**Terms of reference for the 2021 CIE review of the EBS Pacific cod stock assessment**

Grant Thompson

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).