990Garzón-Ferreira J. 1990. An isopod, *Rocinela signata*(Crustacea: Isopoda: Aegidae), that attacks humans. Bulletin of Marine Science. 46:813–815. http://www.ingentaconnect.com/contentone/umrsmas/bullmar/1990/00000046/00000003/art00019[Web of Science ®],, [Google Scholar]), *R. signata* attaches to the body surfaces, gills, and branchial chambers of marine fish hosts (Kensley and Shotte 1989Kensley B, Schotte M. 1989.

Marine isopod crustaceans of the Caribbean. Washington (DC): Smithsonian Institution Press, 308 pp. [Google Scholar]; Bunkley-Williams et al. 2006Bunkley-Williams L, Williams EH, Jr, Bashirullah AK. 2006. Isopods (Isopoda: Aegidae, Cymothoidae, Gnathiidae) associated with Venezuelan marine fishes (Elasmobranchii, Actinopterygii). Revista de Biología Tropical. 54:175–188. doi: 10.15517/rbt.v54i3.26912[Crossref],, [Google Scholar]). *Rocinela signata* distinguishes from its congers, among other morphological attributes, by having a prominently visible, dark pigmented, inverted, W-shaped band on the pleotelson (Kensley and Shotte 1989Kensley B, Schotte M. 1989. Marine isopod crustaceans of the Caribbean. Washington (DC): Smithsonian Institution Press, 308 pp. [Google Scholar]).

In the southern Gulf of Mexico, lionfish has become established in coral reefs of the Alacranes Reef, off the northern Yucatan Peninsula (Aguilar-Perera and Tuz-Sulub 2010Aguilar-Perera A, Tuz-Sulub A. 2010. Non-native, invasive Red lionfish (*Pterois volitans* [Linnaeus, 1758]: Scorpaenidae), is first recorded in the southern Gulf of Mexico, off the northern Yucatan Peninsula, Mexico. Aquatic Invasions. 5:9–12. doi: 10.3391/ai.2010.5.S1.003[Crossref], [Web of Science ®],, [Google Scholar]; López-Gómez et al. 2014López-Gómez MJ, Aguilar-Perera A, Perera-Chan L.2014. Mayan diver-fishers as citizen scientists: detection and monitoring of the invasive red lionfish in the Parque Nacional Arrecife Alacranes, southern Gulf of Mexico. Biological Invasions 16:1351–1357. doi: 10.1007/s10530-013-0582-0[Crossref], [Web of Science ®],, [Google Scholar]). Here, a previously reported isopod parasitizing lionfish is the snapper choking isopod *Cymothoa excisa* (Aguilar-Perera et al. 2018Aguilar-Perera A, Quijano-Puerto L, Carrillo-Flota E, Williams EH, Bunkley-Williams L. 2018. First record of the snapper-choking isopod *Cymothoa excisa* (Isopoda: Cymothoidae) parasitizing invasive lionfish *Pterois volitans* (Scorpaeniformes: Scorpaenidae). Journal of the Marine Biological Association of the United Kingdom. 1–3. doi: 10.1017/S0025315417001576[Crossref],, [Google Scholar]). While *Rocinela signata* has been recorded in the northern Gulf of Mexico (Fogg et al. 2016Fogg AQ, Ruiz CF, Curran SS, Bullard SA. 2016. Parasites from the red lionfish, *Pterois volitans*from the Gulf of Mexico. Gulf and Caribbean Research. 27:SC1–SC5. doi: 10.18785/gcr.2701.07[Crossref],, [Google

Scholar]), nothing is known of its occurrence in the southern Gulf of Mexico. The aim of this study was to calculate prevalence, mean abundance, and mean intensity of infection of *R. signata* parasitizing lionfish in this region.

Materials and methods

During October and November 2017, lobster fishermen speared lionfish at mesophotic coral ecosystems (>35 m deep) off the northern Yucatan Peninsula from two localities: (1) Alacranes Reef (22°21'44N; 89°48'00W) at 130 km off the coast and (2) Cayo Arenas reef (22°07'09 N; 91°24' 38 W) at 150 km off the coast (Tunnell 2007Tunnell JW, Jr. 2007. Reef distribution. In: Tunnell JW, Jr, Chávez EA, Withers K, editors. Coral reefs of the Southern Gulf of Mexico. Corpus Christi, TX: A&M University Press; p. 17–29. [Google Scholar]). After capture, lionfish specimens were frozen and later transported for examination to the laboratory at the Departmento de Biología Marina, Facutad de Medicina Veterinaria y Zootecnia, Universidad Autónoma de Yucatán, Mexico. Lionfish was taxonomically identified following Schultz (1986Schultz ET. 1986. *Pterois volitans* and *Pterois miles*: two valid species Copeia 1986. Copeia. 1986:686–690. doi: 10.2307/1444950[Crossref], [Web of Science ®],, [Google Scholar]), total length (TL) measured to the nearest millimetres (defined as length from tip of snout to end of the caudal fin), and total weight recorded to the nearest gram. Based on maturation size (>20 cm TL), all lionfish examined were adults (230–490 mm TL), but many showed inactive gonads during the period of collection (September and October); consequently, macroscopic sex determination was not possible.

The mouth and gill chambers of each lionfish were thoroughly examined for ectoparasites, specifically for isopods, which were removed with forceps, counted, and preserved in 95% ethanol labelled tubes. Later, isopods were taxonomically identified under a stereoscope following taxonomic guides (Kensley and Schotte 1989Kensley B, Schotte M. 1989. Marine isopod crustaceans of the Caribbean. Washington (DC): Smithsonian Institution Press, 308 pp. [Google Scholar]; Brusca and France 1992Brusca RC, France SC.1992. The genus *Rocinela*(Crustacea: Isopoda: Aegidae) in the tropical eastern Pacific. Zoological Journal of Linnean Society London. 106:231–275. doi: 10.1111/j.1096-

3642.1992.tb01248.x[Crossref], [Web of Science ®],, [Google Scholar]). Prevalence, mean abundance, and mean intensity of isopod infection were calculated for locality and for the total sample following Bush et al. (1997Bush AO, Lafferty KD, Lotz JM, Shostak AW. 1997. Parasitology meets ecology on its own terms: Margolis et al. revisited. Journal of Parasitology. 83:575–583. doi: 10.2307/3284227[Crossref], [PubMed], [Web of Science ®],, [Google Scholar]). Isopods were measured with a calliper for body length (BL) to the nearest millimetre (from the tip of isopod's head to the end of telson). The Spearman's rank-correlation test (rs) was applied to verify either a positive or a negative correlation between lionfish's total length and their isopods per locality. The Mann–Whitney *U*-test was applied to verify significant differences between isopods' body length per locality and for differences between lionfish's length per locality. Also, Mann–Whitney *U*-test was applied to verify differences between infected and non-infected lionfish' length. All analyses were done at $\alpha = 0.05$.

Results and discussion

In Cayo Arenas, 431 lionfish *Pterois volitans* (mean 370 mm TL SD ± 39.71, range 144–490 mm TL) were examined and in Alacranes Reef 232 specimens (mean 343 mm TL SD ± 58.40, range 129–460 mm TL). A total of 663 specimens (mean 373 mm TL SD ± 41.86, range 129–490 mm TL) were examined for the whole study. Among this latter, only 21 lionfish (mean 374 mm TL ± 64.6, range 230–490 mm TL) were infected in the branchial chamber with 31 individuals of *Rocinela signata* (mean BL 11 mm SD ± 4.14, range 4–18 mm BL; Figure 1). Total prevalence, mean abundance, and mean intensity of infection were 3.17%, 0.03, 1.48 SD ± 0.81, respectively.

Figure 1. *Rocinella signata* (18 mm BL) parasitizing Indo-Pacific lionfish *Pterois volitans* in the southern Gulf of Mexico, Alacranes Reef and Cayo Arenas reef, off the northern Yucatan Peninsula, Mexico. (a) dorsal view, (b) lateral view, (c) ventral view. In (a) dorsal view, notice the inverted W-shaped band in telson, which is characteristic of this species. In (c) lateral view, notice the highly distended abdomen full of lionfish's blood. Scale bar: 1 mm.

Display full size

In Cayo Arenas, 12 lionfish (mean 412 mm TL SD ± 44.28, range 330–460 mm TL) were infected with 18 isopods (mean BL 11 mm BL, SD ± 4.14, range 4–18 mm BL). In Alacranes Reef, 9 lionfish (mean 324 mm TL, SD ± 52.97, range 230–394 mm TL) were infected with 13 isopods (mean 11 mm BL SD ± 4.26, range 6–18 mm BL). In Cayo Arenas, *R. signata* showed a prevalence of 2.78%, mean abundance of 0.04, and mean intensity of infection of 1.5 SD ± 0.6, varying from 1 to 3 isopods per host. In Alacranes Reef, it showed a prevalence of 3.88%, mean abundance of 0.06, and mean intensity of infection of 1.4 SD ± 1.01, varying from 1 to 4 isopods per host. The vast majority of isopods were found attached to lionfish's gills (either left or right), and just three isopods were found attached to the anterio-ventral portion of lionfish's branchial chamber with the isopod's head directed towards lionfish's ventral side.

Isopod's total body length was negatively correlated to that of lionfish (Spearman's rank-correlation test) per locality (Alacranes reef rs = −0.57, Cayo Arenas rs = −0.28). Isopod' body length in Alacranes reef showed no significant difference with that from Cayo Arenas reef ($N = 31$, Mann–Whitney *U*-test; $U = 99.5$, $p > .05$). Infected lionfish were significantly larger in Cayo Arenas compared to those in Alacranes reef ($N = 21$, Mann–Whitney *U*-test; $U = 8$, $p < .05$). No difference was found between infected and non-infected lionfish's length ($p > .05$).

This study represents the first record of *Rocinela signata*parasitizing lionfish off the northern Yucatan Peninsula, Mexico, Southern Gulf of Mexico. For other geographic regions, such as Puerto Rico, *R. signata* was recorded infecting lionfish's skin (Ramos-Ascherl et al. 2015Ramos-Ascherl Z, Williams EH, Jr, Bunkley-Williams L, Tuttle LJ, Sikkel PC, Hixon MA. 2015. Parasitism in *Pterois volitans*(Scorpaenidae) from Coastal Waters of Puerto Rico, the Cayman Islands, and the Bahamas. The Journal of Parasitology. 101:50–56. doi: 10.1645/13-422.1[Crossref], [PubMed], [Web of Science ®],, [Google Scholar]) and the buccal cavity and gill chambers in lionfish from the northern Gulf of Mexico (Fogg et al. 2016Fogg AQ, Ruiz CF, Curran SS, Bullard SA. 2016. Parasites from the red

lionfish, *Pterois volitans*from the Gulf of Mexico. Gulf and Caribbean Research. 27:SC1–SC5. doi: 10.18785/gcr.2701.07[Crossref],, [Google Scholar]). The only prevalence value available for *R. signata* on lionfish is 1.6% from Puerto Rico. Unfortunately, no other prevalence, mean abundance, and mean intensity records on lionfish are available for comparisons. *Rocinela signata* prevalence obtained from the two localities off the northern Yucatan Peninsula (3.17%) was high compared to that in Puerto Rico.

Rocinela signata is an opportunistic parasitic isopod showing no preference for any particular host species and parasitizing about 15 teleost species and three elasmobranch species in the Western Atlantic (Kensley and Schotte 1989Kensley B, Schotte M. 1989. Marine isopod crustaceans of the Caribbean. Washington (DC): Smithsonian Institution Press, 308 pp. [Google Scholar]). Very high prevalence values of *R. signata* have been documented for native fishes off Brazilian's coast, such as the Spanish mackerel *Scomberomorus braziliensis* with 44.4% (Lima et al. 2005Lima JTAX, Chellappa S, Thatcher V. 2005. *Lironeca redmanni* Leach (Isopoda, Cymothoidae) e *Rocinela signata* Schioedte & Meinert (Isopoda, Aegidae), ectoparasitos de *Scomberomorus brasiliensis* Collette, Russo & Zavala-Camin (Ostheichthyes, Scombridae) no Rio Grande do Norte, Brasil. Revista Brasileira Zoolgia. 22:1104–1108. doi: 10.1590/S0101-81752005000400041[Crossref],, [Google Scholar]), a parrotfish *Sparisoma frondosum* with 37.5% (Cavalcanti et al. 2012Cavalcanti ETS, Nascimento SKS, Barros NHC, Chellappa S. 2012. Occu rrence of the isopod parasite *Rocinela signata*(Isopoda: Aegidae) on marine fish *Sparisoma frondosum* (Osteichthyes: Scaridae). Marine Biodiversity Records. 5:e66. doi: 10.1017/S1755267212000516[Crossref],, [Google Scholar]), and a seabream *Archosargus rhomboidalis* with 18.2% (Lima et al. 2011Lima JTAX, Freitas MDF, Fernandes BLF, Bezerra JTA, Jr. 2011. Preferência de diferentes habitats do parasita *Rocinela signata*em peixes marinos *Archosargus rhomboidalis*e *Chloroscombrus chrysurus* no litoral do Rio Grande do Norte. Revista Eletrônica Científica Centauro. 2:23–27. http://crmvrn.gov.br/documents/revista/vol2/Rev%20Centauro%20v2%20n1%2023-27-1.pdf [Google Scholar]). Compared to these latter prevalence values, those of lionfish in Alacranes reef and Cayo Arenas are very low.

It is remarkable that *R. signata* infected lionfish in mesophotic coral ecosystems (MCEs) at 40 m deep off the northern Yucatan Peninsula. MCEs are potential refugia providing resilience for degraded shallow coral reefs (Bongaerts et al. 2010Bongaerts P, Ridgway T, Sampayo EM, Hoegh-Guldberg O. 2010. Assessing the "deep reef refugia" hypothesis: focus on Caribbean reefs. Coral Reefs. 29:309–327 doi: 10.1007/s00338-009-0581-x[Crossref], [Web of Science ®],, [Google Scholar]) through physical and genetic connectivity (Slattery et al. 2011Slattery M, Lesser MP, Brazeau D, Stokes MD, Leichter JJ. 2011. Conne ctivity and stability of mesophotic coral reefs. Journal of Experimental Marine Biology and Ecology. 408:32–41. doi: 10.1016/j.jembe.2011.07.024[Crossref], [Web of Science ®],, [Google Scholar]). Lionfish on MCEs is a high ecological risk to the stability of the marine ecosystem due to lionfish's predation (Andradi-Brown et al. 2017Andradi-Brown DA, Vermeij MJ, Slattery M, Lesser M, Bejarano I, Appeldoorn R, Goodb ody-Gringley G, Chequer AD, Pitt JM, Eddy C, et al. 2017. Large-scale invasion of western Atlantic mesophotic reefs by lionfish potentially undermines culling-based management. Biological Invasions. 19:939–954. doi: 10.1007/s10530-016-1358-0[Crossref], [Web of Science ®],, [Google Scholar]). In Alacranes reef, lionfish has invaded MCEs (Aguilar-Perera et al. 2017Aguilar-Perera A, Quijano-Puerto L, Hernández-Landa RC. 2017. Lionfish invaded the mesophotic coral ecosystem of the Parque Nacional Arrecife Alacranes, Southern Gulf of Mexico. Marine Biodiversity. 47:15–16. doi: 10.1007/s12526-016-0536-8[Crossref], [Web of Science ®],, [Google Scholar]), and now it has invaded Cayo Arenas reef as confirmed in this study of *R. signata*. Our work expands the depth range of *R. signata*, considered common in shallow waters fish' hosts, and reports a maximum size (18 mm BL) for parasitic *R. signata* in the Gulf of Mexico.

In our study, *Rocinela signata* was the only isopod found and no single specimen of the isopod *Cymothoa excisa* was recorded. This latter species was previously found on lionfish in Alacranes reef for the first time (Aguilar-Perera et al. 2018Aguilar-Perera A, Quijano-Puerto L, Carrillo-Flota E, Williams EH, Bunkley-Williams L. 2018. First record of the snapper-choking isopod *Cymothoa excisa* (Isopoda: Cymothoidae) parasitizing invasive

lionfish *Pterois volitans* (Scorpaeniformes: Scorpaenidae). Journal of the Marine Biological Association of the United Kingdom. 1–3. doi: 10.1017/S0025315417001576[Crossref],, [Google Scholar]). Reasons why no other isopod species was found during our work are unknown, but season of the year (September and October only) and depth (40 m) are plausible factors. A permanent monitoring on lionfish's isopod infestation throughout the year is highly recommended to verify and quantify other isopod species.

Rocinela signata, a facultative parasitic isopod with low host specificity (Brusca 1983Brusca RC. 1983. A monograph on the isopod family Aegidae in the tropical eastern Pacific. I. The genus *Aega*. Allan Hancock Monographs Marine Biology. 12:1–39. [Google Scholar]) which has been reported to bite humans (Garzón-Ferreira 1990Garzón-Ferreira J. 1990. An isopod, *Rocinela signata*(Crustacea: Isopoda: Aegidae), that attacks humans. Bulletin of Marine Science. 46:813–815. http://www.ingentaconnect.com/contentone/umrsmas/bullmar/1990/00000046/00000003/art00019[Web of Science ®],, [Google Scholar]) may inflict wounds predisposing fish hosts to secondary infections (Bunkley-Williams and Williams 1998Bunkley-Williams L, Williams EH. 1998. Isopods associated with fishes: a synopsis and corrections. The Journal of Parasitology 84:893–896. doi: 10.2307/3284615[Crossref], [PubMed], [Web of Science ®],, [Google Scholar]). In our work, *R. signata* showed darkly coloured, distended abdomens as evidence of suctioned lionfish's blood (Figure 1) and a partial tissue damage to lionfish's branchial chambers in the area of attachment. However, *R. signata* appears not to affect lionfish's growth since infected lionfish were large (mean 374 mm TL, maximum length 490 mm TL) compared to non-infected lionfish in the invaded region. So far, severe adverse effects inflicted by *R. signata* on lionfish are unknown.

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Guadalupe Villamonte-Cab, and Andrea Villarreal-Caballero. We thank Luis Quijano-Puerto, Alberto Cen-López, and lobster fishermen from the Alacranes Reef for providing samples, especially Mariano Canul-Uicab. Cristian Aguilar-Perera helped assembling Figure 1. Thanks to the Alacranes Reef National Park authority (Cristóbal Cáceres-G.Cantón) and Fundación UADY.

Disclosure statement

No potential conflict of interest was reported by the authors.

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   [Crossref], [Web of Science ®]

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   [Crossref], [Web of Science ®]

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Additional information

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