

**Project #:** B54

**Title:** Seasonal Bioenergetics of Pollock, Cod and Arrowtooth Flounder in the Bering Sea

**Principal Investigator(s) and Recipient Organization(s):**

PI: Ron Heintz  
NOAA Fisheries  
Auke Bay Laboratories  
17109 Glacier Hwy  
Junau, AK 99801

**Contract Period and Amount of Funding:**

15 April 2008 to 30 September 2012  
\$324,000

**Report Period:**

15 April 2009 through 30 Sep 2009

**Report Date:**

16 Sep 2009

**Lead Author of Report:**

Ron Heintz

**Proposed timeline and milestones within report period:**

- Continue RNA/DNA, calorimetric and proximate analysis of samples collected in FY08
- Complete FY09 laboratory studies on growth
- Obtain samples on 2009 cruises: NPCREP, Knorr, MACE, BASIS

**Project Summary:** The objectives of this project are to build models relating the energy phenology of YOY and juvenile pollock, Pacific cod and arrowtooth flounder (ATF) to seasonal changes in their distribution and abundance. Fish will be collected seasonally and analyzed to determine their energy, lipid and protein content. In addition, growth will be monitored by examining their RNA and DNA content. In particular, the seasonal energy content and allocation will be examined for four year

**Progress Summary:** Work completed since April 15, 2009 can be divided into analysis of field samples, laboratory analysis of growth dynamics in Pacific cod and collection of field samples on FY09 cruises. During the report period we completed bomb calorimetry and lipid analysis of 34 pollock collected during the 2008 BASIS survey, RNA/DNA analysis of 45 larvae from the 2008 NPCREP survey and 18 RNA/DNA analyses from the 2008 Healy survey. We developed a spectrophotometric assay for measuring small masses of lipid and completed analysis of 5 groups of larvae from the 2008 NPECREP survey representing 44 individuals.

We also completed a laboratory study to examine the time to starvation in Pacific cod larvae following different amounts of time feeding. Larvae were sampled on 0, 14, 28, 42 and 56 days of feeding post hatch to continue building our RNA/DNA model for growth. In addition, fish fed for those periods were held without food and sampled at 10%, 25% and 50% mortality. In the end we processed approximately 350 fish from this experiment for RNA/DNA and related these observations to growth, mass loss and mortality. These data will help us interpret field observations or RNA/DNA.

Cruises staffed during the FY09 surveys included NPCREP, Knorr (summer), MACE and BASIS surveys. We did not acquire any samples from the NPCREP survey as very few larvae were found along the sample track. We collected 15 age 0+ Pacific cod, 491 age 0+ pollock and 73 YOY arrowtooth flounder on the summer Knorr survey. We obtained approximately 30 age 1+ pollock during the MACEc

survey. The BASIS survey is currently underway, but we are obtaining large numbers of pollock from age 0+ to 2+.

Our analysis of larval and juvenile pollock collected in 2008 indicates the following :

- 1) Larval growth in 2008 was slow, consistent with previous reports of larval growth in cold years.
- 2) The bulk of larval growth occurs in the post-flexion stage. Larvae increased in length by about 0.1 mm per day between May and July and by 0.31 mm per day between July and September. RNA/DNA analysis indicates most larvae were starving in May, but by July instantaneous growth rates (wet mass) were approximately 7.8% per day.
- 3) There was little change in the way pollock allocated energy between May and July, larvae averaged 10.7% and 11.4% lipid (dry mass) in May and July, respectively.
- 4) As a result of similar energy allocation strategies, the energy densities of pre-flex and post-flex larvae were nearly constant; averaging approximately 18.5 kJ/g (dry mass).
- 5) By September pollock had transformed into juveniles. Dry mass increased by approximately 200-fold, lipid increased from 10% to 20% of dry mass and energy density increased from 18 kJ/g to 23 kJ/g.

**Lessons learned and project adjustments:** RNA/DNA ratios of fish sampled in May suggest there is a high degree of starvation occurring during this period. Unfortunately we were unable to obtain samples of larvae from the May 2009 cruise. However, we will process more of our 2008 samples to better understand the distribution of RNA/DNA ratios in May. Our new method for analyzing lipid in small samples will allow us to better examine spatial variation in the lipid content of post-flexion larvae collected in July of 2009. We were able to collect more ATF during the Knorr summer cruise this year, future analysis will include these fish. Pacific cod continue to be difficult to obtain.

**Integration activity:** We continue to rely on samples collected under the BASIS (B90) NPCREP (B53), BEST (B53) and MACE (B62) cruises. In addition, we have been working with the functional foraging group (B61) to make sure we share samples.

**Education and Outreach:** Heintz gave a lecture to Juneau students participating in the Ocean Sciences Bowl about the work we are doing in the Bering Sea and presented initial larval data at the AFS Larval Fish Conference held in Portland, Oregon in July.

**Next year's Workplan:** In the next six months we plan to continue analyzing and collecting samples. We will be publishing our RNA/DNA growth model.