

## 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 (varian	
##	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	# logNO vector of initial number	
##	14.0	5.00	18.00	1	0	5.00	15.00	# logNO vector of initial number	
##	13.5	5.00	18.00	1	0	5.00	15.00	# logNO vector of initial number	

```
## ## GROWTH PARAM CONTROLS
```

```
## ## Two lines for each parameter if split sex, one line if not
```

#	ival	lb	ub	phz	prior	p1	p2	# parameter	#
##	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
## ## index index par sex ival lb ub prior p1 p2 phz start end ##
## ## mirror period period ##
## # Gear-1
##      1      1      1  0  0.432928096608 0.001 2.0  0  0  1 -2 1978 2008
##      1      2      2  0  0.670336057209 0.001 2.0  0  0  1 -2 1978 2008
##      1      3      3  0  1.0 0.001 2.0  0  0  1 -2 1978 2008
##      1      1      1  0  0.392207758620 0.001 2.0  0  0  1 -2 2009 2015
##      1      2      2  0  0.956150805823 0.001 2.0  0  0  1 -2 2009 2015
##      1      3      3  0  1.0 0.001 2.0  0  0  1 -2 2009 2015
## # Gear-2
##      2      7      1  0  40 10.0 200  0  10 200 -3 1978 2015
##      2      8      2  0  60 10.0 200  0  10 200 -3 1978 2015
## # Gear-3
##      3      9      1  0  40 10.0 200  0  10 200 -3 1978 2015
##      3     10      2  0  60 10.0 200  0  10 200 -3 1978 2015
## # Gear-4
##      4      8      1  0  0.79506450558 0.001 2.0  0  0  1 -2 1978 2015
##      4      9      2  0  1.08723867992 0.001 2.0  0  0  1 -2 1978 2015
##      4     10      3  0  1.0 0.001 2.0  0  0  1 -2 1978 2015
## # Gear-5
##      5     11      1  0  0.405292074017 0.001 2.0  0  0  1 -2 1978 2015
##      5     12      2  0  0.855141058500 0.001 2.0  0  0  1 -2 1978 2015
##      5     13      3  0  1.0 0.001 2.0  0  0  1 -2 1978 2015
## ## Retained
## # Gear-1
##     -1     14      1  0  120 100 200  0  1  900 -1 1978 2015
##     -1     15      2  0  123 110 200  0  1  900 -1 1978 2015
## # Gear-2
##     -2     16      1  0  595  1  700  0  1  900 -3 1978 2015
##     -2     17      2  0   10  1  700  0  1  900 -3 1978 2015
## # Gear-3
##     -3     18      1  0  590  1  700  0  1  900 -3 1978 2015
##     -3     19      2  0   10  1  700  0  1  900 -3 1978 2015
## # Gear-4
##     -4     20      1  0  580  1  700  0  1  900 -3 1978 2015
##     -4     21      2  0   20  1  700  0  1  900 -3 1978 2015
## # Gear-5
##     -5     22      1  0  580  1  700  0  1  900 -3 1978 2015
##     -5     23      2  0   20  1  700  0  1  900 -3 1978 2015
##
## ## ----- ##
## ## PRIORS FOR CATCHABILITY

```

```

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

```

```

## ## ----- ##
##
## ## ----- ##
## ## 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)
## ##      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 (varian
## 0.2      -10.0     0.75   -4      0   -10.0    0.75    # log(sigma_R)
## 0.75      0.20     1.00   -2      3     3.0     2.00    # steepness
## 0.01      0.00     1.00   -3      3     1.01    1.01    # recruitment autocorrelation
## 14.5      5.00     18.00    1      0     5.00    15.00    # logN0 vector of initial numbe
## 14.0      5.00     18.00    1      0     5.00    15.00    # logN0 vector of initial numbe
## 13.5      5.00     18.00    1      0     5.00    15.00    # logN0 vector of initial numbe
## ## GROWTH PARAM CONTROLS
## ## Two lines for each parameter if split sex, one line if not
## # ival      lb      ub      phz  prior    p1    p2      # parameter      #
## 14.1      10.0     30.0     -3      0     0.0    999.0    # alpha males or combined
## 0.0001     0.0      0.01    -3      0     0.0    999.0    # beta males or combined
## 0.45      0.01     1.0      -3      0     0.0    999.0    # gscale males or combined
## 121.5     65.0    145.0     -4      0     0.0    999.0    # molt_mu males or combined
## 0.060     0.0      1.0      -3      0     0.0    999.0    # molt_cv males or combined
##
## ## -----
## ## SELECTIVITY CONTROLS
## ## Each gear must have a selectivity and a retention selectivity. If a uniform
## ## prior is selected for a parameter then the lb and ub are used (p1 and p2 are
## ## ignored)
## ## LEGEND
## ## sel type: 0 = parametric, 1 = coefficients, 2 = logistic, 3 = logistic95,
## ##            4 = double normal (NIY)
## ## gear index: use +ve for selectivity, -ve for retention
## ## sex dep: 0 for sex-independent, 1 for sex-dependent
## ## -----
## ## ivector for number of year periods or nodes
## ## POT      TBycatch FBycatch  NMFS_S  ADFG_pot
## ## Gear-1   Gear-2   Gear-3   Gear-4   Gear-5
## 2          1         1         1         1      # Selectivity periods
## 0          0         0         0         0      # sex specific selectivity
## 0          3         3         0         0      # male selectivity type
## ## Gear-1   Gear-2   Gear-3   Gear-4   Gear-5
## 1          1         1         1         1      # Retention periods
## 0          0         0         0         0      # sex specific retention
```

```

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

```

```

## ## ----- ##
##
## ## ----- ##
## ## ADDITIONAL CV FOR SURVEYS/INDICES ##
## ## If a uniform prior is selected for a parameter then the lb and ub are used (p1 ##
## ## and p2 are ignored). ival must be > 0 ##
## ## LEGEND ##
## ## prior: 0 = uniform, 1 = normal, 2 = lognormal, 3 = beta, 4 = gamma ##
## ## ----- ##
## ## ival lb ub phz prior p1 p2 ##
## 0.00001 0.000001 10.0 -4 4 1.0 100 # NMFS
## 0.00001 0.000001 10.0 -4 4 1.0 100 # ADF&G
## ## ----- ##
##
## ## ----- ##
## ## PENALTIES FOR AVERAGE FISHING MORTALITY RATE FOR EACH GEAR ##
## ## ----- ##
## ## Mean_F STD_PHZ1 STD_PHZ2 PHZ ##
## 0.3 0.05 50.0 1 # Pot
## 0.001 0.05 50.0 1 # Trawl
## 0.001 0.05 50.0 1 # Fixed
## 0.00 2.00 20.00 -1 # NMFS
## 0.00 2.00 20.00 -1 # ADF&G
## ## ----- ##
##
## ## ----- ##
## ## OPTIONS FOR SIZE COMPOSTION DATA (COLUMN FOR EACH MATRIX) ##
## ## ----- ##
## ## LIKELIHOOD OPTIONS
## ## -1) Multinomial with estimated/fixed sample size
## ## -2) Robust approximation to multinomial
## ## -3) logistic normal (NIY)
## ## -4) multivariate-t (NIY)
## ## -5) Dirichlet
## ## AUTOTAIL COMPRESSION
## ## pmin is the cumulative proportion used in tail compression.
## ## ----- ##
## # 1 1 1 # Type of likelihood
## 2 2 2 # Type of likelihood
## # 5 5 5 # Type of likelihood
## 0 0 0 # Auto tail compression (pmin)
## 1 1 1 # Initial value for effective sample size multiplier
## -4 -4 -4 # Phz for estimating effective sample size (if appl.)
## 1 2 3 # Composition aggregator
## ## ----- ##
##
## ## ----- ##
## ## TIME VARYING NATURAL MORTALIITY 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 (varian
## 0.2      -10.0      0.75     -4      0      -10.0      0.75      # log(sigma_R)
## 0.75      0.20      1.00     -2      3      3.0      2.00      # steepness
## 0.01      0.00      1.00     -3      3      1.01      1.01      # recruitment autocorrelation
## 14.5      5.00      18.00      1      0      5.00      15.00      # logN0 vector of initial numbe
## 14.0      5.00      18.00      1      0      5.00      15.00      # logN0 vector of initial numbe
## 13.5      5.00      18.00      1      0      5.00      15.00      # logN0 vector of initial numbe
## ## GROWTH PARAM CONTROLS
## ## Two lines for each parameter if split sex, one line if not
## # ival      lb      ub      phz      prior      p1      p2      # parameter      #
## 14.1      10.0      30.0      -3      0      0.0      999.0      # alpha males or combined
## 0.0001     0.0      0.01     -3      0      0.0      999.0      # beta males or combined
## 0.45      0.01      1.0      -3      0      0.0      999.0      # gscale males or combined
## 121.5      65.0      145.0     -4      0      0.0      999.0      # molt_mu males or combined
## 0.060      0.0      1.0      -3      0      0.0      999.0      # molt_cv males or combined
##
## ## -----
## ## SELECTIVITY CONTROLS
## ## Each gear must have a selectivity and a retention selectivity. If a uniform
## ## prior is selected for a parameter then the lb and ub are used (p1 and p2 are
## ## ignored)
## ## LEGEND
## ## sel type: 0 = parametric, 1 = coefficients, 2 = logistic, 3 = logistic95,
## ##            4 = double normal (NIY)
## ## gear index: use +ve for selectivity, -ve for retention
## ## sex dep: 0 for sex-independent, 1 for sex-dependent
## ## -----
## ## ivector for number of year periods or nodes
## ## POT      TBycatch FBycatch NMFS_S ADFG_pot
## ## Gear-1    Gear-2    Gear-3    Gear-4    Gear-5
## 2           1           1           1           1      # Selectivity periods
## 0           0           0           0           0      # sex specific selectivity
## 0           3           3           0           0      # male selectivity type
## ## Gear-1    Gear-2    Gear-3    Gear-4    Gear-5
## 1           1           1           1           1      # Retention periods
## 0           0           0           0           0      # sex specific retention
```

```

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

```

```

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

```