Pacific Ocean Perch

Stock Assessment Review (STAR) Panel Report

Hotel Deca, Seattle, Washington

20-24 June 2011

STAR Panel Members

Yong Chen	Center for Independent Experts
Ray Conser (Chair)	Southwest Fisheries Science Center
	PFMC Scientific & Statistical Committee (SSC)
James Ianelli	Alaska Fisheries Science Center
Kevin Stokes	Center for Independent Experts

Pacific Fishery Management Council (PFMC) Advisors

John DeVore	PFMC Staff
Dan Erickson	Oregon Department of Fisheries & Wildlife
	PFMC Groundfish Management Team (GMT)
Pete Leipzig	West Coast Seafood Processors Association
	PFMC Groundfish Advisory Subpanel (GAP)

Stock Assessment Team (STAT)

Owen Hamel	Northwest Fisheries Science Center
Kotaro Ono	University of Washington

Overview

The Pacific Ocean Perch STAR Panel (Panel) met in Seattle, Washington during 20-24 June 2011 to review a draft stock assessment of Pacific ocean perch (*Sebastes alutus*) (POP) off the U.S. west coast, prepared by the POP stock assessment team (STAT). Dr. Ray Conser (Panel Chair) welcomed participants; reviewed the Pacific Fishery Management Council's (PFMC) *Terms of Reference for the Groundfish Stock Assessment and Review Process*; and discussed the background material and logistics for the Panel meeting. Dr. James Ianelli agreed to serve as rapporteur. A list of participants is provided in Appendix 1. A list of acronyms and other terms used in this report can be found in Appendix 2.

The draft assessment document (including model input and output files) and extensive background material (previous assessments, previous STAR Panel reports, etc.) were provided (via the PFMC FTP site) to the Panel two weeks in advance of the Panel meeting. The FTP site was also used for common access to all presentation material and the additional model runs that were conducted during the course of the Panel meeting.

Dr. Owen Hamel led the presentation of the draft assessment document and subsequent analyses carried out during the week. Kotaro Ono presented parts of the draft assessment and subsequent analyses.

A full stock assessment of POP was conducted and reviewed by a STAR Panel in 2003. While periodic updates were done afterwards (2005, 2007, and 2009), this year's full assessment (2011) is the first since 2003, and the first one conducted using the Stock Synthesis (SS) model since the 1990s. Since 2000, all other full and update assessments had used a forward-projection statistical catch-at-age model (coded in AD Model Builder) that was similar to SS in theory, but quite different in several key aspects of its implementation. POP has been classified as an overfished stock and subject to various forms of PFMC rebuilding plans since 1981.

The 2011 stock assessment used the most recent version of SS with data from the commercial trawl fisheries (landings, discards, and length- and age-compositions); indices of abundance from a variety of surveys and from standardized commercial logbook CPUE; size compositions from all surveys and age-compositions, as available; and biological data on mean length-, maturity-, and fecundity-at-age. The assessment region covers the Columbia and Vancouver INPFC areas ranging from southern Oregon to the USA-Canada border. This area encompasses the most southern part of the range of POP. As with past stock assessments, linkages with POP in British Columbia (via movement of adults or larval transport) were assumed to be negligible in this assessment. Multiple model runs were conducted and reviewed to examine model assumptions and structure, and to identify uncertainties in the assessment.

The POP stock status – as indicated by the spawning stock output (SSO) depletion ratio (SSO_{2011}/SSO_0=0.19) – is more pessimistic than that reported in the 2009 assessment update (SSO_{2009}/SSO_0=0.29). The principal reason for this difference in stock status is the estimate of a much larger SSO_0 in the 2011 assessment – driven primarily by the change in modelling platform used for the 2011 assessment and a concomitant change in weighting of the various data components, such that what was previously characterized as a single large recruitment event in the early 1950s, now is considered a larger initial biomass. More specifically, POP on the U.S. West Coast continue to be overfished ($SSO_{2011}/SSO_0<0.25$) but are in the process of rebuilding (SSO is increasing in recent years); and overfishing is not occurring ($F_{2010} < F_{50\%}$).

There is considerable uncertainty associated with the assessment results (Figure 1). The objective function has a flat (uninformative) response surface caused in part by the high degree of (negative) correlation between the natural mortality rate (M) and spawner-recruit steepness (h) parameters. A POP decision table was developed using three plausible values for h as states of nature (Table 1), as is typical for many PFMC groundfish assessments. However, the Panel cautions that other unaccounted for sources of uncertainty may also be important.

The Panel concluded that this POP assessment was based on the best available data, the new assessment results constitute the best available information on stock status, and are suitable to serve as the basis for fishery management decisions and stock status determinations.

The Panel commends the STAT for their excellent presentations, well-written and complete documentation, their willingness to respond to the Panel's requests for additional analyses, and their dedication in finding possible solutions to difficult assessment problems. The NWFSC and PFMC staff are thanked for arranging the meeting facilities, hotel accommodations, and the FTP site containing the background materials.

Discussion and Additional Analyses Requested by the STAR Panel

The draft stock assessment document was presented by the STAT. The major sources of data and biological information for this assessment included:

- Landed catch, as recorded by comprehensive catch landing receipts and historical data from foreign and domestic fisheries
- Age and size composition of the landed catch
- Mean length at age data
- Maturity and fecundity at age
- Bottom trawl research surveys conducted triennially (1977-2004) in the 30-200 fathom depth range provide the primary, long-term index of POP abundance ("shelf survey"). Additional indices of abundance from (i) deep water (100-700 fathom) trawl surveys conducted annually since the mid-1990's ("AFSC and NWFSC slope surveys"); (ii) trawl surveys that targeted on POP in 1979 and 1985; and (iii) a fishery logbook CPUE index covering early years of the target fishery (1956-73).
- Age and size composition from the shelf and slope surveys

Initially, Panel discussion focused on the key changes incorporated into the 2011 draft assessment base case relative to the last assessment update conducted in 2009. This year's full assessment (2011) is the first since 2003, and the first one conducted using the Stock Synthesis (SS) model since the 1990s. Since 2000, all other full and update assessments had used a forward-projection statistical catch-at-age model (coded in AD Model Builder) that was similar to SS in theory, but substantially different in several important aspects of its implementation.

The key differences in the 2011 assessment are listed below.

a. Data were disaggregated where possible and modeled by sex (females and males). Previously, the sexes were combined.
b. Length-based selectivities were estimated for all surveys and fisheries. Previously, selectivity-at-age was estimated.
c. Growth was estimated within the model. Previously a single mean weight-at-age vector was assumed.
d. Discard information was explicitly included and used in the estimation of retention functions and rates. Previously, discard data (or assumptions about discard rates) were simply added to the total landings information.
e. Survey data were modeled using a GLM approach prior to being applied within the assessment model. Previously, conventional design-based estimates of biomass (and variances) were used.

f. A new prior distribution on natural mortality was developed and used (based on a new study using a type of meta-analysis that is in preparation by the lead author).
g. A new prior distribution on stock-recruitment steepness was used (updated from the work of Dorn et al. 2009).
h. Conditional age given length data were compiled and were available for guiding model parameter estimates. The previous model only fit marginal age composition data.
i. A new maturity schedule was estimated and used in the assessment model. The age at 50% maturity changed from 8 years to 6 years.
j. Age composition data from surface readings of otoliths were omitted. Previous assessments used these data as biased, uncertain ages

Based on the background documents, the material presented, and the ensuing discussions, the Panel initiated an iterative process of (i) making requests of the STAT for additional information and analyses, (ii) reviewing the results of same (usually the next day), and (iii) making additional follow-up requests of the STAT. This process continued throughout the course of the meeting with results of the final requests being presented to the Panel during the morning of the last meeting day. The goal of this process was to achieve an agreed base case and to fully characterize the uncertainty about the base case results. The next section (*STAR Panel Requests*) describes each request as well as the rationale for the request and a brief summary of the response. The results of the key consequent analyses conducted by the STAT and the ensuing discussions with the Panel are outlined in the *Discussion of Results from Panel Requests* section, below.

STAR Panel Requests

1) Use discard rates over time from Pikitch data
Rationale: Better data exists than what was assumed in base case as presented
Response: Used updated values provided by Dan Erickson.

2) Check discard sample size used
Rationale: Seems like actual number of fish are used and therefore different than survey and fishery approaches used.
Response: Actually correct values used, but should be reweighted by factor of about 50%.

3) Omit 2004 age data from the survey (perhaps it may be okay for the marginal age compositions) unless it can be corrected.
Response: Found that age data from one of three vessels for 2004 survey was mis-entered, so

used data from the other two vessels only.

4) Compare mean weights-at-age from 2009 assessment to this year
Rationale: Need a way to compare growth
Response: Found that mean weights–at-age used for 2000-2009 assessments did not match the data in the assessment, and the current weights-at-age fit much better.

5) Exchange conditional age-length data for marginal age compositions
Rationale: In the bridge analysis and elsewhere, it was apparent that the composition data had a large impact—fix growth if needed
Response: Fixed growth and switched to age data. This eliminated the very large early recruitment in the 1950s.

6) Check old model numbers over time (e.g. age 3) with SS cross (A) from the bridge analysis. Investigate what may be causing the difference in recent depletion and in B_{MSY} and other reference point estimates.
Rationale: To try to better understand the difference between old and new assessments.
Response: Major difference is change in B_0.

7) Try a run with R1 specified
Rationale: See if that improves the behavior of the single, large year class.
Response: Does not improve.

8) Do a run with and without the Oregon catch reconstruction
Rationale: Further examination of the differences in the old and new model results
Response: Removing both the Oregon and Washington reconstruction does change B0 and current status, but there are no data prior to 1956 without the reconstruction.

9) Try a run with higher σ_R (i.e. 2.0 or 3.0) and steepness fixed at 1.0
Rationale: See if M estimates change
Response: Yes, M gets larger (0.09), but the entire trajectory is not reasonable.

10) Show pairwise diagnostic plots of MCMC chain
Rationale: May show correlations among parameters and if there are parameters that are poorly determined.
Response: Produced these – nothing obvious came of this.

11) Summarize results from recent Canadian assessment
Response: Showed results from assessment around Queen Charlotte Islands which are similar in terms of timing of large removals and overall trajectory.

12) Show plots of priors on M and h relative to previously used values.
Response: Shown (no prior on h previously, and very tight prior on M)

13) Provide table and summary of the meta-analysis used for steepness prior.
Response: Provided by Martin Dorn.

14) Provide maps showing coverage of the surveys relative to the fishery.
Response: Attempted, but lack of time. STAT felt description indicated adequate coverage.

Discussion of Results from Panel Requests

The results from Panel requests that influenced interpretation of modelling results and/or contributed to the modification of the base case (as presented in the draft assessment document) are discussed below. Several of the Panel's requests were intended to provide additional data and information – supplemental to that included in the draft assessment document – to help the Panel better understand the underlying data, assumptions, and POP biology. The results from these requests are not discussed below.

Stock Structure

As noted by the previous STAR Panel (2003), the POP fishery and survey catches are continuously distributed across the USA-Canada boundary. The current assessment considers only the USA resource, and excludes Canadian data. The POP resource in Canadian waters is thought to be considerably larger than that in USA waters (at least 2 times larger, *cf.* Schnute et al., CSAS Res. Doc. 2007). A draft updated Canadian stock assessment (unavailable to the STAR panel) indicated that the current Canadian POP spawning stock relative to SSB_0 is estimated to range from 8% to 43% depending on model configuration and including uncertainty estimates. Furthermore, the Canadian POP spawning stock appears to be at historic low levels. The effects of movement of POP and their larvae into or out of the assessed USA area are unknown, but may influence SS modelling of the USA area, e.g. when estimating the spawner-recruit steepness (h).

Discard Rates

A trawl discard rate of 16% was applied to landings data in the initial draft of the 2011 POP assessment. This rate has been used for many of the previous POP assessments, but was calculated using widow rockfish catch data from the trawl discard study described by Pikitch et al. (1988). The Panel recommended recalculating the discard rate using only POP data from Pikitch et al. (1988). These new discard rates (discard weight / (discard weight + utilized weight)) were calculated for two trip limits that were in effect during the 1985-1987 trawl-discard study (5,000 lbs / trip and 10,000 lbs / trip) as grand means of expanded weights (i.e., equivalent to haul-by-haul discard ratios weighted by total POP catch) across the years 1985, 1986, and 1987. The POP discard rates were calculated as:

1985-1987 (5,000 lb / trip)	=	5.5% (± 1.5% SE)
1985-1987 (10,000 lb / trip)	=	0.7% (± 0.5% SE)
1985-1987 (all)	=	2.6% (+ 0.7% SE)

Based on these results, the STAT proposed including the following POP discard rates in the current assessment, based on predominant historical trip limits:

1982-1988 = 5%

1989-1994 = 10%

New Software Implementation

Since this assessment was a new analysis on the status of POP (using the SS3 model for the first time), nearly all the data had to be re-compiled relative to previous assessments. Although the SS software used to assess POP this year has been extensively used and analyzed, the vast number of options increases the potential for unintended (and/or undocumented within the assessment) model configurations. These options also add to the complexity of the review process in that some feature switches may be inappropriately invoked and go undetected. Feedback from the STAT provided confidence that models were carefully specified and that parameters were well estimated based on convergence properties (e.g., a Hessian that was positive definite and estimates that were repeated given "jittered" starting values). Also, the bridge-analysis that was performed (where SS was configured to be most like the model used previously) suggested that general patterns between the two models were shown to be qualitatively similar. However, some aspects of the difference observed caused some concern. For example, the estimate of depletion level for the two models differed by about 25%. Requests for further investigation on the cause indicated that the selectivity functions were different (double-normal versus non-parametric smoothed coefficients) and could partially explain some of the difference. It was also noted that extensive tests for model convergence (for both implementations) were not carried out and that the likelihood surfaces were relatively flat (and complex) across parameters that affect depletion levels (e.g. M and h).

After examining numerous runs, the Panel suggested that due to the flat, uninformative response surface – caused in part by the high degree of (negative) correlation between M and h – that M and h should be fixed rather than estimated in the base case model. While it was recognized that the CIs from this base case would underestimate uncertainty within the model, the enhanced stability was thought to be a worthwhile tradeoff. A sensitivity run was made with M and h estimated to better capture the range of a credible 95% CI (Figure 1). Further, the STAT was asked to develop a decision table that explored across model uncertainty rather than within model uncertainty (see Table 1 and the discussion in the next section).

Description of base model and alternative models used to bracket uncertainty

A parsimonious model with adequate flexibility to fit the data was selected as the base model. Growth parameters were estimated in preliminary models including conditional age-at-length data and mean-length at age data; and the female natural mortality rate was fixed at M=0.05 with a male offset estimated. Steepness (h) was estimated as well in a second preliminary model.

The key aspects of the final base model were:

- female natural mortality was fixed at M=0.05 and steepness were fixed at the value obtained from the preliminary run (h=0.4);
- growth parameters were fixed at values obtained from the preliminary run;
- fishery selectivity was modeled as being dome-shaped in length;
- selectivity for the triennial shelf survey was allowed to be domed-shaped as well (but the model estimated triennial selectivity as being asymptotic);
- the POP, AFSC slope, and NWFSC slope surveys shared a single asymptotic selectivity curve;
- an asymptotic selectivity curve for the NWFSC shelf/slope survey was estimated;
- fishery retention was modeled as an asymptotic curve with the asymptote estimated in time blocks to fit the observed discard rates and length compositions; and
- the surveys were re-weighted one time.

The estimated exploitation rate peaked in the mid-1960’s when foreign fishing was intensive. The rate dropped by the late 1960’s, but increased slowly and steadily from 1975 to the early 1990’s, due to further declines in biomass. Over the past 10 years the exploitation rate has fallen further from around 2% to under 1%. The stock remains at a relatively low level of abundance with apparent increase in recent years. The current (2011) spawning stock biomass output is near 20% of the unfished level (SSB_0) – below the PFMC threshold for designating a stock as overfished (25%) and about half of the rebuilding target (40% of SSB_0). POP fisheries have a history of being sustained by large, but infrequently occurring year-classes. There appears to be some evidence of a strong year-class in 2008 but data to confirm this are presently limited.

Likelihood profiles on steepness (h) coupled with model runs with h fixed at three values (0.35, 0.40, and 0.55) were used to characterize uncertainty in the assessment, and to develop a management decision table (Table 1 and Figure 2). Within model uncertainty was best represented by the 95% CIs from a sensitivity run that was structured identically to the base case except that M and h were estimated (Figure 1). The two approaches to characterizing uncertainty have similar central tendencies and similar upper levels but the latter approach includes a wider range of depletion at the lower end (*cf.* Figures 1 and 2). However, the asymptotic confidence interval from SS tends to be overly wide on the lower end relative to that which would be expected from a full Bayesian distribution. As such, the decision table appears to adequately cover the range of uncertainty in this assessment. Finally, the relatively high level of uncertainty in the 2011 spawning depletion estimate is to be expected given the sparseness of the fishery data and the uncertain survey information.

Comments on the technical merits of the assessment

The Pacific ocean perch stock assessment was carried out in a highly professional manner. The draft document was complete, well written, and distributed to the Panel well in advance of its meeting. The presentations prepared by the STAT were clear, comprehensive, and supplemented the written document quite well. While there were no major flaws in the draft analyses, the Panel made numerous requests of the STAT in order to better understand the analyses and the underlying data and ultimately, to improve the assessment. The STAT responded admirably to all of the Panel's requests, and incorporated the agreed suggestions into a new base case.

The Panel concluded that the Pacific ocean perch stock assessment was based on the best available data, the new assessment results constitute the best available information on stock status, and are suitable to serve as the basis for fishery management decisions.

Areas of Disagreement

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

Unresolved problems and major uncertainties

Problems unresolved at the end of the meeting form the basis for some of the research recommendations, below. Many of the research recommendations address detailed aspects of the fishery and survey data; the biology and vital rates; and nuances of the modelling. But the overarching unresolved problem / major uncertainty that most greatly affects scientific interpretation of the assessment results is the stock structure issue. The U.S. POP "stock," as modeled in the assessment, is almost certainly shared to some important degree with Canada. Yet Canadian catches and other important information from the Canadian fisheries and surveys are not considered. While resolution of this issue is beyond the scope of what can be reasonably expected from the STAT, it is critical for the credibility of the management system to establish a formal framework and to conduct POP assessments (and perhaps other transboundary stocks) jointly with Canada.

Concerns raised by the GMT and GAP advisors during the meeting

As discussed in the Requests, above, the GMT advisor raised concern regarding the use of the discard data for POP from the Pikitch studies. Consequently, the discard estimates were revised and used in the base case development. In general, the Panel and STAT were greatly appreciative for the interventions by the GMT and GAP advisors as they very much improved the stock assessment.

Research Recommendations

- Considering transboundary stock effects should be pursued. In particular the consequences of having spawning contributions from external stock components should be evaluated relative to the steepness estimates obtained in the present assessment (see more complete discussion of this recommendation under the *Unresolved Problems and Major Uncertainties* section, above).
- The benefits of adopting the complex model used this year should be evaluated relative to simpler assumptions and models. While the transition from the simpler old model to Stock Synthesis was shown to be similar for the historical period, the depletion estimates in the most recent years were different enough to warrant further investigation.
- Discard estimates from observer programs should be presented, reviewed (similar to the catch reconstructions), and be made available to the assessment process.
- The quality of the age and length composition data, as presented, should be re-evaluated since they appear to affect model results.
- A survey that is better suited to rockfish species would be beneficial for the assessment.

- The ability to allow different "plus groups" for specific data types should be evaluated (and implemented in Stock Synthesis). For example, this would provide the ability to use the biased surface-aged data in an appropriate way.
- Historical catch reconstruction estimates should be formally reviewed prior to being used in assessments and should be coordinated so that interactions between stocks are appropriately treated. The relative reliability of the catch estimates over time could provide an axis of uncertainty in future assessments.

Table 1. Decision Table for Pacific ocean perch. The three catch streams from 2013-2022 are based upon the current rebuilding SPR rate ($F_{86.4\%}$) under low (h=0.35), base (h=0.40), and high (h=0.55) states of nature. The 2011 and 2012 catch levels are based upon current management.

		Base		Low h.35		Base h.4		High h.55	
	Year	OFL	Catch	Sp. Out	Depletion	Sp. Out	Depletion	Sp. Out	Depletion
	2011	1,026	180	7,987	0.118	12,532	0.191	26,089	0.399
	2012	1,049	183	7,998	0.119	12,621	0.193	26,388	0.403
	2013	844	94	8,124	0.120	12,906	0.197	27,107	0.414
	2014	864	96	8,366	0.124	13,358	0.204	28,124	0.430
Low	2015	893	98	8,647	0.128	13,882	0.212	29,283	0.448
Catch	2016	926	101	8,904	0.132	14,369	0.219	30,351	0.464
Series	2017	958	104	9,129	0.135	14,804	0.226	31,287	0.478
	2018	986	107	9,291	0.138	15,133	0.231	31,977	0.489
	2019	1,011	109	9,423	0.140	15,413	0.235	32,551	0.498
	2020	1,035	111	9,553	0.142	15,693	0.239	33,113	0.506
	2021	1,058	113	9,743	0.144	16,075	0.245	33,881	0.518
	2022	1,080	115	9,966	0.148	16,514	0.252	34,751	0.531
	2011	1,026	180	7,987	0.118	12,532	0.191	26,089	0.399
	2012	1,049	183	7,998	0.119	12,621	0.193	26,388	0.403
	2013	844	150	8,124	0.120	12,906	0.197	27,107	0.414
	2014	862	153	8,336	0.124	13,328	0.203	28,094	0.430
Medium	2015	889	158	8,587	0.127	13,821	0.211	29,223	0.447
Catch	2016	920	164	8,812	0.131	14,277	0.218	30,259	0.463
Series	2017	950	169	9,004	0.134	14,679	0.224	31,162	0.476
	2018	976	174	9,132	0.135	14,975	0.228	31,819	0.486
	2019	999	178	9,230	0.137	15,221	0.232	32,359	0.495
	2020	1,020	182	9,327	0.138	15,467	0.236	32,887	0.503
	2021	1,041	185	9,481	0.141	15,814	0.241	33,620	0.514
	2022	1,062	189	9,666	0.143	16,215	0.247	34,453	0.527
	2011	1,026	180	7,987	0.118	12,532	0.191	26,089	0.399
	2012	1,049	183	7,998	0.119	12,621	0.193	26,388	0.403
	2013	844	316	8,124	0.120	12,906	0.197	27,107	0.414
	2014	856	322	8,248	0.122	13,240	0.202	28,006	0.428
High	2015	878	333	8,408	0.125	13,643	0.208	29,045	0.444
Catch	2016	903	344	8,540	0.127	14,007	0.214	29,988	0.458
Series	2017	927	354	8,637	0.128	14,314	0.218	30,796	0.471
	2018	947	363	8,671	0.129	14,515	0.221	31,358	0.479
	2019	964	370	8,675	0.129	14,667	0.224	31,804	0.486
	2020	980	377	8,678	0.129	14,820	0.226	32,240	0.493
	2021	994	383	8,733	0.129	15,068	0.230	32,875	0.503
	2022	1,009	388	8,815	0.131	15,366	0.234	33,607	0.514

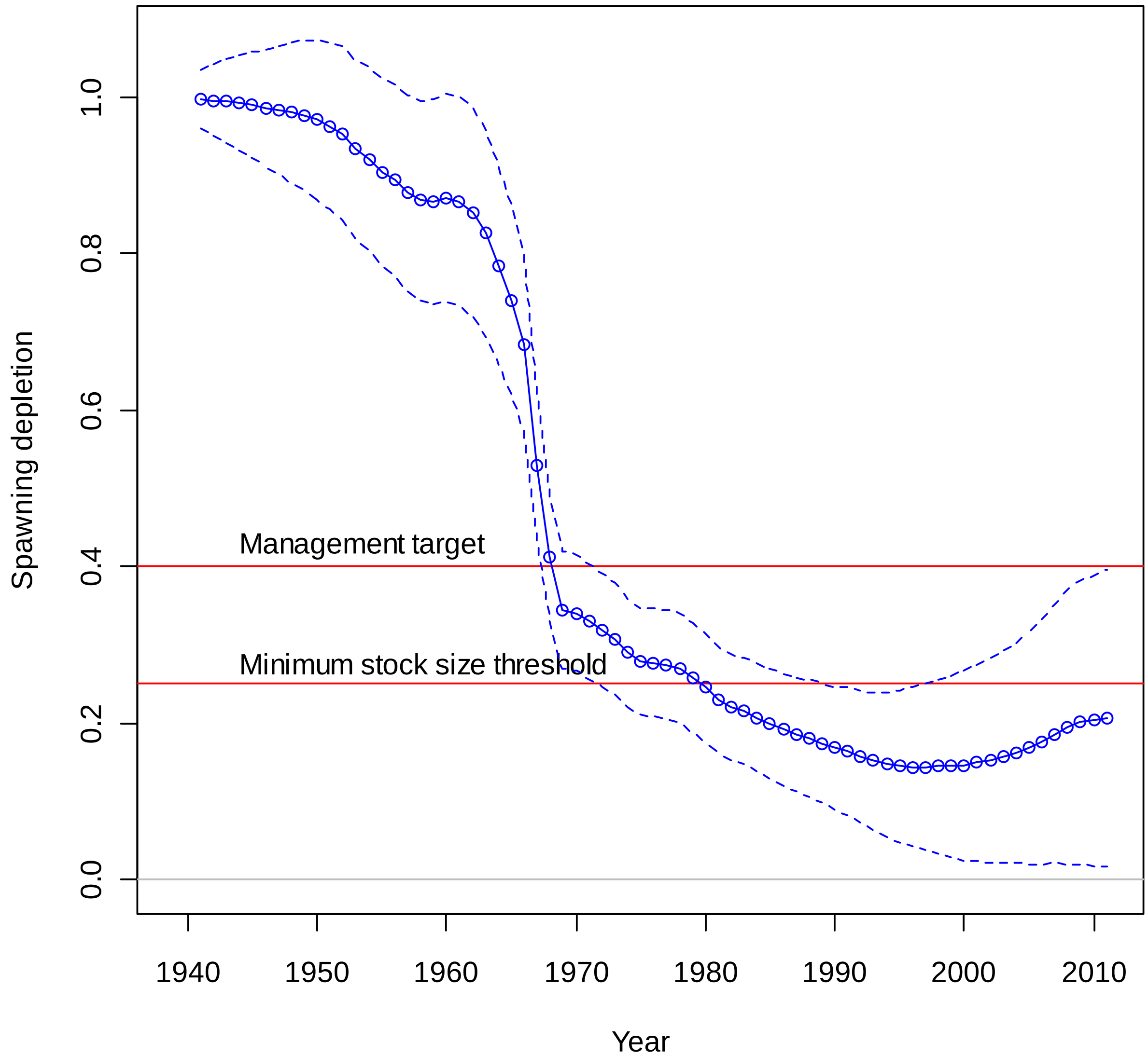

Figure 1. Spawning output depletion trajectory and 95% confidence interval (CI) for a sensitivity run in which the natural rate of females (M) and spawner-recruit steepness (h) were estimated. While the base case fixed both M and h, the 95% CI from this run better depicts the within model uncertainty than the corresponding CI from the base case.

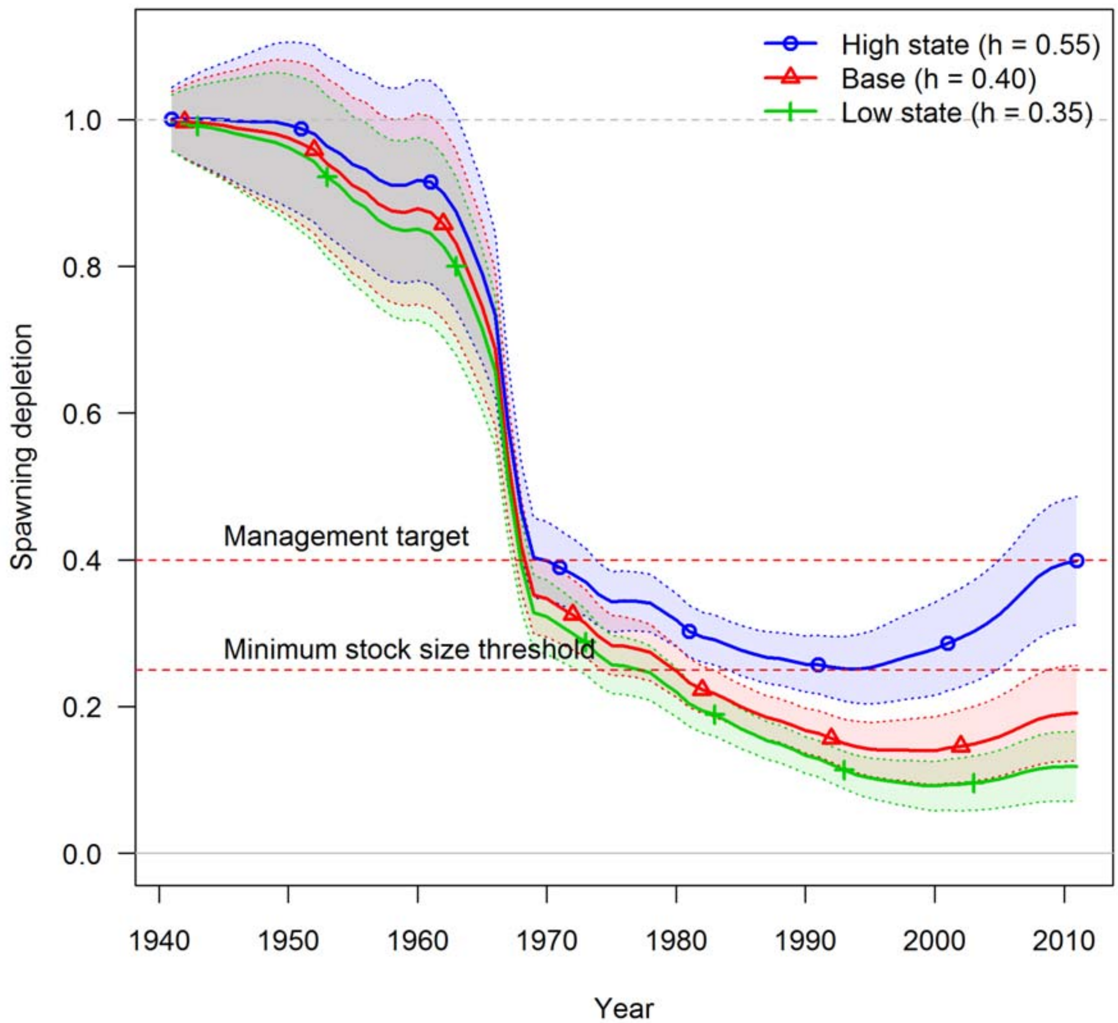

Figure 2. Spawning output depletion trajectories and the corresponding 95% confidence intervals for the three values of steepness (h) representing the low (h=0.35), base (h=0.40), and high (h=0.55) states of nature in the management decision table (Table 1).

Appendix 1. List of Participants

STAR Panel Members

Yong Chen	Center for Independent Experts (CIE)
Ray Conser (Chair)	NMFS, Southwest Fisheries Science Center
	PFMC Scientific & Statistical Committee (SSC)
James Ianelli	NMFS, Alaska Fisheries Science Center
Kevin Stokes	Center for Independent Experts (CIE)

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Stock Assessment Team (STAT)

Owen Hamel	Northwest Fisheries Science Center
Kotaro Ono	University of Washington

Others in Attendance

Jim Hastie	NWFSC
Stacey Miller	NWFSC
Jason Cope	NWFSC
Martin Dorn	AFSC
Chantel Wetzel	NWFSC
Brad Pettinger	
Corey Niles	WDFW
Colby Brady	

Appendix 2. List of acronyms and other terms used in this report

ABC	Allowable Biological Catch
AFSC	Alaska Fisheries Science Center
CAP	Cooperative Ageing Program
CDFG	California Department of Fish and Game
CIE	Center for Independent Experts
CPFV	Commercial passenger fishing vessel
CPUE	Catch per unit effort
CRFS	California Recreational Fisheries Survey
CV	Coefficient of variation
GAP	Groundfish advisory subpanel
GLM	Generalized linear model
GMT	Groundfish management team
h	Steepness of the spawner-recruit relationship
M	Natural Mortality rate
MSST	Minimum Spawning Stock Threshold
NMFS	National Marine Fisheries Service
NWFSC	Northwest Fisheries Science Center
ODFW	Oregon Department of Fisheries and Wildlife
OFL	Overfishing limit
Panel	Shorthand for the Stock Assessment Review Panel
SS	Stock Synthesis (model)
SSB	Spawning stock biomass
SSB_0	Spawning stock biomass in the absence of fishing
SSC	Scientific and Statistical Committee (of the Pacific Fishery Management Council)
STAR	Stock Assessment Review
STAT	Stock Assessment Team
SWFSC	Southwest Fisheries Science Center
WDFW	Washington Department of Fish and Wildlife