BEST-BSIERP Bering Sea Project

Climate Related Changes in the Nutritional Condition of Young-of-the-Year (YOY) Pollock From the Eastern Bering Sea

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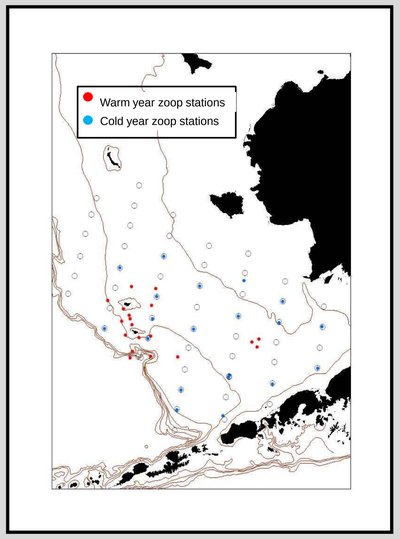
Issue

The Bering Sea pollock fishery is the largest fishery in the US. Climate change is expected to bring profound changes to high latitude ecosystems. The impact of these changes on pollock and those that depend on them are unknown.

Background

- The SE Bering Sea oscillates between warm and cold conditions.
- Zooplankton composition depends on these climate conditions.
- Annual BASIS survey, conducted in SE Bering Sea in Aug/Sept , samples pollock diets and prey.
- NOAA/AFSC Nutritional Ecology Lab maintains a database describing the nutritional value of forage species the Bering Sea.



Open symbols show the BASIS sampling grid solid symbols show locations where zooplankton were sampled for lipid analysis in warm (2004) and cold (2009) years.

Southeast Bering Sea

Approach

We reconstructed the lipid content of YOY pollock diets from warm (2004) and cold years (2009). Lipid in diets at the ith sampling location were estimated from:

$$\%\ lipid_i = \sum p_j f_{ij}$$

where p_j is the percentage of lipid (wet mass) of the jth prey item and f_{ij} is the proportion of the jth prey in the diet of fish at the ith station.

The $\%lipid_i$ values were averaged across all stations for each year. The averages were compared by using Student's *t*.

We validated conclusions from diet reconstruction by examining a time series of pollock energy densities to see if climate influences body composition.

We evaluated the importance of climate related differences in nutrition by comparing the energy content of YOY pollock to their recruitment the following year.

Question...

How do climate-induced changes in the prey field composition influence juvenile pollock?

Results

Prey Quality

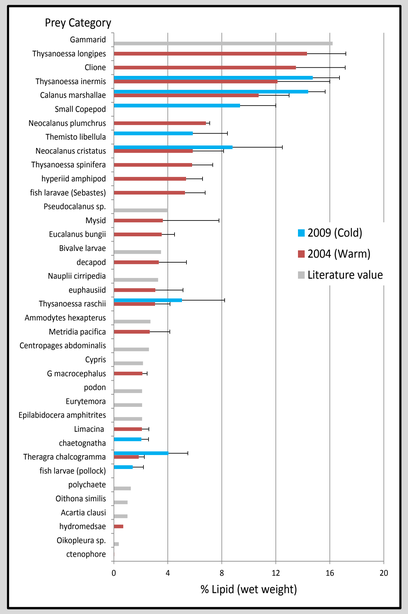
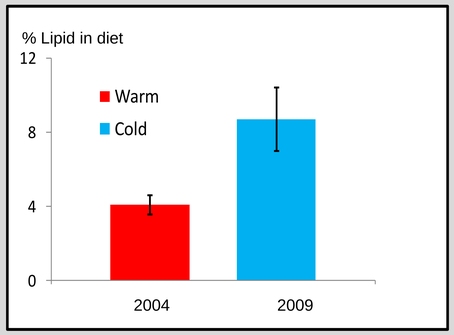


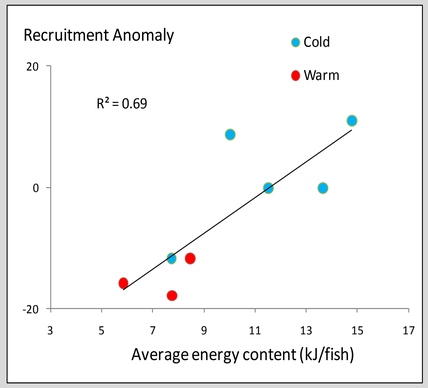
Chart (left) shows prey items in pollock diets arranged in order of their lipid content. Note that when prey were sampled in both years, lipid content was higher in the cold year. Diets of YOY pollock are not shown, however in the warm year (2004) the diet was primarily composed of low lipid organisms located near the bottom of the chart (left). Items consumed in the cold year were primarily high in lipid.

Effect of Climate on Lipid Intake



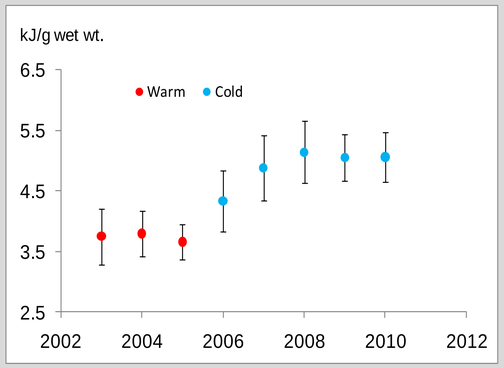
Diets of YOY pollock in the warm year (2004)) were significantly leaner ($t = 43.08$; $p < 0.001$) than the cold year (2009). This was an effect of climate on the quality and type of prey consumed.

Effect of Condition on Winter Survival



The total energy content of YOY pollock is directly related to the number of age-1 recruits the following summer.

Effect of Climate on Body Composition



Changes in energy density relate to the proportion of body mass given over to lipid. Over the last 8 years the SE Bering has transitioned from a warm phase to a cold phase.

During the same period the average energy density of YOY pollock has increased.

Conclusions

Improved forage quality in cold years confers a survival advantage on YOY pollock.
Climate change models indicate future marine conditions in the SE Bering are more likely to resemble warm conditions.
These data suggest warming in the SE Bering is likely to reduce pollock production by degrading the quality of their prey.

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