Ecosystem Approach to Barents Sea Ecology: spatial and trophic relationships

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Introduction

The success of future management and conservation practice in the Barents Sea will depend on an integrated, ecosystem level understanding of its ecology. Patterns of abundance and diversity of pelagic and benthic communities on different spatial scales must be available if the driving global and local ecological processes are to be identified. Coordinated Russian-Norwegian Cruises permit a first, near synoptic, look at the whole Barents Sea in an ecosystem perspective.

Presented here are the newly registered data from the August-September 2006 ecosystem cruises which consisted of a total of 205 vessel days and a sailing distance of 19000 nautical miles. The Norwegian and Russian vessels made a total of 1108 hauls to collect data on zooplankton, pelagic fish, bottom fish, benthic animals, and oceanography. The Norwegian biomass data are presented in this poster.

Material and Methods

Temperature data were obtained via CTD sampling, whereas bathymetric data for the Barents Sea were downloaded from a oceanographic database (at walrus.wr.usgs.gov). Sampling of the four groups of organisms was based on the following methods: zooplankton, WP2 net-hauls; pelagic fish, acoustic (ER-60) echo sounder; bottom fish and benthos, bottom (Campelen) trawl. Deep sea prawn (*Pandalus borealis*), gelatinous zooplankton and squids (Cephalopoda) were omitted from the sample estimates of total biomass. Biomass estimates for the relevant survey area, shown in the charts, were obtained by linear interpolation of the sample estimates of (log-transformed) biomass. The implemented linear interpolation algorithm, available in the R package *Akima*, was set to work on a 160x160 interpolation grid, to optimize the use of available point estimates.

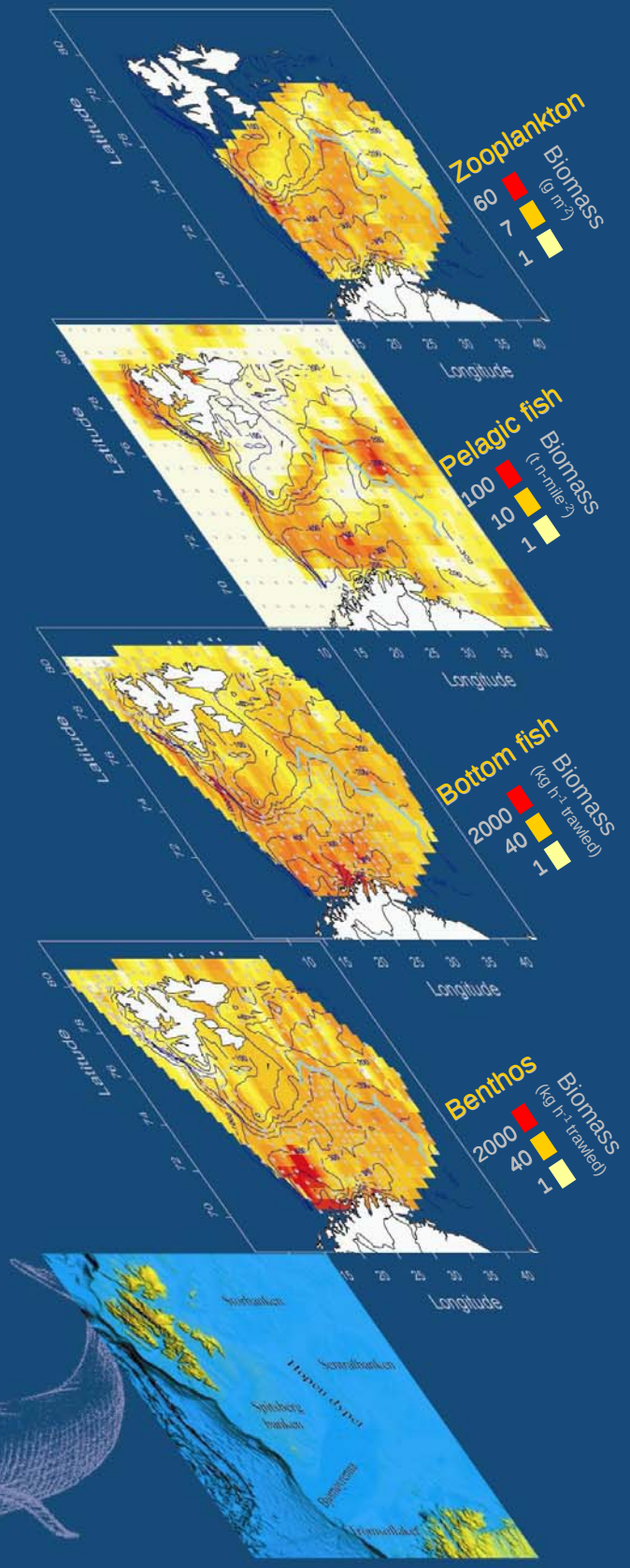
Figure legend

From top to bottom: Biomass charts of zooplankton, pelagic fish, bottom dwelling fish, invertebrate benthos (note differences in scale); bottom topography. Biomass data for the survey area were obtained by linear interpolation of the sampling stations estimates (log-transformed). The light blue, thick line inside each biomass chart depicts the 3°C isotherm indicating the northern distribution of Atlantic water. The thin blue lines display the bathymetric isoclines (blue labels indicate depth in meters). The gray dots show the position of the sampling stations. Contours of Svalbard and Northern Scandinavia are shown for reference.

References

Hassel et al (1991) Impact of grazing from capelin (*Mallotus villosus*) on zooplankton: a case study in the northern Barents Sea in August 1985. Polar Research 10:371-388

Wassmann et al (2006) Food webs and carbon flux in the Barents Sea. Progress in Oceanography 71:232-287



Results and Discussion

Pelagic habitat - High **zooplankton** biomass values were recorded in the western Barents Sea, in Bjørnøyrenna and Hopendypet (the areas are shown in the bathymetric map) northwest of the Central Bank. These areas are characterized by North Atlantic water masses, where the copepod *Calanus finmarchicus* and krill are key zooplankton components. Elevated biomass values, dominated by the crustaceans *Calanus glacialis* and *Themisto libellula*, were recorded in the northernmost samples of arctic water masses.
High **pelagic fish** biomass was recorded in Atlantic waters, in the southern and western parts of the area. Blue whiting (*Micromesistius poutassou*) and herring (*Clupea harengus*) dominated in the trawls. Capelin (*Mallotus villosus*) had its main distribution in the Sentral – Hopen – Storbank area. Still further north and east, the polar cod (*Boreogadus saida*) dominated the pelagic fish.

The high abundance of the planktivorous fish capelin, registered in the colder waters of the Central bank region, was associated with low zooplankton biomass. Also, the high zooplankton biomass observed in Bjørnøyrenna southeast of Hopen was associated with low abundance of planktivorous fish species such as Blue whiting (*Micromesistius poutassou*) and Herring (*Clupea harengus*), which are otherwise abundant in Atlantic waters. These negative associations between abundance of planktivorous fish and their prey are suggestive of patterns generated by consumption (Hassel et al 1991).

Benthic habitat - **Bottom fish** displayed high biomass values in Atlantic waters, to the south and west of the sampling area, where Boreal species like Cod (*Gadus morhua*) and Haddock (*Melanogrammus aeglefinus*) dominated. Long rough dab (*Hippoglossoides platessoides*) were recorded in high biomasses at Stor- and Sentralbanken and as far as 81° N.
High **benthos** biomass values, dominated by sponges, were recorded in the Atlantic water in the southwest. Echinoderms (sea stars, brittle stars, sea cucumbers),crustaceans (crabs and prawns) and molluscs (snails and mussels) were abundant on the Spitsbergbank. Crustaceans and sponges dominated in the north.

Comparing the distribution of benthos with that of benthivorous fish suggests that the high biomasses of sponges in south-western Barents Sea could function as a nursery and feeding ground. The low biomass of benthos associated with high fish biomass north and east of North Cape might indicate high demersal fishing pressure on benthos (Wassmann et al 2006) and feeding grounds. Elevated biomass of both fish and benthos along the 3°C isotherm might indicate productive areas as a consequence of water mixing.

Conclusions

- **Pelagic biomass data confirm the relevance of different water masses in structuring the large scale distribution of zooplankton and fish**
- **On a smaller spatial scale, negative associations between planktivorous fish and zooplankton abundance suggest a role of predation in shaping pelagic communities**
- **Areas of high water mixing may favour high abundance of benthos and bottom dwelling fish via enhanced productivity**
- **Positive associations between high biomass of sponges, edible invertebrate benthos and benthivorous fish, indicate the presence of nursery and feeding grounds in the south-western Barents Sea**
- **Large scale, near synoptic sampling of Barents Sea oceanographic and biological data provides the empirical basis for an ecosystem approach to management and conservation**

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