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

Does Water Temperature Influence Pollock Spawning?

INVESTIGATING "BOOM" AND "BUST" YEARS

Walleye pollock is a vital component of the food web in the Bering Sea, providing food for myriad fish, bird, and marine mammal species, as well as humans. But pollock management is challenged by notoriously variable spawning success and the subsequent survival of young pollock. In fact, the particular sequence of "boom" and "bust" years largely determines the success of the fishery and the ecology of the Bering Sea for many years. Spawning conditions influence a series of events that set year class strength.

We suspected that variability in water temperature contributes to walleye pollock spawning success and changes of spawning distribution, suggesting that climate change could influence when and where pollock spawn. We were most interested in determining whether individual pollock conserve a memory of their previous or parental spawning locations or whether they exhibit flexibility in choosing their spawning sites. If we could understand how water temperature influences pollock spawning

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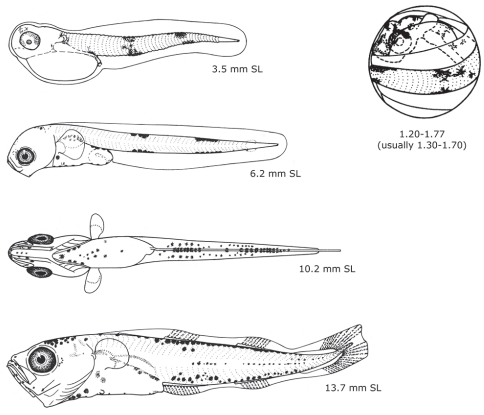
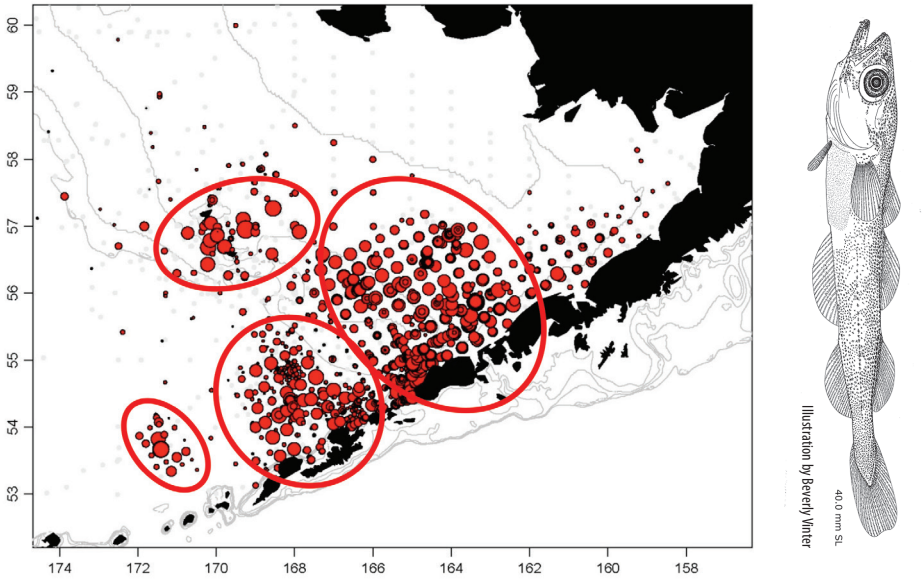


Illustrations by Beverly Vinter

Fig. 1



We found four areas of pollock spawning in the eastern Bering Sea based on long-term egg collections.

The Big Picture

Environmental variability is increasingly recognized as a regulator of marine fish spawning success and subsequent growth and survival of eggs and larvae. Using long-term egg collections and spawning adult catches, we examined the relationship between walleye pollock spawning distribution and success in relation to variability of spawning season (from March to May) and water temperature. Using a novel statistical analysis we predict that pollock spawning activity progresses from the Aleutian Basin to the shelf region of the Bering Sea from March to May. We also found that pollock spawning increases modestly throughout the study area as mean annual water temperature increases, but this increase is spatially homogeneous. So the overall spatial distribution does not change in relation to water temperature.

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dynamics (abundance and distribution), then we could better predict the influence of climate change on the ecological dynamics of the Bering Sea.

How We Did It

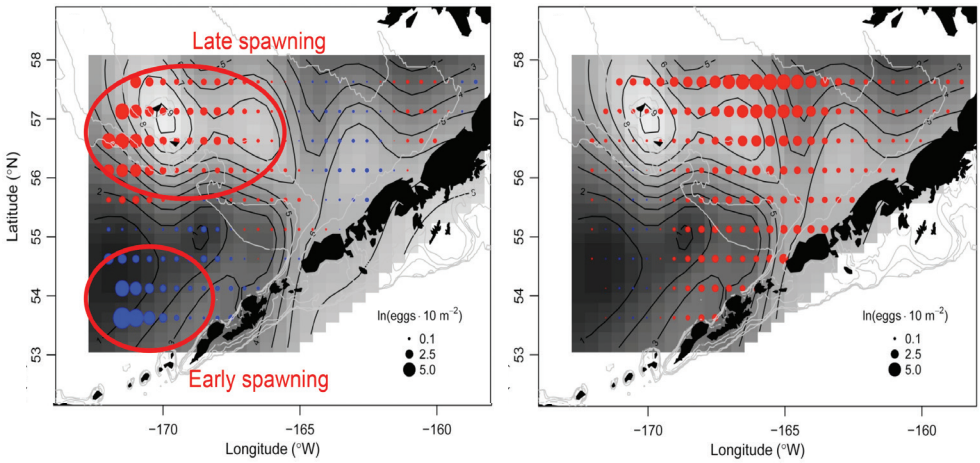
We used a novel modeling approach to relate the catch of pollock eggs or spawning adults to progression of the spawning season and to water temperature, after accounting for other potential influences on pollock spawning. Data for this study consisted of 19 years of pollock egg and larval collections, as well as 22 years of adult pollock spawning season catch data. Our models allowed us to understand when and where catches of eggs or spawning adults increased or decreased under different conditions of water temperature. Here we only show data and results from egg catches, which are similar to those obtained from spawning adult pollock catches..

In the eastern Bering Sea, most pollock spawning activity occurs during spring (March to May). There are four main spawning aggregations (Fig. 1) going from the Aleutian Basin to the Pribilof Islands in the shelf region of the southeast Bering Sea. Pollock spawning progresses from the Basin in March to the shelf in May (Fig. 2). On average, pollock spawning is positively influenced by an increase of water temperature throughout the study region (Fig. 2). However, because the increase of spawning activity is spatially homogeneous, the distribution of pollock spawning does not change considerably in relation to changes of water temperature.

Why We Did It

Understanding the influence of a changing climate on pollock spawning is an important and timely topic of research because pollock is a key component of the Bering Sea food web and is heavily harvested. We were most interested in determining whether individual pollock conserve a memory of their previous or parental spawning locations or whether they exhibit flexibility in choosing their spawning sites. We found that environmental variability (e.g., temperature), while affecting the overall success, did not much alter the spatial assemblage of spawning locations, so we concluded that individuals do conserve a memory of their spawning sites and have limited flexibility to respond to interannual variations of environmental conditions.

Fig. 2



Pollock spawning progressed from the Aleutian Basin in March to near the Pribilof Islands in May (left panel). Increased water temperature results in greater spawning activity but does not influence its location (right panel). The black contour lines and grey shading denote the average predicted egg density (from multiple years); darkest color corresponding to lower density. Overlaid on the image are red or blue bubbles, the size of which is proportional to an expected increase (red) or decrease (blue) of the egg density as time progressed from March to May (left panel), or as water temperature increases by one degree (right panel). Grey lines are bathymetric contours.

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