IPHC Scientific Review Board Meeting

October 2014

Dr Sean P. Cox, Associate Professor, School of Resource and Environmental Management, Simon Fraser University, 8888 University Dr., Burnaby, B.C., Canada V5A 1S6
Dr James Ianelli, Research Scientist, National Marine Fisheries Service-NOAA, 7600 Sand Pt Way NE, Seattle, WA, USA 98115
Dr Marc Mangel, Distinguished Research Professor and Director, Center for Stock Assessment Research, University of California, Santa Cruz, CA 95064

18 November 2014

Overview

We were asked to comment on both

- 2013-14 progress on SRB Oct 2013 recommendations

and

- 2014 progress on SRB June 2014 recommendations.

General comments

Although we feel reasonably well informed about the stock assessment data and models, our future contributions to IPHC science and stock assessment research will require detailed mathematical specifications of the models in the assessment ensemble, as well as dynamic pool and operating models used for the MSE. Specifically, we will need formal descriptions of the models, including the equations and explanations of how parameters are determined. We are cognizant of the time requirements of IPHC staff, so this material can be reported to us as the methods section of a putative paper.

Additionally, providing the key input files (e.g., for 2014 SS3 model runs) might help in future to pick up on details that are difficult to portray in a presentation. This would allow the SRB to learn more about the configuration, assumptions, and overall results by running the model and looking at specific outputs.

It is clear that the fishery has been dominated by the 1987 year-class, which was exceptional, and for that reason management has been buffered in a way that we cannot expect in the foreseeable future. We encourage the IPHC staff to start thinking now about the potential scientific and management implications of those issues.

Response to specific IPHC questions

1. How should alternative models and sources of uncertainty be best incorporated into the 2014 ensemble and decision table results?

We recommend adopting the expanded catch table, but with revisions as discussed for presentation, namely to present table sub-sections in any PPT presentations and the full table in assessment documents.

1a. Candidate stock assessment models for the 2014 ensemble

Comments on the candidate models for the 2014 ensemble

VPA-ADAPT is based on the tenuous assumption that age-specific survey trends and observation errors are independent. We note differences in scale, but similar trends between this model and other candidates for the ensemble and the terminal spawning biomass estimates were very similar to the coastwide model. The ***VPA-ADAPT*** retrospective pattern is not very good, which seems to be typical of this approach.

The ***Areas As Fleets (AAF)*** model is based on assumptions that are similar to the coastwide assessment model, but takes better account of spatial differences in fishery selectivity. We suggest a review of the female and male selectivity-at-age functions because there appears to be some constraint in how much these can vary between fleets (or over time?). Consistent appearance of males at older ages in this model should be investigated.

In the ***AAF-Long*** model, area-specific weight-at-age is difficult to obtain outside the short period. We consider it worth investigating how area-specific weight-at-age assumptions affect differences between the ***AAF-Short*** and ***AAF-Long*** models over a comparable period (i.e., the short period).

We note that the ***AAF-Long*** model fit shows odd residuals at the extra 20-year-old plus group, as well as some other areas, and we suggest closer investigation of these patterns.

In the ***Coastwide-Short***, model the plus group was over-estimated for the period 1997-2001 and there was a large plus-group residual at age-20 that should be investigated. The retrospective pattern is slightly worse than the ***AAF-Short*** model.

For the ***Coastwide-Long*** model, we encourage IPHC staff to investigate why higher natural mortality (M) leads to higher biomass and lower M implies lower biomass (this is possibly caused by linear growth). This is a puzzle worth solving.

Recommendations

We recommend the following models for the 2014 ensemble: ***Coastwide-Short***, ***Coastwide-Long***, ***AAF-Short***, and ***AAF-Long***.

1b. What aspects of data analysis and stock assessment model development should be prioritized for 2015?

We suggest that IPHC staff consider adding a spatial model component to the ensemble by fitting area-specific models with halibut movement/exchange among areas. For example, one could explore a multi-stock delay-difference approach. In addition, a model in which movement propensities were fit (called a gravity model by the UBC crowd) to generate Markov movement probabilities could be explored.

It appears to us that uncertainty in the Bering Sea indices is under-estimated since, as far as we can tell, only the point estimates are used in the calibration. We recommend investigating methods for propagating trawl survey measurement errors through the trawl-longline survey calibration model.

Sensitivity to the AAF models' assumed weight-at-age by fleet should be conducted and where possible, regional estimates should be developed (or defended if data are limited).

More study on halibut abundances in the EBS should be pursued, particularly if resources become available for another calibration survey. Also, it may be possible to more explicitly evaluate the EBS model (see Appendix) compared to the coastwide model to provide a better accounting for U26 fish. Also the comment about assumed observation errors in the EBS setline index being small also would apply to this analysis.

An evaluation of models using discard mortality parameters within the model (with a prior) should be pursued.

The SPR image is effective at communicating what is probably non-intuitive to most Commissioners and stakeholders. The approach presented to us is one possibility, but we recommend trying some variations. For instance, one could use a single halibut, chopped into various pieces. If SPR is going to be a major tool, we suggest that the Commission invest in a design and communications specialist to develop the most informative communications tool. In addition, F_{SPR} implied by F_{MSY} should be explored. Finally, we note that SPR calculations in the assessment and in the catch tables are different.

A communications consultant could also help in a developing a graphical explanation of replacement yield and surplus production based on existing stock assessment models.

2. Is the coastwide operating model structure appropriate for use by the MSAB and Commission?

We note the progress made over the past year on the coastwide halibut operating model. There has been considerable progress in two directions. First, IPHC staff developed a steady state analytical framework for addressing interrelationships among halibut biology, size and slot limits, discard mortality rates, and catch composition among fleets. The web-based platform and interface are critically important for the future MSE process for halibut, because it provides a vehicle to engage stakeholders (and commissioners) in the analytical process. Stakeholder ownership is the single most important factor in establishing a productive MSE process and the web-based interface represents a way for stakeholders to get involved and stay informed.

Our recommendations are these:

a. IPHC staff should continue developing the web-based interface as well as an efficient mechanism for training stakeholders. In particular, (i) add a "Biology" tab to the interface to summarize biological assumptions and data, (ii) include a long-term projection from one of the current assessment models to demonstrate what is meant by "equilibrium" and how it relates to the current assessment.

b. Rapid feedback will probably be important for non-IPHC users of the web-based model. Considerably faster response times may be achieved using simulation methods applied in other contexts (e.g., climate models, cosmology, complex systems); see Lee (2004), Kaufman et al. (2011), Wolters and Bingham (2011), and Gramacy and Lian (2012). Briefly, these methods pre-compute simulation model outputs over a high-dimensional grid of control inputs and then fit statistical models to the outputs. Treating the output like a spatial model, for example, allows one to apply powerful tools such as Bayesian spatial hierarchical models in which the outputs at unsampled points can be modeled via GLMs for the deterministic part and conditional auto-regressive spatial effects for the random parts. Output from these models would be nearly instantaneous to compute and therefore useful for rapid feedback as well as for designing simulation experiments. Cox and Mangel have colleagues who work exactly in this area and will gladly provide introductions for IPHC staff.

   It may be worthwhile exploring the possibility of a statistics graduate student supported at UCSC or SFU to do this work.

c. It is highly likely that the Commission will continue to rely on statistical catch-at-age (SCAA) modeling for annual assessments. Therefore, we recommend investigating a fast and efficient SCAA model (e.g., short

coastwide) for use in preliminary MSE simulations. Some research will be needed on the structure of age-composition errors and biases if the simulations are to be representative of future SCAA model performance.

d. Investigate methods to characterize historical TAC decision-making behaviour well enough to be captured in quantitative models. MSE simulations will need to be "believable" to stakeholders in the sense that decision outputs from the simulations should be consistent with historical decisions under similar circumstances.

References

R.B. Gramacy, H. Lian. 2012. Gaussian process single-index models as emulators for computer experiments. *Technometrics*, 54: 30-41

Kaufman, C., Bingham, D., Habib, S., Heitman, K. and Friedman, J. 2011, "Efficient Emulators of Computer Experiments Using Compactly Supported Correlation Functions with an Application to Cosmology", *Annals of Applied Statistics*, 5, 2470-2492. □

Lee. H.K.H. 2004. Bayesian Nonparametrics via Neural Networks. ASA-SIAM Series in Statistics and Applied Probability, SIAM, Philadelphia, PA

Wolters, M.A. and Bingham, D. 2011. Simulated Annealing Model Search for Subset Selection in Screening Experiments. *Technometrics*, 53: 225-237.

Appendix: Eastern Bering Sea (EBS) Model of Juvenile Halibut Population Dynamics

The EBS model was developed to investigate patterns in apparent mortality rates of small halibut occupying this region and captured in EBS trawl surveys. Trawl survey catch rates in EBS indicate an increase in abundance around 2006 followed by decline. There is no directed halibut fishing in this region, so inter-annual variation in estimated mortality rates should arise from some combination of (i) natural mortality; (ii) emigration from the region; (iii) bycatch mortality in non-halibut fisheries; and (iv) survey catchability, which could change with environmental factors (e.g., temperature) similar to other flatfishes in the region.

The EBS model is an interesting initial exploration into the possible linkages between halibut in the EBS and the Gulf of Alaska. We therefore recommend continuing investigations with this model. For instance, the model could be used to compute a net export of halibut from the EBS to compare with expected juvenile input the GOA. Trawl survey estimates averaging approximately 330 million pounds of mainly small (juvenile) halibut are much larger than the estimated juvenile halibut bycatch in the region, which is approximately 4 million pounds. It would be useful to determine whether the apparent bycatch mortality derived from this model (e.g., 100% x (4/330) = 1.2%) is on the appropriate scale.