# Stock Assessment and Stock Definition Considerations for Selection of Species and Areas for Assessment in 2023

## Overview

The process of selecting species for assessment in 2023 is scheduled to be finalized at the September 2022 Pacific Fishery Management Council (Council) meeting. At the June 2022 meeting, the Council requested additional information regarding the intersection of areas and species selected for assessment and the stock definition agenda item to inform decision making. The species under consideration for assessment in 2023 are: black rockfish, copper rockfish (all or subset of West Coast areas), canary rockfish, petrale sole, rex sole, and shortspine thornyhead. Two of these species, black and copper rockfishes, have historically been assessed as multiple assessment areas off the West Coast (e.g., black rockfish in 2015 was assessed as three areas aligning with the state borders). All remaining species under consideration have been previously assessed as coastwide stocks (i.e., noting that canary rockfish was last assessed as a coastwide stock with three separate state areas within the model).

At the outset of the stock definition discussion, it is important to identify three different, though related, species 'area' concepts. The one most immediately related to Stock Definition can be referred to as a 'stock status area': a region in which notable differences in genetics or other biological processes, exploitation history, and/or stock status and population trends are differentiated from the species' presence/characteristics in other regions. Another aspect of regionalization for species involves 'assessment areas'. In addition to factors that might lead to separation of an area, for purposes of determining stock status, other factors such as data availability and consistency play important roles in the establishment of assessment area boundaries. Finally, there are 'management areas'. These areas frequently align with one or both of the others, but it is not necessary that they do so. In some cases, for example, differential management of a species within sub-areas of an assessment or stock area might be warranted by differing amounts of potential fishing effort.

One of the objectives of the stock definition process is to define stock status areas for all species within the groundfish Fishery Management Plan (FMP), with initial focus on the species of most immediate need. The stock status areas are geographic regions across which a stock's status will be determined; stock status areas may be coastwide or cover smaller areas along the coast. Future stock assessments will need to consider the selected stock status areas in order to ensure they are able to report stock status in a manner that aligns with the stock status areas. This is of particular importance for species that are selected to have multiple stock status areas along the

West Coast. The choice of stock status boundaries may constrain assessment modeling choices in ways that restrict the use of available data. The stock definition process is scheduled to run across multiple Council meetings, with final decision making occurring near the conclusion of 2023 assessment cycle occurring next summer. Hence, it is critical that the Council provide an early indication of the likely stock status areas to be selected for species assessed in 2023, particularly for those that may have multiple stock status areas along the coast, to ensure that assessment science conducted over the next ten months aligns with the future reporting and management needs.

The ability of the Council to provide an early indication of preferred stock status areas/boundaries is particularly important for copper rockfish. At the June Council meeting, during the stock assessment agenda item, there was considerable discussion about the potential implications of selecting only a portion of the stock off the West Coast for assessment and how that decision would affect options for selecting stock status areas during the stock definition process. A detailed discussion of interconnections between options for copper rockfish stock definition 2023 assessments is provided below, for Council consideration, with additional related information provided in Agenda Item G.7, Attachment 1, September 2022. If the Council is unable to confidently indicate a preferred direction for copper rockfish stock boundaries by November, then it will need to be prepared to also revisit assessment planning for 2023 at its November meeting. It is essential that assessment authors understand by November how stock boundaries will be defined for the species they are assessing in 2023.

As a final general comment, we note that nearly all prior full assessments for nearshore species have included an assessment boundary at 42° N. Lat., the border between Oregon and California. When considering an alternative stock boundary in that vicinity, such as 40°10′ N. Lat., the Council should realize that it is impossible to fully predict the degree to which shifting assessment boundaries from the former to the latter might adversely impact data availability/consistency or model performance. We do believe that reasonable justifications—usually data-related—have been espoused within those assessments for selecting 42° N. Lat. as a dividing line between assessment areas off Oregon and California.

**Considerations for Copper Rockfish**

In 2021, copper rockfish off the West Coast was assessed as four areas using available catch, select fishery-independent indices of abundance, and length data (i.e., only one modeled area included an index of abundance). Based on the assessment results, particularly for the assessment area south of Point Conception in California, copper rockfish is being considered for full assessment(s) (i.e., benchmark assessments) in 2023 which will allow all available data to be considered for use in the assessment. At the June Council meeting, several assessment areas and assessment options were discussed: full assessment of copper rockfish coastwide which would likely be conducted as multiple area-based models (i.e., 1-2 California areas, Oregon, and Washington), full assessment of copper rockfish in only selected areas (i.e., California) with no re-evaluation of other areas off the coast, and a combination of both full, update, or data-moderate assessments for all areas. The

tentative assessment plan adopted by the Council in June called for two full assessments off California, and none to the north in 2023.

Table 1 includes the three simplest options for defining one or two stock areas for copper rockfish. These include the status quo, with one area for the entire coast, and two other two-area options, with dividing boundaries at either 42° N. Lat. (one of the boundaries between 2021 assessment areas) or 40°10′ N. Lat. The tentative assessment plan adopted by the Council in June called for two full assessments off California, and none to the north in 2023. Moving forward with this plan would be most easily facilitated by plans to implement two stock areas for copper rockfish, divided at 42° N. Lat. A Council preference for alternative stock definitions would likely necessitate additional copper assessment modeling in 2023, and that would have implications for stock assessment planning that are discussed in greater detail in Agenda Item G.7, Attachment 1, September 2022. The main message provided in Table 1 is that there are linkages between Council direction on stock boundaries for copper rockfish, the number (and possibly type) of copper rockfish assessments that will be needed in 2023, and in turn, the amount of assessment capacity that will be available to address other species in the list adopted by the Council in June.

**Table 1. Alternative assessment options for copper rockfish for the south and north model areas depending upon the selection of a stock boundary. The south model area is defined as either all of California or California south of 40°10′ N. Lat. The north assessment areas include either Oregon (OR), Washington (WA), or California north of 40°10′ N. Lat. with Oregon (OR + N.CA) and length-based data-moderate (LB-DM) or full assessments options.**

| Stock-Status Area | Copper Rockfish Assessment Options | | Comments |
| --- | --- | --- | --- |
| | South | North | |
| Coastwide | New Full Assessments Covering California | 1) Use 2021 LB-DMs for OR, WA | Maximum flexibility for structuring 2023 assessments. Potential to adversely impact harvest options coastwide if the coastwide stock status is below MSST[2]. Will require dropping one to two species from the proposed list if coastwide full assessments are selected. |
| | | 2) Update 2021 LB-DMs for OR, WA | |
| | | 3) New Full Assessments for OR, WA | |
| North and South 42° N. Lat. | New Full Assessments Covering California | 1) Use 2021 LB-DMs for OR, WA | Capacity to conduct assessments for all proposed species. All CCFRP[1] stations and California recreational catch-per-unit-effort used in California assessments. |
| | | 2) Update 2021 LB-DMs for OR, WA | |
| North and South 40° 10' N. Lat. | New Full Assessments Covering California South of 40° 10' N. Lat. | 1) New LB-DMs for OR+N.CA, WA | New model and data structure and the two northern-most CCFRP[1] stations would likely not be used and potentially no fishery CPUE in the N.CA+OR model. Will required dropping one species from the proposed list. |
| | | 2) New LB-DM for OR+N.CA only | |

[1] California Cooperative Fisheries Research Program

[2] Minimum stock size threshold

In keeping with SSC recommendations, one or more assessments have historically covered the entire West Coast range of a species within the same assessment cycle. This approach has allowed for the ability to quantify stock status at scales ranging from assessment areas to the entire coast, at a consistent point in time. However, comprehensive spatial coverage has not always been achieved through use of full assessments throughout the range. Additionally, a motivation for considering not doing so for copper in 2023 was the perception of a greater need for new, full assessments off California combined with a desire to develop new assessments for species that will have gone without for 10 years.

Assuming two full assessments off California, Council preference for a coastwide copper rockfish stock status area would require some additional information from the north, in order to quantify coastwide status in 2023. This could be provided by new full assessments or updated LB-DM assessments, or reliance on status estimate for Oregon and Washington based on the 2021 LB-DM assessments, for one or both states. In order to provide resources for other assessments, this option might be acceptable, based on the low historical and current proportions of coastwide abundance off Oregon and Washington.

Planning to conduct full assessments for copper rockfish coastwide would provide maximum flexibility to accommodate the range of possible stock definition options. However, this option is also the most labor and time intensive option and would, based on our evaluation in Agenda Item G.7, Attachment 1, September 2022 require two species to be dropped from assessment consideration for 2023 (i.e., likely rex sole and shortspine thornyhead), and would reduce age reading time for petrale sole and canary rockfish by 6 weeks (potentially 24 reader-weeks). Additionally, the available data not considered in the 2021 assessments, that could be added with full assessments in 2023, may be limited for some areas off the northern coast, or could involve data series not previously used in any assessments. If copper rockfish is selected for full assessments coastwide and if there is a high likelihood of selecting multiple stock status areas off the coast, these areas will need to be identified by the November Council meeting in order to ensure the assessments are constructed to align with stock status areas. Limiting copper assessments in the north to one or two LB-DMs would preserve opportunities to assess shortspine thornyhead, but not rex sole.

The second set of stock-boundary and assessment options presented in Table 1 reflect two stock status areas divided at 42° N. Lat. This option would allow status for the northern area to be derived from the 2021 LB-DM assessments, with status to the south calculated from summing results from the new full assessments. This permutation—with a stock boundary at 42° N. Lat. and no new copper rockfish assessments in the north—provides the only path to conducting the full slate of 2023 assessments that was tentatively adopted at the June Council meeting. This option provides the ability to do full assessments in areas of greatest concern, where more data could be added to the prior California LB-DM assessments, and best aligns anticipated assessment workload and assessment capacity to provide new science for species with old assessments. If having a common

year (2023) for all copper rockfish status determinations were a priority, the 2021 LB-DMs for the northern states could be updated, at the cost of assessing rex sole in 2023.

The last set of options presented in Table 1 reflect two stock status areas divided at 40°10′ N. Lat. Because this stock boundary would not align with the 2021 assessment areas, a new LB-DM modeling of Oregon plus California north of 40°10′ N. Lat. would be needed. This would need to be accompanied by an update of the 2021 LB-DM for Washington, or an agreement to use a status estimate for Washington based on last year's model.

## Considerations for Black Rockfish

Black rockfish is an additional species that is likely to have multiple assessment areas across the West Coast. The species was last assessed in 2015, where the modeled areas aligned with state borders (i.e., separate California, Oregon, and Washington models). Similar to copper rockfish, the Council will need to identify the likely selection of stock status areas within the stock definition process by November 2022 in order to ensure assessments are constructed in a manner that will provide management advice aligning with the stock status areas. It is important to note that individual areas modeled in the assessment do not need to cover the entire stock status area since results from one or more assessment models can be combined to provide a summed stock status for the whole stock status area. For example, if two stock status areas were selected for black rockfish—e.g., a California area and an Oregon/Washington area—while the assessment areas were the same as those used in 2015, the resulting assessments would be able to provide stock status estimates that align with the stock status areas through combining results from the separate Oregon and Washington models. However, if a later decision were made to split the stock status areas at 40°10′ N. Lat., no combination of the assessed areas would exactly cover either of the stock status areas. If the Council's preferred direction for a stock boundary were to change after November from 42° N. Lat. to 40°10′ N. Lat., it would be very challenging for the assessment team to reconfigure data and models in time for a summer 2023 review. Unlike in the copper rockfish situation or the scenario described above, Council preference for a stock boundary somewhere other than at 42° N. Lat. for black rockfish, would have minimal consequences for the overall stock assessment plan for 2023, as a coastwide suite of assessments is already envisioned.

## General Considerations for All Other Species

Historically, the management of species within complexes has most commonly been split north and south of 40°10′ N. Lat. Although, as noted above, most assessments for nearshore species have included model separation at 42° N. Lat. The stock definition agenda item provides the opportunity to reevaluate whether the existing split between management regions aligns with the needs for stock status (and assessment) areas across nearshore, shelf, and slope species included in the FMP. Two factors that should be considered during this process are the connectivity of fish populations across the West Coast and whether current fishery dynamics (i.e., commercial or recreational) are being driven at regional, state, or coastwide scales. Considering and accounting for the

intersectionality of stock status areas that ensure sustainable fisheries, current and projected future fishery dynamics, and ease of management across groundfish species will be critical for success.

Nearshore species have nearly always been assessed at a regional scale, resulting in multiple assessment areas across the West Coast. This approach has been driven by several factors. First, nearshore species can commonly be associated with specific habitat structure, with limited juvenile or adult movement across larger, open spatial areas, resulting in a gradient of connectivity across regions with potential little-to-no connectivity between the southern and northern range of the coast. Secondly, given the potential for low stock connectivity in nearshore species, differences in regional exploitation and management actions can result in distinct regional stock dynamics, and differences in growth rates are not uncommon across large coastal distances. Finally, available data sources, particularly data sources across limited areas of the coast (e.g., Northwest Fisheries Science Center Hook and Line survey), and the ability to split data between potential assessment areas is carefully considered when selecting assessment areas.

In the absence of perfect information (i.e., detailed genetic and connectivity data across spatial and temporal scales), a number of recent nearshore assessments have opted for assessment areas that align with state boundaries between California/Oregon and Oregon/Washington. These decisions are often heavily influenced by the historical exploitation by state (or regions within a state), management actions which can vary by state (or regionally within a state), and the ability to confidently split existing data sources. Additionally, particularly for nearshore species, there are often existing or nascent state-specific data sources (e.g., state-specific fisheries catch-per-unit effort, Oregon Remote Operated Vehicle, California Remote Operated Vehicle, California Collaborative Fisheries Research Program surveys) that would not be available for use if the assessment area did not cover all/most of the data collection range or included additional neighboring state areas where those data were not available. Selecting stock status areas, for appropriate nearshore species, that correspond with state boundaries (e.g., 42° N. Lat.) would align management needs, available data sources, and with how these species are commonly being assessed.

The considerations between state boundaries (e.g., 42° N. Lat.) and 40°10′ N. Lat. (and other potential break points) for the determination of stock status areas will vary across nearshore, shelf, and slope species. There are several factors that should be considered. First, there are two deeper shelf species, lingcod and yellowtail rockfish, where clear genetic differences have been demonstrated north and south of areas of overlap covering several degrees of latitude that encompass 40°10′ N. Lat. Those conducting recent assessments for each of these species opted to split north and south of 40°10′ N. Lat. based upon both the genetic information and the feasibility of splitting existing data sources within California at lines other than 40°10′ N. Lat.

This may indicate that 40°10′ N. Lat. would generally be a good choice for deeper shelf species. However, that does not directly translate for nearshore or slope species which have different rates of movement and connectivity across life stages. A second factor to consider if choosing between

40°10′ N. Lat. and 42° N. Lat. is the quantity of data available between these two latitudes for each species. If there is limited data within this area that may result in model estimates that are primarily driven by the dynamics of other areas included in the model, and past and future management and catch history may be important factors when considering whether to merge this area with areas to the north or south. Another data-related concern is the potential for orphaning nearshore data collected off northern California, e.g., sampling by the California Collaborative Fisheries Research Program. Examination of those data earlier this year indicated that a significant proportion of that survey's catch of quillback rockfish occurred at the two stations located north of 40°10′ N. Lat. Finally, across nearly all fisheries off the coast there are varying levels of fishing and landings that cross state or management lines, with the magnitude likely to be related to the average distance of fishing trips, the continuity of habitat (e.g., rocky habitat), and the species being targeted. If the portion of fishing across stock status areas is a substantial portion of total removals, selecting larger stocks status areas (e.g., Oregon plus Washington; coastwide) may be warranted, depending upon other factors.

Those species assigned a single coastwide stock status area will have maximum flexibility for the selection of assessment areas. This choice would allow assessment authors to select assessment areas based on species-specific data and fishery attributes with the results from each modeled area being easily summed to a coastwide level to report stock status for management. There would still be situations where area-based management actions could be needed based on the results of a regional assessment area, and these could be accomplished with existing management tools. However, one potential risk of setting a coastwide stock status area, particularly for species that may have regionally distinct differences in abundances, would be if the summed coastwide stock status was below the Minimum Stock Size Threshold (MSST) with the results largely being driven by a single coastal region. For example, the coastwide summed stock status of quillback rockfish in 2021 was approximately 26 percent of unfished spawning biomass where this overall estimate was being driven by the assessment results within California that were well below the MSST, while the estimated stock statuses in Oregon and Washington were near or above the relative biomass target (i.e., 40 percent of unfished). This specific situation could result in coastwide management actions, unduly impacting portions of the stock assessed to be at healthy levels, in order to rebuild the species over a single, coastwide stock area. It could also promote, or fail to effectively address, localized depletion.

Finally, there are clear advantages in the ease of tracking and management if the selection of stock status areas is generally consistent among species that are likely to be caught and managed together (e.g., species within complexes, or those occupying similar depths and habitat types). While a few species may have sufficient information to make decisions on stock status areas based on genetics and/or known stock connectivity, most species within the groundfish FMP will lack that level of clear guidance. In those situations, selecting stock status areas with an eye towards consistency across co-occurring species within the nearshore, shelf, and slope could balance future administrative, tracking, and management needs. Even if future genetic and population evidence suggested a variety of stock boundaries in the northern California region, for any co-occurring

group of species, considerable management challenges would likely be associated with attempting to manage an assemblage of coincidently-caught species, particularly nearshore ones, with a variety of north-south stock and management lines. Compromises in where to draw stock boundaries may well be needed to reasonably accommodate assessments, as with the 2021 lingcod assessment, and multi-species management challenges.