Appendix to Gmacs SMBKC Stock Assessment

The data file:

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## #=====================================================================================================
## # Gmacs Main  Data  File  Version 1.1:  SM15 example
## # GEAR_INDEX    DESCRIPTION
## #    1          : Pot fishery retained catch.
## #    1          : Pot fishery with discarded catch.
## #    2          : Trawl bycatch
## #    3          : Fixed bycatch
## #    4          : Trawl survey
## #    5          : Pot survey
##
## # Fisheries:  1 Pot Fishery,  2 Pot Discard,  3 Trawl by-catch, 3 Fixed by-catch
## # Surveys:    4 NMFS Trawl Survey, 5 Pot Survey
## #=====================================================================================================
##
## 1978  # Start year
## 2016  # End year
## 2017  # Projection year
## 5     # Number of seasons
## 5     # Number of distinct data groups (among fishing fleets and surveys)
## 1     # Number of sexes
## 1     # Number of shell condition types
## 1     # Number of maturity types
## 3     # Number of size-classes in the model
## 5     # Season recruitment occurs
## 5     # Season molting and growth occurs
## 4     # Season to calculate SSB
## 1     # Season for N output
## # size_breaks (a vector giving the break points between size intervals with dimension nclass+1)
## 90   105   120   135
## # weight-at-length input method (1 = allometry i.e. w_l = a*l^b, 2 = vector by sex, 3 = matrix by se:
## 3
## # weight-at-length allometry w_l = a*l^b
## 4.03E-07
## # b (male, female)
## 3.141334
## # Male weight-at-length
## 0.000748427    0.001165731    0.001930510
## 0.000748427    0.001165731    0.001688886
## 0.000748427    0.001165731    0.001922246
## 0.000748427    0.001165731    0.001877957
## 0.000748427    0.001165731    0.001938634
## 0.000748427    0.001165731    0.002076413
## 0.000748427    0.001165731    0.001899330
## 0.000748427    0.001165731    0.002116687
## 0.000748427    0.001165731    0.001938784
## 0.000748427    0.001165731    0.001939764
## 0.000748427    0.001165731    0.001871067
## 0.000748427    0.001165731    0.001998295
## 0.000748427    0.001165731    0.001870418
## 0.000748427    0.001165731    0.001969415
## 0.000748427    0.001165731    0.001926859
## 0.000748427    0.001165731    0.002021492
```

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## 0.000748427      0.001165731      0.001931318
## 0.000748427      0.001165731      0.002014407
## 0.000748427      0.001165731      0.001977471
## 0.000748427      0.001165731      0.002099246
## 0.000748427      0.001165731      0.001982478
## 0.000748427      0.001165731      0.001930932
## 0.000748427      0.001165731      0.001930932
## 0.000748427      0.001165731      0.001930932
## 0.000748427      0.001165731      0.001930932
## 0.000748427      0.001165731      0.001930932
## 0.000748427      0.001165731      0.001930932
## 0.000748427      0.001165731      0.001930932
## 0.000748427      0.001165731      0.001930932
## 0.000748427      0.001165731      0.001930932
## 0.000748427      0.001165731      0.001891628
## 0.000748427      0.001165731      0.001795721
## 0.000748427      0.001165731      0.001823113
## 0.000748427      0.001165731      0.001807433
## 0.000748427      0.001165731      0.001930932
## 0.000748427      0.001165731      0.001894627
## 0.000748427      0.001165731      0.001850611
## 0.000748427      0.001165731      0.001930932
## # Male mature weight-at-length (weight * proportion  mature)
## 0 0.001165732 0.001945911
## # Proportion mature by sex
## 0 1 1
## # Natural mortality per season input type (1 = vector by season, 2 = matrix by season/year)
## 2
## # Proportion of the total natural mortality to be applied each season (each row must add to 1)
## #0  0.0025  0  0.6245  0.373
##     0.0000   0.0700   0.0000   0.5600   0.3700
##     0.0000   0.0600   0.0000   0.5700   0.3700
##     0.0000   0.0700   0.0000   0.5600   0.3700
##     0.0000   0.0500   0.0000   0.5800   0.3700
##     0.0000   0.0700   0.0000   0.5600   0.3700
##     0.0000   0.1200   0.0000   0.5100   0.3700
##     0.0000   0.1000   0.0000   0.5300   0.3700
##     0.0000   0.1400   0.0000   0.4900   0.3700
##     0.0000   0.1400   0.0000   0.4900   0.3700
##     0.0000   0.1400   0.0000   0.4900   0.3700
##     0.0000   0.1400   0.0000   0.4900   0.3700
##     0.0000   0.1400   0.0000   0.4900   0.3700
##     0.0000   0.1400   0.0000   0.4900   0.3700
##     0.0000   0.1800   0.0000   0.4500   0.3700
##     0.0000   0.1400   0.0000   0.4900   0.3700
##     0.0000   0.1800   0.0000   0.4500   0.3700
##     0.0000   0.1800   0.0000   0.4500   0.3700
##     0.0000   0.1800   0.0000   0.4500   0.3700
##     0.0000   0.1800   0.0000   0.4500   0.3700
##     0.0000   0.1800   0.0000   0.4500   0.3700
##     0.0000   0.1800   0.0000   0.4500   0.3700
##     0.0000   0.1800   0.0000   0.4500   0.3700
##     0.0000   0.1800   0.0000   0.4500   0.3700
```

```
##     0.0000    0.1800    0.0000    0.4500    0.3700
##     0.0000    0.1800    0.0000    0.4500    0.3700
##     0.0000    0.1800    0.0000    0.4500    0.3700
##     0.0000    0.1800    0.0000    0.4500    0.3700
##     0.0000    0.1800    0.0000    0.4500    0.3700
##     0.0000    0.1800    0.0000    0.4500    0.3700
##     0.0000    0.1800    0.0000    0.4500    0.3700
##     0.0000    0.1800    0.0000    0.4500    0.3700
##     0.0000    0.4400    0.0000    0.1900    0.3700
##     0.0000    0.4400    0.0000    0.1900    0.3700
##     0.0000    0.4400    0.0000    0.1900    0.3700
##     0.0000    0.4400    0.0000    0.1900    0.3700
##     0.0000    0.4400    0.0000    0.1900    0.3700
##     0.0000    0.4400    0.0000    0.1900    0.3700
##     0.0000    0.4400    0.0000    0.1900    0.3700
##     0.0000    0.4400    0.0000    0.1900    0.3700
## # Fishing fleet names (delimited with : no spaces in names)
## Pot_Fishery:Trawl_Bycatch:Fixed_bycatch
## # Survey names (delimited with : no spaces in names)
## NMFS_Trawl:ADFG_Pot
## # Number  of  catch data  frames
## 4
## # Number  of  rows  in  each  data  frame
## 27  15  25  25
## ##  CATCH DATA
## ##  Type of catch: 1 = retained, 2 = discard
## ##  Units of catch: 1 = biomass, 2 = numbers
## ##  for SMBKC Units are in number of crab for landed & 1000 kg for discards.
## ##  Male Retained
## # year  seas   fleet   sex     obs      cv      type    units   mult    effort  discard_mortality
## 1978    2      1       1       436126   0.03    1       2       1       0       0
## 1979    2      1       1       52966    0.03    1       2       1       0       0
## 1980    2      1       1       33162    0.03    1       2       1       0       0
## 1981    2      1       1       1045619  0.03    1       2       1       0       0
## 1982    2      1       1       1935886  0.03    1       2       1       0       0
## 1983    2      1       1       1931990  0.03    1       2       1       0       0
## 1984    2      1       1       841017   0.03    1       2       1       0       0
## 1985    2      1       1       436021   0.03    1       2       1       0       0
## 1986    2      1       1       219548   0.03    1       2       1       0       0
## 1987    2      1       1       227447   0.03    1       2       1       0       0
## 1988    2      1       1       280401   0.03    1       2       1       0       0
## 1989    2      1       1       247641   0.03    1       2       1       0       0
## 1990    2      1       1       391405   0.03    1       2       1       0       0
## 1991    2      1       1       726519   0.03    1       2       1       0       0
## 1992    2      1       1       545222   0.03    1       2       1       0       0
## 1993    2      1       1       630353   0.03    1       2       1       0       0
## 1994    2      1       1       827015   0.03    1       2       1       0       0
## 1995    2      1       1       666905   0.03    1       2       1       0       0
## 1996    2      1       1       660665   0.03    1       2       1       0       0
## 1997    2      1       1       939822   0.03    1       2       1       0       0
## 1998    2      1       1       635370   0.03    1       2       1       0       0
## 2009    2      1       1       103376   0.03    1       2       1       0       0
## 2010    2      1       1       298669   0.03    1       2       1       0       0
## 2011    2      1       1       437862   0.03    1       2       1       0       0
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## 2012     2      1        1       379386  0.03    1       2       1       0       0
## 2014     2      1        1       69109   0.03    1       2       1       0       0
## 2015     2      1        1       24407   0.03    1       2       1       0       0
## # Male   discards  Pot fishery
## #1990    2      1        1       115.656434568   0.6     2       1       1       0       0.2
## #1991    2      1        1       241.060561216   0.6     2       1       1       0       0.2
## #1992    2      1        1       476.447140104   0.6     2       1       1       0       0.2
## #1993    2      1        1       431.576005096   0.6     2       1       1       0       0.2
## #1994    2      1        1       549.19331788    0.6     2       1       1       0       0.2
## #1995    2      1        1       164.704698304   0.6     2       1       1       0       0.2
## #1996    2      1        1       239.734258208   0.6     2       1       1       0       0.2
## #1997    2      1        1       627.2383574     0.6     2       1       1       0       0.2
## #1998    2      1        1       354.302071976   0.6     2       1       1       0       0.2
## #2009    2      1        1       55.960098632    0.2     2       1       1       0       0.2
## #2010    2      1        1       138.189524352   0.2     2       1       1       0       0.2
## #2011    2      1        1       218.339684344   0.2     2       1       1       0       0.2
## #2012    2      1        1       198.372110912   0.2     2       1       1       0       0.2
## #2014    2      1        1       20.631178528    0.2     2       1       1       0       0.2
## #above are the 2015 file values. It looks like the lbs has been converted twice for kg. The following
## 1990     2      1        1       254.9787861     0.6     2       1       1       0       0.2
## 1991     2      1        1       531.4483252     0.6     2       1       1       0       0.2
## 1992     2      1        1       1050.387026     0.6     2       1       1       0       0.2
## 1993     2      1        1       951.4626128     0.6     2       1       1       0       0.2
## 1994     2      1        1       1210.764588     0.6     2       1       1       0       0.2
## 1995     2      1        1       363.112032      0.6     2       1       1       0       0.2
## 1996     2      1        1       528.5244687     0.6     2       1       1       0       0.2
## 1997     2      1        1       1382.825328     0.6     2       1       1       0       0.2
## 1998     2      1        1       781.1032977     0.6     2       1       1       0       0.2
## 2009     2      1        1       123.3712279     0.2     2       1       1       0       0.2
## 2010     2      1        1       304.6562225     0.2     2       1       1       0       0.2
## 2011     2      1        1       481.3572126     0.2     2       1       1       0       0.2
## 2012     2      1        1       437.3360731     0.2     2       1       1       0       0.2
## 2014     2      1        1       45.4839749      0.2     2       1       1       0       0.2
## 2015     2      1        1       21.19378597     0.2     2       1       1       0       0.2
## # Trawl fishery discards
## 1991     2      2        1       3.538   0.31    2       1       1       0       0.8
## 1992     2      2        1       1.996   0.31    2       1       1       0       0.8
## 1993     2      2        1       1.542   0.31    2       1       1       0       0.8
## 1994     2      2        1       0.318   0.31    2       1       1       0       0.8
## 1995     2      2        1       0.635   0.31    2       1       1       0       0.8
## 1996     2      2        1       0.0001  0.31    2       1       1       0       0.8
## 1997     2      2        1       0.0001  0.31    2       1       1       0       0.8
## 1998     2      2        1       0.0001  0.31    2       1       1       0       0.8
## 1999     2      2        1       0.0001  0.31    2       1       1       0       0.8
## 2000     2      2        1       0.0001  0.31    2       1       1       0       0.8
## 2001     2      2        1       0.0001  0.31    2       1       1       0       0.8
## 2002     2      2        1       0.726   0.31    2       1       1       0       0.8
## 2003     2      2        1       0.998   0.31    2       1       1       0       0.8
## 2004     2      2        1       0.091   0.31    2       1       1       0       0.8
## 2005     2      2        1       0.0001  0.31    2       1       1       0       0.8
## 2006     2      2        1       2.812   0.31    2       1       1       0       0.8
## 2007     2      2        1       0.045   0.31    2       1       1       0       0.8
## 2008     2      2        1       0.272   0.31    2       1       1       0       0.8
## 2009     2      2        1       0.635   0.31    2       1       1       0       0.8
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## 2010    2       2       1       0.363   0.31    2       1       1       0       0.8
## 2011    2       2       1       0.181   0.31    2       1       1       0       0.8
## 2012    2       2       1       0.0001  0.31    2       1       1       0       0.8
## 2013    2       2       1       0.181   0.31    2       1       1       0       0.8
## 2014    2       2       1       0.0001  0.31    2       1       1       0       0.8
## 2015    2       2       1       0.0001  0.31    2       1       1       0       0.8
## # Fixed fishery discards
## 1991    2       3       1       0.045   0.31    2       1       1       0       0.5
## 1992    2       3       1       2.268   0.31    2       1       1       0       0.5
## 1993    2       3       1       0.0001  0.31    2       1       1       0       0.5
## 1994    2       3       1       0.091   0.31    2       1       1       0       0.5
## 1995    2       3       1       0.136   0.31    2       1       1       0       0.5
## 1996    2       3       1       0.045   0.31    2       1       1       0       0.5
## 1997    2       3       1       0.181   0.31    2       1       1       0       0.5
## 1998    2       3       1       0.907   0.31    2       1       1       0       0.5
## 1999    2       3       1       1.361   0.31    2       1       1       0       0.5
## 2000    2       3       1       0.0001  0.31    2       1       1       0       0.5
## 2001    2       3       1       0.862   0.31    2       1       1       0       0.5
## 2002    2       3       1       0.408   0.31    2       1       1       0       0.5
## 2003    2       3       1       1.134   0.31    2       1       1       0       0.5
## 2004    2       3       1       0.635   0.31    2       1       1       0       0.5
## 2005    2       3       1       0.590   0.31    2       1       1       0       0.5
## 2006    2       3       1       1.451   0.31    2       1       1       0       0.5
## 2007    2       3       1       69.717  0.31    2       1       1       0       0.5
## 2008    2       3       1       6.622   0.31    2       1       1       0       0.5
## 2009    2       3       1       7.530   0.31    2       1       1       0       0.5
## 2010    2       3       1       9.571   0.31    2       1       1       0       0.5
## 2011    2       3       1       0.590   0.31    2       1       1       0       0.5
## 2012    2       3       1       0.590   0.31    2       1       1       0       0.5
## 2013    2       3       1       0.272   0.31    2       1       1       0       0.5
## 2014    2       3       1       0.272   0.31    2       1       1       0       0.5
## 2015    2       3       1       0.635   0.31    2       1       1       0       0.5
## ##   RELATIVE  ABUNDANCE DATA
## ##   Units of abundance: 1 = biomass, 2 = numbers
## ##   for SMBKC Units are in  crabs for Abundance.
## ##   Number  of  relative  abundance indicies
## 2
## ##   Number  of  rows  in  each  index
## 39  8
## # Survey data (abundance indices, units are mt for trawl survey and crab/potlift for pot survey)
## # Year, Seas, Fleet,  Sex,  Abundance,  CV      units
## 1978  1 4 1 6832.819  0.394 1
## 1979  1 4 1 7989.881  0.463 1
## 1980  1 4 1 9986.830  0.507 1
## 1981  1 4 1 6551.132  0.402 1
## 1982  1 4 1 16221.933 0.344 1
## 1983  1 4 1 9634.250  0.298 1
## 1984  1 4 1 4071.218  0.179 1
## 1985  1 4 1 3110.541  0.210 1
## 1986  1 4 1 1416.849  0.388 1
## 1987  1 4 1 2278.917  0.291 1
## 1988  1 4 1 3158.169  0.252 1
## 1989  1 4 1 6338.622  0.271 1
## 1990  1 4 1 6730.130  0.274 1
```

```
## 1991   1 4 1 6948.184  0.248 1
## 1992   1 4 1 7093.272  0.201 1
## 1993   1 4 1 9548.459  0.169 1
## 1994   1 4 1 6539.133  0.176 1
## 1995   1 4 1 5703.591  0.178 1
## 1996   1 4 1 9410.403  0.241 1
## 1997   1 4 1 10924.107 0.337 1
## 1998   1 4 1 7976.839  0.355 1
## 1999   1 4 1 1594.546  0.182 1
## 2000   1 4 1 2096.795  0.310 1
## 2001   1 4 1 2831.440  0.245 1
## 2002   1 4 1 1732.599  0.320 1
## 2003   1 4 1 1566.675  0.336 1
## 2004   1 4 1 1523.869  0.305 1
## 2005   1 4 1 1642.017  0.371 1
## 2006   1 4 1 3893.875  0.334 1
## 2007   1 4 1 6470.773  0.385 1
## 2008   1 4 1 4654.473  0.284 1
## 2009   1 4 1 6301.470  0.256 1
## 2010   1 4 1 11130.898 0.466 1
## 2011   1 4 1 10931.232 0.558 1
## 2012   1 4 1 6200.219  0.339 1
## 2013   1 4 1 2287.557  0.217 1
## 2014   1 4 1 6029.220  0.449 1
## 2015   1 4 1 5877.433  0.770 1
## 2016   1 4 1 3485.909  0.393 1
## 1995   1 5 1 12042.000 0.130 2
## 1998   1 5 1 12531.000 0.060 2
## 2001   1 5 1 8477.000  0.080 2
## 2004   1 5 1 1667.000  0.150 2
## 2007   1 5 1 8643.000  0.090 2
## 2010   1 5 1 10209.000 0.130 2
## 2013   1 5 1 5643.000  0.190 2
## 2015   1 5 1 2805.000  0.180 2
## ##2016
## ##  Number  of  length  frequency  matrices
## 3
## ##  Number  of  rows  in  each  matrix
## 15  39  8
## ##  Number  of  bins  in  each  matrix  (columns  of  size  data)
## 3  3  3
## ##  SIZE  COMPOSITION DATA  FOR ALL FLEETS
## ##  SIZE  COMP  LEGEND
## ##  Sex:  1 = male, 2 = female, 0 = both  sexes combined
## ##  Type  of  composition: 1 = retained, 2 = discard,  0 = total composition
## ##  Maturity  state:  1 = immature, 2 = mature, 0 = both  states  combined
## ##  Shell condition: 1 = new shell,  2 = old shell,  0 = both  shell types combined
## ##length  proportions of  pot discarded males
## ##Year, Seas, Fleet,  Sex,  Type, Shell,  Maturity, Nsamp,  DataVec
##   1990  2 1 1 0 0 0 15  0.1133  0.3933  0.4933
##   1991  2 1 1 0 0 0 25  0.1329  0.1768  0.6902
##   1992  2 1 1 0 0 0 25  0.1905  0.2677  0.5417
##   1993  2 1 1 0 0 0 25  0.2807  0.2097  0.5096
##   1994  2 1 1 0 0 0 25  0.2942  0.2714  0.4344
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##    1995   2 1 1 0 0 0 25   0.1478   0.2127   0.6395
##    1996   2 1 1 0 0 0 25   0.1595   0.2229   0.6176
##    1997   2 1 1 0 0 0 25   0.1818   0.2053   0.6128
##    1998   2 1 1 0 0 0 25   0.1927   0.2162   0.5911
##    2009   2 1 1 0 0 0 50   0.1413   0.3235   0.5352
##    2010   2 1 1 0 0 0 50   0.1314   0.3152   0.5534
##    2011   2 1 1 0 0 0 50   0.1314   0.3051   0.5636
##    2012   2 1 1 0 0 0 50   0.1417   0.3178   0.5406
##    2014   2 1 1 0 0 0 50   0.0939   0.2275   0.6786
##    2015   2 1 1 0 0 0 50   0.1148   0.2518   0.6333
## ##length  proportions of  trawl survey  males
## ##Year, Seas, Fleet,  Sex,  Type,  Shell,  Maturity, Nsamp,  DataVec
##    1978   1 4 1 0 0 0 50    0.3865   0.3478   0.2657
##    1979   1 4 1 0 0 0 50    0.4281   0.3190   0.2529
##    1980   1 4 1 0 0 0 50    0.3588   0.3220   0.3192
##    1981   1 4 1 0 0 0 50    0.1219   0.3065   0.5716
##    1982   1 4 1 0 0 0 50    0.1671   0.2435   0.5893
##    1983   1 4 1 0 0 0 50    0.1752   0.2726   0.5522
##    1984   1 4 1 0 0 0 50    0.1823   0.2085   0.6092
##    1985   1 4 1 0 0 0 46.5  0.2023   0.2010   0.5967
##    1986   1 4 1 0 0 0 23    0.1984   0.4364   0.3652
##    1987   1 4 1 0 0 0 35.5  0.1944   0.3779   0.4277
##    1988   1 4 1 0 0 0 40.5  0.1879   0.3737   0.4384
##    1989   1 4 1 0 0 0 50    0.4246   0.2259   0.3496
##    1990   1 4 1 0 0 0 50    0.2380   0.2332   0.5288
##    1991   1 4 1 0 0 0 50    0.2274   0.3300   0.4426
##    1992   1 4 1 0 0 0 50    0.2263   0.2911   0.4826
##    1993   1 4 1 0 0 0 50    0.2296   0.2759   0.4945
##    1994   1 4 1 0 0 0 50    0.1989   0.2926   0.5085
##    1995   1 4 1 0 0 0 50    0.2593   0.3005   0.4403
##    1996   1 4 1 0 0 0 50    0.1998   0.3054   0.4948
##    1997   1 4 1 0 0 0 50    0.1622   0.3102   0.5275
##    1998   1 4 1 0 0 0 50    0.1276   0.3212   0.5511
##    1999   1 4 1 0 0 0 26    0.2224   0.2214   0.5562
##    2000   1 4 1 0 0 0 30.5  0.2154   0.2180   0.5665
##    2001   1 4 1 0 0 0 45.5  0.2253   0.2699   0.5048
##    2002   1 4 1 0 0 0 19    0.1127   0.2346   0.6527
##    2003   1 4 1 0 0 0 32.5  0.3762   0.2345   0.3893
##    2004   1 4 1 0 0 0 24    0.2488   0.1848   0.5663
##    2005   1 4 1 0 0 0 21    0.2825   0.2744   0.4431
##    2006   1 4 1 0 0 0 50    0.3276   0.2293   0.4431
##    2007   1 4 1 0 0 0 50    0.4394   0.3525   0.2081
##    2008   1 4 1 0 0 0 50    0.3745   0.2219   0.4036
##    2009   1 4 1 0 0 0 50    0.3057   0.4202   0.2741
##    2010   1 4 1 0 0 0 50    0.4081   0.3371   0.2548
##    2011   1 4 1 0 0 0 50    0.2179   0.3940   0.3881
##    2012   1 4 1 0 0 0 50    0.1573   0.4393   0.4034
##    2013   1 4 1 0 0 0 37    0.2100   0.2834   0.5065
##    2014   1 4 1 0 0 0 50    0.1738   0.3912   0.4350
##    2015   1 4 1 0 0 0 50    0.2340   0.2994   0.4666
##    2016   1 4 1 0 0 0 50    0.2255   0.2780   0.4965
##    ##length  proportions of  pot survey
##    ##Year, Seas, Fleet,  Sex,  Type,  Shell,  Maturity, Nsamp,  DataVec
##    1995   1 5 1 0 0 0 100 0.1594  0.2656   0.5751
```

```
##    1998  1 5 1 0 0 0 100  0.0769  0.2205  0.7026
##    2001  1 5 1 0 0 0 100  0.1493  0.2049  0.6457
##    2004  1 5 1 0 0 0 100  0.0672  0.2484  0.6845
##    2007  1 5 1 0 0 0 100  0.1257  0.3148  0.5595
##    2010  1 5 1 0 0 0 100  0.1299  0.3209  0.5492
##    2013  1 5 1 0 0 0 100  0.1556  0.2477  0.5967
##    2015  1 5 1 0 0 0 100  0.0706  0.2431  0.6859
## ##2016
## ##  Growth data (increment)
## # nobs_growth
## 3
## # MidPoint Sex Increment CV
##  97.5  1  14.1  0.2197
## 112.5  1  14.1  0.2197
## 127.5  1  14.1  0.2197
## #  97.5   1 13.8 0.2197
## #  112.5  1 14.1 0.2197
## #  127.5  1 14.4 0.2197
## # Use custom growth transition matrix (0=no, 1=yes)
## 1
## # The custom growth matrix (if not using just fill with zeros)
## # Alternative TM (loosely) based on Otto and Cummiskey (1990)
## 0.2  0.7  0.1
## 0.0  0.4  0.6
## 0.0  0.0  1.0
## ## eof
## 9999
##
```

The base model control file:

```
## # Set up to do Stock Reduction Analysis using Catch data and informative priors.
## # Controls for leading parameter vector theta
## # LEGEND FOR PRIOR:
## #                  0 -> uniform
## #                  1 -> normal
## #                  2 -> lognormal
## #                  3 -> beta
## #                  4 -> gamma
## # ntheta
##   12
## # ival      lb       ub      phz   prior    p1      p2       # parameter          #
##   0.18     0.01       1      -4      2    0.18    0.02       # M
##   14.3     -7.0      30      -2      0    -7       30        # log(R0)
##   10.0     -7.0      20      -1      1    -10.0    20.0      # log(Rini)
##   13.7222  -7.0      20       1      0    -7       30        # log(Rbar)
##   80.0     30.0     310      -2      1    72.5     7.25      # Recruitment size distribution
##   0.25      0.1       7      -4      0    0.1      9.0       # Recruitment size scale (varian
##   0.2     -10.0     0.75     -4      0    -10.0    0.75      # log(sigma_R)
##   0.75     0.20     1.00     -2      3    3.0      2.00      # steepness
##   0.01     0.00     1.00     -3      3    1.01     1.01      # recruitment autocorrelation
##   14.5     5.00     18.00     1      0    5.00     15.00     # logN0 vector of initial number
##   14.0     5.00     18.00     1      0    5.00     15.00     # logN0 vector of initial number
```

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```
## 13.5         5.00     18.00         1      0    5.00  15.00            # logN0 vector of initial number
## ## GROWTH PARAM CONTROLS                                                        ##
## ## Two lines for each parameter if split sex, one line if not                   ##
## # ival       lb        ub      phz  prior    p1      p2      # parameter         #
##   14.1      10.0      30.0      -3      0    0.0   999.0      # alpha males or combined
##    0.0001    0.0       0.01     -3      0    0.0   999.0      # beta males or combined
##    0.45      0.01      1.0      -3      0    0.0   999.0      # gscale males or combined
##  121.5      65.0     145.0      -4      0    0.0   999.0      # molt_mu males or combined
##    0.060     0.0       1.0      -3      0    0.0   999.0      # molt_cv males or combined
##
## ## --------------------------------------------------------------------------- ##
## ## SELECTIVITY CONTROLS                                                         ##
## ##      Each gear must have a selectivity and a retention selectivity. If a uniform   ##
## ##      prior is selected for a parameter then the lb and ub are used (p1 and p2 are  ##
## ##      ignored)                                                                ##
## ## LEGEND                                                                       ##
## ##      sel type: 0 = parametric, 1 = coefficients, 2 = logistic, 3 = logistic95,    ##
## ##                4 = double normal (NIY)                                       ##
## ##      gear index: use +ve for selectivity, -ve for retention                 ##
## ##      sex dep: 0 for sex-independent, 1 for sex-dependent                     ##
## ## --------------------------------------------------------------------------- ##
## ## ivector for number of year periods or nodes                                 ##
## ## POT        TBycatch FBycatch  NMFS_S   ADFG_pot
## ## Gear-1     Gear-2   Gear-3    Gear-4   Gear-5
##    2          1        1         1        1          # Selectivity periods
##    0          0        0         0        0          # sex specific selectivity
##    0          3        3         0        0          # male selectivity type
## ## Gear-1     Gear-2   Gear-3    Gear-4   Gear-5
##    1          1        1         1        1          # Retention periods
##    0          0        0         0        0          # sex specific retention
##    3          2        2         2        2          # male retention type
##    1          0        0         0        0          # male retention flag (0 -> no, 1 -> yes)
## ## gear   par   sel                                  phz    start  end        ##
## ## index index par sex   ival   lb     ub     prior p1      p2    mirror period period    ##
## # Gear-1
##    1      1     1   0   0.432928096608 0.001 2.0    0       0       1      -2     1978   2008
##    1      2     2   0   0.670336057209 0.001 2.0    0       0       1      -2     1978   2008
##    1      3     3   0   1.0            0.001 2.0    0       0       1      -2     1978   2008
##    1      1     1   0   0.392207758620 0.001 2.0    0       0       1      -2     2009   2015
##    1      2     2   0   0.956150805823 0.001 2.0    0       0       1      -2     2009   2015
##    1      3     3   0   1.0            0.001 2.0    0       0       1      -2     2009   2015
## # Gear-2
##    2      7     1   0   40             10.0  200    0      10      200     -3     1978   2015
##    2      8     2   0   60             10.0  200    0      10      200     -3     1978   2015
## # Gear-3
##    3      9     1   0   40             10.0  200    0      10      200     -3     1978   2015
##    3     10     2   0   60             10.0  200    0      10      200     -3     1978   2015
## # Gear-4
##    4      8     1   0   0.79506450558  0.001 2.0    0       0       1      -2     1978   2015
##    4      9     2   0   1.08723867992  0.001 2.0    0       0       1      -2     1978   2015
##    4     10     3   0   1.0            0.001 2.0    0       0       1      -2     1978   2015
## # Gear-5
##    5     11     1   0   0.405292074017 0.001 2.0    0       0       1      -2     1978   2015
##    5     12     2   0   0.855141058500 0.001 2.0    0       0       1      -2     1978   2015
```

```
##     5      13     3    0    1.0                   0.001 2.0    0         0       1    -2     1978    2015
## ## Retained
## # Gear-1
##    -1     14     1    0    120   100   200   0      1    900   -1     1978    2015
##    -1     15     2    0    123   110   200   0      1    900   -1     1978    2015
## # Gear-2
##    -2     16     1    0    595   1     700   0      1    900   -3     1978    2015
##    -2     17     2    0    10    1     700   0      1    900   -3     1978    2015
## # Gear-3
##    -3     18     1    0    590   1     700   0      1    900   -3     1978    2015
##    -3     19     2    0    10    1     700   0      1    900   -3     1978    2015
## # Gear-4
##    -4     20     1    0    580   1     700   0      1    900   -3     1978    2015
##    -4     21     2    0    20    1     700   0      1    900   -3     1978    2015
## # Gear-5
##    -5     22     1    0    580   1     700   0      1    900   -3     1978    2015
##    -5     23     2    0    20    1     700   0      1    900   -3     1978    2015
##
## ## ------------------------------------------------------------------------ ##
## ## PRIORS FOR CATCHABILITY
## ##      If a uniform prior is selected for a parameter then the lb and ub are used (p1   ##
## ##      and p2 are ignored). ival must be > 0                                          ##
## ## LEGEND                                                                              ##
## ##      prior: 0 = uniform, 1 = normal, 2 = lognormal, 3 = beta, 4 = gamma             ##
## ## ------------------------------------------------------------------------ ##
## ##  LAMBDA: Arbitrary relative weights for each series, 0 = do not fit.
## ## SURVEYS/INDICES ONLY
## ## ival     lb       ub     phz    prior   p1        p2      Analytic?   LAMBDA
##   1.0       0        2      -1     0       0         9.0     0           1       # NMFS trawl
## 4.26724288404e-06 0 5      1      0       0         9.0     0           1       # ADF&G pot
## ## ------------------------------------------------------------------------ ##
##
## ## ------------------------------------------------------------------------ ##
## ## ADDITIONAL CV FOR SURVEYS/INDICES                                                   ##
## ##      If a uniform prior is selected for a parameter then the lb and ub are used (p1   ##
## ##      and p2 are ignored). ival must be > 0                                          ##
## ## LEGEND                                                                              ##
## ##      prior: 0 = uniform, 1 = normal, 2 = lognormal, 3 = beta, 4 = gamma             ##
## ## ------------------------------------------------------------------------ ##
## ## ival        lb        ub       phz    prior   p1      p2
##   0.00001     0.000001   10.0     -4     4       1.0     100    # NMFS
##   0.00001     0.000001   10.0     -4     4       1.0     100    # ADF&G
## ## ------------------------------------------------------------------------ ##
##
## ## ------------------------------------------------------------------------ ##
## ## PENALTIES FOR AVERAGE FISHING MORTALITY RATE FOR EACH GEAR
## ## ------------------------------------------------------------------------ ##
## ## Mean_F  STD_PHZ1   STD_PHZ2      PHZ
##   0.3       0.05      50.0        1   # Pot
##   0.001     0.05      50.0        1   # Trawl
##   0.001     0.05      50.0        1   # Fixed
##   0.00      2.00      20.00       -1  # NMFS
##   0.00      2.00      20.00       -1  # ADF&G
## ## ------------------------------------------------------------------------ ##
```

```
##
## ## -------------------------------------------------------------------------------------- ##
## ## OPTIONS FOR SIZE COMPOSTION DATA (COLUMN FOR EACH MATRIX)
## ## -------------------------------------------------------------------------------------- ##
## ## LIKELIHOOD OPTIONS
## ##    -1) Multinomial with estimated/fixed sample size
## ##    -2) Robust approximation to multinomial
## ##    -3) logistic normal (NIY)
## ##    -4) multivariate-t (NIY)
## ##    -5) Dirichlet
## ## AUTOTAIL COMPRESSION
## ##    pmin is the cumulative proportion used in tail compression.
## ## -------------------------------------------------------------------------------------- ##
## #  1   1   1  # Type of likelihood
##    2   2   2  # Type of likelihood
## #  5   5   5   # Type of likelihood
##    0   0   0   # Auto tail compression (pmin)
##    1   1   1   # Initial value for effective sample size multiplier
##   -4  -4  -4   # Phz for estimating effective sample size (if appl.)
##    1   2   3   # Composition aggregator
##    1   1   1   # LAMBDA
## ## -------------------------------------------------------------------------------------- ##
##
## ## -------------------------------------------------------------------------------------- ##
## ## TIME VARYING NATURAL MORTALIIY RATES                                                   ##
## ## -------------------------------------------------------------------------------------- ##
## ## TYPE:
## ##      0 = constant natural mortality
## ##      1 = Random walk (deviates constrained by variance in M)
## ##      2 = Cubic Spline (deviates constrained by nodes & node-placement)
## ##      3 = Blocked changes (deviates constrained by variance at specific knots)
## ##      4 = Time blocks
## ## -------------------------------------------------------------------------------------- ##
## ## Type
## 3
## ## Phase of estimation
## 4
## ## STDEV in m_dev for Random walk
## 10.0
## ## Number of nodes for cubic spline or number of step-changes for option 3
## 2
## ## Year position of the knots (vector must be equal to the number of nodes)
## 1998 1999
## ## -------------------------------------------------------------------------------------- ##
##
## ## -------------------------------------------------------------------------------------- ##
## ## OTHER CONTROLS
## ## -------------------------------------------------------------------------------------- ##
##   3      # Estimated rec_dev phase
##   3      # Estimated rec_ini phase
##   0      # VERBOSE FLAG (0 = off, 1 = on, 2 = objective func)
##   2      # Initial conditions (0 = Unfished, 1 = Steady-state fished, 2 = Free parameters)
##   1978   # First year for average recruitment for Bspr calculation
##   2016   # Last year for average recruitment for Bspr calculation
```

```
##    0.35      # Target SPR ratio for Bmsy proxy
##    1         # Gear index for SPR calculations (i.e. directed fishery)
##    1         # Lambda (proportion of mature male biomass for SPR reference points)
##    1         # Use empirical molt increment data (0 = FALSE, 1 = TRUE)
##    0         # Stock-Recruit-Relationship (0 = None, 1 = Beverton-Holt)
## ## EOF
## 9999
```

The selex model control file:

```
## # Set up to do Stock Reduction Analysis using Catch data and informative priors.
## # Controls for leading parameter vector theta
## # LEGEND FOR PRIOR:
## #                    0 -> uniform
## #                    1 -> normal
## #                    2 -> lognormal
## #                    3 -> beta
## #                    4 -> gamma
## # ntheta
##   12
## # ival        lb        ub        phz   prior     p1      p2        # parameter           #
##   0.18       0.01        1        -4      2     0.18    0.02        # M
##   14.3       -7.0        30       -2      0      -7      30         # log(R0)
##   10.0       -7.0        20       -1      1     -10.0   20.0        # log(Rini)
##   13.7222    -7.0        20        1      0      -7      30         # log(Rbar)
##   80.0       30.0        310      -2      1     72.5    7.25        # Recruitment size distribution
##   0.25       0.1          7       -4      0      0.1     9.0        # Recruitment size scale (varia
##   0.2       -10.0        0.75     -4      0     -10.0   0.75        # log(sigma_R)
##   0.75       0.20        1.00     -2      3      3.0    2.00        # steepness
##   0.01       0.00        1.00     -3      3     1.01    1.01        # recruitment autocorrelation
##   14.5       5.00       18.00      1      0     5.00    15.00       # logN0 vector of initial number
##   14.0       5.00       18.00      1      0     5.00    15.00       # logN0 vector of initial number
##   13.5       5.00       18.00      1      0     5.00    15.00       # logN0 vector of initial number
## ## GROWTH PARAM CONTROLS                                                                   ##
## ## Two lines for each parameter if split sex, one line if not                             ##
## # ival        lb        ub        phz  prior    p1      p2        # parameter           #
##   14.1       10.0       30.0      -3      0     0.0    999.0        # alpha males or combined
##    0.0001    0.0        0.01      -3      0     0.0    999.0        # beta males or combined
##    0.45      0.01       1.0       -3      0     0.0    999.0        # gscale males or combined
##   121.5      65.0       145.0     -4      0     0.0    999.0        # molt_mu males or combined
##    0.060     0.0        1.0       -3      0     0.0    999.0        # molt_cv males or combined
##
## ## --------------------------------------------------------------------------- ##
## ## SELECTIVITY CONTROLS                                                         ##
## ##     Each gear must have a selectivity and a retention selectivity. If a uniform      ##
## ##     prior is selected for a parameter then the lb and ub are used (p1 and p2 are     ##
## ##     ignored)                                                                ##
## ## LEGEND                                                                       ##
## ##     sel type: 0 = parametric, 1 = coefficients, 2 = logistic, 3 = logistic95,        ##
## ##              4 = double normal (NIY)                                        ##
## ##     gear index: use +ve for selectivity, -ve for retention                  ##
## ##     sex dep: 0 for sex-independent, 1 for sex-dependent                      ##
## ## --------------------------------------------------------------------------- ##
## ## ivector for number of year periods or nodes                                 ##
## ## POT        TBycatch FBycatch  NMFS_S   ADFG_pot
## ## Gear-1     Gear-2   Gear-3    Gear-4   Gear-5
##   2          1        1         1        1          # Selectivity periods
##   0          0        0         0        0          # sex specific selectivity
##   0          3        3         0        0          # male selectivity type
## ## Gear-1     Gear-2   Gear-3    Gear-4   Gear-5
##   1          1        1         1        1          # Retention periods
##   0          0        0         0        0          # sex specific retention
```

```
##     3            2            2            2            2            # male retention type
##     1            0            0            0            0            # male retention flag (0 -> no, 1 -> yes)
## ## gear  par   sel                                            phz   start  end         ##
## ## index index par sex  ival   lb    ub       prior p1      p2    mirror period period     ##
## # Gear-1
##     1     1     1   0   0.432928096608 0.001 2.0    0        0      1     2     1978   2008
##     1     2     2   0   0.670336057209 0.001 1.0    0        0      1     2     1978   2008
##     1     3     3   0   1.0            0.001 2.0    0        0      1    -2     1978   2008
##     1     1     1   0   0.392207758620 0.001 2.0    0        0      1     2     2009   2015
##     1     2     2   0   0.956150805823 0.001 1.0    0        0      1     2     2009   2015
##     1     3     3   0   1.0            0.001 2.0    0        0      1    -2     2009   2015
## # Gear-2
##     2     7     1   0   40         10.0  200    0       10     200   -3     1978   2015
##     2     8     2   0   60         10.0  200    0       10     200   -3     1978   2015
## # Gear-3
##     3     9     1   0   40         10.0  200    0       10     200   -3     1978   2015
##     3    10     2   0   60         10.0  200    0       10     200   -3     1978   2015
## # Gear-4
##     4     8     1   0   0.79506450558  0.001 2.0    0        0      1     2     1978   2015
##     4     9     2   0   1.08723867992  0.001 1.0    0        0      1     2     1978   2015
##     4    10     3   0   1.0            0.001 2.0    0        0      1    -2     1978   2015
## # Gear-5
##     5    11     1   0   0.405292074017 0.001 2.0    0        0      1     2     1978   2015
##     5    12     2   0   0.855141058500 0.001 1.0    0        0      1     2     1978   2015
##     5    13     3   0   1.0            0.001 2.0    0        0      1    -2     1978   2015
## ## Retained
## # Gear-1
##    -1    14     1   0   120       100   200    0       1      900   -1     1978   2015
##    -1    15     2   0   123       110   200    0       1      900   -1     1978   2015
## # Gear-2
##    -2    16     1   0   595        1    700    0       1      900   -3     1978   2015
##    -2    17     2   0   10         1    700    0       1      900   -3     1978   2015
## # Gear-3
##    -3    18     1   0   590        1    700    0       1      900   -3     1978   2015
##    -3    19     2   0   10         1    700    0       1      900   -3     1978   2015
## # Gear-4
##    -4    20     1   0   580        1    700    0       1      900   -3     1978   2015
##    -4    21     2   0   20         1    700    0       1      900   -3     1978   2015
## # Gear-5
##    -5    22     1   0   580        1    700    0       1      900   -3     1978   2015
##    -5    23     2   0   20         1    700    0       1      900   -3     1978   2015
##
## ## ------------------------------------------------------------------- ##
## ## PRIORS FOR CATCHABILITY
## ##     If a uniform prior is selected for a parameter then the lb and ub are used (p1   ##
## ##     and p2 are ignored). ival must be > 0                                            ##
## ## LEGEND                                                                               ##
## ##     prior: 0 = uniform, 1 = normal, 2 = lognormal, 3 = beta, 4 = gamma               ##
## ## ------------------------------------------------------------------- ##
## ##  LAMBDA: Arbitrary relative weights for each series, 0 = do not fit.
## ## SURVEYS/INDICES ONLY
## ## ival    lb      ub    phz   prior  p1       p2    Analytic?  LAMBDA
##    1.0     0       2     -1    0      0        9.0   0          1         # NMFS trawl
## 4.26724288404e-06 0 5    1     0      0        9.0   0          1         # ADF&G pot
```

```
## ## ------------------------------------------------------------------------------------------- ##
##
## ## ------------------------------------------------------------------------------------------- ##
## ## ADDITIONAL CV FOR SURVEYS/INDICES                                                           ##
## ##     If a uniform prior is selected for a parameter then the lb and ub are used (p1           ##
## ##     and p2 are ignored). ival must be > 0                                                    ##
## ## LEGEND                                                                                       ##
## ##     prior: 0 = uniform, 1 = normal, 2 = lognormal, 3 = beta, 4 = gamma                       ##
## ## ------------------------------------------------------------------------------------------- ##
## ## ival         lb          ub      phz   prior    p1      p2
##    0.00001      0.000001   10.0      -4     4       1.0     100    # NMFS
##    0.00001      0.000001   10.0      -4     4       1.0     100    # ADF&G
## ## ------------------------------------------------------------------------------------------- ##
##
## ## ------------------------------------------------------------------------------------------- ##
## ## PENALTIES FOR AVERAGE FISHING MORTALITY RATE FOR EACH GEAR
## ## ------------------------------------------------------------------------------------------- ##
## ## Mean_F  STD_PHZ1  STD_PHZ2     PHZ
##    0.3       0.05      50.0        1   # Pot
##    0.001     0.05      50.0        1   # Trawl
##    0.001     0.05      50.0        1   # Fixed
##    0.00      2.00      20.00      -1   # NMFS
##    0.00      2.00      20.00      -1   # ADF&G
## ## ------------------------------------------------------------------------------------------- ##
##
## ## ------------------------------------------------------------------------------------------- ##
## ## OPTIONS FOR SIZE COMPOSTION DATA (COLUMN FOR EACH MATRIX)
## ## ------------------------------------------------------------------------------------------- ##
## ## LIKELIHOOD OPTIONS
## ##   -1) Multinomial with estimated/fixed sample size
## ##   -2) Robust approximation to multinomial
## ##   -3) logistic normal (NIY)
## ##   -4) multivariate-t (NIY)
## ##   -5) Dirichlet
## ## AUTOTAIL COMPRESSION
## ##   pmin is the cumulative proportion used in tail compression.
## ## ------------------------------------------------------------------------------------------- ##
## #  1   1   1  # Type of likelihood
##    2   2   2  # Type of likelihood
## #  5   5   5   # Type of likelihood
##    0   0   0  # Auto tail compression (pmin)
##    1   1   1   # Initial value for effective sample size multiplier
##   -4  -4  -4   # Phz for estimating effective sample size (if appl.)
##    1   2   3   # Composition aggregator
##    1   1   1   # LAMBDA
## ## ------------------------------------------------------------------------------------------- ##
##
## ## ------------------------------------------------------------------------------------------- ##
## ## TIME VARYING NATURAL MORTALIIY RATES                                                         ##
## ## ------------------------------------------------------------------------------------------- ##
## ## TYPE:
## ##       0 = constant natural mortality
## ##       1 = Random walk (deviates constrained by variance in M)
## ##       2 = Cubic Spline (deviates constrained by nodes & node-placement)
```

```
## ##        3 = Blocked changes (deviates constrained by variance at specific knots)
## ##        4 = Time blocks
## ## ------------------------------------------------------------------------------ ##
## ## Type
## 3
## ## Phase of estimation
## 4
## ## STDEV in m_dev for Random walk
## 10.0
## ## Number of nodes for cubic spline or number of step-changes for option 3
## 2
## ## Year position of the knots (vector must be equal to the number of nodes)
## 1998 1999
## ## ------------------------------------------------------------------------------ ##
##
## ## ------------------------------------------------------------------------------ ##
## ## OTHER CONTROLS
## ## ------------------------------------------------------------------------------ ##
##   3        # Estimated rec_dev phase
##   3        # Estimated rec_ini phase
##   0        # VERBOSE FLAG (0 = off, 1 = on, 2 = objective func)
##   2        # Initial conditions (0 = Unfished, 1 = Steady-state fished, 2 = Free parameters)
##   1978     # First year for average recruitment for Bspr calculation
##   2016     # Last year for average recruitment for Bspr calculation
##   0.35     # Target SPR ratio for Bmsy proxy
##   1        # Gear index for SPR calculations (i.e. directed fishery)
##   1        # Lambda (proportion of mature male biomass for SPR reference points)
##   1        # Use empirical molt increment data (0 = FALSE, 1 = TRUE)
##   0        # Stock-Recruit-Relationship (0 = None, 1 = Beverton-Holt)
## ## EOF
## 9999
```

The Francis model control file:

```
## # Set up to do Stock Reduction Analysis using Catch data and informative priors.
## # Controls for leading parameter vector theta
## # LEGEND FOR PRIOR:
## #                   0 -> uniform
## #                   1 -> normal
## #                   2 -> lognormal
## #                   3 -> beta
## #                   4 -> gamma
## # ntheta
##   12
## # ival        lb        ub      phz  prior    p1     p2          # parameter        #
##   0.18       0.01        1      -4      2   0.18   0.02          # M
##  14.3       -7.0        30      -2      0    -7      30          # log(R0) - unfished recruits
##  10.0       -7.0        20      -1      1  -10.0   20.0          # log(Rini) - initial recruitmen
##  13.7222    -7.0        20       1      0    -7      30          # log(Rbar) - average recruits(a
##  80.0       30.0       310      -2      1   72.5   7.25          # Recruitment size distribution
##   0.25       0.1         7      -4      0    0.1    9.0          # Recruitment size scale (varia
##   0.2      -10.0       0.75     -4      0  -10.0   0.75          # log(sigma_R)
##   0.75      0.20       1.00     -2      3    3.0   2.00          # steepness
##   0.01      0.00       1.00     -3      3   1.01   1.01          # recruitment autocorrelation
##  14.5       5.00      18.00      1      0   5.00  15.00          # logN0 vector of initial number
##  14.0       5.00      18.00      1      0   5.00  15.00          # logN0 vector of initial number
##  13.5       5.00      18.00      1      0   5.00  15.00          # logN0 vector of initial number
## ## GROWTH PARAM CONTROLS                                                                      ##
## ## Two lines for each parameter if split sex, one line if not                                ##
## # ival        lb        ub      phz  prior    p1     p2          # parameter        #
##  14.1       10.0       30.0     -3      0    0.0  999.0          # alpha males or combined
##   0.0001     0.0       0.01     -3      0    0.0  999.0          # beta males or combined
##   0.45      0.01        1.0     -3      0    0.0  999.0          # gscale males or combined
## 121.5       65.0      145.0     -4      0    0.0  999.0          # molt_mu males or combined
##   0.060      0.0        1.0     -3      0    0.0  999.0          # molt_cv males or combined
##
## ## ----------------------------------------------------------------------------- ##
## ## SELECTIVITY CONTROLS                                                          ##
## ##    Each gear must have a selectivity and a retention selectivity. If a uniform ##
## ##    prior is selected for a parameter then the lb and ub are used (p1 and p2 are ##
## ##    ignored)                                                                   ##
## ## LEGEND                                                                        ##
## ##    sel type: 0 = parametric, 1 = coefficients, 2 = logistic, 3 = logistic95,  ##
## ##             4 = double normal (NIY)                                           ##
## ##    gear index: use +ve for selectivity, -ve for retention                     ##
## ##    sex dep: 0 for sex-independent, 1 for sex-dependent                         ##
## ## ----------------------------------------------------------------------------- ##
## ## ivector for number of year periods or nodes                                   ##
## ## POT       TBycatch FBycatch NMFS_S   ADFG_pot
## ## Gear-1    Gear-2   Gear-3   Gear-4   Gear-5
##   2          1        1        1        1           # Selectivity periods
##   0          0        0        0        0           # sex specific selectivity
##   0          3        3        0        0           # male selectivity type
## ## Gear-1    Gear-2   Gear-3   Gear-4   Gear-5
##   1          1        1        1        1           # Retention periods
##   0          0        0        0        0           # sex specific retention
```

```
##     3            2            2            2            2            # male retention type
##     1            0            0            0            0            # male retention flag (0 -> no, 1 -> yes)
## ## gear par  sel                                              phz   start  end         ##
## ## index index par sex  ival   lb    ub       prior p1     p2     mirror period period    ##
## # Gear-1
##     1     1     1   0   0.432928096608 0.001 2.0    0      0       1     2    1978   2008
##     1     2     2   0   0.670336057209 0.001 1.0    0      0       1     2    1978   2008
##     1     3     3   0   1.0            0.001 2.0    0      0       1    -2    1978   2008
##     1     1     1   0   0.392207758620 0.001 2.0    0      0       1     2    2009   2015
##     1     2     2   0   0.956150805823 0.001 1.0    0      0       1     2    2009   2015
##     1     3     3   0   1.0            0.001 2.0    0      0       1    -2    2009   2015
## # Gear-2
##     2     7     1   0   40         10.0 200    0      10    200    -3    1978   2015
##     2     8     2   0   60         10.0 200    0      10    200    -3    1978   2015
## # Gear-3
##     3     9     1   0   40         10.0 200    0      10    200    -3    1978   2015
##     3    10     2   0   60         10.0 200    0      10    200    -3    1978   2015
## # Gear-4
##     4     8     1   0   0.79506450558  0.001 2.0    0      0       1     2    1978   2015
##     4     9     2   0   1.08723867992  0.001 1.0    0      0       1     2    1978   2015
##     4    10     3   0   1.0            0.001 2.0    0      0       1    -2    1978   2015
## # Gear-5
##     5    11     1   0   0.405292074017 0.001 2.0    0      0       1     2    1978   2015
##     5    12     2   0   0.855141058500 0.001 1.0    0      0       1     2    1978   2015
##     5    13     3   0   1.0            0.001 2.0    0      0       1    -2    1978   2015
## ## Retained
## # Gear-1
##    -1    14     1   0   120    100   200    0      1     900    -1    1978   2015
##    -1    15     2   0   123    110   200    0      1     900    -1    1978   2015
## # Gear-2
##    -2    16     1   0   595    1     700    0      1     900    -3    1978   2015
##    -2    17     2   0   10     1     700    0      1     900    -3    1978   2015
## # Gear-3
##    -3    18     1   0   590    1     700    0      1     900    -3    1978   2015
##    -3    19     2   0   10     1     700    0      1     900    -3    1978   2015
## # Gear-4
##    -4    20     1   0   580    1     700    0      1     900    -3    1978   2015
##    -4    21     2   0   20     1     700    0      1     900    -3    1978   2015
## # Gear-5
##    -5    22     1   0   580    1     700    0      1     900    -3    1978   2015
##    -5    23     2   0   20     1     700    0      1     900    -3    1978   2015
##
## ## --------------------------------------------------------------------- ##
## ## PRIORS FOR CATCHABILITY
## ##      If a uniform prior is selected for a parameter then the lb and ub are used (p1    ##
## ##      and p2 are ignored). ival must be > 0                                            ##
## ## LEGEND                                                                                ##
## ##      prior: 0 = uniform, 1 = normal, 2 = lognormal, 3 = beta, 4 = gamma               ##
## ## --------------------------------------------------------------------- ##
## ##  LAMBDA: Arbitrary relative weights for each series, 0 = do not fit.
## ## SURVEYS/INDICES ONLY
## ## ival    lb      ub    phz   prior  p1      p2    Analytic?   LAMBDA
##     1.0     0       2    -1     0     0      9.0    0           1        # NMFS trawl
## 4.26724288404e-06 0 5    1      0     0      9.0    0           1        # ADF&G pot
```

```
## ## ---------------------------------------------------------------------------------- ##
##
## ## ---------------------------------------------------------------------------------- ##
## ## ADDITIONAL CV FOR SURVEYS/INDICES                                                  ##
## ##     If a uniform prior is selected for a parameter then the lb and ub are used (p1  ##
## ##     and p2 are ignored). ival must be > 0                                          ##
## ## LEGEND                                                                             ##
## ##     prior: 0 = uniform, 1 = normal, 2 = lognormal, 3 = beta, 4 = gamma             ##
## ## ---------------------------------------------------------------------------------- ##
## ## ival        lb         ub       phz   prior     p1      p2
##    0.00001     0.000001   10.0      -4     4        1.0     100    # NMFS
##    0.00001     0.000001   10.0      -4     4        1.0     100    # ADF&G
## ## ---------------------------------------------------------------------------------- ##
##
## ## ---------------------------------------------------------------------------------- ##
## ## PENALTIES FOR AVERAGE FISHING MORTALITY RATE FOR EACH GEAR
## ## ---------------------------------------------------------------------------------- ##
## ## Mean_F  STD_PHZ1  STD_PHZ2     PHZ
##    0.3       0.05      50.0        1    # Pot
##    0.001     0.05      50.0        1    # Trawl
##    0.001     0.05      50.0        1    # Fixed
##    0.00      2.00      20.00      -1    # NMFS
##    0.00      2.00      20.00      -1    # ADF&G
## ## ---------------------------------------------------------------------------------- ##
##
## ## ---------------------------------------------------------------------------------- ##
## ## OPTIONS FOR SIZE COMPOSTION DATA (COLUMN FOR EACH MATRIX)
## ## ---------------------------------------------------------------------------------- ##
## ## LIKELIHOOD OPTIONS
## ##   -1) Multinomial with estimated/fixed sample size
## ##   -2) Robust approximation to multinomial
## ##   -3) logistic normal (NIY)
## ##   -4) multivariate-t (NIY)
## ##   -5) Dirichlet
## ## AUTOTAIL COMPRESSION
## ##   pmin is the cumulative proportion used in tail compression.
## ## ---------------------------------------------------------------------------------- ##
##    1   1   1  # Type of likelihood
## #  2   2   2  # Type of likelihood
## #  5   5   5   # Type of likelihood
##    0   0   0  # Auto tail compression (pmin)
##    1   1   1   # Initial value for effective sample size multiplier
##   -4  -4  -4   # Phz for estimating effective sample size (if appl.)
##    1   2   3   # Composition aggregator
## #  1   1   1   # LAMBDA
##    1.6081   0.6184   1.1189
## ## ---------------------------------------------------------------------------------- ##
##
## ## ---------------------------------------------------------------------------------- ##
## ## TIME VARYING NATURAL MORTALIIY RATES                                               ##
## ## ---------------------------------------------------------------------------------- ##
## ## TYPE:
## ##      0 = constant natural mortality
## ##      1 = Random walk (deviates constrained by variance in M)
```

```
## ##       2 = Cubic Spline (deviates constrained by nodes & node-placement)
## ##       3 = Blocked changes (deviates constrained by variance at specific knots)
## ##       4 = Time blocks
## ## ------------------------------------------------------------------------------ ##
## ## Type
## 0
## ## Phase of estimation
## 4
## ## STDEV in m_dev for Random walk
## 10.0
## ## Number of nodes for cubic spline or number of step-changes for option 3
## 2
## ## Year position of the knots (vector must be equal to the number of nodes)
## 1998 1999
## ## ------------------------------------------------------------------------------ ##
##
## ## ------------------------------------------------------------------------------ ##
## ## OTHER CONTROLS
## ## ------------------------------------------------------------------------------ ##
##   3       # Estimated rec_dev phase
##   3       # Estimated rec_ini phase
##   0       # VERBOSE FLAG (0 = off, 1 = on, 2 = objective func)
##   2       # Initial conditions (0 = Unfished, 1 = Steady-state fished, 2 = Free parameters)
##   1978    # First year for average recruitment for Bspr calculation
##   2016    # Last year for average recruitment for Bspr calculation
##   0.35    # Target SPR ratio for Bmsy proxy
##   1       # Gear index for SPR calculations (i.e. directed fishery)
##   1       # Lambda (proportion of mature male biomass for SPR reference points)
##   1       # Use empirical molt increment data (0 = FALSE, 1 = TRUE)
##   0       # Stock-Recruit-Relationship (0 = None, 1 = Beverton-Holt)
## ## EOF
## 9999
```

The no M_{1998} model control file:

```
## # Set up to do Stock Reduction Analysis using Catch data and informative priors.
## # Controls for leading parameter vector theta
## # LEGEND FOR PRIOR:
## #                 0 -> uniform
## #                 1 -> normal
## #                 2 -> lognormal
## #                 3 -> beta
## #                 4 -> gamma
## # ntheta
##    12
## # ival       lb         ub       phz  prior    p1     p2       # parameter         #
##   0.18      0.01         1       -4      2    0.18   0.02       # M
##  14.3      -7.0         30       -2      0     -7     30        # log(R0)
##  10.0      -7.0         20       -1      1   -10.0   20.0       # log(Rini)
##  13.7222   -7.0         20        1      0     -7     30        # log(Rbar)
##  80.0      30.0        310       -2      1    72.5   7.25       # Recruitment size distribution
##   0.25      0.1          7       -4      0     0.1    9.0       # Recruitment size scale (varia
##   0.2     -10.0        0.75      -4      0   -10.0   0.75       # log(sigma_R)
##   0.75     0.20        1.00      -2      3     3.0   2.00       # steepness
##   0.01     0.00        1.00      -3      3    1.01   1.01       # recruitment autocorrelation
##  14.5      5.00       18.00       1      0    5.00  15.00       # logN0 vector of initial number
##  14.0      5.00       18.00       1      0    5.00  15.00       # logN0 vector of initial number
##  13.5      5.00       18.00       1      0    5.00  15.00       # logN0 vector of initial number
## ## GROWTH PARAM CONTROLS                                                                  ##
## ## Two lines for each parameter if split sex, one line if not                            ##
## # ival       lb         ub       phz  prior    p1     p2       # parameter         #
##  14.1       10.0       30.0      -3      0     0.0   999.0      # alpha males or combined
##   0.0001     0.0       0.01      -3      0     0.0   999.0      # beta males or combined
##   0.45       0.01       1.0      -3      0     0.0   999.0      # gscale males or combined
## 121.5       65.0      145.0      -4      0     0.0   999.0      # molt_mu males or combined
##   0.060      0.0        1.0      -3      0     0.0   999.0      # molt_cv males or combined
##
## ## ----------------------------------------------------------------------------- ##
## ## SELECTIVITY CONTROLS                                                          ##
## ##     Each gear must have a selectivity and a retention selectivity. If a uniform ##
## ##     prior is selected for a parameter then the lb and ub are used (p1 and p2 are ##
## ##     ignored)                                                                  ##
## ## LEGEND                                                                        ##
## ##     sel type: 0 = parametric, 1 = coefficients, 2 = logistic, 3 = logistic95, ##
## ##               4 = double normal (NIY)                                         ##
## ##     gear index: use +ve for selectivity, -ve for retention                    ##
## ##     sex dep: 0 for sex-independent, 1 for sex-dependent                        ##
## ## ----------------------------------------------------------------------------- ##
## ## ivector for number of year periods or nodes                                   ##
## ## POT       TBycatch FBycatch  NMFS_S   ADFG_pot
## ## Gear-1    Gear-2   Gear-3    Gear-4   Gear-5
##    2         1        1         1        1          # Selectivity periods
##    0         0        0         0        0          # sex specific selectivity
##    0         3        3         0        0          # male selectivity type
## ## Gear-1    Gear-2   Gear-3    Gear-4   Gear-5
##    1         1        1         1        1          # Retention periods
##    0         0        0         0        0          # sex specific retention
```

```
##    3          2          2          2          2          # male retention type
##    1          0          0          0          0          # male retention flag (0 -> no, 1 -> yes)
## ## gear  par  sel                                         phz   start  end         ##
## ## index index par sex  ival  lb     ub       prior p1      p2     mirror period period      ##
## # Gear-1
##    1     1    1   0   0.432928096608 0.001 2.0    0       0      1     2     1978  2008
##    1     2    2   0   0.670336057209 0.001 1.0    0       0      1     2     1978  2008
##    1     3    3   0   1.0            0.001 2.0    0       0      1    -2     1978  2008
##    1     1    1   0   0.392207758620 0.001 2.0    0       0      1     2     2009  2015
##    1     2    2   0   0.956150805823 0.001 1.0    0       0      1     2     2009  2015
##    1     3    3   0   1.0            0.001 2.0    0       0      1    -2     2009  2015
## # Gear-2
##    2     7    1   0   40         10.0 200    0       10     200   -3     1978  2015
##    2     8    2   0   60         10.0 200    0       10     200   -3     1978  2015
## # Gear-3
##    3     9    1   0   40         10.0 200    0       10     200   -3     1978  2015
##    3    10    2   0   60         10.0 200    0       10     200   -3     1978  2015
## # Gear-4
##    4     8    1   0   0.79506450558  0.001 2.0    0       0      1     2     1978  2015
##    4     9    2   0   1.08723867992  0.001 1.0    0       0      1     2     1978  2015
##    4    10    3   0   1.0            0.001 2.0    0       0      1    -2     1978  2015
## # Gear-5
##    5    11    1   0   0.405292074017 0.001 2.0    0       0      1     2     1978  2015
##    5    12    2   0   0.855141058500 0.001 1.0    0       0      1     2     1978  2015
##    5    13    3   0   1.0            0.001 2.0    0       0      1    -2     1978  2015
## ## Retained
## # Gear-1
##   -1    14    1   0   120    100  200    0       1      900   -1     1978  2015
##   -1    15    2   0   123    110  200    0       1      900   -1     1978  2015
## # Gear-2
##   -2    16    1   0   595    1    700    0       1      900   -3     1978  2015
##   -2    17    2   0   10     1    700    0       1      900   -3     1978  2015
## # Gear-3
##   -3    18    1   0   590    1    700    0       1      900   -3     1978  2015
##   -3    19    2   0   10     1    700    0       1      900   -3     1978  2015
## # Gear-4
##   -4    20    1   0   580    1    700    0       1      900   -3     1978  2015
##   -4    21    2   0   20     1    700    0       1      900   -3     1978  2015
## # Gear-5
##   -5    22    1   0   580    1    700    0       1      900   -3     1978  2015
##   -5    23    2   0   20     1    700    0       1      900   -3     1978  2015
##
## ## ------------------------------------------------------------------------ ##
## ## PRIORS FOR CATCHABILITY
## ##     If a uniform prior is selected for a parameter then the lb and ub are used (p1   ##
## ##     and p2 are ignored). ival must be > 0                                ##
## ## LEGEND                                                                   ##
## ##     prior: 0 = uniform, 1 = normal, 2 = lognormal, 3 = beta, 4 = gamma   ##
## ## ------------------------------------------------------------------------ ##
## ##  LAMBDA: Arbitrary relative weights for each series, 0 = do not fit.
## ## SURVEYS/INDICES ONLY
## ## ival    lb      ub    phz  prior  p1      p2    Analytic?  LAMBDA
##    1.0     0       2     -1    0     0       9.0   0          1        # NMFS trawl
## 4.26724288404e-06 0 5    1     0     0       9.0   0          0.2      # ADF&G pot
```

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```
## ## -------------------------------------------------------------------------------- ##
##
## ## -------------------------------------------------------------------------------- ##
## ## ADDITIONAL CV FOR SURVEYS/INDICES                                                ##
## ##     If a uniform prior is selected for a parameter then the lb and ub are used (p1  ##
## ##     and p2 are ignored). ival must be > 0                                        ##
## ## LEGEND                                                                           ##
## ##     prior: 0 = uniform, 1 = normal, 2 = lognormal, 3 = beta, 4 = gamma           ##
## ## -------------------------------------------------------------------------------- ##
## ## ival        lb          ub        phz   prior    p1       p2
##    0.00001     0.000001   10.0       -4     4       1.0      100    # NMFS
##    0.00001     0.000001   10.0       -4     4       1.0      100    # ADF&G
## ## -------------------------------------------------------------------------------- ##
##
## ## -------------------------------------------------------------------------------- ##
## ## PENALTIES FOR AVERAGE FISHING MORTALITY RATE FOR EACH GEAR
## ## -------------------------------------------------------------------------------- ##
## ## Mean_F  STD_PHZ1  STD_PHZ2     PHZ
##    0.3        0.05      50.0        1   # Pot
##    0.001      0.05      50.0        1   # Trawl
##    0.001      0.05      50.0        1   # Fixed
##    0.00       2.00      20.00      -1   # NMFS
##    0.00       2.00      20.00      -1   # ADF&G
## ## -------------------------------------------------------------------------------- ##
##
## ## -------------------------------------------------------------------------------- ##
## ## OPTIONS FOR SIZE COMPOSTION DATA (COLUMN FOR EACH MATRIX)
## ## -------------------------------------------------------------------------------- ##
## ## LIKELIHOOD OPTIONS
## ##   -1) Multinomial with estimated/fixed sample size
## ##   -2) Robust approximation to multinomial
## ##   -3) logistic normal (NIY)
## ##   -4) multivariate-t (NIY)
## ##   -5) Dirichlet
## ## AUTOTAIL COMPRESSION
## ##   pmin is the cumulative proportion used in tail compression.
## ## -------------------------------------------------------------------------------- ##
##   1   1   1  # Type of likelihood
## # 2   2   2  # Type of likelihood
## # 5   5   5   # Type of likelihood
##   0   0   0  # Auto tail compression (pmin)
##   1   1   1   # Initial value for effective sample size multiplier
##  -4  -4  -4   # Phz for estimating effective sample size (if appl.)
##   1   2   3   # Composition aggregator
## # 1   1   1   # LAMBDA
##    1.6549   1.0187   2.6640
## ## -------------------------------------------------------------------------------- ##
##
## ## -------------------------------------------------------------------------------- ##
## ## TIME VARYING NATURAL MORTALIIY RATES                                             ##
## ## -------------------------------------------------------------------------------- ##
## ## TYPE:
## ##     0 = constant natural mortality
## ##     1 = Random walk (deviates constrained by variance in M)
```

```
## ##        2 = Cubic Spline (deviates constrained by nodes & node-placement)
## ##        3 = Blocked changes (deviates constrained by variance at specific knots)
## ##        4 = Time blocks
## ## ------------------------------------------------------------------------------- ##
## ## Type
## 0
## ## Phase of estimation
## -4
## ## STDEV in m_dev for Random walk
## 10.0
## ## Number of nodes for cubic spline or number of step-changes for option 3
## 2
## ## Year position of the knots (vector must be equal to the number of nodes)
## 1998 1999
## ## ------------------------------------------------------------------------------- ##
##
## ## ------------------------------------------------------------------------------- ##
## ## OTHER CONTROLS
## ## ------------------------------------------------------------------------------- ##
##   3      # Estimated rec_dev phase
##   3      # Estimated rec_ini phase
##   0      # VERBOSE FLAG (0 = off, 1 = on, 2 = objective func)
##   2      # Initial conditions (0 = Unfished, 1 = Steady-state fished, 2 = Free parameters)
##   1978   # First year for average recruitment for Bspr calculation
##   2016   # Last year for average recruitment for Bspr calculation
##   0.35   # Target SPR ratio for Bmsy proxy
##   1      # Gear index for SPR calculations (i.e. directed fishery)
##   1      # Lambda (proportion of mature male biomass for SPR reference points)
##   1      # Use empirical molt increment data (0 = FALSE, 1 = TRUE)
##   0      # Stock-Recruit-Relationship (0 = None, 1 = Beverton-Holt)
## ## EOF
## 9999
```