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ANTARCTIC SCIENCE IN WINTER

SEEKING CLUES ABOUT LIFE IN THE COLD

Between August 3 and 30, 2015, the fourth US-Antarctic Marine Living Resources (AMLR) Program conducted studies to further develop knowledge of the spatial and temporal variability of the Antarctic krill (*Euphausia superba*) in the northern Antarctic Peninsula and South Shetland Islands. Dr. Javier Arata, who was then a staff member with the Chilean Antarctic Institute (INACH), participated in the campaign under special invitation.



1. Sea ice in the Bransfield Strait. Photo by Javier Arata



❶ 2. Antarctic krill (*Euphausia superba*). Photo by Javier Arata.

Life in Winter

The invitation to participate in the fourth campaign of the US-Antarctic Marine Living Resources (AMLR) program provided an impressive experience. I was able to take part in a high-level scientific cruise that involved the rigorous working conditions we associate with the austral winter, in order to understand how the Antarctic krill are getting on during the challenging winter months.

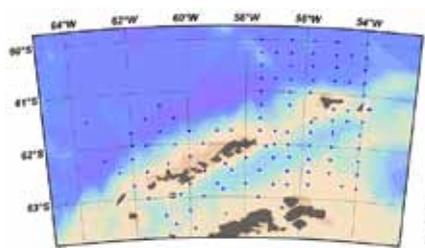
It's true that many studies of these krill have been done during the summer season, but one of the critical periods of their survival takes place in winter, when research work is very difficult, and as a result there is a general shortfall in information about krill behavior during that season. In the winter, there is little to no daylight and so there is almost no growth in the algae that provide nourishment for the krill. At the same time, the seas are covered in ice. This effectively provides a new platform, below which layers of micro-algae form, and these serve as a sort of collateral food source for krill and other creatures during winter.

Contrary to what might be expected, there is a great deal of activity in Antarctica even in winter. During our cruise we spotted Antarctic fur seals (*Arctocephalus gazella*), crabeater seals (*Lobodon carcinophagus*), leopard seals (*Hydrurga leptonyx*), elephant seals (*Mirounga leonina*) and even Minke whales (*Balaenoptera bonaerensis*), in addition to groups of Adélie and Gentoo penguins.

This expedition was organized by the US-AMLR Program and the National Oceanic and Atmospheric Administration (NOAA) and conducted by the US oceanic research icebreaker, the *Nathaniel B. Palmer*. On the cruise there were participating researchers from NOAA and several US universities, along with two colleagues from the Peruvian Oceanic Institute (Instituto del Mar del Perú -IMARPE). Another Chilean researcher, Paola Reinoso, from the Universidad Católica de Valparaíso, also took part and was in charge of sampling of seawater nutrients.

The work on this cruise was focused on determining the abundance of krill in this region. For that purpose, samples were taken at pre-established stations every 15–20 nautical miles (27 to 36 km). At each station seawater samples were taken at various depths using a device called a Niskin bottle rosette. This is done to characterize the amount of food present (microalgae, nutrients). Zooplankton (small animals that live suspended in a water column) samples were taken using a net, at depths between the surface and 170 meters. Among the stations, soundings were taken using hydroacoustic (or "sonar") data which allow characterizing of the abundance and vertical (depth) distribution of fish and krill.

Once aboard, the zooplankton samples were classified according to species and abundance (the number of individuals of each species) by counting under a magnifying glass or microscope.



❶ 3. Work grid used on the fourth campaign of the US Antarctic Marine Living Resources program (blue dots).

Since the ship does not make rest stops, work is carried out in shifts of 12 hours each, some by day and some by night. In my own case, I worked primarily with the group that did the quantification of the presence of the various species of zooplankton.

Did you know that there are more than six species of krill in Antarctica? Well, the Antarctic krill is the largest and best known of all and it can reach 60 mm and weigh nearly 2 grams.

The other species are smaller (10–30 mm) but are interesting all the same. There is a marked difference in their distribution. Basically, when there is a lot of Antarctic krill, other species are almost absent. The smallest species tend to be more abundant in the open ocean, north of the South Shetland Islands. Besides krill, jellyfish and salps (mostly transparent, gelatinous chordates) are also found, along with gastropods with and without shells, amphipods, and copepods, which are another type of crustacean often found in the oceans.

We also captured several types of myctophids (lantern fish) due to the presence of photophores along the length of the body which shine in the darkness.

Doing Scientific Work at Minus Thirty

The part that I most enjoyed was helping to prepare and place the net into the water. We had days at -15°C , which felt like -30°C due to the wind-chill factor, thanks to a 30-knot breeze. We had to bundle ourselves completely, wear a helmet and gloves, and pull the fleece right up to our eyes in order to prepare the frame for the IKMT (Isaacs-Kidd Midwater Trawl) net, which would weigh about 60 kg, stretch the net which was about 8 meters long and always half frozen, and then maneuver it down from the stern into the water about 2 meters below.

❶ 4. Crabeater seal emerging from the sea ice. Photo by Alexa Kownacki.



❶ 5. Deck team deploying the IKMT net.
Photo by Alexa Kownacki.



The winch operator's work was crucial since he has to carefully lift and shift the net to the stern at the same time, but slowly. All this is while the ship is making way through the sea ice, opening a channel where we could deploy the net. After lowering and then raising the net, there was always some anxiousness in opening the capture container, which is a cylinder at the end of the net where everything that was caught would accumulate, to see which and how many species we had collected.

Besides identifying and counting zooplankton species, which was done during the night shift, I worked with the group that did sightings of birds and marine mammals, between dawn and noon.

Significance for Chile

Currently, Chile is attempting to position itself as a regional contender in Antarctic research. To that end it is modernizing its infrastructure on the White Continent. It is hoped within a few years that it will have a new icebreaker, this time with oceanographic capability which would allow

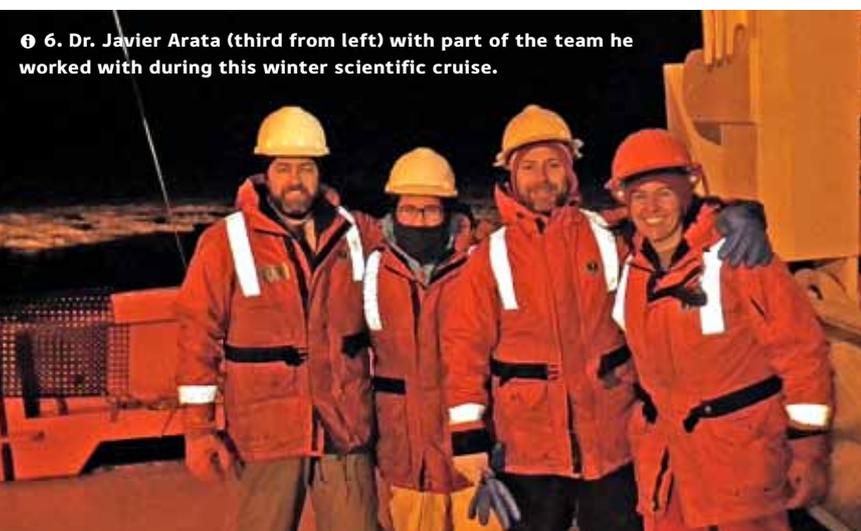
On the other hand, inasmuch as Antarctic krill is a key species in the Antarctic ecosystem, it's apparent that there is a lack of national research in this area. Thus one of my objectives on this cruise was to get to know the current methods for evaluating the state of the krill population, which is essential for the satisfactory management of this resource.

With this experience I hope to continue supporting the National Antarctic Science

Our participation on this cruise was also a showpiece of cooperation between Chile and the United States in the area of Antarctic krill studies, with our sights on improving the current management of this resource under the auspices of the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR). Both nations share similar interests and work in the South Shetland Islands.

The experience of sailing in the seas covered with ice has changed forever my vision of the ocean. This is another universe. There are no waves and rather than sailing, the ship crawls through the ice. You hear the soft groaning of the ice as it crumbles beneath the weight of the ship. The sea-ice is a large white beach where seals, sea lions, and penguins can climb out of the water and rest. And all this ice is variable, taking various forms: uncompacted or dense, a smooth surface or a rough pancake surface, thick or thin, with or without lakes. And every ice form attracts its own separate fauna.

The problem with the changing climate is that the thicker and more compact ice, that shelters the majority of the fauna, is diminishing. The thin ice which is not as compacted does not form as thick a layer of microalgae as does the denser ice and this results in a lower abundance of krill. Also, animals such as seals and sea lions prefer a solid ice platform for resting after feeding.



❶ 6. Dr. Javier Arata (third from left) with part of the team he worked with during this winter scientific cruise.

world-class marine research, further out than the coastal strip to which we are restricted today. However, we have very little experience working in the Southern Ocean and under harsh Antarctic conditions. This experience allowed me to become familiar with work conditions, the details of the daily routines, and to see what worked and what didn't.

Program, now with better understanding about work practices on the high seas. Likewise I expect to assist in the design of the new icebreaker with its new scientific capabilities for Chile, now projected for the year 2020.