# Appendix to Gmacs Example Stock Assessment

### The OneSex 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 #
## #                   4 -> gamma
## # ------------------------------------------------------------------------------------------ #
## # ntheta
##   9
## # ------------------------------------------------------------------------------------------ #
## # ival        lb        ub        phz   prior     p1      p2         # parameter          #
## # ------------------------------------------------------------------------------------------ #
##   0.18      0.01         1         -4       2   0.18    0.02         # M
##   11.0       -10        40          2       0  -10.0    40.0         # log(R0)
##   15.0       -10        40          2       0  -10.0    40.0         # log(Rini)
##   10.0       -10        20         -1       1   10.0    35.0         # log(Rbar)
##   72.0        55       100         -2       1   72.5    7.25         # Recruitment Expected Value
##   0.561      0.1         5         -3       0    0.1     5.0         # Recruitment scale (variance co
##  -0.40       -10      0.75         -4       0  -10.0    0.75         # ln(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
## ## ------------------------------------------------------------------------------------------ ##
##
## ## ------------------------------------------------------------------------------------------ ##
## ## GROWTH PARAM CONTROLS                                                                      ##
## ## nGrwth
## ##                                                                                            ##
## ## Two lines for each parameter if split sex, one line if not                                 ##
## ## ------------------------------------------------------------------------------------------ ##
## # ival        lb        ub        phz   prior     p1      p2         # parameter          #
## # ------------------------------------------------------------------------------------------ #
##   17.5      10.0      30.0         -3       0    0.0   999.0         # alpha males or combined
##   0.10       0.0       0.5         -3       0    0.0   999.0         # beta males or combined
##   0.30       0.01      1.0         -3       0    0.0   999.0         # gscale males or combined
##  140.5      65.0     165.0         -4       0    0.0   999.0         # molt_mu males or combined
##   0.071      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                          ##
## ## LEGEND sel_type:1=coefficients,2=logistic,3=logistic95                                     ##
## ##        Index: use +ve for selectivity, -ve for retention
```

```
## ##        sex dep: 0 for sex-independent, 1 for sex-dependent.
## ## ------------------------------------------------------------------------------------ ##
## ## ivector for number of year blocks or nodes
## ## POT       TBycatch  NMFS_S   BSFR_S
## ## Gear-1    Gear-2    Gear-3   Gear-4
##    1         1         2        1         # Selectivity periods
##    0         0         0        0         # sex specific selectivity
##    3         3         3        3         # male selectivity type
## ## Gear-1    Gear-2    Gear-3   Gear-4
##    1         1         1        1         # Retention periods
##    0         0         0        0         # sex specific retention
##    3         2         2        2         # male retention type
##    1         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    129  100    200    0      1     200    -1     1975   2014
##    1     2     2   0    156  100    200    0      1     200    -1     1975   2014
## # Gear-2
##    2     3     1   0     90   10    200    0      10    200    -2     1975   2014
##    2     4     2   0    180   10    200    0      10    200    -2     1975   2014
## # Gear-3
##    3     5     1   0  77.63   60    200    0       1    200    -3     1975   1981
##    3     6     2   0     96   60    200    0       1    200    -4     1975   1981
##    3     7     1   0  89.48   60    200    0       1    200    -3     1982   2014
##    3     8     2   0    145   60    200    0       1    200    -4     1982   2014
## # Gear-4
##    4     9     1   0  78.02    1    200    0       1    200    -4     1975   2014
##    4     10    2   0     90    1    200    0       1    200    -4     1975   2014
## ## ------------------------------------------------------------------------------------ ##
## ## Retained
## ## gear  par   sel                                              phz    start  end        ##
## ## index index par sex  ival  lb    ub     prior p1     p2     mirror period period     ##
## # Gear-1
##   -1     11    1   0    133   50    200    0      1     900    -1     1975   2014
##   -1     12    2   0    137   50    200    0      1     900    -1     1975   2014
## # Gear-2
##   -2     15    1   0    595    1    700    0      1     900    -3     1975   2014
##   -2     16    2   0     10    1    700    0      1     900    -3     1975   2014
## # Gear-3
##   -3     17    1   0    590    1    700    0      1     900    -3     1975   1981
##   -3     18    2   0     10    1    700    0      1     900    -3     1982   2014
## # Gear-4
##   -4     19    1   0    580    1    700    0      1     900    -3     1975   2014
##   -4     20    2   0     20    1    700    0      1     900    -3     1975   2014
## ## ------------------------------------------------------------------------------------ ##
##
## ## ------------------------------------------------------------------------------------ ##
## ## PRIORS FOR CATCHABILITY
## ##     If a uniform prior is selected for a parameter then the lb and ub are used (p1   ##
## ##     and p2 are ignored). ival must be > 0                                            ##
## ## LEGEND                                                                              ##
```

```
## ##     prior: 0 = uniform, 1 = normal, 2 = lognormal, 3 = beta, 4 = gamma                ##
## ## ------------------------------------------------------------------------------------ ##
## ##  LAMBDA: Arbitrary relative weights for each series, 0 = do not fit.
## ## SURVEYS/INDICES ONLY
## ## ival    lb       ub    phz   prior   p1       p2    Analytic?   LAMBDA
##    0.935    0.001   5      4    0  0.001         5     0           4       # NMFS trawl
##    1.0      0.001   5      4    0  0.001         5     0           1       # BSFRF
## ## ------------------------------------------------------------------------------------ ##
##
## ## ------------------------------------------------------------------------------------ ##
## ## 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 type: 0 = uniform, 1 = normal, 2 = lognormal, 3 = beta, 4 = gamma          ##
## ## ------------------------------------------------------------------------------------ ##
## ## ival        lb        ub        phz   prior     p1      p2
##    0.001       0.0       10.0      -4    4         1.0     100   # NMFS
##    0.001       0.0       10.0      -4    4         1.0     100   # BSFRF
## ## ------------------------------------------------------------------------------------ ##
##
## ## ------------------------------------------------------------------------------------ ##
## ## PENALTIES FOR AVERAGE FISHING MORTALITY RATE FOR EACH GEAR
## ## ------------------------------------------------------------------------------------ ##
## ## Mean_F  STD_PHZ1  STD_PHZ2     PHZ
##      0.20      0.05      5.00      1  # Trap
##      0.01      0.05      5.00      1  # Trawl
##      0.00      2.00     20.00     -1  # NMFS
##      0.00      2.00     20.00     -1  # BSFRF
## ## ------------------------------------------------------------------------------------ ##
##
## ## ------------------------------------------------------------------------------------ ##
## ## OPTIONS FOR SIZE COMPOSTION DATA (COLUMN FOR EACH MATRIX)
## ## LIKELIHOOD OPTIONS:
## ##  • 0 ignore composition data in model fitting.
## ##  • 1 multinomial with estimated/fixed sample size
## ##  • 2 robust_multi. Robust approximation to multinomial
## ##  • 3 logistic normal  (NIY)
## ##  • 4 multivariate-t   (NIY)
## ## AUTOTAIL COMPRESSION:
## ##   - pmin is the cumulative proportion used in tail compression.
## ## ------------------------------------------------------------------------------------ ##
##  1   1   1   1   1   1 # Type of likelihood.
## # 2   2   2   2   2   2 # Type of likelihood.
##  0   0   0   0   0   0 # Auto tail compression (pmin)
##  1   1   1   1   1   1 # Initial value for effective sample size multiplier
## -4  -4  -4  -4  -4  -4 # Phz for estimating effective sample size (if appl.)
## # 1   2   3   4   4   5 # Composition aggregator
##  1   2   3   4   5   6 # Composition aggregator
## # 1   1   1   1   1   1 # LAMBDA
##  0.1   0.1   0.1   0.1   0.1   0.1 # 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)
## ##      5 = Blocked changes (deviates constrained by variance AT specific knots relative to base)
##   0
## ## Phase of estimation
##   3
## ## STDEV in m_dev for Random walk
##    0.1
## ## 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)
##    1980 1985
## ## ------------------------------------------------------------------------------------- ##
##
## ## ------------------------------------------------------------------------------------- ##
## ## OTHER CONTROLS
## ## ------------------------------------------------------------------------------------- ##
##    3       # Estimated rec_dev phase
##    3       # Estimated rec_ini phase
##    0       # VERBOSE FLAG (0 = off, 1 = on, 2 = objective func)
##    1       # Initial conditions (0 = Unfished, 1 = Steady-state fished, 2 = Free parameters)
##    1984    # First year for average recruitment for Bspr calculation.
##    2014    # 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 TwoSex model control file:

```
## ## ------------------------------------------------------------------------------------- ##
## ## LEADING PARAMETER CONTROLS                                                            ##
## ##     Controls for leading parameter vector (theta)                                     ##
## ## LEGEND                                                                                ##
## ##     prior: 0 = uniform, 1 = normal, 2 = lognormal, 3 = beta, 4 = gamma                ##
## ## ------------------------------------------------------------------------------------- ##
## ## ntheta
##    9
## ## ------------------------------------------------------------------------------------- ##
## ## ival        lb        ub        phz   prior     p1      p2         # parameter       ##
## ## ------------------------------------------------------------------------------------- ##
##     0.18        0.01      1         -4       2    0.18    0.04        # M
##    14.0       -10        20         2       1   10.0    30.0         # logR0
##    14.0       -10        20         2       1   10.0    30.0         # logR1, to estimate if NOT in
##    14.0       -10        20        -1       1   10.0    30.0         # logRbar, to estimate if NOT
```

```
##    72.0        55       100         -4       1   72.5     7.25        # recruitment expected value
##     0.561       0.1       5         -3       0    0.1     5.0         # recruitment scale (variance
##    -0.40      -10         0.75      -4       0  -10.0     0.75        # ln(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
## ## ------------------------------------------------------------------------------------------ ##
##
## ## ------------------------------------------------------------------------------------------ ##
## ## GROWTH PARAMETER CONTROLS                                                                  ##
## ##     Two lines for each parameter if split sex, one line if not                             ##
## ## ------------------------------------------------------------------------------------------ ##
## ## ival       lb        ub        phz   prior     p1      p2          # parameter       ##
## ## ------------------------------------------------------------------------------------------ ##
##    17.5       1.0      90.0        -3       0    0.0    999.0        # alpha males or combined
##    17.5       1.0      90.0        -3       0    0.0    999.0        # alpha
##     0.10      0.0       0.9        -3       0    0.0    999.0        # beta males or combined
##     0.10      0.0       0.9        -3       0    0.0    999.0        # beta
##     0.30      0.0      90.0        -4       0    0.0    999.0        # gscale males or combined
##     0.30      0.15     90.0        -4       0    0.0    999.0        # gscale
##   140.5       1.0     195.0        -3       0    0.0    999.0        # molt_mu males or combined
##   400.0       1.0     999.0        -4       0    0.0    999.0        # molt_mu
##     0.071     0.0001    9.0        -4       0    0.0    999.0        # molt_cv males or combined
##     0.1       0.0001    9.0        -4       0    0.0    999.0        # molt_cv
## ## ------------------------------------------------------------------------------------------ ##
##
## ## ------------------------------------------------------------------------------------------ ##
## ## SELECTIVITY CONTROLS                                                                       ##
## ##     Selectivity P(capture of all sizes). 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 (NIY), 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                                    ##
## ## ------------------------------------------------------------------------------------------ ##
## ## Gear-1   Gear-2   Gear-3   Gear-4
##    1         1         2         1          # selectivity periods
##    1         0         1         1          # sex specific selectivity
##    3         3         3         3          # male selectivity type
##    3         3         3         3          # female selectivity type
## ## Gear-1   Gear-2   Gear-3   Gear-4
##    1         1         1         1          # retention periods
##    1         0         0         0          # sex specific retention
##    3         2         2         2          # male   retention type
##    2         2         2         2          # female retention type
##    1         0         0         0          # male   retention flag (0 = no, 1 = yes)
##    0         0         0         0          # female retention flag (0 = no, 1 = yes)
## ## ------------------------------------------------------------------------------------------ ##
## ## gear  par   sel                                                  start  end          ##
## ## index index par sex  ival  lb    ub     prior   p1   p2     phz   period period      ##
## ## ------------------------------------------------------------------------------------------ ##
## # Gear-1
##    1      1    1   1    100    5    185    0       1    999   -3     1975   2014
```

```
##    1      2    2   1    120    5    185    0       1    999   -3     1975   2014
##    1      3    1   2     80   60    150    0       1    999   -3     1975   2014
##    1      4    2   2     95   60    150    0       1    999   -3     1975   2014
## # Gear-2
##    2      5    1   0    110    5    185    0       1    999   -3     1975   2014
##    2      6    2   0    150    5    185    0       1    999   -3     1975   2014
## # Gear-3
##    3      7    1   1     74   60    150    0       1    999   -3     1975   1981
##    3      8    2   1     95   60    150    0       1    999   -3     1975   1981
##    3      9    1   1     95   60    200    0       1    999   -3     1982   2014
##    3     10    2   1    140   60    200    0       1    999   -3     1982   2014
##    3     11    1   2     90   60    200    0       1    999   -3     1975   1981
##    3     12    2   2    160   60    200    0       1    999   -3     1975   1981
##    3     13    1   2    100   60    200    0       1    999   -3     1982   2014
##    3     14    2   2    170   60    200    0       1    999   -3     1982   2014
## # Gear-4
##    4     15    1   1     70    1    200    0       1    999   -4     1975   2014
##    4     16    2   1     90    1    200    0       1    999   -4     1975   2014
##    4     17    1   2    110    1    200    0       1    999   -4     1975   2014
##    4     18    2   2    190    1    200    0       1    999   -4     1975   2014
## ## ------------------------------------------------------------------------------------ ##
## ## Retained                                                                            ##
## ## ------------------------------------------------------------------------------------ ##
## # Gear-1
##   -1     19    1   1    133    1    999    0       1    999   -4     1975   2014
##   -1     20    2   1    137    1    999    0       1    999   -4     1975   2014
##   -1     21    1   2    591    1    999    0       1    999   -3     1975   2014
##   -1     22    2   2     11    1    999    0       1    999   -3     1975   2014
## # Gear-2
##   -2     23    1   0    595    1    999    0       1    999   -3     1975   2014
##   -2     24    2   0     10    1    999    0       1    999   -3     1975   2014
## # Gear-3
##   -3     25    1   0    590    1    999    0       1    999   -3     1975   1981
##   -3     26    2   0     10    1    999    0       1    999   -3     1982   2014
## # Gear-4
##   -4     27    1   0    580    1    999    0       1    999   -3     1975   2014
##   -4     28    2   0     20    1    999    0       1    999   -3     1975   2014
## ## ------------------------------------------------------------------------------------ ##
##
## ## ------------------------------------------------------------------------------------ ##
## ## 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              ##
## ## ------------------------------------------------------------------------------------ ##
## ## ival    lb       ub    phz   prior   p1       p2    Analytic?   LAMBDA
##    0.843136  0        2     -4    1     0.843136 0.03   0           4       # NMFS, 0.896 is the mag
##    1.0       0        5     -4    0     0.001    5.00   0           1       # BSFRF
## ## ------------------------------------------------------------------------------------ ##
##
## ## ------------------------------------------------------------------------------------ ##
## ## 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 type: 0 = uniform, 1 = normal, 2 = lognormal, 3 = beta, 4 = gamma          ##
## ## ------------------------------------------------------------------------------------- ##
## ## ival        lb        ub        phz   prior     p1      p2
##    0.0001      0.00001   10.0      -4    4         1.0     100   # NMFS
##    0.0001      0.00001   10.0      -4    4         1.0     100   # BSFRF
## ## ------------------------------------------------------------------------------------- ##
##
## ## ------------------------------------------------------------------------------------- ##
## ## PENALTIES FOR AVERAGE FISHING MORTALITY RATE FOR EACH GEAR
## ## ------------------------------------------------------------------------------------- ##
## ## Mean_F   STD_PHZ1   STD_PHZ2   PHZ
##    0.20     0.05       45.50      1   # Pot
##    0.05     0.05       45.50      1   # Trawl
##    0.00     2.00       20.00     -1   # NMFS trawl survey (0 catch)
##    0.00     2.00       20.00     -1   # BSFRF (0)
## ## ------------------------------------------------------------------------------------- ##
##
## ## ------------------------------------------------------------------------------------- ##
## ## OPTIONS FOR SIZE COMPOSTION DATA                                                       ##
## ##     One column for each data matrix                                                   ##
## ## LEGEND                                                                                 ##
## ##     Likelihood: 1 = Multinomial with estimated/fixed sample size                      ##
## ##                 2 = Robust approximation to multinomial                               ##
## ##                 3 = logistic normal (NIY)                                             ##
## ##                 4 = multivariate-t (NIY)                                              ##
## ##                 5 = Dirichlet                                                         ##
## ## AUTO TAIL COMPRESSION                                                                 ##
## ##     pmin is the cumulative proportion used in tail compression                        ##
## ## ------------------------------------------------------------------------------------- ##
## #  0   0   0   0   0   1   1   1   1  1  # Type of likelihood
##    1   1   1   1   1   1   1   1   1  1  # Type of likelihood
##    0   0   0   0   0   0   0   0   0  0  # Auto tail compression (pmin)
##    1   1   1   1   1   1   1   1   1  1  # Initial value for effective sample size multiplier
##   -4  -4  -4  -4  -4  -4  -4  -4  -4 -4  # Phz for estimating effective sample size (if appl.)
## #   1   2   2   3   3   4   4   4   5  5  # Composition aggregator
##    1   2   3   4   5   6   7   8   9  10  # Composition aggregator
##    1   1   1   1   1   1   1   1   1  1  # LAMBDA
## ## ------------------------------------------------------------------------------------- ##
##
## ## ------------------------------------------------------------------------------------- ##
## ## TIME VARYING NATURAL MORTALIIY RATES                                                   ##
## ## LEGEND                                                                                ##
## ## 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
##    3
```

```
## ## STDEV in m_dev for Random walk
##    0.20
## ## 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)
##    1980 1985
## ## ---------------------------------------------------------------------------------- ##
##
## ## ---------------------------------------------------------------------------------- ##
## ## OTHER CONTROLS
## ## ---------------------------------------------------------------------------------- ##
##    3       # Estimated rec_dev phase
##    3       # Estimated rec_ini phase
##    0       # VERBOSE FLAG (0 = off, 1 = on, 2 = objective func)
##    0       # # Initial conditions (0 = Unfished, 1 = Steady-state fished, 2 = Free parameters)
##    1984    # First year for average recruitment for Bspr calculation.
##    2014    # 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
```