# Panel Review of the Stock Assessment

# for Pacific Cod in the Eastern Bering Sea

Virtual Panel

April 26-30, 2021

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# Introduction

## 1. Workshop Time and Place

This workshop took place virtually on Google Meet from April 26-30, 2021.

## 2. Terms of Reference

**Terms of Reference for the Peer Review**

The Terms of Reference were compiled from recommendations submitted by the Groundfish Plan Team for the Bering Sea and Aleutian Islands, the Scientific and Statistical Committee, and Alistair Dunn (a consultant contracted by the Freezer Longline Coalition). These were organized into six general topics, with three specific recommendations per topic. After reading the background materials and receiving the initial set of presentations during the review, the reviewers will prioritize the six topics and identify at least one recommendation per topic to be addressed by the review. The reviewers will then address as many of the topics (and the identified recommendation(s)), in priority order, as time allows.

# Topic 1: Movement

## Recommendation 1a:

Comment on avenues for incorporating spatial dynamics and movement.

## Recommendation 1b:

Consider how to inform the dynamics of movement or abundance between the Northern Bering Sea and the Eastern Bering Sea, specifically from additional experiments and analyses, data analyses that include these assumptions (i.e., VAST), and how these can best be used within the different models as indices of abundance.

## Recommendation 1c:

Develop movement models.

# Topic 2: Ensemble modeling

## Recommendation 2a:

Evaluate the use of ensemble modeling in the NPFMC management system, and specifically whether the structural uncertainty and historical challenges in identifying a robust base model make Pacific cod a good application for ensemble modeling.

## Recommendation 2b:

Develop the models to include in an ensemble.

## Recommendation 2c:

Consider whether to apply the sloping harvest control rule before or after ensemble averaging of SSB and other reference points.

# Topic 3: Age data

## Recommendation 3a:

Attempt to resolve problems with using fishery age compositions.

## Recommendation 3b:

Consider how best to include the fisheries age and size composition data, including consideration of fleet specific age composition data in the model.

## Recommendation 3c:

Investigate whether a change in growth contributed to the ageing bias fit for 2008 and onward in the complex models as ageing bias and growth may be confounded.

# Topic 4: Fishery CPUE

## Recommendation 4a:

Discuss standardization of fishery CPUE using alternative statistical methods, including a discussion of historical changes in the fishery that may affect the relationship of the index to abundance.

## Recommendation 4b:

Develop a fishery CPUE index.

## Recommendation 4c:

Consider how best to further analyze CPUE, including development of spatio-temporal analyses of fleet specific CPUE indices that may help inform the model or supplement the trawl survey biomass indices.

# Topic 5: Compositional data

## Recommendation 5a:

Consider methods (e.g., bootstrapping) to estimate uncertainty and variance in the composition data, with the results then used to estimate initial sample sizes for each season, fleet, combination for input into the assessment model.

## Recommendation 5b:

Review methods to scale the composition data and include consideration of methods that scale observer samples to the catch by vessel, location, and time of event.

## Recommendation 5c:

Consider analyses of the size- and age- composition data to identify if there are specific locations or time periods when a recruitment signal may be apparent to assist in informing the assessment model of the strength of recent recruitment.

# Topic 6: Other

## Recommendation 6a:

Consider incorporation of dome-shaped survey selectivity.

## Recommendation 6b:

Consider the diagnostic plots of fits and residuals (including normalised or Pearson residuals) for the age and size composition data and make recommendations on how the model fits may be improved.

## Recommendation 6c:

Consider inclusion of other survey information (e.g., the IPHC and sablefish surveys).

## 3. List of Participants

Ingrid Spies …………………………………….Chair, NOAA Fisheries, Alaska Fisheries Science Center

Grant Thompson………………Assessment Author, NOAA Fisheries, Alaska Fisheries Science Center

Steve Barbeaux……..…………Assessment Author, NOAA Fisheries, Alaska Fisheries Science Center

Henrik Sparholt……………………………………………...…………Reviewer, University of Copenhagen

Yan Jiao……..…………………………………………………………………………Reviewer, Virginia Tech

Arni Magnusson………………………………………………………………………………………..Reviewer

Thomas Helser……..……...…………………………. NOAA Fisheries, Alaska Fisheries Science Center

Jason Conner……..……...…………………………….NOAA Fisheries, Alaska Fisheries Science Center

Delsa Anderl……..……...……………………………. NOAA Fisheries, Alaska Fisheries Science Center

Joel Kraski……..……...………………………………. NOAA Fisheries, Alaska Fisheries Science Center

Chad See……..…………………………………………………………….....……Freezer Longline Coalition

Kalei Shotwell……..……...……………..……………. NOAA Fisheries, Alaska Fisheries Science Center

Tim Loher…………………..………………………………………International Pacific Halibut Commission

Craig Kastelle……..……...…………………..………. NOAA Fisheries, Alaska Fisheries Science Center

Kali Stone……..……...…………………………….…. NOAA Fisheries, Alaska Fisheries Science Center

Suzanne Mcdermott……..……...……………………. NOAA Fisheries, Alaska Fisheries Science Center

Julie Neilsen……………………………………………..…………………….University of Alaska Fairbanks

Mary Furuness……..……...…………….……………………………………………………. NOAA Fisheries

Gerry Merrigan…….……………………………………………………….....……Freezer Longline Coalition

Giancarlo Correa……………………………………………..……………………………………………………University of Oregon

## 4. Documents and Presentations circulated for Review Workshop

<https://archive.fisheries.noaa.gov/afsc/refm/stocks/plan_team/2021_pcod_cie/>

Thompson, G. 2021 Cross-conditional model averaging: A potential tool for improving stock assessment estimates. Draft manuscript.

Thompson, G., Conner, J., Shotwell, K., Fissel, B., Hurst, T., Laurel, B., Rogers, L., Siddon, E. 2020. Assessment of the Pacific cod stock in the Eastern Bering Sea

Spies, I., Gruenthal, K.M., Drinan, D.P., Hollowed, A.B., Stevenson, D.E., Tarpey, C.M. and Hauser, L., 2020. Genetic evidence of a northward range expansion in the eastern Bering Sea stock of Pacific cod. *Evolutionary applications*, *13*(2), pp.362-375.

O’Leary, C., Kotwicki, S., Hoff, G., Thorson, J., Kulik, V., Ianelli, J., Lauth, R., Nichol, D., Conner, J., Punt, A.

Estimating spatiotemporal availability of transboundary fishes to fishery-independent surveys DRAFT NOT FOR CIRCULATION

The following presentations were pre-recorded and posted on the website:

1. Conner—survey data. Author: Jason Conner works in the Groundfish Assessment Program (GAP) of the AFSC.
2. Stone and Anderl—ageing.  Authors: Kali Stone and Delsa Anderl work in the Age and Growth Unit of the AFSC.
3. Kraski—North Pacific Observer Program.  Author: Joel Kraski works in the Fishery Monitoring and Analysis Division of the AFSC.
4. Furuness—catch accounting system and inseason management.  Author: Mary Furuness works in the NMFS Alaska Region office.
5. Nielsen—tagging. Author: Julie Nielsen (Kingfisher Marine Research) is a contractor with GAP/AFSC.
6. Correa—somatic growth variability.  Author: Giancarlo M. Correa is a PhD student of Lorenzo Ciannelli at Oregon State University.
7. Thorson—ADT movement models.  Author: Jim Thorson leads the Habitat and Ecosystem Processes Research Program of the AFSC.
8. Thorson—VAST fishery CPUE model.  Author: See above.
9. Shotwell—Ecosystem and Socioeconomic Profile (ESP). Author: Kalei Shotwell works in SSMA/AFSC.
10. Thompson—assessment background as context for the ToR.  Author: See above.

Additional presentations

Merrigan, G. Additional information on Bering Sea p-cod fisheries from the Freezer-Longline Coalition (FLC = Catcher-processor hook-and-line vessels)

O’Leary, C. Estimating spatiotemporal availability of transboundary fishes to fishery-independent surveys.

# Executive Summary

Stock assessment scientists provided detailed methods for the stock assessment of the Pacific cod stock in the Eastern Bering Sea, as well as documentation and code for the assessment model. The Eastern Bering Sea stock assessment is assessed using Stock Synthesis 3 (SS3). During the second day of the workshop, the panel discussed the relevance of the Terms of Reference and prioritized them as follows:

# 1: Ensemble modeling (originally labeled as “Topic 2”)

# 2: Movement (originally labeled as “Topic 1”)

# 3: Fishery CPUE (originally labeled as “Topic 4”)

# 4: Age data (originally labeled as “Topic 3”)

# 5: Compositional data (originally labeled as “Topic 5”)

# 6: Other (originally labeled as “Topic 6”)

Although not listed in the original set of recommendations for the “other” category, consideration of density dependence in a variety of life history processes was considered important to include in assessment models.

Most of the workshop focused on Ensemble modeling. Model selection related to this topic involved a broad discussion of all the models considered. The panel discussed how the models in an ensemble could be weighted and established five models and weights they would prioritize. Further, the panel discussed whether model averaging should be applied before or after application of the Harvest Control Rule.

The discussion of Movement primarily focused on whether cod stock surveyed in the Eastern Bering Sea may move into Russian waters, and there was a large emphasis placed on work by Cecilia O’Leary on this topic.