Distribution and abundance of zooplankton on the northern Gulf of Alaska shelf relative to water masses

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Introduction: Zooplankton abundance and distribution on the northern Gulf of Alaska shelf are tightly linked to physical processes influencing production and extraction of water masses on and off the shelf. A primary goal of the LTOP project was to document the cross shelf distribution and abundance of major zooplankton taxa relative to water mass movements and to elucidate processes leading to interannual differences in abundance. This paper illustrates cross shelf distribution of major zooplankton species relative to their depth distribution and water mass movements. Contrary to expectation, the abundance of Neocalanus flemingeri, an oceanic species, is negatively correlated to salinity. The abundance-salinity correlation and interannual differences in Neocalanus abundance are related to physical processes, potentially linking production.

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Methods

1. Large zooplankton were collected with 1-mm meshes and 500 µm mesh. Samples collected in 30 m depth increments from the surface to 100 m into the surface at right.
2. Neocalanus abundance is from 18 stations (12 PWS box, 6 Inner Shelf) sampled with a 50 cm diameter CTD equipped with a 150 µm mesh. Vertical and horizontal distributions were collected during the day.
3. Water column profiles were collected with a fluorometer.
4. Samples were collected during years and the months listed below:
   - 1998: X X X X X X
   - 2000: X X X X X X
   - 2001: X X X X X X
   - 2002: X X X X X X
   - 2003: X X X X X X
   - 2004: X X X X X X

Collection Sites:
1. 13 Stations along Seward Line (12 stations)
2. 5 Stations in Prince William Sound (PWS box) (Inner Shelf)
3. 0 Stations at Highshelf Entrance (31 RE)

Animals which avoid the upper mixed layer, even at night, occur primarily in the fjord. Animals which avoid the upper mixed layer, even at night, occur primarily in the fjord. Animals which avoid the upper mixed layer, even at night, occur primarily in the fjord. Animals which avoid the upper mixed layer, even at night, occur primarily in the fjord.

Cross Shelf Distribution of Major Zooplankton Species Relative to Depth Distribution (bar graph insets)

Summary of observations

1. Copepod abundance is strongly and negatively correlated to salinity.
2. Copepod abundance shows little or no correlation to water column stability.
3. Copepod abundance shows little or no correlation to upper mixed temperature.
4. When copepod abundance is low, intrusion of oceanic water occurs on the shelf. When copepod abundance is high, the mixing zone is spread across the shelf from the coastal current to the shelf break. When copepod abundance is high, the mixing zone is spread across the shelf from the coastal current to the shelf break.
5. Macronutrient concentrations are positively correlated to potential energy (stability).
6. Iron concentrations in the euphotic zone are very low from ocean station P in the central Gulf of Alaska gyre northward to the shelf break off Seward Alaska. Iron concentrations in the euphotic zone are very low from ocean station P in the central Gulf of Alaska gyre northward to the shelf break off Seward Alaska. Iron concentrations in the euphotic zone are very low from ocean station P in the central Gulf of Alaska gyre northward to the shelf break off Seward Alaska.

Hypothesis: The most likely explanation for the observations is that horizontal mixing between high-nutrient, low-iron oceanic water and high-iron, low-nutrient ACC water promotes elevated primary production in the mixing zone, leading to elevated production of zooplankton.