Introduction

- Alaska's climate has changed over the last 50 years. The change is seasonally asymmetric with pronounced warming in winter (3.5°C), freshwater runoff now occurs earlier in the spring (Karl et al. 2009).
- Annual temperature and freshwater-input cycles greatly affect the physical structure of the coastal ocean in the Gulf of Alaska (GDA) (Stabeno et al. 2004).
- Coastal fishes grow mostly during summer, but environmental effects are not well quantified.
- Otolith annuli can quantify the yearling walleye pollock growing season timing, duration, and magnitude.

Objectives

1. Verify spring formation of the first annulus in the otoliths of juvenile walleye pollock in the western Gulf of Alaska (GDA).
2. Use the first annulus to quantify the timing, duration, and magnitude of the growing season of yearling walleye pollock.

Methods & Materials

Samples were collected opportunistically from August 2000 to September 2001 in the western GDA. Members of the 2000 year class were selected by body length and the occurrence of 1 annulus. Samples were grouped by geographic region (Kodiak, not Kodiak) based on a historical difference in length at age.

Results

Formation timing

A logistic model was used to quantify the first-annulus formation schedule (Fig. 1). The model predicts that 50% of the population had a first annulus on 16 March 2001. No difference was detected between geographic regions.

Growing season

A logistic growth model was used to describe the mean post-annulus growth (Fig. 2), which was the difference between length at capture and back-calculated length at the first annulus. No difference was detected between geographic regions. The growing-season model (growth rate) was derived from the logistic growth model and provides parameters that quantify growing-season timing, duration, and magnitude (Fig. 3).

Climate/environmental effects

The formation-timing and growing-season models related to water temperature and day length (Fig. 4). During spring, all variables increased synchronously. During late summer, however, growth rate decreased as temperature exceeded 9°C, above which gross growth efficiency declines (Koksa et al. 2007).

Conclusion/Discussion

Formation timing

Prevalence of the first annulus increased from January to May 2001 with 50% of the population having an annulus on 16 March, which is within historical peak spawn dates (15 March to 2 May). In the Bering Sea, formation timing was comparable (LaLanne 1977) or earlier (Kimura et al. 2006), but methodological differences prevent rigorous comparison.

Growing Season

Yearling walleye pollock grew at >0.01 mm d⁻¹ from 30 March to 12 October 2001 (116 d) with a peak of 0.58 mm d⁻¹ on 2 July 2001. The growing-season model provided a reasonable estimate of fish length at the end of the growing season.

Climate/environmental effects

If the growing season is temperature dependent, moderate climate warming should cause it to start earlier in accordance with earlier spring warming, and it should end earlier in late summer as temperature exceeds the physiological optimum. Optimal conditions may return as temperature cools in autumn. With extreme climate warming, the growing season should diminish in duration and magnitude.

References


Acknowledgements

The recommendations and general content presented in this poster do not necessarily represent the views or official position of the Department of Commerce, the National Oceanic and Atmospheric Administration, or the National Marine Fisheries Service.