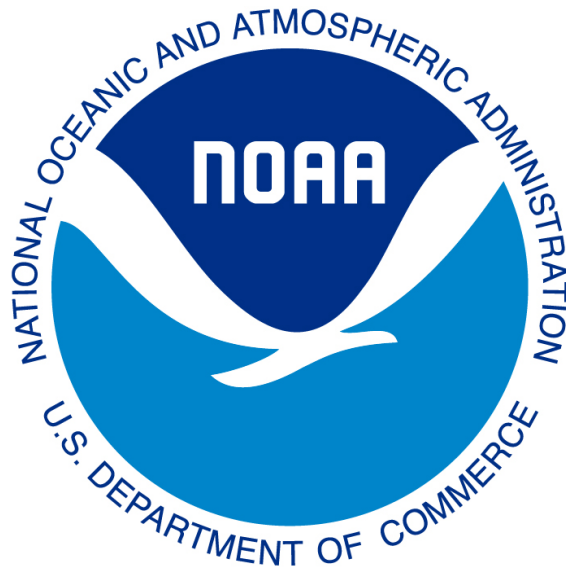


Reviewer report for 2023 Japanese domestic stock assessments

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Peter T Kuriyama

NOAA Southwest Fisheries Science Center
8901 La Jolla Shores Drive
La Jolla, CA 92037
peter.kuriyama@noaa.gov



1. General Comments

From 7-10 November, 2023, I was one of three external reviewers for five domestic stock assessments: Japanese anchovy Pacific stock, Japanese anchovy Tsushima Current Stock, Japanese Seabream in western Sea of Japan and East China Sea stock, Japanese Seabream in Central and Western Seto Inland Sea Stock, and Bastard Halibut Seto Inland Sea Stock. I have some general comments regarding the review process, modeling approach, and data availabilities.

The format of the review panel did not allow for much exploration of alternative data and model configurations. This is a component of US stock assessment review panels and ensures that the assessment results are robust and the model represents the best scientific information available. It was difficult to conclude that the data were adequate to understand the stock dynamics of the target species and whether the stock assessment methodology was based on the most appropriate available study. For the relatively data-rich stocks such as Japanese anchovy Pacific stock, more specific treatment of the data (such as year-specific age length keys) may have been justified. For the stocks with less data available it was not possible to evaluate if a stock assessment was even justified given the potentially large proportion of the catches that occur outside Japanese waters. A more detailed review that allows for more evaluation of alternative data treatments and model configurations would be necessary to conclude that the assessments represent the best scientific information available.

The cohort analyses may not have been the most appropriate assessment method for each stock and no alternative models were evaluated in the assessment documents. For the data-poor stocks, a biomass-based approach (without any age structure) or even a model like stock reduction analysis which relies on catch information may have been more appropriate. This may be the case in specific cases where not many fish are directly aged and the ages are assumed to be associated with specific lengths. The data-rich stocks may have been better modeled with integrated statistical catch-at-age models (for example software like Stock Synthesis 3), in which the fishery-dependent data and fishery-independent data are modeled separately. Because the review process did not allow for more thorough investigations of different modeling approaches, it was difficult to conclude that the modeling methodologies were appropriate for the data and representative of the best scientific information available. Similarly, the validity of the future projections depended on the use of the models.

For some of the stock assessments, there seemed to be challenges with assuming that the fishery-dependent data were representative of the overall population. Fishers can target sizes of certain fish due to market preferences or proximity to port. In an integrated statistical catch-at-age model this preference could be modeled with a fishery selectivity pattern so that the composition data from the fishery are separated from the overall population. In the cohort analyses, the fishery data were assumed to be representative of the overall population which required making biological assumptions such as increasing natural mortality by age in order to fit the data. The fishery data may be considered representative of the population if it was possible to visualize cohorts through time. But typically, the composition data saw predominantly young fish and infrequently observed older fish.

Generally, each stock would benefit from the addition of a fishery-independent data source and an ageing program in which samples collected from the potential habitat are measured routinely. I acknowledge that data improvements require an enormous amount of time, effort, and financial resources. The changes will not occur overnight. Data may never be available from international stocks that are caught in South Korea and China. As a result, I think it would be beneficial to explore different modeling approaches in the future to better match data availability. My sense is that it may be better to use a biomass-based population dynamics model rather than to assume that specific lengths are related to specific ages in order to meet the data input requirements of an age-structured model.

Another difficulty with the cohort analyses is that the uncertainty in the data could not be propagated into the uncertainty in the assessment results and management quantities. One benefit of statistical catch-at-age models is that it is possible to account for both observation error in the data and process error in the model ability to estimate parameters. The accuracy of the projections is likely complicated by not having a means to account for both sources of uncertainty.

Thanks to the scientists for the efforts, presentations, and responsiveness to requests and questions. Thanks also to the organizers for coordinating travel logistics and facilitating the review panel.

2. Japanese anchovy Pacific stock

This stock was relatively data rich and had two fishery-independent indices of abundance, many age and length observations, and catch data. As a result, there was the possibility to handle the data differently and explore various model types to assess the stock.

From 2000-2017 there were more than 25,000 aged anchovy from scale readings. This level of data quality would perhaps allow for generation of age-length keys for each season and year. The presentation mentioned that it may not be possible to have fine-scale ALKs, but perhaps the model results would have changed if the assessment used annual ALKs rather than seasonal ALKs that applied for all years. Anchovy are likely to have density-dependence and given the catches and estimated biomass, there may be reason to believe that the ALKs would be time-varying, and the variability may be greater year to year rather than season to season. Variability in growth is connected to recruitment and thus maximum sustainable yield values. The model results may have been sensitive to different ALK configurations.

The cohort analysis required assuming the fishery age compositions were representative of the overall population. I think this assumption may have required using values of natural mortality (M) that increased as age increased. Typically, M decreases with age (Lorenzen 1996). Predation may increase on older fish, thus M increases with age, but there was no evidence that predation impacted these anchovy. The fishery seems to catch mostly age-0 and age-1 fish, and since these fishery age compositions are considered to represent the overall population, the natural mortality has to increase above 1 for ages 2 and 3 in order to fit the data. This pattern in the age compositions may be due to fishers' preference to fish closer to port and the older fish may be distributed further offshore. In other words, modeling the fishery data separately from the overall

population (with a fishery selectivity curve) may allow for more biologically reasonable assumptions for age-specific natural mortality and perhaps resolution of the high F values.

An integrated statistical catch-at-age model would allow the fishery data to be modeled separately from the population. My hypothesis is that modeling the fishery age composition data with a selectivity curve would result in more biologically realistic estimates of M . This approach would also allow for exploration of the catchability values around the trawl survey as it likely only covers a fraction of the potential anchovy habitat. The information contained in each of the data sets (such as the egg survey and trawl survey) could be compared with this approach. Additionally, these models would allow for uncertainty in the data to be propagated to uncertainty in the estimates and management quantities.

3. Japanese anchovy Tsushima

The main challenge with this stock is that the data that represent the full range of the stock are not available. The stock is distributed and landed in China and Korea, yet it was not possible to include these numbers in the stock assessment. As a result, it is not possible to conclude that this stock assessment is representative of the entire stock. Obtaining data from neighboring countries will be necessary to conduct a comprehensive stock assessment.

Similar to the Pacific Japanese anchovy stock, an integrated statistical catch-at-age model may be a better approach as the fishery and the overall population can be modeled separately. There were no records of anchovy older than age 2 in the region, and the fishery operates in coastal areas. Taken together, these suggest that the fishery data are not representative of the overall population. This seems more likely as the stock extends to Korean and Chinese waters. Analyzing the data in an alternative model may help bracket potential states of the stock given different hypotheses around data in neighboring countries.

This type of integrated statistical catch-at-age analysis would explore stock status assuming different data scenarios. For example, how might stock status change if the Korean catches were assumed to have catch at age that caught more age-2 and age-3 anchovy? How might stock statuses change if Chinese catches were assumed to be two or three times the Japanese catch amounts? While it is not exactly a model sensitivity, it might be beneficial to have these analyses if additional data are collected or obtained in the future.

Similar to other stocks, it will be beneficial to develop an ageing program for these fish, particularly if cohort analyses will be used in the future.

4. Japanese seabream Western Sea of Japan and East China Sea

Data availability is a concern for this stock. The stock boundaries are defined based on fishery activity, which may not represent the full spatial distribution of the stock. It seems that there is potentially connectivity between Japanese and Korean stocks but no data are available to quantify this. Additionally, biological data (and perhaps associated spatial and temporal variability) for age and growth should be a high priority for future stock assessment efforts. These data are fundamental to cohort analyses, and uncertainty in these biological data can have a large impact on model results. The data availabilities may be one explanation for the continued

poor stock status, even with the hatchery releases. If possible, it would also be beneficial to standardize the catch-at-age protocols among prefectures.

The stock enhancement component is interesting, and I agree with Steve Teo that there may be potential to conduct a mark-recapture study to estimate potential population size and natural mortality. I think the challenge may be that hatchery released fish in recent years have not had deformity of the inter-nostril epidermis. It may be necessary to look for additional bio markers to distinguish hatchery and wild fish in the future. Additional study to evaluate potential biological differences (like maturity or growth) in wild and hatchery adults would be beneficial.

Similar to the other stock assessments, there seems to be fishery preference for age 1 and 2 fish across years. These fisheries may not represent the overall population age distribution, require hard assumptions about age-specific natural mortality. This might be resolved (or at least further explored) with shifting to an integrated statistical catch-at-age model.

5. Japanese Seabream Seto Inland Sea

It seems that this stock used data that represented a larger proportion of the stock, perhaps due to the location in an inland sea. The stock status seemed to follow a predictable trajectory, that is as overfishing decreased, the stock moved above the overfished level. Nearly 400 fish were aged recently, which is beneficial and will hopefully continue into the future and be expanded to cover additional prefectures.

It still seems that the fishery data do not cover the full population age distribution. Although this does not seem to pose major issues to the assessment. It seems this may be due to the biomass levels increasing, although this level has not been high enough to result in fish surviving to older ages like 15. The issue seems to arise in the age 5 and 6+ F values estimated to be high relative to the values in the age composition. It seems worthwhile to explore moving to a statistical integrated catch-at-age model.

If possible, a fishery-independent index would be useful to include. Inclusion of this may allow for the cohort analysis to be tuned to an index. This inclusion may also dampen the retrospective pattern.

6. Bastard halibut Seto Inland Sea

The challenges with this stock assessment are similar to those for other stocks. The fishery seems to catch similar ages of fish year to year. There is a slight difference between the Seto Inland Sea stock and Southern Pacific Coast fishery age distributions. Assuming that the fishery data are representative of the overall population may result in F values that are biased high, particularly for older fish. The high F may be resolved if the fishery data can be modeled separately from the overall population with a fishery selectivity curve.

There seems to be similarities between the Seto Inland Sea stock and the southern Pacific stock, at least in the fishery age compositions. It may be worthwhile to continue to evaluate these relationships. The connectivity between the regions may increase as the stock levels continue to increase.

Standardizing the CPUE index should be considered in the future. Without standardization the patterns in CPUE may be affected by changes in effort or changes in biomass levels. It will likely be useful to incorporate other fishery-independent data sources that are available. Integrated statistical catch-at-age models would allow for comparison between the different available indices. Some data sources may contain more information about the stock than others.

References

Lorenzen, K. "The relationship between body weight and natural mortality in juvenile and adult fish: a comparison of natural ecosystems and aquaculture." *Journal of fish biology* 49.4 (1996): 627-642.