

Bocaccio Rebuilding Analysis for 2005

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Introduction

In 1998, the PFMC adopted Amendment 11 of the Groundfish Management Plan, which established a minimum stock size threshold of 25% of unfished biomass. Based on the stock assessment by Ralston et al. (1996), bocaccio was declared formally to be overfished, thereby requiring development of a rebuilding plan for consideration by the Council in the fall of 1999. Rebuilding was initiated by catch restrictions beginning in 2000.

A number of bocaccio stock assessments (MacCall et al. 1999, MacCall 2002, MacCall 2003a, MacCall 2005) and rebuilding analyses (MacCall 1999, MacCall and He 2002, MacCall 2003b) have now been conducted since the stock was declared overfished. In 2004, a formal rebuilding plan for bocaccio was enacted by the Pacific Fishery Management Council (PFMC) as part of Amendment 16-3 to the Pacific Coast Groundfish Fishery Management Plan (PFMC 2004).

The 2003 stock assessment examined three models of bocaccio. One of those, the STATc model, was used as the basis for subsequent fishery management and as the basis of FMP Amendment 16-3. The 2005 bocaccio stock assessment updated the 2003 STATc model, and is the basis of this rebuilding analysis. Also, the 2005 assessment is the first new assessment since the formal Rebuilding Plan (FMP Amendment 16-3) was established.

IMPORTANT NOTE: In preparing this rebuilding analysis, an error was discovered in the Rebuilding Plan, Amendment 16-3. Although the PFMC clearly selected a bocaccio rebuilding plan with P_0 (probability of reaching rebuilding target by T_{max}) of 70%, the corresponding value of T_{targ} (year with a 50% probability of reaching the target) was incorrectly specified as 2023. The 2003 rebuilding analysis indicated that a 50% probability rebuilding would require 23 years, but this assumed a beginning date of 2004 (the first simulated year). Accordingly, the correct value of T_{targ} was 2027. Both values of T_{targ} are examined in the present analysis.

Management Performance

Details of management performance are provided in Table 1. The rebuilding OY was set at 100 MT for 2000-2002 as a transition to a constant fishing mortality rate policy beginning in 2003. This was a learning period for fishery management, which required unprecedented

restrictions on both commercial and recreational fishing opportunities. Actual harvest exceeded management targets in the first three years, but with a smaller excess by the third year. In response to the 2002 bocaccio assessment, which indicated very low productivity, the 2003 OY was set at 20MT, and the retained catch was about 12MT. Including mortality of estimated discards, estimated 2003 total kill was 22MT. Based on the 2003 assessment, which showed a much more productive stock, the 2004 OY was set at 250MT, but management used an operational target of 199MT; the final catch was 78MT. Discards brought the estimated 2004 kill to 83MT. Thus, recent management has shown substantial improvement in performance, and has been achieving total removals at (2003) or well below (2004) maximum target levels. The anticipated bocaccio mortality in 2005 also is expected to fall well below the maximum level set by the OY.

Table 1. Recent history of bocaccio management performance.

| Year | Commercial | | | Recreational | | | Total | | | ABC | OY |
|------|------------|---------|-------|--------------|---------|-------|-------|---------|-------|------|------|
| | Catch | Discard | Total | Catch | Discard | Total | Catch | Discard | Total | | |
| 1995 | 730 | * | 730 | 31 | 2 | 33 | 761 | 2 | 763 | 1700 | 1700 |
| 1996 | 480 | * | 480 | 89 | 4 | 93 | 569 | 4 | 573 | 1700 | 1700 |
| 1997 | 324 | * | 324 | 146 | 11 | 157 | 470 | 11 | 481 | 265 | 265 |
| 1998 | 157 | * | 157 | 51 | 0 | 51 | 208 | 0 | 208 | 230 | 230 |
| 1999 | 73 | * | 73 | 120 | 4 | 124 | 193 | 4 | 197 | 230 | 230 |
| 2000 | 25 | 49 | 74 | 103 | 9 | 112 | 128 | 58 | 186 | 164 | 100 |
| 2001 | 22 | 76 | 98 | 103 | 6 | 109 | 125 | 82 | 207 | 122 | 100 |
| 2002 | 21 | 30 | 51 | 82 | 2 | 84 | 103 | 32 | 135 | 122 | 100 |
| 2003 | 1 | 10 | 11 | 9 | 2 | 11 | 10 | 12 | 22 | 244 | <20 |
| 2004 | 12 | 10 | 22 | 54 | 8 | 62 | 66 | 18 | 84 | 400 | 199 |
| 2005 | | | | | | | | | 150** | 566 | 307 |

* Discarded commercial catch was not estimated and is assumed to be negligible.

** Anticipated 2005 bocaccio mortality given in June 2005 GMT document dated "6/16/06 17:45" [actual year 2005]

Simulation Model

This analysis uses the SSC Default Rebuilding Analysis (version 2.8a). All data and parameters use as input to this analysis were taken from the STATc model in the 2005 assessment. An example input file is given in Appendix A. Future recruitments were simulated by re-sampling estimated historical recruits/spawning output (**R/B**) ratios from years 1970 to 2005. Re-sampling **R/B** values is justified by the estimated Mace-Doonan steepness value of $h = 0.211$ in the 2005 stock assessment. This value of steepness indicates negligible curvature in the estimated stock-recruitment relationship. Probability distributions are based on 2000 simulations.

As a comparability check, the input data from the 2003 rebuilding analysis were run in this most recent version of the SSC simulation model, and results were identical to those in the original 2003 analysis. Note that due to differences in model structure, the projections made by the SSC model may differ from projections made by the Stock Synthesis model used in the 2005 stock assessment (MacCall 2005).

Rebuilding Parameters/Management Reference Points

B_{unfished}: Unfished biomass (measures as spawning output) is estimated by multiplying average recruitment (**R**) by the spawning output per recruit achieved when the fishing mortality rate is zero (**SPR_{F=0}** = 2.499, spawning output in billion eggs, recruitment in thousand fish at age 1). Based on the 2005 bocaccio assessment, the estimated unfished spawning output (**B_{unfished}**) is 13325 billion eggs (compared with 13387 billion eggs estimated in the 2003 rebuilding analysis), based on the average recruitment from spawning years between 1950 and 1985. This time period was chosen as representing a presumably “natural” range of stock abundance. Because recruitment is highly variable, this calculation of unfished abundance is imprecise (CV \$ 10%; variability is underestimated because estimated recruitment in the first ten years is held constant).

B_{msy}: The rebuilding target is the spawning abundance level that produces MSY. This value cannot be determined directly for bocaccio, so this analysis uses the PFMC proxy value of 40% of estimated unfished spawning output. Estimated **B_{msy}** is 5330 billion eggs (compared with 5355 billion eggs in the 2003 rebuilding analysis).

Current status: According to the 2005 stock assessment as modified for input to the SSC Rebuilding Analysis model, current (2005) spawning output is 1419 billion eggs, which is 27% of the estimated **B_{msy}**. This is a substantial increase over the 2003 values. Historical abundance relative to the rebuilding target is shown in Figure 1.

Mean generation time: Mean generation time of bocaccio is estimated from the net maternity function, and is 14 years.

The following table summarizes results of the 2003 and 2005 rebuilding analyses. Reference years are unchanged by the 2005 update.

Table 2. Parameters and reference points for rebuilding

| Date of Analysis | 2003 | 2005 |
|---|--------|--------------|
| Assessment model used as basis | STATc | STATc update |
| First year of rebuilding | 2000 | 2000 |
| Present year (Final year of assessment) | 2003 | 2005 |
| First simulated year | 2004 | 2006 |
| Tmin | 2018 | 2018 |
| Mean Generation Time | 14 | 14 |
| Tmax | 2032 | 2032 |
| Prob rebuild by Tmax | 0.7 | |
| Rebuild SPR | 0.693 | |
| Exploitation Rate | 0.0498 | |
| Ttarg from 2003 Rebuilding Analysis | 2027 | |
| Ttarg from Amendment 16-3 (wrong) | 2023 | |

Results of Simulations

Table 3 is a suite of projections requested by the GMT. Because of the alternative interpretations of T_{targ} for bocaccio, two versions of run #2 are presented: Version “a” uses $T_{\text{targ}} = 2027$ and version “b” uses $T_{\text{targ}} = 2023$. Both values of T_{targ} are also considered in run #1.

Table 3. Rebuilding projections requested by the GMT.

| Run # | Prob (recovery) | By | Based on |
|--|-----------------|------------------------------------|---------------|
| #1 (default) | Estimated | Current T_{TARGET} | Current SPR |
| #2 (T_{TARGET} with 50% prob) | 0.5 | Current T_{TARGET} | Estimated SPR |
| #3 (#1 based on T_{MAX}) | Estimated | Current T_{MAX} | Current SPR |
| #4 (#2 based on T_{MAX}) | P_0 | Current T_{MAX} | Estimated SPR |
| #5 (#3 with re-estimated T_{MAX}) | Estimated | T_{MAX} (re-estimated) | Current SPR |
| #6 (#4 with re-estimated T_{MAX}) | P_0 | T_{MAX} (re-estimated) | Estimated SPR |

Projection results, including time series of median catch and median spawning output relative to the rebuilding target are shown in Table 4. Because the value of T_{max} did not change from the 2003 value, some of the GMT-requested runs are identical (3 and 5, 4 and 6), and Table 4 is condensed accordingly. Results for four additional runs are also shown: cases of $F=0$, catches under ABC ($F_{50\%}$) and the 40-10 rules, an 80% probability of achieving the rebuilding target by T_{max} , and a “scorecard F projection” requested by the GMT (John Field, Pers. Comm.). The latter projection is based on a constant harvest rate equivalent to a 2005 catch of 148.9 mtons. Catches and biomasses projected under an ABC (i.e., F_{msy} proxy = $F_{50\%}$) harvest policy do not correspond to the ABC for individual years under other policies, but rather represent projections under the maximum allowable harvest rate. Also note that the $F=0$ projection now has a median rebuilding date of 2022 because of actual catches taken during 2000-2006 (i.e., this scenario represents no harvest beginning in 2007) as opposed to the original T_{min} of 2018 which assumed no harvest beginning in 2000.

Simulated individual rebuilding trajectories are erratic due to rare large recruitments (Figure 1). The time series of percentiles and medians of simulated catch and abundance trajectories (Figures 2, 3, 4) provide a more informative overview of likely rebuilding performance and uncertainty.

Table 4. Results of rebuilding projections. Bold numbers are specifications for runs (see Table 3). Shaded cells indicate median abundance exceeds rebuilding target. Where applicable, rebuilding policy reverts to 40-10 policy upon achieving target abundance.

| Run | re-do 2003 | 1a, 1b, 3, 5 | 2a | 2b | 4, 6 | F=0 | F50%(AB C) | 40-10 Policy | P=0.8 by Tmax | Scorecard F |
|--|------------|---------------|------------|------------|-------------|----------|------------|-----------------|---------------|--------------|
| SPR | 0.693 | 0.692 | 0.717 | 0.883 | 0.705 | 1.000 | 0.5 | variable | 0.777 | 0.844 |
| F | 0.0498 | 0.0498 | 0.0450 | 0.0166 | 0.0475 | 0 | 0.0971 | variable | 0.034 | 0.023 |
| P(by 2023) | 0.316 | 0.240 | 0.270 | 0.5 | 0.254 | 0.638 | 0.0445 | 0.284 | 0.37 | 0.448 |
| P(by 2027) | 0.517 | 0.458 | 0.5 | 0.726 | 0.48 | 0.8365 | 0.1145 | 0.5 | 0.726 | 0.688 |
| P(by 2032) | 0.7 | 0.678 | 0.720 | 0.9 | 0.7 | 0.958 | 0.228 | 0.706 | 0.8 | 0.868 |
| T(P=0.5) | 2027 | 2028 | 2027 | 2023 | 2028 | 2022 | 2044 | 2027 | 2026 | 2024 |
| Median Catch | | | | | | | | | | |
| 2004 | 306 | | | | | | | | | |
| 2005 | 308 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 148.9 |
| 2006 | 309 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 147 |
| 2007 | 316 | 314 | 284 | 106 | 300 | 0 | 602 | 38 | 216 | 147 |
| 2008 | 337 | 316 | 287 | 109 | 302 | 0 | 585 | 53 | 219 | 150 |
| 2009 | 368 | 334 | 304 | 118 | 319 | 0 | 601 | 73 | 234 | 161 |
| 2010 | 400 | 359 | 328 | 129 | 344 | 0 | 627 | 101 | 254 | 176 |
| 2011 | 429 | 388 | 356 | 142 | 373 | 0 | 664 | 137 | 277 | 194 |
| 2012 | 457 | 425 | 390 | 158 | 408 | 0 | 707 | 187 | 306 | 215 |
| 2013 | 483 | 462 | 426 | 175 | 444 | 0 | 753 | 252 | 336 | 237 |
| 2014 | 520 | 498 | 460 | 192 | 479 | 0 | 785 | 327 | 365 | 259 |
| 2015 | 555 | 535 | 495 | 211 | 516 | 0 | 825 | 424 | 395 | 283 |
| 2016 | 594 | 567 | 526 | 228 | 547 | 0 | 848 | 532 | 423 | 305 |
| Median Spawning Output Relative to Target | | | | | | | | | | |
| 2005 | 0.25 | 0.27 | 0.27 | 0.27 | 0.27 | 0.27 | 0.27 | 0.27 | 0.27 | 0.27 |
| 2006 | 0.26 | 0.28 | 0.28 | 0.28 | 0.28 | 0.28 | 0.28 | 0.28 | 0.28 | 0.28 |
| 2007 | 0.28 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 |
| 2008 | 0.29 | 0.31 | 0.31 | 0.31 | 0.31 | 0.31 | 0.30 | 0.31 | 0.31 | 0.31 |
| 2009 | 0.31 | 0.31 | 0.32 | 0.33 | 0.31 | 0.33 | 0.30 | 0.33 | 0.32 | 0.32 |
| 2010 | 0.33 | 0.32 | 0.33 | 0.34 | 0.33 | 0.35 | 0.30 | 0.35 | 0.33 | 0.34 |
| 2011 | 0.36 | 0.34 | 0.35 | 0.37 | 0.34 | 0.38 | 0.31 | 0.38 | 0.35 | 0.36 |
| 2012 | 0.38 | 0.36 | 0.37 | 0.40 | 0.36 | 0.42 | 0.31 | 0.40 | 0.38 | 0.39 |
| 2013 | 0.41 | 0.38 | 0.39 | 0.43 | 0.39 | 0.46 | 0.33 | 0.44 | 0.41 | 0.42 |
| 2014 | 0.44 | 0.41 | 0.42 | 0.47 | 0.42 | 0.51 | 0.34 | 0.48 | 0.44 | 0.46 |
| 2015 | 0.47 | 0.44 | 0.45 | 0.52 | 0.45 | 0.56 | 0.35 | 0.52 | 0.48 | 0.50 |
| 2016 | 0.50 | 0.48 | 0.49 | 0.57 | 0.48 | 0.62 | 0.37 | 0.56 | 0.52 | 0.55 |
| 2017 | 0.53 | 0.51 | 0.53 | 0.62 | 0.52 | 0.69 | 0.39 | 0.61 | 0.56 | 0.60 |
| 2018 | 0.57 | 0.55 | 0.56 | 0.68 | 0.55 | 0.76 | 0.40 | 0.64 | 0.61 | 0.65 |
| 2019 | 0.61 | 0.58 | 0.60 | 0.73 | 0.59 | 0.82 | 0.42 | 0.68 | 0.65 | 0.70 |
| 2020 | 0.65 | 0.61 | 0.64 | 0.79 | 0.63 | 0.90 | 0.43 | 0.72 | 0.69 | 0.75 |
| 2021 | 0.69 | 0.65 | 0.68 | 0.85 | 0.66 | 0.98 | 0.45 | 0.76 | 0.74 | 0.81 |
| 2022 | 0.73 | 0.69 | 0.72 | 0.92 | 0.71 | 1.07 | 0.46 | 0.79 | 0.79 | 0.87 |
| 2023 | 0.78 | 0.73 | 0.77 | 0.97 | 0.75 | 1.16 | 0.48 | 0.83 | 0.85 | 0.94 |
| 2024 | 0.84 | 0.78 | 0.82 | 1.01 | 0.80 | 1.28 | 0.50 | 0.87 | 0.91 | 1.02 |
| 2025 | 0.90 | 0.84 | 0.88 | 1.05 | 0.86 | 1.40 | 0.51 | 0.90 | 0.95 | 1.11 |
| 2026 | 0.95 | 0.89 | 0.93 | 1.08 | 0.91 | 1.53 | 0.53 | 0.94 | 1.00 | 1.19 |
| 2027 | 0.98 | 0.94 | 0.97 | 1.12 | 0.95 | 1.67 | 0.55 | 0.97 | 1.03 | 1.28 |
| 2028 | 1.02 | 1.00 | 1.00 | 1.16 | 0.99 | 1.82 | 0.56 | 1.01 | 1.07 | 1.38 |
| 2029 | 1.06 | 1.06 | 1.04 | 1.21 | 1.02 | 2.00 | 0.58 | 1.05 | 1.10 | 1.49 |
| 2030 | 1.10 | 1.13 | 1.07 | 1.25 | 1.06 | 2.18 | 0.60 | 1.08 | 1.14 | 1.61 |
| 2031 | 1.14 | 1.20 | 1.11 | 1.31 | 1.10 | 2.38 | 0.63 | 1.13 | 1.19 | 1.73 |
| 2032 | 1.19 | 1.28 | 1.16 | 1.37 | 1.14 | 2.61 | 0.65 | 1.18 | 1.24 | 1.87 |
| 2033 | 1.24 | 1.37 | 1.22 | 1.43 | 1.19 | 2.88 | 0.68 | 1.24 | 1.30 | 2.04 |

Analysis of Sustainability

Under the fishing rates given by this rebuilding analysis, the probability of further long-term decline in bocaccio abundance is negligibly small (less than one percent over the next 100 years).

Acceptable Biological Catch (ABC) in 2007 and 2008

The value of ABC for 2007 is 602mtons, as given by the median catch for the ABC scenario in Table 4, which is conditional on actual catches of 150 mtons in 2005 and 2006. Table 5 shows that ABC for 2008 depends weakly on the actual catch in 2007, which in turn is influenced by the choice of rebuilding policies.

Table 5. Median estimated values of ABC in 2008.

| | | | | |
|-----------------------|-----|-----|-----|-----|
| Assumed catch in 2005 | 150 | 150 | 150 | 150 |
| Assumed catch in 2006 | 150 | 150 | 150 | 150 |
| Assumed catch in 2007 | 100 | 150 | 200 | 300 |
| 2008 ABC (median) | 621 | 618 | 614 | 607 |

References

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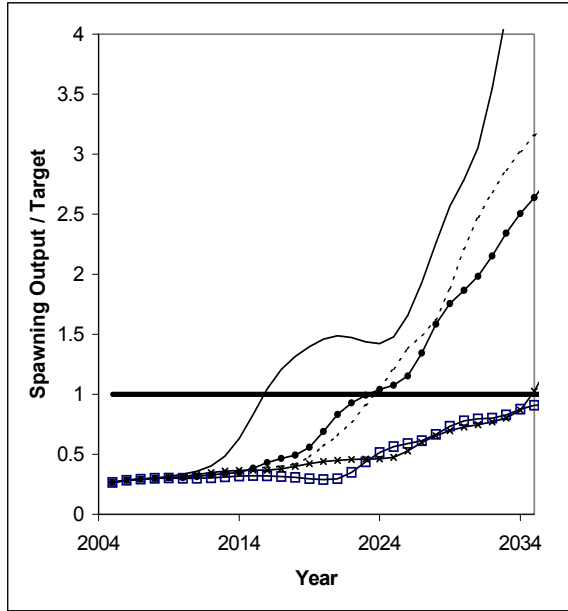


Figure 1. Example individual rebuilding trajectories for bocaccio.

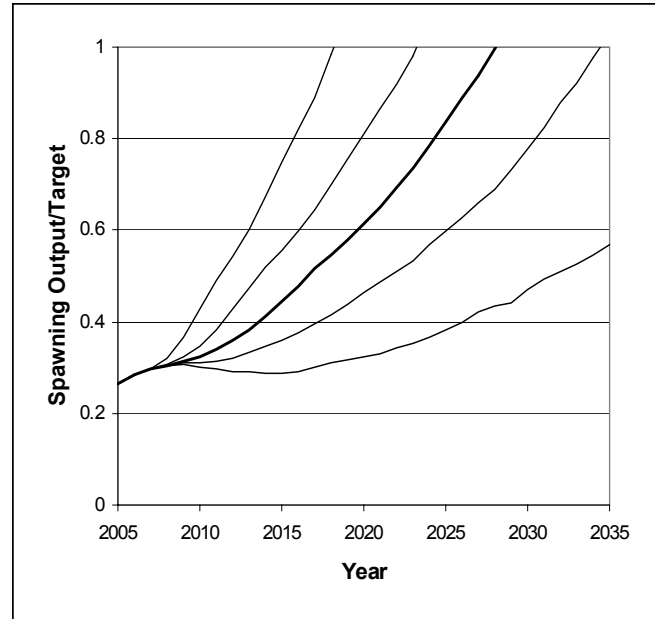


Figure 2. Envelope of rebuilding trajectories for GMT run 1 (current $F = 0.0498$). Lines are 5, 25, 50, 75 and 95 percentiles of 2000 simulations.

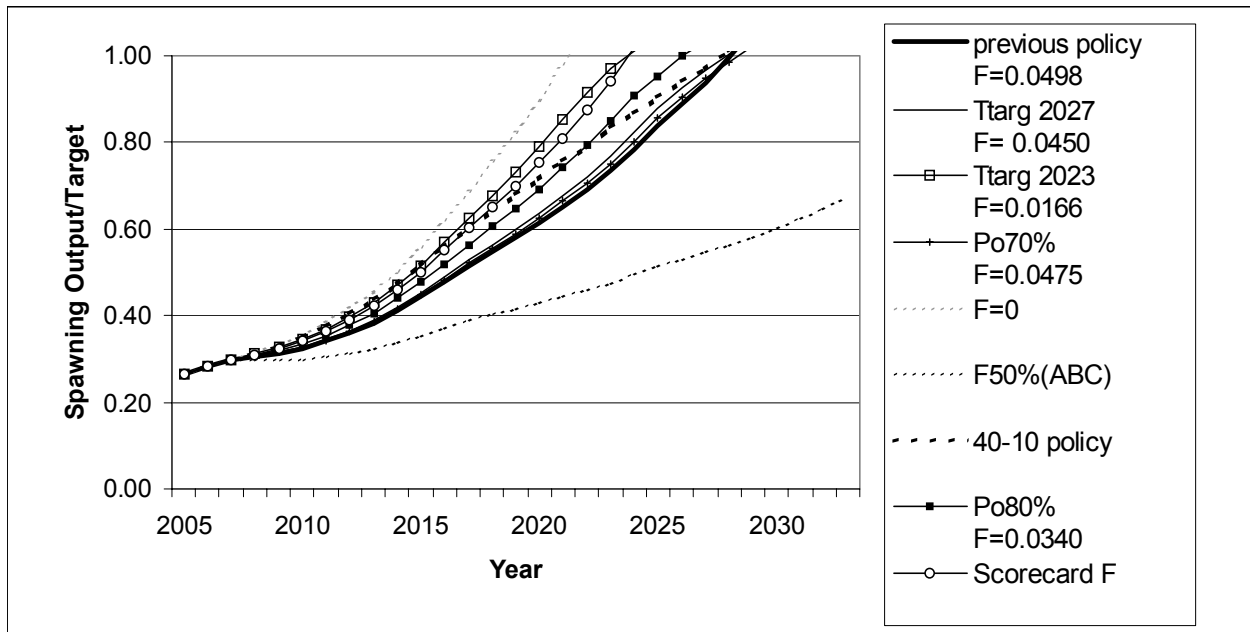


Figure 3. Median trajectories of abundance (relative to rebuilding target) for various cases in Table 4.

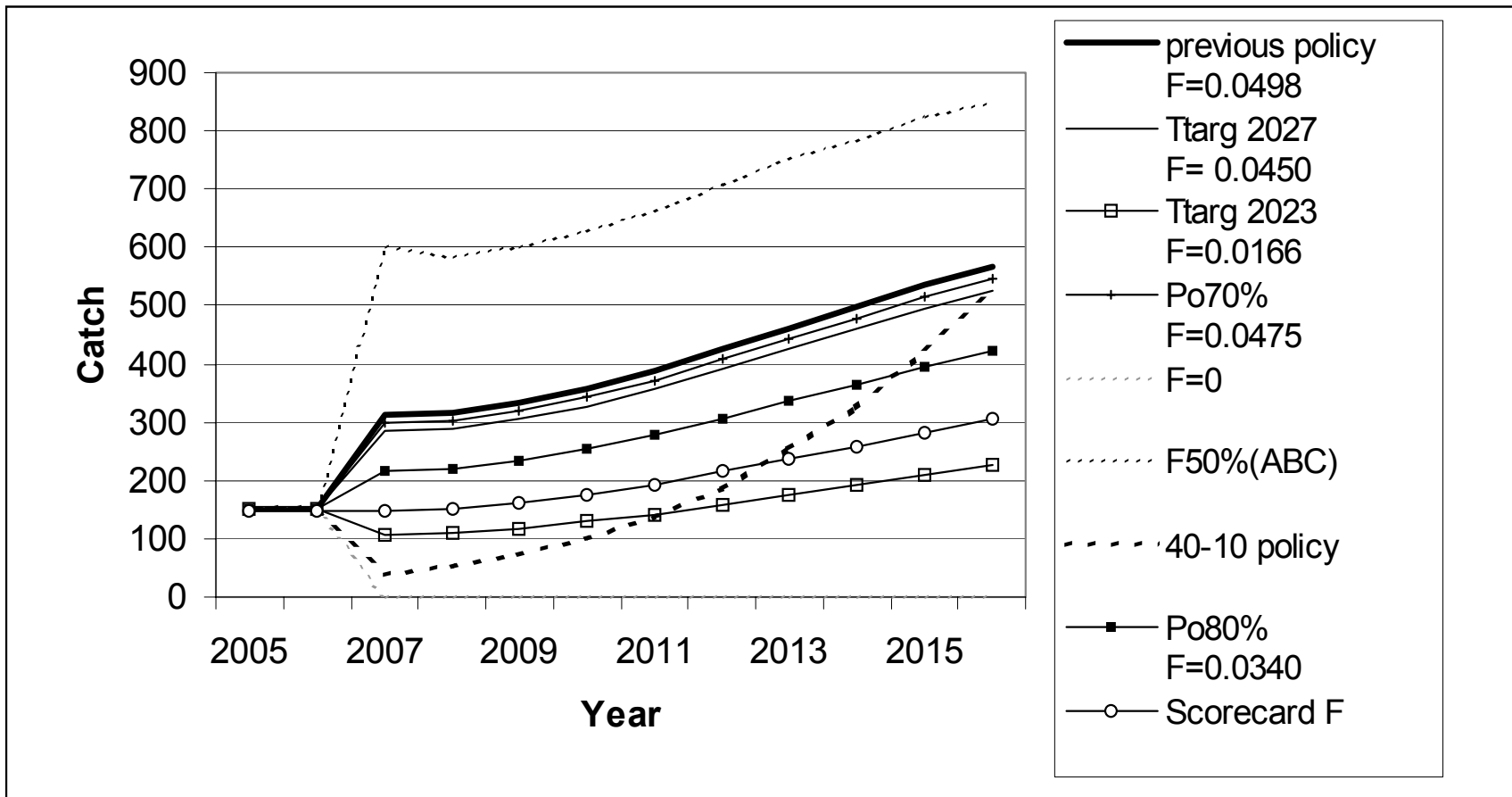


Figure 4. Median trajectories of catch for various cases in Table 4.

Appendix A. Projection data file for Run 1a.

```

# Title
bocaccio 2005 model STATC2005 resample to 2005 use current SPR=0.693 F=0.0498
# Number of sexes
2
# Age range to consider (minimum age; maximum age)
1 21
# Number of fleets to consider
1
# First year of the 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)
2
# 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
21
# Fecundity-at-age
# 1 2 3 4 5 6 7 8 9 ... 21+
0.000 0.002 0.026 0.131 0.325 0.547 0.762 0.965 1.160 1.345 1.513 1.659 1.781
1.882 1.965 2.032 2.086 2.129 2.163 2.191 2.265
# Age specific information (Females then males) weight and selectivit
# Females
0.223 0.499 0.878 1.313 1.771 2.227 2.663 3.071 3.446 3.783 4.074 4.319 4.522
4.690 4.828 4.939 5.028 5.100 5.157 5.203 5.328
0.166 0.501 0.792 0.965 0.987 0.903 0.775 0.647 0.545 0.477 0.436 0.411 0.396
0.386 0.379 0.373 0.369 0.366 0.364 0.362 0.357
# Males
0.223 0.463 0.770 1.101 1.430 1.742 2.025 2.276 2.495 2.681 2.839 2.972 3.082
3.174 3.250 3.313 3.365 3.408 3.442 3.471 3.560
0.167 0.466 0.725 0.906 0.995 1.000 0.958 0.898 0.833 0.772 0.717 0.671 0.633
0.602 0.578 0.559 0.545 0.533 0.524 0.517 0.501
# Age specific information (Females then males), natural mortality and numbers at age
# Females
0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15
0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15
442 575 151 91 13 1147 65 34 115 40 57 47 15
40 32 2 40 7 4 3 24
# Males
0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15
0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15
442 575 151 91 13 1150 65 35 115 40 57 47 15
41 32 2 36 6 3 2 11
# Initial age-structure (for Tmin)
2618 154 83 279 96 134 109 34 92 73 4 89 16
9 6 29 1 0 1 1 21
2618 154 83 280 98 138 113 36 96 76 4 83 13
7 4 18 1 0 0 0 6
# Year for Tmin Age-structure
2000
# Number of simulations

```

2000

Recruitment and Spanwer biomasses

Number of historical assessment years

55

Historical data: Year, Recruitment, Spawner biomass, Used to compute B0, Used to project based

on R, Used to project based on R/S

| | | | | | |
|------|-------|------|---|---|---|
| 1951 | 3523 | 3659 | 1 | 0 | 0 |
| 1952 | 3523 | 3640 | 1 | 0 | 0 |
| 1953 | 3523 | 3626 | 1 | 0 | 0 |
| 1954 | 3523 | 3564 | 1 | 0 | 0 |
| 1955 | 3523 | 3474 | 1 | 0 | 0 |
| 1956 | 3523 | 3362 | 1 | 0 | 0 |
| 1957 | 3523 | 3164 | 1 | 0 | 0 |
| 1958 | 3523 | 2933 | 1 | 0 | 0 |
| 1959 | 3523 | 2638 | 1 | 0 | 0 |
| 1960 | 2278 | 2432 | 1 | 0 | 0 |
| 1961 | 1268 | 2292 | 1 | 0 | 0 |
| 1962 | 1698 | 2247 | 1 | 0 | 0 |
| 1963 | 53828 | 2225 | 1 | 0 | 0 |
| 1964 | 767 | 2073 | 1 | 0 | 0 |
| 1965 | 602 | 2509 | 1 | 0 | 0 |
| 1966 | 802 | 4092 | 1 | 0 | 0 |
| 1967 | 1247 | 6054 | 1 | 0 | 0 |
| 1968 | 1860 | 7092 | 1 | 0 | 0 |
| 1969 | 2041 | 7610 | 1 | 0 | 0 |
| 1970 | 3091 | 7785 | 1 | 0 | 1 |
| 1971 | 15118 | 7626 | 1 | 0 | 1 |
| 1972 | 1732 | 7319 | 1 | 0 | 1 |
| 1973 | 2039 | 6841 | 1 | 0 | 1 |
| 1974 | 15668 | 5910 | 1 | 0 | 1 |
| 1975 | 5451 | 4821 | 1 | 0 | 1 |
| 1976 | 1258 | 4139 | 1 | 0 | 1 |
| 1977 | 511 | 3783 | 1 | 0 | 1 |
| 1978 | 23029 | 3860 | 1 | 0 | 1 |
| 1979 | 2367 | 3714 | 1 | 0 | 1 |
| 1980 | 8090 | 3499 | 1 | 0 | 1 |
| 1981 | 1395 | 3470 | 1 | 0 | 1 |
| 1982 | 1520 | 3488 | 1 | 0 | 1 |
| 1983 | 151 | 3144 | 1 | 0 | 1 |
| 1984 | 586 | 2610 | 1 | 0 | 1 |
| 1985 | 10474 | 2087 | 1 | 0 | 1 |
| 1986 | 1413 | 1723 | 1 | 0 | 1 |
| 1987 | 1332 | 1337 | 0 | 0 | 1 |
| 1988 | 1550 | 1212 | 0 | 0 | 1 |
| 1989 | 5564 | 1214 | 0 | 0 | 1 |
| 1990 | 167 | 1035 | 0 | 0 | 1 |
| 1991 | 1822 | 863 | 0 | 0 | 1 |
| 1992 | 1485 | 873 | 0 | 0 | 1 |
| 1993 | 374 | 844 | 0 | 0 | 1 |
| 1994 | 830 | 789 | 0 | 0 | 1 |
| 1995 | 755 | 751 | 0 | 0 | 1 |
| 1996 | 413 | 737 | 0 | 0 | 1 |
| 1997 | 953 | 731 | 0 | 0 | 1 |
| 1998 | 234 | 728 | 0 | 0 | 1 |
| 1999 | 362 | 760 | 0 | 0 | 1 |
| 2000 | 5235 | 795 | 0 | 0 | 1 |
| 2001 | 50 | 825 | 0 | 0 | 1 |
| 2002 | 291 | 878 | 0 | 0 | 1 |
| 2003 | 413 | 1038 | 0 | 0 | 1 |

```

2004 1342 1261 0 0 1
2005 885 1430 0 0 1
# Number of years with pre-specified catches
2
# Catches for years with pre-specified catches
2005 150
2006 150
# 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.)
2
# Steepness and sigma-R and auto-correlations
0.211 1.000000 0.0
# Target SPR rate (FMSY Proxy)
0.5
# Target SPR information: Use (1=Yes) and power
0 20
# Discount rate (for cumulative catch)
0.100000
# Truncate the series when 0.4B0 is reached (1=Yes)
0
# Set F to FMSY once 0.4B0 is reached (1=Yes; 2=Apply 40:10 rule after recovery)
2
# Percentage of FMSY which defines Ftarget
0.900000
# 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
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
# First 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 2 0 0.5
# Catches and Fs (Year; 1/2 (F or C); value); Final row is -1
2007 1 0.0498
-1 -1 -1
# Split of Fs
2005 1
2006 1
-1 1

```

```
# Time varying weight-at-age (1=Yes;0=No)
0
# File with time series of weight-at-age data
HakWght.Csv
```