ACCEPTED PRACTICES GUIDELINES FOR GROUNDFISH STOCK ASSESSMENTS IN 2025 AND 2026

The following guidelines are intended to supplement the Council's *Terms of Reference for Groundfish Stock Assessments* and provide groundfish stock assessment teams (STATs) with default approaches to consider when dealing with certain stock assessment data and modeling issues. The STATs may diverge from the guidelines and should provide adequate justification for doing so prior to the stock assessment review (STAR) panel or other review body meetings. These guidelines are not intended to provide a comprehensive treatment of all potential issues, which are too numerous to list. Rather, the guidelines focus on a limited number of issues that the Scientific and Statistical Committee (SSC) has so far considered. The purpose of having these guidelines is to lessen the time that might otherwise be spent during stock assessment reviews in discussions about how particular steps in the assessment process should have been conducted. The guidelines are subject to change as the SSC evaluates additional data sources and modeling approaches. STATs should consult with Council staff to obtain the most recent set of guidelines, which the SSC will finalize in March 2025 for use with 2025 stock assessments.

Spatial Considerations

Spatial Stock Assessment Structure for Groundfish Species

STATs conducting assessments of groundfish species should explore regional differences in biology (or the underlying environmental conditions that influence biology), life history, and fishing patterns when defining stock assessment structure (e.g., single model, separate or multi-area assessments). The Council has initiated a stock definition process that will provide the basis for stock definitions outside of the assessment process. Assessment areas should be structured to be consistent to these defined stock identification boundaries, either directly or in summative units. Models should use consistent approaches for modeling productivity and data weighting if there are separate regional models for a species. STATs conducting assessments of nearshore groundfish species should explore state-specific or finer-scale stratifications for the assessment models to account for differences in exploitation and management history.

For STATs that explicitly include spatial structure within an assessment model, the SSC strongly recommends that STATs review both assessment documentation and STAR Panel reports of recent spatially-explicit models (e.g., canary rockfish in 2015 (Thorson and Wetzel 2015), yelloweye rockfish in 2017 (Gertseva and Cope 2017)) as a starting place to consider how to confront and evaluate model sensitivity to spatial considerations, such as parameterizing movement rates and the partitioning of new recruits across areas. STATs should also consider the location of capture, not just the location of landings when considering either explicit or implicit spatial structure within assessment models.

There are several other key considerations that STATs should be aware of when developing spatial stock assessment models (Berger et al. 2017, Punt 2019a, Punt 2019b, Cadrin 2020) for operational management use (Goethel et al. 2023). In particular, STATs should pay close attention to key decision-points during spatial model development (e.g., reasons for spatial structure and interactions among them; number of areas; the estimation of recruitment, movement, growth, and dispersal characteristics; and subsequent model parameterization). The development of spatial models can increase resource demand due to added complexity, so investing in workflow components that emphasize reproducibility, transparency, and fluidity will be particularly beneficial for STATs conducting spatial assessments.

Accounting for Large Spatial Closures

Closed spatial areas are among a number of factors that can influence the catchability and selectivity of fisheries and surveys, including temporal and spatial variability inherent to the fishing process (e.g., changes in gear, market incentives, bycatch restrictions, and in areas open to fishing) and changing fish distributions (when movement isn't explicitly considered). Assuming fixed or constant catchability values and selectivity patterns may be inappropriate when any of those factors vary over time in a substantial manner for a fishery or survey. However, it is important to note that not all regulation changes or spatial closures may result in changes in selectivity. Assessment authors should carefully consider the below factors in relation to the stock being assessed and determine whether the above considerations are appropriate.

For large spatial closures, which can restrict access to some portion of the biomass and differentially restrict access to certain size and age classes, the following guidance applies:

1. Changes in closed areas over time may lead to changes in selectivity and catchability related to indices of abundance that can be addressed (in concert with changes to other factors) through time-blocks (or other time-varying parameterizations). Regulatory changes over time, including closed areas, can be complex. Regulation histories compiled by Council staff and the Groundfish Management Team (GMT), in collaboration with the states, provide the timing and magnitude of changes to regulations likely affecting selectivity and catchability. Past efforts to better visualize changes in depth restrictions over time as done in the northern California vermilion rockfish assessment (Monk et al. 2021, Figure H2) can assist in identifying time periods for further examination in time blocking for sensitivity analyses. In addition, regulations that resulted in a shift in effort to or from a species or species complex should also be considered. Additional examples, if helpful, could include the 2019 assessment of cowcod (Dick and He 2019), the 2021 assessment of vermilion/sunset rockfish for the area south of Point Conception, California (Dick et al. 2021) and the 2015 assessment of bocaccio (He et al. 2015).

2. Another approach is directly accounting for depth restrictions as a variable in normalizing indices of abundance. Relative indices of abundance can include standardization by depth restrictions to account for differential depth distribution and variation in access (e.g., including depths open to fishing across time as a factor as done in Cope and Whitman (2021) for the ORBS-based recreational catch-per-unit-effort (CPUE) index and in the northern California vermilion rockfish assessment for the CPFV onboard observer index (Monk et al. 2021)).

3. Weighting indices or composition data by some inverse measure of proportion of habitat available for surveying or surveyed in each stratum may be appropriate in some cases. An example is weighting indices and composition data using the seafloor mapping results as undertaken in the stock assessment for vermilion/sunset rockfish in northern California (Monk et al. 2021).

4. Additional insights and guidance for addressing large spatial closures can be found in the literature review developed by Langseth and Barcelo (in preparation), which was discussed at the 2024 GFSC Accepted Practices review and can be found on the meeting website. Although the review includes no explicit recommendations for addressing spatial closures in groundfish stock assessments, the review does include ways closed areas have been incorporated into assessment frameworks within the primary literature and therefore provides approaches that could also be applied to assessments for the Council, along with a description of data gaps and challenges associated with these approaches.

Data Considerations

Landings Data

STATs should either (a) verify with the states that the relevant unidentified fish categories (e.g., URCK, UFLT) and/or group categories (e.g., nearshore, shelf, and slope rockfish) in the Pacific Fisheries Information Network (PacFIN) and the Recreational Fisheries Information Network (RecFIN) have no appreciable quantities of the species being assessed or (b) develop and apply, in partnership with the states, an appropriate species proportion to the landings of unidentified fish to estimate corresponding landings of the species being assessed. Ideally, STATs will provide information regarding the data quality associated with species composition estimates in mixed species market categories.

STATs should consult with each of the state's data stewards, well in advance of the STAR, to verify that they have acquired the correct landings data series and that the series are complete. STATs should check with Washington Department of Fish and Wildlife (WDFW) on the status of fish tickets included in the PacFIN (or the North Pacific Groundfish and Halibut Observer (NORPAC) database, which also stores the Northwest Fisheries Science Center (NWFSC) At-Sea Hake Observer Program data for at-sea catches) for recent Tribal landings and confirm there are complete Tribal landings data.

The historical catch reconstruction developed for California in Ralston et al. (2010) does not consistently account for fish landed into California that were caught off Oregon or Washington. This issue is limited to the years 1948 through 1968, with the greatest volume of landings represented by flatfish (see the Groundfish Catch Reconstruction workshop report for more details; Agenda Item I.2 Attachment 1 March 2017)). STATs should establish if this portion of the historical fishery in California accounts for appreciable quantities of the species being assessed.

Discard Data

For discards in commercial fishing operations, the STATs should obtain estimates of discards and summaries of any available biological information for discarded fish from the NWFSC West Coast Groundfish Observer Program (WCGOP). Estimates of total commercial fishery discards and discard mortality are reported by WCGOP in the Groundfish Expanded Mortality Multi-year (GEMM) annual report. The STATs should contact the state data stewards and RecFIN to obtain available data for discards by recreational fishers. Recreational discards should include both the "released dead" and "released alive" categories. STATs should provide rationale for any assumed discard mortality rates. In some cases, the "released alive" category may include mortality calculations applied by the states to account for discard mortality by depth.

The STATs should include an analysis to evaluate whether there is evidence of size-based discarding and determine if the assessment model should include size-based retention for either commercial or recreational catch.

Compositional Data

When combining compositional samples from different geographic strata, the composition proportions should be weighted by some appropriate measure of the numerical abundance in each stratum (catch in numbers for fisheries; numerical abundance for surveys). Catch weights would not be appropriate if the average weights of the fish vary appreciably among the regions. STATs should be mindful of the potential for size sorting of landings (separation of fish of various sizes given marketability or differing ex-vessel price) and how sorting has changed over time for species such as sablefish and petrale sole. The 2019 assessments for these species looked at this issue in detail, identifying that only a single size group was recorded per fish ticket, resulting in no special consideration being needed when processing the data. Size sorting can influence the compositions reflected in commercial length and age data and has implications for how expansions are constructed.

A software package (pacfintools) developed by scientists at the NWFSC is available p to process biological sample data stored in PacFIN, in the Biological Data Samples (BDS), and to generate time series of compositional data that are formatted for use with the Stock Synthesis program. The STATs should use this software or provide a rationale for why they do not. If a STAT uses other software, they should provide some comparison of the results of each approach, as well as a comprehensive rationale for why they have used alternative expansion approaches or data.

The composition data for the recreational fishery can be obtained from RecFIN. STATs should consult with the state data stewards regarding their use and expansion for contemporary and historical sampling programs. In addition to age and length composition data from landed catch, length composition for discarded catch from onboard sampling in California (Type 3d data from the California Recreational Fishery Survey) can be informative of more recent recruitment patterns. Further evaluation of appropriate methods of weighting discard length data in situations in which discards may be better sampled than retained catch have been identified as a source of tension in some past stock assessment models (see 2021 lingcod STAR panel report). However, the most appropriate solution, likely to be separate weighting of discard and retained length frequency data, may not be feasible in which case the weighting of length frequency data may benefit from additional sensitivity analyses.

Constructing Indices of Abundance

Biomass Indices from Bottom Trawl Surveys

The geostatistical delta-GLMM (delta-Generalized Linear Mixed Modeling) software (Vector Autoregressive Spatial Temporal model, VAST), developed by Dr. Jim Thorson (AFSC), and the sdmTMB (species distribution model in Template Model Builder) software are acceptable tools for developing biomass indices from bottom trawl survey data, though exploration of other methods is encouraged. For survey data, the software includes a range of options that can either replicate previously recommended model configurations (e.g., delta-GLMM with vessel as a random effect) or use more advanced analytical methods, such as spatial autocorrelation (Thorson 2019). Appropriate diagnostic statistics should be provided if the geostatistical features are used.

The following references offer guidance for using the approved software, including recommended defaults and practices.

1. VAST wiki page (overview) – https://github.com/James-Thorson/VAST/wiki (and linked pages).
2. Software wrappers used to describe the application of species distribution models to West Coast Groundfish Bottom Trawl data are available at https://github.com/pfmc-assessments.

Biomass Indices from Fishery-Dependent Sources (e.g., Logbooks)

If a catch-per-unit-effort (CPUE) index is developed from a multi-species recreational data source that does not report fishing locations at a fine scale (e.g., the data were not collected by at-sea observers), the data should be filtered (e.g., the Stephens and MacCall (2004) method) to identify data records that were unlikely to include the species being assessed.

Species distribution models (e.g., GLM, VAST, sdmTMB have been used previously and approved by the SSC) can also be used to standardize fishery CPUE data for use as biomass indices. An objective mechanism for imputing catch rates from regions with no fishing should be provided if the geostatistical option is used. STATs who apply the software to fishery-dependent data will need to provide the STAR Panels with substantive interpretation and diagnostics to demonstrate that the analysis appropriately considers issues such as changes in fishing power and truncation of large catches due to trip limits.

Standardizing Hook-and-Line Survey Indices of Abundance

The following recommendations are from the 2022 hook-and-line methodology review report (also see the 2022 WDFW hook and line survey workshop report):

1. The index standardization approach should attempt to capture as much of the realistic uncertainty as possible, noting that an additional index variance term will still need to be explored in assessments. As always, the additional variance term should reflect variability in the index rather than poor fit of the model to index trend.
2. Investigate and characterize overdispersion and the consequences of different assumptions about the error structure.
3. Where applicable, generate a single index that integrates habitat inside and outside of closed areas (such as the Cowcod Conservation Area (CCA) by weighting by the area of habitat inside and outside of closed areas. Habitat quality differs across habitat types and the quality and availability of habitat data may differ across state and federal waters.
4. If habitat information is not available, create separate indices for inside and outside (currently or recently) closed areas, and consider if there is information to inform relative weighting of the two indices. In that case, sensitivity analyses should be conducted in the assessment to characterize the relative influence of the two indices.
5. Pool length composition data (with appropriate weighting) across inside and outside closed areas and analyze with a selectivity time block, and potentially a catchability (q) time block, when shifts in the areas covered occur (e.g., 2014 for the CCAs and 2017 for the California Collaborative Fisheries Research Program (CCFRP)) and a single combined index is used. Note that CCAs will likely be open to fishing in the future so selectivity may need to change again.
6. Use posterior predictive checks, in particular with respect to fitting Bayesian hurdle models.
7. Explore multiple error models, such as Binomial, Negative Binomial, Delta-gamma, logit normal, or others as appropriate. The SSC Groundfish Subcommittee (GFSC) supports exploring the use of hurdle models as well, noting they may not be appropriate or computationally feasible for all species.
8. Consider models that use alternative levels of data aggregation (e.g., hook, drop/drift and site) to try to understand the consequences for the variances estimated using these approaches. Note that angler effect was included in the Bayesian binomial model (John Wallace's model) for the NWFSC Hook-and-Line survey and has been influential for some species. Drift level modeling for the CCFRP is most appropriate. The current recommendation is to not model CCFRP at the angler level, which would only be relevant if an individual angler were used as the effort. Furthermore, some programs do not track individual anglers (e.g. Humboldt).

Modeling

Prior Distributions for Natural Mortality (M)

At minimum, assessments should report the prior probability distribution for natural mortality (*M*) computed using the updated meta-analytical approach (Hamel and Cope 2022) based on maximum ages (Hamel, 2015; Then et al., 2015). Other approaches can be considered (e.g., age-specific *M* or another method when maximum age is not reliably estimated) and STATs should explore using the prior to inform the assessment models. This prior is defined as a lognormal distribution with median value (corresponding to the mean in log-space) = 5.40 / maximum age and log-scale sigma = 0.31. The *M* parameter should include exactly three significant digits.

The maximum age values on which *M* priors are based should generally be from fish caught within the area of the assessment, not from Alaskan catches of the same species for example. If a prior for *M* is used to provide a fixed value for *M*, the fixed value should be set equal to the median value of the prior (e.g., 5.40 / maximum age for the prior defined above).

Age- or Sex-specific M

For assessment models with age-specific *M,* the default modeling approach should be a step function rather than a linear ramp, which is a more complicated form of age-dependence. If the Lorenzen approach (Lorenzen, 1996, 2022; Methot and Wetzel, 2013) is used to model age-dependent *M,* the assessment should also present a comparison run that uses constant *M* (i.e., no age-dependence).

STATs should exercise care when estimating sex-specific values for *M* because of the potential for confounding with sex-specific selectivity. In such cases, STATs should provide sensitivity analyses to explore consequences of potential confounding effects.

Weighting of Compositional Data

There are three accepted approaches for weighting age and length composition data: (1) the McAllister and Ianelli (1997) harmonic mean approach; the Francis (2011) approach; and the Thorson et al. (2017) Dirichlet multinomial likelihood approach. The first two methods have been used routinely in Council assessments, whereas the third method, which became available in Stock Synthesis in 2017, has been used less frequently. There is no clear consensus that one approach is superior in all circumstances. The Francis method has become the most used method and provides a basis for comparison to evaluate the preferred method for the stock in question. STATs are encouraged to provide a rationale for the method they select and conduct sensitivity runs with the other methods. STATs should explore correlations in residuals among age or length bins and years to rationalize the weighting approach. Visual examination of bubble plots may be used to evaluate potential correlations between years and ages or lengths.

The calculation of the weighting coefficients for compositional data is done iteratively for the harmonic mean and Francis methods. Starting values are used and updated after each iteration. STATs may need to conduct multiple iteration steps (usually two or three) for the McAllister-Ianelli and Francis methods to evaluate stability in the coefficients.

The starting values for weighting coefficients for marginal compositional data (based on age or length) should be the number of bottom trawl survey tows or fishing trips contributing fish to the composition, or a formulaic combination of the two quantities (Stewart and Hamel, 2014). The starting values for conditional age-at-length data should be the actual numbers of fish on which each composition is based.

Growth

For some species, there may be length or age data available from special projects that fall outside normal sampling programs (e.g., research samples from nearshore nursery areas). Such data may provide information that more completely informs growth curves and can be used in an assessment. Such data are typically not appropriate to use in modeling fishery selectivities. However, these data can be included and associated with their own fleet where there is a shortage of other age data in the model. Including conditional age-at-length data as a survey fleet with constant selectivity for all ages and lengths should set up the model to use the data as desired, unless there is evidence of age-based selectivity (as opposed to length-based selectivity). Non-randomly collected fishery age data can be included (with or without the randomly collected fishery data) as conditional age-at-length data associated with that fishery.

Check for Stability in Length-at-age

Assessment models often assume that growth is time- and space-invariant. Where sufficient data are available, plots depicting mean length-at-age by fleet, time, and/or area would inform the assumption that growth has been constant.

Fecundity

The relationships between body weight or length and fecundity for rockfish should reflect the best available science. Rockfish stock assessments should consider relationships from the meta-analysis in Dick et al. (2017), at the appropriate taxonomic scale, if better species-specific relationships are unavailable. If a size-dependent fecundity relationship is not used in the base model, the model should include a sensitivity analysis that compares spawning output proportional to mature female biomass and an increasing weight-specific fecundity. A sensitivity analysis applying methods in Dick et al. (2017) should also be provided if another method is used in the base model when assessing rockfishes. Stock assessment reports should also include a justification for using alternative methods.

Diagnostics

In addition to the standard set of likelihood profiles identified in the Groundfish Stock Assessment Terms of Reference (across the parameters $\ln(R_0)$[1], *M,* and steepness), the STATs may wish to consider other diagnostics, such as those highlighted in Carvalho et al. (2017).

Prior on Steepness – Sebastes Species

The SSC-approved steepness prior for rockfish species carried over from the 2021 assessment cycle should continue to be used for 2025 (pg 5, Agenda Item I.2.a Supp SSC GFSC Report March 2017). The prior has a mean value of 0.72 and standard deviation of 0.16. Both parameters are defined to exactly two significant digits. If the assessment model does not estimate steepness, the STAT should fix the steepness value at 0.72. This applies to all 2025 rockfish assessments, even for species that were included in the 2017 meta-analysis (i.e., no "Type-C" special case) (Thorson et al. 2019).

Prior on Steepness – Other Species

If a prior is used to fix steepness, the fixed value should be set equal to the mean value of the prior.

[1] Parameter R_0 is the expected number of age-0 annual recruits in an unfished stock.

Adding *Variability Parameters with an Index*

Although standard model tuning practices, including the estimation and use of added variance parameters within stock synthesis, represent best current practices, STATs should do their best to be cautious about adding variability to an index as a means of resolving model structure issues such as conflicts among data sources. Rather, STATs should identify an error structure appropriate for the data. When including additional variance to indices, one should look for possible overinflation of variance due to conflicts with other data (e.g., biological compositions). In those instances, it may be more appropriate to determine which data sources contain the most representative population signal and justify the need to add variance to index values. Sensitivity analyses should be conducted to evaluate assumptions about which data sets and types are most representative.

Jittering to Verify Convergence

In Stock Synthesis, the jitter fraction defines a uniform distribution in cumulative normal space +/- the jitter fraction from the initial value (in cumulative normal space). The normal distribution for each parameter, for this purpose, is defined such that the minimum bound is at 0.001, and the maximum at 0.999 of the cumulative distribution. If the jitter fraction and original initial value are such that a portion of the uniform distribution goes beyond 0.0001 or 0.9999 of the cumulative normal, that portion beyond those bounds is reset at one-tenth of the way from the bound to the original initial value. Therefore, sigma = (max-min) / 6.18. For parameters that are on the log-scale, sigma may be the correct measure of variation for jitters. For real-space parameters, CV (= sigma/original initial value) may be a better measure.

If the original initial value is at or near the middle of the range, then for each 0.1 of jitter, the range of jitters extends about 0.25 sigmas to either side of the original value, and the average absolute jitter is about half that. For values far from the middle of the range, the resulting jitter is skewed in parameter space, and may hit the bound, invoking the resetting mentioned above.

Summary tables that include estimates of sigma, CV, and initial values (available via the 'r4ss' package in R) should be provided whenever jittering is conducted.

Strategies for Phase Sequencing

In general, it is often best to evaluate parameters that scale the population (e.g., R_0, catchability, recruitment deviations, and initial abundance) in early phases, before proceeding to evaluate selectivity, growth, time blocks, or time-varying parameters. Alternative phase sequences can have an impact on parameter estimation, likelihood minimization, and model convergence. STATs should consider alternative phase sequencing as a model diagnostic tool in addition to jittering.

Default Assumptions for Removals in Projections and Decision Tables

The default assumptions for the removals to include in projections are context dependent. The default for specifying removals in projection and decision tables is to use projected attainment for the remainder of the regulatory cycle (provided by the GMT representative) and full attainment for the rest of the projection period. An exploration should be conducted of any removal scenarios (e.g., based on lower than 100% attainment) considered in the last assessment. In cases in which the fishery has been stable with low Annual Catch Limit (ACL) attainment, considering future scenarios with low attainment is likely justified. A rationale should be provided if the removal scenarios differ from the default or from the last assessment. The STAT should collaborate with the GMT representative and Council staff regarding removal assumptions. The GMT may have projections from the recent regulatory specification analysis to inform removals for the next two years (e.g., 2025 and 2026 for the 2025 assessment cycle). The default assumption for future removals is full attainment unless a different assumption was used in the last assessment and still well supported or the GMT provides a strong justification for something less than full attainment. The full attainment alternative should always be evaluated for comparison purposes.

The GEMM total mortality annual report, ideally used to update catch for the most recent year, is not available until September, though the catch-based projections and other assessments need to be completed and reviewed by the SSC at the September Council meeting. The SSC two-week notice for documents (Council Operating Procedure 4) has been waived given the quick turnaround time. In the absence of updated catch from the GEMM report, the GMT may provide the data they have in hand for the most recent year and projected impacts in the remaining months as the basis for analysis.

Risk Tables

Following Council and SSC guidance, risk tables will be developed for as many benchmark assessments as possible in 2025. Risk tables should follow the approach described in the 2024 CCIEA report (Agenda Item H.1.a CCIEA Team Report 1, September 2024) which describes a structured framework for including ecosystem and environmental conditions that are not included in the assessment model, assessment data, and assessment model fit and uncertainty. These tables should be in the Executive Summary of the assessment. They should be succinct and the description of them and resulting proposed risk levels should not exceed 2 pages total. Science Center stock assessment and ecosystem scientists should work together to complete the table and accompanying write-up. The first two columns of the risk table (ecosystem and environment, and assessment data) should be included in draft form in the pre-STAR draft stock assessment document. A draft version of the third column may be included, but could also be developed during and after the STAR panel for inclusion in the post-STAR, pre-GFSC draft assessment. The GFSC will review all risk tables for consistency across stocks and make any determinations of adjustments to sigma during their review.

Additions Identified for Future Consideration

- Given the linkage between the input sample size and the Dirichlet multinomial data-weighting approach, future research should be conducted to provide improved guidance on developing input sample size for weighting compositional data (particularly for the Dirichlet approach).
- Explore categorizing uncertainty by using model estimated uncertainty, sigma, or the default category sigma value (if greater than the model estimates) to create low and high alternative states of nature, taking into account asymmetric uncertainty while integrating total variance in the model.
- Explore the use of Markov chain Monte Carlo (MCMC) runs for groundfish assessments to explore uncertainty in a probabilistic fashion, akin to what is currently being provided in the Pacific whiting stock assessment report. The time it takes to run an MCMC may be prohibitive for benchmark assessments given the compressed time frame between getting final data and document deadlines as well as issues with running alternative model configurations during a review. Application to update assessments may be more reasonable given the few changes and less extensive review process.
- Recommendation to conduct research needed to distribute relevant unidentified fish categories (e.g., URCK, UFLT) and/or group categories (e.g., nearshore, shelf, and slope rockfish) into species-specific landings.

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02/06/25