

**Project #:** B54

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

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

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**Contract Period and Amount of Funding:**

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

**Report Period:**

1 Oct 2008 through 31 March 2009

**Report Date:**

14 April 2009

**Lead Author of Report:**

Ron Heintz

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

- Begin RNA/DNA, calorimetric and proximate analysis of samples

**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 classes of pollock and cod and three year classes of age-0 ATF. The latter group will depend on availability to surface and midwater oriented gear. Seasonal changes in energy content will be compared with acoustically determined estimates of abundance to understand the relative importance of energetic bottlenecks in the recruitment of these species. These data will be used to test the hypotheses that energetic demands during metamorphosis limit recruitment of YOY pollock, cod and ATF. In addition, the hypotheses that energetic demands limit winter survival of pollock and cod will also be tested. Finally, laboratory studies will be performed to understand the relationships between growth and metabolic demand to water temperature.

**Progress Summary:** Much of the work performed since October 1, 2008 has been to develop methods for analyzing larvae collected last summer. We have developed protocols for measuring larval lengths, dry masses, RNA/DNA, caloric and lipid content. Those methods have been applied to most of the pollock larvae collected last summer. In addition, we have completed the RNA/DNA analysis of Pacific cod and pollock larvae grown under experimental conditions at our Newport Lab. We are currently processing age-1 fish collected by the AFSC MACE survey last summer. No ATF were captured in the summer 2008 surveys.

Our analysis of the lengths of larval pollock collected in May near the Alaskan Peninsula during the NPCREP survey indicates an average length of 6.6 mm and 350 ug dry mass. Juvenile pollock sampled from the same area in September during the BASIS survey averaged 73.0 mm in length, suggesting a 1.7% growth rate over summer. Larvae collected near the Pribilof Islands during the July

Healy survey apparently grew faster. Larvae averaged 10.8 mm in length and 1030 ug dry mass in July. By September, juveniles averaged 56 mm, suggesting a 2.2% growth rate. If these differences in growth continued it would take an additional 50 days before the two groups would be equal in size. Thus, improved growing conditions near the Pribilofs may not have offset the benefit of the longer growing season observed near the Alaska Peninsula. We hasten to point out that these data should be considered preliminary, confirmation will be available after we complete analysis of condition and RNA/DNA ratios.

**Lessons learned and project adjustments:** We have learned that larval dry masses are too small to make direct measurements of caloric content. While the method we developed is sufficiently accurate, it requires combining large numbers of individuals in order to obtain sufficient mass to analyze. Consequently, we lose resolution because sample sizes are reduced. We are revamping our approach to measuring caloric content. Rather than using bomb calorimetry, we will measure the proximate composition of the fish and estimate energy from calorific equivalents for lipid and protein. This will require development of a total protein assay that relies on spectrophotometry. We will combine this with chromatographic methods to measure total lipid content. These methods will allow us to estimate the total energy per individual and examine energy allocation strategies. However, these new methods will require further development. We anticipate completing analysis of larvae collected in 2008 by December of 2009. Energetic data for non-larval specimens will be reported by June 1, 2009.

**Integration activity:** We have begun the planning phase for the coming field season. We will be relying 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:** We produced a poster that was presented at the Alaska Marine Sciences Symposium. In addition, data we compiled on the energy density of YOY pollock in fall have been used in one manuscript and were seen in several other posters at the Alaska Marine Sciences Symposium. I gave a lecture to Juneau students participating in the Ocean Sciences Bowl about the work we are doing in the Bering Sea. We also submitted an abstract to the AFS Larval Fish Conference in Portland to discuss changes in the condition of pollock larvae during development in the Bering Sea.

**Next year's Workplan:** On a separate page, we have appended our workplan for the coming year, following the style that Mike Sigler specified in the Progress Report template.

**BSIERP O2.24****PROJECT TITLE:** Seasonal Bioenergetics of Pollock, Cod and Arrowtooth Flounder in the Bering Sea**CONTACT NAME:**

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2009-2012 Tasks, Assignments, Timeline

<i>What</i>	<i>Who</i>	<i>Start</i>	<i>Status</i>
Collect samples on BASIS cruise	<b>Heintz</b>	September 2008	Complete
Develop RNA/DNA assay	<b>Heintz</b>	Begin Sept. 2008	Complete
Develop lipid processing assay	<b>Heintz</b>	December 2008	Complete
Develop calorimetric method	<b>Heintz</b>	Begin Sept. 2008	Complete
Complete chemical analysis of samples collected in FY07-FY08	<b>Nutrition Lab staff</b>	Begin Sept. 2008	Larval analysis delayed, non-larval analysis complete
Report data to NPRB	<b>Heintz</b>	Jan 2009	Not complete due to revamping of methods
Develop sampling plan for FY09 surveys	<b>Heintz</b>	Begin winter 2008/2009	Underway
Write semi-annual report summarizing results of first field year	<b>Heintz</b>	April 2009	Complete
Begin FY09 laboratory studies to examine bioenergetic parameters	<b>Hurst; Laurel</b>	May 2009	Underway
Collect larval fish from field	<b>Project O2.7; Heintz; AFSC staff</b>	May, July, August, September 2008	
Complete biological analysis of samples collected in FY09	<b>Nutrition Lab staff</b>	Begin August 2009	
Complete chemical analysis of samples from FY09 laboratory studies	<b>Nutrition Lab staff</b>	Begin August 2009	
Write semi-annual report	<b>Heintz</b>	October 2009	
Complete chemical analysis of FY09 field samples	<b>Heintz</b>	Begin Sept 2009	
Report FY09 samples to NPRB	<b>Heintz</b>	Jan 2010	
Develop sampling plan for FY10 surveys	<b>Heintz</b>	Begin winter 2010	
Write semi-annual report	<b>Heintz</b>	April 2010	
Begin FY10 laboratory study of bioenergetic parameters		May 2010	
Collect larval and juvenile fish from FY10 surveys	<b>Project O2.7; Heintz; AFSC</b>	May 2010	

	<b>staff</b>		
Complete biological analysis of samples collected in FY10	<b>Nutrition Lab staff</b>	Begin August 2010	
Complete chemical analysis of samples from FY10 laboratory studies	<b>Nutrition Lab staff</b>	Begin August 2010	
Write semi-annual report	<b>Heintz</b>	October 2010	
Complete chemical analysis of FY10 field samples	<b>Heintz</b>	Begin Sept 2009	
Report data to NPRB	<b>Heintz</b>	Jan 2011	
Write-up results	<b>Heintz</b>	Begin spring 2011	