

University of Groningen

A review of Caribbean Copepoda associated with reef-dwelling cnidarians, echinoderms and sponges

Korzhavina, Oksana A.; Hoeksema, Bert W.; Ivanenko, Viatcheslav N.

Published in:
Contributions to Zoology

DOI:
[10.1163/18759866-20191411](https://doi.org/10.1163/18759866-20191411)

IMPORTANT NOTE: You are advised to consult the publisher's version (publisher's PDF) if you wish to cite from it. Please check the document version below.

Document Version
Publisher's PDF, also known as Version of record

Publication date:
2019

[Link to publication in University of Groningen/UMCG research database](#)

Citation for published version (APA):
Korzhavina, O. A., Hoeksema, B. W., & Ivanenko, V. N. (2019). A review of Caribbean Copepoda associated with reef-dwelling cnidarians, echinoderms and sponges. *Contributions to Zoology*, 88(3), 297-349. <https://doi.org/10.1163/18759866-20191411>

Copyright
Other than for strictly personal use, it is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license (like Creative Commons).

Take-down policy
If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Downloaded from the University of Groningen/UMCG research database (Pure): <http://www.rug.nl/research/portal>. For technical reasons the number of authors shown on this cover page is limited to 10 maximum.



BRILL

A review of Caribbean Copepoda associated with reef-dwelling cnidarians, echinoderms and sponges

Oksana A. Korzhavina

Department of Invertebrate Zoology, Biological Faculty, Lomonosov Moscow State University, Moscow, Russia

Bert W. Hoeksema

Taxonomy and Systematics Group, Naturalis Biodiversity Center, Leiden, The Netherlands
Groningen Institute for Evolutionary Life Sciences, University of Groningen, Groningen, The Netherlands

Viatcheslav N. Ivanenko

Department of Invertebrate Zoology, Biological Faculty, Lomonosov Moscow State University, Moscow, Russia

Taxonomy and Systematics Group, Naturalis Biodiversity Center, Leiden, The Netherlands
ivanenko.slava@gmail.com

Abstract

This review of copepod crustaceans associated with reef-dwelling cnidarians, sponges and echinoderms of the Greater Caribbean is based on published records, systematically arranged by the classification of symbiotic copepods and their hosts, sampling sites, coordinates, depth and date of sampling, literature sources, and three recent surveys (Cuba, St. Eustatius in the Eastern Caribbean and Curaçao in the Southern Caribbean). This resulted in totals of 532 records of 115 species of symbiotic copepods (47 genera, 17 families, three orders) hosted by 80 species of invertebrates, representing scleractinians (47%), octocorals (9%), echinoderms (3%), and sponges (1%). Among ten Caribbean ecoregions, the Greater Antilles (with 64 species of symbiotic copepods) as well as the Southern and Eastern Caribbean (with 46 and 17 species of copepods, respectively) are the most studied and best represented, whereas only six species of copepods are known from Bermuda, one from Southwestern Caribbean and none from the Gulf of Mexico. The absence of poecilostomatoid copepods (Anchimolgidae, Rhynchomolgidae and Xarifidae) on Caribbean stony corals as noted by Stock (1988) is confirmed. The results indicate that the diversity and ecology of Caribbean symbiotic copepods are still poorly investigated.

Keywords

Crustacea – Cnidaria – Echinodermata – Porifera – reefs, diversity – symbiosis – parasitism

Introduction

Symbiotic copepods are a widespread, numerous and diverse group of crustaceans living in association (parasitism, commensalism, mutualism) with other marine animals (Gotto, 1979, 1993; Humes, 1985a, 1994; Ho, 2001). At least one third of all known copepods are symbionts of marine fish and invertebrates. Symbiotic copepods are the most diverse in the tropics, and only a small number of their potential marine invertebrate hosts has been explored so far (1.14% according to Humes, 1994). A high degree of endemism as well as a remarkable difference in taxonomic composition of copepods living in a poorly studied symbiosis with Caribbean stony corals is noticed in comparison with the Indo-Pacific (Stock, 1988). The paucity of knowledge of symbiotic copepods of the Greater Caribbean region has repeatedly been noted (Stock, 1973, 1975a, 1987, 1988; Humes & Hendler, 1972; Herriott & Immermann, 1979; Grygier, 1980; Ivanenko et al., 2017).

The first study of symbiotic copepods living on cnidarians, echinoderms and sponges of the Greater Caribbean was conducted by Edwards (1891), who discovered *Diogenidium nasutum* (fig. 1c), living on the sea cucumber *Holothuria scabra*, in the Bahamas (species authorities in tables 1–2). Taxonomic studies of the Caribbean symbiotic copepods were continued by a number of researchers, who described large numbers of new species, as reviewed by Gotto (1993). A number of copepods representing two families (the ectosymbiotic Asterocheridae and the endoparasitic Corallovexiidae) have been found living on and in stony corals (Hoeksema et al., 2017b). Very few are reports have been published about the Asterocheridae living and usually

abundant on sponges (Stock & Kleeton, 1964; Stock, 1967; Boxshall & Huys, 1994; Kim, 2010; Varela et al., 2005b, 2007a, b, 2008; Varela, 2010a, b, 2012). Twelve families of copepods have been reported on diverse Caribbean echinoderms (Edwards, 1891; Emson & Mladenov, 1987; Emson et al., 1985; Hendler & Kim, 2010; Humes & Hendler, 1972, 1999; Humes & Ho, 1970, 1971; Humes & Stock, 1973; Humes, 1969a, 1998, 2000; Kim, 2009, 2010; Stock & Gooding, 1986; Stock & Humes, 1995; Stock et al., 1962, 1963a, b; Stock, 1968; Varela et al., 2003, 2005b, 2008; Varela, 2010a, 2011a). Most of these studies on Caribbean invertebrate-associated copepods are from the last century and only 19 of them have been published since 2000 (Humes, 2000; Varela et al., 2003, 2005a, b, 2007a, b, 2008; Varela & Lalana, 2007; Kim, 2009, 2010; Hendler & Kim, 2010; Varela, 2010a, b, 2011a, b, 2012; Ivanenko et al., 2017; Shelyakin et al., 2018; Garcia-Hernandez et al., 2019).

Caribbean reef corals are under threat from climate change and local impacts (Carpenter et al., 2008; Hughes et al., 2017) and some symbiotic (including parasitic) copepods potentially may have an impact on the state of corals and other invertebrate hosts (Stock, 1975a; Butter, 1979; Herriott & Immermann, 1979; Burke & Maidens, 2004; Ivanenko et al., 2017; Shelyakin et al., 2018). Despite a long history of marine biodiversity research in the Caribbean, our knowledge of microscopic symbiotic copepods does not satisfy the needs for defining priorities in conservation and the development of management plans (Miloslavich et al., 2010; Zeppilli et al., 2015, 2018). The goal of our review is to analyze all published data on copepods living in symbiosis with the Caribbean reef-dwelling anthozoans, echinoderms and sponges as important structural

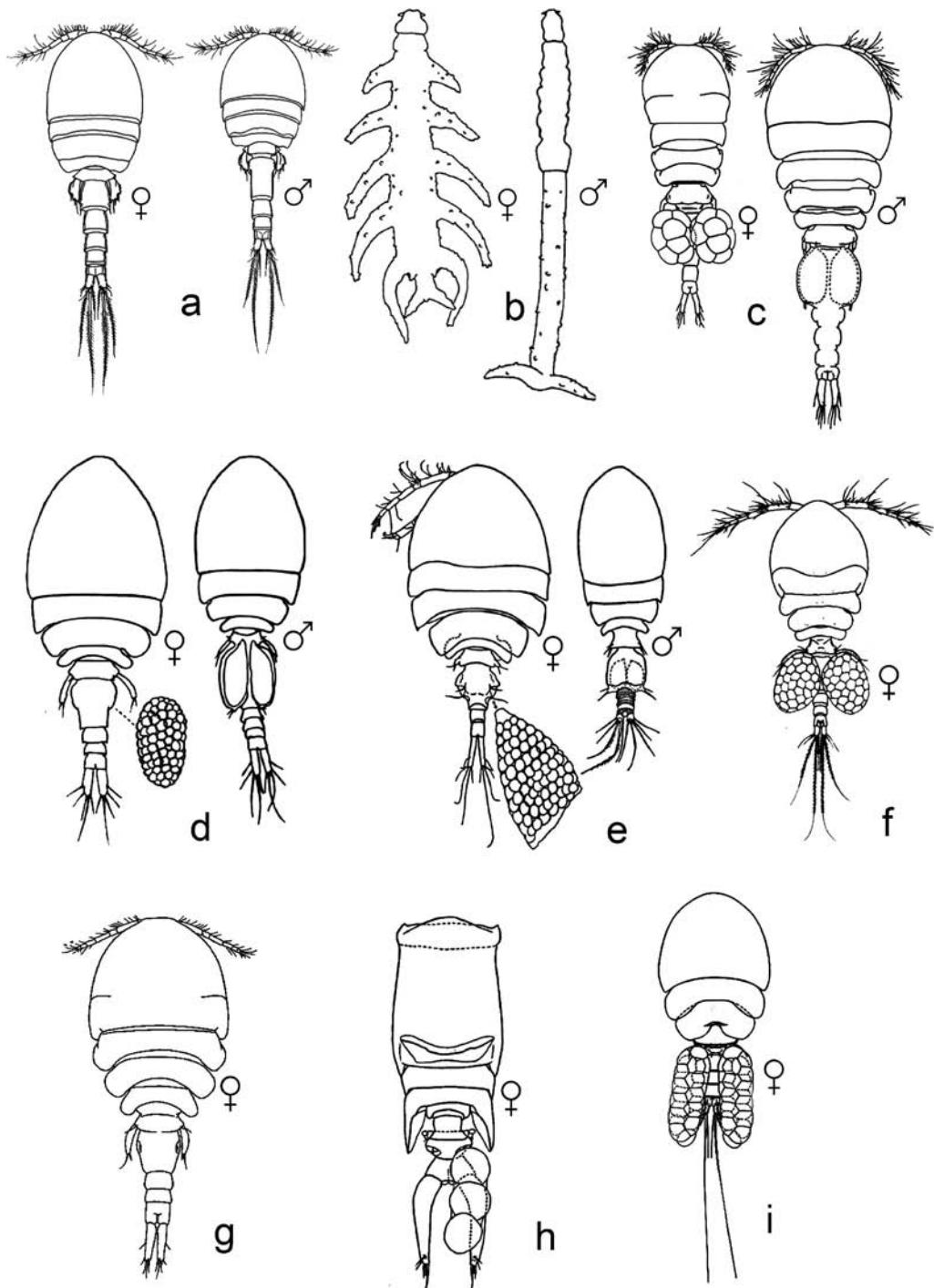


FIGURE 1 Poecilostomatoid Cyclopoida, dorsal view. a – *Hemicyclops columnaris* (Clausidiidae), b – *Corallovexia similis* (Corallohexidae), c – *Diogenidium nasutum* (Lichomolgidae), d – *Macrochiron echinicolum* (Macrochironidae), e – *Pseudanthessius deficiens* (Pseudanthessiidae), f – *Doridicola astrophyticus* (Rhynchomolgidae), g – *Eupolymniphilus occidentalis* Kim, 2009 (Sabelliphilidae), h – *Meomiccola amplexans*, i – *Presynaptiphilus amphiophi* (Synapticolidae). After Stock et al. (1963b), Humes & Ho (1969), Humes & Hendler (1972), Stock (1973, 1975a), Humes & Stock (1973), Kim (2009).

and functional components of Caribbean coral reefs in order to identify the least-studied ecoregions and groups of hosts as well as to identify directions for further research.

Characteristics of the Greater Caribbean

The Greater Caribbean (The Caribbean s.l.) in the present review consists of the Caribbean Sea plus the Gulf of Mexico and Bermuda (Spalding et al., 2007; Hoeksema et al., 2017a). The Caribbean Sea (Caribbean s.s.) is a large semi-enclosed sea of the western Atlantic Ocean with clear and warm water (22–29°C) and low tidal amplitude (0.4 m) (Kinder et al., 1985). The Caribbean is enclosed by the land masses of Central and South America (Brazil) from the west and south. It is separated by island arcs of the Great and Lesser Antilles in the north and east (Bayer, 1961; Spalding et al., 2004; Alvarado, 2011). The Caribbean is a unique biogeographic region with a number of endemic species (Rivera-Monroy et al., 2004; Alvarado, 2011). It is recognized as a global marine biodiversity hot spot and an important biogeographic coral reef province (Spalding et al., 2001; Roberts et al., 2002; Miloslavich et al., 2010; Alvarado, 2011). The Greater Caribbean includes ten marine ecoregions: Northern Gulf of Mexico, Southern Gulf of Mexico, Floridian, Western Caribbean, Greater Antillean, Southwestern Caribbean, Southern Caribbean, Eastern Caribbean, Bahamian, and Bermudian (Burke & Maidens, 2004; Spalding et al., 2007; Hoeksema et al., 2017a). The Bahamian and Bermudian are adjacent to the temperate northwestern Atlantic. The marine ecoregions of the Southern and Eastern Caribbean are affected by biota from adjacent Brazilian waters (Alvarado, 2011). The Gulf of Mexico has colder and more isolated water, which is relatively poor in species (Felder & Camp, 2009).

Material

The data are combined in the originally designed Database on Caribbean copepod crustaceans associated with reef-dwelling corals, echinoderms and sponges. This database includes five main tables: Hosts, Symbionts, Samples, Sites, and Publications linked with each other and two combined tables Literature Records and Sample Records; each record contains data on the taxonomy of the host and its symbiont, the references to unique records in the World of Copepods (Walter & Boxshall, 2019), the number of associates per host, the nature of the association, the name and coordinates of the collection site, the depth and the date of collection, as well as their reference (Korzhavina & Ivanenko, 2019). In addition, data on samples of symbiotic copepods and their hosts collected at St. Eustatius (in 2015, with 104 samples), Curaçao (in 2017, with 77 samples) and Cuba (in 2019, with 56 samples) preserved in 96% ethanol and including underwater photographs have been added to the table Sample Records.

Results and discussion

The database includes 532 records from 154 localities and 54 references published since 1891 (Edwards, 1891). There are 115 species of copepods (47 genera, 17 families, 3 orders) found in symbiosis with 80 invertebrate host species representing 58 genera, 39 families, 22 orders and 7 classes of corals, sponges and echinoderms (figs. 1–7, tables 1–7). Only one species of copepods, the poecilostomatoid cyclopoid *Hemicyclops columnaris* (syn *Hemicyclops geminatus*) was found in the area under consideration (Bahamas, Barbados, Curaçao, and Jamaica, associated with a burrowing ghost shrimp, a sponge, an ophiuroid, hermit crabs) and on the Pacific coast of Panama (on a stony

TABLE 1 Copepod crustaceans recorded as associated with Caribbean reef-dwelling anthozoans, echinoderms and sponges

Copepod	Host species: valid name (and as in original record)	Host abbreviation*	Site abbreviation**	Reference
Copepoda				
Calanoida				
Pseudocyclopidae				
<i>Ridgegervaya fosshageni</i> Humes & Smith, 1974	<i>Bartholomea annulata</i> (Le Sueur, 1817)	Act	Pan	Humes & Smith, 1974
Cyclopoida				
Clausiidae				
<i>Hemicyclops columnaris</i> Humes, 1984	<i>Ophiocoma wendtii</i> Müller & Troschel, 1842 (as <i>Ophiocoma riisei</i> Lütken, 1856)	Op	Bah	Kim, 2009
<i>Hemicyclops columnaris</i> Humes, 1984		Po	Bah	Kim, 2009
Corallioxestidae				
<i>Corallonoxia baki</i> Stock, 1975	<i>Dendrogyra cylindrus</i> Ehrenberg, 1834	Sc	Cur	Stock, 1975a
<i>Corallonoxia baki</i> Stock, 1975	<i>Eusmilia fastigiata</i> (Pallas, 1766)	Sc	Cur	Stock, 1975a
<i>Corallonoxia longicauda</i> Stock, 1975	<i>Dendrogyra cylindrus</i> Ehrenberg, 1834	Sc	Cur	Stock, 1975a
<i>Corallonoxia longicauda</i> Stock, 1975	<i>Meandrina meandrites</i> (Linnaeus, 1758)	Sc	Cur	Stock, 1975a; But- ter, 1979
<i>Corallonoxia</i> sp.				Stock, 1975a
	<i>Dichocoenia stokesi</i> Milne Edwards & Haime, 1848	Sc	Cur	
	<i>Pseudodiploria strigosa</i> (Dana, 1846) (as <i>Diploria</i> <i>strigosa</i> (Dana, 1846))	Sc	VI	Herriott & Immer- mann, 1979
	<i>Diploria labyrinthiformis</i> (Linnaeus, 1758)	Sc	Cur	Stock, 1975a
	<i>Montastraea cavernosa</i> (Linnaeus, 1767) (as <i>Montastraea brasiliensis</i> (Verrill, 1901))	Sc	Cur	Stock, 1975a
	<i>Montastraea cavernosa</i> (Linnaeus, 1767)	Sc	Cur	Stock, 1975a
Corallioxestidae				
<i>Corallonexia brevibrachium</i> Stock, 1975				
<i>Corallonexia brevibrachium</i> Stock, 1975				
<i>Corallonexia dorsospinosa minor</i> Stock, 1975				
<i>Corallonexia dorsospinosa</i> Stock, 1975				

TABLE 1 Copepod crustaceans recorded as associated with Caribbean reef-dwelling anthozoans, echinoderms and sponges (cont.)

Copepod	Host species: valid name (and as in original record)	Host abbreviation*	Site abbreviation**	Reference
<i>Corallloexia kristensis</i> Stock, 1975	<i>Colpophyllia natans</i> (Houttuyn, 1772) (as <i>Colpophyllia natans</i> (Müller))	Sc	Cur	Stock, 1975a
<i>Corallloexia longibrachium</i> Stock, 1975	<i>Pseudodiploria strigosa</i> (Dana, 1846)	Sc	Cur	Stock, 1975a
<i>Corallloexia longibrachium</i> Stock, 1975	<i>Colpophyllia natans</i> (Houttuyn, 1772)	Sc	Cur	Stock, 1975a
<i>Corallloexia longibrachium</i> Stock, 1975	<i>Manicina areolata</i> (Linnaeus, 1758) (as <i>Manicina</i> <i>areolata</i> f. <i>meyeri</i> Wells, 1936)	Sc	Cur	Stock, 1975a
<i>Corallloexia mediotbrachium</i> Stock, 1975	<i>Colpophyllia natans</i> (Houttuyn, 1772)	Sc	VI	Herriott & Immer- mann, 1979
<i>Corallloexia mediotbrachium</i> Stock, 1975	<i>Manicina areolata</i> (Linnaeus, 1758)	Sc	Cur	Stock, 1975a
<i>Corallloexia mediotbrachium</i> Stock, 1975	<i>Pseudodiploria clivosa</i> (Ellis & Solander, 1786) (as <i>Diploria clivosa</i> (Ellis & Solander, 1786))	Sc	Cur, VI	Stock, 1975a; Herri- ott & Immermann, 1979
<i>Corallloexia mediotbrachium</i> Stock, 1975	<i>Pseudodiploria strigosa</i> (Dana, 1846) (as <i>Diploria</i> <i>strigosa</i> (Dana, 1846))	Sc	Cur, VI	Stock, 1975a; Herri- ott & Immermann, 1979
<i>Corallloexia mixtibrachium</i> Stock, 1975	<i>Colpophyllia natans</i> (Houttuyn, 1772)	Sc	Cur, VI	Stock, 1975a; Herri- ott & Immermann, 1979
<i>Corallloexia similis</i> Stock, 1975	<i>Acropora palmata</i> (Lamarck, 1816)	Sc	Cur, VI	Stock, 1975a; Herri- ott & Immermann, 1979
<i>Corallloexia similis</i> Stock, 1975	<i>Pseudodiploria strigosa</i> (Dana, 1846)	Sc	VI	Herriott & Immer- mann, 1979
<i>Corallloexia sp.</i>	<i>Acropora palmata</i> (Lamarck, 1816)	Sc	VI	Herriott & Immer- mann, 1979
<i>Corallloexia sp.</i>	<i>Meandrina meandrites</i> (Linnaeus, 1758)	Sc	VI	Herriott & Immer- mann, 1979

<i>Coralllorenzia</i> sp.	<i>Montastraea cavernosa</i> (Linnaeus, 1767)	Sc	VI	Herriott & Immermann, 1979
<i>Coralllorenzia</i> sp.	<i>Mycetophyllia lamarkiana</i> Milne Edwards & Haime, 1849	Sc	VI	Herriott & Immermann, 1979
<i>Coralllorenzia</i> sp.	<i>Orbicella annularis</i> (Ellis & Solander, 1786) (as <i>Montastraea annularis</i> (Ellis & Solander, 1786))	Sc	Cur	Stock, 1975a
<i>Coralllorenzia</i> sp.	<i>Pseudodiploria strigosa</i> (Dana, 1846)	Sc	VI	Herriott & Immermann, 1979
<i>Coralllorenzia ventrospinosa</i> Stock, 1975	<i>Montastraea cavernosa</i> (Linnaeus, 1767)	Sc	Cur	Stock, 1975a
Lamippidae				
<i>Enalcyonium</i> sp.	<i>Plexaura nutans</i> (Duchassaing & Michelotti, 1860)	Oc	Cub	Varela et al., 2005b
<i>Enalcyonium euniciae</i> Stock, 1973	<i>Eunicea mammosa</i> Lamouroux, 1816	Oc	PR	Stock, 1973
<i>Enalcyonium nudum</i> Stock, 1973	<i>Plexaura homomalla</i> (Esper, 1794) (as <i>Plexaura homomalla</i> Esper, 1794)	Oc	PR	Stock, 1973
<i>Enalcyonium ramosum</i> Stock, 1973	<i>Plexaura homomalla</i> (Esper, 1794)	Oc	PR	Stock, 1973
<i>Enalcyonium varicauda</i> Stock, 1973	<i>Briareum asbestinum</i> (Pallas, 1766)	Oc	PR	Stock, 1973
<i>Lamippina aequalis</i> Stock, 1973	<i>Antillorgia Bayer, 1951</i> (as <i>Pseudopterorgia</i> Kükenthal, 1919)	Oc	Cur	Stock, 1973
<i>Lamippina aequalis</i> Stock, 1973	<i>Antillorgia acerosa</i> (Pallas, 1766) (as <i>Pseudopterorgia acerosa</i> (Pallas, 1766))	Oc	Cur	Stock, 1973
<i>Linaresia boutiquandi</i> Stock, 1979	<i>Placogorgia</i> sp.	Oc	Flo	Stock, 1979
<i>Magnipipe caputmedusae</i> Stock, 1978	<i>Thesea</i> sp.	Oc	Flo	Stock, 1978
<i>Sphaerippe caliginosa</i> Grygier, 1980	<i>Callogorgia</i> sp.	Oc	Bah	Grygier, 1980
<i>Sphaerippe</i> sp.	<i>Gorgonia ventralina</i> Linnaeus, 1758	Oc	SE	Ivanenko et al., 2017
Lichomolgidae				
<i>Diogenella deichmannae</i> Humes & Ho, 1970	<i>Holothuria (Thymioscyta) arenicola</i> Semper, 1868	Hol	Bar	Humes & Ho, 1970
<i>Diogenella impar</i> Humes & Ho, 1970	<i>Holothuria (Thymioscyta) arenicola</i> Semper, 1868	Hol	Bar	Humes & Ho, 1970
	(as <i>Brandtothuria arenicola</i> (Semper))			

TABLE 1 Copepod crustaceans recorded as associated with Caribbean reef dwelling anthozoans, echinoderms and sponges (*cont.*)

Copepod	Host species: valid name (and as in original record)	Host abbreviation*	Site abbreviation**	Reference
<i>Diogenella seticauda</i> Stock, 1968	<i>Holothuria (Thymiosycia) arenicola</i> Semper, 1868	Hol	MI	Humes & Ho, 1970
<i>Diogenella seticauda</i> Stock, 1968	<i>Holothuria (Thymiosycia) impatiens</i> (Forsskål, 1775) (as <i>Holothuria impatiens</i> (Forsskål, 1775))	Hol	PR	Stock, 1968; Humes
<i>Diogenella seticauda</i> Stock, 1968	<i>Holothuria (Semperothuria) surinamensis</i> Ludwig, 1875 (as <i>Halodeima surinamensis</i> (Ludwig))	Hol	MI, PR	Stock, 1968; Humes & Ho, 1970
<i>Diogenella spinicauda</i> Stock, 1968	<i>Holothuria (Halodeima) mexicana</i> Ludwig, 1875 (as <i>Ludwigothuria mexicana</i> (Ludwig))	Hol	Bah, Cur, Jam, MI, PR	Stock, 1968; Humes & Ho, 1970
<i>Diogenidium deforme</i> Stock, 1968	<i>Holothuria (Selenkothuria) glaberrima</i> Selenka, 1867	Hol	PR	Stock, 1968
<i>Diogenidium deforme</i> Stock, 1968	<i>Holothuria (Halodeima) mexicana</i> Ludwig, 1875	Hol	Bah, PR	Hendler & Kim, 2010
<i>Diogenidium deforme</i> Stock, 1968	<i>Holothuria (Thymiosycia) arenicola</i> Semper, 1868	Hol	Bar	Hendler & Kim, 2010
<i>Diogenidium nasutum</i> Edwards, 1891	<i>Actinopyga agassizii</i> (Selenka, 1867) (as <i>Mueleria agassizii</i> Selenka, 1867)	Hol	Bah	Hendler & Kim, 2010
<i>Diogenidium nasutum</i> Edwards, 1891	<i>Holothuria (Halodeima) grisea</i> Selenka, 1867	Hol	Jam	Hendler & Kim, 2010
<i>Diogenidium nasutum</i> Edwards, 1891	<i>Holothuria (Halodeima) mexicana</i> Ludwig, 1875	Hol	Cur, Jam, MI, PR	Stock, 1968; Hendler & Kim, 2010
<i>Diogenidium nasutum</i> Edwards, 1891	<i>Holothuria (Metridiyla) scabra</i> Jaeger, 1833	Hol	Bah	Edwards, 1891
<i>Diogenidium spinulosum</i> Stock, 1968	<i>Isostichopus badionotus</i> (Selenka, 1867)	Hol	Jam, PR	Stock, 1968; Hendler & Kim, 2010
<i>Diogenidium tectum</i> Humes & Ho, 1971	<i>Actinopyga agassizii</i> (Selenka, 1867)	Hol	Bah, Jam	Hendler & Kim, 2010
<i>Macrochironidae</i>				
<i>Macrochiron echinicolum</i> Humes & Stock, 1973	<i>Echinometra viridis</i> A. Agassiz, 1863	Ec	Cur	Humes & Stock, 1973

<i>Macrochiron echinicolum</i> Humes & Stock, 1973	<i>Lytechinus variegatus</i> (Lamarck, 1816)	Ec	Bah, Bar, Bon, Cur, Jam, MI, PR	Humes & Stock, 1973
<i>Macrochiron sargassi</i> Sars, 1916	<i>Renilla reniformis</i> (Pallas, 1766)	Oc	SM	Humes & Stock, 1973
Pseudanthessiidae				
<i>Pseudanthessius acutus</i> Kim, 2009	Porifera	Po	Jam	Kim, 2009
<i>Pseudanthessius deficiens</i> Stock, Humes & Gooding, 1963	<i>Holothuria (Halodeima) mexicana</i> Ludwig, 1875	Hol	Cur	Stock et al., 1963b
<i>Pseudanthessius deficiens</i> Stock, Humes & Gooding, 1963	<i>Ophioderma brevispina</i> (Say, 1825) (as <i>Ophioderma brevispinum</i> (Say, 1825))	Op	Bel	Humes & Hendler, 1999
<i>Pseudanthessius deficiens</i> Stock, Humes & Gooding, 1963	<i>Ophioderma cinerea</i> Müller & Troschel, 1842 (as <i>Ophioderma cinereum</i> Müller & Troschel, 1842)	Op	Bel, Cur, MI, SM	Stock et al., 1963b; Humes & Hendler, 1999
<i>Pseudanthessius exilicornis</i> Stock & Humes, 1995	<i>Meoma ventricosa</i> (Lamarck, 1816)	Ec	Cur	Stock & Humes, 1995
<i>Pseudanthessius pectinifer</i> Stock, Humes & Gooding, 1964	<i>Cypraeaster rosaceus</i> (Linnaeus, 1758)	Ec	Bah, Jam, MI	Stock et al., 1963b
Rhynchomolgidae				
<i>Acanthomolgus aquisetata</i> Stock, 1975	<i>Muricea laxa</i> Verill, 1864	Oc	Cur	Stock, 1975c
<i>Acanthomolgus affinis</i> Stock, 1975	<i>Eunicea flexuosa</i> (Lamouroux, 1821)	Oc	Cur	Stock, 1975c
<i>Acanthomolgus affinis</i> Stock, 1975	<i>Plexaura</i> sp.	Oc	Cub	Varela, 2011a
<i>Acanthomolgus affinis</i> Stock, 1975	<i>Plexaura homomalla</i> (Esper, 1794)	Oc	Cur	Stock, 1975c
<i>Acanthomolgus bayeri</i> Humes, 1973	<i>Gorgia ventalina</i> Linnaeus, 1758	Oc	Ber	Humes, 1973
<i>Acanthomolgus bayeri</i> Humes, 1973	<i>Pseudoplexaura</i> sp.	Oc	Cub	Varela et al., 2003
<i>Acanthomolgus blobipes</i> Humes & Stock, 1973	<i>Pseudoplexaura porosa</i> (Houttuyn, 1772)	Oc	Ber	Humes, 1973
<i>Acanthomolgus blobipes</i> Humes & Stock, 1973	<i>Antillogorgia acerosa</i> (Pallas, 1766)	Oc	Bar, Cur, Jam	Humes & Stock, 1973; Stock, 1975c
<i>Acanthomolgus blobipes</i> Humes & Stock, 1973	<i>Antillogorgia elastica</i> Bieschowsky	Oc	PR	Humes & Stock, 1973

TABLE 1 Copepod crustaceans recorded as associated with Caribbean reef dwelling anthozoans, echinoderms and sponges (*cont.*)

Copepod	Host species: valid name (and as in original record)	Host abbreviation*	Site abbreviation**	Reference
<i>Acanthomolgus dionyx</i> Stock, 1975	<i>Antillogorgia americana</i> (Gmelin, 1791) (as <i>Pseudopterogorgia americana</i> (Gmelin, 1791))	Oc	Cur	Stock, 1975c
<i>Acanthomolgus gorgoniae</i> Humes, 1973	<i>Gorgia ventinalia</i> Linnaeus, 1758	Oc	Ber, Cur, SE	Humes, 1973;
<i>Acanthomolgus intermedius</i> Stock, 1975				Stock, 1975c
<i>Acanthomolgus intermedius</i> Stock, 1975	<i>Eunicea laciniata</i> Duchassaing & Michelotti, 1860	Oc	Cur	Varela et al., 2003
<i>Acanthomolgus longidactylus</i> Stock, 1975	<i>Muricea</i> sp.	Oc	Cub	Stock, 1975c
<i>Acanthomolgus longifurca</i> Stock, 1975	<i>Eunicea flexuosa</i> (Lamouroux, 1821)	Oc	Cur	Stock, 1975c
<i>Acanthomolgus mononyx</i> Stock, 1975	<i>Eunicea tourneforti</i> Milne Edwards & Haime, 1857	Oc	Cur	Stock, 1975c
<i>Acanthomolgus muriceanus</i> Humes, 1973	<i>Eunicea clavigera</i> Bayer, 1961	Oc	Cur	Stock, 1975c
	<i>Muricea atlantica</i> (Kükenthal, 1911)	Oc	Ber	Humes, 1973;
				Stock, 1975c
<i>Acanthomolgus seticornis</i> Stock, 1975	<i>Plexaurella dichotoma</i> (Esper, 1791)	Oc	SM	Stock, 1975c
<i>Acanthomolgus triangulipes</i> Stock, 1975	<i>Gorgia ventinalia</i> Linnaeus, 1758	Oc	Cur, SE, SM	Stock, 1975c
<i>Acanthomolgus triangulipes</i> Stock, 1975	<i>Gorgia mariae</i> Bayer, 1961	Oc	Cub	Varela et al., 2008
<i>Acanthomolgus verrucipes</i> Humes, 1973	<i>Eunicea cylindrica</i> (Ellis & Solander, 1786)	Oc	Ber	Humes, 1973
<i>Aspidomolgus stochactinus</i> Humes, 1969	<i>Corynactis denticulosa</i> (Le Sueur, 1817) (as <i>Homostichanthus denticulatus</i> (Le Sueur, 1817))	Act	Barad, PR, SM	Stock, 1975b
<i>Aspidomolgus stochactinus</i> Humes, 1969	<i>Stichodactyla helianthus</i> (Ellis, 1768) (as <i>Stoichactis helianthus</i> (Ellis, 1768))	Act	Bah, Bar, Bon, Cub, Cur, FK, Jam, MI, PR	Humes, 1969a; Stock, 1975b; Ortiz et al., 1998
<i>Calonastes imparipes</i> Humes & Goenaga, 1978	<i>Stichopathes</i> sp.	Anti	PR	Humes & Goenaga, 1978
<i>Calonastes imparipes</i> Humes & Goenaga, 1978				Humes & Goenaga, 1978
<i>Critomolgus</i> Humes & Stock, 1983	<i>Astrophyton muricatum</i> (Lamarck, 1816)	Op	PR	Varela et al., 2008

<i>Critonolagus astrophyticus</i> (Humes & Stock, 1973) (as <i>Doridicola astrophyticus</i> Humes & Stock, 1973)	<i>Astrophyton muricatum</i> (Lamarck, 1816)	Op	Bar, Jam, MI, PR	Humes & Stock, 1973
<i>Critonolagus titillans</i> (Humes, 1982) (as <i>Doridicola titillans</i> Humes, 1982)	<i>Condylactis gigantea</i> (Weinland, 1860)	Act	PR	Humes, 1982
<i>Paranolagus antillianus</i> Stock, 1975	<i>Ricordea florida</i> Duchassaing & Michelotti, 1860	Cor	PR	Stock, 1975c
Sabelliphilidae				
<i>Eupolymniphilus occidentalis</i> Kim, 2009	Porifera	Po	Jam	Kim, 2009
Synapticolidae				
<i>Caribulus</i> sp	<i>Actinopyga agassizii</i> (Selenka, 1867)	Hol	Bah, Cur, Jam	Humes, 1969b
<i>Caribulus</i> sp	<i>Isostichopus badionotus</i> (Selenka, 1867)	Hol	Bar, Jam	Humes, 1969b
<i>Caribulus sculptus</i> (Humes, 1969) (as <i>Scambicornus sculptus</i> Humes, 1969)	<i>Actinopyga agassizii</i> (Selenka, 1867)	Hol	Bah, Bon, Cur, Jam	Humes, 1969b
<i>Caribulus sculptus</i> (Humes, 1969)	<i>Isostichopus badionotus</i> (Selenka, 1867)	Hol	Bah, Bar, Jam, MI, PR	Humes, 1969b
<i>Caribulus sculptus</i> (Humes, 1969)	<i>Holothuria mexicana</i> Ludwig, 1875	Hol	Bah, Bon, Cub, Cur, Jam	Humes 1969b; Varela et al., 2003
<i>Meonicola amplexans</i> Stock, Humes & Gooding, 1963	<i>Meoma ventricosa</i> (Lamarck, 1816)	Ec	Cur, Jam	Stock et al., 1963b
Synaptiphilidae				
<i>Presynaptiphilus amphiploii</i> Humes & Hendler, 1972	<i>Amphioplus</i> sp.	Op	FK	Humes & Hendler, 1972
Thaumatopsyllidae				
<i>Caribeopsyllus chavayi</i> Suárez-Morales in Suárez-Morales & Castellanos, 1998	<i>Ophiothrix angulata</i> (Say, 1825)	Op	Bel	Hendler & Kim, 2010
<i>Caribeopsyllus chavayi</i> Suárez-Morales in Suárez-Morales & Castellanos, 1998	<i>Ophiothrix oerstedi</i> Lütken, 1856	Op	Bel	Hendler & Kim, 2010
<i>Caribeopsyllus</i> sp.A	Ophiuroidea	Op	SE	Ivanenko, unpublished

TABLE 1 Copepod crustaceans recorded as associated with Caribbean reef dwelling anthozoans, echinoderms and sponges (*cont.*)

Copepod	Host species: valid name (and as in original record)	Host abbreviation*	Site abbreviation**	Reference
<i>Caribeopsyllus</i> sp.A	<i>Ophiothrix angulata</i> (Say, 1825)	Op	Bel	Hendler & Kim, 2010
Siphonostomatida				
Asterocheridae				
<i>Asterocheres</i> sp.				
<i>Asterocheres antillensis</i> Varela, 2010	<i>Calyspongia vaginalis</i> (Lamarck, 1814) <i>Calyspongia</i> sp.	Po	Cub	Varela et al., 2005b
<i>Asterocheres bahamensis</i> Kim, 2010	Porifera	Po	Cub	Varela, 2010
<i>Asterocheres crinidicola</i> Humes, 2000	Crinoidea	Cr	Bah	Kim, 2010
<i>Asterocheres crinidicola</i> Humes, 2000	<i>Davidiaster rubiginosus</i> (Pourtales, 1869)	Cr	Jam	Kim, 2010
			Bel, Cub	Humes, 2000;
				Varela, 2010
<i>Asterocheres crinidicola</i> Humes, 2000	<i>Nemaster grandis</i> AH Clark, 1909	Cr	Bel	Varela, 2010
<i>Asterocheres cubensis</i> Varela, 2010	<i>Agelas dilatata</i> Duchassaing & Michelotti, 1864	Po	Cub	Humes, 2000
<i>Asterocheres espinosai</i> Varela, Ortiz & Lalana, 2007	<i>Calyspongia vaginalis</i> (Lamarck, 1814)	Po	Cub	Varela et al., 2007a
<i>Asterocheres fernandezmilleri</i> Varela, 2010	<i>Agelas wiedenmayeri</i> Alcolado, 1984	Po	Cub	Varela, 2010b
<i>Asterocheres garridoi</i> Varela, Ortiz & Lalana, 2007	<i>Ptilocaulis walpersii</i> (Duchassaing & Michelotti, 1864)	Po	Cub	Varela et al., 2007
<i>Asterocheres kimi</i> Varela, 2012	<i>Niphates digitalis</i> (Lamarck, 1814)	Po	Cub	Varela, 2012
<i>Asterocheres lalanae</i> Varela, 2013	<i>Niphates digitalis</i> (Lamarck, 1814)	Po	Cub	Varela, 2012
<i>Asterocheres maxillatus</i> Stock, 1987	<i>Manicina areolata</i> (Linnaeus, 1758)	Sc	Cur	Stock, 1987
<i>Asterocheres maxillatus</i> Stock, 1987	<i>Orbicella annularis</i> (Ellis & Solander, 1786)	Sc	Cur	Stock, 1987, 1989
<i>Asterocheres oricurus</i> Kim, 2010	Porifera	Po	Jam	Kim, 2010
<i>Asterocheres penicillatus</i> Kim, 2010	Porifera	Po	Bah	Kim, 2010
<i>Asterocheres plumosus</i> Kim, 2010	Porifera	Po	Bah	Kim, 2010
<i>Asterocheres reginae</i> Boxshall & Huys, 1994	<i>Agelas</i> sp.	Po	Cub	Varela et al., 2008
<i>Asterocheres reginae</i> Boxshall & Huys, 1994	<i>Agelas clathrodes</i> (Schmidt, 1870)	Po	Bel	Boxshall & Huys, 1994

<i>Asterocheres simulans</i> (T. Scott, 1898) (<i>as Ascomyzon simulans</i> T. Scott, 1898)	<i>Lytechinus variegatus</i> (Lamarck, 1816)	Ec	Cur	Stock & Humes, 1995
<i>Asterocheres trisetatus</i> Kim, 2010	Porifera	Po	Bah	Kim, 2010
<i>Asterocheres unioviger</i> Kim, 2010	<i>Eucidaris tribuloides</i> (Lamarck, 1816)	Ec	Bah, PR	Kim, 2010
<i>Asterocheres unioviger</i> Kim, 2010	Echinoidea	Ec	Jam	Kim, 2010
<i>Asteropontella foliata</i> Stock, 1989	<i>Orbicella annularis</i> (Ellis & Solander, 1786)	Sc	Cur	Stock, 1989
<i>Asteropontius capillatus</i> Kim, 2010	<i>Meandrina</i> sp.	Sc	Bar	Kim, 2010
<i>Asteropontius iuxtus</i> Stock, 1989	<i>Meandrina meandrites</i> (Linnaeus, 1758)	Sc	Cur	Stock, 1989
<i>Asteropontius longipalpus</i> Stock, 1975	<i>Ricordea florida</i> Duchassaing & Michelotti, 1860	Cor	PR	Stock, 1975b
<i>Asteropontius mycetophyllae</i> Varela, Ortiz & Lalana, 2005	<i>Mycetophyllia lamarkiana</i> Milne Edwards & Haime, 1849	Sc	Cub	Varela et al., 2005
<i>Asteropontius parvipalpus</i> Stock, 1975	<i>Condylactis gigantea</i> (Weinland, 1860)	Act	Bah, Cur, Jam, MI, PR	Stock, 1975b; Humes, 1982
<i>Asteropontius proximus</i> Stock, 1987	<i>Colpophyllia natans</i> (Müller)	Sc	Cur	Stock, 1987
<i>Asteropontius ungellatus</i> Stock, 1975	<i>Phymanthus crucifer</i> (Le Sueur, 1817)	Act	MI	Stock, 1975b
<i>Asteropontius ungellatus</i> Stock, 1975	<i>Stichodactyla helianthus</i> (Ellis, 1768)	Act	Jam, PR 2010	Stock, 1975b; Kim, 2010
<i>Asteropontopsis faviae</i> Stock, 1987	<i>Favia fragum</i> (Esper, 1795)	Sc	Cur	Stock, 1987
<i>Chelacheres longipalpus</i> Stock & Humes, 1995	<i>Echinometra lucunter</i> (Linnaeus, 1758)	Ec	Bah, Cub, Cur, Jam, PR, SM	Stock & Humes, 1995; Varela, 2014
<i>Chelacheres longipalpus</i> Stock & Humes, 1995	<i>Tripneustes ventricosus</i> (Lamarck, 1816)	Ec	Cur	Stock & Humes, 1995
<i>Chelacheres optans</i> Stock & Humes, 1995	<i>Echinometra lucunter</i> (Linnaeus, 1758)	Ec	PR	Stock & Humes, 1995
<i>Collocheres lunulifer</i> Humes, 1998	<i>Ophiothrix (Ophiothrix) angulata</i> (Say, 1825)	Op	Bar	Humes, 1998
<i>Collocheres lunulifer</i> Humes, 1998	<i>Ophiothrix (Acanthophiothrix) suensonii</i> Lütken, 1856	Op	Bar	Humes, 1998
<i>Hermacheres diploriae</i> Stock, 1987	<i>Pseudodiploria clivosa</i> (Ellis & Solander, 1786)	Sc	Cur	Stock, 1987
<i>Hermacheres montastreae</i> Stock, 1987	<i>Montastraea cavernosa</i> (Linnaeus, 1767)	Sc	Cur	Stock, 1989

TABLE 1 Copepod crustaceans recorded as associated with Caribbean reef dwelling anthozoans, echinoderms and sponges (*cont.*)

Copepod	Host species: valid name (and as in original record)	Host abbreviation*	Site abbreviation**	Reference
<i>Hetairosynella aculeata</i> Kim, 2010	Porifera	Po	Bah	Kim, 2010
<i>Hetairosynella angulata</i> Kim, 2010	Porifera	Po	Jam	Kim, 2010
<i>Hetairosynella bifurcata</i> Kim, 2010	Porifera	Po	Jam	Kim, 2010
<i>Kimchères fastigatus</i> (Kim, 2010) (as <i>Astrocheres fastigatus</i> Kim, 2010)	Porifera	Po	Bar	Kim, 2010
<i>Meandromyzon coronatum</i> Stock, 1989	<i>Meandrina meandrites</i> (Linnaeus, 1758)	Sc	Cur	Stock, 1989
<i>Neoastrocheres humesi</i> (Varela, 2012)	<i>Calyspongia vaginalis</i> (Lamarck, 1814)	Po	Cub	Varela, 2012
<i>Onychochères alatus</i> Stock & Gooding, 1986	<i>Diadema antillarum</i> Philippi, 1845	Ec	Cub, Cur	Stock & Gooding, 1986; Varela et al., 2005b
<i>Orecturus antillensis</i> Varela, 2011	<i>Eunicea mammosa</i> Lamouroux, 1816	Oc	Cub	Varela, 2011b
<i>Orecturus ortizi</i> Varela & Lalana, 2007	<i>Briareum asbestinum</i> (Pallas, 1766)	Oc	Cub	Varela & Lalana, 2007
<i>Ophiurocheres bellulus</i> Humes, 1998	<i>Ophionyxa flaccida</i> (Say, 1825)	Op	MI	Humes, 1998
<i>Peltomyzon rostratum</i> Stock, 1975	<i>Montastraea cavernosa</i> (Linnaeus, 1767)	Sc	Cur	Stock, 1975d
<i>Scottocheres elongatus</i> (Scott T. & Scott A., 1894)	<i>Lotrochota birotulata</i> (Higgin, 1877)	Po	Cub	Varela et al., 2008
<i>Setachères paraboecki</i> (Johnson, 1998)	<i>Calyspongia vaginalis</i> (Lamarck, 1814)	Po	Cub	Varela, 2012
<i>Stenomyzon edentatum</i> Kim, 2010	Porifera	Po	PR	Kim, 2010
<i>Cancerillidae</i>				
<i>Ophiopsyllus latus</i> Humes & Handler, 1999	<i>Ophiocomella ophiactoides</i> (Clark, 1900)	Op	Bel	Humes & Handler, 1999
<i>Ophiopsyllus latus</i> Humes & Handler, 1999	<i>Ophiocoma pumila</i> Lütken, 1856	Op	Bel, FK	Humes & Handler, 1999
<i>Ophiopsyllus latus</i> Humes & Handler, 1999	<i>Ophiocomella ophiactoides</i> (Clark, 1900)	Op	Bel	Humes & Handler, 1999

<i>Ophiopsyllus reductus</i> Stock, Humes & Gooding, 1963	<i>Ophiocoma echinata</i> (Lamark, 1816)	Op	Bel, Cur	Stock et al., 1963a; Humes & Hendler, 1999
<i>Ophiopsyllus reductus</i> Stock, Humes & Gooding, 1963	<i>Ophiocoma ophiactoides</i> (Clark, 1900)	Op	Bel, Ber, Jam	Emson et al., 1985; Emson & Mladenov, 1987
<i>Parophiopsyllus ligatus</i> Humes & Hendler, 1972	<i>Amphioplus</i> sp.	Op	FK	Humes & Hendler, 1972
Entomolepididae				
<i>Parmulodes verrucosa</i> Wilson C.B., 1944	<i>Chondrella mucula</i> Schmidt, 1862	Po	PR	Stock, 1992b
<i>Parmulella emarginata</i> Stock, 1992	<i>Chondrella mucula</i> Schmidt, 1862	Po	Cur	Stock, 1992b
<i>Parmulodes verrucosa</i> Wilson C.B., 1944 (as <i>Parmulodes verrucosus</i> Wilson C.B., 1944)	<i>Chondrella mucula</i> Schmidt, 1862	Po	Aru, Cub, Cur, PR	Stock, 1992b; Varela et al., 2008
Micropontiidae				
<i>Microponitus glaber</i> Stock, Humes & Gooding, 1963	<i>Meoma ventricosa</i> (Lamark, 1816)	Ec	Jam	Stock et al., 1963a
Nanaspidae				
<i>Nanaspis exigua</i> Stock, Humes & Gooding, 1962	<i>Isostichopus badionotus</i> (Selenka, 1867)	Hol	Jam	Stock et al., 1962
<i>Nanaspis media</i> Stock, Humes & Gooding, 1962	<i>Isostichopus badionotus</i> (Selenka, 1867)	Hol	MI, PR	Stock et al., 1962
<i>Nanaspis pollens</i> Stock, Humes & Gooding, 1962	<i>Holothuria (Thymioscygia) arenicola</i> Semper, 1868	Hol	Jam	Stock et al., 1962
<i>Nanaspis pollens</i> Stock, Humes & Gooding, 1962	<i>Holothuria (Semperothuria) surinamensis</i> Ludwig, 1875	Hol	MI	Stock et al., 1962
<i>Nanaspis pollens</i> Stock, Humes & Gooding, 1962	<i>Holothuria (Thymioscygia) arenicola</i> Semper, 1868 (as <i>Brandtithuria arenicola</i>) and <i>Holothuria</i> (<i>Semperothuria</i>) <i>surinamensis</i> Ludwig, 1875 (as <i>Semperothuria surinamensis</i>) (mixed)	Hol	PR	Stock et al., 1962
<i>Nanaspis pollens</i> Stock, Humes & Gooding, 1962	<i>Isostichopus badionotus</i> (Selenka, 1867)	Ec	Bah, Jam	Stock et al., 1962
<i>Nanaspis pollens</i> Stock, Humes & Gooding, 1962	<i>Meoma ventricosa</i> (Lamark, 1816)		Jam	Stock et al., 1962

TABLE 1 Copepod crustaceans recorded as associated with Caribbean reef dwelling anthozoans, echinoderms and sponges (*cont.*)

Copepod	Host species: valid name (and as in original record)	Host abbreviation*	Site abbreviation**	Reference
<i>Nanaspis truncata</i> Stock, Humes & Gooding, 1962	<i>Holothuria (Platyperona) parvula</i> (Selenka, 1867) <i>Holothuria (Thymioscytia) arenicola</i> Semper, 1868	Hol Hol	MI, PR MI	Stock et al., 1962 Stock et al., 1962
<i>Nanaspis truncata</i> Stock, Humes & Gooding, 1962				

* Host Abbreviations: Act – Actiniaria, Anti – Antipatharia, Cor – Corallimorpharia, Cr – Crinoidea, Ec – Echinoidea, Hol – Holothuroidea, Oc – Octocorallia, Op – Ophiuroidea, Po – Porifera, Sc – Scleractinia.

** Site Abbreviations: Aru – Aruba, Bah – Bahamas, Bar – Barbados, Barad – Baradal, Bel – Belize, Ber – Bermuda, Bon – Bonaire, Cub – Cuba, Cur – Curacao, Flo – Florida, Jam – Jamaica, MI – Magueyes Island, LK – Loggerhead Key, Pan – Panama, PR – Puerto Rico, SE – St. Eustatius, SM – St. Martin, VI – Virgin Islands.

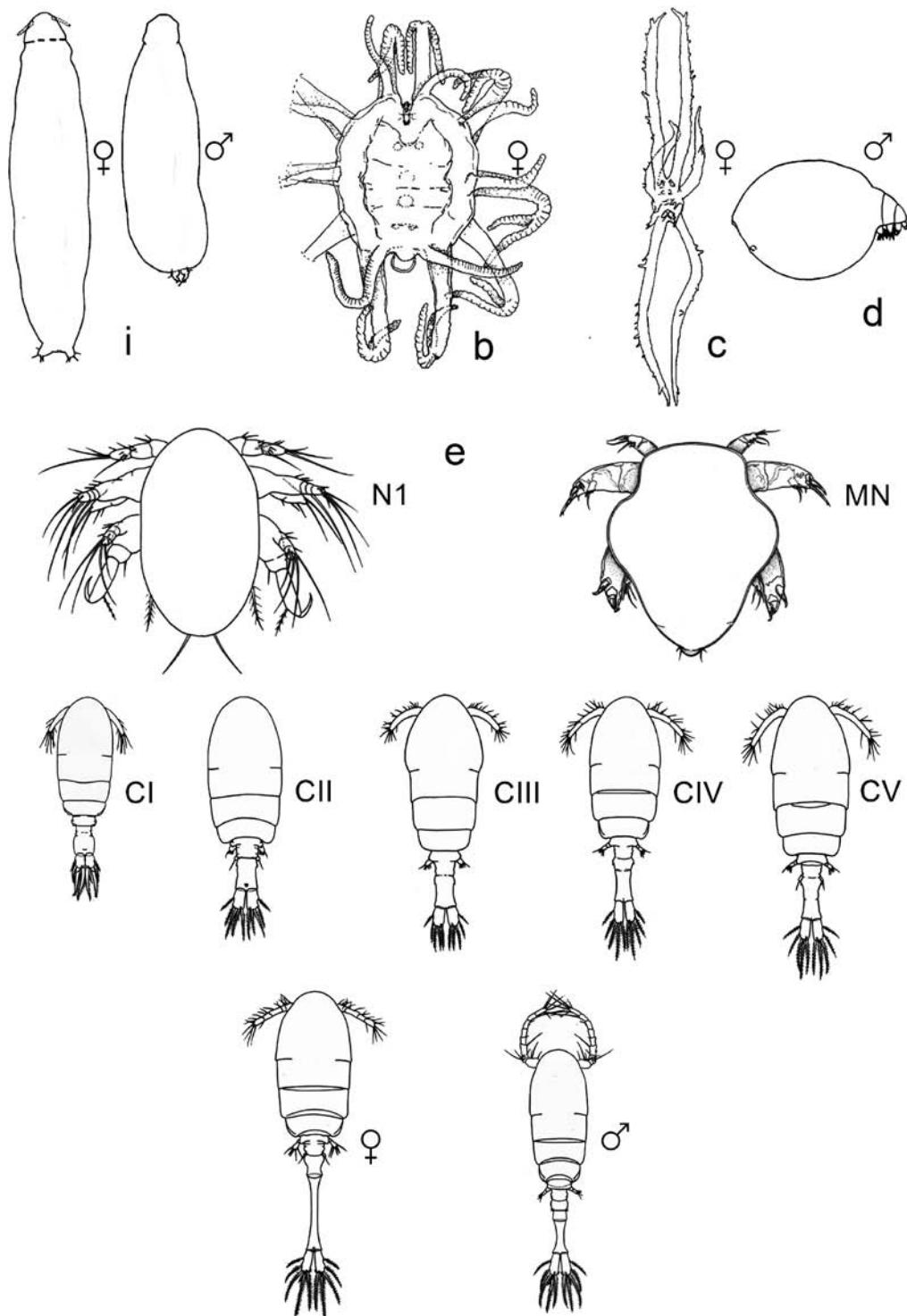


FIGURE 2 Cyclopoida. Lamippidae (a–d): a – *Enalcyonium nudum*, dorsal view; b – *Linaresia bouligandi*, dorsal view; c – *Magnippe caputmedusae*, ventral view; d – *Sphaerippe caligincola*, lateral view. Thaumatoxylidae (e): nauplius (N1), metanauplius (MN), copepodid stages 1–5 (CI–CV) of *Caribeopsyllus amphidiae*, dorsal view. After Stock (1973, 1978, 1979), Grygier (1980), Dojiri et al. (2008). Downloaded from https://academic.oup.com/cjz/article/1/2/313/5934544 by guest on 14 May 2021

via Universiteit of Groningen

TABLE 2 Caribbean reef-dwelling anthozoans, echinoderms and sponges as hosts of copepod crustaceans

Invertebrate Host (valid name and as indicated in the original record)	Copepod species name	Copepod family abbreviation*	Site abbreviation**	Reference
Cnidaria				
Anthozoa				
Hexacorallia				
Actiniaria				
<i>Condylactis gigantea</i> (Weinland, 1860)	<i>Asteropontius parvipalpus</i> Stock, 1975	Ast	Bah, Cur, Jam, MI, PR	Stock, 1975b; Humes, 1982
<i>Condylactis gigantea</i> (Weinland, 1860)	<i>Criatomolgus titillans</i> (Humes, 1982) (as <i>Doridicola titillans</i> Humes, 1982)	Rhy	PR	Humes, 1982
<i>Corynactis denticulosa</i> (Le Sueur, 1817) (as <i>Homostichanthus denticulosa</i> (Le Sueur, 1817))	<i>Aspidomolgus stoichactinus</i> Humes, 1969	Rhy	Barad, PR, SM	Stock, 1975b
<i>Phymanthus crucifer</i> (Le Sueur, 1817)	<i>Asteropontius ungellatus</i> Stock, 1975	Ast	MI	Stock, 1975b
<i>Stichodactyla helianthus</i> (Ellis, 1768) (as <i>Stoichactis anemone</i> (Ellis, 1768) and <i>Stoichactis helianthus</i> (Ellis, 1768))	<i>Aspidomolgus stoichactinus</i> Humes, 1969	Rhy	Bah, Bar, Bon, Cub, Cur, FK, Jam, MI, PR	Humes, 1969a; Stock, 1975b; Ortiz et al., 1998
<i>Stichodactyla helianthus</i> (Ellis, 1768)	<i>Asteropontius ungellatus</i> Stock, 1975	Ast	Jam, PR	Stock, 1975b; Kim, 2010
Antipatharia				
<i>Bartholomea annulata</i> (Le Sueur, 1817)	<i>Ridgewaya fosshageni</i> Humes & Smith, 1974	Psec	Pan	Humes & Smith, 1974
<i>Stichopathes</i> sp.	<i>Calonastes imparipes</i> Humes & Goenaga, 1978	Rhy	PR	Humes & Goenaga, 1978
<i>Stichopathes luthkeni</i> Brook, 1889	<i>Calonastes imparipes</i> Humes & Goenaga, 1978	Rhy	PR	Humes & Goenaga, 1978

Corallimorpharia						
<i>Ricordea florida</i> Duchassaing & Michelotti, 1860	<i>Asteropontius longipalpus</i> Stock, 1975	Ast	PR		Stock, 1975b	
<i>Ricordea florida</i> Duchassaing & Michelotti, 1860	<i>Paramolgus antillianus</i> Stock, 1975	Rhy	PR		Stock, 1975b	
Scleractinia						
<i>Acropora palmata</i> (Lamarck, 1816)	<i>Corallovexia</i> sp.	Cor	VI		Herriott & Immermann, 1979	
<i>Acropora palmata</i> (Lamarck, 1816)	<i>Corallovexia similis</i> Stock, 1975	Cor	Cur, VI		Stock, 1975a; Herriott & Immermann, 1979	
<i>Colophyllia natans</i> (Houttuyn, 1772) (as <i>Colophyllia natans</i> (Muller))	<i>Asteropontius proximus</i> Stock, 1987	Ast	Cur		Stock, 1987	
<i>Colophyllia natans</i> (Houttuyn, 1772)	<i>Corallovexia kristenseni</i> Stock, 1975	Cor	Cur		Stock, 1975a	
<i>Colophyllia natans</i> (Houttuyn, 1772)	<i>Corallovexia longibrachium</i> Stock, 1975	Cor	Cur		Stock, 1975a	
<i>Colophyllia natans</i> (Houttuyn, 1772)	<i>Corallovexia mediobrachium</i> Stock, 1975 (as <i>Corallovexia mediobrachium</i> Stock, 1975)	Cor	VI		Herriott & Immermann, 1979	
<i>Colophyllia natans</i> (Houttuyn, 1772)	<i>Corallovexia mixtibrachium</i> Stock, 1975	Cor	Cur, VI		Stock, 1975a; Herriott & Immermann, 1979	
<i>Dendrogyra cylindrus</i> Ehrenberg, 1834	<i>Corallonoxia baki</i> Stock, 1975	Cor	Cur		Stock, 1975a	
<i>Dendrogyra cylindrus</i> Ehrenberg, 1834	<i>Corallonoxia longicauda</i> Stock, 1975	Cor	Cur		Stock, 1975a	
<i>Dichocoenia stokesii</i> Milne Edwards & Haime, 1848	<i>Corallonoxia</i> sp.	Cor	Cur		Stock, 1975a	
<i>Diploria labyrinthiformis</i> (Linnaeus, 1758)	<i>Corallovexia brevibrachium</i> Stock, 1975	Cor	Cur		Stock, 1975a	
<i>Eusmilia fastigiata</i> (Pallas, 1766)	<i>Corallonoxia baki</i> Stock, 1975	Cor	Cur		Stock, 1975a	
<i>Favia fragum</i> (Esper, 1795)	<i>Asteropontopsis faviae</i> Stock, 1987	Ast	Cur		Stock, 1987	
<i>Manicina areolata</i> (Linnaeus, 1758) (as <i>Manicina areolata</i> f. <i>majori</i> Wells, 1936)	<i>Asterocheres maxillatus</i> Stock, 1987	Ast	Cur		Stock, 1987	

TABLE 2 Caribbean reef-dwelling anthozoans, echinoderms and sponges as hosts of copepod crustaceans (*cont.*)

Invertebrate Host (valid name and as indicated in the original record)	Copepod species name	Copepod family abbreviation*	Site abbreviation**	Reference
<i>Manicina areolata</i> (Linnaeus, 1758)	<i>Corallonexia mediobrachium</i> Stock, 1975	Cor	Cur	Stock, 1975a
<i>Manicina areolata</i> (Linnaeus, 1758)	<i>Corallonexia longibrachium</i> Stock, 1975	Cor	Cur	Stock, 1975a
<i>Meandrina</i> sp.	<i>Asteropontius capillatus</i> Kim, 2010	Ast	Bar	Kim, 2010
<i>Meandrina meandrites</i> (Linnaeus, 1758)	<i>Asteropontius iuxitus</i> Stock, 1989	Ast	Cur	Stock, 1989
<i>Meandrina meandrites</i> (Linnaeus, 1758)	<i>Corallonoxia longicauda</i> Stock, 1975	Cor	Cur	Butter, 1979
<i>Meandrina meandrites</i> (Linnaeus, 1758)	<i>Corallonexia</i> sp.	Cor	VI	Herriott & Immermann, 1979
<i>Meandrina meandrites</i> (Linnaeus, 1758)	<i>Meandromyzon coronatum</i> Stock, 1989	Ast	Cur	Stock, 1989
<i>Montastraea cavernosa</i> (Linnaeus, 1767) (as <i>Montastraea brasiliiana</i> (Verrill, 1901))	<i>Corallonexia dorsospinosa minor</i> Stock, 1975	Cor	Cur	Stock, 1975a
<i>Montastraea cavernosa</i> (Linnaeus, 1767)	<i>Corallonexia dorsospinosa</i> Stock, 1975	Cor	Cur	Stock, 1975a
<i>Montastraea cavernosa</i> (Linnaeus, 1767)	<i>Corallonexia</i> sp.	Cor	VI	Herriott & Immermann, 1979
<i>Montastraea cavernosa</i> (Linnaeus, 1767)	<i>Corallonexia ventrospinosa</i> Stock, 1975	Cor	Cur	Stock, 1975a
<i>Montastraea cavernosa</i> (Linnaeus, 1767)	<i>Hernacheres montastrae</i> Stock, 1987	Ast	Cur	Stock, 1989
<i>Montastraea cavernosa</i> (Linnaeus, 1767)	<i>Peltomyzon rostratum</i> Stock, 1975	Ast	Cur	Stock, 1975b
<i>Mycetophyllia lamarciana</i> Milne Edwards & Haime, 1849	<i>Asteropontius mycetophylliae</i> Varela, Ortiz & Lalana, 2005	Ast	Cub	Varela et al., 2005
<i>Mycetophyllia lamarciana</i> Milne Edwards & Haime, 1849	<i>Corallonexia</i> sp.	Cor	VI	Herriott & Immermann, 1979
<i>Orbicella annularis</i> (Ellis & Solander, 1786) (as <i>Montastraea annularis</i> (Ellis & Solander, 1786))	<i>Asterocheres maxillatus</i> Stock, 1987	Ast	Cur	Stock, 1989
<i>Orbicella annularis</i> (Ellis & Solander, 1786)	<i>Asteropontella foliata</i> Stock, 1989	Ast	Cur	Stock, 1989

<i>Orbicella annularis</i> (Ellis & Solander, 1786)	<i>Corallovexia</i> sp.	Cor	Cur	Stock, 1975a
<i>Pseudodiploria clivosa</i> (Ellis & Solander, 1786) (as <i>Diploria clivosa</i> (Ellis & Solander, 1786))	<i>Corallovexia mediobrachium</i> Stock, 1975	Cor	VI	Herriott & Immermann, 1979
<i>Pseudodiploria clivosa</i> (Ellis & Solander, 1786)	<i>Hernacheres diploriae</i> Stock, 1987	Ast	Cur	Stock, 1987
<i>Pseudodiploria clivosa</i> (Ellis & Solander, 1786)	<i>Corallovexia mediobrachium</i> Stock, 1975	Cor	Cur, VI	Stock, 1975a; Herriott & Immermann, 1979
<i>Pseudodiploria strigosa</i> (Dana, 1846) (as <i>Diploria strigosa</i> (Dana, 1846))	<i>Corallovexia brevibrachium</i> Stock, 1975	Cor	VI	Herriott & Immermann, 1979
<i>Pseudodiploria strigosa</i> (Dana, 1846)	<i>Corallovexia longibrachium</i> Stock, 1975	Cor	Cur	Stock, 1975a
<i>Pseudodiploria strigosa</i> (Dana, 1846)	<i>Corallovexia mediobrachium</i> Stock, 1975	Cor	Cur, VI	Stock, 1975a; Herriott & Immermann, 1979
<i>Pseudodiploria strigosa</i> (Dana, 1846)	<i>Corallovexia similis</i> Stock, 1975	Cor	VI	Herriott & Immermann, 1979
<i>Pseudodiploria strigosa</i> (Dana, 1846)	<i>Corallovexia</i> sp.	Cor	VI	Herriott & Immermann, 1979
<i>Pseudodiploria strigosa</i> (Dana, 1846)	<i>Hernacheres diploriae</i> Stock, 1987	Ast	Cur	Stock, 1987
<i>Otocorallia</i>				
<i>Alcyonacea</i>				
<i>Antillorgia acerosa</i> (Pallas, 1766) (as <i>Pseudopterorgia acerosa</i> (Pallas, 1766))	<i>Acanthomolgus bilobipes</i> Humes & Stock, 1973	Rhy	Bar, Cur, Jam	Humes & Stock, 1973;
<i>Antillorgia acerosa</i> (Pallas, 1766)	<i>Lamippina aequalis</i> Stock, 1973	Lam	Cur	Stock, 1975c
<i>Antillorgia americana</i> (Gmelin, 1791) (as <i>Pseudopterorgia americana</i> (Gmelin, 1791))	<i>Acanthomolgus dionyx</i> Stock, 1975	Rhy	Cur	Stock, 1973
<i>Antillorgia</i> sp. (as <i>Pseudopterorgia</i> sp.)	<i>Lamippina aequalis</i> Stock, 1973	Lam	Cur	Stock, 1973
<i>Antillorgia acerosa</i> var. <i>elastica</i> Bielschowsky, 1929 (as <i>Antillorgia elastica</i> Bielschowsky, 1929)	<i>Acanthomolgus bilobipes</i> Humes & Stock, 1973	Rhy	PR	Humes & Stock, 1973

TABLE 2 Caribbean reef-dwelling anthozoans, echinoderms and sponges as hosts of copepod crustaceans (*cont.*)

Invertebrate Host (valid name and as indicated in the original record)	Copepod species name	Copepod family abbreviation*	Site abbreviation**	Reference
<i>Briareum asbestinum</i> (Pallas, 1766)	<i>Enacyonium variicauda</i> Stock, 1973	Lam	PR	Stock, 1973
<i>Briareum asbestinum</i> (Pallas, 1766)	<i>Orecturus ortizi</i> Varela & Lalana, 2007	Ast	Cub	Varela & Lalana, 2007
<i>Callogorgia</i> sp.	<i>Sphaerippe caliginola</i> Grygier, 1980	Lam	Bah	Grygier, 1980
<i>Eunicea caryculata</i> (Ellis & Solander, 1786)	<i>Acanthomolgus verrucipes</i> Humes, 1973	Rhy	Ber	Humes, 1973
<i>Eunicea clavigera</i> Bayer, 1961	<i>Acanthomolgus mononyx</i> Stock, 1975	Rhy	Cur	Stock, 1975c
<i>Eunicea flexuosa</i> (Lamouroux, 1821) (as <i>Plexaura flexuosa</i> Lamouroux, 1821)	<i>Acanthomolgus affinis</i> Stock, 1975	Rhy	Cur	Stock, 1975c
<i>Eunicea flexuosa</i> (Lamouroux, 1821)	<i>Acanthomolgus longidactylus</i> Stock, 1975	Rhy	Cur	Stock, 1975c
<i>Eunicea laciniata</i> Duchassain & Michelotti, 1860	<i>Acanthomolgus intermedius</i> Stock, 1975	Rhy	Cur	Stock, 1975c
<i>Eunicea mammosa</i> Lamouroux, 1816	<i>Endacyonium eumiceae</i> Stock, 1973	Lam	PR	Stock, 1973
<i>Eunicea mammosa</i> Lamouroux, 1816	<i>Orecturus antillensis</i> Varela, 2011	Ast	Cub	Varela, 2011b
<i>Eunicea tournefortii</i> Milne Edwards & Haime, 1857	<i>Acanthomolgus longifurca</i> Stock, 1975	Rhy	Cur	Stock, 1975c
<i>Gorgonia mariae</i> Bayer, 1961	<i>Acanthomolgus triangulipes</i> Stock, 1975	Rhy	Cub	Varela et al., 2008
<i>Gorgonia ventalina</i> Linnaeus, 1758	<i>Acanthomolgus bayeri</i> Humes, 1973	Rhy	Ber	Humes, 1973
<i>Gorgonia ventalina</i> Linnaeus, 1758	<i>Acanthomolgus gorgoniae</i> Humes, 1973	Rhy	Ber, Cur, SE	Humes, 1973; Stock, 1975c
<i>Gorgonia ventalina</i> Linnaeus, 1758	<i>Acanthomolgus triangulipes</i> Stock, 1975	Rhy	Cur, SE, SM	Stock, 1975c
<i>Muricella</i> sp.	<i>Sphaerippe</i> sp.	Lam	SE	Ivanenko et al., 2017
	<i>Acanthomolgus intermedius</i> Stock, 1975	Rhy	Cub	Varela et al., 2003

<i>Muricca atlantica</i> (Kukenthal, 1911)	<i>Acanthomolgus muriceanus</i>	Rhy	Ber	Humes, 1973; Stock, 1975c
<i>Muricca laxa</i> Verill, 1864	Humes, 1973			Stock, 1975c
<i>Placogorgia</i> sp.	<i>Acanthomolgus aequiseta</i> Stock, 1975	Rhy	Gur	Stock, 1975c
<i>Plexaura</i> sp.	<i>Linareastra bouligandi</i> Stock, 1979	Lam	Flo	Stock, 1979
<i>Plexaura homomalla</i> (Esper, 1794) (as <i>Plexaura homomalla f. homomalla</i> Esper, 1794)	<i>Acanthomolgus affinis</i> Stock, 1975	Rhy	Cub	Varela, 2011a
<i>Plexaura homomalla</i> (Esper, 1794)	<i>Acanthomolgus affinis</i> Stock, 1975	Rhy	Cur	Stock, 1975c
<i>Plexaura homomalla</i> (Esper, 1794)	<i>Enalyconium nudum</i> Stock, 1973	Lam	PR	Stock, 1973
<i>Plexaura homomalla</i> (Esper, 1794)	<i>Enalyconium ramosum</i> Stock, 1973	Lam	PR	Stock, 1973
<i>Plexaurella dichotoma</i> (Esper, 1791)	<i>Acanthomolgus seticornis</i> Stock, 1975	Rhy	SM	Stock, 1975c
<i>Plexaurella nutans</i> (Duchassaing & Michelotti, 1860)	<i>Enalyconium</i> sp.	Lam	Cub	Varela et al., 2005b
<i>Pseudoplexaura porosa</i> (Houttuyn, 1772)	<i>Acanthomolgus bayeri</i> Humes, 1973	Rhy	Ber	Humes, 1973
<i>Pseudoplexaura</i> Wright & Studer, 1889	<i>Acanthomolgus bayeri</i> Humes, 1973	Rhy	Cub	Varela et al., 2003
<i>Thesea</i>	<i>Magnipipe caputmedusae</i> Stock, 1978	Lam	Flo	Stock, 1978
Pennatulacea				
<i>Renilla reniformis</i> (Pallas, 1766)	<i>Macrochiron sargassi</i> Sars, 1916	Mac	SM	Humes & Stock, 1973
Echinodermata				
Crinoidea	<i>Asterocheres crinoidicola</i> Humes, 2000	Ast	Jam	Kim, 2010
Crinoidea				
Comatulida				
<i>Davidaster rubiginosus</i> (Pourtales, 1869)	<i>Asterocheres crinoidicola</i> Humes, 2000	Ast	Bel, Cub	Humes, 2000; Varela, 2010
<i>Nemaster grandis</i> Clark, 1909	<i>Asterocheres crinoidicola</i> Humes, 2000	Ast	Bel	Humes, 2000
Echinoidea	<i>Asterocheres unioviger</i> Kim, 2010	Ast	Jam	Kim, 2010
Echinoidea				
Camarodonta				
<i>Echinometra lucunter</i> (Linnaeus, 1758)	<i>Chelacheres longipalpus</i> Stock & Humes, 1995	Ast	Bah, Cub, Cur, Jam, MI, SM, PR	Stock & Humes, 1995; Varela, 2011a

TABLE 2 Caribbean reef-dwelling anthozoans, echinoderms and sponges as hosts of copepod crustaceans (*cont.*)

Invertebrate Host (valid name and as indicated in the original record)	Copepod species name	Copepod family abbreviation*	Site abbreviation**	Reference
<i>Echinometra lucunter</i> (Linnaeus, 1758)	<i>Chelacheres optans</i> Stock & Humes, 1995	Ast	PR	Stock & Humes, 1995
<i>Echinometra viridis</i> A. Agassiz, 1863	<i>Macrochiron echinicolum</i> Humes & Stock, 1973	Mac	Cur	Humes & Stock, 1973
<i>Lytachinus variegatus</i> (Lamarck, 1816)	<i>Asterocheres simulans</i> (T. Scott, 1898) (as <i>Ascomyzon simulans</i> T. Scott, 1898)	Ast	Cur	Stock & Humes, 1995
<i>Lytachinus variegatus</i> (Lamarck, 1816)	<i>Macrochiron echinicolum</i> Humes & Stock, 1973	Mac	Bon, Cur, Jam, MI, PR	Humes & Stock, 1973
<i>Tripneustes ventricosus</i> (Lamarck, 1816)	<i>Chelacheres longipalpus</i> Stock & Humes, Ast 1995		Cur	Stock & Humes, 1995
<i>Tripneustes ventricosus</i> (Lamarck, 1816)	<i>Macrochiron echinicolum</i> Humes & Stock, 1973	Mac	Bah, Bar, Cur, Jam, MI	Humes & Stock, 1973
Cidaroida				
<i>Eucidaris tribuloides</i> (Lamarck, 1816)	<i>Asterocheres unioviger</i> Kim, 2010	Ast	Bah, PR	Kim, 2010
Clypeasteroida				
<i>Clypeaster rosaceus</i> (Linnaeus, 1758)	<i>Pseudanthessius pectinifer</i> Stock, Humes Pse & Gooding, 1964		Bah, Jam, MI	Stock et al., 1963b
Diadematoida				
<i>Diadema antillarum</i> Philippi, 1845	<i>Onychocheres atlatus</i> Stock & Gooding, 1986	Ast	Cub, Cur	Stock & Gooding, 1986; Varela et al., 2005b
Spatangoida				
<i>Meoma ventricosa</i> (Lamarck, 1816)	<i>Meomicola amplectans</i> Stock, Humes & Sync Gooding, 1963		Cur, Jam	Stock et al., 1963b
<i>Meoma ventricosa</i> (Lamarck, 1816)	<i>Microponitus glaber</i> Stock, Humes & Gooding, 1963	Mic	Jam	Stock et al., 1963a

<i>Meoma ventricosa</i> (Lamarck, 1816)	<i>Nanaspis pollens</i> Stock, Humes & Gooding, 1962	Nan	Jam	Stock et al., 1962
<i>Meoma ventricosa</i> (Lamarck, 1816)	<i>Pseudanthessius exicornis</i> Stock & Humes, 1995	Pse	Cur	Stock & Humes, 1995
Holothuroidea				
<i>Actinopyga agassizii</i> (Selenka, 1867) (as <i>Muelleria agassizii</i> Selenka, 1867)	<i>Carilulus</i> sp.	Sync	Bah, Jam	Humes, 1969b
<i>Actinopyga agassizii</i> (Selenka, 1867)	<i>Carilulus sculptus</i> (Humes, 1969)	Sync	Bah, Jam	Humes, 1969b
<i>Actinopyga agassizii</i> (Selenka, 1867)	<i>Diogenidium nasutum</i> Edwards, 1891	Lic	Bah	Hendler & Kim, 2010
<i>Actinopyga agassizii</i> (Selenka, 1867)	<i>Diogenidium tectum</i> Humes & Ho, 1971	Lic	Bah, Jam	Hendler & Kim, 2010
<i>Holothuria (Halodeima) grisea</i> Selenka, 1867	<i>Carilulus sculptus</i> (Humes, 1969)	Sync	Jam	Humes, 1969b
<i>Holothuria (Halodeima) grisea</i> Selenka, 1867	<i>Diogenidium nasutum</i> Edwards, 1891	Lic	Jam	Hendler & Kim, 2010
<i>Holothuria (Halodeima) mexicana</i> Ludwig, 1875	<i>Carilulus</i> sp.	Sync	Bah, Cur, Jam	Humes, 1969b
<i>Holothuria (Halodeima) mexicana</i> Ludwig, 1875	<i>Carilulus sculptus</i> (Humes, 1969) (as <i>Scambicornus sculptus</i> Humes, 1969)	Sync	Bah, Bon, Cub, Cur, Jam	Humes, 1969b; Varela et al., 2003
<i>Holothuria (Halodeima) mexicana</i> Ludwig, 1875	<i>Diogenella spinicauda</i> Stock, 1968	Lic	Bah, Cur, Jam, MI, PR	Stock, 1968; Humes & Ho, 1970
<i>Holothuria (Halodeima) mexicana</i> Ludwig, 1875	<i>Diogenidium deforme</i> Stock, 1968	Lic	Bah, PR	Hendler & Kim, 2010
<i>Holothuria (Halodeima) mexicana</i> Ludwig, 1875	<i>Diogenidium nasutum</i> Edwards, 1891	Lic	Cur, Jam, MI, PR	Stock, 1968; Hendler & Kim, 2010
<i>Holothuria (Metriatyla) scabra</i> Jaeger, 1833	<i>Pseudanthessius deficiens</i> Stock, Humes & Gooding, 1963	Pse	Cur	Stock et al., 1963b
<i>Holothuria (Platyperona) parvula</i> (Selenka, 1867) (as <i>Microthele parvula</i> (Selenka))	<i>Diogenidium nasutum</i> Edwards, 1891	Lic	Bah	Edwards, 1891
<i>Holothuria (Selenkothuria) glaberrima</i> Selenka, 1867	<i>Nanaspis truncata</i> Stock, Humes & Gooding, 1962	Nan	MI, PR	Stock et al., 1962
	<i>Diogenidium deforme</i> Stock, 1968	Lic	PR	Stock, 1968

TABLE 2 Caribbean reef-dwelling anthozoans, echinoderms and sponges as hosts of copepod crustaceans (*cont.*)

Invertebrate Host (valid name and as indicated in the original record)	Copepod species name	Copepod family abbreviation*	Site abbreviation**	Reference
<i>Holothuria (Semperothuria) surinamensis</i> Ludwig, 1875	<i>Diogenella seticauda</i> Stock, 1968	Lic	MI, PR	Stock, 1968; Humes & Ho, 1970
<i>Holothuria (Semperothuria) surinamensis</i> Ludwig, 1875 (as <i>Halodeima surinamensis</i> (Ludwig))	<i>Nanaspis pollens</i> Stock, Humes & Gooding, 1962	Nan	MI	Stock et al., 1962
<i>Holothuria (Thymioscyta) arenicola</i> Semper, 1868	<i>Diogenella deichmannae</i> Humes & Ho, 1970	Lic	Bar	Humes & Ho, 1970
<i>Holothuria (Thymioscyta) arenicola</i> Semper, 1868 (as <i>Brandtothuria arenicola</i> (Semper, 1868))	<i>Diogenella impar</i> Humes & Ho, 1970	Lic	Bar	Humes & Ho, 1970
<i>Holothuria (Thymioscyta) arenicola</i> Semper, 1868	<i>Diogenidium deforme</i> Stock, 1968	Lic	Bar	Hendler & Kim, 2010
<i>Holothuria (Thymioscyta) arenicola</i> Semper, 1868	<i>Diogenella seticauda</i> Stock, 1968	Lic	MI	Humes & Ho, 1970
<i>Holothuria (Thymioscyta) arenicola</i> Semper, 1868	<i>Nanaspis pollens</i> Stock, Humes & Gooding, 1962	Nan	Jam	Stock et al., 1962
<i>Holothuria (Thymioscyta) arenicola</i> Semper, 1868	<i>Nanaspis truncata</i> Stock, Humes & Gooding, 1962	Nan	MI	Stock et al., 1962
<i>Holothuria (Thymioscyta) impatiens</i> (Forskal, 1775)	<i>Diogenella seticauda</i> Stock, 1968	Lic	PR	Stock, 1968
Synallactida				
<i>Istostichopus badionotus</i> (Selenka, 1867)	<i>Carilulus</i> sp.	Sync	Bah, Bar, Jam	Humes, 1969b
<i>Istostichopus badionotus</i> (Selenka, 1867)	<i>Carilulus sculptus</i> (Humes, 1969)	Sync	Bah, Bar, Jam, MI, PR	Humes, 1969b
<i>Istostichopus badionotus</i> (Selenka, 1867)	<i>Diogenidium spinulosum</i> Stock, 1968	Lic	Jam, PR	Stock, 1968; Hendler & Kim, 2010

<i>Isostichopus badionotus</i> (Selenka, 1867)	<i>Nanaspis exigua</i> Stock, Humes & Gooding, 1962	Nan	Jam	Stock et al., 1962
<i>Isostichopus badionotus</i> (Selenka, 1867)	<i>Nanaspis media</i> Stock, Humes & Gooding, 1962	Nan	MI, PR	Stock et al., 1962
<i>Isostichopus badionotus</i> (Selenka, 1867)	<i>Nanaspis pollens</i> Stock, Humes & Gooding, 1962	Nan	Bah, Jam	Stock et al., 1962
Ophiuroidea				
Euryalida				
<i>Astrophyton muricatum</i> (Lamarck, 1816)	<i>Critomolgas</i> Humes & Stock, 1983	Rhy	Cub	Varela et al., 2008
<i>Astrophyton muricatum</i> (Lamarck, 1816)	<i>Critomolgas astrophyticus</i> (Humes & Stock, 1973) (as <i>Doridicola astrophyticus</i> Humes & Stock, 1973)	Rhy	Bar, Jam, MI, PR	Humes & Stock, 1973
Ophiurida				
<i>Ophiuroidea</i>	<i>Caribeopsyllus</i> sp. A	Tha	SE	Ivanenko, unpublished
<i>Amphiothus</i> sp.	<i>Parophiopsyllus ligatus</i> Humes & Hendler, 1972	Can	FK	Humes & Hendler, 1972
<i>Amphiothus</i> sp.	<i>Presynaptiphilus amphiothi</i> Humes & Hendler, 1972	Symp	FK	Humes & Hendler, 1972
<i>Ophiocoma echinata</i> (Lamarck, 1816)	<i>Ophiopsyllus reductus</i> Stock, Humes & Gooding, 1963	Can	Bel, Cur	Humes & Hendler, 1999; Stock et al., 1963a
<i>Ophiocoma pumila</i> Lutken, 1856	<i>Ophiopsyllus latus</i> Humes & Hendler, 1999	Can	Bel, FK	Humes & Hendler, 1999
<i>Ophiocoma wendtii</i> Muller & Troschel, 1842 (as <i>Ophiocoma riisei</i> Lutken, 1856)	<i>Hemicyclops columnaris</i> Humes, 1984	Cla	Bah	Kim, 2009
<i>Ophiocomella ophiactoides</i> (Clark, 1900)	<i>Ophiopsyllus latus</i> Humes & Hendler, 1999	Can	Bel	Humes & Hendler, 1999
<i>Ophiocomella ophiactoides</i> (Clark, 1900)	<i>Ophiopsyllus reductus</i> Stock, Humes & Gooding, 1963	Can	Bel, Jam	Emson & Mladenov, 1987; Emson et al., 1985

TABLE 2 Caribbean reef-dwelling anthozoans, echinoderms and sponges as hosts of copepod crustaceans (*cont.*)

Invertebrate Host (valid name and as indicated in the original record)	Copepod species name	Copepod family abbreviation*	Site abbreviation**	Reference
<i>Ophiocerda brevispina</i> (Say, 1825) (as <i>Ophiocerda brevispinum</i> (Say, 1825))	<i>Pseudanthessius deficiens</i> Stock, Humes & Gooding, 1963	Pse	Bel	Humes & Handler, 1999
<i>Ophiocerda cinerea</i> Muller & Troschel, 1842 (as <i>Ophiocerda cinereum</i> Muller & Troschel, 1842)	<i>Pseudanthessius deficiens</i> Stock, Humes & Gooding, 1963	Pse	Bel, Cur, MI, SM	Stock et al., 1963b; Humes & Handler, 1999
<i>Ophionyxxa flaccida</i> (Say, 1825)	<i>Ophiurocheres bellulus</i> Humes, 1998	Ast	MI	Humes, 1998
<i>Ophiothrix</i> (<i>Acanthophiothrix</i>) <i>suensonii</i> Lutken, 1856	<i>Collocheres lunulifer</i> Humes, 1998	Ast	Bar	Humes, 1998
<i>Ophiothrix</i> (<i>Ophiothrix</i>) <i>angulata</i> (Say, 1825)	<i>Cariaeopsyllus</i> sp. A	Tha	Bel	Handler & Kim, 2010
<i>Ophiothrix</i> (<i>Ophiothrix</i>) <i>angulata</i> (Say, 1825)	<i>Cariaeopsyllus chavayi</i> Suarez-Morales, In: Suarez-Morales & Castellanos, 1998	Tha	Bel	Handler & Kim, 2010
<i>Ophiothrix</i> (<i>Ophiothrix</i>) <i>angulata</i> (Say, 1825)	<i>Collocheres lunulifer</i> Humes, 1998	Ast	Bar	Humes, 1998
<i>Ophiothrix</i> (<i>Ophiothrix</i>) <i>oerstedi</i> Lutken, 1856	<i>Cariaeopsyllus chavayi</i> Suarez-Morales, In: Suarez-Morales & Castellanos, 1998	Tha	Bel	Handler & Kim, 2010
Porifera				
Porifera	<i>Asterocheres bahamensis</i> Kim, 2010	Ast	Bah	Kim, 2010
Porifera	<i>Asterocheres oricurus</i> Kim, 2010	Ast	Jam	Kim, 2010
Porifera	<i>Asterocheres peniculatus</i> Kim, 2010	Ast	Bah	Kim, 2010
Porifera	<i>Asterocheres plumosus</i> Kim, 2010	Ast	Bah	Kim, 2010
Porifera	<i>Asterocheres trisetatus</i> Kim, 2010	Ast	Bah	Kim, 2010
Porifera	<i>Eupohyniphus occidentalis</i> Kim, 2009	Sab	Jam	Kim, 2009
Porifera	<i>Hemicyclops columnaris</i> Humes, 1984	Cla	Bah	Kim, 2009
Porifera	<i>Hetairosynella aculeata</i> Kim, 2010	Ast	Bah	Kim, 2010
Porifera	<i>Hetairosynella angulata</i> Kim, 2010	Ast	Jam	Kim, 2010
Porifera	<i>Hetairosynella bifurcata</i> Kim, 2010	Ast	Jam	Kim, 2010

Porifera	<i>Kimchères fastigatus</i> (Kim, 2010) (as <i>Asterochères fastigatus</i> Kim, 2010)	Ast	Bar	Kim, 2010
Porifera	<i>Pseudanthessius acutus</i> Kim, 2009	Pse	Jam	Kim, 2009
Porifera	<i>Stenomyzon edentatum</i> Kim, 2010	Ast	PR	Kim, 2010
Calcarea				
Calcinea				
Clathrinida	<i>Clathrina lutea</i> Azevedo, Padua, Moraes, Rossi, Muricy & Klautau, 2017	Copepoda	PR	Garcia-Hernandez et al., 2019
Demospongiae				
Heteroscleromorpha				
Agelasiida				
<i>Agelas</i> sp.	<i>Astrocheres reginae</i> Boxshall & Huys, 1994	Ast	Cub	Varela et al., 2008
<i>Agelas clathrodes</i> (Schmidt, 1870)	<i>Astrocheres reginae</i> Boxshall & Huys, 1994	Ast	Bel	Boxshall & Huys, 1994
<i>Agelas dilatata</i> Duchassaing & Michelotti, 1864	<i>Astrocheres cubensis</i> Varela, 2010	Ast	Cub	Varela, 2010b
<i>Agelas wiedenmayeri</i> Alcolado, 1984	<i>Astrocheres fernandezmillerai</i> Varela, 2010	Ast	Cub	Varela, 2010b
Axinellida				
<i>Ptilocaulis walpersii</i> (Duchassaing & Michelotti, 1864)	<i>Astrocheres garridoi</i> Varela, Ortiz & Lalana, 2007	Ast	Cub	Varela et al., 2007
Haplosclerida				
<i>Calypspongia</i> sp.	<i>Astrocheres antillensis</i> Varela, 2010	Ast	Cub	Varela, 2010
<i>Calypspongia vaginalis</i> (Lamarck, 1814)	<i>Astrocheres Boeck,</i> 1859	Ast	Cub	Varela et al., 2005b
<i>Calypspongia vaginalis</i> (Lamarck, 1814)	<i>Astrocheres spinosai</i> Varela, Ortiz & Lalana, 2007	Ast	Cub	Varela et al., 2007a
<i>Calypspongia vaginalis</i> (Lamarck, 1814)	<i>Neoastrocheres humesi</i> (Varela, 2012)	Ast	Cub	Varela, 2012

TABLE 2 Caribbean reef dwelling anthozoans, echinoderms and sponges as hosts of copepod crustaceans (*cont.*)

Invertebrate Host (valid name and as indicated in the original record)	Copepod species name	Copepod family abbreviation*	Site abbreviation**	Reference
<i>Callyspongia vaginalis</i> (Lamarck, 1814)	<i>Setacheres paraboeki</i> (Johnsson, 1998)	Ast	Cub	Varela, 2012
<i>Niphates digitalis</i> (Lamarck, 1814)	<i>Asterocheres kimi</i> Varela, 2012	Ast	Cub	Varela, 2012
<i>Niphates digitalis</i> (Lamarck, 1814)	<i>Asterocheres lalancai</i> Varela, 2013	Ast	Cub	Varela, 2012
Poecilosclerida				
<i>Iotrochota birotulata</i> (Higgin, 1877)	<i>Scottocheres elongatus</i> (Scott T. & Scott A., 1894)	Ast	Cub	Varela et al., 2008
Verongimorpha				
Chondrillida				
<i>Chondrilla nucula</i> Schmidt, 1862	<i>Parmulella emarginata</i> Stock, 1992	Ent	Cur	Stock, 1992b
<i>Chondrilla nucula</i> Schmidt, 1862	<i>Parmulodes verrucosa</i> Wilson C.B., 1944 (as <i>Parmulodes verrucosus</i>)	Ent	Aru, Cub, Cur, PR	Stock, 1992b; Varela et al., 2008

* Copepod family Abbreviation: Ast – Asterocheridae, Can – Cancerillidae, Cla – Clausidiidae, Cor – Coralloveliidae, Ent – Entomolepididae, Lam – Lamippidae, Lic – Lichomolgidae, Mac – Macrochironidae, Mic – Microponidae, Nan – Nanaspidae, Pse – Pseudanthessiidae, Psec - Pseudocyclopidae, Rhy – Rhynchomolgidae, Sab – Sabeliphilidae, Sync – Synapticolidae, Symp – Sympatophilidae, Tha – Thaumatopsyllidae.

** Site Abbreviation: Aru – Aruba, Bah – Bahamas, Bar – Barbados, Bel – Belize, Ber – Bermuda, Bon – Bonaire, Cub – Cuba, Cur – Curacao, Flo – Florida, Jam – Jamaica, MI – Magneyes Island, LK – Loggerhead Key, Pan – Panama, PR – Puerto Rico, SE – St. Eustatius, SM – St. Martin, VI – Virgin Islands.

coral) (fig. 1a) (Humes, 1984; Stock, 1992a; Kim, 2009). All other species of symbiotic copepods are found in the Caribbean only, which may be the result of high endemism of their host species (Miloslavich et al., 2010; Soest et al., 2012; Zea et al., 2014; Ivanenko, 2016).

The copepods were collected by washing of the hosts in seawater or tap water (Butter, 1979; Garcia-Hernandez et al., 2017), a solution of formalin (Varela & Lalana, 2007; Varela et al., 2003, 2005a, b, 2007a, b, 2008; Varela, 2010a, b, 2011a, b, 2012), a solution of ethanol (Stock et al., 1962, 1963a, b, Humes, 1969a, 1998, 2000; Humes & Stock, 1973; Stock, 1975a, b, d; Herriott & Immermann, 1979; Stock & Humes, 1995) or a solution of magnesium-chloride (Stock & Humes, 1995), dissecting of the host's tissues or galls (see Stock et al., 1962; Humes & Hendler, 1972, 1999; Humes & Goenaga, 1978; Stock, 1978; Grygier, 1980; Emson et al., 1985; Emson & Mladenov, 1987; Hendler & Kim, 2010; Ivanenko et al., 2017), by a suction device (Humes & Stock, 1973) or by dissolving soft tissues of host corals with bleach (Stock 1975a, 1989). Most of the host invertebrates were collected by SCUBA living down to 41 m depth. The only exceptions are the three of eight species of the Caribbean copepods of the family Lamippidae tentatively included in the database found in galls or tissue of octocorals collected by a submersible away from reefs at depths of 55–330 m (fig. 2 a–d) (Stock, 1978, 1979; Grygier, 1980). It is noteworthy that there are no data on symbiotic copepods associated with reef-dwelling sponges, echinoderms and corals living at mesophotic depths; studies on reef communities and coral-associated fauna from mesophotic depths seems to be an important task that has just started (Bongaerts et al. 2010, 2015; van der Meij et al., 2015; Hoeksema et al., 2017c; García-Hernández et al., 2018; Veglia et al., 2018).

Symbiotic copepods are reported from eight out of ten ecoregions of the Greater Caribbean, but none from the Northern and

Southern Gulf of Mexico (table 6, figs. 4–7; Spalding et al., 2007; Hoeksema et al., 2017a). Eight records are known for Bermuda: four species of poecilostomatoid cyclopoids representing genus *Acanthomolgus* and the siphonostomatoid *Ophiopsyllus reductus* were found associated with alcyonaceans and an ophiuroid, respectively (Stock et al., 1963a; Humes, 1973). Only one record is reported for the Southwestern Caribbean: the calanoid *Ridgewayia fosshageni* aggregating on the actinarian *Bartholomea annulata*. Only *Aspidomolgus stoichactinus* living on the actiniarian *Stichodactyla helianthus* and the corallimorpharian *Corynactis denticulosa*, recorded as *Homostichanthus denticulosus*, is found in five ecoregions (Humes, 1969a; Stock, 1975b). Five species of copepods are found in four ecoregions, viz. *Caribulus sculptus* living on holothurians, *Chelacheres longipalpus* and *Macrochiron echinicum* (fig. 1d) found on sea urchins, *Ophiopsyllus reductus* living on ophiuroids. Seventeen and 87 species of copepods are recorded found in only two and one ecoregions, respectively (table 6).

The data show that the three most intensively explored ecoregions are the Bahamian, Greater Antilles and Southern Caribbean, with studies centered at Curaçao (123 records, 36 species of hosts, 49 species of copepods), Puerto Rico (105, 22, 27) and the Bahamas (57, 11, 19). The mosaic data show poor knowledge of most ecoregions as well as and many host taxa. This current state of the knowledge limits analysis of the distribution of symbiotic copepods in the whole Caribbean. Well planned studies of different Caribbean regions and the application of modern methods of integrative taxonomy are needed to carry out such analyses (DeBiasse et al., 2016; Jossart et al., 2017; Ivanenko et al., 2018).

A comparison of taxonomic names from literature sources with their current nomenclature revealed name changes for 29 (of 80) species and 12 (of 58) genera of the hosts

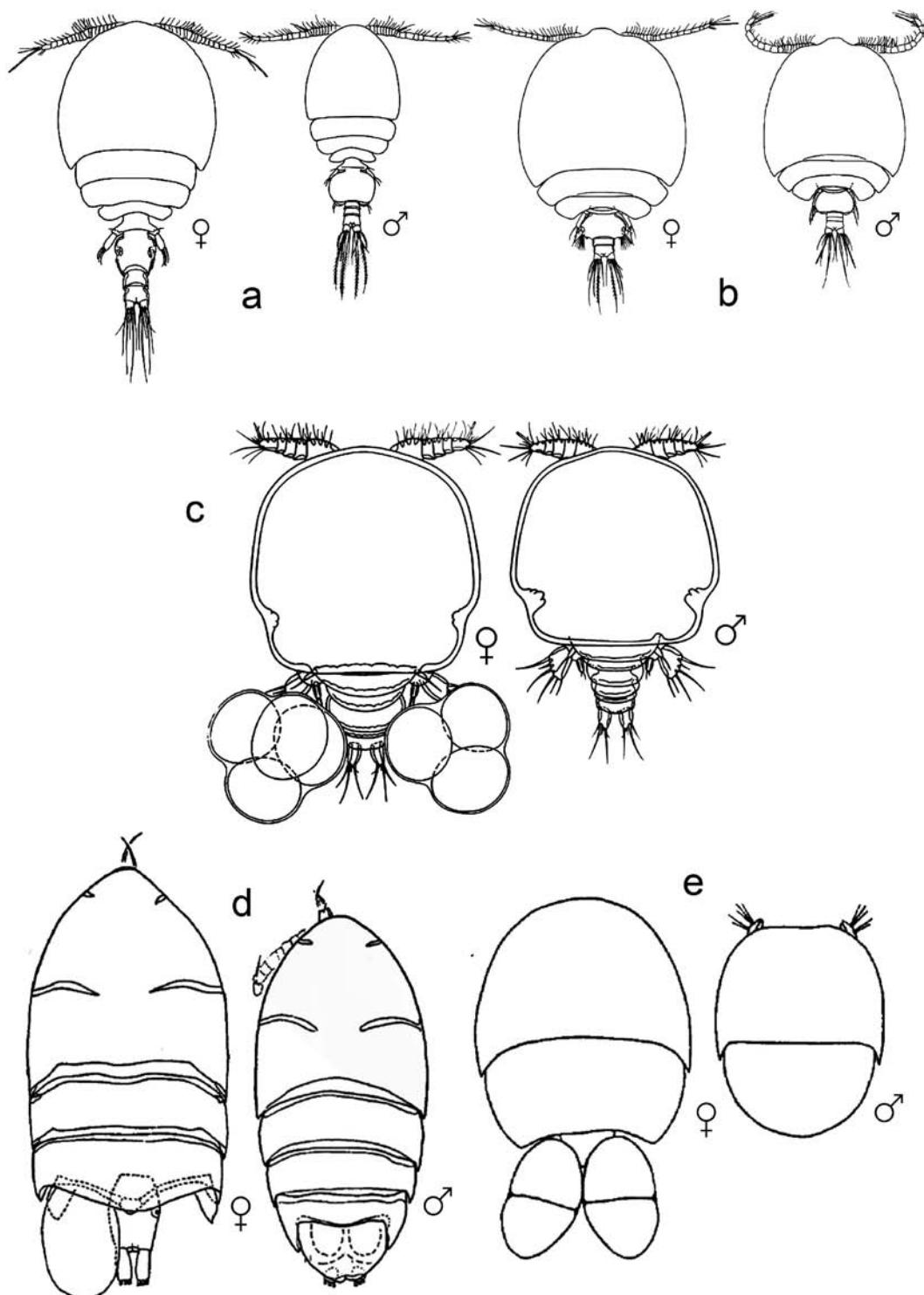


FIGURE 3 Siphonostomatoida, dorsal view. a – *Asterochernes unioviger*, b – *Cyclochernes sensilis* (Asterocheridae), c – *Parophiopsyllus ligatus* (Cancerillidae), d – *Micropontius glaber* (Micropontiidae), e – *Nanaspis poliensis* (Nanaspidae). After Stock et al. (1962, 1963a), Humes & Hendler (1972), Kim (2010).

TABLE 3 Numbers of records and species of Caribbean symbiotic copepods found on reef-dwelling anthozoans, echinoderms and sponges attributed to the host family

Host family	Number of copepod records	Number of copepod species
Echinodermata		
Holothuriidae	75	12
Stichopodidae	35	5
Ophiocomidae	29	3
Ophiotrichidae	19	2
Toxopneustidae	18	3
Echinometridae	17	3
Gorgonocephalidae	13	1
Ophiodermatidae	10	1
Amphiuridae	9	2
Brissidae	9	4
Clypeasteridae	6	1
Diadematidae	4	1
Comatulidae	3	1
Cidaridae	2	1
Ophiomyxidae	1	1
Cnidaria		
Faviidae	47	12
Plexauridae	29	16
Stichodactylidae	22	2
Gorgoniidae	21	6
Meandrinidae	20	5
Actiniidae	16	3
Montastraeidae	13	6
Merulinidae	7	2
Acroporidae	5	2
Corallimorphidae	4	2
Briareidae	4	2
Aiptasiidae	2	1
Antipathidae	2	1
Ricordeidae	2	1
Renillidae	1	1
Phymanthidae	1	1
Primnoidae	1	1
Porifera		
Clathrinidae	42	1
Chondrillidae	12	2

TABLE 3 Numbers of records and species of Caribbean symbiotic copepods found on reef-dwelling anthozoans, echinoderms and sponges attributed to the host family (*cont.*)

Host family	Number of copepod records	Number of copepod species
Callyspongiidae	5	4
Agelasidae	4	3
Niphatidae	2	2
Iotrochotidae	1	1
Axinellidae	1	1

TABLE 4 Number of records and species per family of symbiotic copepods living on reef-dwelling Caribbean hosts (anthozoans, echinoderms and sponges)

Copepod family	Number of records	Number of species
Asterocheridae	103	45
Rhynchomolgidae	78	19
Corallovexiidae	66	11
Synapticolidae	53	3
Lichomolgidae	43	8
Cancerillidae	34	3
Pseudanthessiidae	21	4
Nanaspidae	19	4
Macrochironidae	18	2
Thaumatomysyllidae	17	1
Lamippidae	16	8
Entomolepididae	12	2
Synaptiphilidae	3	1
Clausidiidae	2	1
Micropontiidae	2	1
Pseudocyclopidae	2	1
Sabelliphilidae	1	1

(WoRMS, 2019). The taxonomic names are changed for nine (of 115) species and six (of 47) genera of the copepods. There are six records of symbiotic copepods identified to genus (*Asterocheres*, *Corallovexia*, *Corallonoxia*, *Critomolgus*, *Enalcyonium*, *Sphaerippe*). These taxa are included in; among 16 hosts (for 18 records) that have no identification at species level; of these one is assigned to a phylum, three to a class and 12 to a genus. There are

41 records for which the hosts are identified only to taxonomic categories such as phylum, order or subclass. There are 81 records of copepods found on sponges, but hosts of 14 of them are defined only to phylum (Kim, 2009, 2010). The absence of precise identifications and the necessity of linking outdated host names with valid ones show the need for specimen collections of not only copepods but also of their invertebrate hosts as well as

TABLE 5 Families of reef-dwelling Caribbean symbiotic copepods and their host families (anthozoans, echinoderms and sponges)*

Copepod family	Host family	Host class or type
Asterocheridae	Actiniidae	Ant
	Agelasidae	Dem
	Axinellidae	Dem
	Briareidae	Ant
	Callyspongiidae	Dem
	Cidaridae	Ech
	Comatulidae	Cri
	Diadematidae	Ech
	Echinometridae	Ech
	Iotrochotidae	Dem
	Meandrinidae	Ant
	Merulinidae	Ant
	Montastraeidae	Ant
	Niphatidae	Dem
	Ophiomyxidae	Oph
	Ophiotrichidae	Oph
	Phymantidae	Ant
	Plexauridae	Ant
	Ricordeidae	Ant
	Stichodactylidae	Ant
	Toxopneustidae	Ech
Cancerillidae	Amphiuridae	Oph
	Ophiocomidae	Oph
Clausidiidae	Ophiocomidae	Oph
Corallovexiidae	Acroporidae	Ant
	Meandrinidae	Ant
	Merulinidae	Ant
	Montastraeidae	Ant
	Faviidae	Ant
Entomolepididae	Chondrillidae	Dem
Lamippidae	Briareidae	Ant
	Gorgoniidae	Ant
	Plexauridae	Ant
	Primnoidae	Ant
Lichomolgidae	Holothuriidae	Hol
	Stichopodidae	Hol
Macrochironidae	Echinometridae	Ech
	Renillidae	Ant
	Toxopneustidae	Ech
Micropontiidae	Brissidae	Ech

TABLE 5 Families of reef-dwelling Caribbean symbiotic copepods and their host families (anthozoans, echinoderms and sponges)* (*cont.*)

Copepod family	Host family	Host class or type
Nanaspidae	Brissidae	Ech
	Holothuriidae	Hol
	Stichopodidae	Hol
Pseudanthessiidae	Brissidae	Ech
	Clypeasteridae	Ech
	Holothuriidae	Hol
	Ophiodermatidae	Oph
Rhynchomolgidae	Actiniidae	Ant
	Antipathidae	Ant
	Corallimorphidae	Ant
	Gorgoniidae	Ant
	Gorgonocephalidae	Oph
	Plexauridae	Ant
	Ricordeidae	Ant
	Stichodactylidae	Ant
	Porifera	Po
Sabelliphilidae	Brissidae	Ech
	Holothuriidae	Hol
Synapticolidae	Ophiotrichidae	Oph
	Stichopodidae	Hol
	Amphiuridae	Oph
Synaptiphilidae	Ophiotrichidae	Oph
Thaumatopsyllidae		

* Abbreviations: Ant – Anthozoa, Cri – Crinoidea, Dem – Demospongiae Ech – Echinoidea, Hol – Holothuroidea, Hom – Homoscleromorpha, Oph – Ophiuroidea, Po – Porifera.

morphological and molecular studies of this material (Rocha et al., 2014). The DNA-barcoding of the hosts, photographing of hosts alive underwater, and photographing of host skeletons along with basic locality data are important for both identification and maintaining information about each copepod host and the establishment of base line information about their distributions (Hoeksema et al., 2011).

In total, there are 253, 197 and 81 records of copepods found associated with echinoderms, cnidarians and sponges, respectively (figs. 1–3). Forty-seven and 20 records of copepods are linked to the scleractinian coral families Favii-

dae and Meandrinidae (updated classification in Hoeksema & Cairns, 2019), respectively; 36 and 16 of these records pertain to the endoparasitic copepod symbionts belonging to the family Corallovexiidae. Most records from holothurians from the families Holothuriidae and Stichopodidae (75 and 35 records), from ophiuroids the families Ophiocomidae and Ophiotrichidae (29 and 19 records) are most common, from sea cucumbers the family Stichopodidae (35 records) is well represented, alcyonaceans the family Plexauridae (29), and corallimorpharians (four records) also are represented (table 3). Many

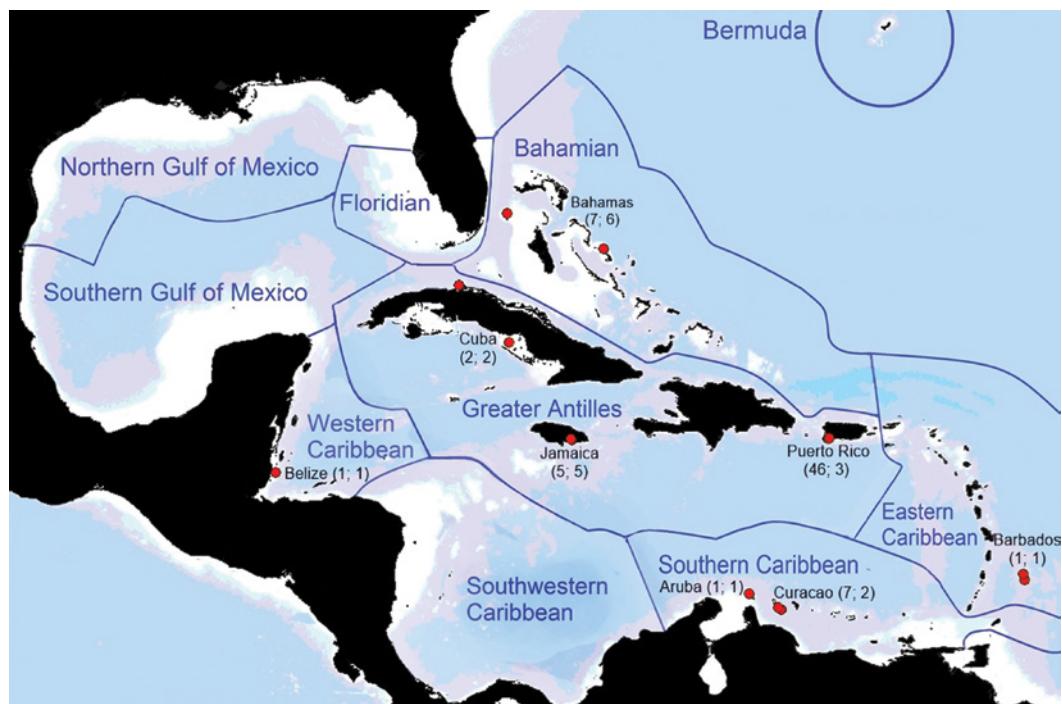


FIGURE 4 Caribbean copepods found on sponges (x; x = number of records and number of copepod species, respectively).

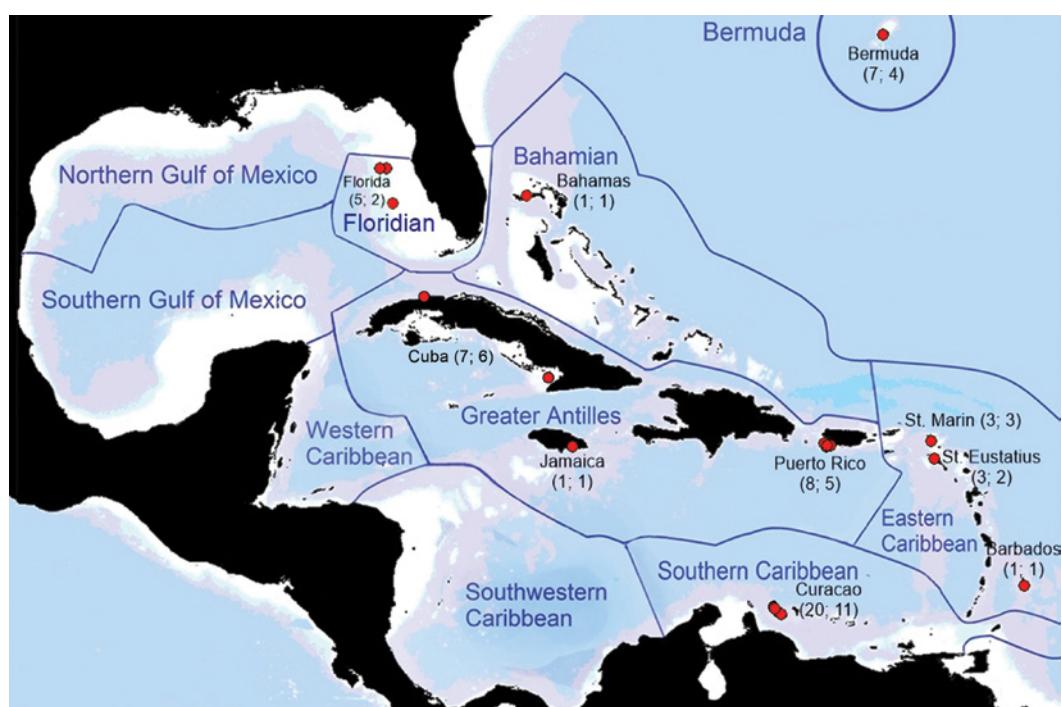


FIGURE 5 Caribbean copepods found on octocorals (*Anthozoa: Octocorallia*) (x; x – number of records and number of copepod species, respectively).

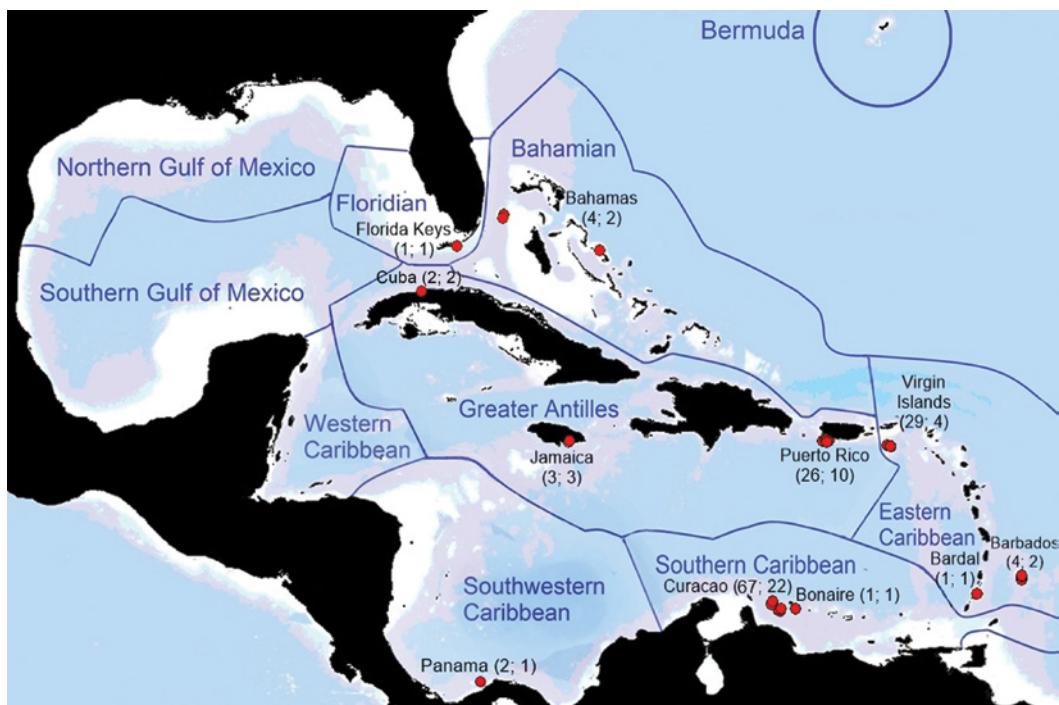


FIGURE 6 Caribbean copepods found on hexacorallians (Anthozoa: Hexacorallia) (x; x – number of records and number of copepod species, respectively).

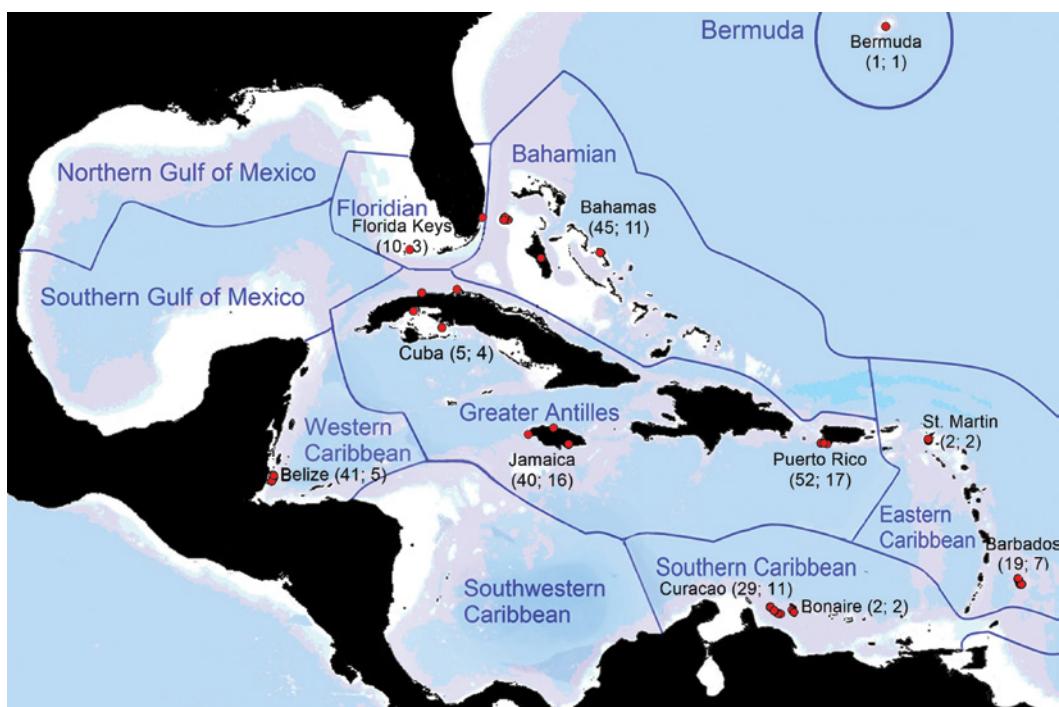


FIGURE 7 Caribbean copepods found on echinoderms (x; x – number of records and number of copepod species, respectively).

TABLE 6 Symbiotic copepods recorded on reef-dwelling anthozoans, echinoderms and sponges of the Greater Caribbean. The Gulf of Mexico has no records and is not included

Copepod species / Ecoregion	Bahamian	Bermuda	Eastern Caribbean	Floridian	Greater Antilles	Southern Caribbean	Southwestern Caribbean	Western Caribbean
<i>Acanthomolgus aequiseta</i> Stock, 1975					x			
<i>Acanthomolgus affinis</i> Stock, 1975					x	x		
<i>Acanthomolgus bayeri</i> Humes, 1973	x				x	x		
<i>Acanthomolgus bilobipes</i> Humes & Stock, 1973		x			x	x		
<i>Acanthomolgus dionyx</i> Stock, 1975				x	x	x	x	x
<i>Acanthomolgus gorgoniae</i> Humes, 1973	x				x	x		
<i>Acanthomolgus intermedius</i> Stock, 1975			x		x	x		
<i>Acanthomolgus longidactylus</i> Stock, 1975				x	x	x		
<i>Acanthomolgus longifurca</i> Stock, 1975				x	x	x		
<i>Acanthomolgus mononyx</i> Stock, 1975				x	x	x		
<i>Acanthomolgus muriceanus</i> Humes, 1973	x				x	x	x	x
<i>Acanthomolgus seticornis</i> Stock, 1975				x	x	x	x	x
<i>Acanthomolgus triangulipes</i> Stock, 1975			x	x	x	x	x	x
<i>Acanthomolgus verrucipes</i> Humes, 1973				x	x	x	x	x
<i>Aspidomolgus stoichactinus</i> Humes, 1969	x				x	x	x	x
<i>Asterocheres</i> sp.					x	x	x	x
<i>Asterocheres antillensis</i> Varela, 2010					x			
<i>Asterocheres bahamensis</i> Kim, 2010					x			
<i>Asterocheres crinidicola</i> Humes, 2000					x	x	x	x
<i>Asterocheres cubensis</i> Varela, 2010					x	x	x	x
<i>Asterocheres espinosai</i> Varela, Ortiz & Lalana, 2007					x	x	x	x
<i>Asterocheres fernandezmillerai</i> Varela, 2010					x	x	x	x
<i>Asterocheres garridoi</i> Varela et al., 2007					x	x	x	x
<i>Asterocheres kimi</i> Varela, 2012					x	x	x	x
<i>Asterocheres lalanae</i> Varela, 2013					x	x	x	x

TABLE 6 Symbiotic copepods recorded on reef dwelling anthozoans, echinoderms and sponges of the Greater Caribbean. The Gulf of Mexico has no records and is not included (*cont.*)

Copepod species / Ecoregion	Bahamian	Bermuda	Eastern Caribbean	Floridian	Greater Antilles	Southern Caribbean	Southwestern Caribbean	Western Caribbean
<i>Asterocheres maxillatus</i> Stock, 1987					x			
<i>Asterocheres reginae</i> Boxshall & Huys, 1994			x					
<i>Asterocheres oricurus</i> Kim, 2010			x					
<i>Asterocheres peniculatus</i> Kim, 2010	x							
<i>Asterocheres plumosus</i> Kim, 2010	x							
<i>Asterocheres reginae</i> Boxshall & Huys, 1994				x				
<i>Asterocheres simulans</i> (T. Scott, 1898)			x		x			
<i>Asterocheres trisetatus</i> Kim, 2010	x			x				
<i>Asterocheres unioviger</i> Kim, 2010	x			x				
<i>Asteropectella foliata</i> Stock, 1989				x				
<i>Asteropontius capillatus</i> Kim, 2010		x						
<i>Asteropontius iuxitus</i> Stock, 1989			x					
<i>Asteropontius longipalpus</i> Stock, 1975			x					
<i>Asteropontius mycetophylliae</i> Varela, Ortiz & Lalana, 2005, 2005			x		x			
<i>Asteropontius parvipalpus</i> Stock, 1975	x			x				
<i>Asteropontius proximus</i> Stock, 1987				x	x			
<i>Asteropontius ungellatus</i> Stock, 1975				x				
<i>Asteropontopsis faviae</i> Stock, 1987				x				
<i>Calonastes imparipes</i> Humes & Goenaga, 1978			x					
<i>Caribeopsyllus</i> sp. A				x				
<i>Caribeopsyllus chanwayi</i> Suárez-Morales, 1998							x	x
<i>Caribulus sculptus</i> (Humes, 1969)						x	x	x
<i>Chelacheres longipalpus</i> Stock & Humes, 1995	x					x		x
<i>Chelacheres optans</i> Stock & Humes, 1995	x						x	x

TABLE 6 Symbiotic copepods recorded on reef dwelling anthozoans, echinoderms and sponges of the Greater Caribbean. The Gulf of Mexico has no records and is not included (*cont.*)

Copepod species / Ecoregion	Bahamian	Bermuda	Eastern Caribbean	Floridian	Greater Antilles	Southern Caribbean	Southwestern Caribbean	Western Caribbean
<i>Hemicyclops columnaris</i> Humes, 1984	×	×						
<i>Hermacheres diploriae</i> Stock, 1987			×				×	
<i>Hermacheres montastreae</i> Stock, 1987					×		×	
<i>Hetairosynella aculeata</i> Kim, 2010	×							
<i>Hetairosynella angulata</i> Kim, 2010				×				
<i>Hetairosynella bifurcata</i> Kim, 2010					×			
<i>Kimchères fastigatus</i> (Kim, 2010)								
<i>Lamippina aequalis</i> Stock, 1973						×		
<i>Linaresia bouligandi</i> Stock, 1979								
<i>Macrochiron echinicolum</i> Humes & Stock, 1973	×							
<i>Macrochiron sargassi</i> Sars, 1916								
<i>Magnipipe caputmedusae</i> Stock, 1978				×				
<i>Meandromyzon coronatum</i> Stock, 1989						×		
<i>Meomicola amplexans</i> Stock, Humes & Gooding, 1963						×		
<i>Micropontius glaber</i> Stock, Humes & Gooding, 1963							×	
<i>Nanaspis exigua</i> Stock, Humes & Gooding, 1962						×	×	
<i>Nanaspis media</i> Stock, Humes & Gooding, 1962						×	×	
<i>Nanaspis pollens</i> Stock, Humes & Gooding, 1962					×	×	×	
<i>Nanaspis truncata</i> Stock, Humes & Gooding, 1962						×	×	
<i>Neoasterocheres humesi</i> (Varela, 2012)								
<i>Onychocheres dilatus</i> Stock & Gooding, 1986							×	
<i>Ophiopsyllus latus</i> Humes & Hendler, 1999								×
<i>Ophiopsyllus reductus</i> Stock, Humes & Gooding, 1963							×	×

<i>Ophiurochères bellulus</i> Humes, 1998								
<i>Orecturus antillensis</i> Varela, 2011								
<i>Paramolgus antillanus</i> Stock, 1975								
<i>Parmulella emarginata</i> Stock, 1992								
<i>Parmulides verrucosa</i> Wilson C.B., 1944								
<i>Parophiopsyllus ligatus</i> Humes & Hendler, 1972								
<i>Peltomyzon rostratum</i> Stock, 1975								
<i>Presynaptiphilus amphiophi</i> Humes & Hendler, 1972								
<i>Pseudanthessius acutus</i> Kim, 2009								
<i>Pseudanthessius deficiens</i> Stock, Humes & Gooding, 1963								
<i>Pseudanthessius exilicornis</i> Stock & Humes, 1995								
<i>Pseudanthessius pectinifer</i> Stock, Humes & Gooding, 1964								
<i>Pseudanthessius pectinifer</i> Stock, Humes & Gooding, 1964								
<i>Ridgevania fossilagena</i> Humes & Smith, 1974								
<i>Scottochères elongatus</i> (Scott T. & Scott A., 1894)								
<i>Setachères paraboeki</i> (Johnsson, 1998)								
<i>Sphaerippe caliginosa</i> Grygier, 1980								
<i>Sphaerippe</i> sp.								
<i>Stenomyzon edentatum</i> Kim, 2010								

TABLE 7 Numbers of reef-dwelling species of Caribbean anthozoans, sponges, and echinoderms recorded as host for copepods

Taxa	Estimated number of invertebrate host species	Number of species associated with copepods	Percent of total species
Subclass Hexacorallia (1)	45	21	47%
Subclass Octocorallia (2)	195	18	9%
Phylum Echinodermata (3, 4)	955	31	3%
Phylum Porifera (5)	760	9	1%
Total number	1955	79	4%

1 – Ivanenko, 2016, 2 – Bayer, 1961, 3 – Alvarado, 2011, 4 – Pawson et al., 2009, 5 – Perez et al., 2017

(25 of 81) records of copepods found on unidentified sponges.

Cyclopoida, representing mainly poecilostomatoids, with 317 records for 59 species is the most diverse order of copepods found in symbiosis with corals, sponges and echinoderms; Siphonostomatoida with 170 records of 55 species is the next (figs. 1–3, table 4). The order Calanoida is represented by the only known symbiotic calanoid copepod *Ridgewayia fosshageni* found associated with an actinarian at the Atlantic coast of Panama (Humes & Smith, 1974). The absence in the literature of any records of symbiotic harpacticoids is contradicted by the results recently obtained from samples of undescribed harpacticoids representing the family Laophontidae (see Yeom et al., 2018). Siphonostomatoid copepods of the diverse but poorly investigated family Asterocheridae and poecilostomatoid cyclopoids representing endoparasitic Corallovexiidae have the greatest diversity of associations and the highest number of host families (table 5). Asterocheridae are found living on invertebrates belonging to 22 families of cnidarians, echinoderms and sponges; Rhynchomolgidae are recorded from eight families of anthozoans and echinoderms; Corallovexiidae from five

families of stony corals only. Three families (Lamippidae, Pseudanthessiidae, and Synaptophilidae) are found associated with four host families; Macrochironidae and Nanaspidae are found with three host families; Canceriliidae and Lichomolgidae are found with two host families; seven families (Clausidiidae, Entomolepididae, Micropontiidae, Pseudocyclopidae, Sabelliphilidae, Synaptophilidae, and Thaumatopsyllidae) are restricted to only one family of invertebrate hosts (table 5). The remarkable absence on Caribbean host corals for copepods of the families Anchimolgidae (124 species in 32 genera) and Xarididae (96 species in 6 genera) so far only found on Indo-Pacific scleractinians (Stock, 1988), is confirmed by literature data and results of our recent sampling (Cheng et al., 2016; Hoeksema et al., 2017b; table 1). To explain this distribution a study of phylogenetic relationships of Corallovexiidae with other families of the order and the additional search for endoparasitic copepods living in Indo-Pacific stony corals is needed. This proposed study should include methods that enabled dissolution only of soft coral tissue while the chitinous exoskeletons of microscopic crustaceans to remain intact.

Fifty of 115 species of symbiotic copepods are mentioned in literature only once; 83 of 115 species of copepods are reported from only one species or one genus of the host. Only 13 species are reported in symbiosis with representatives of different families. Four species of copepods, the poecilostomatoids *Eupolytmophilus occidentalis* (fig. 1g), *Hemicyclops columnaris*, *Pseudanthessius deficiens* (fig. 1e) and the siphonostomatoid *Nanaspis pollens* (fig. 3e) are found in symbiosis with representatives of different classes. Of these species only *Hemicyclops columnaris* is found associated with invertebrates representing different phyla: echinoderms, corals, sponges and arthropods. The finding on sponge and on a compound ascidian of the copepod *Eupolytmophilus occidentalis* (family Sabelliphilidae) typically living on tubicolous polychaetes requires additional confirmation (Kim, 2009). Only two species of copepods are reported living on different classes: *Pseudanthessius deficiens* is found on three species of echinoderms to holothurians and echinoids; *Nanaspis pollens* is found on holothurians and ophiurioids. Thus, most species of symbiotic copepods are found associated with invertebrate hosts belonging to a single genus or only one family. These findings suggest the need to study the effect of host specificity more extensively. Similar studies of host switching events may show that this phenomenon has occurred several times during the evolution of symbiotic copepods, as it has among decapod crustacean taxa (Fransen & Hoeksema, 2014; Brinkmann & Fransen, 2016; García-Hernández et al., 2016; Horká et al., 2016; Hoeksema & Fransen, 2017; Hoeksema et al., 2018). The very nature of the specificity of copepods to the host or to the group of hosts requires a thorough sampling program as well as the use of molecular methods (Ivanenko et al., 2018).

The number of copepod species found on a single host species varies from one to

six. The sea cucumber *Holothuria arenicola* hosts six species of copepods (table 2). Three scleractinian and two holoturian species host five copepod species. The sea urchin *Meoma ventricosa* and the sea cucumber *Actinopyga agassizii* host four copepod species; three corals and one sponge host three species each; 18 host species have been recorded with two associated species of symbiotic copepods. Numerous findings of different species of symbiotic copepods on the same hosts as well as the presence on these hosts of other symbionts (shrimps, polychaetes, decapods, amphipods, fish etc.) shows little knowledge of species relationships in the symbiotic complexes (Stella et al., 2011; Hoeksema et al., 2012).

Copepod crustaceans living in symbiosis with the Caribbean reef invertebrates express diverse body shapes (cyclopiform, spherical, flattened etc.), remarkably different body sizes ranging from 0.25 mm (such as *Collocheres lunulifer*) to 4.75 mm (such as *Coralloxenia ventrospinosa*), and various types of feeding apparatuses as well as host utilizations. Analysis of literature and sorting of samples shows a different, and sometimes very large number of individual copepods living on a single host. The most numerous are the poorly studied asterocherid copepods living on and in diverse sponges: in one sample on one sponge thousands of individual copepods belonging to several species (Schirl, 1973; Ivanenko & Smurov, 1997; Ivanenko, 1998; Klinger et al., 2019; present study). The diversity, host specificity and phylogenetic relationships of these copepods with other siphonostomatoid copepods, especially species found in association with Caribbean stony corals are among the most interesting unexplored topics in coral reef ecology.

The symbiotic copepods are characterized by different ways of attachment to their host (loosely associated with or aggregating on the host's surface, tightly attached to the host

by claw-like appendages, inducing a gall-like structure, or residing inside of intestine, body cavity, or the host tissues). They also show marked variation in the number of embryos present in the egg-sacs (from one embryo, as in *Peltomyzon rostratum*, to 50 embryos, as in *Caribulus sculptus*) or numerous embryos laid in copepod-induced galls. The symbiotic copepods have different types of lecithotrophic and planktotrophic naupliar stages, some of which, like Thaumatoxylidae, are parasitic in the stomach of its host brittle star (fig. 2e; Hender & Kim, 2010).

Most of the ecological observations of the Caribbean symbiotic copepods are short comments added to the taxonomic descriptions and describe behavioral features and/or location on the host. Exceptions are the study of *Ophiopsyllus reductus* parasitizing on shallow-water ophiuroids (Emson & Mladenov, 1987; Emson et al., 1985), the ecological observations of the endoparasitic copepods of the family Coralloveliidae living in stony corals (Butter, 1979; Herriott & Immermann, 1979), the studies of the life cycle and ecology of copepods of the family Thaumatoxylidae parasitizing living in the ophiuroids at naupliar stages and having non-feeding adult and subadult copepodid stages (Suarez-Morales & Castellanos, 1998; Suarez-Morales & Tovar, 2004; Hender & Kim, 2010; Ferrari et al., 2010; Ferrari & von Vaupel Klein, 2019), and the experiments on calanoid copepods that were discovered in a host-specific association with only one species of actinarian (Humes & Smith, 1974). Recent field trips to sample Caribbean symbiotic copepods lead to the discovery of new species of highly transformed gall-inducing copepods of the genus *Sphaerippe* (Lamippidae) causing the Multiple Purple Spot Syndrome previously found in *Gorgia ventalina* (Ivanenko et al., 2017; Tracy et al., 2018).

The Caribbean symbiotic copepods are found on 47% species of scleractinians, 9%

species of octocorals, 3% of echinoderms and of less than 1% species of sponges (table 7). They are found on 4% of potential hosts of the Caribbean invertebrates which corresponds with previous data on symbiotic copepods (Humes, 1994). The literature and samples analyses indicate a poor knowledge of the diversity and distribution of symbiotic copepods living on different hosts in various ecoregions, and a particularly poor knowledge of copepods living on corals and sponges (Boxshall & Huys, 1994; García-Hernández et al., 2019; present study) with unknown but potentially high impact on their host and reef community (Ho, 2001; Berkenbusch & Rowden, 2003; Hatcher et al., 2012; Shelyakin et al., 2018; Zeppilli et al., 2015, 2018).

Acknowledgements

The preparation of the database, sampling in Cuba and processing of the paper were supported by the Russian Foundation for Basic Research (grant 18-54-34007). The data on samples from St. Eustatius (2015) and Curaçao (2017) were obtained with support of a Temminck-Fellowships to VNI by Naturalis Biodiversity Center. BWH and VNI want to thank staffs of the Caribbean Netherlands Science Institute (CNSI) at St. Eustatius and the Carmabi Research Station at Curaçao for hospitality and assistance. Sorting of samples and identification of copepods were conducted with partial support of the Russian Foundation for Basic Research (grant 18-04-01192). Jaaziel Emmanuel Garcia-Hernandez (University of Puerto Rico at Mayagüez) provided identification of sponges collected during the field trips; Frank Ferrari commented on a draft of the manuscript; Maickel Armenteros (University of Havana) hosted VNI and OAK during the field trip to Cuba.

References

- Alvarado, J.J. (2011) Echinoderm diversity in the Caribbean Sea. *Mar. Biodivers.*, 41, 261–285.
- Bayer, F.M. (1961) The shallow-water Octocorallia of the West Indian region. *Stud. Fauna Curaçao Caribb. Is.*, 12, 1–373.
- Berkenbusch, K. & Rowden, A.A. (2003) Ecosystem engineering: moving away from 'just-so' stories. *New Zeal. J. Ecol.*, 27, 67–73.
- Bongaerts, P., Ridgway, T., Sampayo, E.M. & Hoegh-Guldberg, O. (2010) Assessing the "deep reef refugia" hypothesis: focus on Caribbean reefs. *Coral Reefs*, 29, 309–327.
- Bongaerts, P., Frade, P.R., Hay, K.B., Englebert, N., Latijnhouwers, K.R.W., Bak, R.P.M., Vermeij, M.J.A. & Hoegh-Guldberg, O. (2015) Deep down on a Caribbean reef: lower mesophotic depths harbor a specialized coralendosymbiont community. *Sci. Rep.*, 5, 7702.
- Boxshall, G.A. & Huyss, R. (1994) *Asterocheres reginae*, a new species of parasitic copepod (Siphonostomatoida: Asterocheridae) from a sponge in Belize. *System. Parasitol.*, 27, 19–33.
- Brinkmann, B.W. & Fransen, C.H.J.M. (2016) Identification of a new stony coral host for the anemone shrimp *Periclimenes Rathbunae* Schmitt, 1924 with notes on the host-use pattern. *Contrib. Zool.*, 85, 437–456.
- Butter, M.E. (1979) Biology and infestation rate of *Corallonoxia longicauda*, an endoparasitic copepod of the West Indian reef coral *Meandrina meandrites*. *Bijdr. Dierk.*, 48, 141–155.
- Carpenter, K.E., Abrar, M., Aeby, G., Aronson, R.B., Banks, S. et al. (2008) One-third of reef-building corals face elevated extinction risk from climate change and local impacts. *Science*, 321, 560–563.
- Carvalho, S., Curdia, J., Pereira, F., Guerra-Garcia, J.M., Santos, M.N. & Cunha, M.R. (2014) Biodiversity patterns of epifaunal assemblages associated with the gorgonians *Eunicella gazella* and *Leptogorgia lusitanica* in response to host, space and time. *J. Sea Res.*, 85, 37–47.
- Cheng, Y.R., Meng, P.J., Mayfield, A.B. & Dai, C.F. (2016) Copepods associated with scleractinian corals: a worldwide checklist and a case study of their impact on the reef-building coral *Pocillopora damicornis* (Linnaeus, 1758) (Pocilloporidae). *Zootaxa*, 4174, 291–345.
- DeBiasse, M.B., Richards, V.P., Shivji, M.S. & Hellberg, M.E. (2016) Shared phylogeographical breaks in a Caribbean coral reef sponge and its invertebrate commensals. *J. Biogeogr.*, 43, 2136–2146.
- Dojiri, M., Hendler, G. & Kim, I.H. (2008) Larval development of *Caribeopsyllus amphiodiae* (Thaumatoxylidae: Copepoda), an enterozoic parasite of the brittle star *Amphiodia urtica*. *J. Crust. Biol.*, 28, 281–305.
- Edwards, C.L. (1891) Beschreibung einiger neuen Copepoden und eines neuen copepodenähnlichen Krebses, *Leuckartella paradoxa*. *Arch. Naturgesch.*, 57, 75–104.
- Emson, R.H. & Mladenov, P.V. (1987) Brittlestar host specificity and apparent host discrimination by the parasitic copepod *Ophiopsyllus reductus*. *Parasitology*, 94, 7–15.
- Emson, R.H., Mladenov, P.V. & Wilkie, I.C. (1985) Studies of the biology of the West Indian copepod *Ophiopsyllus reductus* (Siphonostomatoida: Cancerillidae) parasitic upon the brittle-star *Ophiocomella ophiactoides*. *J. Nat. Hist.*, 19, 151–171.
- Felder, D.L. & Camp, D.K. (2009) *Gulf of Mexico. Origins, Waters, and Biota. Vol. 1. Biodiversity*. Texas A&M University Press, College Station. 1393 pp.
- Ferrari, F.D. & von Vaupel Klein, J.C. (2019) Rhabdomoplea, a new superorder for the thaumatoxylid copepods: the consequence of an alternative hypothesis of copepod phylogeny. *Crustaceana*, 92, 177–188.
- Ferrari, F.D., Ivanenko, V.N. & Dahms, H.U. (2010) Body architecture and relationships among basal copepods. *J. Crust. Biol.*, 30, 465–477.
- Fransen, C.H.J.M. & Hoeksema, B.W. (2014) Going for the stars: extending the host record for the reef-dwelling Emperor shrimp, *Periclimenes*

- imperator* (Pontoniinae). *Mar. Biodivers.*, 44, 465–466.
- García-Hernández, J.E., Reimer, J.D. & Hoeksema, B.W. (2016) Sponges hosting the Zoantharia-associated crab *Platypodiella spectabilis* at St. Eustatius, Dutch Caribbean. *Coral Reefs*, 35, 209.
- García-Hernández, J.E., Sanchez, P.J., Hammerman, N.M. & Schizas, N.V. (2018) Fish, coral, and sponge assemblages associated with altiphotic and mesophotic reefs along the Guánica Biosphere Reserve continental shelf edge, Southwest Puerto Rico. *Front. Mar. Sci.*, 5, 303.
- García-Hernández, J.E., Hammerman, N.M., Cruz-Motta, J.J. & Schizas, N.V. (2019) Associated organisms inhabiting the calcareous sponge *Clathrina lutea* in La Parguera Natural Reserve, Puerto Rico. *bioRxiv*, 596429. doi:10.1101/596429
- Gotto, R.V. (1979) The association of copepods with marine invertebrates. *Adv. Mar. Biol.*, 16, 1–109.
- Gotto, R.V. (1993) Commensal and parasitic copepods associated with marine invertebrates (and whales). In: D.M. Kermack, R.S.K. Barnes & J.H. Crothers (Eds) *Synopses of the British Fauna (New Series)*, 46, pp. 1–264.
- Grygier, M.J. (1980) Two new lamippid copepods parasitic on gorgonians from Hawaii in the Bahamas. *Proc. Biol. Soc. Wash.*, 93, 662–673.
- Hatcher, M.J., Dick, J.T.A. & Dunn, A.M. (2012) Diverse effects of parasites in ecosystems: linking interdependent processes. *Front. Ecol. Environ.*, 10, 186–194.
- Hendler, G. & Kim, I.H. (2010) Larval biology of thaumatoxylid copepods endoparasitic in Caribbean ophiuroids. *J. Crust. Biol.*, 30, 206–224.
- Herriott, A.B. & Immermann, F.W. (1979) A preliminary report on copepods endoparasitic in stony corals of St. Croix, U.S. Virgin Islands. *Crustaceana*, 36, 166–172.
- Ho, J-S. (2001) Why do symbiotic copepods matter? *Hydrobiologia*, 453/454, 1–7.
- Hoeksema, B.W. & Cairns, S. (2019) World List of Scleractinia. Available online: <http://www.marinespecies.org/scleractinia> [Accessed 26 April 2019].
- Hoeksema, B.W., van der Land, J., van der Meij, S.E.T., van Ofwegen, L.P., Reijnen, B.T., van Soest, R.W.M. & de Voogd, N.J. (2011) Unforeseen importance of historical collections as baselines to determine biotic change of coral reefs: the Saba Bank case. *Mar. Ecol.*, 32, 135–141.
- Hoeksema, B.W., van der Meij, S.E.T. & Fransen, C.H.J.M. (2012) The mushroom coral as a habitat. *J. Mar. Biol. Assoc. U.K.*, 92, 647–663.
- Hoeksema, B.W., Reimer, J.D. & Vonk, R. (2017a) Editorial: biodiversity of Caribbean coral reefs (with a focus on the Dutch Caribbean). *Mar. Biodivers.*, 47, 1–10.
- Hoeksema, B.W., van Beusekom, M., ten Hove, H.A., Ivanenko, V.N., van der Meij, S.E.T. & van Moorsel, G.W.N.M. (2017b) *Helioseris cucullata* as a host coral at St. Eustatius, Dutch Caribbean. *Mar. Biodivers.*, 47, 71–78.
- Hoeksema, B.W., Bongaerts, P. & Baldwin, C.C. (2017c) High coral cover at lower mesophotic depths: a dense *Agaricia* community at the leeward side of Curaçao, Dutch Caribbean. *Mar. Biodivers.*, 47, 67–70.
- Hoeksema, B.W., Butôt, R., & García-Hernández, J.E. (2018) A new host and range record for the gall crab *Fungicola fagei* as symbiont of the mushroom coral *Lobactis scutaria* at Hawai'i. *Pac. Sci.*, 72, 251–261.
- Horká, I., De Grave, S., Fransen, C.H.J.M., Petrusk, A. & Ďuriš, Z. (2016) Multiple host switching events shape the evolution of symbiotic palaeomonid shrimps (Crustacea: Decapoda). *Sci Rep.*, 6, 26486.
- Humes, A.G. (1969a) *Aspidomolgus stoichactinus* n. gen., n. sp. (Copepoda, Cyclopoida) associated with an actiniarian in the West Indies. *Crustaceana*, 16, 225–242.
- Humes, A.G. (1969b) Copepods of the genus *Scambicornus* (Cyclopoida, Lichomolgidae) associated with holothurians in the West Indies. *Stud. Fauna Curacao Caribb. Is.*, 29, 79–95.
- Humes, A.G. (1973) Cyclopoid copepods of the genus *Acanthomolgus* (Lichomolgidae) associated

- with gorgonians in Bermuda. *J. Nat. Hist.*, 7, 85–115.
- Humes, A.G. (1982) A review of Copepoda associated with sea anemones and anemone-like forms (Cnidaria, Anthozoa). *Trans. Am. Philosoph. Soc. Phil.*, 72, 1–120.
- Humes, A.G. (1984) *Hemicyclops columnaris* sp. n. (Copepoda, Poecilostomatoida, Clausidiidae) associated with a coral in Panama (Pacific side). *Zool. Scr.*, 13, 33–39.
- Humes, A.G. (1985) Cnidarians and copepods: a success story. *Trans. Am. Microsc. Soc.*, 104, 313–320.
- Humes, A.G. (1994) How many copepods? *Hydrobiologia*, 292, 1–7.
- Humes, A.G. (1998) Copepoda (Siphonostomatoida) associated with Ophiuroidea in Jamaica, Puerto Rico and Barbados. *Zool. Verh.*, 323, 365–382.
- Humes, A.G. (2000) *Asterocheres crinoidicola* n. sp., a copepod (Siphonostomatoida: Asterocheridae) parasitic on crinoids in Belize. *Syst. Parasitol.*, 47, 103–110.
- Humes, A.G. & Goenaga, C. (1978) *Calonastes imparipes*, new genus, new species (Copepoda, Cyclopoida), associated with the antipatharian coral genus *Stichopathes* in Puerto Rico. *Bull. Mar. Sci.*, 28, 189–197.
- Humes, A.G. & Hendler, G. (1972) New cyclopoid copepods associated with the ophiuroid genus *Amphioplus* on the eastern coast of the United States. *Trans. Am. Microsc. Soc.*, 91, 539–555.
- Humes, A.G. & Hendler, G. (1999) Biology and taxonomy of species of *Ophiopsyllus* and *Pseudanthessius* (Copepoda) associated with brittle stars (Ophiuroidea) in Belize. *Bull. Mar. Sci.*, 65, 699–713.
- Humes, A.G. & Ho, J.S. (1970) The genus *Diogenella* (Copepoda, Cyclopoida) parasitic in holothurians in the West Indies. *Crustaceana*, 19, 15–36.
- Humes, A.G. & Ho, J.S. (1971) The genus *Diogenidium* (Copepoda, Cyclopoida) parasitic in holothurians in the West Indies. *Crustaceana*, 20, 171–191.
- Humes, A.G. & Stock, J.H. (1973) A revision of the family Lichomolgidae Kossmann, 1877, cyclopoid copepods mainly associated with marine invertebrates. *Smiths. Contr. Zool.*, 127, 1–368.
- Humes, A.G. & Smith, W.L. (1974) *Ridgeawayia foss-hageni* n. sp. (Copepoda, Calanoida) associated with an actiniarian in Panama, with observations on the nature of the association. *Caribb. J. Sci.*, 14, 125–139.
- Hughes, T.P., Barnes, M.L., Bellwood, D.R., Cinner, J.E., Cumming, G.S. et al. (2017) Coral reefs in the Anthropocene. *Nature*, 546, 82–90.
- Ivanenko, V.N. (1998) *Laperocheres koorius*, a new genus and species (Copepoda: Siphonostomatoida: Asterocheridae) associated with the sponge *Amphimedon* in Australia. *Proc. Biol. Soc. Wash.*, 111, 263–271.
- Ivanenko, V.N. (2016) Symbiotic copepods associated with invertebrates at St. Eustatius. In: B.W. Hoeksema (Ed.) *Marine Biodiversity Survey of St. Eustatius, Dutch Caribbean, 2015*, pp. 60–66. Naturalis Biodiversity Center, Leiden, and ANEMOON Foundation, Bennebroek.
- Ivanenko, V.N., Nikitin, M.A. & Hoeksema, B.W. (2017) Multiple purple spots in the Caribbean sea fan *Gorgonia ventalina* caused by parasitic copepods at St. Eustatius, Dutch Caribbean. *Mar. Biodivers.*, 47, 79–80.
- Ivanenko, V.N., Hoeksema, B.W., Mudrova, S.V., Nikitin, M.A., Martínez, A., Rimskaya-Korsakova, N.N., Berumen, M.L. & Fontaneto, D. (2018) Lack of host specificity of copepod crustaceans associated with mushroom corals in the Red Sea. *Mol. Phylogenet. Evol.*, 127, 770–780.
- Ivanenko, V.N. & Smurov, A.V. (1997) *Asterocheres flustrae* n. sp. (Copepoda: Siphonostomatoida: Asterocheridae) associated with *Flustra foliacea* L. (Bryozoa) from the White Sea. *Syst. Parasitol.*, 38, 111–130.
- Jossart, Q., De Ridder, C., Lessios, H.A., Bauwens, M., Motreuil, S., Rigaud, T., Wattier, R.A. & David, B. (2017) Highly contrasted population genetic structures in a host-parasite pair in the Caribbean Sea. *Ecol. Evol.* 7: 9267–9280.

- Kim, I.H. (2009) Poecilostome copepods (Crustacea: Cyclopoida) associated with marine invertebrates from tropical waters. *Kor. J. Syst. Zool. Spec. Issue*, 7, 1–90.
- Kim, I.H. (2010) Siphonostomatoid Copepoda (Crustacea) associated with invertebrates from tropical waters. *Kor. J. Syst. Zool. Spec. Issue*, 8: 1–176.
- Kinder, T.H., Heburn, G.W. & Green, A.W. (1985) Some aspects of the Caribbean circulation. *Mar. Geol.*, 68, 25–52.
- Klinger, C., Żółtowska-Aksamitowska, S., Wysocki, M., Tsurkan, M.V., Galli, R., Petrenko, I., Machałowski, T., EreskovSKY, A., Martinović, R., Muzychka, L., Smolii, O.B., Bechmann, N., Ivanenko, V., Schupp, P.J., Jesionowski, T., Giovine, M., Joseph, Y., Bornstein, S.R., Voronkina, A. & Ehrlich, H. (2019) Express method for isolation of ready-to-use 3D chitin scaffolds from *Aplysina archeri* (Aplysinidae: Verongida) Demosponge. *Mar. Drugs*, 17, 131.
- Korzhavina, O.A., Ivanenko, V.N. (2019) *Copepoda Associated with Caribbean Reef-Dwelling Cnidarians, Echinoderms and Sponges*. Lomonosov Moscow State University. Occurrence dataset: <https://doi.org/10.15468/qlseki> [Accessed via GBIF.org 28 June 2019].
- Loh, T.L. & Pawlik, J.R. (2014) Chemical defenses and resource trade-offs structure sponge communities on Caribbean coral reefs. *Proc. Nat. Acad. Sci. USA*, 111, 4151–4156.
- Miloslavich, P., Dhaz, J.M., Klein, E., Alvarado, J.J., Dhaz, C., et al. (2010) Marine biodiversity in the Caribbean: Regional estimates and distribution patterns. *PLoS ONE*, 5, e11916.
- Ortiz, M., Lalana, R. & Figueroa, L. (1998) La presencia de *Aspidomolgus stoichactinus* Humes, 1969 (Copepoda, Cyclopoida), en Cuba. *Avicennia*, 8, 161–162.
- Pawson, D.L., Vance, D.J., Messing, C.G., Solhs-Marhn, F.A. & Mah, C.L. (2009) Echinodermata of the Gulf of Mexico. In: D.L. Felder & D.K. Camp (Eds) 1177–1204, *Gulf of Mexico: Origin, Waters, and Biota. Vol. 1. Biodiversity*. Texas A&M University Press, College Station.
- Perez, T., Dhaz, M.C., Ruiz, C., Cyndor-Lujan, B., Klautau, M., Hajdu, E. et al. (2017) How a collaborative integrated taxonomic effort has trained new spongiologists and improved knowledge of Martinique Island (French Antilles, eastern Caribbean Sea) marine biodiversity. *PLoS ONE*, 12, e0173859.
- Rivera-Monroy, V.H., Twilley, R.R., Bone, D., Childers, D.L., Coronado-Molina, R.C. et al. (2004) A conceptual framework to develop long-term ecological research and management objectives in the wider Caribbean region. *Bio-science*, 54, 843–856.
- Roberts, C., McClean, C., Veron, J., Hawkins, J., Allen, G. et al. (2002) Marine biodiversity hotspots and conservation priorities for tropical reefs. *Science*, 295, 1280–1284.
- Rocha, L.A., Aleixo, A., Allen, G., Almeda, F., Baldwin, C.C. et al. (2014) Specimen collection: an essential tool. *Science*, 344, 815–816.
- Schirl, K. (1973) Cyclopoida Siphonostoma (Crustacea) von Banyuls (Frankreich, Pyrénées-Orientales) mit besonderer Berücksichtigung des Gast-Wirtverhältnisses. *Bijdr. Dierk.*, 43, 64–92.
- Scott, P.J.B. (1987) Associations between corals and macro-infaunal invertebrates in Jamaica, with a list of Caribbean and Atlantic coral associates. *Bull. Mar. Sci.*, 40, 271–286.
- Shelyakin, P.V., Garushyants, S.K., Nikitin, M.A., Mudrova, S.V., Berumen, M., Speksnijder, A.G.C.L., Hoeksema, B.W., Fontaneto, D., Gelfand, M.S. & Ivanenko, V.N. (2018) Microbiomes of gall-inducing copepod crustaceans from the corals *Stylophora pistillata* (Scleractinia) and *Gorgonia ventalina* (Alcyonacea). *Sci. Rep.*, 8, 11563.
- Spalding, M.D., Fox, H.E., Allen, G.R., Davidson, N., Ferdaña, Z.A. et al. (2007) Marine ecoregions of the world: a bioregionalization of coastal and shelf areas. *Bioscience*, 57, 573–583.
- Stella, J.S., Pratchett, M.S., Hutchings, P.A., Jones, G.P. (2011) Coral associated invertebrates: diversity,

- ecological importance and vulnerability to disturbance. *Oceanogr. Mar. Biol. Ann. Rev.*, 49, 43–104.
- Stock, J.H. (1968) Copepoda endoparasitic of tropical holothurians. *Bull. Zool. Mus. Univ. Amster.*, 1, 89–105.
- Stock, J.H. (1973) Copepoda of the family Lamippidae from the western Atlantic and Caribbean. *Stud. Fauna Curaçao Caribb. Is.*, 43, 22–41.
- Stock, J.H. (1975a) Corallovexiidae, a new family of transformed copepods endoparasitic in reef corals, with two new genera and ten new species from Curaçao. *Stud. Fauna Curaçao Caribb. Is.*, 47, 1–45.
- Stock, J.H. (1975b) Copepoda associated with West Indian Actiniaria and Corallimorpharia. *Stud. Fauna Curaçao Caribb. Is.*, 48, 88–118.
- Stock, J.H. (1975c) On twelve species of the genus *Acanthomolgus* (Copepoda Cyclopoida: Lichomogidae) associated with West Indian octocorals. *Bijdr. Dierk.*, 45, 237–269.
- Stock, J.H. (1975d) *Peltomyzon rostratum* n. gen., n. sp., a siphonostome cyclopoid copepod associated with the West Indian coral *Montastrea*. *Bull. Zool. Mus. Univ. Amster.*, 4, 111–117.
- Stock, J.H. (1978) *Magnippe caputmedusae* n. gen., n. sp. (Copepoda: Lamippidae), a highly transformed endoparasite in octocorals of the genus *Thesea* from the Gulf of Mexico. *Mem. Hourgl. Cruises*, 3, 1–11.
- Stock, J.H. (1979) A new species of *Linaresia* (Copepoda: Lamippidae) endoparasitic in the octocoral *Placogorgia* from the Gulf of Mexico. *Mem. Hourgl. Cruises*, 5, 1–7.
- Stock, J.H. (1987) Copepoda Siphonostomatoida associated with West Indian hermatypic corals I: Associates of Scleractinia: Faviinae. *Bull. Mar. Sci.*, 40, 464–483.
- Stock, J.H. (1988) Copepods associated with reef corals: a comparison between the Atlantic and the Pacific. Copepods associated with reef corals: a comparison between the Atlantic and the Pacific. *Hydrobiologia*, 167–168, 545–547.
- Stock, J.H. (1989) Copepoda Siphonostomatoida associated with West Indian hermatypic corals. 2. Associates of Scleractinia: Montastreinae and Trochosmiliidae. Studies in Honour of Dr. Pieter Wagenaar Hummelinck. *Uitgaven Naturwetenschappelijke Studiekring voor Suriname en de Nederlandse Antillen* 123, 145–169.
- Stock, J.H. (1992a) A new species of *Hemicyclops* (Crustacea, Copepoda, Poecilostomatoida, Clausidiidae) associated with hermit crabs in Curaçao. *Stud. Fauna Curaçao Caribb. Is.*, 71, 69–78.
- Stock, J.H. (1992b) Entomolepididae (Copepoda, Siphonostomatoida) from the Antilles. *Stud. Fauna Curaçao Caribb. Is.*, 71, 53–68.
- Stock, J.H. & Gooding, R.U. (1986) A new siphonostomatoid copepod associated with the West Indian sea urchin, *Diadema antillarum*. *Bull. Mar. Sci.*, 39, 102–109.
- Stock, J.H. & Humes, A.G. (1995) Copepoda associated with Echinoidea from the West Indies. *Stud. Fauna Curaçao Caribb. Is.*, 72, 25–46.
- Stock, J.H., Humes, A.G. & Gooding, R.U. (1962) Copepoda associated with West Indian invertebrates – I. The genus *Nanaspis* (Siphonostomata, Nanaspidae). *Stud. Fauna Curaçao Caribb. Is.*, 13, 1–20.
- Stock, J.H., Humes, A.G. & Gooding, R.U. (1963a) Copepoda associated with West Indian invertebrates – II. Cancerillidae, Micropontonidae (Siphonostoma). *Stud. Fauna Curaçao Caribb. Is.*, 15, 1–23.
- Stock, J.H., Humes, A.G. & Gooding, R.U. (1963b) Copepods associated with West Indian invertebrates – IV The genera *Octopiscola*, *Pseudanthes-sius* and *Meomicola* (Cyclopoida, Lichomolgidae). *Stud. Fauna Curaçao Caribb. Is.*, 18, 1–74.
- Suarez-Morales, E. & Castellanos, I.A. (1998) *Caribeopsyllus chawayi*, new genus, new species (Copepoda: Cyclopoida: Thaumatopsyllidae), from a Mexican reef area. *J. Crust. Biol.*, 18, 199–204.
- Suarez-Morales, E. & Tovar, E. (2004) Postnaupliar stages of a thaumatopsyllid copepod from a

- reef area of the western Caribbean Sea. *Sarsia*, 89, 223–244.
- Terrón-Sigler, A., Penalver-Duque, P., Leon-Muez, D., Espinosa Torre, F. (2014) Spatio-temporal macrofaunal assemblages associated with the endangered orange coral *Astroides calyculus* (Scleractinia: Dendrophylliidae). *Aquat. Biol.*, 21, 143–154.
- Tracy, A.M., Weil, E. & Harvell, C.D. (2018) Octocoral co-infection as a balance between host immunity and host environment. *Oecologia*, 186, 743–753.
- van der Meij, S.E.T., van Tienderen, K.M., and Hoeksema, B.W. (2015) A mesophotic record of the gall crab *Opecarcinus hypostegus* from a Curaçaoan reef. *Bull. Mar. Sci.*, 91, 205–206.
- van Soest, R.W.M., Boury-Esnault, N., Vacelet, J., Dohrmann, M., Erpenbeck, D. et al. (2012) Global diversity of sponges (Porifera). *PLoS ONE*, 7, e35105.
- Varela, C. (2010a) Nueva especie de *Asterocheres* y primer registro para Cuba de *A. crinoidicola* (Copepoda: Siphonostomatoida: Asterocheridae). *Rev. Cienc. Mar. Cost.*, 2, 53–59.
- Varela, C. (2010b) Dos nuevas especies de *Asterocheres* Boeck, 1860 (Crustacea: Copepoda) para Cuba. *Novit. Carib.*, 3, 36–43.
- Varela, C. (2011a) Especie nueva de *Hermannella* (Crustacea: Copepoda), con dos nuevos registros de copépodos para Cuba. *Solenodon*, 9, 1–7.
- Varela, C. (2011b) Una nueva especie de *Orecturus* Humes, 1992 (Copepoda: Siphonostomatoida: Asterocheridae) de Cuba. *Rev. Cienc. Mar. Cost.*, 3, 1–97.
- Varela, C. (2012) Tres especies nuevas de *Asterocheres* (Crustacea, Copepoda, Siphonostomatoida) con un nuevo registro para Cuba. *Solenodon*, 10, 8–22.
- Varela, C. & Lalana, R. (2007) Especie nueva de *Orecturus* (Crustacea: Copepoda) para Cuba. *Solenodon*, 6, 15–19.
- Varela, C., Castellanos, S. & L. Hernández (2008) Registros nuevos de invertebrados (Cnidaria y Crustacea) para Cuba. *Cocuyo*, 17, 12–14.
- Varela, C., Ortiz, M. & Lalana, R. (2003) Nuevos registros de copépodos asociados a invertebrados marinos (Poecilostomatoidea: Lichomolgoidae), en aguas cubanas. *Rev. Invest. Mar.*, 24, 25–256.
- Varela, C., Ortnz, M. & Lalana, R. (2005a) Especie nueva de *Asteropontius* (Copepoda: Siphonostomatoida) para Cuba. *Solenodon*, 5, 6–9.
- Varela, C., Ortiz, M. & Lalana, R. (2005b) Nuevos registros de copépodos (Crustacea: Maxillopoda: Copepoda), para aguas cubanas. *Rev. Invest. Mar.*, 26, 79–80.
- Varela, C., Ortiz, M. & Lalana, R. (2007a) A new species of copepod of the genus *Asterocheres* Boeck, 1860 (Copepoda: Siphonostomatoida), from Cuban waters. *Avicennia*, 19, 31–36.
- Varela, C., Ortiz, M. & Lalana, R. (2007b) Especie nueva de copepodo espongicola (Copepoda: Siphonostomatoida: Asterocheridae) para Cuba. *Solenodon*, 6, 1–7.
- Veglia, A.J., Hammerman, N.H., Rivera Rosaly, C.R., Lucas, M.Q., Galindo, A., Estranza Corgosinho, P.H. & Schizas, N.V. (2018) Characterizing population structure of coral-associated fauna from mesophotic and shallow habitats in the Caribbean. *J. Mar. Biol. Assoc. U.K.*, 99, 619–629. doi:10.1017/S0025315418000413
- Walter, T.C. & Boxshall G. (2019) World of Copepods database. Available online: <http://www.marinespecies.org/copepoda> [Accessed 5 April 2019].
- WoRMS Editorial Board (2019) World Register of Marine Species. Available online: <http://www.marinespecies.org> at VLIZ [Accessed 22 June 2019].
- Yeom, J., Nikitin, M.A., Ivanenko, V.N. & Lee, W. (2018) A new minute ectosymbiotic harpacticoid copepod living on the sea cucumber *Eupentacta fraudatrix* in the East/Japan Sea. *PeerJ*, 6, e4979.
- Zea, S., Henkel, T.P. & Pawlik, J.R. (2014) The Sponge Guide: a picture guide to Caribbean sponges. 3rd Edition. Available online: www.spongeguide.org [Accessed 6 April 2019].

- Zeppilli, D., Leduc, D., Fontanier, C., Fontaneto, D., Fuchs, S. et al. (2018) Characteristics of meiofauna in extreme marine ecosystems: a review. *Mar. Biodivers.*, 48, 35–71.
- Zeppilli, D., Sarrazin, J., Leduc, D., Arbizu, P.M., Fontaneto, D. et al. (2015) Is the meiofauna a good indicator for climate change and anthropogenic impacts? *Mar. Biodivers.*, 45, 505–53.

RECEIVED: 29 APRIL 2019 | REVISED AND

ACCEPTED: 2 JULY 2019

EDITOR: R.W.M. VAN SOEST