AGENDA D-1(a)
MARCH/APRIL 2012

MEMORANDUM

TO: Council, SSC and AP Members

FROM: Chris Oliver
Executive Director

ESTIMATED TIME
6 HOURS
ALL D-1 ITEMS

DATE: March 20, 2012

SUBJECT: BSIERP Management Strategy Evaluation report

ACTION REQUIRED

(a) Receive BSIERP Management Strategy Evaluation report.

BACKGROUND

A two-day workshop to discuss a management strategy evaluation (MSE) project in conjunction with the Bering Sea Integrated Ecosystem Program (BSIERP) was held 27 & 28 October 2011 at the Alaska Fisheries Science Center, Seattle. The overall BSIERP is developing complex coupled oceanographic and biological models of the Eastern Bering Sea with specific focus on walleye pollock, Pacific cod, and arrowtooth flounder and their fisheries. This fully integrated model provides a unique tool to compare stock assessment methods (including applications of multi-species models). The MSE project is evaluating trade-offs among different management control rules that can be tested and evaluated against alternative climate scenarios.

The workshop was open to the public and had the following objectives:

1. Provide an update on the Forage and Euphausiid Abundance in Space and Time (FEAST) model.
2. Outline the economic and management models which can be linked to the FEAST model.
3. Identify priority management strategies for evaluation in the balance of the project. These strategies will include methods for how stock assessments will be conducted in future, for how stock assessment outcomes are translated in Overfishing Levels, Acceptable Biological Catches and Total Allowable Catches, and for how time-area constraints will be imposed on harvest. Strategies that include assessments that take multi-species interactions into account may also be explored.
4. Review the suite of climate scenarios to explore.
5. Review approaches for applying multi-species OFL and ABC control rules.

The workshop report is attached as Item D-1(a)(1). The Principal Investigators for the MSE project will be available to provide an overview of the workshop, updated results as available and future plans.

Bering Sea Project
Management Strategies Evaluation Workshop

The Bering Sea Integrated Ecosystem Program (http://bsierp.nprb.org/), funded by the North Pacific Research Board, is developing complex coupled oceanographic and biological models of the Eastern Bering Sea with specific focus on walleye pollock, Pacific cod, and arrowtooth flounder and their fisheries. This fully integrated model provides a unique tool to compare stock assessment methods (including applications of multi-species models). Additionally, trade-offs among different management control rules can be tested and evaluated against alternative climate scenarios.

SCOPE OF WORKSHOP

A two-day workshop was held on 27 & 28 October 2011 at the Alaska Fisheries Science Center, Seattle, with objectives:

1. Provide an update on the Forage and Euphausiid Abundance in Space and Time (FEAST) model.
2. Outline the economic and management models which can be linked to the FEAST model.
3. Identify priority management strategies for evaluation in the balance of the project. These strategies will include methods for how stock assessments will be conducted in future, for how stock assessment outcomes are translated in Overfishing Levels, Acceptable Biological Catches and Total Allowable Catches, and for how time-area constraints will be imposed on harvest. Strategies that include assessments that take multi-species interactions into account may also be explored.
4. Review the suite of climate scenarios to explore.
5. Review approaches for applying multi-species OFL and ABC control rules.

PARTICIPANTS

The workshop was chaired by André Punt, and facilitated by Jim Ianelli and Liz Moffitt. Other presenting participants included Kerim Aydin, Nick Bond, Mike Dalton, Kirstin Holsman, and Ivonne Ortiz. NPFMC members Bill Tweit and John Henderschedt participated, as did NPRB Board member Heather McCarty. NPFMC staff participation included Jane DiCosimo and Diana Stram. Industry representatives included Ed Richardson. A full list of attendees is available on request.

BACKGROUND

Management strategies in the context of Management Strategy Evaluation (MSE) consist of combinations of specifications for how future data will be collected, for the stock assessment method to be applied and for how the results of the stock assessment will be used to set Overfishing Levels, Acceptable Biological Catches, and Total Allowable Catches (Fig. 1).

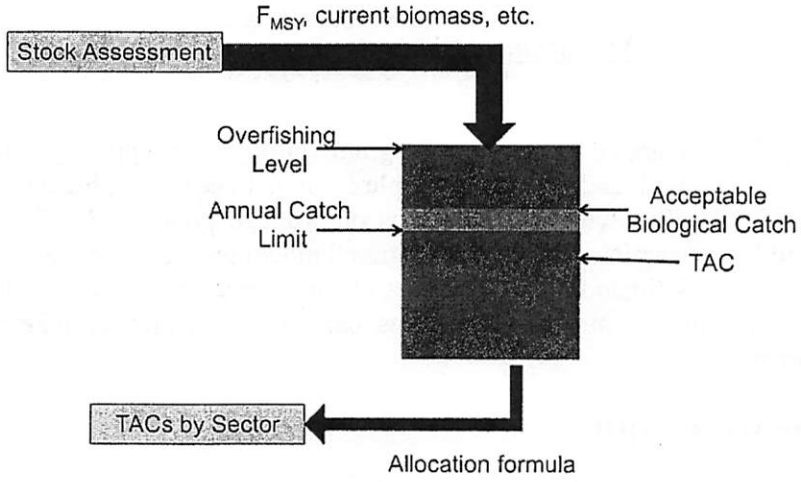

Figure 1. Schematic of a management strategy.

This MSE project will be testing the currently-used single species assessment models for the three species of interest and the multi-species assessment models MSMt and Ecosim. MSMt is a statistical predator-prey assessment model, which includes the three species of interest: pollock, pacific cod, and arrowtooth flounder. The Ecosim model is a food web model that includes the three species of interest plus 20 other species groups.

The MSE project will use the BSIERP vertically-integrated model as the operating model (i.e., the "real world" model in the simulation). The vertically-integrated model consists of multiple linked models: climate; physical oceanography; lower and upper trophic levels; and fishing effort allocation (Fig. 2). Although the MSE project is specifically concerned with fish species in the upper trophic level (FEAST) (Fig. 3), these species interact and are dependent on all other modules in the vertically-integrated model. Therefore, the entire model must be run concurrently. The hindcast will be run for the years 1970-2005 and the forecast will be run for the years 2000-2050.

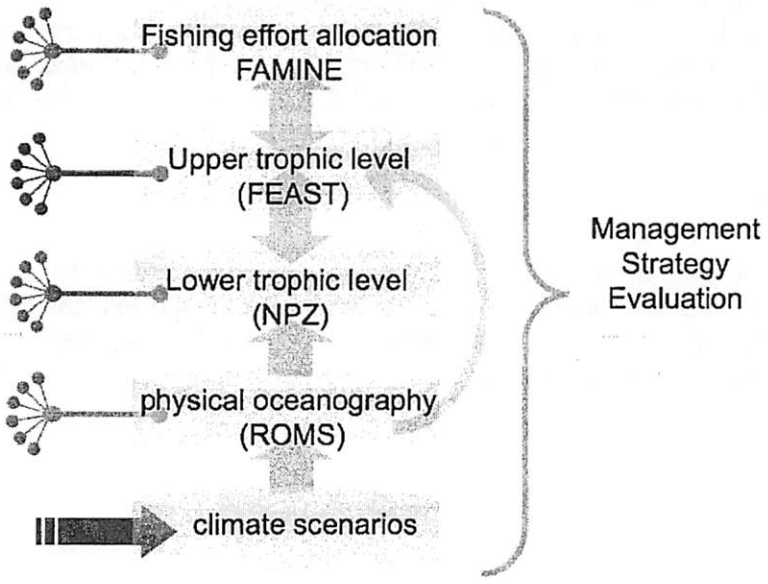

Figure 2. The vertically-integrated model that will be used as the operating model in the management strategy evaluation. Gray arrows represent directions of model linkages.

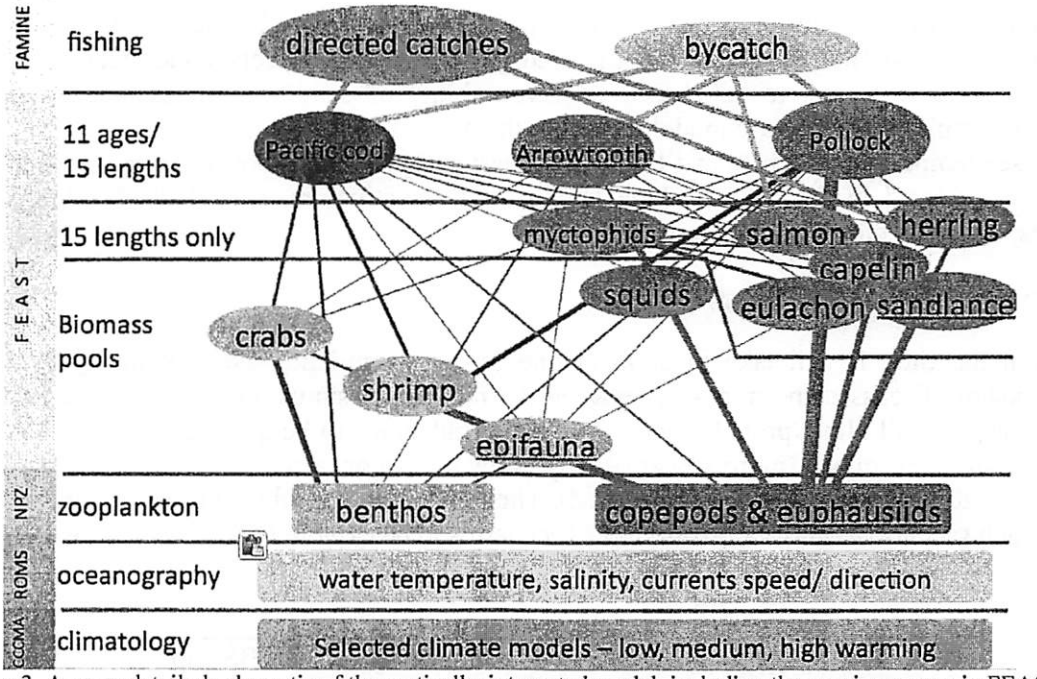

Figure 3. A more detailed schematic of the vertically-integrated model, including the species groups in FEAST.

The scale of the vertically-integrated model consists of a 10x10km horizontal grid in the Eastern Bering Sea (Fig. 4). The modules below FEAST (oceanography-NPZ) are split into 60 vertical depth layers and run at a time step of 10 min. The species in FEAST operate on a daily time step.

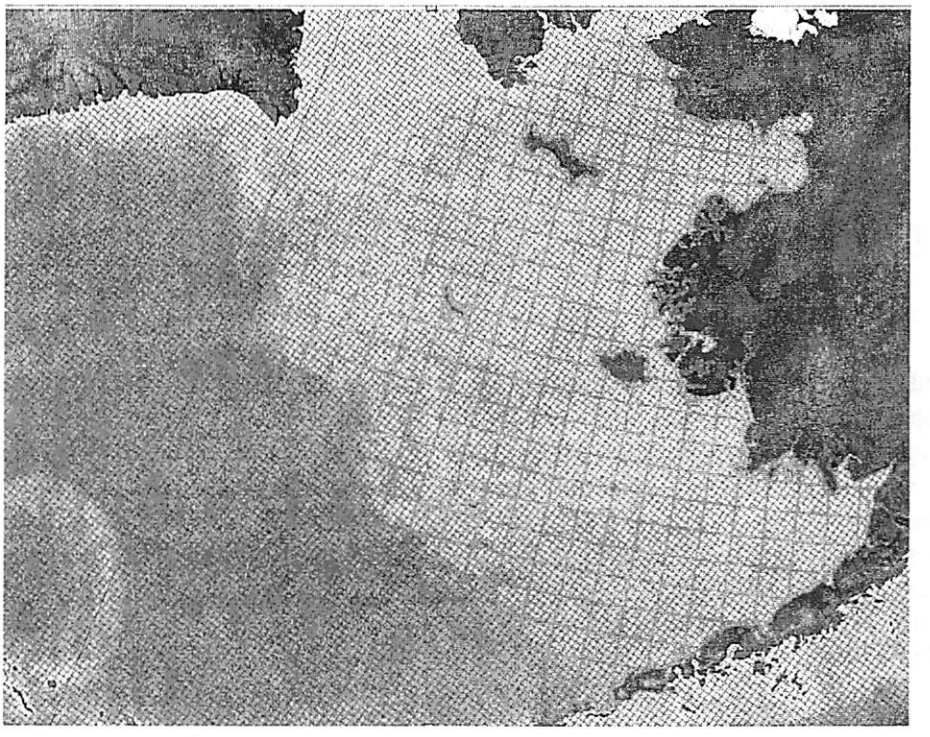

Figure 4. The spatial scale of the MSE (tan area) in the Eastern Bering Sea, Stat 6 management areas (pink), and the 10km vertically-integrated model grid cells (small blue grid).

Fish in FEAST are subject to spatial fishing mortality (determined by the FAMINE model), size- and species-specific predation mortality, and growth via bioenergetics and location conditions. They move from cell to cell based on favourability of conditions in each location. Many oceanographic variables are modelled within the entire vertically integrated model: including air and sea temperatures; winds and tides; ice cover; and plankton blooms. Outputs specific to the fish considered in the MSE include length- and age-structure, spatial distribution, mortality rates, total fish biomass, and recruitment.

WORKSHOP OUTCOMES

Given the time it will take to conduct one 35-year simulation (approximately 7 days), the Workshop discussed the trade-off between the number of simulations for each scenario (more simulations will allow probabilities of particular outcomes to be quantified) versus the number of scenarios examined (more scenarios may allow the major factors influencing the performance of management strategies to be identified). The Workshop agreed to run only a few simulations for each scenario to allow a broader set of scenarios to be explored (Table 1, Figure 5).

Assessment model	Climate model	EBS cap
Single species models	A	2 million t
MSMt	A	2 million t
Ecosim	A	2 million t
Single species models	B	2 million t
MSMt	B	2 million t
Single species models	C	2 million t
Single species models	A	Change cap

Table 1. The consensus on which scenarios to run in forecast for the MSE. The specific climate models to be used are being finalized.

The scenarios identified by the Workshop explore the impact of the type of assessment method (single-species; multi-species, and whole-ecosystem), the climate model used to drive the ROMS model and hence the dynamics of the lower trophic levels, and the impact of the 2 million t cap. The Workshop noted that the results of the MSE should be considered primarily in a relative sense (i.e. the direction and relative amount of change in spawning biomass of pollock between scenarios will be the focus, rather than the absolute biomass). The Workshop noted that fewer strategies will be examined than originally anticipated because of the time it has taken to develop the vertically-integrated model, as well as because of the time it takes to run this model. However, once developed, additional scenarios could be explored with relatively little additional work.

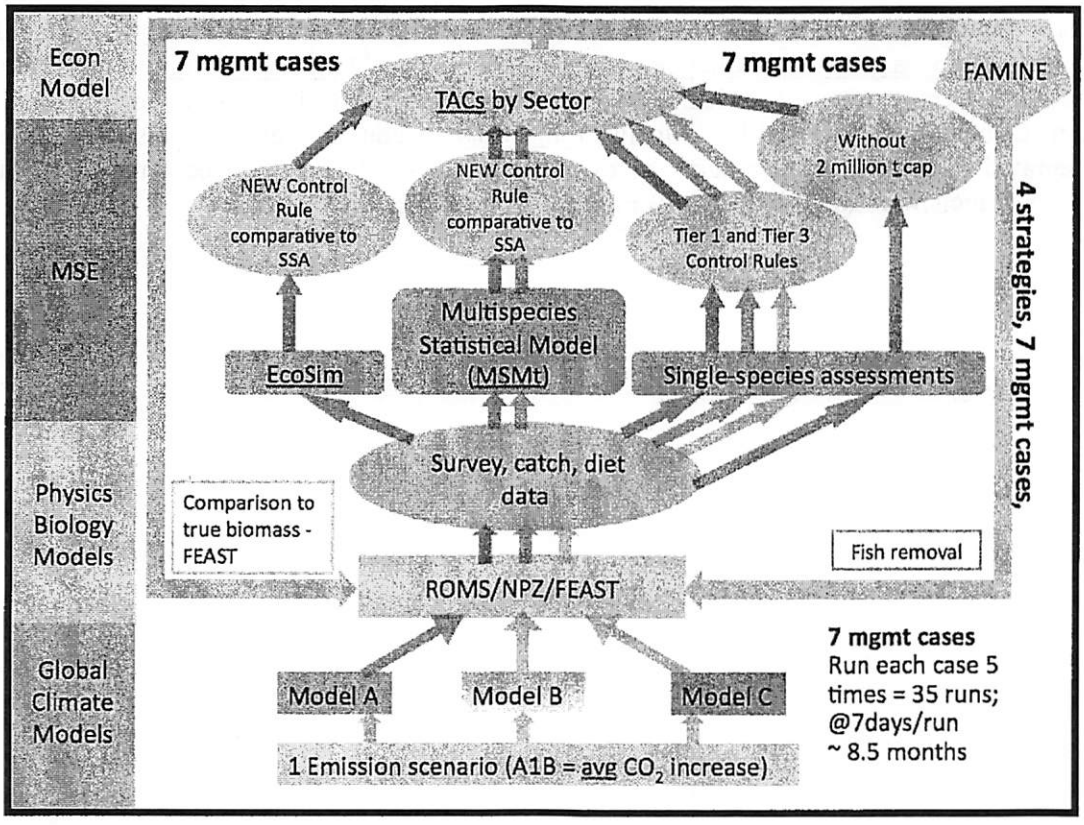

Figure 5. The general plan for the MSE project as determined by the October 27-28 2011 workshop.

The Workshop noted that many multi-species and whole-ecosystem models have been developed, and several of these have been applied to the Bering Sea ecosystem. However, these models have not been used for tactical fisheries management advice, e.g. to provide advice on Acceptable Biological Catches. The Workshop identified nine possible ways in which the NPFMC control rules could be applied to multi-species and whole-ecosystem models, with the aim that these ways are as comparable as possible to how management advice is provided based using single-species assessment models. The Workshop identified one of these ways as a baseline for further work and a second way as a possible sensitivity case, but also recommended further analyses be undertaken to check that the selected methods perform reasonably before basing simulations on them. This work is currently being done.

Results from this workshop have been documented in a technical report and given in a presentation and poster at the Alaska Marine Science Symposium in January 2012.

NEXT STEPS

We will continue to develop the options for multispecies harvest control rules. Further discussion on the general results of this workshop will occur at the BSIERP PI meeting in March 2012. A second workshop will be planned for late 2012.

RESOURCES

More detailed information in the form of workshop presentations is available at ftp://ftp.afsc.noaa.gov/afsc/public/plan_team/MSEworkshop/BSIERPmse.htm. For the full Technical Report or specific MSE workshop questions contact the workshop organizers André Punt (aepunt@uw.edu) or Liz Moffitt (emoffitt@uw.edu). General questions about the integrated modelling work and/or the overall Bering Sea Project can be directed to Francis Wiese (francis.wiese@nprb.org) or Tom Van Pelt (tvanpelt@nprb.org).