Variability of under-ice and open water communities in the Central Arctic Ocean

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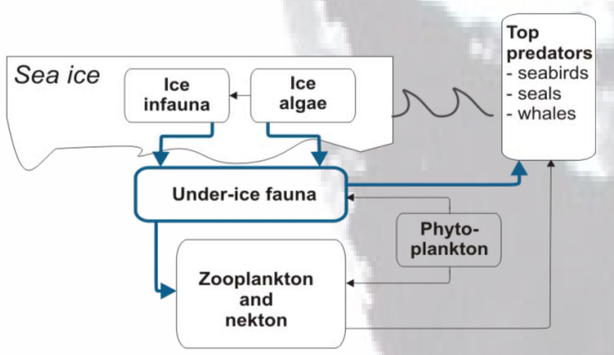
Introduction

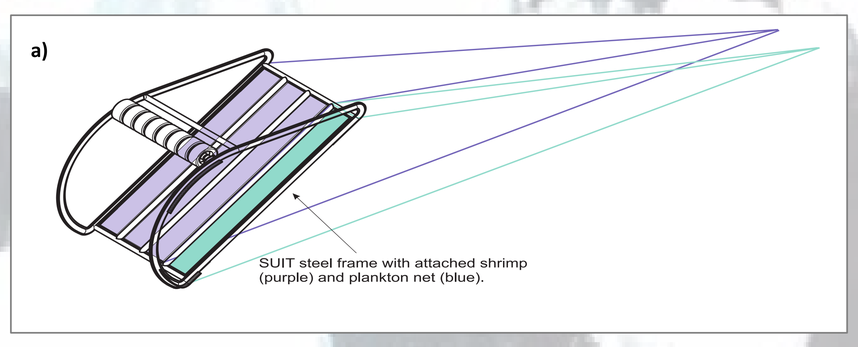
Arctic sea ice ecosystems thrive significantly on carbon produced by ice-associated microalgae (Gosselin, 1997). Species feeding in the ice-water interface layer probably play a key role in transferring carbon from sea ice into pelagic food webs (Flores, 2011). The significance of this trophic carbon flux, however, is poorly known. This is because until very recently it was difficult to sample the under-ice community at the relevant spatial scales due to the inaccessibility of the ice underside to quantitative macrofauna sampling. Furthermore, estimating the relationship of key species with properties of their sea ice habitat is important to understand future changes of the Arctic sea ice system.

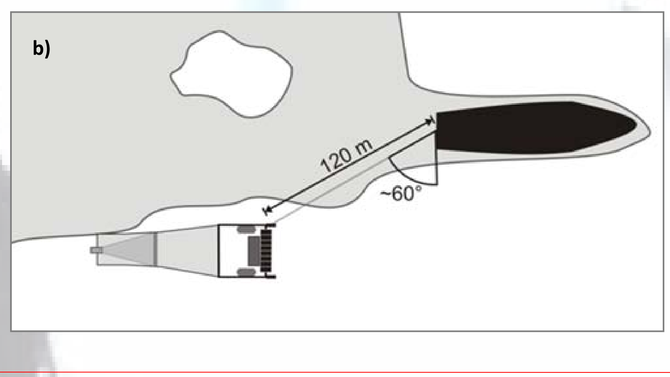


A major **objective** of the HGF Young Investigators Group *Iceflux* was to investigate the relationship of the under-ice community with physical habitat properties in Central Arctic Ocean during **RV Polarstern cruise ARK XXVII/3**.

Materials and Methods

Under-ice fauna was sampled at 15 stations with a Surface and Under-Ice Trawl (SUIT; van Franeker et al. 2009). The SUIT consists of a sideward-shearing steel frame equipped with floaters enabling the net to glide in close contact with the underside of sea ice. The frame was equipped with two parallel nets attached next to each other in the mouth opening of 2.01 m height: A shrimp net (7 mm half-mesh) covering 1.54 m of the opening, and a zooplankton net (0.3 mm mesh) covering 0.42 m of the opening. A bio-environmental sensor array was mounted in the SUIT frame, consisting of an Acoustic Doppler Current Profiler, a CTD probe with built-in fluorometer and altimeter, two spectral radiometers, and a video camera. Hereafter, results of hauls 1-12 are presented.





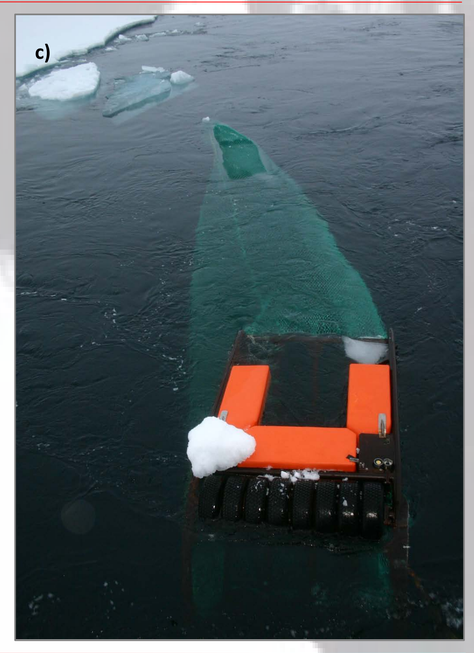


Fig.1 **S**urface and **U**nder-**I**ce **T**rawl in Arctic Ocean (SUIT; van Franeker et al. 2009)
(a) SUIT frame and nets scheme;
(b) birds-eye-view of SUIT during operational mode;
(c) photo of SUIT in the water

Preliminary results

Macrofauna composition

- species number in stations range from 2 to 13, from a total of 15 identified
- cumulated abundances in stations range from 0.2ind.m^{-2} to 2.1ind.m^{-2} (**Fig.2**)

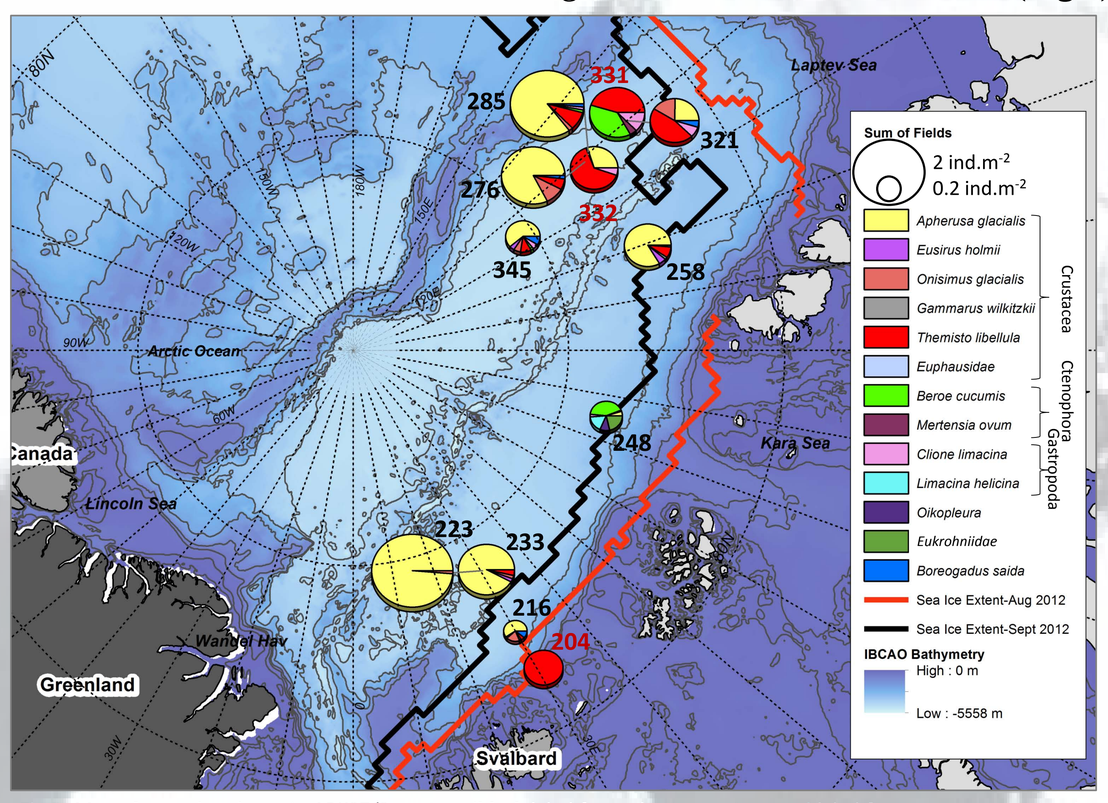


Fig.2 Macrofauna abundance in ARK27/3 stations (**black** label for under-ice stations, red label for open water stations) caught with the SUIT shrimp net; Sea ice extents are courtesy of NSIDC

Community types

- **under-ice community** characterised by the dominance of the sympagic amphipod ***A.glacialis*** and **polar cod**
- **open water community** characterised by dominance of the amphipod ***T.libellula***
- unique species assemblage characterised by the presence of appendicularians, chaetognates, and the gastropod *L.helicina* (**Fig.3**)
- commonly found species were *C.limacina* and *B.cucumis*, ctenophores present in high number in stations 248 and 331

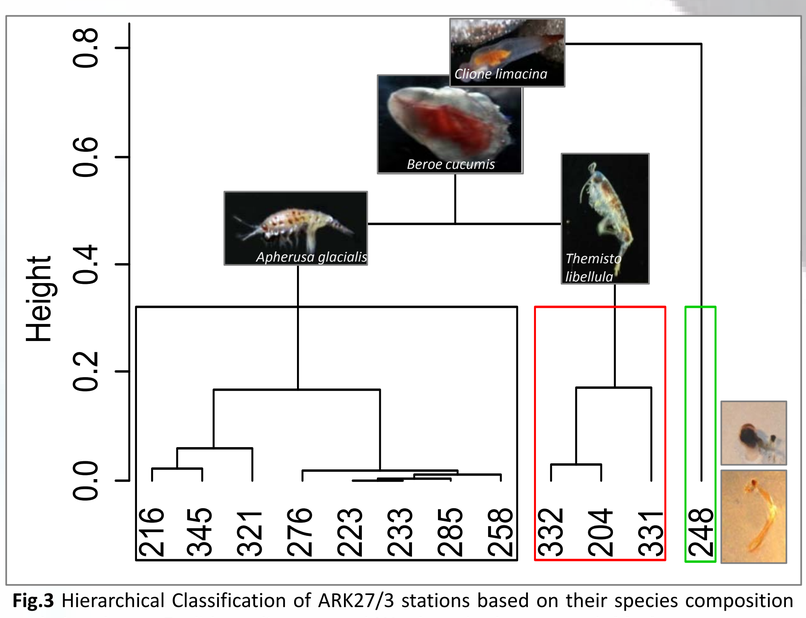


Fig.3 Hierarchical Classification of ARK27/3 stations based on their species composition and abundance; Euclidean distance and Ward method were used; **black** square groups under-ice stations, red open water stations and green the unique station

Polar cod

- abundance range from 0.2 in open-water stations to 1.9 ind.m^{-2} in under-ice stations (**Fig.4**)
- size spectra shows presence of three cohorts: juvenils, first year and second year fish (**Fig.5**)
- qualitative diet investigation indicated mainly *A.glacialis* and in lower proportion *T.libellula* and *Calanus spp*

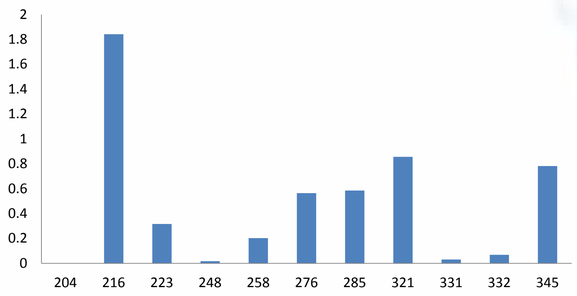


Fig.4 Polar cod abundance (ind.100 m^{-2}) in ARK27/3 stations

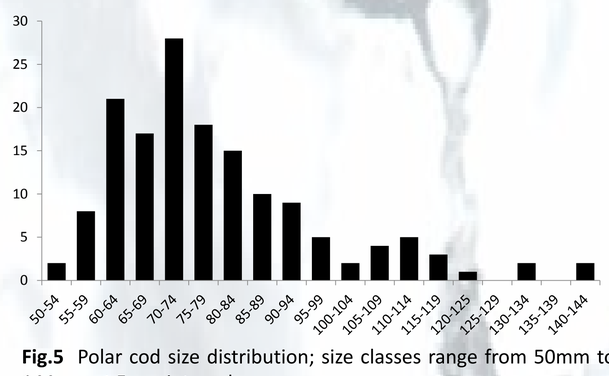


Fig.5 Polar cod size distribution; size classes range from 50mm to 144mm at 5mm intervals

Ecosystem variability in ARK27/3 stations

- Association of sea ice properties with sympagic amphipods and polar cod are inversely correlated with association of water temperature and the amphipod *T.libellula*
- *B.saida* and *O.glacialis* are inversely correlated with salinity (**Fig.6**)

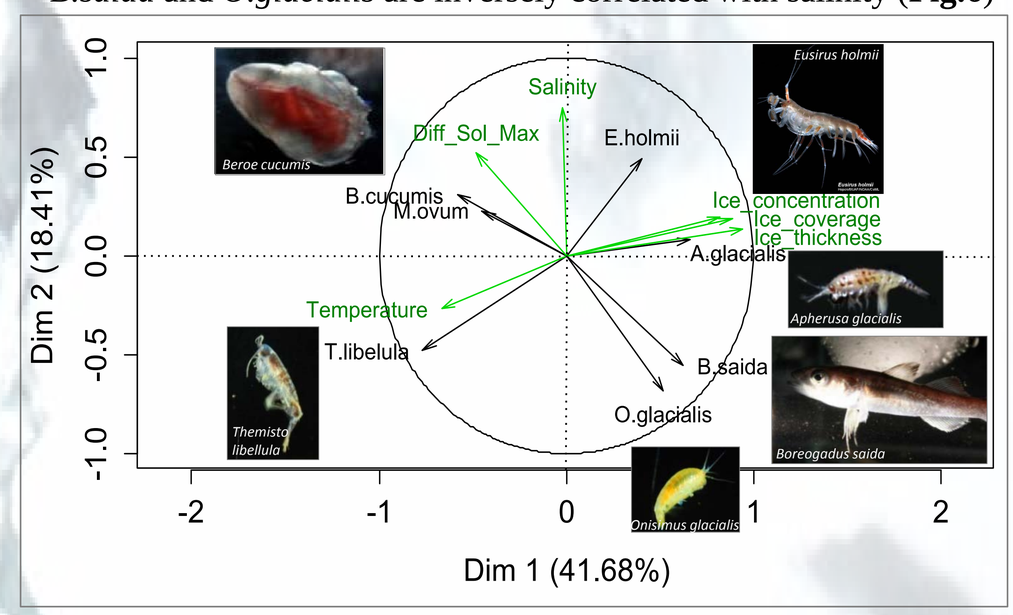


Fig.6 Principal Component Analysis on representative species in ARK27/3 samples and physical parameters describing the habitats; Variables map presented as correlation circle with the first two dimensions

Conclusions

- The **first trawl survey of under-ice fauna** in the Arctic Ocean provided a geographically **unique dataset**.
- A **rich and diverse under-ice community** appears to be present virtually throughout the eastern Arctic deep-sea basins.
- **Polar cod** and ice-associated **amphipod *A.glacialis*** represent **key species** of the under-ice habitat.
- Under-ice **swarms of gelatinous** ctenophores suggest an important role , but **underestimated in total carbon fluxes**.
- The association of this community with the under-ice habitat indicates a possibly **important role of ice algal production** in the Arctic ecosystem.

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