II. Reproduction and Recruitment of Keystone Species, and Ecosystem Studies

11. Biophysical Processes Relevant to Recruitment Dynamics of Walleye Pollock (*Theragra chalcogramma*) in the Eastern Bering Sea

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Abstract

Walleye pollock is a nodal species in the Bering Sea ecosystem: juvenile pollock are the dominant prey of fishes, seabird, and marine mammals in this productive ecosystem. The estimated adult pollock biomass in the eastern Bering Sea and central basin exceeds 9 MMT, and is the target of an ca. $1 B fishery.

To develop an understanding of stock structure and recruitment variation in Bering Sea pollock, the Coastal Ocean Program (National Oceanic and Atmospheric Administration, NOAA) funded an interdisciplinary 5-year (1992-1996) study for which NOAA and academic researchers were selected through a competitive process. The program goals, based on recommendations from an international symposium on pollock, were to determine stock structure in the Bering Sea and its potential relationship to physical oceanography, and to examine recruitment processes in the eastern Bering Sea. Both of these have direct implication to management. Field and modeling studies investigated circulation throughout the Oceanic Regime. Other components sought to establish if genetic "finger-prints" existed for the different stocks. A later component contrasted survival of juvenile animals in the well mixed Inner Shelf Domain to those in the two-layer Middle Shelf Domain around the Pribilof Islands. The recruitment component of the program focused on understanding causes of variable mortality of pollock larvae in the several habitats of the southeastern Bering Sea. The major emphasis of the recruitment studies was to determine: the dominant physical oceanographic features (stratification, temperature and transport) which could influence survival of pollock larvae, factors controlling food production for the larvae and factors that determine favorable juvenile habitat. Both field studies and modeling approaches were applied to the problem. Field studies included conducting 20 cruises to the area, deploying four long term biophysical moorings (some of which supported meteorological sensors), using over 40 satellite tracked drifters, and conducting overflights with a P3 airplane equipped with meteorological and ocean surface sensors.

We found that pollock spawning occurs in discrete concentrations during winter and spring in a variety of habitats which include oceanic (basin and slope) and shelf waters.

Biophysical phenomena that affect conditions for larval survival and eventual recruitment exhibit marked differences between the Oceanic and Shelf Regimes. In the Oceanic Regime eddies are a common feature. While their genesis is not well known, eddies have unique biophysical characteristics and occur with such regularity that they likely affect larval survival. High concentrations of larval pollock often are associated with eddies. Some of these eddies are transported onto the shelf thereby providing larvae to the Outer Shelf Domain. Observations from biophysical instrument platforms moored over the basin demonstrated that advection rather than local production dominated the observed springtime increase in chlorophyll (often a correlate of larval food). Over most of the southeastern shelf eddies are absent and other phenomena are important. Seasonal sea-ice and the associated cold pool of bottom layer water are striking features of the Middle Shelf Domain. Interannual variability in sea-ice and cold-pool extent affects developmental rate of larvae, timing of the phytoplankton bloom (and potentially the match/mismatch of larvae and prey), and abundance and distribution of juvenile pollock.