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Sympagic occurrence of Eusirid and Lysianassoid amphipods under Antarctic pack ice

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Abstract

During three Antarctic expeditions (2004, ANT XXI-4 and XXII-2; 2006, ANT XXIII-6) with the German research icebreaker R/V *Polarstern*, six different amphipod species were recorded under the pack ice of the Weddell Sea and the Lazarev Sea. These cruises covered Austral autumn (April), summer (December) and winter (August) situations, respectively. Five of the amphipod species recorded here belong to the family Eusiridae (*Eusirus antarcticus*, *E. laticarpus*, *E. microps*, *E. perdentatus* and *E. tridentatus*), while the last belongs to the Lysianassidea, genus *Cheirimedon* (cf. *femoratus*). Sampling was performed by a specially designed under-ice trawl in the Lazarev Sea, whereas in the Weddell Sea sampling was done by scuba divers and deployment of baited traps. In the Weddell Sea, individuals of *E. antarcticus* and *E. tridentatus* were repeatedly observed *in situ* during under-ice dives, and single individuals were even found in the infiltration layer. Also in aquarium observations, individuals of *E. antarcticus* and *E. tridentatus* attached themselves readily to sea ice. Feeding experiments on *E. antarcticus* and *E. tridentatus* indicated a carnivorous diet. Individuals of the Lysianassoid *Cheirimedon* were only collected in baited traps there. Repeated conventional zooplankton hauls performed in parallel to this study did not record any of these amphipods from the water column. In the Lazarev Sea, *E. microps*, *E. perdentatus* and *E. laticarpus* were regularly found in under-ice trawls. We discuss the origin and possible sympagic life style of these amphipods.

Keywords: Antarctic; Amphipods; Under-ice fauna; Sympagic; Weddell Sea; Lazarev Sea

1. Introduction

The lower boundary layer of polar sea ice is inhabited by several allochthonous and autochthonous species, of which amphipods have been described as the most conspicuous macrofaunal elements in the Arctic, while euphausiids are the dominant group in the Antarctic (Lønne and Gulliksen, 1991; Gulliksen and Lønne, 1991). Copepods are common in the sea-ice habitats of both regions. Unlike in the Arctic sea-ice zone, where amphipods have been commonly recorded both under coastal fast ice as well as under offshore pack ice, Antarctic sympagic amphipods have mostly been described for the coastal fast-ice zone (Arndt and Swadling, 2006). In this habitat, species like *Paramoera walkeri*, *Cheirimedon fougneri* and *Pontogeneia antarctica* seem to originate from the benthos and occur under the sea ice only seasonally and in relatively shallow water depths (Sagar, 1980; Gulliksen and Lønne, 1991; Garrison, 1991). Comparatively little is known about the distribution of Antarctic amphipods in sea ice above greater water depths, although several reports of amphipods in the sub-ice or even under-ice habitat have been published recently (Kaufmann et al., 1993, 1995; Fisher et al., 2004). This could be due to the relative inaccessibility of these areas, as

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well as the higher frequency and greater feasibility of studies based on land stations. Also, the distribution of these highly motile under-ice organisms at the ice undersurface is often very patchy (Hop et al., 2000), and the effective observation and collection require the use of divers or ROVs (remotely operated vehicles), while core-hole based methods like under-ice pumping or video camera systems cover only a very limited sampling area surrounding the hole (Werner and Lindemann, 1997).

Ainley et al. (1986) discovered the amphipod *Eurythenes gryllus* along with the decapod *Pasiphaea longispina* and the ostracod *Gygantocypris mulleri* in sea bird stomachs collected in pack ice of the Southern Ocean. All three species were otherwise believed to be mesopelagic, but since the sea bird species examined (Antarctic petrel, *Thalassoica antarctica*) was known to dive no deeper than 5 m, it was concluded that these crustacean plankton species must have migrated to the immediate sub-ice habitat. Another report by Kaufmann et al. (1995) mentions the Lysianassoid *Abyssorchomene rossi* in large numbers from baited traps deployed directly under pack ice of the northwestern Weddell Sea, while deeper traps did not catch any of these amphipods.

During the three Antarctic research cruises reported here, six amphipod taxa were sampled directly from the underside of sea-ice floes by various methods, in what we believe to be the first recorded observation and collection of these species from Antarctic pack ice.

The aims of this paper are: (1) to present findings of new sympagic occurrences of Eusirid and Lysianassoid amphipods; (2) to record feeding behaviour observed in some of these taxa; (3) to compare these findings with other reports of Antarctic amphipods found in association with sea ice.

2. Material and methods

2.1. Study area

This study is based on three Antarctic cruises with the German research icebreaker R/V *Polarstern*. The two expeditions into the Lazarev Sea (ANT XXI-4, March–May 2004 and ANT XIII-6, June–August 2006) were part of the multiyear study **LA**zarev Sea **KR**ill **S**urvey (**LAKRIS**). The goal of the expedition into the Weddell Sea (ANT XXII-2, November 2004 to January 2005) was to carry out the **I**ce **S**tation **POL**arstern experiment (**ISPOL**), see Hellmer et al. (2008). For the purpose of this paper, the three expeditions will be referred to by these acronyms: **LAKRIS 2004**, **ISPOL** and **LAKRIS 2006** (see Fig. 1, Tables 1 and 2 for details).

2.2. ISPOL—sampling

The ISPOL drift station was set up in an area where sea-ice cover contained both first-year and multi-year ice, with ice cover of 8–9/10. The vessel was moored to a large ice floe and drifted with it for the period of November 29, 2004 to January 02, 2005, between positions 68°2.7′S 54°51.1′W and 67°21.2′S 55°24.3′W, while sounded depths ranged from 1030 to 2075 m. An introduction and overview of the ISPOL experiment is given by Hellmer et al. (2008).

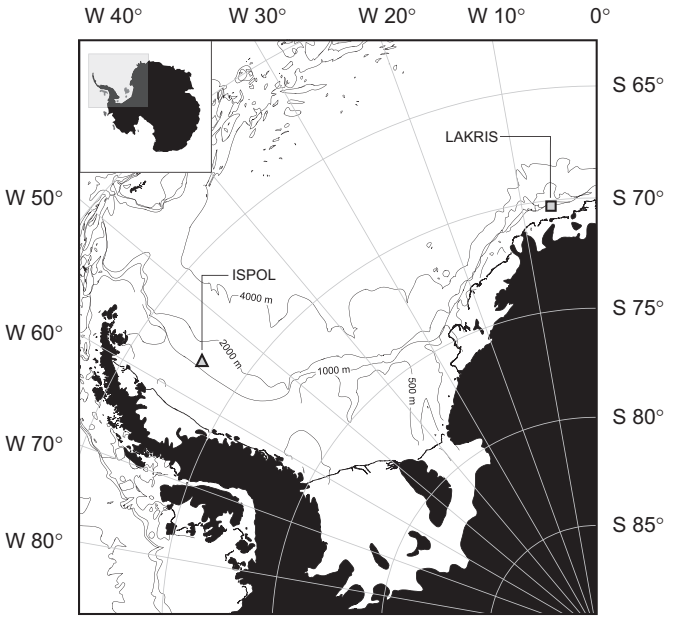

Fig. 1. Map of the study area indicating the sampling areas of the ISPOL drift station and the LAKRIS 2004 and 2006 cruises. For details on positions, ice cover and depth, refer to tables.

During the course of the ISPOL experiment, ice underside and under-ice temperatures, salinity and chlorophyll *a* values were measured from ice cores as well as under-ice water samples at regular intervals. Ice-core salinity and chlorophyll *a* content were measured from sampled core segments, melted at 4 °C in the dark. Chlorophyll *a* content also was determined from melted core segments that were filtered and extracted from a detailed time-series study of these parameters in the ISPOL floe (Steffens & Dieckmann, unpublished data). Under-ice water and zooplankton samples were obtained from an under-ice pumping system, deployed simultaneously to the time-series core sampling events, and results of this are presented in detail in Kiko et al. (2008).

Under-ice fauna was sampled by scuba diving as well as by deployment of baited traps (see Table 1). Scuba divers used a hand-net with 25 × 25-cm frame opening and 500-μm mesh size, which was scraped along the underside of the ice. Sampling by scuba diving was done on five different dates and positions (see Table 1), while baited traps were checked every other day from initial deployment on December 07, 2004 until final retrieval on January 2, 2005.

Traps deployed along the floe edge as well as through core holes were plastic tubes with 102.5 mm inside diameter, 150 mm tube length, with a funnel opening to the inside on one end and a 100-μm aluminium mesh on the other end. The opening of the funnel was 12 mm wide, and traps were suspended in the water column in such a way