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

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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 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

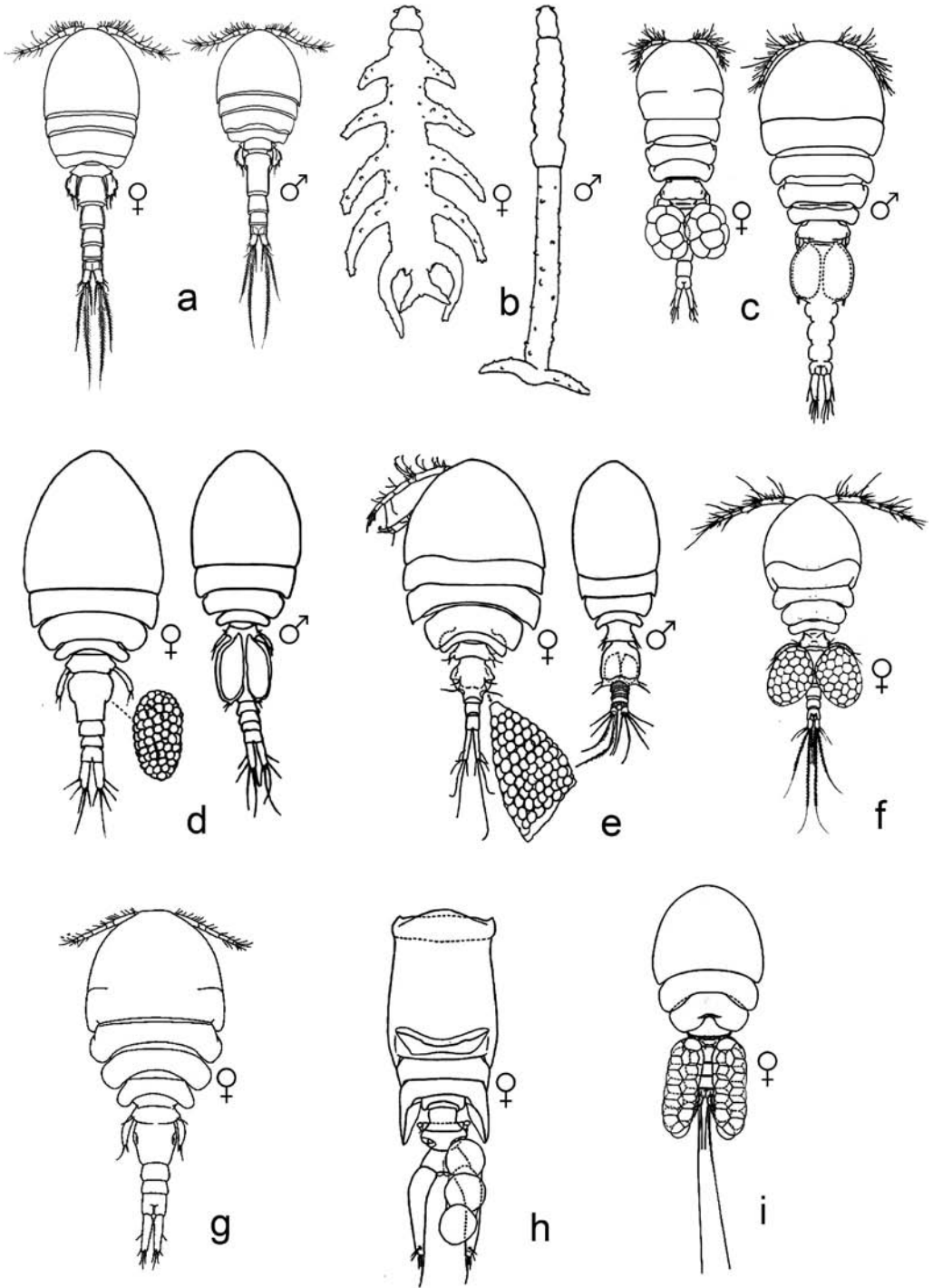


FIGURE 1 Poecilostomatoid Cyclopoida, dorsal view. a – *Hemicyclops columnaris* (Clausidiidae), b – *Corallovexia similis* (Corallovexiidae), c – *Diogenidium nasutum* (Lichomolgidae), d – *Macrochiron echinicum* (Macrochironidae), e – *Pseudanthessius deficiens* (Pseudanthessiidae), f – *Doridicola astrophyticus* (Rhynchomolgidae), g – *Eupolymniphilus occidentalis* Kim, 2009 (Sabelliphilidae), h – *Meomicola amplectans*, i – *Presynaptiphilus amphiopli* (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	<i>Clathrina lutea</i> Azevedo et al., 2017	Po	PR	Garcia-Hernandez et al., 2017
Calanoida				
Pseudocyclopidae				
<i>Ridgewayia fossahageni</i> Humes & Smith, 1974	<i>Bartholomea annulata</i> (Le Sueur, 1817)	Act	Pan	Humes & Smith, 1974
Cyclopoidea				
Clausidiidae				
<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	Porifera	Po	Bah	Kim, 2009
Corallovexiidae				
<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; Butler, 1979
Corallonoxia sp.	<i>Dichocoenia stokesii</i> Milne Edwards & Haime, 1848	Sc	Cur	Stock, 1975a
Corallovexia brevibrachium Stock, 1975	<i>Pseudodiploria strigosa</i> (Dana, 1846) (as <i>Diploria strigosa</i> (Dana, 1846))	Sc	VI	Herriott & Immermann, 1979
Corallovexia brevibrachium Stock, 1975	<i>Diploria labyrinthiformis</i> (Linnaeus, 1758)	Sc	Cur	Stock, 1975a
Corallovexia dorsospinosa minor Stock, 1975	<i>Montastraea cavernosa</i> (Linnaeus, 1767) (as <i>Montastraea brasiliiana</i> (Verrill, 1901))	Sc	Cur	Stock, 1975a
Corallovexia dorsospinosa Stock, 1975	<i>Montastraea cavernosa</i> (Linnaeus, 1767)	Sc	Cur	Stock, 1975a

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>Coralloplexia kristenseni</i> Stock, 1975	<i>Colpophyllia natans</i> (Houttuyn, 1772) (as <i>Colpophyllia natans</i> (Müller))	Sc	Cur	Stock, 1975a
<i>Coralloplexia longibrachium</i> Stock, 1975	<i>Pseudodiploria strigosa</i> (Dana, 1846)	Sc	Cur	Stock, 1975a
<i>Coralloplexia longibrachium</i> Stock, 1975	<i>Colpophyllia natans</i> (Houttuyn, 1772)	Sc	Cur	Stock, 1975a
<i>Coralloplexia longibrachium</i> Stock, 1975	<i>Manicina areolata</i> (Linnaeus, 1758) (as <i>Manicina areolata</i> f. <i>mayori</i> Wells, 1936)	Sc	Cur	Stock, 1975a
<i>Coralloplexia mediobrachium</i> Stock, 1975	<i>Colpophyllia natans</i> (Houttuyn, 1772)	Sc	VI	Herriott & Immer- mann, 1979
<i>Coralloplexia mediobrachium</i> Stock, 1975	<i>Manicina areolata</i> (Linnaeus, 1758)	Sc	Cur	Stock, 1975a
<i>Coralloplexia mediobrachium</i> Stock, 1975	<i>Pseudodiploria clavosa</i> (Ellis & Solander, 1786) (as <i>Diploria clavosa</i> (Ellis & Solander, 1786))	Sc	Cur, VI	Stock, 1975a; Herri- ott & Immermann, 1979
<i>Coralloplexia mediobrachium</i> Stock, 1975	<i>Pseudodiploria strigosa</i> (Dana, 1846) (as <i>Diploria strigosa</i> (Dana, 1846))	Sc	Cur, VI	Stock, 1975a; Herri- ott & Immermann, 1979
<i>Coralloplexia mixtibrachium</i> Stock, 1975	<i>Colpophyllia natans</i> (Houttuyn, 1772)	Sc	Cur, VI	Stock, 1975a; Herri- ott & Immermann, 1979
<i>Coralloplexia similis</i> Stock, 1975	<i>Acropora palmata</i> (Lamarck, 1816)	Sc	Cur, VI	Stock, 1975a; Herri- ott & Immermann, 1979
<i>Coralloplexia similis</i> Stock, 1975	<i>Pseudodiploria strigosa</i> (Dana, 1846)	Sc	VI	Herriott & Immer- mann, 1979
<i>Coralloplexia</i> sp.	<i>Acropora palmata</i> (Lamarck, 1816)	Sc	VI	Herriott & Immer- mann, 1979
<i>Coralloplexia</i> sp.	<i>Meandrina meandrites</i> (Linnaeus, 1758)	Sc	VI	Herriott & Immer- mann, 1979

<i>Corallohexia</i> sp.	<i>Montastraea cavernosa</i> (Linnaeus, 1767)	Sc	VI	Herriott & Immermann, 1979
<i>Corallohexia</i> sp.	<i>Mycetophyllia lamarckiana</i> Milne Edwards & Haime, 1849	Sc	VI	Herriott & Immermann, 1979
<i>Corallohexia</i> sp.	<i>Orbicella annularis</i> (Ellis & Solander, 1786) (as <i>Montastraea annularis</i> (Ellis & Solander, 1786))	Sc	Cur	Stock, 1975a
<i>Corallohexia</i> sp.	<i>Pseudodiploria strigosa</i> (Dana, 1846)	Sc	VI	Herriott & Immermann, 1979
<i>Corallohexia ventrospinosa</i> Stock, 1975	<i>Montastraea cavernosa</i> (Linnaeus, 1767)	Sc	Cur	Stock, 1975a
Lamippidae				
<i>Enalcyonium</i> sp.	<i>Plexaurella nutans</i> (Duchassaing & Michelotti, 1860)	Oc	Cub	Varela et al., 2005b
<i>Enalcyonium euniceae</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> f. <i>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 variicauda</i> Stock, 1973	<i>Briareum asbestinum</i> (Pallas, 1766)	Oc	PR	Stock, 1973
<i>Lamippina aequalis</i> Stock, 1973	<i>Antillogorgia</i> Bayer, 1951 (as <i>Pseudopterogorgia</i> Kükenthal, 1919)	Oc	Cur	Stock, 1973
<i>Lamippina aequalis</i> Stock, 1973	<i>Antillogorgia acerosa</i> (Pallas, 1766) (as <i>Pseudopterogorgia acerosa</i> (Pallas, 1766))	Oc	Cur	Stock, 1973
<i>Linaresia bouligandi</i> Stock, 1979	<i>Placogorgia</i> sp.	Oc	Flo	Stock, 1979
<i>Magnippe caputmedusae</i> Stock, 1978	<i>Thesea</i> sp.	Oc	Flo	Stock, 1978
<i>Sphaerippe caligicola</i> Grygier, 1980	<i>Callogorgia</i> sp.	Oc	Bah	Grygier, 1980
<i>Sphaerippe</i> sp.	<i>Gorgonia ventalina</i> Linnaeus, 1758	Oc	SE	Ivanenko et al., 2017
Lichomolgidae				
<i>Diogenella deichmannae</i> Humes & Ho, 1970	<i>Holothuria (Thymiosyca) arenicola</i> Semper, 1868	Hol	Bar	Humes & Ho, 1970
<i>Diogenella impar</i> Humes & Ho, 1970	<i>Holothuria (Thymiosyca) arenicola</i> Semper, 1868 (as <i>Brandtothuria arenicola</i> (Semper))	Hol	Bar	Humes & Ho, 1970

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 (Thymiosyca) arenicola</i> Semper, 1868	Hol	MI	Humes & Ho, 1970
<i>Diogenella seticauda</i> Stock, 1968	<i>Holothuria (Thymiosyca) impatiens</i> (Forskål, 1775) (as <i>Holothuria impatiens</i> (Forskål, 1775))	Hol	PR	Stock, 1968
<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 (Thymiosyca) arenicola</i> Semper, 1868	Hol	Bar	Hendler & Kim, 2010
<i>Diogenidium nasutum</i> Edwards, 1891	<i>Actinopyga agassizii</i> (Selenka, 1867) (as <i>Muelleria 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 (Metriatyla) 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
Macrochironidae				
<i>Macrochiron echinocolum</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 SM	Humes & Stock, 1973 Humes & Stock, 1973
<i>Macrochiron sargassi</i>	Sars, 1916	<i>Renilla reniformis</i> (Pallas, 1766)	Oc		
Pseudanthessiiidae					
<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>Clypeaster rosaceus</i> (Linnaeus, 1758)	Ec	Bah, Jam, MI	Stock et al., 1963b
Rhynchomolgidae					
<i>Acanthomolgus aequiset</i>	Stock, 1975	<i>Muricea laxa</i> Verrill, 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>Gorgonia 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 bayeri</i>	Humes, 1973	<i>Pseudoplexaura porosa</i> (Houttuyn, 1772)	Oc	Ber	Humes, 1973
<i>Acanthomolgus bilobipes</i>	Humes & Stock, 1973	<i>Antillogorgia acerosa</i> (Pallas, 1766)	Oc	Bar, Cur, Jam	Humes & Stock, 1973; Stock, 1975c
<i>Acanthomolgus bilobipes</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 dtorix</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>Gorgonia ventalina</i> Linnaeus, 1758	Oc	Ber, Cur, SE	Humes, 1973; Stock, 1975c
<i>Acanthomolgus intermedius</i> Stock, 1975	<i>Eunicea lactiniata</i> Duchassaing & Michelotti, 1860	Oc	Cur	Stock, 1975c
<i>Acanthomolgus intermedius</i> Stock, 1975	<i>Muricea</i> sp.	Oc	Cub	Varela et al., 2003
<i>Acanthomolgus longidactylus</i> Stock, 1975	<i>Eunicea flexuosa</i> (Lamouroux, 1821)	Oc	Cur	Stock, 1975c
<i>Acanthomolgus longifurca</i> Stock, 1975	<i>Eunicea tourneforti</i> Milne Edwards & Haime, 1857	Oc	Cur	Stock, 1975c
<i>Acanthomolgus mononyx</i> Stock, 1975	<i>Eunicea clavigera</i> Bayer, 1961	Oc	Cur	Stock, 1975c
<i>Acanthomolgus muriceanus</i> Humes, 1973	<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>Gorgonia ventalina</i> Linnaeus, 1758	Oc	Cur, SE, SM	Stock, 1975c
<i>Acanthomolgus triangulipes</i> Stock, 1975	<i>Gorgonia mariae</i> Bayer, 1961	Oc	Cub	Varela et al., 2008
<i>Acanthomolgus verrucipes</i> Humes, 1973	<i>Eunicea cacyculata</i> (Ellis & Solander, 1786)	Oc	Ber	Humes, 1973
<i>Aspidomolgus stoichactinus</i> Humes, 1969	<i>Corynactis denticulosa</i> (Le Sueur, 1817) (as <i>Ho- mostichanthus denticulosus</i> (Le Sueur, 1817))	Act	Barad, PR, SM	Stock, 1975b
<i>Aspidomolgus stoichactinus</i> Humes, 1969	<i>Stichodactyla helianthus</i> (Ellis, 1768) (as <i>Stoichac- tis anemone</i> (Ellis), <i>Stoichactis helianthus</i> (Ellis, 1768))	Act	Bah, Bar, Bon, Cub, Cur, FK, Jam, MI, PR 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	<i>Stichopathes lutkeni</i> Brook, 1889	Anti	PR	Humes & Goenaga, 1978
<i>Critomolgus</i> Humes & Stock, 1983	<i>Astrophyton muricatum</i> (Lamarck, 1816)	Op	Cub	Varela et al., 2008

<i>Critomolgus 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>Critomolgus titillans</i> (Humes, 1982) (as <i>Doridicola titillans</i> Humes, 1982)	<i>Condylactis gigantea</i> (Weinland, 1860)	Act	PR	Humes, 1982
<i>Paramolgus antillianus</i> Stock, 1975	<i>Ricordea florida</i> Duchassaing & Michelotti, 1860	Cor	PR	Stock, 1975c
Sabelliphilidae	Porifera	Po	Jam	Kim, 2009
<i>Eupolympophilus occidentalis</i> 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>Meomicola amplexans</i> Stock, Humes & Gooding, 1963	<i>Meoma ventricosa</i> (Lamarck, 1816)	Ec	Cur, Jam	Stock et al., 1963b
Synaptiphilidae				
<i>Presynaptiphilus amphiopti</i> Humes & Hendler, 1972	<i>Amphioptilus</i> sp.	Op	FK	Humes & Hendler, 1972
Thaumatopsyllidae				
<i>Caribeopsyllus chawayi</i> Suárez-Morales in Suárez-Morales & Castellanos, 1998	<i>Ophiothrix angulata</i> (Say, 1825)	Op	Bel	Hendler & Kim, 2010
<i>Caribeopsyllus chawayi</i> Suárez-Morales in Suárez-Morales & Castellanos, 1998	<i>Ophiothrix oerstedii</i> Lütken, 1856	Op	Bel	Hendler & Kim, 2010
<i>Caribeopsyllus</i> sp.A	Ophiuroida	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
Siphonostomatoidea				
Asterocheridae				
<i>Asterocheres</i> sp.	<i>Callyspongia vaginalis</i> (Lamarck, 1814)	Po	Cub	Varela et al., 2005b
<i>Asterocheres antillensis</i> Varela, 2010	<i>Callyspongia</i> sp.	Po	Cub	Varela, 2010
<i>Asterocheres bahamensis</i> Kim, 2010	Porifera	Po	Bah	Kim, 2010
<i>Asterocheres crinoicicola</i> Humes, 2000	Crinoidea	Cr	Jam	Kim, 2010
<i>Asterocheres crinoicicola</i> Humes, 2000	<i>Davidaster rubiginosus</i> (Pourtales, 1869)	Cr	Bel, Cub	Humes, 2000; Varela, 2010
<i>Asterocheres crinoicicola</i> Humes, 2000	<i>Nemaster grandis</i> AH Clark, 1909	Cr	Bel	Humes, 2000
<i>Asterocheres cubensis</i> Varela, 2010	<i>Ageles dilatata</i> Duchassaing & Michelotti, 1864	Po	Cub	Varela, 2010b
<i>Asterocheres espinosai</i> Varela, Ortiz & Lalana, 2007	<i>Callyspongia vaginalis</i> (Lamarck, 1814)	Po	Cub	Varela et al., 2007a
<i>Asterocheres fernandezmileri</i> Varela, 2010	<i>Ageles 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 lalanai</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 oricurvus</i> Kim, 2010	Porifera	Po	Jam	Kim, 2010
<i>Asterocheres peniculatus</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>Ageles</i> sp.	Po	Cub	Varela et al., 2008
<i>Asterocheres reginae</i> Boxshall & Huys, 1994	<i>Ageles clathrodes</i> (Schmidt, 1870)	Po	Bel	Boxshall & Huys, 1994

<i>Asterocheres simulans</i> (T. Scott, 1898) (as <i>Asco- myzon simulans</i> T. Scott, 1898)				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>Asteropontella foliata</i> Stock, 1989	Echinoidea			Ec	Jam	Kim, 2010
<i>Asteropontius capillatus</i> Kim, 2010	<i>Orbicella annularis</i> (Ellis & Solander, 1786)			Sc	Cur	Stock, 1989
<i>Asteropontius iuxtatus</i> Stock, 1989	<i>Meandrina</i> sp.			Sc	Bar	Kim, 2010
<i>Asteropontius longipalpus</i> Stock, 1975	<i>Meandrina meandrites</i> (Linnaeus, 1758)			Sc	Cur	Stock, 1989
<i>Asteropontius mycetophylliae</i> Varela, Ortiz & Lalana, 2005	<i>Ricordea florida</i> Duchassaing & Michelotti, 1860			Cor	PR	Stock, 1975b
<i>Asteropontius parvipalpus</i> Stock, 1975	<i>Mycetophyllia lamarckiana</i> Milne Edwards & Haime, 1849			Sc	Cub	Varela et al., 2005
<i>Asteropontius proximus</i> Stock, 1987	<i>Condylactis gigantea</i> (Weinland, 1860)			Act	Bah, Cur, Jam, MI, PR	Stock, 1975b; Humes, 1982
<i>Asteropontius ungelattus</i> Stock, 1975	<i>Colpophyllia natans</i> (Müller)			Sc	Cur	Stock, 1987
<i>Asteropontius ungelattus</i> Stock, 1975	<i>Phymanthus crucifer</i> (Le Sueur, 1817)			Act	MI	Stock, 1975b
<i>Asteropontius ungelattus</i> Stock, 1975	<i>Stichodactyla helianthus</i> (Ellis, 1768)			Act	Jam, PR	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, 2011
<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) suensoni</i> Lütken, 1856			Op	Bar	Humes, 1998
<i>Hermacheres diploporiae</i> Stock, 1987	<i>Pseudodiploporia clivosa</i> (Ellis & Solander, 1786)			Sc	Cur	Stock, 1987
<i>Hermacheres montastreae</i> Stock, 1987	<i>Montastrea 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>Kimcheres fastigatus</i> (Kim, 2010) (as <i>Asterocheres 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>Neoasterocheres humesi</i> (Varela, 2012)	<i>Calybspongia vaginalis</i> (Lamarck, 1814)	Po	Cub	Varela, 2012
<i>Orychocheres 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, 2011
<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>Ophiomyxa flaccida</i> (Say, 1825)	Op	MI	Humes, 1998
<i>Peltonomyzon rostratum</i> Stock, 1975	<i>Montastraea cavernosa</i> (Linnaeus, 1767)	Sc	Cur	Stock, 1975d
<i>Scottocheres elongatus</i> (Scott T. & Scott A., 1994)	<i>Iotrochota birotulata</i> (Higgin, 1877)	Po	Cub	Varela et al., 2008
<i>Setacheres paraboecki</i> (Johnsson, 1998)	<i>Calybspongia vaginalis</i> (Lamarck, 1814)	Po	Cub	Varela, 2012
<i>Stenomyzon edentatum</i> Kim, 2010	Porifera	Po	PR	Kim, 2010
Cancerillidae				
<i>Ophiopsyllus latus</i> Humes & Hendler, 1999	<i>Ophiocomella ophiactoides</i> (Clark, 1900)	Op	Bel	Humes & Hendler, 1999
<i>Ophiopsyllus latus</i> Humes & Hendler, 1999	<i>Ophiocoma pumila</i> Lütken, 1856	Op	Bel, FK	Humes & Hendler, 1999
<i>Ophiopsyllus latus</i> Humes & Hendler, 1999	<i>Ophiocomella ophiactoides</i> (Clark, 1900)	Op	Bel	Humes & Hendler, 1999

<i>Ophiopsyllus reductus</i> Stock, Humes & Gooding, 1963	<i>Ophiocoma echinata</i> (Lamarck, 1816)	Op	Bel, Cur	Stock et al., 1963a; Humes & Hendler, 1999
<i>Ophiopsyllus reductus</i> Stock, Humes & Gooding, 1963	<i>Ophiocomella 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>Chondrilla nucula</i> Schmidt, 1862	Po	PR	Stock, 1992b
<i>Parmulella emarginata</i> Stock, 1992	<i>Chondrilla nucula</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>Chondrilla nucula</i> Schmidt, 1862	Po	Aru, Cub, Cur, PR	Stock, 1992b; Varela et al., 2008
Microponitidae				
<i>Microponitius glaber</i> Stock, Humes & Gooding, 1963	<i>Meoma ventricosa</i> (Lamarck, 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 (Thymiosyca) 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 (Thymiosyca) arenicola</i> Semper, 1868 (as <i>Brandtothuria arenicola</i>) and <i>Holothuria (Semperothuria) 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)	Hol	Bah, Jam	Stock et al., 1962
<i>Nanaspis pollens</i> Stock, Humes & Gooding, 1962	<i>Meoma ventricosa</i> (Lamarck, 1816)	Ec	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)	Hol	MI, PR	Stock et al., 1962
<i>Nanaspis truncata</i> Stock, Humes & Gooding, 1962	<i>Holothuria (Thymiosycia) arenicola</i> Semper, 1868	Hol	MI	Stock et al., 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.

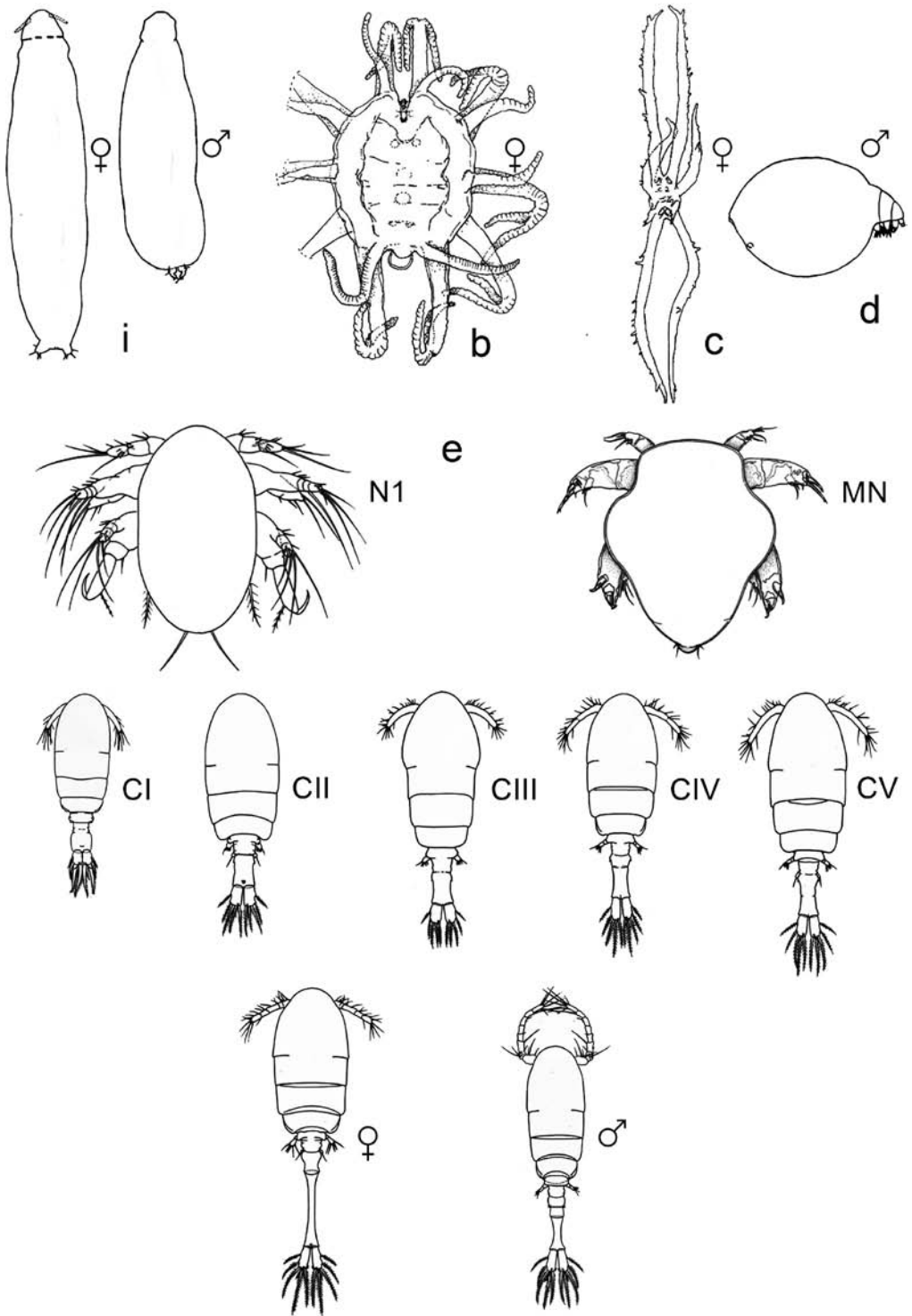


FIGURE 2 Cyclopoida. Lamippidae (a-d): a – *Enalcyonium nudum*, dorsal view; b – *Linaresia bouligandi*, dorsal view; c – *Magnippe caputmedusae*, ventral view; d – *Sphaerippe caligicola*, lateral view. Thaumatopsyllidae (e): nauplius (N1), metanauplius (MN), copepodid stages 1–5 (CI–CV) of *Caribeopsyllus amphiodiae*, dorsal view. After Stock (1973, 1978, 1979), Grygier (1980), Dojiri et al. (2008).

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>Asteroponitius parvipalpus</i> Stock, 1975	Ast	Bah, Cur, Jam, MI, PR	Stock, 1975b; Humes, 1982
<i>Condylactis gigantea</i> (Weinland, 1860)	<i>Critomolgus 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 denticulosus</i> (Le Sueur, 1817))	<i>Aspidomolgus stoichactinus</i> Humes, 1969	Rhy	Barad, PR, SM	Stock, 1975b
<i>Phymanthus crucifer</i> (Le Sueur, 1817)	<i>Asteroponitius ungelatus</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>Asteroponitius ungelatus</i> Stock, 1975	Ast	Jam, PR	Stock, 1975b; Kim, 2010
Antipatharia				
<i>Bartholomea annulata</i> (Le Sueur, 1817)	<i>Ridgewayia 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 lutkeni</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>Colpophyllia natans</i> (Houttuyn, 1772) (as <i>Colpophyllia natans</i> (Muller))	<i>Asteropontius proximus</i> Stock, 1987	Ast	Cur	Stock, 1987			
<i>Colpophyllia natans</i> (Houttuyn, 1772)	<i>Corallovexia kristenseni</i> Stock, 1975	Cor	Cur	Stock, 1975a			
<i>Colpophyllia natans</i> (Houttuyn, 1772)	<i>Corallovexia longibrachium</i> Stock, 1975	Cor	Cur	Stock, 1975a			
<i>Colpophyllia natans</i> (Houttuyn, 1772)	1975						
<i>Colpophyllia natans</i> (Houttuyn, 1772)	<i>Corallovexia mediobrachium</i> Stock, 1975 (as <i>Corallovexia mediobrachium</i> Stock, 1975)	Cor	VI	Herriott & Immermann, 1979			
<i>Colpophyllia 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 brevivibrachium</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>mayori</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>Coralloplexia medibrachium</i> Stock, 1975	Cor	Cur	Stock, 1975a
<i>Manicina areolata</i> (Linnaeus, 1758)	<i>Coralloplexia 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 iuxtus</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>Coralloplexia</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)	<i>Coralloplexia dorsospinosa minor</i> Stock, 1975	Cor	Cur	Stock, 1975a
(as <i>Montastraea brasiliana</i> (Verrill, 1901))				
<i>Montastraea cavernosa</i> (Linnaeus, 1767)	<i>Coralloplexia dorsospinosa</i> Stock, 1975	Cor	Cur	Stock, 1975a
<i>Montastraea cavernosa</i> (Linnaeus, 1767)	<i>Coralloplexia</i> sp.	Cor	VI	Herriott & Immermann, 1979
<i>Montastraea cavernosa</i> (Linnaeus, 1767)	<i>Coralloplexia ventrosospinosa</i> Stock, 1975	Cor	Cur	Stock, 1975a
<i>Montastraea cavernosa</i> (Linnaeus, 1767)	<i>Hermacheres montastreae</i> Stock, 1987	Ast	Cur	Stock, 1989
<i>Montastraea cavernosa</i> (Linnaeus, 1767)	<i>Peltopezom rostratum</i> Stock, 1975	Ast	Cur	Stock, 1975b
<i>Mycetophyllia lamarckiana</i> Milne Edwards & Haime, 1849	<i>Asteropontius mycetophylliae</i> Varela, Ortiz & Lalana, 2005	Ast	Cub	Varela et al., 2005
<i>Mycetophyllia lamarckiana</i> Milne Edwards & Haime, 1849	<i>Coralloplexia</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>Hermacheres diploritae</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>Hermacheres diploritae</i> Stock, 1987	Ast	Cur	Stock, 1987
Octocorallia				
Alcyonacea				
<i>Antillogorgia acerosa</i> (Pallas, 1766) (as <i>Pseudopterogorgia acerosa</i> (Pallas, 1766))	<i>Acanthomolgus bilobipes</i> Humes & Stock, 1973	Rhy	Bar, Cur, Jam	Humes & Stock, 1973; Stock, 1975c
<i>Antillogorgia acerosa</i> (Pallas, 1766)	<i>Lamippina aequalis</i> Stock, 1973	Lam	Cur	Stock, 1973
<i>Antillogorgia americana</i> (Gmelin, 1791) (as <i>Pseudopterogorgia americana</i> (Gmelin, 1791))	<i>Acanthomolgus dioryx</i> Stock, 1975	Rhy	Cur	Stock, 1975c
<i>Antillogorgia</i> sp. (as <i>Pseudopterogorgia</i> sp.)	<i>Lamippina aequalis</i> Stock, 1973	Lam	Cur	Stock, 1973
<i>Antillogorgia acerosa</i> var. <i>elastica</i> Bielschowsky, 1929 (as <i>Antillogorgia 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>Enalcyonium varicauda</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 caligicola</i> Grygier, 1980	Lam	Bah	Grygier, 1980
<i>Eunicea calyculata</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)	<i>Acanthomolgus affinis</i> Stock, 1975	Rhy	Cur	Stock, 1975c
(as <i>Plexaura flexuosa</i> Lamouroux, 1821)				
<i>Eunicea flexuosa</i> (Lamouroux, 1821)	<i>Acanthomolgus longidactylus</i> Stock, 1975	Rhy	Cur	Stock, 1975c
<i>Eunicea laciniata</i> Duchassaing & Michelotti, 1860	<i>Acanthomolgus intermedius</i> Stock, 1975	Rhy	Cur	Stock, 1975c
<i>Eunicea mammosa</i> Lamouroux, 1816	<i>Enalcyonium euniceae</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 tourneforti</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>Gorgonia ventalina</i> Linnaeus, 1758	<i>Sphaerippe</i> sp.	Lam	SE	Ivanenko et al., 2017
<i>Muricea</i> sp.	<i>Acanthomolgus intermedius</i> Stock, 1975	Rhy	Cub	Varela et al., 2003

<i>Muricea atlantica</i> (Kukenthal, 1911)	<i>Acanthomolgus muriceanus</i> Humes, 1973	Rhy	Ber	Humes, 1973; Stock, 1975c
<i>Muricea laxa</i> Verrill, 1864	<i>Acanthomolgus aequiseta</i> Stock, 1975	Rhy	Cur	Stock, 1975c
<i>Placogorgia</i> sp.	<i>Linaresia bouligandi</i> Stock, 1979	Lam	Flo	Stock, 1979
<i>Plexaura</i> sp.	<i>Acanthomolgus affinis</i> Stock, 1975	Rhy	Cub	Varela, 2011a
<i>Plexaura homomalla</i> (Esper, 1794) (as <i>Plex- aura homomalla</i> f. <i>homomalla</i> Esper, 1794)	<i>Acanthomolgus affinis</i> Stock, 1975	Rhy	Cur	Stock, 1975c
<i>Plexaura homomalla</i> (Esper, 1794)	<i>Enalcyonium nudum</i> Stock, 1973	Lam	PR	Stock, 1973
<i>Plexaura homomalla</i> (Esper, 1794)	<i>Enalcyonium 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>Enalcyonium</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>Magnippe caputmedusae</i> Stock, 1978	Lam	Flo	Stock, 1978
Pennatulacea	<i>Macrochiron sargassi</i> Sars, 1916	Mac	SM	Humes & Stock, 1973
<i>Renilla reniformis</i> (Pallas, 1766)				
Echinodermata				
Crinoidea				
Crinoidea	<i>Asterocheres crinoicola</i> Humes, 2000	Ast	Jam	Kim, 2010
Comatulida				
<i>Davidaster rubiginosus</i> (Pourtales, 1869)	<i>Asterocheres crinoicola</i> Humes, 2000	Ast	Bel, Cub	Humes, 2000; Varela, 2010
	<i>Asterocheres crinoicola</i> Humes, 2000	Ast	Bel	Humes, 2000
<i>Nemaster grandis</i> Clark, 1909	<i>Asterocheres crinoicola</i> Humes, 2000	Ast		
Echinoidea				
Echinoidea	<i>Asterocheres unitoviger</i> Kim, 2010	Ast	Jam	Kim, 2010
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>Lytechinus variegatus</i> (Lamarck, 1816)	<i>Astrocheres simulans</i> (T. Scott, 1898) (as <i>Ascomyzon simulans</i> T. Scott, 1898)	Ast	Cur	Stock & Humes, 1995
<i>Lytechinus 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, 1995	Ast	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>Astrocheres unioviger</i> Kim, 2010	Ast	Bah, PR	Kim, 2010
Clypeasteroida				
<i>Clypeaster rosaceus</i> (Linnaeus, 1758)	<i>Pseudanthessius pectinifer</i> Stock, Humes & Gooding, 1964	Pse	Bah, Jam, MI	Stock et al., 1963b
Diadematoidea				
<i>Diadema antillarum</i> Philippi, 1845	<i>Orychocheres alatus</i> Stock & Gooding, 1986	Ast	Cub, Cur	Stock & Gooding, 1986; Varela et al., 2005b
Spatangoida				
<i>Meoma ventricosa</i> (Lamarck, 1816)	<i>Meomicola amplexans</i> Stock, Humes & Gooding, 1963	Sync	Cur, Jam	Stock et al., 1963b
<i>Meoma ventricosa</i> (Lamarck, 1816)	<i>Micropontius 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 exilicornis</i> Stock & Humes, 1995	Pse	Cur	Stock & Humes, 1995
Holothuroidea				
<i>Actinopyga agassizii</i> (Selenka, 1867) (as <i>Muelleria agassizii</i> Selenka, 1867)	<i>Caribulus</i> sp.	Sync	Bah, Jam	Humes, 1969b
<i>Actinopyga agassizii</i> (Selenka, 1867)	<i>Caribulus 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>Caribulus 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>Caribulus</i> sp.	Sync	Bah, Cur, Jam	Humes, 1969b
<i>Holothuria (Halodeima) mexicana</i> Ludwig, 1875	<i>Caribulus 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 (Halodeima) mexicana</i> Ludwig, 1875 (as <i>Ludwigothuria mexicana</i> (Ludwig))	<i>Pseudanthessius deficiens</i> Stock, Humes & Gooding, 1963	Pse	Cur	Stock et al., 1963b
<i>Holothuria (Metriatyla) scabra</i> Jaeger, 1833	<i>Diogenidium nasutum</i> Edwards, 1891	Lic	Bah	Edwards, 1891
<i>Holothuria (Platyperona) parvula</i> (Selenka, 1867) (as <i>Microthele parvula</i> (Selenka))	<i>Nanaspis truncata</i> Stock, Humes & Gooding, 1962	Nan	MI, PR	Stock et al., 1962
<i>Holothuria (Selenkothuria) glaberrima</i> Selenka, 1867	<i>Diogenidium deforme</i> Stock, 1968	Lic	PR	Stock, 1968

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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 (Thymiosyca) arenicola</i> Semper, 1868	<i>Diogenella deichmannae</i> Humes & Ho, 1970	Lic	Bar	Humes & Ho, 1970
<i>Holothuria (Thymiosyca) 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 (Thymiosyca) arenicola</i> Semper, 1868	<i>Diogenidium deforme</i> Stock, 1968	Lic	Bar	Hendler & Kim, 2010
<i>Holothuria (Thymiosyca) arenicola</i> Semper, 1868	<i>Diogenella seticauda</i> Stock, 1968	Lic	MI	Humes & Ho, 1970
<i>Holothuria (Thymiosyca) arenicola</i> Semper, 1868	<i>Nanaspis pollens</i> Stock, Humes & Gooding, 1962	Nan	Jam	Stock et al., 1962
<i>Holothuria (Thymiosyca) arenicola</i> Semper, 1868	<i>Nanaspis truncata</i> Stock, Humes & Gooding, 1962	Nan	MI	Stock et al., 1962
<i>Holothuria (Thymiosyca) impatiens</i> (Forsskal, 1775)	<i>Diogenella seticauda</i> Stock, 1968	Lic	PR	Stock, 1968
Synallactida				
<i>Isostichopus badionotus</i> (Selenka, 1867)	<i>Caribulus</i> sp.	Sync	Bah, Bar, Jam	Humes, 1969b
<i>Isostichopus badionotus</i> (Selenka, 1867)	<i>Caribulus sculptus</i> (Humes, 1969)	Sync	Bah, Bar, Jam, MI, PR	Humes, 1969b
<i>Isostichopus 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>Critomolgus</i> Humes & Stock, 1983	Rhy	Cub	Varela et al., 2008
<i>Astrophyton muricatum</i> (Lamarck, 1816)	<i>Critomolgus astrophyticus</i> (Humes & Stock, 1973) (as <i>Doridicola astrophyticus</i> Humes & Stock, 1973)	Rhy	Bar, Jam, MI, PR	Humes & Stock, 1973
Ophiurida				
Ophiuroida	<i>Caribeopsyllus</i> sp. A	Tha	SE	Ivanenko, unpublished
<i>Amphioplus</i> sp.	<i>Parophiopsyllus ligatus</i> Humes & Hendler, 1972	Can	FK	Humes & Hendler, 1972
<i>Amphioplus</i> sp.	<i>Presyncaptiphilus amphiopti</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 risei</i> Lutken, 1856)	<i>Hemicyclops columariis</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

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Invertebrate Host (valid name and as indicated in the original record)	Copepod species name	Copepod family abbreviation*	Site abbreviation**	Reference
<i>Ophioderma brevispina</i> (Say, 1825)	<i>Pseudanthessius deficiens</i> Stock, Humes & Gooding, 1963	Pse	Bel	Humes & Hendler, 1999
(as <i>Ophioderma brevispinum</i> (Say, 1825))				
<i>Ophioderma cinerea</i> Muller & Troschel, 1842 (as <i>Ophioderma cinereum</i> Muller & Troschel, 1842)	<i>Pseudanthessius deficiens</i> Stock, Humes & Gooding, 1963	Pse	Bel, Cur, MI, SM	Stock et al., 1963b; Humes & Hendler, 1999
<i>Ophiomyxa flaccida</i> (Say, 1825)	<i>Ophiurocheres bellulus</i> Humes, 1998	Ast	MI	Humes, 1998
<i>Ophiothrix (Acanthophiothrix) suensoni</i> Lutken, 1856	<i>Collocheres lunulifer</i> Humes, 1998	Ast	Bar	Humes, 1998
<i>Ophiothrix (Ophiothrix) angulata</i> (Say, 1825)	<i>Caribeopsyllus</i> sp. A	Tha	Bel	Hendler & Kim, 2010
<i>Ophiothrix (Ophiothrix) angulata</i> (Say, 1825)	<i>Caribeopsyllus chawwayi</i> Suarez-Morales, In: Suarez-Morales & Castellanos, 1998	Tha	Bel	Hendler & Kim, 2010
<i>Ophiothrix (Ophiothrix) angulata</i> (Say, 1825)	<i>Collocheres lunulifer</i> Humes, 1998	Ast	Bar	Humes, 1998
<i>Ophiothrix (Ophiothrix) oerstedii</i> Lutken, 1856	<i>Caribeopsyllus chawwayi</i> Suarez-Morales, In: Suarez-Morales & Castellanos, 1998	Tha	Bel	Hendler & Kim, 2010
Porifera				
Porifera	<i>Asterocheres bahamensis</i> Kim, 2010	Ast	Bah	Kim, 2010
Porifera	<i>Asterocheres oricurvus</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>Eupolymniphilus occidentalis</i> Kim, 2009	Sab	Jam	Kim, 2009
Porifera	<i>Hemicyclops colummnaris</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>Kimcheres fastigatus</i> (Kim, 2010) (as <i>Asterocheres 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
Calcareea				
Calcinea				
Clathrinida				
<i>Clathrina lutea</i> Azevedo, Padua, Moraes, Rossi, Muricy & Klautau, 2017	Copepoda		PR	Garcia-Hernandez et al., 2019
Demospongiae				
Heteroscleromorpha				
Agelasida				
<i>Agelas</i> sp.	<i>Asterocheres reginae</i> Boxshall & Huys, 1994	Ast	Cub	Varela et al., 2008
<i>Agelas clathrodes</i> (Schmidt, 1870)	<i>Asterocheres reginae</i> Boxshall & Huys, 1994	Ast	Bel	Boxshall & Huys, 1994
<i>Agelas dilatata</i> Duchassaing & Michelotti, 1864	<i>Asterocheres cubensis</i> Varela, 2010	Ast	Cub	Varela, 2010b
<i>Agelas wiedenmayeri</i> Alcolado, 1984	<i>Asterocheres fernandezmilleri</i> Varela, 2010	Ast	Cub	Varela, 2010b
Axinellida				
<i>Ptilocaulis walpersii</i> (Duchassaing & Michelotti, 1864)	<i>Asterocheres garridoi</i> Varela, Ortiz & Lalana, 2007	Ast	Cub	Varela et al., 2007
Haplosclerida				
<i>Callyspongia</i> sp.	<i>Asterocheres antillensis</i> Varela, 2010	Ast	Cub	Varela, 2010
<i>Callyspongia vaginalis</i> (Lamarck, 1814)	<i>Asterocheres</i> Boeck, 1859	Ast	Cub	Varela et al., 2005b
<i>Callyspongia vaginalis</i> (Lamarck, 1814)	<i>Asterocheres espinosai</i> Varela, Ortiz & Lalana, 2007	Ast	Cub	Varela et al., 2007a
<i>Callyspongia vaginalis</i> (Lamarck, 1814)	<i>Neoaasterocheres 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>Calyspongia vaginalis</i> (Lamarck, 1814)	<i>Setacheres paraboecki</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 lalanai</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 – Cancerrillidae, Cla – Clausidiidae, Cor – Corallovexiidae, Ent – Entomolepididae, Lam – Lamippidae, Lic – Lichomolgidae, Mac – Macrochironidae, Mic – Micropontidae, Nan – Nanaspidae, Pse – Pseudanthessiidae, Psec – Pseudocyclopididae, Rhy – Rhynchomolgidae, Sab – Sabeliphilidae, Sync – Synapticolidae, Synp – Synaptiphilidae, Tha – Thaumatoptyllidae.

** Site Abbreviation: Aru – Aruba, Bah – Bahamas, Bar – Barbados, Barad – Baradai, 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.

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 actinairian *Bartholomea annulata*. Only *Aspidomolgus stoichactinus* living on the actinarian *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 (DeBiaise 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

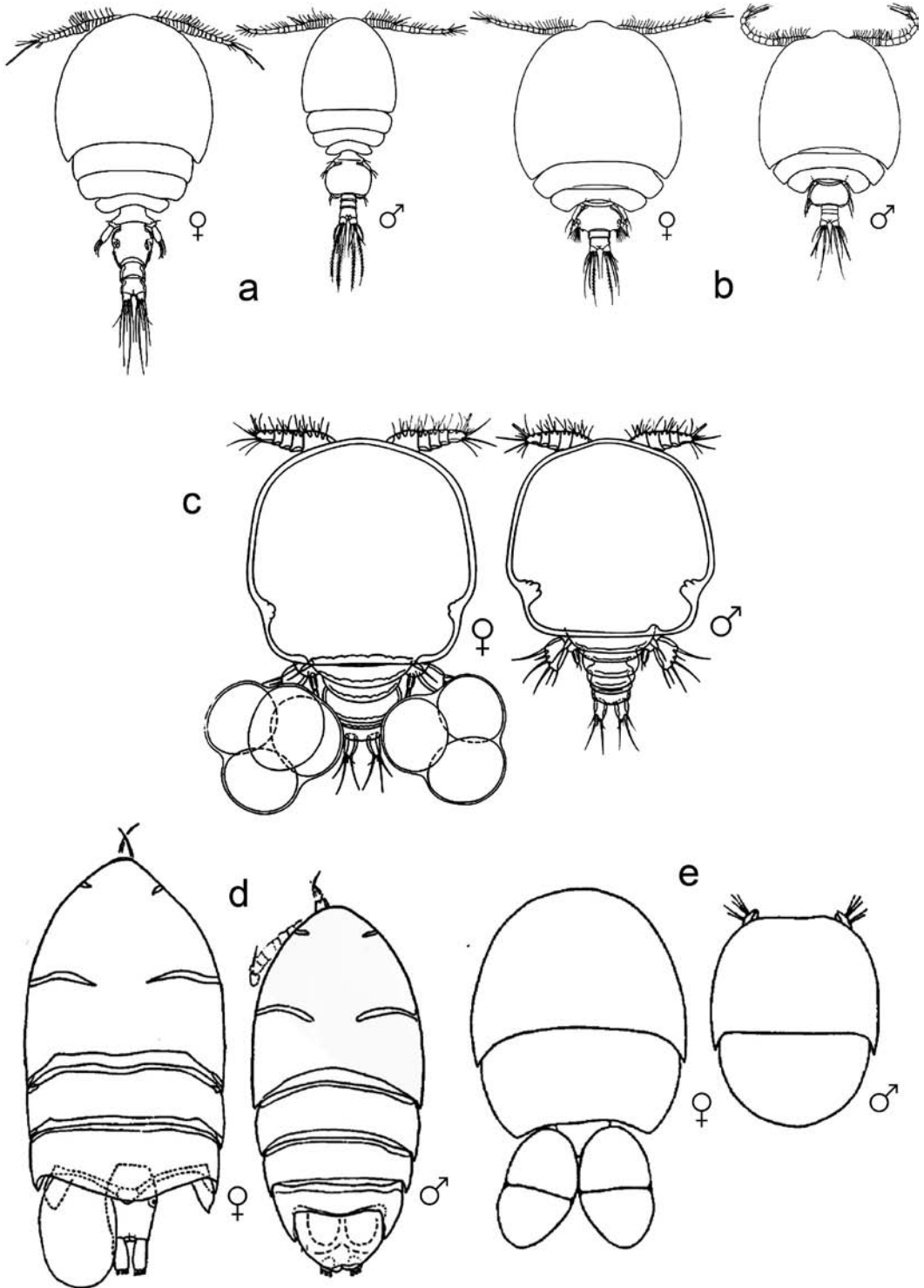


FIGURE 3 Siphonostomatoidea, dorsal view. a – *Asterocheres unioviger*, b – *Cyclocheres sensilis* (Asterocheridae), c – *Parophiopsyllus ligatus* (Cancerillidae), d – *Micropontius glaber* (Micropontiidae), e – *Nanaspis polens* (Nanaspidae). After Stock et al. (1962, 1963a), Humes & Hendler (1972), 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
Astrocheridae	103	45
Rhynchomolgidae	78	19
Corallovexiidae	66	11
Synapticolidae	53	3
Lichomolgidae	43	8
Cancerillidae	34	3
Pseudanthessiidae	21	4
Nanaspididae	19	4
Macrochironidae	18	2
Thaumatopsyllidae	17	1
Lamippidae	16	8
Entomolepididae	12	2
Synaptiphilidae	3	1
Clausidiidae	2	1
Micropontiidae	2	1
Pseudocyclopididae	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 (*Astrocheres*, *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
	Phymanthidae	Ant
	Plexauridae	Ant
	Ricordeidae	Ant
Stichodactylidae	Ant	
Toxopneustidae	Ech	
Cancerillidae	Amphiuridae	Oph
	Ophiocomidae	Oph
Clausidiidae	Ophiocomidae	Oph
Coralloveliidae	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
	Ophiidermatidae	Oph
Rhynchomolgidae	Actiniidae	Ant
	Antipathidae	Ant
	Corallimorphidae	Ant
	Gorgoniidae	Ant
	Gorgonocephalidae	Oph
	Plexauridae	Ant
	Ricordeidae	Ant
	Stichodactylidae	Ant
	Sabelliphilidae	Porifera
Synapticolidae		Brissidae
Synapticolidae	Holothuriidae	Hol
	Ophiotrichidae	Oph
	Stichopodidae	Hol
	Synaptiphilidae	Amphiuridae
Thaumatopsyllidae	Ophiotrichidae	Oph

* 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

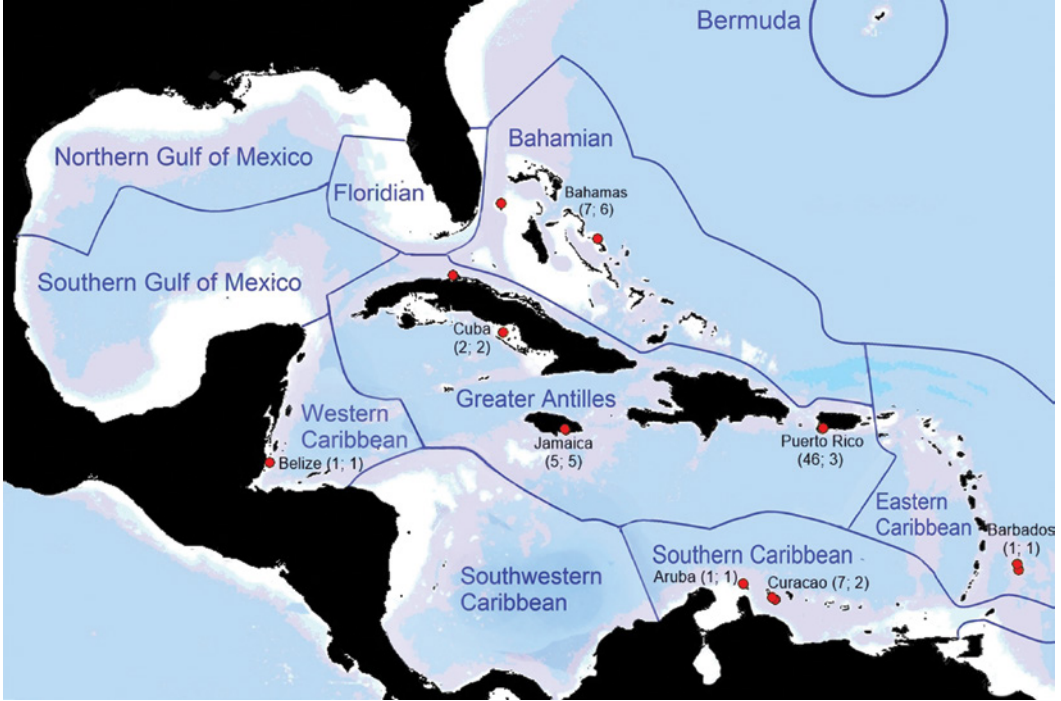


FIGURE 4 Caribbean copepods found on sponges (x; x = number of records and number of copepod species, respectively).

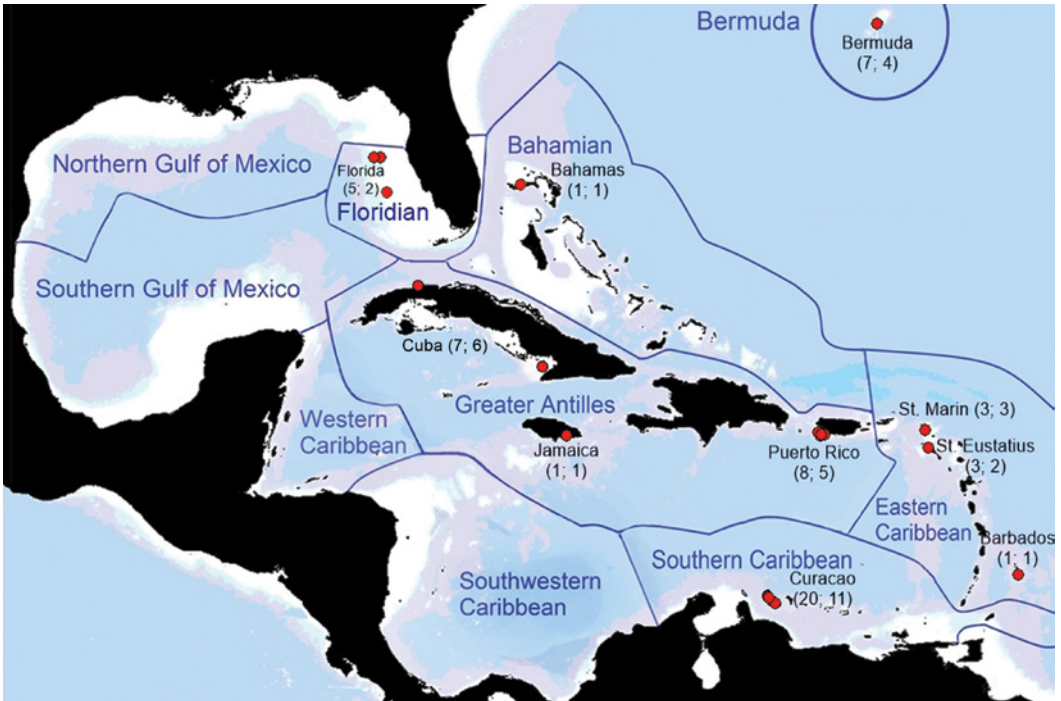


FIGURE 5 Caribbean copepods found on octocorals (Anthozoa: Octocorallia) (x; x – number of records and number of copepod species, respectively).

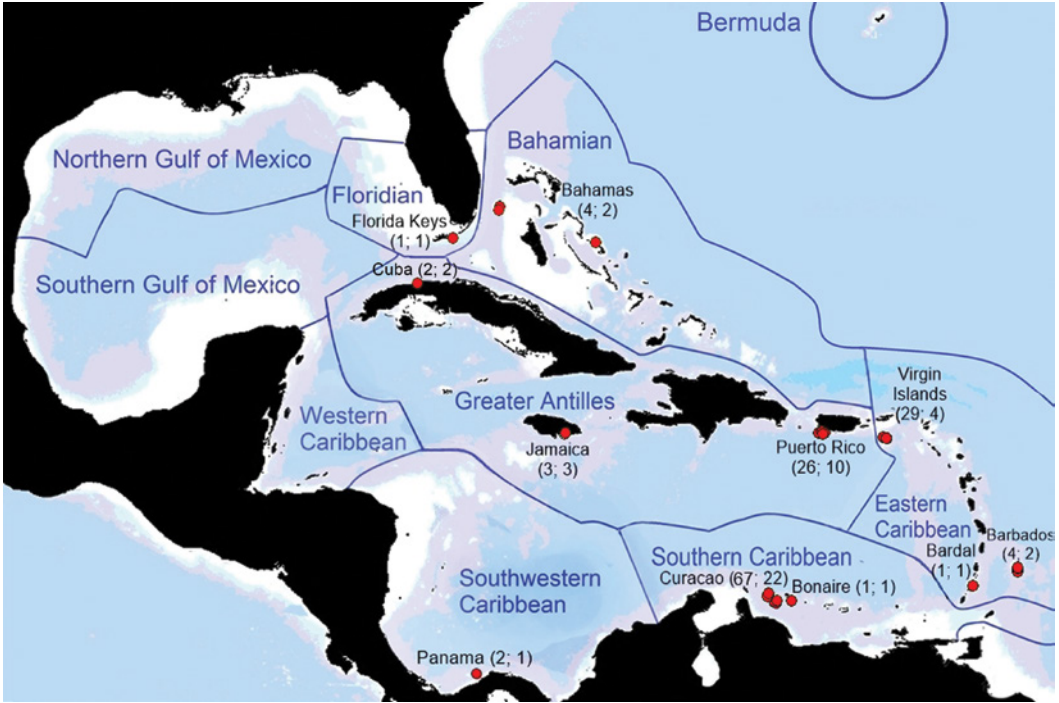


FIGURE 6 Caribbean copepods found on hexacorallians (Anthozoa: Hexacorallia) (x; x – number of records and number of copepod species, respectively).

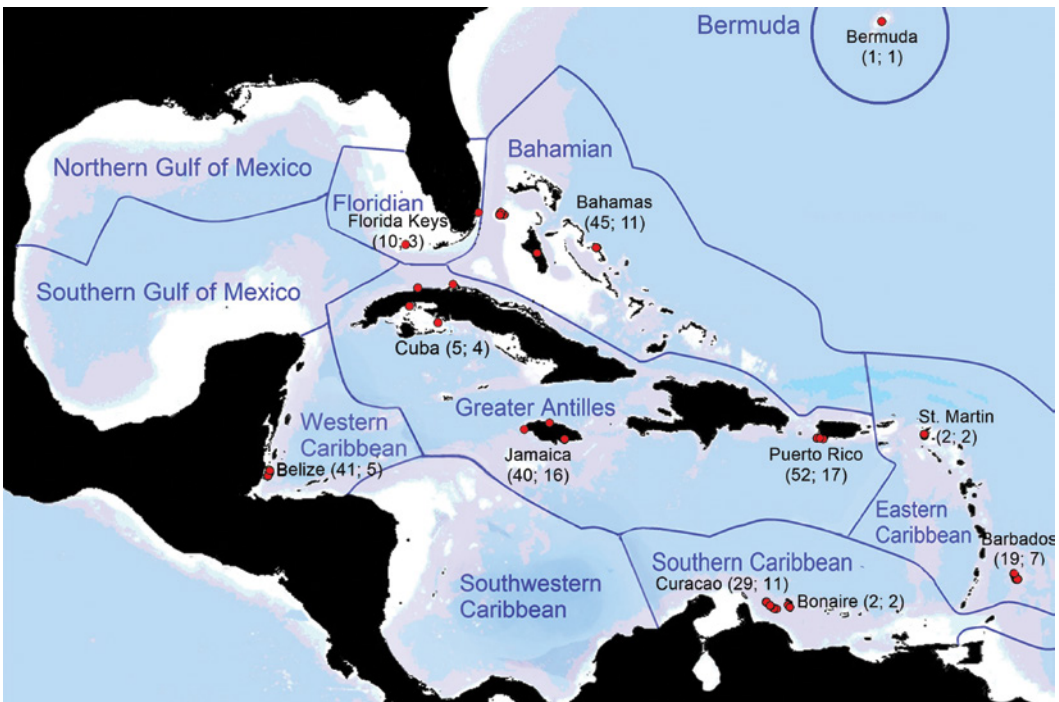


FIGURE 7 Caribbean copepods found on echinoderms (x; x – number of records and number of copepod species, respectively).

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 aquiseta</i> Stock, 1975						X		
<i>Acanthomolgus affinis</i> Stock, 1975					X			X
<i>Acanthomolgus bayeri</i> Humes, 1973		X			X			
<i>Acanthomolgus bilobipes</i> Humes & Stock, 1973			X		X			
<i>Acanthomolgus dioryx</i> Stock, 1975					X			
<i>Acanthomolgus gorgoniae</i> Humes, 1973		X				X		X
<i>Acanthomolgus intermedius</i> Stock, 1975					X			
<i>Acanthomolgus longidactylus</i> Stock, 1975						X		
<i>Acanthomolgus longifurca</i> Stock, 1975						X		
<i>Acanthomolgus mononyx</i> Stock, 1975						X		
<i>Acanthomolgus muriceanus</i> Humes, 1973		X						
<i>Acanthomolgus seticornis</i> Stock, 1975								X
<i>Acanthomolgus trianguilipes</i> Stock, 1975					X			X
<i>Acanthomolgus verrucipes</i> Humes, 1973		X						
<i>Aspidomolgus stoichactinus</i> Humes, 1969			X		X			X
<i>Asterocheres</i> sp.					X			
<i>Asterocheres antillensis</i> Varela, 2010					X			
<i>Asterocheres bahamensis</i> Kim, 2010		X						
<i>Asterocheres crinoidicola</i> Humes, 2000					X			X
<i>Asterocheres cubensis</i> Varela, 2010					X			
<i>Asterocheres espinosai</i> Varela, Ortiz & Lalana, 2007					X			
<i>Asterocheres fernandezmillerai</i> Varela, 2010					X			
<i>Asterocheres garridoi</i> Varela et al., 2007					X			
<i>Asterocheres kimi</i> Varela, 2012					X			
<i>Asterocheres lalanai</i> Varela, 2013					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						×		
<i>Asterocheres reginae</i> Boxshall & Huys, 1994				×	×			
<i>Asterocheres oricurvus</i> Kim, 2010				×				
<i>Asterocheres peniculatus</i> Kim, 2010	×							
<i>Asterocheres plumosus</i> Kim, 2010	×							
<i>Asterocheres reginae</i> Boxshall & Huys, 1994								×
<i>Asterocheres simulans</i> (T. Scott, 1898)						×		
<i>Asterocheres trisetatus</i> Kim, 2010	×							
<i>Asterocheres unioviger</i> Kim, 2010	×			×				
<i>Asteropontella foliata</i> Stock, 1989						×		
<i>Asteropontius capillatus</i> Kim, 2010			×					
<i>Asteropontius iuxtus</i> Stock, 1989						×		
<i>Asteropontius longipalpus</i> Stock, 1975				×				
<i>Asteropontius mycetopylliae</i> Varela, Ortiz & Lalana, 2005, 2005				×	×			
<i>Asteropontius parvipalpus</i> Stock, 1975		×		×	×	×		
<i>Asteropontius proximus</i> Stock, 1987						×		
<i>Asteropontius ungelatus</i> Stock, 1975				×				
<i>Asteropontopsis faviae</i> Stock, 1987						×		
<i>Calonastes imparipes</i> Humes & Goenaga, 1978					×			
<i>Caribeopsyllus</i> sp. A			×					×
<i>Caribeopsyllus ctawayi</i> Suárez-Morales, 1998					×			×
<i>Caribulus sculptus</i> (Humes, 1969)		×		×	×	×		
<i>Chelacheres longipalpus</i> Stock & Humes, 1995		×		×	×	×		×
<i>Chelacheres optans</i> Stock & Humes, 1995					×			

<i>Collocheres lunulifer</i> Humes, 1998	x							
<i>Corallonoxia baki</i> Stock, 1975			x					
<i>Corallonoxia longicauda</i> Stock, 1975			x					
<i>Corallovexia brevivrachium</i> Stock, 1975	x							
<i>Corallovexia dorsopinososa minor</i> Stock, 1975			x					
<i>Corallovexia dorsopinososa</i> Stock, 1975			x					
<i>Corallovexia kristenseni</i> Stock, 1975			x					
<i>Corallovexia longibrachium</i> Stock, 1975			x					
<i>Corallovexia mediobrachium</i> Stock, 1975	x							
<i>Corallovexia mixtibrachium</i> Stock, 1975	x							
<i>Corallovexia similis</i> Stock, 1975	x							
<i>Corallovexia ventrospinososa</i> Stock, 1975								x
<i>Critomolgus</i> sp.						x		
<i>Critomolgus astrophyticus</i> (Humes & Stock, 1973)	x					x		
<i>Critomolgus titillans</i> (Humes, 1982)						x		
<i>Diogenella deichmannae</i> Humes & Ho, 1970	x							
<i>Diogenella impar</i> Humes & Ho, 1970	x							
<i>Diogenella seticauda</i> Stock, 1968						x		
<i>Diogenella spinicauda</i> Stock, 1968	x							x
<i>Diogenidium deforme</i> Stock, 1968	x							
<i>Diogenidium nasutum</i> Edwards, 1891						x		
<i>Diogenidium spinulosum</i> Stock, 1968						x		
<i>Diogenidium tectum</i> Humes & Ho, 1971						x		
<i>Enalcyonium</i> sp.								x
<i>Enalcyonium euniceae</i> Stock, 1973								x
<i>Enalcyonium nudum</i> Stock, 1973								x
<i>Enalcyonium ramosum</i> Stock, 1973								x
<i>Enalcyonium varicauda</i> Stock, 1973								x
<i>Eupolymiphilus occidentalis</i> Kim, 2009								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	X	X						
<i>Hermacheres diplooriae</i> Stock, 1987					X	X		
<i>Hermacheres montastreae</i> Stock, 1987					X	X		
<i>Hetairosynella aculeata</i> Kim, 2010	X							
<i>Hetairosynella angulata</i> Kim, 2010					X			
<i>Hetairosynella bifurcata</i> Kim, 2010					X			
<i>Kimcheres fastigatus</i> (Kim, 2010)			X					
<i>Lamippina aequalis</i> Stock, 1973						X		
<i>Linaresia bouligandi</i> Stock, 1979				X				
<i>Macrochiron echinocolum</i> Humes & Stock, 1973	X		X		X	X		X
<i>Macrochiron sargassi</i> Sars, 1916								
<i>Magnippe caputmedusae</i> Stock, 1978				X				
<i>Meandronyzon coronatum</i> Stock, 1989						X		
<i>Meomicola amplexans</i> Stock, Humes & Gooding, 1963					X	X		
<i>Micropontius glaber</i> Stock, Humes & Gooding, 1963					X	X		
<i>Nanaspis exigua</i> Stock, Humes & Gooding, 1962					X	X		
<i>Nanaspis media</i> Stock, Humes & Gooding, 1962					X	X		
<i>Nanaspis pollens</i> Stock, Humes & Gooding, 1962	X				X	X		
<i>Nanaspis truncata</i> Stock, Humes & Gooding, 1962					X	X		
<i>Neoaesterocheres humesi</i> (Varela, 2012)					X	X		
<i>Orychocheres alatus</i> Stock & Gooding, 1986					X	X		X
<i>Ophiopsyllus latus</i> Humes & Hendler, 1999				X				X
<i>Ophiopsyllus reductus</i> Stock, Humes & Gooding, 1963		X			X	X		X

<i>Ophiurocheres bellulus</i> Humes, 1998			×		
<i>Orecturus antillensis</i> Varela, 2011			×		
<i>Orecturus ortizi</i> Varela & Lalana, 2007			×		
<i>Paramolgus antillianus</i> Stock, 1975			×		
<i>Parmulella emarginata</i> Stock, 1992				×	
<i>Parmulodes verrucosa</i> Wilson C.B., 1944			×		×
<i>Parophiopysyllus ligatus</i> Humes & Hendler, 1972		×			
<i>Peltomyzon rostratum</i> Stock, 1975				×	
<i>Presynaptiphilus amphiopti</i> Humes & Hendler, 1972		×			
<i>Pseudanthessius acutus</i> Kim, 2009			×		
<i>Pseudanthessius deficiens</i> Stock, Humes & Gooding, 1963			×		×
<i>Pseudanthessius exiticornis</i> Stock & Humes, 1995				×	
<i>Pseudanthessius pectinifer</i> Stock, Humes & Gooding, 1964					×
<i>Pseudanthessius pectinifer</i> Stock, Humes & Gooding, 1964					
<i>Ridgewayia fossahageni</i> Humes & Smith, 1974					×
<i>Scotocheres elongatus</i> (Scott T. & Scott A., 1894)			×		
<i>Setacheres paraboeki</i> (Johnsson, 1998)			×		
<i>Sphaerippe caligicola</i> Grygjer, 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 Synaptiphilidae) are found associated with four host families; Macrochironidae and Nanaspidae are found with three host families; Cancerillidae and Lichomolgidae are found with two host families; seven families (Clausidiidae, Entomolepididae, Micropontiidae, Pseudocyclopidae, Sabelliphilidae, Synaptiphilidae, and Thaumatosyllidae) 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 Xarifidae (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 enable 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 *Eupolymniphilus 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 *Eupolymniphilus 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 holothurian 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 (cycloform, spherical, flattened etc.), remarkably different body sizes ranging from 0.25 mm (such as *Collocheres lunulifer*) to 4.75 mm (such as *Corallovidia 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 Thaumatopsyllidae, are parasitic in the stomach of its host brittle star (fig. 2e; Hendler & 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 Corallovexiidae living in stony corals (Butter, 1979; Herriott & Immermann, 1979), the studies of the life cycle and ecology of copepods of the family Thaumatopsyllidae 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; Hendler & 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 *Gorgonia 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).

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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. & Huys, 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* (Thaumatosyllidae: 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 brittlestar *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 thaumatospylloid 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 thaumatopsyllid 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. & Franssen, 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., Franssen, C.H.J.M., Petrusek, 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 actinarian 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) *Ridgewayia fossahageni* 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 kooriius*, 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., Rinskaya-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., Machalowski, 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* (Aplysineidae: 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/qjseki> [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 1: 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 Natuurwetenschappelijke 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 *Octopicola*, *Pseudanthessus* 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.
- Terron-Sigler, A., Penalver-Duque, P., Leon-Muez, D., Espinosa Torre, F. (2014) Spatio-temporal macrofaunal assemblages associated with the endangered orange coral *Astroides calycularis* (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. Marin. 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: Lichomolgoidea), en aguas cubanas. *Rev. Invest. Mar.*, 24, 25–256.
- Varela, C., Ortzn, 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 espongiicola (Copepoda: Siphonostomatoida: Asterocheridae) para Cuba. *Solenodon*, 6, 1–7.
- Veglia, A.J., Hammerman, N.H., Rivera Rosaly, C.R., Lucas, M.Q., Galindo, A., Estronza 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.

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