

## 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 c
## # -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
```

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## ##          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
## ## index index par sex  ival  lb   ub   prior p1    p2    phz  start end
## ## 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
## ## index index par sex  ival  lb   ub   prior p1    p2    phz  start end
## ## 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 MORTALITY 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 in

```

```

##      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
## ## index index par sex ival lb ub prior p1 p2 phz start end
## ## ----- ##
## # Gear-1
##      1      1      1      1      100      5      185      0      1      999      -3      1975      2014

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##      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 ##

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## ##      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

```