Cowcod Rebuilding Analysis 2005
Analysis of the Progress towards rebuilding in the Southern California Bight

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Introduction

Cowcod (*Sebastes levis*) population status was initially assessed by Butler et al (1999) and declared overfished in 2000. The original stock assessment was conducted using a Delay-Difference model that estimated recruitments as a random walk function. The model estimated that the spawning stock abundance was 7% of an unfished stock in 1999 and that resilience of the stock was low. The original cowcod rebuilding analysis was completed using a surplus production model because of the density dependent population growth inherent in the logistic equation. The surplus production rebuilding analysis was modeled using a log-normal distribution fitted to recruitment (1951-1998) estimated in the original delay difference model (Butler et al. 1999). A subsequent rebuilding analysis (Butler and Barnes 2000) estimated the following rebuilding parameters and quantities that were adopted by the PFMC in 2004 (PFMC 2004):

Current Adopted Rebuilding Parameters

Year declared overfished	2000
Year rebuilding plan adopted	2004
B_0	3367 t
B_{msy}	1350 t
$B_{current}$	7% (of B0)
T_{min}	2062
T_{max}	2099
P_{max}	60%
T_{target}	2090
Harvest control rule	F=0.0093 (78% SPR)

A new assessment was conducted in 2005 (Piner et al. 2005). The new assessment differed from the previous assessment in that the recruitment process was described by a Stock/Recruit (S/R) relationship. This was a departure from the previous assessment and represents much of the difference in results between the two assessments. Only the level of unexploited recruitment (*R*0) was estimated, and the level of steepness (*h*) in the S/R relationship was fixed. This fixing of *h* greatly reduced the uncertainty in the model because it was the parameter that the STAR panel believed expressed the most uncertainty in the stock assessment (STAR Panel Report 2005). The review of the assessment considered a value of *h*=0.5 to be the most appropriate choice, but that actual steepness may be somewhat higher or lower. The assessment estimated that 2005 spawning biomass was 18% of unfished (*h*=0.5), but reached as low as 9% of unfished spawning biomass in 1990.

Methods

To evaluate the progress of rebuilding, the Science and Statistical Committee of the Pacific Fishery Management Council suggested that the analytical team use a Synthetic posterior approach. The Synthetic posterior was created from the output of individual model runs bounding a credible range of stock steepness (*h*=0.25-0.75, increment 0.025). The posterior was symmetrical around a mean h = 0.5 with a S.D. of 0.1, with the frequency of the output from each run reflecting the probability of that steepness (Figure 1). We acknowledge that the Synthetic posterior approach is subjective, but the advantage of this approach is that it incorporates some uncertainty surrounding a fixed but unknown estimate of *h*. The rebuilding trajectories were calculated using the 'Puntalizer' software (version 2.8 April, 2005) developed by Andre Punt. A total of 1000 iteration were used in each rebuilding run. We chose to use 1000 because the results of a 10,000 iterations run (run#1) were nearly identical to same run using only 1000 iterations. The probability of rebuilding in this analysis is the probability of being at or above $B_{40\%}$ by T_{target}. Biological and fishery parameters-at-age are given in Table 1. Appendix I is the rebuild.data file used for run 1. Rebuilding projections are based upon the following calculations and assumptions:

A) the old F in the adopted rebuilding plan = SPR of 0.78. The calculation of the SPR rate that corresponded to F=0.009 was done in a spreadsheet using the weight at age, maturity at age, selectivity at age and natural mortality used in the assessment. Identical (or nearly so) assumptions about these parameters were made in the current and preceding assessment.
B) Unfished spawning biomass (SB0) is calculated the same as the assessment.
C) Recruitment is generated from the S/R curve taken from the assessment and uncertainty generated using the synthetic posterior and Sigma-R=0.5.
D) A single selectivity pattern is used to describe the removals.

Six rebuilding projections were done following guidelines developed by the NW Region, NW Center, Council Staff and the SSC. The results of the six runs are given in Table 1 and are defined as the following (the same as in the Hastie memo):

Run #1- probability of recovery estimated, T_{target} is the adopted target, harvest rate is adopted SPR.
Run #2- probability of recovery 0.5, T_{target} is the adopted target, harvest rate is estimated SPR.
Run #3- probability of recovery estimated, T_{target} is the adopted T_{max}, harvest rate is adopted SPR.
Run #4- probability of recovery adopted P_0, T_{target} is the adopted T_{max}, harvest rate is estimated SPR.
Run #5- probability of recovery estimated, T_{target} is the estimated T_{max}, harvest rate is adopted SPR.
Run #6- probability of recovery adopted P_0, T_{target} is the estimated T_{max}, harvest rate is estimated SPR.

Results

The results of the analysis of the progress towards rebuilding indicate that cowcod are more likely to rebuild by the old T_{target} than indicated in the first rebuilding analysis (Table 2). A new estimated T_{max} of 2074 was estimated, which is 25 years earlier than the

2099 estimated previously (Butler and Barnes 2000). The estimated catches of cowcod across all 6 SSC scenarios were 6-12 t, and this is projected to increase slowly over time (Table 3). Although this is higher than the 2-3 t in the current rebuilding plan, it is likely that it will be difficult to measure the difference using the historical data sources. At the request of the GMT, Table 4 gives the projected catch for run#6 over all probabilities (0.5-0.9).

A sensitivity analysis was done to the shape of the normal distribution used to construct the Synthetic posterior. Rebuilding parameterization corresponding to run 1 was used in the exploration of the affects of the shape of the Synthetic posterior on the rebuilding results. Results of using a more narrowly defined posterior defined as *h* mean=0.5, sd=0.059, range 0.35-0.65 and more diffuse distribution defined as *h* mean=0.5, sd=0.12, range 0.25-0.75 are given in Table 2. These results suggest that the more narrowly defined the posterior distribution (and smaller range of *h*) the more likely the stock is to rebuild by the current T_{target} and the more diffuse the distribution the less likely the stock is to rebuild.

Conclusions:

The results of this analysis indicate that if the stock of cowcod in the SCB has a population resilience as described in the current stock assessment (Piner et al. 2005) and this synthetic posterior rebuilding analysis, it is 20% more likely to rebuild by the old T_{target} (2090) than previously thought. However, the probability of recovery using the old harvest rate and a new T_{max} is not greater than 80%.

This rebuilding plan is based upon many assumptions. We have no information if the assumption of the Stock/Recruitment relationship and corresponding Synthetic posterior is appropriate. The results of this rebuilding analysis suggest that the previous analysis was not incorrect to suggest that rebuilding of cowcod may take several decades. The true state of nature of the cowcod resilience is quite uncertain and unlikely to become significantly clearer in the near future.

Literature Cited

Butler, J. L., and J.T. Barnes. 2000. Rebuilding plan for cowcod (Sebastes levis). Unpublished document. PFMC, 2130 WSW fifth avenue, suite 224, Portland, Oregon 97201.

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Council. Status of the Pacific Coast groundfish fishery through 2005 and recommended acceptable biological catches for 2007: stock assessments and fishery evaluation. Pacific Fishery Management Council, Portland, Oregon.

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Table 1. The biological and fishery parameters used in the 2005 rebuilding analysis of Cowcod.

					Fleet 1								
Age	Fec	M	Init N	Init N Tmin	Wt	Sel	Age	Fec	M	Init N	Init N Tmin	Wt	Sel
0	0.000	0.055	27.658	23.489	0.017	0.000	41	8.518	0.055	0.075	0.014	8.600	1.000
1	0.000	0.055	25.462	21.419	0.017	0.000	42	8.680	0.055	0.051	0.009	8.758	1.000
2	0.000	0.055	23.379	19.287	0.022	0.000	43	8.834	0.055	0.034	0.006	8.909	1.000
3	0.000	0.055	21.402	17.376	0.057	0.000	44	8.982	0.055	0.023	0.004	9.054	1.000
4	0.000	0.055	19.519	16.208	0.114	0.000	45	9.124	0.055	0.015	0.003	9.192	1.000
5	0.000	0.055	17.841	14.885	0.196	0.000	46	9.259	0.055	0.010	0.002	9.324	1.000
6	0.000	0.055	16.269	14.031	0.302	0.000	47	9.388	0.055	0.007	0.001	9.450	1.000
7	0.000	0.055	14.650	12.754	0.433	0.000	48	9.511	0.055	0.004	0.001	9.570	1.000
8	0.002	0.055	13.198	11.937	0.589	0.010	49	9.628	0.055	0.003	0.000	9.685	1.000
9	0.021	0.055	12.311	10.879	0.767	0.090	50	9.740	0.055	0.002	0.000	9.794	1.000
10	0.136	0.055	11.306	9.988	0.965	0.310	51	9.846	0.055	0.001	0.000	9.898	1.000
11	0.464	0.055	10.657	9.297	1.183	0.650	52	9.948	0.055	0.001	0.000	9.997	1.000
12	0.939	0.055	9.686	10.042	1.418	0.900	53	10.044	0.055	0.001	0.000	10.091	1.000
13	1.380	0.055	9.062	10.603	1.666	1.000	54	10.136	0.055	0.000	0.000	10.181	1.000
14	1.735	0.055	8.255	12.225	1.927	1.000	55	10.224	0.055	0.000	0.000	10.266	1.000
15	2.041	0.055	7.571	13.006	2.198	1.000	56	10.307	0.055	0.000	0.000	10.347	1.000
16	2.330	0.055	7.035	13.041	2.477	1.000	57	10.386	0.055	0.000	0.000	10.423	1.000
17	2.616	0.055	7.585	11.996	2.762	1.000	58	10.460	0.055	0.000	0.000	10.496	1.000
18	2.905	0.055	7.997	11.306	3.051	1.000	59	10.532	0.055	0.000	0.000	10.566	1.000
19	3.196	0.055	9.208	10.166	3.342	1.000	60	10.599	0.055	0.000	0.000	10.632	1.000
20	3.488	0.055	9.785	9.277	3.634	1.000	61	10.663	0.055	0.000	0.000	10.694	1.000
21	3.780	0.055	9.800	8.288	3.926	1.000	62	10.724	0.055	0.000	0.000	10.753	1.000
22	4.072	0.055	9.005	7.103	4.216	1.000	63	10.782	0.055	0.000	0.000	10.810	1.000
23	4.361	0.055	8.477	5.922	4.504	1.000	64	10.837	0.055	0.000	0.000	10.863	1.000
24	4.646	0.055	7.613	4.812	4.788	1.000	65	10.889	0.055	0.000	0.000	10.913	1.000
25	4.928	0.055	6.939	3.739	5.067	1.000	66	10.938	0.055	0.000	0.000	10.961	1.000
26	5.204	0.055	6.192	2.851	5.341	1.000	67	10.984	0.055	0.000	0.000	11.007	1.000
27	5.475	0.055	5.301	2.138	5.609	1.000	68	11.029	0.055	0.000	0.000	11.050	1.000
28	5.740	0.055	4.414	1.591	5.870	1.000	69	11.070	0.055	0.000	0.000	11.091	1.000
29	5.999	0.055	3.583	1.168	6.125	1.000	70	11.110	0.055	0.000	0.000	11.129	1.000
30	6.250	0.055	2.780	0.853	6.373	1.000	71	11.148	0.055	0.000	0.000	11.166	1.000
31	6.494	0.055	2.118	0.613	6.614	1.000	72	11.183	0.055	0.000	0.000	11.200	1.000
32	6.731	0.055	1.587	0.438	6.847	1.000	73	11.217	0.055	0.000	0.000	11.233	1.000
33	6.960	0.055	1.179	0.311	7.072	1.000	74	11.249	0.055	0.000	0.000	11.264	1.000
34	7.182	0.055	0.865	0.217	7.290	1.000	75	11.279	0.055	0.000	0.000	11.294	1.000
35	7.395	0.055	0.631	0.150	7.499	1.000	76	11.308	0.055	0.000	0.000	11.321	1.000
36	7.601	0.055	0.453	0.102	7.702	1.000	77	11.335	0.055	0.000	0.000	11.348	1.000
37	7.800	0.055	0.323	0.069	7.896	1.000	78	11.360	0.055	0.000	0.000	11.373	1.000
38	7.991	0.055	0.229	0.046	8.083	1.000	79	11.385	0.055	0.000	0.000	11.396	1.000
39	8.174	0.055	0.160	0.031	8.263	1.000	80	11.408	0.055	0.000	0.000	11.419	1.000
40	8.350	0.055	0.110	0.021	8.435	1.000							

Table 2. Results of the six model runs requested by the SSC for when evaluating a currently existing rebuilding plan and two sensitivity runs to the shape of the pseudo-posterior.

Run description	F (SPR) Rate	T_{max} year	T_{target} year	P_{0-} (prob of rec by T_{target})	T_{min}	Generation time (yrs)	Virgin spawn (target spawn) (t)
			Requested Runs				
Run 1	0.009 (0.78)	2099	2090	81%	2036	39	3045 (1218)
Run 2	0.021 (0.601)	2099	2090	50%	2035	39	3045 (1218)
Run 3	0.009 (0.78)	2099	2099	83%	2035	39	3045 (1218)
Run 4	0.019 (0.63)	2099	2099	60%	2035	39	3045 (1218)
Run 5	0.009 (0.78)	2074	2074	75%	2035	39	3045 (1218)
Run 6	0.015 (0.69)	2074	2074	60%	2035	39	3045 (1218)
			Sensitivity Runs				
Reduced	0.009 (0.78)		2090	90%			
Diffuse	0.009 (0.78)		2090	78%			

n/a indicates this rebuilding parameter does not apply to the run

Table 3. Ten year projected catches and ABC levels under the six rebuilding scenarios requested by the SSC. Projected catches for Runs #1, 3 and 5 are the same because the runs used the same exploitation rate.

	Run #1 (t)		Run #2		Run #3		Run #4		Run #5		Run #6	
year	OY	ABC	OY	ABC	OY	ABC	OY	ABC	OY	ABC	OY	ABC
2007	6	17	12	17	6	17	11	17	6	17	9	17
2008	6	17	13	17	6	17	11	17	6	17	9	17
2009	6	18	13	17	6	18	11	17	6	18	9	18
2010	6	18	13	18	6	18	12	18	6	18	9	18
2011	6	19	13	18	6	19	12	18	6	19	9	18
2012	6	19	13	18	6	19	12	18	6	19	10	19
2013	6	19	13	18	6	19	12	18	6	19	10	19
2014	7	20	13	18	7	20	12	19	7	20	10	19
2015	7	20	14	19	7	20	12	19	7	20	10	20
2016	7	21	14	19	7	21	13	19	7	21	10	20

Table 4. Projected catches in metric tons under rebuilding run #6 request by the GMT. The probability of recovery by Tmax is given across the top of column and predicted catch across rows.

Prob. year	50% (t)	60%	70%	80%	90%
2007	11	9	7	3	0
2008	11	9	7	4	0
2009	11	9	7	4	0
2010	11	9	7	4	0
2011	11	9	7	4	0
2012	11	10	7	4	0
2013	12	10	8	4	0
2014	12	10	8	4	0
2015	12	10	8	4	0
2016	12	10	8	4	0

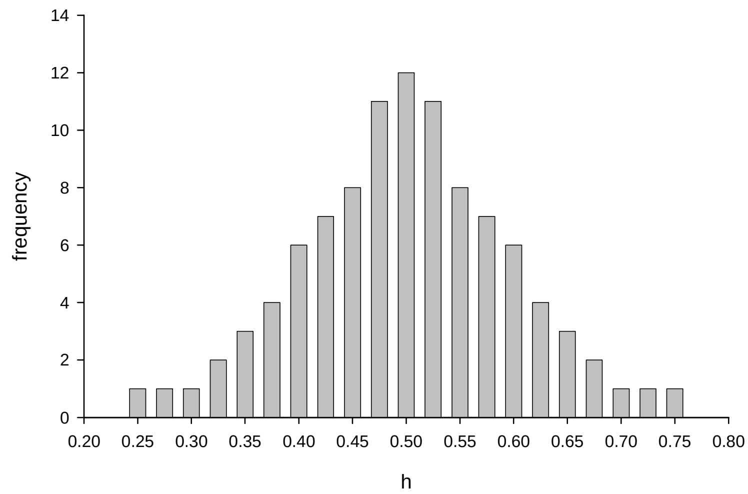

Figure1. Distribution of *h* from the model runs used to create the synthetic posterior used in the rebuilding analysis (*h* mean=0.5, sd=0.1).

Appendix I.
Rebuild.dat file corresponding to run1 in table 2.

```
#Title
COW - STAR panel model
# Number of sexes
1
# Age range to consider (minimum age; maximum age)
0 80
# Number of fleets
1
# First year of projection
2005
# Year declared overfished
2000
# 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
83
# Fecundity-at-age need to change to weight*maturity
# 0 to 80
2.14288E-11  2.14288E-11  2.14335E-11  5.04419E-10  1.78424E-08  4.62721E-07  9.30794E-06  0.000151707  0.00203723  0.0211324  0.13572  0.464185
             0.93892      1.37984      1.73516      2.04064      2.32951      2.61622      2.9049       3.19583     3.48808    3.78042  4.07164
             4.3606       4.64629      4.92782      5.20442      5.47546      5.74037      5.99871      6.2501      6.49428    6.73102  6.96018
             7.18165      7.39541      7.60145      7.79981      7.99056      8.1738       8.34966      8.51828     8.67982    8.83445  8.98237
             9.12376      9.25883      9.38777      9.5108       9.62812      9.73993      9.84645      9.94787     10.0444    10.1362  10.2236
             10.3066      10.3855      10.4604      10.5316      10.5992      10.6633      10.7241      10.7819     10.8366    10.8885  10.9377
             10.9843      11.0285      11.0704      11.1101      11.1477      11.1833      11.217       11.2489     11.2791    11.3077  11.3347
             11.3604      11.3846      11.4076
# Age specific information (Females then males) weight  selectivity
#
0.0168015    0.0168015    0.0222434    0.0574434    0.114456     0.195677     0.30197      0.43322      0.588562    0.766579   0.96547  1.18319
             1.41754      1.6663       1.92722      2.19814      2.47697      2.76176      3.0507       3.34209     3.63441    3.92629  4.21649
             4.50392      4.78763      5.06678      5.34068      5.60871      5.87038      6.12529      6.37311     6.61359    6.84655  7.07188
             7.2895       7.4994       7.70159      7.89613      8.08311      8.26264      8.43486      8.59992     8.75799    8.90924  9.05387
             9.19207      9.32405      9.45001      9.57016      9.6847       9.79384      9.89778      9.99673     10.0909    10.1805  10.2656
             10.3465      10.4234      10.4965      10.5658      10.6316      10.6941      10.7534      10.8096     10.8629    10.9134  10.9613
             11.0067      11.0498      11.0905      11.1291      11.1657      11.2003      11.2331      11.2642     11.2936    11.3214  11.3477
             11.3727      11.3962      11.4186
0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.01        0.09       0.31     0.65
             0.90         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        1.00       1.00     1.00
             1.00         1.00         1.00
# M and initial age-structure
#
0.055        0.055        0.055        0.055        0.055        0.055        0.055        0.055        0.055       0.055      0.055    0.055
             0.055        0.055        0.055        0.055        0.055        0.055        0.055        0.055       0.055      0.055    0.055
             0.055        0.055        0.055        0.055        0.055        0.055        0.055        0.055       0.055      0.055    0.055
             0.055        0.055        0.055        0.055        0.055        0.055        0.055        0.055       0.055      0.055    0.055
             0.055        0.055        0.055        0.055        0.055        0.055        0.055        0.055       0.055      0.055    0.055
             0.055        0.055        0.055        0.055        0.055        0.055        0.055        0.055       0.055      0.055    0.055
             0.055        0.055        0.055        0.055        0.055        0.055        0.055        0.055       0.055      0.055    0.055
             0.055        0.055        0.055
27.6581      25.4615      23.3788      21.4015      19.5187      17.8413      16.2692      14.6499      13.1979     12.3113    11.3061  10.6566
             9.68567      9.06191      8.25489      7.57081      7.03514      7.58531      7.99687      9.20847     9.78546    9.80023  9.00456
             8.47665      7.61305      6.93917      6.19182      5.30059      4.41363      3.58279      2.7803      2.11816    1.58659  1.17905
             0.865047     0.631135     0.453183     0.323102     0.229102     0.160158     0.11014      0.0749628   0.0506906  0.034094  0.0228424
             0.015273     0.0101753    0.00676334   0.00448062   0.00296042   0.0019501    0.00128113   0.000840131 0.000550735 0.000360606 0.000235928
             0.000154213  0.000100741  6.58E-05     4.29E-05     2.80E-05     1.83E-05     1.19E-05     7.72E-06    5.01E-06   3.25E-06  2.10E-06
             1.35E-06     8.62E-07     5.47E-07     3.44E-07     2.13E-07     1.30E-07     7.75E-08     4.48E-08    2.48E-08   1.29E-08  6.09E-09
             2.42E-09     6.68E-10     4.00E-11
# Initial age-structure
23.4886      21.4188      19.287       17.3755      16.2083      14.885       14.0307      12.7544      11.9365     10.8791    9.98805  9.29686
             10.0417      10.6025      12.2245      13.0059      13.0408      11.996       11.306       10.1662     9.27731    8.28793  7.10331
             5.92156      4.81237      3.73868      2.85143      2.13815      1.59061      1.16819      0.85316     0.6132     0.437596  0.310568
             0.217299     0.149561     0.101876     0.0689435    0.0464055    0.0311133    0.0208176    0.0138784   0.00923061 0.00611886 0.00404518
             0.00266614   0.00175247   0.0011498    0.000754099  0.00049399   0.000323337  0.000211436  0.000138177 9.03E-05   5.89E-05  3.85E-05
             2.51E-05     1.63E-05     1.06E-05     6.89E-06     4.46E-06     2.88E-06     1.85E-06     1.19E-06    7.53E-07   4.73E-07  2.93E-07
             1.79E-07     1.07E-07     6.17E-08     3.42E-08     1.78E-08     8.39E-09     3.34E-09     9.21E-10    5.44E-11   1.13E-13  9.01E-14
             7.57E-14     6.43E-14     5.12E-13
# Year for Tmin Age-structure
2000
# Number of simulations
10000
#  recruitment and biomass
# Number of historical assessment years
91
# Historical data
# year recruitment spawner in B0 in R project in R/S project
1915         59.5551      2998.44      1            0            0
```

1916	59.3267	2998.44	0	0	0
1917	59.294	2991.91	0	0	0
1918	59.2367	2980.52	0	0	0
1919	59.1766	2968.65	0	0	0
1920	59.1434	2962.13	0	0	0
1921	59.1089	2955.36	0	0	0
1922	59.0832	2950.34	0	0	0
1923	59.0624	2946.29	0	0	0
1924	59.0354	2941.04	0	0	0
1925	59.0124	2936.58	0	0	0
1926	58.9836	2931.01	0	0	0
1927	58.937	2922.02	0	0	0
1928	58.9018	2915.27	0	0	0
1929	58.8672	2908.66	0	0	0
1930	58.837	2902.88	0	0	0
1931	58.7966	2895.21	0	0	0
1932	58.7568	2887.66	0	0	0
1933	58.7331	2883.19	0	0	0
1934	58.7179	2880.33	0	0	0
1935	58.7049	2877.89	0	0	0
1936	58.6902	2875.13	0	0	0
1937	58.6781	2872.85	0	0	0
1938	58.6691	2871.17	0	0	0
1939	58.6664	2870.67	0	0	0
1940	58.6666	2870.7	0	0	0
1941	58.6645	2870.3	0	0	0
1942	58.6638	2870.17	0	0	0
1943	58.6814	2873.47	0	0	0
1944	58.6859	2874.32	0	0	0
1945	58.6562	2868.75	0	0	0
1946	58.563	2851.38	0	0	0
1947	58.4914	2838.16	0	0	0
1948	58.4396	2828.64	0	0	0
1949	58.3965	2820.76	0	0	0
1950	58.3483	2811.97	0	0	0
1951	58.2766	2798.99	0	0	0
1952	58.1889	2783.21	0	0	0
1953	58.0594	2760.18	0	0	0
1954	57.9264	2736.8	0	0	0
1955	57.7025	2698.11	0	0	0
1956	57.3729	2642.57	0	0	0
1957	56.9993	2581.59	0	0	0
1958	56.6673	2529.08	0	0	0
1959	56.3446	2479.48	0	0	0
1960	56.0677	2438.03	0	0	0
1961	55.7611	2393.25	0	0	0
1962	55.5216	2359.08	0	0	0
1963	55.2895	2326.62	0	0	0
1964	55.0614	2295.3	0	0	0
1965	54.8674	2269.13	0	0	0
1966	54.5938	2232.92	0	0	0
1967	53.9872	2155.42	0	0	0
1968	53.1728	2057	0	0	0
1969	52.6124	1992.75	0	0	0
1970	52.2639	1954.14	0	0	0
1971	51.6485	1888.32	0	0	0
1972	51.1752	1839.64	0	0	0
1973	50.2998	1753.79	0	0	0
1974	49.1778	1651.03	0	0	0
1975	47.628	1521.02	0	0	0
1976	46.1513	1408.41	0	0	0
1977	44.0725	1265.85	0	0	0
1978	42.5715	1172.91	0	0	0
1979	41.4415	1107.79	0	0	0
1980	39.6995	1014.67	0	0	0
1981	37.8253	923.191	0	0	0
1982	37.027	886.685	0	0	0
1983	34.9855	799.296	0	0	0
1984	34.2606	770.164	0	0	0
1985	31.166	655.655	0	0	0
1986	27.0606	524.64	0	0	0
1987	21.9187	386.943	0	0	0
1988	19.52	330.794	0	0	0
1989	17.0506	277.504	0	0	0
1990	17.3169	283.048	0	0	0
1991	17.8478	294.24	0	0	0
1992	18.5339	308.996	0	0	0
1993	18.7441	313.583	0	0	0
1994	19.5163	330.711	0	0	0
1995	19.5965	332.517	0	0	0
1996	20.1968	346.175	0	0	0
1997	20.4925	353.009	0	0	0
1998	21.5297	377.52	0	0	0
1999	22.6299	404.501	0	0	0
2000	23.4886	426.298	0	0	0
2001	24.3218	448.097	0	0	0
2002	25.2408	472.919	0	0	0
2003	26.0972	496.82	0	0	0
2004	26.9011	519.964	0	0	0
2005	27.6581	542.417	0	0	0

Number of years with pre-specified catches
2
catches for years with pre-specified catches

```
2005 0.5
2006 2
# 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.)
3
# Steepness sigma-R Auto-correlation
0.5 0.5 0.5
# Target SPR rate (FMSY Proxy)
0.78
# 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)
-1
# 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)
3
# File with multiple parameter vectors
MCMC.PRJ
# Number of parameter vectors
100
# User-specific projection (1=Yes); Output replaced (1->6)
0 6 0 0.5
# Catches and Fs (Year; 1/2 (F or C); value); Final row is -1
2007 1 0.01025
-1 -1 -1
# Split of Fs
2005 1
-1 1
# Time varying weight-at-age (1=Yes;0=No)
0
# File with time series of weight-at-age data
Elvis_lives.CSV
```