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**Results of a survey on krill, environment and predators in CCAMLR division 88.1 in the Austral summer 2003-2004**

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The Ross Sea is unique in Antarctica in that two similar and competing species of krill (*Euphausia superba* and *Euphausia chryssalorophias*) dominate the biomass and play a central role in this pelagic ecosystem. The coexistence of similar species in the same area requires their dynamics and/or foraging strategies to be different (Levin, 1974; Gopalsamy, 1977; Sala et al., 2002).

Krill data for this region are already available from six large scale hydroacoustic surveys carried out from 1989 to 2000. The aim of our surveys was to gain a deeper understanding into the mechanisms that allow the coexistence of the two krill species in the Ross Sea, and the relationship of each species with predators and the environment.

The survey results are not only of importance in understanding the ecology of the region, but also for the future management of krill fisheries in the Ross Sea. Both species are devoured by carnivores, but *E. superba* is preferred by whales and is used for human food. *E. superba* fisheries are presently underexploited but could increase in the future and thus altering the mechanisms that allow the coexistence of the two species.

The aims of the last survey carried out in the Austral summer 2003-2004 were:

- To study in depth the abundance, spatial distribution and ecology of the two krill populations living in the Ross Sea.

- To study the demography, genetic structure and biochemical composition of the two krill populations of the Ross Sea and the possible genetic differences between the populations of *E. superba* that live in the Ross Sea and the adjacent area of the Pacific Ocean.
- To use krill as a model organism to investigate the interactions between the physical and biological environment.

The acoustic survey on krill lasted 33 days (from 28/12/2003 to 31/01/2004) and the census on the krill predators 25 days (from 28/12/2003 to 23/01/2004). Both the acoustic and the visual surveys were taken 24 hours a day. *E. superba* and *E. chryssalorophias* were acoustically recognised, examined (average length) and discriminated from other zooplankton using the three frequency method (Azzali et al., 2000).

The census of krill predators was achieved with both a traditional and a digital-binoculars, which can photograph the observed animals and file the photographs, with the time and geographical position, in the acoustic database. This allowed a more accurate recognition of the animals and facilitated the studying of the interaction between krill and its predators.

A new plankton net, called HPRI-1000, designed in Italy at the CNR-ISMAR of Ancona was used for the surveys. The net performance was excellent. In particular, the *E. superba* catch,

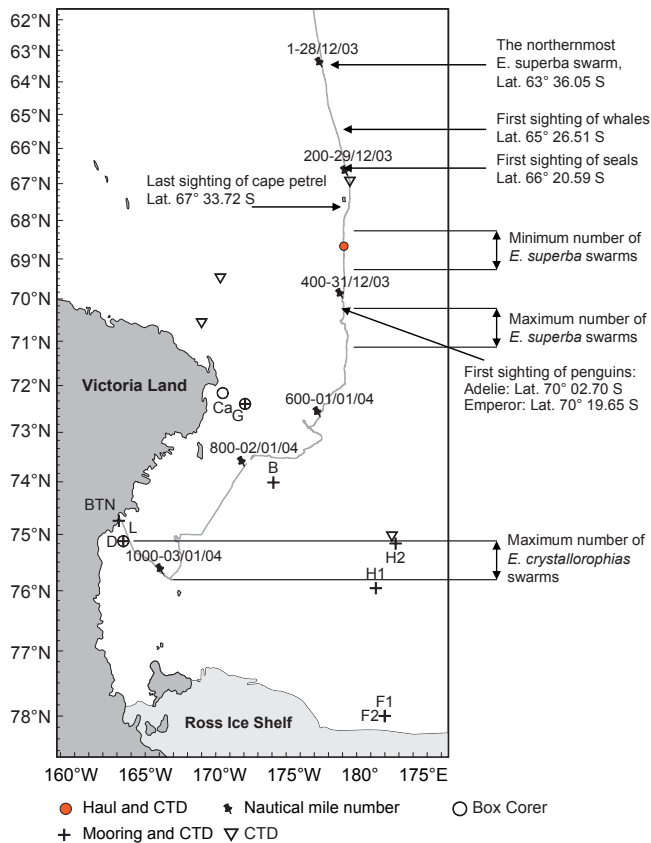


Figure 1. Transects of the acoustic sampling in the first phase of the research (28/12/2003 – 04/01/2004).

was higher than for previous expeditions. The water masses were sampled with a CTD and XBT when weather conditions allowed. Krill predators were also sampled at the same time, therefore we can say that four synoptic surveys were made.

The survey was divided into four phases, firstly focusing on the passage from the Pacific to the Ross Sea (Fig. 1), the second phase was where the maximum density of the two krill species were found, the third phase focused on completing the description of krill distribution in the Ross Sea and the final phase focused on a detailed survey of krill distribution in a small rectangular area. In total 5394 nautical miles were covered of which 530 were in the Pacific Ocean (Fig. 2).

The preliminary results of this survey, together with historical surveys in the Ross Sea, seem to indicate that the two krill species move with different spatial and temporal scales and tend to occupy different places. The northern end of the Ross Sea seems particularly suitable for the *E. superba* population, the southern end for *E. crystallorophias* population, while in the central area of the Ross Sea there is a combination of the two species.

The central core of the *E. superba* population moves significantly over the years (hundreds of nautical miles, from 75°50'S (1994) to 70°30'S (2004)) whilst the central core of the *E. crystallorophias* population seems more stable (74-77°N). The central core of the *E. superba* population has always been found a few degrees further north than the *E. crystallorophias* core and it seems that the two krill populations tend to segregate their habitats from each other. It was also found that the sightings of whales tend to peak around the nucleus of the *E. superba* population.

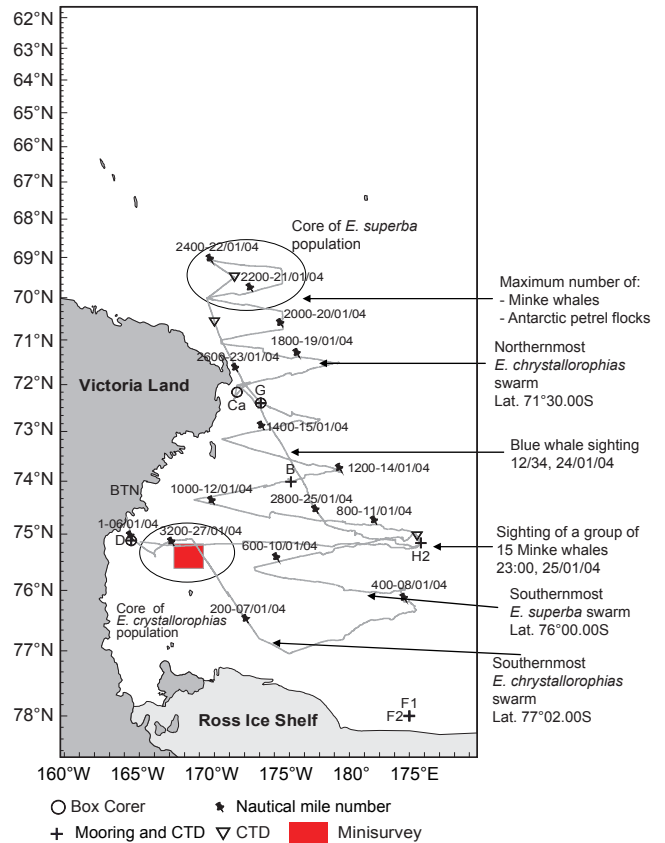


Figure 2. Transects of acoustic monitoring during the second, third and fourth phase of the research (06/01/2004 – 31/01/2004).

Future works will focus on using the data from this survey as well as the historical data to ascertain the physical and biological factors that govern the formation and movements of the patterns of the two krill species and their relationship with different predators. In particular the thermal and salinity data, measured for the first time in this survey, will allow to investigators to study how patterns (both horizontal and vertical) and biological characteristics of *E. superba* and *E. crystallorophias* can be influenced by differences in water masses.

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