

2009 Darkblotched Rockfish Rebuilding Analysis

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1. Introduction

The Pacific Fishery Management Council (PFMC) adopted Amendment 11 to its Groundfish Management Plan in 1998. This amendment established a definition for an overfished stock of 25% of the unfished spawning biomass ($0.25B_0$). Darkblotched rockfish (*Sebastes crameri*) was declared overfished in January 2001 based on the most recent stock assessment at that time (Rogers et al. 2000). Rebuilding analyses were first conducted in mid-year 2001 (Methot and Rogers 2001) and included a partial update of the 2000 stock assessment.

The stock assessment for darkblotched rockfish was updated in 2003 (Rogers 2003). Full assessments were conducted in 2005 (Rogers 2005) and 2007 (Hamel 2007), using Stock-Synthesis II. An assessment update was done in 2009 (Wallace and Hamel 2009) using version 3 of Stock-Synthesis. In 2005 the natural mortality rate used in the assessment was changed from the previously used value of 0.05 (based largely on Hoenig's method) to 0.07 (as a balance between Hoenig's method and Gunderson's method based on gonadosomatic index (GSI)). This latter value was used in the 2007 assessment and the 2009 update as well. The largest change in assumptions between the 2005 and 2007 assessments was the value of stock-recruitment steepness. In 2005, steepness was estimated at 1.0, and was set at 0.95. In 2007, a good deal more age data was included in the assessment, largely as conditional age-at length compositions, and steepness was estimated (using the prior from Dorn's meta-analysis) at 0.6. That value of steepness was then fixed in the 2007 assessment and hence also used in the 2009 update.

The SPR chosen following the 2005 rebuilding analysis (0.607) corresponded to a T_{target} (median rebuilding year) of 2011, which was much earlier than for previous rebuilding analyses, due largely to the high value of steepness (and thus high productivity at low stock sizes) assumed in the 2005 assessment. Based on the 2007 rebuilding analysis, the darkblotched rockfish stock was projected to recover 19 years later (2030) than anticipated from the 2005 rebuilding analysis. This then led to the adoption by the Pacific Council of a new T_{TARGET} equal to 2028.

2. Specifications

2.1 Selection of B_0

As in 2007 the unfished spawning stock biomass, B_0 , was determined from the fitted stock-recruitment relationship in order to be consistent with the assumptions underlying the current stock assessment. This is in contrast to previous rebuilding analyses for darkblotched rockfish which used a range of estimated historical recruitments to estimate B_0 . The MPD estimate of B_0 is 32,800 mt.

2.2 Generation of future recruitment

Future recruitments are generated using the Beverton-Holt spawner recruit relationship with steepness = 0.6 and $\sigma_r = 0.8$ as estimated within the 2007 assessment (Hamel, 2007) and used in the 2009 update (Wallace and Hamel 2009). This is in contrast to rebuilding analyses previous to 2007 which re-sampled from a range of estimated historical recruitments. Again, this choice is consistent with the assumptions underlying the current stock assessment.

2.3 Methods used

The revised SSC default rebuilding analysis (Punt 2009) was used to find all rebuilding milestones, such as T_{MIN} and the mean generation time, in addition to the results for the various harvest strategies specified below. Darkblotched biological information can be found within the rebuilding analysis input file in Appendix A.

2.4 Harvest strategies

Table 1 shows darkblotched summary statistics by assessment year. Table 2 shows an assortment of projections, which include 1) the SPR of 0.607 listed in the rebuilding plan in the FMP (Amendment 16-4 2006), 2) the SPR corresponding to the 2009-10 OY, 3) the new SPR of 0.621 on which the current OY's are based, 4) the SPR for the 2009-10 revised T_{TARGET} of 2028, 5) the FMP T_{MAX} of 2033, 6) the FMP T_{TARGET} of 2011, 7) no harvest (SPR = 1.0), 8) three evenly spaced quartiles between $T_{F=0}$ and T_{MAX} , 9) the ABC rule (SPR = 0.5), and 10) the 40:10 rule.

Figure 1 shows this information in one succinct picture. Shown is the estimated probability of rebuilding darkblotched by year and $1 - SPR$. The current T_{TARGET} of 2028 is highlighted along with the new model's corresponding SPR of 0.596.

3. Evaluation

$T_{REBUILD}$, the new time to rebuild at the current SPR_{TARGET} , is 2027 which is one year earlier than the currently adopted T_{TARGET} of 2028. $T_{REBUILD}$ is also substantially below the new T_{MAX} of 2037, as can be seen graphically in Figure 1.

4. Supplement

At the Groundfish Management Team's request a supplemental run to Table 2 has been included in Table 2: Supplement. This run gives a 130 mt OY in 2011 with continuation of the implied SPR of 0.818.

References

- Amendment 16-4. 2004. Pacific Fishery Management Council, Portland, OR.
- Hamel, O.S. 2007. Status and future prospects for the darkblotched rockfish resource in waters off Washington, Oregon and California as assessed in 2007. Pacific Fishery Management Council, Portland, OR.
- 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.
- PFMC. 2004. Darkblotched rockfish (*Sebastes crameri*) rebuilding plan pursuant to the Pacific coast groundfish management plan adopted June 2003 and 2004 addendum to the darkblotched rockfish rebuilding plan *in* Status of the Pacific Coast Groundfish Fishery through 2003 and Recommended Acceptable Biological Catches for 2004. Pacific Fishery Management Council, 7700 NE Ambassador Place, Suite 200, Portland, OR 97201.
- Proposed acceptable biological catch and optimum yield specifications and management measures for the 2009-10 Pacific Coast Groundfish Fishery. 2009. Pacific Fishery Management Council, Portland, OR.
- Punt, A.E. 2009. SSC default rebuilding analysis. Technical specifications and user manual. Ver. 3.12.
- Rogers, J.B. 2005. Update of Darkblotched (*sic*) Rockfish (*Sebastes crameri*) Rebuilding Analyses. Pacific Fishery Management Council, 7700 NE Ambassador Place, Suite 200, Portland, OR 97201.
- Rogers, J.B. 2005. Status of the Darkblotched Rockfish (*Sebastes crameri*) Resource in 2005. Pacific Fishery Management Council, 7700 NE Ambassador Place, Suite 200, Portland, OR 97201.
- Rogers, J.B. 2003. Darkblotched rockfish (*Sebastes crameri*) 2003 stock status and rebuilding update, appendix to Status of the Pacific coast groundfish fishery through 2003 and recommended acceptable biological catches for 2004. Pacific Fishery Management Council, 7700 NE Ambassador Place, Suite 200, Portland, OR 97201.
- 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.
- Wallace, J.W., Hamel, O.S. 2009. Status and future prospects for the darkblotched rockfish resource in waters off Washington, Oregon and California as assessed in 2009. Pacific Fishery Management Council, Portland, OR.

Table 1. Summary statistics for darkblotched rockfish by assessment year. The sum of the catch divided by the sum of the OY for years 2001-2007 is 97.0%.

Value	2001	2002	2003	2004	2005	2006	2007	2008	2009
ABC	302-349	187	205	240	269	294	456	487	437
OY	130	168	172	240	269	200	290	330	285
Landings (mt)	173	113	80	189	98	109	145	117	
Catch (mt)	274	179	127	252	129	200	264	213	
1+ Biomass ^F	6,382	7,231	8,266	9,326	10,204	11,142	11,899	12,423	12,836
Sp. Output ^F (10^8 eggs)	3,099	3,252	3,572	3,999	4,466	5,230	6,166	7,090	7,940
Sp. Output-Relative to Target ^F	26.9%	28.2%	31.0%	34.7%	38.7%	45.4%	53.5%	61.5%	68.9%
Recruits (10^3) ^F	986	968	2,346	2,817	2,478	545	46	2,002	2,104
B_0 (mt) (1+ Biomass)							34,509		32,783
1+ Biomass at B_{40}							16,528		15,763
Year declared overfished	X								
T_{MIN}	2014		2011		2009		2015		2012
$T_{F=0}$ (beginning 2 years after the assessment year)							2018		2016
Mean generation time	33 yrs		33 yrs		24 yrs		25 yrs		25 yrs
T_{MAX}	2047		2044		2033		2040		2037
Adopted T_{TARGET}	2030		2019		2011		2028		
Adopted SPR_{TARGET}					0.607		0.621		
$T_{REBUILD}$, new time to rebuild at current SPR_{TARGET}									2027
2009-2010 OY SPR									0.649

^F2009 assessment results and projection (for the 2009 recruits)

Table 2. Darkblotched projections. The vertical double lines demarcate the evenly spaced quartile increments. Note that if an integer year is wanted for the year in which 50% probability is achieved, then, given the yearly nature of fishery management, that number should only be “rounded up” to the next highest integer.

	OLD FMP SPR	2009- 2010 OY SPR	SPR on which current OY's are based	Current T _{target} , Yr = 2028	FMP T _{MAX} = 2033	FMP T _{Target} = 2011 & F = 0	Yr = 2021	Yr = 2026	Yr = 2031	New T _{MAX} = 2037	ABC Rule	40-10 rule
SPR (target)	0.607	0.649	0.621	0.596	0.551	1.000	0.719	0.629	0.564	0.528	0.500	0.507-0.526 [†]
50% Prob Yr	2027.0	2024.4	2026.1	2028.0	2033.0	2015.5	2021.3	2025.6	2031.0	2037.0	2045.5	2040.7
OY (2011)	349.2	297.6	331.5	363.6	427.1	0.0	221.6	322.0	407.1	461.4	507.8	465.7
ABC (2011)	507.8	507.8	507.8	507.8	507.8	507.8	507.8	507.8	507.8	507.8	507.8	507.8
OY (2012)	346.1	296.1	329.0	360.0	421.6	0.0	221.8	319.9	401.6	453.3	497.0	465.2
ABC (2012)	503.3	505.3	504.0	502.7	500.1	517.1	508.3	504.3	501.0	499.8	497.0	498.7
Probability of Recovery by Year (See the '50% Prob Yr' row above for the year of 50% probability of recovery.)												
2012	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2016	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
2020	11.2	19.0	13.5	10.1	5.6	100.0	38.5	15.1	6.6	4.4	3.1	3.8
2024	35.4	47.7	39.8	31.9	20.8	100.0	70.3	41.9	23.6	7.3	12.2	13.9
2028	53.6	66.3	58.0	50.0	36.2	100.0	84.6	59.5	40.8	22.5	21.4	25.0
2032	66.4	78.5	70.9	62.9	48.0	100.0	91.4	73.1	52.7	37.9	30.3	34.3
2036	74.9	85.2	78.8	71.4	57.2	100.0	95.1	80.3	62.8	48.8	37.6	42.5
2040	80.7	90.0	85.1	78.3	64.5	100.0	97.3	86.5	68.6	55.9	42.9	48.7

[†] Range of the 40-10 rule SPR is for years 2011-2040.

Table 2. cont.

	OLD FMP SPR	2009- 2010 OY SPR	SPR on which current OY's are based	Current T _{target} , Yr = 2028	FMP T _{MAX} = 2033	FMP T _{Target} = 2011 & F = 0	Yr = 2021	Yr = 2026	Yr = 2031	New T _{MAX} = 2037	ABC Rule	40-10 rule	
SSB / Target by Year													
2009	0.689	0.689	0.689	0.689	0.689	0.689	0.689	0.689	0.689	0.689	0.689	0.689	
2010	0.748	0.748	0.748	0.748	0.748	0.748	0.748	0.748	0.748	0.748	0.748	0.748	
2011	0.801	0.801	0.801	0.801	0.801	0.801	0.801	0.801	0.801	0.801	0.801	0.801	
2012	0.841	0.844	0.842	0.840	0.835	0.865	0.850	0.843	0.837	0.833	0.830	0.833	
2016	0.884	0.903	0.891	0.879	0.857	1.015	0.931	0.894	0.864	0.845	0.830	0.841	
2020	0.902	0.933	0.912	0.893	0.856	1.133	0.980	0.918	0.868	0.838	0.813	0.830	
2024	0.949	0.991	0.964	0.938	0.888	1.275	1.056	0.971	0.904	0.863	0.829	0.852	
2028	1.006	1.06	1.024	0.992	0.929	1.434	1.146	1.034	0.949	0.899	0.857	0.884	
2032	1.059	1.124	1.081	1.041	0.967	1.587	1.227	1.093	0.991	0.931	0.883	0.910	
2036	1.099	1.173	1.123	1.079	0.993	1.709	1.291	1.136	1.020	0.952	0.897	0.927	
2040	1.126	1.21	1.154	1.104	1.012	1.829	1.345	1.170	1.040	0.966	0.906	0.929	
ABC by Year												40-10 SPR	
2009	483.5	483.5	483.5	483.5	483.5	483.5	483.5	483.5	483.5	483.5	483.5	483.5	0.648
2010	500.7	500.7	500.7	500.7	500.7	500.7	500.7	500.7	500.7	500.7	500.7	500.7	0.651
2011	507.8	507.8	507.8	507.8	507.8	507.8	507.8	507.8	507.8	507.8	507.8	507.8	0.526
2012	503.3	505.3	504.0	502.7	500.1	517.1	508.3	504.3	501.0	498.8	497.0	498.7	0.521
2016	499.2	508.2	502.3	496.7	485.6	563.1	521.8	503.9	489.2	480.0	472.3	477.7	0.519
2020	521.7	536.5	526.7	517.6	499.8	630.8	559.1	529.4	505.4	490.9	478.6	487.2	0.521
2024	556.3	577.1	563.4	550.6	526.2	712.7	609.1	567.2	534.1	513.9	497.5	509.1	0.518
2028	588.0	614.4	596.4	581.4	551.1	790.6	655.4	601.5	560.8	535.6	514.5	526.5	0.513
2032	610.5	641.4	620.8	602.7	566.7	857.6	690.5	626.5	578.2	548.9	525.1	536.7	0.510
2036	627.3	662.8	639.4	617.5	576.4	914.4	719.9	645.6	589.3	556.5	529.4	541.8	0.508
2040	636.9	675.0	649.7	626.9	583.1	956.3	735.9	656.6	597.1	561.4	532.6	546.9	0.508

Table 2. cont.

	OLD FMP SPR	2009- 2010 OY SPR	SPR on which current OY's are based	Current $T_{target, Yr} =$ 2028	FMP T_{MAX} = 2033	FMP $T_{Target} =$ 2011 & F = 0	Yr = 2021	Yr = 2026	Yr = 2031	New T_{MAX} = 2037	ABC Rule	40-10 rule
	OY (Annual Catch) by Year											
2009	285.0	285	285.0	285.0	285.0	285.0	285.0	285.0	285.0	285.0	285.0	285.0
2010	291.0	291	291.0	291.0	291.0	291.0	291.0	291.0	291.0	291.0	291.0	291.0
2011	349.2	297.6	331.5	363.6	428.1	0.0	221.6	322.0	407.1	461.4	507.8	465.7
2012	346.1	296.1	329.0	360.0	421.6	0.0	221.8	319.9	401.6	453.3	497.0	465.2
2016	343.3	297.8	327.8	355.6	409.3	0.0	227.6	319.6	392.2	436.1	472.3	447.6
2020	358.7	314.4	343.8	370.6	421.2	0.0	243.9	335.7	405.2	446.0	478.6	455.6
2024	382.5	338.2	367.7	394.2	443.4	0.0	265.8	359.7	428.1	466.9	497.5	480.3
2028	404.4	360	389.3	416.3	464.5	0.0	286.0	381.5	449.6	486.7	514.5	507.3
2032	419.8	375.9	405.2	431.5	477.5	0.0	301.2	397.3	463.6	498.7	525.1	519.4
2036	431.4	388.4	417.4	442.1	485.7	0.0	314.1	409.5	472.4	505.6	529.4	529.7
2040	438.0	395.5	424.0	448.9	491.3	0.0	321.0	416.3	478.7	510.1	530.4	532.6

Table 2: Supplement. 2011 OY of 130 mt with continuation of the implied SPR of 0.818 .

	2011 OY of 130 mt
SPR (target)	0.818
50% Prob Yr	2018.0
OY (2011)	130.4
ABC (2011)	507.8
OY (2012)	131.4
ABC (2012)	511.9

Probability of Recovery by Year	
(See the '50% Prob Yr' row above for the year of 50% probability of recovery.)	
2012	0.0
2016	0.3
2020	81.0
2024	93.0
2028	96.7
2032	99.0
2036	99.7
2040	99.8

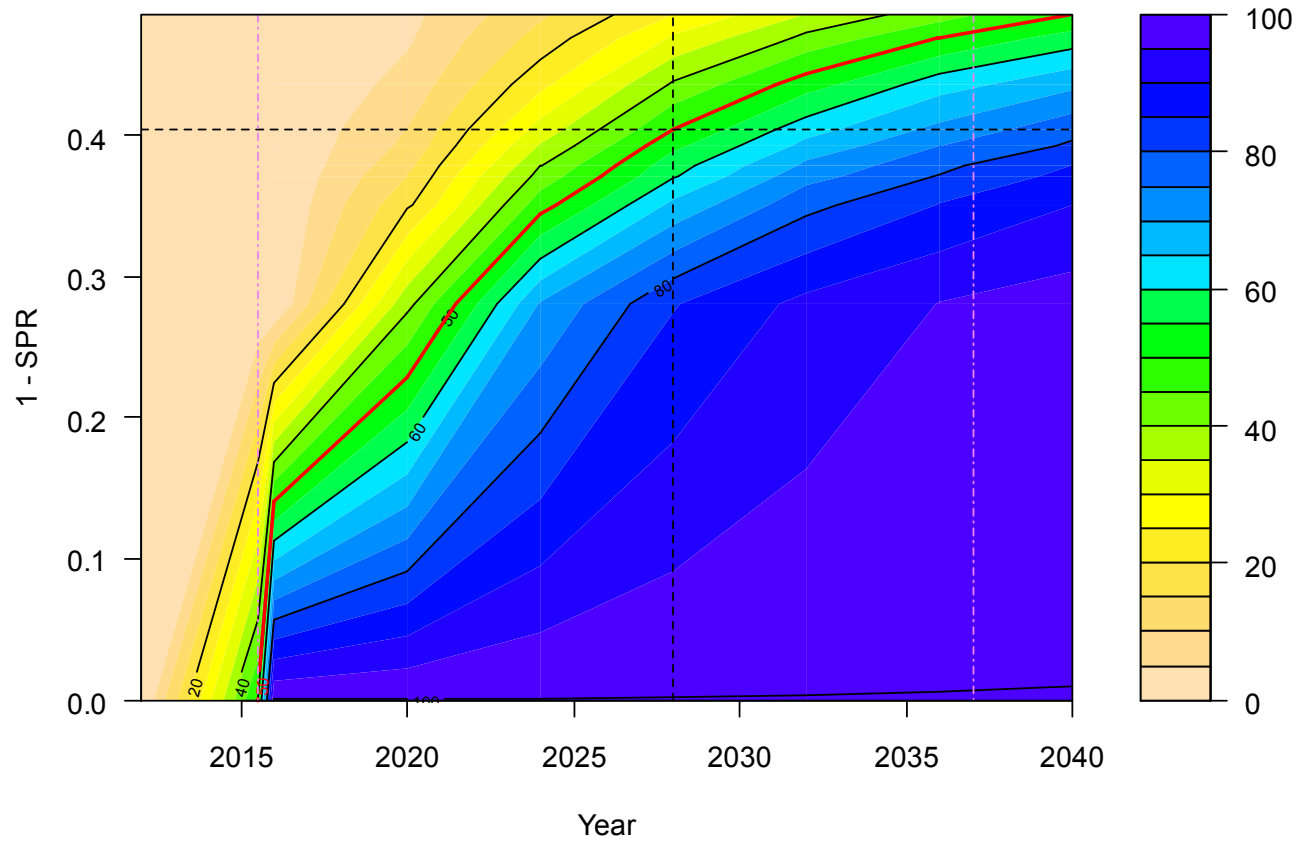


Figure 1. Estimated percent probability of rebuilding for darkblotched by year and $1 - \text{SPR}$. Fishing increases as $1 - \text{SPR}$ increases. The black dashed lines show a (one minus) SPR of 0.596 intersecting with the 50% median year to rebuild of 2028. The violet dashed-dotted lines show the current assessment's $F = 0$ (2016) and the new T_{MAX} of 2037.

Appendix A: Input file for Puntlizer ver. 3.12 Aug26a (for SPR based on 2009-10 OY's = 0.649)

```

#Title
SSv3_default_rebuild.dat
# Number of sexes
2
# Age range to consider (minimum age; maximum age)
0 45
# Number of fleets
1
# First year of projection (Yinit)
2009
# First Year of rebuilding period (Ydecl)
2001
# 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 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 #runnumber:
22 darkblotched_data.SS darkblotched_control.SS 3837.25 28828.1 7940.52
0 0 3.16774e-007 2.54679e-005 0.000837822 0.0126918 0.0864787 0.278624 0.564818 0.882487 1.18737 1.46187 1.70257 1.91108 2.09036
2.24355 2.37376 2.48387 2.57658 2.65434 2.71935 2.77353 2.81859 2.85599 2.88697 2.91261 2.93379 2.95128 2.96572 2.97761 2.98746
2.99556 3.00224 3.00773 3.01225 3.01597 3.01903 3.02155 3.02362 3.02532 3.02672 3.02787 3.02882 3.02959 3.03023 3.03076 #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
0.0124938 0.0503047 0.128144 0.245018 0.391633 0.520983 0.6346 0.736871 0.833009 0.922564 1.00311 1.07362 1.1343 1.18597 1.22964
1.26634 1.29705 1.32266 1.34396 1.36165 1.37629 1.38841 1.39843 1.40669 1.41351 1.41914 1.42377 1.42758 1.43072 1.43331 1.43544
1.4372 1.43864 1.43982 1.4408 1.4416 1.44226 1.4428 1.44325 1.44362 1.44392 1.44417 1.44437 1.44454 1.44467 1.44479
0 0.0770398 0.0775982 0.0985685 0.236154 0.521366 0.78728 0.926724 0.977326 0.992862 0.997518 0.998992 0.999503 0.9997 0.999784
0.999823 0.999843 0.999854 0.99986 0.999864 0.999867 0.999868 0.99987 0.999871 0.999871 0.999872 0.999872 0.999872 0.999873
0.999873 0.999873 0.999873 0.999873 0.999873 0.999873 0.999873 0.999873 0.999873 0.999873 0.999873 0.999873 0.999873 0.999873 0.999873
0.999873 0.999873 0.999873
#wt and selex for gender,fleet: 2 1
0.0124938 0.0503047 0.129492 0.245635 0.386296 0.504057 0.600373 0.680777 0.749745 0.809361 0.860213 0.902821 0.937985 0.966678
0.9899 1.00858 1.02354 1.03549 1.045 1.05256 1.05856 1.06331 1.06708 1.07006 1.07241 1.07428 1.07575 1.07692 1.07784 1.07856 1.07914
1.07959 1.07995 1.08023 1.08045 1.08063 1.08077 1.08088 1.08097 1.08103 1.08109 1.08113 1.08116 1.08119 1.08121 1.08123
0 0.0770398 0.0776545 0.0990975 0.224079 0.46455 0.696422 0.844034 0.920125 0.956773 0.974657 0.983831 0.988836 0.991739 0.993518
0.994662 0.995427 0.995956 0.996331 0.996604 0.996805 0.996955 0.997069 0.997156 0.997223 0.997275 0.997315 0.997346 0.997371
0.99739 0.997405 0.997417 0.997426 0.997433 0.997439 0.997444 0.997447 0.99745 0.997452 0.997454 0.997455 0.997456 0.997457
0.997458 0.997458 0.997459
# M and current age-structure in year Yinit: 2009
# gender = 1
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
1051.75 933.527 19.9608 220.044 931.298 982.986 753.938 285.316 265.193 1626.43 1299.85 179.191 403.612 206.041 546.348 156.737
38.4129 58.5202 59.0507 34.5849 10.314 108.991 67.7332 24.6448 17.1232 13.2149 10.1398 11.615 26.9034 33.4823 26.6616 7.05105 4.59981
9.12567 10.3175 7.48178 6.76283 6.13315 5.56472 5.02744 4.52888 4.19205 3.86386 3.58663 3.23492 29.193
# gender = 2
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
1051.75 933.527 19.9608 220.044 931.287 983.201 754.987 286.298 266.592 1636.86 1309.68 180.746 407.638 208.691 556.223 160.752
39.8464 61.4481 62.4157 36.597 10.9117 115.388 71.6993 26.086 18.1674 14.0499 10.7876 12.371 28.6369 35.5205 28.1522 7.40275 4.803
9.48543 10.6791 7.71769 6.95418 6.28475 5.68797 5.13431 4.62685 4.28673 3.95251 3.66557 3.29979 29.8729
# Age-structure at Ydeclare= 2001

```

```
492.804 3095.64 2529.7 357.507 828.965 436.146 1181.88 342.584 84.2666 128.52 129.73 75.9889 22.6625 239.485 148.831 54.1525 37.6251
29.0374 22.2805 25.5219 59.1156 73.5717 58.5843 15.4935 10.1073 20.0521 22.671 16.4399 14.8602 13.4765 12.2275 11.0469 9.95144
9.21132 8.49017 7.88102 7.10818 6.40223 5.58935 4.70865 3.93328 3.38097 3.01516 2.74907 2.52789 31.84
492.804 3095.64 2529.7 357.505 828.921 436.604 1189.32 348.172 86.8725 134.403 136.745 80.2505 23.9396 253.231 157.383 57.2673
39.8871 30.8489 23.6872 27.1648 62.884 78.0015 61.822 16.2565 10.5476 20.8305 23.452 16.9486 15.2719 13.8018 12.4913 11.2754 10.161
9.41407 8.68009 8.04996 7.24667 6.52249 5.72364 4.87551 4.11658 3.54507 3.13825 2.83513 2.58961 32.2578
# 20) Year for Tmin Age-structure (set to Ydecl by SS)
2001
# recruitment and biomass
# 21) Number of historical assessment years
83
# 22) Historical data
# year recruitment spawner in B0 in R project in R/S project
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 #years (with first value representing R0)
3025.54 3025.56 3025.27 3024.94 3024.59 3024.17 3023.93 3023.7 3023.48 3023.25 3023.13 3022.98 3022.79 3022.5 3022.22 3021.88 3021.68
3020.4 3016.82 3008.9 3004.38 3000.31 2998.41 2996.53 2994.57 2991.74 2989.42 2987.43 2985.42 2982.52 2978.58 2973.96 2969.97 2966.58
2962.6 2959.52 2955.38 2950.84 2948.67 2942.39 2845.69 2758.1 2677.76 2677.8 2680.12 2678.12 2672.14 2657.88 3272.5 2568.75 1141.47
1527.67 4974.89 5307.29 3558.47 1261.39 895.281 946.016 990.694 1155.7 2577.76 3386.51 261.128 710.405 982.924 784.498 410.832
1365.74 4011.65 1310.28 2262.07 894.157 5860.18 6640.19 985.607 968.436 2345.58 2817.19 2477.82 544.783 45.9886 2002.43 2103.5
#recruits; first value is R0 (virgin)
28828.1 28828.1 28811.3 28792.6 28772.5 28748.9 28734.9 28721.9 28709.2 28696.2 28689.4 28680.9 28670.3 28654 28638.2 28618.9
28607.4 28535.5 28335.2 27900.9 27658.2 27442.2 27342.3 27244.4 27142.6 26996.8 26878.5 26777.4 26676 26530.7 26335.6 26109.9 25917.4
25755.6 25567.7 25423.9 25232.4 25025.4 24927.5 24647.5 20900.9 18224 16201.1 16202.1 16255.6 16209.4 16072.3 15752.2 15536.1 15471.8
15404.7 15613.1 15698.1 15274.9 15238.1 14861.2 14304.7 13834.8 13082.5 12047.2 11616.1 10282.1 9436.51 8737.94 7562.48 6692.91
6291.83 5563.79 5171.54 4824.38 4460.46 3961.86 3322.5 3177.26 3098.74 3251.95 3571.94 3998.79 4465.93 5229.8 6165.92 7089.72 7940.52
#spbio; first value is S0 (virgin)
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 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 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 # in Bzero
0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 0 0 0 # in R project
0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 0 0 0 # in R/S project
# 23) Number of years with pre-specified catches
2
# 24) catches for years with pre-specified catches go next
2009 285
2010 291
# 25) Number of future recruitments to override
9
# Process for overriding (-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
# 27) Which probability to product detailed results for (1=0.5; 2=0.6; etc.)
3
# Steepness sigma-R Auto-correlation
0.6 0.8 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
4
```

```
# Definition of the 40-10 rule
10 40
# 37) 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)
1 6
# 42) Catches and Fs (Year; 1/2/3 (F or C or SPR); value); Final row is -1
2011 3 0.649
-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
2009 0.0191475
-1 1
# 45) Yrs to define T_target for projection type 4 (a.k.a. 5 pre-specified inputs)
2011 2021 2028 2033 2040
# Eight years for probability of recovery
2012 2016 2020 2024 2028 2032 2036 2040
# 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
```