



Checklist and new records of Lophogastrida (Malacostraca, Peracarida) in Chilean waters

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ABSTRACT

Specimens of lophogastrids were collected off Chile, including four first records: *Ceratolepis hamata* G.O. Sars, 1883 in the vicinity of Easter Island, *Eucopeia unguiculata* (Willemoës-Suhm, 1875) the Juan Fernández Archipelago, *Gnathophausia zoea* Willemoës-Suhm, 1873 off Concepción, and *Neognathophausia ingens* (Dohrn, 1870) off Valparaíso. Additional records were also obtained for Chile for four species: *Eucopeia australis* Dana, 1852, *Eucopeia grimaldii* Nouvel, 1942, *Fagegnathophausia gracilis* (Willemoës-Suhm, 1875), and *Paralophogaster* sp. Based on these records, lophogastrids are now represented off Chile, in the southeastern Pacific, by nine species.

KEYWORDS

Biodiversity, Chile, Lophogastrida, Peracarida, southeastern Pacific

INTRODUCTION

The order Lophogastrida is little known worldwide and is considered more primitive than its closest and better-studied relative order Mysida. Species of Lophogastrida are considered of great importance in the links for energy conversion in the oceans, and they are considered as one of the main consumers of zooplankton in deep water. The scarcity of studies is in great part related to their habitat and the difficulty of routine sampling in deep waters (Meland and Willassen, 2007; Meland et al., 2015).

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Species of Lophogastrida inhabit both meso- and bathypelagic environments in the oceans worldwide (Castellani et al., 2017). They belong to three families: Lophogastridae G.O. Sars, 1870, Eucopiidae G.O. Sars, 1885, and Gnathophausiidae Udrescu, 1984 (Meland and Willassen, 2007). According to Clarke (1962), the oldest record of a lophogastrid (group that gave rise to the *Gnathophausia* Willemoës-Suhm, 1873) was that of M. Sars who reported, in 1857, *Lophogaster typicus* in his report of the “Challenger” campaigns carried out between 1873 and 1876. Years later, G.O. Sars (1885) recognized nine species in the genus *Gnathophausia* from different parts of the world (Ibarra and Hendrickx, 2008).

Some of the most complete works dealing with the eastern Pacific lophogastrids are those by Tattersall (1951) and Banner (1954), who studied the material from the “Americas” included in the collections of the Smithsonian Institution, Washington D.C. Additional records of species, or new material of lophogastrids, were also reported by Austin (1985), Brusca and Hendrickx (2005), Ibarra and Hendrickx (2008), Hendrickx (2019), Hendrickx and López (2019), and Huber et al. (2019). A complete checklist of lophogastrids occurring in the Mexican Pacific was proposed by Hernández-Payán and Hendrickx (2020) who reported eight species from this area. Three families of Lophogastrida are represented in Chilean waters. Lophogastrida differs notably from the Mysida, with the major differences being well-developed gills on most thoracopods for both sexes, the presence of pleopods in both sexes, a marsupium consisting of seven pairs of oostegites in females, and the absence of a statocyst in the external branch of the uropod (Nouvel et al., 1999), although some species of deep-sea Mysida, like the family Petalophthalmidae, also lack statocysts in the base of uropods and have oostegites. Pleural plates are present in the Lophogastridae and Gnathophausiidae and absent in Eucopiidae (except in *Eucopia* Dana, 1852). The Gnathophausiidae feature a long and thin rostrum, armed with small teeth, while in the Lophogastridae the rostrum is unarmed, short, and wide (Casanova et al., 1998; Murano, 1999).

Neognathophausia gigas (Willemoës-Suhm, 1875) and *Fagegnathophausia gracilis* (Willemoës-

Suhm, 1875) (both previously belonged in the genus *Gnathophausia*) have been cited for the Chile-Peru and Iquique trench, respectively (Soto and Retamal, 1991). Brandt et al. (1998) cited *Eucopia australis* Dana, 1852 from the southern tip of South America.

Studies carried out by the former Soviet Union in the region indicate the presence of five species of lophogastrids in the vicinity of the seamounts of the Salas and Gómez and the Nazca mountain ranges (Vereshchaka, 1990).

During biodiversity studies of the Chilean mesopelagic zone, specimens of nine species of lophogastrids were collected, none of which had been previously recorded from the southeastern Pacific (SEP). This material is reported herein and includes new records for the Chilean fauna.

MATERIAL AND METHODS

The specimens reported here were collected by different expeditions off the coast of Chile. In the northern zone, material was obtained from the United Nations development project (FAO-UNDP CHI/87/007) between longitude 18°38'S and 21°47'S and from the coast to latitude 72°04'W. Other material was collected by the CIMAR programs of the National Oceanographic Committee expeditions to the Chilean Oceanic Islands (CIMAR 5, CIMAR 6, CIMAR 21, CIMAR 22), and to the Chilean fjords (CIMAR 14, CIMAR 25). Other expeditions included the MOPEX Expedition off Valparaíso, the ONR expedition off Concepción, and the ATACAMEX expedition in the Atacama trench off Antofagasta. Specimens were collected with an IKMT (Isaacs-Kidd Midwater Trawl) net. The material examined is deposited in the Museum of the Sea of the Arturo Prat University. A restricted synonymy is provided for each species, including the prime synonymy and references relevant to this study.

RESULTS

Nine species were registered during this study, four of which are recorded for the first time in waters of the SEP off Chile:

Order Lophogastrida Boas, 1883**Family Eucopiidae G.O. Sars, 1885****Genus *Eucopia* Dana, 1852*****Eucopia australis* Dana, 1852**

Eucopia australis Dana, 1852: 609–611, pl. 40 (10a–m). — Hansen, 1913: 8. pl. I, fig. 1a, b. — Illig, 1930: 404–405. — Fage, 1942: 41–47, figs. 28a, 29–35. — Tattersall, 1951: 33 [distribution, remarks]. — Tattersall, 1955: 48–49, fig. 4C, D. — Birstein and Tchindonova, 1962: 61. — Kathman et al., 1986: 140–141. — Wittmann, 1990: 130, fig. 257.

Material examined. 3 females, station E-14 PNUD/Chi-87 (20°20'S 70°58'W) (Fig. 1).

Previous records from SEP. This is the first record from the SEP.

Geographic distribution. Cosmopolitan, meso- to bathypelagic, under 600 m depth (Mauchline and Murano, 1977).

Depth range. 600–6,050 m (Müller, 1993).

***Eucopia grimaldii* Nouvel, 1942**

Eucopia grimaldii Nouvel, 1942: 5, 6, figs. 5, 6.

Eucopia grimaldii — Birstein and Tchindonova, 1962: 61, 62. — Kathman et al., 1986: 144, 145.

Eucopia grimaldi — Vereshchaka, 1990: 119.

Material examined. 2 females, station 4 CIMAR 21 (26°59'54"S 71°12'57"W).

Previous records from SEP. In the vicinity of the “Soldier” seamount (21°41'S 81°46'W) of the Salas & Gomez submarine ridge (Vereshchaka, 1990).

Geographic distribution. Pan oceanic from Alaska to the Antarctic (San Vicente, 2016).

Depth range. 300–5,430 m (most commonly in about 2,000 m) (Müller, 1993; Wittman, 2020a).

***Eucopia unguiculata* (Willemoës-Suhm, 1875)**

Chalaraspis unguiculata Willemoës-Suhm, 1875: 40, pl. 8.

Eucopia unguiculata. — Hansen, 1905: 3. — Hansen, 1910: 20, 21, pl. I, fig. 3a. — Hansen, 1912: 187–188; — Hansen, 1927: 20. — Holt and W.M. Tattersall, 1906: 20 (and references therein). — Tattersall, 1951: 34 [distribution]. — Birstein and Tchindonova, 1962: 62. — Austin, 1985: 560. — Kathman et al., 1986 (and references therein): 145, 147, text figs. a, b, d, f, h. — Price et al., 2009: 927.

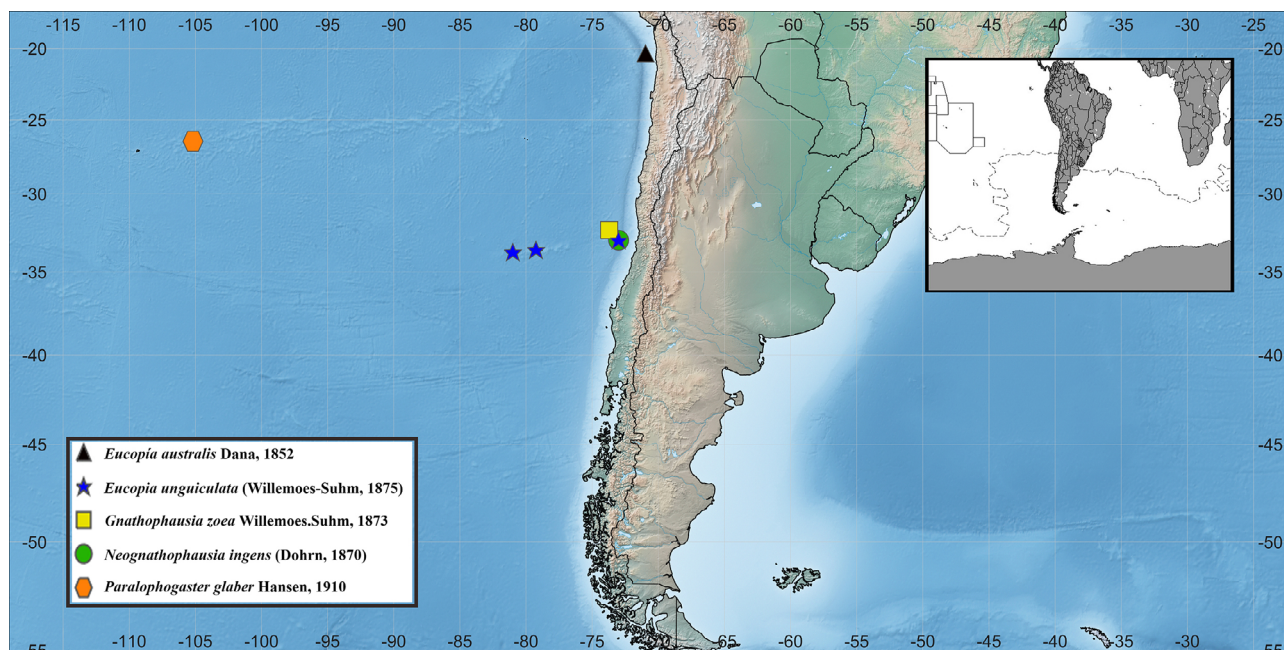


Figure 1. Localities where species of the order Lophogastridae are present in Chilean waters.

Material examined. 1 male, station 26 CIMAR 22 (33°45'00"S 81°00'00"W); 1 male, station 34 CIMAR 22 (33°36'00"S 79°15'00"W); 2 females and one male, station 38 CIMAR 22 (33°00'00"S 73°00'00"W) (Fig. 1).

Previous records from SEP. First record from the Southeast Pacific.

Geographic distribution. Pan oceanic in tropical to Arctic waters, latitudes all along from Arctic to Antarctic oceans (Wittmann, 2020b).

Depth range. 100–6,500 m (Müller, 1993).

Family Gnathophausiidae Udrescu, 1984

Genus *Fagegnathophausia* Petryashov, 2015

Fagegnathophausia gracilis (Willemoës-Suhm, 1875)

Gnathophausia gracilis Willemoës-Suhm, 1875: 33, pl. 9, fig. 1.

Gnathophausia gracilis — G.O. Sars, 1885: 48, pl. VII, figs. 6–10. — Ortmann, 1907: 39. — Hansen, 1912: 185, 186. — Fage, 1941: 27, fig. 27. — Tattersall, 1951: 28. — Pequegnat, 1965: 409, fig. 6. — Vereshchaka, 1990: 119.

Gnathophausia brevispinis — Faxon, 1895: 216, pl. J.

Gnathophausia dentata Faxon, 1893: 217.

Material examined. 1 male associated with the “centollón del norte” (Lithodidae) fishing offshore of Iquique in 2001; 1 male collected during the ATACAMEX expedition in 2018 to the Atacama trench.

Previous records from SEP. In the vicinity of the “Soldier” seamount (21°41'S 81°46'W).

Geographic distribution. Widely distributed from 34°N to 22°S, bathypelagic (Mauchline and Murano, 1977; Soto and Retamal, 1991; Murano, 1999).

Depth range. 500–5,225 m (Müller, 1993; Wittmann, 2020a).

Gnathophausia zoea Willemoës-Suhm, 1873

Gnathophausia zoea Willemoës-Suhm, 1875: 32, pl. 9, figs. 2–15. — G.O. Sars, 1885: 44. — Faxon, 1896: 164. — Ortmann, 1907: 42, pl. 2, fig. 2a, b. — Hansen, 1910: 17; — Hansen, 1912: 186. — Fage, 1941: 34. — Tattersall, 1951: 29. — Birstein and Tchindonova, 1958: 261. — Pequegnat, 1965: 410. — Vereshchaka, 1990: 119. — Brusca and Hendrickx, 2005: 141.

Gnathophausia Willemoësi G.O. Sars, 1885: 38, pl. 5, figs. 1–6. — Faxon, 1895: 215, pl. K, fig. 1. — Ortmann, 1906: 969.

Gnathophausia zoea sarsi — Ortmann, 1907: 42.

Material examined. 1 specimen collected by the expedition ONR agt11 in front of Concepción (32°21'S 73°43'W) (Fig. 1).

Previous records from SEP. First record from the Southeast Pacific.

Geographic distribution. Cosmopolitan in temperate and tropical zones of the Pacific, Indian and Atlantic oceans, between 65°N–37°S (Mauchline and Murano 1977; Lagardere, 1983; Brusca and Hendrickx, 2005; Hendrickx, 2019).

Depth range. 400–6,050 m (Müller, 1993).

Neognathophausia ingens (Dohrn, 1870)

Lophogaster ingens Dohrn, 1870: 610, pl. 31, figs. 12–14.

Gnathophausia ingens — G.O. Sars, 1885: 30, pl. II. — Ortmann, 1907: 28, pl. II, fig. 1a. — Hansen, 1912: 184, 185. — Fage, 1941: 15. — Tattersall, 1951: 25. — Clarke, 1961: 313, fig. 1. — Birstein and Tchindonova, 1962: 59. — Pequegnat, 1965: 403, figs. 3, 4. — Kathman et al., 1986: 160. — Escobar-Briones, 2002: 295.

Gnathophausia calcarata G.O. Sars, 1885: 35, pl. IV. — Ortmann, 1907: 30, pl. 1, fig. 2a–f.

Neognathophausia ingens — Petryashov, 1992: 47, 48.

Material examined. 1 specimen damaged, station 38 CIMAR 22 (33°00'00"S 73°00'00"W) (Fig. 1).

Previous records from SEP. First record from the Southeast Pacific.

Geographic distribution. Cosmopolitan, between 40°N and 45°S (Mauchline and Murano, 1977).

Depth range. 225–3,914 m (Müller, 1993).

Family Lophogastridae G.O. Sars, 1870

Genus *Ceratolepis* G.O. Sars, 1883

***Ceratolepis hamata* G.O. Sars, 1883**

Ceratolepis hamata G.O. Sars, 1883: 4.

Ceratolepis hamata — Fage, 1941: 9–14, figs. 11–19.
— Vereshchaka, 1990: 118.

Material examined. 4 females, station e-43 CIMAR-5 (27°00'30"S 109°12'17"W).

Previous records from SEP. In the vicinity of the seamounts “Rock” (25°58'S 100°41'), “Ichthyologist” (25°07'S 99°35'W) and “Dome” (25°04'S 97°26'W) (Vereshchaka, 1990).

Geographic distribution. Samoa, Indo-Pacific between 10° and 25°S, epi- and mesopelagic between 25 and 300 m (Mauchline and Murano, 1977).

Depth range. 25–4,780 m (Müller, 1993).

Genus *Paralophogaster* Hansen, 1910

***Paralophogaster glaber* Hansen, 1910**

Paralophogaster glaber Hansen, 1910: 16, 17, pl. I, fig. 2a–n. — Tattersall, 1951: 22–24 [distribution, remarks].

Paralophogaster glaber pacificus Vereshchaka, 1990: 119–122, fig. 1.

Material examined. 1 female and 2 males, station E-74 CIMAR 5 (26°28'06" 105°10'45"W). In the vicinity of Salas and Gómez Islands. (Fig. 1).

Previous records from SEP. First record from the Southeast Pacific.

Geographical distribution. West Pacific Atlantic between 40°N and 35°S (Tattersall, 1951; Mauchline and Murano, 1977).

Depth range. Surface to 310 m (Müller, 1993).

DISCUSSION

Lophogastrids correspond to non-decapod pelagic organisms similar to shrimp, mostly with distributions limited to deep waters. Their records seem to be accidental in plankton samples, for which special sampling equipment for deep waters is required. In Chile they have been reported occasionally (Soto and Retamal, 1991).

The genus *Eucopia* contains nine valid species (Mees and Meland, 2012), including one fossil species (*Eucopia praecursor* Secretan and Riou, 1986+). Most species of this genus have a wide distribution and several are cosmopolitan (Kathman et al., 1986; Burghart et al., 2007).

Eucopia australis has been cited for the SEP; however, the group of lophogastrids in the SEP present complexities in the taxonomic status of some of them. Three species of *Eucopia* have been recorded in the SEP, but the few records available do not allow establishment of distributional patterns in this area of the Pacific. Of these three species, *E. grimaldii* has been recorded in the vicinity of seamounts by Vereshchaka (1990). The differences between the three species are relatively clear. The telson of *E. unguiculata* has a very truncate apex armed with two long spines, this character is unique to this species. In the case of *E. australis* and *E. grimaldii*, they can be differentiated by a series of characters such as the shape of the anterior margin of the carapace; i.e., broad in *E. grimaldii* and narrow in *E. australis*, the relationship between the length of the sixth pleonite and the length of the telson, and the shape of the end of the telson and its armature.

Species of Gnathophausidae are quite characteristic for their intense red color and their body ornamented with thorns and keels. The taxonomic status of the species of this family has been reviewed rather extensively and there is clarity in this regard (Meland and Aas, 2013; Petryashov, 2015).

The family Lophogastridae is represented in the SEP by three species or subspecies, *C. hamata*, *P. glaber glaber*, and *P. glaber pacificus*. *Ceratolepis hamata* has been collected in the SEP only on two occasions, both in the vicinity of the seamounts of the Salas and Gómez Mountain ranges (Vereshchaka, 1990; this study), and this record of *C. hamata* would be the westernmost limit of this species. Both subspecies of *P. glaber* are present in the SEP. According to Vereshchaka (1990), the specimens collected in the vicinity of the seamounts of the Salas and Gómez Mountain range differ from the typical *P. glaber*, something that had already been noted by Bacescu (1981) in specimens from different locations analyzed in Bacescu (1981). The specimens recorded here match the original description of Hansen (1910) and differ from that indicated by Vereshchaka (1990). The number of spines on the telson corresponds well with the original description of Hansen and that indicated by other authors (Hansen, 1910; Tattersall, 1951; Bacescu, 1981).

In the Northeast Pacific, eight species of the order Lophogastrida have been cited (Ibarra and Hendrickx, 2008; Hendrickx, 2019; Hernández-Payán and Hendrickx, 2020) of which four are present in the SEP: *E. unguiculata*, *F. gracilis*, *G. zoea*, and *N. ingens*.

Hernández-Payán and Hendrickx (2020), taking into account the information reported by Austin (1985), Brusca and Hendrickx (2005), Ibarra and Hendrickx (2008), Mees and Meland (2012), San Vicente (2016), Hendrickx (2019), and Hernández-Payán (2020), reevaluated the fauna of Lophogastrida for the eastern Pacific (from Alaska to Chile) and concluded that there are 13 species of Lophogastrida known from this region. Based on this study, two species are added to this list (*E. unguiculata*, *Eucopeia sculpticauda* Faxon, 1893) thus reaching a total of 15 species currently known from the eastern Pacific (Tab. 1).

Recent studies of deepwater have increased the number of species of the order Lophogastrida in Chilean waters (Fig. 1). However, a greater number of samples are required in the area as well as the use of specialized equipment to obtain stratified samples to determine the vertical distribution of the different species. It is also recommended to obtain new material not preserved in formaldehyde for genetic analysis to clarify the phylogenetic relationships among species.

Table 1. Updated list of Lophogastrida species recorded in eastern Pacific waters (Alaska to Chile). Species reported in the Chilean Pacific in bold. FR = first record in Chilean waters.

Order Lophogastrida
Family Eucopiidae G.O. Sars, 1885
Genus <i>Eucopeia</i> Dana, 1852
<i>Eucopeia australis</i> Dana, 1852 FR
<i>Eucopeia grimaldi</i> Nouvel, 1942
<i>Eucopeia major</i> Hansen, 1910
<i>Eucopeia sculpticauda</i> Faxon, 1893
<i>Eucopeia unguiculata</i> (Willemoës-Suhm, 1875) FR
Family Gnathophausiidae Udrescu, 1984
Genus <i>Fagegnathophausia</i> Petryashov, 2015
<i>Fagegnathophausia gracilis</i> (Willemoës-Suhm, 1875)
Genus <i>Gnathophausia</i> Willemoës-Suhm, 1873
<i>Gnathophausia childressi</i> Casanova, 1996
<i>Gnathophausia scapularis</i> Ortmann, 1906
<i>Gnathophausia zoea</i> Willemoës-Suhm, 1873 FR
Genus <i>Neognathophausia</i> Petryashov, 1992
<i>Neognathophausia gigas</i> (Willemoës-Suhm, 1873)
<i>Neognathophausia ingens</i> (Dohrn, 1870) FR
Family Lophogastridae G.O. Sars, 1870
Genus <i>Ceratolepis</i> G.O. Sars, 1883
<i>Ceratolepis hamata</i> G.O. Sars, 1883
Genus <i>Chalaraspidum</i> Willemoës-Suhm, 1895
<i>Chalaraspidum alatum</i> (Willemoës-Suhm, 1876)
Genus <i>Lophogaster</i> M. Sars, 1857
<i>Lophogaster japonicus</i> W.M. Tattersall, 1951
Genus <i>Paralophogaster</i> Hansen, 1910
<i>Paralophogaster glaber</i> Hansen, 1910

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ADDITIONAL INFORMATION AND DECLARATIONS

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Conceptualization and Design: JCH-P. Performed research: JCH-P, GG, NOC. Acquisition of data: JCH-P, GG, NOC. Analysis and interpretation of data: JCH-P, GG, NOC. Writing - original draft: JCH-P, GG, NOC. Writing - critical review & editing: JCH-P, GG, NOC.

Consent for publication

All the authors give their consent, approve, and give the go-ahead for the publication of this manuscript in their journal.

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There is no conflict of interest between the authors of this manuscript.

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