Appendix to Gmacs SMBKC Stock Assessment

The base model data file:

```
## Warning in file(con, "r"): cannot open file '../../examples/smbkc2/model_1/
## sm16.dat': No such file or directory
```

```
## Error in file(con, "r"): cannot open the connection
```

```
## Error in ts[i]: object of type 'closure' is not subsettable
```

The base model control file:

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

```
## ## ivector for number of year periods or nodes                                    ##
## ## POT       TBycatch FBycatch  NMFS_S   ADFG_pot
## ## Gear-1    Gear-2   Gear-3    Gear-4   Gear-5
##    2         1        1         1        1         # Selectivity periods
##    0         0        0         0        0         # sex specific selectivity
##    0         3        3         0        0         # male selectivity type
## ## Gear-1    Gear-2   Gear-3    Gear-4   Gear-5
##    1         1        1         1        1         # Retention periods
##    0         0        0         0        0         # sex specific retention
##    3         2        2         2        2         # male retention type
##    1         0        0         0        0         # male retention flag (0 -> no, 1 -> yes)
## ## gear  par   sel                                          phz    start  end        ##
## ## index index par sex  ival  lb    ub     prior p1     p2     mirror period period     ##
## # Gear-1
##    1     1     1   0    0.432928096608 0.001 2.0    0       0      1    -2     1978   2008
##    1     2     2   0    0.670336057209 0.001 2.0    0       0      1    -2     1978   2008
##    1     3     3   0    1.0            0.001 2.0    0       0      1    -2     1978   2008
##    1     1     1   0    0.392207758620 0.001 2.0    0       0      1    -2     2009   2015
##    1     2     2   0    0.956150805823 0.001 2.0    0       0      1    -2     2009   2015
##    1     3     3   0    1.0            0.001 2.0    0       0      1    -2     2009   2015
## # Gear-2
##    2     7     1   0    40       10.0  200    0      10    200    -3     1978   2015
##    2     8     2   0    60       10.0  200    0      10    200    -3     1978   2015
## # Gear-3
##    3     9     1   0    40       10.0  200    0      10    200    -3     1978   2015
##    3    10     2   0    60       10.0  200    0      10    200    -3     1978   2015
## # Gear-4
##    4     8     1   0    0.79506450558 0.001 2.0    0       0      1    -2     1978   2015
##    4     9     2   0    1.08723867992 0.001 2.0    0       0      1    -2     1978   2015
##    4     10    3   0    1.0           0.001 2.0    0       0      1    -2     1978   2015
## # Gear-5
##    5     11    1   0    0.405292074017 0.001 2.0    0       0      1    -2     1978   2015
##    5     12    2   0    0.855141058500 0.001 2.0    0       0      1    -2     1978   2015
##    5     13    3   0    1.0            0.001 2.0    0       0      1    -2     1978   2015
## ## Retained
## # Gear-1
##   -1     14    1   0   120   100   200    0      1    900   -1     1978   2015
##   -1     15    2   0   123   110   200    0      1    900   -1     1978   2015
## # Gear-2
##   -2     16    1   0   595    1    700    0      1    900   -3     1978   2015
##   -2     17    2   0    10    1    700    0      1    900   -3     1978   2015
## # Gear-3
##   -3     18    1   0   590    1    700    0      1    900   -3     1978   2015
##   -3     19    2   0    10    1    700    0      1    900   -3     1978   2015
## # Gear-4
##   -4     20    1   0   580    1    700    0      1    900   -3     1978   2015
##   -4     21    2   0    20    1    700    0      1    900   -3     1978   2015
## # Gear-5
##   -5     22    1   0   580    1    700    0      1    900   -3     1978   2015
##   -5     23    2   0    20    1    700    0      1    900   -3     1978   2015
##
## ## ------------------------------------------------------------------------------ ##
## ## PRIORS FOR CATCHABILITY
## ##     If a uniform prior is selected for a parameter then the lb and ub are used (p1   ##
```

```
## ##     and p2 are ignored). ival must be > 0                                          ##
## ## LEGEND                                                                           ##
## ##     prior: 0 = uniform, 1 = normal, 2 = lognormal, 3 = beta, 4 = gamma           ##
## ## ------------------------------------------------------------------------------- ##
## ##  LAMBDA: Arbitrary relative weights for each series, 0 = do not fit.
## ## SURVEYS/INDICES ONLY
## ## ival    lb       ub    phz   prior   p1       p2    Analytic?   LAMBDA
##    1.0     0        2     -1    0       0        9.0   0           1       # NMFS trawl
## 4.26724288404e-06 0 5      1    0       0        9.0   0           1       # ADF&G pot
## ## ------------------------------------------------------------------------------- ##
##
## ## ------------------------------------------------------------------------------- ##
## ## ADDITIONAL CV FOR SURVEYS/INDICES                                               ##
## ##     If a uniform prior is selected for a parameter then the lb and ub are used (p1   ##
## ##     and p2 are ignored). ival must be > 0                                       ##
## ## LEGEND                                                                          ##
## ##     prior: 0 = uniform, 1 = normal, 2 = lognormal, 3 = beta, 4 = gamma          ##
## ## ------------------------------------------------------------------------------- ##
## ## ival        lb        ub        phz   prior     p1      p2
##    0.00001      0.000001   10.0      -4    4         1.0     100   # NMFS
##    0.00001      0.000001   10.0      -4    4         1.0     100   # ADF&G
## ## ------------------------------------------------------------------------------- ##
##
## ## ------------------------------------------------------------------------------- ##
## ## PENALTIES FOR AVERAGE FISHING MORTALITY RATE FOR EACH GEAR
## ## ------------------------------------------------------------------------------- ##
## ## Mean_F  STD_PHZ1  STD_PHZ2     PHZ
##    0.3       0.05     50.0       1   # Pot
##    0.001     0.05     50.0       1   # Trawl
##    0.001     0.05     50.0       1   # Fixed
##    0.00      2.00     20.00     -1   # NMFS
##    0.00      2.00     20.00     -1   # ADF&G
## ## ------------------------------------------------------------------------------- ##
##
## ## ------------------------------------------------------------------------------- ##
## ## OPTIONS FOR SIZE COMPOSTION DATA (COLUMN FOR EACH MATRIX)
## ## ------------------------------------------------------------------------------- ##
## ## LIKELIHOOD OPTIONS
## ##   -1) Multinomial with estimated/fixed sample size
## ##   -2) Robust approximation to multinomial
## ##   -3) logistic normal (NIY)
## ##   -4) multivariate-t (NIY)
## ##   -5) Dirichlet
## ## AUTOTAIL COMPRESSION
## ##   pmin is the cumulative proportion used in tail compression.
## ## ------------------------------------------------------------------------------- ##
## #  1   1   1  # Type of likelihood
##   2   2   2  # Type of likelihood
## #  5   5   5   # Type of likelihood
##   0   0   0   # Auto tail compression (pmin)
##   1   1   1   # Initial value for effective sample size multiplier
##  -4  -4  -4   # Phz for estimating effective sample size (if appl.)
##   1   2   3   # Composition aggregator
##   1   1   1   # LAMBDA
```

```
## ## ------------------------------------------------------------------------------------ ##
##
## ## ------------------------------------------------------------------------------------ ##
## ## TIME VARYING NATURAL MORTALIIY RATES                                                 ##
## ## ------------------------------------------------------------------------------------ ##
## ## TYPE:
## ##      0 = constant natural mortality
## ##      1 = Random walk (deviates constrained by variance in M)
## ##      2 = Cubic Spline (deviates constrained by nodes & node-placement)
## ##      3 = Blocked changes (deviates constrained by variance at specific knots)
## ##      4 = Time blocks
## ## ------------------------------------------------------------------------------------ ##
## ## Type
## 3
## ## Phase of estimation
## 4
## ## STDEV in m_dev for Random walk
## 10.0
## ## Number of nodes for cubic spline or number of step-changes for option 3
## 2
## ## Year position of the knots (vector must be equal to the number of nodes)
## 1998 1999
## ## ------------------------------------------------------------------------------------ ##
##
## ## ------------------------------------------------------------------------------------ ##
## ## OTHER CONTROLS
## ## ------------------------------------------------------------------------------------ ##
##   3       # Estimated rec_dev phase
##   0       # VERBOSE FLAG (0 = off, 1 = on, 2 = objective func)
##   2       # Initial conditions (0 = Unfished, 1 = Steady-state fished, 2 = Free parameters)
##   1978    # First year for average recruitment for Bspr calculation
##   2015    # Last year for average recruitment for Bspr calculation
##   0.35    # Target SPR ratio for Bmsy proxy
##   1       # Gear index for SPR calculations (i.e. directed fishery)
##   1       # Lambda (proportion of mature male biomass for SPR reference points)
##   1       # Use empirical molt increment data (0 = FALSE, 1 = TRUE)
##   0       # Stock-Recruit-Relationship (0 = None, 1 = Beverton-Holt)
## ## EOF
## 9999
```

The selex model control file:

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

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

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

```
## ##      3 = Blocked changes (deviates constrained by variance at specific knots)
## ##      4 = Time blocks
## ## ------------------------------------------------------------------------------------- ##
## ## Type
## 3
## ## Phase of estimation
## 4
## ## STDEV in m_dev for Random walk
## 10.0
## ## Number of nodes for cubic spline or number of step-changes for option 3
## 2
## ## Year position of the knots (vector must be equal to the number of nodes)
## 1998 1999
## ## ------------------------------------------------------------------------------------- ##
##
## ## ------------------------------------------------------------------------------------- ##
## ## OTHER CONTROLS
## ## ------------------------------------------------------------------------------------- ##
##   3       # Estimated rec_dev phase
##   0       # VERBOSE FLAG (0 = off, 1 = on, 2 = objective func)
##   2       # Initial conditions (0 = Unfished, 1 = Steady-state fished, 2 = Free parameters)
##   1978    # First year for average recruitment for Bspr calculation
##   2015    # Last year for average recruitment for Bspr calculation
##   0.35    # Target SPR ratio for Bmsy proxy
##   1       # Gear index for SPR calculations (i.e. directed fishery)
##   1       # Lambda (proportion of mature male biomass for SPR reference points)
##   1       # Use empirical molt increment data (0 = FALSE, 1 = TRUE)
##   0       # Stock-Recruit-Relationship (0 = None, 1 = Beverton-Holt)
## ## EOF
## 9999
```

The add CV model control file:

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

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

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

```
## ##      2 = Cubic Spline (deviates constrained by nodes & node-placement)
## ##      3 = Blocked changes (deviates constrained by variance at specific knots)
## ##      4 = Time blocks
## ## ------------------------------------------------------------------------------------- ##
## ## Type
## 0
## ## Phase of estimation
## 4
## ## STDEV in m_dev for Random walk
## 10.0
## ## Number of nodes for cubic spline or number of step-changes for option 3
## 2
## ## Year position of the knots (vector must be equal to the number of nodes)
## 1998 1999
## ## ------------------------------------------------------------------------------------- ##
##
## ## ------------------------------------------------------------------------------------- ##
## ## OTHER CONTROLS
## ## ------------------------------------------------------------------------------------- ##
##   3       # Estimated rec_dev phase
##   0       # VERBOSE FLAG (0 = off, 1 = on, 2 = objective func)
##   2       # Initial conditions (0 = Unfished, 1 = Steady-state fished, 2 = Free parameters)
##   1978    # First year for average recruitment for Bspr calculation
##   2015    # Last year for average recruitment for Bspr calculation
##   0.35    # Target SPR ratio for Bmsy proxy
##   1       # Gear index for SPR calculations (i.e. directed fishery)
##   1       # Lambda (proportion of mature male biomass for SPR reference points)
##   1       # Use empirical molt increment data (0 = FALSE, 1 = TRUE)
##   0       # Stock-Recruit-Relationship (0 = None, 1 = Beverton-Holt)
## ## EOF
## 9999
```

The no M_{1998} model control file:

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

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

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

```
## ##      2 = Cubic Spline (deviates constrained by nodes & node-placement)
## ##      3 = Blocked changes (deviates constrained by variance at specific knots)
## ##      4 = Time blocks
## ## ------------------------------------------------------------------------------------- ##
## ## Type
## 0
## ## Phase of estimation
## -4
## ## STDEV in m_dev for Random walk
## 10.0
## ## Number of nodes for cubic spline or number of step-changes for option 3
## 2
## ## Year position of the knots (vector must be equal to the number of nodes)
## 1998 1999
## ## ------------------------------------------------------------------------------------- ##
##
## ## ------------------------------------------------------------------------------------- ##
## ## OTHER CONTROLS
## ## ------------------------------------------------------------------------------------- ##
##   3       # Estimated rec_dev phase
##   0       # VERBOSE FLAG (0 = off, 1 = on, 2 = objective func)
##   2       # Initial conditions (0 = Unfished, 1 = Steady-state fished, 2 = Free parameters)
##   1978    # First year for average recruitment for Bspr calculation
##   2015    # Last year for average recruitment for Bspr calculation
##   0.35    # Target SPR ratio for Bmsy proxy
##   1       # Gear index for SPR calculations (i.e. directed fishery)
##   1       # Lambda (proportion of mature male biomass for SPR reference points)
##   1       # Use empirical molt increment data (0 = FALSE, 1 = TRUE)
##   0       # Stock-Recruit-Relationship (0 = None, 1 = Beverton-Holt)
## ## EOF
## 9999
```