

**Darkblotched Rockfish**  
**Stock Assessment Review (STAR) Panel Meeting Report**  
**Hotel Deca**  
**4507 Brooklyn Ave NE**  
**Seattle, WA 98105**  
**April 27 - May 1, 2015**

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## Overview

The STAR panel reviewed a new benchmark stock assessment of darkblotched rockfish over the course of a five day meeting in Seattle, WA. The assessment region covers the U.S. west coast ranging from Southern California north of Pt. Conception to the U.S.-Canada border. This area encompasses the range of darkblotched rockfish within the jurisdiction of the Pacific Fishery Management Council. Linkages with darkblotched in British Columbia (via movement of adults or larval transport) are assumed to be negligible in this assessment.

## Summary of Data and Assessment Models

### Description of the model

This assessment employs Stock Synthesis (v3.24U) with the following main sources of information:

1. Landed catch, as recorded by comprehensive catch landing receipts and historical data from foreign and domestic fisheries.
2. Size composition of the landed and discarded catch.
3. Age composition of landed and discarded catch.
4. Maturity at length and fecundity at weight.
5. Fishery independent research surveys included were the AFSC shelf survey (often called "triennial", since it was conducted every third year); the AFSC slope survey; the NWFSC slope survey, and the NWFSC shelf-slope survey (often referred to as "combo" survey).

The key model features include:

- 1) Data were disaggregated where possible and modeled by females and males
- 2) Length-based selectivities were estimated for all surveys and fisheries
- 3) Growth was estimated within the model
- 4) Discard information was explicitly included and used in the estimation of retention functions and rates
- 5) Survey abundance indices were estimated using a GLMM approach prior to being applied within the assessment model.
- 6) A new prior distribution on stock-recruitment steepness was used, updated from the work of Dorn et al. 2009.
- 7) Conditional age given length data were compiled and were available for guiding model parameter estimates.
- 8) Age composition data were generated using a break-and-burn ageing method.

## Requests by the STAR Panel and Responses by the STAT

The following sets of runs and analyzes requested by the STAR panel are summarized (with rationale for the request, and STAT response) below:

### Request 1: Conduct and evaluate a sensitivity analysis by adding the British Columbia

**trawl catch history, based on DFO data, to the US trawl catch history.**

*Rationale:* There is interest in exploring potential stock connectivity and how this added catch might affect model results.

*STAT Response:* This was completed and is expected to appear in the final stock assessment document. The STAR panel noted that the effect was relatively minor, but future work should be pursued (see Recommendations for Future Research, below).

**Request 2: In the base model, exclude catch from BC and AK that was inadvertently included in the WA catch history.**

*Rationale:* It was discovered that, for some species, the WA catch history was contaminated with non-WA catch data (from BC and AK). This data should be removed from the time series.

*STAT Response:* It was determined that this was not an issue for darkblotched rockfish.

**Request 3: In the base model, reconcile inconsistencies in the male and female growth curves (both sexes should have a common L1 in Figure 41).**

*Rationale:* It doesn't appear that Figure 41 is correct.

*STAT Response:* A bug in the plotting routine was corrected.

**Request 4: Profile steepness by each index informing the assessment.**

*Rationale:* It will be useful to determine which indices are affected by different values of steepness. If the NWFSC survey is important, it could be instructive to conduct profiling without the added variance. Alternatively, the profiling could be conducted using the non-spatial survey index.

*STAT Response:* This profile was completed and revealed that the NWFSC survey was the most influential (Figure 1).

**Request 5: Conduct and evaluate a model run with asymptotic fishery selectivity.**

*Rationale:* This will provide some continuity from the previous assessment.

*STAT Response:* This was completed and had relatively minor impact on the base model but degraded the fit to fishery composition data. The STAR panel recommended that further investigations on selectivity are needed because the shape of the selectivity curve in the base was extremely peaked.

**Request 6: Some ill-behaved residuals exist in the catch composition data. Evaluate a time-varying selectivity pattern for the fishery. To explore the residual pattern issue, examine**

**the spatial distribution or other factors that may change the size composition observed in the catch.**

*Rationale:* This could form the basis for time-varying selectivity in the base model.

*STAT Response:* This investigation resulted in some improvement to the fits and a blocked selectivity time period in the base model was accepted by the group.

**Request 7: In figures showing status history, change axis for the 1-SPR ratio since  $F_{64\%}$  relates to the rebuilding strategy and  $F_{50\%}$  is the SPR proxy for  $F_{MSY}$ .**

*Rationale:* This was requested for the final version of the assessment document.

*STAT Response:* This was corrected.

**Request 8: It would be useful to know what the “catchability” of the NWFSC survey is, by size.**

*Rationale:* It would be useful to know if the area-swept biomass estimates show consistency with the base model results. This computation would entail using the survey selectivity.

*STAT Response:* This was completed and showed reasonable values (there was no further concern).

**Request 9: If possible, output the dynamic  $B_0$  report option for the base model (Report\_1 for the spawning biomass report of SS3).**

*Rationale:* This was requested as a diagnostic.

*STAT Response:* This was reported and shown to be relatively flat.

**Request 10: Increase the weight (decrease the CV) of the NWFSC survey index to evaluate the effect on other indices and results.**

*Rationale:* The residual pattern for the survey estimates could be better. One approach would be to remove the “added” variance to this index.

*STAT Response:* This resulted in fitting the survey data better but the residual pattern remained. After considerable discussion the added variance configuration was retained for the base model.

**Request 11: Add the British Columbia catch without the discards and extend to 2014 using recent average catches.**

*Rationale:* This is a more realistic sensitivity run (cf Request 2).

*STAT Response:* This was completed and the conclusions were the same as noted above.

**Request 12: Check to see the model configuration with respect to the period of estimating stock recruit deviation estimates (perhaps increment by 2 years relative to the 2013 assessment).**

*Rationale:* The 2013 year class is estimated to be above average and this appears to arise from the 2014 NWFSC survey age conditioned on length data.

*STAT Response:* This was completed and affected the base model and was corrected to be consistent with the practice from the earlier assessment. The group agreed that the estimate of the 2014 year-class should be set to the expected value. The 2013 year class continues to be above average based on 1-year olds in the 2014 data and to some extent, the 0's in 2013, based primarily on length data.

**Request 13: Do a model sensitivity run excluding all composition data but including survey catchabilities and selectivities as fixed (at the base model estimates)**

*Rationale:* This may help to illustrate the impact of composition data on model results relative to indices and catch.

*STAT Response:* Due to lack of clear guidance, this was covered in a subsequent request.

**Request 14: Do a model run without the indices but retain the composition data.**

*Rationale:* Same idea as Request 13, but to see the influence of the composition data alone.

*STAT Response:* This was completed but because q values were fixed, the result was similar to the base model (a follow-up request with q estimated was made – see Request 23).

**Request 15: Determine a range for plausible sensitivities for steepness for potential decision table specification (at 0.6 and 0.93).**

*Rationale:* Steepness is a candidate for an axis of uncertainty.

*STAT Response:* This was completed and carried forward for the decision table considerations.

**Request 16: Evaluate a range of values for plausible M that equates to depletion values as bounds seen on steepness.**

*Rationale:* Comparing likelihoods between this result and that for steepness (in Request 15) will benefit selection for use in the decision table and may help in establishing bounds on uncertainty in M.

*STAT Response:* This was completed and carried forward for the decision table considerations

(Figure 2).

**Request 17: Do a run without the 2014 NWFSC survey composition data.**

*STAT Response:* This was completed and shown to be extremely influential. The group discussed this at length and evaluated various parameters and likelihood components to try to determine the main factors causing the change. In the end, the data affected both the model scale and recent recruitment. The uncertainty with and without the 2014 data is high (Figure 3).

**Request 18: Provide alternative model runs with a high and low and BC catch series.**

*Rationale:* This was requested as a further sensitivity.

*STAT Response:* This was completed and has a relatively minor effect.

**Request 19: Jitter the new base model.**

*Rationale:* Provide evidence of model convergence.

*STAT Response:* Jittering was done and model convergence at the global minimum has apparently been achieved.

**Request 20: Show tables of likelihood components, including management parameters of interest, for all sensitivities above, figures for profiles over  $M$ ,  $h$ ,  $\ln(R_0)$ , and the retrospective runs.**

*Rationale:* To help evaluate model results (as standard for objective review).

*STAT Response:* Completed.

**Request 21: Explore model sensitivity of the sample size for age composition data for age 0 in 2013 and age 0 and 1 in 2014. Downweight the sample size of the age input data by a factor of 10.**

*Rationale:* The estimated variance for the 2013 recruitment estimate seems too low.

*STAT Response:* This had little effect, but it revealed that it was the length composition data from the NWFSC survey that had the largest impact.

**Request 22: Provide numbers at age for the base model and the alternative run without 2014 composition data.**

*STAT Response:* This showed that the older fish were estimated to be less abundant with the 2014 data included and that the 2013 recruitment estimate was considerably higher (Figure 4).

**Request 23: Do a model sensitivity evaluating without any composition data but including natural mortality (male and female), growth, and all selectivities as fixed (at the base model estimates).**

*Rationale:* This may help illustrate the impact of composition data on model results relative to indices and catch.

*STAT Response:* This made little difference to the base case.

**Request 24: Do a model run with lambda set to zero for all abundance indices.**

*Rationale:* Same as Request 23.

*STAT Response:* This was very similar to the base case indicating little influence of abundance indices on model results.

**Request 25: Compute the likelihoods for the observations (and predictions) over the same period for the run with the 2014 composition data omitted so that the likelihoods can be compared.**

*Rationale:* This exploration is to try to understand why there is a shift in population scale when only one year of survey composition data (2014) is added.

*STAT Response:* This was not easily available from the model output. However, a series of comparative figures from other assessments provided by the STAT showed that the scale of the model historically can vary considerably when one year of data are dropped from the model.

**Request 26: The Panel requested the following three figures for the report: 1) a model run comparison between the base model and a model dropping the 2014 NWFSC survey composition data, 2) for the same runs, a figure comparing terminal year numbers at age, and 3) a comparison of the SSB time series for the present assessment with historical darkblotched assessments.**

*Rationale:* These figures will help to determine the priority that should be given during the Star Panel to full resolution of the reason for the change in model behavior after the addition of 2014 data.

*STAT Response:* This was completed (Figures 3-5). The Panel agreed that this did provide evidence for less concern given that the change was within the variability of the model from other sources.

## **Description of the Base Model and Alternative Models used to**

## **Bracket Uncertainty**

### **Summary of issues considered leading to a base case model**

Explorations arising from the requests have resulted in the following modifications to the base model:

- Including alternative catch history scenarios (e.g., including catch from BC fishery) showed relatively minor differences and were included in the assessment only as a sensitivity, until further research is completed on the potential of conducting a combined US-Canada assessment
- The forecast recruitment deviations were set so that the age-zero darkblotched rockfish for 2014 are equal to the expectation (based on the stock-recruit relationship). We acknowledge that for forecasts, the uncertainty should still be propagated for projections.
- Blocking selectivity for fishery selectivity (by adding 2011-2014 block to the shoreside fishery) improved the fit to the size composition data and appears to be justified based on changes in rockfish management (IFQ fishery).
- Results appear sensitive to estimating the added variance component of the NWFSC survey index. The residual pattern for this series is highly correlated over time. The STAT recommended and the STAR panel concurred that retaining the option to estimate the added variance was reasonable given survey uncertainties.
- A concern remains on the impact of the 2014 data (changes the population scale and relative stock status markedly) and the source of this appears to be partly due to the 2014 age-length data from the NWFSC survey and the length composition data. There was lengthy discussion about this and how it might be further explored and maybe resolved (or understood). The STAT pointed out that such a pattern is not uncommon for other stocks when new data are incorporated. Compared to past assessments, the results from this base model was reasonably consistent (Figure 3) and within the bounds of uncertainty.

*The STAR Panel recommended that the data and model configuration are the best available for management guidance and as such the assessment is ready to go forward for final review by the SSC groundfish subcommittee and full SSC.*

### **Technical Merits of the Assessment**

The assessment did a good job of incorporating and modeling the available data.

### **Technical Deficiencies of the Assessment**

None were identified by the STAR panel.

### **Areas of Disagreement Regarding STAR Panel Recommendations**

The Panel and the participants (including GMT and GAP representatives) had no areas of disagreement for all conclusions during the STAR panel meeting.

Between the STAR Panel and the STAT Team: None.



Management, Data, or Fishery Issues raised by the GMT or GAP Representatives During the STAR Panel Meeting: None.

## **Unresolved Problems and Major Uncertainties**

Note: references to figure numbers below correspond to the pre-STAR draft assessment document provided to the panel.

*The assessment relies on fixed values for steepness and female natural mortality that are assumed to be known. Recent work to develop priors from meta-analyses has assisted with the choice of base values, but this is still a major source of uncertainty.*

*Uncertainties in US catch and discard history remain.*

*Systematic lack of fit to the NWFSC shelf-slope survey abundance index.*

The index shows a flat to declining trend (depending on whether 2003 and 2014 are included), and the estimated available biomass for this index increases by about 25% over the same period (Figure 52). The peak of the dome-shaped selectivity for this survey is at about 24cm (about age 3-7), and the peak selectivity of the fisheries is at 35cm (about ages 8-14) (Figure 92), the shelf-slope survey can almost be considered as a pre-recruit survey, uninfluenced by fishery impacts and more reflective of recruitment strength. Over the same period as the NWFSC survey, the spawning potential of the stock in the base case increased by a factor of almost 2 (Figure 108) due to buildup of older fish in the population not highly selected by this index. Request 23 has shown that the abundance indices do not contribute to the overall abundance trend for the stock. The dynamics of the population affected by the fishery in the most recent 15 years is highly informed by patterns in age or length structure and the overall productivity of the stock.

*Reliance on length-frequency data for age dynamics of older fish.*

Even with the relatively low CVs on growth, a male or female of true age above about 9 would be very difficult to assign to an age based on its length (see revised age-at-length plot provided by Ian Taylor in requests). It is of concern that length composition is informing the dynamics of the stock for older ages when those data are least reliable for distinguishing patterns by age.

*Rescaling of  $B_0$  after introduction of 2014 length composition data.*

A retrospective pattern demonstrating a “shift in scale” was evident when 2014 data were removed from the model (Figure 119 of Post STAR Panel draft assessment. It is suspected that this is related to the lack of fit to the NWFC index above. The model is using changes in composition data to estimate abundance trends. If an additional year of composition data has patterns in the older fish (ages above about 8) that are not easily fitted by the model run to 2013, freedom exists to change various parameters ( $R_0$ , recruitment deviations, life history or selectivity) that may potentially result in a rescaling of the entire biomass series.

*Systematic lack of fit on the right hand side of length compositions from surveys and the at-sea hake fishery (Figure 70).*

The fit for both length (Figure 73) and age (Figure 76) is more acceptable for the domestic fishery (from which the fishery removals are mostly modelled). Further work is required to determine whether alternative functional forms for selectivity or changes in other aspects of the model might better resolve this difficulty.

*British Columbia catches appear to have an impact on the US regional stock assessment.*

During the meeting, a sensitivity analysis was constructed that added BC catches to those in the base model, assuming average recent catches for the years past 2007 where BC catches were unavailable. While these catches were relatively low and constant throughout the fishery history, they did lower the apparent recent extent of stock rebuilding because they recently make a higher proportion of the total catch. A true combined assessment would require an updated catch series and inclusion of composition and index data from BC, so this sensitivity was considered as a preliminary investigation only, and did not cause an adjustment of the current base case.

## **Recommendations for Future Research and Data Collection**

Catch and discard history for this stock in US waters is highly uncertain. While the STAT was able to construct alternative upper and lower bounds for catch using simple multipliers on certain years of historical catch, this is arbitrary. Work to assess the uncertainty related to each individual data source would allow a better investigation of the overall combined uncertainty and its effect on stock assessments.

Improved documentation is required to clearly outline the process used to construct the historical catch and discard time series from the various data sources. Such documentation should also include the process for construction of alternative catch histories that are used to propagate such uncertainty into the stock assessment.

It is highly undesirable that the lack of an abundance index for the older fish in the population most affected by fishing (particularly in recent years) forces the model to rely on composition data for information on abundance trends. Unfortunately, such an index is currently unavailable, but would have the potential to considerably improve future stock assessments if commenced in the future.

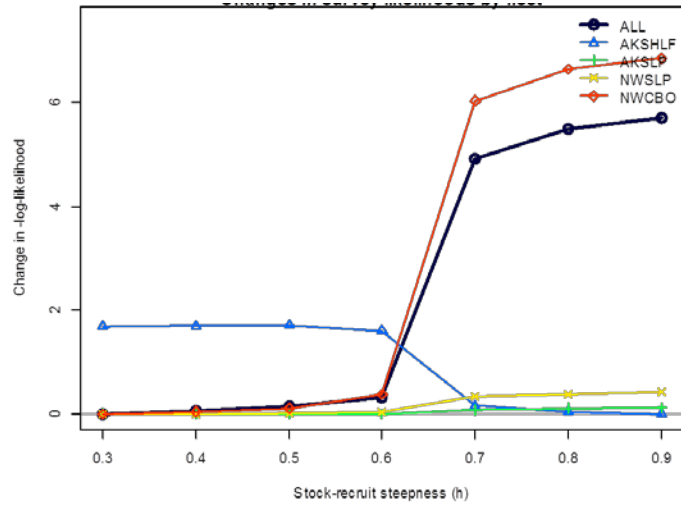
Work towards a combined US/Canadian stock assessment should be pursued.

## **Acknowledgements**

The STAR Panel thanks NWFSC and Council staff and advisors for facilitating the meeting and engaging in discussions. The Panel commends the stock assessment team for their work, and on their cooperation in conducting additional analysis and revisions in response to this review.

# Figures

Profile analysis for the base model (extra standard deviation for NWCBO is estimated).



Profile analysis for the model with NO extra standard deviation for NWCBO included. The logic behind addition extra SD: There are sources of variability in survey that are not captured in GLMM. For example, survey does not run in the untrawable habitats as well as in the midwater.

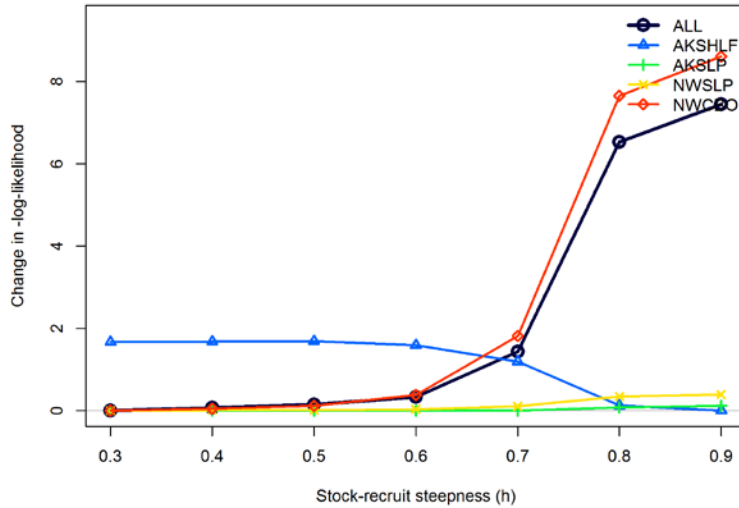
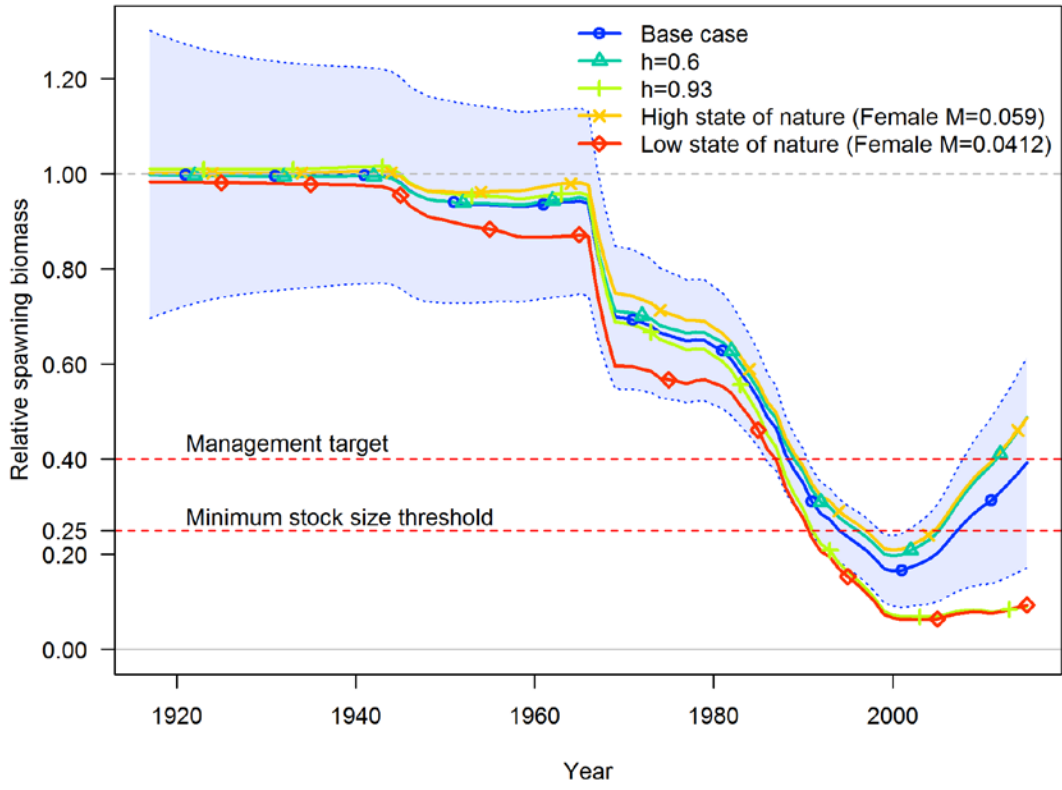


Figure 1. Results from Request 4.



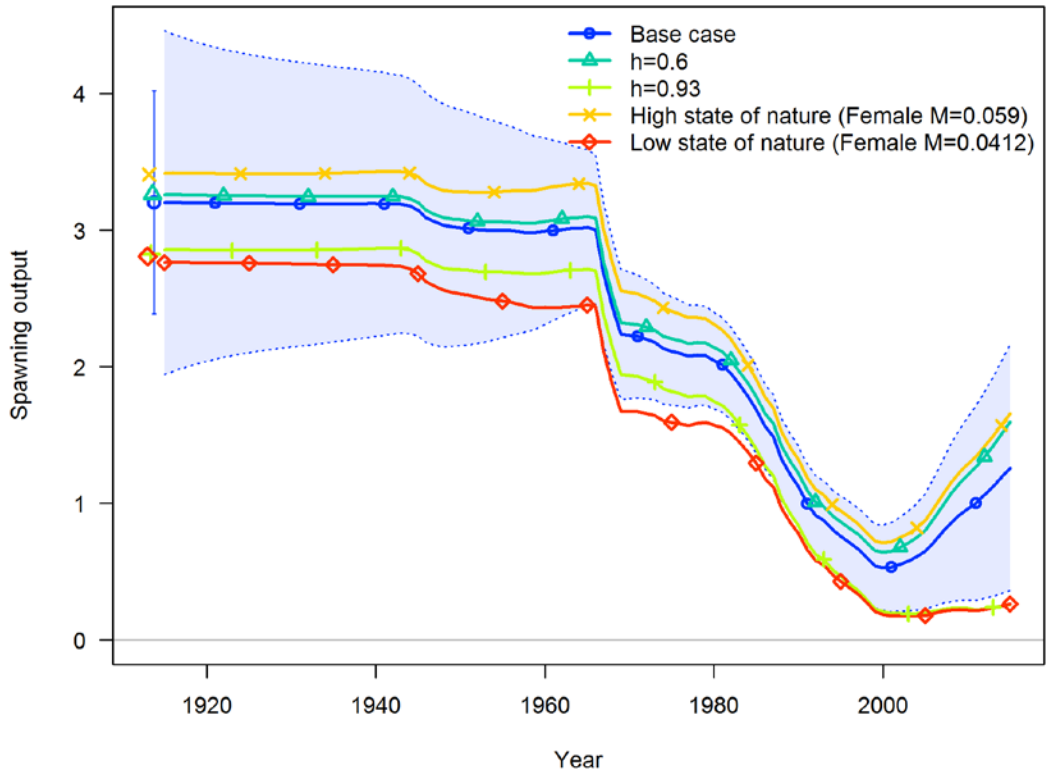
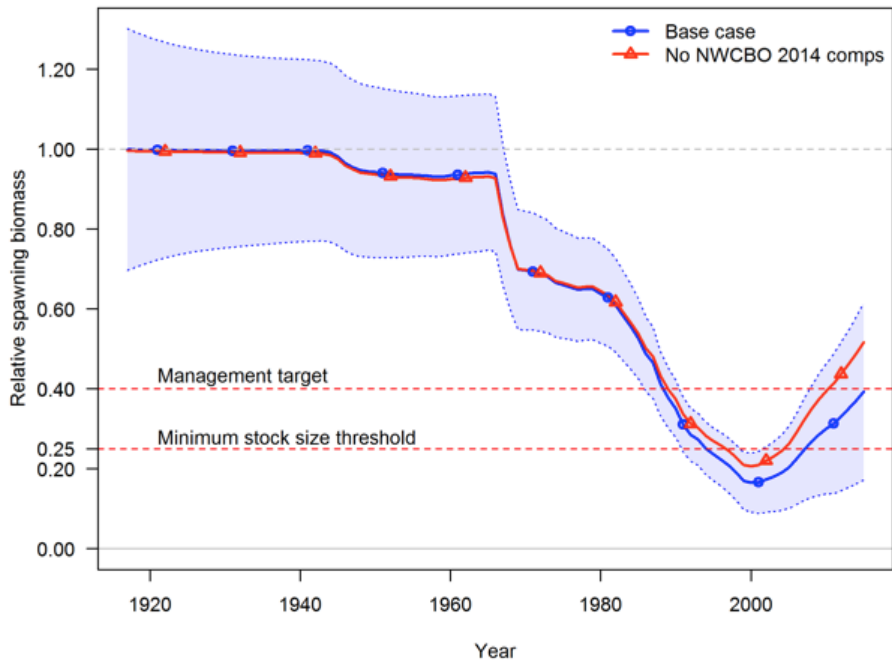
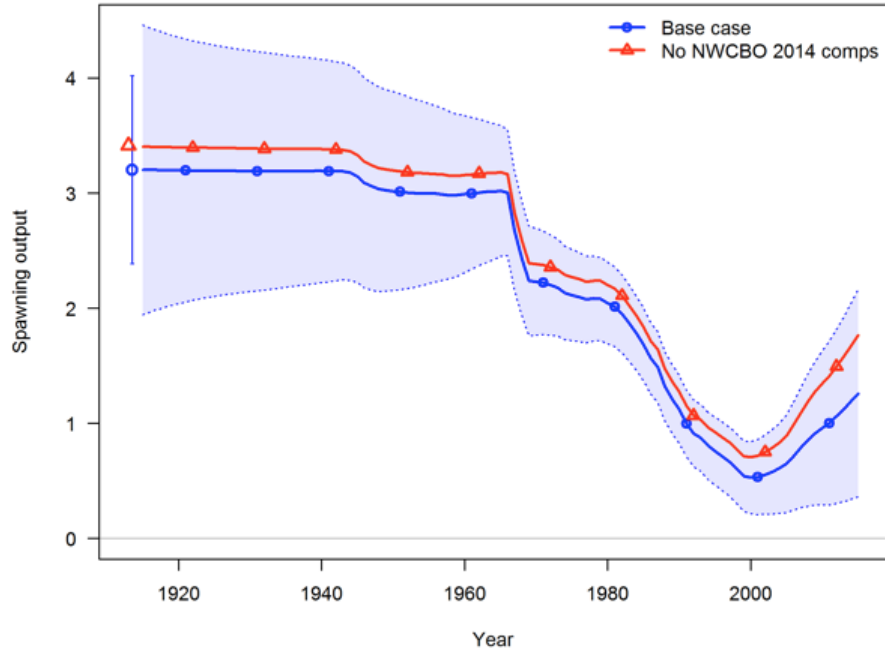
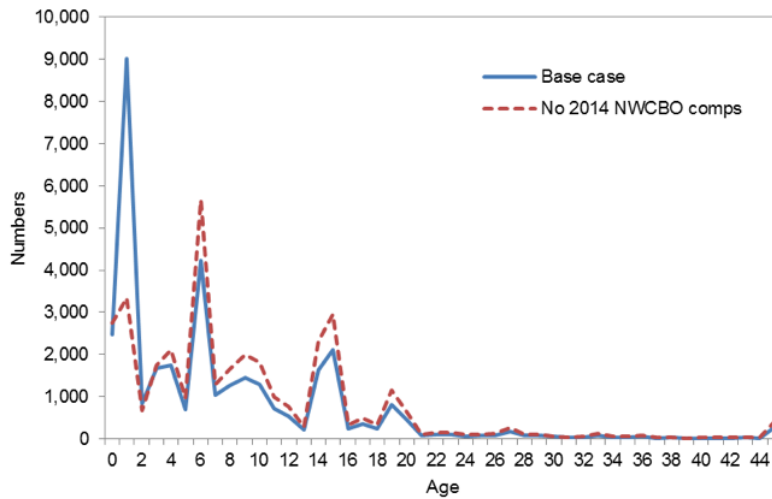


Figure 2. Results from Request 16.

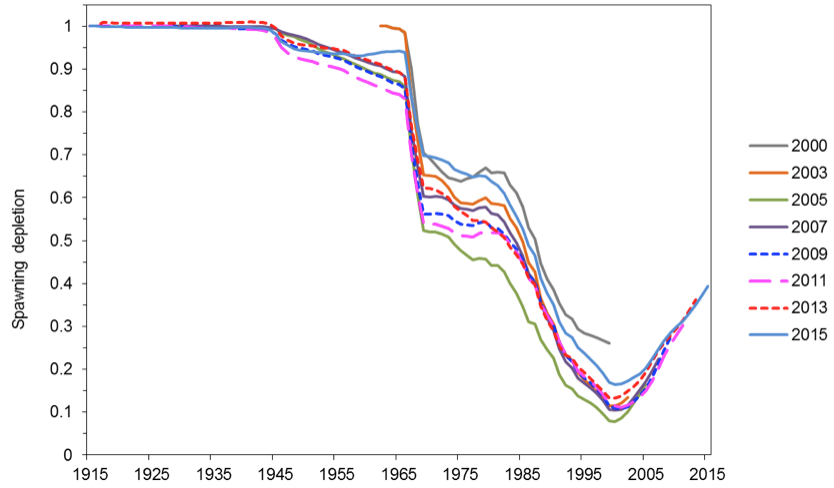




**Figure 3. Results from Request 17. Comparison of the spawning stock trends between the base case and the run when the 2014 NWFSC shelf-slope survey (NWCBO) composition data are removed on 1) an absolute scale (bottom panel) and 2) a relative scale (top panel).**



**Figure 4. Results from Request 22. Comparison of the estimated numbers-at-age (as of 2014) between the base case and the run when 2014 NWFSC shelf-slope survey (NWCBO) composition data are removed.**



**Figure 5. Results from Request 26. Comparison of the relative stock biomass over recent assessments and updates.**