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
##     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    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 number
##   14.0    5.00    20.00      1      0     5.00   20.00       # logN0 vector of initial number
##   13.5    5.00    20.00      1      0     5.00   20.00       # 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)                                                               ##
```

9

```
## ## 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
##    0.2      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 number
##  14.0       5.00     20.00        1      0    5.00   20.00         # logN0 vector of initial number
##  13.5       5.00     20.00        1      0    5.00   20.00         # 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    0.4   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
##    0.2        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 recruitmen
##   10.0      -7.0        20         1       0     -7     20       # 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     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
```

17

```
##      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
##    0.2        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
##   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
## ## ---------------------------------------------------------------------------------------- ##
##
## ## ---------------------------------------------------------------------------------------- ##
## ## 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      # 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 (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      20.00       1      0    5.00   20.00     # logN0 vector of initial number
##  14.0      5.00      20.00       1      0    5.00   20.00     # logN0 vector of initial number
##  13.5      5.00      20.00       1      0    5.00   20.00     # 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    0.4   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
##    0.2        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
##   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
##    2.2756   0.4039   1.0044
## ## --------------------------------------------------------------------------------------- ##
##
## ## --------------------------------------------------------------------------------------- ##
## ## 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 number
##   14.0          5.00         20.00              1         0      5.00   20.00              # logN0 vector of initial number
##   13.5          5.00         20.00              1         0      5.00   20.00              # 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    0.4   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
##    0.2      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
##   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
##   1.3479   0.2796   0.3908
## ## ------------------------------------------------------------------------------- ##
##
## ## ------------------------------------------------------------------------------- ##
## ## 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
```