

Bering Sea Integrated Ecosystem Research Project: Semiannual Progress Report

Project #: B.61

Title: Functional Foraging Response

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

Kerim Aydin kerim.aydin@noaa.gov
Ed Farley ed.farley@noaa.gov
Troy W. Buckley troy.buckley@noaa.gov

Contract Period and Amount of Funding:

Contract Period: April 1, 2007 – September 30, 2010

Amount of Funding: \$341,631

Report Period: April 1, 2008 – September 30, 2009

Report Date: October 1, 2009

Lead Author of Report: Kerim Aydin, Ed Farley, Troy W. Buckley

Proposed timeline and milestones within report period:

| <i>Milestone</i> | <i>Who</i> | <i>Due</i> | <i>Status</i> |
|--|------------------------|---------------------------|---|
| Food habits data from field work through March 2009 made available (submitted to data manager) | Buckley, Aydin, Farley | September 30, 2009 | Stomach contents data from arrowtooth and Kamchatka flounders and walleye pollock have been submitted to the BSIERP data manager. |

Project Summary: This project is aimed at distinguishing between temperature related and prey density related responses of juvenile and adult pollock, a nodal species in the eastern Bering Sea food web. Understanding these biological responses will help predict ecosystem responses to projected reduced production, increased overlap between piscivores and forage fishes, and increased abundance of piscivores due to predicted warming of the climate. The specific functional forms and relationships measured between predator and prey will become a critical component of the FEAST model (Project B.70).

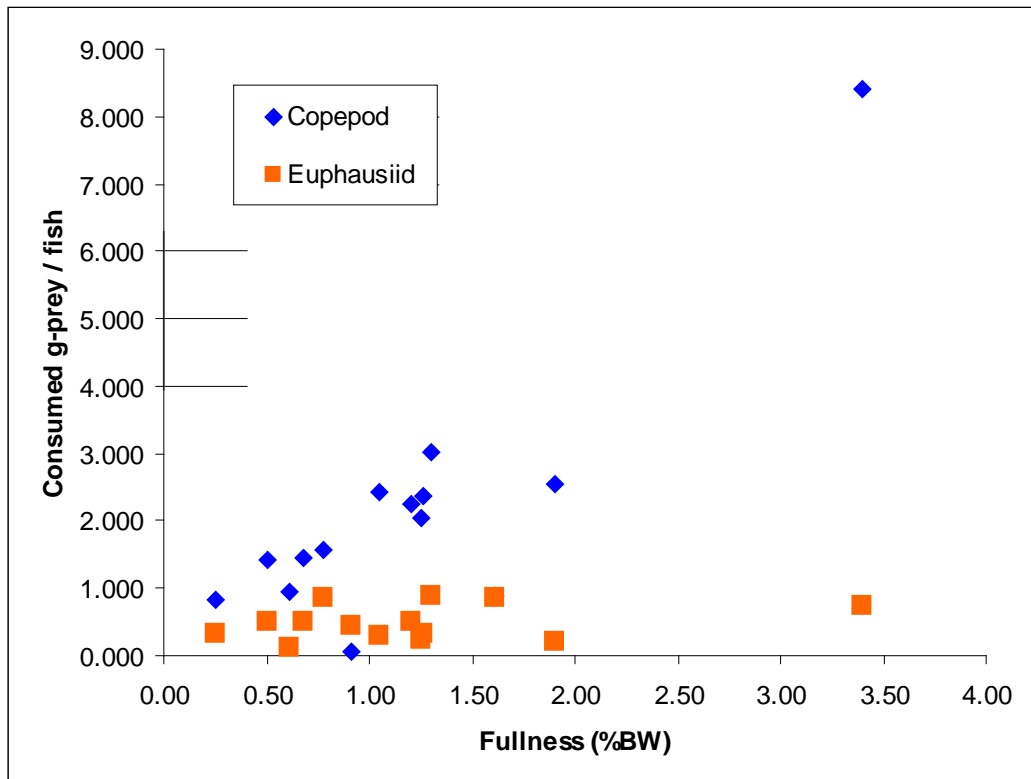
Progress Summary: Stomach samples were collected during both the Bottom Trawl and Hydroacoustic surveys of the eastern Bering Sea in summer of 2009. Walleye pollock stomachs were collected during both surveys; 1,424 from the Bottom Trawl Survey and 800 from the Hydroacoustic Survey. Stomachs from arrowtooth and Kamchatka flounders (413) and Pacific cod (1,390) were collected from the Bottom Trawl Survey. For related dietary analyses, eulachon (210), capelin (438) and Pacific herring (293) were collected during these surveys and about half of these specimens were frozen to allow for any desired tissue sampling. Effort was directed toward collecting samples that could provide more information about the localized interactions between vertical thermal structure, zooplankton abundance and feeding of walleye pollock. On one bottom trawl survey vessel, pollock were sampled from the last station of the day whenever they were caught, and bongo tows were conducted near this station when water-depth and weather permitted. Stomach samples collected during the Hydroacoustic Survey will have synoptic

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estimates of local zooplankton abundance using frequency differencing. Pollock were available for stomach sampling from only 49 trawls (fewer than expected) during the 2009 Hydroacoustic Survey.

During this reporting period, the new methods of increased detail in zooplankton identification were implemented for most of the walleye pollock stomach samples. Laboratory analysis of the 1,867 walleye pollock stomach samples collected during the 2008 Bottom Trawl Surveys was completed. The data from the stomach samples of arrowtooth and Kamchatka flounders and walleye pollock collected in 2008 has been error checked and submitted to the BSIERP data manager. Subsamples of zooplankton found in the stomachs of walleye pollock have been preserved for examination by zooplankton experts for a possible further increase in detail of the stomach contents data for some walleye pollock samples. Discussions with the FEAST modelers (B.70) have resulted in a shift in priorities away from Pacific cod stomach samples toward more rapid laboratory analysis of the 2009 arrowtooth and Kamchatka founder stomach samples. Laboratory analysis of these stomach samples has already begun. All of this data is undergoing exploratory visual and statistical analyses and is being shared with the FEAST model PIs (Project B.70) as it becomes available.

Retrospective comparisons of zooplankton data and pollock diet data has begun. About 250 zooplankton sampling stations have been identified that are within 7 days and 60 miles of 85 stations where pollock diet information has been collected. Fewer stations will be available with zooplankton community composition data to match with pollock diet information. Frequency differencing is being used to provide estimates of euphausiid backscatter from Hydroacoustic Surveys back to 2004 (Project B.62 – Forage Fish Distribution and Ocean Conditions). During these years, prior to 2009, pollock stomachs were collected only from 14 trawl stations in the northern Bering Sea during the 2004 survey. cursory examination of this data indicates no relationship between local euphausiid backscatter density nor local pollock density. Average stomach fullness as a percentage of individual pollock body weight (%BW) appears to be related more to the variation in copepod consumption than euphausiid consumption as indicated by the average amount of each prey type eaten per fish (g-prey / fish). However, all evidence suggests the overall abundance of euphausiids in 2004 was extremely low.



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Lessons learned and project adjustments:

We have learned that retrospective studies recommended by the Ecosystem Modeling Committee yield few close matches (in time and space) between historical pollock diet data and data on zooplankton abundance and composition. A better understanding of the scale of interactions possible over short periods of time and the temporal persistence of spatial dietary patterns would improve the confidence in which temporal and spatial envelopes provide the most meaningful comparisons. We are analyzing data relevant to this question.

Discussions with the FEAST modelers (B.70) have resulted in a shift in priorities away from Pacific cod stomach samples toward more rapid laboratory analysis of stomach samples from the 2009 arrowtooth and Kamchatka founders and walleye pollock. The milestone to submit the stomach contents data to the BSIERP data manager from field work through September 2008 was not wholly met by the March 31, 2009 due date. The procedures for analyzing stomach samples in the laboratory were previously adjusted to meet the modeling need of more detailed zooplankton identification, and these new methods are more time consuming. Additional personnel are being contracted to assist with the overall laboratory responsibilities.

Integration activity: The Functional Foraging Response project component has the same lead PI (Kerim Aydin) as in the Modeling project and in the Science Advisory Board, thus facilitating communication with both groups. Previously established collaborative communication between Resource Ecology and Ecosystem Modeling (REEM) and Fisheries Oceanography Coordinated Investigations (bongo tows for zooplankton prey), REEM and Midwater Assessment and Conservation Engineering (euphausiid prey abundance), REEM and Groundfish Assessment (pollock distribution), and REEM and Pacific Marine Environmental Laboratory (water temperature profiles and fronts) has continued to develop.

Education and Outreach: None to date.

Next year's Work plan:

BSIERP Project B.61, Functional Foraging Response

Contacts:

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| Troy W. Buckley | troy.buckley@noaa.gov | 206-526-4349 |
| Kerim Aydin | kerim.aydin@noaa.gov | 206-526-4225 |
| Ed Farley | ed.farley@noaa.gov | 907-789-6085 |

2009-2012 Tasks, Assignments, Timeline:

| <i>Milestone</i> | <i>Who</i> | <i>Due</i> | <i>Status</i> |
|---|------------------------|----------------|--|
| Food habits data from field work through September 2008 made available (submitted to data manager). | Buckley, Aydin, Farley | March 31, 2009 | For most species, data has been provided or will be provided by April 30, 2009. One species (Pacific cod) will not be complete until Sept. 2009. |

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|--|---|---------------------------|---|
| identify additional stomach sampling platforms that potentially can provide physical (e.g. temperature), prey-field (e.g. zooplankton) and predator-field (e.g. arrowtooth flounder, pollock, P. cod) information. | | | This milestone has been met and sampling plans have been established for these platforms. |
| Food habits data from field work through March 2009 made available (submitted to data manager) | Buckley, Aydin, Farley | September 30, 2009 | Stomach contents data from arrowtooth and Kamchatka flounders and walleye pollock have been submitted to the BSIERP data manager. |
| Food habits data from field work through September 2009 made available (submitted to data manager) | Buckley, Aydin, Farley | March 31, 2010 | Laboratory analysis has begun. Pacific cod now have lower priority. |
| Analyzed maps of food habits and functional responses for field work to date prepared for input into FEAST model | Aydin, Buckley, Farley | April 30, 2010 | Ad hoc examination of data has begun. |
| Food habits data from field work through March 2010 made available (submitted to data manager) | Buckley, Aydin, Farley | September 30, 2010 | |
| Manuscript submitted: Functional response between pollock and prey (specifically zooplankton), local environmental factors affecting functional response, and global extrapolation of geographic conditions (e.g. cold pool) in relation to functional response. | Buckley, Aydin, Farley, other fish group members | September 30, 2010 | |
| Food habits data from field work through September 2010 made available (submitted to data manager) | Buckley, Aydin, Farley | March 30, 2011 | |
| Manuscript: Functional responses and foraging from the BASIS survey. | Farley, other Fish group members | March 30, 2011 | |
| Manuscript: Statistics of diet and functional response analysis: implications for multispecies models. | Aydin, Buckley, other Fish group members | March 30, 2011 | |
| Manuscript: Bioenergetic growth potential (dynamic habitat) of pollock given prey and oceanographic conditions. | Aydin, Buckley, Hollowed, Heinz, other Fish group members | Sept 30, 2011 | |

Additional publications leveraging BSIERP PIs and other NPRB work:

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1. Buckley, Hurst, Aydin: Cod and prey, specifically focusing on Benthic/pelagic split:
~September 2010.
2. Aydin, Buckley, Zador, Cianelli: the relationship between ATF density and pollock consumption:
extend focus on local factors (water column, etc.): ~December 2009.