Weekly report no. 3 GLOBEC II (ANT XXI/4) RV „Polarstern“ 15 April 2004

On our way south into the Lazarev Sea we assembled and tested our sampling equipment to be ready for the intensive krill survey to come. Early in the morning of the 7th April we approached the first of 77 stations lying a distance of 20 nautical miles apart on 4 transects perpendicular to the Antarctic shelf ice coast. The routine deployment of gear started. Most often used are the RMT (rectangular midwater trawl), the CTD and the vertical deployed Bongo plankton net. With about 2 hours station work and 2 hours steaming between stations, scientists and crew are kept busy around the clock for the next 21 days. At selected stations, an additional plankton Multiunit and the SUIT (surface under ice trawl) are used to catch other plankton and fish species living in special habitats. Before explaining more details let us consider some background information on which our research is based.

Our target species for this expedition is Antarctic krill (Euphausia superba). The term "Krill” originated from the Norwegian language and means "what the whale eats". That can be a large variety of organisms including zooplankton, euphausiids and other swimming crustaceans. Six euphausiid species live in Antarctic waters whereby 5 of these species are found in the Lazarev Sea. We use the term krill explicit for the largest euphausiid (E. superba) that also dominates in biomass and abundance.

Several geographical locations of high krill abundance are known around Antarctica since the early observations of Marr around 1930. The last 35 years of international research has concentrated on these rather restricted regional areas located north of the Antarctic Peninsula (Scotia Sea), around South Georgia, Elephant Island, and South Shetland Islands and in the Bellingshausen Sea. Krill is commercially harvested in these areas since 30 years ago especially with fleets originating from Ukraine (former USSR), Japan and during the last years with increasing effort also from Korea, Poland and the USA. Total catch in 2002 was around 120 000 tonnes, well below the limit of 4 Mill. tonnes set by CCAMLR. Krill is used for human consumption, as food in aquaculture, for aquarium fishes and as bait in sports fishing. In future we expect krill to be used for high quality products as chitin-chitosane, pharmaceutical oils, special fat products (omega-3-fatty acids), the red coloured astaxanthin and other chemical, pharmaceutical, medical and cosmetical products. Krill catches were much higher than today when between 1978 and 1993 the Soviet fleet alone caught 300 to 400 thousand tonnes of krill annually.

Other areas of dense krill occurrence are located in the Pacific sector of the Southern Ocean north of the Ross Sea and north of Prydz Bay in the Indian sector. We assume that species drift between the populations of these areas and that krill is distributed circumpolar. As this has to be proven, we store samples for molecular genetic tests in the minus 80°C freezers on board ship.

Krill has a central role in pelagic Antarctic ecosystems as it serves as food organism for many vertebrates including whales, seals, penguins, flying birds and fish. Also the food spectrum of krill is highly diverse reaching from minute plankton organisms to the biota living under and in the sea ice. Krill can live for 7 years and reach 50 to a maximum of 63 mm in body length, whereby they only grow during the few summer months rich in food. As krill matures in their 3rd year, they can reproduce for up to 4 years allowing the stock to sustain several unfavourable years. Investigations from the Antarctic Peninsula indicate years of high sea ice concentration also being years of high krill production and vice versa. We deploy the 8 m2 big RMT from the ships stern and fish for about 40 minutes with a ships speed of 2 knots oblique down to 200m. After retrieval, the catch is preserved, examined under the stereomicroscope; specimens are identified to species and developmental stage, sex and stage of maturity and counted. From the database obtained, population dynamic parameters will be derived including age structure of the population, hatching success and the regional distribution of krill. With additional data in the forthcoming years we will be able to predict krill production for our investigation area.

Previous expeditions using remotely operated under ice vehicles have obtained video information of krill living in between rafted ice floes. This hiding ground against predators also provides plenty of nutritious ice algae - a rich feeding habitat. In the transition zone between open water and permanently ice-covered areas, the marginal sea ice zone MIZ, our bird and whale watchers have encountered numerous vertebrates feeding on krill. These findings and the deployment of the SUIT will be topic of the next weekly report.

The facts that krill encounters slow growth and developmental rates and that the species is long living, are evolutionary adaptations to the Antarctic environment where not each year provides the suitable conditions for sufficient growth and survival of the larvae. A population of long living invertebrates capable to reproduce in several subsequent years will not be affected by unfavourable conditions so much if at least every fourth year or so turns out to be a good krill year with heavy ice and large plankton biomass production.

Unlike adult krill that can starve for several weeks, if not months, krill larvae have to find food rather continuously. This time period in which krill larvae can sustain without any food is determined on board Polarstern in temperature controlled laboratory containers. For the experiments the larvae have to be caught as gentle as possible by means of the vertically towed Bongo net. Two 4m long nets made of 0.2mm gauze are attached to a frame similar to the music instrument. The catch is sorted under a stereo microscope and krill larvae are grouped in lumps of several hundred according to their developmental stage, to determine their respiration rates, their growth and their enzymatic activities as metabolic indicators. We also need to learn more about the consumption of krill larvae in autumn

and winter to determine the mechanisms how they can survive into the next spring.

On Good Friday Polarstern approached the MIZ. In bright sunshine we first passed single ice flows that later consolidated to larger fields. As these 1 m2 round flows constantly touch each other and scrape their edges round, they look like and are named pancake ice. Still travelling at 10 knots speed Polarstern smoothly passed the growing ice fields hosting many spectators on the bridge. Many photos were taken that day, either with normal or digital cameras of the wonderful white world and its habitants the Weddell seals and sea leopards. In the night to Easter Sunday we reached the 40m high shelf ice edge by passing the residence area of several tens of icebergs stranded on the 400m shallow shelf. Early morning on Easter Monday we again headed north with beautiful sunrise illuminating the white cliff in red and pink colours. This exceptional Easter present and an international selection of deliciously prepared, well decorated and served meals accounted for the ongoing work during Easter and will remain in our memories as the culinary highlight of this cruise.

Now we got back to the routine of krill fishing, which will keep us busy for the next two weeks.

Best wishes to all of you
Uli Bathmann