

# AMPHIPACIFICA

Journal of Aquatic Systematic Biology

Volume II

Number 4

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October 10, 2000

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**AMPHIPACIFICA** is an international journal of aquatic systematic biology aimed primarily at publication of monographic studies that are overly large (25-50+ printed pages) for traditional taxonomic journals. The journal has featured studies on crustaceans of the faunistically rich and palaeobiologically ancient North American Pacific coastal marine region. However, the geographic scope extends to other marine regions, and to adjacent fresh waters. Faunistically, it encompasses other free-living and parasitic invertebrate taxa, and aspects of aquatic vertebrate animals that may involve systematics, ecology and behaviour.

**AMPHIPACIFICA** is scheduled to appear approximately quarterly, with a run of 250-300 copies per issue, each of about 125 pages, and a total volume pagination of approximately 500. The printed page size is 8.5 X 11 inches (22 X 27.5 cm). Paper quality accommodates line cuts and half tones at 300-600 d.p.i., and a limited number of colour plates at author cost. Manuscripts are to be submitted in "camera-ready" computerized format (IBM- or MAC-compatible diskettes), and also in hard copy, that have previously been refereed (name to be supplied) and text-edited at the author's instigation. Suitability of manuscripts, based on content and adherence to submission regulations, will be decided by the Advisory Board of the Journal.

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**AMPHIPACIFICA** is published by Amphipacifica Research Publications under the Ontario Business Program License No. 100013820, January, 2000.

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#### **Registration.**

The journal **AMPHIPACIFICA** is registered at the National Library of Canada, Legal Deposit Office, 395 Wellington St., Ottawa, Canada, as ISSN Number 1189-9905.

**Printing.** Elm Printing Incorporated, 280 Albert St., Ottawa, ON, Canada.

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**POSTMASTER:** Please send changes of address to: **Amphipacifica**, att: Dr. E. L. Bousfield, Managing Editor, 1710-1275 Richmond Rd., Ottawa, ON, Canada K2B 8E3.



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JOURNAL OF AQUATIC SYSTEMATIC BIOLOGY

Volume II, Number 4  
October 10, 2000.

AMPHIPACIFICA, Journal of Aquatic Systematic Biology (ISSN No. 1189-9905) is published by Amphipacifica Research Publications, 1710-1275 Richmond Rd., Ottawa, ON CANADA K2B 8E3  
Annual subscription rates are \$50. Canadian funds (\$40 US).



## **DEDICATION**

The Journal AMPHIPACIFICA is dedicated to the promotion of systematic biology and to the conservation of Earth's natural resources.

**Cover design:** Adapted from the title page of S. J. Holmes (1904). "Amphipod Crustaceans of the Expedition."  
Harriman Alaska Expedition, pages 233-244.



## Editorial Commentary . . .

### Welcome back to Amphipacifica!

During an absence of more than 3 years, former readers of *Amphipacifica* frequently expressed appreciation for the role that had been played by this research journal in communicating new knowledge of aquatic systematic biology. Its contents, mainly in the form of fully illustrated and keyed monographic treatments, have proven particularly useful to marine environmental biologists of the Northeastern Pacific coastal marine region. Hopefully, this need will continue to be fulfilled through revival of the journal at its new base of operations in Ottawa. Its "resurrection" has been made possible only through the technical editorial services now being provided by Dr. David G. Cook, former editor of the *Canadian Journal of Fisheries and Aquatic Sciences*.

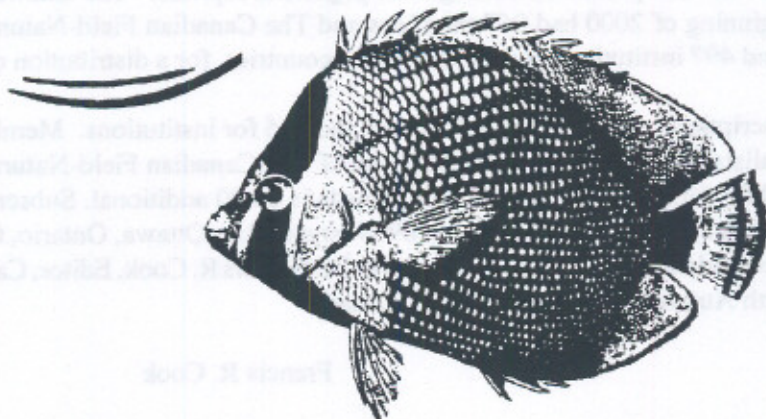
The original intent of *Amphipacifica* was to provide a peer-reviewed, credible and affordable outlet for systematic works, especially for larger papers that traditional journals find difficult or impossible to accommodate. These goals remain in place. However, to keep the journal affordable for both contributors and subscribers, and maintain production in a timely and academically acceptable manner, some hard editorial compromises have had to be made.

We strongly urge contributors to follow our "Guide for Authors" (inside back cover) as meticulously as possible when preparing their final manuscripts, to

facilitate the final stages of compiling camera-ready copy for the printer. The latter can be an unnecessarily onerous task if guidelines are not followed, and could delay publication considerably if the Editors were to strive for complete and overall consistency of format. We could insist that contributors conform to the more detailed author guidelines, available on request, before acceptance. Even then it is our experience that diverse factors such as individual habits and preferences, cultural differences, software diversity, and electronic incompatibility virtually ensure that editorial adjustments (often extensive) still need to be made before publication. Regrettably, we cannot afford to undertake this work. Hence, to avoid rejecting or delaying worthy studies while maintaining realistic targets for publication, we have been forced to sacrifice global consistency within *Amphipacifica*, and to aim simply to render individual papers internally consistent.

The present issue continues directly from the previous series, as Vol. II, No. 4. Volume III will also contain four issues, the first number of which is scheduled to appear before the end of this year, and the remainder throughout the year 2001, on an approximately quarterly basis. We are particularly anxious to expand the faunistic and regional scope of the journal over that encompassed in previous issues. We solicit contributions from all aquatic invertebrate disciplines, free-living and parasitic, including freshwater and hypogean environments, and from geographical regions other than those bordering the Pacific ocean.

# SEA WIND



**SEA WIND** is published quarterly and may be obtained through membership or subscription from OCEAN VOICE INTERNATIONAL, 2255 Carling Ave., Suite 400, Ottawa, ON K2B 1A6, CANADA  
www.o.v.i.ca and phone no. (613) 721-4541. Regular memberships are \$25. per year



### **The Canadian Field-Naturalist: 120 years of northern biodiversity publication**

The Canadian Field-Naturalist publishes articles and notes on original research and observations on natural history relevant to Canada (therefore on northern portions of both Nearctic and Palaearctic regions) including distribution, faunal analyses, taxonomy, ecology, and behaviour, and items of news, comment, tributes, review papers, book reviews and new titles. The official publication of The Ottawa Field-Naturalists' Club, it prints minutes of the annual meeting and awards presented by the Club. Since 1984, it has featured edited Status Reports for many individual species designated by the Convention on Species of Endangered Wildlife in Canada (COSEWIC), particularly those on fish and marine mammals. As well, recent special issues have featured the history of botanical investigation of Canada, St. Pierre et Miquelon, and Greenland; a biography of the Canadian ornithologist Percy A. Taverner, a history of the Canadian Wildlife Service, and an analysis of the Orchids of the Ottawa district.

The Ottawa Field-Naturalists' Club was formed in 1879 by scientists from embryonic federal departments, including the Geological Survey and the Dominion Experimental Farm, together with leading amateurs of the time; a similar mix remains as its strength to this day. The Club quickly emphasized publication, and for seven years beginning in 1880, it annually issued the Transactions of the Ottawa Field-Naturalists' Club. With volume 3 in 1887, the Transactions became a subtitle for Volume 1 of The Ottawa Naturalist, a new monthly publication. With Volume 3 of The Ottawa Naturalist in 1889 emphasis shifted from largely local members' reports to national ones and in 1919 the journal was renamed The Canadian Field-Naturalist (starting with Volume 33 which was Volume 35 of the Transactions, although this subtitle was soon omitted). The issues per year were gradually reduced from 12 to 9 to 6 and, eventually, to 4; the latter beginning with Volume 67 in 1953, but the individual issue size increased. The annual pages published reached a record of 794 in 1988 (volume 102) and 1994 (volume 112). The largest single issue 254 pages was, however, published in 1996 as 110(1). Since 1967, the Club has separately published a local (Ottawa area) natural history journal, Trail & Landscape, now also issued 4 times a year.

Submissions to The Canadian Field-Naturalist and its predecessors have been peer reviewed since its inception, first through a "Publishing Committee", later "Sub-editors", and then "Assistant Editors" until the present designation "Associate Editors" was adopted in 1885. Currently, most submissions also go to at least one (often more) additional reviewer(s). Associate Editors are listed in every issue and, since 1982, additional reviewers been acknowledged individually in the Editor's Report annually. A formal publication policy was published in The Canadian Field-Naturalist 97(2): 231-234. "Advice to Contributors" is published in one or more issues annually giving format and charges. The journal is entirely supported through a portion of club membership (40%), subscriptions (100%), annual interest on Club investment funds (80%) and publication charges for pages and reprints. The Ottawa Field-Naturalists' Club at the beginning of 2000 had 957 members and The Canadian Field-Naturalist an additional 253 individual and 497 institutional subscribers in 22 countries, for a distribution of 1707 copies.

The current annual subscription rate is \$28 for individuals and \$45 for institutions. Membership in The Ottawa Field-Naturalists' Club (which includes receipt of The Canadian Field-Naturalist) is \$28 for individuals and \$30 for families. Postage outside Canada is \$5.00 additional. Subscriptions should be sent to The Canadian Field-Naturalist, Box 35069 Westgate P.O., Ottawa, Ontario, Canada K1Z 1A2. Manuscripts for consideration should be addressed to Dr. Francis R. Cook, Editor, Canadian Field-Naturalist, RR 3, North Augusta, Ontario K0G 1R0, Canada.

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## The Species of *Lysmata* (Caridea: Hippolytidae) from the Eastern Pacific Ocean

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### ABSTRACT

Three new species, *Lysmata argentopunctata*, *L. chica*, and *L. nayaritensis*, are described from the eastern Pacific. The species can be distinguished by the rostral teeth, number of free articles of the accessory branch of the flagellum of the antennule, the length of the stylocerite, and the number of articles in the carpus of the second pereopods. The color patterns of *L. argentopunctata* and *L. chica* are characteristic. Including these new species, eight species of *Lysmata* are known from the eastern Pacific. A key and brief diagnoses of all species are provided.

### INTRODUCTION

Species of *Lysmata* are known as red rock shrimp, peppermint shrimp or cleaner shrimp. They live among rocks, corals or other hard substrates, and are nocturnally active. Some are cleaners: they remove debris, parasites, diseased tissue, etc. from fishes.

While examining specimens of *Lysmata* spp. from the vicinity of La Paz, Baja California Sur, Mexico, students, colleagues and I encountered specimens that could not be identified with certainty using existing keys (Wicksten 1983, 1990). I compared these specimens with material from among the collections of the California Academy of Sciences (CAS), Los Angeles County Museum of Natural History (LACM), United States Museum of Natural History (USNM), Scripps Institution of Oceanography (SIO), Charles Darwin Research Station, Galapagos Islands, Ecuador (CDRS), and 18 specimens of *L. intermedia* from Isla de Lobos, Gulf of Mexico, Mexico from the Texas A&M University Systematic Collection of Invertebrates (catalogue numbers 2-2141, 2144, 2146-2147, 2149-2152, 2154-2156, 2159 and 3252). With the aid of Carlos Sánchez Ortiz, Luis Hernández and students of the Universidad Autónoma de Baja California Sur (UBCS), La Paz, I collected and photographed fresh specimens of *Lysmata* spp. at four locations in Baja California Sur: Punta Arenas, Calerita, Los Islotes and Cabo San Lucas. With the aid of Rodrigo Bustamante and the staff of the marine laboratory of the Charles Darwin Research Station (CDRS), I collected specimens in the Galapagos Islands. Cleveland Hickman, Jr. of Washington and Lee University, Arlington, Virginia photographed specimens in life and loaned previously collected specimens of *Lysmata* from the Galapagos Is-

lands. Examination of these shrimp revealed four unidentifiable species. One of these, *L. gracilirostris*, has been described in a previous paper (Wicksten 2000).

The descriptions of the new species are given herein, along with a key for identification. Carapace lengths (CL) are given in millimeters. The illustrations are by Michael Hodnett, Texas A&M University.

I found misidentifications and confusion in the literature regarding tropical eastern Pacific species, and have re-examined specimens when possible to confirm their identity. However, some of the identifications in regional checklists and keys remain in doubt. The reader should use the revised key presented here instead of those given by Wicksten (1983, 1990) and double-check the identities of specimens of interest.

I am grateful to Cedric d'Udekem d'Acoz of Braine-l'Alleud, Belgium for sharing with me information on morphology of *L. intermedia*, and reviewing an earlier version of the manuscript. Ken-Ichi Hayashi of the National Fisheries University, Shimonoseki, Japan also reviewed an earlier version of the manuscript.

### SYSTEMATICS

#### *Lysmata argentopunctata*, new species

(Figs. 1-3)

*Lysmata intermedia* Kerstitch 1989: 81, fig. 199. (misidentification. not *Hippolysmata intermedia* Kingsley, 1878).

*Lysmata californica* Wicksten 1983: 27 (in part); Wicksten 1990: 596 (in part); Wicksten 1991: 151 (in



part); Wicksten and Hendrickx 1992: 7 (in part); Wicksten 1996: 287. (misidentifications: not *Hippolytina californica* Stimpson, 1866).

**Material examined:** HOLOTYPE: ov. female, CL 9.2; Morro Colorado, Sonora (28°20'N, 111°18'W), under rocks, 5-10 m, 126 January 1982, Alex Kerstitch, LACM 19821381. PARATYPES: PACIFIC COAST OF BAJA CALIFORNIA, MEXICO: Male, CL 5.1; Ridge north of North Rock, Rocas Alijos, 30-35 m, 15 Feb. 1993, Jeff Bozanic, LACM. GULF OF CALIFORNIA, MEXICO: 3 females, CL 7.2-10.0, none ov.; Isla Blanca, Bahía Bacochibampo, Sonora, 6 m, rubble, 3 July 1978, Alex Kerstitch, LACM 1192-01. 4 ov. females, CL 8.0-10.2, male, CL 7.3; Morro Colorado, Sonora, under rocks, 5-10 m, 16 January 1982, Alex Kerstitch, LACM 82-0116. Male, CL 5.6; Bahía San Gabriel, Isla Espíritu Santo, among coral, 7 March 1937, Velero III sta. 638-37, USNM cat. no. 237435. 10 females, CL 3.5-6.6, 3 of them ov., 3 males, CL 3.4-5.6, also 2 broken specimens; Bahía San Gabriel, among coral, 7 March 1937, Velero III sta. 638-37, USNM cat. no. 237436. Female, CL 3.8, male, CL 4.1, 1 broken specimen; Bahía San Gabriel, among coral in shallow water, 20 March 1936, Velero III sta. 604-36, USNM cat. no. 237415. 17 females, CL 2.3-6.1, 10 of them ov., male, CL 3.6; Los Islotes, Baja California Sur, 30 m, among rocks, 27 July 1997, Luis Hernández, UBCS. 5 females, CL 3.3-7.2, 1 of them ov.; Roca Pelicano, Cabo San Lucas, Baja California Sur, 2-5 m, in crack in rock, 20 July 1996, Carlos Sánchez and party, UBCS. GALAPAGOS ISLANDS, ECUADOR: 2 ov. females, CL 8.2-8.6, male, CL 6.3; Isla Albany, 23 August 1997, C.P. Hickman, CDRS 97-348, 97-349. Ov. female, CL 6.2; Devil's Crown (also called Corona del Diablo or Isla Onslow), under rock, 10-18 m, 17 Aug. 1998, CDRS 98-508. Ov. female, CL 5.8; Devil's Crown, 10-15 m, 18 Aug. 1998, CDRS 98-585. Ov. female, CL 7.0; Same location and date, CDRS 98-513. Ov. female, CL 6.6; Isla Mosquera, 8 m, 20 Aug. 1998, CDRS 98-540.

**Description.** Rostrum straight, not reaching end of second segment of antennular peduncle, with 1-3 dorsal teeth on carapace and 2-3 teeth on rostrum proper, 2 or 3 (usually 2) ventral teeth (Fig. 1A-D, H). Dorsal teeth usually not extending past cornea of eye; bare space between anteriormost spine and apex of rostrum. Carapace with slight forward protrusion above strong antennal spine, and minute pterygostomian spine.

Pleura of first to third abdominal somites rounded, fourth slightly produced, fifth with posterolateral point, sixth somite with posteroventral point (Fig. 1D). Telson (Fig. 1J) slightly shorter than uropods, with 2 pairs dorsolateral spines: one pair near midlength and other closer to apex than to anterior pair. Apex of telson pointed and flanked by two pairs of spines: lateral pair long, mesial pair very short.

Eyes large, cornea darkly pigmented. In juveniles, eyes proportionally larger than in adults.

Antennal peduncle (Fig. 1A, H) short and stout, about 0.5 X length of scaphocerite. Stylocerite reaching or overreaching first segment of antennular peduncle. First segment with tuft of spinules on anterior margin and small ventromesial spine, longer than second segment; second segment longer than third. Antennular flagella almost as long as body. Accessory branch of outer flagellum with 13-17 free articles, free for nearly half of its length, and 13-15 fused articles, densely setose in juveniles but with fewer setae in adults.

Basicerite with sharp anterolateral spine. Scaphocerite (Fig. 1A, H) elongate and slender, 4X long as wide, lateral tooth distinctly overreaching scale. Scale approximately 2X length of antennular peduncle. Flagellum of antenna longer than body.

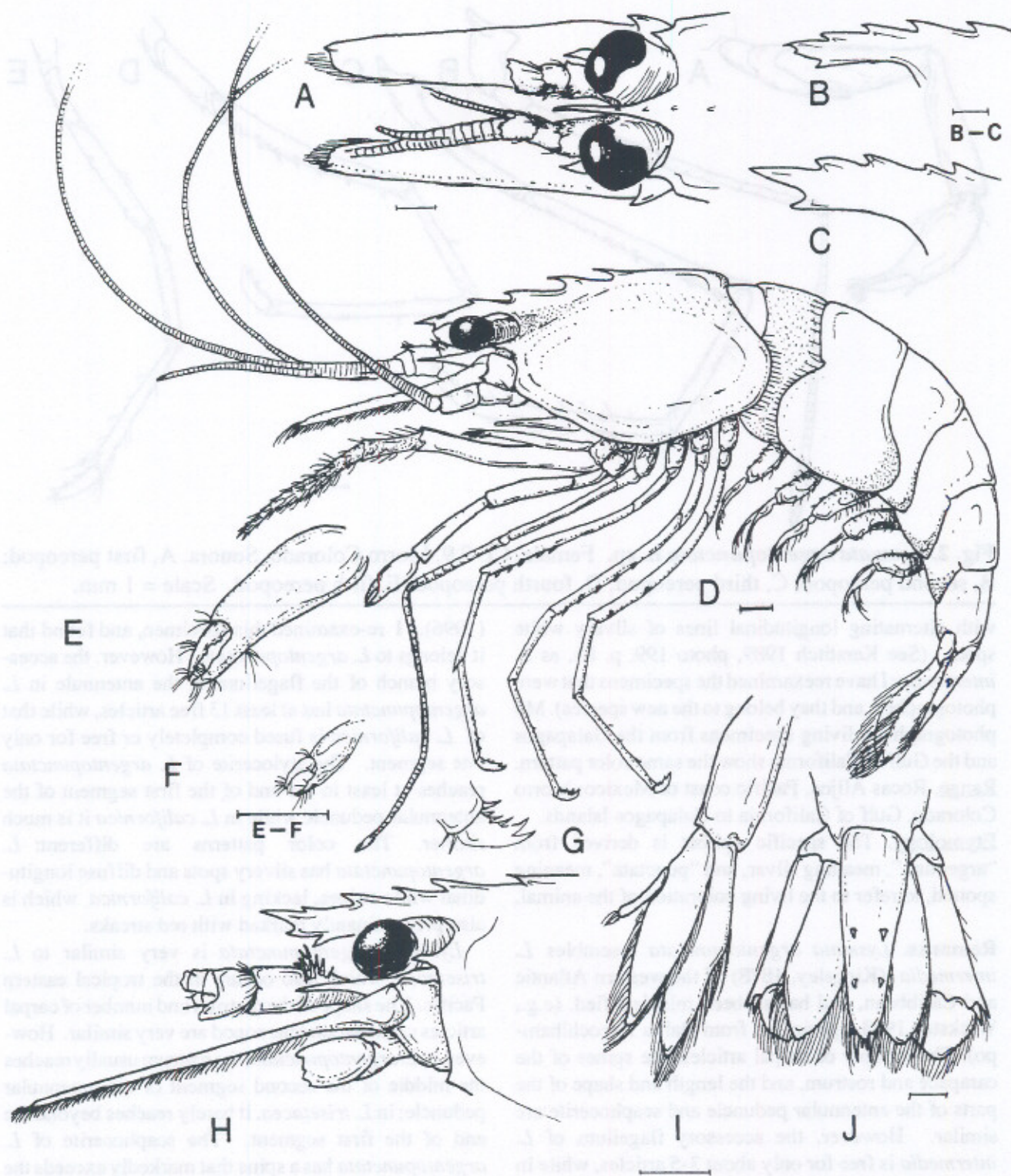
Mouthparts as figured (Fig. 3). Third maxilliped (Fig. 3A) reaching past end of antennal scale, with exopod reaching well past midlength of antepenultimate segment. Penultimate segment short, less than 0.5X length of ultimate segment. Ultimate segment setose, especially in juveniles, with 4-5 spines at and near apex. Epipod present.

First to fourth pereopods with epipods, all reaching to or beyond end of antennal scale when extended. First pereopod (Fig. 2A) short and chelate, fingers of chela less than 0.5X palm (Fig. 1E). Carpus at least as long as chela. Merus slightly longer than carpus. Ischium short. Second pereopod (Fig. 2B) elongate. Fingers of chela (Fig. 1F) shorter than palm. Carpus with 20-27 articles (usually 23-25). Merus with 9-12 indistinct articles, ischium with 6 indistinct articles. Third pereopod (Fig. 2C) with dactyl about 0.25 X propodus, biunguiculate, with 2-3 smaller spines on flexor margin. Propodus with 7-9 spinules along flexor margin. Carpus about 0.7 X propodus, with 2-3 minute spinules on flexor margin. Merus with 4-7 ventrolateral spines. Ischium short. Fourth pereopod (Fig. 2D) similar to third, but shorter, merus with 3-7 ventrolateral spines. Fifth pereopod (Fig. 2E) shorter still, merus with 2-4 ventrolateral spines. Meral spines fewer or missing from specimens with regenerating appendages.

First pleopod (Fig. 3I) with endopod slender and short. Second pleopod (Fig. 1I, 3G, H) with appendix interna. Appendix masculina (Fig. 3G, H) about 2X length of appendix interna. Outer uropod (Fig. 1J) with posterolateral spines. Carapace length of female to 10.2 mm, male to 7.9.

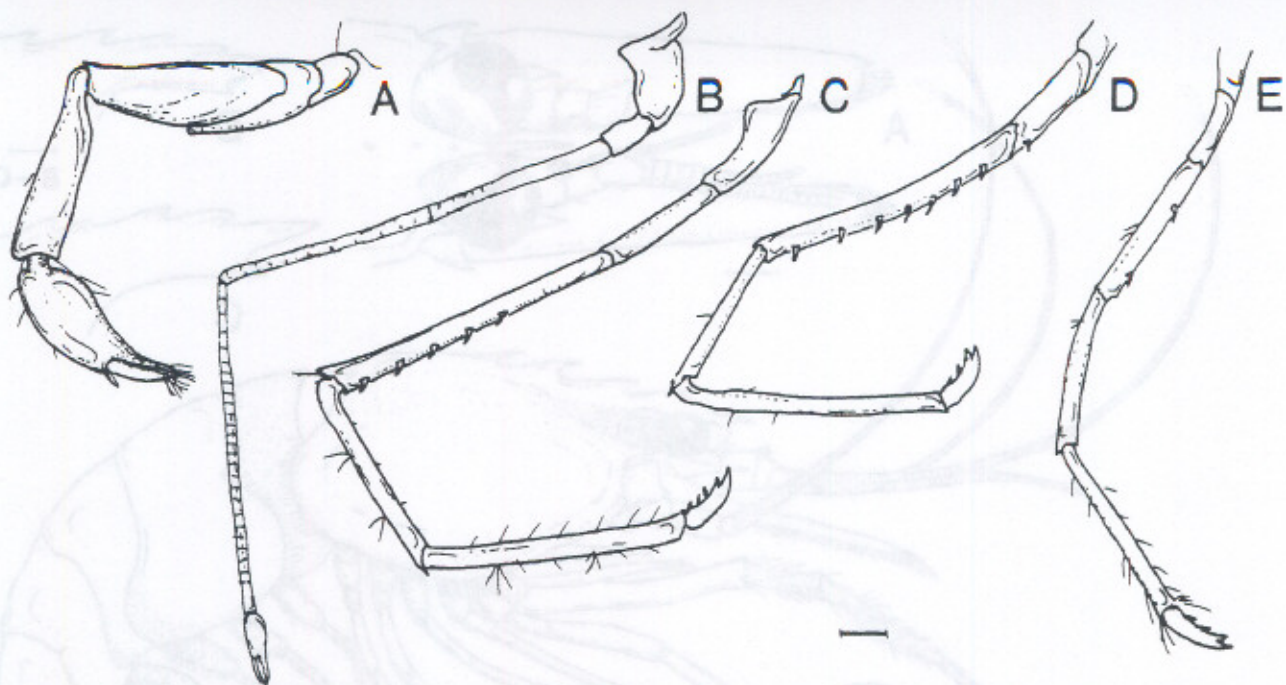
**Color in life.** Antennae and appendages red. Body with dark greenish or red longitudinal lines interspersed





**Fig. 1.** *Lysmata argentopunctata*, n. sp. Female, CL 8.0, Morro Colorado, Sonora, Mexico. A, frontal region in dorsal view; B, C, two shapes of the rostrum from paratype specimens; D, entire animal in lateral view; E, detail of chela of first pereopod; F, detail of chela of second pereopod; G, dactyl of third pereopod; H, frontal region in lateral view; I, female second pereopod; J, telson and uropods. Scales = 1 mm.





**Fig. 2.** *Lysmata argentopunctata* n. sp. Female, CL 9.9, Morro Colorado, Sonora. A, first pereopod; B, second pereopod; C, third pereopod; D, fourth pereopod; E, fifth pereopod. Scale = 1 mm.

with alternating longitudinal lines of silvery white spots. (See Kerstitch 1989, photo 199, p. 81, as *L. intermedia*; I have reexamined the specimens that were photographed, and they belong to the new species). My photographs of living specimens from the Galapagos and the Gulf of California show the same color pattern. **Range.** Rocas Alijos, Pacific coast of Mexico; Morro Colorado, Gulf of California to Galapagos Islands.

**Etymology.** The specific epithet is derived from "argentum", meaning silver, and "punctata", meaning spotted, to refer to the living coloration of the animal.

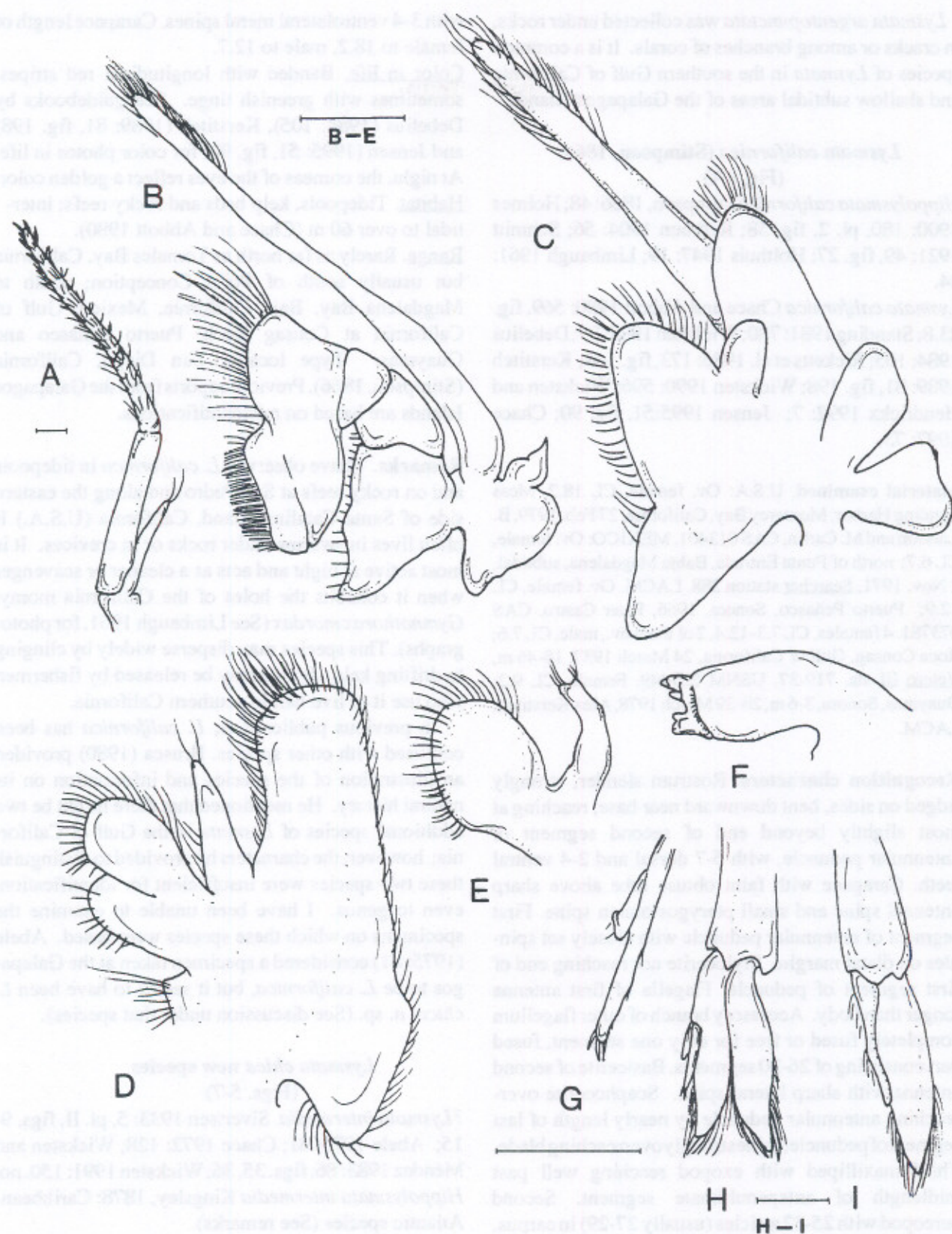
**Remarks.** *Lysmata argentopunctata* resembles *L. intermedia* (Kingsley, 1878) of the western Atlantic and Caribbean, and has so been misidentified. (e.g., Wicksten, 1983, specimens from Bahía Bacoichibampo). The number of carpal articles, the spines of the carapace and rostrum, and the length and shape of the parts of the antennular peduncle and scaphocerite are similar. However, the accessory flagellum of *L. intermedia* is free for only about 3-5 articles, while in *L. argentopunctata*, it is free for up to 17 articles, more than half of its length. The rostrum of *L. intermedia* has dorsal teeth equally spaced up to the apex, while that of *L. argentopunctata* has a bare space near the apex.

Because of the similarity in the rostrum, *L. argentopunctata* and *L. californica* have been confused in the past. The specimen from the Rocas Alijos was previously reported as *L. californica* by Wicksten

(1996). I re-examined this specimen, and found that it belongs to *L. argentopunctata*. However, the accessory branch of the flagellum of the antennule in *L. argentopunctata* has at least 13 free articles, while that of *L. californica* is fused completely or free for only one segment. The stylocerite of *L. argentopunctata* reaches at least to the end of the first segment of the antennular peduncle while in *L. californica* it is much shorter. The color patterns are different: *L. argentopunctata* has silvery spots and diffuse longitudinal white stripes, lacking in *L. californica* which is also predominantly marked with red streaks.

*Lysmata argentopunctata* is very similar to *L. trisetacea*, which also occurs in the tropical eastern Pacific. The shape of the rostrum and number of carpal articles of the second pereopod are very similar. However, in *L. argentopunctata*, the rostrum usually reaches the middle of the second segment of the antennular peduncle; in *L. trisetacea*, it barely reaches beyond the end of the first segment. The scaphocerite of *L. argentopunctata* has a spine that markedly exceeds the blade, which is 4x as long as wide; while in *L. trisetacea*, the spine barely exceeds the blade if at all, and the blade is 3x as long as wide. In *L. argentopunctata*, the upper flagellum of the antennule has 13-17 slender free articles, while *L. trisetacea* has 7-10 wide free articles (usually 8). The merus of the third pereopod of *L. argentopunctata* has 4-7 ventrolateral spines, while *L. trisetacea* has two or three ventrolateral meral spines.





**Fig. 3.** *Lysmata argentopunctata* n. sp. Female, CL 9.9, Morro Colorado, Sonora. A, third maxilliped; B, second maxilliped; C, first maxilliped; D, second maxilla; E, first maxilla (broken); F, mandible. G-I, male, CL 7.3, Morro Colorado, Sonora. G, detail of appendices masculina and interna; H, second pleopod; I, first pleopod. Scales = 1 mm.



*Lysmata argentopunctata* was collected under rocks, in cracks or among branches of corals. It is a common species of *Lysmata* in the southern Gulf of California and shallow subtidal areas of the Galapagos Islands.

***Lysmata californica* (Stimpson, 1866)**  
(Fig. 4A)

*Hippolysmata californica* Stimpson, 1866: 48; Holmes 1900: 180, pl. 2, fig. 38; Rathbun 1904: 56; Schmitt 1921: 49, fig. 27; Holthuis 1947: 19; Limbaugh 1961: 44.

*Lysmata californica* Chace and Abbott 1980: 569, fig. 23.8; Standing 1981: 780; Wicksten 1983: 27; Debelius 1984: 105; Ricketts et al. 1985: 173, fig. 144; Kerstitch 1989: 81, fig. 198; Wicksten 1990: 596; Wicksten and Hendrickx 1992: 7; Jensen 1995: 51, fig. 90; Chace 1997: 73.

**Material examined.** U.S.A.: Ov. female, CL 18.2. Moss Landing Harbor, Monterey Bay, California, 27 Feb. 1979, B. Larsson and M. Carlin, CAS 013401. MEXICO: Ov. female, CL 6.7; north of Punta Entrada, Bahía Magdalena, subtidal, 2 Nov. 1971, Searcher station 288, LACM. Ov. female, CL 12.9; Puerto Peñasco, Sonora, 1966, Peter Castro, CAS 073781. 4 females, CL 7.3-12.4, 2 of them ov., male, CL 7.6; Roca Consag, Gulf of California, 24 March 1937, 18-46 m, Velero III sta. 719-37, USNM 237449. Female, CL 9.2; Guaymas, Sonora, 3-6 m, 28-29 March 1978, Alex Kerstitch, LACM.

**Recognition characters.** Rostrum slender, strongly ridged on sides, bent downward near base, reaching at most slightly beyond end of second segment of antennular peduncle, with 5-7 dorsal and 2-4 ventral teeth. Carapace with faint obtuse lobe above sharp antennal spine and small pterygostomial spine. First segment of antennular peduncle with closely set spinules on distal margin. Stylocerite not reaching end of first segment of peduncle. Flagella of first antenna longer than body. Accessory branch of outer flagellum completely fused or free for only one segment, fused part consisting of 26-30 segments. Basicerite of second antenna with sharp lateral spine. Scaphocerite overreaching antennular peduncle by nearly length of last segment of peduncle, spine strongly overreaching blade. Third maxilliped with exopod reaching well past midlength of antepenultimate segment. Second pereopod with 25-32 articles (usually 27-29) in carpus. Third to fifth pereopods with stout, biunguiculate dactyls and 2-3 spines on flexor border; merus of third pereopod with 6-7 ventrolateral spines, fourth pereopod, with 5-6 ventrolateral meral spines; fifth pereopod,

with 3-4 ventrolateral meral spines. Carapace length of female to 18.2, male to 12.7.

**Color in life.** Banded with longitudinal red stripes, sometimes with greenish tinge. See guidebooks by Debelius (1984: 105), Kerstitch (1989: 81, fig. 198) and Jensen (1995: 51, fig. 90) for color photos in life. At night, the corneas of the eyes reflect a golden color.

**Habitat.** Tidepools, kelp beds and rocky reefs; intertidal to over 60 m (Chace and Abbott 1980).

**Range.** Rarely as far north as Tomales Bay, California but usually south of Point Conception; south to Magdalena Bay, Baja California, Mexico; Gulf of California at Consag Rock, Puerto Peñasco and Guaymas. Type locality San Diego, California (Stimpson, 1866). Previous reports from the Galapagos Islands are based on misidentifications.

**Remarks.** I have observed *L. californica* in tidepools and on rocky reefs at San Pedro and along the eastern side of Santa Catalina Island, California (U.S.A.) It often lives in swarms under rocks or in crevices. It is most active at night and acts as a cleaner or scavenger when it cohabits the holes of the California moray, *Gymnothorax mordax* (See Limbaugh 1961, for photographs). This species may disperse widely by clinging to drifting kelp. It also may be released by fishermen who use it as live bait in southern California.

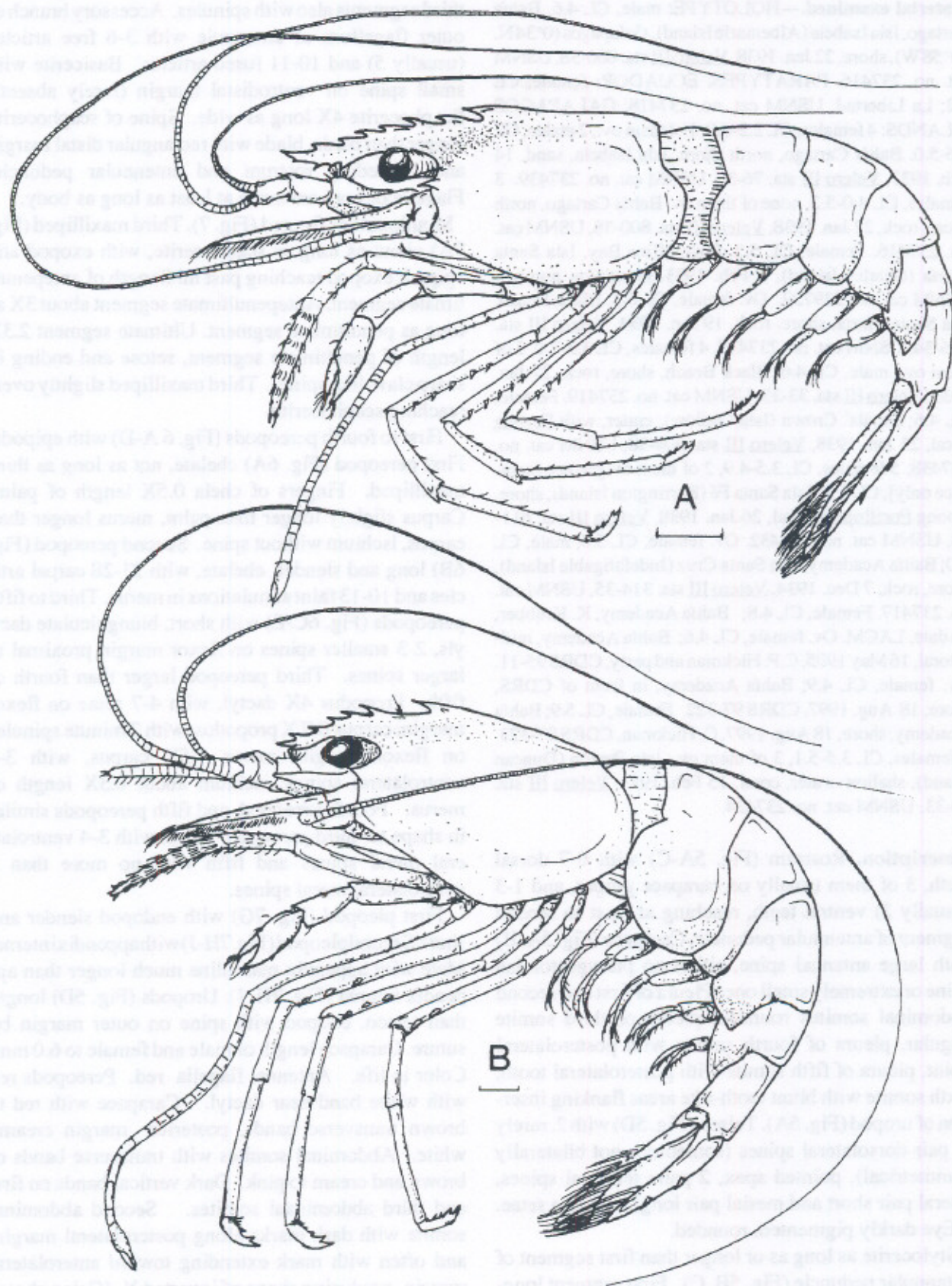
In previous publications, *L. californica* has been confused with other species. Brusca (1980) provided an illustration of the species and information on its natural history. He mentioned that there might be two additional species of *Lysmata* in the Gulf of California; however, the characters he provided to distinguish these two species were insufficient for identification, even to genus. I have been unable to examine the specimens on which these species were based. Abele (1975: 81) considered a specimen taken at the Galapagos to be *L. californica*, but it seems to have been *L. chica*, n. sp. (See discussion under that species).

***Lysmata chica* new species**  
(Figs. 5-7)

?*Lysmata intermedia* Sivertsen 1933: 5, pl. II, figs. 9-15; Abele 1975: 81; Chace 1972: 128; Wicksten and Méndez 1983: 86, figs. 35, 36; Wicksten 1991: 150. not *Hippolysmata intermedia* Kingsley, 1878: Caribbean-Atlantic species (See remarks).

*Lysmata californica* Wicksten 1991: 151 (in part); Wicksten and Hendrickx 1992: 7 (in part); (misidentification: not *Hippolysmata californica* Stimpson, 1866).





**Fig. 4. A, *Lysmata californica* (Stimpson). Female, CL 12.4, Consag Rock, Gulf of California, Mexico; B, *Lysmata galapagensis* Schmitt. Male, CL 7.1, Mazatlán Sinaloa, Mexico. Scale A = 3 mm B = 1 mm**



**Material examined.**—HOLOTYPE: male, CL 4.6. Bahía Cartago, Isla Isabela (Albemarle Island), Galapagos (0°34'N, 90°58'W), shore, 22 Jan. 1938, *Velero III* sta. 800-38, USNM cat. no. 237416. PARATYPES: ECUADOR: female, CL 4.2; La Libertad, USNM cat. no. 237418. GALAPAGOS ISLANDS: 4 females, CL 2.2-6.0, 1 of them ov., 2 males, CL 4.5-5.0. Bahía Cartago, north shore, Isla Isabela, sand, 14 Feb. 1933, *Velero III* sta. 76-33, USNM cat. no. 237439. 3 females, CL 4.0-5.2, none of them ov. Bahía Cartago, north shore, rock, 22 Jan. 1938, *Velero III* sta. 800-38, USNM cat. no. 237416. Female, CL 5.2. Post Office Bay, Isla Santa María (Charles Island), 5 Feb. 1933, no station number, USNM cat. no. 229729. Ov. female, CL 6.3; Black Beach, Isla Santa María, shore, rock, 19 Jan. 1934, *Velero III* sta. 166-34, USNM cat. no. 237437. 4 females, CL 3.3-7.0, 3 of them ov., male, CL 4.6; Black Beach, shore, rock, 27 Jan. 1933, *Velero III* sta. 33-33, USNM cat. no. 237419. Female, CL 4.6; Devils' Crown (Isla Onslow), crater, with *Pavona* coral, 23 Jan. 1938, *Velero III* sta. 804-38, USNM cat. no. 237438. 5 females, CL 3.5-4.9, 2 of them ovigerous, [carapace only], CL 4.2; Isla Santa Fé (Barrington Island), shore, among *Pocillopora* coral, 26 Jan. 1938, *Velero III* sta. 811-38, USNM cat. no. 237432. Ov. female, CL 5.0, male, CL 6.0; Bahía Academy, Isla Santa Cruz (Indefatigable Island), shore, rock, 7 Dec. 1934, *Velero III* sta. 314-35, USNM cat. no. 237417. Female, CL 4.8; Bahía Academy, K. Krubber, no date, LACM. Ov. female, CL 4.6; Bahía Academy, mid-littoral, 16 May 1995, C.P. Hickman and party, CDRS 95-11. Ov. female, CL 4.9; Bahía Academy, in front of CDRS, shore, 18 Aug. 1997, CDRS 97-322. Female, CL 5.9; Bahía Academy, shore, 18 Aug. 1997, C. Hickman, CDRS 97-323. 6 females, CL 3.5-5.1, 3 of them ov.; Isla Pinzón (Duncan Island), shallow water, coral, 15 Feb. 1933, *Velero III* sta. 80-33, USNM cat. no. 237434.

**Description.** Rostrum (Fig. 5A-C) with 6-7 dorsal teeth, 3 of them usually on carapace proper, and 1-3 (usually 2) ventral teeth, reaching at least to second segment of antennular peduncle. Carapace (Fig. 5A, B) with large antennal spine, either no pterygostomial spine or extremely small one. Pleura of first and second abdominal somites rounded, pleura of third somite angular, pleura of fourth somite with posterolateral point, pleura of fifth somite with posterolateral tooth, sixth somite with blunt tooth-like areas flanking insertion of uropod (Fig. 5A). Telson (Fig. 5D) with 2, rarely 3, pair dorsolateral spines (sometimes not bilaterally symmetrical), pointed apex, 2 pairs terminal spines, lateral pair short and mesial pair long; and long setae.

Eye darkly pigmented, rounded.

Stylocerite as long as or longer than first segment of antennular peduncle (Fig. 5B, C). First segment longest of segments of antennular peduncle, with tuft of spinules on distal margin. Distal margins of second and

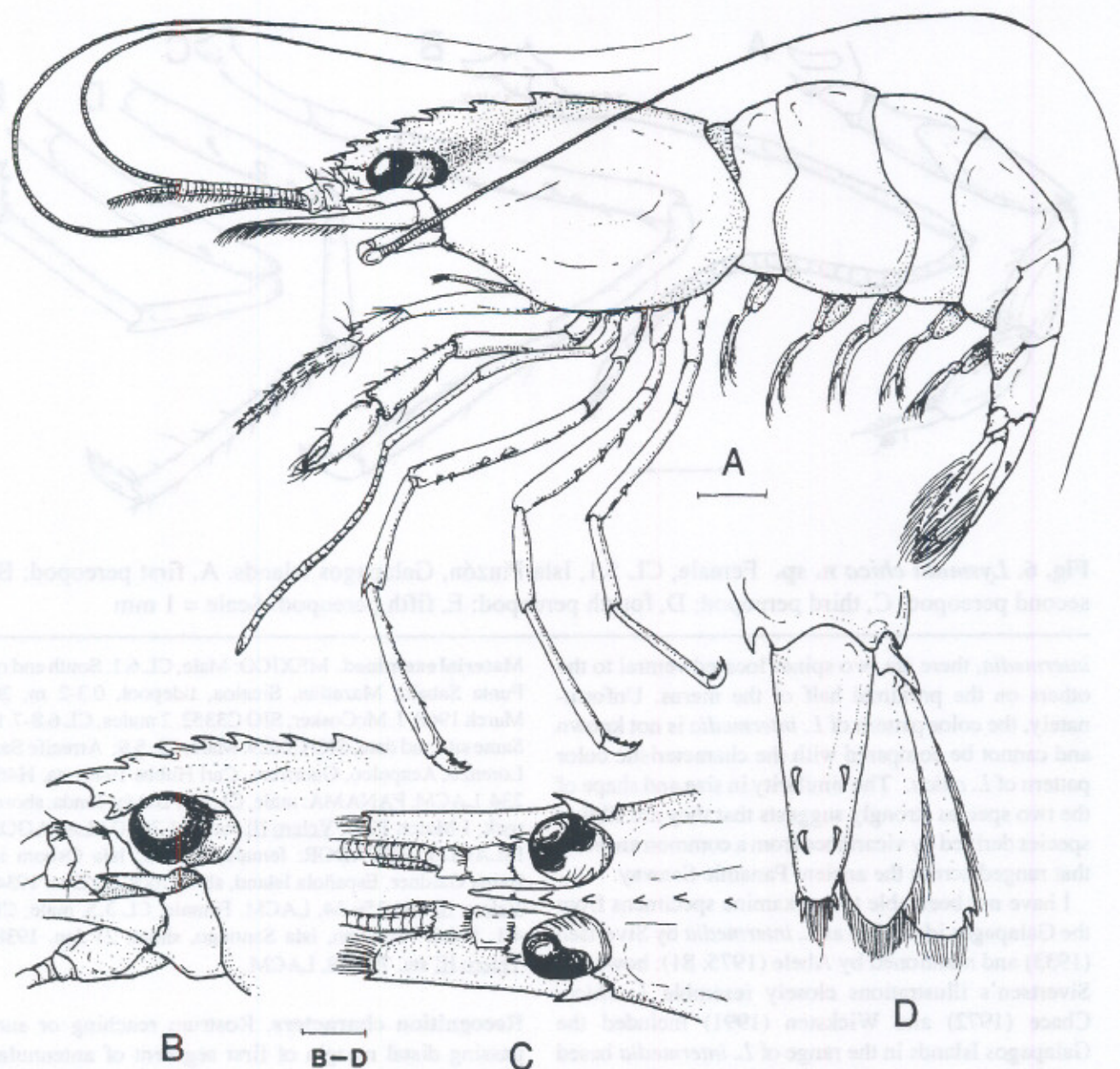
third segments also with spinules. Accessory branch of outer flagellum of antennule with 3-6 free articles (usually 5) and 10-11 fused articles. Basicerite with small spine on ventrodistal margin (rarely absent). Scaphocerite 4X long as wide. Spine of scaphocerite longer than blade, blade with rectangular distal margin and exceeding rostrum and antennular peduncle. Flagella of both antennae at least as long as body.

Mouthparts as figured (Fig. 7). Third maxilliped (Fig. 7A) about as long as scaphocerite, with exopod and epipod; exopod reaching past midlength of antepenultimate segment. Antepenultimate segment about 3X as long as penultimate segment. Ultimate segment 2.3X length of penultimate segment, setose and ending in sharp claw-like spines. Third maxilliped slightly overreaching scaphocerite.

First to fourth pereopods (Fig. 6 A-D) with epipods. First pereopod (Fig. 6A) chelate, not as long as third maxilliped. Fingers of chela 0.5X length of palm. Carpus slightly longer than palm, merus longer than carpus, ischium without spine. Second pereopod (Fig. 6B) long and slender, chelate, with 23-28 carpal articles and 10-13 faint annulations in merus. Third to fifth pereopods (Fig. 6C-E) with short, biunguiculate dactyls, 2-3 smaller spines on flexor margin proximal to larger spines. Third pereopod larger than fourth or fifth. Propodus 4X dactyl, with 4-7 setae on flexor margin; carpus 0.7 X propodus, with 2 minute spinules on flexor margin; merus 1.5X carpus, with 3-4 ventrolateral spines; ischium about 0.3X length of merus. Fourth pereopod and fifth pereopods similar in shape to third pereopod, fourth with 3-4 ventrolateral meral spines and fifth with no more than 3 ventrolateral meral spines.

First pleopod (Fig. 7G) with endopod slender and short. Second pleopod (Fig. 7H-J) with appendix interna. Male with appendix masculina much longer than appendix interna (Fig. 7H, I). Uropods (Fig. 5D) longer than telson, exopod with spine on outer margin by suture. Carapace length of male and female to 6.0 mm. Color in life. Antennal flagella red. Pereopods red with white band near dactyl. Carapace with red to brown transverse bands, posterior margin creamy white. Abdominal somites with transverse bands of brown and cream to pink. Dark vertical bands on first and third abdominal somites. Second abdominal somite with dark marks along posterolateral margin, and often with mark extending toward anterolateral margin, producing shape of inverted Y. (Color photos of specimens CDRS 97-322 and 97-323, Cleveland Hickman, Jr.)





**Fig. 5.** *Lysmata chica* n. sp. Female, CL 4.4. Bahía Academy, Galapagos Islands. A, entire animal in lateral view; B, frontal region in lateral view; C, frontal region in dorsal view; D, telson and uropod. Scales = 1 mm.

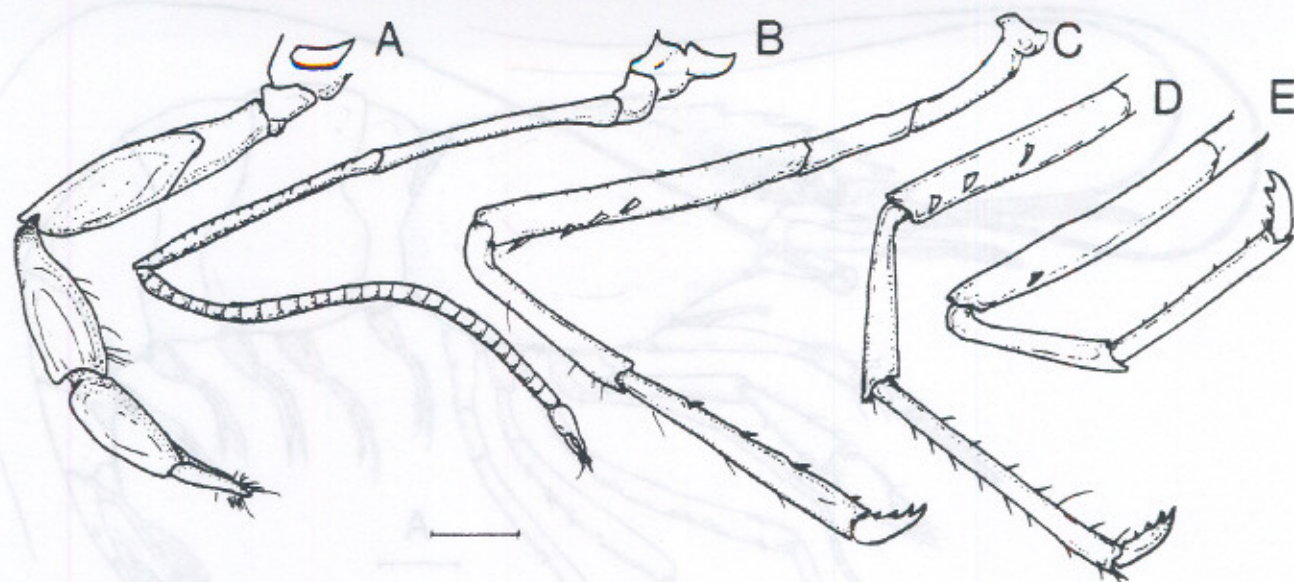
**Range.** Galapagos Islands, possibly Peru (See remarks).

**Etymology.** The specific epithet is the Spanish word "chica", to be treated as a noun in apposition and feminine in gender. The word means "little one"; in Mexico, the word has a connotation of cuteness. The name is given because of the small size of the shrimp.

**Remarks.** *Lysmata chica* closely resembles specimens of *L. intermedia* (Kingsley, 1878) from the Gulf of Mexico, Caribbean and western Atlantic. I com-

pared the specimens of the new species to specimens of *L. intermedia* from Isla de Lobos, Gulf of Mexico, Mexico. In *L. chica*, the third maxillipeds barely exceed the scaphocerite; in *L. intermedia*, they surpass it by nearly the length of the ultimate segment. *Lysmata chica* has more robust and shorter appendages than *L. intermedia*. In most specimens of *L. chica*, the carpus of the first pereopod is about as long as the chela; in *L. intermedia*, the carpus usually is longer than the chela. In *L. chica*, the meral spines of the third pereopod are in a single line extending ventrolaterally, in *L.*





**Fig. 6.** *Lysmata chica* n. sp. Female, CL 5.1, Isla Pinzón, Galapagos Islands. A, first pereopod; B, second pereopod; C, third pereopod; D, fourth pereopod; E, fifth pereopod. Scale = 1 mm

*intermedia*, there are two spines located ventral to the others on the proximal half of the merus. Unfortunately, the color pattern of *L. intermedia* is not known and cannot be compared with the characteristic color pattern of *L. chica*. The similarity in size and shape of the two species strongly suggests that they are sibling species derived by vicariance from a common ancestor that ranged across the ancient Panamic Seaway.

I have not been able to re-examine specimens from the Galapagos identified as *L. intermedia* by Sivertsen (1933) and mentioned by Abele (1975: 81); however, Sivertsen's illustrations closely resemble *L. chica*. Chace (1972) and Wicksten (1991) included the Galapagos Islands in the range of *L. intermedia* based on Sivertsen's record. The specimens from Peru identified as *L. intermedia* by Wicksten and Méndez (1983) may be *L. chica*, but these, too, need to be re-examined. Specimens reported from the Galapagos as *L. californica* by Wicksten (1991) are a mixture of *L. chica* and *L. gracilirostris*.

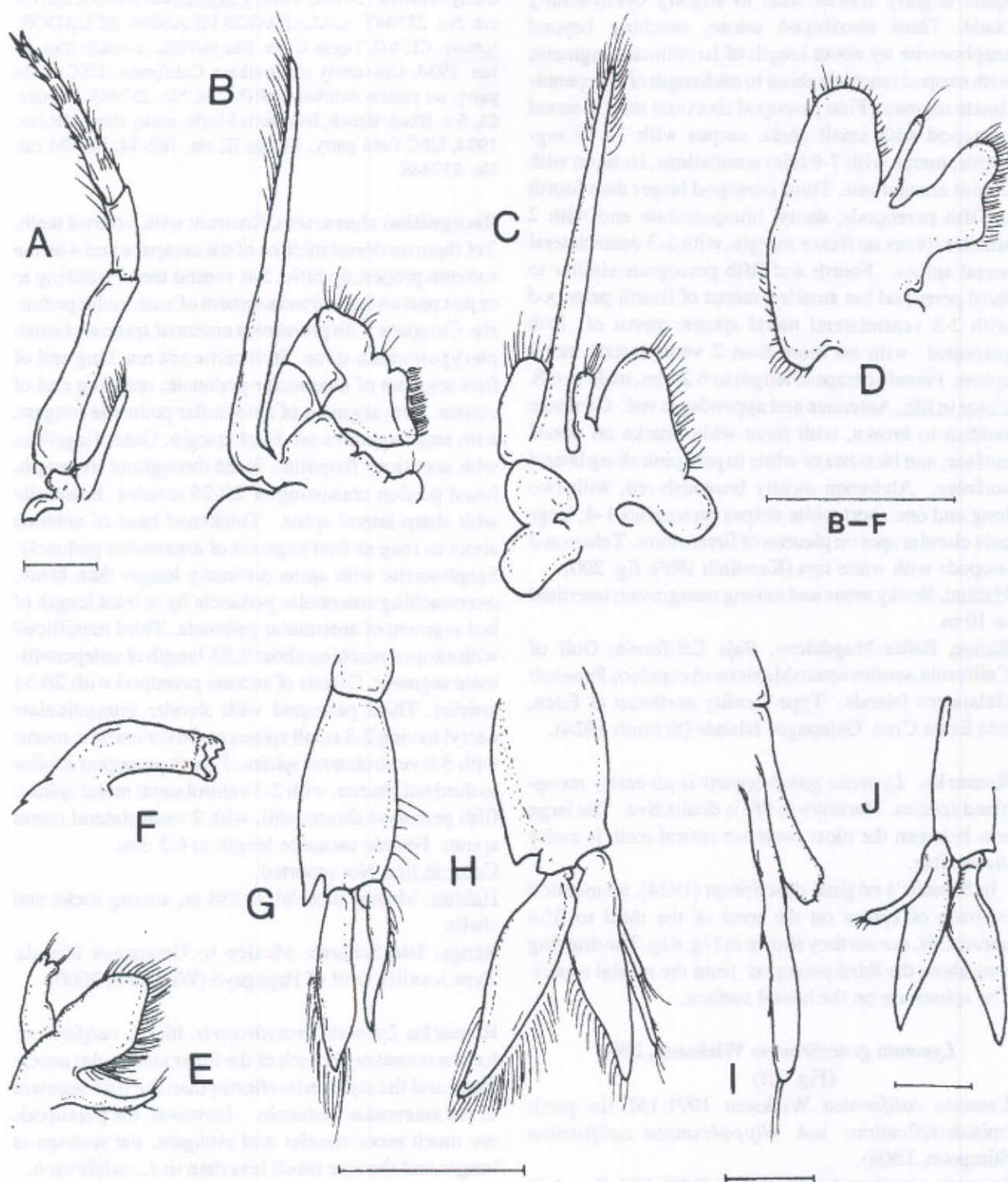
***Lysmata galapagensis* Schmitt, 1924**  
(Fig. 4B)

*Lysmata galapagensis* Schmitt, 1924: 165, fig. 41; Hult 1939: 6; Holthuis 1947: 219; Abele 1975: 81; Wicksten 1979: 629; Wicksten 1983: 27; Hendrickx and Wicksten 1987: 14; Hendrickx 1989: 246; Kerstitch 1989: 82, fig. 200; Wicksten 1990: 596; Wicksten 1991: 150; Wicksten and Hendrickx 1992: 7; Chace, 1997: 72.

**Material examined.** MEXICO: Male, CL 6.1. South end of Punta Sabalo, Mazatlán, Sinaloa, tidepool, 0.3-2 m, 20 March 1968, J. McCosker, SIO C3352. 2 males, CL 6.8-7.1; Same site and date, SIO C2629. Male, CL 5.9; Arrecife San Lorenzo, Acapulco, Guerrero, Carl Hubbs 1946, sta. H46-234, LACM. PANAMA: male, CL 5.0; Bahía Honda, shore, rock, 1 March 1938, *Velero III* sta. 861-38. GALAPAGOS ISLANDS, ECUADOR: female, CL 3.2; Isla Osborn in Bahía Gardner, Española Island, shore rock, 19 Dec. 1934, *Velero III* sta. 359-34, LACM. Female, CL 3.5, male, CL 4.1; Bahía Sullivan, Isla Santiago, shore, 21 Jan. 1938, *Velero III* sta. 796-38, LACM.

**Recognition characters.** Rostrum reaching or surpassing distal margin of first segment of antennular peduncle, with 5-7 dorsal teeth, 1-2 of them on carapace proper, and one ventral tooth near apex; long setae on dorsal crest between posteriormost and next most posterior dorsal teeth. Carapace with prominent antennal spine, no pterygostomial spine; pterygostomial margin obtuse. Stylocerite slightly overreaching first segment of antennular peduncle. First segment of antennular peduncle with tufts of spinules on distal margin; longer than second segment; third segment shortest. Free part of accessory flagellum of outer antennular flagellum with 5-7 articles, fused part with 6-13 articles. Basicerite with lateral spine. Base of antennal flagellum at most barely reaching end of first segment of antennular peduncle. Scaphocerite longer than antennular peduncle by nearly 0.5X of its length,





**Fig. 7. *Lyismata chica* n. sp.** Female, CL 5.1, Isla Pinzón, Galapagos Islands. A, third maxilliped; B, second maxilliped; C, first maxilliped; D, second maxilla; E, first maxilla; F, mandible; J, second pleopod. Scales = 1 mm. G-I, male, CL 5.0, Bahía Cartago, Isla Isabela. G, first pleopod; H, second pleopod; I, detail of appendices interna and masculina. Scales G,H, J = 1 mm; I = 0.2 mm.



spine slightly shorter than to slightly overreaching blade. Third maxilliped setose, reaching beyond scaphocerite by about length of its ultimate segment; with exopod reaching about to midlength of antepenultimate segment. First pereopod short and stout. Second pereopod with small chela, carpus with 17-19 segments, merus with 7-9 faint annulations, ischium with 2 faint annulations. Third pereopod larger than fourth or fifth pereopods, dactyl biunguiculate and with 2 smaller spines on flexor margin, with 2-3 ventrolateral meral spines. Fourth and fifth pereopods similar to third pereopod but smaller; merus of fourth pereopod with 2-3 ventrolateral meral spines, merus of fifth pereopod with no more than 2 ventrolateral meral spines. Female carapace length to 6.2 mm, male to 4.8. **Color in life.** Antennae and appendages red. Carapace reddish to brown, with three white marks on dorsal surface, and blotches of white to pale pink along lateral surfaces. Abdomen mostly brownish-red, with two long and one short white stripes on somites 1-4; large pale circular spot on pleuron of first somite. Telson and uropods with white tips (Kerstitch 1989, fig. 200).

**Habitat.** Rocky areas and among mangroves; intertidal to 10 m.

**Range.** Bahía Magdalena, Baja California; Gulf of California, southwestern Mexico to Acapulco; Panamá; Galapagos Islands. Type locality northeast of Eden, Isla Santa Cruz, Galapagos Islands (Schmitt 1924).

**Remarks.** *Lysmata galapagensis* is an easily recognized species. The color in life is distinctive. The large seta between the most posterior rostral teeth is easily discernible.

In Schmitt's original description (1924), no mention is made of spines on the meri of the third to fifth pereopods, nor are they shown in Fig. 41g. The drawing may show the third pereopod from the mesial aspect. The spines are on the lateral surface.

#### *Lysmata gracilirostris* Wicksten, 2000

(Fig. 8B)

*Lysmata californica* Wicksten 1991:151 (in part); (misidentification: not *Hippolysmata californica* Stimpson, 1866).

*Lysmata gracilirostris* Wicksten, 2000: 207, figs. 1-3.

**Material examined.** MEXICO: Broken specimen, CL 4.2; Off Bahía Braithwaite, Isla Socorro, 129-138 m, rocks and shell, 18 March 1939, *Velero III* sta. 925-39, LACM. COSTA RICA: 2 females, CL 5.8-6.3, neither of them ov.; Gulf of Papagayo, 81-86 m, 2 April 1978, *Alpha Helix*, SIO cat. No. C4062. PANAMA: female, CL 4.9, off Isla Jicarita, 44 m,

shelly substrate, 20 Feb. 1934, *Velero III* sta. 240-35, USNM cat. No. 237447. GALAPAGOS ISLANDS, ECUADOR: female, CL 6.0, Tagus Cove, Isla Isabela, in roach trap, 15 Jan. 1934, University of Southern California (USC) field party, no station number, USNM cat. No. 237445. Female, CL 6.4, Black Beach, Isla Santa María, rocky shore, 18 Jan. 1934, USC field party, *Velero III* sta. 162-34, USNM cat. No. 237448.

**Recognition characters.** Rostrum with 6 dorsal teeth, 2 of them on dorsal midline of the carapace and 4 on the rostrum proper; tip bifid, 5-6 ventral teeth, reaching to or just past end of second segment of antennular peduncle. Carapace with prominent antennal spine and small pterygostomian spine. Stylocerite not reaching end of first segment of antennular peduncle, reaching end of cornea. First segment of antennular peduncle longest, with small spinules on distal margin. Outer flagellum with accessory flagellum fused throughout its length, fused portion consisting of 20-25 articles. Basicerite with sharp lateral spine. Thickened base of antenna about as long as first segment of antennular peduncle. Scaphocerite with spine distinctly longer than blade, overreaching antennular peduncle by at least length of last segment of antennular peduncle. Third maxilliped with exopod reaching about 0.5X length of antepenultimate segment. Carpus of second pereopod with 28-31 articles. Third pereopod with slender biunguiculate dactyl having 2-3 small spines on flexor margin, merus with 5-6 ventrolateral spines. Fourth pereopod similar to third but shorter, with 2-3 ventrolateral meral spines; fifth pereopod shorter still, with 2 ventrolateral meral spines. Female carapace length to 6.3 mm.

**Color in life.** Not reported.

**Habitat.** Mostly subtidal, 0-138 m, among rocks and shells.

**Range.** Isla Socorro, Mexico to Galapagos Islands. Type locality Gulf of Papagayo (Wicksten, 2000).

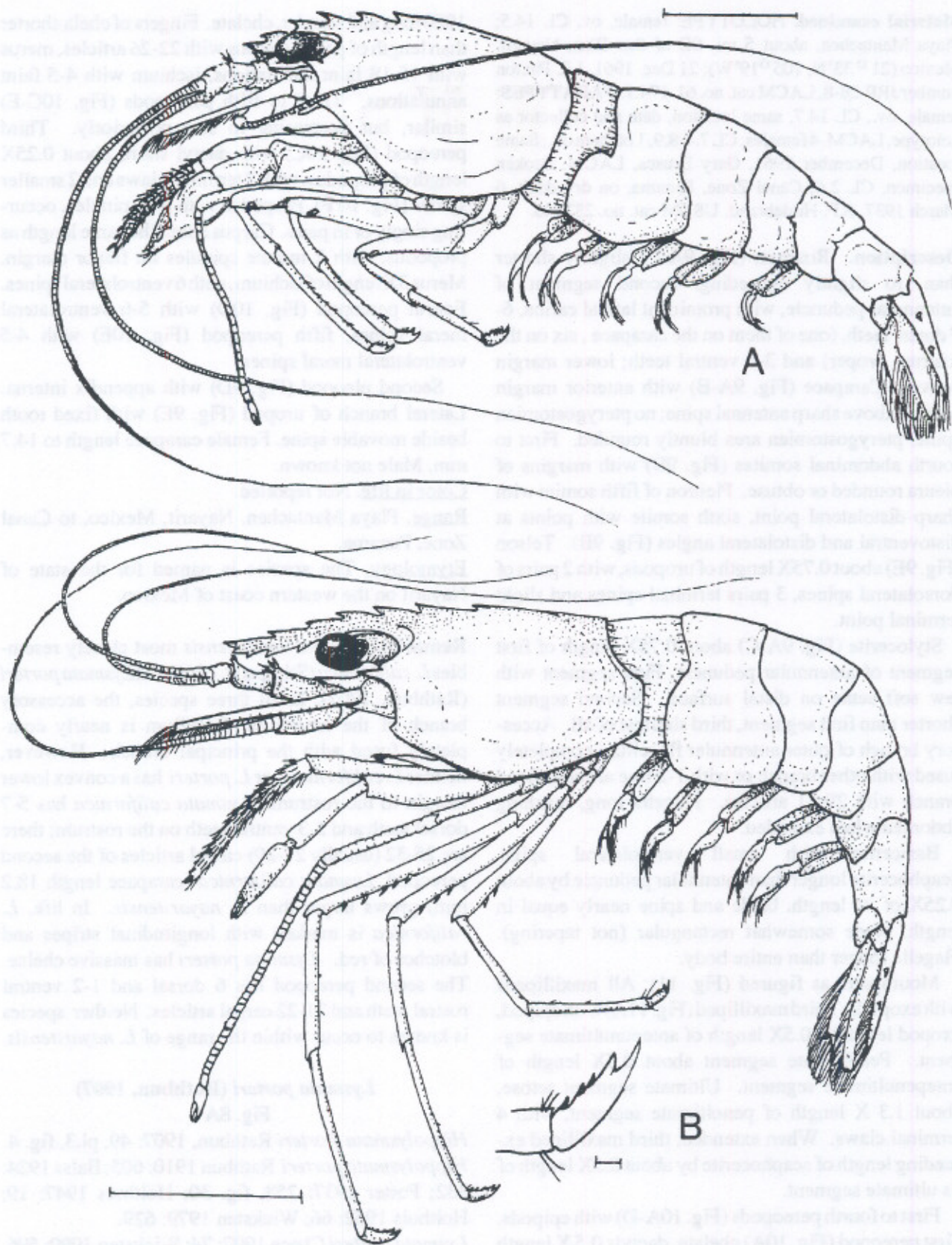
**Remarks.** *Lysmata gracilirostris*, like *L. californica*, has the accessory branch of the inner antennular article fused and the stylocerite shorter than the first segment of the antennular peduncle. However, the pereopods are much more slender and elongate, the rostrum is longer, and the size much less than in *L. californica*.

#### *Lysmata nayaritensis* new species

Figs 9-11

*Lysmata intermedia* Wicksten 1983: 28 (in part); Wicksten 1990: 596 (in part); Hendrickx and Wicksten 1992: 7 (in part). Not *Hippolysmata intermedia* Kingsley, 1878.





**Fig. 8. A, *Lysmata porteri* (Rathbun).** Male, CL 8.7, Cumberland Bay, Islas Juan Fernández, Chile; **B, *Lysmata gracilirostris* Wicksten.** Female, CL 6.3, Gulf of Papagayo, Costa Rica; with detail of dactyl of third pereopod. Scales A, B=5 mm; scale C= 2 mm.



**Material examined.** HOLOTYPE: female, ov. CL 14.5; Playa Mantachen, about 5 mi. SE of San Blas, Nayarit, Mexico (21°33'N, 105°19'W); 21 Dec. 1961, J.R. Paxton number JRP-28-8, LACM cat. no. 61-174.1. PARATYPES: female, ov., CL 14.7, same location, date and collector as holotype, LACM. 4 females, CL 7.4-8.9, 1 of them ov.; Same location, December 1961, Gary Brusca, LACM. Broken specimen, CL 2.6; Canal Zone, Panama, on dry dock, 6 March 1937, S.F. Hildebrand, USNM cat. no. 237446.

**Description.** Rostrum (Fig. 9A-C) slightly shorter than, to slightly exceeding, second segment of antennular peduncle, with prominent lateral carina, 6-7 dorsal teeth, (one of them on the carapace, six on the rostrum proper) and 3-6 ventral teeth; lower margin convex. Carapace (Fig. 9A-B) with anterior margin convex above sharp antennal spine; no pterygostomian spine, pterygostomian area bluntly rounded. First to fourth abdominal somites (Fig. 9B) with margins of pleura rounded or obtuse. Pleuron of fifth somite with sharp distolateral point, sixth somite with points at distoventral and distolateral angles (Fig. 9B). Telson (Fig. 9E) about 0.75X length of uropods, with 2 pairs of dorsolateral spines, 3 pairs terminal spines and slight terminal point.

Stylocerite (Fig. 9A-C) about 0.75X length of first segment of antennular peduncle. First segment with few soft setae on distal surface. Second segment shorter than first segment, third shortest of all. Accessory branch of outer antennular flagellum completely fused with other branch or with 1-2 free articles, fixed branch with 29-31 articles. Flagella long, reaching abdomen when extended.

Basicerite with small ventrolateral spine. Scaphocerite longer than antennular peduncle by about 0.25X of its length, blade and spine nearly equal in length, blade somewhat rectangular (not tapering). Flagella longer than entire body.

Mouthparts as figured (Fig. 11). All maxillipeds with exopods. Third maxilliped (Fig. 11A) with epipod, exopod less than 0.5X length of antepenultimate segment. Penultimate segment about 0.5X length of antepenultimate segment. Ultimate segment setose, about 1.3 X length of penultimate segment, with 4 terminal claws. When extended, third maxilliped exceeding length of scaphocerite by about 0.5X length of its ultimate segment.

First to fourth pereopods (Fig. 10A-D) with epipods. First pereopod (Fig. 10A) chelate, dactyls 0.5 X length of palm. Carpus about as long as palm. Merus slightly longer than carpus, its lower margin convex along proximal end. Ischium short. Second pereopod (Fig.

10B) long and slender, chelate. Fingers of chela shorter than length of palm. Carpus with 22-26 articles, merus with 15-18 faint annulations, ischium with 4-5 faint annulations. Third to fifth pereopods (Fig. 10C-E) similar, but decreasing in size posteriorly. Third pereopod (Fig. 10C) with dactyl short, about 0.25X length of propodus, with 2 terminal claws and 2 smaller spines (Fig. 10 F). Propodus with 5-7 spinules, occurring singly or in pairs. Carpus about the same length as propodus, with 2 minute spinules on flexor margin. Merus 3X length of ischium, with 6 ventrolateral spines. Fourth pereopod (Fig. 10D) with 5-6 ventrolateral meral spines, fifth pereopod (Fig. 10E) with 4-5 ventrolateral meral spines.

Second pleopod (Fig. 9D) with appendix interna. Lateral branch of uropod (Fig. 9E) with fixed tooth beside movable spine. Female carapace length to 14.7 mm. Male not known.

**Color in life.** Not reported.

**Range.** Playa Mantachen, Nayarit, Mexico, to Canal Zone, Panama.

**Etymology.** The species is named for the state of Nayarit on the western coast of Mexico.

**Remarks.** *Lysmata nayaritensis* most closely resembles *L. californica* (Stimpson, 1866) and *Lysmata porteri* (Rathbun, 1907). In all three species, the accessory branch of the antennular flagellum is nearly completely fused with the principal branch. However, neither *L. californica* nor *L. porteri* has a convex lower margin to the rostrum. *Lysmata californica* has 5-7 dorsal teeth and 2-3 ventral teeth on the rostrum; there are 25-32 (usually 27-29) carpal articles of the second pereopod. *Lysmata californica* (carapace length 18.2 mm) grows larger than *L. nayaritensis*. In life, *L. californica* is marked with longitudinal stripes and blotches of red. *Lysmata porteri* has massive chelae. The second pereopod has 6 dorsal and 1-2 ventral rostral teeth and 21-22 carpal articles. Neither species is known to occur within the range of *L. nayaritensis*.

#### *Lysmata porteri* (Rathbun, 1907)

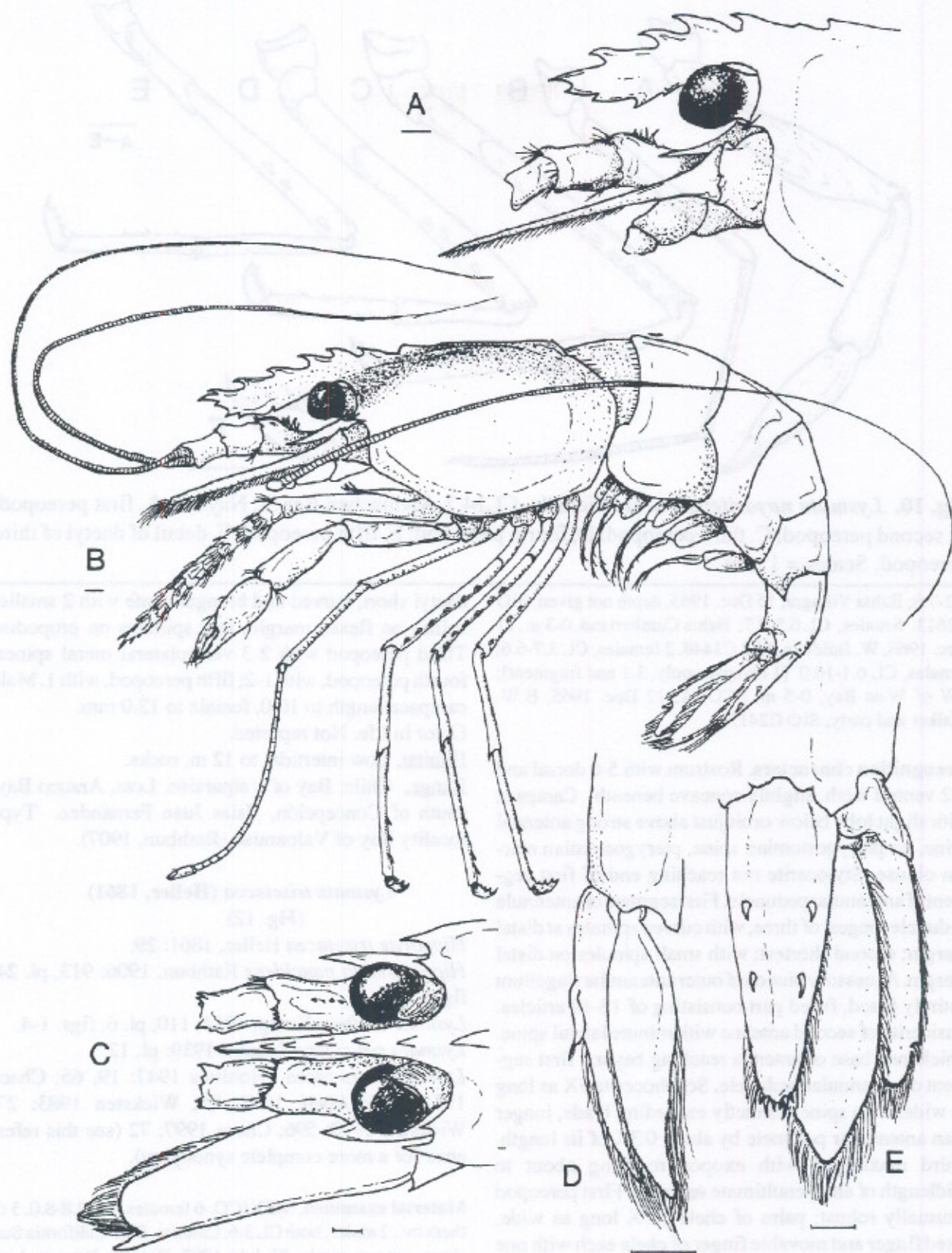
Fig. 8A

*Hippolysmata Porteri* Rathbun, 1907: 49, pl.3, fig. 4. *Hippolysmata porteri* Rathbun 1910: 605; Balss 1924: 332; Porter 1937: 258, fig. 30; Holthuis 1947: 19; Holthuis 1952: 66; Wicksten 1979: 629.

*Lysmata porteri* Chace 1997: 74; Wicksten 1990: 596.

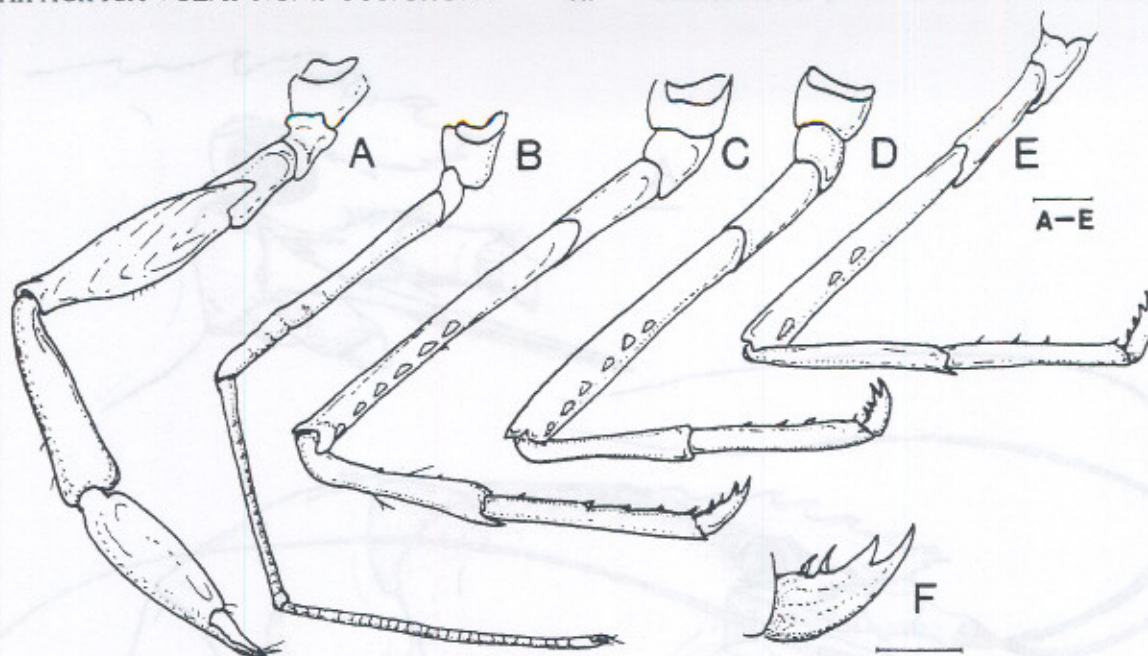
**Material examined.** CHILE, JUAN FERNANDEZ ISLANDS: 2 females, CL 11.7-12.0, both ov., 16 males, CL





**Fig. 9.** *Lysmata nayaritensis* n. sp. Female, CL 14.7, Mantachen Beach, Nayarit, Mexico. A, frontal region in lateral view; B, entire animal in lateral view; C, frontal region in dorsal view; D, second pleopod; E, telson and uropod. Scales = 1 mm.





**Fig. 10.** *Lysmata nayaritensis* n. sp. Female, CL14.7, Mantachen Beach, Nayarit. A, first pereopod; B, second pereopod; C, third pereopod; D, fourth pereopod; E, fifth pereopod; F, detail of dactyl of third pereopod. Scales = 1 mm.

4.2-7.8; Bahía Villagra, 15 Dec. 1965, depth not given, SIO C2613. 6 males, CL 6.5-8.7; Bahía Cumberland, 0-3 m, 11 Dec. 1968, W. Baldwin, SIO C3448. 2 females, CL 3.7-6.6; 5 males, CL 6.1-10.0 [1 carapace only, 3.1 and fragment]; SW of West Bay, 0-5 m, SCUBA, 12 Dec. 1965, B.W. Walker and party, SIO C2417.

**Recognition characters.** Rostrum with 5-6 dorsal and 1-2 ventral teeth, slightly concave beneath. Carapace with slight lobe below orbit just above strong antennal spine, no pterygostomial spine, pterygostomial margin obtuse. Stylocerite not reaching end of first segment of antennular peduncle. First segment of antennular peduncle longest of three, with curved spinules at distal margin; second shortest; with small spinules on distal margin. Accessory branch of outer antennular flagellum entirely fused, fused part consisting of 18-19 articles. Basicerite of second antenna with minute lateral spine. Thickened base of antenna reaching beyond first segment of antennular peduncle. Scaphocerite 3X as long as wide, with spine distinctly exceeding blade, longer than antennular peduncle by about 0.3X of its length. Third maxilliped with exopod reaching about to midlength of antepenultimate segment. First pereopod unusually robust; palm of chela 2.7X long as wide, fixed finger and movable finger of chela each with one low tooth fitting into concavity on opposing finger, tips of fingers curved. Second pereopod elongate, with small chela and 20-24 carpal articles. Third to fifth pereopods similar; third pereopod largest of these;

dactyl short, curved and biunguiculate with 2 smaller spines on flexor margin, few spinules on propodus. Third pereopod with 2-3 ventrolateral meral spines; fourth pereopod, with 1-2; fifth pereopod, with 1. Male carapace length to 10.0, female to 12.0 mm.

Color in life. Not reported.

**Habitat.** Low intertidal to 12 m, rocks.

**Range.** Chile: Bay of Valparaíso, Lota, Arauco Bay, south of Concepción, Islas Juan Fernández. Type locality Bay of Valparaíso (Rathbun, 1907).

#### *Lysmata trisetacea* (Heller, 1861)

(Fig. 12)

*Hippolyte trisetacea* Heller, 1861: 29.

*Hippolysmata paucidens* Rathbun, 1906: 913, pl. 24, fig. 4.

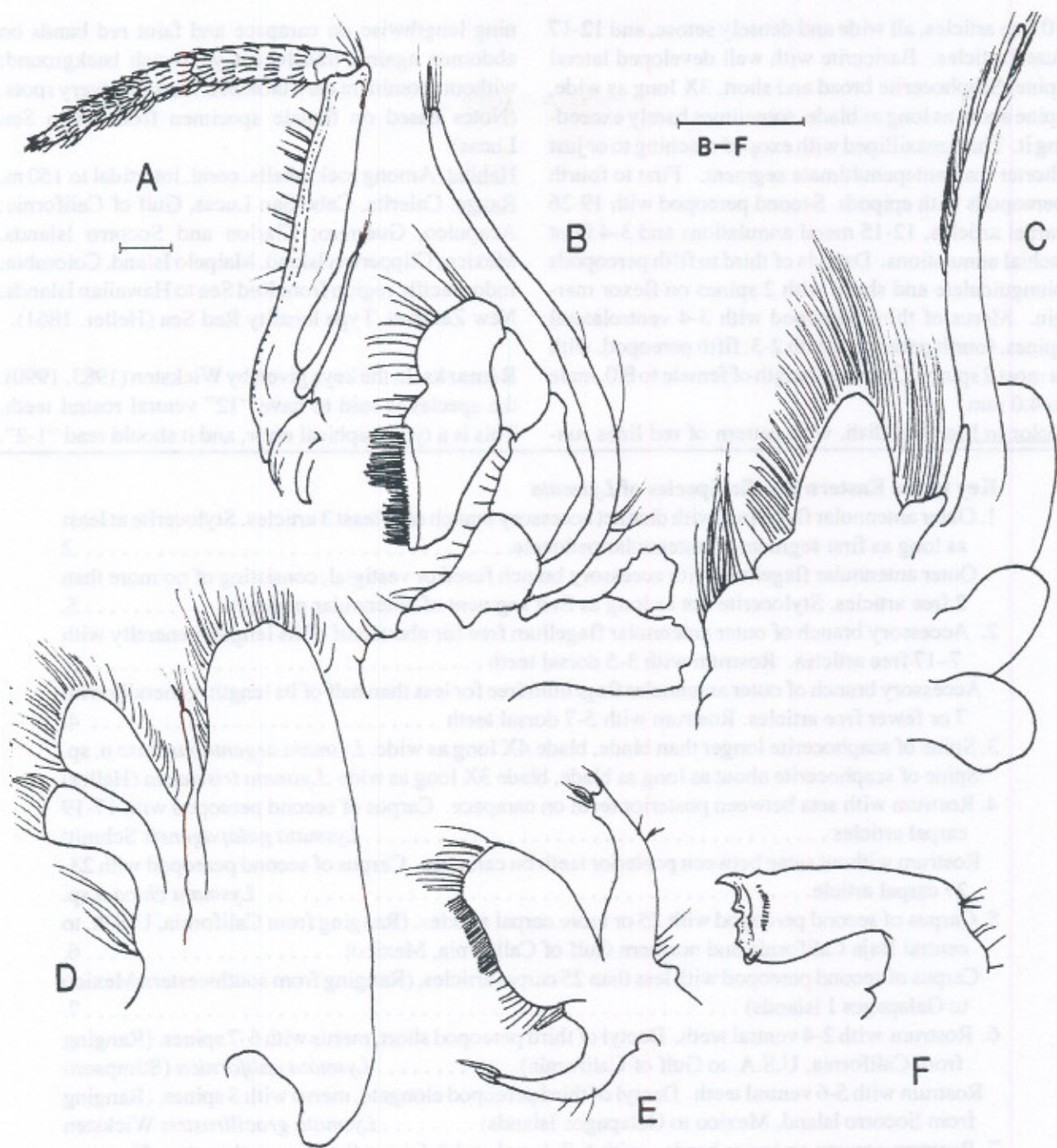
*Lysmata chiltoni* Kemp, 1914: 110, pl. 6, figs. 1-4.

*Lysmata paucidens* Schmitt 1939: pl. 12.

*Lysmata trisetacea* Holthuis 1947: 19, 65; Chace 1962: 614; Abele 1975: 81; Wicksten 1983: 27; Wicksten 1990: 596; Chace 1997: 72 (see this reference for a more complete synonymy).

**Material examined.** MEXICO: 6 females, CL 2.8-8.0, 3 of them ov., 2 males, both CL 3.6, Calerita, Baja California Sur, shore, among corals, 23 July 1997, Ricardo Pereyra, Luis Hernández and party, UBCS. 2 females, CL 4.7-4.8, 1 of them ov., Roca Pelicano, Cabo San Lucas, Baja California, 2-5 m, 26 July 1997, Carlos Sánchez and party, UBCS. 3 females, CL 4.8-5.1, all ov., 2 males, CL 3.0-3.7, 2 frag-





**Fig. 11.** *Lysmata nayaritensis* n. sp. Female, CL 8.5, Mantachen Beach, Nayarit. A, third maxilliped; B, second maxilliped; C, first maxilliped; D, second maxilla; E, first maxilla; F, mandible. Scales = 1 mm.

ments, CL 3.6-4.5, Bahía Sulphur, Isla Clarion, rocks and tide pools, shore, 10 June 1934, Velero III sta. 298-35, LACM. Male, CL 4.0. Bahía Braithwaite Bay, Isla Socorro, 3 Jan. 1934, Velero III sta. 131-34, LACM. HAWAIIAN ISLANDS: 2 females, CL 5.0-5.4, both ov., fragment, CL 5.0, Pukee, Molokai, reef, USNM 48958. Female, CL 4.6, Honolulu, Hawaii, 1901, USNM 25410. 4 females, CL 3.7-4.8, 3 of them ov., intersex, CL 2.9, Laysan, May 1902, USNM 30981.

**Recognition characters.** Rostrum with 3-5 dorsal and 1-3 ventral teeth, reaching slightly beyond end of first segment of antennular peduncle. Carapace with antennal spine, no pterygostomian spine, pterygostomian area rounded. Stylocerite as long as or longer than first segment of antennular peduncle. First segment of antennular peduncle with tuft of setae on distal margin. Accessory branch of outer antennular flagellum with 7-



10 free articles, all wide and densely setose, and 12-17 fused articles. Basicerite with well developed lateral spine. Scaphocerite broad and short, 3X long as wide, spine about as long as blade, sometimes barely exceeding it. Third maxilliped with exopod reaching to or just shorter than antepenultimate segment. First to fourth pereopods with epipods. Second pereopod with 19-26 carpal articles, 12-15 meral annulations and 3-4 faint ischial annulations. Dactyls of third to fifth pereopods biunguiculate and short, with 2 spines on flexor margin. Merus of third pereopod with 3-4 ventrolateral spines, fourth pereopod, with 2-3; fifth pereopod, with at most 2 spines. Carapace length of female to 8.0, male to 4.0 mm.

**Color in life.** Reddish, with pattern of red lines run-

ning lengthwise on carapace and faint red bands on abdomen against translucent yellowish background; without prominent dark blotches, lines or silvery spots. (Notes based on female specimen from Cabo San Lucas).

**Habitat.** Among rock, shells, coral, intertidal to 150 m. **Range.** Calerita, Cabo San Lucas, Gulf of California; Acapulco, Guerrero; Clarion and Socorro Islands, Mexico; Clipperton Island, Malpelo Island, Colombia; Indo-Pacific region from Red Sea to Hawaiian Islands; New Zealand. Type locality Red Sea (Heller, 1861).

**Remarks.** In the keys given by Wicksten (1983, 1990), the species is said to have "12" ventral rostral teeth. This is a typographical error, and it should read "1-2".

### Key to the Eastern Pacific Species of *Lysmata*

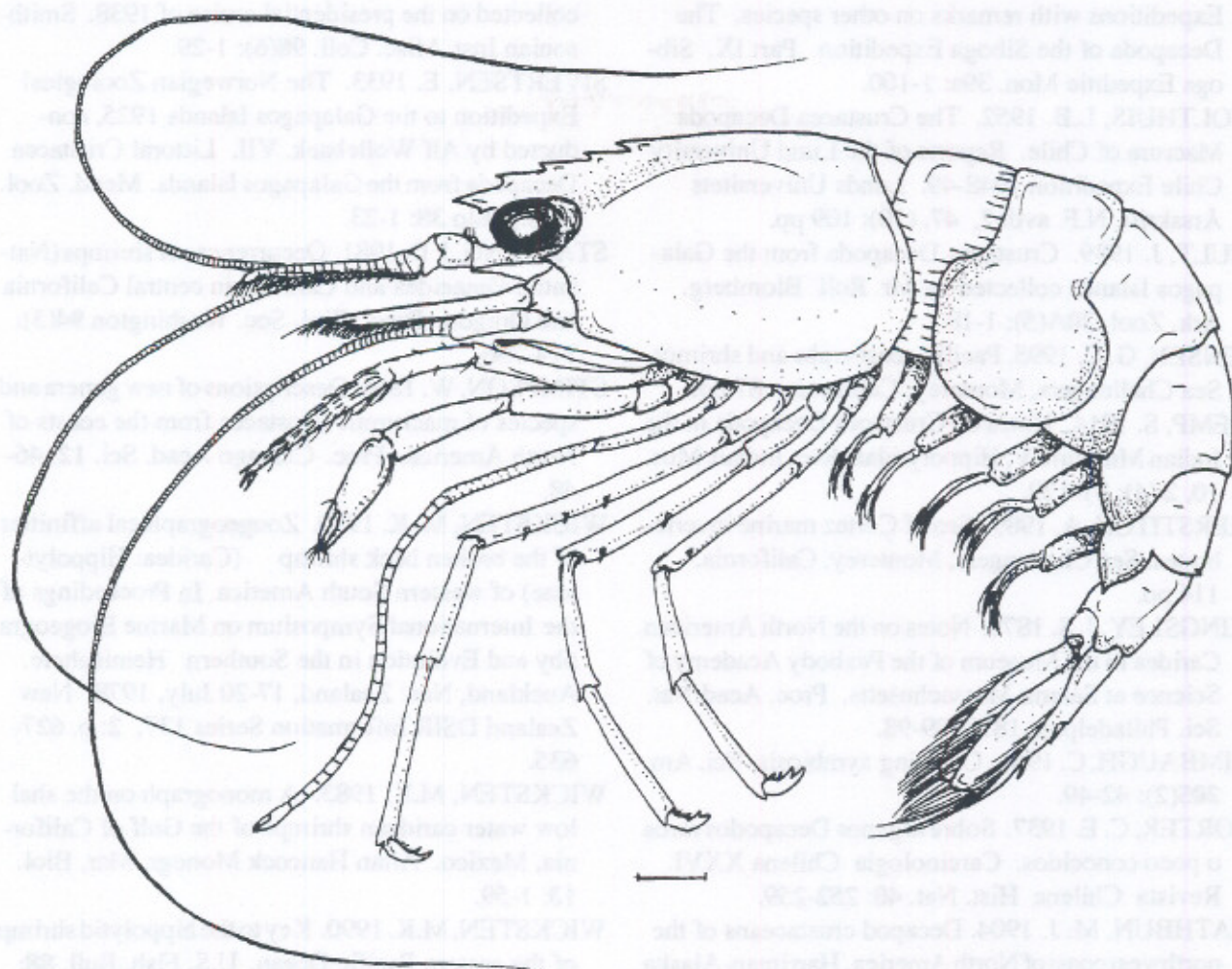
1. Outer antennular flagellum with distinct accessory branch of at least 3 articles. Stylocerite at least as long as first segment of antennular peduncle. . . . . 2
- Outer antennular flagellum with accessory branch fused or vestigial, consisting of no more than 2 free articles. Stylocerite not as long as first segment of antennular peduncle . . . . . 5.
2. Accessory branch of outer antennular flagellum free for about half of its length, generally with 7-17 free articles. Rostrum with 3-5 dorsal teeth . . . . . 3.
- Accessory branch of outer antennular flagellum free for less than half of its length, generally with 7 or fewer free articles. Rostrum with 5-7 dorsal teeth . . . . . 4.
3. Spine of scaphocerite longer than blade, blade 4X long as wide. *Lysmata argentopunctata* n. sp.
- Spine of scaphocerite about as long as blade, blade 3X long as wide. *Lysmata trisetacea* (Heller)
4. Rostrum with seta between posterior teeth on carapace. Carpus of second pereopod with 17-19 carpal articles . . . . . *Lysmata galapagensis* Schmitt
- Rostrum without setae between posterior teeth on carapace. Carpus of second pereopod with 23-27 carpal article. . . . . *Lysmata chica* n.sp.
5. Carpus of second pereopod with 25 or more carpal articles. (Ranging from California, U.S.A. to central Baja California and northern Gulf of California, Mexico). . . . . 6.
- Carpus of second pereopod with less than 25 carpal articles. (Ranging from southwestern Mexico to Galapagos I Islands) . . . . . 7.
6. Rostrum with 2-4 ventral teeth. Dactyl of third pereopod short, merus with 6-7 spines. (Ranging from California, U.S.A. to Gulf of California) . . . . . *Lysmata californica* (Stimpson)
- Rostrum with 5-6 ventral teeth. Dactyl of third pereopod elongate, merus with 3 spines. (Ranging from Socorro Island, Mexico to Galapagos Islands) . . . . . *Lysmata gracilirostris* Wicksten
7. Rostrum convex on lower border, with 6-7 dorsal and 3-6 (usually 4) ventral teeth. Fingers of chela of first pereopod without teeth. (Ranging from western Mexico to Panama) . . . . .
- . . . . . *Lysmata nayaritensis* n. sp.
- Rostrum relatively straight on lower border, with 6 dorsal and 2 ventral teeth. Fingers of chela of first pereopod with teeth. (Ranging from Chile to Juan Fernandez Islands) . . . . .
- . . . . . *Lysmata porteri* Rathbun

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**Fig.12. *Lysmata trisetacea* (Heller).** Female, CL 5.5, Calerita, Baja California, Mexico. Scale = 1 mm.

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# THE AMPHIPOD FAMILY MELITIDAE ON THE PACIFIC COAST OF NORTH AMERICA: PART II. THE MAERA - CERADOCUS COMPLEX.

T. Krapp-Schickel<sup>1</sup> & N. E. Jarrett<sup>2</sup>

## ABSTRACT

In the North American Pacific coastal marine region, from Alaska to Baja California, species of Melitidae (Hadzioidea) belonging to the *Maera-Ceradocus* complex were studied and the following genera treated: *Maera* Leach (sensu stricto), *Quadrimeaera* Krapp & Ruffo, *Lupimaera* Barnard, *Anamaera* Thomas & Barnard, and *Maera* (sensu lato). Within *Maera* sensu stricto, a *M. danae* - clade [with *M. danae* (Stimpson), *M. fusca* (Bate), *M. loveni* (Bruzeliuss) and *M. nelsonae* n. sp.] as well as a *Maera similis* - clade [with *M. similis* Stout, *M. bousfieldi* n. sp., and *M. jerrica* n. sp.] could be found and a key constructed for all members. One probable new species (only one young female) belongs to the still unravelled group of *Maera* species sensu lato, around *M. rathbunae* Pearse, but full description awaits further material. The genus *Meximaera* Barnard is withdrawn and *Meximaera diffidentia* returned to *Maera* (sensu lato) *diffidentia* Barnard, with *Maera caroliniana* Bynum & Fox as junior synonym. Within *Quadrimeaera* Krapp & Ruffo we could recognize a *Q. reishi* - clade [with *Quadrimeaera reishi* (Barnard) nov. comb., *Q. chinarra* (Barnard) nov. comb. and *Q. carla* n. sp.] we provisionally attribute the former *Maera vigota* Barnard. The large genus *Elasmopus* needs revision as it is undoubtedly not monophyletic; at the moment we describe only some material with (more than one) species of *Elasmopus prope antennatus* (Stout). Within genus *Ceradocus* we found only *Ceradocus spinicauda* (Holmes) in the study region. The former *C. torelli* (Goës) here becomes the type of *Wimvadocus* n. gen. and the former *Ceradocus baffini* Stephensen is transferred to genus *Megaceradocus* Mukai.

## INTRODUCTION

In 1977 Bousfield revised the old Gammaridae by establishing a superfamily Gammaroidea with *Gammarus* - like freshwater inhabitants, and a superfamily Melitoidea (now Hadzioidea) consisting of the family Melitidae containing mainly marine *Melita*- and *Maera* - like genera (with distinct inner lobes on their lower lips), and the family Hadziidae composed of brackish and fresh water species (lacking these inner lobes).

Barnard & Barnard (1983) still discussed groups within the "Gammaroids", without giving them unambiguous scientific names. Thus, on p. 137 they describe the Hadzioids (Melitoids) with "Hadziids" containing "the *Melita* group", distinguish a "greater *Ceradocus* group", which contains "the *Ceradocus* group" with *Anelasmopus*, *Elasmopoides*, *Paraweckelia* from the complex of genera around *Ceradocus*, *Elasmopus* and *Maera*.

Jarrett & Bousfield (1996) presented a detailed revision of the genus *Melita* (with about 60 species then known) based on material from the North American Pacific coast. The present study deals with species belonging to *Maera* (with about 80 species known at the moment) and *Ceradocus* (about 25 nominal species) from the same region.

The genus *Ceradocus* was first described by Costa (1853) for *C. orchestipes* from Naples, and *Maera* was erected by Leach (1814) for *Cancer grossimanus* Montagu, 1808, from English coasts. This species complex retains a magniramous third uropod, in contrast to the "melitids" with dispariramous third uropods. Whereas *Ceradocus* still has a triangular inner plate on the first maxilla, with many setae on the inner margin as well as a densely setose inner plate on the second maxillae, *Maera* has a slender inner plate on the first maxilla, and (on both maxillae) no setae on the inner margins of the inner plate. Furthermore, all species of *Ceradocus* have a reduced last article of the mandible palp, while in *Maera* all conditions (article 3 longer, equal or shorter than article 2) are found. The genus *Elasmopus* is closely related to *Maera* (and certainly also needs revision, being polyphyletic at the moment), but is defined by the special falcate shape of mandibular palp article 3, and generally has a much more robust habitus.

The first eastern Pacific amphipods were described by Dana (1853) from Puget Sound. Also Stimpson (1856a, 1857, 1864), Calman (1898) and Walker (1898) studied the Puget Sound region. Boeck (1871), though working mostly with North Atlantic material, treated animals from Californian coasts. At the end of the 19th

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century the great carcinologists stopped dealing with Crustacea as a whole in one work, and specialisation began. Holmes (1908) worked exclusively on Californian amphipods and Stout (1912, 1913) described 18 new species from this region. C. R. Shoemaker, from 1916 to his death in 1958, and posthumously, published many papers on eastern Pacific amphipods; he summarized arctic Alaskan records in 1955. Alderman (1936) worked on the fauna of Moss Beach; Schellenberg (1936) on specimens from the coast of British Columbia; and Thorsteinson (1941) on material from Puget Sound. Wailes (1931) and Austin (1985) summarized records from British Columbia.

The region of British Columbia was intensively covered by Bousfield (1958, 1977, 1978, 1979, 1981a,b, 1982, 1983, until the present), and by Mills 1961, 1962. Bousfield and colleagues published several papers on Pacific amphipods in "Amphipacifica", 1994 to 1997, continued in the present "revived" series of this journal of aquatic systematic biology. Hurley (1963) studied Californian material. Barnard (1954) commenced his numerous monographic studies in the North American Pacific region. Following his field survey of rocky intertidal amphipods (1969a) he continued publications on the Pacific fauna, even after his transfer to the North American Atlantic coast. For an overview of western North Pacific literature see Kozloff (1987: 346-348) or Jarrett & Bousfield (1996: 5). For a general faunistic overview, see Light (1954) or Smith & Carlton (1975).

The present study treats material collected along the whole Pacific coast of North America, from Point Barrow (Alaska) to Cabo San Lucas (Baja California). It encompasses the Alaska Current entering from the Arctic Ocean, the North Pacific Drift, the Californian Current with cold-temperate water, the warm-temperate region defined between Pt. Conception, California and Bahia Magdalena, Baja California, and the coastal part between Bahia Magdalena and Cape Lucas with strong tropical affinities, with currents leading later into the E-W and W-E equatorial currents of the Central Pacific.

#### ABBREVIATIONS USED IN TEXT AND FIGURES:

A1,2 = antenna 1, 2

art = article

b = breadth

CMNC = Canadian Museum of Nature, Ottawa

Cx = coxa

Ep 1,2,3 = epimeral plates 1,2,3

Gn 1,2 = gnathopod 1, 2

l = length

Md = mandible

Mx 1, 2 = maxillae 1, 2

Mxp = maxilliped

P3-7 = pereopods

Pls = pleon segment

T = telson

U1,2,3 = uropods 1,2,3

Us = urosome segment

USNM = Smithsonian Institution, Washington

#### MATERIAL AND METHODS:

Fluid preservative is 70% alcohol with 3% propylene glycol. Microscope slides are mounted in polyvinyl lactophenol, stained with lignin pink. Illustrations have been photographically reduced from inked line drawings on vellum, approx. 19 x 29 inches.

#### SYSTEMATICS

##### Family Melitidae Bousfield, 1973

Bousfield, 1973: 61; 1977: 299 (revised); 1982: 281; Jarrett & Bousfield 1996: 4; Lowry & Fenwick, 1983: 201.

For family diagnosis, see Jarrett & Bousfield (1996: 5).

The most plesiomorphic character states within the large species group of *Maera* (sensu lato), are displayed by *Maera othonis* Milne-Edwards, 1830 (now *Othomaera* fide Krapp-Schickel 2000). These include subchelate gnathopods subequal in shape and size, without clear sexual dimorphism (at least after Sars (1895), with rounded propodus hind margins lacking a defined palmar corner; their P3-7 dactyli are simple, the basis of P3-7 slender, U3 rami subequal and lanceolate, and the telson is deeply cleft, with short spines. The genus *Maera* Leach has lost the maxillar setae on the inner margins compared to the basic gammarid "Bauplan" and has specializations on many other parts of the body. In *Ceradocus*, the bathyal species *torelli* and *baffini* (in Barnard & Barnard 1983 still within the genus, but now separated and into other genera) avoided the need of specialization by retirement into the presumed less competitive depths, while retaining many plesiomorphic characters.

The genus *Elasmopus* has mainly tropical members, and 5 species are known from California (Barnard 1969a: 117-121). *Ceradocus* is reported from circumtropical, mainly Indopacific localities (7 species from the Atlantic, one from the Mediterranean). The *quadrimana*-complex (now *Quadrimaera*, see Krapp-



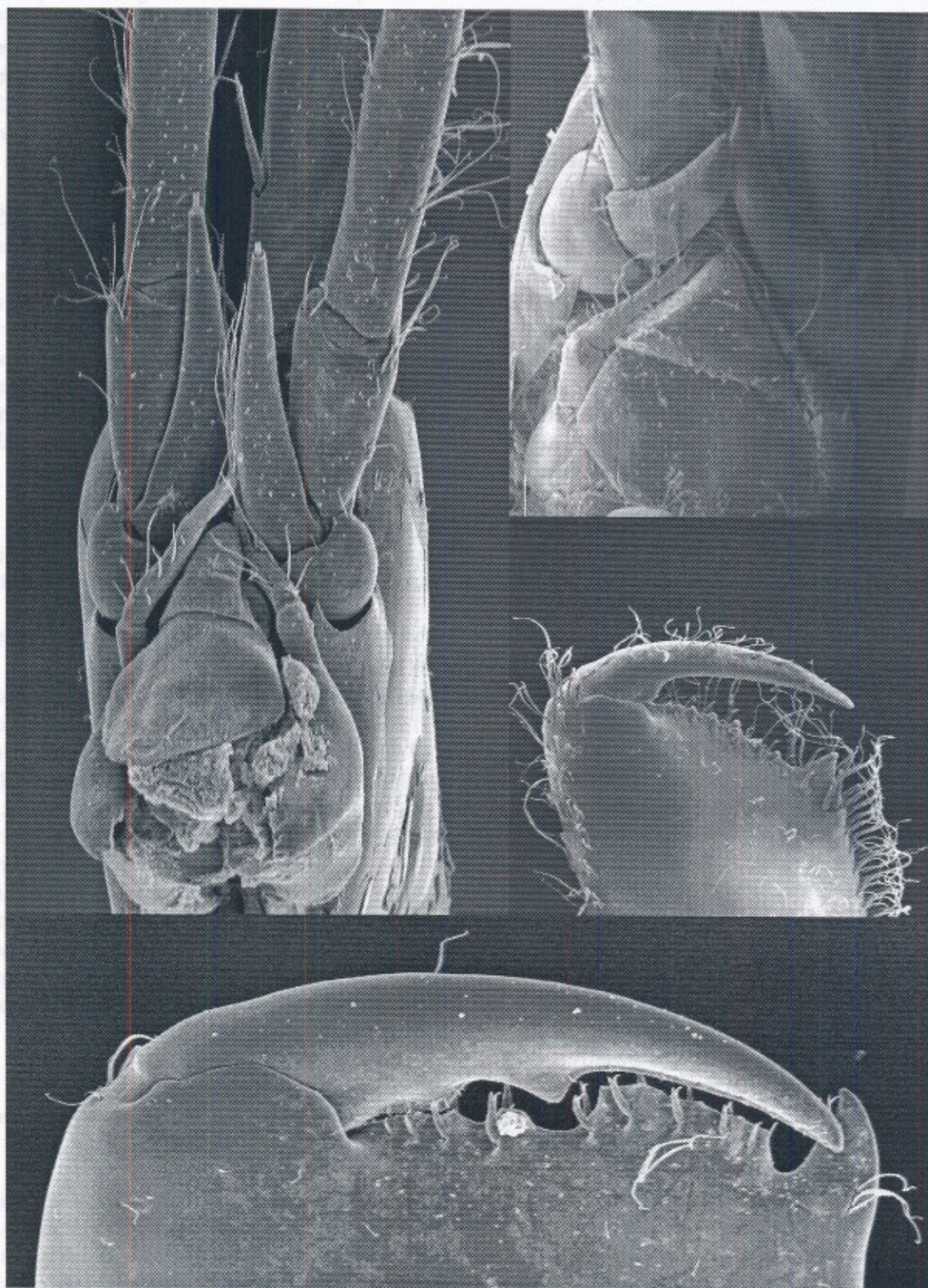


Fig. 1. SEM pictures of mouthpart-bundle and male Gn2: left and below *Quadrinemaera serrata*, above right and right-middle: *Maera danae*.



Schickel & Ruffo, 2000) is also mainly tropical, with its center of evolution apparently in the West Pacific and only 3 species from the east coast. The *grossimana* complex (= *Maera* sensu stricto) contains east Pacific inhabitants, but was previously unknown from the western Pacific.

For decades the large group of "*Maera* sensu lato" species has never been tackled, as characters seemed to have developed independently in many directions. But, in addition to describing and drawing morphological features, we are now able to make SEM pictures, and we learned a lot by plotting many of the characters together in a matrix for computer cladistics. Both methods together helped reveal that species similar to *Maera grossimana* (Montagu) always have the same mix of characters: reniform eyes, Md palp art 1 obliquely lengthened or tooth-shaped, A1 flag. acc. short, and (the most striking one) many setae on the outer margin of Gn2 dactylus, inner margin smooth (Fig. 1 middle right). In contrast, all species similar to *Gammarus quadrimanus* Dana have round eyes, a rounded Md palp art 1, long A1 flag. acc., and only 1 seta on Gn2 dactylus outer margin, inner margin excavate or with humps (Fig. 1). This result led to the decision to erect a separate genus *Quadrimaera* for a quarter of all extant *Maera* sensu lato species, after defining the characters of *Maera* sensu stricto Leach (see Krapp-Schickel & Ruffo 2000).

The character of more than one setae on the outer margin of Gn2 dactylus also divides the genus *Niphargus* into two groups, and within the *Melita* group it is present (to varying degree) in all other genera, while absent in *Melita* s. str. It would be interesting to know the function of these setae. Scanning electron pictures of the mouthpart-bundle of *Maera* sensu stricto, and *Quadrimaera* species, reveal that in *Maera* species the mandible corpus is short and stout, art 1 is mediolaterally inserted, and the articulation of art 1 and art 2 is an angled knee, thus directing the palps toward each other (Fig. 1 above right). Ventral to this "knee" is a more or less developed tooth, that probably stabilizes the articulation. In *Quadrimaera* the mandible corpus is lengthened at the insertion of the palp (Fig. 1 above left), the palp continues this protuberance in a linear fashion, and all articulations are straight. This may be connected with the different biotopes and different feeding habits of the two genera: *Quadrimaera* species are inhabitants of rocky intertidal habitats and probably feed on algae or their epiphytes, while *Maera* are found in sandy-muddy regions of less turbulent water and should be filter feeders.

Another synapomorphy of *Quadrimaera* seemed to

be the "spur" on the outer margin of the peraeopod dactyli. But in this paper we will present Pacific members of *Maera* sensu stricto which also possess so-called "bifid" peraeopod dactyli. Ledoyer described *Maera* (sensu lato) *multispinosa* (1982, p. 530-531, fig. 199) from Madagascar with bifid dactyli and the character is reported from *Maera* (sensu lato) *ascensionis* K. H. Barnard, 1932 p. 214 fig. 132 = *Maera atlantica* Mateus & Mateus, 1986, p. 158 fig. 21-23, found in the Central Atlantic. The figures illustrating *Maera grossimana* in Karaman-Ruffo 1971 show a serration on the outer margin of peraeopod dactyli; the step in developing a bifid dactylus [or trifid, as in *Quadri-maera viridis* (Haswell, 1879)] does not seem large. This character could have developed independently in many groups; it is present in animals living in shallow and rocky biotopes, and could be connected with grasping ability.

#### *Maera* group

For comparison of genera belonging to or near the *Maera* group see Barnard & Barnard (1983: 139).

#### NORTH PACIFIC GENERA OF THE MAERA GROUP

**Diagnosis:** Eyes rounded, oval or reniform. Md palp art 1 distally rounded, obliquely lengthened or toothed; art 3 slender (versus falciform in *Elasmopus*), shorter, equal or longer than art 2. Mx1 inner plate a slender lobe (vs. triangularly widened in *Ceradocus*); Mx2 inner plate on inner margin only distally scarcely beset with setae (vs. strongly setose on whole inner margin in *Ceradocus*). Gnathopod 1 not sexually dimorphic (vs. dimorphic in *Melita* group). Gnathopod 2 subchelate, dactylus with 1 or with many setae on outer margin. Peraeopod 5-7 dactyls simple or bifid. Uropod 3 aequiramous, outer ramus article 2 rudimentary or lacking. (see key to genera, p. 28).

#### *Maera* Leach (sensu stricto)

*Maera* Leach, 1814: 403; 432 (*Cancer grossimanus* Montagu, 1808).

**Diagnosis:** Eyes oval to reniform (vs. round in *Quadrimaera*). A1 acc. flag < 0.5 length of flagellum (vs. > 0.5 in *Quadrimaera*). Md palp art 1 distally obliquely lengthened, often pointed and toothed, (vs. rounded in *Quadrimaera*), art 3 < art 2. Gn2 propodus palm oblique, palmar corner defined, about 120-150° (vs. 90° in *Quadrimaera*, 180° = undefined in *Othomaera* Krapp-Schickel, 2000). Gn2 dactylus on outer margin beset (continued on p. 29)



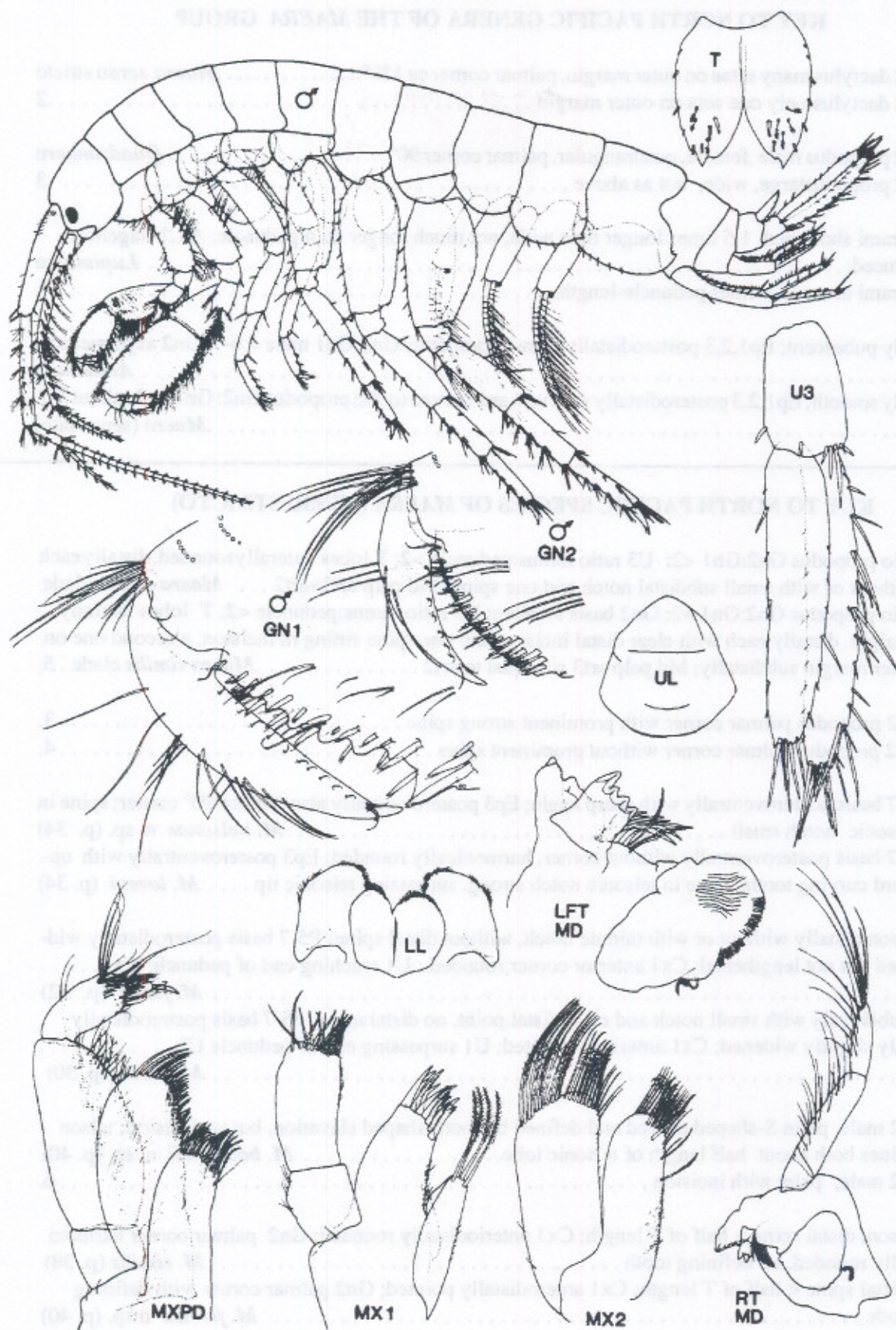


Fig. 2. *Maera* cf. *danae* (Stimpson). Male 12mm, Montague Island, MacLeod Harbor, Gulf of Alaska.



## KEY TO NORTH PACIFIC GENERA OF THE MAERA GROUP

1. Gn2 dactylus many setae on outer margin, palmar corner ca 120° ..... *Maera* sensu stricto  
Gn2 dactylus only one seta on outer margin ..... 2
2. Gn2 propodus male, female, quadrangular, palmar corner 90° ..... *Quadrimaera*  
Gn2 propodus large, wide, not as above ..... 3
3. U3 rami shortened, 1.5 times longer than wide, not much longer than peduncle; A1,2 flagellum reduced. .... *Lupimaera*  
U3 rami about 2-3 times peduncle-length. .... 4.
4. Body pubescent; Ep1,2,3 posterodistally serrate, propodus Gn2:Gn1 male = 6-7, Gn2 asymmetrical ..... *Anamaera*  
Body smooth; Ep1,2,3 posterodistally with upward-curved tooth; propodus Gn2:Gn1 male about 3:2. .... *Maera* (sensu lato)

## KEY TO NORTH PACIFIC SPECIES OF MAERA (SENSU STRICTO)

1. Ratio propodus Gn2:Gn1 <2; U3 ratio ramus:peduncle >2; T lobes laterally rounded, distally each without or with small subdistal notch and one spine; Md palp art3>art2 ... *Maera danae* clade  
Ratio propodus Gn2:Gn1 >2; Gn2 basis swollen; U3 ratio ramus:peduncle <2; T lobes laterally straight, distally each with clear distal incision and one spine sitting in incision, a second one on outer margin subdistally; Md palp art3 subequal to art2 ..... *Maera similis* clade . 5.
2. Gn2 propodus palmar corner with prominent strong spine ..... 3.  
Gn2 propodus palmar corner without prominent spine ..... 4.
3. P5-7 basis posteroventrally with sharp angle; Ep3 posteroventrally also with ca 90° corner; spine in telsonic notch small ..... *M. nelsonae* n. sp. (p. 34)  
P5-7 basis posteroventrally without corner, harmonically rounded; Ep3 posteroventrally with upward curving tooth; spine in telsonic notch strong, surpassing telsonic tip .... *M. loveni* (p. 34)
4. Telson distally without or with minute notch, without distal spine; P5-7 basis posterodistally widened but not lengthened; Cx1 anterior corner rounded.; U1 reaching end of peduncle U3 ....  
..... *M. fusca* (p. 32)  
T subdistally with small notch and clear distal point, no distal spine; P5-7 basis posterodistally only slightly widened; Cx1 anteriorly pointed; U1 surpassing end of peduncle U3 .....  
..... *M. danae* (p. 30)
5. Gn2 male, palm S-shaped curved and defined by tooth-shaped elevation, but no incision; telson spines both about half length of telsonic lobe. .... *M. bousfieldi* n. sp. (p. 40)  
Gn2 male, palm with incision ..... 6.
6. Telson, distal spine > half of T length; Cx1 anterodistally rounded; Gn2 palmar corner harmonically rounded, no defining tooth ..... *M. similis* (p. 38)  
T distal spine < half of T length; Cx1 anterodistally pointed; Gn2 palmar corner with defining tooth. .... *M. jerrica* n.sp. (p. 40)



KEY TO ALL SPECIES OF *MAERA* SENSU STRICTO WORLD-WIDE

1. Gn2 dactylus outer margin with 4-5 setae, propodus hind margin shorter than palm: species may NOT belong to *Maera* sensu stricto ..... *M. tinkerensis* (8-9mm)  
Gn2 dactylus outer margin with many setae; propodus of hind margin slonger than palm ..... 2.
2. Eyes absent ..... 3.  
Eyes present ..... 5.
3. P5-7 basis linear and very elongate ..... *M. tenera* (10mm)  
P5-7 basis widened and rounded ..... 4.
4. Gn2 palmar corner with about 90°; head antero-inferiorly produced into long and acute tooth .....  
..... *M. edwardsi* (12.5mm)  
Gn2 palmar corner scarcely developed; head without tooth defining subantennal sinus .....  
..... *M. anoculata* (6.5mm)
5. Telson lobes V-shaped incised, with spine sitting in incision. .... 6.  
T with 3 spines and more than one notch; Gn1 palmar corner with ... *M. pachytelson* (7-8mm)
6. P5-7 dactyli bifid; Gn2 male, basis bottle-shaped swollen... .. *M. similis* clade (see key above)  
P5-7 dactyli simple ..... 7.
7. U3 rami very elongate, > twice the length of peduncle... .. *M. danae* clade (see key )  
U3 rami shorter than 2x peduncle length. .... 8.
8. P5-7, dactyl > half length of propod, basis proximally widened, distally very narrow, hind margin nearly straight, no posterodistal lobe ..... *M. sodalis* (11.5m)  
P5-7 dactyli ≤ half length of propodi ..... 9.
9. Ep3 inferior margin serrated; P5-7 basis hind margin rounded, small postero-distal lobe present, eyes rounded ..... *M. schieckei* (6mm)  
Ep3 inferior margin smooth; P5-7 basis otherwise, lacking postero-distal lobe; eyes reniform .... 10.
10. Gn2 male, palm with V-shaped incision. .... *M. hirondellei* (9mm)  
Gn2 male, palm without incision ..... *M. grossimana* (9-10 mm)
11. Telson with 3 spines and more than one notch; Gn1 palmar corner square .....  
..... *M. pachytelson* (7-8 mm)  
Telson with <3 spines, with one or no notch; Gn1 palmar coner obtuse or absent ..... 12.
12. P5-7 basis linear and very elongate; Gn2 palmar corner ornate, with prominent spine; telson with notch or spine(s); eyes occasionally weakly pigmented ..... *M. loveni* (19 mm)  
P5-7 basis widened; Gn2 palmar corner without prominent spine; telson without notch or spines, eyes normally pigmented ..... *M. fusca* (14 mm)

beset with many setae; never excavated on inner margin. P3-7 dactyli simple or bifid. U3 with long and slim or short rami, at least outer ramus distally truncate, not pointed (vs. lanceolate and pointed in *Otho-maera*). Telson deeply cleft.

**MAERA DANAEE - CLADE**

As species of this group have extremely small (but constant) morphological differences, we revised very carefully the collections at the USNM and CMNC, comparing North Atlantic with North Pacific material and studying the various descriptions.



We recognize a panarctic species, probably *Maera danae* and revalidate *Maera fusca* found partly in the north, but reaching further south and seemingly ecologically differentiated (from sponges or living on worms). *Maera loveni* was found also in the North Atlantic, Arctic, and North Pacific, and a quite similar new species is defined from California.

**Diagnosis:** Eyes oval to reniform. A1 acc.flag < 0.5 length of flagellum. Md palp art 1 distally obliquely lengthened, or pointed, art3 = 0.6-0.75 length of art2. Gn2 propodus in both sexes not much widened, palm oblique, palmar corner well defined, about 120-150°. Gn2 dactylus with many setae on outer margin; P3-7 dactyli simple (vs. bifid in *Maera similis* - clade). U3 with long and narrow rami (vs. short and truncate in *Maera grossimana*, the type species), l:b > 4, distal spines short. Telson lobes distally entire or notched, 0-1 robust spines distally.

#### *Maera danae* (Stimpson, 1853)

*Leptothoe danae* Stimpson, 1853: 46, pl. 3, fig. 32  
*Moera danae* Bate 1862: 190, pl. 34, fig. 6  
*Maera danae* Holmes 1905: 525, pl. 12, fig. 2; Shoemaker, 1955: 53; Bousfield 1973: 222, pl. X, fig. 1.  
*?Maera prionochira spec. dubia* Brüggén, 1907: 230, fig. 5-7; Gurjanova 1951: 758, fig. 527 (cites Brüggén); Stephensen 1935-42: 310-313, fig. 39 (cites Brüggén).

**Taxonomic comments:** Stimpson described his *Leptothoe danae* thoroughly, but gave only a sketchy illustration. His type came from Grand Manan, Bay of Fundy, (New Brunswick); about 23mm long, had a uniform bright flesh colour, small subreniform eyes, acc. flag = 1/3 flagellum; A2 art4=5, and his figure of P5-7 shows an elongate, scarcely broadened basis. While the type was taken from the *Laminaria* zone (patches of sandy bottom with numerous weedy rocks), the presumed young appeared in less deep regions in the Coralline zone.

Shortly after him, Bate (1862) transferred *Leptothoe* to the genus *Moera* and redescribed the (?same) animals, with another quite sketchy figure. The essential difference is the indication of the length, which Bate gives as 0.7 inches (about 18 mm).

Two years later, Bate (1864) treated N-Pacific material from Esquimalt Harbour, Vancouver Island, and recognized *Maera fusca* (from a sponge at 19m depth); he gave a very poor description, with no length and no figures. Stebbing (1888: 277, and 1906: 440) gave an

overview of the literature.

Holmes (1904: 239) cited *M. dubia* from Popoff Island, Alaska (under rocks on the shore), and he also agreed in differentiating [1905: 525, pl. 12 (a photograph)] *Maera danae* from Eastport, Maine.

Shoemaker (1955) studied material from Point Barrow, Alaska, and gave a synopsis to the literature.

Bousfield (1973) gave a detailed figure of *Maera danae* (female 22mm) and summarized the distribution as North Atlantic Ocean, from the Gulf of St. Lawrence, Nova Scotia and Gulf of Maine to New Jersey.

It is impossible to decide with certainty whether or not *Maera danae* may be synonymous with *?Maera prionochira spec. dubia* Brüggén, 1907, from Spitzbergen and Barents Sea. The very detailed description deals with a badly preserved and partly anomalous animal of 15mm. Gurjanova cites the same material and reprints the illustrations of Brüggén (1951: 758, fig. 527) as does Stephensen (1935, 42: 310-313, fig. 39) who could not check the so-called Gn2 female on type-material. Brüggén's text tells about flagella with 17-27 articles and a richer material from the collections of the Zool. Inst. Acad. USSR from the Kara-, Chukchi and Bering Seas. Gurjanova (1951, p. 759) reports *M. prionochira* from 6 m depth in the Barents Sea, South Spitzbergen, and Brüggén (1907) and Stephensen (1935-42: 313) from 9 m.

The Smithsonian collection contains Atlantic material of *Maera danae* (Stimpson, 1853) from the type region and at a depth 50-74 m from Massachusetts (1 female ov. 13mm USNM 135096, 1 male 12mm, USNM 135095) and New Jersey (ca 15 juv.). Although Shoemaker (1955) reports on 18mm specimens from the Atlantic that were deposited in the Smithsonian collection, we could not find them. The specimens from Massachusetts are much smaller than described for the type or by Bousfield (1973); otherwise there are no essential differences and the Massachusetts material matches perfectly with that from Point Barrow or from the Arctic Bay in the North Pacific. Bryazgin (1997: 99) reports *Maera prionochira* from SE Barents sea, 2-50m, without further details.

#### *Maera cf. danae* (Fig. 2)

**Material examined:**  
 GULF OF ALASKA:

CMNC 1999-0019, Montague Island, MacLeod Harbor (59°53'N, 147°46'W), Gulf of Alaska, Pacific Ocean; eelgrass, gravel, coll. E.L. Bousfield Stn. 1961-123, 13 July 1961 - 1 male 12mm, partly in alcohol, partly mounted as slide.



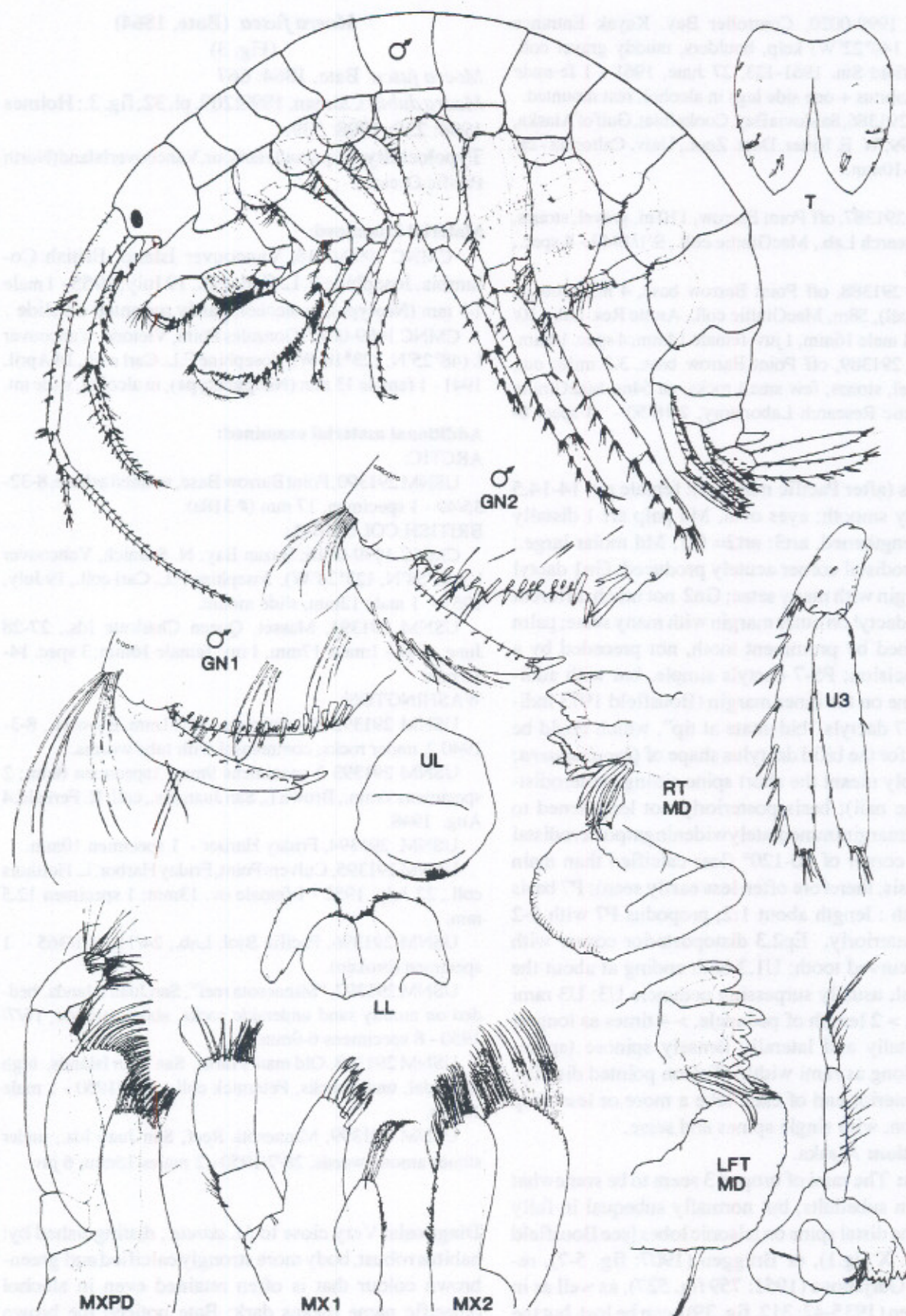


Fig. 3. *Maera fusca* (Bate) Male 14mm, Vancouver Island, B.C.



CMNC 1999-0020, Controller Bay, Kayak Entrance (59°59'N, 144°22'W) kelp, boulders, muddy gravel coll. E.L. Bousfield Stn. 1961-123, 27 June, 1961 - 1 fe-male 14.5mm, habitus + one side legs in alcohol, rest mounted.

USNM 291386, Saldovia Bay, Cooks Inlet, Gulf of Alaska, July 22 1899, W. E. Ritter, Dept. Zool., Univ. California - ca. 30 spec. 8-10mm.

#### ARCTIC:

USNM 291387, off Point Barrow, 110 m, gravel, stones, Arctic Research Lab., MacGinitie coll., 9/1/1949 - 4 spec., 12-14 mm.

USNM 291388, off Point Barrow base, 4 miles out, ca gravel (small), 58m, MacGinitie coll., Arctic Res. Lab., 10/14/1949 - 1 male 16mm, 1 juv. female 14mm, 4 spec. 10mm.

USNM 291389, off Point Barrow base, 3.2 miles out, mud, gravel, stones, few small rocks, ca 54m, MacGinitie coll., Arctic Research Laboratory, 2/18/50 - 4 spec. 8-12mm.

**Diagnosis** (after Pacific material): female ov. 14-14.5 mm. Body smooth; eyes oval, Md palp art 1 distally acutely lengthened, art3: art2= 0.7; Md molar large.; Cx1 anterodistal corner acutely produced; Gn1 dactyl outer margin with many setae; Gn2 not much different sexually, dactyl on outer margin with many setae; palm well defined by prominent tooth, not preceded by a special incision; P5-7 dactyls simple, but with additional spine on the inner margin (Bousfield 1973 indicated P5-7 dactyls "bidentate at tip", which could be mistaken for the bifid dactylus shape of *Quadrimaera*; he probably meant the short spine sitting posterodistally of the nail); basis posteriorly not lengthened to lobe, hindmargin immediately widening at posterodistal end with corner of 90-120° (less calcified than main part of basis, therefore often less easily seen); P7 basis ratio width : length about 1:2; propodus P7 with 0-2 spines posteriorly. Ep2,3 distoposterior corner with upwards curved tooth; U1,2 both ending at about the same level, usually surpassing peduncle U3; U3 rami subequal, > 2 length of peduncle, > 4 times as long as wide, distally and laterally densely spinose (spines about as long as rami width). Telson pointed distally, on distointerior end of each lobe a more or less deep indentation, with single spines and setae.

#### Distribution:

**Remarks:** The rami of uropod 3 seem to be somewhat unequal in subadults, but normally subequal in fully adults. The distal spine on telsonic lobes [see Bousfield (1973: pl. X fig.1), or Brügger (1907: fig. 5-7), repeated in Gurjanova (1951: 759 fig. 527), as well as in Stephensen (1935-42: 312, fig. 39)] can be lost, but the incision, interior and distal to the tip, is always clearly visible.

### *Maera fusca* (Bate, 1864)

(Fig. 3)

*Maera fusca* Bate, 1864: 667

*Maera dubia* Calman, 1898: 269, pl. 32, fig. 3.; Holmes 1904: 239; 1908: 539.

**Typelocality:** Esquimalt Harbour, Vancouver Island (North Pacific Ocean).

#### Material Examined:

CMNC 1999-0016, Vancouver Island, British Columbia, Josephine F. L. Carl coll., 19 July, 1955 - 1 male 14 mm (**Neotype**), in alcohol, partly mounted on slide.

CMNC 1999-0017, Gonzales Point, Victoria, Vancouver I. (48°25'N, 123°18'W), Josephine F.L. Carl coll., 14 April, 1941 - 1 female 13 mm (**Neoparatype**), in alcohol, slide mt.

#### Additional material examined:

##### ARCTIC:

USNM 291390, Point Barrow Base, washed ashore, 8-32-35/49 - 1 specimen, 17 mm (# 318a).

##### BRITISH COLUMBIA:

CMNC 1999-0016; Bazan Bay, N. Saanich, Vancouver I., (48°58'N, 123°24'W), Josephine F.L. Carl coll., 19 July, 1955 - 1 male 12mm, slide mount.

USNM 291391, Masset, Queen Charlotte Ids., 27-28 June, 1946 - 1 male 17mm, 1 juv. female 16mm, 3 spec. 14-12 mm.

##### WASHINGTON:

USNM 291392, 6 specimens, 10-11mm, Brown I., 8-3-1940 ?, under rocks, commensal with tube worms.

USNM 291393 3 specimens 9mm; 1 specimen 8mm; 2 specimens 6mm., Brown I., San Juan Ids., coll. R. Fernald. 4 Aug., 1948,

USNM 291394, Friday Harbor - 1 specimen 10mm.

USNM 291395, Culvers Point, Friday Harbor, L. Holthuis coll., 22 July, 1952 - 1 female ov. 13mm; 1 specimen 12.5 mm.

USNM 291396, Pacific Biol. Lab., 24/11, 101/365 - 1 specimen (broken).

USNM 291397, "Minnesota reef", San Juan Islands, bedded on muddy sand underside rocks, about midtide, 16/7/1950 - 8 specimens 6-9mm.

USNM 291398, Old man's farm, San Juan Islands, high intertidal, under rocks, Peternick coll., 30/7/1950 - 1 male 15mm.

USNM 291399, Minnesota Reef, San Juan Ids., under stones among weeds, 28/7/1950 - 2 males 15mm, 6 juv.

**Diagnosis:** Very close to *M. danae*, distinguished by: habitus robust, body more strongly calcified and green-brown colour that is often retained even in alcohol (specific name means dark; Bate noticed the brown colour also in his original description); Md palp art 1 distally obliquely lengthened, art 3 about half of art 2.



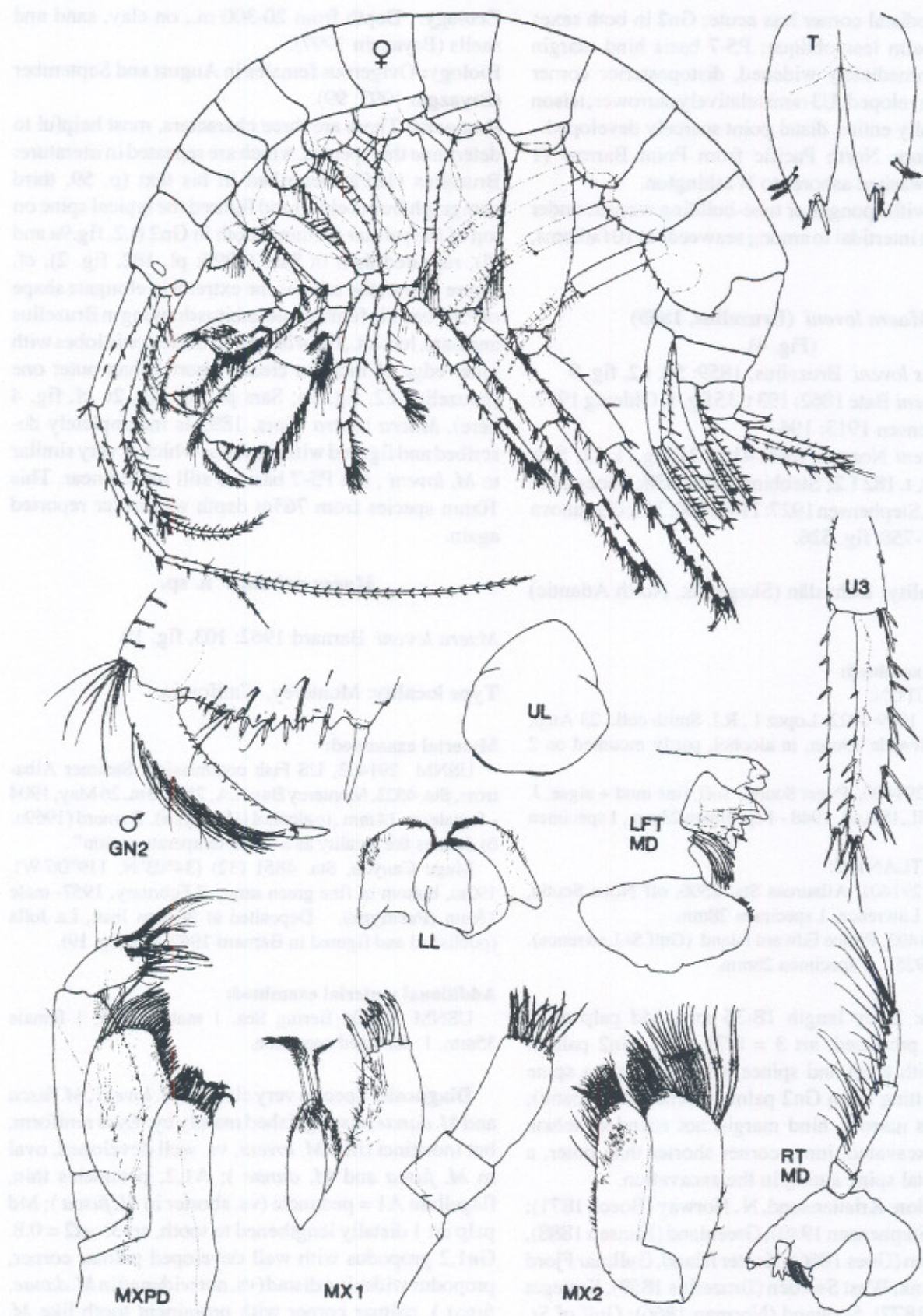


Fig. 4. *Maera loveni* (Bruzellus). Female 19mm, Alaska



Cx1 anterodistal corner less acute; Gn2 in both sexes broader, palm less oblique; P5-7 basis hind margin distally immediately widened, distoposterior corner strongly developed; U3 rami relatively narrower; telson lobes distally entire, distal point scarcely developed.

**Distribution:** North Pacific from Point Barrow (1 specimen washed ashore) to Washington.

**Ecology:** with sponges or tube-building worms, under rocks from intertidal to among seaweeds at 10 fathoms, ca 18m.

***Maera loveni* (Bruzeliuss, 1859)**

(Fig. 4)

*Gammarus loveni* Bruzeliuss, 1859: 59, t.2, fig. 9

*Moera loveni* Bate 1862: 193 t.35 fig. 1; Oldevig 1917: 36; Stephensen 1913: 194

*Maera loveni* Norman 1868: 416 t. 21, fig. 11, 12; Sars 1895: 519, t. 182 f.2; Stebbing 1906: 438; Shoemaker 1930: 116; Stephensen 1927: 114; 1940: 311; Gurjanova 1951: 757-758, fig. 526.

**Type locality:** Bohuslän (Skagerrak, North Atlantic) 73-110m.

**Material examined:**

**WASHINGTON:**

CMNC 1999-0022: Lopez I., R.I. Smith coll., 23 Aug., 1955 - 1 female 19mm, in alcohol, partly mounted on 2 slides.

USNM 291400, Puget Sound, soft, fine mud + algae, J. L. Mohr coll., 18 Aug. 1948 - 1 specimen 23mm, 1 specimen 18mm.

**NORTH ATLANTIC:**

USNM 291401, Albatross Sta. 2506, off Nova Scotia, Gulf of St. Lawrence, 1 specimen 28mm.

USNM 291402, Prince Edward Island (Gulf St. Lawrence), 23 Nov., 1925 - 1 specimen 28mm.

**Diagnosis:** Body length 18-35 mm. Md palp art 1 obliquely produced, art 3 = 0.75 art 2. Gn2 palmar margin with teeth and spines, with one strong spine directly sitting upon Gn2 palmar corner (diagnostic); P5-7 basis narrow, hind margin not rounded; telson distally excavated, inner corner shorter than outer, a robust distal spine sitting in the excavation.

**Distribution:** Kristiansund, N. Norway (Boeck 1871); Tromsø (Stephensen 1940); Greenland (Hansen 1888), Spitzbergen (Goes 1866); Koster Island, Gullmar Fjord in Skagerrak, West Sweden (Bruzeliuss 1859), Kattegat (Meinert 1877), Scotland (Norman 1866); Gulf of St. Lawrence, Nova Scotia (Shoemaker 1930); SE Barents sea (Bryazgin 1997).

**Ecology:** Depth from 20-300 m., on clay, sand and shells (Bryazgin 1997).

**Biology:** Oviparous females in August and September (Bryazgin 1997: 99).

**Remarks:** There are three characters, most helpful to determine this species, which are repeated in literature: Bruzeliuss (1859) described in his text (p. 59, third paragraph from below) and figured the typical spine on top of the palmar defining tooth in Gn2 (t.2, fig. 9a and 9l), repeated then in Sars (1895: pl. 182, fig. 2), cf. figure 4 here; the other is the extremely elongate shape of P5-7 basis in female (see habitus drawing in Bruzeliuss and Sars, loc. cit., fig. 4 here) and the telsonic lobes with inner edge of incision clearly shorter than outer one (Bruzeliuss t.2, fig. 9n; Sars pl. 182 fig. 2t, cf. fig. 4 here). *Maera tenera* Sars, 1895 is incompletely described and figured with a habitus which is very similar to *M. loveni*, but P5-7 basis is still more linear. This 10mm species from 763m depth was never reported again.

***Maera nelsonae* n. sp.**

*Maera loveni* Barnard 1962: 103, fig. 19.

**Type locality:** Monterey, California.

**Material examined:**

USNM 291403, US Fish commission, Steamer Albatross, Sta. 4523, Monterey Bay, CA, 75-108m, 26 May, 1904 - female ov. 14mm, in alcohol (**Holotype**). Barnard (1969a: 6) defines the locality as a "cold-temperate region".

Mugu Canyon, Sta. 4851 (32) (34°03'N, 119°06'W), 192m, bottom of fine green sand, 7 February, 1957 - male 15mm (**Paratype**). Deposited at Scripps Inst., La Jolla (published and figured in Barnard 1962: 103, fig. 19).

**Additional material examined:**

USNM 291404 Bering Sea, 1 male 37mm, 1 female 35mm, 1 damaged specimen.

**Diagnosis:** Species very close to *M. loveni*, *M. fusca* and *M. danae*, distinguished mainly by: Eyes reniform, but indistinct (like *M. loveni*, vs. well developed, oval in *M. fusca* and *M. danae*); A1,2, peduncles thin, flagellum A1 = peduncle (vs. shorter in *M. fusca*); Md palp art 1 distally lengthened to tooth, art 3: art 2 = 0.8. Gn1,2 propodus with well developed palmar corner, propodus widening distad (vs. not widened in *M. danae*, *M. fusca*), palmar corner with prominent tooth like *M. loveni*, but without strong spine directly on palmar corner (spine diagnostic for *M. loveni*), but spines



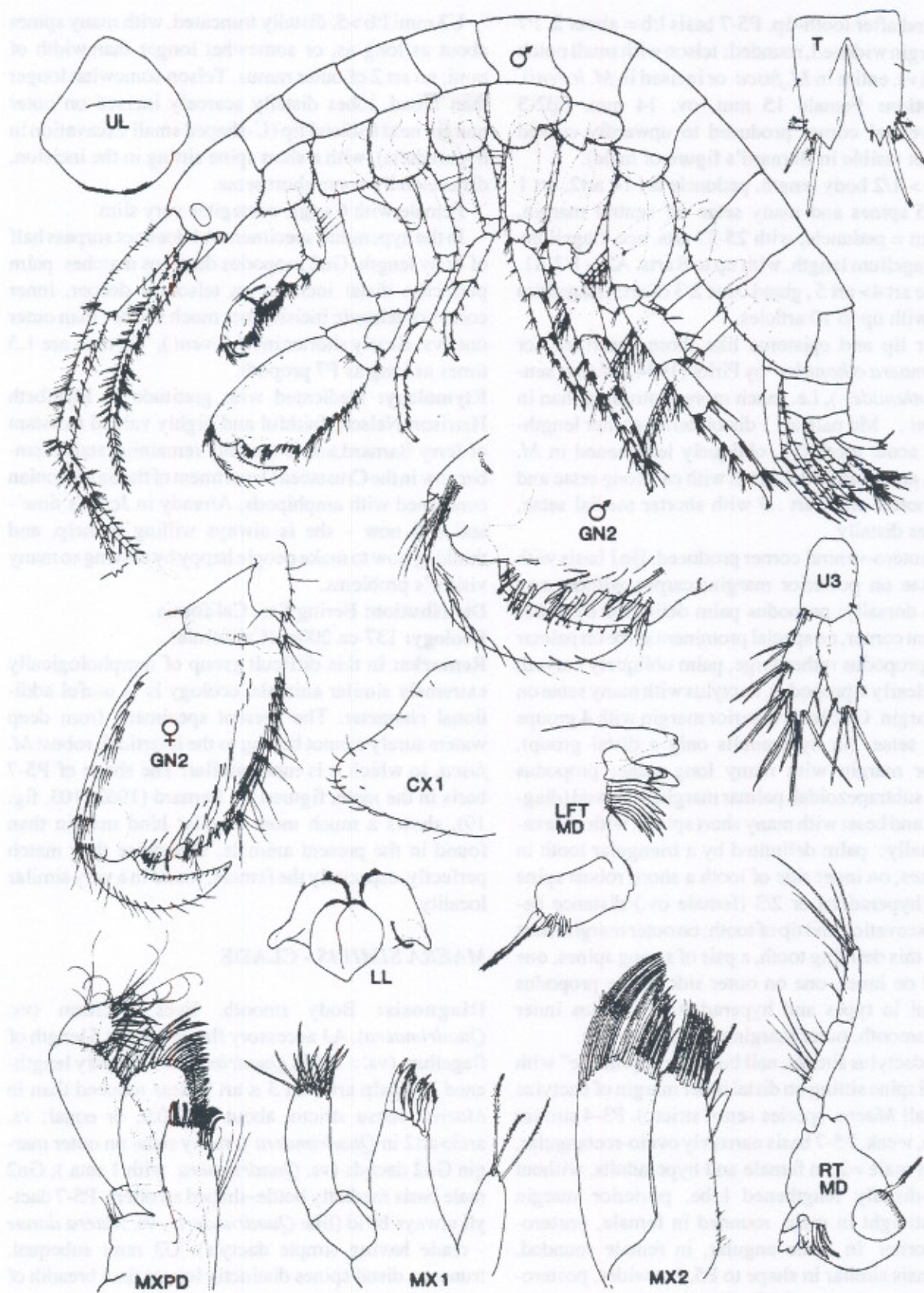


Fig. 5. *Maera similis* Stout. Female 6.5mm, Cape Beale V.I., B.C.



before and after tooth-tip. P5-7 basis l:b = about 2, P7 hind margin widened, rounded; telson with small notch distally (vs. entire in *M. fusca* or incised in *M. loveni*). **Description:** Female 15 mm, ov. 14 mm. Ep2-3 posteroventral corner produced to upwardly curved tooth (not visible in Barnard's figure of male).

A1 =  $> 1/2$  body length, peduncle art 1 < art2, art 1 with 4-5 spines and many setae on ventral margin, flagellum = peduncle, with 25-27 arts, acc. flagellum  $1/4$  of flagellum length, with up to 8 arts. A2  $> 1/2$  A1, peduncle art 4 > art 5, gland cone  $2/3$  of art3, flagellum setose, with up to 10 articles.

Upper lip and epistome like those described for "*Linguimaera othonides*" by Pirlot (1934) (*Maera* sensu lato *othonides*), i.e. much more protruding than in *M. loveni*. Md palp art 1 distointerior corner lengthened to acute tooth (vs. obliquely lengthened in *M. loveni*), arts 3: art2=0.8, art. 2 with ca 7 long setae and many shorter ones, art. 3 with shorter medial setae, long ones distally.

Cx1 antero-ventral corner produced. Gn1 basis with long setae on posterior margin; carpus without any incision dorsally; propodus palm delimited by a distinct blunt corner, no special prominent spine on palmar corner; propodus rather large, palm obliquely curved; carpus clearly > propodus, dactylus with many setae on outer margin. Gn2 basis anterior margin with 4 groups of long setae, (in hyperadults only a distal group), posterior margin with many long setae; propodus broadly subtrapezoidal, palmar margin S-curved (diagnostic!) and beset with many short spines, with excavation distally; palm delimited by a triangular tooth in both sexes, on inner side of tooth a short, robust spine on half(hyperadult) or  $2/3$  (female ov.) distance between excavation and tip of tooth; on outer margin, next to tip of this defining tooth, a pair of strong spines, one inserted on inner, one on outer side of the propodus (identical in types and hyperadults); dactylus inner margin smooth, outer margin with many setae.

P3-7 dactylus simple, nail building a "pincette" with a curved spine sitting on distal inner margin of dactylus (like in all *Maera* species sensu stricto). P3-4 similar in shape, weak. P5-7 basis narrowly ovato-rectangular, l:b  $> 2$  in male =2, in female and hyperadults, without postero-distally lengthened lobe, posterior margin nearly straight in male, rounded in female, postero-distal corner in male angular, in female rounded, P6, 7, basis similar in shape to P5, but wider, postero-distal corner of merus P5-7 with very short setae; P6, 7 propodus posterior margin without setae.

U3 rami l:b  $> 5$ , distally truncated, with many spines about as long as, or somewhat longer than, width of rami, no art 2 of outer ramus. Telson somewhat longer than broad, lobes distally scarcely incised on outer margin next to distal tip (U-shaped small excavation in hyperadults), with a short spine sitting in the incision, distolaterally some short setae.

Female with 6 eggs, oostegites very slim.

In the hyperadult specimens A1 does not surpass half of body length, Gn2 propodus dactylus matches palm perfectly, distal incision on telson is deeper, inner corner of telsonic incision not much shorter than outer one (vs. clearly shorter in *M. loveni*), U3 rami are 1.5 times as long as P7 propodi.

**Etymology:** Dedicated with gratitude to Elizabeth Harrison-Nelson, faithful and highly valued assistant of Jerry Barnard, and is the only remaining staff member now in the Crustacea Department of the Smithsonian concerned with amphipods. Already in Jerry's time - and still now - she is always willing to help, and thinking how to make people happy by solving so many visitor's problems.

**Distribution:** Bering Sea, California.

**Ecology:** 137-ca 200m (California).

**Remarks:** In this difficult group of morphologically extremely similar animals, ecology is a useful additional character. The present specimens from deep waters surely cannot belong to the intertidal, robust *M. fusca*, to which it is most similar. The shape of P5-7 basis in the male, figured by Barnard (1962: 103, fig. 19), shows a much more angular hind margin than found in the present animals. Otherwise they match perfectly, especially the female, found in a very similar locality.

#### MAERA SIMILIS - CLADE

**Diagnosis:** Body smooth. Eyes reniform (vs. *Quadrimaera*). A1 accessory flagellum  $< 0.5$  length of flagellum (vs.  $> 0.5$  in *Quadrimaera*). Scarcely lengthened Md palp art1, art 3  $\leq$  art 2 (less reduced than in *Maera* sensu stricto, about 0.85-0.9, or equal; vs. art3 > art2 in *Quadrimaera*); many setae on outer margin Gn2 dactyls (vs. *Quadrimaera* with 1 seta); Gn2 male basis medially bottle-shaped swollen; P5-7 dactyli always bifid (like *Quadrimaera*, vs. *Maera danae* - clade having simple dactyls). U3 rami subequal, truncate, distal spines distinctly longer than breadth of rami, which length never exceeds 3 times width (vs. *Maera danae* - clade). Telson distally deeply incised,



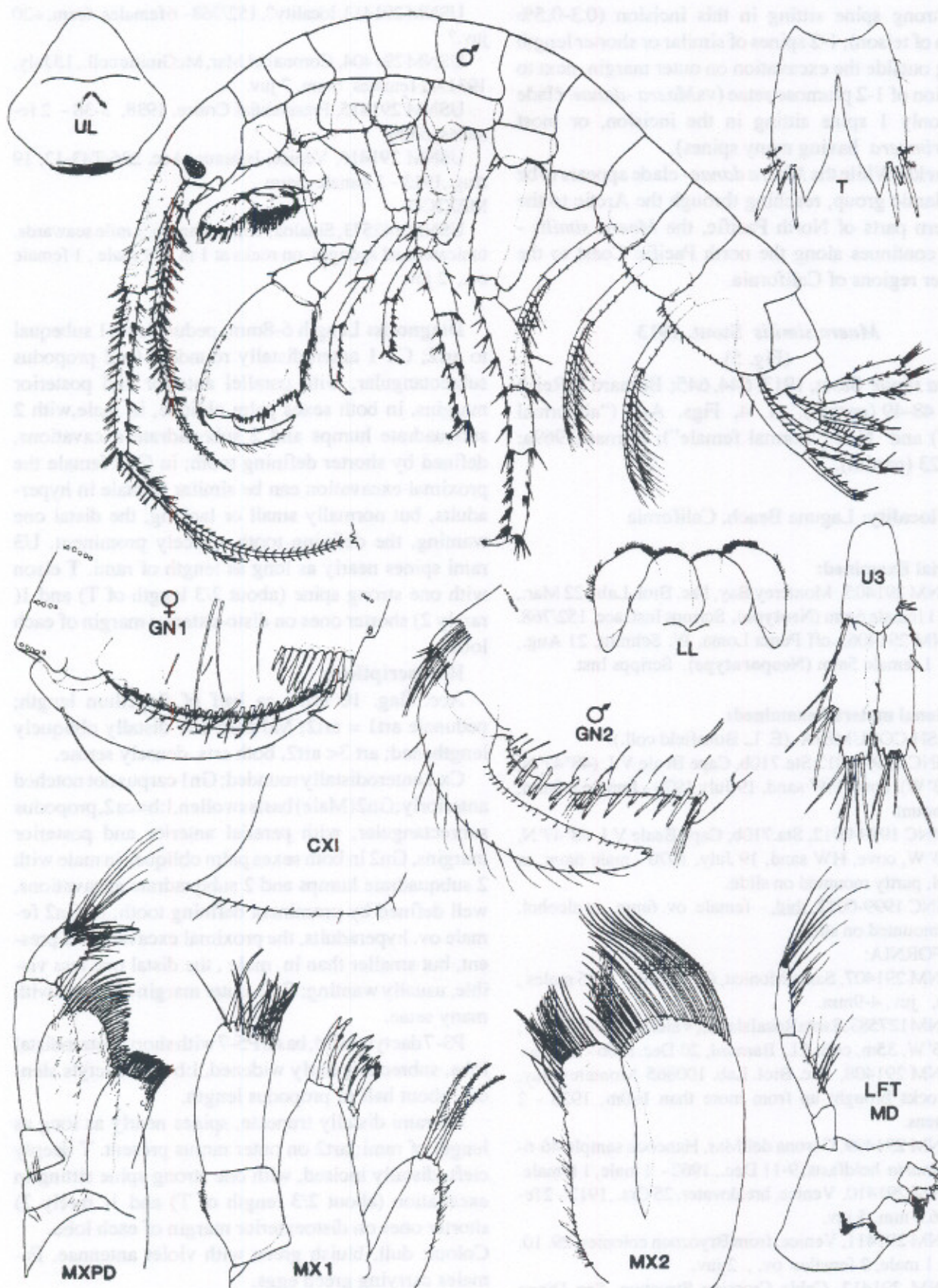


Fig. 6. *Maera bousfieldi* n. sp. Male 11.5mm, Clover Pt., B.C.



one strong spine sitting in this incision (0.3-0.5% length of telson), 1-2 spines of similar or shorter length sitting outside the excavation on outer margin, next to insertion of 1-2 plumose setae (vs *Maera danae* clade with only 1 spine sitting in the incision, or most *Quadrimaera* having many spines).

**Remarks:** While the *Maera danae* - clade appears to be an Atlantic group, reaching through the Arctic to the northern parts of North Pacific, the *Maera similis* - clade continues along the north Pacific Coast to the warmer regions of California.

***Maera similis* Stout, 1913**

(Fig. 5)

*Maera simile* Stout, 1913: 644, 645; Barnard & Reish 1959: 48-49 (partim), pl. 4, Figs. A-P ("abnormal male") and N,O ("normal female"); Barnard 1969a: 122, 123 (partim).

**Type locality:** Laguna Beach, California

**Material Examined:**

USNM 291405, Monterey Bay, Pac. Biol. Lab., 22 Mar., 1930 - 1 female 6mm (**Neotype**), Scripps Inst. acc. 152/768.

USNM 291406, off Punta Loma, W. Schmitt, 21 Aug., 1918 - 1 female 5mm (**Neoparatype**), Scripps Inst.

**Additional material examined:**

BRITISH COLUMBIA (E. L. Bousfield coll.):

CMNC 1999-0012 Sta. 710b, Cape Beale V.I. (48°47'N, 125°13'W), cove, HW sand, 19 July 1970 - female 6.5mm, slide mount.

CMNC 1999-0012, Sta. 710b, Cape Beale V.I. 48°47'N, 125°13'W, cove, HW sand, 19 July, 1970 - male 6mm, in alcohol, partly mounted on slide.

CMNC 1999-0012, *ibid.* - female ov. 6mm, in alcohol, partly mounted on slide.

**CALIFORNIA:**

USNM 291407, Santa Monica, Clark coll. - + 25 males, female, juv. 4-9mm.

USNM 127583, Santa Rosa Island, (Velero IV), 34°01'05", 120°16'W, 35m, coll. J.L. Barnard, 20 Dec. 1956 - 3 spec.

USNM 291408, Pac. Biol. Lab. 100865 Monterey Bay, from rocks brought up from more than 180m, 1928 - 2 specimens.

USNM 291409, Corona del Mar, Hancock sample 46-6, *Laminaria* holdfasts, 9-11 Dec., 1962 - 1 male, 1 female.

USNM 291410, Venice, breakwater, 25 Oct., 1912 - 2 females 6.5 mm, 5 juv.

USNM 291411, Venice, from Bryozoan colonies, 29. 10. 1913 - 1 male, 2 females ov., 2 juv.

USNM 291412, Cable Crossing Structure, San Diego Harbor, coll. T. Bowman, 30 Dec., 1948 - 1 female ov. 7 mm, 1 female 8mm.

USNM 291413, locality?, 152/768 - 6 females 6mm, +20 juv.?

USNM 291404, Corona del Mar, McGinitie coll., 15 July, 1931 - 2 females 6mm, 7 juv.

USNM 291415, Presidential Cruise, 1938, 3-38 - 2 females 6mm.

USNM 291416, Venice, Isthmus, Acc. 236-T43-12, 19 Aug., 1913 - 1 female 6mm.

**MEXICO:**

USNM 142573, Sinaloa, Topolobampo, 1 mile seawards, tunicates and sponges, on rocks at 1 m - 1 male, 1 female ov., 2 juv.

**Diagnosis:** Length 6-8mm; peduncle art1 subequal to art2; Cx 1 anterodistally rounded; Gn2 propodus subrectangular, with parallel anterior and posterior margins, in both sexes palm oblique, in male, with 2 subquadrate humps and 2 subquadrate excavations, defined by shorter defining tooth; in Gn2 female the proximal excavation can be similar to male in hyperadults, but normally small or lacking, the distal one wanting, the defining tooth scarcely prominent. U3 rami spines nearly as long as length of rami. Telson with one strong spine (about 2/3 length of T) and 1( rarely 2) shorter ones on disto-exterior margin of each lobe.

**Redescription:**

Acc. flag. 10 arts., ca half of flagellum length; peduncle art1 = art2; Md palp art1 distally obliquely lengthened; art 3 < art2, both arts. densely setose.

Cx 1 anterodistally rounded; Gn1 carpus not notched anteriorly; Gn2 (Male) basis swollen, l:b=ca2, propodus subrectangular, with parallel anterior and posterior margins, Gn2 in both sexes palm oblique, in male with 2 subquadrate humps and 2 subquadrate excavations, well defined by prominent defining tooth; in Gn2 female ov. hyperadults, the proximal excavation is present, but smaller than in male, the distal one less visible, usually wanting; Gn2, outer margin of dactyl with many setae.

P3-7 dactyls bifid, basis P5-7 with short posterodistal lobe, subrectangularly widened, l:b = 2; dactyls slender, about half of propodus length.

U3 rami distally truncate, spines nearly as long as length of rami; art2 on outer ramus present. T deeply cleft, distally incised, with one strong spine sitting in excavation (about 2/3 length of T) and 1( rarely 2) shorter ones on distoexterior margin of each lobe.

Colour: dull, bluish green with violet antennae. Females carrying green eggs.

**Distribution:** British Columbia to Mexico.

**Ecology:** kelp holdfast from deep water (Stout 1913);



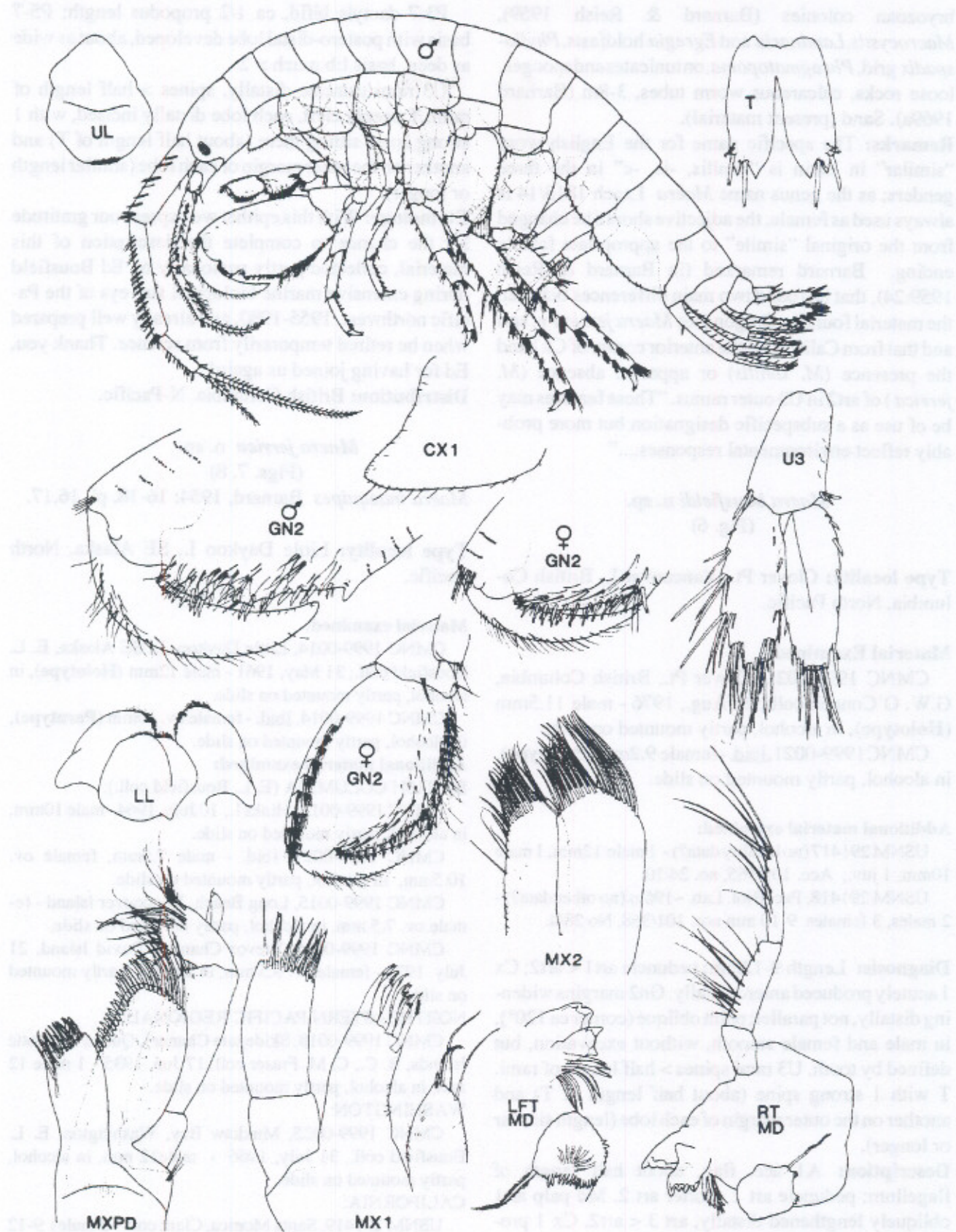


Fig. 7. *Maera jerrica* n. sp. Male 12mm, Little Daykoo I., SE Alaska.



bryozoan colonies (Barnard & Reish 1959), *Macrocytis*, *Laminaria* and *Egregia* holdfasts, *Phyllospadix* grid, *Phragmatopoma*, ontunicates and sponges, loose rocks, calcareous worm tubes, 3-8m (Barnard 1969a). Sand (present material).

**Remarks:** The specific name for the English word "similar" in Latin is "similis, -is, -e" in the three genders; as the genus name *Maera* Leach 1813/14 is always used as female, the adjective should be changed from the original "simile" to the appropriate female ending. Barnard remarked (in Barnard & Reish 1959:24), that he found two main differences between the material found in Oregon (see *Maera jerrica* n. sp.) and that from California: the anterior corner of Cx1 and the presence (*M. similis*) or apparent absence (*M. jerrica*) of art2 in U3 outer ramus. "These features may be of use as a subspecific designation but more probably reflect environmental responses...."

*Maera bousfieldi* n. sp.

(Fig. 6)

**Type locality:** Clover Pt., Vancouver I., British Columbia, North Pacific.

**Material Examined:**

CMNC 1999-0021, Clover Pt., British Columbia, G.W. O'Connell coll., 25 Aug., 1976 - male 11.5mm (**Holotype**), in alcohol, partly mounted on slide.

CMNC 1999-0021, *Ibid.* - female 9.2mm (**Paratype**), in alcohol, partly mounted on slide.

**Additional material examined:**

USNM 291417 (no locality data?) - 1 male 12mm, 1 male 10mm, 1 juv., Acc. 101/365, no. 24/10.

USNM 291418, Pac. Biol. Lab. ~196m (no other data?) - 2 males, 3 females 9-10 mm acc. 101/368, No 28/4.

**Diagnosis:** Length 9-12mm; peduncle art1 < art2; Cx1 acutely produced anterodistally. Gn2 margins widening distally, not parallel; palm oblique (corner ca 120°), in male and female smooth, without excavation, but defined by tooth. U3 rami spines > half length of rami. T with 1 strong spine (about half length of T) and another on the outer margin of each lobe (length similar or longer).

**Description:** A1 acc. flag. about half length of flagellum; peduncle art 1 shorter art 2. Md palp art1 obliquely lengthened distally, art 3 < art2. Cx 1 produced to acute corner anterodistally.

Gn2 palm oblique (corner ca 120°), in male and female smooth until prominent defining tooth.

P3-7 dactyls bifid, ca 1/2 propodus length; P5-7 basis with postero-distal lobe developed, about as wide as deep, basis l:b much > 2.

U3 rami truncate distally, spines > half length of rami. T deeply cleft, each lobe distally incised, with 1 strong spine sitting there (about half length of T) and another on the outer margin of each lobe (similar length or longer).

**Etymology:** With this epithet we express our gratitude for the chance to complete the description of this material, collected partly personally by Ed Bousfield during extensive marine biological surveys of the Pacific northwest, 1955-1980, and already well prepared when he retired temporarily from science. Thank you, Ed for having joined us again!

**Distribution:** British Columbia, N-Pacific.

*Maera jerrica* n. sp.

(Figs. 7, 8)

*Maera inaequipis* Barnard, 1954: 16-18, pl. 16,17.

**Type locality:** Little Daykoo I., SE Alaska, North Pacific.

**Material examined:**

CMNC 1999-0014, Little Daykoo I., SE Alaska, E. L. Bousfield coll., 31 May, 1961 - male 12mm (**Holotype**), in alcohol, partly mounted on slide.

CMNC 1999-0014, *Ibid.* - female ov. 10mm (**Paratype**), in alcohol, partly mounted on slide.

**Additional material examined:**

BRITISH COLUMBIA (E. L. Bousfield coll.):

CMNC 1999-0013, Hinks I., 10 July, 1964 - male 10mm, in alcohol, partly mounted on slide.

CMNC 1999-0027, *Ibid.* - male 7.5mm, female ov. 10.5mm, in alcohol, partly mounted on slide.

CMNC 1999-0015, Long Beach, Vancouver Island - female ov. 7.5 mm, in alcohol, partly mounted on slide.

CMNC 1999-0026, Trevor Channel, David Island, 21 July, 1970 - female ov. 9.5 mm, in alcohol, partly mounted on slide.

**NORTHEASTERN PACIFIC REGIONAL:**

CMNC 1999-0018, Skidegate Channel, Queen Charlotte Islands, B. C., C. M. Fraser coll., 17 Jun. 1935 - 1 male 12 mm, in alcohol, partly mounted on slide.

**WASHINGTON:**

CMNC 1999-0025, Mukkaw Bay, Washington, E. L. Bousfield coll., 31 July, 1966 - male 12 mm, in alcohol, partly mounted on slide.

**CALIFORNIA:**

USNM 291419, Santa Monica, Clark coll. - 5 males 9-12 mm, 1 female ov. 12 mm, 2 males, 1 female 10mm.

USNM 291420, locality?, acc. Nr. 154967 - 1 male 9 mm, 1 female ov. 12mm.



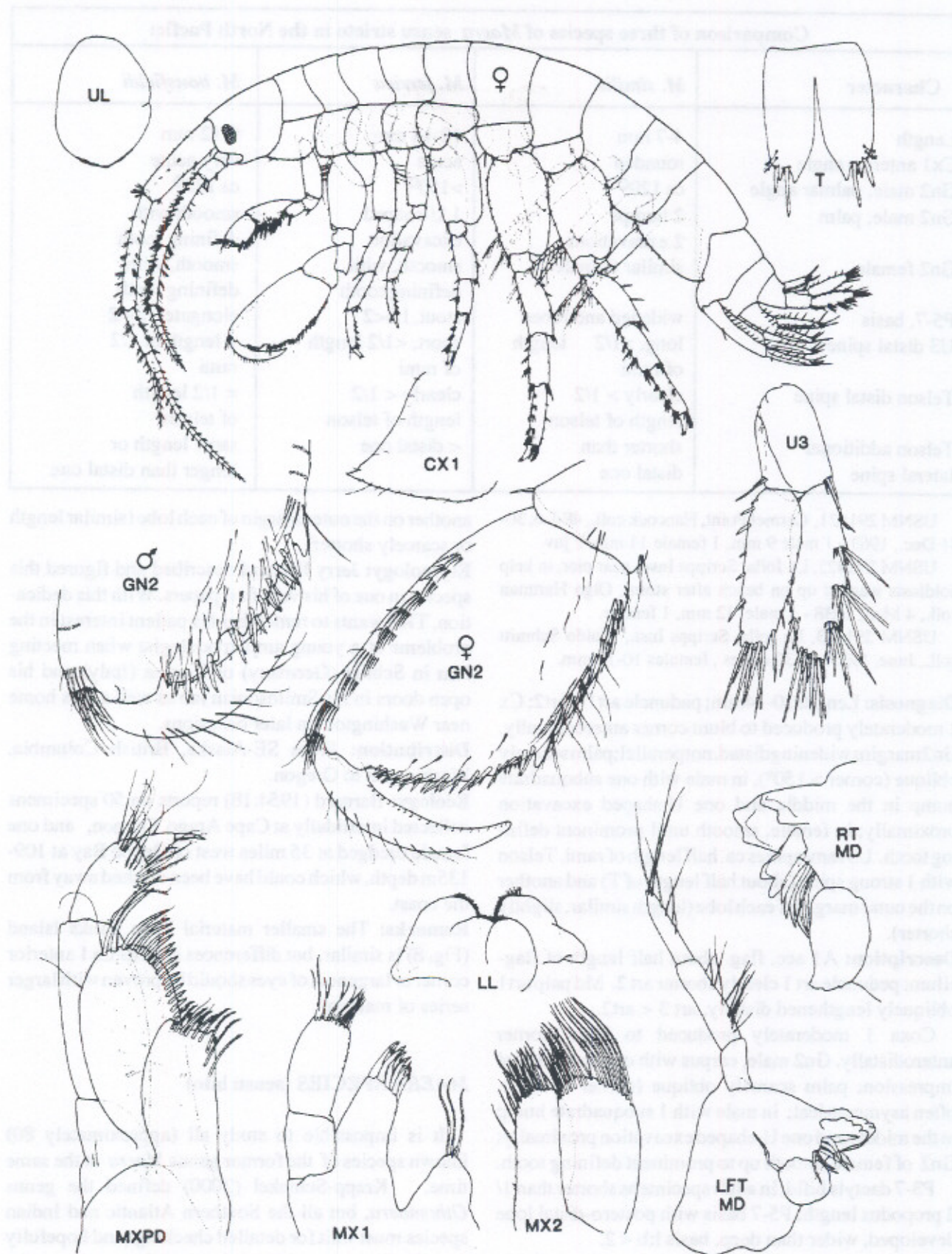


Fig. 8. *Maera cf. jerrica* n. sp. Male 8-9mm, Hinks I., B.C.



Comparison of three species of *Maera* sensu stricto in the North Pacific:

Character	<i>M. similis</i>	<i>M. jerrica</i>	<i>M. bousfieldi</i>
Length	4-7 mm	10-14 mm	9-12 mm
Cx1 anterior angle	rounded	acute	very acute
Gn2 male, palmar angle	ca 120°	>150°	ca 120°
Gn2 male, palm	2 humps	1 U-shaped excavation	smooth with defining tooth
Gn2 female	2 excavations similar to male	smooth, with defining tooth	smooth, with defining tooth
P5-7, basis	widened and lobed	stout, l:b<2	elongate, l:b<2
U3 distal spines	long, >1/2 length of rami	short, <1/2 length of rami	> length of 1/2 rami
Telson distal spine	clearly > 1/2 length of telson	clearly < 1/2 length of telson	= 1/2 length of telson
Telson additional lateral spine	shorter than distal one	< distal one	same length or longer than distal one

USNM 291421, Carmel Point, Hancock coll., 48-1-6, 30-31 Dec., 1963 - 1 male 9 mm, 1 female 11 mm, 2 juv.

USNM 291422, La Jolla, Scripps Inst., near pier, in kelp holdfasts washed up on beach after storm, Olga Hartman coll., 4 Mar., 1938 - 1 male 12 mm, 1 female.

USNM 291423, La Jolla, Scripps Inst., Waldo Schmitt coll., June, 1935 - + 30 males, females 10-12 mm.

**Diagnosis:** Length 10-14mm; peduncle art1 < art2; Cx 1 moderately produced to blunt corner anterodistally. Gn2 margins widening distad, not parallel; palm scarcely oblique (corner > 150°), in male with one subquadrate hump in the middle and one U-shaped excavation proximally; in female, smooth until prominent defining tooth. U3 rami spines ca. half length of rami. Telson with 1 strong spine (about half length of T) and another on the outer margin of each lobe (length similar, slightly shorter).

**Description:** A1 acc. flag. about half length of flagellum; peduncle art 1 clearly shorter art 2. Md palp art 1 obliquely lengthened distally, art 3 < art 2.

Coxa 1 moderately produced to blunt corner anterodistally. Gn2 male, carpus with one deep dorsal impression; palm scarcely oblique (corner > 150°), often asymmetrical; in male with 1 subquadrate hump in the middle and one U-shaped excavation proximally; Gn2 of female smooth up to prominent defining tooth.

P3-7 dactyls bifid, in adult specimens shorter than 1/2 propodus length; P5-7 basis with postero-distal lobe developed, wider than deep, basis l:b < 2.

U3 rami truncate distally, spines ca half length of rami. T deeply cleft, each lobe distally incised, with 1 strong spine sitting there (about half length of T) and

another on the outer margin of each lobe (similar length or scarcely shorter).

**Etymology:** Jerry Barnard described and figured this species in one of his very first papers. With this dedication, TKS wants to remember his patient interest in the problems of a young amphipodologist when meeting him in Schlitz (Germany) or Verona (Italy) and his open doors in his Smithsonian lab as well as his home near Washington on later occasions.

**Distribution:** From SE-Alaska, British Columbia, Washington to Oregon.

**Ecology:** Barnard (1954:18) reports on 50 specimens collected intertidally at Cape Arago, Oregon, and one female dredged at 35 miles west of Depoe Bay at 109-135m depth, which could have been washed away from the coast.

**Remarks:** The smaller material from Hinks Island (Fig. 8) is similar, but differences such as Cx1 anterior corner or largeness of eyes should be proven with larger series of material.

#### MAERA SPECIES (sensu lato)

It is impossible to study all (approximately 80) known species of the former genus *Maera* at the same time. Krapp-Schickel (2000) defined the genus *Othomaera*, but all the Southern Atlantic and Indian species must wait for detailed checking (and hopefully grouping). It may seem very unsatisfactory, but at the moment there seems no other solution than to leave them in the mixed pool of "*Maera* sensu lato".



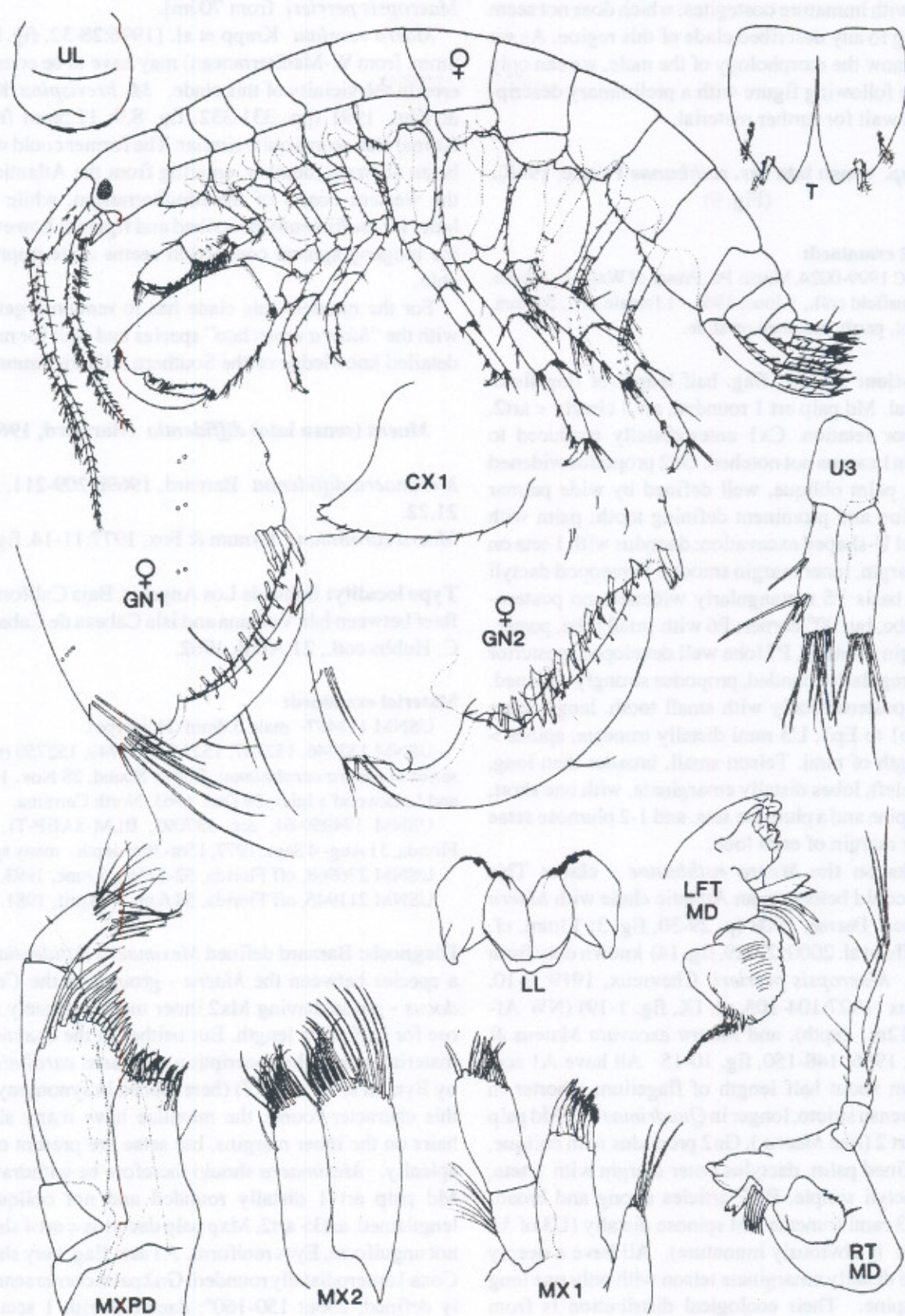


Fig. 9. *Maera* sp. (sensu lato) (nr. *rathbunae* Pearse). Female 5 mm, Marsh Pt., SE Alaska.



female with immature oostegites, which does not seem to belong to any described clade of this region. As we do not know the morphology of the male, we can only offer the following figure with a preliminary description and wait for further material.

***Maera* sp. sensu lato (nr. *rathbunae* Pearse, 1908). (Fig. 9)**

**Material examined:**

CMNC 1999-0024, Marsh Pt., Prince of Wales I., Alaska, E. L. Bousfield coll., 1 June, 1961 - 1 female juv., 5.0 mm, in alcohol, partly mounted on slide.

**Description:** A1 acc. flag. half length of flagellum. Eyes oval. Md palp art 1 rounded, art 3 clearly < art2, very poor setation. Cx1 anterodistally produced to tooth. Gn1 carpus not notched. Gn2 propodus widened distally, palm oblique, well defined by wide palmar excavation and prominent defining tooth; palm with proximal U-shaped excavation; dactylus with 1 seta on outer margin, inner margin smooth. Peraeopod dactyli simple, basis P5 rectangularly widened, no posterodistal lobe, but 90° corner; P6 with small lobe, posterior margin rounded, P7 lobe well developed, posterior margin regularly rounded, propodus strongly widened. Ep 1-3 posterodistally with small tooth, lengthening from Ep1 to Ep3; U3 rami distally truncate, spines > half length of rami. Telson small, broader than long, deeply cleft, lobes distally emarginate, with one short, robust spine and a plumose seta, and 1-2 plumose setae on outer margin of each lobe.

**Remarks on the *Maera rathbunae* - clade:** This species could belong to an Atlantic clade with *Maera rathbunae* Pearse, 1908 (p. 29-30, fig. 3; 13mm, cf. also Ruffo et al. 2000: 27-29, fig. 14) known only from Florida. *Maeropsis perrieri* Chevreux, 1919: 9-10, Chevreux (1927: 104-105, pl. IX, fig. 1-19) (NW Africa, 9-12m depth), and *Maera excavata* Mateus & Mateus, 1986: 148-150, fig. 10-15. All have A1 acc. flagellum about half length of flagellum (shorter in *Maera* sensu stricto, longer in *Quadrimeaera*), Md palp art 3 < art 2 (like *Maera*), Gn2 propodus with oblique, well defined palm, dactylus outer margin with 1 seta, P3-7 dactyli simple, P5-7 articles strong and broadened, U3 rami truncate and spinose distally (U3 of *M. excavata* is obviously immature). All have a deeply cleft and distally emarginate telson with only one long apical spine. Their ecological distribution is from greater depth and not intertidal [*M. rathbunae* was described from 175-220m (in Ruffo et al. 2000, depth is erroneously measured in feet and not fathoms);

*Maeropsis perrieri* from 700m].

*Maera revelata* Krapp et al. (1996:28-32, fig. 1-3; 8mm, from W-Mediterranean) may have to be considered in the vicinity of this clade. *M. brevispina* Kim & Kim, 1991 (pp. 331-332, fig. 8,9; 12.5mm from Korea) also seems quite similar. The former could well be an aberrant member, entering from the Atlantic to the western coasts of the Mediterranean, while the latter is insufficiently described and figured; however, the biogeographical connection seems quite improbable.

For the moment this clade has to remain together with the "*Maera* sensu lato" species and wait for more detailed knowledge of the Southern Atlantic fauna.

***Maera* (sensu lato) *diffidentia* (Barnard, 1969)**

*Meximaera diffidentia* Barnard, 1969b:209-211, fig. 21,22.

*Maera caroliniana* Bynum & Fox, 1977:11-14, fig. 7.

**Type locality:** Bahia de Los Angeles, Baja California, Reef between Isla Ventana and Isla Cabeza de Caballo, C. Hubbs coll., 21 April, 1962.

**Material examined:**

USNM 111497- male 5.8mm (Holotype).

USNM 152746, 152747, 152748, 152749, 152750 (type series of *Maera caroliniana*), Bogue Sound, 28 Nov. 1966 and Lockwood's Inlet, 29 Dec. 1963, North Carolina.

USNM 174959-61, acc. 337093, BLM-SABP-TI, off Florida, 31 Aug- 4 Sept., 1977, 15m-26m depth - many spec.

USNM 276968, off Florida, 52-125m, 5 June, 1983.

USNM 211945, off Florida, 58.6 m, 24 April, 1981.

**Diagnosis:** Barnard defined *Meximaera diffidentia* as a species between the *Maera* - group and the *Ceradocus* - group, having Mx2 inner margin densely setose for half of its length. But neither in the examined material, nor in the description of *Maera caroliniana* by Bynum & Fox (1977) (here placed in synonymy) is this character found: the maxillae have many short hairs on the inner margins, but setae are present only apically. *Meximaera* should therefore be withdrawn. Md palp art 1 distally rounded and not obliquely lengthened, art3 > art2. Mxp palp dactylus = art 4 short, not unguiform. Eyes reniform. A1 acc. flag. very short. Coxa 1 anterodistally rounded. Gn2 palm corners scarcely defined, about 150-160°; dactylus with 1 seta on outer margin. Peraeopod dactyli simple. U3 distally truncate, clearly visible art2 on outer ramus. Telson deeply cleft, with 2-3 spines on outer margins, distally



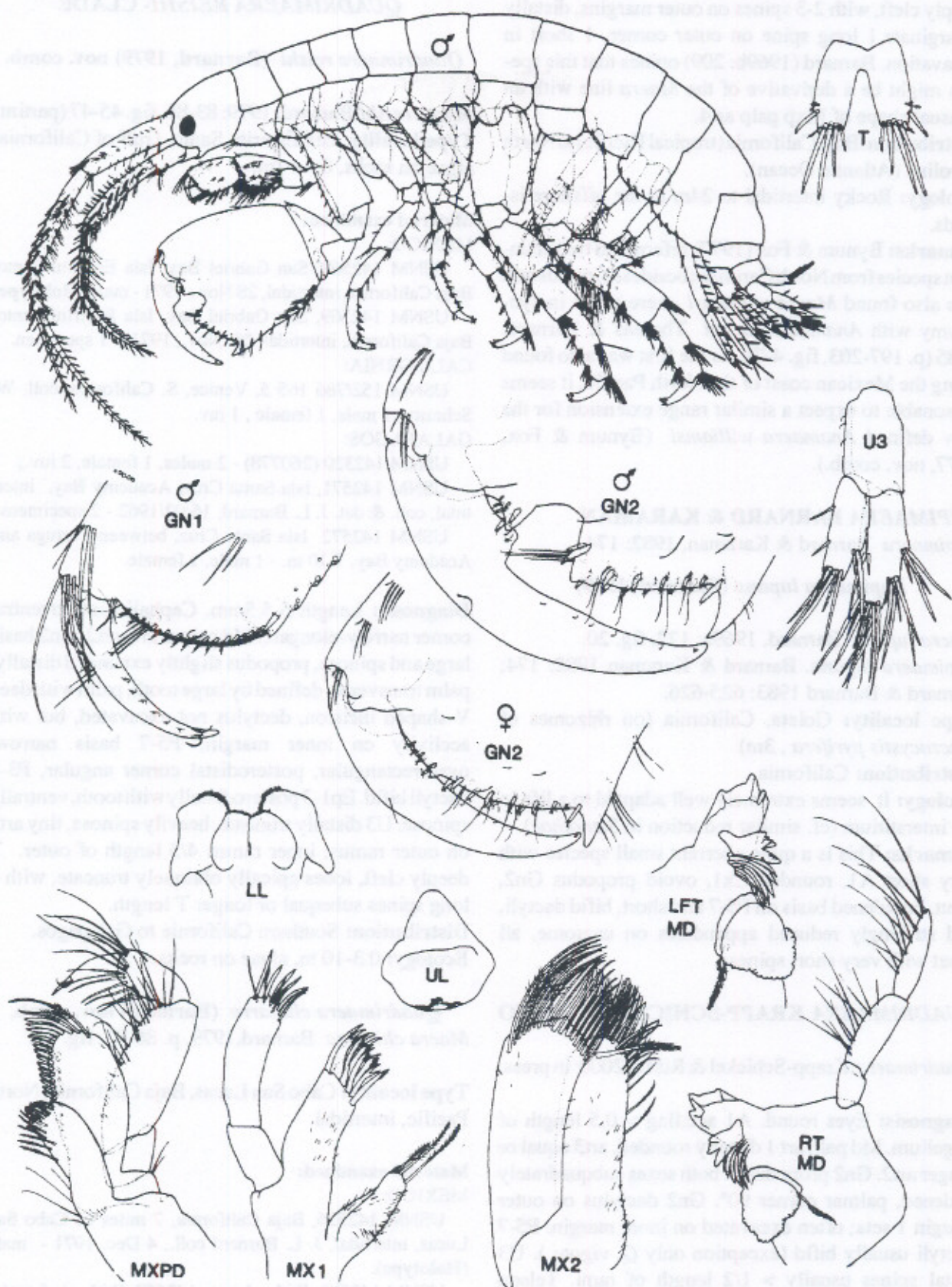


Fig. 10. *Quadrimaera carla* n. sp. Female 6.5mm, Queen Charlotte Is., Houston Stewart Channel, B.C.



deeply cleft, with 2-3 spines on outer margins, distally emarginate, 1 long spine on outer corner, 1 short in excavation. Barnard (1969b: 209) opines that this species might be a derivative of the *Maera* line with an unusual shape of Mxp palp art4.

**Distribution:** Baja California (tropical Pacific) to North Carolina (Atlantic Ocean).

**Ecology:** Rocky intertidal to 24m in the offshore islands.

**Remarks:** Bynum & Fox (1977) referred to two abundant species from North Carolina; besides *M. diffidentia* was also found *Maera williamsi*, here given in synonymy with *Anamaera hixonii* Thomas & Barnard, 1985 (p. 197-203, fig. 4-7). As the first was also found along the Mexican coast of the North Pacific, it seems reasonable to expect a similar range extension for the now defined *Anamaera williamsi* (Bynum & Fox, 1977, nov. comb.).

#### LUPIMAERA BARNARD & KARAMAN

*Lupimaera* Barnard & Karaman, 1982: 174

##### *Lupimaera lupana* (Barnard, 1969)

*Maera lupana* Barnard, 1969a: 122, fig. 20.

*Lupimaera lupana*. Barnard & Karaman 1982: 174; Barnard & Barnard 1983: 625-626.

**Type locality:** Goleta, California (on rhizomes of *Macrocystis pyrifera*, 3m)

**Distribution:** California.

**Ecology:** It seems extremely well adapted to a life in the interstitium (cf. similar reduction in *Stenothoe*).

**Remarks:** This is a quite aberrant small species with very short A1, rounded Cx1, ovoid propodus Gn2, stout, broadened basis on P5-7 and short, bifid dactyli, and strikingly reduced appendices on urosome, all beset with very short spines.

#### QUADRIMAERA KRAPP-SCHICKEL & RUFFO

*Quadrimaera* Krapp-Schickel & Ruffo, 2000: in press.

**Diagnosis:** Eyes round. A1 acc.flag > 0.5 length of flagellum. Md palp art 1 distally rounded, art3 equal or longer art2. Gn2 propodus in both sexes subquadrately widened, palmar corner 90°. Gn2 dactylus on outer margin 1 seta; often excavated on inner margin. P5-7 dactyli usually bifid (exception only *Q. vigota*). U3 distal spines usually > 1/2 length of rami. Telson distally incised, spinose.

For key to species see Krapp-Schickel & Ruffo (2000).

#### QUADRIMAERA REISHI- CLADE

##### *Quadrimaera reishi* (Barnard, 1979) nov. comb.

*Maera reishi* Barnard, 1979: 83-86, fig. 45-47 (partim)

**Type locality:** Isla Espiritu Santo, Gulf of California, algae on rocks, 0.3 - 1m.

##### Material examined:

###### MEXICO:

USNM 142568, San Gabriel Bay, Isla Espiritu Santo, Baja California, intertidal, 28 Nov., 1971 - male (**Holotype**)

USNM 142569, San Gabriel Bay, Isla Espiritu Santo, Baja California, intertidal, 28. Nov., 1971 - 1 specimen.

###### CALIFORNIA:

USNM 152/786 165 5, Venice, S. California, coll. W. Schmitt - 1 male, 1 female, 1 iuv.

###### GALAPAGOS:

USNM 142320 (260778) - 2 males, 1 female, 2 iuv.;

USNM 142571, Isla Santa Cruz, Academy Bay, intertidal, coll. & det. J. L. Barnard, 16/02/1962 - 2 specimens.

USNM 142572 Isla Santa Cruz, between Tortuga and Academy Bay, 7-10 m. - 1 male, 1 female.

**Diagnosis:** Length 5-5.5mm. Cephalic anteroventral corner narrow-elongate. Md palp art3 > art2. Gn2 basis large and spinose, propodus slightly expanded distally, palm transverse, defined by large tooth, palm with deo V-shaped incision, dactylus not excavated, but with acclivity on inner margin, P5-7 basis narrow, ovato-rectangular, posterodistal corner angular, P3-7 dactyli bifid. Ep1-3 posterodistally with tooth, ventrally spinose. U3 distally truncate, heavily spinose, tiny art2 on outer ramus; inner ramus 4/5 length of outer. T deeply cleft, lobes apically obliquely truncate, with 4 long spines subequal or longer T length.

**Distribution:** Southern California to Galapagos.

**Ecology:** 0.3-10 m, algae on rocks.

##### *Quadrimaera chinarra* (Barnard) nov. comb.

*Maera chinarra* Barnard, 1979, p. 86-87, fig. 29.

**Type locality:** Cabo San Lucas, Baja California, North Pacific, intertidal.

##### Material examined:

###### MEXICO:

USNM 142556, Baja California, 7 miles E. Cabo San Lucas, intertidal, J. L. Barnard coll., 4 Dec. 1971 - male (**Holotype**).

USNM 142560, *Ibid.* - 1 juv., 142557, *Ibid.* - 1 female; 142558, *Ibid.* - 1 spec.; 142561, *Ibid.* - 1 male; 142562, *Ibid.* - 3 spec.; 142563, *Ibid.* - 2 spec.; 142564, *Ibid.* - 4 spec.; 142559, *Ibid.* - 1 female.



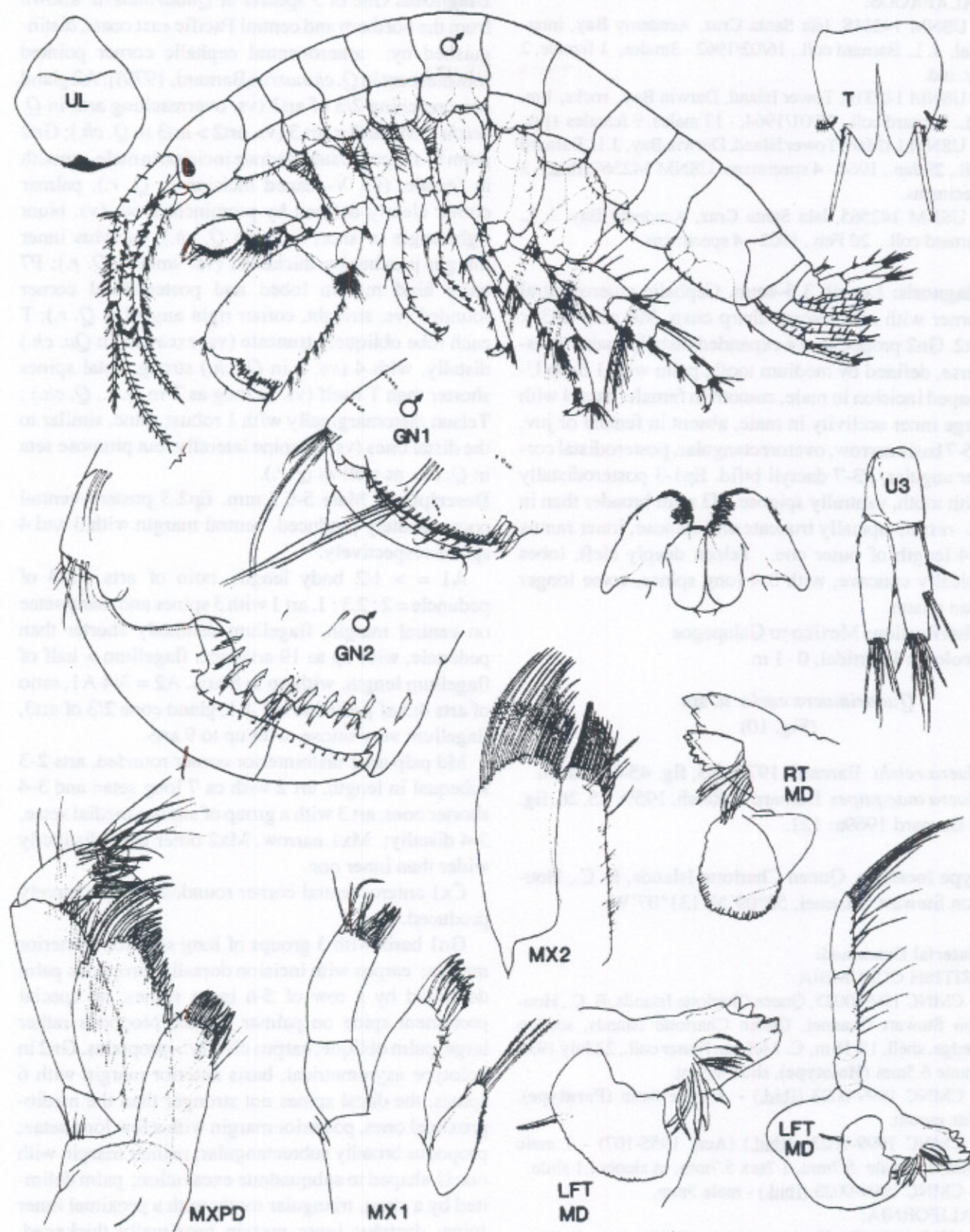


Fig. 11. *?Quadrimeaera vigota* (Barnard, nov comb.). Male 8.5mm, Marsh Pt., SE Alaska.



## GALAPAGOS:

USNM 142318, Isla Santa Cruz, Academy Bay, intertidal, J. L. Barnard coll., 16/02/1962 - 3 males, 1 female, 2 juv. ind.

USNM 142319, Tower Island, Darwin Bay, rocks, 1 m, J. L. Barnard coll., 27/01/1964, - 12 males, 9 females + juv.

USNM 142566, Tower Island, Darwin Bay, J. L. Barnard coll., 29 Jan., 1964 - 4 specimens; USNM 142567, *Ibid.* - 3 specimens.

USNM 142565, Isla Santa Cruz, Academy Bay, J. L. Barnard coll., 20 Feb., 1962 - 4 specimens.

**Diagnosis:** Length 3.5-4 mm. Cephalic anteroventral corner with obsolescent sharp cusp. Md palp art3 < art2. Gn2 propodus not expanded distally, palm transverse, defined by medium tooth, palm with 1 deep U-shaped incision in male, smooth in female, dactyl with large inner acclivity in male, absent in female or juv. P5-7 basis narrow, ovato-rectangular, posterodistal corner angular. P3-7 dactyli bifid. Ep1-3 posterodistally with tooth, ventrally spinose. U3 rami broader than in *Q. reishi*, apically truncate and spinose, inner ramus 3/4 length of outer one. Telson deeply cleft, lobes apically concave, with 3-4 long spines, some longer than telson.

**Distribution:** Mexico to Galapagos

**Ecology:** Intertidal, 0 - 1 m.

*Quadrimaera carla* n. sp.

(Fig. 10)

*Maera reishi* Barnard, 1979: 83, fig. 45-46 partim

*Maera inaequipes* Barnard & Reish, 1959: 25, 26, fig. 5; Barnard 1969a: 121.

**Type locality:** Queen Charlotte Islands, B. C., Houston Stewart Channel, 52°09'N, 131°07'W.

**Material Examined:**

## BRITISH COLUMBIA:

CMNC 1999-0023, Queen Charlotte Islands, B. C., Houston Stewart Channel, Queen Charlotte Islands, scallop dredge, shell, 15-18 m, C. McLean Fraser coll., 22 July 1935 - male 6.5 mm (**Holotype**), slide mount.

CMNC 1999-0023 (*Ibid.*) - female 6 mm (**Paratype**), slide mount.

CMNC 1999-0023 (*Ibid.*) (Acq. 1955-107) - 1 male 6 mm, 1 female 5.7 mm, 1 ?sex 5.7 mm, in alcohol, 1 slide.

CMNC 1999-0023 (*Ibid.*) - male 5 mm.

## CALIFORNIA:

USNM 291424, Venice, southern California, coll. W. L. Schmitt coll. - 2 males, 4 females, 3 juv.

USNM 291424, *Ibid.*, A. Hancock sample 1042-40 (sub *M. inaequipes* det. Barnard) - 3 males, 3 females.

**Diagnosis.** One of 3 species of *Quadrimaera* known from the northern and central Pacific east coast, distinguished by: anteroventral cephalic corner pointed [obsolescent in *Q. chinarra* (Barnard, 1979)]; A2 gland cone reaching 2/3 of art3 (vs. overreaching art3 in *Q. reishi*); Md art2 = art3 (vs. art2 > art3 in *Q. ch.*); Gn2 palm U-shaped to subquadrate incision in male, smooth in female, (vs. V-shaped incision in *Q. r.*), palmar corner clearly defined by prominent tooth (vs. blunt right angle or short tooth in *Q. ch.*), dactylus inner margin proximally thickened (vs. smooth *Q. r.*); P7 basis hind margin lobed and posterodistal corner rounded (vs. straight, corner right angled at *Q. r.*); T each lobe obliquely truncate (vs. excavate in *Qu. ch.*) distally, with 4 (vs. 3 in *Q. ch.*) strong distal spines shorter than T itself (vs. as long as T in *Q. r.*, *Q. ch.*); Telson distomarginally with 1 robust spine, similar to the distal ones (vs. no spine laterally, but plumose seta in *Q. ch.* as well as *Q. r.*).

**Description:** Male 5-6.5 mm. Ep2-3 postero-ventral corner acutely produced, ventral margin with 3 and 4 spines respectively.

A1 = > 1/2 body length, ratio of arts 1:2:3 of peduncle = 2:2.3:1, art 1 with 3 spines and many setae on ventral margin, flagellum distinctly shorter than peduncle, with up to 19 arts, acc. flagellum > half of flagellum length, with up to 8 arts. A2 = 3/4 A1, ratio of arts 4:5 of peduncle = 1.4:1, gland cone 2/3 of art3, flagellum very setose, with up to 9 arts.

Md palp art 1 distointerior corner rounded, arts 2-3 subequal in length, art 2 with ca 7 long setae and 3-4 shorter ones, art 3 with a group of shorter medial setae, 3-4 distally; Mx1 narrow, Mx2 outer plate distinctly wider than inner one.

Cx1 antero-ventral corner rounded, not or scarcely produced.

Gn1 basis with 3 groups of long setae on posterior margin; carpus with incision dorsally; propodus palm delimited by a row of 5-6 inner spines, no special prominent spine on palmar corner; propodus rather large, palm oblique; carpus clearly > propodus. Gn2 in holotype asymmetrical, basis anterior margin with 6 spines, the distal spines not stronger than the medio-proximal ones, posterior margin with a few long setae; propodus broadly subrectangular, palmar margin with one U-shaped to subquadrate excavation; palm delimited by a short, triangular tooth, with a proximal inner spine; dactylus inner margin proximally thickened, with a right angle near proximal end of palmar excavation.

P3-7 dactylus with bifid nail. P3-4 similar in shape,



**Differences in 3 sibling *Quadrinemaera* species (*Q. reishi* - clade)  
of Northern and central Pacific East-coast.**

	<i>Q. reishi</i>	<i>Q. chinarra</i>	<i>Q. carla</i>
<b>Length</b>	4.5-5.5mm	3.5-4mm	5.5-6.5mm
<b>Anteroventral cephalic corner</b>	acute	obsolescent	acute
<b>A2 gland cone</b>	overreaching art3	1/2 art3	reaching 2/3 of art3
<b>Md palp</b>	art2=3	art2>3	art2=3
<b>Gn2 palmar corner</b>	prominent acute tooth	tooth lacking or short, not much prominent	prominent triangular tooth
<b>Gn2 palm</b>	narrow V-inc.	wide U-incision	wide U-incision
<b>Gn2 dactyl inner margin</b>	smooth	proximally thickened	proximally thickened
<b>P7 basis posterior margin</b>	straight	broadened	rounded
<b>P7 basis postero-distal corner</b>	right angle	short lobe	round lobe
<b>Telson distally</b>	without tooth on corners	truncate with tooth on inner and outer corner	excavated, with tooth on outer end, obliquely truncate
<b>T distomarginally</b>	1-2 plumose setae	2 plumose setae	1 robust seta, some times 1 plumose seta

basis with 2 long setae and some short spines on posterior margin, and with a row of short spines on anterior margin. P5 basis narrowly ovato-rectangular, with marked posterodistal rounded lobe, posterior margin feebly convex, nearly smooth, with few short setae, propodus without setae on posterior margin. P6 basis similar in shape to P5, but wider, posterior margin scarcely convex, in P7 basis clearly widened and regularly rounded on posterior margin; postero-distal corner of merus P5-7 with short setae, not reaching 1/2 carpal length; P6,7 propodus posterior margin with a medial tuft of setae not reaching end of propodus.

U3 stout, rami broad and flat, distally truncated, with numerous spines, inner ramus clearly shorter than outer, art 2 of outer ramus rudimentary, barely visible in between the spines. Telson about as broad as long, lobes not distally incised, but truncate, with acutely produced distoexterior corner, and 4 distal spines in-

creasing in length from inner to outer side, the longest still shorter than telson, distolaterally with 1 strong spine of the same structure like the distal ones, and 2 short subdistal simple setae.

Female (ov.) 6 mm. Similar to male. Gn2 shorter than in male, excavation of the palmar margin absent. Oostegites very slim.

**Etymology:** We wish to honour the late "Babs" Carl (Josephine F.L. Hart, wife of G.C. Carl, former director of the Royal British Columbia Museum), who contributed enormously to knowledge of malacostracan crustaceans of the Pacific coast of Canada. The specific name reminds also of the type locality in the Queen Charlotte Islands, the French diminutive of the Latin name Carla.

**Distribution:** It seems that this new species has the northernmost distribution within this genus. The type comes from British Columbia and additional material



from Californian coasts, while *Quadrimaera reishi* reaches from the Galapagos to southern California, and *Q. chinarra* is known from Baja California, the Californian Gulf and the Galapagos Islands.

**Ecology:** Depth range 27-33m. Sand, shell fragments, on pilings (Barnard & Reish 1959, see remarks). In *Amaroucium* sp., in *Macrocystis* holdfasts at 3m, in tunicate and polychaete tubes, with *Spheciospongia* sp., *Phragmatopoma* and *Phyllospadix* - coralline (Barnard 1969a: 121,122).

**Remarks:** *Maera reishi* Barnard, 1979 (p. 83 partim discussion on Californian material) could well be this species: the type material of *reishi* shows an extremely narrow V-shaped excavation like in fig. 46 G2, while "vG2o" could be the present new species. Also *Maera inaequipes* Barnard & Reish, 1959 (p. 25, 26, fig. 5 concerning Newport, California) matches the present description well. *Maera reishi* Berents, 1983 (p. 129 fig. 23 nec *reishi* Barnard, 1979) from Australia seems quite similar to the present new species, but Gn2 of the male is also excavated similarly (but smooth in the new species) and the telson has a prominent tooth on disto-interior corner. The taxonomic status of this material should be checked in more detail.

*? Quadrimaera vigota* (Barnard), nov. comb.  
(Fig. 11)

*Maera vigota* Barnard, 1969a: 125-125, fig. 21.

**Type locality:** Cayucos, central California, 5-6 January 1962, J. L. Barnard coll., on cobbles buried under small boulders.

**Material examined:**

CMNC Collections, Marsh Pt., SE Alaska - 1 male 8.5mm.  
USNM 128433 Type-series, type locality and date - 1 female ov. 7.5mm, 1 male 7mm, 2 juv., male 6mm, 4 juv.

USNM 291426 Carmel Point, central California, Allan Hancock foundation Sta. 48-H-4, 30-31 Dec., 1963 - 1 female ov. 7.5mm.

**Diagnosis:** A1 acc. flag. > 0.5 flagellum like other *Quadrimaera*, but eyes reniform. Md palp art 1 distally rounded, art2 = art3. Upper lip thickened ("Lingui-maera"-like). Basis of Gn1,2, P3,4 posteriorly unusually densely setose; Gn1 carpus anteriorly not notched; Gn2 propodi, asymmetrical, otherwise sexually not different; not as subquadrate as typical for genus, but rectangular with parallel anterior and posterior margin; palmar incision not in the middle of the palm, but right at the beginning, near dactylus insertion; dactylus with

1 seta on outer margin. P5-7 dactyli simple (only exception in genus). U3 rami truncate, many distal spines longer than half length of rami; outer ramus with minute art2. Telson, outer margin of lobes subdistally notched, where 1 single strong spine is inserted (length about the same as T length).

Colour: pink.

**Distribution:** Gulf of Alaska to central California.

**Ecology:** Abundant on buried cobbles, on sponges and tunicates; intertidal.

**Remarks:** Our figures match well the one given in Barnard (1969a:125, fig. 21), except for the much stouter and shorter U3 given for the Californian male of 9mm compared with the 8.5mm male from S-Alaska, where U3 rami are clearly longer than double width. But in the Californian type series, determined by Barnard, this U3 shape varies depending on age. Barnard (1970, p. 147-150, fig. 90,91) discusses the allometry in U3 of *Maera kaiulana* Barnard, 1970, another aberrant member of this species-complex which is otherwise very homogeneous in the Pacific region.

**ELASMOPUS COSTA, 1853**

*Elasmopus* Costa, 1853:170, 175 (*Elasmopus rapax* Costa, 1853); Stebbing 1906:441.

**Diagnosis:** Similar to *Maera* sensu stricto, except in the shape of Md palp art3, but the generally stouter and more well pigmented appearance of *Elasmopus* is helpful too. A1,2 moderate to elongate; A1 much > A2, acc. flagellum 1 or more arts. Md palp art 3 strongly falciform, with D and E setae. Inner lobes of lower lip present. Mx1,2 not or weakly setose on inner margins, Mx1 inner plate ovate, Mx2 without oblique row of setae, only few setae medioapically. - Gn1,2 different in size and shape, palms oblique, in Gn2 usually sculptured with specific tooth formulas, dactylus elongate or short, sometimes riding onto inner face of propodus. P5-7 generally short, stout. Uropods 1,2 subequal rami, peduncle U1 with basofacial spine. U3 scarcely extended, magni- to parviramous, at least outer ramus broad, short, strongly spinose; art2 vestigial or lacking. T deeply cleft (but Shoemaker 1933 reported fused mutants), apically spinose, each lobe often apico-medially excavated.

We do not fully treat the more than 60 known species of *Elasmopus* here, but we discuss one species in more detail because it is found unusually far North for the mainly tropical distribution of the genus.



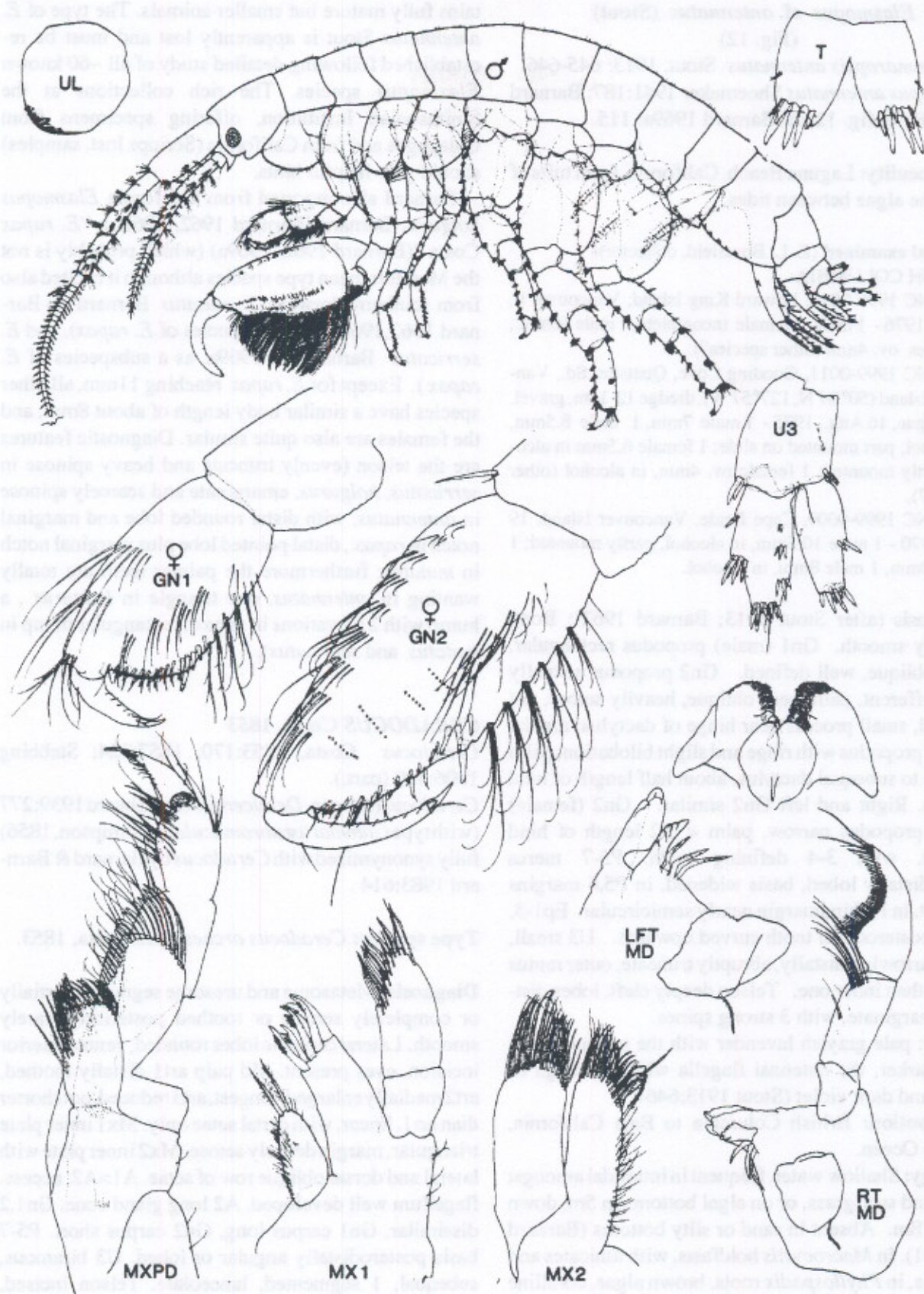


Fig. 12. *Elasmopus* cf. *antennatus* (Stout). Male 8.5mm, Vancouver I., Gooding Cove, B. C.



***Elasmopus cf. antennatus* (Stout)**

(Fig. 12)

*Neogammaropsis antennatus* Stout, 1913: 645-646.*Elasmopus antennatus* Shoemaker 1941:187; Barnard 1962:88-91, fig. 12,13; Barnard 1969a: 115.**Type locality:** Laguna Beach, California, from tufts of coralline algae between tides.**Material examined** (E. L. Bousfield, collector):

BRITISH COLUMBIA:

CMNC 1999-0010, Edward King Island, Vancouver I., 10 Jul., 1976 - 1 male, 1 female incomplete, 1 male 10mm., 3 females ov. 4mm (other species?).

CMNC 1999-0011, Gooding Cove, Quatsino Sd., Vancouver Island (50°24'N, 127°57'W), dredge 12-14m, gravel, sand, algae, 16 Aug., 1975 - 1 male 7mm, 1 male 8.5mm, in alcohol, part mounted on slide; 1 female 6.5mm in alcohol, partly mounted; 1 female ov. 4mm, in alcohol (other species?).

CMNC 1999-0009, Cape Beale, Vancouver Island, 19 July, 1970 - 1 male 10.5mm, in alcohol, partly mounted; 1 male 10mm, 1 male 8mm, in alcohol.

**Diagnosis** (after Stout 1913; Barnard 1962): Body dorsally smooth. Gn1 (male) propodus rectangular, palm oblique, well defined. Gn2 propodus sexually very different, palm very oblique, heavily setose, not defined, small process near hinge of dactylus; medial face of propodus with ridge and slight bilobation; palm shorter to subequal dactylus, about half length of hind margin. Right and left Gn2 similar. Gn2 (female) small, propodus narrow, palm < 1/2 length of hind margin, with 3-4 defining teeth. P5-7 merus anterodistally lobed, basis widened, in P5,6 margins straight, in P7 hindmargin nearly semicircular. Ep1-3, small posterodistal tooth curved upwards. U3 small, rami narrowing distally, abruptly truncate, outer ramus longer than inner one. Telson deeply cleft, lobes distally emarginate, with 3 strong spines.

Colour: pale grayish lavender with the appendages a little darker, the antennal flagella with two rings of white and dark violet (Stout 1913:646).

**Distribution:** British Columbia to Baja California, Pacific Ocean.**Ecology:** Shallow water, frequent in intertidal amongst algae and surf-grass, or on algal bottoms in 5m, down to 10-18m. Absent in sand or silty bottoms (Barnard 1962:91). In *Macrocystis* holdfasts, with tunicates and sponges, in *Phyllospadix* roots, brown algae, coralline algae (Barnard 1969a:115-117).**Remarks:** The material found in British Columbia partly matches the original description, but partly con-tains fully mature but smaller animals. The type of *E. antennatus* Stout is apparently lost and must be re-established following detailed study of all ~60 known *Elasmopus* species. The rich collections at the Smithsonian Institution, offering specimens from Galapagos and from California (Scripps Inst. samples) should give helpful hints.Barnard also reported from California *Elasmopus holgurus* Barnard (Barnard 1962, 1969a), "*E. rapax* Costa" (Barnard 1962, 1969a) (which probably is not the Mediterranean type species although it is cited also from southern Norway), *E. mutatus* Barnard (in Barnard 1962, 1969a, as a subspecies of *E. rapax*), and *E. serricatus* Barnard (in 1969a, as a subspecies of *E. rapax*). Except for *E. rapax* reaching 11mm, all other species have a similar body length of about 8mm, and the females are also quite similar. Diagnostic features are the telson (evenly truncate and heavy spinose in *serricatus*, *holgurus*, emarginate and scarcely spinose in *antennatus*, with distal rounded lobe and marginal notch in *rapax*, distal pointed lobe plus marginal notch in *mutatus*; furthermore the palmar teeth are totally wanting in *antennatus*, one triangle in *holgurus*, a hump with 2 elevations in *rapax*, rectangular hump in *mutatus* and *serricatus*).***CERADOCUS* Costa, 1853***Ceradocus* Costa, 1853:170, 1857:224; Stebbing 1906:430 (part.).*Ceradocus*(subgen. *Denticeradocus*) Sheard 1939:277 (with type *Gammarus rubromaculatus* Stimpson, 1856) fully synonymized with *Ceradocus* by Barnard & Barnard 1983:614.**Type species:** *Ceradocus orchestipes* Costa, 1853.**Diagnosis:** Metasome and urosome segments partially or completely serrate or toothed posteriorly, rarely smooth. Lateral cephalic lobes rounded, ventroanterior incision, eyes present. Md palp art1 distally toothed, art2 medially enlarged, longest, art3 reduced, not shorter than art1, linear, with distal setae only. Mx1 inner plate triangular, margin densely setose. Mx2 inner plate with lateral and dorsal oblique row of setae. A1>A2, access. flagellum well developed. A2 long gland cone. Gn1,2 dissimilar, Gn1 carpus long, Gn2 carpus short. P5-7 basis posterodistally angular or lobed. U3 biramous, subequal, 1 segmented, lanceolate. Telson incised, lobes distally notched with short spine.**Distribution:** marine, widely distributed in the tropics, with a few species in higher latitudes.



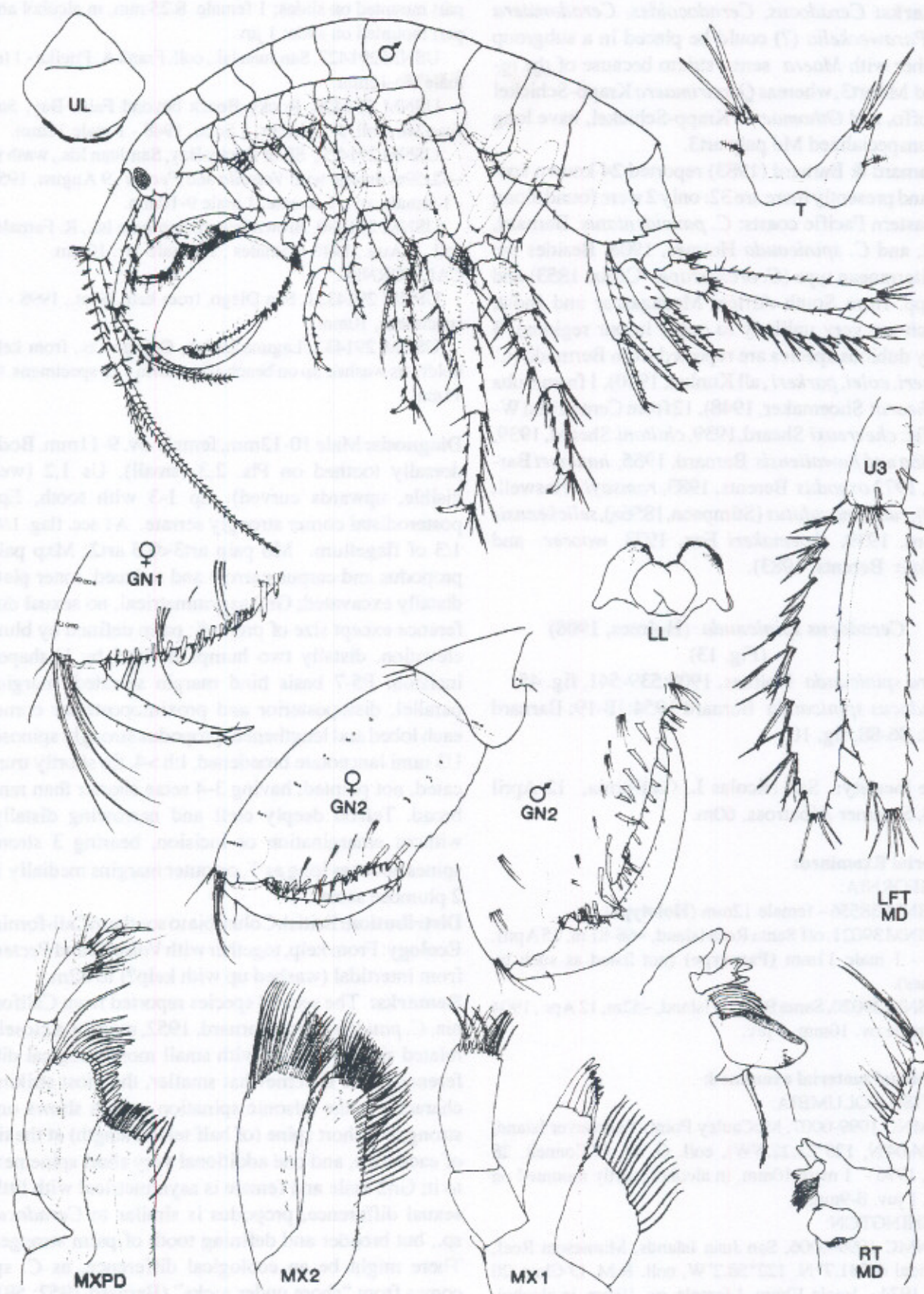


Fig. 13. *Ceradocus spinicauda* (Holmes). Male 10mm, Vancouver I., McCauley Point, B.C.



**Remarks:** *Ceradocus*, *Ceradocoides*, *Ceradomaera* and *Paraweckelia* (?) could be placed in a subgroup together with *Maera* sensu stricto because of the reduced Md art3, whereas *Quadrinemaera* Krapp-Schickel & Ruffo, and *Othomaera* Krapp-Schickel, have long and unspecialized Md palp art3.

Barnard & Barnard (1983) reported 24 known species and presently there are 32: only 2 were found along the eastern Pacific coasts: *C. paucidentatus* Barnard, 1952, and *C. spinicauda* Holmes, 1908. Besides the Mediterranean type (*C. orchestiipes* Costa, 1853) and 12 spp. from South Africa, Madagascar and India, (which are very unlikely to occur in our regions), 3 partly dubious species are reported from Bermuda (*C. breweri*, *colei*, *parkeri*, all Kunkel, 1910), 1 from Cuba (*C. sheardi* Shoemaker, 1948), 12 from Central and W-Pacific: *chevreuxi* Sheard, 1939, *chiltoni* Sheard, 1939, *dooliba* and *hawaiiensis* Barnard, 1955, *haumuri* Barnard, 1972, *oxyodus* Berents, 1983, *ramsayi* (Haswell, 1879), *rubromaculatus* (Stimpson, 1856a), *selickennsis* Sheard, 1939, *shoemakeri* Fox, 1973, *wooree* and *yandala* Berents, 1983).

***Ceradocus spinicauda* (Holmes, 1908)**

(Fig. 13)

*Maera spinicauda* Holmes, 1908:539-541, fig. 45.

*Ceradocus spinicauda* Barnard 1954:18-19; Barnard 1962: 86-88, fig. 10.

**Type locality:** San Nicolas I., California, 12 April 1904, Steamer Albatross, 60m.

**Material Examined:**

**CALIFORNIA:**

USNM 38556 - female 12mm (**Holotype**).

USNM 39021, off Santa Rosa Island, ~68-81 m, 15 April, 1904 - 1 male 11mm (**Paratype**) (not listed as such by Holmes).

USNM 39020, Santa Barbara Island, ~52m, 12 Apr., 1904 - 1 female ov. 10mm, 1 juv.

**Additional material examined:**

**BRITISH COLUMBIA:**

CMNC 1999-0007, McCauley Point, Vancouver Island, (48°24.04'N, 123°23.22.6'W), coll. G. W. O'Connell, 28 Aug., 1976 - 1 male 10mm, in alcohol, partly mounted on slide; 1 juv. 8-9mm.

**WASHINGTON:**

CNMC 1999-0006, San Juan Islands, Minnesota Reef, intertidal 48°31.7'N, 122°58.2'W, coll. R.M. O'Clair, 20 June, 1974 - 1 male 12mm, 1 female ov. 10mm, in alcohol,

part mounted on slides; 1 female 8.25 mm, in alcohol and part mounted on slide; 1 juv.

USNM 291427, San Juan Isl., coll. Frank A. Pitelka - 1 female ov. 12mm.

USNM 291428, Rocky Beach beyond False Bay, San Juan Isl., coll. J. L. Mohr, 1 Sept., 1948 - 1 male 12mm.

USNM 291429, SE of Rocky Bay, San Juan Ids., wash in ~42-59m dredge with *Volsella* and *Pecten*, 9 August, 1950 - 1 female ov., 1 female, 1 male 9-10mm.

USNM 291430, Brown Island, San Juan Isl., R. Fernald, coll., 4 Aug., 1948 - 5 males, 1 female ov. 10mm.

**CALIFORNIA:**

USNM 2914321, San Diego, from kelp, Sept., 1998 - 6 specimens, 10mm.

USNM 291432, Laguna Beach, Orange Co., from kelp holdfasts washed up on beach after storm - 12 specimens, 9-11mm.

**Diagnosis:** Male 10-12mm, female ov. 9-11mm. Body dorsally toothed on Pls. 2,3 (small), Us 1,2 (well visible, upwards curved); Ep 1-3 with tooth, Ep3 posterodistal corner strongly serrate. A1 acc. flag. 1/4-1/3 of flagellum. Md palp art3<0.5 art2; Mxp palp propodus and carpus narrow and reduced, inner plate distally excavated; Gn2 asymmetrical, no sexual difference except size of propodi; palm defined by blunt elevation, distally two humps divided by V-shaped incision. P5-7 basis hind margin serrated, margins parallel, distoposterior and proximoposterior corner each lobed and lengthened, propodus strongly spinose. U3 rami lanceolate broadened, l:b>4, tip shortly truncated, not pointed, having 3-4 setae shorter than rami broad. Telson deeply cleft and narrowing distally, without emargination or incision, bearing 3 strong spines about as long as T, on outer margins medially 1-2 plumose setae.

**Distribution:** British Columbia to southern California.

**Ecology:** From kelp, together with *Volsella* and *Pecten*, from intertidal (washed up with kelp?) to 82m.

**Remarks:** The second species reported from California, *C. paucidentatus* Barnard, 1952, must be a closely related sibling species with small morphological differences: size is somewhat smaller, the most striking character is the telsonic spination, which shows one strong, but short spine (of half telson length) at the tip of each lobe, and one additional very short spine next to it; Gn2 male and female is asymmetrical with little sexual difference, propodus is similar to *Ceradocus* sp., but broader and defining tooth of palm stronger. There might be an ecological difference, as *C. sp.* comes from "shore under rocks" (Barnard 1952: 58).



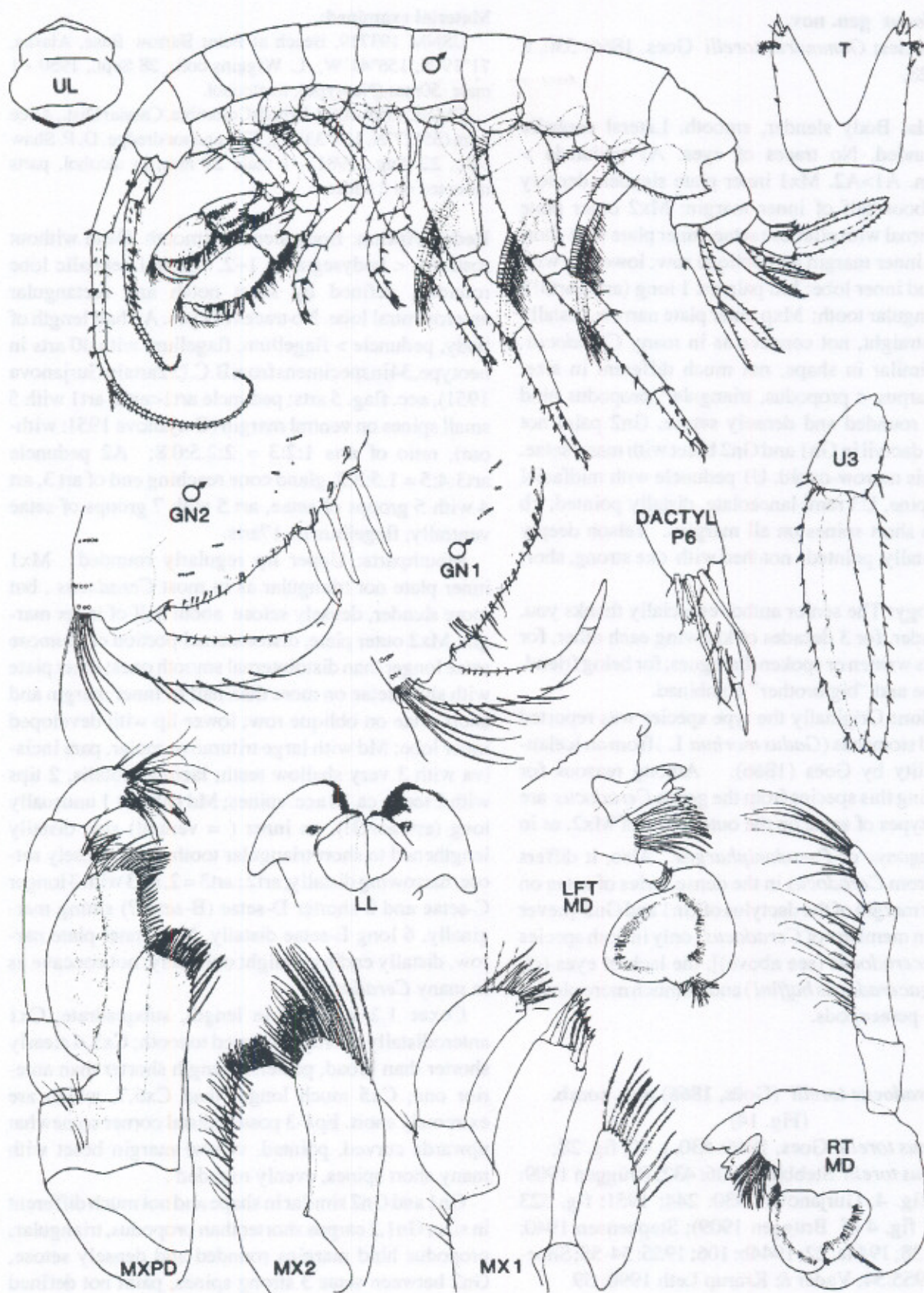


Fig. 14. *Wimvadocus torelli* (Goës) nov comb. Male 29 mm, Cassiar Dist., B.C.



**Wimvadocus gen. nov.**

**Type species:** *Gammarus torelli* Goes, 1866: 530, t. 40, fig. 28.

**Diagnosis:** Body slender, smooth. Lateral cephalic lobe rounded. No traces of eyes. A1 peduncle > flagellum. A1>A2. Mx1 inner plate slender, densely setose about half of inner margin; Mx2 outer plate distoexternal with plumose setae, inner plate with short setae on inner margin and oblique row; lower lip with developed inner lobe; Md palp art 1 long (art1≥art3!), with triangular tooth; Mxp inner plate narrow, distally ending straight, not concave as in many *Ceradocus*. Gn1,2 similar in shape, not much different in size; Gn1,2 carpus < propodus, triangular; propodus hind margins rounded and densely setose, Gn2 palm not defined, dactyli in Gn1 and Gn2 beset with many setae. P5-7 basis narrow-ovoid. U1 peduncle with midfacial strong spine, U3 rami lanceolate, distally pointed, l:b >4, with short spines on all margins. Telson deeply cleft, distally pointed, notched with one strong, short spine.

**Etymology:** The senior author especially thanks you, Wim Vader, for 3 decades of knowing each other, for countless written or spoken dialogues, for being friend, colleague and "big brother" combined.

**Discussion:** Originally the type species was reported from cod stomachs (*Gadus morhua* L.) from an Icelandic locality by Goës (1866). Among reasons for eliminating this species from the genus *Ceradocus* are the two types of setae on the outer plate of Mx2, as in *Allocrangonyx* or *Pseudoniphargus*. Also, it differs clearly from *Ceradocus* in the dense series of setae on the outer margin of the dactylus of Gn1 and Gn2 [never present in members of *Ceradocus*, only in both species of *Megaceradocus* (see above)], the lack of eyes (cf. also *Megaceradocus baffini*) and its much more plesiomorphic peraeopods.

***Wimvadocus torelli* (Goës, 1866) nov. comb.**  
(Fig. 14)

*Gammarus torelli* Goes, 1866: 530, t. 40, fig. 28;  
*Ceradocus torelli* Stebbing 1906: 432; Brüggén 1909: 38, pl., fig. 4; Gurjanova 1930: 244; 1951: fig. 523 (repeats fig. 4 of Brüggén 1909); Stephensen 1940: 310, fig. 38; 1944a: 22; 1944b: 106; 1955: 54-55; Shoemaker 1955: 54; Vader & Krarup Leth 1990: 59

**Type locality:** Iceland or Faroes, locality not noted.

**Material examined:**

USNM 193719, Beach at Point Barrow Base, Alaska, 71°19'N, 156°41'W, L. Wiggins coll., 28 Sept., 1950 - 1 male 50mm (**Neotype**), in alcohol.

CMNC 1999-0008, British Columbia, Cassiar Dist., Alice Arm (55°27'N, 129°33'W), 57m anchor dredge, D. P. Shaw coll., 22 Aug., 1981 - 1 male 29 mm, in alcohol, parts mounted on 2 slides.

**Redescription:** Body slender, smooth. Head without rostrum, < bodysegment 1+2. Lateral cephalic lobe rounded, defined by short notch and rectangular anteroventral lobe. No traces of eyes. A1 half length of body, peduncle > flagellum, flagellum with 40 arts in neotype, 34 in specimens from B.C. (32 arts in Gurjanova 1951), acc. flag. 5 arts; peduncle art1<art2, art1 with 5 small spines on ventral margin (Gurjanova 1951: without), ratio of arts 1:2:3 = 2:2.5:0.8; A2 peduncle art3:4:5 = 1.5:3:2, gland cone reaching end of art 3, art 4 with 5 groups of setae, art 5 with 7 groups of setae ventrally, flagellum 16-17 arts.

**Mouthparts:** Upper lip regularly rounded. Mx1 inner plate not triangular as in most *Ceradocus*, but more slender, densely setose about half of inner margin; Mx2 outer plate, distoexternal portion of plumose setae longer than distoexternal smooth ones; inner plate with short setae on more than half of inner margin and short setae on oblique row; lower lip with developed inner lobe; Md with large triturative molar, pars incisiva with 3 very shallow teeth; lacinia mobilis, 2 tips with 2 teeth, ca 10 acc. spines; Md palp art 1 unusually long (art1≥art3!), on inner (= ventral) side distally lengthened to short triangular tooth; art 2 densely setose, narrowing distally, art2: art3 = 2, art3 with 3 longer C-setae and 2 shorter D-setae (B-setae?) sitting marginally, 6 long E-setae distally. Mxp inner plate narrow, distally ending straight obliquely, not concave as in many *Ceradocus*.

Coxae 1,2 subequal in length, subquadrate, Cx1 anterodistally shortly produced to tooth; Cx3,4 clearly shorter than broad, posterior length shorter than anterior one; Cx5 much longer than Cx6,7, which are extremely short. Ep1-3 posterodistal corner somewhat upwards curved, pointed, ventral margin beset with many short spines, evenly rounded.

Gn1 and Gn2 similar in shape and not much different in size; Gn1,2 carpus shorter than propodus, triangular; propodus hind margins rounded and densely setose, Gn2 between setae 3 strong spines, palm not defined (Gurjanova 1951: defined, probably by these spines?), dactyli in Gn1 and Gn2 beset with many setae.

P3,4 similar in size and shape, slender, basis with



long setae on posterior margin, dactyli > half propodus length, simple with separate nail; P5-7 basis narrow-ovoid (Gurjanova 1951: pear-shaped), minutely serrated, proximal a bit wider, posterodistal corner blunt, no posterodistal lengthened lobe, but obtusely shortening.  $P5 < P6 < P7$ , otherwise very similar.

U1 peduncle with midfacial strong spine, somewhat unequal rami; U2 rami similar to U1; U3 in 29mm spec. < U1, in 50mm  $U3=U1$  (Gurjanova redescribing the material of Brügger of 61-62mm, reports  $U3>U1$ ), rami lanceolate, distally pointed,  $l:b > 4$ , with scarce short spines on all margins.

Telson scarcely longer than U3 peduncle, deeply cleft, distally each lobe pointed, distointeriorly notched with one strong, short spine and 2-3 short setae along outer margins and 1-2 plumose setae disto-marginally. Colour: flesh- pink with hyaline-white on: ocular lobe, mediodorsal parts of all body segments, hind margins of mesosome and metasome, Gn1,2 (anterior margins of propodus and carpus red), P3,4 (merus red), P5-7 (coxa, basis and merus red), Us 1 red, Us2,3 white, U3 distally white, proximal third red, telson white. A1,2 deep red, ventral margin flesh-coloured (Stephensen 1955:55).

**Distribution:** Circum-Arctic. Matovskij-Gulf, Kola (Gurjanova 1930: 231-248). Gurjanova (1951) reports this species from estuaries and coasts of the northern Atlantic in Iceland, Faerø, West Greenland, Bering or Okhotsk Seas, Novosibirskiye Ostrova, at depths of 24-240m. Other records include East Greenland (Stephensen 1944a,b, 1955: 106, see also map Fig. 7); Iceland (Stephensen 1935-42, Oldevig 1959); Siberia (Brügger 1909, Derjavin 1930, Gurjanova 1951); Norway (Vader & Krarup Leth 1990); Gulf of St. Lawrence (Conlan in litt.); here for the first time from the northern Pacific.

**Ecology:** Shoemaker (1955: 55) writes "littoral-sublittoral, but mainly found deeper down", and reports material from 350-500m from West Greenland, deposited at the Copenhagen Museum. Vader & Krarup Leth (1990: 59) surmise that this species could live in deeply excavated galleries in clayey substrate.

**Remarks:** During the review of all *Ceradocus* species it turned out that three other genera are closely related, and their species have been for a long time included in the genus *Ceradocus*. These are:

1) *Animoceradocus* Karaman, 1984, with body similar to *Ceradocus*, but dorsally smooth, A1 ped. art 3  $l:b = ca 4$  (short in *Ceradocus*), Md palp art 1 rounded (vs. toothed); monotypic: *A. semiserratus* (Bate, 1862);

2) *Bathyceradocus* Pirlot, 1934, with metasome and urosome toothed, Cx4 posteriorly excavated, A1 subequal A2, Md palp art 1 rounded (vs. toothed), art 3 weakly falcate to falcate (vs. slender); with *B. stephenseni* Pirlot, 1934, and *B. iberiensis* Andres, 1977;

3) *Megaceradocus* Mukai, 1978, with smooth body, rostrum or eyes absent;  $A1 > A2$ , acc. flag. ca 1/4 of flagellum. Md palp art 1 rounded, art 3 not falcate, only scarcely shorter than art 2, Mx1 IP densely setose, not triangular but slender. Mx2 marginal, but no oblique row of setae. Dactylus Gn2 outer margin with dense setae; with *Megaceradocus gigas* Mukai, 1979 and *Megaceradocus baffini* (Stephensen, 1933) nov. comb.

The deep-sea species *Ceradocus baffini* Stephensen, 1933 (also Stephensen 1944) was more than once surmised to be synonymous with *C. torelli*, as both have setae on Gn2 dactylus outer margin, and are blind and rarely collected deep-water inhabitants. Karaman & Barnard (1979) proposed to move it eventually to the genus *Animoceradocus*, but we find this solution unsatisfactory. It fits perfectly the diagnosis of *Megaceradocus* Mukai, 1978, concerning the matching mouthparts, short A1 acc. flag., similar cephalic lobe, both lacking palm on Gn1,2, propodus Gn1 ovoid rounded, Gn2 carpus longer than wide, many setae on Gn2 dactylus outer margin, P5-7 basis narrowing distally, posterodistal corner right-angled, U1 peduncle with one strong spur-shaped spine medially, one distally; however U3 rami in *Megaceradocus gigas* Mukai, are more robust and much shorter ( $l:b ca. 4$ ), in *baffini* much longer ( $l:b > 7$ ). The telson in *baffini* is symmetrically shallow-emarginate, whereas in *M. gigas* it is somewhat asymmetrically notched. Thus, we establish for the blind deep-water species *Ceradocus baffini*, recorded at depths from 55m down to 1600m in Baffin Bay, west of Greenland, the new combination *Megaceradocus baffini* (Stephensen, 1933).

## SUMMARY

In the course of treating all amphipods found along the Pacific coast of North America, the family Melitidae has been studied in two parts: the *Melita* group in Jarrett & Bousfield (1996) and the *Maera* - *Ceradocus* group here. Six genera were found in the north Pacific: *Maera* (sensu stricto as well as sensu lato), *Quadrimaera*, *Lupimaera*, *Anamaera*, *Ceradocus*, and *Wimvadocus*. Several new species are described, synonymized or revalidated and poorly described ones redescribed.



## ACKNOWLEDGEMENTS

The authors wish to thank the management of Amphipacifica for support in publication costing. We are grateful to Dr. E. L. Bousfield for assistance in the initial preparation of the illustrations and to Susan Laurie-Bourque, Hull, Quebec, for inking the drawings. The work was funded through a research assistance account of the Royal Ontario Museum, Toronto, and facilitated at the Holly Lane laboratory of the Canadian Museum of Nature, Ottawa. Dirk Platvoet, Amsterdam, facilitated preparation of the SEM photographs.

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## The Whale Lice (Amphipoda: Cyamidae) of the Northeastern Pacific Region

Leo Margolis<sup>1</sup>, T. E. McDonald<sup>2</sup>, and E. L. Bousfield<sup>3</sup>

## ABSTRACT

This study treats the systematics and host relationships of cyamid ectoparasites of whales (Cetacea) of the northeastern Pacific region. The caprellidean amphipod family Cyamidae is revised, and keys to all component genera, subgenera and regional species are provided. *Orcinocyamus* n. g., *Cyamus* (*Apocyamus*) n. subg., and *Cyamus* (*Mesocyamus*) n. subg., *Cyamus* (*Mesocyamus*) *mesorubraedon* n. sp., and *Cyamus* (*Apocyamus*) *eschrichtii* n. sp., are newly defined, and subgenus *Cyamus* (*Paracyamus*) G. O. Sars is revived. Redescribed and refigured, wholly or in part, are: *Cyamus* (*Cyamus*) *ceti* (L.) Lamarck, *C. (Cyamus) monodontis* Lütken, *C. (Cyamus) erraticus* R. de Vauzème, *C. (Cyamus) ovalis* R. de Vauzème, *C. (Cyamus) gracilis* R. de Vauzème, *Cyamus* (*Paracyamus*) *balaenopterae* K. H. Barnard, *C. (Paracyamus) boopis* Lütken, *C. (Mesocyamus) catodontis* Margolis, *C. (Mesocyamus) orubraedon* Waller, *C. (Apocyamus) scammoni* Dall, *C. (Apocyamus) kessleri* Brandt, *Neocyamus physteris* (Pouchet), *Isocyamus delphinii* (Guérin-Méneville), *I. globicipitis* Lütken, and *Platycyamus flaviscutatus* Waller. Analysis of a broad range of characters and character states suggests that the phyletic position of the Cyamidae within the Caprellidea may be closer to Caprogammaridae-Caprellidae than to the Caprellinoididae-Phtisicidae evolutionary grouping as suggested elsewhere. Phyletic classification of the Cyamidae accords reasonably well with that of the host Cetacea. Thus, species of the most primitive genus *Cyamus* (and subgenera) are found mainly on the most primitive whales (Mysticeti) whereas the more advanced genera of cyamids (*Isocyamus*, *Neocyamus*, *Orcinocyamus*, *Syncyamus*, and *Scutocyamus*) occur only on the more advanced Odontoceti. Some species of *Cyamus* occur on more primitive members of the Odontoceti (e.g., on *Physeter*, *Berardius*, *Monodontidae*) but host size and life style may also prove significant factors here. Two distinct groups of advanced cyamids recognized herein could support other evidence for polyphyletic origin within the Odontoceti. However, such conclusions would seem premature since many host-parasite relationships remain undiscovered.

## Introduction

The caprellidean family Cyamidae comprises a major parasitic group of amphipod crustaceans. Some gammaridean family groups (e.g., Opisidae, Trischizostomatidae, Lafystiidae) are ectoparasites of fishes, *Hyachelia* (Talitroidea) occurs on marine turtles, and members of the suborder Hyperiidea attach to pelagic coelenterates and tunicates (Bousfield & Kabata 1988). Only the Cyamidae, consisting of seven genera and 34 known species, are ectoparasites of Cetacea. Three genera and eight species have previously been reported from the Northeastern Pacific, of which two genera and five species have been noted on whales in North American Pacific waters. The purpose of this study is to update knowledge of the systematics and host-parasite relationships of this regional crustacean group.

Early studies on Cyamidae in the northeastern Pacific marine region commenced with the work of Dall (1872a, b, 1874). From Californian waters he described as new species *Cyamus suffusus* (ex humpback whale, *Megaptera nodosa*) and *Cyamus scammoni* (ex California Gray whale, *Eschrichtius gibbosus*). From Alaskan waters Dall described the new species *Cyamus tentator* and *C. gracilis* [(ex Pacific right

whale (=black right whale) *Balaena sieboldii* (= *B. glacialis*)], as well as *C. mysticeti* (ex bowhead whale, *Balaena mysticetus*). Illustrations of *C. suffusus*, *C. scammoni*, and *C. mysticeti* appear in Scammon's (1874) account of North American Pacific Cetacea. Lütken (1887), after reexamining Dall's specimens, considered *C. tentator* identical with *C. ovalis* R. de Vauzème, 1834, *C. mysticeti* Dall identical with *C. monodontis* Lütken, 1870 (= *C. ceti* Linnaeus, 1758) and *C. suffusus* identical with *C. pacificus* Lütken, 1873. This last species was described by Lütken (1873) from an unidentified cetacean caught off the Pacific coast of Central America. Lütken (1873, 1887) further considered *C. pacificus* as probably identical with *Cyamus boopis* Lütken, 1870, a view upheld by later workers. Sars (1895) created the new genus *Paracyamus* for *C. boopis*. Subsequently *Cyamus gracilis* was transferred to this genus by Barnard (1932). *Paracyamus boopis* has also been recorded from the humpback whale in British Columbia by Cornwall (1928) and in Alaskan waters by Scheffer (1939). However, the genus *Paracyamus* was recently placed in synonymy of *Cyamus* by Margolis (1959).

In the northwestern Pacific ocean, several species

<sup>1</sup> deceased, January, 1996

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have been recorded from Kamchatka, Korea, and Japan. A. Brandt (1871) believed he had rediscovered *Sirenocyamus rhytinae* J. F. Brandt, 1846. Later he noted its great similarity to *Cyamus ovalis*, attached to a piece of skin of what he believed to be *Rhytina borealis* (the extinct sea cow), which was preserved in the St. Petersburg museum. The animal was apparently caught off Kamchatka. *Cyamus ovalis* was later recorded by A. Brandt (1872) from *Balaena japonica* (probably identical with *B. glacialis*) in Kamchatka waters and thereby considered *C. rhytinae* as only a variety of *C. ovalis*. Lütken (1873) came to the conclusion that *C. rhytinae* of A. Brandt, 1871, was identical with *C. ovalis* and the piece of skin from which Brandt recovered his specimens was actually from *B. japonica* and not *R. borealis*. The original amphipod parasite of *R. borealis* was described by Steller in 1751 and named *Sirenocyamus rhytinae* by J. F. Brandt in 1846. He considered this parasite to be closely related to the genus *Cyamus*. Lütken (1873) temporarily placed the species in the genus *Cyamus*, but its true systematic position remains in doubt. Cognizant of the descriptions of Steller (*loc. cit.*) and J. F. Brandt (*loc. cit.*), these amphipods doubtfully belong to the genus *Cyamus* or even the family Cyamidae. Lütken (1873) also listed *C. gracilis* (i.e., *Paracyamus gracilis*) as a parasite of *Balaena japonica* in the seas off Kamchatka.

Andrews (1914) reported *C. scammoni* as parasitic on the gray whale in Korean waters. From Japanese seas Ishii (1915) recorded a species of *Cyamus* from *Berardius bairdi*, which Iwasa (1934) believed was probably *P. boopis*. The latter author redescribed *C. ovalis* and *C. erraticus* R. de Vauzème, 1834, taken from *B. glacialis*. *Cyamus elongatus* was newly described from the humpback whale by Hiro (1938). The latter also recorded *C. globicipitis* Lütken, 1873 (= *Isocyamus delphini* (Guérin-Méneville, 1836) from *Globicephalus scammoni* in Japanese waters.

A more recent account of cyamid ectoparasites from the North American Pacific coast was given by Margolis & Dailey (1972), and the world cyamid fauna updated by Berzin & Vaslova (1982). Fourteen cyamid species are here recorded from whales caught off the British Columbia coast and landed at Coal Harbour, and from other localities along the coast of British Columbia (Table I, p. 110, and species accounts). Two species *Cyamus* (*Mesocyamus*) *mesorubraedon* and *Cyamus* (*Apocyamus*) *eschrichtii*, are described as new to science. The specimens were collected by Mr. G. C. Pike, unless otherwise noted. All specimens formerly in the collections of Dr. Leo Margolis, Pacific Biological Station, Nanaimo, B. C.,

are now in the Parasitology Collections of the Canadian Museum of Nature (CMN), Ottawa.

### Acknowledgements

Several research institutions and colleagues contributed to the success of this study. The Pacific Biological Station at Nanaimo, B. C., provided a base of operations and comprehensive research facilities for the two senior authors during accumulation of study material over the years. The Canadian Museum of Nature (CMN) in Ottawa provided research facilities for taxonomic work on the collections and preparation of most of the line illustrations during the period 1993-1995. It continues to provide valuable curatorship of study material, especially through collections managers Judith Price and Jean-Marc Gagnon; Ed Hendrycks, Research, also kindly prepared recent slide mounts. Susan Laurie-Bourque, Hull, Quebec, very capably inked all line drawings based on this material (**Abbreviations for figures**: please see Table II, p. 117).

We wish to acknowledge the help of Drs. Craig P. Staude (FHL) and David Spurgeon (BC) in providing sources of information on whale strandings and potential cyamid material from the west coast of North America. Drs. Robin Baird (Dalhousie University) and C. R. Harington (CMN) were especially helpful in providing recent references concerning the classification of marine mammals. We are especially grateful to Dr. Roger Lincoln (British Museum) for kind permission to reproduce his published illustrations in this paper, and wish to thank in advance other authors whom we have not been able to contact.

### Systematics

#### Family Cyamidae Rafinesque, 1817

Cyamidae Lütken 1873; Sars 1895; Chevreux & Fage 1925; Stephensen 1942; Margolis 1954; Leung 1967; Grüner 1975; Laubitz 1993; Krapp-Schickel 1993.

#### Type genus: *Cyamus* Latreille, 1796

Genera: *Orcinocyamus* new genus; *Isocyamus* Gervais & Van Beneden, 1859; *Neocyamus* Margolis, 1955; *Platycyamus* Lütken, 1870; *Synicyamus* Bowman, 1955; *Scutocyamus* Lincoln & Hurley, 1974.

**Diagnosis:** Body (peraeon) short, wide, dorsoventrally depressed, usually smooth dorsally, often with short adhesion spines ventrally. Peraeon 1 usually fused with head. Eyes small, dorsal. Antenna 1 short; antenna 2 very short or rudimentary. Buccal mass small, mouthparts reduced. Upper lip usually notched



apically, lobes variously asymmetrical. Lower lip, inner lobes present, often fused. Mandible lacking palp; molar rudimentary. Maxilla 1, palp small, 1-segmented. Maxilla 2 small, plates very small or fused. Maxilli-ped basal segments often fused medially; palp often lacking.

Gnathopods 1 & 2 strongly subchelate, unequal in size, slightly sexually dimorphic; segments 3 & 5 often fused with 2 & 4 respectively. Peraeopods 3 & 4 lacking. Peraeopods 5-7 short, stout, powerfully clasping (raptorial) in form. Peraeon segments 3 & 4 each with paired coxal gills, simple or ramified, usually with accessory gills. Pleopods (one pair) rudimentary and fused in male, lacking in female. All species ectoparasitic on Cetacea.

**Remarks:** The diagnosis is adapted partly from Sars (1895) Chevreux & Fage (1925), Grüner (1975) and Krapp-Schickel (1993) whose key (*loc. cit.*), involving presence of a mandibular palp appears to have been a printing lapsus (*pers. comm.*).

#### *Cyamus* Latreille, 1796

**Subgenera:** *Cyamus* (L.) Lamarck, 1801 (nominate); *Paracyamus* G. O. Sars, 1895; *Mesocyamus*, new subgenus (p. 82); *Apocyamus*, new subgenus (p. 87).

**Diagnosis:** Mostly relatively large animals, ectoparasitic on large whales, mainly Mysticeti, Ziphiidae, Monodontidae, and Physteridae.

Body variable, often slender in males; lateral lobes of peraeon segments separate, not contiguous or overlapping. Peraeon segments 5-7 with ventral adhesion spines.

Antenna 1 large, 4-segmented. Antenna 2 medium small, 4-segmented.

Mouthparts: Upper lip shallowly incised apically, lobes variously asymmetrical; epistome variously developed often strongly. Lower lip, inner lobes separated distally, small; outer lobes broad, moderately to widely separated. Mandible: molar flat, weakly triturative, with proximal molar seta; incisor typically 5-dentate; left lacinia basically 5-dentate, right lacinia trifid; blade spines present in spine row. Maxilla 1, body short, broad; outer plate with 6 (7) short apical spine-teeth; palp short, 1-segmented. Maxilla 2 short, outer plate distinctly set off from inner plate. Maxilliped: basal plates separated, segment 3 (ischium) not exceeding segment 2 (basis); palp 4-segmented, present in early life stages, often persisting in adult.

Gnathopod 1 medium, 6-segmented (ischium distinct); propodal palm distinct, dactyl short, with fused unguis; carpus large; basis slender. Gnathopod 2 large; 5-segmented (ischium fused with basis); propod elongate, palm oblique, bidentate; carpus small, cryptic; basis short, broad, with distinct anterior "flange"; Coxal gills usually simple, slender; accessory gills present, variously developed, 2-4 lobate.

Peraeopods 5-7 similar, 5-segmented; carpus large, propod large, elongate; dactyl large; merus small, subcryptic; ischium variously fused to short basis having large anterior flange.

Abdomen narrow. Male pleopods variously cleft distally, apices rounded, finely setulose.

Female: body size smaller and peraeon typically broader than in male; brood plates with marginal setae.

**Remarks:** As noted below, the percentage of species of the genus *Cyamus* (*sens. lat.*) remaining to be discovered is probably quite low. These cyamids tend to be ectoparasitic on large, relatively slow swimming and commercially important species of whales. Many thousands of whale carcasses have been examined and ectoparasites relatively frequently observed and collected during legal whaling operations that lasted for about two centuries.

#### Subgenus *Cyamus* Latreille, 1796 (revised status)

**Type species:** *Cyamus ceti* (L.) Lamarck, 1801

Species: *Cyamus erraticus* Roussel de Vauzème, 1834; *Cyamus gracilis* R. de Vauzème, 1834; *Cyamus ovalis* R. de Vauzème, 1834; *Cyamus monodontis* Lütken, 1873; *Cyamus nodosus* Lütken, 1873.

**Diagnosis:** Primitive cyamids, with generally plesiomorphic mouthparts and appendages.

Head elongate, lateral margins bulging posteriorly. Peraeon 2 slightly broadening posteriorly, hind corners produced. Peraeon segments 3 & 4 short, lateral "wings" separated. Peraeon segment 7 little broadening distally.

Mouthparts basic, little modified. Upper lip, epistome strongly developed. Lower lip, outer lobes large, narrowing distally. Left mandible, lacinia usually regularly 4-5-dentate; several blades in spine row. Maxilla 1, outer plate often with 7 teeth on left side, 6 on right side; inner distal margin bare. Maxilla 2, outer plate narrow, little exceeding inner plate. Maxilliped: palp usually present in adult stage (except *C. gracilis*). (continued on p. 71).



## KEY TO GENERA OF CYAMIDAE

1. Peraeon 1 separated from head region [Figs. 1 (A.4); 27]; gnathopod 1 relatively large, palm vertical [Fig. 1 (F.1)] ..... 2.  
 Peraeon 1 distinctly fused with head [Fig. 1 (A.1-3)]; gnathopod 1 relatively small, palm typically oblique or lacking [Fig. 1(F.2-4)] ..... 3.
2. Peraeon 1 distinct from peraeon 2 [Fig. 26]; peraeon segments 6 & 7 distinct . *Platycyamus* (p. 102)  
 Peraeon segment 1 fused with peraeon 2, marked by marginal notch [Fig. 27]; peraeon segments 6 & 7 fused dorsally ..... *Syncyamus* (p. 106)
3. Antenna 2 small, 4-segmented [Fig. 5A]; maxilla 2 inner & outer lobes distinct [Fig. 1 (D.1-3)] ....  
 ..... *Cyamus* (p. 65)  
 Antenna 2 minute, 2-3 (rarely 4) segmented [Fig. 24]; maxilla 2, inner lobe lacking [Fig. 1 (D.5)]. 4.
4. Coxal gills multi-branched [Fig. 23]; peraeopods 5-7 slender, segment 4 elongate [Fig. 1(H.1)]. ....  
 ..... *Neocyamus* (p. 101)  
 Coxal gills normal simple or paired [Figs. 2, 20]; peraeopods 5-7, stout, segments 4 short, ....  
 [Fig. 1(H.2-4)] ..... 5.
5. Peraeon segments 6 & 7 separated dorsally [Fig. 9]; maxilliped 2-segmented [Fig. 1 (E.2-3)]. ... 6.  
 Peraeon segments 6 & 7 fused dorsally [Figs. 27, 28]; maxilliped 1-segmented, fused basally [Fig. 1(E.4)] ..... *Scutocyamus* (p. 108)
6. Gnathopod 1, unguis of dactyl distinct [Figs 20, 24]; coxal gills single, with large accessory gill [Figs. 20, 21] ..... *Isocyamus* (p. 96)  
 Gnathopod 1, unguis of dactyl fused [Fig. 2] ; coxal gills double, accessory gill lacking [Fig. 19] .  
 ..... *Orcinocyamus* (p. 93)

## KEY TO NORTH AMERICAN PACIFIC SPECIES OF CYAMUS (SENS. LAT.)

(not including *C. nodosus*, ectoparasitic on the Arctic narwhal, *Monodon monoceros*).

1. Outer plate of maxilla 1 typically with 6 apical spine teeth (occ. 7 on one , rarely on both), inner distal margin nearly bare [Fig. 7]; upper lip, epistome strongly developed distally [Fig. 5]. .... 1.  
 Outer plate of maxilla 1 usually with 7 apical spine teeth (both sides), inner distal margin strongly setose [Fig. 10]; upper lip, epistome weakly or not developed apically [Fig. 14]. .... 8.
2. Lower lip, outer lobes distally broad [Fig. 1(B.1)]; maxilliped palp usually lacking in adults [Fig. 1(E.3)] ..... *Cyamus* (*Paracyamus*) 3.  
 Lower lip, outer lobes distally narrowing [Fig. 1 (B.2); maxilliped palp usually present in adults; [Fig. 1 (E.1)] ..... *Cyamus* (*Cyamus*) 4.
3. Coxal gills very slender, elongate (both sexes) [Fig. 8]; antenna 1 elongate, >twice head length; peraeopods 5-7, segment 4 with acute posterior process; on *Megaptera novaeangliae*. ....  
 ..... *C. (Paracyamus) boopis* (p. 80)  
 Coxal gills relatively short, thick (sausage like in female) [Fig. 9]; antenna 1 short, < 2X length of head; peraeopods 5-7, segment 4 rounded below; on species of *Balaenoptera*. ....  
 ..... *C. (Paracyamus) balaenopterae* (p. 80)



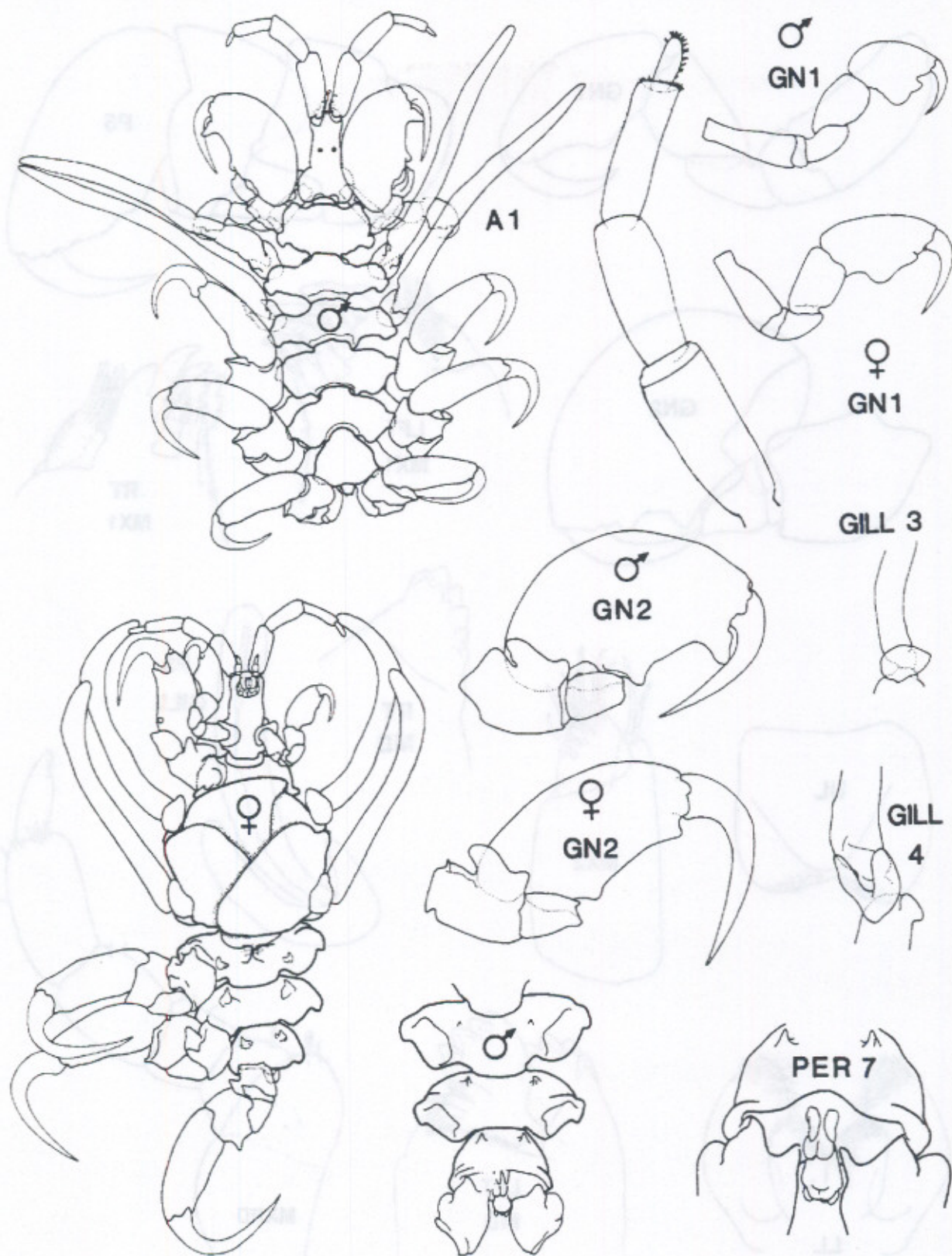
CHARACTER BODY PARTS	CHARACTER STATES WITHIN GENUS CYAMUS			ALL GENERA MOST ADVANCED
	PLESIOMORPHIC	INTERMEDIATE	ADVANCED	
(A) Head				
(B) Lower lip				
(C) Lft mandible				
(D) Maxilla 2				
(E) Maxilliped				
(F) Gnathopod 1				
(G) Gnathopod 2				
(H) Peraeopod 5				
	1.	2.	3.	4.

Fig. 1. Characters and character states within family Cyamidae.



4. Peraeon segment 5 & 6 with 2 pairs of ventral (adhesion) spines; maxilliped palp usually present in adults; on various Mysticeti and Monodontidae ..... 5.  
 Peraeon segment 7 with single pair (or none) of ventral adhesion spines; maxilliped palp usually lacking in adults; on *Eubalaena glacialis* only ..... 7.
5. Coxal gills double on each side of peraeon segments 3 & 4 [Fig. 5]; accessory gills elongate on peraeon 4; gnathopod 2, palm short, deeply concave [Fig. 1(G.1-2)]; maxilliped palp segments 2 & 3 subequal in length; on *Eubalaena glacialis* ..... *Cyamus (Cyamus) ovalis* (p. 74)  
 Coxal gills single; accessory gills short; gnathopod 2, palm broad, shallow [Fig. 1(G.3)]; maxilliped palp, segment 2 less than segment 3 ..... 6.
6. Peraeon segments narrow, "wings" widely separated [Fig. 3]; coxal gills slender, elongate, exceeding head; maxilla 2, outer plate large, distinctly exceeding inner plate [Fig. 3]; on *Balaena mysticeta* and *Eschrichtius robustus*. ..... *Cyamus (Cyamus) ceti* (p. 71)  
 Peraeon segments wide, "wings" narrowly separated; coxal gills relatively short, sausage-like, not extending beyond head; maxilla 2, outer plate narrow, little or not exceeding inner plate [Fig. 4]; on *Delphinaptera* and *Monodon* ..... *Cyamus (Cyamus) monodontis* (p. 71)
7. Peraeon segment 7 with 1 pair ventral (adhesion) spines [Fig. 6]; left mandible with 5-8 blades in spine row; accessory gills sexually dimorphic ..... *Cyamus (Cyamus) erraticus* (p. 76)  
 Peraeon segment 7, ventral spines faint or lacking [Fig. 7]; left mandible with 2-3 blades in spine row; accessory gills small, similar ..... *Cyamus (Cyamus) gracilis* (p. 76)
8. Head distinctly longer than broad [Fig. 1 (A.1-2)]; peraeopods 5-7 and dactyls powerful, elongate; gnathopod 2, propod powerful, elongate (Fig. 1(G.3)); palms usually shallow, elongate. .... *Cyamus (Mesocyamus)* 9.  
 Head short, length little (or not) longer than basal width [Fig. 1(A.3)]; peraeopods 5-7, propods and dactyls relatively short and weak; gnathopod 2, propod short, deep, palm short, sharply concave [Fig. 1(G.2)] ..... *Cyamus (Apocyamus)* 11.
9. Maxilliped palp usually present in adults; upper lip with moderate epistome; maxilla 2, inner plate exceeding outer plate; on *Physeter* only. .... *Cyamus (Mesocyamus) catodontis* (p. 82)  
 Maxilliped palp lacking in adults; upper lip, epistome indistinct or lacking; maxilla 2, outer plate the larger; on ziphiid and eschrichtiid whales. .... 10.
10. Antenna 1 large, much exceeding head; coxal gills slender, elongate, extending beyond head; on *Eschrichtius robustus* ..... *Cyamus (Mesocyamus) mesorubraedon* (p. 87)  
 Antenna 1 short, little longer than head length; coxal gills short, not extending beyond head; on *Berardius bairdi* ..... *Cyamus (Mesocyamus) orubraedon* (p. 84)
11. Maxilliped lacking palp in adults; lower lip, inner lobes nearly totally fused distally; maxilla 2, inner plate fused to outer ..... *Cyamus (Apocyamus) kessleri* (p. 93)  
 Maxilliped palp usually present in adults; lower lip, inner lobes distally separated; maxilla 2, inner plate distinctly demarcated from outer. .... 12.
12. Coxal gills paired (double) on each side, strongly coiled [Fig. 13]; peraeon segment 2 broadly shield-shaped, with subacute lateral "wings" ..... *Cyamus (Apocyamus) scammoni* (p. 90)  
 Coxal gills single, sausage-like [Fig. 15]; peraeon segment 2, lateral wings posteriorly broadest. .... *Cyamus (Apocyamus) eschrichtii* (p. 90).





**Fig. 2.** *Cyamus (Cyamus) ceti* (L.) Lamarck, 1801. Male (12 mm); female (10.5 mm).  
*ex Balaena mysticetus*, Sooke, B. C.



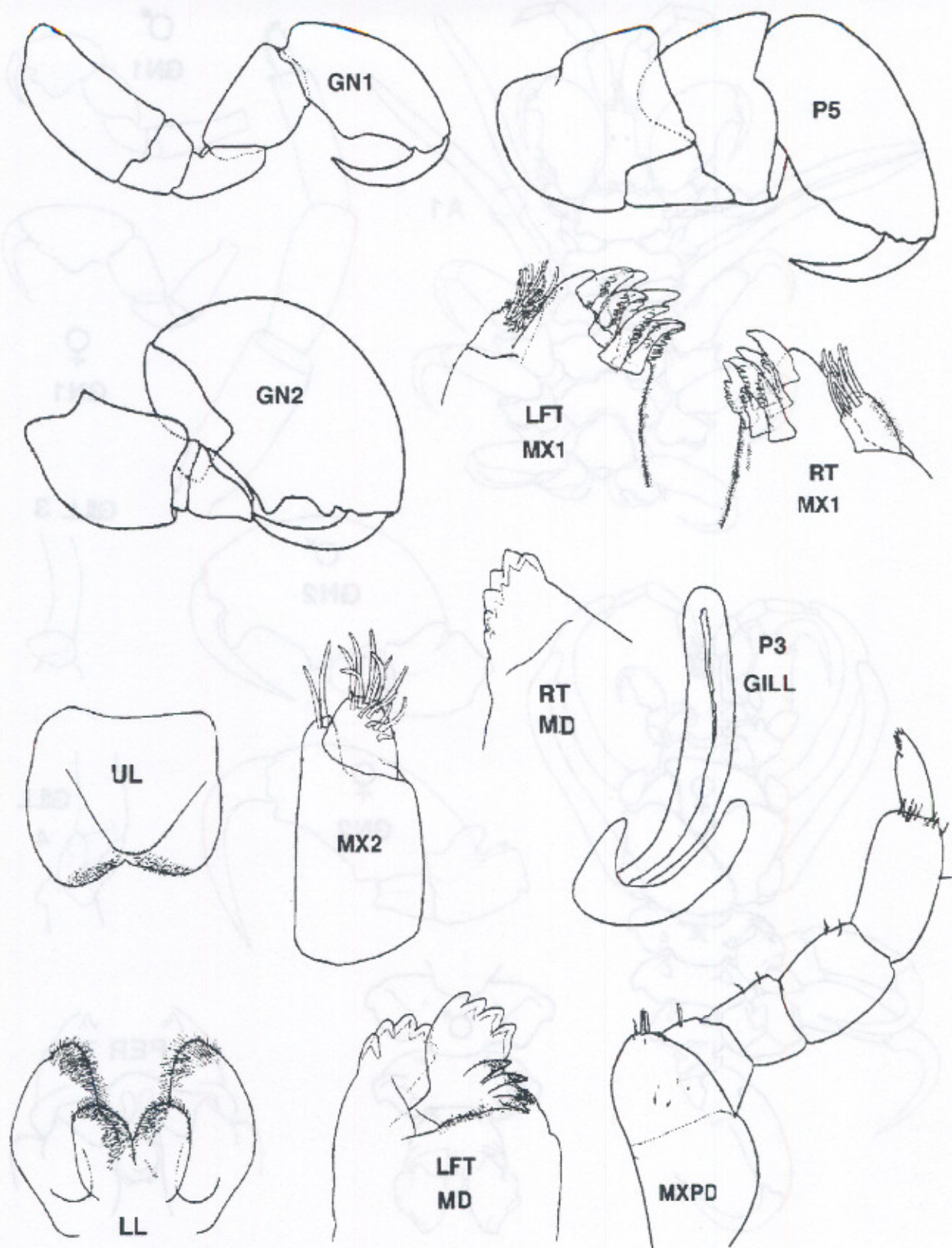


Fig. 3. *Cyamus (Cyamus) ceti* (L.) Lamarck, 1801. (peraeopods and mouthparts).



Gnathopod 1 distinctly 6-segmented, propod palm steeply oblique. Gnathopod 2 powerful, 5-segmented; anterior flange of basis strongly developed; propod powerfully elongate-ovate; dactyl strong. Peraeopods 5-7 powerful; carpus deep, propod elongate ovate; dactyl strong.

Coxal gills usually single, slender occasionally double on each side. Accessory gills double, variously developed.

Male pleopods deeply notched apically.

Female: generally smaller than male. Margins of brood lamellae strongly lined with setae.

**Remarks:** Most species of subgenus *Cyamus* are ectoparasites of primitive mysticetid whales (Balaeidae) but may occur also on *Eschrichtius*. Two species are apparently found only on arctic monodontid whales, a group that is not closely related to the Mysticeti.

*Cyamus (Cyamus) ceti* (L., 1758) (Lamarck, 1801) (Figs. 2, 3)

*Cyamus ceti* Stephensen 1942; Margolis 1955; Leung 1967; Levin & Pfeiffer 1999.

*Cyamus mysticeti* Lütken, 1860; Lütken 1873.

#### Material Examined:

Sooke, B. C., ex stranded gray whale, Oct. 29/89, R. Baird & P. Steacy colls., - several specimens, CMN collections.

St. Lawrence Island, Bering Sea, Alaska, ex bowhead whale (*Balaena mysticeti*) - 1 vial of specimens (identified for Bud Fay, June, 1961), CMN collections.

Point Hope, Alaska, ex bowhead whale - 1 female specimen (identified for R. Rausch, February, 1963).

Alaska (loc. undet.), ex bowhead whale - 1 specimen (identified for Larry Jensen 16-IV-81), CMN collections.

#### Diagnosis: Male (to 12 mm)

Body short, broad; peraeon segment 4 widest; peraeon segments 5-7 each with single pair of ventral adhesion spines. Antennae typical of the genus.

Mouthparts: Upper lip broadly and shallowly notched below, lobes subequal. Lower lip, inner lobes distinct, mandibular lobes large, not widely separated. Mandibular incisor appearing 4-toothed; left lacinia 5-dentate; 4 blades in spine row. Maxilla 1, outer plate with 7 apical spine-teeth on left side, 2 groups of 3 spines on the right; palp with stiff apical setae. Maxilla 2 short, small; inner plate small, with 1-2 apical setae; exceeded by distinct, broad, apically setose outer plate. Maxilliped distinct in adults; dactyl elongate, apex setulose (not subacute), inner margin not pectinate;

segments 2 and 3 subequal in length; basis 1/2 fused to opposite number, lobe evanescent, margin with 2 setules.

Gnathopod 1 6-segmented, with slightly oblique propodal palm and dactyl lacking distinct unguis. Gnathopod 2 short, powerful, segments 3 & 5 vestigial; propod large, deep, palm steeply oblique, hinge tooth strong.

Coxal gills single, thick, with distinct, large, unequally paired basal accessory gills.

Peraeopods 5-7 short, powerful; basis short, broad, antero-distal flange large; segment 3 vestigial, partly fused to 2; segment 4 subcryptic, with no free anterior margin; segment 5 very short and deeper than length of basis; propod short, stout, with slight distal palm; dactyl short, not strongly curved.

Male pleopods regular. Penes nearly straight.

Female (ov.) (10.5 mm): brood lamellae large, margins strongly setose.

**Remarks:** Material illustrated here may vary slightly from that taken from arctic bowhead whales figured by Lütken (loc. cit.) and others.

*Cyamus (Cyamus) monodontis* Lütken, 1870. (Fig. 4)

*Cyamus monodontis* Lütken 1873; Stephensen 1942; Leung 1967.

#### Material Examined:

Vancouver Public Aquarium, B. C., ex Beluga (*Delphinaptera leucas*), A. C. McNeill coll., November, 1972 - male (7.0 mm), slide mount, CMN NMCC 1989-101.

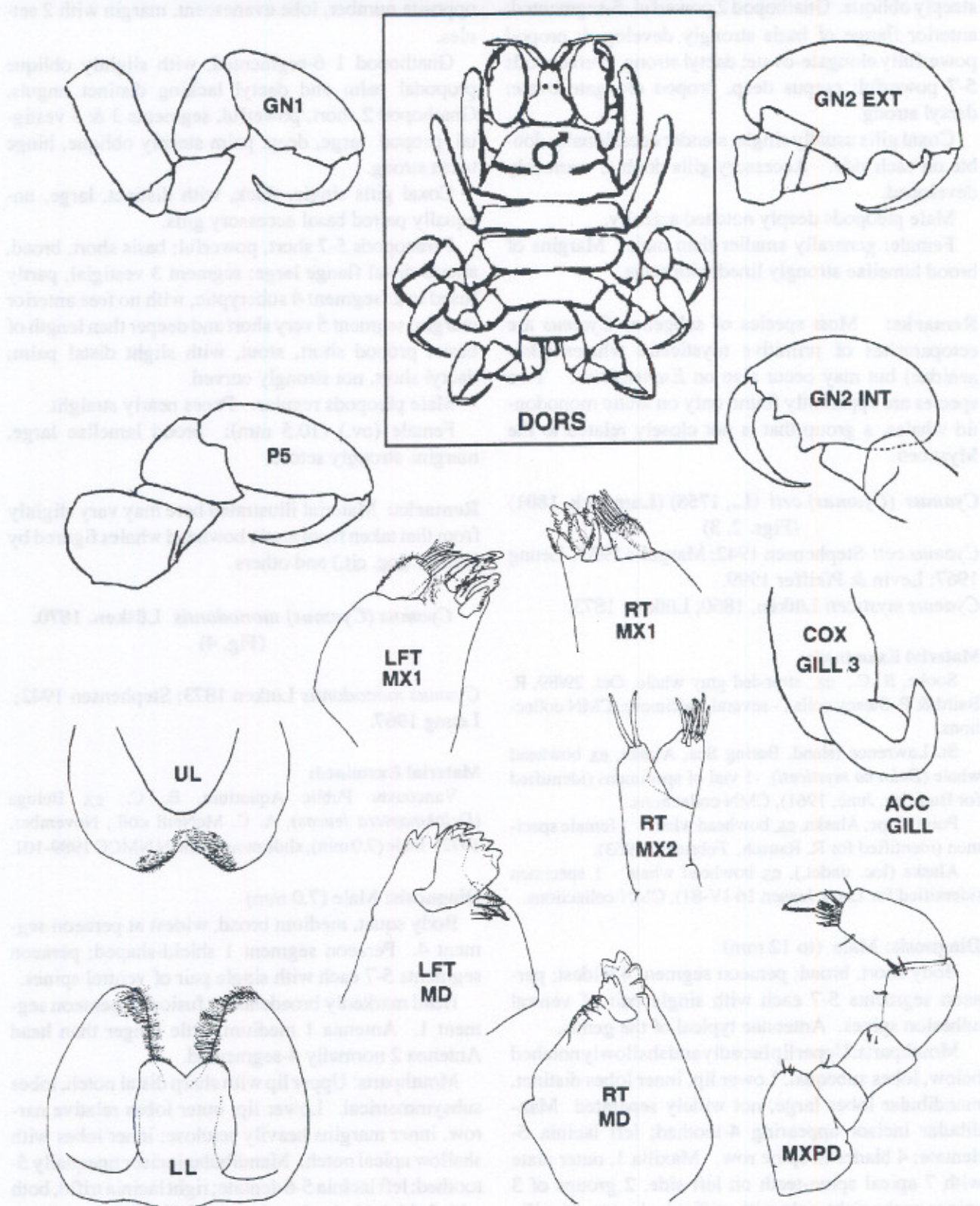
#### Diagnosis: Male (7.0 mm)

Body squat, medium broad, widest at peraeon segment 4. Peraeon segment 1 shield-shaped; peraeon segments 5-7 each with single pair of ventral spines.

Head markedly broadened at fusion of peraeon segment 1. Antenna 1 medium, little longer than head. Antenna 2 normally 4-segmented.

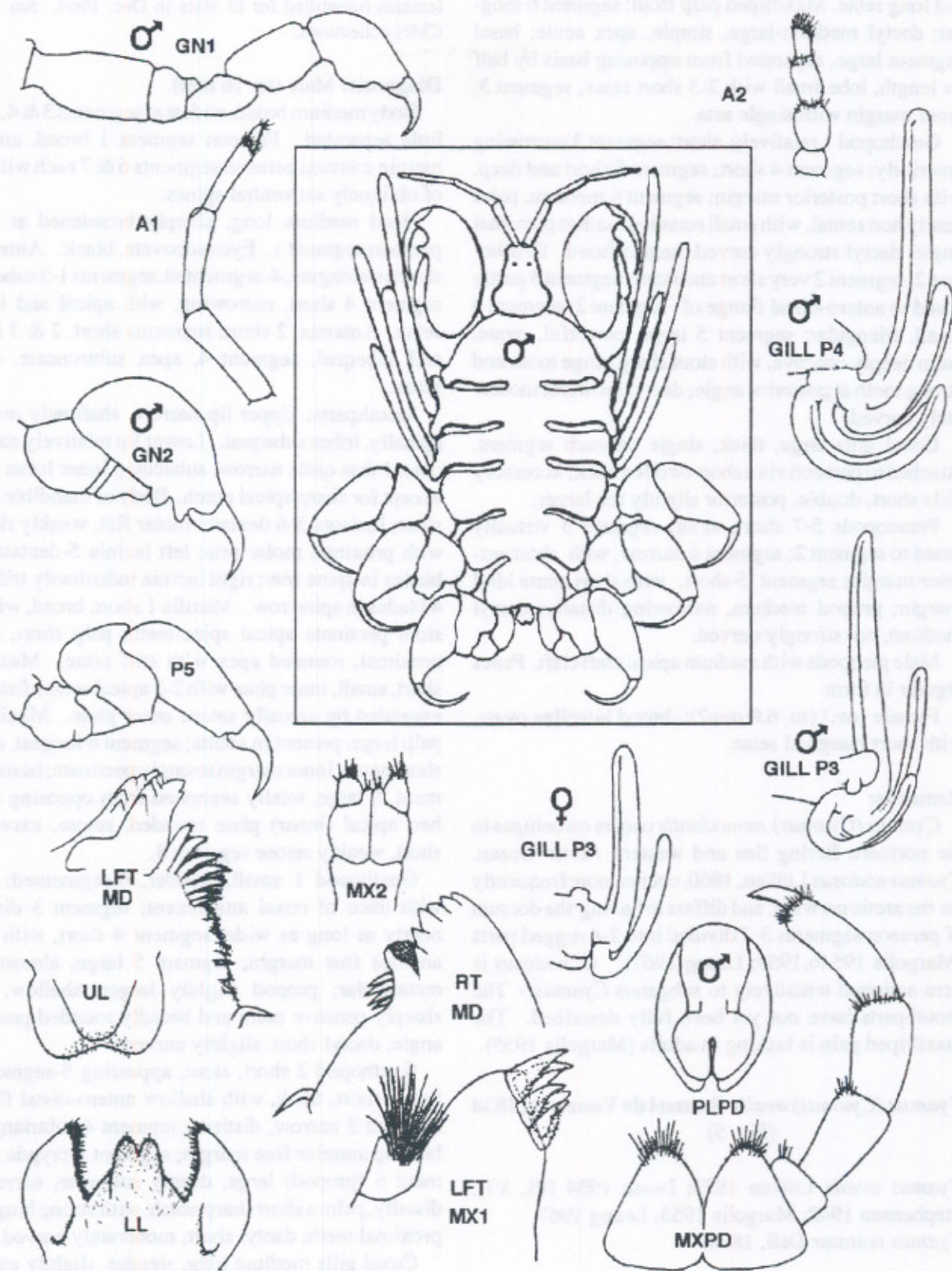
Mouthparts: Upper lip with sharp distal notch, lobes subsymmetrical. Lower lip, outer lobes relative narrow, inner margins heavily setulose; inner lobes with shallow apical notch. Mandibular incisor unequally 5-toothed; left lacinia 5-6 dentate; right lacinia trifid, both with 3 thick blades in spine row. Maxilla 1 medium-large, deep, outer plate with 6 apical pectinate spine-teeth; palp relatively large, reaching end of outer plate, apex bearing several stout blade-like setae. Maxilla 2 very small; outer plate distinct, with several apical





**Fig. 4.** *Cyamus (Cyamus) monodontis* Lütken, 1873. Male (7.0 mm) ex *Delphinaptera* (beluga).  
Vancouver Public Aquarium, B. C.





**Fig. 5.** *Cyamus (Cyamus) ovalis* Roussel de Vauzème, 1834. Male (16 mm); female (10 mm).  
*ex Eualaena glacialis*, North Pacific Ocean. (after Iwasa 1934; inset: after Lütken 1873).



setae, barely exceeding distinct inner plate tipped with 2-3 long setae. Maxilliped palp stout; segment 6 longest; dactyl medium-large, simple, apex acute; basal segment large, separated from opposing basis by half its length, lobe small with 2-3 short setae; segment 3, inner margin with single seta.

Gnathopod 1 relatively short; segment 3 narrowing anteriorly; segment 4 short; segment 5 short and deep, with short posterior margin; segment 6 medium, palm nearly horizontal, with small rounded tooth at proximal angle; dactyl strongly curved, unguis fused. Gnathopod 2, segment 2 very short and stout; segment 3 partly fused to antero-distal flange of segment 2; segment 4 small, triangular; segment 5 large, powerful, ovate, palm deeply concave, with stout sharp hinge tooth and strong tooth at posterior angle; dactyl medium, moderately curved.

Coxal gills large, thick, single on each segment, attached to peraeon via a short swollen stalk; accessory gills short, double, posterior slightly the larger.

Peraeopods 5-7 short, stout; segment 3 virtually fused to segment 2; segment 4 narrow, with short anterior margin; segment 5 short, with short acute hind margin; propod medium, narrowing distally; dactyl medium, not strongly curved.

Male pleopods with medium apical cleft cleft. Penes regular in form.

Female (ov.) (to 6.0 mm?): brood lamellae ovate, with short marginal setae.

#### Remarks:

*Cyamus (Cyamus) monodontis* occurs on belugas in the northern Bering Sea and western Arctic Ocean. *Cyamus nodosus* Lütken, 1860, occurs more frequently on the arctic narwhal, and differs in having the dorsum of peraeon segments 3-7 divided into 2-4 rugged parts (Margolis 1954b, 1955; Leung 1967). *C. nodosus* is here assigned tentatively to subgenus *Cyamus*. The mouthparts have not yet been fully described. The maxilliped palp is lacking in adults (Margolis 1955).

*Cyamus (Cyamus) ovalis* Roussel de Vauzème, 1834 (Fig. 5)

*Cyamus ovalis* Lütken 1873; Iwasa 1934 (PL VI); Stephensen 1942; Margolis 1955; Leung 1967.  
*Cyamus tentator* Dall, 1874.

#### Material Examined:

Off Alaska, southern Bering Sea, ex right whale - several male & female specimens (identified for D. Rice, Dec. 1964 & Jan. 1965, CMN collections).

Southern Bering Sea, ex right whale - several males & females (identified for D. Rice in Dec. 1964, Jan. 1965; CMN collections).

#### Diagnosis: Male (to 16 mm).

Body medium broad, widest at segments 3 & 4, lobes little separated. Peraeon segment 1 broad, anterior margin convex; peraeon segments 6 & 7 each with pair of obliquely set ventral spines.

Head medium long, sharply broadened at fused peraeon segment 1. Eyes subovate, black. Antenna 1 slender, elongate, 4-segmented, segments 1-3 subequal, segment 4 short, narrowing, with apical and lateral setae. Antenna 2 short, segments short, 2 & 3 larger and subequal, segment 4, apex subtruncate, short-setose.

Mouthparts: Upper lip narrow, shallowly notched apically, lobes subequal. Lower lip relatively narrow, outer lobes quite narrow, subacute; inner lobes fused except for sharp apical notch. Body of mandible short, stout; incisors 5-6 dentate; molar flat, weakly ridged, with proximal molar seta; left lacinia 5-dentate; 6-7 blades in spine row; right lacinia indistinctly trifold; 3-4 blades in spine row. Maxilla 1 short, broad, with six stout pectinate apical spine-teeth; palp short, thick, proximal, rounded apex with stiff setae. Maxilla 2 short, small, inner plate with 2-3 apical setae, distinctly exceeded by apically setose outer plate. Maxilliped palp large, present in adults; segment 6 longest, dactyl short, acute, inner margin strongly pectinate; basis (segment 2) large, totally separated from opposing member, apical (inner) plate rounded, setose, exceeding short, weakly setose segment 3.

Gnathopod 1 small, slender, 6-segmented; basis with trace of coxal attachment; segment 3 distinct, nearly as long as wide; segment 4 short, with short anterior free margin; segment 5 large, almost subrectangular; propod slightly larger, shallow, with sharply concave palm and broadly rounded posterior angle; dactyl short, slightly curved.

Gnathopod 2 short, stout, appearing 5-segmented; basis short, thick, with shallow antero-distal flange; segment 3 narrow, distinct; segment 4 subtriangular, lacking anterior free margin; segment 5 cryptic; segment 6 (propod) large, deeply subovate, narrowing distally, palm a short sharp notch, with strong hinge and proximal teeth; dactyl short, moderately curved.

Coxal gills medium long, slender, slightly exceeding head, unequally triple on peraeon 3, unequally quadruple on peraeon segment 4.

Peraeopods 5-7 short, stout, strong, 5-segmented, peraeopod 7 slightly smallest; segment 3 fused to short



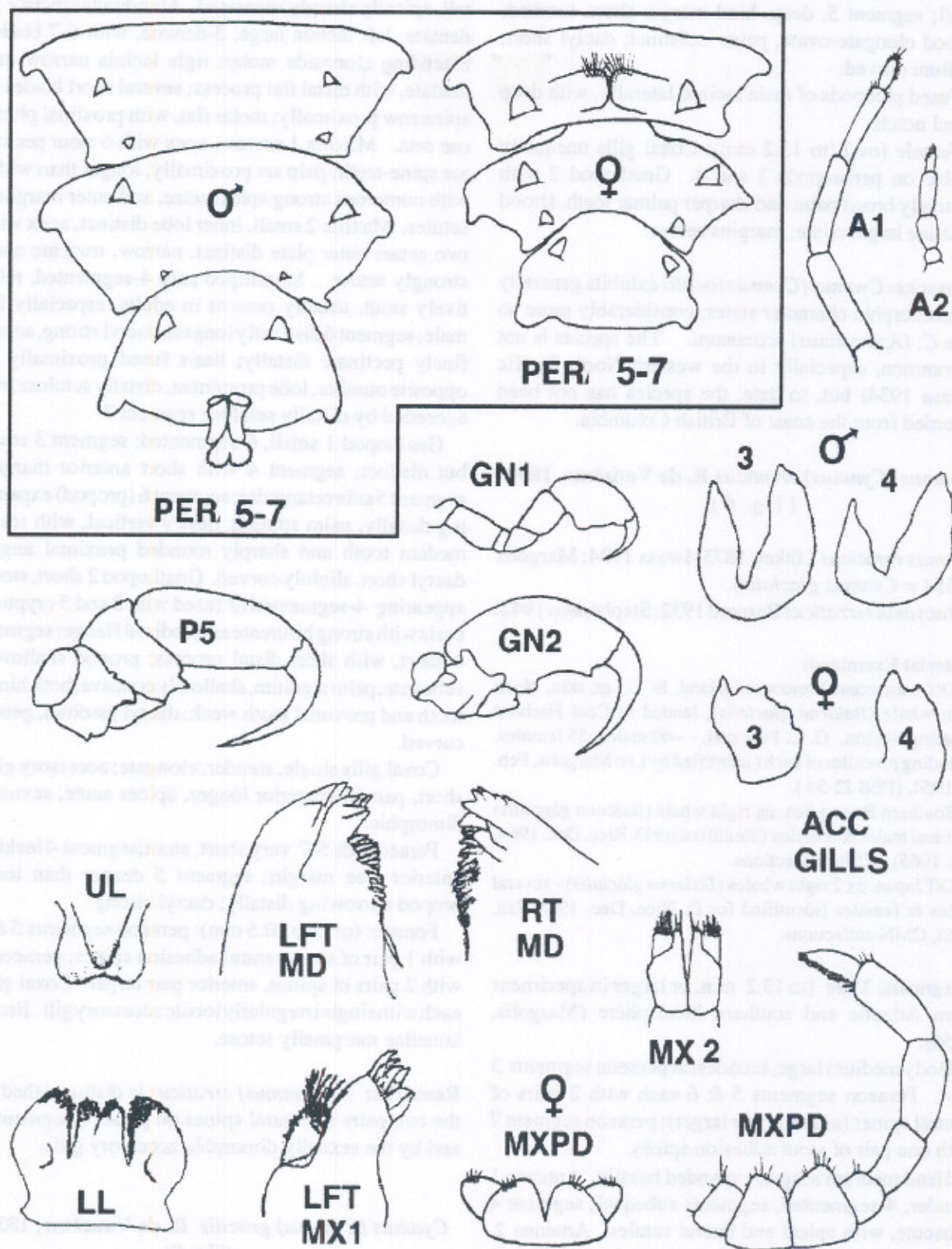


Fig. 6. *C. (Cyamus) erraticus* (Roussel de Vauzème, 1834). Male (13.2mm; female (10.5 mm).  
ex *Eubalaena glacialis*, Sooke, B. C. [after Iwasa 1934; Inset: after Margolis 1955).



basis having ventral facial adhesion spine; segment 4 small; segment 5, deep, hind margin short, toothed; propod elongate-ovate, palm indistinct; dactyl short, medium curved.

Fused pleopods of male incised laterally, with deep apical notch.

Female (ov.) (to 13.2 mm): Coxal gills unequally double on pereopods 3 and 4. Gnathopod 2 with relatively broad palm and sharper palmar teeth. Brood lamellae large, ovate, margins setose.

**Remarks:** *Cyamus* (*Cyamus*) *ovalis* exhibits generally plesiomorphic character states, considerably more so than *C. (Apocyamus) scammoni*. The species is not uncommon, especially in the western North Pacific (Iwasa 1934) but, to date, the species has not been recorded from the coast of British Columbia.

*Cyamus (Cyamus) erraticus* R. de Vauzème, 1834  
(Fig. 6)

*Cyamus erraticus* Lütken 1873; Iwasa 1934; Margolis 1955 (= *Cyamus glacialis*).

*Paracyamus erraticus* Barnard 1932; Stephensen 1942.

**Material Examined:**

Off west coast Vancouver Island, B. C., ex skin, black right whale (*Balaena glacialis*), landed at Coal Harbour Whaling Station, G. C. Pike coll. - ~40 males, 55 females, including juveniles of each (identified by Leo Margolis, Feb. 2, 1954, (PBS J2-54)).

Southern Bering Sea, ex right whale (*Balaena glacialis*) - several males & females (identified for D. Rice, Dec. 1964; Jan. 1965), CMN collections.

Off Japan, ex 2 right whales (*Balaena glacialis*) - several males & females (identified for D. Rice, Dec. 1964; Jan. 1965, CMN collections).

**Diagnosis:** Male (to 13.2 mm, or larger in specimens from Atlantic and southern hemisphere (Margolis, 1955).

Body medium large, broadest at pereon segments 3 & 4. Pereon segments 5 & 6 each with 2 pairs of ventral spines (anterior pair larger); pereon segment 7 with one pair of stout adhesion spines.

Head medium longer, expanded basally. Antenna 1 slender, 4-segmented, segments subequal; segment 4 subacute, with apical and lateral setules. Antenna 2, medium-short, 4-segmented; segment 1 very short, 3 longest, 2 medium, swollen; segment 4 acute, with apical and marginal setules.

Mouthparts: Upper lip narrow, with shallow apical notch; lobes subequal; epistome prominent. Lower lip,

outer lobes narrow, inner margins straight; inner lobes tall, apically sharply separated. Mandibular incisor 5-dentate; left lacinia large, 5-dentate, with 6-7 blades extending alongside molar; right lacinia narrow, tridentate, with distal flat process; several short blades in spine row proximally; molar flat, with proximal plumose seta. Maxilla 1 narrow, apex with 6 stout pectinate spine-teeth; palp set proximally, longer than wide, with numerous strong apical setae, and outer marginal setules. Maxilla 2 small, inner lobe distinct, apex with two setae; outer plate distinct, narrow, truncate apex strongly setose. Maxilliped palp 4-segmented, relatively stout, usually present in adults, especially female; segment 6 distinctly longest, dactyl strong, acute, finely pectinate distally; basis fused proximally to opposite number, lobe prominent, distally setulose, not exceeded by distally setulose segment 3.

Gnathopod 1 small, 6-segmented; segment 3 small but distinct; segment 4 with short anterior margin; segment 5 subrectangular; segment 6 (propod) expanding distally, palm straight, nearly vertical, with small median tooth and sharply rounded proximal angle; dactyl short, slightly curved. Gnathopod 2 short, stout, appearing 4-segmented (3 fused with 2 and 5 cryptic); basis with strong bifurcate anterodistal flange; segment 4 short, with short distal process; propod shallowly subovate, palm medium, shallowly concave, both hinge tooth and proximal tooth weak; dactyl medium, gently curved.

Coxal gills single, slender, elongate; accessory gills short, paired, posterior longer, apices acute, sexually dimorphic.

Pereopods 5-7 very short, stout; segment 4 lacking anterior free margin; segment 5 deeper than long; propod narrowing distally; dactyl strong

Female: (ov.) (to 10.5 mm): pereon segments 5 & 7 with 1 pair of stout ventral adhesion spines; pereon 6 with 2 pairs of spines, anterior pair larger. Coxal gills each with single irregularly lobate accessory gill. Brood lamellae marginally setose.

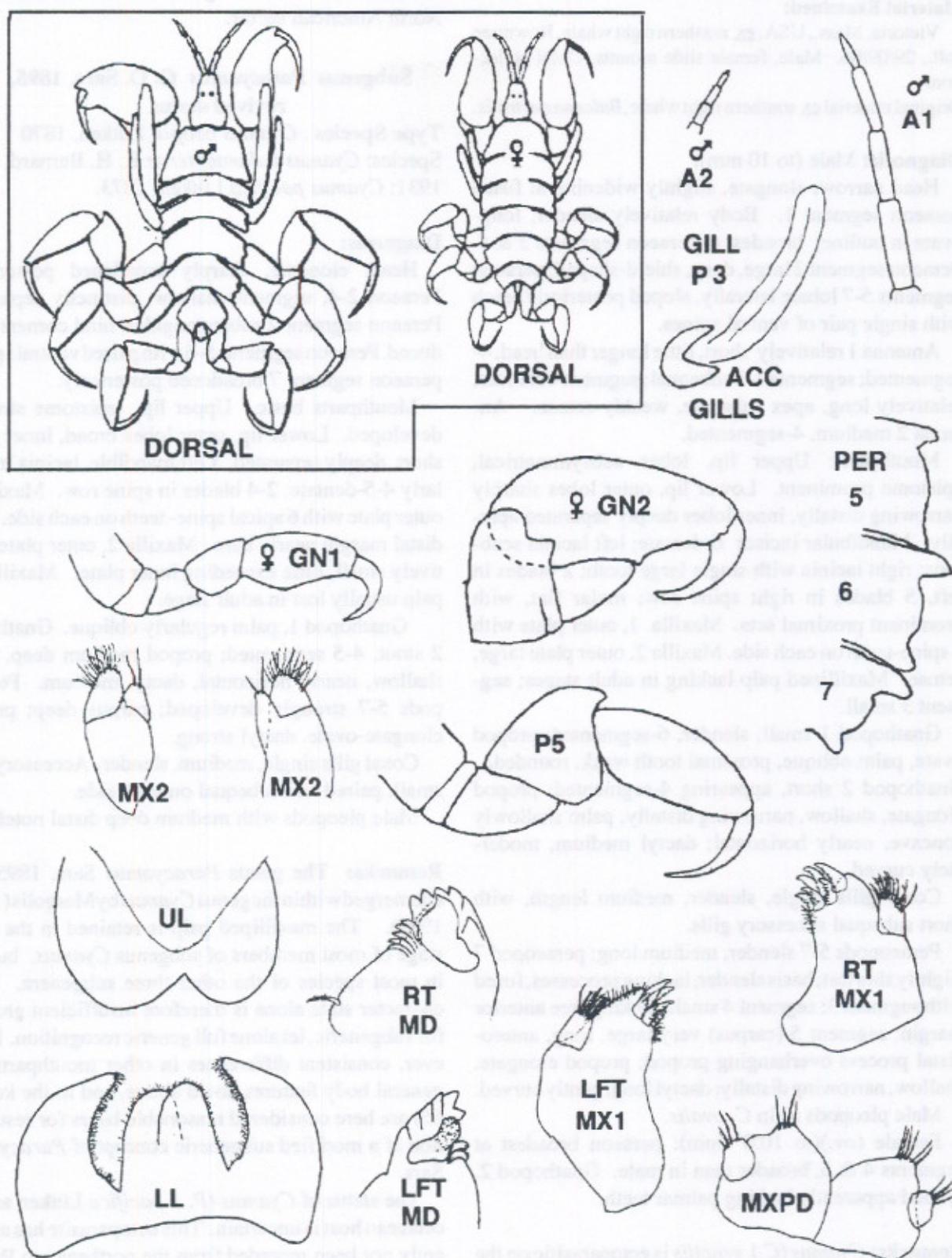
**Remarks:** *C. (Cyamus) erraticus* is distinguished by the two pairs of ventral spines on pereon segment 6, and by the sexually dimorphic accessory gills.

*Cyamus (Cyamus) gracilis* R. de Vauzème, 1834  
(Fig. 7)

*Cyamus gracilis* Lütken 1873; Margolis 1955; Leung 1967.

*Paracyamus gracilis* Barnard 1932.





**Fig. 7.** *Cyamus (Cyamus) gracilis* (R. de Vauzème). Male (10 mm); Female (ov.) (8 mm), ex *Eubalaena glacialis*, North Pacific Ocean [ after Iwasa (1934); Inset: after Lütken (1873)].



**Material Examined:**

Victoria, Mass., USA, ex northern right whale, Rowntree coll., 29/09/86. Male, female slide mounts, CMN collections.

Original material ex southern right whale, *Balaena australis*.

**Diagnosis:** Male (to 10 mm).

Head narrow, elongate, slightly widening at fused peraeon segment 1. Body relatively slender, long-ovate in outline; broadest at peraeon segments 3 & 4. Peraeon segment 2 large, deep, shield-shaped; peraeon segments 5-7 lobate laterally, sloped posteriorly, each with single pair of ventral spines.

Antenna 1 relatively short, little longer than head, 4-segmented; segments 1-3 subequal; segment 4 slender, relatively long, apex subacute, weakly setose. Antenna 2 medium, 4-segmented.

Mouthparts: Upper lip, lobes subsymmetrical, epistome prominent. Lower lip, outer lobes sharply narrowing distally, inner lobes deeply separated apically. Mandibular incisor 6-dentate; left lacinia scabrous; right lacinia with single large tooth; 2 blades in left, 5 blades in right spine row; molar flat, with prominent proximal seta. Maxilla 1, outer plate with 6 spine-teeth on each side. Maxilla 2, outer plate large, setose. Maxilliped palp lacking in adult stages; segment 3 small.

Gnathopod 1 small, slender, 6-segmented; propod ovate, palm oblique, proximal tooth weak, rounded. Gnathopod 2 short, appearing 4-segmented; propod elongate, shallow, narrowing distally; palm shallowly concave, nearly horizontal; dactyl medium, moderately curved.

Coxal gills single, slender, medium length, with short subequal accessory gills.

Peraeopods 5-7 slender, medium long; peraeopod 7 slightly shortest; basis slender, lacking processes, fused with segment 3; segment 4 small, lacking free anterior margin; segment 5 (carpus) very large, long, antero-distal process overhanging propod; propod elongate, shallow, narrowing distally; dactyl long, gently curved.

Male pleopods as in *C. ovalis*.

Female (ov.) (to 10.0 mm): peraeon broadest at segments 4 & 5, broader than in male. Gnathopod 2, propod apparently lacking palmar teeth.

**Remarks:** *Cyamus* (*C.*) *gracilis* is ectoparasitic on the northern right whale but has seldom been recorded

from the North Pacific region, and not to date from the North American sector.

**Subgenus *Paracyamus* G. O. Sars, 1895,  
revived status**

**Type Species:** *Cyamus boopis* Lütken, 1870

**Species:** *Cyamus balaenopterae* K. H. Barnard, 1931; *Cyamus pacifica* Lütken, 1873.

**Diagnosis:**

Head, elongate, sharply broadened posteriorly. Peraeon 2-4, segments narrow, distinctly separated. Peraeon segment 2 subrectangular, hind corners produced. Peraeon segments 5-6 with paired ventral spines; peraeon segment 7 broadened posteriorly.

Mouthparts basic. Upper lip, epistome strongly developed. Lower lip, outer lobes broad, inner lobes short, deeply separated. Left mandible, lacinia irregularly 4-5-dentate; 2-4 blades in spine row. Maxilla 1, outer plate with 6 apical spine-teeth on each side, inner distal margin nearly bare. Maxilla 2, outer plate relatively small, little exceeding inner plate. Maxilliped, palp usually lost in adult stage.

Gnathopod 1, palm regularly oblique. Gnathopod 2 stout, 4-5 segmented; propod medium deep, palm shallow, nearly horizontal, dactyl medium. Peraeopods 5-7 strongly developed; carpus deep; propod elongate-ovate, dactyl strong.

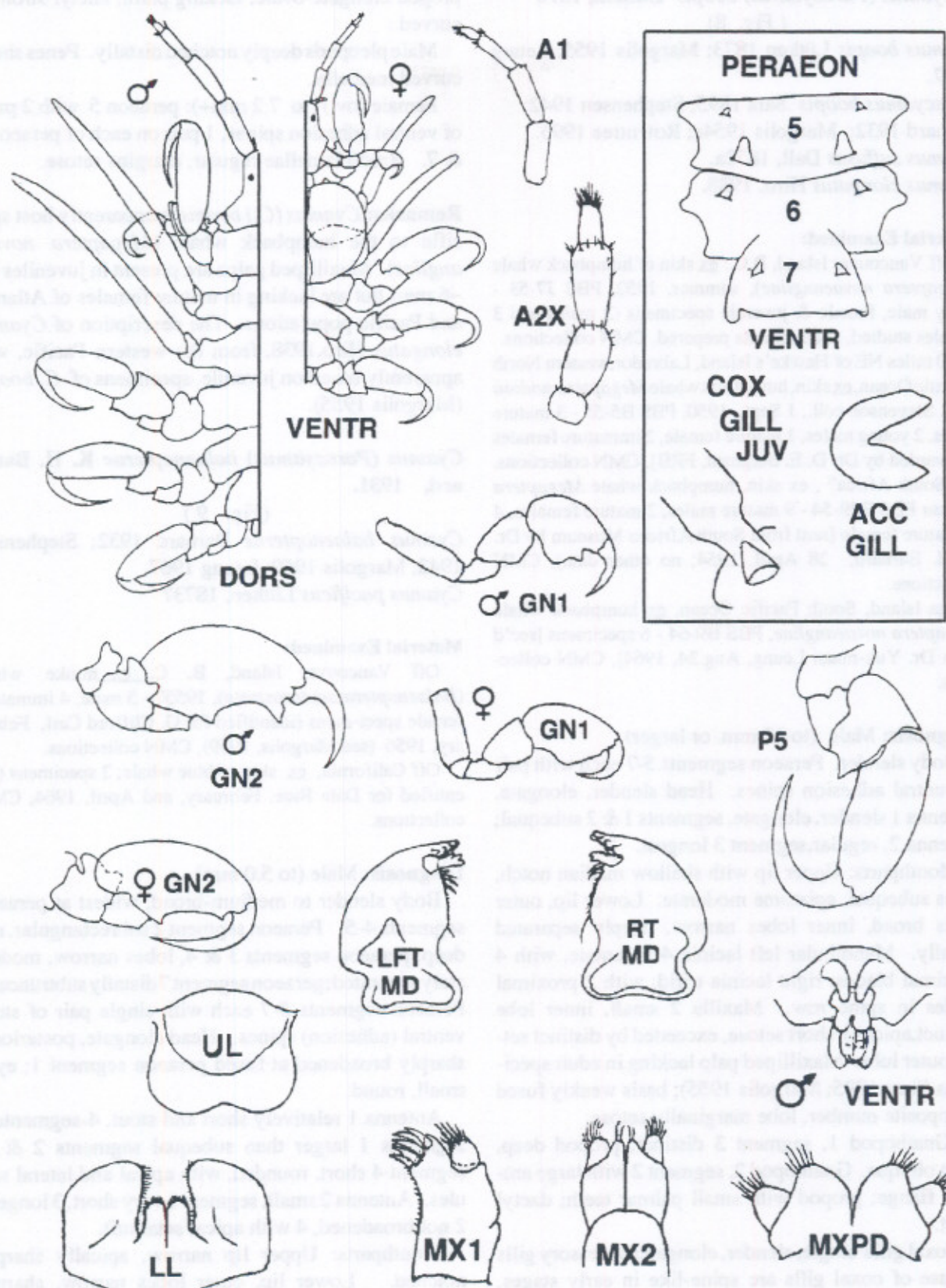
Coxal gills single, medium, slender. Accessory gills small, paired and subequal on each side.

Male pleopods with medium deep distal notch.

**Remarks:** The genus *Paracyamus* Sars, 1895 was submerged within the genus *Cyamus* by Margolis (1955, 1959). The maxilliped palp is retained in the adult stage of most members of subgenus *Cyamus*, but lost in most species of the other three subgenera. This character state alone is therefore insufficient grounds for subgeneric, let alone full generic recognition. However, consistent differences in other mouthparts and general body features noted above, and in the key (p. 66) are here considered reasonable bases for resurrection of a modified subgeneric concept of *Paracyamus* Sars.

The status of *Cyamus* (*P.*) *pacifica* Lütken and its cetacean host is uncertain. This ectoparasite has apparently not been recorded from the northeastern Pacific region.





**Fig. 8.** *Cyamus (Paracyamus) boopis* Lütken, 1870. Male (12 mm); female (ov.) (7.2 mm). ex *Megaptera novaeangliae*. North Pacific Ocean (after Sars 1895; inset: after Margolis 1955).



***Cyamus (Paracyamus) boopis* Lütken, 1870**

(Fig. 8)

*Cyamus boopis* Lütken 1873; Margolis 1955; Leung 1967.*Paracyamus boopis* Sars 1895; Stephensen 1942; Barnard 1932; Margolis 1954a; Rowntree 1996.*Cyamus suffusus* Dall, 1872a.*Cyamus elongatus* Hiro, 1938.**Material Examined:**

Off Vancouver Island, B.C.: ex skin of humpback whale (*Megaptera novaeangliae*), summer, 1952, PBS J7-53 - many male, female & juvenile specimens (3 males and 3 females studied, slide mounts prepared, CMN collections).

60 miles NE of Hawke's Island, Labrador, western North Atlantic Ocean, ex skin, humpback whale *Megaptera nodosa* R. L. Stevenson coll., 1 Sept., 1950, PBS B5-55 - 3 mature males, 2 young males, 1 mature female, 2 immature females [forwarded by Dr. D. E. Sergeant, FRB], CMN collections.

Off South Africa?, ex skin, humpback whale *Megaptera nodosa* PBS B29-54 - 9 mature males, 2 mature females, 4 immature female [sent from South African Museum by Dr. K. H. Barnard, 28 April, 1954; no other data], CMN collections.

Tonga Island, South Pacific Ocean, ex humpback whale *Megaptera novaeangliae*, PBS B9-64 - 6 specimens [rec'd from Dr. Yuk-maan Leung, Aug. 24, 1964], CMN collections.

**Diagnosis:** Male (to 12 mm. or larger).

Body slender. Peraeon segments 5-7 each with pair of ventral adhesion spines. Head slender, elongate. Antenna 1 slender, elongate, segments 1 & 2 subequal; Antenna 2, regular, segment 3 longest.

Mouthparts: Upper lip with shallow median notch, lobes subequal, epistome moderate. Lower lip, outer lobes broad, inner lobes narrow, deeply separated distally. Mandibular left lacinia 4-5-dentate, with 4 proximal blades; right lacinia trifid, with 2 proximal blades in spine row. Maxilla 2 small, inner lobe distinct, apically short setose, exceeded by distinct setose outer lobe. Maxilliped lacking in adult specimens (Sars 1895; Margolis 1955); basis weakly fused to opposite number, lobe marginally setose.

Gnathopod 1, segment 3 distinct; propod deep, palm oblique. Gnathopod 2, segment 2 with large anterior flange; propod with small palmar teeth; dactyl short.

Coxal gills single, slender, elongate; accessory gills at base of coxal gills are spine-like in early stages, subequally bifurcate in adult males and females [no ventral spines present (see Margolis 1955)].

Peraeopod 5-7 stout, 5-segmented. Basis short;

propod elongate-ovate, lacking palm; dactyl strongly curved.

Male pleopods deeply notched distally. Penes short, curved medially.

Female (ov.) (to 7.2 mm+): peraeon 5 with 2 pairs of ventral adhesion spines, 1 pair on each of peraeon 6 & 7. Brood lamellae regular, margins setose.

**Remarks:** *Cyamus (C.) boopis* is apparently host specific to the humpback whale (*Megaptera novaeangliae*). Maxilliped palps are present in juveniles (to ~6 mm) but are lacking in mature females of Atlantic and Pacific populations. The description of *Cyamus elongatus* Hiro, 1938, from the western Pacific, was apparently based on juvenile specimens of *C. boopis* (Margolis 1955).

***Cyamus (Paracyamus) balaenopterae* K. H. Barnard, 1931.**

(Fig. 9)

*Cyamus balaenopterae* Barnard 1932; Stephensen 1942; Margolis 1959; Leung 1967.*Cyamus pacificus* Lütken, 1873?**Material Examined:**

Off Vancouver Island, B. C., ex minke whale (*Balaenoptera acutorostrata*), 1955? - 5 male, 4 immature female specimens (identified for G. Clifford Carl, February, 1956 (see Margolis, 1959), CMN collections.

Off California, ex skin of blue whale; 2 specimens (identified for Dale Rice, February, and April, 1964, CMN collections.

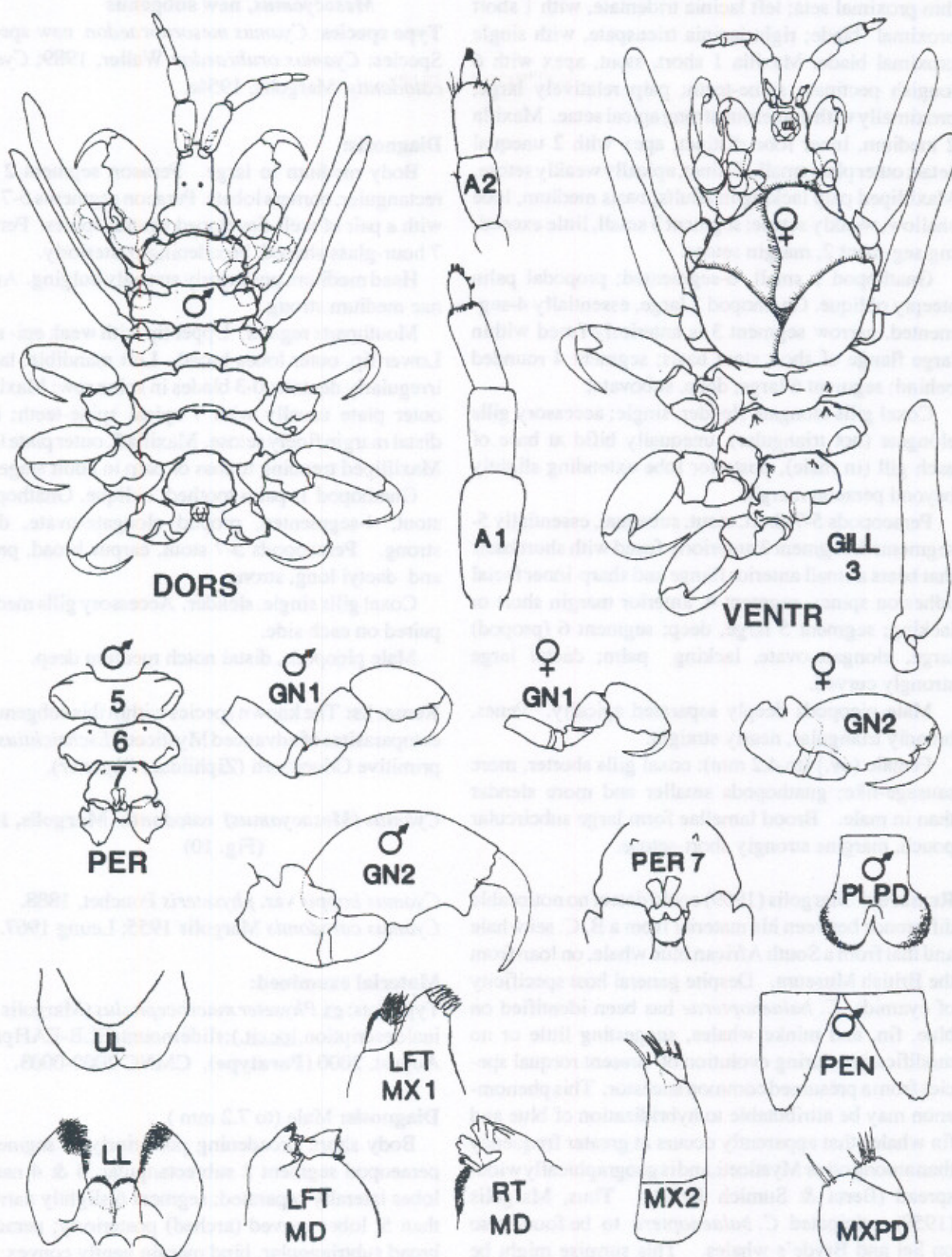
**Diagnosis:** Male (to 5.0 mm).

Body slender to medium-broad, widest at peraeon segments 4-5. Peraeon segment 2 subrectangular, not deep; peraeon segments 3 & 4, lobes narrow, moderately separated; peraeon segment 7 distally subtruncate. Peraeon segments 5-7 each with single pair of stout ventral (adhesion) spines. Head elongate, posteriorly sharply broadened at fused peraeon segment 1; eyes small, round.

Antenna 1 relatively short and stout, 4-segmented; segments 1 larger than subequal segments 2 & 3; segment 4 short, rounded, with apical and lateral setules. Antenna 2 small, segment 1 very short, 3 longest, 2 not broadened, 4 with apical setal tuft.

Mouthparts: Upper lip narrow, apically sharply notched. Lower lip, outer lobes narrow, sharply rounded, with strong inner distal setules; inner lobes, low, deeply separated. Mandibular incisor 4-5 dentate; molar flat, weakly tritulative and setulose, with





**Fig. 9.** *Cyamus (Paracyamus) balaenopterae* Barnard, 1931. Male (5.0 mm); female (4.2 mm),  
ex *Balaenoptera acutirostrata*, off Vancouver I., B. C.



thin proximal seta; left lacinia tridentate, with 1 short proximal blade; right lacinia tricusate, with single proximal blade. Maxilla 1 short, stout, apex with 6 longish pectinate spine-teeth; palp relatively large, proximally with numerous strong apical setae. Maxilla 2 medium, inner lobe distinct, apex with 2 unequal setae; outer plate small, distinct, apically weakly setose. Maxilliped palp lacking in adults; basis medium, lobe shallow, weakly setose; segment 3 small, little exceeding segment 2, margin setose.

Gnathopod 1 small, 6-segmented; propodal palm steeply oblique. Gnathopod 2 large, essentially 4-segmented, narrow segment 3 is anteriorly fused within large flange of short stout basis; segment 4 rounded behind; segment 6 large, deep, subovate;

Coxal gills elongate slender, single; accessory gills elongate (not triangular), unequally bifid at base of each gill (in male), posterior lobe extending slightly beyond peraeon margin.

Peraeopods 5-7 short, stout, subequal, essentially 5-segmented, segment 3 anteriorly fused with short basis that bears a small anterior flange and sharp inner facial adhesion spine; segment 4, anterior margin short or lacking; segment 5 large, deep; segment 6 (propod) large, elongate-ovate, lacking palm; dactyl large strongly curved.

Male pleopods deeply separated apically. Penes, broadly triangular, nearly straight.

Female (ov.) (to 4.2 mm): coxal gills shorter, more sausage-like; gnathopods smaller and more slender than in male. Brood lamellae form large subcircular pouch, margins strongly short-setose.

**Remarks:** Margolis (1959) could detect no noticeable difference between his material from a *B. C. sei* whale and that from a South African blue whale, on loan from the British Museum. Despite general host specificity of cyamids, *C. balaenopterae* has been identified on blue, fin, and minke whales, suggesting little or no modification during evolution of present rorqual species from a presumed common ancestor. This phenomenon may be attributable to hybridization of blue and fin whales that apparently occurs at greater frequency than among other Mysticeti, and is geographically widespread (Berta & Sumich 1999). Thus, Margolis (1959) anticipated *C. balaenoptera* to be found also on Sei and Bryde's whales. This surmise might be carefully checked by re-examination of ectoparasites from all five rorqual species that occur commonly along the B. C. coast.

### *Mesocyamus*, new subgenus

**Type species:** *Cyamus mesorubraedon* new species.  
**Species:** *Cyamus orubraedon* Waller, 1989; *Cyamus catodontis* Margolis, 1954a.

### **Diagnosis:**

Body medium to large. Peraeon segment 2 subrectangular, corners lobate. Peraeon segments 5-7 each with a pair of well-developed ventral spines. Peraeon 7 hour-glass shaped, broadening posteriorly.

Head medium, posteriorly strongly bulging. Antennae medium strong.

Mouthparts regular. Upper lip with weak epi-stom. Lower lip, outer lobes broad. Left mandible, lacinia irregularly dentate; 0-3 blades in spine row; Maxilla 1, outer plate usually with 7 apical spine-teeth; inner distal margin finely setose. Maxilla 2, outer plate large. Maxilliped trending to loss of palp in adult stage.

Gnathopod 1, palm toothed, oblique. Gnathopod 2 stout, 4-segmented, propod elongate-ovate, dactyl strong. Peraeopods 5-7 stout, carpus broad, propod and dactyl long, strong.

Coxal gills single, slender. Accessory gills medium, paired on each side.

Male pleopods, distal notch medium deep.

**Remarks:** The known species within this subgenus are ectoparasites of advanced Mysticeti (*Eschrichtius*) and primitive Odontoceti (Ziphiidae, *Physeter*).

*Cyamus (Mesocyamus) catodontis* Margolis, 1954a  
(Fig. 10)

*Cyamus boopis* var. *physeteris* Pouchet, 1888.

*Cyamus catodontis* Margolis 1955; Leung 1967.

### **Material examined:**

Type lots: ex *Physeter macrocephalus* (Margolis original description, loc. cit.); slide mount (ELB-EAH prep.), August, 2000 (**Paratype**), CMNC 2000-0003.

### **Diagnosis: Male (to 7.2 mm)**

Body short, broadening posteriorly to segment 5; peraeopod segment 2 subrectangular, 3 & 4 narrow, lobes laterally separated; segment 6 slightly narrower than 5; lobes curved (arched) posteriorly; peraeon 7 broad subtriangular, hind margin gently convex; ventral surface of 6-7 each with single pair of stout adhesion spines.

Antenna 1 strong, segment 1 thickest; segment 2



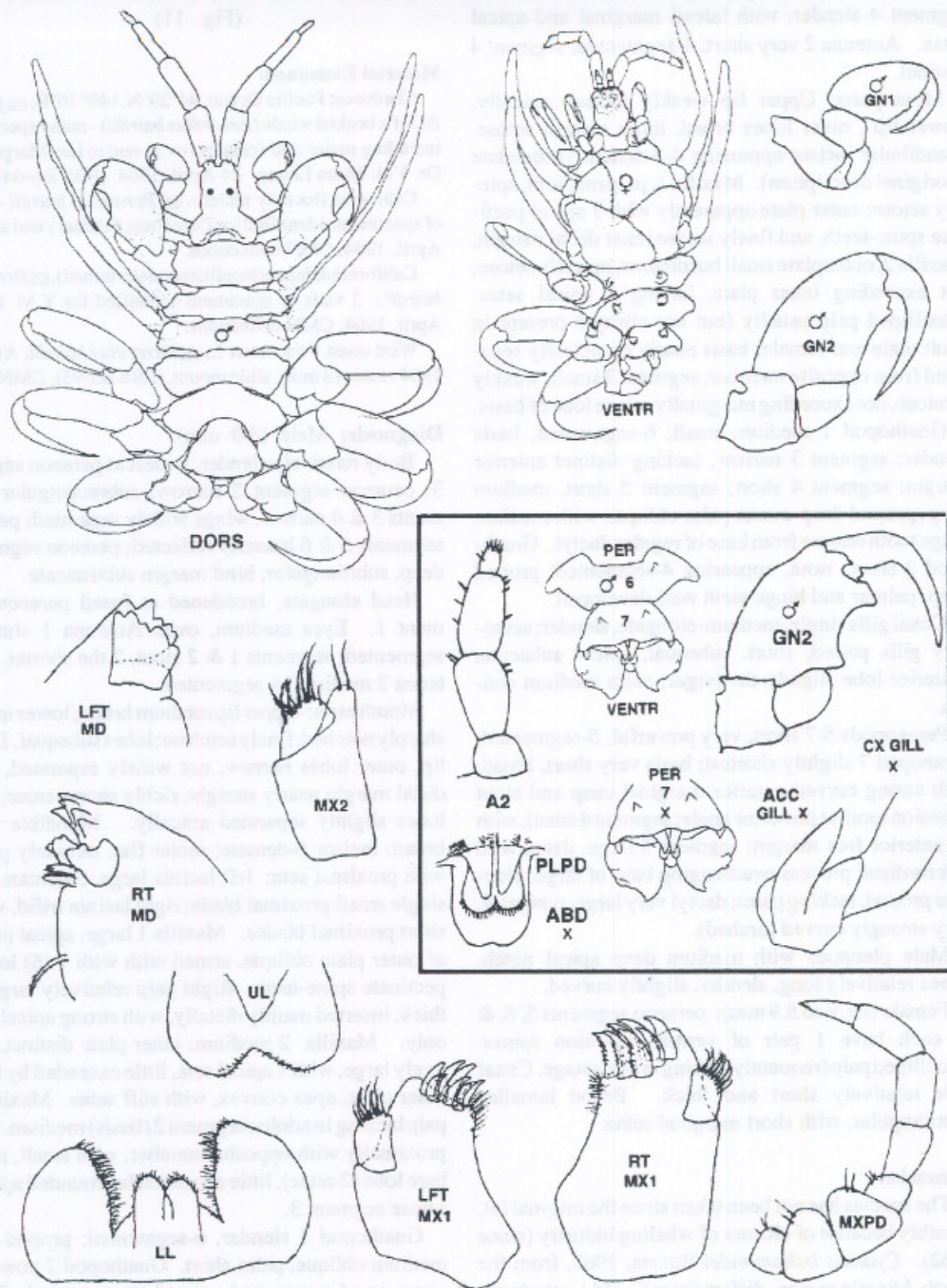


Fig. 10. *Cyamus* (*Mesocyamus*) *catodontis* Margolis, 1954. Male (Holotype) (7.2 mm); female (allotype) (5.9 mm); *ex-Physeter macrocephalus* (Inset: after Margolis 1954a).



thinner, subequal in length; segment 3 slender, shorter; segment 4 slender, with lateral marginal and apical setae. Antenna 2 very short, 4-segmented, segment 4 distinct.

**Mouthparts:** Upper lip weakly incised apically. Lower lip, outer lobes broad, inner margin setose. Mandibular incisor appearing 4-5 dentate (tridentate in original description). Maxilla 1, palp medium, apically setose; outer plate apparently with 7 apical pectinate spine-teeth, and finely setose inner distal margin. Maxilla 2, outer plate small but distinct, apically setose, not exceeding inner plate, having 2 apical setae. Maxilliped palp usually (but not always) present in adult male and female; basis nearly completely separated from opposite member; segment 3 small, weakly setulose, not exceeding marginally setose lobe of basis.

Gnathopod 1 medium small, 6-segmented; basis slender; segment 3 narrow, lacking distinct anterior margin; segment 4 short; segment 5 short, medium deep; propod deep-ovate; palm oblique, with medium hinge tooth remote from base of regular dactyl. Gnathopod 2 short, stout, appearing 4-segmented; propod deep, palmar and hinge teeth well developed.

Coxal gills single, medium-elongate, slender; accessory gills paired, short, subequal, apices subacute, posterior lobe slightly the larger; palm medium convex.

Peraeopods 5-7 short, very powerful, 5-segmented; peraeopod 7 slightly shortest; basis very short, broad, with strong curved anterior marginal cusp and stout adhesion tooth at posterior angle; segment 4 small, with no anterior free margin; segment 5 large, deep, with antero-distal process overhanging base of large, elongate propod, lacking palm; dactyl very large, powerful, very strongly curved (arched).

Male pleopods with medium deep apical notch. Penes relatively long, slender, slightly curved.

Female (ov.) (to 5.9 mm): peraeon segments 5, 6, & 7) each have 1 pair of ventral adhesion spines. Maxilliped palp frequently lacking in adult stage. Coxal gills relatively short and thick. Brood lamellae subtriangular, with short marginal setae.

#### Remarks:

The species has not been taken since the original lot, possibly because of closure of whaling industry (since 1962). *Cyamus bahamondei* Buzeta, 1963, from the North Atlantic region, differs from *C. (M.) catodontis* in having two pairs of ventral spines on peraeon 7, and the accessory gills (male) are equally bifurcated, with tips rounded (Leung 1967).

#### *Cyamus (Mesocyamus) orubraedon* Waller, 1989 (Fig. 11)

#### Material Examined:

Northwest Pacific Ocean, 44°29' N, 149°26' E; ex jaws of Baird's beaked whale (*Berardius bairdii*) - many specimens, including males and females (ov.); sent to Leo Margolis by Dr. Yuk-Maan Leung, 24 April, 1964; (PBS B6-64).

California (locality undet.), ex *Berardius bairdii* - 1 vial of specimens, identified for Dale Rice, February and again in April, 1964, CMN collections.

California & Japan (localities undetermined), ex *Berardius bairdii*; 2 vials of specimens identified for Y.M. Leung, April, 1964, CMN collections.

West coast Vancouver I., ex *Berardius bairdii*, Aug. 14, 1964 - male (8 mm), slide mount, (PBS B5-95), CMN coll's.

#### Diagnosis: Male (8.0 mm).

Body relatively slender, widest at peraeon segment 3; peraeon segment 2 narrow, subrectangular; segments 3 & 4 narrow, wings widely separated; peraeon segments 5 & 6 laterally reflected; peraeon segment 7 deep, subtriangular, hind margin subtruncate.

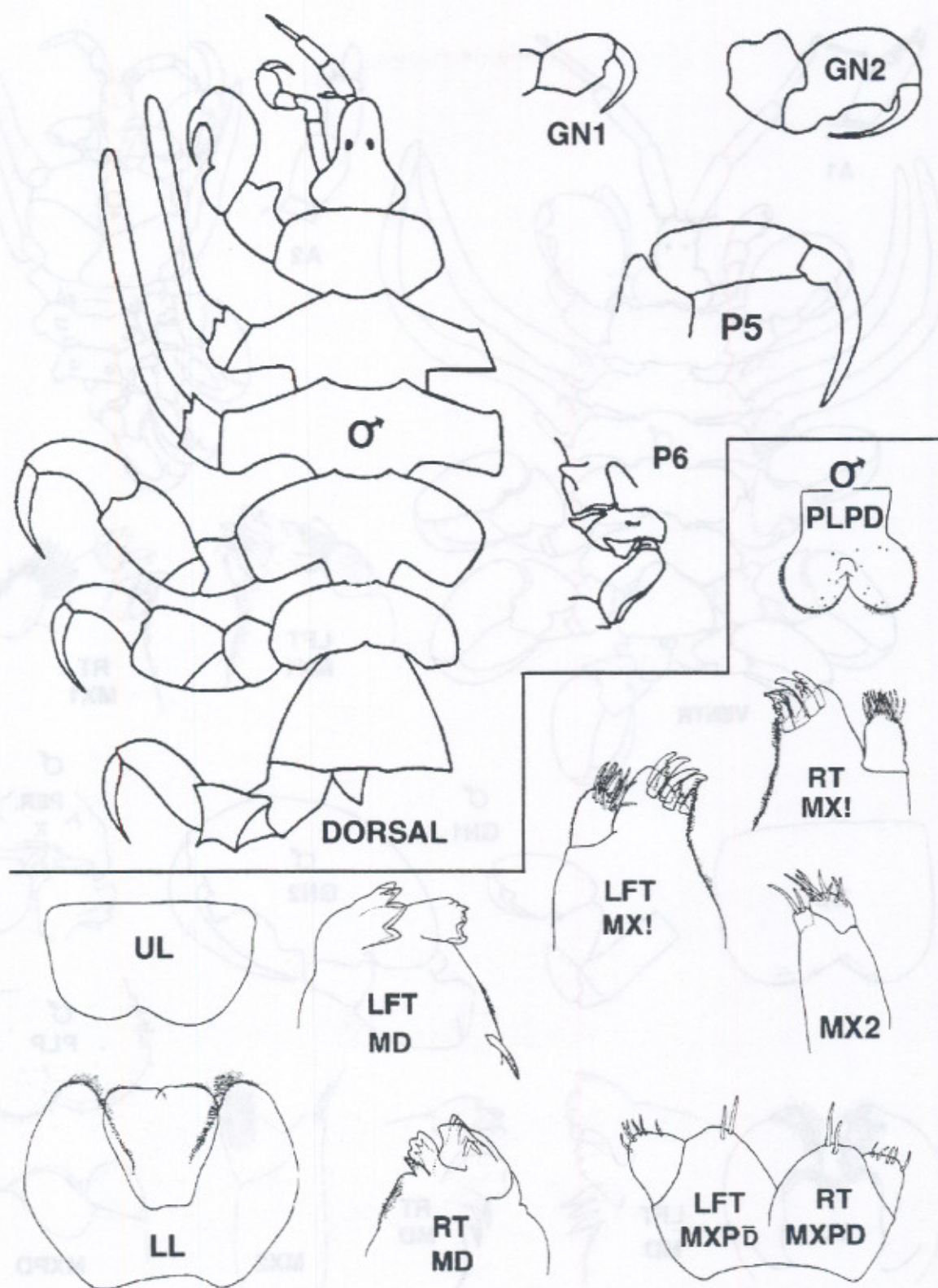
Head elongate, broadened at fused peraeon segment 1. Eyes medium, oval. Antenna 1 short, 4-segmented; segments 1 & 2 stout, 2 the shorter. Antenna 2 medium, 4-segmented.

**Mouthparts:** Upper lip medium broad, lower margin sharply notched, finely setulose; lobes subequal. Lower lip, outer lobes narrow, not widely separated, inner distal margin nearly straight, richly short-setose; inner lobes slightly separated apically. Mandible short, broad; incisor 5-dentate; molar flat, minutely pilose, with proximal seta; left lacinia large, 5-dentate, with single small proximal blade; right lacinia trifid, with 2 short proximal blades. Maxilla 1 large, apical margin of outer plate oblique, armed with 7 (6) longish pectinate spine-teeth. Right palp relatively large and thick, inserted mainly distally, with strong apical setae only. Maxilla 2 medium; inner plate distinct, relatively large, with 1 apical seta, little exceeded by broad outer plate, apex convex, with stiff setae. Maxilliped palp lacking in adults; segment 2 (basis) medium, fused proximally with opposite member, with small, nearly bare lobe (2 setae), little exceeded by rounded apically setose segment 3.

Gnathopod 1 slender, 6-segmented; propod palm medium oblique, palm short. Gnathopod 2 powerful, appearing 4-segmented; propod stout, palm shallowly concave, nearly horizontal.

Peraeopods 5-7 strong; basis short; carpus deep, toothed; propod shallowly long-ovate; dactyl strong.





**Fig. 11.** *Cyamus (Mesocyamus) orubraedon* Waller, 1989. Male (8 mm), *ex Berardius bairdi*, off west coast Vancouver I., B. C. (Upper inset: after Waller 1989).



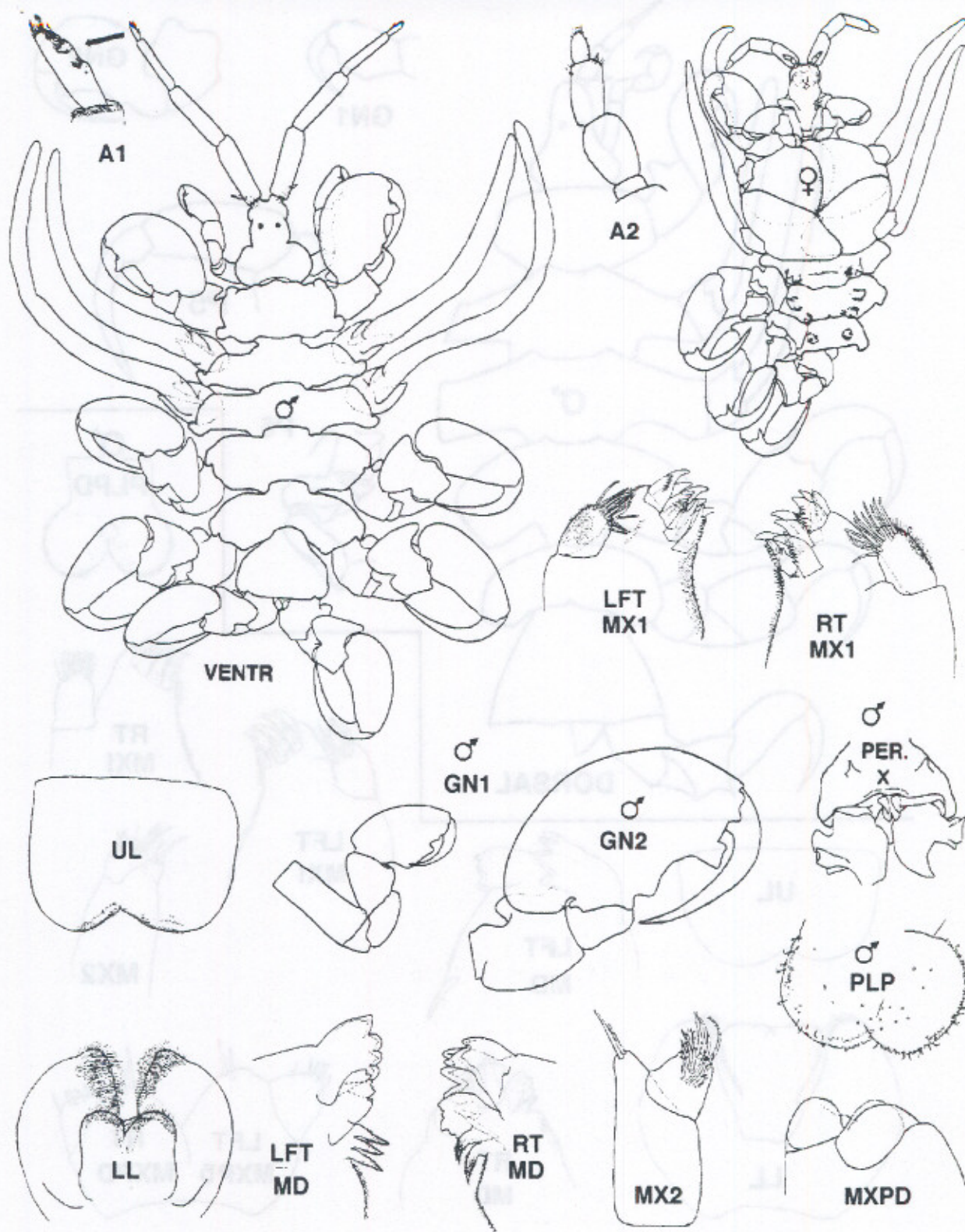


Fig. 12. *Cyamus (Mesocyamus) mesorubraedon* n. sp. Male (18 mm); female (9.5 mm)  
ex *Eschrichtius robustus*, Sooke, B. C.



Coxal gills single, slender. Accessory gills small, double, paired on each side.

Male pleopods medium deeply separately apically, apices rounded, strongly setulose.

Female: (to 6 mm) (not described).

#### Remarks:

Waller's original description and illustration of *Cyamus orubraedon* was limited and contained little information about the mouthparts. The species is known only from the beaked whale *Berardius bairdii*.

#### *Cyamus (Mesocyamus) mesorubraedon*, n. sp. (Fig. 12)

#### Material Examined:

Outer coast of Vancouver Island, British Columbia, ex skin of cachelot (*Physeter macrocephalus*) (no other data?) Male (18 mm) (Holotype), CMNC 2000-0007; female (ov.) (6.5 mm) (Allotype), CMNC 2000-000; male (12 mm?), slide mount (Paratype), CMNC 2000-0009.

**Diagnosis:** Male (to 18 mm); female (to 9.5 mm).

Body large, medium, broad, widest at peraeon segment 4; peraeon 2 subrectangular; peraeon segment 6 with two pairs of ventral adhesion spines.

Head medium. Antenna 1 strong, regular, 4-segmented; segments 1 & 2 subequal, segment 3 shorter, segment 4 apically and marginally setulose. Antenna 2 small, segments 1 & 4 short, small.

Mouthparts: Upper lip narrow, regularly incised apically, lobes unequal. Lower lip, inner lobes separated distally; outer lobes narrow, not widely spaced. Mandibular incisor 4-5-dentate; left lacinia irregularly denticulate, with 3 short blades in spine row; molar broad, flat, finely ridged, with stout proximal seta; right lacinia distally crenulate, with 2 stout proximal blades. Maxilla 1 short, broad, with 7 medium-tall pectinate spine-teeth on both sides; palp short, with narrow blade-like apical setae. Maxilla 2 small; outer plate large, rounded, apex with strong narrowly blade-like setae, distinctly exceeding small inner plate, apex with 2 setae. Maxilliped, basal segment lacking distomedial marginal setules.

Gnathopod 1 appearing 4-segmented; propod subovate, palm nearly horizontal, with strong hinge tooth and weak proximal tooth. Gnathopod 2 short, stout, 5-segmented; basis with large anterodistal flange; segment 3 distinct; segment 5 cryptic; propod short, very deep; palm short, shallowly concave, hinge and proximal teeth small, rounded; dactyl regular, not strongly curved.

Coxal gills long, slender, single, each with double accessory gills, posterior gills slightly the longer.

Peraeopods 5-7 short, compact; peraeopod 7 distinctly smallest; basis with anterior teeth or cusps; segment 3 nearly completely fused with distal portion of segment 2; segment 4 with distinct anterior margin; propod small, ovate; palm with distinct hinge tooth.

Male pleopods fused nearly totally, distal margin with small medial cleft. Penes subtriangular.

Female (ov.) (6.5 mm) (Allotype): distinctly smaller than male. Coxal gills slender, little shorter than in male. Inner margins of brood lamellae lined with fine setae.

**Etymology:** The species is near *C. orubraedon* and represents an intermediate condition between primitive and advanced members of the genus *Cyamus*, hence the combining name "meso" + "rubraedon".

**Remarks:** *C. (Mesocyamus) mesorubraedon* co-occurs with *C. (Apocyamus) eschrichtii* but is readily distinguished by its larger size, more elongate slender gills, and more powerful peraeopods 5-7.

#### *Apocyamus*, new subgenus

**Type species:** *Cyamus scammoni* Dall, 1872.

Species: *Cyamus kessleri* Brandt, 1872; *Cyamus eschrichtii*, new species.

#### Diagnosis:

Body very large and broad. Peraeon segment 2 not rectangular, broadest medially or posteriorly; peraeon ventral spines present, various; peraeon segment 7 rectangular or rounded behind.

Head short, broad, little longer than wide. Antenna 1 relatively short, segments thick.

Mouthparts modified. Upper lip, epistome weakly or not produced. Lower lip, inner lobes trending to distal fusion. Left mandible, lacinia modified, scabrous; usually 2 blades in spine row. Maxilla 1, outer plate mostly with 7 apical spine teeth on each side, inner distal margin finely setose. Maxilla 2 inner plate trending to reduction and fusion with outer plate, Maxilliped palp trending to loss in adult stage.

Gnathopod 1, palm shallow, oblique, teeth weak. Gnathopod 2 appearing 4-segmented; propod short, palm sharply concave, dactyl short. Peraeopods 5-7 not powerfully developed, propods and dactyl short.

Coxal gills stout, single or double; accessory gills paired on each side, well developed. Male pleopods with shallow distal notch.

**Etymology:** In balance, character states of the subgenus are considered most advanced of all subgenera within the genus, hence the name "apo" + "cyamus".



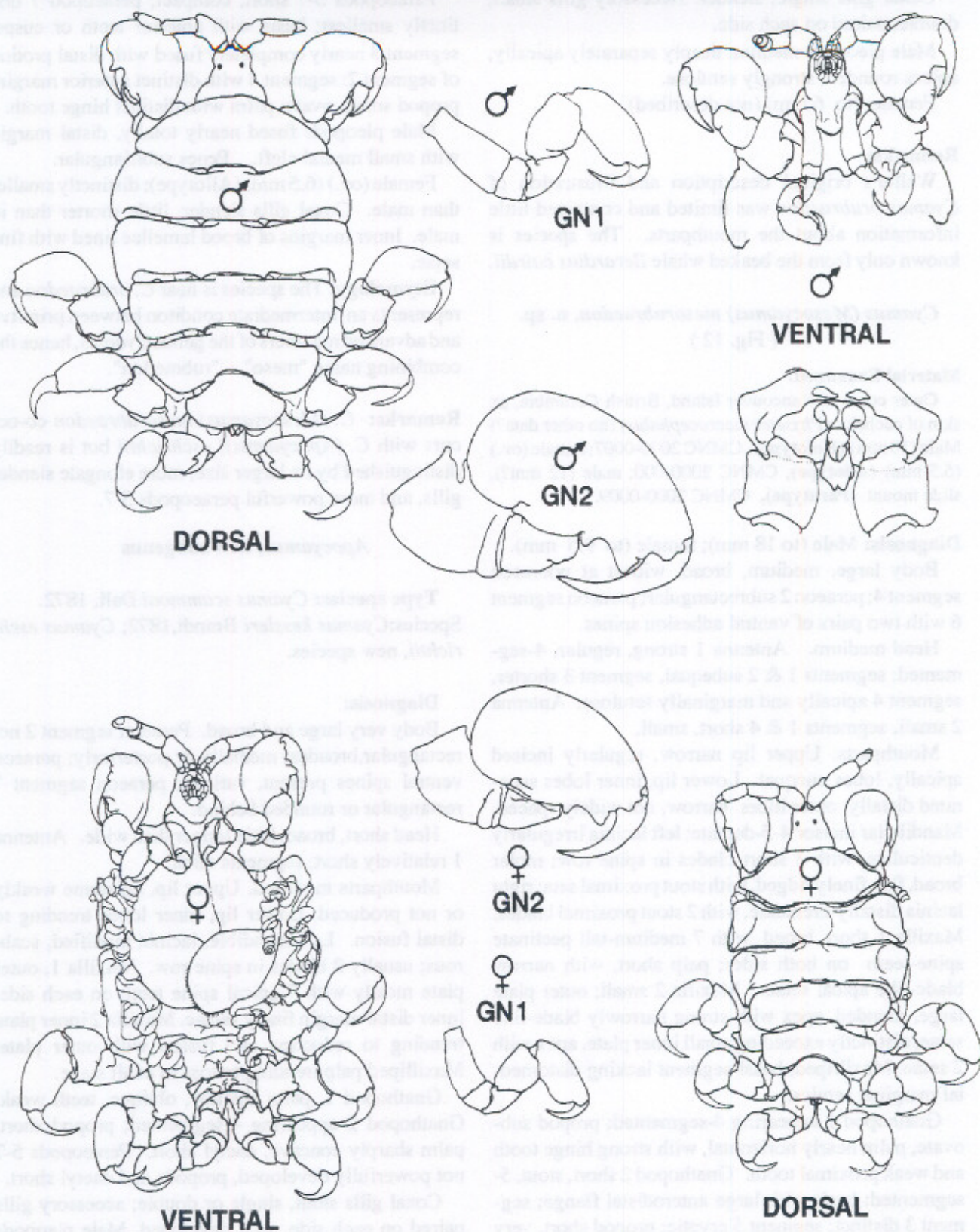
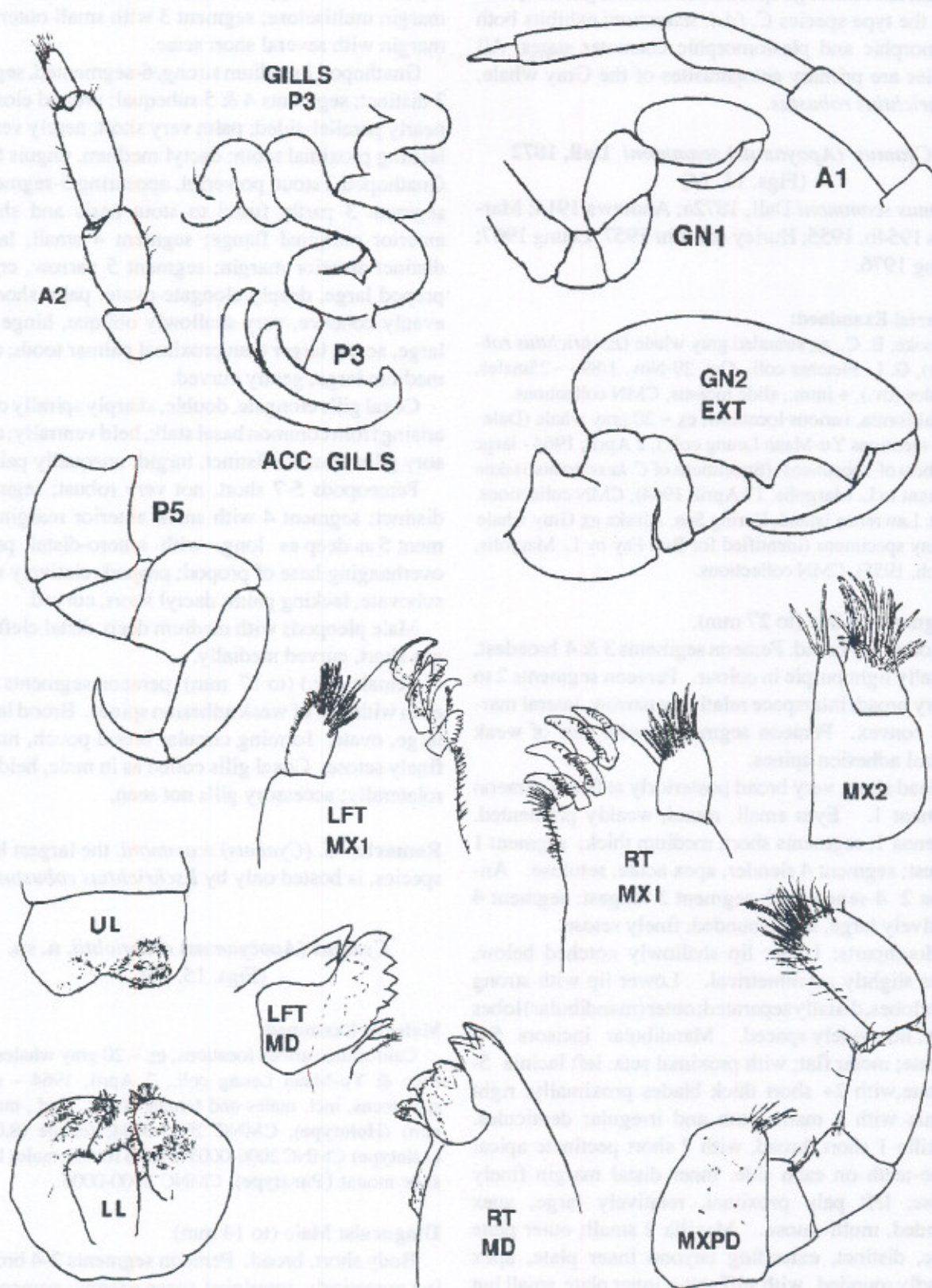


Fig. 13. *Cyamus (Apocyamus) scammoni* Dall, 1872. Male (14 mm); female (ov.) (12 mm).  
ex *Eschrichtius robustus*, Sooke, B. C.





**Fig. 14.** *Cyamus (Apocyamus) scammoni* Dall, 1872. (peraeopods and mouthparts).



**Remarks.** Although specialized in coxal gill morphology, the type species *C. (A.) scammoni* exhibits both apomorphic and plesiomorphic character states. All species are primary ectoparasites of the Gray whale, *Eschrichtius robustus*.

***Cyamus (Apoyamus) scammoni* Dall, 1872**

(Figs. 13, 14)

*Cyamus scammoni* Dall, 1872a; Andrews 1914; Margolis 1954b, 1955; Hurley & Mohr 1957; Leung 1967; Leung 1976.

**Material Examined:**

Sooke, B. C., ex stranded gray whale (*Eschrichtius robustus*), G. L. Fletcher coll., Oct. 29-Nov. 1/89 - ~25 males, females (ov.), + imm., slide mounts, CMN collections.

California, various locations, ex ~ 20 gray whale (Dale Rice mentions Yu-Maan Leung coll.), 2 April, 1964 - large numbers of specimens (Specimens of *C. kessleri* also taken and sent to L. Margolis, 17 April, 1964), CMN collections.

St. Lawrence Island, Bering Sea, Alaska ex Gray whale - many specimens (identified for Bud Fay by L. Margolis, March, 1955), CMN collections.

**Diagnosis: Male (to 27 mm).**

Body very broad. Peraeon segments 3 & 4 broadest, dorsally light purple in colour. Peraeon segments 2 to 7 very broad, interspace relatively narrow, lateral margins convex. Peraeon segment 6 with pair of weak ventral adhesion spines.

Head short, very broad posteriorly at fused peraeon segment 1. Eyes small, round, weakly pigmented. Antenna 1, segments short, medium thick; segment 1 largest; segment 4 slender, apex acute, setulose. Antenna 2 4-segmented; segment 3 longest; segment 4 relatively large, apex rounded, finely setose.

Mouthparts: Upper lip shallowly notched below, lobes slightly asymmetrical. Lower lip with strong inner lobes, distally separated; outer (mandibular) lobes large, not widely spaced. Mandibular incisors 5-6 dentate; molar flat; with proximal seta; left lacinia 5-dentate, with 2+ short thick blades proximally; right lacinia with a main tooth and irregular denticles. Maxilla 1 short, broad, with 7 short pectinate apical spine-teeth on each side, inner distal margin finely setose; left palp proximal, relatively large, apex rounded, multi-setose. Maxilla 2 small; outer plate large, distinct, extending beyond inner plate, apex broadly rounded, with stiff setae; inner plate small but distinct, apex with 1-2 medium setae. Maxilliped short; palp relatively short, always present in adults; segments 4 & 5 shorter than 6; dactyl short, acute, medial margin finely pectinate; basal segment totally

separated from opposite member; inner lobe distinct, margin multisetose; segment 3 with small outer lobe, margin with several short setae.

Gnathopod 1 medium strong, 6-segmented, segment 3 distinct; segments 4 & 5 subequal; propod elongate, nearly parallel-sided; palm very short, nearly vertical, lacking proximal tooth; dactyl medium, unguis fused. Gnathopod 2 stout, powerful, appearing 5-segmented; segment 3 partly fused to stout basis and shallow anterior marginal flange; segment 4 small, lacking distinct anterior margin; segment 5 narrow, cryptic; propod large, deeply elongate-ovate; palm short, unevenly concave, very shallowly oblique, hinge tooth large, acute, larger than proximal palmar tooth; dactyl medium large, gently curved.

Coxal gills elongate, double, sharply spirally coiled, arising from common basal stalk, held ventrally; accessory gills present, distinct, turgid, unequally paired.

Peraeopods 5-7 short, not very robust; segment 3 distinct; segment 4 with small anterior margin; segment 5 as deep as long, with antero-distal process overhanging base of propod; propod relatively short, subovate, lacking palm; dactyl short, curved.

Male pleopods with medium deep distal cleft. Penes short, curved medially.

Female (ov.) (to 17 mm): peraeon segments 6 & 7 each with pair of weak adhesion spines. Brood lamella large, ovate, forming circular brood pouch, margins finely setose. Coxal gills coiled as in male, held ventrolaterally; accessory gills not seen.

**Remarks:** *C. (Cyamus) scammoni*, the largest known species, is hosted only by *Eschrichtius robustus*.

***Cyamus (Apocyamus) eschrichtii*, n. sp.**

(Figs. 15, 16)

**Material Examined:**

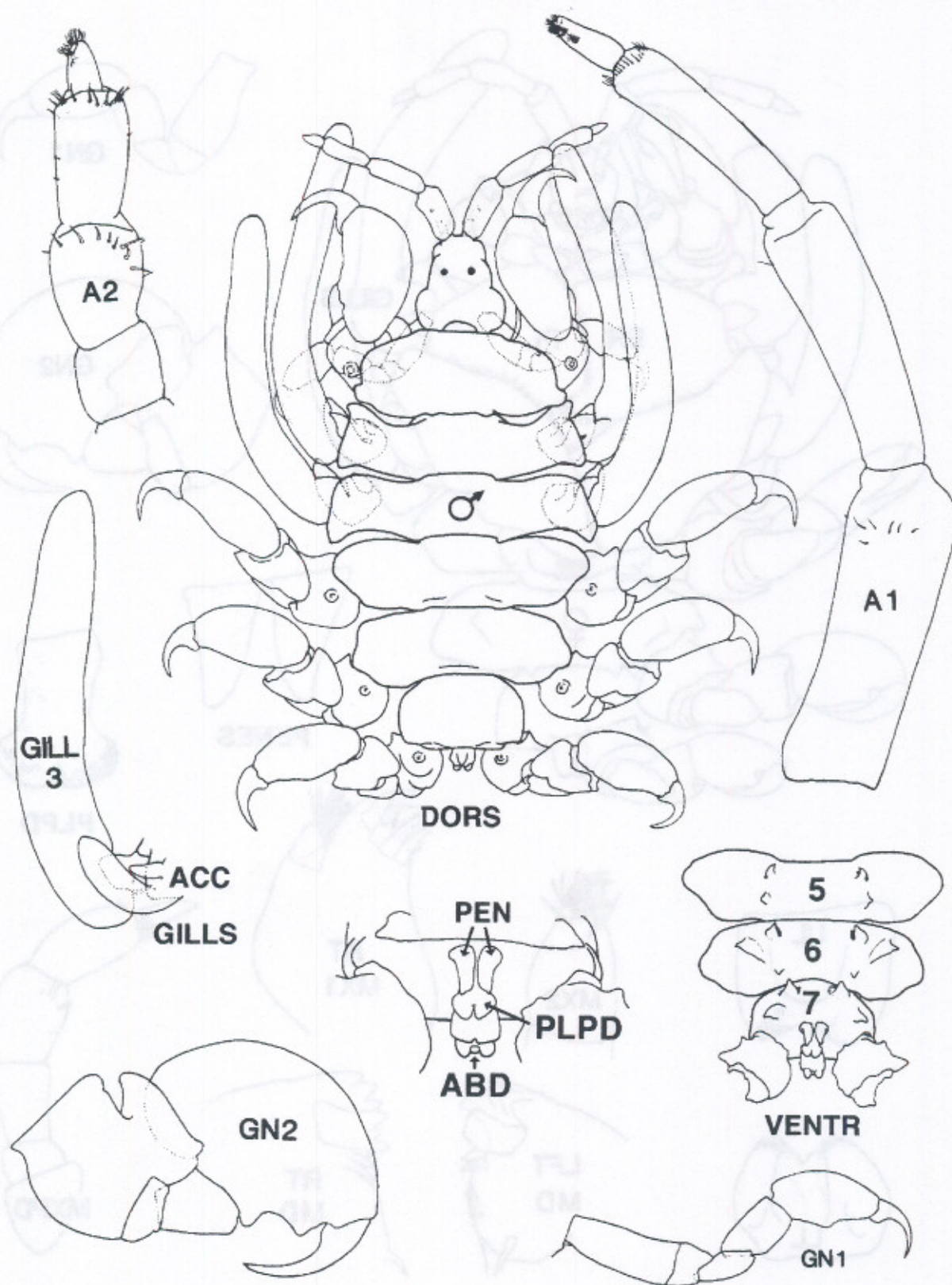
California, various locations, ex ~ 20 gray whales, Dale Rice & Yu-Maan Leung coll., 2 April, 1964 - several specimens, incl. males and females (ov); *Ibid.*, male (10 mm) (**Holotype**), CMNC 2000-0004; female (8.0 mm) (**Allotype**) CMNC 2000-0005 (PBS B10-95); male (10 mm) slide mount (**Paratype**), CMNC 2000-0006.

**Diagnosis: Male (to 14 mm)**

Body short, broad. Peraeon segments 2-4 broadening posteriorly, interlobal space narrow; peraeon segments 5 & 6 broad, segment 7 subrectangular; ventral surfaces each with 2-3 stout, paired, medium adhesion spines.

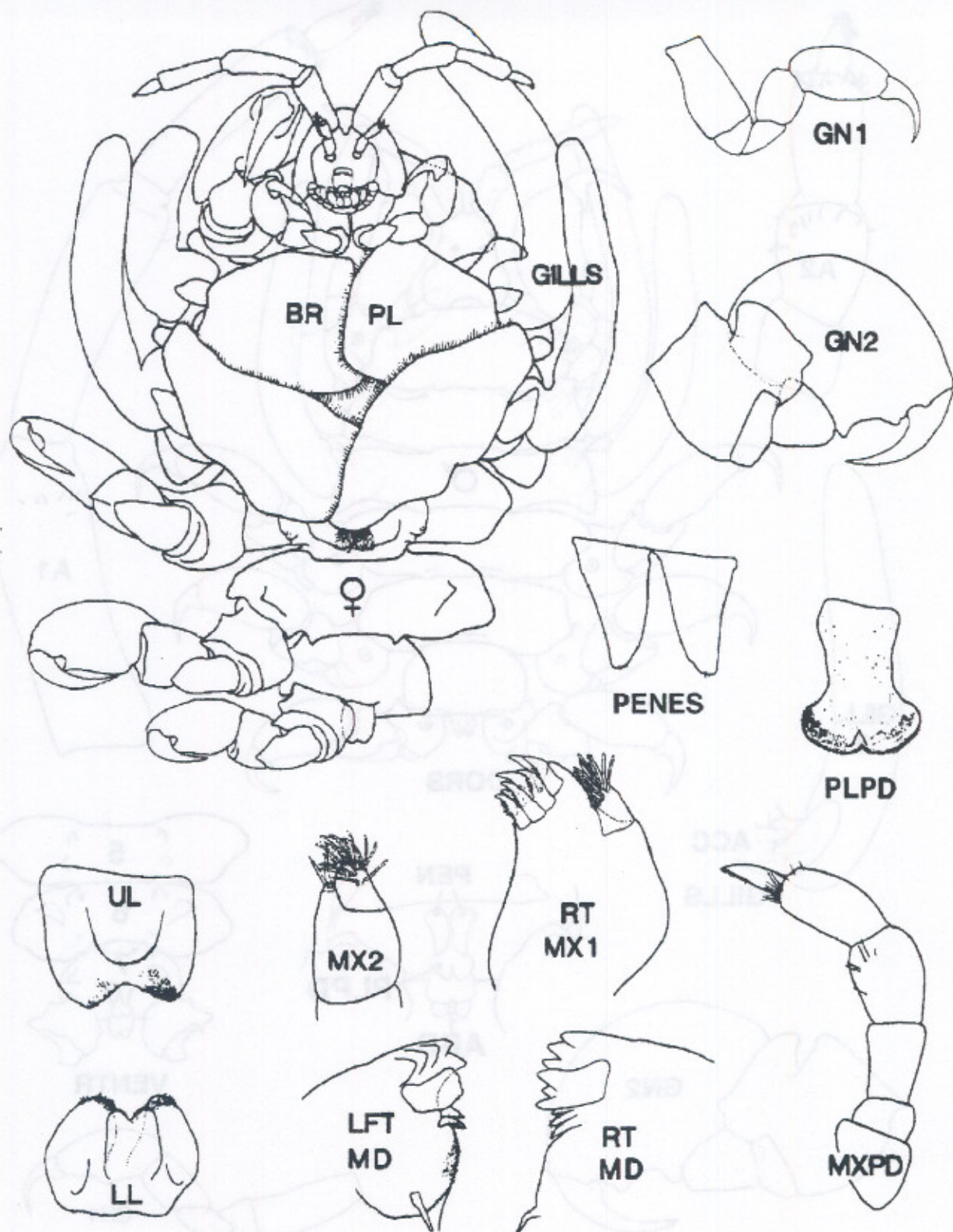
Head short, broadened posteriorly. Antenna 1 me-





**Fig. 15.** *Cyamus (Apocyamus) eschrichtii* n. sp. Male (10 mm); female (ov.) (8 mm).  
ex *Eschrichtius robustus*, California.





**Fig. 16.** *Cyamus (Apocyamus) eschrichtii* n. sp. Female (ov.) (8 mm); male (10 mm).  
*ex Eschrichtius robustus*, Sooke, B. C.



dium, 4-segmented; segments 1 & 2 subequal, segment 3 slightly shorter, 4 distinct, ~1/3 segment 4. Antenna 2 short, 4-segmented; segment 3 slightly longest; segment 4 with apical and subapical tufts of setules.

**Mouthparts:** Upper lip narrow, median notch shallow, lobes slightly asymmetrical. Lower lip, inner lobes distinct, separated distally. Mandibular incisor 5-dentate; molar weakly triturative, with proximal seta; left lacinia laminar, with 2 proximal blades; right lacinia trifid, with 3 blades in spine row. Maxilla 1, right outer plate with 7 spine-teeth, inner distal margin finely setulose. Maxilla 2, plates distinct, outer plate larger. Maxilliped palp 4-segmented, persisting in adult stage; dactyl medium long, pectinate.

Gnathopod 1 medium stout; basis slender; segment 3 large, distinct; segment 4 with short anterior margin; segment 5 long, margins subparallel; propod elongate-ovate, palm shallowly oblique and slightly concave, proximal palmar tooth low, obtuse; dactyl short, strongly curved. Gnathopod 2 short, stout, powerful, 5-segmented; basis short, thick, with strong antero-distal flange; segment 3 narrow; segment 4 distinct; propod large, deep, powerful, anterior margin arched strongly; palm short, sharply concave, nearly horizontal, hinge and proximal palmar teeth rounded apically; dactyl ordinary.

Coxal gills single, medium thick, with short basal stalk; accessory gills double, markedly unequal, posterior lobe more than twice length of anterior lobe.

Peraeopods 5-7 short, stout; peraeopod 5 slightly smallest; basis short, broad, anterior margin with proximal and distal adhesion teeth; segment 3 narrow, anteriorly fused to basis; segment 4 subcryptic, lacking anterior free margin; segment 5 medium-deep; segment 6 sub-ovate, not elongate; palm short, oblique, with weakly defined proximal tooth; dactyl short, strongly curved.

Male pleopods with shallow distal notch. Penes short, curving outwards.

Female (ov.) (8.0 mm): coxal gills shorter and thicker than in male. Posterior brood lamellae the larger, margins richly setose.

**Etymology:** Living on the Gray whale, *Eschrichtius robustus*.

*Cyamus (Apocyamus) kessleri* Brandt, 1872.

(Figs. 17, 18)

*Cyamus kessleri* Lütken 1873; Hurley & Mohr 1957; Leung 1967.

#### Material examined:

Pt. Barrow, Beaufort Sea, coast of Alaska, ex skin of gray whale *Eschrichtius robustus*; J. L. Mohr coll., 10 Aug., 1954 - male, female specimens (part of a lot identified by J. L. Mohr & D. E. Hurley; sent to Leo Margolis by J. L. Mohr, 15 July, 1957 (PBS B2-57); CMN collections.

Off Victoria, B. C., ex stranded gray whale - 1 female ov. (8 mm), slide mount, (PBS B2-57), CMN collections.

California, various locations, ex ~ 20 gray whales, Dale Rice & Yu-Maan Leung coll., 2 April, 1964 - large numbers of specimens (sent to L. Margolis, 17 April, 1964); CMN collections.

#### Diagnosis: Male (to 15 mm).

Body slender, widest at peraeon segment 4. Peraeon segment 2 narrow; peraeon segments 3 & 4 with blunt ventral spinous processes; peraeon segments 5 & 6 with weak ventral adhesion spines.

Antenna 1, segment 3 longest; segment 4 with apical setae only. Antenna 2, segment 2 longest.

**Mouthparts:** Upper lip broadly notched, lobes distinctly asymmetrical. Lower lip, outer lobes rounded; inner lobes shallow, nearly completely fused, with slight median notch. Mandibular incisor 4-5 dentate; molar appearing weakly triturative, with proximal seta; left lacinia scabrous, with 2 blades in spine row. Maxilla 1, left and right outer plates with 6 & 7 apical spine-teeth respectively; palp richly setose. Maxilla 2, inner plate partly fused with outer plate. Maxilliped palp absent in adults; segment 3 very small; basis strongly fused with opposite member.

Gnathopod 1 small; segment 3 partly fused with basis; propod deep, palm strongly concave. Gnathopod 2, segment 5 cryptic; propod large, deep, ovate; palm sharply concave, defining teeth large; dactyl short.

Coxal gills single, elongate, with weak accessory lob; accessory gills paired on each side, anterior gill longer.

Peraeopods 5-7 relatively weak; basis broad; propod short, ovate; dactyl short.

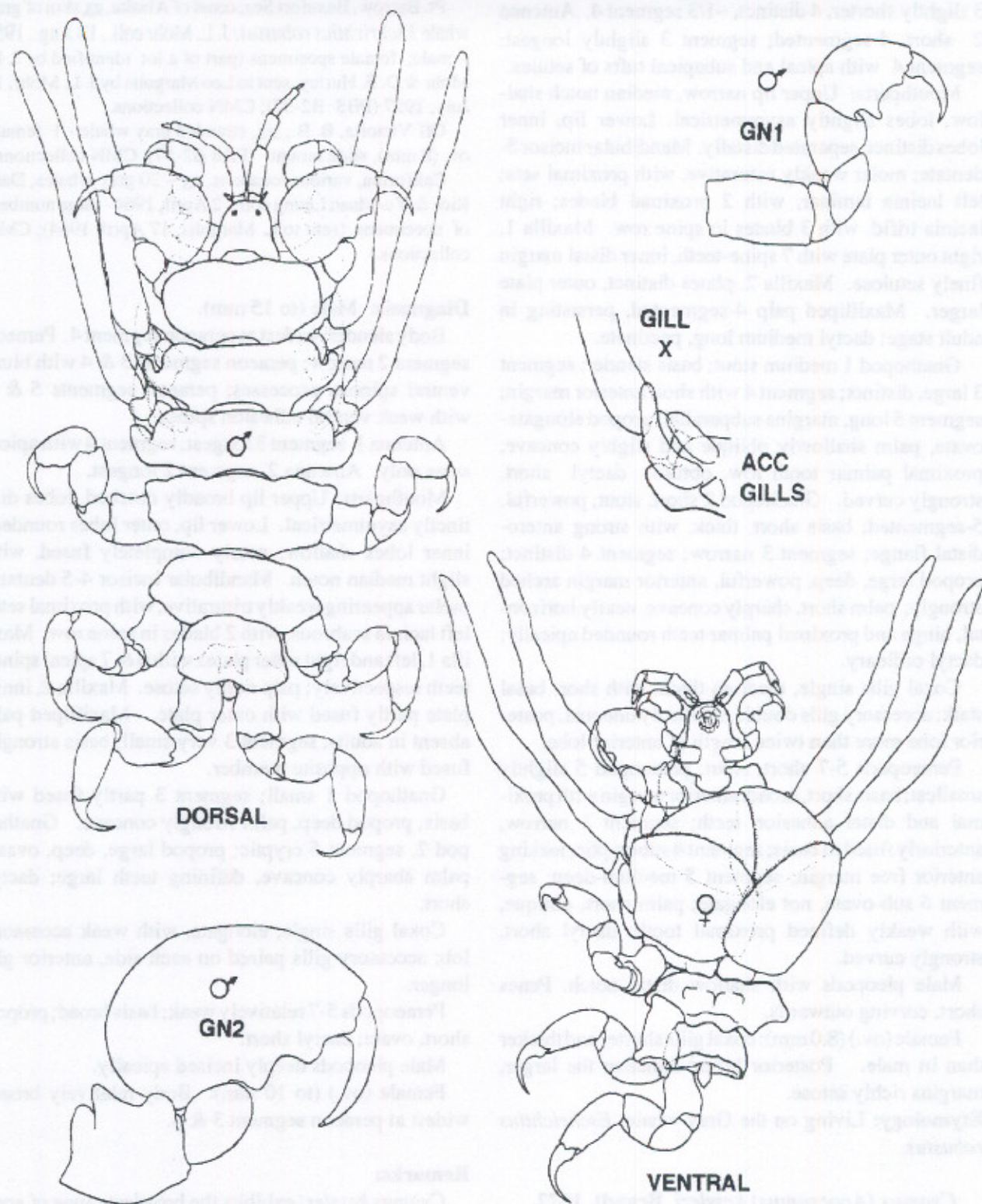
Male pleopods deeply incised apically.

Female (ov.) (to 10 mm): Body relatively broad, widest at peraeon segment 3 & 4.

#### Remarks:

*Cyamus kessleri* exhibits the broadest range of apomorphy within character states utilized here, and represents the most advanced species within the sub-genus and genus *Cyamus*.





**Fig. 17. *Cyamus (Apocyamus) kessleri* Brandt, 1872.** Male (10.5 mm); female (8.0 mm).  
ex *Eschrichtius robustus*, Sooke, B. C.



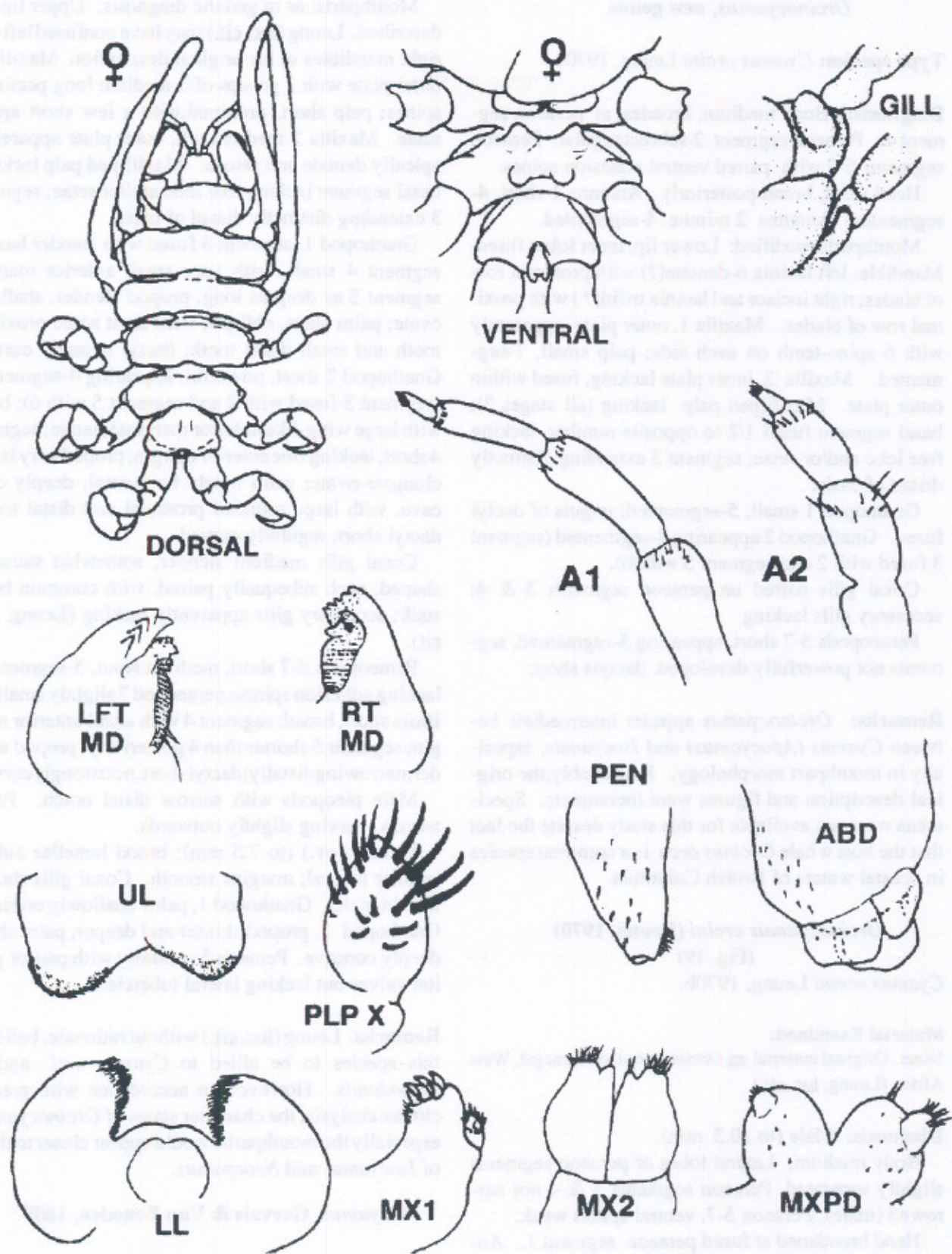


Fig. 18. *Cyamus (Apocyamus) kessleri* Brandt, 1872. Male (15 mm); female (10.0 mm),  
ex *Eschrichtius robustus*, Pt. Barrow, Alaska (after Hurley & Mohr, 1957).



*Orcinocyamus*, new genus**Type species:** *Cyamus orcini* Leung, 1970b**Diagnosis:** Body medium, broadest at peraeon segment 4. Peraeon segment 2 subrectangular. Peraeon segments 5-7 with paired ventral adhesion spines.

Head short, broad posteriorly. Antenna 1 short, 4-segmented. Antenna 2 minute, 4-segmented.

Mouthparts modified: Lower lip, inner lobes fused. Mandible: left lacinia 6-dentate(?) with proximal row of blades; right incisor and lacinia trifid(?) with proximal row of blades. Maxilla 1, outer plate apparently with 6 spine-teeth on each side; palp small, 1-segmented. Maxilla 2, inner plate lacking, fused within outer plate. Maxilliped palp lacking (all stages?); basal segment fused 1/2 to opposite number, lacking free lobe and/or setae; segment 3 extending distinctly distad of basis.

Gnathopod 1 small, 5-segmented; unguis of dactyl fused. Gnathopod 2 appearing 4-segmented (segment 3 fused with 2 and segment 5 with 6).

Coxal gills paired on peraeon segments 3 &amp; 4; accessory gills lacking

Peraeopods 5-7 short, appearing 5-segmented, segments not powerfully developed, dactyls short.

**Remarks:** *Orcinocyamus* appears intermediate between *Cyamus* (*Apocyamus*) and *Isocyamus*, especially in mouthpart morphology. Regrettably, the original description and figures were incomplete. Specimens were not available for this study despite the fact that the host whale *Orcinus orca* is a common species in coastal waters of British Columbia.*Orcinocyamus orcini* (Leung, 1970)

(Fig. 19)

*Cyamus orcini* Leung, 1970b.**Material Examined:**None. Original material ex *Orcinus orca*, off Senegal, West Africa (Leung, loc. cit.).**Diagnosis:** Male (to 10.5 mm).

Body medium, Lateral lobes of peraeon segments slightly separated. Peraeon segments 3 &amp; 4 not narrowed (male); Peraeon 5-7, ventral spines weak.

Head broadened at fused peraeon segment 1. Antenna 1, segments successively shortening and narrowing distally. Antenna 2, segment 3 longest, terminal segment apically setose.

Mouthparts: as in generic diagnosis. Upper lip not described. Leung (loc. cit.) may have confused left and right mandibles in his original description. Maxilla 1, outer plate with 2 groups of 3 medium long pectinate spines; palp short, proximal, with a few short apical setae. Maxilla 2 medium tall, outer plate apparently apically dentate and setose. Maxilliped palp lacking; basal segment lacking free lobe and/or setae; segment 3 extending distinctly distad of basis.

Gnathopod 1, segment 3 fused with slender basis; segment 4 small, with very small anterior margin; segment 5 as deep as long; propod slender, shallow-ovate; palm short, oblique, with stout acute proximal tooth and small distal tooth; dactyl strongly curved. Gnathopod 2 short, powerful, appearing 4-segmented (segment 3 fused with 2 and segment 5 with 6); basis with large wing-like anterior marginal flange; segment 4 short, lacking free anterior margin; propod very large, elongate-ovate; palm nearly horizontal, deeply concave, with large rounded proximal and distal tooth; dactyl short, regularly curved.

Coxal gills medium slender, somewhat sausage-shaped, each subequally paired, with common basal stalk; accessory gills apparently lacking (Leung, loc. cit.).

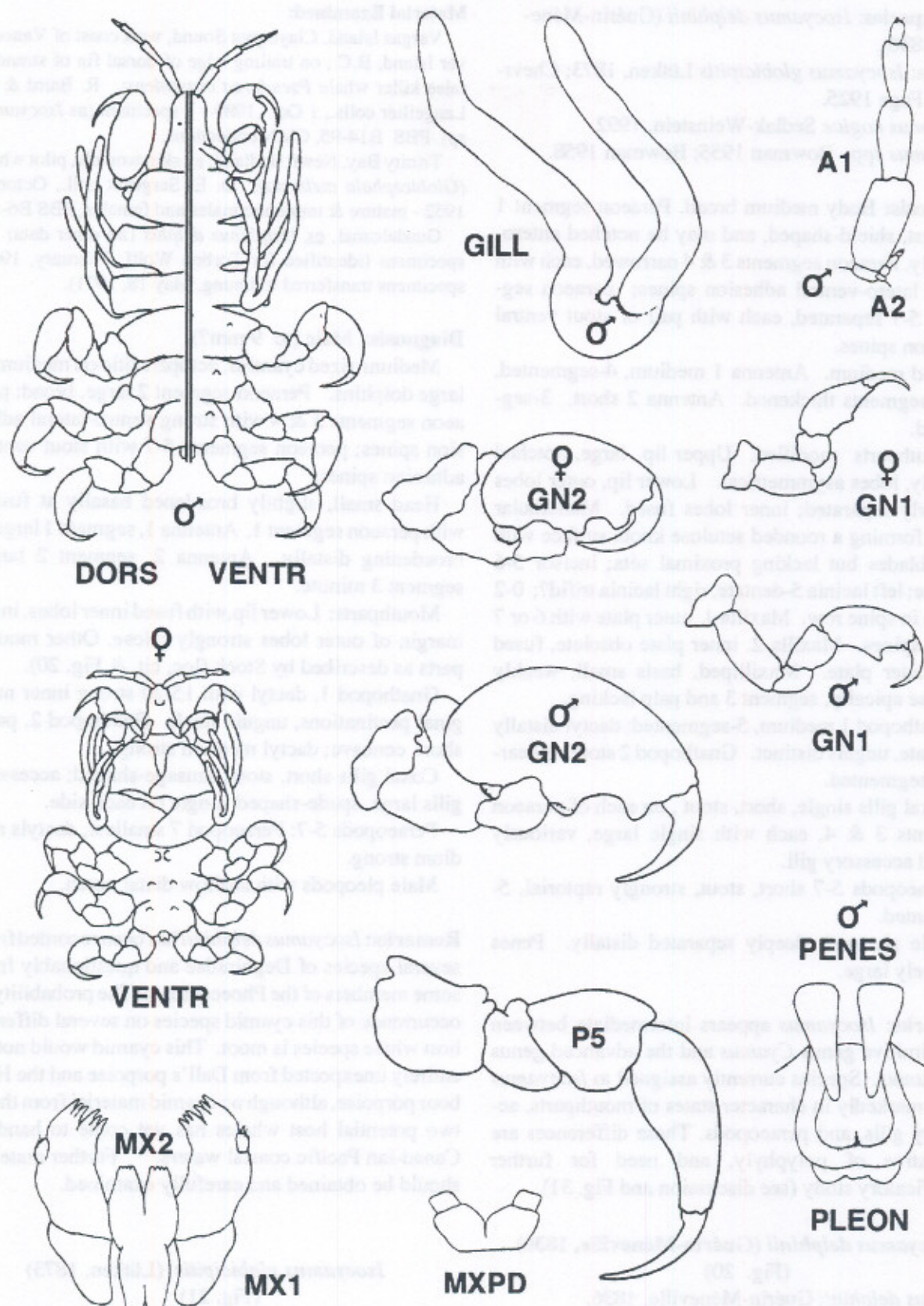
Peraeopods 5-7 short, medium stout, 5-segmented, lacking adhesion spines; peraeopod 7 slightly smallest. Basis short, broad; segment 4 with small anterior margin; segment 5 shorter than 4 posteriorly; propod slender, narrowing distally; dactyl short, not strongly curved.

Male pleopods with narrow distal notch. Penes narrow, curving slightly outwards.

Female (ov.) (to 7.5 mm): brood lamellae subtriangular to oval, margins smooth. Coxal gills shorter than in male. Gnathopod 1, palm shallowly concave. Gnathopod 2, propod shorter and deeper, palm short, deeply concave. Peraeon 5 ventrally with pair of genital valves but lacking lateral tubercles.

**Remarks.** Leung (loc. cit.) without rationale, believes this species to be allied to *Cyamus ceti* and *C. monodontis*. However, in accordance with present cluster analysis, the character states of *Orcinocyamus*, especially the mouthparts, would appear closer to those of *Isocyamus* and *Neocyamus*.*Isocyamus* Gervais & Van Beneden, 1859*Cyamus* (part) Lütken 1870.*Isocyamus* Chevreux & Fage 1925; Barnard 1932; Stephensen 1942; Leung 1967.





**Fig. 19.** *Orcinocyamus orcini* (Leung, 1970b). Male (10.5 mm); female (ov.)(7.5 mm), ex *Orcinus orca*. Atlantic Ocean, off Dakar, Senegal.



**Type species:** *Isocyamus delphinii* (Guérin-Méneville, 1836).

**Species:** *Isocyamus globicipitis* Lütken, 1873; Chevreux & Fage 1925.

*Isocyamus kogiae* Sedlak-Weinstein, 1992.

*Isocyamus* spp. Bowman 1955; Bowman 1958.

**Diagnosis:** Body medium broad. Peraeon segment 1 broadest, shield-shaped, and may be notched antero-laterally. Peraeon segments 3 & 4 narrowed, each with paired latero-ventral adhesion spines; peraeon segments 5-7 separated, each with pair of stout ventral adhesion spines.

Head medium. Antenna 1 medium, 4-segmented, basal segments thickened. Antenna 2 short, 3-segmented.

Mouthparts modified. Upper lip large, notched apically, lobes asymmetrical. Lower lip, outer lobes narrowly separated; inner lobes fused. Mandibular molar forming a rounded setulose knob, surface with short blades but lacking proximal seta; incisor 5-6 cusped; left lacinia 5-dentate, right lacinia trifid?; 0-2 blades in spine row. Maxilla 1, outer plate with 6 or 7 apical spines. Maxilla 2, inner plate obsolete, fused with outer plate. Maxilliped, basis small, weakly setulose apically, segment 3 and palp lacking.

Gnathopod 1 medium, 5-segmented; dactyl distally pectinate, unguis distinct. Gnathopod 2 stout, appearing 4-segmented.

Coxal gills single, short, stout, on each of peraeon segments 3 & 4, each with single large, variously shaped accessory gill.

Peraeopods 5-7 short, stout, strongly raptorial, 5-segmented.

Male pleopods deeply separated distally. Penes relatively large.

**Remarks:** *Isocyamus* appears intermediate between the primitive genus *Cyamus* and the advanced genus *Syncyamus*. Species currently assigned to *Isocyamus* differ markedly in character states of mouthparts, accessory gills, and peraeopods. These differences are suggestive of polyphyly, and need for further classificatory study (see discussion and Fig. 31).

*Isocyamus delphinii* (Guérin-Méneville, 1836)

(Fig. 20)

*Cyamus delphinii* Guérin-Méneville, 1836.

*Isocyamus delphinii* Barnard 1932; Stephensen 1942; Bowman 1958; Stock 1973; Leung 1967; Balbuena & Ragan 1991; Wardle et al. 2000.

**Material Examined:**

Vargas Island, Clayoquot Sound, west coast of Vancouver Island, B.C.; on trailing edge of dorsal fin of stranded false killer whale *Pseudorca crassidens*; R. Baird & K. Langellier colls., 1 Oct. 1989 - 1 specimen (as *Isocyamus* sp). PBS B14-95, CMN collections.

Trinity Bay, Newfoundland; ex skin wounds, pilot whale (*Globicephala melaena*); D. E. Sergeant coll., October, 1952 - mature & immature males and females, PBS B6-55.

Guadalcanal, ex *Delphinus delphis* (no other data) - 2 specimens (identified for Torben Wolff, February, 1964; specimens transferred to Leung, May 18, 1971).

**Diagnosis:** Male (to 9 mm?).

Medium-sized cyamids, ectoparasitic on medium to large dolphins. Peraeon segment 2 large, broad; peraeon segments 3 & 4 with strong ventro-lateral adhesion spines; peraeon segments 5-7 with stout ventral adhesion spines.

Head small, slightly broadened basally at fusion with peraeon segment 1. Antenna 1, segment 1 largest, broadening distally. Antenna 2, segment 2 large; segment 3 minute.

Mouthparts: Lower lip, with fused inner lobes, inner margin of outer lobes strongly pilose. Other mouthparts as described by Stock (*loc. cit.* & Fig. 20).

Gnathopod 1, dactyl with 15-20 strong inner marginal pectinations, unguis small. Gnathopod 2, palm short, concave; dactyl medium strong.

Coxal gills short, stout, sausage-shaped; accessory gills large, spade-shaped, single on each side.

Peraeopods 5-7: Peraeopod 7 smallest; dactyls medium strong.

Male pleopods with shallow distal notch.

**Remarks:** *Isocyamus delphinii* has been recorded from several species of Dephinidae and questionably from some members of the Phocoenidae. The probability of occurrence of this cyamid species on several different host whale species is moot. This cyamid would not be entirely unexpected from Dall's porpoise and the Harbour porpoise, although no cyamid material from those two potential host whales has yet come to hand in Canadian Pacific coastal waters. Further material should be obtained and carefully examined.

*Isocyamus globicipitis* (Lütken, 1873)

(Fig. 21)

*Cyamus globicipitis* Lütken, 1873; Chevreux & Fage 1925.

*Isocyamus globicipitis* Hiro 1938.



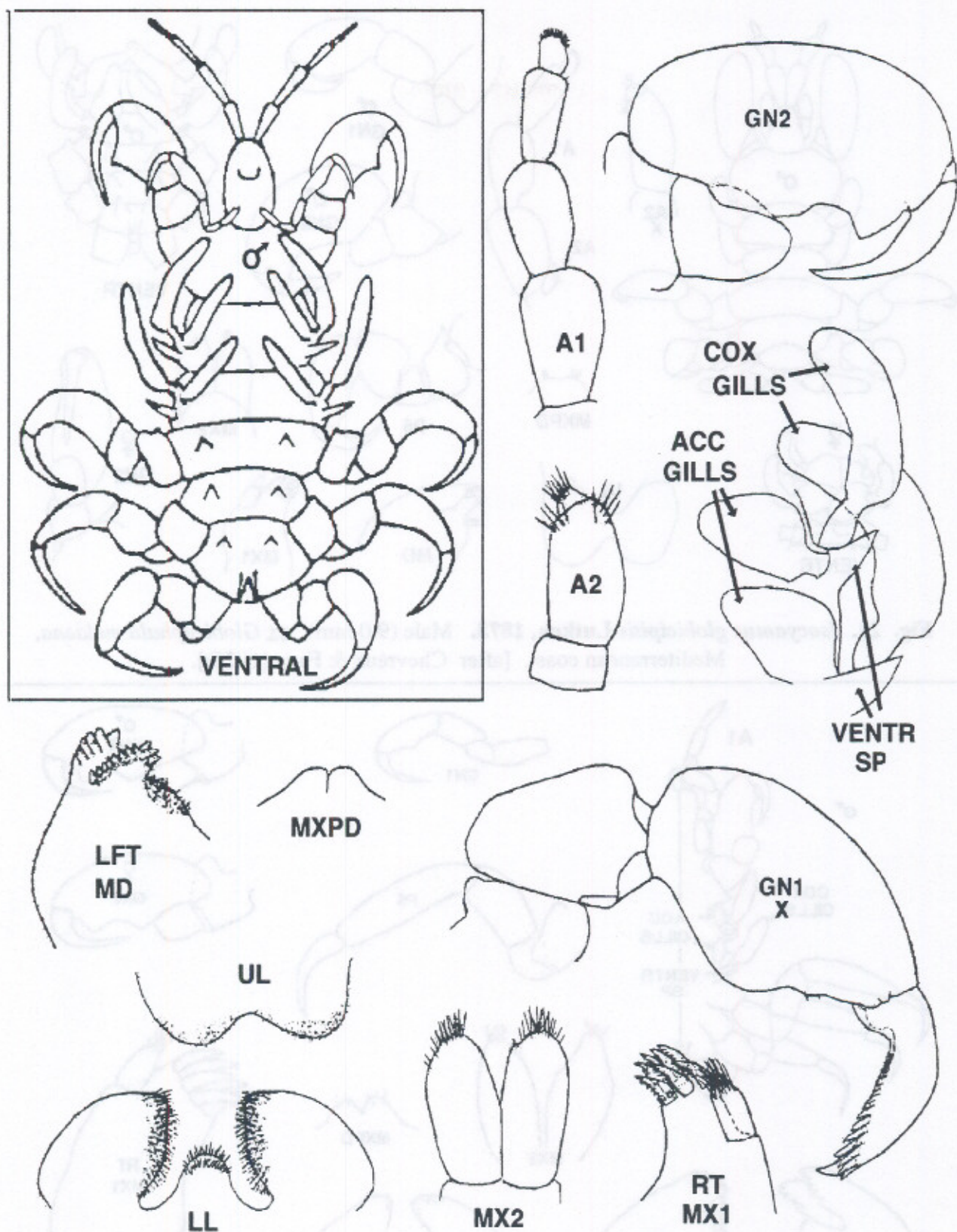


Fig. 20. *Isocyamus delphinii* Guérin-Méneville, 1836. Male (9 mm?).  
ex *Delphinus delphus*, North Sea region [after Stock 1973; inset: after Leung 1967].



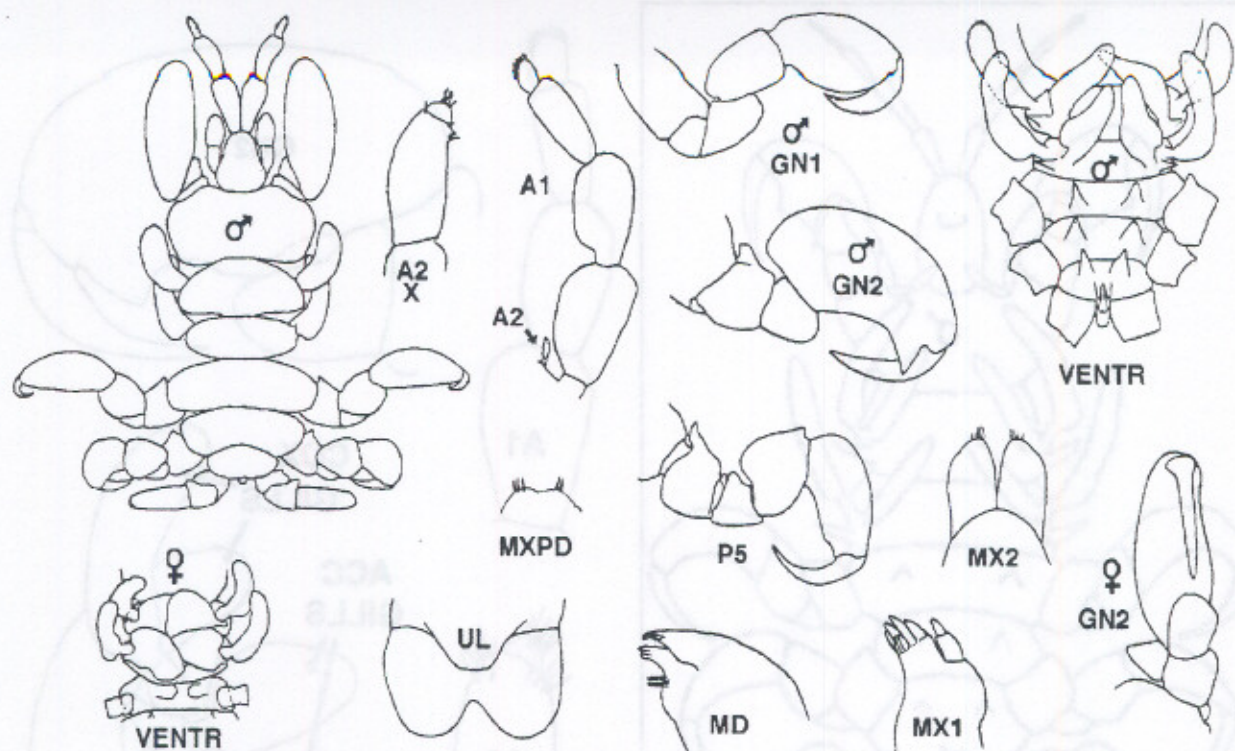


Fig. 21. *Isocyamus globicipitis* Lutken, 1873. Male (9.0 mm). ex *Globicephala melaena*, Mediterranean coast. [after Chevreux & Fage (1925)].

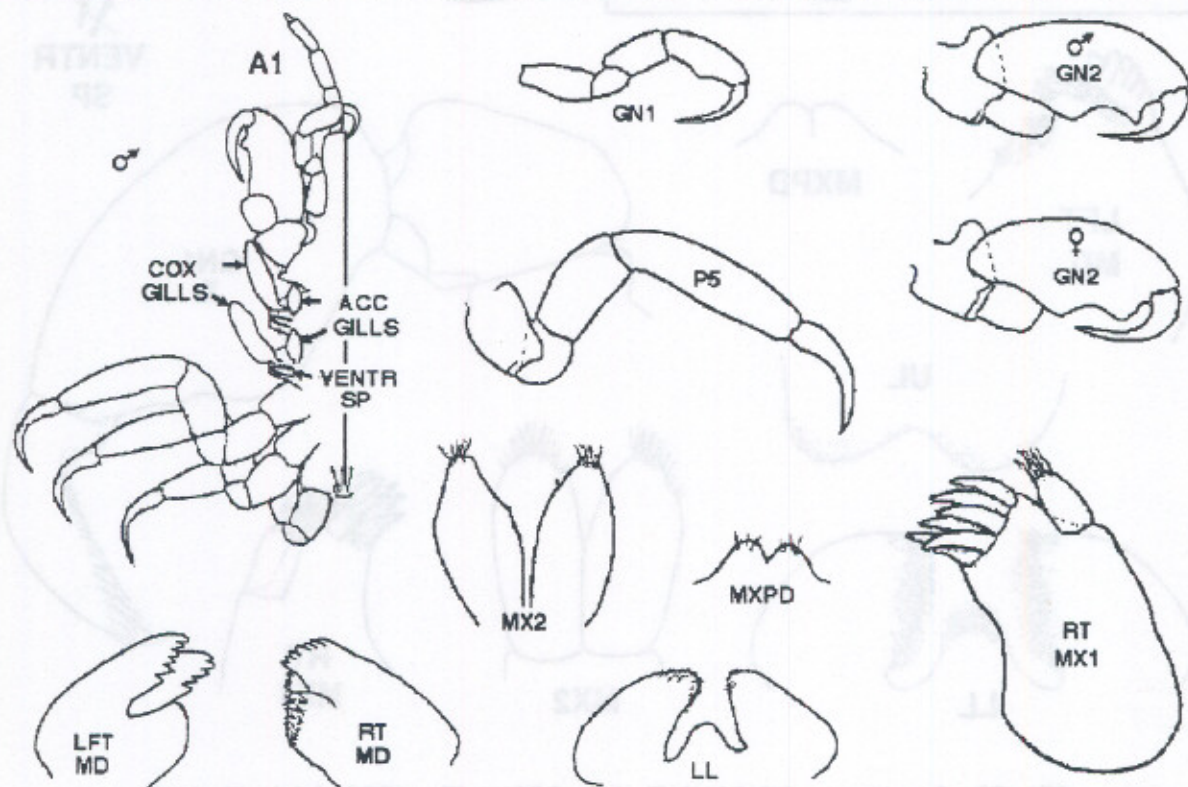


Fig. 22. (?) *Isocyamus kogiae* Sedlak-Weinstein, 1992. Male (to 5.5 mm); female (3.8 mm?). ex *Kogia breviceps*, South Australia. .



**Material Examined:**

None from the Pacific coast of North America.

**Diagnosis:** Male (to 9.0 mm); female (ov.) (to 6.5 mm)

Peraeon segment 1 large, deep, slightly broader than peraeon 3 & 4; peraeon segment 5-7 with prominent ventral spines. Head somewhat elongate, lateral margins of fused peraeon 1 not bulging laterally. Maxilla 2, outer plate with 7 apical spine-teeth; palp apparently 2-segmented. Gnathopod 1, dactyl with fused unguis (not clearly demarcated).

**Remarks:**

The description by Chevreux & Fage (*loc. cit.*), of *Isocyamus globicipitis* from the bottlenose dolphin in the Mediterranean region differs from the diagnosis of Stock (1973) based on material taken from *Delphinus* from the North Sea region. Most notable is the 7 apical spine teeth and 2-jointed palp of the maxilla 1 described by Chevreux & Fage (*loc. cit.*).

***Isocyamus kogiae* Sedlak-Weinstein, 1992.**

(Fig. 22)

**Remarks:** Sedlak-Weinstein (*loc. cit.*) has recently described this species from the pygmy sperm whale in Australian waters. *Kogia breviceps* is a relatively rare visitor to the Northeastern Pacific region (Orr 1972; Spalding 1998) but cyamid ectoparasites, probably of this type, might be expected to occur on them.

Sedlak-Weinstein's description of *Isocyamus kogiae* conforms somewhat with diagnostic features of the genus (e.g., in having medium long head, and comb spines on the dactyl of gnathopod 1 (but lacking unguis?). However, this species differs from *I. delphinii* in several character states including: small size; lack of right mandibular lacinia; shallower and less broadened peraeon segment 2, with anterolateral "epaulettes" (as in *Syncyamus*); peraeon 5-7 lacking ventral spines (both sexes); and segments of peraeopods 5-7 very slender and elongate. Some of these may prove to be of generic or subgeneric value (see Fig. 31).

***Neocyamus* Margolis, 1955**

**Type species:** *Cyamus physeteris* Pouchet, 1888.

*Neocyamus physeteris* Margolis 1959; Buzeta 1963; Leung 1967.

**Diagnosis:** Body slender, widest at peraeon segments 5 & 6. Peraeon 2-4, lateral lobes small. Peraeon 5-7 each ventrally with pair of stout adhesion spines.

Head elongate, widest posteriorly. Antenna 1 short, 4-segmented. Antenna 2 very small, 2-segmented.

Mouthparts modified: Lower lip, inner lobes fused to medium tall plate. Mandible: incisors 5-toothed; molar eobsolete; left lacinia 5-dentate, right lacinia tridentate, 1-3 blades in each spine row. Maxilla 1, outer plate with 7 pectinate spine-teeth. Maxilla 2 tall, inner plate fused with outer plate. Maxilliped palp lacking in adults, 4-segmented in juveniles; basis small, fused 1/2 with opposite member; segment 3 extending beyond basis in adults.

Gnathopod 1 6-segmented; segment 3 distinct; dactyl pectinate, unguis distinct. Gnathopod 2 appearing 4-segmented; segment 2 (basis) elongate; segment 4 lacking anterior margin, convex behind; propod elongate, broadening distally, palm sharply concave, with strong hinge tooth; dactyl strongly curved.

Coxal gills single, multi-filamentous (fasciculate); accessory gills lacking in males.

Peraeopods 5-segmented; basis with small adhesion spine; segment 4 elongate, anterior margin with distal tooth; segment 5 with strong posterior adhesion tooth; propod slender, elongate; dactyl strong.

Male penes strong, curving medially.

Female (ov.) (to 6.0 mm): posterior brood lamellae large, margins unlined.

**Remarks:** *Neocyamus* is slightly more advanced than *Orcinocyamus* in the condition of antenna 2, and in some mouthpart morphology, but retains several plesiomorphic features of *Cyamus*.

***Neocyamus physeteris* (Pouchet, 1888)**

(Figs. 23, 24)

*Cyamus physeteris* Pouchet, 1888.

*Cyamus fascicularis* Verrill, 1902; Kunkel 1910.

*Paracyamus physeteris* Stephensen 1942.

*Neocyamus physeteris* Margolis 1955; Leung 1967.

**Material Examined:**

Off west coast, Vancouver Island, B.C., ex sperm whale (*Physeter macrocephalus*), D. W. Rice coll., 7 April, 1956 - 2 males, 1 female, slide mounts (PBS B1-59), CMN coll'ns.

North Sea (?), ex skin sperm whale (*Physeter catodon*), A. Pouchet coll., 18 Nov., 1871 - 1 mature female, 1 mutilated male, several juveniles (obtained from Dr. Torben Wolff, Copenhagen Museum, 4 April, 1954 (PBS B25-54).

Off San Francisco, California, ex 2 sperm whales, Rice, 14 Oct., 1965 - 6 specimens (sent to L. Margolis, PBS), CMN collections.

Kurile Islands, ex *Phocoenoides truei* - 1 immature specimen (identified as *Neocyamus physeteris*, for Y.M. Leung, August, 1964. (See Leung 1967, p. 280).



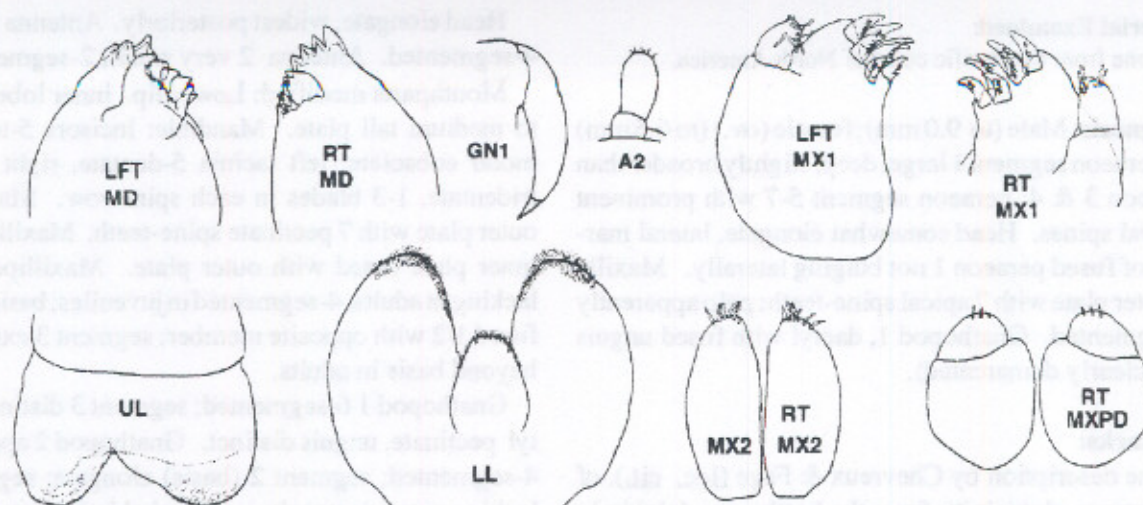


Fig. 23. *Neocyamus physeteris* (Pouchet, 1888). (mouthparts and appendages)

**Diagnosis:** Male (7.8 mm)

Body slender, widest at peraeon segments 5 & 6. Peraeon 2-4, lateral lobes small, widely separated; peraeon 7 subtriangular, posteriorly truncate.

Head elongate, fused segment 1 "bulging" on each side; eyes relatively large, multifaceted. Antenna 1 not longer than head length; segments 1-3 slender, subequal, segment 4 distinct. Antenna 2, segment 2 longest, rounded, apex finely setulose.

Mouthparts: Upper lip narrow, deep, apically deeply incised, lobes asymmetrical. Lower lip, outer lobes medium broad, not widely separated apically. Mandibular incisor 5-6 dentate; left lacinia broad, 5-dentate, with 1 short proximal blade; right lacinia short, thick, apex with 3 small teeth, three distinct proximal blades in spine row. Maxilla 1 short, thick, apices strongly oblique; palp short, thick, with short apical setae, medially sited. Maxilla 2 tall, inner plate not discernible. Maxilliped palp, segment 3 subtriangular, extending beyond basis, apex setulose.

Gnathopod 1, segment 3 distinct, segment 4 with small free anterior margin; segment 5 subtriangular, with small posterior lobe; propod shallow-ovate, palm oblique, concave, with weak hinge-tooth and strong rounded posterior palmar tooth; dactyl strongly curved distally finely pectinate, unguis distinct. Gnathopod 2 slender; segment 3 fused with segment 2 and segment 5 with 6; segment 4 with small anterior free margin; propod elongate, palm sharply concave, with strong acute hinge and posterior palmar teeth; dactyl large, very strongly curved.

Peraeopods 5-7 slender; basis stout, slightly longer than wide, hind margin distally with small adhesion spine; segment 3 nearly totally fused with 2, segment 4

elongate, with long free margins of which anterior margin is variously tooth-like distally; segment 5 short, subtriangular, poster lobe extended as strong curved adhesion tooth; propod slender, parallel-sided; dactyl very large, strongly hook-shaped.

Pleopods (male) rounded, distal notch indistinct. Penes large, slightly curved inwards.

**Remarks:** *Neocyamus* seems closest to *Isocyamus* but differs in its 2-segmented antenna 2, fasciculate coxal gills, but lack of accessory gills and lack of maxillipedal palp in adults. Several other differences in form of gnathopods, mouth parts, and form of peraeopods are also noteworthy.

***Platycyamus* Lütken, 1870**

**Type species:** *Platycyamus thompsoni* (Gosse, 1855) Lütken 1870.

Species: *Platycyamus flaviscutatus* Waller, 1989.

**Diagnosis:**

Body slender, widest at peraeon segment 5; segments 3 & 4 narrowed, each with single ventro-lateral adhesion spines; peraeon segments 1 & 2 distinct; segments 6 & 7 not fused; segments 5-7 each with single pair of ventral adhesion spines.

Head short, broad. Antenna 1 short, 4-segmented. Antenna 2 small, 4-segmented, sexually dimorphic.

Mouthparts modified. Upper lip apically rounded. Lower lip, outer lobes broadly separated; inner lobes fused. Mandibular molar a rounded mound, lacking proximal seta; left lacinia 5-dentate, right lacinia trifid,



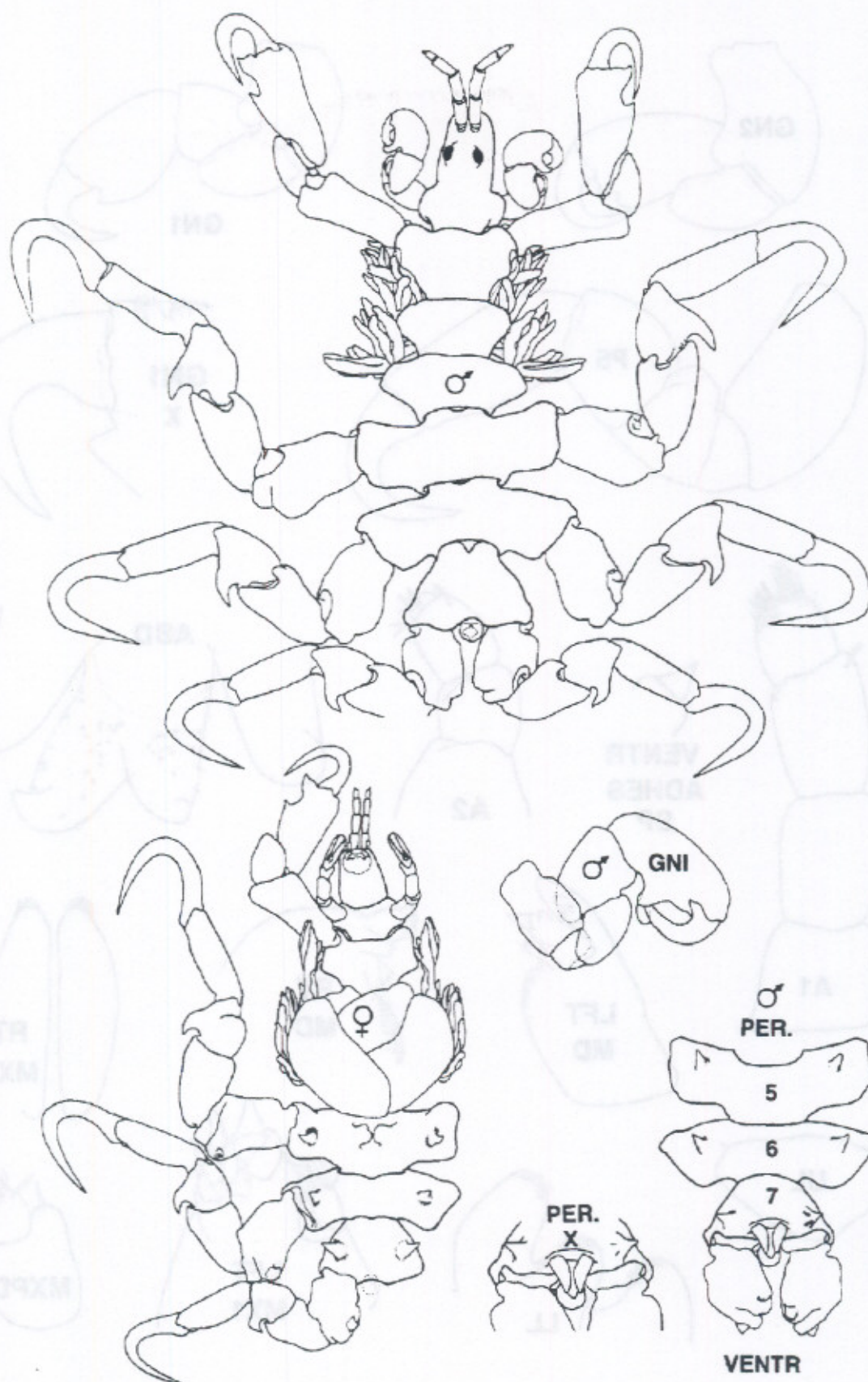


Fig. 24. *Neocyamus physeteris* (Pouchet, 1888). Male (7.8 mm); female (6.0mm?)  
ex *Physeter macrocephalus*, off west coast of British Columbia.



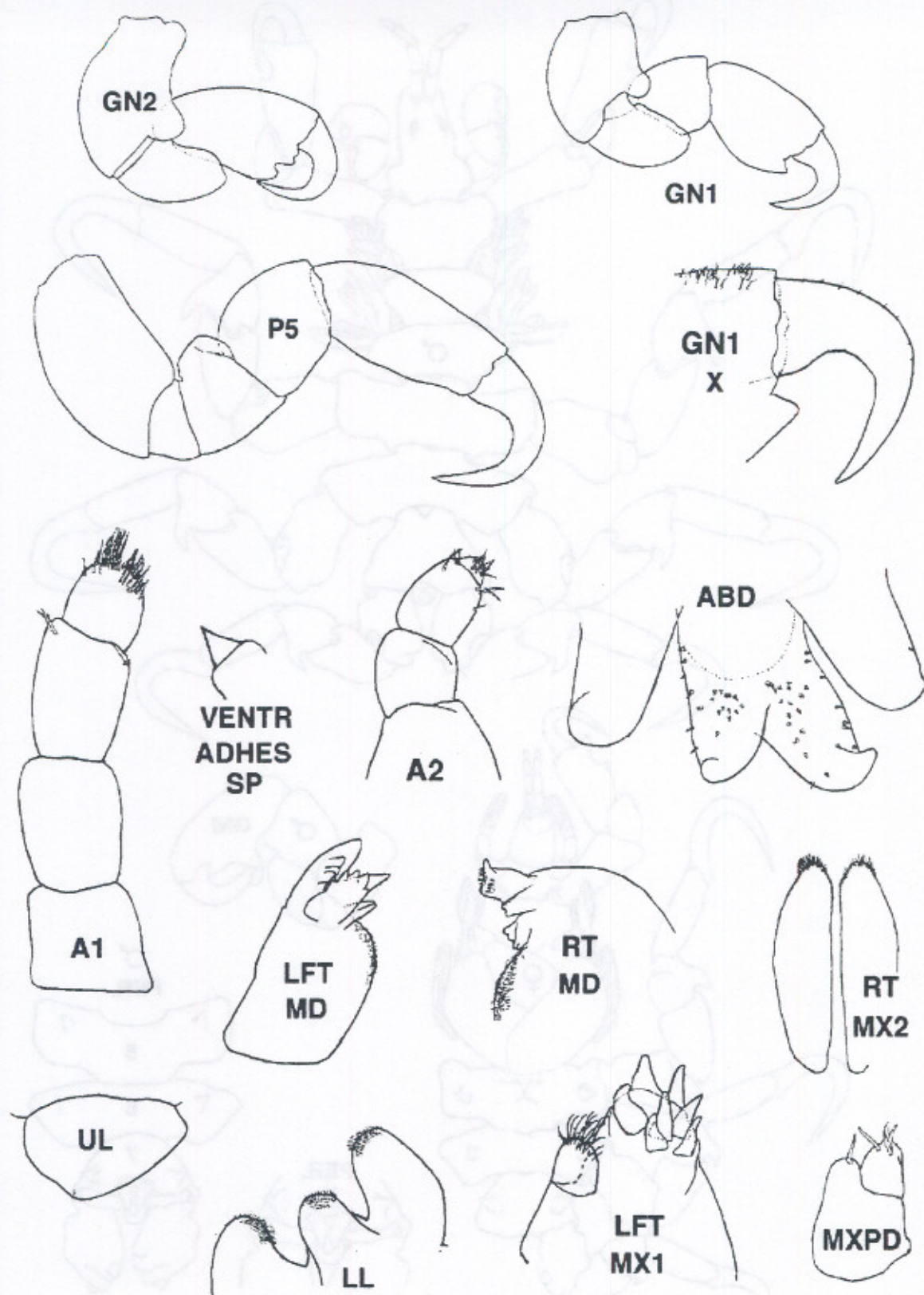


Fig. 25. *Platycyamus flaviscutatus* Waller, 1989. Male (9.0 mm, ex *Berardius bairdi* (giant bottlenose whale), off B. C. coast.



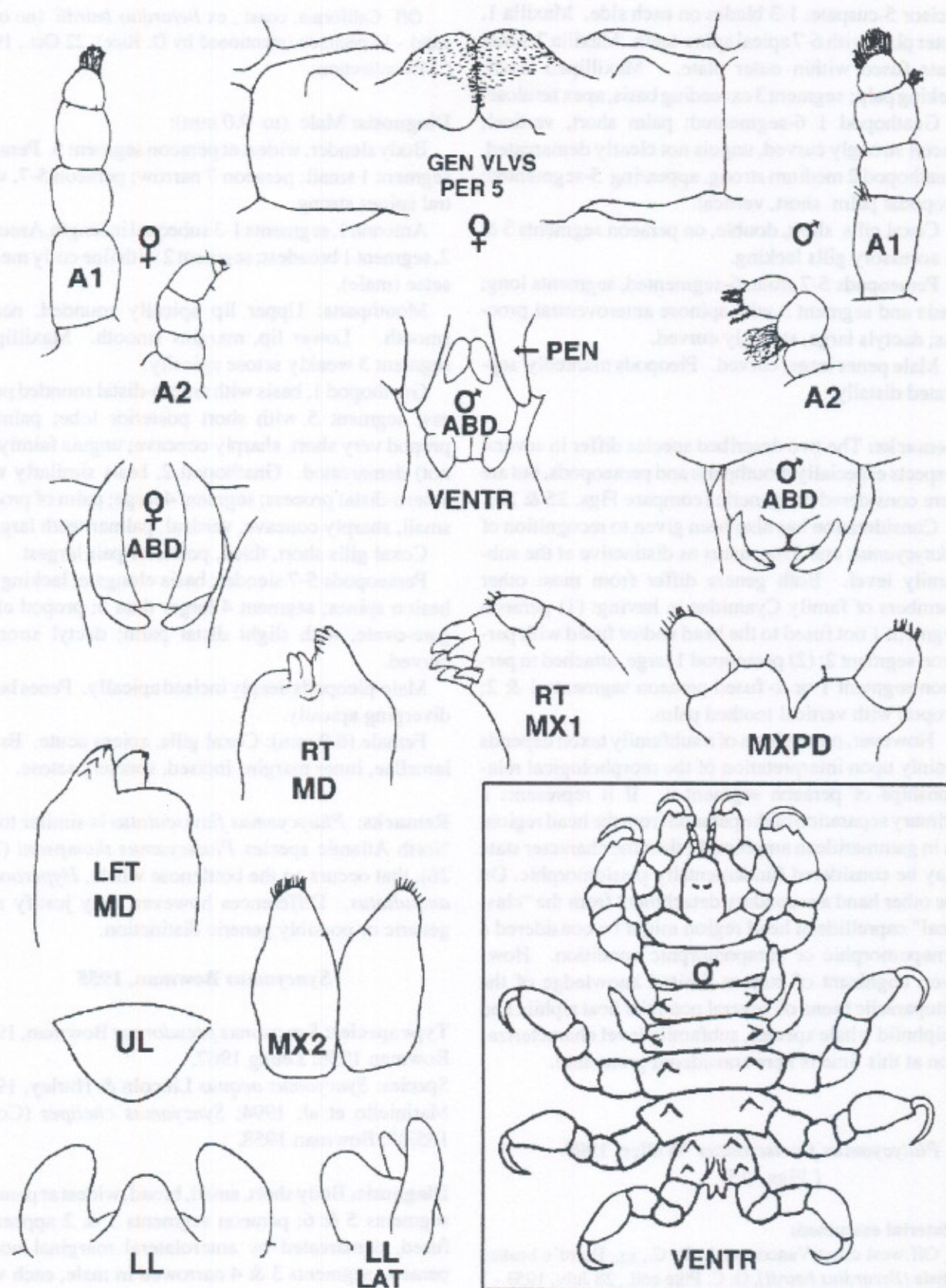


Fig. 26. *Platycyamus thompsoni* (Gosse, 1855) (mouthparts and abdomen), ex *Hyperoodon ampullatus* (bottle-nosed whale), North Sea (after Wolff 1958; Inset: after Leung 1967).



incisor 5-cusped; 1-3 blades on each side. Maxilla 1, outer plate with 6-7 apical spine-teeth. Maxilla 2, inner plate fused within outer plate. Maxilliped small, lacking palp; segment 3 exceeding basis, apex setulose.

Gnathopod 1 6-segmented; palm short, vertical; dactyl strongly curved, unguis not clearly demarcated. Gnathopod 2 medium strong, appearing 5-segmented; propodal palm short, vertical.

Coxal gills short, double, on peraeon segments 3 & 4; accessory gills lacking.

Peraeopods 5-7 stout, 6-segmented, segments long; basis and segment 3 with spinose anteroventral process; dactyls large, strongly curved.

Male penes large, curved. Pleopods markedly separated distally.

**Remarks:** The two described species differ in several respects especially mouthparts and peraeopods, but are here considered congeneric (compare Figs. 25 & 26).

Consideration has also been given to recognition of *Platycyamus* and *Syncyamus* as distinctive at the subfamily level. Both genera differ from most other members of family Cyamidae in having: (1) peraeon segment 1 not fused to the head and/or fused with peraeon segment 2; (2) peraeopod 1 large, attached to peraeon segment 1 or to fused peraeon segments 1 & 2; propod with vertical toothed palm.

However, recognition of a subfamily taxon depends mainly upon interpretation of the morphological relationships of peraeon segment 1. If it represents a primary separation of the peraeon from the head region, as in gammaridean amphipods, then the character state may be considered fundamentally plesiomorphic. On the other hand a secondary detachment from the "classical" caprellidean head region might be considered a synapomorphic or autapomorphic condition. However, cognizant of current limited knowledge of the ectoparasitic fauna of several potential host ziphiid and delphinid whale species, subfamily level characterization at this time is here considered premature.

***Platycyamus flaviscutatus* Waller, 1989**  
(Figs. 25)

**Material examined:**

Off west coast Vancouver I., B. C., ex Baird's beaked whale (*Berardius bairdii*), G. C. Pike coll., 28 July, 1953 - 1 male (9 mm), slide mount, 1 female, (sent to J. Mohr (USC), identified by Mohr as *Platycyamus thompsoni*; sent from Dr. Yuk-Maan Leung, 23 Aug. 1964 (PBS B8-64), CMN colls.

Off California, coast, ex *Berardius bairdii* (no other data) - 1 specimen (mentioned by D. Rice), 22 Oct., 1965, CMN collections.

**Diagnosis: Male (to 9.0 mm):**

Body slender, widest at peraeon segment 5. Peraeon segment 1 small; peraeon 7 narrow; peraeon 5-7, ventral spines strong.

Antenna 1, segments 1-3 subequal in length. Antenna 2, segment 1 broadest; segment 2 with fine curly medial setae (male).

Mouthparts: Upper lip apically rounded, nearly smooth. Lower lip, margins smooth. Maxilliped, segment 3 weakly setose apically.

Gnathopod 1, basis with antero-distal rounded process; segment 5 with short posterior lobe; palm of propod very short, sharply concave; unguis faintly (or not) demarcated. Gnathopod 2, basis similarly with antero-distal process; segment 4 large; palm of propod small, sharply concave, vertical, palmar teeth large,

Coxal gills short, thick, posterior pair largest.

Peraeopods 5-7 slender; basis elongate, lacking adhesion spines; segment 4 larger than 5; propod elongate-ovate, with slight distal palm; dactyl strongly curved.

Male pleopods deeply incised apically. Penes large, diverging apically.

Female (6.0 mm): Coxal gills, apices acute. Brood lamellae, inner margins incised, sparsely setose.

**Remarks:** *Platycyamus flaviscutatus* is similar to the North Atlantic species *Platycyamus thompsoni* (Fig. 26), that occurs on the bottlenose whale, *Hyperoodon ampullatus*. Differences however, may justify subgeneric or possibly generic distinction.

***Syncyamus* Bowman, 1955**

**Type species:** *Syncyamus pseudorca* Bowman, 1955; Bowman 1958; Leung 1967.

Species: *Syncyamus aequus* Lincoln & Hurley, 1981; Mariniello et al. 1994; *Syncyamus chelipes* (Costa, 1853)?; Bowman 1958.

**Diagnosis:** Body short, small, broad, widest at peraeon segments 5 & 6; peraeon segments 1 & 2 appearing fused, demarcated by anterolateral marginal notch; peraeon segments 3 & 4 narrowed in male, each with paired ventral adhesion spines; peraeon segment 6 & 7 dorsally fused; peraeon segments 5-7 each with paired ventral adhesion spines.



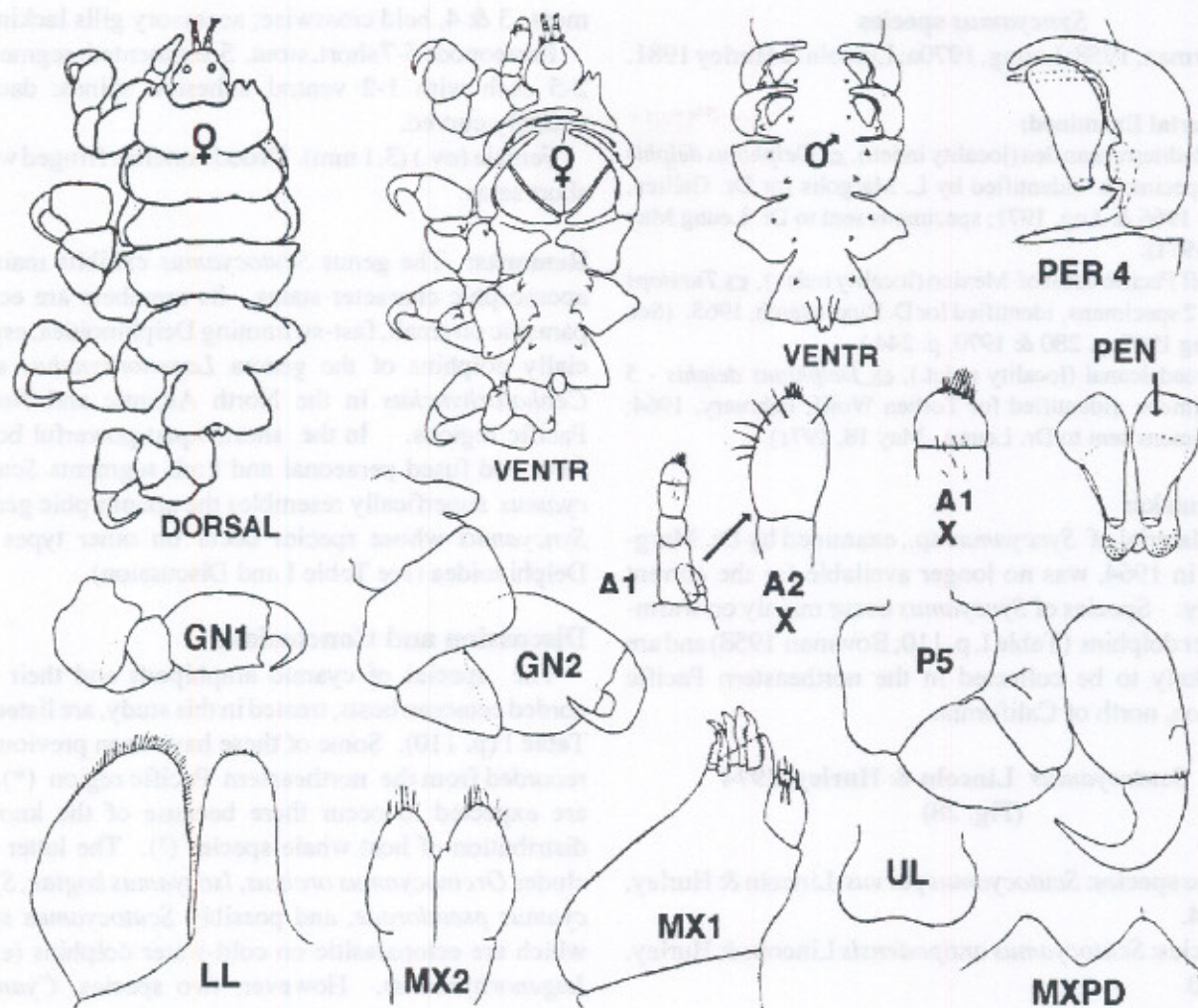


Fig. 27. *Syncyamus pseudorcae* Bowman, 1955. Male (4.0 mm); female (4.8 mm)  
ex *Pseudorca crassidens*, Gulf of Mexico (after Bowman 1955).

Antenna 1 very short, 4-segmented; antenna 2 minute, 2-segmented.

Mouthparts modified. Upper lip slightly incised apically. Lower lip, outer lobes approximating distally; inner lobes fused. Mandible, incisors multidentate, otherwise undescribed. Maxilla 1, outer plate with 6 or 7 apical spine-teeth. Maxilla 2, inner plate fused totally within outer plate. Maxillipeds fused basally, each a low conical mound; segment 3 and palp lacking.

Gnathopod 2 medium large and stout, 5-segmented; propodal palm distinct, vertical; dactyl strongly curved, not pectinate, unguis not distinct. Gnathopod 2 stout, powerful, 4-segmented; propodal palm distinct, vertical.

Coxal gills single, short, thick, tapering, on pereopod segments 3 & 4; a single pair of accessory gills present in male.

Pereopods 5-7 short, stout, powerful, appearing 5-

segmented, segments 2 & 4 with antero-ventral adhesion spines.

Male penes stout, tapering distally diverging slightly. Pleopods shallowly, separated distally.

**Remarks:** The definition of this genus is problematical. Bowman's original figures of the type species *Syncyamus pseudorcae*, reproduced here (Fig. 27), indicate that gnathopod 1 is attached to fused pereopod segments 1 & 2 (demarcated by an antero-lateral marginal notch). Comparable figures for *S. aequus* (Lincoln and Hurley 1981; Mariniello et al. 1994) show the lateral marginal notch, but are otherwise ambiguous; in the ventral view of the male, the point of attachment is not shown; in the female, the point of attachment is indicated as the head proper, despite any suggestion of a posteriorly broadened head region. To clarify this problem, careful re-examination of type material is recommended.



***Syncyamus* species**

Bowman, 1958; Leung, 1970a; Lincoln & Hurley 1981.

**Material Examined:**

Mediterranean Sea (locality indet.), *ex Delphinus delphis* - 3 specimens (identified by L. Margolis for Dr. Gallien, Dec. 1966 & Aug. 1971; specimens sent to Dr. Leung May 18, 1971).

Off Pacific coast of Mexico (locality indet.), *ex Tursiops* sp. - 2 specimens, identified by D. Rice, March, 1965. (See Leung 1967, p. 280 & 1970, p. 244.)

Guadalcanal (locality indet.), *ex Delphinus delphis* - 5 specimens (identified for Torben Wolff, February, 1964; specimens sent to Dr. Leung, May 18, 1971).

**Remarks:**

Material of *Syncyamus* sp., examined by Dr. Margolis in 1964, was no longer available for the current study. Species of *Syncyamus* occur mainly on warm-water dolphins (Table I, p. 110; Bowman 1958) and are unlikely to be collected in the northeastern Pacific region, north of California.

***Scutocyamus* Lincoln & Hurley, 1974**

(Fig. 28)

**Type species:** *Scutocyamus parvus* Lincoln & Hurley, 1974.

**Species:** *Scutocyamus antipodensis* Lincoln & Hurley, 1980.

**Diagnosis:** Male (2.4 mm)

Body small, short, stout; widest at peraeon segments 5 & 6; peraeon segments 3 & 4 small, fused, narrowed in male; segments 6 & 7 fused dorsally. Peraeon segments 5-7 ventral adhesion spines.

Head very short. Antenna 1 very short, 3-segmented. Antenna 2 minute, 2-segmented.

Mouthparts: Upper lip slightly notched apically. Lower lip, outer lobes moderately separated; inner lobes fused. Mandibular molar small, rounded, lacking proximal seta; incisor 5-cusped; left lacinia 2-3 dentate, right lacinia bifid? 1-2 blades on each side. Maxilla 1, outer plate with 6 apical spine-teeth. Maxilla 2, inner plate fused within outer plate. Maxilliped, basal segments fused, lobe subacute, segment 3 and palp lacking.

Gnathopod 1 very small, 5-segmented; propodal palm lacking; dactyl irregularly pectinate distally, (combs of teeth), unguis not defined. Gnathopod 2 short, thick, powerful, appearing 3-segmented.

A single pair of coxal gills on each of peraeon seg-

ments 3 & 4, held crosswise; accessory gills lacking.

Peraeopods 5-7 short, stout, 5-segmented; segments 2-5 each with 1-2 ventral adhesion spines; dactyl strongly curved.

Female (ov.) (3.1 mm). Brood lamellae fringed with short setae.

**Remarks:** The genus *Scutocyamus* exhibits mainly apomorphic character states. Its members are ectoparasitic on small, fast-swimming Delphinoidea, especially dolphins of the genera *Lagenorhynchus* and *Cephalorhynchus* in the North Atlantic and North Pacific regions. In the short, squat powerful body form and fused peraeonal and limb segments *Scutocyamus* superficially resembles the apomorphic genus *Syncyamus* whose species occur on other types of Delphinoidea (see Table I and Discussion).

**Discussion and Conclusions**

The species of cyamid amphipods and their recorded cetacean hosts, treated in this study, are listed in Table I (p. 110). Some of these have been previously recorded from the northeastern Pacific region (\*), or are expected to occur there because of the known distribution of host whale species (!). The latter includes *Orcinocyamus orcinus*, *Isocyamus kogiae*, *Syncyamus pseudorca*, and possibly *Scutocyamus* spp. which are ectoparasitic on cold-water dolphins (e.g., *Lagenorhynchus*). However, two species, *Cyamus* (*Mesocyamus*) *mesorubraedon*, and *C. (Apocyamus)* *eschrichti*, proved new to science and two others, *Cyamus* (*Mesocyamus*) *orubraedon* and *Cyamus* (*Cyamus*) *monodontis* are apparently new to the region. Further new distributional records may be anticipated through close examination of little-studied host whales, including the common Orca, Dall's, and Harbour porpoises. However, new records from large, slow-moving, commercially valuable whale species (rorquals, right whales) are much less likely. Closer attention might be paid to ectoparasites of stranded ziphioid whales, and smaller whale species that are held captive in marine aquaria.

The evolutionary history of the cyamid amphipods is inextricably inter-related with that of the host Cetacea. Ancestral Cetacea almost certainly became aquatic prior to the evolution of the Cyamidae from an ancestral group within the Amphipoda Caprellidea. In attempting to reconstruct these events, we may first examine the possible ancestry and phylogeny of the Cyamidae within the Caprellidea, followed by a "best consensus" phyletic grouping of families within the



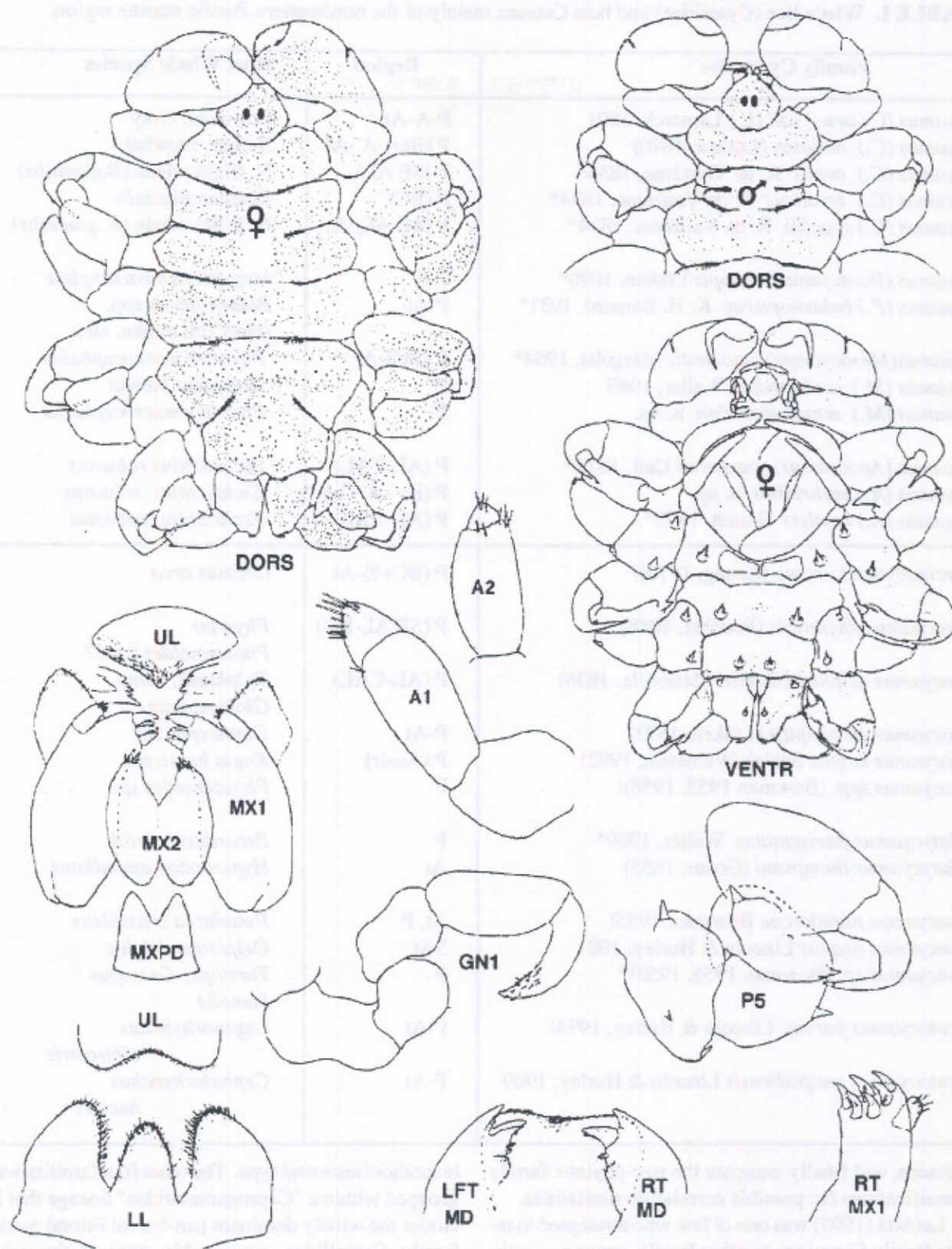


Fig. 28. *Scutocyamus parvus* Lincoln & Hurley, 1974. Male (2.4 mm); female (3.1 mm),  
ex *Lagenorhynchus albirostris*, North Sea. (after Lincoln & Hurley, 1974).



**TABLE I.** Whale lice (Cyamidae) and host Cetacea mainly of the northeastern Pacific marine region.

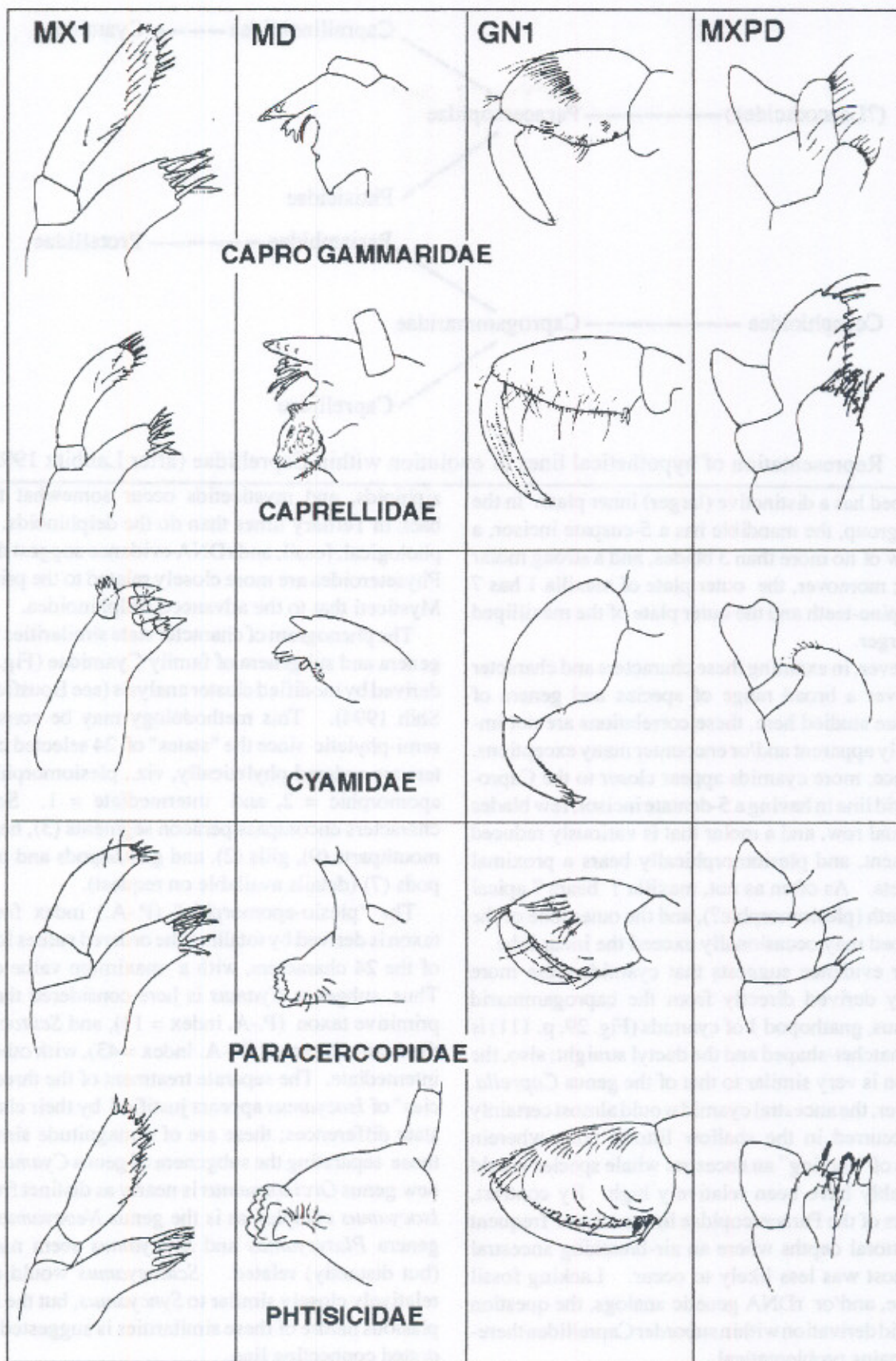
Family Cyamidae	Region	Host Whale Species
<i>Cyamus</i> ( <i>Cyamus</i> ) <i>ceti</i> (L.) Lamarck, 1801	P-A-At	Bowhead, Gray
<i>Cyamus</i> ( <i>C.</i> ) <i>nodosus</i> (Lütken, 1870)	P (Ber)-A -At	Beluga, narwhal
<i>Cyamus</i> ( <i>C.</i> ) <i>ovalis</i> R. de Vauzème, 1834*	P (SE AL)	N. Right whale ( <i>B. glacialis</i> )
<i>Cyamus</i> ( <i>C.</i> ) <i>erraticus</i> R. de Vauzème, 1834*	P (BC)	<i>Balaena glacialis</i>
<i>Cyamus</i> ( <i>C.</i> ) <i>gracilis</i> R. de Vauzème, 1834*	P (SE AL)-At	N. Right whale ( <i>B. glacialis</i> )
<i>Cyamus</i> ( <i>Paracyamus</i> ) <i>boopis</i> Lütken, 1870*	P-A	<i>Megaptera navaeangliae</i>
<i>Cyamus</i> ( <i>P.</i> ) <i>balaenopterae</i> K. H. Barnard, 1931*	P-At	<i>Balaenoptera</i> spp. (blue, fin, minke, etc.)
<i>Cyamus</i> ( <i>Mesocyamus</i> ) <i>catodontis</i> Margolis, 1954*	P (BC)-At	<i>Physeter macrocephalus</i>
<i>Cyamus</i> ( <i>M.</i> ) <i>orubraedon</i> Waller, 1989	P	<i>Berardius bairdii</i>
<i>Cyamus</i> ( <i>M.</i> ) <i>mesorubraedon</i> n. sp.	P	<i>Physeter macrocephalus</i>
<i>Cyamus</i> ( <i>Apocyamus</i> ) <i>scammoni</i> Dall, 1872*	P (AL-CAL)	<i>Eschrichtius robustus</i>
<i>Cyamus</i> ( <i>A.</i> ) <i>eschrichtii</i> n. sp.	P (Be - S. Cal)	<i>Eschrichtius robustus</i>
<i>Cyamus</i> ( <i>A.</i> ) <i>kessleri</i> Brandt, 1872*	P (AL-CAL)	<i>Eschrichtius robustus</i>
<i>Orcinocyamus orcini</i> (Leung, 1970)!	P (BC+?)-At	<i>Orcinus orca</i>
<i>Neocyamus physeteris</i> (Pouchet, 1888)*	P (SE AL-BC)	<i>Physeter</i> <i>Phocoenoides truei</i> ?
<i>Isocyamus delphini</i> (Guérin-Ménéville, 1836)	P (AL-CAL)	<i>Delphinus</i> , <i>Steno</i> <i>Globicephalus</i>
<i>Isocyamus globicipitis</i> (Lütken, 1873)	P-At	<i>Globicephalus</i>
<i>Isocyamus kogiae</i> Sedlak-Weinstein, 1992!	P (Austr)	<i>Kogia breviceps</i>
<i>Isocyamus</i> spp. (Bowman 1955, 1958)!	P	<i>Phocoenoides</i> sp.
<i>Platycyamus flaviscutatus</i> Waller, 1989*	P	<i>Berardius bairdii</i>
<i>Platycyamus thompsoni</i> (Gosse, 1855)	At	<i>Hyperoodon ampullatus</i>
<i>Syncyamus pseudorcae</i> Bowman, 1955!	At, P	<i>Pseudorca crassidens</i>
<i>Syncyamus aequus</i> Lincoln & Hurley, 1981	SAAt	<i>Delphinus delphis</i>
<i>Syncyamus</i> sp. (Bowman 1955, 1958)*	P	<i>Tursiops</i> , <i>Grampus</i> <i>Stenella</i>
<i>Scutocyamus parvus</i> Lincoln & Hurley, 1974!	P-At	<i>Lagenorhynchus</i> <i>albirostris</i>
<i>Scutocyamus antipodiensis</i> Lincoln & Hurley, 1980	P-At	<i>Cephalorhynchus</i> <i>hectori</i>

Cetacea, and finally compare the two phyletic family classifications for possible correlative similarities.

Laubitz (1993) was one of few who attempted to relate family Cyamidae to other family groupings within the Caprellidea (Fig. 30). She viewed the Caprellidea as a polyphyletic group encompassing 8 distinct families. Four families were grouped within a "Paracercopidae" lineage, presumably derived from a

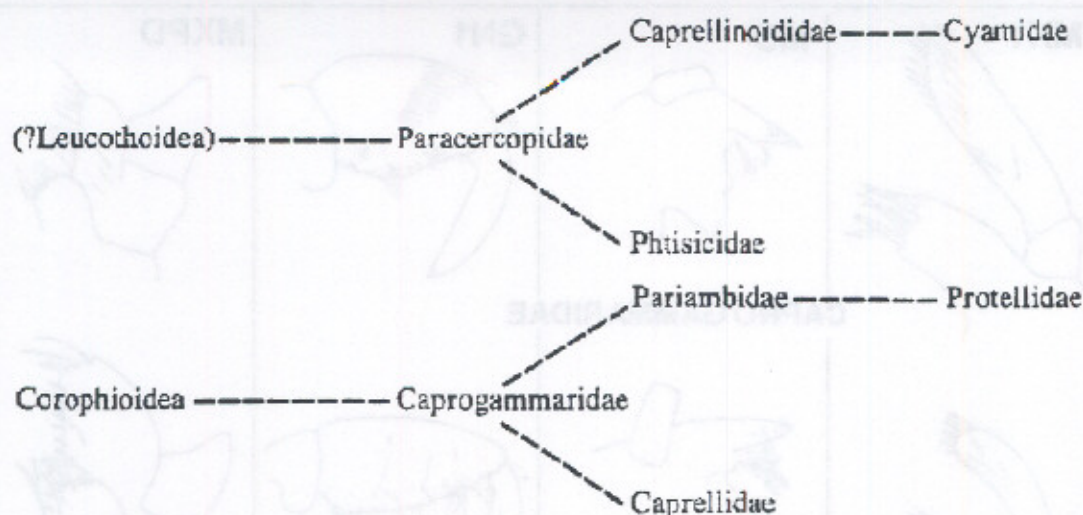
leucothoid ancestral type. The other four families were grouped within a "Caprogammaridae" lineage that includes the widely dominant pan-boreal littoral marine family Caprellidae, presumably derived through a corophi-oidean ancestry. The first grouping is morphologically distinguished by a mandible with 6-toothed incisor, variable setal row, and lacks a molar; maxilla 1 has 6 spiniform apical "setae" (spine-teeth) and the





**Fig. 29.** Selected characters and character states of family Cyamidae in comparison with those of major family groupings within Caprellida (after Laubitz, 1993).





**Fig. 30** Representation of hypothetical lines of evolution within Caprellidae (after Laubitz 1993).

maxilliped has a distinctive (larger) inner plate. In the second group, the mandible has a 5-cusped incisor, a setal row of no more than 3 blades, and a strong molar process; moreover, the outer plate of maxilla 1 has 7 apical spine-teeth and the outer plate of the maxilliped is the larger.

However, in examining these characters and character states over a broad range of species and genera of Cyamidae studied here, these correlations are not immediately apparent and/or encounter many exceptions. In balance, more cyamids appear closer to the Caprogammarid line in having a 5-dentate incisor, few blades in the setal row, and a molar that is variously reduced but present, and plesiomorphically bears a proximal molar seta. As often as not, maxilla 1 bears 7 apical spine-teeth (plesiomorphic?), and the outer lobe of the maxilliped may occasionally exceed the inner lobe.

Other evidence suggests that cyamids were more probably derived directly from the caprogammarid line. Thus, gnathopod 1 of cyamids (Fig. 29, p. 111) is clearly hatchet-shaped and the dactyl straight; also, the abdomen is very similar to that of the genus *Caprella*. Moreover, the ancestral cyamid would almost certainly have occurred in the shallow littoral zone wherein chances of "fouling" an ancestral whale species would presumably have been relatively high. By contrast, members of the Paracercopidae line are more frequent in sublittoral depths where an air-breathing ancestral whale host was less likely to occur. Lacking fossil evidence, and/or rDNA genetic analogs, the question of cyamid derivation within suborder Caprellidea therefore remains problematical.

The ancestry of the Cetacea has been summarized neatly by Berta & Sumich (1999). Fossil physeteroids,

ziphioids, and mysticetids occur somewhat further back in Tertiary times than do the delphinoids. Morphological, fossil, and rDNA evidence suggest that the Physeteroidea are more closely related to the primitive Mysticeti than to the advanced Delphinoidea.

The phenogram of character state similarities within genera and subgenera of family Cyamidae (Fig. 31) is derived by modified cluster analysis (see Bousfield and Shih 1994). This methodology may be considered semi-phyletic since the "states" of 24 selected characters are ordered phyletically, viz., plesiomorphic = 0, apomorphic = 2, and intermediate = 1. Selected characters encompass peraeon segments (3), head (3), mouthparts (9), gills (2), and gnathopods and peraeopods (7) (details available on request).

The "plesio-apomorphic" (P.-A.) index for each taxon is derived by totalling the ordered values for each of the 24 characters, with a maximum value of 48. Thus, subgenus *Cyamus* is here considered the most primitive taxon (P.-A. index = 11), and *Scutocyamus* the most advanced (P.-A. Index = 43), with other taxa intermediate. The separate treatment of the three "species" of *Isocyamus* appears justified by their character state differences; these are of a magnitude similar to those separating the subgenera of genus *Cyamus*. The new genus *Orcinocyamus* is nearly as distinct from the *Isocyamus* complex as is the genus *Neocyamus*. The genera *Platycyamus* and *Syncyamus* seem naturally (but distantly) related. *Scutocyamus* would appear relatively closely similar to *Syncyamus*, but the homoplasious nature of these similarities is suggested by the dotted connecting line.

The phyletic "trees" of both cyamids and whales (Figs. 31, 32) may now be compared. In general the



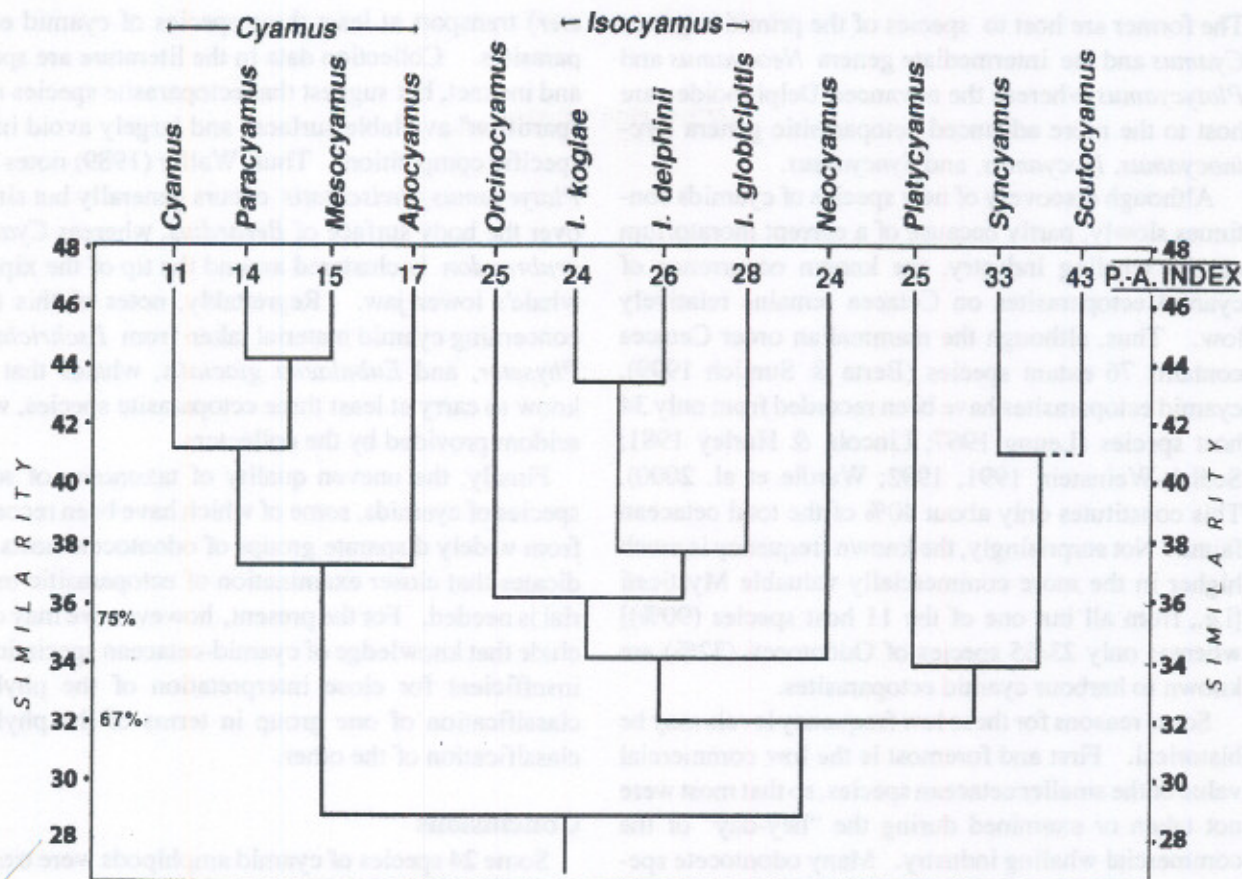


Fig. 31. Phenogram of hypothetical relationships between genera and subgenera of Cyamidae.

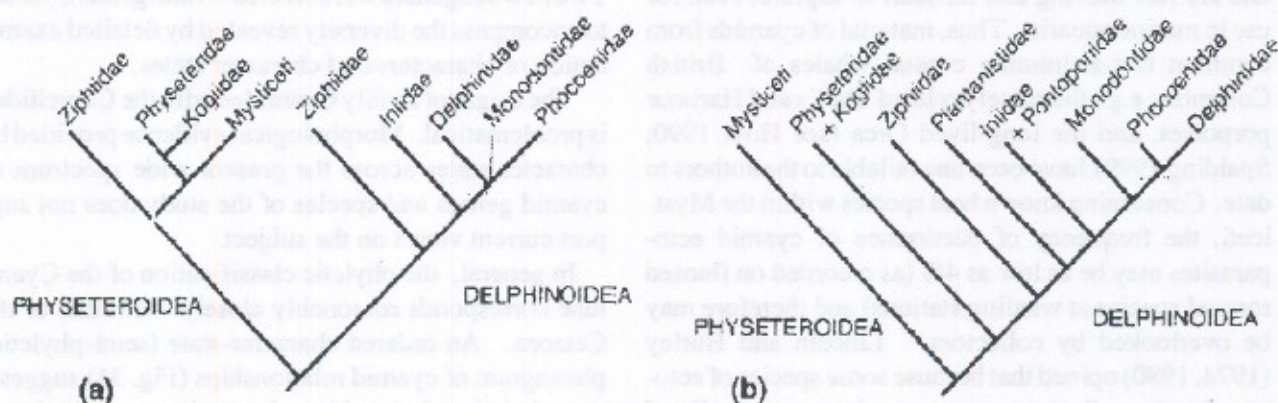


Fig. 32. Hypothetical relationships of extant mysticetid-odontocetid whales based on (a) cytochrome b sequence data; (b) morphological data (after Berta & Sumich 1999).

correlation is reasonably good. Thus, species of the primitive genus *Cyamus* (and subgenera) occur mainly on the primitive Mysticeti, some on the primitive Odontoceti (Ziphiidae, Physeteridae, and Monodontidae), but none on the advanced Delphinoidea. On the other hand, the advanced ectoparasitic genera (*Isocyamus*, *Orcinocyamus*, *Scutocyamus* and *Syncyamus*) occur only on the Odontoceti and not on the primitive Mysticeti.

Further analysis of the relationships between supergroups and families within the Cetacea (Fig. 32) provides a basis for comparison with the phyletic classification of cyamid ectoparasites. Berta and Sumich (1999) indicate that the Physeteridae and Ziphiidae, having modified double blowholes, are more closely related to the Mysticeti, having double blowholes (primitive condition), than to the Delphinoidea, having single dorsal blowholes (advanced condition).



The former are host to species of the primitive genus *Cyamus* and the intermediate genera *Neocyamus* and *Platycyamus* whereas the advanced Delphinoidea are host to the more advanced ectoparasitic genera *Orcinocyamus*, *Isocyamus*, and *Syncyamus*.

Although discovery of new species of cyamids continues slowly, partly because of a current moratorium on the whaling industry, the known occurrence of cyamid ectoparasites on Cetacea remains relatively low. Thus, although the mammalian order Cetacea contains 76 extant species (Berta & Sumich 1999), cyamid ectoparasites have been recorded from only 34 host species (Leung 1967; Lincoln & Hurley 1981; Sedlak-Weinstein 1991, 1992; Wardle et al. 2000). This constitutes only about 40% of the total cetacean fauna. Not surprisingly, the known frequency is much higher in the more commercially valuable Mysticeti [i.e., from all but one of the 11 host species (90%)] whereas only 23/65 species of Odontoceti (32%) are known to harbour cyamid ectoparasites.

Some reasons for these low frequency levels may be historical. First and foremost is the low commercial value of the smaller cetacean species, so that most were not taken or examined during the "hey-day" of the commercial whaling industry. Many odontocete species, especially among the 19 species of beaked whales, are very rarely stranded or taken in oceanic long-lines, and are fast-moving and difficult to capture, even for use in marine aquaria. Thus, material of cyamids from common fast-swimming coastal whales of British Columbia, e.g., the closely related Dall's and Harbour porpoises, and the long-lived Orca (see Hoyt 1990; Spalding 1999) have been unavailable to the authors to date. Concerning known host species within the Mysticeti, the frequency of occurrence of cyamid ectoparasites may be as low as 4% (as recorded on flensed rorqual species at whaling stations) and therefore may be overlooked by collectors. Lincoln and Hurley (1974, 1980) opined that because some species of ectoparasites (e.g., *Scutocyamus parvus*) are very small and occur only around genital organs and blow holes, they are likely to be overlooked by all but the most careful collectors. About ten species of whales (within Platanistidae, Pontoporiidae, Iniidae, and Lipotidae) are restricted mainly to fresh waters of India, Brazil, and China, presumably posing intolerable physiological limitations to ectoparasitism by cyamids of strictly marine ancestry.

As noted above, some species of whales (e.g., *Megaptera*) apparently carry only one species, whereas others (e.g., *Eschrichtius*, *Balaena mysticetus*, *Phys-*

*eter*) transport at least three species of cyamid ectoparasites. Collection data in the literature are sparse and inexact, but suggest that ectoparasite species may "partition" available surfaces and largely avoid interspecific competition. Thus, Waller (1989) notes that *Platycyamus flaviscutatus* occurs generally but singly over the body surface of *Berardius*, whereas *Cyamus orubraedon* is clustered around the tip of the xiphiid whale's lower jaw. Regrettably, notes of this type concerning cyamid material taken from *Eschrichtius*, *Physeter*, and *Eubalaena glacialis*, whales that are known to carry at least three ectoparasite species, were seldom provided by the collectors.

Finally, the uneven quality of taxonomy of some species of cyamids, some of which have been recorded from widely disparate groups of odontocete hosts, indicates that closer examination of ectoparasitic material is needed. For the present, however, we may conclude that knowledge of cyamid-cetacean speciation is insufficient for close interpretation of the phyletic classification of one group in terms of the phyletic classification of the other.

## Conclusions

Some 24 species of cyamid amphipods were treated systematically of which two were new to science, and 6 others were new to the northeastern Pacific region. Two new subgenera were erected within genus *Cyamus* to encompass the diversity revealed by detailed examination of characters and character states.

The origin of family Cyamidae with the Caprellidea is problematical. Morphological evidence provided by character states across the present wide spectrum of cyamid genera and species of the study does not support current views on the subject.

In general, the phyletic classification of the Cyamidae corresponds reasonably closely with that of the Cetacea. An ordered character-state (semi-phyletic) phenogram of cyamid relationships (Fig. 31) suggests that phyletic relationships of cyamid genera and species corresponds to those of the host whale taxa (cf. Fig. 32). Thus, members of the most primitive genus, *Cyamus* (and subgenera) occur mainly on the most primitive groups of whales (Mysticeti) and none on the most advanced group of Odontoceti (Delphinoidea). Conversely, advanced genera of cyamids are found only on the advanced Odontoceti.

The cyamid fauna of the world is yet insufficiently studied to facilitate critical use of the group as a potential guide to the origin and evolution of the Cetacea.



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#### Table II. Abbreviations for Figures:

A1	-	antenna 1
A2	-	antenna 2
ABD	-	abdomen
ACC	-	accessory
ADHES	-	adhesion
BR PL	-	brood plates
COX	-	coxal
DORS	-	dorsal
GEN	-	genital
GN1	-	gnathopod 1
GN2	-	gnathopod 2
HD	-	head
JUV	-	juvenile
LAT	-	lateral
LFT	-	left
LL	-	lower lip (labium)
MD	-	mandible
MX1	-	maxilla 1
MX2	-	maxilla 2
MXPD	-	maxilliped
P5-7	-	peraeopods 5, 6, 7
PEN	-	penis
PER	-	peraeon segment
PLP	-	palp
PLPD	-	pleopod
RT	-	right
SP	-	spine
UL	-	upper lip (labrum)
X	-	magnified



**DALL'S PORPOISE**

*Phocoenoides dalli*



**NOTES:**



# AMPHIPACIFICA

## INSTRUCTIONS TO AUTHORS

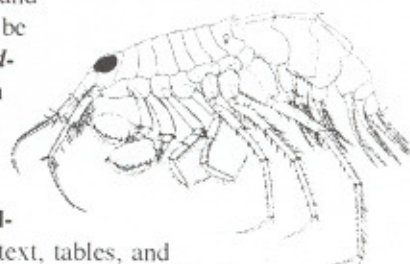
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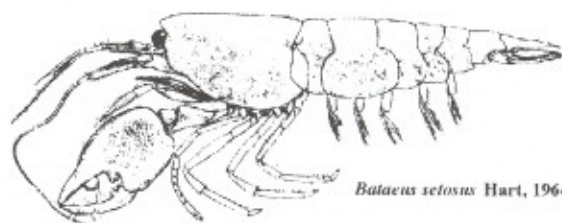
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*Balaen setosus* Hart, 1964

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