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Agenda Item G.2.a  
Attachment 5  
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**DRAFT Rebuilding Update for Pacific Ocean Perch in 2009**

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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 ( $0.25B_0$ ). NMFS determined that a rebuilding plan was required for Pacific ocean perch (*Sebastes alutus*) in March 1999 based on the most recent stock assessment at that time (Ianelli and Zimmerman 1998). The PFMC began developing a rebuilding plan for Pacific ocean perch and submitted this plan to NMFS in February 2000. However, NMFS deferred adoption of the plan until the stock assessment was updated and reviewed, later that year (Ianelli *et al.* 2000).

A full stock assessment for Pacific ocean perch stock was conducted in 2003 (Hamel *et al.*, 2003), and subsequently updated every two years (Hamel 2005, 2007, 2009). This assessment, similar to that of Ianelli *et al.* (2000), involves fitting an age-structured population dynamics model to catch, catch-rate, length-frequency, age-composition, and survey data. Ianelli *et al.* (2000), Hamel *et al.* (2003), and Hamel (2005, 2007, 2009) presented results based on maximum likelihood and Bayesian estimation frameworks. Punt (2002) conducted a rebuilding analysis based upon the estimates corresponding to the maximum of the posterior density function (the MPD estimates) from Ianelli *et al.*'s Model 1c because the STAR panel selected this model variant as the "best assessment" (PFMC 2000). In contrast, the STAR panel that evaluated the 2003 assessment of Pacific ocean perch endorsed both the MPD estimates and the distributions for the model outputs that arose from the application of the MCMC algorithm to sample equally likely parameter vectors from the posterior distribution (PFMC 2003). Punt *et al.* (2003) conducted a rebuilding analysis with runs based upon both the MPD estimates and the MCMC outputs. The PFMC adopted a rebuilding plan based upon the results of the MCMC analysis. This rebuilding analysis was updated in 2005 and 2007. For this update, rebuilding plan parameters are those specified after the rebuilding analyses in 2005/7.

Management under rebuilding has been effective. While catch exceed the OY in 2001 (by 3 mt) and 2007 (by 6 mt), total catch for 2000-2008 (1376 mt) was only 47% of the combined OYs (2938 mt).

## 2. Specifications

### 2.1 Selection of $B_0$

The unfished spawning stock biomass,  $B_0$ , is determined from the fitted stock-recruitment relationship in order to be more consistent with the assumptions underlying the original stock assessment. The MPD estimate of  $B_0$  is 36,983 mt of spawning output while the posterior median and 90% intervals for  $B_0$  are 34,573 mt and (27,620; 44,097). The values for  $B_0$  are slightly lower than those on which the previous rebuilding analyses were based (Table 1). The MPD depletion estimate at the start of 2009 is 0.275 while the posterior median and 90% intervals are 0.311 (0.228; 0.398)

**Table 1.** MPD and posterior median estimates of unfished spawning stock biomass ( $B_0$ ) and depletion for the 2003, 2005, 2007 and 2009 stock assessments.

|                             | 2003   | 2005   | 2007   | 2009   |
|-----------------------------|--------|--------|--------|--------|
| $B_0$ MPD (mt)              | 39,198 | 37,838 | 36,983 | 37,780 |
| $B_0$ Posterior Median (mt) | 37,230 | 35,371 | 34,573 | 35,391 |
| $B_0$ 90% Interval (mt)     | 29,035 | 28,022 | 27,620 | 27,728 |
|                             | 47,393 | 44,866 | 44,097 | 45,189 |
| Depletion MPD               | 25.4%  | 23.4%  | 27.5%  | 28.6%  |
| Depletion Posterior Median  | 27.7%  | 27.6%  | 31.1%  | 33.2%  |
| Depletion 90% Intervals     | 20.1%  | 19.8%  | 22.8%  | 23.8%  |
|                             | 38.4%  | 37.1%  | 39.8%  | 45.3%  |

2.2 Generation of future recruitment

Recruitment in the assessment and projection models for Pacific ocean perch relate to the abundance of 3 year olds. The assessment of Pacific ocean perch by Hamel *et al.* (2003) and its updates (Hamel 2005, 2007, 2009) include the assumption that, *a priori*, recruitment is related to spawning output according to a Beverton-Holt stock-recruitment relationship. The rebuilding analysis conducted by Punt *et al.* (2003) included three different approaches: 1) basing the projections on resampling historical recruitments or from those for the years 1965-2001, 2) basing the projections on resampling historical recruits per spawner for those same years, and 3) assuming a Beverton-Holt spawner recruit relationship. The first approach was chosen by the Council for the final rebuilding plan.

The rationale for generating future recruitment by sampling historical recruitment for the rebuilding analysis conducted by Punt (2002) was that 1965-1998 was a period of relative stability in recruitment. In contrast to recruitment, recruits/spawning output showed an increasing trend over time. Resampling historical recruitment (3 year olds from the years 1965-2007; year classes 1962-2004) is used exclusively for the analyses in this document in order to remain consistent with the adopted rebuilding plan. Figure 1 plots the MPD estimates of recruitment and recruits / spawning output from the assessments conducted by Hamel *et al.* (2003) and Hamel (2005, 2007, 2009). Hamel (2009) estimated steepness for Pacific ocean perch to be 0.51.

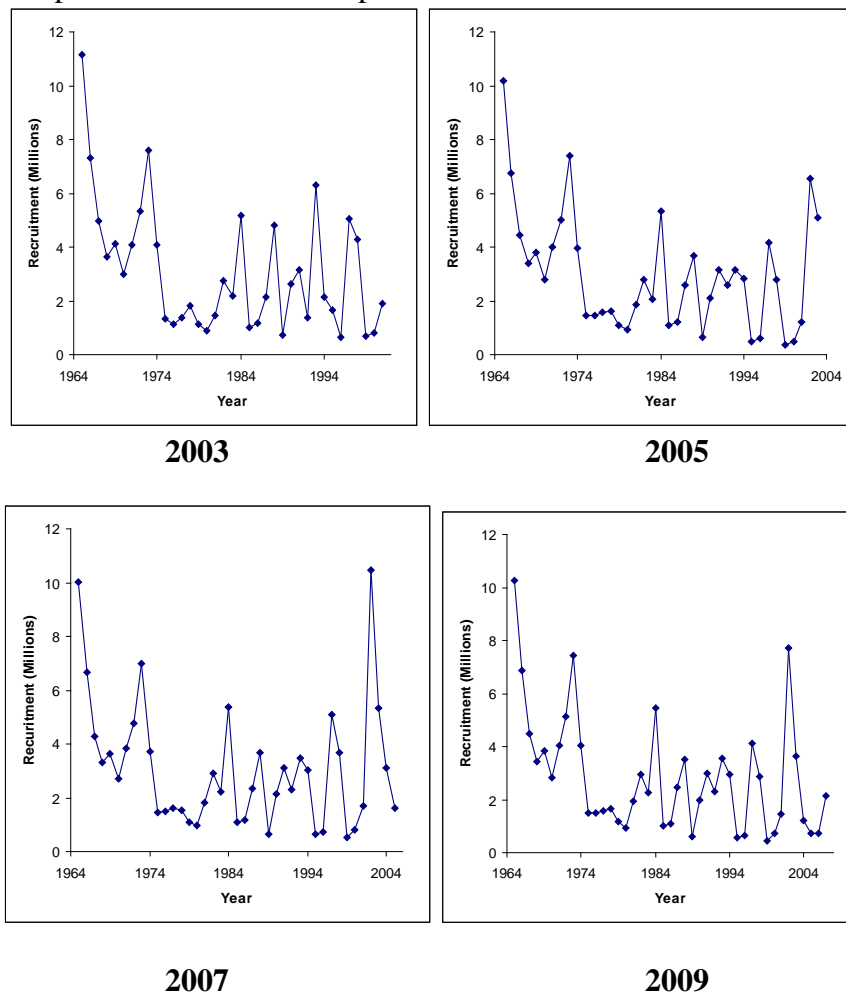
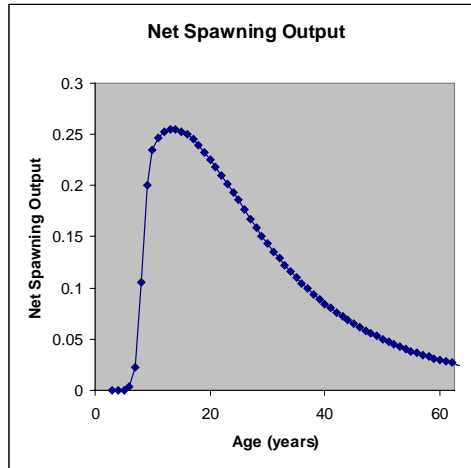


Figure 1: Recruitment: Pacific ocean perch assessments conducted in 2003, 2005, 2007 and 2009.

### 2.3 Mean generation time

The mean generation time is defined as the mean age weighted by net spawning output (see Figure 2 for net spawning output *versus* age (MPD estimates)). The best estimate of the mean generation time for the full posterior is 28 years. This is unchanged from the previous rebuilding analyses (Table 3).



**Figure 2:** Relationship between net spawning output and age for Pacific Ocean perch.

### 2.4 The harvest strategies

Table 2 summarizes the options considered in the rebuilding analyses. These include a no catch option (case 1), using the calculated SPR from the last rebuilding analysis (case 2), using the implied SPR in the current analysis from the 2009-10 OYs (189/200 mt; case 3), or using the ABC harvest rule (Case 4). The other 7 cases using values of  $T_{target}$  near the calculated  $T_{50\%}$  for cases 2 and 3 (cases 5-7), and a spread of cases from  $T_{min}$  to  $T_{max}$  (cases 8-11). I report the probability of recovering by 2031, choosing the date halfway between  $T_{min}$  and  $T_{max}$ .

| Case | Name                          | $T_{50\%}$ | 2011 OY | SPR   | $P_{2031}$ |
|------|-------------------------------|------------|---------|-------|------------|
| 1    | $T_{F=0}$                     | 2018       | 0       | 1.000 | 0.855      |
| 2    | SPR from 2005/7 rebuilding    | 2020       | 180     | 0.864 | 0.771      |
| 3    | SPR from 2009-10 OYs          | 2021       | 204     | 0.848 | 0.754      |
| 4    | ABC rule                      | 2065       | 1026    | 0.500 | 0.351      |
| 5    | $T_{target} = 2019$           | 2019       | 111     | 0.912 | 0.807      |
| 6    | $T_{target} = 2020$           | 2020       | 198     | 0.852 | 0.757      |
| 7    | $T_{target} = 2021$           | 2021       | 265     | 0.811 | 0.714      |
| 8    | $T_{target} = 2024$           | 2024       | 404     | 0.736 | 0.633      |
| 9    | $T_{target} = 2031$           | 2031       | 635     | 0.636 | 0.500      |
| 10   | $T_{target} = 2038$           | 2038       | 751     | 0.595 | 0.435      |
| 11   | $T_{target} = 2045 (T_{MAX})$ | 2045       | 836     | 0.568 | 0.402      |

### 2.5 Other specifications

The calculations in this document were performed using Version 2.8 and 3.12a of the rebuilding software developed by Punt (2005, 2009) and the results are based on 3,000 Monte Carlo replicates (3 simulations for each of 1,000 samples for the posterior).

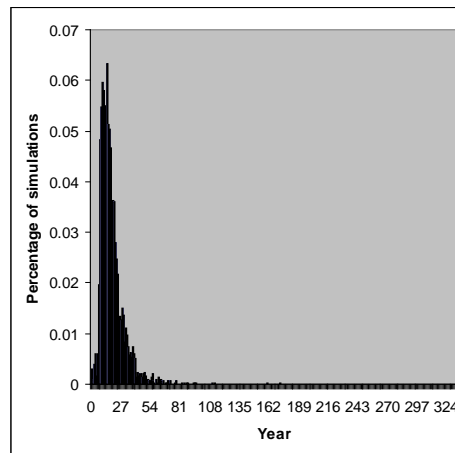
The definition of “recovery by year  $y$ ” in this analysis is that the spawning output reaches  $0.4B_0$  by year  $y$  (even if it subsequently drops below this level due to recruitment variability). Appendix 1 lists the MPD estimates for the biological and technological parameters and the age-structure of the population at the start of 2000 and 2009. Appendix 2 lists the MPD time-series of recruitment and

spawning output. The input to the rebuilding programs is given as Appendix 3 and 4. The catch for 2009 and 2010 were set to 189 and 200 mt (the Council-selected OYs for 2009-2010).

### 3. Results

#### 3.1 Time-to-recovery

The median year for rebuilding to the target level in the absence of fishing since the year of overfished declaration,  $T_{min}$ , is 2017. Figure 3 shows the distribution for the number of years beyond the year 2000 that it would have taken to recover to  $0.4B_0$  had there been no harvest since 2000.  $T_{max}$ , the maximum permissible time period for rebuilding the stock to its target biomass, is 2042 when using the new information on the depletion level and the age-structure of the population in 2000. Table 3 gives summary statistics from the 2003, 2005 and 2007 rebuilding plans and the current analysis for full posterior results. The difference between the 2007 and 2009 results are largely due to the relatively low NWFSC trawl survey indices for POP in 2007 and 2008, coupled with a small data error in the 2007 assessment which was corrected in the current assessment. The results for the 2009 rebuilding analysis are relatively close to those from 2005. While the rebuilding timeline has changed substantially from the 2007 version, the resulting catch from a  $SPR = 0.864$  policy has a much smaller change.  $T_{F=0}$  (zero catch from 2011 onward) is greater than  $T_{min}$  due to a decade of catches in the interim.



**Figure 3:** Distribution of time to recovery used to calculate  $T_{min}$ , the median year for rebuilding to the target level  $0.4B_0$  in the absence of fishing since 2000 for the base-case analysis.

**Table 3:** Summary statistics

| Value   | 2003     | 2005     | 2007     | 2009     |
|---|----------|----------|----------|----------|
| $T_{min}$   | 2014     | 2015     | 2009     | 2017     |
| Mean generation time  | 28 years | 28 years | 28 years | 28 years |
| $T_{max}$   | 2042     | 2043     | 2037     | 2045     |
| $T_{F=0}$ (No fishing mortality beginning in 2004, 2007, 2009, or 2011) | 2014     | 2015     | 2010     | 2018     |
| $P_{MAX}$   | 70.0     | 92.9     |          |          |
| $T_{TARGET}$  | 2027     | 2017     |          |          |
| $SPR_{TARGET}$  |          | 86.4%    |          |          |

#### 3.2 OYs and fishing mortalities

Table 4 gives the probabilities of recovery at 2031 and  $T_{max}$  (2045) and 10 year projected OY values based on the SPR for each of the 11 cases explored in this rebuilding analysis.

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**Table 4:** Ten year OY/ABC projections.

| Case  | 1          | 2             | 3              | 4          | 5           | 6           | 7           | 8           | 9           | 10          | 11          |     |      |     |      |     |      |     |      |     |      |
|---|------------|---------------|----------------|------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-----|------|-----|------|-----|------|-----|------|-----|------|
| <b>RUN</b>  | <b>F=0</b> | <b>SPR'07</b> | <b>OY'9-10</b> | <b>ABC</b> | <b>2019</b> | <b>2020</b> | <b>2021</b> | <b>2024</b> | <b>2031</b> | <b>2038</b> | <b>2045</b> |     |      |     |      |     |      |     |      |     |      |
| SPR   | 1          | 0.864         | 0.848          | 0.5        | 0.912       | 0.852       | 0.811       | 0.736       | 0.636       | 0.595       | 0.568       |     |      |     |      |     |      |     |      |     |      |
| F   | 0          | 0.0079        | 0.0090         | 0.0450     | 0.0048      | 0.0087      | 0.0116      | 0.0177      | 0.0279      | 0.0330      | 0.0368      |     |      |     |      |     |      |     |      |     |      |
| T50%  | 2018       | 2020          | 2021           | 2065       | 2019        | 2020        | 2021        | 2024        | 2031        | 2038        | 2045        |     |      |     |      |     |      |     |      |     |      |
| P2031   | 85.5       | 77.1          | 75.4           | 35.1       | 80.7        | 75.7        | 71.4        | 63.3        | 50.0        | 43.5        | 40.2        |     |      |     |      |     |      |     |      |     |      |
| P2045   | 95.8       | 89.7          | 88.7           | 42.7       | 92.9        | 88.9        | 85.6        | 78.1        | 62.7        | 55.0        | 50.0        |     |      |     |      |     |      |     |      |     |      |
| 10 Year projected OYs and ABCs at SPR rate above: |            |               |                |            |             |             |             |             |             |             |             |     |      |     |      |     |      |     |      |     |      |
| 2011  | 0          | 1026          | 180            | 1026       | 204         | 1026        | 1026        | 111         | 1026        | 198         | 1026        | 265 | 1026 | 404 | 1026 | 635 | 1026 | 751 | 1026 | 836 | 1026 |
| 2012  | 0          | 1057          | 183            | 1049       | 208         | 1048        | 1007        | 113         | 1052        | 202         | 1048        | 269 | 1045 | 408 | 1039 | 635 | 1028 | 747 | 1023 | 829 | 1019 |
| 2013  | 0          | 1073          | 185            | 1057       | 210         | 1054        | 983         | 115         | 1063        | 204         | 1055        | 271 | 1049 | 408 | 1036 | 628 | 1015 | 735 | 1004 | 812 | 996  |
| 2014  | 0          | 1097          | 187            | 1072       | 212         | 1069        | 964         | 117         | 1081        | 206         | 1070        | 273 | 1061 | 409 | 1043 | 625 | 1012 | 729 | 998  | 803 | 987  |
| 2015  | 0          | 1122          | 191            | 1089       | 216         | 1085        | 946         | 119         | 1102        | 210         | 1086        | 278 | 1074 | 414 | 1050 | 628 | 1010 | 729 | 992  | 801 | 978  |
| 2016  | 0          | 1150          | 194            | 1110       | 219         | 1104        | 933         | 121         | 1125        | 213         | 1105        | 281 | 1091 | 418 | 1062 | 627 | 1013 | 726 | 990  | 795 | 973  |
| 2017  | 0          | 1177          | 198            | 1129       | 224         | 1123        | 927         | 124         | 1147        | 218         | 1124        | 287 | 1107 | 424 | 1072 | 632 | 1018 | 729 | 991  | 797 | 971  |
| 2018  | 0          | 1204          | 202            | 1151       | 229         | 1144        | 926         | 127         | 1171        | 222         | 1146        | 292 | 1125 | 431 | 1086 | 639 | 1025 | 734 | 995  | 800 | 973  |
| 2019  | 0          | 1236          | 207            | 1174       | 234         | 1167        | 926         | 130         | 1198        | 227         | 1168        | 299 | 1147 | 438 | 1105 | 645 | 1036 | 739 | 1004 | 804 | 980  |
| 2020  | 0          | 1273          | 212            | 1203       | 239         | 1194        | 924         | 133         | 1231        | 232         | 1196        | 304 | 1171 | 445 | 1120 | 650 | 1044 | 743 | 1007 | 808 | 982  |

**References**

- Hamel, O.S. 2009. Status and future prospects for the Pacific Ocean Perch resource in waters off Washington and Oregon as assessed in 2009. Pacific Fishery Management Council, Portland, OR.
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- Punt, A.E. 2002. Revised Rebuilding Analysis for Pacific Ocean Perch (July 2002). Pacific Fishery Management Council, 7700 Ambassador Place NE, Suite 200, Portland, OR.
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**Appendix 1** : Biological and technological parameters used for the rebuilding analyses based on the MPD estimates.

| Age | Fecundity | Weight<br>(kg) | Selectivity | Natural<br>mortality | <i>N</i><br>(2000) | <i>N</i><br>(2009) |
|-----|-----------|----------------|-------------|----------------------|--------------------|--------------------|
| 3   | 0.000     | 0.169          | 0.001       | 0.0524               | 730                | 1,620              |
| 4   | 0.000     | 0.241          | 0.004       | 0.0524               | 430                | 1,540              |
| 5   | 0.000     | 0.317          | 0.016       | 0.0524               | 2,580              | 1,930              |
| 6   | 0.004     | 0.396          | 0.062       | 0.0524               | 3,540              | 620                |
| 7   | 0.028     | 0.474          | 0.197       | 0.0524               | 530                | 580                |
| 8   | 0.137     | 0.550          | 0.408       | 0.0524               | 440                | 930                |
| 9   | 0.274     | 0.622          | 0.598       | 0.0524               | 2,080              | 2,630              |
| 10  | 0.339     | 0.690          | 0.779       | 0.0524               | 2,340              | 5,300              |
| 11  | 0.375     | 0.752          | 0.915       | 0.0524               | 1,360              | 940                |
| 12  | 0.404     | 0.809          | 0.989       | 0.0524               | 1,590              | 450                |
| 13  | 0.431     | 0.861          | 1.000       | 0.0524               | 930                | 260                |
| 14  | 0.454     | 0.908          | 0.979       | 0.0524               | 250                | 1,550              |
| 15  | 0.475     | 0.950          | 0.979       | 0.0524               | 1,270              | 2,110              |
| 16  | 0.494     | 0.987          | 0.979       | 0.0524               | 780                | 310                |
| 17  | 0.510     | 1.021          | 0.979       | 0.0524               | 300                | 250                |
| 18  | 0.525     | 1.050          | 0.979       | 0.0524               | 240                | 1,200              |
| 19  | 0.538     | 1.076          | 0.979       | 0.0524               | 1,140              | 1,340              |
| 20  | 0.550     | 1.099          | 0.979       | 0.0524               | 410                | 780                |
| 21  | 0.560     | 1.119          | 0.979       | 0.0524               | 470                | 910                |
| 22  | 0.569     | 1.137          | 0.979       | 0.0524               | 270                | 530                |
| 23  | 0.576     | 1.153          | 0.979       | 0.0524               | 120                | 140                |
| 24  | 0.583     | 1.166          | 0.979       | 0.0524               | 130                | 730                |
| 25+ | 0.589     | 1.178          | 0.979       | 0.0524               | 3,260              | 4,090              |

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**Appendix 2** : MPD historical series of spawning output and recruitment.

| Year | Recruitment<br>(age 3) | Spawning output |
|------|------------------------|-----------------|
| 1956 | 3,810                  | 33,483          |
| 1957 | 46,540                 | 32,280          |
| 1958 | 4,120                  | 31,161          |
| 1959 | 18,630                 | 30,732          |
| 1960 | 8,860                  | 30,451          |
| 1961 | 4,180                  | 30,606          |
| 1962 | 3,610                  | 32,342          |
| 1963 | 4,870                  | 33,959          |
| 1964 | 14,420                 | 33,573          |
| 1965 | 10,270                 | 33,217          |
| 1966 | 6,870                  | 30,673          |
| 1967 | 4,490                  | 21,904          |
| 1968 | 3,440                  | 16,061          |
| 1969 | 3,850                  | 14,180          |
| 1970 | 2,820                  | 15,863          |
| 1971 | 4,030                  | 16,683          |
| 1972 | 5,120                  | 17,054          |
| 1973 | 7,440                  | 17,215          |
| 1974 | 4,030                  | 16,882          |
| 1975 | 1,490                  | 16,615          |
| 1976 | 1,490                  | 16,675          |
| 1977 | 1,570                  | 16,645          |
| 1978 | 1,660                  | 17,048          |
| 1979 | 1,170                  | 16,913          |
| 1980 | 940                    | 16,394          |
| 1981 | 1,930                  | 15,548          |
| 1982 | 2,930                  | 14,735          |
| 1983 | 2,260                  | 14,140          |
| 1984 | 5,460                  | 13,015          |
| 1985 | 1,020                  | 11,987          |
| 1986 | 1,090                  | 11,126          |
| 1987 | 2,480                  | 10,510          |
| 1988 | 3,520                  | 10,195          |
| 1989 | 600                    | 9,888           |
| 1990 | 1,970                  | 9,499           |
| 1991 | 3,000                  | 9,091           |
| 1992 | 2,290                  | 8,514           |
| 1993 | 3,570                  | 8,252           |
| 1994 | 2,930                  | 7,825           |
| 1995 | 580                    | 7,477           |
| 1996 | 650                    | 7,362           |
| 1997 | 4,140                  | 7,349           |
| 1998 | 2,860                  | 7,500           |
| 1999 | 450                    | 7,669           |
| 2000 | 730                    | 7,711           |
| 2001 | 1,450                  | 7,811           |
| 2002 | 7,710                  | 8,025           |
| 2003 | 3,620                  | 8,448           |
| 2004 | 1,210                  | 8,676           |
| 2005 | 710                    | 8,708           |
| 2006 | 720                    | 8,884           |
| 2007 | 2,150                  | 9,528           |
| 2008 | 1,620                  | 10,342          |
| 2009 |                        | 10,794          |

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Appendix 3: Input File Ver. 2.8 (2005) (for SPR based on 2007-2010 specifications)

```
#Title
POP Re2009
# Number of sexes
1
# Age range to consider (minimum age; maximum age)
3 25
# Number of fleets
1
# First year of projection
2009
# 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)
1
# 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
34

# Fecundity-at-age
# 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
3.84E-06 4.03E-05 0.000392248 0.003560962 0.028260766 0.1374925 0.273954602 0.338584679 0.375081501
0.404469053 0.430553194 0.453991276 0.4749965 0.493739 0.510395 0.52515 0.53818 0.549655 0.559745
0.568595 0.576345 0.58313 0.589055

# Age specific information (Females then males) weight selectivity
#
0.169105 0.240603 0.317273 0.395966 0.474162 0.54997 0.62206 0.689572 0.752022 0.80921 0.861146
0.907988 0.949993 0.987478 1.02079 1.0503 1.07636 1.09931 1.11949 1.13719 1.15269 1.16626 1.17811

0.001053831 0.004071712 0.016086685 0.062376525 0.197451646 0.407541849 0.597679152
0.77855632 0.914572718 0.989329767 1 0.97908111 0.97908111 0.97908111
0.97908111 0.97908111 0.97908111 0.97908111 0.97908111 0.97908111
0.97908111 0.97908111 0.97908111

# M and current age-structure
#
0.0524459 0.0524459 0.0524459 0.0524459 0.0524459 0.0524459 0.0524459
0.0524459 0.0524459 0.0524459 0.0524459 0.0524459 0.0524459 0.0524459
0.0524459 0.0524459 0.0524459 0.0524459 0.0524459 0.0524459
0.0524459 0.0524459 0.0524459 0.0524459 0.0524459

1621.2 1538.35 1934.49 618.412 576.981 928.787 2627.6 5297.23 942.499 445.726 259.836 1550.73 2105.33
308.998 254.436 1196.52 1337.2 775.886 909.249 530.029 141.388 729.503 4091.12

# Age-structure at declaration
728.677 427.942 2576.32 3536.44 525.92 438.302 2081.86 2341.98 1360.89 1591.29 925.018 246.453 1271.6
782.641 298.887 243.973 1141.13 414.899 473.571 271.56 115.097 125.361 3264.12

# Year for Tmin Age-structure
2000

# Number of simulations
3000

# recruitment and biomass
```

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# Number of historical assessment years

55

# Historical data

# year recruitment spawner in B0 in R project in R/S project

|      |          |         |   |   |   |
|------|----------|---------|---|---|---|
| 1955 | 5.05071  | 37780   | 1 | 0 | 0 |
| 1956 | 3.81005  | 33482.7 | 0 | 0 | 0 |
| 1957 | 46.539   | 32279.7 | 0 | 0 | 0 |
| 1958 | 4.12277  | 31160.8 | 0 | 0 | 0 |
| 1959 | 18.6279  | 30731.8 | 0 | 0 | 1 |
| 1960 | 8.86124  | 30450.6 | 0 | 0 | 1 |
| 1961 | 4.17782  | 30605.6 | 0 | 0 | 1 |
| 1962 | 3.60617  | 32342.1 | 0 | 0 | 1 |
| 1963 | 4.87395  | 33958.9 | 0 | 0 | 1 |
| 1964 | 14.4209  | 33572.9 | 0 | 0 | 1 |
| 1965 | 10.2657  | 33217.2 | 1 | 1 | 1 |
| 1966 | 6.86537  | 30673.1 | 1 | 1 | 1 |
| 1967 | 4.49322  | 21903.8 | 1 | 1 | 1 |
| 1968 | 3.43633  | 16060.9 | 1 | 1 | 1 |
| 1969 | 3.85028  | 14179.7 | 1 | 1 | 1 |
| 1970 | 2.82413  | 15862.9 | 1 | 1 | 1 |
| 1971 | 4.02554  | 16682.5 | 1 | 1 | 1 |
| 1972 | 5.11638  | 17054.4 | 1 | 1 | 1 |
| 1973 | 7.44304  | 17214.7 | 1 | 1 | 1 |
| 1974 | 4.03033  | 16881.6 | 1 | 1 | 1 |
| 1975 | 1.48891  | 16615.4 | 1 | 1 | 1 |
| 1976 | 1.49155  | 16675.4 | 1 | 1 | 1 |
| 1977 | 1.56796  | 16645   | 0 | 1 | 1 |
| 1978 | 1.65985  | 17048   | 0 | 1 | 1 |
| 1979 | 1.17152  | 16912.9 | 0 | 1 | 1 |
| 1980 | 0.939295 | 16393.5 | 0 | 1 | 1 |
| 1981 | 1.93024  | 15547.9 | 0 | 1 | 1 |
| 1982 | 2.93066  | 14734.7 | 0 | 1 | 1 |
| 1983 | 2.25863  | 14140.4 | 0 | 1 | 1 |
| 1984 | 5.46058  | 13015   | 0 | 1 | 1 |
| 1985 | 1.01962  | 11987.4 | 0 | 1 | 1 |
| 1986 | 1.08802  | 11126.4 | 0 | 1 | 1 |
| 1987 | 2.47944  | 10510.4 | 0 | 1 | 1 |
| 1988 | 3.51639  | 10194.9 | 0 | 1 | 1 |
| 1989 | 0.597451 | 9888.32 | 0 | 1 | 1 |
| 1990 | 1.97259  | 9499.19 | 0 | 1 | 1 |
| 1991 | 3.00426  | 9091.12 | 0 | 1 | 1 |
| 1992 | 2.28769  | 8513.58 | 0 | 1 | 1 |
| 1993 | 3.57031  | 8252.42 | 0 | 1 | 1 |
| 1994 | 2.93232  | 7825.35 | 0 | 1 | 1 |
| 1995 | 0.576252 | 7476.51 | 0 | 1 | 1 |
| 1996 | 0.650919 | 7362.1  | 0 | 1 | 1 |
| 1997 | 4.14277  | 7348.73 | 0 | 1 | 1 |
| 1998 | 2.86189  | 7499.76 | 0 | 1 | 1 |
| 1999 | 0.451006 | 7668.72 | 0 | 1 | 1 |
| 2000 | 0.728677 | 7711.22 | 0 | 1 | 1 |
| 2001 | 1.45313  | 7811.13 | 0 | 1 | 1 |
| 2002 | 7.71169  | 8025.19 | 0 | 1 | 1 |
| 2003 | 3.61549  | 8448.11 | 0 | 1 | 1 |
| 2004 | 1.20941  | 8675.66 | 0 | 1 | 1 |
| 2005 | 0.712026 | 8708.42 | 0 | 1 | 1 |
| 2006 | 0.72388  | 8884.16 | 0 | 1 | 1 |
| 2007 | 2.1485   | 9528.15 | 0 | 1 | 1 |
| 2008 | 1.6212   | 10341.6 | 0 | 0 | 0 |
| 2009 | 1.6212   | 10794.1 | 0 | 0 | 0 |

# Number of years with pre-specified catches  
2  
# catches for years with pre-specified catches  
2009 189  
2010 200  
# Number of future recruitments to override  
0  
# Process for overriding (-1 for average otherwise index in data list)  
# Which probability to product detailed results for (1=0.5; 2=0.6; etc.)  
3

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```
# Steepness sigma-R Auto-correlation
0.514 1 0
# 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)
-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)
1
# Number of replicates to use
10
# Random number seed
-99004
# Conduct projections for multiple starting values (0=No;else yes)
1
# File with multiple parameter vectors
mcmcreb.dat
# Number of parameter vectors
1000
# User-specific projection (1=Yes); Output replaced (1->9)
1 5 0 0.1
# Catches and Fs (Year; 1/2/3 (F or C or SPR); value); Final row is -1
2011 3 0.864
-1 -1 -1
# Split of Fs
2009 1
-1 1
# Time varying weight-at-age (1=Yes;0=No)
0
# File with time series of weight-at-age data
HakWght.Csv
```

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Appendix 4: Input File Ver. 3.12a (2009)

```
#Title
POP Re2009
# Number of sexes
1
# Age range to consider (minimum age; maximum age)
3 25
# Number of fleets
1
# First year of projection
2009
# First year OY could have been 0
2000
# Number of simulations
3000
# Maximum number of years to simulate
200
# Conduct projections with multiple starting values (0 = no)
1
# 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 BH stock-recruitment (3) or Ricker (4)
1
# 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
# 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
3.84E-06 4.03E-05 0.000392248 0.003560962 0.028260766 0.1374925 0.273954602 0.338584679 0.375081501
0.404469053 0.430553194 0.453991276 0.4749965 0.493739 0.510395 0.52515 0.53818 0.549655 0.559745
0.568595 0.576345 0.58313 0.589055
# Age specific information (Females then males) weight selectivity
#
0.169105 0.240603 0.317273 0.395966 0.474162 0.54997 0.62206 0.689572 0.752022 0.80921 0.861146
0.907988 0.949993 0.987478 1.02079 1.0503 1.07636 1.09931 1.11949 1.13719 1.15269 1.16626 1.17811
0.001053831 0.004071712 0.016086685 0.062376525 0.197451646 0.407541849 0.597679152
0.77855632 0.914572718 0.989329767 1 0.97908111 0.97908111 0.97908111
0.97908111 0.97908111 0.97908111 0.97908111 0.97908111 0.97908111
0.97908111 0.97908111 0.97908111
# M and current age-structure
#
0.0524459 0.0524459 0.0524459 0.0524459 0.0524459 0.0524459 0.0524459 0.0524459
0.0524459 0.0524459 0.0524459 0.0524459 0.0524459 0.0524459 0.0524459
0.0524459 0.0524459 0.0524459 0.0524459
1621.2 1538.35 1934.49 618.412 576.981 928.787 2627.6 5297.23 942.499 445.726 259.836 1550.73 2105.33
308.998 254.436 1196.52 1337.2 775.886 909.249 530.029 141.388 729.503 4091.12
# Age-structure at declaration
728.677 427.942 2576.32 3536.44 525.92 438.302 2081.86 2341.98 1360.89 1591.29 925.018 246.453 1271.6
782.641 298.887 243.973 1141.13 414.899 473.571 271.56 115.097 125.361 3264.12
# Year Yinit^0 (used to compute the stock size at the start of year Ydecl)
2000
#Recruitment and Spawner biomasses
# Number of historical assessment years
55
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# Historical data: Year, Recruitment, Spawner biomass, Used to compute B0, Used to project based
# on R, Used to project based on R/S
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
5050.71 3810.05 46539 4122.77 18627.9 8861.24 4177.82 3606.17 4873.95 14420.9 10265.7 6865.37 4493.22
3436.33 3850.28 2824.13 4025.54 5116.38 7443.04 4030.33 1488.91 1491.55 1567.96 1659.85 1171.52
939.295 1930.24 2930.66 2258.63 5460.58 1019.62 1088.02 2479.44 3516.39 597.451 1972.59 3004.26
2287.69 3570.31 2932.32 576.252 650.919 4142.77 2861.89 451.006 728.677 1453.13 7711.69 3615.49
1209.41 712.026 723.88 2148.5 1621.2 1621.2
37780 33482.7 32279.7 31160.8 30731.8 30450.6 30605.6 32342.1 33958.9 33572.9 33217.2 30673.1 21903.8
16060.9 14179.7 15862.9 16682.5 17054.4 17214.7 16881.6 16615.4 16675.4 16645 17048 16912.9
16393.5 15547.9 14734.7 14140.4 13015 11987.4 11126.4 10510.4 10194.9 9888.32 9499.19 9091.12
8513.58 8252.42 7825.35 7476.51 7362.1 7348.73 7499.76 7668.72 7711.22 7811.13 8025.19 8448.11
8675.66 8708.42 8884.16 9528.15 10341.6 10794.1
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 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 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 0 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
0 0
# Number of years with pre-specified catches
2
# catches for years with pre-specified catches
2009 189
2010 200
# 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
# Which probability to product detailed results for (1=0.5; 2=0.6; etc.)
3
# Steepness sigma-R Auto-correlation
0.514 1 0
# Target SPR rate (FMSY Proxy)
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
# Definition of recovery (1=now only;2=now or before)
2
#Projection Type
4
# Definition of the ""40-10"" rule
10 40
# Calculate coefficients of variation (1=Yes)
0
# Number of replicates to use
10

```

# DRAFT

```
# Random number seed
-99004
# File with multiple parameter vectors
mcmcreb.dat
# User-specific projection (1=Yes); Output replaced (1->9)
0      5      0      0.1
# Catches and Fs (Year; 1/2/3 (F or C or SPR); value); Final row is -1
2011   3      0.864
-1     -1     -1
# Fixed Catch project (1=yes)
0
# Split of Fs
2009   1
-1     1
#prespecified inputs:
2020 2024 2031 2038 2045
# Years for which probability of recovery is needed
2019  2020  2021  2022 2024  2031  2038  2045
# Time-varying weight at age (1=yes,0=no)
0
# File with time series of weight-at-age data
HakWght.Csv
# Use bisection (0) or linear interpolation (1)
0
# Target Depletion
0.4
# CV of implementation error
0
```