Methods for spatial survey modelling - Update on work since June SRB10 meeting

PREPARED BY: IPHC SECRETARIAT (R. WEBSTER; 29 AUGUST 2017)

PURPOSE

To update SRB members on space-time related modelling work undertaken since the June 2017 meeting.

BACKGROUND/INTRODUCTION

In 2016, IPHC Secretariat staff began using a space-time modelling approach to estimate indices of density and biomass for use in stock assessment modelling and estimation of stock distribution. Among other advantages over the previous empirical method, the modelling allows easy integration of data from expansions of the IPHC fishery-independent setline survey (FISS), removing the need for computing ad-hoc adjustment scalars each time new regions are covered by the survey. Further, the space-time modelling can be used to evaluate the benefits of periodic survey expansions into waters that are not covered annually by the FISS. At the June 2017 meeting of the SRB, the IPHC Secretariat presented an evaluation of the effect of FISS expansions in IPHC Regulatory Areas 2A and 4A on relative error and precision of the mean weight-per-unit-effort (WPUE) index estimated from the modelling. A version of the evaluation report addressing SRB suggestions has been prepared for the IPHC Commissioners' work meeting. The Secretariat's response to the SRB is also presented in this report for discussion with SRB members, along with a summary of space-time modelling-related work undertaken since the June SRB meeting.

IPHC REGULATORY AREA 2A AND 4A EVALUATIONS

At the June SRB meeting, the IPHC Secretariat presented the SRB with an evaluation of the 2011 and 2014 FISS expansions in Regulatory Areas 2A and 4A. The evaluation involved comparing posterior mean WPUE values from reduced data sets that excluded groups of expansion stations to estimates from the full data. In particular, we examined the effect of expansion stations on relative error and precision on the WPUE index for these areas.

The SRB had made suggestions regarding how best to summarise the implications of the results of the evaluations. In our report for the IPHC Commissioners' September Work Meeting, we included the text and Table 1 below. We welcome further SRB input on how these results should be effectively conveyed to Commissioners and stakeholders.

Based on the assessment of the data presented in this report, we have given a recommendation of the future FISS frequency in expansion regions. This recommendation is based on a region's influence on the overall density indices for its Regulatory Area, which is affected by its density, variability and size (number of stations). Northern California north of 40°N, represents the southern limit of Pacific halibut at densities significantly above zero, and as such a case can be made for relatively frequent FISS here in order to monitor whether the Pacific halibut range is increasing or retracting. Data here also influence estimates in the low density regions further south, which after 2017 will only have been surveyed once or twice, something that is not the case with regions adjacent to the Salish Sea.

Table 1. Summary of FISS expansion data and recommendations for future survey frequency.

IPHC Regulatory Area	Expansion region	Density†	Variability (spatial/ temporal)	Recommend FISS frequency
2A	Deep and shallow waters	Low	Low	≥ 10 years
2A	Salish Sea	Low-average	High	5 years
2A	Northern California	Average above 40°N; low south of 40°N	Average (during expansion period 2011-2014)	3-5 years
4A	Aleutian Islands	High	High	3-5 years
4A	Shelf edge	Average	Low	≥ 10 years

† Density relative to annually surveyed parts of the regulatory area

The SRB made several other suggestions in their report of the June 2017 meeting (IPHC-2017-SRB10-R), some of which were beyond the scientific focus of current evaluation (examination of revenue and cost-recovery; cost benefit analyses) and could be examined in future work, while one other (precision goal for coastwide biomass index) requires further discussion among the IPHC Secretariat. A suggestion to forecast the effect on CV of the presence or absence of expansion FISS stations is something we have considered and could comprise a significant future project. The remaining suggestions (plotting relative error against number of stations; comparison of frequency of zeros between standard and expansion FISS stations) are more straightforward, and can be examined once the 2017 FISS expansion data are available. It is likely that many of the SRB's requests will be most usefully considered once the full FISS expansion is completed in 2019 and a comprehensive evaluation of all FISS expansion data can be undertaken.

OTHER UPDATES SINCE JUNE 2017

No new modelling has been undertaken since the June 2017 SRB meeting, and updates to the models discussed at that meeting will await the completion of data entry from the 2017 FISS. The following items of work have been addressed since June:

- Updating of the survey timing adjustment using 2016 data. Following the recommendation of the SRB, calculation of this adjustment now lags a year: the adjustment for the previous year is calculated in the current year, and is also applied to current year's survey data.
- Updating of R code for prediction locations. A number of survey stations' locations have been shifted from their original target locations, notably in Regulatory Area 2B to avoid closures to fishing within protected areas. In 2016, model predictions were made at each station's most recent location. This year, the code is being updated so that the most frequently recorded target location in the database is used. This will suffice until database fields are introduced to indicate the original target locations.
- Bottom area estimates have been revised using the most recent bathymetry data. All changes from previous estimates were minor. Bottom area is used to compile coastwide estimates from regulatory area estimates, and in calculation of stock distribution estimates.
- A journal manuscript on space-time modelling and survey calibration in Regulatory Area 4CDE is in preparation.