
The crinoid *Heliometra glacialis*.

region (SBI) and the Canadian Archipelago (CASES) – that extend the Norwegian findings across the pan-arctic region. This will be supplemented by a full programme of invited and submitted presentations.

### Social events

In addition to the formal discussions, various social events are planned to provide opportunities for further dialogue in a more relaxed atmosphere. These include a reception in the Polar Environmental Centre and Tromsø Town Hall, a trip on the coastal steamer *MS Polarlys* (i.e. 'polar light'), including dinner, and also an opportunity to have dinner and go dog-sledging at the Tromsø Wilderness Centre. All week, the conference will have exclusive use of Ølhallen, the oldest pub in Tromsø.

You may also wish to extend your stay either side of the conference, to visit the Tromsø Film Festival, the largest film festival in Scandanavia, or the Northern Light Festival, a week of music and theatre.

### Participation

Arctic Frontiers is a MarBEF-supported event. Further details on the conference can be found on the website **www.arctic-frontiers.com**.

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# Global warming-driven biodiversity change

## Pelagic versus benthic domain [Arctic 79°N case study]

By Monika Kędra and Wojciech Walkusz

Increasing interest in the consequences of global warming has motivated the current trend of research in the Arctic, an area particularly vulnerable to climate change. Our study focuses on the fjord Kongsfjorden 79°N (Spitsbergen, Svalbard Archipelago). Although it is located in the Arctic, this fjord seems to be more characteristic of a sub-Arctic rather than an Arctic fjord, mainly due to warm Atlantic water carried with the West Spitsbergen Current. As it receives variable input of both Arctic and Atlantic influence, Kongsfjorden can function as a climatic indicator on a local scale. It represents a transitional area between Atlantic and Arctic biogeographic zones and its fauna is composed of both arctic and boreal species. Subsequently, increased input of Atlantic waters into Kongsfjorden could change its environment toward a more boreal ecosystem.


Kongsfjorden, the fjord opening (Out station).

The location of Kongsfjorden on the border of different climatic and biogeographic zones makes it particularly ideal for studying how the zooplankton communities tackle the consequences of climate change. There is high local variability in the zooplankton and it is strongly dependent on the balance between the input of Arctic and Atlantic water masses, which is most likely sensitive to climate changes. The marine macrozoobenthos is commonly regarded as a good indicator for long-term ecosystem changes. However, as it is well known that many marine benthic populations exhibit periodic variations at different temporal scales, it is therefore important to treat the short-term data series with appropriate caution.

Kongsfjorden hosts the most active tidal glacier of Svalbard Archipelago, Kongsbreen, which is retreating at a rate of up to 0.5km per year. The glacier activity has a direct influence on the benthic communities' diversity and its variability with the scale and magnitude of the impact, depending on the activity of the glacier. Since Kongsfjorden is an open fjord with no sill at the entrance, the exchange across shelf and fjord boundary has a direct impact on biological and physical variation of the benthic system. During the four years of our study, both "cold" (2004 – a large volume of Arctic waters were present at the surface, characterised by lower temperature and salinity and the presence of ice) and "warm" (2002 – where a vast amount of Atlantic water was present in the main fjord, which penetrated into the glacial bay) seasons occurred and different amounts of relatively warm Atlantic waters were observed to have a direct impact on the Kongsfjorden hydrography.

Benthos and zooplankton samples were collected at two stations in the Arctic fjord, Kongsfjorden. The outer station (Fig. 1) was set at the fjord mouth in the deep water basin, while the bay station (Fig. 2), was located in the inner basin situated at the end of the fjord. Both benthos and zooplankton samples were collected from *RV Oceania* in the last week of July during four consecutive years (2001-2004).

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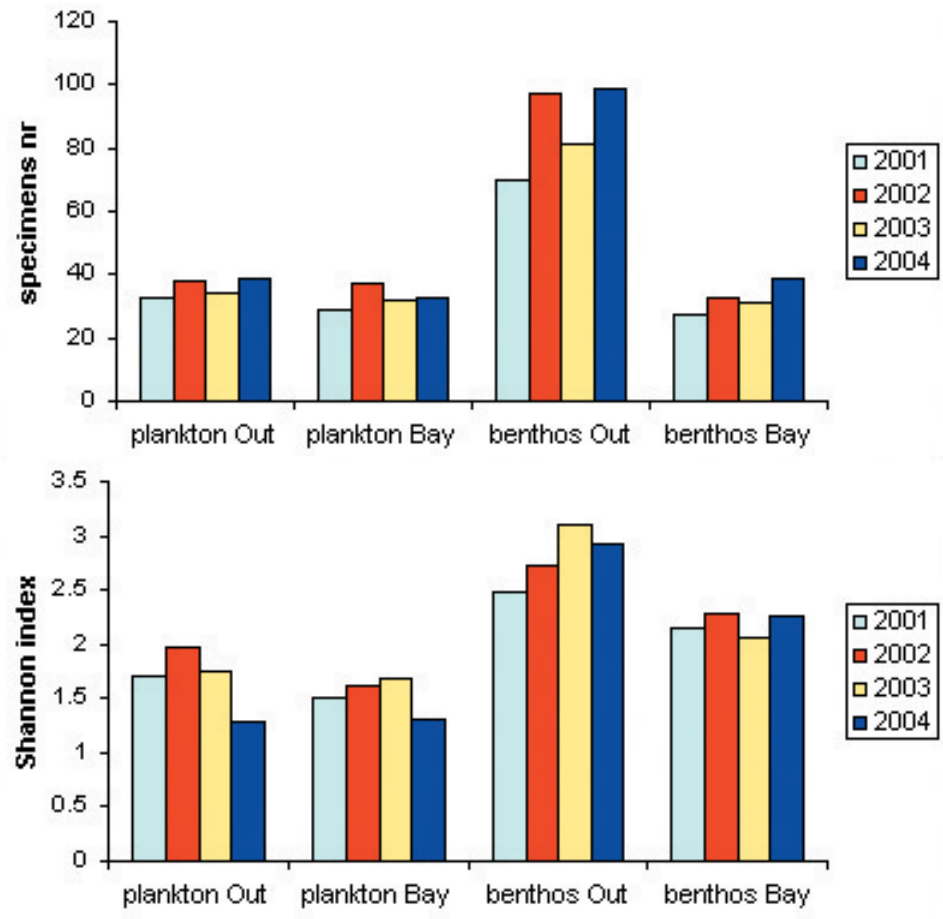
Kongsfjorden, the glacial bay (Bay station).

Different hydrological conditions were affecting the planktonic species composition instantly. In the warm year, 2002, the diversity and species richness was higher than in other years, especially when compared with the cold year in 2004. This is a result of strong Atlantic water intrusion bringing warm-water species into the fjord as well as into the inner basin of the fjord. Large abundance of Echinoderm larvae were brought with strong dominance Atlantic water in 2002 masses and this may indicate typical warm-year environmental conditions in the fjord. The abnormally large amounts of Atlantic waters brought into the arctic fjörds may have a significant influence not only on the species composition of the plankton assemblages but also on the benthic ones and may lead to re- or introduction of Atlantic species. Zooplankton was dominated by small opportunistic species like *Oithona similis,* in all years, that benefit from the changing and therefore unstable environmental conditions, and may replace large Arctic species.

The changing environmental situation does not seem to affect the benthic assemblages in a direct way. The outer part of the fjord is exposed to changeable hydrological conditions, but still the conditions are far more stable than in the glacial bay. Any change in environmental conditions would affect the benthos far more than in the glacial bay, where species inhabiting the area are used to disturbance. Neither the cold- or warm-year conditions seem to have an impact on the diversity of benthic assemblage, but it seems that the diversity and species richness is increasing in case of large amounts of Atlantic water filling the fjord. Due to the harsh conditions in the glacial bay, fauna is less diverse, and only the very well adapted species may become successful in this area. In warm years, the environmental conditions may become even more difficult and the influence of the glacier is increased. During the cold years observed, the catastrophic events were limited and therefore the benthic fauna less disturbed. Consequently, the cold year (2004) facilitated more favourable environmental conditions, which may explain the higher diversity as well as species richness in the glacial bay.




**Figures 1 & 2.** Species richness (number of species) and species diversity (Shannon index) for plankton and benthos in the Out and Bay station from 2001 to 2004. 2002 was regarded as a "warm" year and 2004 as a "cold" one.

We concluded that different amounts of warm Atlantic water-masses (i.e. climatic differences) have a direct and very immediate influence on the species composition of plankton as well as on its biodiversity, while the benthic response was less defined and did not occur immediately (Fig. 1). In both domains, changes were observed in species composition; however, changes in species diversity and species richness were also noted. Atlantic species occurring and missing in both domains may indicate "cold" and "warm" years. The changes were more visible and happened more quickly in the planktonic domain and therefore it may be a better indicator of global warming-driven changes than the benthic one. However, benthic fauna are a good indicator of "slow" changes, especially when observed over a long period of time, corroborating the 'signal' received from the planktonic domain.

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