

Systematics and distribution of cumaceans collected during BENTART-95 cruise around South Shetland Islands (Antarctica)*

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SUMMARY: During the BENTART-95 cruise, 24 stations around the South Shetland Islands and Trinity Island, ranging from 45 to 649 m bottom depth, were sampled using a Macer-GIROQ sledge. Altogether, 1236 specimens of cumaceans belonging to 25 species were captured. Four of them are new species named *Cumella emergens*, *Procampylaspis halei*, *Campylaspis heterotuberculata* and *Leucon (Crymoleucon) costatus*. Distribution of cumaceans in this area is depth-dependent and the highest diversity was observed at the deeper station. A total of 68 species have been recorded from Antarctic and Subantarctic waters, the greatest part (47 species) were found between 50 and 300 m depth; only 3 species inhabit below 2,500 m depth. Antarctic cumacean fauna shows a high degree of endemism at a specific level (91%), however, only one genus of 19 is endemic. By regions, the Kerguelen Islands have the highest percentage of endemic species (56%). Antarctic cumaceans do not seem to have a common origin, some species could have colonized Antarctica through Scotia Arc (as the genus *Campylaspis*) or emerged from deep-sea while others may be radiated from Antarctica to lower latitudes (as the species of subgenus *Crymoleucon*).

Key words: Cumacea, swimming activity, suprabentos, systematics, distribution, biogeography, Antarctica.

INTRODUCTION

Cumaceans are mainly marine benthic peracarid crustaceans inhabiting all oceans from the intertidal zone to the deepest bottoms (Jones 1969). Although cumaceans can penetrate into the sediment (Fage, 1951) they are an important component of suprabenthic communities (Mees and Jones, 1997). Some littoral species undertake nictemeral migrations (Macquart-Moulin, 1991) and recently, vertical movements have also been observed for a few deep sea species (Cartes and Sorbe, 1997). This behavioural pattern would support the presumed contribution of cumaceans, as other suprabenthic crustaceans

(Brandt 1993, 1995), to the bioturbation and resuspension in the benthic ecosystem. Moreover cumaceans are a food source for fishes (Kurian and Radhadevi, 1983) and other macrobenthic invertebrates (Cartes, 1993).

In Antarctic waters, studies on cumaceans are focused mainly on systematics. Most of the expeditions sampled with dredges (Lomakina, 1968; Ledoyer, 1974, 1977; Mühlenhardt-Siegel, 1994; Blazewicz and Jazdzewski, 1995), trawls (Hale, 1937; Jones, 1971; Gamô, 1987; Ledoyer, 1993) and box-corer (Ledoyer, 1993). These gears probably do not sample efficiently on cumaceans (Jones and Sanders, 1972) due to the small size and low density of these crustaceans. Significant differences are observed in composition and density of peracarids

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crustaceans assemblages from the English Channel, which have been sampled with different tow gears (Smith-McIntyre grab and Macer-GIROQ sledge; Dauvin and Zouhiri, 1996). No data on cumaceans sampled with a suprabenthic sled in the Antarctica have been published up to now, however, Siegel and Mühlenhardt-Siegel (1988) reported the use of a Beyer's sled in Antarctic Peninsula region.

Ledoyer (1993) lists 56 species of cumaceans from the Antarctic region, two of them show a wide distribution, 19 are subantarctic species (including 3 from the Magellan region), 13 have Antarctic and subantarctic distribution and 23 are high Antarctic species. However, Ledoyer (1993) did not include the eight species described in his work, and later Roccatagliata and Heard (1992) and Mühlenhardt-Siegel (1994, 1996) added three new species.

The present study deals with the faunistical composition and distribution of cumaceans that occur near the South Shetland Islands and it summarizes the present knowledge on both bathymetric and geographic distribution of Antarctic cumaceans.

MATERIAL AND METHODS

Twenty-four stations located around the Livingston Island, the Deception Island and the Bransfield Strait, at depths ranging from 45 to 650 m, were sampled using a modified version (Cartes *et al.*, 1994) of the Macer-GIROQ sled (Brunel *et al.*, 1978; Dauvin and Lorgeré, 1989) during the BENTART-95 cruise. This cruise was carried out from 16 January to 4 February 1995 on board of the *RV Hespérides* (see San Vicente *et al.*, 1997 for a detailed characteristics of sampling and preliminary observations on suprabenthic assemblages).

The sled used was equipped with an opening-closing system and with three superposed nets 0.5 mm mesh size with a rectangular opening of 40 x 80 cm that sample in three water layers: 10-50 cm (net 1), 55-95 cm (net 2) and 100-140 cm (net 3) above the sea floor.

The material was sorted with a dissecting stereomicroscope, after fixation in neutral formaline (10%) and later being transferred into ethanol (70%). Only the new species and those which showed a special taxonomic importance were studied in the systematic account. Type material and a reference collection was deposited in the cumacean collection of the *Institut de Ciències del Mar* (ICM) of Barcelona. Type material of two Antarctic species of the genus

Leucon [*Leucon vanhoeffeni* Zimmer, 1907 paratypes (5 especimens) MNB n° 18342; Obsevatory Bay, Kerguelen Island; and *Leucon kerguelensis* Zimmer 1908 holotype MNB n° 13362; Gazellehafen, St. 160 Deutsche Tiefsee-Expedition, Kerguelen] deposited in the *Museum für Naturkunde der Humboldt-Universität zu Berlin*(MNB) were studied.

Data analysis

Abundance of species was expressed as the number of individuals. A diversity index was calculated using the formula of Shannon-Waever:

$$H = -\sum p_i \log_2 p_i$$

An index of swimming activity (Brunel, 1972; Saint-Marie and Brunel, 1985) was calculated for the more abundant species using the following formula:

$$K_1 = N_2/N_t$$

$$K_2 = N_3/N_t$$

where N_2 and N_3 are the number of individuals collected in 55-95 cm and 100-140 cm water layers above the sea floor respectively and N_t is the cumulative number of individuals from three water layers sampled by the sled.

Cumacean assemblages were identified on the basis of species composition of samples using the cluster analysis (Jaccard's similarity coefficient and UPGMA aggregation algorithm). A Principal Component Analysis (PCA) was performed using a

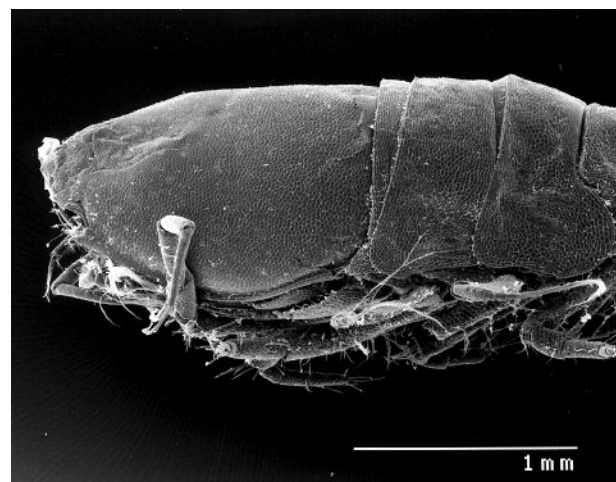


FIG. 1. – *Vaunthompsonia laevifrons* Gamô 1987, SEM microphotograph of carapace in lateral view.



FIG. 2. – *Vaunthompsonia laevifrons* Gamô 1987, adult female; a) uropod; b) first antenna; c) second pereopod; d) mandible; e) third maxilliped; f) first pereopod. Scale bar 0.5 mm.

transformed abundance matrix comprising the most frequently occurring species to determine the role of environmental parameters on the distribution of cumaceans.

RESULTS

Systematics

Order CUMACEA
 Family BODOTRIIDAE
 Subfamily Vaunthompsoniinae

Vaunthompsonia laevifrons Gamô 1987 (Fig. 1, 2)

Vaunthompsonia laevifrons: Gamô 1987, p. 147-149, fig. 2. Ledoyer 1993, p. 1052-1053, fig. 2B.

Material examined: BENTART-95 cruise sta. 3: 6 preadult ♀♀, 3 preadult ♂♂; sta. 4T2: 1 preadult ♀; sta. 5: 1 preadult ♂; sta. 6: 29 preadult ♀♀, 10 preadult ♂♂, 4 jov.; sta. 15: 8 preadult ♀♀, 1 preadult ♂; sta. 16: 2 adult ♀♀, 20 preadult ♀♀, 13 preadult ♂♂, 28 jov.; sta. 17: 1 preadult ♀; sta. 19: 3 preadult ♀♀, 2 jov.; sta. 25T1, 1 preadult ♀; sta. 25T2, 2 preadult ♀♀; sta. 28: 2 jov.; sta. 29: 3 preadult ♀♀; sta. 30: 7 preadult ♀♀, 2 preadult ♂♂.

Description: Ovigerous female 6.75 mm total length (from the tip of pseudorostrum to the end of

last abdominal somite), carapace (1.5 mm length) (Fig. 1) 1.7 times as long as deep and longer than the four anterior pedigerous somites. Anterolateral margin of pseudostrahl lobes with 2-3 small teeth, pseudostrahl not meeting in front of the eyelobe which is rounded and without spines. Antennal notch excavated, anterolateral angle acute and lower margin serrated. Last abdominal somite produced backwards between uropods with one pair of long terminal setae and another very small one.

Peduncle of first antenna (Fig. 2b) three-segmented, first article longer than the following two articles; main flagellum with two aesthetascs. Mandible (Fig. 2d) with eight setae between the incisive and molar process. Basis of third maxilliped (Fig. 2e) longer than the remaining segments together, distal margin slightly produced and with 6-8 long plumose setae. First pereopod (Fig. 2f) with basis shorter than the rest of limb, ischium short, carpus

propodus and dactyl long and of similar length. Basis of second pereopod (Fig. 2c) shorter than the rest of limb, ischium very short, merus and carpus of similar length, propodus short and dactyl as long or longer than carpus. Uropod peduncle (Fig. 2a) subequal in length to the last abdominal somite, inner margin with 10-11 spines; rami of same length about 1.5 times as long as peduncle, endopod bi-segmented, proximal article twice as long as distal with 15 spines on inner margin some setae on outer margin; second article with 4 spines on inner margin, 2 setae on outer margin and 3 spines distally.

Remarks: *Vaunthompsonia inermis* was described from three specimens collected in South Georgia and is distinguished from *V. meridionalis* by the lack of dorsomedian serrated carines. Later, Gamô (1987) described a new species, *V. laevifrons*, also without dorsomedian serrated carines and based

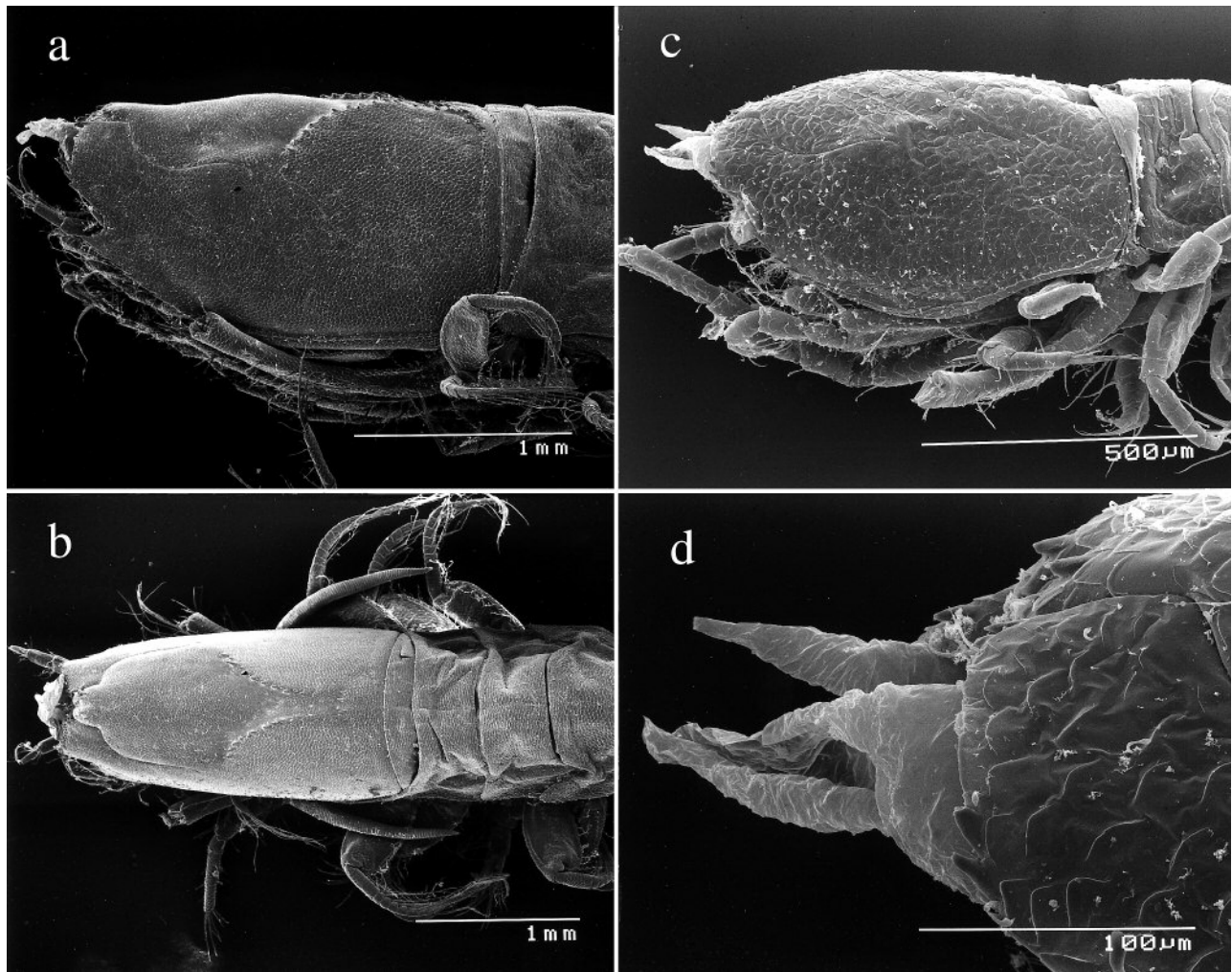


FIG. 3. – *Vaunthompsonia meridionalis* Sars 1887, SEM microphotograph; a) carapace in lateral view; b) preadult male, carapace in dorsal view; c) manca stage, carapace in lateral view; d) manca stage, anterior tip of carapace showing two small denticles on eyelobe.

on the relative length of carapace and pereon. However, as Ledoyer (1993) has mentioned, the type material of this species is damaged and this character cannot be considered as valid. This last author attributes the Weddell Sea material to *V. laevifrons* on the basis of the denticulated upper margin of antennal notch. However, the structure of this margin is not mentioned in the short description of *V. inermis* and it is very difficult to discern in the small figure of Zimmer (1909). Specimens collected during the BENTART cruise are similar to the description of Ledoyer and, have like those from the Weddell Sea a lower number of setae on the hind margin of last pleonite. However, the setation of mandible is not as described by Gamô. Unfortunately, the mandible was not described by Ledoyer (1993). In spite of the mentioned difference in mandible, I prefer to assign the material of the BENTART cruise to *V. laevifrons* following Ledoyer's criterium.

***Vaunthompsonia meridionalis* Sars 1887**
(Fig. 3)

Vaunthompsonia meridionalis Sars 1887, p. 23-25, pl. 2 fig. 1-5. Calman 1905, p. 17. Zimmer 1908, p. 166-168, pl. 38 fig. 34-45, pl. 39 fig. 46-52; Zimmer 1909, p. 4; Zimmer 1920, p. 131. Lomakina 1968, p. 127. Ledoyer 1977, p. 195-196.

Material examined: BENTART-95 sta. 3: 42 preadult ♀♀, 19 preadult ♂♂, 1 jov.; sta. 4T1: 3 preadult ♀♀, 2 preadult ♂♂, 5 jov.; sta. 9: 2 preadult ♀♀, 3 jov.; sta. 10: 1 adult ♀, 2 preadult ♀♀, 2 jov.; sta 11: 1 preadult ♀; sta. 16, 1 ind.; sta. 28: 4 adult ♀♀, 95 preadult ♀♀, 17 preadult ♂♂, 72 jov.

Remarks: *Vaunthompsonia meridionalis* is differentiated from the other two Antarctic species of this genus by the two longitudinal dorsomedian serrated carines (Fig. 3a, b). However, this character lacks in manca stage (first postmarsupial stage with pereopod 5 not developed) (Fig. 3c). The detailed study of mancas did not provide differences with manca specimens attributed to *V. laevifrons*, only in some individuals, a pair of small denticles on eyelobe has been observed (Fig. 3d). But this character is very difficult to observe in specimens since mancas, which are generally poorly calcified and frequently damaged. For this reason, mancas was not classified at specific level.

Family NANNASTACIDAE Bate, 1866
***Cumella emergens* sp. nov.**
(Fig. 4)

Type material: Holotype preadult ♂ ICM NAN001. *Type locality:* North of the Livingston Island, BENTART-95 sta. 30, 62°01.45'S 60°25.75'W, 649 m. Paratypes from the same locality: 2 preadult ♂♂ ICM NAN002

Etymology: Referring to the probable deep-water origin of this Antarctic species.

Description: Preadult male (Fig. 4a) total length 2.3 mm. Carapace 1.6 times as long as deep, slightly tumid posteriorly with 2-3 forward-pointing mid-dorsal teeth on the anterior half. Pseudorostrum short and truncate slightly upturned and siphons moderately long. Eyelobe rounded not elongate, with one spine. Antennal notch wide but little excavated; anterolateral angle marked by a spine followed by serrations. Pereon and pleon unarmed; pleon longer than the carapace and pereon together, last pleonite produced backwards between uropod peduncles.

Basis of first pereopod (Fig. 4d) shorter than the following four segments combined length, ischium and merus short, carpus longer than two preceding segments, propodus shorter than carpus and more than twice as long as dactyl. Second pereopod basis (Fig. 4c) as long as the rest of limb, ischium very short, carpus twice as long as merus and with a long spine on the distal margin, propodus half length of merus, dactyl shorter than carpus and propodus combined length. Uropod peduncle (Fig. 4b) as long as the fifth abdominal somite, endopod 0.8 times as long as peduncle with one spine on inner margin and 2 terminally; exopod tow-segmented shorter than endopod, second article with a spine on inner margin and 2 distally one of them as longer as exopod.

Remarks: *Cumella emergens* sp. nov. is anatomically related with deep-water Atlantic species of this genus. *Cumella emergens* is similar to *C. compacta* Jones, 1984, *C. decipiens* Jones, 1984 and *C. meridionalis* Jones, 1984 for its rounded eyelobe and the moderately upturned pseudorostrum. However it differs from these species by the combined following characters: mid-dorsal teeth only on the anterior half of carapace, anterolateral angle acute and eyelobe with one spine.

***Campylaspis heterotuberculata* sp. nov.**
(Fig. 5)

Type material: Holotype preadult ♀ ICM NAN-003. *Type locality:* Deception Island, BENTART-95 sta. 22, 63°03.56'S 60°39.54'W, 330 m. Paratype from the same locality: preadult ♀ ICM NAN-004

Etymology: Referring to the different size of carapace tubercles.

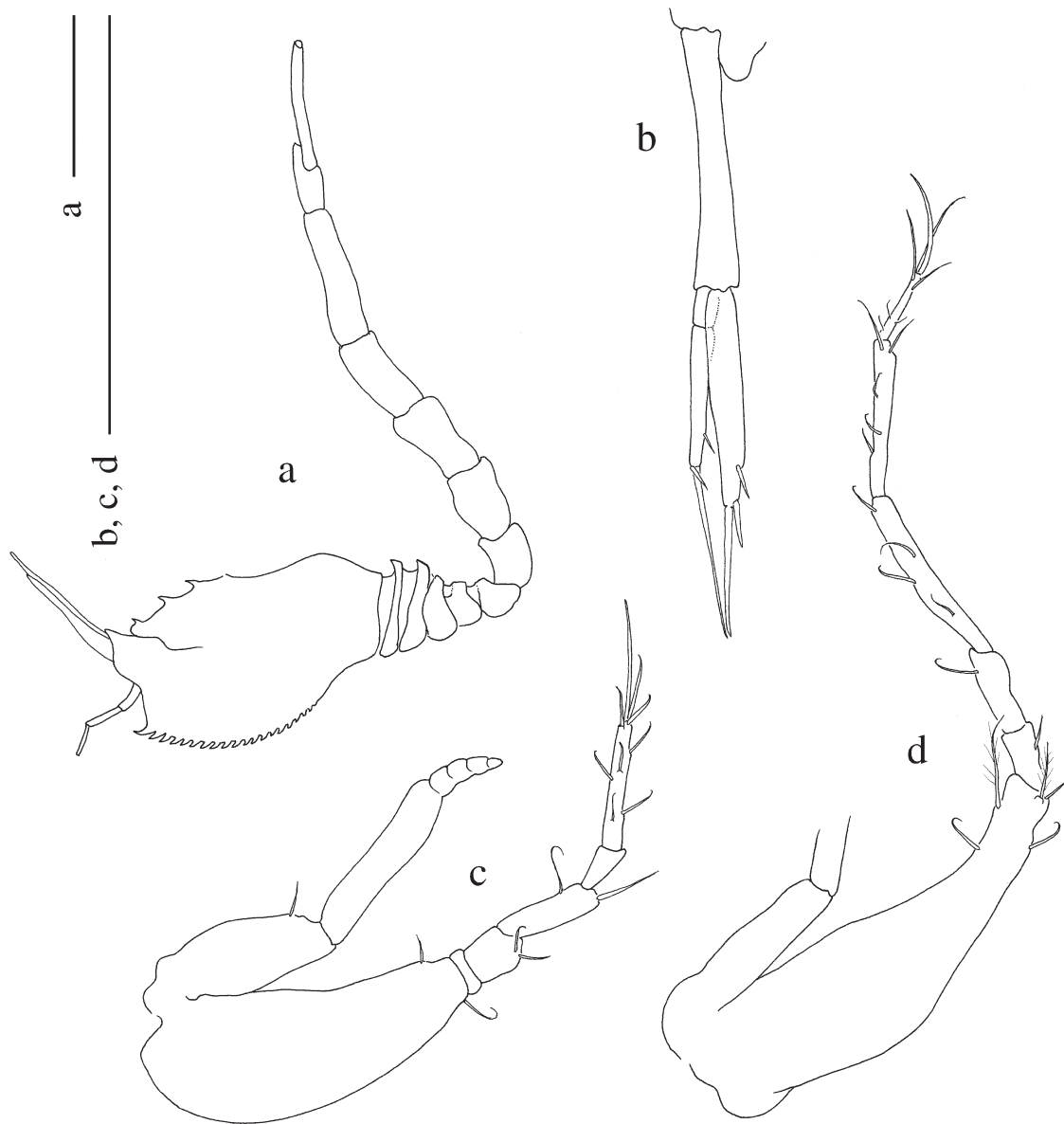


FIG. 4. – *Cumella emergens* sp. nov. preadult male; a) whole animal in lateral view; b) uropod; c) second pereopod; d) first pereopod. Scale bar 0.5 mm.

Description: Preadult female, 5.1 mm total length. Carapace (Fig. 5a, b) shorter than half total length, slightly elevated posteriorly, covered with tubercles of different sizes, the two biggest of them located dorsally in the middle of carapace and turned forwards; pseudorostral lobes short and slightly upturned; eyelobe rounded, elevated in lateral view; antennal notch distinct and anterolateral angle rounded. Pereon and pleon without tubercles; fifth pleonite without transverse sulcus.

Third maxilliped basis (Fig. 5d) longer than the rest of limb, ischium very short, merus longer than carpus and with distal teeth, outer edge of carpus

denticulated, propodus twice as dactyl. Basis of first pereopod (Fig. 5e) wide and shorter than the rest of limb and with distal part of edges denticulated, ischium very short, rest of articles of decreasing length. Basis of second pereopod (Fig. 5f) wide and shorter than deconvined length of the following four articles, merus as wide as long, propodus as long as dactyl. Uropod peduncle (Fig. 5c) longer than the last abdominal somite, three times as long as wide and unarmed; endopod one third of peduncle length with 3 small spines on inner edge and 2 distally; exopod two-segmented, shorter than endopod, second segment with 2 small spines distally

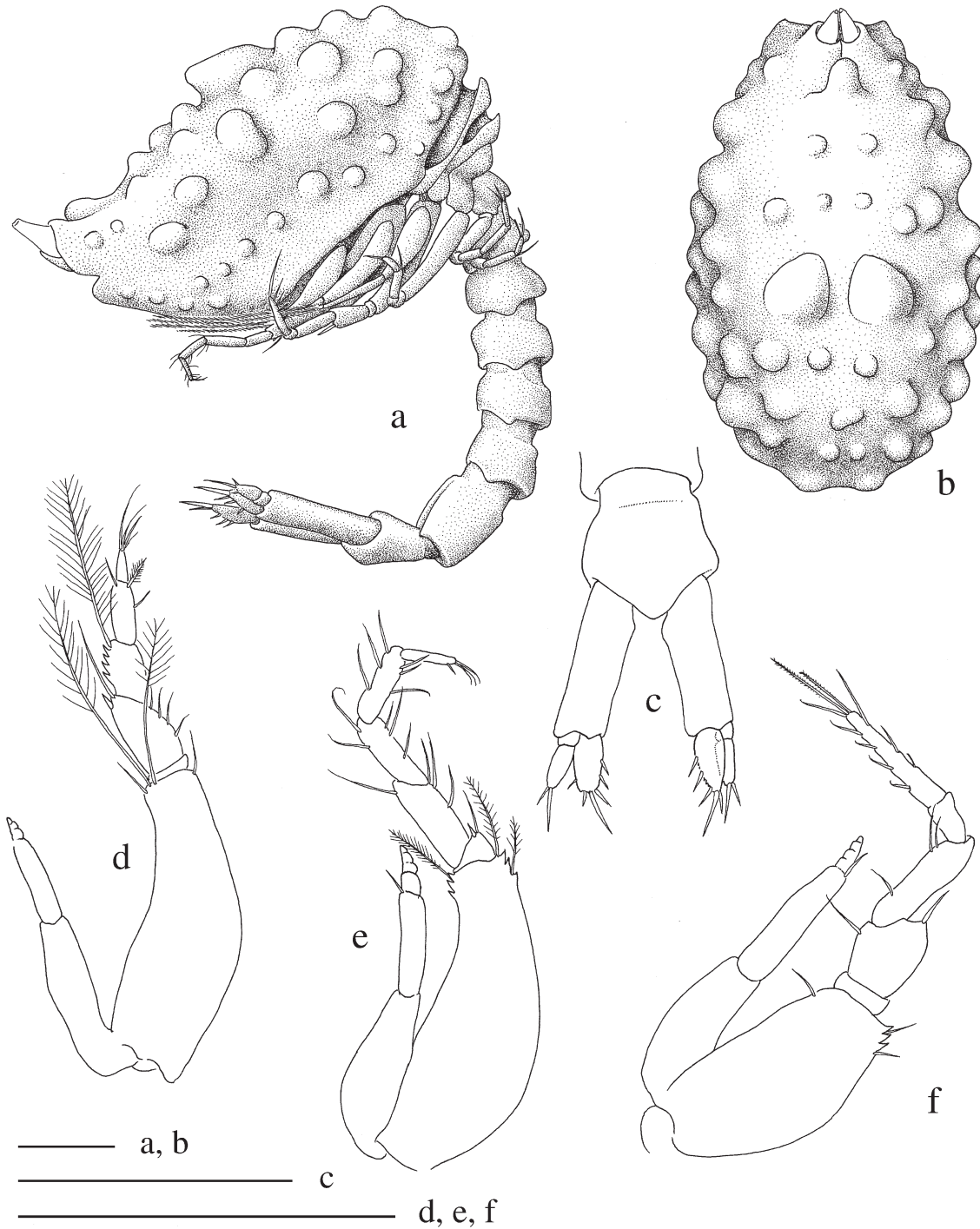


FIG. 5. – *Campylaspis heterotuberculata* sp. nov. preadult female; a) whole animal in lateral view; b) dorsal view of carapace; c) uropods and last abdominal somite; d) third maxilliped; e) first pereopod; f) second pereopod. Scale bar 0.5 mm.

Remarks: *Campylaspis heterotuberculata* sp. nov. is closely related with *C. breviramis* Ledoyer, 1993 and *C. quadridentata* Ledoyer, 1993 specially by the structure of the uropod. However, the shape and distribution of carapace tubercles and the lack of transverse sulcus on the fifth pleonite differ *C. heterotuberculata* from the other two species.

***Procampylaspis halei* sp. nov.**
(Fig. 6)

Type material: Holotype: adult ♀ ICM NAN-005. *Type locality:* North of the Livingston Island, BENTART-95 sta. 30, 62°01.45'S 60°25.75'W, 649 m. Paratype from the same locality: preadult ♀ ICM NAN-006

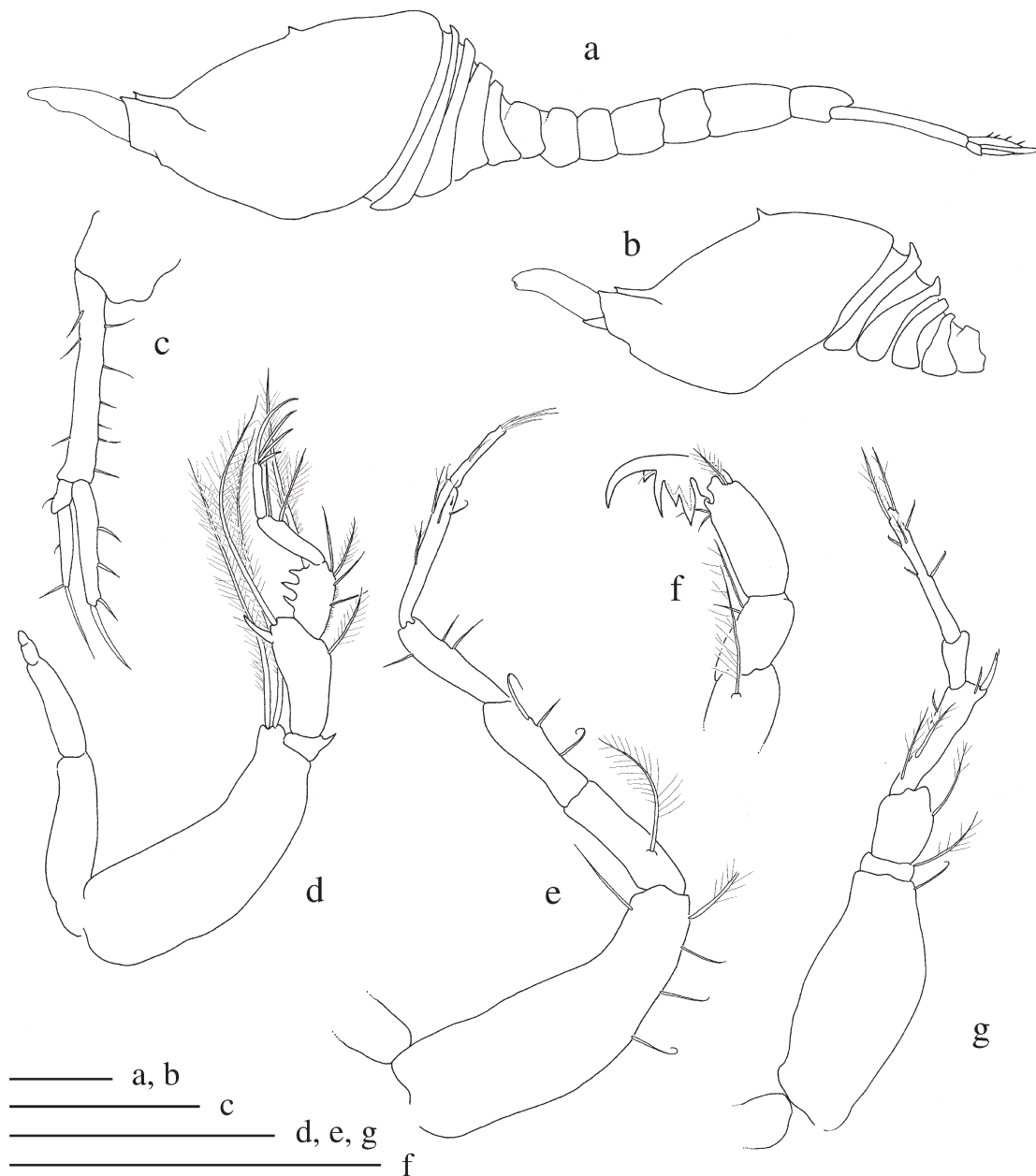


FIG. 6. – *Procampylaspis halei* sp. nov. adult female (a, d-g) and preadult male (b, c); a) whole animal in lateral view; b) carapace and five free thoracic somites; c) uropod; d) third maxilliped; e) first pereopod; f) last segments of second maxilliped; g) second pereopod. Scale bar 0.5 mm.

Etymology: This species is named in honour of the Australian carcinologist H. M. Hale.

Description: Adult female 3.6 mm total length. Carapace less than half of total length, slightly tumid posteriorly and with a single median dorsal spiniform tubercle (Fig. 6a). Eyelobe narrow, longer than half length of pseudorostral lobes and ending by a small teeth. Antennal notch very open and little excavated, anterolateral angle very obtuse.

Dactyl of second maxilliped (Fig. 6f) with tree teeth on inner margin, first of them bifid not deeply cleft, with the proximal part longer than distal part and similar in length to the second teeth. Ischium of the third maxilliped (Fig. 6d) short with an inner tooth, merus widest distally with an outstanding spine on outer margin, carpus outer margin three-dentated, inner margin unarmed. Basis of first pereopod (Fig. 6e) shorter than following three articles combined lengths, propodus twice as carpus. Basis of second pereopod (Fig. 6g) longer than following

three articles together, carpus widest distally with a distal spine and dactyl as long as carpus. Uropod peduncle (Fig. 6c) subequal in length to the last two abdominal somites, with some setae on inner and outer margin; endopod 0.6 times as long as peduncle with 3 spines on inner margin and 1 distally; exopod two-segmented, shorter than endopod; first article with 1 small seta on outer margin, second article with 1 seta on outer margin and 2 distally (longest seta as long as second article).

Remarks: *Procampylaspis halei* sp. nov. is quite similar to *P. sordida* Hale, 1945 especially by the mid-dorsal spine of carapace, the relative length of the second pereopod dactyl and the spine of merus of the third maxilliped. However, the proximal teeth of dactyl of the second maxilliped that is bifid and not deeply cleft, together with the carpus armature of the third maxilliped, differ *P. halei* from *P. sordida*.

Family LEUCONIDAE Sars, 1878
Leucon (Crymoleucon) costatus sp. nov.
 (Figs. 7-9)

Type material: Holotype adult ♀ ICM LEU-001. *Type locality:* South of the Livingston Island, BENTART-95 sta. 9, 62°39.73'S 60°39.36'W, 163 m. Paratypes from the same locality: 2 preadult ♂♂, and 2 preadult ♀♀ ICM LEU-002

Material examined: BENTART-95 sta. 3: 1 adult ♀, 13 preadult ♀♀, 7 preadult ♂♂; sta. 4T1: 5 adult ♀♀, 32 preadult ♀♀, 20 preadult ♂♂; sta. 4T2: 3 adult ♀♀, 14 preadult ♀♀, 8 preadult ♂♂; sta. 5: 3 preadult ♀♀, 2 preadult ♂♂, 1 jov.; sta. 9: 9 adult ♀♀, 41 preadult ♀♀, 40 preadult ♂♂, 2 jov.; sta. 10: 10 adult ♀♀, 26 preadult ♀♀, 17 preadult ♂♂, 5 jov.; sta. 16: 1 preadult ♀; sta. 28: 3 adult ♀♀, 17 preadult ♀♀, 5 preadult ♂♂, 1 jov.

Etymology: From Latin *costa* (ridge) referring to the dorsolateral ridge on the carapace.

Description: Adult female 4.2 mm total length. Carapace (Fig. 7c,d) less than one-third of total length, dorsally serrated with 10 serrations on ante-

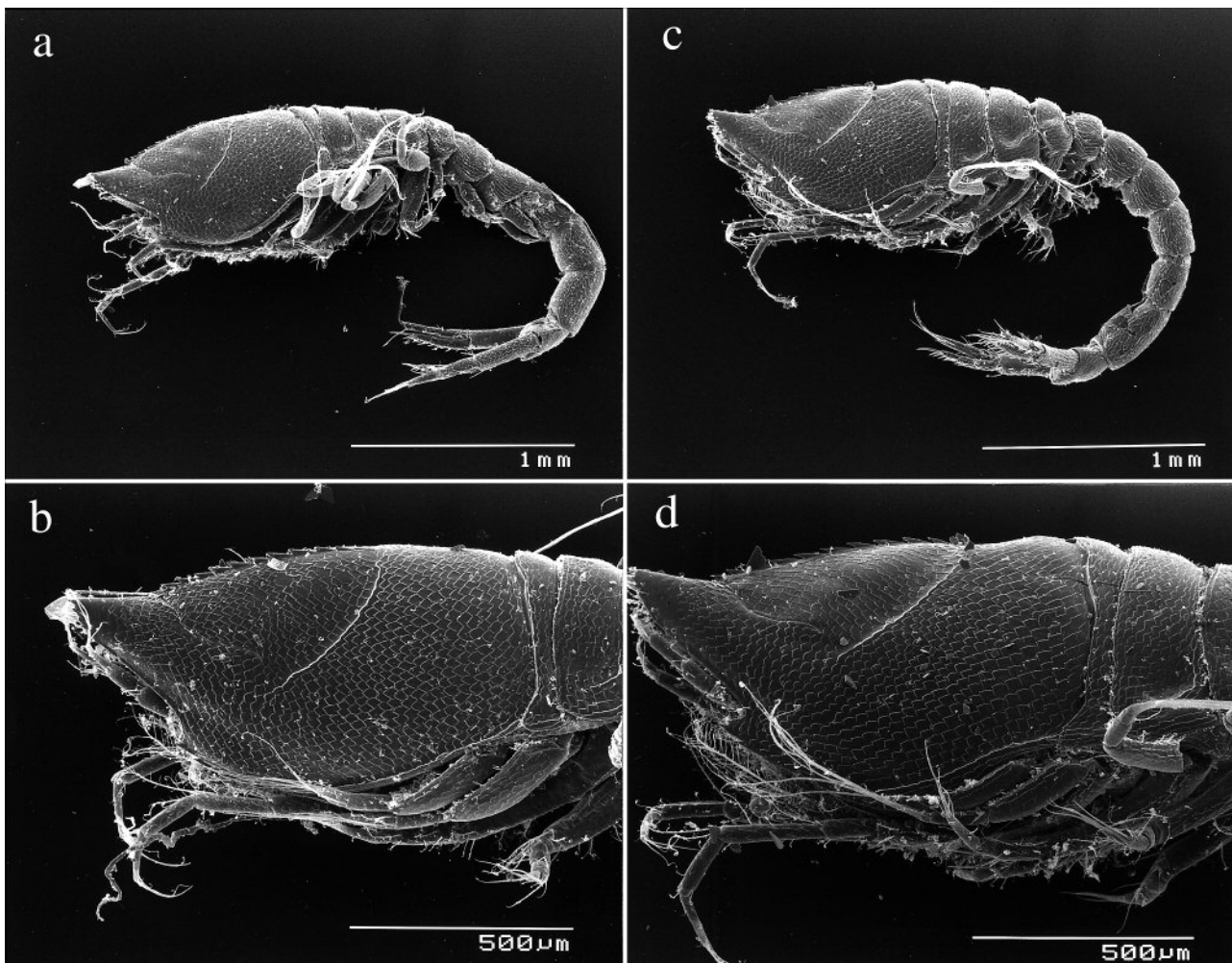


FIG. 7. – *Leucon (Crymoleucon) costatus* sp. nov. preadult male (a, b) and adult female (c, d); a) whole animal in lateral view; b) lateral view of carapace; c) whole animal in lateral view; d) lateral view of carapace.



FIG. 8. – *Leucon* (*Crymoleucon*) *costatus* sp. nov. adult female; a) anterior half of carapace showing the dorsolateral ridge and the anterolateral angle; b) first antenna; c) uropod; d) third maxilliped; e) first pereopod; f) second pereopod. Scale bar 0.5 mm.

rior half (Fig. 8a); antennal notch deep, anterolateral angle acute, ventral margin with two teeth. Carapace with a dorsolateral slanting ridge.

Antennular peduncle three-segmented (Fig. 8b), last segment 1.25 times as long as second; accessory flagellum longer than half length of basal article of main flagellum. Basis of third maxilliped longer than the rest of limb, distal margin rather laterally extended and bearing three long plumose setae, car-

pus also with a long plumose seta, and the last three segments of decreasing length (Fig. 8d). First pereopod (Fig. 8e) with basis longer than the following four segments together and its inner margin with a row of plumose setae; merus shorter than carpus, both with a distal long seta. Basis of second pereopod (Fig. 8f) of similar length than the remaining articles together; ischium very short; dactyl twice of propodus. Peduncle of uropod (Fig. 8c) longer than



FIG. 9. – *Leucon (Crymoleucon) costatus* sp. nov. preadult male; a) anterior half of carapace showing the dorsolateral ridge and the anterolateral angle; b) uropod; c) first antenna; d) third maxilliped; e) first pereopod; f) second pereopod. Scale bar 0.5 mm.

the last abdominal somite with 6 small spines on inner margin. Endopod two-segmented, slightly shorter than peduncle; first article 1.6 times as long as second, with 7 spines on inner margin; second article with 5 spines on inner margin and 1 distally which is long as the second article. Exopod two-segmented, longer than peduncle; second article with some small setae on upper side and long plumose

and simple setae on inner margin and distally.

Preadult male (Fig. 7a, b and 9) is very similar to the adult female but differs by the shape of antennal notch which is very shallow.

Remarks: *Leucon costatus* sp. nov. is very closely related with *L. vanhoeffeni* Zimmer, 1907 but it differs by the dorsolateral slanting ridge and the higher

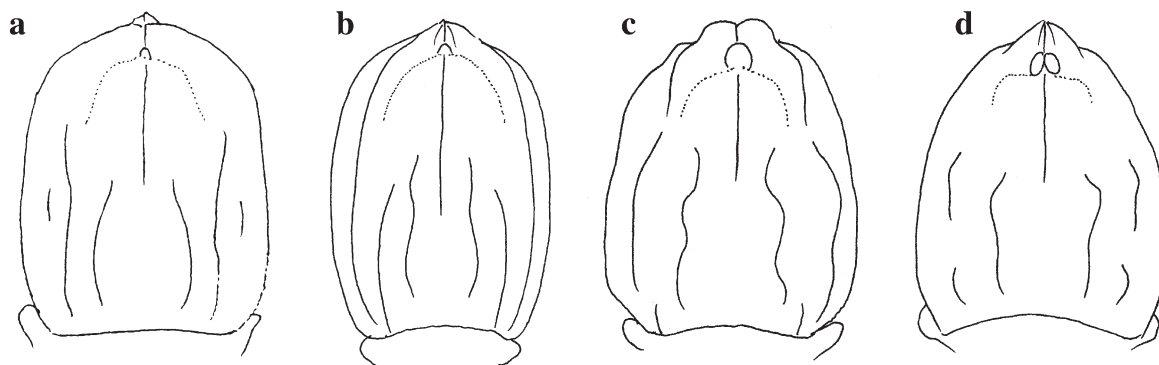


FIG. 10. – Carapace diagrammatic representation of four *Paralamprops* species found in Antarctic waters showing dorso-lateral ridge distribution; a) *P. serratocostatus*; b) *P. asper*; c) *P. rossi*; d) *P. mawsoni*.

number of serrations on the middorsal carina. Moreover, the peduncle of uropod is longer than the inner rami in *L. vanhoeffeni* and of similar length in *L. costatus*. *Leucon vanhoeffeni* has been synonymized with *L. kerguelensis* by Lomakina (1968) but without discussion, the study of type material of both species has not furnished criteria for this synonymy.

Family LAMPROPIDAE Sars, 1878
Paralamprops asper Zimmer, 1907

Paralamprops aspera: Zimmer 1907, p. 373; Zimmer 1913, p. 457-458, pl. 6 fig. 52-55.

Material examined: BENTART-95, sta. 30: 1 adult ♀ (without pleon), 1 preadult ♀, 2 preadult ♂♂.

Remarks: Four species of genus *Paralamprops* have been recorded from the Antarctic waters: *P. serratocostatus* Sars, 1887, *P. asper* Zimmer, 1907, *P. mawsoni* (Hale, 1937) and *P. rossi* Jones, 1971. The carapace of the four species show similar structure, broad and flattened anteriorly but elevated at hind half, with a mid-dorsal carina on the anterior half and a lateral carina running round the sides of carapace. Between them there are three pairs of dorso-lateral ridges of different length and shape (Fig. 10). *P. serratocostatus* has the first and second dorso-lateral ridge as long as or longer than half carapace and the third very reduced, all ridges are serrated. *P. mawsoni* has the second and third ridge very reduced. *P. rossi* has the second ridge very short and located at the hind end of carapace (not figured in Jones, 1971) and the third extending backwards from the sides of pseudorostrum formed by two lobes with an interruption between them. Finally, *P. asper* is very similar to *P. rossi* but with the dorso-lateral ridges slightly serrated and the third of them not interrupted.

Although the specimens of South Shetland Islands do not show spines on the integument, they have the third dorsolateral ridge continuous and the telson of same length as the uropod peduncle; moreover, the adult females have rudimentary exopods on pereopods 3 and 4. This set of characters assign this material to *Paralamprops asper*.

Paralamprops mawsoni (Hale, 1937)
(Fig. 11)

Hemilamprops mawsoni: Hale 1937, p. 44-46, fig. 4, 5.

Material examined: BENTART-95 sta. 29, 240 m: 1 preadult ♀, 1 preadult ♂, 2 jov.

Description: Preadult female total length 14.2 mm (from de tip of pseudorostrum to the end of last abdominal somite). Integument well calcified. Carapace (Fig. 11a, b) slightly less than one third of total length; mid-dorsal carina extending from the eyelobe to the half of carapace, one pair of abruptly elevated ridges running from the end of mid-dorsal carina to the posterior margin of carapace; a pair of short carina near hind margin and another located before it. Eyelobe formed by a pair of oval protuberances. Antennal notch distinct.

Pedigerous somites, each with two pair of dorso-lateral protuberances. Pereopods 3 and 4 without traces of exopodites. Telson slightly shorter than uropod peduncle with three terminal spines.

First antenna peduncle of three articles (Fig. 11c), the proximal is clearly longer than the second which is slightly longer than the third; main flagellum of six segments, the first is longer than the others; accessory flagellum of three segments and shorter than the main one. Third maxilliped (Fig. 11e) with basis longer than rest of limb and with plumose setae on its inner edge; ischium short;

merus distally produced and rounded, carpus longer than propodus, both with abundant setation on inner edges; dactyl shorter than propodus. First pereopod (Fig. 11f) long and slender, basis shorter than the remaining segments together, with the distal part of inner edge serrated; ischium short; merus, carpus and propodus of increasing length, dactyl shorter than propodus and as long as merus. Second pereopod (Fig. 11g) with basis longer than the rest of

limb; carpus longer than ischium and merus together and with spines on inner margin; propodus and dactyl combined length shorter than carpus. Uropod peduncle (Fig. 11d) shorter than the two last abdominal somites, inner margin with 12-13 spines.

Preadult male (carapace length 4.35 mm) similar in shape to the female. With exopods on the pereopod 1-4 and three pair of pleopods. Immature males as preadult but without traces of pleopods.

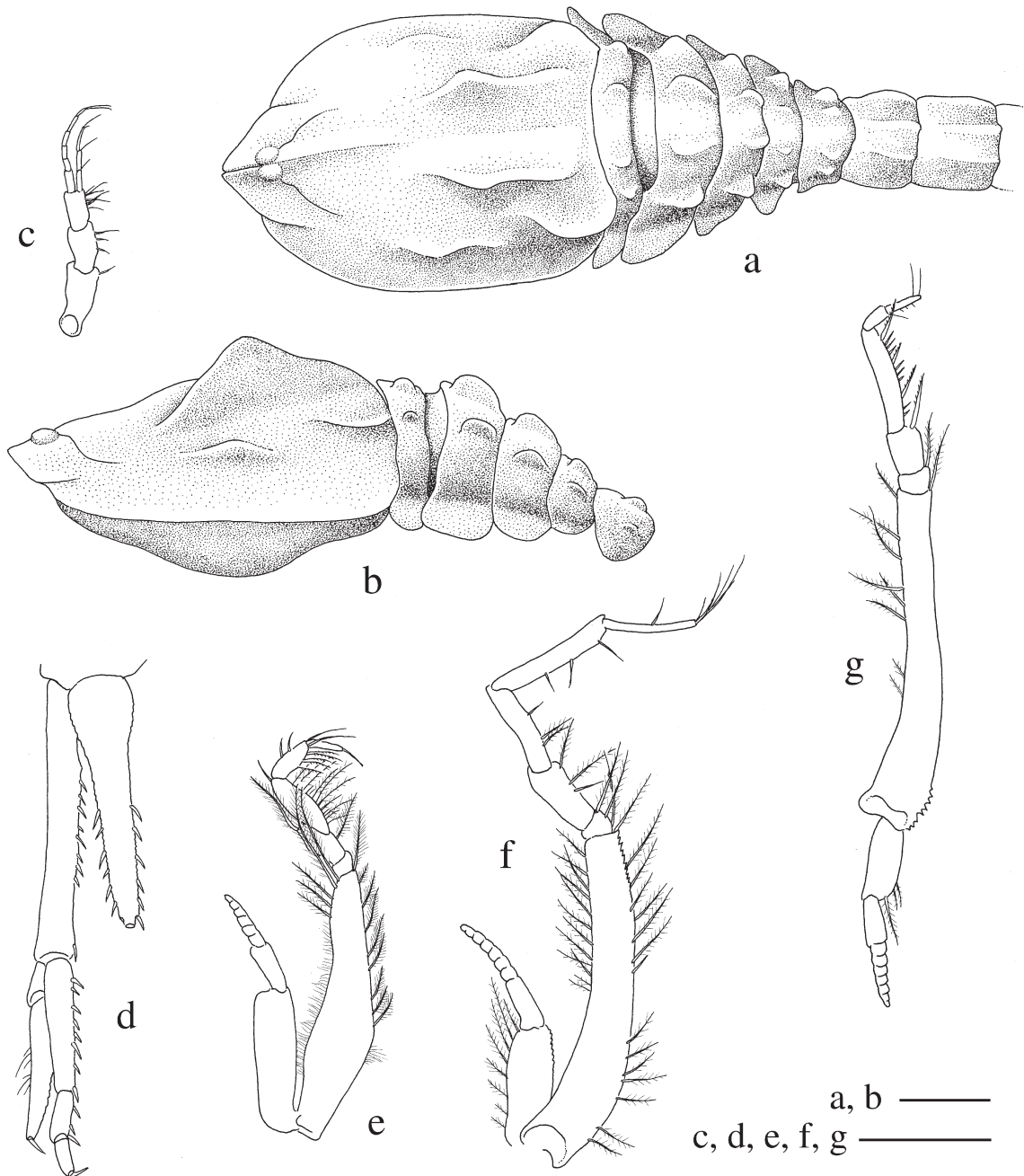


FIG. 11. – *Paralamprops mawsoni* (Hale, 1937) preadult female (a-c, e-g) and preadult male (d); a) carapace, thorax and first two abdominal somites in dorsal view; b) lateral view of carapace and thoracic somites; c) first antenna; d) uropod; e) third maxilliped; f) first pereopod; g) second pereopod. Scale bar 1 mm.

Remarks: This species was originally placed, with doubts, in the genus *Hemilamprops*. However, Jones (1969), Bacescu (1992) and Ledoyer (1993) moved this species to the genus *Paralamprops* due to the structure of uropod exopod and the general shape of the carapace. The lack of exopods on pereopods 3 and 4 of female would place this species in the genus *Platysympus*, but there is doubt about the generic value of this character (Jones, 1971;

Ledoyer, 1993). The antennal notch, the three pairs of pleopods of the male and the shape of the carapace place this species in the genus *Paralamprops*.

Distribution and ecological notes

In total, 1236 specimens of cumaceans belonging to 25 species have been collected around South Shetland Islands during the BENTART cruise (Table

TABLE 1. – Abundance and bathymetric distribution of cumaceans found around South Shetland Islands during the BENTAR-95 cruise.

STATION Depth (m)	T6 45	T27 71	T3 89	T23 104	T17 107	T28 124	T9 163	T11 167	4T1 176	4T2 188	T10 221	T19 234	T29 242	T5 262	T22 330	T15 331	25T1 357	25T2 361	T21 420	T16 427	T30 649	
<i>Diastylis helleri</i>	1																					
<i>Diastylis mawsoni</i>						1																
<i>Eudorella gracilior</i>						15	3		30	1	2											
<i>Campylaspis breviramis</i>				1			2		3		2	2	1									
<i>Leucon (Crym.) costatus</i>				21		26	92		57	25	58			6						1		
<i>Cumella australis</i>	9					1				2		3	4									5
<i>Vaunthompsonia</i> spp. (manca)	47		76		4	37	23		6	2	2					2						
<i>Vaunthompsonia meridionalis</i>			62			188	5	1	10		5										1	
<i>Vaunthompsonia laevifrons</i>	43		9		1	2				1		5	3	1		9	1	2		63	9	
<i>Leptostylis crassicauda</i>	1					3					1					2			1	6	7	
<i>Diastylopsis goekei</i>		5				41			2							1	5		1	6		
<i>Diastylis anderssoni</i>						1														3		
<i>Diastylis inornata</i>						10							4									2
<i>Hemilamprops ultimaespei</i>						16	1						13		6				2			4
<i>Paralamprops mawsoni</i>													4									
<i>Cyclaspis gigas</i>										1			1									
<i>Campylaspis frigida</i>										1	2											
<i>Campylaspis heterotuberculata</i>															2							
<i>Leucon (Leucon) assimilis</i>												3					1		3	2	3	
<i>Campylaspis antarctica</i>													8									5
<i>Procampylaspis compressa</i>																	2		2			
<i>Diastylis corniculata</i>													1			2				2	1	
<i>Leucon (Crym.) intermedius</i>																		1			1	
<i>Paralamprops asper</i>																						4
<i>Cumella emergens</i>																						3
<i>Procampylaspis halei</i>																						10
<i>Campylaspis</i> sp.*	1								4		1						1		2			
<i>Diastylopsis</i> sp.*							1												1			
Indetermined species*									1				1							6	4	
Total individuals	102	5	178	1	5	341	127	1	113	31	73	15	40	7	8	16	10	3	12	90	58	
Total species	4	1	5	1	1	11	5	1	5	4	7	5	9	2	2	4	4	2	5	8	12	
Diversity (Shanon-Weaver Index)	0.59	0	1.12	0	0.7	1.77	1.15	0	1.66	0.99	1.21	2.23	2.80	0.59	0.81	1.37	1.66	0.91	2.19	1.43	3.3	

* Damaged specimens

TABLE 2. – Total abundance (N_i) of the main cumacean species in the 10-50 cm (N_1), 55-90 cm (N_2) and 100-140 cm (N_3) near-bottom layers sampled with the three nets of the sled, and the swimming activity indices ($K_1 = N_2/N_1$ and $K_2 = N_3/N_1$).

	Nt	N1	N2	N3	K1	K2
<i>Vaunthompsonia laevifrons</i>	149	152	6	1	0.03	0.01
<i>Vaunthompsonia meridionalis</i>	272	261	11	0	0.04	0
<i>Vaunthompsonia</i> spp. (manca stage)	199	168	27	4	0.14	0.02
<i>Leucon costatus</i>	286	192	58	36	0.20	0.13
<i>Eudorella gracilior</i>	60	51	8	1	0.13	0.02
<i>Cumella australis</i>	24	19	2	3	0.08	0.13
<i>Diastylis inornata</i>	16	15	1	0	0.06	0
<i>Diastylopsis goekei</i>	61	54	4	3	0.07	0.05
<i>Leptostylis crassicauda</i>	21	12	9	0	0.43	0
<i>Hemilamprops ultimaespei</i>	42	36	3	3	0.08	0.07
Total	1236	1047	145	54	0.12	0.04

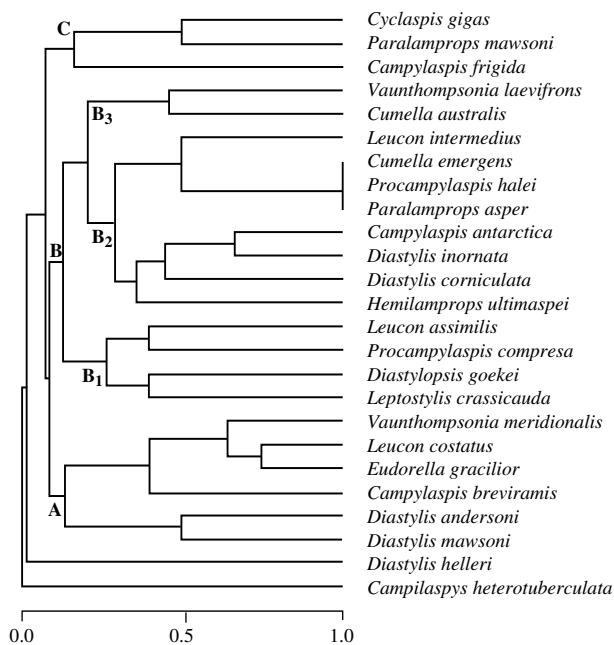


FIG. 12. – Dendrogram of similarities (using Jaccard's index and UPGMA aggregation algorithm) between the 25 cumacean species collected during BENTART-95 cruise.

1). Cumaceans were absent from three sampling stations (2, 11 and 18) located in the Deception Island caldera and the other two sampling stations of this area (11 and 17) showed lower abundances. Higher abundance (341 ind.) was observed at station 28 in north of Livingston Island.

The highest number of species was observed at three stations in the north of Livingston Island (28, 29 and 30) and the deepest of them (sta. 30) showed the maximum number (13 species). The diversity index (Table 1) follows a similar trend of species number and increases significantly with depth.

All species of cumaceans showed a clear vertical distribution gradient with a decrease of abundance from the 10-50 cm to the 100-140 cm water layers above the bottom. Within the most abundant species, *Leucon costatus* had the highest swimming coefficients ($K_1 = 0.2$; $K_2 = 0.13$) (Table 2). *Leptostylis crassicauda* was only recorded in the two water layers near the bottom (10-50 cm and 55-95 cm), but with a similar proportion ($K_1 = 0.43$). Males of two species of *Vaunthompsonia* showed higher values of these coefficients ($K_1 = 0.14$; $K_2 = 0.02$) than the remaining specimens (preadults females, preadult males and adult females).

Cluster analysis (Fig. 12) discriminated species in three groups. Group A was composed of species inhabiting above 300 m depth, as *Eudorella gracilior*, *Leucon costatus* and *Vaunthompsonia meridionalis*. Group C was only formed by *Campylaspis frigida*, *Paralamprops mawsoni* and *Cyclops gigas* which were collected between 221 and 242 m depth. Finally, group B was composed by euribathic species (subgroup B_1 and B_3) as well as by species collected below 300 m depth (subgroup B_2). In this last subgroup, *Paralamprops asper*, *Procampylaspis halei* and *Cumella emergens* were only collected at the deeper station (649 m depth).

The ordination of species on the axis representing the first two factors in the PCA (Fig. 13) shows that the first factor, which explains 29.6% of the total variance, clearly segregated the species *Campylaspis breviramis*, *Leucon costatus*, *Eudorella gracilior* and *Vaunthompsonia meridionalis* from the rest of the species considered. Correlation (Spearman rank) between the species scores and the

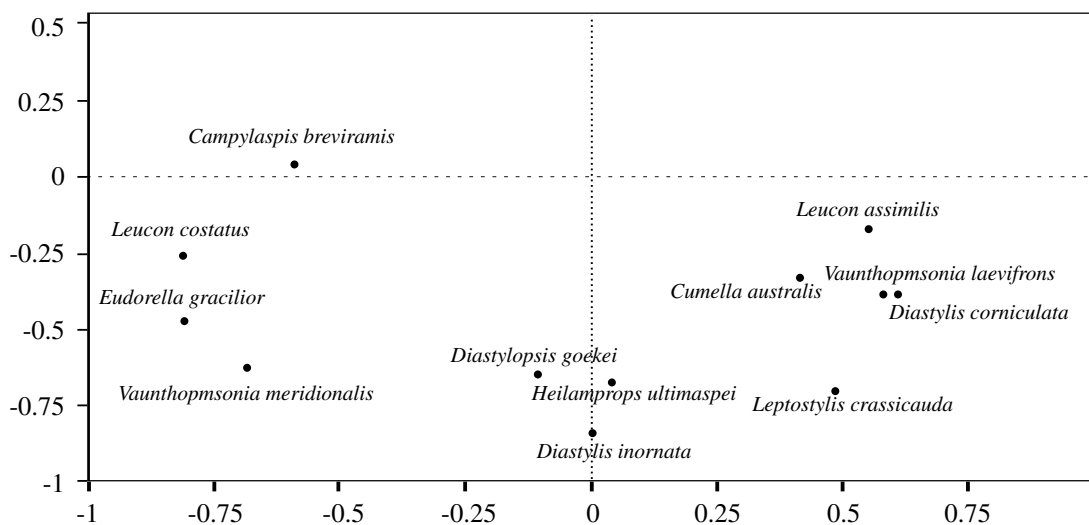


FIG. 13. – Principal Component Analysis (PCA) performed with the 12 most frequent cumacean species.

environmental parameters (depth, % of organic matter content, sediment median grain size, and redox potential) determined that is depth the main parameter affecting the species distribution.

DISCUSSION

The 25 species found around the South Shetland Islands represent 36% of total species recorded from the Antarctic and Subantarctic waters. This species number is similar to the one reported from Weddell Sea (Ledoyer, 1993) but significantly greater than the number observed in Ross Sea by Jones (1971). The lower values of abundance and species number observed in Deception Island caldera has been attributed to the recent volcanic activity that could have destroyed benthic communities (Gallardo, 1992). The present acidic conditions in the superficial sediments (San Vicente *et al.*, 1997) may also have contributed.

Diversity increases with depth and it is higher at the deepest station (649 m) on the continental slope in the North of Livingston Island. High values of diversity and species number were also reported from cumacean assemblages of bathyal bottoms in Bay of Biscay (Elizalde *et al.*, 1993) and western Mediterranean (Cartes and Sorbe; 1997). The continental slope is a region with the most intensive water column activity caused by boundary currents and it is here where one would expect speciation to be very active (Wilson and Hessler, 1987).

Recent studies on suprabenthic communities have provided data on the swimming activity of cumaceans (Elizalde *et al.*, 1993; Dauvin and Zouhiri, 1996; Cartes and Sorbe, 1997). These crustaceans show a marked vertical gradient with a maximum abundance in the nearest bottom water layer. In the continental slope of the Catalan Sea (western Mediterranean), Cartes and Sorbe (1997) reported intraspecific differences of swimming coefficients. In some species, adult males showed higher swimming coefficients, specially for *Leucon longirostris* and *Diastylodes serratus*. A male of this last species was captured by a sediment trap located 30 m above the bottom in the same area (Gili, pers. com.). While for shallow water species, vertical movements mainly by adult males, have a circadian rhythm that is controlled by changes of irradiance (Macquard-Moulin, 1991); no data are known on the factors and rhythms affecting the movements of deep water species. During the

BENTART-95 cruise no adult male was collected, however, intraspecific differences of swimming activity were observed for the genus *Vaunthompsonia*. Males of this genus showed higher activity than the preadults and adults. This behaviour could favour the dispersion of these crustaceans which do not have a planktonic larval stage.

In the South Shetland Islands the main environmental parameter affecting distribution of cumaceans was depth. This seems to be a common factor observed in the western Mediterranean (Corbera and Cardell, 1995) and on the Brazilian coast (Dos Santos and Pires-Vanin, 1999).

Based on bathymetric distribution, three groups of species can be distinguished. A group of species distributed between 45 and 300 m depth, a second group collected between 300 and 650 m depth and finally species that co-occur in both deep ranges. In the Weddell Sea, Ledoyer (1993) reported a group of species inhabiting between 200 and 500-600 m depth, a second group of deep-sea species distributed below 500 m depth and a group of species with wide distribution (between 200 and 2000 m). It is difficult to establish comparison between two studies because while bottoms shallower than 200 m in the Weddell Sea are not accessible due to the ice-shelf, bottoms below 650 m were not sampled during the present study. However, the increase of species at station 30 of the present study (649 m depth) could corroborate the change of cumacean assemblages around 500-600 m suggested by Ledoyer in the Weddell Sea.

Distribution and biogeography of Antarctic Cumaceans

To my knowledge, 68 species have been described from Antarctic and Subantarctic waters (excluding the Magellan region) (Table 3). Eighty-seven percent of these species were found between 50 to 700 m depth. Between 50 and 300 m depth 47 species were found and between 300 and 700 m depth 38 species. In shallow bottoms (upper 50 m depth) only 18 species have been recorded, three of these species, *Leucon kerguelensis*, *L. vanhoeffeni* and *L. inexcavatus* are exclusive for shallow bottoms and are confined to Kerguelen Island. The low number of species in shallower bottoms may be due, as in other faunistical groups, to the scarcity of this type of habitat in Antarctica and to the impact of the anchor ice and iceberg scour (Arntz *et al.*, 1994)

TABLE 3. – Regional and bathymetrical distribution of Antarctic cumaceans. EA, Eastern Antarctica; WS, Weddell Sea; AP, Antarctic Peninsula and Bellingshausen Sea (including South Shetland Islands); RS, Ross Sea; KI, Kerguelen Island; SG, South Georgia.

Species	Depth range (m)	AP	WS	EA	RS	KI	SG
<i>Campylaspis maculata</i>	6-250	•					
<i>Campylaspis heterotuberculata</i>	240	•					
<i>Leucon (Crymoleucon) costatus</i>	89-427	•					
<i>Cumella emergens</i>	650	•					
<i>Procampylaspis halei</i>	650	•					
<i>Leucon (Macrauloleucon) parasiphonatus</i>	363-424	•	•				
<i>Campylaspis breviramis</i>	457-462	•	•				
<i>Hemilamprops ultimaespei</i>	12-1223	•	•				
<i>Diastylopsis goekei</i>	2-430	•	•		•		
<i>Procampylaspis compressa</i>	350-1223	•	•	•			
<i>Gaussicuma vanhoeffeni</i>	1996-3423	•	•	•			
<i>Leucon (Leucon) assimilis</i>	150-650	•	•	•			
<i>Diastylis mawsoni</i>	124-582	•	•	•			
<i>Leptostylis crassicauda</i>	50-1223	•	•	•			
<i>Diastylis anderssoni</i>	124-810	•	•	•			•
<i>Cumella australis</i>	50-650	•	•	•	•		
<i>Cyclaspis gigas</i>	160-700	•	•	•	•		
<i>Campylaspis antarctica</i>	193-522	•	•	•	•		
<i>Eudorella gracilior</i>	15-752	•	•	•	•		•
<i>Diastylis helleri</i>	0-70	•	•	•	•		•
<i>Eudorella splendida</i>	0-310	•	•	•	•	•	•
<i>Paralamprops asper</i>	385-650	•		•	•		
<i>Cumella pectinifera</i>	275-283	•		•			
<i>Leucon (Crymoleucon) intermedius</i>	280-791	•		•			
<i>Paralamprops mawsoni</i>	240-300	•		•			
<i>Platysympus brachyurus</i>	385	•		•			
<i>Diastylis corniculata</i>	218-650	•		•			•
<i>Vaunthompsonia inermis</i>	24-650	•					•
<i>Vaunthompsonia meridionalis</i>	15-310	•				•	•
<i>Campylaspis frigida</i>	24-2011	•				•	
<i>Diastylis inornata</i>	124-650	•				•	
<i>Campylaspis johnstoni</i>	193-2018		•	•		•	
<i>Vaunthompsonia laevifrons</i>	123-577		•	•			
<i>Campylaspis quadriplicata</i>	165-2707		•	•			
<i>Leucon (Crymoleucon) antarcticus</i>	69-752		•	•	•		
<i>Paralamprops rossi</i>	406-705		•	•	•		
<i>Makrokyllindrus inscriptus</i>	799-2012		•		•		
<i>Leucon (Macrauloleucon) weddelli</i>	399-537		•				
<i>Leucon (Alytoleucon) polarsterni</i>	1153-1223		•				
<i>Atlantocuma elongatum</i>	506-839		•				
<i>Campylaspis quadridentata</i>	406-506		•				
<i>Campylaspis excavata</i>	185-515		•				
<i>Diastylis enigmatica</i>	270-280		•				
<i>Diastylis galeronae</i>	1165-2012		•				
<i>Diastylis pseudoinornata</i>	90		•				
<i>Lamprops comatus</i>	3423		•				
<i>Cyclaspis cristulata</i>	276-279			•			
<i>Leucon (Crymoleucon) breidens</i>	275-283			•			
<i>Schizocuma molossa</i>	385			•			
<i>Diastylopsis diaphanes</i>	385			•			
<i>Hemilamprops pellucidus</i>	226-3725			•			
<i>Campylaspis nodulosa</i>	1-5000			•		•	
<i>Diastylopsis annulata (= D. dentifrons)</i>	4-355			•		•	•
<i>Procampylaspis meridiana</i>	110				•		
<i>Cyclaspis kerguelensis</i>	195					•	
<i>Leucon (Crymoleucon) kergelensis</i>	5-10,5					•	
<i>Leucon (Crymoleucon) vanhoeffeni</i>	1-3					•	
<i>Leucon (Crymoleucon) inexcavatus</i>	31					•	
<i>Diastylis horrida</i>	20-540					•	
<i>Diastylis zimmeri</i>	18-90					•	
<i>Hemilamprops serrulatus</i>	195					•	
<i>Paralamprops serratocostatus</i>	230					•	
<i>Kerguelenica platycephala</i>	195					•	
<i>Cimmerius subantarcticus</i>	196					•	
<i>Leucon (Crymoleucon) sagitta</i>	12-310					•	•
<i>Eudorella fallax</i>	64-610						•
<i>Cyclaspis quadrituberculata</i>	75						•
<i>Leptostylis antipus</i>	12-310						•

Only 14 species live below 700 m depth and, three of them, named *Gaussicuma vanhoeffeni*, *Hemilamprops pellucidus* and *Lamprops comatus* were found below 2500 m depth. *Lamprops comatus* is the only species which can only be found in abyssal bottoms (below 2500 m). Within the 14 deep-water species, eight of them show a wide range of bathymetric distribution.

The species number is maximum between 50 and 700 m depth and decreases drastically in lower parts. This pattern of distribution contrasts with the one observed in other oceans. In the Atlantic, Jones and Sanders (1972) found the highest species number between 1000 and 2000 m depth and the number of species is not significantly lower below 4000 m depth. In the Mediterranean, the maximum of species number was observed between 2000 and 3000 m (Reyss, 1973). Low species number in Antarctic deepest bottoms may be due to low-sampling effort there.

The total species found in Antarctic waters (High Antarctic and Subantarctic regions) represents less than 6% of the cumacean world fauna (currently around 1250 species). Antarctic cumaceans show a high degree of endemism (91% of species). Only six species recorded in Antarctica are common with other geographical regions: *Hemilamprops pellucidus* from the southern Atlantic Ocean and *Hemilamprops ultimaspei*, *Campylaspis johnstoni*, *C. nodulosa*, *C. frigida* and *C. quadriplicata* from the South American coasts. However, at a generic level the degree of endemism is very low (5.3%), only the genera *Kerguelenica* is endemic and was found only in the Kerguelen Island. The high level of endemism is a striking feature of the Southern Ocean (Clarke and Crame, 1989; Arntz *et al.*, 1997) and is observed in many benthic groups as isopods (Brandt, 1992), amphipods (Jazdzewski, *et al.*, 1991), pycnogonids (Fry, 1964) and bryozoans (Hayward, 1995) and may be due to the isolation of Antarctica from the other continents after the opening of the Drake Passage and the posterior development of circumantarctic current (Clarke and Crame, 1989; Brandt, 1992; Arntz *et al.*, 1994).

High Antarctic regions have a higher number of species than Subantarctic regions, and in the Antarctic Peninsula and in the Bellingshausen Sea is where this number is higher (32 species, Table 4). The four High Antarctic regions considered, East Antarctica, Weddell Sea, Antarctic Peninsula (including Bellingshausen Sea) and Ross Sea have a high number of species in common. On the other hand, the

TABLE 4. – Endemism of cumaceans of the Subantarctic and High Antarctic regions. N: number of species recorded in the region. End. Sp.: number of endemic species.

Region	N	End. Sp.	%
East Antarctica	30	4	13.3
Wedell Sea	29	8	27.6
Antarctic Peninsula and Bellingshausen Sea	32	6	18.7
Ross Sea	12	1	8.3
Kerguelen Islands	18	10	55.6
South Georgia	12	3	25.0

Kerguelen Island and South Georgia, have few species in common and compared with the High Antarctic regions. The Ross Sea and the Weddell Sea also have one species in common with the Kerguelen Island.

By regions, the Weddell Sea shows the highest percentage of endemism within the High Antarctic regions (28%) and the Ross Sea shows the lowest (9%) (Table 4), but Subantarctic regions have a more elevated endemism than High Antarctic regions (25% in South Georgia and 56% in the Kerguelen Island).

Phylogeny of cumaceans is practically unknown, thus, it is difficult to establish the origin of Antarctic cumacean fauna. Based on the biogeographic distribution and assuming the actual systematic classification is based on phylogeny, it seems to be clear that cumaceans do not have a common and recent origin as proposed by Sieg (1988). Different processes may contribute to the establishment of the present fauna of cumaceans as has been postulated by Clarke and Crame (1989) for the whole marine fauna and quite similar for isopods (Brandt, 1992).

Four Antarctic species of genus *Campylaspis* also live in the Magellan region. Both faunas may have a common origin that diverged after the separation of the two continents and the posterior establishment of circumantarctic current (4.3-1.6 Ma) as Watling and Thurston (1989) have proposed for the amphipod family Iphimediidae.

However, another hypothesis would explain the present distribution of genus *Campylaspis*. The four species that also live in South American show a very wide bathymetrical range of distribution and would have colonized Antarctica through the Scotia Arc.

Eight species of the subgenus *Crymoleucon* inhabit only Antarctic shallow waters while a similar number is distributed in deep water of the Mediterranean Sea, the Indic Ocean, the Pacific Ocean and the Atlantic Ocean. This pattern of distribution suggests

that subgenus *Crymoleucon* would have originated in Antarctic shallow waters and later, colonised deep water favoured by the similar physical conditions of the water masses. This phenomenon of submergence has been suggested for the isopod family Serolidae and subfamily Arcturinae (Brandt, 1992).

An opposite phenomenon is known for the deep fauna. Deep water species evolved and diversified in the deep sea favoured by the long time environmental stability (Lipps and Hickman, 1982) and some species could colonise continental shelves mainly in high latitudes (Hessler and Thistle, 1975; Knox and Lowry, 1977; Lipps and Hickman, 1982; Hessler and Wilson, 1983). This process of emergence could be followed by *Cumella emergens* which would evolve from the Atlantic deep water group of this genus (see Jones, 1984) and by the species of family Lampropidae and Diastylidae.

The only Antarctic species of the family Pseudocumatidae, *Kerguelenica platycephala*, described from Kerguelen Islands is of special interest. Species of the family Pseudocumatidae are currently distributed mainly in the Caspian Sea, the Azov Sea, the Black Sea, the Mediterranean Sea and the northeastern Atlantic (Bacescu, 1992) and it suggests a Tethyan origin for this family. *Kerguelenica platycephala* may be a paleoendemism originated in the early Cretaceous when the Tethys Sea surrounded northern Gondwana. Relict species would have survived the ice ages in faunistic refuges as was pointed out by Brandt (1992) and supported by the current presence of a benthic community under the shelf-ice (Bruchhausen *et al.*, 1979; Lipps *et al.*, 1979).

Further studies on the phylogeny as well as on the deep Antarctic fauna of cumaceans will supply important data which could contribute to explain the evolution of cumaceans in this area.

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