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Updates on Cyamidae (Crustacea: Amphipoda): redescriptions of *Cyamus monodontis* Lütken, 1870 and *Cyamus nodosus* Lütken, 1861, a new species of *Isocyamus*, and new host records for *Syncyamus ilheusensis* Haney, De Almeida and Reis, 2004

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Updates on Cyamidae (Crustacea: Amphipoda): redescriptions of *Cyamus monodontis* Lütken, 1870 and *Cyamus nodosus* Lütken, 1861, a new species of *Isocyamus*, and new host records for *Syncyamus ilheusensis* Haney, De Almeida and Reis, 2004

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ABSTRACT

Specimens of cyamids were collected from fresh cetacean carcasses from Brazil, Iceland and New Caledonia. Identifications were based on literature and comparative material. Redescriptions based on the type series of *Cyamus monodontis* and *Cyamus nodosus* collected from narwhal *Monodon monoceros* are proposed, and lectotypes and paralectotypes are designated. A new species of *Isocyamus* was described herein, *Isocyamus indopacetus* sp. nov., which is characterised by the maxilliped with outer plate and two spine-like processes on the bases of gills. This is the first record of a cyamid parasitising the Longman's beaked whale (*Indopacetus pacificus*) from New Caledonia. An updated key to *Isocyamus* is presented herein. *Syncyamus ilheusensis* is registered for the first time for the melon-headed whale *Peponocephala electra* and from the Clymene's dolphin *Stenella clymene* from Ceará, Brazil.

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Introduction

Cyamids are commonly known as whale-lice and they exclusively parasitise cetaceans (Lincoln and Hurley 1980; Martin and Heyning 1999; Rohde 2005). The family Cyamidae Rafinesque, 1815, which belongs to the order Amphipoda Latreille, 1816, has been accepted as part of the superfamily Caprelloidea Leach, 1814 in the suborder Senticaudata (Lowry and Myers, 2013). Cyamidae is comprised by six genera and 31 species: *Cyamus* Latreille, 1796 with 18 species, *Isocyamus* Gervais and Beneden, 1859 with four species, *Syncyamus* Bowman, 1955 with four species, *Platycyamus* Lütken, 1870 and *Scutocyamus* Lincoln and Hurley, 1974a with two species, and *Neocyamus* Margolis, 1955 with one species (Ahyong et al. 2011).

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While whale-lice are considered generalists on odontocetes (e.g. *Isocyamus delphinii* (Guérin-Méneville, 1836) is recorded for more than 10 species of dolphins, porpoises and beaked whales; Martin and Heyning 1999; Wardle et al. 2000), they are considered host-specific on mysticetes, such as *Cyamus boopis* Lütken, 1870, a specific parasite of humpback whales *Megaptera novaeangliae* (Borowski) (Leung 1970; Geraci and Aubin 1987; Carvalho et al. 2010; Iwasa-Arai et al. 2016). According to Callahan (2008), the presence of a single cyamid species on more than one host species suggests horizontal transmission rather than a strict association by descent (Hafner and Nadler 1990; Brooks and McLennan 1991). Thus, the process of horizontal transmission may play an important role in shaping the evolutionary and biogeographic histories of some lineages of whale lice. Studies of whale lice are scarce due to the difficulty of collecting samples, which depends on whaling and freshly stranded cetaceans (Margolis et al. 2000; Haney et al. 2004), as well as the lack of contact between cetaceologists and carcinologists. In order to increase the knowledge of the family Cyamidae and the biology of its hosts, the present study takes into account three different taxonomic approaches: (1) the redescription of *C. monodontis* Lütken, 1870 and *C. nodosus* Lütken, 1861 based on the type series with designation of lectotypes and paralectotypes; (2) the description of a new species of *Isocyamus*, *I. indopacetus* sp. nov., with an updated key for the genus; and (3) the recording of two new host species for *Syncyamus ilheusensis* Haney, De Almeida and Reis, 2004.

Material and methods

Samples of whale lice were collected from different cetacean host species and stranding localities. Specimens were fixed and preserved in 70% ethanol and sent to the Museu Nacional, Universidade Federal do Rio de Janeiro, Brazil (MNRJ) for identification. Measurements were made from the top of the head to the tip of the pleon. A complete list of cyamids collected, host species and stranding localities is shown in Table 1.

The type material of *C. monodontis* and *C. nodosus*, which was collected from narwhal *Monodon monoceros* Linnaeus, 1758 in Greenland, was observed and is redescribed herein with designation of lectotypes and paralectotypes that were deposited at the Zoologisk Museum, University of Copenhagen, Denmark (ZMUC).

Seven Longman's beaked whales *Indopacetus pacificus* Longman were found stranded together in southern New Caledonia in November 2013 (Garrigue et al. 2016). One whale louse was collected. The holotype was deposited at the Muséum National d'Histoire Naturelle, Paris, France (MNHN).

Cyamids were also collected from the skin around the blowhole of two melon-headed whales *Peponocephala electra* (Gray), one *Stenella clymene* (Gray), and one short-finned pilot whale *Globicephala macrorhynchus* Gray, which were stranded in north-east Brazil between 2012 and 2016. Identification of specimens was made based on comparative material from the MNRJ and on the following literature: Lincoln and Hurley (1981), Raga (1988), Sedlak-Weinstein (1991), Haney et al. (2004). The material was deposited at MNRJ.

Table 1. Cyamids, hosts and stranding data.

Ref. no.	Cyamid	Host	Stranding location	Lat., Long.	Date
MNHN-IU-2014-12863	*Isocyamus indopacetus*	*Indopacetus pacificus*	Baie de la Somme, New Caledonia	22°19′45.7″S, 166°49′28.3″E	November 2013
MNRJ 26765	*Syncyamus ilheusensis*	*Peponocephala electra*	Aracati, Ceará, Brazil	04°27′26.9″S, 37°44′47.3″W	September 2012
MNRJ 26766	*Syncyamus ilheusensis*	*Peponocephala electra*	Fortaleza, Ceará, Brazil	03°48′28.6″S, 38°24′41.2″W	December 2014
MNRJ XXX	*Syncyamus ilheusensis*	*Stenella clymene*	Aquiraz, Ceará, Brazil	03°53′34″S, 38°21′10.5″W	January 2016
MNRJ 26767	*Syncyamus ilheusensis*	*Globicephala macrorhynchus*	Cruz, Ceará, Brazil	02°48′44.0″S, 40°24′54.9″W	January 2012
ZMUC CRU-8685	*Cyamus monodontis*	*Monodon monoceros*	Greenland		1870
ZMUC CRU-467	*Cyamus monodontis*	*Monodon monoceros*	Greenland		1870
ZMUC CRU-7641	*Cyamus monodontis*	*Monodon monoceros*	Greenland		
ZMUC CRU-8570	*Cyamus monodontis*	*Monodon monoceros*	Thule, Greenland		April 1921
ZMUC CRU-8687	*Cyamus nodosus*	*Monodon monoceros*	Greenland		1861
ZMUC CRU-494	*Cyamus nodosus*	*Monodon monoceros*	Greenland		1861
ZMUC CRU-7641	*Cyamus nodosus*	*Monodon monoceros*	Greenland		
ZMUC CRU-8570	*Cyamus nodosus*	*Monodon monoceros*	Thule, Greenland		April 1921

Results and discussion

Taxonomy

Class **MALACOSTRACA** Latreille, 1802
Order **AMPHIPODA** Latreille, 1816
Suborder **SENTICAUDATA** Lowry and Myers, 2013
Infraorder **COROPHIIDA** Leach, 1814 (sensu Lowry and Myers, 2013)
Family **CYAMIDAE** Rafinesque, 1815
Genus ***Cyamus*** Latreille, 1796

Diagnosis

Antenna 1 long, with 4 articles, terminal article with multiple groupings of setae. Lower lip partially fused. Maxilla 2 with inner and outer lobes separated. Maxillipeds inner lobes triangular, outer lobes present, laterally based, palps present or absent. Gnathopod 1 palm elongate, dactylus semi recurved. Gnathopod 2 propodus' palm elongate. Pereonites 3 and 4 wider or subequal in width to pereonite 5 in males and wider in females, with uni- or biramous lateral gills, sausage shaped. Accessory gills always present in males, usually bilobed, and usually present in females, oval. Oostegite plates 3 subtriangular, plates 4 oval.

Type species

Oniscus ceti Linnaeus, 1758.

Cyamus monodontis Lütken, 1870
(Figures 1 and 2)

Cyamus monodontis Lütken, 1870: 279. – Lütken 1873: 282. – Leung 1967: 285, fig. 4c. – Lincoln and Hurley 1974b: 68. – Leung 1976: 160. – Berzin and Vlasova 1982: 157, 158. – Margolis and Arai 1989: 12. – Haney 1999: 124–128, figs 47–49. – Martin and Heyning 1999: 28.
Cyamus (Cyamus) monodontis – Margolis *et al*. 2000: 71–74, fig. 4.

Material examined (host Monodon monoceros)

Lectotype. One male, 9.4 mm, Greenland, ZMUC-CRU-8685. Paralectotypes: four males, 8.5–9.3 mm, Greenland, ZMUC CRU-467. Allotype: one female, 7.2 mm, Thule, Greenland, ZMUC CRU-8686. Other non-type material: one female, 5.4 mm, Greenland, ZMUC CRU-7641; three males, 5.2–7.2 mm, 3 females, 7.1–7.8 mm, Thule, Greenland, ZMUC CRU-8570.

Hosts

Monodon monoceros, Delphinapterus leucas (Pallas).

Diagnosis

Pereonite 2 without knoblike process on the posterior margin. Lateral gills stout, uniramous; male accessory gills asymmetrically bilobed, anterior lobe shortest, female accessory gills oval. Pereonite 5 smooth, male pereonites 6 and 7 with two pairs of acute ventral processes, female P6 with three pairs and P7 with one pair of acute ventral processes.

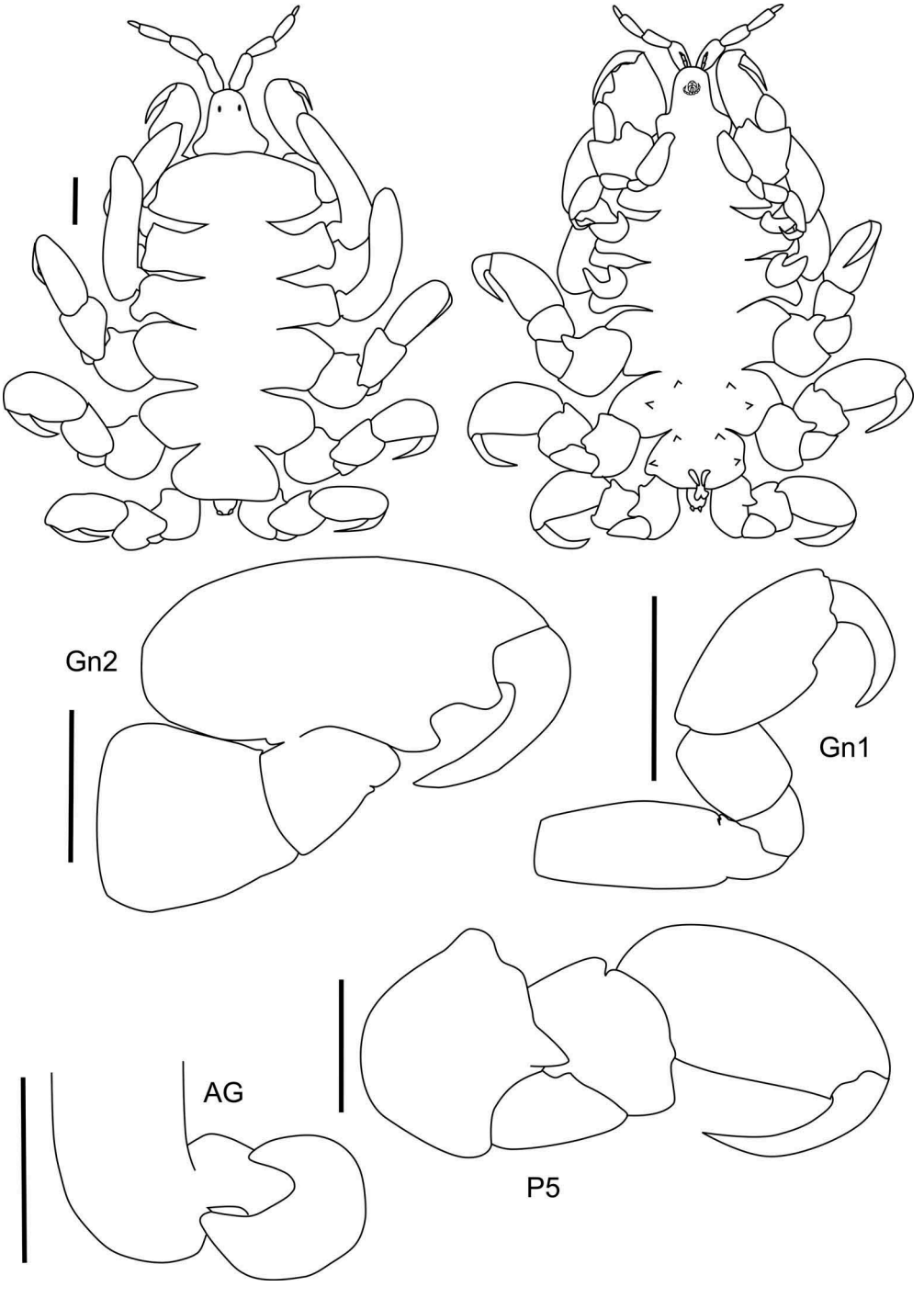

Figure 1. *Cyamus monodontis* Lütken, 1870. Lectotype, male, 9.4 mm, ZMUC CRU-8685. AG: accessory gill; Gn: gnathopod; LG: lateral gill. Scale bars = 1 mm.

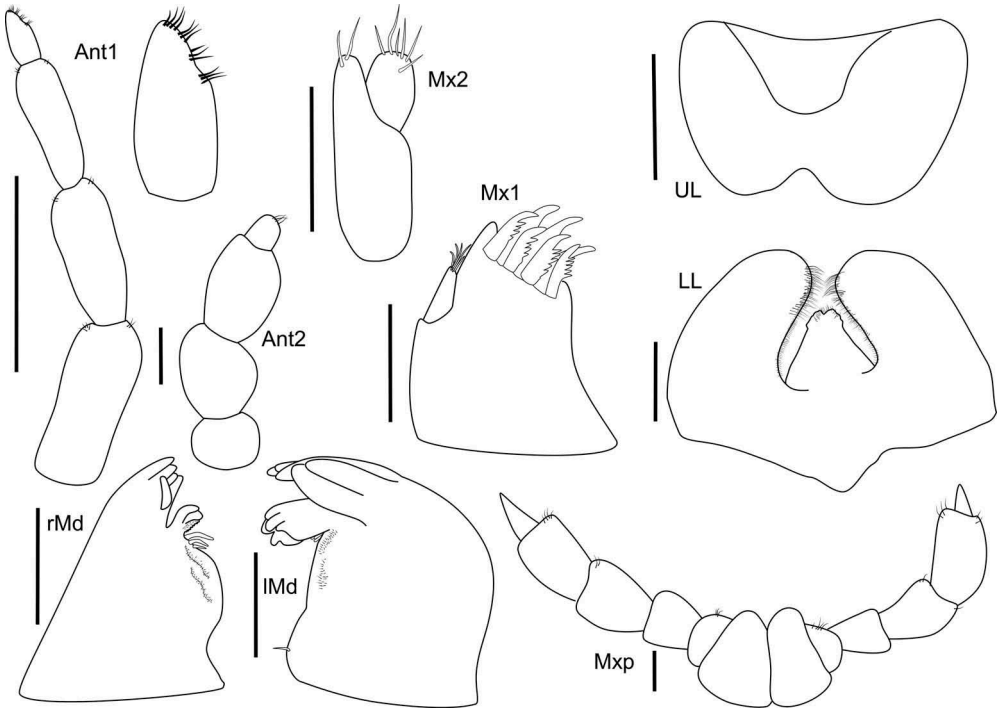

Figure 2. *Cyamus monodontis* Lütken, 1870. Lectotype, male, 9.4 mm, ZMUC CRU-8685. Ant: antenna; LL: lower lip; lMd: left mandible; rMd; right mandible; Mx: maxilla; Mxp: maxilliped; UL: upper lip. Scale bars: antenna 1 = 1 mm; all others = 100 µm.

Redescription

Lectotype, male, 9.4 mm, ZMUC CRU-8685. Body compact and dorso-ventrally depressed. Eyes small and ovoid. Head quadrangular, partially fused with pereonite 1; lateral incision between head and pereonite 1 absent. Pereonite 1 with lateral expansion. Pereonite 2 with squared process on posterolateral margin. Pereonites 3 and 4 shorter in length than pereonites 1, 2 and 5–7, subequal in width to pereonite 5, with terminal posterior projections, without pereopods, each bearing one pair of gills and one accessory gill. Pereonite 5 smooth. Pereonites 6 and 7 each bearing two pairs of acute ventral processes (ventral spines), the first pair antero-directed, the second, latero-directed. Pereonite 7 triangular. Penes large, stout (Figure 1).

Antenna 1 long, with 4 articles, terminal article narrow and long, bearing apical tuft of setae, and brush-like setal groupings on the internal margin of terminal article; other articles sparsely setose. Antenna 2 with 4 articles, with setae on terminal article; article 3 the longest. Upper lip with distomedial invagination, producing distally rounded left and right subequal lobes, epistome moderate, not reaching distomedial invagination. Lower lip outer lobes longer than inner lobes; outer lobes broad, triangular; inner margin setose; inner lobes partially fused, rounded distally. Left mandible with palp absent; incisor five-toothed; lacinia mobilis five-toothed; spine row short, with three setae; molar process absent. Right mandible with palp absent; right incisor five-toothed; lacinia

mobilis multituberculate with two teeth; spine row of three setae; molar process absent; submolar setae lacking. Maxilla 1 with seven denticulate setae on outer lobe; palp 1 one-articulate, with long setae. Maxilla 2 with distomedial expansion of inner lobe bearing two setae. Maxillipeds with inner plate lacking setae; outer plate with 3–4 setae, palp 4-articulated, sparsely setose (Figure 2).

Gnathopod 1 approximately one-fourth size of gnathopod 2, coxa not fused with pereon, anterior margin of propodus with elongate expansion. Gnathopod 2 coxa not fused with pereon; ventral face of basi-ischium with blunt process on antero-lateral corner, large blunt expansion located proximally of process; carpus and propodus fused; proximal process of interior margin of propodus oval, propodus with subacute palmar tooth, subequal in length to proximal process, dactylus large and unornamented, reaching propodus' oval proximal process. Pereopods 3 and 4 absent. Pereonites 3 and 4 bearing stout, uniramous and outwardly directed lateral gill; lateral gill cylindrical, 3.5 times longer than wide. Pereonites 3 and 4 bearing bilobed medial (accessory) gill; accessory gill much shorter than lateral gill, also arising as coxal epipod. Accessory gill lobes asymmetrical, posterior lobe the longest. Pereopods 5–7 coxae not fused with pereon. Basi-ischium with large, acute process, distally directed, located distally on antero-ventral face. Anterior margin of ischium uniform, unornamented. Inferior margin of merus uniform. Carpus with anterolateral expansion. Propodus subelliptical; with no teeth or spines. Dactylus acute, angle of recurve dactylus extreme, approximately 90° (Figure 1).

Pleon reduced with one pair of pleopods, fused basally and separate distally; with each pleopod ending in a spherical lobe and bearing short setae along its lateral margins.

Female, 7.2 mm, ZMUC CRU-8686 – Pereonites 3 and 4 broader than those of male, subequal in width to pereonites 5 and 6, bearing triangular oostegite. Margins of oostegites lined with short, simple setae. Pereonites 3 and 4 bearing small round accessory gills, posterior margin smooth. Pereonite 5 without ventral acute processes, genital valves present; medial margin of genital valve well rounded, bearing cluster of short setae. Pereonite 6 bearing three pairs of ventral acute processes, forwardly, laterally and backwardly directed, pereonite 7 with one pair of ventral acute processes, laterally directed; pleon lacking pleopods.

Remarks

The syntype series of *Cyamus monodontis* was available from the Zoologisk Museum, University of Copenhagen, which made it possible for us to designate a lectotype and paralectotypes, and provide a redescription using modern standards. *Cyamus monodontis* was described originally as an ectoparasite of *Monodon monoceros* from Greenland (Lütken, 1870). Its body shape is similar to that of *Cyamus nodosus*, which co-occurs on *Monodon monoceros*, and to that of *Cyamus ceti* (Linnaeus, 1758), ectoparasite of bowhead whales *Balaena mysticetus* Linnaeus, 1758 and gray whales *Eschrichtius robustus* (Lilljeborg). Lateral gills of *C. monodontis* are more similar to those of *C. nodosus*, while its accessory gills are more similar to those of *C. ceti*, which are asymmetrically bilobed. *Cyamus monodontis* differs from them by the spination on the ventral face of pereonites 5–7 and the absence of knob-like processes on the posterior margin of pereonite 2.

Despite *C. monodontis* being recorded for both *M. monoceros* and *D. leucas*, all the examined material was collected from a single host species, *M. monoceros*.

Delphinapterus leucas was recorded by Margolis (1954) and Grüner (1975) as host, but it seems that the majority of the available material in collections is from *M. monoceros* (Margolis 1954; Lincoln and Hurley 1974b; Haney 1999). A description of *C. monodontis* specimens from *D. leucas* is available in Margolis et al. (2000).

Cyamus nodosus Lütken, 1861
(Figures 3 and 4)

Cyamus nodosus Lütken, 1861: 591. – Lütken 1870: 280. – Lütken 1873: 282. – Leung 1967: 286, fig. 3c. – Lincoln and Hurley 1974b: 68–69. – Berzin and Vlasova 1982: 157–158. – Margolis and Arai 1989: 12. – Martin and Heyning 1999: 28. – Haney 1999: 128–133, figs 50–52. – Margolis *et al*. 2000: 74.
Paracyamus nodosus – Stephensen 1942: 451–452. – Margolis 1955: 128.

Material examined (host Monodon monoceros)
Lectotype. One male, 8.6 mm, Greenland, ZMUC CRU-8687. Paralectotypes: four males, 5.8–7.2 mm, Greenland, ZMUC CRU-494. Allotype: one female, 7.1 mm, ZMUC CRU-8688. Other non-type material: two males, 6.4–7.0 mm, one female, 5.4 mm, one juvenile, 3.8 mm, Greenland, ZMUC CRU-7641; 15 males, 6.5–7.0 mm, 13 females, 5.9 mm–7.1 mm, 16 juveniles, not measured, Thule, Greenland, ZMUC CRU-8570.

Hosts
Monodon Monoceros, Delphinapterus leucas.

Diagnosis
Dorsal face of pereonites 2–7 with broad protuberances; Lateral gills stout, uniramous; accessory gills of male subtriangular, uniramous; pereonite 5 of male smooth, pereonites 6 and 7 of male bearing one pair of blunt ventral processes.

Redescription
Lectotype, male, 8.6 mm, ZMUC CRU-8687. Body compact and dorso-ventrally depressed, dorsal surface uneven, with broad protuberances. Eyes small and ovoid. Head quadrangular, partially fused with pereonite 1; lateral incision between head and pereonite 1 absent. Pereonite 1 without lateral expansion. Pereonite 2 with knob-like process on posterolateral margin. Pereonites 3 and 4 subequal in length to other somites, wider than pereonite 5–7; pereonite 4 with posterolateral projection, without pereopods, each bearing one pair of gills and one accessory gill. Pereonite 5 smooth. Pereonites 6 and 7 each bearing one pair of blunt ventral processes (ventral spines) antero-directed. Pereonite 7 triangular. Penes large, stout (Figure 3).

Antenna 1 with 4 articles, terminal article narrow and long, bearing apical tuft of setae, and brush-like setal groupings on the internal margin of terminal article; subterminal article sparsely setose. Antenna 2 four-articulate, with setae on terminal article; article 3 the longest. Upper lip with distomedial invagination, producing distally rounded left and right subequal lobes, setose on inner margin of both lobes, epistome moderate, not reaching distomedial invagination. Lower lip outer lobes longer than

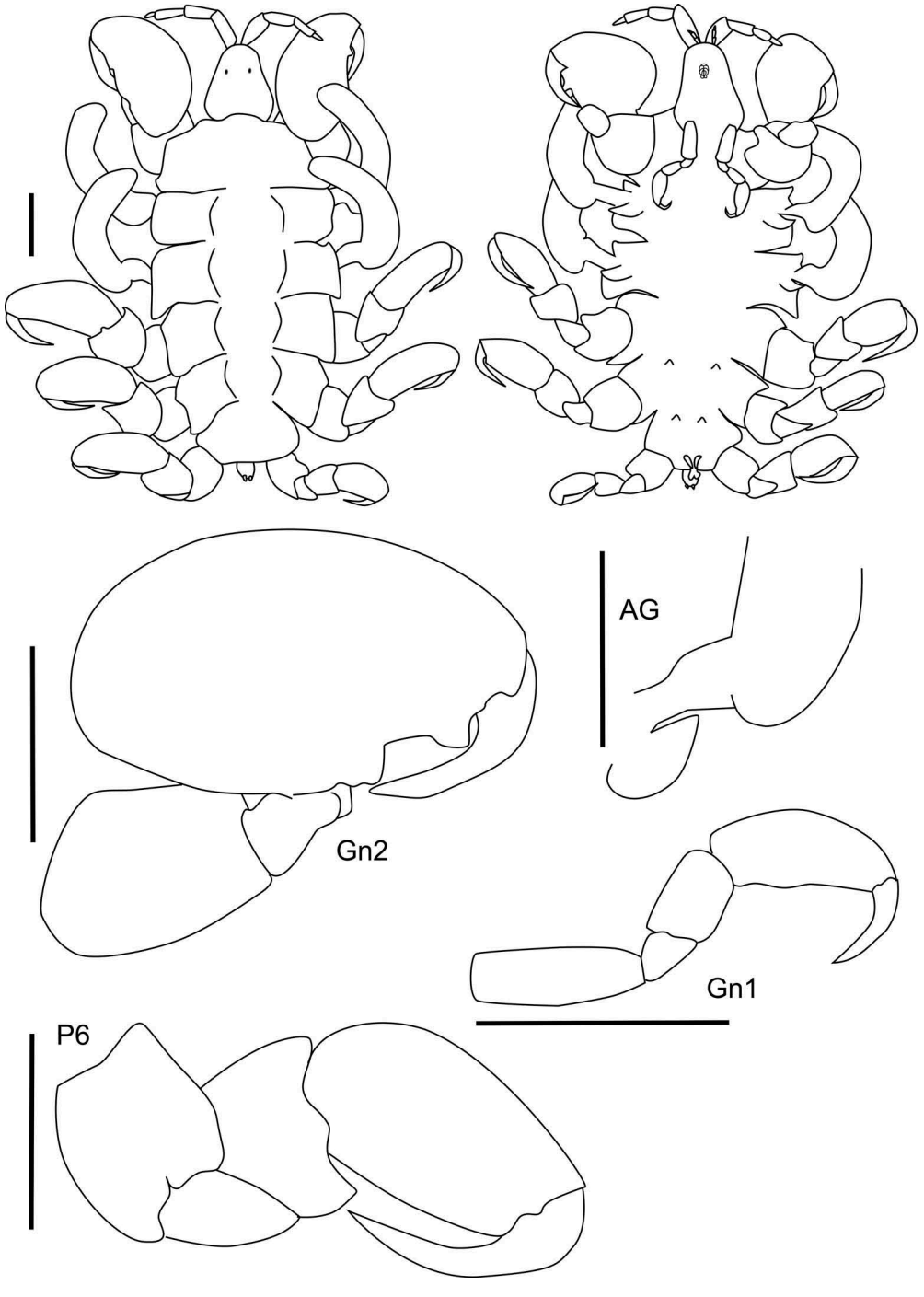

Figure 3. *Cyamus nodosus* Lütken, 1861. Lectotype, male, 8.6 mm, ZMUC CRU-8687. AG: accessory gill; Gn: gnathopod; P: pereopod. Scale bars = 1 mm.

inner lobes; outer lobes slender, triangular; inner margin setose; inner lobes partially fused, rounded distally. Left mandible with palp absent; incisor seven-toothed; lacinia mobilis seven-toothed; spine row of three or more setae; molar process absent,

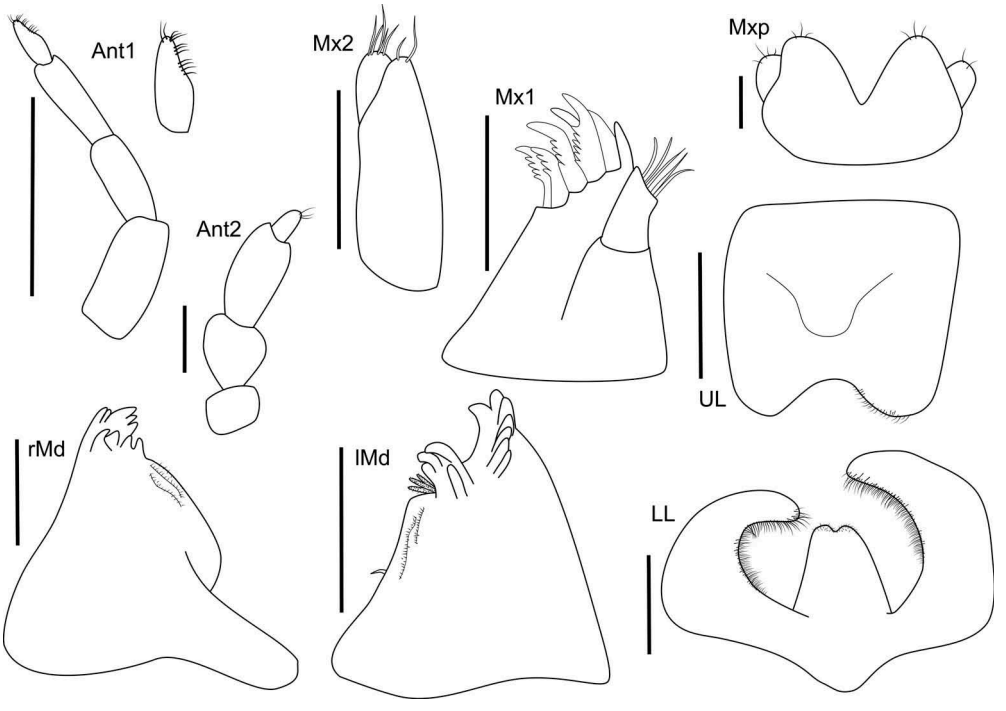

Figure 4. *Cyamus nodosus* Lütken, 1861. Lectotype, male, 8.6 mm, ZMUC CRU-8687. Ant: antenna; LL: lower lip; lMd: left mandible; rMd; right mandible; Mx: maxilla; Mxp: maxilliped; UL: upper lip. Scale bars: antenna 1 = 1 mm; all others = 100 µm.

submolar setae long. Right mandible with palp absent; right incisor five-toothed; lacinia mobilis multituberculate with four teeth; spine row of two setae; molar process absent; submolar setae present. Maxilla 1 with seven denticulate setae on outer lobe; palp 1one-articulate, with long setae. Maxilla 2 with distomedial expansion of inner lobe bearing two setae. Maxillipeds with inner plate setose; outer plate with 4–6 setae, palp absent (Figure 4).

Gnathopod 1 approximately one-fourth size of gnathopod 2, coxa not fused with pereon, anterior margin of propodus with elongate expansion. Gnathopod 2 coxa not fused with pereon; ventral face of basi-ischium with large blunt expansion on anterior margin; carpus and propodus fused; proximal process of interior margin of propodus triangular, propodus with subacute palmar tooth, subequal in length to proximal process, dactylus large and unornamented, reaching propodus' triangular proximal process. Pereopods 3 and 4 absent. Pereonites 3 and 4 bearing stout, uniramous and outwardly directed lateral gill; lateral gill cylindrical, 3.5 times longer than wide. Pereonites 3 and 4 bearing subtriangular medial (accessory) gill; accessory gill much shorter than lateral gill, also arising as coxal epipod. Coxae of pereopods 5–7 not fused with pereon. Basi-ischium uniform, lacking anterolateral acute process on ventral face. Anterior margin of ischium uniform, unornamented. Inferior margin of merus uniform. Carpus without anterolateral expansion. Propodus subelliptical; with no teeth or spines. Dactylus acute, angle of recurve dactylus extreme, approximately 90° (Figure 3).

Pleon reduced with one pair of pleopods, fused basally and separate distally; with each pleopod ending in a spherical lobe and bearing short setae along its lateral margins.

Female, 7.1 mm, ZMUC CRU-8688 – Pereonites 3 and 4 broader than those of male, subequal in width to pereonites 5 and 6, bearing triangular oostegite. Margins of oostegites lined with short, simple setae. Pereonites 3 and 4 bearing small round accessory gills, posterior margin smooth. Pereonite 5 with a pair ventral acute processes on posterolateral margin of genital valves; medial margin of genital valve well rounded, bearing cluster of short setae. Pereonite 6 bearing two pairs of ventral blunt processes, pereonite 7 with one pair of ventral blunt processes; pleon lacking pleopods.

Remarks

The syntype series of *Cyamus nodosus* was available from the Zoologisk Museum, University of Copenhagen, which made it possible to designate a lectotype and paralectotypes, and provide a redescription following modern standards. *Cyamus nodosus* is easily distinguishable from other *Cyamus* species by the presence of broad tubercles on its pereon. It was described by Lütken (1861) for *M. monoceros* from Greenland.

Cyamus nodosus was described for *Monodon monoceros*, and later recorded for *Delphinapterus leucas* by Margolis (1954), who emphasised the host specificity of whale-louse species and suggested that contact between host species should provide the parasite's horizontal transfer, by the observation of rare occurrence of *C. nodosus* and *C. monodontis* on *D. leucas*.

Genus ***Isocyamus*** Gervais and Beneden, 1859

Diagnosis

Antenna 1, with 4 articles and with a continuous band of setae on terminal article. Lower lip inner lobes fused. Maxilla 2 outer lobes fused. Maxilliped inner lobes rounded, outer lobes usually lacking, palps lacking. Gnathopod 1 palm elongate, dactylus semi-recurved. Gnathopod 2 propodus' palm elongate. Lateral gills sausage shaped. Accessory gills present, usually sausage shaped or subtriangular; 1–2 spine-like processes present on the base of lateral gills. Oostegites plates 3 subtriangular, plates 4 oval.

Table 2. Host records of *Isocyamus*.

Species	Host	Reference
Isocyamus antarcticensis Berzin and Vlasova, 1982	*Orcinus orca* (Linnaeus, 1758)	Berzin and Vlasova (1982)
Isocyamus delphinii (Guérin-Meneville, 1836)	*Delphinus delphis* Linnaeus, 1758; *Pseudorca crassidens* (Owen); *Grampus griseus* (G. Cuvier); *Globicephala macrorhynchus* Gray; *G. melas* (Traill); *Steno bredanensis* (G. Cuvier in Lesson); *Mesoplodon europaeus* (Gervais); *Lagenorhynchus albirostris* (Gray); *Peponocephala electra* (Gray); *Phocoena phocoena* (Linnaeus, 1758); *O. orca*; *Tursiops truncatus* (Montagu)	Wardle et al. (2000)
Isocyamus deltobranchium Sedlak-Weinstein, 1992b	*G. macrorhynchus*; *G. melas*	Sedlak-Weinstein (1992b)
Isocyamus indopacetus sp. nov.	*Indopacetus pacificus* (Longman, 1926)	Present study
Isocyamus kogiae Sedlak-Weinstein, 1992a	*Kogia breviceps* (de Blainville, 1838)	Sedlak-Weinstein (1992a)

Type species

Cyamus delphinii Guérin-Méneville, 1836

Remarks

Species of *Isocyamus* are distinguished from other genera of whale lice by their elongate, whitish appearance, reduced maxillipeds, presence of spine-like processes on the base of lateral gills (sausage-shaped gills), and large accessory gills (Sedlak-Weinstein 1992a, 1992b). With the description of *Isocyamus indopacetus* sp. nov. the genus diagnosis is amended as this species shows the maxilliped with a round distal lobe, which is a unique character within the genus. Species of *Isocyamus* are found in different odontocete hosts, and they usually parasitise more than one host species (Table 2) (Leung 1970).

Isocyamus indopacetus Iwasa-Arai and Serejo, sp. nov. (Figures 5–7)

Material examined

Holotype, male, 9.2 mm, Baie de la Somme (22.329°S; 166.824°E), New Caledonia, from *Indopacetus pacificus*, C. Garrigue et al. col., November 2013, MNHN-IU-2014-12863.

Diagnosis

Maxilliped inner lobes rounded, with distal outer lobes. Gnathopod 2 with proximal palmar expansion and triangular palmar tooth. Accessory gills subtriangular; lateral gills with a pair of spine-like processes at the base. Maxilla 2 with reduced outer lobes. Lower lip with inner lobes fully fused. Pereopod 5–7 basi-ischium with anterolateral acute process distally directed.

Etymology

The specific epithet refers to the host genus, *Indopacetus* Moore).

Description

Holotype, male, 9.2 mm, MNHN-IU-2014-12863. Body compact and dorso-ventrally depressed, dorsal surface smooth. Eyes small and ovoid. Head quadrangular, partially fused with pereonite 1; lateral incision between head and pereonite 1 absent. Pereonite 1 with lateral expansion. Pereonite 2 with typical anterodorsal epaulet-like cuticular infoldings and knob-like process on posterolateral margin (Figures 5 and 7(a)). Pereonites 3 and 4 subequal in length to other somites, slightly narrower than pereonite 5, without pereopods, each bearing one pair of sausage-like gills, one subtriangular accessory gill and two accessory spine-like processes arising from each lateral gill (Figures 5 and 7(b)). Pereonites 5, 6 and 7 each bearing one pair of acute ventral processes (ventral spines), antero-directed (Figures 5 and 7(d)). Pereonite 7 triangular. Penes large, stout.

Antenna 1 four-articulate, terminal article narrow and long, bearing a continuous band on the internal margin of terminal article; subterminal article sparsely setose. Antenna 2 three-articulate, with sparse setae. Upper lip with distomedial invagination,

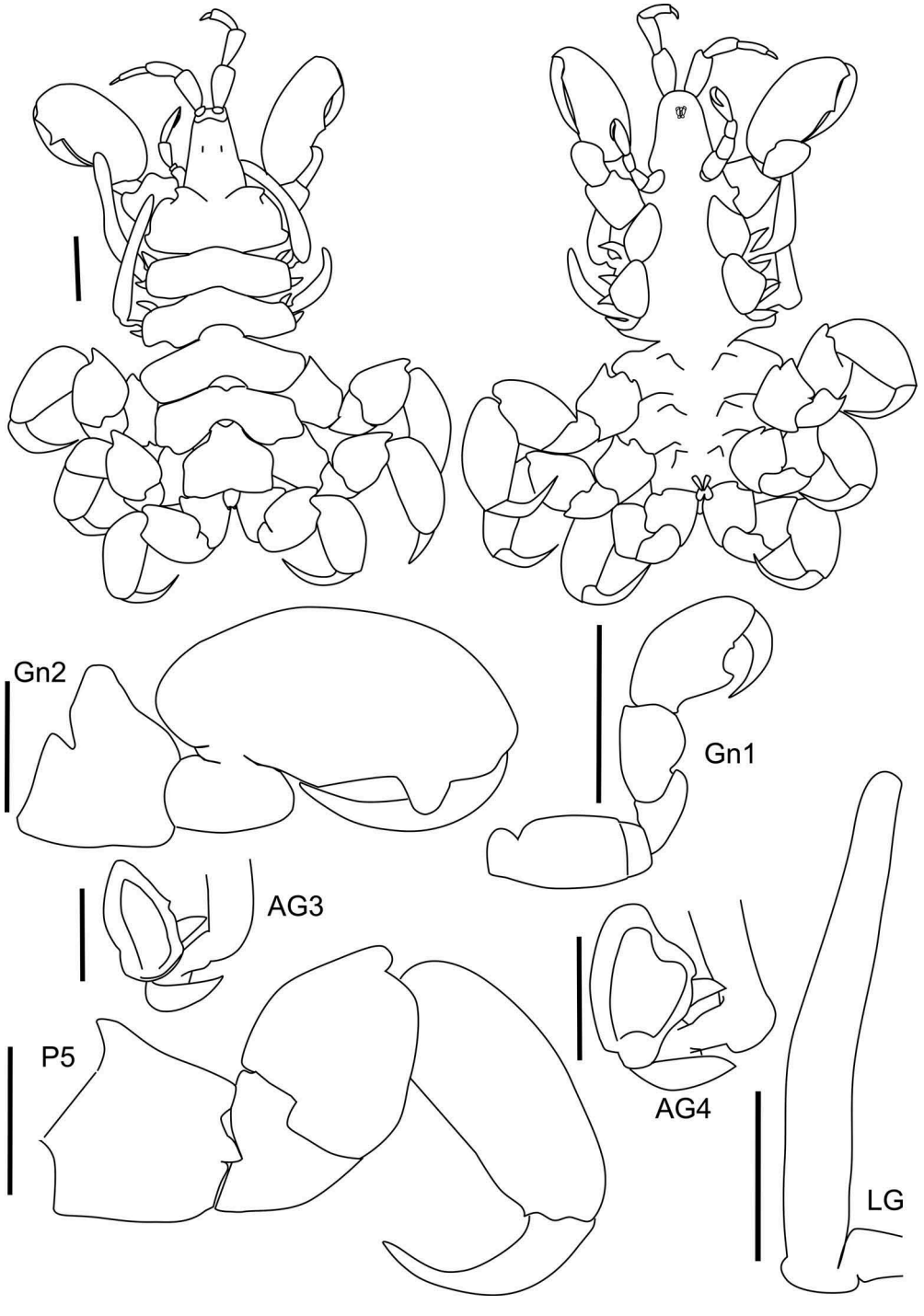

Figure 5. *Isocyamus indopacetus* Iwasa-Arai and Serejo sp. nov. Holotype, male, 9.2 mm, MNHN-IU-2014-12863. AG: accessory gill; Gn: gnathopod; LG: lateral gill; P: pereopod. Scale bars = 1 mm.

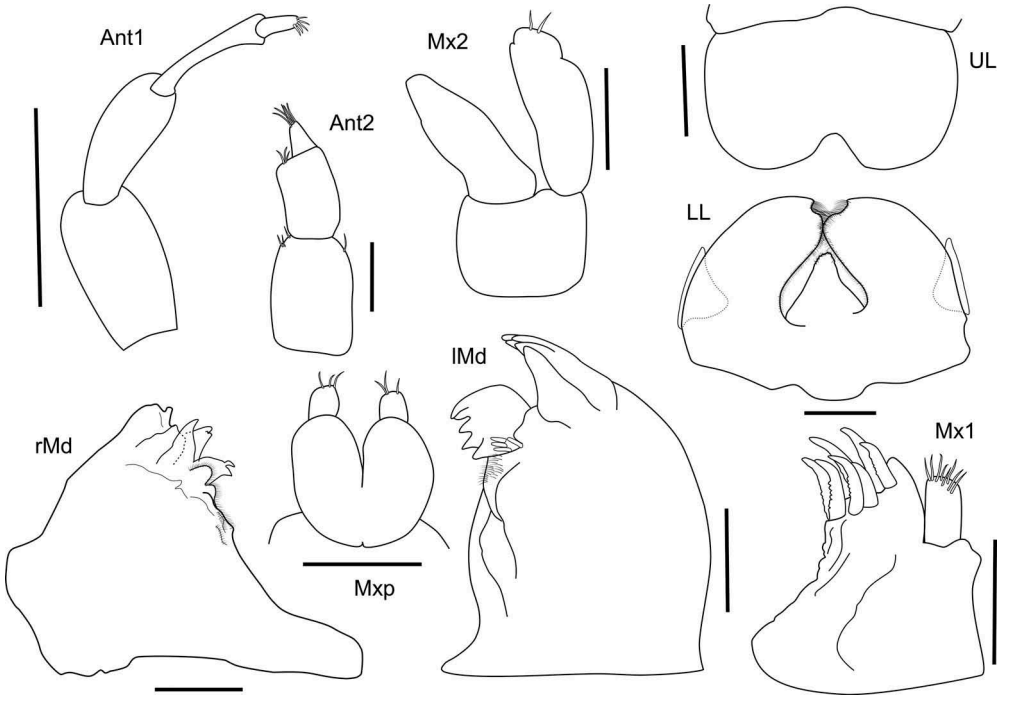

Figure 6. *Isocyamus indopacetus* Iwasa-Arai and Serejo sp. nov. Holotype, male, 9.2 mm, MNHN-IU-2014-12863. Ant: antenna; LL: lower lip; lMd: left mandible; rMd; right mandible; Mx: maxilla; Mxp: maxilliped; UL: upper lip. Scale bars: antenna 1 = 1 mm; all others = 100 µm.

producing distally rounded left and right subequal lobes, epistome moderate, not reaching distomedial invagination. Lower lip outer lobes longer than inner lobes; outer lobes broad, triangular; terminal margin heavily setose and inner margin setose; inner lobes fully fused, triangular. Left mandible with palp absent; incisor five-toothed; lacinia mobilis five-toothed; spine row of three setae; molar process absent. Right mandible with palp absent; right incisor six-toothed; lacinia mobilis multituberculate with two teeth; spine row absent; molar process absent; submolar setae lacking. Maxilla 1 with seven denticulate robust setae on outer lobe; palp one-articulate, with long setae, not reaching outer lobe setae. Maxilla 2 with distomedial expansion of inner lobe; outer lobe fused. Maxillipeds with inner plate lacking setae, fused basally, maxillipeds outer plate present, anteriorly directed; palp absent (Figures 6 and 7(c)).

Gnathopod 1 approximately one-fourth size of gnathopod 2, coxa not fused with pereon, anterior margin of propodus with proximal broad expansion. Gnathopod 2 coxa not fused with pereon; basi-ischium with large triangular expansion on anterior margin; carpus and propodus fused; proximal interior margin of propodus with a small blunt projection, propodus with subacute palmar tooth, larger than proximal expansion, dactylus large and unornamented, reaching propodus' proximal expansion. Pereopods 3 and 4 absent. Pereonites 3 and 4 bearing stout, uniramous and outwardly directed lateral gill; lateral gill cylindrical, 7.5 times longer than wide. Pereonites 3 and 4 bearing triangular, leaf-shaped medial (accessory) gill; accessory gill subequal in length to lateral gill, also arising as coxal epipod; pair of spine-like process arising from each gill, laterally

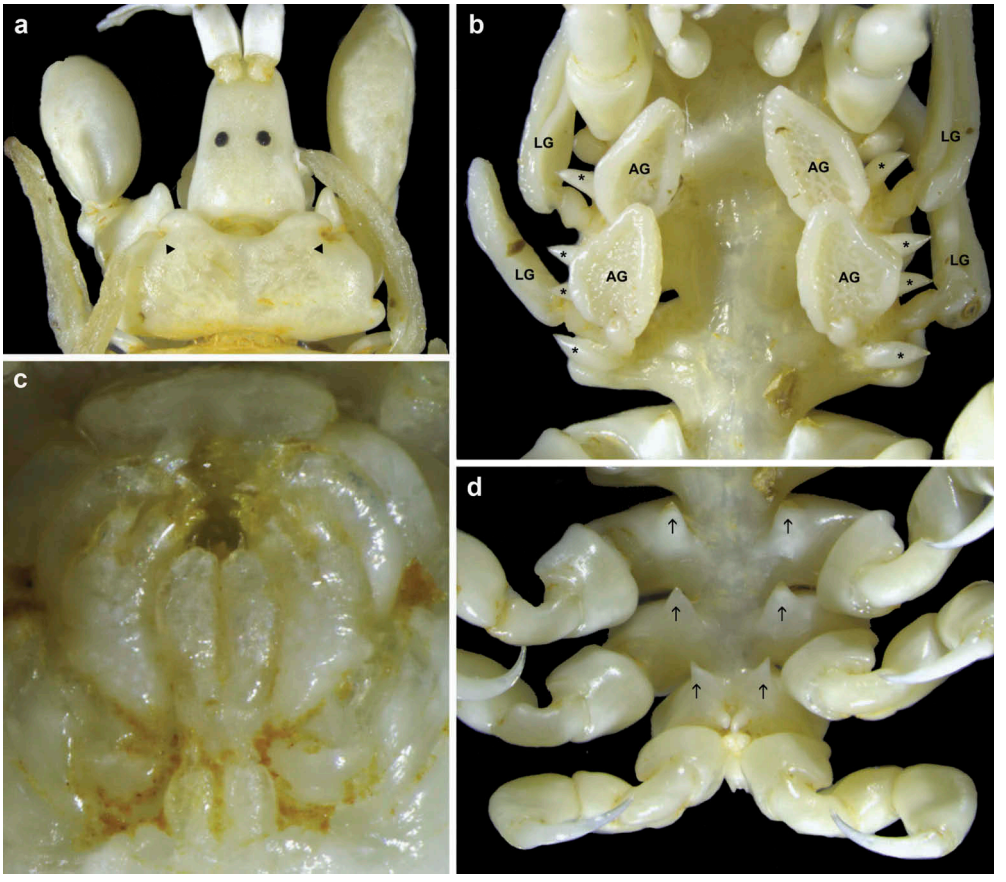

Figure 7. *Isocyamus indopacetus* Iwasa-Arai and Serejo sp. nov. Holotype, male, 9.2 mm, MNHN-IU-2014-12863. (a) Dorsal view. Triangles indicate epaulet-like cuticular infoldings. (b) Ventral view. Asterisks indicate spine-like processes of gills. AG: accessory gill; LG: lateral gill. (c) Mouthparts. (d) Ventral view. Arrows indicate acute ventral processes of pereonites 5, 6 and 7.

directed. Coxae of pereopods 5 through 7 not fused with pereon. Basi-ischium with anterolateral acute process on ventral face, distally directed. Anterior margin of ischium uniform, unornamented. Inferior margin of merus uniform. Carpus with anterolateral expansion. Propodus subelliptical, with no teeth or spines. Dactylus acute, angle of recurve dactylus extreme, approximately 90° (Figure 5).

Pleon reduced with one pair of pleopods, fused basally and separate distally, with each pleopod ending in a spherical lobe and bearing short setae along its lateral margins.

Remarks

Until the present study *Isocyamus* included four species that are ectoparasites of different hosts (Table 2). *Isocyamus indopacetus* sp. nov. is close to *I. deltobranchium* in the subtriangular shape of accessory gills, which is an exclusive character of these species. However, *I. indopacetus* sp. nov. presents two spine-like processes at the base of each lateral gill, whereas *I. deltobranchium* has only one process per gill (Figures 5 and

Table 3. Diagnostic features of *Isocyamus*.

Species	Maxilliped outer lobe	Accessory gills in males	Spines on basis of gills	Epaulette-like processes at anterodorsal margin of Pr2	Acute ventral processes on Pr5/Pr6/Pr7
Isocyamus antarcticensis Berzin and Vlasova, 1982	Absent	Clavate	1	Present	Present
Isocyamus delphinii (Guérin-Meneville, 1836)	Absent	Cylindrical	1	Absent	Present
Isocyamus deltobranchium Sedlak-Weinstein, 1992b	Absent	Subtriangular	1	Present	Present
Isocyamus indopacetus sp. nov.	Present	Subtriangular	2	Present	Present
Isocyamus kogiae Sedlak-Weinstein, 1992a	Absent	Leaf-like	1	Present	Absent

7(b); Table 3). Also, *Isocyamus indopacetus* sp. nov. exhibits the maxilliped with outer plate, an unique character among other *Isocyamus* (Figures 6 and 7(c)). Nonetheless, while other species of *Isocyamus* have the dactyl of gnathopod 1 with a combed ridge, it is smooth in *I. indopacetus* sp. nov. (Figure 5).

Longman's beaked whale is considered one of the rarest and least well known cetaceans (Garrigue et al. 2016). This is the first record of a whale-louse species parasitising the Longman beaked whale, though Yamada et al. (2012) reported that *Indopacetus pacificus* often carried unidentified whale lice, and highlighted the importance of having more research on external parasites of these beaked whales.

Key to species of *Isocyamus* (modified from Sedlak-Weinstein 1992b)

1. One pair of ventral acute processes on segments 5–7 2
– No ventral processes on segments 5–7 ..... *I. kogiae*

2. Accessory gills in males shorter than lateral gills, subtriangular or clavate, pereonite 2 with anterodorsal epaulet-like cuticular infoldings 3
– Accessory gills in males equal in length to lateral gills, cylindrical, pereonite 2 anterodorsal margin straight ..... *I. delphinii*

3. One spine-like process on basis of lateral gills 4
– Two spine-like processes on basis of lateral gills .... *I. indopacetus* sp. nov. (Figure 2)

4. Accessory gills in males triangular, palm of gnathopod 2 of female with posterior tooth only… .... *I. deltobranchium*
– Accessory gills in males clavate, palm of gnathopod 2 of female with anterior and posterior pointed teeth .... *I. antarcticensis*

Genus ***Syncyamus*** Bowman, 1955

Diagnosis

Antenna 1 short, 4-segmented, terminal article sparsely setose. Lower lip inner lobes fused. Maxilla 2 outer lobes fused. Maxillipeds inner lobes triangular, fused basally, outer lobes lacking, palps lacking. Gnathopod 1 palm short, dactylus very recurved. Gnathopod 2 propodus robust, palm short. Pereonites 3 and 4 short, with uniramous lateral gills, sausage-shaped. Accessory gills present, sausage-shaped, spinelike processes on the base of lateral gills absent. Oostegites plates 3–4 boot shaped.

Type species

Syncyamus pseudorcae Bowman, 1955.

Syncyamus ilheusensis Haney, De Almeida and Reis, 2004 (Figure 8)

Syncyamus ilheusensis Haney, De Almeida and Reis, 2004: 410–416, figs 1–5.

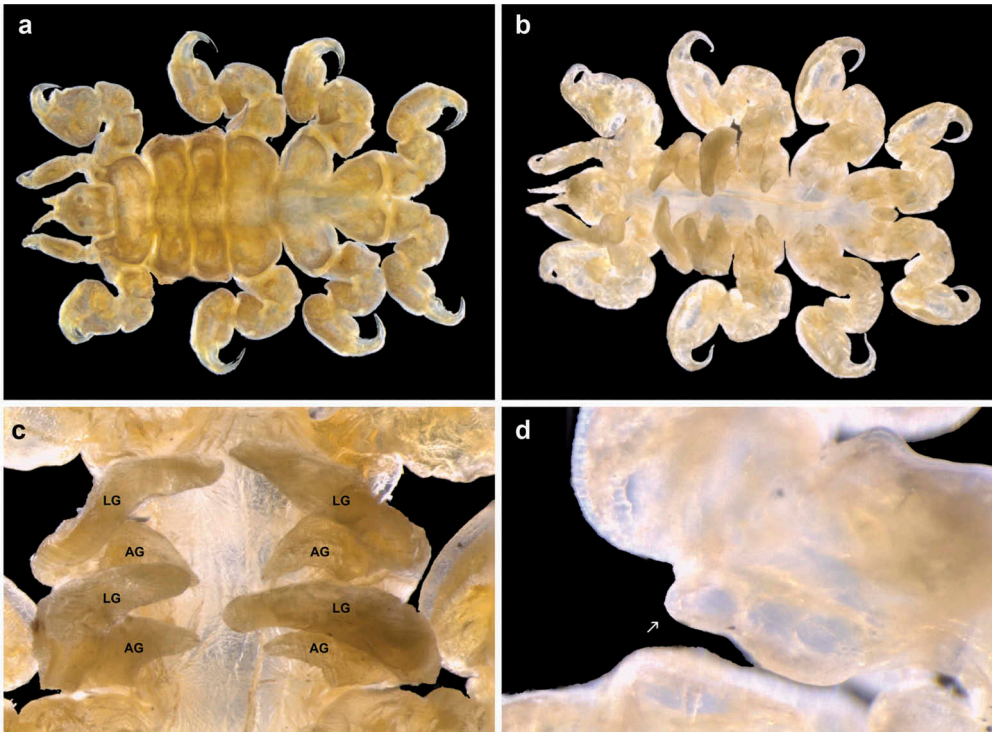

Figure 8. *Syncyamus ilheusensis* Haney, De Almeida and Reis, 2004. Non-type male, 3.4 mm. MNRJ 26765. (a) Dorsal view. (b) Ventral view. (c) Ventral view. Gills. AG: accessory gill; LG: lateral gill. (d) Ventral view of pereopod 7. Arrow indicates blunt process on basi-ischium.

Material examined

Host *Peponocephala electra*: one male, 3.4 mm, four females, 3.4–5.5 mm, two juveniles, 1.5 mm, Aracati (4.457°S; 37.746°W), Ceará, Brazil, MNRJ 26765 (AQUASIS 02C1511/562); one male, 3.2 mm, two ovigerous females, 3.5–4.3 mm, one female, 3.6 mm, Fortaleza (3.808°S; 38.411°W), Ceará, Brazil, MNRJ 26766 (AQUASIS 05C1511/673); host *Stenella clymene*: one male, 3.1 mm, one female, 4.3 mm, Aquiraz (3.893°S; 38.353°W), Ceará, Brazil, MNRJ 28469 (AQUASIS 02C1151/720); host *Globicephala macrorhynchus*: one male, 3.5 mm, Cruz (2.812°S; 40.415°W), Ceará, Brazil, MNRJ 26767 (AQUASIS 02C1921/527).

Hosts

Globicephala macrorhynchus, *Peponocephala electra* (new host record), *Stenella clymene* (new host record).

Diagnosis (adapted from Haney et al. 2004)

Anterior margin of pereonite 2 bilobed, with intern lobe much larger in size (Figure 8(a)); lateral gills uniramous and ventrally directed, not reaching anterior margin of pereonite 2 (Figure 8(b,c)); accessory gills of male subtriangular, approximately two-thirds length of lateral gill; pereonites 3 and 4 lacking acute ventral processes; pereonites 5 and 6 of male bearing two pairs of acute ventral processes, pereonite 7 of male with one pair of acute ventral processes (Figure 8(d)).

Remarks

Syncyamus is a genus of small cyamids composed of four described species all of which are ectoparasites of warm-water dolphins. *Syncyamus ilheusensis* differs from *S. aequus* Lincoln and Hurley, 1981 by the number of acute ventral processes on pereonite 5, the presence of accessory gills in males and larger body size. *Syncyamus ilheusensis* differs from *S. pseudorcae* Bowman, 1955 by the asymmetrical lobes on anterior margin of pereonite 2, the absence of acute ventral processes on pereonites 3 and 4, and the presence of an acute process on the postero-medial margin of the basi-ischium of pereopod 7. The original description of *S. ilheusensis* was based on specimens collected from a short-finned pilot whale (*G. macrorhynchus*) stranded on the north-east coast of Brazil (Haney et al. 2004).

The specimens examined from *P. electra* and *S. clymene* agree with the general description of *S. ilheusensis*. A small difference was noticed, in the presence of a large blunt process on the postero-medial margin of the basi-ischium of pereopod 7 instead of a small acute process (Figure 8(d)). Comparative material examined from *G. macrorhynchus* also exhibited a blunt process. This is a new record of *S. ilheusensis* for Ceará, which was also found on different host species, *P. electra* and *S. clymene*. It is known that melon-headed whales host another species of whale-louse, *Isocyamus delphinii* (Wardle et al. 2000); however, the two cyamids were not recorded together. Cyamids from *Stenella clymene* were previously assessed by Carvalho et al. (2010), who reported the whale louse *S. pseudorcae*.

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Disclosure statement

No potential conflict of interest was reported by the authors.

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