

NEP-CCS Progress Report 2004

GLOBEC: APPLYING MOLECULAR ORGANIC TRACERS TO DETERMINE AGE STRUCTURE, NUTRITIONAL STATUS AND POSSIBLE TROPHIC TRANSFER IN THE EUPHAUSIIDS *EUPHAUSIA PACIFICA* AND *THYSANOESSA SPINIFERA*.

PRINCIPLE INVESTIGATOR: Dr. H. Rodger Harvey.
Chesapeake Biological Laboratory
U of MD Center for Environmental Science
P.O. Box 38,
Solomons, MD 20688 USA
E-mail: harvey@cbl.umces.edu

PROJECT SUMMARY

This project developed a biochemical method to estimate the age of euphausiids and applied this method to determine population age structure of the target krill species (*Euphausia pacifica* and *Thysanoessa spinifera*). The method was coupled with parallel measures of nutritional conditions (total lipid, fatty acids, and sterols) of these target species through mesoscale cruises and laboratory experiments. In particular, specific individual lipid markers have provided valuable information for feeding history of the two target species (including stage-specific feeding) and aid in understanding the effect of physical features on euphausiid population dynamics. Our results suggest that the biochemical aging (lipofuscin) method is practical to estimate age of krill and may also provide additional estimates of vital rates (i.e., longevity, mortality, growth) and population dynamics of the two target species. Furthermore, the results of lipid biomarker distribution suggest that while adult euphausiids collected across shelf transects often reflect the varied food resources available in the water column, stage- and species-specific feedings were detected in several areas and depths. Furcilia-stages, particularly for *E. pacifica*, contained additional algal markers compared to adult-stages or surrounding seston, suggesting that either furciliae fed on alternate phytoplankton in the water column or were advected from areas of feeding prior to collection. Through integration of such chemical tracers with biological measures and physical features, a more complete picture of biological/physical coupling mechanisms in these complex coastal zones may be possible. These results have been prepared for 4 publications and have been presented at 12 (oral + poster) at National (AGU), International (PICES, GLOBEC), and PI meetings.

OBJECTIVES

1. Apply recent advances in biochemical methods to determine the age structure in populations of two target euphausiid species *Euphausia pacifica* and *Thysanoessa spinifera* and the effects of mesoscale dynamics on maintenance or disruption of cohort populations seasonally and interannually. Calibration of animals with laboratory rearings conducted in parallel will allow absolute ages in cohorts to be

determined.

2. Examine the effects of physical zonation in shelf waters on the nutritional status and reproductive potential in juvenile and adult euphausiids (and eggs) using lipid classes; seasonal and interannual measures will be used provide information on the potential effects of changing nutritional status on subsequent recruitment and variations in abundance.
3. To combine age structure information with lipid analysis in sets of the same individuals to understand the impact of nutritional status on age structure in field populations of *E. pacifica* and *T. spinifera* over seasonal and interannual time scales.
4. To investigate individual lipids in euphausiids and other zooplankton as molecular markers of diet and their potential as makers of trophic transfer to their predators. Individual fatty acids, alcohols, and sterols will be used to trace feeding habits and trophodynamics.

PRESENTATIONS AND PUBLICATIONS

Presentations:

- Ju, Se-J. and H. R. Harvey. 2000. Age structure, nutritional status and potential for trophic transfer in the euphausiids *Euphausia pacifica* and *Thysanioessa spinifera*. (Talk) 12-14 Nov., *At the 2000 GLOBEC PI meeting*, Corvallis, Oregon, USA
- Ju, Se-J. and H. R. Harvey. 2001. Relationship between phytoplankton community structure and mesoscale physical features of the Northeast Pacific as determined by multiple biochemical markers. (Poster) 13-16 Nov., *At the 2001 CGOA CCS GLOBEC SI meeting*, Seattle, Washington, USA
- Ju, Se-J. and H. R. Harvey. 2001. Determination of Age Structure, Nutritional Status and Potential for Trophic Transfer in the Euphausiids *Euphausia pacifica* and *Thysanioessa spinifera* using Multiple Organic Tracers. (Poster) 13-16 Nov., *At the 2001 CGOA CCS GLOBEC SI meeting*, Seattle, Washington, USA
- Ju, Se-J. and H. R. Harvey. 2002. Determination of Age Structure, Nutritional Status and Potential for Trophic Transfer in the Euphausiids *Euphausia pacifica* and *Thysanioessa spinifera* using Multiple Organic Tracers. (Poster) 11-15 Feb., *At the 2002 Ocean Science meeting*, Honolulu, Hawaii, USA.
- Harvey, H. R. and Se-J. Ju. 2002. The Use of Multiple Organic Markers to Track the Diet History and Nutritional Status of Euphausiids: Advection or Selection? (Talk) 25-28 Sep., *At the 49th Eastern Pacific Ocean Conference*, Oregon, USA.

Harvey, H. R. and Se-J. Ju. 2002. The Application of Multiple Lipid Markers to Track the Diet History and Nutritional Status of Euphausiids in the NEP. (Talk & Poster) 19-21 Nov., *At the 2002 NEP-CCS SI meeting*, Corvallis, Oregon, USA

Harvey, H. R. and Se-J. Ju. 2003. Using of Multiple Organic Markers to Track the Diet History and Nutritional Status of Euphausiids in the Antarctic and North East Pacific Oceans. (Poster) 20-23 May, *At the 3rd Zooplankton Production Symposium titled "The Role of Zooplankton in Global Ecosystem Dynamics: Comparative Studies from the World Oceans"*, Gijon, Spain.

Harvey, H. R., Se-J. Ju, W. T. Peterson and L. Feinberg. 2004. Age determination of Euphausiids using extractable biochemical markers. (Talk) 26-30 Jan. *At the 2004 AGU Ocean Science meeting*, Portland, Oregon, USA.

Ju, Se-J. and H. R. Harvey. 2004. Tracking the Diet History and Nutritional Status of Euphausiids in the Antarctic Using Lipid Markers. (Poster) 26-30 Jan. *At the 2004 AGU Ocean science meeting*, Portland, Oregon, USA.

Ju, Se-J. and H. R. Harvey. 2004. The Application of Multiple Organic Markers to Understand the Diet History and Nutritional Status of Euphausiids in Dynamic Ecosystem. (Poster) 26-30 Jan. *At the 2004 AGU Ocean science meeting*, Portland, Oregon, USA.

Ju, Se-J. and H. R. Harvey. 2004. The Application of Multiple Organic Markers to Understand the Diet History and Nutritional Status of Euphausiids in Dynamic Ecosystem. (Poster) 30-31 Jan. *At the 2004 NEP-GLOBEC SI meeting*, Portland, Oregon, USA.

Ju, Se-J. and H. R. Harvey. 2004. The Application of Multiple Organic Markers to Understand the Demographic structure and Nutritional Status of Euphausiids. (Poster) 15-16 Nov. *At the 2004 GLOBEC PI meeting*, Corvallis, Oregon, USA

Papers in preparation:

- Harvey, Ju, Feinberg and Peterson. Biochemical determination of population age structure in euphausiids. To be submitted late 2004.
- Ju and Harvey. Lipid ecology of Euphausiids in the Antarctic and North East Pacific Ocean. Submission in early 2005.
- Ju and Harvey. Mesoscale features of phytoplankton community structure and potential effect on zooplankton feeding behavior in the North East Pacific.

- Ju and Harvey. Linking biological and physical processes in the North East Pacific using multiple organic markers II. Nutritional condition and feeding ecology of krill

AVAILABLE DATA SETS

All data sets are being prepared for on-line distribution in conjunction with publications and comparisons with other systems. Data sets include independently collected TSP and CHN particles mesoscale cruises in surface waters and chlorophyll max during 2000 (48 samples) together with detailed lipid composition and pigment composition. For 2002 additional samples were collected. Both years also include detailed lipid analysis of krill. A summary of samples and results being compiled are shown below.

For particle samples

Mesoscale	Fatty acids+sterols	Algal pigment	TSP	POC & PON
June-2000	12	11	10	11
Aug.-2000	20	16	16	11
June-2002*	44 (22 st. *2 depth)	44	44	44
Aug.-2002*	56 (22 st. *2 depth)	56	56	56

For krill – Length and mass data are also available

Mesoscale	Lipid (lipid content+ class+ fatty acid+ sterol)	
	<i>E. pacifica</i>	<i>T.spinifera</i>
June-2000	5 samples (from 5 stations)	1 samples (from 1 st)
Aug.-2000	8 samples (from 7 st)	2 (from 2 st)
June-2002*	8 samples (from 4 st)	8 (from 5 st.)
Aug.-2002*	25 samples (from 19 st)	11 (from 9 st)