Appendix to Gmacs SMBKC Stock Assessment

The base model data file:

```
## Warning in file(con, "r"): cannot open file '../../examples/smbkc2/model_1/
## sm15.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   0.670036057209 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
```

```
## ## ------------------------------------------------------------------------------- ##
##
## ## ------------------------------------------------------------------------------- ##
## ## 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 number
##   14.0       5.00     18.00        1       0    5.00   15.00        # logN0 vector of initial number
##   13.5       5.00     18.00        1       0    5.00   15.00        # logN0 vector of initial number
## ## GROWTH PARAM CONTROLS                                                                ##
## ## Two lines for each parameter if split sex, one line if not                           ##
## # ival        lb        ub       phz  prior      p1      p2        # parameter        #
##   14.1       10.0      30.0       -3       0     0.0   999.0        # alpha males or combined
##    0.0001     0.0      0.01       -3       0     0.0   999.0        # beta males or combined
##    0.45      0.01       1.0       -3       0     0.0   999.0        # gscale males or combined
##  121.5       65.0     145.0       -4       0     0.0   999.0        # molt_mu males or combined
##    0.060      0.0       1.0       -3       0     0.0   999.0        # molt_cv males or combined
##
## ## ------------------------------------------------------------------------------- ##
## ## SELECTIVITY CONTROLS                                                            ##
## ##     Each gear must have a selectivity and a retention selectivity. If a uniform  ##
## ##     prior is selected for a parameter then the lb and ub are used (p1 and p2 are ##
## ##     ignored)                                                                    ##
## ## LEGEND                                                                          ##
## ##     sel type: 0 = parametric, 1 = coefficients, 2 = logistic, 3 = logistic95,   ##
## ##               4 = double normal (NIY)                                           ##
## ##     gear index: use +ve for selectivity, -ve for retention                      ##
## ##     sex dep: 0 for sex-independent, 1 for sex-dependent                         ##
## ## ------------------------------------------------------------------------------- ##
## ## ivector for number of year periods or nodes                                     ##
## ## POT       TBycatch FBycatch NMFS_S   ADFG_pot
## ## Gear-1    Gear-2   Gear-3   Gear-4   Gear-5
##   2          1         1         1        1         # Selectivity periods
##   0          0         0         0        0         # sex specific selectivity
##   0          3         3         0        0         # male selectivity type
## ## Gear-1    Gear-2   Gear-3   Gear-4   Gear-5
##   1          1         1         1        1         # Retention periods
##   0          0         0         0        0         # sex specific retention
```

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

```
## ## --------------------------------------------------------------------------- ##
##
## ## --------------------------------------------------------------------------- ##
## ## ADDITIONAL CV FOR SURVEYS/INDICES                                            ##
## ##     If a uniform prior is selected for a parameter then the lb and ub are used (p1  ##
## ##     and p2 are ignored). ival must be > 0                                    ##
## ## LEGEND                                                                       ##
## ##     prior: 0 = uniform, 1 = normal, 2 = lognormal, 3 = beta, 4 = gamma       ##
## ## --------------------------------------------------------------------------- ##
## ## ival         lb          ub        phz   prior    p1        p2
##    0.00001      0.000001    10.0       -4    4        1.0       100    # NMFS
##    0.00001      0.000001    10.0       -4    4        1.0       100    # ADF&G
## ## --------------------------------------------------------------------------- ##
##
## ## --------------------------------------------------------------------------- ##
## ## PENALTIES FOR AVERAGE FISHING MORTALITY RATE FOR EACH GEAR
## ## --------------------------------------------------------------------------- ##
## ## Mean_F  STD_PHZ1  STD_PHZ2     PHZ
##    0.3       0.05      50.0        1   # Pot
##    0.001     0.05      50.0        1   # Trawl
##    0.001     0.05      50.0        1   # Fixed
##    0.00      2.00      20.00      -1   # NMFS
##    0.00      2.00      20.00      -1   # ADF&G
## ## --------------------------------------------------------------------------- ##
##
## ## --------------------------------------------------------------------------- ##
## ## OPTIONS FOR SIZE COMPOSTION DATA (COLUMN FOR EACH MATRIX)
## ## --------------------------------------------------------------------------- ##
## ## LIKELIHOOD OPTIONS
## ##   -1) Multinomial with estimated/fixed sample size
## ##   -2) Robust approximation to multinomial
## ##   -3) logistic normal (NIY)
## ##   -4) multivariate-t (NIY)
## ##   -5) Dirichlet
## ## AUTOTAIL COMPRESSION
## ##    pmin is the cumulative proportion used in tail compression.
## ## --------------------------------------------------------------------------- ##
## #  1   1   1  # Type of likelihood
##    2   2   2  # Type of likelihood
## #  5   5   5   # Type of likelihood
##    0   0   0  # Auto tail compression (pmin)
##    1   1   1   # Initial value for effective sample size multiplier
##   -4  -4  -4   # Phz for estimating effective sample size (if appl.)
##    1   2   3   # Composition aggregator
## ## --------------------------------------------------------------------------- ##
##
## ## --------------------------------------------------------------------------- ##
## ## 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 number
##   14.0       5.00       18.00     1       0   5.00   15.00       # logN0 vector of initial number
##   13.5       5.00       18.00     1       0   5.00   15.00       # logN0 vector of initial number
## ## GROWTH PARAM CONTROLS                                                              ##
## ## Two lines for each parameter if split sex, one line if not                        ##
## # ival       lb         ub       phz  prior    p1      p2        # parameter         #
##   14.1      10.0        30.0     -3       0   0.0    999.0       # alpha males or combined
##    0.0001    0.0        0.01     -3       0   0.0    999.0       # beta males or combined
##    0.45      0.01       1.0      -3       0   0.0    999.0       # gscale males or combined
##  121.5      65.0        145.0    -4       0   0.0    999.0       # molt_mu males or combined
##    0.060     0.0        1.0      -3       0   0.0    999.0       # molt_cv males or combined
##
## ## ---------------------------------------------------------------------------- ##
## ## SELECTIVITY CONTROLS                                                          ##
## ##     Each gear must have a selectivity and a retention selectivity. If a uniform ##
## ##     prior is selected for a parameter then the lb and ub are used (p1 and p2 are ##
## ##     ignored)                                                                  ##
## ## LEGEND                                                                        ##
## ##     sel type: 0 = parametric, 1 = coefficients, 2 = logistic, 3 = logistic95, ##
## ##               4 = double normal (NIY)                                         ##
## ##     gear index: use +ve for selectivity, -ve for retention                    ##
## ##     sex dep: 0 for sex-independent, 1 for sex-dependent                       ##
## ## ---------------------------------------------------------------------------- ##
## ## ivector for number of year periods or nodes                                   ##
## ## POT       TBycatch FBycatch NMFS_S   ADFG_pot
## ## Gear-1    Gear-2   Gear-3   Gear-4   Gear-5
##   2         1        1        1        1           # Selectivity periods
##   0         0        0        0        0           # sex specific selectivity
##   0         3        3        0        0           # male selectivity type
## ## Gear-1    Gear-2   Gear-3   Gear-4   Gear-5
##   1         1        1        1        1           # Retention periods
##   0         0        0        0        0           # sex specific retention
```

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

```
## ## --------------------------------------------------------------------------------- ##
##
## ## --------------------------------------------------------------------------------- ##
## ## ADDITIONAL CV FOR SURVEYS/INDICES                                                  ##
## ##     If a uniform prior is selected for a parameter then the lb and ub are used (p1 ##
## ##     and p2 are ignored). ival must be > 0                                          ##
## ## LEGEND                                                                             ##
## ##     prior: 0 = uniform, 1 = normal, 2 = lognormal, 3 = beta, 4 = gamma            ##
## ## --------------------------------------------------------------------------------- ##
## ## ival        lb        ub      phz   prior     p1      p2
##    0.00001    0.000001  10.0       4     4        1.0     100    # NMFS
##    0.00001    0.000001  10.0       4     4        1.0     100    # ADF&G
## ## --------------------------------------------------------------------------------- ##
##
## ## --------------------------------------------------------------------------------- ##
## ## PENALTIES FOR AVERAGE FISHING MORTALITY RATE FOR EACH GEAR
## ## --------------------------------------------------------------------------------- ##
## ## Mean_F  STD_PHZ1  STD_PHZ2     PHZ
##    0.3       0.05      50.0        1   # Pot
##    0.001     0.05      50.0        1   # Trawl
##    0.001     0.05      50.0        1   # Fixed
##    0.00      2.00      20.00      -1   # NMFS
##    0.00      2.00      20.00      -1   # ADF&G
## ## --------------------------------------------------------------------------------- ##
##
## ## --------------------------------------------------------------------------------- ##
## ## OPTIONS FOR SIZE COMPOSTION DATA (COLUMN FOR EACH MATRIX)
## ## --------------------------------------------------------------------------------- ##
## ## LIKELIHOOD OPTIONS
## ##   -1) Multinomial with estimated/fixed sample size
## ##   -2) Robust approximation to multinomial
## ##   -3) logistic normal (NIY)
## ##   -4) multivariate-t (NIY)
## ##   -5) Dirichlet
## ## AUTOTAIL COMPRESSION
## ##   pmin is the cumulative proportion used in tail compression.
## ## --------------------------------------------------------------------------------- ##
## #  1   1   1  # Type of likelihood
##    2   2   2  # Type of likelihood
## #  5   5   5   # Type of likelihood
##    0   0   0  # Auto tail compression (pmin)
##    1   1   1   # Initial value for effective sample size multiplier
##   -4  -4  -4   # Phz for estimating effective sample size (if appl.)
##    1   2   3   # Composition aggregator
## ## --------------------------------------------------------------------------------- ##
##
## ## --------------------------------------------------------------------------------- ##
## ## 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 no M_{1998} model control file:

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

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```
##      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
```

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