External Independent Peer Review
for the
Center for Independent Experts (CIE)
Stock Assessment Review (STAR) Panel 2
of
Black Rockfish in Washington, in Oregon, in Northern California and in Central California
July 10-14, 2023
Southwest Fisheries Science Center
Santa Cruz Laboratory and Online
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by
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Executive Summary

i. Assessments of four Black Rockfish stocks were reviewed during a formal, public meeting of fishery stock assessment experts from 10-14 July 2023. Two Center for Independent Experts (CIE) reviewers were included in the Review Panel. The four stocks were: Washington Black Rockfish, Oregon Black Rockfish, Northern California Black Rockfish and Central California Black Rockfish

ii. The Washington Black Rockfish model included data from trawl, non-trawl and recreational fleets (now the dominate catch), six abundance indices, length composition data from fisheries and surveys and conditional age-at-length composition from the commercial and recreational fisheries. Fishery-dependent indices of abundance for 1981 to 2022 were used for the private and charter recreational fleets. Additionally, 4 fishery-independent indices were available, though of varying years of duration. The primary source of fishery-independent length and age data for Washington black rockfish is the recreational fishery. An SS model was constructed stratified by sex. Natural mortality was fixed at 0.17 for females and 0.152 for males from the last assessment, as those were still deemed reasonable estimates given potential longevity. Sex-specific growth parameters were estimated external to the model. The parameter t_0 was fixed in the base model since estimation led to extremely high current biomass values, while L infinity and k were estimated. Additional data and parameters included weight-at-length, maturity-at-length, fecundity-at-length, and steepness (h) fixed at the guidance of 0.72, recruitment variability ($\boldsymbol{\sigma}_R = 0.6$), as well as ageing error matrices. In addition, parameters for initial population scale ($ln R_0$), selectivity for each fishery and survey, and added survey variance were estimated. The Panel made no recommendations to modify the reference model to be presented to the SSC from the model provided in the pre-STAR 2 assessment document.

iii. The assessment model for Oregon black rockfish was informed by catch data from two commercial fleets and two recreational fleets, six abundance indices, five sets of length composition data, and three sets of conditional age-at-length compositions. The model used multiple ageing error matrices to incorporate ageing imprecision. It utilized fixed parameters for weight-at-length, maturity-at-length, fecundity-at-length, the Beverton-Holt stock-recruitment steepness value (h=0.72). Life history parameters were sex-specific with natural mortality fixed at external estimates, and growth and recruitment deviation parameters estimated. Additional parameters that were estimated include initial population scale ($lnR0$), selectivity for each fishery and survey, and extra survey variance. An additional data point was the results of an Acoustic-Visual (AV) Survey conducted in 2021 that was purported to be an estimate of total biomass of black rockfish for the Oregon coast. The Panel recommended that the model provided in the pre-STAR 2 assessment document be modified for its presentation to the SSC. That modification involved a reweighting of size and age data relative to the AV survey, Outcomes reflect the relatively poor understanding of the tension between these two data components.

iv. The northern California assessment was based on data sources including commercial and recreational catches, size samples from both fishery and survey platforms, ageing data and a suite of indices of abundance, including both catch-per-unit-effort (CPUEs) from fisheries data and fishery-independent surveys. Black rockfish are taken by recreational and commercial fleets in California, but northern recreational fisheries have accounted for the majority of statewide removals in recent decades. The assessment was structured as a single, sex-disaggregated population, spanning U.S. waters from the Oregon/California border south to Point Arena, California. The model was conditioned on catch from two sectors (commercial and recreational) divided among six fleets (three commercial and two recreational) plus two discard "fleets", one for each sector. Additionally, there were three time series of relative abundance indices available, two being fishery-dependent from the recreational sector and the other being a fishery-independent survey. None of these surveys were initiated before 2002 and none had a continuous series in annual data over the time period 2003-2022. Several fixed or prior-constrained parameters were used for M and h. Weight-length, maturity, and fecundity relationships were estimated external to the model or taken from values reported in the literature. The Panel recommended that the model provided in the pre-STAR 2 assessment document be modified for its presentation to the SSC. That modification involved including updated aging error models and a spline (as opposed to logistic) functional maturity model.

v. The central California black rockfish assessment was structured as a single, sex-disaggregated population. The model was conditioned on catch from commercial and recreational sectors divided among six fleets, and is informed by four time series of relative abundance (one fishery-independent survey, one CPUE index from a shore-based recreational sampling program, and two CPUE indices from onboard CPFV observer programs operating over different time periods). A Beverton-Holt stock recruitment relationship, using a fixed steepness of 0.72 and a fixed sigma R = 0.6. Growth was modeled across a range of ages from 0 through 50 and natural mortality parameters in the central area reference model were fixed at the values estimated in the northern area. The Panel recommended that the model provided in the pre-STAR 2 assessment document be modified for its presentation to the SSC. That modification involved including updated aging error models and a spline (as opposed to logistic) functional maturity model.

vi. These modified assessment models represent the best science available given the existing data as the assessment goes forward to the final model runs for the SSC.

vii. The need for more aging, size samples and expanded surveys are ubiquitous in these assessments. As opposed to assessments of other stocks around the world, the current WA, OR, CA indices are not very informative

viii. Implicit within all these assessments is that migration at pre- or post- recruitment time periods are not important to the dynamics (i.e. that the stock-delineation is correct). While it is important to augment research on stock identification, it is also important to explore management procedures which are robust to stock-id mis-specifications.

ix. Usually, the axes of uncertainty are focused on natural mortality and steepness. Two of the stocks in this evaluation used alternative measures, but they still are correlated with h and M. There is a need for simulation research on best practices regarding the joint choice of h, M and SigmR in the stock recruitment relationship including statistical structure of the sigmas (alternatives to lognormal, shifting SigmaR with spawning output, etc).

x. The review meeting was constructive and productive with effective excellent co-operation from the STAT teams. Meeting facilities were good, and the local staff provided great support to the reviewers. There were no major disagreements between Panel members or the STATs

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Background

The National Marine Fisheries Service (NMFS) is mandated by the Magnuson-Stevens Fishery Conservation and Management Act, Endangered Species Act, and Marine Mammal Protection Act to conserve, protect, and manage our nation's marine living resources based upon the best scientific information available (BSIA). NMFS science products, including scientific advice, are often controversial and may require timely scientific peer reviews that are strictly independent of all outside influences. A formal external process for independent expert reviews of the agency's scientific products and programs ensures their credibility. Therefore, external scientific peer reviews have been and continue to be essential to strengthening scientific quality assurance for fishery conservation and management actions.

The National Marine Fisheries Service and the Pacific Fishery Management Council will hold three stock assessment review (STAR) panels and potentially one mop-up panel (if needed), to evaluate and review benchmark assessments of Pacific coast groundfish stocks. The goals and objectives of the groundfish STAR process are to: 1) ensure that stock assessments represent the best available scientific information and facilitate the use of this information by the Council to adopt Overfishing Limits (OFLs), Allowable Biological Catches (ABCs), Annual Catch Limits (ACLs), Harvest Guidelines (HGs), and Annual Catch Targets (ACTs); 2) meet the mandates of the Magnuson-Stevens Fisheries Conservation and Management Act (MSA) and other legal requirements; 3) follow a detailed calendar and fulfill explicit responsibilities for all participants to produce required reports and outcomes; 4) provide an independent external review of stock assessments; 5) increase understanding and acceptance of stock assessments and peer reviews by all members of the Council family; 6) identify research needed to improve assessments, reviews, and fishery management in the future; and 7) use assessment and review resources effectively and efficiently.

This report addresses the 2nd of the STAR reviews which met July 10-14, 2023, in-person at the Southwest Fisheries Science Center, Santa Cruz with a remote participation option to facilitate public comment and participation. The Panel full reviewed full benchmark assessments for four Black Rockfish stocks: Washington, Oregon, Northern California and Central California. The panel operated under the Pacific Fishery Management Council's (PFMC) Terms of Reference for the Groundfish and Coastal Pelagic Species Stock Assessment Review Process for 2023-2024. This document will be referred to as the PFMC_ToRs in the remainder of this document.

Description of the Individual Reviewer's Role in the Review Activities

The STAR Panel for the July 10-14 review was comprised of John Budrick (California Department of Fish and Wildlife, Chair), Martin Dorn (University of Washington), Yong Chen (CIE) and myself, also as a designate of the CIE. Additionally, I was designated as the "common" CIE reviewer for the three STAR Panel groundfish reviews to be conducted in June-July 2023. The Panel's (and, thus, my) responsibilities were to examine the documentation provided prior to the meeting and then to interact within the meeting to evaluate details of the assessments, suggest alternatives to the base model if appropriate and provide feedback on possible improvements in modeling, research and data, both short- and long-term.

Thus, as a CIE reviewer, I am to submit a report addressing the Terms of Reference for this CIE review as noted in the Performance Work Statement (Appendix 2). The report herein is my evaluation addressing the second of the STAR Panel meetings.

Summary of Findings for each ToR in which the weaknesses and strengths are described

The **Terms of Reference (TORs)** for this CIE review include the specific responsibilities of the STAR Panels, as well as additional tasks assigned to the CIE reviewers. These are listed below. My response to each **TOR** is provided after each item in the list. This item-by-item response to each **TOR** is required by the CIE Performance Work Statement (Appendix 2). However, several of these **TORs** are fairly generic (for example "become familiar", "discuss … during the open meeting", etc). Therefore, my responses to those items were that those events did, indeed, occur. Hence, my technical comments and discussions are mostly grouped under **TORs 3, 4** and **6**. Additionally, **TOR 5** is a response to the best available science question. Discussions and conclusions that support that response are included in the other **TOR**s.

Terms of Reference for CIE Reviewers

TOR 1. Become familiar with the draft stock assessment documents, data inputs, and analytical models along with other pertinent information (e.g., previous assessments and STAR panel report when available), and the PFMC_ToRs prior to review panel meeting

(Note, the PFMC_ToRs are terms of reference for the scope and details of the assessments, not to be confused with the CIE Terms of Reference for this review).

Background documentation as listed in Appendix 1 were provided two weeks prior to the STAR 2 Panel meeting, as well as the PFMC's guidelines for conducting assessments and reviews of those assessments for the 2023-2024 STAR cycle. These were reviewed prior to the meeting. Thus, I became familiar with the assessment approaches, data inputs and basic STAR Panel requirements.

TOR 2. Discuss the technical merits and deficiencies of the input data and analytical methods during the open review panel meeting.

I participated in the STAR Panel 2 discussions during the meeting. Those discussions covered the technical merits, limitations of input data and analytical methods. The results of those discussions are summarized in the above **Executive Summary** and in **TOR 7** below. The technical details of those discussions and my thoughts on those issues are contained in responses to **TORs 3**, **4** and **6**.

TOR 3. Evaluate model assumptions, estimates, and major sources of uncertainty.

Model assumptions, estimates and major sources of uncertainty were examined at the July 10-14 meeting by the Panel making requests of the STAT to conduct short-term analyses on the four stocks being evaluated. The results of these analyses provided Panel members (including CIE reviewers) further understanding of the implications of assumptions, model structure and uncertainty estimates (or ranges). The scope of those requests and outcomes are summarized for each stock assessment, below.

Washington Black Rockfish

The assessment included data from trawl, non-trawl and recreational fleets (now the dominate catch), six abundance indices, length composition data from fisheries and surveys and conditional age-at-length composition from the commercial and recreational fisheries from 1940-2022. The data were stratified by fishery and sex. Fishery-dependent indices of abundance for 1981 to 2022 were used for the private and charter recreational fleets. Bag limit and depth restriction changes were addressed as covariates in addition to year, month and area for the private fleet providing an index for 1981 to 2016, since large bag limit restrictions were put in effect in 2017 affecting comparability to the earlier time series. The charter index included year, month, area, daily bag limit and depth restrictions as covariates, providing a time series from 1981-1994, given the reduction to 10 fish in 1995.Addtionally, 4 fishery-independent indices were available though of varying years of duration. The primary source of fishery-independent length and age data for Washington black rockfish is the recreational fishery from 1979-2022.

The SS model was constructed stratified by sex. Natural mortality was fixed at 0.17 for females and 0.152 for males from the last assessment, as those were still deemed reasonable estimates given potential longevity. Sex-specific growth parameters were estimated external to the model. The parameter t_0 was fixed in the base model since estimation led to extremely high current biomass values, while L infinity and k were estimated. Additional data and parameters included weight-at-length, maturity-at-length, fecundity-at-length, and steepness (h) fixed at the PFMC_ToRs "guidance" of 0.72, recruitment variability ($\boldsymbol{\sigma}_R = 0.6$), as well as ageing error matrices. In addition, parameters for initial population scale ($ln R_0$), selectivity for each fishery and survey, and added survey variance were estimated.

The Panel had the STAT examine parameter uncertainty (within a model) and model uncertainty (alternative models) using sensitivity analyses and alternative model structures. These included: exploring temporal variability in functional maturity and variability of mean length and mean age over time; effects of removing "extra variance" feature in indices; retrospective patterns and M and h profiles. In the end the Panel (and I as a Panel member) did not recommend any changes to the reference model.

Although many uncertainties were examined, the base model was unchanged during the course of the Panel. A search was conducted across fixed values of *lnR0* to attain the current year spawning output values for the high and low states of nature. Spawning output for the high and low states of nature given by the base model mean plus or minus

1.15 standard deviations (i.e., the 12.5th and 87.5th percentiles) and this was recommended as an appropriate approach for designing "axes of uncertainty" required by the PFMC_ToRs. I, as a Panel member, concurred.

Oregon Black Rockfish

The assessment model for Oregon black rockfish integrated data and information from multiple sources into the stock synthesis modeling framework. The model was informed by catch data from two commercial fleets and two recreational fleets, six abundance indices, five sets of length composition data, and three sets of conditional age-at-length compositions. The model used multiple ageing error matrices to incorporate ageing imprecision. It utilized fixed parameters for weight-at-length, maturity-at-length, fecundity-at-length, the Beverton-Holt stock-recruitment steepness value (h=0.72), and recruitment variability per guidance from the PFMC_ToRs. Life history parameters were sex-specific (i.e., a two-sex model) with natural mortality fixed at external estimates, and growth and recruitment deviation parameters estimated. Additional parameters that were estimated include initial population scale ($lnR0$), selectivity for each fishery and survey, and extra survey variance. An additional data point was the results of an Acoustic-Visual (AV) Survey conducted in 2021 that was purported to be an estimate of total biomass of black rockfish for the Oregon coast.

A number of analyses designed to evaluate sensitivities were conducted including M and h profiles, comparing effects of the Marine Reserve Indices and comparing with other indices. Additionally, efforts focused on the compatibility of the AV data point results with age and length data (using different target strengths for the AV, alternative weighting of AV versus age/length and alternative catchabilities for the AV data point). Much of the Panel/STAT discussion centered on the latter issue in that conflict in the data suggested that the 2021 AV estimate was an overestimate of total biomass and thus, was fit in the model with a catchability. In the end the reference model was modified such that length selectivities were estimated in an initial model run and then fixed, and marginal age data are added to likelihood and the model was rerun. This approach reduced the importance of the length data in the assessment and increased the importance of the acoustic-visual survey (it gives comparable results to assigning a weight (lambda) of 0.25 to length data, or, alternatively, a lambda of 10 to acoustic-visual estimate). Although this approach resulted in an improved fit to the acoustic-visual survey estimate, the fit to this data point remained relatively poor.

To bracket uncertainty, the Panel focused on alternative treatments of the acoustic-visual survey estimate, which the Panel considered to be the overriding dimension of uncertainty for the Oregon black rockfish assessment. The high state of nature was given by a model that pinned the acoustic-visual catchability (q) to 1.8 by reducing the CV of the survey to a small value. This model was the original base model in the pre-STAR draft assessment. The lower state of nature was given by a model in which the acoustic-survey catchability is freely estimated, essentially ignoring the information content of the survey. This was recommended as an appropriate approach for designing "axes of uncertainty" required by the PFMC_ToRs. I, as a Panel member, concurred.

Northern California Black Rockfish

Two separate assessments were conducted on California black rockfish with data separated between Northern California (north of Point Arena, 38°57′30" N. lat.) and Central California (south of Point Arena). The northern California assessment was based on multiple data sources including commercial and recreational catches, size samples from both fishery and survey platforms, ageing data and a suite of indices of abundance, including both catch-per-unit-effort (CPUEs) from fisheries data and fishery-independent surveys. Black rockfish are taken by recreational and commercial fleets in California, but northern recreational fisheries have accounted for the majority of statewide removals in recent decades. In recent years, black rockfish landed alive have accounted for about 50% of the commercial catch in weight.

The northern California black rockfish assessment was structured as a single, sex-disaggregated population, spanning U.S. waters from the Oregon/California border south to Point Arena, California. The model was conditioned on catch from two sectors (commercial and recreational) divided among six fleets (three commercial and two recreational) plus two discard "fleets", one for each sector. Additionally, there were three time series of relative abundance indices available, two being fishery-dependent from the recreational sector and the other being a fishery-independent survey. None of these surveys were initiated before 2002 and none had a continuous series in annual data over the time period 2003-2022. Size and age composition data include lengths and ages from 1972-2022 and ages with intermittent gaps in each data type. Several fixed/prior-constrained parameters were used. A prior distribution was specified for the estimated female natural mortality parameter with a median of $M = 0.154$ and a log-scale standard deviation of 0.31, with male mortality estimated as an exponential offset with a flat prior. Parameters of sex-specific von Bertalanffy growth equations were either estimated (length at age 20, k, and CVs of length at age 20) or fixed (5-cm length at age 0 and a CV of 10% for length at age 0). Weight-length, maturity, and fecundity relationships were estimated external to the model or taken from values reported in the literature. A Beverton-Holt stock recruitment relationship, using a fixed steepness of 0.72 and a fixed sigma R = 0.6 per guidance from the PFMC_ToRs with lognormal deviations being fitted from 1963-2022.

Analyses were provided for M and h profiles, comparing indices, updating aging error methods, comparing functional maturity spline vs logistic models, mirroring non-trawl dead selectivity with non-trawl live and exploring retrospective patterns through Mohns rho and analysis of recruitment timing in indices. In the end the Panel recommended the reference model be modified using the updated ageing error and the spline approach to modeling functional maturity.

The STAR Panel recommended that the upper and lower states of nature be defined based on the uncertainty in natural mortality. That range in uncertainty was centered on the point estimate of the base model and with the range as being the 12.5 and 87.5 percentiles of the distribution for lower and upper states of nature. This was recommended as an appropriate approach for designing "axes of uncertainty" required by the PFMC_ToRs. I, as a Panel member, concurred.

Central California Black Rockfish

The central California black rockfish assessment was structured as a single, sex-disaggregated population, spanning U.S. waters from the US/Mexico border to Point Arena, California (38°57′30" N. lat.). Black rockfish are rare south of Point Conception (34°27′ N. lat.), so the central California model focused on the region between Point Conception and Point Arena. The model was conditioned on catch from two sectors (commercial and recreational) divided among six fleets, and is informed by four time series of relative abundance (one fishery-independent survey, one CPUE index from a shore-based recreational sampling program, and two CPUE indices from onboard CPFV observer programs operating over different time periods). Size and age composition data included lengths from 1959-2022 and ages from 1980-2022, with intermittent gaps in each data type. A Beverton-Holt stock recruitment relationship, using a fixed steepness of 0.72 and a fixed sigma R = 0.6 per guidance from the PFMC_ToRs with lognormal deviations being fitted from 1963-2022 was used. .Growth was modeled across a range of ages from 0 through 50. All catches were assumed to be known with high precision (log-scale standard error of 0.05). Since most available age data is from north of Point Arena, natural mortality parameters in the central area base model are fixed at the values estimated in the northern area for both females and males (exponential offset from females).

Analyses were evaluated at the meeting to obtain M and h profiles, comparing indices, updating aging error methods, comparing functional maturity spline vs logistic models, exploring retrospective patterns through Mohns rho and analysis of recruitment timing in indices, exploring available YOY indices and testing the use of asymptotic selectivities and their relationship to M. The results of the latter two analyses suggest avenues for future research. In the end the Panel recommended the reference model be modified using the updated ageing error and the spline approach to modeling functional maturity.

The uncertainty in the prior for natural mortality was used to obtain possible upper and lower states of nature for the central California black rockfish assessment area. This uncertainty was centered on the point estimate of the northern base model and was defined at the 12.5 and 87.5 percentile of the distribution for lower and upper states of nature. This was recommended as an appropriate approach for designing "axes of uncertainty" required by the PFMC_ToRs. I, as a Panel member, concurred.

TOR 4. Provide constructive suggestions for current improvements if technical deficiencies or major sources of uncertainty are identified.

I am interpreting suggestions for "current" improvements to be those improvements that were made to the final reference model and supporting information to be presented to the SSC and subsequently to the Council. Therefore, current improvements are the changes to the reference model recommended by the Panel (and by me as a Panel member). Those modifications were noted in **TOR 3** and highlighted here. Research improvements (both analytical and data) discussed in **TOR 6**,

Washington Black Rockfish

Although many uncertainties were examined, the reference model was unchanged during the course of the Panel meeting from the pre-STAR 2 assessment report.

Oregon Black Rockfish

The reference model was modified such that length selectivities were estimated in an initial model run and then fixed, and marginal age data are added to likelihood and the model was rerun. This approach reduced the importance of the length data in the assessment and increased the importance of the acoustic-visual survey (it gives comparable results to assigning a weight (lambda) of 0.25 to length data, or, alternatively, a lambda of 10 to acoustic-visual estimate). Although this approach resulted in an improved fit to the acoustic-visual survey estimate, the fit to this data point remained relatively poor.

Northern California Black Rockfish

The Panel recommended the pre-STAR 2 reference model be modified using the updated ageing error and the spline approach to modeling functional maturity.

Central California Black Rockfish

The Panel recommended the ore-STAR 2 reference model be modified using the updated ageing error and the spline approach to modeling functional maturity.

TOR 5. Determine whether the science reviewed is considered to be the best scientific information available.

Washington Black Rockfish

In my scientific opinion the science reviewed at the July 10-14 meeting and the recommended modifications to the reference model given in the Summary Report (and noted in TOR4) represent the best scientific information available on Washington Black Rockfish to go forward to the SSC.

Oregon Black Rockfish

In my scientific opinion the science reviewed at the July 10-14 meeting and the recommended modifications to the reference model given in the Summary Report (and noted in TOR4) represent the best scientific information available on Oregon Black Rockfish to go forward to the SSC.

Northern California Black Rockfish

In my scientific opinion the science reviewed at the July 10-14 meeting and the recommended modifications to the reference model given in the Summary Report (and

noted in TOR4) represent the best scientific information available on Northern California Black Rockfish to go forward to the SSC.

Central California Black Rockfish

In my scientific opinion the science reviewed at the July 10-14 meeting and the recommended modifications to the reference model given in the Summary Report (and noted in TOR4) represent the best scientific information available on Central California Black Rockfish to go forward to the SSC.

TOR 6. When possible, provide specific suggestions for future improvements in any relevant aspects of data collection and treatment, modeling approaches and technical issues, differentiating between the short-term and longer-term time frame.

Following are lists of research suggestions made by the STATs and the Panel. I have assigned each a designation of short-term or longer-term. Note the time frame assignments are my opinions and not necessarily those of the Panel, at large. At the end of the response to TOR 6, I include a more detailed discussion about future modeling research including some analytical support. These are my opinions, independent of the Panel.

Washington Black Rockfish

STATs recommendations: a) continue to develop the nearshore fishery-independent survey, as the other available surveys provide weak information for the trend in the population (**longer-term**); b) Improve understanding of broader ecosystem considerations within the context of Black Rockfish (and other nearshore species) management (**longer-term**); c) evaluate and develop linkages between black rockfish population dynamics and environmental, oceanographic, and climate variables. In particular, develop multi-scale models (e.g., species distribution models) that can evaluate spatial patterns (e.g., multi-use areas or closures to fishing) and climate impacts (e.g., growth or distribution shifts) for vulnerable nearshore species (**longer-term**); d) utilize the growing body of ecosystem information available for the California Current Large Marine Ecosystem, as exemplified in the PFMC Integrated Ecosystem Assessment (IEA) report (**longer-term**); e) continue work on the investigation into the movement, behavior or mortality of older (> age 10) females to further reconcile their absence in fisheries data. In particular, conduct genetics studies on fish observed off of the continental shelf (middle of the gyre and at sea mounts) to determine their association with the nearshore stocks (**longer-term**); f) continue to build evidence for appropriate natural mortality values for females and males. This will help resolve the extent to which dome-shaped age-based selectivity may be occurring for each(**longer-term**); g) design and conduct research studies to better understand the trade-offs revealed in this assessment between black rockfish biology and population scale that seem to be at odds. If discrepancies cannot be uncovered, evaluate management procedures that are as robust as can be to this trade-off (**longer-term**); and h) Conduct early life history studies that provide a better understanding of the ecology

and habitats of black rockfish from settlement to age-1 (**longer-term**).

Additionally, the STAR panel recommends: a) simulation studies, meta-analyses across species or other research to examine circumstances in which options for treatment sex data for composition data in Stock Synthesis are preferable under Option 1 or 2 treating them as separate or Option 3 treating them as combined. Such studies should aim to provide criteria for their application to inform guidance in the PFMC's Groundfish Terms of Reference and Accepted Practices documents (**short-term**); b) data informing the functional maturity ogive were collected during a period of extreme variability in ocean conditions and further examination of the drivers of variability observed may prove beneficial (**short-term**); c) compare trends in abundance and patterns of recruitment across species to examine commonalities, differences and their causes may help inform accounting for environmental determinants (**longer-term**); d) account for variance in catch history to help reflect the full degree of uncertainty in the assessment (**short-term**); and e) re-examine methods to generate estimates of abundance from the WDFW Tagging Program using approaches used for similar data sets from analogous studies in Oregon (**short-term**).

Oregon Black Rockfish

STATs recommendations: a) continue work on the investigation into the movement, and behavior or mortality of older (> age 10) females to further reconcile their absence in fisheries data (**longer-term**); b) conduct population genetics studies on fish observed off of the continental shelf (middle of the gyre and at sea mounts) to determine their association with the nearshore stocks (**longer-term**); c) continue to build evidence for appropriate natural mortality values for females and males (**longer-term**); d) improved historical catch reconstructions. specifically, the historic trawl fishery catches (pre-1987) in particular require particular attention. A synoptic catch reconstruction is recommended, where states work together to resolve cross-boundary state catch issues as well as standardize the approach to catch recommendations to the extent possible (**short-term**); e) stock structure for black rockfish is a complicated topic that needs further analysis. How this is determined (e.g., exploitation history, genetics, life history variability, biogeography, etc.) and what this means for management units needs to be further refined. This is a general issue for all nearshore stocks that likely have significant and small-scale stock structure among and within states, but limited data collections to support small-scale management (**longer-term**); f) continue acoustic-visual fisheries independent coastwide survey to develop a time series. Further refine the survey by addressing the recommendations of the SSC methodology review from 2022. Examine the potential of using spatial modeling to reduce the uncertainty in the population estimates from the acoustic-visual fisheries independent coastwide survey (**longer-term**); g) Reconcile contradictory signals in the black rockfish biology versus the population scale (**short-term**); and h) better understand the ecology and habitats of black rockfish from settlement to age 4. Further development of surveys aimed specifically at recruitment or settlement rates of nearshore species, such as OSU's Standard Monitoring Units for the Recruitment of Fishes (SMURF) collections, that are not frequently encountered in offshore federal age-0 surveys is needed (**longer-term**).

Additionally, the STAR panel recommends: a) with respect to the STAT's recommendation (f) above on the acoustic-visual survey, the Panel recommends that the survey team focus on improving the survey estimates by: obtaining a target strength estimate for black rockfish; developing a method for in-situ transducer calibration, and improving backscatter identification using visual surveys and other methods as appropriate. Concentrating on the echo integration component of the survey seems warranted given that methods are well developed and widely used, and it is regarded as a reliable and robust acoustic survey technique (**longer-term**); b) develop additional capacities in stock synthesis to model marine reserves (i.e., closed to fishing) and areas that are open to fishing (**short-term**); c) explore tradeoffs between the different options to fitting sex-specific composition data in stock synthesis and develop recommendations for acceptable practices (**short-term**); d) using acoustic visual survey data to develop an informative prior for the PIT tag survey was considered during the STAR panel meeting, but there was insufficient time to fully explore this approach. Future assessments should continue to develop and evaluate this approach (**short-term**); e) continue to collect functional maturity information and evaluate the role of geography, environmental forcing, and density dependence on functional maturity estimates for black rockfish (**longer-term**).

Northern and Central California Black Rockfish

STATs recommendations: a) there is conflicting evidence and limited information with which to evaluate black rockfish stock structure, especially off California. Future research on larval dispersal, life history traits, adult movement, and genetics south of the California-Oregon border would improve inputs for stock assessments and provide support for the spatiotemporal scale that is most appropriate for modeling black rockfish. Specifically, information about growth, maturity, and mortality north and south of Point Arena would further justify the separation of black rockfish at this location. Further genetic evaluation regarding the extent to which Point Arena may serve as a barrier to gene flow would also be valuable for this stock (**longer-term**); b) specific estimates of larval dispersal and movement rates at various life stages would further our understanding about connectivity among the three West Coast stocks of black rockfish. Although most black rockfish show moderate to high site fidelity and some degree of homing, a notable proportion of fish appear to cross stock boundaries. Additional research on the directions and distances that black rockfish move in northern California and southern Oregon would help elucidate the degree of intergenerational exchange across this particular stock boundary (**longer-term**); c) finally, much of what we know about the habitat associations and ecological role of black rockfish come from Oregon, Washington, and Alaska. Research that is specific to central and northern California is needed to fully understand variation in black rockfish life history, population structure, and trophic positioning (**longer-term**); d) exploration of multiple-area models for the stock is recommended when sufficient data are available to parameterize movement within the model. Directional movement between areas (south to north, as observed in the CCFRP movement data) may partially explain sustained differences in size and age composition throughout the state (**short-term, I believe some exploration with existing, though very incomplete, data would be useful**); e) attempts to investigate recruitment

indices (RREAS, SWFSC SCUBA) for the fleets-as-areas model configuration were not successful, and there was not enough time to evaluate area-specific indices prior to the STAR panel document deadline (although they have been developed). Future assessments may benefit from an analysis of these recruitment indices representing sub-areas defined in this assessment (**short-term**); and f) further research is also needed to explain skewed sex ratios among older individuals in the population. This assessment assumes that size-dependent selectivity is equal for both sexes, and does not consider alternative hypotheses such as sex- or age-specific selectivity or age-dependent natural mortality, both of which could also explain, in whole or in part, the reduced fraction of older females in the data (**longer-term**).

Additionally, the STAR panel recommends: a) inclusion of ecosystem consideration to evaluate possible shifts in productivity and environments and how such changes may influence fish life history, population dynamics, phenology of movement, distributions, and fisheries (**longer-term**); b) continue the current tagging study to better understand the movement and spatial distribution of black rockfish in California (**longer-term**); c) exploration and development of a spatially explicit model (e.g., 2-box model) to integrate the assessment of the northern and central California assessment areas accounting for migration rates between assessment areas using data from CCFRP and other tagging efforts (**short-term**); d) conducting habitat modeling to better understand spatio-temporal dynamics of black rockfish suitable habitats and how the changes may influence the existing monitoring programs and stock assessment (**longer-term**); e) development of functional maturity-length relationships using the data collected in the central California assessment area (**short-term**).

General Comments and Recommendations on Assessment Research

Targets

Following is the equilibrium yield= equilibrium dB/dt plot taken from the draft executive summary of the pre-STAR 2 Washington black rockfish document. However, note that only the y-axis and the "current S/S0" are a result of the assessment. Everything else is a result of the assumption of steepness imposed by the PFMC_ToRs. This figure (Figure 1) has shown up throughout the STAR process for other rockfish stocks, where h=0.72 was used.

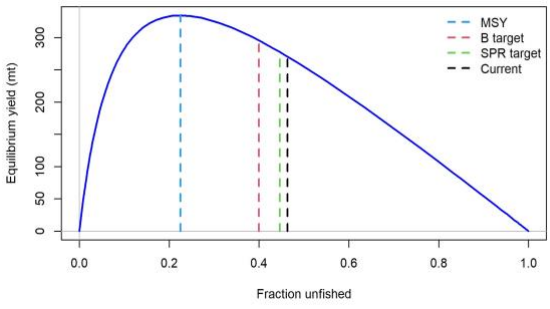

Figure 1: Rockfish equilibrium yield vs. fraction unfished.

The equilibrium results from the Beverton-Holt relationships:

$$\frac{S}{S_0} = \frac{SPR - ((1-h)/(4h))}{1 - ((1-h)/(4h))} \; and \; SPR_{MSY} \cong SPR_{Max\ Excess\ Rec} = \sqrt{(1-h)/(4h)}$$

Examination of this figure tells us 1) that all the equilibrium "targets" are more than 1.5 times the spawning output at msy (Smsy) including the current S; and 2) a depleted stock (S<Smsy) has the potential for a fairly rapid recovery to Smsy (the slope of the curve on the left is steeper than the right. All of this comes from the specification of h without an assessment. I only mention this because it is unclear to me what the various "targets" are trying to achieve and how they are folded into a control rule and how consistent they are with the h or Smsy/S0 specification.

Consequences of h, M and SigmaR Specification

SPR and SPR at the Origin
The SPR at the origin of a BH stock-recruitment curve is (1-h)/4h. This says that with a BH SR curve with h=0.72, equilibrium SPRs <=0.0972 will go to extinction. Taking N California Rockfish as an example (Table 40 of the Pre-STAR 2 assessment report) there were a couple of years where SPR<0.0972 (Figure 2). Thus, by the model, not necessarily in reality, the stock was close to extinction. This is a reminder that the h specification in the rockfish models can have some unintended influences in the highly constrained parameter space the models are operating in.

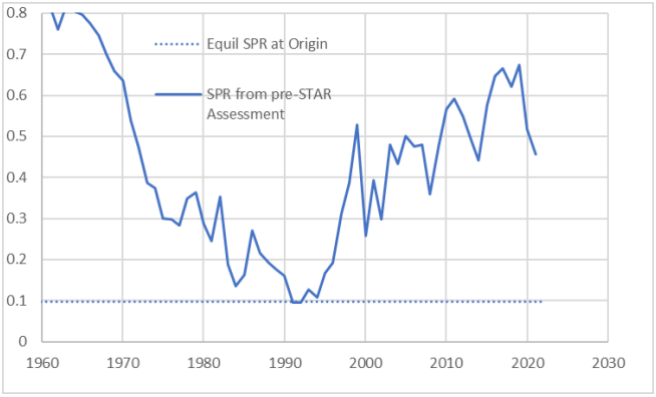

Figure 2: Change in SPR by year.

That constrained parameter space is demonstrated by a simple production model: dB/dt=aB - bB^p -Y, where a, b and p are parameters B is the biomass and Y is the yield in weight. Specifying h=0.72 gives Smsy/S0=0.238. The value of p that gives the equivalent Bmsy/B0=0.238 is p=0.461. The value of B0 (carrying capacity is taken from the N California assessment Table 40. Thus, the simple model becomes dB/dt= B0*b*(1-p)*(B^p)-bB-Y. Taking b=M, we get dB/dt= B0*alpha*(B^p)-MB-Y, where alpha=M*(1-p). I know the M mortality rate in the assessments are in numbers but, here it is weight. But it will be seen that it serves an equivalent scaling property in both models. Essentially, what I have done here is create a simple population dynamics model which uses the same basic assumptions that the detailed assessment model uses (B0, h or p and priors on M) and coupled with the observed catches in weight (Y's). Then I numerically solved dB/dt. The resulting dynamics are very similar to the reference model

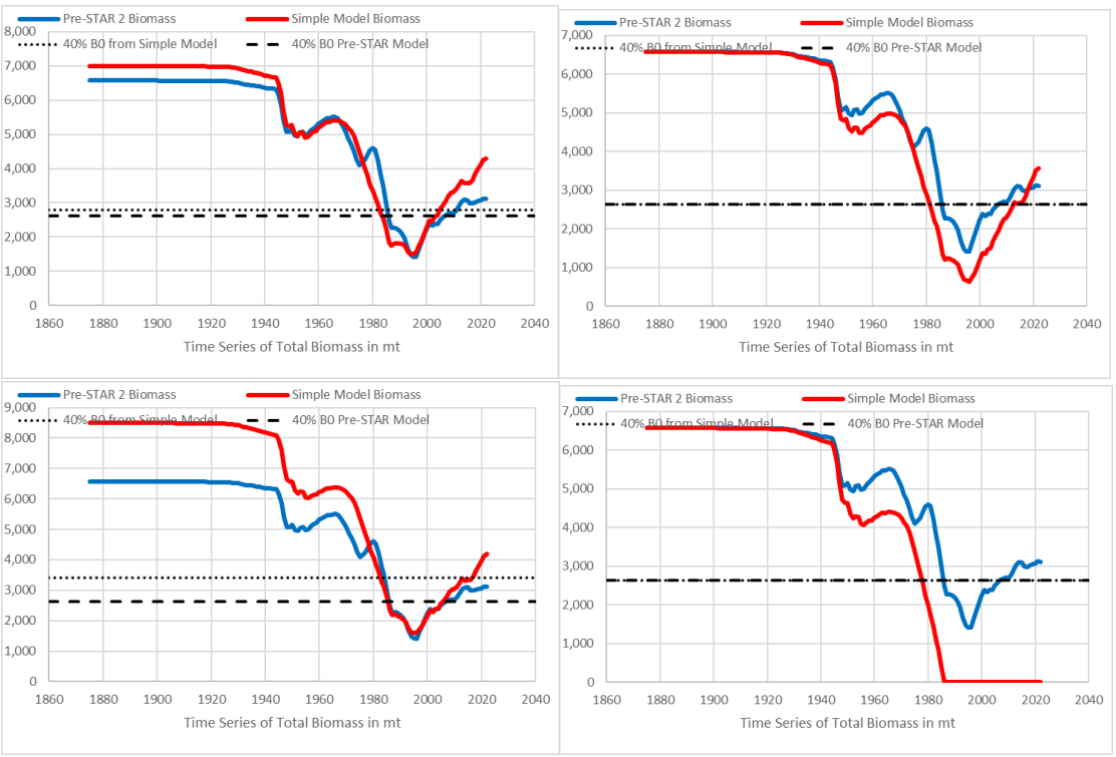

Figure 3: Biomass trajectories (blue lines) from the N California Black Rockfish pre-STAR 2 assessment where h=0.72, M estimated at 0.21 and B0=6573 from Table 40. Red lines are the simple production model with parameters p=0.461 (equivalent to h=0.72); Upper left: M =0.21 the same as the estimate from the pre-STAR model and B0 fixed at 7000; Upper Right: M=0.21, B0=6573; Lower Left: M=0.154 the prior used in pre-STAR and B0=8500; and Lower Right: M=0.154, B0=6573. Note Lower Right collapses because the low M is not sufficient to cover history of catches at that B0 (equivalent to SPR at origin issue in the previous figure).

What these graphs in Figure 3 suggest is that 1) the basic dynamics are being driven by the h and M assumptions and the history of catches; 2) since almost all the index and size data other than catches were collected post depletion, those data are estimating recovery and are only weakly related to scale (R0, S0 or B0); 3) the rockfish assessments at h=0.72 and the priors on M are forcing the model into a confined space during the time period 1995-2005 where slight reductions in M would cause stock collapse unless the scale (B0, S0 or R0) is inflated. Therefore, the SS modeling is essentially using aging/size data and limited index data in the later years (post 2000) to modulate what the dynamics imposed by M and h are trying to do. And it is doing this by estimating recruitment deviations since the index data are not very informative.

Most of the rockfishes in STAR 1 and STAR 2 (and STAR 3 as well) have similar histories of catch, the same specification for h, priors on M and the same SigmaR. This leads me to a generic recommendation for modeling/simulation research:

> **My recommendation from this discussion is that there is a need for simulation research which explores the relationship of h, M and SigmR and the statistical structure of the sigmas (alternatives to lognormal, shifting SigmaR vs S, etc). We usually consider these choices independently from one another, or not at all. This research is beyond the scope of a single assessment and could probably be achieved in 2-4 years.**

Alternative Models

Also, the PFMC_ToRs and the STAR meetings themselves are structured around the SS3 platform. The modeling philosophy is to try to use the data as collected and to derive an accurate model often with the result of estimating high precision (Hessian) that is known to be biased. Often this results from the fixing of important parameters. Then at the end, the assessment defaults to overall uncertainty best practices (sigma). There is a need to expand the modeling to encompass the diversity of model responses to sequential time series of data,

> **Ensemble modeling approaches should be explored since there might be alternative modeling structures that estimate rates better, while others may estimate scale better. How to structure an assessment accordingly and how to weight results would be an important contribution. For example, a simple model might be used for projections as in a management procedure. This research is beyond the scope of a single assessment and could probably be achieved in 2-4 years.**

Marine Reserve Data

Several rockfish assessments use Marine Reserve data for indices of abundance including the area where the Reserve exists and designated "comparison areas", where both are periodically monitored. Maybe I am missing something but it is unclear that combing trends between the two would be very useful for indicating trends of the stock as a whole. I would recommend that some model formulation effort be conducted with the objective to obtain informative indices of abundance. AND consider model constructs that would isolate the data from the no fishing reserves into a likelihood component to help estimate M. Such an effort might suggest feasible modifications to data collection to support this effort.

Total Biomass Data

The Oregon assessment included an estimate of total biomass of black rockfish off the Oregon coast. The result was an estimate of ~12,000 mt with a CV of 0.45. Since there was only one year of this estimate and since it was not very compatible with the length/age data, there was an ad hoc fix that was finally suggested to appropriately weight the data for this assessment. However, total biomass estimates are being attempted and considered for several stocks throughout the country. It would be useful to develop appropriate protocols and best practices which would address how to incorporate a single data point (as in the Oregon assessment); if the estimate and CV are deemed inappropriate what's the best way to approach estimating a q for that data point; should the q's of indices that cover the same year have a likelihood component that includes the total B estimate, and so on. The best approaches are not very clear and an effort to explore these issues would be useful.

TOR 7. Provide a brief description on panel review proceedings highlighting pertinent discussions, issues, effectiveness, and recommendations.

The review was conducted in a constructive manner and the STAT teams were responsive to the requests from the Panel for additional analyses with all the essential runs being completed during the meeting. Those issues were referred to in the TOR 3 response.

These included: updates of aging error, maturity models, alternative selectivity assumptions that better explained the observed data, appropriate assumptions on natural mortality, steepness and SigmaR and discussions on the states of nature for decision tables. Overall, there was effective engagement from all members of the Panel, the STATs and the Panel advisors. This led to improvements in the configuration of the base models.

TOR 8. CIE Reviewers shall provide a critique of the NMFS review process, including suggestions for improvements of both process and products.

The review process functioned well in that the meeting time was fully utilized, interactions were collegial and productive and important elements of the four assessments were explored. The meeting itself was constructive and productive with effective and excellent co-operation from the STAT teams. Meeting facilities were good, and the local staff provided great support to the reviewers.

In terms of scheduling. the guidance given in the PFMC_ToRs is: *"The number of groundfish assessment models reviewed per panel should ideally be two, except in extraordinary circumstances if the SSC and NMFS agree that it is advisable, feasible, and/or necessary, taking into account multiple area models per species or the potential for also reviewing data-moderate assessments in the STAR panel".* In the present case of STAR Panel 2, four assessments were evaluated within the 5=day meeting. Nevertheless, under the advice and leadership of the STAR Panel 2 chair, we spent approximately one day for evaluation and re-evaluation (based on request responses by the STAT) plus ¼ day for Summary Report writing for each of the four stocks. The SSC/NMFS/Council must have considered STAR Panel 2 an "extraordinary circumstance" just as they considered STAR Panel 1 an "extraordinary circumstance". Clearly, the SSC/NMFS/Council is aware of the trade-offs of this type of scheduling, but they bear repeating here. Time limitation did not allow some detailed examination of (for example) some index data especially the AV data point, joint interactions of choices for steepness and M (typically the axes of uncertainty in assessments) and with SigmaR. These items and others were highlighted in **TOR 6** and in the **Panel Summary Report** and were, thus, relegated to future analysis/research. This is not a complaint by me as a CIE reviewer or by the Panel. It is just a statement that this review, as all reviews, provide best advice under the organizational constraints given. But I wish to give my support to the original guidance in the PFMC_ToRs that the number of assessments for a single STAR Panel meeting should ideally be two.

Conclusions and Recommendations in Accordance with the ToRs.

The assessments of four stocks of black rockfish represent the best science available given the existing data and the guidance imposed by the PFMC_ToRs. The analyses were thorough and considerable work had gone into making good use of data from a variety of sources. The limited amount of age data and lack of informative fishery independent abundance indices means that despite the complexity and detail of the assessments, there remains uncertainty in estimated stock trends. If these stocks are of sufficient importance, the research suggestions in **TOR 6** form a template to address that uncertainty.

As usual, natural mortality and the stock-recruitment relationship (h, M and SigmaR) remain a source of uncertainty. There is a need to examine through simulation the best practices for specifying their relationships.

SS3 has a wide use and has a large array of options and diagnostics. Some additional thought is needed on the trade-offs of model complexity and the management needs for short-term forecasts of sustainable catches.

The review meeting was constructive and productive with effective excellent co-operation from the STAT teams. Meeting facilities were good, and the local staff provided great support to the reviewers. There were no major disagreements between Panel members or the STAT.

Appendix 1: Bibliography of Materials Provided for Review

Cope, J.M., L.K. Hillier, C.B. Niles , T. Tsou, K.E. Hinton, F.P. Caltabellotta. 2023. Status of Black Rockfish (*Sebastes melanops*) in 2023 in state and federal waters off Washington state. Pacific Fishery Management Council, Portland, Oregon. 219p.

Cope, J.M., A.D. Whitman, A.M. Berger, L.R. Rasmuson. 2023. Status of Black Rockfish *Sebastes melanops*) in 2023 in state and federal waters off Oregon. Pacific Fishery Management Council, Portland, Oregon. 224p.

Dick, E.J., C. Barnes, J. Coates, N. Grunloh, M. Monk, and T. Rogers. 2023. The Status of Black Rockfish in U.S. Waters off California in 2023. Pacific Fishery Management Council, Portland, OR. Available from http://www.pcouncil.org/groundfish/stock-assessments/

Additionally, zipped files of model runs were provided.

Appendix 2: CIE Performance Work Statement
Stock Assessment Review (STAR) Panel 2 (CLIN 0002) Black Rockfish

Background

The National Marine Fisheries Service (NMFS) is mandated by the Magnuson-Stevens Fishery Conservation and Management Act, Endangered Species Act, and Marine Mammal Protection Act to conserve, protect, and manage our nation's marine living resources based upon the best scientific information available (BSIA). NMFS science products, including scientific advice, are often controversial and may require timely scientific peer reviews that are strictly independent of all outside influences. A formal external process for independent expert reviews of the agency's scientific products and programs ensures their credibility. Therefore, external scientific peer reviews have been and continue to be essential to strengthening scientific quality assurance for fishery conservation and management actions.

Scientific peer review is defined as the organized review process where one or more qualified experts review scientific information to ensure quality and credibility. These expert(s) must conduct their peer review impartially, objectively, and without conflicts of interest. Each reviewer must also be independent from the development of the science, without influence from any position that the agency or constituent groups may have. Furthermore, the Office of Management and Budget (OMB), authorized by the Information Quality Act, requires all federal agencies to conduct peer reviews of highly influential and controversial science before dissemination, and that peer reviewers must be deemed qualified based on the OMB Peer Review Bulletin standards[1].

Scope:

The National Marine Fisheries Service and the Pacific Fishery Management Council will hold three stock assessment review (STAR) panels and potentially one mop-up panel (if needed), to evaluate and review benchmark assessments of Pacific coast groundfish stocks. The goals and objectives of the groundfish STAR process are to:

1) ensure that stock assessments represent the best available scientific information and facilitate the use of this information by the Council to adopt Overfishing Limits (OFLs),
Allowable Biological Catches (ABCs), Annual Catch Limits (ACLs), Harvest Guidelines (HGs), and Annual Catch Targets (ACTs);

2) meet the mandates of the Magnuson-Stevens Fisheries Conservation and Management Act (MSA) and other legal requirements;

[1] https://www.whitehouse.gov/wp-content/uploads/legacy_drupal_files/omb/memoranda/2005/m05-03.pdf

3) follow a detailed calendar and fulfill explicit responsibilities for all participants to produce required reports and outcomes;

4) provide an independent external review of stock assessments;

5) increase understanding and acceptance of stock assessments and peer reviews by all members of the Council family;

6) identify research needed to improve assessments, reviews, and fishery management in the future; and

7) use assessment and review resources effectively and efficiently.

A benchmark stock assessment will be conducted and reviewed for Black Rockfish, which was identified within the top twenty-five rankings for assessment consideration during the Pacific coast groundfish regional stock assessment prioritization process:

(https://www.pcouncil.org/documents/2022/05/f-3-attachment-2-nmfs-assessmentprioritization-workbook-electronic-only.xlsx/)

which was based on the national stock assessment prioritization framework

(http://www.st.nmfs.noaa.gov/Assets/stock/documents/PrioritizingFishStockAssessments_FinalWeb.pdf).

Black Rockfish (*Sebastes melanops*) is a nearshore species exhibiting internal fertilization and bearing live young. Adults tend to occur in schools over rocky structure at depths less than 40 fathoms, and sometimes feed actively on or near the surface. Black Rockfish begin recruiting to nearshore fisheries at 3-4 years of age, corresponding to a fork length of about 25-30 cm, and 50% of females attain maturity at about 6-8 years, corresponding to a fork length of about 3842 cm. Adult females grow 3-5 cm larger than males, with a few females attaining fork lengths greater than 55 cm. Black Rockfish are taken mainly in recreational fisheries, so the indices of abundance are different from the standard trawl-based indices commonly used in West Coast groundfish assessments

Black Rockfish was last assessed in 2015. The stock assessment team prepared separate geographic assessments that were spatially stratified with boundaries at the CA/OR border (42°00' N latitude) and OR/WA border (46°15' N latitude). This spatial stratification was chosen based on two observations: (a) that nearshore species do not exhibit much adult movement and (b) exploitation and management histories have varied significantly among the three states. Together these features would likely create appreciable state-to-state differences in age composition. The 2015 stock assessment for Washington found the stock to be above the management target of 40% of initial spawning stock biomass, and the California stock above the minimum size threshold of 25% of initial spawning stock biomass. The Oregon stock assessment

was found to be above the 40% target, but with very high uncertainty such that the assessment was downgraded for management purposes.

Assessments for these stocks will provide the basis for the management of the groundfish fisheries off the West Coast of the U.S., including providing scientific basis for setting OFLs and ABCs as mandated by the Magnuson-Stevens Act. The technical review will take place during a formal, public, multiple-day virtual meeting of fishery stock assessment experts. Participation of external, independent reviewers is an essential part of the review process. The Terms of Reference (ToRs) of the peer review are attached in **Annex 2**.

Requirements:
Two CIE reviewers will participate in the stock assessment review panel. One CIE reviewer, requested herein, shall conduct an impartial and independent peer review of the assessments described above and in accordance with the Performance Work Statement (PWS) and ToRs herein. Additionally, one "common" CIE reviewer will participate in all STAR panels held in 2023 and the PWS and ToRs for the "common" CIE reviewer are included in **Attachment A**.

The CIE reviewers shall be active and engaged participants throughout panel discussions and able to voice concerns, suggestions, and improvements, while respectfully interacting with other review panel members, advisors, stock assessment technical teams, and other participants. The CIE reviewers shall have excellent communication skills in addition to working knowledge and recent experience in fish population dynamics; with experience in the integrated-analysis modeling approach, using age- and size- (and possibly spatially-) structured models, and methods for quantifying uncertainty. Familiarity with environmental, ecosystem and climatic effects on population dynamics and distribution may also be beneficial. The CIE reviewer's duties shall not exceed a maximum of 14 days to complete all work tasks of the peer review described herein.

Tasks for Reviewers:
The CIE reviewer shall complete the following tasks in accordance with the PWS and Schedule of Milestones and Deliverables herein.

Prior to the Peer Review: Upon completion of the CIE reviewer selection by the CIE Steering Committee, the CIE shall provide the CIE reviewer information (full name, title, affiliation, country, address, email) to the NMFS Contracting Officer Representative (COR), who forwards this information to the NMFS Project Contact no later than the date specified in the Schedule of Milestones and Deliverables. The CIE is responsible for providing the PWS and ToRs to the CIE reviewer. The NMFS Project Contact is responsible for providing the CIE reviewer with the background documents, reports, and other information concerning pertinent meeting arrangements. The NMFS Project Contact is also responsible for providing the Chair a copy of the PWS in advance of the panel review meeting. Any changes to the PWS or ToRs must be made through the COR prior to the commencement of the peer review.

Pre-review Background Documents: Two weeks before the peer review, the NMFS Project Contact will send (by electronic mail or make available at a File Transfer Protocol (FTP) site) to the CIE reviewers the necessary background information and reports for the peer review. In the case where the documents need to be mailed, the NMFS Project Contact will consult with the CIE Lead Coordinator on where to send documents. CIE reviewers are responsible only for the pre-review documents that are delivered to the reviewer in accordance to the PWS scheduled deadlines specified herein. The CIE reviewer shall read all documents in preparation for the peer review.

Documents to be provided to the CIE reviewers prior to the STAR Panel meeting include:

- The current draft stock assessment reports;
- Previous stock assessments and STAR Panel reports for the assessments to be reviewed;
- The Pacific Fishery Management Council's Scientific and Statistical Committee's Terms of Reference for Stock Assessments and STAR Panel Reviews;
- Stock Synthesis (SS) Documentation;
- Additional supporting documents as available;
- An electronic copy of the data, the parameters, and the model used for the assessments (if requested by reviewer).

Panel Review Meeting: The CIE reviewer shall conduct the independent peer review in accordance with the PWS and ToRs, and shall not serve in any other role unless specified herein. **Modifications to the PWS and ToRs cannot be made during the peer review, and any PWS or ToRs modifications prior to the peer review shall be approved by the COR and CIE Lead Coordinator.** Each CIE reviewer shall actively participate in a professional and respectful manner as a member of the review panel's virtual meeting, and their peer review tasks shall be focused on the ToRs as specified herein. The NMFS Project Contact is responsible for any facility arrangements (e.g., video or teleconference arrangements). The NMFS Project Contact is responsible for ensuring that the Chair understands the contractual role of the CIE reviewers as specified herein. The CIE Lead Coordinator can contact the Project Contact to confirm any peer review arrangements, including the meeting facility arrangements. The agenda will be made available two weeks prior to the start of the Panel Review Meeting.

Contract Deliverables - Independent CIE Peer Review Reports: The CIE reviewer shall complete an independent peer review report in accordance with the PWS. Each CIE reviewer shall complete the independent peer review according to required format and content as described in **Annex 1**. The CIE reviewer shall complete the independent peer review addressing each ToR as described in **Annex 2**.

Other Tasks – Contribution to Summary Report: The CIE reviewer should assist the Chair of the panel review meeting with contributions to the Summary Report, based on the terms of reference of the review. The Chair is not provided by the CIE under this contract. A CIE reviewer is not required to reach a consensus with other members of the Panel, and should provide a brief summary of the reviewer's views on the summary of findings and conclusions reached by the review panel in accordance with the ToRs.

Place of Performance:
The CIE reviewers shall conduct an independent peer review during the panel review meeting scheduled for the dates of July 10-14, 2023. The meeting shall take place in Santa Cruz, California. In the event that conditions at the time warrant, this meeting will be conducted instead as a virtual meeting, with technical assistance provided by staff from the Pacific Fishery Management Council.

Period of Performance:
The period of performance shall be from the time of award through **August 2023**. The CIE reviewers' duties shall not exceed 14 days to complete all required tasks.

Schedule of Milestones and Deliverables:
CIE shall complete the tasks and deliverables described in this PWS in accordance with the following schedule.

Within two weeks of the award	Contractor selects and confirms reviewers. This information is sent to the COR, who then transmits this to the NMFS Project Contact
Approximately two weeks later	Contractor provides the pre-review documents to the CIE reviewers
July 10-14, 2023	**Panel Review Meeting, Santa Cruz, California**
Approximately two weeks later	Contractor receives draft reports
Within two weeks of receiving draft reports	Contractor submits final CIE independent peer review reports to the COR

Note: The Chair's Summary Report shall not be submitted to, reviewed, or approved by the Contractor.

Applicable Performance Standards
The acceptance of the contract deliverables shall be based on three performance standards:

(1) The reports shall be completed in accordance with the required formatting and content; (2) The reports shall address each TOR as specified; and (3) The reports shall be delivered as specified in the schedule of milestones and deliverables.

Travel:
All travel expenses shall be reimbursable in accordance with Federal Travel Regulations (http://www.gsa.gov/portal/content/104790). International travel is authorized for this contract. Travel is not to exceed $12,000.00.

Restricted or Limited Use of Data:
The contractors may be required to sign and adhere to a non-disclosure agreement.
NMFS Project Contact:
Andi Stephens, NMFS Project Contact
National Marine Fisheries Service,
Newport, OR 97365
Andi.Stephens@noaa.gov
Phone: 843-709-9094

Annex 1: Format and Contents of CIE Independent Peer Review Report

1. The CIE independent report shall be prefaced with an Executive Summary providing a concise summary of the findings and recommendations, and specify whether the science reviewed is the best scientific information available.

2. The main body of the reviewer report shall consist of a Background, Description of the Individual Reviewer's Role in the Review Activities, Summary of Findings for each ToR in which the weaknesses and strengths are described, and Conclusions and Recommendations in accordance with the ToRs.

a. Reviewers should describe in their own words the review activities completed during the panel review meeting, including providing a brief summary of findings, of the science, conclusions, and recommendations.

b. Reviewers should discuss their independent views on each ToR even if these were consistent with those of other panelists, and especially where there were divergent views.

c. Reviewers should elaborate on any points raised in the Summary Report that they feel might require further clarification.

d. Reviewers shall provide a critique of the NMFS review process, including suggestions for improvements of both process and products.

e. The CIE independent report shall be a stand-alone document for others to understand the weaknesses and strengths of the science reviewed, regardless of whether or not they read the summary report. The CIE independent report shall be an independent peer review of each ToRs, and shall not simply repeat the contents of the summary report.

3. The reviewer report shall include the following appendices:

Appendix 1: Bibliography of materials provided for review
Appendix 2: A copy of the CIE Performance Work Statement
Appendix 3: Panel Membership or other pertinent information from the panel review meeting.

Annex 2: Terms of Reference for the Peer Review

Stock Assessment Review (STAR) Panel 2

The specific responsibilities of the STAR panel are to:

1. Become familiar with the draft stock assessment documents, data inputs, and analytical models along with other pertinent information (e.g., previous assessments and STAR panel report when available), and the Pacific Fisheries Management Council Terms of Reference for the Groundfish Stock Assessment Review Process for 2023-2024 prior to review panel meeting.
2. Discuss the technical merits and deficiencies of the input data and analytical methods during the open review panel meeting.
3. Evaluate model assumptions, estimates, and major sources of uncertainty.
4. Provide constructive suggestions for current improvements if technical deficiencies or major sources of uncertainty are identified.
5. Determine whether the science reviewed is considered to be the best scientific information available.
6. When possible, provide specific suggestions for future improvements in any relevant aspects of data collection and treatment, modeling approaches and technical issues, differentiating between the short-term and longer-term time frame.
7. Provide a brief description on panel review proceedings highlighting pertinent discussions, issues, effectiveness, and recommendations.

Appendix 3: Panel Membership or other pertinent information from the panel review meeting.

STAR 2 Panel Members

John Budrick, California Department of Fish and Wildlife (Chair)
Martin Dorn, University of Washington
Yong Chen, Center for Independent Experts
Joseph Powers, Center for Independent Experts

Stock Assessment Team (STAT) Members

E.J. Dick, National Marine Fisheries Service Southwest Fisheries Science Center
Melissa Monk, National Marine Fisheries Service Southwest Fisheries Science Center
John Field, National Marine Fisheries Service Southwest Fisheries Science Center
Tanya Rogers, National Marine Fisheries Service Southwest Fisheries Science Center
Jason Cope, National Marine Fisheries Service Northwest Fisheries Science Center
Aaron Berger, National Marine Fisheries Service Northwest Fisheries Science Center
Julia Coates, California Department of Fish and Wildlife
Alison Whitman, Oregon Department of Fish and Wildlife
Lief Rasmuson, Oregon Department of Fish and Wildlife
Cheryl Barnes, Oregon Department of Fish and Wildlife
Kristen Hinton, Washington Department of Fish and Wildlife
Theresa Tsou, Washington Department of Fish and Wildlife
Corey Niles, Washington Department of Fish and Wildlife
Lisa Hillier, Washington Department of Fish and Wildlife
Fabio Caltabellotta, Washington Department of Fish and Wildlife
Clair Rosemond, Oregon State University

STAR Panel Advisors

Katie Pierson, Oregon Department of Fish and Wildlife,
Groundfish Management Team representative
Gerry Richter, B&G Seafoods, Groundfish Advisory Subpanel representative
Marlene A. Bellman, Pacific Fishery Management Council representative