Hilborn points on quillback assessment in SSC and Council presentations.

My primary concern with the assessment is that it is totally dependent on a wide range of assumptions, particularly numerous fixed parameters, and the assumption that the length frequency data are representative of the total population and the fixed parameters particularly the size at age are appropriate for California. As I pointed out in my comments to the Council and SSC, my many years of involvement in fisheries assessment have taught me to be skeptical, and I have seen so many assessments based on far better data than the quillback assessment be shown to be wrong. The SSC's own experience with widow rockfish and Petrale sole illustrates this. We don't yet have a track record for assessments based only on catch and length frequency data, but I think everyone would recognize that there are far more ways those assessments can go wrong compared to assessments that have an abundance trend index.

I identified several issues that should raise alarm bells to any reviewer and will elaborate on them.

Changes in closed areas and unfished areas

The most obvious concern is that so much of the habitat of quillback rockfish has been closed to fishing, the areas closed have changed over time and likely more areas have been unfished due to distance from harbors. The proportion open, closed in RCAs and closed in MPAs is shown in Figure 1. This means that the length data are necessarily a biased sample of the total population and given the changes over time in what areas were closed and there is evidence for ontogenetic depth migration, selectivity is highly likely to have changed. Yet the base case model assumed constant selectivity, with no allowance for a possible descending righthand limb, which is common with ontogenetic depth migration.

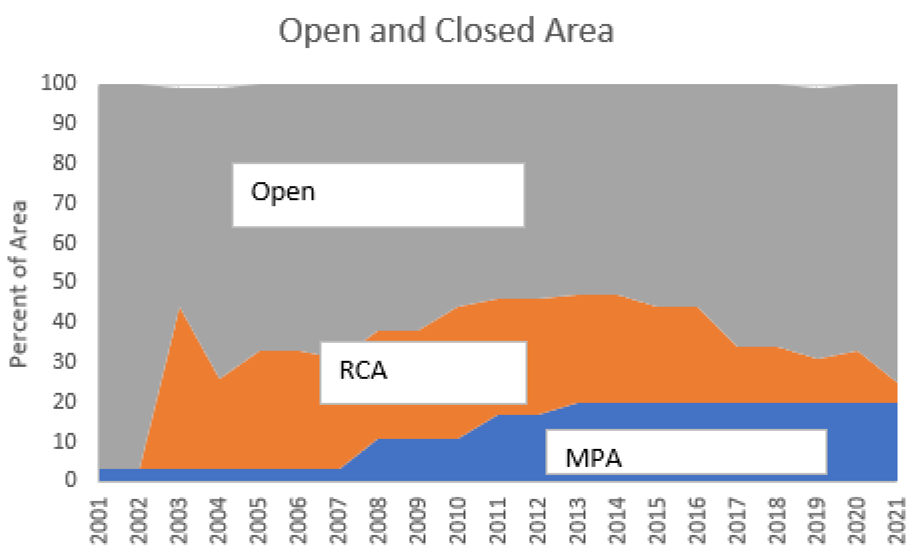

Figure 1. The proportion of quillback habitat open or closed by status. From Table 21 of assessment.

North of Point Arena, the predominant depth restriction was 20 fathoms for the last 20 years, preventing access to the primary depth distribution of adult quillback rockfish resulting biasing the length sampling and presumably leading to reduced selectivity of larger quillback. Further, because the RCAs and MPAs tend to have major differences in depth, it would seem likely that the shifting proportion of closures between RCA and MPA would also impact selectivity. The base case model assumes asymptotic selectivity over all time. This decision was made despite better fits to the data for some of the alternative selectivity regimes tested as a sensitivity.   The evidence is strong that selectivity has changed. The authors of the assessment dismiss any of the alternative selectivity regimes because none indicated a significantly different stock status. Given the many changes in closed areas over the last two decades it would seem likely that there were many changes in selectivity, not just a change in 2001 as tested in the sensitivity tests and selectivity would most likely have been continuously changing due to the changing proportions of areas closed in different depth categories. Further, the sensitivity runs were done one at a time, rather than looking across a range of sensitivity, steepness, natural mortality and growth parameters.

Estimate rise in exploitation rates

The second alarm bell comes from the model results, suggesting a rapid rise in exploitation rate for quillback, while at the same time there has been no similar increase for other species in the inshore rockfish complex. Figure 2 below shows the estimated annual exploitation rate for quillback compared to copper, vermillion/sunset, blue/deacon and gopher/black/yellow. All of these stocks show no overall trend in exploitation rate, whereas starting in 2014 the exploitation rate for quillback increased 5 fold.

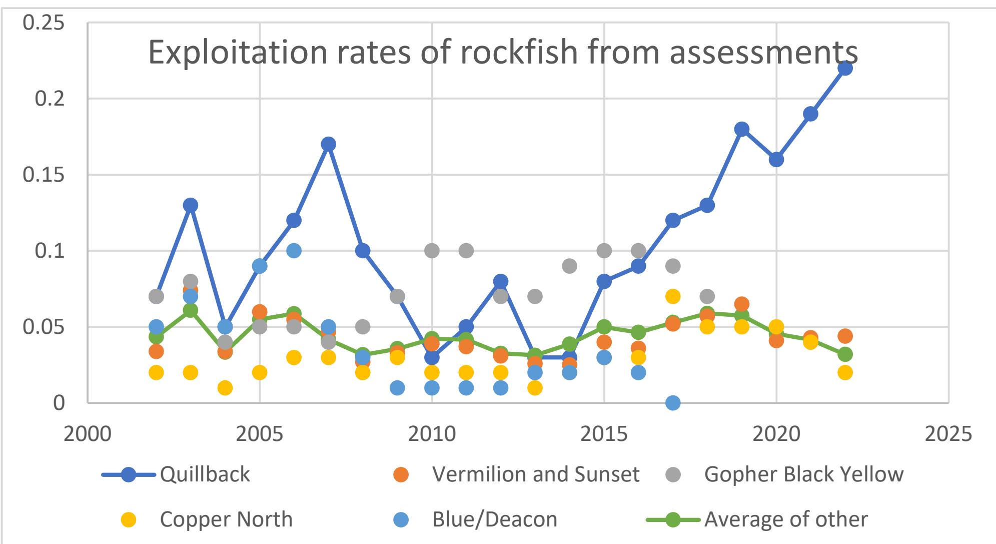

Figure 2. Trend in exploitation rates for different inshore rockfish species from PFMC assessments.

This simply fails any “sniff-test.” This suggests that in the last 3 years of the assessment almost 60% of the total population was captured. When you combine this unlikely pattern with the likelihood profile information, which shows that the best fits to the data would provide higher stock abundance in recent years, and thus lower exploitation rates, this provides added support for alternative values of the fixed parameters.

Fixed parameters

Dr. Maunder has also highlighted the critical fact that in almost every case, the “base case” fixed parameters were not the best fit to the data, and in almost every case the best fit to the data suggests lower recent exploitation rates and a higher stock size. The stock recruitment steepness and the natural mortality rate seem particularly important.

I found the following text in the stock assessment report particularly concerning regarding steepness. "However, this approach was subsequently rejected for future analysis in 2019 when the new meta-analysis resulted in a mean value of approximately 0.95. In the absence of a new method for generating a prior for steepness the default approach reverts to the previously endorsed method, the 2017 value." I cannot understand why 0.95 was not used as the base case. The text says it was because there was no method of generating a prior, yet the assessment did not use the prior, only the fixed value. The best available science for west coast rockfish is that there is almost no indication of lower recruitment at lower spawning stock sizes. The assessment should have fixed steepness at 0.95 or 1.0, and this entire rebuilding analysis would likely have been unnecessary. That would have been "best available science."

The spawner-recruit relation estimated in the base case is certainly consistent with no decline in recruitment at lower spawning stock sizes. Looking at Figure 31 a steepness of 0.95 provides a much more optimistic view of the stock status.

Further with respect to the steepness values is seen in the model results. The recreational length data begin in 1980 and commercial length data in 1990. Yet by 1980 the assessment suggests the spawning output was already reduced by 50%. This is totally dependent on the assumption of stationary conditions for the spawner-recruitment relationship and natural mortality. As Dr Maunder noted, "A dynamic spawning biomass reference point might be more appropriate so that it is based on recent recruitment, adjusted by the stock-recruitment relationship." A model run that began in 1980 with the population size in that year being estimated would likely give a different picture of the stock status and might allow for a better fit to the length data. As Dr. Maunder suggested, adjusting reference points to be based on the recruitments in the years we have length data would make more sense than driving the model with steepness of 0.72 and total stationarity.

Dr. Maunder also pointed out that the natural mortality rate used in the base case model 0.057 is based on a single female that was apparently not from California. The likelihood profiles also indicate better fits to the data with higher natural mortality rates, and these in turn indicate higher current abundance. As Maunder pointed out, the max age of 76 (higher than any observed age of fish used in the assessment, would produce an estimated natural mortality of 0.071 which figure 34 shows would make the current stock just slightly below the overfishing threshold

The yield curve (Figure 57) that results from the assessment shows the long-term yield at current stock size roughly equivalent to the long-term yield at the rebuilding target, so there will be no benefit to yield of quillback from rebuilding the stock. It also shows that the model estimated BMSY is about 30% B0 whereas the default management target is 40%. I believe this reflects several layers of "precaution" built into the reference points, that seems more like a policy issue that "best available science". Looking at Figure 57, the best available science suggests the target should be 30%.

Fit to length data

In my testimony I raised the issue of poor fit to length data. Some of this may be due to the assumptions about selectivity as discussed in the previous paragraph. A second reason for poor fit to size data may be incorrect specification of the growth curve. The use of Oregon and Washington growth data rather than California growth data may explain some of the poor fit.

Fits to the recent commercial length composition data are quite poor (Figures 18 and 63 of the assessment). The model fits consistently overestimate average length up to 2000 and underestimate it after 2010. This suggests changes in selectivity that were not incorporated in the assessment. The fit to recreational length data is better for recent years but also overestimates mean length before 1990 (Figure 20).

Finally figure 54 of the assessment shows that the California data seem to largely fall below the line for the parameters used in the assessment, suggesting the data used in the growth curve are not actually representative of the biology of California quillback. In his comments to the Council Dr. Maunder highlighted the difference between the length at age data for California and that used in the base case model. Figure 3 below shows the best fit to different length age data sets, highlighting the significant differences in the estimated growth parameters.

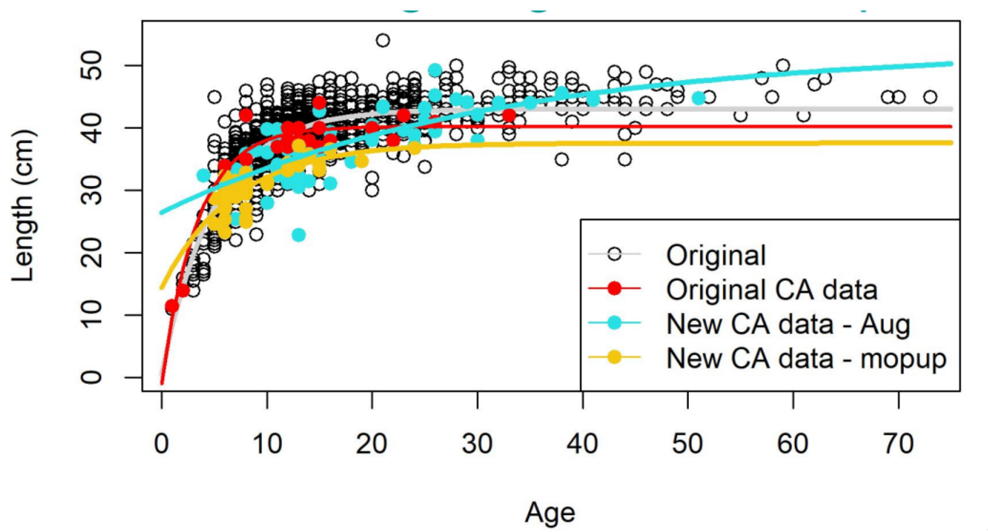

Figure 3. Figure 54 of the assessment plotted with fits to alternative blocks of data.

As I pointed out in my comments, the current mean size is highest ever for commercial catch and nearly so for recreational catch. It would appear the model is explaining this (even though it doesn't come close to fitting the commercial data) by low recent recruitments from the combined steepness assumption and low recruitment deviates. Looking at the commercial length data (figure 63) there is a notable lack of small fish beginning about 2009. That roughly corresponds to the implementation of the MLPA closed areas, which have protected many areas where small fish are found. The recreational fishery continued to catch small fish, presumably because recreational boats are unlikely to go as far offshore as commercial boats.

Recommended alternative model cases

For the reasons discussed above it would seem more appropriate for the base case to have a steepness of 0.95 and an M of 0.072. This would be more consistent with recent meta-analysis for steepness and M based upon fish used in the assessment. Dr. Maunder has run this case. Another run would allow for selectivity changing over time. Dr. Maunder also ran this scenario, with the details of the selectivity options given in the sso file. Table 1 shows that both models provide highly significant improvements in fit to the data, and a stock that is well above the level requiring a rebuilding plan.

Table 1. Summary statistics of alternative stock synthesis runs

Model	NegLL	Current B/B0
Base	186.9	0.14
M=0.072 h=0.95	170.8	0.34
M=0.072 h=0.95 change select	111.5	0.29

Summary

My primary recommendation would be that the SSC recognize the limitations of the available data, that the "best available science" whatever values of the fixed parameters are chosen, is simply not adequate to provide management advice at this point. Alternative values of fixed parameters will give alternative stock status, and certainly the real values of those fixed parameters are unknown, not known perfectly without error. Known "perfectly without error" is the basic assumption of the base case on which current management advice is derived.

This committee would seem to have three choices (1) dismiss the critiques as already having been considered and accept the assessment (2) some tinkering with new runs such as the one I suggested, or (3) recognize the great uncertainty in an assessment using only catch and length data, lack of size at age data from the area being assessed, major changes in where the fishery operated, and an assessment that suggests a rapid rise in exploitation rate while there appears to have been no increase in effort. I would ask the SSC to consider if accepting this assessment would meet the Magnuson-Stevens act objective of "will provide the greatest overall benefit to the Nation, particularly with respect to food production and recreational opportunities, and taking into account the protection of marine ecosystems." How does accepting this assessment further those objectives?

There is far more data available now on size at age from California and index of abundance from CCFRP data that will be available for a new assessment. It would make much more sense to recognize that the 2021 assessment was data deficient for the reasons both Dr. Maunder and I outlined and wait until a more reliable assessment can be conducted. The choice of accepting the assessment or putting it aside until a more thorough assessment can be done is highly subjective, it is not going to be driven but likelihood scores, but personal decisions about what you think is most reasonable.

A major principle of fitting models to data is to let the data speak. The best available science should be the model that fits the data best. I recognize that "the data" includes more than just the catch and length data, but also includes biological understanding. However, I know of no other sources of data that make a case that the steepness should be 0.72, nor that the alternative fits to the data with different values of M and the growth curve should be fixed at the base case values.