

**Project #: B73**

**Title:**  
**Management Strategy Evaluation**

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

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**Contract Period and Amount of Funding:**

1 February 2008 to 31 December 2012  
\$ 409,126 (UW); 69,500 (AFSC)

**Report Period:**

1 April 2008 through 30 September 2009

**Report Date:**

29 September 2009

**Lead Author of Report:**

André Punt

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

- This project will only begin in earnest once the FEAST model is sufficiently well developed that it is feasible to begin to implement the assessment models and decision rules that will be tested. Therefore, the activities during the current reporting period are primarily related to planning.
- Advertise and appoint for the Postdoctoral Fellow.
- Prepare NPRB semi-annual report (April-September, due October 1)

**Project Summary:**

We will conduct a formal Management Strategy Evaluation (MSE) in which the FEAST model acts as an “operating model” and currently developed methods (stock assessments, MSM, and Ecosim) act as “assessment” models. Models from the range currently available for the Bering Sea, including: single species-assessments w/ correlative recruitment indices; multi-species models; and whole ecosystem models, will be tested. In addition, autocorrelative biomass dynamics/network models and nonlinear correlative models will be tested as “null” models for determining the added value of the more mechanistic approaches. We will attempt to implement the guidelines of Marasco et al. (2007) as regards evaluating management strategies in an ecosystem context. The metrics for evaluating the success of the “assessment” models will be the accuracy (lack of bias) and precision (lack of variance) of key model outputs (such as recruitment and biomass, both in the past and as forecast under given management

regimes) when they are fit to data generated (with observation error) from the operating (FEAST) model. The aim will be to provide information about the skill of each model in determining past and current states (hindcast/nowcast) as well as the success of each model when predicting future states from current states. When combined with management decision rules, success will be defined as the ability to keep fish populations and yields above a “best performance” reference point determined from the operating model and the ability to achieve high economic returns. An experiment will be also be performed to determine how often correlative models (including stock assessment models) need to be updated given a (simulated) “intensive field and retrospective sampling season” (in addition to standard monitoring data).

#### **Progress Summary:**

Dr Punt was not funded, and hence did not work, on this project for most of July and September as he was overseas.

It took longer than anticipated to appoint the postdoctoral fellow. However, a postdoctoral fellow (Dr Elizabeth Moffitt) has now been appointed and began working on the project on 1 September 2009. She worked with Drs Aydin and Ortiz to become fully familiar with the BSIERP project and, in particular, the FEAST model. Dr Moffitt attended NPFMC groundfish PLAN meetings to become more familiar with the management advisory process in the North Pacific. She has been researching the current stock assessment methods used for the focal species in the North Pacific, as well as the multi-species models that are planned for use as “assessment” models in the project.

#### **Lessons learned and project adjustments:**

No project adjustments have been needed. However, the importance of ensuring that the PIs on projects B73 and B70 collaborate closely to ensure that FEAST is designed with the capability of providing the data needed to apply the “assessment” methods to be evaluated is clear from the planning effort undertaken to date.

#### **Integration activity:**

The PIs of projects B73 and B70 have collaborated on the documentation for the FEAST model and to ensure that FEAST is able to provide the structure needed for the MSE analyses.

#### **Education and Outreach:**

N/A

#### **Next year's Workplan:**

The workplan outlined below is tentative. However, with a postdoctoral fellow now appointed we expect substantial progress to occur rapidly. A key reason for the tentative nature of the workplan is that Drs Punt and Ianelli have been fully engaged in the NPFMC (and PFMC) activities during September (Dr Punt only returned from Australia in mid-September). A formal workplan will be developed once the PIs (and Dr Moffitt) are back in Seattle (likely after the October BSIERP PI meeting).

2009-2012 Tasks, Assignments, Timeline

<i>What</i>	<i>Who</i>	<i>Completion date</i>	<i>Task duration (Project Months)</i>	<i>Notes</i>
Appointment of Post Doc	André Punt	1 Jan 2009		Completed (1 Sept 2009)
Project overview, how they may relate to NMFS and Council objectives	PI's, PostDoc	Feb 4 2009		Completed (4 Feb 2009)
Selection of "assessment" models	PIs, PostDoc	31 December 2009	1-3	In progress.
Mathematical specifications for all "assessment" models drafted and circulated	PostDoc	31 December 2009	2-4	Will be provided to original authors of the methods concerned for review / comment
Coding of assessment models completed	Post Doc	30 March 2010	4-9	
Testing of assessment models I completed (application to actual data)	Post Doc	30 June 2010	4-9	
Selection of operating model scenarios	PIs, PostDoc			Involves PIs for B70
Selection of decision rules, assessment methods for further testing, and performance measures	PIs, PostDoc, Model Wshp I	July 2010		Model Workshop I
Testing of assessment models II completed (application to deterministic FEAST data)	Post Doc	30 September 2010	5-12	
Council update on progress	PI, PostDoc	October 2010		Seattle Council meeting focus on objectives
Implementation of data generation using FEAST outcomes	Post Doc	31 October 2010	13-15	
Testing of assessment models III completed (application to stochastic FEAST data)	Post Doc	31 December 2010	13-18	
Publication 1 drafted	PIs, Post Doc	31 December 2010	19-21	
Implementation of decision rules	Post Doc	30 March 2011	19-21	May involve NPFMC, LTK component
Implementation of performance measures	Post Doc	31 March 2011	19-22	May require collaboration with project B71
Contribute to construction of ensemble	Post Doc	30 June 2011	19-30	Depends on ensemble

runs based on tested assessment methods				model component being funded.
Evaluation of management strategies based on outcomes from Wshp I	Post Doc	30 June 2011	19-30	
Review of MSE results, revision of decision rules, assessment methods	PIs, PostDoc, Model Wshp II	July 2011		Model Workshop II
Council update on progress	PI, PostDoc	February 2012		Seattle Council meeting focus on objectives
Evaluation of frequency of how often models need to be updated	PIs, PostDoc	31 March 2012	31-39	Involves PIs for B70
Revised MSE runs completed	PostDoc	31 March 2012	31-39	
Publication 2 drafted, final report		30 June 2012	39-42	

**(Anticipated) key publications and outreach activities**

1. Performance of multi-species and single-species assessment models for the Eastern Bering Sea ecosystem.
2. Can multi-species ecosystem-based management strategies achieve ecosystem objectives for the Eastern Bering Sea fisheries?
3. Results will be presented to relevant advisory bodies (e.g. Plans Teams, SSC, etc.) and the public starting in June 2010 if deemed appropriate by the NPFMC.

# **BSIERP Management Strategy Evaluation project**

February 2009, NPFMC SSC Discussion paper

## **Project Summary**

A formal Management Strategy Evaluation (MSE) has been funded as part of the Bering Sea Integrated Ecosystem Research Project (BSIERP). One of the models central to this work is the “Forage Euphausiid Abundance in Time and Space” (FEAST) which will be used as an operating model to test and evaluate currently developed assessment methods (single and multi-species stock assessment methods and ECOSIM). FEAST is a set of linked models: oceanographic (a ROMS model) N-P-Z, and a spatial ecosystem model. The foraging characteristics within FEAST will have bottom-up and top-down trophic interactions as an emergent property (depending on the current state). Catch from the assessment models will provide feedback to the dynamics of FEAST. The guidelines of Marasco et al. (2007) will be followed to evaluate management strategies in an ecosystem context. The metrics for evaluating the success of the assessment models will be the accuracy (lack of bias) and precision (lack of variance) of key model outputs (such as recruitment and biomass, both in the past and as forecast under given management regimes) when they are fit to data generated (with observation error) from the operating (FEAST) model. The aim will be to provide information about the skill of each model in determining past and current states (hindcast/nowcast) as well as the success of each assessment model when predicting future states from current states. When combined with management decision rules, success will be defined as the ability to keep fish populations and yields above a “best performance” reference point determined from the operating model and the ability to achieve high economic returns. An experiment will be also be performed to determine how often correlative models (including stock assessment models) need to be updated given a (simulated) “intensive field and retrospective sampling season” (in addition to standard monitoring data).

The advertisement for the Postdoctoral Fellow has been drafted and has been circulated. It is planned that the Postdoctoral Fellow will start working on the project sometime in April 2009. The PIs of the FEAST project (Aydin) and the BSIERP economics project (Dalton) will work closely with those for this MSE.

## **Anticipated key publications and outreach activities**

4. Performance of multi-species and single-species assessment models for the Eastern Bering Sea ecosystem.
5. Can multi-species ecosystem-based management strategies achieve ecosystem objectives for the Eastern Bering Sea fisheries?
6. Results will be presented to relevant advisory bodies (e.g. Plans Teams, SSC, etc.) and the public starting in June 2010 if deemed appropriate by the NPFMC.

The responsibilities of the post-doc include the development and application of the Management Strategy Evaluation (MSE) framework to evaluate the performance of multispecies stock assessment models and related decision rules. The MSE research will be conducted at the AFSC, as part of BSIERP. This research will be developed in collaboration with Dr. Jim Ianelli and Dr. Punt. It will include developing software which implements an MSE framework that links to the FEAST model being developed by Dr Kerim Aydin and his research group at AFSC. On the “assessment” side, the post-doc will implement single and multispecies stock assessment methods and decision rules and link these to the MSE framework. Summarizing the estimation ability of the multispecies stock assessment methods and the management performance of the associated decision rules will be important. The project scientists will

work closely with economic modelers and make presentations, and publish methods and results in agency reports, granting organization reports, for management council bodies, and peer-reviewed publications.

## SSC Input

The PIs of this project wish to establish a record of SSC input on specifics for both strategic (plan-based) and tactical (procedural) components of the management strategy evaluations.

## Project activity schedule

<b>~Date</b>	<b>Activity</b>
Feb-2009	Project overview, how they may relate to NMFS and Council objectives
Apr-2009	Selection of preliminary “assessment” models
May-2009	Mathematical specifications for all “assessment” models drafted and circulated
Oct-2009	Coding of assessment models completed
Oct-2009	Testing of assessment models I completed (application to actual data)
Dec-2009	Testing of assessment models II completed (application to deterministic FEAST data)
Feb-2010	Council update on progress
Mar-2010	Implementation of data generation using FEAST outcomes
Jun-2010	Testing of assessment models III completed (application to stochastic FEAST data)
Sep-2010	Publication 1 drafted
Jul-2010	Selection of decision rules, assessment methods for testing, and performance measures
Sep-2010	Implementation of decision rules
Oct-2010	Implementation of performance measures
Feb-2011	Council update on progress
Jun-2011	Contribute to construction of ensemble runs based on tested assessment methods
Jun-2011	Evaluation of management strategies based on outcomes from Wshp I
Jul-2011	Review of MSE results, revision of decision rules, assessment methods
Mar-2012	Evaluation of frequency of how often models need to be updated
Mar-2012	Revised MSE runs completed
Jun-2012	Publication 2 drafted, final report