
TERMS OF REFERENCE

FOR THE
JOINT TECHNICAL COMMITTEE
OF

AGREEMENT BETWEEN THE GOVERNMENT OF
THE UNITED STATES OF AMERICA AND
GOVERNMENT OF CANADA ON PACIFIC HAKE/
WHITING

Joint Technical Committee
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List of Terms and Acronyms

Acceptable biological catch (ABC): The Acceptable biological catch is a scientific calculation of the sustainable harvest level of a fishery used historically to set the upper limit for fishery removals by the Pacific Fishery Management Council. It is calculated by applying the estimated (or proxy) harvest rate that produces maximum sustainable yield (*MSY*, see below) to the estimated exploitable stock biomass (the portion of the fish population that can be harvested). For Pacific Hake, the calculation of the acceptable biological catch and application of the 40:10 adjustment is now replaced with the default harvest rate and the Total Allowable Catch.

Advisory Panel (AP): The advisory panel on Pacific Hake/Whiting established by the Agreement.

Agreement (“Treaty”): The Agreement between the Government of the United States and the Government of Canada on Pacific Hake/Whiting, signed at Seattle, Washington, on November 21, 2003, entered into force June 25, 2008, and formally established in 2011 with the formation of the management committees.

Default harvest rate: The application of F-40 Percent with the 40:10 adjustment. Having considered any advice provided by the Joint Technical Committee, Scientific Review Group or Advisory Panel, the Joint Management Committee may recommend a different harvest rate if the scientific evidence demonstrates that a different rate is necessary to sustain the offshore hake/whiting resource.

Joint Management Committee (JMC): The joint management committee established by the Agreement.

Joint Technical Committee (JTC): The joint technical committee established by the Agreement.

Pacific Fishery Management Council (PFMC): The U.S. organization under which historical stock assessments for Pacific hake were conducted.

Pacific Hake/Whiting (“Pacific Hake”): The stock of *Merluccius productus* located in the offshore waters of the United States and Canada (not including smaller stocks located in Puget Sound and the Strait of Georgia).

Scientific Review Group (SRG): The scientific review group established by the Agreement.

Spawning potential ratio (SPR): A metric of fishing intensity. The ratio of the spawning output per recruit under a given level of fishing to the estimated spawning output per recruit in the absence of fishing. It achieves a value of 1.0 in the absence of fishing and declines toward 0.0 as fishing intensity increases.

F-40 Percent ($F_{40\%}$): The rate of fishing mortality estimated to reduce the spawning potential ratio to 40%.

40:10 Adjustment: an adjustment to the overall total allowable catch that is triggered when the biomass falls below 40% of its average equilibrium level in the absence of fishing. This

adjustment reduces the total allowable catch on a straight-line basis from the 40% level such that the total allowable catch would equal zero when the stock is at 10% of its average equilibrium level in the absence of fishing.

Total Allowable Catch (TAC): The maximum fishery removal under the terms of the Agreement.

U.S./Canadian allocation: The division of the total allowable catch of - 73.88% as the United States' share and 26.12% as the Canadian share.

Introduction and Overview

The purpose of this terms of reference is to outline the guidelines and procedures for the stock assessment of Pacific Hake/Whiting (*Merluccius productus*) by the Joint Technical Committee (JTC) as defined by the Agreement between the Government of Canada and the Government of the United States of America on Pacific Hake/Whiting (the treaty).

As approved by the Joint Management Committee (JMC), this document will reflect the terms of reference for the JTC until modified. This document reflects the fact that, prior to November 2011, the stock assessment and stock assessment review for Pacific hake previously fell under the responsibility of the Pacific Fishery Management Council (PFMC) and, for continuity, is generally based on the terms of reference used by the PFMC. As processes evolve under the treaty, it is expected that these terms of reference will also evolve in coming years. Participants should therefore anticipate the need to be flexible and address new issues as they arise.

Under the treaty language, the JTC is tasked to:

- 1) Propose its terms of reference for stock assessment and review (this document) for approval by the JMC.
- 2) Develop stock assessment criteria and methods, and design survey methods.
- 3) Exchange survey information, including information on stock abundance, distribution, and age composition.
- 4) Exchange and review relevant annual catch and biological data, including information provided by the public.
- 5) Provide, by no later than February 1 of each year unless otherwise directed by the JMC, a stock assessment that includes scientific advice on the annual potential yield of the Pacific hake resource that may be caught for that fishing year, taking into account uncertainties in stock assessment and stock productivity parameters and evaluating the risk of errors in parameter estimates produced in the assessment.
- 6) Perform other analyses that may be referred to it by the Scientific Review Group (SRG) and the JMC.

JTC Responsibilities

The JTC is responsible for conducting a complete and technically sound stock assessment that conforms to accepted standards of quality and in accordance with these terms of reference. The products of the JTC will be a draft stock assessment document to be reviewed by the SRG and a final version that follows the outline specified in Appendix A below.

Terms of Reference for the JTC

The goals and objectives for the stock assessment and review process are to:

- a) Ensure that the Pacific Hake stock assessment represents the "best available" scientific information and facilitate the use of this information by the JMC and Advisory Panel (AP). In particular, provide information that will allow the JMC to set annual catch limits.
- b) Meet the mandates of the Pacific Hake treaty and other legal requirements.
- c) Follow a detailed calendar and explicit responsibilities for all participants to produce required outcomes and reports.
- d) Provide for a review of the stock assessment methods by the SRG.
- e) Use assessment and review resources effectively and efficiently.
- f) Increase understanding of the Pacific Hake stock assessment and review process.
- g) Identify research needed to improve data collection, surveys, assessments, reviews, and fishery management in the future.

In order to facilitate peer review, the JTC should carry out its work according to these terms of reference. Generally, in the assessment document the JTC should discuss all data sources, identify the ones being used in the assessment, and provide the rationale for data sources being excluded. The JTC should coordinate early in the process with data stewards in both countries to ensure timely delivery of data required. The JTC will provide industry and members of the public the opportunity to discuss any aspect of their work. Such opportunity will be provided as part of the JTC regular meetings, as time is available. All JTC members should attend these meetings in addition to the stock assessment review meeting. The JTC must consider and respond to research recommendations of prior review meetings, and must make a good faith effort to address the issues raised in those reports, to the extent practicable.

The JTC is responsible for preparing two versions of the stock assessment document:

- 1) A draft document for peer review during the stock assessment review with the SRG.
- 2) A final document for distribution to the JMC and AP reflecting the outcome of the stock assessment review for use in discussions regarding catch advice.

The JTC is responsible for bringing data in digital format and model files to the review meeting so that they can be analyzed on site. The JTC should have several models ready to present to the SRG and be prepared to discuss the merits of each. The JTC also should identify a candidate base model, fully-developed and well-documented in the draft assessment, for the stock assessment review meeting.

The JTC should provide a draft assessment document to the SRG, JMC and AP chairs two weeks prior to the stock assessment review meeting to allow timely review of the draft assessment. The draft assessment document should include all elements listed in Appendix A except for the: 1) population abundance tables, 2) point-by-point responses to current SRG recommendations, and 3) acknowledgements. It is the JTC's responsibility to make sure the document is complete and complies with these terms of reference.

The JTC and the SRG may disagree on technical issues regarding an assessment, and a complete final stock assessment document must include a point-by-point response of the JTC to each of the SRG's recommendations. The final version must be made available to the SRG prior to

distribution to the JMC. Their comments should be limited to editorial issues, and confirming that the document adequately reflects the discussions and decisions made during the stock assessment review meeting. The final version of the assessment document should be provided to the JMC within one week of the end of the stock assessment review meeting.

Electronic versions of final assessment documents, parameter files, data files, and key output files will be made available to all committees and interested parties. Copies of these files will also be included in a stock assessment archives maintained by the U.S. National Marine Fisheries Service and Fisheries and Oceans Canada.

Appendix A: Outline for Stock Assessment Documents

In this outline, the term "stock assessment" includes activities, analyses and reports, beginning with data collection and continuing through to scientific recommendations for the fishery. Stock assessments provide the fundamental basis for management decisions on fishery harvests. To best serve that purpose, stock assessments should attempt to identify and quantify major uncertainties, balance realism and parsimony and make best use of the available data.

This is an outline of items that should be included in the stock assessment report for Pacific Hake. It is a working document meant to provide the JTC with flexible guidelines about how to best organize and communicate their work. Items with asterisks (*) are optional for draft assessment documents prepared for stock assessment review but should be included in the final document. In the interest of clarity, stock assessment authors and reviewers are encouraged to use the same organization and section names as in the outline. However, in the interest of brevity, sections that have been described in previous stock assessment documents and remain unchanged in the most recent stock assessment should be briefly described with a reference to details in previous stock assessment documents. It is important that complete time series of catch, abundance, harvest rates, recruitment and other key quantities be presented in tabular form to facilitate full understanding and follow-up analyses.

1. Title page and list of preparers – the names and affiliations of the stock assessment team (including the JTC and any other contributors) listed at the discretion of the authors.
2. Executive Summary (see template in Appendix B).
3. Introduction
 - 3.1. Scientific name, distribution, the basis for the choice of stock structure, including regional differences in life history or other biological characteristics that should form the basis of management units.
 - 3.2. A discussion of new understandings of ecosystem considerations.
 - 3.3. A map depicting the scope of the assessment and identifying boundaries for fisheries or data collection strata.
 - 3.4. Important features of life history that affect management (e.g., migration, sexual dimorphism, bathymetric demography).
 - 3.5. Important features of current fishery and relevant history of fishery.
 - 3.6. Reference to management history (e.g., changes in mesh sizes, trip limits, or other management actions that may have significantly altered selection, catch rates, or discards).
 - 3.7. Management performance – a table or tables comparing historical management limits and targets with fishery removals for each area and year.
4. Data
 - 4.1. Historical catch estimates by year and fishery, catch-at-age, weight-at-age, abundance indices, data used to estimate biological parameters (e.g., growth rates, maturity schedules, and natural mortality) with coefficients of variation (CVs) or variances if available. Include complete tables and figures and date of extraction.
 - 4.2. Sample size information for length and age composition data by area, year, gear, market category, etc., including both the number of trips and fish sampled.
 - 4.3. All data sources that are used in the assessment and rationale for data sources that are

excluded.

5. Assessment

5.1. A description of estimated parameters and priors on those parameters.

5.2. History of modeling approaches used for this stock.

5.3. Changes between current and previous assessment models.

5.3.1. Response to stock assessment review meeting recommendations from the most recent assessment.

5.4. Model description

5.4.1. Complete description of any new modeling approaches.

5.4.2. Definitions of fleets and areas.

5.4.3. Analysis software used with last revision date.

5.4.4. List and description of all likelihood components in the model.

5.4.5. Priors and/or constraints on parameters, selectivity assumptions, natural mortality, treatment of age reading bias and/or imprecision, and other fixed parameters.

5.4.6. Description of stock-recruitment constraints or components.

5.4.7. Description of how the first year that is included in the model was selected and how the population state at the time is defined.

5.4.8. Critical assumptions and potential consequences of assumption failures.

5.5. Model selection and evaluation

5.5.1. Evidence of search for balance between model realism and parsimony.

5.5.2. Comparison of key model assumptions, include comparisons based on nested models (e.g., asymptotic vs. domed selectivities, constant vs. time-varying selectivities).

5.5.3. Summary of alternate model configurations that were tried but rejected.

5.5.4. Residual analysis for the base-run configuration (e.g., residual plots, time series plots of observed and predicted values, or other approaches).

5.5.5. Convergence status and convergence criteria for the base-run model.

5.5.6. Evidence of search for global best estimates.

5.6. *Point-by-point response to the most recent SRG recommendations

5.7. Base model results

5.7.1. Table listing all explicit parameters in the stock assessment model used for the base model, its purpose (e.g., recruitment parameter, selectivity parameter) and whether or not the parameter was actually estimated in the stock assessment model.

5.7.2. Population numbers at age by year and, if applicable, by sex.

5.7.3. Time-series of total, 1+, summary, and spawning biomass (and/or spawning output), depletion relative to B₀, recruitment and fishing mortality or exploitation rate estimates (table and figures).

5.7.4. Selectivity estimates.

5.7.5. Stock-recruitment relationship.

5.7.6. Clear description of units for all outputs.

5.7.7. Qualitative evaluation of credibility of parameter estimates.

5.8. Uncertainty and sensitivity analyses. The best approach for describing uncertainty may depend on the specific situation; important factors to consider include:

- 5.8.1. Uncertainty in parameter estimates and in derived outputs of the model (e.g., bootstrap, asymptotic methods, Bayesian integration).
 - 5.8.2. Likelihood profile or posterior profile for the base-run (or proposed base-run model for a draft assessment undergoing review) configuration over one or more key parameters (e.g., natural mortality, steepness of the stock-recruitment function) to investigate consistency among input data sources.
 - 5.8.3. Sensitivity to dataset choice and weighting of data and likelihood components.
 - 5.8.4. Consideration of recent patterns in recruitment.
 - 5.8.5. Sensitivity to assumptions about model structure.
 - 5.8.6. Retrospective analyses, where the model is fitted to a series of shortened input data sets, with the most recent years of input data being dropped, and current results compared with historical assessments.
 - 5.8.7. If a range of sensitivity runs is used to characterize uncertainty it is important to attempt to provide some qualitative or quantitative information about the relative probability of each.
6. Reference points needed to produce default harvest rate calculations
- 6.1. Unexploited equilibrium spawning stock biomass (or spawning output, if spawning output is other than linearly related to spawning biomass), summary age biomass, and recruitment.
 - 6.2. Reference points based on SB40% (spawning biomass and/or output, SPR, exploitation rate, equilibrium yield).
 - 6.3. Reference points based on F40% (spawning biomass and/or output, SPR, exploitation rate, equilibrium yield).
 - 6.4. Reference points based on MSY (if estimated; spawning biomass and/or output, SPR, exploitation rate, equilibrium yield).
 - 6.5. Equilibrium yield curve showing various BMSY proxies.
7. Harvest projections and decision tables
- 7.1. Decision tables should follow the format of past assessment documents, in which the columns represent the states of nature and the rows the management alternatives. Management alternatives should represent the sequence of catches obtained by applying the default harvest policy to each state of nature and/or other alternatives requested by the JMC.
 - 7.2. Information presented should include biomass, stock depletion, and yield projections of potential TAC values for three years into the future, beginning with the current year.
 - 7.3. Harvest projections and decision tables should cover the plausible range of uncertainty about current biomass and a range of harvest levels. Harvest levels should include calculation of the TAC based on the default harvest rate. Additionally, TAC calculations based on FMSY and/or other options, as requested by the JMC or on the basis of analyses provided by the JTC may be included. States of nature described in the decision table will be drawn from a probability distribution which describes the pattern of uncertainty regarding the status of the stock and the consequences of alternative future management actions. Where alternatives are not formally associated with a probability distribution, the assessment should provide subjective probabilities for each alternative.
8. Research needs (prioritized)

9. Acknowledgments

10. Literature cited

11. Appendices

11.1. A list of definitions and acronyms for technical terms used in the document.

11.2. Complete input files for the stock assessment program(s).

Appendix B: Template for Executive Summary Prepared by JTC

Stock: Spatial extent of the assessment including an evaluation of any potential biological basis for regional management.

Catches: Historical and current levels, including a table for last 10 years and a graph with the entire time-series.

Data and assessment: Date of last assessment, type of assessment model(s), data available, new information, and information lacking.

Stock biomass: Historical and current biomass estimates, as well as relative depletion estimates. This section should include a description of uncertainty, and tables of biomass and depletion for the last 10 years and graphs with the entire available time-series.

Recruitment: Historical and current estimates, this section should include a description of uncertainty and a table for the most recent 10 years and a graph with the entire time-series.

Exploitation status: Exploitation rates (i.e., total catch divided by exploitable biomass, or the annual SPR harvest rate). This section should include a table with the last 10 years of estimates and a graph with the entire time-series.

Management performance: A table or tables comparing total fishery removals with historical management limits and targets during the most recent 10 years. This section should include a phase-plot showing the trend in fishing mortality relative to the target (y-axis) plotted against the trend in biomass relative to the target (x-axis).

Reference points: Management targets and definition of overfishing, including the harvest rate that brings the stock to equilibrium at $SB_{40\%}$ and the equilibrium stock size that results from fishing at the default harvest rate. Include a summary table that compares estimated spawning biomass, exploitation rate and yield based on reference points.

Unresolved problems and major uncertainties: A discussion of major sources of uncertainty and possible sources of bias in the stock assessment results. This should include a discussion of major information gaps.

Forecasts and Decision table: Three-year projections of spawning biomass, and stock depletion and exploitation rates for management alternatives.

Research and data needs: Prioritize potential future research that may appreciably reduce the uncertainty in future stock assessments and management.