Agenda Item E.2.a
Attachment 15
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GREENSTRIPED ROCKFISH

STAR Panel Report

August 3-6, 2009

Hotel Deca
4507 Brooklyn Ave NE
Seattle, WA 98105

Panel Reviewers

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Stock Assessment (STAT) Team members present

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Overview

A draft assessment of greenstriped rockfish (*Sebastes elongatus*) stock status off the U. S. west coast (California, Oregon, and Washington) was reviewed by the STAR panel from August 3-6, 2009 in Seattle, WA. Within the model the population is treated as a single homogeneous stock, but with fisheries that vary spatially. Greenstriped rockfish is a diminutive, low-value bycatch species and, as a consequence, there is great uncertainty about historical discarding practices. Recent data on discards collected by the West Coast Groundfish Observer Program from 2002-2007 were used in the assessment to model retention throughout the modeled period (1916-2008), although discard data collected during the 1980s were considered during the development of a base-model.

The assessment utilized the Stock Synthesis modeling platform and included a wide variety of data sets. Five fisheries were modeled, including: (1) Washington-Oregon (WA/OR) trawl, (2) California (CA) trawl, (3) foreign catches from 1966-1976, (4) "other" commercial gears, and (5) recreational harvests. Three fishery-independent time series of abundance were developed using Δ-GLMM analyses, i.e., early (1980-1992) and late (1995-2004) triennial trawl survey and the NWFSC combined trawl survey (2003-2008). Length compositional data were available to inform estimation of fishery and survey selectivities and conditional age-at-length data were obtained from the combined trawl survey.

This is the first assessment of greenstriped rockfish and a number of structural assumptions were evaluated and incorporated into the final model, including:

- Use of SS3 version 3.03a modeling framework;
- Inclusion of reconstructed landings with the modeled period beginning in 1916;
- Full bias-corrected stochastic recruitment from 1987-2005 with ramped bias corrections before (1970-1986) and after (2006-2020);
- Estimation of retention curves and discards for trawl and "other" commercial gears;
- Incorporation of weight-specific fecundity;
- Unbiased aging error estimates based on the method of Punt *et al*. (2008);
- Fixed $\boldsymbol{M}$ (0.08 yr^{-1}) based on longevity and Hoenig (1983);
- Fixed steepness ($\boldsymbol{h}$ = 0.69) based on Dorn's prior for an unobserved rockfish.

Results of the base assessment model indicate that depletion of the greenstriped rockfish stock (81%) is well above the Council's target for groundfish (40%) and that recent harvests (9-94 mt) are substantially below the potential yield. Uncertainty about the final base model was bracketed by jointly varying natural mortality and the discard retention curve. While decision table results vary widely over the range of possibilities considered, all indications are that the stock is in good condition. Given the robust conclusion that this stock is not currently in jeopardy, nor is it likely to be in the foreseeable future, the STAR panel recommends that this stock not be reassessed until such time that conditions within the fishery have changed substantially (e.g., targeting on greenstriped rockfish occurs) and/or fishery-independent survey statistics indicate a decline in stock abundance.

The STAR panel concluded that the greenstriped rockfish stock assessment developed by the STAT constitutes the best available scientific information on the status of this species off the U.S. west coast and recommends that it be used for status determination and management in the Council process. The STAR panel thanks the STAT team members for their exceptional preparation, hard work, and willingness to respond to panel requests.

Panel Requests to the Greenstriped Rockfish STAT

The following prioritized requests were made by the STAR panel to the greenstriped rockfish STAT:

1) Proposed new base case model. Beginning with the August 2nd version (which included minor updates to landings data, which the Panel endorsed), make the following changes:

   - Remove 1980 triennial survey length-frequency data (but not the 1980 survey index).
   - Re-run the ageing precision and bias estimation model assuming no bias in the ageing process; use the revised precision estimate in the new base case.
   - Use recruitment bias correction ramp (1970-1986).
   - All changes can be done in a single revised run.

Rationale: Sample sizes are small and there is potential bias in favor of mid-sized and more common fish in the early triennial survey length-frequency data. The calculation of both precision and bias in the ageing analysis was inappropriate. The difference between age readers was small and a better estimate of ageing imprecision is obtained by running the analysis with no bias between the readers. Research that is currently underway indicates the ramp-up bias correction method generates less biased estimates of recruitment.

Response: Tuning was done on the new base model for σ_R and resulted in a $\sigma_{R,in}$ of 1.05 and a $\sigma_{R,out}$ of 1.02. It is likely that σ_R increased because the main recruit deviation period from which $\sigma_{R,out}$ is calculated is shorter (1987–2005) and contains highly variable recruitments without the earlier recruitments dampening them. When $\sigma_{R,in}$ was 0.85 (prior to tuning), the estimated current depletion was 0.71, but when $\sigma_{R,in}$ was increased to 1.05, the estimated current depletion was 0.61, which is similar to the estimated depletion from the original base case model without the ramping in of the bias adjustment. So, even though originally it looked liked adjusting the bias adjustment may have an effect on current depletion, the model suggested tuning would bring it back to the same space. Other model parameter estimates were similar to those from the previous base case.

2) Two sensitivity runs that are modifications of the proposed base case model: The first, has a common selectivity for the WA/OR and CA trawl fisheries, but has different retention functions. The second run has a common WA/OR and CA trawl fishery retention function and different selectivity functions.

Rationale: It is difficult to disentangle the combined influence of the selectivity and retention functions on the residual pattern in the fits to the length-frequency data.

Response: The run with the mirrored retention function fit the data slightly worse, mostly in the length-frequency and mean-weight datasets. The overall results of the run were similar to the new base run. The asymptote of the retention curve was estimated at 0.4154 and selectivity curves were similar to the new base.

Somewhat different results were seen for the run with common selectivity for the WA/OR and CA trawl fisheries, but different retention functions. In comparison to the base model this model has poorer fits to the length and discards biomass data. The combined selectivity is most similar to the WA/OR trawl selectivity from the base model. The CA trawl fishery is now selecting fewer small fish in comparison to the base model but the WA/OR trawl selectivity is no longer having a problem with the peak parameter hitting the bound. The retention curve for the CA trawl suggests that the fishery is retaining more fish than the base model.

3) Two sensitivity runs to investigate uncertainty in historical retention rates. For both runs modify the proposed base case model to have a common WA/OR and CA trawl fishery retention function. These sensitivity runs have two time blocks with different retention functions: 1916-1999 and 2000-2008. The WCGOP discard data will apply to the 2000-2008 retention period.

   The first sensitivity run uses the Pikitch discard data for estimating retention parameters for the first time block. The second sensitivity run decreases the estimated asymptote of the retention curve (as estimated for the WCGOP data) by 50% for application to the first time period.

Rationale: The Pikitch data shows very different discard rates to the later WCGOP data, with much lower discarding rates. It seems unlikely that this Oregon data represents the full historical coastwide period, given the perception that historically greenstriped rockfish landings were a small fraction of the catch. These two sensitivity runs are constructed to bound the potential range of historical discards.

Response: The sample sizes for the Pikitch length-frequencies were set at 5 times the number of tows sampled, which resulted in 30 and 15 for 1986 and 1987, respectively. This was done as a tuning exercise as well as to increase the weight on the two length-frequencies which are the only information to inform a long time period. In addition, when just the number of tows was used for sample size, the retention asymptote was estimated at 0.05 and did not fit the length-frequencies at all. The results of the run with the Pikitch data resulted in a retention asymptote of 1.0 for the early time block and the fits to the Pikitch length-frequencies were reasonable. The unfished spawning output was 2,888 million eggs and the current depletion was estimated at 0.63. The retention asymptote for the later time block (WCGOP data) was 0.54. CA selectivity was still shifted to the left and WA/OR selectivity was shifted to the right. The discard fraction in the early time block was around 0.5-0.65 and in the later years was above 0.8.

The run with the retention asymptote fixed at 0.2077 estimated the discard fraction near 0.9 for the entire time period. The unfished spawning output was 10,700 million eggs and the estimated current depletion was 0.62.

4) Two sensitivity runs were requested to investigate the lack of fit to the 1993 year-class signal in the marginal age-composition data. For the first run, all research trawl length-

frequency data will be weighted lower. A maximum sample size of 200 will be used. For the second run, the marginal age-composition from the NWFS survey will be fitted and the length-frequency data removed.

Rationale: To investigate potential conflict between the length-frequency and marginal age-composition data.

Response: Decreasing the effective sample sizes of the survey length frequency data (maximum sample sizes of 200) produced better fits to the conditional age data in comparison to the base model, however visually the fit to the 1993 year class was not substantially improved. In this model run the $\sigma_{R,in}$ was 1.05 and $\sigma_{R,out}$ was 1.08. One run was completed to look at tuning σ_R up to 1.1 but the $\sigma_{R,out}$ was still higher than the input indicating that further tuning could be done.

The second model run removed the length-frequency from the NWFSC survey while retaining the marginal age composition data from that survey. With the length composition data removed the model was still unable to fit the high proportions in the age data from the 1993 cohort. The removal of the length-frequency data resulted in a new selectivity curve for the NWFSC that was shifted to the right with the peak parameter estimated at 43cm for females and 40cm for males which in turn result in a higher q for the NWFSC of 2.55. Due to this difficulty with the estimated selectivity, the length data were put back into the model with lambdas of 0.5 on the length frequencies and marginal age compositions from the NWFSC survey to improve the selectivity estimation. This resulted in a selectivity estimate similar to the base model and a q of 1 for the NWFSC survey. The model still failed to fit the large proportions of the 1993 year-class observed in multiple years. The final depletion estimated in this model was 0.58 compared to the base model estimate of 0.61.

During the meeting, an additional model run was conducted with ageing error turned off. This run resulted in substantially improved fits to the high proportions observed for the 1993 year class in the marginal age frequency data. With tuning, σ_R was estimated at 0.6 which is lower than the estimate of 0.85 for the base case model run. Because there certainly is error in ageing, and a potential for bias in the ageing data (from assigning more fish to a known strong year-class) the Panel decided that ageing error should be maintained in the base case model formulation. But, the lower σ_R (0.6) was considered more appropriate for this stock, and the base case model should fix σ_R at this value.

5) Check the discard ratio values presented in Table 9.

Rationale: Tabulated values appear suspicious because of similarity among the annual estimates for WA, OR, and CA.

Response: The formula used to calculate the discard ratios was incorrect (because data had been provided based on a North/South split, rather than a State-based split), and revised values for northern and southern regions were presented.

6) Provide model estimates of annual total catch and total retained catch from the base case and the two alternative retention scenarios.

Rationale: To determine how discard ratios vary between the base case and alternative retention scenario model runs.

Response: Results were presented in conjunction with the sensitivity runs discussed above.

7) Check data input for 2003 WA/OR trawl landings and discard length-frequency.

Rationale: Residuals for the landings and discard length-frequencies have opposite patterns.

Response: The data had been entered correctly and the suspicious residual pattern was the result of small sample sizes for the discard data.

8) Requested change to the assessment document: authors to document that the foreign fishery did not begin prior to 1966.

Rationale: Foreign fleet catches were high in 1966, suggesting the fishery could have begun earlier.

Response: The Rogers foreign catch reconstruction document states there was no foreign catch in US waters in 1965. The only catches reported in 1966 were from Soviet vessels, from the Monterey, Columbia, and US. Vancouver INPFC areas.

Description of base case model and alternative models to bracket uncertainty

- Start year of the model = 1916;
- Spatial structure: coastwide, single-area model;
- Discard for trawl and other-gear fisheries estimated within model from retention function;
- M set to 0.08 yr^{-1} for females and 0.08 yr^{-1} males following sensitivity analysis;
- h set to 0.692 on the basis of Dorn's prior;
- σ_R set to 0.6 following investigation of interaction with ageing imprecision;
- von Bertalanffy growth parameters, including dispersion of individual growth, estimated for females and males;

Fisheries:

Washington/Oregon trawl
California trawl
Foreign
Other commercial gears
Coastwide recreational

Abundance indices:

- Early Triennial trawl survey (1980-1992)
- Late Triennial trawl survey (1995-2004)
- NWFSC shelf-slope trawl survey (2003-2008)

Discard data [mt discarded]:

- Washington/Oregon trawl (2002-2007)
- CA trawl (2002-2007)
- Other commercial gears (2002-2007)

Discard data [mean body weight]:

- Washington/Oregon trawl (2002-2007)
- CA trawl (2002-2007)
- Other commercial gears (2002-2007)

Length composition[1]:

- Washington/Oregon trawl (1996-2008)
- California trawl (1978-2007)
- Other commercial gears (1979-2008)
- Coastwide recreational (1980-2003)
- Triennial trawl survey (1980-2004; triennial)
- NWFSC shelf-slope trawl survey (2003-2008)
- Washington/Oregon trawl discards (2003-2007)
- CA trawl discards (2002-2007)
- Other commercial gear discards (2005-2007)

Age composition (as conditional age-at-length by sex):

- NWFSC shelf/slope trawl survey (2003-2008)

Uncertainty – Greenstriped rockfish are small bodied and have only sporadically been caught but never targeted by the fishery and fishery sampling programs; much of the catch is discarded (about 80% by weight in recent years). There is much uncertainty in both the reconstruction of historical landings and especially in historical levels of discard. The effect of this uncertainty is bracketed by setting the historical retention curve to higher and lower values than the base-case value estimated from recent (2002-2008) observer data. The higher historical retention curve is supported by the discard observations obtained by Pikitch for the Oregon trawl fishery in the mid 1980s. The lower retention curve is supported by the widespread occurrence of greenstriped rockfish in fishery-independent trawl surveys, yet their low landed catch in some areas. Higher retention, hence less discard and lower historical total catch, scales historical stock abundance lower and vice versa for the lower retention curve. In addition, the natural mortality is not precisely determined and the base model uses a value of 0.08. The high end of the range is set to 0.10 based on high values predicted from life history characteristics and the low end is set to 0.06 based upon values of natural mortality estimated from the data included in the assessment.

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[1] Some years have no samples, see assessment document for details of sample availability.

The choice of natural mortality affects the estimated depletion, but even when M = 0.06, results still indicate that the stock is above the target stock size. The assessment finds that greenstriped rockfish have never been substantially reduced in abundance so the spawner-recruitment steepness cannot be estimated. Steepness is set equal to the mean of the prior derived from other rockfish species and the assessment result for greenstriped is not sensitive to this value.

Technical merits of the assessment

The greenstriped rockfish stock assessment team was very well prepared and had completed a thorough analysis, including a variety of sensitivity runs, in advance of the STAR panel meeting. Efforts to reconstruct landings for the States of Washington and Oregon were comprehensive and formed an essential component of the stock assessment, although additional work on landings reconstructions is expected to further improve our understanding of this species. Because greenstriped rockfish is essentially a non-targeted bycatch species, use of data from the West Coast Groundfish Observer Program (and the Pikitch study) to inform estimation of retention functions and total discards was a noteworthy technical accomplishment of the assessment.

Explanation of areas of disagreement regarding STAR panel recommendations

A. Among STAR panel members (including concerns raised by the GAP and GMT representatives

There were no areas of disagreement among STAR panel members.

B. Between the STAR panel and the STAT team

There were no areas of disagreement between the STAR panel and the STAT team.

Unresolved problems and major sources of uncertainty

It was the STAR panel's view that the principal source of uncertainty in the assessment relates to historical discarding practices. Recent data show significant discarding of all sizes of greenstriped rockfish, whereas data from Pikitch show both a lower overall discard rate and virtually no discarding of fish larger than 30cm. Given the ubiquity of this species in fishery-independent trawl surveys and relatively low reported landings over many years of observations, the Pikitch data were viewed with some skepticism and, as a consequence, were not included in the final assessment model. Nonetheless, the panel was concerned about application of discard data from the last decade, a time period of intense management, to the preceding historical period that started in 1916. While it is not clear how this issue can be resolved through further study, this remains a major source of uncertainty for greenstriped rockfish, for which discarding is generally acknowledged to be high.

Another source of uncertainty identified by the STAR panel is the estimate of greenstriped rockfish natural mortality (***M***), which in the base model was fixed at 0.08 yr^{-1}. Given observed longevities of male (49 yr) and female (51 yr) fish, which are relatively easy to age, the adopted value is reasonable. However, likelihood profiling indicates that a much better fit occurs at a lower value ($M \cong 0.06\ yr^{-1}$). Importantly, the difference between these two estimates has a considerable effect on estimates of stock size and potential production.

Management, data, or fishery issues raised by the GAP and the GMT representatives

No specific issues or concerns pertaining to the greenstriped rockfish stock assessment were raised by the GAP and/or GMT representatives during the meeting. It was acknowledged by industry participants at the meeting that on occasion catches were retained and landed during the course of normal fishing operations, but that targeting was unlikely to have occurred.

Prioritized recommendations for future research and data collection

<u>Specific to greenstriped rockfish:</u>

1. Develop alternative methods to deal with historical discards, where information is limited or non-existent. Co-occurrence of greenstriped rockfish with other species in fishery-independent trawl survey catches may provide a basis for estimating relative fishing effort trends.

2. Conduct a blind re-read of ageing structures from the strong 1993 year-class to ascertain if there is ageing bias resulting from an expectation of a strong year-class.

3. Explore stock structure and potential differences in northern/southern greenstriped rockfish life history characteristics.

<u>General:</u>

1. Continue to develop standardized landings reconstruction methodologies over all three west coast states.

2. Explore a GLMM approach with a calendar date covariate to estimate CPUE indices for the entire triennial survey time series. A species assemblage meta-analysis approach could be used to develop priors for the ratios of q among the early triennial, the late triennial and the NWFSC surveys.

3. Explore the relationship between ageing precision, recruitment variability, and bias adjustment (and effects on depletion estimates) using simulation methods, and develop recommended procedures for appropriate methods to follow.

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