Agenda Item E.1.a
Attachment 5
November 2011

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Rebuilding analysis for bocaccio, based on the 2011 stock assessment

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Introduction

In 1998, the PFMC adopted Amendment 11 of the Groundfish Management Plan, which established a minimum stock size threshold of 25% of unfished biomass. Based on the 1996 stock assessment, bocaccio rockfish (*Sebastes paucispinis*) was declared formally to be overfished, thereby requiring development of a rebuilding plan for consideration by the Council in the fall of 1999. Rebuilding was initiated by catch restrictions beginning in 2000. A number of bocaccio stock assessments have been conducted since that time (see overview in Field et al. 2009, or Field and He 2009). In 2004, a formal rebuilding plan for bocaccio was enacted by the Pacific Fishery Management Council (PFMC) as part of Amendment 16-3 to the Pacific Coast Groundfish Fishery Management Plan. That plan was revised by Amendment 16-4, which was based on the 2005 rebuilding analysis (MacCall 2005). Since 1999, catches have typically been well below the OY/ACL value (40% when catches and OYs are summed over the 2000-2010 period), and even further below the ABC/OFL value (18% over the 2000-2010 period, Table 1).

The most recent bocaccio stock assessment update is pending SSC review (Field, in review), as a traditional update adhering to the terms of reference provided a result that was considered by the STAT team to be unrealistically optimistic. Essentially, that model suggested an essentially unprecedented strong recruitment in 2010, based almost entirely on length composition data from the 2010 NWFSC trawl survey, which is dominated by small (Young-of-the-Year, YOY) individuals and has an overly strong influence on the model results. Based on this observation, and the guidance provided by the SSC in June of 2011, the STAT developed an alternative model for consideration. In this model, it is assumed that the bottom trawl survey does not provide an accurate index of age 0 abundance. Consequently, these fish (fish smaller than 20 cm) are removed from the CPUE and compositional data, the index is recalculated with age selectivity fixed to be non-selective for age 0 fish, and fully selected for age 1+ fish (for which a length-based selectivity curve continues to be estimated). Additionally, in order to account for what is expected to be one or several strong year classes, we also include the southern California power plant impingement survey for YOY bocaccio, which predicts strong recruitment in recent years.

Simulation Model

This analysis uses the SSC Default Rebuilding Analysis (Version 3.12b, January 2010, Punt 2009). All data and parameters, including reference points (unfished spawning output and recruitment) were taken from STAT base model in the 2011 assessment update (Field, in revision), and the input file is given in Appendix A. Recruitments are pre-specified from 2000 through 2010 for the re-estimation of reference parameters, and future recruitments were simulated by drawing off of the spawner-recruit relationship, estimated in the base model (using the Dorn prior) with a steepness of 0.60 and σ_R of 1. Probability distributions are based on 5000 simulations. The key model parameters are given in Table 2. The rebuilding target is based on the PFMC proxy value for MSY of 40% of estimated unfished spawning output. The mean generation time of bocaccio is estimated at 13 years, unchanged from the last rebuilding analysis.

Twelve scenarios are examined (Table 3). The scenarios include cases of no fishing, of fishing at the current Council adopted SPR rate of 0.777, fishing at the SPR rate associated with catches which average 269 tons in 2011 and 2012 (average of 263 and 274 ACLs for 2011 and 2012; that SPR rate is 0.800 in the current model), of fishing at a rate comparable to recent catches (SPR of 0.92 and 0.95), of fishing at a rate that achieves a 50% probability of rebuilding by T_{target}, a 40-10 harvest policy scenario, an F_{msy} proxy (SPR=0.50) scenario, and several alternative SPR rate scenarios to explore the full range of results.

Results

The individual rebuilding trajectories from these simulations are erratic due to rare large recruitments (Figure 1), which lead to a wide range of variability in future population trajectories that is not necessarily captured by the estimates of median rebuilding times under alternative harvest rates. This is a consequence of the very high recruitment variability in bocaccio, and indicates a wide spread of probable outcomes around the median point estimates for any given harvest rate or scenario. This range is captured in Figure 2, which shows the estimated 5th, 25th, 50th, 75th and 95th percentiles of estimated spawning output (relative to target) under continuation of the SPR 0.777 strategy into the future. Both the probability that the stock will not be rebuilt within 50 years, as well as the probability that the stock will be at or above (mean) unfished abundance levels, are non-trivial (approximately 5% each) due to the magnitude of recruitment variability observed for this species.

Table 3, and Figure 3 shows the median probabilities of recovery under a range of adopted harvest rate strategies, from no harvest (SPR 1) to the ABC rule (SPR 0.5). Under the SPR rate adopted in the most recent rebuilding plan (0.777), the population would be expected to be rebuilt by 2021, consistent with the 2009 rebuilding plan (Field and He 2009). If harvest rates approximate the status quo over recent years (approximately 0.92 to 0.95), the stock is expected to rebuild faster, by 2019, only a year later than the expected rebuilding year under the F=0 alternative. Alternatively, if the rebuilding policy were to seek a policy of maintaining a 50% probability of rebuilding by T_{target} (2022), a greater optimal yield could be sustained. Figure 4 shows the trade-off between higher harvest rates and the probabilities of recovery by 2022, as well as the associated median rebuilding times. Table 4 shows the median probability of rebuilding by year for each of these scenarios as well.

The estimated 2013 and 2014 ACLs and OFLs are also reported in Table 3, those values are 340 and 358 mt for the ACL, with OFL estimates of 940 and 989 mt. Under the fishing rates that are consistent with recent ACL targets and catches, the probability of further long-term decline in bocaccio abundance is negligible in the near term (particularly if the magnitude of the 2009 and 2010 year classes are as great or greater than currently anticipated), and rebuilding is projected to continue at a rate somewhat greater than previously estimated. However, as with past assessments and rebuilding analyses, recruitment variability remains a key factor determining future abundance and rebuilding success. In particular, the exact magnitude of the 2010 year class will have a strong influence on progress towards rebuilding in the near future; rebuilding could potentially take place at a considerably faster pace if this year class is larger than currently estimated.

References

Field, J.C. in review. Status of bocaccio, *Sebastes paucispinis*, in the Conception, Monterey and Eureka INPFC areas in 2011. Pacific Fishery Management Council.

Field, J.C., E.J. Dick, D. Pearsons and A.D. MacCall. 2009. Status of bocaccio, *Sebastes paucispinis*, in the Conception, Monterey and Eureka INPFC areas for 2009. Pacific Fishery Management Council.

Field, J.C. and X. He. 2009. Bocaccio Rebuilding Analysis for 2009. Pacific Fishery Management Council Stock Assessment and Fishery Evaluation

MacCall, A. 2005. Bocaccio rebuilding analysis for 2005. Pacific Fishery Management Council.

Punt, A. 2010. SSC default rebuilding analysis: Technical specifications and user manual (Version 3.12b). University of Washington, Seattle.

Table 1. Recent catches of bocaccio rockfish south of Cape Blanco (in metric tons), as a total and as a percentage of the ACL/OY or OFL/ABC value.

	Catch	ACL	OFL	% OY/ACL	% OFL/ABC
1999	213	230	230	93%	93%
2000	160	164	100	160%	98%
2001	131	100	122	131%	108%
2002	90	100	122	90%	73%
2003	13	20	244	64%	5%
2004	85	199	400	43%	21%
2005	107	307	566	35%	19%
2006	60	306	549	20%	11%
2007	63	218	602	29%	10%
2008	39	218	618	18%	6%
2009	58	288	793	20%	7%
2010	75	288	793	26%	10%
2011		263	737		
2012		274	732		

Table 2. Parameters and re-estimated reference points for rebuilding from this analysis

Parameter	2011	2009	2007 (Stat C)
Year declared overfished	2000	2000	2000
Current year	2009	2009	"2007"
First OY year	2013	2011	2009
T_{MIN}	2018	2018	2019
Mean generation time	13	13	14
T_{MAX} (estimated)	2031	2031	2033
$T_{F=0}$ (beginning year)	2019 (2013)	2018 (2011)	2020 (2007)
Bunfished (billion eggs)	7812	7946	13554
Rebuilding target ($B_{40\%}$)	3125	3178	5421
Current SPR (2010)	0.93	0.95 (2008)	0.939 (2006)
Target SPR	0.777	0.777	0.777
Current T_{TARGET}	2022	2026	2026
Spawning output $_{\text{(end year)}}$	2029 (2011)	2249 (2009)	1727 (2007)

Table 3: Results of the suite of rebuilding alternatives considered for this analysis.

	SPR= .600	SPR= .70	SPR= .777	SPR= .900	SPR= .92	SPR= .950	50% T_{target} (2022)	50% Tmax (2031)	SPR for 2011-12 OY	F=0	40-10 rule	ABC Rule
Rationale	range	range	target	range	current	range	min	max	target	F=0	40:10	ABC
SPR (target)	0.600	0.700	0.777	0.900	0.920	0.950	0.708	0.539	0.800	1.000	0.553	0.500
ACL (2013)	691	482	340	142	112	69	466.3	837	301	0	803	940
OFL (2013)	940	940	940	940	940	940	939.9	940	940	940	940	940
ACL (2014)	705	501	358	152	120	74	485.3	843	318	0	824	937
OFL (2014)	959	977	989	1006	1009	1013	978.2	946	992	1019	949	937
50% Prob Yr	2027	2023	2021	2019	2019	2019	2022	2031	2021	2019	2032	2037
P > SSB2011 in 100 years	98.2	99.7	99.9	100	100.0	100	97.5	91.8	99.9	100	91.9	83.2
<5th %tile, output/target in T_{max}	0.63	0.758	0.85	1.00	1.027	1.06	0.71	0.56	0.88	1.13	0.58	0.51
Median, output/target in T_{max}	1.04	1.238	1.39	1.63	1.664	1.72	0.99	0.92	1.43	1.82	0.90	0.85
>95th %tile, output/target in T_{max}	1.82	2.135	2.38	2.76	2.827	2.93	1.64	1.63	2.45	3.09	1.54	1.50
Percent probability of recovery by pre-specified years												
2020	23	35	45	62	65	70	36	16	48	77	16	13
2021	27	42	53	71	74	77	43	19	56	83	18	16
2022	33	49	60	77	80	83	50	23	64	88	21	18
2023	37	55	66	82	84	87	56	27	69	90	25	21
2024	42	59	71	86	88	90	60	31	74	93	29	24
2025	47	63	75	89	91	93	64	35	79	94	32	27
2026	49	67	79	91	93	94	68	39	82	96	36	30
2031	63	70	90	97	98	98	65	51	92	99	48	41

Table 4: Year specific probabilities of rebuilding to target levels for Table 3 scenarios.

	SPR= .600	SPR= .700	SPR= .777	SPR= .900	SPR= 0.92	SPR= .950	50% Ttarget (2022)	50% Tmax (2031)	SPR for 2011-12 OY	F=0	40-10 rule	ABC Rule
2011	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
2012	*0*	*0*	*0*	*0*	*0*	*0*	0	*0*	*0*	*0*	*0*	*0*
2013	0	0	0	0	0	0	0	0	0	0	0	0
2014	0	0	0	0	0	0	0	0	0	0	0	0
2015	0.002	0.002	0.003	0.003	0.003	0.003	0.002	0.002	0.003	0.003	0.002	0.001
2016	0.024	0.031	0.035	0.057	0.058	0.063	0.031	0.018	0.037	0.071	0.018	0.012
2017	0.055	0.097	0.128	0.203	0.217	0.234	0.100	0.044	0.134	0.275	0.045	0.036
2018	0.114	0.187	0.251	0.369	0.392	0.429	0.189	0.083	0.272	0.49	0.08	0.07
2019	0.171	0.274	0.361	0.513	0.543	0.588	0.279	0.118	0.389	0.653	0.115	0.101
2020	0.228	0.349	0.454	0.617	0.654	0.695	0.359	0.162	0.483	0.769	0.156	0.129
2021	0.269	0.424	0.527	0.713	0.736	0.774	0.430	0.193	0.562	0.834	0.182	0.157
2022	0.326	0.487	0.604	0.773	0.796	0.828	0.500	0.228	0.641	0.876	0.213	0.179
2023	0.373	0.55	0.664	0.818	0.843	0.867	0.560	0.271	0.695	0.904	0.25	0.214
2024	0.421	0.593	0.709	0.857	0.877	0.902	0.601	0.310	0.746	0.928	0.288	0.243
2025	0.465	0.631	0.754	0.892	0.911	0.927	0.642	0.349	0.789	0.943	0.323	0.273
2026	0.493	0.669	0.787	0.911	0.934	0.941	0.679	0.388	0.818	0.958	0.361	0.299
2027	0.527	0.701	0.824	0.93	0.943	0.95	0.713	0.409	0.853	0.964	0.387	0.328
2028	0.567	0.737	0.851	0.941	0.953	0.961	0.750	0.442	0.873	0.982	0.416	0.35
2029	0.59	0.769	0.864	0.954	0.964	0.972	0.778	0.460	0.887	0.987	0.432	0.375
2030	0.616	0.793	0.883	0.965	0.974	0.981	0.802	0.482	0.900	0.989	0.452	0.387
2031	0.633	0.808	0.901	0.972	0.978	0.983	0.818	0.508	0.917	0.991	0.483	0.409
2032	0.663	0.825	0.918	0.977	0.983	0.988	0.835	0.526	0.929	0.995	0.504	0.43
2033	0.681	0.837	0.92	0.981	0.988	0.991	0.850	0.553	0.940	0.996	0.525	0.45
2034	0.702	0.855	0.935	0.988	0.991	0.992	0.864	0.566	0.948	0.996	0.54	0.47
2035	0.719	0.878	0.944	0.989	0.992	0.993	0.886	0.586	0.956	0.997	0.559	0.48
2036	0.731	0.889	0.952	0.99	0.992	0.993	0.897	0.611	0.962	0.997	0.584	0.494
2037	0.747	0.9	0.96	0.99	0.992	0.993	0.907	0.624	0.969	0.998	0.595	0.511
2038	0.764	0.91	0.963	0.992	0.993	0.994	0.917	0.636	0.971	0.999	0.611	0.529
2039	0.783	0.921	0.971	0.993	0.993	0.997	0.928	0.648	0.978	0.999	0.623	0.539
2040	0.797	0.93	0.975	0.996	0.997	0.999	0.935	0.663	0.980	0.999	0.64	0.549
2041	0.815	0.935	0.98	0.999	0.999	0.999	0.941	0.682	0.985	0.999	0.656	0.565
2042	0.825	0.942	0.984	0.999	0.999	0.999	0.947	0.696	0.987	0.999	0.671	0.577
2043	0.833	0.946	0.986	0.999	0.999	0.999	0.952	0.713	0.990	0.999	0.683	0.592
2044	0.844	0.95	0.99	0.999	0.999	0.999	0.958	0.727	0.992	0.999	0.702	0.605
2045	0.849	0.955	0.992	0.999	0.999	0.999	0.962	0.740	0.993	0.999	0.71	0.623
2046	0.859	0.961	0.994	0.999	0.999	0.999	0.967	0.750	0.995	1	0.719	0.633
2047	0.865	0.963	0.994	0.999	1	1	0.969	0.762	0.996	1	0.735	0.644
2048	0.872	0.967	0.994	1	1	1	0.972	0.773	0.996	1	0.747	0.656
2049	0.88	0.97	0.995	1	1	1	0.974	0.781	0.996	1	0.754	0.665
2050	0.886	0.974	0.995	1	1	1	0.976	0.789	0.997	1	0.761	0.672
2051	0.893	0.976	0.996	1	1	1	0.978	0.799	0.997	1	0.776	0.686
2052	0.896	0.978	0.996	1	1	1	0.979	0.804	0.997	1	0.781	0.696
2053	0.901	0.981	0.996	1	1	1	0.982	0.808	0.997	1	0.787	0.702
2054	0.905	0.981	0.996	1	1	1	0.983	0.815	0.997	1	0.789	0.713
2055	0.91	0.984	0.996	1	1	1	0.984	0.816	0.998	1	0.796	0.717
2056	0.917	0.984	0.997	1	1	1	0.984	0.822	0.998	1	0.802	0.726
2057	0.925	0.985	0.998	1	1	1	0.985	0.830	0.999	1	0.807	0.736
2058	0.929	0.985	0.998	1	1	1	0.985	0.838	0.999	1	0.815	0.743
2059	0.934	0.987	0.998	1	1	1	0.987	0.844	0.999	1	0.823	0.751
2060	0.942	0.988	0.998	1	1	1	0.988	0.848	0.999	1	0.828	0.757

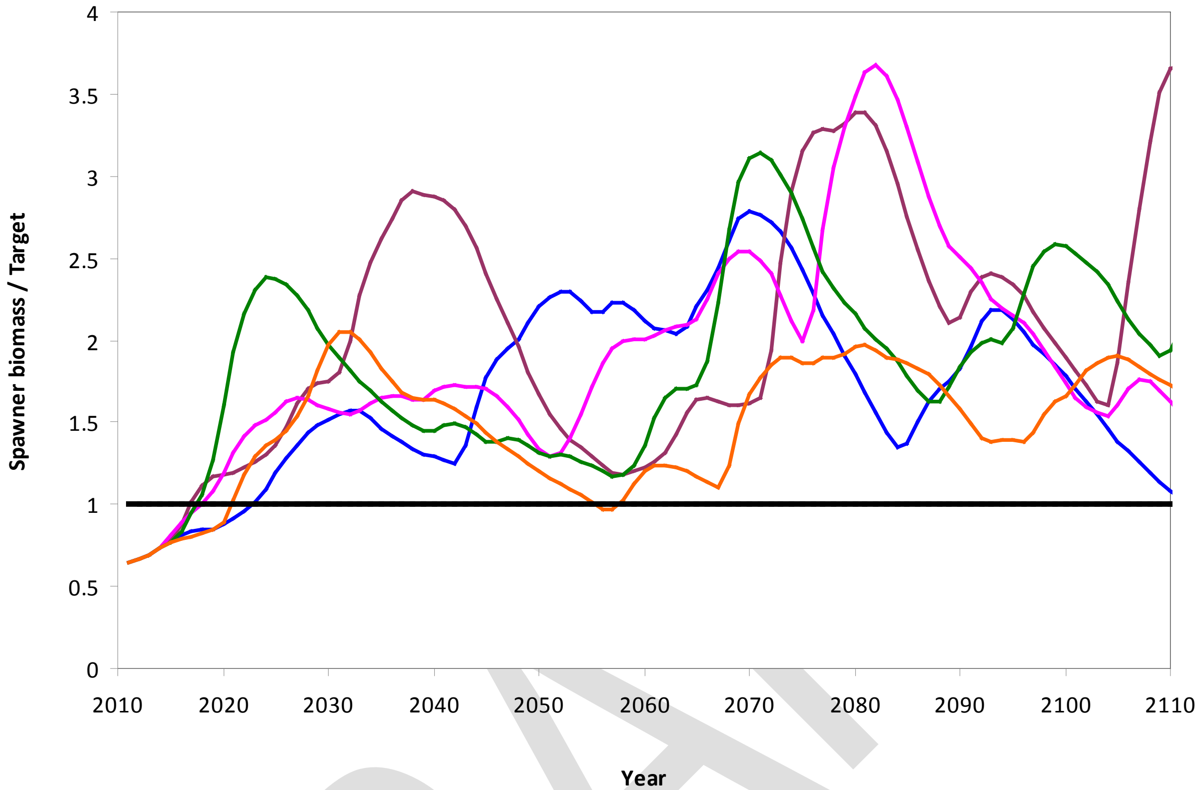

Figure 1. Examples of individual rebuilding trajectories for bocaccio (based on the rebuilding plan SPR rate of 0.777)

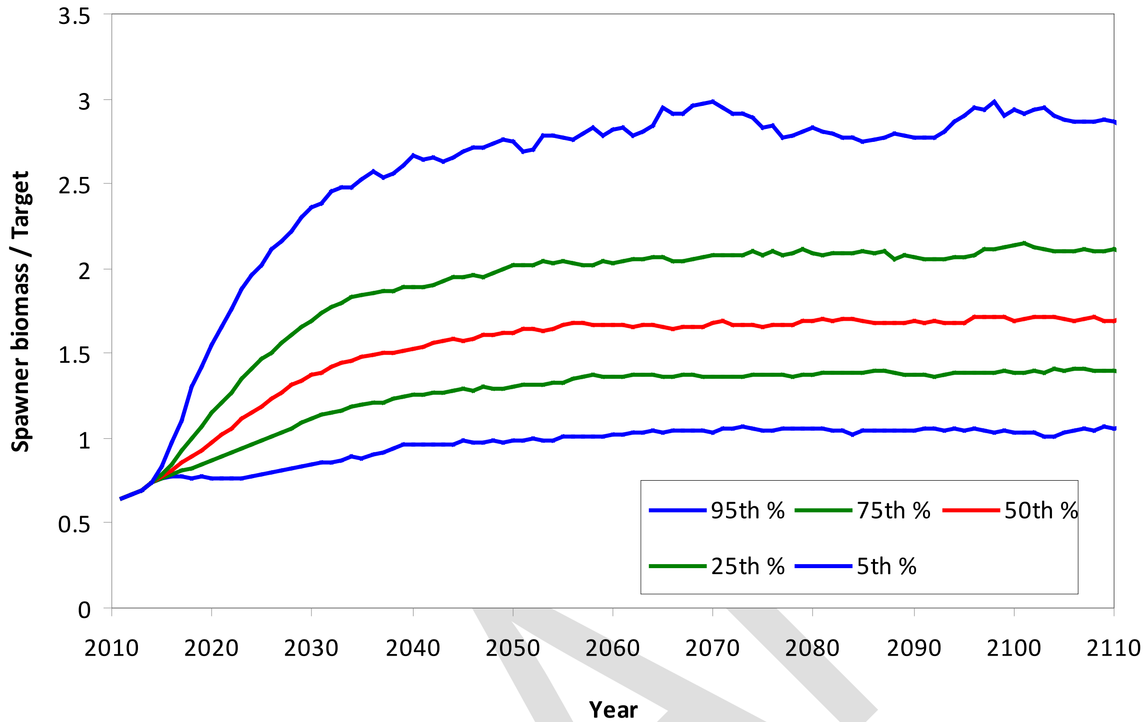

Figure 2. Estimated 5th, 25th, 50th, 75th and 95th percentiles of spawning output (relative to target) under continuation of the SPR 0.777 strategy into the future.

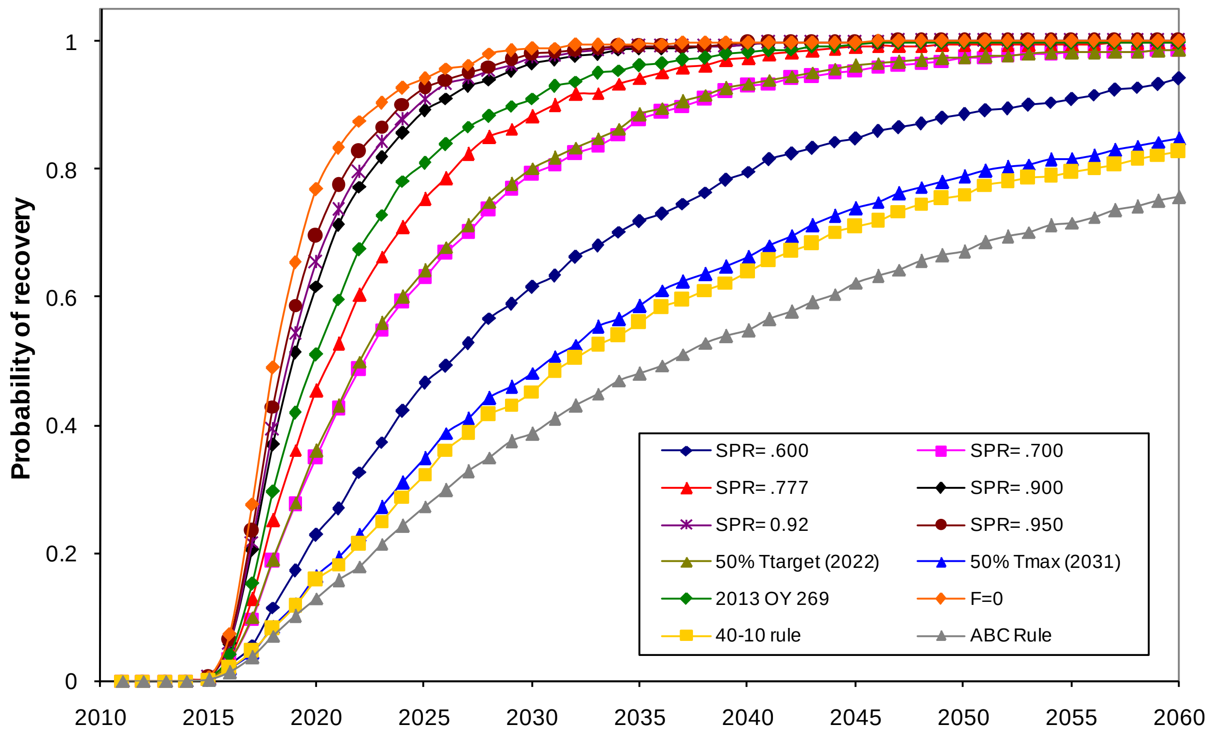

Figure 3: Probability of recovery for a suite of the rebuilding alternatives described in Table 3.

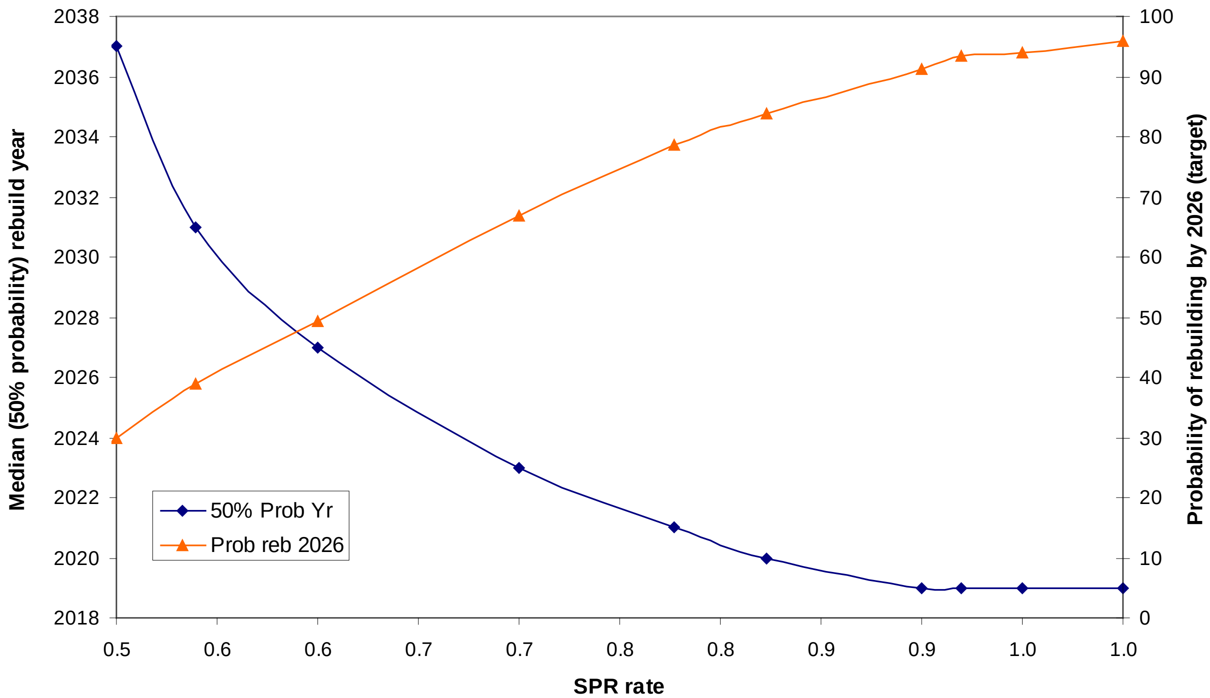

Figure 4: Probability of recovery by the target year (2026, left y axis) and estimated median year of rebuilding (right y axis) under alternative SPR harvest rates.

Appendix A. Projection data file for base run.

```
#Title, #runnumber: 1058 boc10.dat boc6.ctl 3303.81 7.81206e+006 2.02872e+006 StartTime: Mon Sep 12 08:18:24 2011
SSv3_default_rebuild.dat
# Number of sexes
2
# Age range to consider (minimum age; maximum age)
0 21
# Number of fleets
6
# First year of projection (Yinit)
2011
# First Year of rebuilding period (Ydecl)
2000
# Number of simulations
1000
# Maximum number of years
500
# Conduct projections with multiple starting values (0=No;else yes)
0
# Number of parameter vectors
1000
# Is the maximum age a plus-group (1=Yes;2=No)
1
# Generate future recruitments using historical recruitments (1)  historical recruits/spawner (2)  or a stock-recruitment (3)
3
# Constant fishing mortality (1) or constant Catch (2) projections
1
# Fishing mortality based on SPR (1) or actual rate (2)
1
# Pre-specify the year of recovery (or -1) to ignore
-1
# Fecundity-at-age
# 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 #runnumber: 1058 boc10.dat boc6.ctl 3303.81 7.81206e+006 2.02872e+006
 0 0.0320825 4.54013 61.4275 190.476 331.761 467.901 598.212 720.679 832.77 932.782 1020.1 1095.01 1158.36 1211.33 1255.23 1291.35 1320.89 1344.95 1364.47 1380.26 1412.67 #female fecundity; weighted by N in year Y_init across morphs and areas
# Age specific selectivity and weight adjusted for discard and discard mortality
 #wt and selex for gender,fleet: 1 1
 0.0509727 0.263362 0.544146 0.838294 1.14467 1.44513 1.73046 2.00044 2.25163 2.47859 2.67751 2.84752 2.99015 3.10822 3.20507 3.28399 3.34801 3.39975 3.44147 3.47504 3.50202 3.55736
 3.35367e-005 0.0305682 0.380303 0.830179 0.922681 0.826163 0.697022 0.591561 0.517352 0.467588 0.434418 0.412034 0.396631 0.385806 0.37804 0.372368 0.368158 0.36499 0.362581 0.36073 0.359299 0.356576
 #wt and selex for gender,fleet: 1 2
 0.0397567 0.287442 0.616104 0.946246 1.25332 1.53823 1.79547 2.02765 2.24118 2.43801 2.61635 2.77395 2.90988 3.02485 3.12066 3.19962 3.26421 3.31672 3.35925 3.39359 3.42125 3.47817
 6.89948e-005 0.00149117 0.0687717 0.384436 0.741303 0.883479 0.858237 0.770434 0.679948 0.606851 0.552814 0.514067 0.486412 0.466534 0.452074 0.441417 0.433464 0.427459 0.42288 0.419359 0.416632 0.411436
 #wt and selex for gender,fleet: 1 3
 0.0397053 0.194662 0.702259 1.01749 1.27084 1.51128 1.73378 1.93903 2.13205 2.31455 2.48441 2.63825 2.77367 2.89001 2.98809 3.06962 3.13671 3.1915 3.23601 3.27203 3.3011 3.36107
 0.00194768 0.00240969 0.0201079 0.286251 0.697782 0.826254 0.746641 0.616962 0.504661 0.422432 0.365441 0.326369 0.299363 0.280404 0.266855 0.257001 0.249722 0.24427 0.240137 0.236975 0.234535 0.229917
 #wt and selex for gender,fleet: 1 4
 0.0418485 0.230526 0.48774 0.785015 1.09171 1.37863 1.63808 1.86966 2.07521 2.25671 2.41571 2.55353 2.67155 2.77143 2.85507 2.92446 2.9816 3.02837 3.06646 3.09735 3.12234 3.17415
 0.00822552 0.241504 0.79666 0.942072 0.805145 0.612528 0.452719 0.339958 0.264548 0.214532 0.180971 0.158006 0.141949 0.130483 0.122139 0.115967 0.111336 0.107821 0.105127 0.103046 0.101427 0.0983199
 #wt and selex for gender,fleet: 1 5
 0.0430448 0.230548 0.505319 0.823989 1.17416 1.5289 1.865 2.16927 2.43632 2.6656 2.85929 3.02094 3.15461 3.26437 3.35398 3.42684 3.48586 3.53356 3.57201 3.60297 3.62785 3.67887
 0.00808596 0.132424 0.535422 0.836838 0.945386 0.979254 0.990734 0.99519 0.997165 0.998144 0.998678 0.998993 0.999189 0.999318 0.999406 0.999468 0.999513 0.999546 0.999571 0.99959 0.999604 0.999631
 #wt and selex for gender,fleet: 1 6
 0.0477974 0.279318 0.616483 0.905532 1.21128 1.54221 1.86918 2.17035 2.43637 2.66531 2.85889 3.02053 3.15421 3.26398 3.35362 3.42649 3.48552 3.53323 3.57169 3.60265 3.62754 3.67857
```

1.0597e-005 0.00269629 0.120172 0.563768 0.866183 0.962562 0.988349 0.99571 0.998126 0.999046 0.999447 0.999643 0.999749 0.999811 0.999849 0.999874 0.99989 0.999902 0.999911 0.999917 0.999922 0.99993
#wt and selex for gender,fleet: 2 1
0.0509727 0.263362 0.521574 0.772631 1.01176 1.23019 1.41907 1.57839 1.71084 1.81941 1.9072 1.9773 2.03271 2.07612 2.10992 2.13609 2.15628 2.17181 2.18372 2.19285 2.19983 2.21171
3.35367e-005 0.0305682 0.339622 0.76314 0.921722 0.907751 0.83961 0.767574 0.70724 0.660684 0.625869 0.600097 0.581041 0.56691 0.556391 0.548527 0.542627 0.538187 0.534836 0.532302 0.530382 0.527242
#wt and selex for gender,fleet: 2 2
0.0397567 0.287442 0.5896 0.874603 1.12152 1.33294 1.51111 1.65741 1.77568 1.87053 1.94616 2.00609 2.05329 2.09022 2.11898 2.14127 2.15847 2.17171 2.18188 2.18968 2.19564 2.20579
6.89948e-005 0.00149117 0.0561195 0.297491 0.609118 0.807102 0.883506 0.890742 0.868737 0.838518 0.809231 0.784064 0.763601 0.747425 0.734835 0.725119 0.717659 0.711949 0.707585 0.704254 0.701713 0.697508
#wt and selex for gender,fleet: 2 3
0.0397053 0.194662 0.665514 0.956802 1.16112 1.33703 1.48834 1.61463 1.71807 1.8019 1.86932 1.9231 1.9657 1.99918 2.02535 2.04569 2.06142 2.07356 2.08289 2.09005 2.09554 2.10491
0.00194768 0.00240969 0.0148015 0.195297 0.544258 0.769738 0.832044 0.810359 0.761553 0.711065 0.667512 0.632523 0.605296 0.584418 0.568517 0.556438 0.547272 0.540316 0.535034 0.531022 0.527973 0.522958
#wt and selex for gender,fleet: 2 4
0.0418485 0.230526 0.466482 0.718019 0.96194 1.17632 1.35673 1.50516 1.62541 1.7217 1.79808 1.85819 1.90518 1.94172 1.97 1.99182 2.00861 2.02149 2.03136 2.03891 2.04468 2.05456
0.00822552 0.241504 0.765079 0.946648 0.881161 0.751715 0.629672 0.533686 0.46288 0.411703 0.374796 0.348049 0.32852 0.314153 0.30351 0.29558 0.289644 0.285182 0.281818 0.279276 0.277352 0.274206
#wt and selex for gender,fleet: 2 5
0.0430448 0.230548 0.482511 0.75087 1.02062 1.27294 1.49508 1.68259 1.83641 1.96012 2.05821 2.13521 2.1952 2.24167 2.27753 2.30511 2.32628 2.34249 2.35489 2.36437 2.37161 2.38383
0.00808596 0.132424 0.503074 0.79293 0.914239 0.959655 0.977991 0.986306 0.990513 0.992845 0.994236 0.995115 0.995694 0.99609 0.996367 0.996565 0.996709 0.996815 0.996893 0.996951 0.996995 0.997065
#wt and selex for gender,fleet: 2 6
0.0477974 0.279318 0.592072 0.841934 1.0736 1.3001 1.50878 1.68977 1.84039 1.96245 2.05965 2.13613 2.1958 2.24208 2.2778 2.3053 2.3264 2.34257 2.35494 2.3644 2.37162 2.38381
1.0597e-005 0.00269629 0.0978591 0.463173 0.772632 0.908703 0.95975 0.979668 0.988257 0.99238 0.99456 0.995807 0.996569 0.997059 0.997386 0.997611 0.99777 0.997885 0.997968 0.998029 0.998074 0.998146
M and current age-structure in year Yinit: 2011
gender = 1
0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15
1720.43 1477.09 1384.88 464.724 414.19 162.173 605.172 67.8134 453.604 124.269 27.9318 27.7433 547.715 70.9507 12.2363 42.279 21.2638 30.7965 33.1208 11.4298 28.2171 95.9771
gender = 2
0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15
1720.43 1477.09 1384.88 464.921 414.377 162.126 604.265 67.5976 451.509 123.456 27.6611 27.3975 540.106 69.8904 12.0372 41.4691 20.8448 30.2174 32.431 11.2006 27.5552 82.2794
Age-structure at Ydeclare= 2000
154.651 3104.11 410.27 71.0048 243.312 121.068 173.766 185.649 63.7727 156.94 123.278 17.3224 217.064 47.115 9.60269 7.95676 59.5434 5.60479 0.339728 1.22872 1.70762 40.4542
154.651 3104.11 410.27 71.1364 244.083 121.801 175.332 187.104 64.3379 157.765 122.554 16.9437 207.116 43.6024 8.49474 6.50806 44.583 3.88767 0.216451 0.70021 0.852578 13.1678
Year for Tmin Age-structure (set to Ydecl by SS)
2000
recruitment and biomass
Number of historical assessment years
121
Historical data
year recruitment spawner in B0 in R project in R/S project
1891 1892 1893 1894 1895 1896 1897 1898 1899 1900 1901 1902 1903 1904 1905 1906 1907 1908 1909 1910 1911 1912 1913 1914 1915 1916 1917 1918 1919 1920 1921 1922 1923 1924 1925 1926 1927 1928 1929 1930 1931 1932 1933 1934 1935 1936 1937 1938 1939 1940 1941 1942 1943 1944 1945 1946 1947 1948 1949 1950 1951 1952 1953 1954 1955 1956 1957 1958 1959 1960 1961 1962 1963 1964 1965 1966 1967 1968 1969 1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 #years (with first value representing R0)
5106.28 5074.64 5074.36 5074.27 5074.3 5074.4 5074.55 5074.77 5075.09 5075.51 5075.67 5075.56 5075.2 5074.62 5073.81 5072.81 5071.63 5070.28 5068.78 5066.83 5064.46 5061.67 5058.49 5054.94 5051.04 5046.81 5041.19 5029.98 5017.8 5011.87 5006.07 5002.72 5000.88 4997.77 4995.98 4993.01 4985.57 4980.63 4975.29 4971.07 4964.39 4958.42 4956.16 4957.34 4957.27 4956.29 4953.06 4950.87 4951.85 4954.97 4957.96 4962.69 4971.68 4976 4968.53 4943.22 4933.03 4923.11 4917.96 4911.47 4894.92 4862.51 4823.71 5185.25 1304.29 5535.8 1317.68 3013.03 15885.5 4663.61 3981.3 3878.74 82499.4 3804.66 3733.67 16595.4 3740.92 3763.02 4263.64 6137.57 4342.58 11958.8 23622.2 8306.33 1838.98 2263.86 37478.9 2838.99 7376.35 1981 1027.84 190.472 2047.8 14188.8 1271.18 1026.61 3230.34 9600.12 516.416 2569.24 2343.01 690.242 1485.25 1076.02 591.912

961.175 232.078 1118.98 7215.65 309.302 267.124 1023.1 3186.96 405.302 3090.07 707.436 1542.45 1475.24 3749.74 3432.6 3440.87 #recruits; first value is R0 (virgin)
7.81206e+006 7.53538e+006 7.53304e+006 7.53224e+006 7.5325e+006 7.53332e+006 7.53459e+006 7.53651e+006 7.53922e+006 7.5428e+006 7.5441e+006 7.54319e+006 7.54017e+006 7.53517e+006 7.52835e+006 7.51987e+006 7.50988e+006 7.4985e+006 7.48586e+006 7.46956e+006 7.44974e+006 7.42659e+006 7.40032e+006 7.37116e+006 7.33934e+006 7.30505e+006 7.25995e+006 7.17135e+006 7.07706e+006 7.03193e+006 6.98814e+006 6.96314e+006 6.94938e+006 6.92633e+006 6.91315e+006 6.89134e+006 6.8371e+006 6.80149e+006 6.76333e+006 6.73339e+006 6.68647e+006 6.64499e+006 6.6294e+006 6.6375e+006 6.63702e+006 6.63029e+006 6.60809e+006 6.59313e+006 6.59984e+006 6.62121e+006 6.6418e+006 6.67459e+006 6.73774e+006 6.76839e+006 6.7155e+006 6.5412e+006 6.47311e+006 6.40787e+006 6.37441e+006 6.33265e+006 6.22813e+006 6.0312e+006 5.80814e+006 5.53512e+006 5.24878e+006 4.86333e+006 4.37667e+006 3.829e+006 3.2534e+006 2.80678e+006 2.43997e+006 2.43227e+006 2.67424e+006 2.8203e+006 3.09976e+006 4.62126e+006 6.95258e+006 8.30251e+006 9.31441e+006 1.01362e+007 1.04117e+007 1.03547e+007 9.87057e+006 8.66472e+006 7.23332e+006 6.62581e+006 6.22482e+006 5.78792e+006 5.24732e+006 4.98772e+006 5.09892e+006 4.83193e+006 4.17449e+006 3.37392e+006 2.55995e+006 2.04745e+006 1.75044e+006 1.68595e+006 1.55236e+006 1.29138e+006 1.17334e+006 1.25228e+006 1.22097e+006 1.17047e+006 1.12053e+006 1.09042e+006 1.08623e+006 1.06306e+006 1.06725e+006 1.05458e+006 1.05177e+006 1.16088e+006 1.35724e+006 1.50529e+006 1.58797e+006 1.67156e+006 1.76429e+006 1.84965e+006 1.93217e+006 1.98715e+006 2.02872e+006 #spbio; first value is SPB_virgin (virgin)
1 0 # in Bzero
0 1 0 0 0 # in R project
0 1 0 0 0 # in R/S project
Number of years with pre-specified catches
2
catches for years with pre-specified catches go next
2011 263
2012 274
Number of future recruitments to override
11
Process for overiding (-1 for average otherwise index in data list)
2001 1 2001
2002 1 2002
2003 1 2003
2004 1 2004
2005 1 2005
2006 1 2006
2007 1 2007
2008 1 2008
2009 1 2009
2010 1 2010
2011 1 2011
Which probability to product detailed results for (1=0.5; 2=0.6; etc.)
1
Steepness sigma-R Auto-correlation
0.595545 1 0
Target SPR rate (FMSY Proxy); manually change to SPR_MSY if not using SPR_target
0.5
Discount rate (for cumulative catch)
0.1
Truncate the series when 0.4B0 is reached (1=Yes)
0
Set F to FMSY once 0.4B0 is reached (1=Yes)
0
Maximum possible F for projection (-1 to set to FMSY)
-1
Defintion of recovery (1=now only;2=now or before)
2
Projection type
11
Definition of the 40-10 rule
10 40
Calculate coefficients of variation (1=Yes)
0
Number of replicates to use

```
10
# Random number seed
-99004
# File with multiple parameter vectors
rebuild.SSO
# User-specific projection (1=Yes); Output replaced (1->9)
0  5
# Catches and Fs (Year; 1/2/3 (F or C or SPR); value); Final row is -1
2013 2 1
-1 -1 -1
# Fixed catch project (1=Yes); Output replaced (1->9); Approach (-1=Read in else 1-9)
0 2 -1
# Split of Fs
2011  0.0919157 0.0255689 0.00212542 0.782009 0.0585863 0.0397944
-1  1 1 1 1 1 1
# Yrs to define T_target for projection type 4 (a.k.a. 5 pre-specified inputs)
0.50 0.60 0.777 0.9 0.95
# Year for probability of recovery
2020 2021 2022 2023 2024 2025 2026 2027
# Time varying weight-at-age (1=Yes;0=No)
0
# File with time series of weight-at-age data
none
# Use bisection (0) or linear interpolation (1)
1
# Target Depletion
0.4
# CV of implementation error
0
```