



First record of the genus *Anuropodione* Bourdon, 1967 (Crustacea: Isopoda: Bopyridae) from the South Atlantic

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ABSTRACT

The family Bopyridae Rafinesque, 1815 is comprised of parasitic isopods with a life cycle involving an intermediate host (copepod) and a definitive host (decapod crustacean). The genus *Anuropodione* Bourdon, 1967 occurs in all oceans and encompasses five species that are only known as parasites of squat lobsters belonging to the genus *Munida* Leach, 1820. Despite the broad distribution of the genus, no species has ever been recorded from the South Atlantic. A total of 416 specimens of *Munida iris* A. Milne-Edwards, 1880 were collected in Potiguar Basin around the isobaths of 400 m, including 24 individuals (5.77%) containing parasites within their branchial chambers. Male parasites showed considerable variability in the number of pleomeres, with many showing four pleomeres, a number previously unknown for males of any species in the genus. These specimens represent the first occurrence of the genus *Anuropodione* and the species *A. carolinensis* Markham, 1974 from the South Atlantic (Brazilian waters).

KEYWORDS

Anuropodione carolinensis, deep-sea, Brazil, *Munida iris*, parasitic isopod.

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The isopod family Bopyridae Rafinesque, 1815 contains species that are parasites of calanoid copepods as their intermediate hosts and decapod crustaceans as their definitive hosts. These parasites are usually found as a female and male pair in the branchial chamber of the definitive host, causing deformations in the carapace of the host or they can occur ventrally under the pleon of the host (Boyko and Williams, 2009; Williams and Boyko, 2012). According to Cardoso (2010), Segadilha (2017), Brito *et al.* (2018), and Horch *et al.* (2018), approximately 23 bopyrid species have been recorded from Brazilian waters, ranging from rivers (near coastal zones) as parasites of prawns (*e.g.*, *Macrobrachium* Bate, 1868) to the deep-sea, where they have been found parasitizing species of *Munida* Leach, 1820, *Nephropsis* Wood-Mason, 1872 and *Paralomis* White, 1856.

The genus *Anuropodione* Bourdon, 1967 has a widespread distribution, occurring in all oceans, especially in relatively deep waters around 200–700 m (Williams and Brown, 1972; Wenner and Windsor, 1979), and is composed of five species: *A. amphindra* (Codreanu, Codreanu and Pike, 1966), *A. carolinensis* Markham, 1974, *A. dubius* (Nierstrasz and Brender à Brandis, 1929), *A. megacephalon* Markham, 1974 and *A. senegalensis* Bourdon, 1967 (Boyko *et al.*, 2008 onwards). To date, species of *Anuropodione* have only been recorded as parasites of squat lobsters, especially those belonging to the genus *Munida* (Williams and Brown, 1972; Markham, 1974; Wenner and Windsor, 1979); the host of *A. dubius* is not certain as it was given as “*Galathea* spec.” by Nierstrasz and Brender à Brandis (1929). Despite wide distribution of the genus, no species of *Anuropodione* has ever been recorded from the South Atlantic. In this paper we report the first occurrence of the genus *Anuropodione* and the species *A. carolinensis* Markham, 1974 collected as a parasite of the squat lobsters *M. iris* A. Milne-Edwards, 1880, from Brazilian waters in the South Atlantic.

The sampling was carried out on the continental slope of Potiguar Basin, located in the northeast of Brazil (03/05°S, 38/35°W), covering the states of Ceará (CE) and Rio Grande do Norte (RN). Specimens were collected on board the R/V Seward Johnson in May 2011, as part of the project *Avaliação da biota bentônica e planctônica da Bacia Potiguar e Ceará (Bpot)* coordinated by *Petróleo Brasileiro S/A (Petrobras)*.

Bottom trawls were carried out on the continental slope between 150 and 2068 m depth using a semi-balloon otter trawl with 50 mm mesh size and 18 m of mouth opening.

After sampling, specimens were fixed in 70% ethanol, with parasites initially identified to species following Markham (1974) and deposited in the carcinological collection of the “Museu de Oceanografia Prof. Petrônio Alves Coelho (MOUFPE)” at the Federal University of Pernambuco in Recife, Brazil. The following body measurements were taken with a caliper (0.01 mm): total length (TL) (for *M. iris* and *A. carolinensis*); carapace length (CL) and carapace width (CW) (for *M. iris*); maximum pereon width (W) (for *A. carolinensis*).

SYSTEMATICS

Family Bopyridae Rafinesque, 1815

Subfamily Pseudioninae Codreanu, 1967

Genus *Anuropodione* Bourdon, 1967

Anuropodione carolinensis Markham, 1974

(Figs. 1–4)

Anuropodione carolinensis Markham, 1974: 620–624, 627, 629, 647, figs. 5–8; —Wenner and Windsor, 1979: 294–302, figs. 2–4; —Wenner, 1982: 362 (mention); —Ross, 1983: 157 (list); —Williams, 1984: 234 (mention); —Markham, 1988: 55 (list); —Román-Contreras, 1993: 46 (mention); —McDermott, 2002: 39 (mention); —Oliveira and Masunari, 2006: 1194 (mention); —Romero-Rodríguez and Román-Contreras, 2008: 1207–1208 (mention); —Thoma and Heard, 2010: 3 (list), 16 (key), 18 (key), fig. 12a, b, 14e; —Boyko *et al.*, 2012: 4, 18 (list); —McLaughlin *et al.*, 2005: 187 (list); —Penha-Lopez *et al.*, 2013: 35 (mention); —Cericola and Williams, 2015: 239 (list).

Anuropodione sp. Williams and Brown, 1972: 307 (mention); —Burse, 1978: 569 (mention).

Anuropodione [sp.] Ross, 1983: 168 (mention).

Host material examined. Brazil: 1 female (28.26 mm TL, 25.41 mm CL; 23.37 mm CW), 1 male (22.69 mm

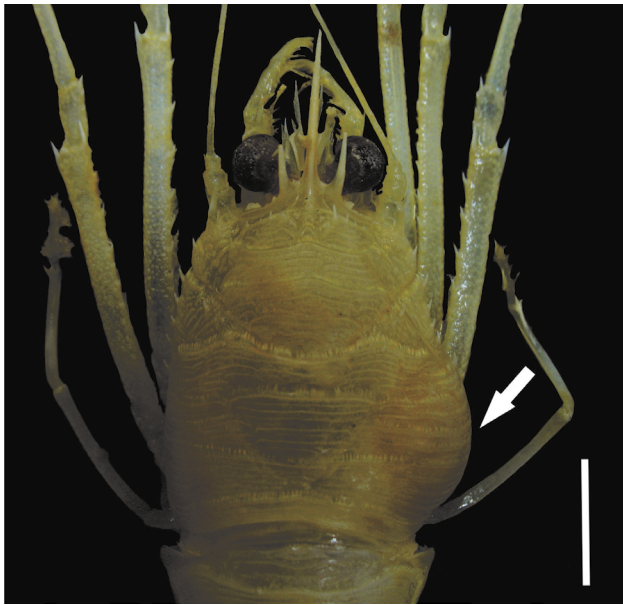


Figure 1. *Munda iris* A. Milne-Edwards, 1880, female (MOUFPE 17607) parasitized by *Anuropodione carolinensis* Markham, 1974, collected in Potiguar Basin, #MT-61, 04°47.83'S, 36°11.02'W, 418 m, Rio Grande do Norte, northeastern Brazil. Scale bar = 1 cm.

TL, 20.24 mm CL, 17.11 mm CW), Potiguar Basin, #MT-61, 04°47.83'S 36°11.02'W, 418 m, temperature 8.15°C, 08.v.2011 (MOUFPE 17607) (Fig. 1); 2 females (18.25–28.3 mm TL, 16.69–25.38 mm CL, 13.07–22.24 mm CW), 4 males (20.52–26.89 mm TL, 18.45–24.01 mm CL, 15.58–17.98 mm CW), Potiguar Basin, #MT-62, 04°43.89'S 36°25.62'W, 415 m, temperature 7.56°C, 07.v.2011 (MOUFPE 17608); 9 females (20.52–26.89 mm TL, 16.86–24.09 mm CL, 9.19–18.84 mm CW), 7 males (17.21–28.47 mm TL, 15.61–25.89 mm CL, 14.86–20.31 mm CW), Potiguar Basin, #MT-64, 04°36.24'S, 36°45.73'W, 416 m, temperature 7.47°C, 12.v.2011 (MOUFPE 17609).

Parasite material examined. Brazil: 2 females (10.3–12.4 mm TL, 5.2–6.3 mm W), 2 males (3.4–4.2 mm TL, 2.5–3.1 mm W), Potiguar Basin, #MT-61, 04°47.83'S 36°11.02'W, 418 m, temperature 8.15°C, 08.v.2011 (MOUFPE 18874); 6 females (10.4–11.3 mm TL, 4.1–5.8 mm W), 6 males (2.6–3.4 mm TL, 2.1–2.8 mm W), Potiguar Basin, #MT-62, 04°43.89'S 36°25.62'W, 415 m, temperature 7.56°C, 07.v.2011 (MOUFPE 18875); 16 females (10.5–12.9 mm TL, 4.7–5.3 mm W), 16 males (2.8–3.1 mm TL, 2.3–2.9 mm W), Potiguar Basin, #MT-64, 04°36.24'S 036°45.73'W, 416 m, temperature 7.47°C, 12.v.2011 (MOUFPE 18876).

Diagnosis. Female: Body ovate, all segments and body regions distinct. Head with large frontal lamina; anterior margin smooth; eyes absent. Antennula with two articles, antenna of four articles. Maxilliped without palp; barbula with two smooth, falcate, lateral projections, median region smooth. Large coxal plates on all pereomeres; dorsolateral bosses on pereomeres 1–4; oostegite 1 posterior segment shorter than anterior, with few lobes on inner margin. Posterior pereopods much larger than anterior ones; bases with expanded dorsal carinae. Pleomeres tapering posteriorly; lateral plates present on pleomeres 1–4; pleotelson bulbous; biramous pleopods on pleomeres 1–5; uropods lacking.

Male: Pereon widest at pereomere 5, tapering anteriorly and posteriorly; all segments distinct. Antennula of two–three articles, antenna of three–five articles. Pereopods subequal in size and shape. Pleon with segmentation ranging from all segments fused to six distinct segments; pleopods and uropods absent.

Distribution. Western Atlantic: United States (North Carolina and Gulf of Mexico) and Brazil (Potiguar Basin, Rio Grande do Norte) (Markham, 1974; Wenner, 1982; present study) (Fig. 4).

Remarks. A total of 416 specimens of *M. iris* were collected in Potiguar Basin, comprising 24 hosts (5.77%) bearing *A. carolinensis* in the branchial chambers (Fig. 1), females (Fig. 2A–I) of which conformed in all characters with the description of Markham (1974). Markham (1974) stated that the antennae of females bear two articles, but this appears to have been an error because all our specimens have antennae with four articles (Fig. 2D). Additionally, all the male specimens we dissected had two or three antennular and three antennal articles, while Markham (1974) reported three antennular and five antennal articles. Parasitization most frequently occurred in adult hosts without distinction as to the sex of the host (12 females and 12 males). A total of 24 males of *A. carolinensis* were examined, of which 33% (n = 8) had only a single pleomere (Fig. 3C, D), 46% (n = 11) had four pleomeres (including the pleotelson) and 21% (n = 5) had six pleomeres (including the pleotelson; Fig. 3A, B). Previous examination of *A. carolinensis* males were made by Markham (1974) and Wenner and Windsor (1979), which revealed variability in the

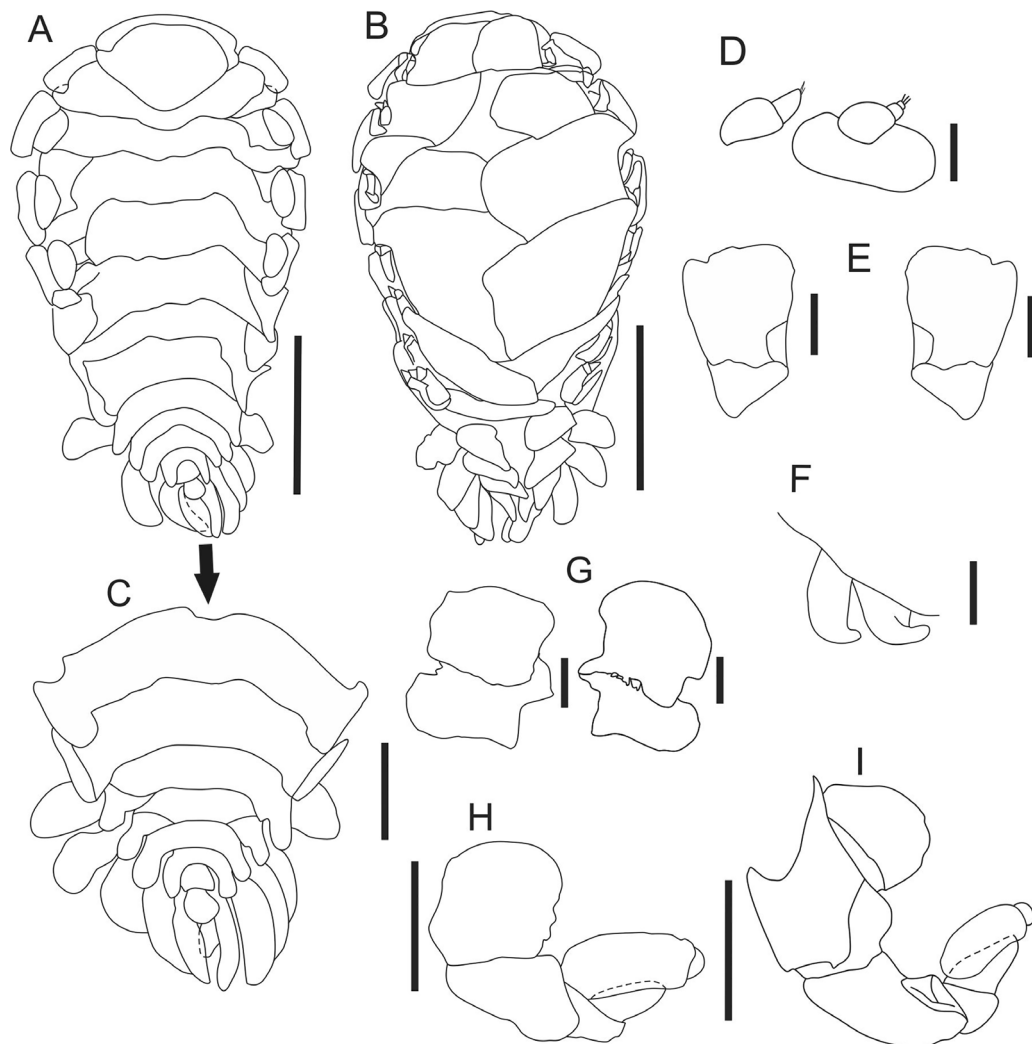


Figure 2. *Anuropodione carolinensis* Markham, 1974 (MOUFPE 18874), Potiguar Basin, station #MT-61, 418 m, Rio Grande do Norte, northeastern Brazil. (A) Mature female, dorsal; (B) mature female, ventral; (C) abdomen and pleotelson, detail; (D) antenna and antennule; (E) maxilliped (left and right); (F) barbula; (G) oostegite 1; (H) pereopod 1; (I) pereopod 7. Scale bar = A, B, 5 mm; C, 2 mm; D–G, 0.5 mm; H, I, 1 mm.

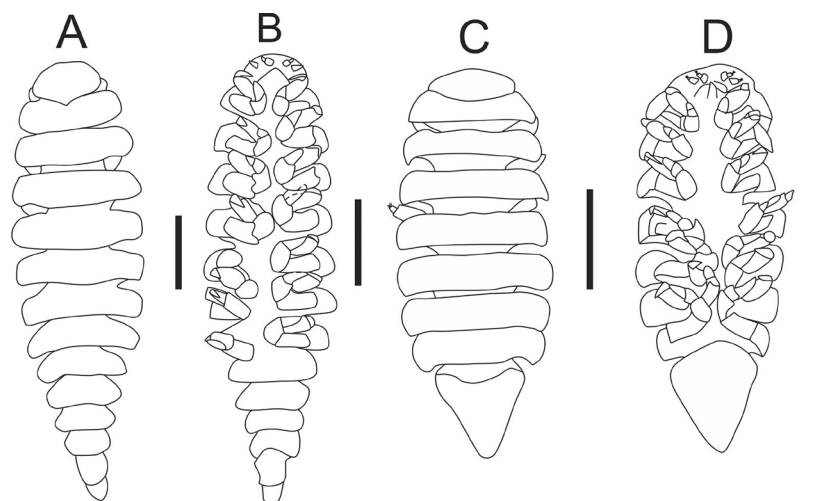


Figure 3. *Anuropodione carolinensis* Markham, 1974 (MOUFPE 18874), Potiguar Basin, station #MT-61, 418 m, Rio Grande do Norte, northeastern Brazil. (A) Male dorsal; (B) male ventral; (C) male with pleomere fused in dorsal view; (D) male with pleomere fused in ventral view. Scale bar = A–E, 1 mm.



Figure 4. Geographic distribution of *Anuropodione carolinensis* Markham, 1974 in the Western Atlantic. Orange circles = previous records; orange star = new record.

number of pleomeres with one, three, and six pleomeres being recorded; the single pleomere condition was by far the most common and very few specimens were found bearing three pleomeres. In contrast, our samples showed the most common condition as being four pleomeres for males of *A. carolinensis*. The presence of four pleomeres on males of this species and, in fact, on males of any species of *Anuropodione* was previously unknown (Boyko et al., 2018).

Records of parasitism on *M. iris* by *A. carolinensis* were previously observed by Markham (1974) from North Carolina (35°05'N, 75°11'W), Wenner and Windsor (1979) from Norfolk Canyon (36°56', 37°09'N, 75°06', 74°33'W) and Wenner (1982) in Norfolk Canyon (36°56', 37°09'N) and Tom's Canyon (38°18', 39°10'N), however, *M. iris* is also parasitized by *Munidion irritans* Boone, 1927 (Burse, 1978). All of the specimens of *M. iris* examined herein were parasitized by individuals of both sexes of *A. carolinensis* (female and male pair), which were observed occurring in *M. iris* only at a depth of 400 m in Potiguar Basin. The depth range of parasites of *A. carolinensis* follow the bathymetric distribution of their hosts and, as the species of *M. iris* can be found in depths up to 1303 m (Melo-Filho, 2006). *Anuropodione carolinensis* is potentially present along a similar large depth range, although it has so far only been reported from 83–662 m (Boyko et al., 2012). In the western Atlantic, *M. iris* has a large geographic distribution, occurring from the United States to Uruguay, and in Brazilian waters from Potiguar Basin (present record), Alagoas, Bahia, São Paulo and Rio Grande do Sul (Melo, 1999; Melo-Filho, 2006; Serejo et al., 2007), however, despite of this wide host distribution, *A. carolinensis* has previously only been recorded from the southeastern United States and the Gulf of Mexico, and is only now known from Brazilian waters in the south Atlantic.

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REFERENCES

- Bate, C.S. 1868. On a new genus, with four new species, of freshwater prawns. *Proceedings of the Zoological Society of London*, 1868: 363–368.
- Bourdon, R. 1967. Sur trois nouveaux Bopyrides de Senegal. *Bulletin de l'Institut Francaise d'Afrique Noire*, 29: 107–122.
- Boone, P.L. 1927. Crustacea from tropical east American seas. *Bulletin of the Bingham Oceanographic Collection*, 1: 1–147.
- Boyko, C.B.; Bruce, N.L.; Hadfield, K.A.; Merrin, K.L.; Ota, Y.; Poore, G.C.B.; Taiti, S.; Schotte, M. and Wilson, G.D.F. (eds) (2008 onwards). World Marine, Freshwater and Terrestrial Isopod Crustaceans database. *Anuropodione* Bourdon, 1967. Accessed through: World Register of Marine Species at: <http://www.marinespecies.org/aphia.php?p=taxdetails&id=248435>. Accessed on 29 August 2018.
- Boyko, C.B.; Williams, J.D. and Markham J.C. 2012. Recent and fossil Isopoda Bopyridae parasitic on squat lobsters and porcelain crabs (Crustacea: Anomura: Chirostyloidea and Galatheaidea), with notes on nomenclature and biogeography. *Zootaxa*, 3150: 1–35.
- Boyko, C.B. and Williams, J.D. 2009. Crustacean Parasites as Phylogenetic Indicators in Decapod Evolution. p. 197–220. In: J.W. Martin, K.A. Crandall and D.L. Felder (eds), *Decapod Crustacean Phylogenetics, Crustacean Issues*, Vol. 18. CRC Press Taylor & Francis Group.
- Boyko, C.B.; Williams, J.D. and Ökter, A. 2018. Redescription of the Mediterranean endemic parasitic isopod *Anuropodione amphiantra* (Codreanu, Codreanu & Pike, 1966) n. comb. (Crustacea: Isopoda: Bopyridae) from *Munida rutilanti* Zariquiey Alvarez, 1952, with new records from Turkey and a review of the genus *Anuropodione* Bourdon, 1967. *Mediterranean Marine Science*, 19: 611–619.
- Brito, A.; Cardoso, I.A. and Boyko, C.B. 2018. A new species of *Pseudione* Kossman, 1881 (Crustacea, Isopoda, Bopyridae) parasitizing the squat lobster *Munida micropthalma* A. Milne-Edwards, 1880 in the Southwestern Atlantic. *Zootaxa*, 4377: 444–450.
- Burse, C.R. 1978. Histopathology of the parasitization of *Munida iris* (Decapoda: Galatheaidea) by *Munidion irritans* (Isopoda: Bopyridae). *Bulletin of Marine Science*, 28: 566–570.
- Cardoso, I.A. 2010. *Paragigantione americana* Markham, 1973. p. 62–63. In: H.P. Lavrado and M.S. Brasil (eds), *Biodiversidade da Região Oceânica Profunda da Bacia de Campos: Megafauna e Ictiofauna Demersal*. Rio de Janeiro, SAG Serv.
- Cericola, M.J. and Williams J.D. 2015. Prevalence, reproduction and morphology of the parasitic isopod *Athelges takanoshimensis* Ishii, 1914 (Isopoda: Bopyridae) from Hong Kong hermit crabs. *Marine Biology Research*, 11: 236–252.
- Codreanu, R.; Codreanu, M. and Pike, R.B. 1966. *Pleurocrypta amphiantra* n. sp., bopyrien parasite branchial de *Munida iris* rutilanti [sic], galatheaide [sic] d'Algérie et les effets d'interbiomorphose. p. 1071–1072. In: A. Corradetti (ed), *Proceedings of the First International Congress of Parasitology* (Roma, 21–26 September 1964), Vol. 2. Oxford, Pergamon Press.
- Codreanu, R. 1967. Clasificarea evolutiva a bopyrienilor, isopode parazite ale crustaceelor decapode si importanta lor biologica generala. *Studii si Cercetari de Biologie Seria Zoologie*, 19: 203–211.

- Horch, A.P.; Huber, A.F.; Araujo, P.B. and Ribeiro, F.B. 2018. A new species of *Pseudione* Kossmann, 1881 (Isopoda, Cymothoidea, Bopyridae) parasitizing the lobster *Nephropsis aculeata* Smith, 1881 (Decapoda, Astacidea, Nephropidae) in the Southwestern Atlantic. *Zootaxa*, 4461: 245–252.
- Leach, W.E. 1820. Galatéadées, Galateadae. Dictionnaire des Sciences Naturelles, dans Lequel on Traite Méthodiquement des Différens êtres de la Nature, Considérés soit en eux-mêmes, d'après l'État Actuel de nos Connoissances, soit relativement a l'Utilité qu'en Peuvent Retirer la Médecine, l'Agriculture, le Commerce et les Artes. *Suivi d'une Biographie des plus Célèbres Naturalistes*, 18: 49–59.
- Markham, J.C. 1974. Six new species of bopyrid isopods parasitic on galatheid crabs of the genus *Munida* in the western Atlantic. *Bulletin of Marine Science*, 23: 613–648.
- Markham, J.C. 1988. Descriptions and revisions of some species of Isopoda Bopyridae of the north western Atlantic Ocean. *Zoologische Verhandelingen*, 246: 1–63.
- McDermott, J.J. 2002. Relationships between the parasitic isopods *Stegias clibanarii* Richardson, 1904 and *Bopyrissa wolffi* Markham, 1978 (Bopyridae) and the intertidal hermit crab *Clibanarius tricolor* (Gibbes, 1850) (Anomura) in Bermuda. *Ophelia*, 56: 33–42.
- McLaughlin, P.A.; Camp, D.K.; Angel, M.V.; Bousfield, E.L.; Brunei, P.; Brusca, R.C.; Cadien, D.; Cohen, A.C.; Conlan, K.; Eldredge, L.G.; Felder, D.L.; Goy, J.W.; Haney, T.; Hann, B.; Heard, R.W.; Hendrycks, E.A.; Hobbs III, H.H.; Holsinger, J.R.; Kensley, B.; Laubitz, D.R.; LeCroy, S.E.; Lemaitre, R.; Maddocks, R.F.; Martin, J.W.; Mikkelsen, P.; Nelson, E.; Newman, W.A.; Overstreet, R.M.; Poly, W.J.; Price, W.W.; Reid, J.W.; Robertson, A.; Christopher Rogers, D.; Ross, A.; Schotte, M.; Schram, F.R.; Chiang-Tai, S.; Watling, L. and Wilson G.D. 2005. Common and scientific names of aquatic invertebrates from the United States and Canada: Crustaceans. *American Fisheries Society Special Publication*, 31: 1–326.
- Milne-Edwards, A. 1880. Reports on the results of dredging under the supervision of Alexander Agassiz, in the Gulf of Mexico and in the Caribbean Sea, etc. VIII. Études préliminaires sur les Crustacés. *Bulletin of the Museum of Comparative Zoology at Harvard College*, 8: 1–68.
- Melo, G.A.S. 1999. Manual de identificação dos Crustacea Decapoda do litoral brasileiro: Anomura; Thalassinidea; Palinuridea e Astacidea. São Paulo, Plêiade/Fapesp, 551p.
- Melo-Filho, G.A.S. 2006. Reports on the results of the N.Oc. Prof. W. Besnard expeditions to the southern coast of Brazil under the Revizee Program: Chirostylidae and Galatheidae (Crustacea: Decapoda: Anomura). *Zootaxa*, 1238: 1–22.
- Nierstrasz, H.F. and Brender à Brandis, G.A. 1929. Papers from Dr. Th. Mortensen's Pacific Expedition 1914–16. 48. Epicaridea 1. *Videnskabelige Meddelelser fra Dansk Naturhistorisk Forening i Kjobenhavn*, 87: 1–44.
- Oliveira, E. and Masunari, S. 2006. Distribuição temporal de densidade de *Aporobopyrus curtatus* (Richardson) (Crustacea, Isopoda, Bopyridae), um parasito de *Petrolisthes armatus* (Gibbes) (Crustacea, Anomura, Porcellanidae) na Ilha do Farol, Matinhos, Paraná, Brasil. *Revista brasileira de Zoologia*, 23: 1188–1195.
- Penha-Lopes, G.; Marques, J.F.; Leal, M.C.; Carvalho, A.F. and Paula, J. 2013. Population structure and reproduction of *Pseudione elongata africana* (Bopyridae, Isopoda). *Western Indian Ocean Journal of Marine Science*, 11: 27–39.
- Rafinesque, C.S. 1815. Analyse de la Nature ou Tableau de l'Univers et des Corps Organisés. Palerme, 224p.
- Román-Contreras, R. 1993. Aspectos Biológicos de *Probopyrus Pacificensis* Román-Contreras, 1993, Parasito del Langostino *Macrobrachium tenellum* (Smith, 1871) en la Laguna Coyuca, Guerrero, México. Universidad Nacional Autónoma de México, Facultad de Ciencias, Doctor en Ciencias (Biología), 86p. [Unpublished]
- Romero-Rodríguez, J. and Román-Contreras, R. 2008. Aspects of the reproduction of *Bopyrinella thorii* (Richardson, 1904) (Isopoda, Bopyridae), a branchial parasite of *Thor floridanus* Kingsley, 1878 (Decapoda, Hippolytidae) in Bahía de la Ascensión, Mexican Caribbean. *Crustaceana*, 81: 1201–1210.
- Ross, D.M. 1983. Symbiotic Relations. p. 163–212. In: F.J. Vernberg and W.B. Vernberg (eds), *The Biology of Crustacea*. Volume 7. Behavior and Ecology. New York, Academic Press.
- Segadilha, J.L. 2017. Bopyridae. In: Catálogo Taxonômico da Fauna do Brasil. PNUD. Available from: <http://fauna.jbrj.gov.br/fauna/faunadobrasil/154907>. Accessed on 19 september 2017.
- Serejo, C.S.; Young, P.S.; Cardoso, I.A.; Tavares, C.; Rodrigues, C. and Almeida, T.C. 2007. Abundância, diversidade e zonação dos crustáceos no talude da costa central do Brasil (11°–22°S) coletados pelo Programa REVIZEE/Score Central: prospeção pesqueira. p. 133–162. In: H.P. Lavrado, A.C. Brasil (eds), *Biodiversidade da fauna marinha profunda na costa central brasileira*, 2. Rio de Janeiro, Brasil, Museu Nacional.
- Thoma, J.N. and Heard, R.W. 2010. A key to epicaridean isopods of the South Atlantic Bight. Available from: <http://www.dnr.sc.gov/marine/sertc/Thoma%20%20Heard%20Epicaridean%20key.pdf>. Accessed on 05 December 2018.
- Wenner, E.L. 1982. Notes on the distribution and biology of Galatheidae and Chirostylidae (Decapoda: Anomura) from the Middle Atlantic Bight. *Journal of Crustacean Biology*, 2: 360–377.
- Wenner, E.L. and Windsor, N.T. 1979. Parasitism of galatheid crustaceans from the Norfolk Canyon and Middle Atlantic Bight by bopyrid isopods. *Crustaceana*, 37: 293–303.
- White, A. 1856. Some remarks on Crustacea of the genus *Lithodes* with a brief description of a species apparently hitherto unrecorded. *Proceedings of the Zoological Society of London*, 1856: 132–135.
- Williams, A.B. 1984. Shrimps, Lobsters, and Crabs of the Atlantic Coast of the Eastern United States, Maine to Florida. Washington, D.C., Smithsonian Institution Press, 550p.
- Williams, J.D. and Boyko, C.B. 2012. The global diversity of parasitic isopods associated with crustacean hosts (isopoda: Bopyroidea and Cryptoniscoidea). *PLoS One*, 7: e35350.
- Williams, A.B. and Brown, W.S. 1972. Notes on structure and parasitism of *Munida iris* A. Milne-Edwards (Decapoda, Galatheidae) from North Carolina, U.S.A. *Crustaceana*, 22: 303–308.
- Wood-Mason, J. 1872. On *Nephropsis stewarti*, a new genus and species of macrourus crustaceans, dredged in deep water off the eastern coast of the Andaman Islands. *Proceedings of the Asiatic Society of Bengal*, 1872: 1–151.