4.7 Reports of the IPHC Scientific Review Board (SRB)

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Two reports are included here:

1. IPHC Scientific Review Board Meeting - June 2016, Seattle, WA, USA (link)
2. Report of the 9th Session of the Scientific Review Board (SRB09) — 27-29 September, 2016, Seattle, WA, USA (link)

IPHC Scientific Review Board Meeting

June 2016

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Overview

We met on 21-22 June 2016 to review the data and model development completed during 2016 and to provide strategic guidance for the upcoming 2016 stock assessment and management process.

Spatio-Temporal Survey (STS) modeling of the IPHC survey: a model-based survey index of abundance and biomass

We are very pleased to see the application of a statistical spatio-temporal model (INLA: integrated nested Laplace approximation; details at http://www.r-inla.org/) to the extensive IPHC survey data. The STS model makes better use of the available data in computing survey abundance indices coastwide and by regulatory area, and because of its Bayesian structure, forces one to be honest about uncertainties.

We also see this as an improved approach over the simple regulatory-area mean estimate for interpolating missing station values. For example, the Strait of Georgia predicted values more closely resemble nearby Area 2A observations than either the overall 2B mean or values closer to the more distant 2C survey. Although these missing values are filled in, they don't contribute that much to overall regulatory area or coast-wide means because their prediction uncertainty is high—the regulatory-area means are a weighted combination of station means, where the weights are higher for more certain stations and lower for more uncertain stations such as those based only on predictions.

In response to specific IPHC staff questions, we SRB recommend:

1. Using the new STS model rather than *ad hoc* adjustment factors to predict survey CPUE at missing survey stations (due to incomplete coverage of bottom area, failed sets, etc.). The model-predicted values better propagate the uncertainty arising from filling in the missing values;
2. Generating predicted STS model values at missing locales by station rather than by station bottom depth because the latter will involve uncertainties associated with depth effects that are not well-understood at this time;
3. Using the new STS model coast-wide and regulatory-area abundance indices for the 2016 assessment and apportionment. The STS model is more consistent with the original survey design and intent of apportionment, compared to the more *ad hoc* adjustment factors and post-smoothing survey time series via the Kalman Filter.

SRB research recommendations

1. Explore some classical metrics of spatial patterning, such as the Negative Binomial k or Moran's I, to summarize patchiness of halibut abundance. These may be useful later to simulate survey observations for the MSE;

2. Explore biogeographical definitions of halibut habitat and then compute STS biomass indices for each since this type of classification is more realistic biologically than arbitrary regulatory-areas;
3. Consider the feasibility/utility of coding the STS model via Template Model Builder. The automatic differentiation capability of TMB could allow evaluation of anisotropy (i.e., that the spatial correlation is not the same in all directions) as well as the benefits of applying the STS model across the entire survey range rather than by regulatory-area.
4. Consider expanding the mesh size somewhat to make the current INLA model more computationally efficient.
5. Compare versions of the model fit to O32 Pacific halibut versus all sizes.
6. Consider including a covariate on depth, which may reduce sensitivity to the isotropy assumption (i.e., that the spatial correlation is the same in all directions).

Biological and Ecosystem Science Program

The proposed ecosystem work, which includes genetic methods for sexing fish, temperature-dependent sex determination, skipped spawning, partial migration, and growth experiments all are interesting and fit squarely into Pasteur's Quadrant (Stokes 1977) in which an important applied problem motivates a search for fundamental understanding. The key will be for the staff to explore synergies between this work and more traditional stock assessment and MSE modeling. The potential here is enormous, but there is also the potential for the two work streams to become isolated.

Our specific concern relative to the growth studies is understanding how changes in diet and variable food availability (as observed from stomach content data) may impact Pacific halibut growth in the wild.

Stock assessment modeling for 2016

IPHC staff described progress toward fishery-based estimates of sex ratios in the catch - we are especially encouraged that this work has been popular (particularly in 2B).

Staff presented the development of a spatial model, which results in 21 fishing fleets. With staff, we discussed complexities and trade-offs of assuming fixed movements between areas and regional recruitment patterns. The tagging data are aggregated over sex and this is an apparent limitation since the survey suggests old males are relatively abundant in the GOA and females appear to moving from area 3 down to area 2. It might be worthwhile to propose hypothetical recruitment-by-area scenarios, and then compute the biomass spatial distribution at equilibrium, contrasting results based on (for example):

i. average weight-at-age for all areas vs area-specific weight-at-age;
ii. fishing vs no fishing;
iii. alternative movement rates among areas.

A spatial yield per recruit analysis could be derived each of the above scenarios given the biomass spatial distribution.

Subjective weighting is a common problem in ensemble modeling and IPHC staff have made progress exploring more objective ways of evaluating relative model performance. We encourage further exploration of methods for objectively weighting models based on both retrospective performance (i.e., comparing historical model estimates over time) and prospective performance (comparing model ability to predict new data).

We recommend that IPHC staff begin developing a series of data benchmarks that acceptable stock assessment models need to capture. Inevitably, there will be differences between model predictions and observations; the key is to determine the particular observations that must be captured by a model (e.g., juvenile catch in the Bering Sea or the downstream effects of direct exploitation) as opposed to observations that are probably less important (e.g., early 20th century removals). The goal may not necessarily be to make the best possible halibut model but to make the one that is the best for addressing current (i.e., stock assessment) and future (i.e., MSE) management issues.

Halibut fishery MSE

In our June 2015 report, we recommended that MSAB move forward under the original charge of making progress on evaluating management procedures for the halibut fishery. We were encouraged by the progress over 2016. Although most of the progress was organizational and more related to objectives, these provide the clarity of purpose and focus needed for progress by the science team.

Work-plans

The work-plans all show high potential for synergy. We particularly encourage IPHC staff to further integrate the proposed ecosystem work into the stock assessment model, perhaps in the short term by helping to develop growth models based on environmental factors. A clear link might also include specific advice on how the PDO is presently applied and how that might be refined based on some of the growth studies underway and planned.

Citations

Stokes, D. 1997. *Pasteur's Quadrant. Basic Science and Technological Change.* Brookings Institution Press, Washington, DC

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INTERNATIONAL PACIFIC HALIBUT COMMISSION

IPHC-2016-SRB09-R

Report of the 9th Session of the IPHC Scientific Review Board (SRB09)

Seattle, United States of America, 27–29 September 2016

DISTRIBUTION:
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BIBLIOGRAPHIC ENTRY
IPHC 2016. Report of the 9th Session of the IPHC Scientific Review Board (SRB09). Seattle, Washington, U.S.A., 27–29 September 2016. *IPHC–2016–SRB09–R, 5 pp.*

IPHC-2016-SRB09-R

IPHC Scientific Review Board Meeting

September 2016

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Overview

We met on 27-29 September 2016 for 1 full day and two half days. IPHC staff requested that we prepare a brief commentary to the Commission summarizing our discussions, conclusions, and comments on research priorities for early 2017.

We begin, as in June, by noting that in the last 2.5 years, IPHC scientists and the SRB have developed a successful pattern in which the June meeting is the major one for input from the SRB, giving IPHC scientists the time between June and the end of September to develop and investigate the ideas we discuss. The September in-person meeting and the December teleconference are then effectively used to fine-tune the developments before the Annual meeting. We recommend that this pattern of non-confrontational, but critical, advice become the norm for SRB interactions with IPHC scientists.

Geostatistical approach to survey indices

Dr. Webster presented a refinement of the new geostatistical approach (GeoStat) to computing biomass indices from the IPHC survey data that he introduced to us in June. To minimize confusion with past methods, we propose a standard naming convention for the new "Geostat Approach" and the previous "Empirical Approach."

The GeoStat approach exploits the well-known spatial and temporal coherence of halibut abundance. It is a uniform treatment of the survey data informed by knowledge of halibut biology.

We continue to support the GeoStat approach because it takes into account the space and time components of fish distribution that fishermen and the public can understand and relate to – that is, where spatial patches of biomass hotspots persist over time. By accounting for these patterns, the GeoStat approach can be used to fill-in survey gaps without resorting to ad-hoc expansion and correction factors as has been done in the past. Ultimately, the GeoStat approach provides more realistic and reliable estimates of uncertainty in biomass indices derived from the coastwide survey.

Recommendations for the GeoStat approach:

1. NOAA's Auke Bay Lab (ABL) longline survey data should continue to be applied to help with edge effects for deeper depth areas;
2. The Commission should put a high priority on staff publishing the GeoStat approach in a peer-reviewed journal because it will be an important contribution to both the statistical and the fisheries literature.

Survey timing adjustment

The current approach to adjusting survey biomass indices is circular via dependence on the outdated notion of coastwide exploitable biomass (i.e., EBio). The survey timing adjustment is meant to account for the local harvest rate within a regulatory area; however, there is no simple way to estimate that harvest rate. Noting that harvest rates have generally declined in all regulatory areas toward area-specific targets, **we recommend simplifying the timing adjustment by using the area-specific harvest rates in the computation rather than the estimated**

area-specific harvest rates. This alternative will provide a more transparent (i.e., non-circular) and stable survey timing adjustment.

We also request that, in the future IPHC provide detailed mathematical specifications for models and analyses that we are expected to comment on.

Hook competition adjustment
IPHC analysts moved the hook competition adjustment to the surveys at the station level, which is preferred over the previous method that applied the adjustment region-wide. We consider this to be a further refinement and improvement in the analysis.

Other matters: survey expansion
Cook Inlet bathymetry and tidal effects raised some concerns about expansion to areas that are questionable Pacific halibut habitat. We encourage staff scientists to continue to think about novel ways of handling this issue.

Extending results among other areas using meta-analysis may provide a way to illicit prior distributions on some coefficients used in the GeoStat approach. For example, the relationship of halibut density and depth seems to be similar in most areas and less well defined in others. Using such results from other areas as priors may help and this is something that might be evaluated in the future (short of doing a coast-wide simultaneous estimation).

Stock assessment overview

Dr. Stewart began the presentation with an overview of bycatch, wastage, and other sources of Pacific halibut mortality. He developed a new system for presenting the information needed to help determine what data will most improve estimates of fish handled, discarded, and killed. The current version captures the ideas well and is ready to go public provided that the presentation carefully builds in a sequence such as; e.g.,

1. Mean Total not retained
2. Range of total not retained
3. Mean DMR
4. Range of DMR
5. Range of dead fish

We also recommend clarifying the assumptions about observer coverage by gear type, in particular for the GOA trawl and longline gears.

Spatially explicit stock assessment model
The spatially explicit model is meant as a strategic tool for testing alternative harvest strategies. We don't foresee this as a tactical model for near term use in developing harvest recommendations. If it were a tactical model, then it would need to sufficiently explain most, but not all, of the observed data. As a strategic tool, the spatially explicit model should be able to explain certain parts of the data depending on the hypotheses being represented.

We suggest reducing the emphasis on accurately predicting how particular strong year-classes propagate (apparently) from the Bering Sea shelf region and instead, determine what types of observations would need to be explained for the model to be considered plausible enough for harvest strategy evaluation. For instance, there may be metrics that could be predicted well by the spatial model (e.g., average delays between recruitment and survey cpue in distant areas).

Including the NMFS trawl survey data in the spatial model may show the relative paucity of juveniles and pre-recruits in the region and may help with some alternative hypotheses on movement dynamics.

Management strategy work

Abundance Based Management
Dr. Hicks presented recent activities related to North Pacific Fishery Management Council's action on developing an abundance-based Pacific halibut bycatch limit (known as "Prohibited Species Catch" or PSC limit).

The main issue for this activity involves evaluating tradeoffs between constraints to the non-Pacific halibut groundfish fishery and the economic impacts of bycatch allocation to directed Pacific halibut fishing communities in area 4CDE.

We note that time-varying PSCs could affect the 2nd line of the decision table used to inform annual harvest decisions. We suggest **examining the SPR rates due to bycatch in a sensitivity context; e.g., what would a blue-line SPR be under zero by-catch, current level, and double the anticipated by-catch.** This may show the impact on the remaining directed fishery allowances and also show the relative consequence/footprint on coast-wide SPR rate estimates.

Current and planned harvest policy developments

The second part of the presentation included an examination of the current harvest policy by the IPHC. This included an overview of the different metrics and decision tables used and how the Commission has recommended catch scenarios compared to a reference level (the blue line). We suggest evaluating near-term harvest relative to the actual average harvest rates rather than blue-line values.

Together with staff scientists, we discussed the issues and problems related to the EBIO calculation; it became clear that there is an inconsistency between this value and the recent assessments. In particular, the EBIO calculation is based on assumptions of selectivity by area that are unlikely to represent current selectivity patterns. **We recommend that the EBIO calculation be phased out as it was made clear that the estimates may be misleading and alternatives can be developed (e.g., the implied SPR rate from recent years).** We also agree with the staff that SPR estimates provide a more consistent way to evaluate catch specifications relative to impacts on spawning biomass.

We also recommend that other measures of fishing intensity be explored. One example includes the spawning-exploitation harvest rate, which is simply the 1-(B/A) where "B" is the actual estimated spawning biomass estimate at the end of the year and "A" is the spawning biomass estimated *in the absence of fishing*. While this measure tends to exclude harvests of immature Pacific halibut, it does provide an alternative simple approach that should be comparable from year to year. If a target rate is developed, then consideration of catches of immature Pacific halibut would be explicitly included (i.e., given a selection pattern overall for different ages).

We also discussed the current area-specific harvest rates and noted that the history of the 16% and 20% rates were originally based on having a lower rate in areas that were perceived to have greater uncertainty. Also there were apparent differences in yield per recruit between regions. Without the EBIO calculation, the proposal involves embedding these rates (which were revised to 16.125% and 21.5%) in the apportionment procedure where area-specific rate would be combined with relative biomass. For background on SRB discussions about apportionment, please refer to the first SRB report.

Biological Research

Dr. Planas presented all the different types of research activities underway and planned at the IPHC. This included reproductive studies and sex-determination evaluations including genetic sex markers (SNP assays).

Growth studies proposed on Pacific halibut include using fish in captivity to evaluate molecular growth measures. This includes evaluating alternative feeding and temperature settings in the lab. Deliverables include identification of growth markers from field studies (fast vs slow growers). We asked about size-at-age and how traditional methods (e.g., observed differences in size at age from direct measure) compare.

Dr. Planas presented a variety of activities related to estimating discard mortality rates.

We note that, for trawl bycatch DMRs, it will be important to cover a broad range of the types of vessels (weighted perhaps by fisheries where most of the bycatch occurs) and also coordinate with the NOAA observer program is used in grading halibut condition.

We recommend that staff consider simulation studies to evaluate the effectiveness of different types of tagging programs and data requirements needed to address mortality estimates.

Migration patterns via genetics, elemental, and isotopic information of adults was discussed. It was raised whether some of the isolation by distance studies can be used to evaluate how areas might be connected and if the current movement estimates are consistent with these.

We are delighted to see the Commission scientists working in collaboration with other agencies and universities. This research is more academic than much of that done at the Commission, but has the potential for great synergies with the Commission's applied work. When done properly, it will sit squarely in Pasteur's Quadrant (Stokes 1997) in which an important applied problem motivates a search for basic understanding.

Other business

Jim Ianelli will attend the Interim Meeting in Seattle.

Reference

Stokes, D. 1997. *Pasteur's Quadrant.* Brookings Institution Press, Washington, DC