Scientific and Statistical Committee

Pacific Fishery Management Council
Via Webinar

June 23-24, 2021

Members in Attendance

Dr. John Budrick, California Department of Fish and Wildlife, Belmont, CA
Mr. Alan Byrne, Idaho Department of Fish and Game, Boise, ID
Dr. Fabio Caltabellotta, Oregon State University, Corvallis, OR
Dr. John Field, National Marine Fisheries Service Southwest Fisheries Science Center, Santa Cruz, CA
Dr. Marisol Garcia-Reyes, Farallon Institute, Petaluma, CA
Dr. Melissa Haltuch, National Marine Fisheries Service Northwest Fisheries Science Center, Seattle, WA
Dr. Owen Hamel, National Marine Fisheries Service Northwest Fisheries Science Center, Seattle, WA
Dr. Michael Harte, Oregon State University, Corvallis, OR
Dr. Dan Holland, National Marine Fisheries Service Northwest Fisheries Science Center, Seattle, WA
Dr. Galen Johnson, SSC Chair, Northwest Indian Fisheries Commission, Olympia, WA
Dr. Kristin Marshall, National Marine Fisheries Service Northwest Fisheries Science Center, Seattle, WA
Dr. André Punt, University of Washington, Seattle, WA
Dr. William Satterthwaite, National Marine Fisheries Service Southwest Fisheries Science Center, Santa Cruz, CA
Dr. Jason Schaffler, Muckleshoot Indian Tribe, Auburn, WA
Dr. Ole Shelton, National Marine Fisheries Service Northwest Fisheries Science Center, Seattle, WA
Dr. Cameron Speir, National Marine Fisheries Service Southwest Fisheries Science Center, Santa Cruz, CA
Dr. Tien-Shui Tsou, Washington Department of Fish and Wildlife, Olympia, WA
Dr. Will White, Oregon State University, Corvallis, Oregon

Members Absent

None.

SSC Recusals for the June 2021 Meeting		
SSC Member	**Issue**	**Reason**
Dr. John Budrick	G.5 – Adopt Stock Assessments	Dr. Budrick was on the STAT for the data-moderate assessments.
Dr. Melissa Haltuch	G.5 – Adopt Stock Assessments	Dr. Haltuch was on the sablefish STAT.
Dr. Owen Hamel	G.5 – Adopt Stock Assessments	Dr. Hamel supervises STAT members on these assessments.
Dr. André Punt	G.5 – Adopt Stock Assessments	Dr. Punt is Ms. Kapur's major PhD advisor.
Dr. Will Satterthwaite	BSIA	Dr. Satterthwaite contributed to the draft BSIA framework .
Dr. Theresa Tsou	G.5 – Adopt Stock Assessments	Dr. Tsou was on the STAT for the copper and quillback rockfish assessments.

A. Call to Order

Dr. Galen Johnson called the meeting to order at 0800. Mr. Chuck Tracy briefed the Scientific and Statistical Committee (SSC) on the meeting and the Pacific Fishery Management Council's (Council's or PFMC's) expectations for the items on the SSC agenda. Mr. Tracy briefed the SSC on the recent Council Coordination Committee (CCC) meeting. The Scientific Coordination

Subcommittee's 7th meeting will be held in person next year in Alaska. A draft National Oceanic and Atmospheric Association (NOAA) Technical Memo on management reference points is available for public comment. The public comment deadline has been extended and the SSC will review the memo in September. The PFMC will host the CCC meeting in October, which will occur in Monterey.

E. Salmon Management

1. Southern Oregon Northern California Coast Coho Endangered Species Act Consultation

Mr. Ray Beamesderfer (Fish Science Solutions) briefed the Scientific and Statistical Committee (SSC) on the Southern Oregon Northern California Coast (SONCC) coho Ad-Hoc Technical Workgroup's Fishery Harvest Control Rule Risk Assessment (Agenda Item E.1.a, SONCC Workgroup Report 1). This risk assessment framework is intended to inform the Pacific Fishery Management Council (Council) of potential impacts of proposed harvest control rules (HCRs) for SONCC coho in Council managed fisheries. Proposed HCRs are intended to allow fishing on abundant salmon stocks while not impeding the recovery of Endangered Species Act (ESA)-listed SONCC coho. HCRs could take a variety of forms (i.e., fixed vs. tiered exploitation rates or total exploitation rates vs. ocean exploitation rates) and could consider the status of subcomponents of the evolutionarily significant unit (ESU) where data availability allows. The SSC appreciates the hard work and careful thought the workgroup put into this risk assessment.

The SONCC coho ESU is composed of seven diversity strata and 40 populations. There were only sufficient wild spawning escapement data to assess six populations. Impacts in ocean fisheries are assessed based on historical coded wire tag (CWT) recoveries from one hatchery program used to inform the coho Fishery Regulation Assessment Model (FRAM). These CWT recoveries (late 1980s - early 1990s) were from prior to ESA listing and under a different fishery structure than current, which leads to increased uncertainty when applied to current conditions. Further the SSC notes that the coho FRAM has not been fully reviewed and validated for use in producing these estimates.

SONCC coho are currently managed with an ocean exploitation rate (ER) cap of 13 percent. This risk assessment proposed 12 HCRs (eight fixed ERs, three abundance-based ERs, and a matrix-based ER that has not yet been completed). Though some fixed ERs applied only to ocean fisheries, the risk assessment is based on total exploitation and therefore assumed a recent year average freshwater exploitation for those alternatives. An accurate forecast is required to apply an abundance-based HCR. However, promising relationships were found for only 2 of 6 populations after analysis of correlations between potential predictors and abundance for 26 models. The analysis suggests abundance-based HCRs provided greater overall fisheries opportunity on SONCC coho than fixed HCRs with comparable levels of predicted risk. It may be premature to pursue abundance-based HCR modeling further unless and until sufficient data have been collected to develop and validate abundance forecasts. In addition, allowable harvest of SONCC coho alone may not be an informative performance metric for mixed-stock ocean fisheries that harvest other coho and Chinook salmon stocks.

The SSC notes the lack of data for informing management decisions involving SONCC coho and the considerable uncertainty this introduces into the risk assessment. The complexity of these analyses may not be supported by the data quality or availability. However, the theoretical basis for the risk analysis remains sound, though the emphasis should be on relative rather than absolute predictions of risk. The SSC recommends adopting the proposed risk analysis framework for evaluating HCRs for consideration in informing management decisions for SONCC coho, with further attention given to combined versus disaggregated-independent implementations of simulations involving aggregate abundance-based control rules or a matrix approach if those options are considered further.

SSC Notes:

The Freshwater Creek population is one population that simulations indicate could benefit from an abundance based management approach, but there is limited potential for forecasting this population and it is not correlated with populations where forecasting may be more promising.

Environmental indicators in the CCIEA report such as stoplight indicators might be a potential means to inform forecasts or categories in a matrix.

Modeled Extinction Risks are sensitive to productivity but data to inform productivity is poor.

H. Coastal Pelagic Species Management

2. Pacific Mackerel Assessment and Management Measures

Dr. Kevin Hill (Southwest Fisheries Science Center) presented the results of the catch-only update to the Pacific mackerel stock assessment (Agenda Item H.2, Attachment 1). Pacific mackerel is currently managed with a benchmark assessment every four years with a catch projection conducted two years later and used for the last two years of the four-year cycle. The catch-only projection followed the Terms of Reference for catch-only projections.

The catch-only projection was based on the benchmark assessment conducted in 2019 (ALT_19), which provided the basis for overfishing limits, acceptable biological catches (ABCs), and annual catch limits (ACLs) for the 2019-20 and 2020-21 fishing seasons. No changes to the assessment were made except to update the catch series for 2017 through December 2020 and project catches through June 2022. Recruitment for the base model was taken from the stock-recruitment relationship. The baseline model projected 1+ biomass was 57,832 mt (July 2021) and 45,925 mt (July 2022) under the assumption that the total harvest guideline (HG) will be attained in the 2021-22 fishing year. Sensitivity was explored to alternative catch series and assumptions about recruitment strength.

The Scientific and Statistical Committee (SSC) endorses the catch-only projection as the best scientific information available for management of Pacific mackerel. The SSC further endorses the overfishing limits of 12,145 mt for 2021-22 and 9,644 mt for 2022-23. The 2022-23 overfishing limit could be recalculated if the ABC for 2021-22 is less than the harvest guideline for that year. This assessment is assigned to category 3 because of high uncertainty regarding the scale of the biomass, great sensitivity to assumptions, and the facts that almost all the biomass derives from

year-classes that are currently poorly sampled or taken directly from the stock-recruitment relationship. The final ABCs depend on the Council's risk tolerance as reflected in the choice of P*.

Conducting benchmark assessments for a short-lived species every fourth year means that major changes in recruitment or stock biomass could occur but not be reflected in management advice. Past Stock Assessment Team, Stock Assessment Review Panel, and SSC advice has been that management be based on the results of the Acoustic Trawl Method survey, but this requires conducting a management strategy evaluation which is yet to occur for Pacific mackerel. An update assessment every year is ideal until the Acoustic Trawl Method survey estimate can be used directly for management purposes for Pacific mackerel. However, logistics and demands on staff time may make this infeasible for Pacific mackerel; update assessments every second year may balance workload demands and the desire to base management decisions on the most recent data. The SSC therefore recommends that Pacific mackerel assessments be conducted in a four-year cycle with benchmark and update assessments (rather than catch-only projections) every second year.

SSC Notes:

- *The next benchmark assessment is tentatively scheduled for 2023.*
- *Projected weight-at-age is set to that for the final year of the assessment.*
- *Average US commercial catch was ~2,500 mt.*
- *The category 2 sigmas should be 1.15 for the 2021-22 fishing season and 1.225 for the 2022-23 fishing season. These sigmas reflect increasing uncertainty with time since the previous assessment. The table of category 2 ABCs (Table 3 of Attachment 1) was based on the incorrect sigmas and was updated.*
- *A model run including the 2019 ATM estimate could have been added as a further sensitivity test.*
- *Future catch-only projections should include measures of uncertainty.*

3. Management Framework for the Central Subpopulation of Northern Anchovy

Coastal Pelagic Species Management Team (CPSMT) member Gregory Krutzikowsky presented a summary of the CPSMT report on the proposed management framework for the Central Subpopulation of the Northern Anchovy (CSNA). The report includes revisions to the flowchart that details the management framework and describes potential ways to implement the management framework. The Scientific and Statistical Committee (SSC) endorses the framework, as an improvement on the status quo. The SSC also notes that there are some caveats and ongoing research needs that deserve further research and consideration. These are addressed below.

The SSC discussed the need for further work on a Management Strategy Evaluation (MSE), as the 2018 Acoustic-Trawl Methodology (ATM) review stated that performing an MSE for CSNA was necessary before using the ATM survey to inform management decisions, as proposed in this framework. The SSC agreed that although future work on an MSE would be useful to further explore potential biases and uncertainty (species composition, target strength, fish behavior,

nearshore correction, etc.) in the surveyed index of abundance, it is not required, as the essential elements of an MSE have now been completed for CSNA (Agenda Item D.4, Attachment 1, November 2019). The parameters used to inform the 2019 simulations might merit updating based on the results of a full assessment.

A question of the timely availability of data relative to the start of the fishing management year was raised. The proposed change of the fishing year start date to July 1 would allow for more rapid responses to survey biomass estimates, expected to be available by February for review and potential adoption at the April Council meeting. Changing the fishing year start date under this approach depends on the Southwest Fisheries Science Center workload and the feasibility to have a completed assessment, that includes the most recent survey estimate, available for adoption at the April Council meeting. This would primarily be an issue in years when a full assessment was required, but unanticipated delays in processing survey data could be an issue in non-assessment years. This would be less of an issue if the survey data were available before the end of the calendar year. An alternative start date between July 1 and January 1 might help to better align the availability of data in order to complete the assessment.

Finally, the SSC recommends that a stock assessment is done prior to implementing the approach outlined in the framework to ensure that the E_{MSY} value is based on the most current data. Some other parameters in the framework could change once the new assessment is done, since the information used to parameterize simulations informing the CPSMT's proposed parameters for the framework is from a very outdated assessment. Also, the SSC recommends that the framework's short-term biomass be based on survey biomass estimates directly, using the already endorsed ATM surveys, and one of the inshore correction approaches described previously (Agenda Item D.4, Attachment 1, November 2019). Uncertainties in the ATM survey biomass estimate, including but not limited to nearshore biomass, should remain a priority for further research and refinement.

SSC Notes:

The proposed framework approach (infrequent stock assessments and management consideration in the years between) is an approach used in other stocks around the globe.

Inshore is the source of ATM bias that has received the most attention, but issues like target strength and species composition are also important and the direction of biases introduced by those factors are not known.

Relevant past statements:
https://www.pcouncil.org/documents/2018/04/agenda-item-c-4-a-supplemental-ssc-report-1.pdf/ andhttps://www.pcouncil.org/documents/2019/11/agenda-item-d-4-a-supplemental-ssc-report-1.pdf/

The analyst suggested a list of analyses to further consider uncertainties, however the SSC considered that a broader discussion is necessary. It was noted that the MSE does not simulate specific sources of uncertainty, nor has many sensitivity tests, although some tests could be done if a list of issues is provided.

Agenda Item D.4, Attachment 1, November 2019 concluded that methods for estimating biomass in nearshore waters based on direct synoptic observations are preferable to extrapolation, and that acoustic sampling conducted by industry vessels is most comparable to ATM surveys. However, while direct synoptic observations are the preferred approach, any of the four approaches described in the report are acceptable, including extrapolation. Logistical and timing constraints may limit the available options in any given year. Assessment analysts should determine the most appropriate approach in their particular case, so long as the caveats and limitations of different approaches are considered.

G. Groundfish Management

2. Fixed Gear Catch Share Review – Scoping

The Scientific and Statistical Committee (SSC) received a report from Dr. Cameron Speir (Southwest Fisheries Science Center) on the outcome of the joint meeting of the Economics Subcommittee and Groundfish Subcommittee of the SSC held via webinar on May 26, 2021. The two subcommittees reviewed a draft outline of the proposed topics for the upcoming Limited Entry Fixed Gear (LEFG) Program review. The report of the subcommittees is appended to this statement. The SSC also received a brief presentation from Jim Seger and Jessi Doerpinghaus summarizing the upcoming LEFG review.

The SSC offered several technical recommendations to the review team. First, the proposed analysis of whether high-grading is occurring would be improved by comparing the distributions of retained fish in observed and unobserved trips. This would quantify whether there is an observer effect in retention behavior.

Second, little of the proposed analysis characterizes the LEFG program impacts at the community level. Similarly, there is no analysis of impacts or description of crew or processors. A description and analysis of impacts on these stakeholders is needed. A recent survey of fishing industry participants by the Northwest Fishery Science Center could be a source of vessel owner demographics and impacts of the owner on board requirement.

Third, obtaining data on permit prices should be a priority for the upcoming review. Permit prices are an indicator of expected future profits in the fishery. They are also an indicator of the ease of entry into the fishery by new participants.

The SSC also discussed how it could be involved in the LEFG review. The SSC could review draft analyses for determining best scientific information available, whether current data collections are adequate to support the program evaluation, and in recommending research and data needs.

ECONOMICS AND GROUNDFISH SUBCOMMITTEES OF THE SCIENTIFIC AND STATISTICAL COMMITTEE REPORT ON
FIXED GEAR CATCH SHARE REVIEW – SCOPING

The Economics Subcommittee and Groundfish Subcommittee of the Scientific and Statistical Committee (Subcommittees) held a joint meeting via webinar on May 26, 2021. The purpose of the meeting was to consider two items relating to groundfish management. The first item was a review of the Quota Share Owner Survey to determine whether it is suitable for use in decision-making by the Council. The Subcommittees did not see any major problems with the data collection or analysis and recommends that the Council and relevant advisory bodies see this information at some future date. The second item was a preliminary outline of the upcoming Limited Entry Fixed Gear (LEFG) Fishery five-year review.

At its April 2021 meeting, the SSC had also planned for the subcommittees to review an analysis of proposed alternatives for limiting the use of fixed gear in the trawl individual fishing quota fishery gear switching. However, the Council has not yet defined alternatives for this item and therefore the proposed analysis is not ready for review. This report summarizes the Subcommittees discussion of the LEFG Fishery five-year review.

The Subcommittees received a presentation from Jim Seger and Jessi Doerpinghaus outlining proposed analyses for the upcoming LEFG Fishery five-year review. The Subcommittees also received a draft outline of the proposed topics that will be included in the June 2021 briefing book under Agenda Item G.2. The LEFG fishery is a catch share program implemented prior to 2007 and therefore the Magnuson Stevens Act requires program reviews every five years. The last review was completed in June 2014. At the June 2021 Council meeting, the Council will scope content issues for the review and provide guidance on a timeline for completion. The subcommittees offered several items for the analysts and the Council to consider as the scoping process for the LEFG five-year review continues.

Section 2.1.8 of the draft outline contains an analysis of whether high-grading is occurring by comparing the size distributions of retained and discarded fish. This analysis would be improved by also comparing the distributions of retained fish in observed and unobserved trips. This would quantify whether there is an observer effect in retention behavior.

Nearly all of the program impacts are characterized in terms of vessel owners and operators. Very little of the proposed analysis characterizes the program impacts or fishery at the community level. Similarly, there is no analysis of impacts or description of crew or processors. Description and analysis of impacts on these stakeholders is likely of interest. A recent survey of fishing industry participants by the Northwest Fishery Science Center could be a source of crew demographics and impacts of the owner on board requirement.

Permit prices are discussed in general terms and the analysts are considering more detailed analysis of permit prices in the review. Better data and consistent tracking of permit prices was a recommendation of the 2014 review and is listed as a future research need. The analysts note that reliable permit data do not exist and propose some methods of obtaining it. The Subcommittees recommend that obtaining data on permit price be a priority for the upcoming review. In addition

to being an indicator of expected future profits in the fishery, permit prices are also an indicator of the ease of entry into the fishery by new participants.

5. Adopt Stock Assessments

The Scientific and Statistical Committee (SSC) received a report from Dr. Kristin Marshall (Northwest Fisheries Science Center) on the results of the Groundfish Subcommittee (GFSC) meeting held June 21-22 to review the 2021 benchmark stock assessments for Pacific spiny dogfish and Dover sole, a stock assessment update for sablefish, and length-based data-moderate stock assessments for copper rockfish, quillback rockfish, and squarespot rockfish. The subcommittee report is appended to this statement and Table 1 summarizes the assessments, associated category levels, and future assessment recommendations. The SSC commends the assessment authors and stock assessment review (STAR) panel reviewers for their extensive and thorough work.

Dover Sole

The benchmark stock assessment for Dover sole (Agenda Item G.5, Attachment 1) models a single coastwide stock in US west coast waters using data sources that include: landings data and discard estimates; survey indices of abundance, length- and/or age-composition data for each fishery or survey; information on weight-at-length, maturity-at-length, and fecundity-at-length; information on natural mortality and the steepness of the Beverton-Holt stock-recruitment relationship; and estimates of ageing error. Model estimates show that the scale of the spawning biomass is uncertain, and that the stock size is well above the target reference point and has been above the target reference point throughout the duration of the fishery. The scale of the estimates of stock size are lower than from the 2011 assessment, driven by improved parameterization of survey selectivity (double normal and sex specific).

Results from this assessment are consistent with those from the 2011 assessment. The new assessment estimates a depletion of 79 percent at the start of 2021. There are several sources of uncertainty in the model, including the level of recruitment variability, sensitivity to the treatment of natural mortality (M), and sensitivity to alternative selectivity parameterizations. Finally, the SSC notes that using the sigma for category 1 stocks when specifying the states of nature in the decision table was an appropriate approach for capturing the range of uncertainty for this stock.

The SSC supports the modeling approach, agrees that the model fits the data adequately, and agrees with the conclusions of the 2021 Dover sole stock assessment. This model estimates depletion well, although there is uncertainty in scale. The SSC endorses the 2021 full assessment of Dover sole as providing the best scientific information available and suitable for informing management decisions. The SSC recommends the stock be assigned to category 1 and that the next Dover sole assessment be an update assessment unless new data sources become available.

Spiny Dogfish

The SSC benchmark stock assessment for spiny dogfish (Agenda Item G.5, Attachment 3) included improvements from the 2011 assessment, including updated fisheries and survey-related data, abundance indices estimated using the vector autoregressive spatial temporal (VAST) modeling approach, revised historical discard estimates, updated selectivity assumptions from asymptotic to dome-shaped with sex-specific offset, updated biological parameters, and updated tuning for age data. The magnitude of historical discards remains one of the main concerns in assessment data. Age determination is another unresolved issue for female dogfish, which has impacts on the growth parameters and the assumed natural mortality rate.

Results indicate that the stock is in the precautionary zone (34 percent of unfished spawning biomass), whereas the last assessment indicated the stock was 63 percent of unfished spawning biomass. The estimated spawning output in 2021 under the new assessment decreased from 18,354,000 pups projected in the previous assessment to 6,703,000 pups. Bridging analyses adding and updating data indicated that the scale of the assessment had changed as a result of 1) revised estimates for catchability (q) for the Northwest Fisheries Science Center (NWFSC) West Coast Bottom Trawl Survey (WCBTS) changing from 0.27 to 0.586, 2) new WCBTS composition data, and 3) new research indicating a gestation period of two years rather than one reducing fecundity estimates to half that assumed previously contributing to the change to the perception of stock status and harvest levels.

The West Coast Groundfish Survey q was fixed at a 0.586 in the base model, though it is subject to considerable uncertainty due to lack of contrast in the data included in the assessment and an inability to qualify 1) seasonal migrations (of up to 600 km) during the summer relative to the timing of the WCBTS that operated from April through October that likely affects availability, 2) potential net avoidance given strong swimming abilities, 3) the distribution of a portion of the stock shoreward of the WCBTS area, and 4) availability to the net itself given their semi-pelagic habits. These considerations provide an indication that a q value lower than 0.586 may be more realistic. The SSC supports further research to better understand seasonal availability of spiny dogfish to the survey because the stock assessment and the published literature suggest a fairly strong seasonal migration of spiny dogfish, in which the animals are generally distributed further north during summer, and further south in the winter.

The relatively flat likelihood profile for q implies that the data are uninformative about this parameter even though it is influential on the scale and depletion in the assessment. Catchability is listed as the major axis of uncertainty in decision tables and the best estimate determines the lower and upper bounds. The uncertainty in q is problematic since it affects the estimates of key parameters including natural mortality (M) and growth, creating tension in the model between these variables. There is a tradeoff between M and q, and the model fit improved when M was lower and q was higher.

The estimate of steepness for spiny dogfish is among the lowest values reported for marine fish stocks. The F_{MSY} of 0.003yr-1 corresponds to a spawning potential ratio (SPR) of 90 percent while an SPR of 88.3 percent corresponds to $SB_{40\%}$ given the value for steepness. The current $SPR_{50\%}$ harvest policy appears inconsistent with the biology if these results are correct. The SSC highlights that the SPR proxy is significantly higher than the SPR estimated to correspond to maximum sustainable yield (MSY) and the stock is predicted to collapse if it is fished at a SPR of 50 percent.

While a spawner-recruitment relationship meta-analysis might help inform a more ideal HCR, such an analysis is unlikely to be possible given the limited number of species with this life history. The Stock Assessment Team (STAT) can create a harvest policy that would allow rebuilding to target level for the Groundfish Management Team (GMT) to consider.

The SSC endorses the 2021 full assessment of spiny dogfish as providing the best scientific information available and suitable for informing management decisions. The SSC recommends the stock be assigned to category 2 since recruitment deviations are not estimated and data do not inform scale well. The SSC recommends that the next assessment of spiny dogfish be a full assessment due to the technical issues discussed in the assessment and STAR panel report.

Sablefish

The current stock assessment update for sablefish (Agenda Item G.5, Attachment 5) is the first update of the 2019 benchmark assessment. The updated data and time series include an additional year of the WCBTS data (index, lengths, and ages for 2019, there was no 2020 survey), West Coast Groundfish Observer Program (WCGOP) discard rates and average weights, and the sea level index of recruitment. Additionally, WCGOP discard length compositions were added into the model to allow the model to fit a recent increase in trawl discard rates, likely due to the large 2016 year class, in the absence of the 2020 WCBTS survey and length composition data. The SSC agreed with the decision to include the discard length data in the assessment and to re-estimate the retention curve. These changes were necessary because the updated model produced implausible and inconsistent model results regarding recent (2019) recruitment, and the fit to the 2019 WCBTS degraded.

Although the general trends in spawning output and recruitment were consistent with the 2019 benchmark, the update assessment increases the scale of spawning biomass. Historically, the sablefish assessment has large estimates of uncertainty in scale, resulting in variation in estimates of spawning biomass among assessments. Estimates of 2019 unfished biomass, spawning biomass and depletion increased. The uncertainty in the update assessment includes stock depletion levels both above and within the precautionary zone with the point estimate suggesting that the stock has remained above the target level of 40 percent of the unfished spawning output, while the 2019 assessment indicated the stock was in the precautionary zone from 2011 through 2019.

The update assessment indicates that the 2021 depletion is 57.9 percent of the unfished level. Catch projections indicate that catch attainment consistent with current harvest policies would result in the stock declining from 57.9 percent of the unfished level in 2021 to approximately 50 percent of the unfished level in 2031. The basis for uncertainty in the decision table was the asymptotic standard deviation for the 2021 spawning biomass from the base model, consistent with the 2019 benchmark assessment, and alternative values of P* for the calculation of ACLs.

The SSC endorses the 2021 update assessment of sablefish as providing the best scientific information available and suitable for informing management decisions. The SSC assigned the stock to Category 1. The SSC recommends that the next sablefish assessment be a full assessment due to the technical issues discussed in the 2019 STAR Panel.

Copper Rockfish

New data-moderate stock assessments were reviewed for copper rockfish south of Pt. Conception (Agenda Item G.5, Attachment 6), north of Pt. Conception in California (Agenda Item G.5, Attachment 7), Oregon (Agenda Item G.5, Attachment 8), and Washington (Agenda Item G.5, Attachment 9). While the 2021 assessments provided justification for the modeled areas, there is considerable uncertainty in stock structure. All models relied primarily on length-composition data, most of which came from recreational fleets. There were retrospective patterns, and the fit to the NWFSC Hook-and-Line Survey index in the southern California assessment was poor, possibly indicating model mis-specification. The results of the 2013 index-based data-moderate assessment for California south of Pt. Conception resulted in an estimated depletion of 76 percent in 2013, which is in contrast with the current result of 28 percent from the current length-based data-moderate assessment in 2013. All four assessments had reduced data availability from 2020 due to COVID-19 impacts on data collection agencies.

The SSC was generally supportive of the modeling approach and satisfied with the model fits to data and resulting conclusions. Other issues discussed by the SSC were:

- The model for Northern California estimated a pattern of high recruitment during the 1960s and lower recruitment during the 1970s, which is not consistent with trends in the recruitment for other rockfishes during that time.
- Concerns were raised regarding the declining trend in the recent time period of the Southern California model, which is inconsistent with population trends from other southern California stocks for which data are available (e.g., bocaccio, cowcod), most of which have seen signs of strong recruitment over the past decade.
- Age-length estimates (and hence the growth curve) for northern California may not be representative because they rely on data from Oregon and Washington where water temperatures are different and growth may differ as a result.
- The fit to the hook-and-line survey in the Southern California assessment was poor. This likely reflects differences in the composition from the fishery disproportionately reflecting areas open to fishing closer to port as compared to the more spatially balanced sampling of the survey, more equally representing habitat offshore and in the Cowcod Conservation Areas (CCAs) and in the Rockfish Conservation Areas (RCAs).
- California Department of Fish and Wildlife (CDFW) quantified the percent of habitat in Marine Protected Areas (MPAs), CCAs and RCAs, along with charts for further consideration to make clear the amount of habitat that is not represented in recent years. Data from the recreational fishery only represents areas open to fishing, potentially making the stock appear more depleted than it is as a whole. Two-area models, estimates of biomass from recently reviewed CDFW remotely operated vehicle (ROV) surveys, and inclusion of the California Collaborative Fisheries Research Program that sample in MPAs can be incorporated in future assessments to help reflect differences in composition and fishing mortality in open and closed areas. Additional data to represent the composition in closed areas would be beneficial.

There were fishery-dependent indices of abundance and several additional length datasets that were potentially available to inform the future assessments (Table 2; e.g., recreational catch per unit effort data, ROV data) but the former were not included in the base model because of

restrictions imposed by the Data-Moderate Assessment Terms of Reference (TOR). The SSC concluded that the base models represent the best assessments available.

The data-moderate copper rockfish assessments estimate 2020 depletions of 18.1 percent, 39.3 percent, 73.6 percent, and 42 percent for the stocks in California south of Pt. Conception, California north of Pt. Conception, Oregon, and Washington, respectively. The SSC notes the stock size estimated south of Pt. Conception is below the minimum stock size threshold. The assessments suggest different estimates of stock size relative to unfished in northern and southern California but there is limited evidence that those are actually distinct stocks. The SSC endorses the 2021 data-moderate assessments of copper rockfish as providing the best scientific information available and suitable for informing management decisions. All the copper rockfish stocks are assigned to category 2 given these are data-moderate assessments. The SSC recommends that the next copper rockfish assessments be full assessments to allow for full evaluation of all available data and improved understanding of the current stock status and scale.

Quillback Rockfish

Length-based data-moderate stock assessments were reviewed for quillback rockfish in California (Agenda Item G.5, Attachment 10), Oregon (Agenda Item G.5, Attachment 11), and Washington (Agenda Item G.5, Supplemental REVISED Attachment 12). All three assessments included two fleets (a recreational fleet and a commercial fleet), externally estimated biological relationships (length-weight, length-age, natural mortality, fecundity, and maturity), double-normal selectivity, and the stock-recruitment relationship was Beverton-Holt ($h = 0.72$). Recruitment deviations were estimated for California and Oregon, and the model for Washington assumed deterministic recruitment.

There was substantial uncertainty in the California model given sensitivity to assumed growth and mortality parameters. For the Oregon model, the key sensitivities are whether annual recruitment deviation should be estimated, which has an effect on the model scale in 2021, and assuming asymptotic recreational selectivity, which reduces the fraction of unfished spawning biomass. In the Washington model, there was more variability in model estimates, and sensitivity to estimating parameters (M, CV of larger individuals, and L infinity), as well as sensitivities around recruitment, and estimation of recruitment deviations.

The use of growth from fish sampled in Oregon and Washington, applied in the California assessment presents an unresolved uncertainty, since California is subject to higher water temperatures that can affect growth rates making them potentially unrepresentative. There are additional datasets available to potentially inform the future assessments (Table 2) that were not included in the base model because of restrictions imposed by the Data-Moderate Assessment TOR. The SSC concluded that the base models represent the best assessments available.

The data-moderate quillback rockfish assessments estimate 2020 depletions of 14 percent, 47 percent, and 39 percent for the stocks in California, Oregon, and Washington, respectively. The SSC notes the estimated stock size of California quillback rockfish is below the minimum stock size threshold. The SSC endorses the 2021 data-moderate assessments of quillback rockfish as providing the best scientific information available and suitable for informing management decisions. The SSC recommends that the Oregon and California quillback rockfish assessments be assigned to category 2, and Washington be assigned to category 3 due to greater data limitations.

The SSC recommends that the next quillback rockfish assessment be a full assessment to better understand the current depletion and scale of the stock.

Squarespot Rockfish

A length-based data-moderate stock assessment was conducted for squarespot rockfish in California (Agenda Item G.5, Attachment 13). There are no prior assessments for this species, and since 2010, the Depletion Corrected Average Catch (DCAC) method has been used to set annual catch limits, based on assuming a relative depletion of 40 percent.

This species is treated as one stock, as there is no evidence of population structure. Due to its small size, squarespot rockfish are not targeted by the recreational or commercial fisheries. Catches mostly consist of large females. Thus, the fishery mainly affects spawning biomass. The assessment model did not fit the NWFSC Hook-and-Line Survey index and associated length compositions. During the meeting, some additional exploration of the California Cooperative Fisheries Investigations (CalCOFI) index was conducted but did not lead either the STAT or the Panel to recommend changes to the base model.

The data-moderate squarespot rockfish assessment estimates a 2021 depletion of 37 percent, below the management target of 40 percent. The SSC endorses the 2021 data-moderate assessment of squarespot rockfish as providing the best scientific information available and suitable for informing management decisions. The SSC recommends the squarespot rockfish stock be assigned to category 2, the default for data-moderate assessments. The SSC recommends that the next squarespot rockfish assessment be a data-moderate assessment.

General Comments on Data-moderate Assessments

This was the first review of assessments based on SS-CL and SS-CL+Index. The SSC provides the following observations for consideration when stock assessment TOR revisions and a workplan for the "off year" is developed (more detail is provided in the appended GFSC report):

- The SS-CL and SS-CL+Index methods are suitable for status determination for SSC-endorsed assessments.
- Treatment of Recruitment: The workshop that led to the approval of SS-CL and SS-CL+Index did not consider guidelines for when recruitment deviations should be estimated. Further guidance could be provided.
- Fishery-Dependent Indices: The current TOR restricts the indices that can be used in data moderate assessments (fishery-dependent indices cannot be used). The SSC should consider whether or not to expand the data-moderate TOR to allow consideration of such indices.
- Review: It should be recognized that the SS-CL and comparable data-moderate assessments are based on age-structured modeling frameworks and thus have considerable opportunity for complexity and a broad range of options for parameterization, comparable in many cases to that of full assessments. Thus, a longer review should be considered.
- Potential Data Sources: The assessments should document the data sources that were potentially available but not included in the assessment as well as a list of those that could not be included in the assessment given the data-moderate TORs but could be considered in a full assessment. There should be no requirement for analysis of these data or use of these data for data-moderate assessments. All data should be provided in a usable form and

with adequate description by the data deadline so that they can be considered for inclusion in data-moderate assessments, although they may be excluded following consideration.

- Ensemble Modeling: The length-based data-moderate approaches can be highly constrained by fixing biological parameters and not estimating recruitment, which leads to the concerns of model mis-specification. Guidelines on how best to conduct an ensemble modeling approach should be considered, discussed, and included in the TORs.
- The SSC should review how best to assess nearshore species, particularly with large recreational fisheries, that have strong spatial management (e.g., MPAs, rockfish closures) and a pattern of higher effort nearshore. This can lead to divergence in data between fishery-dependent data and fishery-independent data, depending on the biology of the species (movement, in particular), particularly if the handling of the latter is not informed by spatial gradients in fishing effort.

Table 1. Summary of outcomes of the SSC review of stock assessments.

Species/Stock	Assessment Type	Depletion	Category / sigma	Next Assessment
Sablefish	Update	58%	1	Full
Copper rockfish				Full
Southern California	Data-moderate	18%	2	
Northern California	Data-moderate	39%	2	
Oregon	Data-moderate	74%	2	
Washington	Data-moderate	42%	2	
Quillback rockfish				Full
California	Data-moderate	14%	2	
Oregon	Data-moderate	47%	2	
Washington	Data-moderate	39%	3	
Squarespot rockfish	Data-moderate	37%	2	Data-moderate
Spiny dogfish	Full	34%	2	Full
Dover sole	Full	79%	1	Update

Table 2. Additional potential data sources that could be explored for length-based data-moderate (D-M) stock assessments.

Data Source	Quillback Rockfish	Copper Rockfish North	Copper Rockfish South	Squarespot Rockfish
CDFW So Cal Onboard Sampling Data 1975-1979 Collins and Crooke			Length-based D-M/Full	Length-based D-M/Full
CDFW So Cal Onboard Sampling Data 1986-1989 Alley and Ono			Length-based D-M/Full	Length-based D-M/Full
CDFW Central California Onboard CPFV Sampling Data 1987-1998 Deb Wilson-Vandenberg	Length-based D-M/Full	Length-based D-M/Full		
California Collaborative Fisheries Research Program 2007-Present-https://mlml.sjsu.edu/ccfrp/about/	Index-based D-M/Length-based D-M/Full	Index-based D-M/Length-based D-M/Full		
California Department of Fish and Wildlife Remotely Operated Vehicle Biomass Estimates and Lengths 2014 and 2020-https://www.pcouncil.org/documents/2020/09/agenda-item-d-4-a-supplemental-ssc-report-1-2.pdf/	Full	Full	Full	Full
Southern California Observer Indexes (1999-2011) SoCalOBS-https://www.pcouncil.org/documents/2015/01/data-moderate-stock-assessments-for-brown-china-copper-sharpchin-stripetail-and-yellowtail-rockfishes-and-english-and-rex-soles-in-2013-published-january-2015.pdf/			Index-based D-M/Full	Index-based D-M/Full

RecFIN (dockside sampling) 1980 to 2003 - https://www.pcouncil.org/documents/2015/01/data-moderate-stock-assessments-for-brown-china-copper-sharpchin-stripetail-and-yellowtail-rockfishes-and-english-and-rex-soles-in-2013-published-january-2015.pdf/	Index-based D-M/Full	Index-based D-M/Full	Index-based D-M/Full	Index-based D-M/Full
Central California Observer Indexes (1988-1998+) CenCalOBS- https://www.pcouncil.org/documents/2015/01/data-moderate-stock-assessments-for-brown-china-copper-sharpchin-stripetail-and-yellowtail-rockfishes-and-english-and-rex-soles-in-2013-published-january-2015.pdf/	Index-based D-M/Full	Index-based D-M/Full		

SSC Notes:

The catchability coefficient, q, was not estimated in the 2011 assessment but rather estimated analytically (essentially treated as a scaling parameter), while the q was estimated in the current assessment and then fixed at the estimated value. While the two approaches are computationally equivalent, fixing the catchability at the estimated value in the current assessment assumes a greater level of information content in this parameter relative to the 2011 assessment. The likelihood profile indicated a wide range of plausible values, from 0.18 to 1.3. A more developed ecosystem consideration section for spiny dogfish assessment would facilitate further consideration of uncertainties relative to estimation of q.

Jim Hastie noted that similar changes in perception observed between the previous index-based data-moderate copper rockfish assessment compared to the present assessment, have been observed in China rockfish that showed a similar reversal of status for 2013 index to full assessment including data. Changes like this can happen with inclusion of comp data. The STAT provided a sensitivity with fishery dependent indices from the previous assessment and that information to the conclusion that it didn't have a qualitative effect with data through 2011.

Some SSC members were curious about contradictory stock trajectories between the northern and southern California assessments given lack of stock structure. Population structure from microsatellite analysis by Sivasunder and Palumbi (2010) was noted as well as the presence of three recognized color morphs that have not been examined genetically. In addition, the regions have differing exploitation history and fishery characteristics making the 2021 assessment structure justified, additional analysis of population structure is warranted. That said, investigation of a statewide model for comparison may be worth examining for the sake of comparison.

Judgement calls on growth. Use of model-based estimates of growth parameters $L_{infinity}$ and k for copper rockfish in northern CA were considered given that they were well informed from the length

composition data and the proxy growth parameters from Oregon and Washington may not be representative of growth in the warmer waters off California. Though it may be standard practice to fix growth when there is no age data inside the model, the TOR for data moderate assessments do allow for estimation of biological parameters. $L_{infinity}$ estimates are assumed not valid with dome-shaped selectivity. Exploring $L_{infinity}$ may be more viable than k unless distinct size classes until fully grown are visible, but usually have significant overlap potentially biasing estimates without age. Good practice to do sensitivities to growth addressing selectivity for the youngest fish since this may pose an issue to estimating k if you had the growth data to evaluate how large of a difference you see given use of the same area age data. The SSC supports sampling otoliths, sex, and length across the range of copper rockfish and quillback rockfish in California to account for differences in growth with regional water temperature.

There are concerns regarding the growth rate for quillback rockfish related to natural mortality M based on maximum age pooled over all data requiring more ageing data than we have to evaluate. Estimated M may have an impact on growth given sensitivity of $L_{infinity}$ to M. All areas modeled used the same natural mortality parameter. Estimation is an issue due to tensions with other parameters and may not be plausible. Estimating parameters is allowed in the TOR, but a word of caution is justified.

Future GFSC meetings to review stock assessments should be held at least three weeks prior to Council meetings at which they will be reviewed to provide additional time for composing, reviewing, and consuming the report as well as avoiding unreasonable workload and distraction from review of other items on the Council agenda.

Consider making use of the check-in review provided for in the TOR for length-based assessments at the GFSC meeting prior to the June Council meeting and final review at the August GFSC meeting to provide time to address larger issues and allow for more complete review. These and other considerations relative to the review process can be revisited at the post-mortem process review in winter of 2021.

GMT members noted the need for a more inclusive process of review for the data-moderate assessments to allow input as is the case for full assessments with GMT and GAP advisors. The process would benefit from their input.

Growth can be estimated directly from lengths external to the model in programs such as Multifan and other methods could be used to estimate growth from lengths. The SSC could explore the viability of these methods. Length frequency for slow growing species for use in estimation of growth can be tricky. There are methods that can provide growth estimates irrespective of the presence of specific cohorts, which may not be included in stock synthesis.

While the fixed value of q is the estimated value, fixing it will artificially reduce the perceived sensitivity of the model results to varying aspects of the specifications of the assessment. Data from net-mounted cameras to estimate net avoidance and or archival tagging studies to quantify the availability to the net itself given their semi-pelagic habitats are not available to inform q directly. The West Coast Groundfish Observer Program (WCGOP) and At Sea Hake Observer Program (ASHOP) provide data on catch rates during the year that can be used to examine the potential effects of seasonal migrations.

There is considerable variation in fleet selectivities among regions, and in some cases fitted selectivities do not match qualitative expectations (e.g., the Oregon commercial fleet). This reflects a tension between a desire for parsimony and allowing data to inform the models.

In the Oregon assessment, the analysis of sensitivity to estimating recruitment deviations with commercial selectivity fixed to the base model estimate had unusual results.

Alternative model runs that included the RecFIN index and the CPFV observer index with data through 2011 from the 2013 data moderate assessment did not result in large changes to stock status.

Selectivity assumptions differed between regions, with asymptotic selectivity assumed for both recreational and commercial fleets in California and Washington, compared to selectivity in Oregon, which was assumed to be dome-shaped for the recreational fleet and asymptotic for the commercial fleet.

All the area models used the Hamel prior for natural mortality (M = 0.057 yr-1) and growth was determined for both sexes combined (L infinity = 43.04, and k = 0.199). The length and age data were combined using fishery-independent data available from the WCBTS, mostly from Oregon and some additional data from Washington, as well as collections from the recreational and commercial fisheries in Washington and Oregon.

The model-based estimates of growth parameters were influential given sensitivity to L infinity and k, resulting in the stock being in the precautionary zone, rather than overfished with fixed values based on proxied growth from Oregon and Washington in the base mode as seen in Figure 43 of the assessment. While some felt applying growth derived from model-based estimates of k and $L_{infinity}$ would present a more representative assessment given uncertainty from using data from Oregon and Washington, they remained in the base model. Additional length data that could have been explored in the assessment reflecting historical CDFW onboard CPFV surveys from the 1980s and 1990s but were omitted in preference for length data consistently collected over time and space from the CRFS and MRFSS surveys. In addition, 15 years of data is available from California Collaborative Fisheries Research Program reflecting length compositions both inside and outside no take MPAs now protecting 20% of quillback rockfish habitat in California. Additional data to inform indices of abundance and biomass estimates from ROVs are available to inform a full assessment in California (Table 2).

The SSC recognizes that the assessments were developed within the context of the established TORs. The intent of index-based indices of abundance noted in the methodology review panel report (Agenda Item H.3.a, Attachment 1, September 2012) recommended that the results not be used for status determination given the greater uncertainty relative to full stock assessments, but rather that they be ranked in overfished, precautionary and healthy categories to inform prioritization for full stock assessments. This framework was intended to allow the Council to assess a greater number of assessments to identify conservation concerns, then prioritize full assessments to further evaluate stock status and make status determination resulting from use of all available data to reduce uncertainty in status determinations while assessing more of the 90 plus stocks in the groundfish FMP. The SSC notes that some of the stocks subject to length-based data-moderate assessments may be the focus of full assessments in the future., are subject to potential changes in status perception. The additional data available for a full assessment may

have implications for BSIA designations of length-based assessments given inclusivity criteria in National Standard 2.

The reports for data-moderate stock assessments should include an Executive Summary although the format for the Executive Summary might differ in detail from that of a full assessment.

References

Sivasundar A. and S.R. Palumbi. 2010. Life history, ecology, and the biogeography of strong genetic breaks among 15 species of Pacific rockfish, Sebastes. Mar Biol. 157: 1433–1452.

SCIENTIFIC AND STATISTICAL GROUNDFISH SUBCOMMITTEE REPORT ON ADOPT STOCK ASSESSMENTS

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Mr. Louis Zimm, Sportfishing Association of California, San Diego, CA

SSC Recusals for this Meeting		
SSC Member	**Issue**	**Reason**
Dr. John Budrick	Copper Rockfish, Quillback Rockfish, and Squarespot Rockfish	Dr. Budrick was on the STAT for these assessments.
Dr. Melissa Haltuch	Sablefish	Dr. Haltuch was on the sablefish STAT.
Dr. Owen Hamel	All assessments	Dr. Hamel supervises STAT members on these assessments, and was on sablefish STAT.
Dr. André Punt	Sablefish	Dr. Punt is Ms. Kapur's major PhD advisor.
Dr. Tien-Shui Tsou	Copper Rockfish and Quillback Rockfish	Dr. Tsou was on the STAT for these assessments.

The Groundfish Subcommittee of the Scientific and Statistical Committee (GFSC) met via webinar on June 21-22, 2021 to review the data moderate and update assessments, and benchmark assessments reviewed under the first stock assessment review (STAR) panel. The GFSC received reports from stock assessment teams (STATs) and from Dr. Theresa Tsou (Washington Department of Fish and Wildlife) on the STAR panel reviews of Dover sole and spiny dogfish. The GFSC commends the STATs and the STAR panel reviewers for their extensive and thorough work. The Subcommittee endorses the STAT and STAR panel recommendations for future research and data needs. An overview of the recommendations of the GFSC with respect to stock categories and the next assessment for each stock is summarized in Table 1.

Dover Sole

The GFSC reviewed a new benchmark stock assessment for Dover sole (Agenda Item G.5, Attachment 1) and the STAR panel report (Agenda Item G.5, Attachment 2) from the May 2021 review of the assessment. The 2021 Dover Sole stock assessment models a single coast-wide stock in US west coast waters using data sources that include: landings data and discard estimates; survey indices of abundance, length- and/or age-composition data for each fishery or survey; information on weight-at-length, maturity-at-length, and fecundity-at-length; information on natural mortality and the steepness of the Beverton-Holt stock-recruitment relationship; and estimates of ageing error. The assessment model has two sexes to capture dimorphic growth and two trawl fleets; Oregon and Washington combined and California. Model estimates show that the scale of the spawning biomass is uncertain, and that the stock size is well above the target reference point and has been above the target reference point throughout the duration of the fishery. The lowest spawning biomass sizes relative to unfished were estimated to have occurred during the mid-1990s, followed by an increasing trend. Fishing mortality is estimated to have been well below the target level for the duration of the time series. The scale of the estimates of stock size are lower than from the 2011 assessment, driven by improved parameterization of survey selectivity (double normal and sex-specific). Results from this assessment are broadly consistent with those from the 2011 assessment. The new assessment estimates a depletion of 79 percent at the start of 2021.

The GFSC discussed sources of uncertainty in the model, including: the level of recruitment variability, sensitivity to the treatment of natural mortality (M), and sensitivity to alternative selectivity parameterizations. It was noted that the variability in recruitment deviations in the Dover sole assessment are lower than those for rockfish and are similar to other flatfish assessments. The choice of estimating or fixing natural mortality for females impacts model-derived quantities due to a conflict in the data. Fixing female M allows for the estimation of the male offset to females. Model-estimated M is not well-aligned with standard methods for specifying M priors given maximum ages between 45 and 59 years, thus female M is fixed in the model. It was also noted that the survey selectivity parametrization in the 2011 assessment led to much greater uncertainty estimates compared to this 2021 assessment. Finally, the GFSC notes that using the sigma for category 1 stocks when specifying the states of nature in the decision table was an appropriate approach for capturing the range of uncertainty for this stock.

The GFSC supports the modeling approach, agrees that the model fits the data adequately, and agrees with the conclusions of the 2021 Dover sole stock assessment. This model estimates depletion well, although there is uncertainty with respect to stock size in absolute terms. The GFSC recommends that the SSC endorse the 2021 full assessment of Dover sole as providing the best scientific information available and suitable for informing management decisions. The GFSC recommends the stock be assigned to category 1. The GFSC recommends that the next Dover sole assessment be an update assessment unless new data sources become available.

Spiny Dogfish

The GFSC reviewed a new benchmark stock assessment for spiny dogfish (Agenda Item G.5, Attachment 3) and the STAR panel report (Agenda Item G.5, Attachment 4) from the May 2021 review of the assessment. The assessment was presented by Drs. Vlada Gertseva and Ian Taylor

(Northwest Fisheries Science Center; NWFSC). It included many improvements from the 2011 assessment and indicated that the stock is in the precautionary zone (34 percent of unfished), whereas the last assessment indicated the stock was 63 percent of unfished. The ACL under the new assessment would decrease from 1,585 mt in 2022 to 1,001 mt in 2023. Bridging analyses adding and updating data indicated that the scale of the assessment had changed as a result of the value for catchability (q) for the NWFSC West Coast Bottom Trawl Survey (WCBTS) changing from 0.27 in the last assessment to 0.586 in the current assessment. The West Coast Groundfish Survey q was fixed at a 0.586 in the base model, though it is subject to considerable uncertainty due to lack of contrast in the data included in the assessment and an inability to qualify 1) seasonal migrations (of up to 600 miles) during the summer relative to the timing of the WCBTS that operated from March through October that likely affects availability, 2) potential net avoidance given strong swimming abilities, 3) the distribution of a portion of the stock shoreward of the WCBTS area, and 4) availability to the net itself given their semi-pelagic habits. These considerations provide an indication that a q value lower than 0.586 may be more realistic.

While the fixed value of q is the estimated value, fixing it will artificially reduce the perceived sensitivity of the model results to varying aspects of the specifications of the assessment. Data from net-mounted cameras to estimate net avoidance and or archival tagging studies to quantify the availability to the net itself given their semi-pelagic habitats are not available to inform q directly. The West Coast Groundfish Observer Program (WCGOP) and At-Sea Hake Observer Program (ASHOP) provide data on catch rates during the year that can be used to examine the potential effects of seasonal migrations. The GFSC proposes the following research project to better understand seasonal availability of spiny dogfish to the survey because the stock assessment and the published literature suggest a fairly strong seasonal migration of spiny dogfish, in which the animals are generally distributed further north during summer, and further south in the winter.

- The spatial patterns suggested in the WCBTS indicate that the greatest abundance is found off of Washington during the summer but catch and bycatch rates may be significantly greater during the winter, particularly in other areas of the coast, as a result of seasonal distribution behavior. This pattern is suggested by landings data but would be more appropriately evaluated from catch rates from bycatch data. An analysis of the seasonality of bycatch rates of spiny dogfish from WCGOP and other available data sources (e.g., ASHOP, Pikitch et al. (1988) bycatch study) should be conducted to evaluate whether the data indicate a strong seasonal availability of spiny dogfish as bycatch to fisheries. This could be done by using month as a factor in a General Linear Model (GLM) of bycatch rates (there would have to be some consideration of the appropriate targeting fishing strategies to include, and how to account for spatial patterns). The idea would be to use this information to develop a weakly informative "upper bound" prior for catchability based on the ratio of bycatch rates during the months which the survey takes place to the months in which spiny dogfish are likely to be more abundant but no survey effort is conducted (e.g., late fall and winter months). Ideally, this would include both a spatial and a temporal component, for example it might be instructive to conduct a VAST analysis of bycatch rates in the winter, relative to the summer, to better understand seasonal availability or shifts in the centroid of abundance (e.g., mean latitude of catch). Alternatively, this analysis could be conducted by state or region, as a strong southward shift in distribution could result in only modest changes in relative abundance off of Washington state, but a greater increase in bycatch rates off of Oregon and/or Northern

California. The results of this work could be used to develop a weakly informative prior for *q* (representing an upper bounds of plausible q values) to better inform the model (for a comparable example of a weakly informed boundary prior, see He et al. 2006).

The relatively flat likelihood profile for *q* implies that the data are uninformative about this parameter even though it is influential on the scale and depletion of the assessment. Catchability is listed as the major axis of uncertainty in decision tables and the best estimate determines the lower and upper bounds. The uncertainty in *q* is problematic since it affects the estimates of key parameters including natural mortality (*M*) and growth, creating tension in the model between these variables. There is a tradeoff between *M* and q, and the model fit improved when *M* was lower and q was higher.

Considerations Regarding Productivity and Harvest Policy Implications of Results Relative to the Proxy SPR 50 Percent

The estimate of steepness for spiny dogfish is among the lowest value for any marine organism. The F_{MSY} of 0.003yr-1 corresponds to an SPR of 90 percent while an SPR of 88.3 percent corresponds to SB_{40} given the value for steepness. The current SPR_{50} percent harvest policy appears inconsistent with the biology if these results are correct. The GFSC highlights that the SPR proxy is significantly higher than the SPR estimated to correspond to MSY and the stock is predicted to collapse if it is fished at an SPR of 50 percent. While a spawner-recruitment relationship meta-analysis might help inform a more ideal HCR, such an analysis is unlikely to be possible given the limited number of species with this life history.

Under the low state of nature depletion drops to 34 percent, which is a function of the presumed steepness. An SPR of 88.3 percent would achieve rebuilding to SB_{40}. The STAT can create a harvest policy that would allow rebuilding to target level for the GMT to consider.

The GFSC endorses the 2021 full assessment of spiny dogfish as providing the best scientific information available and suitable for informing management decisions. The GFSC recommends the stock be assigned to category 2 since recruitment deviations are not estimated and data do not inform scale well. The GFSC recommends that the next assessment of spiny dogfish be a full assessment due to the technical issues discussed in the assessment and STAR panel report.

Sablefish

The current stock assessment update for sablefish (Agenda Item G.5, Attachment 5) is the first update of the 2019 benchmark assessment. The updated data and time series include an additional year of the WCBTS data (2019, there was no 2020 survey) and additional age and length composition data from both that survey and from commercial fisheries. Although the general trends in spawning output and recruitment were consistent with the 2019 benchmark, the update assessment indicated an increase to the scale of spawning biomass. Specifically, the estimate of unfished spawning biomass increased from 147,729 to 168,875 mt between the 2019 benchmark and the 2021 assessment update, the spawning biomass in 2019 increased from 57,444 mt to 83,925 mt, and depletion in 2019 increased from 38.9 percent in the 2019 benchmark to 50 percent (in 2019) in the 2021 update. The update assessment suggests that the stock had never been below

the target level of 40 percent of the unfished spawning output, while the 2019 assessment indicated that the stock had been below the target level between 2011 and 2019.

Although the model followed the Terms of Reference for stock assessment updates, the STAT found it necessary to make technical changes to the model structure to accommodate unanticipated complications related to updated data series. This is consistent with the TOR guidance, which states that alterations to the specification of a full assessment can be considered as long as the update assessment justifies the need for such changes and provides a step-by-step transition (via sensitivity analysis) from the last full assessment to the update documenting the effects of these changes. For the 2021 update, the STAT found that there was a need to refit the discard retention curve due to increased discarding in the trawl fleet in 2019 (thought to be related to the strong 2016 year class), which in turn required including the discard length frequency data in the model.

During the 2019 benchmark review, the decision was made to fix the retention curve at the estimated values and remove the discard length frequency data, as those data had an unexpectedly strong influence on scaling the model. Although the mechanism was unclear, the STAT and the STAR Panel in 2019 agreed that the observed result was undesirable, and the recommendation was made to conduct future research on the possible mechanism for the observed changes. During the same review, the length data for commercial fisheries were excluded, due to tension among data sources (particularly between age and length data) and associated scaling issues. The GFSC agreed with the decision to include the discard length data in the assessment and to re-estimate the retention curve. These changes were necessary because the updated model produced implausible and inconsistent model results regarding recent (2019) recruitment, and the fit to the 2019 WCBTS degraded without these changes.

In addition to the increase in scale, the statistical uncertainty in the update assessment is wider than the 2019 benchmark, with the stock trajectory in recent years outside of the uncertainty bounds of the 2019 benchmark. The increase in the estimate of natural mortality (females from 0.073 to 0.076yr-1; males from 0.060 to 0.068yr-1) in the update assessment partially explains the increase in scale, while the lack of 2020 WCBTS data also contributed to greater uncertainty but is likely not the sole factor driving the greater uncertainty. The update also resulted in some shifts in data weighting for the triennial survey (which seems to fit slightly better) and shifts in the timing of early (1960s) recruitment events, which are generally not well-informed by data. These changes did not warrant greater concern.

The update assessment indicates that the current depletion is 57.9 percent of the unfished level in 2021, that recent catches have been below the OFL and ACL, and projects OFL values of 11,577.1 and 10,669.8 mt for 2023 and 2024, assuming 2021-2022 ACL attainment. Catch projections indicate that catch attainment consistent with current harvest policies would result in the stock declining from 57.9 percent of the unfished level in 2021 to approximately 50 percent of the unfished level in 2031. The basis for uncertainty in the decision table was the asymptotic standard deviation for the 2021 spawning biomass from the base model, consistent with the 2019 benchmark assessment, and alternative values of P* for the calculation of ACLs.

The GFSC recommends that the SSC endorse the 2021 update assessment of sablefish as providing the best scientific information available and suitable for informing management decisions. The GFSC recommends the stock be assigned to Category 1, although the GFSC notes that uncertainty appears to be greater in the 2021 update than it did in the 2019 benchmark, as reflected by the observation that the base model is outside of the uncertainty of the 2019 benchmark. The GFSC

recommends that the next sablefish assessment be a full assessment due to the technical issues discussed in the 2019 STAR Panel, most of which persist in the 2021 update.

Copper Rockfish

New data-moderate stock assessments were reviewed for copper rockfish south of Pt. Conception (Agenda Item G.5, Attachment 6), north of Pt. Conception in California (Agenda Item G.5, Attachment 7), Oregon (Agenda Item G.5, Attachment 8), and Washington (Agenda Item G.5, Attachment 9) The assessment for all four regions shared the same model framework and many key elements regarding the types of data and model assumptions, but there were important differences in the choices regarding selectivity, estimation of recruitment deviations, and availability of fishery-independent data (Table 2). While the 2021 assessment provided justification for the stock structure decisions made during this assessment, considerable uncertainty remains. This warrants further research into genetic stock structure for Copper rockfish. All models were implemented in the most recent version of Stock Synthesis 3 and relied primarily on length-composition data. All regions had both a commercial and recreational fleet, with the vast majority of landings by the recreational fleet in most years. The assessments used Hamel priors for natural mortality (M) and the standard Thorson-Dorn prior for steepness (h) for rockfish stocks. For all four assessments, there were less-than-usual data from 2020 due to COVID-19 impacts on data collection by agencies.

The GFSC was generally supportive of the modeling approach and satisfied with the model fits to data and resulting conclusions. The exception was the Southern California assessment, for which there was a retrospective pattern, and the fit to the NWFSC Hook-and-Line Survey index was very poor, possibly indicating a model mis-specification. Other issues raised by the GFSC were:

- There is considerable variation in fleet selectivities among regions, and in some cases fitted selectivities do not match qualitative expectations (e.g., the Oregon commercial fleet). This reflects a tension between a desire for parsimony and allowing data to inform the models. This variation should be considered in future assessments.
- The model for Northern California estimated a pattern of high recruitment during the 1960s and lower recruitment during the 1970s. This was a period prior to the availability of length-composition data so the fit reflects the model attempting to match the observed length distributions later in time series, but the recruitment pattern is not consistent with known trends in the recruitment for other rockfishes during that time. However, setting those recruitments deviations to zero resulted in even less-plausible model performance later in model years.
- In the Oregon assessment, the analysis of sensitivity to estimating recruitment deviations with commercial selectivity fixed to the base model estimate had unusual results.
- Age-length estimates (and hence the growth curve) for Northern California may be suspect because they rely on data from Oregon and Washington where water temperatures are different and growth may also differ.
- The fit to the hook-and-line survey in the Southern California assessment was very poor. This likely reflects spatial structure in the fishery and the stock. The fishery - particularly the recreational fishery that constitutes a majority of landings - is centered on shorter day trips, and thus limited to very nearshore portions of the stock that experience high fishing pressure and likely have truncated size structure. Though some overnight trips to the islands and offshore banks are also sampled, the onboard sampling is mostly focused on

day boats closer to shore, leaving the composition of the biomass offshore that is likely subject to less fishing pressure under-represented in the data, potentially making the stock appear more depleted. The fishery-independent survey includes data from further offshore, including in areas where recreational fishing for copper rockfish is prohibited. Thus, length compositions from the survey provides a more spatially balanced sampling, representing larger fish than observed in the fishery, and is focused in deeper waters explaining the divergence. A related problem for both Southern and Northern California is the high proportion of habitat in no-take Marine Protected Areas (MPAs) or other areas closed to fishing for groundfish in Cowcod Conservation Areas (CCAs) or in the Rockfish Conservation Areas (RCAs), making the landings data non-representative of the entire population. CDFW quantified the percent of habitat in MPAs, CCAs and RCAs along with charts for further consideration to make clear the amount of habitat that is not represented in recent years. Finally, concerns were raised regarding the declining trend in the recent time period of the Southern California model, which is inconsistent with population trends from other southern California stocks for which data are available (e.g., bocaccio, cowcod), most of which have seen signs of strong recruitment over the past decade.

There were fishery-dependent indices of abundance and several additional length datasets that were potentially available to inform the Southern California assessment (e.g., recreational catch per unit effort data, ROV data) but the former were not included in the base model because of restrictions imposed by the Terms of Reference, though the latter could be added. Alternative model runs that included the RecFIN index and the CPFV observer index from the 2013 data moderate assessment did result in some increase in the relative abundance but did not substantively alter the estimated model trend. Given the limitations in the TOR, including additional indices of abundance datasets was not pursued, the GFSC agreed that a subsequent full assessment should examine the full set of available data for potential inclusion (Table 4).

At request of the GFSC, the STAT presented several additional analyses for the Southern California model to examine potential solutions to the poor fit to the NWFSC hook-and-line survey. Various options such as reweighting the likelihood associated with the survey, removing data collected in the Cowcod Conservation Area, or allowing a dome-shaped selectivity for the survey did not lead to material differences in model fit. Allowing the model to fit stochastic recruitment deviations improved the fit to the hook-and-line survey but led to surprising recruitment patterns that are likely driven by high catches later in the time series, given the lack of age data to constrain recruitment estimates. This possibility was confirmed by a retrospective analysis; removing recent length-composition data that should inform the recruitment deviations did not result in deviations converging on zero, indicating that they are driven by the need for recruitment to enable the recent high catches to be taken. Eliminating the survey altogether led to worse model fits to the fishery-dependent length compositions. Thus, after discussion, the GFSC concluded that the base model was the best possible assessment given the constraints of the ToR, and that reservations about the model fit cannot be resolved by further modification.

The data-moderate copper rockfish assessments estimate 2020 depletions of 18.1 percent, 39.3 percent, 73.6 percent, and 42 percent for the stocks in California south of Pt. Conception, California north of Pt. Conception, Oregon, and Washington, respectively. The GFSC notes the stock size estimated south of Pt. Conception is below the minimum stock size threshold. The

assessments suggest different estimates of stock size relative to unfished in Northern and Southern California but there is limited evidence that those are actually demographically distinct stocks. The GFSC recommends that the SSC endorse the 2021 data-moderate assessments of copper rockfish as providing the best scientific information available and suitable for informing management decisions. The GFSC recommends all the copper rockfish stocks be assigned to category 2 given these are data-moderate assessments. The GFSC recommends that the next copper rockfish assessments be full assessments to better understand the current depletion and scale of these stocks.

Quillback Rockfish

New data-moderate stock assessments were reviewed for quillback rockfish in California (Agenda Item G.5, Attachment 10), Oregon (Agenda Item G.5, Attachment 11), and Washington (Agenda Item G.5, Supplemental REVISED Attachment 12). The assessments shared the same model structure across areas as follows: two fleets (a recreational fleet and a commercial fleet), biological relationships estimated externally (length-weight, length-age, natural mortality, fecundity, and maturity), selectivity was assumed to be double-normal, and the stock-recruitment relationship was Beverton-Holt (h = 0.72, Table 3). Parameters estimated within each area were ln(R_0) and selectivity for the two fleets. Area-specific components were: for each area catches and length data, age data (only used to inform biological relationships), and selectivities (California and Washington are asymptotic for both recreational and commercial fleets, Oregon selectivity is dome-shaped for the recreational fleet and asymptotic for the commercial fleet). Recruitment deviations ($sigma_R$ = 0.6) were estimated for California and Oregon, and the model for Washington assumed deterministic recruitment.

All the area models used the Hamel prior for natural mortality (M = 0.057 yr-1) and growth parameters combined across sexes (one-sex-model; L infinity = 43.04, and k = 0.199). The length and age data were combined using fishery-independent data available from the WCBTS, mostly from Oregon and slightly less from Washington, as well as estimates from the recreational and commercial fleets. Fishery-dependent data were also used to inform ages and were only available from Washington and Oregon.

The uncertainty in the model for California is quite influential, indicating sensitivities around estimates of growth and mortality parameters. For the Oregon model, the key sensitivities are whether annual recruitment deviation should be estimated, which has an effect on the model scale in 2021, and for assuming asymptotic recreational selectivity, which reduces the fraction of unfished to near the MSST. For Washington, there is more variability in model estimates and the sensitivities around estimating parameters (M, CV of larger individuals, and L infinity) are quite impactful, as well as sensitivities around recruitment, and including whether recruitment deviations are estimated.

The use of growth from fish sampled in Oregon and Washington, applied in the California assessment presents an unresolved uncertainty since California is subject to higher water temperatures that can affect growth rates, making them potentially unrepresentative. The model-based estimates of growth were influential, given sensitivity to L infinity and k. While some felt that estimating the growth parameters within the assessment would be preferable, the externally estimated growth parameters from Oregon and Washington remained in the base model. Additional length data that could have been explored in the assessment reflecting historical CDFW onboard CPFV surveys from the 1980s and 1990s as well as data from the California Collaborative

Fisheries Research Program reflecting data both inside and outside MPAs from the last 15 years (Table 4).

The data-moderate quillback rockfish assessments estimate 2020 depletions of 14 percent, 47 percent, and 39 percent for the stocks in California, Oregon, and Washington, respectively. The GFSC notes the estimated stock size of California quillback rockfish is below the minimum stock size threshold. The GFSC recommends that the SSC endorse the 2021 data-moderate assessments of quillback rockfish as providing the best scientific information available and suitable for informing management decisions. The GFSC recommends the quillback rockfish stocks be assigned to category 2 for Oregon and California, given these are data-moderate assessments and category 3 for Washington due to data limitations. The GFSC recommends that the next quillback rockfish assessments be full assessments to better understand the current depletion and scale of these stocks.

Squarespot Rockfish

A new data-moderate stock assessment was conducted for squarespot rockfish in California using data through 2020 (Agenda Item G.5, Attachment 13). There are no prior assessments for this species. Since 2010, the Depletion Corrected Average Catch (DCAC) was used to set annual catch limits (Dick and MacCall, 2010), which assumed a relative depletion of 40 percent in 2009 and estimated the mean sustainable yield of 5.7 mt (median 5.9 mt).

Squarespot rockfish (*Sebastes hopkinsi*) is a relatively small rockfish found from Mexico to southern Oregon, with a core distribution in southern California. This species is treated as one stock, as there is no evidence of population structure. Squarespot rockfish is a long-lived dwarf species that has sex-specific growth with females reaching larger sizes (29 cm) than males (23 cm). Due to its small size, squarespot rockfish is not targeted by the recreational or commercial fisheries. Catches mostly consist of large females. Thus, the fishery mainly affects spawning biomass.

Fishery catch data used in the model represent total removals (landings plus discards). The recreational and commercial catches were combined into a single fleet by aggregating across gear types. Data from the NWFSC hook-and-line survey were used as a relative index of abundance. Length compositions from the fishery and survey were included. The NWFSC WCBTS data were not used as an index of abundance but biological data from this survey were used to develop life history parameters.

All life history parameters were fixed in the model. Sex-specific growth parameters were fixed at the values estimated external to the model. The Natural Mortality Tool (NMT; https://github.com/shcaba/Natural-Mortality-Tool), which includes multiple natural mortality estimators, was used to obtain estimates of natural mortality. The final composite M distribution was based on four empirical estimators and resulted in a median value of 0.133yr-1 (mean of 0.136yr-1), with a CV of 0.22. Recruitment is deterministic with steepness fixed at 0.72.

Estimated parameters were the two selectivity parameters each for the fishery and survey selectivities, and the log of the initial recruitment ($logR0$). Selectivities for the fishery and survey were specified using the double normal parameterization within Stock Synthesis where selectivity was fixed to be asymptotic with the ascending slope and size of maximum selectivity parameters estimated. Francis data weightings were used.

The model does not fit the survey index and associated length compositions. During the meeting, some additional exploration of the CalCOFI index was conducted, but did not lead either the STAT or the Panel to recommend changes to the base model. The GFSC noted that the method of developing an index of abundance using the hook-and-line survey may need further examination in the future. The dip in abundance trend around 2012 and 2013 was also observed for other species. This may indicate other mechanisms are affecting the trends.

The data-moderate squarespot rockfish assessment estimates a 2021 depletion of 37 percent or just below the management target of 40 percent. The GFSC endorses the 2021 data-moderate assessment of squarespot rockfish as providing the best scientific information available and suitable for informing management decisions. The GFSC recommends the squarespot rockfish stock be assigned to category 2 given this is a data-moderate assessment. The GFSC recommends that the next squarespot rockfish assessment be a data-moderate assessment and encourages further exploration of the CalCOFI data.

General Comments on Data-moderate Assessments

This was the first review of assessments based on SS-CL and SS-CL+Index. The GFSC provides the following observations which could be considered when the TOR for stock assessments are next revised and when a workplan for the "off year" is developed:

- Executive Summary: The reports for data-moderate stock assessments should include an Executive Summary although the format for the Executive Summary might differ from that of a full assessment.
- Treatment of Recruitment: The workshop that led to the approval of SS-CL and SS-CL+Index did not consider guidelines for when recruitment deviations should be estimated. A future workshop could consider this issue as well as providing guidance for situations when unreasonably large recruitment deviations are estimated to accommodate the observed catches and accounting for expectations that recruitments should show some spatial coherence among modeled areas.
- Fishery-Dependent Indices: The current TOR restricts the indices that can be used in DM assessments (fishery-dependent indices cannot be used). The SSC should consider whether or not to expand the data-moderate TOR to allow consideration of such indices (though it could reduce the number of data-moderate assessments conducted during an assessment cycle due to increased workload). However, the increased workload may mean that assessments that rely primarily on nearshore recreational data should, by default, be assessed using full assessments.
- Review: It should be recognized that the SS-CL and comparable data-moderate assessments are based on full age-structured models and thus have considerable opportunity for complexity and a broad range of options for parameterization, comparable in many cases to that of full assessments. The opportunity to request additional runs or analyses during the meeting was helpful in understanding the behavior and data conflicts among these models. If future data moderate assessments are to be developed to inform management, a slightly longer (2.5-3 day) review panel, more similar to a STAR panel, may be helpful to ensure adequate time to review models, consider alternative model structures or sensitivity runs, and better understand the model dynamics. This is particularly true if the SSC considers the opportunity to include fishery dependent indices in such models. Another approach would be a two-meeting process, with, for example, a

preliminary review in one Groundfish Subcommittee meeting and a final review in a second, more than a month later, and well before the Council meeting.

- Length Data: All relevant length data should be provided in a usable form and with adequate description by the data deadline so that they can be considered for inclusion in data-moderate assessments, although they may be excluded following consideration.
- Potential Data Sources: The assessments should document the data sources that were potentially available but not included in the assessment as well as a list of those that could not be included in the assessment given the data-moderate TORs but would have likely been explored for use in a full assessment. There should be no requirement for analysis of these data or use of these data for data-moderate assessments.
- Ensemble Modeling: The length-based data-moderate approaches can be highly constrained by fixing biological parameters and not estimating recruitment, which leads to the concerns of model mis-specification. Guidelines on how best to conduct an ensemble modeling approach should be considered, discussed, and included in the TORs.

The GFSC notes that there is often more data available for stocks assessed using data-moderate techniques than can be accommodated, which is undesirable but a necessary consequence of the use of data-moderate assessment. A list of potential additional data available that could be explored for stocks assessed using length-based data-moderate assessment methods is provided in Table 4.

The SSC should investigate how best to assess nearshore species, particularly with large recreational fisheries, that have strong spatial management (e.g., MPAs, rockfish closures) and a pattern of higher effort nearshore. This can lead to divergence in data between fishery-dependent data and fishery-independent data, depending on the biology of the species (movement, in particular), particularly if the handling of the latter is not informed by spatial gradients in fishing effort.

References

Dick, E.J. and MacCall, A.D., 2010. Estimates of sustainable yield for 50 data-poor stocks in the Pacific Coast groundfish fishery management plan.

He, X. and Mangel, M. and MacCall, A. (2006) A prior for steepness in stock-recruitment relationships, based on an evolutionary persistence principle. Fishery Bulletin, 104(3), pp. 428-433.

Pikitch, E.K., D.L. Erickson and J.R. Wallace. 1988. An evaluation of the effectiveness of trip limits as a management tool. NWAFC Processed Report 88-27: NMFS

Table 1. Summary of outcomes of the GFSC review of stock assessments.

Species/Stock	Assessment Type	Depletion	Category / sigma	Next Assessment
Sablefish	Update	58%	1	Full
Copper rockfish				Full
Southern California	Data-moderate	18%	2	
Northern California	Data-moderate	39%	2	
Oregon	Data-moderate	74%	2	
Washington	Data-moderate	42%	2	
Quillback rockfish				Full
California	Data-moderate	14%	2	
Oregon	Data-moderate	47%	2	
Washington	Data-moderate	39%	3	
Squarespot rockfish	Data-moderate	37%	2	Data-Moderate
Spiny dogfish	Full	34%	2	Full
Dover sole	Full	79%	1	Update

Table 2. Comparison of attributes for copper rockfish model areas

Model Attributes	California - South	California - North	Oregon	Washington
Model Years	1916 -2020	1916 -2020	1927 -2020	1935 -2020
Fishing Fleets	Commercial	Commercial	Commercial	Commercial
	Recreational	Recreational	Recreational	Recreational
Survey Fleets	NWFSC Hook and Line Survey	None	None	None
Selectivity	Double-Normal	Double-Normal	Double-Normal	Double-Normal
Selectivity Shape	Commercial – Domed	Commercial – Asymptotic 1916-2007, Domed 2008-2020	Commercial – Asymptotic	Recreational – Asymptotic
	Recreational – Domed	Recreational – Asymptotic	Recreational – Domed	(Commercial Mirrored)
	NWFS Hook and Line Survey – Asymptotic			
Recruitment	Deterministic	Stochastic	Deterministic	Deterministic
Data	Catch	Catch	Catch	Catch
	Lengths - Recreational, Commercial, NWFSC Hook and Line)	Lengths - Recreational and Commercial	Lengths - Recreational and Commercial	Lengths - Recreational
	Index of Abundance			

Table 3. Comparison of attributes for quillback rockfish model areas

Model Attribute	Common to all	California	Oregon	Washington
Time period		1916-2020	1892-2020	1958-2020
Fleets	Recreational Commercial			
Data		Catches Lengths	Catches Lengths	Catches Lengths
External Biology	Length-weight Length-age Natural mortality Fecundity Maturity			
Selectivity	Double-normal	Asymptotic (rec, com)	Dome-shaped (rec) Asymptotic (com)	Asymptotic (rec, com)
Recruitment	Beverton-Holt ($h = 0.72$)	Annual recruitment deviations ($\sigma_R = 0.6$)	Annual recruitment deviations ($\sigma_R = 0.6$)	Deterministic
Parameters est.	R0, Selectivity	Annual rec. devs.	Annual rec. devs.	

Table 4. Additional potential data sources that could be explored for length-based stock assessments.

Data Source	Quillback Rockfish	Copper Rockfish North	Copper Rockfish South	Squarespot Rockfish
CDFW So Cal Onboard Sampling Data 1975-1979 Collins and Crooke			Length-based D-M/Full	Length-based D-M/Full
CDFW So Cal Onboard Sampling Data 1986-1989 Alley and Ono			Length-based D-M/Full	Length-based D-M/Full
CDFW Central California Onboard CPFV Sampling Data 1987-1998 Deb Wilson-Vandenberg	Length-based D-M/Full	Length-based D-M/Full		
California Collaborative Fisheries Research Program 2007-Present-https://mlml.sjsu.edu/ccfrp/about/	Index-based D-M/Length-based D-M/Full	Index-based D-M/Length-based D-M/Full		
California Department of Fish and Wildlife Remotely Operated Vehicle Biomass Estimates and Lengths 2014 and 2020-https://www.pcouncil.org/documents/2020/09/agenda-item-d-4-a-supplemental-ssc-report-1-2.pdf/	Length-based D-M?/Full	Length-based D-M?/Full	Length-based D-M?/Full	Length-based D-M?/Full
Southern California Observer Indexes (1999-2011) SoCalOBS-https://www.pcouncil.org/documents/2015/01/data-moderate-stock-assessments-for-brown-china-copper-sharpchin-stripetail-and-yellowtail-rockfishes-and-english-and-rex-soles-in-2013-published-january-2015.pdf/			Index-based D-M/Full	Index-based D-M/Full

RecFIN (dockside sampling) 1980 to 2003 - https://www.pcouncil.org/documents/2015/01/data-moderate-stock-assessments-for-brown-china-copper-sharpchin-stripetail-and-yellowtail-rockfishes-and-english-and-rex-soles-in-2013-published-january-2015.pdf/	Index-based D-M/Full	Index-based D-M/Full	Index-based D-M/Full	Index-based D-M/Full
Central California Observer Indexes (1988-1998+) CenCalOBS- https://www.pcouncil.org/documents/2015/01/data-moderate-stock-assessments-for-brown-china-copper-sharpchin-stripetail-and-yellowtail-rockfishes-and-english-and-rex-soles-in-2013-published-january-2015.pdf/	Index-based D-M/Full	Index-based D-M/Full		

SSC Notes:

Spiny Dogfish:

Many improvements were made over the 2011 assessment, including estimates of discards, more flexible selectivity, corrected fecundity parameters, explored age issues and incorporated growth others documented in the assessment. Landings are now estimated based on catch of sablefish used to estimate bycatch rates for dogfish, which are uncertain due to the moderate correlations. This assessment brought in age data, growth fully estimated, fecundity parameters were updated.

We know that q is not 1, but spiny dogfish are seen consistently in the survey, with 50percent positive hauls. The estimate of q from the model was 0.586, though no empirical estimates are available, but the STAT considers it to be within the range of reasonable values.

Retrospective analyses showed a drop in scale and depletion.

Literature discussing the behavior of Atlantic spiny dogfish showing diel movements and less extreme seasonal movements than previously thought.

The subcommittee considered whether the realism of the estimate address the biological reasons that a lower q should be considered including southward migrations of 600 miles, returning to the survey area when the survey had completed.

The Pikitch et al. data (1988) indicated that most catch was in late winter and early spring, with less in spring.

Examining the percent increase in encounters relative to other species was significant, indicating a strong migratory pattern in the summer when the stock is out of the area.

The percent of catch from Pikitch et al. 1988 showed variability, presenting uncertainty in the seasonal movement.

The STAT does not think there is such a great degree of migration to justify a lower q value and work is planned to examine the broader distribution and timing throughout the year. There are catches in the bottom trawl survey during the summer. A study observing behavior around the survey net would be beneficial to examine local availability questions.

The Groundfish Subcommittee asked whether there is sufficient information on q to inform an alternative value or whether the issue should be documented and examined in the future? Further examination of the bycatch data and Ian Taylor's dissertation research may inform migration relative to catchability.

Some on the subcommittee believe q to be too high given seasonal migration and behavior relative to the net.

There is one pass of the WCBTS in May and another in August and hake fishery data for the Fall indicates higher bycatch rates, though part of the fleet is fishing in Alaska that time of year.

They are often caught in mid-water, but it is unclear whether they are often there in the absence of potential food resources, i.e., hake and euphausiids in the midwater.

A request for future research and data needs regarding the seasonality in the bycatch data and ratio in the months when the survey takes place and the rest of the year was composed for inclusion. If bycatch rates are on the order of magnitude of three fold of summer, then there is reason to consider a lower value. Northern California dogfish is more available in the winter than the summer (Ripley 1949). Examination of bottom trawl bycatch from WCGOP and ASHOP may provide a more direct analysis and could be done now or flagged as a research and data needs to get an upper bound on q.

Video studies and archival tagging to address local position relative to the net and a more regional analysis are research and data needs for future assessments.

Catch rates are preferable to catch for examining questions and ASHOP data from the Whiting fishery supports the migration out of the survey area in the summer.

Table 1, shows a range of estimated q value within differing natural mortality and growth, showing tension between these variables and the survey. There is a seasonal migration north, but the STAT considered it uncertain as to what proportion of the population is unavailable. There is no information on the movement around the net or empirical estimates of q are available in literature searches from the STAT. The STAT feels that the proposed value is within the range and no data is available to inform a quantitative estimate to refine the parameter outside the model. The seasonality of bycatch and considerations relative to behavioral response to the net remain uncertain and a concern.

No age data were available in 2011 and spine wear affects estimates of age. The extrapolation methods for warn spine are not applicable for mature females.

There is another layer of complexity since q is likely time varying, uncertain, and data can't discriminate values of M, h, and q, resulting in a high level of uncertainty. The q affects scale and depletion in any event, but we can be better explore uncertainty. All components of q should be explored with the vertical availability component and the seasonal component combined.

Ripley, W. E. 1949. Shark and shark liver, pp.129-134. In: The commercial fish catch of California for the year 1947 with an historical review, 1916-1947. California Department of Fish and Game Fisheries Bulletin 74.

Sablefish:

While the "TOR" model and the STAT model were certainly helpful diagnostics to put the decision to add back the discard length frequency data, it might have been helpful to sequentially walk through the model changes that deviated from the general guidance to adhere to the previous model structure to the extent practicable. This could have been done by developing the new base model, then undoing the key model changes that were considered necessary to develop an acceptable update in more of a "step by -step" transition. This might also have helped to understand and diagnose the mechanisms behind the unusual sensitivity to the discard length composition data observed in the 2019 model. Additionally, including the fits to the discard length data in the "TOR" model as a ghost fleet might have been another helpful diagnostic.

Copper Rockfish:

The key differences in the modeling and data among regions were (also see Table 2):

- *Recruitment was deterministic in all regions except Northern California, with the latter estimating recruitment deviations. This choice reflected high sensitivity of stock size estimates to the inclusion of stochastic recruitment in the other three regions (including stochasticity led to up to >50percent reductions in the estimates of stock size) and the importance of very high recruitment pulses in the late 2000s to the fit of the Northern California model.*
- *Selectivity varied among fleets and regions. The recreational fleet was estimated to have dome-shaped selectivity in Southern California and Oregon and asymptotic elsewhere; the commercial fleet was dome-shaped in Southern California but asymptotic in Oregon and Washington (the latter because a lack of commercial data from Washington required that fleet's selectivity to simply mirror the recreational fleet). In Northern California, the commercial fleet was blocked to have asymptotic selectivity in earlier years but dome-shaped since 2008. These differences are thought to reflect regional variation in the prevalence and timing of depth restrictions on fishing that limit the take of large copper rockfish (e.g., Rockfish Conservation Areas and Cowcod Conservation Areas) as well as possible regional variations in market preferences in the live-fish fishery for 'plate-sized' fishes. In general, the model results were highly sensitive to constraints on the estimated selectivity, with constraining fleets to asymptotic selectivity resulting in highly pessimistic stock size estimates (as expected because that assumption would imply the absence of larger fish in the stock).*
- *In both California regions a substantial fraction of copper rockfish habitat is in marine protected areas (approximately 20percent north of Pt. Conception, and 43 percent south of Pt. Conception). Other depth-related closures (related to Yelloweye Rockfish) in*

California have recently been relaxed, allowing access to previously unfished portions of the stock. The assessments are not spatial so do not account for closed areas and hence differences in population structure spatially

- *In Washington, only data from the recreational fleet are available, and only data on length composition and numbers (not mass) of fish caught. Given the limited data, for that region the STAT compared the Stock Synthesis results to results from Simple Stock Synthesis and a Length-Based SPR analysis. The latter had a result similar to the base SS model while the latter returned a more optimistic stock size estimate. A similar analysis was conducted in Oregon and obtained the opposite result: LB-SPR estimated a nearly identical stock size to the base model, while length-only Simple Stock Synthesis was more pessimistic.*
- *The Oregon and Northern California assessments relied only on data from the commercial and recreational fleets, but in Southern California a NWFSC hook-and-line survey was also available and included in the analysis as an abundance index.*

More age-length data is needed from California to obtain parameter estimates specific to that environmental context.

Quillback Rockfish:

- *The sensitivity in growth for California is a consideration given that the STAT team is borrowing data from Oregon to inform this. There's a large portion of California that has very different water temperatures North of Pt. Conception.*
- *Although the STAT team observed among the age data a maximum age of 71 yrs., this data was not used based on the belief that quillback rockfish are indeed a very long-lived species and the literature estimate supports a maximum age of 95 years.*
- *The k estimate used in the models for pooled sexes is on the higher side of literature values (0.06-0.19). However, based on the natural mortality estimate the M/k ratio was 0.29, which is in the range for Pacific Sebastes presented in the literature.*
- *The WCGBTS has very few samples from California that were aged.*
- *The general pattern in recruitment deviations for California exhibited an increase on higher than the average recruitment period up to ~2000 and then a period of lower than average recruitments with the exception of 2011. The uncertainties around these estimates were high, however, what could be potentially driving it was inconclusive.*
- *For California, dome-shaped selectivity was explored for the commercial and recreational fleets and the effect was fairly minor as observed in the sensitivities. In terms of considering dome-shaped selectivity for the whole time, there is a block after 2003 for the recreational fishery, where there were really strict depth restrictions. North of Pt. Conception was 20 and 30 fathoms, and 40 fathoms in the central management area.*
- *Additional catches between 1948-1968 landed at California ports were caught off Oregon and Washington and the total removals prior to 2002, where no WCGOP data were available, were calculated using the average discard rates from WCGOP in 2002-2018 for California (3.6 percent) rather than using the data for Oregon and Washington. Applying WCGOP rates for OR and WA would be sensible. The catches are very small (no more than 0.08 mt in any year, and typically lower than that) so differences in discard rates*

would have minimal effects. The rate for California from WCGOP was 3.7 percent, Oregon was 5.8 percent (fixed gears) and 9.2 percent (all gears), and Washington was 8.3 percent.

- *The retrospective patterns of all assessments were quite strong. It was raised concerns about the way that the retrospective analysis was conducted, which could result in estimating the recruitments better.*

Squarespot Rockfish:

The GFSC suggested additional model runs to explore adding the CalCOFI survey and removing the NWFSC Hook-and-Line survey and add the CalCOFI survey, which is often used in assessments for California stocks. The recommended model runs included:

- *[a] Base model + CalCOFI (as index of SSB)*
- *[b] As "a" plus estimate recedes (Sigmar=0.6)*
- *[c] As "a" plus estimate rec_devs – NO H&L Data (Index + Comps + selex parameters)*
- *[d] As "a" – NO H&L Data (Index + Comps + selex parameters)*

General results indicated that:

- *Adding CalCOFI under the reference model configuration had almost no effect.*
- *Assigning more weight on the CalCOFI survey decreases stock scale and depletion; this is contradictory to the signal in the Hook and Line survey that increases stock scale and depletion.*
- *Recruitment estimation is almost identical to the reference model, and thus not defensible.*

General

While these were "data-moderate" assessments, they were not workload-moderate assessments. Data workup was substantial, even while limiting the types of data used. Given eight species-area assessments, and other assessment duties this year for the authors, the workload was substantial. It would be helpful to discuss after the assessment cycle whether we can structure these to reduce workload, or if things can be done to reduce individual assessment workload for working up associated length data.

The STATs were generally opposed to including fishery dependent indices given workload, mission creep towards full assessments, and the perceived higher value of age data, and prefer that if there are concerns, that should trigger a full assessment. Data-moderate assessments reduce the number of things to look at, but if STATs have to look at nearly everything, then there is no point to having data-moderate assessments.

One option, perhaps worth discussion, is for the STATs and SSC or GFSC to agree on a limited set of either/both fisheries dependent or fisheries independent data to be considered in individual DM assessments. There is agreement that a wide-open scope for any possible indices is an unreasonable workload, however limiting to fisheries independent indices only may well be too constraining and suggests that most nearshore stocks (typically the most data limited) would require full assessments. For copper rockfish, it could have likely been discussed that the trawl

survey was unlikely to be helpful, while the onboard observer index would have been worth some investigation.

The GFSC used a pre-review Q&A google doc for this meeting, encouraging the subcommittee members to post questions for the STATs and allowing, but not requiring, them to respond before the meeting began. Some benefits of this approach were to streamline the conversation during the meeting and allow for earlier notice of some of the issues identified. If this approach is used again, clarity of its intent and earlier posting of questions by reviewers would improve the process.

CalCOFI: Data on larval abundance from the CalCOFI ichthyoplankton survey have been used in stock assessments of several species, including bocaccio, cowcod and shortbelly rockfish, and presented in others to provide context on regional trends (blue/deacon, chilipepper). Although the long-term dataset is limited to a small subset of species for which morphological identification of larvae has been possible, recent efforts based on genetic identification have provided relative abundance data for a broader suite of species (Thompson et al. 2017). Those time series should be considered in future full or data moderate assessments of stocks in the Southern California Bight, particularly if the current time series (which spans the time period from 1998 through 2013) can be extended. The adopted stock assessments for cowcod and bocaccio should be used to guide how the index is best incorporated into a model (e.g., as an index of relative spawning output).

Appendix C. to the copper and quillback stock assessments reflecting the percent of habitat in MPAs, RCAs and CCAs vs. open to fishing for groundfish provides greater context for understanding the potential implications of the spatial distribution of sampling for the structure, parameterization, and interpretation of stock assessments. Inclusion of such materials is encouraged in future assessments.

References Cited

Thompson, A.R., Chen, D.C., Guo, L.W., Hyde, J.R. and Watson, W., 2017. Larval abundances of rockfishes that were historically targeted by fishing increased over 16 years in association with a large marine protected area. Royal Society open science, 4(9), p.170639.

SSC Administrative Matters

8. Draft Framework for Determining Best Scientific Information Available

The SSC received a presentation from Mr. Jon Carey (NMFS WCR) describing best scientific information (BISA) determination under the salmon FMP, which had similar content to a written document and spreadsheet provided earlier via email. The presentation was strongly focused on the annual process for BSIA determination with respect to catch specifications (ABCs and ACLs for the three salmon stocks that currently receive them) and status determinations (overfishing, and overfished/rebuilding/rebuilt). It was noted that salmon management operates on a compressed timeline, and many products used in management are provided by, and reviewed by, bodies external to the Council.

The presentation summarized the annual process well and identified external bodies responsible for review of many products that are not currently reviewed by the SSC. The presentation seemed to conflict with COP15 in how it described the participants and roles of various advisory bodies and the Council in the September (final topic selection) and November (reporting and adoption of

methodology review outcome) stages. In particular, COP15 says that the "SSC informs" the Council of topics in September as opposed to the SSC, STT, and MEW all recommending topics and the Council deciding; and COP15 does not describe a role for the MEW reporting back in November. It is unclear whether the SSC can "inform" the Council that an existing methodology or reference point/conservation objective should be reviewed.

The SSC discussed consistency among FMPs in how BSIA is determined, focusing on four points:

1) External bodies perform reviews in some other FMPs (most notably, Highly Migratory Species [HMS]), in those cases the external review processes are described in a Federal Register Notice.

2) Timelines are very tight in salmon management due to the biology and phenology of the species constraining when data become available, and by choices about the timing of the management process . The SSC has very limited time to review SAFE documents and questions were raised how the SSC could meaningfully review documents received only days before meetings, or numbers generated via methods unknown to and unreviewed by the SSC (e.g., escapement estimates and exploitation rate estimates generated by the Pacific Salmon Commission).

3) Assessments and other science products used in other FMPs report uncertainty, and National Standards guidelines call for this. Most salmon management is based on point estimates that do not account for uncertainty.

4) In other FMPs, both the models used and their annual/regular application are reviewed. For example, Stock Synthesis is used in most groundfish assessments. Stock Synthesis itself has been extensively reviewed, as is each application and the data inputs used in each assessment.

Ms. Sarah Shoffler (SWFSC) informed the SSC that review satisfying the requirements for BSIA may take place in external bodies, but tight timelines or external review bodies do not relieve the requirement for adequate review. The SSC recommended that there could be value in establishing a consistent standard across review bodies, while recommending the Council has little to no ability to impose such a bar on external agencies. The SSC also noted concerns about being expected to sign off on "reviewing" products they were not able to examine closely.

Overall, the presentations and document provided described the existing BSI A process for annual catch specifications and status determinations well. Numerous questions regarding the review and updating of the reference points used in status determinations remained, as did questions about the process for initiating reviews of the processes and models providing inputs to annual salmon management, such as the forecasts used to inform catch specifications.

C. Administrative Matters

9. Membership Appointments and Council Operating Procedures

The Scientific and Statistical Committee (SSC) discussed potential changes to Council Operating Procedure (COP) 4 regarding the make-up of the SSC and offers the following comments.

The SSC recommends that the treatment of alternate members be consistent between agency and at-large seats. COP 4 states that alternates for specific SSC meetings may be designated if members representing Federal, state, or tribal agencies are unable to attend. However, designees are not authorized for at-large SSC members. The SSC recommends that either no alternates be permitted for any members or that all members be permitted to have alternates.

The SSC recommends that at-large seats have staggered terms, rather than all serving concurrently. More frequent openings as staggered at-large terms expire would allow for more opportunities to increase SSC diversity and add expertise in emerging areas.

SSC Notes:

While greater use of alternate members could potentially allow for greater participation by experts with expertise on specific topics, the SSC notes that we can, and often do, invite subject-matter experts to participate in discussions without being members.

The SSC discussed the possibility of converting two at-large seats to NMFS seats. The consensus was that the current makeup of at-large to NMFS seats is preferable because it allows for greater representation by academics and others not affiliated with management agencies. However, the SSC notes that there is some risk to the current set-up of four designated NMFS seats with other NMFS employees serving in an at-large capacity. If the Science Centers decide to reallocate resources, the SSC could be left short-handed unless the Council can more successfully recruit qualified non-NMFS SSC members.

10. Future Council Meeting Agenda and Workload Planning

The Scientific and Statistical Committee (SSC) discussed future workload planning and has the following updates to our April 2021 statement under this agenda item.

The SSC recommends a one day SSC Ecosystem Subcommittee meeting on September 8, 2021, to be devoted to the review of California Current Integrated Ecosystem Assessment (CCIEA) products, including threshold relationships between environmental drivers and performance of salmon preseason abundance forecasts, year class strength and distribution of small groundfish, krill-based indicators, and possibly additional review of port-level linkages between fisheries using network analysis. Review of the first item would benefit from the involvement of SSC Salmon Subcommittee (SSCSS) members, as well as interested Salmon Technical Team members.

Salmon Science Review

The SSCSS convened an online meeting on June 4, 2021, to discuss the SSC's role in reviewing salmon forecast methodologies and other analyses that inform Pacific Fishery Management Council (PFMC or Council) decisions. The primary goal of this meeting was to reduce confusion and ambiguity about the role of the SSC for reviewing salmon science.

During the meeting, the SSCSS reviewed the Pacific Coast Salmon Fishery Management Plan (FMP) and Council Operating Procedure (COP) 15 and highlighted areas where the SSC has a role in scientific review. The SSCSS report (attached) from the meeting identifies a number of specific cases where this role is unclear or where current practices may contradict what is written in the salmon FMP or COP 15. Much of the discussion involved ambiguity in the SSC's role to initiate a review of topics and how frequently particular models and reference points should be updated.

The SSC has three major requests of the Council that would help standardize the review process for science to inform salmon management.

1. Clarify the definition of "major stocks." COP 15 provides details on the process for conducting salmon methodology reviews and states that "forecasting methods for major PFMC stocks" is an issue that could merit a full review but does not define "major". The SSC proposes that the Council explicitly define which stocks are 'major".

2. Establish a database that describes the forecast methodology used for each "major" stock, when that method was adopted, and when it was last reviewed. Ideally the history of all forecast methods and reviews for each stock would be included. The performance of the forecast should be evaluated and reported on each year in Pre-1 and in the database.

3. Establish a process that outlines how and when reference points and conservation objectives are reviewed and updated as appropriate.

The first request can be implemented with feedback from the Council. The second and third requests could be implemented as salmon methodology review topics in 2021 and will relate to the Council's discussion of the Best Scientific Information Available.

SSC Notes:

Salmon

The SSC suggests that major stocks include, at minimum, salmon stocks for which the PFMC specifies ABCs (SRFC, KRFC, Willapa Bay natural coho), all Chinook and coho stocks considered a fishery target stock in Tables 1-1 and 1-2 of the FMP, and all stocks with harvest control rules.

The SSC repeatedly has discussions regarding what we need to review. Ultimately, we would like a document listing what the SSC needs to review and how reviews should be initiated.

COP says reference points should be endorsed by the SSC, but no protocol for review. We've discovered many cases of possibly out of date RPs and Conservation Objectives. How do we update these?

The compressed timeline for implementing annual salmon management measures means that it is important to have a good review of the process for developing forecasts and reference points. Recommendations 2 and 3 would develop procedures for ensuring annual specifications reflect

BSIA. There is concern that these methods may not be consistent with modern data, statistical methods, and biology.

The salmon calendar is compressed, but the SSC is still asked to endorse catch limits and make status determinations. If the SSC does not have sufficient time to review this information thoroughly, we need to have the ability to state this and have the opportunity to revisit later in the year when there is sufficient time for careful review. In short, we would like guidance on what's more important: sticking to schedule or having adequate review?

Proposed Workshops and SSC Subcommittee Meetings for 2021							
	Workshop/Meeting	**Potential Dates**	**Sponsor/ Tentative Location**	**SSC Reps.**	**Additional Reviewers**	**AB Reps.**	**Council Staff**
1	Groundfish STAR Panel 2 Lingcod	July 12-16	Council/Webinar	Field (Chair) White	2 CIE (Cieri, Dichmont)	Mattes Richter	Phillips DeVore
2	Groundfish STAR Panel 3 Vermilion & Sunset Rockfishes	July 26-30	Council/Webinar	Budrick (Chair)	2 CIE (Cieri, Medley), Hicks	Mandrup Richter	DeVore Phillips
3	SSC Groundfish Subcommittee Review of Assessments and Prioritizing Mop-up Tasks	August 17	Council/Webinar	Groundfish Subcommittee Members	NA	GMT Richter	DeVore
4	SSC Ecosystem Subcommittee	September 8	Council/ Spokane, WA	SSC Ecosystem & Salmon Subcommittee Members	CCIEA Team	EWG EAS	DeVore Dahl
5	Groundfish Mop-up STAR Panel, if needed	September 27-October 1	Council/TBD	TBD	2 CIE	GMT Richter	DeVore
6	Salmon Methodology Review	October TBD	Council/TBD	Salmon Subcommittee members	NA	STT MEW	Ehlke

7	CSNA STAR Panel	November 30 – December 3	Council/TBD	Punt (Chair), Hamel (tentative), & Other CPS Subcommittee Members TBD	2 CIE	CPSMT CPSAS	Griffin DeVore
8	Proposed Workshop for Conducting Nearshore ROV Surveys	TBD	Council/TBD	TBD	TBD	GMT GAP	DeVore
9	Post-mortem Review of the Groundfish Assessment Process	Fall/Winter 2021 After Assessment Cycle, TBD	Council/TBD	Groundfish Subcommittee Members	TBD	GMT Richter	DeVore
10	7th National Meeting of the Scientific Coordination Subcommittee of the Council Coordination Committee	2022 TBD	NPFMC/ TBD, AK	4 TBD	NA	NA	DeVore

SCIENTIFIC AND STATISTICAL COMMITTEE'S
SALMON SUBCOMMITTEE REPORT

Pacific Fishery Management Council
Via Webinar

June 4, 2021

The Scientific and Statistical Committee's Salmon Subcommittee (SSCSS) convened an online meeting on June 4, 2021 to discuss the Scientific and Statistical Committee's (SSC) role in reviewing salmon forecast methodologies and other analyses that inform the Pacific Fishery Management Council (PFMC or Council) decisions as specified in the Pacific Coast Salmon Fishery Management Plan (FMP) and Council Operating Procedure 15 (COP) 15. The primary goal of this meeting was to reduce confusion and ambiguity about the role of the SSC for reviewing salmon science. Four management categories are used for salmon stocks managed by the PFMC. The Magnuson-Stevens Act (MSA) applies to all however, each category has different requirements of the PFMC and SSC under the FMP. The four categories are 1) salmon stocks for which the PFMC has management authority, including setting the acceptable biological catch (ABC) and annual catch limit (ACL), via the MSA; 2) salmon stocks that are managed under the MSA but fall under an international treaty exception--primarily the Pacific Salmon Treaty (PST); 3) salmon stocks that are managed under the MSA but fall under the ESA exception; and 4) salmon stocks of exclusively hatchery origin. The SSCSS received presentations on each of these categories of stocks except stocks that are exclusively hatchery origin and followed up these presentations with a discussion of areas where the SSC has a clearly defined role in salmon science while noting areas where the role was ambiguous.

Dr. Will Satterthwaite (SWFSC) presented on salmon stocks for which the PFMC has management authority, including setting the ABC and ACL, via the MSA. The three primary stocks that fall under this category with specified ABCs are the Sacramento River Fall Chinook (SRFC), Klamath River Fall Chinook (KRFC), and Willapa Bay natural coho. Two of these stocks (SRFC and KRFC) are considered indicator stocks for stock complexes which contain additional stocks that are not actively managed, on the assumption that managing the indicator stocks suffices. There are a number of tasks specifically assigned to the SSC which include specification of the ABC and the ABC control rule, review of forecasts, review of reference points and conservation objectives, methodology reviews, and changes to stock complex composition. However, among these tasks there is often ambiguity in who initiates the review or changes and on what schedule. There is also ambiguity in the SSC's role reviewing annual values (e.g., year-specific forecasts or exploitation rates) versus the methods used to generate them. There is no specific SSC role spelled out in the FMP or COP 15 for annual status determinations or rebuilding plans, although the SSC is routinely asked to weigh in on both.

Dr. Galen Johnson (NWIFC) presented on salmon stocks managed under the MSA but falling under the PST exception. Stocks subject to the PST are those stocks that originate in the waters of one Party and are 1) subject to interception by the other Party, 2) affect the management of stocks of the other Party, or 3) affect biologically the stocks of the other Party. The SSC does not need to

specify ABCs or associated reference points for these stocks. The SSC is tasked with reviewing forecasts to determine if they represent the best scientific information available (BSIA), and can review forecast methodology changes, status determination criteria, conservation objectives, or harvest control rules through a similar review process as other stocks managed through the PFMC. However, there is considerable uncertainty who initiates these reviews and how to proceed if it was determined best scientific information available was not used. It was further noted that insufficient time is generally available to review these forecasts during the March PFMC meeting.

Dr. Ole Shelton (NWFSC) presented on salmon stocks that are managed under the MSA but fall under the ESA exception. The National Marine Fisheries Service (NMFS) conducts ESA consultations with respect to the effects of PFMC managed fisheries on listed salmon stocks to issue a jeopardy or no jeopardy ruling. Where the consultation results in a no jeopardy opinion, NMFS issues an incidental take statement that authorizes take of the listed species which would otherwise be prohibited. If the consultation results in a jeopardy opinion, NMFS develops reasonable and prudent alternatives to the proposed action which authorizes limited take. ESA consultations are a form of a fishery control rule that is deemed sufficient to meet the intention of the MSA overfishing provisions.

Following the three presentations, the SSCSS had a discussion of the SSC's role in reviewing salmon science. The SSCSS identified a number of specific cases where this role was unclear or where current practices may contradict what is written in the salmon FMP or COP 15. Specific cases we identified are summarized in the Table 1. The major topics discussed at the SSCSS meeting are summarized below.

<u>Major Ambiguities</u>
Much of the discussion involved ambiguity in the SSC's role to initiate a review of topics and how frequently particular models and outputs should be updated. There are cases described in the FMP where the SSC reviews certain items. However, it is unclear how these reviews should be initiated and by what entity.

Reference points and conservation objectives
Salmon FMP sections 3.1.7 and 3.2.2 state that modifications to reference points and conservation objectives may be made after a comprehensive technical review. It is not clear how such a review should be initiated. Further, it is not clear whether or how often reference points or conservation objectives should be periodically updated (or at least assessed for the need to update). For example, the Sacramento River Fall Chinook S_{MSY} reference point and conservation objective are based on a report published in 1984 that was based on data from the 1950's. Several Washington coastal stocks have conservation objectives derived from reports published in 1979 or 1984 (FMP Table 3-1).

Abundance forecasts
The SSC reviews abundance forecast methods and is tasked with reviewing annual abundance forecasts outputs provided to the Council for pre-season rulemaking. The abundance forecasts are used to calculate Acceptable Biological Catch for non-treaty, non-listed indicator stocks (Klamath River Fall Chinook, Sacramento River Fall Chinook, and Willapa Bay coho). It is unclear whether the SSC is implicitly endorsing forecast methods each year (without a review) when it endorses

forecast outputs. In these cases, it may be that the SSC is forced to conclude that the forecasts reflect the BSIA simply because no alternative information is available.

It is unclear whether and how the SSC should evaluate and address concerns about forecast methods when past forecast performance is unsatisfactory. Further, should the SSC propose forecast performance metrics that would trigger a review of the forecast methods if performance standards were not met? Could the SSC initiate a review in this case without a proposal for a change to the methods?

COP 15 provides details on the process for conducting salmon methodology reviews and states that "forecasting methods for major PFMC stocks" is an issue that could merit a full review. However, there is not definition of what constitutes a "major stock". Further, the COP 15 does not indicate whether methods should be reviewed annually, at some frequency, or only when changed. The relevant sentence in the COP 15 refers only to methods, not changes in methods, but elsewhere in the FMP and COP 15 it is implied that methods are only reviewed when changed or a change is proposed.

Frequency and initiation of reviews
The Council clearly has the authority to initiate review of abundance forecasts methods or reference points. There is ambiguity around whether the SSC on its own can initiate such a review. This has occurred in cases involving other FMPs. For example, the SSC updated sigmas for use in setting groundfish harvest limits without specific direction from the Council. In the salmon FMP, section 3.3.3 suggests that part of the SSC's role may be to initiate reviews of forecast methods and other elements of ABC specification on its own (p. 28): "The SSC will have an ongoing role in evaluating ABCs through their annual review of stock abundance forecasts and their prerogative to initiate re-evaluation of the ABC control rule. Abundance forecast methods are periodically revised and these revisions are evaluated by the SSC through the salmon methodology review process. The SSC could revisit the ABC control rule as needed during the salmon methodology review."

The utility of periodic review came up repeatedly, and there would seem to be great value in a structured process for periodically revisiting established reference points and methodologies to verify that recent performance of models has been acceptable and that old analyses are still robust in the face of new data and current accepted practices for analysis. Forecast models are perhaps the highest priority for periodic model assessment, but harvest models, economic models, the composition of stock complexes and identification of indicator stocks, and other management models would benefit from periodic assessment. Emerging scientific approaches like genetic stock identification (GSI) that have the potential to inform salmon management could warrant a review. Workload constraints mean that the approach to periodic review would need to be carefully structured, as reviewing all relevant analyses for all stocks every year is not feasible.

Escapement, rebuilding plans, and reference points
It was noted that the SSC generally does not review escapement estimation methods (though exceptions including a 1988 SSC review of Washington coho escapement estimates and a 2012 SSC comment made after the fact on changes in Sacramento River Fall Chinook escapement

methodology were noted), although escapement estimates are required for overfishing status determinations and to evaluate the performance of forecasts that the SSC is tasked with reviewing.

There is some ambiguity surrounding the SSC's role in development and review of rebuilding plans. The salmon FMP section 3.1.4 indicates that the Salmon Technical Team (STT) should develop and recommend rebuilding plans to the Council for overfished stocks. No role for the SSC is specified in the FMP or COP 15, but the SSC typically reviews the STT's rebuilding analysis prior to adoption of the plan by the Council. The most recent example of this is the rebuilding plans for SRFC, KRFC, and three coho stocks that were adopted in 2019. Further, MSA National Standard 1 states that "SSCs ... shall provide recommendations for achieving rebuilding targets".

The SSCSS also discussed the question of, how consistent does the process for reviewing salmon methods and reference points need to be with the process used to manage other FMP's? Could the SSCSS and STT draw lessons from scientific review process for CPS and groundfish? One aspect of salmon management that is very different from other FMP's is that many management activities are conducted by other entities (e.g., tribes, the Pacific Salmon Commission, and the states) or driven by other requirements (court decisions, ESA, Pacific Salmon Treaty). Therefore, it may not be possible to make salmon scientific review fully consistent with other FMP's. However, it is important for salmon management to meet requirements of BSIA. Since there is a great deal of information and exchange between the Council and other management agencies, SSC reviews should be done with the cooperation of all parties. Rigorous and timely review of Council products can help catch and prevent the perpetuation of mistakes.

Recommendations

1. Much of the ambiguity concerned the lack of a definition for "major" stock. The SSCSS suggests that 'major" stocks be defined as those salmon stocks for which the PFMC specifies ABCs (SRFC, KRFC, Willapa Bay natural coho), all Chinook and coho stocks considered a fishery target stock in Tables 1-1 and 1-2 of the FMP, and all stocks with harvest control rules.

2. Establish a database that describes the forecast methodology used for each "major" stock, when that method was adopted, and when it was last reviewed. Ideally the history of all forecast methods and reviews for each stock would be included. The performance of the forecast should be evaluated and reported on each year in Pre-1 and in the database.

3. A process should be established that outlines how and when reference points and conservation objectives are reviewed and updated as appropriate.

Table 1. Summary of SSC role as described in the FMP and COP 15, applicable stocks, and unresolved questions that need clarification.

SSC role is ambiguous and not specifically described by the FMP and COP 15	**Applicable stocks**	**Unresolved questions:**
Review of annual values (especially of preseason abundance forecasts, of escapement estimates, and of exploitation rates) versus underlying methodologies responsible for generating the annual estimates.	Potentially all stocks reported on in the Review of Ocean Fisheries and/or Preseason Report 1.	Some inconsistent language with respect to the SSC reviewing forecasts, forecast methods, or changes in forecast methods. Similarly, it is not clear how intensively the SSC is expected to review annual SAFE documents.
Development and review of rebuilding plans (nothing mentioned in FMP or COP 15, but SSC role in rebuilding analyses is described in MSA NS1).	Stocks newly declared overfished (so would exclude hatchery stocks and ESA stocks without MSSTs, could conceivably apply for any other stock in the future).	Should the SSC's role with respect to rebuilding be defined in the FMP and/or COP 15?

Review of escapement estimation methodology.	Any stock with an MSST that escapements are compared to, and potentially any stock forecast the SSC is expected to review. Additionally, some stocks like OCN use parent spawner abundance as an input to the harvest control rule.	Can the SSC endorse preseason abundance forecasts or the underlying forecast methods without endorsing the methods used to generate the postseason estimated abundances they are compared against to evaluate performance? Can the SSC endorse overfished designations without knowing how the escapement estimates driving the determinations are derived?
Review of "algorithm changes" in models developed and used external to the Council process, but also providing inputs to the Council process (e.g., PSC's CTC exploitation rate analysis models).	Chinook stocks where overfishing determinations are based on the output of CTC exploitation rate analyses	COP 15 implies all algorithm changes should be reviewed. Does this include algorithms in models that are developed and (presumably) reviewed outside of the Council process?
Extent of review expected for Preseason Report 1, given its length and very late availability to SSC.	Stocks reported on in Preseason Report 1.	The SSC often has only a few days (in 2021, zero full days) to review Preseason Report 1. How can it be expected to do anything more than a very superficial review unless this timeline is changed?

Analyses related to ESA listed stocks, e.g., MSEs and PVAs that the SSC has been asked to review in the past.	ESA-listed stocks.	Should the SSC's role with respect to listed stocks be defined in the FMP and/or COP 15?
Responsible party for developing stock-specific management approaches for listed ESUs within 5 years of listing (p. 38)	ESA-listed stocks.	There are ESUs listed over 5 years ago for which there is not stock-specific management. Who should be developing and/or reviewing the required approaches?
Where is the line between "algorithm changes" that require review and "data changes" that do not?	All stocks that models are applied to.	For example, would changing the covariates included in a multiple regression be a model change or a data change? Does it depend on whether there is a documented and reviewed approach for variable selection?
Economic analyses.		Which economic analyses is the SSC expected to review?
Assigned to the SSC, but there are questions regarding details or applicable stocks:	**Applicable Stocks:**	**Unresolved questions:**
Review changes to stock complexes, including identification of indicators and "in the fishery" versus EC stocks (p 5)	Any stock proposed for change in stock complex assignment.	Regular process for review? Who initiates periodic or unscheduled review?
Review new/changed reference points for status determination (p 18)	All stocks except[?] ESA-listed or purely hatchery stocks that lack SDC.	Who initiates? Process for regular updating?

Review new/changed conservation objectives (p 19)	All stocks. Natural stocks should go through methodology review process, hatchery stocks can be expedited. NMFS may dictate for ESA stocks.	Who initiates? Process for regular updating?
Endorse forecasts for ABC stocks (p 28)	Currently Klamath River Fall Chinook, Sacramento River Fall Chinook, Willapa Bay coho. ABCs could be designated for additional stocks in the future, as information becomes available for current non-indicators (p. 5, 18).	SSC role in reviewing annual values versus just the methods used? Role initiating review or changes in a particular year given concerns about past performance? Establish threshold of performance that would trigger review/consideration of alternative methods?
Review changes to reference points in control rules (p 37)	Stocks with control rules, not entirely clear if this would apply to all stocks with control rules or only a subset. Clearly applies to control rules for KRFC and SRFC (p. 31-32) since they are ABC stocks. Not clear if this applies to control rules for PST stocks (p. 32-34), Puget Sound coho (p. 33-34), OCN coho (p. 34-36) and/or Sacramento River Winter Chinook (control rule not described in FMP, but recently adopted).	Who can initiate proposed change? What is process for updating control rules? How would this apply for internationally-managed or listed stocks where the control rule is not the sole purview of the Council?

Review new model algorithms (COP 15)	Clearly applies to FRAM stocks (FRAM), KRFC (KOHM), SRFC (SHM), SRWC (WRHM), possibly anything with an MSE or PVA, possibly economic impact models, possibly much more.	Does this apply to models used/developed by PSC technical bodies?
Review forecasting methods for "major" stocks (COP 15)	Major stocks	Which stocks are "major", and are methods to be reviewed annually, at some frequency, or only when changed? The relevant sentence in the COP 15 refers only to methods, not changes in methods, but elsewhere in the FMP and COP 15 it is implied that methods are only reviewed when changed or a change is proposed. Role initiating review or changes in a particular year given concerns about past performance? Establish threshold of performance that would trigger review/consideration of alternative methods?

Review methods for incorporating base data into models (COP 15)	FRAM stocks, maybe more?	Is this referring to FRAM base period updates, and/or some broader selection of data used in models? What does "base data" mean?
Review experimental design of proposed experimental fisheries (COP 15)	Relevant stocks would depend on proposed fisheries	How do things like GSI sampling proposals fit in here?
Review procedures used to determine allowable harvest via methodology reviews (p 47)	Harvested stocks	"Procedures" seems like a broad catch all. Is this adding any tasks or review topics not identified more specifically elsewhere?
Assigned to the SSC, with applicable stocks clearly defined and no outstanding questions:	**Applicable stocks:**	
Specification of ABCs (p 28)	Currently Klamath River Fall Chinook, Sacramento River Fall Chinook, Willapa Bay coho. ABCs could be designated for additional stocks in the future, as information becomes available for current non-indicators (p. 5, 18).	
Initiate re-evaluation of ABC control rule as appropriate (p 28)	Currently Klamath River Fall Chinook, Sacramento River Fall Chinook, Willapa Bay coho. ABCs could be designated for additional stocks in the future, as information becomes available for current non-indicators (p. 5, 18).	

Review changes to models used to estimate bycatch (p 41)	Bycatch
Review methods used for estimating ocean abundance of OPI-area coho stocks (p 50)	OPI-area coho stocks
Review the Review of Ocean Fisheries report (p 71)	All stocks contained in Review of Ocean Fisheries

Tasks that are not the purview of the SSC
Allocation
Updating existing datasets in models
Changing CWT representation of modeled stocks
Adding new stocks to existing models
Changing data ranges used to estimate parameters in models

SSCSS Notes:

Language in the FMP says review of reference points and conservation objectives should be part of the methodology review process. How can it be determined whether something needs to be changed/updated without some routine evaluation of things like recent model performance or whether the analyses supporting specific reference points is BSIA?

If the management timeline is too short to allow for proper scientific review, is the appropriate response to lower the bar for BSIA or is the appropriate response to modify management such that it allows for good science? The SSC has not had adequate time to review Preseason I in recent years.

There is text in the FMP about developing active management for other stocks as information becomes available, and while this may be a lesser concern than stale reference points and conservation objectives for "major stocks", it is another case where the concern about who initiates reviews and what happens to stocks that just get forgotten about applies. Sufficient data for actively managing some of these stocks may already exist, and appropriate data streams might be developed for others. How actively should this be pursued? For example, Rogue Chinook rival and sometimes surpass KRFC in abundance, and Klamath River Spring Chinook is of some management interest.

The SSC discussed the OPIH forecast and raised concerns about recent performance, but the STT suggested review may not be needed since the methodology had not changed.
COP 15 states: "At the September meeting the SSC will inform the Council of the methodologies ready for review and recommend a review schedule". Although this is not the way recent methodology reviews have been planned, this could be read as saying the SSC has final say on the topics to review.

SSC Subcommittee Assignments, June 2021

Salmon	Groundfish	Coastal Pelagic Species	Highly Migratory Species	Economics	Ecosystem-Based Management
Alan Byrne	**John Budrick**	**André Punt**	**Michael Harte**	**Cameron Speir**	**Kristin Marshall**
John Budrick	Fabio Caltabellotta	John Budrick	Fabio Caltabellotta	Michael Harte	John Field
Owen Hamel	John Field	Alan Byrne	John Field	Dan Holland	Marisol Garcia-Reyes
Michael Harte	Melissa Haltuch	John Field	Marisol Garcia-Reyes	André Punt	Melissa Haltuch
Galen Johnson	Owen Hamel	Marisol Garcia-Reyes	Dan Holland		Michael Harte
Will Satterthwaite	Kristin Marshall	Owen Hamel	Kristin Marshall		Dan Holland
Jason Schaffler	André Punt	Will Satterthwaite	André Punt		Galen Johnson
Ole Shelton	Jason Schaffler	Tien-Shui Tsou			André Punt
Cameron Speir	Tien-Shui Tsou	Will White			Will Satterthwaite
Tien-Shui Tsou	Will White				Ole Shelton
					Cameron Speir

Bold denotes Subcommittee Chairperson

ADJOURN

PFMC
08/12/21