Appendix B: SMBKC Stock Assessment Input Files

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
```

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##    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
## # 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     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       0.000   0.31    2       1       1       0       0.8
## 1997    2       2       1       0.000   0.31    2       1       1       0       0.8
## 1998    2       2       1       0.000   0.31    2       1       1       0       0.8
## 1999    2       2       1       0.000   0.31    2       1       1       0       0.8
## 2000    2       2       1       0.000   0.31    2       1       1       0       0.8
## 2001    2       2       1       0.000   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       0.000   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
## 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       0.000   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       0.000   0.31    2       1       1       0       0.8
## 2015    2       2       1       0.000   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       0.000   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
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## 1999    2       3       1       1.361   0.31    2       1       1       0       0.5
## 2000    2       3       1       0.000   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  9
## # 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
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## 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  1 5 1 2378.000  0.186 2
## ##  Number  of  length  frequency matrices
## 3
## ##  Number  of  rows  in  each  matrix
## 15  39  9
## ##  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
##   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
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```
##   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  1 5 1 0 0 0 100  0.0832  0.1917  0.7251
## ##  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 transition matrix (0=no, 1=growth matrix, 2=transition matrix, i.e. growth and molting)
## 2
## # 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 match 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         # log(Rini)
##   10.0      -7.0        20         1       0    -7       20         # 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     20.00         1       0    5.00  20.00         # logN0 vector of initial numbe
##  14.0       5.00     20.00         1       0    5.00  20.00         # logN0 vector of initial numbe
##  13.5       5.00     20.00         1       0    5.00  20.00         # logN0 vector of initial numbe
## ## 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    0.490680567427 0.001 2.0    0       0      1    -2     1978   2008
##    1     2     2   0    0.785300542244 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    0.402423912257 0.001 2.0    0       0      1    -2     2009   2016
##    1     2     2   0    0.981647895824 0.001 2.0    0       0      1    -2     2009   2016
##    1     3     3   0    1.0            0.001 2.0    0       0      1    -2     2009   2016
## # Gear-2
##    2     7     1   0    40       10.0  200    0      10    200    -3     1978   2016
##    2     8     2   0    60       10.0  200    0      10    200    -3     1978   2016
## # Gear-3
##    3     9     1   0    40       10.0  200    0      10    200    -3     1978   2016
##    3    10     2   0    60       10.0  200    0      10    200    -3     1978   2016
## # Gear-4
##    4     8     1   0    0.793562338771 0.001 2.0    0       0      1    -2     1978   2016
##    4     9     2   0    1.08339465666 0.001 2.0    0       0      1    -2     1978   2016
##    4     10    3   0    1.0           0.001 2.0    0       0      1    -2     1978   2016
## # Gear-5
##    5     11    1   0    0.411256448303 0.001 2.0    0       0      1    -2     1978   2016
##    5     12    2   0    0.861094630732 0.001 2.0    0       0      1    -2     1978   2016
##    5     13    3   0    1.0            0.001 2.0    0       0      1    -2     1978   2016
## ## Retained
## # Gear-1
##   -1     14    1   0   120   100   200    0      1    900   -1     1978   2016
##   -1     15    2   0   123   110   200    0      1    900   -1     1978   2016
## # Gear-2
##   -2     16    1   0   595    1    700    0      1    900   -3     1978   2016
##   -2     17    2   0    10    1    700    0      1    900   -3     1978   2016
## # Gear-3
##   -3     18    1   0   590    1    700    0      1    900   -3     1978   2016
##   -3     19    2   0    10    1    700    0      1    900   -3     1978   2016
## # Gear-4
##   -4     20    1   0   580    1    700    0      1    900   -3     1978   2016
##   -4     21    2   0    20    1    700    0      1    900   -3     1978   2016
## # Gear-5
```

```
##   -5     22    1   0   580    1    700    0      1    900   -3     1978   2016
##   -5     23    2   0    20    1    700    0      1    900   -3     1978   2016
##
## ## ------------------------------------------------------------------------------------- ##
## ## 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
## 0.00411135867487 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
##    0.0000001      0.00000001   10.0      -4    4         1.0     100   # NMFS
##    0.0000001      0.00000001   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 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         # log(Rini)
##   10.0      -7.0        20         1       0    -7       20         # 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     20.00         1       0    5.00  20.00         # logN0 vector of initial numbe
##  14.0       5.00     20.00         1       0    5.00  20.00         # logN0 vector of initial numbe
##  13.5       5.00     20.00         1       0    5.00  20.00         # logN0 vector of initial numbe
## ## 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    0.4   0.001 1.0    0       0      1      3      1978   2008
##    1     2     2   0    0.7   0.001 1.0    0       0      1      3      1978   2008
##    1     3     3   0    1.0   0.001 2.0    0       0      1     -3      1978   2008
##    1     4     1   0    0.4   0.001 1.0    0       0      1      3      2009   2016
##    1     5     2   0    0.7   0.001 1.0    0       0      1      3      2009   2016
##    1     6     3   0    1.0   0.001 2.0    0       0      1     -3      2009   2016
## # Gear-2
##    2     7     1   0    40    10.0  200    0      10    200    -3      1978   2016
##    2     8     2   0    60    10.0  200    0      10    200    -3      1978   2016
## # Gear-3
##    3     9     1   0    40    10.0  200    0      10    200    -3      1978   2016
##    3     10    2   0    60    10.0  200    0      10    200    -3      1978   2016
## # Gear-4
##    4     11    1   0    0.4   0.001 1.0    0       0      1      4      1978   2016
##    4     12    2   0    0.7   0.001 1.0    0       0      1      4      1978   2016
##    4     13    3   0    1.0   0.001 2.0    0       0      1     -4      1978   2016
## # Gear-5
##    5     14    1   0    0.4   0.001 1.0    0       0      1      4      1978   2016
##    5     15    2   0    0.7   0.001 1.0    0       0      1      4      1978   2016
##    5     16    3   0    1.0   0.001 2.0    0       0      1     -4      1978   2016
## ## Retained
## # Gear-1
##   -1     17    1   0    120   100   200    0       1    900    -1      1978   2016
##   -1     18    2   0    123   110   200    0       1    900    -1      1978   2016
## # Gear-2
##   -2     19    1   0    595    1    700    0       1    900    -3      1978   2016
##   -2     20    2   0     10    1    700    0       1    900    -3      1978   2016
## # Gear-3
##   -3     21    1   0    590    1    700    0       1    900    -3      1978   2016
##   -3     22    2   0     10    1    700    0       1    900    -3      1978   2016
## # Gear-4
##   -4     23    1   0    580    1    700    0       1    900    -3      1978   2016
##   -4     24    2   0     20    1    700    0       1    900    -3      1978   2016
## # Gear-5
##   -5     25    1   0    580    1    700    0       1    900    -3      1978   2016
##   -5     26    2   0     20    1    700    0       1    900    -3      1978   2016
## ## ------------------------------------------------------------------------------------- ##
##
## ## ------------------------------------------------------------------------------------- ##
## ## 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
```

```
##    4e-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         # log(Rini) - initial recruitmer
##   10.0      -7.0        20         1       0    -7       20         # log(Rbar) - average recruits(s
##   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     20.00         1       0    5.00  20.00         # logN0 vector of initial numbe
##  14.0       5.00     20.00         1       0    5.00  20.00         # logN0 vector of initial numbe
##  13.5       5.00     20.00         1       0    5.00  20.00         # logN0 vector of initial numbe
## ## 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    0.4   0.001 1.0    0       0      1      3      1978   2008
##    1     2     2   0    0.7   0.001 1.0    0       0      1      3      1978   2008
##    1     3     3   0    1.0   0.001 2.0    0       0      1     -3      1978   2008
##    1     4     1   0    0.4   0.001 1.0    0       0      1      3      2009   2016
##    1     5     2   0    0.7   0.001 1.0    0       0      1      3      2009   2016
##    1     6     3   0    1.0   0.001 2.0    0       0      1     -3      2009   2016
## # Gear-2
##    2     7     1   0    40    10.0  200    0      10    200    -3      1978   2016
##    2     8     2   0    60    10.0  200    0      10    200    -3      1978   2016
## # Gear-3
##    3     9     1   0    40    10.0  200    0      10    200    -3      1978   2016
##    3     10    2   0    60    10.0  200    0      10    200    -3      1978   2016
## # Gear-4
##    4     11    1   0    0.4   0.001 1.0    0       0      1      4      1978   2016
##    4     12    2   0    0.7   0.001 1.0    0       0      1      4      1978   2016
##    4     13    3   0    1.0   0.001 2.0    0       0      1     -4      1978   2016
## # Gear-5
##    5     14    1   0    0.4   0.001 1.0    0       0      1      4      1978   2016
##    5     15    2   0    0.7   0.001 1.0    0       0      1      4      1978   2016
##    5     16    3   0    1.0   0.001 2.0    0       0      1     -4      1978   2016
## ## Retained
## # Gear-1
##   -1     17    1   0    120   100   200    0       1    900    -1      1978   2016
##   -1     18    2   0    123   110   200    0       1    900    -1      1978   2016
## # Gear-2
##   -2     19    1   0    595    1    700    0       1    900    -3      1978   2016
##   -2     20    2   0     10    1    700    0       1    900    -3      1978   2016
## # Gear-3
##   -3     21    1   0    590    1    700    0       1    900    -3      1978   2016
##   -3     22    2   0     10    1    700    0       1    900    -3      1978   2016
## # Gear-4
##   -4     23    1   0    580    1    700    0       1    900    -3      1978   2016
##   -4     24    2   0     20    1    700    0       1    900    -3      1978   2016
## # Gear-5
##   -5     25    1   0    580    1    700    0       1    900    -3      1978   2016
##   -5     26    2   0     20    1    700    0       1    900    -3      1978   2016
## ## ------------------------------------------------------------------------------------- ##
##
## ## ------------------------------------------------------------------------------------- ##
## ## 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
```

```
##    4.2e-6  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
##   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
##   1.7239   0.5009   1.7008
## ## ------------------------------------------------------------------------------------- ##
##
## ## ------------------------------------------------------------------------------------- ##
## ## 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 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         # log(Rini)
##   10        -7.0        20         1       0    -7       20         # 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     20.00         1       0    5.00  20.00         # logN0 vector of initial numbe
##  14.0       5.00     20.00         1       0    5.00  20.00         # logN0 vector of initial numbe
##  13.5       5.00     20.00         1       0    5.00  20.00         # logN0 vector of initial numbe
## ## 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    0.4   0.001 1.0    0       0      1      3      1978   2008
##    1     2     2   0    0.7   0.001 1.0    0       0      1      3      1978   2008
##    1     3     3   0    1.0   0.001 2.0    0       0      1     -3      1978   2008
##    1     4     1   0    0.4   0.001 1.0    0       0      1      3      2009   2016
##    1     5     2   0    0.7   0.001 1.0    0       0      1      3      2009   2016
##    1     6     3   0    1.0   0.001 2.0    0       0      1     -3      2009   2016
## # Gear-2
##    2     7     1   0    40    10.0  200    0      10    200    -3      1978   2016
##    2     8     2   0    60    10.0  200    0      10    200    -3      1978   2016
## # Gear-3
##    3     9     1   0    40    10.0  200    0      10    200    -3      1978   2016
##    3     10    2   0    60    10.0  200    0      10    200    -3      1978   2016
## # Gear-4
##    4     11    1   0    0.4   0.001 1.0    0       0      1      4      1978   2016
##    4     12    2   0    0.7   0.001 1.0    0       0      1      4      1978   2016
##    4     13    3   0    1.0   0.001 2.0    0       0      1     -4      1978   2016
## # Gear-5
##    5     14    1   0    0.4   0.001 1.0    0       0      1      4      1978   2016
##    5     15    2   0    0.7   0.001 1.0    0       0      1      4      1978   2016
##    5     16    3   0    1.0   0.001 2.0    0       0      1     -4      1978   2016
## ## Retained
## # Gear-1
##   -1     17    1   0    120   100   200    0       1    900    -1      1978   2016
##   -1     18    2   0    123   110   200    0       1    900    -1      1978   2016
## # Gear-2
##   -2     19    1   0    595    1    700    0       1    900    -3      1978   2016
##   -2     20    2   0     10    1    700    0       1    900    -3      1978   2016
## # Gear-3
##   -3     21    1   0    590    1    700    0       1    900    -3      1978   2016
##   -3     22    2   0     10    1    700    0       1    900    -3      1978   2016
## # Gear-4
##   -4     23    1   0    580    1    700    0       1    900    -3      1978   2016
##   -4     24    2   0     20    1    700    0       1    900    -3      1978   2016
## # Gear-5
##   -5     25    1   0    580    1    700    0       1    900    -3      1978   2016
##   -5     26    2   0     20    1    700    0       1    900    -3      1978   2016
## ## ------------------------------------------------------------------------------------- ##
##
## ## ------------------------------------------------------------------------------------- ##
## ## 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
```

```
##    4e-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
##   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
##   1.6131   0.5125   1.2095
## ## ------------------------------------------------------------------------------------- ##
##
## ## ------------------------------------------------------------------------------------- ##
## ## 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 force 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
##   14.0      -7.0        30        -2       0    -7       30         # log(R0)
##   10.0      -7.0        20        -1       1   -10.0     20         # log(Rini)
##   10.0      -7.0        20         1       0    -7       20         # 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     20.00         1       0    5.00  20.00          # logN0 vector of initial numbe
##  14.0       5.00     20.00         1       0    5.00  20.00          # logN0 vector of initial numbe
##  13.5       5.00     20.00         1       0    5.00  20.00          # logN0 vector of initial numbe
## ## 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    0.4   0.001 1.0    0       0      1     3      1978   2008
##    1     2     2   0    0.7   0.001 1.0    0       0      1     3      1978   2008
##    1     3     3   0    1.0   0.001 2.0    0       0      1    -3      1978   2008
##    1     4     1   0    0.4   0.001 1.0    0       0      1     3      2009   2016
##    1     5     2   0    0.7   0.001 1.0    0       0      1     3      2009   2016
##    1     6     3   0    1.0   0.001 2.0    0       0      1    -3      2009   2016
## # Gear-2
##    2     7     1   0    40    10.0  200    0      10    200    -3      1978   2016
##    2     8     2   0    60    10.0  200    0      10    200    -3      1978   2016
## # Gear-3
##    3     9     1   0    40    10.0  200    0      10    200    -3      1978   2016
##    3     10    2   0    60    10.0  200    0      10    200    -3      1978   2016
## # Gear-4
##    4     11    1   0    0.4   0.001 1.0    0       0      1     4      1978   2016
##    4     12    2   0    0.7   0.001 1.0    0       0      1     4      1978   2016
##    4     13    3   0    1.0   0.001 2.0    0       0      1    -4      1978   2016
```

```
## # Gear-5
##    5     14    1   0    0.4   0.001 1.0    0       0       1     4      1978   2016
##    5     15    2   0    0.7   0.001 1.0    0       0       1     4      1978   2016
##    5     16    3   0    1.0   0.001 2.0    0       0       1    -4      1978   2016
## ## Retained
## # Gear-1
##   -1     17    1   0    120   100   200    0       1    900    -1      1978   2016
##   -1     18    2   0    123   110   200    0       1    900    -1      1978   2016
## # Gear-2
##   -2     19    1   0    595    1    700    0       1    900    -3      1978   2016
##   -2     20    2   0     10    1    700    0       1    900    -3      1978   2016
## # Gear-3
##   -3     21    1   0    590    1    700    0       1    900    -3      1978   2016
##   -3     22    2   0     10    1    700    0       1    900    -3      1978   2016
## # Gear-4
##   -4     23    1   0    580    1    700    0       1    900    -3      1978   2016
##   -4     24    2   0     20    1    700    0       1    900    -3      1978   2016
## # Gear-5
##   -5     25    1   0    580    1    700    0       1    900    -3      1978   2016
##   -5     26    2   0     20    1    700    0       1    900    -3      1978   2016
## ## ------------------------------------------------------------------------------------------ ##
##
## ## ------------------------------------------------------------------------------------------ ##
## ## 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        2.0   0           1.5     # NMFS trawl
##    4e-06   0        5      1    0       0        5.0   0           2     # 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
##   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
##   1.4044   0.2623   0.3814
## ## ---------------------------------------------------------------------------------------- ##
##
## ## ---------------------------------------------------------------------------------------- ##
## ## 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
```