Benthos meets plankton: Isopods sampled in the Japan Trench by means of plankton nets fixed to large bottom trawls

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Short Report

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Abstract

During the expedition KH-23-5 with RV *Hakuho Maru* to the Kuril-Kamchatka (KKT) and Japan Trenches (JT) in September 2023, bottom trawls were deployed with plankton nets and yielded a high number of supra- and epibenthic benthic organisms, especially a high number of isopod crustaceans (Peracarida, Malacostraca). In total, we sampled 2,634 specimens of Isopoda from at least 14 families and the suborder Epicaridea at 28 stations. Five families occurred with more than 100 specimens, these were the Munnopsidae with the highest number of specimens (1,122 individuals), followed by Haploniscidae with 564, Macrostylidae with 430, Ischnomesidae with 245, and Desmosomatidae with 168 individuals. Station C8 yielded the highest number of individuals (488) and at station F11 only a single isopod was sampled. Our data document the efficiency of these additional plankton nets and we recommend to deploy bottom trawls with plankton nets in future more frequently.

Introduction

The Northwest Pacific is a very well investigated area of our world oceans, for example, due to the extensive investigations led by Lev Zenkevitch from board of the RV *Vityaz* (e.g. Zenkevitch et al. 1955). Moreover, in the past decade, a total of four expeditions to the Northwest (NW) Pacific were conducted through German-Russian collaborative research, with the aim to study the patterns and processes of biodiversity and biogeography as well as species' turnover, species connectivity, range extensions, and species evolution in this region (Brandt 2016, Brandt et al. 2020).

The deep-water properties and geomorphology of the hadal trench have been extensively discussed in the publications by Johnson (1998) and Jamieson and Stewart (2021). The composition of the isopod and crustacean macrofauna recently sampled in the Northwest Pacific, including the Kuril-Kamchatka Trench and adjacent area, has been documented in Brandt et al. (2020) and Knauber et al (2022a). Depth zonation in this region has also been addressed by Brandt et al. (2019). Comprehensive compilations of the deep-sea fauna of the Sea of Japan can be found in works in Brandt et al. (2010) and Fujita (2014).

The geography and biology of the Northwest Pacific have also been comprehensively summarized by Jamieson (2015) and Jamieson and Stewart (2021). Historically, benthic isopod samples were primarily collected through large bottom trawls aboard RV *Vityaz* (Zenkevitch et al. 1955), and more recently using an epibenthic sledge (Brandt and Barthel 1995; Brenke 2005). The use of plankton nets in large bottom trawls was introduced by Akiyama et al (2008). Given the efficiency of this method, we also employed it during the KH-23-5 expedition aboard the RV *Hakuho Mar*u to the KKT and JT for capturing Isopoda.

Material and methods

The KH-23-5 expedition, conducted aboard RV *Hakuho Maru*, spanned from September 12th to October 2nd, 2023, and was dedicated to exploring the Kuril-Kamchatka Trench and the Japan Trench. The primary objectives of this expedition were to sample 28 stations positioned along four transects traversing the trenches (Table 1; Fig. 1). Deployments with an ORI-type 4-m beam trawl and an Agassiz-type 3-m beam trawl were accompanied by plankton nets either fixed or suspended from the main frame (Fig. 2). Samples from the fixed plankton nets primarily contained pelagic animals from the water column and were fixed immediately upon retrieval of the gear; however, these samples are not referred to in the present paper. The suspended, smaller plankton nets, referred to as the “inner net”, were deployed to sample benthic macrofaunal Peracarida (Crustacea, Malacostraca) from abyssal and hadal depths (Table 1; Fig. 1). The plankton nets used in this study had a mesh size of 330 to 500 µm. This method of combining inner nets with beam trawls (Fig. 2) and “decantation method” is commonly used in Japan and is known to be highly effective in collecting small crustaceans (Akiyama et al. 2008).

Results

The plankton nets attached to the bottom trawls deployed during the KH-23-5 expedition aboved RV *Hakuho Maru* sampled 2,634 isopod specimens from at least 14 families (Table 2) at 28 stations at abyssal and hadal (3,428–7,510 m) depths. Further differentiation within the suborder Epicaridea was hindered as larvae could not be identified to the epicaridean family level. Isopod families identified from this material include Antarcturidae, Arcturidae, Desmosomatidae, Haplomunnidae, Haploniscidae, Ischnomesidae, Janirellidae, Janiridae, Macrostylidae, Mesosignidae, Munnidae, Munnopsidae, Nannoniscidae, and Paramunnidae. The most frequently found families, with more than 100 specimens, are illustrated in Fig. 3.

The isopod family Munnopsidae, known for its swimming capabilities (Hessler and Strömberg 1989), is frequently encountered in the suprabenthos (Frutos et al. 2017) and was the most abundant isopod family at all stations (1,122 ind.). The collected epicarideans were identified as pelagic larvae. In contrast, all other isopod families are either epibenthic or possess the ability to burrow. The second most frequently observed family was the Haplonsicidae (564 ind.), followed by the Macrostylidae (430 ind.), Ischnomesidae (245 ind.), and Desmosomatidae (168 ind.). All other families are much rarer; the Nannoniscidae were recorded with 36 individuals, the Janirellidae (28 ind.), the Antarcturidae (10 ind.), the Janiridae (8 ind.), the Arcturidae (2 ind.), the Haplomunnidae (2 ind.), the Mesosignidae (2 ind.), the Munnidae (2 Ind.), and the Paramunnidae (1 ind.).

The station with the highest number of isopods was C8 with 488 individuals in the western KKT, the one with the least was station F 11 in the northern JT where only a single specimen has been found.

Amongst this material, we currently estimate more than 50 species, excluding counts of Munnopsidae and Desmosomatidae because of the difficulty of identification. This count includes undescribed species that will be described in upcoming publications.

Discussion

The North Pacific is one of the best investigated deep-sea regions due to the Russian efforts involving eleven expeditions with RV *Vityaz* led by Lev Zenkevitch (Zenkevitch 1955; Zenkevitch et al. 1955). This extensive exploration has resulted in the description of many isopod species, accompanied by a wealth of publications by Belyaev (1983; 1989), Belyaev and Vilenkin (1983), Birstein (1957; 1963), and Kussakin (1971; 1988; 1999) and many other authors (e.g. Golovan et al. 2018 and references therein). In recent decades, Malyutina has played a significant role in describing numerous new species of Munnopsidae, obtained during Russian-German and German-Russian expeditions aboard the RVs *Sonne* (Brandt and Malyutina 2015; Brandt et al. 2019)d *Akademik Lavrentyev* (Malyutina and Brandt 2013; Malyutina et al. 2018 and references therein).

The depth zonation of the Northwest Pacific has been comprehensively examined by Brandt et al. (2019) for deep-sea macrofauna based on epibenthic sledge catches from the Sea of Japan, Sea of Okhotsk, KKT and Northwest Pacific abyssal plain. Across these regions, sopods are more prevalent at the abyssal depths compared to both bathyal (Sea of Japan and Sea of Okhotsk) and hadal zones (KKT). In-depth data on isopod biogeography and bathymetry are also provided (Brandt et al. 2019; Malyutina and Brandt 2020; Golovan et al. 2018; Elsner et al. 2013a). The number of isopods collected with plankton nets during the RV *Hakuho Maru* expedition was much lower than the numbers of isopods collected by means of an epibenthic sledge deployed during the above mentioned expeditions in the Northwest Pacific. More specifically, 27,931 isopods were collected in the Sea of Japan due to the bathyal mass occurrence of the munnopsid *Eurycope spinifrons* Gurjanova, 1933 (Elsner et al. 2013b)). Additionally,5,625 isopods were collected in the Sea of Okhotsk and the Bussol Strait, 4,006 in the abyssal Northwest Pacific and at the rim of the KKT, and 4,949 isopods were collected from hadal and abyssal depths in the KKT (Brandt et al. 2019).

In addition to Munnopsidae, Haploniscidae and Ischnomesidae are frequently sampled in the Northwest Pacific. These families were not only frequently sampled in the KKT and JT with the plankton nets, but they also occurred in the Sea of Okhotsk, in the KKT, and the abyssal North Pacific (Bober et al. 2017; 2019; Johannsen et al. 2019; Knauber et al 2022b).

Peracarid isopods captured by the beam trawl's plankton nets are described at family level in the present paper, highlighting that even a large sized beam trawl net can be equipped with fine-mesh sized gear to increase sampling results for macrofaunal organisms, including Isopoda (Akiyama et al. 2008). In the case of epicaridean isopods, we refrain from identification at the family level because all listed specimens were in the larval stage. This study represents the first comprehensive publication of isopods obtained using the "inner net" introduced by Akiyama et al. (2008). Our data demonstrates the efficiency of these additional plankton nets, and we therefore recommend more frequent deployment of bottom trawls with plankton nets in future investigations.

Declarations

Statements and Declarations

Competing Interests and Funding: The authors assure no competing interests and funding.

Compliance with Ethical Standards

We assure that we have adhered to ethical standards in conducting our research.

Data availability statement

All isopods obtained during the KH23-05 expedition are currently stored in the Senckenberg Research Institute and Natural History Museum Frankfurt, Germany, as well as in the Atmosphere and Ocean Research Institute of the University of Tokyo in Kashiwa, Japan, and Hokkaido University, Japan. Species that are being described will be deposited in the natural history collections of Senckenberg and the Museum in the National Museum of Nature and Science Tokyo according to the ICZN.

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Figures

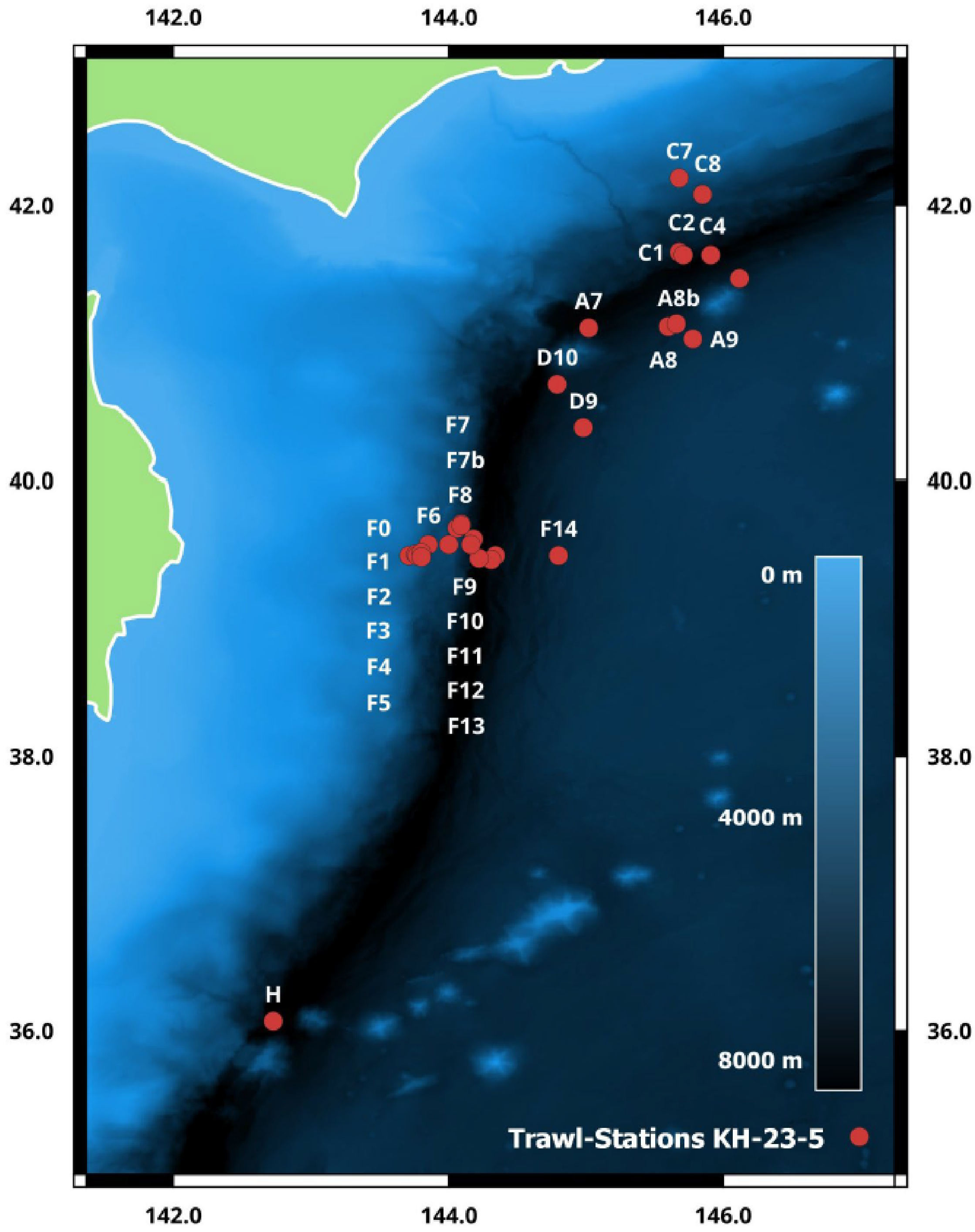

Figure 1

Station map of the RV *Hakuho Maru* expedition KH-23-5.

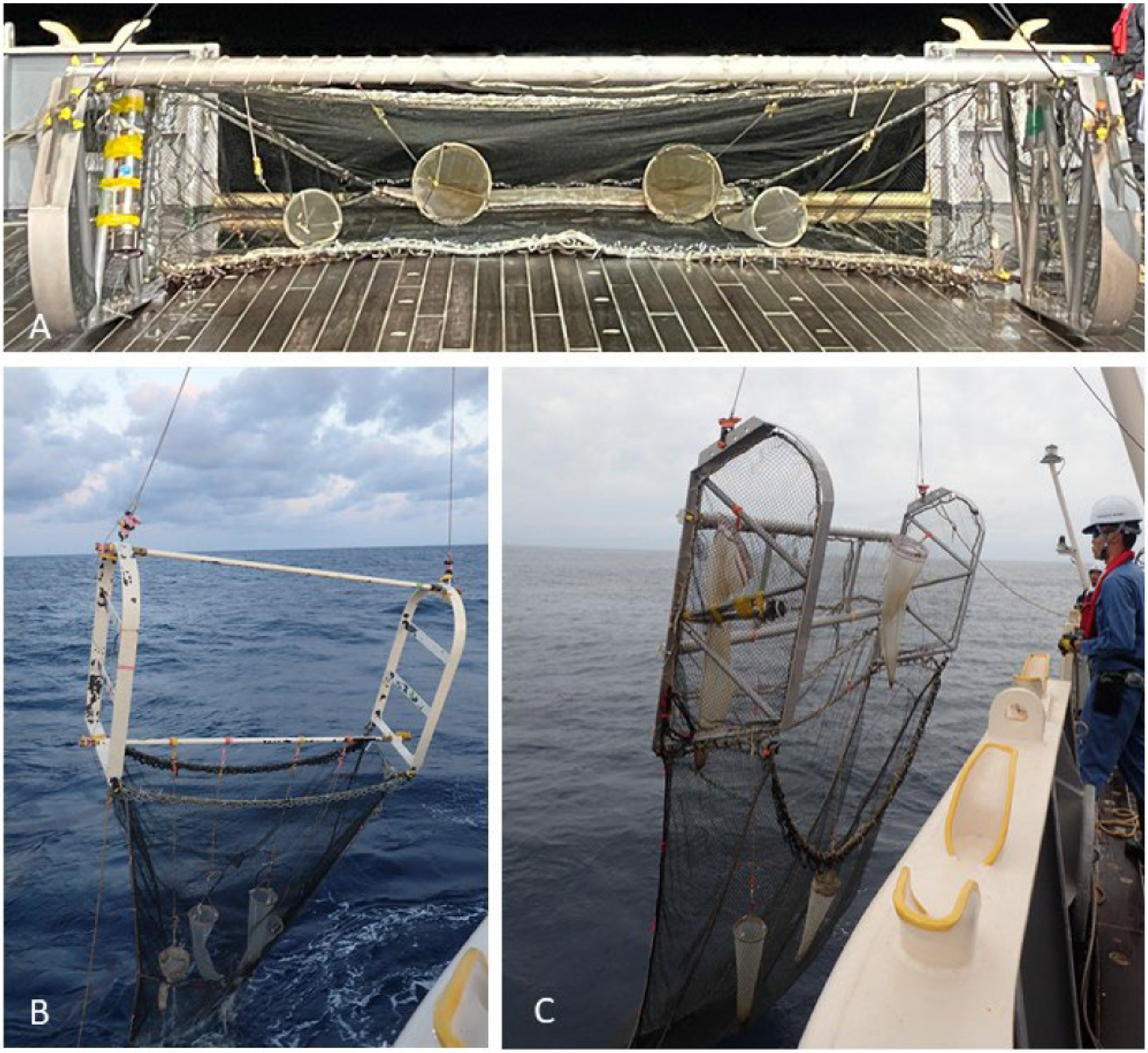

Figure 2

Illustration of the trawls and the plankton-net fixation. A, view of plankton nets in the ORI-type trawl; B, ORI-type 4-m beam trawl; C, Agassiz-type 3-m beam trawl

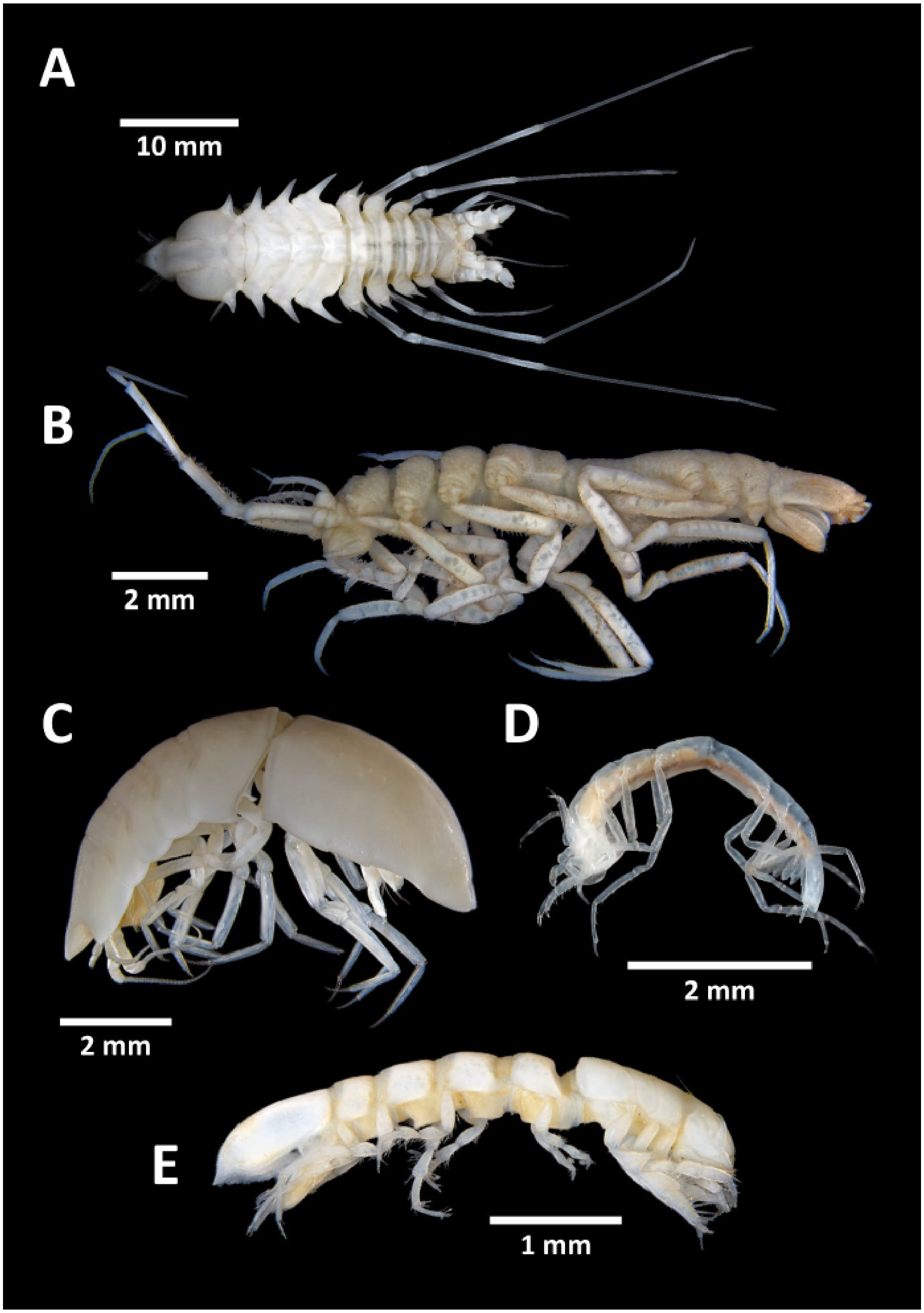

Figure 3

Isopods of the families occurring in the plankton nets most frequently. A, Munnopsidae - © Shoki Shiraki; B, Ischnomesidae - © Andreas Kelch; C, Haploniscidae - © Henry Knauber; D, Desmosomatidae - © Keiichi Kakui; E, Macrostylidae - © Anchita Casaubon

Supplementary Files

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- Table1Stationlist.pdf
- Table2isopodfamilyrecords.pdf