BEST-BSIERP
Bering Sea PROJECT
UNDERSTANDING ECOSYSTEM PROCESSES IN THE BERING SEA 2007–2013

Where You Are Is More Important Than Where You Started

WINDS PROMOTE THE TRANSPORT OF OCEANIC ZOOPLANKTON ONTO THE BERING SEA SHELF, BUT IN SITU PROCESSES MAY CONTROL THEIR SHELF BIOMASS

On-shelf transport of oceanic zooplankton onto the eastern Bering Sea shelf is elevated around submarine canyons traversing the shelf break, and around Cape Navarin in the northern Bering Sea (Figure 1). The extent of on-shelf transport depends primarily on wind direction. Southeasterly winds that blow along the Bering Sea shelf break from January-April result in increased on-shelf transport along the length of the shelf break (Figure 2), but reduced transport at the northern end of the shelf break around Cape Navarin; northwesterly winds have the opposite effect (Figure 3). Southeasterly winds are generally associated with warmer air temperatures, while northwesterly winds are associated with colder air temperatures. Net tow observations of zooplankton abundance on the Bering Sea shelf indicate that *Neocalanus* spp. abundance and biomass actually increase in cold years. The cold years examined did not stand out as having periods of strong SE wind, which promotes on-shelf flow during January-April, a critical time period for transportation of seasonally migrating larvae. This suggests that changes in oceanic

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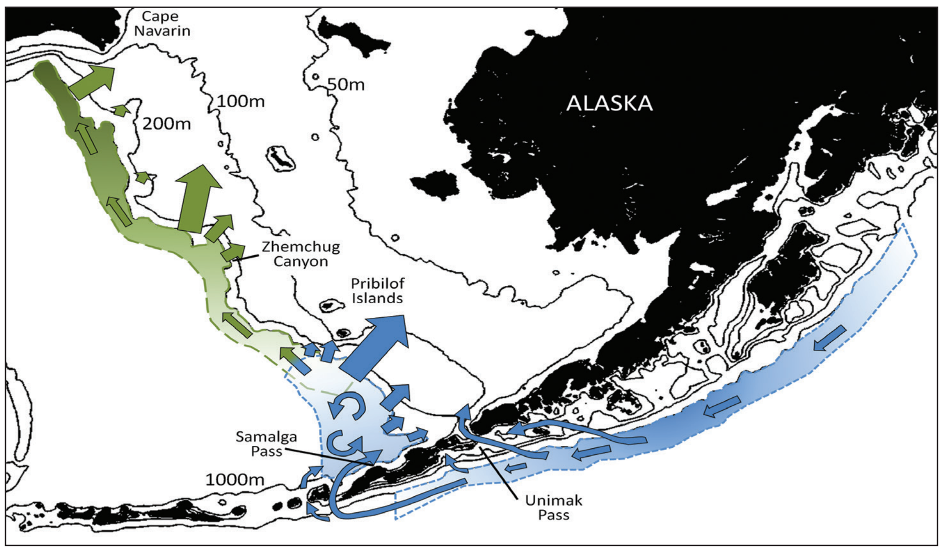
Fig. 1



Conceptual diagram of oceanic zooplankton transport pathways onto the eastern Bering Sea shelf. Shaded regions indicate likely source areas for oceanic zooplankton, which remain relatively constant despite inter-annual variability in wind direction. Shading intensity indicates likelihood that a region supplies zooplankton to the southern (blue) and the northern (green) Bering Sea shelf. Arrow size indicates relative transport volume

The Big Picture

Zooplankton are a major link in the food chain of the Bering Sea shelf. Therefore, the species composition, and the abundance of zooplankton over the shelf can impact the pelagic community at a variety of trophic levels, from fish to birds and marine mammals. The distribution of zooplankton species on the shelf is influenced by processes moving water masses, along with their constituent zooplankton communities, onto and off of the shelf. Our findings suggest that transport of the zooplankton onto the shelf appears to be enhanced in the vicinity of canyons and that wind direction is the primary driver in determining the on-shelf transport of large oceanic zooplankton that inhabit the upper wind-mixed layer for much of their life cycle. However, the success of oceanic zooplankton once on the shelf will depend on conditions encountered, i.e.,. the amount of food they find and the predation they experience. It appears that these in-situ conditions must be at least as important as transport processes in determining the biomass of oceanic zooplankton over the shelf.

DOWNSCALING GLOBAL CLIMATE PROJECTIONS TO THE ECOSYSTEMS OF THE BERING SEA WITH NESTED BIOPHYSICAL MODELS
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zooplankton biomass on the shelf may be more dependent on in-situ processes promoting growth and survival than mechanisms promoting transport. Despite inter-annual differences in the magnitude of on-shelf transport, the relative importance of source areas to supplying zooplankton to the Bering Sea shelf did not vary greatly from year to year (Figure 3). A relatively consistent supply of oceanic copepods to the outer shelf of the southern Bering Sea produces a favorable foraging habitat for higher trophic levels.

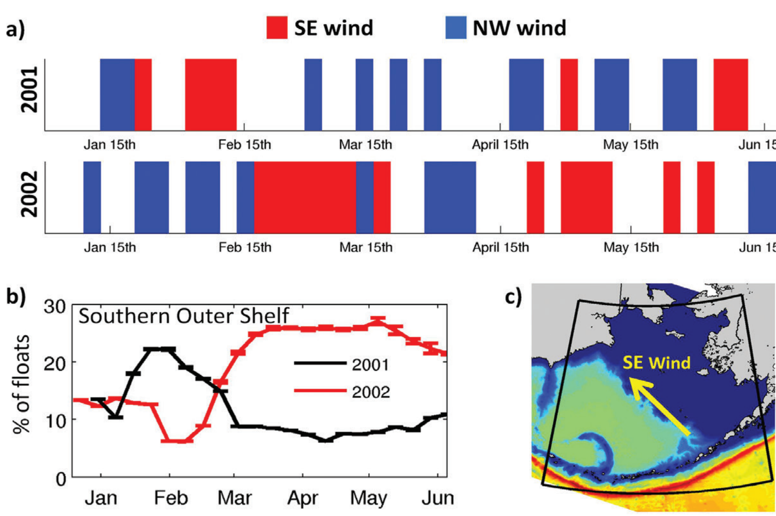
How We Did It

Using a three-dimensional oceanographic model, coupled to a model of 'virtual' floats, designed to have ontogenetic vertical migration behavior similar to the large-bodied oceanic zooplankton *Neocalanus*, we explored the mechanisms, timing and location of the transport of *Neocalanus* onto the eastern Bering Sea shelf from overwintering sources along the Gulf of Alaska and Bering Sea shelf breaks. Float trajectories resulting from alternate climate forcing scenarios were compared to determine which environmental variables and conditions were most influential in controlling cross-shelf transport.

Why We Did It

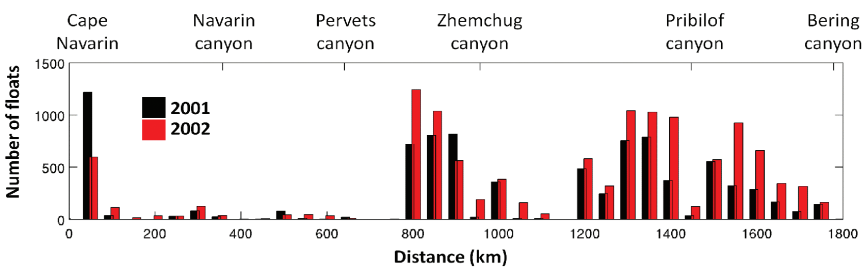
The Eastern Bering Sea shelf is divided into distinct hydrographic domains by structural fronts. Despite frontal obstructions to cross-shelf transport, each year large oceanic copepods—primarily *Neocalanus* spp.—are known to dominate the biomass of the outer-shelf zooplankton communities, and in some years are advected into the middle-shelf domain; the mechanisms promoting on-shelf transport of oceanic zooplankton were poorly understood. The oceanic zooplankton are an important prey source for higher trophic levels such as birds, whales and commercially important fish. Inter-annual variability in environmental conditions promoting shoreward transport of oceanic zooplankton onto the outer Bering Sea shelf have the potential to affect energy transfer and food web relationships throughout the Bering Sea shelf.

Fig. 2



a) Predominant wind direction in 2001 and 2002. Blue indicates NW wind while red indicates SE wind. b) Percentage of all floats released that were on the Bering Sea Southern Outer Shelf from January through June in 2001 (black) and 2002 (red). c) Domain over which the wind direction index shown in (a) was computed.

Fig. 3



Number of virtual zooplankton floats first crossing the 200m isobath at 50 km binned locations along the length of the Bering Sea shelf break, from the northern end of the shelf (Cape Navarin) to the southern end (Bering canyon) for 2001 (black) and 2002 (red). In both years, a total of 21,240 floats were released at 700m depth along the 1000m isobath.

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