

Project #: B75

Title: Correlative Biomass Dynamics Model

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

Co-PI: Dr. Gordon Kruse
Co-PI: Dr. Franz Mueter
School of Fisheries and Ocean Sciences, Juneau Center
University of Alaska Fairbanks
17101 Point Lena Loop Road
Juneau, Alaska 99801

Contract Period and Amount of Funding:

August 1, 2007 to September 30, 2012
\$299,451

Report Period:

1 October 2008 through 31 March 2009

Report Date:

1 April 2009

Lead Author of Report:

Gordon H. Kruse

Proposed timeline and milestones within report period:

N/A – Work is not planned to begin on this project until September 2009.

Project Summary: This study will use a multi-species biomass dynamics model (Collie and DeLong 1999) to examine multi-species interactions among a group of species that show clear evidence of covariation in productivity. The model will include 3-5 species or species groups (functional groups), based on the results of the correlation analyses and multivariate analyses (B68) and on the life-history characteristics of each species (diet, habitat requirements, timing of spawning, etc.). In addition to interaction terms among species, such as competition and predation, we will extend the model of Collie and DeLong (1999) to include shared climate effects on productivity and on the strength and magnitude of predator-prey or competitive interactions among groups, based on the results in (2). For example, the model may include a gadid group, a shelf flatfish group, and a crab group, with an ice or temperature variable that affects the productivity of cod and flatfishes in opposite ways. Alternative models will be constructed with interaction terms that are allowed to vary as a function of climate variability. The model will be fit to existing biomass indices and fisheries history to retrospectively assess if and how climate variability has affected the interactions among selected groups of species. Such models have not been constructed for the eastern Bering Sea and provide a useful intermediate step between the statistical models on climate-productivity relationships described above and complex multi-species age-structured models or ecosystem models.

Using available biological and environmental time series, as well as life history information about predator-prey and competitive interactions among 3-5 species or species groups, we will build a alternative multi-species biomass dynamics models to examine the BSIERP hypothesis that later spring phytoplankton blooms as a result of early ice retreat will increase zooplankton production, thereby resulting in increased abundances of piscivorous fish (pollock, cod and arrowtooth flounder) and a community controlled by top-down processes [Oscillating Control Hypothesis] with the possible trophic consequences. If true, this hypothesis has at least two major consequences: (1) competition with

abundant, piscivorous fish species for forage species will lead to a decline in fur seals, murrens and kittiwakes, and (2) in a top-down control community, fishing will reduce the degree of top-down control of forage species (including juvenile pollock) by adult pollock, cod and arrowtooth flounder. Owing to light exploitation rates, top-down control by arrowtooth flounder will increase, as will their level of competition with piscivorous fish, seabirds and marine mammals. As a result of these two processes, arrowtooth flounder will determine ultimate community composition, such that the climax community will be arrowtooth flounder-dominated (similar to the Gulf of Alaska).

Progress Summary:

This project is scheduled to begin in September 2009. Therefore, no progress was planned during this reporting period. The delayed start is necessary to allow the modeling effort to be informed by preliminary results from project B68 Trophic Interactions - Retrospective Analysis. Progress for project B68 is provided in a separate progress report. The co-PIs are currently recruiting a PhD student for this project.

Integration activity:

We (Mueter) have had regular interactions with the modeling group through the BSIERP PI meeting in October 2008 in Girdwood, an EMC meeting held in conjunction with the Alaska Marine Science Symposium in Anchorage on January 19, 2009, meetings with Fairbanks-based modelers during two visits (Hedstrom, Gibson), and through recently established monthly conference calls, as well as personal communications. At previous EMC meetings we discussed the need for summarizing model output at the same spatial and temporal scales at which retrospective indices are computed to facilitate comparisons and model evaluation. In subsequent discussions with modeling team members, it became apparent that it would be more efficient to make model output available for *post-hoc* comparisons, rather than computing indices comparable to those from the retrospective analyses within the model. We have also participated in most of the monthly lead PI calls.

Education and Outreach: We have participated in several outreach activities related to the BSIERP project during this reporting period:

- Drs. Kruse and Mueter participated in the BSIERP PI meeting held in Girdwood, AK, during 14-16 October 2008. Both Dr. Kruse and Dr. Mueter presented a summary report of one of the break-out groups.
- Dr. Mueter participated in the 17th Annual PICES meeting in Dalian, China and presented a talk entitled "From physics to fish: Climate effects on Bering Sea food webs and fisheries", co-authored with Ken Coyle.
- Dr. Mueter presented a similar talk with new results as part of the UAF Fisheries Division seminar series in Juneau on January 23, 2009, and as a lunch-time seminar at the NOAA, NMFS Alaska Regional Office in Juneau.
- Dr. Kruse also participated in the Annual PICES meeting in Dalian. He co-convened the Science Board Symposium on "Beyond observations to achieve understanding and forecasting in a changing North Pacific Ocean", convened the Fisheries Contributed Paper Session, presented an oral presentation titled "A scenario approach to forecast potential impacts of climate change on red king crabs in the eastern Bering Sea", and co-authored an oral presentation titled "Could the collapse of the Bristol Bay red king crab stock in the early 1980s have been avoided?"
- Dr. Kruse delivered an expanded talk ("A scenario approach to forecast potential impacts of climate change on red king crabs in the eastern Bering Sea") as a department seminar at the School of Fisheries and Ocean Sciences, University of Alaska Fairbanks, on November 14, 2008.
- On 4 February 2009, Dr. Kruse was interviewed by reporter Tom Kazzia for an article on the effects of climate change on Tanner crabs and other species in Alaska. The article "Crab comeback in Kachemak Bay" appeared in Anchorage Daily News on 2/21/2009. Kruse was quoted twice in the article.

- Dr. Kruse chaired the Steering Committee for the 25th Lowell Wakefield Symposium on “Biology and Management of Exploited Crab Populations under Climate Change” held in Anchorage, AK, during March 10-13, 2009. The meeting was attended by approximately 80 participants from 6 countries. Dr. Kruse is lead editor for the proceedings from this symposium.

Next year’s Work plan:

Project B75, Correlative Biomass Dynamics Model

Co-PIs: Gordon Kruse, Franz Mueter; Contact: Gordon Kruse, Gordon.Kruse@uaf.edu, 907-796-5458.

Oct 2008-2012 Tasks, Assignments, Timeline

<i>What</i>	<i>Who</i>	<i>Start</i>	<i>End</i>	<i>Other key dates</i>
2008				
No work planned	Kruse, Mueter	Oct	Nov	<i>October:</i> PI meeting, Girdwood; <i>October :</i> PICES meeting
2009				
Recruiting PhD student	Kruse	Started	Sep	<i>January:</i> Alaska Marine Science Symposium
	Kruse, Mueter	Mar	Mar	<i>March:</i> Report to NPRB <i>September:</i> Report to NPRB; <i>October:</i> PICES Annual meeting
2010				
Select species/taxa for modeling based on retrospective analyses	Kruse, Student, Mueter	Jan	Apr	
Conceptual model development, coding	Kruse, Student, Mueter	Jan	Aug	<i>September:</i> Report to NPRB <i>October:</i> PICES Annual meeting
Compiling/updating groundfish & crab data (SAFE)	Student, Kruse	Dec	Dec	
2011				
Provide compiled data to Ken Coyle (if not included in B68)	Student, Kruse, Mueter	Jan	Jan	<i>January:</i> Presentation at AMSS <i>March:</i> Report to NPRB
Fit model to data, refine model, develop alternative models	Student, Kruse, Mueter	Jan	Aug	
Model evaluation/selection, compare results to retrospective analysis	Student, Kruse, Mueter	May	Dec	<i>September:</i> Report to NPRB <i>October:</i> PICES Annual meeting
2012				
Synthesis/Final Report	Student, Kruse, Mueter	Jan	Jul	<i>January:</i> Presentation at AMSS <i>April:</i> Report to NPRB <i>July:</i> Final report
Manuscript preparation	Student, Kruse, Mueter	Jan	Jul	