
Center for Independent Experts (CIE) Reviewer's Independent Peer Review Report on the 2015 Stock Assessment Review (STAR) Panel 4 on assessments of Widow rockfish and Kelp greenling

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Prepared by

Neil Klaer

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Executive Summary

The 2015 Stock Assessment Review (STAR) Panel 4 on assessments of Widow rockfish (*Sebastes entomelas*) and Kelp greenling (*Hexagrammos decagrammus*) met in Newport, Oregon, from Monday, July 27 to Friday, July 31 2015. The meeting was chaired by Dr David Sampson from the Scientific and Statistical Committee (SSC). The review panel (the Panel) was composed Dr Ian Stewart, International Pacific Halibut Commission, and two scientists affiliated with the Center for Independent Experts (CIE): Dr Paul Medley and Dr Neil Klaer. After model presentations and general discussions, the first four days and part of the last day of the meeting were devoted to the examination of various aspects of the models through the request and response process.

There was some adjustment of data inputs and how they were accounted for by the models for both species that resulted in relatively minor changes to the base cases. My own particular interests were in the choice of stock boundaries, examination of unavailable spawning output and, for Kelp greenling, to attempt to improve the fit of growth curves to lessen systematic residual patterns shown particularly for young fish. Draft STAR Panel Meeting Reports were compiled from reviewer notes on the last day, and further composed and edited during the weeks following the meeting via email.

As I have attended all of the STAR Panel meetings this year I have been accumulating general recommendations that apply to all rockfish species which are included in full here.

Findings for Widow rockfish

Widow rockfish occur over hard bottoms along the continental shelf, forming dense, irregular midwater and semi-demersal schools at depths of greater than 100m at night and disperse during the day. They range from Albatross Bank off Kodiak Island, Alaska, to Todos Santos Bay, Baja California, Mexico. The effect of a potential wider stock particularly across the US/CA border and therefore contribution to the US west coast spawning stock biomass is unknown at present and is a considerable uncertainty.

The complete catch history for all rockfish species is uncertain, particularly for historical periods where unspecified rockfish catch needs to be separated by species using assumptions about species ratios. Further work can be done to evaluate catch uncertainty and to provide alternative plausible catch series for sensitivity testing using the assessment model.

Given the large number of available abundance indices, it was noted during the meeting that the Panel was unable to examine each in detail. The Panel was able to agree with standard procedures used and endorsed by the SSC for many of the indices: delta GLM for individual fishing operations, accounting for extreme catch events for the triennial survey. The Stock Assessment Team (STAT) also noted that they were unable to further investigate procedures used for abundance indices in previous assessments due to time constraints.

The assessment was done using SS3 (ver. 3.24u) and re-examined the fleet structure used for the previous assessment, basing decisions on fishing strategy rather than area. States were combined, but gears were kept separate and fleets were also separated based on discarding

practices. It was a single area, single growth-morph, two-sex model. The Panel was generally impressed with the care and attention to detail by the STAT in producing this assessment.

The Panel requested additional model runs as part of its review. Adjustments to the base model agreed by the STAT and the Panel during the meeting were an updated steepness value and prior that excluded Widow rockfish, fixing the main period of recruitment deviations to begin in 1970, use of survey length compositional data (Triennial and NWFSC) and conditional age-at-length compositional data (NWFSC) both weighted by numbers from the GLMM, and marginal age- and length-compositional data for the fisheries. This new model configuration was tuned using an adjusted sequential lambda approach and resulted in slight changes from the pre-STAR base model. This configuration was considered to be the best currently available for the provision of management advice.

Major sources of uncertainty explored and suggested by the STAT and agreed by the Panel for inclusion in axes of uncertainty for management recommendations were natural mortality, steepness, and the strength of the 2010 recruitment.

Findings for Kelp greenling

Kelp greenling range from southern California, north to the Aleutian Islands, Alaska, but are rarely found south of Point Conception, California. They are most prevalent nearshore and inter-tidally in depths <50m. There is little direct information on the stock structure of kelp greenling off the U.S. west coast. Little is also known of kelp greenling movement patterns, but given their nearshore distribution and the territorial behavior of adults, they are not believed to migrate at great distances. The current assessment examines the stock off the Oregon coast using State borders as boundaries. The southern stock boundary at the OR/CA border is the most uncertain and not set according to biogeographic regions. Larvae are planktonic for about 6 months before settlement, and the effect of a potential wider spawning stock contributing to the stock within the defined boundaries is unknown at present.

They are mostly caught either recreationally by hook-and-line gear or commercially by hook-and-line or longline gear with total annual landings estimated at less than 20mt prior to about 1975, and less than 45mt in all subsequent years except for 60, 100, and 60mt in the years 2001-03. Commercial catches rose sharply in 2002 but management limits on the commercial fishery from 2004 have since stabilized the commercial catch at levels comparable to the recreational fisheries. There is considerable uncertainty in total landings for recreational estuary-boat and shore-based fishing modes, especially pre-1980 when catches were extrapolated from license sales, and 2005-2014 when catches were extended from surrounding years.

The assessment was done using SS3 (ver. 3.24u) and was only the second Kelp greenling assessment, the first being in 2005. It was a single area, single growth-morph, two-sex model. Four fishing fleets were defined: commercial (combination of hook-and-line and longline) and recreational split into ocean-boat, estuary and shore. Natural mortality was fixed at the median of the prior distribution. There were many changes to model structure and available input data (listed in detail in the pre-Panel draft assessment).

The Panel requested additional model runs as part of the review and some became changes to the base model agreed by the STAT and the Panel: removal of the MRFSS abundance index, re-extraction of the MRFSS length composition data, inclusion of age 1 and 2 conditional age-at-length data from the special project, simplification of estimated growth parameters, use of Cabezon ageing error estimates, and filtering logbook CPUE data using a three-year vessel filter. The modified base case is the best currently available for the provision of management advice.

Final model results indicate that while the stock size is small compared to most fisheries, it appears to have been only lightly exploited (except perhaps in 2001-2003) with current spawning biomass at near unfished levels. Stock assessments are generally improved when contrast becomes evident in the input data, which will likely only happen should this stock become more heavily fished.

The major source of uncertainty explored and suggested by the STAT and agreed by the Panel for inclusion as an axis of uncertainty for management recommendations was natural mortality, with the range chosen based on changing the maximum observed age plus and minus 2 years.

1 Introduction

1.1 Background

The 2015 Stock Assessment Review (STAR) Panel 4 on assessments of Widow rockfish (*Sebastes entomelas*) and Kelp greenling (*Hexagrammos decagrammus*) met in Newport, Oregon, from Monday, July 27 to Friday, July 31 2015. The meeting was chaired by Dr David Sampson from the Scientific and Statistical Committee (SSC). The review panel (the Panel) was composed Dr Ian Stewart, International Pacific Halibut Commission and two scientists affiliated with the Center for Independent Experts (CIE): Dr Paul Medley and Dr Neil Klaer.

Draft stock assessment reports as well as all associated background documents were made available via a public FTP site to the Panel on 15 July prior to the review meeting. During the meeting, all documents were available electronically via the same FTP site, and additional documents and presentations made during the meeting were also posted there.

The meeting generally followed the draft agenda and included presentations by the stock assessment teams (STATs) mixed with questions and open discussion. Additional analyses were requested by the Panel from the STATs and the results of those were also subsequently presented. A summary of those requests, rationale and STAT responses is contained in the Stock Assessment Review Panel Meeting Reports for each species. The Panel participated in the review of each Term of Reference (ToR) for the meeting.

1.2 Review Activities

After model presentations and general discussions, the first four days and part of the last day of the meeting were devoted to the examination of various aspects of the models through the request and response process.

There was some adjustment of data inputs and how they were accounted for by the models for both species that resulted in relatively minor changes to the base cases. The appropriate weighting method to use for conditional age-at-length data, whether early recruitment deviations uninformed by composition data should be turned off, and whether the analysis that determined the prior for steepness should remove the species in question were shown to be current technical uncertainties that require resolution. My own particular interests were in the choice of stock boundaries, examination of unavailable spawning output and, for Kelp greenling, to attempt to improve the fit of growth curves to lessen systematic residual patterns shown particularly for young fish. Draft STAR Panel Meeting Reports were compiled from reviewer notes on the last day, and further composed and edited during the weeks following the meeting via email.

Tasks were distributed among the reviewers for working towards a draft report during the meeting, with Ian Stewart assigned to data issues, myself to model structure and Paul Medley to uncertainties. Similarities in some of my comments below and the draft meeting report are due to that process.

2 Review of assessments of Widow rockfish and Kelp greenling

2.1 Terms of reference

The Panel considered the assessments in light of the terms of reference provided as follows:

1. Become familiar with the draft stock assessment documents, data inputs, and analytical models along with other pertinent information (e.g. previous assessments and STAR panel report when available) prior to review panel meeting.

2. Discuss the technical merits and deficiencies of the input data and analytical methods during the open review panel meeting.

3. Evaluate model assumptions, estimates, and major sources of uncertainty.

4. Provide constructive suggestions for current improvements if technical deficiencies or major sources of uncertainty are identified.

5. Determine whether the science reviewed is considered to be the best scientific information available.

6. When possible, provide specific suggestions for future improvements in any relevant aspects of data collection and treatment, modeling approaches and technical issues, differentiating between the short-term and longer-term time frame.

7. Provide a brief description on panel review proceedings highlighting pertinent discussions, issues, effectiveness, and recommendations.

2.2 Findings by term of reference for Widow rockfish

The comments below refer to aspects that were examined during the meeting, but include my own additional commentary for preparation of this CIE report.

2.2.1 Become familiar with the draft stock assessment documents, data inputs, and analytical models along with other pertinent information (e.g. previous assessments and STAR panel report when available) prior to review panel meeting.

The PFMC (2014) Status of the Pacific Coast Groundfish Fishery: Stock Assessment and Fishery Evaluation report provides a very useful summary of the distribution and life history, and stock status and management history for the rockfish species. The previous assessment and associated STAR panel reports provide a useful starting point for the evaluation of progress by the STAT in addressing previous concerns, and for noting those that remain. The PFMC Terms of Reference for the Groundfish and Coastal Pelagic Species Stock Assessment Review Process for 2015-16 (September 2014) includes an outline for stock assessment documents that is commendable. A section is included that addresses responses to previous STAR panel recommendations which is commendable. Inclusion of SS files in background information prior to the meeting allowing reviewers to run the base model if needed is also a good development. This allowed me to have an additional new diagnostic run regarding protected/cryptic spawning output in the week before the meeting.

2.2.2 Discuss the technical merits and deficiencies of the input data and analytical methods during the open review panel meeting.

Stock boundary

Stock boundaries might ideally be based on the following standards in priority order: (1) research information that provides direct evidence for chosen boundaries (e.g. genetic or movement studies), (2) biogeographic regions that appear to define strong boundaries for many stocks based on oceanographic conditions and/or apparent presence or absence of a variety of species, (3) indirect evidence of stock separation due to breaks in occurrence (possibly due to lack of suitable habitat, or apparent biological differences in growth and/or age composition), (4) lines drawn at prominent ocean features that may define biogeographic regions, and (5) lines drawn for data aggregation or management convenience at fishery management region, state or national boundaries. Additional work to further develop an objective procedure for evaluating the chosen stock boundaries across all rockfish (and potentially all other) assessments may be beneficial, and also more directly point to required directions for future research or assessment collaboration across national/international political boundaries.

According to background documents, Widow rockfish occur over hard bottoms along the continental shelf, forming dense, irregular midwater and semi-demersal schools at depths greater than 100m at night and disperse during the day. They range from Albatross Bank off Kodiak Island Alaska to Todos Santos Bay, Baja California, Mexico. They are most abundant from British Columbia to Northern California. Although catches north of the U.S.-Canada border or south of the U.S.-Mexico border were not included in this assessment, it is possible that these populations contribute to the biomass of Widow rockfish off the U.S. west coast through adult and juvenile migration and/or larval dispersion. They are medium-lived (rarely living longer than 20 year for females and 15 years for males), and bear live larvae. The effect of a potential wider stock, particularly across the US/CA border, and therefore contribution to the US west coast spawning stock biomass is unknown at present and is a considerable uncertainty. Under the criteria above, the selection of the stock boundary at the US border only at level (5). I was unable to find an up-to-date Canadian catch history for Widow rockfish to potentially include for US assessment sensitivity testing (there is one available to 1998). However, this species should be included in any future discussions about trans-national stocks that are not assessed as such.

Catches

Most of the catches of Widow rockfish have been taken by commercial trawl and hook-and-line fisheries since the early 20th century. They are desirable and not likely to be discarded for market reasons, although discards of smaller fish closer inshore are uncertain. Catches by recreational, commercial pot and commercial shrimp fisheries are low and not considered in the assessment.

The shoreside and at-sea Pacific Hake fishery catches Widow rockfish as a bycatch, and catches from that fishery were estimated separately.

The complete catch history for all rockfish species is uncertain, particularly for historical periods where unspecified rockfish catch needs to be separated by species using assumptions about species ratios. Further work can be done to evaluate catch uncertainty and to provide alternative plausible catch and discard series for sensitivity testing using the assessment model. Formal rockfish catch reconstructions have been done for Oregon and California but not Washington. The Washington catch reconstruction (for commercial bottom trawl, midwater trawl, longline and net) was done for Widow rockfish specifically for this assessment.

Abundance indices

Table 1. Abundance index summary for Widow rockfish

Region	ID	Fleet	Years	Name	Fishery independent	Filtering	Method	Rank	Method endorsed
Coastwide		8	2003–2014	NWFSC shelf/slope survey	No	South of 34.5 removed	GLMM, Gaussian, ECEs	1	SSC
OR		1	1984–1999	Oregon Bottom Trawl	No	Jan–Mar 42.5–46.5 & 124.6-124.9 >1000 lbs	Delta-GLM	2	Past assessments
OR/WA		3	1991–1998	Domestic at-sea	No		Delta-GLM	3	Past assessments
OR/WA		3	1983, 1985–1990	JV at-sea bycatch	No		Delta-GLM	4	Past assessments
Coastwide		7	1980–2004 (triennially)	Triennial trawl survey	Yes	None	GLMM, Gaussian, ECEs	5	SSC
Coastwide		9	1977-82, 1984-88	Foreign at-sea bycatch	No		Delta-GLM	6	Past assessments
Coastwide		6	2004, 2005–09, 2011 2013-14	Juvenile Survey	Yes		ANOVA	7	Past assessments

Given the large number of available abundance indices, it was noted during the meeting that the Panel was unable to examine each in detail. The Panel was able to agree with standard procedures used and endorsed by the SSC for many of the indices: delta GLM for individual fishing operations, accounting for extreme catch events for the triennial survey. The STAT also noted that they were unable to further investigate procedures used for abundance indices in previous assessments due to time constraints.

Indices from the commercial fisheries (OR/WA domestic at-sea, joint venture at sea and foreign at-sea and Oregon bottom trawl) when plotted together show that the foreign at sea index is noisier than the others, and that there is some correspondence between the hake and bottom trawl indices with a decline to about 1990 and flat to 1998. For the fishery independent indices the model-based triennial survey shows a general decline from 1992 to 2004, and the juvenile survey shows a decline from 2004 to about 2010 and then an increase to 2014.

Length and age data

There are good numbers of length samples by state for the non-hake fisheries (100-300 per year overall 1981-2000, but lower recently at 10-50 per year 2001-2014). Good length sample numbers are available from the at-sea hake fishery (150-1,500 1992-2014) and a small and irregular number of samples by state from the shore-side hake fishery, mostly from Oregon.

Good numbers of age samples are available (50-250 per year 1980-2000, 10-50 2001-2014) generally matching the availability of the length-only samples.

2.2.3 Evaluate model assumptions, estimates, and major sources of uncertainty.

The assessment was done using SS3 (ver. 3.24u) and re-examined the fleet structure used for the previous assessment, basing decisions on fishing strategy rather than area. States were combined, but gears were kept separate and fleets were also separated based on discarding practices. It was a single area, single growth-morph, two-sex model, with recruitment deviations starting in 1900, catch starting in 1916, and steepness fixed at 0.773 (the mean of the Thorson pers. comm. prior, modified during the meeting to 0.798 from an updated analysis excluding Widow) and sigma R at 0.6. The maximum age bin was 40 with a plus group. Five fishing fleets were defined: bottom trawl, midwater trawl, two hake fisheries and hook & line. Natural mortality was estimated, using the Hamel (2013) prior for a maximum age of 54. Indices were weighted by estimation of an extra sd, length and age composition data were weighted using three alternative methods, and conditional age-at-length was unweighted and entered as raw otolith counts. The Panel was generally impressed with the care and attention to detail by the STAT in producing this assessment.

All fishery selectivities were specified as double-normal, although the only one fitted by the model as dome-shaped was midwater trawl (all others asymptotic). Two selectivity time blocks were used to account for Rockfish Conservation Areas (RCAs) for bottom trawl, four blocks for midwater trawl to account for management changes, and two blocks for hook and line to account for RCAs. A cubic spline asymptotic selectivity was used for surveys. Discards for bottom trawl were modeled via a retention curve with 5 time blocks, midwater trawl via flat retention with 4 time blocks, hake fisheries assuming 100% retention and hook and line modeled via a retention curve with 2 time blocks.

Newly developed software was used to plot the amount of spawning output that is not available to exploitation due to the shape of the population-level fishery selection curve, which is comprised of two parts: small fish and large fish (see Appendix 4). The plot indicated that relatively small proportions of large fish biomass are unavailable to exploitation. Because the trawl surveys are assumed to have asymptotic selection, there should be no concern about “cryptic biomass” seen by the model but not by any sampling process.

A bridging analysis was carried out that separately examined the influence of updated SS version, updated catch, updated fishery-independent abundance indices and updated length and age compositions on the previous 2011 assessment. None of these changes caused a substantial change in the overall biomass trend, particularly in terms of relative depletion.

Presentation of (partial) MCMC results was an excellent addition for this stock assessment and should be encouraged as a diagnostic, even though the uncertainty from MCMC is not used for management recommendations. These provide a possible source of distributions for axes of uncertainty (although those axes would best be constructed across different model structures rather than from within a single model).

So-called “squid plots” that show retrospective patterns in recruitment residuals show that it takes about 8 years of data for estimated recruitments to settle as flat reliable estimates, indicating that there is likely to be considerable uncertainty associated with recent recruitments back to about 2008. This period includes the estimated high recruitment for 2010, suggesting that uncertainty in this estimate, particularly for projections, is an important uncertainty in this assessment.

Data weighting was explored using three methods initially: harmonic mean, line fitted by eye through the scatter plot of effective N vs. input N, and Francis weighting. Appropriate weighting procedures are currently an active area of research, and the Center for the Advancement of Population Assessment Methodology (CAPAM) has planned a workshop for October to examine alternative procedures and also to hopefully provide recommendations on standards. A known issue in SS is that reweighted input sample sizes less than 1 are rescaled back to 1 (an interaction with the requirements for bootstrapping) that potentially leads to a bias if small values are common in a data set (particularly a problem with highly partitioned conditional age-at-length samples). Strong arguments were made during the meeting to use the harmonic mean method until an alternative procedure is more broadly recommended, and this was agreed by the Panel and STAT for use in the base case for age and length compositions and also conditional age-at-length data. The 1 re-scaling problem can be avoided by iterating to the required weighting value as normal, then setting all reweighting values back to 1 and applying the weight value directly to the appropriate likelihood component using a lambda. This method was also agreed by the Panel and STAT, while also recognizing that input and effective sample sizes in diagnostics are difficult to interpret when lambdas are used.

At the previous Black rockfish STAR Panel, it was recommended that recruitment deviations be turned off for the early period where recruitments are not informed by subsequent composition data to not give the model freedom to introduce periods of above or below average recruitments in the early period simply to build or reduce overall biomass prior to the data rich period of the assessment. It was noted that turning off early recruitment deviations also turns off the associated error, therefore not properly accounting for model uncertainty during that early period. As the pre-STAR base model available for examination did not show undesirable behavior of recruitment deviations in the earlier period (they were near flat), it was agreed to leave them turned on. The current STAR Panel process requires the selection of a base case without consideration of error estimates from that base model, but via the selection of alternative models that define axes of uncertainty. It is an open question in these circumstances whether early recruitment deviations should be turned off because individual model uncertainty is not used for management recommendations anyway, and to prevent undesirable behavior of early recruitment deviations in models chosen for axes of uncertainty because detailed diagnostics are not usually examined for those models. Advice is also required for how best to set bias adjustment if early recruitment deviations are switched on to avoid an average bias off the curve for the MPD model result.

Major sources of uncertainty explored and suggested by the STAT and agreed by the Panel for inclusion in axes of uncertainty for management recommendations were natural mortality, steepness, and the strength of the 2010 recruitment.

2.2.4 Provide constructive suggestions for current improvements if technical deficiencies or major sources of uncertainty are identified.

Other than adjustments to the base model configuration noted below under 2.2.5, the Panel had no specific suggestions for further changes.

2.2.5 Determine whether the science reviewed is considered to be the best scientific information available.

Responses to earlier review recommendations.

A required section of the draft stock assessment document is responses to STAR panel recommendations from the most recent previous assessment. The STAT adequately responded to most of those recommendations. Those that remain to be further addressed were examination of spatial patterns in fishery harvests/effort, a theoretical investigation of length/age-based selectivity, a formal historical catch reconstruction for Washington, further investigation and possible re-ageing of old otoliths, consideration of linkages to ecosystem models and exploration of the utility of additional legacy data sets such as Oregon bottom trawl CPUE.

Requests and responses during the meeting

The Panel requested additional model runs as part of its review. Adjustments to the base model agreed by the STAT and the Panel during the meeting were an updated steepness value and prior that excluded Widow rockfish, fixing the main period of recruitment deviations to begin in 1970, use of survey length compositional data (Triennial and NWFSC) and CAAL compositional data (NWFSC) both weighted by numbers from the GLMM, and marginal age- and length-compositional data for the fisheries. This new model configuration was tuned using the (sequential) lambda approach and resulted in slight changes from the pre-STAR base model.

The modified base case was the best currently available for the provision of management advice.

2.2.6 When possible, provide specific suggestions for future improvements in any relevant aspects of data collection and treatment, modeling approaches and technical issues, differentiating between the short-term and longer-term time frame.

I agree with the research recommendations in the STAR Panel report made specifically for Widow rockfish and will not repeat those here. As I have attended all of the STAR Panel meetings this year I have been accumulating general recommendations that apply to all rockfish species, some of which appear in the STAR Panel report in reduced form, so I will include those here.

The recommendations below are general to all rockfish (and also Kelp greenling). I leave all recommendations here – some of which do not apply to Widow rockfish as a largely non-recreational species.

Data preparation (medium-term)

- There is a need for more detailed examination of input data prior to stock assessment, particularly in relation to sample size and representativeness. An examination of data sources by year and sub-area in particular may suggest appropriate methods for post-stratification of composition data (also potentially season, depth, boat type, etc. depending on source).

- Continue work to automate data preparation as much as possible, incorporating recommended procedures for data filtration and post-stratification of composition data.

- Additional work is required in each state to better justify most likely catch histories, and also to define alternatives that encapsulate major uncertainties for model sensitivity testing.

- Formal rockfish catch reconstructions have been completed for California and Oregon but not for Washington.

- A recurring problem exists for stock assessments in how to interpret MRFSS length data. There appears to be confusion about how conversion factors have been applied in different periods, and the most appropriate procedure to extract a full time-series of comparable length measurements from the database.

- Post-stratification procedures and methods to determine input sample sizes (often the preferred method is by trip) for composition data need to be standardized, agreed and documented.

Independent measures of stock biomass (medium-term)

Continued work on definition and measurement of suitable habitat for particular rockfish species especially combined with density estimates would assist many aspects of the assessments, particularly as an independent indicator of plausible relative scale of modeled virgin biomass by area/region/state.

Stock boundaries (medium-term)

Additional work to further develop an objective procedure for evaluating the chosen stock boundaries across all rockfish (and potentially all other) assessments may be beneficial, and also more directly point to required directions for future research or assessment collaboration across national/international political boundaries.

Pre-assessment data workshop (short-term)

A specific data meeting perhaps for all rockfish could examine information across a broad range of species due for assessment, and would also assist with the development of more specific documentation of protocols used to compile best available data sets for stock assessment, continue acceptance of agreed procedures for standardization of abundance indices, and also begin work on procedures for the development of alternative data series that capture uncertainty – particularly for historical catch and discards. This would assist in the prevention of data issues becoming apparent later in the process – as has occurred this year for other rockfish species. A nearshore stock assessment workshop was carried out with some of these objectives in 2015 for Black rockfish, China rockfish and Kelp greenling, so input data for Black rockfish was subjected to earlier examination this year.

Abundance indices (short-medium term)

- Consider the development of a fishery-independent survey for nearshore stocks. As the current base model structure has no direct fishery-independent measure of recent rebuilding of the adult portion of the stock, any work to commence collection of such a measure for nearshore rockfish, or use of existing data to derive such an index would greatly assist with this assessment.

- An objective procedure for selection of sub-model error structure (usually gamma or lognormal here) is required for delta-GLM procedures. Consistency is required for the model selection process – preferably using AIC rather than step-wise. The standard delta-GLM procedure should allow for different factors to be considered in the binomial and sub-models. A standard set of diagnostics should be provided to review panels for each abundance index.

- A multi-species simulation study to test whether the Stephens-MacCall filtering may lead to a bias in abundance estimates given differences in abundance trends among species should be considered. Some of this work has been done (Andi Stephens, PhD thesis) and should be published.

Data weighting

Standardized procedures for relative weighting within and across different data sources (particularly length and age composition, age at length composition and abundance indices) are currently an area of active research. Currently recommended procedures are to estimate an additional sd for abundance indices, and to use Francis weighting for length and marginal age compositions. There is currently a lack of consensus on an agreed approach for weighting conditional age-at-length data. A workshop is planned for later this year which may provide guidance if new research that resolves current questions is presented at that meeting.

R4SS/SS3 standard procedures (short-medium term)

- Examination of comparable abundance indices plotted together is a useful consistency check that should be included as part of all assessments with a large number of indices. R code was used by the China rockfish STAT that plotted all indices on the same graph as well as the available biomass for each index from the base model that should be considered as an addition to R4SS.

- The R code developed at the Black rockfish STAR Panel to examine unexploitable spawning output should be a standard model diagnostic included in R4SS.

- A procedure for examination of sources of information on annual recruitment events is required particularly for models where recent recruitment levels are uncertain and have a great impact on projections: profile over recruitment events? Or partition likelihood components?

- A standard procedure for appropriate choice of bounds for jittering is required.

- A method to examine observed and expected sex ratio by age and through time would resolve questions about the appropriateness of sex ratios being produced for the modeled population.

- Weighted residual plots combined across data sources for length and marginal age compositions would allow overview judgment of the model fit to composition data (perhaps catch weighted for fleets with associated catch only?).

- Removal of the re-scaling to 1 problem in SS after weighting is applied to composition data

- Development of standard procedures for the selection of the most appropriate weighting system that should be applied to input data (additional sd for indices, harmonic mean/Francis/other for length and marginal age comps, Harmonic mean/Francis A/other for conditional age-at-length data.

- Where current models appear to provide implausible recruitment deviations particularly early in the series, further work to use available options in SS to force improved model behavior in that period may provide an acceptable resolution. In addition, this work may provide guidance for additional flexibility that might be added to SS to better handle the problems of recruitment estimation.

- The SS input interface is not user-friendly and requires considerable knowledge of formatting requirements and the meaning of some settings in relation to how the model is configured or parameterized. The development of software that includes expert knowledge of common configuration errors and solutions that can be run on model input settings would quickly resolve many common problems.

- Consider the use of “breakout rules” to more objectively determine when the most recent stock assessment has become inconsistent with recent data. An example of such a rule used in Australia examines predicted CPUE trends from the stock assessment model (updated with recent catches) against recent observed CPUE trends (see Appendix 2).

Further investigation of appropriate values for natural mortality and steepness (short/medium term)

- Basic life history research may help to resolve assessment uncertainties regarding appropriate values for natural mortality and steepness.

- Additional work to determine the most appropriate prior to use for each species is required (especially on whether the current species should be included in the meta-analysis that determined the prior).

Assessment documentation (short-term)

The outline for stock assessments (Appendix B in the 2014 Terms of Reference) includes a section for addressing previous STAR Panel recommendations. If a data workshop precedes the stock assessment, as here for Black rockfish, the outline should also include a section on how the recommendations from the data workshop were addressed. Previous CIE reports should also be available as background information for STAR Panels.

It would assist in the review process if reviewers were routinely given access to model source code so that they can run the draft base case prior to the review for themselves if they wish – particularly for SS assessments. It has been good practice to include the starter, data and control files in the draft assessment documentation so that settings can be examined directly in the document. However, there is advantage for reviewers to run the model and examine R4SS output – particularly as it may include diagnostics and plots that are not included in the draft assessment document. As SS is constantly under development, it may also be the case (as here) that the SS version used is more recent than that available publicly from the NOAA toolbox. A simple solution would be to provide the draft base model source files and also the SS version used on the FTP site used for the review, at the same time as documents are made available prior to the meeting.

The Terms of Reference for the Groundfish and Coastal Pelagic Species Stock Assessment Review by the Pacific Fishery Management Council (September 2014) provides a good outline for stock assessment documents (Appendix B) that ensures consistency for draft assessments. While I hesitate to add to the standard requirements, and therefore the work required of the STAT prior to review, there are four items that could be considered, regarding additional new standard R4SS output, a summary table of abundance indices, bridging analysis and tables for comparison of sensitivity analyses.

Several recommendations for new procedures to incorporate as standard output in R4SS have been made above that may be considered for standard inclusion in the standard assessment outline.

A summary of abundance indices used (as in Tables 1 and 2 here) should be considered for standard inclusion in assessment documentation. The STATs should also provide an indication of the ranking of abundance indices in those tables. Ideally, those rankings would be provided from an earlier data workshop that precedes stock assessment, and they should indicate how much additional freedom a model should be given to add process error to an index – i.e. rankings indicate how relatively well indices reflect abundance and are unlikely to be biased (they should not be based on information already available such as the length of a series, or the magnitude of the measurement error).

Where assessments are regularly made for the same species using the same modeling framework, an opportunity arises to comprehensively and transparently provide an audit trail on model changes since the last assessment – commonly called a bridging analysis. Such a bridging analysis involves examination of absolute spawning biomass and recruitment trends over time after the application of sequential changes to model source code version revision, structural assumptions, changes to fixed parameter values or priors, and the inclusion of recent data (source by source where possible – catch, index, age and length composition by fleet). This provides a continuum from the previous assessment to the current base case. Such a process (or an improvement on it) could be considered in the future for any regular SS assessments in the US. It is understood that a detailed bridging analysis may not be required if the absolute biomass and recruitment series have changed little from one assessment to the next, but experience says that this is rarely the case.

For comparison and evaluation of sensitivity analyses it has become standard practice elsewhere to construct tables as detailed for the Canary rockfish assessment in my report for STAR Panel 1 that I think should be considered as standard procedure. The Black rockfish assessment did provide this information for CA and WA (but not OR) as a supplementary table prior to the review.

Standard diagnostics for spatial models (medium-term)

A recent paper by Punt et al. (2015) highlights that adding spatial model structural components (allowing separate stock dynamics by area, including distdevs, area-specific selectivity, allowing mixing) have the potential for the introduction of bias. How far this process should be taken depends on available data. There is a question of what standard diagnostics might assist with making the decision on how far to go with a spatial analysis, and what structural aspects are supported by available data. Punt et al. (2015) say "we propose conducting sensitivity analyses based on several model configurations to select the appropriate structure for an assessment" and "the capacity to examine model residuals spatially remains valuable for inferring problems with model specification". What additional standard diagnostics (specifically that could be added to R4SS) might assist with is an open question. New spatial models are likely to become more commonly proposed as the best currently available, and standard objective procedures for evaluation of spatial models are a work in progress.

2.2.7 Provide a brief description on panel review proceedings highlighting pertinent discussions, issues, effectiveness, and recommendations.

Terms of Reference and assignment of reporting duties

The agenda had assignment of reporting duties for the first day. As the proceedings tend to concentrate on STAR Panel requests and responses for the first four days and early on the fifth, with drafting of the report on the last day, the assignment of duties concentrated more specifically on the recording of the Panel requests and responses. As there were three reviewers and the Chair was to compile the final report, each reviewer was assigned to concentrate on responses and report comments on data (Ian Stewart), model (Neil Klaer) and uncertainties (Paul Medley) respectively. Satisfactory progress was made, allowing initial wording for the meeting report to be provided as an initial basis for a draft report on the last day, which was considerably further drafted and edited during the weeks following the meeting via email.

Agreement on the STAR Panel Meeting Report

All three Panel reviewers and the Chair provided agreement on the language that appears in the STAR Panel Meeting Report.

2.3 Findings by term of reference for Kelp greenling

The comments below refer to aspects that were examined during the meeting, but include my own additional commentary for preparation of this CIE report.

2.3.1 Become familiar with the draft stock assessment documents, data inputs, and analytical models along with other pertinent information (e.g. previous assessments and STAR panel report when available) prior to review panel meeting.

The PFMC (2014) Status of the Pacific Coast Groundfish Fishery: Stock Assessment and Fishery Evaluation report does not provide background information for Kelp greenling, only showing OFL, ABC and ACL values for them from 2014 to 2016. The previous 2005 assessment and associated STAR panel report provided a useful starting point for the evaluation of progress by the STAT in addressing previous concerns, and for noting those that remain. The inclusion of a specific section in the draft assessment document regarding how previous recommendations have been addressed is commendable.

A nearshore stock assessment workshop was carried out in 2015 for Black rockfish, China rockfish and Kelp greenling, so input data for Kelp greenling was subjected to earlier examination this year. There were a large number of recommendations for the 2015 assessment of Kelp greenling from this workshop. Those recommendations are equal or perhaps more important than those from previous STAR Panels, so it would have been useful to include a section in the draft assessment report on responses to those recommendations. I made a request to address this during the meeting which was completed satisfactorily.

2.3.2 Discuss the technical merits and deficiencies of the input data and analytical methods during the open review panel meeting.

Stock boundary

Stock boundaries might ideally be based on the following standards in priority order: (1) research information that provides direct evidence for chosen boundaries (e.g. genetic or movement studies), (2) biogeographic regions that appear to define strong boundaries for many stocks based on oceanographic conditions and/or apparent presence or absence of a variety of species, (3) indirect evidence of stock separation due to breaks in occurrence (possibly due to lack of suitable habitat, or apparent biological differences in growth and/or age composition), (4) lines drawn at prominent ocean features that may define biogeographic regions, and (5) lines drawn for data aggregation or management convenience at fishery management region, state or national boundaries. Additional work to further develop an objective procedure for evaluating the chosen stock boundaries across all rockfish (and potentially all other) assessments may be beneficial, and also more directly point to required directions for future research or assessment collaboration across national/international political boundaries.

According to background documents, Kelp greenling range from southern California, north to the Aleutian Islands, Alaska, but are rarely found south of Point Conception, California. The main population range and fisheries activities are from central California (including the Channel Islands) north through Oregon. They are most prevalent nearshore and inter-tidally in depths <50m. There is little direct information on the stock structure of kelp greenling off the U.S. west coast. Little is also known of kelp greenling movement patterns, but given their nearshore distribution and the territorial behavior of adults, they are not believed to migrate at great distances.

They live to at least 17 years of age, females batch spawn into nests where males territorially fertilize and oxygenate eggs by fanning and guard against predation. Larvae are planktonic for about 6 months (possibly a year, according to some background documentation) before settlement. The effect of a potential wider spawning stock contributing to the stock within the defined boundaries is unknown at present. As suggested by the nearshore stock assessment workshop, this assessment was applied to the State of Oregon alone, using State borders as stock boundaries. It is likely that the Columbia River plume is a natural barrier to the north-south exchange of adults and larvae, so this satisfies (3) above. The southern stock boundary at the OR/CA border only satisfies (5) above and is therefore the most uncertain. The first and only previous stock assessment of Kelp greenling (Cope and MacCall, 2005) modeled a separate sub-stock off the coast of California.

Catches

Kelp greenling are mostly either caught recreationally by hook-and-line gear or commercially by hook-and-line or longline gear with total annual landings estimated at less than 20mt prior to about 1975, and less than 45mt in all subsequent years except for 60, 100, and 60mt in the years 2001-03. Prior to 1996, most of the catch was taken by estuary-boat and shore-based recreational fishing. In more recent years, about half of the catch has been taken commercially. An ocean mode of recreational fishing has taken about a quarter of the total recreational catch since 1973. The commercial fishery was developed due to a market for live fish. Commercial catches rose sharply in 2002, but management limits on the commercial fishery from 2004 have since stabilized the commercial catch at levels comparable to the recreational fisheries. There is considerable uncertainty in total landings for recreational estuary-boat and shore-based fishing modes especially pre-1980 when catches were extrapolated from license sales, and 2005-2014 when catches were extended from surrounding years.

Uncertainty in the historical catch was examined for the pre-STAR base by doubling historical (1915-1980) and recent (2006-2014) catch from the estuary-boat and shore-based recreational fisheries, and by beginning the catch series in 1940. Neither of these scenarios greatly affected current relative biomass depletion levels.

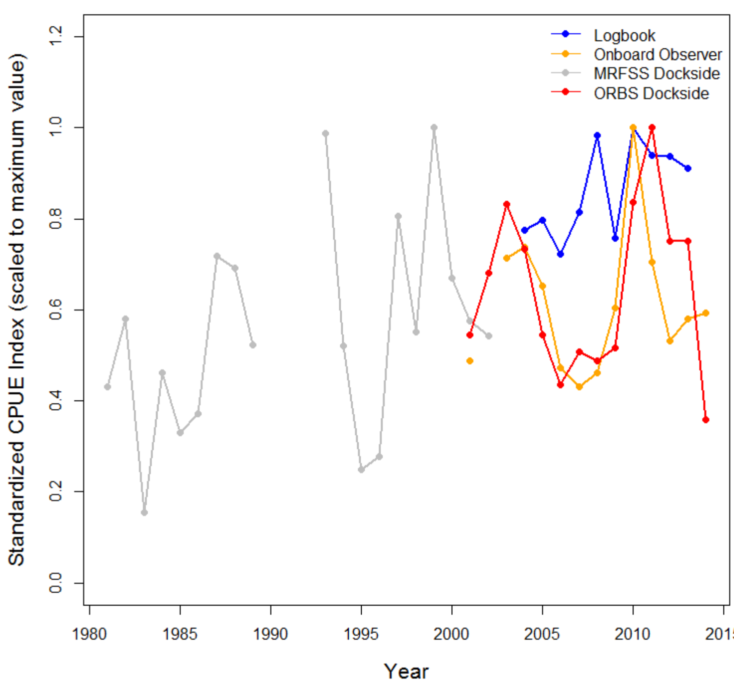
Abundance indices

Table 1. Abundance index summary for Kelp greenling

ID	Fleet	Years	Name	Fishery independent	Filtering	Method	Rank	Method endorsed
1	6	2004-2013	Commercial Logbook	No	Logbook complete, 10 years in fishery (also 3, 5)	delta-GLM (bin-gamma)	2	-
2	7	2001-2014	Onboard Observer CPFV	No	Positive drifts	delta-GLM (bin-lognormal)	1	Nearshore Workshop
1	8	2002-2014	ORBS dockside	No	Stephens-MacCall	delta-GLM (bin-lognormal)	2	SSC
2	9	1981-2002	MRFSS dockside	No	Stephens-MacCall	delta-GLM (bin-lognormal)	3	SSC

The summary shows that no fishery-independent abundance index is available for this stock, and the development of one should be considered. Both the commercial and recreational fisheries are well represented by indices. Use of objective procedures for the selection of lognormal or gamma error distributions for the sub-model for delta-GLMs (other than examination of diagnostics by eye) was a topic of discussion by past STAR Panels for other species. This should be considered further (see general recommendations for the future in section 2.2.6).

Figure 1. Comparison of Kelp greenling abundance indices



The Panel was able to endorse standard procedures used and endorsed by the SSC for many of the indices: delta GLM for individual fishing operations, and Stephens-MacCall filtering of aggregated data by trip or stop followed by a delta GLM. An improved process would be for a data group to examine and approve input data and methods for standardization prior to stock assessments. A data meeting was carried out for nearshore rockfish in March/April 2015, but did not provide endorsement for standardization procedures to be used for each abundance index (see general recommendations for the future in section 2.2.6).

Examination of comparable abundance indices plotted together is a useful consistency check that should be included as part of all assessments with a large number of indices (see general recommendations for the future in section 2.2.6).

The STAT provided a comparison plot in their presentations (Figure 1) that showed that there is no apparent long-term abundance trend and some inconsistencies in trends shown by multiple indices in the most recent period since 2003. There appears to be a good correspondence of trends in the onboard observer and ORBS dockside index, with the logbook index standing out as being dissimilar. Time was taken during the meeting to examine the filtering applied to the logbook index – particularly the application of a requirement that vessels must have fished for 10 years in the fishery. The vessel filter removed nearly 70% of the associated catch for filtered records which was considered to be too aggressive. A filter based on the requirement that vessels fished for at least 3 years removed only about 10% of the associated catch.

The meeting spent considerable time exploring the MRFSS index and also associated biological data. There was uncertainty in how the MRFSS dockside index was aggregated to trip level, so this index was removed from the base model.

Length and age data

Numbers of fish measured from the recreational fisheries number on the order of 400 (mostly from shore) from 1980 to 2000, with the ocean mode providing 1,000-2,000 measurements subsequently. Age samples are available from the ocean recreational fishery from 2005 to 2013, with 100-300 samples in most years but less than 100 from 2006-08. Commercial fishery port length samples number from 100-200 from 2000 to 2014, with 1,000-3,000 fish measured per year. A smaller number of samples are available for 1998 and 1999.

A recurring problem exists for stock assessments in how to interpret MRFSS length data. There is confusion about how conversion factors have been applied in different periods – compounded because Kelp greenling do not have a forked tail, so conversion between fork and total length should not be required. A re-discovered procedure used to extract original measurements from the database (integer values being indicative) was applied to the data that were then included in the base case during the meeting.

No ageing error estimates were available for Kelp greenling, and double-reads of existing otoliths were recommended as an important short-term research item. Otoliths are similar in structure to those of Atka mackerel and those have ageing error estimates, but Kelp greenling has a crystalline structure making them more difficult to age. Cabezon (*Scorpaenichthys* *marmoratus*) was identified as the most appropriate proxy for the provision of ageing error estimates. Lingcod (*Ophiodon elongatus*), which had originally provided ageing error information for the Kelp greenling assessment model, was aged using fin-rays and therefore seemed an inappropriate proxy. Surface reads work on young fish, and ageing is confident for ages 0, 1 and 2.

2.3.3 Evaluate model assumptions, estimates, and major sources of uncertainty.

The assessment was done using SS3 (ver. 3.24u) and was only the second Kelp greenling assessment, the first being in 2005. It was a single area, single growth-morph, two-sex model, with recruitment deviations and catches starting in 1915, steepness fixed at 0.7 (the same as in the previous kelp greenling assessment and similar to the value used in other recent assessments for similar species) and sigma R at 0.71. The maximum age bin was 15 with a plus group. Four fishing fleets were defined: commercial (combination of hook-and-line and longline) and recreational split into ocean-boat, estuary and shore. Natural mortality was fixed at the median of the prior distribution (females = 0.360; males = 0.318) generated following methods in Hamel 2015 and Then et al. 2015. Indices were weighted by estimation of an extra sd, length composition data were weighted using the Francis method as a sensitivity and the harmonic mean for the base case, and conditional age-at-length was unweighted and entered as raw otolith counts. There were so many changes to model structure and available input data (listed in detail in the pre-Panel draft assessment) that the STAT considered a detailed bridging analysis was impractical.

Selectivity was assumed to be asymptotic for the recreational ocean fleet, and dome shaped for the commercial and recreational estuary and shore fleets.

Evidence for model convergence was based on a low value for the final gradient, parameters not hitting bounds and jittering starting values for estimated parameters. While likelihood profiles were not very smooth, they also provided additional evidence for convergence. The Panel agreed that acceptable evidence of convergence was provided.

Newly developed software was used to plot the amount of spawning output that is not available to exploitation due to the shape of the population-level fishery selection curve, which is comprised of two parts: small fish and large fish (see Appendix 4). Kelp greenling show a shift in peak average fishery selectivity from domed to asymptotic in about 1980 due to the introduction of commercial and ocean mode recreational fisheries, shifting from cryptic old to protected young spawning output. If the estimated selectivities and maturity functions are correct, having protected young spawning output recently is a good thing for the stock, with the fishery peak selectivity occurring after mature fish have had an opportunity to spawn. This diagnostic did not cause any concern for the Kelp greenling assessment.

There were insufficient data in the original base case model to estimate growth parameters, and the values of these parameters had a substantial effect on the model results. There were clear patterns in the residuals of the fits to smaller fish when parameters were fixed to externally estimated values. The STAR and STAT opted to include conditional age at length data from “special projects” of age-1 and 2 fish, in order to allow the estimation of a simplified growth curve (only L_{Amax} estimated separately for males and females, and only one parameter describing the spread of length at age for all ages/sizes).

Final model results indicate that while the stock size is small compared to most fisheries, it appears to have been only lightly exploited (except perhaps in 2001-2003) with current spawning biomass at near unfished levels. Stock assessments are generally improved when contrast becomes evident in the input data, which will likely only happen should this stock become more heavily fished.

The major source of uncertainty explored and suggested by the STAT and agreed by the Panel for inclusion as an axis of uncertainty for management recommendations was natural mortality, with the range chosen based on changing the maximum observed age plus and minus 2 years.

2.3.4 Provide constructive suggestions for current improvements if technical deficiencies or major sources of uncertainty are identified.

Other than adjustments to the base model as documented below under 2.3.5, the Panel had no specific suggestions for further changes.

2.3.5 Determine whether the science reviewed is considered to be the best scientific information available.

Responses to earlier review recommendations

A required section of the draft stock assessment document is responses to STAR panel recommendations from the most recent previous assessment. Earlier recommendations that remain to be further addressed were: improved sampling of the recreational fishery (particularly shore-based), a combined assessment that includes sub-stocks, evaluation of a tagging study, alternative techniques for monitoring abundance and a commercial catch reconstruction.

Requests and responses during the meeting

The Panel requested additional model runs as part of the review and some became changes to the base model agreed by the STAT and the Panel: removal of the MRFSS abundance index, re-extraction of the MRFSS length composition data, inclusion of age 1 and 2 conditional age-at-length data from the special project, simplification of estimated growth parameters, use of Cabezon ageing error estimates, and filtering logbook CPUE data using a three-year vessel filter.

The Panel agreed that the modified base case as presented during the meeting adequately employs the best available science to determine the status of the stock.

2.3.6 When possible, provide specific suggestions for future improvements in any relevant aspects of data collection and treatment, modeling approaches and technical issues, differentiating between the short-term and longer-term time frame.

I agree with the research recommendations in the STAR Panel report made specifically for Kelp greenling and will not repeat those here. As I have attended all of the STAR Panel meetings this year I have been accumulating general recommendations that apply to all rockfish species (and species such as Kelp greenling), some of which appear in the STAR Panel report in reduced form.

My list of general recommendations appears in the Widow rockfish section 2.2.6.

2.3.7 Provide a brief description on panel review proceedings highlighting pertinent discussions, issues, effectiveness, and recommendations.

Terms of Reference and assignment of reporting duties

The agenda had assignment of reporting duties for the first day. As the proceedings tend to concentrate on STAR Panel requests and responses for the first four days and early on the fifth, with drafting of the report on the last day, the assignment of duties concentrated more specifically on the recording of the Panel requests and responses. As there were three reviewers and the Chair was to compile the final report, each reviewer was assigned to concentrate on responses and report comments on data (Ian Stewart), model (Neil Klaer) and uncertainties (Paul Medley) respectively. Satisfactory progress was made, allowing initial wording for the meeting report to be provided as an initial basis for a draft report on the last day, which was considerably further drafted and edited during the weeks following the meeting via email.

Agreement on the STAR Panel Meeting Report

All three Panel reviewers and the Chair provided agreement on the language that appears in the STAR Panel Meeting Report.

References

Cope, J. and MacCall, A. 2005. Status of Kelp greenling (*Hexagrammos decagrammus*) in Oregon and California waters as assessed in 2005. Pacific Fisheries Management Council, Portland, OR.

Hamel, O. 2013. Development of prediction intervals and priors for the natural mortality rate using multiple meta-analyses using life-history correlates. NOAA Fisheries, Northwest Fisheries Science Center, Seattle. 4/28/2013.

Punt, A.E., Haddon, M., Tuck, G.N. 2015. Which assessment configurations perform best in the face of spatial heterogeneity in fishing mortality, growth and recruitment? A casestudy based on pink ling in Australia. Fisheries Research 168:85–99.

Then, A.Y., Hoenig, J.M., Hall, N.G., and Hewitt, D.A. 2015. Evaluating the predictive performance of empirical estimators of natural mortality rate using information on over 200 fish species. ICES J. of Mar. Sci. 72, 82-92.

Appendix 1: Bibliography of materials provided for review

Draft Stock Assessment Documents:
Draft 2015 Widow rockfish assessment
Draft 2015 Kelp greenling assessment

Background Materials
2009 Widow rockfish assessment
2011 Widow rockfish assessment
2009 Widow rockfish STAR Panel report
2011 Widow rockfish STAR Panel report
2005 Kelp greenling assessment
2005 Kelp greenling STAR Panel report

Anon. Identifying trips and determining CPUE from RecFIN data.

NWFSC. 2014. Terms of Reference for the Groundfish and Coastal Pelagic Species Stock Assessment Review Process for 2015-2016. NOAA Pacific Fishery Management Council Report.

PFMC. 2014. Status of the Pacific Coast Groundfish Fishery: Stock Assessment and Fishery Evaluation. PFMC Report.

PFMC. 2015. Report on the Nearshore Stock Assessments Workshop.

Ralston, S., Pearson, D.E., Field, J.C., and Key, M. 2010. Documentation of the California catch reconstruction project. NOAA TM NMFS SWFSC 461.

Rogers, J.B. 2003. Species allocation of Sebastes and Sebastolobus sp. caught by foreign countries from 1965 through 1976 off Washington, Oregon, and California, USA. U.S. Dept. Commer., NOAA Tech.Memo. NMFS-NWFSC-57, 117 p.

Soper, B. 2014. Downloading and preparing RecFIN data directly.

Thorson, J.T., Stewart, I.J., and Punt, A.E.. 2011. Accounting for fish shoals in single- and multispecies survey data using mixture distribution models. Can. J. Fish. Aquat. Sci. 68: 1681–1693.

Thorson, J. 2015. Estimating a Bayesian prior for steepness in Pacific rockfishes (Sebastes spp.) off the U.S. West Coast for the 2015 assessment cycle.

Thorson, J. T., Shelton, A. O., Ward, E. J., and Skaug, H. J. Geostatistical delta-generalized linear mixed models improve precision for estimated abundance indices for West Coast groundfishes. – ICES Journal of Marine Science, doi: 10.1093/icesjms/fsu243.

Stock Synthesis Model-Related Documents
Methot, R. D. 2012. User Manual for Stock Synthesis Model Version 3.24s. Updated February 11, 2015. NOAA Fisheries, Seattle, Washington.

Methot, R.D. and Wetzel, C. 2013. Appendix A: Technical Description of the Stock Synthesis assessment program.

Appendix 2

Statement of Work

External Independent Peer Review by the Center for Independent Experts

Stock Assessment Review (STAR) Panel 4

Scope of Work and CIE Process: The National Marine Fisheries Service's (NMFS) Office of Science and Technology coordinates and manages a contract providing external expertise through the Center for Independent Experts (CIE) to conduct independent peer reviews of NMFS scientific projects. The Statement of Work (SoW) described herein was established by the NMFS Project Contact and Contracting Officer's Technical Representative (COTR), and reviewed by CIE for compliance with their policy for providing independent expertise that can provide impartial and independent peer review without conflicts of interest. CIE reviewers are selected by the CIE Steering Committee and CIE Coordination Team to conduct the independent peer review of NMFS science in compliance the predetermined Terms of Reference (ToRs) of the peer review. Each CIE reviewer is contracted to deliver an independent peer review report to be approved by the CIE Steering Committee and the report is to be formatted with content requirements as specified in **Annex 1**. This SoW describes the work tasks and deliverables of the CIE reviewer for conducting an independent peer review of the following NMFS project. Further information on the CIE process can be obtained from *www.ciereviews.org*.

Project Description:
The National Marine Fisheries Service and the Pacific Fishery Management Council will hold four stock assessment review (STAR) panels and potentially one mop-up panel if needed, to evaluate and review benchmark assessments of Pacific coast groundfish stocks. The goals and objectives of the groundfish STAR process are to:

1) ensure that stock assessments represent the best available scientific information and facilitate the use of this information by the Council to adopt OFLs, ABCs, ACLs, (HGs), and ACTs;
2) meet the mandates of the Magnuson-Stevens Fisheries Conservation and Management Act (MSA) and other legal requirements;
3) follow a detailed calendar and fulfill explicit responsibilities for all participants to produce required reports and outcomes;
4) provide an independent external review of stock assessments;
5) increase understanding and acceptance of stock assessments and peer reviews by all members of the Council family;
6) identify research needed to improve assessments, reviews, and fishery management in the future; and
7) use assessment and review resources effectively and efficiently.

Benchmark stock assessments will be conducted and reviewed for widow rockfish and kelp greenling. Widow rockfish is an extremely important species to the commercial trawl fishery. It was managed under a rebuilding plan for roughly a decade, until the 2011 assessment provided a basis for determining that the stock had surpassed the rebuilding target. In the wake of the last assessment concerns were expressed regarding model changes that occurred during the final review panel (i.e. mop-up panel). As a consequence, the Pacific Fishery Management Council has since been more conservative than called for by its default harvest policy in managing the stock. However, following the 2011 start of a catch-share program in the trawl fishery, fleet interest has grown for restoring a mid-water target fishery for widow rockfish. A benchmark assessment is needed, and supported by the SSC, to fully review the structure and parameterization of the widow model and reduce uncertainty regarding the true state of the stock before a large-scale target fishery is initiated.

Kelp greenling is an important species in nearshore recreational and commercial line-gear fisheries. This stock has been managed in recent years based on an Oregon-only benchmark assessment (conducted in 2005), and the results of more recent data-poor (catch-only) assessments for other portions of its range. The importance of conducting a new assessment for kelp greenling was elevated in early 2014, when the Pacific Fishery Management Council's Scientific and Statistical Committee discovered that the catch history used in the last assessment (2005, for Oregon only) was very different than the reconstructed catch history, which was completed more recently. The 2015 benchmark assessment for kelp greenling will focus on the portion of the stock off of Oregon. As time permits, a data-poor or data-moderate model may also be developed for the portion of the stock off of Washington.

These assessments will provide the basis for the management of the widow rockfish and kelp greenling stocks off the West Coast of the U.S. including providing scientific basis for setting OFLs and ABCs as mandated by the Magnuson-Stevens Act. The technical review will take place during a formal, public, multiple-day meeting of fishery stock assessment experts. Participation of external, independent reviewer is an essential part of the review process. The Terms of Reference (ToRs) of the peer review are attached in **Annex 2**. The tentative agenda of the panel review meeting is attached in **Annex 3**.

Requirements for CIE Reviewers: Two CIE reviewers shall conduct an impartial and independent peer review in accordance with the SoW and ToRs herein. One of the CIE reviewers will participate in all STAR panels held in 2015 to provide a level of consistency between the STAR panels. The CIE reviewers shall be active and engaged participants throughout panel discussions and able to voice concerns, suggestions, and improvements while respectfully interacting with other review panel members, advisors, and stock assessment technical teams. The CIE reviewers shall have excellent communication skills in addition to working knowledge and recent experience in fish population dynamics, with experience in the integrated analysis modeling approach, using age-and size-structured models, use of MCMC to develop confidence intervals, and use of Generalized Linear Models in stock assessment models. Each CIE reviewer's duties shall not exceed a maximum of 14 days to complete all work tasks of the peer review described herein.

Location of Peer Review: For the **STAR panel 4 review**, each CIE reviewer shall conduct an independent peer review during the panel review meeting **scheduled in Newport, Oregon during the dates of July 27-31, 2015.**

Statement of Tasks: Each CIE reviewers shall complete the following tasks in accordance with the SoW and Schedule of Milestones and Deliverables herein.

Prior to the Peer Review: Upon completion of the CIE reviewer selection by the CIE Steering Committee, the CIE shall provide the CIE reviewer information (full name, title, affiliation, country, address, email) to the COTR, who forwards this information to the NMFS Project Contact no later than the date specified in the Schedule of Milestones and Deliverables. The CIE is responsible for providing the SoW and ToRs to the CIE reviewers. The NMFS Project Contact is responsible for providing the CIE reviewers with the background documents, reports, foreign national security clearance, and other information concerning pertinent meeting arrangements. The NMFS Project Contact is also responsible for providing the Chair a copy of the SoW in advance of the panel review meeting. Any changes to the SoW or ToRs must be made through the COTR prior to the commencement of the peer review.

Foreign National Security Clearance: When CIE reviewers participate during a panel review meeting at a government facility, the NMFS Project Contact is responsible for obtaining the Foreign National Security Clearance approval for CIE reviewers who are non-US citizens. For this reason, the CIE reviewers shall provide requested information (e.g., first and last name, contact information, gender, birth date, passport number, country of passport, travel dates, country of citizenship, country of current residence, and home country) to the NMFS Project Contact for the purpose of their security clearance, and this information shall be submitted at least 30 days before the peer review in accordance with the NOAA Deemed Export Technology Control Program NAO 207-12 regulations available at the Deemed Exports NAO website: http://deemedexports.noaa.gov/sponsor.html.

Pre-review Background Documents: Two weeks before the peer review, the NMFS Project Contact will send (by electronic mail or make available at an FTP site) to the CIE reviewers the necessary background information and reports for the peer review. In the case where the documents need to be mailed, the NMFS Project Contact will consult with the CIE Lead Coordinator on where to send documents. CIE reviewers are responsible only for the pre-review documents that are delivered to the reviewer in accordance to the SoW scheduled deadlines specified herein. The CIE reviewers shall read all documents in preparation for the peer review. Documents to be provided to the CIE reviewers prior to the STAR Panel meeting include:

- The current draft stock assessment reports;
- The Pacific Fishery Management Council's Scientific and Statistical Committee's Terms of Reference for Stock Assessments and STAR Panel Reviews;
- Stock Synthesis (SS) Documentation
- Additional supporting documents as available.
- An electronic copy of the data, the parameters, and the model used for the assessments (if requested by reviewer).

Panel Review Meeting: Each CIE reviewer shall conduct the independent peer review in accordance with the SoW and ToRs, and shall not serve in any other role unless specified herein. **Modifications to the SoW and ToRs cannot be made during the peer review, and any SoW**

or ToRs modifications prior to the peer review shall be approved by the COTR and CIE Lead Coordinator. Each CIE reviewer shall actively participate in a professional and respectful manner as a member of the meeting review panel, and their peer review tasks shall be focused on the ToRs as specified herein. The NMFS Project Contact is responsible for any facility arrangements (e.g., conference room for panel review meetings or teleconference arrangements). The NMFS Project Contact is responsible for ensuring that the Chair understands the contractual role of the CIE reviewers as specified herein. The CIE Lead Coordinator can contact the Project Contact to confirm any peer review arrangements, including the meeting facility arrangements.

<u>Contract Deliverables - Independent CIE Peer Review Reports</u>: Each CIE reviewer shall complete an independent peer review report in accordance with the SoW. Each CIE reviewer shall complete the independent peer review according to required format and content as described in Annex 1. Each CIE reviewer shall complete the independent peer review addressing each ToR as described in Annex 2.

<u>Other Tasks – Contribution to Summary Report</u>: Each CIE reviewer may assist the Chair of the panel review meeting with contributions to the Summary Report, based on the terms of reference of the review. Each CIE reviewer is not required to reach a consensus, and should provide a brief summary of the reviewer's views on the summary of findings and conclusions reached by the review panel in accordance with the ToRs.

Specific Tasks for CIE Reviewers: The following chronological list of tasks shall be completed by each CIE reviewer in a timely manner as specified in the **Schedule of Milestones and Deliverables**.

1) Conduct necessary pre-review preparations, including the review of background material and reports provided by the NMFS Project Contact in advance of the peer review.
2) Participate during the STAR Panel 1 review meeting in **tentatively scheduled in Newport, Oregon) during the dates of July 27-31 , 2015** as specified herein, and conduct an independent peer review in accordance with the ToRs (**Annex 2**).
3) No later than **August 7, 2015**, each CIE reviewer shall submit an independent peer review report addressed to the "Center for Independent Experts," and sent to Mr. Manoj Shivlani, CIE Lead Coordinator, via email to *shivlanim@bellsouth.net*, and to Dr. David Die, CIE Regional Coordinator, via email to *ddie@rsmas.miami.edu*. Each CIE report shall be written using the format and content requirements specified in Annex 1, and address each ToR in **Annex 2**.

Tentative Schedule of Milestones and Deliverables: CIE shall complete the tasks and deliverables described in this SoW in accordance with the following schedule.

June 15, 2015	CIE sends reviewer contact information to the COR, who then sends this to the NMFS Project Contact
July 6, 2015	NMFS Project Contact sends the CIE Reviewers the pre-review documents
July 27-31, 2015	Each reviewer participates and conducts an independent peer review during the panel review meeting
August 7, 2015	CIE reviewers submit draft CIE independent peer review reports to the CIE Lead Coordinator and CIE Regional Coordinator
August 21, 2015	CIE submits CIE independent peer review reports to the COR
August 28, 2015	The COR distributes the final CIE reports to the NMFS Project Contact and regional Center Director

Modifications to the Statement of Work: Requests to modify this SoW must be approved by the Contracting Officer at least 15 working days prior to making any permanent substitutions. The Contracting Officer will notify the COTR within 10 working days after receipt of all required information of the decision on substitutions. The COTR can approve changes to the milestone dates, list of pre-review documents, and ToRs within the SoW as long as the role and ability of the CIE reviewers to complete the deliverable in accordance with the SoW is not adversely impacted. The SoW and ToRs shall not be changed once the peer review has begun.

Acceptance of Deliverables: Upon review and acceptance of the CIE independent peer review reports by the CIE Lead Coordinator, Regional Coordinator, and Steering Committee, these reports shall be sent to the COTR for final approval as contract deliverables based on compliance with the SoW and ToRs. As specified in the Schedule of Milestones and Deliverables, the CIE shall send via e-mail the contract deliverables (CIE independent peer review reports) to the COTR (William Michaels, via William.Michaels@noaa.gov).

Applicable Performance Standards: The contract is successfully completed when the COTR provides final approval of the contract deliverables. The acceptance of the contract deliverables shall be based on three performance standards:
(1) each CIE report shall completed with the format and content in accordance with **Annex 1**,
(2) each CIE report shall address each ToR as specified in **Annex 2**,
(3) the CIE reports shall be delivered in a timely manner as specified in the schedule of milestones and deliverables.

Distribution of Approved Deliverables: Upon acceptance by the COTR, the CIE Lead Coordinator shall send via e-mail the final CIE reports in *.PDF format to the COTR. The COTR will distribute the CIE reports to the NMFS Project Contact and Center Director.

Support Personnel:

William Michaels, COTR
NMFS Office of Science and Technology
1315 East West Hwy, SSMC3, F/ST4, Silver Spring, MD 20910
William.Michaels@noaa.gov Phone: 301-713-2363 ext 136

Allen Shimada, COTR
NMFS Office of Science and Technology
1315 East West Hwy, SSMC3, F/ST4, Silver Spring, MD 20910
Allen.Shimada@noaa.gov Phone: 301-427-8174

Manoj Shivlani, CIE Lead Coordinator
NTVI Communications, Inc.
10600 SW 131st Court, Miami, FL 33186
shivlanim@bellsouth.net Phone: 305-383-4229

Key Personnel:

Jim Hastie
National Marine Fisheries Service,
2725 Montlake Blvd. E,
Seattle WA 98112
Jim.Hastie@noaa.gov Phone: 206-860-3412

Stacey Miller, NMFS Project Contact
National Marine Fisheries Service,
55 Great Republic Drive,
Gloucester, MA 01930
Stacey.Miller@noaa.gov Phone: 978-281-9203

Annex 1: Format and Contents of CIE Independent Peer Review Report

1. The CIE independent report shall be prefaced with an Executive Summary providing a concise summary of the findings and recommendations, and specify whether the science reviewed is the best scientific information available.

2. The main body of the reviewer report shall consist of a Background, Description of the Individual Reviewer's Role in the Review Activities, Summary of Findings for each ToR in which the weaknesses and strengths are described, and Conclusions and Recommendations in accordance with the ToRs.

   a. Reviewers should describe in their own words the review activities completed during the panel review meeting, including providing a brief summary of findings, of the science, conclusions, and recommendations.

   b. Reviewers should discuss their independent views on each ToR even if these were consistent with those of other panelists, and especially where there were divergent views.

   c. Reviewers should elaborate on any points raised in the Summary Report that they feel might require further clarification.

   d. Reviewers shall provide a critique of the NMFS review process, including suggestions for improvements of both process and products.

   e. The CIE independent report shall be a stand-alone document for others to understand the weaknesses and strengths of the science reviewed, regardless of whether or not they read the summary report. The CIE independent report shall be an independent peer review of each ToRs, and shall not simply repeat the contents of the summary report.

3. The reviewer report shall include the following appendices:

   Appendix 1: Bibliography of materials provided for review
   Appendix 2: A copy of the CIE Statement of Work
   Appendix 3: Panel Membership or other pertinent information from the panel review meeting.

Annex 2: Terms of Reference for the Peer Review

Stock Assessment Review (STAR) Panel 4

1. Become familiar with the draft stock assessment documents, data inputs, and analytical models along with other pertinent information (e.g. previous assessments and STAR panel report when available) prior to review panel meeting.
2. Discuss the technical merits and deficiencies of the input data and analytical methods during the open review panel meeting.
3. Evaluate model assumptions, estimates, and major sources of uncertainty.
4. Provide constructive suggestions for current improvements if technical deficiencies or major sources of uncertainty are identified.
5. Determine whether the science reviewed is considered to be the best scientific information available.
6. When possible, provide specific suggestions for future improvements in any relevant aspects of data collection and treatment, modeling approaches and technical issues, differentiating between the short-term and longer-term time frame.
7. Provide a brief description on panel review proceedings highlighting pertinent discussions, issues, effectiveness, and recommendations.

Annex 3: Tentative Agenda

Final Agenda to be provided two weeks prior to the meeting with draft assessments and background materials.

Stock Assessment Review (STAR) Panel 4
Newport Research Station, Bld. 955
2032 SE OSU Drive,
Newport, Oregon 97365
Phone: 541-867-0500

July 27-31, 2015

Monday, July 27

8:30 a.m.	Welcome and Introductions
9:15 a.m.	Review the Draft Agenda and Discuss Meeting Format (SSC Chair) - Review Terms of Reference (TOR) for assessments and STAR panel - Assign reporting duties - Discuss and agree to format for the final assessment document - Agree on time and method for accepting public comments
9:30 a.m.	Presentation of Assessment 1 - Overview of data and modeling
12:30 p.m.	Lunch (On Your Own)
1:30 p.m.	Q&A session with STAT_1
	STAR Panel discussion - Panel develops written request for additional model runs / analyses
3:30 p.m.	Presentation of Assessment_2 (if time allows) - Overview of data and modeling
5:30 p.m.	Adjourn for Day.

Tuesday, July 28

8:30 a.m.	Continue Presentation of Assessment_2 -- Overview of data and modeling
12:00 p.m.	Lunch (On Your Own)
1:30 p.m.	Q&A Session with STAT_ 2
	Panel Discussion - Panel develops written request for additional model runs / analyses
4:30 p.m.	Check in with –STAT_1
5:30 p.m.	Adjourn for Day.

Stock Assessment Review (STAR) Panel 4

Wednesday, July 29

8:30 a.m.	Presentation of First Set of Model Runs - Q&A session with STAT_1 & Panel discussion - Panel develops request for second round of model runs / analyses –STAT_1
12:00 p.m.	Lunch
1:30 p.m.	Presentation of First Set of Model Runs - Q&A session –STAT_2 & panel discussion - Panel develops request for second round of model runs / analyses –STAT_2.
5:30 p.m.	Adjourn for day.

Thursday, July 30

8:30 a.m.	Presentation of Second Set of Model Runs - Q&A session –STAT_1 & panel discussion - Agreement of preferred model and model runs for decision table - Panel continues drafting STAR report.
12:00 p.m.	Lunch (On Your Own)
1:00 p.m.	Presentation of Second Set of Model Runs - Q&A session –STAT_2 & panel discussion - Agreement of preferred model and model runs for decision table - Panel continues drafting STAR report.
4:00 p.m.	Continue Panel Discussion or Drafting STAR Panel Report
5:30 p.m.	Adjourn for day.

Friday, July 31

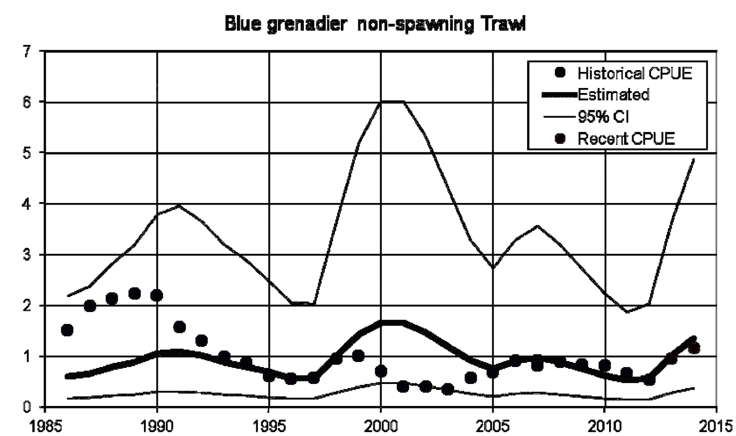
8:30 a.m.	Consideration of Remaining Issues - Review decision tables for assessments
10:00 a.m.	Panel Report Drafting Session
12:00 p.m.	Lunch (on your own)
2:00 p.m.	Review First Draft of STAR Panel Report
4:00 p.m.	Panel Agrees to Process for Completing Final STAR Report by Council's September Meeting Briefing Book Deadline
5:30 p.m.	Review Panel Adjourn.

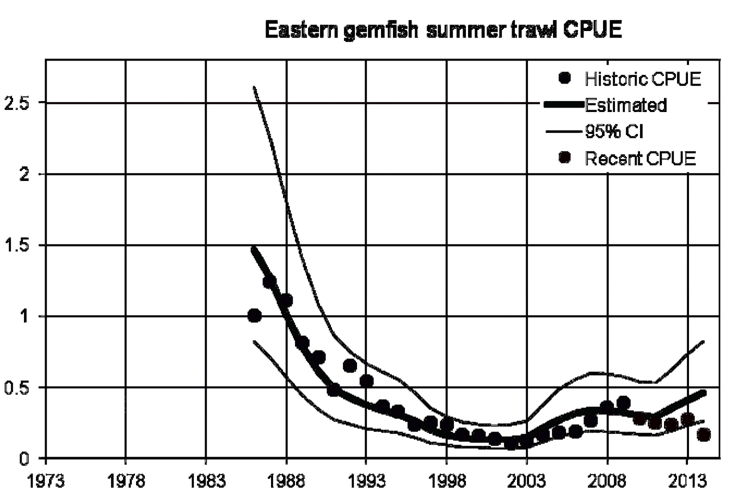
Appendix 3. Example "breakout rule" used in the Australian Southern and Eastern Scalefish and Shark Fishery

A number of Southern and Eastern Scalefish and Shark Fishery (SESSF) quota species on Tier 1 are managed on Multi-Year Total Allowable Catches (MYTACs) so that stock assessments are performed for those species at 3-5 year intervals. The most recently accepted base case stock assessment for each MYTAC stock is used to set future Recommended Biological Catches (RBCs) for the stock during the MYTAC period. Each year, to evaluate the continuing accuracy of the model predictions, actual catches are entered into the model and predicted catch rates are forecast. If observed catch rates fall outside of a 95% confidence interval around the forecast catch rates, then management attention is directed towards the stock.

The process of calculating review triggers involves the following steps:

1. Update the standardized CPUE for the stock of interest.
2. Obtain the recent catch history for the stock (i.e. the catches taken from the stock during the years since the stock assessment model was last updated).
3. Use the base case stock assessment model to project the stock to the current year, given the catches from step 2.
4. Adjust the CPUE series from step 1 to match the CPUE series used to tune the assessment model, calculate 95% confidence bounds (CI) around the forecast CPUE, and determine whether the most recent observed CPUE points fall within the CI.



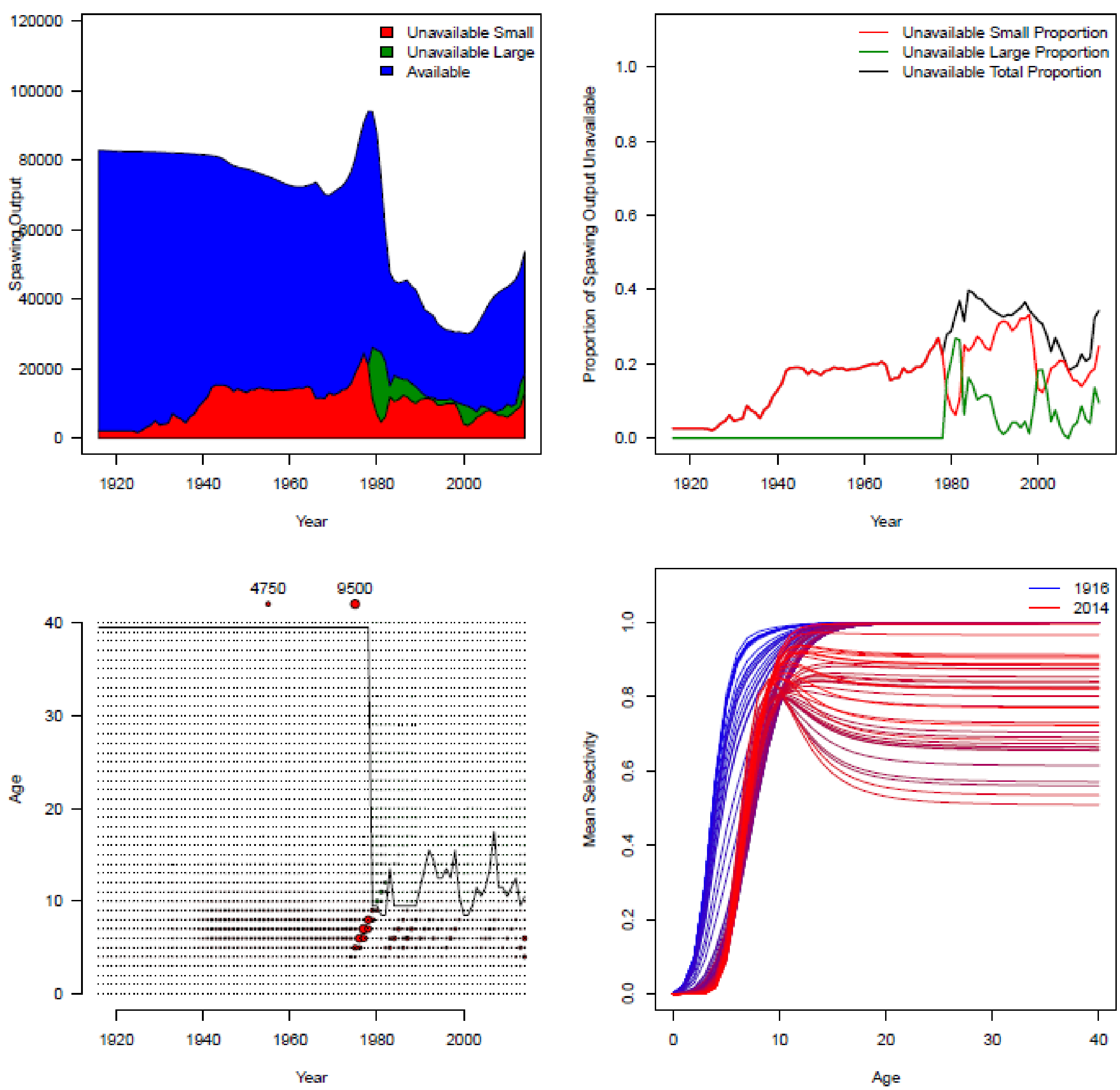


Appendix 4: Plots of unavailable spawning output for Widow rockfish and Kelp greenling.

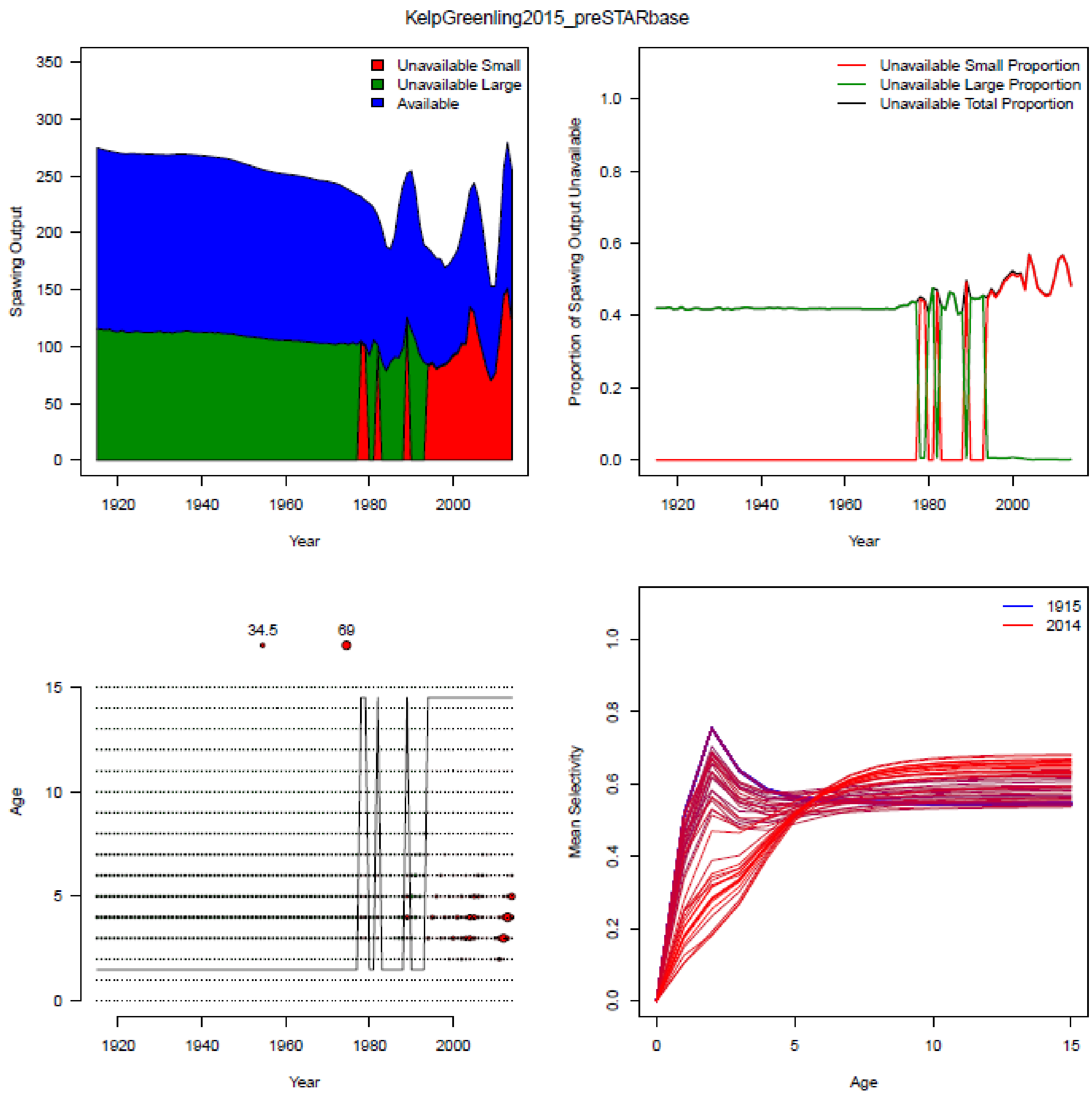
During STAR Panel 3, software was developed to display contributions to spawning output by fish that are not selected by the fisheries (improved plots shown here), and therefore are unseen in the catches. An additional development was to separate the unavailable spawning output into "protected" small fish and "cryptic" old fish using the weighted peak overall selectivity by age in each year (lower right panel to determine the peak, and shown as the black line in the lower left panel). Note that "cryptic" only really applies if the older spawning output is also unseen by surveys, so full interpretation also requires the investigation of years for which length/age composition from asymptotic survey selectivity are available.

There is some protection of young spawning output throughout and little cryptic older spawning output for Widow rockfish.

7.01_Widow2015_preSTARbase



Kelp greenling show a shift in peak average fishery selectivity from domed to asymptotic in about 1980 due to the introduction of commercial and ocean mode recreational fisheries, shifting from cryptic old to protected young spawning output. If the estimated selectivities and maturity functions are correct, having protected young spawning output recently is a good thing for the stock, with the fishery peak selectivity occurring after mature fish have had an opportunity to spawn.



Appendix 5: List of participants

STAR Panel Members:

Dr. David Sampson, Oregon State University, SSC (Chair)
Dr. Neil Klaer, Center for Independent Experts
Dr. Paul Medley, Center for Independent Experts
Dr. Ian Stewart, International Pacific Halibut Commission

Stock Assessment Team Members, Widow rockfish:

Dr. Allan Hicks, National Marine Fisheries Service Northwest Fisheries Science Center

Stock Assessment Team Members, Kelpl greenling:

Dr. Aaron Berger, National Marine Fisheries Service Northwest Fisheries Science Center
Mr. Brett Rodomsky, Oregon Department of Fish and Wildlife

STAR Panel Advisors:

Ms. Heather Mann, Midwater Trawl Commission, GAP
Ms. Lynn Mattes, Oregon Department of Fish and Wildlife, GMT
Mr. John DeVore, Pacific Fishery Management Council