

**Seasonal Changes in the Mesoscale
Distribution of Antarctic Krill (*Euphausia
superba*) in waters West of the Antarctic
Peninsula**

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Objectives

- MAP: Space-Time Distribution of Krill using BioAcoustics
- INTERPRET: Krill Patterns relative to other Habitat Characteristics
 - Concentration and Composition of Food Resources
 - Ice History
 - Large-scale Flow Regimes
 - Hydrographic and Optical Properties of Upper Ocean

Acoustics Field Collection

- Single Frequency, 120 kHz
- Replicate (n=2,3), short (1-3 km) acoustic tows centered on station
- Coincident with oblique zooplankton net tow.

Generate 2-D matrix of krill biomass (g/m³)

- Binned Vertically into 2-m strata from 6 to 185 m depth
- Binned Horizontally into 3-ping records (2-8 meters)

Compute vertically-integrated mean biomass (g/m²) for

- Each acoustic event
- Each station (pool replicates)
- Each cruise (pool all events)

Seasonal Characterization

- Mean biomass by season
 - Spring - 38 g/m²
 - Summer - 65 g/m²
 - Fall - 5 g/m²
 - Winter - 2 g/m²
- Percent Positive Events
 - Spring - 90%
 - Summer - 90%
 - Fall - 40%
 - Winter - 15%
- Swarms per kilometer
 - Spring - 5
 - Summer - 10
 - Fall - 1
 - Winter - 1

Spring: November 1991 (n=15 stations)

- Range of biomass = 0-95 g/m²
- 4 Stations with Biomass > 50 g/m²
 - Inside or Near Dallman Bay, coincident with high concentrations of fucoxanthin
 - Offshore over Circumpolar Deep Water (> 1.5 C)
 - Adjacent to Ice Edge

Summer: Jan-Feb 1993 (n=39 stations)

- Range of biomass = 0-460 g/m²
- 9 Stations with Biomass > 100 g/m²
- Mesoscale hydrography characterized by two major regions
 - Coastal regime - stratified surface waters influenced by meltwater inputs (seasonal water mass)
 - Oceanic regime - isohaline upper ocean overlying Circumpolar Deep Water
- Strong relationships between hydrographic structure and
 - Highest concentrations of krill.
 - Length frequency and maturity stage of krill.
 - Relative abundance of salps and pteropods.

Fall: Apr-May 1993 (n=100 stations)

- Range of biomass = 0-44 g/m²
- 4 Stations with Biomass > 30 g/m²
- Dramatic reduction in krill biomass from summer (3mos)
- High biomass stations isolated from each other
- Coastal regime with stratified surface waters extends further offshore overlying Circumpolar Deep Water for most of survey grid

Winter: Aug-Sep 1993 (n=33 stations)

- Range of biomass = 0-80 g/m²
- 1 Stations with Biomass > 10 g/m²
- Annual sea-ice covered almost entire survey grid.
- Krill absent from open water below sea ice at 80% of stations. Divers observed krill associated with ice.
- Large swarms observed at inshore station on two separate days.

Summary

- Acoustically-detectable krill biomass varied greatly between seasons, with high concentrations during spring and summer followed by low concentrations during fall and winter
- During the summer, strong relationships were observed between the mesoscale hydrographic structure and several biological distributions.
- The spatially averaged krill biomass decreased by an order of magnitude over a 2-month period between summer and fall 1993, despite presence of stratified surface waters in which krill were so abundant during the summer.