Energetic differences in young of the year walleye pollock across the Gulf of Alaska

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Background: Young of the year (YOY) pollock need to allocate energy for growth and lipid storage to maximize their overwinter survival.

Question: Does the nutritional condition of pollock differ between study years and Gulf of Alaska (GOA) regions?

Objectives: Compare body condition (dry weight/length residuals), energy storage, and diet composition across years and regions.

Dry Weight/Length Residuals and Total Energy Content

CGOA Pollock

EGOA Pollock

Nonmetric multidimensional scaling of YOY pollock diet composition. Comparing 2013 to 2012:
- diets in the central GOA shifted away from \textit{Calanus marshallae} toward small copepods and euphausiids
- diets in the eastern GOA shifted towards \textit{Calanus marshallae}, away from small copepods

Summary

CGOA pollock were fatter and more energetically rich than EGOA pollock in 2012.

That pattern switched in 2013 with EGOA pollock having better nutritional condition.

These changes were likely driven by diet rather than by the gulfwide increase in sea surface temperature.

\textit{Calanus marshallae} were predominant prey items in energetically rich pollock.

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The heat is on:
Comparing growth potential ‘hot spots’ of young of the year walleye pollock and Pacific cod in the Gulf of Alaska

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Background:
Variations in temperature and food supply can affect young of the year walleye pollock and Pacific cod growth

Questions:
• What affects predicted growth the most?
• Are there areas of competition between YOY pollock and P. cod in the GOA?

Objectives:
• Use bioenergetics models to predict YOY growth
• Find areas of high growth potential or ‘hot spots’
• Compare those areas between species

Bioenergetics Models

We used Wisconsin-type bioenergetics models parameterized for either juvenile pollock and cod (Cianelli et al., 1998; Siddon et al., 2013)
• Note: cod consumption parameters calculated from Sreenivasan and Heintz (in prep)

Sensitivity Analysis
To test effects of variables on growth, we measured the % difference in growth after increasing or decreasing each variable by 1 standard deviation. We found which variable caused the greatest change (below, * over bars indicate negative %) and plotted the spatial effects of that change (left):

Walleye Pollock

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Pacific Cod

Growth Hot Spots

We scaled the predicted growth rates for both species from 0 – 10 and compared areas with similar scaled growth:

Orange -> red stations = Areas with high growth for both pollock and cod
Red circles = Areas with high pollock and cod catches per unit effort that align with high growth

Preliminary Findings

Pacific cod had higher predicted growth rates (g/g/d) than walleye pollock.
Both GOA regions contained areas where both species had relatively high predicted growth rates.

Because very few cod were caught in the eastern GOA, potential growth hot spots that would increase interspecific competition were only in the central GOA.

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Siddon et al. 2013: Spatial match-mismatch between juvenile fish and prey provides a mechanism for recruitment variability across contrasting climate conditions in the eastern Bering Sea. PLoS ONE 8: e84526.
Sreenivasan and Heintz. In prep: Estimation of the relationship between growth, consumption, and energy allocation in juvenile Pacific cod (Gadus macrocephalus) as a function of temperature and ration. For OSRF.

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