ACCEPTED PRACTICES GUIDELINES FOR GROUNDFISH STOCK ASSESSMENTS

The following guidelines are intended to provide STATs with default approaches they should use for dealing with certain stock assessment data and modeling issues. The STATs may diverge from the guidelines if they provide adequate justification for doing so. 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 specific issues that the 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 by the end of March 2017 for use with 2017 stock assessments.

Biomass indices from bottom trawl surveys

The geostatistical delta-GLMM software (vector autoregressive spatial temporal model, VAST) developed and maintained by Dr. Jim Thorson (NWFSC) is an acceptable tool 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. Analysts are strongly encouraged to compare model results with and without the spatial autocorrelation feature. If they use the geostatistical features they should provide appropriate diagnostic statistics. Assessment documents should include diagnostics supporting the selected model underlying each biomass index and should also include a comparison of the model-based biomass estimates with design-based estimates to gauge the uncertainty associated with the choice of methodology. Dr. Thorson will provide a document describing recommended defaults and practices for using the VAST software.

Biomass indices from fishery dependent sources (e.g., logbooks)

The VAST software can also be used to standardize fishery CPUE data series for use as biomass indices. If the geostatistical option is used the approach provides an objective mechanism for imputing catch rates from regions with no fishing. 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.

Spatial stock structure for groundfish species

STATs conducting assessments of groundfish species should explore regional differences in biology (or the underlying environmental conditions that influence biology) when defining stock structure in assessments. If there are separate regional models for a species the models should use consistent approaches for modeling productivity and for data weighting. STATs conducting assessments of nearshore groundfish species should explore state-specific or finer-scale stratifications for the assessment models to account for regional differences in exploitation and management history.

Prior distributions for natural mortality (*M*)

Assessments for groundfish species should report the prior probability distribution for natural mortality (*M*) based on the meta-analytical approach updated by Dr. Owen Hamel (NWFSC) based on maximum ages (Hamel, 2015; Then et al. 2015) and STATs should explore using the prior to inform the assessment models. 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.

Age- or gender-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 is used to model age-dependent *M* (Lorenzen, 1996) the assessment should also present a comparison run that uses constant *M* (i.e., no age-dependence).

If an assessment model includes values for *M* that differ by gender, the assessment should consider whether there is corroborating (or contrary) evidence of age-dependence in the sex ratio and present a comparison model run that uses the same *M* for both genders.

Weighting of compositional data

STATs by default should use the Francis method for weighting age- and length-compositional data. Assessment documents should include sensitivity runs that use (a) the harmonic mean weighting approach as well as (b) the Dirichlet multinomial likelihood approach, as a mechanism to gauge the uncertainty associated with the choice of methodology. Assessment documents should report the adjustment factors for composition data computed using the harmonic mean and Francis methods, as well as the corresponding weighting parameter estimated for the Dirichlet approach.

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 should continue the iteration process until the changes in biomass between successive iterations is less than 5%.

The starting values for the 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. For conditional age-at-length data the starting values should be the actual numbers of fish on which each composition is based.

The STATs should scan the fits to compositional data for unusual patterns or trends in the residuals that might indicate data conflicts, erroneous data, or poor specification of the model. In such circumstances it may not be appropriate to estimate "extra variability" for survey catchability coefficients because doing so will degrade the influence of those survey indices.

Data Extractions

The STATs should record and report the versions of any databases they use and the dates of any database queries and data extractions so there can be verification that the most up-to-date data

were used.

Landings Data

STATs should either (a) verify that the relevant unidentified fish category (e.g., URCK, UFLT) in PacFIN and RecFIN has no appreciable quantities of the species being assessed or (b) develop and apply an appropriate species proportion to the landings of unidentified fish to estimate corresponding landings of the species being assessed.

STATs should be mindful that tribal landed catches may not be included in PacFIN (or NORPAC for at-sea catches). STATs should directly contact tribal representatives to obtain tribal landings data.

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.

The historical catch reconstruction developed for California currently does not account for fish landed into California that were caught off Oregon or farther north. STATs should establish if this portion of the historical fishery in California accounts for appreciable quantities of the species being assessed.

Discard Data

The STATs should check in with the NWFSC Groundfish Observer program to obtain estimates of discards and summaries of any available biological information for discarded fish. 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.

A software package is available from the NWFSC 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 Stock Synthesis. The STATs should use this software. If a STAT uses other software, they should verify that the other software produces equivalent results.

Recreational Catch-per-Unit-Effort Data

If a catch-per-unit-effort 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 screened using the Stephens and MacCall (2004) method to identify data records that were unlikely to include the species being assessed.

Modeling - Selectivity

Non-selected biomass, sometimes described as "Cryptic biomass", is a term used to describe the phenomenon whereby a model predicts biomass that is not directly observed in data from any fleet. Non-selected biomass can only arise if all fleets have selectivity curves that are dome-shaped. An assessment that has all fleets with dome-shaped selectivity curves should as a

sensitivity run include at least one fleet that has asymptotic selectivity and should provide a figure or estimate of the amount of non-selected biomass for cases where all selectivity curves are dome-shaped. R code is available for producing this figure.

Modeling - Fecundity

Rockfish stock assessments should consider the fecundity relationships from the meta-analysis in Dick et al. (2017) 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 run comparing spawning output proportional to mature female biomass versus increasing weight-specific fecundity.

Modeling – Diagnostics

Every stock assessment document should at a minimum include likelihood profiles across the parameters $\ln(R0)$[1], M and steepness. These profiles should show the normalized likelihood values for each individual component separately. The purpose is to help identify which data components are providing information on the estimate of scale and if there are conflicts between those components. This diagnostic is an aid to understanding and structuring a model; it may not identify model misspecification.

Modeling – Prior on Steepness – *Sebastes* Species

If the stock being assessed is **not** in the set of *Sebastes* stocks used to derive the steepness prior and the assessment model does **not** estimate the steepness parameter, then fix the steepness value at the mean of the prior distribution.

If the stock is **not** in the set of *Sebastes* stocks used to estimate the steepness prior and the assessment model does estimate steepness, then use the mean and standard deviation of the prior distribution as the mean and standard deviation for assessment model's prior on steepness.

If the stock is in the set of *Sebastes* stocks used to estimate the steepness prior and the assessment model does **not** estimate steepness, then fix the steepness value at the mean of the prior distribution.

If the stock is in the set of *Sebastes* stocks used to estimate the steepness prior and the assessment model does estimate steepness, use a "Type-C" value that is recalculated while excluding that stock. For 2017 assessments, this will apply to Pacific ocean perch and yellowtail rockfish. This ensures that the prior distribution does not "double count" data for that stock when estimating steepness. For Type-C priors, assessment authors should contact Dr. James Thorson with at least a one-month lead prior to when the value is needed.

Modeling – Prior on Steepness – Other Species

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

[1] Parameter $R0$ is the number of age-0 annual recruits in an unfished stock.

References

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Addendum – 18 April 2017

After finalizing the Accepted Practices Guidelines document in late March 2017 some issues were identified with regard to possible incompatibilities between the biological data from California that are stored in the CalCOM system and the software package available from the NWFSC to process biological sample data stored in PacFIN's Biological Data Samples (BDS) and generate time series of compositional data that are formatted for use with Stock Synthesis. There will not be time prior to the start of the 2017 assessment cycle to identify the incompatibilities and fully revise and test the NWFSC software package. Consequently STATs conducting assessments that use biological data from California are requested to develop two sets of compositional data series. Series (1) should be based on the NWFSC software and data from the PacFIN BDS (as specified in the original Accepted Practices Guidelines); series (2) should use expanded compositional data from the CalCOM system for fish landed into California and should use the NWFSC software and data from the PacFIN BDS for any fish landed into Oregon and Washington. STATs will decide which data series is best for their base model and should use the other compositional series as a sensitivity run if it is different from the Base model set.

Revised 20 April 2017