Report of the Pre-Assessment Workshop for a Full Assessment of Petrale Sole and Data-Moderate Assessments of Shortspine Thornyhead and Rex Sole in 2023

Pacific Fishery Management Council
Online Meeting

March 20, 2023

Introduction

A pre-assessment workshop for 2023 groundfish stock assessments of petrale sole, shortspine thornyhead and rex sole was held virtually on March 20, 2023 (https://www.pcouncil.org/events/pre-assessment-workshop-for-shortspine-thornyhead-rex-sole-and-petrale-sole-to-be-held-online-march-20-2023/). The purpose of this workshop was to review proposed data inputs, modeling approaches, and any other pertinent information to inform the upcoming stock assessments with a goal of promoting dialogue between the stock assessment team (STAT) and data providers. The Pacific Fishery Management Council's (PFMC) Scientific and Statistical Committee (SSC) Groundfish Subcommittee members serving as stock assessment review (STAR) Panel Chairs were Dr. Jason Schaffler for shortspine thornyhead and rex sole (STAR Panel 1) and Dr. John Field for petrale sole (STAR Panel 3). Appendix 1 notes SSC Groundfish Subcommittee members and STAT team members who participated.

The 2023 length-based data-moderate shortspine thornyhead and rex sole stock assessments will be conducted through the Applied Stock Assessment course (University of Washington FISH 576-577) taught by Drs. Vladlena Gertseva, Melissa Haltuch, Owen Hamel, and Kiva Oken. Madison Heller-Shipley, Joshua Zahner, Haley Oleynik, Jane Sullivan, Emily Sellinger, Markus Min, Terrance Wang, Sabrina Beyer, Adam Hayes, Alberto Rovellini, Ingrid Spies, Matthieu Veron, Kun Wang, Pierre-Yves Hernvann, Andrea Odell, and Sophia Wassermann are class members that will conduct the assessments.

Shortspine Thornyhead

Shortspine thornyhead range from Alaska to Mexico and were historically caught alongside Dover sole and sablefish. Juveniles typically settle at 100-400 m depth. Adults show ontogenetic movement to greater depths and may live up to 100 years. Shortspine thornyhead are managed as a single stock off the U.S. West Coast. The last assessment occurred in 2013 and indicated the stock was healthy as biomass was well above management targets. That assessment identified three areas for additional research and data needs that included: 1) additional research into aging methods and maturity, 2) a comprehensive catch reconstruction prior to 1981, and 3) an exploration of simpler assessment methods.

The shortspine thornyhead assessment is considered data-moderate, and the proposed modeling approach for 2023 will start with the same model structure as the 2013 assessment, which included four fleets. Those fleets are two trawl fleets that are stratified into a northern (Oregon and Washington) and southern (California) fleet and two 'other' (non-trawl) fleets that are geographically stratified. The non-trawl fleets are primarily composed of fixed gear commercial landings. Overall, approximately 75% of catch occurs in the trawl fishery with a fixed gear (hook and line) fishery that accounts for the remainder. Combining the southern and northern 'other' fleets will be explored to further reduce model complexity due to their limited landings.

Historical catch reconstructions from California, Oregon, and Washington will be included in the 2023 stock assessment along with contemporary catch from the Pacific Fisheries Information Network (PacFIN) database. These new catch reconstructions are a better representation of catch than an assumption of a fixed percentage of sablefish catch used in the 2013 assessment. Unidentified thornyheads were partitioned into longspine and shortspine based on state and gear-specific identified proportions. Unidentified thornyheads made up a small proportion of the catch in California and Oregon.

Discard rates are available from three primary sources: 1) West Coast Groundfish Observer Program (WCGOP), 2) Enhanced Data Collection Project (EDCP), and 3) Pikitch et al. (1988). Discard rates are available for each fleet from the WCGOP data from 2002-2021. Pikitch et al. (1988) and EDCP provide historic estimates of discard rates from the 1980s and 1990s. Overall discards are much smaller than landed catch and for trawl gear generally decrease over time except for the most recent years. The STAT team should follow up with Brad Pettinger about potential causes for recent trends, which could include the higher value of plate-sized individuals and possible market influences due to COVID-19 disruptions.

Four fishery independent surveys will be included. These include 1) the Alaska Fisheries Science Center Triennial Shelf Survey from 1980-2004, 2) the Alaska Fisheries Science Center Slope Survey from 1997-2001, 3) the Northwest Fisheries Science Center Slope Survey from 1998-2002, and 4) the West Coast Groundfish Bottom Trawl Survey (WCGBTS) from 2003-2022. The Triennial Survey is expected to be combined into a single abundance index which differs from the 2013 assessment. Multiple geostatistical error structures (delta-gamma and delta-lognormal) will be investigated for the WCGBTS. Additional exploration removing the AFSC and NWFSC slope surveys will also be conducted.

Fishery lengths compositions are available from the WCGOP, Pikitch et al. (1988), and the PacFIN database from 1977-2022 for males, females, and unsexed individuals. Discard length compositions are available from Pikitch et al. (1988) and WCGOP. Discarded individuals in the trawl fishery are smaller than retained individuals. Discarded individuals in the non-trawl fishery are larger than those in the trawl fishery but there is more uncertainty. Fishery independent surveys have similar length compositions and are similar to lengths from the fishery.

There is no validated ageing method for shortspine thornyhead. One of the research and data needs from the 2013 assessment was for additional aging work. Subsequent to that recommendation, multiple age reads were undertaken but variance was greater than desirable. Butler et al. (1995) and Kline (1996) examined growth and results differ somewhat but it is not known what those differences are attributable to. For the 2023 assessment, the STAT is proposing to use Butler et al. (1995) to produce sex-specific growth curves, which differs from the 2013 assessment approach. Further, the STAT is proposing to perform sensitivity analyses using 25% and -10% on lengths instead of the +/- 10% approach used for the 2013 assessment. The current upper bound approach will account for the larger size-at-age seen in Kline (1996).

Length-at-maturity was based on Pearson and Gunderson (2003) for the 2005 and 2013 assessments and that approach produced an almost knife edge transition from immature to mature. During the 2011-2012 WCGBTS, histological data were collected and analyzed by Melissa Head (NOAA). Preliminary results suggested the length at 50% maturity was much larger and length at 100% maturity is not attained until over 60 cm. The 2023 assessment will use updated maturity-at-length information provided by Melissa Head (NOAA) from the WCGBTS and from port samples collected by the Oregon Department of Fish and Wildlife and Washington Department of Fish and Wildlife. For the 2013 assessment, fecundity was

assumed to be proportional to biomass. For the 2023 assessment, the STAT is proposing to use fecundity-at-length information available from Cooper et al. (2005). This will account for greater relative fecundity of larger females. The STAT is proposing to fix M at 0.054 for the 2023 assessment which is based on maximum age of 100 years. However, the STAT will explore estimating M in the model. This approach is similar to previous assessments where M was fixed at 0.05 (2005) or 0.0505 (2013). A bridging analysis from Stock Synthesis v3.24.0 (2013 assessment) to v3.30.21 (2023 assessment) indicates no difference due to version changes.

Rex Sole

Rex sole is a medium sized (up to 61 cm) and moderately long lived (up to 29 years) flatfish that is distributed from Mexico to Alaska. Rex sole is commonly found to 500 m, and infrequently encountered as deep as 1,100 m. The last stock assessment was conducted in 2013 and was a data-moderate assessment using only removals and abundance indices which indicated the stock was at 80% of the estimated unfished biomass. The 2023 stock assessment is proposed to be a length-based data-moderate assessment.

A historical catch reconstruction for California is available beginning in 1916, catches used in the 2013 assessment will be updated through 2022. Oregon commercial landings begin in 1929 and have been updated from the 2013 assessment. Washington commercial landings were not included in the 2013 assessment and will be used in the 2023 assessment with the data beginning in 1948. Over 98% of landings come from trawl catches and recreational landings are negligible. While the previous assessment used one coastwide fleet, this assessment may model a California fleet and a combined Oregon and Washington fleet separately due to differences in catch histories and length compositions. Sensitivity of model outputs to the two fleet structures (i.e. coastwide versus split) will be explored during model fitting.

In the commercial landings, 97% of length data is sexed. Males have smaller median lengths than females. For rex sole, length increases from south to north. This pattern is evident between California and Oregon/Washington as well as in Alaska.

Discards were added to landings in the 2013 assessment but will be separated from landings in the 2023 assessment. This different treatment is because discarded rex sole are smaller than retained individuals and up to 30% of the catch is discarded. Discard data (rates and length compositions) comes from the WCGOP for 2002-2021 and Pikitch et al. (1988) from 1986-1988. Discarded individuals are smaller than retained fish and splitting discards from landings may improve model estimates of fishery selectivity.

Model-based fishery independent indices from the WCGBTS and Triennial survey will be included in the assessment. Additional indices from the AFSC and NWFSC slope surveys will be considered. Length data is available for all years from the WCGBTS and Triennial surveys, and for 2001 from the NWFSC slope survey. The length data is almost 100% sexed.

A growth curve for both sexes combined was used in the 2013 assessment and was based on data from the Gulf of Alaska. For the 2023 assessment, sex-specific growth curves developed from WCGBTS data will be included because U.S. West Coast fish are smaller at age or have a lower L_∞ than Alaska fish and exhibit dimorphic growth. The maturity schedule will be changed from one based on Alaska fish to one based on Oregon fish from 1969-1973 (Hosie and Horton 1977). This reduced the length at 50%

maturity from 35 cm in the 2013 assessment to 24 cm for the 2023 assessment. Fecundity was assumed proportional to biomass in the 2013 assessment, but may be updated with data from Hosie and Horton (1977) to a hyper-allometric relationship, which is similar to other U.S. West Coast flatfish. Natural mortality in this assessment will either be fixed or estimated within the model using a longevity-based prior as suggested by Hamel and Cope (2022); the median value of M in this prior is 0.186 based on a maximum age of 29 years.

The 2013 assessment used Stock Synthesis v3.24 and the 2023 assessment will use v3.30.21. Bridging analysis indicates complete overlap which was due to the large number of fixed parameters and simple structure. The STAT should speak with Dr. Chantel Wetzel about additional bridging analyses and examples from recent assessments.

Petrale Sole

Drs. Ian Taylor and Vladlena Gertseva briefed the meeting on data availability and model structure plans for the upcoming petrale sole stock assessment (available at https://www.pcouncil.org/documents/2023/03/petrale-sole-workshop-presentation-march-20-2023.pdf/). They began by noting that petrale sole is a highly desirable, high attainment stock with a long exploitation history. The stock was estimated to be well below target level from the 1960s through the 20th century. The stock was declared overfished in 2009, but declared rebuilt following a pulse of strong recruitment estimated in a 2015 assessment update. At the time the stock was declared overfished the PFMC acting on advice from the SSC, implemented a change in reference points for petrale sole and other flatfishes to reflect their generally greater productivity and compensatory dynamics. The petrale sole assessment was updated again in 2019, but the 2023 assessment will be the first full benchmark assessment since 2013.

Landings data extend to at least 1900 in California waters, and fisheries extended north to Oregon and Washington waters during the 1930s. By the 1940s landings were comparable to contemporary levels and concerns about stock depletion had been raised as early as the 1950s, when fisheries developed for petrale sole on their winter spawning grounds. Due to concerns about different selectivity patterns on winter spawning grounds relative to the more widespread distribution of petrale sole on the continental shelf from late spring through early fall, the 1999 assessment and subsequent benchmark and updates split the fisheries into summer and winter fisheries, with regional (California vs Oregon/Washington) fleets to account for different catch histories and selectivity patterns. Discards are estimated to have been low for all fisheries. The initial catch reconstruction for historical catches in California did not include fish caught in Oregon and Washington waters and landed in California. However, this was corrected in the 2019 model and will be carried forward. In addition, there are revisions to the Washington historical catch history relative to earlier models.

Survey data from the West Coast Groundfish Bottom Trawl Survey (WCGBTS) will be used in the model, as will data from the AFSC triennial shelf survey. Data from the NWFSC and AFSC slope surveys will not be used due to the short duration of the time series and inconsistent spatial coverage. Plus, slope surveys have very little petrale sole catch, as they ran deeper than most petrale sole occur. Abundance indices from the surveys will be developed using sdmTMB. The STAT noted that the WCGBTS survey index has very large uncertainty in 2021 as a result of a very large haul off of Northern California (the largest catch of petrale sole in the survey time series). Interestingly, the STAT

also noted that the second largest petrale sole haul in the WCGBTS time series took place on the same date and in the same region in 2014. The STAT shared their intent to use a single time series for the triennial trawl survey rather than two separate indices (1980-1992, 1995-2004, to reflect changes in depth distribution and seasonality of the survey). The STAT will explore offsets on catchability and selectivity that could be associated with these shifts in the triennial survey. Both surveys include robust length and age composition data. The model will include updated natural mortality priors, updated maturity and fecundity data and will estimate growth internally in the model.

The STAT intends to explore and likely implement four significant changes to the model structure, to minimize the number of parameters used (there were 304 estimated parameters in the 2019 update), reduce data conflicts, achieve a more parsimonious model and reduce model run times.

The first major change the STAT plans to explore is dropping the fishery dependent catch per unit effort (CPUE) index, which has been used in some form since the 1999 assessment. The STAT (and previous assessments) noted that CPUE increased significantly in 2004 during the time of the groundfish fishery vessel buyback, leading to concerns about the representativeness of pre- versus post-buyback fishing behavior. There are also concerns regarding the use of the index as it appears to be nonlinearly related to abundance, presumably due to the hyperstability of catch rates when fishing on spawning grounds. Finally, it was also noted that removing the index resulted in no substantive change to the model result. The meeting discussed the merits of showing the sensitivity of the 2019 model to some of these changes, or to bridge the 2019 model to the upcoming model and then show change in model results. There was general agreement that removing the index was reasonable, recognizing that exploration of the sensitivity of the model to this change would be beneficial.

The second major change proposed by the STAT is to remove the seasonal structure of the fishing fleets, rather than continue to have separate winter and summer landings histories, compositional data and CPUE index (for the winter fishery). The STAT has explored mirroring selectivity curves in the 2019 model, and their results suggest only modest differences in selectivity patterns and no substantive changes in the overall model result. The STAT noted that the benefits would include requiring 22 fewer selectivity parameters, and a much smaller number of length and age composition vectors. The STAT plans to further explore this change prior to the review panel, recognizing that the rationale for these differences was the presence of generally larger, older fish in the winter fishery (which generally takes place in deeper water), and may reserve the capacity to maintain some seasonal structure if the results of the seasonal and annual models differ significantly. The meeting discussed whether the differences in size could reflect within year differences in growth, the STAT reported that this was explored but that the impact of seasonal growth was negligible. The meeting also discussed that this has been the only U.S. west coast groundfish model with seasonal structure.

The third major change proposed by the STAT is related to the observation that there are often more males than females in small age and size bins, such that modeling sex-specific selectivity has been necessary in previous assessments to fit length composition data. In light of the recognition that other species of flatfish have environmentally driven sex determination, the STAT proposes to utilize options within stock synthesis that allow the model to estimate the sex ratio of new recruits.

The fourth prospective major change is related to the potential to incorporate an environmentally driven recruitment index in the model, based on earlier work (published 2019) by Melissa Haltuch and coauthors regarding oceanographic drivers of petrale sole recruitment in the California Current

ecosystem. In their analysis, a suite of environmental indicators derived from a Regional Ocean Modeling System (ROMS) model explained 73% of the observed recruitment variation estimated within the stock assessment. There is hope by the STAT that assessment forecasts could be much better informed with the use of such an index, although the authors recognize that the ROMS tool used for this analysis was a hindcast rather than a forecast.

Other topics discussed by the STAT and the workshop included efforts by Canadian fisheries biologists to develop an assessment for petrale sole in 2023, the first in Canadian waters since 2009. As it has long been recognized that petrale sole is a transboundary stock, the STAT has been discussing a suite of collaborations with the Canadian team, to include comparison of index trends, population demographic structure, and potentially the exploration of sharing data among the two models. There was general agreement that this was a promising development, and that the other plans and efforts were reasonable and likely to improve the overall assessment model.

References

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Appendix 1.

SSC Groundfish Subcommittee Members Present

Dr. John Budrick, (SSC Groundfish Subcommittee Chair; STAR Panel 2 Chair), California Department of Fish and Wildlife, San Carlos, CA
Dr. John Field (STAR Panel 3 Chair), National Marine Fisheries Service Southwest Fisheries Science Center, Santa Cruz, CA
Dr. Chris Free, University of California Santa Barbara, Santa Barbara, CA
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
Dr. Jason Schaffler (SSC Vice-Chair; STAR Panel 1 Chair), Muckleshoot Indian Tribe, Auburn, WA
Dr. Tien-Shui Tsou, Washington Department of Fish and Wildlife, Olympia, WA

Stock Assessment Team Members Present

Dr. Vlada Gertseva, National Marine Fisheries Service Northwest Fisheries Science Center, Seattle, WA
Dr. Melissa Haltuch, National Marine Fisheries Service Alaska Fisheries Science Center, Seattle, WA
Dr. Owen Hamel, National Marine Fisheries Service Northwest Fisheries Science Center, Seattle, WA
Dr. Kiva L. Oken, National Marine Fisheries Service Northwest Fisheries Science Center, Seattle, WA
Dr. Ian Taylor, National Marine Fisheries Service Northwest Fisheries Science Center, Seattle, WA

Applied Stock Assessment course (University of Washington FISH 576-577):
Madison Heller-Shipley, Joshua Zahner, Haley Oleynik, Jane Sullivan, Emily Sellinger, Markus Min, Terrance Wang, Sabrina Beyer, Adam Hayes, Alberto Rovellini, Ingrid Spies, Matthieu Veron, Kun Wang, Pierre-Yves Hernvann, Andrea Odell, and Sophia Wassermann

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