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ORIGINAL RESEARCH ARTICLE

The malacostracan fauna of two Arctic fjords (west Spitsbergen): the diversity and distribution patterns of its pelagic and benthic components

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Summary This study examines the performance of pelagic and benthic Malacostraca in two glacial fjords of west Spitsbergen: Kongsfjorden, strongly influenced by warm Atlantic waters, and Hornsund which, because of the strong impact of the cold Sørkapp Current, has more of an Arctic character. The material was collected during 12 summer expeditions organized from 1997 to 2013. In all, 24 pelagic and 116 benthic taxa were recorded, most of them widely distributed Arctic-boreal species. The advection of different water masses from the shelf had a direct impact on the structure of the pelagic Malacostraca communities, resulting in the clear dominance of the sub-arctic hyperiid amphipod *Themisto abyssorum* in Kongsfjorden and the great abundance of Decapoda larvae in Hornsund. The taxonomic, functional and size compositions of the benthic malacostracan assemblages varied between the two fjords, and also between the glacier-proximate inner bays and the main fjord basins, as a result of the varying dominance patterns of the same assemblage of species. There was a significant drop in species richness in the strongly disturbed glacial bays of both fjords, but only in Hornsund was this accompanied by a significant decrease in density and diversity, probably due to greater isolation and poorer quality of sediment organic matter in its innermost basin. Our results suggest that the diversity and distribution of benthic malacostracans in these two fjords are only distantly related to the different hydrological regimes; rather, they are governed by

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locally acting factors, such as depth, sediment type, the variety of microhabitats and the availability and quality of food.

1. Introduction

Malacostracan crustaceans are widespread across a broad range of Arctic habitats from intertidal (Węsławski et al., 1993) and sea ice (Macnaughton et al., 2007) to deep ocean basins (Brandt, 1997). They can locally dominate the benthic (Conlan et al., 2013; Grebmeier et al., 1989) and plankton (Hirche et al., 2015; Huenerlage et al., 2015) biomass. The total number of bottom-dwelling malacostracan species noted in the Arctic Ocean surpasses 800, while about 50 planktonic forms are known (Sirenko, 2001). They contain both mobile and sessile forms, exhibit a variety of life strategies and hold crucial positions within food-webs, acting as conduits of nutrients and energy to higher trophic levels such as fish, birds and mammals (e.g. Highsmith and Coyle, 1990). The wide functional diversity exhibited by polar crustaceans results from the large species pool, but also from the considerable potential of ontogenetic niche shifts due to the relatively long life cycles and distinct size differences between juveniles and adults (Węsławski et al., 2010). Functional roles within populations are dynamic since different age or sex cohorts may vary considerably in terms of motility, microhabitat choice and food preferences (Carey and Boudrias, 1987; Hopkins et al., 1993; Legeżyńska, 2008; Sainte-Marie, 1986).

Svalbard crustaceans have been studied extensively over the last 150 years and are known to have the greatest species diversity of all the macrozoobenthic taxa (Palerud et al., 2004). Planktonic malacostracans being relatively large and mobile, are not target organisms of standard zooplankton sampling nets (WP-2, mesh 180-μm), therefore they are rarely included in routine plankton surveys. Sampling with specialized equipment (e.g. Tucker trawl or Isaacs-Kidd net with mesh size >1 mm) has shown that euphausiids (*Thysanoessa inermis*, *Thysanoessa raschii* and *Thysanoessa longicaudata*) and amphipods (*Themisto libellula* and *Themisto abyssorum*) are prominent members of the zooplankton communities in Svalbard fjords (Buchholz et al., 2010; Dalpadado et al., 2016; Hirche et al., 2015; Hop et al., 2002). Identification of the epifaunal components of Svalbard benthic communities is still not comprehensive, but investigations using dredges, baited traps and materials collected by SCUBA divers have recorded dense populations of malacostracan crustaceans, especially in the littoral (Nygård et al., 2010; Węsławski et al., 1993) and shallow sublittoral (Berge et al., 2009; Kaczmarek et al., 2005; Laudien et al., 2007; Legeżyńska, 2001; Nygård, 2011; Voronkov et al., 2013). Estimating their density, however, is complicated because of their motility and also the difficulty of taking quantitative samples on the heterogeneous substrates overgrown with macroalgae often found in shallow waters. Grabs operated from on board ship are suitable for catching infauna and small epifauna on soft sediments below 30 m but are much less efficient in the case of large, mobile and rare epifaunal species. Typically, therefore, crustaceans are poorly represented in grab samples and have been overlooked in the majority of subtidal benthic studies from Spitsbergen (e.g. Włodarska-Kowalczuk and Pearson, 2004; Włodarska-Kowalczuk et al., 2012; Włodarska-Kowalczuk and Węsławski, 2008).

Understanding ongoing processes in the Arctic ecosystem requires a better knowledge of the specific life-histories and functional traits of the available species pool (Cochrane et al., 2012; Węsławski et al., 2011). Here we summarize knowledge of planktonic and benthic Malacostraca based on samples collected during 12 summer expeditions organized from 1997 to 2013 by the Institute of Oceanology PAS to two Spitsbergen fjords: Kongsfjorden and Hornsund. The fjords have been frequently used as model oceans (Buchholz et al., 2010), because they have the same physical and biological processes as the adjacent seas, but are ecosystems of manageable size. The two fjords compared are eminently suitable for observations on the possible effects of climate change on the functioning of the Arctic ecosystem. Because of the sea currents on the Spitsbergen shelf they are differently exposed to present-day warming and can be regarded as representing two phases in the course of global warming: a cold one (Hornsund) and a warm one (Kongsfjorden). Furthermore, both fjords have secluded inner glacial bays, which are strongly influenced by the surrounding glaciers. One of the key effects of glacier activity is the considerable accumulation of fine-grained sediments, which is causing bottom habitat heterogeneity in the glacial bays to decline. It has been predicted, however, that glacier retreat in the coming decades will cause the homogenization of the seafloor over large areas of the coastal Arctic and will pose a major threat to species richness, diversity and the trophic structure of bottom communities in the Arctic (Węsławski et al., 2011). Therefore, surveys in the glacial bays may help to assess the changes that, in the future, are likely to take place across seafloor biota on a larger scale.

Our main aims were to update the checklist of malacostracan taxa from Hornsund and Kongsfjorden, and to explore and compare the distribution, abundance and diversity patterns of species in both fjords and their glacial bays and outer basins. We also examined the functional roles and size structure within the crustacean community. Our results provide baseline information for further monitoring research on climate-change-induced effects on the crustacean fauna of the European Arctic.

2. Study area

Hornsund and Kongsfjorden are similarly-sized glacial fjords situated on the west coast of Spitsbergen (Svalbard archipelago; Fig. 1). Both fjords are open to the Greenland Sea

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