



New records of isopod species of the Antarctic Specially Managed Area No. 1, Admiralty Bay, South Shetland Islands

Karol ZEMKO, Krzysztof PABIS*, Jacek SICIŃSKI and Magdalena BŁAŻEWICZ

*Laboratory of Polar Biology and Oceanobiology, University of Łódź,
Banacha 12/16, 90-237 Łódź, Poland*

** corresponding author <cataclysta@wp.pl>*

Abstract: Admiralty Bay (King George Island) is an Antarctic Specially Managed Area and one the most thoroughly studied small-scale marine basins in the Southern Ocean. Our study provides new data on the isopod fauna in this glacially affected fjord. Twelve species of isopods were recorded in this basin for the first time. Six of them were found for the first time in the region of the South Shetland Islands. The highest number of species new for Admiralty Bay were found in the families Munnopsidae (4 species) and Munnidae (3 species).

Key words: Antarctic, King George Island, Crustacea, glacial fjords, ASMA, biodiversity.

Introduction

General knowledge about the biodiversity of the Antarctic benthic fauna has increased in recent years as a result of intensified sampling programs and the creation of large databases like the Register of Antarctic Marine Species (RAMS), a key element of the SCAR Mar-BIN program (De Broyer *et al.* 2011; Griffiths *et al.* 2011; Jossart *et al.* 2015). Results of large international programs like the *Census of Antarctic Marine Life* (CAML) and the *ANtartic benthic DEEP-sea biodiversity: colonization history and recent community patterns* (ANDEEP) has increased our knowledge about the distribution of benthic marine life in the Southern Ocean and resulted in findings of many new taxa, especially in the deep sea (Brandt *et al.* 2007). The proportion of new taxa in various collections from different Antarctic locations is still very high even in shallower shelf areas (*e.g.* Pabis *et al.* 2015). Some regions of the Southern Ocean, including large parts of the West Antarctic, are relatively well-studied in terms of biodiversity (Griffiths

2010). Nevertheless, there is a need to develop the network of monitoring sites that can be treated as reference points for future studies describing the influence of global changes on marine diversity, especially in the region of the West Antarctic Peninsula (Moon *et al.* 2015; Sahade *et al.* 2015). Ongoing, rapid climate warming observed in this part of the world (Walsh 2009) implies the necessity of detailed biodiversity assessments, especially in the protected areas and in basins that can be included in the list of monitoring sites. This approach fits also in the general concept of the All Taxa Biodiversity Inventory (ATBI) sites that was originally proposed over 20 years ago (Yoon 1993) but it is still developed in many marine and terrestrial sites, including polar fjords (Kędra *et al.* 2010).

Admiralty Bay is one of the most comprehensively studied small scale areas in the Southern Ocean. Over 1300 benthic species (*e.g.*, 172 species of amphipods, 162 of polychaetes, 135 species of foraminiferans, 80 species of echinoderms, 48 species of gastropods and 39 species of bivalves) were recorded in this bay over 35+ years of Polish, Brazilian and German research (Siciński *et al.* 2011). In 1996 it was designated by the Scientific Committee on Antarctic Research as an Antarctic Specially Managed Area (ASMA No. 1) and as an “*important area which might warrant future consideration as legacy site requiring special protection*” (Siciński *et al.* 2011). There are about 100 papers focusing on various aspects of marine life in this basin. Some of them (Pabis *et al.* 2011; Siciński *et al.* 2012) were recently included in the compilation of circumpolar information on Antarctic benthic communities that “*provides unique georeferenced biological basic information*” (Gutt *et al.* 2013) for the future studies prepared under the umbrella of various international programs like Antarctic Thresholds – Ecosystem Resilience and Adaptation as well as planning of Marine Protected Areas. As pointed out in one of the CAML contributions this semi-closed glacially affected ecosystem is a perfect model system for studies of influence of warming on marine benthic fauna (Siciński *et al.* 2011).

Isopods are among the most speciose groups of benthic macrofauna of the Southern Ocean (De Broyer *et al.* 2011) and third most speciose group of benthic macrofauna of Admiralty Bay (Arnaud *et al.* 1986; Presler 1986; Teodorczyk and Wägele 1994; Zemko and Brix 2012; Siciński *et al.* 2012; Zemko and Kaiser 2012; Zemko *et al.* 2015, 2017). However, recent studies of the soft-bottom isopod communities demonstrated that despite the very large sampling effort the species accumulation curves are still steep and a comprehensive evaluation of the isopod species richness in this basin is still far from being complete (Zemko *et al.* 2017). Our study provides new data on species richness of the isopod fauna of Admiralty Bay, which will enhance future biodiversity assessments of this basin.

Material and methods

Study area. — Admiralty Bay is a medium-size glacial basin on the King George Island (South Shetlands). It covers an area of about 120 km². It consists of a central basin and three inner fjords: Ezcurra Inlet, Martel Inlet and MacKellar Inlet. Large part of the Admiralty Bay coastline is covered with glaciers and icefalls (Braun and Grossmann 2002). The bay is strongly affected by various glacial processes (Pęcherzewski 1980; Lipski 1987; Campos 2013). Admiralty Bay is influenced by Bellingshausen Sea and Weddell Sea waters (Tokarczyk 1987). Bottom deposits are poorly sorted. The sediments can be described as sand (in the shallow sublittoral zone) and mud (silty clay sand and sandy clay silt) in deeper parts of the bay (Siciński 2004; Campos 2013). The phytal zone covers about 30% of the Admiralty Bay bottom (Zieliński 1990). Detailed description of hydrology and other environmental characteristics of this basin were recently summarized by Siciński *et al.* (2011).

Sampling

We gathered new records of isopod species from 21 random van Veen grab [0.1 m²] samples collected in the summer season of the 1978, 1979/1980 (13 samples) and 2007 (8 samples). Larger series of 32 bottom trawls collected in the summer season of 1977/78 (5 samples) and summer season of the 1980/1981 (27 samples) were also used in the analysis. Material was collected along a full depth range of Admiralty Bay (13–165 m for van Veen grab samples, 15–500 m for the trawling samples) and in different parts of Admiralty Bay, mainly in Ezcurra Inlet and central basin. Samples were sieved on a 0.5 mm mesh sieve and preserved in 4% formalin solution. After sorting material was fixed in alcohol.

Results and discussion

Twelve species of Isopoda new to Admiralty Bay were recorded in the studied material (Table 1). Those species represented six families. The highest number of new species were found in the families Munnopsidae (4 species) and Munnidae (3 species). Both of those families are also very common and speciose in the whole Southern Ocean. There are 95 species of Munnopsidae and 34 species of Munnidae known from this part of the World Ocean (Kaiser 2014). All the families except Stenetriidae were already found in previous research. Generally, the species richness of isopods in Admiralty Bay is high, especially when taking into account the small size of this basin. Currently 441 species of Isopoda are recorded in the whole Southern Ocean (De Broyer *et al.* 2011),

while the number of species found in the Admiralty Bay, together with our present results equals 99 (Arnaud *et al.* 1986; Presler 1986; Teodorczyk and Wägele 1994; Zemko and Brix 2011; Zemko and Kaiser 2012; Siciński *et al.* 2012; Zemko *et al.* 2015). This further highlights the fact that this bay is an important biodiversity hot spot for the benthic fauna. It was already suggested that the high diversity of habitats (including different types of soft and hard bottom, macroalgae forests) and dynamic set of environmental properties can be a reason of high diversity of the Admiralty Bay macrofauna in many taxonomic groups (Siciński *et al.* 2011). High diversity of habitats can be vitally important in the case of isopods, because their distribution in the Admiralty Bay is very patchy and most of the species were rare (Zemko *et al.* 2017). Therefore, there is a need for further studies based on large sampling effort, and exploration of different types of habitats. Moreover, our study showed that the use of different sampling gears like bottom trawls might also contribute to finding of some new taxa. Differences in species composition were observed for example in the case of polychaetes studied with the use of a van Veen grab and bottom trawl in the Admiralty Bay (Siciński 2004; Pabis and Siciński 2010). Until now most of the data on the isopod fauna in Admiralty Bay based on van Veen grab samples collected at point scale or samples collected from kelp holdfasts (Zemko *et al.* 2015). On the other hand this basin is also undoubtedly very well studied, and this fact results in a more comprehensive list of taxa.

The majority of the species new to Admiralty Bay were recorded in the middle sublittoral zone. Only *Cryosignum incisum* (Richardson 1908) was found in the shallowest sublittoral and it seems that this species is generally associated only with the shallower sublittoral zone (Doti *et al.* 2005). Most of the species found in our study were singletons, doubletons and tripletons, which supports earlier results from the Admiralty Bay soft bottom (Zemko *et al.* 2017) and other studies showing low densities of the Antarctic isopods (Richardson and Hedgpeth 1977; Brandt 2001), although it is worth mentioning that van Veen grab is not a perfect tool for isopod sampling. A higher number of individuals was found only for *Eurycope crassiramus* Golovan, 2008 and *Coulmannia australis* Hodgson, 1910, however both species were found in two samples only. Despite the fact that the knowledge on isopod species richness in the studied region is relatively comprehensive, six of the species were found for the first time in the South Shetland Islands (Castello 2004 and references therein). Most of those species were already recorded in the West Antarctic. Some of them are also known from East Antarctic and subantarctic islands, mostly from very similar depth ranges (Table 1).

Only in the case of one species recorded in our study we noted important information about its whole range in the Southern Ocean. *Coperonus nordenstami* Wilson, 1989 has been previously recorded only from South Georgia (Wilson 1989). Our study further provides new data on bathymetric distribution of some

Table 1

List of isopod species new for the Admiralty Bay. Species recorded in the South Shetland Islands for the first time are marked with an asterisk. W – West Antarctic, E – East Antarctic, S – Scotia Arc, G – South Georgia.

	Number of individuals	Sample details (No. of samples in brackets)	Depth range [m] in the Antarctic (literature data)	Depth range [m] in present study	References	Distribution in the SO
Acanthaspidiidae						
<i>Ianthopsis ruseri</i> Vanhöffen, 1914	2	bottom trawl (2), 23 I, 24 III 1981	385	70–240	Castello (2004), Brandt (1991), Choudhury and Brandt (2009)	W/E
Desmosomatidae						
<i>Whoia</i> sp. nov.*	1	van Veen grab (1), 28 III 2007	–	112	Brix (2006), Kaiser <i>et al.</i> (2007)	W
Munnidae						
<i>Munna maculata</i> Beddard, 1886	3	van Veen grab, (3), 27 III, 28 III, 28 III 2007	22–141	109–145	Castello (2004), Choudhury and Brandt (2009) Teodorczyk and Wägele (1994), Amar and Roman (1974)	W/E/S
<i>Munna psychrophila</i> Vanhöffen, 1914*	2	van Veen grab, (2), 27 III, 28 III 2007	10–1153	112–116	Schotte 2008b, Teodorczyk and Wägele 1994	W/E
<i>Munna studeri</i> Hilgendorf, 1893*	2	van Veen grab, (2), 27 III 2007	0–210	108–110	Choudhury and Brandt (2009), Teodorczyk and Wägele (1994)	W/E/S
Munnopsidae						
<i>Eurycope crassiramis</i> Golovan, 2008*	8	van Veen grab (2), 27 III 2007	1582	108–112	Golovan (2008)	W
<i>Coperonus gracilis</i> Brandt, 1992	2	van Veen grab, (2), 27 III, 28 III 2007	45–420	108–145	Castello (2004), Brandt (1992), Wilson and Shotte (2009), Doti <i>et al.</i> (2005)	W
<i>Coperonus nordenstami</i> Wilson, 1989*	2	van Veen grab (1), 28 III 2007	252–310	116	Wilson 1989	G

Table 1 continued

	Number of individuals	Sample details (No. of samples in brackets)	Depth range [m] in the Antarctic (literature data)	Depth range [m] in present study	References	Distribution in the SO
<i>Lionectes humicephalotus</i> Wilson, 1989	1	van Veen grab (1), 28 III 2007	6–659	112	Castello (2004), Wilson (1989)	W
Paramunnidae						
<i>Cryosignum incisum</i> (Richardson, 1908)*	1	van Veen grab (1), 7 III 1980	0–15	17	Doti <i>et al.</i> (2005), Just and Wilson (2007)	W
<i>Coulmannia australis</i> Hodgson, 1910	5	bottom trawl, (2), 17 III 1981	183–400	290–430	Castello (2004), Schotte (2008a), Choudhury and Brandt (2009)	W/E
Stenetriidae						
<i>Tenupedunculus acutum</i> (Vanhöffen, 1914)	3	bottom trawl (1), 24 III 1981	150–3397	240	Castello (2004), Serov and Wilson (1995), Nordenstam (1933), Zimmerman and Brandt (1992)	W/E

other species (Table 1), although in most cases our data only slightly increased the current knowledge. *Eurycope crassiramis* has been previously found only in the deep sea (1582 m). It was recorded for the first time since its original description and it has been previously known only from the *locus typicus* in the northern part of the Weddell Sea, in a relatively short distance from the South Shetlands (Golovan 2008). Generally, there are isopod species in the Southern Ocean that have wide or even circumpolar distributions or can be found along large bathymetric ranges (Kaiser 2014). Some families, like Munnopsidae, have good swimming abilities (Brix and Svavarsson 2010; Brandt *et al.* 2011). Many species may float on thalli and holdfasts of large macroalgae drifting with the Antarctic Circumpolar Current (Edgar 1987).

We also discovered a first record of the genus *Whoia* on the shelf of the South Shetland Island. This desmosomatid isopod genus includes only four described species. *W. angusta* (G.O. Sars, 1899) is known from Skagerrak Strait, *W. dumbshafensis* Svavarsson, 1988 was described from the North Sea. Two other species, *W. variabilis* Hessler, 1970 and *W. victoriensis* Brix, 2006, are known from the North Atlantic and the Australian waters respectively (Brix 2006). In the Southern Ocean it was recorded only in the deep sea (Kaiser *et al.* 2007) but it was still not formally described. In the material from the Admiralty Bay

it was represented by only a single individual and that is why we have not decided to describe it as a new species.

Admiralty Bay as an ASMA site needs special attention in biodiversity studies. Isopods are one of the most speciose groups of invertebrates of this basin, just after Amphipoda and Polychaeta (Siciński *et al.* 2011). As good indicators of environmental changes that are sensitive to ongoing climate warming in the region of the Antarctic Peninsula (Ingels *et al.* 2012) this invertebrate group is also important for the future studies describing changes in biodiversity, especially in comprehensively studied reference sites located along the Antarctic Peninsula. High diversity of the Admiralty Bay bottom fauna and its geographic position makes this basin not only a good monitoring point but also a scientific legacy site. Several species of macrofauna, including six isopod species, have type localities in this basin which further confirms its scientific and historic legacy (Teodorczyk and Wägele 1994; Siciński *et al.* 2011; Zemko and Brix 2011; Zemko and Kaiser 2012). A high level of rarity of some isopod species found in the Admiralty Bay shows the importance of a comprehensive species richness assessment of this basin. Over 250 benthic samples were collected with use of various sampling gears like: bottom trawls, epibenthic sledge, box corers and van Veen grabs during many Polish, Brazilian and German sampling campaigns. Nevertheless, there are still some species like *Whoia* sp., *Lionectes humicephalotus* or *Cryosignum incisum* that are known in this basin from only one single specimen (Table 1). Climate changes might influence the small populations of some of those species in the Admiralty Bay, therefore it is important to monitor and document new records of taxa in this basin as a basis for future research. Further studies should be based on material collected with use of different sampling methods.

Acknowledgments. — The study was supported by a grant of the Polish Ministry of Science and Higher Education No 51/N-IPY/2007/0 as well as the Census of Antarctic Marine Life project. Karol Zemko and Krzysztof Pabis were also supported by University of Łódź internal funds. We are very grateful to three reviewers for all important suggestions. Thanks are also due to David Drumm who kindly corrected language through the manuscript.

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Received 29 March 2017

Accepted 15 June 2017