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## First record of anomuran and brachyuran larvae (Crustacea: Decapoda) from Antarctic waters

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**Abstract** Two decapod crustacean larval morphotypes belonging to the Anomura and Brachyura were found for the first time in Antarctic waters. Nine specimens were obtained from qualitative plankton hauls in Maxwell Bay (Bransfield Strait) (62°14'33S; 58°43'81W) off King George Island, Antarctic Peninsula. The anomuran morphotype belonged to the Hippidae, and apparently to the genus *Emerita*, whereas the brachyuran representative was assigned to the genus *Pinnotheres* (Pinnotheridae). At present, species determination is not possible due to lack of knowledge of larval morphology in both families. Adult forms of these reptant decapods are not known from Antarctic waters; the occurrence of the present larval forms is considered as a possible intrusion of Subantarctic water masses into the Antarctic environment. This hypothesis is supported by the additional presence of the copepod genus *Acartia* in the same sample material, which is exclusively known from Subantarctic waters.

### Introduction

Diversity of decapod crustaceans in the higher latitudes of both hemispheres has been frequently shown to be outstandingly low (Yaldwyn 1965; Abele 1982; Briggs 1995). In the Antarctic, the impoverishment in decapod fauna is assumed to be a result of Antarctic cooling during the formation of the Antarctic Circumpolar Current (ACC), a process that may have ended about 23 Ma ago (for review see Barker et al. 1991; Crame 1999; see also Lawver et al. 1992). Recently, the benthic

decapod fauna of the Antarctic regime is represented by only about a dozen benthic, natant species (Yaldwyn 1965; Kirkwood 1984; Tiefenbacher 1990; Thatje 2003). However, some anomuran lithodid species were recently found in deeper waters off the continental shelf of the Antarctic Bellingshausen Sea (Klages et al. 1995; Arana and Retamal 2000), suggesting that the southern limits of reptants and the distribution-limiting ecophysiological processes involved are not well defined.

In the present study, two reptant larval morphotypes obtained from a plankton haul taken in Antarctic Maxwell Bay off King George Island (62°14'33S, 58°43'81W, Fig. 1) are described. This first record of anomuran and brachyuran larvae in Antarctic waters is discussed, taking into account biogeography and oceanographic aspects.

### Materials and methods

Sampling of plankton material was carried out on a weekly basis (January to April 2002) in Maxwell Bay (62°14'33S, 58°43'81W, Fig. 1) off King George Island. Qualitative surface samples from the upper water layer (about 10 m depth to surface) were obtained by means of a Bongo net of 200 µm mesh, towed by an inflatable dinghy (1 km transect). Samples were preserved in 3% formalin solution buffered with hexamethylenetetramine, and later transferred into 70% ethanol. Anomuran and brachyuran larvae were only obtained from the sample taken on 28 March. Carapace (CL) and total lengths (TL) of the larvae were measured from the base of the rostrum between the eyes to the posterior dorsal margin of the carapace, and to the posterior margin of the telson, respectively. Dissection of the decapod larval material was done using a Zeiss stereomicroscope.

### Results

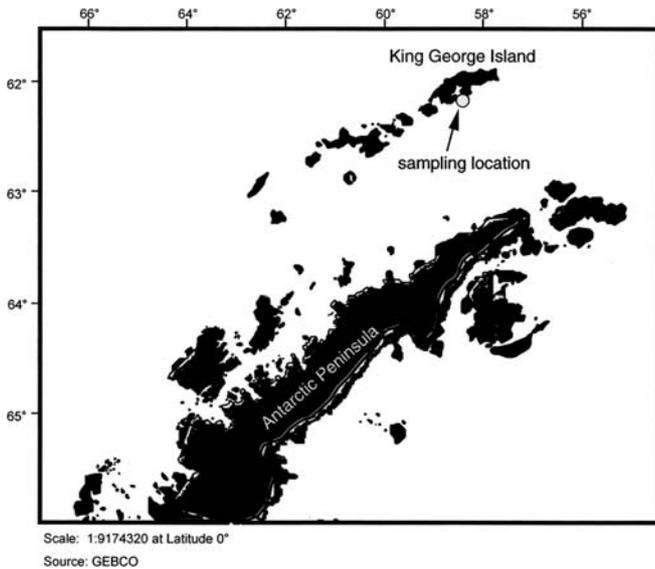
#### Larval morphology

Anomura: Hippidae: *Emerita* sp.

Early zoea, five specimens, TL = 1.25 mm, CL = 0.52 mm (Fig. 2A–C)

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**Fig. 1** Sampling location of anomuran (Hippidae) and brachyuran (Pinnotheridae) larvae in Maxwell Bay (62°14'33S; 58°43'81W) off King George Island, Antarctica, in March 2002

**General characteristics** Carapace smooth, colourless; eyes conspicuously stalked and directing laterally, reaching beyond margin of carapace (Fig. 2A, B); rostrum with wide base and rounded tip, directing anterior-ventrally (Fig. 2A, B); abdomen of four short, smooth segments (Fig. 2A), last segment with lateral posterior expansion; telson as wide as long, posteriorly rounded margin with 30 short spines, central ones larger in size; one pair of posteriolateral short spines present (Fig. 2C); antennae pointing and much longer than rostrum; first and second maxillipeds very similar; exopod of elongated segment slightly longer than endopod; short terminal segment with four long, plumose setae (Fig. 2A).

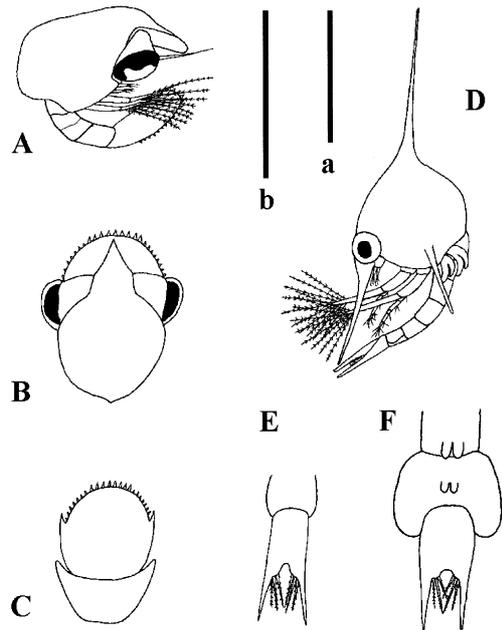
**Remarks** The larvae reveal morphological attributes of the genus *Emerita* (compare with, e.g., Johnson and Lewis 1942; Knight 1967). The present species seems to be related to *Emerita brasiliensis*; both have a strong similarity in telson setation, including the posterolateral pair of spines (compare with Veloso and Calazans 1993). However, the extremely broad base and rounded tip of the rostrum (Fig. 2A, B) and the posterolateral expansion of the last abdominal segment (Fig. 2C) may discard all close relations, suggesting the present larval material belongs to an unknown hippid (see also Rees 1959).

Brachyura: Pinnotheridae: *Pinnotheres* sp.

Early zoea, two specimens, TL = 1.08 mm, CL = 0.46 mm (Fig. 2D, E)

Advanced zoea, two specimens, TL = 2.14 mm, CL = 0.88 mm (Fig. 2F)

**General characteristics** Eyes sessile; carapace with long dorsal and one pair of lateral spines (about half as long as dorsal spine), directing postero-ventrally (Fig. 2D);



**Fig. 2A–F** Decapod crustacean morphotypes found in Maxwell Bay (62°14'33S; 58°43'81W) off King George Island (Antarctica) in March 2002. Anomura: Hippidae (A–C), A lateral view; B dorsal view; C telson, dorsal view; Brachyura: Pinnotheridae (D–F), D lateral view of early zoea; E telson of early zoea; F telson of advanced zoea. Scale bars: a = 0.5 mm (D), b = 0.75 mm (A–C, E, F)

rostral spine slightly shorter than dorsal spine; first and second maxillipeds very similar in morphology; elongated segment of exopod with ten terminal feathered setae, slightly longer than endopod; endopod of five segments; abdomen of four segments, smooth; advanced zoea with pleopodal buds on all somites (Fig. 2F), which are absent in early morphotype; last segment of pleon with lateral expansions (Fig. 2E; more developed in advanced zoea, Fig. 2F); telson with strong furca and medial cleft, and long distinct furcal spines, more developed in advanced zoea (compare Fig. 2E, F); telson with three setose spines on each furca; both larval stages with rudimentary pereopodal buds.

**Remarks** The above general characteristics identify the larval material as belonging to the genus *Pinnotheres* within the Pinnotheridae (compare with Saelzer and Hapette 1986; Pohle et al. 1999). Due to great similarity in morphology, both morphotypes are assumed to belong to the same species (see also Costlow and Bookhout 1966; Roberts 1975).

## Discussion

### Biogeographic origin of larvae

The Pinnotheridae and Hippidae occur in the intertidal to shallow subtidal of sandy beaches (Roberts 1975;

Saelzer and Hapette 1986), an environment virtually absent from the Antarctic. The southernmost records of the genus *Pinnotheres* of the Atlantic and Pacific coasts off South America are reported for northern Argentina (Mar del Plata, 38°S) and the island of Chiloe (42°S; Retamal 1981). Hippidae usually occur in warmer waters, their southernmost distribution in America being northern Chile and southern Brazil (Retamal 1981; Boschi et al. 1992). However, *E. analoga* Stimpson, 1857, has been found in the Strait of Magellan and Tierra del Fuego (about 52°S; Efford 1976; Boschi et al. 1992), although these rare finds have not been confirmed by recent investigations (Gorny 1999). We were not able to assign both reptant larval morphotypes to the species-level, due to the limited knowledge of larval morphology of both families. It is likely that the larvae described are related to species from South America, which is closest to the Antarctic Peninsula.

#### Intrusion of water masses into the Antarctic regime?

The Antarctic Circumpolar Current (ACC), including the Polar Front, is assumed to be the principal physical barrier for plankton organisms. Antezana (1999) suggested that the occasional appearance of Antarctic plankton organisms in the Subantarctic Magellan region may be explained by Antarctic cold-water rings, which are generated from meanders at the Polar Front (for discussion see Joyce and Patterson 1977; Joyce et al. 1981; Nowlin and Klinck 1986). A probable more impacting oceanographic feature could be the superficial breach of the ACC by water masses (for discussion see Li et al. 2002). We assume similar oceanographic phenomena to be responsible for our present find of reptant decapod larvae in Antarctic waters. Since reptant decapods are virtually absent from the Antarctic (Gorny 1999; Frederich et al. 2001), and the reptant larvae found in our samples were associated with specimens of the Subantarctic copepod genus *Acartia*, these hints are further indications of an introduction of Subantarctic plankton into the Antarctic regime. The intrusion of Subantarctic warm-water rings south of the Polar Front may serve as a homogeneous environment for the transported plankton community (Nowlin and Klinck 1986) and may, therefore, allow survival and further larval development, and could explain the appearance of more advanced pinnotherid larvae in our samples. The fact that the reptant larvae and Subantarctic copepods were associated with some typical Antarctic copepod representatives, such as *Metridia gerlachei*, *Calanus propinquus*, *Calanoides acutus* and *Rincalanus gigas*, indicates a mixture of water masses in our sampling area.

The occurrence of anomuran and brachyuran larvae in Antarctic waters suggests that breach of the Antarctic Counter Current is possible and is a possible transport mechanism for plankton organisms.

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#### References

- Abele LG (1982) Biogeography. In: Abele LG (ed) The biology of Crustacea, 1.1. Systematics, the fossil record and biogeography. Academic, New York, pp 242–304
- Antezana T (1999) Plankton of southern Chilean fjords: trends and linkages. *Sci Mar* 63 [Suppl 1]:69–80
- Arana PM, Retamal MA (2000) Nueva distribución de *Paralomis birsteini* Macpherson 1988 en aguas antártidas (Anomura, Lithodidae, Lithodinae). *Invest Mar Valparaíso* 27:101–110
- Barker PF, Dalziel IWD, Storey BC (1991) Tectonic development of the Scotia Arc region. In: Tingey RJ (ed) The geology of Antarctica. Clarendon, Oxford, pp 215–248
- Boschi EE, Fischbach CE, Iorio MI (1992) Catálogo ilustrado de los crustáceos estomatópodos y decápodos marinos de Argentina. *Frente Mar Montevideo* 10:7–94
- Briggs JC (1995) Global biogeography. Elsevier, Amsterdam
- Costlow JC, Bookhout GG (1966) Larval stages of the crab *Pinnotheres maculatus* under laboratory conditions. *Chesapeake Sci* 7:157–163
- Crame JA (1999) An evolutionary perspective on marine faunal connections between southernmost South America and Antarctica. *Sci Mar* 63 [Suppl 1]:1–14
- Efford IE (1976) Distribution of the sand crabs in the genus *Emerita* (Decapoda, Hippidae). *Crustaceana* 30:169–183
- Frederich M, Sartoris FJ, Pörtner HO (2001) Distribution patterns of decapod crustaceans in polar areas: a result of magnesium regulation? *Polar Biol* 24:719–723
- Gorny M (1999) On the biogeography and ecology of the Southern Ocean decapod fauna. *Sci Mar* 63 [Suppl 1]:367–382
- Johnson MW, Lewis WM (1942) Pelagic larval development of the sand crab *Emerita analoga* (Stimpson), *Blepharipoda occidentalis* Randall, and *Lepidopa myops* Stimpson. *Biol Bull* 83:67–87
- Joyce TM, Patterson RC (1977) Cyclonic ring formation of the polar front in the Drake Passage. *Nature* 265:131–133
- Joyce TM, Patterson RC, Millard RC (1981) Anatomy of a cyclonic ring in Drake Passage. *Deep Sea Res* 28:1287–1981
- Kirkwood JM (1984) A guide to the Decapoda of the Southern Ocean. *ANARE Res Notes* 11:1–47
- Klages M, Gutt J, Starman A, Bruns T (1995) Stone crabs close to the Antarctic continent: *Lithodes murrayi* Henderson, 1888 (Crustacea; Decapoda; Anomura) off Peter I Island (68°51'S, 90°51'W). *Polar Biol* 15:73–75
- Knight MD (1967) The larval development of the sand crab *Emerita rathbunae* Schmitt (Decapoda, Hippidae). *Pac Sci* 21:58–76
- Lawver LA, Gahagan LM, Coffin MF (1992) The development of paleoseaways around Antarctica. The Antarctic paleoenvironment: a perspective on global change. *Antarct Res Ser* 56:7–30
- Li X, Donato TF, Zheng Q, Pichel WG, Clemente-Colón P (2002) An extraordinary breach of the Gulf Stream north wall by a cold water intrusion. *Geophys Res Lett* 29. DOI 10.1029/2002GLO15378
- Nowlin EW, Klinck JM (1986) The physics of the Antarctic zCircumpolar Current. *Rev Geophys* 24:489–491
- Pohle G, Mantelatto FLM, Negreiros-Fransozo ML, Fransozo A (1999) Larval Decapoda (Brachyura). In: Boltovskoy D (ed) South Atlantic zooplankton. Backhuys, Leiden, pp 1281–1351

- Rees GH (1959) Larval development of the sand crab *Emerita talpoida* (Say) in the laboratory. Biol Bull 117:356–370
- Retamal MA (1981) Catálogo ilustrado de los crustáceos decápodos de Chile. Gayana 44:1–110
- Roberts MH (1975) Larval development in *Pinnotheres chamae* reared in the laboratory. Chesapeake Sci 16:242–252
- Saelzer HE, Hapette AM (1986) Desarrollo larvario de *Pinnotheres politus* (Smith, 1870) (Brachyura, Pinnotheridae) en condiciones de laboratorio. Gayana Zool 50:63–79
- Thatje S (2003) *Campylonotus arntzianus*, a new species of the Campylonotidae (Crustacea: Decapoda: Caridea) from the Scotia Sea (Antarctica). Polar Biol: DOI 10.1007/s00300-002-0469-5
- Tiefenbacher L (1990) *Eualus kinzeri*, a new hippolytid shrimp from the Weddell Sea (Antarctica) (Crustacea: Decapoda: Natantia). Spixiana 13:117–120
- Veloso VG, Calazans DK (1993) Descrição dos estágios larvais de *Emerita brasiliensis* Schmitt, 1935 (Decapoda: Hippidae) obtidos de amostras do plancton, Rio Grande do Sul. Neritica 7:133–144
- Yaldwyn JC (1965) Antarctic and subantarctic decapod Crustacea. In: Miegheem J van, Oye P van (eds) Biogeography and ecology in the Antarctic. Junk, The Hague, pp 324–332