**PlotMSY installation and use instructions**

**Introduction**

The R function plotMSY() provides an interface to ADMB code to calculate Fmsy and potential proxies values for fish stocks. Fmsy is calculated based on the three common stock recruit relationships; Ricker, Beverton-Holt and Hockeystick (approximated by a continuous function as formulated by Mesnil and Rochet, 2010). Data is input as sen and sum files in the Aberdeen file format, and output as a tab delimited text file (suitable for importing into Excel) and plots in Portable Network Graphics (PNG) format.

Full details of the method used in this program to calculate MSY and related quantities are given in a separate document. Please report any bugs to [timothy.earl@cefas.co.uk](mailto:timothy.earl@cefas.co.uk) to see whether these can be removed in future versions.

**Installation**

While running, the function creates and deletes a number of files in the working directory. It is therefore recommended that no user files are stored in the same directory as the executable files. Input and output files may be stored in subdirectories of the working directory.

The minimum requirement for the program to run in R is that there must be a directory containing the following files:

* **srmsymc.exe** and **srmsymc2.exe** – compiled ADMB code. *Where the executables are provided as source code, they should be compiled with ADMB 4.4.0 or later.*
* **readLow.r** – for reading Lowestoft format files to find pf and pm
* **plotMSY.r** as an interface to the ADMB code
* **run\_plotMSY.r** – a simplified interface for running plotMSY.r
* **convertSumSen.r** for file type conversions
* A subdirectory called “**output**” used by default for text and PDF output files.

The functions have been tested with R versions 2.8, 2.9, 2.10 and 2.14. It may work under other versions, and has no dependencies except base packages.

**Running the program**

The program requires a sen and sum file in the Aberdeen file formats. These should be in the same directory (as each other) and have the same name except for the extension. Optionally an index file in the Lowestoft file format can be provided, which is used to find the files containing pm and pf, the proportion of fishing mortality and natural mortality occurring before spawning.

If sen and sum files of the required format are not available, datfiles can be provided in the format required by ADMB –examples are provided as in Appendix 2.

An example of the input files, is the files cod.sum and cod.sen (from appendix 1). These should be saved in a directory called “cod data” within the working directory to run the examples below.

**Method 1**

Edit the working directory and “settings” section in run\_plotMSY.r and save it. This script can then be run in R. After executing the script, the variable stock contains the data from this run.

**Method 2**

Set the R working directory to the folder containing the directory with the executable files and R scripts. This can be done from the “file” menu in R, by choosing “Change dir…” (this only needs to be done once in each R session), or using the command setwd().

Run the command

> source("plotMSY.r")

This should indicate that plotMSY has been loaded successfully. If not, ensure that the files listed in the “Installation” section are in the same folder, and that this is the working directory.

Run the plotMSY() function with appropriate parameters, for example to use the example cod data (instructions for saving this data are above) use a command such as:

cod = plotMSY (".\\cod data\\cod.sen", pfpm=c(0,0), nits=10)

which will produce output in folder .\\output\\cod\\ . The R object called “cod” may also be useful for diagnostics

**Function arguments**

In general, the program is run with the following command:

plotMSY(senfilename, indexfilename, pfpm, nits, nhair, varybiodata, stockname, fpa, flim, outputfolder, datfilename, silent, onlyYPR)

|  |  |
| --- | --- |
| senfilename | Name of the sen file, including absolute or relative path, eg “.\\data\\cod.sen”.  Default is NA, which provides interactive file selection in Windows. |
| indexfilename | Name and path of the Lowestoft index file used to find pf and pm.  Default is NA which provides interactive file selection occurs in Windows. indexfilename is ignored if pfpm is provided and pfpm is not NA. |
| pfpm | A vector of two numbers, pf and pm, e.g. c(0,0). pf is the proportion of fishing mortality that occurs before spawning, pm is the proportion of natural mortality that occurs before spawning.  Default is NA which looks up pf and pm from the Lowestoft format file indicated by indexfilename. |
| srweights | The relative weights to be given to each of the stock-recruit functions, a vector of 3 non-negative numbers, in the order Ricker, Beverton-Holt, smooth hockeystick. NA is used to indicate automatic weighting by likelihood. If any value is NA, all values must by NA or 0 – i.e. manual and automatic weighting cannot be combined.  the default is c(NA,NA,NA). See Appendix 3 for details of automatic weights and trimming. |
| trimming | Proportion of least likely iterations to trim from the harmonic mean when calculating automatic weights for SR models. NA is used to create a diagnostic for choosing a suitable value of trimming. See Appendix 3 for details of automatic weights and trimming. |
| nits | Number of iterations of the MCMC to output. The MCMC will perform 100,000 iterations as a burn in, and then output every 10,000th iteration until nits iterations have been output.  Default is 100. |
| nhair | Maximum number of lines to output on “hair plots”.  Default is 100. |
| varybiodata | If TRUE, (default) bootstraps the biological data (weight, maturity, mortality) .  if FALSE, varies SR relationship only. |
| stockname | Display title for stock used in titles and output path.  Defaults to senfilename without the “.sen” extension. |
| fpa | Value of Fpa to be plotted on output.  Default NA indicates no value plotted. |
| flim | Value of Flim to be plotted on output.  Default NA indicates no value plotted. |
| bpa | Value of Bpa – currently not used.  Default NA indicates no value plotted. |
| blim | Value of Blim to be plotted on output.  Default NA indicates no value plotted. |
| outputfolder | Location for output files.  Defaults to ".\\output\\[stockname]\\"  (Note: the ’.’ is interpreted by R as the current working directory.) |
| datfilename | Name and path of a pre-calculated dat file. If datfilename is provided, senfilename, indexfilename, varybiodata and pfpm are ignored\*.  Default is NA. |
| Silent | Suppresses the majority of the output to screen.  Default is TRUE. |
| onlyYPR | Calculates only the yield per recruit statistics. Used when the SRRs are not believed to be reliable, or are hard to estimate. |

\*if datfilename and senfilename are both provided, data from the datfile will be passed to the ADMB executable. If a sum file with the same name as senfilename exists, this will be used to add historic data points to the yield and SSB plots, and provide text for the plot axis labels. The sen file need not exist.

During execution, the R window may appear to stop responding, as it has passed control to an external executable. It will resume when the executable is complete. The only way to halt execution is to close R (Since R version 2.14, pressing ‘escape’ may cancel execution part way through). The largest influence on the execution time is the value of nits; typical execution times for values of nits on a PC[[1]](#footnote-1) are given below:

|  |  |
| --- | --- |
| **Nits** | **Total execution time (min:sec)** |
| 10 | 0:24 |
| 100 | 1:49 |
| 1000 | 15:50 |

**Output files**

The function creates the files described below and invisibly returns a list to R. The list contains the same data as in the [stock].txt file, except the header information. The contents of the image files (those marked with ‘\*’ are not produced when running with the ‘onlyYPR’ option) and the files produced are as follows (‘[stock]’ is replaced by the name of the stock given to the function):

* **[stock]\_SRR.png\*** illustrates the uncertainty inherent in the estimation of the stock and recruitment curves. The left hand curves in each figure illustrate the confidence intervals from X/nits re-samples (printed at the bottom of the legend) from the MCMC chain; where X (recorded in the legend) represents the number of samples that have feasible parameter estimates (i.e. alpha and beta are positive for the usual parameterisation of the functions). The right hand figures present curves plotted from the first nhair re-samples for illustration. In this, and the following plots, the blue line indicates a deterministic estimate, separate from the MCMC chain.
* **[stock]\_diagnostics.png\*** presents the range and correlation of the alpha and beta parameters for each stock and recruit function, the figures on the left as estimated using a transformation to increase orthogonality, on the right as defined for the original formulations of each of the curves. The transformation may reduce the correlation between the parameters allowing an improved estimate for both the Ricker and Beverton Holt curve parameters.
* **[stock]\_Yield\_Ri.png\*** presents for the fit of the Ricker curve:

1. box plots of the estimated Fmsy fishing mortality with proxies for Fmsy, based on the yield per recruit definitions of Fmax, F0.1, F35% and F40%, and also Flim, Fpa and F in the final year, for comparison;
2. the equilibrium landings versus fishing mortality plot based on the fitted stock and recruit plot and the selection, maturity and weight at age data. The left hand figure illustrates the percentiles from re-sampling the MCMC chain with the assessment data points, the right hand figure the first nhair re-samples of the estimated relationship;
3. the equilibrium SSB versus fishing mortality relationship for the fitted stock and recruit plot, selection, weight and maturity at age data, with the assessment data points.

* **[stock]\_Yield\_BH.png\*** – as stock\_Yield\_Ri.wmf for Beverton-Holt
* **[stock]\_Yield\_HS.png\*** – as stock\_Yield\_Ri.wmf for Hockeystick
* **[stock]\_YPR.png** presents the yield per recruit output from the model:

1. The estimates of Fmax, F0.1, F35% and F40% SPR with Flim Fpa and the final year F.
2. The human consumption yield per recruit at specified levels of fishing mortality.
3. The spawner biomass per recruit at the specified level of fishing mortality.

* **[stock]\_Fmsy.png\*** contains a histogram of the Fmsy values estimated by the three stock-recruit models, weighting each model equally, with quantiles for the overall distribution.
* **[stock]\_Fmsy2.png\*** contains a histogram of the Fmsy values estimated by the three stock-recruit models, weighting each model either by its likelihood or by manually imposed weights, with quantiles for the overall distribution. The procedure for weighting by likelihood is to calculate the harmonic mean Hi for each model i using the number of samples given by nits, then to allocate a weighting to model i as follows: Hi/iHi. A model can be ignored by either method (likelihood or manual weighting) by allocating a zero to it in the srweights vector.
* **[stock]\_Fmsy3.png\*** is plotted if Blim is specified. This plot gives the probability of SSB being below Blim at different values of F using the weighted combination of stock-recruit models for whichever choice of weighting is used in the file [stock]\_Fmsy2.png. This is done by sampling, at different values of F, a number of SSB values from each model in proportion to the relevant weighting, and calculating the proportion of SSB values from the combined set that are below Blim. The 5%-ile , and corresponding F-value are shown as an indication of F values consistent with the precautionary approach.
* **[stock].txt** is a tab delimited file (for Excel or similar spreadsheet packages) containing a summary of the output plotted in the images. This is split into three sections:

1. A header, listing the stock name, senfile used, pf and pm or the index file used to find them, the number of MCMC iterations saved, whether variation in biological parameters is simulated and whether the SR relationships are constrained to be physically plausible. These all coincide with input parameters.
2. For each Stock Recruitment relationship, the name of the SR relationship is followed by the number of MCMC iterations that produced feasible stock-recruit parameters, and then a table indicating the estimated values of Fcrash, FMSY, MSY, BMSY, the transformed alpha and beta and their untransformed counterparts, and AICc. For each value, the deterministic value, mean, selected percentiles and coefficient of variation are given. Also included is N, the number of iterations used to derive the statistic (the remainder having been discarded because of a boundary issue, such as F hitting an upper permitted bound, here 5 for Fcrash and 3 for FMSY).
3. A table of per recruit statistics, giving the same statistics as in the previous table for F20%, F25%, F30%, F35%, F40%, F0.1, Fmax BMSYpr, MSYpr FPA and Flim. FPA and Flim are provided as arguments to the function, rather than estimated by this, so there is no estimate of their variability.
4. Aggregated percentiles of FMSY, Fcrash, MSY and BMSY are shown with models equally weighted and weighted either manually or proportionally to the likelihood of the model (labelled with \_w), whichever of these weighting choices has been made. The weights applied to each model for the manual or likelihood weighting are also given.

* **[stock]\_trim\_diag.png** is plotted if trimming is NA, it shows the weights allocated to the three stock-recruit functions under different levels of trimming.
* **[stock] \_trim\_diag.csv** is a csv file produced if trimming is NA, containing a table of the weights allocated to the three stock-recruit functions under different levels of trimming.

Reference

Mesnil, B., and Rochet, M-J. 2010. A continuous hockey stick stock–recruit model for estimating MSY reference points. ICES Journal of Marine Science, 67: 1780–1784.

**Appendix 1 – example sen and sum files**

cod.sum (information used by PlotMSY given in bold)

Stock summary Cod in Division 347

12

1 0 0

Year

1963 2011

Recruits age 1 (millions)

1 1000000

SSB ('000 t)

1000

TSB ('000 t)

1000

Catch Total ('000 t)

1000

Catch H.cons ('000 t)

1000

Not used used

1000

Not used used

1000

Mean F Total

2 4

Mean F H.cons.

2 4

Not used used

0 0

Not used used

0 0

**1963 465.56 151.90 514.01 124.99 111.46 13.54 0 0.485 0.432 0.053 0**

**1964 852.56 164.23 686.94 152.82 139.57 13.25 0 0.513 0.469 0.044 0**

**1965 1069.82 203.82 862.85 203.21 182.00 21.21 0 0.543 0.486 0.057 0**

**1966 1379.18 227.29 1050.73 249.20 217.11 32.09 0 0.560 0.488 0.072 0**

**1967 1271.87 251.45 1135.97 298.05 264.53 33.51 0 0.605 0.537 0.068 0**

**1968 656.71 262.24 944.11 299.54 278.63 20.91 0 0.635 0.591 0.044 0**

**1969 606.22 258.59 804.52 239.67 227.53 12.14 0 0.623 0.591 0.032 0**

**1970 1839.49 273.76 1333.08 268.07 244.04 24.03 0 0.639 0.582 0.057 0**

**1971 2369.05 276.23 1460.08 351.86 290.81 61.05 0 0.705 0.583 0.122 0**

**1972 584.20 241.35 976.76 361.86 327.54 34.32 0 0.768 0.695 0.073 0**

**1973 875.02 213.20 800.51 259.63 235.05 24.58 0 0.752 0.681 0.071 0**

**1974 807.74 232.35 755.40 240.87 215.94 24.93 0 0.736 0.660 0.076 0**

**1975 1377.80 212.99 859.41 238.47 206.32 32.15 0 0.772 0.668 0.104 0**

**1976 849.16 182.96 659.34 237.52 200.21 37.31 0 0.803 0.677 0.126 0**

**1977 2096.96 161.14 1007.52 244.02 181.09 62.93 0 0.798 0.592 0.206 0**

**1978 1271.87 160.33 1122.42 323.51 283.95 39.56 0 0.858 0.753 0.105 0**

**1979 1435.47 166.71 1006.51 314.27 272.41 41.86 0 0.804 0.697 0.107 0**

**1980 2273.88 181.50 1172.91 339.42 272.98 66.45 0 0.860 0.692 0.168 0**

**1981 885.58 194.66 989.54 362.94 324.70 38.24 0 0.890 0.796 0.094 0**

**1982 1407.04 188.34 1018.66 334.70 294.49 40.21 0 0.983 0.865 0.118 0**

**1983 819.13 154.97 817.50 282.38 256.81 25.57 0 0.972 0.884 0.088 0**

**1984 1426.88 132.46 828.19 246.22 199.59 46.63 0 0.916 0.743 0.173 0**

**1985 378.51 126.63 569.78 225.71 202.93 22.78 0 0.887 0.797 0.090 0**

**1986 1692.98 115.73 776.85 206.49 161.64 44.85 0 0.936 0.733 0.203 0**

**1987 671.32 108.99 739.70 248.20 218.27 29.93 0 0.938 0.825 0.113 0**

**1988 462.31 100.61 550.73 199.59 186.64 12.94 0 0.948 0.887 0.061 0**

**1989 767.58 94.28 538.21 169.06 136.47 32.59 0 0.966 0.780 0.186 0**

**1990 333.70 80.18 378.89 136.22 114.42 21.79 0 0.906 0.761 0.145 0**

**1991 370.28 73.64 350.46 120.21 105.48 14.74 0 0.910 0.798 0.112 0**

**1992 792.54 71.11 517.62 134.86 107.77 27.09 0 0.877 0.701 0.176 0**

**1993 446.86 68.60 431.06 149.34 123.69 25.66 0 0.891 0.738 0.153 0**

**1994 944.11 72.11 527.02 153.43 115.05 38.38 0 0.906 0.679 0.227 0**

**1995 557.94 81.06 562.98 185.91 152.10 33.80 0 0.934 0.764 0.170 0**

**1996 403.53 79.22 459.09 165.55 142.84 22.71 0 0.955 0.824 0.131 0**

**1997 1059.17 75.21 632.23 166.38 126.33 40.04 0 0.961 0.730 0.231 0**

**1998 170.59 61.27 342.83 140.79 108.72 32.07 0 0.980 0.757 0.223 0**

**1999 303.46 55.94 256.53 100.91 86.42 14.50 0 0.999 0.856 0.144 0**

**2000 548.53 49.66 344.90 101.93 81.09 20.83 0 0.995 0.792 0.203 0**

**2001 208.98 41.73 247.95 90.85 71.59 19.26 0 0.956 0.753 0.203 0**

**2002 255.76 42.57 266.47 88.52 79.03 9.49 0 0.926 0.827 0.099 0**

**2003 119.13 36.90 151.00 60.72 51.03 9.69 0 0.901 0.757 0.144 0**

**2004 200.19 31.98 149.64 47.62 38.27 9.35 0 0.857 0.689 0.168 0**

**2005 137.45 29.76 144.93 47.05 39.11 7.94 0 0.800 0.665 0.135 0**

**2006 344.90 26.24 156.53 41.61 31.93 9.68 0 0.723 0.555 0.168 0**

**2007 147.12 32.83 185.54 56.11 29.20 26.90 0 0.669 0.348 0.321 0**

**2008 178.80 38.25 186.09 54.12 29.66 24.46 0 0.630 0.345 0.285 0**

**2009 191.19 47.19 211.72 56.90 37.67 19.23 0 0.602 0.399 0.203 0**

**2010 326.44 51.79 246.23 61.82 45.83 15.99 0 0.583 0.432 0.151 0**

**2011 165.71 56.33 236.81 66.90 50.16 16.75 0 0.572 0.429 0.143 0**

[Col2=Recruitment, Col3=SSB, Col4=TSB, Col5=total catch, Col6=human consumption landings, Col7=discards, Col8=industrial bycatch, Col9=total mean F, Col10=human consumption mean F, Col11=discards mean F, Col12=industrial bycatch mean F]

cod.sen (information used by PlotMSY given in bold)

cod347

1 7 2011 3 First age, last age, starting year, number of catch components

(H=human consumption, D=discards, I=industrial bycatch)

1 1 0 Catch components used (1=used, 0=not used)

'N1' 327748 0.458 Population estimates in 2011 (survivors) with CV

'N2' 49021 0.214

'N3' 32860 0.165

'N4' 6374 0.147

'N5' 2101 0.148

'N6' 821 0.176

'N7' 829 0.198

**'sH1' 0.016 0.175 Human consumption F at age in 2011 with CV**

**'sH2' 0.176 0.097**

**'sH3' 0.483 0.076**

**'sH4' 0.598 0.079**

**'sH5' 0.648 0.085**

**'sH6' 0.698 0.109**

**'sH7' 0.690 0.109**

**'sD1' 0.128 0.175 Discard F at age in 2011 with CV**

**'sD2' 0.280 0.097**

**'sD3' 0.159 0.076**

**'sD4' 0.060 0.079**

**'sD5' 0.021 0.085**

**'sD6' 0.018 0.109**

**'sD7' 0.026 0.109**

**'WH1' 0.747 0.112 Human consumption weights at age in 2011 with CV**

**'WH2' 1.306 0.143**

**'WH3' 2.634 0.137**

**'WH4' 4.236 0.097**

**'WH5' 6.104 0.062**

**'WH6' 7.642 0.05**

**'WH7' 9.701 0.04**

**'WD1' 0.286 0.255 Discard weights at age in 2011 with CV**

**'WD2' 0.755 0.282**

**'WD3' 1.726 0.419**

**'WD4' 3.542 0.542**

**'WD5' 5.964 0.48**

**'WD6' 6.674 0.345**

**'WD7' 8.823 0.792**

**'WS1' 0.339 0.196 Stock weights at age in 2011 with CV**

**'WS2' 0.964 0.138**

**'WS3' 2.404 0.136**

**'WS4' 4.173 0.093**

**'WS5' 6.112 0.061**

**'WS6' 7.647 0.059**

**'WS7' 9.770 0.036**

**'M1' 1.0385 0.1 Natural mortality at age in 2011 with CV**

**'M2' 0.6975 0.1**

**'M3' 0.4895 0.1**

**'M4' 0.2325 0.1**

**'M5' 0.2 0.1**

**'M6' 0.2 0.1**

**'M7' 0.2 0.1**

**'MT1' 0.01 0 Proportion mature at age in 2011 with CV**

**'MT2' 0.05 0.1**

**'MT3' 0.23 0.1**

**'MT4' 0.62 0.1**

**'MT5' 0.86 0**

**'MT6' 1 0**

**'MT7' 1 0**

'R06' 117233 0.458 Estimated recruitment for 2012 with CV

'R07' 117233 0.458 Estimated recruitment for 2013 with CV

'HF06' 1 0.05 Year-effect multipliers on human consumption & discard F with CV

'HF07' 1 0.05 (Industrial multiplier would appear separately if used)

'HF08' 1 0.05

'K06' 1 0.1 Year-effect multipliers on natural mortality with CV

'K07' 1 0.1

'K08' 1 0.1

Cod Information from Aberdeen suite files (can be ignored)

347

1

1 7 1

2

H.cons.

2 4

Discards

2 4

1963 2011

Stock numbers in 2011 are SAM estimates

-1

**Appendix 2 – example dat files**

srmsymc.dat

#stkname, filname // stkname=stock dealing with; filname=name of 2nd file

out out.dat

#ybeg, yend, r, A, Ropt, simopt, senopt,penopt // ybeg=1st yr; yend=last yr; r=recr age; A=plusgroup; Ropt=S-R function type, simopt (0=no sim, 1=do sim); senopt (0=error only in recr, 1=error in recr & steady-state vectors); penopt (0=no SR constraints, 1=apply SR constraints)

1963 2011 1 7 1 1 1 1

#R, Bssb // R=recr; Bssb=SSB

465.56 151.90

852.56 164.23

1069.82 203.82

1379.18 227.29

1271.87 251.45

656.71 262.24

606.22 258.59

1839.49 273.76

2369.05 276.23

584.20 241.35

875.02 213.20

807.74 232.35

1377.80 212.99

849.16 182.96

2096.96 161.14

1271.87 160.33

1435.47 166.71

2273.88 181.50

885.58 194.66

1407.04 188.34

819.13 154.97

1426.88 132.46

378.51 126.63

1692.98 115.73

671.32 108.99

462.31 100.61

767.58 94.28

333.70 80.18

370.28 73.64

792.54 71.11

446.86 68.60

944.11 72.11

557.94 81.06

403.53 79.22

1059.17 75.21

170.59 61.27

303.46 55.94

548.53 49.66

208.98 41.73

255.76 42.57

119.13 36.90

200.19 31.98

137.45 29.76

344.90 26.24

147.12 32.83

178.80 38.25

191.19 47.19

326.44 51.79

165.71 56.33

out.dat

#fno, sno, f, m // fno=nr fleets; sno=fleet for ypr stats; f=F before spwn; m=M before spwn

2 1 0 0

#sdat // col1=sel fleet 1 (landings); col2=sel fleet 2

0.0273348519362187 0.2186788154897490

0.3006833712984050 0.4783599088838270

0.8251708428246010 0.2716400911161730

1.0216400911161700 0.1025056947608200

1.1070615034168600 0.0358769931662870

1.1924829157175400 0.0307517084282460

1.1788154897494300 0.0444191343963554

#sdat cv // col1=sel fleet 1 (landings); col2=sel fleet 2

0.175 0.175

0.097 0.097

0.076 0.076

0.079 0.079

0.085 0.085

0.109 0.109

0.109 0.109

#wdat // col1=wght fleet 1 (landings); col2=wght fleet 2

0.747 0.286

1.306 0.755

2.634 1.726

4.236 3.542

6.104 5.964

7.642 6.674

9.701 8.823

#wdat cv // col1=wght fleet 1 (landings); col2=wght fleet 2

0.112 0.255

0.143 0.282

0.137 0.419

0.097 0.542

0.062 0.480

0.050 0.345

0.040 0.792

#biodat // col1=natural mortality; col2=maturity; col3=wght in stock

1.0385 0.01 0.339

0.6975 0.05 0.964

0.4895 0.23 2.404

0.2325 0.62 4.173

0.2000 0.86 6.112

0.2000 1.00 7.647

0.2000 1.00 9.770

#biodat cv // col1=natural mortality; col2=maturity; col3=wght in stock

0.1 0.0 0.112

0.1 0.1 0.143

0.1 0.1 0.137

0.1 0.1 0.097

0.1 0.0 0.062

0.1 0.0 0.050

0.1 0.0 0.040

Notes:

* Positioning of comment lines is important. Additional comment lines should not be added.
* Filename in “srmsymc.dat” indicates the name of the file called “out.dat” in this example.
* multiple entries on a line should be separated by space(s) or tab(s)
* line breaks separate data for each year (srmsymc.dat) or age (out.dat). The number of lines should correspond to the year range and age range given in line 4 of srmsymc.dat.
* The remaining parameters on line 4 are:

**Ropt** – stock recruit option (ignored by plotMSY)

**simopt** – use Monte Carlo Markov Chain, always 1 (TRUE)

**senopt** – add noise to biological parameters 1 (TRUE) or 0 (FALSE)

**penopt** – penalise unfeasible SR relationships, i.e. where alpha or beta are less than zero, or the hockeystick breakpoint is outside the range of the data.

**Appendix 3 – Automatic weighting**

Where there is no *a priori* information about the likelihood of each of the stock-recruit relationships being fitted to the data, the likelihood of each model can be assessed by taking the harmonic mean of the likelihoods of individual iterations of each stock-recruit function (J. Simmonds, personal communication). Within this program, this is done by setting the srweights of two or three of the models to NA, this is referred to in this guide as automatic weighting.

The harmonic mean of likelihoods is numerically unstable, because a single low likelihood iteration can significantly alter the weights allocated to each model. To correct for this, the program allows the user to select a level of trimming which removes this proportion of the least likely iterations before calculating the harmonic mean. To allow the user to choose a suitable value of trimming, a diagnostic is available, produced with trimming=NA. This produces a plot and table showing the effect of different levels of trimming as is shown in Figure 1. A suitable choice of trimming would be the lowest value where the weights seem to have stabilised after the initial variability at low levels of trimming, perhaps 2% in this case. J.Simmonds (personal communication) suggested identifying the trimming value as the lowest value of trimming such that the maximum percentage difference by trimming an extra point is less than 1000/nits%. For example, Table 1 shows the start of a trim diagnostics file for a simulation with nits=1000, so the least acceptable trim percentage is where the relative changes from one row to the next are all less than 1%. The percentage change in BH weight from 0.3-0.4 is 2.2%, but none of the percentage changes from 0.4-0.5 are greater than 1%, so a trim value of 0.4% would be chosen.

|  |  |  |  |
| --- | --- | --- | --- |
| Trim Percentage | Ricker | Beverton-Holt | Smooth hockeystick |
| 0 | 0.088663003 | 0.130909267 | 0.78042773 |
| 0.1 | 0.131280931 | 0.134228228 | 0.73449084 |
| 0.2 | 0.130347436 | 0.137496333 | 0.732156231 |
| 0.3 | 0.123401989 | 0.137162076 | 0.739435935 |
| 0.4 | 0.123312989 | 0.140222716 | 0.736464295 |
| 0.5 | 0.12340671 | 0.141063786 | 0.735529504 |
| ... | ... | ... | ... |

Table : Extract from an example trim diagnostics table

To summarise the use of stock-recruit weights and trimming, a flow chart is shown in Figure 2, indicating a possible approach to identifying suitable values of these parameters for a stock.

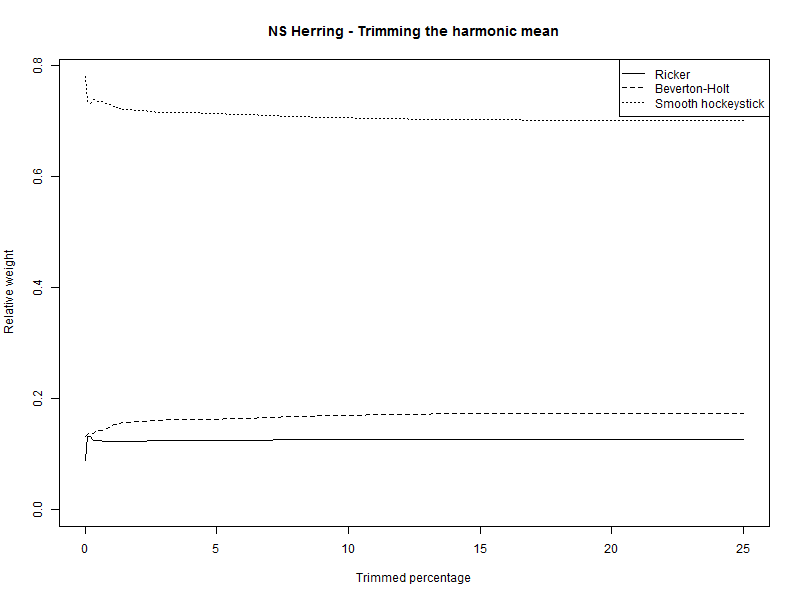


Figure : Weights given to Stock-recruit functions under different levels of trimming



Figure : Flow chart of possible model runs depending on which stock-recruit functions are appropriate for a stock

1. R 2.10.1 running under XP 32 bit on a 2.3Ghz processor with 3.45GB RAM [↑](#footnote-ref-1)