Joint U.S.-Canada Scientific Review Group Report for 2018

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3177 196th St. SW
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Introduction

Under the authority of the Agreement Between The Government of The United States of America and The Government of Canada on Pacific Hake/Whiting (hereafter referred to as "the Treaty"), the Scientific Review Group (SRG) met in Lynnwood, Washington, 26 February to 2 March 2018 to review the draft stock assessment document prepared by the Canada/US Joint Technical Committee (JTC), plans for progress on an MSE focused on Pacific Hake/Whiting, and acoustic survey research conducted by both nations in 2017. The SRG based its terms of reference on the language of the Treaty and on the Pacific Fishery Management Council's Stock Assessment and Review (STAR) terms of reference; the Joint Management Committee (JMC) has approved these as the formal Terms of Reference for the SRG. The SRG is composed of two US, two Canadian, and two independent members designated by the JMC, based on recommendations from the Advisory Panel (AP). The JMC also appointed two industry advisors to assist the SRG in its deliberations. This year, the SRG included a new member, Jaclyn Cleary, representing Canada.

The Scientific Review Group provides independent peer review of the Joint Technical Committee's work. The SRG is charged with:

1. Reviewing the stock assessment data and methods and survey methodologies used by the Joint Technical Committee;

2. Providing annually, by March 1 unless otherwise specified by the Joint Management Committee, a written technical report of the stock assessment and its scientific advice on annual potential yield; and

3. Performing other duties and functions as directed by the Joint Management Committee.

The SRG meeting convened at 13:00 Monday, February 26, 2018. Michelle McClure (meeting co-chair) welcomed attendees and after a round of introductions reviewed the agenda (Attachment 1) and SRG Terms of Reference and then assigned reporting duties. It was noted that the SRG was expected to submit its report to the JMC by March 5th. Meeting participants represented the AP, JMC, JTC, Survey Team, MSE Technical Team, and stakeholders (Attachment 2). **Text highlighted in bold through this report is a request from the SRG for more information or analysis.**

Conclusions

The following points summarize the main findings of the SRG with respect to the 2018 stock assessment and acoustic survey research.

1. The structure of the 2018 assessment model is similar to the 2017 model, with the addition of a 2017 survey biomass index value and age-composition data, 2017 fishery catch and age-composition data, weight-at-age data for 2017, and a new age-based maturity ogive. The uncertainty measures in the assessment include only the structure of and processes included in the model. Thus, uncertainty in current stock status and projections is likely underestimated.

2. The SRG considers the 2018 Pacific hake assessment report and appendices to present the best available scientific information. However, it became apparent during our review that the model results and corresponding estimates of stock status (e.g., relative spawning biomass) are strongly affected by the choice of weights-at-age (annual matrix or average vector applied over all years) used in estimating fecundity. As a consequence, the SRG requested that the JTC include two sets of decision and risk tables in its report: one set of tables from the base-case model, which included time-invariant fecundity-at-age (based on the average vector of weights-at-age over all years) and is consistent with previous assessments; the other set from an alternative model using time-varying fecundity-at-age calculated with annual estimates of mean weights-at-age, which is presented in Appendix A of the assessment report. The range of uncertainty of each model includes the median estimate of current spawning biomass estimated by the other model. However, the alternative model estimates that stock status is lower and much closer to the reference point (B_{40}) than the base-case model. This result occurred because the alternative model estimates a higher unfished spawning biomass (B_0) as a consequence of using higher mean weights-at-age in the early years of the time series (1975-1979), which are important in calculating B_0. The SRG notes that the weights-at-age in the 1975-1979 period are the highest in the available time series. The probability that 2018 spawning biomass is below the B_{40} reference point is estimated as 7% by the base-case model and 48% by the alternative model. Despite substantial discussion, the SRG is unable to offer advice at present on which model is more plausible and has requested additional work in the coming year from the JTC to address the issue.

3. An acoustic survey was conducted in 2017, beginning at Point Conception, CA, (34.5°N) and moving northward to Dixon Entrance, BC (54°N). The 2017 survey estimated age 2+ biomass of 1.418 Mt (million tonnes), a 34% decrease from the 2015 survey biomass estimate of 2.156 Mt.

4. The 2017 (last year's) assessment estimated that the 2014 cohort (age-3 fish) was very large and uncertain but influential in the decision tables. The 2014 cohort was fully vulnerable to the 2017 survey as age-3 fish and is estimated to be smaller in size and with less uncertainty about its size than in the 2017 assessment. Based on the 2017 survey and other data, the base model estimates only a 5% probability that the 2014 cohort is larger than the 2010 cohort. The 2010 cohort (age-7 fish in 2017) also has declined in size relative to the 2017 assessment estimate, due to natural slowing of growth, coupled with the effects of natural and fishing mortality. The 2010 cohort was numerically dominant in Canadian fishery catches, while both the 2010 and the 2014 cohorts were numerically dominant in US fishery catches in 2017. The 2016 cohort (age-1 fish in 2017) is estimated to be above average by the base model, but there is only one year of data on which this estimate is based. This cohort was encountered by the survey and the fisheries in both countries. It is unusual for the Canadian fishery to catch age-1 fish.

5. Female Spawning Biomass Estimates

   - The base-case model estimates that median female spawning biomass at the beginning of 2018 is 1.357 Mt, with a 95% credibility interval of 0.610 to 3.161 Mt. This estimate translates to a relative spawning biomass of 66.7% (95% interval from 32.7% to 136.1%).

The joint probability that the stock at the beginning of 2018 is below $B_{40\%}$ and that fishing intensity is above $F_{40\%}$ is estimated to be 5.7%.

- The alternative model estimates that median female spawning biomass at the beginning of 2018 is 1.210 Mt, with a 95% credibility interval of 0.548 to 2.774 Mt. This estimate translates to a relative spawning biomass of 40.7% (95% interval from 19.5% to 80.2%). The corresponding joint probability that the stock at the beginning of 2018 is below $B_{40\%}$ and that fishing intensity is above $F_{40\%}$ is estimated to be 16.4%.

8. Total stock biomass (age 2+, males and females) is estimated to be 3.337 million tonnes (range: 1.485 Mt to 8.987 Mt) by the base-case model and 3.458 Mt (1.489 to 8.646 Mt) by the alternative model.

9. The decision and risk tables presented for the base and alternative models report the expected effects of various catch levels on stock biomass and fishing intensity (a measure of the relative magnitude of fishing often expressed as a percentage) and together, the two tables reflect a substantial amount of the joint uncertainty related to equilibrium assumptions influencing the calculation of unfished biomass, B_0.

   - The base-case model forecasts that median catches of 639,000 t in 2018 and 554,000 t in 2019 could be achievable when fishing at the $F_{40\%}$ reference point, with an equal probability of being above or below the reference point. Applying the default harvest control rule yields an allowable catch of 725,984 t for 2018.

   - The alternative model forecasts that median catches of 668,000 t in 2018 and 582,000 t in 2019 could be achievable when fishing at the $F_{40\%}$ reference point, with an equal probability of being above or below the reference point. Applying the default harvest control rule yields an allowable catch of 583,970 t in 2018. Fishing at $F_{40\%}$ results in higher catch forecasts than the base model because the higher weights-at-age/fecundities-at-age result in higher biomass from which catches are removed in the alternative model.

10. The SRG reviewed the draft work plan of the MSE process for Pacific hake and plans for supporting analyses on environmental drivers of hake spatial distribution and notes that they are well thought-out. These work plans outline steps, timelines, and deliverables for the next two years and are specific, measurable, achievable, realistic, and timely. The SRG supports implementation of these plans.

11. The SRG appreciates that both the Survey Team and the JTC continue to provide high quality analysis and advice to the SRG and for management of the stock.

2018 Stock Assessment

Overview

The 2018 assessment uses the same basic model structure as used in assessments since 2014. Annual catches-at-age in the model begin in 1966 and are modeled as being taken by a single coast-wide fleet. The model is informed by age-composition observations from the fishery, an age 2+ biomass index from the acoustic survey, and observations of survey age composition from trawl samples taken during the survey. Age-specific selectivity for ages 1 to 6 is estimated for the survey and fishery, with constrained annual variation allowed in fishery selection up to age 6. The base model uses a matrix of empirical (observed) weights-at-age to calculate total biomass, but a vector of mean weights-at-age averaged over all years to calculate fecundity and spawning biomass. Using empirical weights-at-age avoids the complexity of modeling growth and size-at-age, which vary considerably from year to year for this species. The base model uses a Bayesian approach for parameter estimation, with informative priors specified for natural mortality and spawner-recruit steepness.

Changes from the 2017 assessment included the addition of the 2017 survey biomass index and corresponding age-composition data, as well as the 2017 fishery catch, age-composition, and weight-at-age data. In addition, the software used for the 2018 assessment was upgraded to Stock Synthesis software 3.30 (SS 3.30) and a new approach (not available in previous versions of the SS software) was used for estimating the relative weightings applied to the age-composition data. The new data-weighting approach is based on modeling the compositional data using Dirichlet multinomial distributions.

The 2018 assessment continues the use (initiated in the 2017 assessment) of a higher value for the parameter that controls year-to-year variation in the estimated fishery selectivity. In the 2016 assessment (and back to the 2014 assessment) phi (φ) was fixed at 0.03; in the 2017 assessment it was increased to 0.20, to allow more variation in fishery selectivity. In the 2018 assessment the SS 3.30 software required a transformed parameter (called Phi (Φ) and equal to 1.40) that approximates the value of φ used in the 2017 assessment. A bridging analysis presented by the JTC demonstrated this numerical equivalency of φ and Φ. The higher parameter value in 2017 and 2018 (Φ in the 2018 assessment, φ in the 2017 assessment) had the desired effect of reducing estimated recruitment for 2014 and 2016, which otherwise would have been implausibly large.

The most consequential change to the 2018 assessment model arose during review of a new maturity-at-age relationship based on histological estimates of functional maturity from ovaries and associated age estimates from Pacific hake samples collected since 2009. The JTC converted the maturity-at-age percentages to time-invariant fecundities-at-age using average weights-at-age (where fecundity in the model is assumed proportional to body weight). Such time-invariant fecundity-at-age has been used in the Pacific hake stock assessment model since 2011, although the same model calculates total biomass with time-varying weights-at-age. The SRG questioned the approach, given that the weights-at-age exhibit considerable inter-annual variability that is not reflected in the fecundity-at-age vector that is calculated in the base-case model. For this reason and to provide consistency in calculations of total biomass and spawning biomass, the SRG requested that the JTC provide the alternative model that is found in Appendix A of the assessment report.

The 2018 assessment included the suite of sensitivity analyses that the SRG has requested as a standard package: alternate standard deviations of the priors for natural mortality, alternative values for steepness, alternative values for sigma-R (a parameter limiting recruitment variability), and inclusion of the experimental age-1 acoustic survey index.

The 2018 assessment also included sensitivity runs that illustrated the sensitivity of the assessment results to the following:

- the method used for age-composition data weighting;

- time-invariant ageing error rather than cohort-based;
- an alternative method for aggregating monthly age-composition data from the U.S. fishery;
- an alternative catch stream that addressed issues related to small amounts of catch not counted or double-counted in recent annual catches;
- alternative maximum-age assumptions for estimating selectivity; and
- alternative values for the parameter Φ controlling fishery time-varying selectivity.

As noted above, the SRG requested additional sensitivity runs to evaluate the influence of using time-varying fecundity-at-age rather than time-invariant fecundity-at-age used in the base model. One of these additional sensitivity runs became the basis for the alternative model shown in Appendix A of the assessment report. An unresolved issue is how best to derive fecundity-at-age for early years in the series (pre-1975) for which no observations of weight-at-age are available. The alternative model has higher fecundities-at-age in the early years, which has a direct influence on the estimate of unfished spawning biomass and on the perception of stock status relative to unfished biomass. The SRG is requesting additional work from the JTC to further explore the use of empirical weights-at-age wherever possible, and to examine the historical data and evaluate approaches for parameterizing fecundity-at-age for years without data (pre-1975), given their strong influence on estimates of equilibrium unfished biomass.

SRG Recommendations and Conclusions for the Hake Stock Assessment

The SRG has several recommendations for future iterations of the hake stock assessment.

1. The stock assessment results and stock status are highly sensitive to two aspects of the model:
    - o <u>Weights-at-age</u>: Maturity-at-age was recalculated in the 2018 assessment based on an analysis of ovaries collected during the fishery and survey in recent years to produce an empirical vector of the proportion mature (i.e., that will likely spawn) at each age. Spawning biomass in the base-case model is calculated as the product of numbers-at-age, maturity-at-age, and mean weight-at-age (averaged over all years 1975-2017). The SRG noted that this approach ignores the conspicuous pattern of weights-at-age being much higher in the late 1970s than in recent years. Although the base-case model accounts for this pattern by using annual weights-at-age when calculating total biomass and catches , the variability and pattern in weight-at-age are not included in the calculation of fecundity-at-age and spawning biomass. The SRG considers it more appropriate to calculate spawning biomass using annual weights-at-age for years with data, especially given the higher weights-at-age in the 1970s, and requested a sensitivity to explore the influence of this decision. To conduct this sensitivity an assumption was made that for calculating spawning biomass in 2018 and future projections, average weight-at-age in the most recent 3 years of data be used; and for calculating spawning biomass in the unfished state and years before 1975, the average weight-at-age in the first 5 years of data (1975-1979) be used.[1] Three hypotheses that might explain the observed changes in

[1] The alternative model maintained the base model's approach for estimating total biomass prior to 1975 and also in projections (using the weights-at-age averaged over 1975 to 2017). The SRG has requested that the JTC apply calculations for these periods consistent with decisions taken at this meeting when it reports back at the 2019 SRG meeting.

weights-at-age: density-dependent growth, environmental drivers, and fishing-induced evolution. **The SRG requests that the JTC examine the historical weights-at-age data, evaluate approaches for parameterizing fecundity-at-age for years without data (pre-1975), and evaluate other methods of deriving biological reference points such as B_0.**

- Variance in recruitment deviations (sigmaR): The SRG notes the high sensitivity of the model to the variance parameter assumed for recruitment deviations (sigmaR, a parameter that is not directly observable). While the spawning biomass trajectories across values of sigmaR were very close to one another, the corresponding estimates of R0 led to widely different estimates of stock status (relative spawning biomass). The JTC presented evidence that supported the value used in the assessment. **The SRG encourages the JTC to explore methods for parameterizing recruitment and/or estimating sigmaR that would reduce model sensitivity to the value of this constraint**.

2. The SRG notes that when setting values for other parameters that cannot be estimated directly with confidence, the choice of values should be made using methods that are objective, repeatable, and depend on fits to the observed data rather than on the model's subsequent estimates of biomass or recruitment. One clear example is setting the parameter controlling time-varying fishery selectivity (ϕ), with a goal of establishing repeatable steps for setting ϕ each year. **The SRG recommends that the JTC provide a review of how time-varying selectivity is parameterized and estimated in other assessments.**

3. After reviewing the sensitivity analysis for minor corrections to the catch series, the SRG agrees that the assessment results were not significantly affected. **However, the coding and database errors should be rectified as soon as possible.**

4. The new histological analysis of ovaries for maturity, like previous analyses, showed a distinct difference in the percent of hake that are mature at age 2 and age 3 between areas, with a greater proportion mature south of Point Conception (34.47°N). These data suggest that there may be two populations of hake, north and south of this boundary. The SRG also notes that ovaries collected in Canada were not used to update the maturity ogive. The hake found in Canada are generally older age fish and including samples of these fish in the maturity analysis should improve the robustness of the maturity ogive. **The SRG strongly supports the planned genetic analyses to determine whether there are also genetic differences between these two southern regions and other regions as well. In addition, the SRG notes that Canadian samples should be included in the maturity analysis.**

5. The 2018 assessment diverged from past practice in its approach to determining the data weights applied to the age-composition data. Past assessments used an iterative approach (sometimes referred to as the McAllister-Ianelli approach) to arrive at these weightings. The 2018 assessment incorporates the weightings as estimable parameters, thereby eliminating the need for iterative reweighting. This streamlines the assessment process and the SRG considers it to be a sensible and useful improvement. **However, the SRG requests that the JTC provide thorough documentation of all changes in methods of data weighting.**

6. The issue of data weighting remains a significant technical challenge for stock assessments (such as the Pacific hake assessment) that integrate information of different forms (e.g., biomass indices and age compositions) from different sources (e.g., different fishing sectors). The SRG notes that the JTC has considered alternative schemes for data weighting such as the Francis (2011) method. **The SRG notes that it would be useful for such explorations to be documented in future assessment reports, and requests that JTC perform a sensitivity analysis for this method in future assessments.**

   A potential issue related to data weighting that should be explored in the next assessment is the JTC's approach to deriving the initial set of data weightings associated with the fishery and survey age-composition observations. Table 5 in the assessment document shows the annual number of at-sea hauls and shore-based trips from which fish ages were incorporated into the age-composition series and the document states that "initial sample sizes are simply the summed hauls and trips". If there are changes in the number of fish associated with each sample unit (haul or trip) over time, one would expect a corresponding change in the information content of an age-composition sample. For example, there may have been more fish per sample in early years than later years, implying that the assessment model should provide a better fit to early samples than to later samples. The approach taken to deriving the initial data weights could account for changes in the number of fish per sampling unit. Alternatively, the Dirichlet multinomial parameter that accounts for variability in the age-composition observations could include a time-varying component to account for changes in the number of fish per sampling unit. **The SRG recommends that the JTC include information in the next assessment on the annual numbers of fish underlying each annual age-composition observation and present an analysis of the potential influence of changes in sampling.**

7. **The SRG requests that the estimates of total age-2+ biomass be included in Table 18 of the assessment report in the future.**

8. **The SRG recommends that the JTC produce a table showing changes in model structure and parameterization that have been implemented since 2011 as a standard table to be included in the assessment document.**

Management Strategy Evaluation (MSE) and Supporting Analyses

Overview

The SRG received briefings on a planned project identifying associations between environmental drivers and hake summer distribution, and also on a MSE process aimed at addressing unresolved questions raised by the JMC that cannot be addressed within the current stock assessment framework.

The NOAA Fisheries and the Environment (FATE) program is funding a project focused on understanding how environmental forcing governs the summer spatial distribution of Pacific hake. The project will test three hypotheses concerning drivers of hake summer distribution and migration dynamics involving (1) temperature at depth, (2) intensity and position of the poleward undercurrent, and (3) the age or size distribution of the population. These relationships are intended to be used in the development of pre-season forecasts of summer distribution, which could be used to inform planning of the acoustic survey and scenarios considered in the hake MSE.

The SRG discussed the relative merits of the modeling approach (generalized additive models), potential response variables (acoustic biomass estimates of age 2+) and predictor variables (e.g., depth, distance from the shelf-break), and the proposed cross-validation approach for validating the models.

The SRG's 2017 report provided guidance to the JMC on the MSE because the process had stalled. During the past year, NOAA Fisheries has provided renewed support to the MSE work through an MSE Coordinator position at the NWFSC and a scientist to develop a spatially explicit operating model and conduct the hake MSE. The SRG received a presentation on the work plan that describes 13 steps expected to provide results to inform discussions on management choices by Dec 2019.

Overall, the SRG believes that the FATE project on environmental drivers and the MSE process are interconnected and important for advancing hake stock-assessment science and is pleased to note that the MSE work plan appears to address the major points of guidance that were provided by the SRG last year.

Recommendations for the MSE and Supporting Analyses

1. The SRG notes that the draft MSE work plan appears to address the major points of guidance provided by the SRG last year. The SRG also notes that this guidance remains pertinent to the MSE process as it evolves.

2. **The SRG recommends that the performance of assessment models be tested against the more complex reality of the MSE operating model (OM) scenarios to evaluate assessment accuracy and the confidence that can be placed in the annual tactical advice (e.g., TAC) arising from stock assessment.** In order to accomplish this task, the OM must be structurally different from, and more complex than, the assessment model.

3. One goal of MSE processes is to evaluate the robustness of management procedures to uncertainties about the true states of nature. **The SRG recommends that operating model scenarios representing a world experiencing climate change be developed to test the robustness of current and future management procedures**.

4. The SRG continues to emphasize the importance of coordinating the hake survey and the FATE ecological investigation of summer distribution to ensure that priority data are collected and results are used to inform the operating model. The SRG commends the MSE Technical Team for including such coordination in the draft MSE work plan.

5. The SRG emphasizes that the following topics (which are not listed in rank order) are important for inclusion in the development and conduct of the MSE:

    i. Climate change and its impacts on fish and fisheries;
    ii. Spatial distribution of fish of various ages/sizes and the resulting consequences to the parties, under alternative environmental and fishing scenarios;
    iii. Utility of the age-one index under alternative resourcing scenarios;

iv. Technical aspects of assessment modeling including:
   a. Effects of various assumptions on fecundity at age;
   b. Evaluate methods of deriving biological reference points such as B_0;
   c. Methods of parameterizing and constraining recruitment variation, sigmaR;
   d. Choices in modeling fishery selectivity;
   e. Representing spatial processes affecting the fish and the fishing;

v. Survey frequency, spacing and design.

At-Sea Investigations

Winter Cruises

The SRG received an informative presentation about winter cruises conducted in 2016 and 2017 to address questions about hake biomass estimation and hake natural history.

Recommendations and Conclusions for the Winter Cruises

1. Winter cruises, Jan-Feb, were conducted in 2016 and 2017 in part to examine whether a winter survey could efficiently estimate hake biomass as the distribution of hake was thought to be compressed into a smaller area in winter than summer according to the classical model of hake migration (Alverson and Larkins 1969). However, the cruise results show that there is great interannual variability in hake distribution in winter leading to a wide and unpredictable scattering of cohorts latitudinally and longitudinally, and estimates of biomass were around 30% of the summer survey estimates. **The SRG agrees with the Survey Team conclusion that a winter survey using the design and protocols of the 2016/2017 surveys is not suitable for estimating hake biomass in support of the stock assessment.**

2. Gonad samples collected during the winter cruises coupled with ongoing maturity studies support the idea that spawning may occur year-round for this species, rather than in a well defined period as assumed previously.

3. The winter cruises have provided valuable empirical observations of hake distribution at times not normally observed. These results have significant implications for the structure of the MSE's OM as the OM will be used to address questions resulting from the spatial distribution of hake.

4. The winter cruises also have yielded much additional new information on hake life history. Findings included the lack of any observed large spawning aggregations; much lower observed biomass in the survey area, evidence of hake feeding in winter; observations of hake diel migration; increased depth of hake in winter; and the presence of all hake age classes in winter samples.

5. **The SRG recommends that the Survey Team complete data analyses from the winter cruises, in anticipation that the results will inform the direction of the winter cruise effort in the future.**

2017 Summer Acoustic Survey

A joint U.S. – Canada acoustic trawl survey was conducted in 2017. The survey was conducted from June 15 to September 13, covering the area from Point Conception (34.5°N) to Dixon

Entrance (54°N). A total of 137 parallel transects were surveyed (Shimada: 102, Nordic Pearl: 35), with 10 nmi transect spacing. Due to lost survey days, a total of 15 transects were dropped (Shimada: 13, Nordic Pearl: 2), chosen randomly while ensuring transect spacing was never less than 20 nmi. The Survey Team collected a full suite of acoustic, biological, and oceanographic data and they presented data highlights and distributional comparisons. The SRG recognizes the efforts of the Survey Team in producing a flow chart of the biomass estimation process and the descriptions of the data collection, kriging and other steps.

Recommendations and Conclusions for the 2017 Survey

1. **The SRG recommends that the Survey Team provide statistical analysis of the trawl justification and trawl results from the 2017 survey (i.e., expected trawl results vs. observed trawl results table) and that the Survey Team continue to collect and analyze such data in the future**. **The SRG recommends using these analyses to better characterize uncertainty in interpreting acoustic signals and build a record of objective feedback for the survey team on interpretation successes and failures.**

2. The SRG has consistently recommended in previous reports that the Survey Team identify and quantify sources of variability in the survey. The SRG appreciates the Jolly-Hampton variance estimates presented as part of the 2017 survey results and **expects that the Survey Team will continue to work on better quantifying the survey variance.**

3. **The SRG recommends that the Survey Team to complete its analysis of the age-1 index and present those results at the 2019 SRG meeting for further consideration of the inclusion in the annual hake assessment.**

4. The Survey Team plans to conduct trawl calibration and standardization in the summer of 2018 with paired trawls to compare the performance of the US net (net dynamics, catch composition, size selectivity) when using the standard US codend liner (32 mm) and the standard Canadian codend liner (7 mm). The SRG recognizes that the trawl calibration issue is important to the AP and there are other issues such as net design that could be explored in the future.

5. The SRG is pleased that the Survey Team is moving forward with documentation of survey methods and protocols in technical reports for each country and **requests that the SRG have the opportunity to review the documents in May prior to entering the publication process in each agency.**

6. **The SRG also recommends that the biomass estimation process flowchart reviewed at this meeting be included in the survey methods and protocol documentation.** Work to improve the clarity of the document should be undertaken prior to publication. In this connection, review by researchers not involved in the survey might help identify areas where clarity could be improved.

7. The SRG found the analysis of commercial catch and fishing effort, based on eight years of data, to be an extremely informative. This analysis showed that the survey area almost completely encompasses the area fished commercially. **The SRG recommends conducting**

this kind of analysis on a regular basis to ensure that the survey is achieving its goal of covering the entire summer range of Pacific hake.

Inter-Vessel Calibration

Inter-vessel calibration was conducted between the Nordic Pearl (Canadian) and the Bell Shimada (U.S.) during the 2017 survey, using a side-by-side design d. The vessels covered 8 transects at the northern end of Vancouver Island with the vessels 0.5 nmi apart, alternating starboard and port sides. The resulting backscatter (NASC) at 38 kHz did not differ significantly between the two vessels, although the number of transects was low. The SRG agrees with the investigators that a leader-follower design would be an improvement and inter-vessel calibration experiments should be considered whenever a new vessel is used, including when the new Canadian research vessel becomes operational.

Survey-Related Research

The SRG received an informative presentation on survey-related research planned for summer 2018, including testing of the EK-80 broadband system, a Saildrone (an unmanned ocean-going surface vessel) proof-of-concept survey, progress on work using acoustic moorings in Canada, and trawl calibration work. The SRG looks forward to reviewing the results of these projects at future meetings.

Other SRG Recommendations

1. The SRG is concerned about a meeting schedule with a short period between the end of the SRG meeting and the start of the JMC meeting (e.g., 3 days in 2018). If a serious issue is identified, as occurred this year, then there is insufficient time to re-run the assessment, revise the assessment document, and present updated management advice before the JMC meeting. **The SRG recommends a gap of at least one week between the two meetings to allow time for corrective actions if needed, and for the SRG to complete its work in a more considered manner.**

2. The SRG valued the role that Miako Ushio (as Pacific Whiting Treaty Coordinator) played in keeping communications open between groups and appreciates Stacey Miller for stepping into this role this year. **The SRG suggests that routine communication be maintained between all bodies (AP, JMC, SRG, JTC, Survey Team, MSE Working Group, MSE Technical Team) supporting the implementation of the Pacific Hake/Whiting Agreement so that members of the SRG are updated about research and analysis priorities and concerns of the management and stakeholder communities.**

3. **The SRG also requests that the JMC, when it identifies areas on which it would like SRG input, submit written requests to the SRG co-chairs two weeks before the SRG meeting to allow time for the SRG agenda to be adjusted appropriately, and for review by SRG members of any background materials.**

4. The SRG appreciates that for several years now, both the survey team and the JTC presented explicit responses to previous SRG recommendations. **We request that this approach be continued into the foreseeable future.**

5. **The SRG recommends that the JTC look into the logistics and availability of electronic copies of the data and model files.**
6. **The SRG also recommends that all archived Pacific hake stock assessment documents be made available either through a link on the hake/whiting agreement page to the relevant PFMC page or by placing duplicate copies of the relevant documents on the hake/whiting agreement website.**

Literature Cited

Alverson, D.L., and Larkins, H.A. 1969. Status of the knowledge of the Pacific hake resource. California Cooperative Oceanic Fisheries Investigations Reports: 13: 24-31.

Francis, R.I.C.C. 2011. Data weighting in statistical fisheries stock assessment models. Canadian Journal of Fisheries and Aquatic Sciences 68: 1124-1138.

ATTACHMENT 1

Joint US-Canada Scientific Review Group for Pacific Whiting

Room 2A
Lynnwood Convention Center
3711 196th St. SW
Lynnwood, WA 98036

February 26 – March 1, 2018

PROPOSED MEETING AGENDA – REVISED 22 February 2018

Monday, February 26, 2018

13:00 Welcome and Introductions

13:15 Review and Approve Meeting Agenda (Chair)
- Review Terms of Reference for Assessments and Review Meeting
- Meeting report mechanics
- Assignment of reporting duties

13:30 Fisheries, Data, and Inputs Used in the 2018 Pacific Hake/Whiting Assessment, and associated discussion (JTC)

15:00 Break

15:15 2018 Pacific Hake Stock Assessment Methods, Results (JTC) and discussion
- Approaches to setting ϕ in assessment

16:15 Public comment

16:45 Adjourn for the day

Tuesday, February 27, 2018

08:30 Discussion of previous day, follow-up questions, etc.

09:00 2018 Pacific Hake Assessment: Sensitivities and Retrospectives and discussion (JTC)

09:45 Management Outcomes of the 2018 Pacific Hake Stock Assessment and discussion (JTC)

10:30 Break

10:45 Further discussion of 2018 Hake Stock Assessment as needed

12:00 Lunch (on your own)

13:15 Hake summer distribution and environmental drivers (Malick)

14:00 MSE work plan and proposed structure update (Marshall and JTC)

15:00 Break

15:15 SRG discussion, tasks for JTC or others

16:00 Public Comment

16:30 Adjourn for the day

Wednesday, February 28, 2018

08:30	Review of previous day, follow-up questions, etc.
09:30	Winter Cruise (Parker-Stetter and survey team) and discussion
10:30	Break
10:45	Winter cruise discussion (continued)
11:15	Progress report on SRG Recommendations (Hufnagle and survey team) • Documentation of trawls
11:45	Lunch (on your own)
13:00	2017 Survey Overview and discussion (Clemons and survey team)
13:45	2017 Biomass estimate and discussion (Thomas and survey team)
14:45	Break
15:00	Additional Survey Analyses, Age-1 Index and discussion (Thomas and survey team)
15:45	SRG Discussion, requests for additional information
16:15	Public comment
16:45	Adjourn for the day

Thursday, March 1, 2018

08:30	Review of previous day, follow-up questions, etc.
09:00	IVC, updates on Canadian vessel, etc. and discussion (Gauthier and survey team)
10:00	Survey-related research (Survey team)
11:00	Final SRG discussion, requests for additional information, etc.
12:00	Lunch (on your own)
13:15	Public comment
14:00	Meeting adjourns

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ATTACHMENT 2

List of Participants

Name	Affiliation
Aaron Berger	NOAA Fisheries, JTC
Trevor Branch	University of Washington, SRG-Independent Member
Courtney Burther	NOAA Fisheries
Al Carter	AP-USA
Ruth Christiansen	United Catcher Boats
Dezhang Chu	NOAA Fisheries, Survey Team
Jaclyn Cleary	Fisheries and Oceans Canada, SRG
Steve de Blois	NOAA Fisheries, Survey Team
Andrew M. Edwards	Fisheries and Oceans Canada, JTC
Arnie Fuglvog	Glacier Fish Company
Stephane Gauthier	Fisheries and Oceans Canada
Chris J. Grandin	Fisheries and Oceans Canada, JTC
Jim Hastie	NOAA Fisheries, Co-chaired Thursday March 1
John Holmes	Fisheries and Oceans Canada, SRG, Co-chair
Larry Hufnagle	NOAA Fisheries, Survey Team
Mike Hyde	AP-USA
Nis Jacobsen	NOAA Fisheries
Kelli Johnson	NOAA Fisheries
Stephanie Johnson	NOAA Fisheries, GCNW
Steve Jonar	JMC-USA
Frank Lockhart	NOAA Fisheries, JMC
Shannon Mann	AP Advisor to SRG-Canadian appointee
Kristin Marshall	NOAA Fisheries
Michelle McClure	NOAA Fisheries, SRG, Co-chair
Stacey Miller	NOAA Fisheries
Mike Okoniewski	AP-USA
Sandy Parker-Stetter	NOAA Fisheries, Survey Team
John Pohl	NOAA Fisheries, Survey Team
Michael Prager	NOAA Retired, SRG-Independent Member
Corey Niles	WDFW
Lori Steele	AP Advisor to SRG-USA
David Sampson	Oregon State University, SRG-Independent Member
Rob Tadey	Fisheries and Oceans Canada
Ian Taylor	NOAA Fisheries, JTC
Rebecca Thomas	NOAA Fisheries, Survey Team
Dan Waldeck	PWCC, JMC-USA