Appendix B: SMBKC Stock Assessment Input Files

The data file:

```
## # Gmacs Main Data File Version 1.1: SM15 example
## # GEAR_INDEX DESCRIPTION
      1
          : Pot fishery retained catch.
## #
              : Pot fishery with discarded catch.
      1
## #
              : 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
              4 NMFS Trawl Survey, 5 Pot Survey
##
## 1978 # Start year
## 2016 # End year
## 2017 # Projection year
       # 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
       # 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_1 = a*1^b, 2 = vector by sex, 3 = matrix by se
## # weight-at-length allometry w_l = a*l^b
## 4.03E-07
## # b (male, female)
## 3.141334
## # Male weight-at-length
                0.001165731
                              0.001930510
## 0.000748427
## 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
                             0.001926859
## 0.000748427
                0.001165731
## 0.000748427
                0.001165731
                              0.002021492
```

```
## 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
                                     0.001930932
                    0.001165731
## 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
##
               0.1400
                         0.0000
                                   0.4900
      0.0000
                                            0.3700
##
      0.0000
               0.1800
                         0.0000
                                   0.4500
                                            0.3700
##
                         0.0000
                                   0.4900
      0.0000
               0.1400
                                            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
      0.0000
               0.1800
                                   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
                                     0.1900
      0.0000
                0.4400
                                               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
       15 25 25
## 27
## ##
       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
                                                                                    effort
                                                                                            discard_mortality
                     fleet
                              sex
                                       obs
                                                cv
                                                         type
                                                                  units
                                                                           mult
## 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
                                                                  2
                                                                                    0
                                                                                             0
                     1
                              1
                                       33162
                                                0.03
                                                         1
                                                                           1
## 1981
            2
                                                                  2
                                                                                    0
                                                                                             0
                     1
                                       1045619 0.03
                                                                           1
                              1
                                                         1
                                                                  2
## 1982
            2
                     1
                              1
                                       1935886 0.03
                                                         1
                                                                           1
                                                                                    0
                                                                                             0
## 1983
            2
                                       1931990 0.03
                                                                  2
                                                                           1
                                                                                    0
                                                                                             0
                     1
                              1
                                                         1
## 1984
            2
                     1
                              1
                                       841017
                                                0.03
                                                                  2
                                                                           1
                                                                                    0
                                                                                             0
## 1985
            2
                     1
                                       436021
                                                0.03
                                                                  2
                                                                           1
                                                                                    0
                                                                                             0
                              1
                                                         1
                                                                  2
## 1986
            2
                     1
                                       219548
                                                0.03
                                                                           1
                                                                                    0
                                                                                             0
                              1
                                                         1
                                                                  2
                                                                                             0
## 1987
            2
                                                0.03
                                                                                    0
                     1
                              1
                                       227447
                                                         1
                                                                           1
## 1988
            2
                     1
                                       280401
                                                0.03
                                                                  2
                                                                           1
                                                                                    0
                                                                                             0
                              1
                                                         1
## 1989
            2
                     1
                                       247641
                                                0.03
                                                                  2
                                                                           1
                                                                                    0
                                                                                             0
                              1
                                                         1
## 1990
            2
                                                                  2
                                                                                    0
                                                                                             0
                     1
                              1
                                       391405
                                                0.03
                                                         1
                                                                           1
## 1991
            2
                                                                  2
                                                                                    0
                                                                                             0
                     1
                                       726519
                                                0.03
                                                                           1
                              1
                                                         1
## 1992
            2
                                                                  2
                                                                                    0
                                                                                             0
                     1
                              1
                                       545222
                                                0.03
                                                         1
                                                                           1
## 1993
            2
                                                                  2
                                                                                    0
                     1
                                       630353
                                                0.03
                                                                           1
                                                                                             0
                              1
                                                         1
            2
                                                                  2
## 1994
                     1
                              1
                                       827015
                                                0.03
                                                         1
                                                                           1
                                                                                    0
                                                                                             0
## 1995
            2
                                                                  2
                                                                                    0
                                                                                             0
                     1
                              1
                                       666905
                                                0.03
                                                         1
                                                                           1
                                                                  2
## 1996
            2
                     1
                              1
                                       660665
                                                0.03
                                                         1
                                                                           1
                                                                                    0
                                                                                             0
            2
                                                                  2
                                                                                    0
## 1997
                     1
                              1
                                       939822
                                                0.03
                                                         1
                                                                           1
                                                                                             0
                                                                  2
## 1998
            2
                                                                                    0
                                                                                             0
                     1
                              1
                                       635370
                                                0.03
                                                         1
                                                                           1
                                                                  2
## 2009
            2
                                                                                    0
                                                                                             0
                     1
                              1
                                       103376
                                                0.03
                                                         1
                                                                           1
## 2010
            2
                     1
                                       298669
                                                0.03
                                                         1
                                                                  2
                                                                           1
                                                                                    0
                                                                                             0
                              1
                                                                  2
## 2011
                     1
                              1
                                       437862
                                                0.03
                                                                           1
                                                                                    0
                                                                                             0
```

	0040	0		4	070000	0.00	4	0	4	^	^	
	2012	2	1	1	379386	0.03	1	2 2	1	0	0	
## ##	2014 2015	2	1 1	1 1	69109 24407	0.03	1 1	2	1 1	0	0	
##	# Male	discards		fishery	24407	0.03	1	2	1	U	U	
	# Male 1990	2	1	1	254.97878	261	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	21.193785	597	0.2	2	1	1	0	0.2
##	# Trawl	fishery		ds								
	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 2002	2	2	1 1	0.000 0.726	0.31 0.31	2 2	1 1	1 1	0	0.8 0.8	
	2002	2	2	1	0.720	0.31	2	1	1	0	0.8	
##	2003	2	2	1	0.990	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	

```
## 1999
                                          0.31
                                                                                 0.5
                          1
                                  1.361
## 2000
          2
                  3
                                  0.000
                                          0.31
                                                 2
                                                         1
                                                                 1
                                                                                 0.5
                          1
## 2001
                  3
                                  0.862
                                          0.31
                                                         1
                                                                         0
                                                                                 0.5
## 2002
                  3
                                                 2
                                                                         0
                                                                                 0.5
          2
                                  0.408
                                          0.31
                                                         1
                                                                 1
                          1
## 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
                  3
                                  0.590
                                          0.31
                                                 2
                                                         1
                                                                 1
                                                                                 0.5
                          1
## 2006
                                                                                 0.5
                  3
                                          0.31
                                                 2
                                                                         0
          2
                          1
                                  1.451
                                                         1
                                                                 1
## 2007
          2
                  3
                          1
                                  69.717
                                         0.31
                                                 2
                                                         1
                                                                 1
                                                                         0
                                                                                 0.5
## 2008
          2
                  3
                                                 2
                                                         1
                                                                         0
                                                                                 0.5
                          1
                                  6.622
                                          0.31
                                                                 1
## 2009
          2
                  3
                          1
                                  7.530
                                          0.31
                                                 2
                                                         1
                                                                 1
                                                                         0
                                                                                 0.5
## 2010
          2
                  3
                                                 2
                                                                         0
                                  9.571
                                          0.31
                                                         1
                                                                 1
                                                                                 0.5
                          1
## 2011
          2
                  3
                                                 2
                                                         1
                                                                         0
                          1
                                  0.590
                                          0.31
                                                                 1
                                                                                 0.5
## 2012
                                                 2
          2
                  3
                                  0.590
                                          0.31
                                                         1
                                                                 1
                                                                         0
                                                                                 0.5
                          1
## 2013
          2
                  3
                                  0.272
                                          0.31
                                                 2
                                                         1
                                                                         0
                                                                                 0.5
                          1
                                                                 1
## 2014
          2
                  3
                                  0.272
                                          0.31
                                                  2
                                                         1
                                                                 1
                                                                         0
                                                                                 0.5
## 2015
          2
                  3
                                  0.635
                                          0.31
                                                  2
                                                         1
                                                                 1
                                                                         0
                                                                                 0.5
                          1
## ## 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
## # 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
        1 4 1 16221.933 0.344 1
## 1982
## 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
        1 4 1 6730.130
## 1990
                        0.274 1
## 1991 1 4 1 6948.184 0.248 1
## 1992 1 4 1 7093.272 0.201 1
## 1993 1 4 1 9548.459 0.169 1
## 1994 1 4 1 6539.133 0.176 1
## 1995
       1 4 1 5703.591 0.178 1
## 1996
        1 4 1 9410.403 0.241 1
## 1997
       1 4 1 10924.107 0.337 1
## 1998 1 4 1 7976.839 0.355 1
## 1999 1 4 1 1594.546 0.182 1
## 2000 1 4 1 2096.795 0.310 1
## 2001
        1 4 1 2831.440 0.245 1
## 2002
       1 4 1 1732.599 0.320 1
## 2003 1 4 1 1566.675 0.336 1
## 2004 1 4 1 1523.869 0.305 1
## 2005 1 4 1 1642.017 0.371 1
```

```
## 2006 1 4 1 3893.875 0.334 1
## 2007 1 4 1 6470.773 0.385 1
## 2008 1 4 1 4654.473 0.284 1
## 2009 1 4 1 6301.470 0.256 1
## 2010 1 4 1 11130.898 0.466 1
## 2011 1 4 1 10931.232 0.558 1
## 2012 1 4 1 6200.219 0.339 1
## 2013 1 4 1 2287.557 0.217 1
## 2014 1 4 1 6029.220 0.449 1
## 2015 1 4 1 5877.433 0.770 1
## 2016 1 4 1 3485.909 0.393 1
## 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
## ## Number of rows in each matrix
      39 9
## 15
## ## 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
```

```
0.1219 0.3065 0.5716
##
    1981 1 4 1 0 0 0 50
##
    1982 1 4 1 0 0 0 50
                         0.1671 0.2435 0.5893
    1983
                         0.1752 0.2726 0.5522
##
         1 4 1 0 0 0 50
##
         1 4 1 0 0 0 50
                         0.1823 0.2085 0.6092
    1984
##
    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
##
         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
##
                         0.2179 0.3940 0.3881
    2011 1 4 1 0 0 0 50
##
##
    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
##
    ##
    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
##
    ##
    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
                                                            30
                                                                         # log(R0)
                                                   -7
##
     10.0
               -7.0
                           20
                                     -1
                                                  -10.0
                                                            20
                                                                         # log(Rini)
                                              1
               -7.0
                                                   -7
##
     10.0
                           20
                                      1
                                              0
                                                            20
                                                                         # log(Rbar)
                                                           7.25
##
     80.0
               30.0
                          310
                                     -2
                                              1
                                                   72.5
                                                                         # Recruitment size distribution
##
     0.25
                0.1
                            7
                                     -4
                                                   0.1
                                                           9.0
                                                                         # Recruitment size scale (varia
##
    0.2
              -10.0
                         0.75
                                     -4
                                              0
                                                 -10.0
                                                          0.75
                                                                         # log(sigma_R)
                                     -2
##
     0.75
               0.20
                         1.00
                                              3
                                                   3.0
                                                          2.00
                                                                         # steepness
                                                                         # recruitment autocorrelation
##
    0.01
               0.00
                         1.00
                                     -3
                                              3
                                                   1.01
                                                          1.01
##
  14.5
               5.00
                        20.00
                                      1
                                              0
                                                   5.00
                                                         20.00
                                                                         # logNO vector of initial number
## 14.0
              5.00
                        20.00
                                      1
                                              0
                                                   5.00
                                                         20.00
                                                                         # logNO vector of initial number
   13.5
               5.00
                        20.00
                                                   5.00 20.00
                                                                         # logNO 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
                                                                         # alpha males or combined
##
     14.1
               10.0
                         30.0
                                      -3
                                               0
                                                    0.0
                                                          999.0
##
     0.0001
                0.0
                          0.01
                                      -3
                                               0
                                                    0.0
                                                          999.0
                                                                         # beta males or combined
                                      -3
##
      0.45
                0.01
                          1.0
                                               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
                 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
                                                          # sex specific selectivity
      0
                 3
                           3
                                     0
                                               0
                                                          # male selectivity type
##
##
   ## Gear-1
                 Gear-2
                           Gear-3
                                     Gear-4
                                               Gear-5
##
                 1
                                               1
                                                          # Retention periods
                           1
                                     1
##
      0
                 0
                           0
                                     0
                                               0
                                                          # sex specific retention
                 2
                           2
                                               2
##
      3
                                      2
                                                          # male retention type
##
                           0
                                     0
                                               0
                                                          # male retention flag (0 -> no, 1 -> yes)
      gear par
                                                                       phz
                                                                               start end
                                                                                                  ##
                   sel
   ## index index par sex ival lb
                                                                       mirror period period
                                                                                                  ##
                                          ub
                                                 prior p1
                                                               p2
   # Gear-1
                                                                                         1978
##
      1
             1
                   1
                       0
                             0.490680567427 0.001 2.0
                                                           0
                                                                    0
                                                                            1
                                                                                 -2
                                                                                                2008
##
      1
             2
                   2
                       0
                             0.785300542244 0.001 2.0
                                                           0
                                                                    0
                                                                            1
                                                                                 -2
                                                                                         1978
                                                                                                2008
             3
                   3
                       0
                             1.0
                                             0.001 2.0
                                                           0
                                                                                 -2
##
      1
                                                                    Ω
                                                                           1
                                                                                         1978
                                                                                                2008
##
      1
             1
                   1
                       0
                             0.402423912257 0.001 2.0
                                                           0
                                                                    0
                                                                           1
                                                                                 -2
                                                                                         2009
                                                                                                2016
             2
                                                                                 -2
##
      1
                   2
                       Ω
                             0.981647895824 0.001 2.0
                                                           0
                                                                    Ω
                                                                           1
                                                                                         2009
                                                                                                2016
##
      1
             3
                                             0.001 2.0
                                                           0
                                                                           1
                                                                                 -2
                                                                                         2009
                                                                                                2016
##
  # Gear-2
      2
             7
                       0
                             40
                                       10.0
                                             200
                                                     0
                                                            10
                                                                   200
                                                                          -3
                                                                                  1978
                                                                                          2016
##
                   1
                                                                                         2016
      2
             8
                   2
                       0
                             60
                                       10.0
                                             200
                                                                   200
                                                                                  1978
##
                                                     0
                                                            10
                                                                          -3
   # 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
                             0.793562338771 0.001 2.0
##
      4
                       0
                                                           0
                                                                    0
                                                                                 -2
                                                                                         1978
                                                                                                2016
             8
                   1
                                                                           1
                   2
                             1.08339465666 0.001 2.0
                                                                   0
                                                                                -2
##
      4
             9
                       0
                                                          0
                                                                          1
                                                                                        1978
                                                                                               2016
##
      4
             10
                   3
                       0
                                            0.001 2.0
                                                          0
                                                                   0
                                                                          1
                                                                                -2
                                                                                        1978
                                                                                               2016
##
  # Gear-5
##
      5
             11
                       0
                             0.411256448303 0.001 2.0
                                                           0
                                                                    0
                                                                           1
                                                                                 -2
                                                                                         1978
                                                                                                2016
                   1
##
      5
             12
                   2
                       0
                             0.861094630732 0.001 2.0
                                                           0
                                                                    0
                                                                           1
                                                                                 -2
                                                                                         1978
                                                                                                2016
                   3
                       0
                             1.0
                                             0.001 2.0
                                                                                 -2
##
                                                           0
                                                                    Ω
                                                                            1
                                                                                         1978
                                                                                                2016
  ## Retained
##
  # Gear-1
     -1
             14
                       0
                            120
                                  100
                                         200
                                                0
                                                        1
                                                             900
                                                                            1978
                                                                                   2016
##
                   1
                                                                    -1
##
     -1
                   2
                       0
                            123
                                  110
                                         200
                                                0
                                                             900
                                                                    -1
                                                                            1978
                                                                                   2016
             15
                                                        1
## # Gear-2
     -2
                            595
                                         700
                       0
                                                             900
                                                                    -3
                                                                            1978
                                                                                   2016
##
             16
                                                0
                   1
                                   1
                                                        1
     -2
                                         700
                                                             900
##
             17
                   2
                       0
                             10
                                   1
                                                0
                                                        1
                                                                    -3
                                                                            1978
                                                                                   2016
   # Gear-3
##
##
     -3
             18
                   1
                       0
                            590
                                   1
                                         700
                                                0
                                                        1
                                                             900
                                                                    -3
                                                                            1978
                                                                                   2016
     -3
                                         700
                                                             900
##
             19
                   2
                       0
                             10
                                   1
                                                0
                                                        1
                                                                    -3
                                                                            1978
                                                                                   2016
##
  # Gear-4
     -4
                            580
                                         700
                                                             900
                                                                    -3
##
             20
                   1
                       0
                                   1
                                                0
                                                        1
                                                                            1978
                                                                                   2016
##
     -4
             21
                   2
                       0
                             20
                                   1
                                         700
                                                0
                                                        1
                                                             900
                                                                    -3
                                                                            1978
                                                                                   2016
## # Gear-5
```

```
1 0
##
   -5
                    580
                         1
                             700
                                   0
                                        1
                                            900
                                                 -3
                                                       1978
##
         23
                     20
                             700
                                   0
                                            900
   -5
                         1
                                        1
                                                -3
                                                       1978
                                                            2016
##
## ## ----- ##
## ## PRIORS FOR CATCHABILITY
       If a uniform prior is selected for a parameter then the 1b and ub are used (p1
       and p2 are ignored). ival must be > 0
## ## I.EGEND
                                                                       ##
## ##
       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
                                             Analytic?
                 ub
                      phz
                         prior p1
                                        p2
                                                       LAMBDA
                                                             # NMFS trawl
    1.0
          0
                      -1
                           0
                                 0
                                        9.0
                                             0
## 0.00411135867487 0 5
                                 0
                      -1
                           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
                                                                       ##
       prior: 0 = uniform, 1 = normal, 2 = lognormal, 3 = beta, 4 = gamma
                                                                       ##
## ## -----
## ## ival
             1b
                     ub
                             phz prior
                                          р1
                                               р2
    0.000001
              0.0000001
                         10.0 -4 4
                                               1.0
                                                     100 # NMFS
                0.0000001
                         10.0
                                  -4
                                       4
                                                     100 # ADF&G
##
    0.0000001
                                               1.0
## ## -----
##
## ## PENALTIES FOR AVERAGE FISHING MORTALITY RATE FOR EACH GEAR
  ## Mean_F STD_PHZ1 STD_PHZ2
                            PHZ
##
           0.05
    0.2
                   50.0
                              # Pot
                            1
##
    0.001
            0.05
                   50.0
                            1
                              # Trawl
                 50.0
    0.001
           0.05
                           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
      \ensuremath{\mathsf{pmin}} is the cumulative proportion used in tail compression.
## # 1 1 1 # Type of likelihood
## 2 2 # Type of likelihood
```

```
## # 5 5 5 # Type of likelihood
     0 0 # Auto tail compression (pmin)
            # Initial value for effective sample size multiplier
            # Phz for estimating effective sample size (if appl.)
  -4 -4 -4
         3
            # Composition aggregator
        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
## ## Phase of estimation
## ## STDEV in m_dev for Random walk
## ## Number of nodes for cubic spline or number of step-changes for option 3
## ## Year position of the knots (vector must be equal to the number of nodes)
## 1998 1999
##
## ## ----- ##
 ## OTHER CONTROLS
  ## ----- ##
##
         # Estimated rec_dev phase
         # Estimated rec_ini phase
##
         # VERBOSE FLAG (0 = off, 1 = on, 2 = objective func)
##
##
         # 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
         # Target SPR ratio for Bmsy proxy
##
   0.35
         # Gear index for SPR calculations (i.e. directed fishery)
##
         # Lambda (proportion of mature male biomass for SPR reference points)
         # Use empirical molt increment data (0 = FALSE, 1 = TRUE)
         # 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
                                     phz
                lb
                                                                        # parameter
                          пþ
                                           prior
                                                   р1
                                                             p2
##
    0.18
              0.01
                           1
                                     -4
                                              2
                                                  0.18
                                                          0.02
                                                                        # M
              -7.0
                                     -2
##
     14.3
                           30
                                              0
                                                   -7
                                                            30
                                                                        # log(R0)
     10.0
              -7.0
                           20
                                     -1
                                                  -10.0
                                                            20
                                                                        # log(Rini)
##
                                              1
     10.0
                                                  -7
                                                            20
##
              -7.0
                          20
                                     1
                                              0
                                                                        # log(Rbar)
                                                           7.25
##
    80.0
              30.0
                         310
                                     -2
                                              1
                                                  72.5
                                                                        # 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
                                                   5.00
                                                         20.00
                                                                        # logNO vector of initial number
                                     1
                                              0
##
   14.0
              5.00
                        20.00
                                      1
                                              0
                                                   5.00
                                                         20.00
                                                                        # logNO vector of initial number
##
   13.5
              5.00
                        20.00
                                      1
                                                   5.00
                                                         20.00
                                                                        # logNO vector of initial number
## ## GROWTH PARAM CONTROLS
                                                                                           ##
                                                                                           ##
## ## Two lines for each parameter if split sex, one line if not
## # ival
                1b
                          ub
                                      phz prior
                                                             p2
                                                                        # parameter
                                                    р1
##
     14.1
              10.0
                         30.0
                                      -3
                                               0
                                                    0.0
                                                          999.0
                                                                        # alpha males or combined
##
                         0.01
                                      -3
                                                                        # beta males or combined
     0.0001
               0.0
                                               0
                                                    0.0
                                                          999.0
##
      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
##
                         1.0
                                      -3
                                                    0.0
                                                          999.0
                                                                        # molt_cv males or combined
               0.0
##
## ## -----
## ## SELECTIVITY CONTROLS
                                                                                           ##
         Each gear must have a selectivity and a retention selectivity. If a uniform
          prior is selected for a parameter then the 1b 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
                                                      # Selectivity periods
                1
                         1
##
                0
                         0
                                            0
                                                      # sex specific selectivity
##
                3
                         3
                                   0
                                           0
                                                      # male selectivity type
## ## Gear-1
                Gear-2
                        Gear-3
                                  Gear-4
                                            Gear-5
##
                                                      # Retention periods
      1
                1
                         1
                                   1
                                            1
##
                         0
                                                      # sex specific retention
```

```
2
                                              # male retention type
                                     2
##
            2
                    2
                                     0
                                             # male retention flag (0 -> no, 1 -> yes)
##
     1
                      0
              0
                                                           phz
## ## gear par sel
                                                                 start end
  ## index index par sex ival lb ub
                                        prior p1
                                                           mirror period period
                                                     p2
  # Gear-1
     1
                   0
                             0.001 1.0
                                                0
                                                           3
                                                                  1978
                                                                        2008
##
          1
                       0.4
                                         0
                                                     1
               1
     1
          2
                             0.001 1.0
                                                           3
##
               2
                   0
                        0.7
                                         0
                                                0
                                                     1
                                                                  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
          5
                                                0
##
     1
               2
                   0
                       0.7
                             0.001 1.0
                                         0
                                                     1
                                                           3
                                                                  2009
                                                                        2016
##
     1
          6
               3
                   0
                       1.0
                             0.001 2.0
                                         0
                                               0
                                                     1
                                                          -3
                                                                  2009
                                                                        2016
## # Gear-2
         7
                                                    200
##
     2
                   0
                        40
                             10.0 200
                                         0
                                               10
                                                          -3
                                                                  1978
                                                                        2016
               1
     2
                2
                                                    200
                                                                  1978
##
          8
                   0
                        60
                             10.0 200
                                         0
                                               10
                                                           -3
                                                                        2016
## # Gear-3
##
     3
          9
               1
                   0
                        40
                             10.0 200
                                         0
                                               10
                                                    200
                                                           -3
                                                                  1978
                                                                        2016
##
     3
                             10.0 200
                                               10
                                                    200
          10
                2
                   0
                        60
                                         0
                                                           -3
                                                                  1978
                                                                        2016
## # Gear-4
                   0
                             0.001 1.0
                                                0
                                                           4
##
     4
                        0.4
                                         0
                                                      1
                                                                  1978
                                                                        2016
          11
                1
##
     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
                   0
                             0.001 1.0
                                                0
          14
                       0.4
                                         0
                                                           4
                                                                  1978
                                                                        2016
                1
                                                      1
     5
                   0
                       0.7
                             0.001 1.0
                                                           4
                                                                  1978
##
          15
                2
                                         0
                                                0
                                                      1
                                                                        2016
##
     5
          16
                3
                   0
                        1.0
                             0.001 2.0
                                         0
                                                0
                                                      1
                                                           -4
                                                                  1978
                                                                        2016
## ## Retained
## # Gear-1
          17
                        120
                             100
                                  200
                                                    900
                                                                  1978
##
    -1
                   0
                                         0
                                                1
                                                           -1
                                                                        2016
               1
##
    -1
                   0
                        123
                                  200
                                                    900
                                                                  1978
                                                                        2016
          18
                2
                             110
                                         0
                                                1
                                                           -1
## # 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
                   0
                        590
                                  700
                                                    900
                                                           -3
          21
                              1
                                         0
                                                1
                                                                  1978
                                                                        2016
                1
##
    -3
          22
                   0
                        10
                                  700
                                         0
                                                1
                                                    900
                                                           -3
                                                                  1978
                                                                        2016
                              1
## # Gear-4
##
   -4
          23
                   0
                        580
                                  700
                                                    900
                                                          -3
                                                                  1978
                                                                        2016
##
    -4
          24
                   0
                        20
                                  700
                                                    900
                                                                  1978
                                                                        2016
                2
                              1
                                         0
                                                1
                                                           -3
## # Gear-5
##
    -5
                   0
                        580
                                  700
                                                    900
                                                           -3
          25
                              1
                                         0
                                                1
                                                                  1978
                                                                        2016
               1
                        20
                                  700
                                                    900
                                                                  1978
          26
                2
                   0
                              1
                                         0
                                                1
                                                           -3
                                                                        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
                                              р2
                                                   Analytic? LAMBDA
                                     0
##
     1.0
            0
                    2
                         -1
                              0
                                              9.0
                                                   0
                                                              1 # NMFS trawl
```

```
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
## ## I.EGEND
                                                               ##
      prior: 0 = uniform, 1 = normal, 2 = lognormal, 3 = beta, 4 = gamma
                                                               ##
## ## ival
           lb
                         phz prior
                                     p1
                                          p2
                  ub
    0.00001
                                           100
            0.000001 10.0
                          -4
                                     1.0
                              4
                                                 # 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
##
         0.05
                50.0
                        1 # Pot
               50.0
    0.001 0.05
##
                        1 # Trawl
   0.001 0.05 50.0
                        1 # Fixed
##
          2.00
               20.00
##
                        -1 # NMFS
   0.00
               20.00
##
    0.00
          2.00
                        -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 # Type of likelihood
## # 1
     1
      2
        2 # Type of likelihood
      5 5 # Type of likelihood
          # Auto tail compression (pmin)
      0
        0
           # Initial value for effective sample size multiplier
      1
        1
     -4 -4 # Phz for estimating effective sample size (if appl.)
     2 3 # Composition aggregator
       1
           # LAMBDA
     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
## 3
## ## Phase of estimation
## 4
## ## STDEV in m_dev for Random walk
## ## Number of nodes for cubic spline or number of step-changes for option 3
## ## Year position of the knots (vector must be equal to the number of nodes)
## 1998 1999
## ## ----- ##
##
## ## OTHER CONTROLS
## ## ------ ##
##
          # Estimated rec dev phase
##
          # Estimated rec_ini phase
          # VERBOSE FLAG (0 = off, 1 = on, 2 = objective func)
##
          # Initial conditions (0 = Unfished, 1 = Steady-state fished, 2 = Free parameters)
##
          # First year for average recruitment for Bspr calculation
##
    1978
          # Last year for average recruitment for Bspr calculation
##
    2016
    0.35
          # Target SPR ratio for Bmsy proxy
##
          # Gear index for SPR calculations (i.e. directed fishery)
          # Lambda (proportion of mature male biomass for SPR reference points)
##
    1
##
          # Use empirical molt increment data (0 = FALSE, 1 = TRUE)
          # 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
                                     phz
                lb
                                                                        # parameter
                          пþ
                                           prior
                                                   р1
                                                             p2
##
    0.18
              0.01
                           1
                                     -4
                                              2
                                                  0.18
                                                          0.02
                                                                        # M
               -7.0
                                     -2
##
     14.3
                           30
                                              0
                                                   -7
                                                            30
                                                                        # log(RO) - unfished recruits
     10.0
               -7.0
                           20
                                     -1
                                                  -10.0
                                                            20
                                                                        # log(Rini) - initial recruitme
##
                                              1
    10.0
                                                  -7
                                                            20
##
              -7.0
                          20
                                     1
                                              0
                                                                        # log(Rbar) - average recruits(
                                                           7.25
                                                                        # Recruitment size distribution
##
    80.0
              30.0
                         310
                                     -2
                                              1
                                                  72.5
##
    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
                                                                        # steepness
                                                          2.00
##
    0.01
              0.00
                        1.00
                                     -3
                                              3
                                                  1.01
                                                          1.01
                                                                        # recruitment autocorrelation
##
   14.5
               5.00
                        20.00
                                                   5.00
                                                         20.00
                                                                        # logNO vector of initial number
                                     1
                                              0
##
   14.0
               5.00
                        20.00
                                      1
                                              0
                                                   5.00
                                                         20.00
                                                                        # logNO vector of initial number
##
   13.5
               5.00
                        20.00
                                      1
                                                   5.00
                                                         20.00
                                                                        # logNO vector of initial number
## ## GROWTH PARAM CONTROLS
                                                                                           ##
                                                                                           ##
## ## Two lines for each parameter if split sex, one line if not
## # ival
                1h
                          ub
                                      phz prior
                                                    р1
                                                             p2
                                                                        # parameter
##
     14.1
               10.0
                         30.0
                                      -3
                                               0
                                                    0.0
                                                          999.0
                                                                        # alpha males or combined
##
                         0.01
                                      -3
     0.0001
               0.0
                                               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
##
                         1.0
                                      -3
                                                    0.0
                                                          999.0
                                                                        # molt_cv males or combined
      0.060
               0.0
##
## ## -----
## ## SELECTIVITY CONTROLS
                                                                                           ##
         Each gear must have a selectivity and a retention selectivity. If a uniform
          prior is selected for a parameter then the 1b 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
                                                      # Selectivity periods
##
                0
                         0
                                            0
                                                      # sex specific selectivity
##
                3
                         3
                                   0
                                            0
                                                      # male selectivity type
## ## Gear-1
                Gear-2
                        Gear-3
                                  Gear-4
                                            Gear-5
##
                                                      # Retention periods
      1
                1
                         1
                                   1
                                            1
##
                         0
                                                      # sex specific retention
```

```
2
                                      2
                                              # male retention type
##
            2
                    2
                                      0
                                              # male retention flag (0 -> no, 1 -> yes)
##
     1
                      0
              0
                                                           phz
## ## gear par sel
                                                                 start end
  ## index index par sex ival lb ub
                                        prior p1
                                                           mirror period period
                                                     p2
  # Gear-1
     1
                   0
                             0.001 1.0
                                                0
                                                           3
                                                                  1978
                                                                        2008
##
          1
                        0.4
                                         0
                                                     1
               1
     1
          2
                             0.001 1.0
                                                           3
##
               2
                   0
                        0.7
                                         0
                                                0
                                                     1
                                                                  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
          5
                                                0
##
     1
               2
                   0
                        0.7
                             0.001 1.0
                                         0
                                                     1
                                                           3
                                                                  2009
                                                                        2016
##
     1
          6
               3
                   0
                        1.0
                             0.001 2.0
                                         0
                                                0
                                                     1
                                                          -3
                                                                  2009
                                                                        2016
## # Gear-2
         7
                                                    200
##
     2
                   0
                        40
                             10.0 200
                                         0
                                               10
                                                          -3
                                                                  1978
                                                                        2016
               1
     2
                2
                                                    200
##
          8
                   0
                        60
                             10.0 200
                                         0
                                               10
                                                           -3
                                                                  1978
                                                                        2016
## # Gear-3
##
     3
          9
               1
                   0
                        40
                             10.0 200
                                         0
                                               10
                                                    200
                                                           -3
                                                                  1978
                                                                        2016
##
     3
                             10.0 200
                                               10
                                                    200
          10
                2
                   0
                        60
                                         0
                                                           -3
                                                                  1978
                                                                        2016
## # Gear-4
                   0
                             0.001 1.0
                                                0
                                                           4
##
     4
                        0.4
                                         0
                                                      1
                                                                  1978
                                                                        2016
          11
                1
##
     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
                   0
                             0.001 1.0
                                                0
          14
                        0.4
                                         0
                                                           4
                                                                  1978
                                                                        2016
                1
                                                      1
     5
                   0
                        0.7
                             0.001 1.0
                                                           4
                                                                  1978
##
          15
                2
                                         0
                                                0
                                                      1
                                                                        2016
##
     5
          16
                3
                   0
                        1.0
                             0.001 2.0
                                         0
                                                0
                                                      1
                                                           -4
                                                                  1978
                                                                        2016
## ## Retained
## # Gear-1
          17
                        120
                             100
                                  200
                                                    900
                                                                  1978
##
    -1
                   0
                                         0
                                                1
                                                           -1
                                                                        2016
               1
##
    -1
                   0
                        123
                                  200
                                                    900
                                                                  1978
                                                                        2016
          18
                2
                             110
                                         0
                                                1
                                                           -1
## # 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
                   0
                        590
                                  700
                                                    900
                                                           -3
          21
                              1
                                         0
                                                1
                                                                  1978
                                                                        2016
                1
##
    -3
          22
                   0
                        10
                                  700
                                         0
                                                1
                                                    900
                                                           -3
                                                                  1978
                                                                        2016
                              1
## # Gear-4
##
   -4
          23
                   0
                        580
                                  700
                                                    900
                                                          -3
                                                                  1978
                                                                        2016
##
    -4
          24
                   0
                        20
                                  700
                                                    900
                                                                  1978
                                                                        2016
                2
                              1
                                         0
                                                1
                                                           -3
## # Gear-5
##
    -5
                   0
                        580
                                  700
                                                    900
                                                           -3
          25
                              1
                                         0
                                                1
                                                                  1978
                                                                        2016
               1
                        20
                                  700
                                                    900
                                                                  1978
##
          26
                2
                   0
                              1
                                         0
                                                1
                                                           -3
                                                                        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
                                     0
##
     1.0
            0
                    2
                         -1
                              0
                                              9.0
                                                   0
                                                              1 # NMFS trawl
```

```
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 1b and ub are used (p1
       and p2 are ignored). ival must be > 0
## ## I.EGEND
                                                                         ##
       prior: 0 = uniform, 1 = normal, 2 = lognormal, 3 = beta, 4 = gamma
                                                                         ##
                                          p1
## ## ival
             lb
                             phz prior
                                                p2
                    ub
    0.00001
                                                 100
              0.000001 10.0
                              -4
                                           1.0
                                  4
                                                        # 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
                             PH7.
                 50.0
##
    0.2
          0.05
                           1 # Pot
                 50.0
    0.001 0.05
##
                           1 # Trawl
    0.001 0.05 50.0
                           1 # Fixed
##
           2.00 20.00
##
                           -1 # NMFS
    0.00
          2.00
                 20.00
    0.00
                           -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 # Type of likelihood
       1
##
      0 0 # Auto tail compression (pmin)
             # Initial value for effective sample size multiplier
     -4 -4 # Phz for estimating effective sample size (if appl.)
   1 2
          3 # Composition aggregator
   1.7526 0.5427 1.8193
##
## ## 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
## ## STDEV in m dev for Random walk
## ## Number of nodes for cubic spline or number of step-changes for option 3
## ## Year position of the knots (vector must be equal to the number of nodes)
## 1998 1999
##
## ## ----- ##
## ## OTHER CONTROLS
##
          # Estimated rec dev phase
##
          # Estimated rec_ini phase
           # VERBOSE FLAG (0 = off, 1 = on, 2 = objective func)
##
##
           # Initial conditions (0 = Unfished, 1 = Steady-state fished, 2 = Free parameters)
##
         # 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
           # Gear index for SPR calculations (i.e. directed fishery)
##
##
           # Lambda (proportion of mature male biomass for SPR reference points)
##
           # Use empirical molt increment data (0 = FALSE, 1 = TRUE)
           # 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
                                     phz
                lb
                                                                        # parameter
                          пþ
                                           prior
                                                   р1
                                                             p2
##
    0.18
              0.01
                           1
                                     -4
                                              2
                                                  0.18
                                                          0.02
                                                                        # M
              -7.0
                                     -2
##
     14.3
                           30
                                              0
                                                   -7
                                                            30
                                                                        # log(R0)
     10.0
              -7.0
                           20
                                     -1
                                                  -10.0
                                                            20
                                                                        # log(Rini)
##
                                              1
##
    10
              -7.0
                                                  -7
                                                            20
                          20
                                     1
                                              0
                                                                        # log(Rbar)
                                                           7.25
##
    80.0
              30.0
                         310
                                     -2
                                              1
                                                  72.5
                                                                        # 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
                                     -3
##
    0.01
              0.00
                        1.00
                                              3
                                                  1.01
                                                          1.01
                                                                        # recruitment autocorrelation
##
   14.5
              5.00
                        20.00
                                                   5.00
                                                         20.00
                                                                        # logNO vector of initial number
                                     1
                                              0
##
   14.0
              5.00
                        20.00
                                      1
                                              0
                                                   5.00
                                                         20.00
                                                                        # logNO vector of initial number
##
   13.5
              5.00
                        20.00
                                      1
                                                   5.00
                                                         20.00
                                                                        # logNO vector of initial number
## ## GROWTH PARAM CONTROLS
                                                                                           ##
                                                                                           ##
## ## Two lines for each parameter if split sex, one line if not
## # ival
                1b
                          ub
                                      phz prior
                                                             p2
                                                                        # parameter
                                                    р1
##
     14.1
              10.0
                         30.0
                                      -3
                                                    0.0
                                                          999.0
                                                                        # alpha males or combined
##
                         0.01
                                      -3
                                                                        # beta males or combined
     0.0001
               0.0
                                              0
                                                    0.0
                                                          999.0
##
      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
##
                         1.0
                                      -3
                                                    0.0
                                                          999.0
                                                                        # molt_cv males or combined
      0.060
               0.0
##
## ## -----
## ## SELECTIVITY CONTROLS
                                                                                           ##
         Each gear must have a selectivity and a retention selectivity. If a uniform
          prior is selected for a parameter then the 1b 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
                                                      # Selectivity periods
               1
                         1
##
               0
                         0
                                            0
                                                      # sex specific selectivity
##
               3
                         3
                                   0
                                           0
                                                      # male selectivity type
## ## Gear-1
               Gear-2
                        Gear-3
                                  Gear-4
                                            Gear-5
##
                                                      # Retention periods
      1
               1
                         1
                                   1
                                            1
##
                         0
                                                      # sex specific retention
```

```
2
                                      2
                                              # male retention type
##
            2
                     2
                                      0
                                              # male retention flag (0 -> no, 1 -> yes)
##
     1
                      0
              0
                                                           phz
## ## gear par sel
                                                                 start end
  ## index index par sex ival lb ub
                                        prior p1
                                                           mirror period period
                                                     p2
  # Gear-1
     1
                   0
                             0.001 1.0
                                                0
                                                           3
                                                                  1978
                                                                        2008
##
          1
                        0.4
                                         0
                                                     1
               1
     1
          2
                             0.001 1.0
                                                           3
##
               2
                   0
                        0.7
                                         0
                                                0
                                                     1
                                                                  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
          5
                                                0
##
     1
               2
                   0
                        0.7
                             0.001 1.0
                                         0
                                                     1
                                                           3
                                                                  2009
                                                                        2016
##
     1
          6
               3
                   0
                        1.0
                             0.001 2.0
                                         0
                                                0
                                                     1
                                                          -3
                                                                  2009
                                                                        2016
## # Gear-2
         7
                                                    200
##
     2
                   0
                        40
                             10.0 200
                                         0
                                               10
                                                          -3
                                                                  1978
                                                                        2016
               1
     2
                2
                                                    200
##
          8
                   0
                        60
                             10.0 200
                                         0
                                               10
                                                           -3
                                                                  1978
                                                                        2016
## # Gear-3
##
     3
          9
               1
                   0
                        40
                             10.0 200
                                         0
                                               10
                                                    200
                                                           -3
                                                                  1978
                                                                        2016
##
     3
                             10.0 200
                                               10
                                                    200
          10
                2
                   0
                        60
                                         0
                                                           -3
                                                                  1978
                                                                        2016
## # Gear-4
                   0
                             0.001 1.0
                                                0
                                                           4
##
     4
                        0.4
                                         0
                                                      1
                                                                  1978
                                                                        2016
          11
                1
##
     4
          12
                2
                   0
                        0.7
                             0.001 1.0
                                         0
                                                0
                                                      1
                                                            4
                                                                  1978
                                                                        2016
          13
##
     4
                3
                   0
                        1.0
                             0.001 2.0
                                         0
                                                0
                                                      1
                                                           -4
                                                                  1978
                                                                        2016
## # Gear-5
##
     5
                   0
                             0.001 1.0
                                                0
          14
                        0.4
                                         0
                                                           4
                                                                  1978
                                                                        2016
                1
                                                      1
     5
                   0
                        0.7
                             0.001 1.0
                                                           4
                                                                  1978
##
          15
                2
                                         0
                                                0
                                                      1
                                                                        2016
##
     5
          16
                3
                   0
                        1.0
                             0.001 2.0
                                         0
                                                0
                                                      1
                                                           -4
                                                                  1978
                                                                        2016
## ## Retained
## # Gear-1
          17
                        120
                             100
                                  200
                                                    900
                                                                  1978
##
    -1
                   0
                                         0
                                                1
                                                           -1
                                                                        2016
               1
##
    -1
                   0
                        123
                                  200
                                                    900
                                                                  1978
                                                                        2016
          18
                2
                             110
                                         0
                                                1
                                                           -1
## # 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
                   0
                        590
                                  700
                                                    900
                                                           -3
          21
                              1
                                         0
                                                1
                                                                  1978
                                                                        2016
                1
##
    -3
          22
                   0
                        10
                                  700
                                         0
                                                1
                                                    900
                                                           -3
                                                                  1978
                                                                        2016
                              1
## # Gear-4
##
   -4
          23
                   0
                        580
                                  700
                                                    900
                                                          -3
                                                                  1978
                                                                        2016
##
    -4
          24
                   0
                        20
                                  700
                                                    900
                                                                  1978
                                                                        2016
                2
                              1
                                         0
                                                1
                                                           -3
## # Gear-5
##
    -5
                   0
                        580
                                  700
                                                    900
                                                           -3
          25
                              1
                                         0
                                                1
                                                                  1978
                                                                        2016
               1
                        20
                                  700
                                                    900
                                                                  1978
##
          26
                2
                   0
                              1
                                         0
                                                1
                                                           -3
                                                                        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
                                     0
##
     1.0
            0
                    2
                         -1
                              0
                                              9.0
                                                   0
                                                              1 # NMFS trawl
```

```
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 1b and ub are used (p1
       and p2 are ignored). ival must be > 0
## ## I.EGEND
                                                                         ##
       prior: 0 = uniform, 1 = normal, 2 = lognormal, 3 = beta, 4 = gamma
                                                                         ##
                                          p1
## ## ival
             lb
                              phz prior
                                                p2
                     ub
    0.00001
              0.000001 10.0
                              -4
                                                 100
                                  4
                                           1.0
                                                        # 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
                             PH7.
                 50.0
##
    0.2
          0.05
                           1 # Pot
                 50.0
    0.001 0.05
##
                           1 # Trawl
    0.001 0.05 50.0
                           1 # Fixed
##
           2.00 20.00
##
                           -1 # NMFS
    0.00
          2.00
                 20.00
    0.00
                           -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 # Type of likelihood
       1
##
      0 0 # Auto tail compression (pmin)
             # Initial value for effective sample size multiplier
     -4 -4 # Phz for estimating effective sample size (if appl.)
   1 2
          3 # Composition aggregator
   1.5938 0.5537 1.3113
##
## ## 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
## ## STDEV in m dev for Random walk
## ## Number of nodes for cubic spline or number of step-changes for option 3
## ## Year position of the knots (vector must be equal to the number of nodes)
## 1998 1999
##
## ## ----- ##
## ## OTHER CONTROLS
##
          # Estimated rec dev phase
##
           # Estimated rec_ini phase
##
           # VERBOSE FLAG (0 = off, 1 = on, 2 = objective func)
##
           # Initial conditions (0 = Unfished, 1 = Steady-state fished, 2 = Free parameters)
          # First year for average recruitment for Bspr calculation
##
           # Last year for average recruitment for Bspr calculation
    2016
           # Target SPR ratio for Bmsy proxy
##
    0.35
           # Gear index for SPR calculations (i.e. directed fishery)
##
           # Lambda (proportion of mature male biomass for SPR reference points)
##
           # Use empirical molt increment data (0 = FALSE, 1 = TRUE)
           # 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
                                                                  # parameter
                        ub
                                 phz
                                       prior p1
                                                     p2
    0.18
                                  -4
##
             0.01
                        1
                                          2
                                             0.18
                                                     0.02
                                                                  # M
                                 -2
             -7.0
                                              -7
##
    14.0
                        30
                                          0
                                                     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
                        7
                                 -4
                                                     9.0
                                                                 # Recruitment size scale (varia
             0.1
                                          0
                                             0.1
                     0.75
                                 -4
                                          0 -10.0
##
    0.2
            -10.0
                                                     0.75
                                                                  # log(sigma_R)
            0.20
                                 -2
                                          3 3.0
##
    0.75
                     1.00
                                                     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
                                                                      # logNO vector of initial number
## 14.0
              5.00
                       20.00
                                                 5.00 20.00
                                                                      # logNO vector of initial number
                                     1
                                            0
## 13.5
              5.00
                       20.00
                                     1
                                            0
                                                 5.00 20.00
                                                                      # logNO vector of initial number
## ## GROWTH PARAM CONTROLS
                                                                                         ##
## ## Two lines for each parameter if split sex, one line if not
                                                                                         ##
## # ival
              1b
                        ub
                                    phz prior
                                                   p1
                                                                                         #
                                                                      # parameter
              10.0
                        30.0
                                     -3
                                             0
    14.1
                                                  0.0
                                                        999.0
                                                                      # alpha males or combined
                                     -3
##
     0.0001
               0.0
                         0.01
                                             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
                                     -4
                                                  0.0
##
   121.5
              65.0
                       145.0
                                             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
## ## Gear-1
               Gear-2 Gear-3
                                  Gear-4
                                          Gear-5
##
     2
                                           1
                                                    # Selectivity periods
               1
                        1
                                  1
     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
               2
                        2
                                  2
                                           2
##
     3
                                                    # male retention type
                        0
                                  0
                                          0
##
               0
                                                    # male retention flag (0 -> no, 1 -> yes)
     1
                                                                 phz
                                                                        start end
## ## gear par
                 sel
## ## index index par sex ival lb
                                                                 mirror period period
                                     ub
                                            prior p1
                                                          p2
## # Gear-1
##
     1
           1
                     0
                          0.4
                                0.001 1.0
                                            0
                                                    0
                                                                 3
                                                                        1978
                                                                               2008
                 1
                                                           1
##
     1
           2
                 2
                     0
                          0.7
                                0.001 1.0
                                            0
                                                    0
                                                           1
                                                                 3
                                                                        1978
                                                                               2008
##
     1
           3
                 3
                     Ω
                          1.0
                                0.001 2.0
                                            0
                                                    Λ
                                                                -3
                                                                        1978
                                                                               2008
                                                           1
##
                          0.4
                                0.001 1.0
                                                    0
                                                                 3
                                                                        2009
     1
           4
                 1
                                            0
                                                           1
                                                                               2016
##
           5
                 2
                     0
                          0.7
                                0.001 1.0
                                            0
                                                    0
                                                                 3
                                                                        2009
                                                                               2016
     1
                                                           1
##
     1
           6
                 3
                     0
                          1.0
                                0.001 2.0
                                            0
                                                    0
                                                           1
                                                                -3
                                                                        2009
                                                                               2016
## # Gear-2
     2
           7
                          40
                                                         200
                                                                -3
                                                                        1978
##
                 1
                     0
                                10.0 200
                                             0
                                                   10
                                                                               2016
     2
                 2
                                                         200
##
                     0
                          60
                                10.0
                                      200
                                                   10
                                                                -3
                                                                        1978
                                                                               2016
           8
                                             0
## # Gear-3
##
     3
                     0
                                                   10
                                                         200
                                                                        1978
           9
                 1
                          40
                                10.0
                                      200
                                             0
                                                                -3
                                                                               2016
##
     3
           10
                 2
                     0
                          60
                                10.0 200
                                            0
                                                   10
                                                         200
                                                                -3
                                                                        1978
                                                                               2016
## # Gear-4
##
     4
                     0
                          0.4
                                0.001 1.0
                                                    0
                                                                 4
                                                                        1978
                                                                               2016
                                            0
           11
                 1
                                                           1
     4
                                0.001 1.0
##
           12
                 2
                     0
                          0.7
                                            0
                                                    0
                                                           1
                                                                 4
                                                                        1978
                                                                               2016
##
     4
           13
                 3
                     0
                          1.0
                                0.001 2.0
                                             0
                                                    0
                                                           1
                                                                -4
                                                                        1978
                                                                               2016
```

Gear-5

```
##
       14
            1 0
                  0.4
                      0.001 1.0
                                0
                                     0
                                       1
                                             4
                                                   1978
                                                        2016
            2
##
    5
        15
               0
                  0.7
                      0.001 1.0
                                0
                                    0
                                          1
                                              4
                                                   1978
                                                        2016
                                                        2016
##
    5
        16
            3
               0
                  1.0
                      0.001 2.0
                                0
                                     0
                                         1
                                              -4
                                                   1978
## ## Retained
## # Gear-1
   -1
               0
                  120
                       100
                           200
                                         900
                                              -1
                                                   1978
                                                        2016
##
        17
                                0
                                     1
            1
   -1
                           200
                                         900
##
        18
               0
                  123
                       110
                                0
                                              -1
                                                   1978
                                                        2016
## # Gear-2
##
   -2
        19
               0
                  595
                       1
                           700
                                0
                                     1
                                         900
                                              -3
                                                   1978
                                                        2016
            1
   -2
               0
                           700
                                         900
##
        20
            2
                  10
                       1
                                Ω
                                     1
                                              -3
                                                   1978
                                                        2016
## # Gear-3
        21
                           700
                                         900
##
   -3
               0
                  590
                                0
                                              -3
                                                   1978
                                                        2016
            1
                       1
                                     1
                                         900
##
   -3
        22
            2
               0
                   10
                       1
                           700
                                0
                                     1
                                              -3
                                                   1978
                                                        2016
## # Gear-4
##
   -4
        23
               0
                  580
                           700
                                         900
                                              -3
                                                   1978
            1
                       1
                                Ω
                                    1
                                                        2016
##
   -4
        24
            2
               0
                  20
                       1
                           700
                                0
                                     1
                                         900
                                              -3
                                                   1978
                                                        2016
## # Gear-5
##
  -5
        25
               0
                  580
                           700
                                0
                                    1
                                         900
                                              -3
                                                   1978
                                                        2016
            1
                   20
                           700
                                         900
##
   -5
        26
            2
               0
                                0
                                              -3
                                                   1978
                                                        2016
                       1
                                     1
## ## ----- ##
##
## ## ----- ##
## ## 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
                                                               ##
                                                               ##
## ##
      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
                              0
                                                2
##
    4e-06 0
               5
                   1
                        0
                                    5.0
                                        0
                                                    # ADF&G pot
## ## -----
##
## ## ----- ##
## ## ADDITIONAL CV FOR SURVEYS/INDICES
      If a uniform prior is selected for a parameter then the 1b 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
## ## ----- ##
           lb
                         phz prior
                                   p1
                                         p2
## ## ival
                ub
            0.000001 10.0
##
    0.00001
                          -4
                             4
                                    1.0
                                          100
                                              # NMFS
            0.000001 10.0
                          -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
```

```
2.00
##
    0.00
                  20.00
                         -1 # NMFS
                         -1 # ADF&G
          2.00
                 20.00
##
    0.00
## ## ----- ##
##
## ## 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 # Type of likelihood
           # Auto tail compression (pmin)
##
     1 1
            # Initial value for effective sample size multiplier
            # Phz for estimating effective sample size (if appl.)
##
     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
## ## STDEV in m_dev for Random walk
## ## Number of nodes for cubic spline or number of step-changes for option 3
## ## Year position of the knots (vector must be equal to the number of nodes)
## 1998 1999
         ----- ##
##
 ## OTHER CONTROLS
## ## ----- ##
##
         # Estimated rec_dev phase
##
        # Estimated rec_ini phase
##
        # VERBOSE FLAG (0 = off, 1 = on, 2 = objective func)
##
        # Initial conditions (0 = Unfished, 1 = Steady-state fished, 2 = Free parameters)
##
        # 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
            # Gear index for SPR calculations (i.e. directed fishery)
##
     1
##
     1
            # Lambda (proportion of mature male biomass for SPR reference points)
            # Use empirical molt increment data (0 = FALSE, 1 = TRUE)
##
            # Stock-Recruit-Relationship (0 = None, 1 = Beverton-Holt)
##
    0
## ## EOF
## 9999
```