Supplementary Material for `Estimating stock status from relative abundance and resilience'

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Available from http://oceanrep.geomar.de/47135/

This Supplement contains:

Appendix 1 with application of AMSY to 24 simulated stocks, without filters, pages 2-27

Appendix 2 with application of AMSY to 24 simulated stocks, with filters, pages 28-53

Appendix 3 with application of AMSY to 38 data-poor stocks, pages 54-168

Results of analysis of simulated data without filters with AMSY_68v.R
29 October 2019

Table 1. Comparison of estimated and "true" parameter values (r, kq, F/Fmsy and B/Bmsy) for 24 simulated stocks. The target value for estimated relative to true value is one. The approximate lower confidence range as fraction of the estimated central value [(est-cl)/est] is an indication of the uncertainty about the estimate. Column 2 shows the median across the 24 simulated stocks. Columns 3 and 4 show the range that includes 95% of the estimated values. Note that this run of AMSY did not filter the potential r-k pairs, thus making the estimates of r and k_q fully depended on and basically equal to the prior ranges for r and kq, as is evident in the graphs displayed below. Source: AMSYResSimNoFilOctober292019_4.xls

	Median	2.5th percentile	97.5th percentile
r: est/true	0.72	0.62	0.97
r: (est-lcl)/est	0.55	0.36	0.68
kq: est /true	1.08	0.82	1.42
kq: (est-lcl)/est	0.24	0.19	0.43
F/Fmsy: est/true	1.45	0.96	5.41
F/Fmsy: (est-lcl)/est	1.42	0.64	5.41
B/Bmsy: est/true	0.94	0.81	1.19
B/Bmsy: (est-lcl)/est	0.44	0.44	0.45

Settings for analysis in R-code:

```
#----------------------------------------
# Required settings, File names
#----------------------------------------
id_file    <- "SimCPUE_ID_8.csv"


#----------------------------------------
# General settings for the analysis ----
#----------------------------------------
smooth.cpue  <- T
filter       <- FALSE
cor.rk       <- -0.607
sigma.r      <- c(0.05,0.07,0.1,0.15)
sigma.cpue   <- 0.3
n.p          <- 50000
n.trial      <- 30
min.viable   <- 20
max.viable   <- 20000
creep.graph  <- F
do.plots     <- T
write.output <- T
kobe.plot    <- F
save.plots   <- F
close.plots  <- F
retros       <- F
```

Generic legend for the subsequent graphs:
Panel (a) shows the time series of CPUE data as bold curve, a smoothed version of CPUE as thin dotted line, the prior range for kq as vertical blue line, and the corresponding upper and lower bounds of the relative Bmsy range as dotted horizontal lines.

Panel (b) shows the r-kq prior space in log scale with a cloud of gray points representing the multivariate log-normal distribution of r and kq corresponding to a correlation of -0.607, derived from full Schaefer models applied to 140 real stocks. The dotted rectangle indicates the prior ranges for r and kq and includes 85% of the gray dots. The red cross indicates the es timated central r-kq pair and the approximate 95% confidence limits. The blue circle indicates the "true" r-kq pair used in the simulation.

Panel (c) is a zoom-in on the viable r-kq pairs, with the red cross indicating the estimated central r-kq pair and its approximate 95% confidence limits and the blue circle indicating the "true" r-kq pair used in the simulation.

Panel (d) shows the time series of catch predicted by AMSY as bold curve relative to MSY, indicated by the dashed horizontal line. The dotted curves indicate the approximate 95% confidence limits. The blue curve shows the "true" catch used in the simulations.

Panel (e) shows the predicted time series of F over Fmsy as bold curve with dotted curves indicating the approximate 95% confidence limits. The dashed horizontal line indicates Fmsy.

Panel (f) shows the predicted time series of B over Bmsy as bold curve with dotted curves indicating the approximate 95% confidence limits. The dashed horizontal line indicates Bmsy, the dotted lines indicate the approximate 95% confidence limits of Bmsy, and the dashed red line indicates half of Bmsy. The blue curve shows the "true" biomass used in the simulations relative to the "true" value of Bmsy, indicated by a blue dashed line.
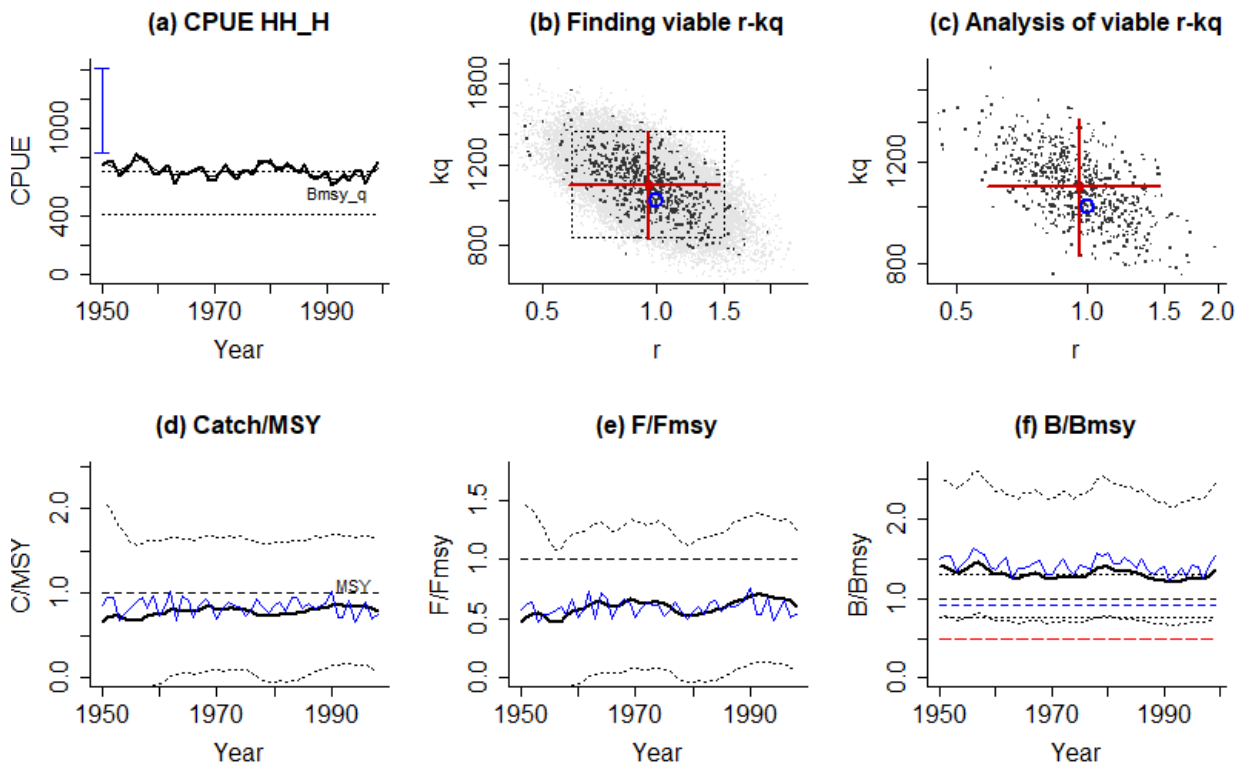
```
File SimCPUE_ID_8.csv read successfully
----------------------------------------------------------------
AMSY Analysis, Tue Oct 29 17:49:52 2019
----------------------------------------------------------------
Stock HH_H, , Simulated data
CPUE data for years 1950 - 1999, CPUE range 656 - 789, smooth = TRUE
Prior for r                = High, NA - NA
Used prior range for r     = 0.6 - 1.5
Prior for 1950 stock status = More than half, NA - NA
Used 1950 prior B/B0 range  = 0.5 - 0.85, prior B/Bmsy = 1 - 1.7
Used prior range for kq    = 832 - 1415 [original range = 832 - 1415]
Comment: True r=1.0, true kq=1000, true MSYq=250

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 20010

 Results:
 viable r-kq pairs   = 20010
 median kq           = 1088, 825 - 1424
 median MSYq         = 260, 178 - 374
 r (4 MSYq/kq)       = 0.955, 0.588 - 1.47
 Fmsy (r/2)          = 0.478, 0.294 - 0.734
 F/Fmsy              = 0.602, 0.0529 - 1.25 (1998), true: 0.539
 B/Bmsy              = 1.36, 0.753 - 2.46 (1999), true: 1.54
----------------------------------------------------------------
```


(a) CPUE HH_H

(b) Finding viable r-kq

(c) Analysis of viable r-kq

(d) Catch/MSY

(e) F/Fmsy

(f) B/Bmsy

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```
Stock HH_L, , Simulated data
CPUE data for years 1950 - 1999, CPUE range 691 - 747, smooth = TRUE
Prior for r                  = Low, NA - NA
Used prior range for r       = 0.05 - 0.5
Prior for 1950 stock status  = More than half, NA - NA
Used 1950 prior B/B0 range   = 0.5 - 0.85, prior B/Bmsy = 1 - 1.7
Used prior range for kq      = 820 - 1394 [original range = 820 - 1394]
Comment: True r=0.25, true kq=1000, true MSYq=62.5

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 20010

 Results:
 viable r-kq pairs   = 20010
 median kq           = 1050, 827 - 1366
 median MSYq         = 43.7, 16.9 - 110
 r (4 MSYq/kq)       = 0.167, 0.0564 - 0.484
 Fmsy (r/2)          = 0.0833, 0.0282 - 0.242
 F/Fmsy              = 1.03, -1.49 - 4.26 (1998), true: 0.577
 B/Bmsy              = 1.32, 0.737 - 2.37 (1999), true: 1.38
------------------------------------------------------------
```
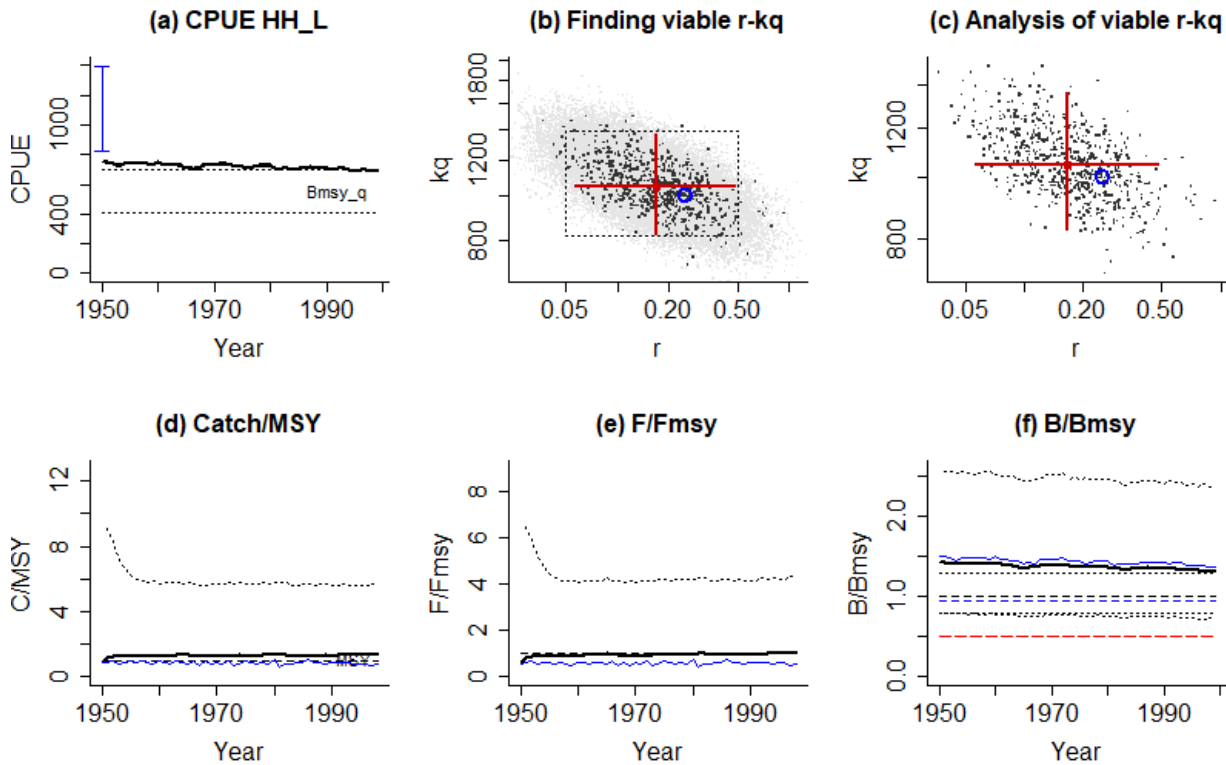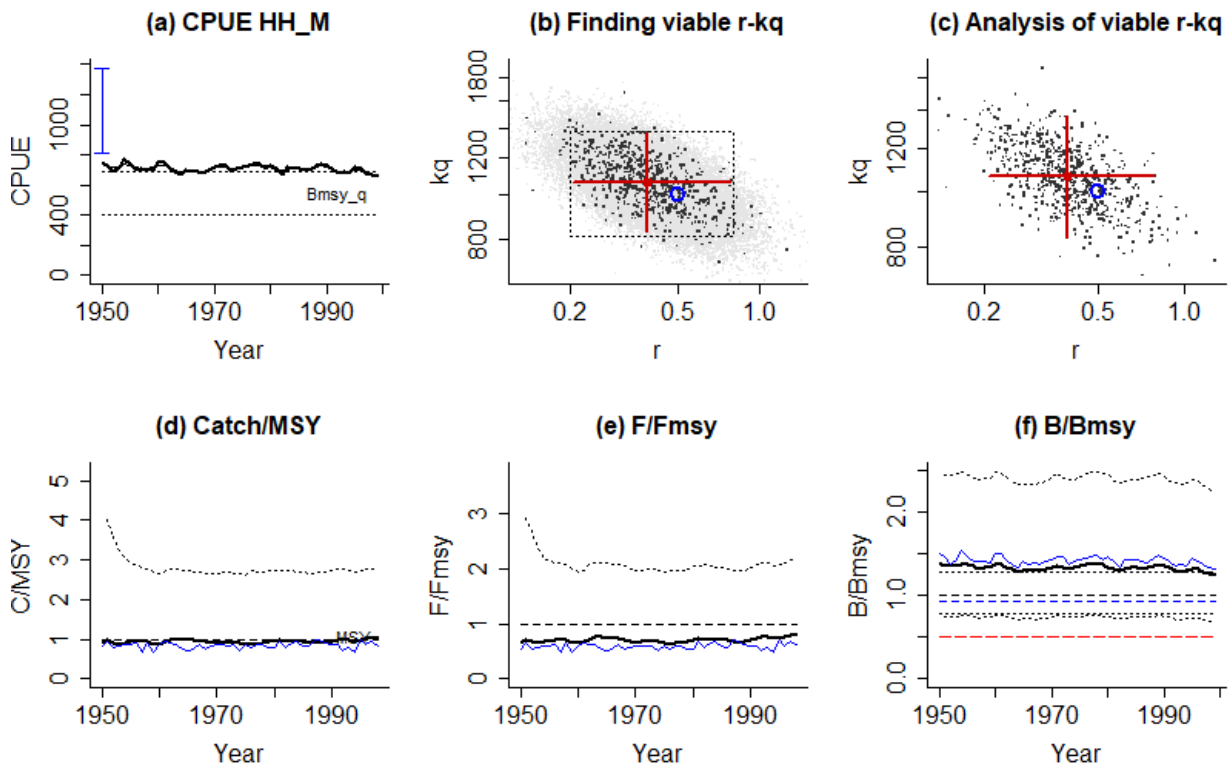

(a) CPUE HH_L (b) Finding viable r-kq (c) Analysis of viable r-kq (d) Catch/MSY (e) F/Fmsy (f) B/Bmsy

```
Stock HH_M, , Simulated data
CPUE data for years 1950 - 1999, CPUE range 665 - 737, smooth = TRUE
Prior for r                    = Medium, NA - NA
Used prior range for r         = 0.2 - 0.8
Prior for 1950 stock status    = More than half, NA - NA
Used 1950 prior B/B0 range     = 0.5 - 0.85, prior B/Bmsy = 1 - 1.7
Used prior range for kq        = 809 - 1375 [original range = 809 - 1375]
Comment: True r=0.5, true kq=1000, true MSYq=125, true q=0.001

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 20010

 Results:
 viable r-kq pairs    = 20010
 median kq            = 1066, 830 - 1365
 median MSYq          = 103, 60.6 - 177
 r (4 MSYq/kq)        = 0.387, 0.206 - 0.779
 Fmsy (r/2)           = 0.193, 0.103 - 0.389
 F/Fmsy               = 0.819, -0.303 - 2.18 (1998), true: 0.623
 B/Bmsy               = 1.24, 0.691 - 2.22 (1999), true: 1.32
-----------------------------------------------------------
```


(a) CPUE HH_M   (b) Finding viable r-kq   (c) Analysis of viable r-kq

(d) Catch/MSY   (e) F/Fmsy   (f) B/Bmsy

```
Stock HH_VL, , Simulated data
CPUE data for years 1950 - 1999, CPUE range 708 - 742, smooth = TRUE
Prior for r                    = Very low, NA - NA
Used prior range for r         = 0.015 - 0.1
Prior for 1950 stock status    = More than half, NA - NA
Used 1950 prior B/B0 range     = 0.5 - 0.85, prior B/Bmsy = 1 - 1.7
Used prior range for kq        = 814 - 1385 [original range = 814 - 1385]
Comment: True r=0.06, true kq=1000, true MSYq=15

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 20010

 Results:
 viable r-kq pairs    = 20010
 median kq            = 1066, 814 - 1417
 median MSYq          = 10.2, 4.51 - 21.7
 r (4 MSYq/kq)        = 0.0381, 0.0148 - 0.0936
 Fmsy (r/2)           = 0.0191, 0.0074 - 0.0468
 F/Fmsy               = 2.31, -8.75 - 18 (1998), true: 0.612
 B/Bmsy               = 1.33, 0.737 - 2.4 (1999), true: 1.42
 -----------------------------------------------------------
```
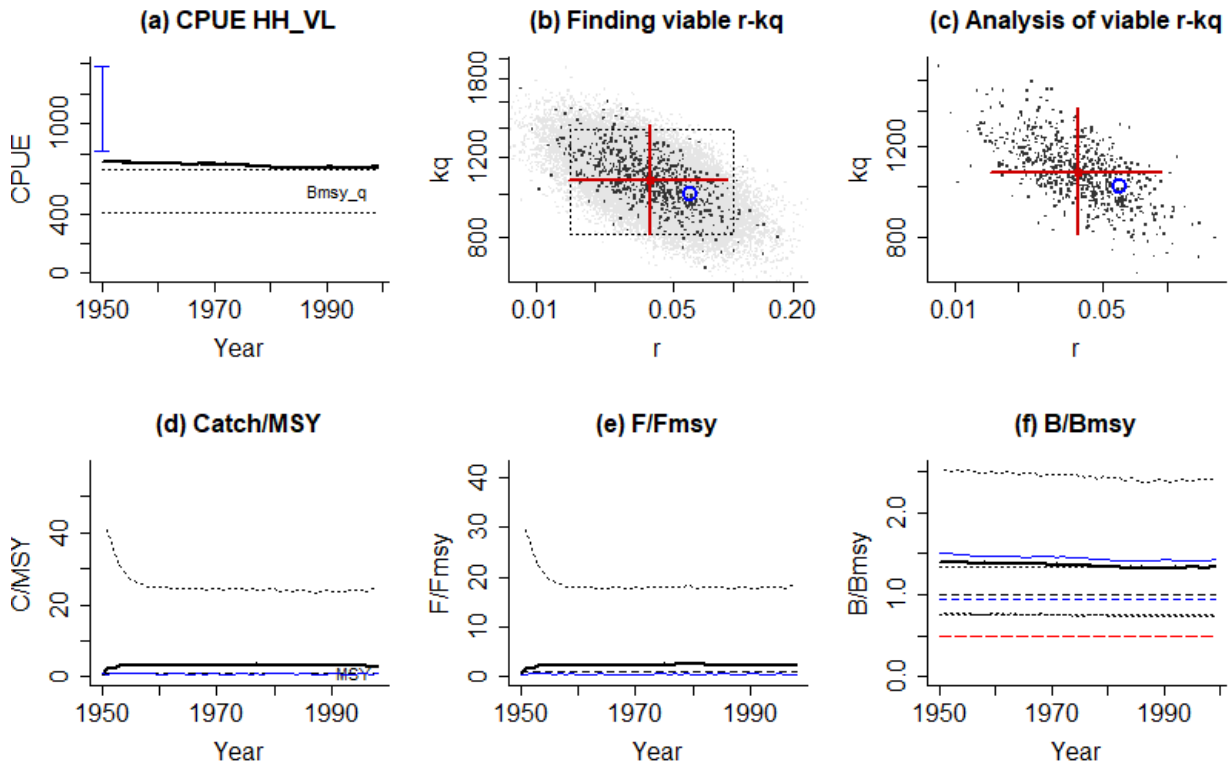

(a) CPUE HH_VL (b) Finding viable r-kq (c) Analysis of viable r-kq
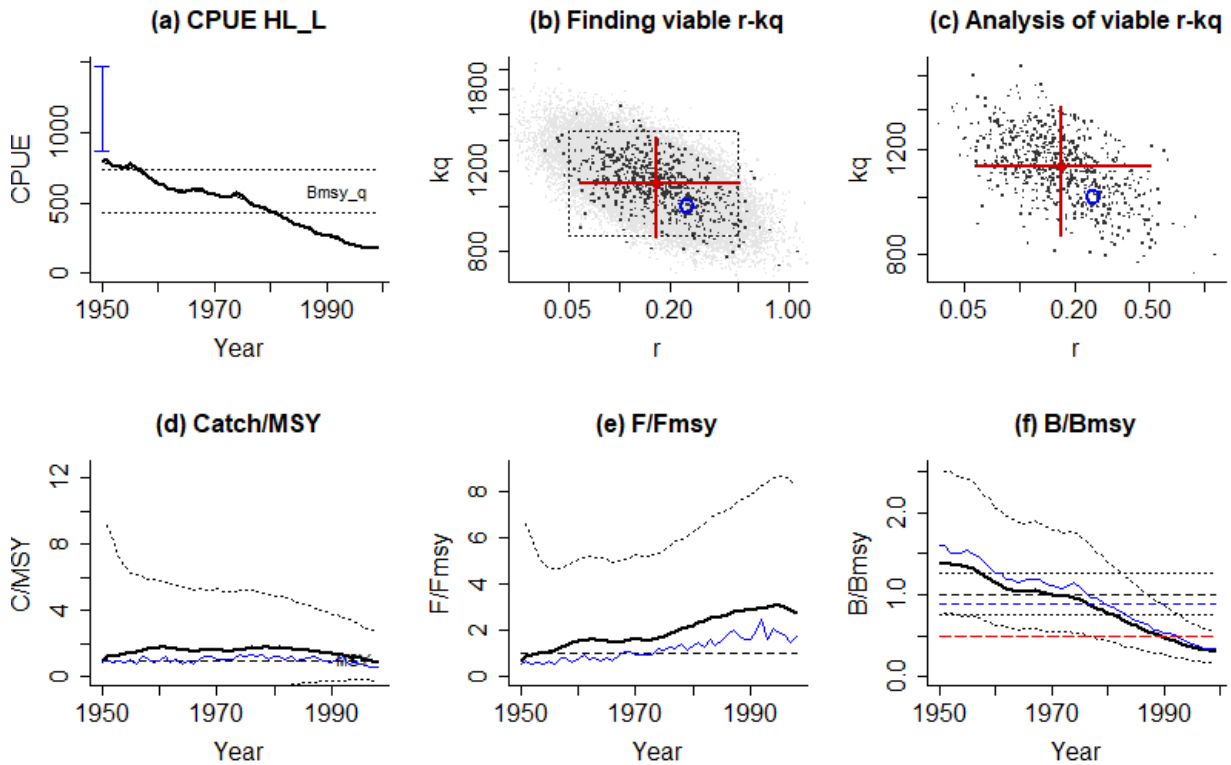(d) Catch/MSY (e) F/Fmsy (f) B/Bmsy

```
Stock HL_H, , Simulated data
CPUE data for years 1950 - 1999, CPUE range 204 - 745, smooth = TRUE
Prior for r                    = High, NA - NA
Used prior range for r         = 0.6 - 1.5
Prior for 1950 stock status    = More than half, NA - NA
Used 1950 prior B/B0 range     = 0.5 - 0.85, prior B/Bmsy = 1 - 1.7
Used prior range for kq        = 818 - 1390 [original range = 818 - 1390]
Comment: True r=1.0, true kq=1000, true MSYq=250

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 20010

 Results:
 viable r-kq pairs    = 20010
 median kq            = 1070, 838 - 1387
 median MSYq          = 251, 175 - 359
 r (4 MSYq/kq)        = 0.938, 0.599 - 1.49
 Fmsy (r/2)           = 0.469, 0.3 - 0.743
 F/Fmsy               = 1.77, 0.687 - 3.32 (1998), true: 1.75
 B/Bmsy               = 0.382, 0.212 - 0.691 (1999), true: 0.36
--------------------------------------------------------------------
```
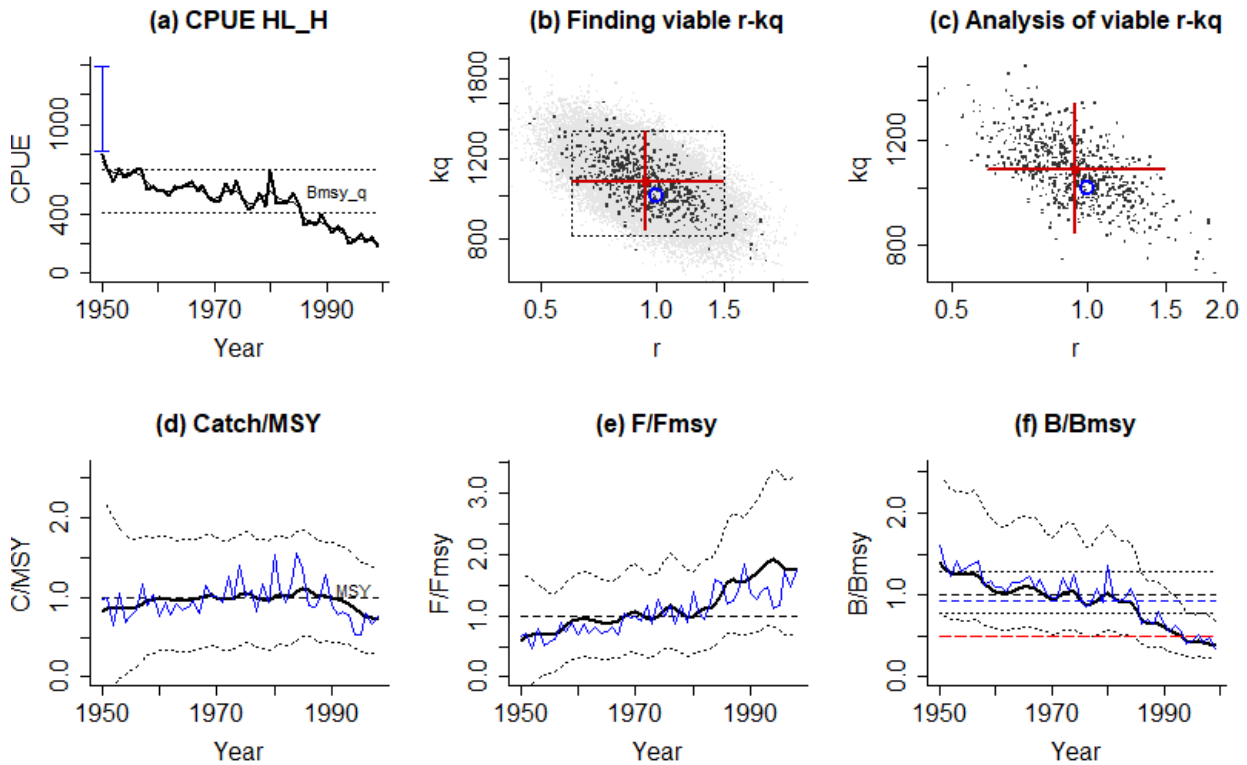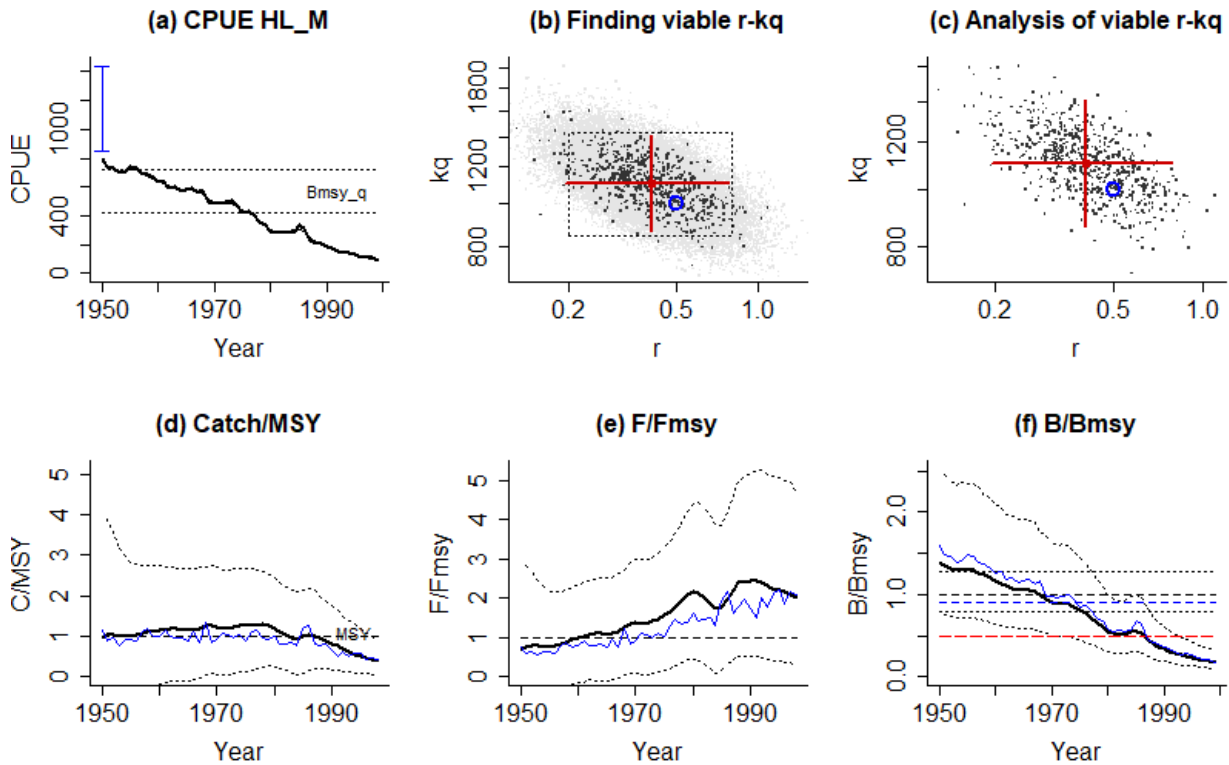
```
Stock HL_L,  , Simulated data
CPUE data for years 1950 - 1999, CPUE range 177 - 787, smooth = TRUE
Prior for r                  = Low, NA - NA
Used prior range for r       = 0.05 - 0.5
Prior for 1950 stock status  = More than half, NA - NA
Used 1950 prior B/B0 range   = 0.5 - 0.85, prior B/Bmsy = 1 - 1.7
Used prior range for kq      = 864 - 1469 [original range = 864 - 1469]
Comment: True r=0.25, true kq=1000, true MSYq=62.5

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 20010

 Results:
 viable r-kq pairs    = 20010
 median kq            = 1125, 859 - 1417
 median MSYq          = 46.7, 16.6 - 122
 r (4 MSYq/kq)        = 0.166, 0.0582 - 0.516
 Fmsy (r/2)           = 0.083, 0.0291 - 0.258
 F/Fmsy               = 2.75, -0.728 - 8.3 (1998), true: 1.79
 B/Bmsy               = 0.314, 0.175 - 0.57 (1999), true: 0.36
----------------------------------------------------------------
```


(a) CPUE HL_L   (b) Finding viable r-kq   (c) Analysis of viable r-kq

(d) Catch/MSY   (e) F/Fmsy   (f) B/Bmsy

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```
Stock HL_M, , Simulated data
CPUE data for years 1950 - 1999, CPUE range 101 - 770, smooth = TRUE
Prior for r                   = Medium, NA - NA
Used prior range for r        = 0.2 - 0.8
Prior for 1950 stock status   = More than half, NA - NA
Used 1950 prior B/B0 range    = 0.5 - 0.85, prior B/Bmsy = 1 - 1.7
Used prior range for kq       = 845 - 1437 [original range = 845 - 1437]
Comment: True r=0.5, true kq=1000, true MSYq=125, true q=0.001

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 20010

 Results:
 viable r-kq pairs    = 20010
 median kq            = 1104, 865 - 1406
 median MSYq          = 112, 60.5 - 195
 r (4 MSYq/kq)        = 0.404, 0.196 - 0.787
 Fmsy (r/2)           = 0.202, 0.0978 - 0.394
 F/Fmsy               = 2, 0.262 - 4.69 (1998), true: 2.09
 B/Bmsy               = 0.183, 0.101 - 0.332 (1999), true: 0.18
-------------------------------------------------------------
```
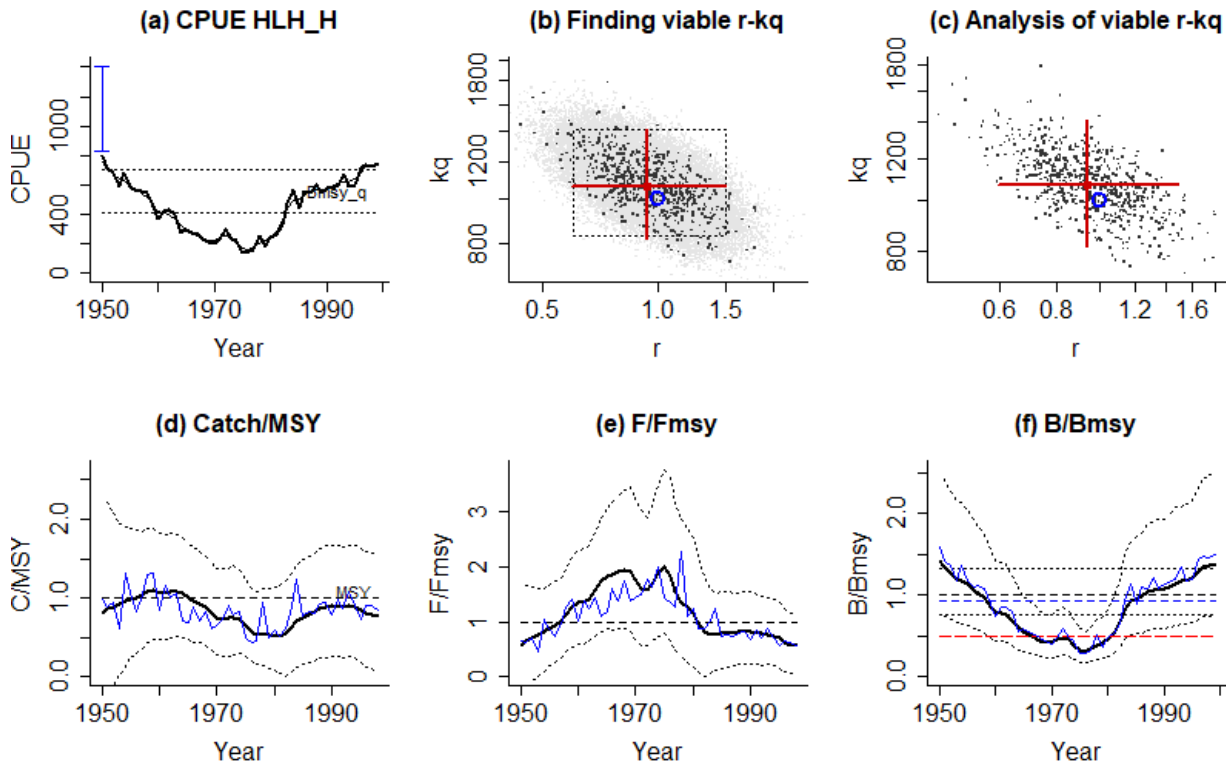

(a) CPUE HL_M   (b) Finding viable r-kq   (c) Analysis of viable r-kq

(d) Catch/MSY   (e) F/Fmsy   (f) B/Bmsy

```
Stock HL_VL, , Simulated data
CPUE data for years 1950 - 1999, CPUE range 244 - 754, smooth = TRUE
Prior for r                 = Very low, NA - NA
Used prior range for r      = 0.015 - 0.1
Prior for 1950 stock status = More than half, NA - NA
Used 1950 prior B/B0 range  = 0.5 - 0.85, prior B/Bmsy = 1 - 1.7
Used prior range for kq     = 828 - 1407 [original range = 828 - 1407]
Comment: True r=0.06, true kq=1000, true MSYq=15

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 20010

 Results:
 viable r-kq pairs   = 20010
 median kq           = 1083, 817 - 1413
 median MSYq         = 10.3, 4.71 - 23.6
 r (4 MSYq/kq)       = 0.038, 0.0153 - 0.0987
 Fmsy (r/2)          = 0.019, 0.00767 - 0.0493
 F/Fmsy              = 5.12, -6.94 - 21.8 (1998), true: 2.41
 B/Bmsy              = 0.45, 0.249 - 0.811 (1999), true: 0.38
-------------------------------------------------------------
```
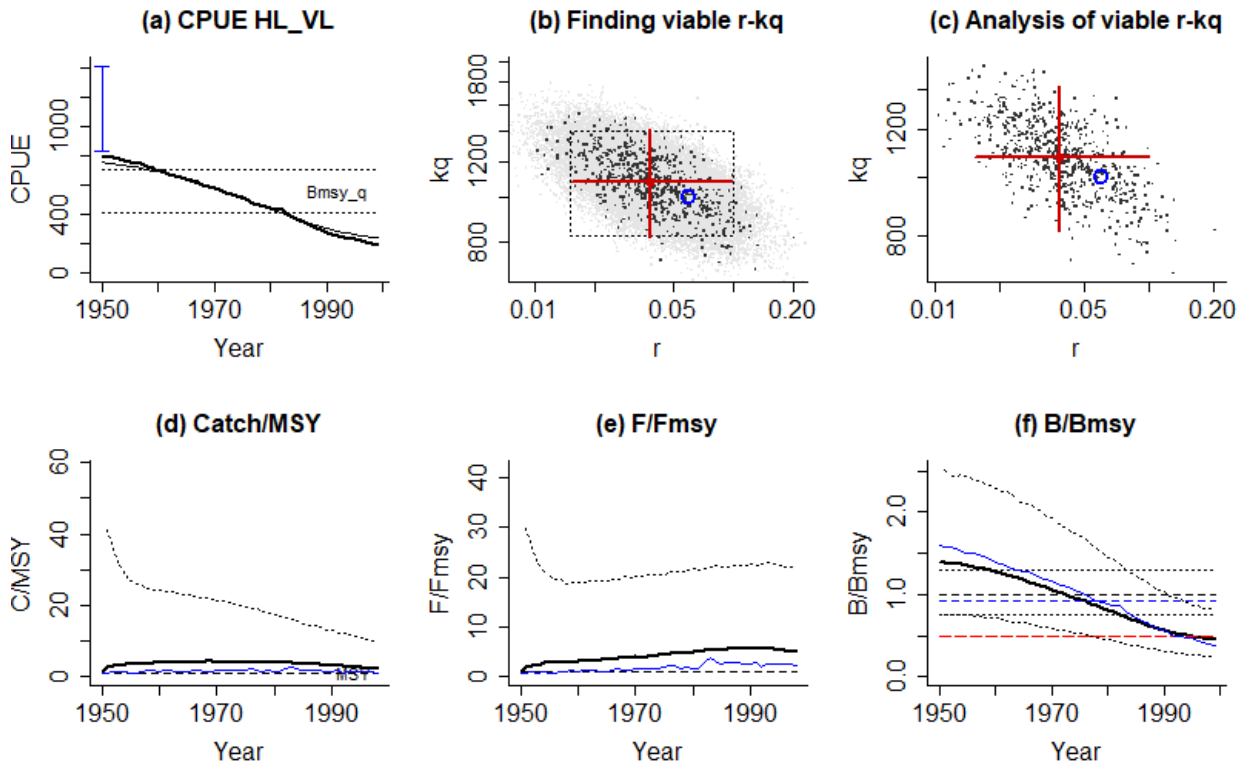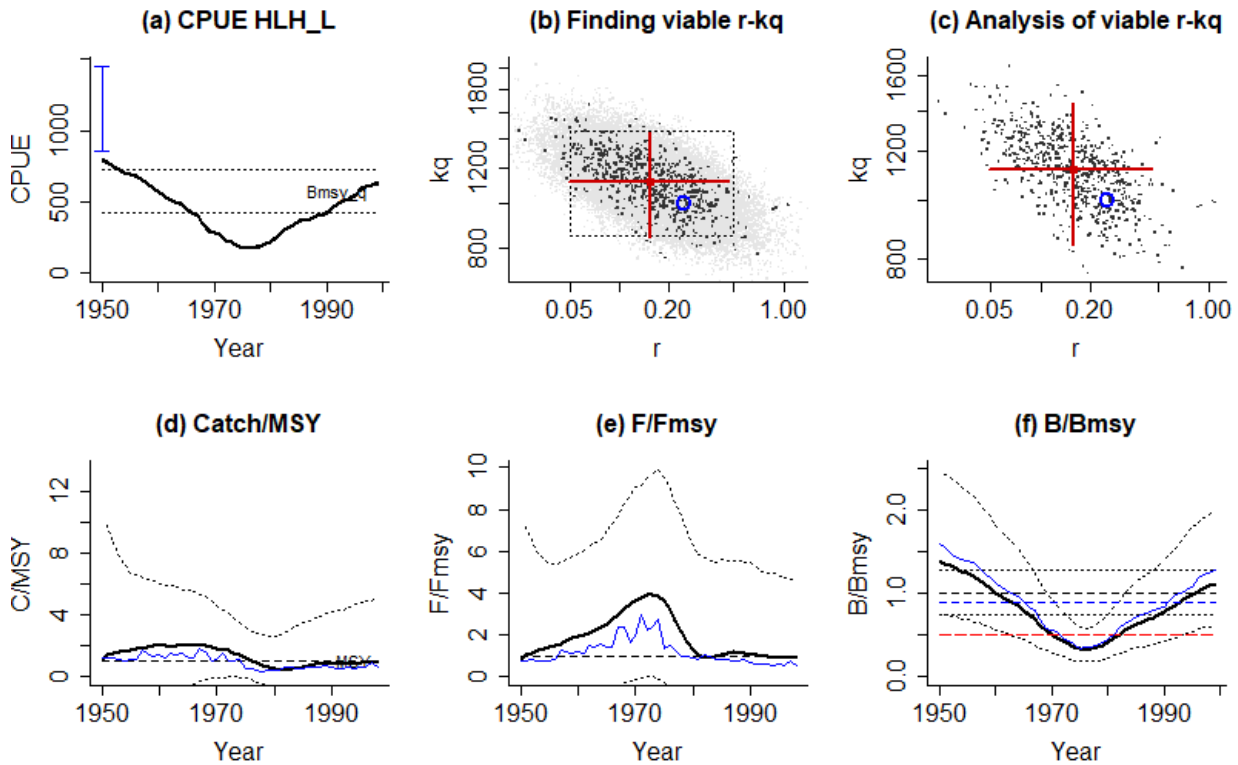
```
Stock HLH_H, , Simulated data
CPUE data for years 1950 - 1999, CPUE range 165 - 753, smooth = TRUE
Prior for r                   = High, NA - NA
Used prior range for r        = 0.6 - 1.5
Prior for 1950 stock status   = More than half, NA - NA
Used 1950 prior B/B0 range    = 0.5 - 0.85, prior B/Bmsy = 1 - 1.7
Used prior range for kq       = 827 - 1405 [original range = 827 - 1405]
Comment: True r=1.0, true kq=1000, true MSYq=250

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 20010

 Results:
 viable r-kq pairs    = 20010
 median kq            = 1065, 819 - 1408
 median MSYq          = 250, 179 - 363
 r (4 MSYq/kq)        = 0.941, 0.594 - 1.5
 Fmsy (r/2)           = 0.47, 0.297 - 0.75
 F/Fmsy               = 0.564, 0.0348 - 1.16 (1998), true: 0.577
 B/Bmsy               = 1.38, 0.776 - 2.5 (1999), true: 1.5
-------------------------------------------------------------
```
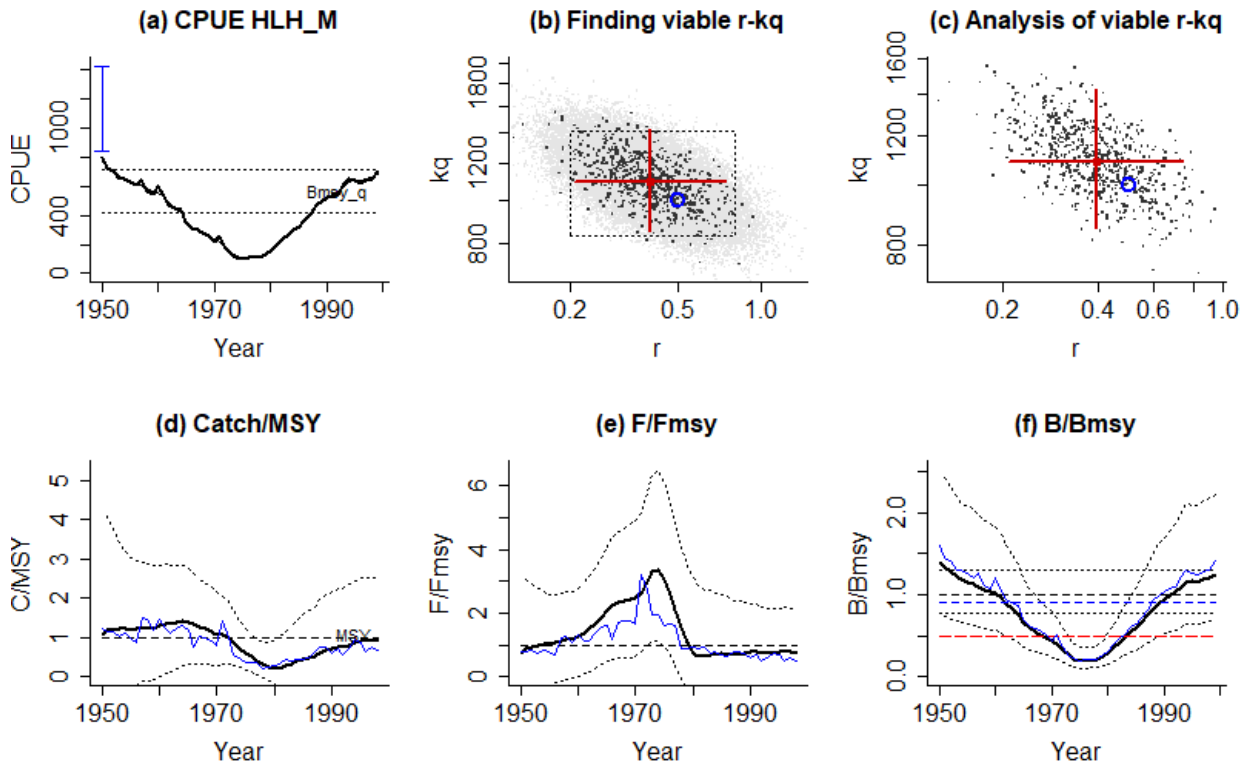

(a) CPUE HLH_H   (b) Finding viable r-kq   (c) Analysis of viable r-kq

(d) Catch/MSY   (e) F/Fmsy   (f) B/Bmsy

```
Stock HLH_L, , Simulated data
CPUE data for years 1950 - 1999, CPUE range 186 - 777, smooth = TRUE
Prior for r                  = Low, NA - NA
Used prior range for r       = 0.05 - 0.5
Prior for 1950 stock status  = More than half, NA - NA
Used 1950 prior B/B0 range   = 0.5 - 0.85, prior B/Bmsy = 1 - 1.7
Used prior range for kq      = 852 - 1449 [original range = 852 - 1449]
Comment: True r=0.25, true kq=1000, true MSYq=62.5

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 20010

 Results:
 viable r-kq pairs   = 20010
 median kq           = 1121, 842 - 1441
 median MSYq         = 43.5, 15.8 - 115
 r (4 MSYq/kq)       = 0.155, 0.0489 - 0.464
 Fmsy (r/2)          = 0.0777, 0.0245 - 0.232
 F/Fmsy              = 0.961, -1.83 - 4.72 (1998), true: 0.546
 B/Bmsy              = 1.11, 0.62 - 2 (1999), true: 1.28
 -----------------------------------------------------------
```
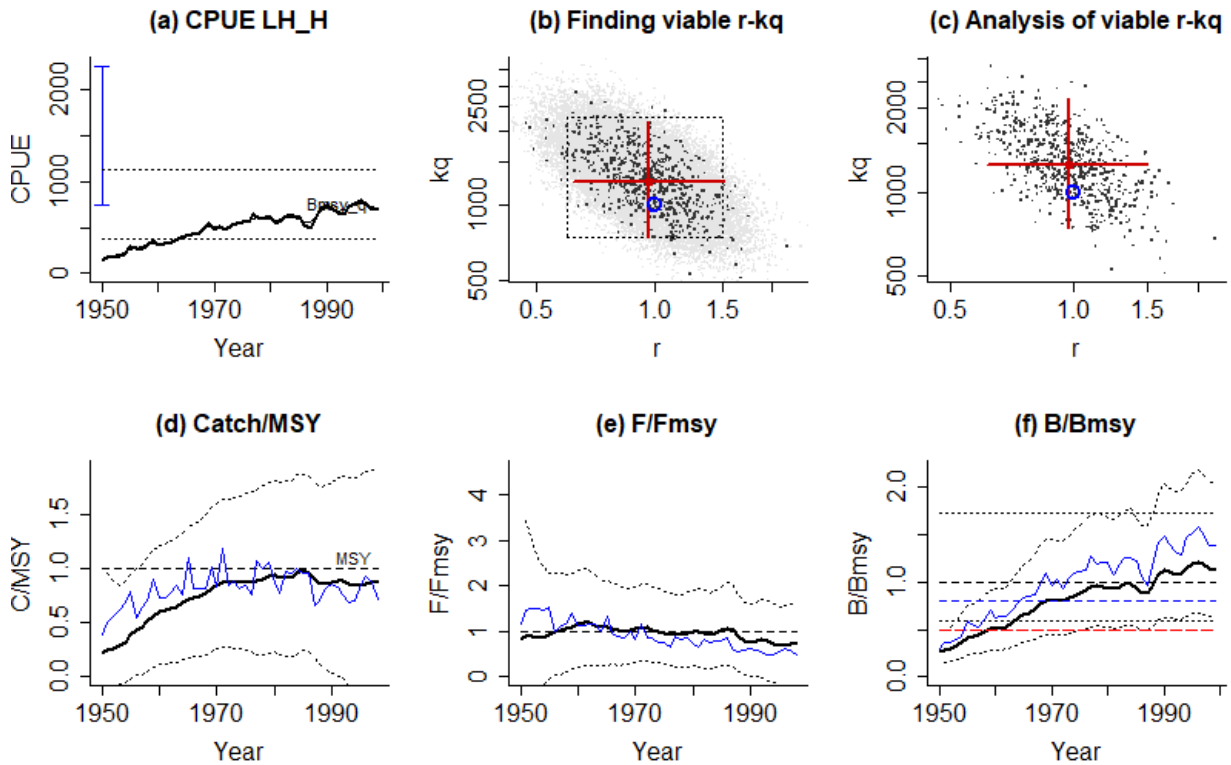

(a) CPUE HLH_L (b) Finding viable r-kq (c) Analysis of viable r-kq
(d) Catch/MSY (e) F/Fmsy (f) B/Bmsy

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```
Stock HLH_M, , Simulated data
CPUE data for years 1950 - 1999, CPUE range 108 - 760, smooth = TRUE
Prior for r                   = Medium, NA - NA
Used prior range for r        = 0.2 - 0.8
Prior for 1950 stock status   = More than half, NA - NA
Used 1950 prior B/B0 range    = 0.5 - 0.85, prior B/Bmsy = 1 - 1.7
Used prior range for kq       = 835 - 1419 [original range = 835 - 1419]
Comment: True r=0.5, true kq=1000, true MSYq=125, true q=0.001

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 20010

 Results:
 viable r-kq pairs   = 20010
 median kq           = 1091, 854 - 1429
 median MSYq         = 108, 63.9 - 185
 r (4 MSYq/kq)       = 0.395, 0.209 - 0.747
 Fmsy (r/2)          = 0.197, 0.104 - 0.373
 F/Fmsy              = 0.755, -0.353 - 2.09 (1998), true: 0.522
 B/Bmsy              = 1.25, 0.688 - 2.22 (1999), true: 1.4
-----------------------------------------------------------
```


(a) CPUE HLH_M   (b) Finding viable r-kq   (c) Analysis of viable r-kq
(d) Catch/MSY   (e) F/Fmsy   (f) B/Bmsy
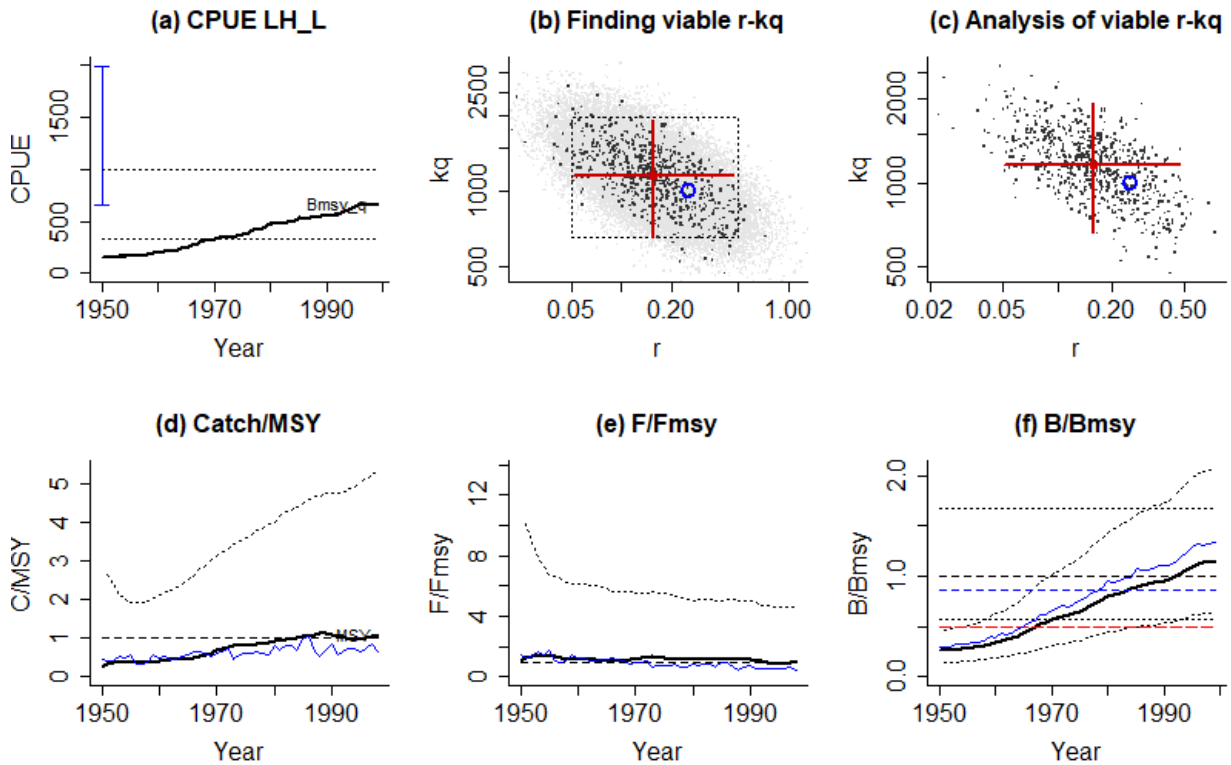
14

```
Stock HLH_VL, , Simulated data
CPUE data for years 1950 - 1999, CPUE range 270 - 631, smooth = TRUE
Prior for r                    = Very low, NA - NA
Used prior range for r         = 0.015 - 0.1
Prior for 1950 stock status    = More than half, NA - NA
Used 1950 prior B/B0 range     = 0.5 - 0.85, prior B/Bmsy = 1 - 1.7
Used prior range for kq        = 692 - 1176 [original range = 692 - 1176]
Comment: True r=0.06, true kq=1000, true MSYq=15

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 20010

 Results:
 viable r-kq pairs    = 20010
 median kq            = 905, 697 - 1166
 median MSYq          = 8.61, 3.84 - 18.6
 r (4 MSYq/kq)        = 0.0381, 0.015 - 0.0933
 Fmsy (r/2)           = 0.019, 0.00752 - 0.0466
 F/Fmsy               = 2.04, -9.09 - 17.9 (1998), true: 0.377
 B/Bmsy               = 0.987, 0.548 - 1.79 (1999), true: 1
 -----------------------------------------------------------
```
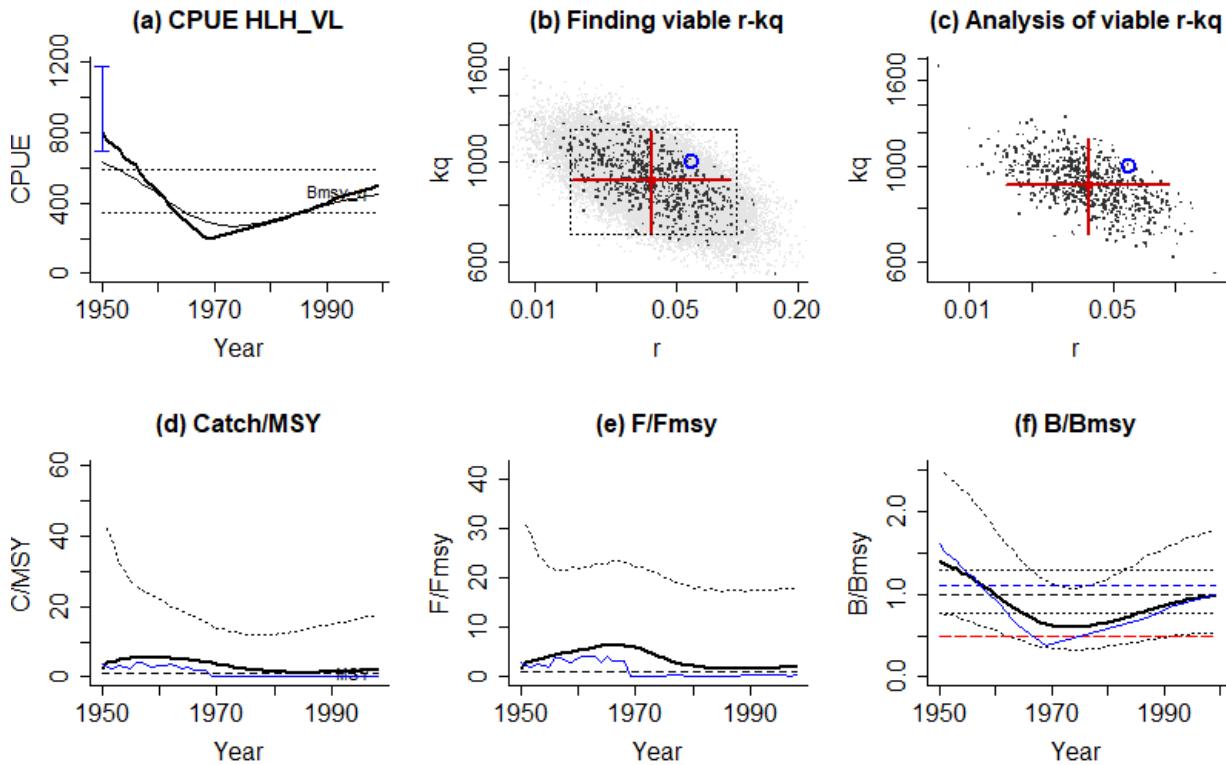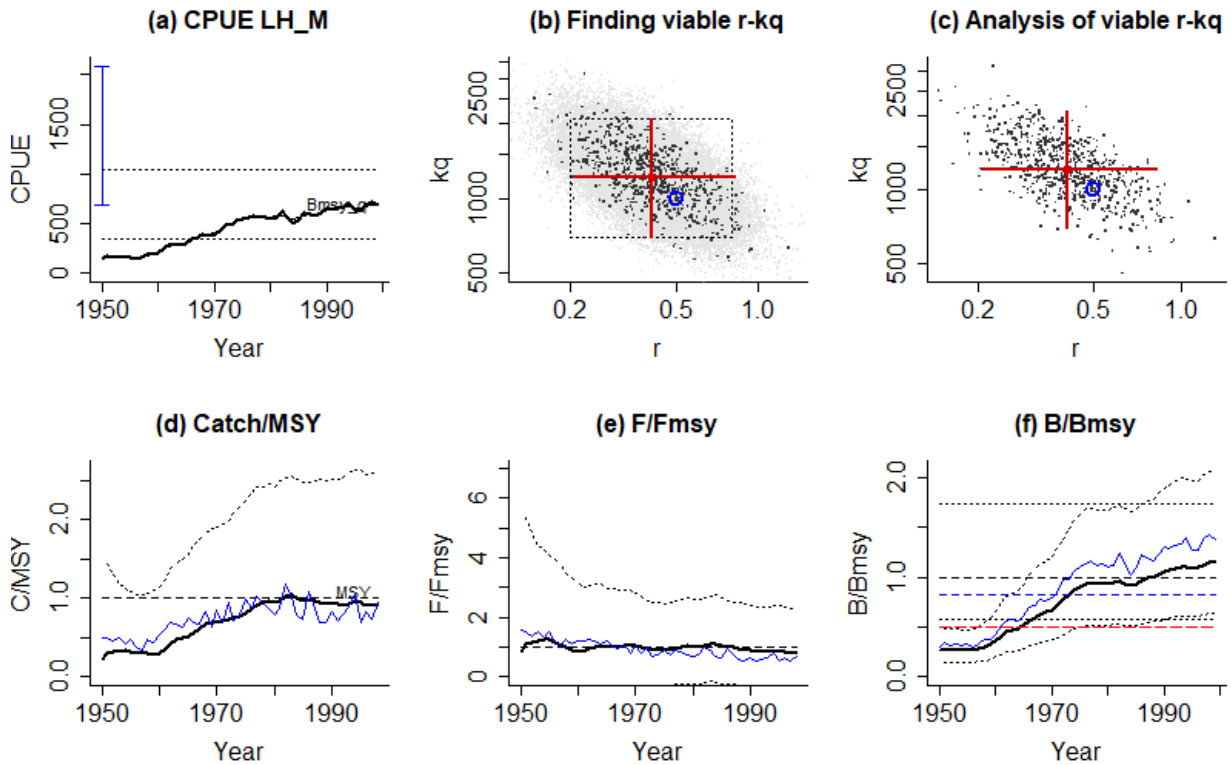
```
Stock LH_H, , Simulated data
CPUE data for years 1950 - 1999, CPUE range 164 - 761, smooth = TRUE
Prior for r                  = High, NA - NA
Used prior range for r       = 0.6 - 1.5
Prior for 1950 stock status  = Very small, NA - NA
Used 1950 prior B/B0 range   = 0.01 - 0.2, prior B/Bmsy = 0.02 - 0.4
Used prior range for kq      = 749 - 2248 [original range = 149 - 2981]
Comment: True r=1.0, true kq=1000, true MSYq=250

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 20010

 Results:
 viable r-kq pairs   = 20010
 median kq           = 1253, 747 - 2162
 median MSYq         = 304, 187 - 487
 r (4 MSYq/kq)       = 0.971, 0.617 - 1.51
 Fmsy (r/2)          = 0.485, 0.309 - 0.756
 F/Fmsy              = 0.771, -0.199 - 1.66 (1998), true: 0.5
 B/Bmsy              = 1.12, 0.619 - 2.02 (1999), true: 1.4
 ----------------------------------------------------------------
```


(a) CPUE LH_H   (b) Finding viable r-kq   (c) Analysis of viable r-kq

(d) Catch/MSY   (e) F/Fmsy   (f) B/Bmsy

```
Stock LH_L, , Simulated data
CPUE data for years 1950 - 1999, CPUE range 152 - 663, smooth = TRUE
Prior for r                  = Low, NA - NA
Used prior range for r       = 0.05 - 0.5
Prior for 1950 stock status  = Very small, NA - NA
Used 1950 prior B/B0 range   = 0.01 - 0.2, prior B/Bmsy = 0.02 - 0.4
Used prior range for kq      = 661 - 1982 [original range = 138 - 2750]
Comment: True r=0.25, true kq=1000, true MSYq=62.5

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 20010

 Results:
 viable r-kq pairs    = 20010
 median kq            = 1157, 658 - 1926
 median MSYq          = 45.1, 17.1 - 110
 r (4 MSYq/kq)        = 0.156, 0.0513 - 0.464
 Fmsy (r/2)           = 0.078, 0.0257 - 0.232
 F/Fmsy               = 0.943, -1.84 - 4.71 (1998), true: 0.484
 B/Bmsy               = 1.15, 0.638 - 2.06 (1999), true: 1.34
 ------------------------------------------------------------
```
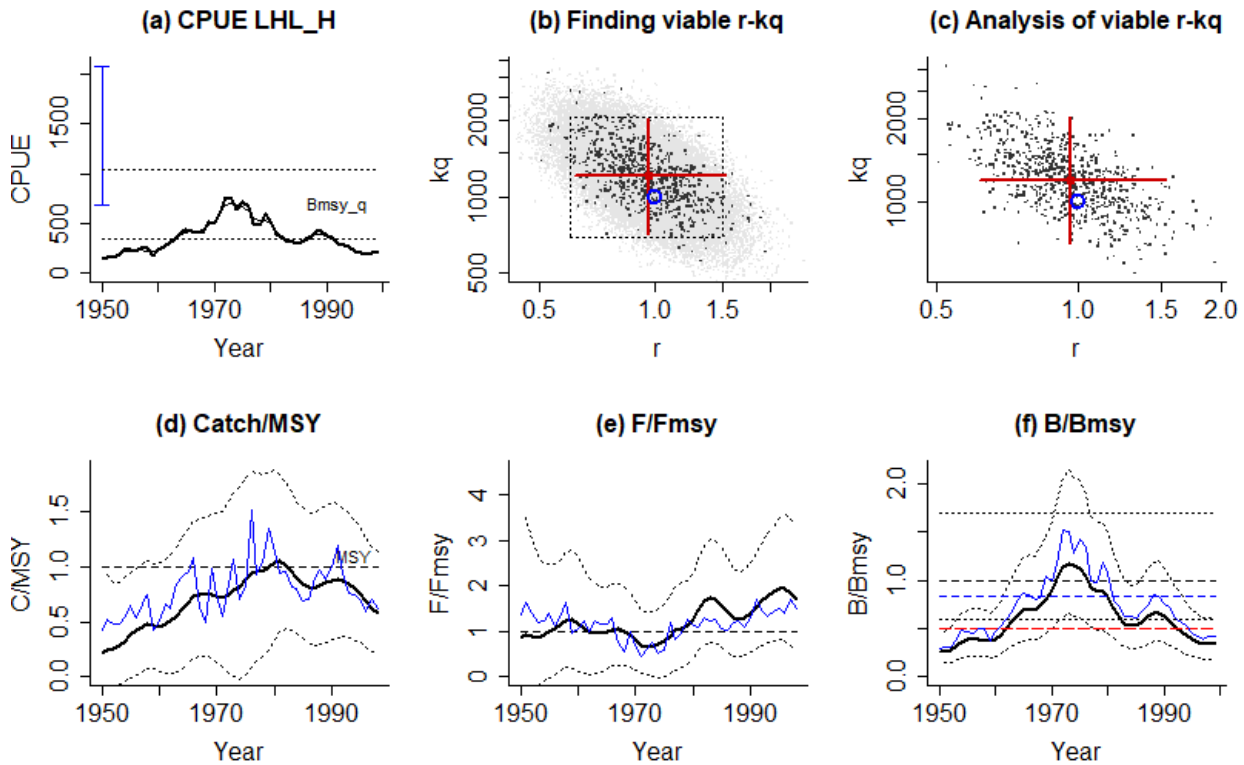

(a) CPUE LH_L (b) Finding viable r-kq (c) Analysis of viable r-kq
(d) Catch/MSY (e) F/Fmsy (f) B/Bmsy

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```
Stock LH_M, , Simulated data
CPUE data for years 1950 - 1999, CPUE range 159 - 697, smooth = TRUE
Prior for r                   = Medium, NA - NA
Used prior range for r        = 0.2 - 0.8
Prior for 1950 stock status   = Very small, NA - NA
Used 1950 prior B/B0 range    = 0.01 - 0.2, prior B/Bmsy = 0.02 - 0.4
Used prior range for kq       = 695 - 2086 [original range = 144 - 2886]
Comment: True r=0.5, true kq=1000, true MSYq=125, true q=0.001

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 20010

  Results:
  viable r-kq pairs   = 20010
  median kq           = 1208, 699 - 2090
  median MSYq         = 122, 71.7 - 203
  r (4 MSYq/kq)       = 0.405, 0.206 - 0.823
  Fmsy (r/2)          = 0.203, 0.103 - 0.412
  F/Fmsy              = 0.794, -0.445 - 2.29 (1998), true: 0.679
  B/Bmsy              = 1.16, 0.639 - 2.08 (1999), true: 1.38
  ----------------------------------------------------------
```
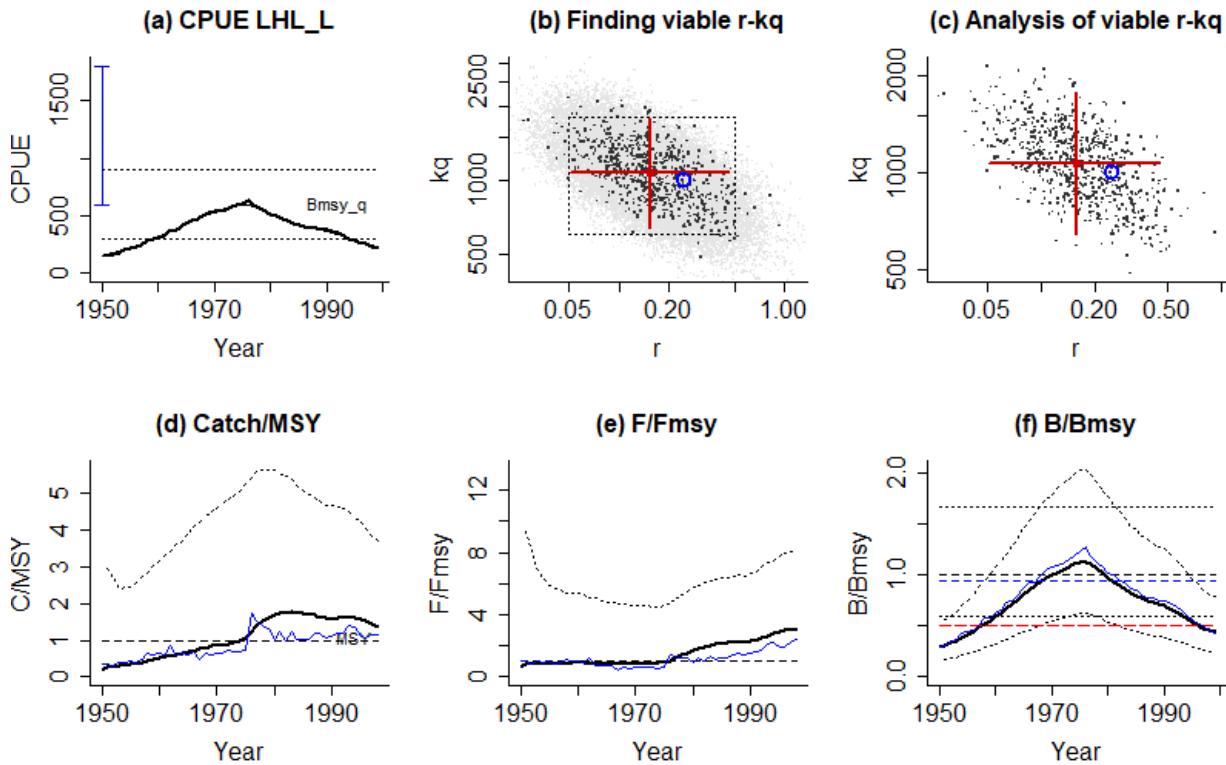

(a) CPUE LH_M (b) Finding viable r-kq (c) Analysis of viable r-kq
(d) Catch/MSY (e) F/Fmsy (f) B/Bmsy

```
Stock LH_VL, , Simulated data
CPUE data for years 1950 - 1999, CPUE range 182 - 555, smooth = TRUE
Prior for r                    = Very low, NA - NA
Used prior range for r         = 0.015 - 0.1
Prior for 1950 stock status    = Very small, NA - NA
Used 1950 prior B/B0 range     = 0.01 - 0.2, prior B/Bmsy = 0.02 - 0.4
Used prior range for kq        = 551 - 1654 [original range = 165 - 3305]
Comment: True r=0.06, true kq=1000, true MSYq=15

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 20010

 Results:
 viable r-kq pairs   = 20010
 median kq           = 936, 563 - 1606
 median MSYq         = 9.12, 4.39 - 19.1
 r (4 MSYq/kq)       = 0.039, 0.0144 - 0.0948
 Fmsy (r/2)          = 0.0195, 0.00722 - 0.0474
 F/Fmsy              = 1.96, -8.57 - 17.2 (1998), true: 0.362
 B/Bmsy              = 1.18, 0.659 - 2.13 (1999), true: 1.2
---------------------------------------------------------------
```
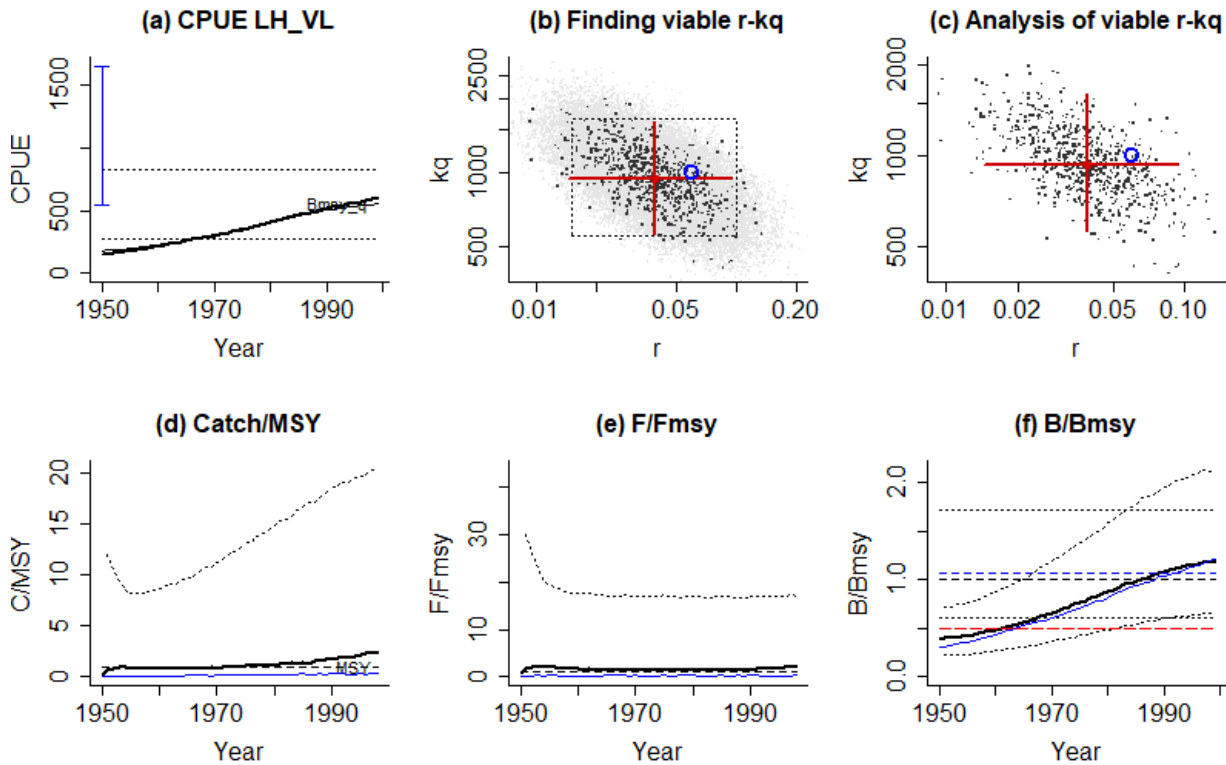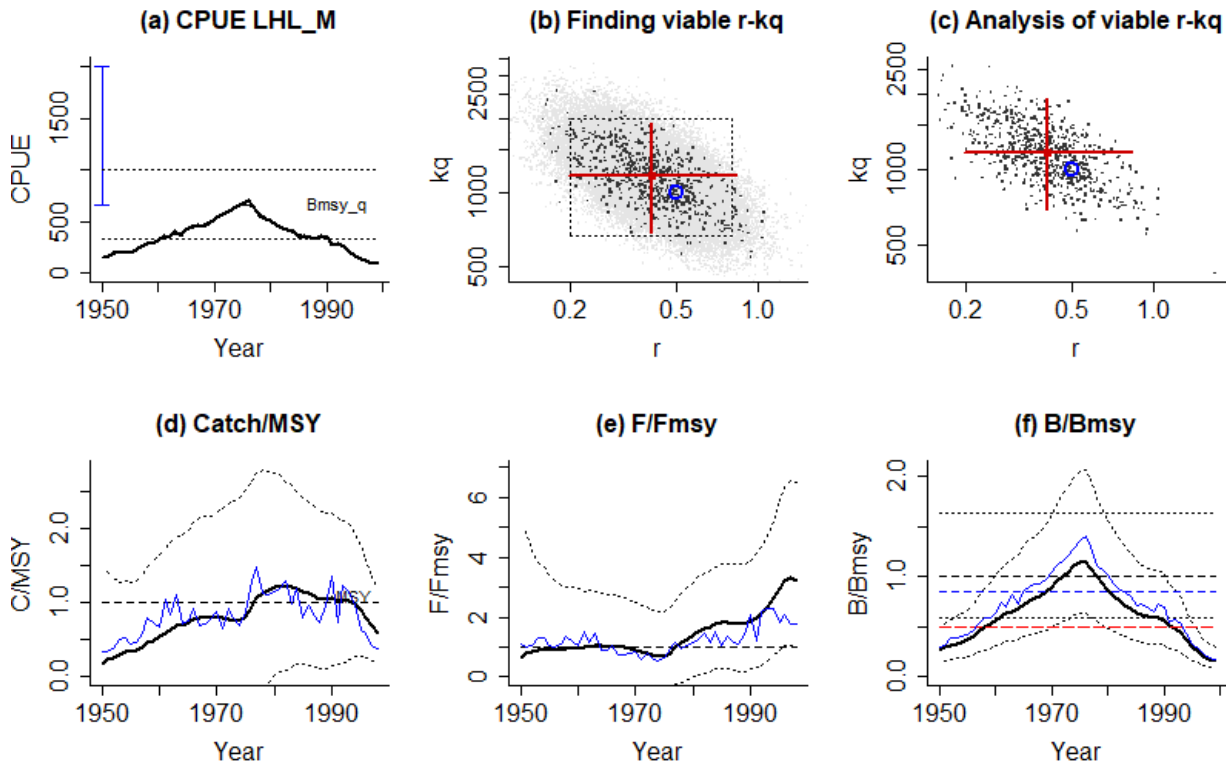
```
Stock LHL_H, , Simulated data
CPUE data for years 1950 - 1999, CPUE range 155 - 708, smooth = TRUE
Prior for r                   = High, NA - NA
Used prior range for r        = 0.6 - 1.5
Prior for 1950 stock status   = Very small, NA - NA
Used 1950 prior B/B0 range    = 0.01 - 0.2, prior B/Bmsy = 0.02 - 0.4
Used prior range for kq       = 693 - 2079 [original range = 140 - 2807]
Comment: True r=1.0, true kq=1000, true MSYq=250

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 20010

  Results:
  viable r-kq pairs    = 20010
  median kq            = 1207, 711 - 2038
  median MSYq          = 290, 190 - 442
  r (4 MSYq/kq)        = 0.961, 0.62 - 1.53
  Fmsy (r/2)           = 0.48, 0.31 - 0.765
  F/Fmsy               = 1.71, 0.595 - 3.33 (1998), true: 1.5
  B/Bmsy               = 0.345, 0.192 - 0.622 (1999), true: 0.42
  --------------------------------------------------------------
```
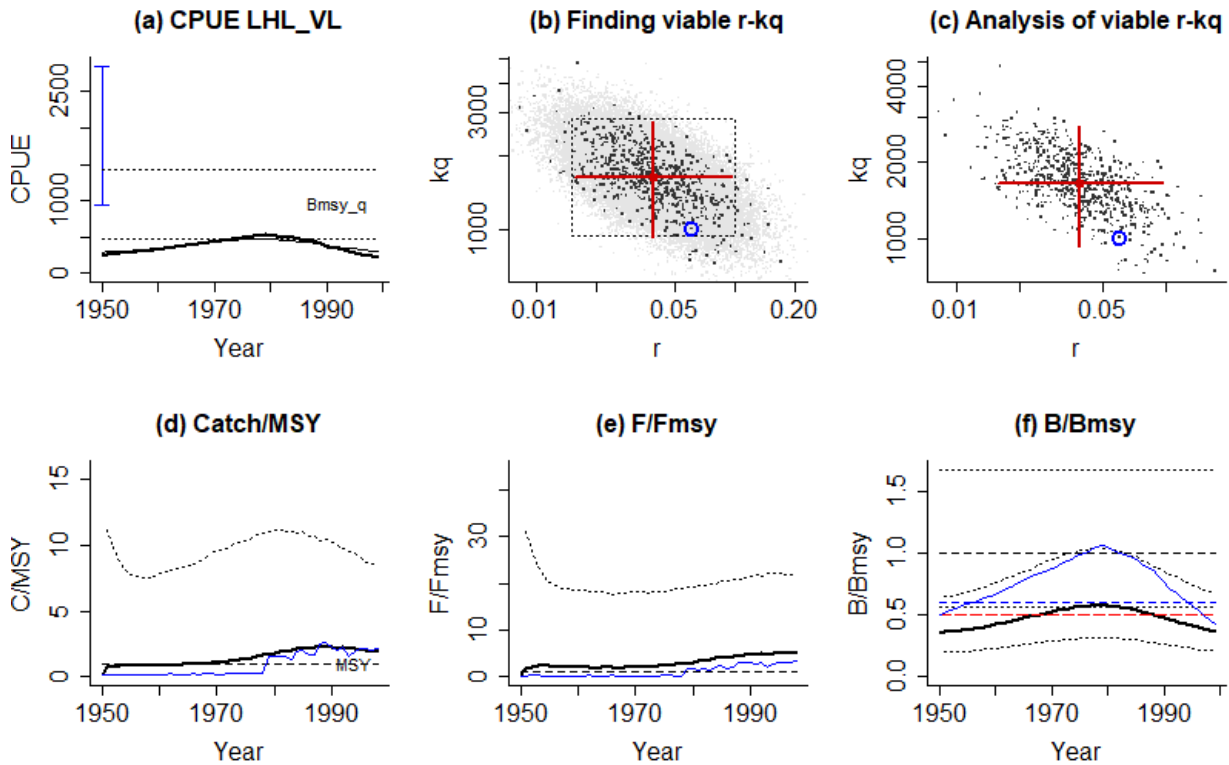

(a) CPUE LHL_H   (b) Finding viable r-kq   (c) Analysis of viable r-kq

(d) Catch/MSY   (e) F/Fmsy   (f) B/Bmsy
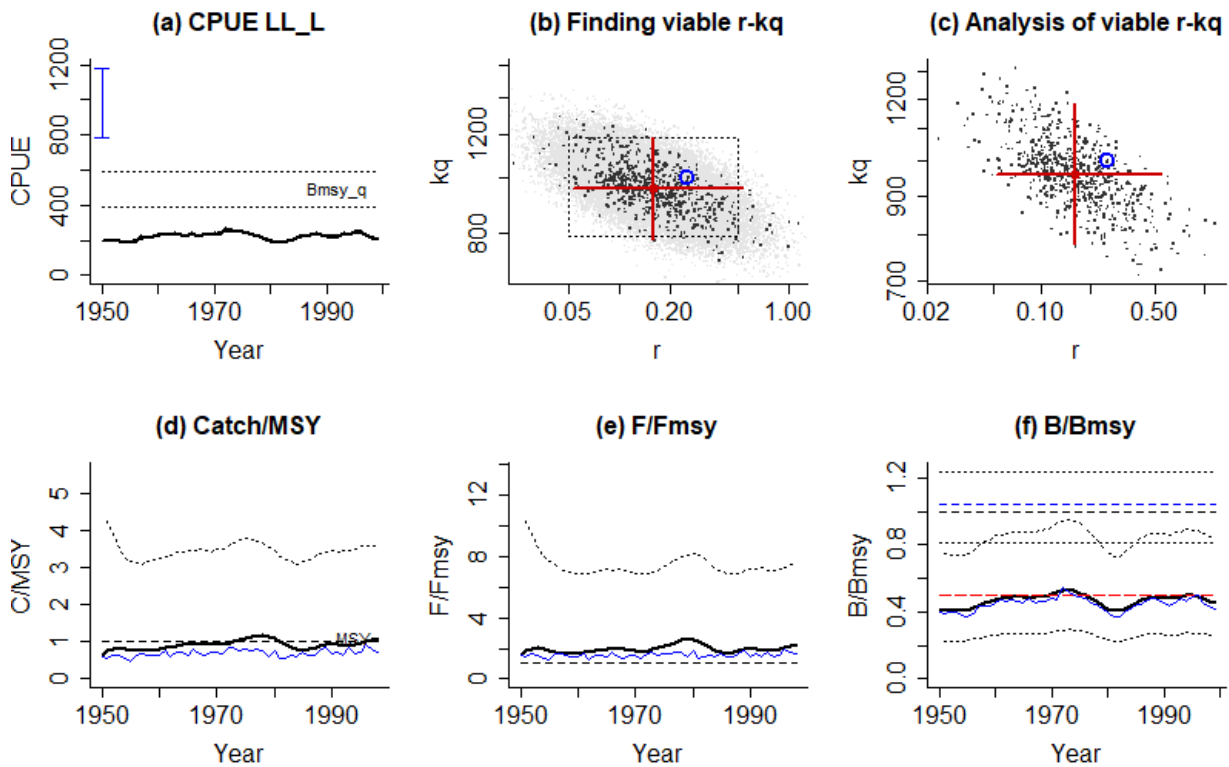
20

```
Stock LHL_L, , Simulated data
CPUE data for years 1950 - 1999, CPUE range 160 - 602, smooth = TRUE
Prior for r                  = Low, NA - NA
Used prior range for r       = 0.05 - 0.5
Prior for 1950 stock status  = Very small, NA - NA
Used 1950 prior B/B0 range   = 0.01 - 0.2, prior B/Bmsy = 0.02 - 0.4
Used prior range for kq      = 600 - 1801 [original range = 145 - 2909]
Comment: True r=0.25, true kq=1000, true MSYq=62.5

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 20010

  Results:
 viable r-kq pairs    = 20010
 median kq            = 1065, 639 - 1787
 median MSYq          = 41.5, 17.1 - 105
 r (4 MSYq/kq)        = 0.156, 0.0514 - 0.461
 Fmsy (r/2)           = 0.0779, 0.0257 - 0.23
 F/Fmsy               = 2.99, -0.641 - 8.15 (1998), true: 2.38
 B/Bmsy               = 0.439, 0.245 - 0.79 (1999), true: 0.42
 --------------------------------------------------------------
```


(a) CPUE LHL_L   **(b) Finding viable r-kq**   **(c) Analysis of viable r-kq**

(d) Catch/MSY   **(e) F/Fmsy**   **(f) B/Bmsy**

```
Stock LHL_M, , Simulated data
CPUE data for years 1950 - 1999, CPUE range 96.7 - 669, smooth = TRUE
Prior for r                   = Medium, NA - NA
Used prior range for r        = 0.2 - 0.8
Prior for 1950 stock status   = Very small, NA - NA
Used 1950 prior B/B0 range    = 0.01 - 0.2, prior B/Bmsy = 0.02 - 0.4
Used prior range for kq       = 668 - 2005 [original range = 144 - 2875]
Comment: True r=0.5, true kq=1000, true MSYq=125, true q=0.001

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 20010

 Results:
 viable r-kq pairs    = 20010
 median kq            = 1164, 693 - 1908
 median MSYq          = 117, 64.1 - 196
 r (4 MSYq/kq)        = 0.401, 0.196 - 0.831
 Fmsy (r/2)           = 0.2, 0.098 - 0.415
 F/Fmsy               = 3.22, 1.01 - 6.48 (1998), true: 1.77
 B/Bmsy               = 0.166, 0.0911 - 0.295 (1999), true: 0.18
 -------------------------------------------------------------
```
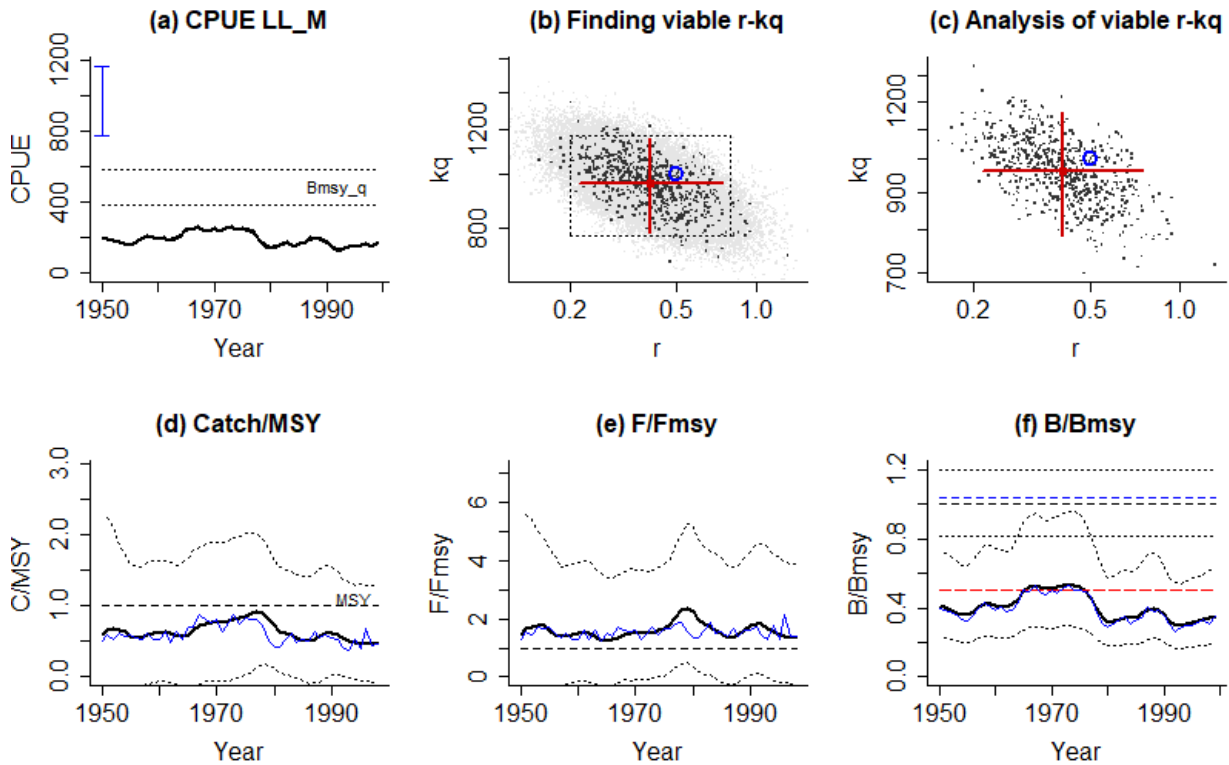
```
Stock LHL_VL, , Simulated data
CPUE data for years 1950 - 1999, CPUE range 293 - 475, smooth = TRUE
Prior for r                    = Very low, NA - NA
Used prior range for r         = 0.015 - 0.1
Prior for 1950 stock status    = Very small, NA - NA
Used 1950 prior B/B0 range     = 0.01 - 0.2, prior B/Bmsy = 0.02 - 0.4
Used prior range for kq        = 949 - 2848 [original range = 266 - 5322]
Comment: True r=0.06, true kq=1000, true MSYq=15

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 20010

 Results:
 viable r-kq pairs   = 20010
 median kq           = 1647, 936 - 2756
 median MSYq         = 15.9, 7.37 - 32.8
 r (4 MSYq/kq)       = 0.0386, 0.0157 - 0.0965
 Fmsy (r/2)          = 0.0193, 0.00785 - 0.0483
 F/Fmsy              = 4.95, -7.03 - 22.1 (1998), true: 3.4
 B/Bmsy              = 0.373, 0.207 - 0.668 (1999), true: 0.42
 -----------------------------------------------------------
```


(a) CPUE LHL_VL

(b) Finding viable r-kq

(c) Analysis of viable r-kq

(d) Catch/MSY

(e) F/Fmsy

(f) B/Bmsy

```
Stock LL_H, , Simulated data
CPUE data for years 1950 - 1999, CPUE range 125 - 272, smooth = TRUE
Prior for r                   = High, NA - NA
Used prior range for r        = 0.6 - 1.5
Prior for 1950 stock status   = Small, NA - NA
Used 1950 prior B/B0 range    = 0.15 - 0.4, prior B/Bmsy = 0.3 - 0.8
Used prior range for kq       = 431 - 1149 [original range = 431 - 1149]
Comment: True r=1.0, true kq=1000, true MSYq=250

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 20010

 Results:
 viable r-kq pairs    = 20010
 median kq            = 704, 421 - 1196
 median MSYq          = 166, 110 - 255
 r (4 MSYq/kq)        = 0.944, 0.585 - 1.42
 Fmsy (r/2)           = 0.472, 0.293 - 0.712
 F/Fmsy               = 1.53, 0.439 - 2.91 (1998), true: 1.31
 B/Bmsy               = 0.455, 0.255 - 0.821 (1999), true: 0.38
 -----------------------------------------------------------
```
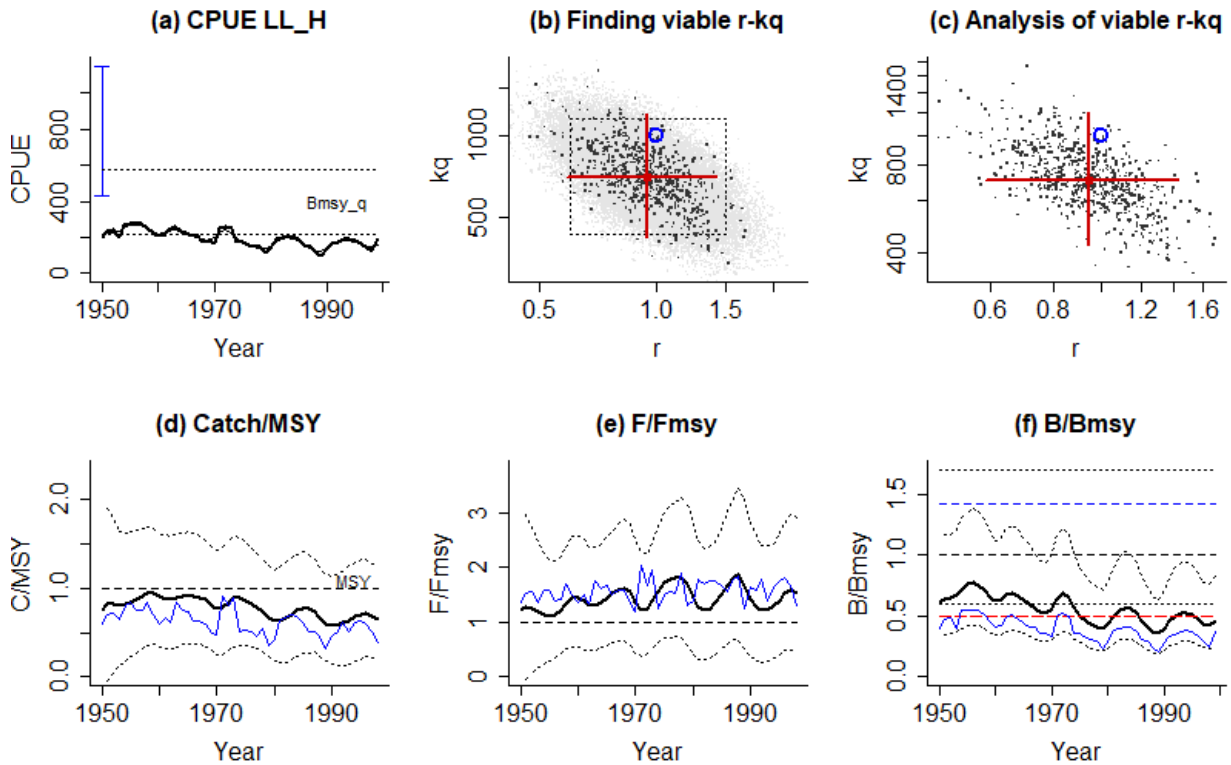
```
Stock LL_L, , Simulated data
CPUE data for years 1950 - 1999, CPUE range 195 - 254, smooth = TRUE
Prior for r                   = Low, NA - NA
Used prior range for r        = 0.05 - 0.5
Prior for 1950 stock status   = Small, NA - NA
Used 1950 prior B/B0 range    = 0.15 - 0.4, prior B/Bmsy = 0.3 - 0.8
Used prior range for kq       = 787 - 1180 [original range = 393 - 1049]
Comment: True r=0.25, true kq=1000, true MSYq=62.5

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 20010

 Results:
 viable r-kq pairs   = 20010
 median kq           = 958, 779 - 1184
 median MSYq         = 38.1, 13.8 - 108
 r (4 MSYq/kq)       = 0.159, 0.0533 - 0.54
 Fmsy (r/2)          = 0.0796, 0.0266 - 0.27
 F/Fmsy              = 2.25, -1.21 - 7.65 (1998), true: 1.64
 B/Bmsy              = 0.456, 0.253 - 0.829 (1999), true: 0.42
 ---------------------------------------------------------------
```


(a) CPUE LL_L (b) Finding viable r-kq (c) Analysis of viable r-kq (d) Catch/MSY (e) F/Fmsy (f) B/Bmsy

```
Stock LL_M, , Simulated data
CPUE data for years 1950 - 1999, CPUE range 144 - 257, smooth = TRUE
Prior for r                    = Medium, NA - NA
Used prior range for r         = 0.2 - 0.8
Prior for 1950 stock status    = Small, NA - NA
Used 1950 prior B/B0 range     = 0.15 - 0.4, prior B/Bmsy = 0.3 - 0.8
Used prior range for kq        = 779 - 1168 [original range = 389 - 1038]
Comment: True r=0.5, true kq=1000, true MSYq=125, true q=0.001

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 20010

 Results:
 viable r-kq pairs    = 20010
 median kq            = 964, 786 - 1155
 median MSYq          = 96.6, 55 - 169
 r (4 MSYq/kq)        = 0.401, 0.215 - 0.752
 Fmsy (r/2)           = 0.2, 0.108 - 0.376
 F/Fmsy               = 1.35, -0.23 - 3.87 (1998), true: 1.4
 B/Bmsy               = 0.348, 0.192 - 0.627 (1999), true: 0.36
 ---------------------------------------------------------------
```

```
Stock LL_VL, , Simulated data
CPUE data for years 1950 - 1999, CPUE range 212 - 226, smooth = TRUE
Prior for r                     = Very low, NA - NA
Used prior range for r          = 0.015 - 0.1
Prior for 1950 stock status     = Small, NA - NA
Used 1950 prior B/B0 range      = 0.15 - 0.4, prior B/Bmsy = 0.3 - 0.8
Used prior range for kq         = 840 - 1260 [original range = 420 - 1120]
Comment: True r=0.06, true kq=1000, true MSYq=15

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 20010

  Results:
  viable r-kq pairs   = 20010
  median kq           = 1039, 829 - 1234
  median MSYq         = 9.89, 4.6 - 24.4
  r (4 MSYq/kq)       = 0.0381, 0.0157 - 0.106
  Fmsy (r/2)          = 0.019, 0.00787 - 0.0528
  F/Fmsy              = 3.38, -8.35 - 20.1 (1998), true: 1.66
  B/Bmsy              = 0.426, 0.237 - 0.774 (1999), true: 0.44
```
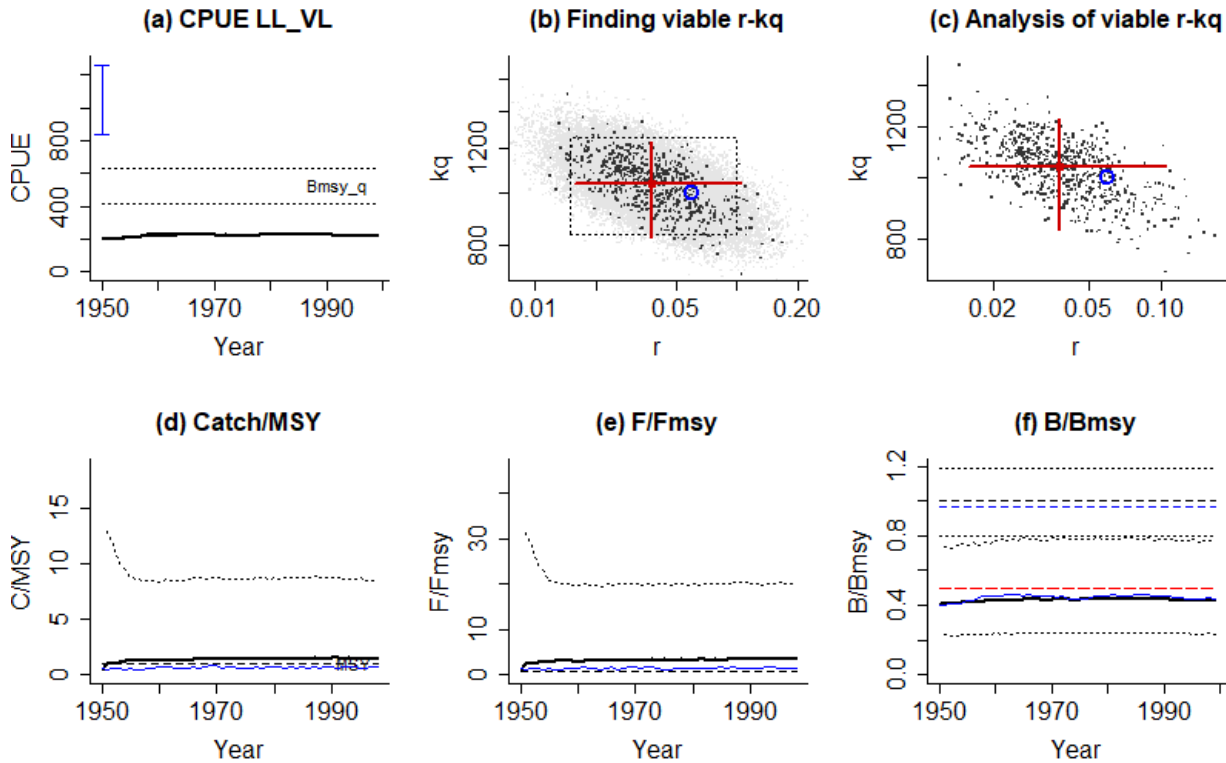

(a) CPUE LL_VL (b) Finding viable r-kq (c) Analysis of viable r-kq (d) Catch/MSY (e) F/Fmsy (f) B/Bmsy

Table 2. Comparison of estimated and "true" parameter values (r, kq, F/Fmsy and B/Bmsy) for 24 simulated stocks. The target value for estimated relative to true value is one. The approximate lower confidence range as fraction of the estimated central value [(est-cl)/est] is an indication of the uncertainty about the estimate. Column 2 shows the median across the 24 simulated stocks. Columns 3 and 4 show the range that includes 95% of the estimated values. Note that this run of AMSY applied several logical filters to the potential r-k pairs, thus making the estimates of r and kq less depended on the priors and basically reducing the cloud of viable r-kq pairs and moving it towards the "true" value within the original prior ranges for r and kq, as is evident in the graphs displayed below. Source: AMSYResSimFil_6.xls

	Median	2.5th percentile	97.5th percentile
r : est/true	1.04	0.89	1.51
r : (est−lcl)/est	0.36	0.29	0.47
kq : est /true	1.07	0.83	1.48
kq : (est−lcl)/est	0.18	0.15	0.34
F/Fmsy: est/true	1.19	0.79	4.14
F/Fmsy: (est−lcl)/est	0.89	0.60	3.53
B/Bmsy: est/true	0.93	0.79	1.17
B/Bmsy: (est−lcl)/est	0.44	0.43	0.45

Settings for analysis in the R-code:

```
#-----------------------------------------
# Required settings, File names
#-----------------------------------------
id_file    <- "SimCPUE_ID_8.csv"

#-----------------------------------------
# General settings for the analysis ----
#-----------------------------------------
smooth.cpue  <- T
filter       <- TRUE
cor.rk       <- -0.607
sigma.r      <- c(0.05,0.07,0.1,0.15)
sigma.cpue   <- 0.3
n.p          <- 50000
n.trial      <- 30
min.viable   <- 20
max.viable   <- 5000
creep.graph  <- F
do.plots     <- T
write.output <- T
kobe.plot    <- F
save.plots   <- F
close.plots  <- F
retros       <- F
```

Generic legend for the subsequent graphs:
Panel (a) shows the time series of CPUE data as bold curve, a smoothed version of CPUE as thin dotted line, the prior range for kq as vertical blue line, and the corresponding upper and lower bounds of the relative Bmsy range as dotted horizontal lines.

Panel (b) shows the r-kq prior space in log scale with a cloud of gray points representing the multivariate log-normal distribution of r and kq corresponding to a correlation of -0.607, derived from full Schaefer models applied to 140 real stocks. The dotted rectangle indicates the prior ranges for r and kq and includes 85% of the gray dots. The red cross indicates the es timated central r-kq pair and the approximate 95% confidence limits. The blue circle indicates the "true" r-kq pair used in the simulation.

Panel (c) is a zoom-in on the viable r-kq pairs, with the red cross indicating the estimated central r-kq pair and its approximate 95% confidence limits and the blue circle indicating the "true" r-kq pair used in the simulation.

Panel (d) shows the time series of catch predicted by AMSY as bold curve relative to MSY, indicated by the dashed horizontal line. The dotted curves indicate the approximate 95% confidence limits. The blue curve shows the "true" catch used in the simulations.

Panel (e) shows the predicted time series of F over Fmsy as bold curve with dotted curves indicating the approximate 95% confidence limits. The dashed horizontal line indicates Fmsy.

Panel (f) shows the predicted time series of B over Bmsy as bold curve with dotted curves indicating the approximate 95% confidence limits. The dashed horizontal line indicates Bmsy, the dotted lines indicate the approximate 95% confidence limits of Bmsy, and the dashed red line indicates half of Bmsy. The blue curve shows the "true" biomass used in the simulations relative to the "true" value of Bmsy, indicated by a blue dashed line.

```
> source('D:/RF_Documents/AMSY/Review/SimFilt/AMSY_68x.R')
File SimCPUE_ID_8.csv read successfully
---------------------------------------------------------------
AMSY Analysis, Fri Nov 01 14:03:00 2019
---------------------------------------------------------------
Stock HH_H, , Simulated data
CPUE data for years 1950 - 1999, CPUE range 656 - 789, smooth = TRUE
Prior for r                 = High, NA - NA
Used prior range for r      = 0.6 - 1.5
Prior for 1950 stock status = More than half, NA - NA
Used 1950 prior B/B0 range  = 0.5 - 0.85, prior B/Bmsy = 1 - 1.7
Used prior range for kq     = 832 - 1415 [original range = 832 - 1415]
Comment: True r=1.0, true kq=1000, true MSYq=250

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 5002

 Results:
 viable r-kq pairs   = 5002
 median kq           = 1097, 918 - 1363
 median MSYq         = 273, 198 - 362
 r (4 MSYq/kq)       = 0.996, 0.677 - 1.42
 Fmsy (r/2)          = 0.498, 0.339 - 0.708
 F/Fmsy              = 0.631, 0.178 - 1.2 (1998), true: 0.536
 B/Bmsy              = 1.35, 0.742 - 2.43 (1999), true: 1.54
---------------------------------------------------------------
```
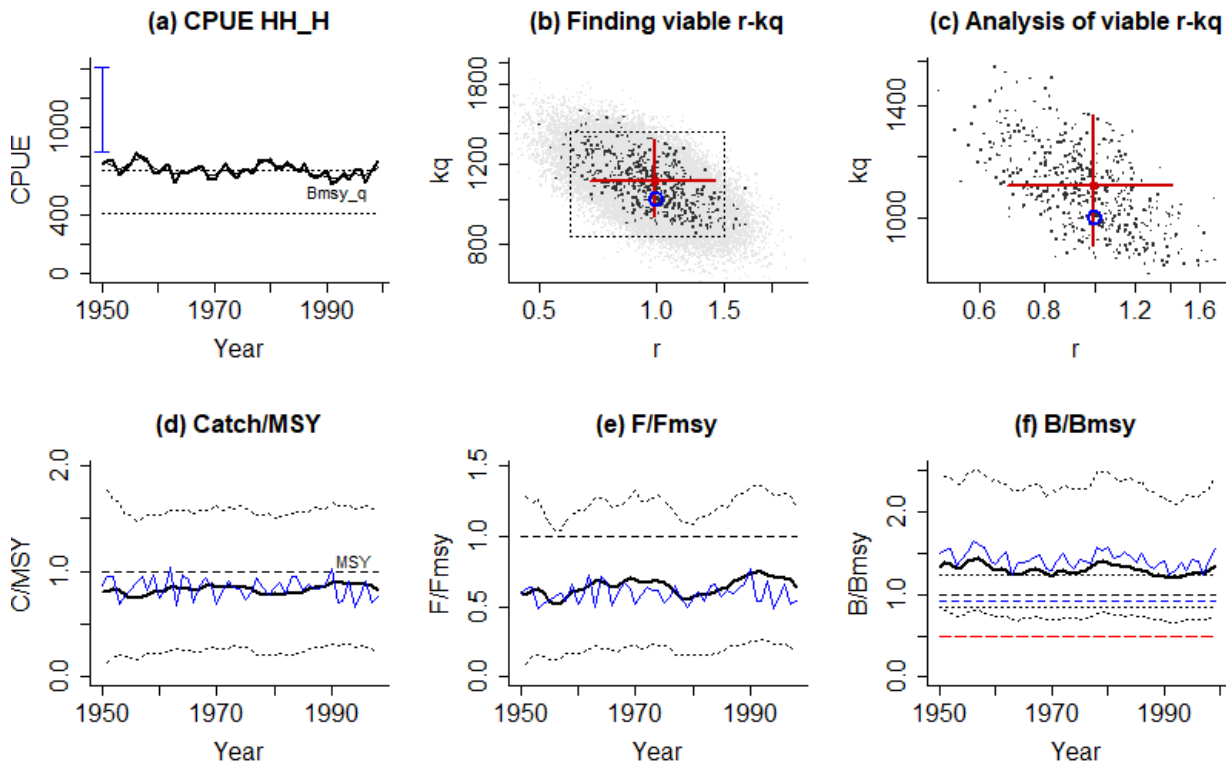

(a) CPUE HH_H (b) Finding viable r-kq (c) Analysis of viable r-kq (d) Catch/MSY (e) F/Fmsy (f) B/Bmsy

```
Stock HH_L, , Simulated data
CPUE data for years 1950 - 1999, CPUE range 691 - 747, smooth = TRUE
Prior for r                   = Low, NA - NA
Used prior range for r        = 0.05 - 0.5
Prior for 1950 stock status   = More than half, NA - NA
Used 1950 prior B/B0 range    = 0.5 - 0.85, prior B/Bmsy = 1 - 1.7
Used prior range for kq       = 820 - 1394 [original range = 820 - 1394]
Comment: True r=0.25, true kq=1000, true MSYq=62.5

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 5003

 Results:
 viable r-kq pairs    = 5003
 median kq            = 1062, 900 - 1298
 median MSYq          = 95, 55.6 - 177
 r (4 MSYq/kq)        = 0.358, 0.199 - 0.741
 Fmsy (r/2)           = 0.179, 0.0995 - 0.37
 F/Fmsy               = 0.889, -0.0313 - 2.15 (1998), true: 0.572
 B/Bmsy               = 1.31, 0.726 - 2.34 (1999), true: 1.38
 -----------------------------------------------------------------
```
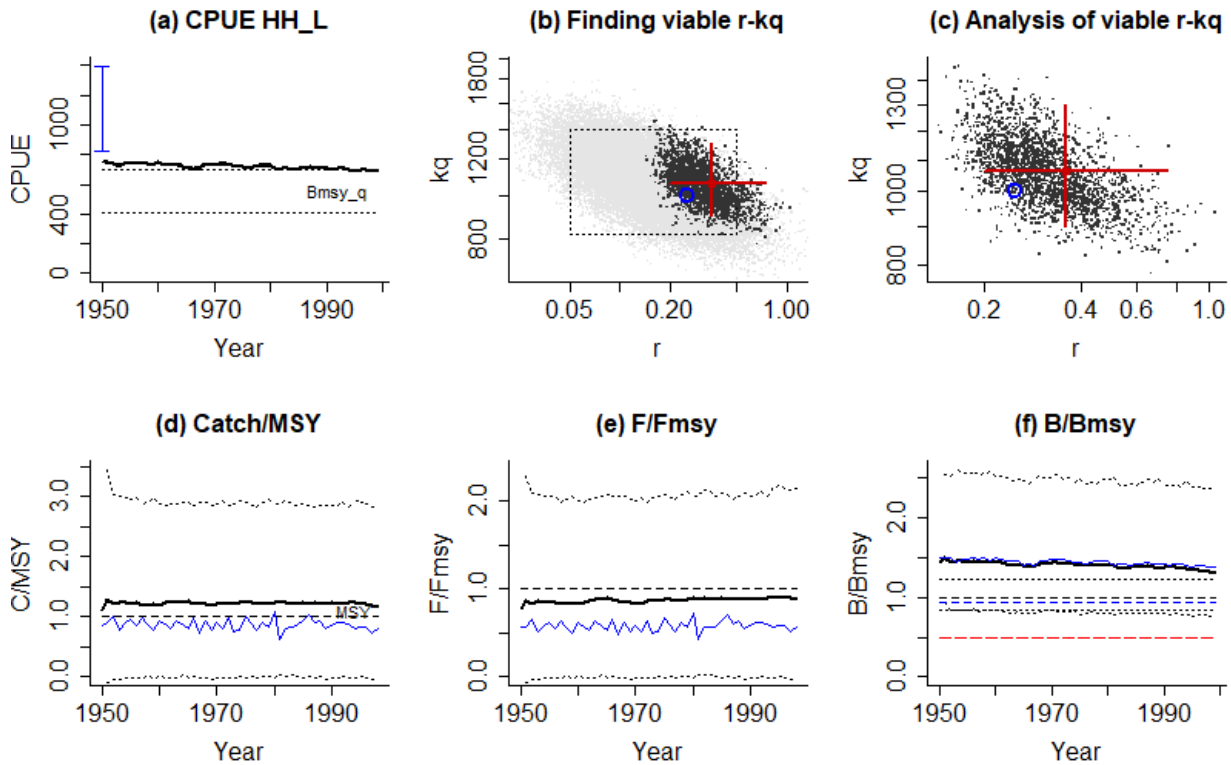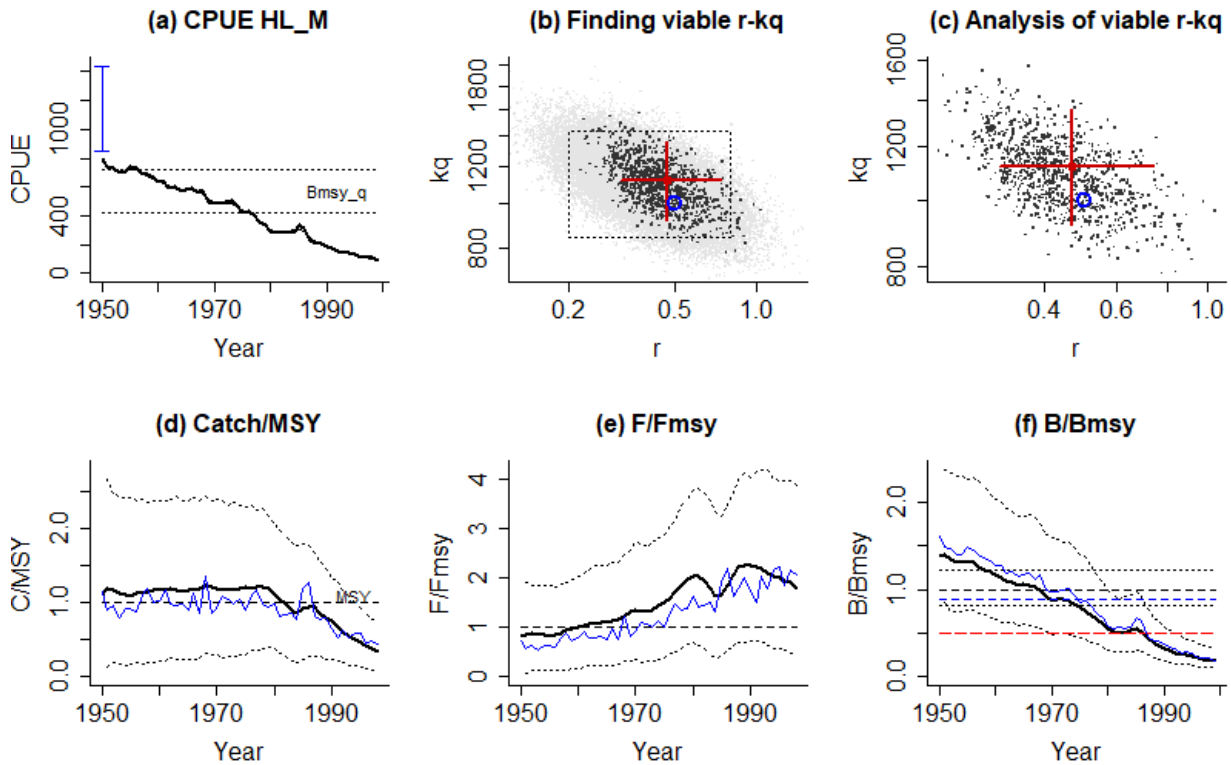

(a) CPUE HH_L (b) Finding viable r-kq (c) Analysis of viable r-kq

(d) Catch/MSY (e) F/Fmsy (f) B/Bmsy

```
Stock HH_M, , Simulated data
CPUE data for years 1950 - 1999, CPUE range 665 - 737, smooth = TRUE
Prior for r                    = Medium, NA - NA
Used prior range for r         = 0.2 - 0.8
Prior for 1950 stock status    = More than half, NA - NA
Used 1950 prior B/B0 range     = 0.5 - 0.85, prior B/Bmsy = 1 - 1.7
Used prior range for kq        = 809 - 1375 [original range = 809 - 1375]
Comment: True r=0.5, true kq=1000, true MSYq=125, true q=0.001

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 5001

 Results:
 viable r-kq pairs    = 5001
 median kq            = 1076, 909 - 1299
 median MSYq          = 146, 103 - 213
 r (4 MSYq/kq)        = 0.542, 0.364 - 0.838
 Fmsy (r/2)           = 0.271, 0.182 - 0.419
 F/Fmsy               = 0.817, 0.135 - 1.71 (1998), true: 0.621
 B/Bmsy               = 1.24, 0.698 - 2.21 (1999), true: 1.32
 ----------------------------------------------------------
```
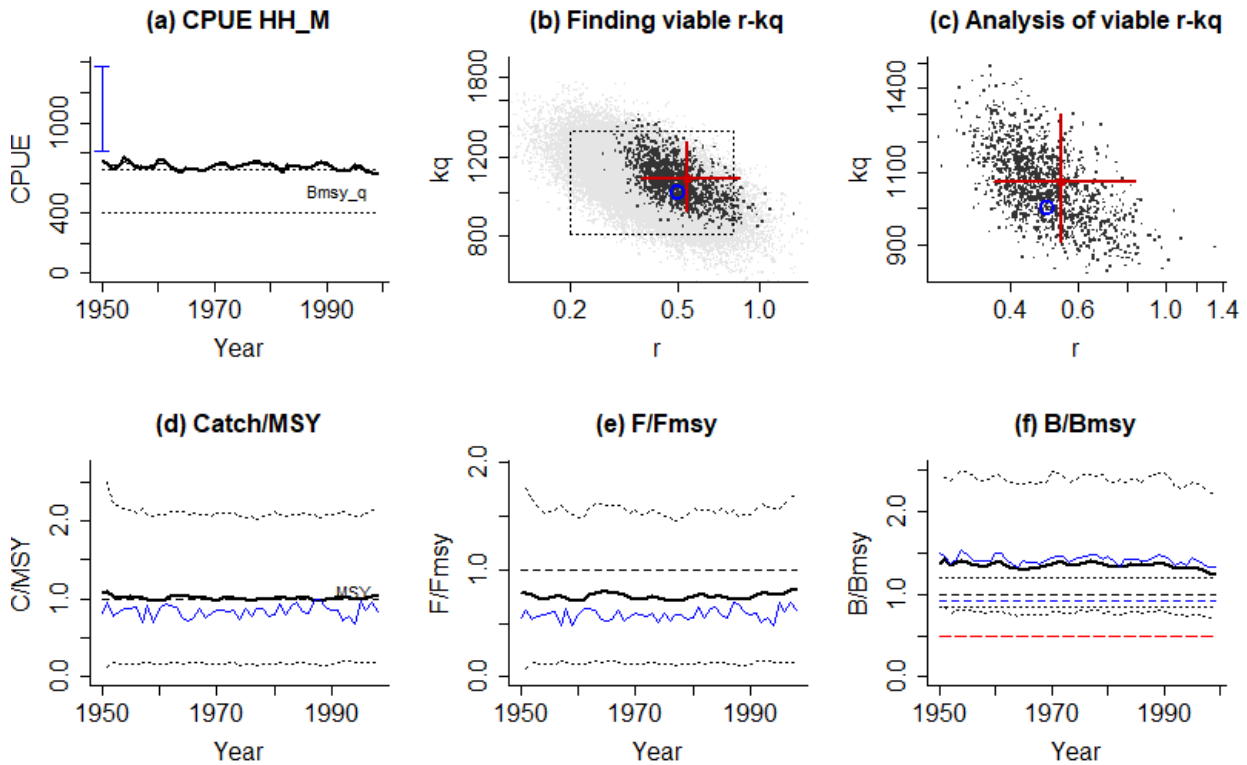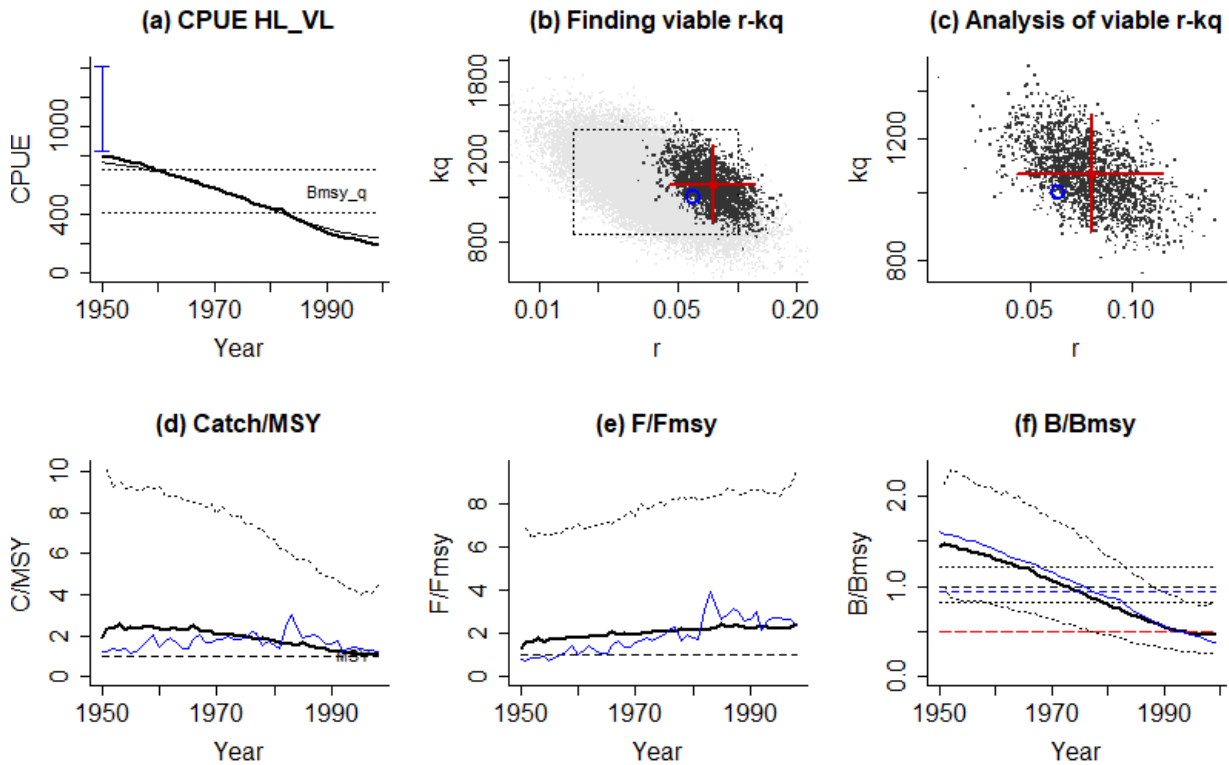

(a) CPUE HH_M   (b) Finding viable r-kq   (c) Analysis of viable r-kq

(d) Catch/MSY   (e) F/Fmsy   (f) B/Bmsy

```
Stock HH_VL, , Simulated data
CPUE data for years 1950 - 1999, CPUE range 708 - 742, smooth = TRUE
Prior for r                   = Very low, NA - NA
Used prior range for r        = 0.015 - 0.1
Prior for 1950 stock status   = More than half, NA - NA
Used 1950 prior B/B0 range    = 0.5 - 0.85, prior B/Bmsy = 1 - 1.7
Used prior range for kq       = 814 - 1385 [original range = 814 - 1385]
Comment: True r=0.06, true kq=1000, true MSYq=15

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 320

  Results:
  viable r-kq pairs  = 320
  median kq          = 1050, 868 - 1296
  median MSYq        = 25.4, 17.5 - 43.8
  r (4 MSYq/kq)      = 0.0969, 0.0631 - 0.186
  Fmsy (r/2)         = 0.0485, 0.0316 - 0.093
  F/Fmsy             = 1.68, -1.47 - 5.46 (1998), true: 0.61
  B/Bmsy             = 1.35, 0.752 - 2.46 (1999), true: 1.42
  --------------------------------------------------------------
```
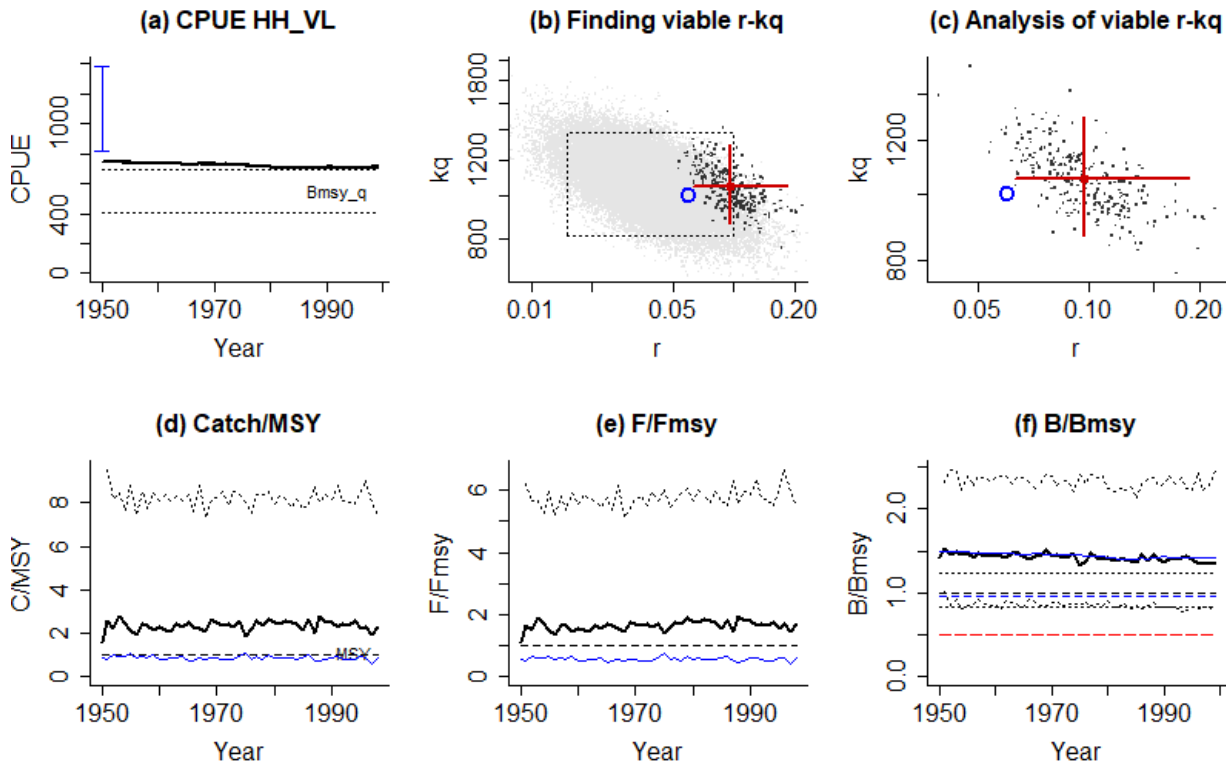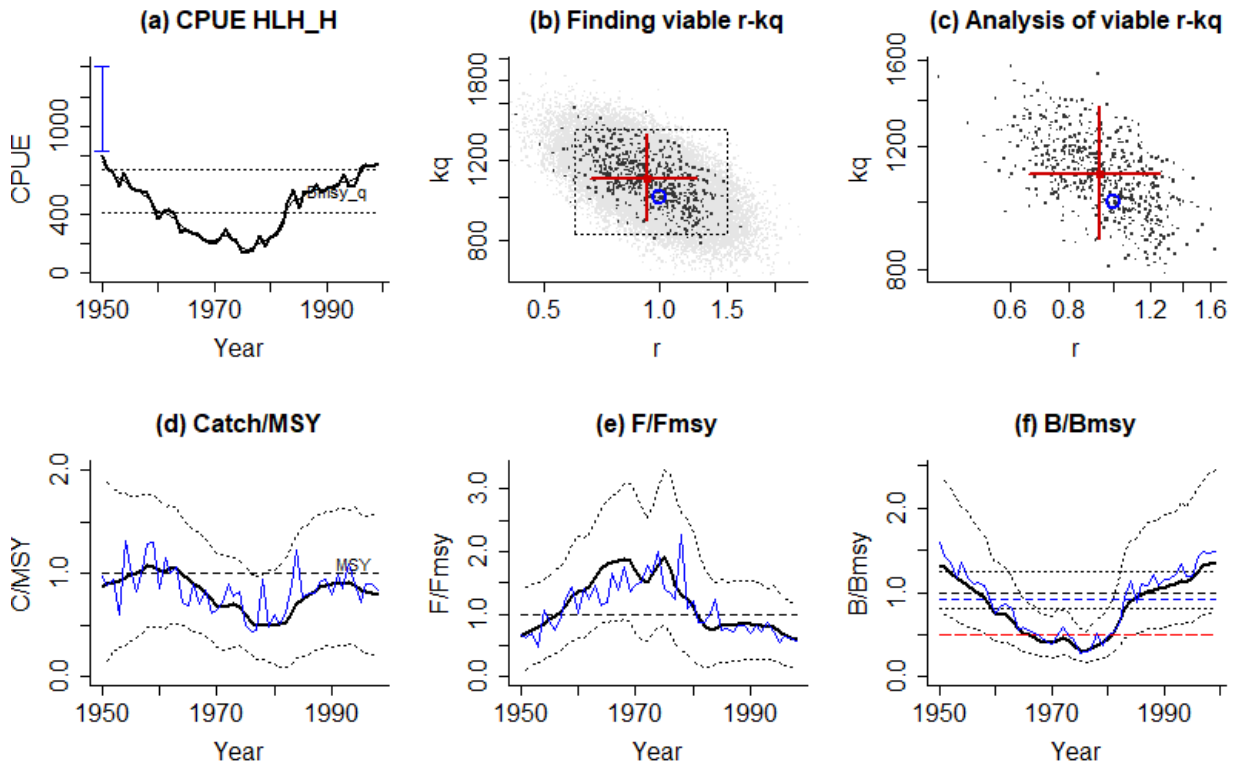

(a) CPUE HH_VL (b) Finding viable r-kq (c) Analysis of viable r-kq (d) Catch/MSY (e) F/Fmsy (f) B/Bmsy

```
Stock HL_H, , Simulated data
CPUE data for years 1950 - 1999, CPUE range 204 - 745, smooth = TRUE
Prior for r                    = High, NA - NA
Used prior range for r         = 0.6 - 1.5
Prior for 1950 stock status    = More than half, NA - NA
Used 1950 prior B/B0 range     = 0.5 - 0.85, prior B/Bmsy = 1 - 1.7
Used prior range for kq        = 818 - 1390 [original range = 818 - 1390]
Comment: True r=1.0, true kq=1000, true MSYq=250

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 5015

 Results:
 viable r-kq pairs    = 5015
 median kq            = 1073, 867 - 1353
 median MSYq          = 256, 189 - 343
 r (4 MSYq/kq)        = 0.953, 0.66 - 1.31
 Fmsy (r/2)           = 0.477, 0.33 - 0.655
 F/Fmsy               = 1.7, 0.706 - 3.03 (1998), true: 1.73
 B/Bmsy               = 0.379, 0.21 - 0.675 (1999), true: 0.36
 ------------------------------------------------------------
```
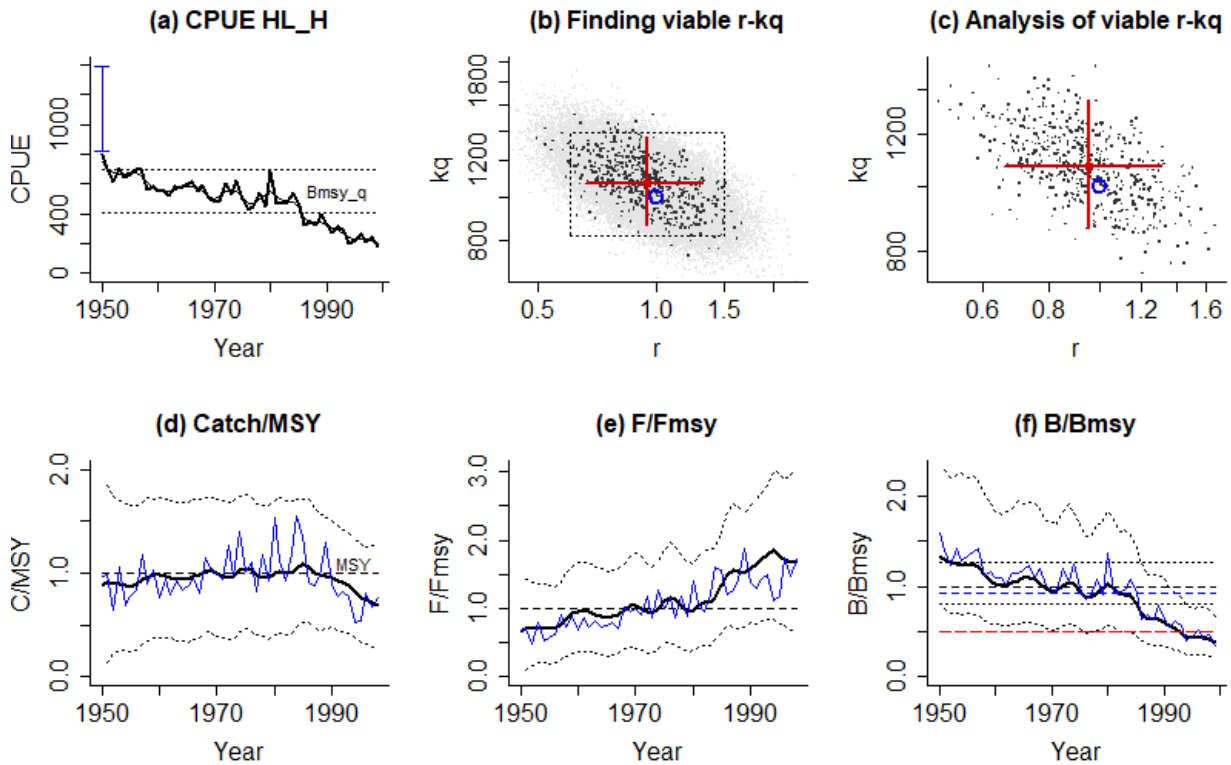

(a) CPUE HL_H

(b) Finding viable r-kq

(c) Analysis of viable r-kq

(d) Catch/MSY

(e) F/Fmsy

(f) B/Bmsy

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```
Stock HL_L, , Simulated data
CPUE data for years 1950 - 1999, CPUE range 177 - 787, smooth = TRUE
Prior for r                  = Low, NA - NA
Used prior range for r       = 0.05 - 0.5
Prior for 1950 stock status  = More than half, NA - NA
Used 1950 prior B/B0 range   = 0.5 - 0.85, prior B/Bmsy = 1 - 1.7
Used prior range for kq      = 864 - 1469 [original range = 864 - 1469]
Comment: True r=0.25, true kq=1000, true MSYq=62.5

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 5001

 Results:
 viable r-kq pairs   = 5001
 median kq           = 1115, 935 - 1350
 median MSYq         = 75.4, 49.9 - 118
 r (4 MSYq/kq)       = 0.271, 0.172 - 0.438
 Fmsy (r/2)          = 0.135, 0.0859 - 0.219
 F/Fmsy              = 1.85, -0.141 - 4.76 (1998), true: 1.8
 B/Bmsy              = 0.32, 0.177 - 0.56 (1999), true: 0.36
------------------------------------------------------------
```
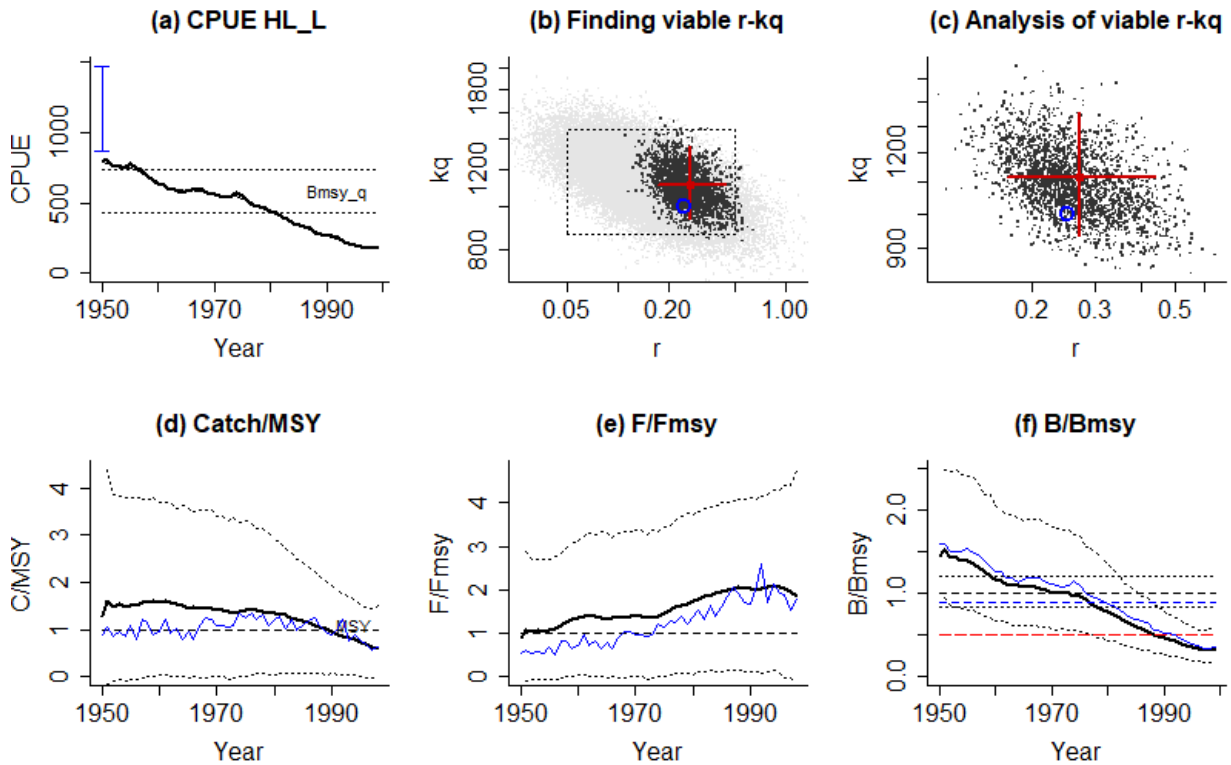

(a) CPUE HL_L (b) Finding viable r-kq (c) Analysis of viable r-kq

(d) Catch/MSY (e) F/Fmsy (f) B/Bmsy

```
Stock HL_M, , Simulated data
CPUE data for years 1950 - 1999, CPUE range 101 - 770, smooth = TRUE
Prior for r                  = Medium, NA - NA
Used prior range for r       = 0.2 - 0.8
Prior for 1950 stock status  = More than half, NA - NA
Used 1950 prior B/B0 range   = 0.5 - 0.85, prior B/Bmsy = 1 - 1.7
Used prior range for kq      = 845 - 1437 [original range = 845 - 1437]
Comment: True r=0.5, true kq=1000, true MSYq=125, true q=0.001

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 5000

 Results:
 viable r-kq pairs   = 5000
 median kq           = 1121, 920 - 1357
 median MSYq         = 131, 90.1 - 195
 r (4 MSYq/kq)       = 0.468, 0.311 - 0.743
 Fmsy (r/2)          = 0.234, 0.155 - 0.371
 F/Fmsy              = 1.8, 0.436 - 3.89 (1998), true: 2.07
 B/Bmsy              = 0.179, 0.1 - 0.328 (1999), true: 0.18
----------------------------------------------------------
```
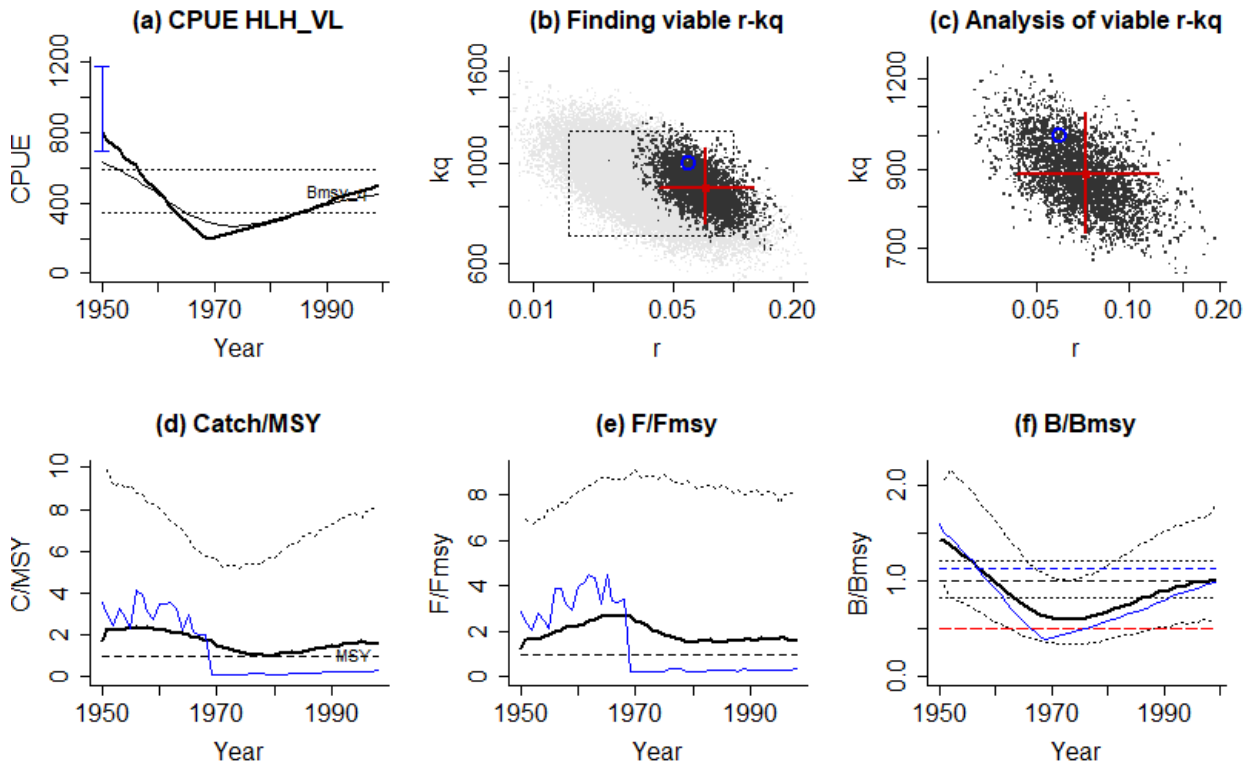

(a) CPUE HL_M   (b) Finding viable r-kq   (c) Analysis of viable r-kq

(d) Catch/MSY   (e) F/Fmsy   (f) B/Bmsy

```
Stock HL_VL, , Simulated data
CPUE data for years 1950 - 1999, CPUE range 244 - 754, smooth = TRUE
Prior for r                    = Very low, NA - NA
Used prior range for r         = 0.015 - 0.1
Prior for 1950 stock status    = More than half, NA - NA
Used 1950 prior B/B0 range     = 0.5 - 0.85, prior B/Bmsy = 1 - 1.7
Used prior range for kq        = 828 - 1407 [original range = 828 - 1407]
Comment: True r=0.06, true kq=1000, true MSYq=15

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 2549

  Results:
 viable r-kq pairs    = 2549
 median kq            = 1067, 883 - 1299
 median MSYq          = 20.3, 13.3 - 32.1
 r (4 MSYq/kq)        = 0.076, 0.0453 - 0.124
 Fmsy (r/2)           = 0.038, 0.0226 - 0.0618
 F/Fmsy               = 2.46, -3.32 - 9.57 (1998), true: 2.4
 B/Bmsy               = 0.46, 0.249 - 0.824 (1999), true: 0.38
 --------------------------------------------------------------
```
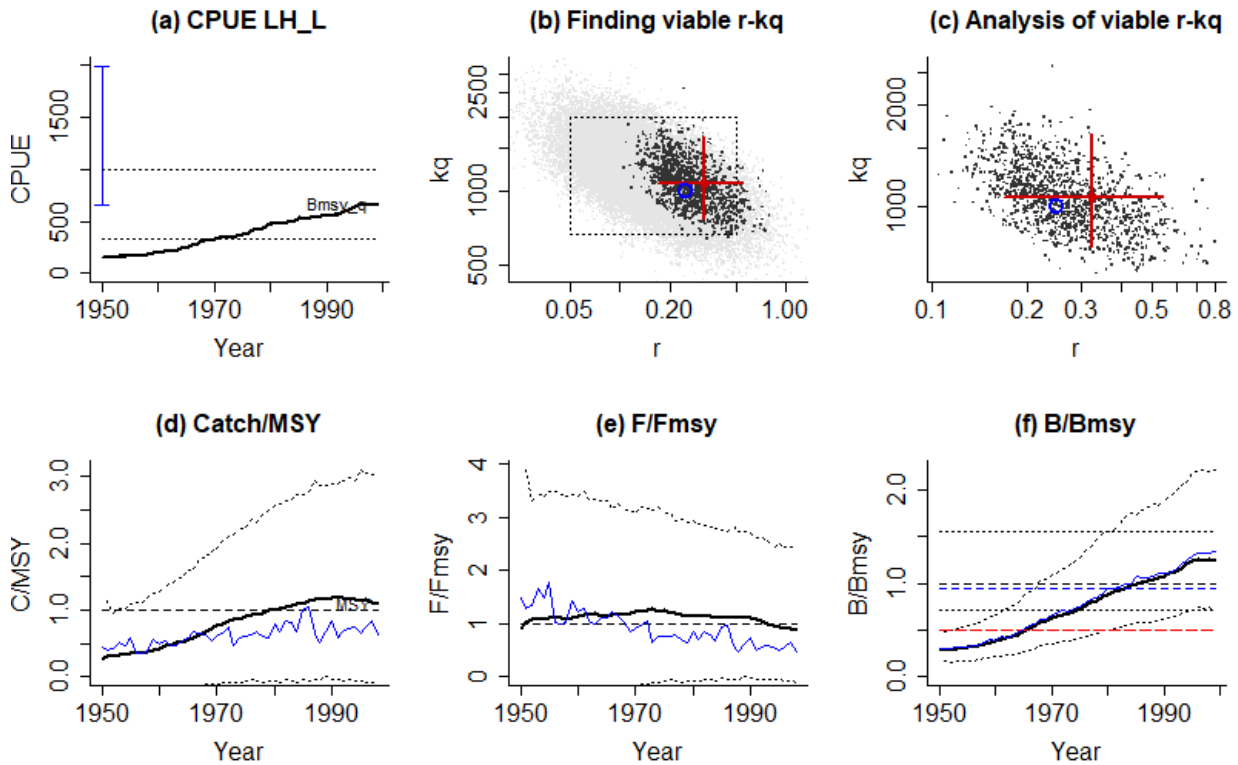

(a) CPUE HL_VL   (b) Finding viable r-kq   (c) Analysis of viable r-kq

(d) Catch/MSY   (e) F/Fmsy   (f) B/Bmsy

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```
Stock HLH_H, , Simulated data
CPUE data for years 1950 - 1999, CPUE range 165 - 753, smooth = TRUE
Prior for r                  = High, NA - NA
Used prior range for r       = 0.6 - 1.5
Prior for 1950 stock status  = More than half, NA - NA
Used 1950 prior B/B0 range   = 0.5 - 0.85, prior B/Bmsy = 1 - 1.7
Used prior range for kq      = 827 - 1405 [original range = 827 - 1405]
Comment: True r=1.0, true kq=1000, true MSYq=250

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 5004

 Results:
 viable r-kq pairs   = 5004
 median kq           = 1096, 884 - 1372
 median MSYq         = 256, 189 - 345
 r (4 MSYq/kq)       = 0.933, 0.66 - 1.25
 Fmsy (r/2)          = 0.467, 0.33 - 0.627
 F/Fmsy              = 0.599, 0.141 - 1.18 (1998), true: 0.577
 B/Bmsy              = 1.34, 0.753 - 2.45 (1999), true: 1.5
--------------------------------------------------------------
```


(a) CPUE HLH_H   (b) Finding viable r-kq   (c) Analysis of viable r-kq

(d) Catch/MSY   (e) F/Fmsy   (f) B/Bmsy

```
Stock HLH_L, , Simulated data
CPUE data for years 1950 - 1999, CPUE range 186 - 777, smooth = TRUE
Prior for r                = Low, NA - NA
Used prior range for r     = 0.05 - 0.5
Prior for 1950 stock status = More than half, NA - NA
Used 1950 prior B/B0 range  = 0.5 - 0.85, prior B/Bmsy = 1 - 1.7
Used prior range for kq     = 852 - 1449 [original range = 852 - 1449]
Comment: True r=0.25, true kq=1000, true MSYq=62.5

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 5000

  Results:
  viable r-kq pairs   = 5000
  median kq           = 1097, 911 - 1312
  median MSYq         = 76.5, 50.4 - 120
  r (4 MSYq/kq)       = 0.279, 0.18 - 0.462
  Fmsy (r/2)          = 0.139, 0.0899 - 0.231
  F/Fmsy              = 1, -0.12 - 2.82 (1998), true: 0.543
  B/Bmsy              = 1.13, 0.645 - 2.05 (1999), true: 1.28
  -------------------------------------------------------------
```
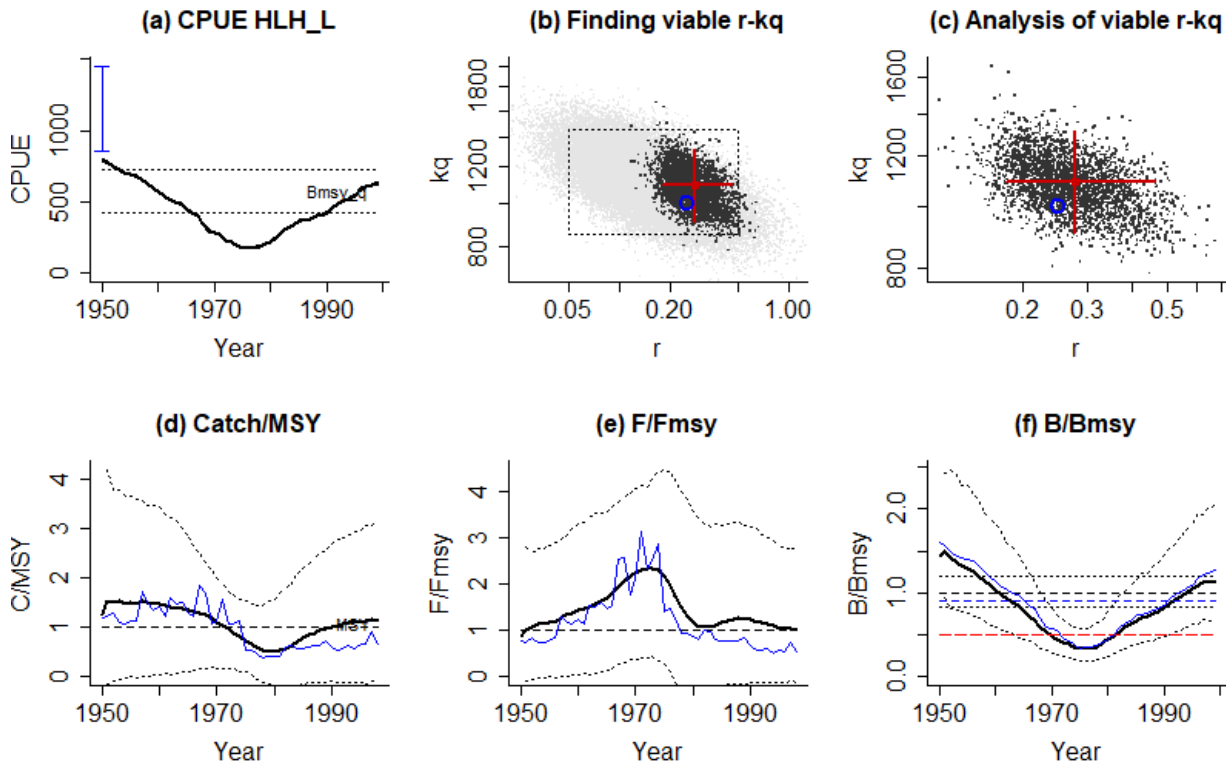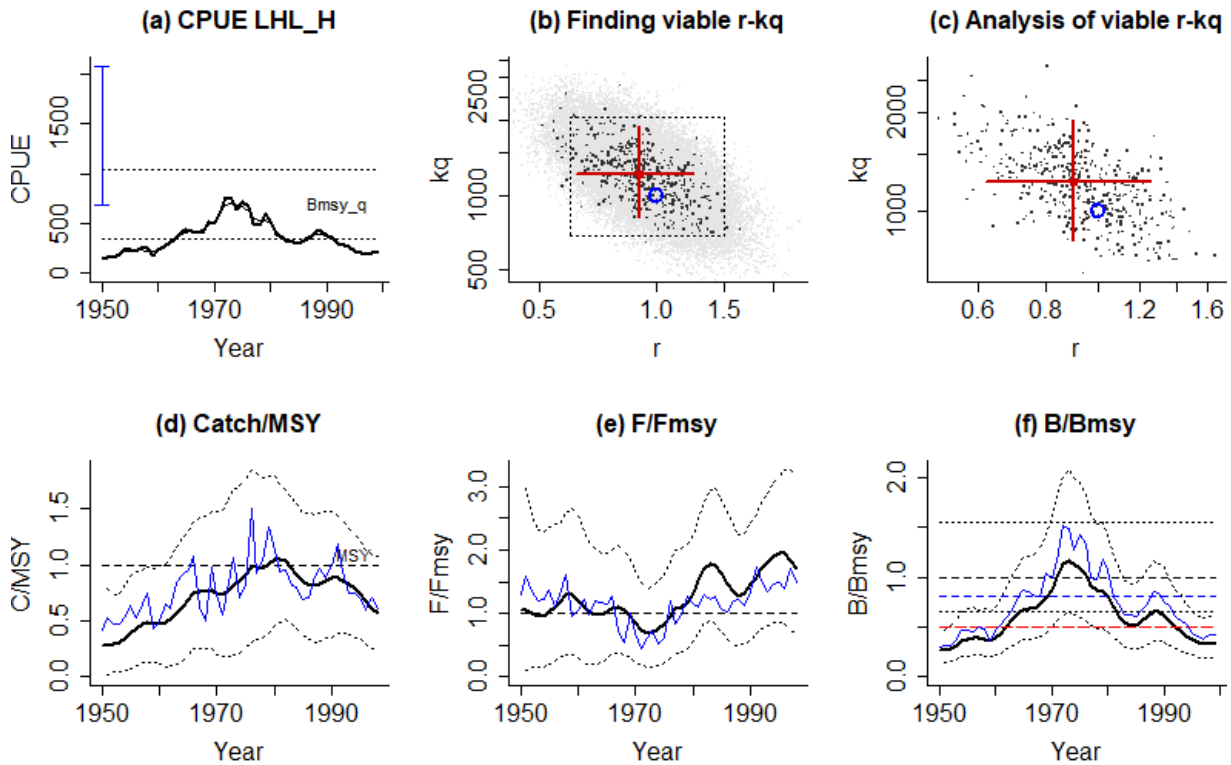

(a) CPUE HLH_L (b) Finding viable r-kq (c) Analysis of viable r-kq
(d) Catch/MSY (e) F/Fmsy (f) B/Bmsy

```
Stock HLH_M, , Simulated data
CPUE data for years 1950 - 1999, CPUE range 108 - 760, smooth = TRUE
Prior for r                  = Medium, NA - NA
Used prior range for r       = 0.2 - 0.8
Prior for 1950 stock status  = More than half, NA - NA
Used 1950 prior B/B0 range   = 0.5 - 0.85, prior B/Bmsy = 1 - 1.7
Used prior range for kq      = 835 - 1419 [original range = 835 - 1419]
Comment: True r=0.5, true kq=1000, true MSYq=125, true q=0.001

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 5004

 Results:
 viable r-kq pairs   = 5004
 median kq           = 1074, 885 - 1310
 median MSYq         = 137, 95.6 - 193
 r (4 MSYq/kq)       = 0.51, 0.342 - 0.747
 Fmsy (r/2)          = 0.255, 0.171 - 0.373
 F/Fmsy              = 0.765, 0.103 - 1.74 (1998), true: 0.515
 B/Bmsy              = 1.26, 0.699 - 2.31 (1999), true: 1.4
-----------------------------------------------------------
```
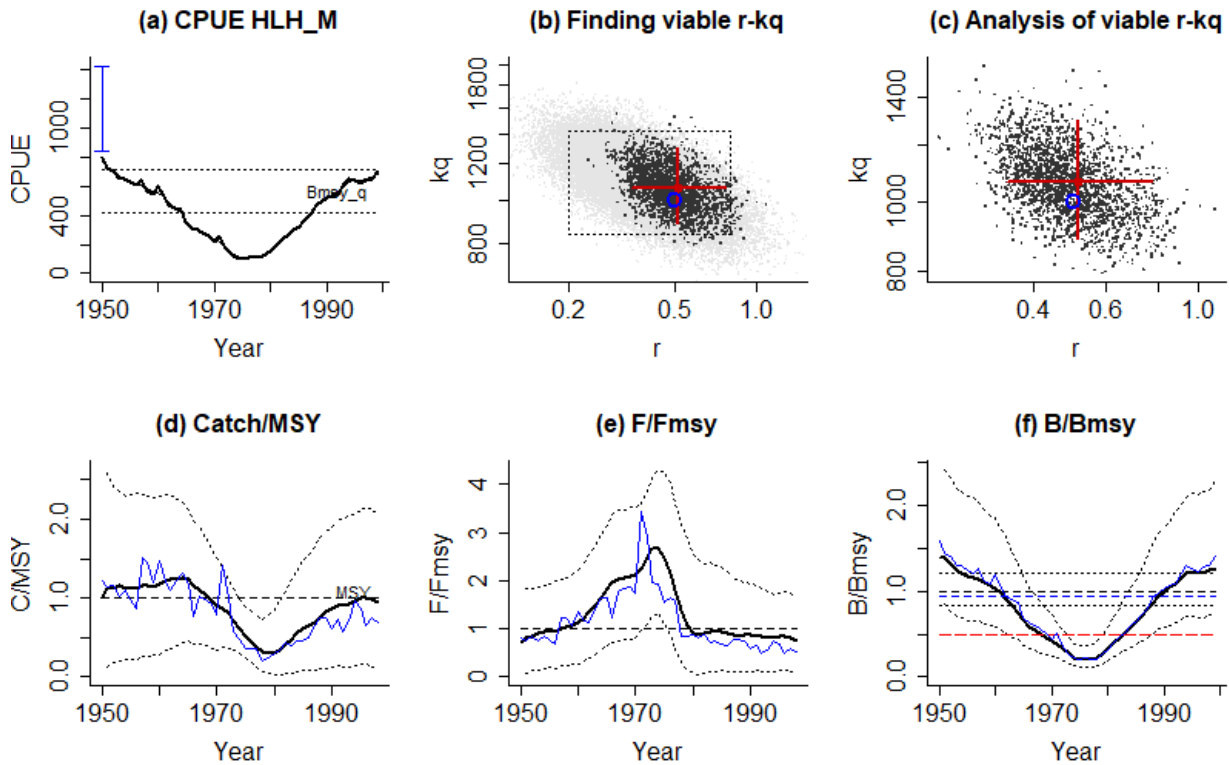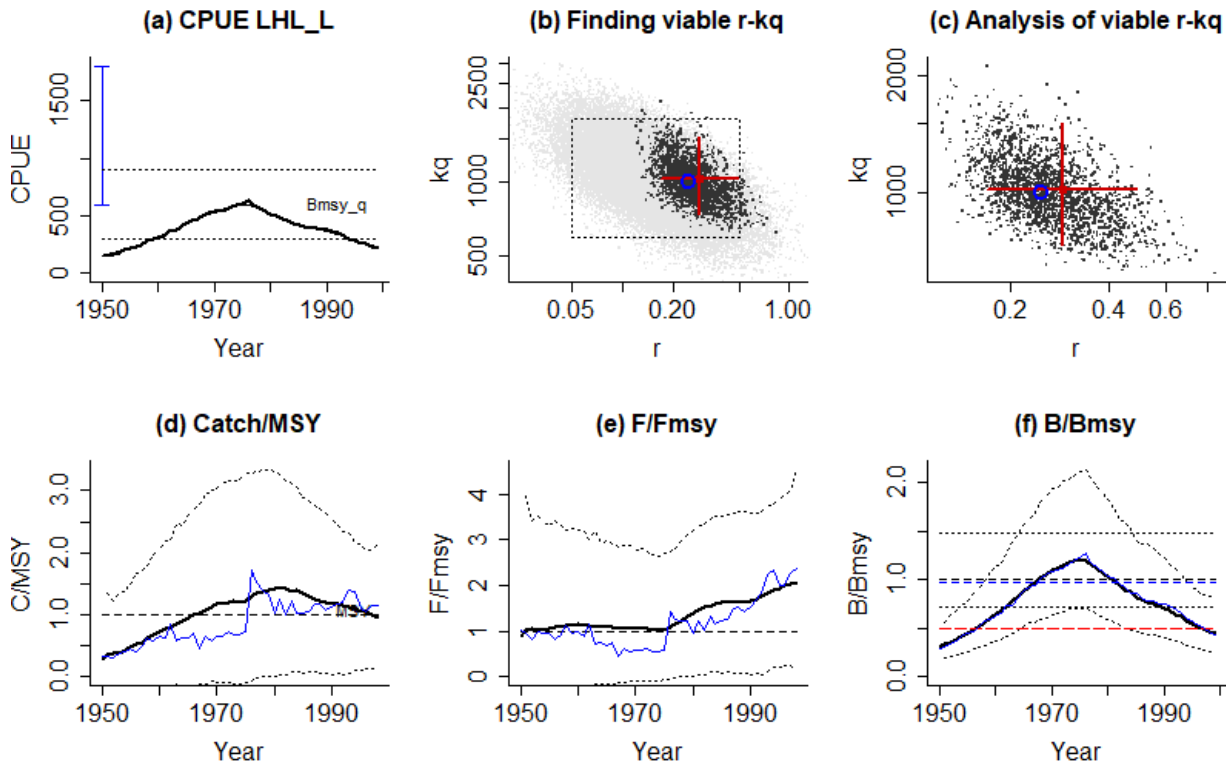
```
Stock HLH_VL, , Simulated data
CPUE data for years 1950 - 1999, CPUE range 270 - 631, smooth = TRUE
Prior for r                    = Very low, NA - NA
Used prior range for r         = 0.015 - 0.1
Prior for 1950 stock status    = More than half, NA - NA
Used 1950 prior B/B0 range     = 0.5 - 0.85, prior B/Bmsy = 1 - 1.7
Used prior range for kq        = 692 - 1176 [original range = 692 - 1176]
Comment: True r=0.06, true kq=1000, true MSYq=15

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 5000

 Results:
 viable r-kq pairs   = 5000
 median kq           = 883, 735 - 1080
 median MSYq         = 16, 10.2 - 26
 r (4 MSYq/kq)       = 0.0725, 0.043 - 0.125
 Fmsy (r/2)          = 0.0363, 0.0215 - 0.0623
 F/Fmsy              = 1.56, -2.76 - 8.15 (1998), true: 0.374
 B/Bmsy              = 1, 0.568 - 1.79 (1999), true: 1
--------------------------------------------------------------
```
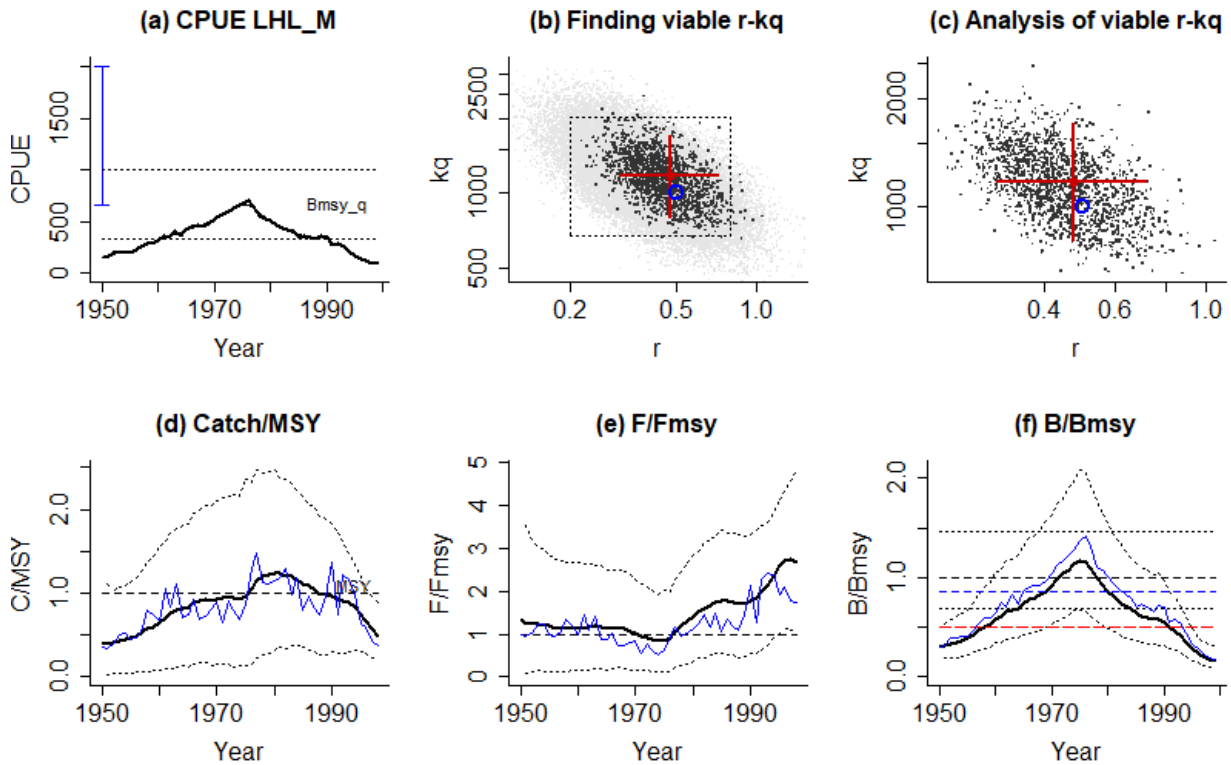

(a) CPUE HLH_VL   (b) Finding viable r-kq   (c) Analysis of viable r-kq

(d) Catch/MSY   (e) F/Fmsy   (f) B/Bmsy

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```
Stock LH_H, , Simulated data
CPUE data for years 1950 - 1999, CPUE range 164 - 761, smooth = TRUE
Prior for r                  = High, NA - NA
Used prior range for r       = 0.6 - 1.5
Prior for 1950 stock status  = Very small, NA - NA
Used 1950 prior B/B0 range   = 0.01 - 0.2, prior B/Bmsy = 0.02 - 0.4
Used prior range for kq      = 749 - 2248 [original range = 149 - 2981]
Comment: True r=1.0, true kq=1000, true MSYq=250

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 5002

 Results:
 viable r-kq pairs   = 5002
 median kq           = 1320, 891 - 2315
 median MSYq         = 327, 225 - 484
 r (4 MSYq/kq)       = 0.99, 0.642 - 1.41
 Fmsy (r/2)          = 0.495, 0.321 - 0.703
 F/Fmsy              = 0.854, 0.238 - 1.67 (1998), true: 0.5
 B/Bmsy              = 1.08, 0.597 - 1.91 (1999), true: 1.4
------------------------------------------------------------
```
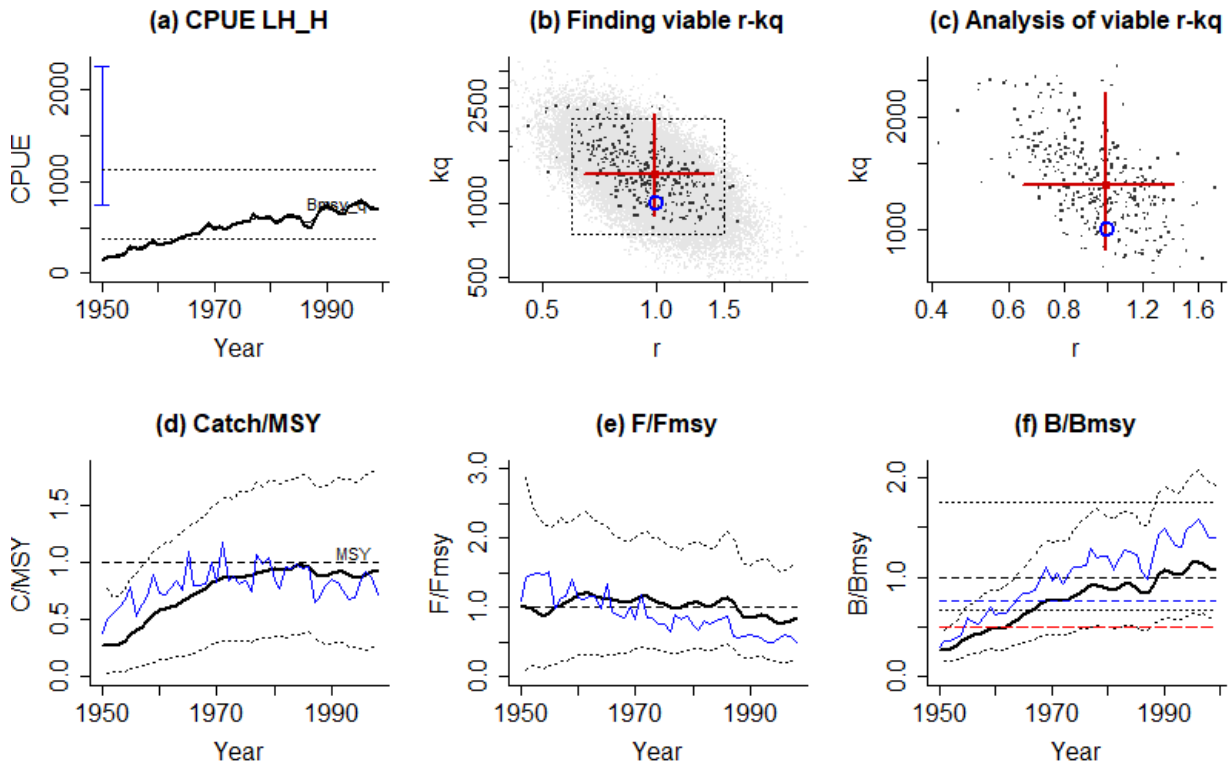

(a) CPUE LH_H (b) Finding viable r-kq (c) Analysis of viable r-kq
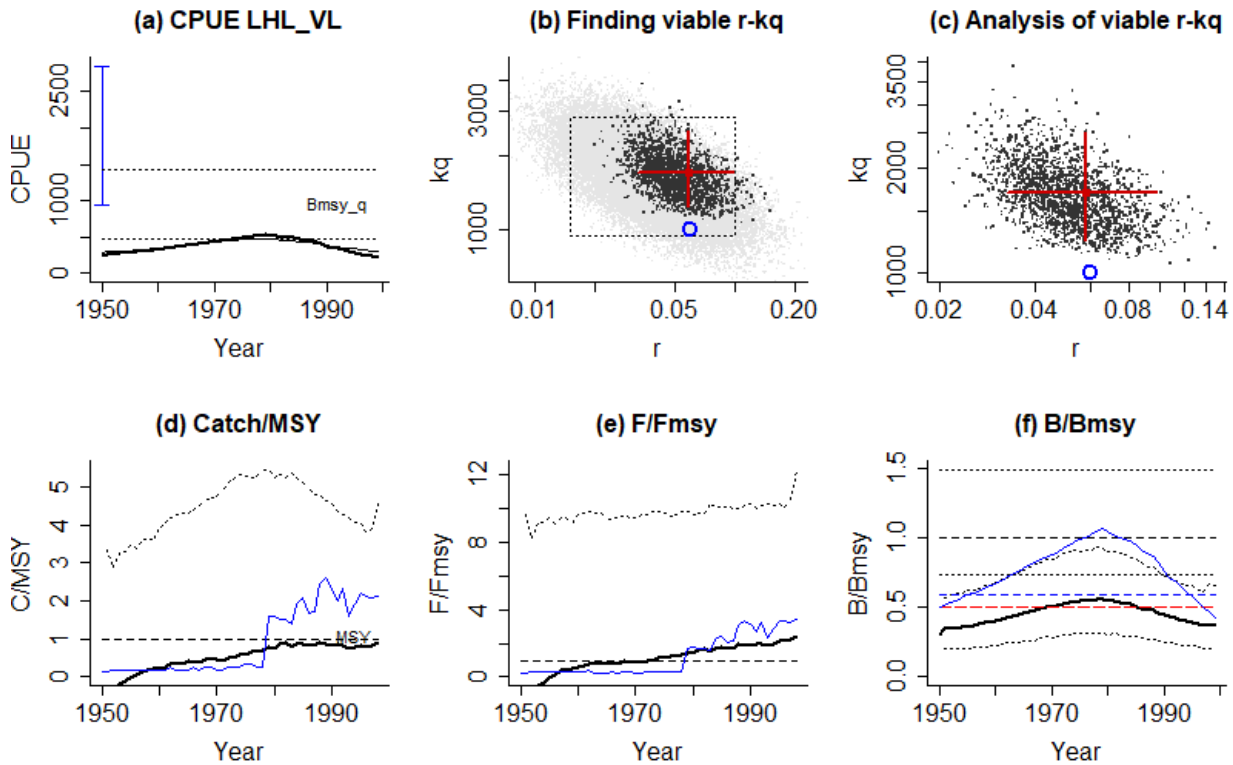
(d) Catch/MSY (e) F/Fmsy (f) B/Bmsy

```
Stock LH_L, , Simulated data
CPUE data for years 1950 - 1999, CPUE range 152 - 663, smooth = TRUE
Prior for r                  = Low, NA - NA
Used prior range for r       = 0.05 - 0.5
Prior for 1950 stock status  = Very small, NA - NA
Used 1950 prior B/B0 range   = 0.01 - 0.2, prior B/Bmsy = 0.02 - 0.4
Used prior range for kq      = 661 - 1982 [original range = 138 - 2750]
Comment: True r=0.25, true kq=1000, true MSYq=62.5

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 5001

 Results:
 viable r-kq pairs    = 5001
 median kq            = 1068, 763 - 1649
 median MSYq          = 85.9, 49 - 141
 r (4 MSYq/kq)        = 0.322, 0.169 - 0.544
 Fmsy (r/2)           = 0.161, 0.0845 - 0.272
 F/Fmsy               = 0.876, -0.097 - 2.43 (1998), true: 0.48
 B/Bmsy               = 1.23, 0.691 - 2.21 (1999), true: 1.34
-------------------------------------------------------------
```
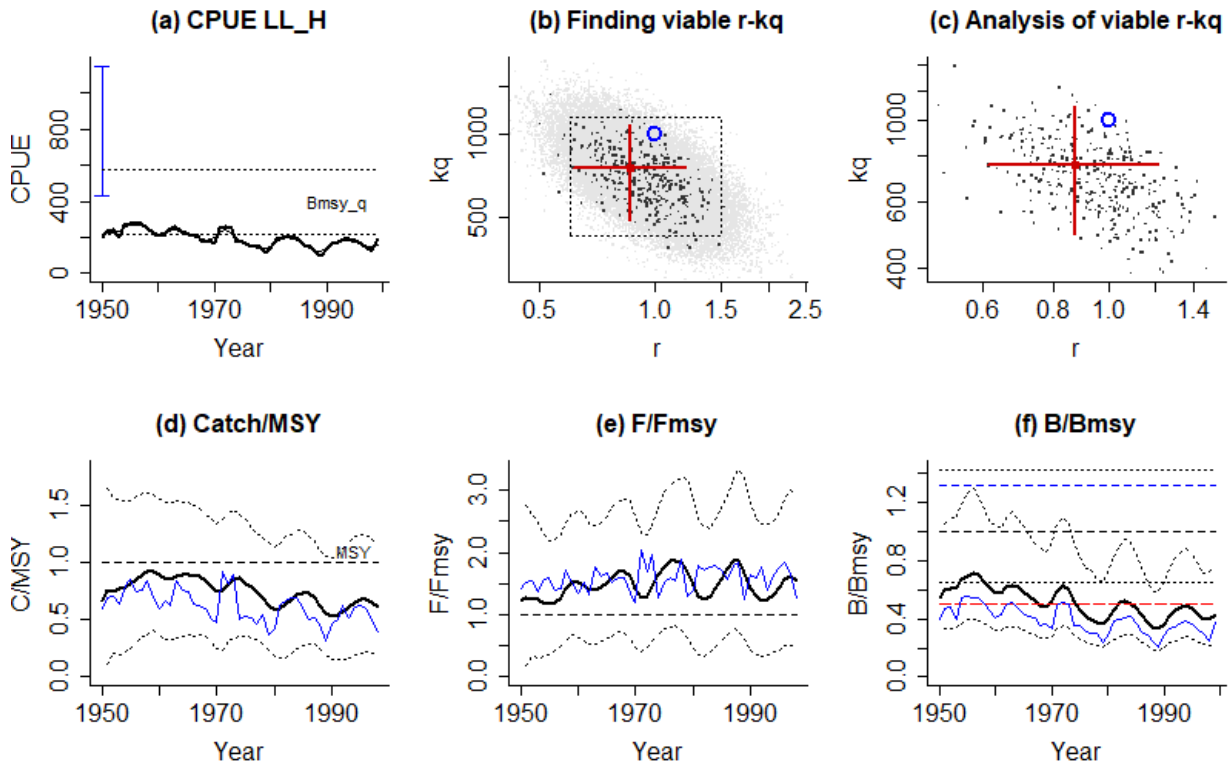

(a) CPUE LH_L (b) Finding viable r-kq (c) Analysis of viable r-kq (d) Catch/MSY (e) F/Fmsy (f) B/Bmsy

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```
Stock LH_M, , Simulated data
CPUE data for years 1950 - 1999, CPUE range 159 - 697, smooth = TRUE
Prior for r                 = Medium, NA - NA
Used prior range for r      = 0.2 - 0.8
Prior for 1950 stock status = Very small, NA - NA
Used 1950 prior B/B0 range  = 0.01 - 0.2, prior B/Bmsy = 0.02 - 0.4
Used prior range for kq     = 695 - 2086 [original range = 144 - 2886]
Comment: True r=0.5, true kq=1000, true MSYq=125, true q=0.001

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 5005

 Results:
 viable r-kq pairs   = 5005
 median kq           = 1154, 826 - 1699
 median MSYq         = 154, 99.9 - 244
 r (4 MSYq/kq)       = 0.533, 0.334 - 0.865
 Fmsy (r/2)          = 0.266, 0.167 - 0.433
 F/Fmsy              = 0.807, 0.111 - 1.83 (1998), true: 0.672
 B/Bmsy              = 1.2, 0.666 - 2.19 (1999), true: 1.38
 --------------------------------------------------------------
```
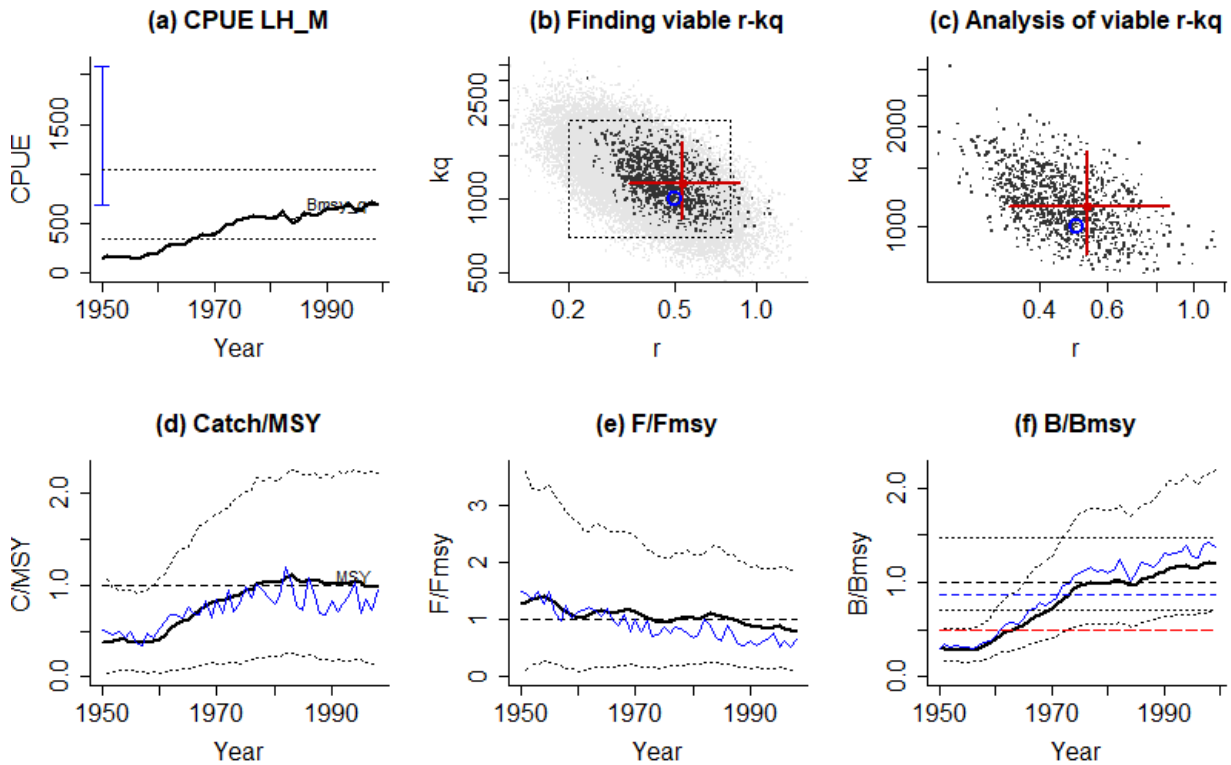

(a) CPUE LH_M (b) Finding viable r-kq (c) Analysis of viable r-kq
(d) Catch/MSY (e) F/Fmsy (f) B/Bmsy

```
Stock LH_VL, , Simulated data
CPUE data for years 1950 - 1999, CPUE range 182 - 555, smooth = TRUE
Prior for r                  = Very low, NA - NA
Used prior range for r       = 0.015 - 0.1
Prior for 1950 stock status  = Very small, NA - NA
Used 1950 prior B/B0 range   = 0.01 - 0.2, prior B/Bmsy = 0.02 - 0.4
Used prior range for kq      = 551 - 1654 [original range = 165 - 3305]
Comment: True r=0.06, true kq=1000, true MSYq=15

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 5003

 Results:
viable r-kq pairs   = 5003
median kq           = 1097, 801 - 1604
median MSYq         = 16.5, 9.87 - 26.2
r (4 MSYq/kq)       = 0.0601, 0.0321 - 0.105
Fmsy (r/2)          = 0.03, 0.0161 - 0.0524
F/Fmsy              = 1.51, -3.51 - 8.75 (1998), true: 0.365
B/Bmsy              = 1.02, 0.56 - 1.82 (1999), true: 1.2
--------------------------------------------------------------
```
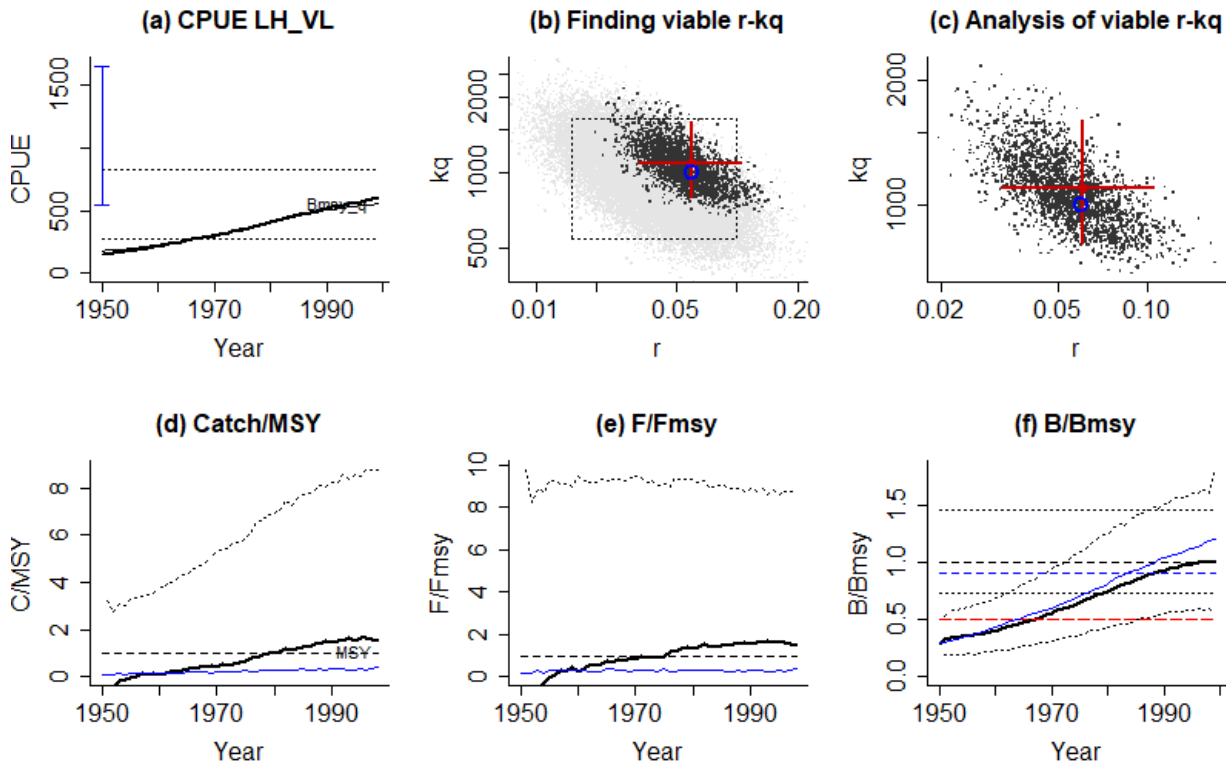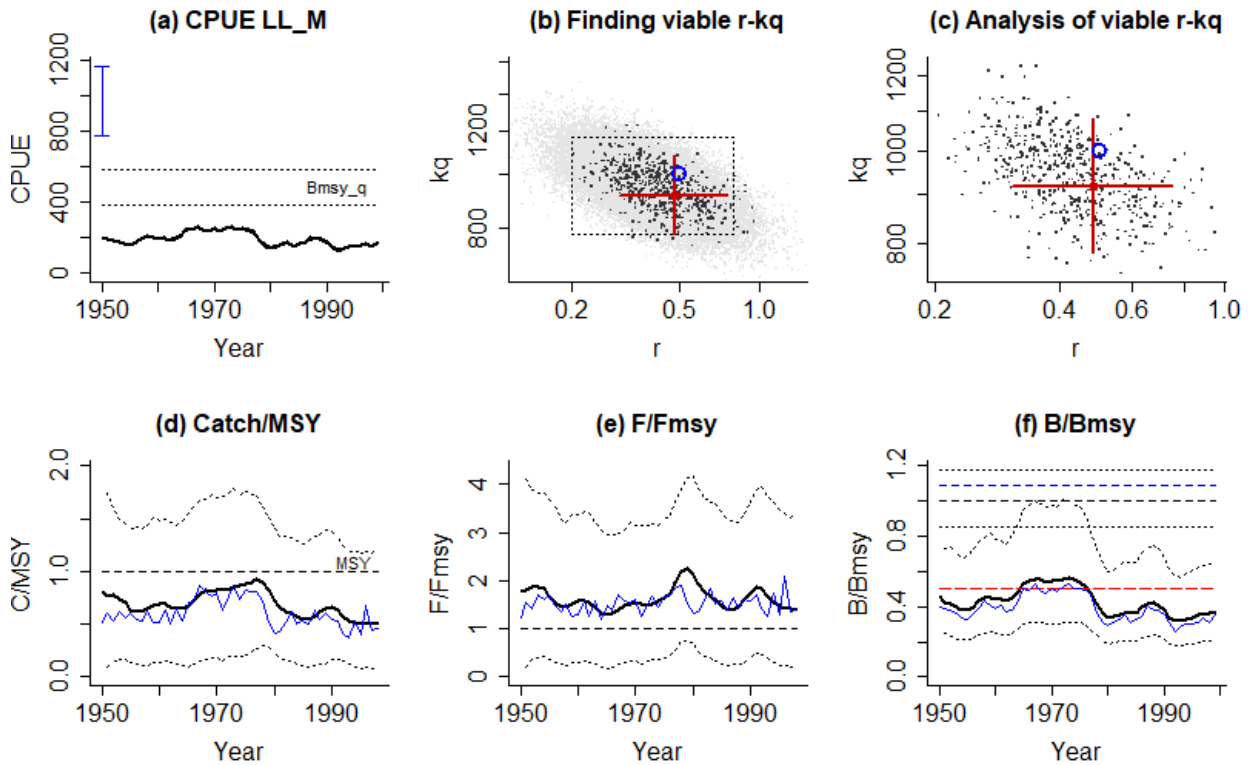
```
Stock LHL_H, , Simulated data
CPUE data for years 1950 - 1999, CPUE range 155 - 708, smooth = TRUE
Prior for r                   = High, NA - NA
Used prior range for r        = 0.6 - 1.5
Prior for 1950 stock status   = Very small, NA - NA
Used 1950 prior B/B0 range    = 0.01 - 0.2, prior B/Bmsy = 0.02 - 0.4
Used prior range for kq       = 693 - 2079 [original range = 140 - 2807]
Comment: True r=1.0, true kq=1000, true MSYq=250

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 5000

 Results:
 viable r-kq pairs    = 5000
 median kq            = 1224, 813 - 1901
 median MSYq          = 276, 196 - 407
 r (4 MSYq/kq)        = 0.903, 0.623 - 1.25
 Fmsy (r/2)           = 0.451, 0.312 - 0.625
 F/Fmsy               = 1.7, 0.666 - 3.19 (1998), true: 1.49
 B/Bmsy               = 0.339, 0.188 - 0.621 (1999), true: 0.42
 ---------------------------------------------------------------
```
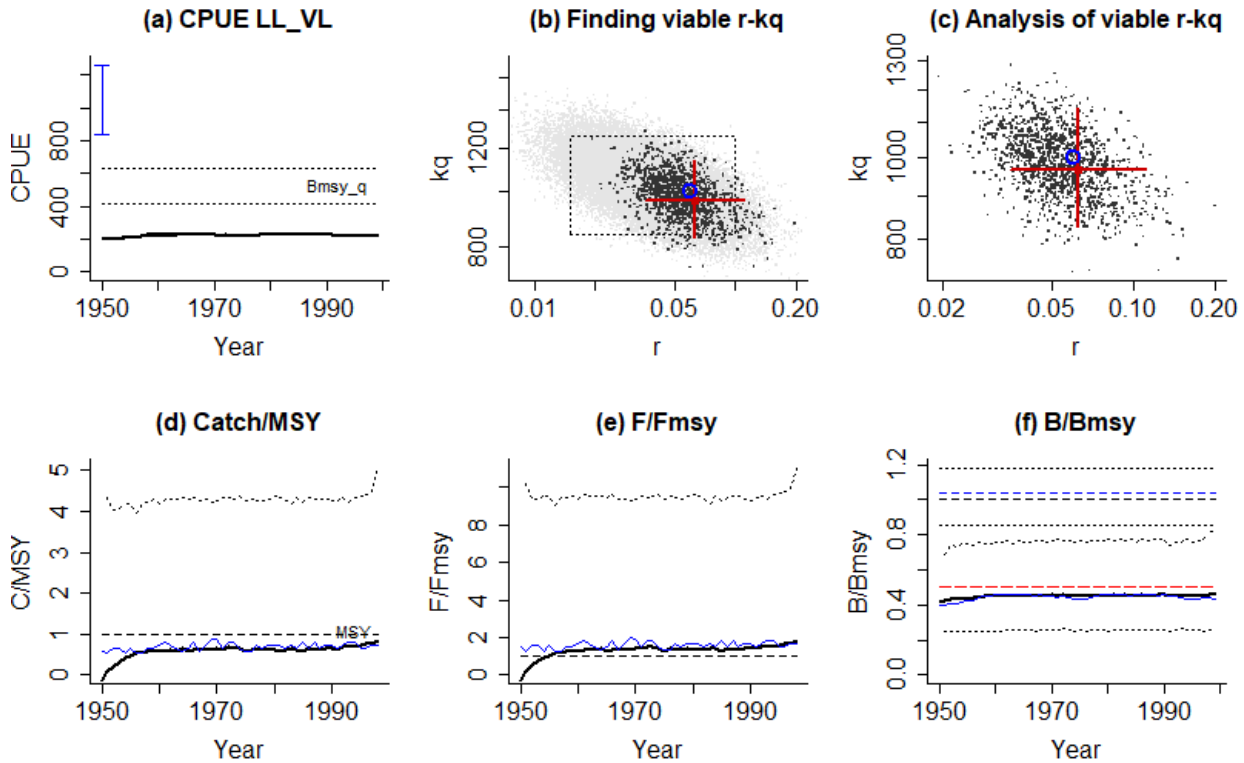

(a) CPUE LHL_H (b) Finding viable r-kq (c) Analysis of viable r-kq

(d) Catch/MSY (e) F/Fmsy (f) B/Bmsy

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```
Stock LHL_L, , Simulated data
CPUE data for years 1950 - 1999, CPUE range 160 - 602, smooth = TRUE
Prior for r                  = Low, NA - NA
Used prior range for r       = 0.05 - 0.5
Prior for 1950 stock status  = Very small, NA - NA
Used 1950 prior B/B0 range   = 0.01 - 0.2, prior B/Bmsy = 0.02 - 0.4
Used prior range for kq      = 600 - 1801 [original range = 145 - 2909]
Comment: True r=0.25, true kq=1000, true MSYq=62.5

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 5001

 Results:
 viable r-kq pairs   = 5001
 median kq           = 1022, 738 - 1509
 median MSYq         = 74, 45.4 - 120
 r (4 MSYq/kq)       = 0.29, 0.171 - 0.489
 Fmsy (r/2)          = 0.145, 0.0855 - 0.245
 F/Fmsy              = 2.03, 0.161 - 4.53 (1998), true: 2.38
 B/Bmsy              = 0.457, 0.251 - 0.811 (1999), true: 0.42
 -----------------------------------------------------------
```


(a) CPUE LHL_L   (b) Finding viable r-kq   (c) Analysis of viable r-kq

(d) Catch/MSY   (e) F/Fmsy   (f) B/Bmsy

```
Stock LHL_M, , Simulated data
CPUE data for years 1950 - 1999, CPUE range 96.7 - 669, smooth = TRUE
Prior for r                  = Medium, NA - NA
Used prior range for r       = 0.2 - 0.8
Prior for 1950 stock status  = Very small, NA - NA
Used 1950 prior B/B0 range   = 0.01 - 0.2, prior B/Bmsy = 0.02 - 0.4
Used prior range for kq      = 668 - 2005 [original range = 144 - 2875]
Comment: True r=0.5, true kq=1000, true MSYq=125, true q=0.001

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 5002

 Results:
 viable r-kq pairs   = 5002
 median kq           = 1165, 803 - 1703
 median MSYq         = 138, 90.2 - 211
 r (4 MSYq/kq)       = 0.473, 0.307 - 0.714
 Fmsy (r/2)          = 0.236, 0.153 - 0.357
 F/Fmsy              = 2.66, 1.05 - 4.83 (1998), true: 1.74
 B/Bmsy              = 0.165, 0.0921 - 0.302 (1999), true: 0.18
 -----------------------------------------------------------
```


(a) CPUE LHL_M (b) Finding viable r-kq (c) Analysis of viable r-kq
(d) Catch/MSY (e) F/Fmsy (f) B/Bmsy

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```
Stock LHL_VL, , Simulated data
CPUE data for years 1950 - 1999, CPUE range 293 - 475, smooth = TRUE
Prior for r                   = Very low, NA - NA
Used prior range for r        = 0.015 - 0.1
Prior for 1950 stock status   = Very small, NA - NA
Used 1950 prior B/B0 range    = 0.01 - 0.2, prior B/Bmsy = 0.02 - 0.4
Used prior range for kq       = 949 - 2848 [original range = 266 - 5322]
Comment: True r=0.06, true kq=1000, true MSYq=15

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 5001

 Results:
 viable r-kq pairs    = 5001
 median kq            = 1687, 1238 - 2509
 median MSYq          = 24.5, 14.2 - 40.1
 r (4 MSYq/kq)        = 0.0581, 0.0326 - 0.0978
 Fmsy (r/2)           = 0.0291, 0.0163 - 0.0489
 F/Fmsy               = 2.42, -4.96 - 12.3 (1998), true: 3.41
 B/Bmsy               = 0.366, 0.202 - 0.654 (1999), true: 0.42
 ---------------------------------------------------------------
```


(a) CPUE LHL_VL   (b) Finding viable r-kq   (c) Analysis of viable r-kq

(d) Catch/MSY   (e) F/Fmsy   (f) B/Bmsy

```
Stock LL_H, , Simulated data
CPUE data for years 1950 - 1999, CPUE range 125 - 272, smooth = TRUE
Prior for r                  = High, NA - NA
Used prior range for r       = 0.6 - 1.5
Prior for 1950 stock status  = Small, NA - NA
Used 1950 prior B/B0 range   = 0.15 - 0.4, prior B/Bmsy = 0.3 - 0.8
Used prior range for kq      = 431 - 1149 [original range = 431 - 1149]
Comment: True r=1.0, true kq=1000, true MSYq=250

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 5013

 Results:
 viable r-kq pairs   = 5013
 median kq           = 759, 491 - 1084
 median MSYq         = 165, 115 - 244
 r (4 MSYq/kq)       = 0.869, 0.613 - 1.21
 Fmsy (r/2)          = 0.434, 0.307 - 0.607
 F/Fmsy              = 1.54, 0.472 - 2.91 (1998), true: 1.29
 B/Bmsy              = 0.424, 0.242 - 0.769 (1999), true: 0.38
 -----------------------------------------------------------
```


(a) CPUE LL_H   (b) Finding viable r-kq   (c) Analysis of viable r-kq

(d) Catch/MSY   (e) F/Fmsy   (f) B/Bmsy

```
Stock LL_L, , Simulated data
CPUE data for years 1950 - 1999, CPUE range 195 - 254, smooth = TRUE
Prior for r                   = Low, NA - NA
Used prior range for r        = 0.05 - 0.5
Prior for 1950 stock status   = Small, NA - NA
Used 1950 prior B/B0 range    = 0.15 - 0.4, prior B/Bmsy = 0.3 - 0.8
Used prior range for kq       = 787 - 1180 [original range = 393 - 1049]
Comment: True r=0.25, true kq=1000, true MSYq=62.5

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 5002

 Results:
 viable r-kq pairs   = 5002
 median kq           = 906, 761 - 1060
 median MSYq         = 63.7, 40.3 - 96.7
 r (4 MSYq/kq)       = 0.282, 0.171 - 0.438
 Fmsy (r/2)          = 0.141, 0.0857 - 0.219
 F/Fmsy              = 1.73, -0.06 - 4.2 (1998), true: 1.65
 B/Bmsy              = 0.481, 0.264 - 0.871 (1999), true: 0.42
 ----------------------------------------------------------
```
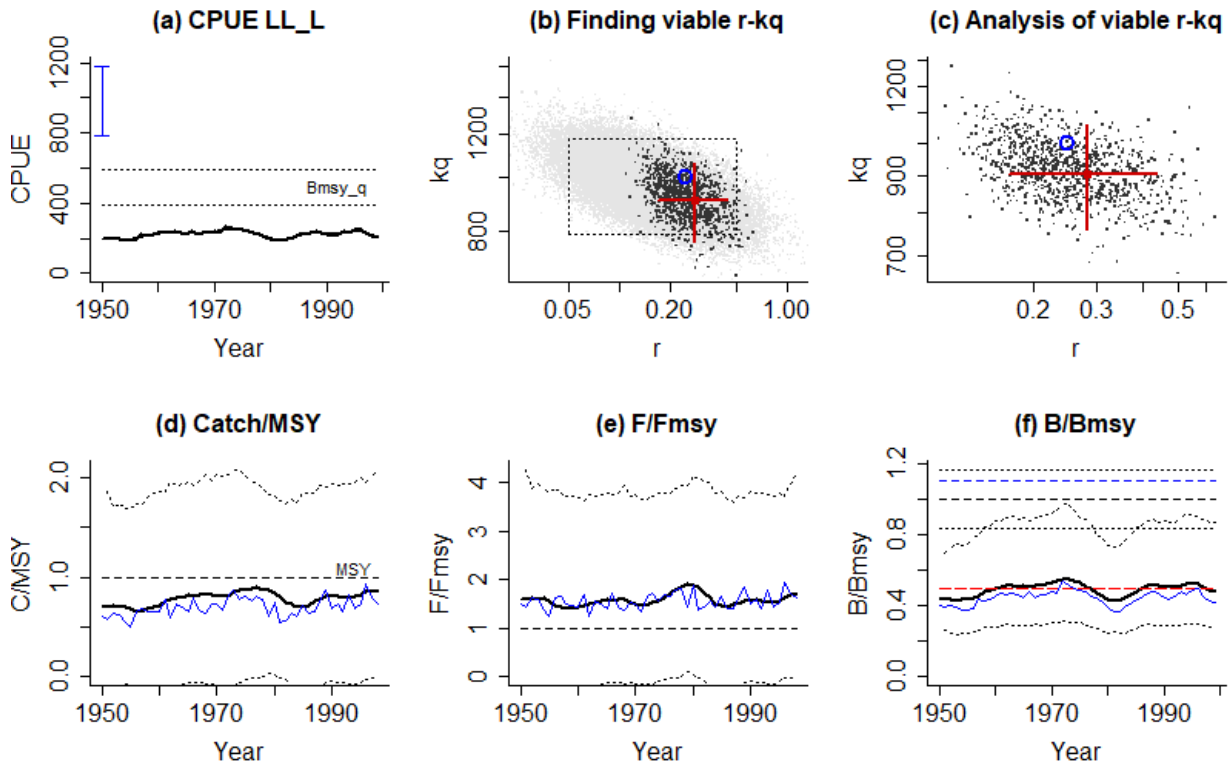

(a) CPUE LL_L
(b) Finding viable r-kq
(c) Analysis of viable r-kq
(d) Catch/MSY
(e) F/Fmsy
(f) B/Bmsy

```
Stock LL_M, , Simulated data
CPUE data for years 1950 - 1999, CPUE range 144 - 257, smooth = TRUE
Prior for r                    = Medium, NA - NA
Used prior range for r         = 0.2 - 0.8
Prior for 1950 stock status    = Small, NA - NA
Used 1950 prior B/B0 range     = 0.15 - 0.4, prior B/Bmsy = 0.3 - 0.8
Used prior range for kq        = 779 - 1168 [original range = 389 - 1038]
Comment: True r=0.5, true kq=1000, true MSYq=125, true q=0.001

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 5003

  Results:
  viable r-kq pairs    = 5003
  median kq            = 919, 784 - 1081
  median MSYq          = 111, 74 - 169
  r (4 MSYq/kq)        = 0.483, 0.306 - 0.752
  Fmsy (r/2)           = 0.241, 0.153 - 0.376
  F/Fmsy               = 1.4, 0.217 - 3.41 (1998), true: 1.38
  B/Bmsy               = 0.364, 0.203 - 0.65 (1999), true: 0.36
  -------------------------------------------------------------
```

```
Stock LL_VL, , Simulated data
CPUE data for years 1950 - 1999, CPUE range 212 - 226, smooth = TRUE
Prior for r                    = Very low, NA - NA
Used prior range for r         = 0.015 - 0.1
Prior for 1950 stock status    = Small, NA - NA
Used 1950 prior B/B0 range     = 0.15 - 0.4, prior B/Bmsy = 0.3 - 0.8
Used prior range for kq        = 840 - 1260 [original range = 420 - 1120]
Comment: True r=0.06, true kq=1000, true MSYq=15

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 5000

 Results:
 viable r-kq pairs    = 5000
 median kq            = 967, 829 - 1141
 median MSYq          = 15.2, 8.99 - 25.9
 r (4 MSYq/kq)        = 0.063, 0.0356 - 0.111
 Fmsy (r/2)           = 0.0315, 0.0178 - 0.0554
 F/Fmsy               = 1.85, -5.19 - 11 (1998), true: 1.66
 B/Bmsy               = 0.456, 0.255 - 0.84 (1999), true: 0.44
```


(a) CPUE LL_VL   **(b) Finding viable r-kq**   **(c) Analysis of viable r-kq**

(d) Catch/MSY   **(e) F/Fmsy**   **(f) B/Bmsy**

Appendix 3: Stocks and species for which AMSY provides the first assessment

This Appendix presents details of the first MSY-level stock assessments for 38 stocks comprising 35 species. For 23 species, these are the first assessments globally. For all stocks, length frequencies were analyzed with the LBB method (Froese et al. 2018, 2019) to obtain priors for relative stock size B/B_0 in a given year. These priors were then used in the analysis of CPUE data obtained from research surveys with the AMSY method presented in this study. R-code and data mentioned below are available as part of the Supplemental Material available at the link indicated on the first page of this document.

Length frequencies and CPUE in numbers by length and area for the Adriatic Sea and Cyprus were obtained from the Mediterranean and Black Sea data call - 2018, after explicit request to the DCF national correspondents. (https://datacollection.jrc.ec.europa.eu/dc/medbs)

Length frequencies and CPUE in kg/km^2 by area for the Aegean Sea were obtained from the MEDITS bottom trawl survey (MEDITS Working Group 2012).

Length frequencies and CPUE in kg/h by length and area for the North Sea were obtained from the GNSIntOT3 survey as standardized in Greenstreet & Moriaty (2018). The data were aggregated with R-code SMFS_kg2B_4.R.

Length frequencies and CPUE in numbers by length and area for the Baltic Sea were obtained from the BITS survey in DATRAS (https://datras.ices.dk/Data_products/Download/Download_Data_public.aspx), accessed in April 2019. The data were aggregated and transformed from numbers to weight with R-code Nh2kghAr_3.R.

Stocks are arranged alphabetically by regions and by stock acronyms with region.

References

Froese, R., Winker, H., Coro, G., Demirel, N., Tsikliras, A.C., Dimarchopoulou, D., Scarcella, G., Probst, W.N., Dureuil, M. and D. Pauly. 2018. A new approach for estimating stock status from length frequency data. ICES Journal of Marine Science 75(6): 2004-2015.

Froese, R., Winker, H., Coro, G., Demirel, N., Tsikliras, A.C., Dimarchopoulou, D., Scarcella, G., Probst, W.N., Dureuil, M. and D. Pauly. 2019. On the pile-up effect and priors for Linf and M/K: response to a comment by Hordyk et al. on "A new approach for estimating stock status from length frequency data". ICES Journal of Marine Science, 76(2): 461–465.

Greenstreet, S.P.R. and Moriarty, M. 2018. Manual for Version 3 of the Groundfish Survey Monitoring and Assessment Data Product. Scottish Government, Scottish Marine and Freshwater Science Report Vol 8, No 18, 77 p.

MEDITS working group (2012). MEDITS. International bottom trawl survey in the Mediterranean. Instruction manual. Version 6. MEDITS-Handbook. Revision n.6, April 2012, MEDITS Working group. https://archimer.ifremer.fr/doc/00117/22783/

Adriatic Sea

```
-----------------------------------------------------------------
LBB results for Illex coindettii, stock Ille_coi_AD, 1996-2016
Files:LBB4AMSY_ID_2.csv, Ille_coi_AD.csv
-----------------------------------------------------------------
Linf prior= 23, SD=0.23 cm (user-defined), Lmax=23.5, median Lmax=20.5
Z/K prior = 3.2, SD=0.12, M/K prior=1.5, SD=0.15
F/K prior = 1.71 (wide range with tau=4 in log-normal distribution)
Lc prior  = 5.1, SD=0.51 cm, alpha prior=42, SD=4.2, Lm50=16 cm

General reference points (median across years):
Linf     = 23.3 (22.8-23.6) cm
Lopt     = 15 cm, Lopt/Linf=0.66
Lc_opt   = 13 cm, Lc_opt/Linf=0.55, Lmean if F=M 9.75 cm
M/K      = 1.52 (1.29-1.79)
F/M      = 0.92 (0.611-1.3), F/K=1.49 (1.12-1.79), Z/K=3.14 (2.95-3.36)
B/B0     = 0.26 (0.14-0.38), B/B0 F=M Lc=Lc_opt 0.37
Y/R'     = 0.017 (0.011-0.033), Y/R' F=M Lc=Lc_opt 0.045

Estimates for 2016 (mean of last 3 years with data):
Lc50      = 6.21 (6.1-6.33) cm, Lc/Linf=0.27 (0.26-0.27)
Lc95      = 8.26, alpha=1.44 (1.38-1.49)
Lmean/Lopt= 0.6, Lc/Lc_opt=0.49, L95th=19.5 cm, L95th/Linf=0.84, Mature=0.34%
F/M       = 2.4 (1.8-3.2), F/K=3.5 (3.2-3.9), Z/K=5.1 (4.8-5.3)
Y/R'      = 0.015 (0.0091-0.024)
B/B0      = 0.15 (0.09-0.24), best LF fit year 2002=0.22 (0.13-0.33)
B/Bmsy    = 0.4 (0.25-0.64), selected B/B0 2009 = 0.24 (0.14-0.39)
RF: removed years with chaotic LF; set Linf to 23 cm between median 20.5 and m
ax 23.5, instead of 24.6 suggested by aggregated data. Selected 2009 for AMSY
prior because of reasonable fit, CL, not too low B/B0 which makes predictions
of k uncertain.
```
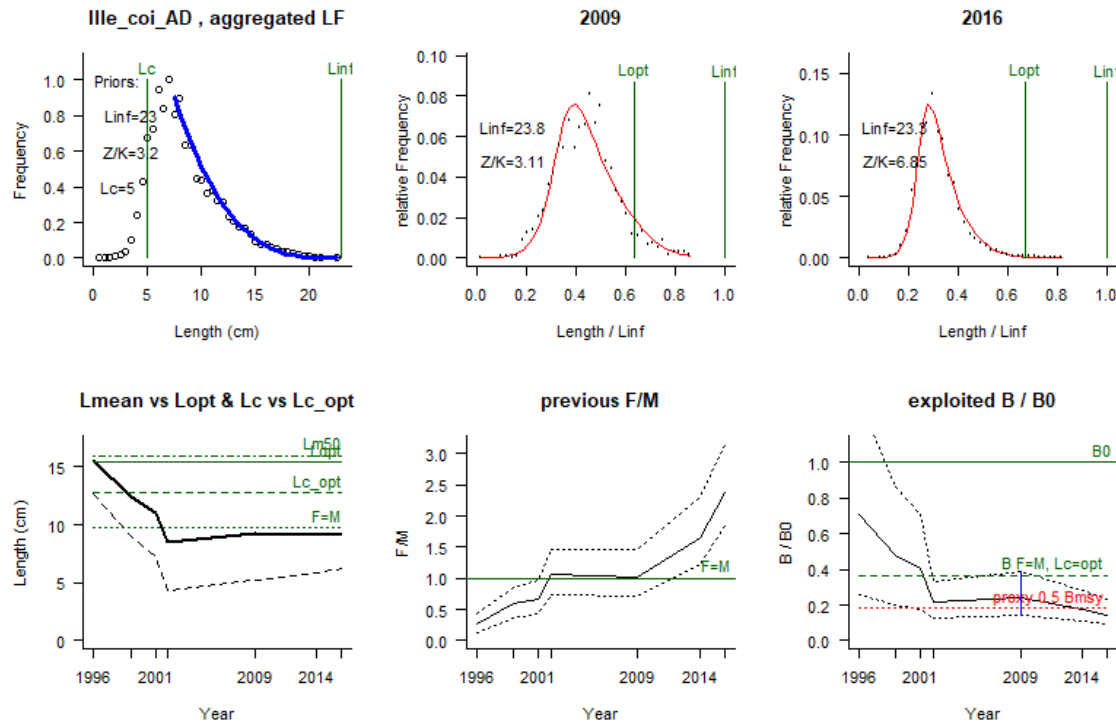
```
File FirstAss_ID_4.csv read successfully
------------------------------------------------------------
AMSY Analysis, Fri Nov 01 16:34:11 2019
------------------------------------------------------------
Stock Ille_coi_AD, Illex coindettii, Shortfin squid
CPUE data for years 2001 - 2017, CPUE range 12.6 - 32.5, smooth = TRUE
Prior for r                   = Medium, 0.34 - 0.78
Used prior range for r        = 0.319 - 0.833
Prior for 2009 stock status   = Small, 0.14 - 0.39
Used 2009 prior B/B0 range    = 0.14 - 0.39, prior B/Bmsy = 0.28 - 0.78
Used prior range for kq       = 33.5 - 93.3 [original range = 33.5 - 93.3]
Comment: B/B0 prior from LBB. RF:  Initial low abundance of stock doubtful. St
arting analysis in 2001. OK
Source:

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 5003

  Results:
  viable r-kq pairs   = 5003
  median kq           = 56.6, 38.8 - 85.9
  median MSYq         = 7.46, 5.2 - 11
  r (4 MSYq/kq)       = 0.527, 0.359 - 0.745
  Fmsy (r/2)          = 0.264, 0.18 - 0.372
  F/Fmsy              = 0.665, 0.0673 - 1.71 (2016)
  B/Bmsy              = 1.14, 0.64 - 2.05 (2017)
```
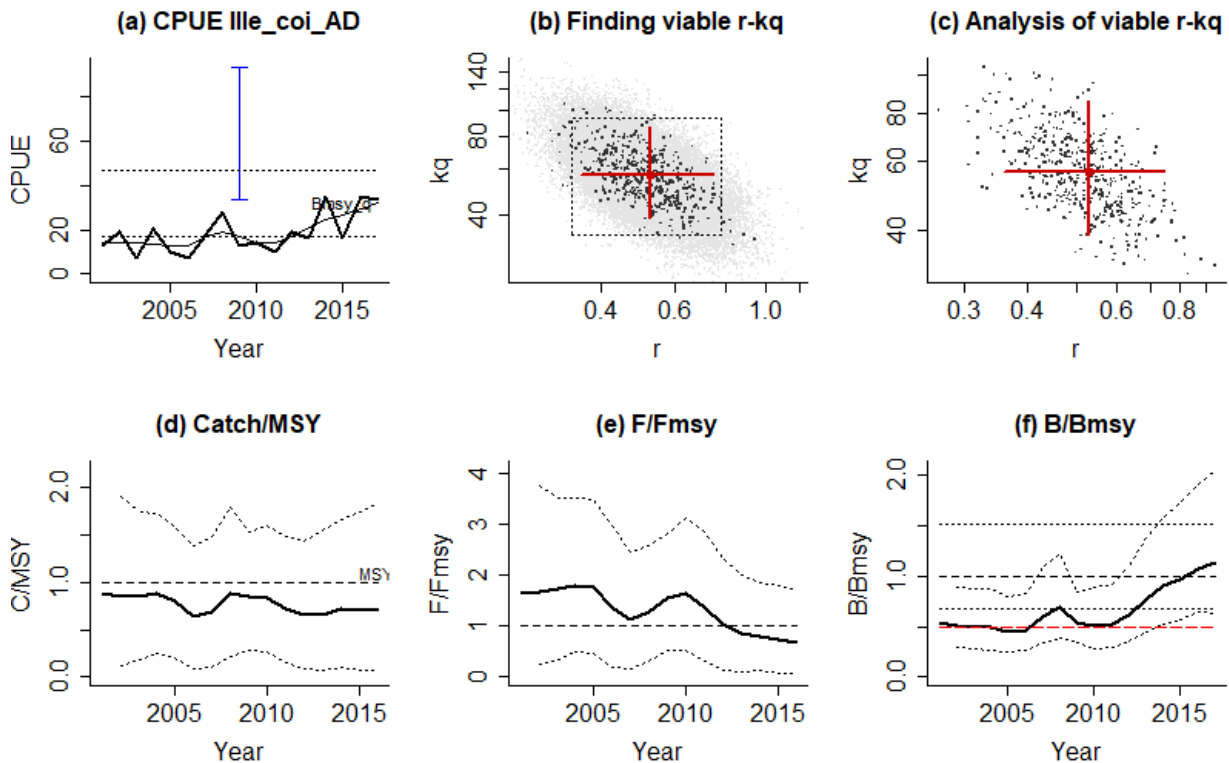
AMSY Kobe and retrospective plots for Ille_coi_AD, *Illex coindettii*

Ille_coi_AD

Ille_coi_AD
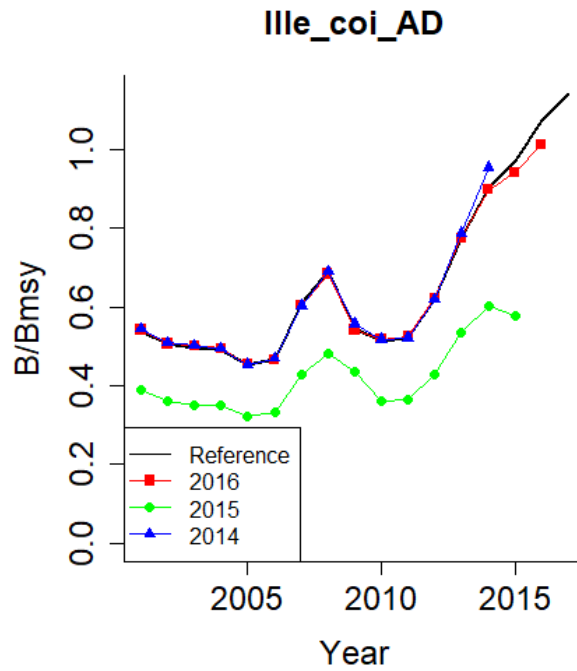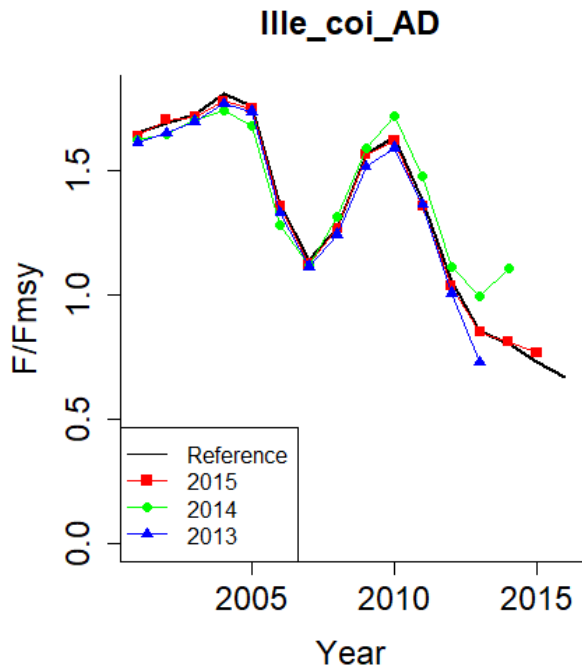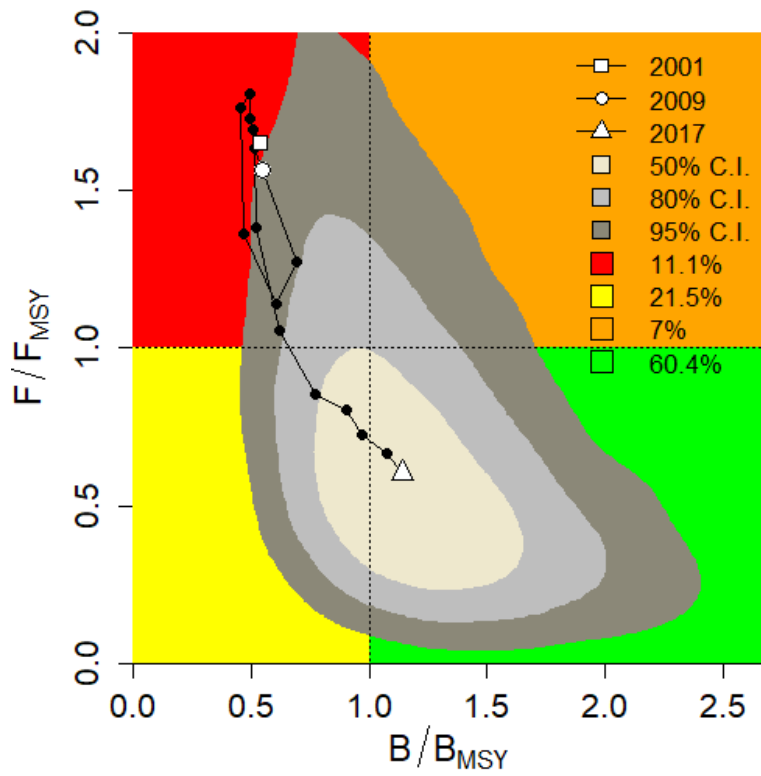
```
----------------------------------------------------------------------
LBB results for Micromesistius poutassou, stock Micr_pou_AD, 1994-2001
Files:LBB4AMSY_ID_2.csv, Micr_pou_AD.csv
----------------------------------------------------------------------
Linf prior= 40, SD=0.4 cm (user-defined), Lmax=44, median Lmax=35
Z/K prior = 2.5, SD=0.39, M/K prior=1.5, SD=0.15
F/K prior = 1.05 (wide range with tau=4 in log-normal distribution)
Lc prior  = 21.9, SD=2.2 cm, alpha prior=37.2, SD=3.7, Lm50=18 cm

General reference points (median across years):
Linf     = 40.3 (39.7-40.9) cm
Lopt     = 27 cm, Lopt/Linf=0.66
Lc_opt   = 24 cm, Lc_opt/Linf=0.59, Lmean if F=M 26.2 cm
M/K      = 1.52 (1.25-1.81)
F/M      = 2.19 (1.67-2.82), F/K=3.29 (2.94-3.84), Z/K=4.84 (4.52-5.35)
B/B0     = 0.19 (0.13-0.27), B/B0 F=M Lc=Lc_opt 0.37
Y/R'     = 0.038 (0.017-0.056)(reduced: B/B0<0.25),Y/R' F=M Lc=Lc_opt 0.045

Estimates for 2001 (mean of last 3 years with data):
Lc50     = 21.2 (21.1-21.3) cm, Lc/Linf=0.53 (0.53-0.53)
Lc95     = 23.4, alpha=1.31 (1.26-1.35)
Lmean/Lopt= 0.9, Lc/Lc_opt=0.88, L95th=33 cm, L95th/Linf=0.82, Mature=100%
F/M      = 4.4 (3.4-5.7), F/K=6.3 (5.5-7.1), Z/K=7.7 (7.1-8.5)
Y/R'     = 0.027 (0.018-0.039)(reduced because B/B0 < 0.25)
B/B0     = 0.16 (0.11-0.23), best LF fit year 1996=0.37 (0.18-0.58)
B/Bmsy   = 0.44 (0.3-0.64), selected B/B0 1995 = 0.29 (0.17-0.41)
RF: set Lcut to 18 cm to ignore distorting high catches of early juveniles;
excluded years with unsuitable LFs; set Linf to 40 cm, between median 36 and
max 44; note that Lc is overestimated, but F of adults and thus B/B0 seems
reasonable. Selected 1995 for reasonable fit, CL, and B/B0.
```
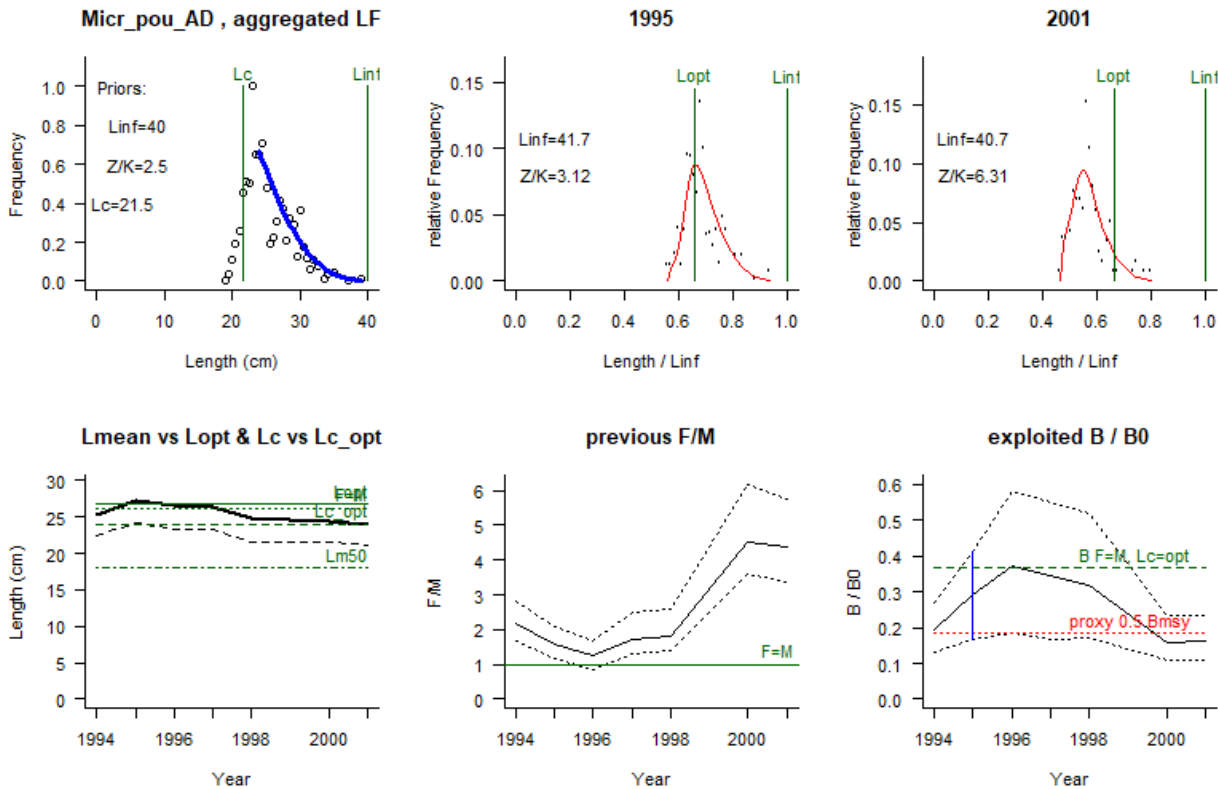
```
------------------------------------------------------------------
AMSY Analysis, Fri Nov 01 16:38:14 2019
------------------------------------------------------------------
Stock Micr_pou_AD, Micromesistius poutassou, Blue whiting
CPUE data for years 1994 - 2017, CPUE range 5.66 - 43.4, smooth = TRUE
Prior for r                  = Medium, 0.31 - 0.71
Used prior range for r       = 0.29 - 0.761
Prior for 1995 stock status  = Small, 0.17 - 0.41
Used 1995 prior B/B0 range   = 0.17 - 0.41, prior B/Bmsy = 0.34 - 0.82
Used prior range for kq      = 38.3 - 88.5 [original range = 36.7 - 88.5]
Comment: B/B0 prior from LBB. RF: OK
Source:

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 5000

  Results:
  viable r-kq pairs   = 5000
  median kq           = 56.1, 42.4 - 78.3
  median MSYq         = 7.61, 5.46 - 10.8
  r (4 MSYq/kq)       = 0.543, 0.374 - 0.77
  Fmsy (r/2)          = 0.272, 0.187 - 0.385
  F/Fmsy              = 1.53, 0.515 - 2.84 (2016)
  B/Bmsy              = 0.731, 0.401 - 1.32 (2017)
```


(a) CPUE Micr_pou_AD (b) Finding viable r-kq (c) Analysis of viable r-kq

(d) Catch/MSY (e) F/Fmsy (f) B/Bmsy
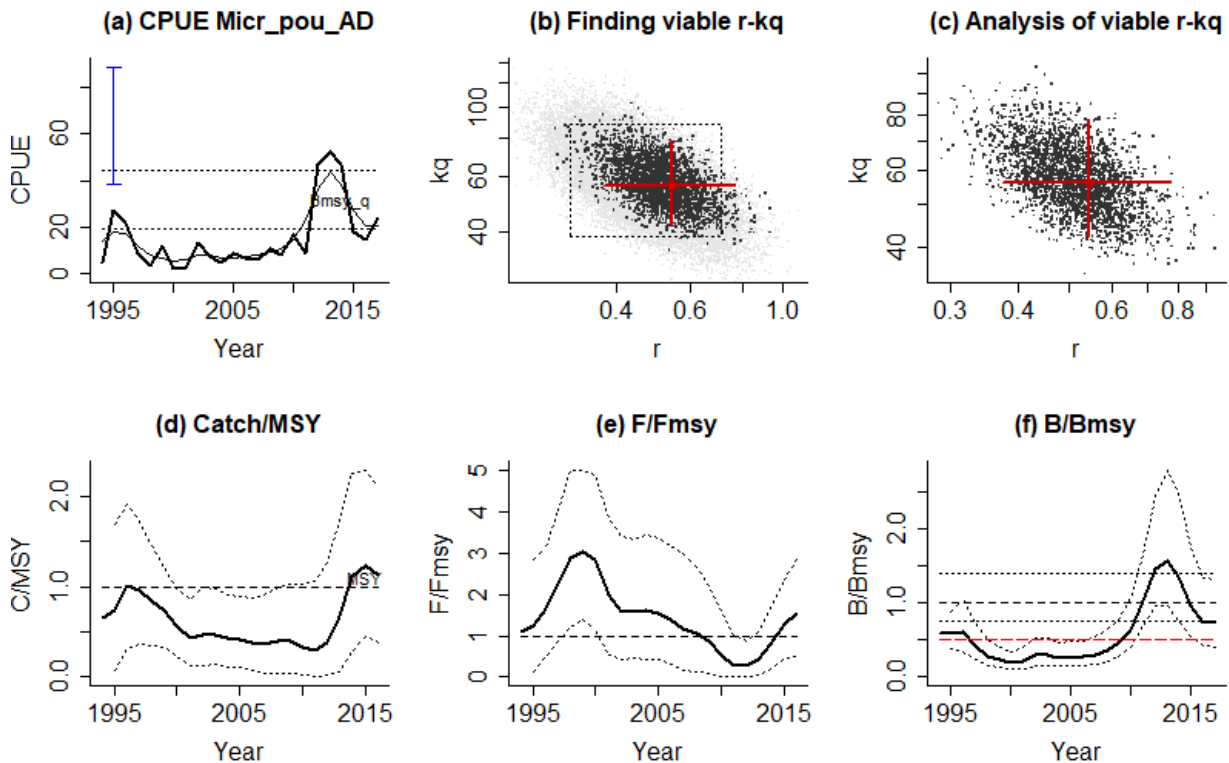
AMSY Kobe plot and retrospective analysis for `Micr_pou_AD`, *Micromesistius poutassou*
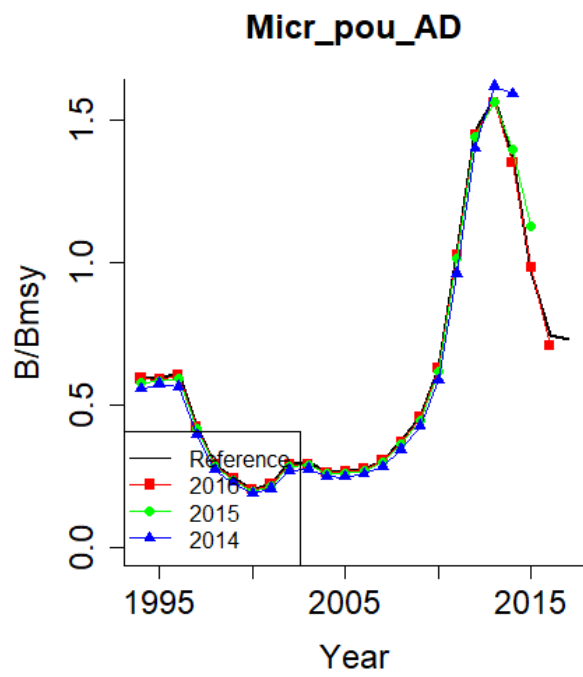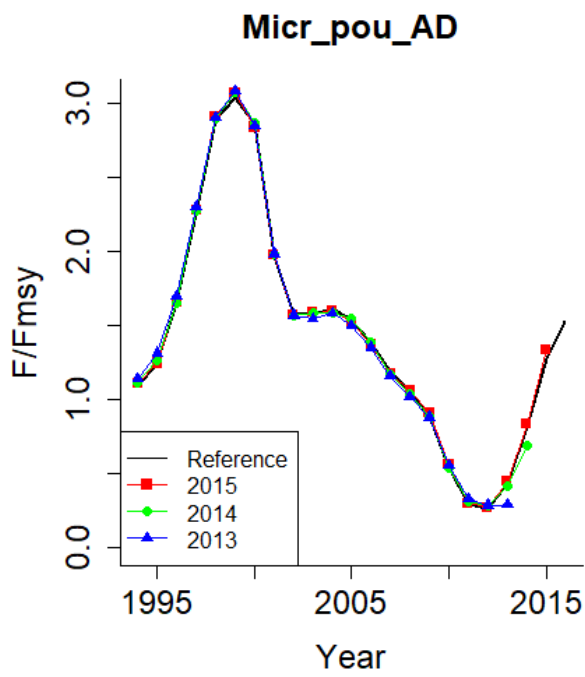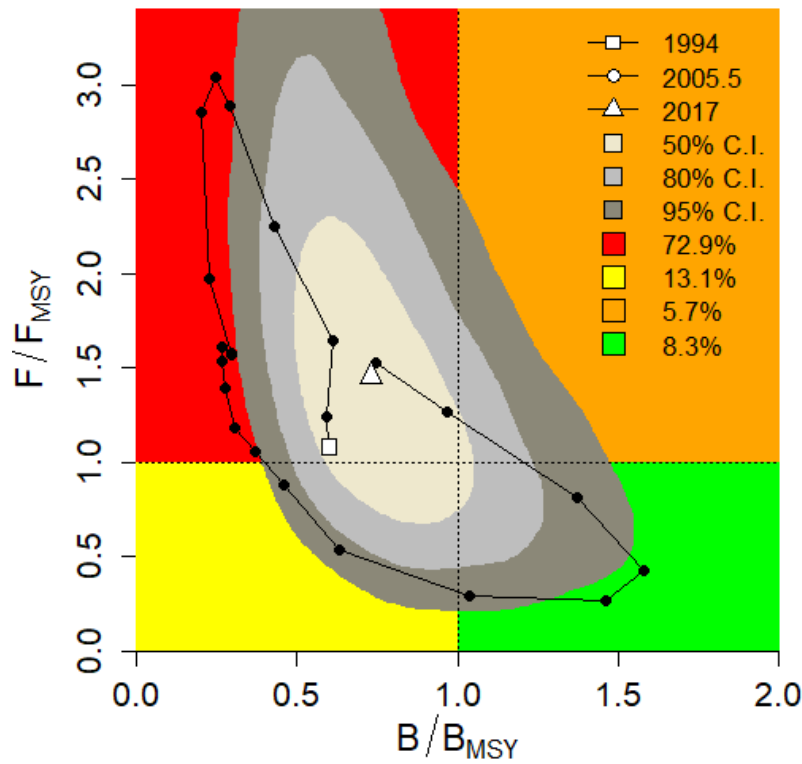
LBB results for *Octopus vulgaris*, stock Octo_vul_AD, 2007-2017
Files:LBB4AMSY_ID_2.csv, Octo_vul_AD.csv
--
Linf prior= 19, SD=0.19 cm (user-defined), Lmax=27, median Lmax=15
Z/K prior = 3.2, SD=0.56, M/K prior=1.5, SD=0.15
F/K prior = 1.67 (wide range with tau=4 in log-normal distribution)
Lc prior = 5.87, SD=0.59 cm, alpha prior=10.2, SD=1, Lm50=11 cm

General reference points (median across years):
Linf   = 19.4 (19.1-19.7) cm
Lopt   = 14 cm, Lopt/Linf=0.74
Lc_opt   = 11 cm, Lc_opt/Linf=0.55, Lmean if F=M 9.2 cm
M/K   = 1.03 (0.81-1.17)
F/M   = 0.276 (0.141-0.519), F/K=0.26 (0.164-0.445), Z/K=1.29 (1.14-1.43)
B/B0   = 0.64 (0.23-1.3), B/B0 F=M Lc=Lc_opt 0.39
Y/R'   = 0.045 (0.016-0.096), Y/R' F=M Lc=Lc_opt 0.077

Estimates for 2017 (mean of last 3 years with data):
Lc50   = 4.14 (3.9-4.4) cm, Lc/Linf=0.21 (0.2-0.23)
Lc95   = 7.81, alpha=0.804 (0.767-0.843)
Lmean/Lopt= 0.61, Lc/Lc_opt=0.39, L95th=17 cm, L95th/Linf=0.88, Mature=32%
F/M   = 0.29 (0.16-0.52), F/K=0.24 (0.14-0.37), Z/K=1.1 (0.98-1.2)
Y/R'   = 0.055 (0.021-0.11)
B/B0   = 0.64 (0.24-1.3), best LF fit year 2009=0.647 (0.22-1.3)
B/Bmsy   = 1.7 (0.63-3.4), **selected B/B0 2012 = 0.59 (0.19-1.2)**
RF: deleted outlier 75 cm in 2015; set Linf=19 cm, between median 15 and max
27 cm; merged LF to increase data per year; 2012 fit looked reasonable and is
proposed for AMSY, albeit with high uncertainty.
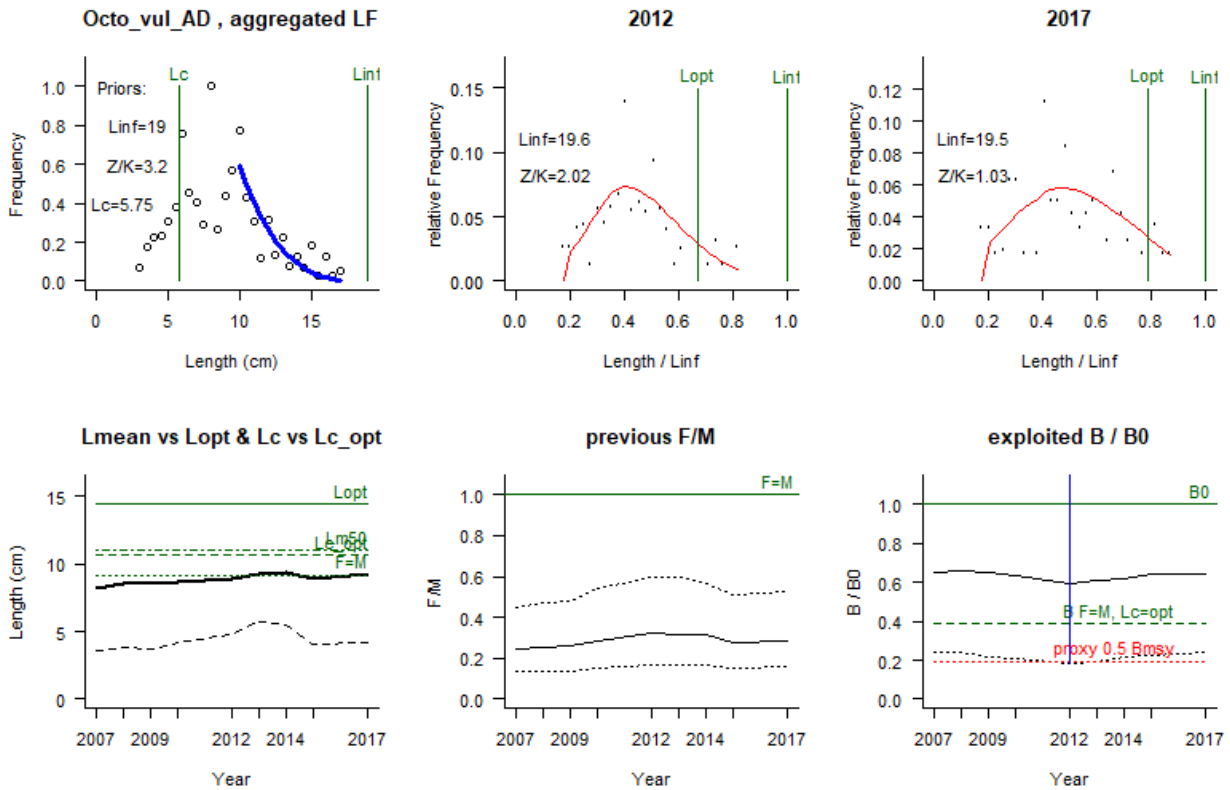
```
--------------------------------------------------------------
AMSY Analysis, Fri Nov 01 16:43:40 2019
--------------------------------------------------------------
Stock Octo_vul_AD, Octopus vulgaris, Common octopus
CPUE data for years 1995 - 2017, CPUE range 1.02 - 2.47, smooth = TRUE
Prior for r                  = High, 0.53 - 1.21
Used prior range for r       = 0.493 - 1.29
Prior for 2012 stock status  = Small, 0.19 - 1.2
Used 2012 prior B/B0 range   = 0.19 - 1.2, prior B/Bmsy = 0.38 - 2.4
Used prior range for kq      = 2.31 - 5 [original range = 0.792 - 5]
Comment: B/B0 prior from LBB.  RF: OK
Source:

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 5013

  Results:
  viable r-kq pairs    = 5013
  median kq            = 3.38, 2.45 - 4.87
  median MSYq          = 0.72, 0.507 - 1.01
  r (4 MSYq/kq)        = 0.851, 0.595 - 1.26
  Fmsy (r/2)           = 0.425, 0.297 - 0.631
  F/Fmsy               = 0.937, 0.289 - 1.74 (2016)
  B/Bmsy               = 1.01, 0.557 - 1.81 (2017)
```


(a) CPUE Octo_vul_AD   (b) Finding viable r-kq   (c) Analysis of viable r-kq

(d) Catch/MSY   (e) F/Fmsy   (f) B/Bmsy

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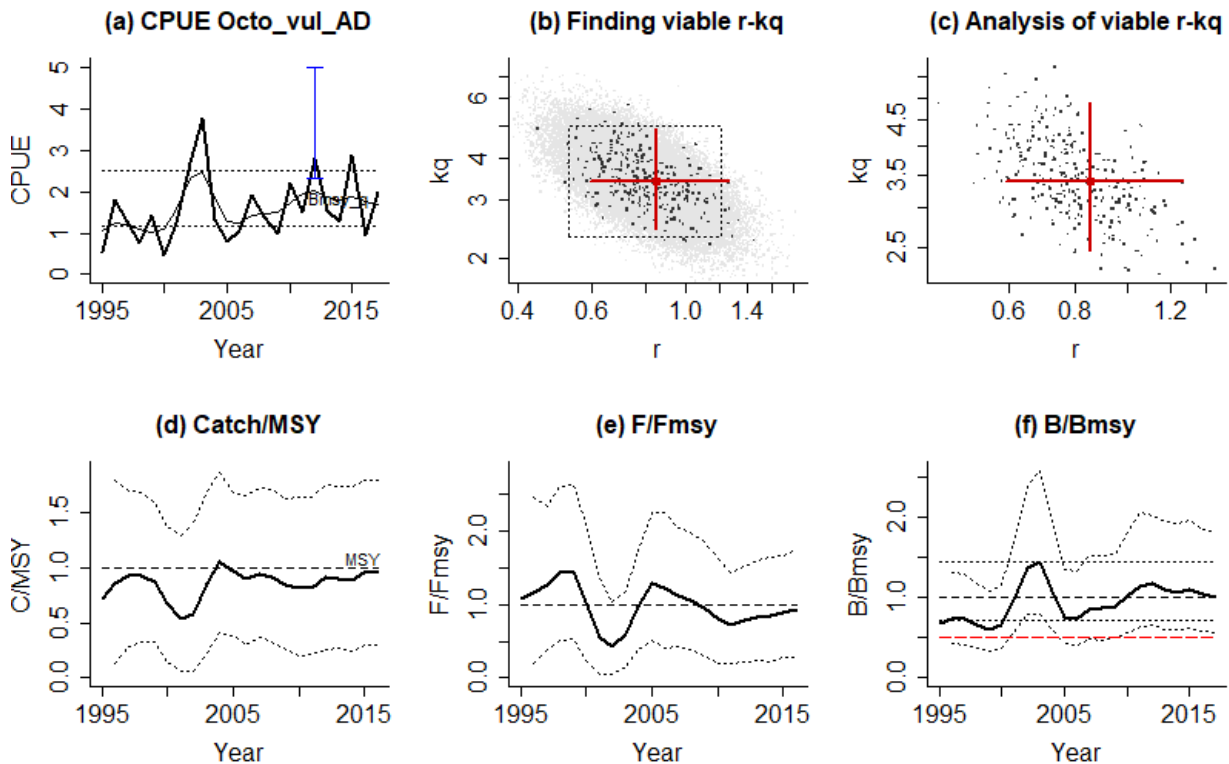
AMSY Kobe plot and retrospective analysis for *Octopus vulgaris* Octo_vul_AD
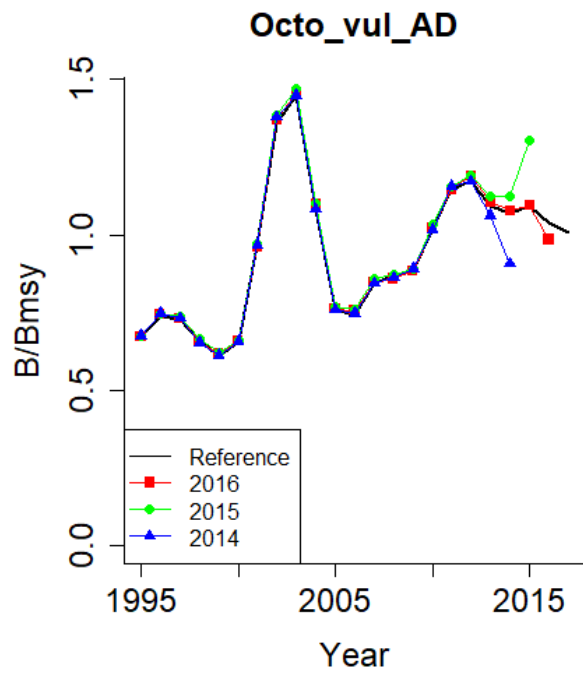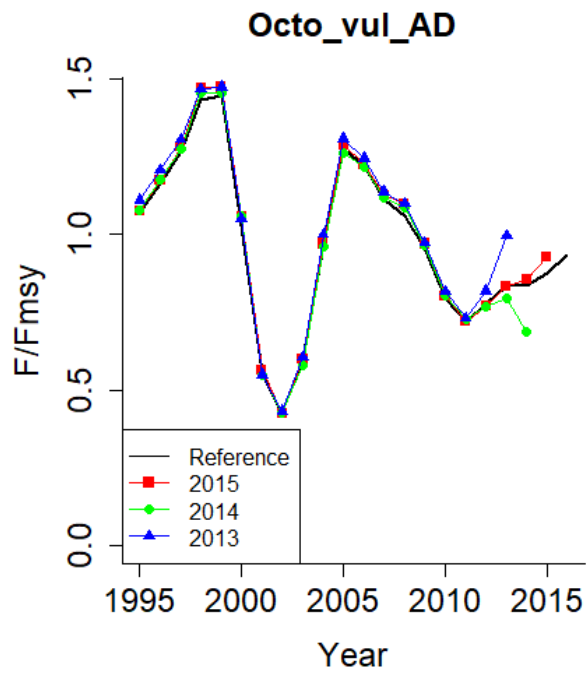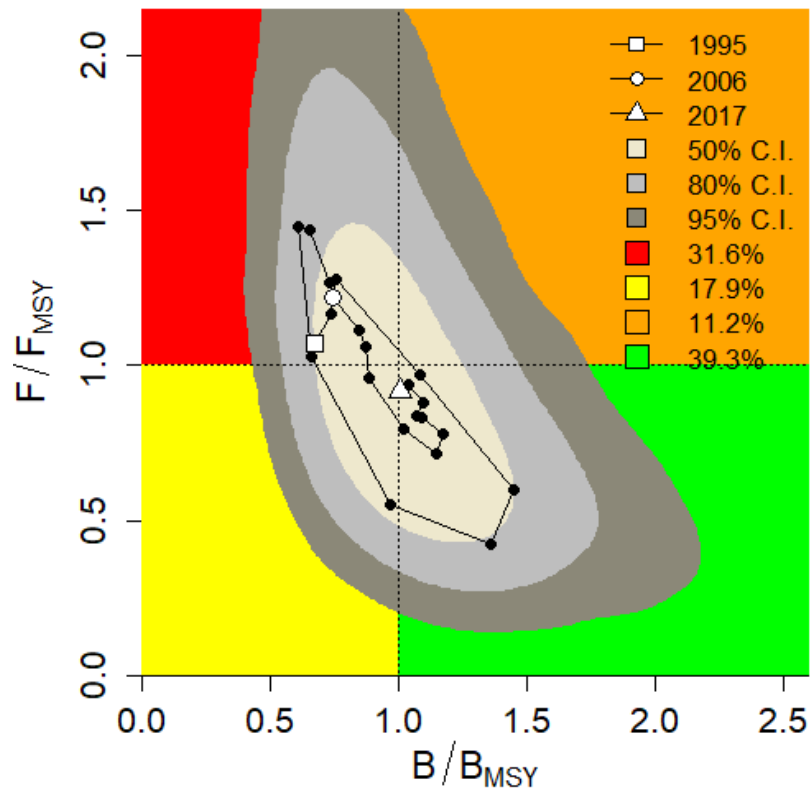
Aegean Sea

```
-------------------------------------------------------------------
LBB results for Diplodus annularis, stock ANN_GSA22, 1994-2016
Files:LBB4AMSY_ID_2.csv, ANN.csv
-------------------------------------------------------------------
Linf prior= 20, SD=0.2 cm (user-defined), Lmax=19.5, median Lmax=18
Z/K prior = 3.2, SD=0.13, M/K prior=1.5, SD=0.15
F/K prior = 1.7 (wide range with tau=4 in log-normal distribution)
Lc prior  = 10.7, SD=1.1 cm, alpha prior=23.6, SD=2.4, Lm50=10 cm

General reference points (median across years):
Linf     = 19.6 (19.3-19.9) cm
Lopt     = 14 cm, Lopt/Linf=0.71
Lc_opt   = 13 cm, Lc_opt/Linf=0.65, Lmean if F=M 14 cm
M/K      = 1.22 (0.97-1.6)
F/M      = 2.81 (1.43-3.62), F/K=2.94 (2.24-3.45), Z/K=4.16 (3.78-4.51)
B/B0     = 0.17 (0.083-0.23), B/B0 F=M Lc=Lc_opt 0.38
Y/R'     = 0.042 (0.024-0.079)(reduced: B/B0<0.25),Y/R' F=M Lc=Lc_opt 0.062

Estimates for 2016 (mean of last 3 years with data):
Lc50     = 10.9 (10.8-10.9) cm, Lc/Linf=0.56 (0.56-0.56)
Lc95     = 12.9, alpha=1.45 (1.41-1.49)
Lmean/Lopt= 0.83, Lc/Lc_opt=0.85, L95th=16.8 cm, L95th/Linf=0.87, Mature=91%
F/M      = 5.9 (-7.9-23), F/K=4 (3.5-4.4), Z/K=4.9 (4.5-5.2)
Y/R'     = 0.033 (-0.027-0.11)(reduced because B/B0 < 0.25)
B/B0     = 0.086 (0.011-0.18), best LF fit year 1998=0.208 (0.12-0.3)
B/Bmsy   = 0.23 (0.029-0.47), selected B/B0 1998 = 0.21 (0.12-0.3)
RF: Set Linf=20 to include Lmax=19.5. Removed years with unsuitable LF;
accepted best-fit year 1998 (high B/B0 with narrow CV) as prior for AMSY.
```
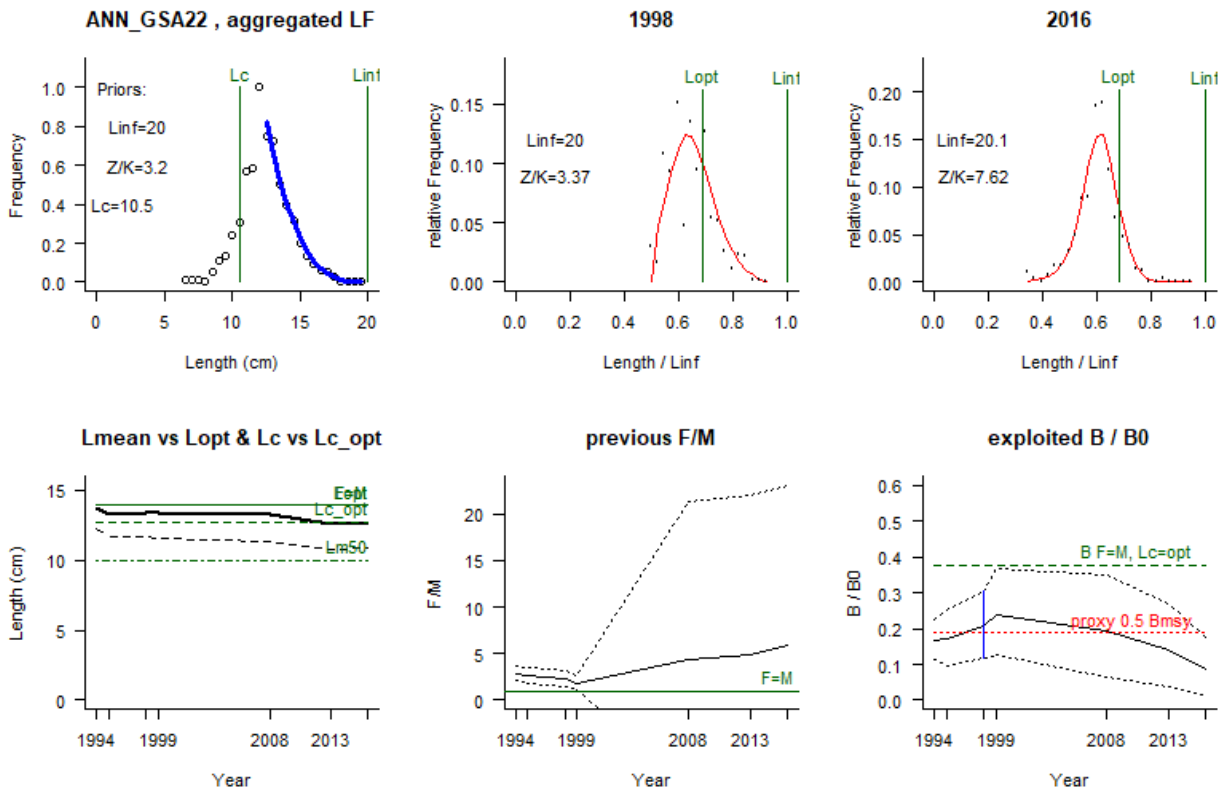
```
----------------------------------------------------------------
AMSY Analysis, Fri Nov 01 16:48:36 2019
----------------------------------------------------------------
Stock DIPL.ANN, Diplodus annularis, Annular seabream
CPUE data for years 1994 - 2016, CPUE range 17.1 - 28.4, smooth = TRUE
Prior for r                   = High, 0.5 - 1.13
Used prior range for r        = 0.468 - 1.2
Prior for 1998 stock status   = Small, 0.12 - 0.3
Used 1998 prior B/B0 range    = 0.12 - 0.3, prior B/Bmsy = 0.24 - 0.6
Used prior range for kq       = 154 - 232 [original range = 77.2 - 193]
Comment: B/B0 prior from LBB. RF: OK
Source:

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 5003

  Results:
  viable r-kq pairs   = 5003
  median kq           = 184, 152 - 221
  median MSYq         = 36.8, 27.2 - 51.4
  r (4 MSYq/kq)       = 0.8, 0.55 - 1.2
  Fmsy (r/2)          = 0.4, 0.275 - 0.599
  F/Fmsy              = 0.877, 0.106 - 2.38 (2015)
  B/Bmsy              = 0.234, 0.131 - 0.416 (2016)
```

DIPL.ANN

DIPL.ANN
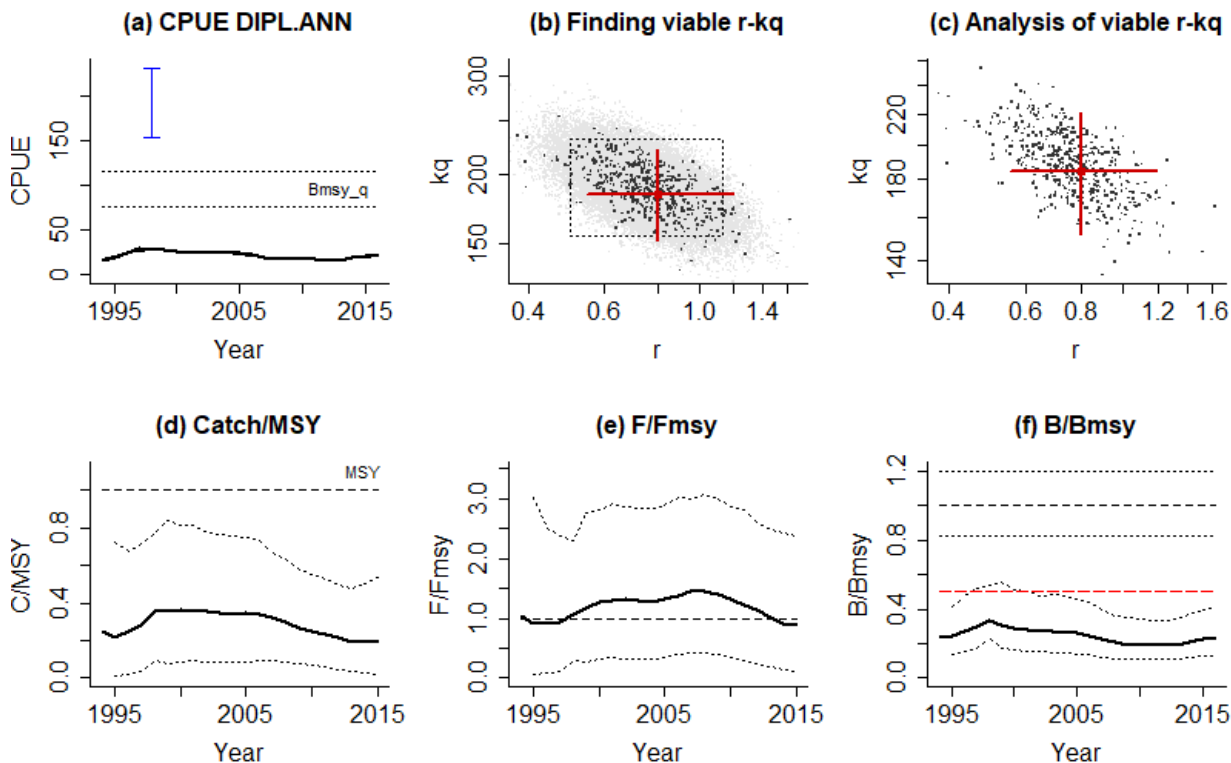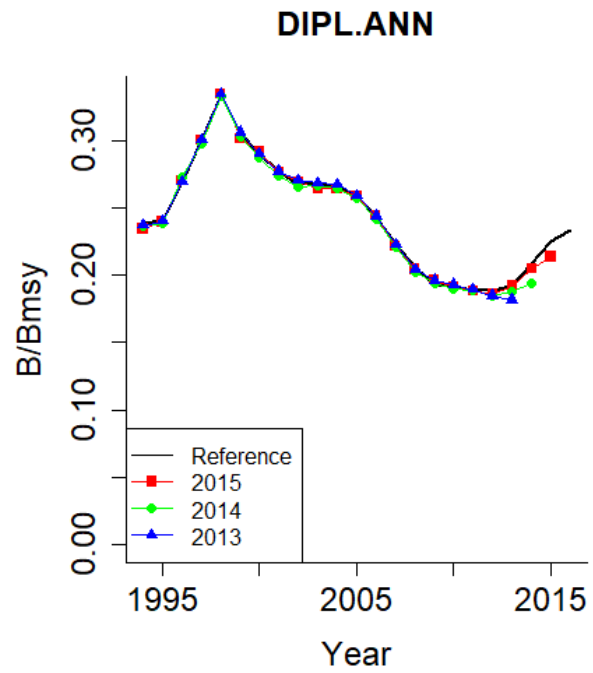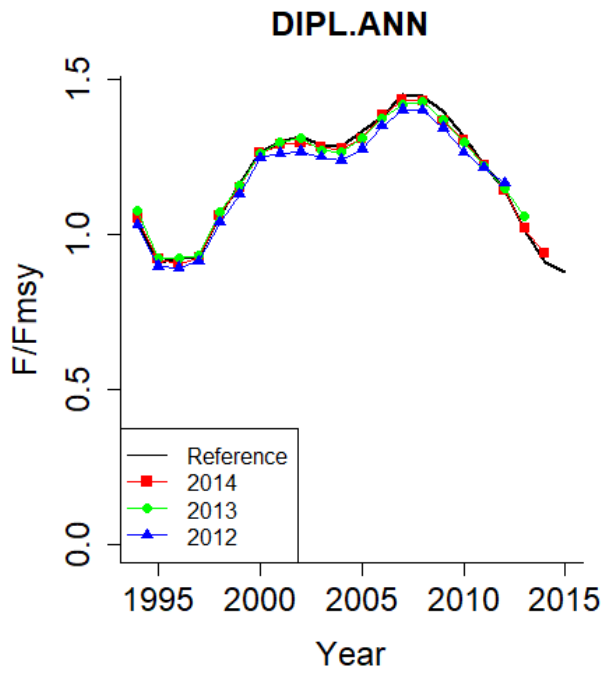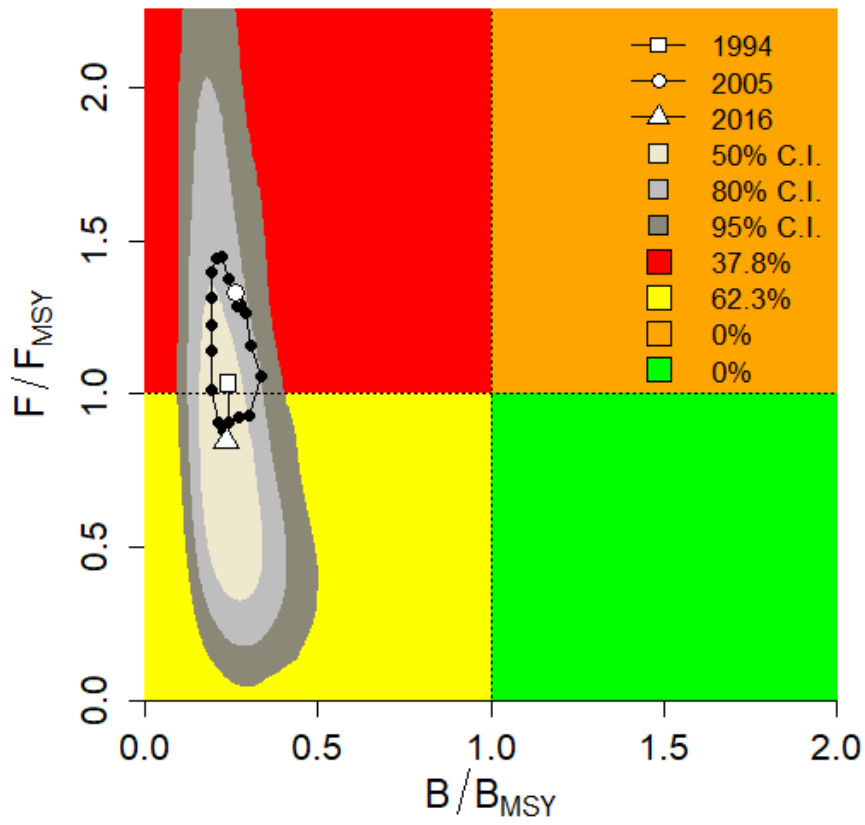
```
--------------------------------------------------------------------
LBB results for Capros aper, stock BOC_GSA22, 1999-2013
Files:LBB4AMSY_ID_2.csv, BOC.csv
--------------------------------------------------------------------
Linf prior= 14, SD=0.14 cm (user-defined), Lmax=13.5, median Lmax=11.2
Z/K prior = 1.6, SD=0.29, M/K prior=1.5, SD=0.15
F/K prior = 0.0745 (wide range with tau=4 in log-normal distribution)
Lc prior  = 6.12, SD=0.61 cm, alpha prior=7.97, SD=0.8, Lm50=6.7 cm

General reference points (median across years):
Linf     = 13.7 (13.5-14) cm
Lopt     = 8.3 cm, Lopt/Linf=0.61
Lc_opt   = 7.5 cm, Lc_opt/Linf=0.54, Lmean if F=M 9.66 cm
M/K      = 1.98 (1.71-2.22)
F/M      = 2.43 (1.45-3.29), F/K=3.64 (2.91-4.28), Z/K=5.15 (4.55-5.76)
B/B0     = 0.31 (0.12-0.45), B/B0 F=M Lc=Lc_opt 0.36
Y/R'     = 0.013 (0.0064-0.02), Y/R' F=M Lc=Lc_opt 0.028

Estimates for 2013 (mean of last 3 years with data):
Lc50     = 6.92 (6.58-7.28) cm, Lc/Linf=0.5 (0.48-0.53)
Lc95     = 11.7, alpha=0.62 (0.596-0.647)
Lmean/Lopt= 0.86, Lc/Lc_opt=0.93, L95th=11.3 cm, L95th/Linf=0.82, Mature=51%
F/M      = 3.6 (2.6-5.1), F/K=4.7 (4-5.4), Z/K=6.1 (5.5-6.7)
Y/R'     = 0.025 (0.014-0.037)
B/B0     = 0.13 (0.075-0.2), best LF fit year 2005=0.526 (0.17-1.5)
B/Bmsy   = 0.37 (0.21-0.55), selected B/B0 2006 = 0.25 (0.11-0.36)
RF: Set Linf=14 to include Lmax=13.5; merged LF to get more points per year;
set Lcut=4 to exclude early juveniles; set Lstart=7 to increase prior fit;
2006 seems least problematic.
```
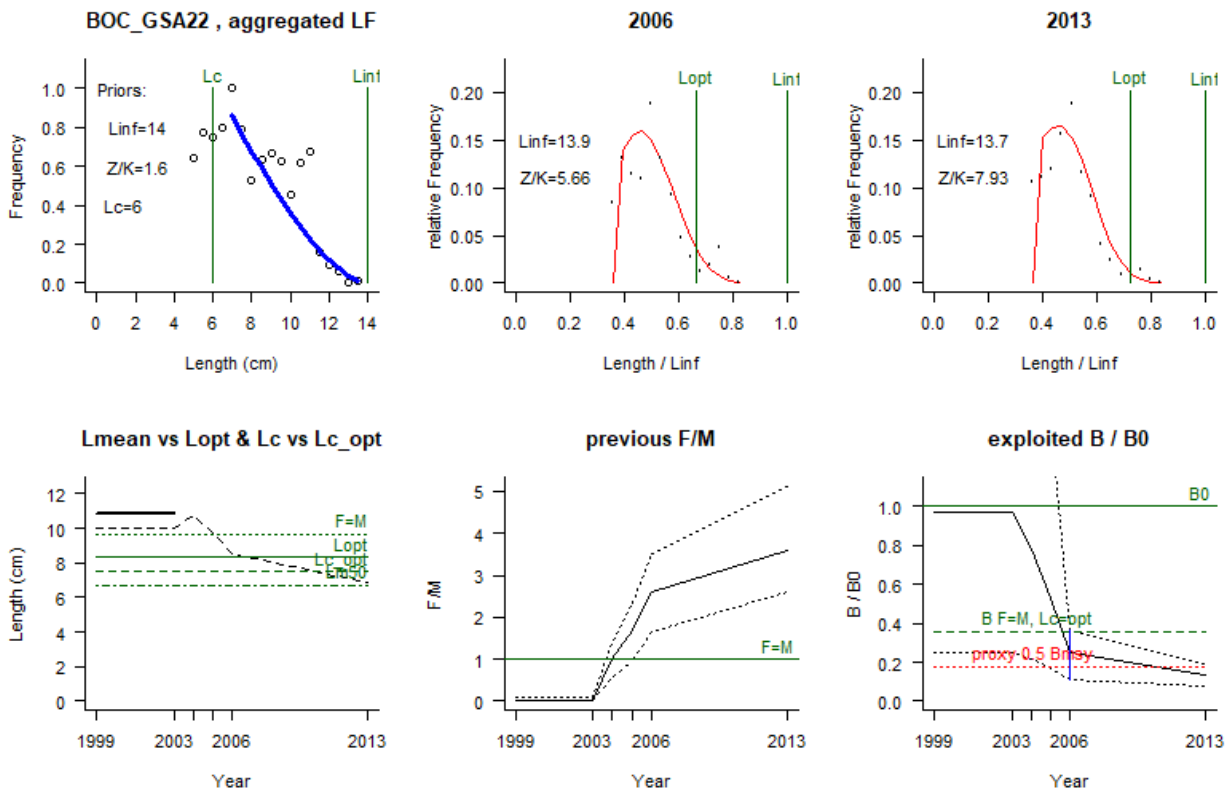
```
----------------------------------------------------------------
AMSY Analysis, Fri Nov 01 17:01:55 2019
----------------------------------------------------------------
Stock CAPO.APE, Capros aper, Boarfish
CPUE data for years 1994 - 2016, CPUE range 9.39 - 16.6, smooth = TRUE
Prior for r                    = Medium, 0.29 - 0.69
Used prior range for r         = 0.272 - 0.735
Prior for 2006 stock status    = Small, 0.1 - 0.4
Used 2006 prior B/B0 range     = 0.1 - 0.4, prior B/Bmsy = 0.2 - 0.8
Used prior range for kq        = 39.9 - 79.8 [original range = 19.9 - 79.8]
Comment: B/B0 prior from LBB. RF: OK
Source:

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 5003

 Results:
 viable r-kq pairs    = 5003
 median kq            = 54.4, 38.7 - 75.4
 median MSYq          = 6.46, 4.45 - 9.18
 r (4 MSYq/kq)        = 0.475, 0.323 - 0.688
 Fmsy (r/2)           = 0.238, 0.162 - 0.344
 F/Fmsy               = 1.3, 0.21 - 2.89 (2015)
 B/Bmsy               = 0.612, 0.344 - 1.09 (2016)
```

CAPO.APE

CAPO.APE
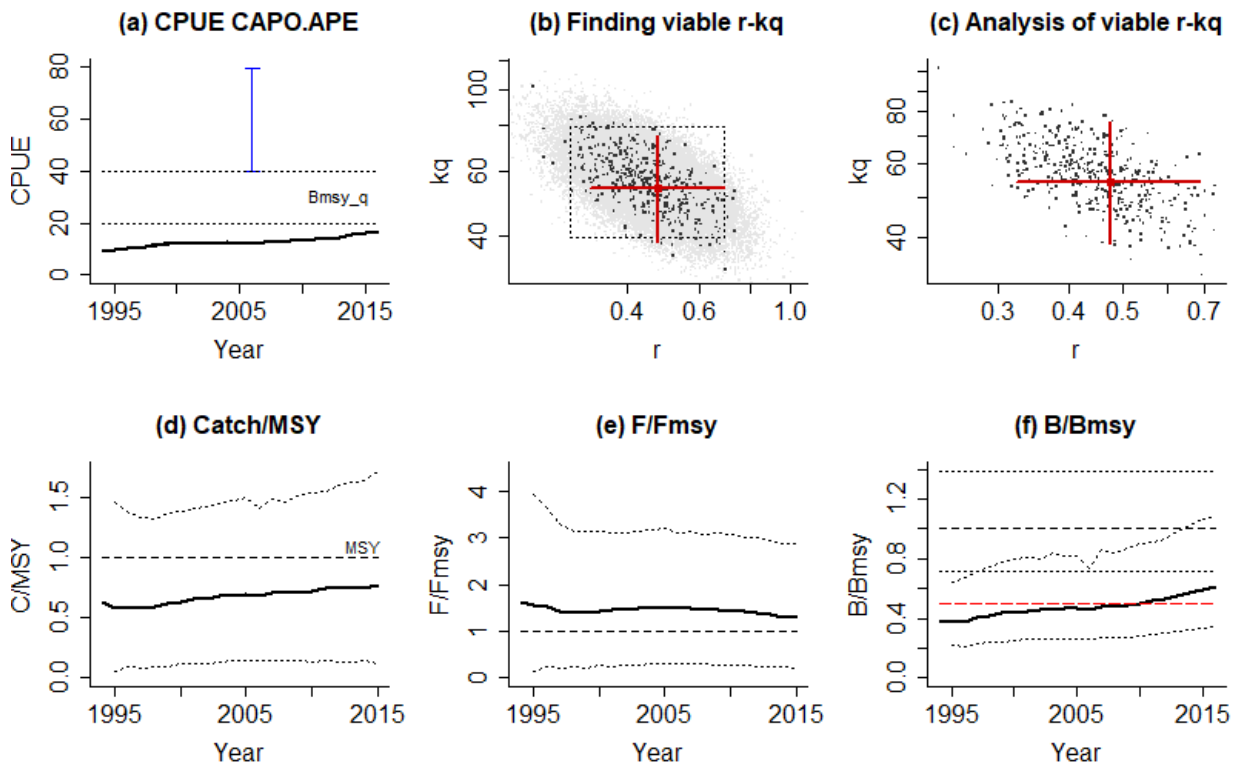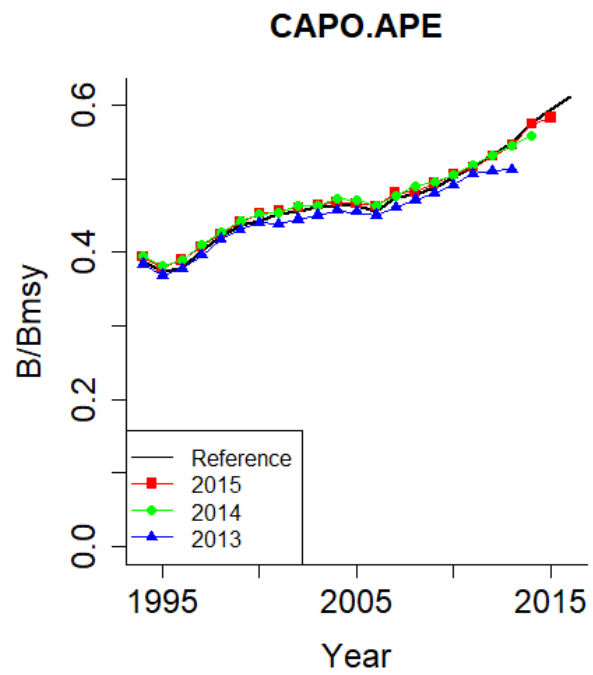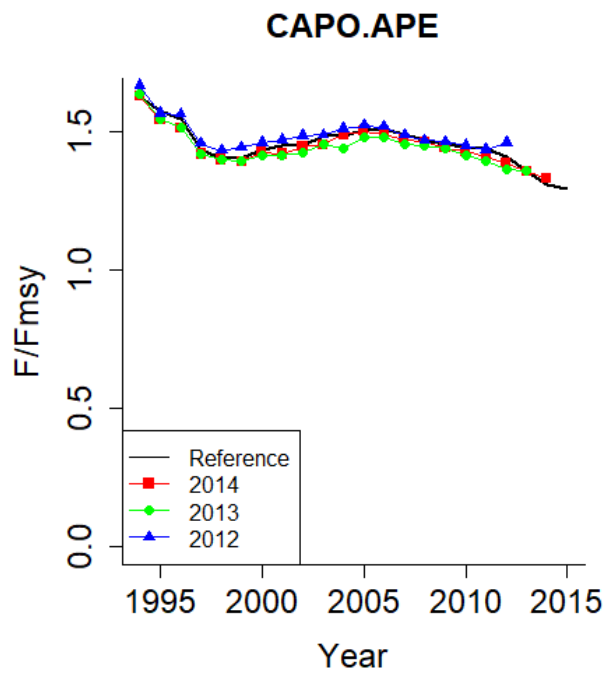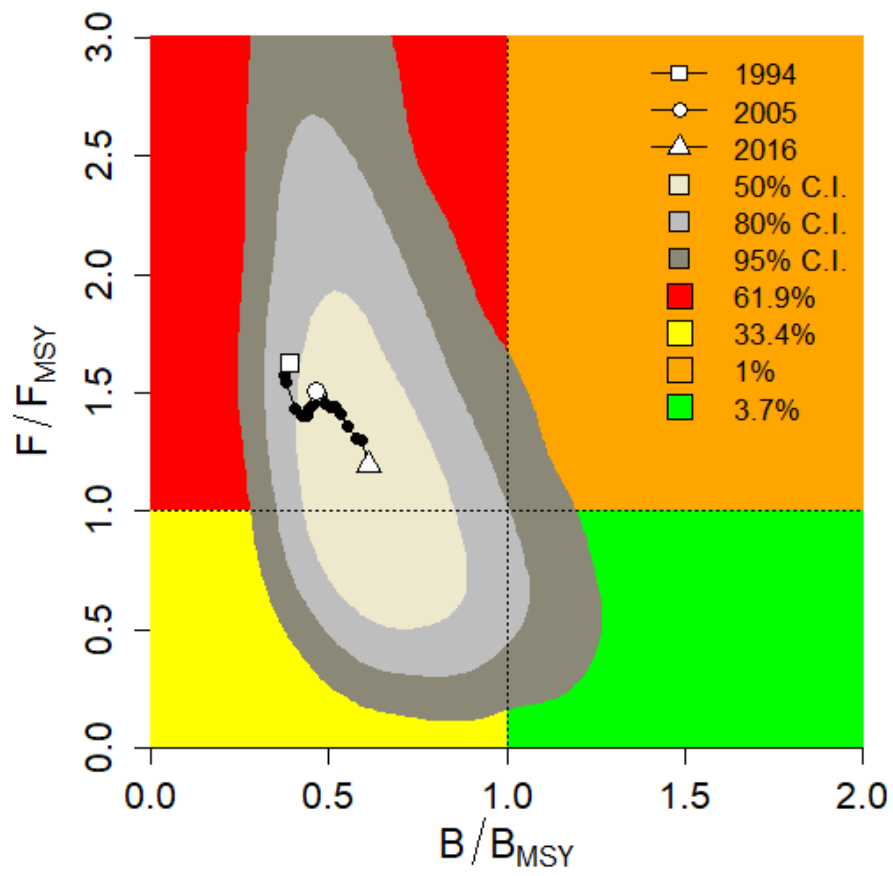
```
------------------------------------------------------------------
LBB results for Helicolenus dactylopterus, stock BRF_GSA22, 1995-2016
Files:LBB4AMSY_ID_2.csv, BRF.csv
------------------------------------------------------------------
Linf prior= 36, SD=0.36 cm (user-defined), Lmax=57, median Lmax=32.8
Z/K prior = 2.3, SD=0.11, M/K prior=1.5, SD=0.15
F/K prior = 0.796 (wide range with tau=4 in log-normal distribution)
Lc prior  = 11.2, SD=1.1 cm, alpha prior=13.7, SD=1.4, Lm50=NA cm

General reference points (median across years):
Linf     = 36 (35.4-36.7) cm
Lopt     = 24 cm, Lopt/Linf=0.65
Lc_opt   = 19 cm, Lc_opt/Linf=0.54, Lmean if F=M 18.9 cm
M/K      = 1.58 (1.29-1.82)
F/M      = 0.829 (0.502-1.22), F/K=1.38 (1.05-1.84), Z/K=2.75 (2.5-3.02)
B/B0     = 0.39 (0.16-0.6), B/B0 F=M Lc=Lc_opt 0.36
Y/R'     = 0.033 (0.014-0.052), Y/R' F=M Lc=Lc_opt 0.04

Estimates for 2016 (mean of last 3 years with data):
Lc50     = 13 (12.4-13.5) cm, Lc/Linf=0.36 (0.35-0.38)
Lc95     = 21.4, alpha=0.347 (0.332-0.362)
Lmean/Lopt= 0.8, Lc/Lc_opt=0.67, L95th=32 cm, L95th/Linf=0.9, Mature=NA%
F/M      = 0.89 (0.58-1.3), F/K=1.4 (1-1.7), Z/K=3 (2.7-3.3)
Y/R'     = 0.031 (0.015-0.048)
B/B0     = 0.36 (0.15-0.56), best LF fit year 2004=0.533 (0.16-0.97)
B/Bmsy   = 0.99 (0.41-1.5), selected B/B0 2006 = 0.34 (0.16-0.54)
RF: Lmax=57 is probably an error, setting Linf=36 close to several annual
Lmax; Lm unknown for the area; set Lcut=8 to exclude early juveniles; excluded
years with unsuitable LF patterns; 2006 possible for AMSY.
```
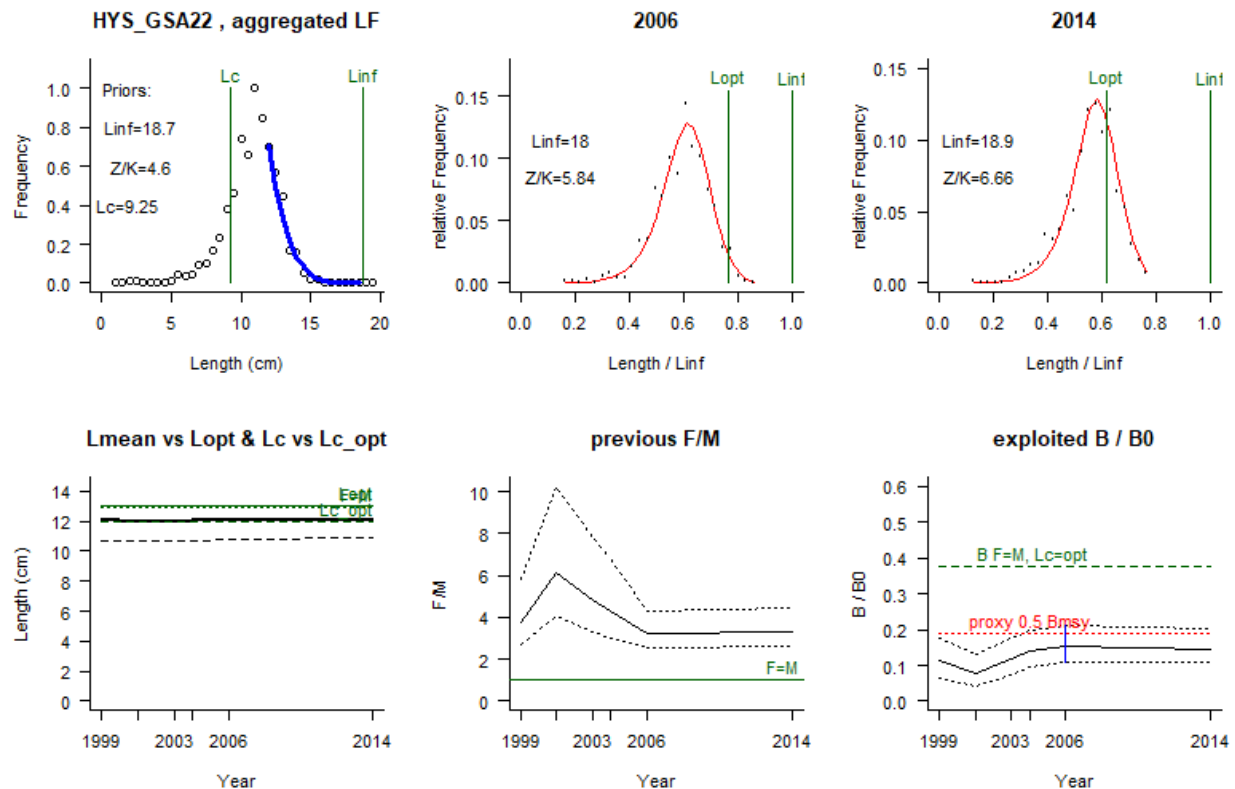

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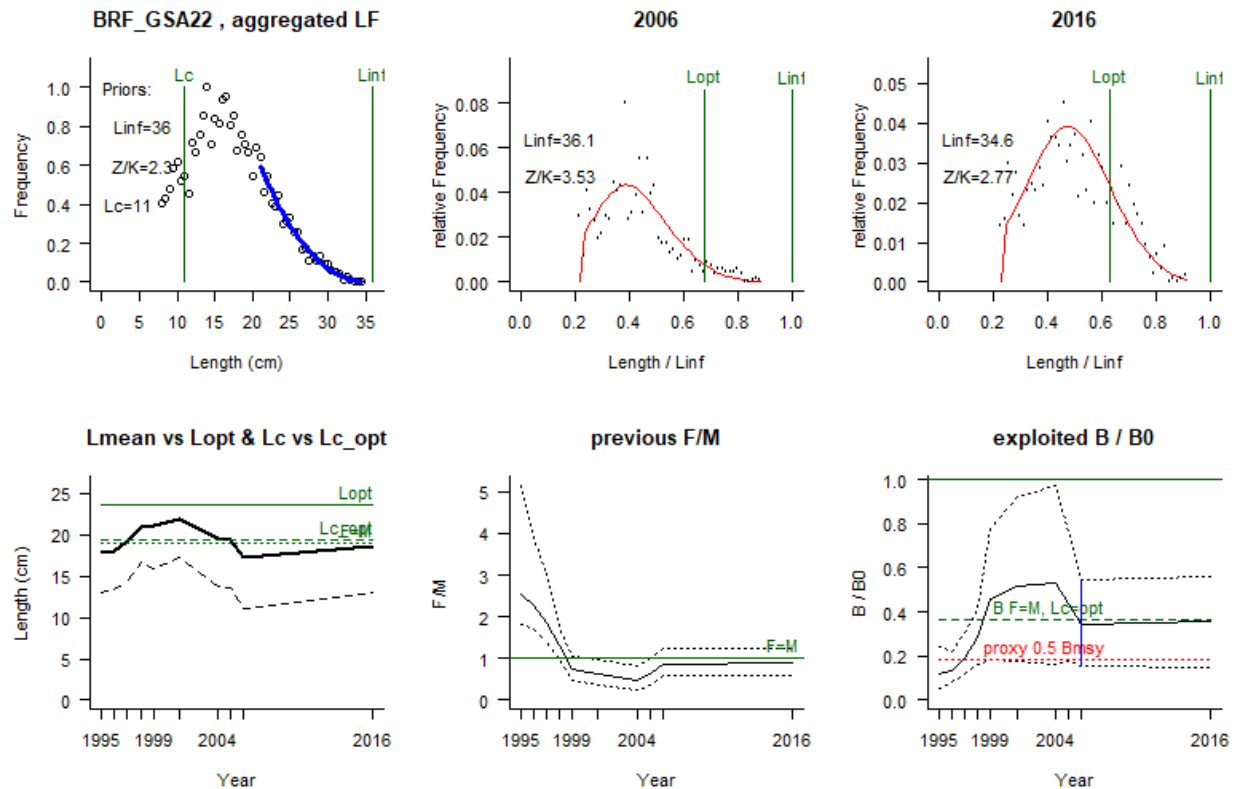
```
------------------------------------------------------------------
AMSY Analysis, Fri Nov 01 17:14:11 2019
------------------------------------------------------------------
Stock HELI.DAC, Helicolenus dactylopterus, Blackbelly rosefish
CPUE data for years 1994 - 2016, CPUE range 2.56 - 26.5, smooth = TRUE
Prior for r                   = Medium, 0.27 - 0.61
Used prior range for r        = 0.253 - 0.652
Prior for 2006 stock status   = About half, 0.16 - 0.54
Used 2006 prior B/B0 range    = 0.16 - 0.54, prior B/Bmsy = 0.32 - 1.08
Used prior range for kq       = 28.6 - 85.7 [original range = 28.6 - 96.4]
Comment: B/B0 prior from LBB. RF: OK
Source:

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 2115

 Results:
 viable r-kq pairs   = 2115
 median kq           = 46.9, 31.8 - 72.9
 median MSYq         = 5.53, 3.89 - 8.2
 r (4 MSYq/kq)       = 0.472, 0.324 - 0.676
 Fmsy (r/2)          = 0.236, 0.162 - 0.338
 F/Fmsy              = 0.757, 0.0695 - 1.88 (2015)
 B/Bmsy              = 1.14, 0.633 - 2.1 (2016)
```


(a) CPUE HELI.DAC   (b) Finding viable r-kq   (c) Analysis of viable r-kq

(d) Catch/MSY   (e) F/Fmsy   (f) B/Bmsy

HELI.DAC

HELI.DAC
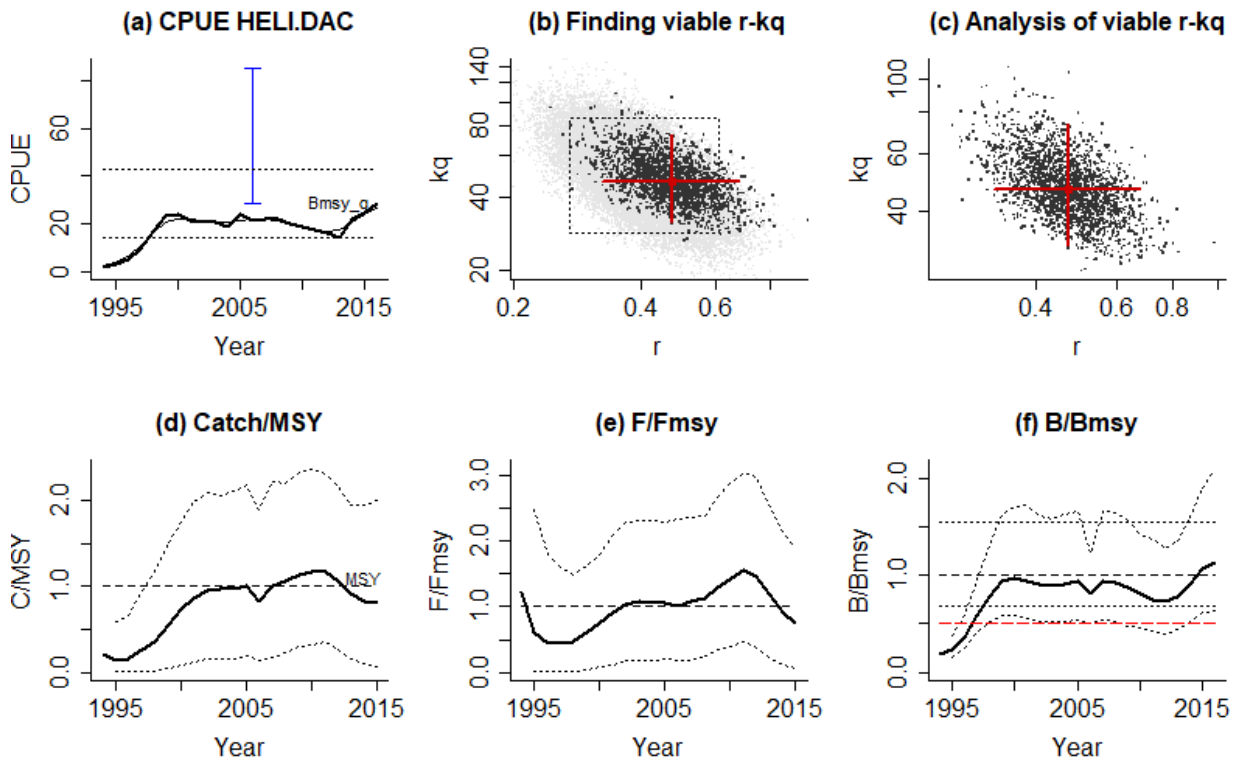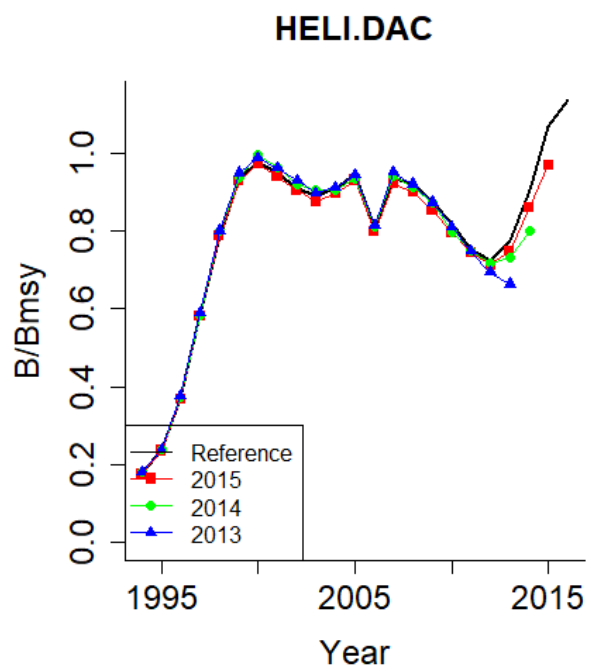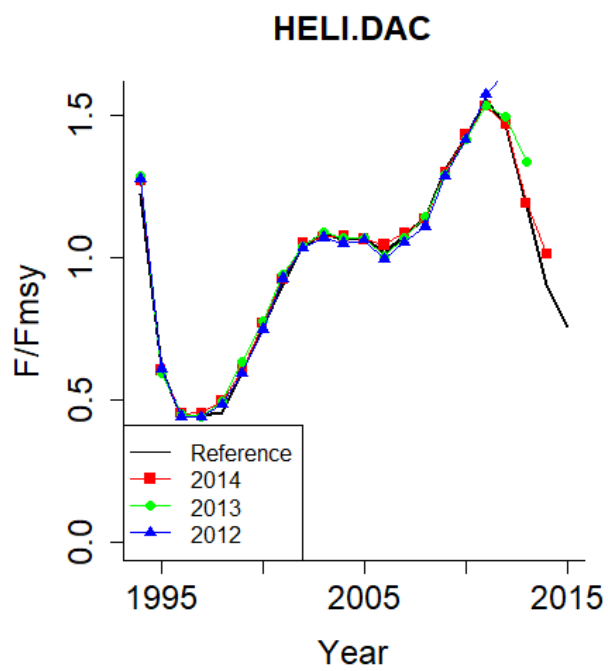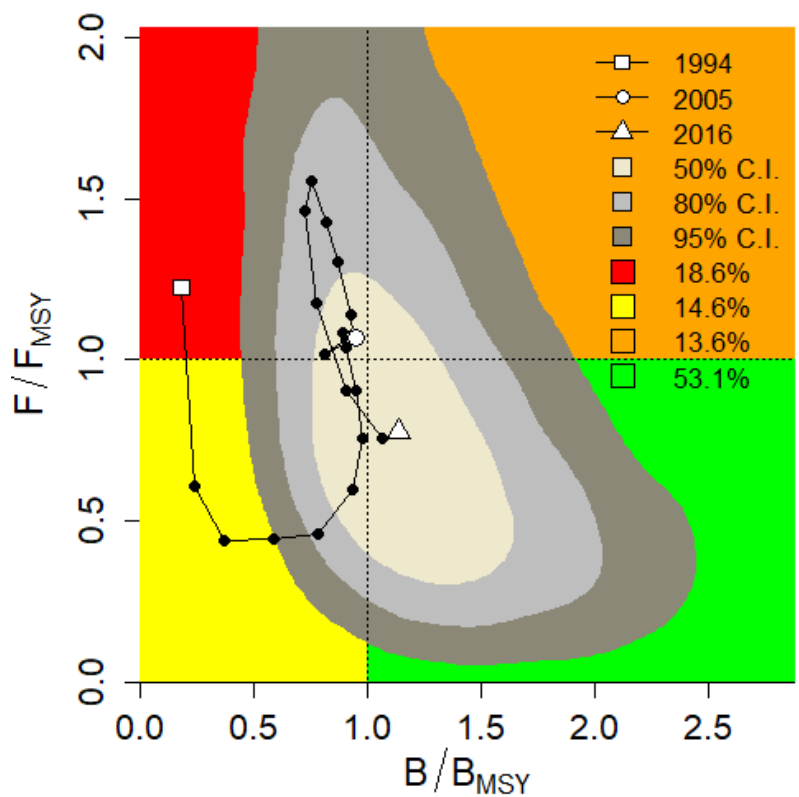
```
----------------------------------------------------------------------
LBB results for Citharus linguatula, stock CIL_GSA22, 1994-2016
Files:Stock_ID_Greece2.csv, CIL.csv
----------------------------------------------------------------------
Linf prior= 27, SD=0.27 cm (user-defined), Lmax=33.5, median Lmax=25.2
Z/K prior = 3.1, SD=0.13, M/K prior=1.5, SD=0.15
F/K prior = 1.65 (wide range with tau=4 in log-normal distribution)
Lc prior  = 7.91, SD=0.79 cm, alpha prior=32.9, SD=3.3, Lm50=NA cm

General reference points (median across years):
Linf     = 26.9 (26.5-27.4) cm
Lopt     = 18 cm, Lopt/Linf=0.68
Lc_opt   = 15 cm, Lc_opt/Linf=0.57, Lmean if F=M 13.3 cm
M/K      = 1.42 (1.12-1.73)
F/M      = 1.07 (0.768-1.58), F/K=1.59 (1.3-1.94), Z/K=3 (2.79-3.25)
B/B0     = 0.26 (0.14-0.4), B/B0 F=M Lc=Lc_opt 0.37
Y/R'     = 0.036 (0.018-0.061), Y/R' F=M Lc=Lc_opt 0.05

Estimates for 2016 (mean of last 3 years with data):
Lc50     = 9.55 (9.4-9.69) cm, Lc/Linf=0.35 (0.35-0.36)
Lc95     = 12.1, alpha=1.16 (1.13-1.2)
Lmean/Lopt= 0.7, Lc/Lc_opt=0.62, L95th=20.3 cm, L95th/Linf=0.75, Mature=NA%
F/M      = 2.3 (1.7-3.2), F/K=3.3 (2.9-3.8), Z/K=4.8 (4.5-5.1)
Y/R'     = 0.019 (0.013-0.028)
B/B0     = 0.12 (0.077-0.17), best LF fit year 2016=0.118 (0.077-0.17)
B/Bmsy   = 0.32 (0.21-0.46), selected B/B0 2006 = 0.18 (0.1-0.28)
RF: Set Linf=27 close to median=26 below max=33. Selected 2006 because of
reasonable LF fit and reasonable B/B0, compared to adjacent estimates.
```


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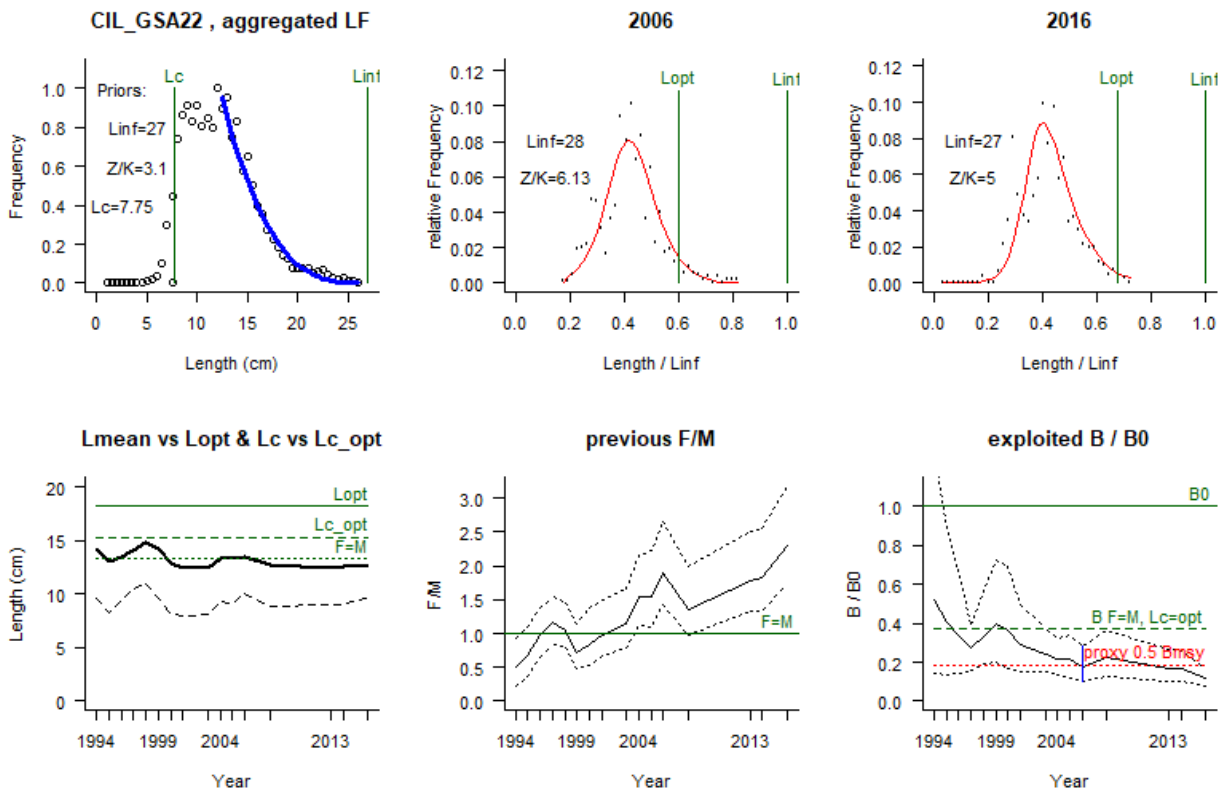
```
-----------------------------------------------------------------
AMSY Analysis, Fri Nov 01 17:22:35 2019
-----------------------------------------------------------------
Stock CITHMAC_AEGEAN, Citharus linguatula , Spotted flounder
CPUE data for years 1994 - 2016, CPUE range 2.24 - 8.34, smooth = TRUE
Prior for r                   = Medium, NA - NA
Used prior range for r        = 0.2 - 0.8
Prior for 2006 stock status   = Small, 0.12 - 0.3
Used 2006 prior B/B0 range    = 0.12 - 0.3, prior B/Bmsy = 0.24 - 0.6
Used prior range for kq       = 18 - 44.9 [original range = 18 - 44.9]
Comment: B/B0 prior from LBB. RF: OK
Source:

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 5000

 Results:
 viable r-kq pairs    = 5000
 median kq            = 26, 18 - 38.3
 median MSYq          = 3.39, 2.03 - 5.49
 r (4 MSYq/kq)        = 0.521, 0.295 - 0.887
 Fmsy (r/2)           = 0.26, 0.147 - 0.443
 F/Fmsy               = 1.55, 0.307 - 3.36 (2015)
 B/Bmsy               = 0.447, 0.251 - 0.803 (2016)
```


(a) CPUE CITHMAC_AEGEAN (b) Finding viable r-kq (c) Analysis of viable r-kq

(d) Catch/MSY (e) F/Fmsy (f) B/Bmsy

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CITHMAC_AEGEAN

CITHMAC_AEGEAN
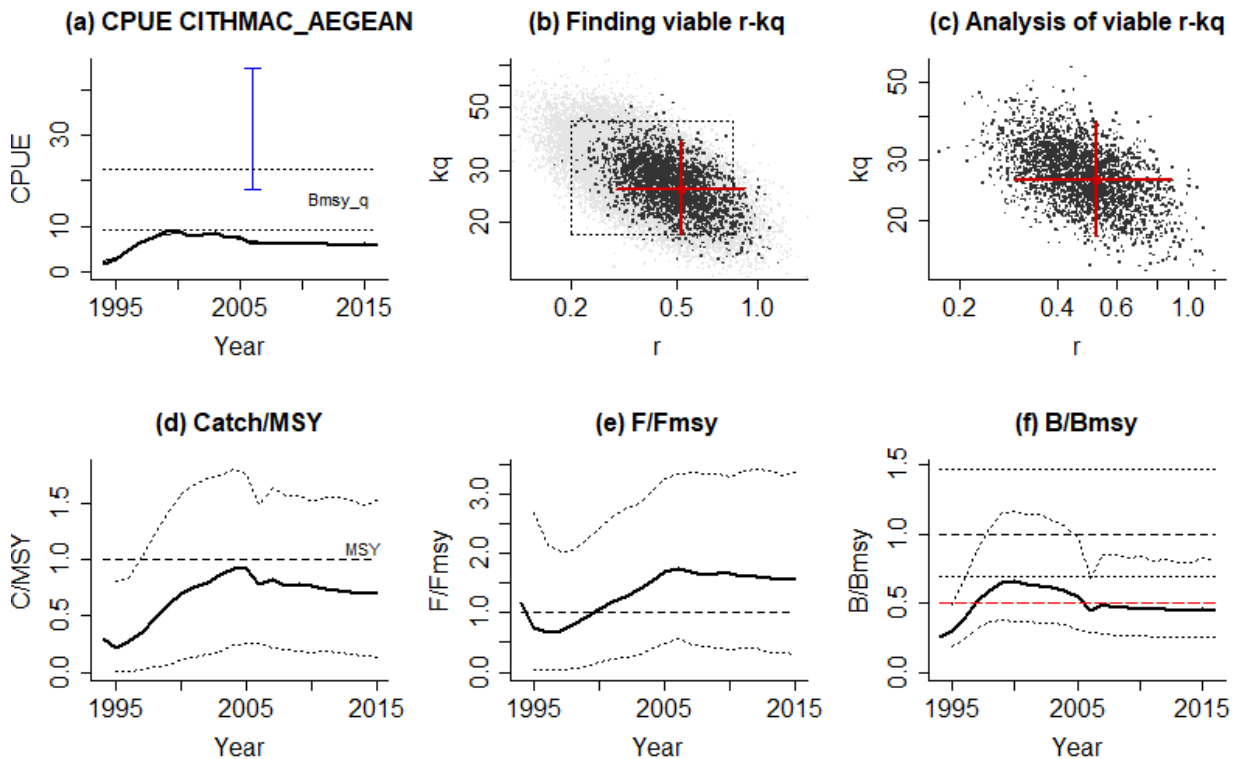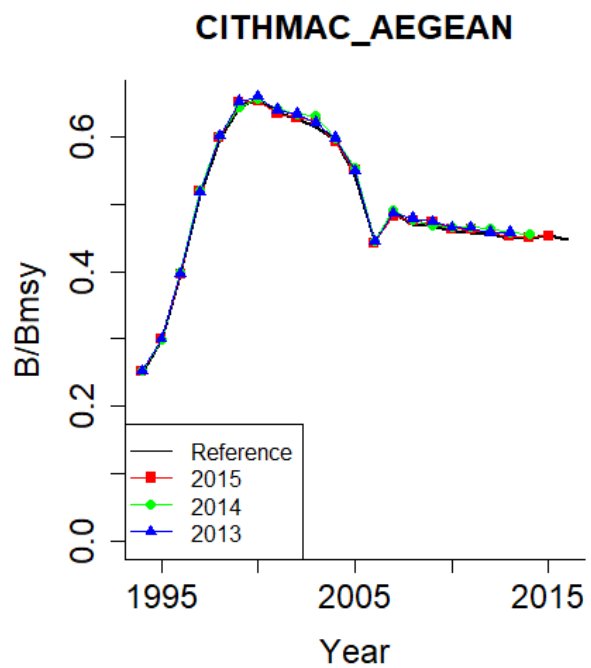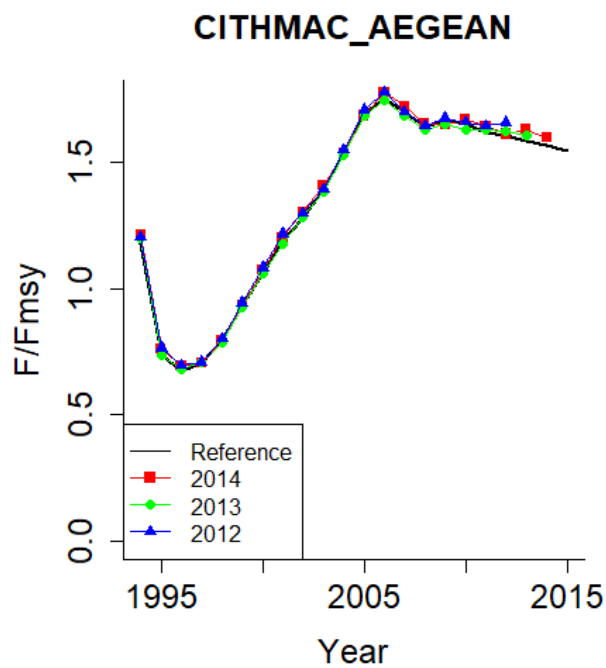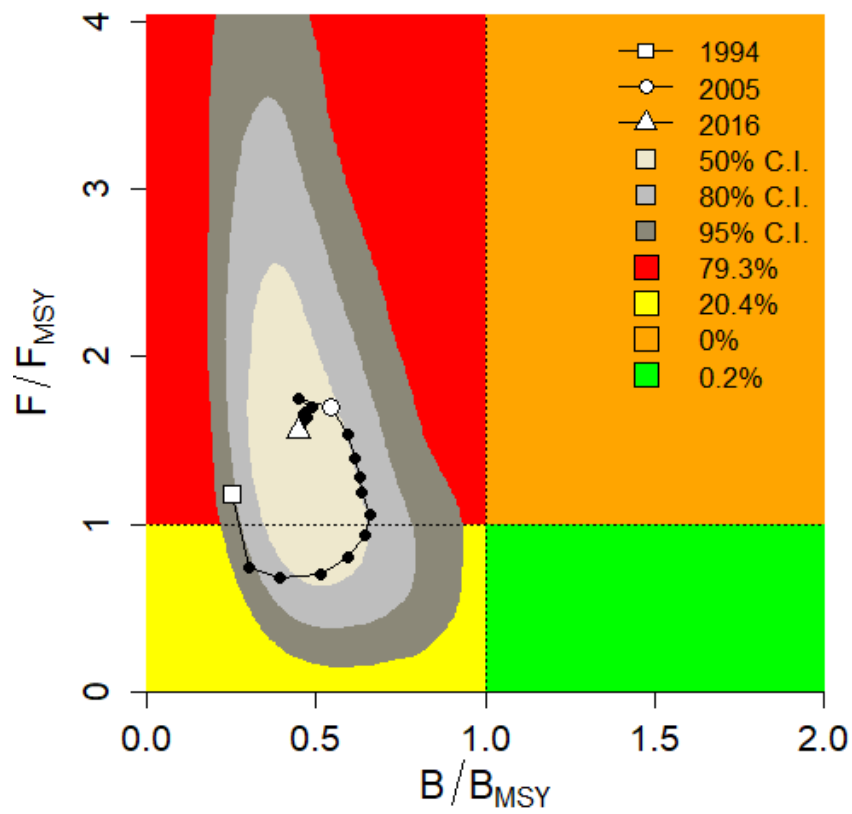
```
--------------------------------------------------------------------
LBB results for Hymenocephalus italicus, stock HYS_GSA22, 1999-2014
Files:Stock_ID_Greece2.csv, HYS.csv
--------------------------------------------------------------------
Linf prior= 18.7, SD=0.19 cm Lmax=21, median Lmax=18.8
Z/K prior = 4.6, SD=3.5, M/K prior=1.5, SD=0.15
F/K prior = 3.14 (wide range with tau=4 in log-normal distribution)
Lc prior  = 9.44, SD=0.94 cm, alpha prior=23.7, SD=2.4, Lm50=NA cm

General reference points (median across years):
Linf     = 18.4 (18.1-18.7) cm
Lopt     = 13 cm, Lopt/Linf=0.71
Lc_opt   = 12 cm, Lc_opt/Linf=0.65, Lmean if F=M 12.9 cm
M/K      = 1.26 (1.02-1.47)
F/M      = 3.2 (2.47-4.61), F/K=4.41 (3.87-5.06), Z/K=5.61 (5.1-6.23)
B/B0     = 0.14 (0.098-0.2), B/B0 F=M Lc=Lc_opt 0.38
Y/R'     = 0.031 (0.021-0.05)(reduced: B/B0<0.25),Y/R' F=M Lc=Lc_opt 0.059

Estimates for 2014 (mean of last 3 years with data):
Lc50     = 10.9 (10.7-11) cm, Lc/Linf=0.58 (0.58-0.59)
Lc95     = 13.6, alpha=1.08 (1.05-1.12)
Lmean/Lopt= 0.95, Lc/Lc_opt=0.91, L95th=15.2 cm, L95th/Linf=0.82, Mature=NA%
F/M      = 3.3 (2.7-4.4), F/K=4.4 (3.9-5), Z/K=5.8 (5.3-6.4)
Y/R'     = 0.032 (0.023-0.045)(reduced because B/B0 < 0.25)
B/B0     = 0.15 (0.11-0.2), best LF fit year 2004=0.141 (0.098-0.2)
B/Bmsy   = 0.39 (0.29-0.54), selected B/B0 2006 = 0.15 (0.11-0.21)
RF: Set Linf=Lmax=21, close to median=18.5. Excluded years with unrealistic LF
fits. Selected 2006 because of good LF fit and reasonable B/B0 compared to
adjacent estimates.
```

```
File FirstAss_ID_4.csv read successfully
---------------------------------------------------------------
AMSY Analysis, Fri Nov 01 17:30:01 2019
---------------------------------------------------------------
Stock HYMEITA_AEGEAN, Hymenocephalus italicus, Glasshead grenadier
CPUE data for years 1994 - 2016, CPUE range 1.22 - 2.3, smooth = TRUE
Prior for r                 = Medium, NA - NA
Used prior range for r      = 0.2 - 0.8
Prior for 2006 stock status = Very small, 0.1 - 0.22
Used 2006 prior B/B0 range  = 0.1 - 0.22, prior B/Bmsy = 0.2 - 0.44
Used prior range for kq     = 15.4 - 23.1 [original range = 7.7 - 16.9]
Comment: B/B0 prior from LBB. RF: OK
Source:

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 5000

  Results:
  viable r-kq pairs   = 5000
  median kq           = 17.6, 14.8 - 21.2
  median MSYq         = 2.34, 1.39 - 3.91
  r (4 MSYq/kq)       = 0.533, 0.294 - 0.975
  Fmsy (r/2)          = 0.267, 0.147 - 0.488
  F/Fmsy              = 1.07, 0.111 - 3.05 (2015)
  B/Bmsy              = 0.262, 0.147 - 0.471 (2016)
```
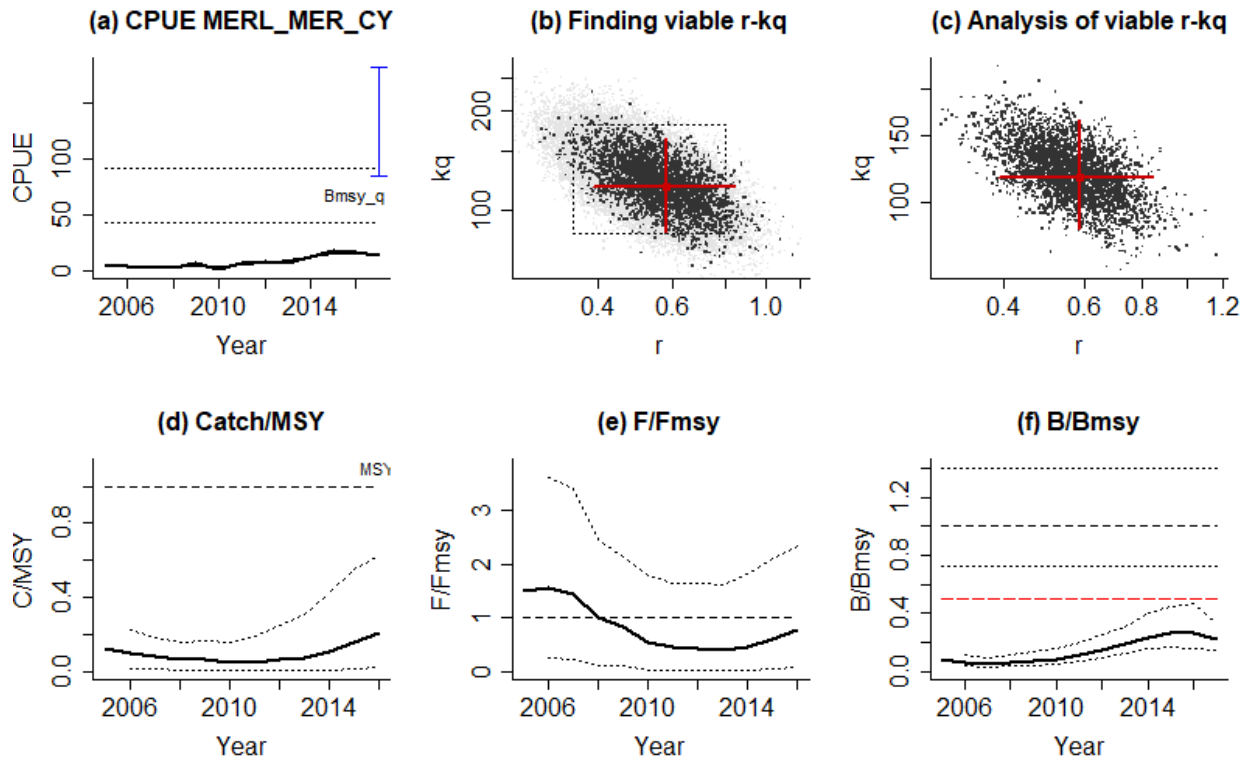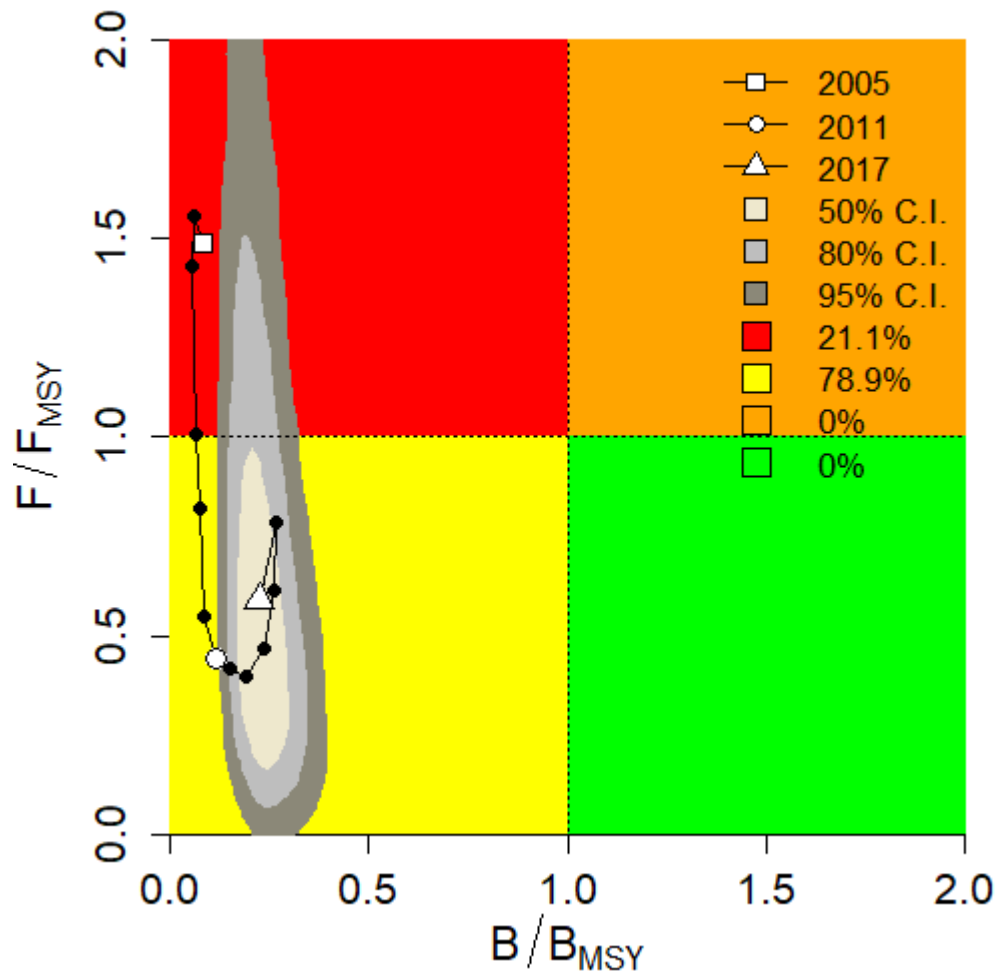

(a) CPUE HYMEITA_AEGEAN (b) Finding viable r-kq (c) Analysis of viable r-kq
(d) Catch/MSY (e) F/Fmsy (f) B/Bmsy

HYMEITA_AEGEAN

HYMEITA_AEGEAN
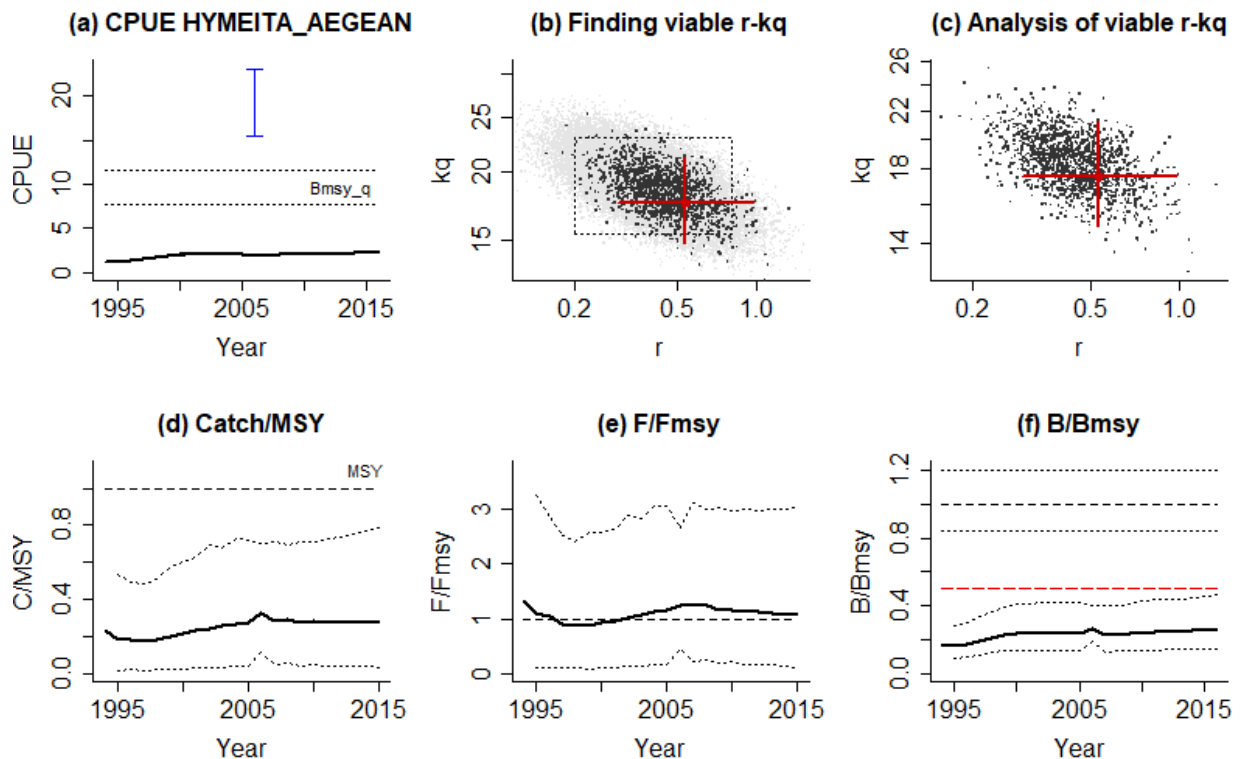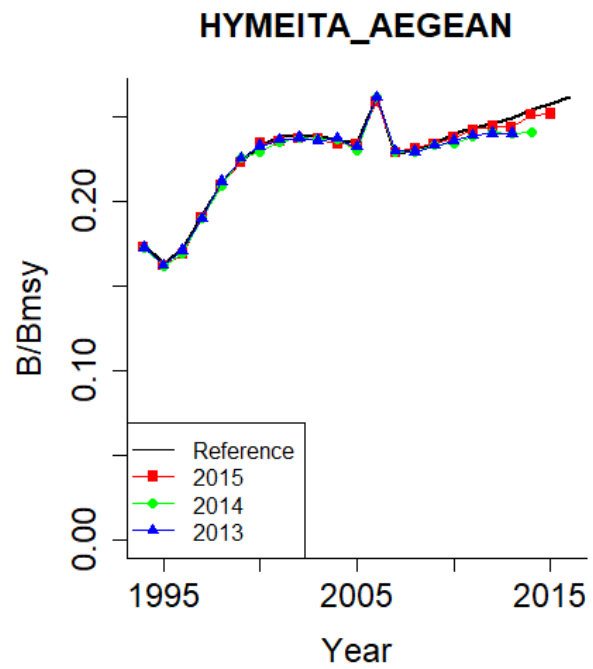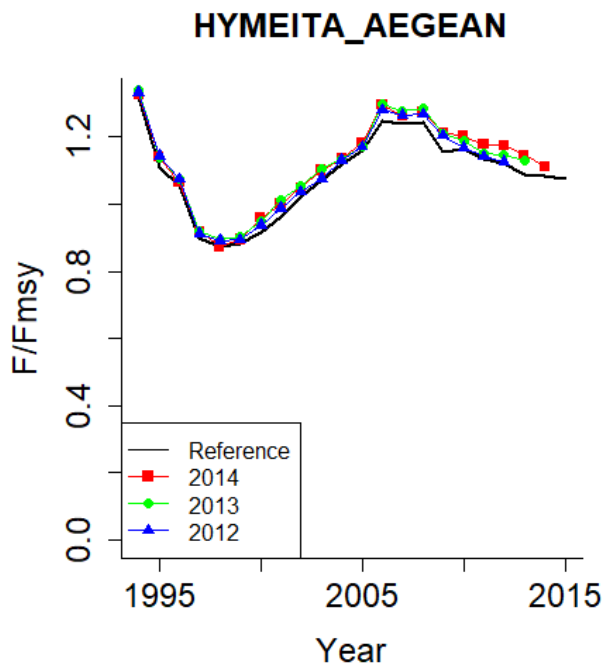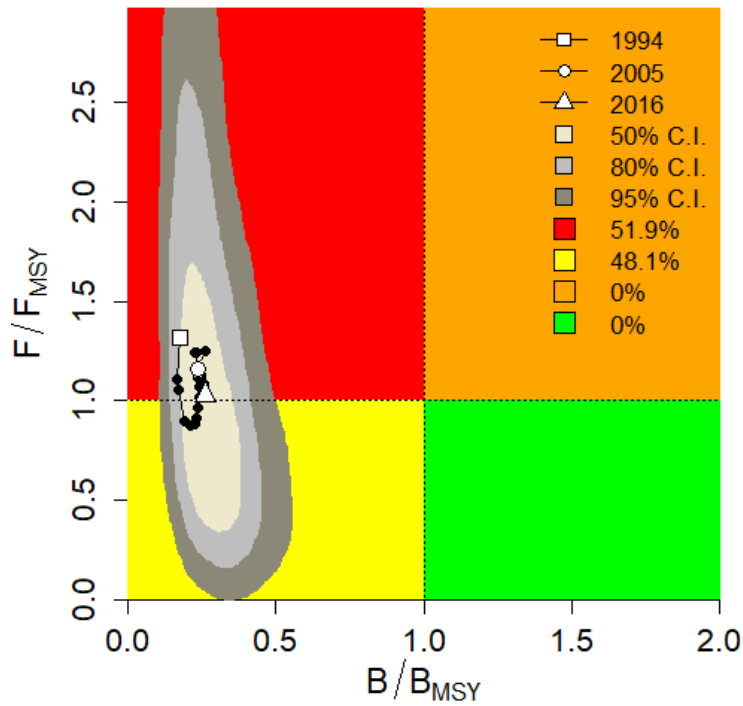
```
------------------------------------------------------------------
LBB results for Scorpaena notata, stock SNQ_GSA22, 1996-2014
Files:Stock_ID_Greece2.csv, SNQ.csv
------------------------------------------------------------------
Linf prior= 19, SD=0.19 cm (user-defined), Lmax=20, median Lmax=17.5
Z/K prior = 2.3, SD=0.22, M/K prior=1.5, SD=0.15
F/K prior = 0.763 (wide range with tau=4 in log-normal distribution)
Lc prior  = 8.93, SD=0.89 cm, alpha prior=19.6, SD=2, Lm50=NA cm

General reference points (median across years):
Linf      = 18.8 (18.5-19.1) cm
Lopt      = 12 cm, Lopt/Linf=0.66
Lc_opt    = 11 cm, Lc_opt/Linf=0.6, Lmean if F=M 13.4 cm
M/K       = 1.57 (1.32-1.86)
F/M       = 2.69 (1.33-3.69), F/K=4.35 (2.3-4.99), Z/K=5.81 (3.93-6.42)
B/B0      = 0.24 (0.13-0.33), B/B0 F=M Lc=Lc_opt 0.36
Y/R'      = 0.035 (0.024-0.049)(reduced: B/B0<0.25),Y/R' F=M Lc=Lc_opt 0.041

Estimates for 2014 (mean of last 3 years with data):
Lc50      = 12.4 (12.2-12.9) cm, Lc/Linf=0.68 (0.67-0.7)
Lc95      = 15.5, alpha=0.953 (0.888-0.986)
Lmean/Lopt= NA, Lc/Lc_opt=1.1, L95th=16.2 cm, L95th/Linf=0.88, Mature=NA%
F/M       = 3 (0.71-4.5), F/K=7.2 (1-10), Z/K=9 (2.6-12)
Y/R'      = 0.041 (0.021-0.065)(reduced because B/B0 < 0.25)
B/B0      = 0.29 (0.055-0.47), best LF fit year 2001=0.236 (0.093-0.35)
B/Bmsy    = 0.79 (0.15-1.3), selected B/B0 2001 = 0.24 (0.093-0.35)
RF: Set Linf=19 between median18 and max 20. Excluded years with unreasonable
LF fits. Selected 2001 because of good fit and reasonable B/B0 compared to
adjacent estimates.
```
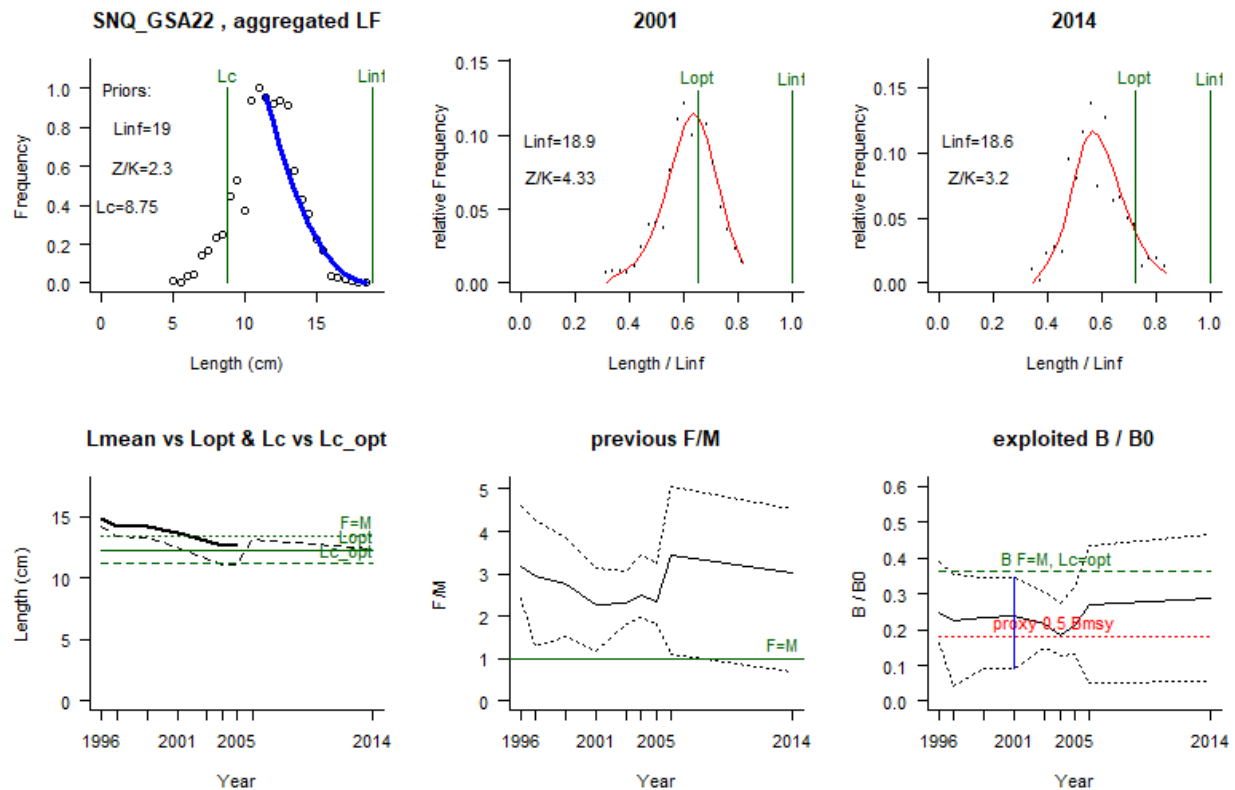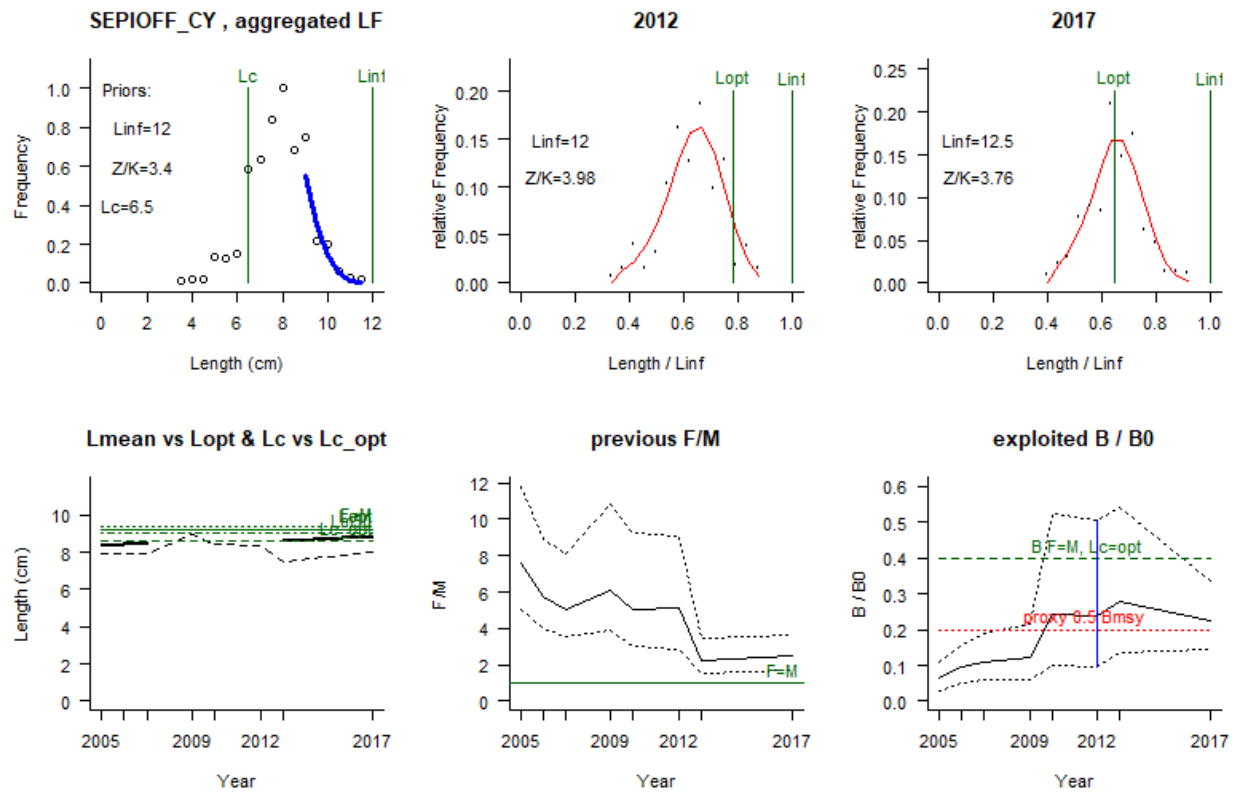
```
------------------------------------------------------------------
AMSY Analysis, Fri Nov 01 17:33:46 2019
------------------------------------------------------------------
Stock SCORNOT_AEGEAN, Scorpaena notata, Small red scorpionfish
CPUE data for years 1994 - 2016, CPUE range 1.46 - 4, smooth = TRUE
Prior for r                   = Medium, NA - NA
Used prior range for r        = 0.2 - 0.8
Prior for 2001 stock status   = Small, 0.09 - 0.35
Used 2001 prior B/B0 range    = 0.09 - 0.35, prior B/Bmsy = 0.18 - 0.7
Used prior range for kq       = 7.28 - 21.8 [original range = 7.28 - 28.3]
Comment: B/B0 prior from LBB. RF: OK
Source:

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 5001

 Results:
 viable r-kq pairs    = 5001
 median kq            = 12.8, 8.64 - 20
 median MSYq          = 1.41, 0.879 - 2.25
 r (4 MSYq/kq)        = 0.441, 0.269 - 0.734
 Fmsy (r/2)           = 0.22, 0.135 - 0.367
 F/Fmsy               = 1.68, 0.264 - 4.03 (2015)
 B/Bmsy               = 0.229, 0.127 - 0.409 (2016)
```
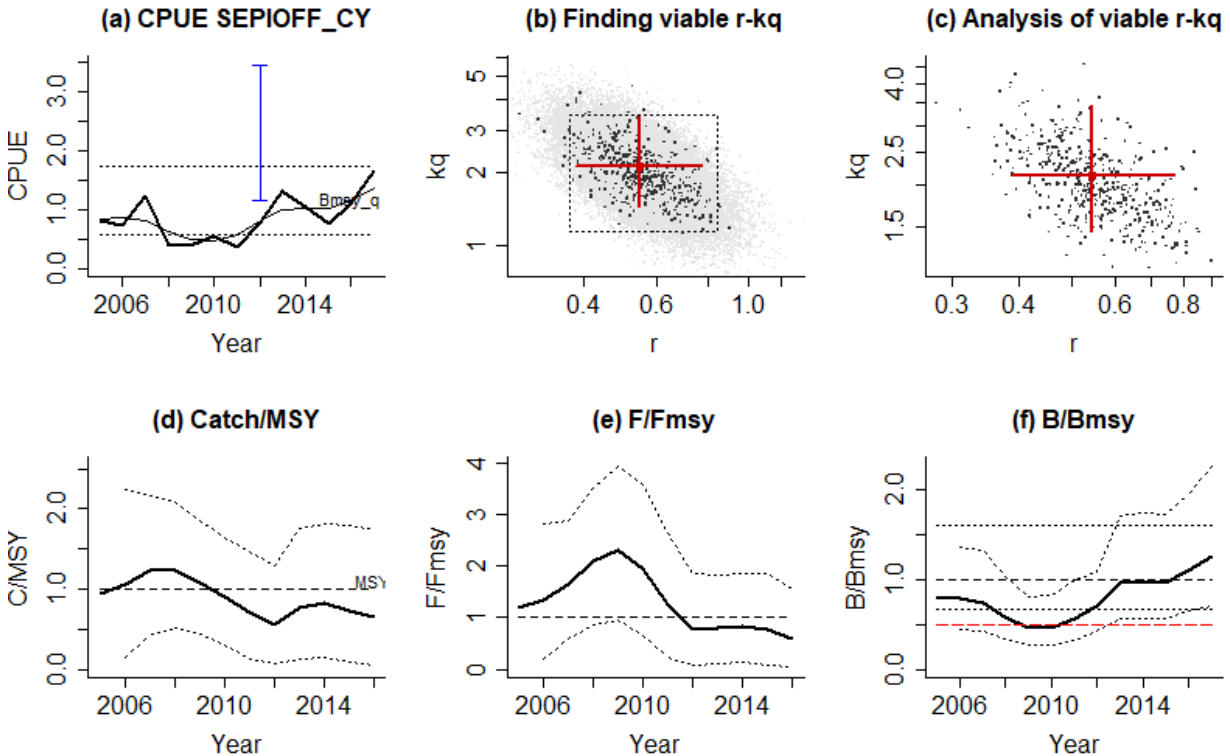

(a) CPUE SCORNOT_AEGEAN   (b) Finding viable r-kq   (c) Analysis of viable r-kq

(d) Catch/MSY   (e) F/Fmsy   (f) B/Bmsy

SCORNOT_AEGEAN

SCORNOT_AEGEAN
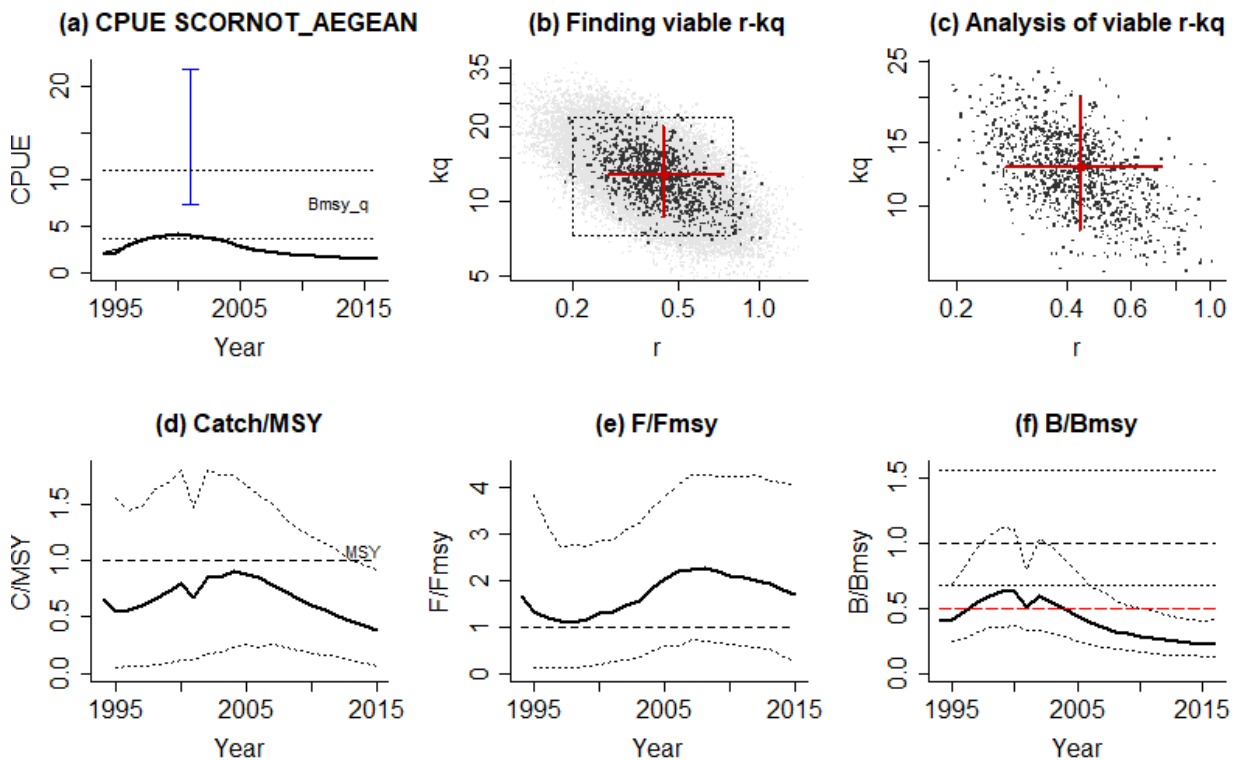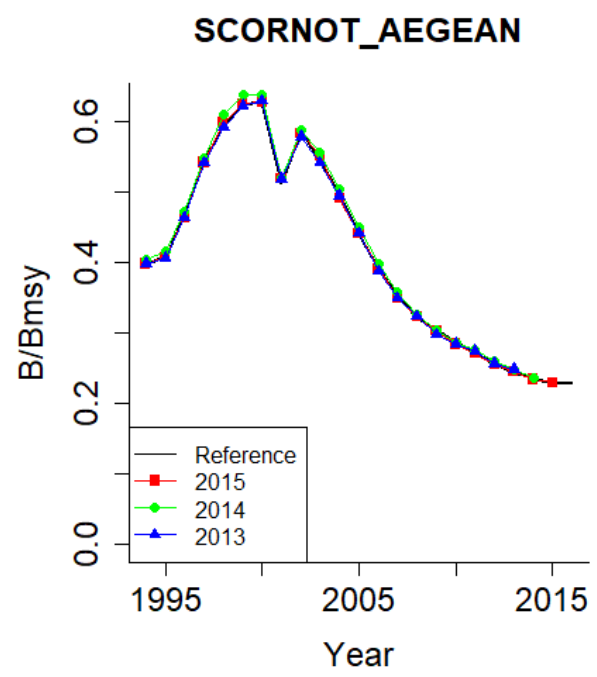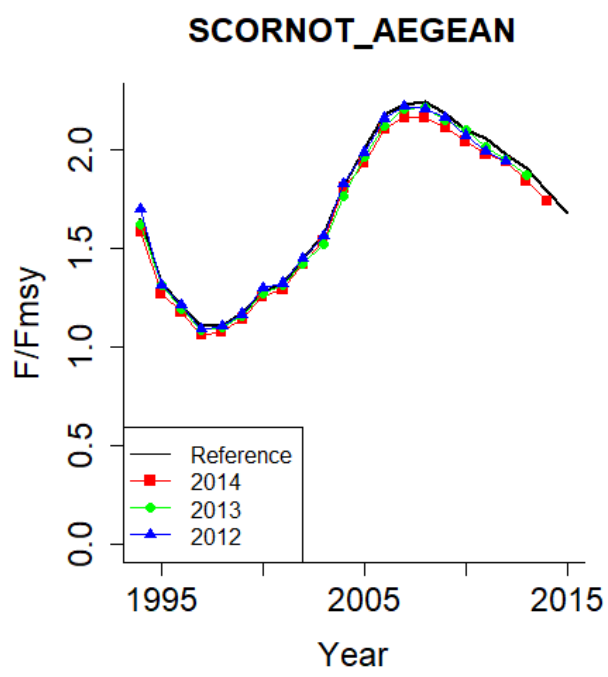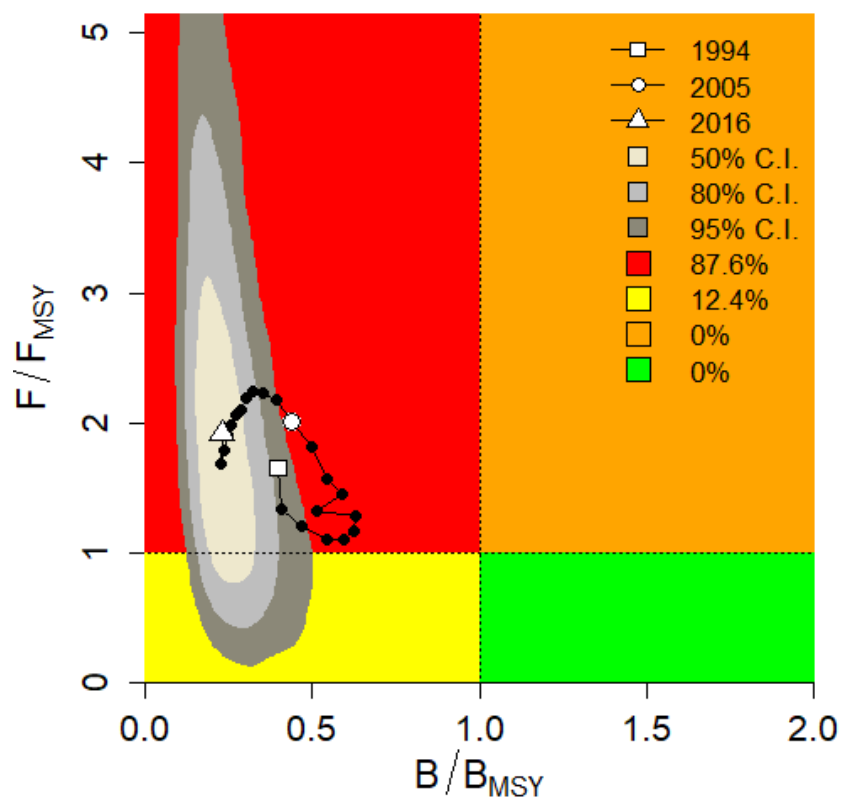
Cyprus

```
----------------------------------------------------------------
LBB results for Merluccius merluccius, stock Merl_mer_CY, 2012-2017
Files:LBB4AMSY_ID_2.csv, Merl_mer_CY.csv
----------------------------------------------------------------
Linf prior= 55, SD=0.55 cm (user-defined), Lmax=54, median Lmax=50
Z/K prior = 5.3, SD=0.71, M/K prior=1.5, SD=0.15
F/K prior = 3.81 (wide range with tau=4 in log-normal distribution)
Lc prior  = 19.6, SD=2 cm, alpha prior=14.9, SD=1.5, Lm50=27 cm

General reference points (median across years):
Linf     = 55.3 (54.4-56.4) cm
Lopt     = 37 cm, Lopt/Linf=0.68
Lc_opt   = 33 cm, Lc_opt/Linf=0.6, Lmean if F=M 27.4 cm
M/K      = 1.44 (1.16-1.68)
F/M      = 2.02 (1.57-2.87), F/K=2.83 (2.48-3.29), Z/K=4.24 (3.96-4.57)
B/B0     = 0.13 (0.087-0.19), B/B0 F=M Lc=Lc_opt 0.37
Y/R'     = 0.022 (0.015-0.029)(reduced: B/B0<0.25),Y/R' F=M Lc=Lc_opt 0.047

Estimates for 2017 (mean of last 3 years with data):
Lc50      = 19.7 (19.2-20.1) cm, Lc/Linf=0.36 (0.35-0.36)
Lc95      = 28.7, alpha=0.327 (0.313-0.338)
Lmean/Lopt= 0.72, Lc/Lc_opt=0.59, L95th=52.7 cm, L95th/Linf=0.96, Mature=21%
F/M       = 3.4 (2.5-4.4), F/K=4.8 (4.1-5.5), Z/K=6.2 (5.6-6.9)
Y/R'      = 0.018 (0.012-0.025)(reduced because B/B0 < 0.25)
B/B0      = 0.11 (0.071-0.15), best LF fit year 2017=0.107 (0.071-0.15)
B/Bmsy    = 0.29 (0.19-0.41), selected B/B0 2017 = 0.11 (0.071-0.15)
RF: set Linf to 55, between median 50.2 and max 59.5. Set Lcut=14 to exclude e
arly juveniles. Set Lstart=25 to improve fit to aggregated data. Merged LF to
increase data per year. 2017 selected for AMSY.
```
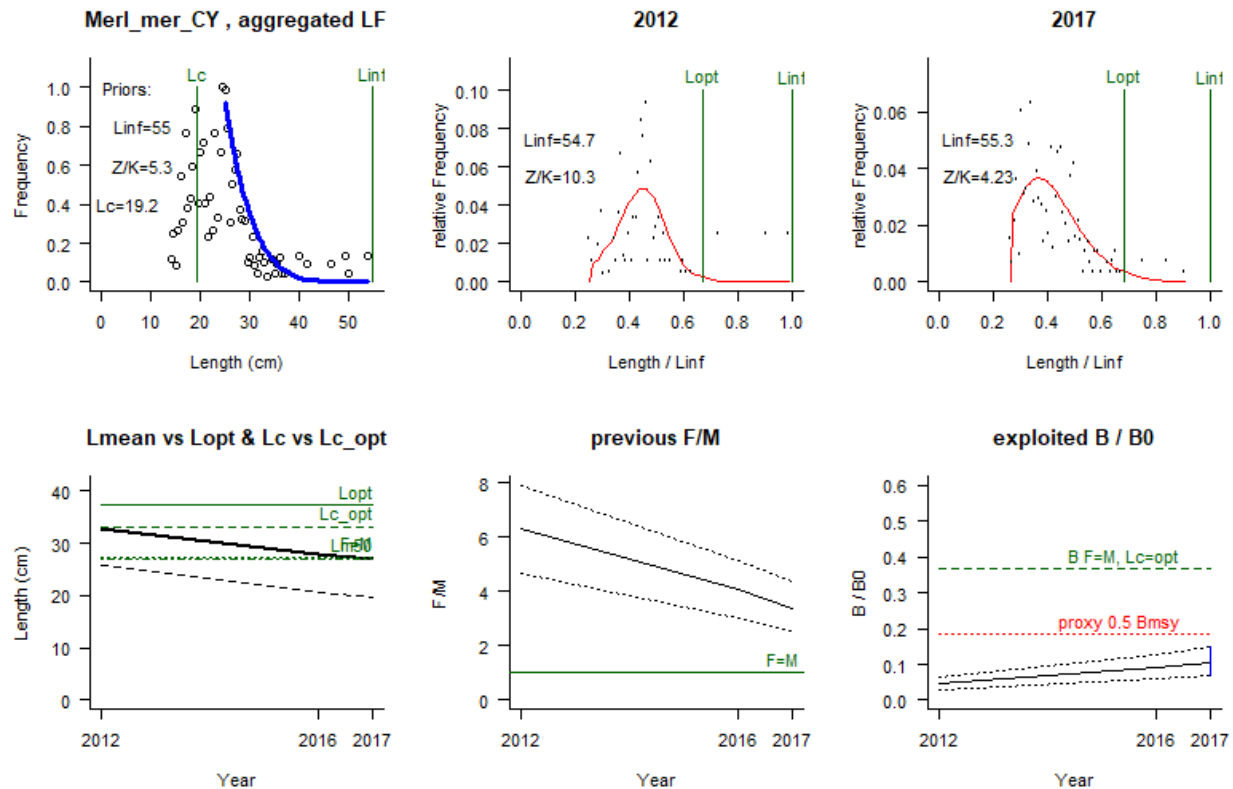
```
--------------------------------------------------
AMSY Analysis, Fri Nov 01 17:37:03 2019
Warning: Retrospective analysis not meaningful and omitted if B/k prior is in
the final year(s)
--------------------------------------------------
Stock MERL_MER_CY, Merluccius merluccius, European hake
CPUE data for years 2005 - 2017, CPUE range 2.94 - 15.1, smooth = TRUE
Prior for r                  = Medium, 0.35 - 0.8
Used prior range for r       = 0.327 - 0.851
Prior for 2017 stock status  = Very small, 0.07 - 0.15
Used 2017 prior B/B0 range   = 0.07 - 0.15, prior B/Bmsy = 0.14 - 0.3
Used prior range for kq      = 84.9 - 182 [original range = 84.9 - 182]
Comment: B/B0 prior from LBB. RF: OK
Source:

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 5000

  Results:
  viable r-kq pairs  = 5000
  median kq          = 117, 85.2 - 164
  median MSYq        = 17.1, 12.2 - 23.9
  r (4 MSYq/kq)      = 0.584, 0.39 - 0.842
  Fmsy (r/2)         = 0.292, 0.195 - 0.421
  F/Fmsy             = 0.785, 0.07 - 2.35 (2016)
  B/Bmsy             = 0.224, 0.146 - 0.333 (2017)
```


(a) CPUE MERL_MER_CY (b) Finding viable r-kq (c) Analysis of viable r-kq
(d) Catch/MSY (e) F/Fmsy (f) B/Bmsy

AMSY Kobe plot for MERL_MERL_CY, *Merluccius merluccius* in Cyprus

```
--------------------------------------------------------------------
LBB results for Sepia officinalis, stock SEPIOFF_CY, 2005-2017
Files:LBB4AMSY_ID_2.csv, SEPIOFF_CY.csv
--------------------------------------------------------------------
Linf prior= 12, SD=0.12 cm (user-defined), Lmax=12, median Lmax=10.2
Z/K prior = 3.4, SD=0.65, M/K prior=1.5, SD=0.15
F/K prior = 1.86 (wide range with tau=4 in log-normal distribution)
Lc prior  = 6.63, SD=0.66 cm, alpha prior=17.4, SD=1.7, Lm50=9 cm

General reference points (median across years):
Linf      = 11.9 (11.8-12.1) cm
Lopt      = 9.2 cm, Lopt/Linf=0.77
Lc_opt    = 8.6 cm, Lc_opt/Linf=0.72, Lmean if F=M 9.35 cm
M/K       = 0.877 (0.591-1.15)
F/M       = 3.77 (2.58-6), F/K=3.12 (2.57-3.58), Z/K=3.95 (3.55-4.39)
B/B0      = 0.13 (0.076-0.23), B/B0 F=M Lc=Lc_opt 0.4
Y/R'      = 0.057 (0.025-0.092)(reduced: B/B0<0.25),Y/R' F=M Lc=Lc_opt 0.093

Estimates for 2017 (mean of last 3 years with data):
Lc50      = 7.98 (7.82-8.11) cm, Lc/Linf=0.65 (0.64-0.66)
Lc95      = 10.4, alpha=1.2 (1.16-1.23)
Lmean/Lopt= 1, Lc/Lc_opt=0.93, L95th=11.2 cm, L95th/Linf=0.91, Mature=15%
F/M       = 2.5 (1.7-3.6), F/K=2.7 (2.2-3.1), Z/K=3.9 (3.5-4.3)
Y/R'      = 0.053 (0.032-0.08)(reduced because B/B0 < 0.25)
B/B0      = 0.23 (0.14-0.34), best LF fit year 2010=0.245 (0.1-0.52)
B/Bmsy    = 0.57 (0.36-0.85), selected B/B0 2012 = 0.24 (0.094-0.5)
RF: Set Linf=12 with median 10.5 and Lmax 12. Merged LF to get more data per y
ear. Discarded years with unsuitable LFs. Chose 2012 for AMSY prior because of
good fit with reasonable CL.
```


SEPIOFF_CY , aggregated LF · 2012 · 2017 · Lmean vs Lopt & Lc vs Lc_opt · previous F/M · exploited B / B0

```
-------------------------------------------------------------
AMSY Analysis, Fri Nov 01 17:42:28 2019
-------------------------------------------------------------
Stock SEPIOFF_CY, Sepia officinalis, common cuttlefish
CPUE data for years 2005 - 2017, CPUE range 0.477 - 1.35, smooth = TRUE
Prior for r                   = Medium, 0.37 - 0.84
Used prior range for r        = 0.346 - 0.897
Prior for 2012 stock status   = Small, 0.09 - 0.5
Used 2012 prior B/B0 range    = 0.09 - 0.5, prior B/Bmsy = 0.18 - 1
Used prior range for kq       = 1.15 - 3.45 [original range = 0.829 - 4.6]
Comment: B/B0 prior from LBB. RF: OK
Source:

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 5010

 Results:
 viable r-kq pairs   = 5010
 median kq           = 2.13, 1.44 - 3.42
 median MSYq         = 0.29, 0.204 - 0.448
 r (4 MSYq/kq)       = 0.544, 0.385 - 0.768
 Fmsy (r/2)          = 0.272, 0.193 - 0.384
 F/Fmsy              = 0.583, 0.0444 - 1.57 (2016)
 B/Bmsy              = 1.26, 0.708 - 2.27 (2017)
```
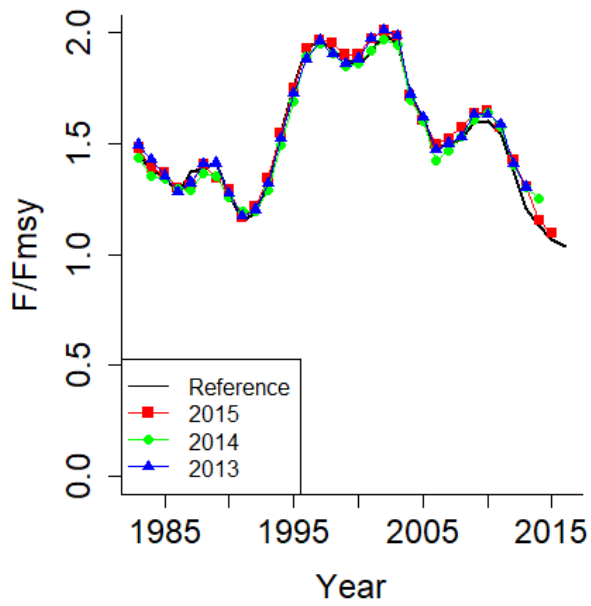

(a) CPUE SEPIOFF_CY   (b) Finding viable r-kq   (c) Analysis of viable r-kq

(d) Catch/MSY   (e) F/Fmsy   (f) B/Bmsy

AMSY Kobe plot and retrospective analysis for *Sepia officinalis* in Cyprus
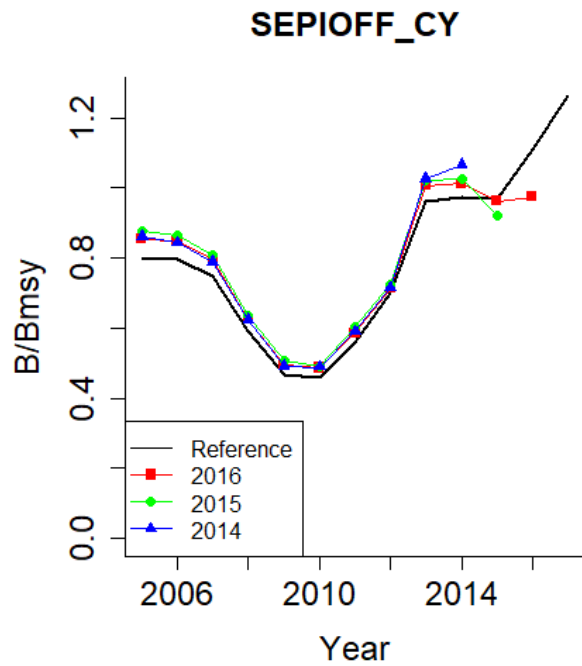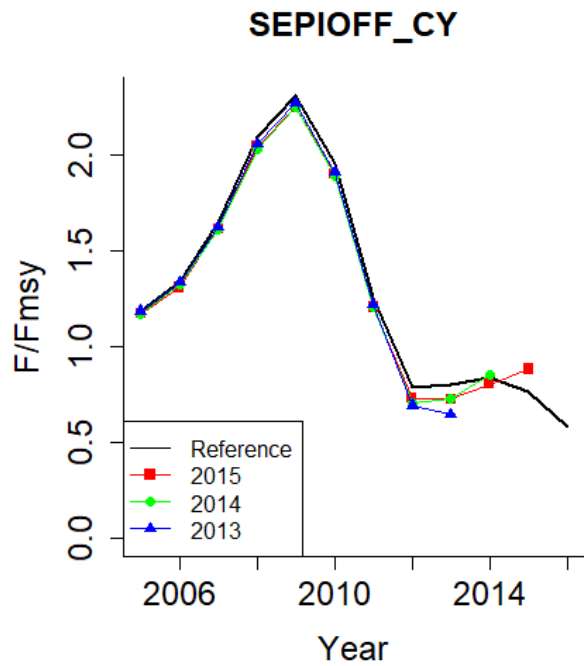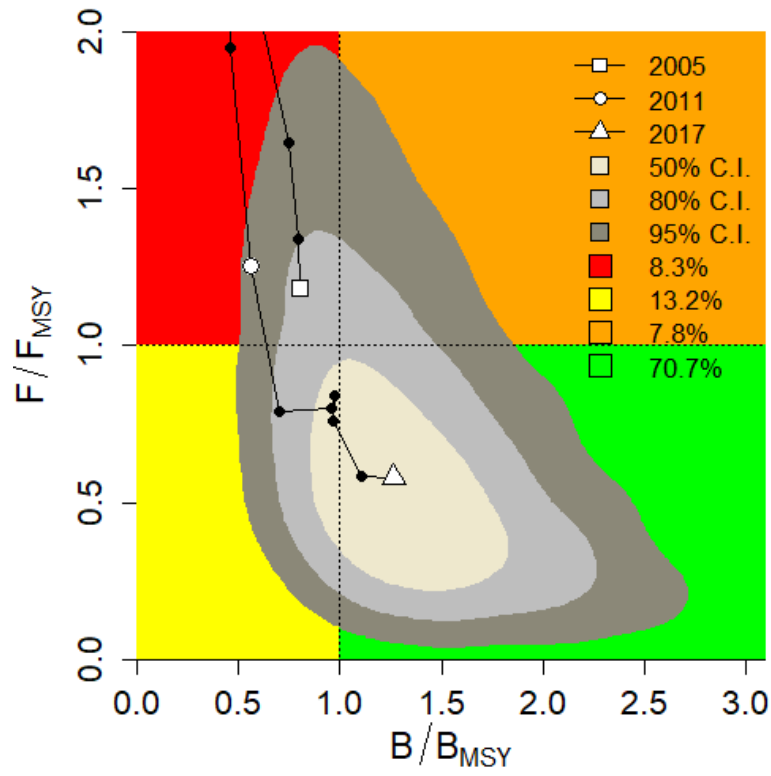
North Sea

```
----------------------------------------------------------------
```
LBB results for *Agonus cataphractus*, stock **Agonus cataphractus**, 1983-2017
Files:LBB4AMSY_ID_3.csv, LBB_June042019_Agonus cataphractus.csv
```
----------------------------------------------------------------
```
Linf prior= 18, SD=0.18 cm (user-defined), Lmax=22, median Lmax=15
Z/K prior = 3.6, SD=0.056, M/K prior=1.5, SD=0.15
F/K prior = 2.12 (wide range with tau=4 in log-normal distribution)
Lc prior = 8.67, SD=0.87 cm, alpha prior=18.9, SD=1.9, Lm50=NA cm

General reference points (median across years):
Linf   = 18 (17.6-18.3) cm
Lopt   = 12 cm, Lopt/Linf=0.66
Lc_opt   = 10 cm, Lc_opt/Linf=0.58, Lmean if F=M 12 cm
M/K   = 1.57 (1.28-1.82)
F/M   = 1.99 (1.46-2.69), F/K=3.08 (2.6-3.63), Z/K=4.6 (4.15-5.06)
B/B0   = 0.21 (0.14-0.31), B/B0 F=M Lc=Lc_opt 0.37
Y/R'   = 0.036 (0.022-0.053)(reduced: B/B0<0.25),Y/R' F=M Lc=Lc_opt 0.041

Estimates for 2017 (mean of last 3 years with data):
Lc50   = 10.9 (10.6-11.3) cm, Lc/Linf=0.62 (0.6-0.64)
Lc95   = 15.3, alpha=0.681 (0.654-0.712)
Lmean/Lopt= 1.1, Lc/Lc_opt=1, L95th=15.7 cm, L95th/Linf=0.88, Mature=NA%
F/M   = 2.8 (2.2-3.7), F/K=4.2 (3.5-5.1), Z/K=5.9 (5.2-6.7)
Y/R'   = 0.031 (0.019-0.045)(reduced because B/B0 < 0.25)
B/B0   = 0.21 (0.13-0.31), best LF fit year 1996=0.132 (0.088-0.18)
B/Bmsy   = 0.58 (0.35-0.84), **selected B/B0 2012 = 0.32 (0.19-0.47)**
RF: Uses SMFS 2017 data. Set Lcut to 7 cm to avoid early juveniles. Set Linf
to 18 cm between median=15 and max=22. Merged LFs of subsequent years to
reduce variability.
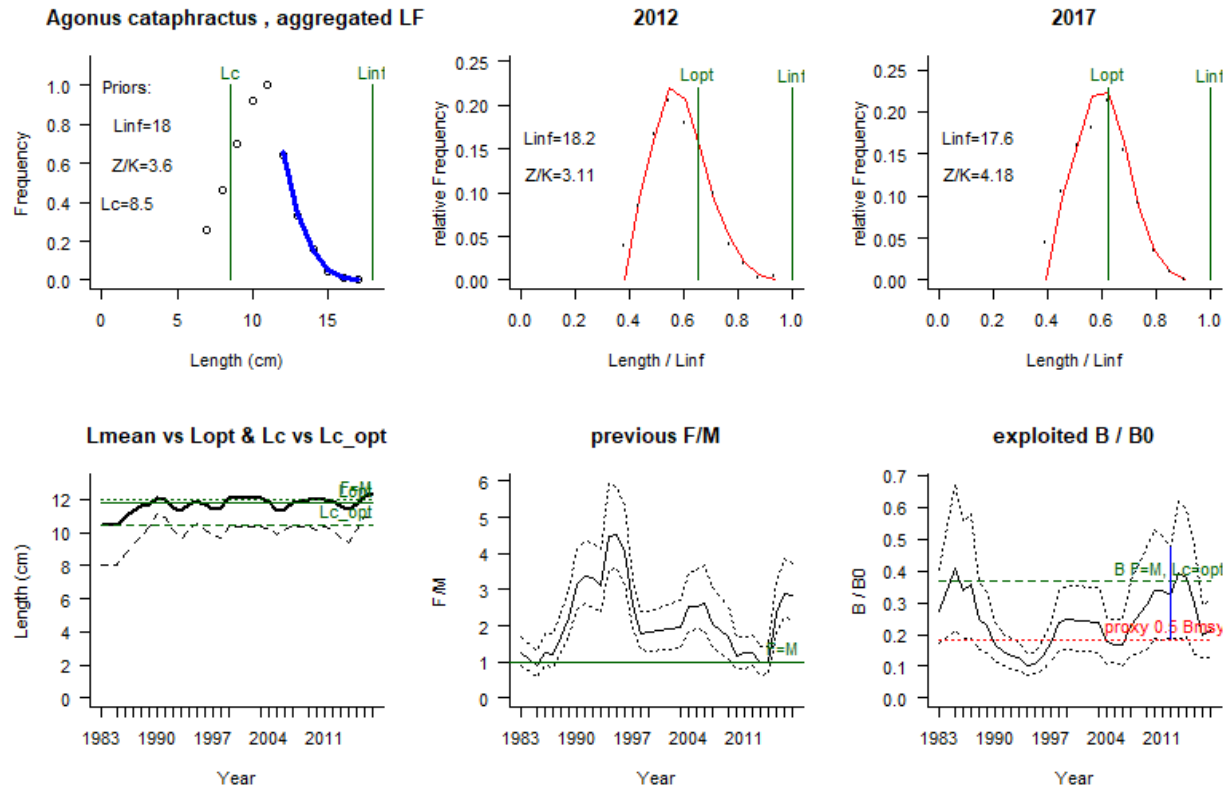
```
-----------------------------------------------------------------
AMSY Analysis, Fri Nov 01 17:46:47 2019
-----------------------------------------------------------------
Stock Agonus cataphractus, Agonus cataphractus, Hooknose
CPUE data for years 1983 - 2017, CPUE range 0.37 - 0.739, smooth = TRUE
Prior for r                  = Medium, NA - NA
Used prior range for r       = 0.2 - 0.8
Prior for 2012 stock status  = About half, 0.19 - 0.47
Used 2012 prior B/B0 range   = 0.19 - 0.47, prior B/Bmsy = 0.38 - 0.94
Used prior range for kq      = 1.22 - 2.02 [original range = 0.815 - 2.02]
Comment: B/B0 prior from LBB. RF: OK
Source: SMFS 2017

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 5001

 Results:
 viable r-kq pairs   = 5001
 median kq           = 1.52, 1.23 - 1.88
 median MSYq         = 0.184, 0.12 - 0.278
 r (4 MSYq/kq)       = 0.485, 0.287 - 0.783
 Fmsy (r/2)          = 0.243, 0.143 - 0.391
 F/Fmsy              = 1.9, 0.585 - 3.68 (2016)
 B/Bmsy              = 0.487, 0.272 - 0.858 (2017)
```
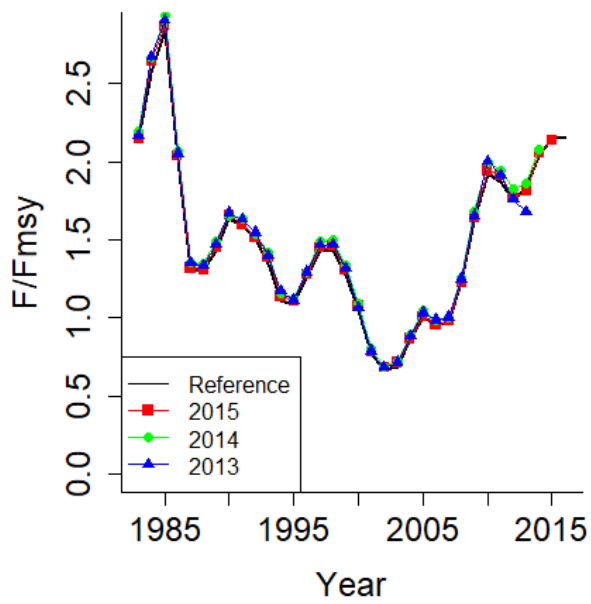
Agonus cataphractus

Agonus cataphractus
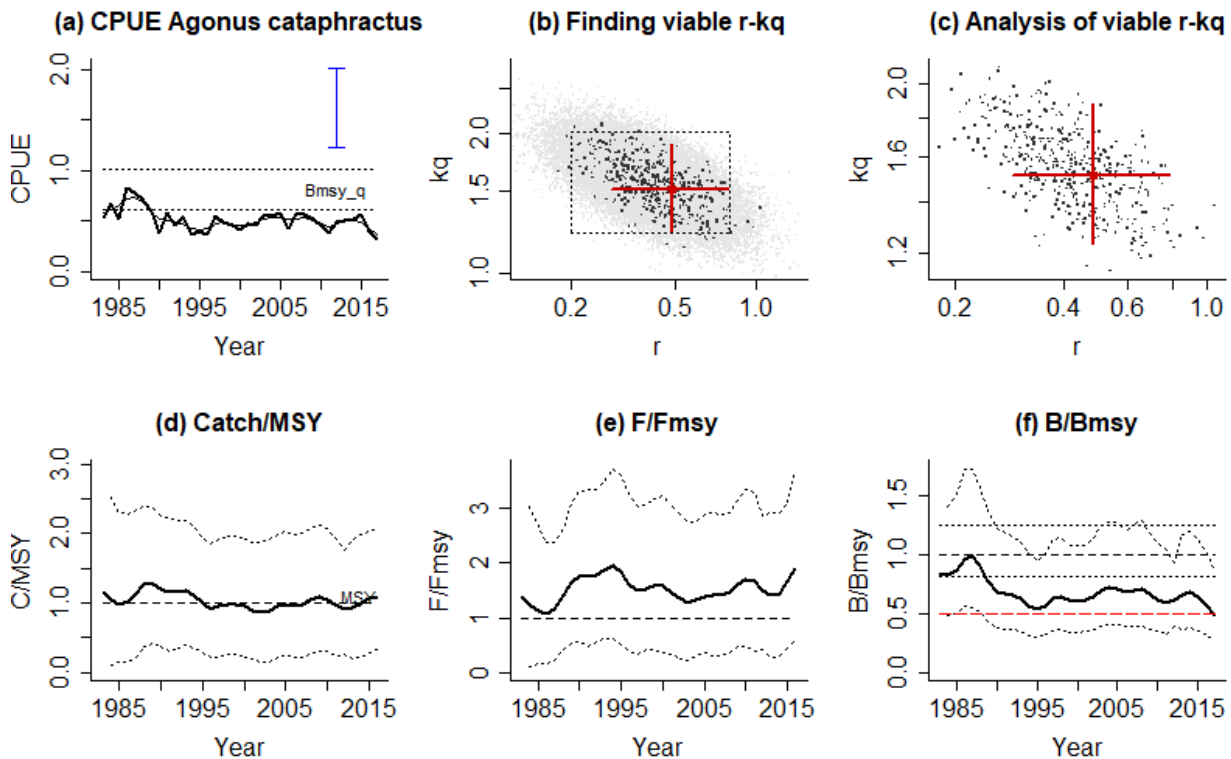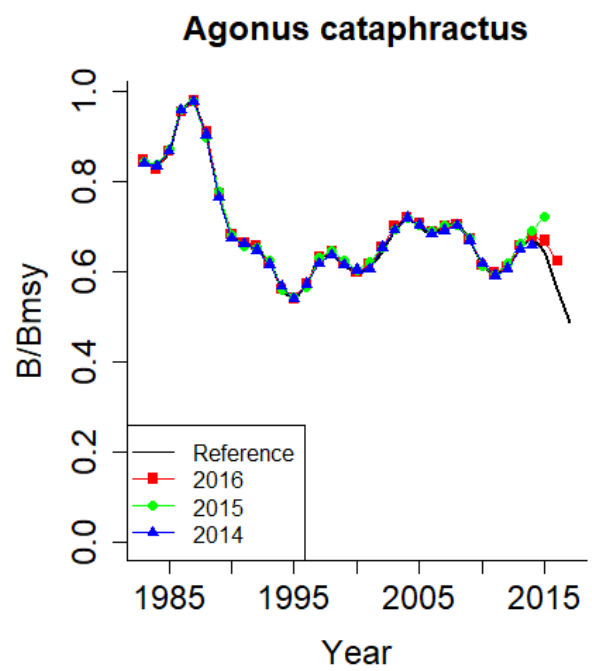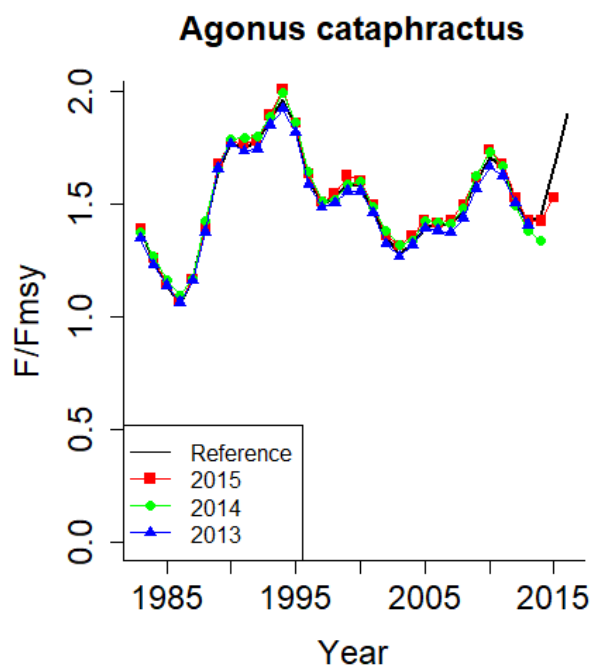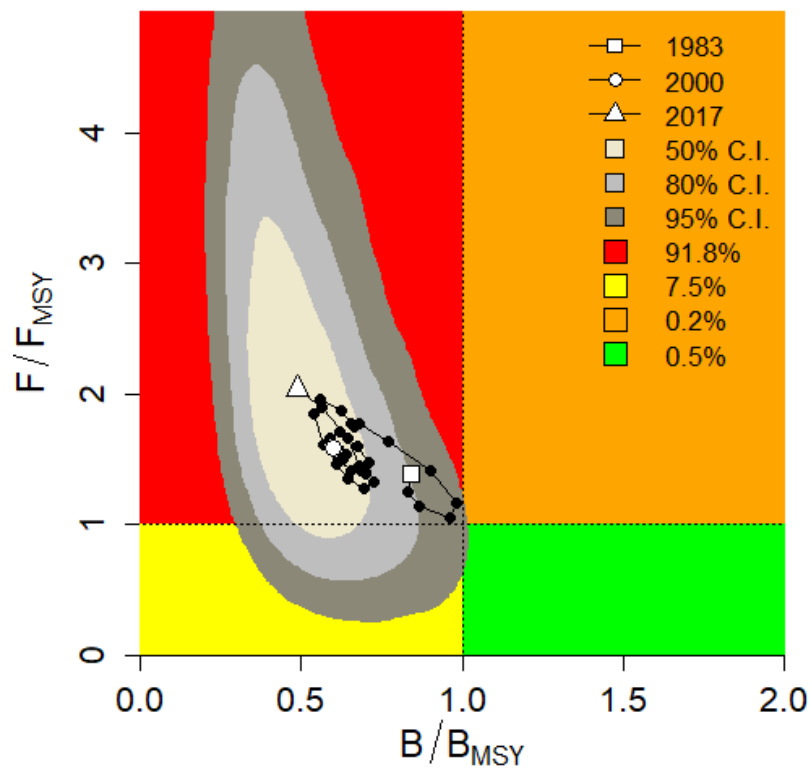
```
--------------------------------------------------------------------
LBB results for Amblyraja radiata, stock Amblyraja radiata, 1983-2017
Files:LBB4AMSY_ID_3.csv, LBB_June052019_Amblyraja radiata.csv
--------------------------------------------------------------------
Linf prior= 75, SD=0.75 cm (user-defined), Lmax=82, median Lmax=58
Z/K prior = 3.4, SD=0.46, M/K prior=1.5, SD=0.15
F/K prior = 1.9 (wide range with tau=4 in log-normal distribution)
Lc prior  = 20.4, SD=2 cm, alpha prior=11.8, SD=1.2, Lm50=46 cm

General reference points (median across years):
Linf      = 73.8 (72.6-75.1) cm
Lopt      = 50 cm, Lopt/Linf=0.68
Lc_opt    = 48 cm, Lc_opt/Linf=0.65, Lmean if F=M 50.4 cm
M/K       = 1.39 (1.14-1.64)
F/M       = 5.74 (4.36-8.33), F/K=8.23 (7.14-9.33), Z/K=9.25 (8.36-10.4)
B/B0      = 0.066 (0.042-0.1), B/B0 F=M Lc=Lc_opt 0.37
Y/R'      = 0.012 (0.0083-0.016)(reduced: B/B0<0.25),Y/R' F=M Lc=Lc_opt 0.048

Estimates for 2017 (mean of last 3 years with data):
Lc50      = 40 (38.9-41) cm, Lc/Linf=0.54 (0.53-0.56)
Lc95      = 58.8, alpha=0.156 (0.152-0.161)
Lmean/Lopt= 0.86, Lc/Lc_opt=0.83, L95th=57.3 cm, L95th/Linf=0.78, Mature=6.3%
F/M       = 6.4 (4.7-8.9), F/K=7.2 (6.2-8.4), Z/K=8.4 (7.4-9.5)
Y/R'      = 0.015 (0.0098-0.024)(reduced because B/B0 < 0.25)
B/B0      = 0.071 (0.046-0.11), best LF fit year 1983=0.0695 (0.046-0.1)
B/Bmsy    = 0.19 (0.12-0.29), selected B/B0 2004 = 0.11 (0.078-0.16)
RF: Set Lstart=40 to avoid error in prior fit. Set Linf=75 between Lmax=82 and
Lmedian=58. Selected 2004 for reasonable fit and CLs.
```
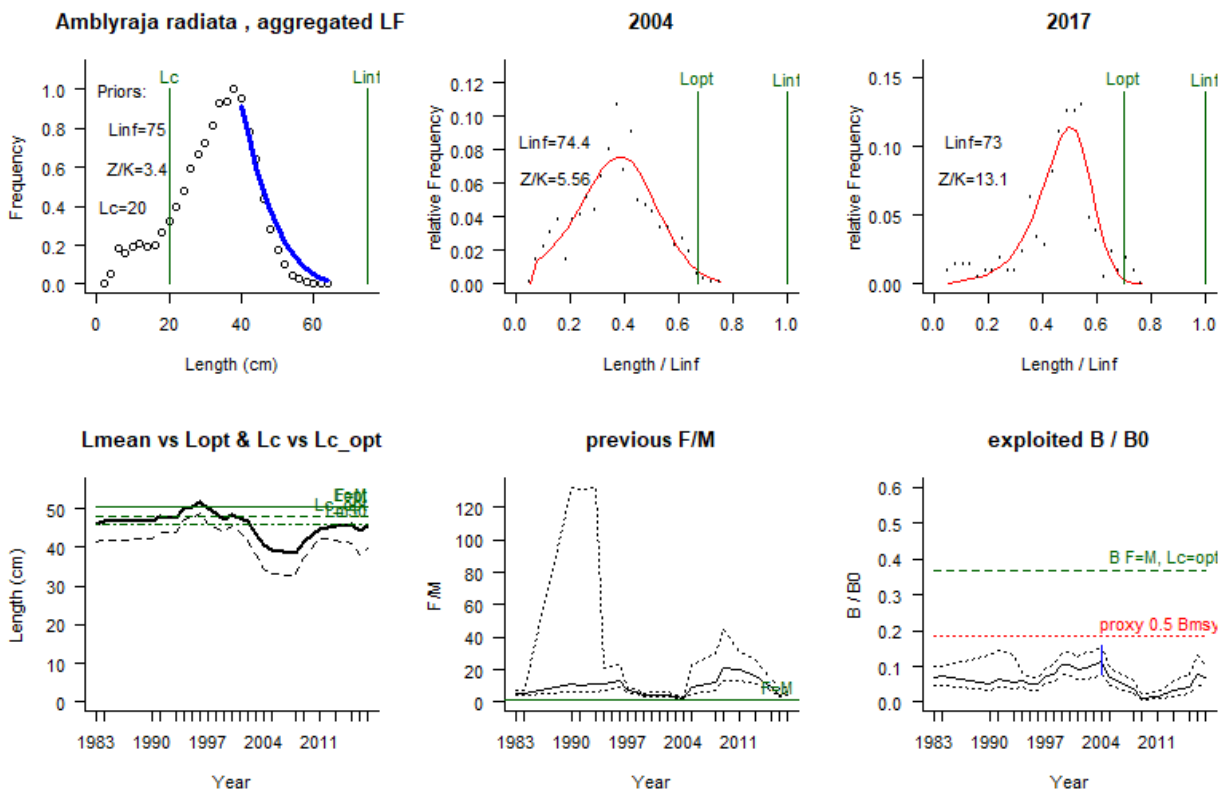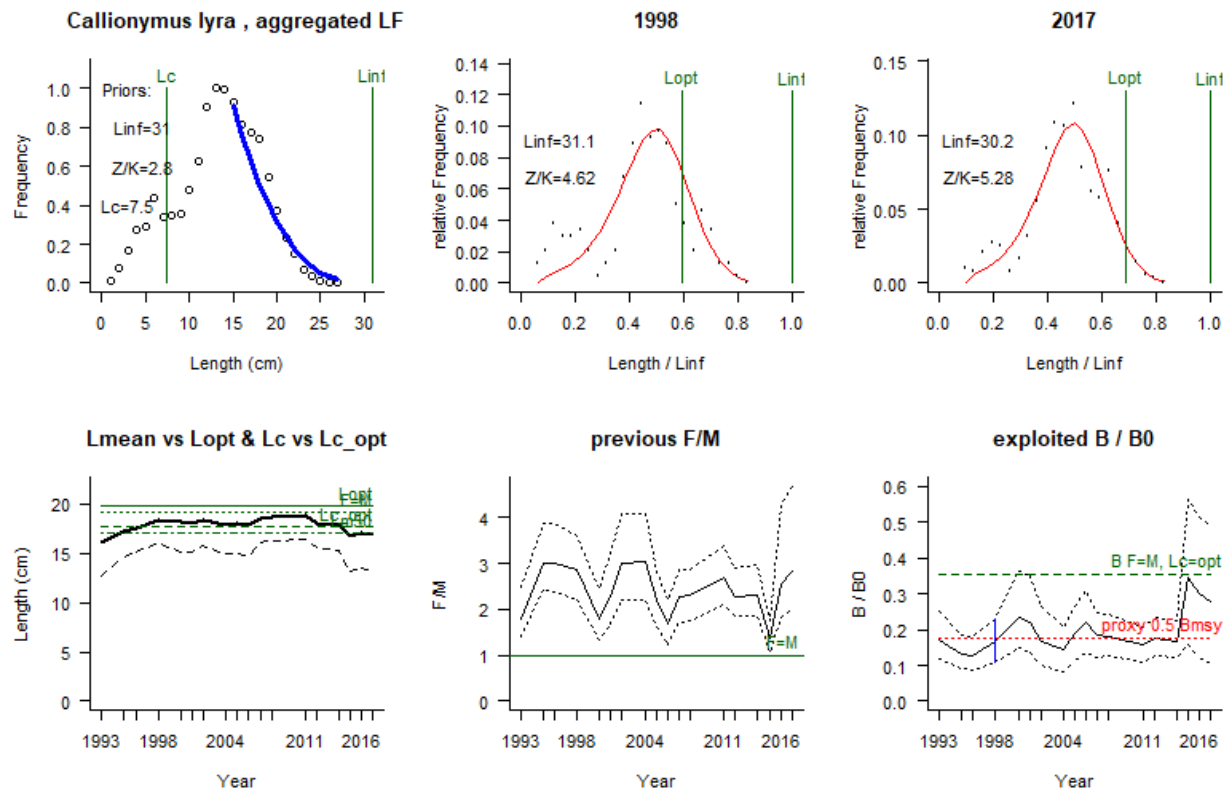
```
------------------------------------------------------------
AMSY Analysis, Fri Nov 01 17:50:42 2019
------------------------------------------------------------
Stock Amblyraja radiata, Amblyraja radiata, Starry ray
CPUE data for years 1983 - 2017, CPUE range 10.5 - 27.6, smooth = TRUE
Prior for r                 = Low, NA - NA
Used prior range for r      = 0.05 - 0.5
Prior for 2004 stock status = Very small, 0.08 - 0.16
Used 2004 prior B/B0 range  = 0.08 - 0.16, prior B/Bmsy = 0.16 - 0.32
Used prior range for kq     = 78.6 - 157 [original range = 78.6 - 157]
Comment: B/B0 prior from LBB. RF: OK
Source: SMFS 2017

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 5000

 Results:
 viable r-kq pairs   = 5000
 median kq           = 106, 82.7 - 142
 median MSYq         = 6.59, 3.79 - 10.8
 r (4 MSYq/kq)       = 0.248, 0.134 - 0.418
 Fmsy (r/2)          = 0.124, 0.0671 - 0.209
 F/Fmsy              = 1.04, -0.84 - 3.99 (2016)
 B/Bmsy              = 0.211, 0.119 - 0.385 (2017)
```


(a) CPUE Amblyraja radiata   (b) Finding viable r-kq   (c) Analysis of viable r-kq
(d) Catch/MSY   (e) F/Fmsy   (f) B/Bmsy

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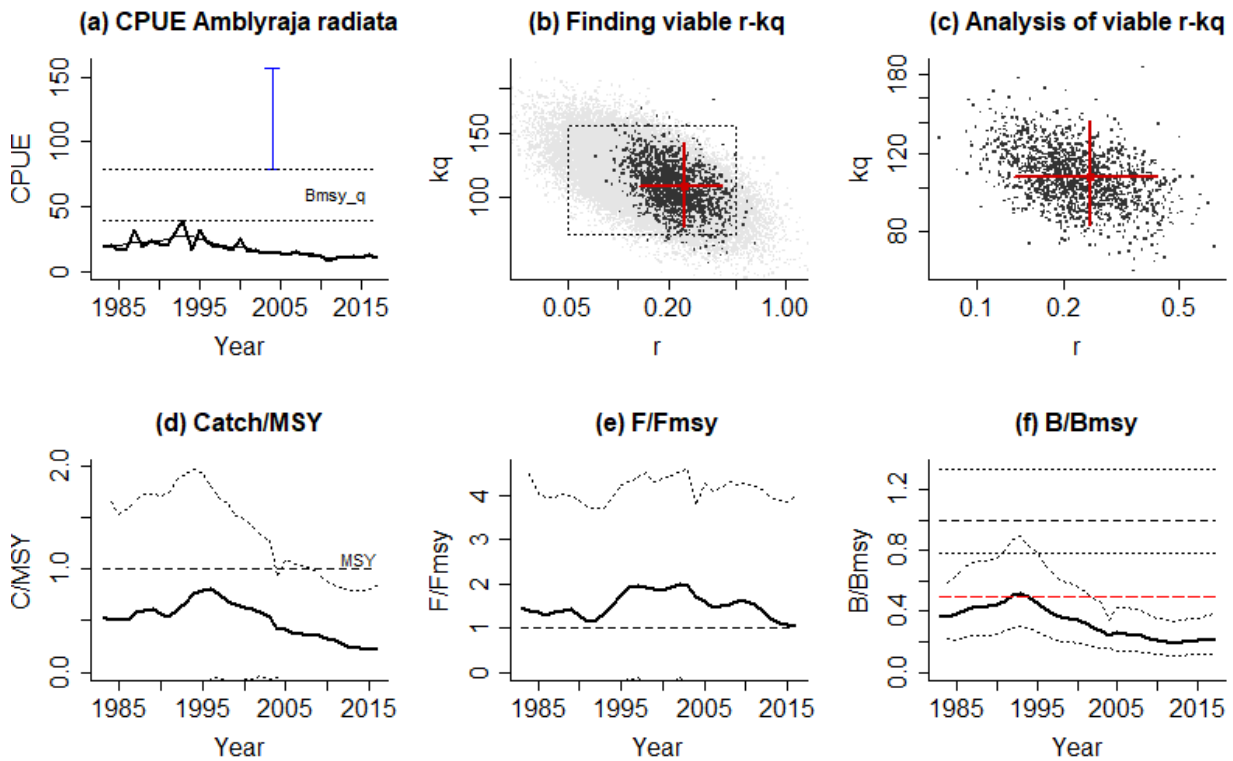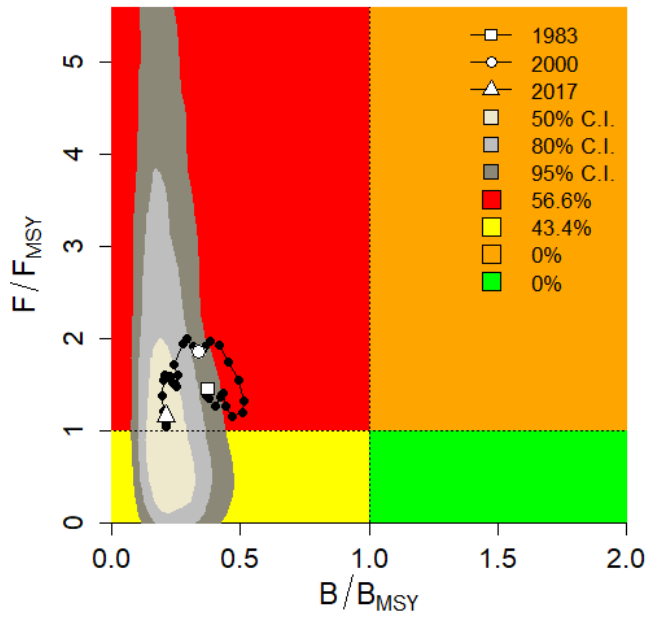
Amblyraja radiata

Amblyraja radiata
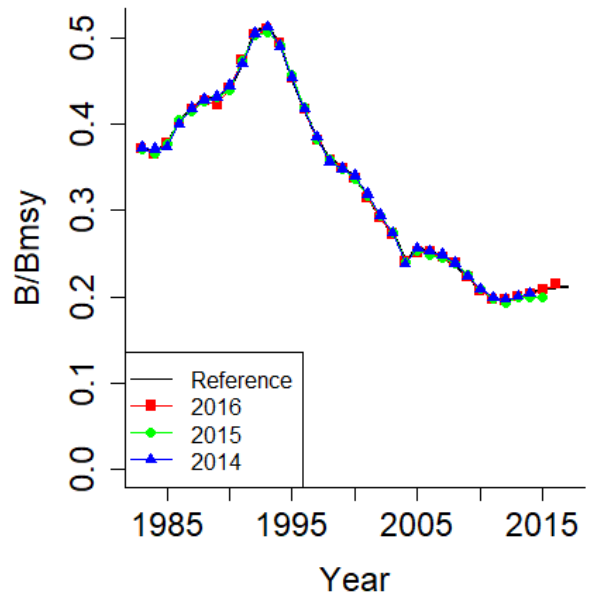
```
--------------------------------------------------------------------
LBB results for Buglossidium luteum, stock Buglossidium luteum, 1983-2017
Files:LBB4AMSY_ID_3.csv, LBB_June052019_Buglossidium luteum.csv
--------------------------------------------------------------------
Linf prior= 16, SD=0.16 cm (user-defined), Lmax=20, median Lmax=13
Z/K prior = 5.5, SD=0.3, M/K prior=1.5, SD=0.15
F/K prior = 3.97 (wide range with tau=4 in log-normal distribution)
Lc prior  = 5.1, SD=0.51 cm, alpha prior=27.3, SD=2.7, Lm50=7.5 cm

General reference points (median across years):
Linf      = 16 (15.8-16.3) cm
Lopt      = 11 cm, Lopt/Linf=0.66
Lc_opt    = 9.9 cm, Lc_opt/Linf=0.62, Lmean if F=M 8.28 cm
M/K       = 1.51 (1.24-1.8)
F/M       = 3.79 (3.01-5.12), F/K=6.03 (5.48-6.71), Z/K=7.77 (7.3-8.38)
B/B0      = 0.058 (0.042-0.082), B/B0 F=M Lc=Lc_opt 0.37
Y/R'      = 0.0073 (0.0055-0.0099)(reduced: B/B0<0.25),Y/R' F=M Lc=Lc_opt 0.045

Estimates for 2017 (mean of last 3 years with data):
Lc50      = 5.52 (5.44-5.61) cm, Lc/Linf=0.34 (0.34-0.35)
Lc95      = 7.2, alpha=1.75 (1.69-1.82)
Lmean/Lopt= 0.66, Lc/Lc_opt=0.56, L95th=10.3 cm, L95th/Linf=0.64, Mature=17%
F/M       = 4.1 (3.4-5.4), F/K=6.4 (5.9-7), Z/K=8 (7.5-8.4)
Y/R'      = 0.0068 (0.005-0.0094)(reduced because B/B0 < 0.25)
B/B0      = 0.055 (0.04-0.076), best LF fit year 1995=0.103 (0.071-0.15)
B/Bmsy    = 0.15 (0.11-0.21), selected B/B0 1987 = 0.15 (0.073-0.23)
RF: Set Linf=15cm above median=14. Selected 1987 because of reasonable fit and
CL with not too low B/B0.
```
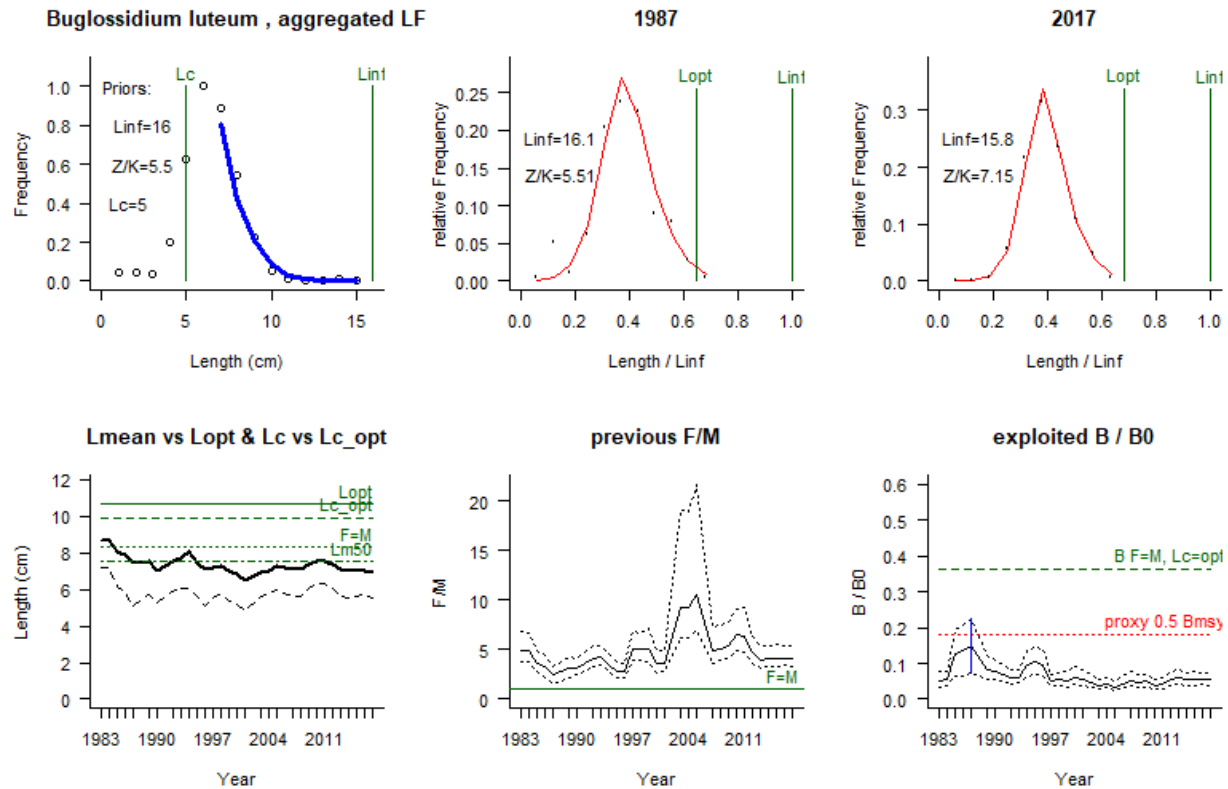
```
------------------------------------------------------------------
AMSY Analysis, Fri Nov 01 17:55:47 2019
------------------------------------------------------------------
Stock Buglossidium luteum, Buglossidium luteum, Solonette
CPUE data for years 1983 - 2017, CPUE range 0.527 - 2.07, smooth = TRUE
Prior for r                  = Medium, NA - NA
Used prior range for r       = 0.2 - 0.8
Prior for 1987 stock status  = Very small, 0.07 - 0.23
Used 1987 prior B/B0 range   = 0.07 - 0.23, prior B/Bmsy = 0.14 - 0.46
Used prior range for kq      = 2.26 - 6.79 [original range = 2.26 - 7.44]
Comment: B/B0 prior from LBB. RF: OK
Source: SMFS 2017

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 5003

  Results:
  viable r-kq pairs  = 5003
  median kq          = 3.8, 2.56 - 5.86
  median MSYq        = 0.48, 0.301 - 0.805
  r (4 MSYq/kq)      = 0.505, 0.304 - 0.844
  Fmsy (r/2)         = 0.252, 0.152 - 0.422
  F/Fmsy             = 2.16, 0.686 - 4.09 (2016)
  B/Bmsy             = 0.42, 0.233 - 0.759 (2017)
```


(a) CPUE Buglossidium luteum

(b) Finding viable r-kq

(c) Analysis of viable r-kq

(d) Catch/MSY

(e) F/Fmsy

(f) B/Bmsy

95
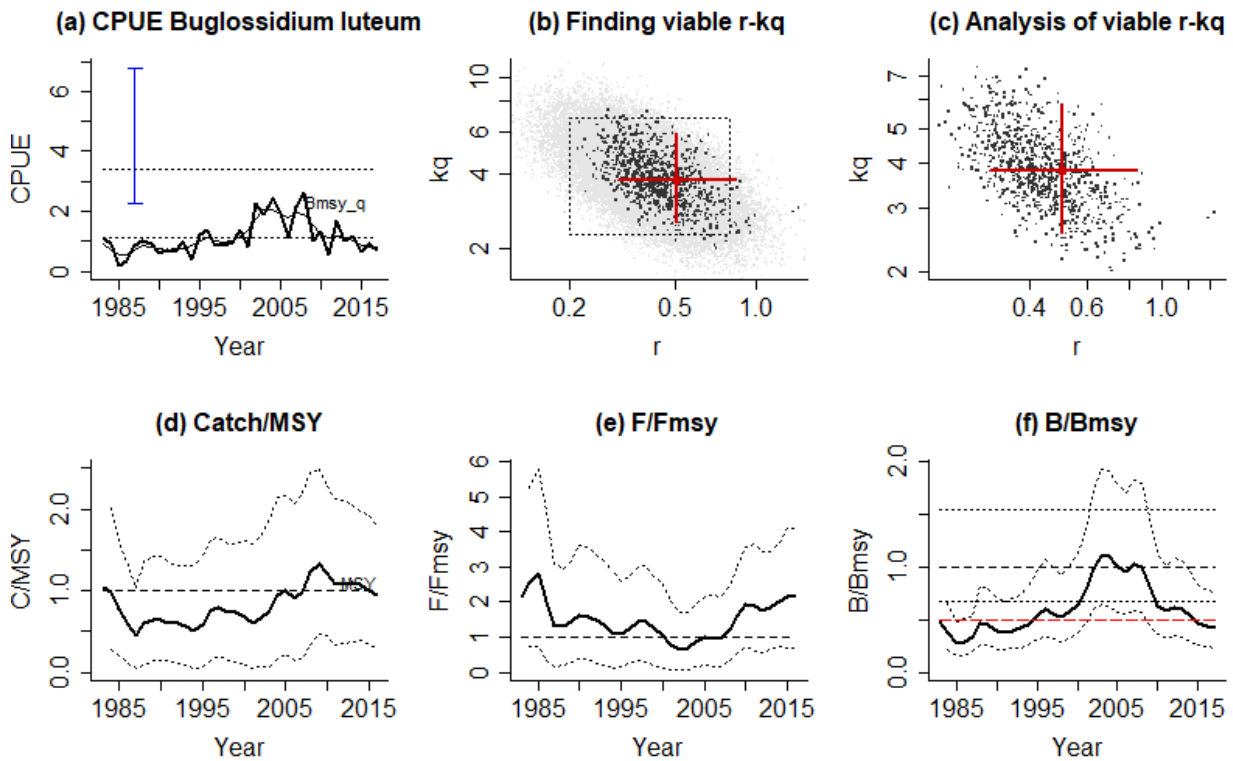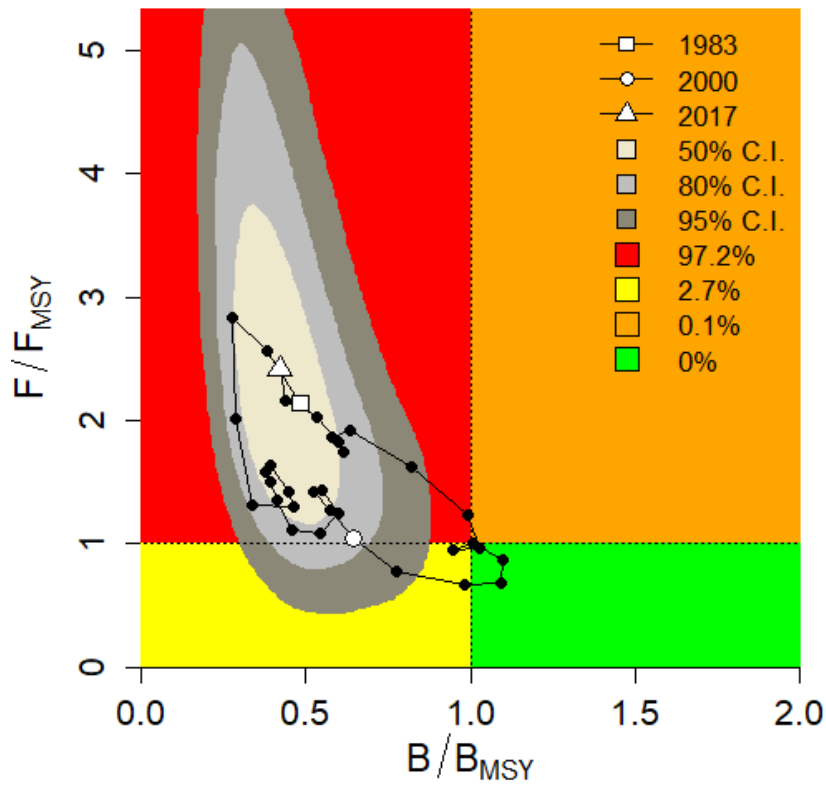
Buglossidium luteum

Buglossidium luteum
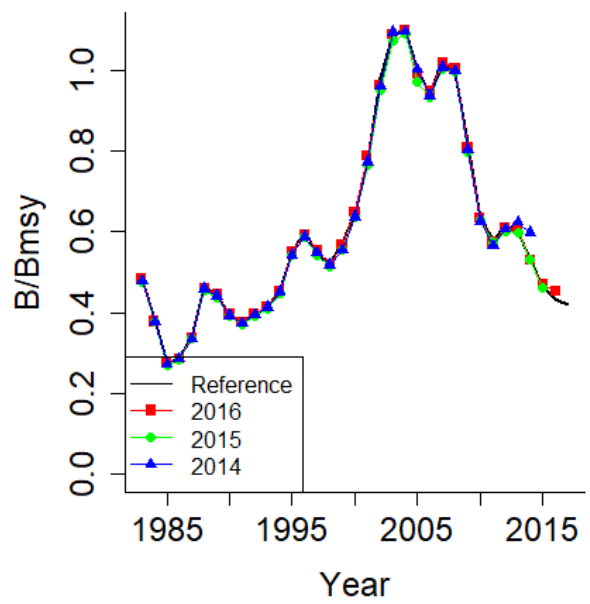
```
--------------------------------------------------------------------
LBB results for Callionymus lyra, stock Callionymus lyra, 1993-2017
Files:LBB4AMSY_ID_3.csv, LBB_June052019_Callionymus lyra.csv
--------------------------------------------------------------------
Linf prior= 31, SD=0.31 cm (user-defined), Lmax=37, median Lmax=25
Z/K prior = 2.8, SD=0.25, M/K prior=1.5, SD=0.15
F/K prior = 1.34 (wide range with tau=4 in log-normal distribution)
Lc prior  = 7.65, SD=0.77 cm, alpha prior=12, SD=1.2, Lm50=17 cm

General reference points (median across years):
Linf     = 31.1 (30.4-31.7) cm
Lopt     = 20 cm, Lopt/Linf=0.64
Lc_opt   = 18 cm, Lc_opt/Linf=0.57, Lmean if F=M 19.1 cm
M/K      = 1.71 (1.45-1.97)
F/M      = 2.04 (1.61-2.54), F/K=4.11 (3.46-4.83), Z/K=5.48 (5.05-6.15)
B/B0     = 0.17 (0.12-0.24), B/B0 F=M Lc=Lc_opt 0.36
Y/R'     = 0.02 (0.014-0.033)(reduced: B/B0<0.25),Y/R' F=M Lc=Lc_opt 0.034

Estimates for 2017 (mean of last 3 years with data):
Lc50     = 13.2 (12.7-13.8) cm, Lc/Linf=0.43 (0.42-0.45)
Lc95     = 21.2, alpha=0.365 (0.352-0.378)
Lmean/Lopt= 0.78, Lc/Lc_opt=0.75, L95th=24.3 cm, L95th/Linf=0.8, Mature=22%
F/M      = 2.8 (2-4.7), F/K=2.7 (2.3-3.2), Z/K=4 (3.6-4.4)
Y/R'     = 0.021 (0.011-0.035)(reduced because B/B0 < 0.25)
B/B0     = 0.28 (0.1-0.49), best LF fit year 2017=0.278 (0.1-0.49)
B/Bmsy   = 0.78 (0.29-1.4), selected B/B0 1998 = 0.17 (0.11-0.23)
RF: Set Linf=31 between median and max. Deleted unrealsitic LF years. Selected
1998 because of reasonale fit and LC.
```


Callionymus lyra , aggregated LF

1998

2017

Lmean vs Lopt & Lc vs Lc_opt

previous F/M

exploited B / B0

```
------------------------------------------------------------
AMSY Analysis, Fri Nov 01 17:59:19 2019
------------------------------------------------------------
Stock Callionymus lyra, Callionymus lyra, Dragonet
CPUE data for years 1983 - 2017, CPUE range 0.729 - 1.32, smooth = TRUE
Prior for r                   = Medium, NA - NA
Used prior range for r        = 0.2 - 0.8
Prior for 1998 stock status   = Very small, 0.11 - 0.23
Used 1998 prior B/B0 range    = 0.11 - 0.23, prior B/Bmsy = 0.22 - 0.46
Used prior range for kq       = 5.81 - 8.71 [original range = 2.9 - 6.07]
Comment: B/B0 prior from LBB. RF: OK
Source: SMFS 2017

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 5000

 Results:
 viable r-kq pairs    = 5000
 median kq            = 6.66, 5.61 - 7.87
 median MSYq          = 0.866, 0.547 - 1.39
 r (4 MSYq/kq)        = 0.52, 0.308 - 0.835
 Fmsy (r/2)           = 0.26, 0.154 - 0.418
 F/Fmsy               = 1.12, 0.12 - 3.15 (2016)
 B/Bmsy               = 0.308, 0.172 - 0.555 (2017)
```


98

Callionymus lyra
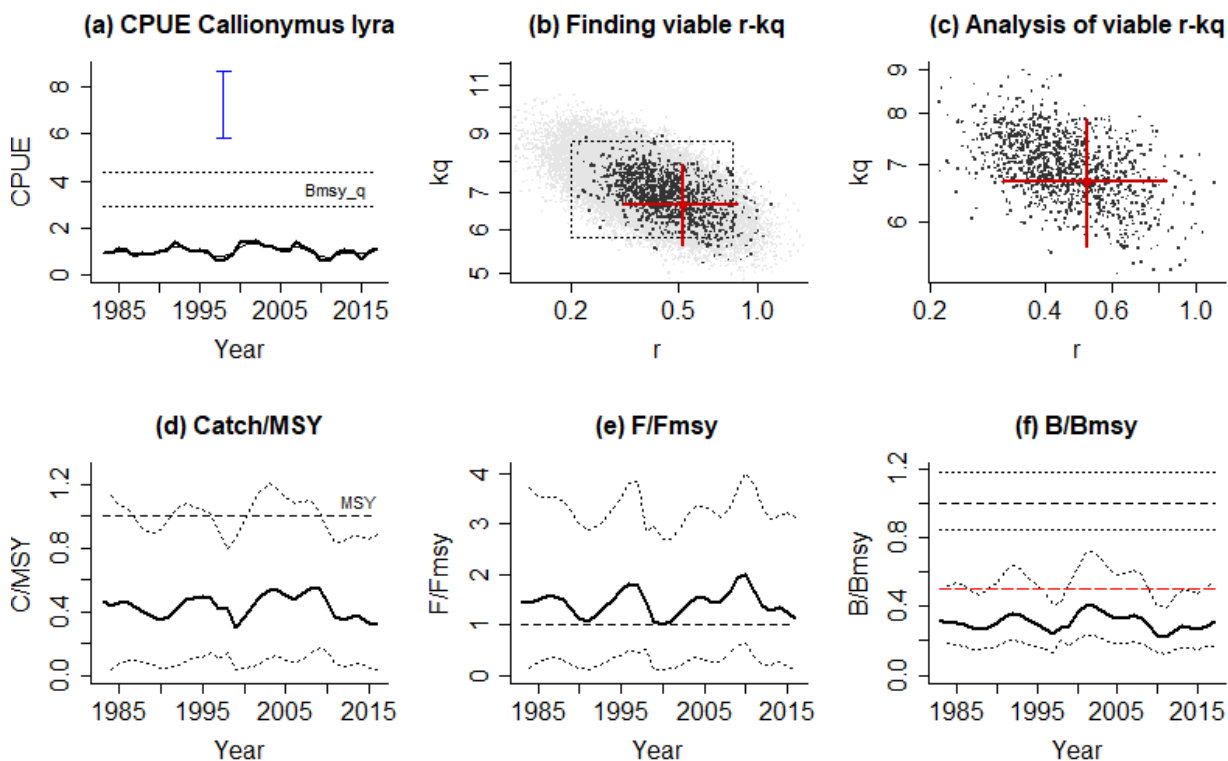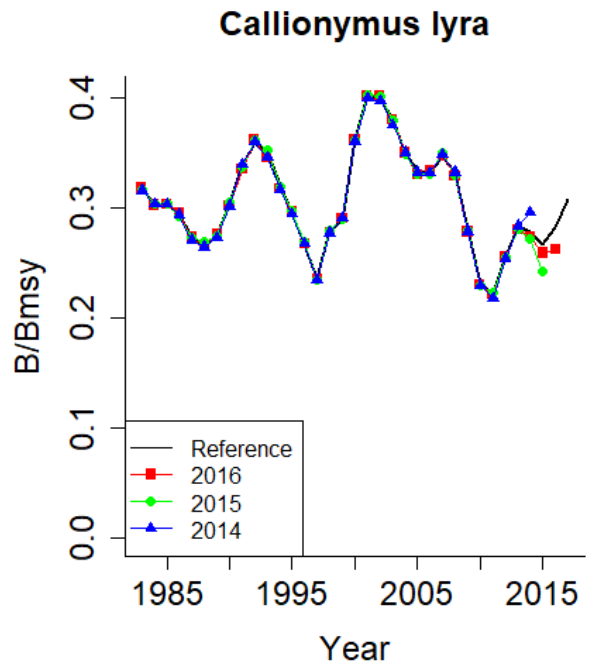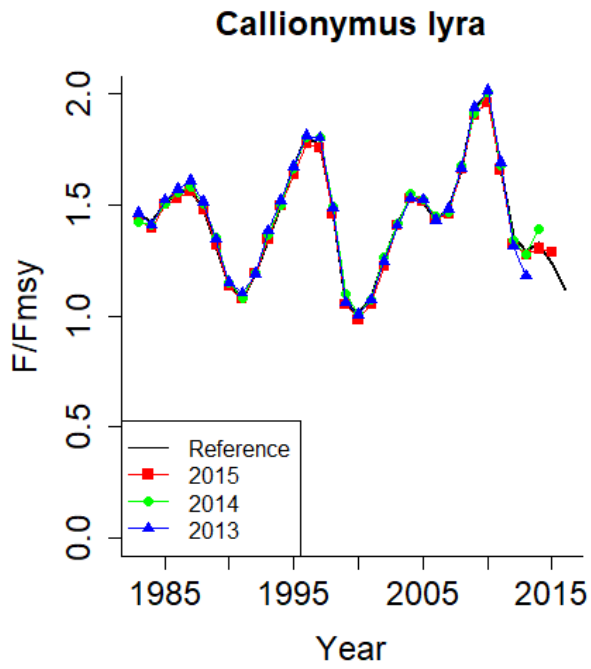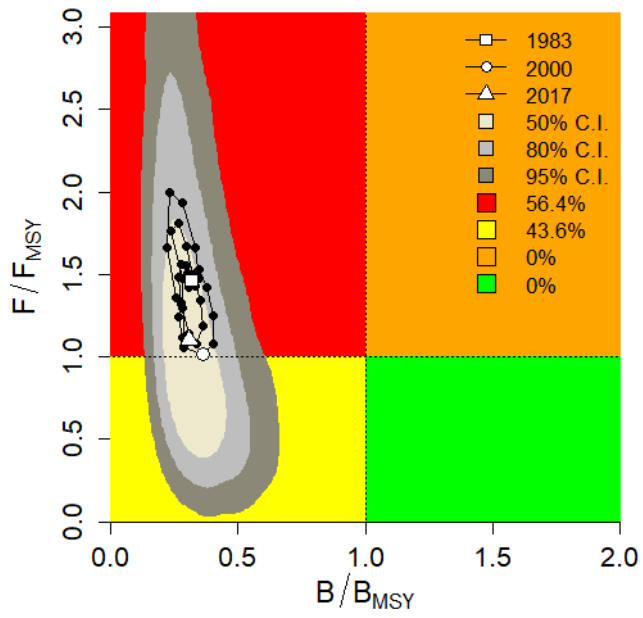
Callionymus lyra

```
----------------------------------------------------------------------
LBB results for Callionymus maculatus, stock Callionymus maculatus, 1983-2016
Files:LBB4AMSY_ID_3.csv, LBB_June052019_Callionymus maculatus.csv
----------------------------------------------------------------------
Linf prior= 18, SD=0.18 cm (user-defined), Lmax=21, median Lmax=15
Z/K prior = 3.1, SD=0.25, M/K prior=1.5, SD=0.15
F/K prior = 1.63 (wide range with tau=4 in log-normal distribution)
Lc prior  = 6.12, SD=0.61 cm, alpha prior=17.8, SD=1.8, Lm50=NA cm

General reference points (median across years):
Linf     = 17.7 (17.3-18) cm
Lopt     = 12 cm, Lopt/Linf=0.68
Lc_opt   = 11 cm, Lc_opt/Linf=0.61, Lmean if F=M 10.3 cm
M/K      = 1.41 (1.15-1.64)
F/M      = 2.35 (1.76-3.03), F/K=3.18 (2.83-3.7), Z/K=4.31 (3.96-4.66)
B/B0     = 0.13 (0.087-0.18), B/B0 F=M Lc=Lc_opt 0.37
Y/R'     = 0.022 (0.013-0.032)(reduced: B/B0<0.25),Y/R' F=M Lc=Lc_opt 0.049

Estimates for 2016 (mean of last 3 years with data):
Lc50     = 8.2 (7.97-8.4) cm, Lc/Linf=0.45 (0.44-0.46)
Lc95     = 11.8, alpha=0.823 (0.796-0.85)
Lmean/Lopt= 0.84, Lc/Lc_opt=0.76, L95th=15 cm, L95th/Linf=0.83, Mature=NA%
F/M      = 2.9 (2.2-3.7), F/K=4.8 (4.2-5.5), Z/K=6.5 (5.8-7.1)
Y/R'     = 0.02 (0.013-0.028)(reduced because B/B0 < 0.25)
B/B0     = 0.12 (0.08-0.17), best LF fit year 2003=0.143 (0.092-0.2)
B/Bmsy   = 0.32 (0.22-0.46), selected B/B0 2011 = 0.24 (0.15-0.36)
RF: Set Linf=18cm between median and max. Selected 2011 because of reasonable
fit and CL and not too low B/B0.
```
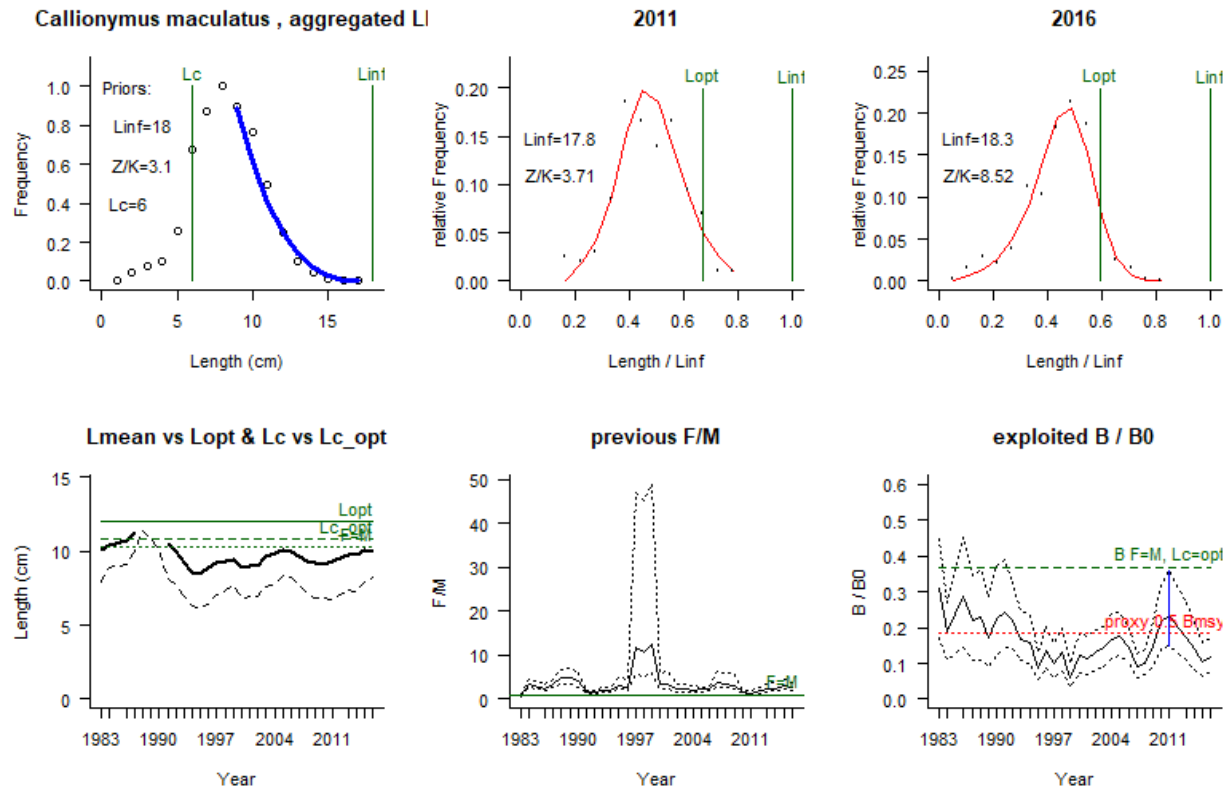
```
-----------------------------------------------------------------
AMSY Analysis, Fri Nov 01 18:03:38 2019
-----------------------------------------------------------------
Stock Callionymus maculatus, Callionymus maculatus, Spotted dragonet
CPUE data for years 1983 - 2017, CPUE range 0.265 - 0.771, smooth = TRUE
Prior for r                   = Medium, NA - NA
Used prior range for r        = 0.2 - 0.8
Prior for 2011 stock status   = Small, 0.15 - 0.36
Used 2011 prior B/B0 range    = 0.15 - 0.36, prior B/Bmsy = 0.3 - 0.72
Used prior range for kq       = 0.745 - 1.5 [original range = 0.625 - 1.5]
Comment: B/B0 prior from LBB. RF: OK
Source: SMFS 2017

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 5000

  Results:
  viable r-kq pairs   = 5000
  median kq           = 1.02, 0.787 - 1.38
  median MSYq         = 0.129, 0.0829 - 0.205
  r (4 MSYq/kq)       = 0.509, 0.314 - 0.884
  Fmsy (r/2)          = 0.254, 0.157 - 0.442
  F/Fmsy              = 1.23, 0.191 - 2.71 (2016)
  B/Bmsy              = 0.79, 0.438 - 1.43 (2017)
```


(a) CPUE Callionymus maculatus   (b) Finding viable r-kq   (c) Analysis of viable r-kq

(d) Catch/MSY   (e) F/Fmsy   (f) B/Bmsy
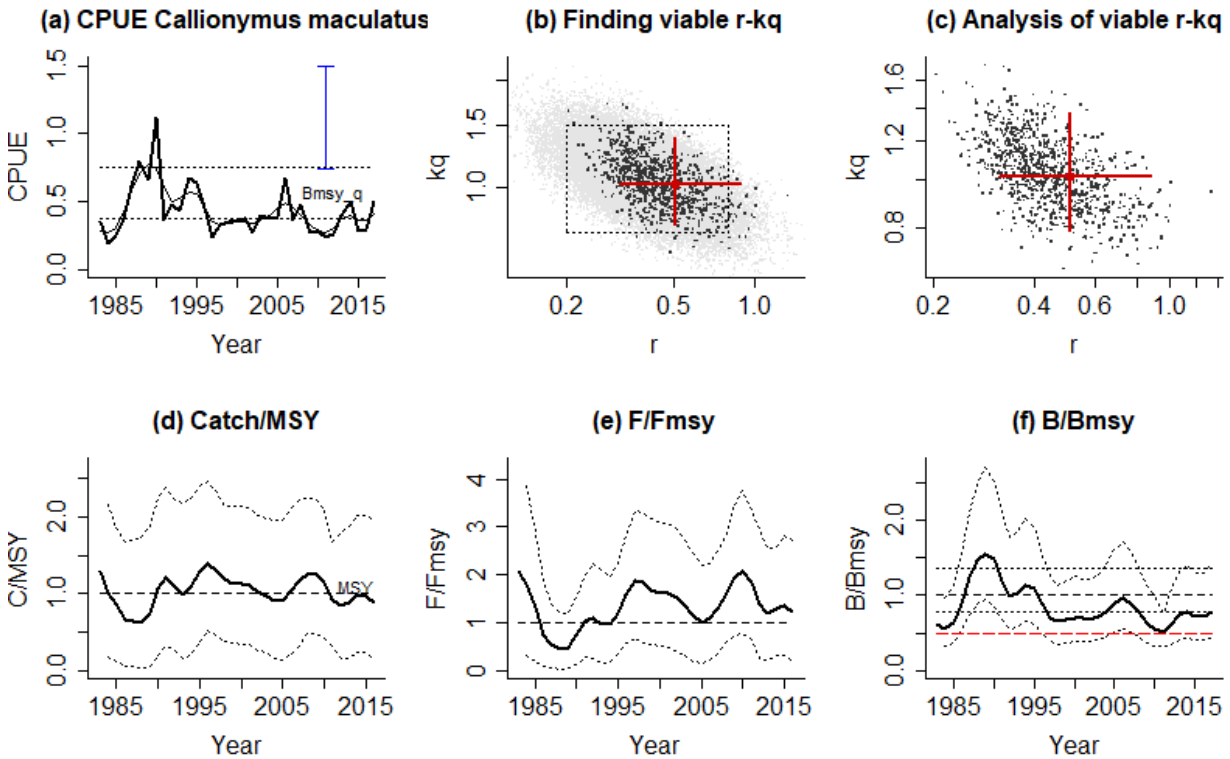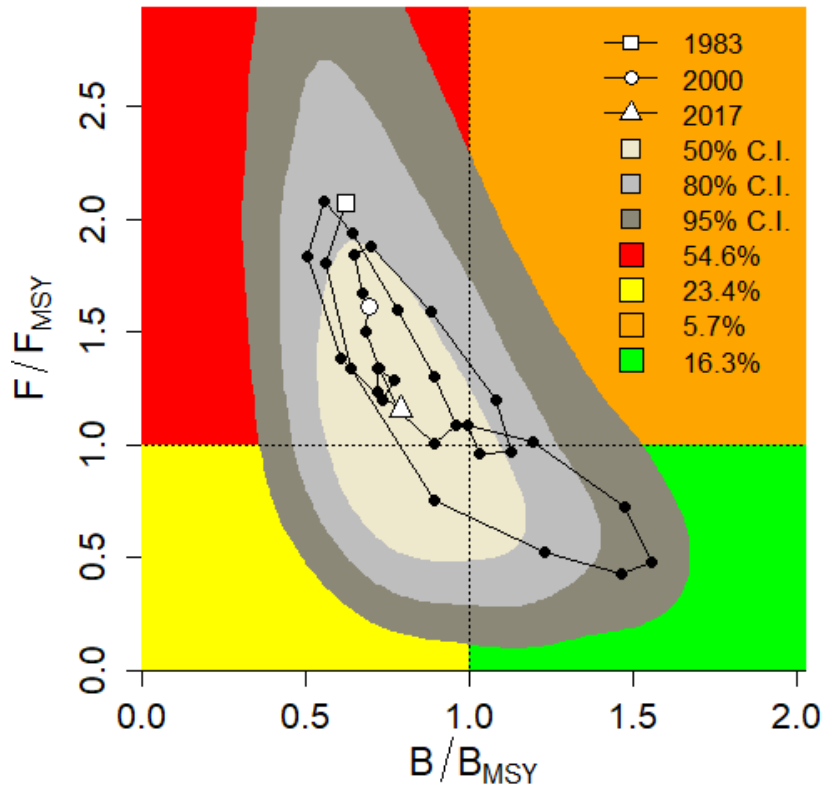
Callionymus maculatus
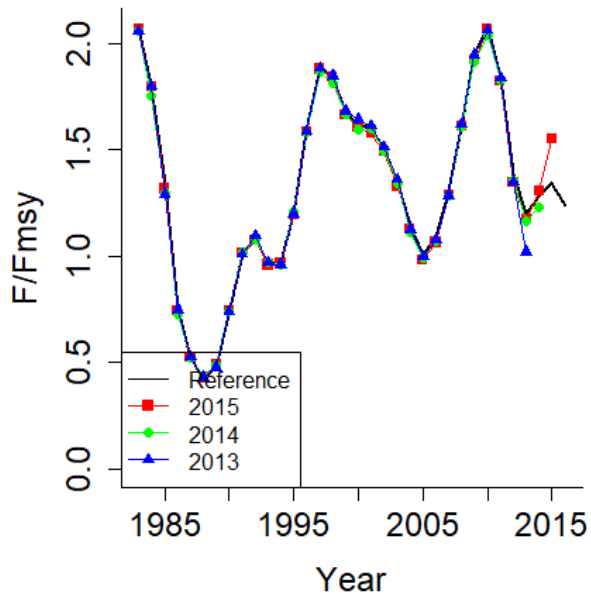
Callionymus maculatus
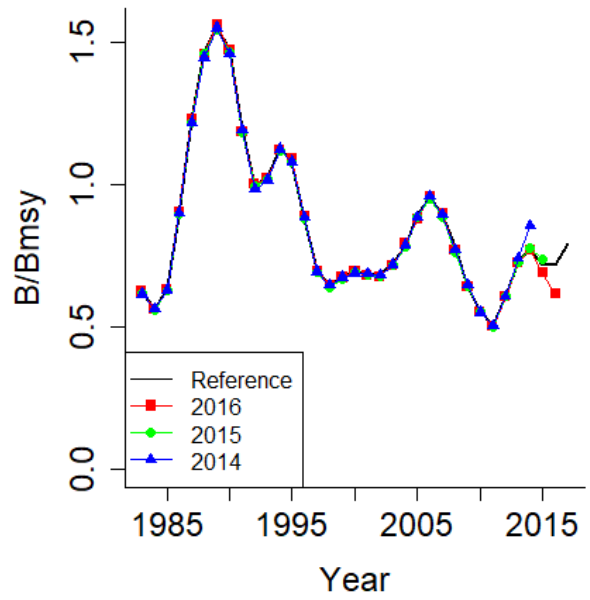
```
--------------------------------------------------------------------
LBB results for Chelidonichthys cuculus, stock Chelidonichthys cuculus, 2001-
2013
Files:LBB4AMSY_ID_3.csv, LBB_June052019_Chelidonichthys cuculus.csv
--------------------------------------------------------------------
Linf prior= 36, SD=0.36 cm (user-defined), Lmax=40, median Lmax=35
Z/K prior = 2, SD=0.066, M/K prior=1.5, SD=0.15
F/K prior = 0.544 (wide range with tau=4 in log-normal distribution)
Lc prior  = 18.4, SD=1.8 cm, alpha prior=13.4, SD=1.3, Lm50=25 cm

General reference points (median across years):
Linf      = 35.8 (35.2-36.4) cm
Lopt      = 23 cm, Lopt/Linf=0.64
Lc_opt    = 20 cm, Lc_opt/Linf=0.56, Lmean if F=M 25.4 cm
M/K       = 1.67 (1.43-1.83)
F/M       = 1.49 (1.2-2.03), F/K=2.01 (1.43-2.57), Z/K=2.89 (2.63-3.23)
B/B0      = 0.29 (0.14-0.47), B/B0 F=M Lc=Lc_opt 0.36
Y/R'      = 0.03 (0.021-0.048), Y/R' F=M Lc=Lc_opt 0.037

Estimates for 2013 (mean of last 3 years with data):
Lc50      = 22.7 (22.2-23.2) cm, Lc/Linf=0.63 (0.62-0.64)
Lc95      = 30, alpha=0.402 (0.389-0.413)
Lmean/Lopt= 0.95, Lc/Lc_opt=1.1, L95th=33.3 cm, L95th/Linf=0.93, Mature=37%
F/M       = 2.7 (1.5-6.4), F/K=1.5 (1.2-1.9), Z/K=2.5 (2.2-2.8)
Y/R'      = 0.059 (0.018-0.14)
B/B0      = 0.35 (0.076-0.79), best LF fit year 2010=0.328 (0.15-0.53)
B/Bmsy    = 0.96 (0.21-2.2), selected B/B0 2012 = 0.29 (0.12-0.55)
RF: Set Linf=36 between median and max. Used 2012 because of good fit and CL.
```
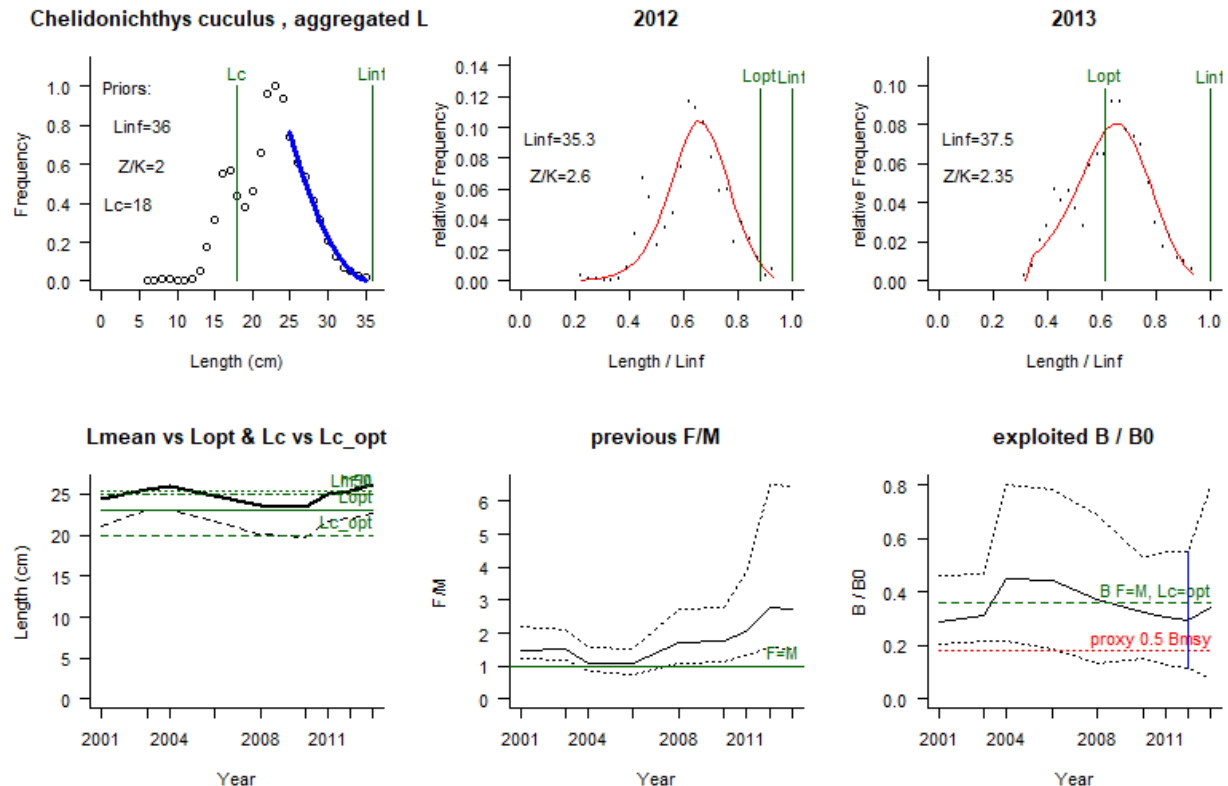
```
--------------------------------------------------------------
AMSY Analysis, Fri Nov 01 18:08:05 2019
--------------------------------------------------------------
Stock Chelidonichthys cuculus, Chelidonichthys cuculus, Red gurnard
CPUE data for years 1984 - 2017, CPUE range 2.86 - 15.7, smooth = TRUE
Prior for r                  = Medium, NA - NA
Used prior range for r       = 0.2 - 0.8
Prior for 2012 stock status  = Small, 0.12 - 0.55
Used 2012 prior B/B0 range   = 0.12 - 0.55, prior B/Bmsy = 0.24 - 1.1
Used prior range for kq      = 15 - 45.1 [original range = 13.1 - 60.2]
Comment: B/B0 prior from LBB. RF: OK
Source: SMFS 2017

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 5000

  Results:
  viable r-kq pairs   = 5000
  median kq           = 24.8, 17.6 - 36.5
  median MSYq         = 3.33, 2.11 - 5.62
  r (4 MSYq/kq)       = 0.537, 0.325 - 0.94
  Fmsy (r/2)          = 0.269, 0.163 - 0.47
  F/Fmsy              = 0.859, 0.13 - 1.88 (2016)
  B/Bmsy              = 1.09, 0.607 - 1.94 (2017)
```


(a) CPUE Chelidonichthys cuculu
(b) Finding viable r-kq
(c) Analysis of viable r-kq
(d) Catch/MSY
(e) F/Fmsy
(f) B/Bmsy
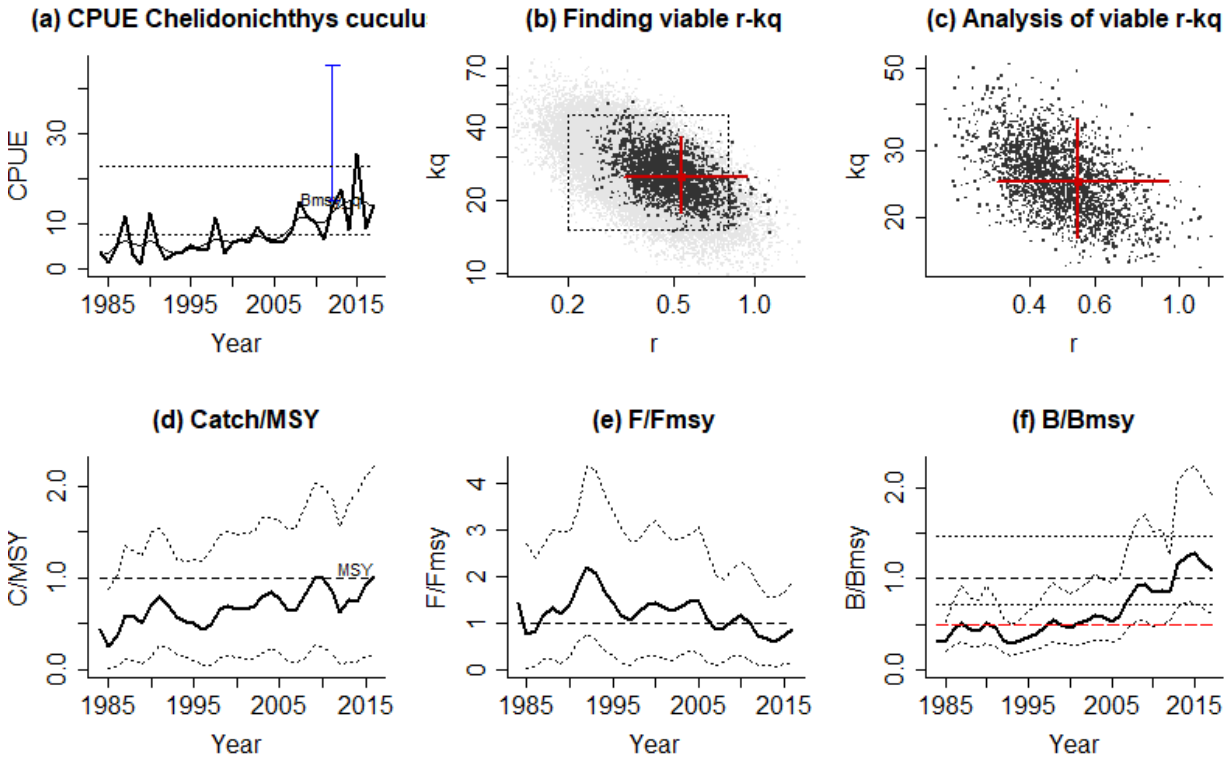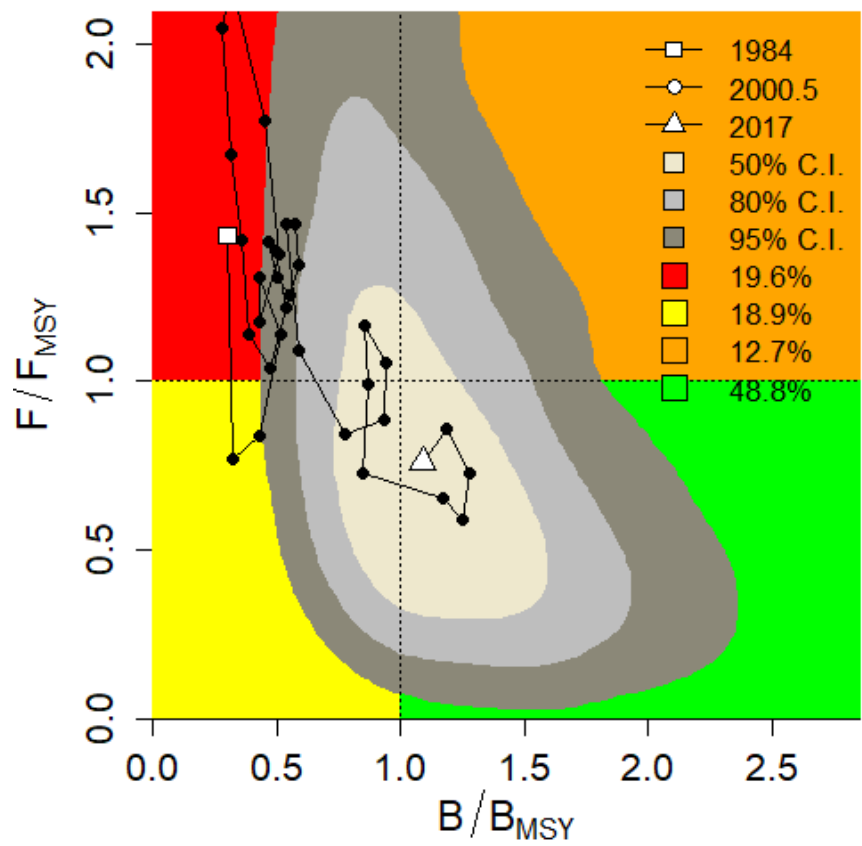
Chelidonichthys cuculus
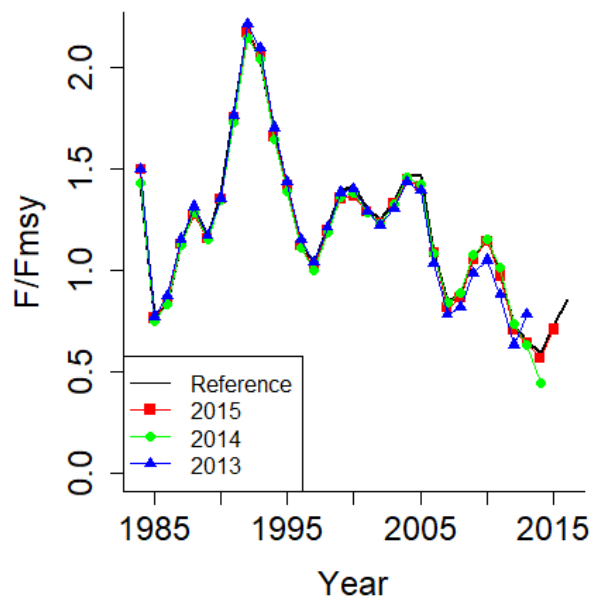
Chelidonichthys cuculus
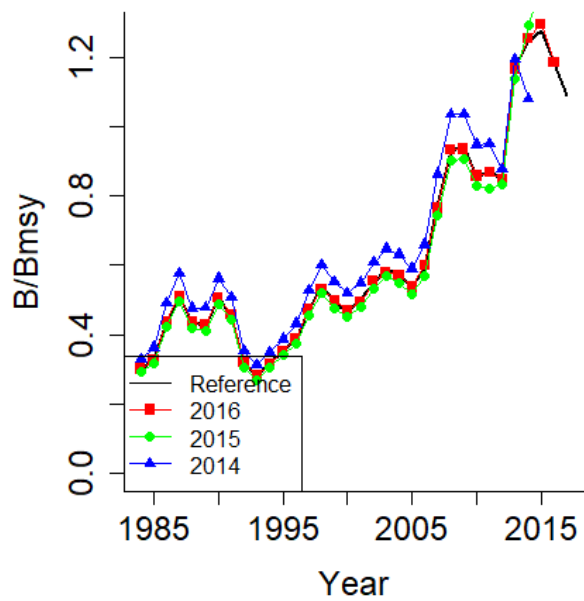
```
--------------------------------------------------------------------
LBB results for Echiichthys vipera, stock Echiichthys vipera, 1998-2017
Files:LBB4AMSY_ID_3.csv, LBB_June052019_Echiichthys vipera.csv
--------------------------------------------------------------------
Linf prior= 17, SD=0.17 cm (user-defined), Lmax=19, median Lmax=15
Z/K prior = 4, SD=0.091, M/K prior=1.5, SD=0.15
F/K prior = 2.55 (wide range with tau=4 in log-normal distribution)
Lc prior  = 7.14, SD=0.71 cm, alpha prior=12.6, SD=1.3, Lm50=NA cm

General reference points (median across years):
Linf      = 16.9 (16.7-17.3) cm
Lopt      = 12 cm, Lopt/Linf=0.69
Lc_opt    = 11 cm, Lc_opt/Linf=0.63, Lmean if F=M 10.8 cm
M/K       = 1.33 (1.09-1.6)
F/M       = 2.84 (2.12-4.1), F/K=3.88 (3.36-4.45), Z/K=4.88 (4.5-5.36)
B/B0      = 0.13 (0.081-0.19), B/B0 F=M Lc=Lc_opt 0.37
Y/R'      = 0.029 (0.019-0.041)(reduced: B/B0<0.25),Y/R' F=M Lc=Lc_opt 0.053

Estimates for 2017 (mean of last 3 years with data):
Lc50      = 8.41 (8.22-8.63) cm, Lc/Linf=0.48 (0.47-0.5)
Lc95      = 12.1, alpha=0.808 (0.778-0.841)
Lmean/Lopt= 0.94, Lc/Lc_opt=0.78, L95th=15.7 cm, L95th/Linf=0.9, Mature=NA%
F/M       = 1.4 (0.99-1.8), F/K=2.5 (2-2.9), Z/K=4.2 (3.9-4.6)
Y/R'      = 0.036 (0.022-0.051)(reduced because B/B0 < 0.25)
B/B0      = 0.25 (0.15-0.36), best LF fit year 2005=0.0774 (0.05-0.11)
B/Bmsy    = 0.68 (0.42-0.97), selected B/B0 2013 = 0.24 (0.15-0.34)
RF: Set Linf=17 between median and max. Exluded years with unrealistic LF fits
. Selected 2013 for reasonable fit and CL.
```
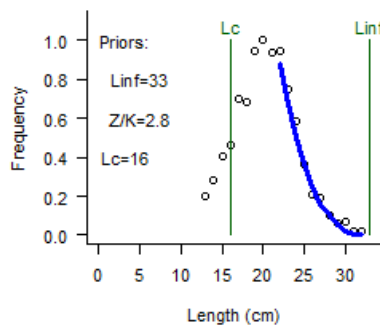

Echiichthys vipera , aggregated LF

2013

2017

Lmean vs Lopt & Lc vs Lc_opt

previous F/M

exploited B / B0
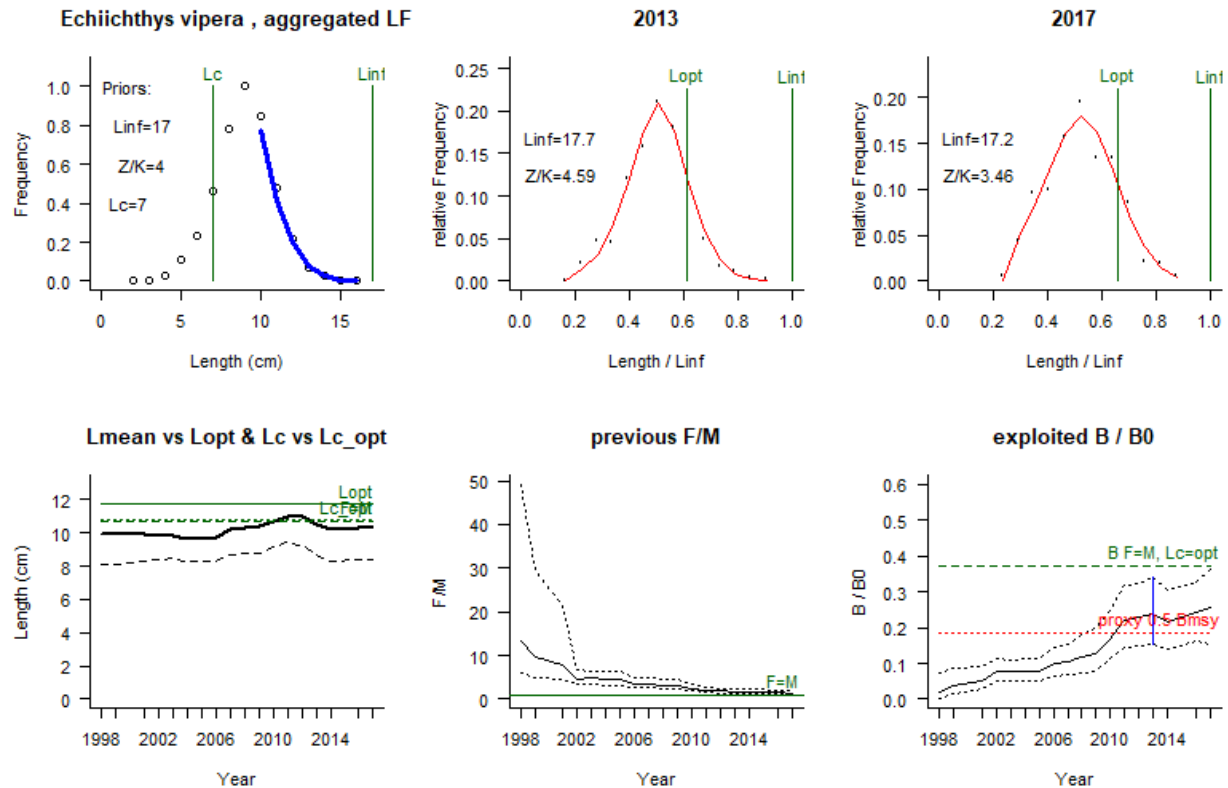
```
------------------------------------------------------------------
AMSY Analysis, Fri Nov 01 18:12:40 2019
------------------------------------------------------------------
Stock Echiichthys vipera, Echiichthys vipera, Lesser weever
CPUE data for years 1983 - 2017, CPUE range 0.489 - 2.16, smooth = TRUE
Prior for r                   = Medium, NA - NA
Used prior range for r        = 0.2 - 0.8
Prior for 2013 stock status   = Small, 0.15 - 0.34
Used 2013 prior B/B0 range    = 0.15 - 0.34, prior B/Bmsy = 0.3 - 0.68
Used prior range for kq       = 3.54 - 8.02 [original range = 3.54 - 8.02]
Comment: B/B0 prior from LBB. RF: OK
Source: SMFS 2017

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 5004

  Results:
  viable r-kq pairs    = 5004
  median kq            = 4.89, 3.64 - 6.86
  median MSYq          = 0.641, 0.404 - 1.01
  r (4 MSYq/kq)        = 0.524, 0.306 - 0.859
  Fmsy (r/2)           = 0.262, 0.153 - 0.43
  F/Fmsy               = 1.46, 0.266 - 3.03 (2016)
  B/Bmsy               = 0.599, 0.331 - 1.06 (2017)
```


(a) CPUE Echiichthys vipera (b) Finding viable r-kq (c) Analysis of viable r-kq
(d) Catch/MSY (e) F/Fmsy (f) B/Bmsy

Echiichthys vipera

Echiichthys vipera
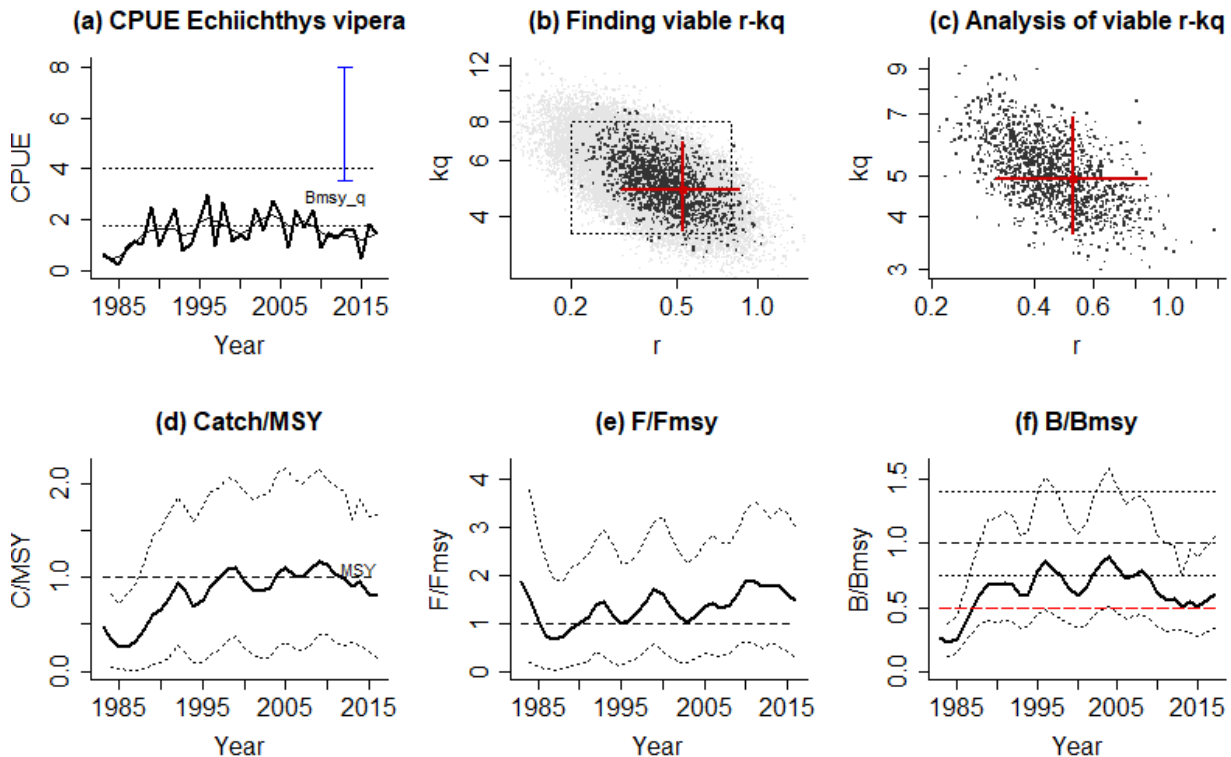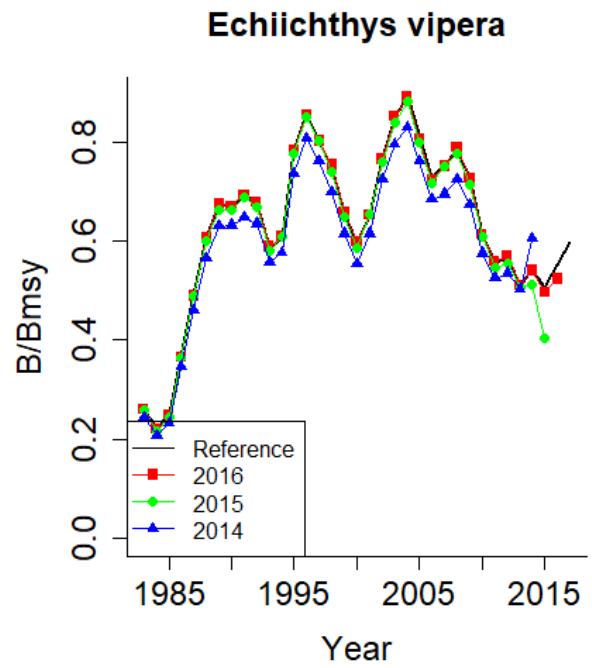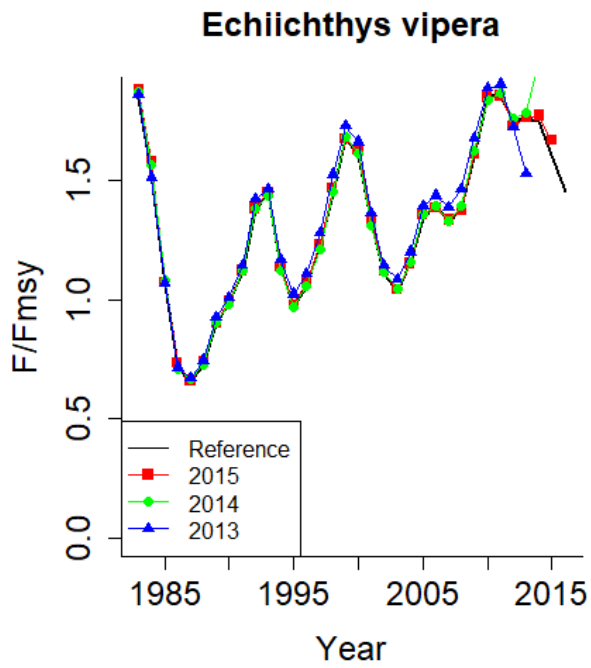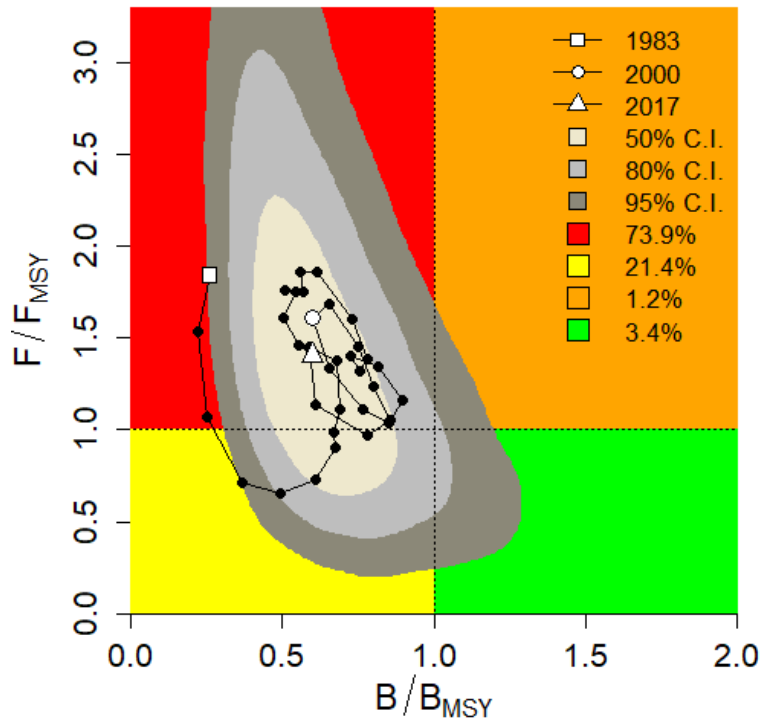
```
--------------------------------------------------------------------------
LBB results for Enchelyopus cimbrius, stock Enchelyopus cimbrius, 1983-2017
Files:LBB4AMSY_ID_3.csv, LBB_June052019_Enchelyopus cimbrius.csv
--------------------------------------------------------------------------
Linf prior= 36, SD=0.36 cm (user-defined), Lmax=44, median Lmax=32
Z/K prior = 3, SD=0.076, M/K prior=1.5, SD=0.15
F/K prior = 1.52 (wide range with tau=4 in log-normal distribution)
Lc prior  = 12.8, SD=1.3 cm, alpha prior=16.6, SD=1.7, Lm50=25 cm

General reference points (median across years):
Linf     = 35.6 (35-36.2) cm
Lopt     = 25 cm, Lopt/Linf=0.69
Lc_opt   = 21 cm, Lc_opt/Linf=0.6, Lmean if F=M 20.4 cm
M/K      = 1.36 (1.16-1.59)
F/M      = 1.65 (1.3-2.42), F/K=2.32 (1.94-2.73), Z/K=3.83 (3.5-4.11)
B/B0     = 0.2 (0.11-0.31), B/B0 F=M Lc=Lc_opt 0.37
Y/R'     = 0.036 (0.02-0.051)(reduced: B/B0<0.25),Y/R' F=M Lc=Lc_opt 0.052

Estimates for 2017 (mean of last 3 years with data):
Lc50     = 14.2 (13.9-14.7) cm, Lc/Linf=0.4 (0.39-0.42)
Lc95     = 20.6, alpha=0.459 (0.444-0.474)
Lmean/Lopt= 0.81, Lc/Lc_opt=0.66, L95th=29.3 cm, L95th/Linf=0.83, Mature=5.7%
F/M      = 1.5 (1.1-2.2), F/K=1.9 (1.5-2.3), Z/K=3.4 (3.1-3.7)
Y/R'     = 0.029 (0.017-0.045)(reduced because B/B0 < 0.25)
B/B0     = 0.3 (0.17-0.46), best LF fit year 1985=0.22 (0.15-0.3)
B/Bmsy   = 0.8 (0.46-1.2), selected B/B0 2000 = 0.23 (0.13-0.36)
RF: Set Linf between median and max. Excluded years with unrealistic LF fits.
Selected 2000 because of reasonable fit and CL
```



Enchelyopus cimbrius , aggregated LF

2000

2017

Lmean vs Lopt & Lc vs Lc_opt

previous F/M

exploited B / B0

109
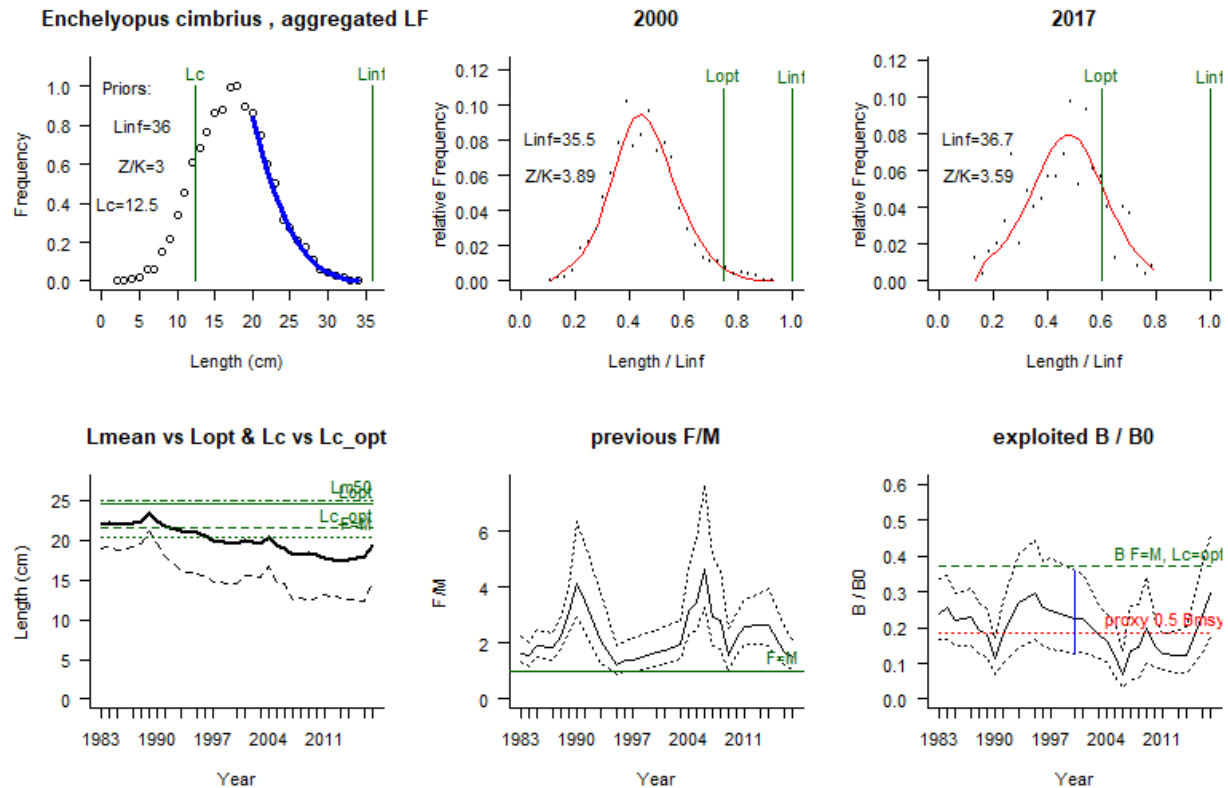
```
-----------------------------------------------------------------
AMSY Analysis, Fri Nov 01 18:16:36 2019
-----------------------------------------------------------------
```

Stock **Enchelyopus cimbrius**, *Enchelyopus cimbrius*, Fourbeard rockling
CPUE data for years 1983 - 2017, CPUE range 1.02 - 3.68, smooth = TRUE
```
Prior for r                  = Medium, NA - NA
Used prior range for r       = 0.2 - 0.8
Prior for 2000 stock status  = Small, 0.13 - 0.36
Used 2000 prior B/B0 range   = 0.13 - 0.36, prior B/Bmsy = 0.26 - 0.72
Used prior range for kq      = 4.84 - 13.4 [original range = 4.84 - 13.4]
```
Comment: B/B0 prior from LBB. RF: OK
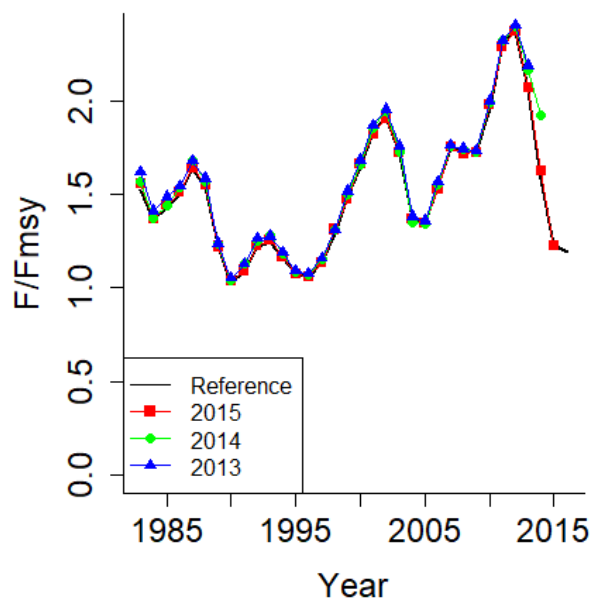Source: SMFS 2017

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 5007

```
  Results:
  viable r-kq pairs  = 5007
  median kq          = 8.07, 5.26 - 11.7
  median MSYq        = 0.912, 0.562 - 1.41
  r (4 MSYq/kq)      = 0.452, 0.277 - 0.724
  Fmsy (r/2)         = 0.226, 0.138 - 0.362
  F/Fmsy             = 1.91, 0.447 - 4.29 (2016)
  B/Bmsy             = 0.254, 0.142 - 0.455 (2017)
```


(a) CPUE Enchelyopus cimbrius (b) Finding viable r-kq (c) Analysis of viable r-kq
(d) Catch/MSY (e) F/Fmsy (f) B/Bmsy
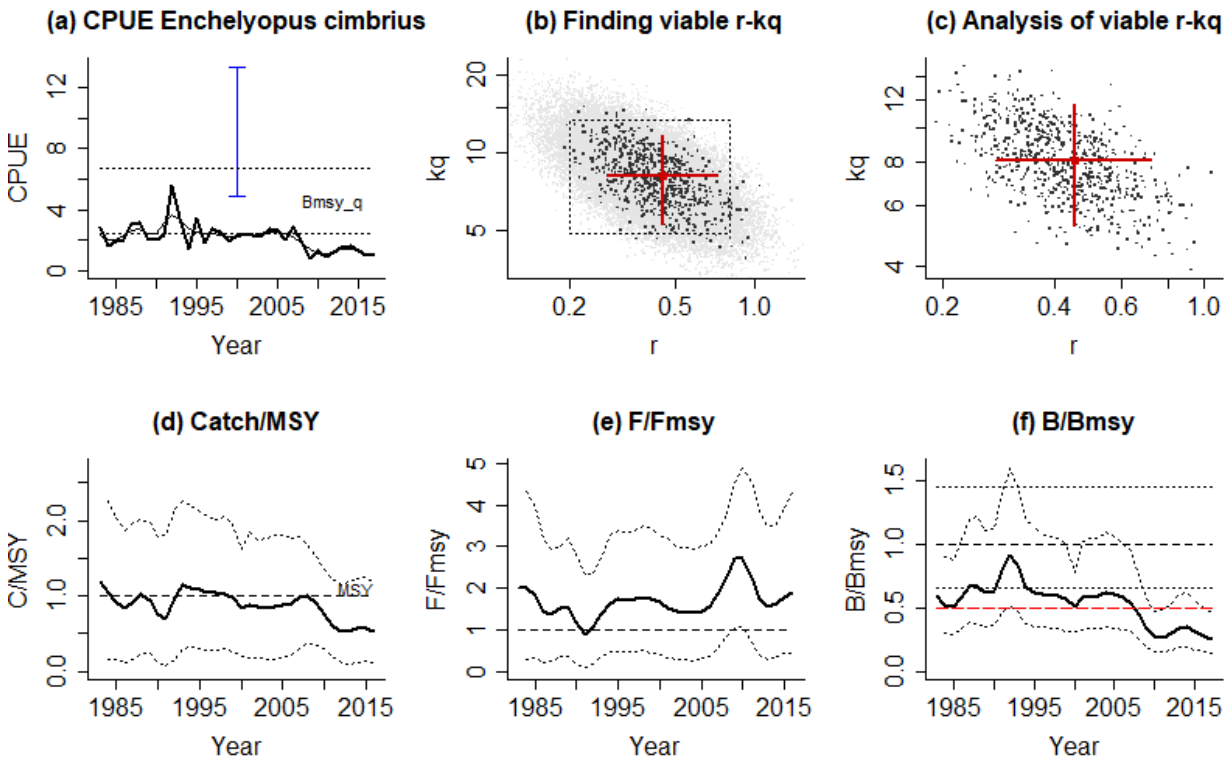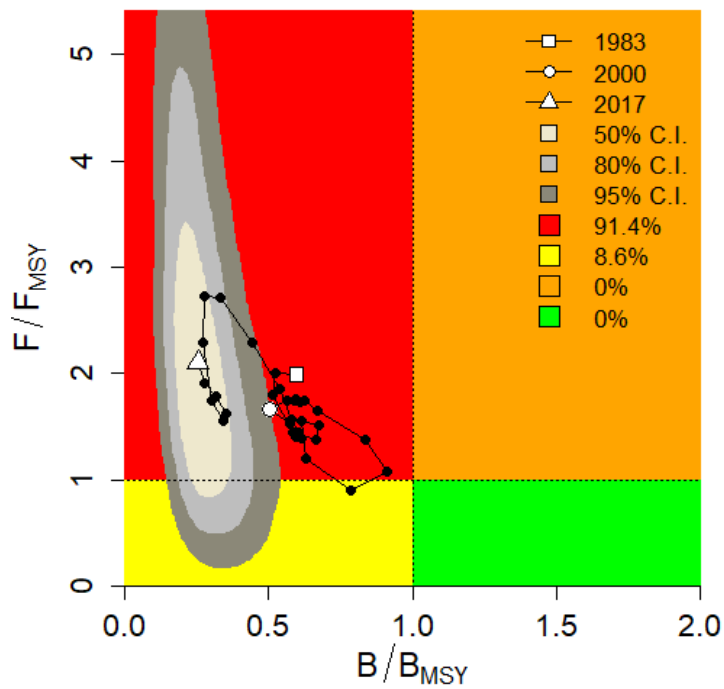
Enchelyopus cimbrius
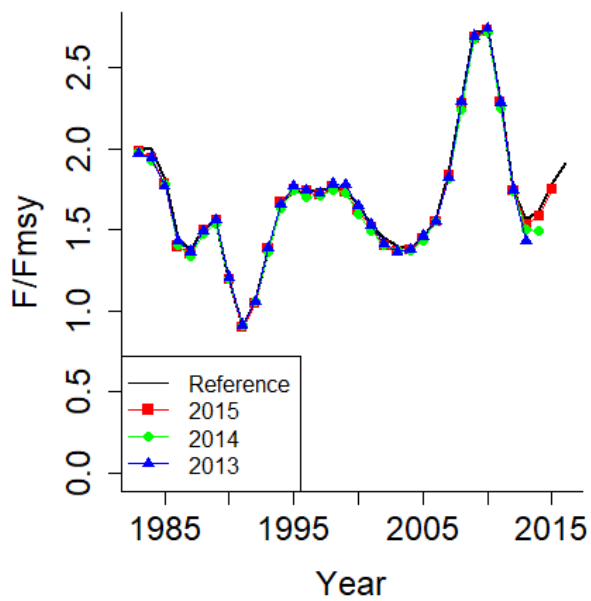
Enchelyopus cimbrius
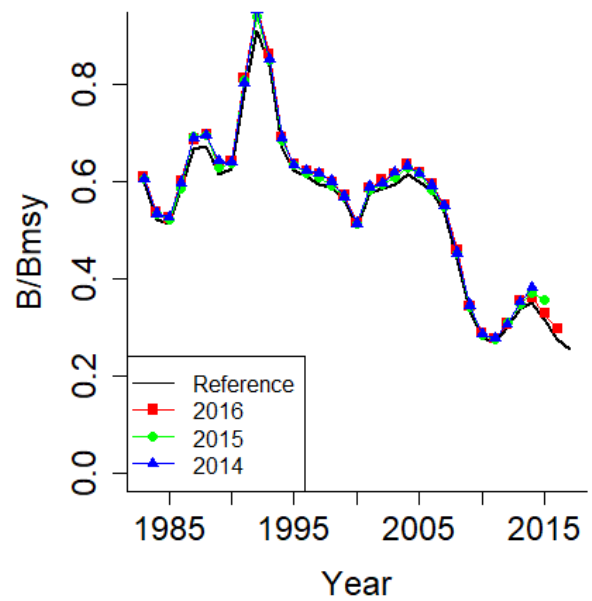
```
-------------------------------------------------------------------
LBB results for Lumpenus lampretaeformis, Lumpenus lampretaeformis, 1999-2017
Files:LBB4AMSY_ID_3.csv, LBB_June052019_Lumpenus lampretaeformis.csv
-------------------------------------------------------------------
Linf prior= 33, SD=0.33 cm (user-defined), Lmax=36, median Lmax=31.5
Z/K prior = 2.8, SD=0.12, M/K prior=1.5, SD=0.15
F/K prior = 1.28 (wide range with tau=4 in log-normal distribution)
Lc prior  = 16.3, SD=1.6 cm, alpha prior=19.9, SD=2, Lm50=20 cm

General reference points (median across years):
Linf     = 33 (32.5-33.6) cm
Lopt     = 21 cm, Lopt/Linf=0.65
Lc_opt   = 19 cm, Lc_opt/Linf=0.56, Lmean if F=M 23 cm
M/K      = 1.62 (1.36-1.9)
F/M      = 1.49 (1.05-2.04), F/K=2.35 (1.82-2.87), Z/K=3.93 (3.52-4.37)
B/B0     = 0.3 (0.18-0.45), B/B0 F=M Lc=Lc_opt 0.36
Y/R'     = 0.032 (0.019-0.052), Y/R' F=M Lc=Lc_opt 0.039

Estimates for 2017 (mean of last 3 years with data):
Lc50     = 20.6 (20.2-21) cm, Lc/Linf=0.63 (0.61-0.64)
Lc95     = 26.8, alpha=0.482 (0.466-0.497)
Lmean/Lopt= 1.1, Lc/Lc_opt=1.1, L95th=28.3 cm, L95th/Linf=0.86, Mature=38%
F/M      = 6.5 (5.1-8), F/K=10 (8.5-11), Z/K=12 (10-13)
Y/R'     = 0.02 (0.013-0.028)
B/B0     = 0.11 (0.072-0.15), best LF fit year 2014=0.097 (0.048-0.19)
B/Bmsy   = 0.29 (0.2-0.41), selected B/B0 1999 = 0.28 (0.19-0.45)
RF: Set Linf between median and max. Set Lcut=13 to exclude early juveniles.
Selected 1999 because of reasonable fit and CL.
```
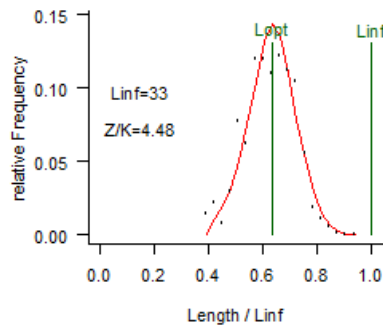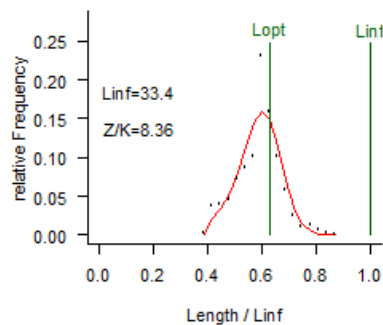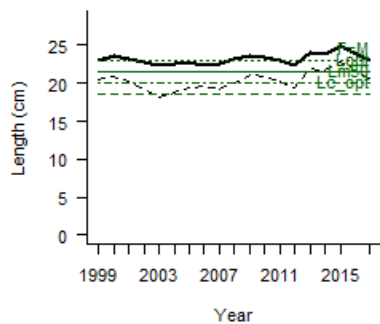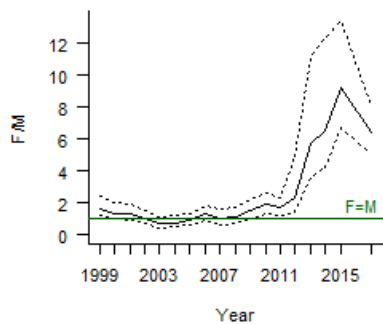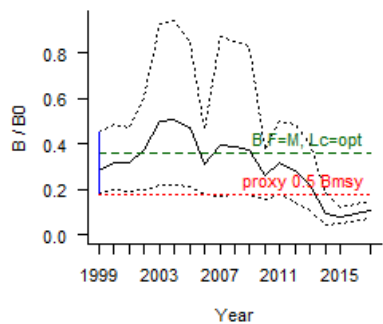
```
------------------------------------------------------------------
AMSY Analysis, Fri Nov 01 18:20:05 2019
------------------------------------------------------------------
Stock Lumpenus lampretaeformis, Lumpenus lampretaeformis, Snake blenny
CPUE data for years 1983 - 2017, CPUE range 0.401 - 0.948, smooth = TRUE
Prior for r                    = Medium, NA - NA
Used prior range for r         = 0.2 - 0.8
Prior for 2000 stock status    = Small, 0.13 - 0.36
Used 2000 prior B/B0 range     = 0.13 - 0.36, prior B/Bmsy = 0.26 - 0.72
Used prior range for kq        = 1.74 - 4.82 [original range = 1.74 - 4.82]
Comment: B/B0 prior from LBB. RF: OK
Source: SMFS 2017

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 5000

  Results:
  viable r-kq pairs     = 5000
  median kq             = 2.75, 1.86 - 4.04
  median MSYq           = 0.335, 0.208 - 0.533
  r (4 MSYq/kq)         = 0.486, 0.302 - 0.755
  Fmsy (r/2)            = 0.243, 0.151 - 0.377
  F/Fmsy                = 1.19, 0.138 - 2.88 (2016)
  B/Bmsy                = 0.454, 0.252 - 0.824 (2017)
```


(a) CPUE Lumpenus lampretaeforn (b) Finding viable r-kq (c) Analysis of viable r-kq

(d) Catch/MSY (e) F/Fmsy (f) B/Bmsy
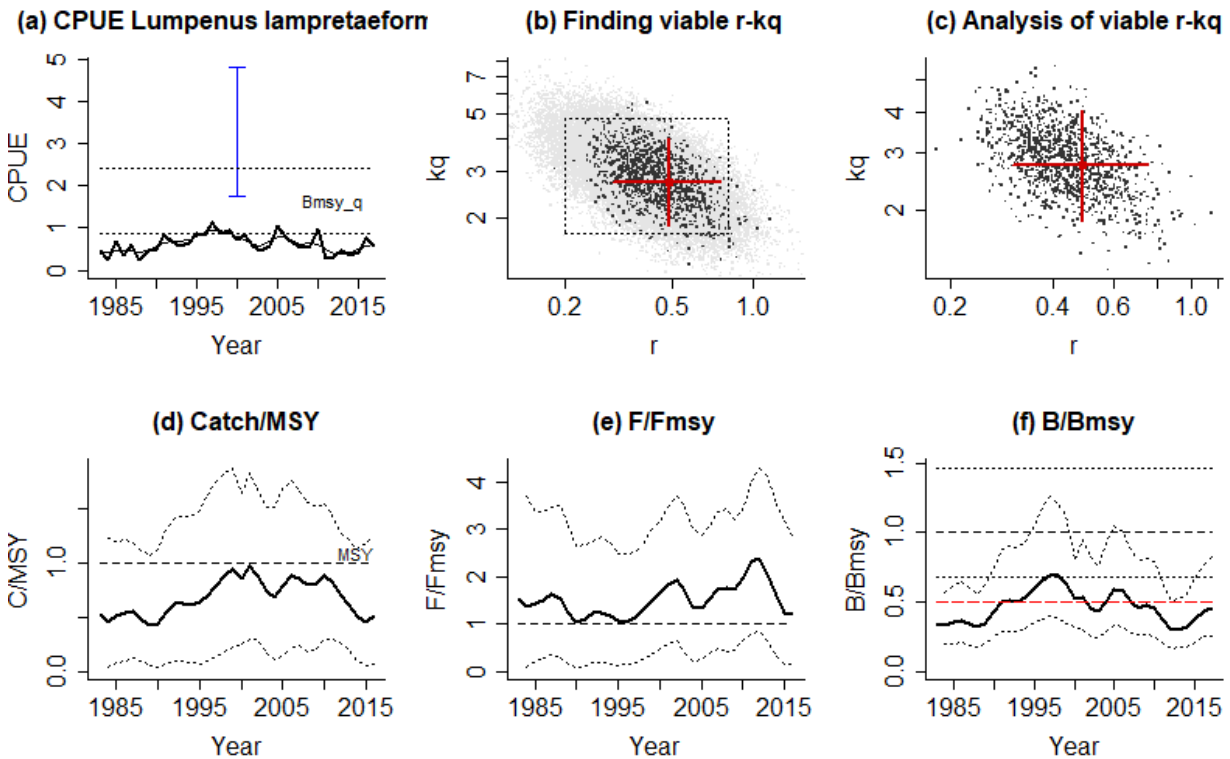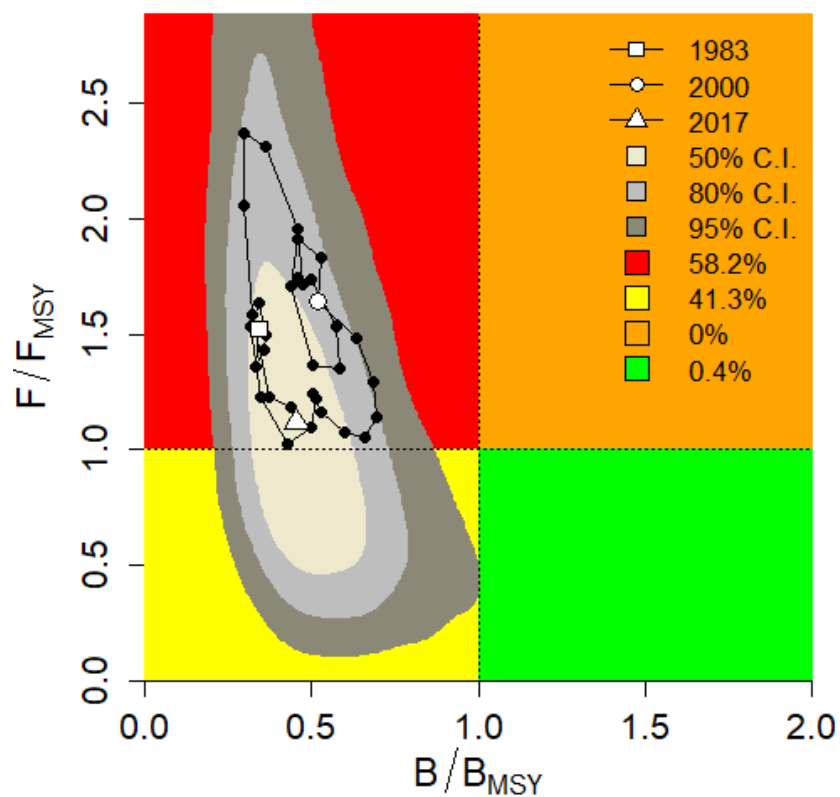
Lumpenus lampretaeformis

Lumpenus lampretaeformis
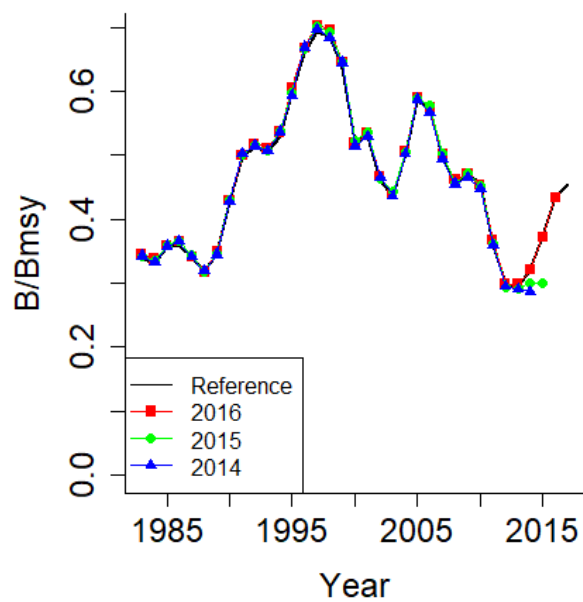
LBB results for *Lycodes vahlii*, stock **Lycodes vahlii**, 1994-2013
Files:LBB4AMSY_ID_3.csv, LBB_June052019_Lycodes vahlii.csv

Linf prior= 25, SD=0.25 cm (user-defined), Lmax=32, median Lmax=22
Z/K prior = 2.2, SD=0.21, M/K prior=1.5, SD=0.15
F/K prior = 0.679 (wide range with tau=4 in log-normal distribution)
Lc prior = 10.2, SD=1 cm, alpha prior=12.2, SD=1.2, Lm50=NA cm

General reference points (median across years):
Linf   = 24.3 (23.8-24.7) cm
Lopt   = 16 cm, Lopt/Linf=0.66
Lc_opt   = 13 cm, Lc_opt/Linf=0.55, Lmean if F=M 16.1 cm
M/K   = 1.54 (1.24-1.75)
F/M   = 0.921 (0.601-1.45), F/K=1.44 (1.09-1.88), Z/K=3.01 (2.73-3.36)
B/B0   = 0.37 (0.18-0.62), B/B0 F=M Lc=Lc_opt 0.36
Y/R'   = 0.033 (0.019-0.069), Y/R' F=M Lc=Lc_opt 0.042

Estimates for 2013 (mean of last 3 years with data):
Lc50   = 15.6 (15.2-15.9) cm, Lc/Linf=0.64 (0.62-0.65)
Lc95   = 20.1, alpha=0.66 (0.636-0.678)
Lmean/Lopt= 1, Lc/Lc_opt=1.2, L95th=20.3 cm, L95th/Linf=0.83, Mature=NA%
F/M   = 3 (2.1-4.3), F/K=4.1 (3.1-4.7), Z/K=5.5 (4.6-6.2)
Y/R'   = 0.032 (0.017-0.052)
B/B0   = 0.24 (0.13-0.38), best LF fit year 2001=0.313 (0.17-0.51)
B/Bmsy   = 0.67 (0.35-1), **selected B/B0 2000 = 0.34 (0.16-0.56)**
RF: Set Linf=26cm between median and max. Excluded years with unrealistic LF
fits. Selected 2000 for reasonable fit, CL and B/B0
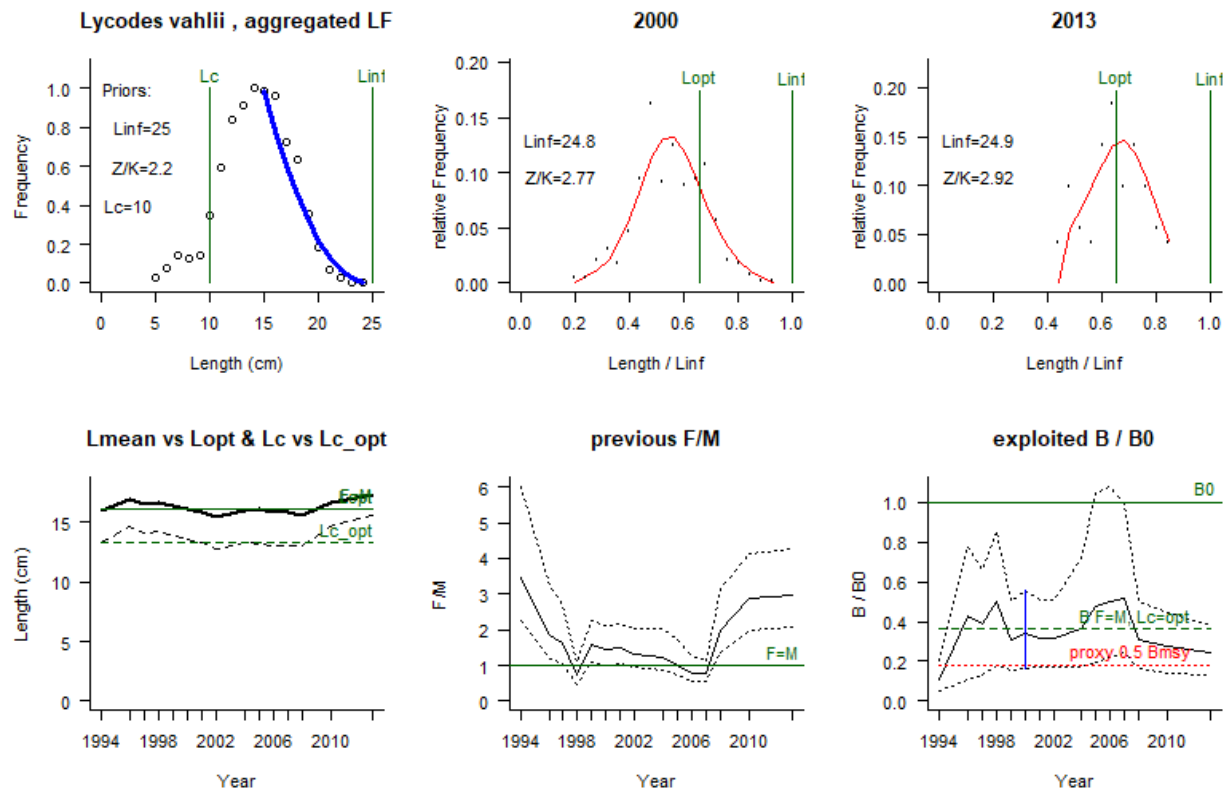
```
----------------------------------------------------------------
AMSY Analysis, Fri Nov 01 18:23:28 2019
----------------------------------------------------------------
Stock Lycodes vahlii, Lycodes vahlii, Vahl's eelpout
CPUE data for years 1983 - 2017, CPUE range 0.295 - 1.59, smooth = TRUE
Prior for r                 = Medium, NA - NA
Used prior range for r      = 0.2 - 0.8
Prior for 2000 stock status = About half, 0.16 - 0.56
Used 2000 prior B/B0 range  = 0.16 - 0.56, prior B/Bmsy = 0.32 - 1.12
Used prior range for kq     = 1.85 - 5.56 [original range = 1.85 - 6.49]
Comment: B/B0 prior from LBB. RF: OK
Source: SMFS 2017

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 5000

  Results:
  viable r-kq pairs  = 5000
  median kq          = 3, 2.04 - 4.58
  median MSYq        = 0.37, 0.243 - 0.562
  r (4 MSYq/kq)      = 0.493, 0.319 - 0.756
  Fmsy (r/2)         = 0.247, 0.159 - 0.378
  F/Fmsy             = 2.36, 0.812 - 4.64 (2016)
  B/Bmsy             = 0.232, 0.13 - 0.425 (2017)
```


(a) CPUE Lycodes vahlii (b) Finding viable r-kq (c) Analysis of viable r-kq
(d) Catch/MSY (e) F/Fmsy (f) B/Bmsy

Lycodes vahlii

Lycodes vahlii
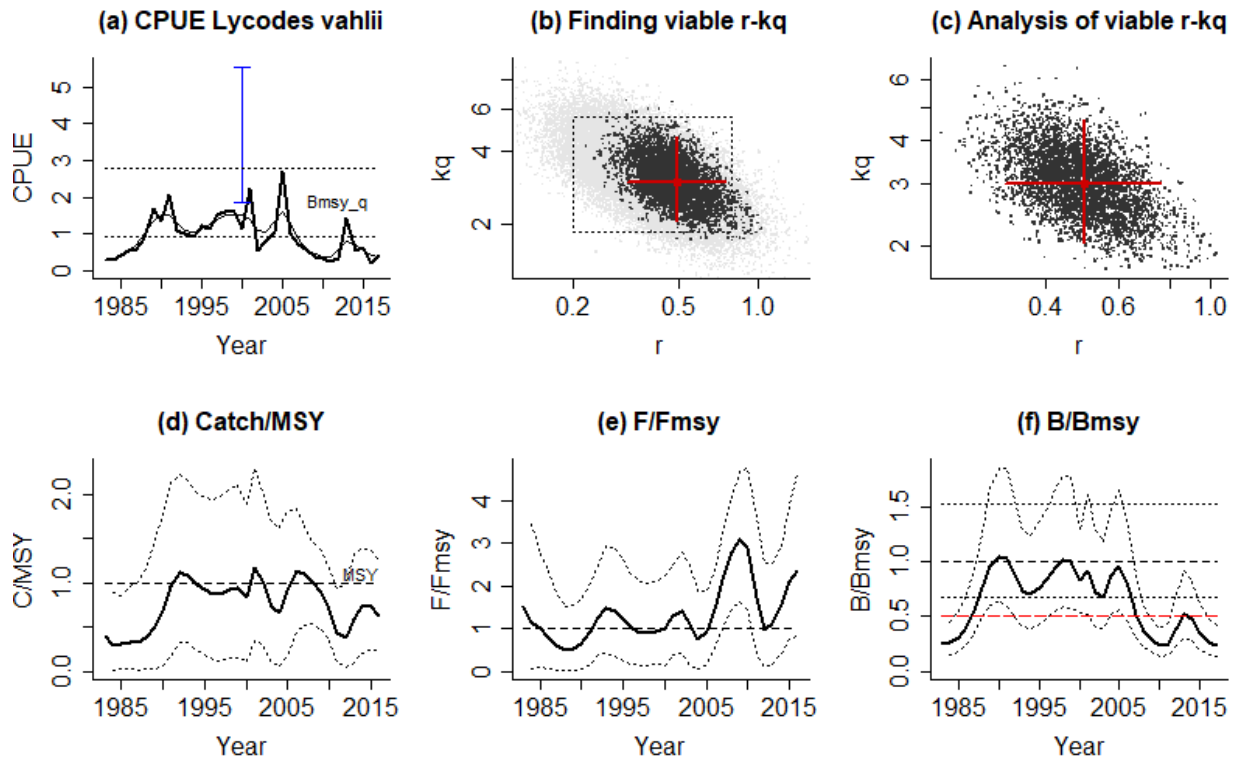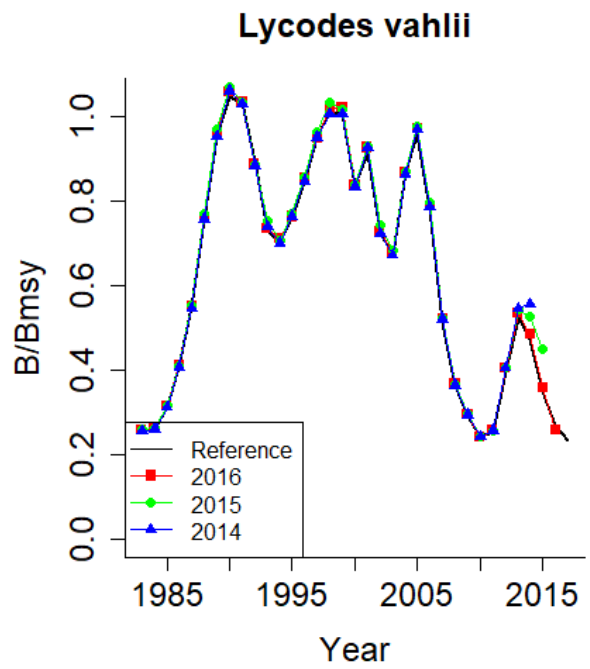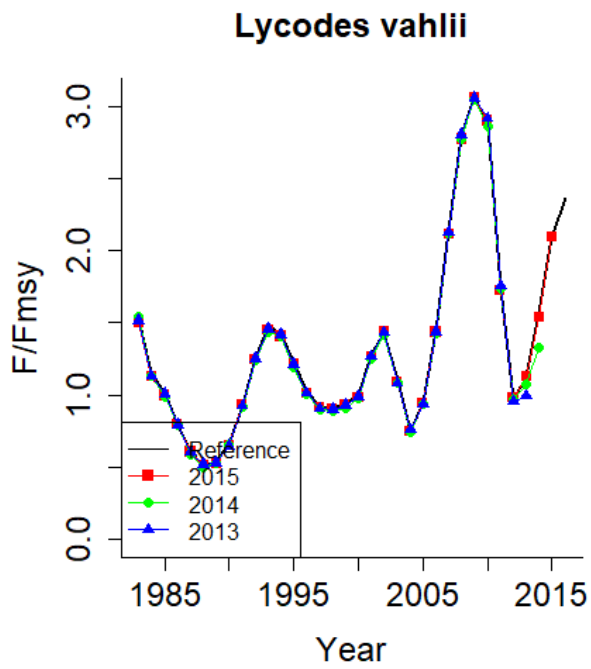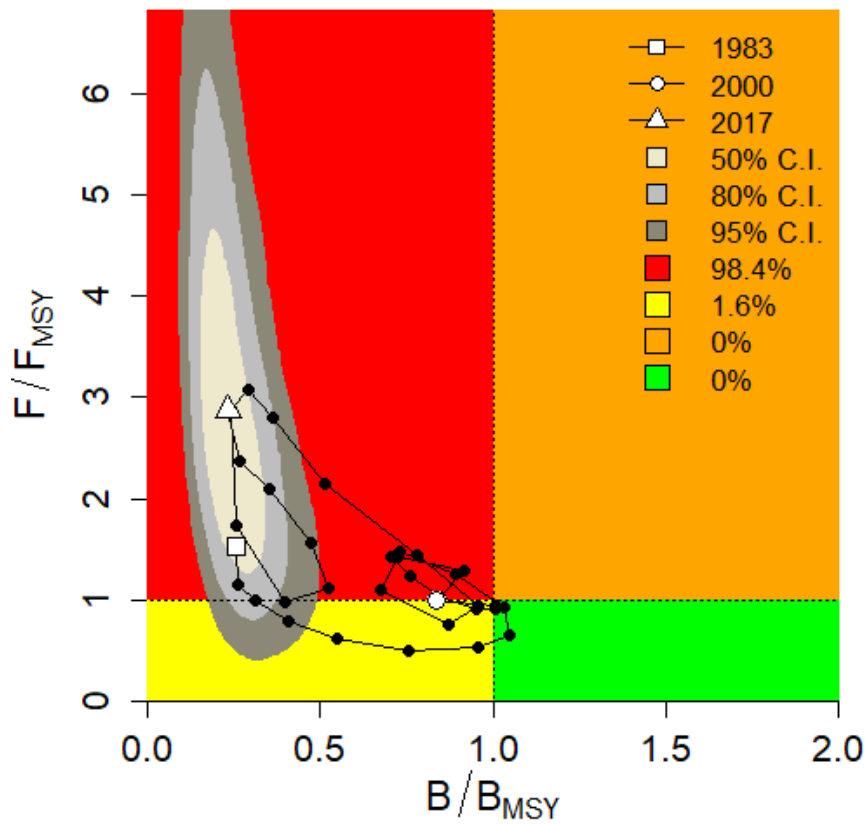
```
--------------------------------------------------------------------
LBB results for Myoxocephalus scorpius, stock Myoxocephalus scorpius,
1983-2016
Files:LBB4AMSY_ID_3.csv, LBB_June052019_Myoxocephalus scorpius.csv
--------------------------------------------------------------------
Linf prior= 31, SD=0.31 cm (user-defined), Lmax=34, median Lmax=29
Z/K prior = 2.1, SD=0.079, M/K prior=1.5, SD=0.15
F/K prior = 0.563 (wide range with tau=4 in log-normal distribution)
Lc prior  = 12.2, SD=1.2 cm, alpha prior=17.3, SD=1.7, Lm50=16 cm

General reference points (median across years):
Linf     = 30.2 (29.8-30.7) cm
Lopt     = 22 cm, Lopt/Linf=0.72
Lc_opt   = 20 cm, Lc_opt/Linf=0.65, Lmean if F=M 20.2 cm
M/K      = 1.14 (0.9-1.33)
F/M      = 2.09 (1.23-3.04), F/K=2.21 (1.53-2.53), Z/K=3.21 (2.99-3.51)
B/B0     = 0.19 (0.11-0.31), B/B0 F=M Lc=Lc_opt 0.38
Y/R'     = 0.04 (0.021-0.08)(reduced: B/B0<0.25),Y/R' F=M Lc=Lc_opt 0.066

Estimates for 2016 (mean of last 3 years with data):
Lc50     = 14.3 (13.9-14.6) cm, Lc/Linf=0.47 (0.46-0.48)
Lc95     = 20.5, alpha=0.472 (0.454-0.486)
Lmean/Lopt= 0.84, Lc/Lc_opt=0.73, L95th=26.3 cm, L95th/Linf=0.86, Mature=39%
F/M      = 1.9 (1.3-2.8), F/K=2.5 (2-3), Z/K=3.9 (3.5-4.3)
Y/R'     = 0.038 (0.021-0.059)(reduced because B/B0 < 0.25)
B/B0     = 0.19 (0.11-0.3), best LF fit year 2012=0.224 (0.14-0.32)
B/Bmsy   = 0.51 (0.29-0.77), selected B/B0 2002 = 0.28 (0.1-0.55)
RF: Set Linf=31 between median and max. Set Lcut=8cm to exclude peaks of early
juveniles. Excluded years with unrealistic LF patterns. Selected 2002 because
of reasonable fit, CL and B/B0 compared to other years.
```
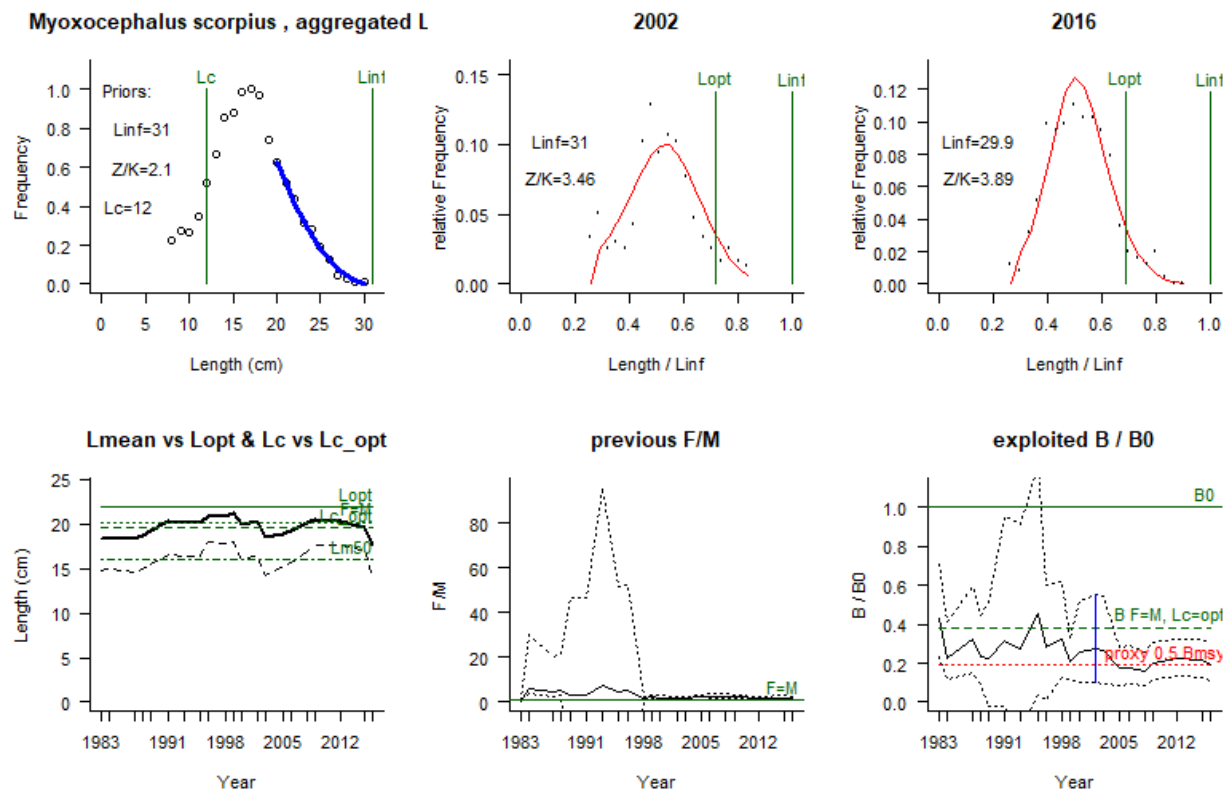
```
------------------------------------------------------------
AMSY Analysis, Fri Nov 01 18:29:22 2019
------------------------------------------------------------
Stock Myoxocephalus scorpius, Myoxocephalus scorpius, Shorthorn sculpin
CPUE data for years 1983 - 2017, CPUE range 2.59 - 6.64, smooth = TRUE
Prior for r                 = Medium, NA - NA
Used prior range for r      = 0.2 - 0.8
Prior for 2002 stock status = About half, 0.1 - 0.55
Used 2002 prior B/B0 range  = 0.1 - 0.55, prior B/Bmsy = 0.2 - 1.1
Used prior range for kq     = 6.62 - 16.4 [original range = 2.97 - 16.4]
Comment: B/B0 prior from LBB. RF: OK
Source: SMFS 2017

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 5001

 Results:
 viable r-kq pairs   = 5001
 median kq           = 10, 7.42 - 15.6
 median MSYq         = 1.26, 0.836 - 2
 r (4 MSYq/kq)       = 0.5, 0.299 - 0.832
 Fmsy (r/2)          = 0.25, 0.15 - 0.416
 F/Fmsy              = 1.93, 0.611 - 3.63 (2016)
 B/Bmsy              = 0.515, 0.287 - 0.906 (2017)
```


(a) CPUE Myoxocephalus scorpiu   (b) Finding viable r-kq   (c) Analysis of viable r-kq

(d) Catch/MSY   (e) F/Fmsy   (f) B/Bmsy

Myoxocephalus scorpius

Myoxocephalus scorpius
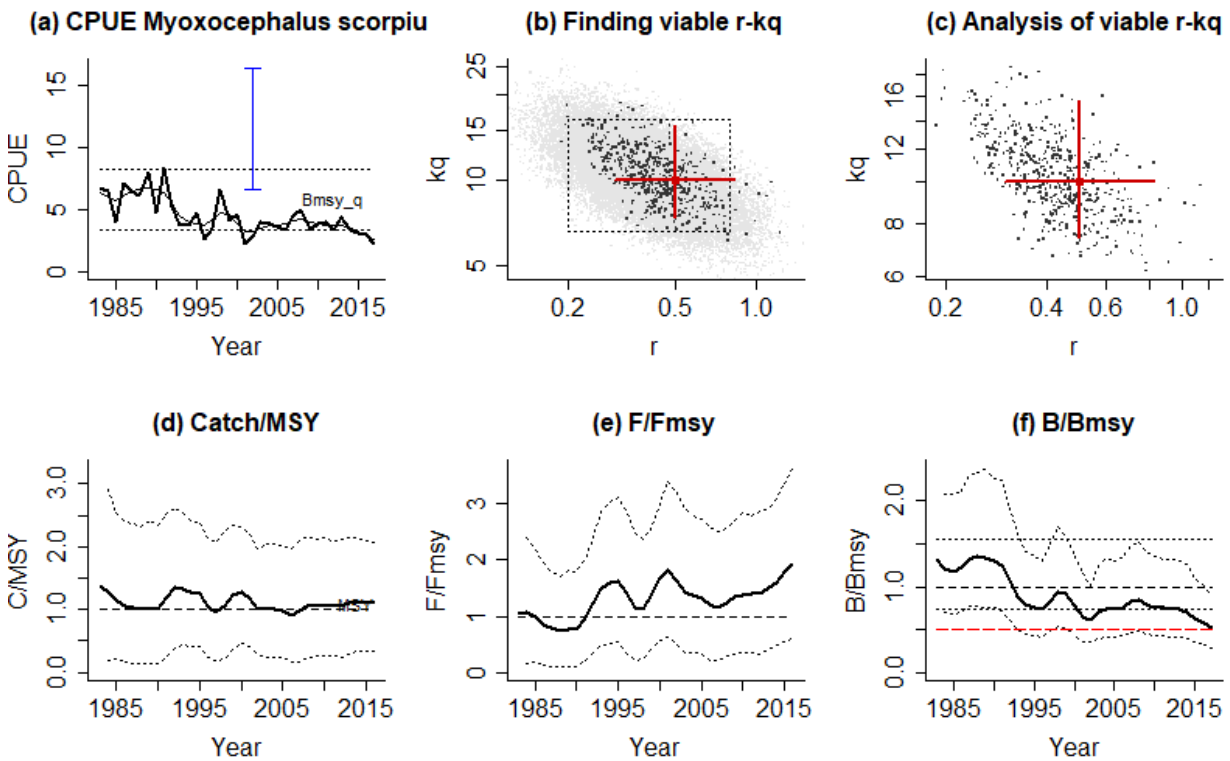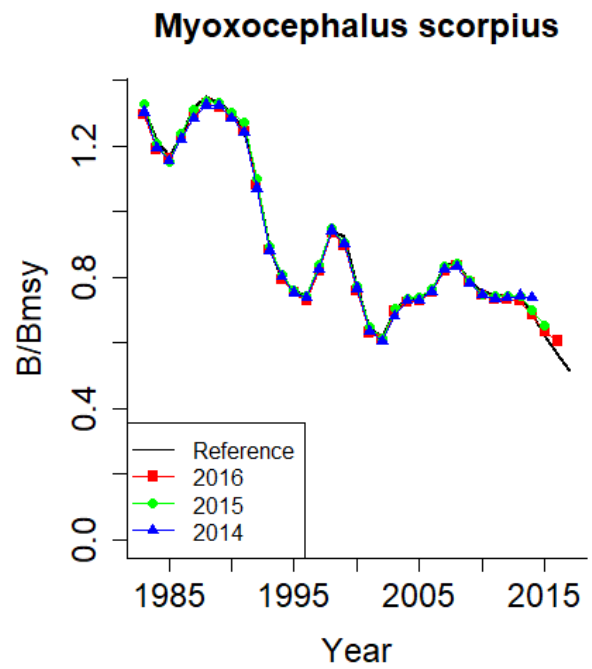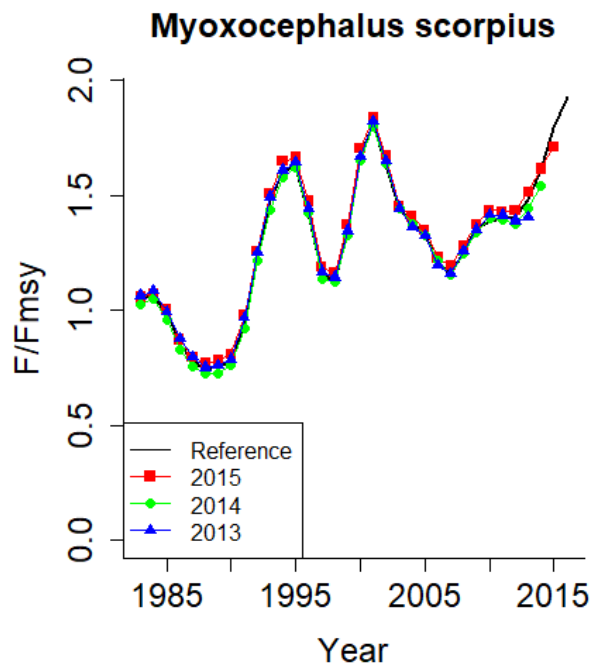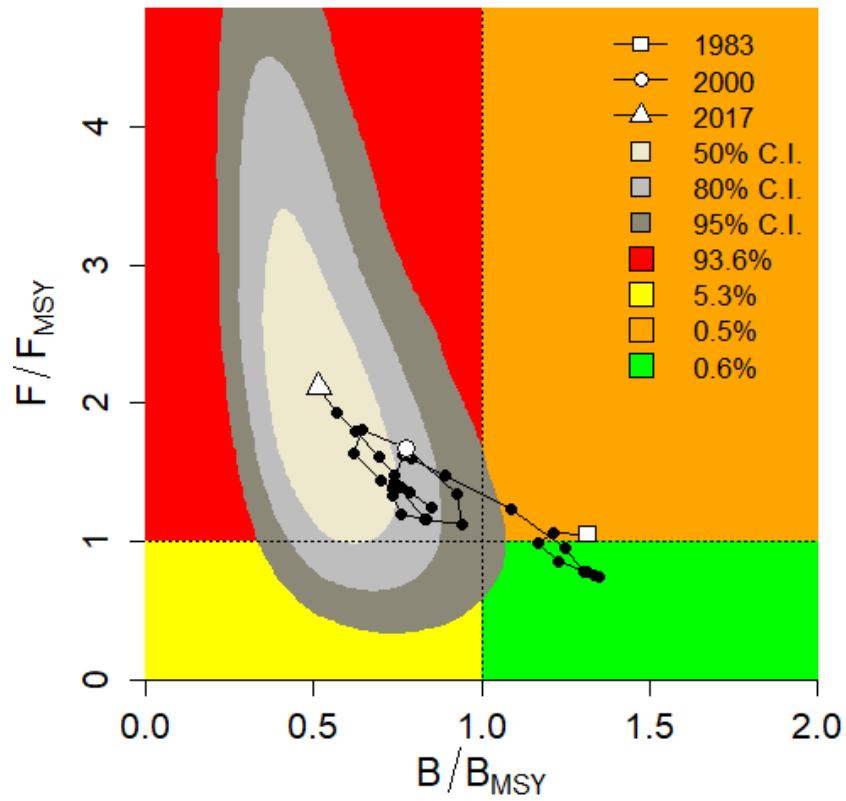
```
--------------------------------------------------------------------
LBB results for Myxine glutinosa, stock Myxine glutinosa, 1995-2017
Files:LBB4AMSY_ID_3.csv, LBB_June052019_Myxine glutinosa.csv
--------------------------------------------------------------------
Linf prior= 40, SD=0.4 cm (user-defined), Lmax=76, median Lmax=36
Z/K prior = 3.1, SD=0.082, M/K prior=1.5, SD=0.15
F/K prior = 1.56 (wide range with tau=4 in log-normal distribution)
Lc prior  = 17.3, SD=1.7 cm, alpha prior=16.7, SD=1.7, Lm50=30 cm

General reference points (median across years):
Linf    = 39.7 (39-40.4) cm
Lopt    = 27 cm, Lopt/Linf=0.69
Lc_opt  = 25 cm, Lc_opt/Linf=0.62, Lmean if F=M 26.7 cm
M/K     = 1.36 (1.07-1.63)
F/M     = 2.6 (2.03-3.73), F/K=3.26 (2.85-3.97), Z/K=4.57 (4.21-5.11)
B/B0    = 0.15 (0.1-0.23), B/B0 F=M Lc=Lc_opt 0.37
Y/R'    = 0.034 (0.02-0.053)(reduced: B/B0<0.25),Y/R' F=M Lc=Lc_opt 0.051

Estimates for 2017 (mean of last 3 years with data):
Lc50      = 23.7 (23.1-24.2) cm, Lc/Linf=0.6 (0.58-0.61)
Lc95      = 31.2, alpha=0.392 (0.379-0.405)
Lmean/Lopt= 1, Lc/Lc_opt=0.96, L95th=33.3 cm, L95th/Linf=0.84, Mature=0.63%
F/M       = 4 (3-5.4), F/K=6.8 (5.5-7.9), Z/K=8.4 (7.1-9.4)
Y/R'      = 0.025 (0.016-0.036)(reduced because B/B0 < 0.25)
B/B0      = 0.13 (0.083-0.19), best LF fit year 2005=0.305 (0.14-0.53)
B/Bmsy    = 0.34 (0.22-0.5), selected B/B0 2002 = 0.31 (0.14-0.53)
RF: Set Linf=40. Set Lcut to 12 to exclude early juveniles. Excluded years
with unrealistic LF fits. Selected 2002 because of reasonable LF fit and B/B0
compatible with adjacent estimates.
```
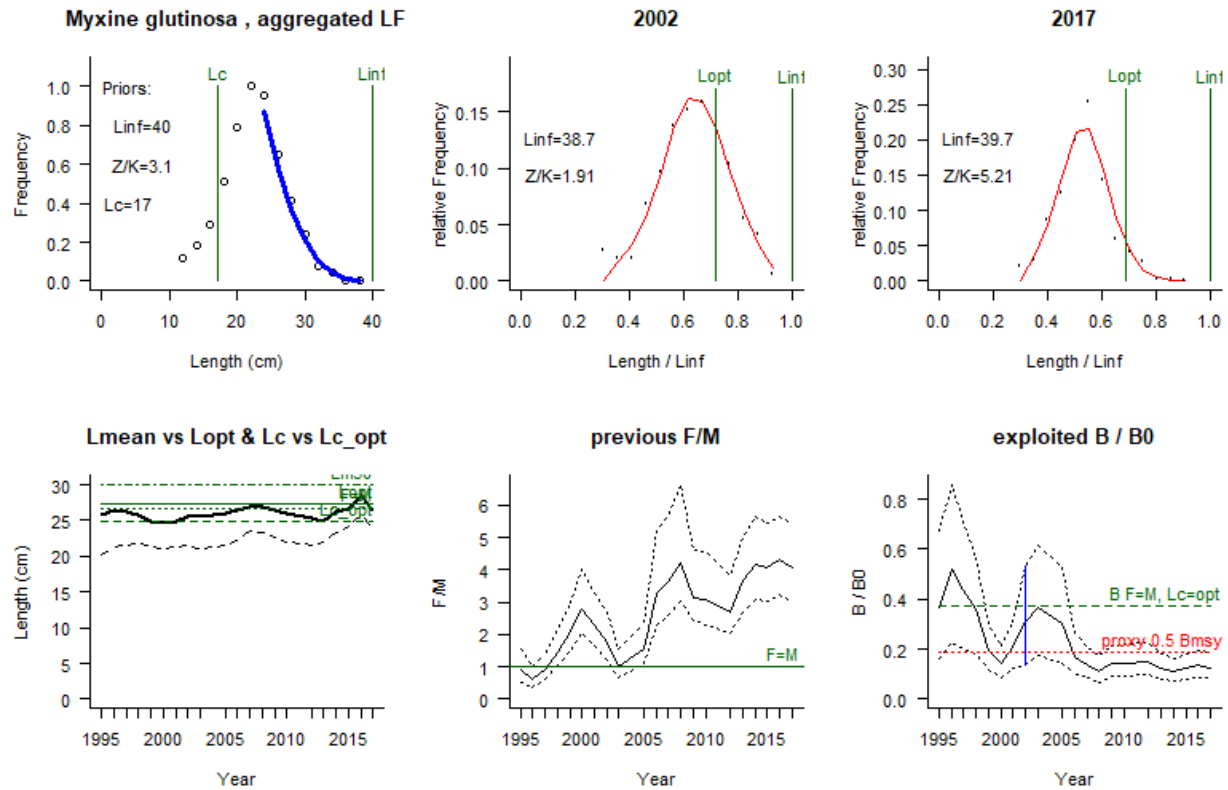
```
-----------------------------------------------------------------
AMSY Analysis, Fri Nov 01 18:33:43 2019
-----------------------------------------------------------------
Stock Myxine glutinosa, Myxine glutinosa, Atlantic hagfish
CPUE data for years 1991 - 2017, CPUE range 0.66 - 1.48, smooth = TRUE
Prior for r                  = Low, NA - NA
Used prior range for r       = 0.05 - 0.5
Prior for 2002 stock status  = About half, 0.14 - 0.53
Used 2002 prior B/B0 range   = 0.14 - 0.53, prior B/Bmsy = 0.28 - 1.06
Used prior range for kq      = 1.64 - 4.91 [original range = 1.64 - 6.19]
Comment: B/B0 prior from LBB. RF: OK
Source: SMFS 2017

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 5001

   Results:
   viable r-kq pairs    = 5001
   median kq            = 2.83, 1.98 - 4.25
   median MSYq          = 0.183, 0.107 - 0.317
   r (4 MSYq/kq)        = 0.258, 0.14 - 0.467
   Fmsy (r/2)           = 0.129, 0.0698 - 0.233
   F/Fmsy               = 1.16, -0.322 - 3.5 (2016)
   B/Bmsy               = 0.696, 0.379 - 1.25 (2017)
```


(a) CPUE Myxine glutinosa (b) Finding viable r-kq (c) Analysis of viable r-kq

(d) Catch/MSY (e) F/Fmsy (f) B/Bmsy

Myxine glutinosa

Myxine glutinosa
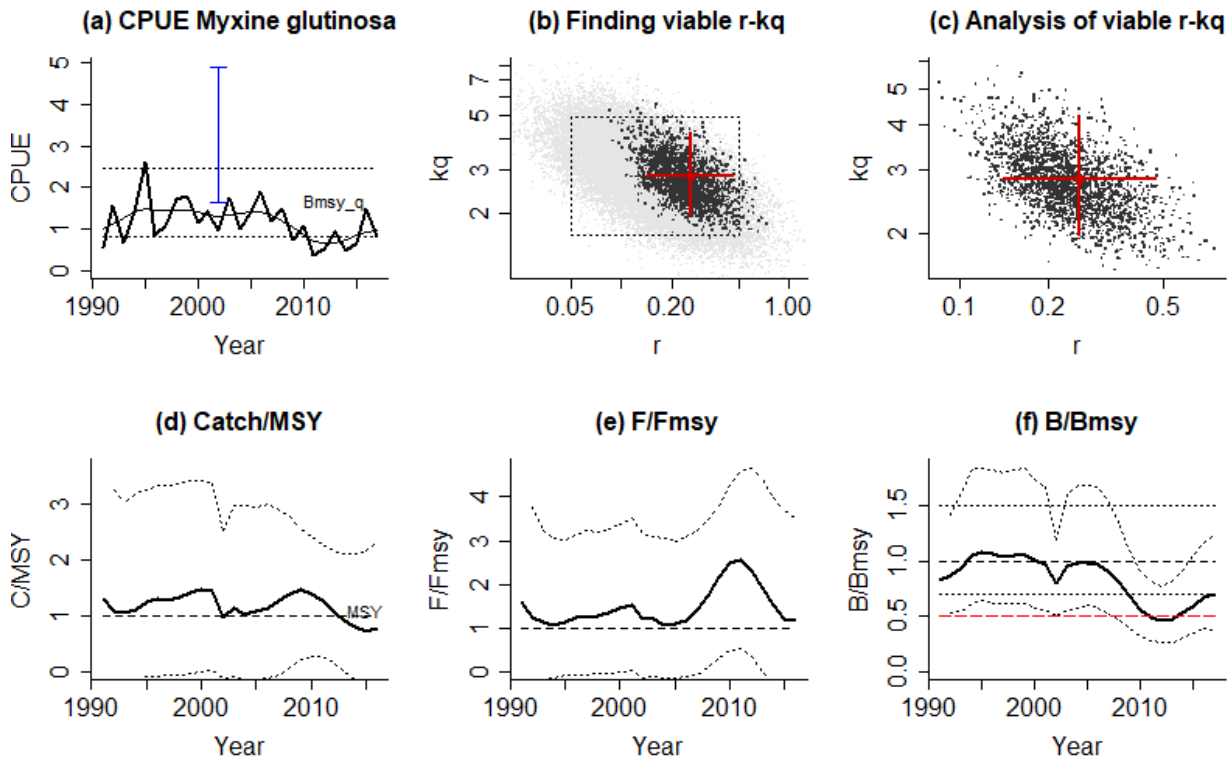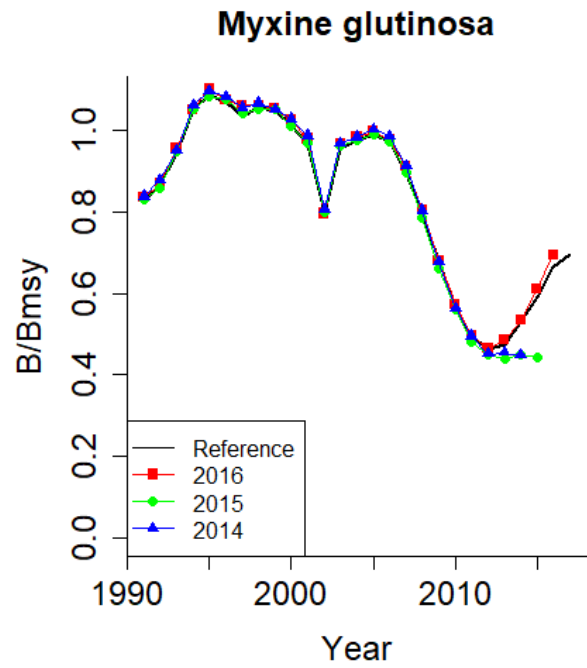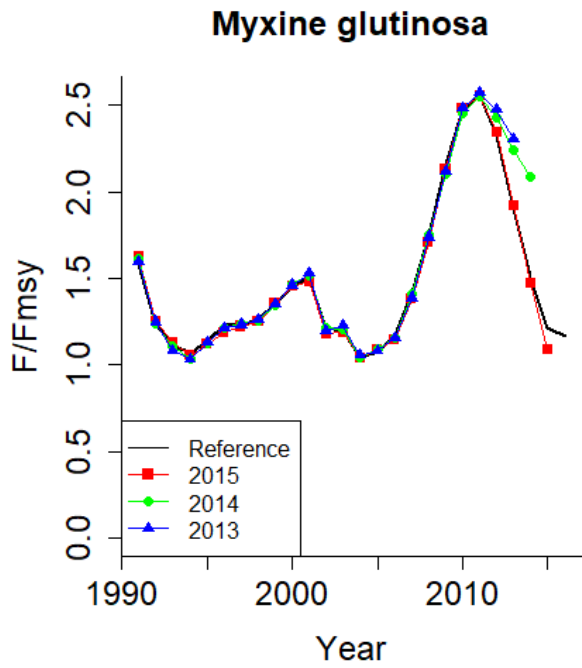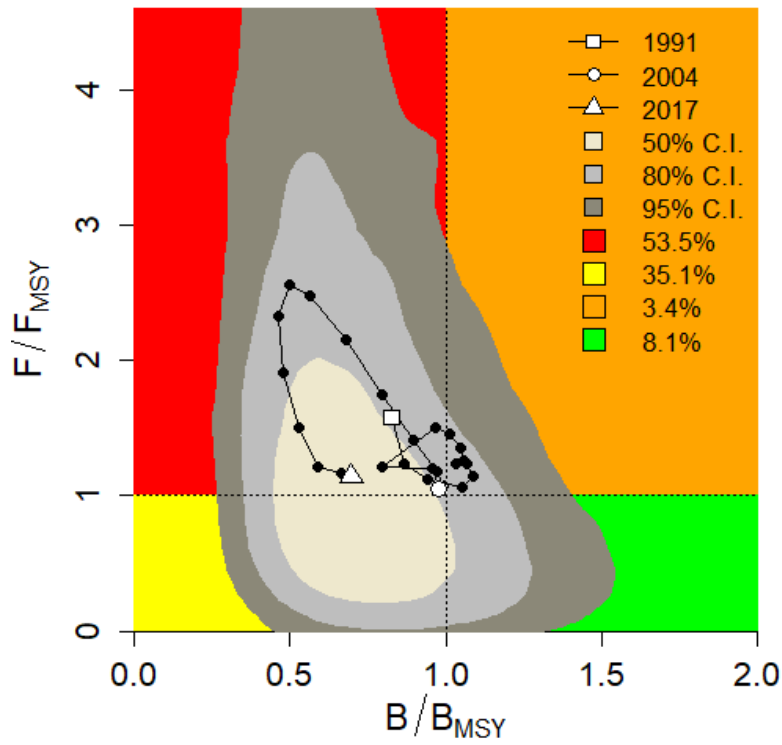
```
--------------------------------------------------------------------
LBB results for Raja clavata, stock rjc.27.3a47d, 1983-2015
Files:LBB4AMSY_ID_3.csv, LBB_June052019_Raja clavata.csv
--------------------------------------------------------------------
Linf prior= 90, SD=0.9 cm (user-defined), Lmax=95, median Lmax=85
Z/K prior = 2.9, SD=0.3, M/K prior=1.5, SD=0.15
F/K prior = 1.43 (wide range with tau=4 in log-normal distribution)
Lc prior  = 22.9, SD=2.3 cm, alpha prior=15.7, SD=1.6, Lm50=40 cm

General reference points (median across years):
Linf     = 92.6 (91.2-94.2) cm
Lopt     = 63 cm, Lopt/Linf=0.68
Lc_opt   = 53 cm, Lc_opt/Linf=0.58, Lmean if F=M 40.2 cm
M/K      = 1.43 (1.17-1.67)
F/M      = 1.23 (0.921-1.91), F/K=1.89 (1.62-2.35), Z/K=3.45 (3.26-3.67)
B/B0     = 0.2 (0.096-0.31), B/B0 F=M Lc=Lc_opt 0.37
Y/R'     = 0.025 (0.012-0.041)(reduced: B/B0<0.25),Y/R' F=M Lc=Lc_opt 0.048

Estimates for 2015 (mean of last 3 years with data):
Lc50     = 21.9 (20.1-23.7) cm, Lc/Linf=0.24 (0.22-0.26)
Lc95     = 35.1, alpha=0.223 (0.217-0.228)
Lmean/Lopt= 0.59, Lc/Lc_opt=0.41, L95th=81.7 cm, L95th/Linf=0.91, Mature=33%
F/M      = 2.5 (1.8-3.4), F/K=3.5 (3.1-3.9), Z/K=4.8 (4.5-5)
Y/R'     = 0.021 (0.0055-0.043)(reduced because B/B0 < 0.25)
B/B0     = 0.19 (0.053-0.41), best LF fit year 2001=0.122 (0.074-0.21)
B/Bmsy   = 0.53 (0.14-1.1), selected B/B0 2000 = 0.25 (0.11-0.42)
RF: Set Linf between median and max. Set Lcut=10 to remove peaks of early
juveniles. Set Lstart=34 to have better fit of aggregated prior Z/K. Used
MergeLF to increase numbers. Excluded years with unrealistic LF fits. Selected
2000 because of intermediate B/B0 and reasonable LF fit.
```


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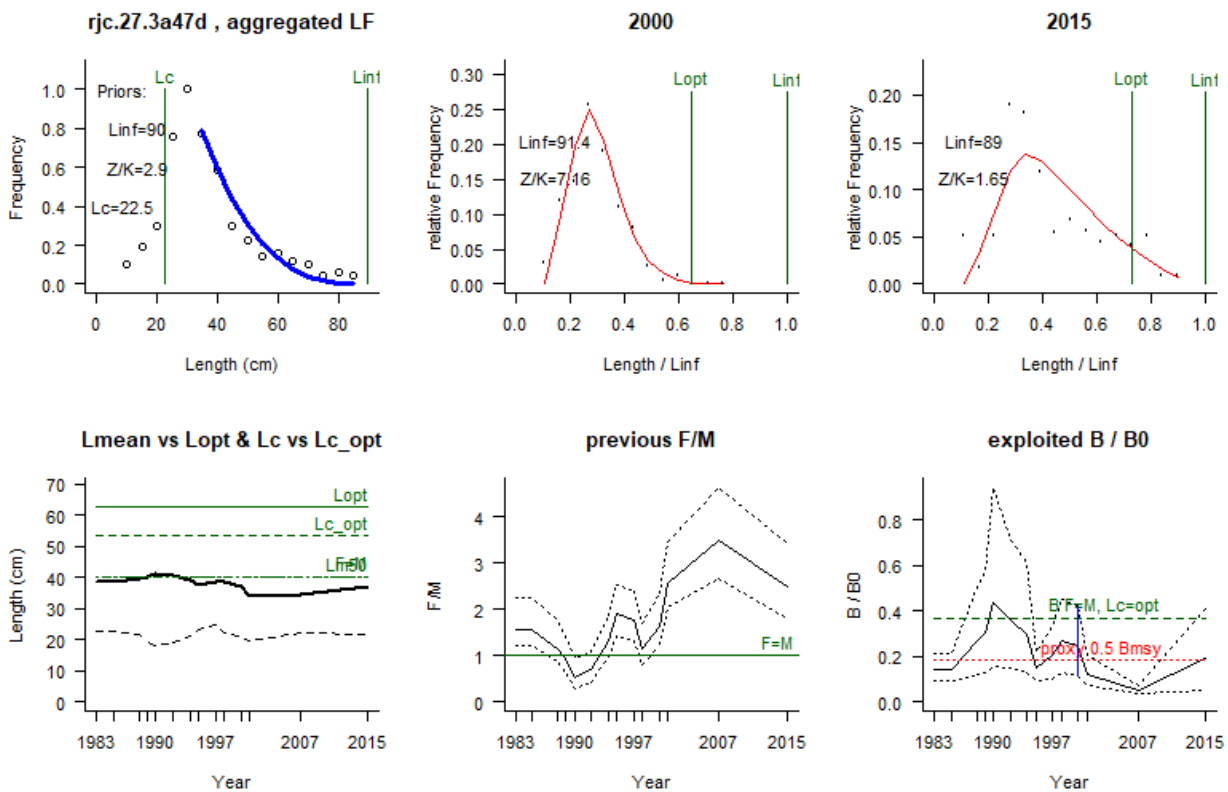
```
----------------------------------------------------------------
AMSY Analysis, Fri Nov 01 18:41:58 2019
----------------------------------------------------------------
Stock rjc.27.3a47d, Raja clavata, Thornback ray
CPUE data for years 1983 - 2017, CPUE range 16.7 - 39, smooth = TRUE
Prior for r                    = Low, 0.07 - 0.45
Used prior range for r         = 0.0606 - 0.522
Prior for 2000 stock status    = Small, 0.11 - 0.42
Used 2000 prior B/B0 range     = 0.11 - 0.42, prior B/Bmsy = 0.22 - 0.84
Used prior range for kq        = 35.1 - 105 [original range = 35.1 - 134]
Comment: B/B0 prior from LBB. RF: Note that the steep increase in cpue in the
last year changes the whole assessment, as nicely shown by the retrospective
analysis. Thus, for management, the analysis should be restricted to 2016
until new data come in to evaluate the peak in 2017.
Source: SMFS 2017 for length and CPUE

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 5000

  Results:
  viable r-kq pairs  = 5000
  median kq          = 62, 43.3 - 91.6
  median MSYq        = 4.28, 2.62 - 7.01
  r (4 MSYq/kq)      = 0.277, 0.162 - 0.488
  Fmsy (r/2)         = 0.138, 0.0812 - 0.244
  F/Fmsy             = 0.675, -0.197 - 2.36 (2016)
  B/Bmsy             = 1.25, 0.702 - 2.25 (2017)
```


(a) CPUE rjc.27.3a47d   (b) Finding viable r-kq   (c) Analysis of viable r-kq

(d) Catch/MSY   (e) F/Fmsy   (f) B/Bmsy

rjc.27.3a47d

rjc.27.3a47d
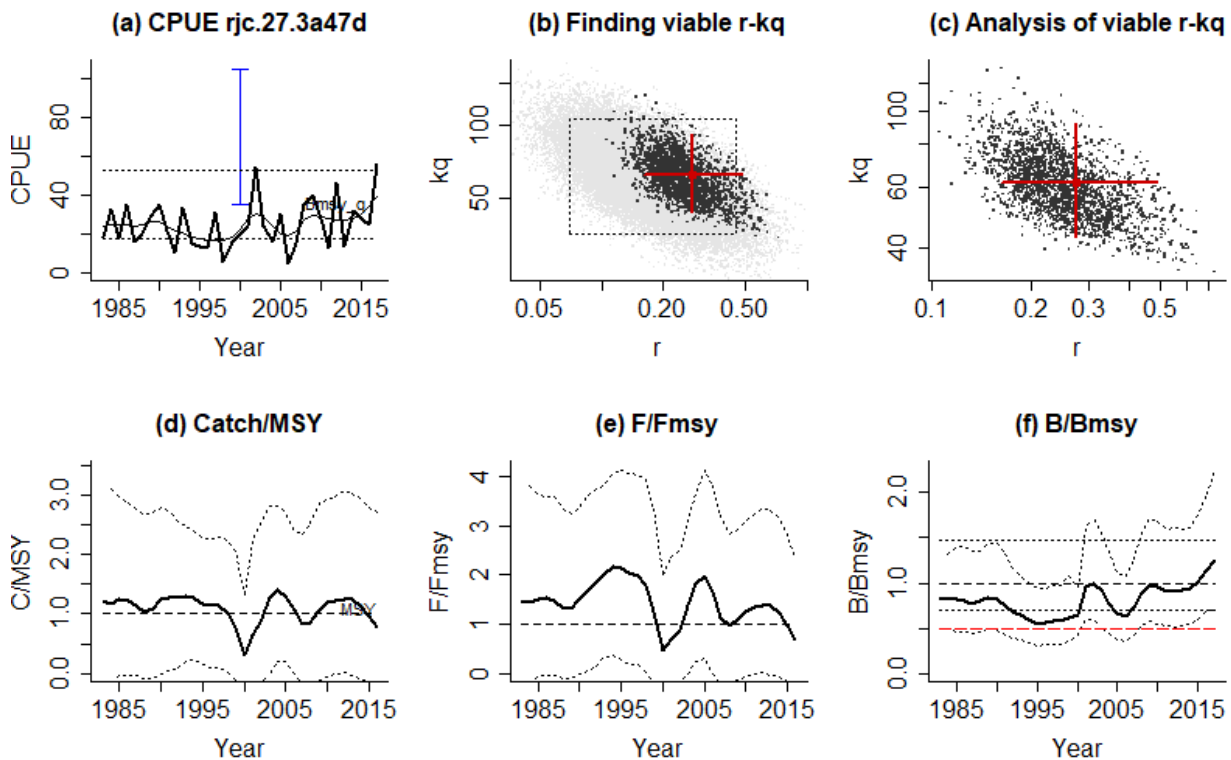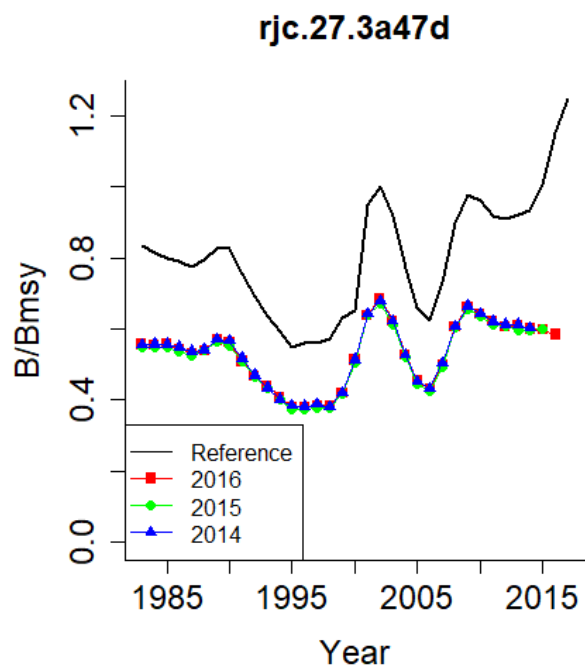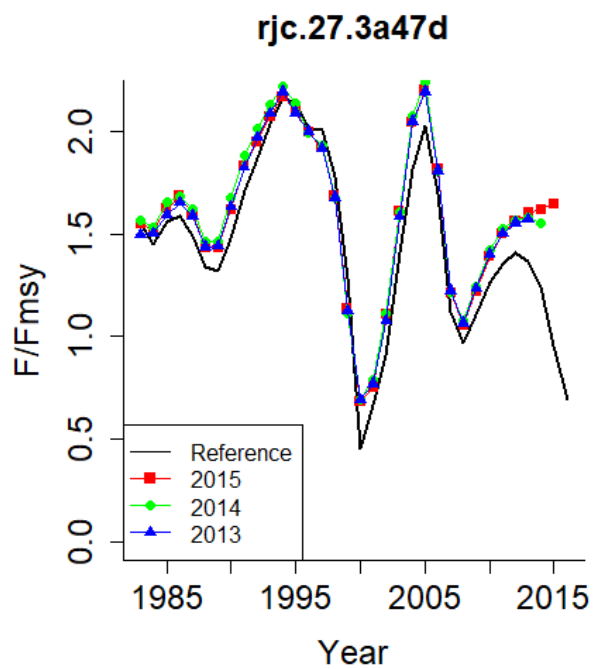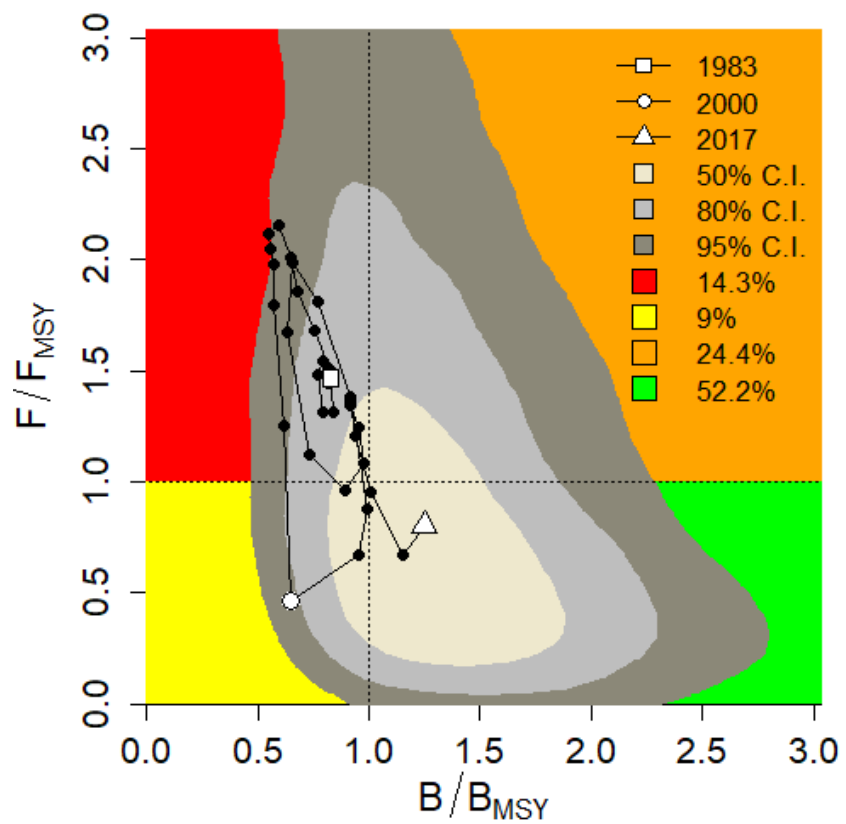
```
-------------------------------------------------------------------
LBB results for Raja montagui, stock rjm.27.3a47d, 1983-2016
Files:LBB4AMSY_ID_3.csv, LBB_June052019_Raja montagui.csv
-------------------------------------------------------------------
Linf prior= 75, SD=0.75 cm (user-defined), Lmax=95, median Lmax=60
Z/K prior = 2.7, SD=0.38, M/K prior=1.5, SD=0.15
F/K prior = 1.24 (wide range with tau=4 in log-normal distribution)
Lc prior  = 30.6, SD=3.1 cm, alpha prior=9.04, SD=0.9, Lm50=59 cm

General reference points (median across years):
Linf     = 73.9 (72.4-75.2) cm
Lopt     = 51 cm, Lopt/Linf=0.69
Lc_opt   = 47 cm, Lc_opt/Linf=0.63, Lmean if F=M 59.6 cm
M/K      = 1.37 (1.17-1.56)
F/M      = 3.04 (2.1-4.63), F/K=5.41 (3.8-8.77), Z/K=6.96 (5.36-10.3)
B/B0     = 0.34 (0.15-0.58), B/B0 F=M Lc=Lc_opt 0.37
Y/R'     = 0.024 (0.014-0.039), Y/R' F=M Lc=Lc_opt 0.048

Estimates for 2016 (mean of last 3 years with data):
Lc50      = 64.6 (62.9-66.7) cm, Lc/Linf=0.89 (0.87-0.92)
Lc95      = 87.5, alpha=0.129 (0.124-0.133)
Lmean/Lopt= NA, Lc/Lc_opt=1.4, L95th=60 cm, L95th/Linf=0.83, Mature=3%
F/M       = 9 (6.9-12), F/K=15 (12-19), Z/K=17 (14-21)
Y/R'      = 0.023 (0.015-0.034)
B/B0      = 0.17 (0.12-0.24), best LF fit year 2012=0.118 (0.08-0.17)
B/Bmsy    = 0.47 (0.32-0.65), selected B/B0 2007 = 0.36 (0.17-0.61)
RF: Set Lstart to 50cm to avoid error in aggregated fit. Set Lcut=10cm to
avoid peaks of early juveniles. Used MergeLF to increase numbers per year. Set
Linf between median and max. All fits are close to unsatisfactory. Selected
2007 for intermediate B/B0 and reasonable fit.
```
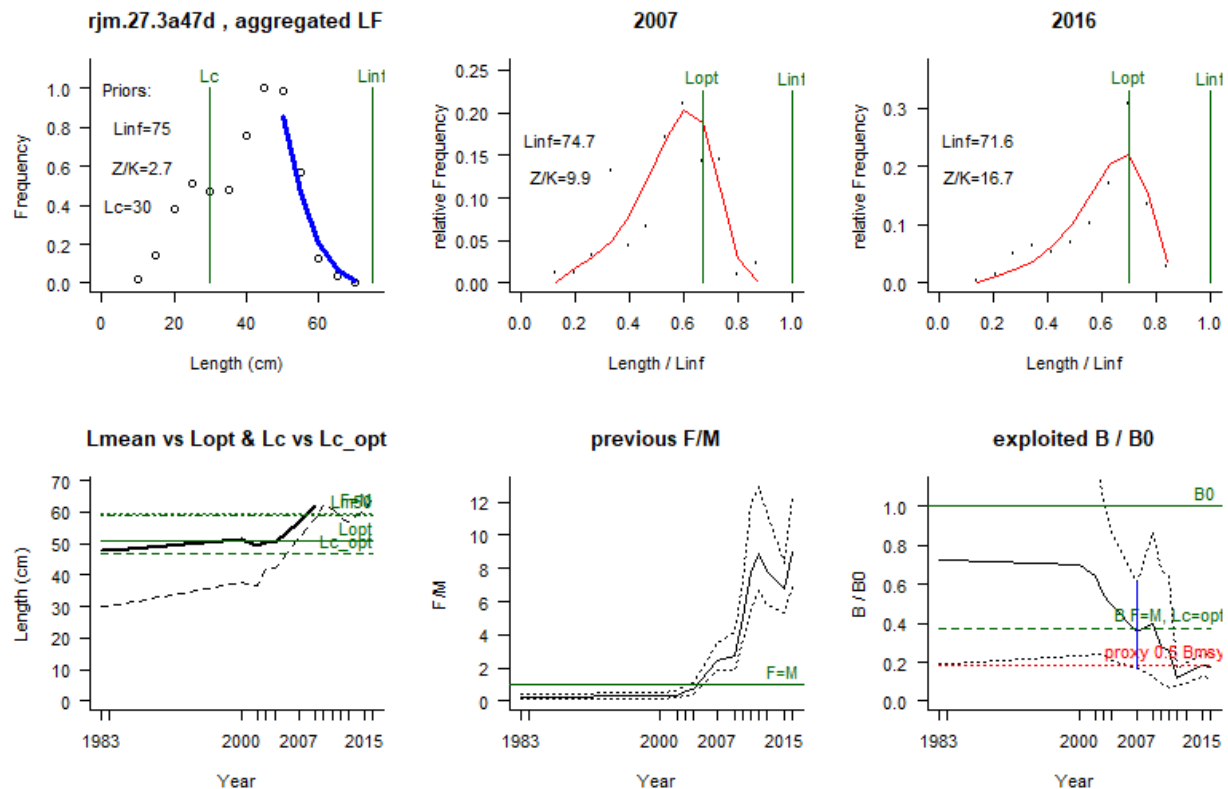
```
--------------------------------------------------------------
AMSY Analysis, Fri Nov 01 19:21:23 2019
--------------------------------------------------------------
Stock rjm.27.3a47d, Raja montagui, Spotted ray
CPUE data for years 1983 - 2017, CPUE range 21.8 - 45.4, smooth = TRUE
Prior for r                  = Low, NA - NA
Used prior range for r       = 0.05 - 0.5
Prior for 2007 stock status  = About half, 0.17 - 0.61
Used 2007 prior B/B0 range   = 0.17 - 0.61, prior B/Bmsy = 0.34 - 1.22
Used prior range for kq      = 45.3 - 93.8 [original range = 26.1 - 93.8]
Comment: B/B0 prior from LBB. RF: OK
Source: SMFS 2017 for length and CPUE.

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 5003

  Results:
  viable r-kq pairs    = 5003
  median kq            = 61.3, 46.8 - 81.6
  median MSYq          = 4.8, 2.78 - 8.18
  r (4 MSYq/kq)        = 0.313, 0.169 - 0.601
  Fmsy (r/2)           = 0.157, 0.0846 - 0.3
  F/Fmsy               = 1.26, -0.0468 - 3.1 (2016)
  B/Bmsy               = 0.915, 0.505 - 1.62 (2017)
```

rjm.27.3a47d

rjm.27.3a47d
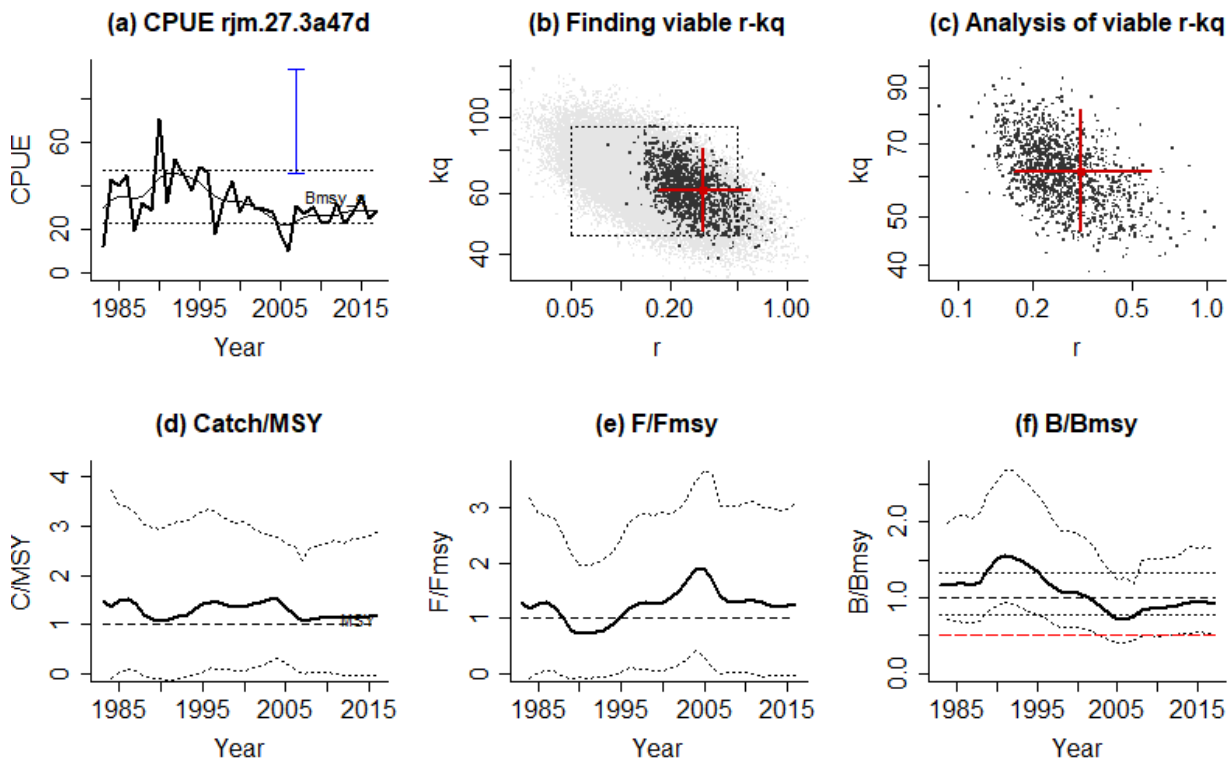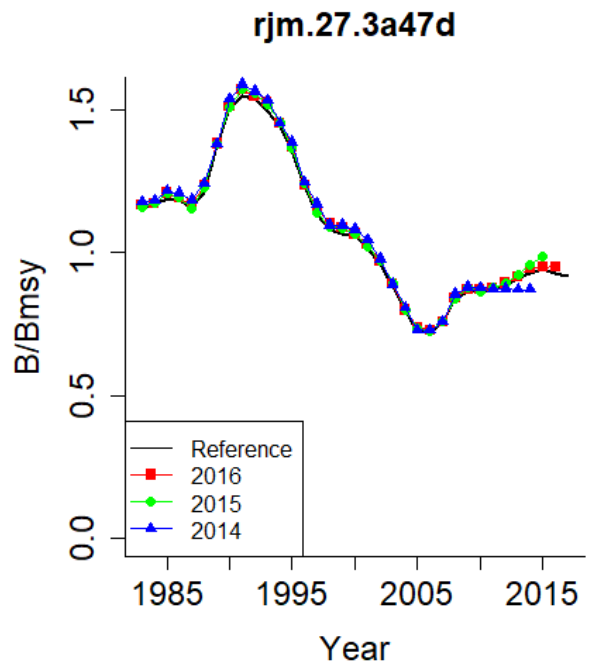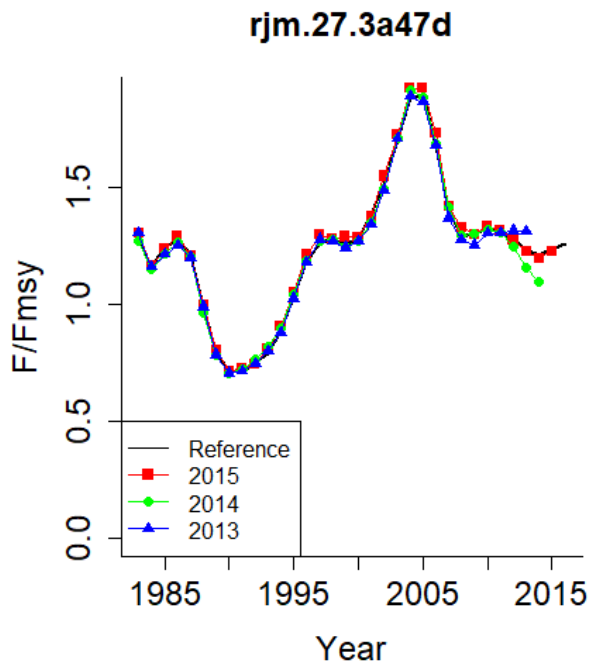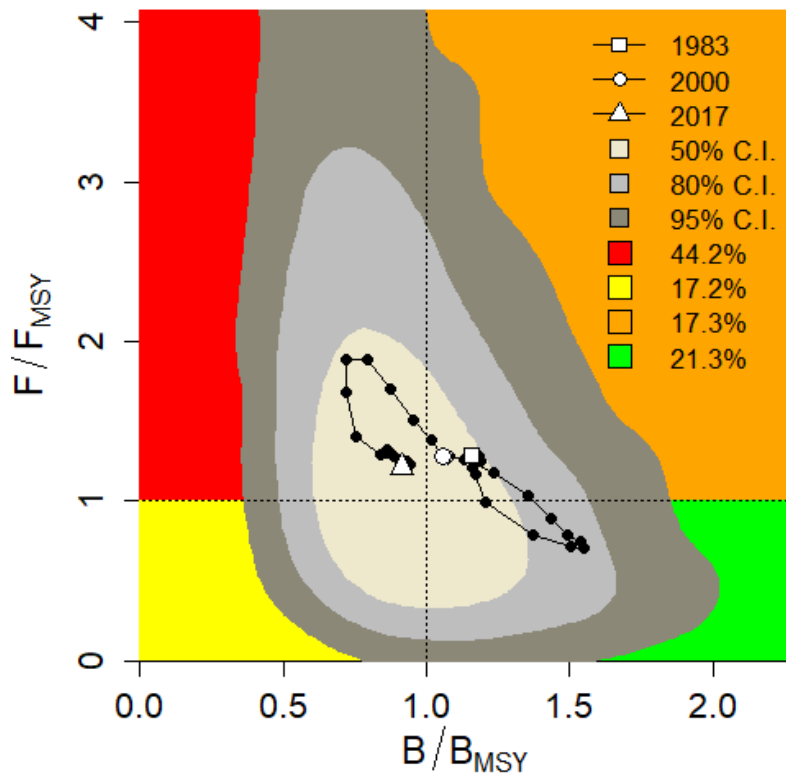
LBB results for *Scyliorhinus canicula*, stock **syc.27.3a47d**, 1984-2017
Files:LBB4AMSY_ID_3.csv, LBB_June052019_Scyliorhinus canicula.csv
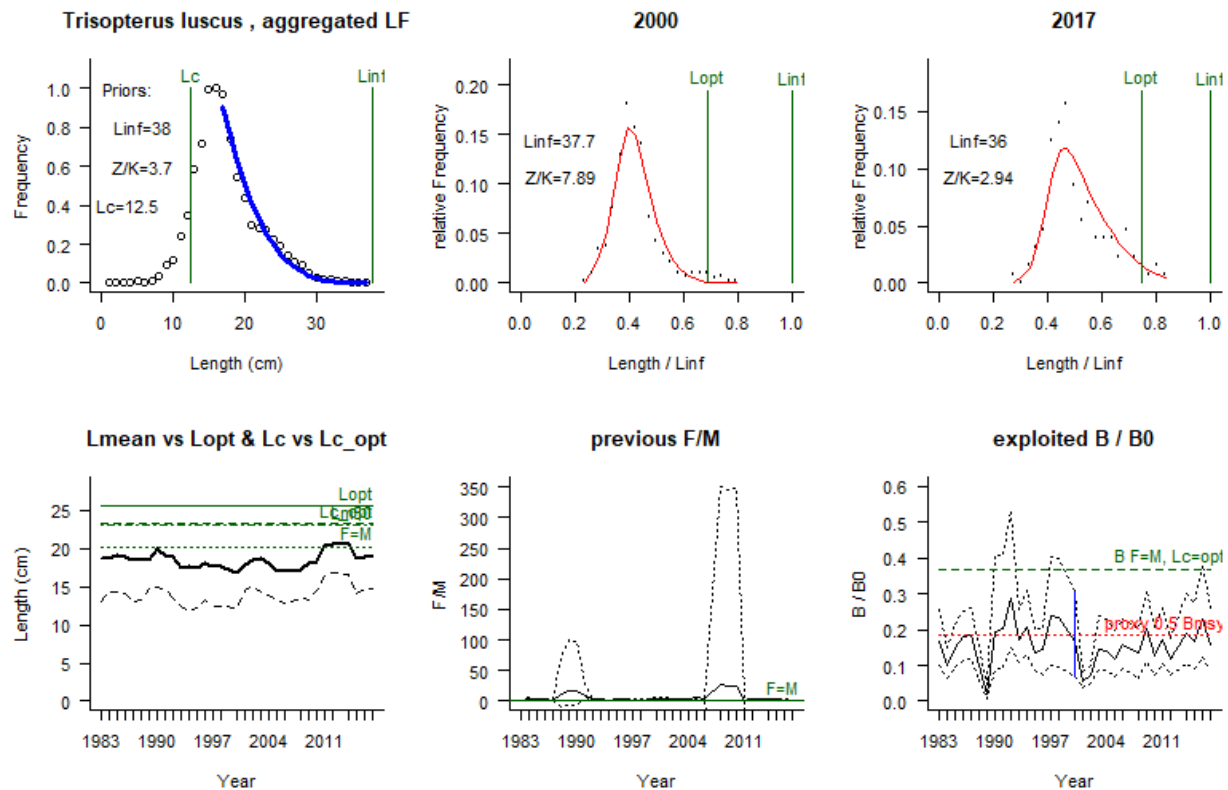--
Linf prior= 85, SD=0.85 cm (user-defined), Lmax=112, median Lmax=72
Z/K prior = 2.4, SD=0.32, M/K prior=1.5, SD=0.15
F/K prior = 0.933 (wide range with tau=4 in log-normal distribution)
Lc prior = 39.8, SD=4 cm, alpha prior=8.9, SD=0.89, Lm50=57 cm

General reference points (median across years):
Linf   = 81.2 (79.8-82.9) cm
Lopt   = 58 cm, Lopt/Linf=0.72
Lc_opt   = 56 cm, Lc_opt/Linf=0.69, Lmean if F=M 76.4 cm
M/K   = 1.19 (0.959-1.42)
F/M   = 8.43 (6.16-12.6), F/K=8.92 (7.26-10.3), Z/K=10.6 (8.16-12.1)
B/B0   = 0.16 (0.09-0.22), B/B0 F=M Lc=Lc_opt 0.38
Y/R'   = 0.032 (0.018-0.056)(reduced: B/B0<0.25),Y/R' F=M Lc=Lc_opt 0.06

Estimates for 2017 (mean of last 3 years with data):
Lc50   = 71.5 (69.1-73.8) cm, Lc/Linf=0.87 (0.85-0.9)
Lc95   = 100, alpha=0.103 (0.099-0.106)
Lmean/Lopt= NA, Lc/Lc_opt=1.3, L95th=74.7 cm, L95th/Linf=0.91, Mature=27%
F/M   = 12 (8.1-17), F/K=11 (9-14), Z/K=13 (10-15)
Y/R'   = 0.028 (0.016-0.041)(reduced because B/B0 < 0.25)
B/B0   = 0.1 (0.064-0.14), best LF fit year 2009=0.301 (0.15-0.6)
B/Bmsy   = 0.26 (0.17-0.36), **selected B/B0 2010 = 0.23 (0.12-0.48)**
RF: Set Linf between median and max. Set Lcut to avoid peaks of early
juveniles. Set Lstart=60 to avoid error message. Excluded years with
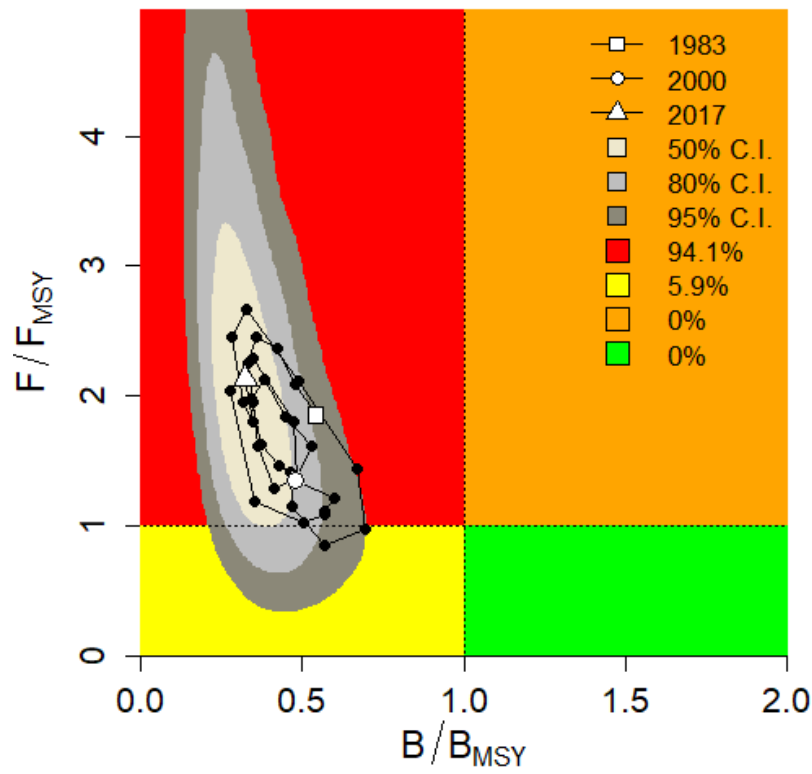unrealistic LF fits. Selected 2010 because of intermediate B/B0 and reasonable
LF fit.201

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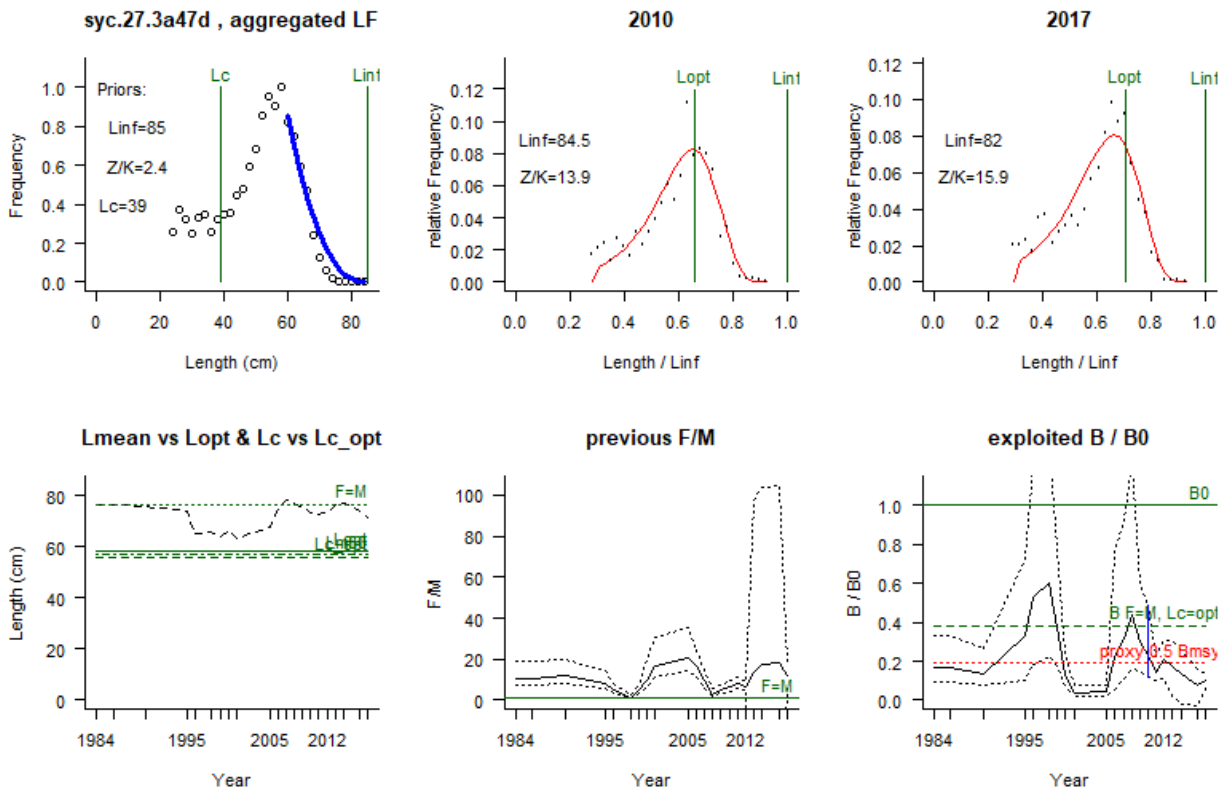
```
------------------------------------------------------------------
AMSY Analysis, Fri Nov 01 19:25:55 2019
------------------------------------------------------------------
Stock syc.27.3a47d, Scyliorhinus canicula, Lesser spotted dogfish
CPUE data for years 1983 - 2017, CPUE range 10.6 - 22, smooth = TRUE
Prior for r                   = Low, 0.23 - 0.53
Used prior range for r        = 0.215 - 0.564
Prior for 2010 stock status   = Small, 0.12 - 0.48
Used 2010 prior B/B0 range    = 0.12 - 0.48, prior B/Bmsy = 0.24 - 0.96
Used prior range for kq       = 21.1 - 63.4 [original range = 19.4 - 77.8]
Comment: B/B0 prior from LBB. RF: the last year sets a new max CPUE and thus
changes the setting of prior kq. This is nicely shown in the retrospective
analysis. For management, the last year should be excluded until confirmed by
more data.
Source: SMFS 2017 for length and CPUE.

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 5003

  Results:
  viable r-kq pairs   = 5003
  median kq           = 39.7, 27.2 - 63
  median MSYq         = 3.4, 2.37 - 5.19
  r (4 MSYq/kq)       = 0.342, 0.242 - 0.492
  Fmsy (r/2)          = 0.171, 0.121 - 0.246
  F/Fmsy              = 0.834, -0.0937 - 2.41 (2016)
  B/Bmsy              = 1.11, 0.601 - 2.01 (2017)
```


(a) CPUE syc.27.3a47d   (b) Finding viable r-kq   (c) Analysis of viable r-kq

(d) Catch/MSY   (e) F/Fmsy   (f) B/Bmsy

syc.27.3a47d

syc.27.3a47d
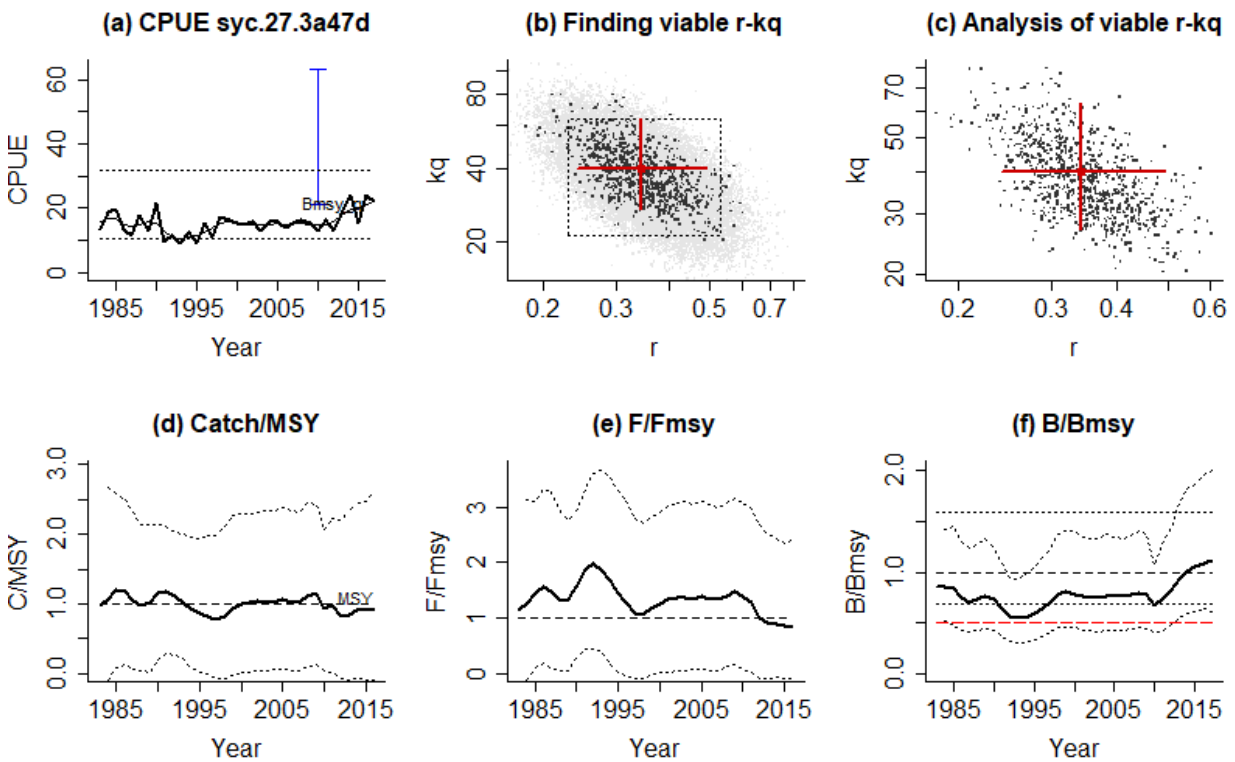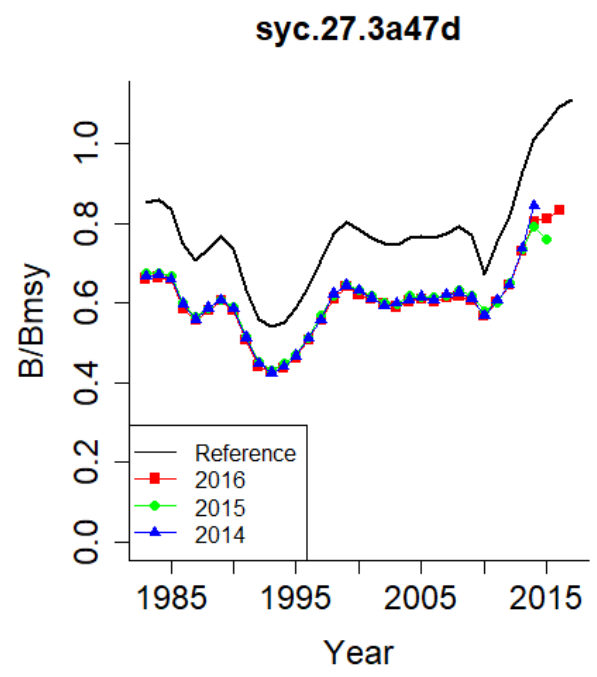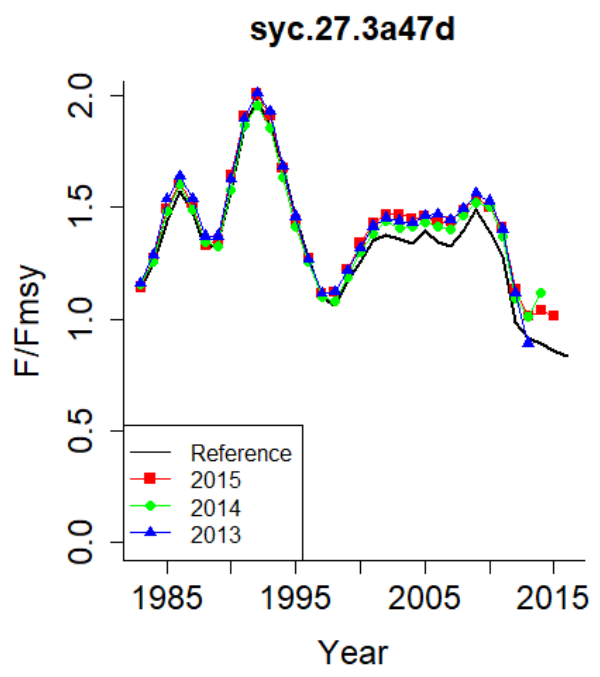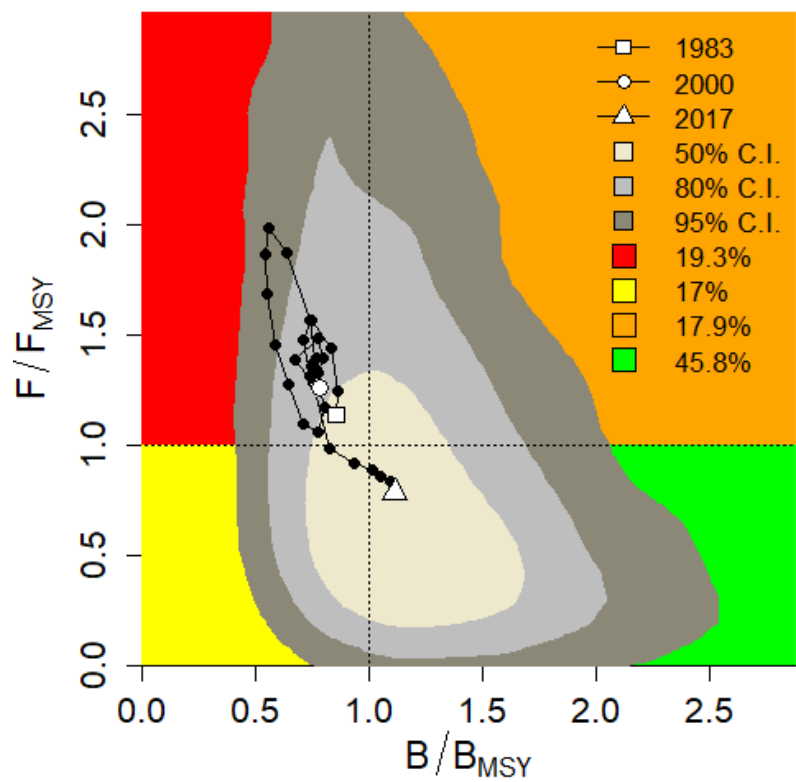
```
--------------------------------------------------------------------
LBB results for Trisopterus luscus, stock Trisopterus luscus, 1983-2017
Files:LBB4AMSY_ID_3.csv, LBB_June052019_Trisopterus luscus.csv
--------------------------------------------------------------------
Linf prior= 38, SD=0.38 cm (user-defined), Lmax=44, median Lmax=33
Z/K prior = 3.7, SD=0.18, M/K prior=1.5, SD=0.15
F/K prior = 2.19 (wide range with tau=4 in log-normal distribution)
Lc prior  = 12.8, SD=1.3 cm, alpha prior=24.5, SD=2.4, Lm50=23 cm

General reference points (median across years):
Linf      = 37.6 (36.9-38.2) cm
Lopt      = 26 cm, Lopt/Linf=0.68
Lc_opt    = 23 cm, Lc_opt/Linf=0.62, Lmean if F=M 20.2 cm
M/K       = 1.41 (1.11-1.66)
F/M       = 2.66 (1.24-3.74), F/K=3.4 (3-3.92), Z/K=4.54 (4.26-4.92)
B/B0      = 0.14 (0.08-0.2), B/B0 F=M Lc=Lc_opt 0.37
Y/R'      = 0.027 (0.016-0.04)(reduced: B/B0<0.25),Y/R' F=M Lc=Lc_opt 0.05

Estimates for 2017 (mean of last 3 years with data):
Lc50      = 14.7 (14.6-14.8) cm, Lc/Linf=0.4 (0.4-0.41)
Lc95      = 17.9, alpha=0.898 (0.874-0.92)
Lmean/Lopt= 0.75, Lc/Lc_opt=0.63, L95th=28.3 cm, L95th/Linf=0.78, Mature=14%
F/M       = 2.4 (1.7-3.7), F/K=3.2 (2.9-3.7), Z/K=4.5 (4.2-4.8)
Y/R'      = 0.036 (0.019-0.059)(reduced because B/B0 < 0.25)
B/B0      = 0.16 (0.086-0.26), best LF fit year 2015=0.168 (0.091-0.27)
B/Bmsy    = 0.43 (0.23-0.71), selected B/B0 2000 = 0.17 (0.071-0.31)
RF: Set Linf between median and max. Excluded years with unrealistic LF fits.
Selected 2000 for intermediate B/B0 and reasonable LF fit.
```


Trisopterus luscus , aggregated LF   2000   2017

Lmean vs Lopt & Lc vs Lc_opt   previous F/M   exploited B / B0

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```
------------------------------------------------------------------
AMSY Analysis, Fri Nov 01 19:33:23 2019
------------------------------------------------------------------
Stock Trisopterus luscus, Trisopterus luscus, Pouting
CPUE data for years 1983 - 2017, CPUE range 2.89 - 7.57, smooth = TRUE
Prior for r                    = Medium, NA - NA
Used prior range for r         = 0.2 - 0.8
Prior for 2000 stock status    = Very small, 0.07 - 0.31
Used 2000 prior B/B0 range     = 0.07 - 0.31, prior B/Bmsy = 0.14 - 0.62
Used prior range for kq        = 12.5 - 37.4 [original range = 12.5 - 55.2]
Comment: B/B0 prior from LBB. RF: OK
Source: SMFS 2017

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 5003

  Results:
  viable r-kq pairs    = 5003
  median kq            = 21.8, 14.8 - 32.2
  median MSYq          = 2.45, 1.53 - 3.68
  r (4 MSYq/kq)        = 0.449, 0.295 - 0.707
  Fmsy (r/2)           = 0.224, 0.147 - 0.354
  F/Fmsy               = 1.8, 0.46 - 3.83 (2016)
  B/Bmsy               = 0.324, 0.183 - 0.583 (2017)
```


(a) CPUE Trisopterus luscus (b) Finding viable r-kq (c) Analysis of viable r-kq (d) Catch/MSY (e) F/Fmsy (f) B/Bmsy

Trisopterus luscus

Trisopterus luscus
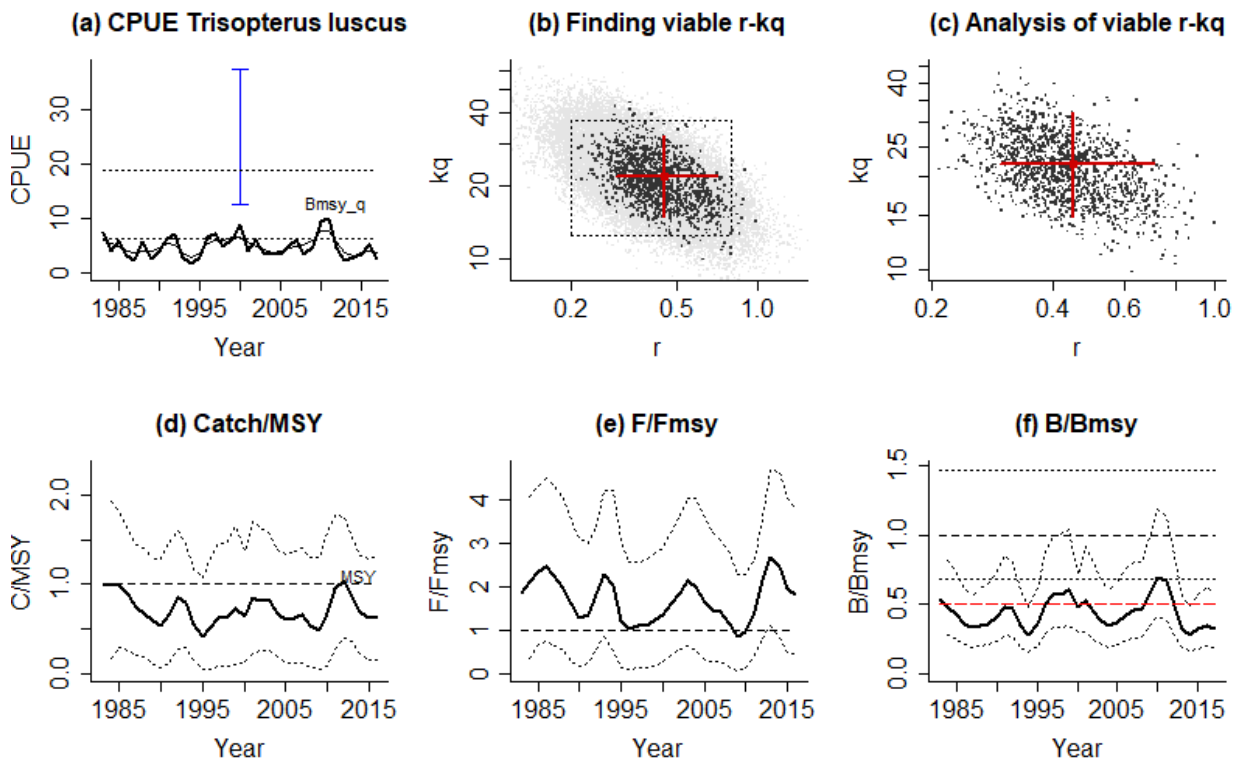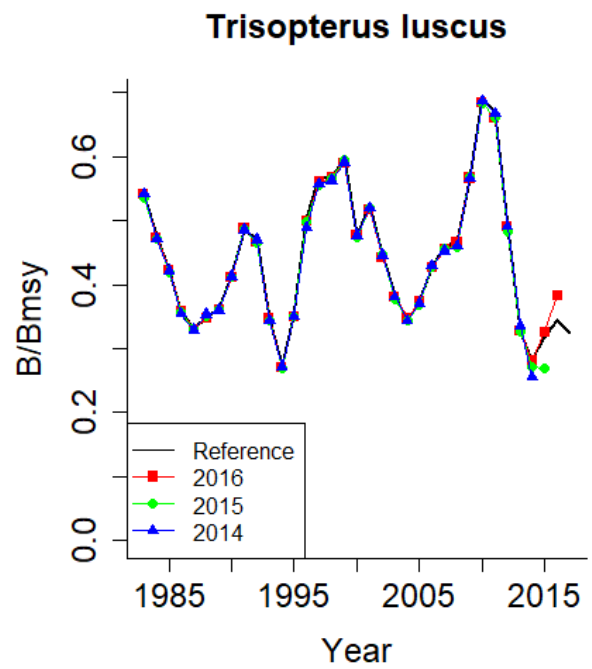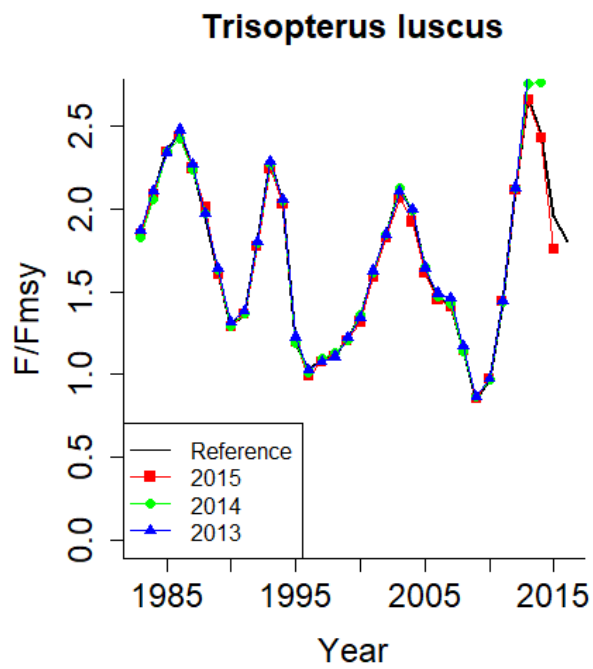
Baltic Sea

```
-----------------------------------------------------------------
LBB results for Enchelyopus cimbrius, stock Ench_cim22-24, 1993-2018
Files:LBB4AMSY_ID_4.csv, LBB_June102019_Enchelyopus cimbrius.csv
-----------------------------------------------------------------
Linf prior= 37, SD=0.37 cm (user-defined), Lmax=37, median Lmax=34
Z/K prior = 1.7, SD=0.16, M/K prior=1.5, SD=0.15
F/K prior = 0.209 (wide range with tau=4 in log-normal distribution)
Lc prior  = 16.8, SD=1.7 cm, alpha prior=15.3, SD=1.5, Lm50=25 cm

General reference points (median across years):
Linf      = 37.5 (36.9-38) cm
Lopt      = 26 cm, Lopt/Linf=0.7
Lc_opt    = 21 cm, Lc_opt/Linf=0.55, Lmean if F=M 24.8 cm
M/K       = 1.29 (1.05-1.61)
F/M       = 0.545 (0.246-1.01), F/K=0.797 (0.414-1.3), Z/K=2.2 (1.97-2.35)
B/B0      = 0.51 (0.13-1), B/B0 F=M Lc=Lc_opt 0.37
Y/R'      = 0.045 (0.012-0.093), Y/R' F=M Lc=Lc_opt 0.056

Estimates for 2018 (mean of last 3 years with data):
Lc50      = 20.3 (20-20.6) cm, Lc/Linf=0.54 (0.53-0.55)
Lc95      = 26.7, alpha=0.459 (0.444-0.476)
Lmean/Lopt= 0.94, Lc/Lc_opt=0.99, L95th=34.7 cm, L95th/Linf=0.92, Mature=32%
F/M       = 1 (0.7-1.7), F/K=1.1 (0.87-1.5), Z/K=2.4 (2.2-2.6)
Y/R'      = 0.059 (0.03-0.1)
B/B0      = 0.45 (0.13-0.99), best LF fit year 2001=0.683 (0.13-1.5)
B/Bmsy    = 1.2 (0.36-2.6), selected B/B0 1999 = 0.51 (0.15-0.97)
RF: Set Linf = Lmax because of relatively undisturbed population. Merged LFs
of adjacent years. Excluded years with unrealistic fits. Selected 1999 because
of reasonable LF and B/B0 fit.
```
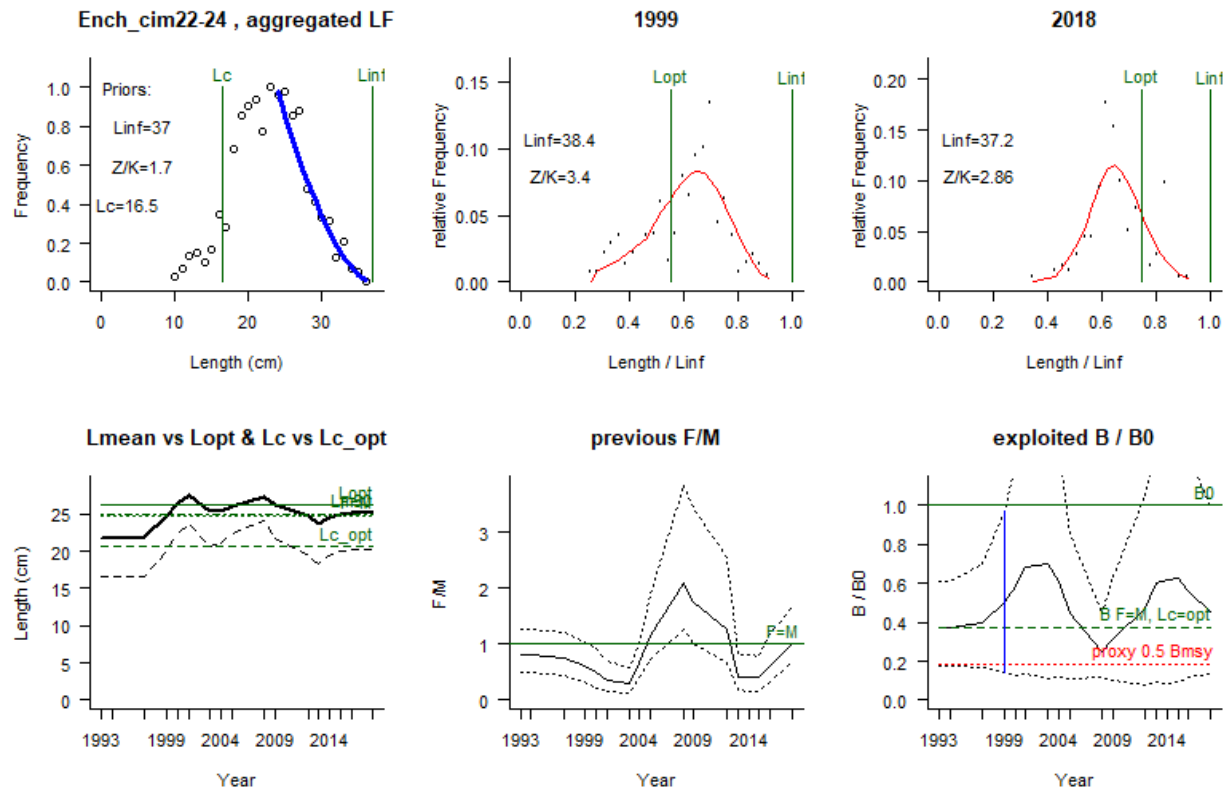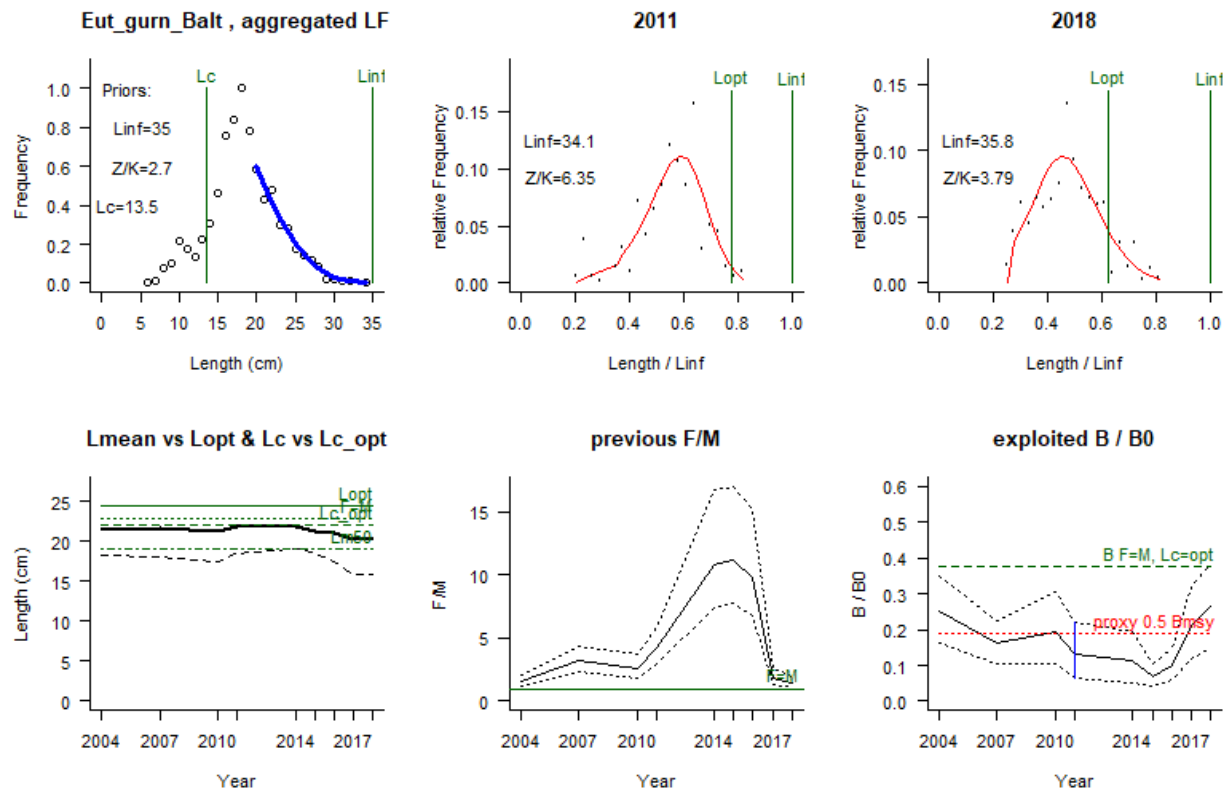
```
------------------------------------------------
AMSY Analysis, Fri Nov 01 19:37:40 2019
------------------------------------------------
Stock Ench_cim22-24, Enchelyopus cimbrius, Fourbeard rockling
CPUE data for years 1991 - 2018, CPUE range 0.0406 - 0.262, smooth = TRUE
Prior for r                   = Medium, NA - NA
Used prior range for r        = 0.2 - 0.8
Prior for 1999 stock status   = About half, 0.15 - 0.97
Used 1999 prior B/B0 range    = 0.15 - 0.97, prior B/Bmsy = 0.3 - 1.94
Used prior range for kq       = 0.229 - 0.496 [original range = 0.0767 -
0.496]
Comment: B/B0 prior from LBB. RF: OK
Source: SMFS 2017

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 5000

  Results:
  viable r-kq pairs    = 5000
  median kq            = 0.307, 0.236 - 0.423
  median MSYq          = 0.0446, 0.0282 - 0.0702
  r (4 MSYq/kq)        = 0.581, 0.343 - 0.943
  Fmsy (r/2)           = 0.291, 0.172 - 0.471
  F/Fmsy               = 2.43, 1.01 - 4.38 (2017)
  B/Bmsy               = 0.289, 0.161 - 0.518 (2018)
```

Ench_cim22-24

Ench_cim22-24
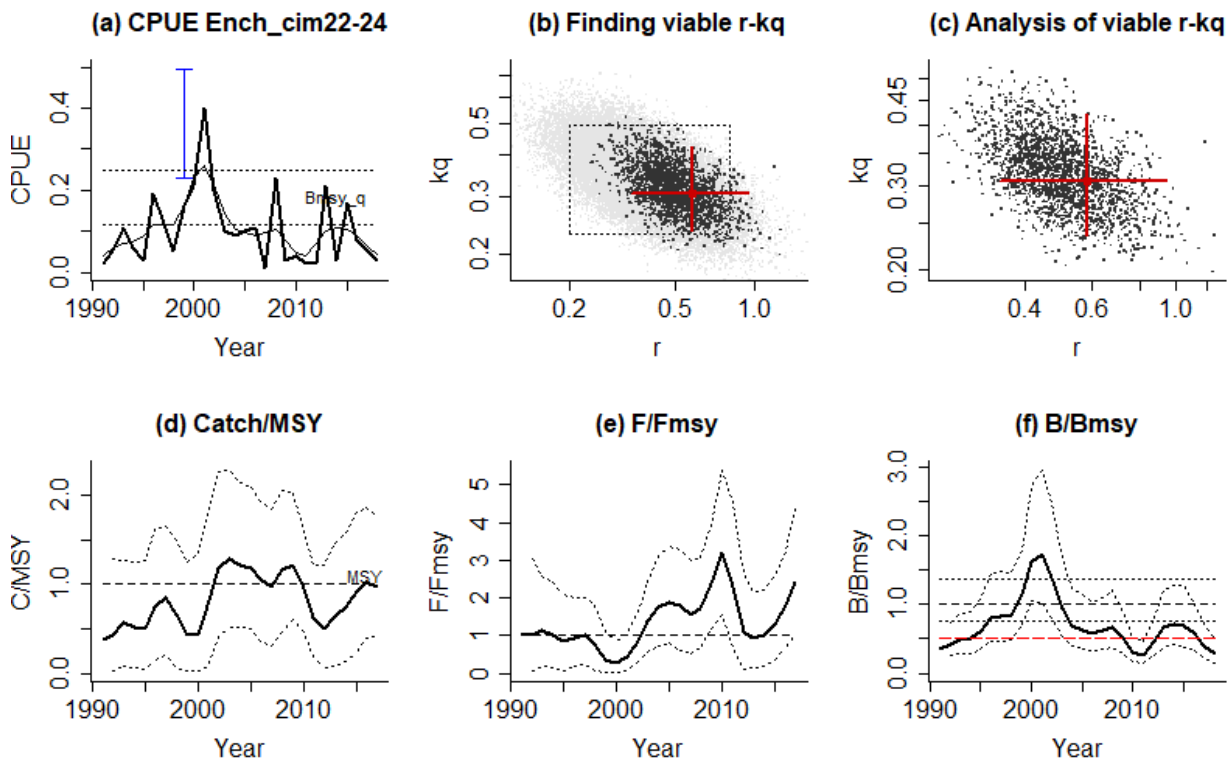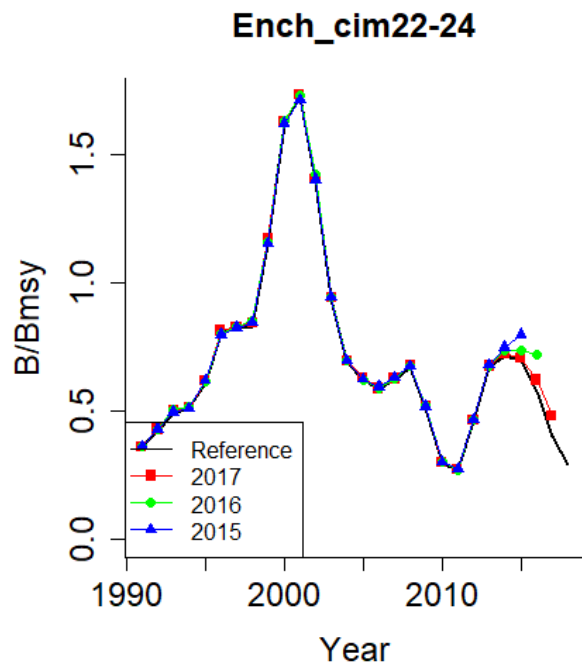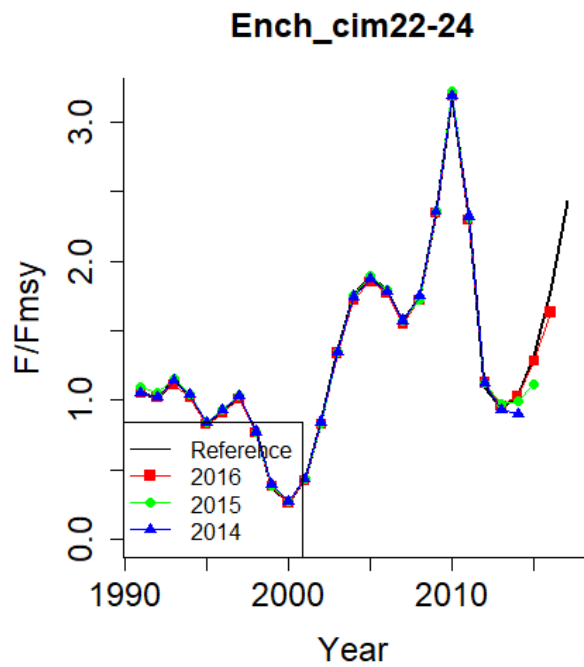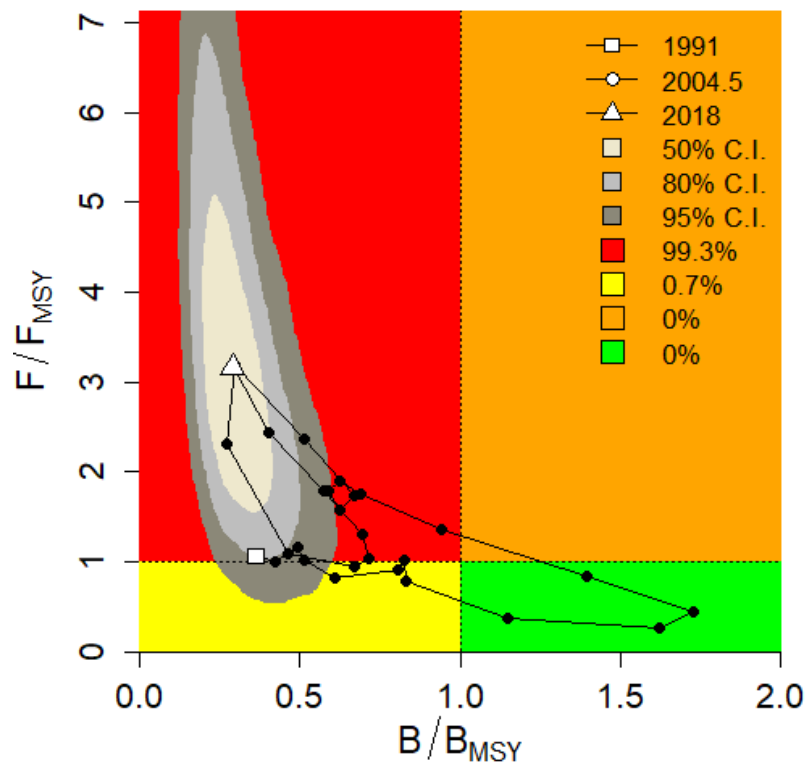
```
-----------------------------------------------------------------
LBB results for Eutrigla gurnardus, stock Eut_gurn_Balt, 2004-2018
Files:LBB4AMSY_ID_4.csv, LBB_June182019_Eutrigla gurnardus.csv
-----------------------------------------------------------------
Linf prior= 35, SD=0.35 cm (user-defined), Lmax=39, median Lmax=29
Z/K prior = 2.7, SD=0.16, M/K prior=1.5, SD=0.15
F/K prior = 1.16 (wide range with tau=4 in log-normal distribution)
Lc prior  = 13.8, SD=1.4 cm, alpha prior=17.8, SD=1.8, Lm50=19 cm

General reference points (median across years):
Linf      = 34.8 (34.1-35.3) cm
Lopt      = 24 cm, Lopt/Linf=0.7
Lc_opt    = 22 cm, Lc_opt/Linf=0.63, Lmean if F=M 22.9 cm
M/K       = 1.26 (0.991-1.5)
F/M       = 2.31 (1.65-3.21), F/K=2.74 (2.3-3.22), Z/K=3.93 (3.64-4.22)
B/B0      = 0.16 (0.095-0.23), B/B0 F=M Lc=Lc_opt 0.38
Y/R'      = 0.031 (0.02-0.046)(reduced: B/B0<0.25),Y/R' F=M Lc=Lc_opt 0.058

Estimates for 2018 (mean of last 3 years with data):
Lc50      = 16 (15.6-16.3) cm, Lc/Linf=0.45 (0.44-0.46)
Lc95      = 22.5, alpha=0.454 (0.438-0.469)
Lmean/Lopt= 0.87, Lc/Lc_opt=0.73, L95th=30.3 cm, L95th/Linf=0.85, Mature=28%
F/M       = 1.4 (1-2), F/K=2.2 (1.8-2.6), Z/K=3.8 (3.5-4.1)
Y/R'      = 0.034 (0.02-0.05)(reduced because B/B0 < 0.25)
B/B0      = 0.26 (0.15-0.38), best LF fit year 2004=0.25 (0.16-0.35)
B/Bmsy    = 0.7 (0.39-1), selected B/B0 2011 = 0.13 (0.062-0.22)
RF: Set Linf between median and max. Excluded years with unrealistic LF fits.
Selected 2011 because of good fit and similar B/B0 as preceding years.
```


Eut_gurn_Balt , aggregated LF   2011   2018

Lmean vs Lopt & Lc vs Lc_opt   previous F/M   exploited B / B0

```
------------------------------------------------------------
AMSY Analysis, Fri Nov 01 19:41:14 2019
------------------------------------------------------------
Stock Eut_gurn_Balt, Eutrigla gurnardus, Grey gurnard
CPUE data for years 2002 - 2018, CPUE range 0.0262 - 0.113, smooth = TRUE
Prior for r                    = Medium, NA - NA
Used prior range for r         = 0.2 - 0.8
Prior for 2011 stock status    = Very small, 0.06 - 0.22
Used 2011 prior B/B0 range     = 0.06 - 0.22, prior B/Bmsy = 0.12 - 0.44
Used prior range for kq        = 0.212 - 0.636 [original range = 0.212 - 0.777]
Comment: B/B0 prior from LBB. RF: OK
Source: DATRAS IBTS

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 5001

 Results:
 viable r-kq pairs    = 5001
 median kq            = 0.338, 0.225 - 0.517
 median MSYq          = 0.0434, 0.0261 - 0.074
 r (4 MSYq/kq)        = 0.513, 0.29 - 0.89
 Fmsy (r/2)           = 0.256, 0.145 - 0.445
 F/Fmsy               = 0.876, 0.0965 - 2.25 (2017)
 B/Bmsy               = 0.669, 0.37 - 1.22 (2018)
```


(a) CPUE Eut_gurn_Balt (b) Finding viable r-kq (c) Analysis of viable r-kq

(d) Catch/MSY (e) F/Fmsy (f) B/Bmsy

Eut_gurn_Balt

Eut_gurn_Balt
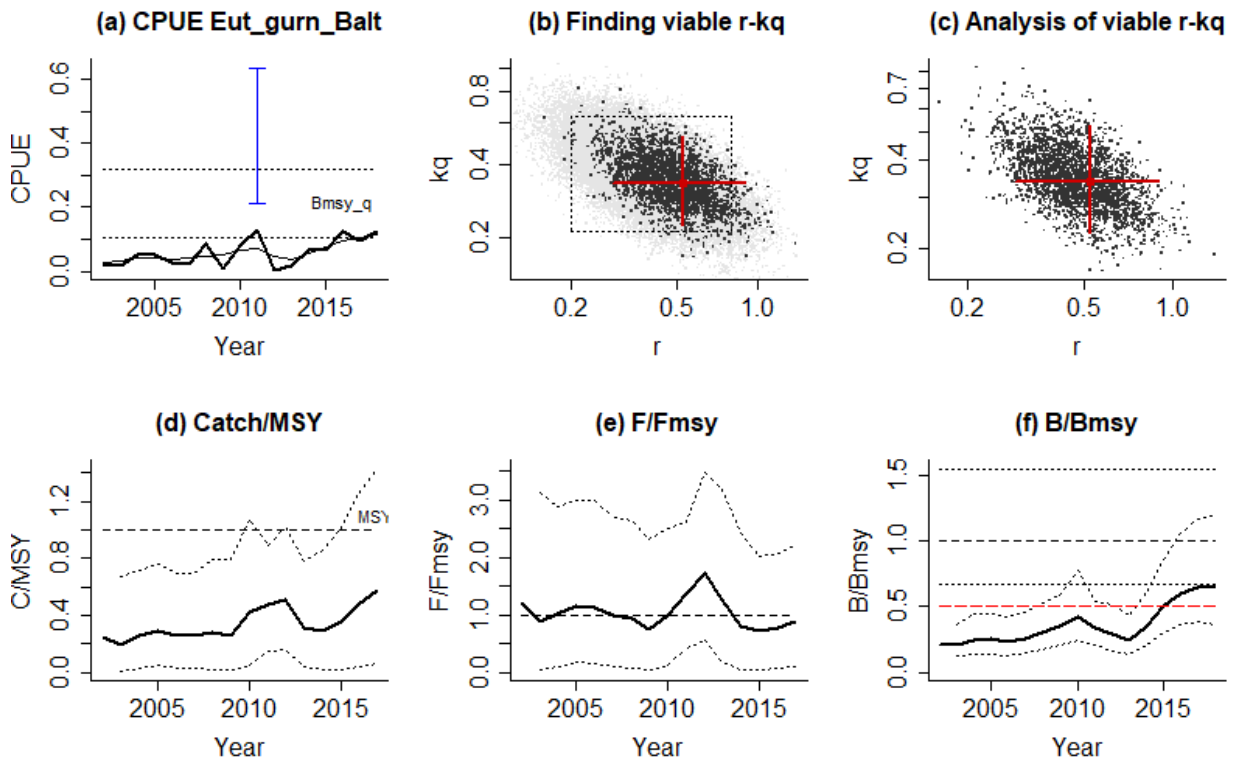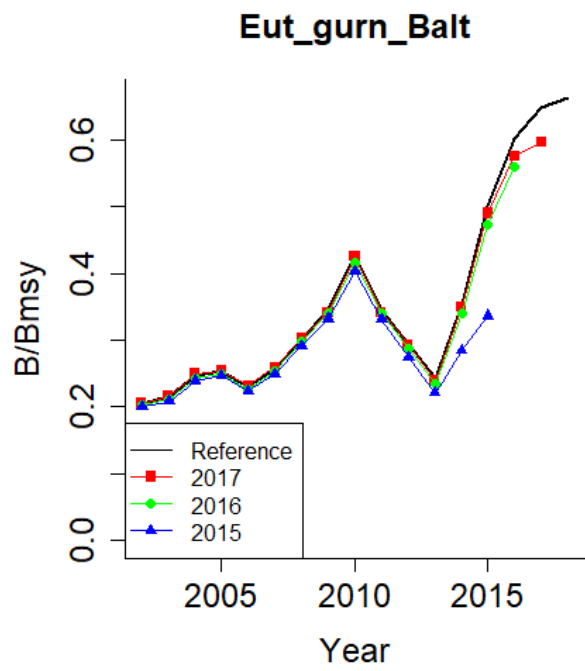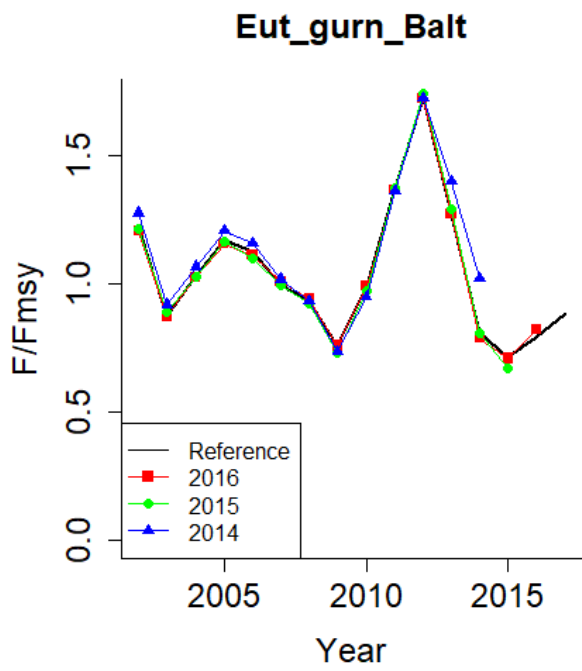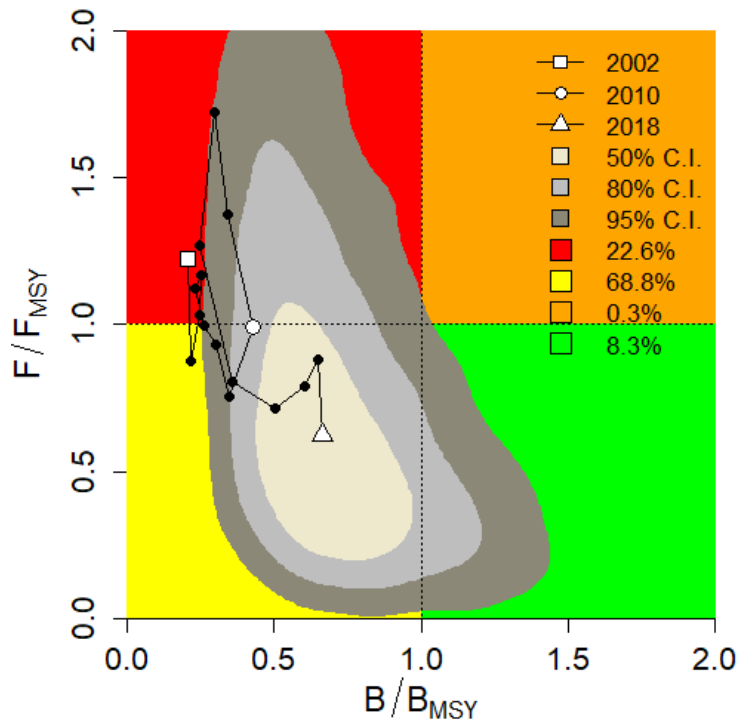
```
--------------------------------------------------------------------------
LBB results for Myoxocephalus scorpius, stock Myox_scor_22-24, 2000-2017
Files:LBB4AMSY_ID_4.csv, LBB_June102019_Myoxocephalus scorpius.csv
--------------------------------------------------------------------------
Linf prior= 32, SD=0.32 cm (user-defined), Lmax=33, median Lmax=29
Z/K prior = 3.3, SD=0.32, M/K prior=1.5, SD=0.15
F/K prior = 1.76 (wide range with tau=4 in log-normal distribution)
Lc prior  = 13.8, SD=1.4 cm, alpha prior=11.5, SD=1.2, Lm50=16 cm

General reference points (median across years):
Linf     = 32 (31.5-32.6) cm
Lopt     = 23 cm, Lopt/Linf=0.71
Lc_opt   = 21 cm, Lc_opt/Linf=0.65, Lmean if F=M 20.6 cm
M/K      = 1.24 (1.01-1.55)
F/M      = 2.85 (2.13-3.94), F/K=3.73 (3.21-4.26), Z/K=4.92 (4.46-5.34)
B/B0     = 0.13 (0.079-0.18), B/B0 F=M Lc=Lc_opt 0.38
Y/R'     = 0.035 (0.02-0.052)(reduced: B/B0<0.25),Y/R' F=M Lc=Lc_opt 0.06

Estimates for 2017 (mean of last 3 years with data):
Lc50     = 17.9 (17.6-18.2) cm, Lc/Linf=0.56 (0.55-0.57)
Lc95     = 22.5, alpha=0.632 (0.613-0.655)
Lmean/Lopt= 0.91, Lc/Lc_opt=0.86, L95th=29 cm, L95th/Linf=0.91, Mature=83%
F/M      = 2.9 (2.1-4), F/K=3.4 (2.9-4), Z/K=4.6 (4.2-5.1)
Y/R'     = 0.044 (0.025-0.066)(reduced because B/B0 < 0.25)
B/B0     = 0.15 (0.087-0.22), best LF fit year 2002=0.0873 (0.055-0.13)
B/Bmsy   = 0.39 (0.23-0.58), selected B/B0 2008 = 0.22 (0.12-0.36)
RF: Set Linf between median and max. Excluded years with unrealistic fit.
Selected 2008 because of reasonable LF and B/B0.
```
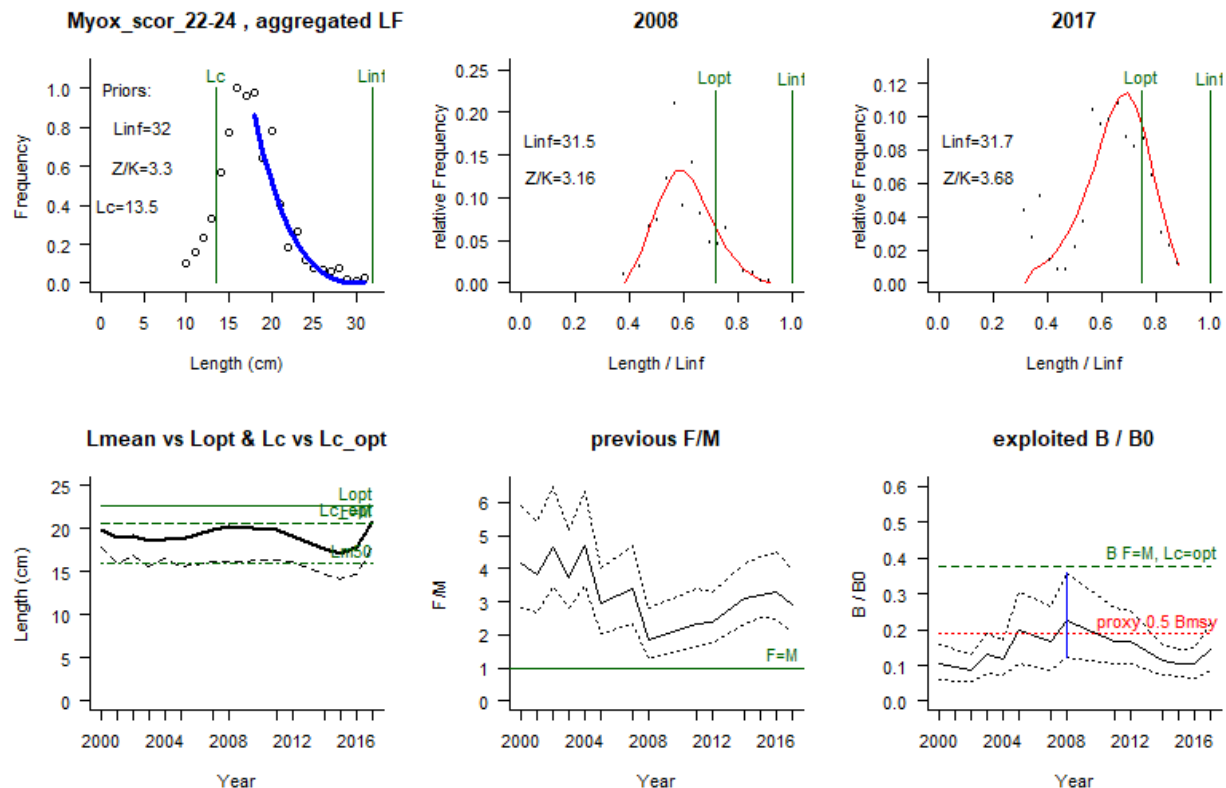
```
---------------------------------------------
AMSY Analysis, Fri Nov 01 19:45:13 2019
---------------------------------------------
Stock Myox_scor_22-24, Myoxocephalus scorpius, Shorthorn sculpin
CPUE data for years 2000 - 2017, CPUE range 0.974 - 3.28, smooth = TRUE
Prior for r                 = Medium, NA - NA
Used prior range for r      = 0.2 - 0.8
Prior for 2008 stock status = Small, 0.12 - 0.36
Used 2008 prior B/B0 range  = 0.12 - 0.36, prior B/Bmsy = 0.24 - 0.72
Used prior range for kq     = 5.06 - 15.2 [original range = 5.06 - 15.2]
Comment: B/B0 prior from LBB. RF: OK
Source: SMFS 2017

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 5000

 Results:
 viable r-kq pairs   = 5000
 median kq           = 8.12, 5.22 - 12.4
 median MSYq         = 1.01, 0.606 - 1.57
 r (4 MSYq/kq)       = 0.496, 0.298 - 0.824
 Fmsy (r/2)          = 0.248, 0.149 - 0.412
 F/Fmsy              = 2.64, 1.1 - 4.87 (2016)
 B/Bmsy              = 0.272, 0.151 - 0.482 (2017)
```

Myox_scor_22-24

Myox_scor_22-24
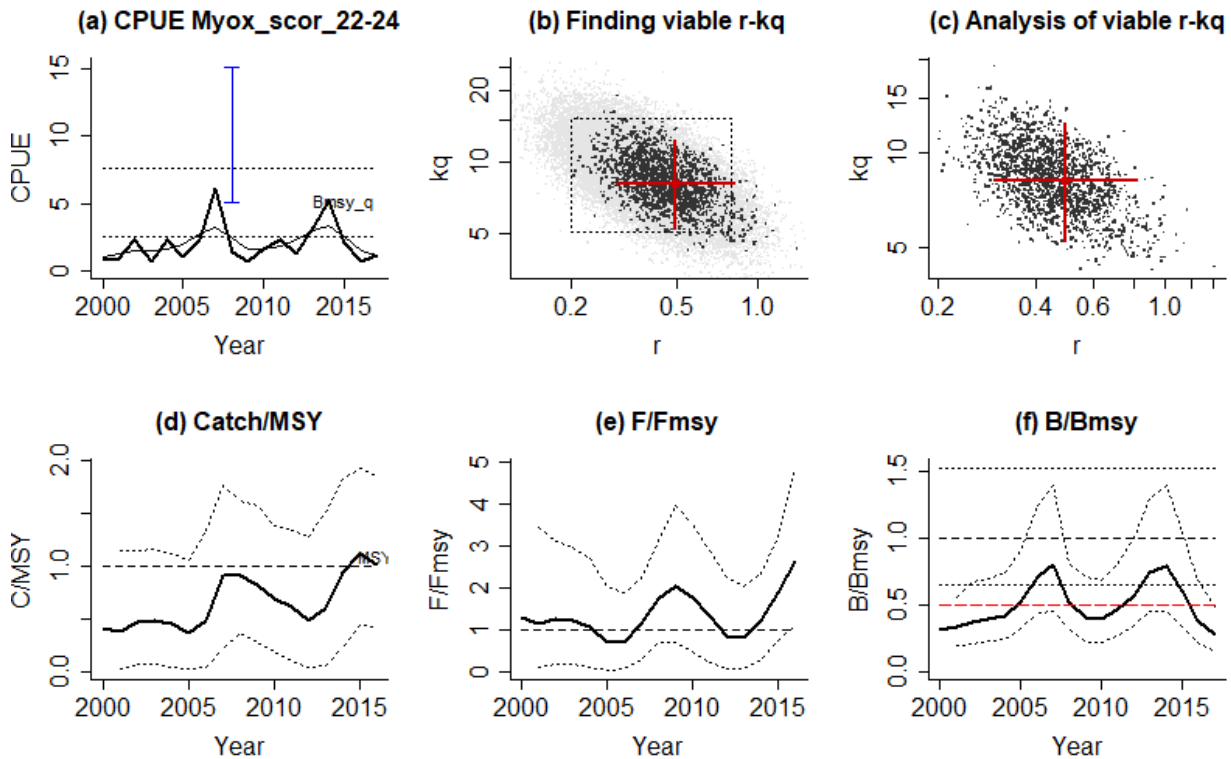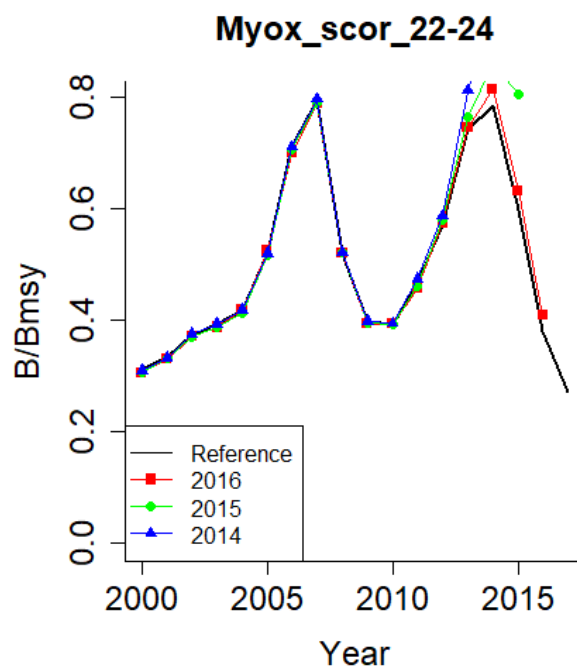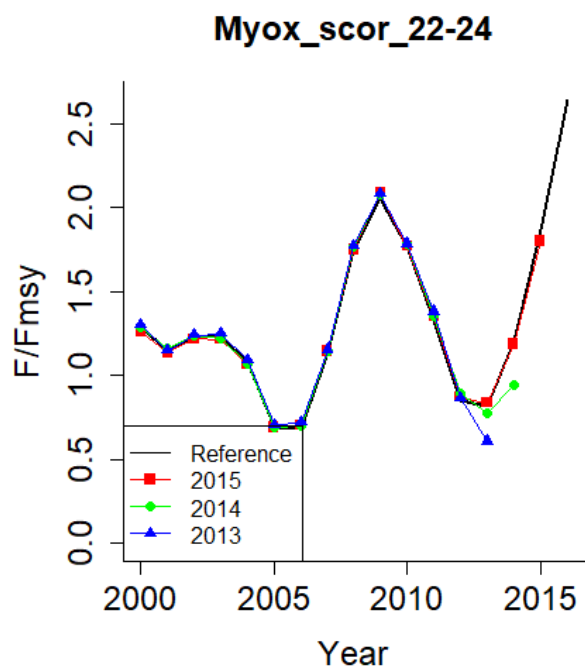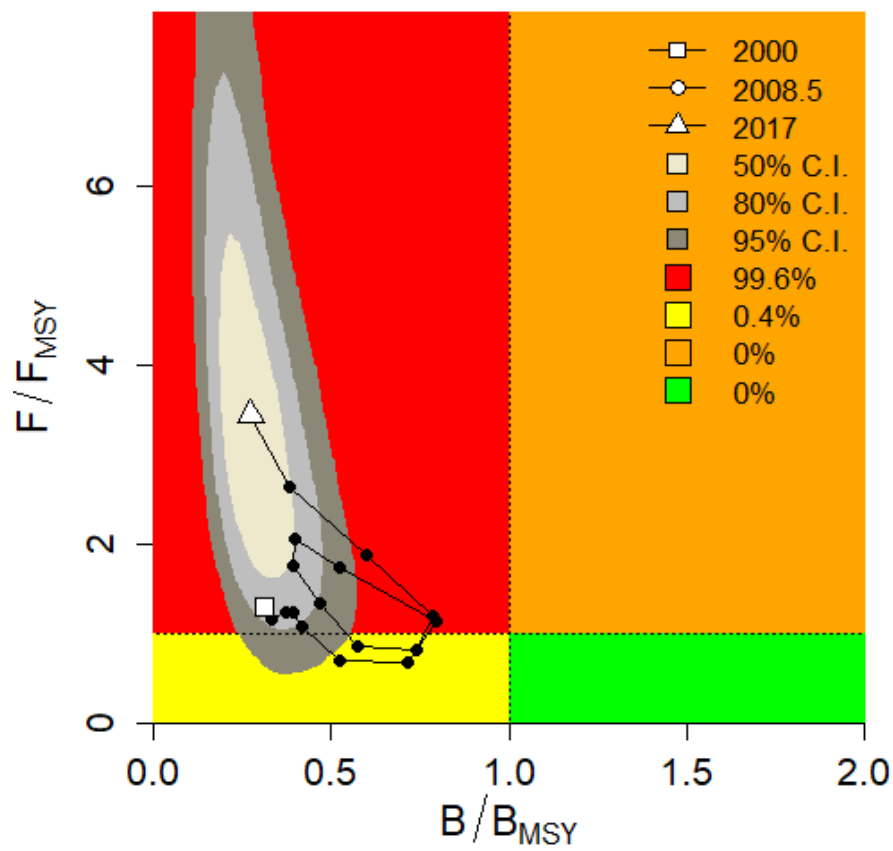
```
--------------------------------------------------------------------
LBB results for Zoarces viviparus, stock Zoar_vivi_Balt, 2000-2017
Files:LBB4AMSY_ID_4.csv, LBB_June182019_Zoar_vivi_Balt.csv
--------------------------------------------------------------------
Linf prior= 38, SD=0.38 cm (user-defined), Lmax=38, median Lmax=34
Z/K prior = 4.4, SD=0.29, M/K prior=1.5, SD=0.15
F/K prior = 2.88 (wide range with tau=4 in log-normal distribution)
Lc prior  = 15.8, SD=1.6 cm, alpha prior=17.7, SD=1.8, Lm50=17 cm

General reference points (median across years):
Linf      = 37.8 (37.2-38.5) cm
Lopt      = 25 cm, Lopt/Linf=0.67
Lc_opt    = 24 cm, Lc_opt/Linf=0.63, Lmean if F=M 24.5 cm
M/K       = 1.46 (1.18-1.7)
F/M       = 4.34 (3.4-5.58), F/K=5.44 (5.01-6.81), Z/K=7.48 (6.48-9.02)
B/B0      = 0.07 (0.044-0.099), B/B0 F=M Lc=Lc_opt 0.37
Y/R'      = 0.012 (0.0085-0.016)(reduced: B/B0<0.25),Y/R' F=M Lc=Lc_opt 0.047

Estimates for 2017 (mean of last 3 years with data):
Lc50      = 18.8 (18.2-19.2) cm, Lc/Linf=0.49 (0.48-0.5)
Lc95      = 24.2, alpha=0.547 (0.527-0.563)
Lmean/Lopt= 0.87, Lc/Lc_opt=0.79, L95th=33 cm, L95th/Linf=0.87, Mature=50%
F/M       = 4 (2.9-5.3), F/K=6.9 (5.2-8.5), Z/K=8.4 (6.8-10)
Y/R'      = 0.024 (0.015-0.037)(reduced because B/B0 < 0.25)
B/B0      = 0.13 (0.082-0.2), best LF fit year 2004=0.0943 (0.061-0.13)
B/Bmsy    = 0.36 (0.22-0.54), selected B/B0 2002 = 0.15 (0.095-0.21)
RF: Set Linf between median and max. Set Lcut=10 to exclude peaks of early
juveniles. Excluded years with unrealistic fits. Selected 2002 because of
reasonable B/B0.
```
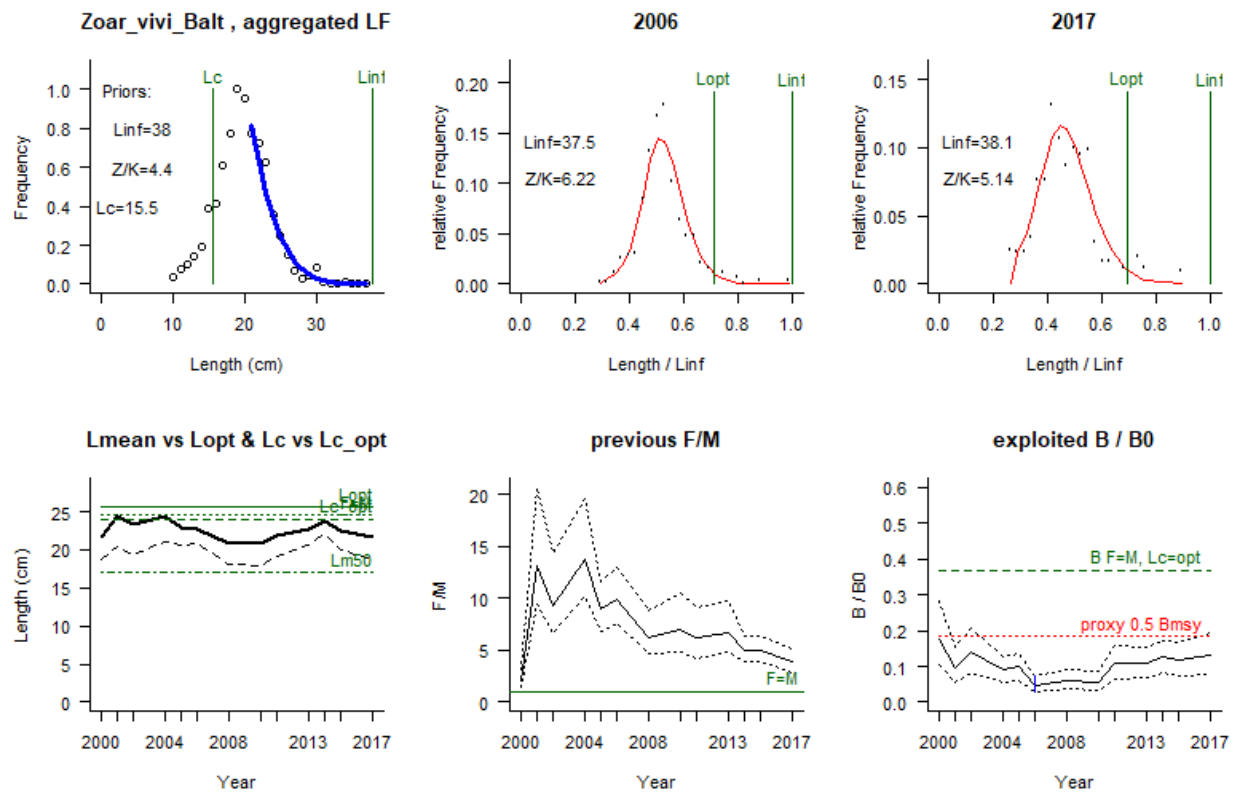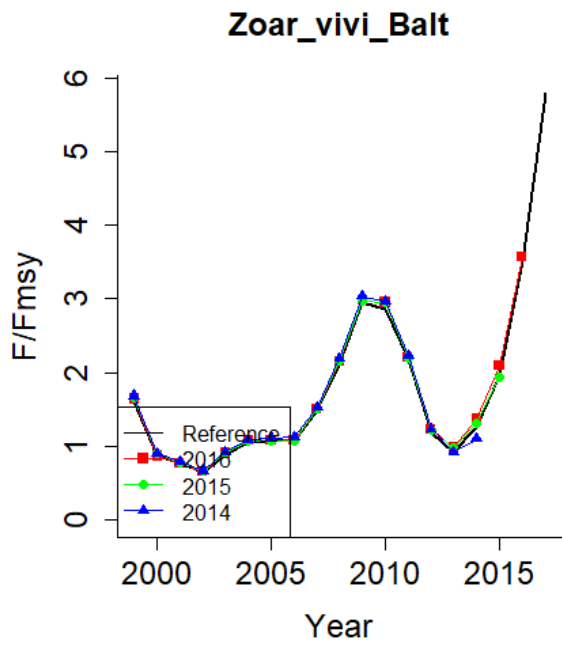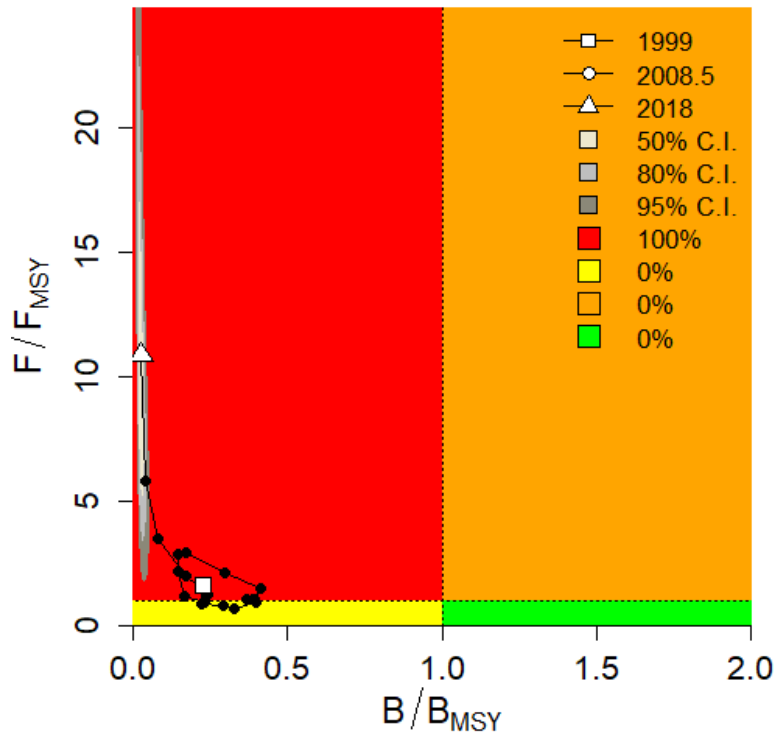
```
------------------------------------------------------------
AMSY Analysis, Fri Nov 01 19:48:23 2019
------------------------------------------------------------
Stock Zoar_vivi_Balt, Zoarces viviparus, Eelpout
CPUE data for years 1999 - 2018, CPUE range 0.0339 - 0.568, smooth = TRUE
Prior for r                   = Medium, NA - NA
Used prior range for r        = 0.2 - 0.8
Prior for 2002 stock status   = Very small, 0.1 - 0.21
Used 2002 prior B/B0 range    = 0.1 - 0.21, prior B/Bmsy = 0.2 - 0.42
Used prior range for kq       = 1.99 - 4.18 [original range = 1.99 - 4.18]
Comment: B/B0 prior from LBB. RF: OK
Source: DATRAS IBTS

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 5002

  Results:
  viable r-kq pairs   = 5002
  median kq           = 2.7, 2.02 - 3.7
  median MSYq         = 0.361, 0.23 - 0.586
  r (4 MSYq/kq)       = 0.535, 0.32 - 0.901
  Fmsy (r/2)          = 0.267, 0.16 - 0.45
  F/Fmsy              = 5.8, 2.89 - 10.6 (2017)
  B/Bmsy              = 0.0252, 0.014 - 0.0453 (2018)
```


(a) CPUE Zoar_vivi_Balt (b) Finding viable r-kq (c) Analysis of viable r-kq

(d) Catch/MSY (e) F/Fmsy (f) B/Bmsy

Zoar_vivi_Balt

Zoar_vivi_Balt
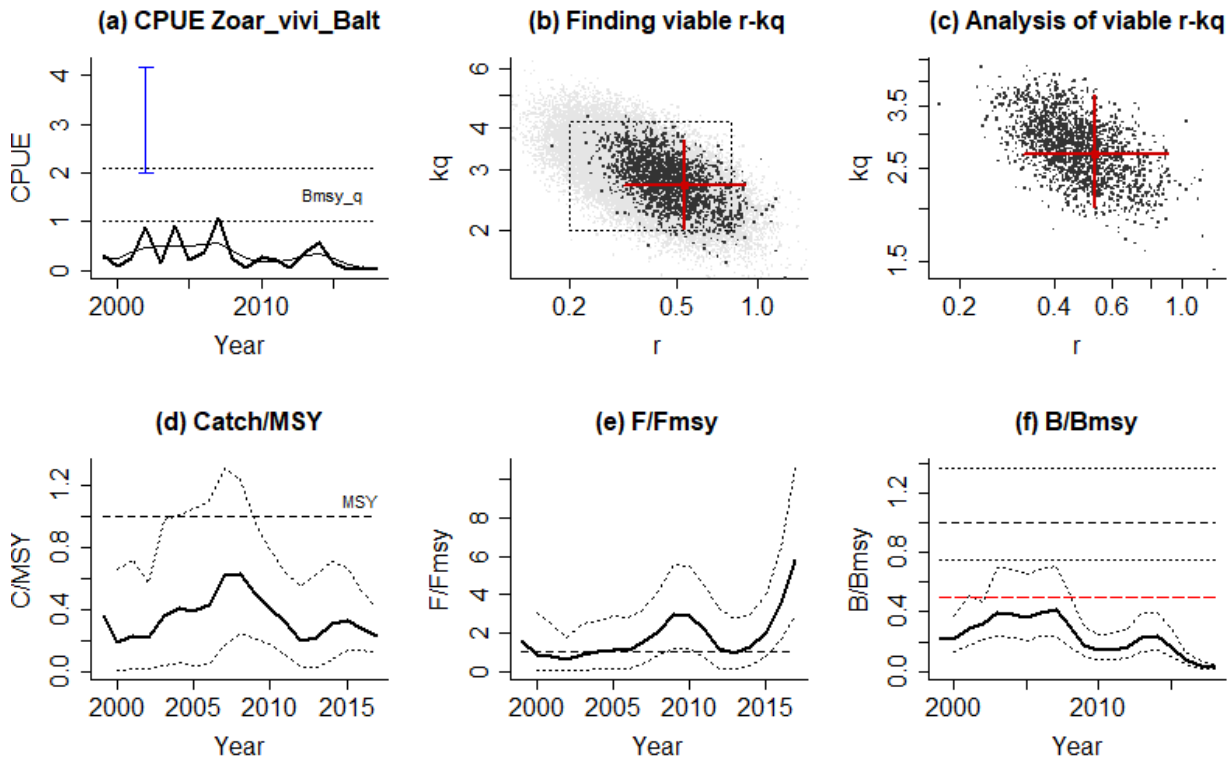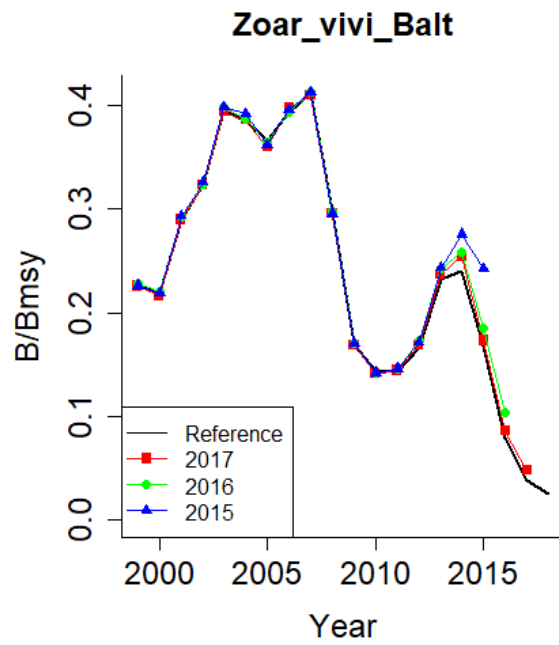
Northwest Atlantic

LBB results for *Leucoraja erinacea*, **Little skate Eastern Canada**, 2007-2018

Linf prior= 65, SD=0.65 cm (user-defined), Lmax=76, median Lmax=62.5

Z/K prior = 5.1, SD=0.37, M/K prior=1.5, SD=0.15
F/K prior = 3.64 (wide range with tau=4 in log-normal distribution)
Lc prior = 44.4, SD=4.4 cm, alpha prior=23.2, SD=2.3, Lm50=47.4 cm

```
General reference points (median across years):
Linf     = 65.3 (64.2-66.4) cm
Lopt     = 43 cm, Lopt/Linf=0.66
Lc_opt   = 40 cm, Lc_opt/Linf=0.61, Lmean if F=M 51.2 cm
M/K      = 1.54 (1.25-1.83)
F/M      = 3.16 (2.49-4.21), F/K=5 (4.21-5.85), Z/K=6.44 (5.68-7.29)
B/B0     = 0.18 (0.12-0.25), B/B0 F=M Lc=Lc_opt 0.39
Y/R'     = 0.034 (0.022-0.047)(reduced: B/B0<0.25),Y/R' F=M Lc=Lc_opt 0.042
Estimates for 2018 (mean of last 3 years with data):
Lc50      = 45.9 (45.5-46.4) cm, Lc/Linf=0.71 (0.7-0.72)
Lc95      = 53, alpha=0.417 (0.399-0.432)
Lmean/Lopt= 1.1, Lc/Lc_opt=1.2, L95th=57.3 cm, L95th/Linf=0.88, Mature=30%
F/M       = 4.3 (3.2-5.7), F/K=6.2 (5.3-7.3), Z/K=7.6 (6.8-8.7)
Y/R'      = 0.032 (0.021-0.047)(reduced because B/B0 < 0.25)
B/B0      = 0.15 (0.098-0.22), best LF fit year 2011=0.205 (0.14-0.28)
B/Bmsy    = 0.38 (0.25-0.55), selected B/B0 2015 = 0.13 (0.085-0.2)
LF data from scientific research surveys provided by Fisheries and Oceans
Canada (DFO); Lm50 average of male and female taken from McPhie, R.P. and
Campana, S.E., 2009. Reproductive characteristics and population decline of
four species of skate (Rajidae) off the eastern coast of Canada. Journal of
Fish Biology, 75(1), pp.223-246.; specimens under 40 cm not considered because
of confusion with winter skate. RF: set Linf to 65 cm slightly above median.
Excluded years with unreasonable fits. Selected 2015 because of good fit and
reasonable B/B0 compared with adjacent estimates.
```
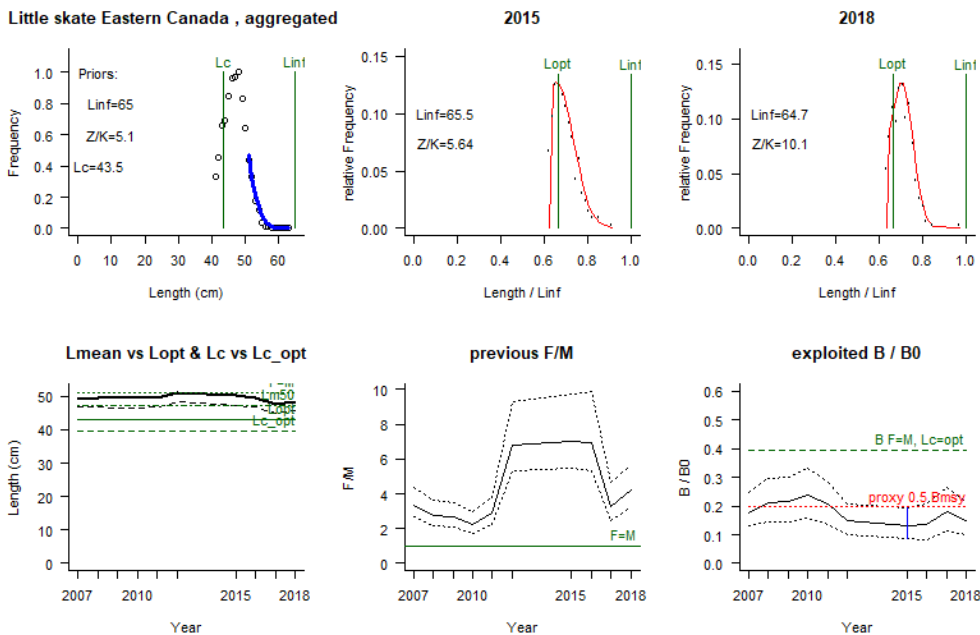
```
------------------------------------------------------------------
AMSY Analysis, Fri Nov 01 19:53:16 2019
------------------------------------------------------------------
Stock Little skate Eastern Canada, Leucoraja erinacea, Little skate
CPUE data for years 1970 - 2018, CPUE range 9.57 - 38.7, smooth = TRUE
Prior for r                   = Low, NA - NA
Used prior range for r        = 0.05 - 0.5
Prior for 2015 stock status   = Very small, 0.09 - 0.2
Used 2015 prior B/B0 range    = 0.09 - 0.2, prior B/Bmsy = 0.18 - 0.4
Used prior range for kq       = 158 - 351 [original range = 158 - 351]
Comment: CPUE from research surveys provided by Fisheries and Oceans Canada
(DFO); Bk priors from LBB; Correspondence with Dave Kulka suggests 0.5 to 0.85
in 2018

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 5008

 Results:
 viable r-kq pairs    = 5008
 median kq            = 223, 164 - 308
 median MSYq          = 14.6, 8.27 - 28
 r (4 MSYq/kq)        = 0.262, 0.139 - 0.565
 Fmsy (r/2)           = 0.131, 0.0696 - 0.282
 F/Fmsy               = 1.05, -0.619 - 4.05 (2017)
 B/Bmsy               = 0.348, 0.191 - 0.622 (2018)
)
```


(a) CPUE Little skate Eastern Cana   (b) Finding viable r-kq   (c) Analysis of viable r-kq

(d) Catch/MSY   (e) F/Fmsy   (f) B/Bmsy
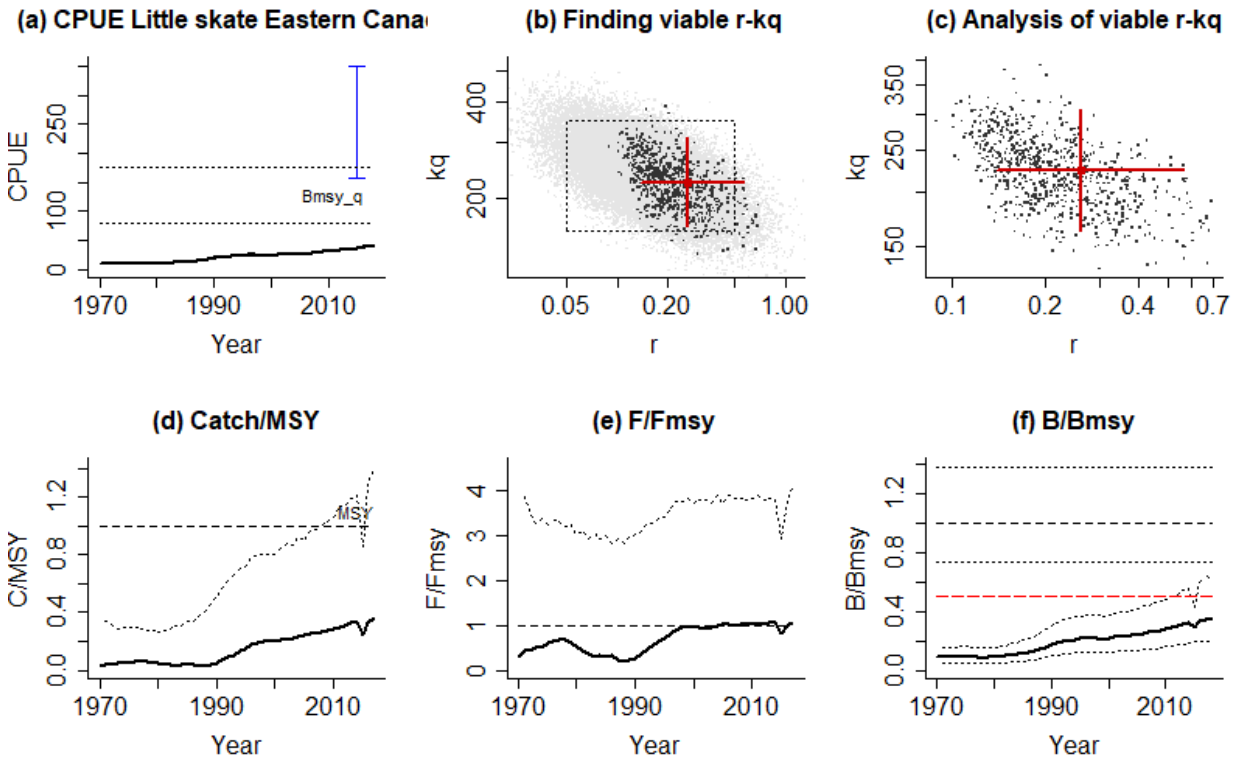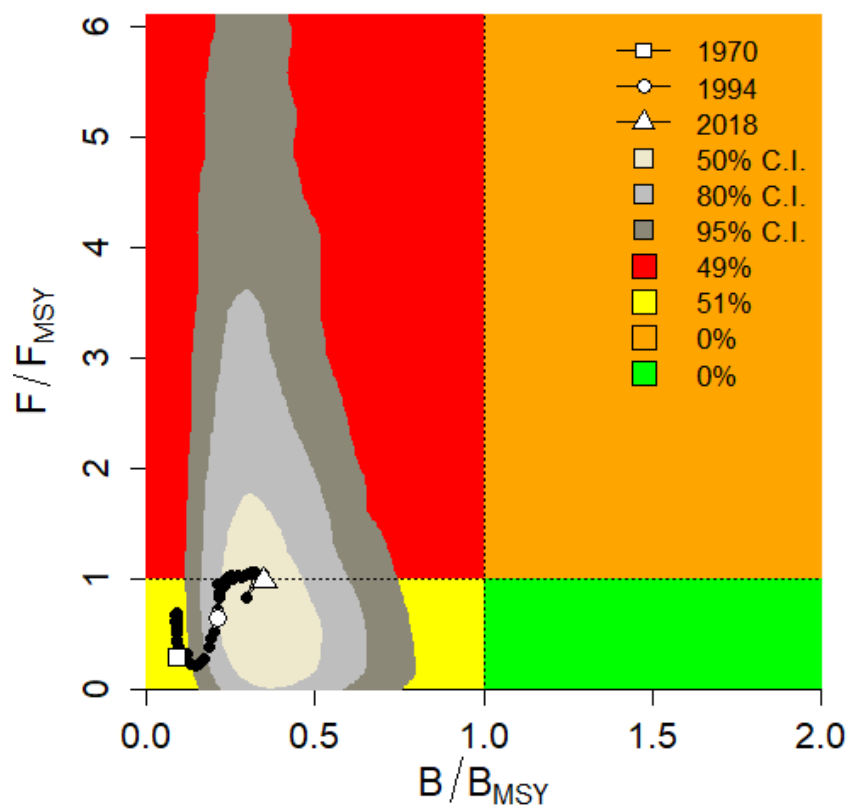
Little skate Eastern Canada
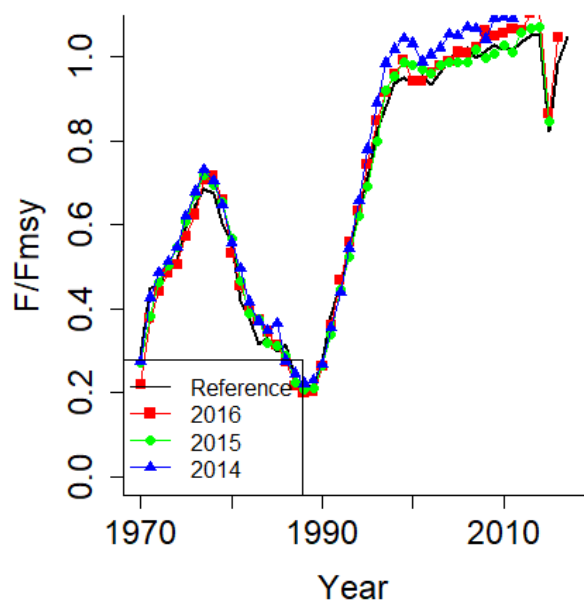
Little skate Eastern Canada
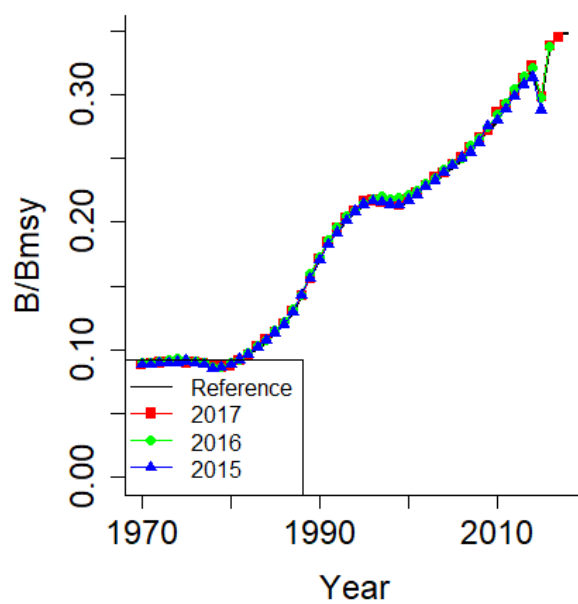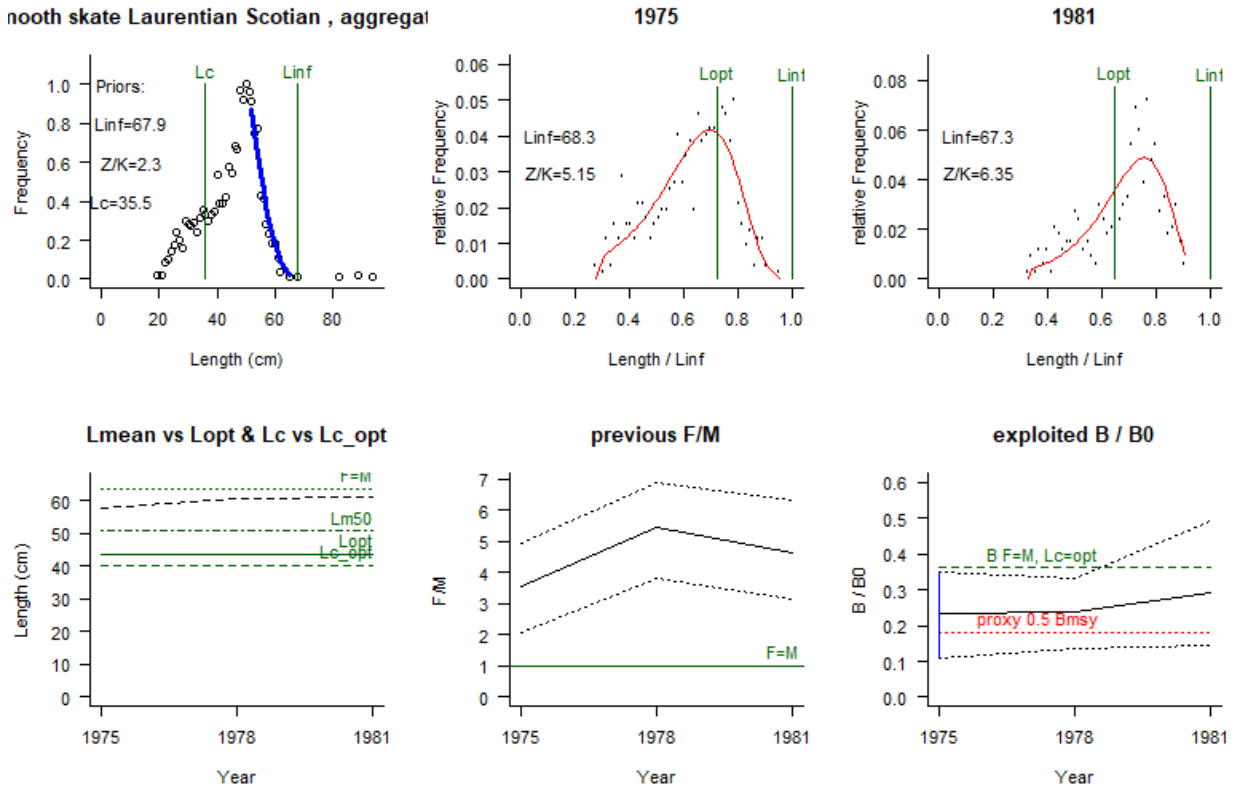

LBB results for *Malacoraja senta*, Smooth skate Laurentian Scotian, 1975-1981
Files:Little_smooth_skate_LBB_ID.csv, LBB_smooth_skate.csv

Linf prior= 67.9, SD=0.68 cm Lmax=94, median Lmax=68
Z/K prior = 2.3, SD=1.6, M/K prior=1.5, SD=0.15
F/K prior = 0.761 (wide range with tau=4 in log-normal distribution)
Lc prior = 36.2, SD=3.6 cm, alpha prior=11.3, SD=1.1, Lm50=50.8 cm

General reference points (median across years):
Linf   = 67.3 (66-68.7) cm
Lopt   = 44 cm, Lopt/Linf=0.65
Lc_opt   = 40 cm, Lc_opt/Linf=0.6, Lmean if F=M 63.8 cm
M/K   = 1.62 (1.42-1.79)
F/M   = 3.54 (2.07-5.18), F/K=4.73 (2.82-7.88), Z/K=6.27 (4.42-9.37)
B/B0   = 0.24 (0.16-0.35), B/B0 F=M Lc=Lc_opt 0.36
Y/R'   = 0.03 (0.02-0.057)(reduced: B/B0<0.25),Y/R' F=M Lc=Lc_opt 0.038

Estimates for 1981 (mean of last 3 years with data):
Lc50   = 61.4 (59.7-63.4) cm, Lc/Linf=0.91 (0.88-0.94)
Lc95   = 80.9, alpha=0.151 (0.146-0.157)
Lmean/Lopt= NA, Lc/Lc_opt=1.5, L95th=62.7 cm, L95th/Linf=0.93, Mature=36%
F/M   = 4.6 (3.1-6.3), F/K=7.1 (5.2-9.4), Z/K=8.6 (6.8-11)
Y/R'   = 0.042 (0.021-0.066)(reduced because B/B0 < 0.25)
B/B0   = 0.29 (0.15-0.49), best LF fit year 1975=0.233 (0.11-0.35)
B/Bmsy   = 0.8 (0.4-1.4), **selected B/B0 1975 = 0.23 (0.11-0.35)**
LF data (average over 3 years) from scientific research surveys provided by
Fisheries and Oceans Canada (DFO); Lm50 average of male and female and
different studies taken from COSEWIC assessment and status report on the
Smooth skate Malacoraja senta, 2012. RF: Selected 2015 because of best LF fit.

```
------------------------------------------------------------
AMSY Analysis, Fri Nov 01 19:57:42 2019
------------------------------------------------------------
Stock Smooth skate Laurentian Scotian, Malacoraja senta, Smooth skate
CPUE data for years 1970 - 2018, CPUE range 32.1 - 44.6, smooth = TRUE
Prior for r                 = Low, NA - NA
Used prior range for r      = 0.05 - 0.5
Prior for 1975 stock status = Small, 0.11 - 0.35
Used 1975 prior B/B0 range  = 0.11 - 0.35, prior B/Bmsy = 0.22 - 0.7
Used prior range for kq     = 178 - 282 [original range = 88.8 - 282]
Comment: CPUE from research surveys provided by Fisheries and Oceans Canada
(DFO); Bk priors from LBB; Correspondence with Dave Kulka suggests 0.25 to
0.85 in 2018

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 5000

  Results:
  viable r-kq pairs  = 5000
  median kq          = 211, 174 - 255
  median MSYq        = 14.6, 8.69 - 23.5
  r (4 MSYq/kq)      = 0.276, 0.162 - 0.451
  Fmsy (r/2)         = 0.138, 0.0809 - 0.225
  F/Fmsy             = 1.51, -0.323 - 4.2 (2017)
  B/Bmsy             = 0.374, 0.209 - 0.676 (2018)
```
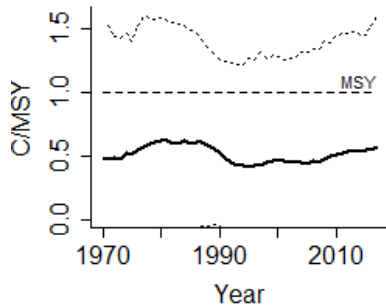

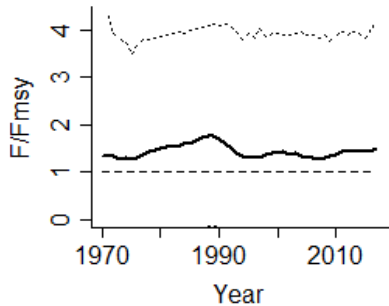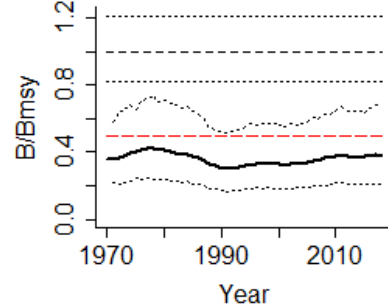(a) CPUE Smooth skate Laurentian Sc   (b) Finding viable r-kq   (c) Analysis of viable r-kq
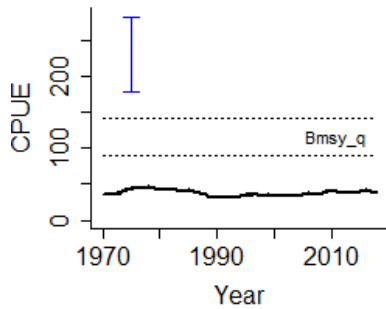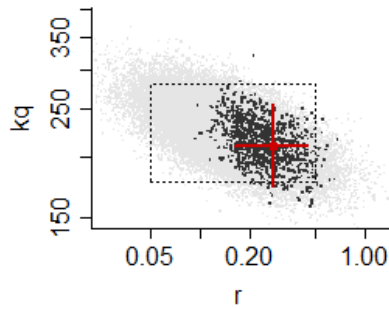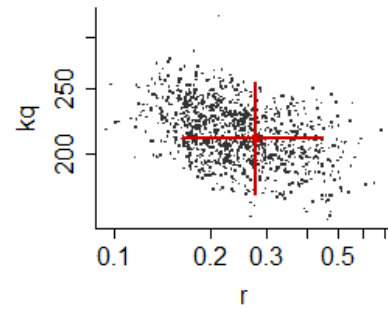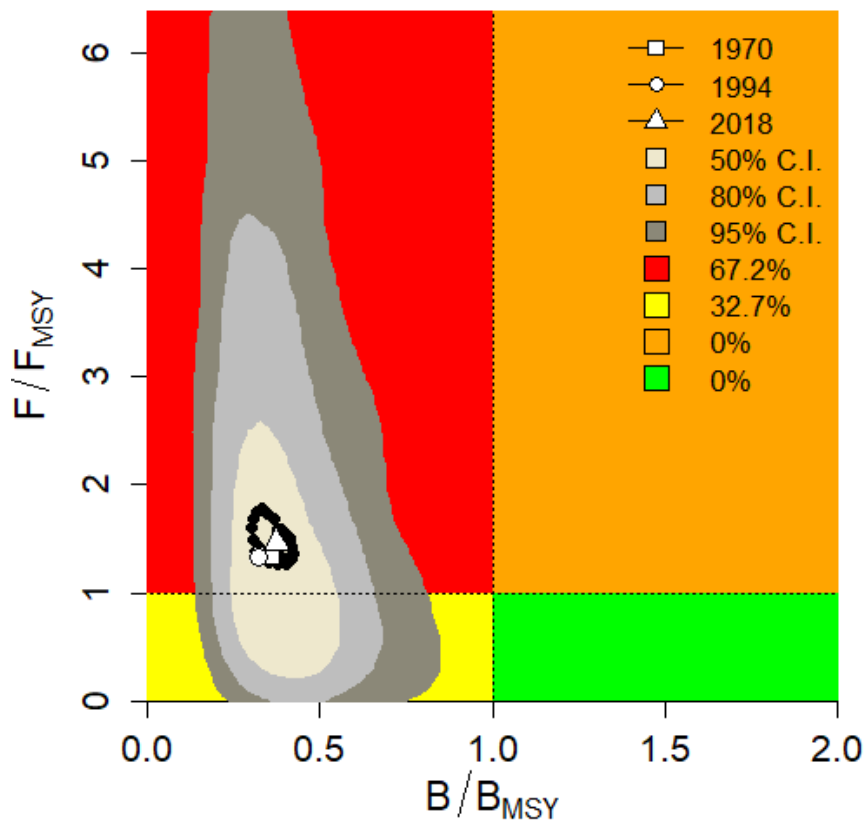
(d) Catch/MSY   (e) F/Fmsy   (f) B/Bmsy
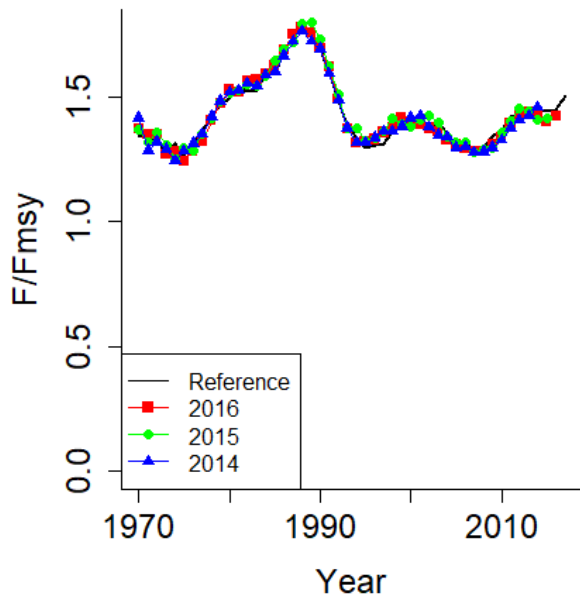
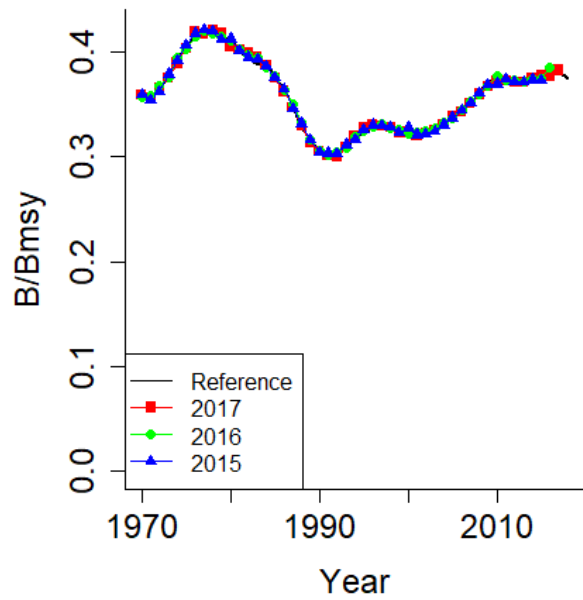**Smooth skate Laurentian Scotian**

Smooth skate Laurentian Scotian

South Africa

```
----------------------------------------------------------------
LBB results for Helicolenus dactylopterus, stock HELDAC, 1993-2017
Files:LBB4AMSY_ID_ZAdem_AMSY.csv, LBBdatZAdem_AMSY.csv
----------------------------------------------------------------
```

Linf prior= 50, SD=0.5 cm Lmax=84, median Lmax=50
Z/K prior = 5.3, SD=2.5, M/K prior=1.5, SD=0.075(user-defined)
F/K prior = 3.78 (wide range with tau=4 in log-normal distribution)
Lc prior = 11.2, SD=1.1 cm, alpha prior=12.8, SD=1.3, Lm50=32 cm

General reference points (median across years):
Linf   = 48.4 (48-49.1) cm
Lopt   = 33 cm, Lopt/Linf=0.68
Lc_opt   = 30 cm, Lc_opt/Linf=0.61, Lmean if F=M 22.3 cm
M/K   = 1.41 (1.27-1.55)
F/M   = 2.27 (1.97-2.68), F/K=2.99 (2.72-3.24), Z/K=4.38 (4.2-4.6)
B/B0   = 0.097 (0.076-0.12), B/B0 F=M Lc=Lc_opt 0.37
Y/R'   = 0.013 (0.01-0.017)(reduced: B/B0<0.25),Y/R' F=M Lc=Lc_opt 0.05

Estimates for 2017 (mean of last 3 years with data):
Lc50   = 14.4 (14.1-14.7) cm, Lc/Linf=0.3 (0.3-0.31)
Lc95   = 22.3, alpha=0.371 (0.362-0.381)
Lmean/Lopt= 0.59, Lc/Lc_opt=0.49, L95th=47.3 cm, L95th/Linf=0.99, Mature=0.7%
F/M   = 4.3 (3.5-5.2), F/K=4.2 (3.9-4.6), Z/K=5.4 (5.1-5.6)
Y/R'   = 0.01 (0.0081-0.013)(reduced because B/B0 < 0.25)
B/B0   = 0.067 (0.053-0.084), best LF fit year 1997=0.111 (0.087-0.14)
B/Bmsy   = 0.18 (0.14-0.23), **selected B/B0 1995 = 0.12 (0.095-0.15)**
Trawl Survey data; RF set MK.user=1.5 to avoid negative M/K; excluded years
with unreasonable LFs; selected 1995 because of good fit and reasonable B/B0
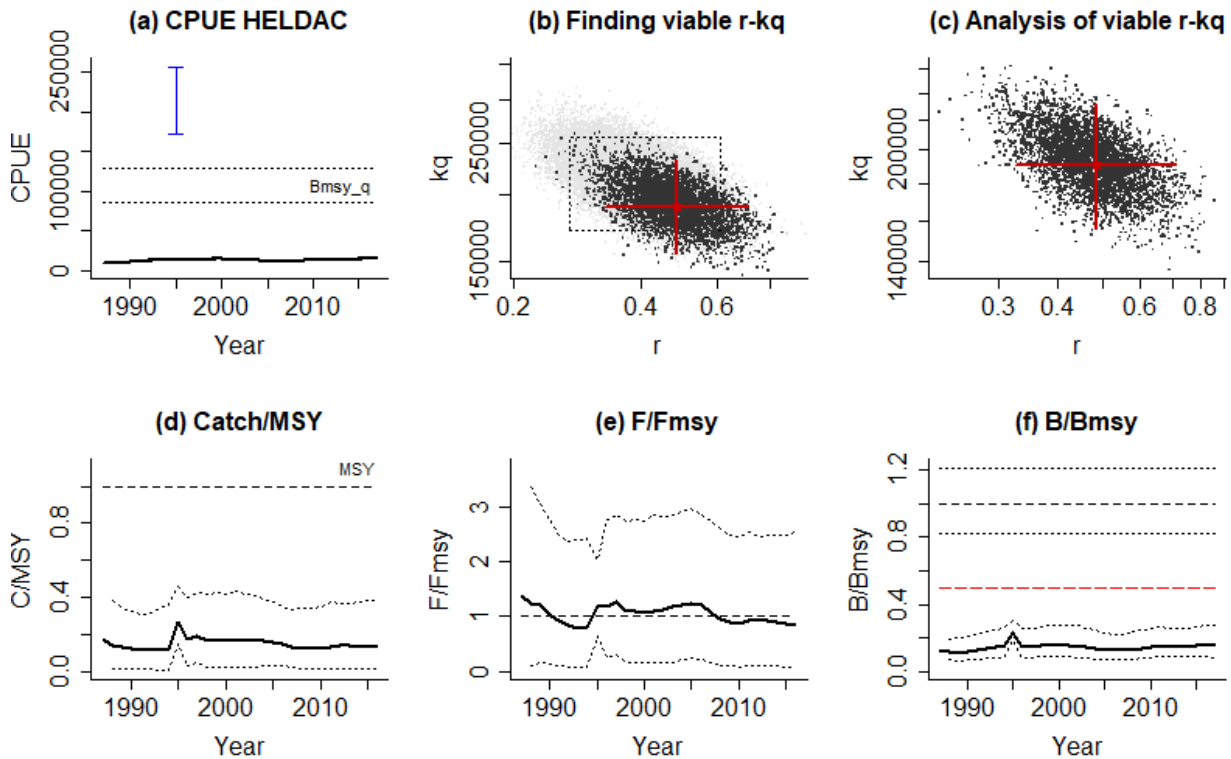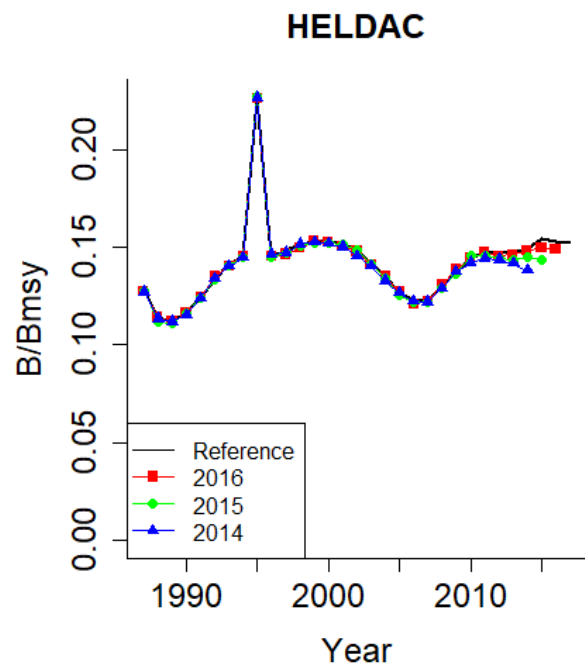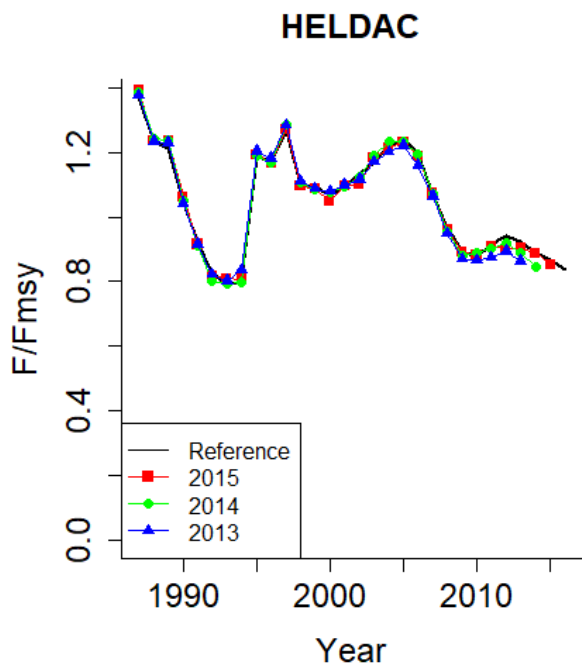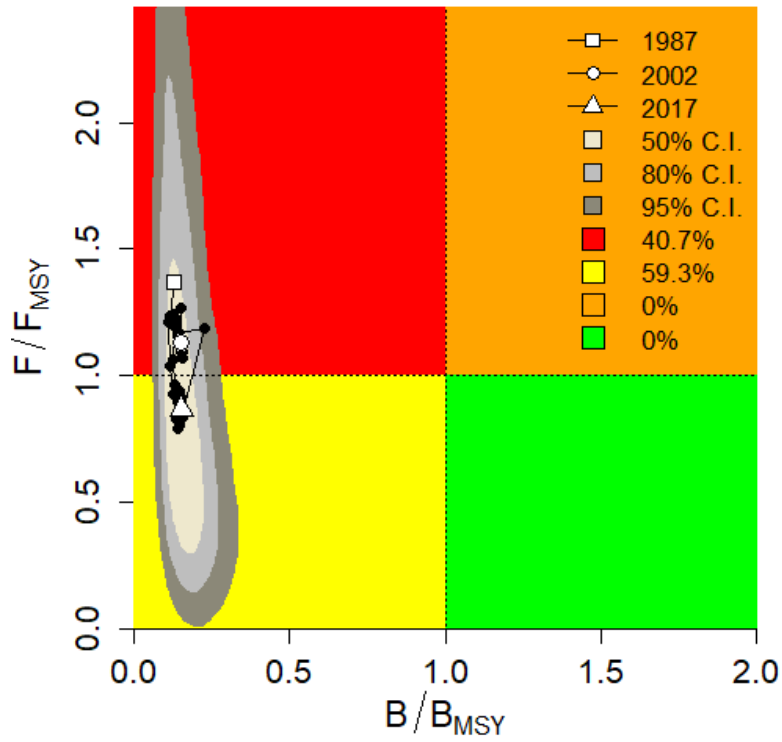compared with adjacent years.
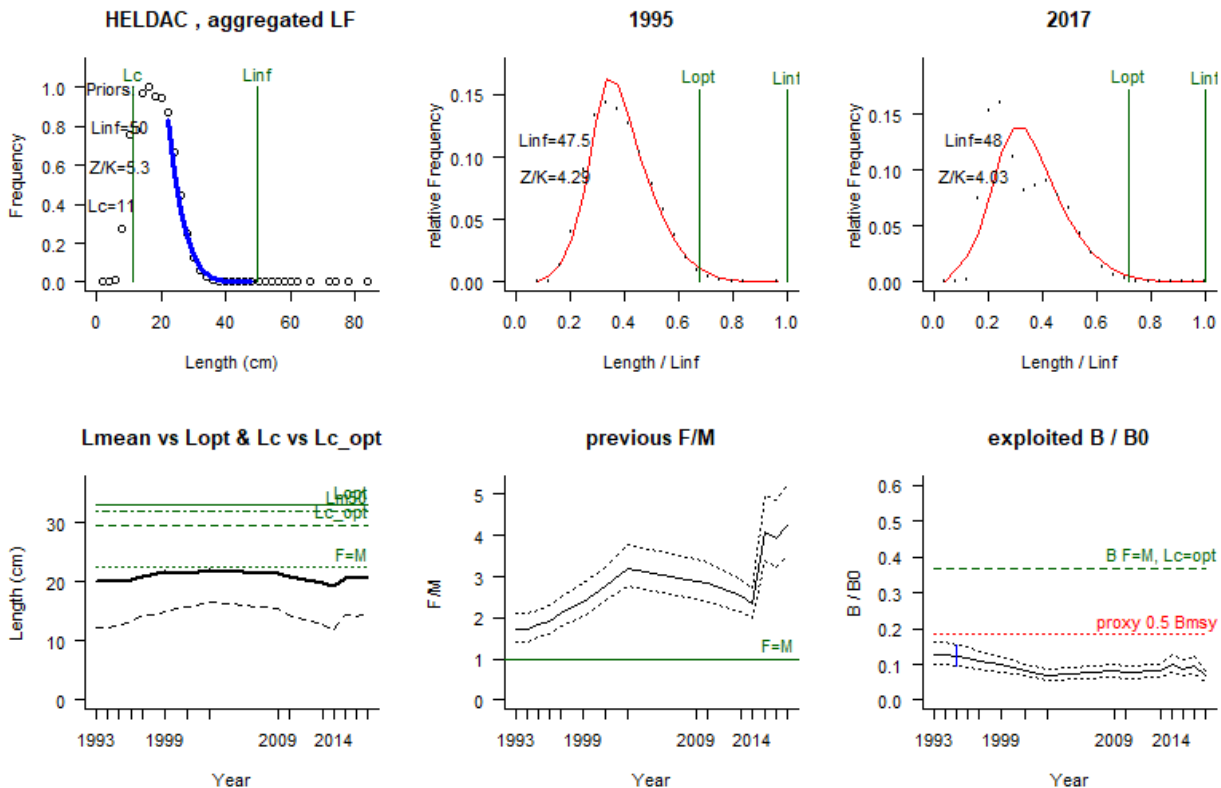
```
-----------------------------------------------------------------
AMSY Analysis, Fri Nov 01 20:01:47 2019
-----------------------------------------------------------------
Stock HELDAC, Helicolenus dactylopterus, Blackbelly rosefish
CPUE data for years 1987 - 2017, CPUE range 9705 - 14521, smooth = TRUE
Prior for r                    = Medium, 0.27 - 0.61
Used prior range for r         = 0.254 - 0.652
Prior for 1995 stock status    = Very small, 0.1 - 0.15
Used 1995 prior B/B0 range     = 0.1 - 0.15, prior B/Bmsy = 0.2 - 0.3
Used prior range for kq        = 171295 - 256942 [original range = 85647 -
128471]
Comment: B/B0 prior from LBB. RF: OK
Source:

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 5000

  Results:
  viable r-kq pairs   = 5000
  median kq           = 190329, 155676 - 231260
  median MSYq         = 22964, 16864 - 31517
  r (4 MSYq/kq)       = 0.483, 0.328 - 0.711
  Fmsy (r/2)          = 0.241, 0.164 - 0.355
  F/Fmsy              = 0.836, 0.0679 - 2.53 (2016)
  B/Bmsy              = 0.153, 0.0838 - 0.274 (2017)
```


(a) CPUE HELDAC

(b) Finding viable r-kq

(c) Analysis of viable r-kq

(d) Catch/MSY

(e) F/Fmsy

(f) B/Bmsy

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HELDAC

HELDAC

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------------------------------------------------------------------------
LBB results for Cymatoceps nasutus, stock PNSK, 2009-2009
Files:LBB4AMSY_ID_2.csv, LBBdatZA.csv
------------------------------------------------------------------------
Linf prior= 114, SD=1.1 cm Lmax=114, median Lmax=114
Z/K prior = 2, SD=3, M/K prior=1.5, SD=0.15
F/K prior = 0.517 (wide range with tau=4 in log-normal distribution)
Lc prior  = 50, SD=5 cm, alpha prior=10.5, SD=1, Lm50=53 cm

General reference points (median across years):
Linf      = 115 (113-116) cm
Lopt      = 86 cm, Lopt/Linf=0.75
Lc_opt    = 78 cm, Lc_opt/Linf=0.68, Lmean if F=M 86.8 cm
M/K       = 0.985 (0.763-1.25)
F/M       = 2.35 (1.58-3.55), F/K=2.31 (1.98-2.9), Z/K=3.32 (2.97-3.82)
B/B0      = 0.2 (0.11-0.32), B/B0 F=M Lc=Lc_opt 0.39
Y/R'      = 0.072 (0.042-0.12)(reduced: B/B0<0.25),Y/R' F=M Lc=Lc_opt 0.079

Estimates for 2009 (mean of last 3 years with data):
Lc50      = 72.8 (71.4-74.3) cm, Lc/Linf=0.63 (0.62-0.65)
Lc95      = 100, alpha=0.107 (0.103-0.109)
Lmean/Lopt= 0.96, Lc/Lc_opt=0.94, L95th=108 cm, L95th/Linf=0.94, Mature=89%
F/M       = 2.4 (1.6-3.6), F/K=2.3 (2-2.9), Z/K=3.3 (3-3.8)
Y/R'      = 0.072 (0.042-0.12)(reduced because B/B0 < 0.25)
B/B0      = 0.2 (0.11-0.32), best LF fit year 2009=0.196 (0.11-0.32)
B/Bmsy    = 0.5 (0.29-0.82)
```
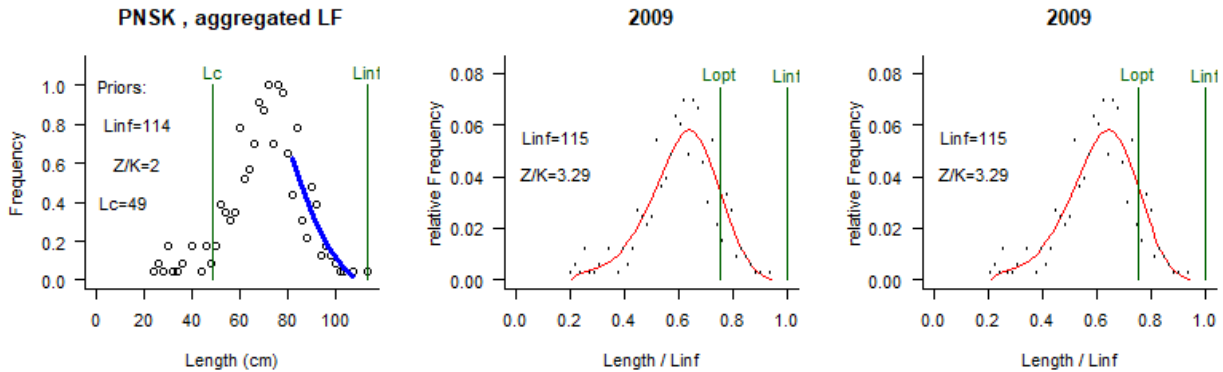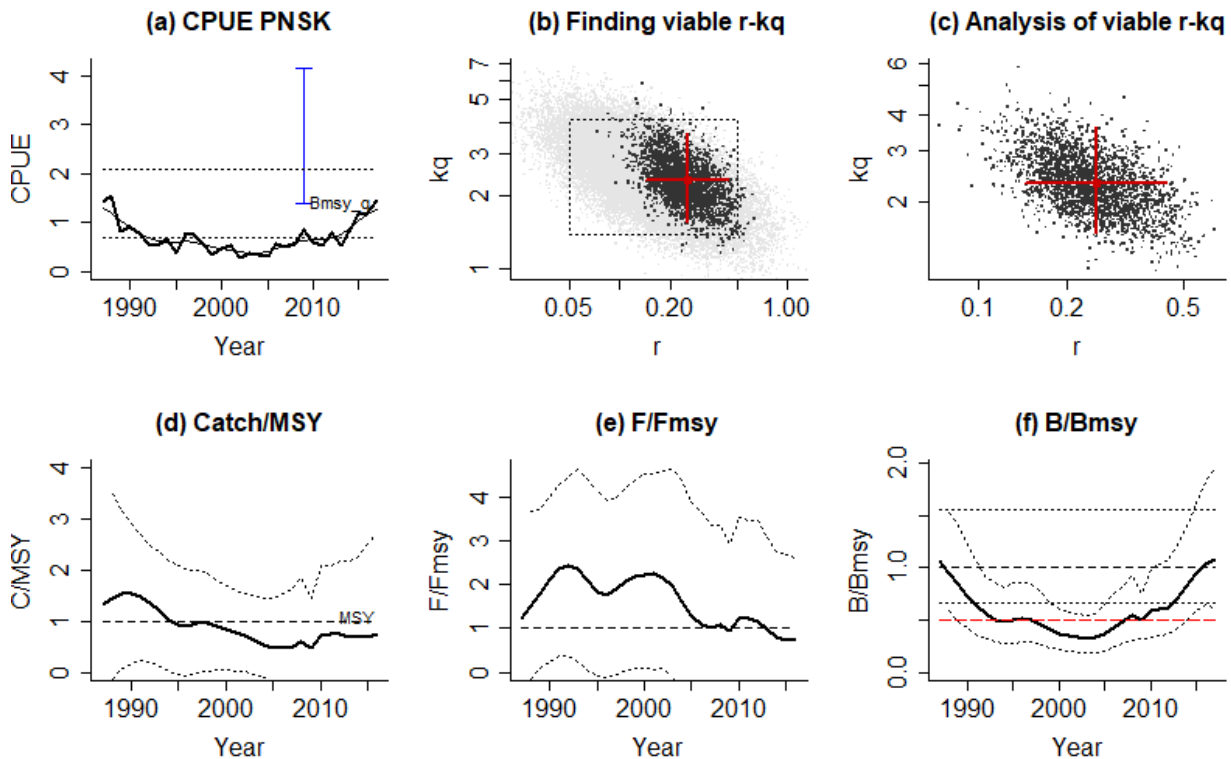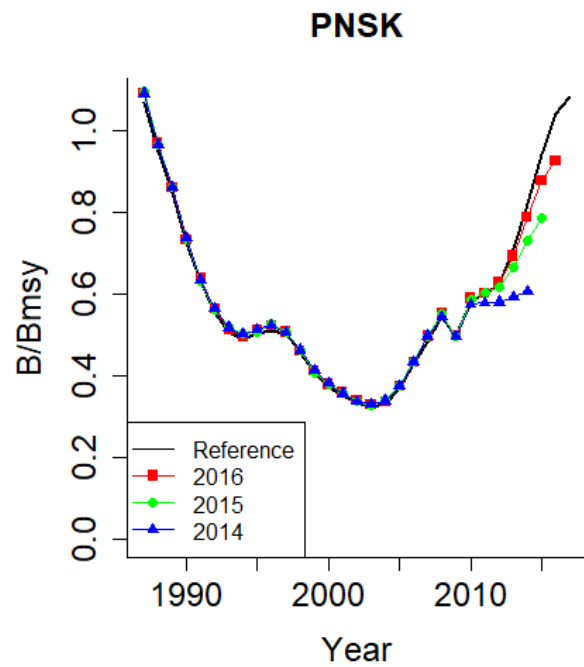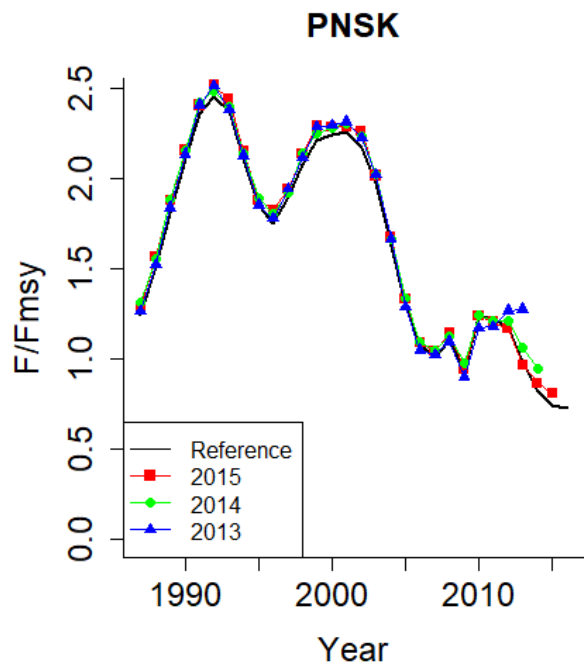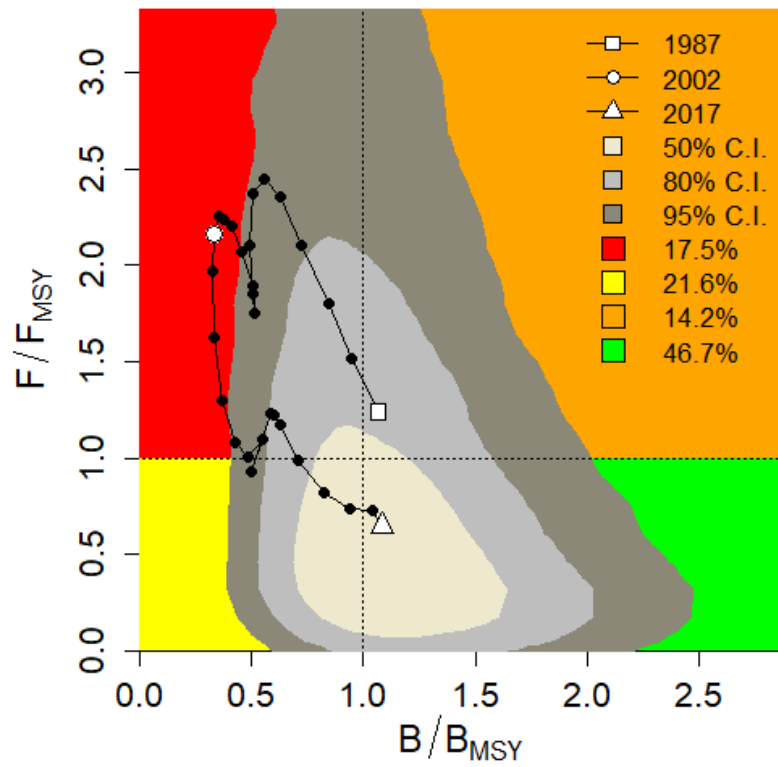
```
-----------------------------------------------------------------
AMSY Analysis, Fri Nov 01 20:09:39 2019
-----------------------------------------------------------------
Stock PNSK, Cymatoceps nasutus, Black musselcracker
CPUE data for years 1987 - 2017, CPUE range 0.374 - 1.29, smooth = TRUE
Prior for r                  = Low, NA - NA
Used prior range for r       = 0.05 - 0.5
Prior for 2009 stock status  = Small, 0.11 - 0.34
Used 2009 prior B/B0 range   = 0.11 - 0.34, prior B/Bmsy = 0.22 - 0.68
Used prior range for kq      = 1.38 - 4.15 [original range = 1.38 - 4.28]
Comment: B/B0 prior from LBB for 2009 (landing observer programm)
Source:

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 5000

  Results:
  viable r-kq pairs   = 5000
  median kq           = 2.33, 1.56 - 3.61
  median MSYq         = 0.148, 0.0889 - 0.247
  r (4 MSYq/kq)       = 0.254, 0.144 - 0.438
  Fmsy (r/2)          = 0.127, 0.0719 - 0.219
  F/Fmsy              = 0.727, -0.246 - 2.62 (2016)
  B/Bmsy              = 1.08, 0.598 - 1.95 (2017)
```


(a) CPUE PNSK
(b) Finding viable r-kq
(c) Analysis of viable r-kq
(d) Catch/MSY
(e) F/Fmsy
(f) B/Bmsy

PNSK

PNSK

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--------------------------------------------------------------------------
LBB results for Argyrosomus thorpei, stock STKB1, 2008-2008
Files:LBB4AMSY_ID_2.csv, LBBdatZA.csv
--------------------------------------------------------------------------
Linf prior= 81.6, SD=0.82 cm Lmax=106, median Lmax=68
Z/K prior = 1.9, SD=11, M/K prior=1.5, SD=0.15
F/K prior = 0.401 (wide range with tau=4 in log-normal distribution)
Lc prior  = 43.9, SD=4.4 cm, alpha prior=20.1, SD=2, Lm50=33 cm

General reference points (median across years):
Linf      = 82.1 (80.3-83.6) cm
Lopt      = 55 cm, Lopt/Linf=0.68
Lc_opt    = 52 cm, Lc_opt/Linf=0.64, Lmean if F=M 53.4 cm
M/K       = 1.44 (1.12-1.74)
F/M       = 4.67 (3.63-6.18), F/K=6.67 (5.99-7.49), Z/K=8.09 (7.36-8.99)
B/B0      = 0.083 (0.055-0.12), B/B0 F=M Lc=Lc_opt 0.37
Y/R'      = 0.017 (0.011-0.024)(reduced: B/B0<0.25),Y/R' F=M Lc=Lc_opt 0.048

Estimates for 2008 (mean of last 3 years with data):
Lc50      = 43.5 (42.9-43.9) cm, Lc/Linf=0.53 (0.52-0.54)
Lc95      = 54.5, alpha=0.268 (0.259-0.278)
Lmean/Lopt= 0.88, Lc/Lc_opt=0.83, L95th=68 cm, L95th/Linf=0.83, Mature=100%
F/M       = 4.7 (3.6-6.2), F/K=6.7 (6-7.5), Z/K=8.1 (7.4-9)
Y/R'      = 0.017 (0.011-0.024)(reduced because B/B0 < 0.25)
B/B0      = 0.083 (0.055-0.12), best LF fit year 2008=0.0826 (0.055-0.12)
B/Bmsy    = 0.22 (0.15-0.32)
Fixed Linf to mean between Linf (too low) and Lmax
```
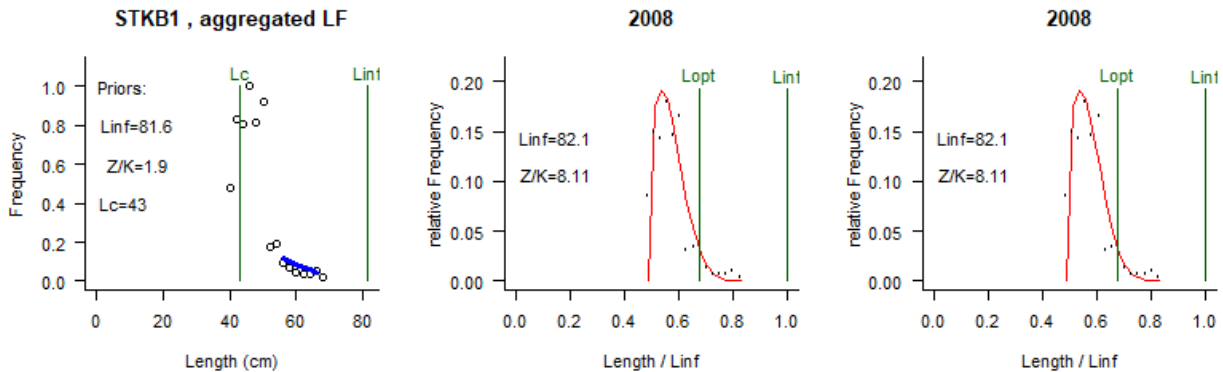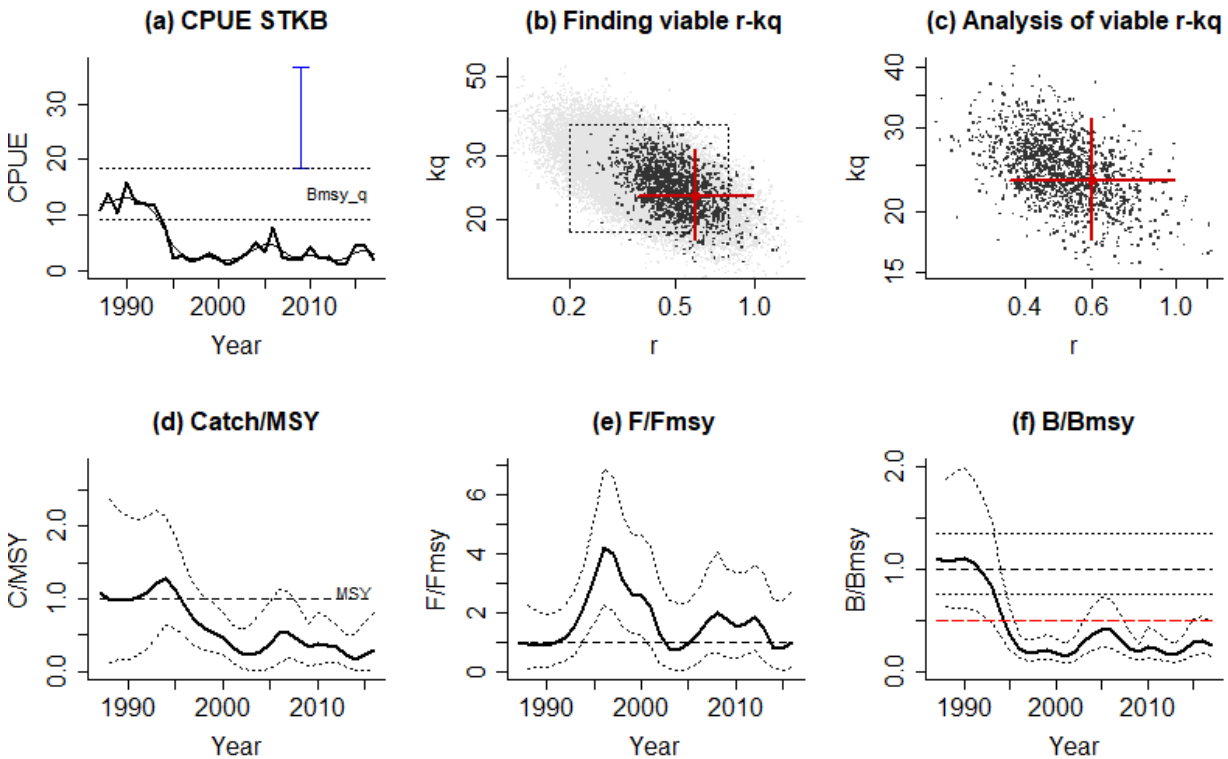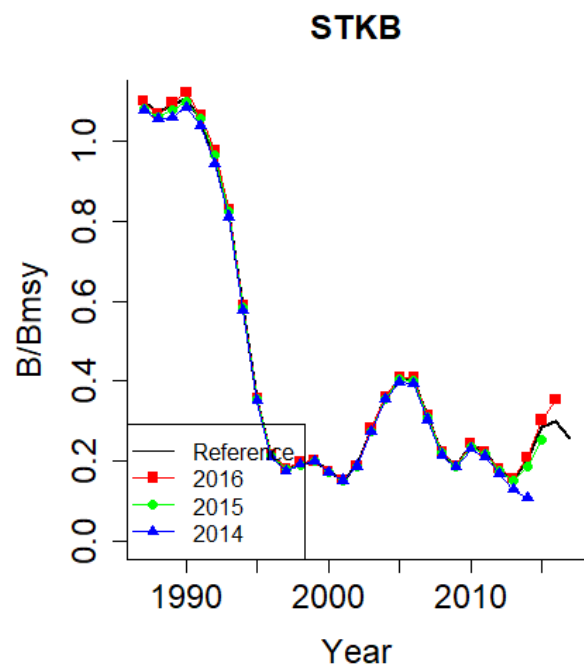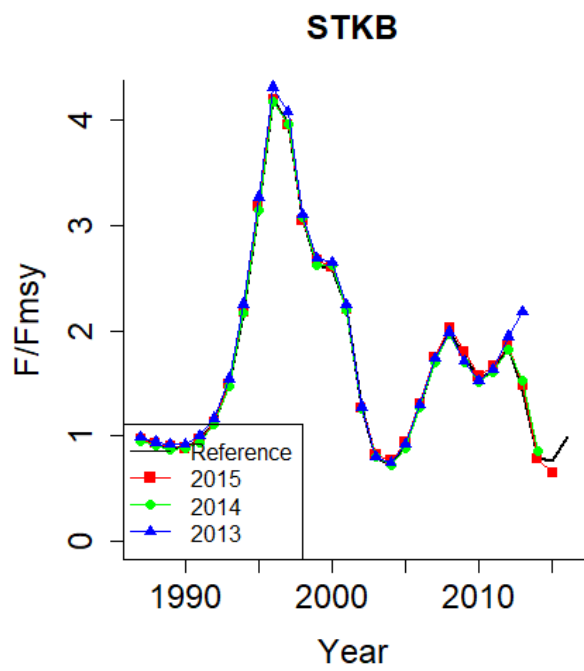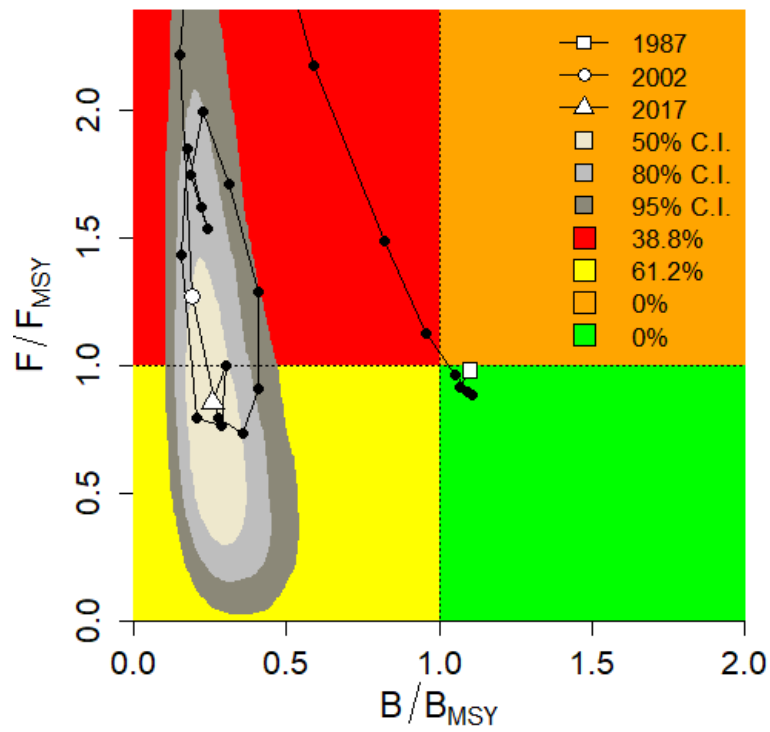

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------------------------------------------------------------------
AMSY Analysis, Fri Nov 01 20:14:58 2019
------------------------------------------------------------------
Stock STKB, Argyrosomus thorpei, Squaretail kob
CPUE data for years 1987 - 2017, CPUE range 1.73 - 13.2, smooth = TRUE
Prior for r                   = Medium, NA - NA
Used prior range for r        = 0.2 - 0.8
Prior for 2009 stock status   = Very small, 0.06 - 0.12
Used 2009 prior B/B0 range    = 0.06 - 0.12, prior B/Bmsy = 0.12 - 0.24
Used prior range for kq       = 18.4 - 36.7 [original range = 18.4 - 36.7]
Comment: B/B0 prior from LBB for 2009 (landing observer programm)
Source:

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 5000

 Results:
 viable r-kq pairs    = 5000
 median kq            = 23.2, 17.5 - 31.2
 median MSYq          = 3.48, 2.22 - 5.66
 r (4 MSYq/kq)        = 0.601, 0.363 - 0.988
 Fmsy (r/2)           = 0.301, 0.182 - 0.494
 F/Fmsy               = 0.996, 0.122 - 2.7 (2016)
 B/Bmsy               = 0.258, 0.146 - 0.465 (2017)
)
```


(a) CPUE STKB **(b) Finding viable r-kq** **(c) Analysis of viable r-kq**

(d) Catch/MSY **(e) F/Fmsy** **(f) B/Bmsy**

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STKB

STKB

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--------------------------------------------------------------------
LBB results for Raja straeleni, stock TBSK, 2007-2017
Files:LBB4AMSY_ID_ZAdem_AMSY.csv, LBBdatZAdem_AMSY.csv
--------------------------------------------------------------------
Linf prior= 83.9, SD=0.84 cm Lmax=94, median Lmax=84
Z/K prior = 3.2, SD=1.9, M/K prior=1.5, SD=0.15
F/K prior = 1.73 (wide range with tau=4 in log-normal distribution)
Lc prior  = 26.5, SD=2.7 cm, alpha prior=25.6, SD=2.6, Lm50=NA cm

General reference points (median across years):
Linf     = 81.6 (80-83.1) cm
Lopt     = 56 cm, Lopt/Linf=0.69
Lc_opt   = 49 cm, Lc_opt/Linf=0.6, Lmean if F=M 44.9 cm
M/K      = 1.36 (1.14-1.72)
F/M      = 1.62 (1.26-2.46), F/K=2.13 (1.76-2.45), Z/K=3.46 (3.22-3.67)
B/B0     = 0.17 (0.094-0.24), B/B0 F=M Lc=Lc_opt 0.37
Y/R'     = 0.031 (0.017-0.042)(reduced: B/B0<0.25),Y/R' F=M Lc=Lc_opt 0.053

Estimates for 2017 (mean of last 3 years with data):
Lc50     = 33.3 (32.8-33.9) cm, Lc/Linf=0.41 (0.4-0.41)
Lc95     = 45.6, alpha=0.239 (0.231-0.249)
Lmean/Lopt= 0.75, Lc/Lc_opt=0.68, L95th=62.7 cm, L95th/Linf=0.77, Mature=NA%
F/M      = 3 (2.2-4.4), F/K=3.8 (3.3-4.2), Z/K=5.1 (4.7-5.5)
Y/R'     = 0.019 (0.013-0.029)(reduced because B/B0 < 0.25)
B/B0     = 0.11 (0.073-0.16), best LF fit year 2017=0.108 (0.073-0.16)
B/Bmsy   = 0.29 (0.2-0.42), selected B/B0 2014 = 0.21 (0.12-0.3)
Trawl Survey data; sharks and rays more consistently measured in chosen recent
period from 2007 onward. RF selected 2014 because of good fit and reasonable
B/B0 compared to adjacent estimates.
```
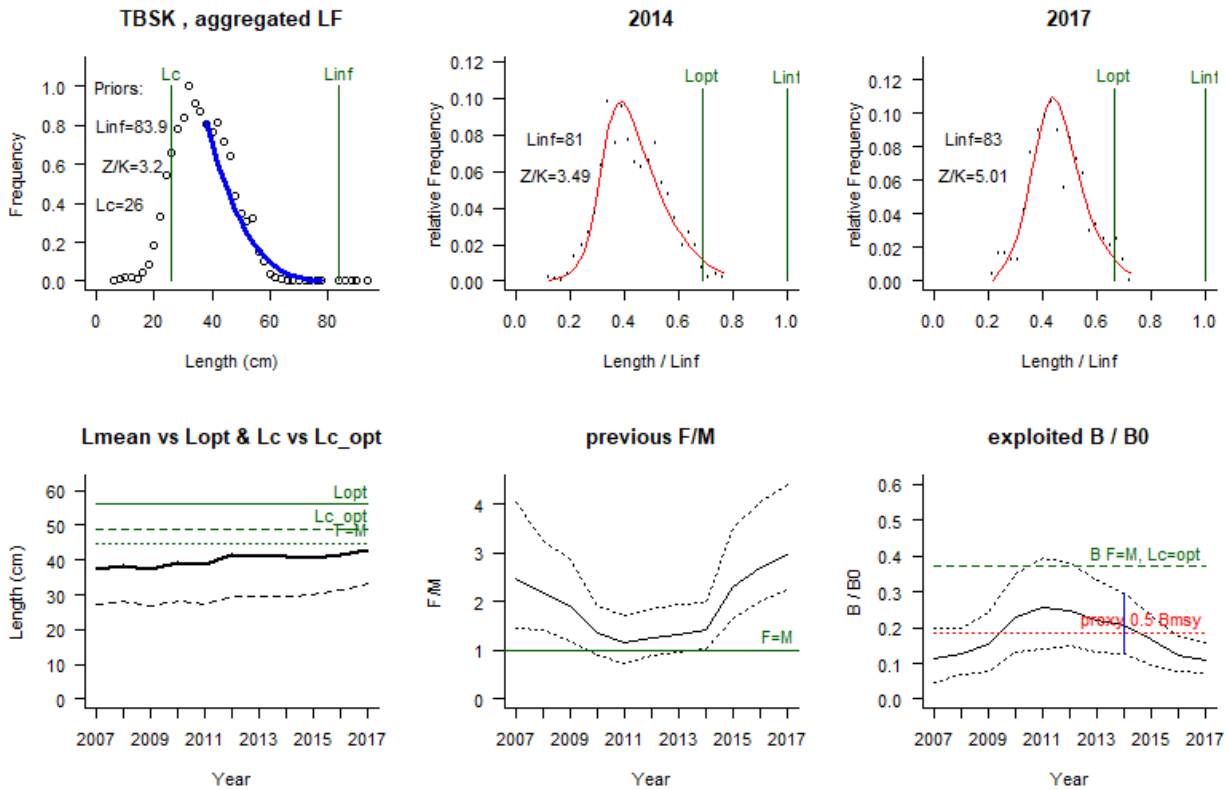

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------------------------------------------------------------
AMSY Analysis, Fri Nov 01 20:18:57 2019
------------------------------------------------------------
Stock TBSK, Raja straeleni, Biscuit skate
CPUE data for years 1991 - 2017, CPUE range 15383 - 21126, smooth = TRUE
Prior for r                   = Low, NA - NA
Used prior range for r        = 0.05 - 0.5
Prior for 2014 stock status   = Small, 0.12 - 0.3
Used 2014 prior B/B0 range    = 0.12 - 0.3, prior B/Bmsy = 0.24 - 0.6
Used prior range for kq       = 86428 - 129642 [original range = 43214 -
108035]
Comment: B/B0 prior from LBB. RF: OK
Source:

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 5003

 Results:
 viable r-kq pairs    = 5003
 median kq            = 101005, 86440 - 118314
 median MSYq          = 6243, 3326 - 10390
 r (4 MSYq/kq)        = 0.247, 0.126 - 0.424
 Fmsy (r/2)           = 0.124, 0.0628 - 0.212
 F/Fmsy               = 1.6, -0.409 - 4.78 (2016)
 B/Bmsy               = 0.305, 0.168 - 0.555 (2017)
```

TBSK

TBSK
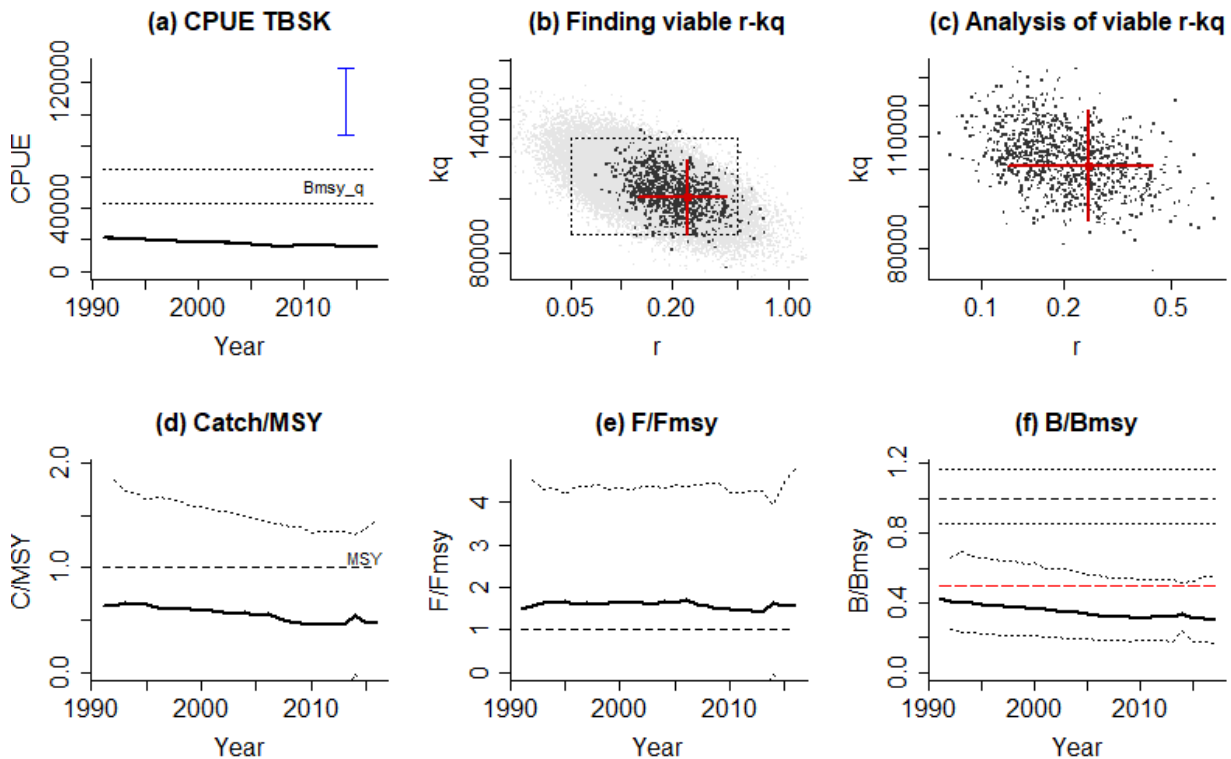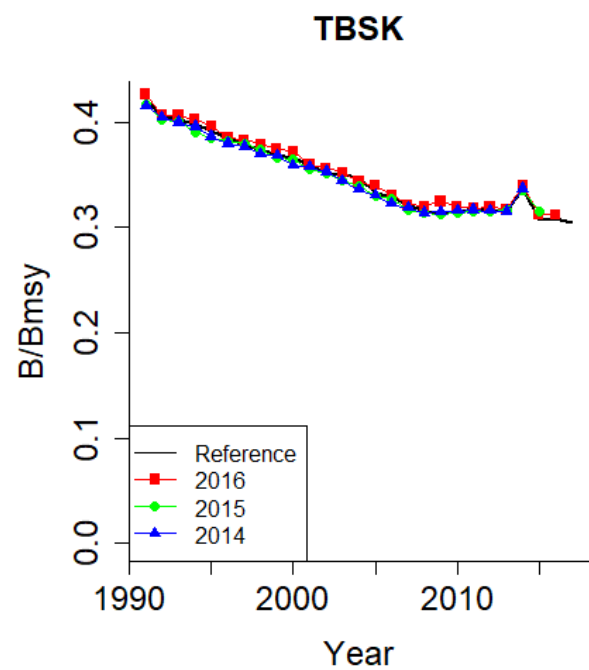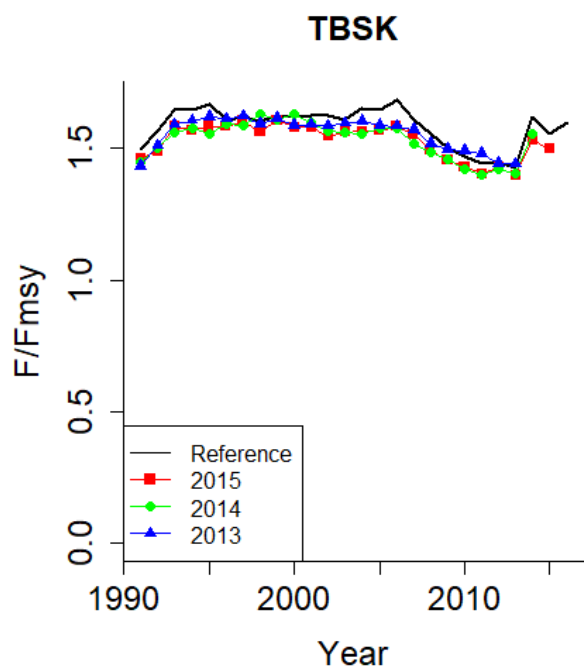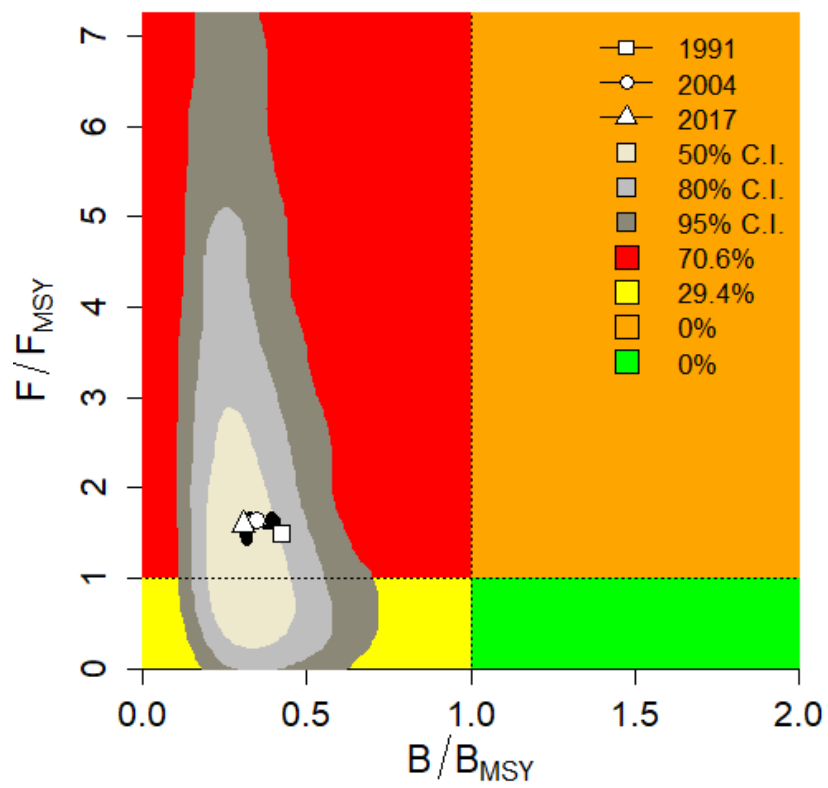
LBB results for *Rhabdosargus globiceps*, stock **WSTM**, 1987-2007
Files:LBB4AMSY_ID_ZAdem_AMSY.csv, LBBdatZAdem_AMSY.csv

Linf prior= 51, SD=0.51 cm Lmax=58, median Lmax=48
Z/K prior = 3, SD=0.68, M/K prior=1.45, SD=0.075(user-defined)
F/K prior = 1.58 (wide range with tau=4 in log-normal distribution)
Lc prior = 25.5, SD=2.6 cm, alpha prior=22.8, SD=2.3, Lm50=NA cm

General reference points (median across years):
Linf   = 51 (50.3-51.6) cm
Lopt   = 35 cm, Lopt/Linf=0.69
Lc_opt   = 30 cm, Lc_opt/Linf=0.6, Lmean if F=M 33.8 cm
M/K   = 1.37 (1.21-1.49)
F/M   = 1.58 (1.3-1.96), F/K=2.18 (1.86-2.47), Z/K=3.55 (3.26-3.83)
B/B0   = 0.24 (0.18-0.31), B/B0 F=M Lc=Lc_opt 0.37
Y/R'   = 0.049 (0.035-0.062)(reduced: B/B0<0.25),Y/R' F=M Lc=Lc_opt 0.052

Estimates for 2007 (mean of last 3 years with data):
Lc50   = 26.2 (25.9-26.5) cm, Lc/Linf=0.52 (0.52-0.53)
Lc95   = 33.1, alpha=0.426 (0.416-0.438)
Lmean/Lopt= 0.92, Lc/Lc_opt=0.86, L95th=46.7 cm, L95th/Linf=0.93, Mature=NA%
F/M   = 0.97 (0.75-1.3), F/K=1.3 (1-1.5), Z/K=2.5 (2.3-2.8)
Y/R'   = 0.055 (0.037-0.078)(reduced because B/B0 < 0.25)
B/B0   = 0.38 (0.25-0.55), best LF fit year 2007=0.382 (0.25-0.55)
B/Bmsy   = 1 (0.68-1.5), **selected B/B0 2004 = 0.3 (0.21-0.4)**
Trawl Survey data; excluded unsuitable LF data; only first period covered. RF
selected 2004 because of good fit and reasonable B/B0 compared to adjacent
estimates.
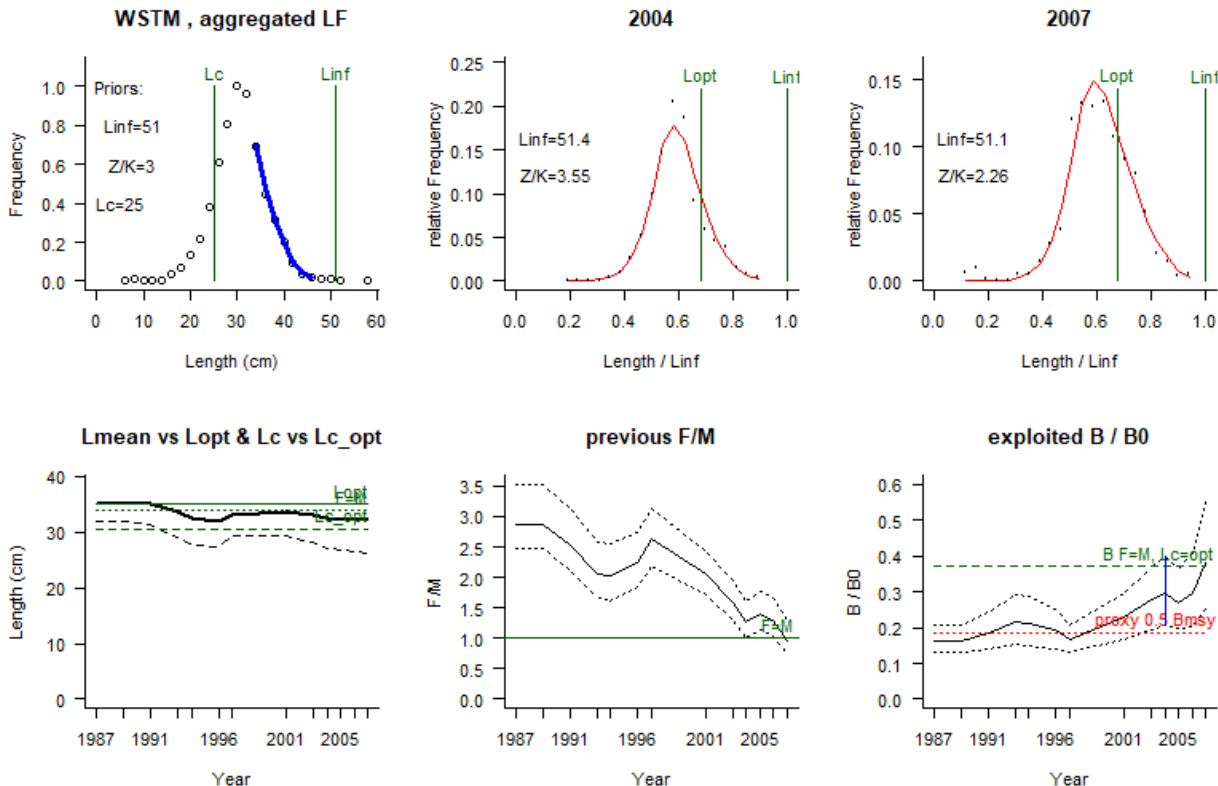
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----------------------------------------------------------------
AMSY Analysis, Fri Nov 01 20:22:08 2019
----------------------------------------------------------------
Stock WSTM, Rhabdosargus globiceps, White stumpnose
CPUE data for years 1987 - 2016, CPUE range 1500 - 3844, smooth = TRUE
Prior for r                  = Medium, NA - NA
Used prior range for r       = 0.2 - 0.8
Prior for 2004 stock status  = Small, 0.21 - 0.4
Used 2004 prior B/B0 range    = 0.21 - 0.4, prior B/Bmsy = 0.42 - 0.8
Used prior range for kq      = 5603 - 10672 [original range = 5603 - 10672]
Comment: B/B0 prior from LBB. RF: OK
Source:

Monte Carlo filtering of r-kq space with 50000 points and 30 error patterns.
Viable r-kq pairs = 5009

  Results:
  viable r-kq pairs   = 5009
  median kq           = 7437, 5532 - 9572
  median MSYq         = 899, 572 - 1419
  r (4 MSYq/kq)       = 0.484, 0.293 - 0.806
  Fmsy (r/2)          = 0.242, 0.146 - 0.403
  F/Fmsy              = 0.887, 0.106 - 2.03 (2015)
  B/Bmsy              = 1.03, 0.572 - 1.85 (2016)
```


(a) CPUE WSTM (b) Finding viable r-kq (c) Analysis of viable r-kq (d) Catch/MSY (e) F/Fmsy (f) B/Bmsy

WSTM

WSTM