Update of Darkbotched Rockfish (*Sebastes crameri*)
Rebuilding Analyses

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Introduction

Darkblotched rockfish was declared overfished in January 2001 (John DeVore, PFMC, pers.comm.). The declaration was based on the 2000 stock assessment (Rogers et al. 2000).

Rebuilding analyses were first conducted in mid-year 2001 (Methot and Rogers 2001). Those analyses included a partial update of the 2000 stock assessment, which added data through 2002 and re-estimated recruitments (Methot and Rogers 2001). The authors presented a range of rebuilding models with varying assumptions regarding recruitment (Table 1). The Pacific fisheries management council (PFMC) selected a model (A1) which assumed that recruitment was based primarily on environmental conditions. Spawning output in the absence of fishing was calculated by assuming recruitment was the average of the entire time series of recruitments, but future recruitments were randomly selected only from recruitments in more recent years (after 1982).

The PFMC used the 2001 rebuilding model A1 to set the 2002 and 2003 Optimum Yields (OYs) and to create a rebuilding plan, which was adopted in June 2003 (PFMC 2004). The model estimated that darkblotched rockfish could not be rebuilt within 10 years, so the maximum year to rebuild the spawning stock (T_{MAX}) was the minimum year to rebuild the stock in the absence of fishing (T_{MIN}) (11.5 years beginning in 2002) plus one mean generation time (33 years) or 2047 (Table 2). The 2002 OY was based on a 70% probability of rebuilding by T_{MAX} (P_{MAX}), while the 2003 OY was based on an 80% P_{MAX}. This 80% probability was the value chosen as policy (Po) in the rebuilding plan (PFMC 2004). The target year to rebuild (T_{TARGET}) was set at 2030, which was the median year to rebuild the stock given Po (T_{MED}). (A glossary of rebuilding terms and abbreviations is provided at the end of this document).

In mid-year 2003, the 2000 assessment and 2001 rebuilding analyses were fully updated (Rogers 2003). In the assessment update, data were added through 2002 and all fitted parameters (selectivities and recruitments) were re-estimated. The 2000 and 2001 age-one recruitments (1999 and 2000 year classes) were estimated to be very high in the assessment update (Figure 1). The rebuilding analyses updated only the model selected by the PFMC (Model A1). Virgin recruitment was set equal to the mean of the entire recruitment time series, but the projected recruitments were randomly selected only from recruitments after 1982. The SSC requested progressively including the high 2000 and 2001 age-one recruitment estimates into the rebuilding analyses (Rogers 2003). Risk of error progressively increased from including those recruitments because they were based on increasingly limited data. The PFMC chose the rebuilding model which included age-one recruitment estimates only through 2000 (Table 2). Recruitments after 2000 were randomly selected from the 1982-2000 estimates.

The PFMC used the 2003 rebuilding model to set the 2004-2006 OYs and produce a 2004 amendment to the rebuilding plan (PFMC 2004). The rebuilding plan addendum reduced T_{MAX} from 2047 to 2044. T_{MAX} was modified because T_{MIN} was reduced from 2014 to 2011 (Table 2). T_{MIN} was reduced for two reasons. The time to rebuild in the absence of fishing was lowered from 11.5 to 10 years, and a 2002 change in the rebuilding software (Punt 2005) caused that 10 years to begin with the year overfishing was declared (2001) rather than the first year of projection (2002). The addendum also increased Po. The Allowable Biological Catch (ABC) was lower than the 2004 OY given the Po of 0.8. Since the OY cannot be greater than the ABC, the ABC was adopted as the OY. Po in the amendment was therefore the probability of rebuilding by 2044 given the ABC catch. That probability was slightly more than 90%.

The 2004 ABC was lower than the 2004 OY given a Po of 0.8 because of a difference in time frames. The ABC was based only on the 2004 biomass available to the fishermen. In 2004, the strong 2000 age-one recruitment was only age 5, so each fish had a relatively small biomass and that age was not yet fully selected by the fishery gear. The rebuilding analyses considered the biomass available during 2004-2044. During that time period, the strong 2000 recruitment would not only affect the biomass available to the fishermen, but could be randomly selected in the prediction of other recruitments.

Although the 2004 addendum reduced T_{MAX} and increased Po, the target year to rebuild (T_{TARGET}) was unchanged from 2030 (PFMC 2004). T_{TARGET} is essentially inviolate according to the FMP, only to be changed if absolutely needed (i.e., its falls outside the range of Tmin to Tmax) (John DeVore, PFMC, pers.comm.). T_{TARGET} was therefore no longer the median year to rebuild given the selected probability of rebuilding by T_{MAX}. T_{MED} given the ABC catches and the new T_{MAX} was 2019 (Table 2).

A full stock assessment for darkblotched rockfish was conducted in 2005, with substantial changes to the 2000-2003 model structure and data (Rogers 2005). The model was extended back to 1928 and data were added through 2004. Data included a new survey index of relative abundance. Growth and discard were estimated within the 2005 model rather than externally, as was done previously. Growth and the fishery selectivity and retention curves in the new model were allowed to change over time in order to better fit the data and reflect known changes. Changes were also made to the fixed life history parameters. Natural morality in the selected model was increased from 0.05 to 0.07 and the fecundity-at-weight and weight-at-length relationships were changed slightly.

This document revises the 2003 rebuilding analyses using the new information from the 2005 assessment. It also provides an assessment of rebuilding progress given the parameters in the current rebuilding plan.

Update of Rebuilding Plan and Addendum

Rebuilding Program and Files

The 2005 rebuilding analyses were primarily conducted in June 2005 using version 2.8a (April 2005) of the SSC default rebuilding analysis software (Punt 2005).

The input file for Model A1 is at the end of this document. That model is a full update of the initial rebuilding analyses using the standard environmental hypothesis (A1), which is the basis of the rebuilding plan (PFMC 2004).

Inputs to the Rebuilding Model

Recruitments

Recruitments estimates input to the 2005 rebuilding model were the number of age 0 fish in 1968-2003 (Table 2). Although the 2005 assessment model was extended back to 1928, recruitments were fit stochastically only after 1967. Fitting recruitments earlier than that led to wide fluctuations due to lack of data, so recruitments in 1928-1967 were taken from the Beverton-Holt stock-recruitment curve. In the new stock recruitment model (SS2) recruitments are always specified as age 0.

The strength of recruitments before and after 1982 was similar in the 2005 stock assessment estimates (Figure 1, Table 3). The 1982 change in recruitments was most evident in the 2001 update (Methot and Rogers 2001). That update indicated that age-one recruitment in 1983-1996 was only 67% of the level in 1963-1982. In the 2000 assessment and the 2003 full update of that assessment, recruitments before and after 1982 were more similar.

Life History

Life history-at-age inputs to the rebuilding program included spawning output (fecundity times proportion mature), body weight in the fishery, and natural mortality (Table 4). This update increased natural mortality from 0.05 to 0.07. It also slightly changed the spawning output and weight at age from the values input in the 2001 and 2003 rebuilding analyses. There were slight changes to the fecundity and weight-at-length relationships fixed in the 2005 assessment model.

Since the 2005 assessment model fit growth within the model, there was slightly slower growth in 1998 than in other years. Given that slower growth, estimates for ages greater than age 6 in 2004 were based on a smaller weight-at-age than estimated for the population before 1998. Although the rebuilding program allows for the life history inputs to change with each year, only the 2004 relationships for spawning output and weight were used in the rebuilding models. Yearly outputs were not available from the stock synthesis assessment model, and the author of the rebuilding model stated that his yearly-change option was not appropriate in this circumstance (Andre Punt, U. of W., pers.comm.).

Age Compositions

Both the 2001 and 2004 age composition data from the assessment model were supplied to the rebuilding model (Table 5). The age composition in 2001, the year the stock was declared overfished, was needed to determine $T_{MIN,}$ which assumed no fishing mortality after that year. Using the 2004 age composition from the assessment model required including the 2004 age-0 recruitment, which was based on the stock-recruitment curve rather than estimated using available data (Table 2). The 2004 age composition was chosen because it was compatible with the available fecundity-at-age and weight-at-age in the fishery, which were output by the stock synthesis model only for the ending year of the assessment model. The 2004 age composition included the high recruitment estimates for both 1999 and 2000 (Figure 1). The STAR panel for the 2005 assessment specified that those recruitments should not be down-weighted in the projections (Rogers 2005).

In the past rebuilding analyses, the age composition input was for a year prior to 2001, so only one age composition was necessary. The 2001 analyses used the 1998 age 1+ population age composition, and the 2003 analyses (as selected by the PFMC) used the 2000 age composition (Table 2). Although the stock assessment ending year age compositions were not used in the previous rebuilding analyses (1999 was not used in the 2001 analyses and 2001 was not used in the 2003 analyses), this was not a problem because growth was constant over time in those models.

Fishery Selectivity

The 2004 fishery selectivity-at-age for males and females was input to the rebuilding model. Those selectivities were higher for the younger ages and had more difference between sexes than the selectivities used in the previous rebuilding analyses (Table 6). Selectivity in the assessment models was based on length and then converted to selectivity-at-age, and the age-length relationship was different in 2004. As mentioned under the above life history section, slower growth in 1998 affected the growth in 2004. The 2004 selectivities were also fit to the fishery data after 2002, when the fishery was shifted out of the depth range of the medium-sized darkblotched rockfish.

Catch

Catch was supplied to the model for 2004-2006. The 2004 catch was based on the known landings and an assumed discard rate of 15%. The 2005-2006 catches were assumed equal to their previously-set OYs, which were the ABCs forecast using the 2003 rebuilding model. Catches were forecast beginning with 2007, the first year these rebuilding analyses could affect the OY (Table 2).

In the previous analyses, catch was also supplied for the last three years. For the 2001 analyses, catch in 1999-2001 was assumed equal to the known landings in 1999-2000 and the OY in 2001. Catches were forecast beginning with 2002 (Table 2). For the 2003 analyses, catch in 2000-2003 were supplied to the rebuilding model. In 2000, the catch was equal to the known landings. In 2001-2002, discard was added to the known landings using limited entry rates assumed by the PFMC (16% in 2001 and 20% in 2002). Catch in 2003 was assumed equal to that estimated for 2002. Catches were forecast beginning in 2004 (Table 2).

Rebuilding Outputs

The new life history inputs to the rebuilding model (primarily the increase in natural mortality) changed the rebuilding program estimates for mean generation time, unfished level of spawning output per recruit, and F50% (Table 2). The mean generation time was reduced from 33 to 24 years and the unfished level of spawning output per recruit was reduced from 18.42 to 10.16. F50%, which was approximately 0.03 in the prior analyses, was increased to 0.046.

Model A1

Model A1 was a standard environmental scenario, similar to the models selected in the initial rebuilding plan (2001 model) and addendum (2003 model). Virgin recruitment was set equal to the 1968-2003 mean recruitment and projected recruitments were randomly sampled from1982-2003 recruitments (Tables 2).

As in the 2003 model, T_{MAX} was re-calculated. Based on the revised generation time (24 years) plus a modified T_{MIN} (8 years), it was now 32 years. The maximum allowable year to rebuild the stock was therefore 2033: 2001 (the year overfishing was declared) plus 32 years. Since T_{MIN} is less than 10 years, given the new information T_{MAX} could be equal to the year the stock was declared overfished plus 10 years, which would occur in 2011. The rebuilding software, however, determined that T_{MAX} was 2033 and the 10 year rule is presently being revised.

Given the T_{MAX} of 2033, the catch based on the ABC at F50% was once again less than the catch given P_{MAX} = 0.80, the Po in the initial rebuilding plan (Tables 7,8 and Figure 2). The P_{MAX} associated with the ABC catches and the new T_{MAX} was 0.97 (Tables 2,7,8). The median year to rebuild given the ABC catches and the new T_{MAX} was 2012. The new T_{MAX} (2033) is close to the previous T_{TARGET} (2030). The probability of rebuilding by that T_{TARGET} is very high (0.96) given the ABC catches (Table 8). Even given the lower 95% confidence interval, the probability of rebuilding by T_{TARGET} is greater than 80% (Figure 3).

The ABC catch was based on a proxy of F50%, which was increased from 0.032 in 2003 to 0.046 in 2005 (Tables 2,6). The 2007 ABC catch projected in 2005 was also greater than that catch projected in 2003. As would be expected, if F was set at the old value for F50% (the current harvest control rule) in the 2005 model projections, the catches were smaller than the ABC based on the new value for F50% (Tables 7,8, Figure 2).

If the 10 year rule is used and T_{MAX} is set equal to 2011, the OY at Po of 0.80 would be intermediate between the current F OY and the F50% OY (Table 9). The probability of rebuilding the stock by 2011 is 100% for the current F OY and 0% given the F50% OY. Use of the 40-10 rule would result in around 40% change of rebuilding by T_{MAX}.

Model A1-b

Because changing the values for T_{MAX} and P_{MAX}, and the harvest control rule (F) might require another amendment to the rebuilding plan, a second model was developed to assess rebuilding progress using the T_{MAX} and Po currently in effect (Table 2). Rebuilding was therefore required by 2044. The current Po is not an exact value, only slightly greater than 0.9, so 0.9 was used as a proxy. This was also compared to the results given the Po of 0.8, from the original rebuilding plan. There was 67% chance of rebuilding by T_{TARGET} given the catches at P0.8, and 79% chance given the catches at P0.9 (Table 10).

Progress Towards Rebuilding

In July 2005, the SSC requested six comparisons which would help determine progress towards rebuilding (Table 11). The fifth comparison was Model A1 and the fourth comparison was Model A1-b. The first comparison (default) is consistent with the results shown in Table 8: that given the ABC catches, the stock has a 96% chance of rebuilding by the current T_{TARGET} of 2030.

Sensitivity Analyses

Model 2

Model 2 used the stock assessment option in the rebuilding model to forecast recruitments. The SSC was requested this comparison for darkblotched rockfish. As in the 2005 assessment model, a Beverton-Holt relationship with a steepness parameter of 0.95 was assumed. The standard deviation of the log-recruitment was set at 0.8, the value that was iteratively fit in the 2005 assessment model. Auto-correlation was set at zero. Although there was some correlation in recruitments with a one-year lag, this could be attributed to slightly miss-specified aging error or coefficient of variation in length-at-age in the assessment model, rather than actual recruitment correlation. Virgin recruitment from the 2005 assessment model was used to estimate B_0 in the rebuilding model. This model could be considered comparable to scenario B2 (optimistic stock-recruitment) in the 2001 analyses (Table 1). ABC catches for Model 2 were also lower than catch given PMAX of 0.9, so the OY was assumed equal to the ABC. The Model 2 OY catches were slightly higher than the Model A1 catches in the later years of ten year projection (Table 12).

Conclusions

Given the parameters in the current rebuilding plan, rebuilding is ahead of schedule. There is a 96% chance of rebuilding by the 2030 target year. If the OY catch continues to be based on the current F, the stock has 100% chance of rebuilding by 2011, which is ten years after the stock was declared overfished.

References

Methot, R. and J.B. Rogers. 2001. Rebuilding analysis for darkblotched rockfish. Pacific Fishery Management Council, 7700 NE Ambassador Place, Suite 200, Portland, OR 97201.

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Rogers, J.B., R.D. Methot, T.L. Builder, K. Piner, and M. Wilkins. 2000. Status of the Darkblotched Rockfish (*Sebastes crameri*) Resource in 2000, appendix to Status of the Pacific coast groundfish fishery through 2000 and recommended acceptable biological catches for 2001. Pacific Fishery Management Council, 7700 NE Ambassador Place, Suite 200, Portland, OR 97201.

Table 1. Rebuilding models compared in 2001 analyses.

Hypothesis			Recruitment		2002 OY (mt)
Label	**Recruitment**	**Type**	**Virgin**	**Forecast**	**P_{MAX} = 0.7**
A1	Environmental	Standard	1963-1996 average	1983-1996	168
A2	Environmental	Optimistic	1963-1996 average	1963-1996	260
B1	Stock-Recruitment	Pessimistic	initial conditions	1983-1996	115
B2	Stock-Recruitment	Standard	initial conditions	1963-1996	196

Table 2. Comparison of scenario A1 models from the 2001 analyses, which were the basis of the rebuilding plan, the 2003 analyses, which were the basis of the plan amendment, and the 2005 analyses presented in this document. Outputs from the assessment models were used as inputs to the rebuilding models.

		Year of Analysis		
Model		**2001**	**2003**	**2005**
Assessment				
	Type	partial update	full update	full
	Ending Year of Model	2001	2002	2004
	Age of Recruits	1	1	0
	Last Year Recruits were Estimated	1999	2001	2003
Rebuilding				
	Utilization	Plan	Amendment	Amendment?
	First Year with Zero Catch (to calculate T_{MIN})	2002	2001	2001
	First Year Catch was Forecast	2002	2004	2007
	Year Declared Overfished - Age Comp	na	na	2001
	Year of Current Age Comp, Life History, Selectivity	1998	2000	2004
	Generation Time	33	33	24
	F_{MSY} proxy (F50%)	0.0321	0.0319	0.0463
	SPR unfiished population	18.42	18.42	10.16
	Age 0 Recruitments used to estimate B_0 (mean)	1962-1995	1962-1999	1968-2003
	Resample for Future Age 0 Recruits (from within range)	1982-1995	1982-1999	1982-2003
	B_0	29,044 mt	30,775 mt	25,361 mt
	B_{MSY}	11,618 mt	12,310 mt	10,144 mt
	T_{MIN} (years)	11.5	10	8
	T_{MIN}	2014	2011	2009
	T_{MAX}	2047	2044	2033
	T_{MED}	2030	2019	2012
	T_{TARGET}	2030	2030	2030
	P_{MAX}	80%	>90% (ABC)	97% (ABC)
	Harvest Control Rule (F)	0.027	0.032	0.046
	2007 OY		314 mt	456 mt

Table 3. Comparison of the mean age-0 recruitments (numbers of fish x 1000) in various time periods, as estimated in the last four stock assessments for darkblotched rockfish. Age-0 recruitments in the 2000-2003 assessments were calculated using age-1 recruitments with natural mortality of 0.05.

		Mean Age 0 Recruitment x 1000			
Time Period	**Years**	**Assessment Year**			
		2000	**2001**	**2003**	**2005**
Last Year Estimated in Model		**1997**	**1998**	**2000**	**2003**
Last Year Used in Rebuilding			**1995**	**1999**	**2003**
virgin	Initial		1961	1757	2623
entire	1962-1995	2001	1658	1663	2402
	1962-1999			1902	2439
	1968-2003				2475
early	up to 1981	2073	1916	1919	2685
late	1982-1995	1898	1288	1297	2023
	1982-1999			1883	2184
	1982-2003				2338

Table 4. Comparison of life history inputs into earlier rebuilding analyses versus those input into the 2005 rebuilding model. The 2005 model had inputs up to age 75, but the values were similar to those at age 40.

	Year of Analysis							
	2001 and 2003				2005			
Age	M	Fecundity 10^7 eggs	Weight (kg) Females	Weight (kg) Males	M	Fecundity 10^7 eggs	Weight (kg) Females	Weight (kg) Males
0					0.07	0.00	0.01	0.01
1	0.05	0.00	0.05	0.04	0.07	0.00	0.06	0.06
2	0.05	0.00	0.14	0.12	0.07	0.00	0.16	0.16
3	0.05	0.00	0.26	0.23	0.07	0.00	0.31	0.30
4	0.05	0.00	0.38	0.33	0.07	0.00	0.45	0.44
5	0.05	0.01	0.47	0.42	0.07	0.04	0.59	0.55
6	0.05	0.04	0.56	0.50	0.07	0.07	0.63	0.59
7	0.05	0.14	0.65	0.57	0.07	0.44	0.81	0.71
8	0.05	0.32	0.73	0.64	0.07	0.78	0.91	0.77
9	0.05	0.57	0.81	0.70	0.07	1.13	1.00	0.82
10	0.05	0.86	0.89	0.75	0.07	1.44	1.08	0.86
11	0.05	1.15	0.96	0.80	0.07	1.71	1.14	0.89
12	0.05	1.43	1.02	0.84	0.07	1.94	1.20	0.91
13	0.05	1.69	1.08	0.87	0.07	2.14	1.24	0.93
14	0.05	1.92	1.13	0.89	0.07	2.30	1.28	0.94
15	0.05	2.13	1.17	0.92	0.07	2.44	1.31	0.95
16	0.05	2.32	1.21	0.93	0.07	2.55	1.34	0.96
17	0.05	2.49	1.24	0.95	0.07	2.64	1.36	0.96
18	0.05	2.63	1.27	0.96	0.07	2.72	1.37	0.97
19	0.05	2.76	1.29	0.97	0.07	2.78	1.39	0.97
20	0.05	2.86	1.32	0.98	0.07	2.83	1.40	0.97
21	0.05	2.96	1.33	0.99	0.07	2.87	1.41	0.97
22	0.05	3.04	1.35	0.99	0.07	2.90	1.41	0.98
23	0.05	3.11	1.36	1.00	0.07	2.93	1.42	0.98
24	0.05	3.17	1.37	1.00	0.07	2.95	1.42	0.98
25	0.05	3.22	1.38	1.00	0.07	2.97	1.43	0.98
26	0.05	3.27	1.39	1.00	0.07	2.98	1.43	0.98
27	0.05	3.30	1.40	1.01	0.07	2.99	1.43	0.98
28	0.05	3.34	1.41	1.01	0.07	3.00	1.44	0.98
29	0.05	3.36	1.41	1.01	0.07	3.01	1.44	0.98
30	0.05	3.39	1.41	1.01	0.07	3.01	1.44	0.98
31	0.05	3.41	1.42	1.01	0.07	3.02	1.44	0.98
32	0.05	3.42	1.42	1.01	0.07	3.02	1.44	0.98
33	0.05	3.44	1.42	1.01	0.07	3.02	1.44	0.98
34	0.05	3.45	1.43	1.01	0.07	3.03	1.44	0.98
35	0.05	3.46	1.43	1.01	0.07	3.03	1.44	0.98
36	0.05	3.47	1.43	1.01	0.07	3.03	1.44	0.98
37	0.05	3.48	1.43	1.01	0.07	3.03	1.44	0.98
38	0.05	3.48	1.43	1.01	0.07	3.03	1.44	0.98
39	0.05	3.49	1.43	1.01	0.07	3.03	1.44	0.98
40	0.05	3.51	1.44	1.01	0.07	3.03	1.44	0.98

Table 5. Comparison of age composition inputs into earlier rebuilding analyses versus those input into the 2005 rebuilding model. The 2005 model had inputs up to age 75+, but those values were summed to age 40+ for purposes of comparison.

	Year of Analysis							
	2001		2003		2005			
	1998 Age Comp		2000 Age Comp		2004 Age Comp		2001 Age Comp	
Age	**females**	**males**	**females**	**males**	**females**	**males**	**females**	**males**
0					1215	1215	836	836
1	1338	1338	3449	3449	1723	1723	2795	2795
2	176	176	272	272	334	334	3133	3133
3	791	791	837	837	677	677	299	299
4	1643	1644	175	175	2256	2255	865	865
5	260	262	781	785	2481	2483	202	202
6	417	424	1672	1692	235	234	1538	1549
7	380	389	185	189	644	647	457	465
8	201	208	309	318	148	149	61	62
9	83	86	248	257	1120	1133	171	175
10	271	282	88	91	332	339	53	55
11	214	223	53	55	44	45	71	73
12	228	238	161	169	124	127	23	24
13	93	97	133	139	39	40	197	204
14	60	63	160	168	51	53	81	83
15	34	35	65	68	17	17	25	26
16	30	32	42	44	143	148	29	30
17	77	81	22	24	58	60	13	13
18	111	117	20	22	18	19	15	16
19	115	120	54	57	21	22	22	23
20	56	59	76	80	9	9	39	41
21	29	30	81	84	11	11	48	50
22	19	20	39	41	16	16	9	10
23	16	16	21	22	28	30	3	4
24	18	18	13	14	35	36	4	4
25	55	56	12	12	7	7	5	5
26	4	4	11	11	2	3	3	3
27	40	41	44	45	3	3	13	13
28	0	0	6	6	3	3	4	4
29	1	1	25	26	2	2	4	5
30	71	73	0	0	9	9	4	5
31	3	3	2	2	3	3	3	3
32	36	37	48	49	3	3	2	2
33	0	0	3	3	3	3	2	2
34	0	0	25	26	2	2	3	3
35	0	0	0	0	1	2	3	3
36	25	26	0	0	1	1	2	2
37	10	10	0	0	2	2	2	2
38	8	9	17	18	2	2	1	2
39	8	8	7	7	2	2	1	1
40+	119	121	97	99	10	10	11	11

Table 6. Comparison of fishery selectivity inputs into earlier rebuilding analyses versus those input into the 2005 rebuilding model. The 2005 model had inputs up to age 75, but the values were similar to those at age 40.

	Year of Analysis					
	2001		2003		2005	
Age	Females	Males	Females	Males	Females	Males
0					0.00	0.00
1	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.01	0.01
3	0.02	0.01	0.03	0.02	0.05	0.05
4	0.11	0.08	0.14	0.11	0.24	0.21
5	0.32	0.26	0.36	0.30	0.51	0.43
6	0.57	0.51	0.59	0.54	0.60	0.50
7	0.76	0.72	0.77	0.73	0.85	0.73
8	0.87	0.84	0.87	0.84	0.92	0.81
9	0.93	0.91	0.92	0.90	0.96	0.86
10	0.96	0.94	0.96	0.94	0.98	0.89
11	0.98	0.96	0.97	0.96	0.99	0.91
12	0.98	0.97	0.98	0.97	0.99	0.92
13	0.99	0.98	0.99	0.98	0.99	0.93
14	0.99	0.98	0.99	0.98	1.00	0.94
15	1.00	0.99	0.99	0.98	1.00	0.94
16	1.00	0.99	1.00	0.99	1.00	0.94
17	1.00	0.99	1.00	0.99	1.00	0.95
18	1.00	0.99	1.00	0.99	1.00	0.95
19	1.00	0.99	1.00	0.99	1.00	0.95
20	1.00	0.99	1.00	0.99	1.00	0.95
21	1.00	0.99	1.00	0.99	1.00	0.95
22	1.00	0.99	1.00	0.99	1.00	0.95
23	1.00	0.99	1.00	0.99	1.00	0.95
24	1.00	1.00	1.00	0.99	1.00	0.95
25	1.00	1.00	1.00	0.99	1.00	0.95
26	1.00	1.00	1.00	0.99	1.00	0.95
27	1.00	1.00	1.00	0.99	1.00	0.95
28	1.00	1.00	1.00	0.99	1.00	0.95
29	1.00	1.00	1.00	0.99	1.00	0.95
30	1.00	1.00	1.00	0.99	1.00	0.95
31	1.00	1.00	1.00	0.99	1.00	0.95
32	1.00	1.00	1.00	0.99	1.00	0.95
33	1.00	1.00	1.00	0.99	1.00	0.95
34	1.00	1.00	1.00	0.99	1.00	0.95
35	1.00	1.00	1.00	0.99	1.00	0.95
36	1.00	1.00	1.00	0.99	1.00	0.95
37	1.00	1.00	1.00	0.99	1.00	0.95
38	1.00	1.00	1.00	0.99	1.00	0.95
39	1.00	1.00	1.00	0.99	1.00	0.95
40	1.00	1.00	1.00	0.99	1.00	0.95

Table 7. Model A1 output (2005 update of the rebuilding plan and addendum).

Quantity	P_{MAX} =0.5	P_{MAX} =0.6	P_{MAX} =0.7	P_{MAX} =0.8	P_{MAX} =0.9	F= 0.032*	F=0	40-10 Rule	ABC Rule
F	0.0715	0.0682	0.0645	0.0594	0.0531	0.032	0		0.046
SPR RATE	0.376	0.389	0.405	0.429	0.461	1.000	1.000		0.500
OY_{2007}(mt)	696.1	665	629.5	581.2	521.4	316.9	0	255.1	456
P_{MAX}	50.0	60.0	70.0	80.1	90.0	100.0	100.0	100.0	97.2
T_{MED}	2033.0	2024.7	2019.6	2016.0	2013.6	2010.5	2009.5	2011.2	2012.2
						* The current rebuild fishing mortality			

Table 8. Comparison of 2005 Model A1 results for a variety of assumptions. P=.8 and P=0.9 are based on T_{MAX} of 2033. The 2004-2006 catches were externally-derived estimates supplied to the model. Values are medians from 1000 runs.

	Probability Rebuilt					OY Catch (mt)			
Year	P= .8	P= .9	F=0	F50%	F=0.032	P= .8	P= .9	F50%	F=0.032
2004	0.00	0.00	0.00	0.00	0.00	227	227	227	227
2005	0.00	0.00	0.00	0.00	0.00	269	269	269	269
2006	0.00	0.00	0.00	0.00	0.00	294	294	294	294
2007	0.00	0.00	0.00	0.00	0.00	581	521	456	317
2008	0.00	0.00	0.00	0.00	0.00	615	554	487	343
2009	0.00	0.00	0.00	0.00	0.00	624	565	500	355
2010	0.00	0.00	1.00	0.00	0.00	641	584	519	373
2011	0.00	0.00	1.00	0.00	1.00	650	594	530	385
2012	0.06	0.19	1.00	0.43	1.00	654	600	538	395
2013	0.25	0.42	1.00	0.74	1.00	659	607	546	403
2014	0.38	0.55	1.00	0.80	1.00	662	612	553	412
2015	0.46	0.61	1.00	0.83	1.00	664	615	558	418
2016	0.50	0.65	1.00	0.86	1.00	662	615	560	422
2017	0.54	0.68	1.00	0.87	1.00	663	618	563	427
2018	0.57	0.71	1.00	0.88	1.00	662	617	563	430
2019	0.60	0.74	1.00	0.89	1.00	664	621	567	435
2020	0.62	0.75	1.00	0.90	1.00	661	619	568	438
2021	0.64	0.77	1.00	0.91	1.00	661	620	568	439
2022	0.66	0.79	1.00	0.92	1.00	659	618	569	440
2023	0.68	0.80	1.00	0.93	1.00	661	622	573	445
2024	0.69	0.82	1.00	0.93	1.00	657	617	570	445
2025	0.71	0.82	1.00	0.94	1.00	656	619	571	447
2026	0.72	0.84	1.00	0.94	1.00	659	622	572	449
2027	0.73	0.85	1.00	0.95	1.00	655	619	571	450
2028	0.75	0.86	1.00	0.96	1.00	657	620	575	451
2029	0.76	0.87	1.00	0.96	1.00	656	620	574	451
2030	0.77	0.88	1.00	0.96	1.00	656	618	573	453
2031	0.78	0.89	1.00	0.97	1.00	652	616	571	452
2032	0.79	0.89	1.00	0.97	1.00	650	614	570	452
2033	0.80	0.90	1.00	0.97	1.00	651	615	571	453

Table 9. Comparison of Model A1 results assuming T_{MAX} is 2011, 10 years after the stock was declared overfished. Values are medians from 1000 runs.

Year	Probability Rebuilt						OY Catch (mt)				
	P=0.8	P= 0.9	40-10	F=0	F=0.032	F50%	P=0.8	P=0 .9	40-10	F=0.032	F50%
2007	0.00	0.00	0.00	0.00	0.00	0.00	333	521	255	317	456
2008	0.00	0.00	0.00	0.00	0.00	0.00	360	554	353	343	487
2009	0.00	0.00	0.00	0.00	0.00	0.00	373	565	421	355	500
2010	0.00	0.00	0.00	1.00	0.00	0.00	390	584	494	373	519
2011	0.80	0.90	0.37	1.00	1.00	0.00	403	594	546	385	530

Table 10. Comparison of 2005 Model A1 results with T_{MAX} fixed at the year in the amendment (2044) (Model A1-b) and P_{MAX} either from the rebuilding plan (0.8) or from the amendment (0.9). Values are medians from 1000 runs.

	Probability Rebuilt		**OY Catch (mt)**	
Year	**P= .8**	**P= .9**	**P= .8**	**P= .9**
2007	0.00	0.00	628	571
2008	0.00	0.00	662	604
2009	0.00	0.00	669	614
2010	0.00	0.00	685	631
2011	0.00	0.00	692	640
2012	0.00	0.08	694	645
2013	0.14	0.28	698	651
2014	0.27	0.41	699	653
2015	0.34	0.48	699	655
2016	0.39	0.53	697	654
2017	0.43	0.56	696	656
2018	0.46	0.59	694	654
2019	0.49	0.62	695	657
2020	0.51	0.64	691	654
2021	0.53	0.67	689	654
2022	0.55	0.68	688	652
2023	0.57	0.70	689	654
2024	0.59	0.71	683	650
2025	0.61	0.73	684	650
2026	0.62	0.74	686	653
2027	0.64	0.75	681	649
2028	0.64	0.77	684	651
2029	0.65	0.79	683	650
2030	0.67	0.79	681	650
2031	0.68	0.81	678	646
2032	0.69	0.82	675	644
2033	0.70	0.83	677	645
2034	0.72	0.84	675	643
2035	0.73	0.85	677	647
2036	0.74	0.86	680	649
2037	0.75	0.86	677	647
2038	0.75	0.87	678	648
2039	0.76	0.87	679	648
2040	0.78	0.88	675	644
2041	0.78	0.88	676	645
2042	0.79	0.89	678	647
2043	0.79	0.90	680	650
2044	0.80	0.90	682	650

Table 11. Comparisons requested by the SSC to evaluate progress towards rebuilding.

	1 (Default)	2	3	4	5	6
P_{MAX}	**estimated**	**0.5**	**estimated**	**P_0**	**estimated**	**P_0**
T_{MAX}	**current T_{TARGET}**	**current T_{TARGET}**	**current T_{MAX}**	**current T_{MAX}**	**new T_{MAX}**	**new T_{MAX}**
BASED ON	**current SPR**	**est SPR**	**current SPR**	**est SPR**	**current SPR**	**est SPR**
Model				**A1-b**	**A1**	
T_{MIN}	2009	2009	2009	2009	2009	2009
T_{MAX}	2030	2030	2044	2044	2033	2033
T_{MED}	2012	2012	2012	2016	2012	2014
P_{MAX}	0.962	0.5	0.986	0.9	0.972	0.9
F	0.0463	0.0701	0.0463	0.0583	0.046	0.0531
SPR rate	0.5	0.381	0.5	0.434	0.5	0.461

Table 12. Comparison of model results with recruitment predicted from stock-recruitment relationship (Model 2) to the model with re-sampled recruitments (Model A1).

	Model A1	Model 2
Age-0 Recruitments		
Estimate B_0 (mean from range)	1968-2003	intial
Resample for Future Recruits (from within range)	1982-2003	S-R
Outputs		
B_0 (10^7 eggs)	25361	26662
B_{MSY} (10^7 eggs)	10144	10665
T_{MIN}	2009	2009
T_{MAX}	2033	2033
P_{MAX}	0.97	0.96
Median year to rebuild given P_{MAX} by T_{MAX}	2012	2014
2007 OY (mt)	456	456
2008 OY (mt)	487	488
2009 OY (mt)	500	500
2010 OY (mt)	519	519
2011 OY (mt)	530	532
2012 OY (mt)	538	540
2013 OY (mt)	546	548
2014 OY (mt)	553	556
2015 OY (mt)	558	563
2016 OY (mt)	560	570
2017 OY (mt)	563	577

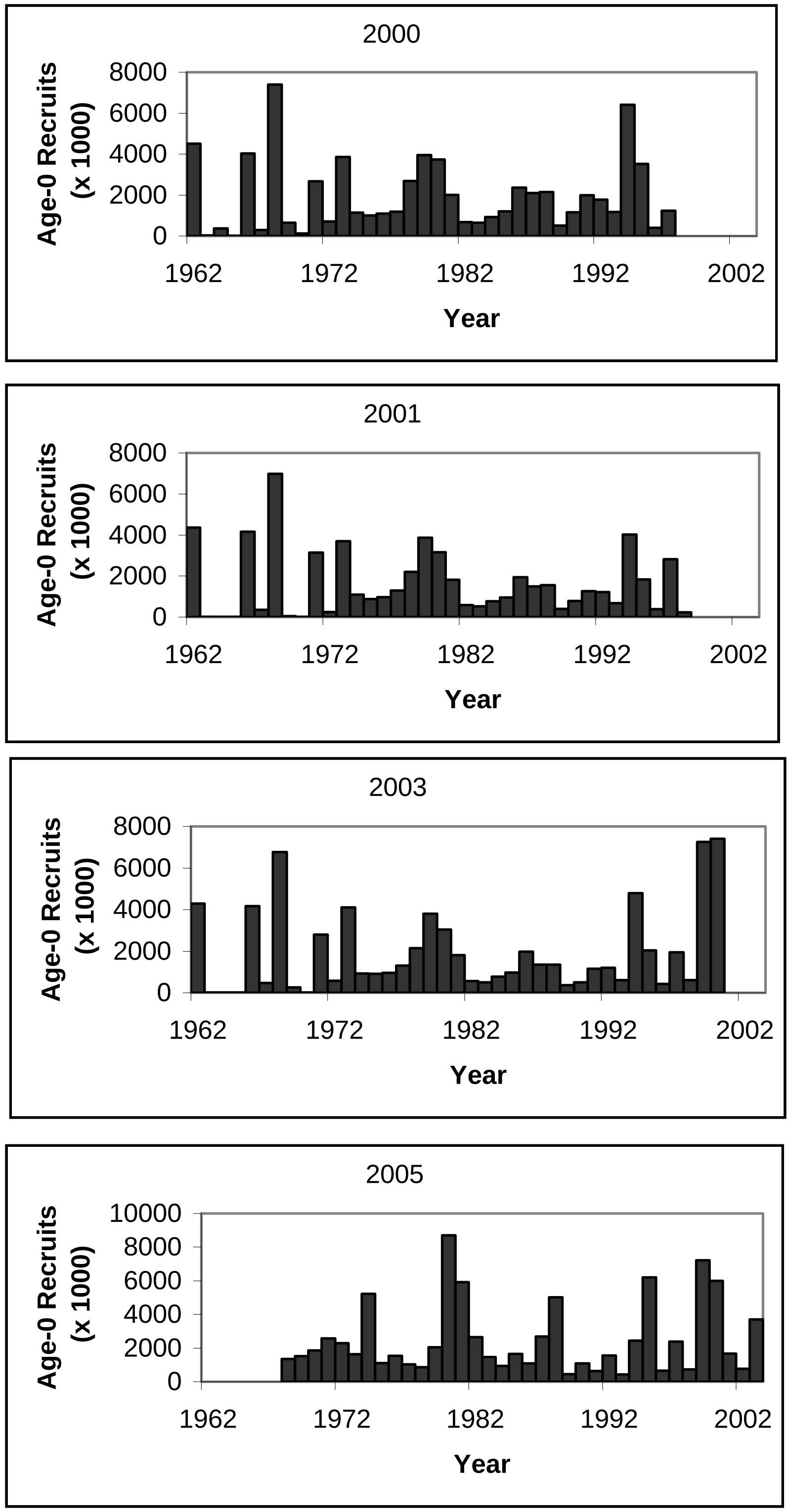

Figure 1. Comparison of recruitments estimated in the three stock assessments for darkblotched rockfish.

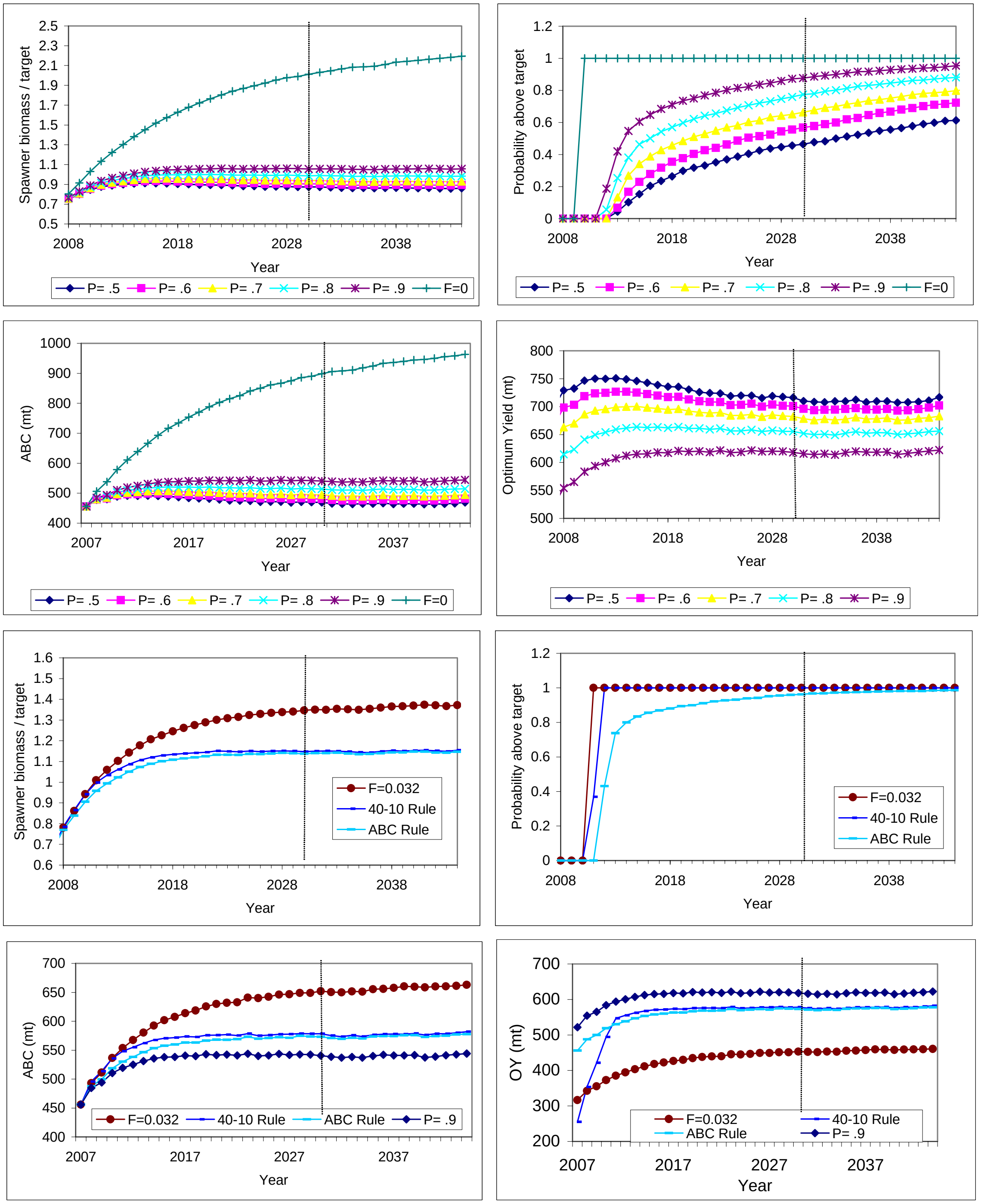

Figure 2. Median time-trajectories for spawning output relative to target level, the probability of being above the target level, the ABC and OY for a set of rebuilding strategies. The vertical dashed line is the year 2030, the target year to rebuild.

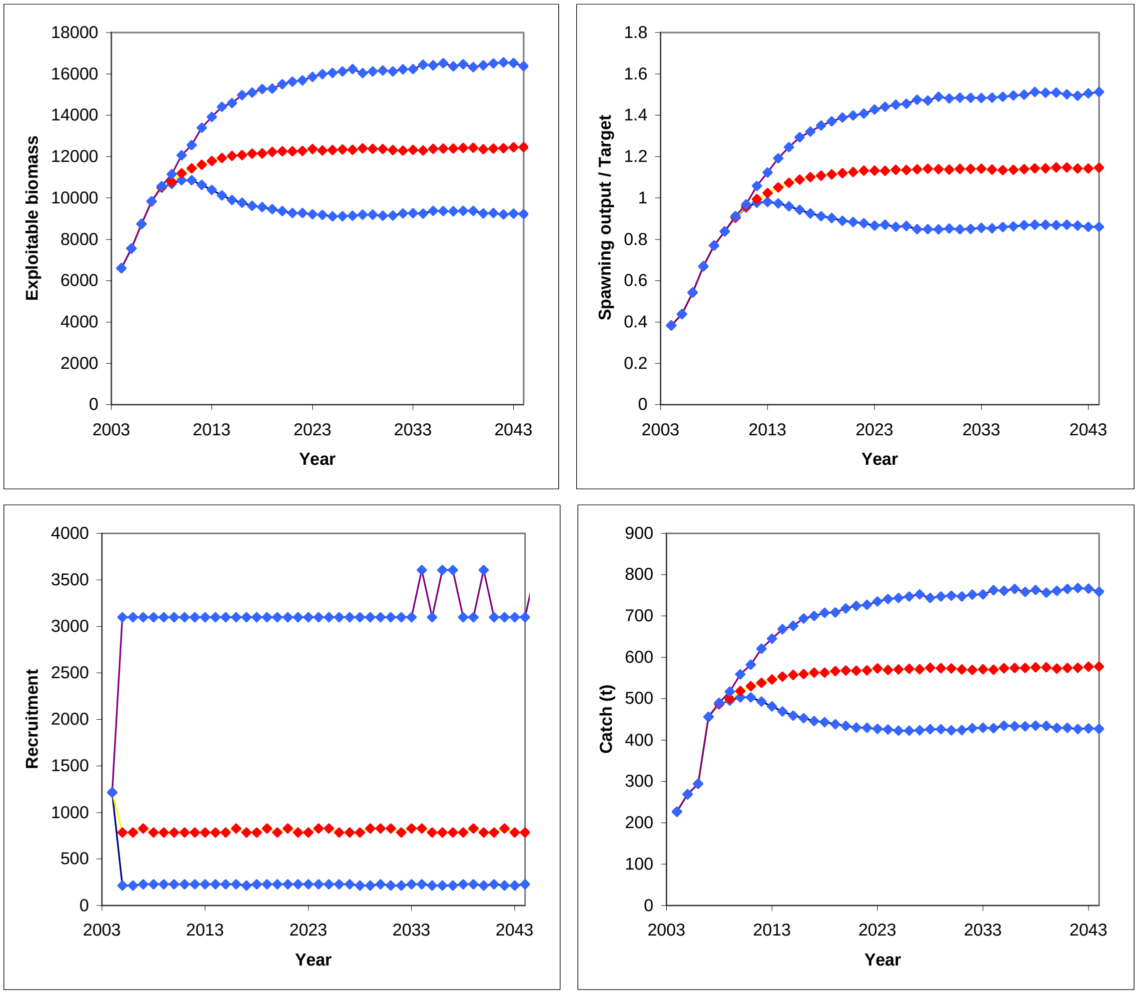

Figure 3. Median and 95% confidence intervals for the ABC harvest strategy, as output by Model A1.

Glossary for Terms Used in this Document

ABC	Allowable Biological Catch
B_0	Population spawning output in the unfished state
B_{MSY}	Population spawning output that can support MSY
B40%	Proxy for $B_{MSY} = 0.40*B_0$
F_{MSY}	Fishing mortality rate which will achieve MSY
F50%	Proxy for F_{MSY}
Harvest Control Rule	Fishing mortality rate applied to the exploitable biomass to determine the OY
Mean Generation Time	Time required for a female to reproduce a reproductive female offspring Sum (age x spawn x survival - for each age)/ sum(spawn x survival - for each age)
MSY	Maximum sustained yield
OY	Optimum Yield -the desired fishery catch in a given year
P_0	The probability of rebuilding by TMAX that was selected as policy by the council
$P_{CURRENT}$	The forecast probability of rebuilding within T_{MAX} given the existing harvest rate.
P_{MAX}	Probability that stock will rebuild by T_{MAX}
Spawning Output	Fecundity output by the females in the population (#age*%mature*fecundity)
T_{MAX}	Maximum allowable rebuilding time (T_{MIN} if T_{MIN} is <= 10, otherwise, T_{MIN} + generation time)
T_{MED}	Median year to rebuild given the selected probability of rebuilding by $T_{MAX)}$
T_{MIN}	Time needed to rebuild in the absence of fishing (beginning with the year the stock was declared overfished)
T_{TARGET}	Time needed to have at least 50% probability of rebuilding within T_{MAX} (often median year to rebuild given the selected probability of rebuilding by $T_{MAX)}$

MODEL A1 INPUT FILES

```
#Title
Darkblotched 2005
# Number of sexes
2
# Age range to consider (minimum age; maximum age)
0 75
# Number of fleets
1
# First year of projection
2004
# Year declared overfished
2001
# 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)
1
# Constant fishing mortality (1) or constant Catch (2) projections
1
# Fishing mortality based on SPR (1) or actual rate (2)
2
# Pre-specify the year of recovery (or -1) to ignore
-1
# Fecundity-at-age
# 2004 eggs ages 0-75
0.00  0.00  0.00  0.00  0.00  0.04  0.07  0.44  0.78  1.13  1.44  1.71
      1.94  2.14  2.30  2.44  2.55  2.64  2.72  2.78  2.83  2.87  2.90
      2.93  2.95  2.97  2.98  2.99  3.00  3.01  3.01  3.02  3.02  3.02
      3.03  3.03  3.03  3.03  3.03  3.03  3.03  3.03  3.03  3.04  3.04
      3.04  3.04  3.04  3.04  3.04  3.04  3.04  3.04  3.04  3.04  3.04
      3.04  3.04  3.04  3.04  3.04  3.04  3.04  3.04  3.04  3.04  3.04
      3.04  3.04  3.04  3.04  3.04  3.04  3.04  3.04  3.04

# Age specific information (Females then males) weight then selectivity
in 2004
# Females
0.01  0.06  0.16  0.31  0.45  0.59  0.63  0.81  0.91  1.00  1.08  1.14
      1.20  1.24  1.28  1.31  1.34  1.36  1.37  1.39  1.40  1.41  1.41
      1.42  1.42  1.43  1.43  1.43  1.44  1.44  1.44  1.44  1.44  1.44
      1.44  1.44  1.44  1.44  1.44  1.44  1.44  1.44  1.44  1.44  1.44
      1.44  1.44  1.44  1.44  1.44  1.44  1.44  1.44  1.44  1.44  1.44
      1.44  1.44  1.44  1.44  1.44  1.44  1.44  1.44  1.44  1.44  1.44
      1.44  1.44  1.44  1.44  1.44  1.44  1.44  1.44  1.44
0.00  0.00  0.01  0.05  0.24  0.51  0.60  0.85  0.92  0.96  0.98  0.99
      0.99  0.99  1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00
      1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00
      1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00
      1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00
      1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00
      1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00
# Males
0.01  0.06  0.16  0.30  0.44  0.55  0.59  0.71  0.77  0.82  0.86  0.89
      0.91  0.93  0.94  0.95  0.96  0.96  0.97  0.97  0.97  0.97  0.98
      0.98  0.98  0.98  0.98  0.98  0.98  0.98  0.98  0.98  0.98  0.98
      0.98  0.98  0.98  0.98  0.98  0.98  0.98  0.98  0.98  0.98  0.98
      0.98  0.98  0.98  0.98  0.98  0.98  0.98  0.98  0.98  0.98  0.98
```

```
      0.98  0.98  0.98  0.98  0.98  0.98  0.98  0.98  0.98  0.98  0.98
      0.98  0.98  0.98  0.98  0.98  0.98  0.98  0.98  0.98
0.00  0.00  0.01  0.05  0.21  0.43  0.50  0.73  0.81  0.86  0.89  0.91
      0.92  0.93  0.94  0.94  0.94  0.95  0.95  0.95  0.95  0.95  0.95
      0.95  0.95  0.95  0.95  0.95  0.95  0.95  0.95  0.95  0.95  0.95
      0.95  0.95  0.95  0.95  0.95  0.95  0.95  0.95  0.95  0.95  0.95
      0.95  0.95  0.95  0.95  0.95  0.95  0.95  0.95  0.95  0.95  0.95
      0.95  0.95  0.95  0.95  0.95  0.95  0.95  0.95  0.95  0.95  0.95
      0.95  0.95  0.95  0.95  0.95  0.95  0.95  0.95  0.95

# M and 2004 age-structure
# Females
0.07  0.07  0.07  0.07  0.07  0.07  0.07  0.07  0.07  0.07  0.07  0.07
      0.07  0.07  0.07  0.07  0.07  0.07  0.07  0.07  0.07  0.07  0.07
      0.07  0.07  0.07  0.07  0.07  0.07  0.07  0.07  0.07  0.07  0.07
      0.07  0.07  0.07  0.07  0.07  0.07  0.07  0.07  0.07  0.07  0.07
      0.07  0.07  0.07  0.07  0.07  0.07  0.07  0.07  0.07  0.07  0.07
      0.07  0.07  0.07  0.07  0.07  0.07  0.07  0.07  0.07  0.07  0.07
      0.07  0.07  0.07  0.07  0.07  0.07  0.07  0.07  0.07
1215  1723  334   677   2256  2481  235   644   148   1120  332   44
      124   39    51    17    143   58    18    21    9     11    16
      28    35    7     2     3     3     2     9     3     3     3
      2     1     1     2     2     2     1     1     1     1     1
      1     1     1     1     0     0     0     0     0     0     0
      0     0     0     0     0     0     0     0     0     0     0
      0     0     0     0     0     0     0     0     1
# Males
0.07  0.07  0.07  0.07  0.07  0.07  0.07  0.07  0.07  0.07  0.07  0.07
      0.07  0.07  0.07  0.07  0.07  0.07  0.07  0.07  0.07  0.07  0.07
      0.07  0.07  0.07  0.07  0.07  0.07  0.07  0.07  0.07  0.07  0.07
      0.07  0.07  0.07  0.07  0.07  0.07  0.07  0.07  0.07  0.07  0.07
      0.07  0.07  0.07  0.07  0.07  0.07  0.07  0.07  0.07  0.07  0.07
      0.07  0.07  0.07  0.07  0.07  0.07  0.07  0.07  0.07  0.07  0.07
      0.07  0.07  0.07  0.07  0.07  0.07  0.07  0.07  0.07
1215  1723  334   677   2255  2483  234   647   149   1133  339   45
      127   40    53    17    148   60    19    22    9     11    16
      30    36    7     3     3     3     2     9     3     3     3
      2     2     1     2     2     2     1     1     1     1     1
      1     1     1     1     0     0     0     0     0     0     0
      0     0     0     0     0     0     0     0     0     0     0
      0     0     0     0     0     0     0     0     1
# 2001 age-structure
836   2795  3133  299   865   202   1538  457   61    171   53    71
      23    197   81    25    29    13    15    22    39    48    9
      3     4     5     3     13    4     4     4     3     2     2
      3     3     2     2     1     1     1     1     1     1     1
      1     1     1     1     1     0     0     0     0     0     0
      0     0     0     0     0     0     0     0     0     0     0
      0     0     0     0     0     0     0     0     1
836   2795  3133  299   865   202   1549  465   62    175   55    73
      24    204   83    26    30    13    16    23    41    50    10
      4     4     5     3     13    4     5     5     3     2     2
      3     3     2     2     2     1     1     1     1     1     1
      1     1     1     1     1     0     0     0     0     0     0
      0     0     0     0     0     0     0     0     0     0     0
      0     0     0     0     0     0     0     0     1
# Year for Tmin Age-structure
```

```
2001
# Number of simulations
1000
#  recruitment and biomass
# Number of historical assessment years
78
# Historical data
# year recruitment spawner in B0 in R project in R/S project
1927  2495  25930 1     0     0
1928  2623  26977 0     0     0
1929  2623  26976 0     0     0
1930  2623  26973 0     0     0
1931  2623  26970 0     0     0
1932  2623  26969 0     0     0
1933  2623  26968 0     0     0
1934  2623  26967 0     0     0
1935  2623  26966 0     0     0
1936  2623  26964 0     0     0
1937  2623  26962 0     0     0
1938  2623  26960 0     0     0
1939  2623  26956 0     0     0
1940  2623  26949 0     0     0
1941  2622  26942 0     0     0
1942  2622  26933 0     0     0
1943  2622  26924 0     0     0
1944  2622  26885 0     0     0
1945  2622  26794 0     0     0
1946  2622  26555 0     0     0
1947  2622  26395 0     0     0
1948  2622  26299 0     0     0
1949  2621  26146 0     0     0
1950  2621  25986 0     0     0
1951  2621  25801 0     0     0
1952  2621  25560 0     0     0
1953  2620  25394 0     0     0
1954  2620  25236 0     0     0
1955  2620  25079 0     0     0
1956  2620  24934 0     0     0
1957  2619  24749 0     0     0
1958  2619  24547 0     0     0
1959  2619  24376 0     0     0
1960  2619  24216 0     0     0
1961  2618  24049 0     0     0
1962  2618  23946 0     0     0
1963  2618  23777 0     0     0
1964  2618  23568 0     0     0
1965  2617  23483 0     0     0
1966  2617  23196 0     0     0
1967  2609  19175 0     0     0
1968  1361  16304 0     0     0
1969  1516  14110 0     0     0
1970  1854  14036 0     0     0
1971  2569  14021 0     0     0
1972  2296  13911 0     0     0
1973  1626  13706 0     0     0
1974  5219  13257 0     0     0
1975  1115  12849 0     0     0
```

```
1976  1547  12567 0     0     0
1977  1037  12294 0     0     0
1978  861   12358 0     0     0
1979  2045  12343 0     0     0
1980  8698  11903 0     0     0
1981  5918  11908 0     0     0
1982  2653  11522 0     1     1
1983  1464  10810 0     1     1
1984  943   10164 0     1     1
1985  1653  9303  0     1     1
1986  1090  8386  0     1     1
1987  2692  8227  0     1     1
1988  5019  7247  0     1     1
1989  455   6627  0     1     1
1990  1087  6090  0     1     1
1991  633   5052  0     1     1
1992  1569  4366  0     1     1
1993  428   4166  0     1     1
1994  2439  3696  0     1     1
1995  6198  3485  0     1     1
1996  650   3280  0     1     1
1997  2385  2985  0     1     1
1998  740   2598  0     1     1
1999  7212  2136  0     1     1
2000  5995  2103  0     1     1
2001  1672  2304  0     1     1
2002  769   2739  0     1     1
2003  3695  3282  0     1     1
2004  2430  3848  0     0     0
# Number of years with pre-specified catches
3
# catches for years with pre-specified catches
2004 227
2005 269
2006 294
# Number of future recruitments to override
0
# Process for overiding (-1 for average otherwise index in data list)
# Which probability to product detailed results for (1=0.5; 2=0.6;
etc.)
9
# Steepness sigma-R Auto-correlation
0.95 0.8 0.00
# Target SPR rate (FMSY Proxy)
0.5
# Target SPR information: Use (1=Yes) and power
0 20
# 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
# Percentage of FMSY which defines Ftarget
0.9
# Maximum possible F for projection (-1 to set to FMSY)
2
```

```
# Conduct MacCall transition policy (1=Yes)
0
# Defintion of recovery (1=now only;2=now or before)
2
# Results for rec probs by Tmax (1) or 0.5 prob for various Ttargets
(2)
1
# Definition of the "40-10" rule
10 40
# Produce the risk-reward plots (1=Yes)
0
# Calculate coefficients of variation (1=Yes)
0
# Number of replicates to use
20
# Random number seed
-89102
# Conduct projections for multiple starting values (0=No;else yes)
0
# File with multiple parameter vectors
MCMC.PRJ
# Number of parameter vectors
100
# User-specific projection (1=Yes); Output replaced (1->6)
1 6 0 0.5
# Catches and Fs (Year; 1/2 (F or C); value); Final row is -1
2007 1 0.032
2008 1 0.032
2009 1 0.032
2010 1 0.032
2011 1 0.032
2012 1 0.032
2013 1 0.032
2014 1 0.032
2015 1 0.032
2016 1 0.032
2017 1 0.032
-1 -1 -1
# Split of Fs
2004 1
-1 1
# Time varying weight-at-age (1=Yes;0=No)
0
# File with time series of weight-at-age data
Fecwt.csv
```