Theme Session F – Zooplankton community structure and biomass in the mesopelagic and deeper layers

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Important ecological questions concern biodiversity, structure and function of the communities of organisms inhabiting the deep ocean. Influence of seasonally and spatially changing abiotic parameters, fluxes of organic matter and communities of vertically migrating zooplankton on the midwater and deep ecosystems composition and productivity is high. Export of organic aggregates and zooplankton distribution may be tightly coupled on both temporal and spatial scales. As consequence, the generation of spatial heterogeneity of zooplankton may influence the geochemical processes and trophic relations as well. During the session, studies on biodiversity and structure of midwater and deep zooplankton communities in relation with the physical structures and with the benthic meiofauna were presented. New sampling and observational methods were demonstrated and involvement of private companies discussed.

Adapted observational and sampling methods are the condition for successful exploration of the deep ocean. Results were presented using a wide variety of sampling gears, optical devices, acoustical methods and ROVs. Zooplankton biodiversity was accurately assessed in the mesopelagic and bathypelagic zones of the Sargasso Sea (Northwest Atlantic Ocean), using integrated morphological and molecular analysis of large-volume sampling to depths of 5000 m. Following specimens' recognition by expert taxonomists, at-sea DNA sequencing was carried out to determine a barcode (i.e., short DNA sequence for species recognition and discovery) for each species. These tools will revolution the zooplankton taxonomy.

Both krill (euphausacea) and copepods are of great ecological importance in the ocean. They stand for a large part of the secondary production in the sea and are the main food for several fish and cetacean species. Their reproduction and diurnal migration were investigated using respectively MIK nets, Multi Plankton Sampler from HydroBios and moored ADCP and BIONESS multinet net system, in the North Atlantic and Mediterranean regions.

Abundance of krill peaks in early summer and late autumn. The main time of spawning is estimated to be in late March/early April. The acoustic backscatter shows a clear diel pattern. The vertical migration of krill was also observed in the Mediterranean. Inversely, the Mediterranean gonostomatiid midwater fish *Cyclothone braueri* did not displayed diel vertical migration. Its stomach content composed of copepod remains suggest that its feeding strategy is based on the encounter with vertically migrating prey. In contrary to the Mediterranean, in the Iceland Basin *Calanus. finmarchicus* copepod overwinters in deep waters and rises to the surface mainly during March and April to spawn.

Vertical distribution and population structure of zooplankton species on the northern Mid-Atlantic Ridge (MAR) showed that the Subpolar Front acts as a boundary for several taxa. Several species were observed to change their vertical distributions along the transect, becoming deeper on the southern stations. The shift in vertical distribution occurred generally south of 51ºN, related to the border between SACW and NACW. This emphasizes the importance of deep tows when describing geographical distributions of cold-water species.

The vertical distribution of macrozooplankton along the MAR was investigated using the Underwater Video Profiler (UVP) optical set-up. Below 200 m the spatial distribution of macrozooplankton community suggests that the Subpolar Front restricts their mixing with adjacent communities down to 1000 m depth. The observed relationship between larvaceans and the evolution of size spectrum of particles with depth points on their aggregating activity, resulting in a shift towards larger sizes classes and higher vertical export of organic matter.

An increase in the abundance and biomass of zooplankton in the near-bottom may be explained by the fact that this layer is often richer in organic material than the water column above. The shallowing of the sea bottom will also affect the vertical distributions of deep water species, and may increase the interaction of meso- and bathypelagic species with the benthopelagic environment.

The hyperbenthic community in the deep Mediterranean was sampled using swimmers in near-bottom sediment traps at a depth of 2347 m. Fluxes of the most abundant organisms (copepods) showed strong temporal variation.

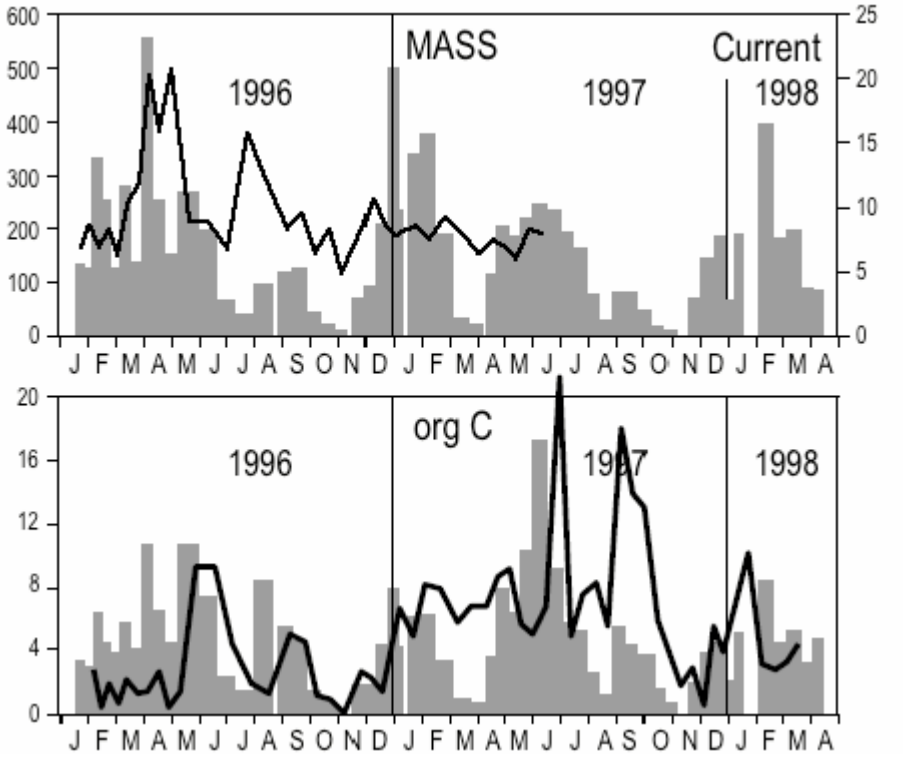

Figure 1. Above: total mass flux in the sediment traps (mg/m^2/d) and current speed (solid line – in cm/s), below: organic C flux (mg/m^2/d) and hyperbenthic copepod flux (solid line–numbers/m^2/d)

Strong near-bottom current in spring and summer 1996 highly disturbed the system, showing very low hyperbenthic copepod concentrations in the traps. In the deep sea, as in coastal waters, benthic organisms with poor swimming abilities (e.g., nematodes) may be passively resuspended when bottom flow increases, while others with good swimming abilities (e.g., cyclopoid copepods) may seek for refuge in harsh conditions, but in optimal conditions actively emerge from the sediment into the water column enriching the benthopelagic environment.

Benthic and pelagic systems are linked through plenty of biological, physical, and geological processes that operate over multiple spatial (centimeters to thousands of kilometers) and temporal (minutes to decades) scales. Our understanding of these events, and therefore our predictive capacity, is limited because conventional ship-based sampling programs are not well adapted for capturing much of the variability inherent in benthic-pelagic coupling. This could be rectified by data collection at very high sampling rates over needed periods. Nearly continuous data would provide a strong statistical basis for understanding events, from tidal forcing to decadal oscillations.

One example can be the SERPENT Project. It is an international program designed to facilitate scientific access to industrial ROVs for routinely collecting data on gelatinous and other planktonic organisms from the surface to the upper bathypelagic zone.

One the future oceanographic key issues will be the response of the deep ecosystems to the increasing environmental pressure. In this session we aimed at the introduction of questions related to the integration of ecosystem and biogeochemical processes in the aphotic ocean (mesopelagic and deep layers). It was shown that transformation of organic matter through zooplankton activities is continuous from the surface to the sediment, but also that the community structures, their dynamics and functioning are largely unknown. The wide range of subjects and technologies presented during the session should focus the attention of the ICES scientific community on the importance of the research on the topics related to the response of deep ecosystems to the global change.