SCIENTIFIC AND STATISTICAL COMMITTEE REPORT ON
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 auotregressive 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 SB40 given the value for steepness. The current SPR50 percent 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 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 Point 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 Point Conception, California north of Pt. Conception, Oregon, and Washington, respectively. The SSC notes the stock size estimated south of Point 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

Data Source	Quillback Rockfish	Copper Rockfish North	Copper Rockfish South	Squarespot Rockfish
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		

PFMC
06/25/21

SCIENTIFIC AND STATISTICAL GROUNDFISH SUBCOMMITTEE REPORT ON ADOPT STOCK ASSESSMENTS

Subcommittee Members

Dr. John Budrick, California Department of Fish and Wildlife, San Carlos, CA
Dr. Fabio Caltabellotta, Oregon State University, Corvallis, OR
Dr. John Field, National Marine Fisheries Service Southwest Fisheries Science Center, Santa Cruz, 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. Kristin Marshall, National Marine Fisheries Service Northwest Fisheries Science Center, Seattle, WA, Co-chair for this meeting
Dr. André Punt, University of Washington, Seattle, WA, Co-chair for this meeting
Dr. Tien-Shui Tsou, Washington Department of Fish and Wildlife, Olympia, WA
Dr. Will White, Oregon State University, Corvallis, OR

Stock Assessment Teams

Dr. Aaron Berger; Dover Sole; National Marine Fisheries Service Northwest Fisheries Science Center, Seattle, WA
Dr. Jason Cope; Copper, Quillback, and Squarespot Rockfish; National Marine Fisheries Service Northwest Fisheries Science Center, Seattle, WA
Mr. Giancarlo Correa; Sablefish; Oregon State University, Corvallis, OR
Dr. Vladlena Gertseva; Spiny Dogfish and Sablefish; National Marine Fisheries Service Northwest Fisheries Science Center, Seattle, WA
Ms. Lisa Hillier; WA Quillback Rockfish; Washington Department of Fish and Wildlife, Olympia, WA
Ms. Kristen Hinton; WA Copper Rockfish; Washington Department of Fish and Wildlife, Montesano, WA
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Dr. Sean Matson; Spiny Dogfish; National Marine Fisheries Service Northwest Fisheries Science Center, Seattle, WA
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Dr. Chantel Wetzel; Copper Rockfish, Quillback Rockfish, Squarespot Rockfish, and Dover Sole; National Marine Fisheries Service Northwest Fisheries Science Center, Seattle, WA
Ms. Ali Whitman; OR Copper and Quillback Rockfish; Oregon Department of Fish and Wildlife, Newport, OR

Other Attendees

Ms. Kelly Ames, National Marine Fisheries Service West Coast Region, Portland, OR
Ms. Susan Chambers, West Coast Seafood Processors Association, GAP, Charleston, OR
Mr. John DeVore, Pacific Fishery Management Council, Portland, OR
Mr. Mark Fina, United States Seafoods, Seattle, WA
Ms. Gretchen Hanshew, National Marine Fisheries Service West Coast Region, GMT, Seattle, WA
Dr. Jim Hastie, National Marine Fisheries Service Northwest Fisheries Science Center, Seattle, WA
Mr. Christian Heath, Oregon Department of Fish and Wildlife, Newport, OR
Mr. Brian Hooper, National Marine Fisheries Service West Coast Region, Seattle, WA
Mr. Will Jasper, Makah Tribe, Neah Bay, WA
Ms. Keeley Kent, National Marine Fisheries Service West Coast Region, Seattle, WA
Mr. Kris Kleinschmidt, Pacific Fishery Management Council, Portland, OR
Lt. Eric Kord, California Department of Fish and Wildlife, San Diego, CA
Ms. Sandra Krause, Pacific Fishery Management Council, Portland, OR
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Ms. Lynn Mattes, Oregon Department of Fish and Wildlife, GMT, Newport, OR
Mr. Merit McCrea, Sportfishing Association of California, GAP, Santa Barbara, CA
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Mr. Brad Pettinger, Brookings, OR
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Ms. Maggie Sommers, Oregon Department of Fish and Wildlife, Newport, OR
Mr. Daniel Studt, National Marine Fisheries Service West Coast Region, GMT, Long Beach, CA
Mr. Dan Waldeck, Pacific Whiting Conservation Cooperative, GAP, Portland, OR
Ms. Marci Yaremko, California Department of Fish and Wildlife, San Diego, CA
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

Data Source	Quillback Rockfish	Copper Rockfish North	Copper Rockfish South	Squarespot Rockfish
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		

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