Assessments of 48 simulated and 159 real stocks with a Monte Carlo and Bayesian Implementation of a Surplus Production Model

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Introduction

This Supplement details the results of applying a Monte Carlo algorithm (CMSY) and a Bayesian state-space implementation of the Schaefer surplus production model (BSM) to 48 simulated and 159 real stocks. The respective R-code and the data files are available as online material. The selection of the real stocks, the generation of the simulated stocks, and the settings used in the CMSY analysis are detailed below. The graphical output of the CMSY and BSM analyses is explained in general before the results are presented in summary tables and in detail in Appendices I to IV.

Material and Methods

Table S1 contains the names and a short description of the content of the files that were used in the context of this study. All files are available for download at http://oceanrep.geomar.de/33076/.

Table S1. List of files that were used in the context of this study, with indication of file name and description of content.

File name	Content
AllStocks_ID20.csv	Stock descriptions, priors, official reference points
AllStocks_Catch16.csv	Time series of catch and biomass or CPUE
AllStocksResults_6.xlsx	Spreadsheet behind the results in Table S5 and S6
CMSY_45y.R	R-code implementing CMSY and BSM for simulated stocks
CMSY_46e.R	R-code implementing CMSY and BSM for real stocks
CMSY_46eFig1.R	R-code used to create Figure 1 in the main text
CMSY_46eFig2.R	R-code used to create Figure 2 in the main text
CMSY_46eFig3.R	R-code used to create Figure 3 in the main text
CMSY_46eFig4.R	R-code used to create Figure 4 in the main text
CMSY_46eFig5-6.R	R-code used to create Figures 5 and 6 in the main text
CPUEStocks_Results_6.xlsx	Spreadsheet behind the results in Table S9 and S10
SimCatch_6.csv	Time series of simulated catch and biomass
SimCatchResults_6.xlsx	Spreadsheet behind the results in Table S3 and S4
SimCatchCPUE_6.csv	Time series of simulated catch and CPUE
SimCatchCPUE_Results_6.xlsx	Spreadsheet behind the results in Table S7 and S8
SimSpec_6.csv	Priors and "true" parameters for simulated stocks with biomass
SimSpecCPUE_6.csv	Priors, "true" parameters for simulated stocks with biomass and CPUE
SimCatchGenerator_6.xlsx	Spreadsheet with algorithm to create simulated stocks with biomass
SimCatchCPUEGenerator_6.xlsx	Spreadsheet with algorithm to create simulated stocks with CPUE

Selection of real stocks

Altogether 128 fully assessed stocks with biomass estimates, 29 data-limited stocks with CPUE data, and two stocks without abundance data were used for the evaluation of the CMSY method. Catch and biomass data were extracted from stock assessment documents that are available online or were provided by the respective assessment bodies. Sixty-two fully assessed stocks from the Northeast Atlantic were obtained from the ICES Stock Summary database and from ICES Advice reports published in 2015 at http://ices.dk. U.S.-managed stocks from the East Pacific and West Atlantic had assessment reports with catch and total biomass estimates available online and were included in the analysis (AFSC 2011; 2012; www.st.nmfs.noaa.gov/sisPortal/sisPortalMain.jsp). Data for six stocks were obtained from working group reports for the Mediterranean and Black Sea (FAO-GFCM, ICES 2014c; JRC 2012). Data for fifteen stocks from the Pacific Ocean were found (BillfishWG–ISC, ISC 2015; www.st.nmfs.noaa.gov/sisPortal/sisPortalMain.jsp) and nine stocks from South Africa (Winker *et al.,* 2012; ICCAT 2015) were made available and included in the analysis. Catch and CPUE for data-limited stocks from the Northeast Atlantic were obtained from ICES advice reports and from the WKLIFE IV workshop held on 27-31 October 2014 in Lisbon, Portugal (ICES 2014a). Files containing the time series data for these stocks and the respective meta-data and priors are available as part of the online material (see Table S1).

Generation of simulated stocks

In order to compare parameter estimates of CMSY and BSM with "true" values, stocks with catch and biomass or catch and CPUE were simulated with a time range of 50 years and a fixed *k* value of 1000. The values for *r* were drawn randomly from a normal distribution with mean and standard deviation as shown in Table S2. A parameter estimate was considered as "good" if it contained the respective "true" value within its confidence limits (Hedderich and Sachs 2015).

Table S2. Means and standard deviations used for generating normal distributions from which *r* values were selected randomly for use in simulations.

Resilience	*r* range	mean	sd
High	0.6 – 1.5	1.05	0.15
Medium	0.2 – 0.8	0.5	0.1
Low	0.05 – 0.5	0.275	0.075
Very **L**ow	0.015 – 0.1	0.0575	0.0142

The goal was to create a range of biomass scenarios, including strongly as well as lightly depleted stocks, with monotone stable or monotone changing (i.e., steadily decreasing or increasing) or with alternating biomass trajectories: patterns of high-high (HH), high-low (HL), high-low-high (HLH), low-low (LL), low-high (LH), and low-high-low (LHL) biomass trends. Simulated stocks have names that indicate the combination of biomass trajectory and intrinsic growth rate, e.g., HH_L signifies a stock

with monotone high biomass and low resilience. Resilience categories were translated into r ranges as shown in Table S2. The biomass trajectories were created by using the fixed k value, a randomly selected r value (see Table S2), and an initial biomass. The biomass in subsequent years was then generated from a Schaefer model according to Equation S1.

$$B_{t+1} = B_t + r \left(1 - \frac{B_t}{k}\right) B_t \, e^{s_1} - C_t \, e^{s_2} \qquad\qquad (S1)$$

where B_{t+1} is the exploited biomass in the year $t+1$, B_t is the biomass in the current year t, C_t is the catch in year t, and e^{s1} and e^{s2} are bias-corrected lognormal errors. Note that the error term s_1 was assigned to the estimation of the surplus production, i.e., to the interaction process of B_t, r and k, and the second error term s_2 was assigned to the catch, representing observation error for the purpose of creating simulated data and for the purpose of CMSY analysis, where abundance is not observed.

If biomass falls below 0.25 k, a linear decline in recruitment towards zero at zero k is assumed and a respective multiplier 4 B_t/k resulting in 1 at 0.25 k to zero at zero k is applied to the surplus production term as shown in Equation S2.

$$B_{t+1} = B_t + 4\frac{B_t}{k} r \left(1 - \frac{B_t}{k}\right) B_t \, e^{s_1} - C_t \, e^{s_2} \qquad\qquad (S2)$$

This consideration of reduced recruitment at low biomass is visible in the indented equilibrium curve at low biomass in Figure 1. It makes the simulated data more realistic and also fixes a bias in CMSY, which otherwise would assume average productivity at severely depleted stock sizes with reduced recruitment and would consequently overestimate surplus production in such cases.

The desired simulated biomass patterns were achieved by manually setting a time series of F/F_{msy} values, with error terms set initially to zero. Once the desired pattern was achieved, the standard deviation of the process error was set to 0.2 and of the observation error to 0.1. To avoid subjectivity, the first time series of catch and biomass produced by the random process and observation errors was selected for analysis, even if it was not a good representation of the intended biomass pattern. The time series and the corresponding parameters were then stored for processing by CMSY and BSM.

For the generation of simulated data for data-limited stocks where only catch and CPUE are available, the simulated catch and biomass data described above were used as a starting point to

generate the corresponding CPUE data. A random catchability coefficient q was drawn from a normal distribution with a mean of 10^{-5} and a standard deviation of $2*10^{-6}$ (CV = 20%). A simulated value of CPUE was then obtained by multiplying the simulated biomass with the random deviate for q. Biomass predictions of CMSY and BSM were compared against the "true" simulated biomass. The routines for generating the simulated data are part of the supplementary material (see file names in Table S1).

Default rules for biomass priors

The priors for biomass as needed by CMSY and BSM are best set by experts. However, for the purpose of comparing CMSY with BSM predictions, we needed to analyze stocks for which no such expert knowledge was available to us. We therefore established generic rules for the setting of biomass priors, based on general knowledge about fisheries. These rules worked reasonably well for North Atlantic stocks but less satisfactory for Alaska with many very lightly exploited stocks. The rules are explained in detail below.

General settings

The rules for setting prior biomass ranges are mostly derived from patterns in the catch, i.e., the timing and ratio of minimum catch to maximum catch, following the approach of Froese and Kesner-Reyes 2002 (see also Froese et al. 2012, 2013). To reduce the influence of extremes, catch data are smoothed by applying a 3-years moving average.

Rules for the initial prior biomass range

If the time series of catch data starts before 1960, high initial biomass (0.5 – 0.9 k) is assumed, because most fisheries were either still recovering or starting anew after World War II. In all other cases medium initial biomass (0.2 – 0.6 k) is assumed.

Rules for the intermediate prior biomass range

For the setting of the intermediate biomass range, the years and amounts of minimum and maximum catch are determined. Cases where minimum or maximum catch fall within 3 years of the beginning or the end of the time series are ignored, as it is deemed to make little sense to set intermediate prior biomass so close to start or end biomass. Instead, the next closest values were used for minimum and maximum catch.

The following rules for the intermediate prior biomass range are applied in priority of sequence.
   1. If overall contrast in catch data is low (overall min catch / overall max catch > 0.6), the intermediate year is set to the mid of the time series and biomass is assumed to be the same as the initial prior biomass.

2. If the minimum catch occurs after the maximum catch, the year before the minimum catch is used to set the intermediate prior biomass.
   a. If initial prior biomass is high and the minimum catch occurs in the first half of the time series and the difference between min and max catch is moderate (min catch / max catch > 0.3) then the intermediate prior biomass range is set to medium.
   b. Else the intermediate prior biomass range is set to low (0.01 – 0.4 k).
3. If the minimum catch occurs before the maximum catch, the year before the maximum catch is used as intermediate year.
   a. If initial prior biomass is high and the maximum catch occurs in the first half of the time series then the intermediate prior biomass range is set to high.
   b. If there is a steep increase in catches ((max catch - min catch) / max catch / (max year – min year) > 0.04), a developing or recovering fishery is assumed and the intermediate prior biomass range is set to high.
   c. Else the intermediate prior biomass range is set to medium.

Rules for the final prior biomass range

1. If the last catch is high relative to overall maximum catch (last catch / overall max catch > 0.7) the final prior biomass range is set to high.
2. If the last catch is low relative to overall maximum catch (last catch / overall max catch < 0.3) then the final prior biomass range is set to low.
3. Else, the final prior biomass range is set to medium.

CMSY analysis

CMSY input data are read from two files, one file containing the time series of catch and abundance (optional), with four columns with mandatory labels for stock identifier (stock), year (yr), catch (ct) and abundance (TB) and the second file containing information about the stock and the priors to be used for *r, k*, initial relative biomass, intermediate year and relative biomass, and final relative biomass. The variable "btype" is used to indicate the type of abundance data, e.g., "observed" or "simulated" biomass, or "CPUE". Note that biomass or CPUE are used only by BSM, so that results of CMSY can be compared with those of a full Bayesian Schaefer model; biomass and CPUE are not used by CMSY and can be completely omitted from the analysis, e.g. by setting "btype" to "None", in which case BSM analysis is omitted. For the real stocks, catch data and biomass or CPUE data are smoothed by applying a 3-year moving average. This is done to reduce the influence of extreme catches, which may be caused by extreme recruitment events, while surplus production models such as CMSY and BSM assume average productivity.

Prior ranges for *r* (see Table S2) and *k* are determined as described in the main text. To provide prior estimates of relative biomass at the beginning and end of the time series, and optionally also in an intermediate year, one of the possible three broad biomass ranges shown in Table 3 in the main text are chosen, depending on the assumed depletion level. Automatic selection of low, medium or high prior biomass ranges is based on the simple default rules described in the previous section. Obvious strong deviations from the rule-based priors are corrected manually in some of the real stocks. The use of default or expert corrected priors is indicated in the CMSY output. For the two sets of simulated stocks, with biomass or with biomass and CPUE, the prior ranges for first and final biomass are set according to the simulated scenario of low or high biomass at the beginning or the end of the simulated time series. The intermediate prior biomass range is fixed to year 25 and is set to high for HH, to medium for LHL, and set to low for all other scenarios.

The procedures for finding viable *r-k* pairs and the most probable values of *r*, *k*, *MSY* and predicted biomass are described in the main text.

BSM analysis

For the purpose of comparing CMSY results with the results of a regular surplus production model rather than against fisheries reference points derived with a variety of methods and often without indication of uncertainty, a Bayesian implementation of a state-space Schaefer model (BSM) was developed and applied to all simulated and real stocks. Other than CMSY, BSM fits a Schaefer model to catch and abundance data, i.e., to biomass or CPUE. Non-overlapping confidence limits between CMSY and BSM indicate significantly different estimates at the 95% level (Knezevic 2008; Hedderich and Sachs 2015). The respective source code is available as part of the online material (see Table S1).

Explanation of graphical CMSY and BSM output

The subsequent appendices show the results from CMSY and BSM runs against 48 simulated stocks and 159 real stocks. The graphical output produced by the R-code for simulated data is shown in Figure 1 for a case of high-low-high biomass of a simulated stock with medium resilience. The six individual panels of the graph are explained below.
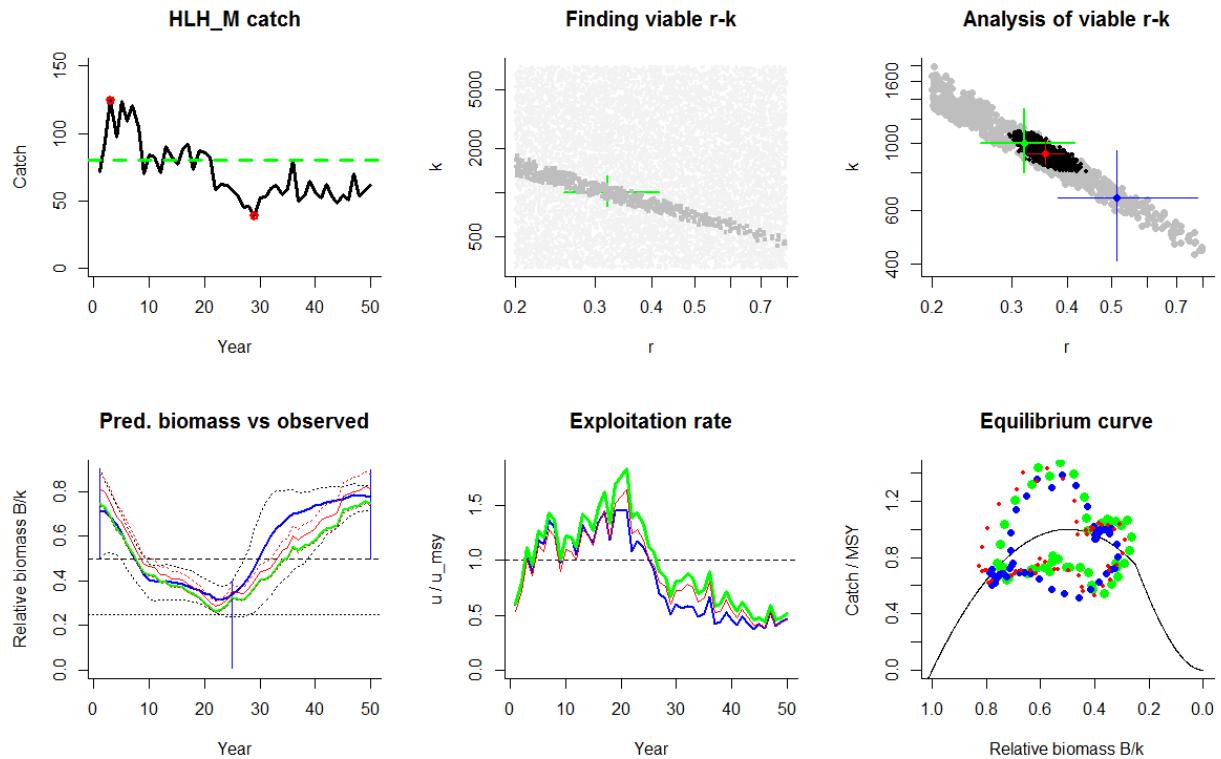
Figure 1. Example of the graphical CMSY-BSM output for a simulated stock with high-low-high biomass and medium resilience (HLH-M). See text for explanation of the panels.

The "HLH_M catch" panel indicates the name of the stock and shows the time series of catch data. The red circles indicated the highest and the lowest catch, respectively, and the dashed green line indicates the "true" value of MSY used in the simulation.

The "Finding viable *r-k*" panel shows the analyzed log-*r-k*-space, with viable *r-k* pairs in dark gray and a green cross indicating the "true" *r-k* pair with approximate confidence limits based on process and observation error as assumed in the simulation. While CMSY is executed, this graph shows progress by adding dots as viable *r-k* pairs are found.

The "Analysis of viable *r-k*" panel shows the result of the CMSY-analysis, with viable pairs in gray and the predicted most probable *r-k* pair in blue, with approximate 95% confidence limits. The black dots are viable pairs identified by the Bayesian implementation of the full Schaefer model (BSM), with the red dot showing the predicted most probably *r-k* pair, with 95% confidence limits. The green dot shows the true values of *r* and *k* as used in the simulation. Good performance of CMSY and BSM is indicated by the green confidence limits overlapping with the blue (CMSY) and red (BSM) ones, respectively.

The "Pred. biomass vs observed" panel shows in blue the median biomass trajectory predicted by CMSY, with 2.5th and 97.5th percentiles as dotted black lines. The green curve shows the simulated

"true" biomass trajectory, scaled by the "true" value of k. The red curves indicate biomass scaled by the BSM estimate of k, with approximate 95% confidence limits as dotted red curves. The Y-axis gives biomass relative to k, so the broken line at 0.5 k indicates B_{msy} and the dotted line at 0.25 k indicates the border to stock sizes that may result in reduced recruitment. The blue vertical lines show the prior biomass ranges set by the user or by prior rules. In the example of Figure 1, it was assumed that the user knew that the stock was in good status at the beginning and the end of the time series, and in bad status in-between, around year 25. Good performance of CMSY and BSM is indicated by the "true" green curve falling within the confidence limits of the black (CMSY) and the red (BSM) curves, respectively.

The "Exploitation rate" graph shows the time series of the catch/biomass ratio (u) relative to the ratio corresponding to MSY. The blue curve is the relative exploitation rate resulting from catch versus biomass predicted by CMSY. The red curve is the relative exploitation rate resulting from catch versus biomass scaled by the r-estimate of BSM. The "true" green curve relates simulated catch to simulated biomass. The dashed horizontal line indicates the maximum sustainable exploitation rate. Good performance of CMSY and BSM is indicated by close proximity of the blue and the red curves, respectively, to the "true" green curve.

The "Equilibrium curve" panel shows the Schaefer parabola with catch expressed relative to MSY on the Y-axis and decreasing biomass relative to k on the X-axis. The right side of the parabola is indented because below 0.25 k, a linear decline of surplus production due to reduced recruitment is assumed. Green dots show the "true" data points of simulated catch and biomass. Blue dots are predicted by the CMSY method and red dots are predicted by BSM. Dots falling on the parabola indicate catches that will maintain the respective biomass. Dots above the parabola will shrink future biomass; dots below the parabola allow future biomass to increase. Good performance of CMSY and BSM is indicated by the blue and red dots being close to the "true" green dots, respectively.

For real stocks, true parameter values are unknown and the parameter estimates of the Bayesian Schaefer model (BSM) are used instead as bench mark for CMSY. If observed biomass or CPUE are available, the graphical output looks as shown in Figure 2 for sole (*Solea solea*) in the Irish Sea. Note the better interpretation of yield at depleted biomass in Panel F, where the indented equilibrium curve suggests ongoing overfishing (red dots above curve). In this case CMSY still slightly overestimates surplus production in the final years, due mostly to the too optimistic final biomass prior. That reduced recruitment is occurring in the final years is indicated by the declining biomass (red curve), despite the exploitation rate being below the MSY level.
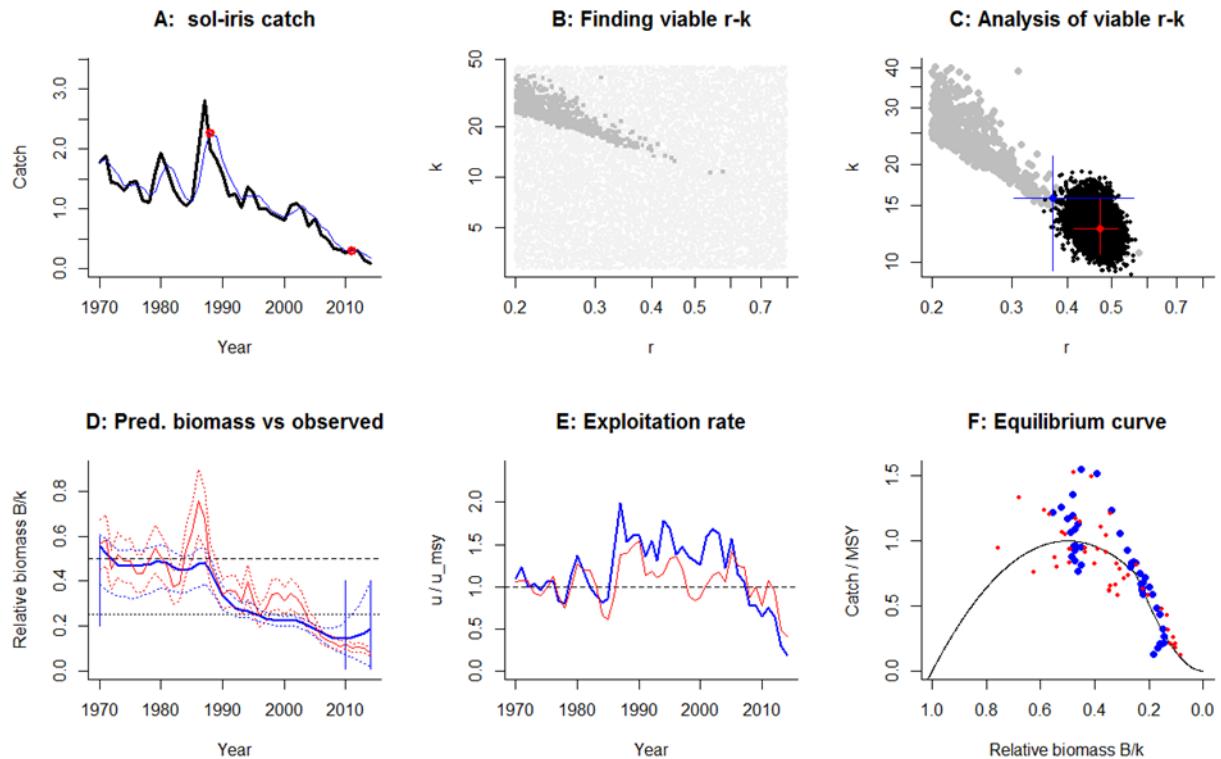
Figure 2. R-code graphical output for stocks for which biomass or CPUE data are available. The thin blue line in Panel A indicates mean catches of the past three years.

For data-limited stocks, an additional graphical output can be generated to support management decisions, as shown below for Baltic dab (*Limanda limanda*, dab-2232) (Figure 3).
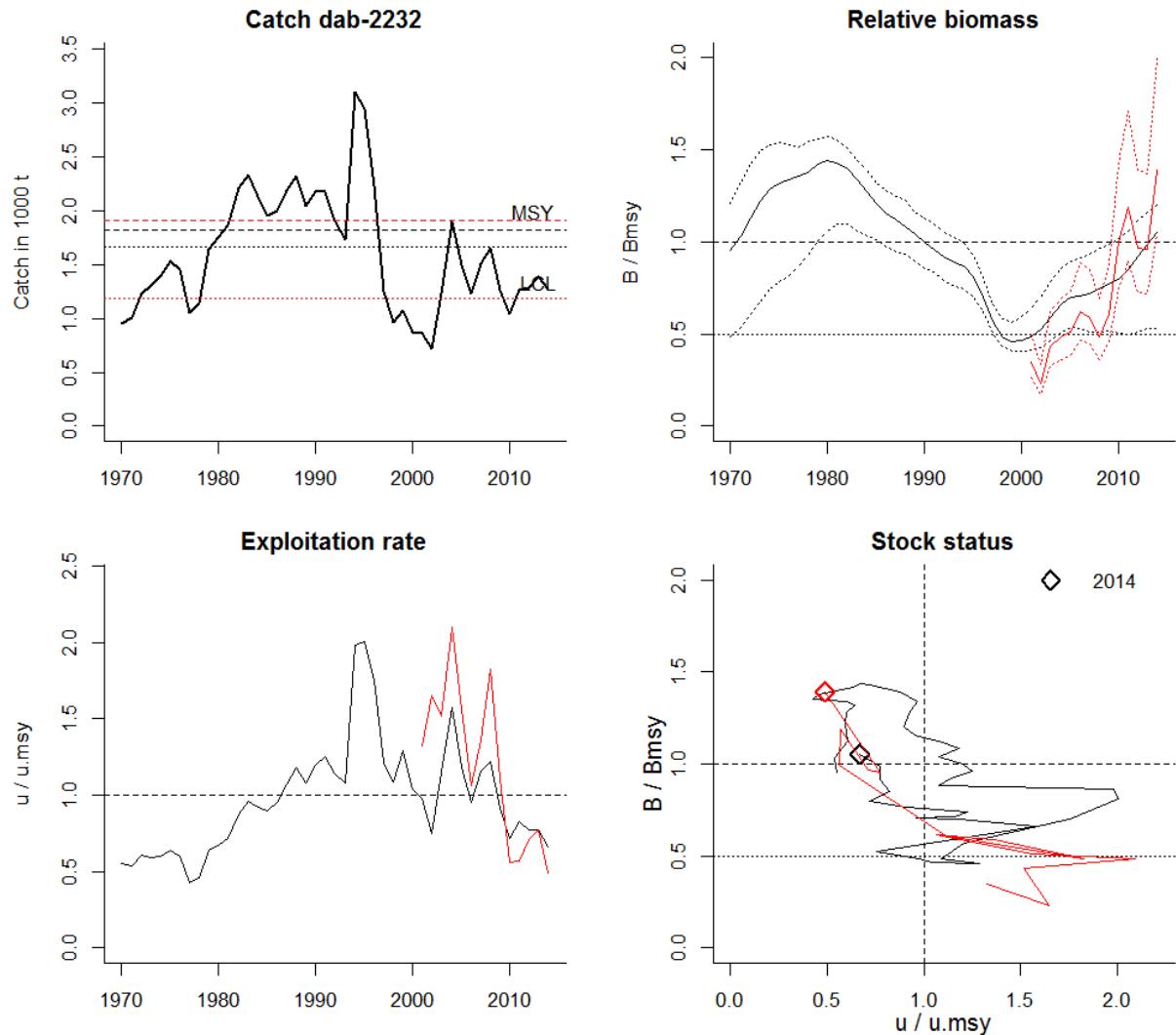
Figure 3. Summary of information relevant for management of Baltic dab (dab-2232), with black curves indicating CMSY results and red curves BSM results. The horizontal dashed lines in the Catch graph indicate *MSY* and the fine dotted line indicates the lower confidence limit of *MSY*. The solid curves in the Relative biomass graph indicate predicted biomass relative to B_{msy}, with confidence limits (dotted curves). Note that abundance time series data (here CPUE scaled to biomass, in red) can start later than the time series of catches. The Exploitation rate graph shows catch over predicted biomass (black curve) and catch over CPUE scaled by catchability q as estimated by BSM (red curve), with the dotted line indicating exploitation compatible with *MSY*. The Stock status graph shows the development of biomass and exploitation relative to B_{msy} (horizontal dashed line) and u_{msy} (vertical dashed line), respectively. The fine dotted line indicates the biomass (0.5 B_{msy}) below which recruitment may be impaired, and the rhomb indicates the final year in the time series.

In Appendix IV, the effect of analyzing landings instead of catches is explored with a simulated stock (07_HLH_M) and North Sea haddock (had-346a-land), a stock with very high rates of discards. The results can be compared with the respective analysis of catches for HLH_M in Appendix I and with had-346a in Appendix II in the ICES area.

Results

CMSY and BSM results compared with "true" values from simulated data

Catch and biomass data were simulated over a period of 50 years to create scenarios of heavily as well as lightly depleted stocks, with monotone stable or monotone changing biomass (i.e., steadily decreasing or increasing) or with alternating biomass trajectories: patterns of high-high (HH), high-low (HL), high-low-high (HLH), low-low (LL), low-high (LH), and low-high-low (LHL) biomass trends. Simulated stocks have names that indicate the combination of biomass trajectory and intrinsic growth rate (High, Medium, Low, Very Low), e.g., HH_L signifies a stock with monotone high biomass and low resilience. See Material and Methods and main text for further description of the simulations. The "true" parameter values of the Schaefer model used in the simulations to generate the time series of biomass given the catches were k = 1,000,000 in all cases, and r drawn randomly from a normal distribution within the ranges associated with the resilience classes (Table S2). Table S3 shows the CMSY estimates of MSY, r, k, and biomass in the last year compared with the "true" values from the simulations. True values were not included in the confidence limits in eight of the 24 simulated stocks.

Table S3. Results of estimating the parameters of the Schaefer model with the CMSY method, for 24 simulated stocks. LCL and UCL indicate the lower and upper 95% confidence limits, respectively. Cases where the confidence limits do not include the "true" parameter values are indicated in bold. [SimCatchResults_6.xlsx]

Stock	MSY	(LCL	UCL)	r	(LCL	UCL)	k	(LCL	UCL)	true B/k	B/k	(2.5th	97.5th)
HH_H	381	191	764	1.19	0.96	1.48	1281	722	2271	0.74	0.83	0.61	0.90
HH_L	89	46	172	0.28	0.16	0.49	1256	519	3038	0.73	0.80	0.54	0.89
HH_M	111	57	213	**0.57**	**0.41**	**0.78**	783	404	1518	0.74	0.82	0.57	0.90
HH_VL	19	5	75	0.06	0.04	0.10	1250	402	3887	0.73	0.81	0.53	0.90
HL_H	230	207	254	1.09	0.88	1.44	842	607	1096	0.30	0.33	0.10	0.39
HL_L	69	61	78	0.23	0.14	0.39	1207	669	2071	0.06	0.23	0.02	0.40
HL_M	115	106	124	0.41	0.32	0.61	1125	728	1473	0.00	**0.11**	**0.01**	**0.38**
HL_VL	18	12	27	0.06	0.04	0.10	1163	603	2244	0.06	0.26	0.02	0.40
HLH_H	264	244	285	1.15	0.94	1.47	917	690	1170	0.74	0.77	0.71	0.82
HLH_L	65	53.2	79	0.28	0.16	0.49	930	481	1797	0.66	0.81	0.59	0.87
HLH_M	85	75	96	**0.51**	**0.38**	**0.78**	**662**	**411**	**947**	0.75	0.77	0.71	0.82
HLH_VL	21	12	37	0.06	0.04	0.10	1318	657	2648	0.72	0.65	0.51	0.83
LH_H	197	181	214	**1.19**	**0.96**	**1.48**	**661**	**509**	**859**	0.72	0.73	0.65	0.80
LH_L	150	39	584	0.26	0.16	0.46	2299	660	7745	0.72	0.84	0.52	0.89
LH_M	168	109	259	0.57	0.40	0.79	1176	686	2110	0.80	0.66	0.52	0.83
LH_VL	5	1	19	**0.07**	**0.05**	**0.10**	**280**	**96**	**812**	0.60	0.62	0.50	0.82
LHL_H	311	284	340	1.19	0.96	1.48	1043	801	1358	0.30	0.27	0.03	0.39
LHL_L	81	55	117	0.18	0.12	0.39	1819	691	3285	0.14	0.28	0.02	0.39
LHL_M	122	97	153	**0.29**	**0.26**	**0.37**	**1698**	**1184**	**2138**	0.40	**0.29**	**0.02**	**0.39**
LHL_VL	11	3	46	**0.06**	**0.04**	**0.10**	710	218	2308	0.35	0.28	0.02	0.40
LL_H	236	211	264	1.03	0.84	1.43	921	623	1192	0.27	0.30	0.03	0.39
LL_L	29	11	74	0.20	0.13	0.32	565	226	1415	0.04	0.25	0.02	0.39
LL_M	**133**	**125**	**142**	0.55	0.40	0.79	964	656	1374	0.25	0.32	0.04	0.40
LL_VL	11	4	32	0.06	0.04	0.10	693	254	1891	0.22	0.25	0.02	0.40

Table S4 shows the BSM estimates of *r*, *k*, and *MSY* compared with the "true" values from the simulations. True values of eight simulated stocks were not included in the respective BSM confidence limits. Five of the "missed" stocks were identical with the ones where also CMSY did not include all of the "true" values in its respective confidence limits.

Table S4. Results of estimating the parameters of the Schaefer model with the BSM method, for 24 simulated stocks. LCL and UCL indicate the lower and upper 95% confidence limits, respectively. The cases where the confidence limits do not include the "true" parameter value are indicated in bold. [SimCatchResults_6.xlsx]

Stock	*MSY*	(LCL	UCL)	*r*	(LCL	UCL)	*k*	(LCL	UCL)
HH_H	266	253	283	1.05	0.97	1.15	1009	976	1046
HH_L	69	61	77	0.27	0.23	0.32	1010	952	1090
HH_M	**113**	**102**	**125**	**0.50**	**0.43**	**0.57**	**909**	**881**	**943**
HH_VL	13	7	18	0.05	0.02	0.08	1022	877	1274
HL_H	**225**	**217**	**234**	**0.94**	**0.88**	**1.01**	955	900	1010
HL_L	73	68	79	0.29	0.27	0.31	995	923	1072
HL_M	**77**	**64**	**95**	0.50	0.45	0.58	**611**	**522**	**718**
HL_VL	18	14	23	0.07	0.06	0.08	1055	894	1202
HLH_H	259	248	272	1.06	1.02	1.13	973	914	1030
HLH_L	60	54	66	0.24	0.23	0.27	981	890	1082
HLH_M	82	78	88	**0.36**	**0.33**	**0.39**	920	851	1015
HLH_VL	**19**	**15**	**24**	0.07	0.06	0.09	1052	900	1197
LH_H	205	196	216	**0.88**	**0.824**	**0.94**	**934**	**890**	**980**
LH_L	62	54	299	0.25	0.22	0.29	991	885	4314
LH_M	**165**	**156**	**173**	**0.66**	**0.61**	**0.70**	997	949	1056
LH_VL	10	7	16	0.05	0.03	0.06	906	568	1424
LHL_H	296	282	312	1.11	1.04	1.21	1065	971	1171
LHL_L	84	78	90	0.35	0.33	0.37	946	897	1006
LHL_M	129	119	140	0.54	0.51	0.58	955	884	1033
LHL_VL	**36**	**13**	**68**	0.04	0.02	0.06	**3308**	**1883**	**4608**
LL_H	230	211	258	1.04	0.94	1.12	884	780	1073
LL_L	91	46	129	0.27	0.21	0.32	1325	900	1632
LL_M	144	129	162	0.60	0.56	0.64	961	843	1093
LL_VL	12	8	59	0.07	0.05	0.13	771	610	1797

Comparison of CMSY and BSM parameter estimates for 128 fully assessed stocks

Table S5 shows a comparison of CMSY parameter estimates of *r* and *k* with those derived from a full Schaefer model (BSM). Significant deviations in estimates of *r* occurred in 14 of the 128 stocks (11%). Significant deviations in the estimates *k* occurred in 20 stocks (16%). These cases are marked bold.

Table S6 shows a comparison of CMSY and BSM estimates of *MSY*. Significant deviations occurred in 6 of the 128 stocks (5%). Table S6 also shows a comparison of last year's observed biomass relative to k estimated by BSM and observed exploitation rate (catch/biomass) and compares these observations with the respective CMSY estimates. The relative biomass estimate was significantly different in 13 of the stocks (10%) and the BSM exploitation rate relative to the MSY level differed more than +/-50% from the CMSY estimate in 40 stocks (31%).

Table S5. Comparison of estimates of r and k by CMSY and BSM fitted to 112 real stocks, where LCL and UCL indicate lower and upper 95% confidence limits, respectively. Cases where the BSM estimate is not included in the CMSY confidence limits are marked in bold. Similarly, cases where the confidence limits of both methods do not overlap are marked in bold. [AllStocks_Results_6.xlsx]

Stock	r_{BSM}	(LCL	UCL)	r_{CMSY}	(LCL	UCL)	k_{BSM}	(LCL	UCL)	k_{CMSY}	(LCL	UCL)
Alaska												
AKSablefish	0.059	0.040	0.083	0.062	0.040	0.097	1,421	983	1,848	1,944	778	4,861
BSAIatka	0.266	0.214	0.300	0.282	0.163	0.487	1,138	1,001	1,361	762	385	1,508
BSAIatf	0.178	0.148	0.217	0.282	0.163	0.487	**912**	815	1,061	367	154	872
BSAIhalibut	0.221	0.169	0.279	0.270	0.159	0.465	**225**	**167**	**350**	81	40	162
BSAInorthern	0.071	0.046	0.125	0.062	0.040	0.097	331	264	459	240	93	615
BSAIplaice	**0.032**	0.017	0.054	0.062	0.040	0.097	1,797	1,386	2,419	2,273	682	7,571
BSAIpop	0.202	0.165	0.253	0.282	0.163	0.487	672	605	754	317	127	790
BSAIrocksole	0.280	0.254	0.320	0.282	0.163	0.487	1,845	1,702	2,002	1,124	450	2,808
BSAIshortraker	**0.017**	**0.007**	**0.035**	0.062	0.040	0.097	67.3	51.6	90.9	28.2	9.6	82.9
BSAIyfin	0.314	0.270	0.370	0.282	0.163	0.487	3,042	2,866	3,262	2,894	1,190	7,039
EBSPcod	0.290	0.258	0.355	0.282	0.163	0.487	2,315	1,997	2,766	4,037	1,631	9,994
EBSpollock	0.332	0.267	0.438	0.282	0.163	0.487	12,871	10,586	15,500	16,877	9,077	31,379
GOAatf	0.188	0.158	0.225	0.282	0.163	0.487	**1,930**	**1,767**	**2,114**	490	198	1,218
GOAdusky	0.202	0.164	0.256	0.282	0.163	0.487	95.1	84.8	108.0	65.1	26.4	161
GOAflathead	0.247	0.195	0.285	0.282	0.163	0.487	**237**	**224**	**255**	60.8	23.8	155
GOAnorthern	0.050	0.029	0.069	0.062	0.040	0.097	333	246	453	428	151	1,209
GOAPcod	0.271	0.222	0.307	0.317	0.129	0.490	1,013	938	1,137	736	445	1,927
GOApollock	0.272	0.228	0.309	0.236	0.145	0.400	2,086	1,684	2,670	1,719	932	3,047
GOApop	0.250	0.205	0.283	0.183	0.121	0.388	2,352	1,936	3,060	2,550	866	5,316
GOArex	0.064	0.044	0.104	0.062	0.040	0.097	212	148	290	172	71.1	419
Pacific												
Aurora_PC	**0.028**	0.012	0.055	0.062	0.040	0.097	12.4	8.3	16.9	8.6	2.5	29.9
BFTuna_P	0.503	0.472	0.544	0.399	0.320	0.527	189	175	207	231	169	299
BMarlin_NP	0.503	0.459	0.565	0.567	0.405	0.785	154	144	165	146	99	219
Boca_PC	0.254	0.216	0.282	0.243	0.148	0.433	55	49	63	57	29	104
BrownRF_PC	0.214	0.194	0.236	0.215	0.136	0.364	3.45	3.22	3.75	3.20	1.76	5.46
ChinaRF_PC	0.185	0.151	0.231	0.270	0.159	0.488	1.25	1.14	1.38	0.68	0.35	1.25

Stock	r_{BSM}	(LCL	UCL)	r_{CMSY}	(LCL	UCL)	k_{BSM}	(LCL	UCL)	k_{CMSY}	(LCL	UCL)
CopperRF_PC	0.184	0.163	0.208	0.200	0.129	0.340	5.35	4.97	5.77	4.41	2.37	7.47
Cowcod_PC	0.275	0.241	0.314	0.254	0.152	0.469	2.05	1.74	2.70	2.00	0.97	3.74
DarkblotchedRF_PC	0.093	0.065	0.118	0.062	0.040	0.097	37.9	33.0	45.7	37.6	20.4	69.6
LongspinTH_PC	0.059	0.043	0.083	0.062	0.040	0.097	184	138	241	114	64	203
PetraleSole_PC	0.446	0.416	0.481	0.381	0.311	0.503	23.8	22.1	25.8	27.1	19.8	34.5
Phake_PC	0.495	0.428	0.547	0.566	0.407	0.785	**3,340**	2,818	4,213	1,945	1,293	2,926
Rougheye_PC	**0.035**	0.019	0.054	0.062	0.040	0.097	29.4	21.1	38.3	23.5	8.5	64.6
Sardine_P	0.501	0.443	0.567	0.566	0.407	0.785	1,409	1,247	1,626	946	598	1,495
ShortspinTH_PC	**0.016**	**0.007**	**0.033**	0.062	0.040	0.097	**589**	**422**	**851**	164	69	394
Northwest Atlantic												
Ahalibut_NWAC	0.270	0.248	0.287	0.254	0.152	0.448	2.17	1.95	2.41	2.28	1.20	4.12
Albacore_NA	0.376	0.338	0.425	0.346	0.289	0.413	451	417	487	497	406	610
BETuna_A	0.451	0.424	0.480	0.568	0.411	0.785	850	831	870	661	451	968
Bluefish_AC	0.474	0.402	0.524	0.399	0.320	0.542	**209**	**160**	**350**	451	222	840
BSbass_MAC	0.522	0.481	0.599	0.564	0.409	0.785	23	20	26	21	14	30
Cod_GB	0.517	0.473	0.596	0.387	0.314	0.592	202	167	266	363	182	586
Cod_GUM	**0.694**	0.570	0.799	0.413	0.329	0.672	**61**	52	77	147	67	248
Haddock_GB	**0.310**	0.263	0.407	0.183	0.122	0.288	**417**	317	607	1,137	507	2,423
Haddock_GoM	0.500	0.436	0.568	0.407	0.325	0.656	23.8	15.8	77.0	30.7	17.3	42.3
Herring_A	0.520	0.473	0.611	0.533	0.391	0.743	1,687	1,470	2,004	1,901	1,263	2,794
Swordfish_NA	0.449	0.423	0.477	0.573	0.422	0.778	127	123	131	97	69	137
Whake_GUMGB	0.396	0.351	0.437	0.262	0.155	0.475	46.2	42.2	51.8	70.2	34.6	133
YTFlo_MA	0.506	0.453	0.597	0.436	0.341	0.573	107	43	230	97	54	171
Caribbean												
GAGGM	**0.512**	**0.470**	**0.594**	0.309	0.268	0.356	**18.0**	**14.8**	**21.8**	29.9	24.4	36.7
RGROUPGM	**0.767**	**0.633**	**0.885**	0.375	0.307	0.500	**5.48**	**4.65**	**6.69**	17	8.68	31.2
VSNAPSATLC	0.220	0.177	0.274	0.282	0.163	0.487	8.84	7.83	10.2	4.95	2.54	9.6
Mediterranean												
Encr_engr_GSA17	0.493	0.429	0.538	0.561	0.405	0.777	312	259	404	235	160	345
mul-gsa6	0.537	0.491	0.621	0.566	0.407	0.785	9.8	7.7	11.6	8.6	5.5	13.5
mullsur_gsa1516	1.067	1.009	1.189	1.165	0.943	1.453	7.0	5.7	8.1	7.0	4.6	10.5

Stock	r_{BSM}	(LCL	UCL)	r_{CMSY}	(LCL	UCL)	k_{BSM}	(LCL	UCL)	k_{CMSY}	(LCL	UCL)
Black Sea												
BS_anch	0.501	0.447	0.575	0.566	0.407	0.785	3,550	2,802	4,678	2,454	1,617	3,724
Spr_BS	0.502	0.449	0.568	0.566	0.407	0.785	577	493	694	616	308	1,231
Tur_BS	**0.498**	**0.459**	**0.534**	0.309	0.268	0.356	**23.8**	**21.4**	**26.7**	40.3	32.3	50.4
South Africa												
CRPN_S	0.227	0.170	0.280	0.278	0.162	0.487	6.2	5.3	9.0	6.2	1.9	19.4
CRPN_SE	0.215	0.177	0.264	0.282	0.163	0.487	10.1	8.6	12.8	8.4	2.7	26.7
HTTN_SW	**0.479**	**0.389**	**0.531**	0.266	0.242	0.292	**1.5**	**1.3**	**1.8**	2.8	2.4	3.2
HTTN_W	**0.480**	**0.391**	**0.531**	0.276	0.248	0.307	**4.0**	**3.7**	**4.8**	6.0	5.1	7.0
KKLI_S	0.170	0.143	0.203	0.278	0.162	0.478	54.5	50.4	59.7	29.2	15.2	56.0
KOB_S	0.343	0.303	0.403	0.278	0.162	0.478	6.9	5.4	8.1	9.5	4.0	22.2
KOB_SE	0.356	0.307	0.416	0.274	0.160	0.468	3.6	2.9	4.4	5.0	2.1	11.6
SLNG	0.494	0.439	0.533	0.541	0.395	0.773	1.9	1.7	2.2	1.5	1.0	2.3
SA-BSH	0.307	0.261	0.388	0.287	0.114	0.482	274	240	324	267	136	779
Northeast Atlantic												
anp-8c9a	**0.703**	**0.580**	**0.822**	0.359	0.298	0.544	**20.5**	**17.8**	**24.7**	59.0	30.6	90.2
Bss-47	0.259	0.211	0.292	0.282	0.163	0.487	40.9	32.7	53.8	38.2	19.3	75.7
cod-2224	**0.859**	**0.702**	**0.989**	0.346	0.289	0.413	**214**	**180**	**263**	626	474	825
cod-347d	**0.519**	**0.477**	**0.603**	0.359	0.297	0.434	**1,653**	**1,371**	**2,121**	2,944	2,222	3,899
cod-7e-k	0.616	0.514	0.714	0.462	0.355	0.731	52.2	43.0	64.9	83.4	50.3	114
cod-arct	0.608	0.541	0.674	0.455	0.351	0.650	4,813	4,326	5,454	6,583	4,441	8,845
cod-farp	0.528	0.481	0.613	0.417	0.330	0.607	172	149	203	244	160	323
cod-iceg	**0.510**	**0.480**	**0.560**	0.333	0.282	0.464	**2,783**	2,408	3,276	4,330	2,985	5,325
cod-scow	0.509	0.464	0.593	0.436	0.341	0.621	114	83	165	212	103	392
dgs-nea	0.106	0.088	0.132	0.183	0.122	0.290	**1,740**	**1,463**	**2,095**	804	470	1,299
ghl-arct	0.315	0.272	0.365	0.236	0.145	0.431	417	342	509	654	267	1,427
had-346a	**0.494**	**0.427**	**0.545**	0.318	0.275	0.385	2,113	1,690	2,934	2,778	2,106	3,505
had-7b-k	**0.505**	0.458	0.584	0.399	0.320	0.500	**111**	89	151	179	130	244
had-arct	0.542	0.486	0.639	0.472	0.360	0.699	1,091	946	1,285	1,337	843	1,876
had-faro	**0.493**	0.429	0.540	0.387	0.312	0.479	146	126	170	180	137	236
had-iceg	0.606	0.523	0.682	0.566	0.407	0.785	405	359	465	513	329	799

Stock	r_{BSM}	(LCL	UCL)	r_{CMSY}	(LCL	UCL)	k_{BSM}	(LCL	UCL)	k_{CMSY}	(LCL	UCL)
had-rock	0.497	0.434	0.556	0.494	0.372	0.779	99	72	157	140	64	259
her-2532-gor	0.361	0.306	0.438	0.364	0.301	0.571	2,839	2,456	3,324	2,529	1,519	3,247
her-30	0.410	0.342	0.497	0.566	0.407	0.785	**862**	**754**	**994**	470	320	689
her-3a22	0.523	0.489	0.571	0.455	0.351	0.717	1,036	891	1,187	1,647	708	3,148
her-47d3	0.485	0.416	0.526	0.463	0.349	0.732	6,369	5,763	7,265	5,592	3,376	7,762
her-67bc	**0.390**	0.329	0.471	0.297	0.261	0.339	1,302	1,177	1,463	1,375	1,115	1,695
her-irls	0.462	0.384	0.515	0.387	0.312	0.479	249	218	301	212	165	272
her-nirs	**0.422**	0.369	0.490	0.321	0.275	0.393	**123**	105	145	182	135	234
her-noss	0.475	0.400	0.523	0.566	0.407	0.785	11,174	10,180	12,366	7,654	4,922	11,904
her-riga	0.495	0.437	0.542	0.566	0.407	0.785	232	205	270	221	148	331
her-vian	**0.432**	0.360	0.503	0.333	0.282	0.410	938	786	1,158	1,103	832	1,404
hke-nrtn	**0.906**	0.733	1.039	0.566	0.407	0.785	**278**	**247**	**315**	715	383	1,333
hke-soth	**0.884**	0.663	1.053	0.465	0.357	0.725	**64**	**55**	**75**	134	78	193
hom-west	0.447	0.368	0.511	0.498	0.373	0.752	**4,013**	**3,438**	**4,927**	2,395	1,486	3,409
lin-icel	0.510	0.482	0.551	0.566	0.407	0.785	129	115	142	99	49	198
mac-nea	0.438	0.367	0.504	0.566	0.407	0.785	7,017	6,248	8,400	6,724	3,719	12,157
mgw-8c9a	0.315	0.268	0.377	0.262	0.155	0.465	6.40	5.09	8.20	11	4.03	26
nep-8ab	0.507	0.476	0.566	0.546	0.395	0.785	44.3	37.9	50.6	39.9	26.1	58.8
nop-34-june	0.498	0.436	0.552	0.430	0.337	0.605	1,909	1,367	2,780	3,714	1,673	7,462
ple-celt	0.525	0.485	0.587	0.525	0.387	0.763	2.23	1.85	2.62	3.04	1.48	5.82
ple-eche	0.589	0.503	0.673	0.537	0.393	0.742	31.4	26.4	37.7	36.6	24.9	53.2
ple-echw	0.500	0.460	0.550	0.498	0.373	0.705	14.8	12.6	17.3	15.3	10.1	21.8
ple-nsea	**0.578**	**0.530**	**0.635**	0.309	0.268	0.356	**1,325**	**1,153**	**1,480**	2,873	2,282	3,618
sai-3a46	**0.504**	**0.468**	**0.557**	0.313	0.269	0.392	**1,253**	**1,081**	**1,471**	2,395	1,667	3,208
sai-arct	0.551	0.503	0.599	0.529	0.389	0.778	1,280	1,188	1,391	1,353	882	1,916
sai-faro	0.493	0.438	0.534	0.566	0.407	0.785	344	314	385	320	213	480
sai-icel	0.477	0.414	0.522	0.533	0.391	0.770	550	478	665	503	323	738
san-ns1	1.056	0.984	1.169	0.995	0.829	1.420	1,406	1,264	1,593	1,482	967	1,910
san-ns2	**1.042**	0.940	1.121	0.896	0.755	1.019	434	380	494	380	309	488
san-ns3	1.050	0.978	1.134	1.049	0.851	1.380	1,210	1,114	1,307	1,262	890	1,675
sar-soth	0.509	0.465	0.591	0.399	0.320	0.565	1,028	842	1,275	1,673	980	2,505

Stock	r_{BSM}	(LCL	UCL)	r_{CMSY}	(LCL	UCL)	k_{BSM}	(LCL	UCL)	k_{CMSY}	(LCL	UCL)
smn-con	0.273	0.236	0.308	0.282	0.163	0.487	307	241	411	420	156	1,134
sol-bisc	0.507	0.466	0.576	0.546	0.395	0.785	42.5	35.6	50.7	40.6	26.3	60.3
sol-celt	0.487	0.421	0.531	0.505	0.377	0.712	9.7	8.5	11.8	9.4	6.3	13.3
sol-eche	0.517	0.476	0.600	0.566	0.407	0.785	33.5	28.8	39.4	31.6	21.0	47.5
sol-echw	0.479	0.413	0.522	0.537	0.393	0.773	8.6	7.8	10.0	8.0	5.4	11.5
sol-iris	0.473	0.412	0.516	0.370	0.304	0.559	12.6	10.6	15.8	15.8	9.4	21.3
sol-kask	0.505	0.460	0.580	0.517	0.383	0.758	6.1	5.3	7.2	6.6	4.2	9.4
sol-nsea	0.507	0.472	0.568	0.456	0.349	0.673	198	168	235	227	148	309
spr-2232	0.490	0.417	0.537	0.561	0.405	0.777	2,756	2,296	3,593	2,466	1,650	3,684
spr-nsea	0.499	0.438	0.563	0.456	0.351	0.637	3,787	2,082	9,737	2,794	1,739	4,177
usk-icel	0.330	0.299	0.372	0.385	0.301	0.493	85	70	100	65	49	88
whb-comb	0.465	0.398	0.515	0.557	0.403	0.785	10,973	9,227	13,398	9,833	6,425	14,751
whg-47d	0.494	0.425	0.549	0.452	0.349	0.664	930	776	1,162	699	424	1,012
whg-7e-k	0.565	0.494	0.661	0.566	0.407	0.785	101	87	123	109	73	161
whg-scow	0.491	0.419	0.538	0.458	0.351	0.685	126	101	167	116	73	163

Stock	MSY_B	(LCL	UCL)	MSY_C	(LCL	UCL)	relB_B	(LCL	UCL)	relB_C	(2.5th	97.5th)	relu_B	relu_C
Alaska														
AKSablefish	20.8	12.8	32.7	30.2	12.0	75.7	0.16	0.12	0.23	0.24	0.02	0.40	1.99	**0.92**
BSAIatka	75.1	61.4	89.5	53.8	41.2	70.2	0.56	0.47	0.63	0.48	0.21	0.60	0.49	**0.79**
BSAIatf	**40.7**	34.6	48.6	25.9	13.8	48.4	**0.97**	0.83	1.08	0.72	0.51	0.83	0.27	**0.57**
BSAIhalibut	12.5	9.0	20.0	5.5	4.0	7.5	0.36	0.23	0.48	0.46	0.23	0.59	0.38	**0.67**
BSAInorthern	**6.06**	**4.06**	**8.93**	3.72	1.41	9.82	**0.67**	0.48	0.84	0.50	0.24	0.60	0.31	**0.65**
BSAIplaice	14.6	7.5	24.3	35.3	8.0	155.4	0.28	0.21	0.36	0.36	0.21	0.51	2.61	**0.84**
BSAIpop	34.0	28.2	41.4	22.3	10.9	45.9	**0.92**	0.82	1.02	0.74	0.51	0.86	0.43	**0.80**
BSAIrocksole	130	115	148	79	38	164	0.88	0.81	0.96	0.81	0.53	0.90	0.28	**0.49**
BSAIshortraker	0.29	0.12	0.60	0.44	0.13	1.51	0.25	0.19	0.33	0.25	0.02	0.40	2.20	1.45
BSAIyfin	239	206	276	204	104	400	0.76	0.71	0.81	0.83	0.57	0.90	0.42	0.46
EBSPcod	171	142	205	285	141	577	0.59	0.50	0.69	0.82	0.53	0.90	1.14	**0.48**
EBSpollock	1,074	780	1,442	1,191	1,030	1,377	**0.74**	**0.62**	**0.90**	0.51	0.23	0.60	0.77	1.02
GOAatf	90.5	76.3	108.3	34.6	17.0	70.5	**1.03**	**0.94**	**1.13**	0.77	0.52	0.88	0.13	**0.46**
GOAdusky	**4.81**	**3.94**	**5.91**	4.59	2.28	9.24	0.76	0.67	0.86	0.78	0.52	0.88	0.44	0.45
GOAflathead	14.65	11.81	16.94	4.29	1.99	9.24	**1.06**	**0.98**	**1.12**	0.78	0.52	0.88	0.08	**0.39**
GOAnorthern	**4.09**	**2.49**	**5.91**	6.63	2.07	21.20	0.33	0.24	0.44	0.40	0.21	0.59	1.63	0.84
GOAPcod	68.2	58.7	76.9	58.2	51.2	66.3	**0.66**	0.59	0.72	0.53	0.50	0.61	0.85	1.25
GOApollock	**141**	107	186	101	86	119	**0.63**	0.49	0.78	0.50	0.27	0.60	0.52	**0.92**
GOApop	**147**	107	204	116	61	221	0.18	0.14	0.21	0.09	0.01	0.38	0.27	**0.66**
GOArex	3.50	2.20	5.13	2.67	1.13	6.34	0.55	0.40	0.79	0.48	0.22	0.60	0.98	1.41
Pacific														
Aurora_PC	0.08	0.04	0.16	0.13	0.03	0.64	0.35	0.26	0.52	0.27	0.02	0.40	0.63	0.53
BFTuna_P	23.9	21.9	26.3	23.0	21.4	24.8	0.26	0.24	0.28	0.32	0.05	0.40	1.70	1.40
BMarlin_NP	19.5	18.3	20.8	20.8	18.2	23.7	0.51	0.48	0.54	0.56	0.50	0.67	0.91	0.78

Stock	MSY_B	(LCL	UCL)	MSY_C	(LCL	UCL)	$relB_B$	(LCL	UCL)	$relB_C$	(2.5th	97.5th)	$relu_B$	$relu_C$
Boca_PC	3.50	2.91	4.11	3.45	2.80	4.26	0.30	0.26	0.33	0.11	0.01	0.38	0.06	**0.17**
BrownRF_PC	0.18	0.17	0.20	0.17	0.15	0.20	0.41	0.37	0.44	0.51	0.27	0.60	0.68	0.57
ChinaRF_PC	**0.06**	0.05	0.07	0.05	0.04	0.05	**0.62**	0.56	0.68	0.47	0.24	0.59	0.44	**0.73**
CopperRF_PC	0.25	0.22	0.27	0.22	0.18	0.26	**0.61**	0.56	0.65	0.52	0.24	0.60	0.26	0.34
Cowcod_PC	0.14	0.12	0.18	0.13	0.10	0.16	0.50	0.38	0.58	0.42	0.21	0.59	0.00	0.01
DarkblotchedRF_PC	**0.88**	0.66	1.10	0.58	0.42	0.81	**0.41**	0.343	0.48	0.25	0.02	0.40	0.26	**0.64**
LongspinTH_PC	**2.76**	1.96	3.80	1.77	1.38	2.28	0.37	0.283	0.49	0.35	0.17	0.40	0.57	**0.93**
PetraleSole_PC	2.65	2.49	2.84	2.59	2.40	2.78	**0.63**	0.582	0.68	0.53	0.29	0.60	0.29	0.34
Phake_PC	**411**	**334**	**517**	275	235	322	**0.65**	0.512	0.77	0.51	0.26	0.60	0.45	**0.84**
Rougheye_PC	0.25	0.14	0.40	0.36	0.12	1.10	0.29	0.222	0.4	0.26	0.02	0.40	1.40	1.09
Sardine_P	**177**	151	207	134	104	173	0.54	0.467	0.61	0.49	0.26	0.60	0.74	1.06
ShortspinTH_PC	2.39	1.02	4.50	2.55	1.10	5.90	**0.40**	0.287	0.58	0.25	0.02	0.40	0.60	0.86
Northwest Atlantic														
Ahalibut_NWAC	0.15	0.13	0.16	0.14	0.12	0.17	0.77	0.69	0.85	0.72	0.53	0.85	0.37	0.40
Albacore_NA	42.5	38.7	46.9	43.0	40.9	45.1	**0.41**	0.38	0.45	0.29	0.02	0.40	0.52	0.72
BETuna_A	95.7	90.9	100.9	93.9	83.6	105.4	0.50	0.49	0.51	0.42	0.22	0.59	0.83	1.01
Bluefish_AC	24.6	19.5	41.2	44.9	20.4	99.1	0.39	0.23	0.51	0.18	0.01	0.39	0.55	0.65
BSbass_MAC	3.05	2.72	3.42	2.89	2.64	3.17	0.55	0.48	0.62	0.50	0.25	0.60	0.61	0.69
Cod_GB	26.5	21.3	34.9	35.1	20.7	59.5	0.14	0.11	0.17	0.11	0.02	0.38	0.46	0.43
Cod_GUM	10.6	8.3	13.8	15.1	8.4	27.1	0.24	0.19	0.28	0.20	0.01	0.40	1.49	1.25
Haddock_GB	33.1	23.4	49.2	51.9	26.0	103.7	0.45	0.31	0.59	0.46	0.22	0.60	0.81	0.49
Haddock_GoM	3.04	1.97	9.54	3.12	2.58	3.77	0.15	0.05	0.23	0.21	0.02	0.39	1.27	0.88
Herring_A	223	188	269	253	218	294	**0.78**	0.66	0.90	0.88	0.85	0.90	0.26	0.20
Swordfish_NA	14.3	13.6	15.0	13.8	12.8	14.9	0.58	0.56	0.60	0.48	0.24	0.59	0.73	0.91
Whake_GUMGB	4.58	4.11	5.05	4.60	3.69	5.73	**0.68**	**0.60**	**0.739**	0.51	0.25	0.60	0.35	0.46
YTFlo_MA	13.7	5.5	29.1	10.6	5.7	19.7	0.05	0.02	0.12	0.12	0.01	0.38	0.28	0.15
Caribbean/Gulf of Mexico														
GAGGM	2.33	1.95	2.81	2.31	2.05	2.60	**0.62**	**0.51**	**0.75**	0.12	0.02	0.36	0.34	**1.71**
RGROUPGM	1.06	0.84	1.27	1.61	0.74	3.51	0.55	0.45	0.64	0.53	0.26	0.60	1.02	0.69
VSNAPSATLC	0.49	0.40	0.60	0.35	0.28	0.44	0.34	0.29	0.38	0.27	0.02	0.40	1.36	**2.39**

Stock	MSY_B	(LCL	UCL)	MSY_C	(LCL	UCL)	$relB_B$	(LCL	UCL)	$relB_C$	(2.5th	97.5th)	$relu_B$	$relu_C$
Mediterranean														
Encr_engr_GSA17	**38.3**	31.5	49.4	33.0	29.5	36.9	**0.71**	0.55	0.85	0.53	0.50	0.60	0.77	**1.20**
mul-gsa6	1.31	1.13	1.50	1.22	0.96	1.55	0.30	0.25	0.38	0.28	0.03	0.40	1.45	1.65
mullsur_gsa1516	1.87	1.56	2.15	2.04	1.41	2.95	**0.42**	0.36	0.51	0.25	0.02	0.40	0.64	**0.98**
Black Sea														
BS_anch	**447**	337	611	347	291	413	0.19	0.14	0.24	0.25	0.03	0.39	1.68	1.64
Spr_BS	72.8	60.3	88.4	87.0	42.6	178.0	0.72	0.60	0.84	0.75	0.51	0.86	0.97	0.77
Tur_BS	2.96	2.62	3.34	3.11	2.66	3.64	0.07	0.06	0.08	0.33	0.03	0.39	3.11	**0.60**
South Africa														
CRPN_S	0.36	0.29	0.44	0.43	0.13	1.40	**0.97**	0.665	1.14	0.87	0.77	0.9	0.149	0.13
CRPN_SE	0.55	0.46	0.65	0.59	0.18	1.95	**0.90**	0.728	1.09	0.83	0.55	0.9	0.2	0.21
HTTN_SW	0.17	0.15	0.21	0.18	0.16	0.21	**0.83**	0.679	0.95	0.9	0.88	0.9	0.191	0.17
HTTN_W	**0.48**	0.41	0.56	0.41	0.37	0.46	**0.95**	0.803	1.06	0.89	0.88	0.9	0.134	0.17
KKLI_S	2.32	2.00	2.71	2.03	1.64	2.51	0.49	0.449	0.53	0.49	0.23	0.6	0.517	0.59
KOB_S	0.59	0.52	0.67	0.66	0.36	1.22	0.47	0.403	0.60	0.40	0.22	0.57	0.793	0.84
KOB_SE	0.32	0.27	0.37	0.34	0.18	0.63	0.50	0.418	0.64	0.43	0.22	0.58	0.604	0.67
SLNG	0.24	0.22	0.26	0.21	0.17	0.25	**0.80**	**0.697**	**0.88**	0.51	0.25	0.59	0.508	**0.92**
SA-BSH	21.4	18.6	24.5	19.1	14.2	25.7	**0.53**	**0.451**	**0.61**	0.24	0.20	0.36	1.284	**3.14**
Northeast Atlantic														
anp-8c9a	3.62	2.90	4.38	5.29	3.31	8.47	0.46	0.38	0.53	0.49	0.23	0.60	0.50	0.31
Bss-47	2.62	2.10	3.32	2.70	2.07	3.52	0.28	0.21	0.35	0.29	0.03	0.40	2.44	2.33
cod-2224	**45.1**	34.7	61.5	54.0	44.6	65.5	0.19	0.16	0.23	0.16	0.02	0.39	1.08	1.08
cod-347d	**218**	176	277	264	221	316	0.20	0.16	0.24	0.12	0.01	0.38	0.50	0.70
cod-7e-k	**8.01**	6.37	10.04	9.63	8.80	10.53	0.23	0.19	0.28	0.25	0.03	0.40	1.79	1.39
cod-arct	732	644	827	749	697	804	0.65	0.58	0.73	0.69	0.60	0.74	0.93	0.86
cod-farp	**22.9**	19.3	27.7	25.5	23.2	27.9	0.16	0.14	0.19	0.15	0.02	0.39	0.83	0.79
cod-iceg	356	314	415	360	333	390	0.42	0.36	0.49	0.52	0.21	0.59	0.71	0.57
cod-scow	14.7	10.6	21.8	23.1	11.2	47.6	0.04	0.03	0.06	0.10	0.01	0.37	1.35	**0.36**
dgs-nea	**46.3**	36.2	60.7	36.7	31.7	42.6	0.13	0.11	0.15	0.17	0.01	0.39	0.20	0.19
ghl-arct	32.8	25.6	42.1	38.5	21.7	68.2	0.74	0.61	0.90	0.74	0.54	0.87	0.30	0.26

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Stock	MSY_B	(LCL	UCL)	MSY_C	(LCL	UCL)	$relB_B$	(LCL	UCL)	$relB_C$	(2.5th	97.5th)	$relu_B$	$relu_C$
had-346a	260	200	365	221	187	261	0.22	0.16	0.27	0.14	0.02	0.37	0.40	**0.73**
had-7b-k	**14.1**	11.1	19.3	17.8	14.8	21.4	0.67	0.49	0.84	0.54	0.50	0.62	1.25	1.24
had-arct	149	122	185	158	138	180	1.06	0.90	1.22	0.53	0.50	0.61	0.73	**1.37**
had-faro	17.8	15.0	21.1	17.4	15.5	19.5	0.14	0.12	0.17	0.21	0.01	0.40	0.57	0.41
had-iceg	61.4	52.7	71.1	72.5	57.8	91.0	0.31	0.27	0.35	0.49	0.23	0.60	1.23	0.66
had-rock	12.3	8.9	19.6	17.3	9.1	33.0	0.18	0.11	0.24	0.12	0.02	0.38	0.36	0.38
her-2532-gor	257	221	306	230	205	259	0.52	0.45	0.60	0.51	0.28	0.60	0.42	0.47
her-30	**88.6**	73.4	107.5	66.5	59.6	74.1	1.06	0.92	1.21	0.52	0.50	0.57	0.57	**1.56**
her-3a22	136	114	163	187	87	401	0.18	0.16	0.21	0.16	0.02	0.39	0.81	0.67
her-47d3	**767**	664	875	647	591	709	0.69	0.60	0.76	0.84	0.80	0.87	0.46	0.45
her-67bc	**127**	105	156	102	88	119	0.28	0.25	0.31	0.19	0.02	0.38	0.37	**0.68**
her-irls	**28.7**	**23.9**	**34.5**	20.5	19.0	22.0	0.83	0.69	0.95	0.60	0.51	0.68	0.34	**0.66**
her-nirs	13.0	10.5	16.0	14.6	12.1	17.6	0.34	0.29	0.39	0.16	0.02	0.38	0.60	**1.15**
her-noss	1,319	1,128	1,491	1,082	866	1,353	0.50	0.45	0.55	0.47	0.22	0.60	0.49	0.65
her-riga	28.6	25.4	32.3	31.3	27.0	36.2	0.54	0.47	0.62	0.44	0.22	0.59	0.86	0.98
her-vian	102	77	135	92	79	106	0.12	0.10	0.14	0.19	0.02	0.38	0.80	0.57
hke-nrtn	63.1	48.5	76.0	101.1	56.7	180.4	0.99	0.87	1.12	0.72	0.52	0.83	0.80	0.69
hke-soth	14.3	10.2	17.7	15.6	12.9	18.9	0.37	0.31	0.42	0.38	0.22	0.56	1.44	1.24
hom-west	**448**	**353**	**564**	298	262	339	0.29	0.23	0.33	0.29	0.02	0.40	0.61	0.91
lin-icel	16.5	14.3	19.0	13.9	6.7	28.8	0.71	0.64	0.79	0.76	0.52	0.88	0.53	0.58
mac-nea	771	690	871	951	566	1,596	0.70	0.58	0.78	0.70	0.52	0.86	0.80	0.64
mgw-8c9a	0.50	0.37	0.71	0.69	0.32	1.47	0.22	0.18	0.28	0.18	0.01	0.39	1.39	1.26
nep-8ab	5.64	5.16	6.19	5.45	4.82	6.17	0.36	0.32	0.42	0.31	0.05	0.40	1.01	1.23
nop-34-june	236	166	346	399	163	974	0.34	0.23	0.47	0.11	0.01	0.37	0.24	**0.44**
ple-celt	0.29	0.24	0.35	0.40	0.20	0.78	0.14	0.12	0.17	0.17	0.01	0.39	0.94	0.59
ple-eche	4.61	3.74	5.59	4.92	4.35	5.55	0.41	0.34	0.49	0.51	0.27	0.60	0.77	0.59
ple-echw	1.85	1.61	2.12	1.90	1.66	2.18	0.45	0.39	0.54	0.49	0.27	0.59	0.90	0.81
ple-nsea	191	172	211	222	187	264	0.46	0.41	0.53	0.52	0.25	0.60	0.60	0.46
sai-3a46	159	137	184	188	143	247	0.26	0.22	0.30	0.22	0.03	0.40	1.04	1.02
sai-arct	176	163	190	179	165	194	0.38	0.35	0.41	0.56	0.45	0.60	1.11	0.74

Stock	MSY_B	(LCL	UCL)	MSY_C	(LCL	UCL)	$relB_B$	(LCL	UCL)	$relB_C$	(2.5th	97.5th)	$relu_B$	$relu_C$
sai-faro	42.2	37.9	46.9	45.3	38.9	52.7	0.62	0.55	0.68	0.37	0.21	0.57	0.54	0.86
sai-icel	65.2	57.7	76.5	67.0	58.0	77.5	0.43	0.35	0.49	0.54	0.29	0.60	1.00	0.76
san-ns1	373	335	425	369	321	424	0.25	0.22	0.28	0.31	0.05	0.40	0.60	0.48
san-ns2	**113**	96	131	85	73	99	0.40	0.35	0.46	0.50	0.36	0.58	0.15	0.16
san-ns3	318	299	336	331	286	383	0.44	0.41	0.48	0.39	0.21	0.57	0.27	0.30
sar-soth	133	107	165	167	116	240	0.12	0.10	0.15	0.23	0.03	0.39	1.37	**0.57**
smn-con	20.9	16.6	28.1	29.6	12.3	71.2	0.34	0.25	0.43	0.38	0.21	0.56	0.71	0.45
sol-bisc	5.41	4.85	6.13	5.55	4.83	6.37	0.34	0.28	0.40	0.43	0.21	0.58	1.14	0.88
sol-celt	1.17	1.06	1.34	1.19	1.07	1.32	0.41	0.34	0.47	0.43	0.23	0.55	1.11	1.06
sol-eche	4.39	3.92	4.92	4.47	3.82	5.23	0.44	0.37	0.51	0.46	0.22	0.59	1.10	1.02
sol-echw	1.03	0.94	1.12	1.08	0.99	1.17	0.65	0.56	0.72	0.51	0.25	0.60	0.65	0.80
sol-iris	1.48	1.25	1.83	1.46	1.18	1.80	0.08	0.06	0.10	0.18	0.02	0.39	0.75	**0.34**
sol-kask	0.78	0.67	0.91	0.85	0.75	0.96	0.38	0.32	0.44	0.30	0.02	0.40	0.58	0.67
sol-nsea	25.3	21.7	30.0	25.9	23.9	28.1	0.26	0.22	0.30	0.23	0.02	0.40	1.25	1.35
spr-2232	334	268	432	346	298	402	0.49	0.38	0.59	0.48	0.23	0.60	0.75	0.75
spr-nsea	**470**	258	1,196	319	242	420	2.00	0.78	3.64	0.89	0.85	0.90	0.06	**0.20**
usk-icel	**7.01**	6.28	7.88	6.29	5.77	6.87	0.26	0.22	0.32	0.37	0.28	0.40	1.84	1.44
whb-comb	1,269	1,042	1,554	1,370	1,165	1,610	0.48	0.40	0.58	0.49	0.22	0.60	0.58	0.53
whg-47d	**114.4**	91.4	145.2	78.9	63.2	98.6	0.52	0.41	0.62	0.48	0.22	0.59	0.23	**0.36**
whg-7e-k	14.4	11.9	17.5	15.3	13.5	17.5	0.66	0.54	0.77	0.60	0.51	0.74	0.49	0.49
whg-scow	**15.3**	12.0	20.4	13.4	11.7	15.3	0.18	0.14	0.23	0.12	0.01	0.37	0.18	**0.30**

Of the 128 fully assessed stock, 72 had estimates of F_{msy}. These official estimates were compared with $F_{msy} = 0.5\ r$ as estimated by BSM. The median ratio of the BSM estimate versus the F_{msy} estimate was 1.0, with 5th percentile 0.51 and 95th percentile 1.84. About 82% of the BSM estimates fell within +/- 50% of the official F_{msy} estimates (see AllStocks_Results_6.xlsx in the online material).

An examination of the recent exploitation history of the 128 fully assessed stocks examined in this study (see AllStocks_Results_6.xlsx in online material) gives the following results: maximum catches had exceeded *MSY* in 118 stocks (92%), resulting in recent biomass below the level that can produce *MSY* in 74 stocks (58%) and in potentially reduced recruitment ($B/k < 0.25$) in 25 stocks (20%). Four stocks (3%) were severely depleted ($B/k < 0.1$). In contrast, of the 10 stocks (8%) where catches never exceeded *MSY*, all stocks had recent biomass levels above the one that can produce *MSY*.

CMSY and BSM results compared with "true" values from simulated CPUE data

Table S7 shows the CMSY estimates of *MSY*, *r*, *k*, and biomass in the last year compared with the "true" values from the simulations of data-limited stocks. "True" values are not included in the confidence limits or 95% ranges of eight of the 24 simulated stocks. The "true" parameter values of the Schaefer model used in the simulations to generate the time series of biomass given the catches were *k* = 1000 in all cases and *r* randomly drawn from a normal distribution corresponding to the respective resilience class (see "Generation of simulated stocks" above). Note that CMSY analyzed here the same data as in Table S3, where some of the "true" values were missed in the same eight stocks. The slight differences in estimated values stem from the random errors that are part of the CMSY model.

Table S7. Results of estimating the parameters of the Schaefer model with the CMSY method, for 24 simulated stocks. LCL and UCL indicate the lower and upper 95% confidence limits, respectively. Cases where the confidence limits do not include the "true" parameter values are indicated in bold. [SimCatchCPUE_Results_6.xlsx]

Stock	MSY	(LCL	UCL)	r	(LCL	UCL)	k	(LCL	UCL)	trueB/k	B/k	(2.5th	97.5th)
HH_H	376	190	745	1.19	0.96	1.48	1,264	717	2,227	0.74	0.82	0.61	0.90
HH_L	87	44	171	0.28	0.16	0.49	1,234	507	3,005	0.73	0.80	0.54	0.89
HH_M	113	59	216	**0.57**	**0.41**	**0.78**	797	412	1,541	0.74	0.82	0.57	0.90
HH_VL	19	5	77	0.06	0.04	0.10	1,231	387	3,918	0.73	0.80	0.52	0.90
HL_H	226	207	247	1.01	0.83	1.44	897	601	1,138	0.30	0.32	0.03	0.39
HL_L	69	61	78	0.23	0.14	0.37	1,206	704	2,068	0.06	0.22	0.02	0.39
HL_M	117	108	126	0.46	0.35	0.65	1,008	692	1,366	0.00	**0.10**	**0.01**	**0.37**
HL_VL	18	12	28	0.06	0.04	0.10	1,167	600	2,268	0.06	0.27	0.02	0.40
HLH_H	262	241	285	1.10	0.90	1.38	956	725	1,210	0.74	0.78	0.71	0.84
HLH_L	65	53	78	0.27	0.16	0.48	943	490	1,776	0.66	0.82	0.61	0.87
HLH_M	85	76	96	**0.53**	**0.39**	**0.78**	**639**	**411**	**924**	0.75	0.78	0.71	0.82
HLH_VL	22	13	37	0.06	0.04	0.10	1,342	680	2,647	0.72	0.65	0.51	0.82
LH_H	197	182	214	**1.19**	**0.96**	**1.48**	**660**	**510**	**854**	0.72	0.72	0.64	0.79
LH_L	152	39	590	0.26	0.16	0.47	2,325	655	7,830	0.72	0.84	0.53	0.90
LH_M	167	102	273	0.57	0.41	0.78	1,178	663	2,116	0.80	0.66	0.52	0.83
LH_VL	5	1	20	**0.07**	**0.05**	**0.10**	**287**	**98**	**839**	0.60	0.63	0.51	0.82
LHL_H	310	286	336	1.19	0.96	1.48	1,039	803	1,344	0.30	0.27	0.02	0.39
LHL_L	79	59	104	0.20	0.13	0.39	1,596	703	2,822	0.14	0.26	0.02	0.39
LHL_M	124	91	170	**0.30**	**0.26**	**0.37**	1,652	1,139	2,238	0.40	**0.27**	**0.08**	**0.39**
LHL_VL	11	3	51	**0.06**	**0.04**	**0.10**	738	220	2,482	0.35	0.28	0.02	0.40
LL_H	233	208	261	0.95	0.82	1.41	977	621	1,197	0.27	0.31	0.04	0.39
LL_L	27	12	60	0.18	0.12	0.32	589	222	1,325	0.04	0.26	0.02	0.40
LL_M	**133**	**125**	**142**	0.56	0.40	0.78	958	662	1,368	0.25	0.32	0.04	0.40
LL_VL	11	4	34	0.06	0.04	0.10	710	258	1,958	0.22	0.24	0.02	0.40

Table S8 shows the BSM estimates of *MSY*, *r*, *k*, and catchability coefficient *q* compared with the "true" values used in the simulations. The "true" value of *k* is 1000 and the "true" value of *q* is $100*10^{-7}$. "True" *MSY* is not included in the BSM confidence limits in three of the 24 stocks (13%); "true" *r* is not included in 12 of the stocks (50%); "true" *k* is not included in eleven stocks (49%); and "true" *q* is not included in 16 of the stocks (67%). In comparison, "true" values were missed in only seven stocks with wider confidence limits of the CMSY method and in eight stocks (33%) with the BSM method when biomass instead of CPUE was used. Note that these "miss-rates" are not indicative of the performance of CMSY or BSM against real stocks, because the simulated stocks included some extreme and unlikely scenarios (see catch and biomass patterns in Appendix IV).

Table S8. Results of estimating the parameters of the Schaefer model with the BSM method for CPUE, for 24 simulated stocks, where q is the catchability coefficient. LCL and UCL indicate the lower and upper 95% confidence limits, respectively. Cases where the confidence limits do not include the "true" parameter value are indicated in bold. [SimCatchCPUE_Results_6.xlsx]

Stock	MSY	(LCL – UCL)		r	(LCL - UCL)		k	(LCL - UCL)		q 10⁻⁷	(LCL - UCL)	
HH_H	244	216	1832	1.05	0.97	1.15	924	804	6,945	**131**	**102**	**163**
HH_L	64	52	86	0.28	0.23	0.33	929	745	1,240	110	73	154
HH_M	77	66	95	**0.50**	**0.45**	**0.58**	**609**	**517**	**745**	180	133	238
HH_VL	10	6	20	0.06	0.03	0.14	**662**	**450**	**982**	157	109	226
HL_H	223	214	233	**1.06**	**0.98**	**1.16**	**843**	**770**	**913**	114	102	127
HL_L	74	64	85	0.26	0.21	0.30	1,124	955	1,406	**86**	**70**	**99**
HL_M	110	82	154	0.50	0.44	0.56	887	670	1,221	**61**	**45**	**79**
HL_VL	14	5	29	**0.03**	**0.01**	**0.06**	**1,901**	**1,324**	**2,952**	60	42	80
HLH_H	261	247	278	1.06	0.99	1.17	984	892	1,072	97	85	110
HLH_L	64	56	75	**0.28**	**0.24**	**0.32**	915	781	1,114	100	84	116
HLH_M	81	75	87	**0.50**	**0.45**	**0.56**	**645**	**569**	**726**	147	127	170
HLH_VL	**53**	**19**	**144**	0.06	0.02	0.14	**3,661**	**2,350**	**6,237**	699	425	985
LH_H	201	190	215	**1.06**	**1.00**	**1.17**	753	679	825	123	107	141
LH_L	56	44	74	0.27	0.23	0.30	825	635	1,140	113	83	147
LH_M	172	156	194	**0.53**	**0.48**	**0.63**	**1,290**	**1,070**	**1,516**	73	59	90
LH_VL	**2**	**1**	**5**	**0.06**	**0.05**	**0.10**	**135**	**72**	**265**	1019	706	1461
LHL_H	298	282	321	**1.04**	**0.94**	**1.12**	1,149	1,057	1,278	78	63	95
LHL_L	80	70	94	**0.28**	**0.25**	**0.33**	1,137	957	1,377	86	71	102
LHL_M	129	119	140	0.50	0.45	0.55	1,033	919	1,160	**82**	**71**	**94**
LHL_VL	18	6	110	0.05	0.03	0.08	1,636	562	6,973	106	72	155
LL_H	244	217	277	**1.05**	**0.97**	**1.14**	928	808	1,088	108	88	123
LL_L	**21**	**18**	**25**	0.27	0.21	0.30	**320**	**263**	**435**	130	106	151
LL_M	134	120	160	**0.49**	**0.42**	**0.54**	1,096	939	1,383	**64**	**50**	**79**
LL_VL	9	5	41	0.06	0.04	0.12	592	327	1,681	102	74	141

Comparison of CMSY and BSM parameter estimates for data-limited stocks

Table S9 shows a comparison of CMSY parameter estimates of r and k with those derived from a full Schaefer model (BSM) for catch and CPUE analysis. Estimates are very similar. Only in two cases (boc-nea and ple-2432) are the BSM estimates of r not included in the confidence limits of CMSY.

Table S9. Comparison of estimates of r and k by BSM for CPUE and CMSY, fitted to 31 data-limited stocks, where LCL and UCL indicate lower and upper 95% confidence limits, respectively. Stocks without estimates from BSM had less than 10 years of CPUE data available. The cases where the BSM estimate is not included in the CMSY confidence limits are marked in bold. [CPUEStocks_Results_6.xlsx]

Stock	r_{BSM}	(LCL	- UCL)	r_{CMSY}	(LCL	- UCL)	k_{BSM}	(LCL	− UCL)	k_{CMSY}	(LCL	− UCL)
arg-rest	0.28	0.24	0.33	0.28	0.16	0.49	27.8	15.6	39.1	32.0	12.0	85.0
bll-2232	0.50	0.45	0.59	0.57	0.41	0.78	0.52	0.38	0.74	0.43	0.27	0.69
bll-nsea	0.50	0.45	0.58	0.57	0.41	0.78	16.9	14.6	20.3	24.7	12.8	47.6
boc-nea	**0.27**	0.23	0.32	0.28	0.16	0.49	1,296	576	3,752	2,110	543	8,201
bsk-nea				0.06	0.04	0.10				128	46.7	349
cod-2532	0.53	0.47	0.65	0.51	0.38	0.74	718	400	958	669	374	1,089
cod-rock	0.50	0.44	0.57	0.46	0.35	0.70	15.7	11.1	22.4	12.3	6.0	21.7
dab-2232	0.58	0.49	0.70	0.49	0.37	0.72	13.0	9.1	17.3	14.8	9.6	20.5
dab-nsea	0.53	0.48	0.65	0.56	0.41	0.77	52.0	41.5	65.2	65.0	44.6	94.8
eel-eur	0.26	0.20	0.30	0.18	0.12	0.27	396	266	644	285	179	456
fle-2223	0.52	0.47	0.67	0.55	0.40	0.78	14.5	6.4	21.2	11.8	7.6	18
fle-2425	0.50	0.45	0.58	0.57	0.41	0.78	82.2	56.5	123	126	63.5	251.8
fle-2628	0.50	0.44	0.56	0.57	0.41	0.78	31.6	26.4	39.3	30.8	19.5	48.6
fle-2732	0.51	0.46	0.60	0.56	0.41	0.78	2.34	1.75	2.80	2.47	1.67	3.63
fle-nsea	0.51	0.47	0.62	0.57	0.41	0.78	25.9	20.7	34.0	25.9	17.5	38.8
gfb-comb	0.51	0.46	0.60	0.57	0.41	0.78	22.8	15.0	34.7	24.4	16.2	37.0
lem-nsea	0.53	0.48	0.63	0.47	0.36	0.71	54.2	43.4	64.7	58.3	36.1	80.5
mur-347d	0.50	0.45	0.58	0.57	0.41	0.78	17.2	15.0	20.4	16.4	10.8	25.0
nep-2829	0.52	0.47	0.64	0.44	0.34	0.65	3.11	2.17	4.45	3.74	2.04	5.96
Pan_bor_1	0.51	0.46	0.59	0.53	0.39	0.75	5.23	4.38	6.25	5.01	3.02	7.98
Pan_bor_2	0.52	0.47	0.62	0.51	0.38	0.74	15.3	12.4	18.7	16.3	9.26	26.9
ple-2123	0.52	0.47	0.65	0.56	0.40	0.78	18.4	13.0	25.9	21.6	13.8	33.6
ple-2432	**0.51**	**0.46**	**0.59**	0.27	0.24	0.29	**7.06**	**4.17**	**10.6**	13.2	10.8	16.1
rjh-pore				0.57	0.41	0.78				4.11	2.09	8.07
sar-78	0.50	0.44	0.56	0.57	0.41	0.78	262	206	351	384	198	743
sck-nea				0.27	0.16	0.46				8.85	3.50	22.4
smn-dp	0.05	0.02	0.08	0.06	0.04	0.1	4,566	2,712	7,351	2,355	1,164	4,762
smn-sp	0.05	0.02	0.1	0.06	0.04	0.1	7,555	4,280	11,714	4,351	1,548	12,232
tur-2232	0.51	0.47	0.62	0.48	0.36	0.78	5.76	4.65	7.37	7.52	3.14	14.5
tur-kask	0.50	0.45	0.58	0.55	0.4	0.77	1.43	1.18	1.80	1.38	0.77	2.41
usk-oth	0.54	0.48	0.68	0.49	0.37	0.69	76.8	54.0	114	84.0	51.9	129

Table S10 shows a comparison of BSM and CMSY estimates of *MSY*, relative biomass (*B/k*) and relative exploitation rate (*u/u.msy*) in the last year of the time series for 31 data-limited stocks. Significant deviations occurred in one stock (eel-eur) (4%) for *MSY* and in four stocks (14%) for relative biomass. Relative exploitation estimated by CMSY differed by more than 50% from the BSM estimate in seven stocks (25%).

Table S10.Comparison of parameter estimates of CMSY and BSM fitted to 28 data-limited stocks, where rel*B* is the *B/k* ratio in the last year and *u* is the catch rate (catch/*B*). LCL and UCL indicate lower and upper 95% confidence limits, respectively. Cases where the BSM estimate of MSY or *B/k* or *u* are not included in the CMSY confidence limits or percentile range are marked in bold. Similarly, cases where the confidence limits do not overlap are marked in bold. [CPUEStocks_Results_6.xlsx].

Stock	MSY_B	(LCL	- UCL)	MSY_C	(LCL	- UCL)	$relB_B$	(LCL	- UCL)	$relB_C$ (2.5th-97.5th)			$relu_B$	$relu_C$
arg-rest	1.94	1.06	2.77	2.25	0.97	5.26	0.11	0.08	0.15	0.13	0.01	0.39	0.03	0.02
bll-2232	0.07	0.05	0.09	0.06	0.05	0.08	0.25	0.18	0.35	0.43	0.22	0.59	0.95	0.60
bll-nsea	2.13	1.88	2.56	3.49	1.83	6.66	0.60	0.46	0.79	0.82	0.58	0.90	0.90	**0.40**
boc-nea	88.2	38.0	264	149	30.4	730	0.11	0.08	0.16	0.18	0.01	0.39	3.53	**1.27**
bsk-nea				1.98	0.66	5.92				0.17	0.01	0.39		0.01
cod-2532	96.6	52.1	126	84.5	57.7	124	0.17	0.11	0.26	0.29	0.02	0.40	1.19	0.76
cod-rock	1.96	1.36	2.85	1.42	0.79	2.55	**0.005**	**0.003**	**0.006**	0.10	0.01	0.38	0.95	**0.06**
dab-2232	1.91	1.18	2.44	1.82	1.67	1.97	**0.70**	0.54	0.88	0.53	0.26	0.60	0.50	0.69
dab-nsea	6.97	5.46	8.82	9.08	8.14	10.13	**0.88**	**0.70**	**1.13**	0.52	0.25	0.60	0.49	0.63
eel-eur	**25.4**	**16.9**	**41.2**	13.0	11.5	14.80	0.04	0.03	0.06	0.09	0.02	0.19	2.39	2.11
fle-2223	1.95	0.82	2.9	1.63	1.34	1.98	**0.83**	0.52	1.18	0.50	0.25	0.60	0.41	**0.79**
fle-2425	10.3	7.01	15.6	17.9	8.81	36.3	**1.16**	0.86	1.59	0.80	0.53	0.90	0.55	0.46
fle-2628	3.94	3.40	4.77	4.35	3.38	5.61	0.14	0.11	0.17	0.28	0.03	0.39	4.19	**1.88**
fle-2732	**0.30**	0.22	0.36	0.35	0.31	0.39	**0.66**	0.50	0.85	0.50	0.25	0.60	0.52	0.59
fle-nsea	3.39	2.66	4.43	3.67	3.21	4.19	0.32	0.25	0.39	0.48	0.24	0.60	0.98	0.59
gfb-comb	2.93	1.92	4.54	3.45	2.93	4.07	0.47	0.38	0.59	0.50	0.24	0.59	0.80	0.64
lem-nsea	7.19	6.05	8.22	6.79	6.07	7.58	0.32	0.27	0.39	0.52	0.26	0.60	0.83	0.54
mur-347d	2.16	1.90	2.58	2.32	1.94	2.78	0.20	0.15	0.26	0.33	0.14	0.40	1.90	1.05
nep-2829	0.41	0.29	0.59	0.41	0.27	0.63	0.37	0.30	0.45	0.25	0.02	0.40	0.66	0.94
Pan_bor_1	0.67	0.58	0.78	0.66	0.49	0.90	0.14	0.12	0.17	0.23	0.02	0.39	1.56	0.97
Pan_bor_2	2.00	1.69	2.38	2.10	1.41	3.11	0.18	0.12	0.24	0.14	0.01	0.38	1.27	1.57
ple-2123	2.45	1.66	3.5	3.01	2.39	3.8	**1.01**	**0.79**	**1.30**	0.47	0.25	0.59	0.37	**0.63**
ple-2432	0.91	0.53	1.37	0.88	0.71	1.08	**0.62**	**0.48**	**0.79**	0.27	0.2	0.4	0.70	**1.66**
rjh-pore				0.58	0.29	1.15				0.49	0.22	0.60		0.35
sar-78	32.7	25.8	44.4	54.3	28.3	104	0.71	0.52	0.98	0.79	0.53	0.89	0.88	0.48
sck-nea				0.60	0.27	1.30				0.11	0.01	0.39		0.002
smn-dp	53.1	18.1	112	36.5	22.0	60.5	0.17	0.12	0.25	0.27	0.02	0.40	1.82	1.73
smn-sp	94.1	30.6	209	67.5	21.4	213	**0.01**	0.01	0.02	0.23	0.02	0.40	1.49	0.12
tur-2232	0.75	0.62	0.95	0.89	0.42	1.90	0.18	0.13	0.24	0.18	0.01	0.39	1.00	0.84
tur-kask	0.18	0.15	0.22	0.19	0.12	0.30	0.16	0.13	0.20	0.30	0.03	0.40	2.24	1.12
usk-oth	10.4	7.09	16.0	10.3	7.77	13.7	0.56	0.45	0.70	0.50	0.26	0.60	0.61	0.69

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Appendix I: Simulated stocks with catch and biomass

[CMSY_45y.R, SimCatch_6.csv, SimSpec_6.csv

Process error: Sim = 0.2, CMSY = 0.1; Observation error: Sim = 0.1, CMSY = 0.1]

Species: NA , stock: HH_H

 Name and region: NA , NA

 Catch data used from years 1 - 50 , biomass = observed

 Prior initial relative biomass = 0.5 - 0.9

 Prior intermediate rel. biomass= 0.5 - 0.9 in year 25

 Prior final relative biomass   = 0.5 - 0.9

 Prior range for r = 0.6 - 1.5 , prior range for k = 332 - 4984

True values used in simulation: r = 1.13 , k = 1000 , MSY = 282

Results from Bayesian Schaefer model using catch & observed biomass

 r = 1.05 , 95% CL = 0.972 - 1.15 , k = 1009 , 95% CL = 976 - 1046

 MSY = 266 , 95% CL = 253 - 283

Biomass in last year = 739 or 0.732 k

 Exploitation rate in last year = 0.302 or 0.574 u.msy

Results of CMSY analysis with altogether 42576 viable trajectories for 4391 r-k pairs

 r = 1.19 , 95% CL = 0.957 - 1.48 , k = 1281 , 95% CL = 722 - 2271

 MSY = 381 , 95% CL = 191 - 764

Relative biomass last year= 0.828 k, 2.5th = 0.609 , 97.5th = 0.897

Relative biomass next year= 0.819 k, 2.5th = 0.589 , 97.5th = 0.91

Relative exploitation rate in last year= 0.343

Comment: Simulated data
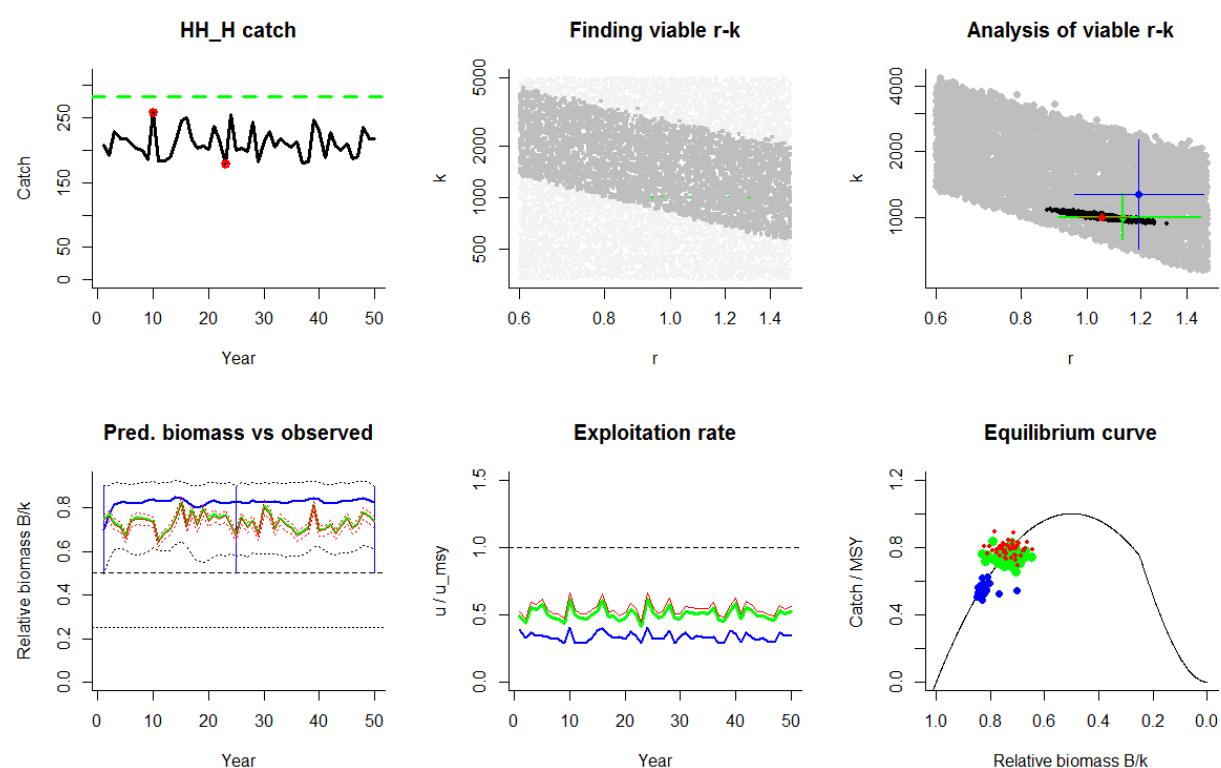
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Species: NA , stock: HH_L
 Name and region: NA , NA
 Catch data used from years 1 - 50 , biomass = observed
 Prior initial relative biomass = 0.5 - 0.9
 Prior intermediate rel. biomass= 0.5 - 0.9 in year 25
 Prior final relative biomass   = 0.5 - 0.9
 Prior range for r = 0.05 - 0.5 , prior range for k = 248 - 14890
True values used in simulation: r = 0.278 , k = 1000 , MSY = 69.5
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.273 , 95% CL = 0.229 - 0.319 , k = 1010 , 95% CL = 952 - 1090
 MSY = 68.9 , 95% CL = 61.3 - 76.9
Biomass in last year = 731 or 0.723 k
 Exploitation rate in last year = 0.0726 or 0.532 u.msy
 Results of CMSY analysis with altogether 30883 viable trajectories for 3176 r-k pairs
 r = 0.282 , 95% CL = 0.163 - 0.487 , k = 1256 , 95% CL = 519 - 3038
 MSY = 88.6 , 95% CL = 45.8 - 172
Relative biomass last year= 0.801 k, 2.5th = 0.535 , 97.5th = 0.894
Relative biomass next year= 0.803 k, 2.5th = 0.535 , 97.5th = 0.895
Relative exploitation rate in last year= 0.336
 Comment: Simulated data
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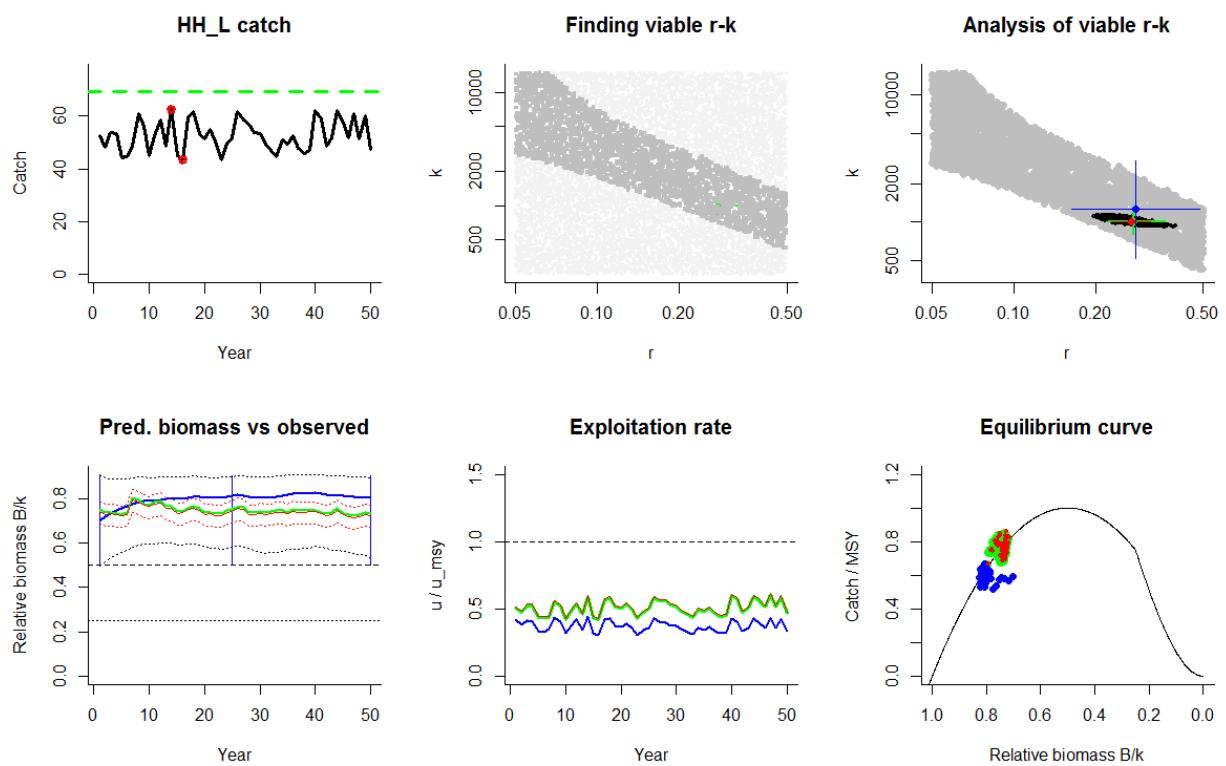
Species: NA , stock: HH_M
 Name and region: NA , NA
 Catch data used from years 1 - 50 , biomass = observed
 Prior initial relative biomass = 0.5 - 0.9
 Prior intermediate rel. biomass= 0.5 - 0.9 in year 25
 Prior final relative biomass   = 0.5 - 0.9
 Prior range for r = 0.2 - 0.8 , prior range for k = 193 - 4638
True values used in simulation: r = 0.352 , k = 1000 , MSY = 88
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.498 , 95% CL = 0.435 - 0.565 , k = 909 , 95% CL = 881 - 943
 MSY = 113 , 95% CL = 102 - 125
Biomass in last year = 744 or 0.818 k
 Exploitation rate in last year = 0.0867 or 0.348 u.msy
 Results of CMSY analysis with altogether 36751 viable trajectories for 3632 r-k pairs
 r = 0.566 , 95% CL = 0.407 - 0.785 , k = 783 , 95% CL = 404 - 1518
 MSY = 111 , 95% CL = 57.5 - 213
Relative biomass last year= 0.816 k, 2.5th = 0.569 , 97.5th = 0.897
Relative biomass next year= 0.818 k, 2.5th = 0.571 , 97.5th = 0.901
Relative exploitation rate in last year= 0.383
Comment: Simulated data
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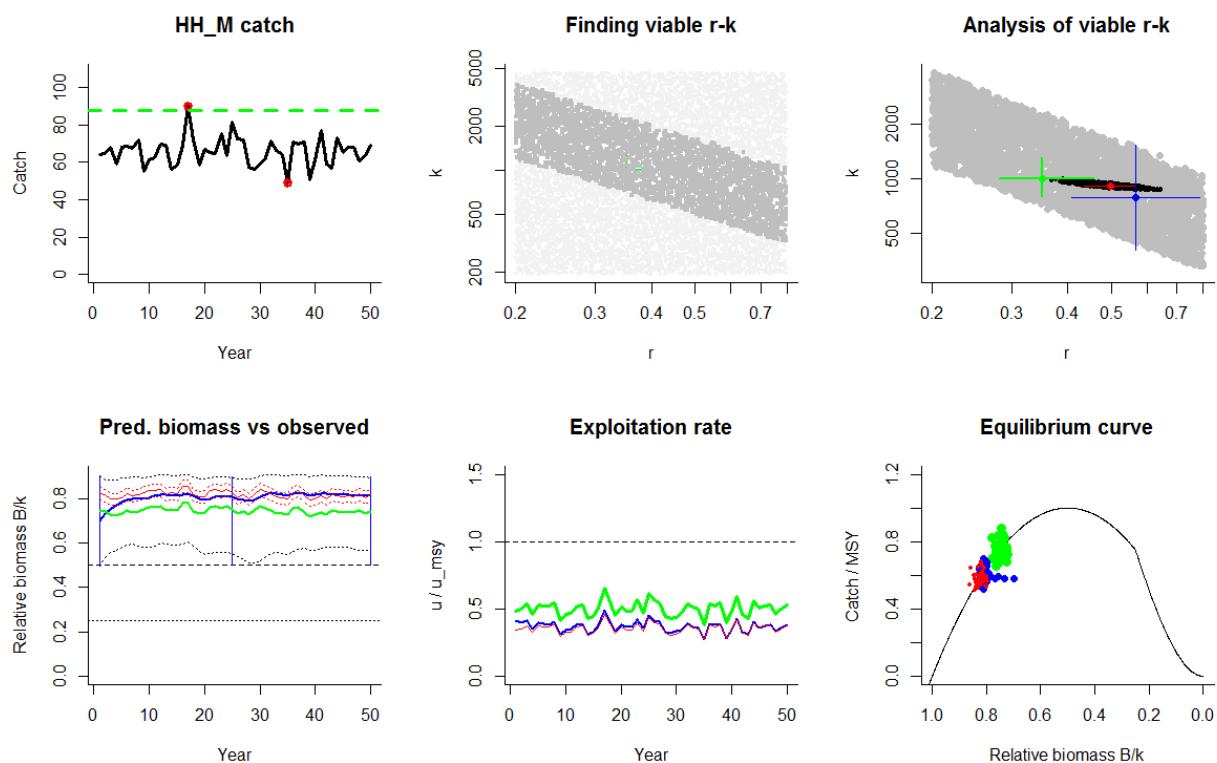
Species: NA , stock: HH_VL
 Name and region: NA , NA
 Catch data used from years 1 - 50 , biomass = observed
 Prior initial relative biomass = 0.5 - 0.9
 Prior intermediate rel. biomass= 0.5 - 0.9 in year 25
 Prior final relative biomass   = 0.5 - 0.9
 Prior range for r = 0.015 - 0.1 , prior range for k = 199 - 7966
True values used in simulation: r = 0.047 , k = 1000 , MSY = 11.8
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.0495 , 95% CL = 0.0244 - 0.0797 , k = 1022 , 95% CL = 877 - 1274
 MSY = 12.6 , 95% CL = 6.8 - 18.4
Biomass in last year = 734 or 0.718 k
 Exploitation rate in last year = 0.0121 or 0.489 u.msy
 Results of CMSY analysis with altogether 53529 viable trajectories for 6256 r-k pairs
 r = 0.062 , 95% CL = 0.0397 - 0.097 , k = 1250 , 95% CL = 402 - 3887
 MSY = 19.4 , 95% CL = 5.03 - 74.7
Relative biomass last year= 0.805 k, 2.5th = 0.527 , 97.5th = 0.897
Relative biomass next year= 0.806 k, 2.5th = 0.525 , 97.5th = 0.898
Relative exploitation rate in last year= 0.31
 Comment: Simulated data
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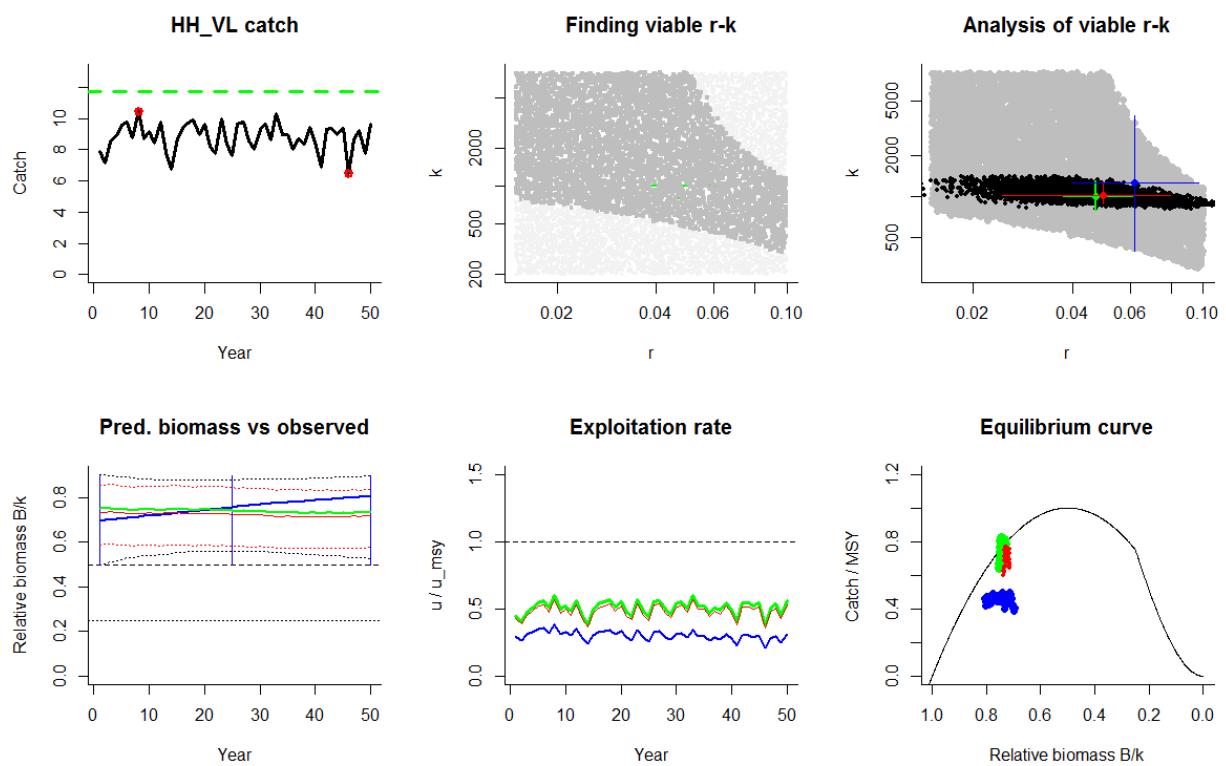
Species: NA , stock: HL_H
Name and region: NA , NA
Catch data used from years 1 - 50 , biomass = observed
Prior initial relative biomass = 0.5 - 0.9
Prior intermediate rel. biomass= 0.01 - 0.4 in year 25
Prior final relative biomass   = 0.01 - 0.4
Prior range for r = 0.6 - 1.5 , prior range for k = 191 - 1913
True values used in simulation: r = 0.86 , k = 1000 , MSY = 215
Results from Bayesian Schaefer model using catch & observed biomass
r = 0.939 , 95% CL = 0.884 - 1.01 , k = 955 , 95% CL = 900 - 1010
MSY = 225 , 95% CL = 217 - 234
Biomass in last year = 298 or 0.312 k
Exploitation rate in last year = 0.531 or 1.13 u.msy
Results of CMSY analysis with altogether 72 viable trajectories for 72 r-k pairs
r = 1.09 , 95% CL = 0.883 - 1.44 , k = 842 , 95% CL = 607 - 1096
MSY = 230 , 95% CL = 207 - 254
Relative biomass last year= 0.33 k, 2.5th = 0.105 , 97.5th = 0.391
Relative biomass next year= 0.363 k, 2.5th = -0.0457 , 97.5th = 0.553
Relative exploitation rate in last year= 1.01
Comment: Simulated data
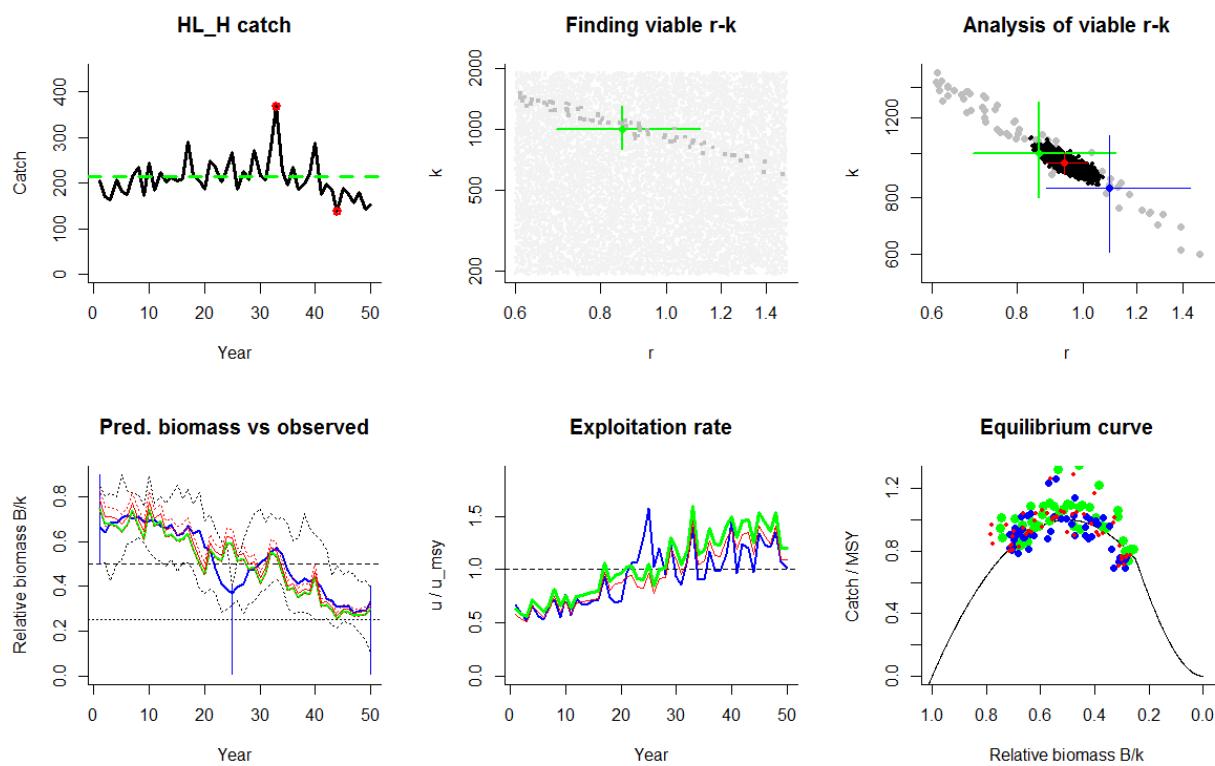
Species: NA , stock: HL_L
 Name and region: NA , NA
 Catch data used from years 1 - 50 , biomass = observed
 Prior initial relative biomass = 0.5 - 0.9
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 25
 Prior final relative biomass   = 0.01 - 0.4
 Prior range for r = 0.05 - 0.5 , prior range for k = 194 - 7754
True values used in simulation: r = 0.29 , k = 1000 , MSY = 72.5
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.293 , 95% CL = 0.275 - 0.313 , k = 995 , 95% CL = 923 - 1072
 MSY = 72.9 , 95% CL = 67.5 - 78.8
Biomass in last year = 55.4 or 0.0557 k
 Exploitation rate in last year = 0.259 or 1.76 u.msy
Results of CMSY analysis with altogether 2910 viable trajectories for 1426 r-k pairs
 r = 0.229 , 95% CL = 0.142 - 0.387 , k = 1207 , 95% CL = 669 - 2071
 MSY = 69 , 95% CL = 60.7 - 78.4
Relative biomass last year= 0.227 k, 2.5th = 0.0186 , 97.5th = 0.396
Relative biomass next year= 0.244 k, 2.5th = 0.0081 , 97.5th = 0.431
Relative exploitation rate in last year= 0.37
Comment: Simulated data
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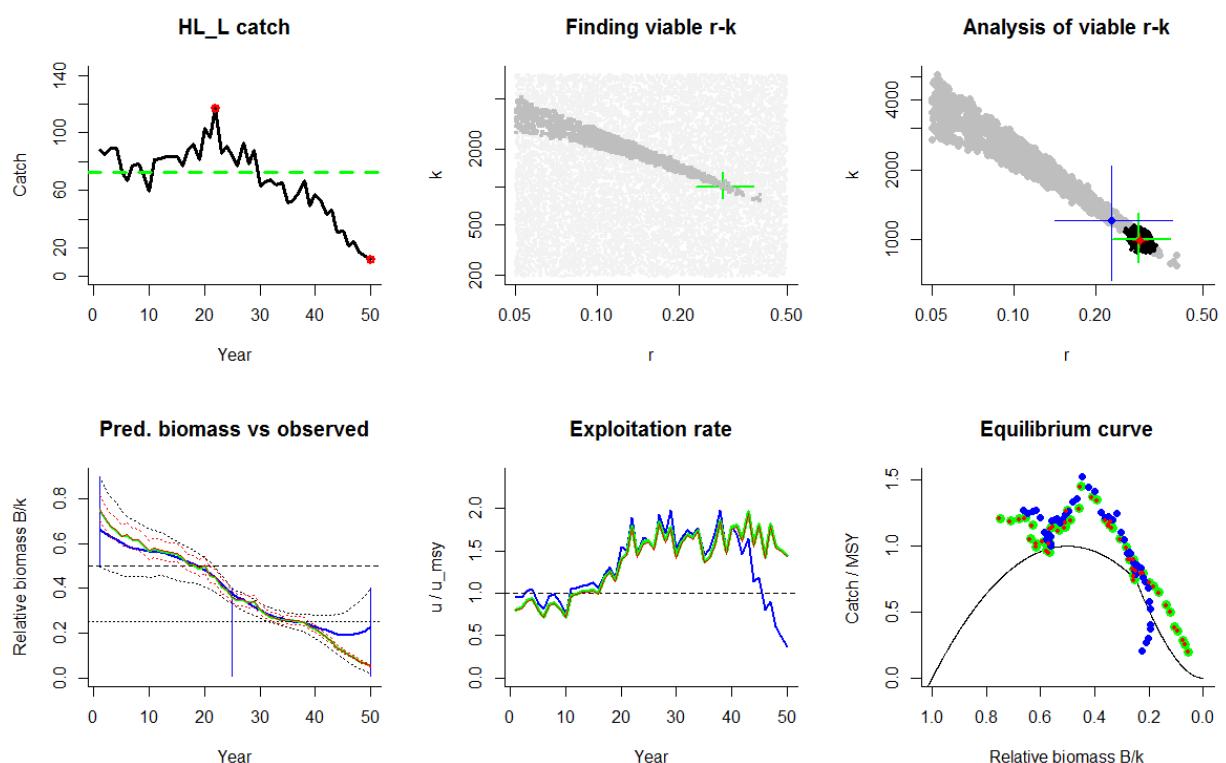
Species: NA , stock: HL_M
 Name and region: NA , NA
 Catch data used from years 1 - 50 , biomass = observed
 Prior initial relative biomass = 0.5 - 0.9
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 25
 Prior final relative biomass   = 0.01 - 0.4
 Prior range for r = 0.2 - 0.8 , prior range for k = 192 - 3079
True values used in simulation: r = 0.48 , k = 1000 , MSY = 120
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.504 , 95% CL = 0.452 - 0.58 , k = 611 , 95% CL = 522 - 718
 MSY = 77.3 , 95% CL = 63.5 - 95
Biomass in last year = 1.2 or 0.00196 k
 Exploitation rate in last year = 0.66 or 2.62 u.msy
Results of CMSY analysis with altogether 1389 viable trajectories for 1010 r-k pairs
 r = 0.408 , 95% CL = 0.324 - 0.606 , k = 1125 , 95% CL = 728 - 1473
 MSY = 115 , 95% CL = 106 - 124
Relative biomass last year= 0.109 k, 2.5th = 0.0138 , 97.5th = 0.378
Relative biomass next year= 0.126 k, 2.5th = 0.0135 , 97.5th = 0.464
Relative exploitation rate in last year= 0.0177
Comment: Simulated data
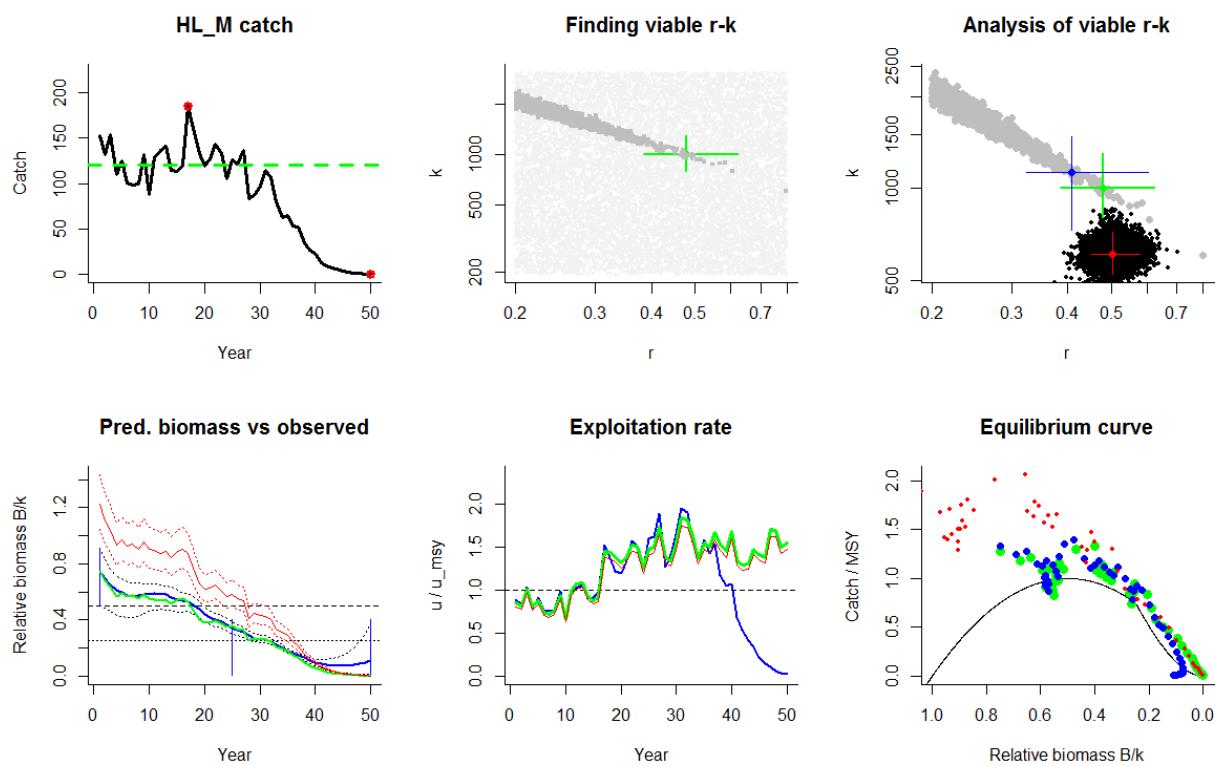
Species: NA , stock: HL_VL
 Name and region: NA , NA
 Catch data used from years 1 - 50 , biomass = observed
 Prior initial relative biomass = 0.5 - 0.9
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 25
 Prior final relative biomass   = 0.01 - 0.4
 Prior range for r = 0.015 - 0.1 , prior range for k = 481 - 12824
True values used in simulation: r = 0.068 , k = 1000 , MSY = 17
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.0683 , 95% CL = 0.0553 - 0.0833 , k = 1055 , 95% CL = 894 - 1202
 MSY = 18 , 95% CL = 14 - 22.7
Biomass in last year = 60.9 or 0.0577 k
 Exploitation rate in last year = 0.0909 or 2.66 u.msy
Results of CMSY analysis with altogether 8501 viable trajectories for 2468 r-k pairs
 r = 0.062 , 95% CL = 0.0397 - 0.097 , k = 1163 , 95% CL = 603 - 2244
 MSY = 18 , 95% CL = 11.9 - 27.3
Relative biomass last year= 0.265 k, 2.5th = 0.0175 , 97.5th = 0.396
Relative biomass next year= 0.271 k, 2.5th = 0.0125 , 97.5th = 0.406
Relative exploitation rate in last year= 0.513
Comment: Simulated data
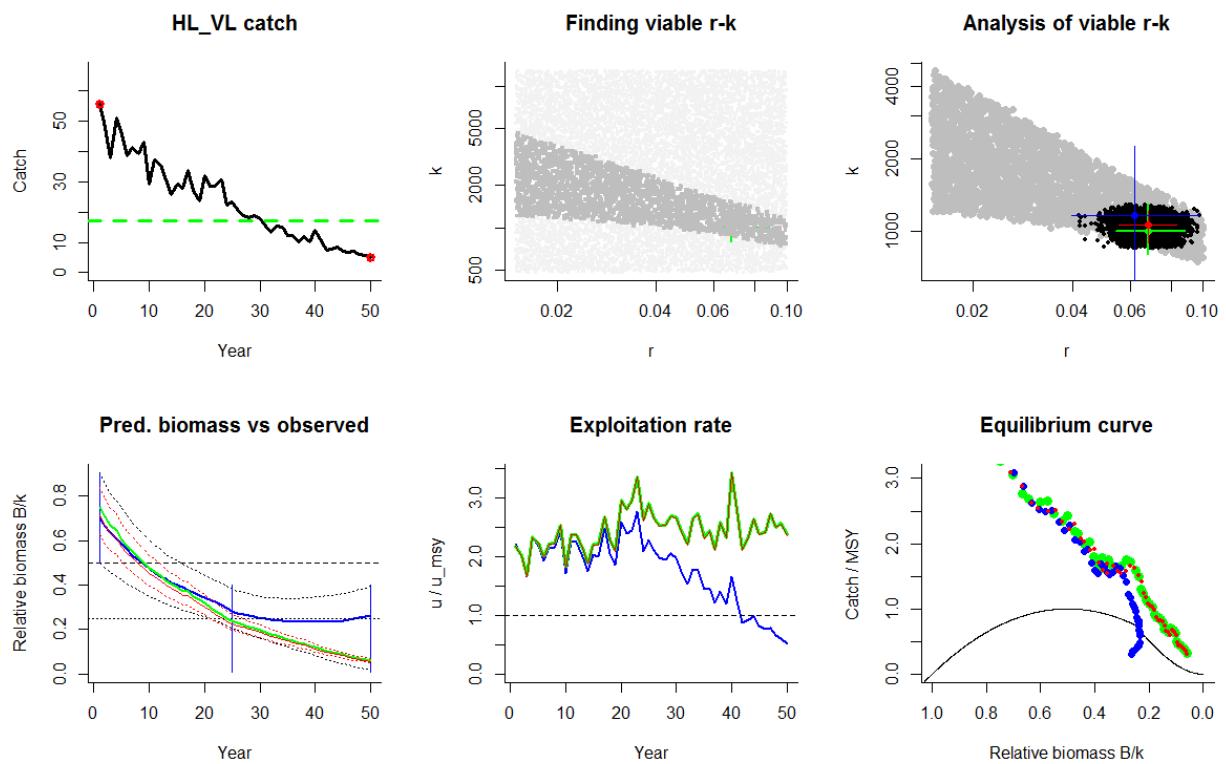
Species: NA , stock: HLH_H
 Name and region: NA , NA
 Catch data used from years 1 - 50 , biomass = observed
 Prior initial relative biomass = 0.5 - 0.9
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 25
 Prior final relative biomass   = 0.5 - 0.9
 Prior range for r = 0.6 - 1.5 , prior range for k = 430 - 6454
True values used in simulation: r = 1.05 , k = 1000 , MSY = 262
Results from Bayesian Schaefer model using catch & observed biomass
 r = 1.06 , 95% CL = 1.02 - 1.13 , k = 973 , 95% CL = 914 - 1030
 MSY = 259 , 95% CL = 248 - 272
Biomass in last year = 736 or 0.756 k
 Exploitation rate in last year = 0.252 or 0.474 u.msy
Results of CMSY analysis with altogether 1627 viable trajectories for 1254 r-k pairs
 r = 1.15 , 95% CL = 0.938 - 1.47 , k = 917 , 95% CL = 690 - 1170
 MSY = 264 , 95% CL = 244 - 285
Relative biomass last year= 0.774 k, 2.5th = 0.714 , 97.5th = 0.824
Relative biomass next year= 0.773 k, 2.5th = 0.712 , 97.5th = 0.836
Relative exploitation rate in last year= 0.466
Comment: Simulated data
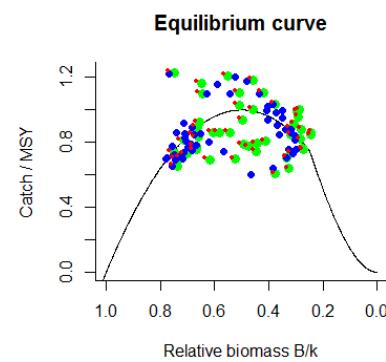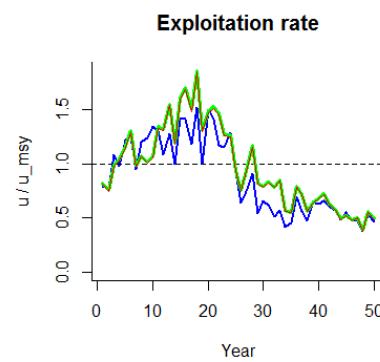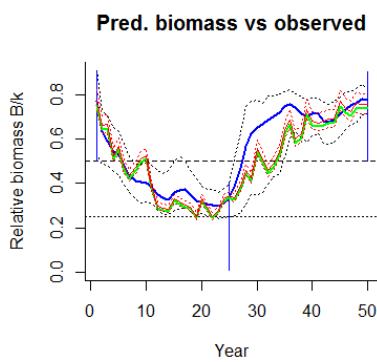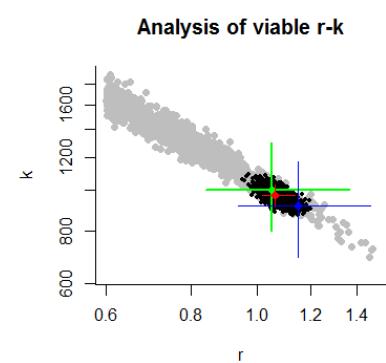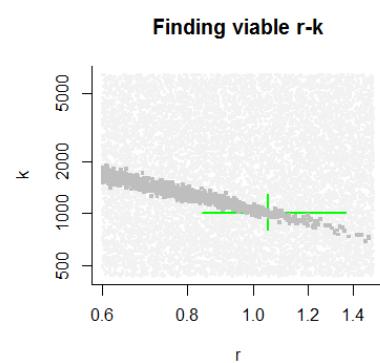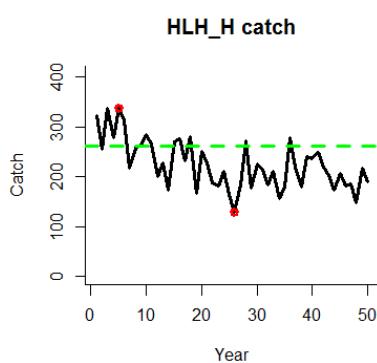
Species: NA , stock: HLH_L
 Name and region: NA , NA
 Catch data used from years 1 - 50 , biomass = observed
 Prior initial relative biomass = 0.5 - 0.9
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 25
 Prior final relative biomass   = 0.5 - 0.9
 Prior range for r = 0.05 - 0.5 , prior range for k = 403 - 24154
True values used in simulation: r = 0.24 , k = 1000 , MSY = 60
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.244 , 95% CL = 0.225 - 0.266 , k = 981 , 95% CL = 890 - 1082
 MSY = 59.8 , 95% CL = 54.5 - 65.9
Biomass in last year = 656 or 0.669 k
 Exploitation rate in last year = 0.06 or 0.492 u.msy
 Results of CMSY analysis with altogether 2215 viable trajectories for 756 r-k pairs
 r = 0.279 , 95% CL = 0.16 - 0.488 , k = 930 , 95% CL = 481 - 1797
 MSY = 65 , 95% CL = 53.2 - 79.3
Relative biomass last year= 0.814 k, 2.5th = 0.587 , 97.5th = 0.87
Relative biomass next year= 0.814 k, 2.5th = 0.594 , 97.5th = 0.865
Relative exploitation rate in last year= 0.369
Comment: Simulated data
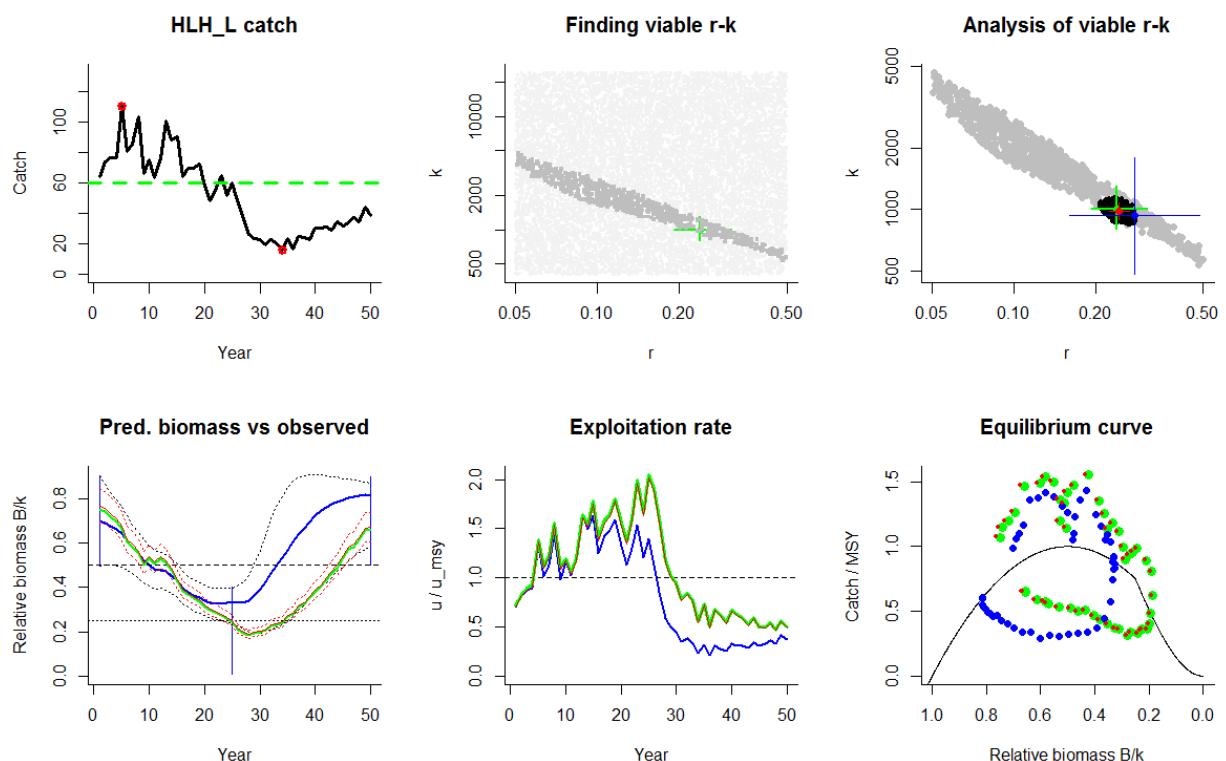
Species: NA , stock: HLH_M
Name and region: NA , NA
Catch data used from years 1 - 50 , biomass = observed
Prior initial relative biomass = 0.5 - 0.9
Prior intermediate rel. biomass= 0.01 - 0.4 in year 25
Prior final relative biomass   = 0.5 - 0.9
Prior range for r = 0.2 - 0.8 , prior range for k = 301 - 7236
True values used in simulation: r = 0.32 , k = 1000 , MSY = 80
Results from Bayesian Schaefer model using catch & observed biomass
r = 0.357 , 95% CL = 0.326 - 0.393 , k = 920 , 95% CL = 851 - 1015
MSY = 82.2 , 95% CL = 77.6 - 87.6
Biomass in last year = 748 or 0.813 k
Exploitation rate in last year = 0.0772 or 0.432 u.msy
Results of CMSY analysis with altogether 1720 viable trajectories for 603 r-k pairs
r = 0.513 , 95% CL = 0.381 - 0.777 , k = 662 , 95% CL = 411 - 947
MSY = 84.9 , 95% CL = 75.2 - 95.8
Relative biomass last year= 0.774 k, 2.5th = 0.715 , 97.5th = 0.821
Relative biomass next year= 0.774 k, 2.5th = 0.713 , 97.5th = 0.82
Relative exploitation rate in last year= 0.469
Comment: Simulated data
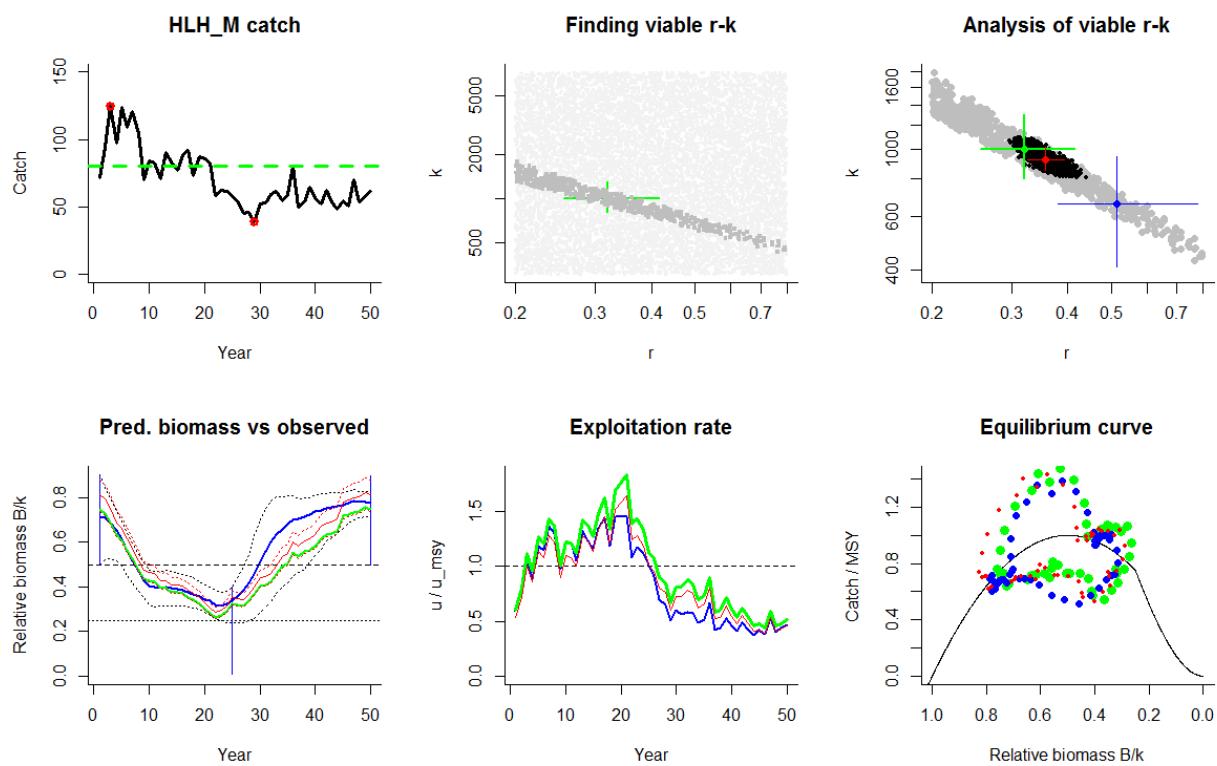
Species: NA , stock: HLH_VL
 Name and region: NA , NA
 Catch data used from years 1 - 50 , biomass = observed
 Prior initial relative biomass = 0.5 - 0.9
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 25
 Prior final relative biomass   = 0.5 - 0.9
 Prior range for r = 0.015 - 0.1 , prior range for k = 821 - 65668
True values used in simulation: r = 0.058 , k = 1000 , MSY = 14.5
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.0736 , 95% CL = 0.057 - 0.0927 , k = 1052 , 95% CL = 900 - 1197
 MSY = 19.3 , 95% CL = 15.1 - 23.8
Biomass in last year = 717 or 0.681 k
 Exploitation rate in last year = 0.00279 or 0.0757 u.msy
 Results of CMSY analysis with altogether 5020 viable trajectories for 2662 r-k pairs
 r = 0.0646 , 95% CL = 0.0429 - 0.0971 , k = 1318 , 95% CL = 657 - 2648
 MSY = 21.3 , 95% CL = 12.1 - 37.5
 Relative biomass last year= 0.648 k, 2.5th = 0.509 , 97.5th = 0.829
 Relative biomass next year= 0.659 k, 2.5th = 0.521 , 97.5th = 0.84
 Relative exploitation rate in last year= 0.0628
 Comment: Simulated data
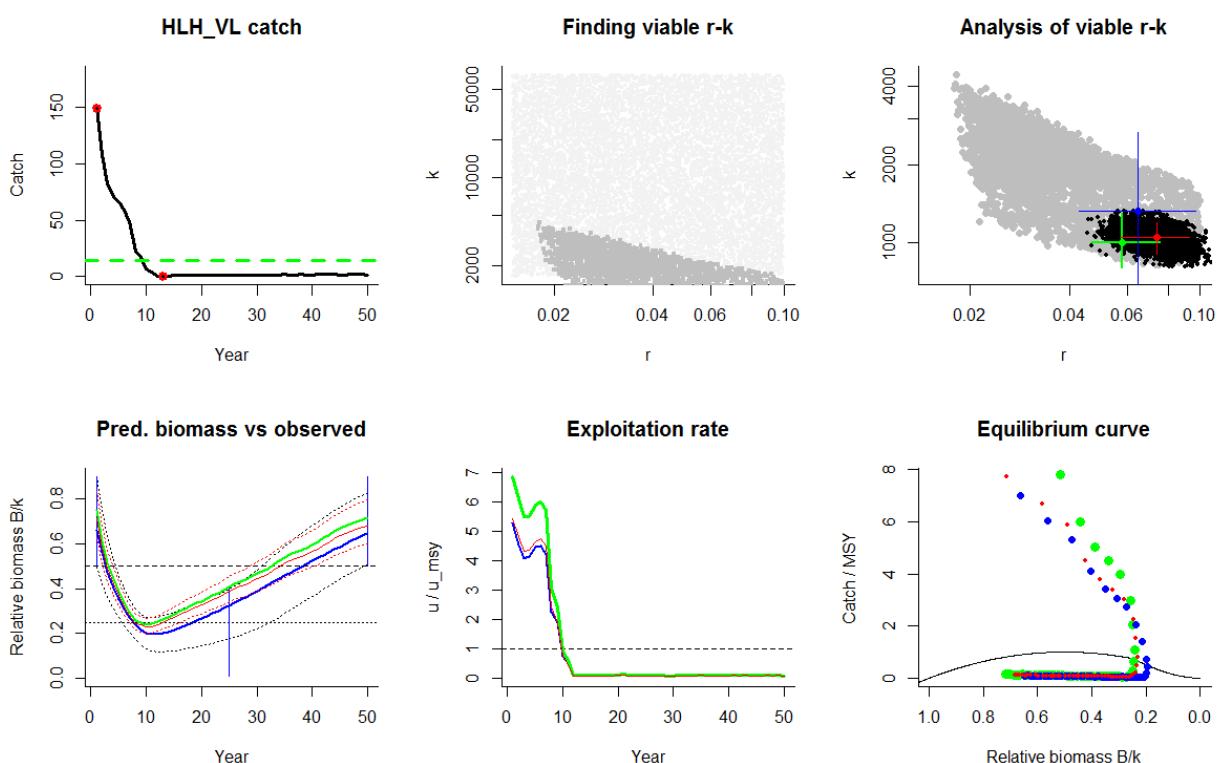
Species: NA , stock: LH_H
 Name and region: NA , NA
 Catch data used from years 1 - 50 , biomass = observed
 Prior initial relative biomass = 0.01 - 0.4
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 25
 Prior final relative biomass   = 0.5 - 0.9
 Prior range for r = 0.6 - 1.5 , prior range for k = 296 - 4438
True values used in simulation: r = 0.79 , k = 1000 , MSY = 198
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.877 , 95% CL = 0.824 - 0.942 , k = 934 , 95% CL = 890 - 980
 MSY = 205 , 95% CL = 196 - 216
Biomass in last year = 724 or 0.775 k
 Exploitation rate in last year = 0.217 or 0.494 u.msy
Results of CMSY analysis with altogether 1932 viable trajectories for 1405 r-k pairs
r = 1.19 , 95% CL = 0.957 - 1.48 , k = 661 , 95% CL = 509 - 859
MSY = 197 , 95% CL = 181 - 214
Relative biomass last year= 0.727 k, 2.5th = 0.645 , 97.5th = 0.798
Relative biomass next year= 0.722 k, 2.5th = 0.639 , 97.5th = 0.795
Relative exploitation rate in last year= 0.526
Comment: Simulated data
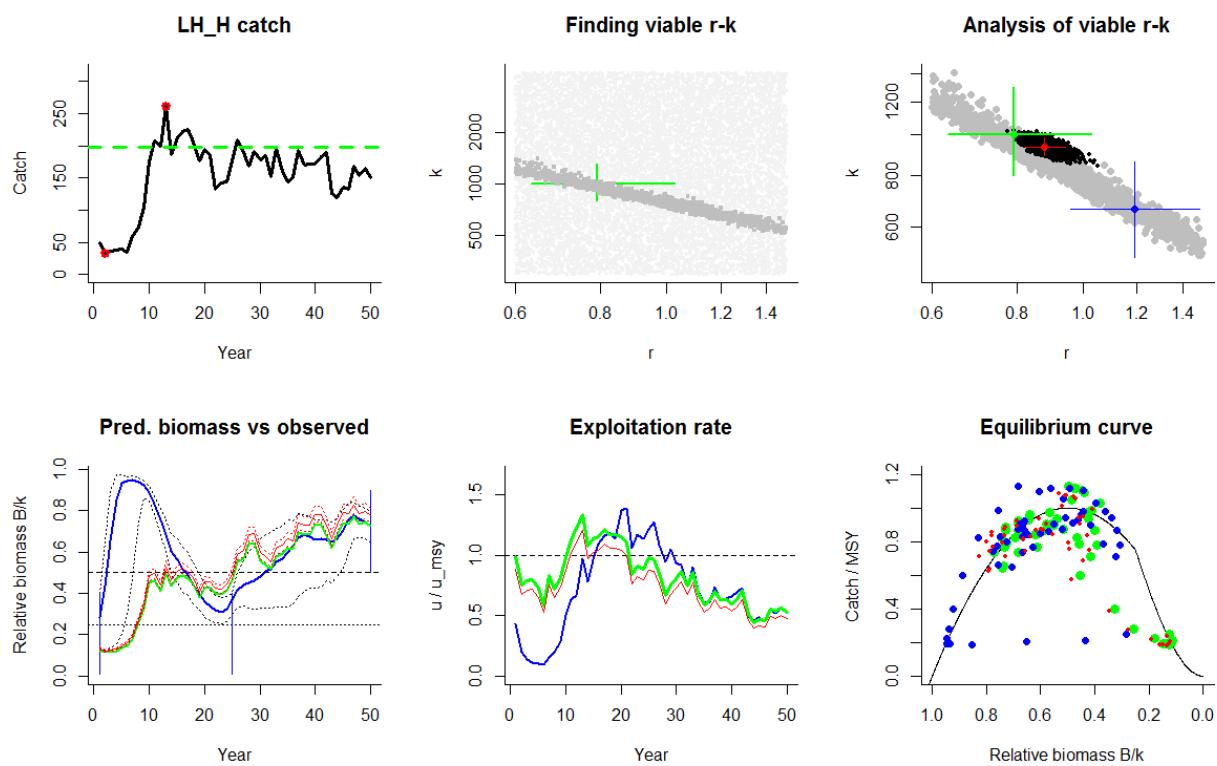
Species: NA , stock: LH_L
 Name and region: NA , NA
 Catch data used from years 1 - 50 , biomass = observed
 Prior initial relative biomass = 0.01 - 0.4
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 25
 Prior final relative biomass   = 0.5 - 0.9
 Prior range for r = 0.05 - 0.5 , prior range for k = 184 - 11070
True values used in simulation: r = 0.24 , k = 1000 , MSY = 60
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.25 , 95% CL = 0.216 - 0.287 , k = 991 , 95% CL = 885 - 4314
 MSY = 61.6 , 95% CL = 53.9 - 299
Biomass in last year = 723 or 0.729 k
 Exploitation rate in last year = 0.0582 or 0.466 u.msy
Results of CMSY analysis with altogether 2973 viable trajectories for 2955 r-k pairs
r = 0.262 , 95% CL = 0.155 - 0.456 , k = 2299 , 95% CL = 660 - 7745
MSY = 150 , 95% CL = 38.7 - 584
Relative biomass last year= 0.836 k, 2.5th = 0.525 , 97.5th = 0.894
Relative biomass next year= 0.843 k, 2.5th = 0.539 , 97.5th = 0.903
Relative exploitation rate in last year= 0.169
Comment: Simulated data
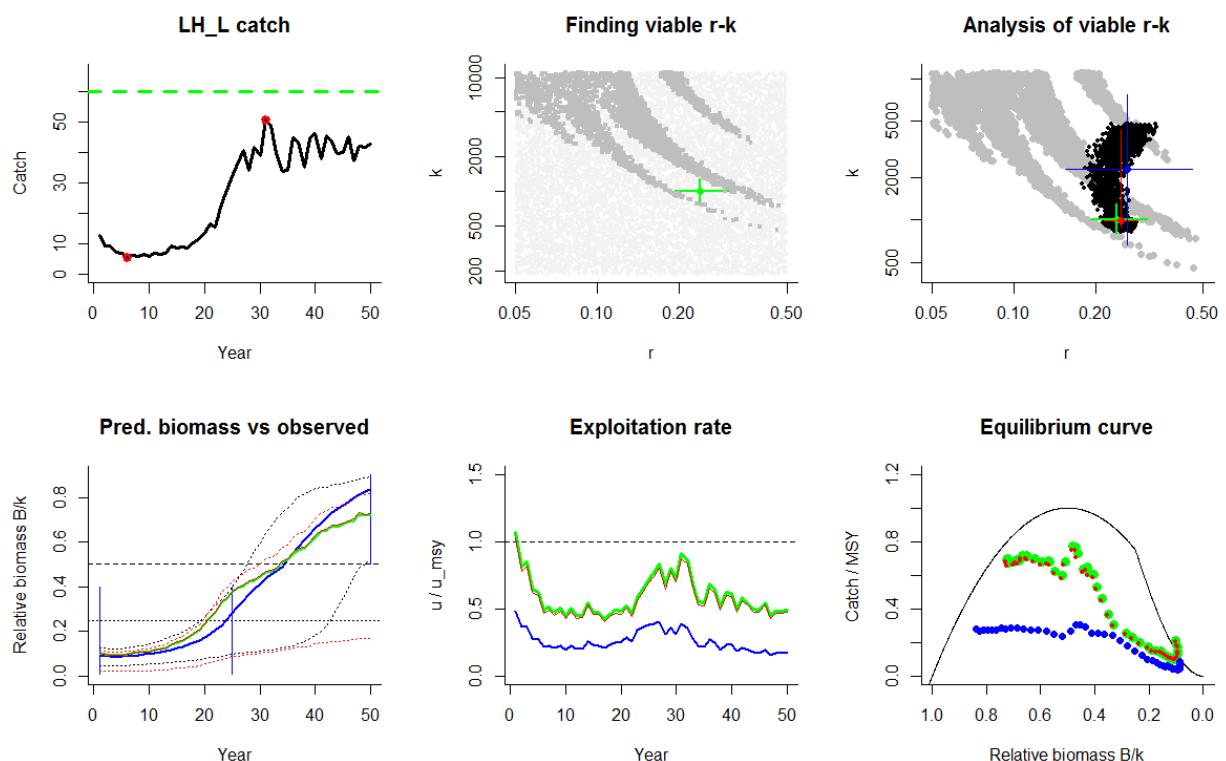
Species: NA , stock: LH_M
 Name and region: NA , NA
 Catch data used from years 1 - 50 , biomass = observed
 Prior initial relative biomass = 0.01 - 0.4
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 25
 Prior final relative biomass   = 0.5 - 0.9
 Prior range for r = 0.2 - 0.8 , prior range for k = 449 - 10787
True values used in simulation: r = 0.71 , k = 1000 , MSY = 178
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.661 , 95% CL = 0.612 - 0.704 , k = 997 , 95% CL = 949 - 1056
 MSY = 165 , 95% CL = 156 - 173
Biomass in last year = 801 or 0.804 k
 Exploitation rate in last year = 0.176 or 0.533 u.msy
Results of CMSY analysis with altogether 2109 viable trajectories for 1737 r-k pairs
 r = 0.571 , 95% CL = 0.397 - 0.785 , k = 1176 , 95% CL = 686 - 2110
 MSY = 168 , 95% CL = 109 - 259
Relative biomass last year= 0.659 k, 2.5th = 0.52 , 97.5th = 0.832
Relative biomass next year= 0.655 k, 2.5th = 0.522 , 97.5th = 0.826
Relative exploitation rate in last year= 0.607
 Comment: Simulated data
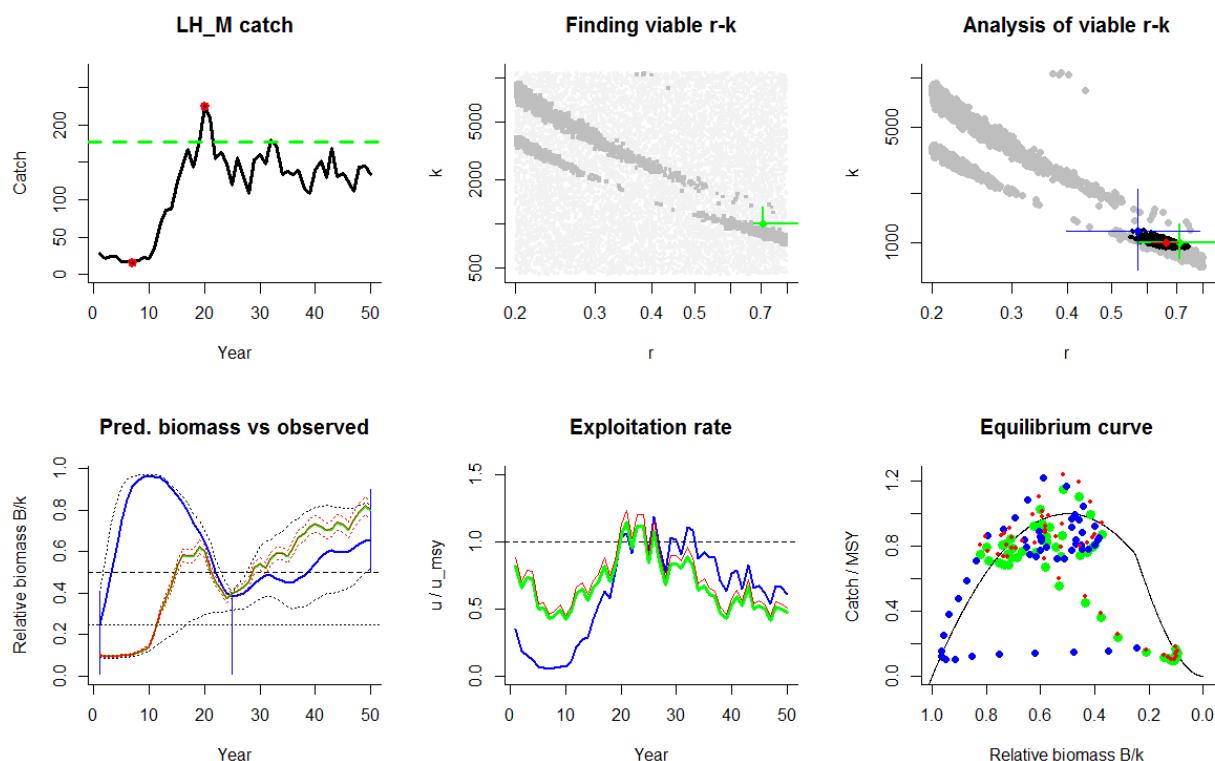
Species: NA , stock: LH_VL
 Name and region: NA , NA
 Catch data used from years 1 - 50 , biomass = observed
 Prior initial relative biomass = 0.01 - 0.4
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 25
 Prior final relative biomass   = 0.5 - 0.9
 Prior range for r = 0.015 - 0.1 , prior range for k = 22.9 - 915
True values used in simulation: r = 0.039 , k = 1000 , MSY = 9.75
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.0465 , 95% CL = 0.0316 - 0.0641 , k = 906 , 95% CL = 568 - 1424
 MSY = 10.2 , 95% CL = 6.88 - 15.8
Biomass in last year = 597 or 0.659 k
 Exploitation rate in last year = 0.00174 or 0.0748 u.msy
Results of CMSY analysis with altogether 4315 viable trajectories for 3643 r-k pairs
 r = 0.0682 , 95% CL = 0.0478 - 0.0974 , k = 280 , 95% CL = 96.3 - 812
 MSY = 4.77 , 95% CL = 1.19 - 19.2
Relative biomass last year= 0.623 k, 2.5th = 0.504 , 97.5th = 0.821
Relative biomass next year= 0.633 k, 2.5th = 0.515 , 97.5th = 0.831
Relative exploitation rate in last year= 0.178
 Comment: Simulated data
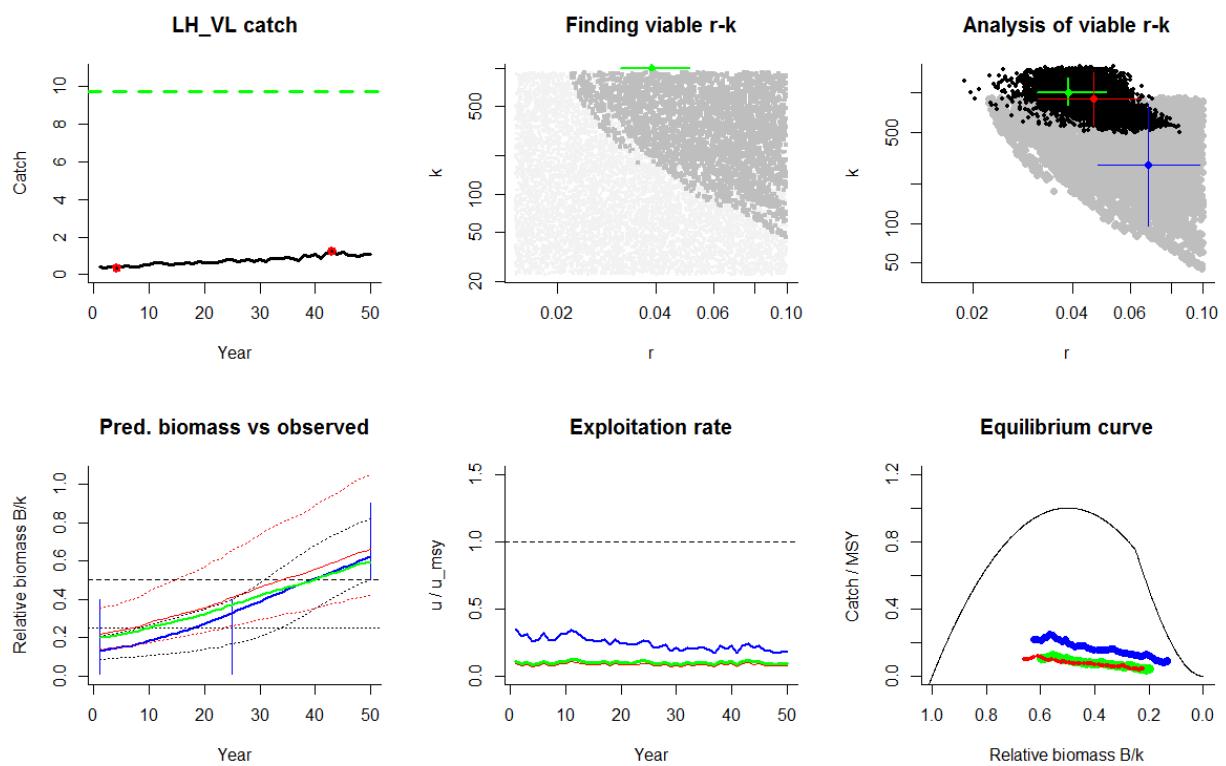
Species: NA , stock: LHL_H
Name and region: NA , NA
Catch data used from years 1 - 50 , biomass = observed
Prior initial relative biomass = 0.01 - 0.4
Prior intermediate rel. biomass= 0.2 - 0.6 in year 25
Prior final relative biomass   = 0.01 - 0.4
Prior range for r = 0.6 - 1.5 , prior range for k = 261 - 2610
True values used in simulation: r = 1.19 , k = 1000 , MSY = 298
Results from Bayesian Schaefer model using catch & observed biomass
r = 1.11 , 95% CL = 1.04 - 1.21 , k = 1065 , 95% CL = 971 - 1171
MSY = 296 , 95% CL = 282 - 312
Biomass in last year = 299 or 0.28 k
Exploitation rate in last year = 0.956 or 1.72 u.msy
Results of CMSY analysis with altogether 3498 viable trajectories for 1323 r-k pairs
r = 1.19 , 95% CL = 0.957 - 1.48 , k = 1043 , 95% CL = 801 - 1358
MSY = 311 , 95% CL = 284 - 340
Relative biomass last year= 0.273 k, 2.5th = 0.0312 , 97.5th = 0.394
Relative biomass next year= 0.232 k, 2.5th = -0.264 , 97.5th = 0.434
Relative exploitation rate in last year= 1.71
Comment: Simulated data
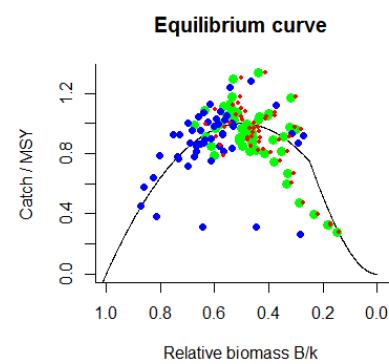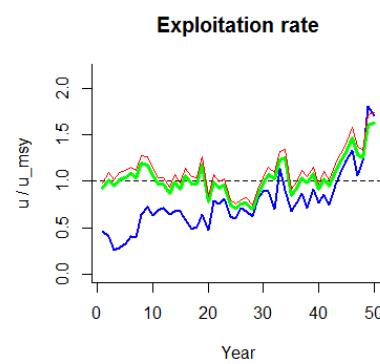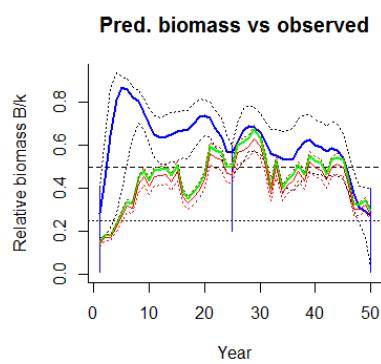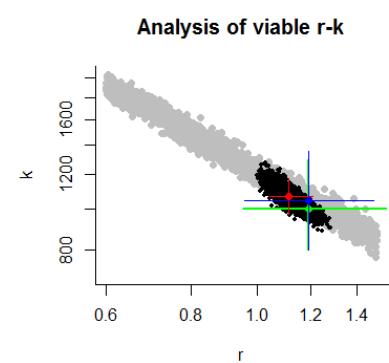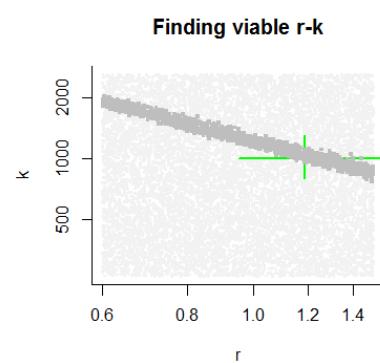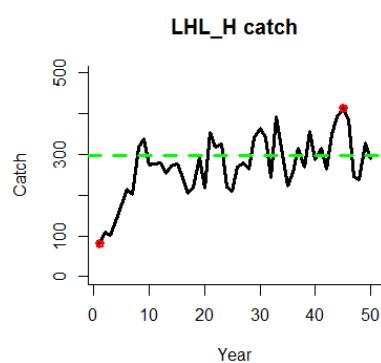
Species: NA , stock: LHL_L
 Name and region: NA , NA
 Catch data used from years 1 - 50 , biomass = observed
 Prior initial relative biomass = 0.01 - 0.4
 Prior intermediate rel. biomass= 0.2 - 0.6 in year 25
 Prior final relative biomass   = 0.01 - 0.4
 Prior range for r = 0.05 - 0.5 , prior range for k = 263 - 10526
True values used in simulation: r = 0.33 , k = 1000 , MSY = 82.5
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.353 , 95% CL = 0.332 - 0.374 , k = 946 , 95% CL = 897 - 1006
 MSY = 83.7 , 95% CL = 77.7 - 89.6
Biomass in last year = 144 or 0.152 k
 Exploitation rate in last year = 0.28 or 1.58 u.msy
 Results of CMSY analysis with altogether 3856 viable trajectories for 2213 r-k pairs
 r = 0.177 , 95% CL = 0.119 - 0.385 , k = 1819 , 95% CL = 691 - 3285
 MSY = 80.6 , 95% CL = 55.3 - 117
Relative biomass last year= 0.276 k, 2.5th = 0.0197 , 97.5th = 0.395
Relative biomass next year= 0.289 k, 2.5th = 0.00235 , 97.5th = 0.412
Relative exploitation rate in last year= 0.718
Comment: Simulated data
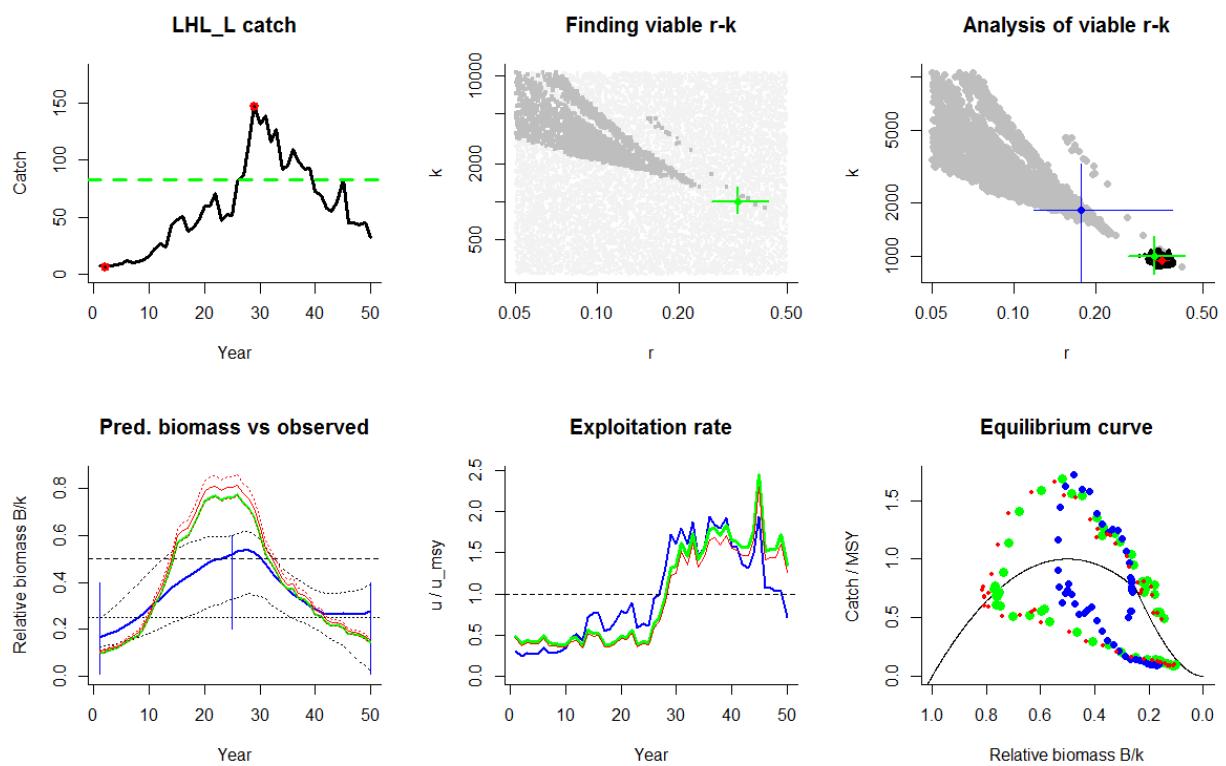
Species: NA , stock: LHL_M
Name and region: NA , NA
Catch data used from years 1 - 50 , biomass = observed
Prior initial relative biomass = 0.01 - 0.4
Prior intermediate rel. biomass= 0.2 - 0.6 in year 25
Prior final relative biomass = 0.01 - 0.4
Prior range for r = 0.2 - 0.8 , prior range for k = 236 - 3774
True values used in simulation: r = 0.52 , k = 1000 , MSY = 130
Results from Bayesian Schaefer model using catch & observed biomass
r = 0.541 , 95% CL = 0.506 - 0.577 , k = 955 , 95% CL = 884 - 1033
MSY = 129 , 95% CL = 119 - 140
Biomass in last year = 405 or 0.424 k
Exploitation rate in last year = 0.247 or 0.914 u.msy
Results of CMSY analysis with altogether 762 viable trajectories for 762 r-k pairs
r = 0.287 , 95% CL = 0.256 - 0.366 , k = 1698 , 95% CL = 1184 - 2138
MSY = 122 , 95% CL = 96.8 - 153
Relative biomass last year= 0.287 k, 2.5th = 0.0248 , 97.5th = 0.389
Relative biomass next year= 0.278 k, 2.5th = -0.0282 , 97.5th = 0.398
Relative exploitation rate in last year= 1.79
Comment: Simulated data
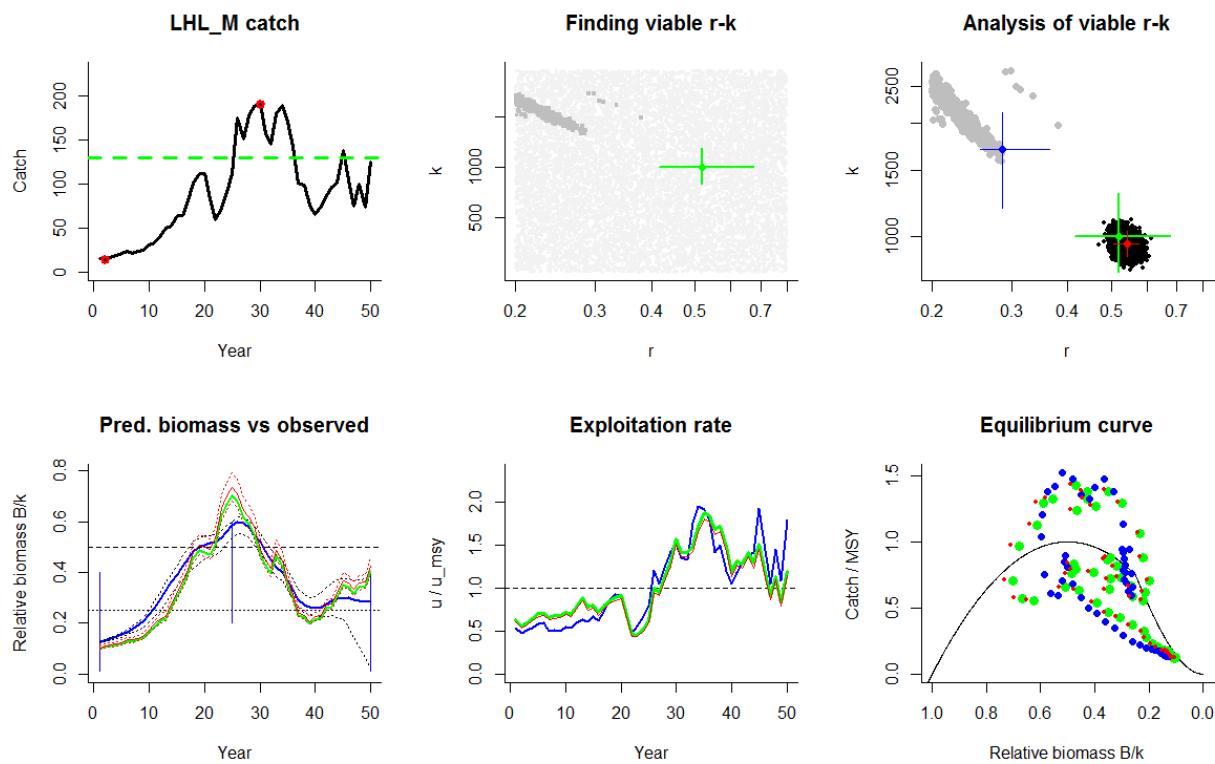
Species: NA , stock: LHL_VL
 Name and region: NA , NA
 Catch data used from years 1 - 50 , biomass = observed
 Prior initial relative biomass = 0.01 - 0.4
 Prior intermediate rel. biomass= 0.2 - 0.6 in year 25
 Prior final relative biomass   = 0.01 - 0.4
 Prior range for r = 0.015 - 0.1 , prior range for k = 202 - 10785
True values used in simulation: r = 0.033 , k = 1000 , MSY = 8.25
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.0434 , 95% CL = 0.0234 - 0.0634 , k = 3308 , 95% CL = 1883 - 4608
 MSY = 36.2 , 95% CL = 12.8 - 67.5
Biomass in last year = 345 or 0.104 k
 Exploitation rate in last year = 0.124 or 5.7 u.msy
Results of CMSY analysis with altogether 37434 viable trajectories for 12580 r-k pairs
 r = 0.062 , 95% CL = 0.0397 - 0.097 , k = 710 , 95% CL = 218 - 2308
 MSY = 11 , 95% CL = 2.62 - 46.3
Relative biomass last year= 0.277 k, 2.5th = 0.0243 , 97.5th = 0.396
Relative biomass next year= 0.205 k, 2.5th = -0.122 , 97.5th = 0.362
Relative exploitation rate in last year= 6.03
Comment: Simulated data
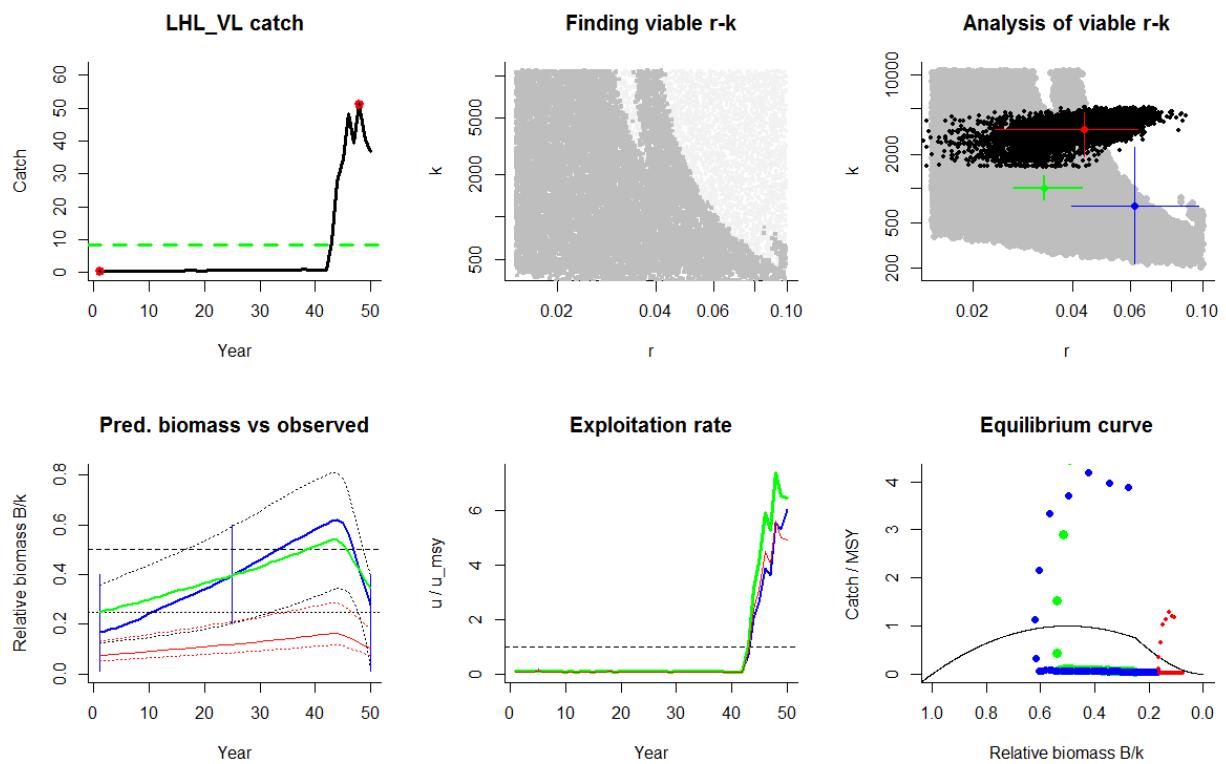
Species: NA , stock: LL_H
 Name and region: NA , NA
 Catch data used from years 1 - 50 , biomass = observed
 Prior initial relative biomass = 0.01 - 0.4
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 25
 Prior final relative biomass = 0.01 - 0.4
 Prior range for r = 0.6 - 1.5 , prior range for k = 206 - 2060
True values used in simulation: r = 0.96 , k = 1000 , MSY = 240
Results from Bayesian Schaefer model using catch & observed biomass
 r = 1.04 , 95% CL = 0.945 - 1.12 , k = 884 , 95% CL = 780 - 1073
 MSY = 230 , 95% CL = 211 - 258
Biomass in last year = 267 or 0.302 k
 Exploitation rate in last year = 0.634 or 1.22 u.msy
 Results of CMSY analysis with altogether 158 viable trajectories for 156 r-k pairs
 r = 1.03 , 95% CL = 0.838 - 1.43 , k = 921 , 95% CL = 623 - 1192
 MSY = 236 , 95% CL = 211 - 264
Relative biomass last year= 0.302 k, 2.5th = 0.0274 , 97.5th = 0.393
Relative biomass next year= 0.317 k, 2.5th = -0.104 , 97.5th = 0.474
Relative exploitation rate in last year= 1.07
Comment: Simulated data
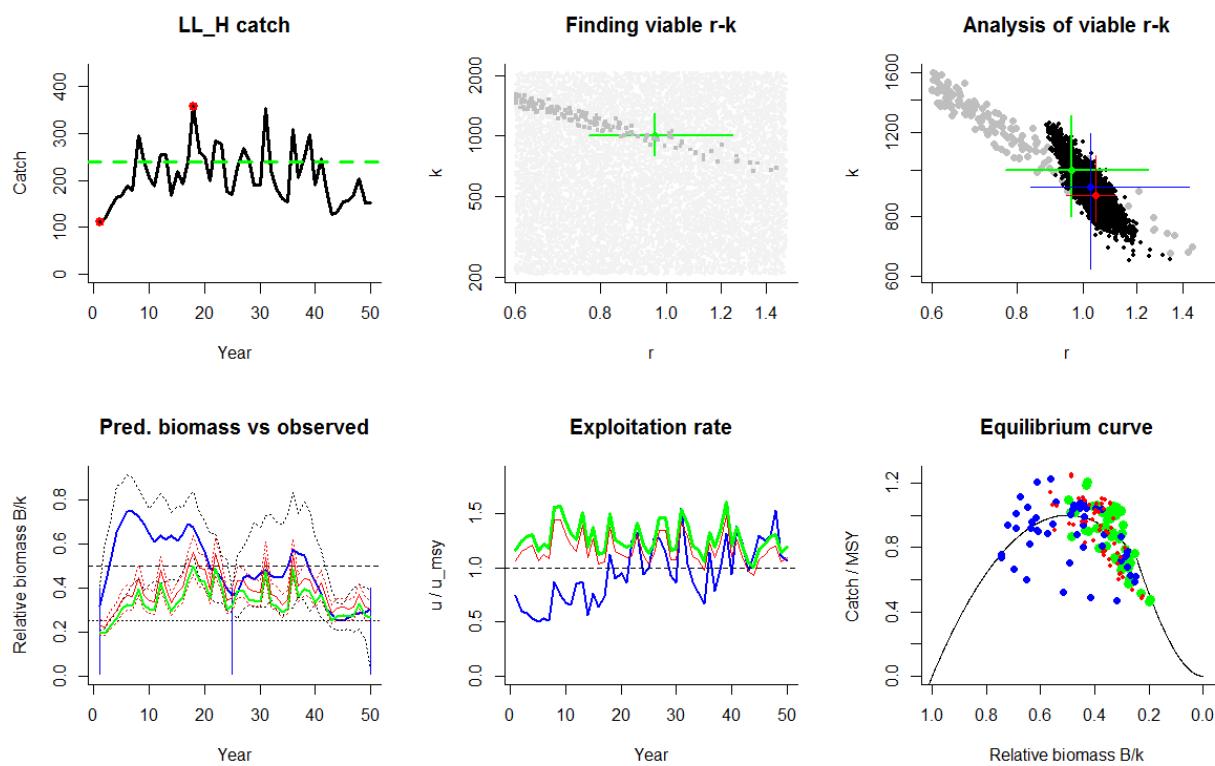
Species: NA , stock: LL_L
 Name and region: NA , NA
 Catch data used from years 1 - 50 , biomass = observed
 Prior initial relative biomass = 0.01 - 0.4
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 25
 Prior final relative biomass   = 0.01 - 0.4
 Prior range for r = 0.05 - 0.5 , prior range for k = 57.4 - 2298
True values used in simulation: r = 0.22 , k = 1000 , MSY = 55
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.273 , 95% CL = 0.205 - 0.32 , k = 1325 , 95% CL = 900 - 1632
 MSY = 90.6 , 95% CL = 46.2 - 129
Biomass in last year = 42.6 or 0.0322 k
 Exploitation rate in last year = 0.189 or 1.39 u.msy
Results of CMSY analysis with altogether 2346 viable trajectories for 1738 r-k pairs
r = 0.204 , 95% CL = 0.132 - 0.317 , k = 565 , 95% CL = 226 - 1415
MSY = 28.9 , 95% CL = 11.3 - 73.7
Relative biomass last year= 0.254 k, 2.5th = 0.0183 , 97.5th = 0.395
Relative biomass next year= 0.267 k, 2.5th = 0.005 , 97.5th = 0.419
Relative exploitation rate in last year= 0.502
Comment: Simulated data
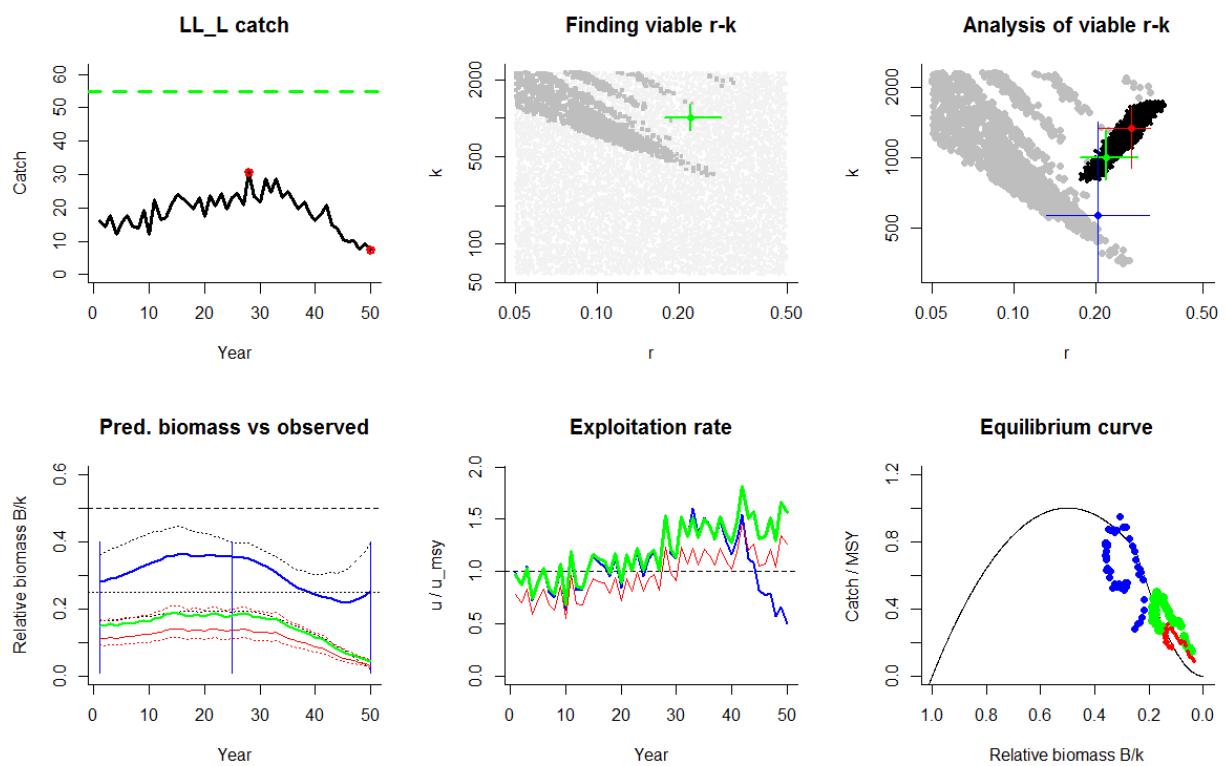
Species: NA , stock: LL_M
 Name and region: NA , NA
 Catch data used from years 1 - 50 , biomass = observed
 Prior initial relative biomass = 0.01 - 0.4
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 25
 Prior final relative biomass   = 0.01 - 0.4
 Prior range for r = 0.2 - 0.8 , prior range for k = 240 - 3837
True values used in simulation: r = 0.6 , k = 1000 , MSY = 150
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.603 , 95% CL = 0.562 - 0.645 , k = 961 , 95% CL = 843 - 1093
 MSY = 144 , 95% CL = 129 - 162
Biomass in last year = 253 or 0.263 k
 Exploitation rate in last year = 0.436 or 1.45 u.msy
Results of CMSY analysis with altogether 1657 viable trajectories for 1499 r-k pairs
 r = 0.553 , 95% CL = 0.401 - 0.785 , k = 964 , 95% CL = 656 - 1374
 MSY = 133 , 95% CL = 125 - 142
Relative biomass last year= 0.32 k, 2.5th = 0.0368 , 97.5th = 0.396
Relative biomass next year= 0.33 k, 2.5th = -0.0651 , 97.5th = 0.429
Relative exploitation rate in last year= 1.38
 Comment: Simulated data
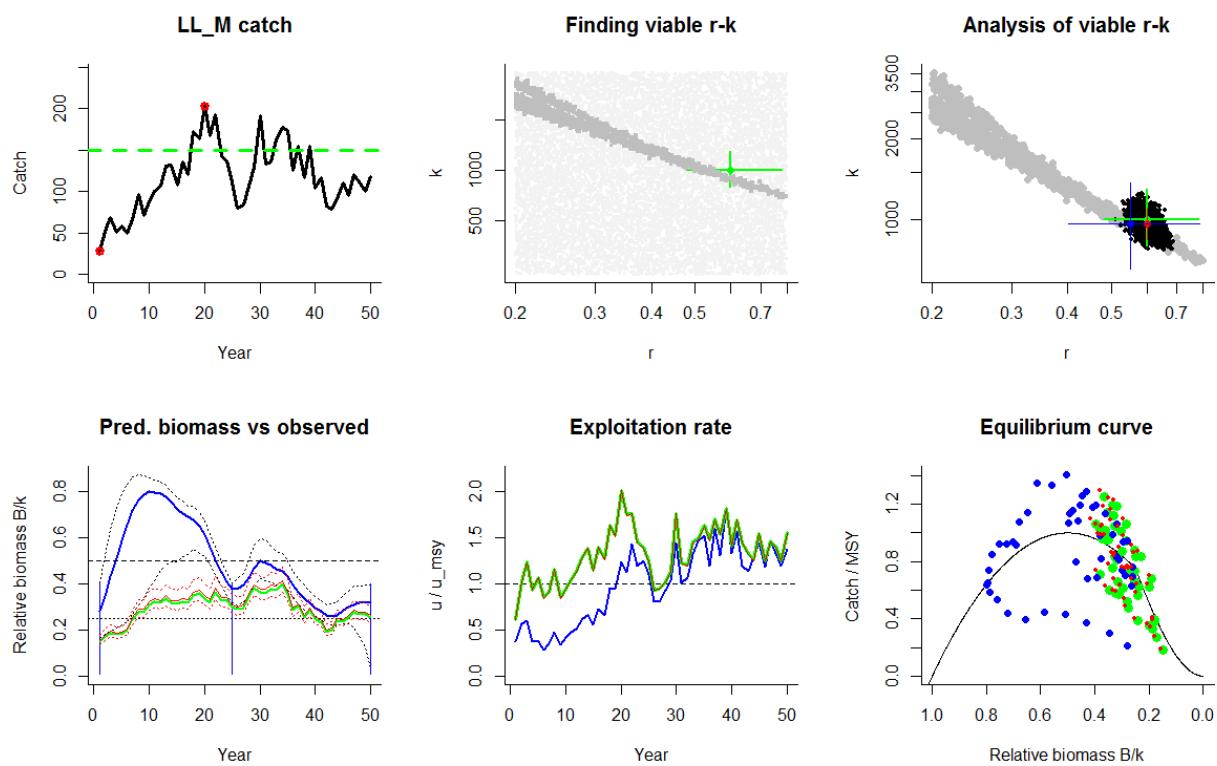
Species: NA , stock: LL_VL
 Name and region: NA , NA
 Catch data used from years 1 - 50 , biomass = observed
 Prior initial relative biomass = 0.01 - 0.4
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 25
 Prior final relative biomass   = 0.01 - 0.4
 Prior range for r = 0.015 - 0.1 , prior range for k = 71.5 - 1908
True values used in simulation: r = 0.078 , k = 1000 , MSY = 19.5
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.0655 , 95% CL = 0.0522 - 0.132 , k = 771 , 95% CL = 610 - 1797
 MSY = 12.5 , 95% CL = 8.34 - 58.7
Biomass in last year = 217 or 0.281 k
 Exploitation rate in last year = 0.0334 or 1.02 u.msy
 Results of CMSY analysis with altogether 10932 viable trajectories for 4284 r-k pairs
 r = 0.062 , 95% CL = 0.0397 - 0.097 , k = 693 , 95% CL = 254 - 1891
 MSY = 10.7 , 95% CL = 3.6 - 32
Relative biomass last year= 0.249 k, 2.5th = 0.016 , 97.5th = 0.396
Relative biomass next year= 0.245 k, 2.5th = 0.00546 , 97.5th = 0.398
Relative exploitation rate in last year= 1.37
 Comment: Simulated data
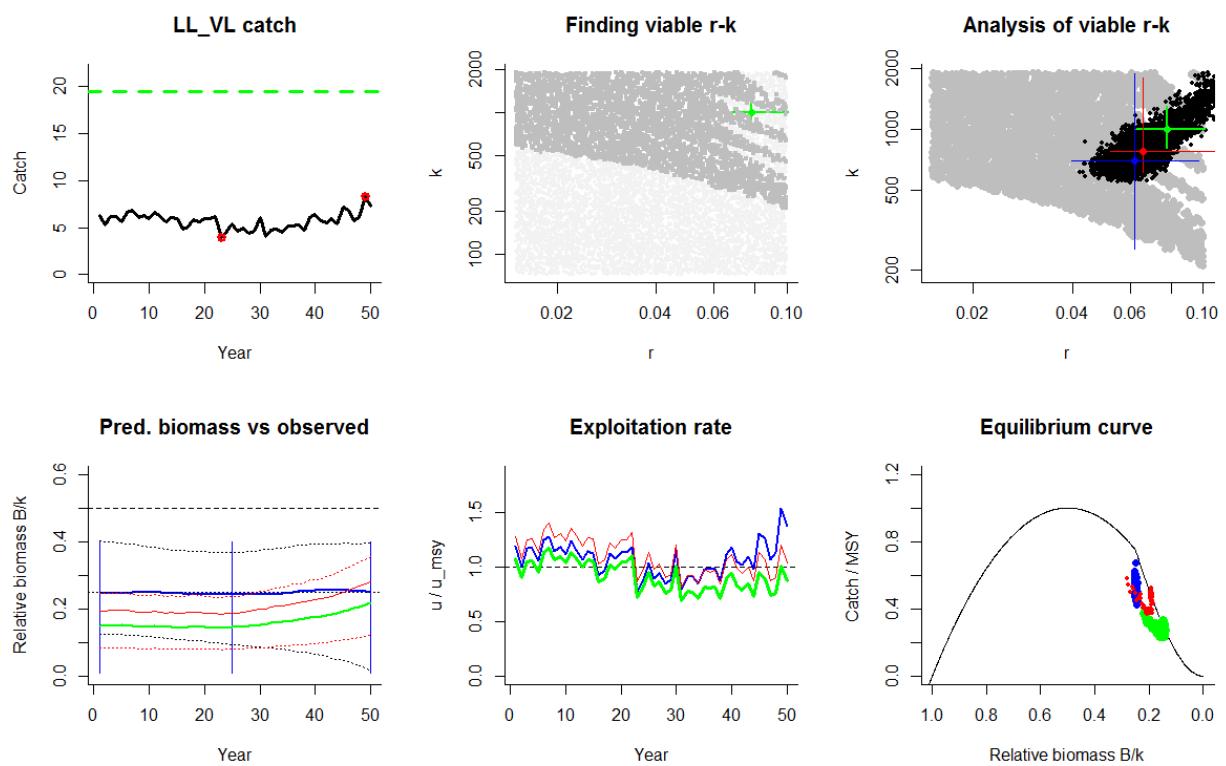
Appendix II: Fully assessed stocks

Region: Alaska

[CMSY_46e.R, AllStocks_ID20.csv, AllStocks_Spec16.csv]
Species: *Anoplopoma fimbria* , stock: AKSablefish
Name and region: Bering Sea/Aleutian Islands/Gulf of Alaska Sablefish , Alaska
Catch data used from years 1970 - 2013 , biomass = observed
Prior initial relative biomass = 0.2 - 0.6 default
Prior intermediate rel. biomass= 0.01 - 0.4 in year 1979 default
Prior final relative biomass = 0.01 - 0.4 expert
Prior range for r = 0.015 - 0.1 default , prior range for k = 447 - 11926
Results from Bayesian Schaefer model using catch & observed biomass
r = 0.0594 , 95% CL = 0.0399 - 0.0832 , k = 1421 , 95% CL = 983 - 1848
MSY = 20.8 , 95% CL = 12.8 - 32.7
Biomass in last year = 228 or 0.161 k
Exploitation rate in last year = 0.0591 or 1.99 u.msy
Results of CMSY analysis with altogether 15805 viable trajectories for 5539 r-k pairs
r = 0.062 , 95% CL = 0.0397 - 0.097 , k = 1944 , 95% CL = 778 - 4861
MSY = 30.2 , 95% CL = 12 - 75.7
Relative biomass last year= 0.243 k, 2.5th = 0.0156 , 97.5th = 0.396
Relative biomass next year= 0.245 k, 2.5th = 0.0079 , 97.5th = 0.403
Relative exploitation rate in last year= 0.914
Comment: OK
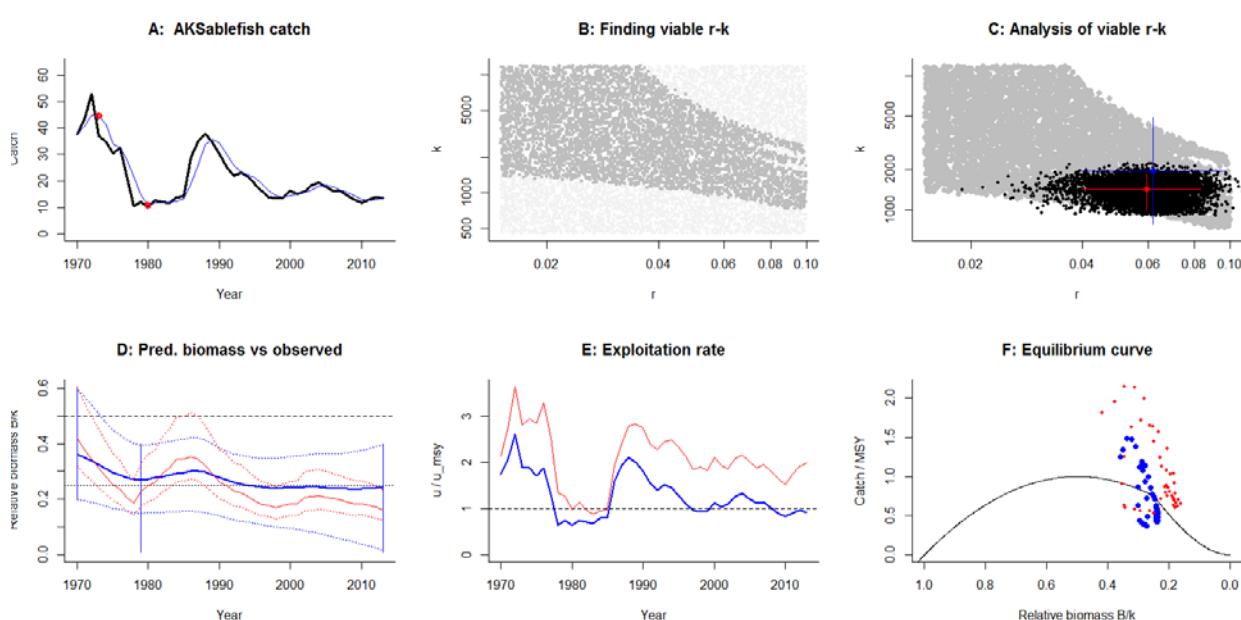
Species: *Atheresthes stomias* , stock: BSAIatf
Name and region: Bering Sea and Aleutian Islands arrowtooth flounder , Alaska
Catch data used from years 1976 - 2013 , biomass = observed
Prior initial relative biomass = 0.2 - 0.6 default
Prior intermediate rel. biomass= 0.5 - 0.9 in year 2008 expert
Prior final relative biomass   = 0.5 - 0.9 expert
Prior range for r = 0.05 - 0.5 default , prior range for k = 120 - 7212
Results from Bayesian Schaefer model using catch & observed biomass
r = 0.178 , 95% CL = 0.148 - 0.217 , k = 912 , 95% CL = 815 - 1061
MSY = 40.7 , 95% CL = 34.6 - 48.6
Biomass in last year = 881 or 0.967 k
Exploitation rate in last year = 0.0239 or 0.268 u.msy
Results of CMSY analysis with altogether 32044 viable trajectories for 4060 r-k pairs
r = 0.282 , 95% CL = 0.163 - 0.487 , k = 367 , 95% CL = 154 - 872
MSY = 25.9 , 95% CL = 13.8 - 48.4
Relative biomass last year= 0.719 k, 2.5th = 0.511 , 97.5th = 0.833
Relative biomass next year= 0.719 k, 2.5th = 0.493 , 97.5th = 0.832
Relative exploitation rate in last year= 0.551
Comment: OK
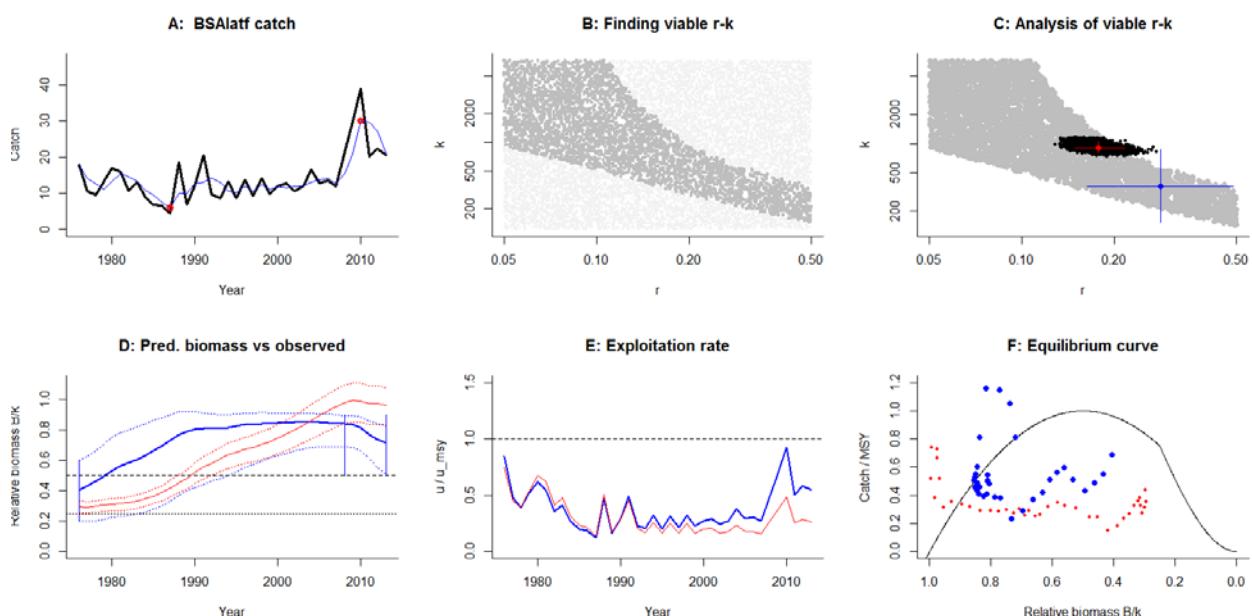
Species: *Pleurogrammus monopterygius* , stock: BSAIatka
 Name and region: Bering Sea and Aleutian Islands atka mackerel , Alaska
 Catch data used from years 1977 - 2013 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.5 - 0.9 in year 1996 default
 Prior final relative biomass   = 0.2 - 0.6 , default
 Prior range for r = 0.05 - 0.5 default , prior range for k = 168 - 6702
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.266 , 95% CL = 0.214 - 0.3 , k = 1138 , 95% CL = 1001 - 1361
 MSY = 75.1 , 95% CL = 61.4 - 89.5
Biomass in last year = 635 or 0.558 k
 Exploitation rate in last year = 0.0645 or 0.485 u.msy
 Results of CMSY analysis with altogether 9874 viable trajectories for 1891 r-k pairs
 r = 0.282 , 95% CL = 0.163 - 0.487 , k = 762 , 95% CL = 385 - 1508
 MSY = 53.8 , 95% CL = 41.2 - 70.2
Relative biomass last year= 0.482 k, 2.5th = 0.214 , 97.5th = 0.596
Relative biomass next year= 0.501 k, 2.5th = 0.194 , 97.5th = 0.625
Relative exploitation rate in last year= 0.447
Comment: OK
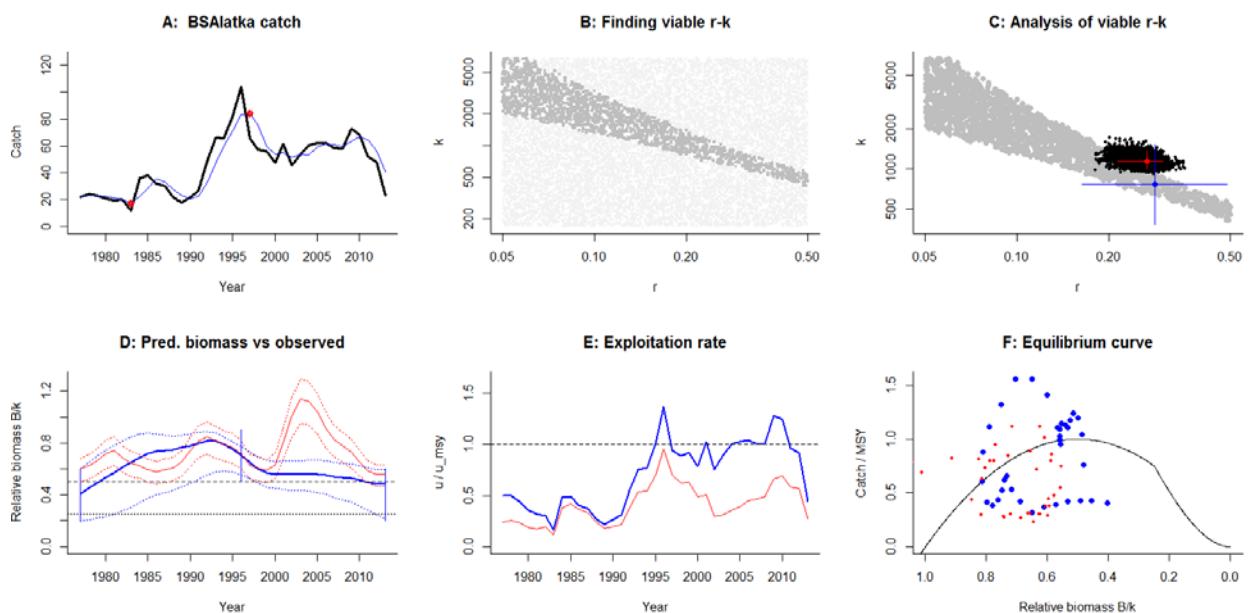
Species: *Reinhardtius hippoglossoides* , stock: BSAIhalibut
Name and region: Bering Sea and Aleutian Islands halibut , Alaska
Catch data used from years 1990 - 2013 , biomass = observed
Prior initial relative biomass = 0.5 - 0.9 expert
Prior intermediate rel. biomass= 0.01 - 0.4 in year 2006 default
Prior final relative biomass   = 0.2 - 0.6 expert
Prior range for r = 0.05 - 0.5 default , prior range for k = 25.4 - 1016
Results from Bayesian Schaefer model using catch & observed biomass
r = 0.221 , 95% CL = 0.169 - 0.279 , k = 225 , 95% CL = 167 - 350
MSY = 12.5 , 95% CL = 8.98 - 20
Biomass in last year = 80.9 or 0.359 k
Exploitation rate in last year = 0.0417 or 0.378 u.msy
Results of CMSY analysis with altogether 4877 viable trajectories for 1555 r-k pairs
r = 0.27 , 95% CL = 0.159 - 0.465 , k = 81.1 , 95% CL = 40.1 - 162
MSY = 5.47 , 95% CL = 4 - 7.47
Relative biomass last year= 0.463 k, 2.5th = 0.226 , 97.5th = 0.589
Relative biomass next year= 0.482 k, 2.5th = 0.222 , 97.5th = 0.62
Relative exploitation rate in last year= 0.345
Comment: Start year set to 1990.
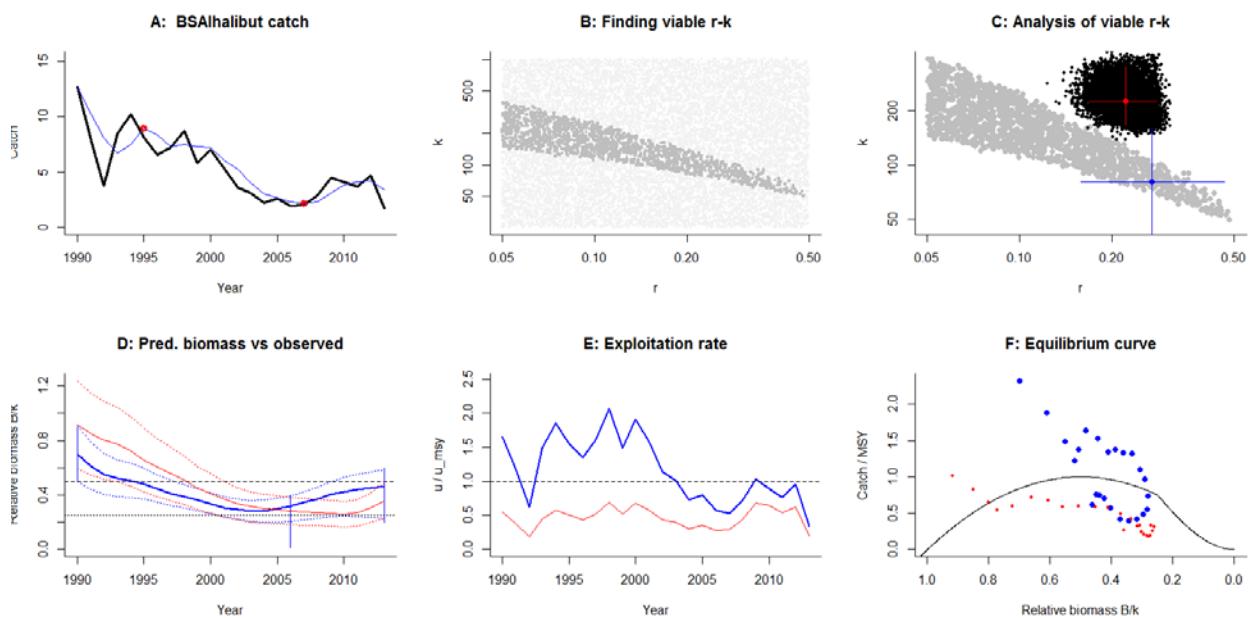
Species: *Sebastes polyspinis* , stock: BSAInorthern
Name and region: Bering Sea and Aleutian Islands northern rockfish , Alaska
Catch data used from years 1977 - 2013 , biomass = observed
Prior initial relative biomass = 0.2 - 0.6 default
Prior intermediate rel. biomass= 0.5 - 0.9 in year 2000 default
Prior final relative biomass   = 0.2 - 0.6 , default
Prior range for r = 0.015 - 0.1 default , prior range for k = 57.7 - 1538
Results from Bayesian Schaefer model using catch & observed biomass
r = 0.0707 , 95% CL = 0.0462 - 0.125 , k = 331 , 95% CL = 264 - 459
MSY = 6.06 , 95% CL = 4.06 - 8.93
Biomass in last year = 221 or 0.668 k
Exploitation rate in last year = 0.011 or 0.311 u.msy
Results of CMSY analysis with altogether 15575 viable trajectories for 5531 r-k pairs
r = 0.062 , 95% CL = 0.0397 - 0.097 , k = 240 , 95% CL = 93.4 - 615
MSY = 3.72 , 95% CL = 1.41 - 9.82
Relative biomass last year= 0.504 k, 2.5th = 0.238 , 97.5th = 0.597
Relative biomass next year= 0.508 k, 2.5th = 0.229 , 97.5th = 0.604
Relative exploitation rate in last year= 0.543
Comment: OK
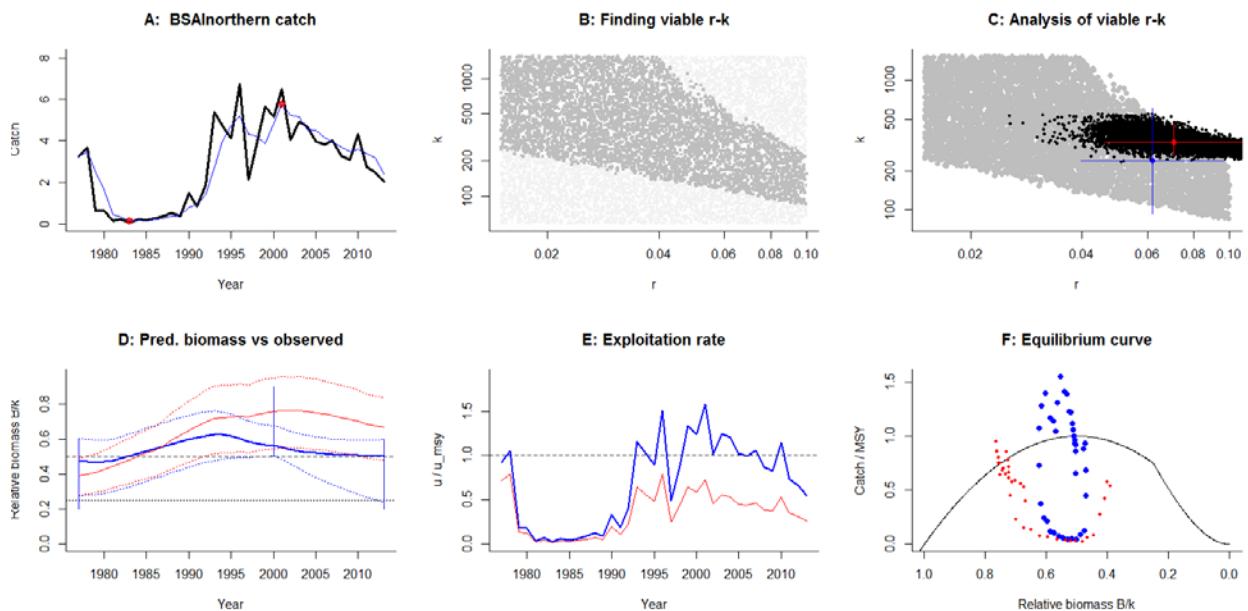
Species: *Pleuronectes quadrituberculatus* , stock: BSAIplaice
 Name and region: Bering Sea and Aleutian Islands Alaska plaice , Alaska
 Catch data used from years 1985 - 2013 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 2004 default
 Prior final relative biomass   = 0.2 - 0.6 , default
 Prior range for r = 0.015 - 0.1 default , prior range for k = 422 - 11264
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.0323 , 95% CL = 0.0168 - 0.0536 , k = 1797 , 95% CL = 1386 - 2419
 MSY = 14.6 , 95% CL = 7.49 - 24.3
Biomass in last year = 505 or 0.281 k
 Exploitation rate in last year = 0.0421 or 2.61 u.msy
 Results of CMSY analysis with altogether 22446 viable trajectories for 7602 r-k pairs
 r = 0.062 , 95% CL = 0.0397 - 0.097 , k = 2273 , 95% CL = 682 - 7571
 MSY = 35.3 , 95% CL = 8 - 155
Relative biomass last year= 0.358 k, 2.5th = 0.209 , 97.5th = 0.511
Relative biomass next year= 0.357 k, 2.5th = 0.199 , 97.5th = 0.524
Relative exploitation rate in last year= 0.932
Comment: Start year set to 1985. OK.
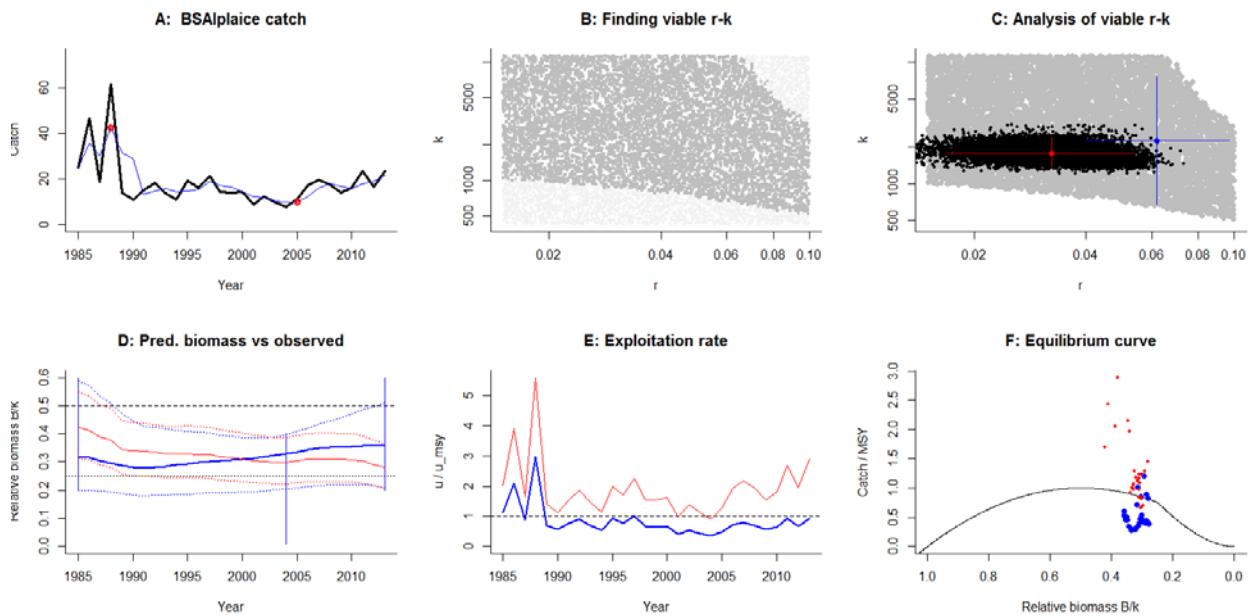
Species: *Sebastes alutus* , stock: BSAIpop
 Name and region: Bering Sea and Aleutian Islands Pacific ocean perch , Alaska
 Catch data used from years 1980 - 2013 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.5 - 0.9 in year 2008 default
 Prior final relative biomass   = 0.5 - 0.9 , default
 Prior range for r = 0.05 - 0.5 default , prior range for k = 106 - 6363
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.202 , 95% CL = 0.165 - 0.253 , k = 672 , 95% CL = 605 - 754
 MSY = 34 , 95% CL = 28.2 - 41.4
Biomass in last year = 619 or 0.921 k
 Exploitation rate in last year = 0.0428 or 0.425 u.msy
 Results of CMSY analysis with altogether 38982 viable trajectories for 4490 r-k pairs
 r = 0.282 , 95% CL = 0.163 - 0.487 , k = 317 , 95% CL = 127 - 790
 MSY = 22.3 , 95% CL = 10.9 - 45.9
 Relative biomass last year= 0.744 k, 2.5th = 0.515 , 97.5th = 0.863
 Relative biomass next year= 0.71 k, 2.5th = 0.443 , 97.5th = 0.846
 Relative exploitation rate in last year= 0.944
 Comment: Resilience set from Very low to Low and start year to 1980.
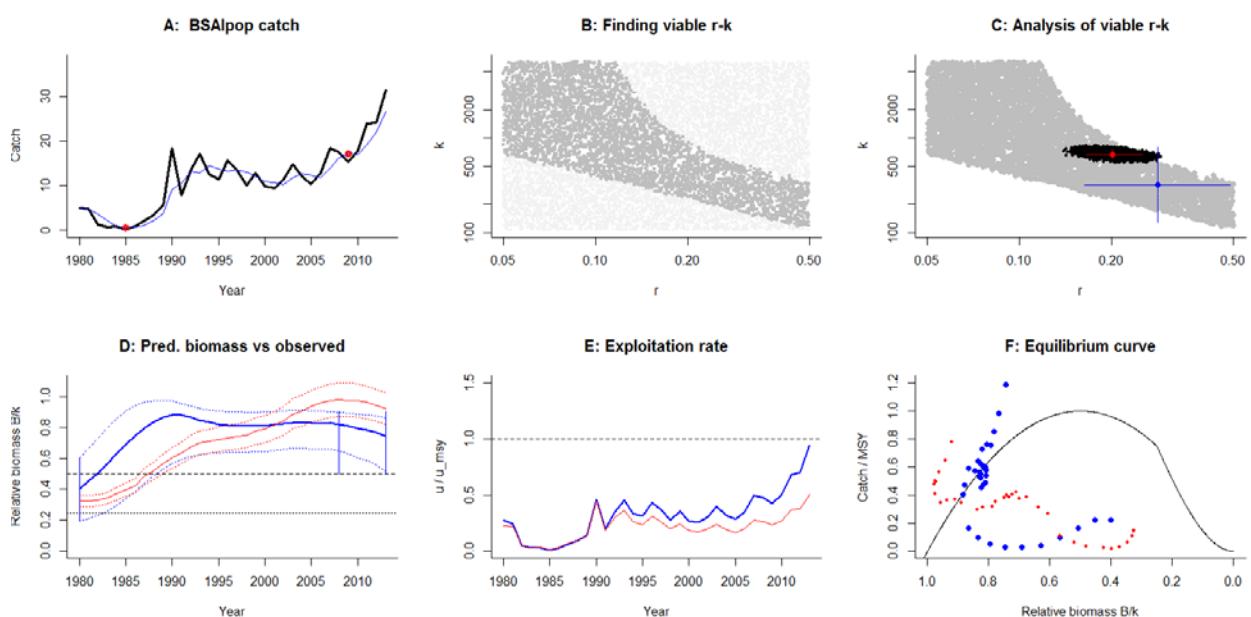
Species: *Lepidopsetta polyxystra* , stock: BSAIrocksole
Name and region: Bering Sea and Aleutian Islands northern rock sole , Alaska
Catch data used from years 1980 - 2012 , biomass = observed
Prior initial relative biomass = 0.2 - 0.6 default
Prior intermediate rel. biomass= 0.5 - 0.9 in year 1988 default
Prior final relative biomass   = 0.5 - 0.9 , default
Prior range for r = 0.05 - 0.5 default , prior range for k = 261 - 15688
Results from Bayesian Schaefer model using catch & observed biomass
r = 0.28 , 95% CL = 0.254 - 0.32 , k = 1845 , 95% CL = 1702 - 2002
MSY = 130 , 95% CL = 115 - 148
Biomass in last year = 1627 or 0.882 k
Exploitation rate in last year = 0.0385 or 0.275 u.msy
Results of CMSY analysis with altogether 27180 viable trajectories for 3974 r-k pairs
r = 0.282 , 95% CL = 0.163 - 0.487 , k = 1124 , 95% CL = 450 - 2808
MSY = 79.3 , 95% CL = 38.4 - 164
Relative biomass last year= 0.811 k, 2.5th = 0.533 , 97.5th = 0.897
Relative biomass next year= 0.796 k, 2.5th = 0.508 , 97.5th = 0.89
Relative exploitation rate in last year= 0.578
Comment: Set start year to 1990.
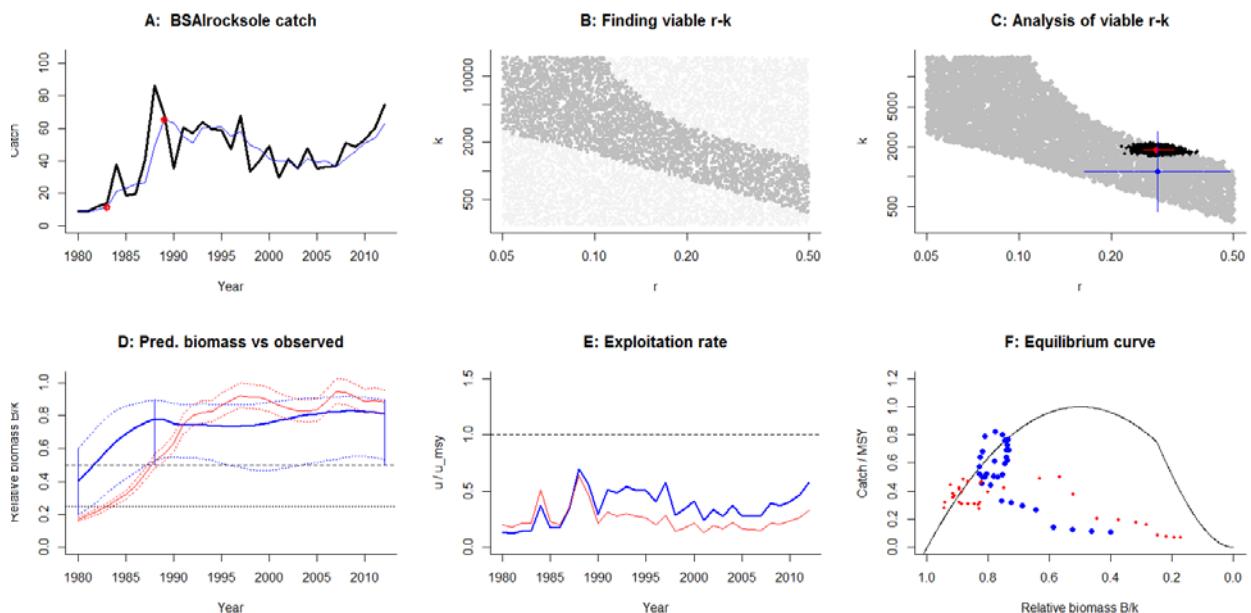
Species: *Sebastes borealis* , stock: BSAIshortraker
 Name and region: Bering Sea and Aleutian Islands Shortraker rockfish , Alaska
 Catch data used from years 1980 - 2012 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 1986 default
 Prior final relative biomass   = 0.01 - 0.4 expert
 Prior range for r = 0.015 - 0.1 default , prior range for k = 8.33 - 222
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.0169 , 95% CL = 0.00703 - 0.0354 , k = 67.3 , 95% CL = 51.6 - 90.9
 MSY = 0.286 , 95% CL = 0.115 - 0.6
Biomass in last year = 16.9 or 0.25 k
 Exploitation rate in last year = 0.0186 or 2.2 u.msy
 Results of CMSY analysis with altogether 23616 viable trajectories for 7271 r-k pairs
 r = 0.062 , 95% CL = 0.0397 - 0.097 , k = 28.2 , 95% CL = 9.57 - 82.9
 MSY = 0.437 , 95% CL = 0.126 - 1.51
 Relative biomass last year= 0.248 k, 2.5th = 0.0163 , 97.5th = 0.396
 Relative biomass next year= 0.244 k, 2.5th = -0.00124 , 97.5th = 0.4
 Relative exploitation rate in last year= 1.3
 Comment: Fit could be improved by setting intbio to 0.2-0.6 in 1990.
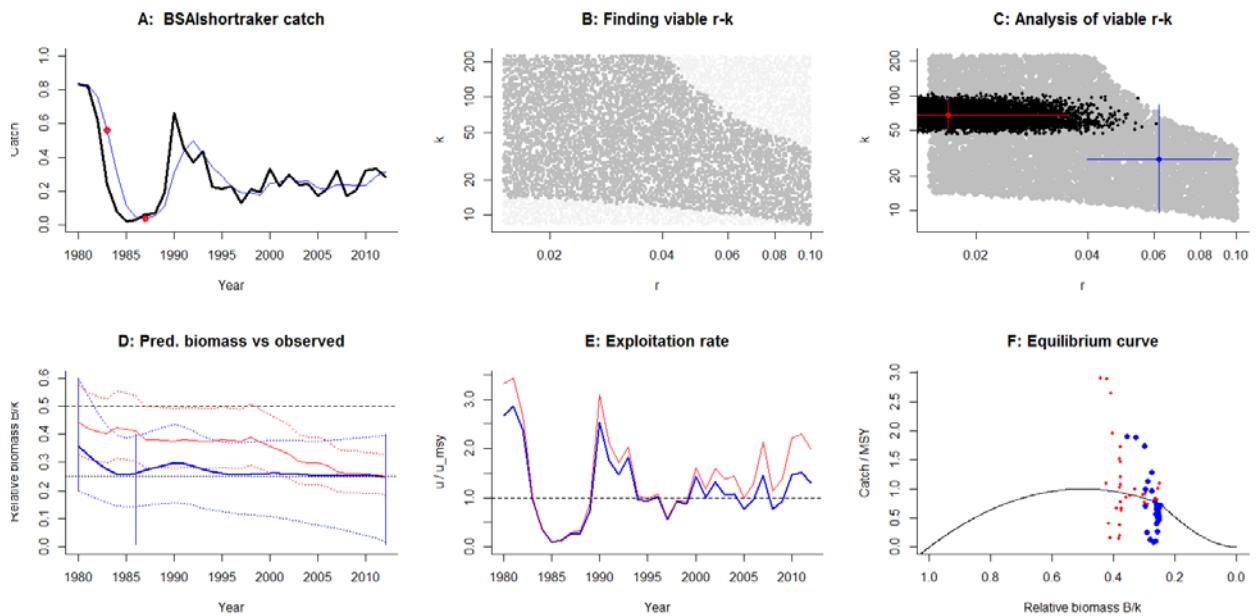
Species: *Limanda aspera* , stock: BSAIyfin
Name and region: Bering Sea and Aleutian Islands yellowfin sole , Alaska
Catch data used from years 1970 - 2013 , biomass = observed
Prior initial relative biomass = 0.2 - 0.6 default
Prior intermediate rel. biomass= 0.5 - 0.9 in year 1986 default
Prior final relative biomass   = 0.5 - 0.9 , default
Prior range for r = 0.05 - 0.5 default , prior range for k = 823 - 49371
Results from Bayesian Schaefer model using catch & observed biomass
r = 0.314 , 95% CL = 0.27 - 0.37 , k = 3042 , 95% CL = 2866 - 3262
MSY = 239 , 95% CL = 206 - 276
Biomass in last year = 2326 or 0.765 k
Exploitation rate in last year = 0.0664 or 0.423 u.msy
Results of CMSY analysis with altogether 26532 viable trajectories for 3721 r-k pairs
r = 0.282 , 95% CL = 0.163 - 0.487 , k = 2894 , 95% CL = 1190 - 7039
MSY = 204 , 95% CL = 104 - 400
Relative biomass last year= 0.828 k, 2.5th = 0.565 , 97.5th = 0.898
Relative biomass next year= 0.816 k, 2.5th = 0.55 , 97.5th = 0.892
Relative exploitation rate in last year= 0.488
Comment: Start year set to 1970.
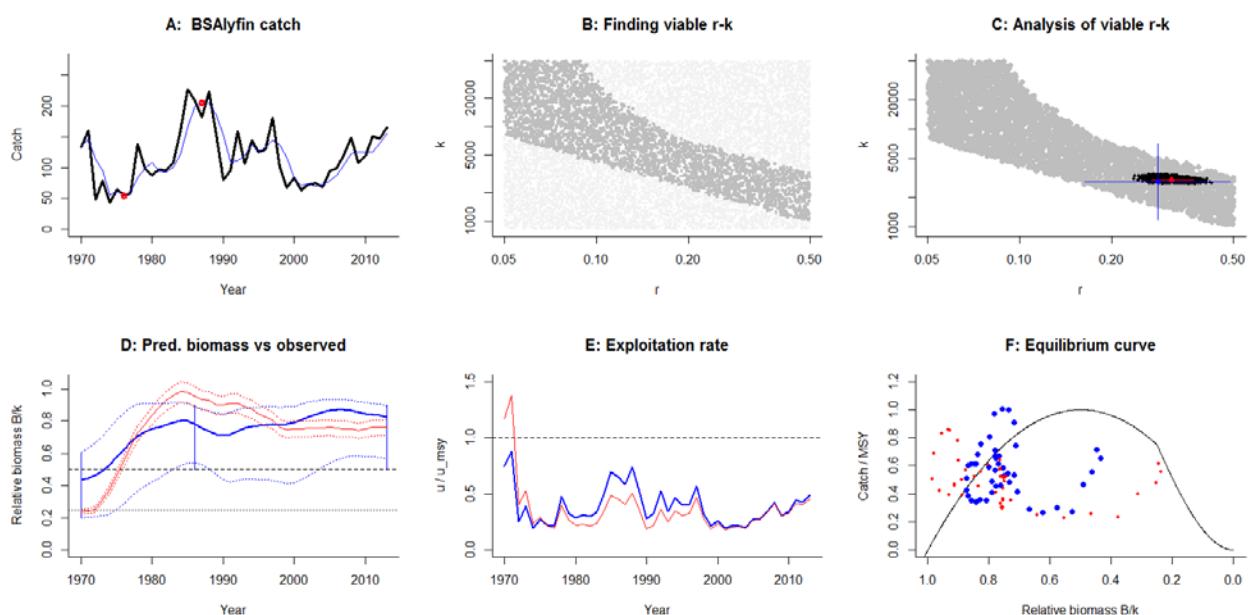
Species: *Gadus macrocephalus* , stock: EBSPcod
 Name and region: Bering Sea Pacific cod , Alaska
 Catch data used from years 1977 - 2013 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.5 - 0.9 in year 1996 default
 Prior final relative biomass   = 0.5 - 0.9 , default
 Prior range for r = 0.05 - 0.5 default , prior range for k = 905 - 54290
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.29 , 95% CL = 0.258 - 0.355 , k = 2315 , 95% CL = 1997 - 2766
 MSY = 171 , 95% CL = 142 - 205
Biomass in last year = 1374 or 0.594 k
 Exploitation rate in last year = 0.165 or 1.14 u.msy
 Results of CMSY analysis with altogether 33076 viable trajectories for 3956 r-k pairs
 r = 0.282 , 95% CL = 0.163 - 0.487 , k = 4037 , 95% CL = 1631 - 9994
 MSY = 285 , 95% CL = 141 - 577
Relative biomass last year= 0.819 k, 2.5th = 0.53 , 97.5th = 0.897
Relative biomass next year= 0.804 k, 2.5th = 0.505 , 97.5th = 0.89
Relative exploitation rate in last year= 0.507
Comment: OK. Fit could be improved by setting intbio Low or Medium in 2007.
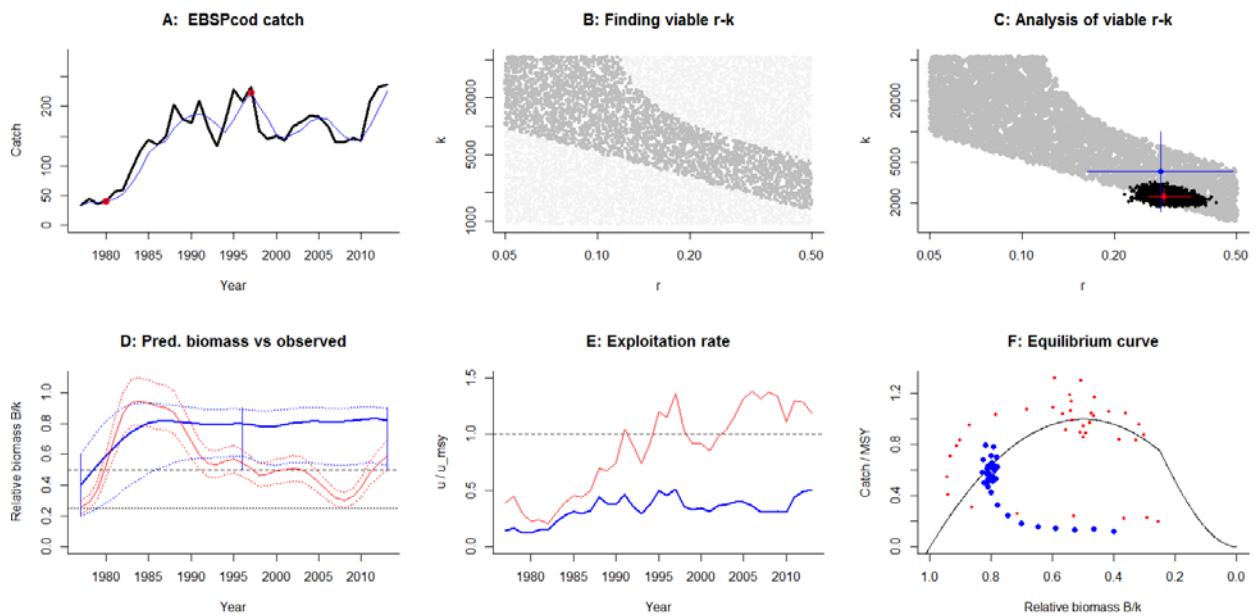
Species: *Theragra chalcogramma* , stock: EBSpollock
 Name and region: Eastern Bering Sea pollock , Alaska
 Catch data used from years 1964 - 2013 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.5 - 0.9 in year 1972 default
 Prior final relative biomass   = 0.2 - 0.6 , default
 Prior range for r = 0.05 - 0.5 default , prior range for k = 3585 - 143392
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.332 , 95% CL = 0.267 - 0.438 , k = 12871 , 95% CL = 10586 - 15500
 MSY = 1074 , 95% CL = 780 - 1442
Biomass in last year = 9541 or 0.741 k
 Exploitation rate in last year = 0.128 or 0.773 u.msy
 Results of CMSY analysis with altogether 5126 viable trajectories for 1094 r-k pairs
 r = 0.282 , 95% CL = 0.163 - 0.487 , k = 16877 , 95% CL = 9077 - 31379
 MSY = 1191 , 95% CL = 1030 - 1377
Relative biomass last year= 0.505 k, 2.5th = 0.232 , 97.5th = 0.597
Relative biomass next year= 0.503 k, 2.5th = 0.205 , 97.5th = 0.602
Relative exploitation rate in last year= 1.06
Comment: OK. Fit could be improved by setting endbio High.
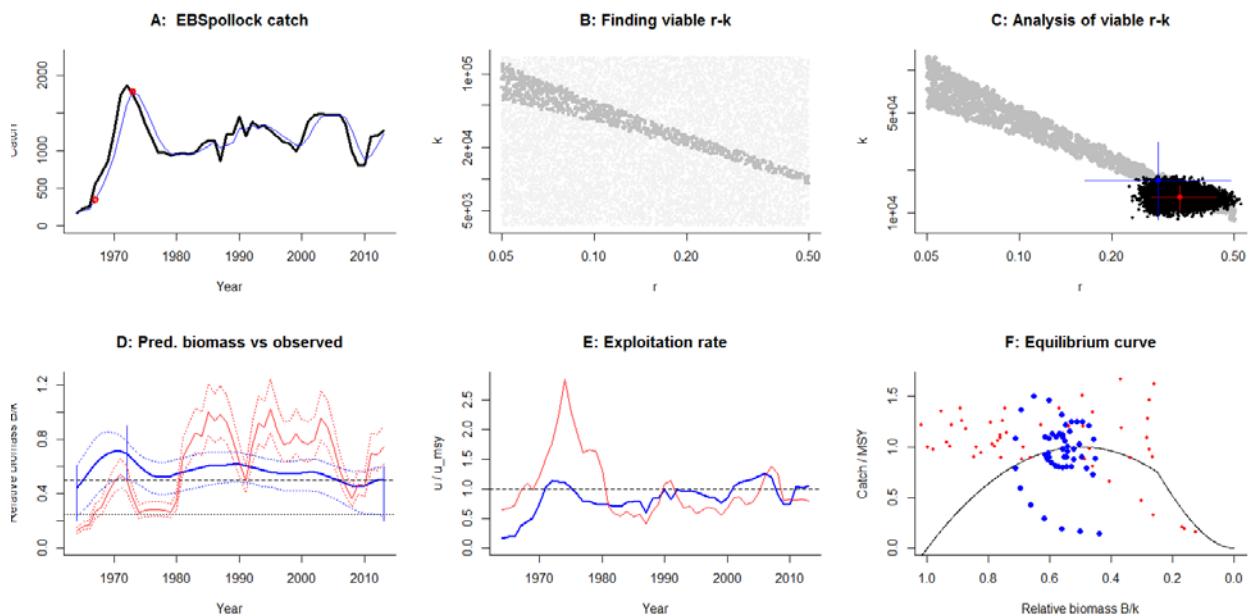
Species: *Atheresthes stomias* , stock: GOAatf
Name and region: Gulf of Alaska arrowtooth flounder , Alaska
Catch data used from years 1970 - 2013 , biomass = observed
Prior initial relative biomass = 0.2 - 0.6 default
Prior intermediate rel. biomass= 0.5 - 0.9 in year 2007 default
Prior final relative biomass   = 0.5 - 0.9 , default
Prior range for r = 0.05 - 0.5 default , prior range for k = 110 - 6595
Results from Bayesian Schaefer model using catch & observed biomass
r = 0.188 , 95% CL = 0.158 - 0.225 , k = 1930 , 95% CL = 1767 - 2114
MSY = 90.5 , 95% CL = 76.3 - 108
Biomass in last year = 1997 or 1.03 k
Exploitation rate in last year = 0.0122 or 0.13 u.msy
Results of CMSY analysis with altogether 37012 viable trajectories for 3997 r-k pairs
r = 0.282 , 95% CL = 0.163 - 0.487 , k = 490 , 95% CL = 198 - 1218
MSY = 34.6 , 95% CL = 17 - 70.5
Relative biomass last year= 0.774 k, 2.5th = 0.519 , 97.5th = 0.881
Relative biomass next year= 0.774 k, 2.5th = 0.505 , 97.5th = 0.881
Relative exploitation rate in last year= 0.404
Comment: Set start year to 1970.
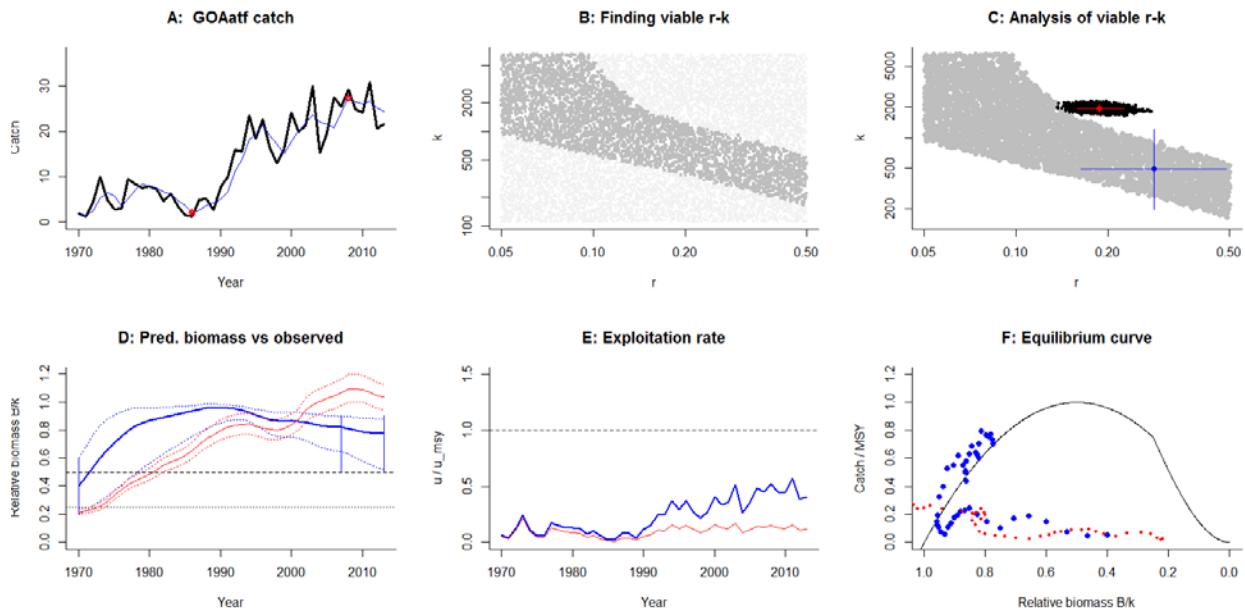
Species: *Sebastes variabilis* , stock: GOAdusky
 Name and region: Gulf of Alaska Dusky Rockfish , Alaska
 Catch data used from years 1977 - 2013 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.5 - 0.9 in year 1999 default
 Prior final relative biomass   = 0.5 - 0.9 , default
 Prior range for r = 0.05 - 0.5 default , prior range for k = 15 - 898
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.202 , 95% CL = 0.164 - 0.256 , k = 95.1 , 95% CL = 84.8 - 108
 MSY = 4.81 , 95% CL = 3.94 - 5.91
Biomass in last year = 72.7 or 0.764 k
 Exploitation rate in last year = 0.0441 or 0.438 u.msy
 Results of CMSY analysis with altogether 35334 viable trajectories for 4093 r-k pairs
 r = 0.282 , 95% CL = 0.163 - 0.487 , k = 65.1 , 95% CL = 26.4 - 161
 MSY = 4.59 , 95% CL = 2.28 - 9.24
Relative biomass last year= 0.78 k, 2.5th = 0.521 , 97.5th = 0.885
Relative biomass next year= 0.777 k, 2.5th = 0.507 , 97.5th = 0.883
Relative exploitation rate in last year= 0.441
Comment: OK. Fit could be improved by setting intbio to Medium in 1990.

A: GOAdusky catch
B: Finding viable r-k
C: Analysis of viable r-k
D: Pred. biomass vs observed
E: Exploitation rate
F: Equilibrium curve
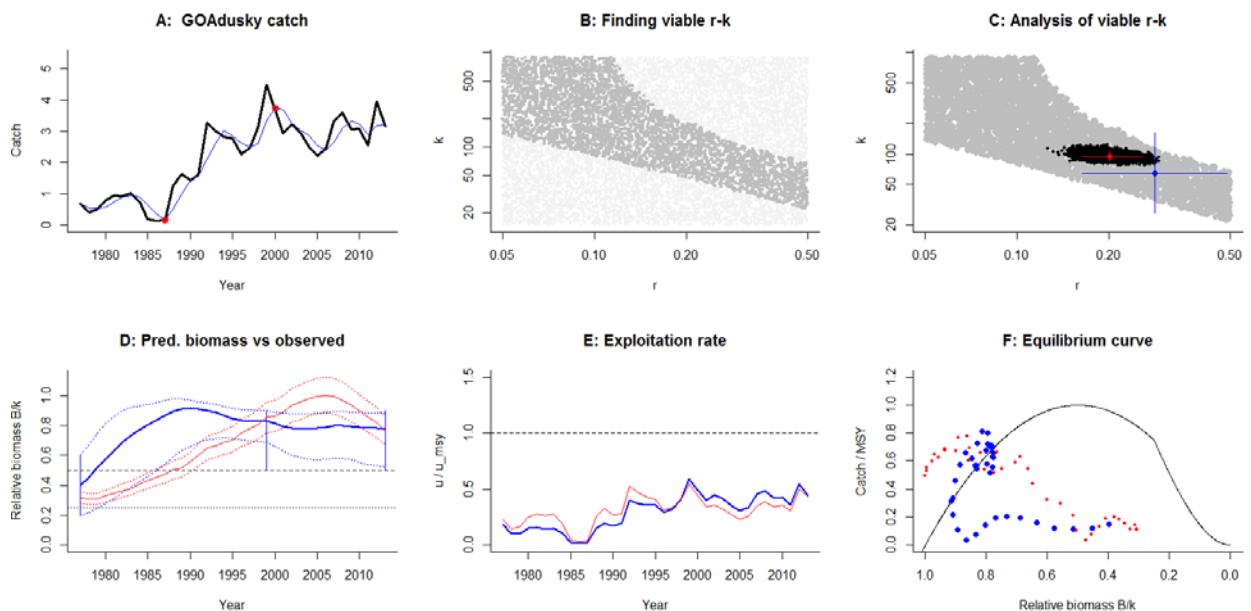
Species: *Hippoglossoides elassodon* , stock: GOAflathead
 Name and region: Gulf of Alaska Flathead sole , Alaska
 Catch data used from years 1978 - 2013 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.5 - 0.9 in year 2009 default
 Prior final relative biomass   = 0.5 - 0.9 , default
 Prior range for r = 0.05 - 0.5 default , prior range for k = 14.6 - 874
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.247 , 95% CL = 0.195 - 0.285 , k = 237 , 95% CL = 224 - 255
 MSY = 14.7 , 95% CL = 11.8 - 16.9
Biomass in last year = 250 or 1.06 k
 Exploitation rate in last year = 0.0103 or 0.0831 u.msy
 Results of CMSY analysis with altogether 38718 viable trajectories for 4332 r-k pairs
 r = 0.282 , 95% CL = 0.163 - 0.487 , k = 60.8 , 95% CL = 23.8 - 155
 MSY = 4.29 , 95% CL = 1.99 - 9.24
 Relative biomass last year= 0.775 k, 2.5th = 0.517 , 97.5th = 0.885
 Relative biomass next year= 0.781 k, 2.5th = 0.514 , 97.5th = 0.89
 Relative exploitation rate in last year= 0.424
 Comment: OK
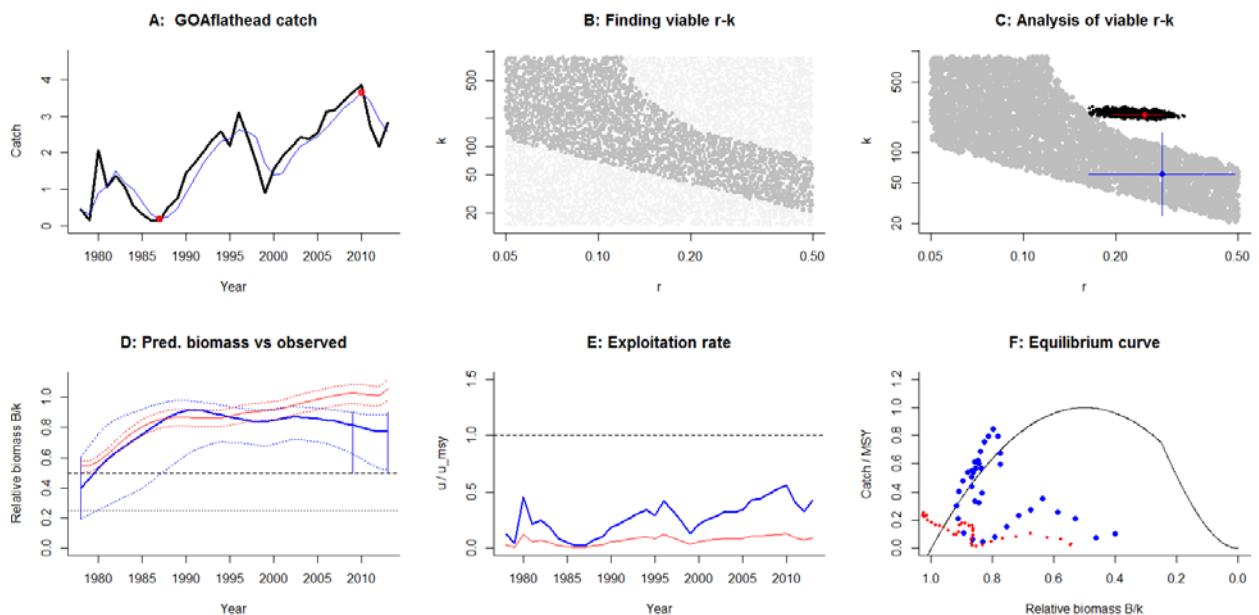
Species: *Sebastes polyspinis* , stock: GOAnorthern
Name and region: Gulf of Alaska northern rockfish , Alaska
Catch data used from years 1961 - 2013 , biomass = observed
Prior initial relative biomass = 0.2 - 0.6 default
Prior intermediate rel. biomass= 0.01 - 0.4 in year 1986 default
Prior final relative biomass   = 0.2 - 0.6 , default
Prior range for r = 0.015 - 0.1 default , prior range for k = 136 - 3619
Results from Bayesian Schaefer model using catch & observed biomass
r = 0.0505 , 95% CL = 0.0286 - 0.0694 , k = 333 , 95% CL = 246 - 453
MSY = 4.09 , 95% CL = 2.49 - 5.91
Biomass in last year = 108 or 0.325 k
Exploitation rate in last year = 0.0411 or 1.63 u.msy
Results of CMSY analysis with altogether 15913 viable trajectories for 6358 r-k pairs
r = 0.062 , 95% CL = 0.0397 - 0.097 , k = 428 , 95% CL = 151 - 1209
MSY = 6.63 , 95% CL = 2.07 - 21.2
Relative biomass last year= 0.402 k, 2.5th = 0.21 , 97.5th = 0.59
Relative biomass next year= 0.404 k, 2.5th = 0.2 , 97.5th = 0.597
Relative exploitation rate in last year= 0.916
Comment: OK
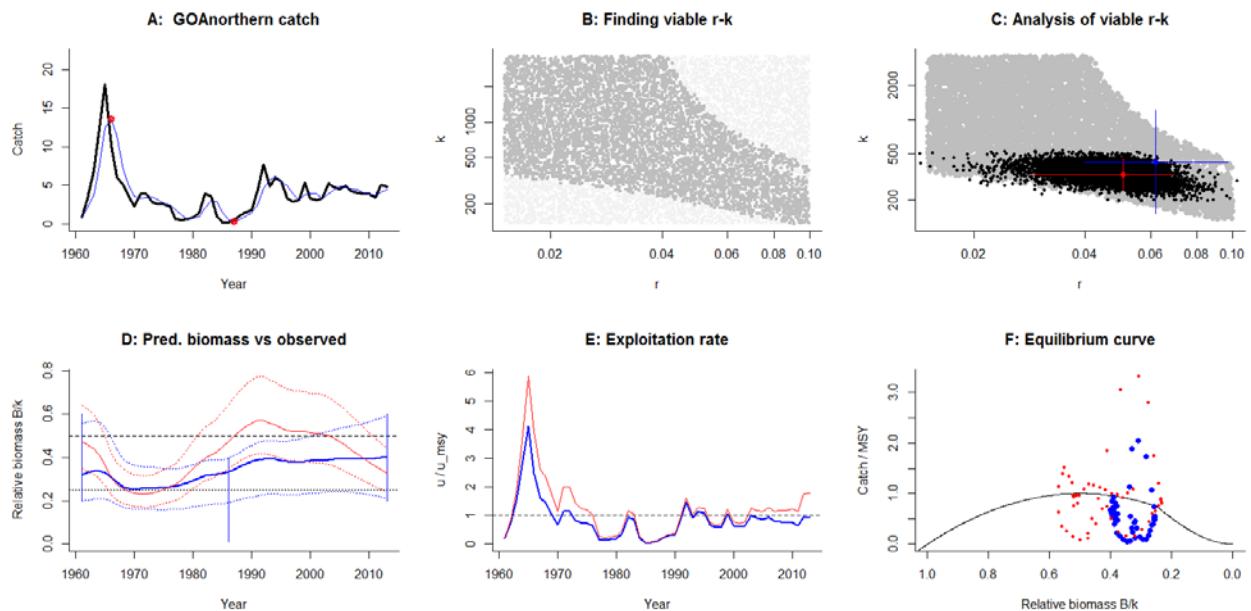
Species: *Gadus macrocephalus* , stock: GOAPcod
Name and region: Gulf of Alaska Pacific cod , Alaska
Catch data used from years 1977 - 2013 , biomass = observed
Prior initial relative biomass = 0.5 - 0.9 expert
Prior intermediate rel. biomass= 0.2 - 0.6 in year 1998 default
Prior final relative biomass   = 0.5 - 0.9 , default
Prior range for r = 0.05 - 0.5 default , prior range for k = 322 - 19326
Results from Bayesian Schaefer model using catch & observed biomass
r = 0.271 , 95% CL = 0.222 - 0.307 , k = 1013 , 95% CL = 938 - 1137
MSY = 68.2 , 95% CL = 58.7 - 76.9
Biomass in last year = 671 or 0.662 k
Exploitation rate in last year = 0.115 or 0.851 u.msy
Results of CMSY analysis with altogether 1218 viable trajectories for 665 r-k pairs
r = 0.317 , 95% CL = 0.129 - 0.49 , k = 736 , 95% CL = 445 - 1927
MSY = 58.2 , 95% CL = 51.2 - 66.3
Relative biomass last year= 0.531 k, 2.5th = 0.501 , 97.5th = 0.61
Relative biomass next year= 0.501 k, 2.5th = 0.453 , 97.5th = 0.589
Relative exploitation rate in last year= 1.11
Comment: OK
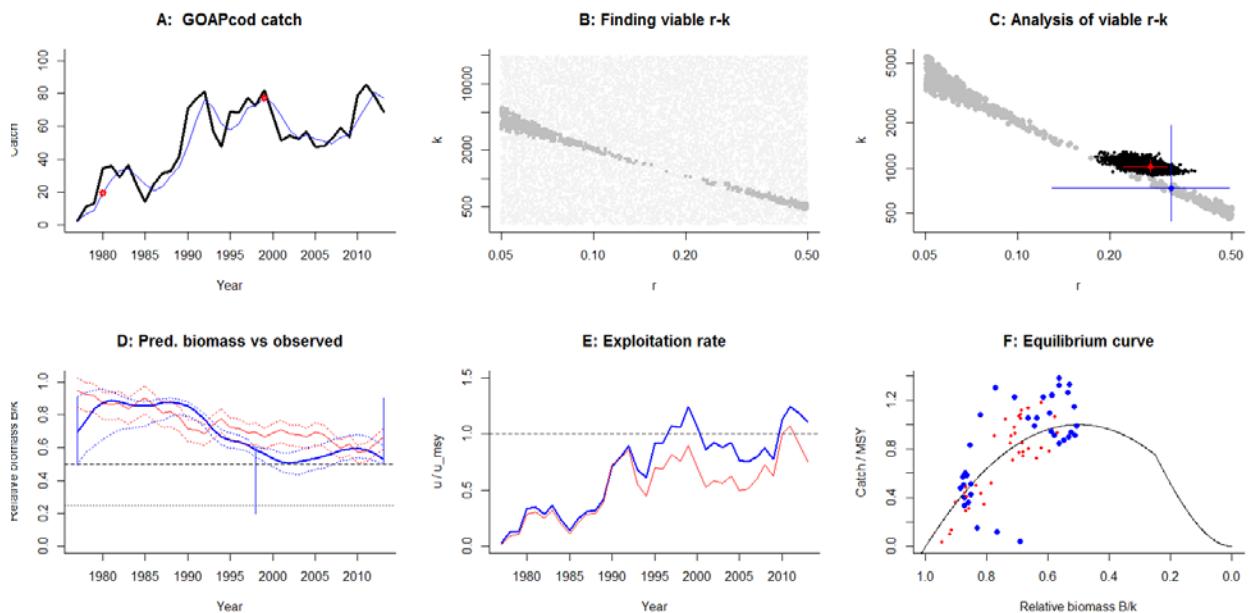
Species: *Theragra chalcogramma* , stock: GOApollock
Name and region: Gulf of Alaska walleye pollock , Alaska
Catch data used from years 1970 - 2013 , biomass = observed
Prior initial relative biomass = 0.2 - 0.6 default
Prior intermediate rel. biomass= 0.5 - 0.9 in year 1984 default
Prior final relative biomass   = 0.2 - 0.6 , default
Prior range for r = 0.05 - 0.5 default , prior range for k = 540 - 21602
Results from Bayesian Schaefer model using catch & observed biomass
r = 0.272 , 95% CL = 0.228 - 0.309 , k = 2086 , 95% CL = 1684 - 2670
MSY = 141 , 95% CL = 107 - 186
Biomass in last year = 1321 or 0.633 k
Exploitation rate in last year = 0.0711 or 0.523 u.msy
Results of CMSY analysis with altogether 5626 viable trajectories for 1925 r-k pairs
r = 0.236 , 95% CL = 0.145 - 0.4 , k = 1719 , 95% CL = 932 - 3047
MSY = 101 , 95% CL = 86 - 119
Relative biomass last year= 0.503 k, 2.5th = 0.265 , 97.5th = 0.597
Relative biomass next year= 0.507 k, 2.5th = 0.252 , 97.5th = 0.604
Relative exploitation rate in last year= 0.945
Comment: OK
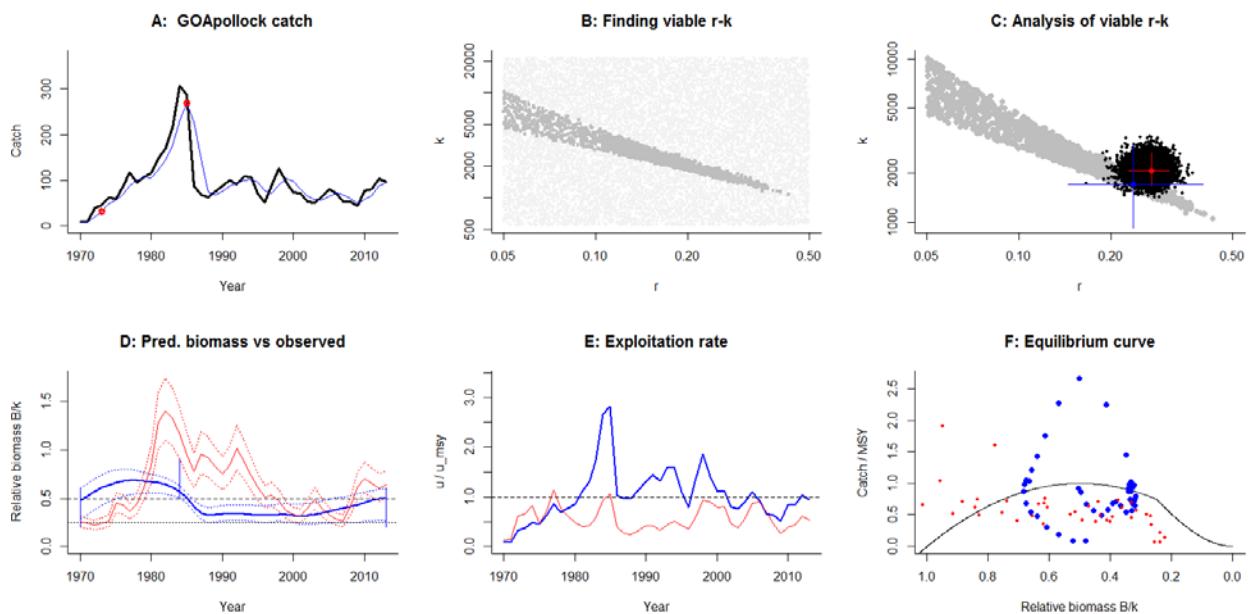
Species: *Sebastes alutus* , stock: GOApop
 Name and region: Gulf of Alaska Pacific ocean perch , Alaska
 Catch data used from years 1961 - 2013 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 1985 default
 Prior final relative biomass   = 0.01 - 0.4 , default
 Prior range for r = 0.05 - 0.5 default , prior range for k = 530 - 21211
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.25 , 95% CL = 0.205 - 0.283 , k = 2352 , 95% CL = 1936 - 3060
 MSY = 147 , 95% CL = 107 - 204
Biomass in last year = 416 or 0.177 k
 Exploitation rate in last year = 0.0339 or 0.272 u.msy
 Results of CMSY analysis with altogether 2973 viable trajectories for 2552 r-k pairs
 r = 0.183 , 95% CL = 0.121 - 0.388 , k = 2550 , 95% CL = 866 - 5316
 MSY = 116 , 95% CL = 61.4 - 221
 Relative biomass last year= 0.0911 k, 2.5th = 0.0129 , 97.5th = 0.379
 Relative biomass next year= 0.0914 k, 2.5th = 0.00838 , 97.5th = 0.409
 Relative exploitation rate in last year= 0.622
 Comment: Set from Very low to Low.
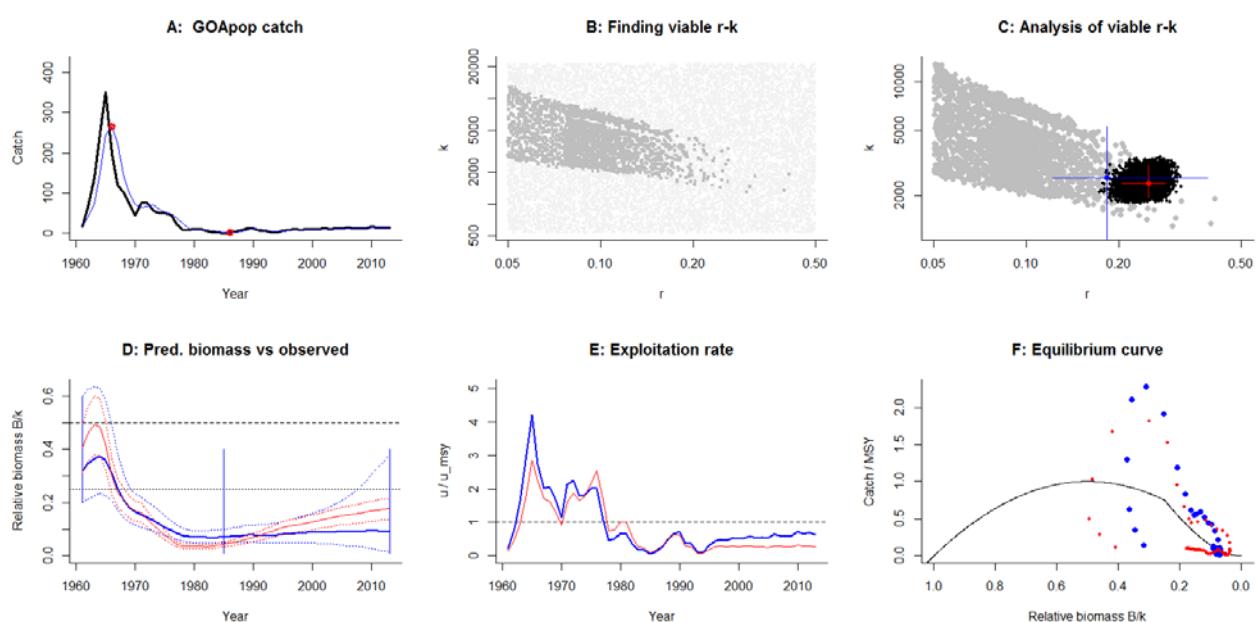
Species: *Glyptocephalus zachirus* , stock: GOArex
 Name and region: Gulf of Alaska Rex sole , Alaska
 Catch data used from years 1982 - 2011 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.5 - 0.9 in year 1995 default
 Prior final relative biomass   = 0.2 - 0.6 expert
 Prior range for r = 0.015 - 0.1 default , prior range for k = 45.2 - 1206
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.064 , 95% CL = 0.0438 - 0.104 , k = 212 , 95% CL = 148 - 290
 MSY = 3.5 , 95% CL = 2.2 - 5.13
Biomass in last year = 117 or 0.552 k
 Exploitation rate in last year = 0.0313 or 0.978 u.msy
 Results of CMSY analysis with altogether 15618 viable trajectories for 5491 r-k pairs
 r = 0.062 , 95% CL = 0.0397 - 0.097 , k = 172 , 95% CL = 71.1 - 419
 MSY = 2.67 , 95% CL = 1.13 - 6.34
Relative biomass last year= 0.484 k, 2.5th = 0.218 , 97.5th = 0.597
Relative biomass next year= 0.476 k, 2.5th = 0.186 , 97.5th = 0.596
Relative exploitation rate in last year= 1
Comment: Set from Low to Very low.
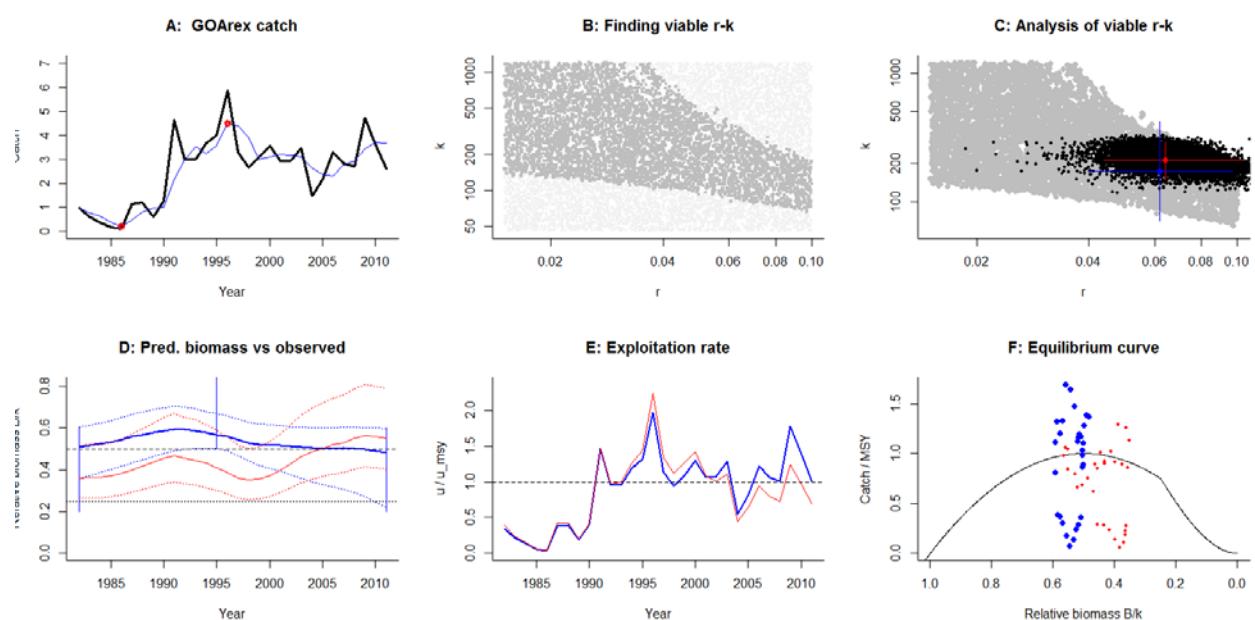
Region: Pacific

[CMSY_46e.R, AllStocks_ID20.csv, AllStocks_Spec16.csv]
Species: *Sebastes aurora* , stock: Aurora_PC
 Name and region: Aurora rockfish - Pacific Coast , Pacific
 Catch data used from years 1990 - 2012 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 2000 default
 Prior final relative biomass   = 0.01 - 0.4 , default
 Prior range for r = 0.015 - 0.1 default , prior range for k = 2.09 - 55.7
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.0279 , 95% CL = 0.012 - 0.0553 , k = 12.4 , 95% CL = 8.27 - 16.9
 MSY = 0.0844 , 95% CL = 0.0367 - 0.159
Biomass in last year = 4.33 or 0.35 k
 Exploitation rate in last year = 0.00878 or 0.631 u.msy
 Results of CMSY analysis with altogether 35386 viable trajectories for 8710 r-k pairs
 r = 0.062 , 95% CL = 0.0397 - 0.097 , k = 8.6 , 95% CL = 2.47 - 29.9
 MSY = 0.133 , 95% CL = 0.0278 - 0.641
 Relative biomass last year= 0.269 k, 2.5th = 0.0189 , 97.5th = 0.396
 Relative biomass next year= 0.273 k, 2.5th = 0.0102 , 97.5th = 0.406
 Relative exploitation rate in last year= 0.6
 Comment: Set from Low to Very low and changed start year to 1990.

A: Aurora_PC catch

B: Finding viable r-k

C: Analysis of viable r-k

D: Pred. biomass vs observed

E: Exploitation rate

F: Equilibrium curve
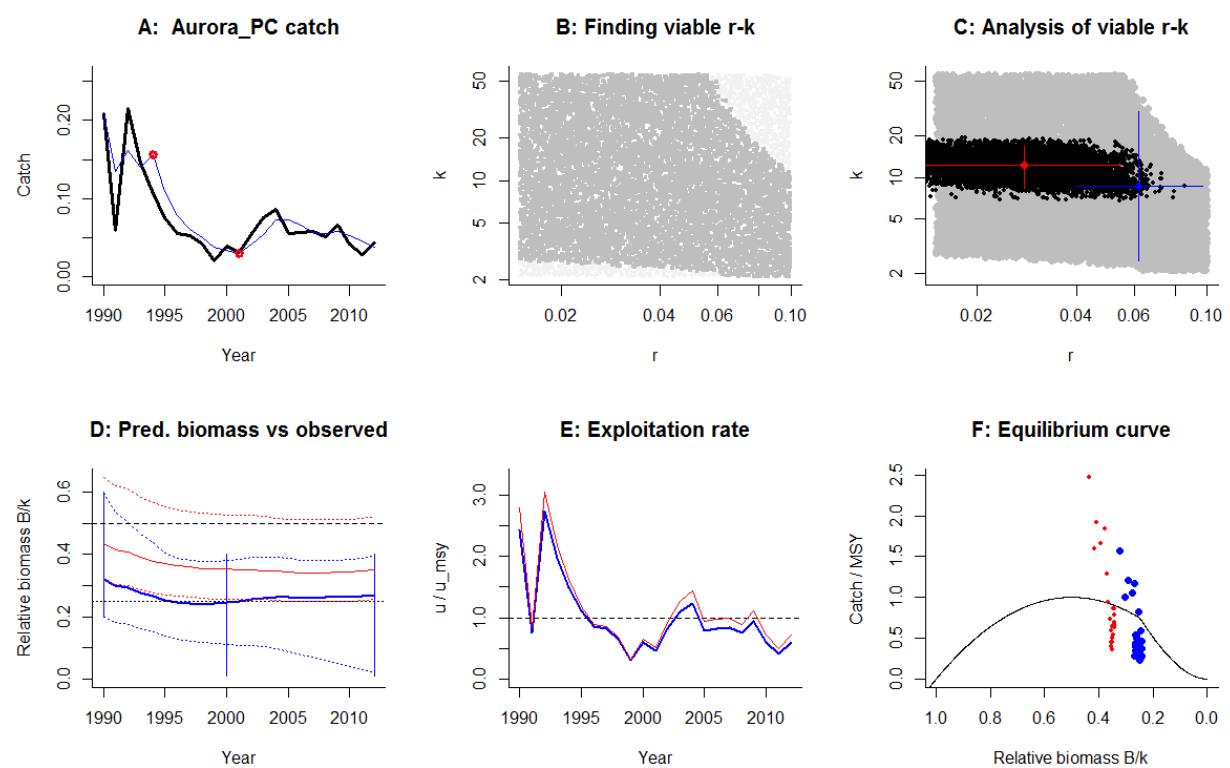
Species: *Thunnus orientalis* , stock: BFTuna_P
 Name and region: Pacific Bluefin tuna , Pacific
 Catch data used from years 1952 - 2010 , biomass = observed
 Prior initial relative biomass = 0.5 - 0.9 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 1989 default
 Prior final relative biomass   = 0.01 - 0.4 expert
 Prior range for r = 0.2 - 0.8 default , prior range for k = 45.4 - 727
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.503 , 95% CL = 0.472 - 0.544 , k = 189 , 95% CL = 175 - 207
 MSY = 23.9 , 95% CL = 21.9 - 26.3
Biomass in last year = 48.9 or 0.259 k
 Exploitation rate in last year = 0.429 or 1.7 u.msy
 Results of CMSY analysis with altogether 3206 viable trajectories for 1639 r-k pairs
 r = 0.399 , 95% CL = 0.32 - 0.527 , k = 231 , 95% CL = 169 - 299
 MSY = 23 , 95% CL = 21.4 - 24.8
 Relative biomass last year= 0.324 k, 2.5th = 0.052 , 97.5th = 0.398
 Relative biomass next year= 0.317 k, 2.5th = -0.0268 , 97.5th = 0.416
 Relative exploitation rate in last year= 1.19
 Comment: OK

A: BFTuna_P catch   B: Finding viable r-k   C: Analysis of viable r-k

D: Pred. biomass vs observed   E: Exploitation rate   F: Equilibrium curve
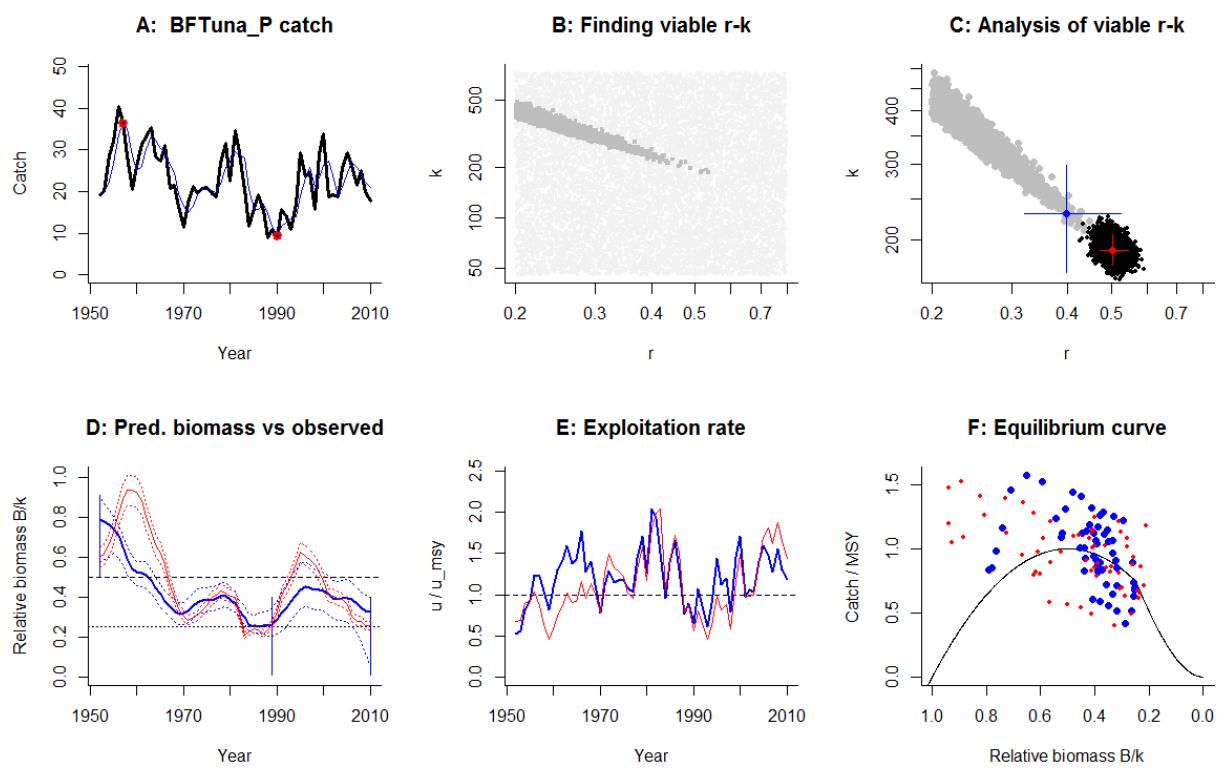
Species: *Makaira nigricans* , stock: BMarlin_NP
 Name and region: Blue marlin - North Pacific , Pacific
 Catch data used from years 1971 - 2011 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.2 - 0.6 in year 2004 default
 Prior final relative biomass   = 0.5 - 0.9 , default
 Prior range for r = 0.2 - 0.8 default , prior range for k = 59.8 - 1434
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.503 , 95% CL = 0.459 - 0.565 , k = 154 , 95% CL = 144 - 165
 MSY = 19.5 , 95% CL = 18.3 - 20.8
Biomass in last year = 78.7 or 0.511 k
 Exploitation rate in last year = 0.23 or 0.913 u.msy
 Results of CMSY analysis with altogether 3643 viable trajectories for 831 r-k pairs
 r = 0.567 , 95% CL = 0.405 - 0.785 , k = 146 , 95% CL = 99 - 219
 MSY = 20.8 , 95% CL = 18.2 - 23.7
 Relative biomass last year= 0.561 k, 2.5th = 0.504 , 97.5th = 0.673
 Relative biomass next year= 0.58 k, 2.5th = 0.501 , 97.5th = 0.69
 Relative exploitation rate in last year= 0.717
 Comment: OK

A: BMarlin_NP catch

B: Finding viable r-k

C: Analysis of viable r-k

D: Pred. biomass vs observed

E: Exploitation rate

F: Equilibrium curve
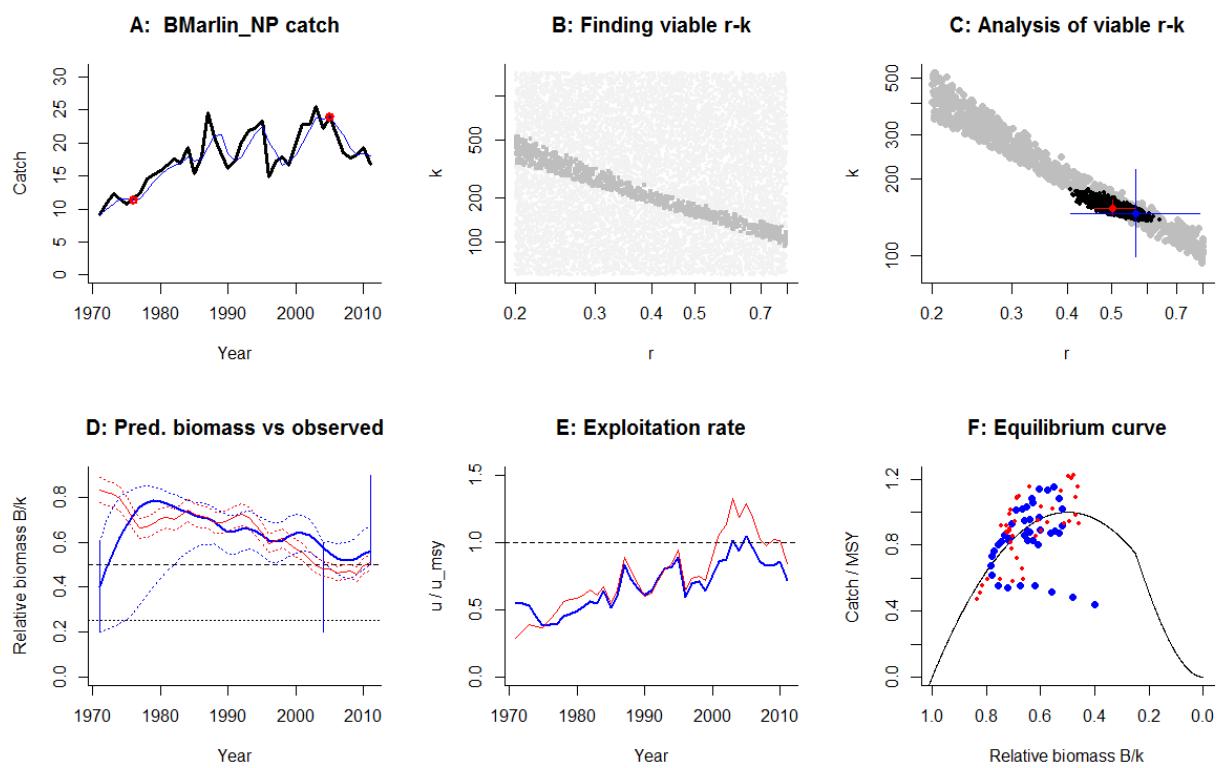
Species: *Sebastes paucispinis* , stock: Boca_PC
 Name and region: Bocaccio - Southern Pacific Coast , Pacific
 Catch data used from years 1935 - 2012 , biomass = observed
 Prior initial relative biomass = 0.5 - 0.9 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 2008 default
 Prior final relative biomass = 0.01 - 0.4 , default
 Prior range for r = 0.05 - 0.5 default , prior range for k = 15.1 - 603
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.254 , 95% CL = 0.216 - 0.282 , k = 55.2 , 95% CL = 49.5 - 62.7
 MSY = 3.5 , 95% CL = 2.91 - 4.11
Biomass in last year = 16.6 or 0.3 k
 Exploitation rate in last year = 0.00755 or 0.0594 u.msy
 Results of CMSY analysis with altogether 3110 viable trajectories for 801 r-k pairs
 r = 0.243 , 95% CL = 0.148 - 0.433 , k = 56.9 , 95% CL = 28.6 - 104
 MSY = 3.45 , 95% CL = 2.8 - 4.26
 Relative biomass last year= 0.107 k, 2.5th = 0.013 , 97.5th = 0.381
 Relative biomass next year= 0.112 k, 2.5th = 0.0112 , 97.5th = 0.425
 Relative exploitation rate in last year= 0.254
 Comment: OK

A: Boca_PC catch   B: Finding viable r-k   C: Analysis of viable r-k

D: Pred. biomass vs observed   E: Exploitation rate   F: Equilibrium curve
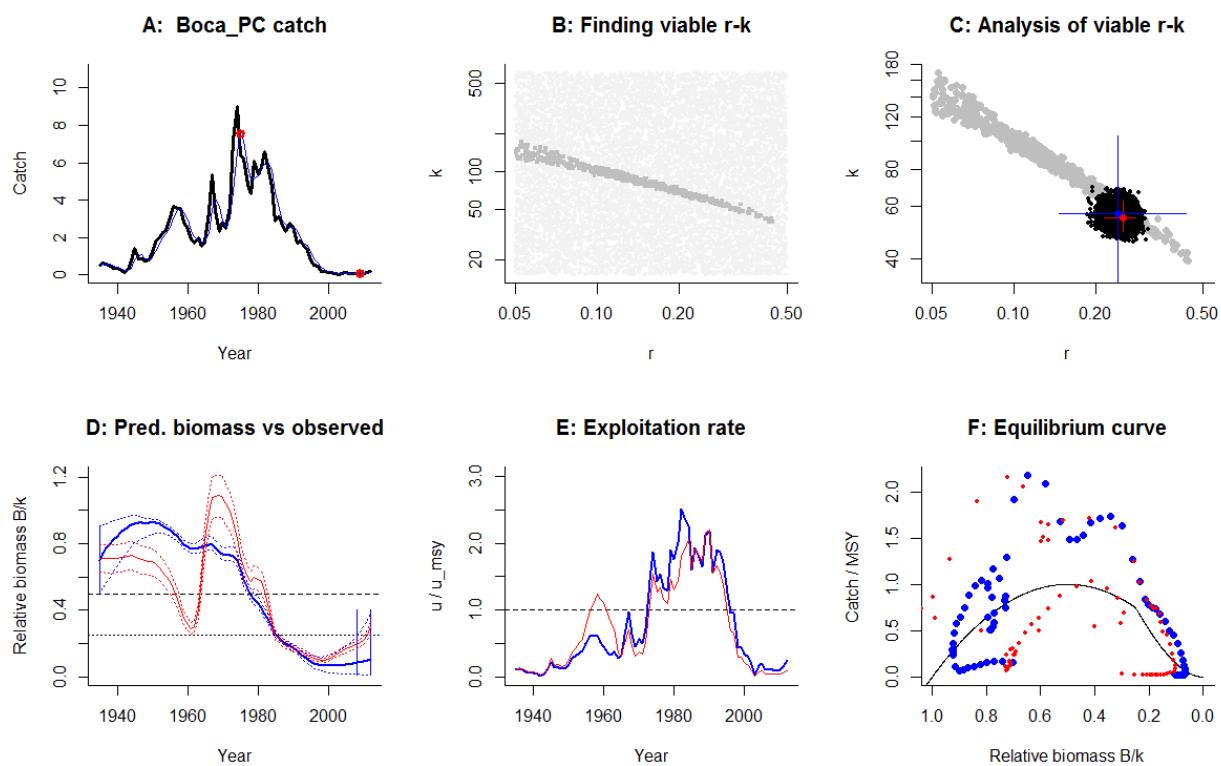
Species: *Sebastes auriculatus* , stock: BrownRF_PC
 Name and region: Brown rockfish - Pacific Coast , Pacific
 Catch data used from years 1950 - 2012 , biomass = observed
 Prior initial relative biomass = 0.5 - 0.9 default
 Prior intermediate rel. biomass= 0.5 - 0.9 in year 1975 default
 Prior final relative biomass   = 0.2 - 0.6 , default
 Prior range for r = 0.05 - 0.5 default , prior range for k = 0.672 - 26.9
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.214 , 95% CL = 0.194 - 0.236 , k = 3.45 , 95% CL = 3.22 - 3.75
 MSY = 0.184 , 95% CL = 0.169 - 0.202
Biomass in last year = 1.4 or 0.406 k
 Exploitation rate in last year = 0.0726 or 0.679 u.msy
 Results of CMSY analysis with altogether 8669 viable trajectories for 1387 r-k pairs
 r = 0.215 , 95% CL = 0.136 - 0.364 , k = 3.2 , 95% CL = 1.76 - 5.46
 MSY = 0.172 , 95% CL = 0.149 - 0.199
 Relative biomass last year= 0.513 k, 2.5th = 0.272 , 97.5th = 0.597
 Relative biomass next year= 0.53 k, 2.5th = 0.278 , 97.5th = 0.617
 Relative exploitation rate in last year= 0.537
 Comment: Start year set to 1950.

A: BrownRF_PC catch

B: Finding viable r-k

C: Analysis of viable r-k

D: Pred. biomass vs observed

E: Exploitation rate

F: Equilibrium curve
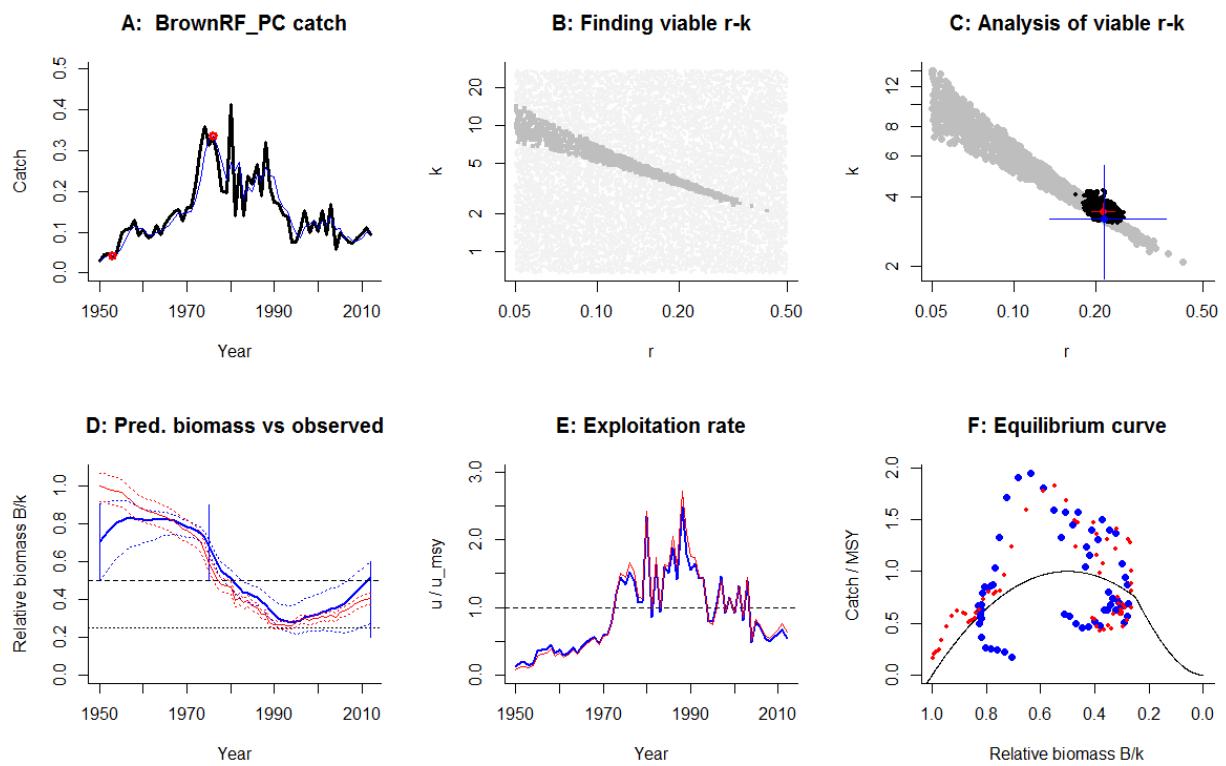
Species: *Sebastes nebulosus* , stock: ChinaRF_PC
 Name and region: China rockfish - Pacific Coast , Pacific
 Catch data used from years 1970 - 2012 , biomass = observed
 Prior initial relative biomass = 0.5 - 0.9 expert
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 2005 default
 Prior final relative biomass = 0.2 - 0.6 , default
 Prior range for r = 0.05 - 0.5 default , prior range for k = 0.132 - 5.28
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.185 , 95% CL = 0.151 - 0.231 , k = 1.25 , 95% CL = 1.14 - 1.38
 MSY = 0.0577 , 95% CL = 0.0493 - 0.0692
Biomass in last year = 0.775 or 0.621 k
 Exploitation rate in last year = 0.0404 or 0.438 u.msy
 Results of CMSY analysis with altogether 3560 viable trajectories for 845 r-k pairs
 r = 0.27 , 95% CL = 0.159 - 0.488 , k = 0.681 , 95% CL = 0.349 - 1.25
 MSY = 0.046 , 95% CL = 0.0396 - 0.0533
 Relative biomass last year= 0.466 k, 2.5th = 0.239 , 97.5th = 0.589
 Relative biomass next year= 0.484 k, 2.5th = 0.239 , 97.5th = 0.619
 Relative exploitation rate in last year= 0.723
 Comment: Start year set to 1970. Fit could be improved by setting intbio to 0.2-0.6 in 2000.

A: ChinaRF_PC catch

B: Finding viable r-k

C: Analysis of viable r-k

D: Pred. biomass vs observed

E: Exploitation rate

F: Equilibrium curve
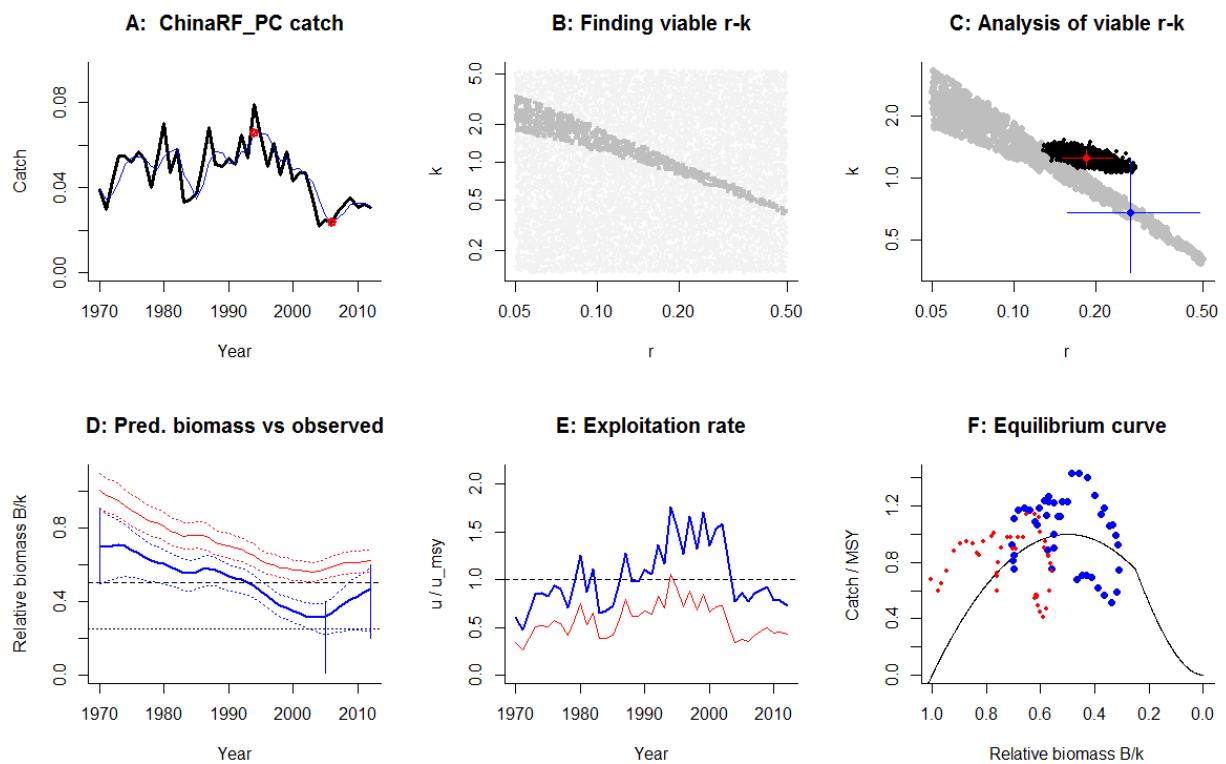
Species: *Sebastes caurinus* , stock: CopperRF_PC
 Name and region: Copper rockfish - Pacific Coast , Pacific
 Catch data used from years 1950 - 2012 , biomass = observed
 Prior initial relative biomass = 0.5 - 0.9 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 2003 default
 Prior final relative biomass   = 0.2 - 0.6 expert
 Prior range for r = 0.05 - 0.5 default , prior range for k = 0.967 - 38.7
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.184 , 95% CL = 0.163 - 0.208 , k = 5.35 , 95% CL = 4.97 - 5.77
 MSY = 0.246 , 95% CL = 0.221 - 0.274
Biomass in last year = 3.25 or 0.607 k
 Exploitation rate in last year = 0.0239 or 0.26 u.msy
 Results of CMSY analysis with altogether 5287 viable trajectories for 1059 r-k pairs
 r = 0.2 , 95% CL = 0.129 - 0.34 , k = 4.41 , 95% CL = 2.37 - 7.47
 MSY = 0.22 , 95% CL = 0.185 - 0.263
 Relative biomass last year= 0.521 k, 2.5th = 0.24 , 97.5th = 0.597
 Relative biomass next year= 0.545 k, 2.5th = 0.251 , 97.5th = 0.62
 Relative exploitation rate in last year= 0.413
 Comment: Start year set to 1950; OK.

A: CopperRF_PC catch

B: Finding viable r-k

C: Analysis of viable r-k

D: Pred. biomass vs observed

E: Exploitation rate

F: Equilibrium curve
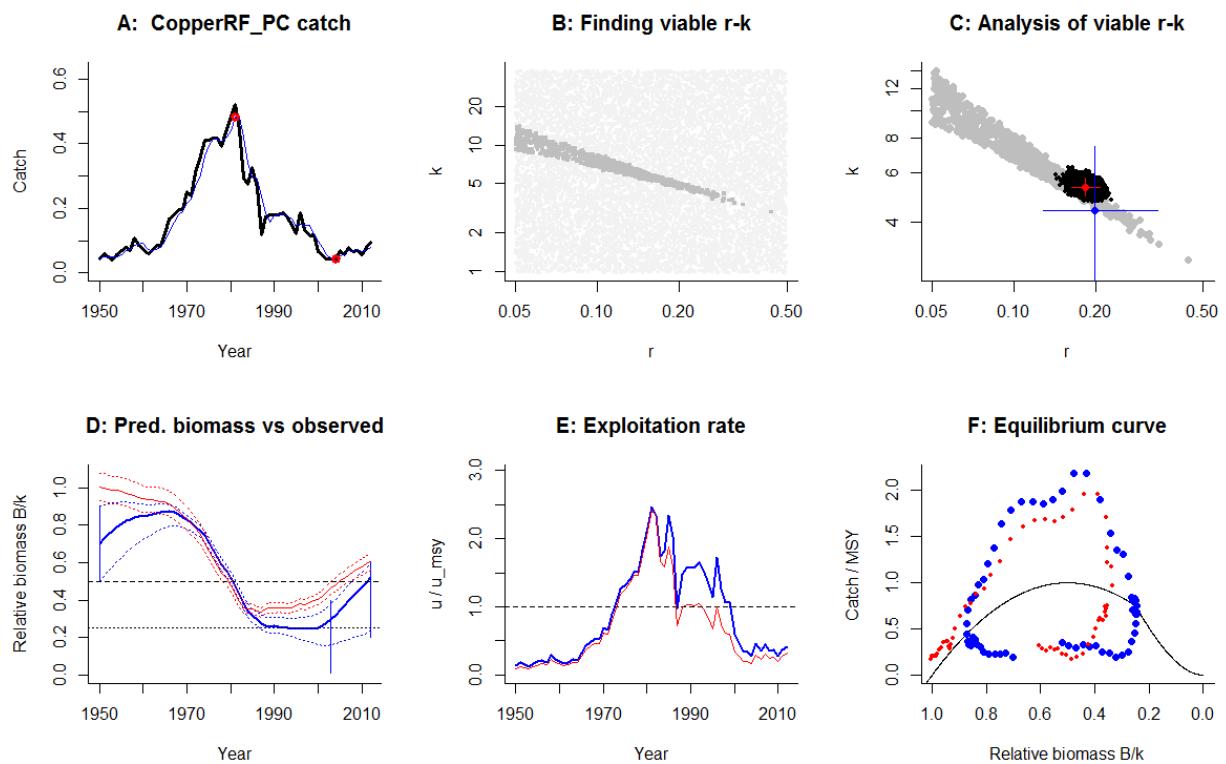
Species: *Sebastes levis* , stock: Cowcod_PC
 Name and region: Cowcod - Southern California , Pacific
 Catch data used from years 1959 - 2012 , biomass = observed
 Prior initial relative biomass = 0.5 - 0.9 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 2006 default
 Prior final relative biomass = 0.2 - 0.6 expert
 Prior range for r = 0.05 - 0.5 default , prior range for k = 0.512 - 20.5
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.275 , 95% CL = 0.241 - 0.314 , k = 2.05 , 95% CL = 1.74 - 2.7
 MSY = 0.141 , 95% CL = 0.116 - 0.184
Biomass in last year = 1.02 or 0.497 k
 Exploitation rate in last year = 0.000655 or 0.00476 u.msy
 Results of CMSY analysis with altogether 3379 viable trajectories for 1260 r-k pairs
 r = 0.254 , 95% CL = 0.152 - 0.469 , k = 2 , 95% CL = 0.972 - 3.74
 MSY = 0.127 , 95% CL = 0.102 - 0.158
 Relative biomass last year= 0.416 k, 2.5th = 0.211 , 97.5th = 0.592
 Relative biomass next year= 0.467 k, 2.5th = 0.236 , 97.5th = 0.646
 Relative exploitation rate in last year= 0.00945
 Comment: Set from Very low to Low.

A: Cowcod_PC catch

B: Finding viable r-k

C: Analysis of viable r-k

D: Pred. biomass vs observed

E: Exploitation rate

F: Equilibrium curve
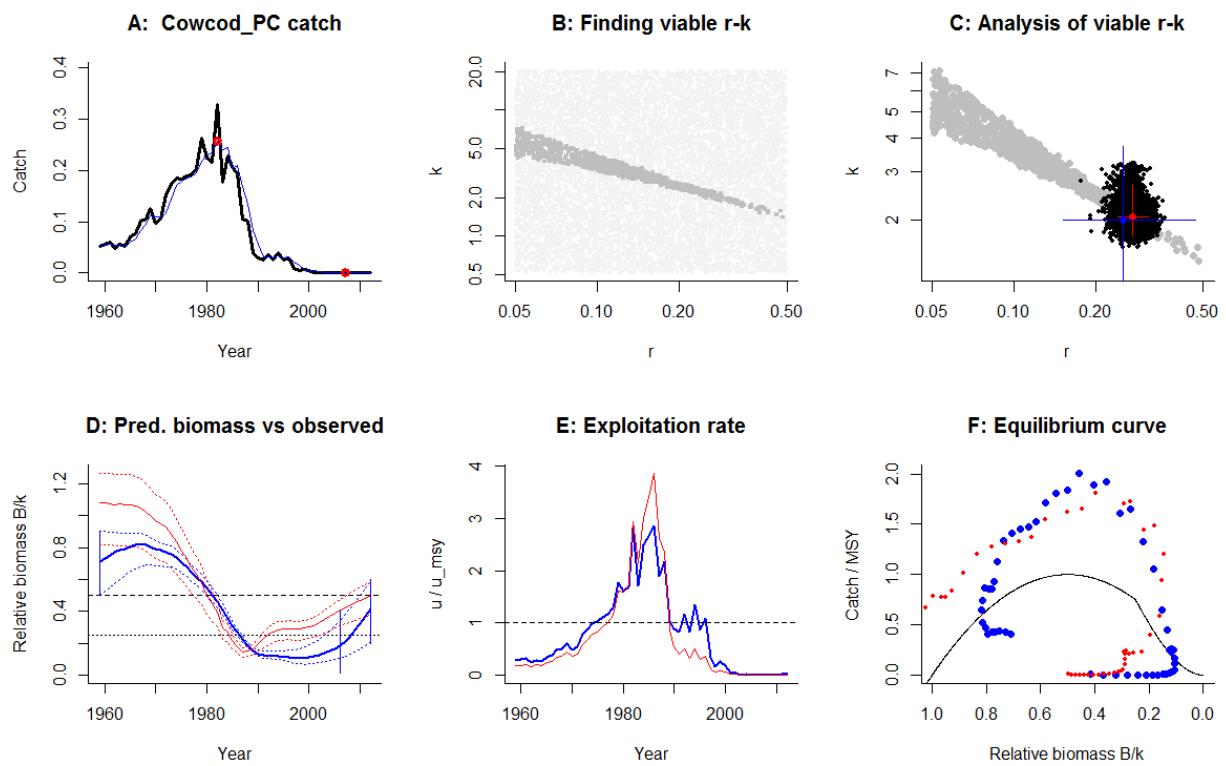
Species: *Sebastes crameri* , stock: DarkblotchedRF_PC
 Name and region: Darkblotched rockfish - Pacific Coast , Pacific
 Catch data used from years 1950 - 2012 , biomass = observed
 Prior initial relative biomass = 0.5 - 0.9 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 2005 default
 Prior final relative biomass   = 0.01 - 0.4 , default
 Prior range for r = 0.015 - 0.1 default , prior range for k = 16.2 - 866
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.0926 , 95% CL = 0.0646 - 0.118 , k = 37.9 , 95% CL = 33 - 45.7
 MSY = 0.882 , 95% CL = 0.657 - 1.1
Biomass in last year = 15.7 or 0.414 k
 Exploitation rate in last year = 0.012 or 0.26 u.msy
 Results of CMSY analysis with altogether 17603 viable trajectories for 3499 r-k pairs
 r = 0.062 , 95% CL = 0.0397 - 0.097 , k = 37.6 , 95% CL = 20.4 - 69.6
 MSY = 0.584 , 95% CL = 0.42 - 0.811
 Relative biomass last year= 0.253 k, 2.5th = 0.0181 , 97.5th = 0.395
 Relative biomass next year= 0.259 k, 2.5th = 0.0135 , 97.5th = 0.405
 Relative exploitation rate in last year= 0.325
 Comment: Set from Low to Very low and start year to 1950.
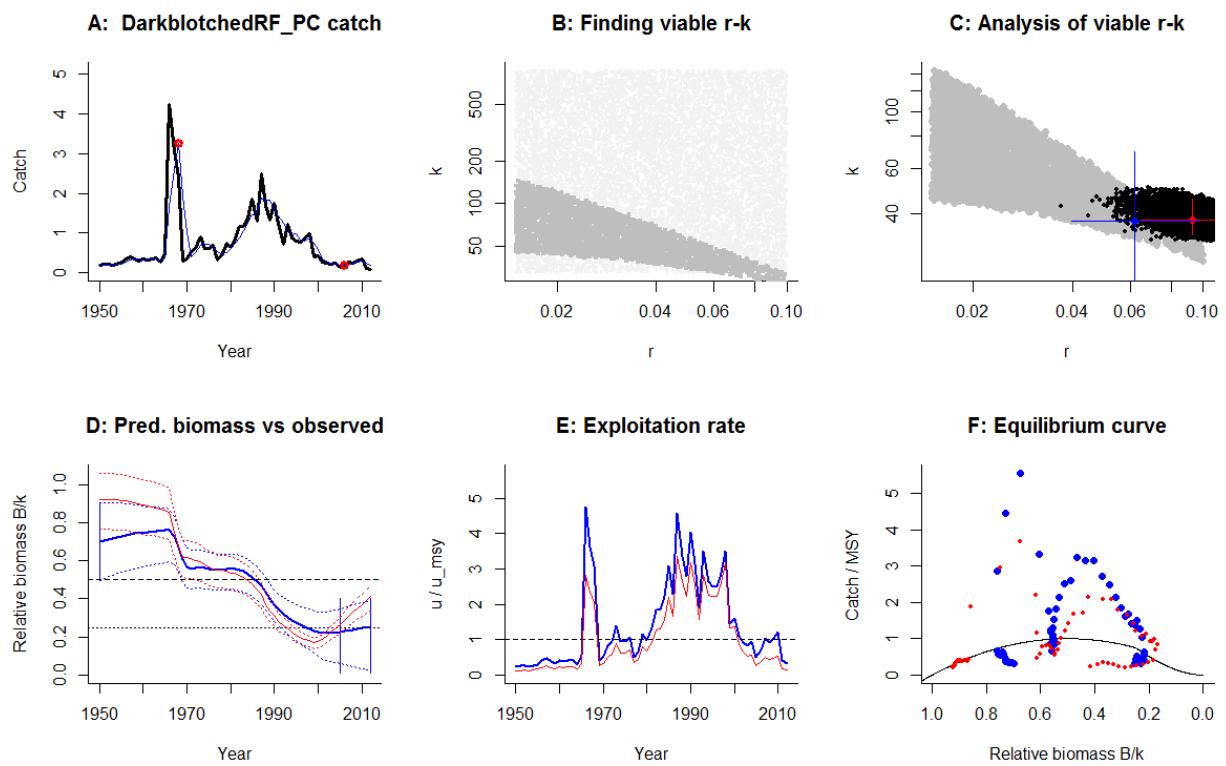
Species: *Sebastolobus altivelis* , stock: LongspinTH_PC
 Name and region: Longspine thornyhead - Pacific Coast , Pacific
 Catch data used from years 1980 - 2012 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.5 - 0.9 in year 1994 default
 Prior final relative biomass   = 0.01 - 0.4 , default
 Prior range for r = 0.015 - 0.1 default , prior range for k = 60.4 - 1610
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.0594 , 95% CL = 0.0432 - 0.083 , k = 184 , 95% CL = 138 - 241
 MSY = 2.76 , 95% CL = 1.96 - 3.8
Biomass in last year = 68.3 or 0.37 k
 Exploitation rate in last year = 0.0169 or 0.57 u.msy
 Results of CMSY analysis with altogether 1052 viable trajectories for 852 r-k pairs
 r = 0.062 , 95% CL = 0.0397 - 0.097 , k = 114 , 95% CL = 64.3 - 203
 MSY = 1.77 , 95% CL = 1.38 - 2.28
 Relative biomass last year= 0.352 k, 2.5th = 0.165 , 97.5th = 0.399
 Relative biomass next year= 0.357 k, 2.5th = 0.16 , 97.5th = 0.404
 Relative exploitation rate in last year= 0.731
 Comment: Set from Low to Very low. Fit could be improved by setting intbio Low in 2000.

A: LongspinTH_PC catch   B: Finding viable r-k   C: Analysis of viable r-k

D: Pred. biomass vs observed   E: Exploitation rate   F: Equilibrium curve
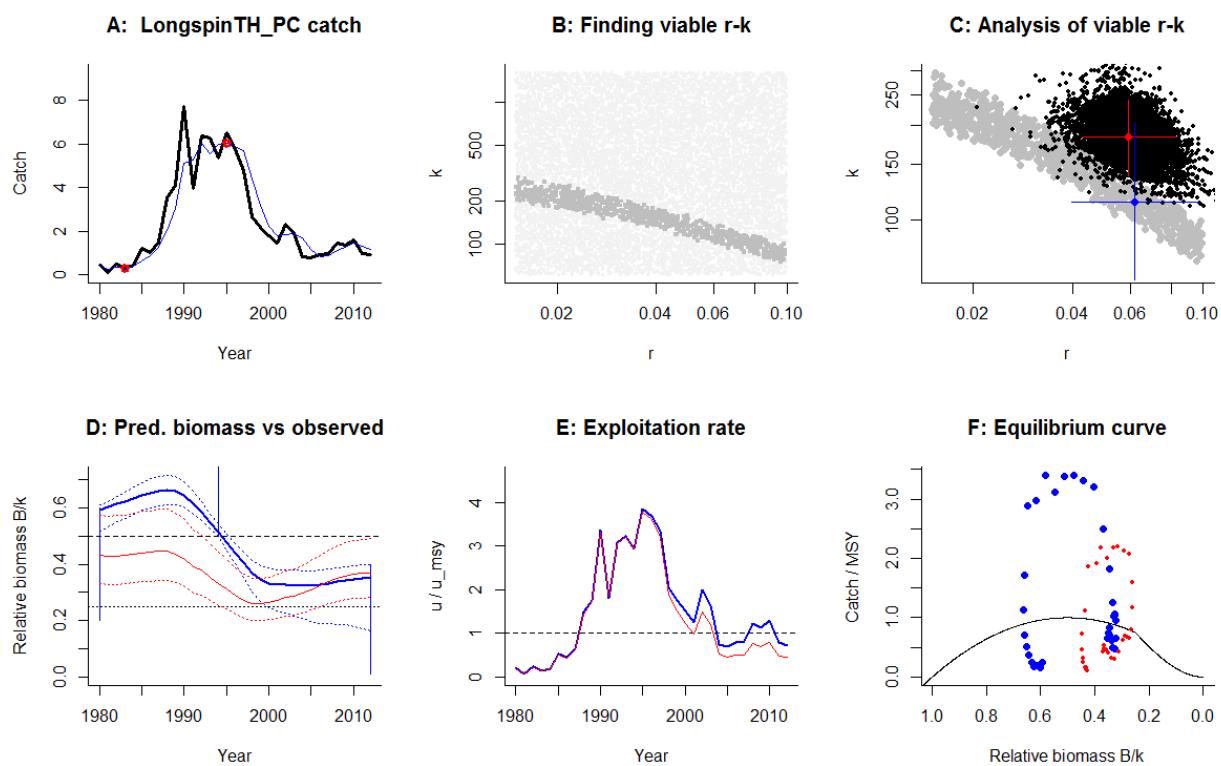
Species: *Eopsetta jordani* , stock: PetraleSole_PC
 Name and region: Petrale sole - Pacific Coast , Pacific
 Catch data used from years 1959 - 2012 , biomass = observed
 Prior initial relative biomass = 0.5 - 0.9 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 1994 default
 Prior final relative biomass   = 0.2 - 0.6 expert
 Prior range for r = 0.2 - 0.8 default , prior range for k = 4.42 - 70.8
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.446 , 95% CL = 0.416 - 0.481 , k = 23.8 , 95% CL = 22.1 - 25.8
 MSY = 2.65 , 95% CL = 2.49 - 2.84
Biomass in last year = 15 or 0.631 k
 Exploitation rate in last year = 0.0622 or 0.279 u.msy
 Results of CMSY analysis with altogether 2832 viable trajectories for 1203 r-k pairs
 r = 0.381 , 95% CL = 0.311 - 0.503 , k = 27.1 , 95% CL = 19.8 - 34.5
 MSY = 2.59 , 95% CL = 2.4 - 2.78
 Relative biomass last year= 0.53 k, 2.5th = 0.293 , 97.5th = 0.598
 Relative biomass next year= 0.583 k, 2.5th = 0.33 , 97.5th = 0.66
 Relative exploitation rate in last year= 0.417
 Comment: OK

A: PetraleSole_PC catch

B: Finding viable r-k

C: Analysis of viable r-k

D: Pred. biomass vs observed

E: Exploitation rate

F: Equilibrium curve
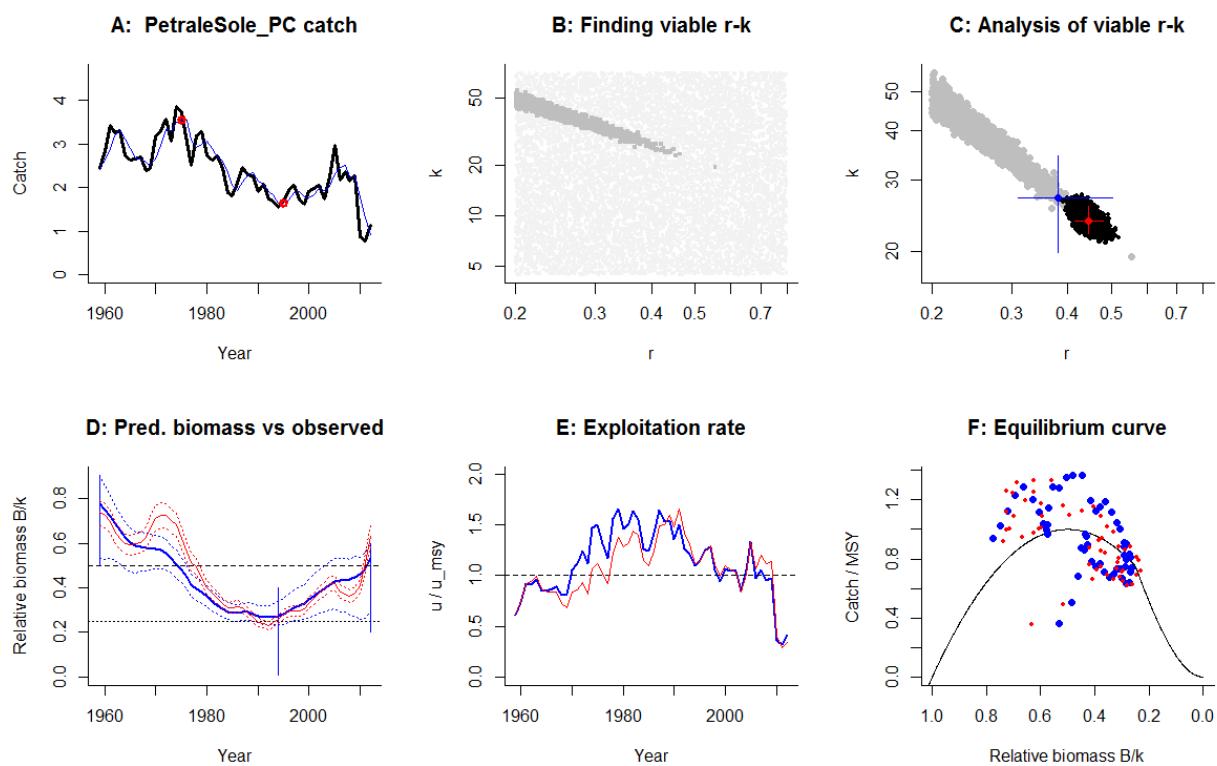
Species: *Merluccius productus* , stock: Phake_PC
 Name and region: Pacific hake - Pacific Coast , Pacific
 Catch data used from years 1990 - 2012 , biomass = observed
 Prior initial relative biomass = 0.5 - 0.9 expert
 Prior intermediate rel. biomass= 0.5 - 0.9 in year 2005 default
 Prior final relative biomass   = 0.2 - 0.6 , default
 Prior range for r = 0.2 - 0.8 default , prior range for k = 443 - 7090
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.495 , 95% CL = 0.428 - 0.547 , k = 3340 , 95% CL = 2818 - 4213
 MSY = 411 , 95% CL = 334 - 517
Biomass in last year = 2156 or 0.646 k
 Exploitation rate in last year = 0.111 or 0.447 u.msy
 Results of CMSY analysis with altogether 7703 viable trajectories for 1197 r-k pairs
 r = 0.566 , 95% CL = 0.407 - 0.785 , k = 1945 , 95% CL = 1293 - 2926
 MSY = 275 , 95% CL = 235 - 322
 Relative biomass last year= 0.514 k, 2.5th = 0.262 , 97.5th = 0.597
 Relative biomass next year= 0.532 k, 2.5th = 0.24 , 97.5th = 0.637
 Relative exploitation rate in last year= 0.721
 Comment: Start year set to 1990.

A: Phake_PC catch

B: Finding viable r-k

C: Analysis of viable r-k

D: Pred. biomass vs observed

E: Exploitation rate

F: Equilibrium curve
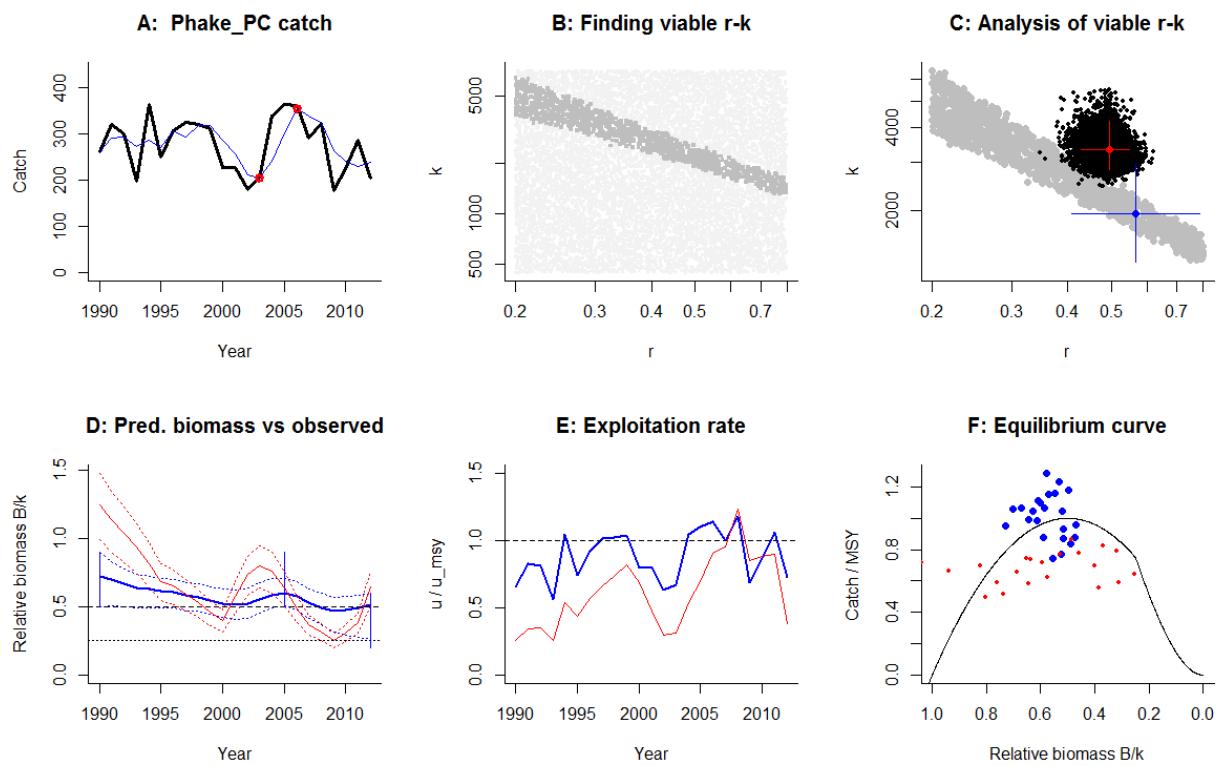
Species: *Sebastes aleutianus* , stock: Rougheye_PC
 Name and region: Rougheye rockfish - Pacific Coast , Pacific
 Catch data used from years 1980 - 2012 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 2003 default
 Prior final relative biomass   = 0.01 - 0.4 expert
 Prior range for r = 0.015 - 0.1 default , prior range for k = 5.84 - 156
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.0347 , 95% CL = 0.0189 - 0.0541 , k = 29.4 , 95% CL = 21.1 - 38.3
 MSY = 0.254 , 95% CL = 0.139 - 0.404
Biomass in last year = 8.49 or 0.289 k
 Exploitation rate in last year = 0.0242 or 1.39 u.msy
 Results of CMSY analysis with altogether 25873 viable trajectories for 6603 r-k pairs
 r = 0.062 , 95% CL = 0.0397 - 0.097 , k = 23.5 , 95% CL = 8.53 - 64.6
 MSY = 0.364 , 95% CL = 0.12 - 1.1
 Relative biomass last year= 0.259 k, 2.5th = 0.0168 , 97.5th = 0.396
 Relative biomass next year= 0.259 k, 2.5th = 0.0031 , 97.5th = 0.4
 Relative exploitation rate in last year= 0.985
 Comment: OK

A: Rougheye_PC catch

B: Finding viable r-k

C: Analysis of viable r-k

D: Pred. biomass vs observed

E: Exploitation rate

F: Equilibrium curve
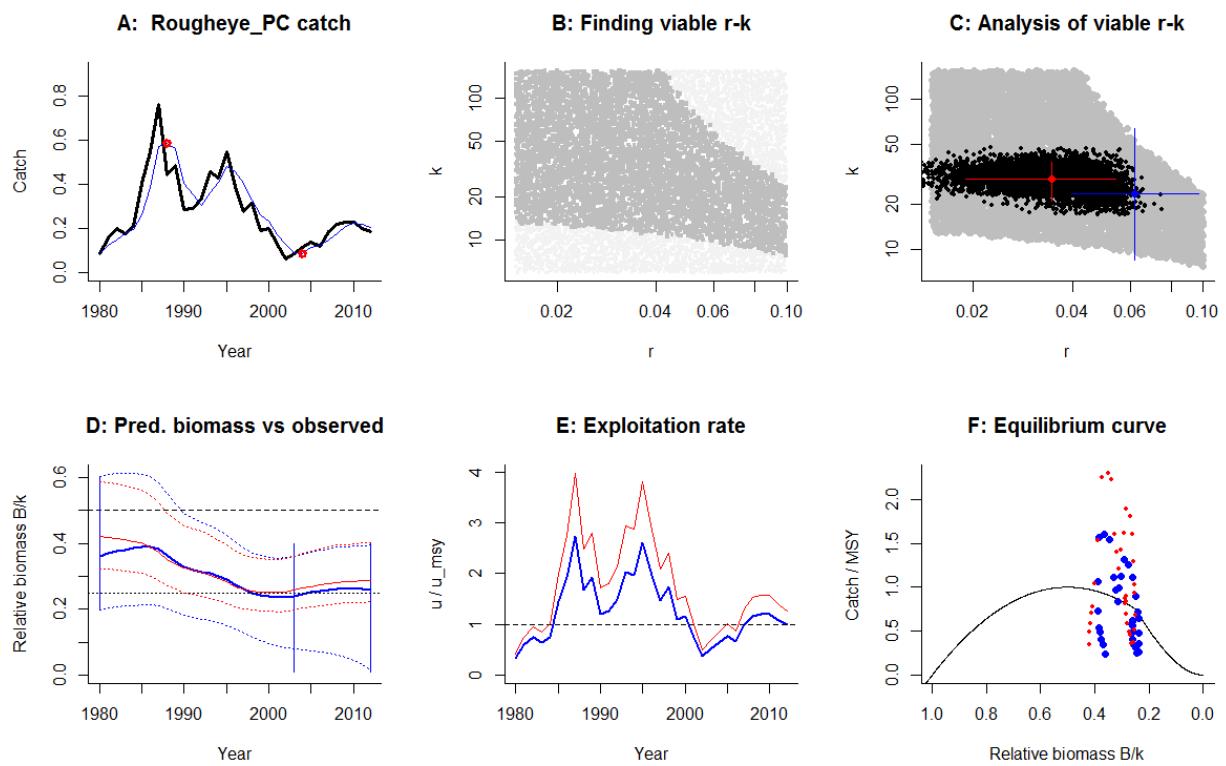
Species: *Sardinops sagax* , stock: Sardine_P
 Name and region: Sardine in Pacific Ocean , Pacific
 Catch data used from years 1993 - 2011 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.5 - 0.9 in year 2007 default
 Prior final relative biomass   = 0.2 - 0.6 expert
 Prior range for r = 0.2 - 0.8 default , prior range for k = 200 - 3201
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.501 , 95% CL = 0.443 - 0.567 , k = 1409 , 95% CL = 1247 - 1626
 MSY = 177 , 95% CL = 151 - 207
Biomass in last year = 759 or 0.539 k
 Exploitation rate in last year = 0.185 or 0.74 u.msy
 Results of CMSY analysis with altogether 11348 viable trajectories for 1942 r-k pairs
 r = 0.566 , 95% CL = 0.407 - 0.785 , k = 946 , 95% CL = 598 - 1495
 MSY = 134 , 95% CL = 104 - 173
 Relative biomass last year= 0.494 k, 2.5th = 0.257 , 97.5th = 0.597
 Relative biomass next year= 0.485 k, 2.5th = 0.187 , 97.5th = 0.617
 Relative exploitation rate in last year= 1.04
 Comment: OK

A: Sardine_P catch

B: Finding viable r-k

C: Analysis of viable r-k

D: Pred. biomass vs observed

E: Exploitation rate

F: Equilibrium curve
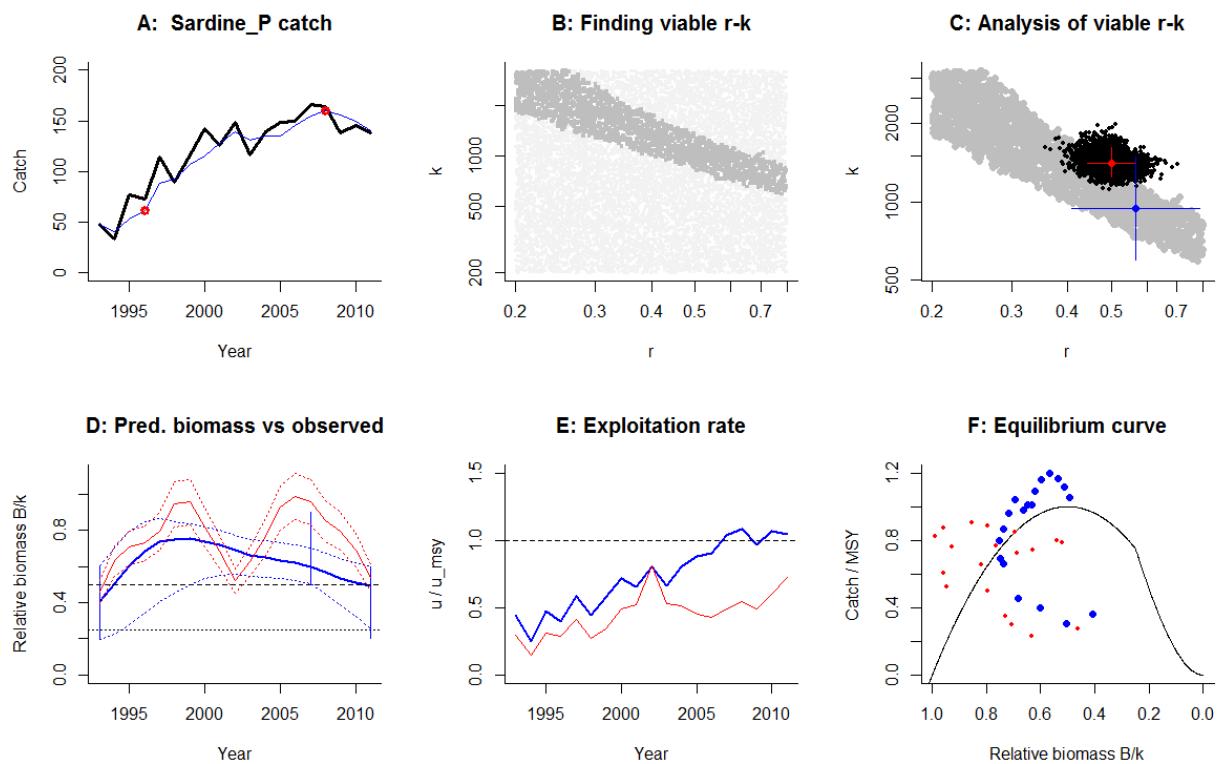
Species: *Sebastolobus alascanus* , stock: ShortspinTH_PC
 Name and region: Shortspine thornyhead - Pacific Coast , Pacific
 Catch data used from years 1970 - 2012 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 2002 default
 Prior final relative biomass   = 0.01 - 0.4 , default
 Prior range for r = 0.015 - 0.1 default , prior range for k = 45.5 - 1212
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.0159 , 95% CL = 0.00675 - 0.0332 , k = 589 , 95% CL = 422 - 851
 MSY = 2.39 , 95% CL = 1.02 - 4.5
Biomass in last year = 244 or 0.415 k
 Exploitation rate in last year = 0.00455 or 0.572 u.msy
 Results of CMSY analysis with altogether 20210 viable trajectories for 5590 r-k pairs
 r = 0.062 , 95% CL = 0.0397 - 0.097 , k = 164 , 95% CL = 68.6 - 394
 MSY = 2.55 , 95% CL = 1.1 - 5.9
 Relative biomass last year= 0.253 k, 2.5th = 0.0162 , 97.5th = 0.396
 Relative biomass next year= 0.256 k, 2.5th = 0.0071 , 97.5th = 0.403
 Relative exploitation rate in last year= 0.706
 Comment: OK. Fit could be improved by setting intbio (anywhere) and endbio to Medium.

A: ShortspinTH_PC catch

B: Finding viable r-k

C: Analysis of viable r-k

D: Pred. biomass vs observed

E: Exploitation rate

F: Equilibrium curve
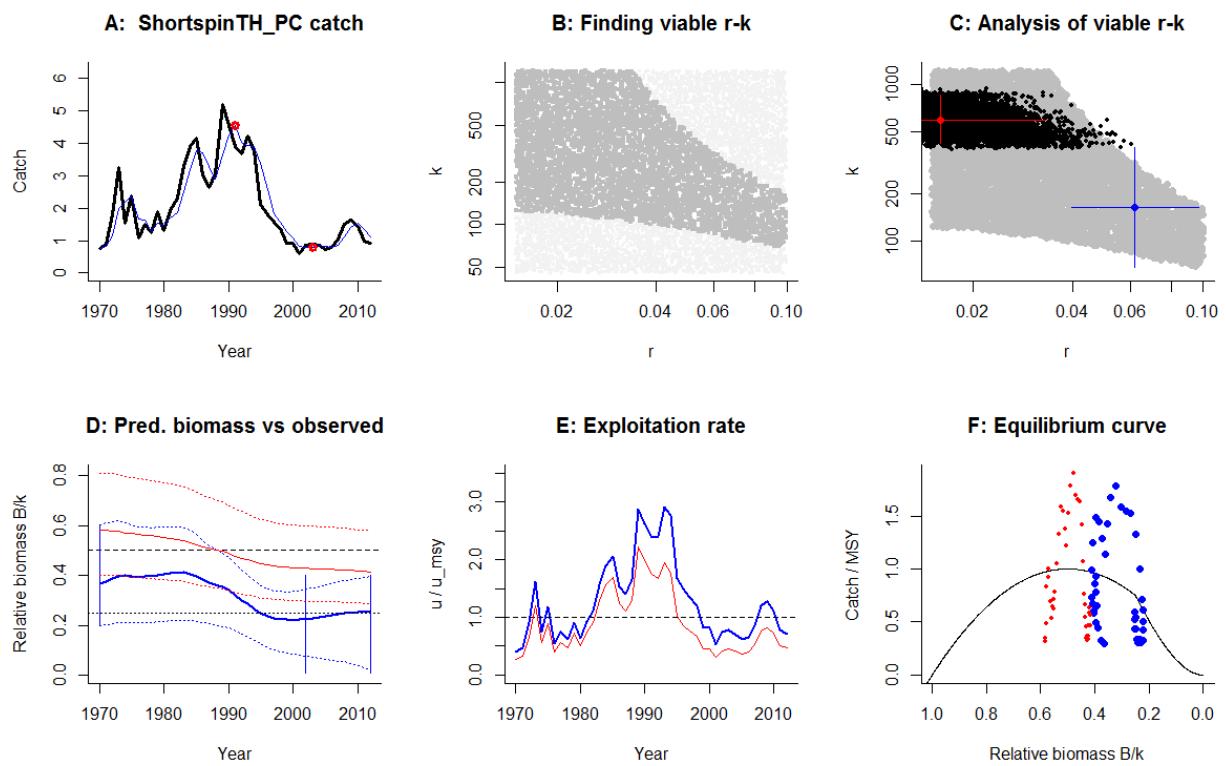
Region: Northwest Atlantic

[CMSY_46e.R, AllStocks_ID20.csv, AllStocks_Spec16.csv]
Species: *Hippoglossus hippoglossus* , stock: Ahalibut_NWAC
Name and region: Atlantic halibut - Northwestern Atlantic Coast , NWA
 Catch data used from years 1950 - 2010 , biomass = observed
 Prior initial relative biomass = 0.5 - 0.9 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 1997 default
 Prior final relative biomass   = 0.5 - 0.9 expert
 Prior range for r = 0.05 - 0.5 default , prior range for k = 1.53 - 92.1
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.27 , 95% CL = 0.248 - 0.287 , k = 2.17 , 95% CL = 1.95 - 2.41
 MSY = 0.145 , 95% CL = 0.13 - 0.161
Biomass in last year = 1.66 or 0.768 k
 Exploitation rate in last year = 0.0495 or 0.367 u.msy
 Results of CMSY analysis with altogether 5783 viable trajectories for 2384 r-k pairs
 r = 0.254 , 95% CL = 0.152 - 0.448 , k = 2.28 , 95% CL = 1.2 - 4.12
 MSY = 0.145 , 95% CL = 0.125 - 0.169
 Relative biomass last year= 0.716 k, 2.5th = 0.527 , 97.5th = 0.852
 Relative biomass next year= 0.727 k, 2.5th = 0.547 , 97.5th = 0.852
 Relative exploitation rate in last year= 0.25
 Comment: Resilience changed from Very low to Low.

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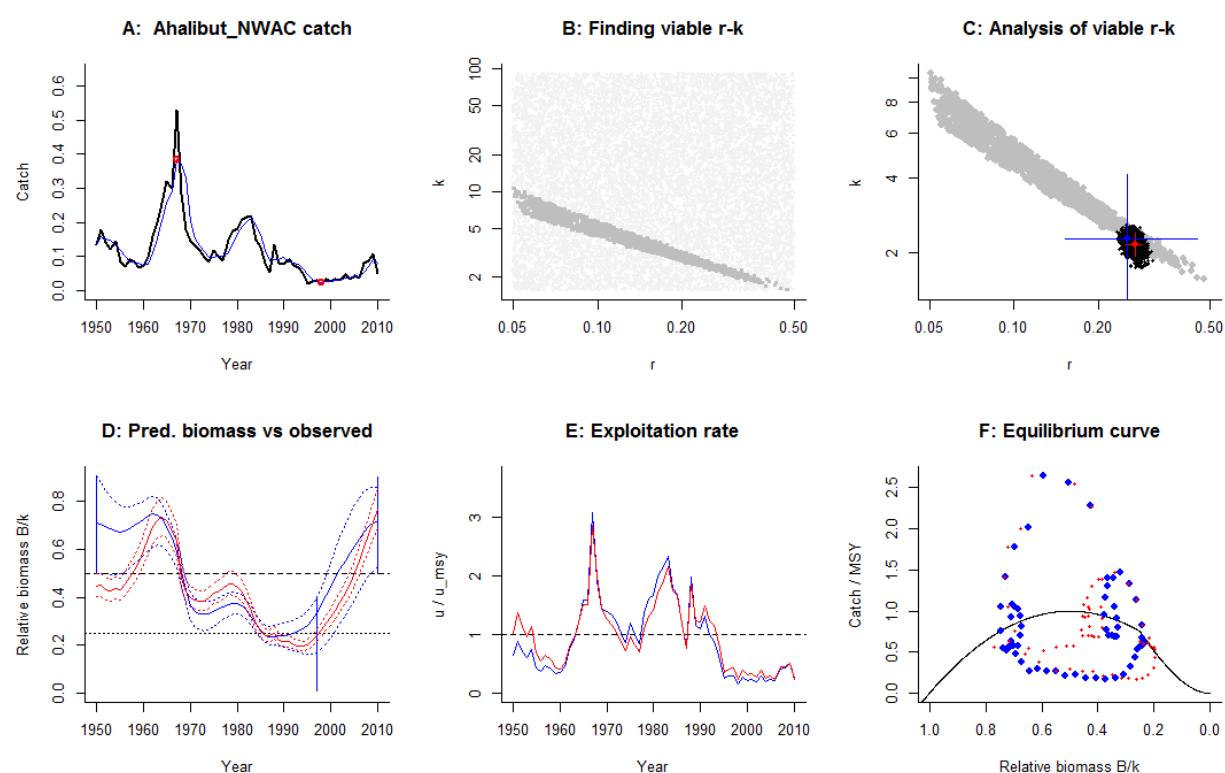
Species: *Thunnus alalunga* , stock: Albacore_NA
 Name and region: Albacore - North Atlantic , NWA
 Catch data used from years 1930 - 2011 , biomass = observed
 Prior initial relative biomass = 0.5 - 0.9 default
 Prior intermediate rel. biomass= 0.5 - 0.9 in year 1964 default
 Prior final relative biomass   = 0.01 - 0.4 , default
 Prior range for r = 0.2 - 0.8 default , prior range for k = 77.3 - 1238
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.376 , 95% CL = 0.338 - 0.425 , k = 451 , 95% CL = 417 - 487
 MSY = 42.5 , 95% CL = 38.7 - 46.9
Biomass in last year = 186 or 0.412 k
 Exploitation rate in last year = 0.0985 or 0.524 u.msy
 Results of CMSY analysis with altogether 2077 viable trajectories for 1097 r-k pairs
 r = 0.346 , 95% CL = 0.289 - 0.413 , k = 497 , 95% CL = 406 - 610
 MSY = 43 , 95% CL = 40.9 - 45.1
 Relative biomass last year= 0.294 k, 2.5th = 0.0247 , 97.5th = 0.398
 Relative biomass next year= 0.321 k, 2.5th = -0.00953 , 97.5th = 0.438
 Relative exploitation rate in last year= 0.793
 Comment: Good fit.

A: Albacore_NA catch

B: Finding viable r-k

C: Analysis of viable r-k

D: Pred. biomass vs observed

E: Exploitation rate

F: Equilibrium curve
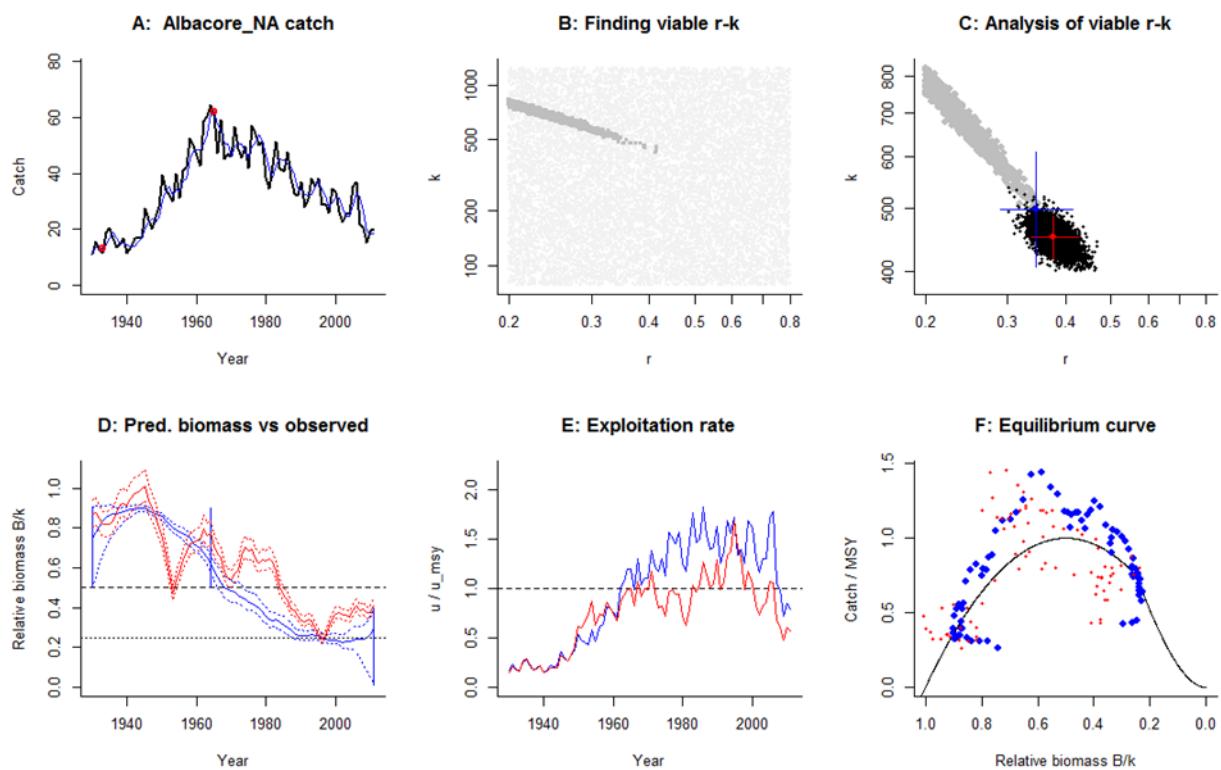
Species: *Thunnus obesus* , stock: BETuna_A
 Name and region: Bigeye tuna - Atlantic , NWA
 Catch data used from years 1950 - 2009 , biomass = observed
 Prior initial relative biomass = 0.5 - 0.9 default
 Prior intermediate rel. biomass= 0.2 - 0.6 in year 1995 default
 Prior final relative biomass   = 0.2 - 0.6 , default
 Prior range for r = 0.2 - 0.8 default , prior range for k = 159 - 2547
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.451 , 95% CL = 0.424 - 0.48 , k = 850 , 95% CL = 831 - 870
 MSY = 95.7 , 95% CL = 90.9 - 101
Biomass in last year = 423 or 0.497 k
 Exploitation rate in last year = 0.187 or 0.829 u.msy
 Results of CMSY analysis with altogether 1410 viable trajectories for 489 r-k pairs
 r = 0.568 , 95% CL = 0.411 - 0.785 , k = 661 , 95% CL = 451 - 968
 MSY = 93.9 , 95% CL = 83.6 - 105
 Relative biomass last year= 0.418 k, 2.5th = 0.216 , 97.5th = 0.593
 Relative biomass next year= 0.445 k, 2.5th = 0.184 , 97.5th = 0.627
 Relative exploitation rate in last year= 1.12
 Comment: OK

A: BETuna_A catch

B: Finding viable r-k

C: Analysis of viable r-k

D: Pred. biomass vs observed

E: Exploitation rate

F: Equilibrium curve
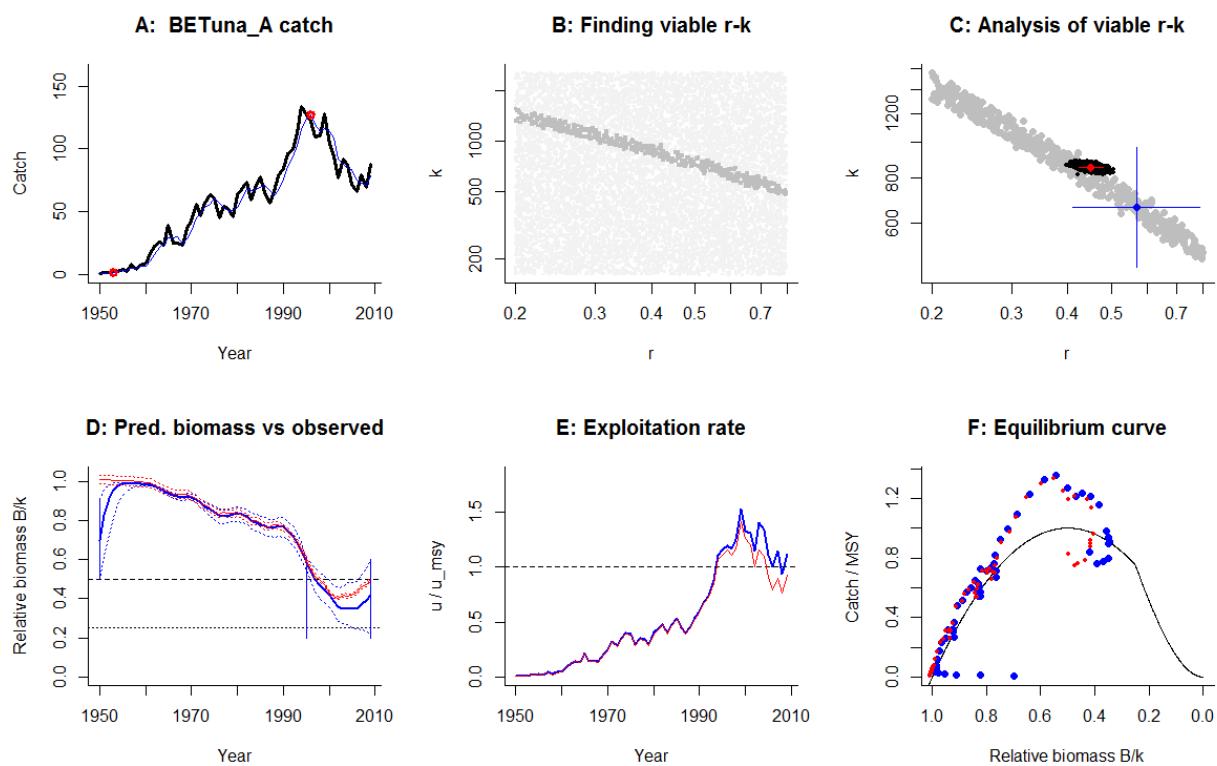
Species: *Pomatomus saltatrix* , stock: Bluefish_AC
Name and region: Bluefish - Atlantic Coast , NWA
Catch data used from years 1985 - 2014 , biomass = observed
Prior initial relative biomass = 0.2 - 0.6 default
Prior intermediate rel. biomass= 0.01 - 0.4 in year 1999 default
Prior final relative biomass = 0.01 - 0.4 , default
Prior range for r = 0.2 - 0.8 default , prior range for k = 56 - 896
Results from Bayesian Schaefer model using catch & observed biomass
r = 0.474 , 95% CL = 0.402 - 0.524 , k = 209 , 95% CL = 160 - 350
MSY = 24.6 , 95% CL = 19.5 - 41.2
Biomass in last year = 82 or 0.393 k
Exploitation rate in last year = 0.129 or 0.546 u.msy
Results of CMSY analysis with altogether 1518 viable trajectories for 1455 r-k pairs
r = 0.399 , 95% CL = 0.32 - 0.542 , k = 451 , 95% CL = 222 - 840
MSY = 44.9 , 95% CL = 20.4 - 99.1
Relative biomass last year= 0.182 k, 2.5th = 0.0133 , 97.5th = 0.393
Relative biomass next year= 0.182 k, 2.5th = -0.00294 , 97.5th = 0.459
Relative exploitation rate in last year= 0.601
Comment: OK

A: Bluefish_AC catch

B: Finding viable r-k

C: Analysis of viable r-k

D: Pred. biomass vs observed

E: Exploitation rate

F: Equilibrium curve

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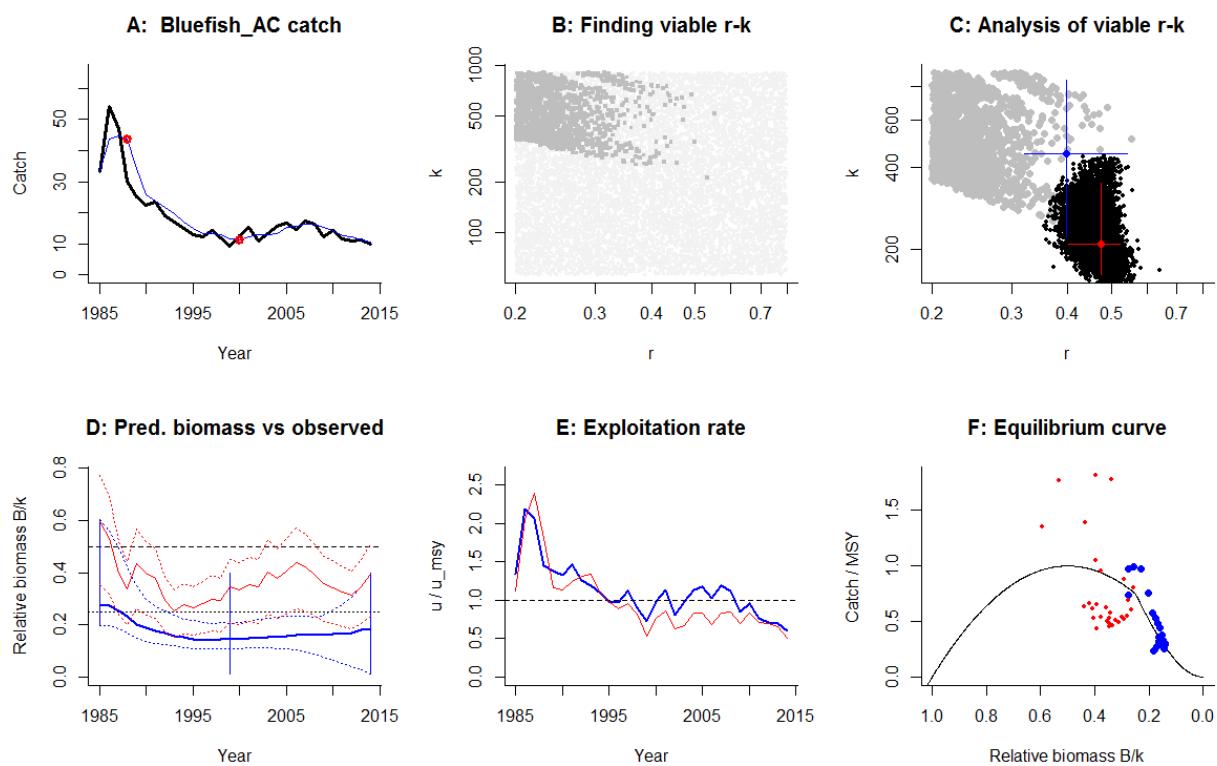
Species: *Centropristis striata* , stock: BSbass_MAC
 Name and region: Black seabass - Mid-Atlantic Coast , NWA
 Catch data used from years 1968 - 2011 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.5 - 0.9 in year 1976 default
 Prior final relative biomass   = 0.2 - 0.6 , default
 Prior range for r = 0.2 - 0.8 default , prior range for k = 4.67 - 74.7
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.522 , 95% CL = 0.481 - 0.599 , k = 23.2 , 95% CL = 20.4 - 26.3
 MSY = 3.05 , 95% CL = 2.72 - 3.42
Biomass in last year = 12.7 or 0.548 k
 Exploitation rate in last year = 0.159 or 0.607 u.msy
 Results of CMSY analysis with altogether 2510 viable trajectories for 622 r-k pairs
 r = 0.564 , 95% CL = 0.409 - 0.785 , k = 20.5 , 95% CL = 14.1 - 29.6
 MSY = 2.89 , 95% CL = 2.64 - 3.17
 Relative biomass last year= 0.504 k, 2.5th = 0.247 , 97.5th = 0.598
 Relative biomass next year= 0.546 k, 2.5th = 0.248 , 97.5th = 0.649
 Relative exploitation rate in last year= 0.532
 Comment: OK
 --

A: BSbass_MAC catch
B: Finding viable r-k
C: Analysis of viable r-k
D: Pred. biomass vs observed
E: Exploitation rate
F: Equilibrium curve
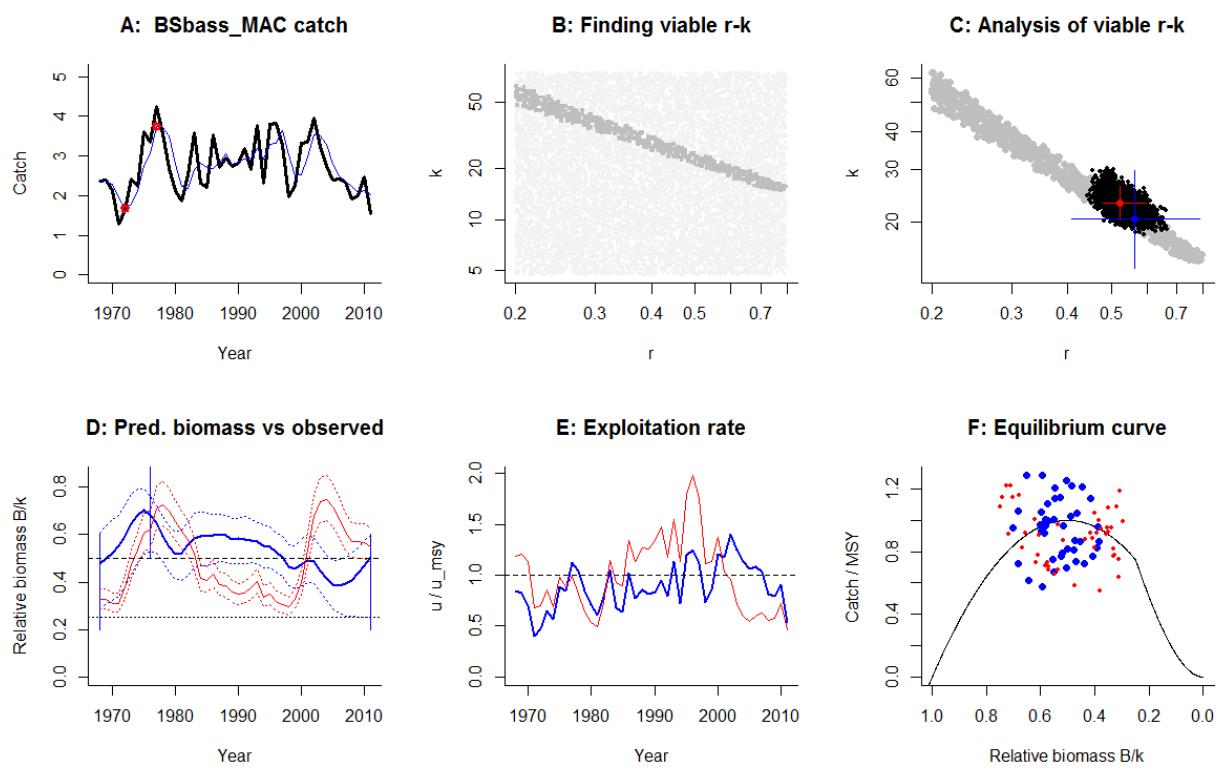
Species: *Gadus morhua* , stock: Cod_GB
 Name and region: Georges Bank Atlantic cod , NWA
 Catch data used from years 1978 - 2011 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 2007 default
 Prior final relative biomass = 0.01 - 0.4 , default
 Prior range for r = 0.2 - 0.8 default , prior range for k = 53.9 - 862
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.517 , 95% CL = 0.473 - 0.596 , k = 202 , 95% CL = 167 - 266
 MSY = 26.5 , 95% CL = 21.3 - 34.9
Biomass in last year = 29.1 or 0.144 k
 Exploitation rate in last year = 0.118 or 0.456 u.msy
 Results of CMSY analysis with altogether 1338 viable trajectories for 1247 r-k pairs
 r = 0.387 , 95% CL = 0.314 - 0.592 , k = 363 , 95% CL = 182 - 586
 MSY = 35.1 , 95% CL = 20.7 - 59.5
 Relative biomass last year= 0.114 k, 2.5th = 0.0174 , 97.5th = 0.384
 Relative biomass next year= 0.12 k, 2.5th = 0.00856 , 97.5th = 0.465
 Relative exploitation rate in last year= 0.465
 Comment: OK

A: Cod_GB catch

B: Finding viable r-k

C: Analysis of viable r-k

D: Pred. biomass vs observed

E: Exploitation rate

F: Equilibrium curve
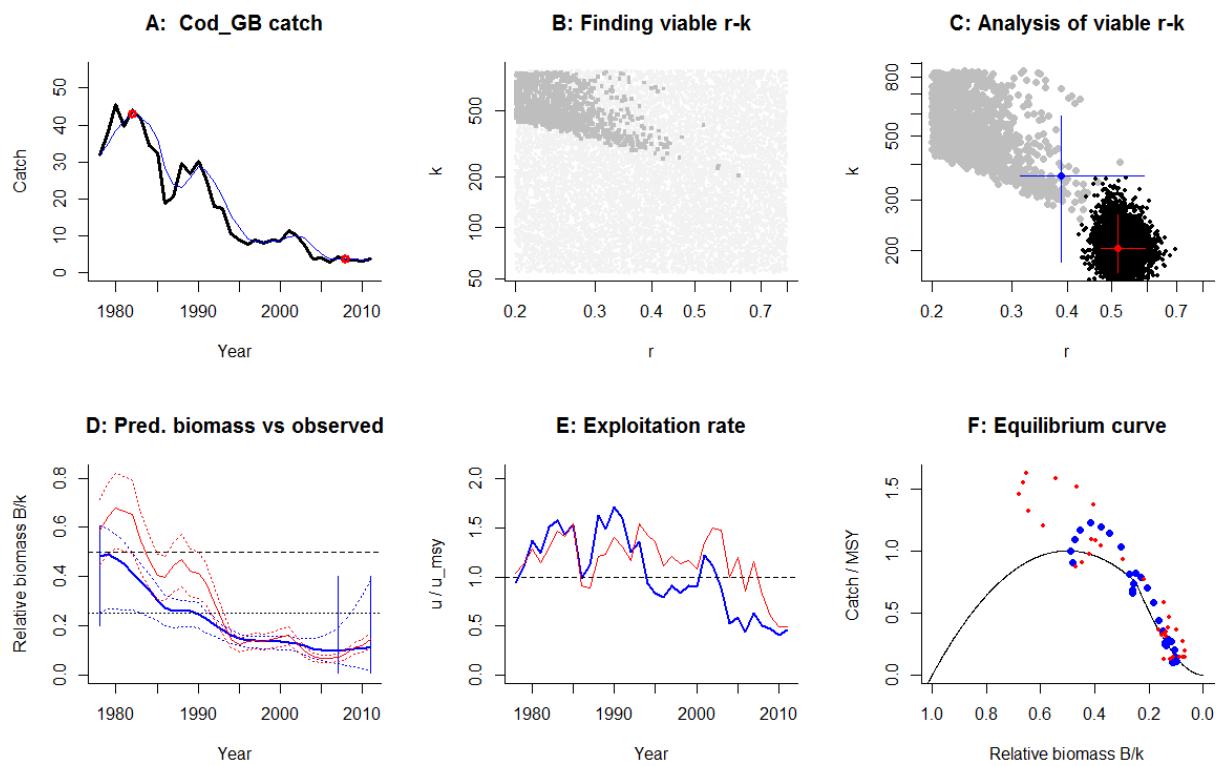
Species: *Gadus morhua* , stock: Cod_GUM
 Name and region: Gulf of Maine Atlantic cod , NWA
 Catch data used from years 1982 - 2011 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 1998 default
 Prior final relative biomass = 0.01 - 0.4 expert
 Prior range for r = 0.2 - 0.8 default , prior range for k = 22.4 - 358
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.694 , 95% CL = 0.57 - 0.799 , k = 61 , 95% CL = 51.8 - 77.2
 MSY = 10.6 , 95% CL = 8.29 - 13.8
Biomass in last year = 14.7 or 0.241 k
 Exploitation rate in last year = 0.517 or 1.49 u.msy
 Results of CMSY analysis with altogether 2055 viable trajectories for 1825 r-k pairs
 r = 0.413 , 95% CL = 0.329 - 0.672 , k = 147 , 95% CL = 66.9 - 248
 MSY = 15.1 , 95% CL = 8.45 - 27.1
 Relative biomass last year= 0.202 k, 2.5th = 0.0136 , 97.5th = 0.396
 Relative biomass next year= 0.199 k, 2.5th = -0.0414 , 97.5th = 0.437
 Relative exploitation rate in last year= 1.12
 Comment: OK

A: Cod_GUM catch

B: Finding viable r-k

C: Analysis of viable r-k

D: Pred. biomass vs observed

E: Exploitation rate

F: Equilibrium curve
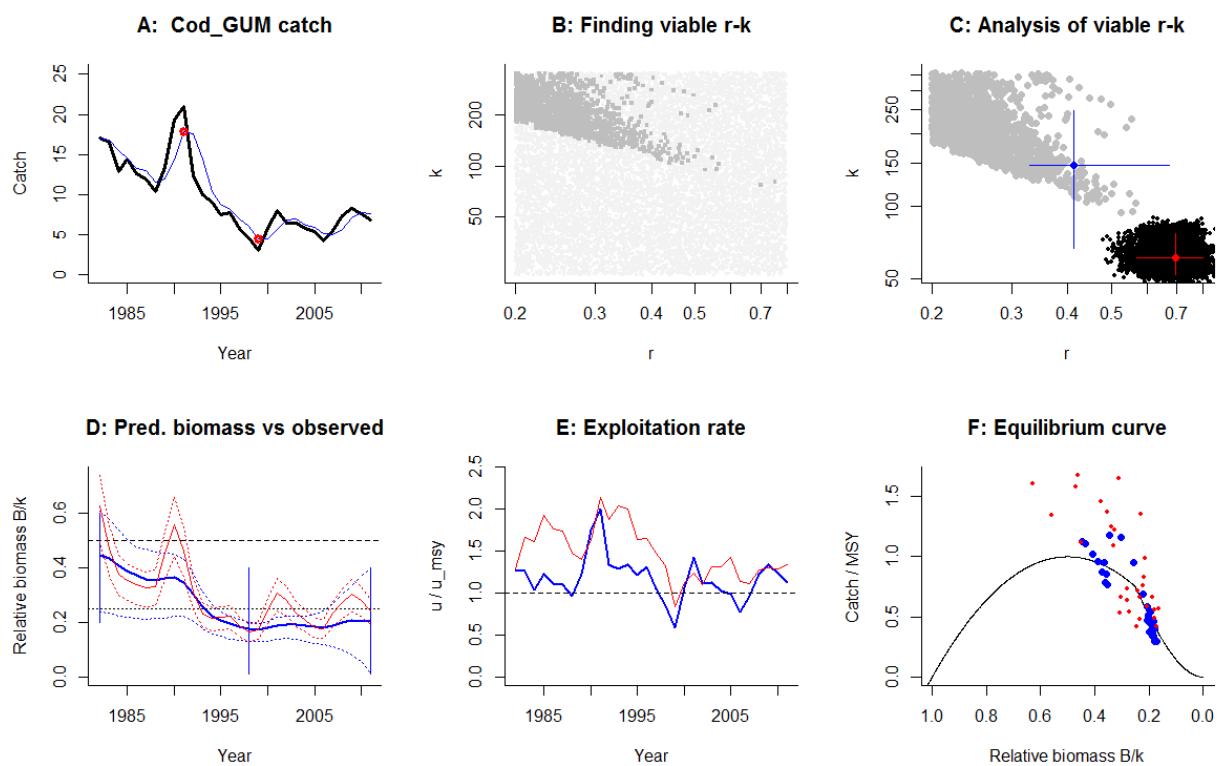
Species: *Melanogrammus aeglefinus* , stock: Haddock_GB
 Name and region: Georges Bank Haddock , NWA
 Catch data used from years 1960 - 2010 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 1996 default
 Prior final relative biomass   = 0.2 - 0.6 expert
 Prior range for r = 0.05 - 0.5 default , prior range for k = 224 - 8953
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.31 , 95% CL = 0.263 - 0.407 , k = 417 , 95% CL = 317 - 607
 MSY = 33.1 , 95% CL = 23.4 - 49.2
Biomass in last year = 186 or 0.445 k
 Exploitation rate in last year = 0.126 or 0.812 u.msy
 Results of CMSY analysis with altogether 2907 viable trajectories for 2479 r-k pairs
 r = 0.183 , 95% CL = 0.122 - 0.288 , k = 1137 , 95% CL = 507 - 2423
 MSY = 51.9 , 95% CL = 26 - 104
 Relative biomass last year= 0.456 k, 2.5th = 0.219 , 97.5th = 0.595
 Relative biomass next year= 0.475 k, 2.5th = 0.225 , 97.5th = 0.614
 Relative exploitation rate in last year= 0.547
 Comment: Resilience set from Medium to Low.
 --

A: Haddock_GB catch

B: Finding viable r-k

C: Analysis of viable r-k

D: Pred. biomass vs observed

E: Exploitation rate

F: Equilibrium curve
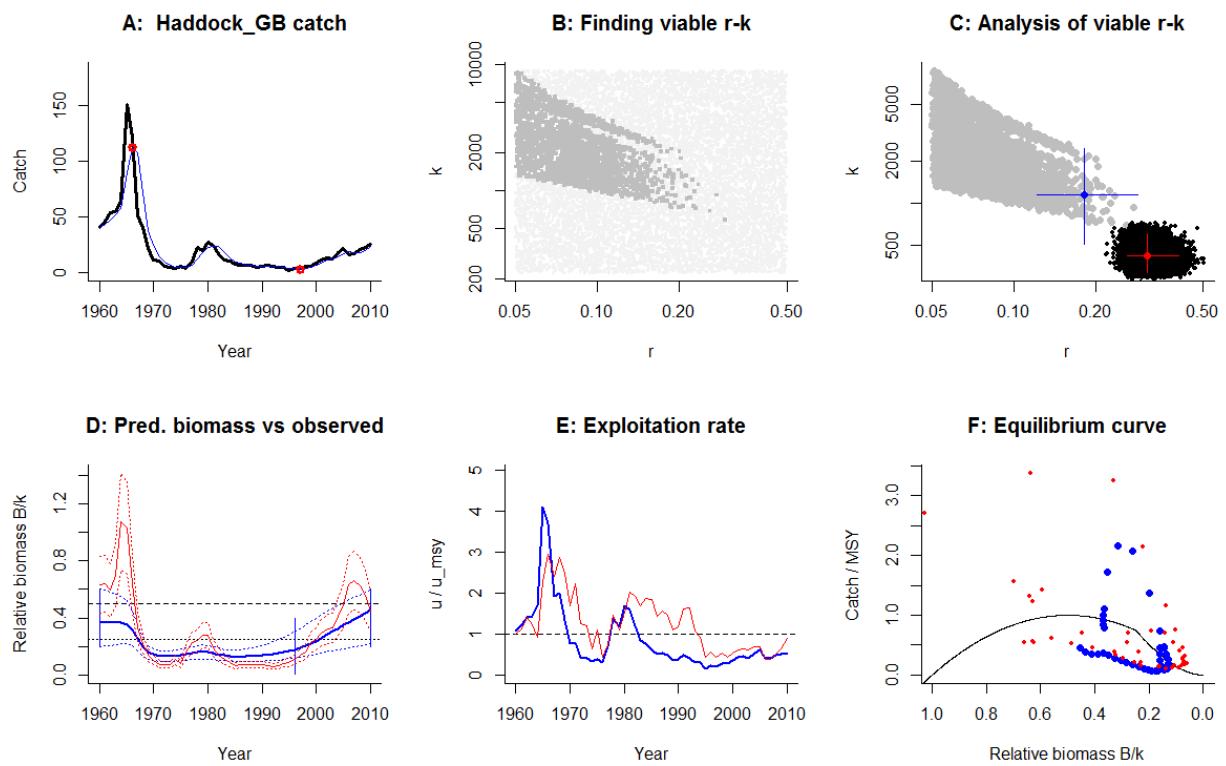
Species: *Melanogrammus aeglefinus* , stock: Haddock_GoM
Name and region: Gulf of Maine Haddock , NWA
 Catch data used from years 1977 - 2010 , biomass = observed
 Prior initial relative biomass = 0.5 - 0.9 expert
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 1993 default
 Prior final relative biomass = 0.01 - 0.4 , default
 Prior range for r = 0.2 - 0.8 default , prior range for k = 7.42 - 119
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.5 , 95% CL = 0.436 - 0.568 , k = 23.8 , 95% CL = 15.8 - 77
 MSY = 3.04 , 95% CL = 1.97 - 9.54
Biomass in last year = 3.65 or 0.153 k
 Exploitation rate in last year = 0.317 or 1.27 u.msy
 Results of CMSY analysis with altogether 2156 viable trajectories for 1901 r-k pairs
 r = 0.407 , 95% CL = 0.325 - 0.656 , k = 30.7 , 95% CL = 17.3 - 42.3
 MSY = 3.12 , 95% CL = 2.58 - 3.77
 Relative biomass last year= 0.211 k, 2.5th = 0.0151 , 97.5th = 0.392
 Relative biomass next year= 0.223 k, 2.5th = -0.0208 , 97.5th = 0.454
 Relative exploitation rate in last year= 0.994
 Comment: OK

A: Haddock_GoM catch

B: Finding viable r-k

C: Analysis of viable r-k

D: Pred. biomass vs observed

E: Exploitation rate

F: Equilibrium curve
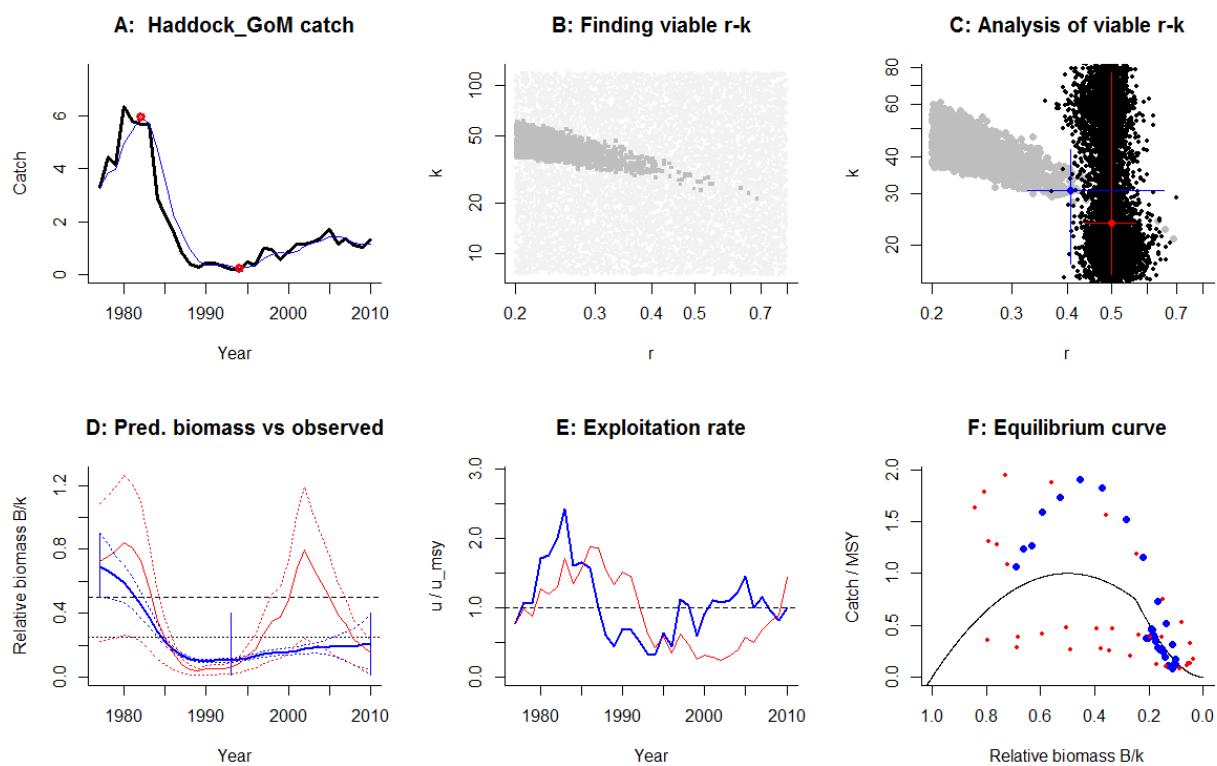
Species: *Clupea harengus* , stock: Herring_A
 Name and region: Atlantic herring , NWA
 Catch data used from years 1965 - 2011 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 1984 default
 Prior final relative biomass   = 0.5 - 0.9 expert
 Prior range for r = 0.2 - 0.8 default , prior range for k = 997 - 23921
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.52 , 95% CL = 0.473 - 0.611 , k = 1687 , 95% CL = 1470 - 2004
 MSY = 223 , 95% CL = 188 - 269
Biomass in last year = 1322 or 0.784 k
 Exploitation rate in last year = 0.0685 or 0.264 u.msy
 Results of CMSY analysis with altogether 4010 viable trajectories for 2798 r-k pairs
 r = 0.533 , 95% CL = 0.391 - 0.743 , k = 1901 , 95% CL = 1263 - 2794
 MSY = 253 , 95% CL = 218 - 294
 Relative biomass last year= 0.882 k, 2.5th = 0.855 , 97.5th = 0.899
 Relative biomass next year= 0.889 k, 2.5th = 0.861 , 97.5th = 0.91
 Relative exploitation rate in last year= 0.19
 Comment: OK

A: Herring_A catch

B: Finding viable r-k

C: Analysis of viable r-k

D: Pred. biomass vs observed

E: Exploitation rate

F: Equilibrium curve
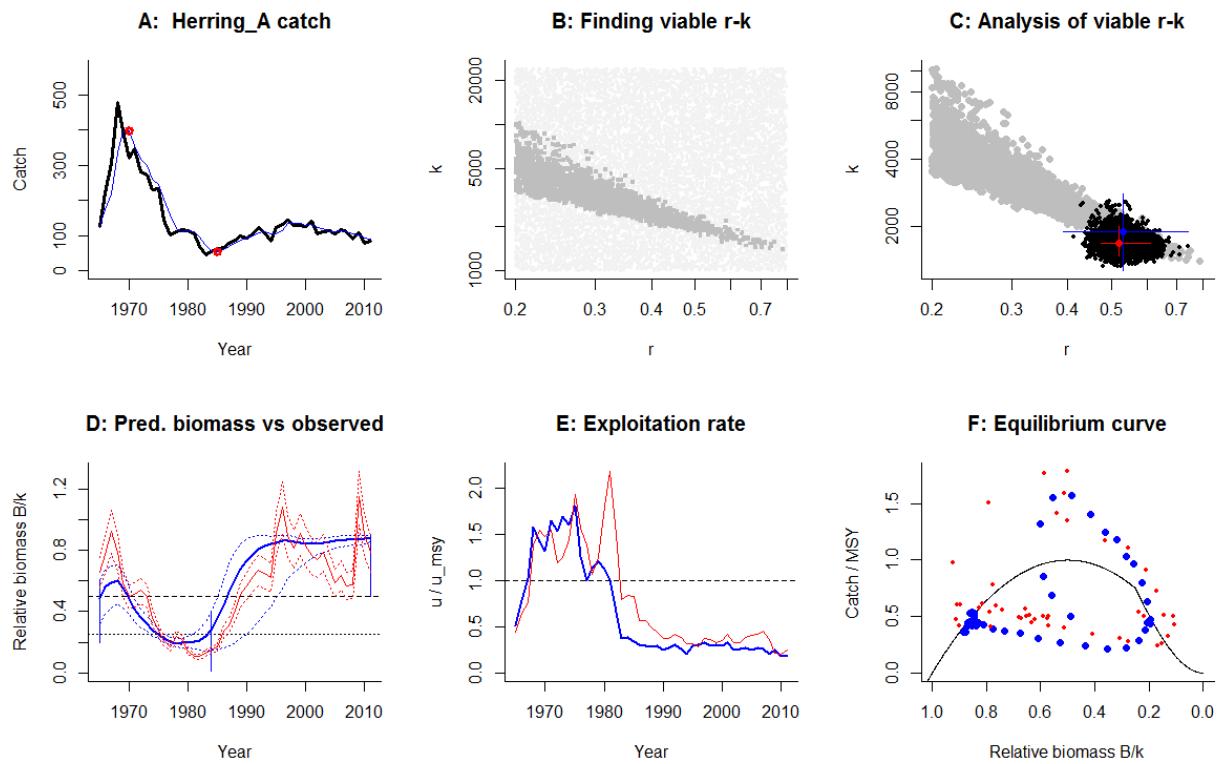
Species: *Xiphias gladius* , stock: Swordfish_NA
 Name and region: Swordfish - North Atlantic , NWA
 Catch data used from years 1950 - 2011 , biomass = observed
 Prior initial relative biomass = 0.5 - 0.9 default
 Prior intermediate rel. biomass= 0.2 - 0.6 in year 1987 default
 Prior final relative biomass   = 0.2 - 0.6 , default
 Prior range for r = 0.2 - 0.8 default , prior range for k = 24.3 - 388
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.449 , 95% CL = 0.423 - 0.477 , k = 127 , 95% CL = 123 - 131
 MSY = 14.3 , 95% CL = 13.6 - 15
Biomass in last year = 73.5 or 0.578 k
 Exploitation rate in last year = 0.164 or 0.73 u.msy
 Results of CMSY analysis with altogether 668 viable trajectories for 595 r-k pairs
 r = 0.573 , 95% CL = 0.422 - 0.778 , k = 96.7 , 95% CL = 68.5 - 137
 MSY = 13.8 , 95% CL = 12.8 - 14.9
 Relative biomass last year= 0.478 k, 2.5th = 0.241 , 97.5th = 0.595
 Relative biomass next year= 0.501 k, 2.5th = 0.23 , 97.5th = 0.628
 Relative exploitation rate in last year= 0.946
 Comment: OK

A: Swordfish_NA catch

B: Finding viable r-k

C: Analysis of viable r-k

D: Pred. biomass vs observed

E: Exploitation rate

F: Equilibrium curve
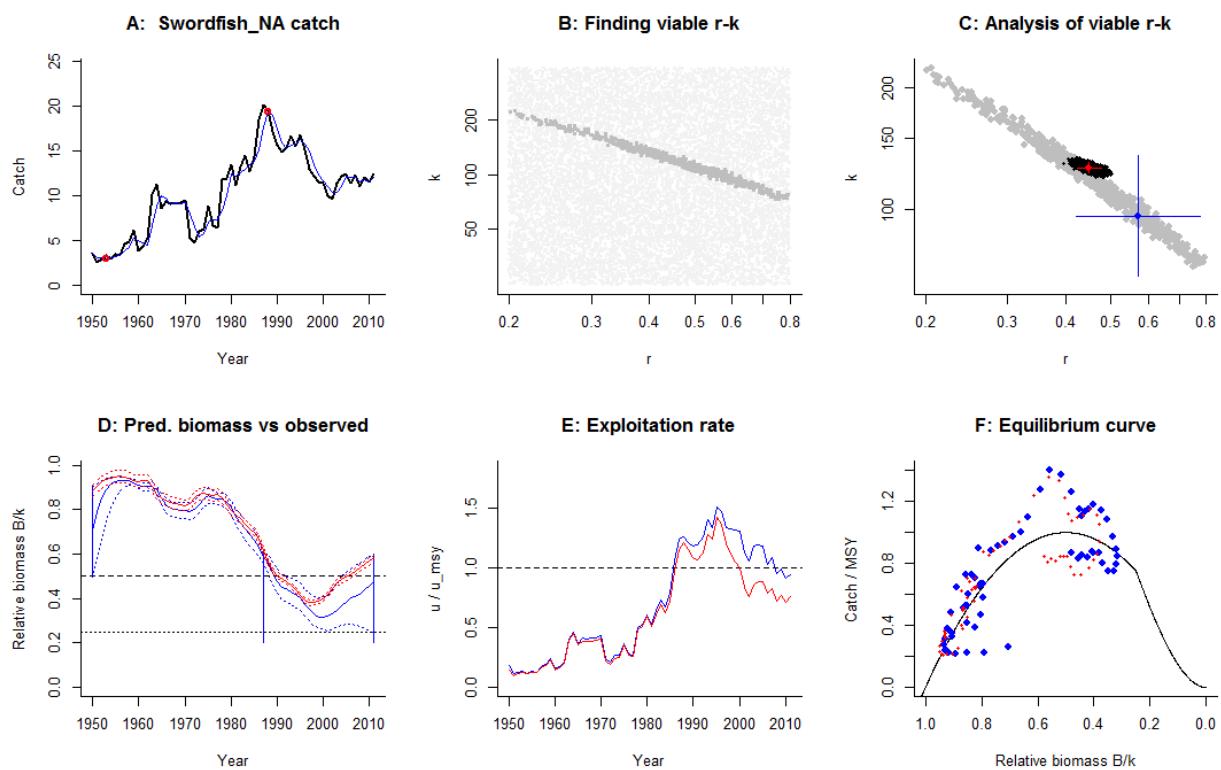
Species: *Urophycis tenuis* , stock: Whake_GUMGB
 Name and region: White hake - Gulf of Maine / Georges Bank , NWA
 Catch data used from years 1963 - 2011 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.2 - 0.6 in year 1992 default
 Prior final relative biomass   = 0.2 - 0.6 expert
 Prior range for r = 0.05 - 0.5 default , prior range for k = 14.3 - 574
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.396 , 95% CL = 0.351 - 0.437 , k = 46.2 , 95% CL = 42.2 - 51.8
 MSY = 4.58 , 95% CL = 4.11 - 5.05
Biomass in last year = 31.2 or 0.676 k
 Exploitation rate in last year = 0.0683 or 0.346 u.msy
 Results of CMSY analysis with altogether 9766 viable trajectories for 2929 r-k pairs
 r = 0.262 , 95% CL = 0.155 - 0.475 , k = 70.2 , 95% CL = 34.6 - 133
 MSY = 4.6 , 95% CL = 3.69 - 5.73
 Relative biomass last year= 0.508 k, 2.5th = 0.246 , 97.5th = 0.597
 Relative biomass next year= 0.535 k, 2.5th = 0.256 , 97.5th = 0.627
 Relative exploitation rate in last year= 0.62
 Comment: OK
 --

A: Whake_GUMGB catch

B: Finding viable r-k

C: Analysis of viable r-k

D: Pred. biomass vs observed

E: Exploitation rate

F: Equilibrium curve
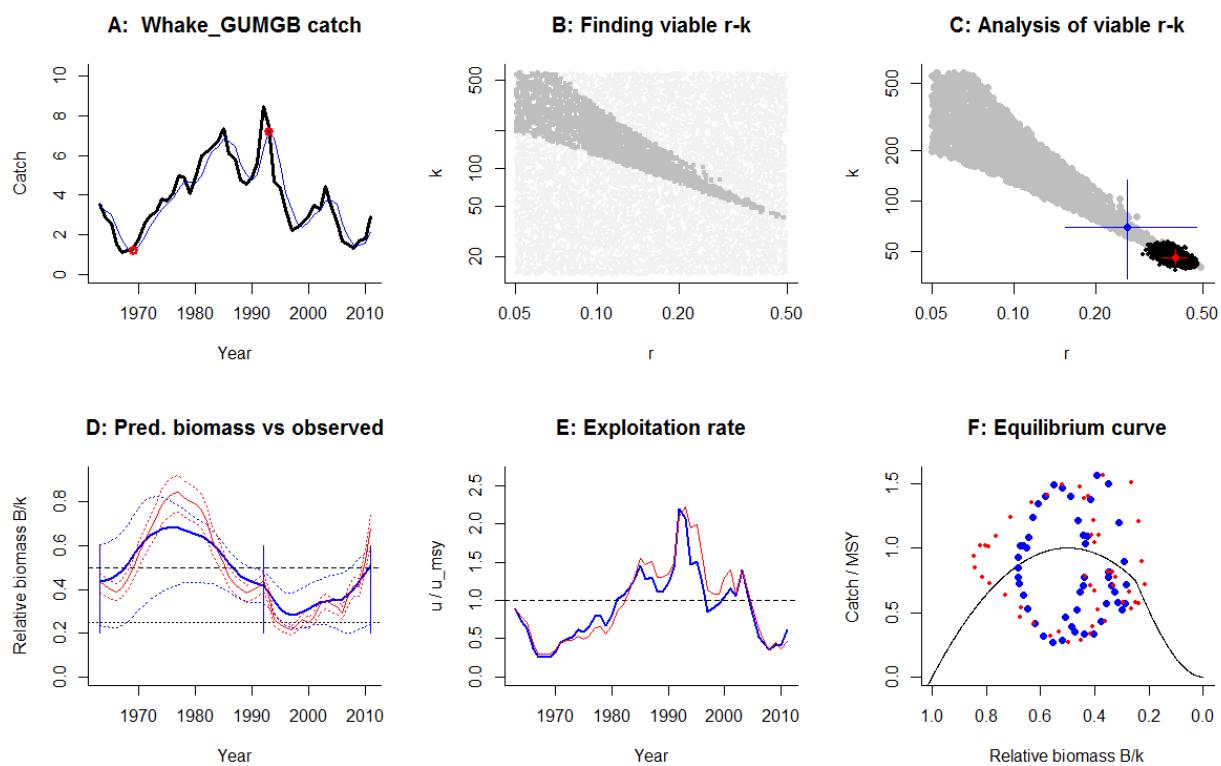
Species: *Limanda ferruginea* , stock: YTFlo_MA
Name and region: Southern New England Mid Atlantic Yellowtail Flounder , NWA
Catch data used from years 1980 - 2011 , biomass = observed
Prior initial relative biomass = 0.2 - 0.6 default
Prior intermediate rel. biomass= 0.01 - 0.4 in year 2006 default
Prior final relative biomass = 0.01 - 0.4 , default
Prior range for r = 0.2 - 0.8 default , prior range for k = 20.5 - 328
Results from Bayesian Schaefer model using catch & observed biomass
r = 0.506 , 95% CL = 0.453 - 0.597 , k = 107 , 95% CL = 42.7 - 230
MSY = 13.7 , 95% CL = 5.51 - 29.1
Biomass in last year = 5.3 or 0.0494 k
Exploitation rate in last year = 0.0713 or 0.282 u.msy
Results of CMSY analysis with altogether 1611 viable trajectories for 1499 r-k pairs
r = 0.436 , 95% CL = 0.341 - 0.573 , k = 97.1 , 95% CL = 53.8 - 171
MSY = 10.6 , 95% CL = 5.69 - 19.7
Relative biomass last year= 0.12 k, 2.5th = 0.0123 , 97.5th = 0.378
Relative biomass next year= 0.134 k, 2.5th = 0.00938 , 97.5th = 0.471
Relative exploitation rate in last year= 0.154
Comment: OK

A: YTFlo_MA catch

B: Finding viable r-k

C: Analysis of viable r-k

D: Pred. biomass vs observed

E: Exploitation rate

F: Equilibrium curve
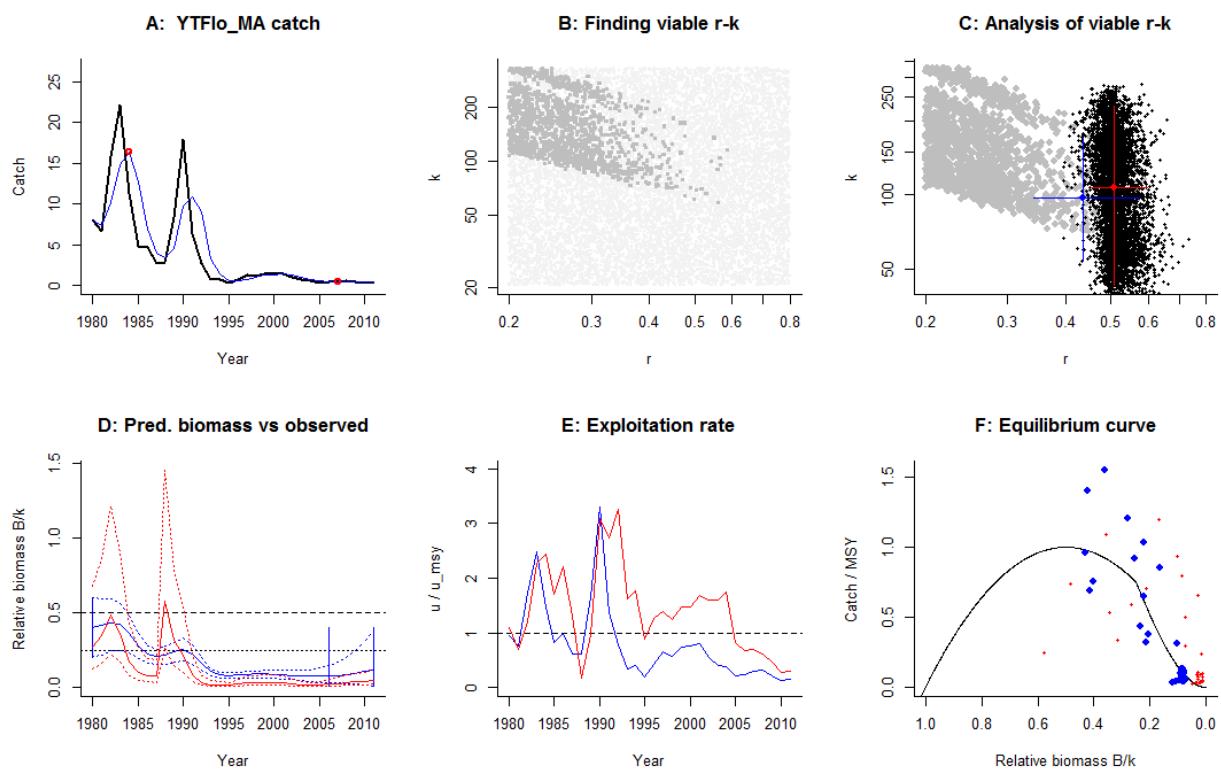
Region: Caribbean / Gulf of Mexico

[CMSY_46e.R, AllStocks_ID20.csv, AllStocks_Spec16.csv]
Species: *Mycteroperca microlepis* , stock: GAGGM
Name and region: Gag - Gulf of Mexico , CA
 Catch data used from years 1963 - 2011 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 1990 expert
 Prior final relative biomass   = 0.01 - 0.4 , default
 Prior range for r = 0.2 - 0.8 default , prior range for k = 6.5 - 104
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.512 , 95% CL = 0.47 - 0.594 , k = 18 , 95% CL = 14.8 - 21.8
 MSY = 2.33 , 95% CL = 1.95 - 2.81
Biomass in last year = 11.2 or 0.621 k
 Exploitation rate in last year = 0.0876 or 0.342 u.msy
 Results of CMSY analysis with altogether 130 viable trajectories for 130 r-k pairs
 r = 0.309 , 95% CL = 0.268 - 0.356 , k = 29.9 , 95% CL = 24.4 - 36.7
 MSY = 2.31 , 95% CL = 2.05 - 2.6
 Relative biomass last year= 0.124 k, 2.5th = 0.0203 , 97.5th = 0.358
 Relative biomass next year= 0.0969 k, 2.5th = -0.0114 , 97.5th = 0.413
 Relative exploitation rate in last year= 1.27
 Comment: OK.
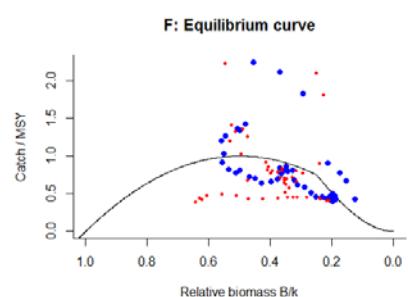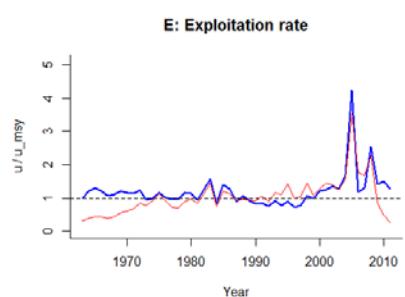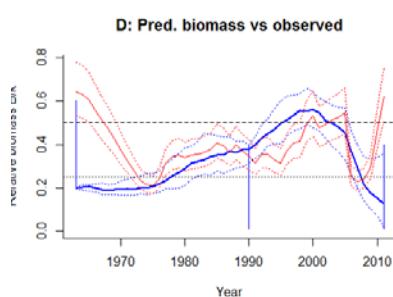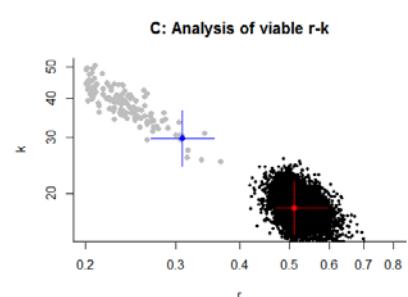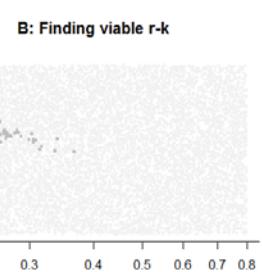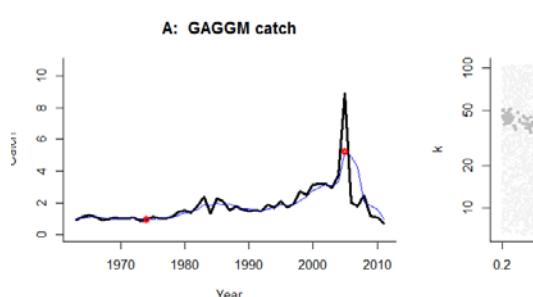
Species: *Epinephelus morio* , stock: RGROUPGM
 Name and region: Red grouper - Gulf of Mexico , CA
 Catch data used from years 1976 - 2008 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 1991 default
 Prior final relative biomass   = 0.2 - 0.6 , default
 Prior range for r = 0.2 - 0.8 default , prior range for k = 2.72 - 43.5
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.767 , 95% CL = 0.633 - 0.885 , k = 5.48 , 95% CL = 4.65 - 6.69
 MSY = 1.06 , 95% CL = 0.842 - 1.27
Biomass in last year = 3 or 0.547 k
 Exploitation rate in last year = 0.392 or 1.02 u.msy
 Results of CMSY analysis with altogether 2426 viable trajectories for 2049 r-k pairs
 r = 0.375 , 95% CL = 0.307 - 0.5 , k = 17.2 , 95% CL = 8.68 - 31.2
 MSY = 1.61 , 95% CL = 0.741 - 3.51
 Relative biomass last year= 0.526 k, 2.5th = 0.256 , 97.5th = 0.598
 Relative biomass next year= 0.537 k, 2.5th = 0.248 , 97.5th = 0.618
 Relative exploitation rate in last year= 0.84
 Comment: OK.
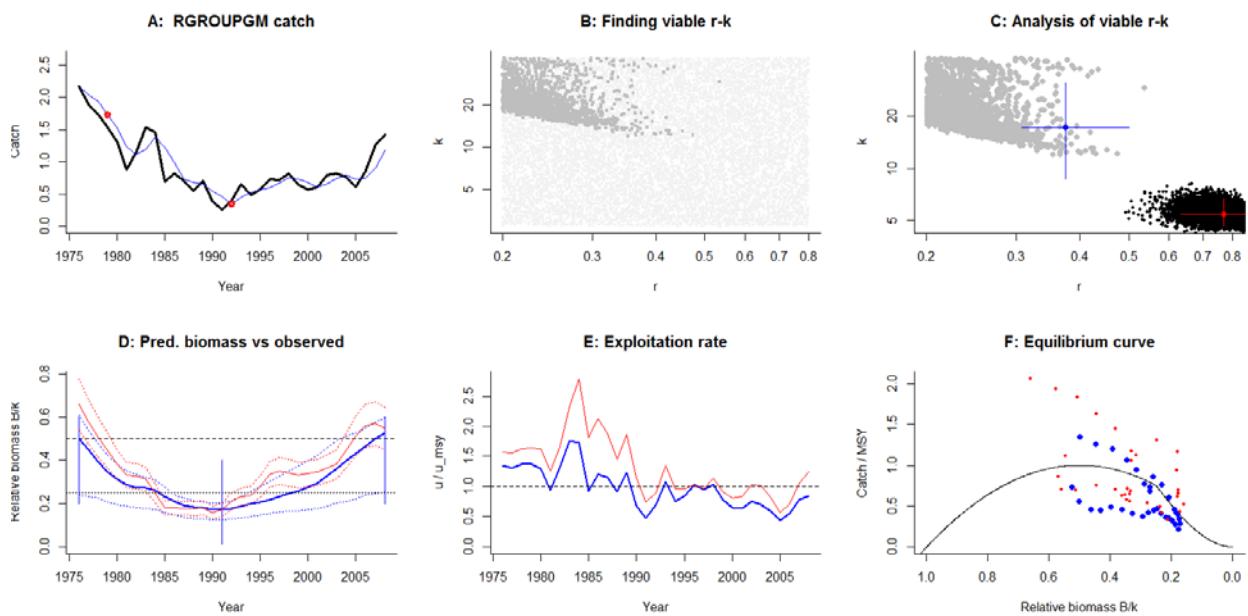
Species: *Rhomboplites aurorubens* , stock: VSNAPSATLC
 Name and region: Vermilion snapper - South Atlantic Coast , CA
 Catch data used from years 1958 - 2007 , biomass = observed
 Prior initial relative biomass = 0.5 - 0.9 default
 Prior intermediate rel. biomass= 0.2 - 0.6 in year 2001 default
 Prior final relative biomass   = 0.01 - 0.4 expert
 Prior range for r = 0.05 - 0.5 default , prior range for k = 1.31 - 52.2
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.22 , 95% CL = 0.177 - 0.274 , k = 8.84 , 95% CL = 7.83 - 10.2
 MSY = 0.488 , 95% CL = 0.397 - 0.604
Biomass in last year = 2.97 or 0.335 k
 Exploitation rate in last year = 0.15 or 1.36 u.msy
 Results of CMSY analysis with altogether 7219 viable trajectories for 881 r-k pairs
 r = 0.282 , 95% CL = 0.163 - 0.487 , k = 4.95 , 95% CL = 2.54 - 9.64
 MSY = 0.349 , 95% CL = 0.276 - 0.442
 Relative biomass last year= 0.267 k, 2.5th = 0.0242 , 97.5th = 0.395
 Relative biomass next year= 0.236 k, 2.5th = -0.0682 , 97.5th = 0.382
 Relative exploitation rate in last year= 2.47
 Comment: Set resilience from Medium to Low - FB Medium
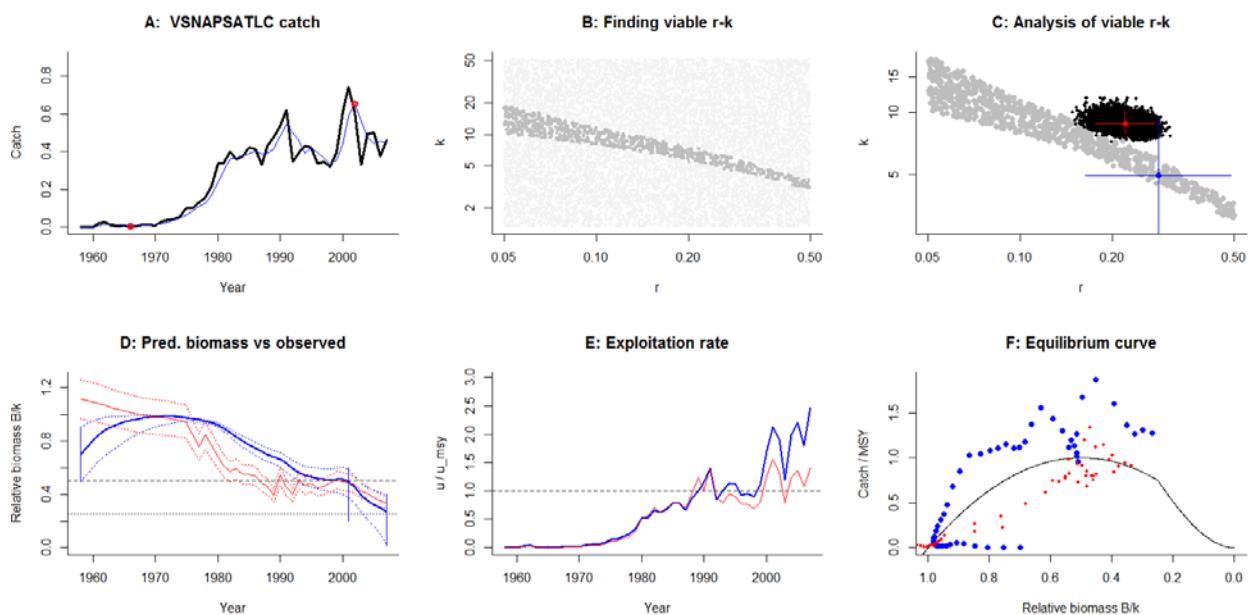
Region: Northeast Atlantic, ICES Area

[CMSY_46e.R, AllStocks_ID20.csv, AllStocks_Spec16.csv]

Species: Lophius piscatorius , stock: anp-8c9a

White anglerfish in Divisions VIIIc and IXa (Cantabrian Sea, Atlanic Iberian Waters) , ICES

Catch data used from years 1980 - 2014 , biomass = observed

Prior initial relative biomass = 0.2 - 0.6 default

Prior intermediate rel. biomass= 0.01 - 0.4 in year 2001 default

Prior final relative biomass   = 0.2 - 0.6 expert

Prior range for r = 0.2 - 0.8 default , prior range for k = 7.93 - 127

Results from Bayesian Schaefer model using catch & observed biomass

r = 0.703 , 95% CL = 0.58 - 0.822 , k = 20.5 , 95% CL = 17.8 - 24.7

MSY = 3.62 , 95% CL = 2.9 - 4.38

Biomass in last year = 9.38 or 0.458 k

Exploitation rate in last year = 0.174 or 0.496 u.msy

Results of CMSY analysis with altogether 1496 viable trajectories for 1329 r-k pairs

r = 0.359 , 95% CL = 0.298 - 0.544 , k = 59 , 95% CL = 30.6 - 90.2

MSY = 5.29 , 95% CL = 3.31 - 8.47

Relative biomass last year= 0.492 k, 2.5th = 0.226 , 97.5th = 0.595

Relative biomass next year= 0.542 k, 2.5th = 0.261 , 97.5th = 0.654

Relative exploitation rate in last year= 0.384

Comment: Fit could be improved by setting startbio high.
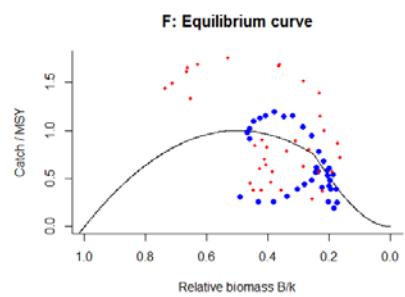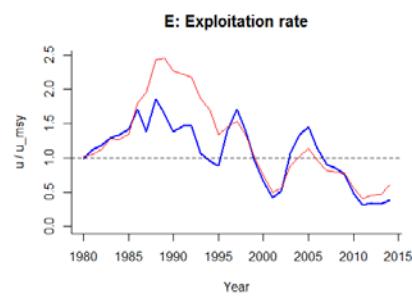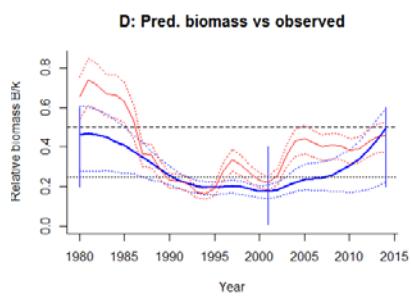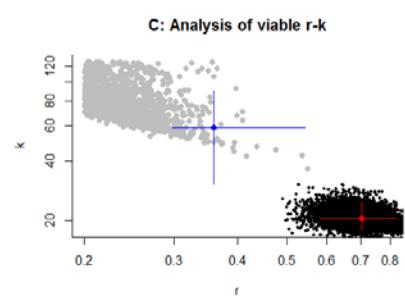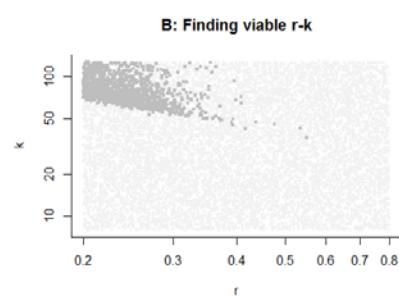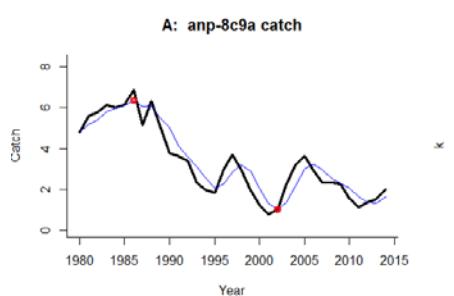
Species: *Dicentrarchus labrax* , stock: Bss-47
 Name and region: Seabass in Divisions IVb and c, VIIa, and VIId–h (Central and South North Sea, Irish Sea, English Channel, Bristol Channel, Celtic Sea) , ICES
 Catch data used from years 1985 - 2014 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.5 - 0.9 in year 2006 default
 Prior final relative biomass = 0.01 - 0.4 expert
 Prior range for r = 0.05 - 0.5 default , prior range for k = 8.58 - 343
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.259 , 95% CL = 0.211 - 0.292 , k = 40.9 , 95% CL = 32.7 - 53.8
 MSY = 2.62 , 95% CL = 2.1 - 3.32
Biomass in last year = 11.4 or 0.279 k
 Exploitation rate in last year = 0.316 or 2.44 u.msy
 Results of CMSY analysis with altogether 4509 viable trajectories for 1116 r-k pairs
 r = 0.282 , 95% CL = 0.163 - 0.487 , k = 38.2 , 95% CL = 19.3 - 75.7
 MSY = 2.7 , 95% CL = 2.07 - 3.52
Relative biomass last year= 0.287 k, 2.5th = 0.0296 , 97.5th = 0.396
Relative biomass next year= 0.249 k, 2.5th = -0.0794 , 97.5th = 0.384
Relative exploitation rate in last year= 1.74
Comment: OK.
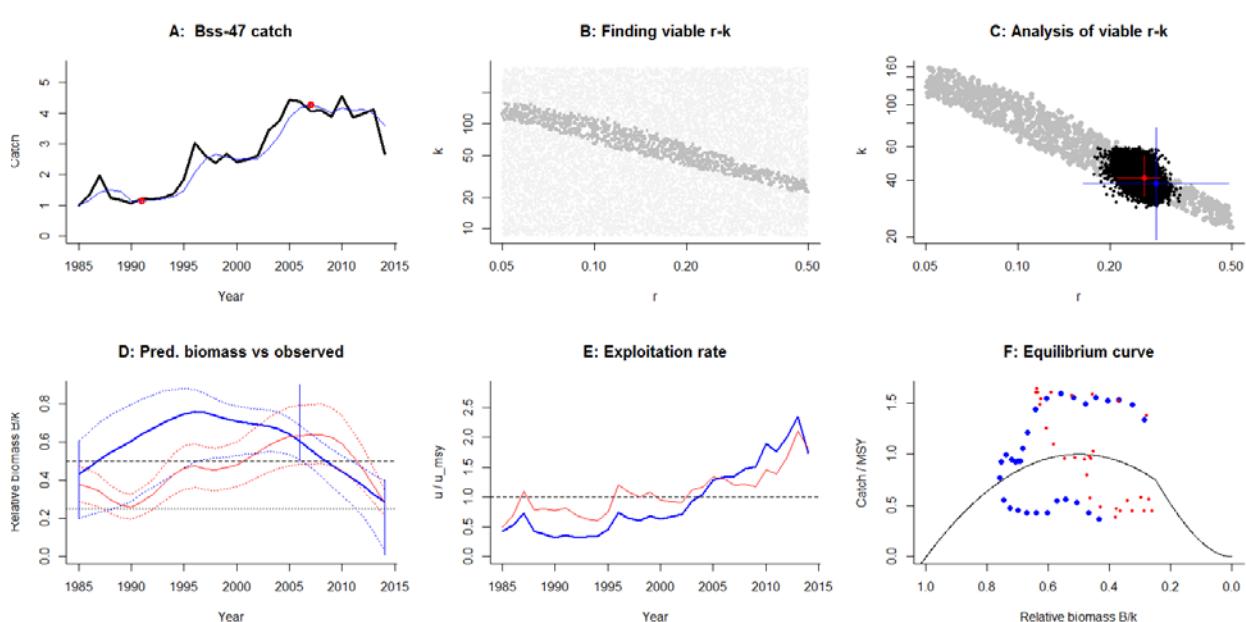
Species: *Gadus morhua* , stock: cod-2224
 Name and region: Cod in Sub-division 22 to 24 , ICES
 Catch data used from years 1970 - 2013 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 2009 default
 Prior final relative biomass   = 0.01 - 0.4 , default
 Prior range for r = 0.2 - 0.8 default , prior range for k = 89.3 - 1428
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.859 , 95% CL = 0.702 - 0.989 , k = 214 , 95% CL = 180 - 263
 MSY = 45.1 , 95% CL = 34.7 - 61.5
Biomass in last year = 40.8 or 0.191 k
 Exploitation rate in last year = 0.463 or 1.08 u.msy
 Results of CMSY analysis with altogether 548 viable trajectories for 533 r-k pairs
 r = 0.346 , 95% CL = 0.289 - 0.413 , k = 626 , 95% CL = 474 - 825
 MSY = 54 , 95% CL = 44.6 - 65.5
 Relative biomass last year= 0.161 k, 2.5th = 0.0157 , 97.5th = 0.39
 Relative biomass next year= 0.16 k, 2.5th = -0.0107 , 97.5th = 0.437
 Relative exploitation rate in last year= 1
 Comment: OK
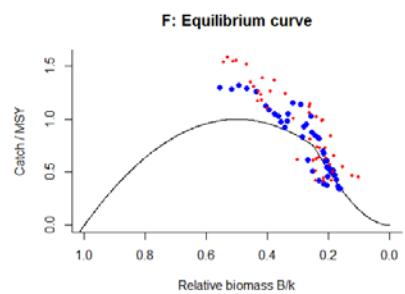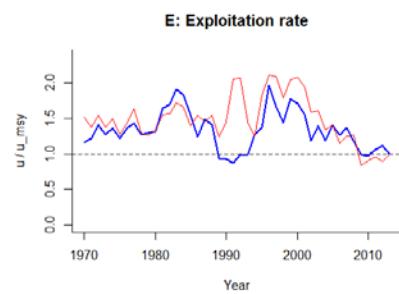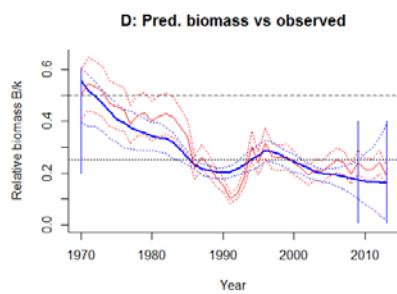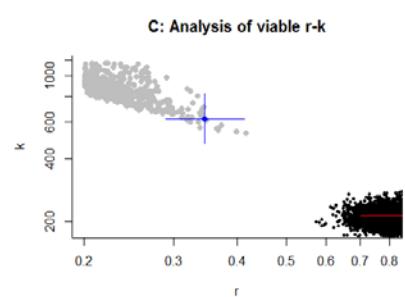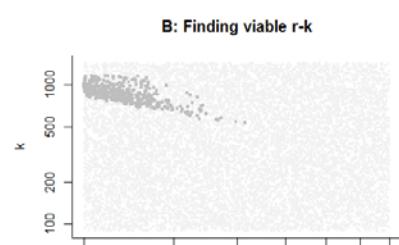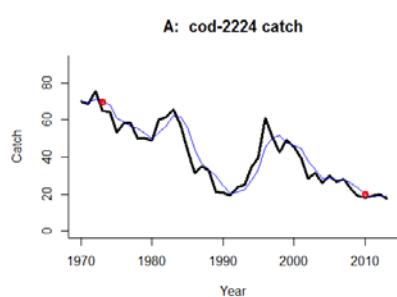
Species: *Gadus morhua* , stock: cod-347d
 Name and region: Cod in Subarea IV (North Sea), Divison VIId and IIIa West , ICES
 Catch data used from years 1963 - 2014 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 2005 default
 Prior final relative biomass   = 0.01 - 0.4 , default
 Prior range for r = 0.2 - 0.8 default , prior range for k = 490 - 7847
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.519 , 95% CL = 0.477 - 0.603 , k = 1653 , 95% CL = 1371 - 2121
 MSY = 218 , 95% CL = 176 - 277
Biomass in last year = 332 or 0.201 k
 Exploitation rate in last year = 0.128 or 0.496 u.msy
 Results of CMSY analysis with altogether 530 viable trajectories for 512 r-k pairs
 r = 0.359 , 95% CL = 0.297 - 0.434 , k = 2944 , 95% CL = 2222 - 3899
 MSY = 264 , 95% CL = 221 - 316
Relative biomass last year= 0.116 k, 2.5th = 0.013 , 97.5th = 0.384
Relative biomass next year= 0.119 k, 2.5th = -2.91e-05 , 97.5th = 0.447
Relative exploitation rate in last year= 0.75
Comment: OK
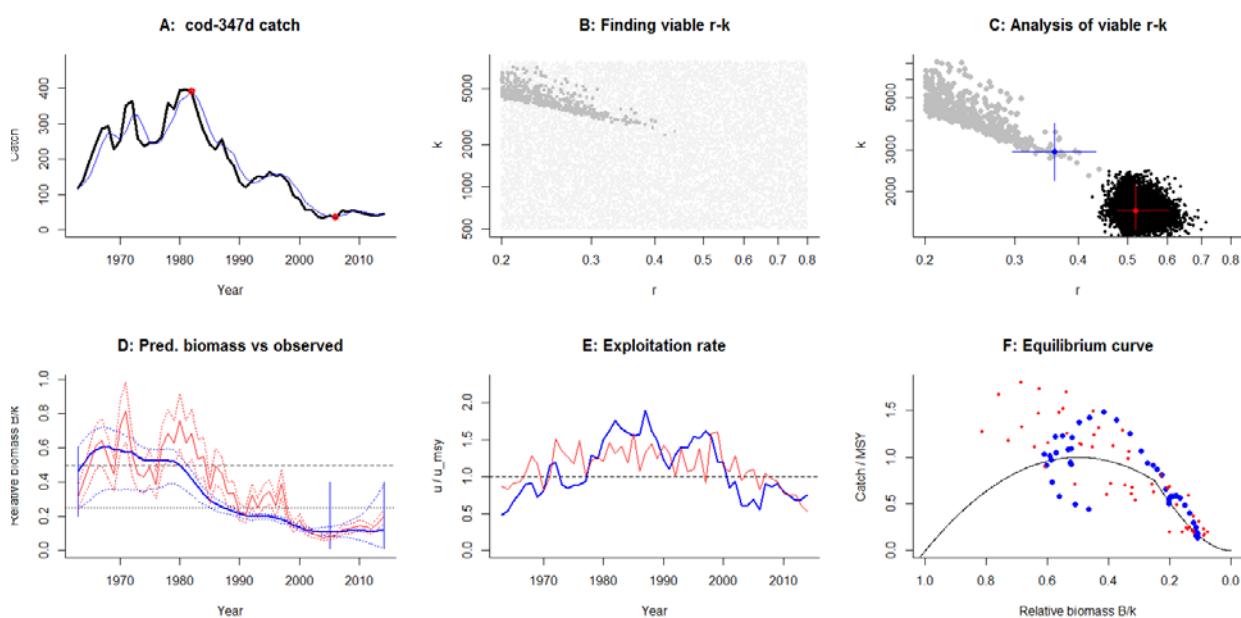
Species: *Gadus morhua* , stock: cod-7e-k
 Name and region: Cod in Divisions VIIe-k (Celtic Sea cod) , ICES
 Catch data used from years 1971 - 2014 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 2009 default
 Prior final relative biomass   = 0.01 - 0.4 expert
 Prior range for r = 0.2 - 0.8 default , prior range for k = 20.7 - 332
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.616 , 95% CL = 0.514 - 0.714 , k = 52.2 , 95% CL = 43 - 64.9
 MSY = 8.01 , 95% CL = 6.37 - 10
Biomass in last year = 12.2 or 0.233 k
 Exploitation rate in last year = 0.551 or 1.79 u.msy
 Results of CMSY analysis with altogether 1994 viable trajectories for 1172 r-k pairs
 r = 0.462 , 95% CL = 0.355 - 0.731 , k = 83.4 , 95% CL = 50.3 - 114
 MSY = 9.63 , 95% CL = 8.8 - 10.5
 Relative biomass last year= 0.25 k, 2.5th = 0.028 , 97.5th = 0.396
 Relative biomass next year= 0.249 k, 2.5th = -0.0498 , 97.5th = 0.427
 Relative exploitation rate in last year= 0.959
 Comment: OK

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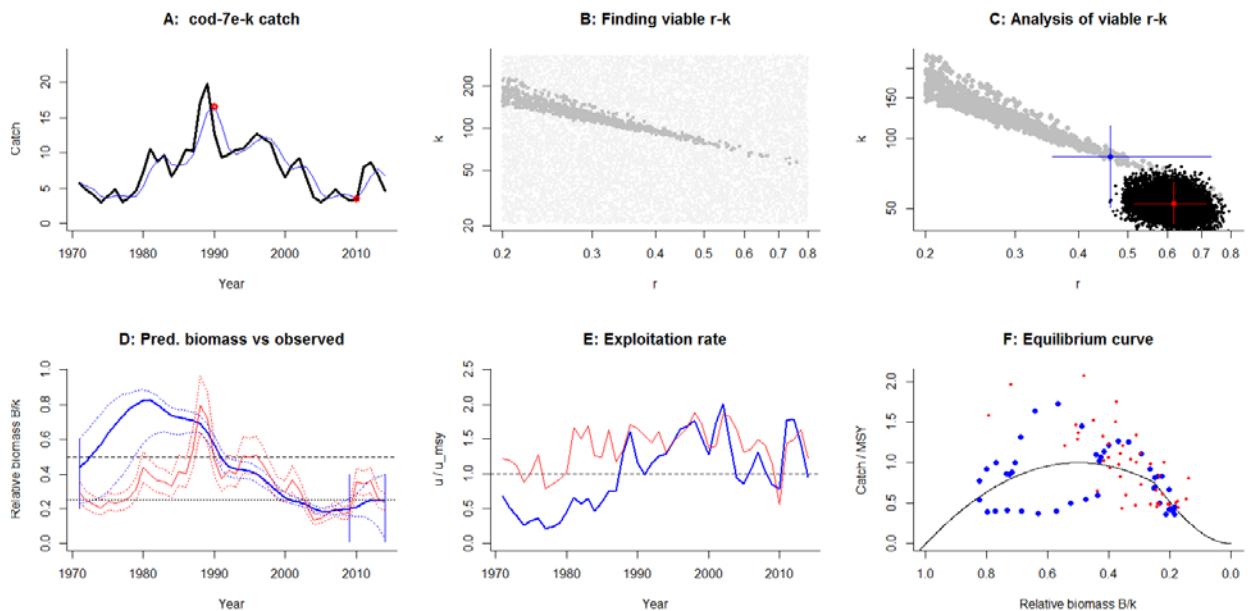
Species: *Gadus morhua* , stock: cod-arct
 Name and region: Cod in Subareas I and II (Northeast Arctic cod) , ICES
 Catch data used from years 1946 - 2014 , biomass = observed
 Prior initial relative biomass = 0.5 - 0.9 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 1990 default
 Prior final relative biomass   = 0.5 - 0.9 , default
 Prior range for r = 0.2 - 0.8 default , prior range for k = 2764 - 66339
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.608 , 95% CL = 0.541 - 0.674 , k = 4813 , 95% CL = 4326 - 5454
 MSY = 732 , 95% CL = 644 - 827
Biomass in last year = 3152 or 0.655 k
 Exploitation rate in last year = 0.283 or 0.932 u.msy
 Results of CMSY analysis with altogether 1749 viable trajectories for 1264 r-k pairs
 r = 0.455 , 95% CL = 0.351 - 0.65 , k = 6583 , 95% CL = 4441 - 8845
 MSY = 749 , 95% CL = 697 - 804
Relative biomass last year= 0.691 k, 2.5th = 0.597 , 97.5th = 0.737
Relative biomass next year= 0.656 k, 2.5th = 0.561 , 97.5th = 0.706
Relative exploitation rate in last year= 0.953
Comment: OK
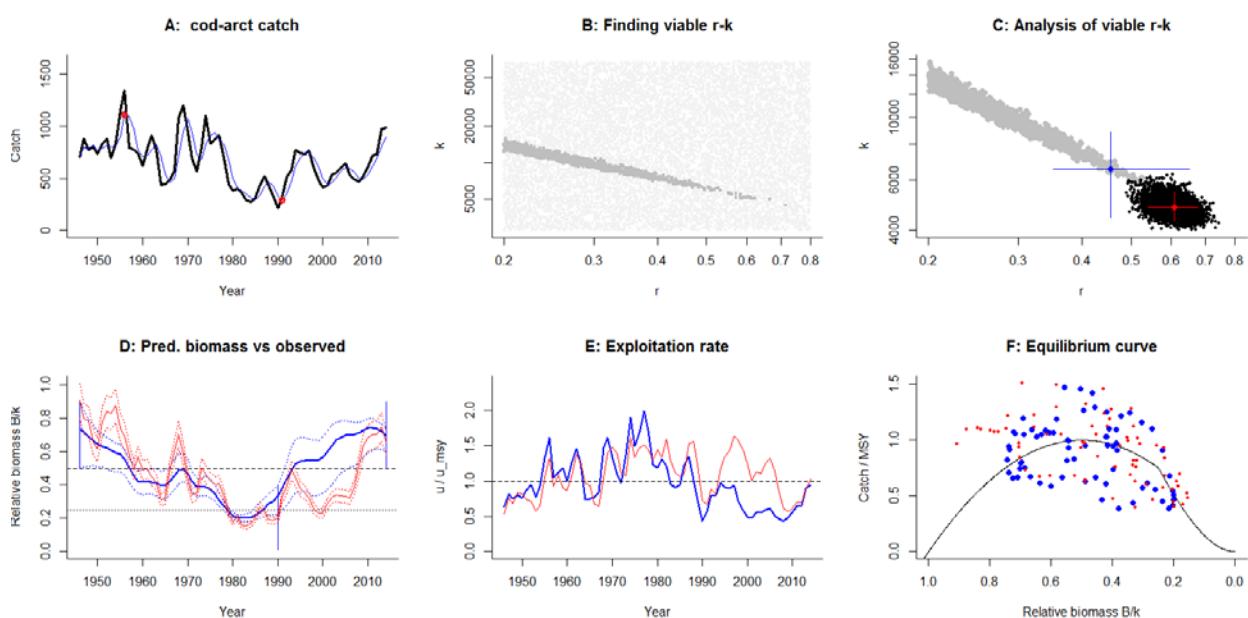
Species: *Gadus morhua* , stock: cod-farp
 Name and region: Cod in Subdivision Vb1 (Faroe Plateau) , ICES
 Catch data used from years 1961 - 2014 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 1992 default
 Prior final relative biomass   = 0.01 - 0.4 , default
 Prior range for r = 0.2 - 0.8 default , prior range for k = 47.7 - 764
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.528 , 95% CL = 0.481 - 0.613 , k = 172 , 95% CL = 149 - 203
 MSY = 22.9 , 95% CL = 19.3 - 27.7
Biomass in last year = 27.7 or 0.161 k
 Exploitation rate in last year = 0.219 or 0.828 u.msy
 Results of CMSY analysis with altogether 1333 viable trajectories for 1094 r-k pairs
 r = 0.417 , 95% CL = 0.33 - 0.607 , k = 244 , 95% CL = 160 - 323
 MSY = 25.5 , 95% CL = 23.2 - 27.9
 Relative biomass last year= 0.15 k, 2.5th = 0.0187 , 97.5th = 0.393
 Relative biomass next year= 0.157 k, 2.5th = -0.00259 , 97.5th = 0.462
 Relative exploitation rate in last year= 0.829
 Comment: OK
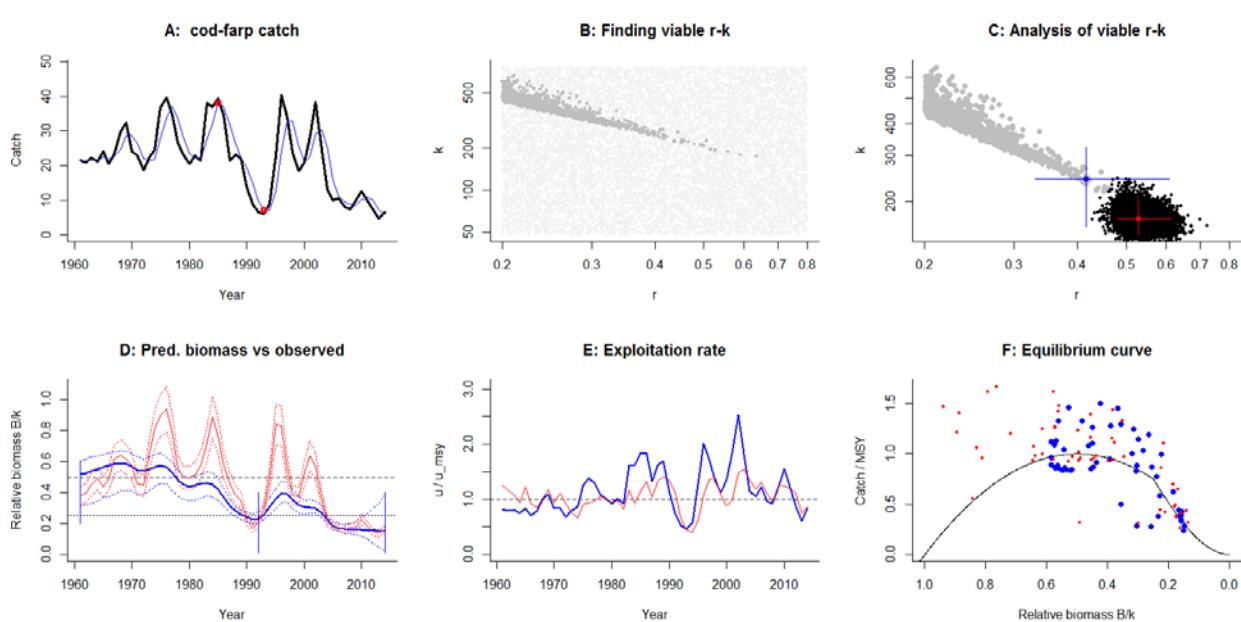
Species: *Gadus morhua* , stock: cod-iceg
 Name and region: Cod in Division Va (Icelandic cod) , ICES
 Catch data used from years 1955 - 2014 , biomass = observed
 Prior initial relative biomass = 0.5 - 0.9 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 2009 default
 Prior final relative biomass   = 0.2 - 0.6 , default
 Prior range for r = 0.2 - 0.8 default , prior range for k = 682 - 10905
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.51 , 95% CL = 0.48 - 0.56 , k = 2783 , 95% CL = 2408 - 3276
 MSY = 356 , 95% CL = 314 - 415
Biomass in last year = 1181 or 0.424 k
 Exploitation rate in last year = 0.18 or 0.708 u.msy
 Results of CMSY analysis with altogether 710 viable trajectories for 605 r-k pairs
 r = 0.333 , 95% CL = 0.282 - 0.464 , k = 4330 , 95% CL = 2985 - 5325
 MSY = 360 , 95% CL = 333 - 390
 Relative biomass last year= 0.516 k, 2.5th = 0.214 , 97.5th = 0.59
 Relative biomass next year= 0.557 k, 2.5th = 0.221 , 97.5th = 0.623
 Relative exploitation rate in last year= 0.596
 Comment: OK

A: cod-iceg catch

B: Finding viable r-k

C: Analysis of viable r-k

D: Pred. biomass vs observed

E: Exploitation rate

F: Equilibrium curve
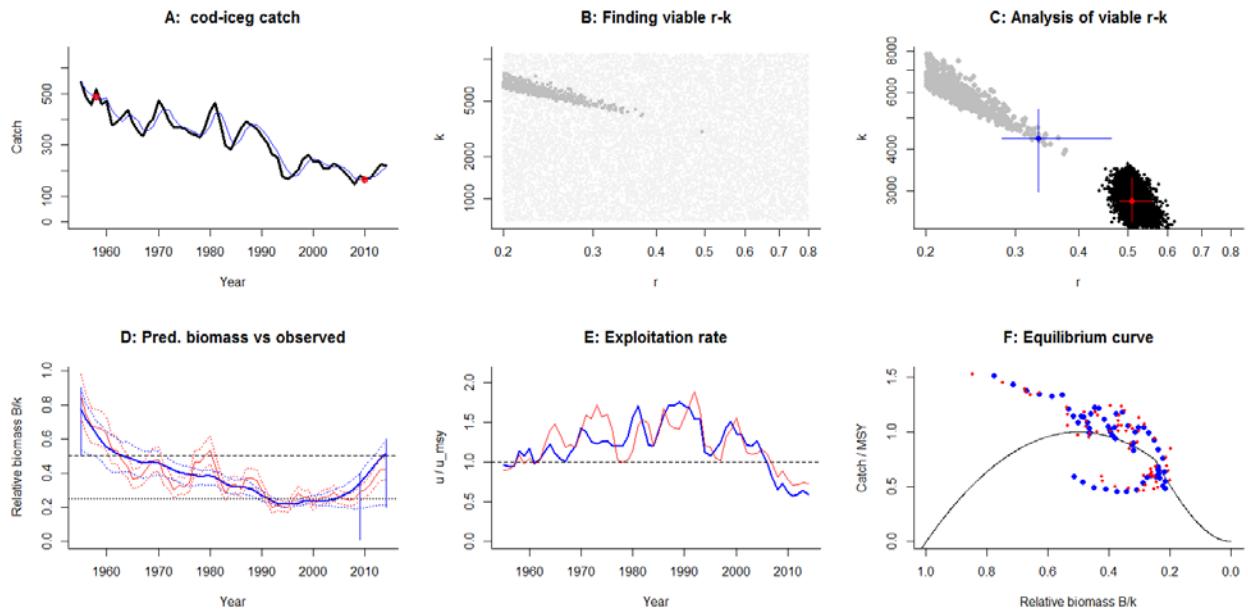
Species: *Gadus morhua* , stock: cod-scow
Name and region: Cod in Division VIa (West of Scotland) , ICES
Catch data used from years 1981 - 2014 , biomass = observed
Prior initial relative biomass = 0.2 - 0.6 default
Prior intermediate rel. biomass= 0.01 - 0.4 in year 2005 default
Prior final relative biomass   = 0.01 - 0.4 , default
Prior range for r = 0.2 - 0.8 default , prior range for k = 30.2 - 483
Results from Bayesian Schaefer model using catch & observed biomass
r = 0.509 , 95% CL = 0.464 - 0.593 , k = 114 , 95% CL = 83 - 165
MSY = 14.7 , 95% CL = 10.6 - 21.8
Biomass in last year = 4.66 or 0.0408 k
Exploitation rate in last year = 0.344 or 1.35 u.msy
Results of CMSY analysis with altogether 1680 viable trajectories for 1581 r-k pairs
r = 0.436 , 95% CL = 0.341 - 0.621 , k = 212 , 95% CL = 103 - 392
MSY = 23.1 , 95% CL = 11.2 - 47.6
Relative biomass last year= 0.0967 k, 2.5th = 0.0123 , 97.5th = 0.37
Relative biomass next year= 0.101 k, 2.5th = 0.00634 , 97.5th = 0.478
Relative exploitation rate in last year= 0.374
Comment: Fit could be improved by setting endbio to 0.01-0.2.
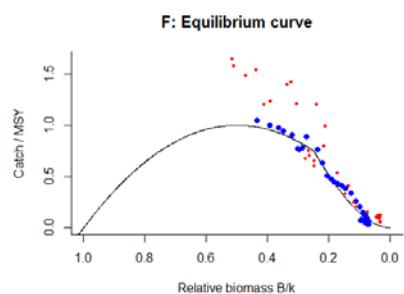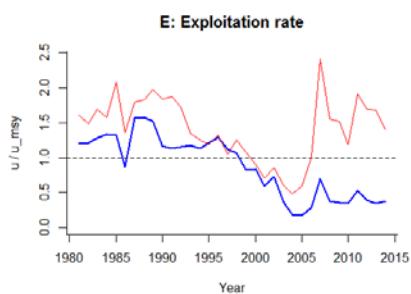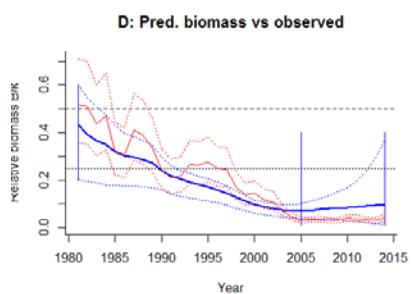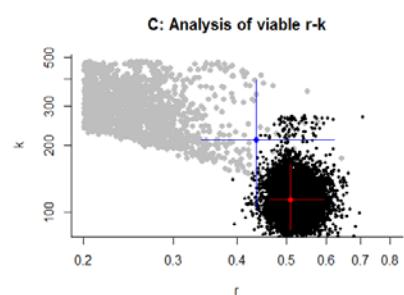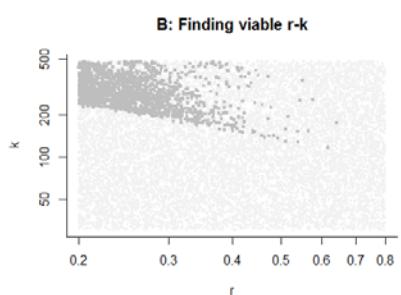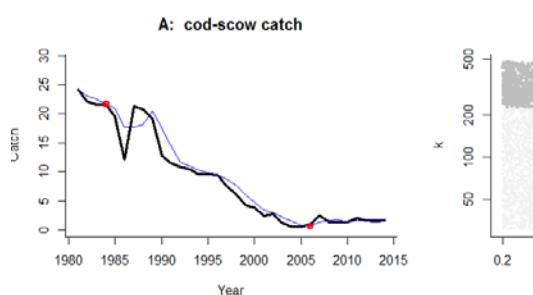
Species: *Squalus acanthias* , stock: dgs-nea
 Name and region: Spurdog in Northeast Atlantic , ICES
 Catch data used from years 1950 - 2009 , biomass = observed
 Prior initial relative biomass = 0.5 - 0.9 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 2005 default
 Prior final relative biomass   = 0.01 - 0.4 , default
 Prior range for r = 0.05 - 0.5 default , prior range for k = 120 - 4792
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.106 , 95% CL = 0.0879 - 0.132 , k = 1740 , 95% CL = 1463 - 2095
 MSY = 46.3 , 95% CL = 36.2 - 60.7
Biomass in last year = 225 or 0.129 k
 Exploitation rate in last year = 0.0106 or 0.2 u.msy
 Results of CMSY analysis with altogether 2967 viable trajectories for 1241 r-k pairs
 r = 0.183 , 95% CL = 0.122 - 0.29 , k = 804 , 95% CL = 470 - 1299
 MSY = 36.7 , 95% CL = 31.7 - 42.6
 Relative biomass last year= 0.169 k, 2.5th = 0.0144 , 97.5th = 0.391
 Relative biomass next year= 0.182 k, 2.5th = 0.0121 , 97.5th = 0.421
 Relative exploitation rate in last year= 0.207
 Comment: Resilience set from Very low to Low.
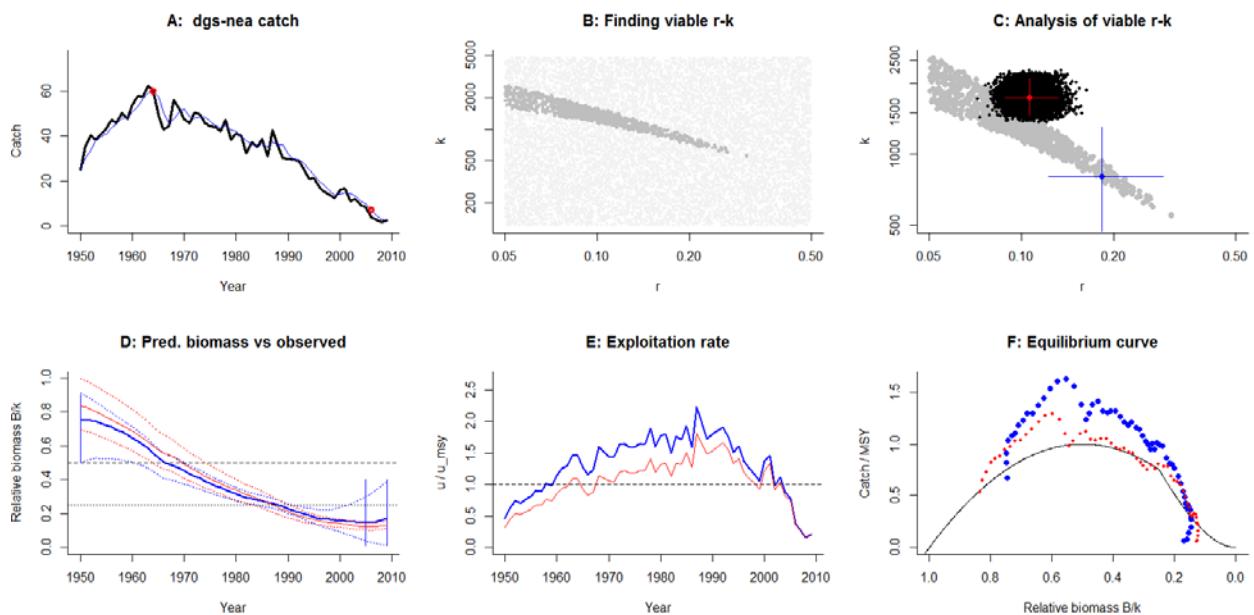
Species: *Reinhardtius hippoglossoides* , stock: ghl-arct
Name and region: Greenland halibut in Subareas I and II , ICES
Catch data used from years 1964 - 2011 , biomass = observed
Prior initial relative biomass = 0.2 - 0.6 default
Prior intermediate rel. biomass= 0.01 - 0.4 in year 1993 default
Prior final relative biomass = 0.5 - 0.9 expert
Prior range for r = 0.05 - 0.5 default , prior range for k = 283 - 16985
Results from Bayesian Schaefer model using catch & observed biomass
r = 0.315 , 95% CL = 0.272 - 0.365 , k = 417 , 95% CL = 342 - 509
MSY = 32.8 , 95% CL = 25.6 - 42.1
Biomass in last year = 309 or 0.741 k
Exploitation rate in last year = 0.0481 or 0.305 u.msy
Results of CMSY analysis with altogether 3701 viable trajectories for 2932 r-k pairs
r = 0.236 , 95% CL = 0.145 - 0.431 , k = 654 , 95% CL = 267 - 1427
MSY = 38.5 , 95% CL = 21.7 - 68.2
Relative biomass last year= 0.738 k, 2.5th = 0.54 , 97.5th = 0.871
Relative biomass next year= 0.755 k, 2.5th = 0.563 , 97.5th = 0.875
Relative exploitation rate in last year= 0.287
Comment: OK
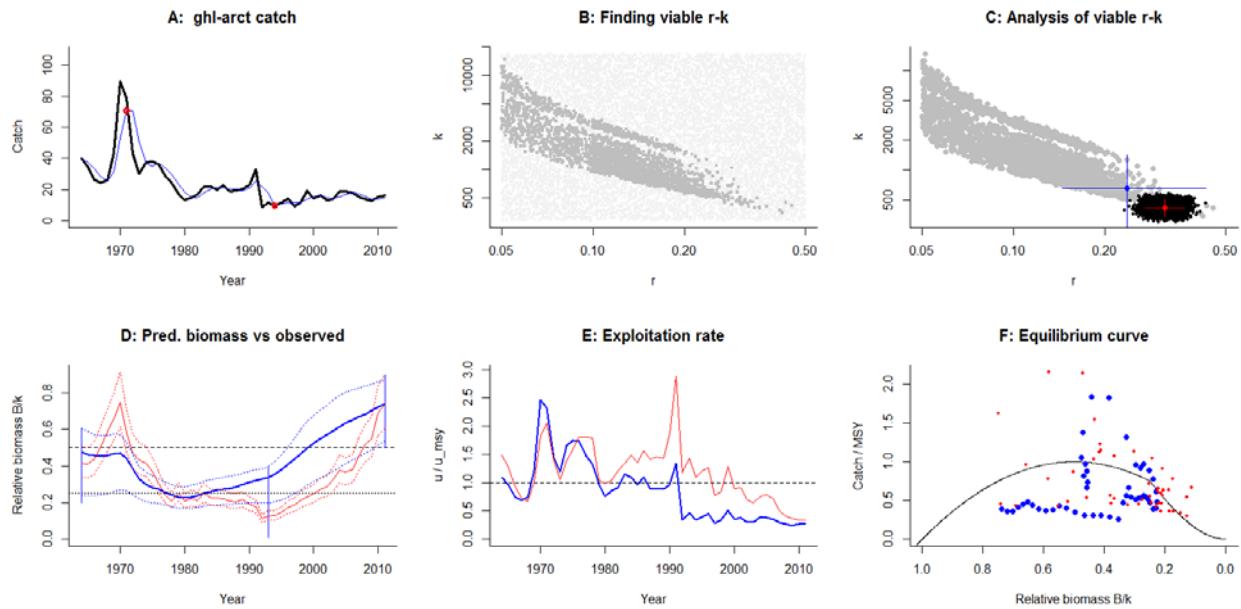
Species: *Melanogrammus aeglefinus* , stock: had-346a
 Name and region: Haddock in Sub-area IV (North Sea) and Division IIIa West and VIa , ICES
 Catch data used from years 1972 - 2014 , biomass = observed
 Prior initial relative biomass = 0.5 - 0.9 expert
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 2009 default
 Prior final relative biomass   = 0.01 - 0.4 , default
 Prior range for r = 0.2 - 0.8 default , prior range for k = 539 - 8623
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.494 , 95% CL = 0.427 - 0.545 , k = 2113 , 95% CL = 1690 - 2934
 MSY = 260 , 95% CL = 200 - 365
Biomass in last year = 461 or 0.218 k
 Exploitation rate in last year = 0.0987 or 0.399 u.msy
 Results of CMSY analysis with altogether 828 viable trajectories for 750 r-k pairs
 r = 0.318 , 95% CL = 0.275 - 0.385 , k = 2778 , 95% CL = 2106 - 3505
 MSY = 221 , 95% CL = 187 - 261
 Relative biomass last year= 0.142 k, 2.5th = 0.0162 , 97.5th = 0.373
 Relative biomass next year= 0.143 k, 2.5th = 0.00087 , 97.5th = 0.432
 Relative exploitation rate in last year= 0.738
 Comment: OK
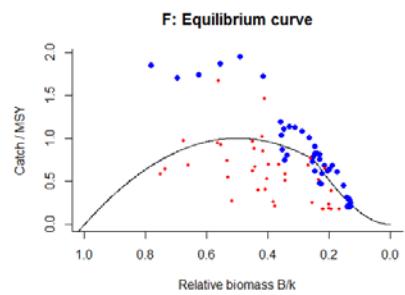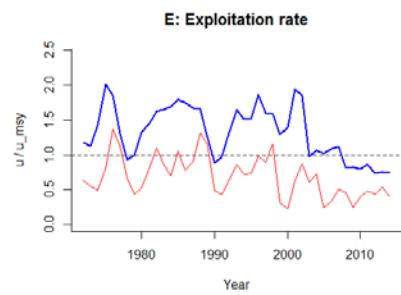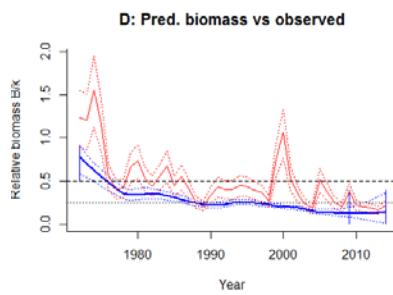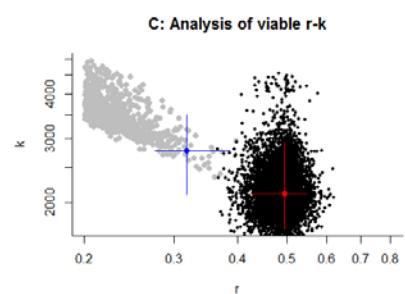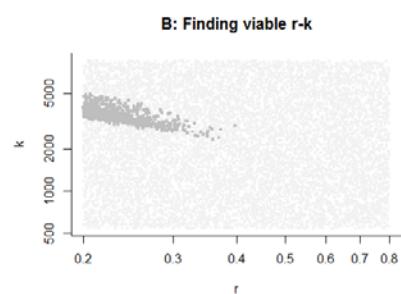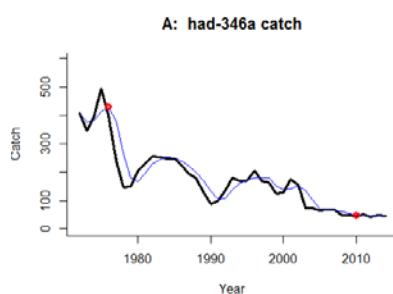
Species: *Melanogrammus aeglefinus* , stock: had-7b-k
Name and region: Haddock in Divisions VIIb,c,e-k , ICES
Catch data used from years 1993 - 2013 , biomass = observed
Prior initial relative biomass = 0.2 - 0.6 default
Prior intermediate rel. biomass= 0.2 - 0.6 in year 2005 expert
Prior final relative biomass = 0.5 - 0.9 , default
Prior range for r = 0.2 - 0.8 default , prior range for k = 68.6 - 1646
Results from Bayesian Schaefer model using catch & observed biomass
r = 0.505 , 95% CL = 0.458 - 0.584 , k = 111 , 95% CL = 89.4 - 151
MSY = 14.1 , 95% CL = 11.1 - 19.3
Biomass in last year = 74.7 or 0.675 k
Exploitation rate in last year = 0.316 or 1.25 u.msy
Results of CMSY analysis with altogether 2931 viable trajectories for 2075 r-k pairs
r = 0.399 , 95% CL = 0.32 - 0.5 , k = 179 , 95% CL = 130 - 244
MSY = 17.8 , 95% CL = 14.8 - 21.4
Relative biomass last year= 0.537 k, 2.5th = 0.501 , 97.5th = 0.624
Relative biomass next year= 0.506 k, 2.5th = 0.445 , 97.5th = 0.604
Relative exploitation rate in last year= 0.8
Comment: OK
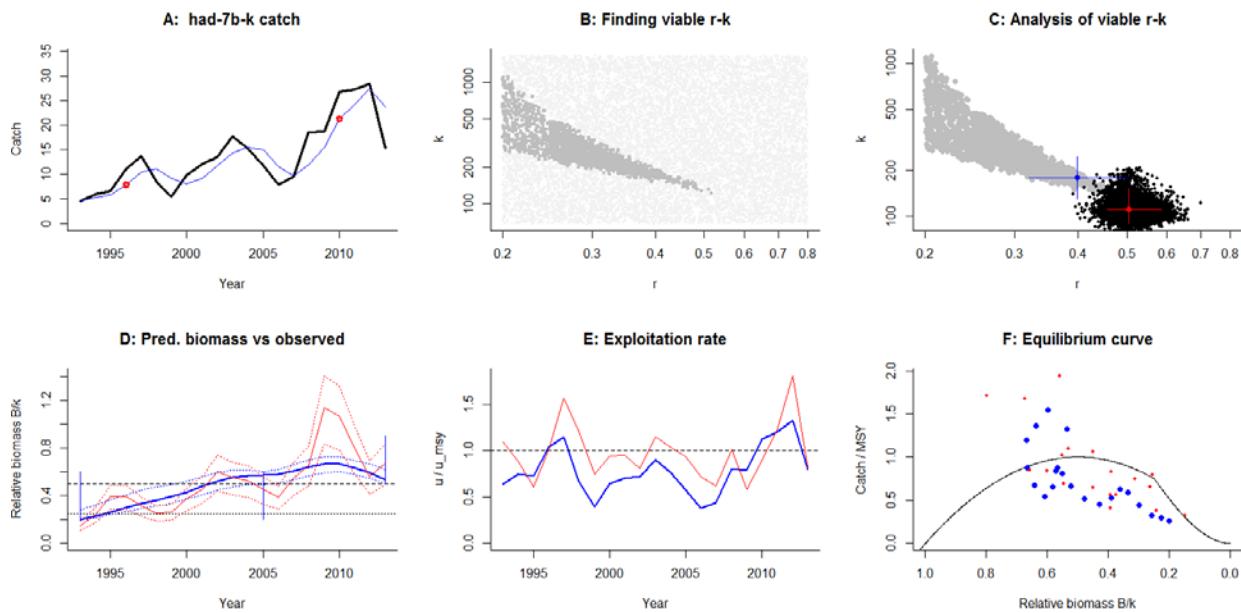
Species: *Melanogrammus aeglefinus* , stock: had-arct
 Name and region: Haddock in Subareas I and II (Northeast Arctic) , ICES
 Catch data used from years 1950 - 2014 , biomass = observed
 Prior initial relative biomass = 0.5 - 0.9 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 1984 default
 Prior final relative biomass = 0.5 - 0.9 , default
 Prior range for r = 0.2 - 0.8 default , prior range for k = 729 - 17492
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.542 , 95% CL = 0.486 - 0.639 , k = 1091 , 95% CL = 946 - 1285
 MSY = 149 , 95% CL = 122 - 185
Biomass in last year = 1153 or 1.06 k
 Exploitation rate in last year = 0.199 or 0.733 u.msy
 Results of CMSY analysis with altogether 1213 viable trajectories for 1032 r-k pairs
 r = 0.472 , 95% CL = 0.36 - 0.699 , k = 1337 , 95% CL = 843 - 1876
 MSY = 158 , 95% CL = 138 - 180
 Relative biomass last year= 0.529 k, 2.5th = 0.501 , 97.5th = 0.609
 Relative biomass next year= 0.485 k, 2.5th = 0.374 , 97.5th = 0.593
 Relative exploitation rate in last year= 1.06
 Comment: Fit could be improved by setting intbio Low in 2000.
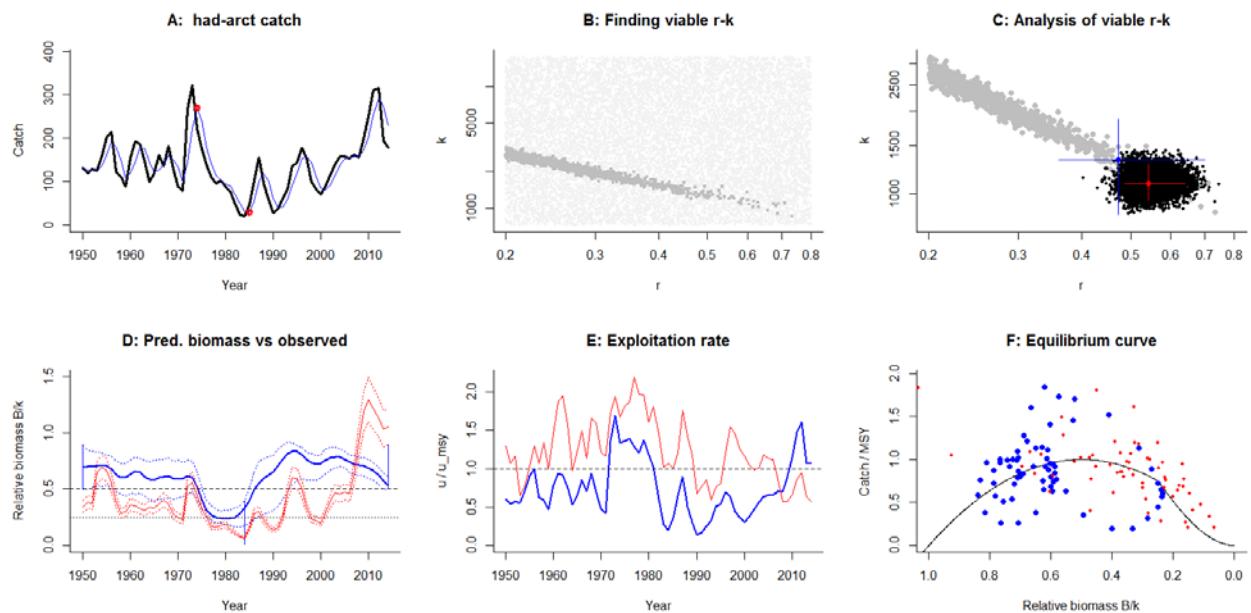
Species: *Melanogrammus aeglefinus* , stock: had-faro
Name and region: Haddock in Division Vb , ICES
Catch data used from years 1957 - 2014 , biomass = observed
Prior initial relative biomass = 0.5 - 0.9 default
Prior intermediate rel. biomass= 0.01 - 0.4 in year 1994 default
Prior final relative biomass   = 0.01 - 0.4 , default
Prior range for r = 0.2 - 0.8 default , prior range for k = 31.5 - 504
Results from Bayesian Schaefer model using catch & observed biomass
r = 0.493 , 95% CL = 0.429 - 0.54 , k = 146 , 95% CL = 126 - 170
MSY = 17.8 , 95% CL = 15 - 21.1
Biomass in last year = 20.9 or 0.143 k
Exploitation rate in last year = 0.14 or 0.568 u.msy
Results of CMSY analysis with altogether 1557 viable trajectories for 1110 r-k pairs
r = 0.387 , 95% CL = 0.312 - 0.479 , k = 180 , 95% CL = 137 - 236
MSY = 17.4 , 95% CL = 15.5 - 19.5
Relative biomass last year= 0.206 k, 2.5th = 0.0137 , 97.5th = 0.397
Relative biomass next year= 0.241 k, 2.5th = -0.00164 , 97.5th = 0.465
Relative exploitation rate in last year= 0.446
Comment: Fit could be improved by setting intbio High in 2000.
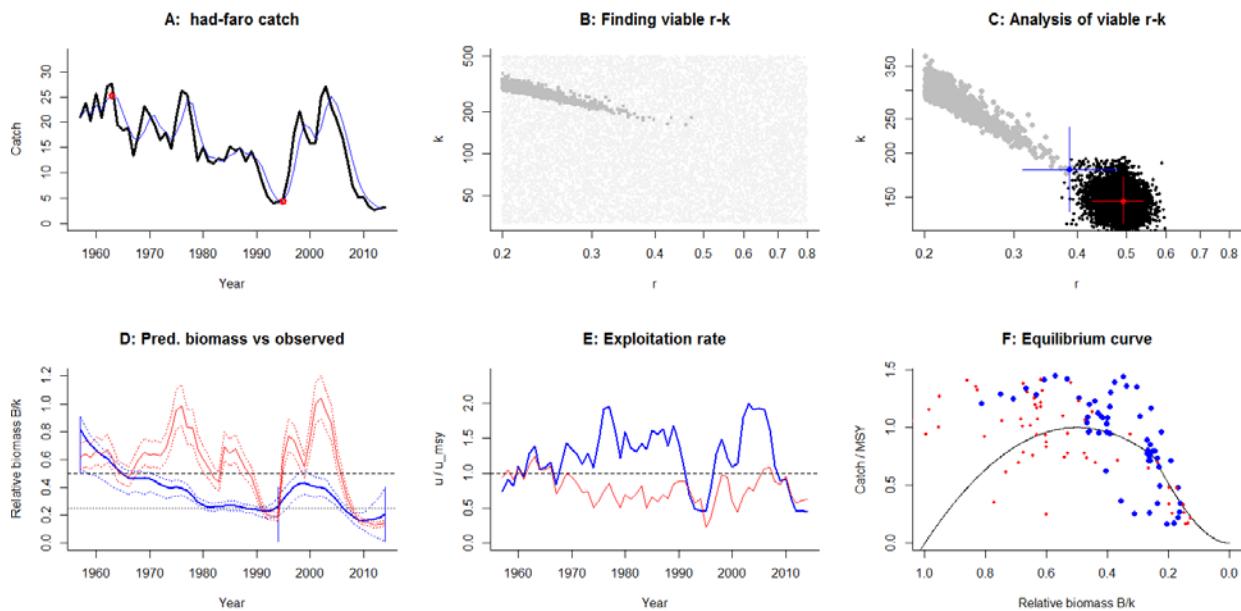
Species: *Melanogrammus aeglefinus* , stock: had-iceg
 Name and region: Haddock in Division Va (Icelandic cod) , ICES
 Catch data used from years 1979 - 2013 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.5 - 0.9 in year 2007 default
 Prior final relative biomass   = 0.2 - 0.6 , default
 Prior range for r = 0.2 - 0.8 default , prior range for k = 129 - 2070
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.606 , 95% CL = 0.523 - 0.682 , k = 405 , 95% CL = 359 - 465
 MSY = 61.4 , 95% CL = 52.7 - 71.1
Biomass in last year = 125 or 0.309 k
 Exploitation rate in last year = 0.372 or 1.23 u.msy
 Results of CMSY analysis with altogether 8665 viable trajectories for 1515 r-k pairs
 r = 0.566 , 95% CL = 0.407 - 0.785 , k = 513 , 95% CL = 329 - 799
 MSY = 72.5 , 95% CL = 57.8 - 91
Relative biomass last year= 0.486 k, 2.5th = 0.225 , 97.5th = 0.597
Relative biomass next year= 0.536 k, 2.5th = 0.211 , 97.5th = 0.666
Relative exploitation rate in last year= 0.626
Comment: OK. Fit could be improved by setting intbio Low in 2000.
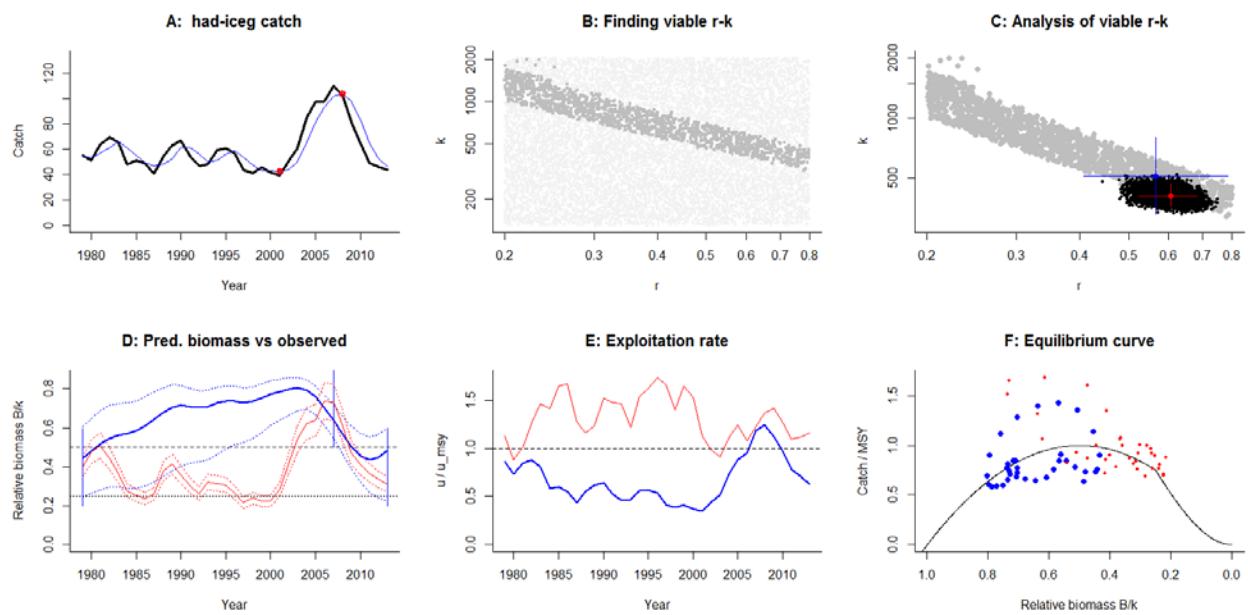

Species: *Melanogrammus aeglefinus* , stock: had-rock
Name and region: Haddock in Division VIb (Rockall) , ICES
Catch data used from years 1991 - 2014 , biomass = observed
Prior initial relative biomass = 0.2 - 0.6 default
Prior intermediate rel. biomass= 0.01 - 0.4 in year 2010 default
Prior final relative biomass = 0.01 - 0.4 , default
Prior range for r = 0.2 - 0.8 default , prior range for k = 23.6 - 378
Results from Bayesian Schaefer model using catch & observed biomass
r = 0.497 , 95% CL = 0.434 - 0.556 , k = 98.6 , 95% CL = 72.3 - 157
MSY = 12.3 , 95% CL = 8.91 - 19.6
Biomass in last year = 17.5 or 0.178 k
Exploitation rate in last year = 0.0883 or 0.355 u.msy
Results of CMSY analysis with altogether 2694 viable trajectories for 2301 r-k pairs
r = 0.494 , 95% CL = 0.372 - 0.779 , k = 140 , 95% CL = 63.9 - 259
MSY = 17.3 , 95% CL = 9.07 - 33
Relative biomass last year= 0.119 k, 2.5th = 0.0152 , 97.5th = 0.385
Relative biomass next year= 0.132 k, 2.5th = 0.00386 , 97.5th = 0.476
Relative exploitation rate in last year= 0.475
Comment: OK; good fit.
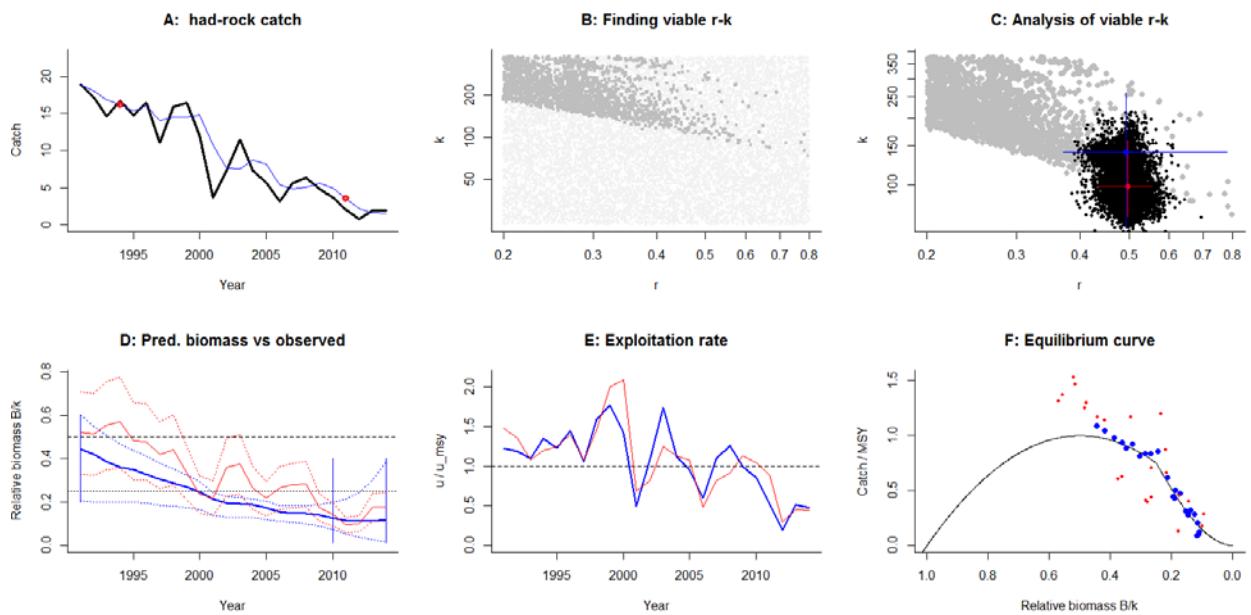
Species: *Clupea harengus* , stock: her-2532-gor
 Name and region: Herring in Subdivisions 25 - 29 (excluding Gulf of Riga) and 32 , ICES
 Catch data used from years 1974 - 2014 , biomass = observed
 Prior initial relative biomass = 0.5 - 0.9 expert
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 2005 default
 Prior final relative biomass = 0.2 - 0.6 , default
 Prior range for r = 0.2 - 0.8 default , prior range for k = 461 - 7373
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.361 , 95% CL = 0.306 - 0.438 , k = 2839 , 95% CL = 2456 - 3324
 MSY = 257 , 95% CL = 221 - 306
Biomass in last year = 1482 or 0.522 k
 Exploitation rate in last year = 0.0752 or 0.417 u.msy
 Results of CMSY analysis with altogether 1784 viable trajectories for 1032 r-k pairs
 r = 0.364 , 95% CL = 0.301 - 0.571 , k = 2529 , 95% CL = 1519 - 3247
 MSY = 230 , 95% CL = 205 - 259
 Relative biomass last year= 0.51 k, 2.5th = 0.275 , 97.5th = 0.597
 Relative biomass next year= 0.555 k, 2.5th = 0.304 , 97.5th = 0.643
 Relative exploitation rate in last year= 0.564
 Comment: OK

A: her-2532-gor catch
B: Finding viable r-k
C: Analysis of viable r-k
D: Pred. biomass vs observed
E: Exploitation rate
F: Equilibrium curve
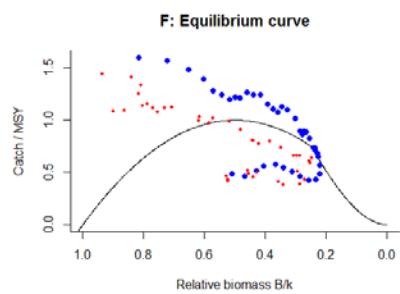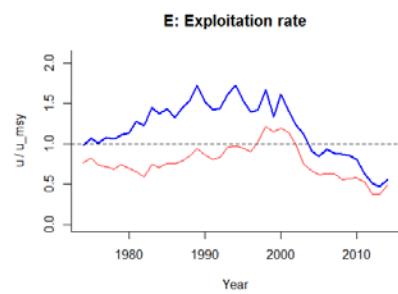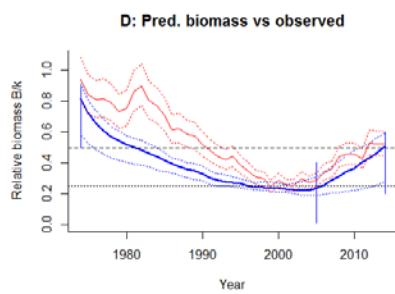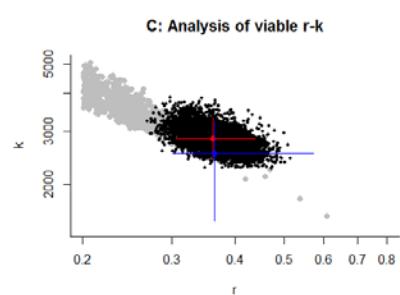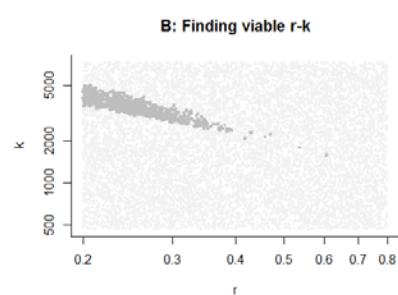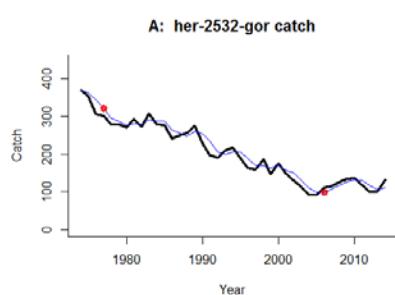
Species: *Clupea harengus* , stock: her-30
 Name and region: Herring in Subdivision 30 (Bothnian Sea) , ICES
 Catch data used from years 1973 - 2014 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.2 - 0.6 in year 2010 default
 Prior final relative biomass   = 0.5 - 0.9 , default
 Prior range for r = 0.2 - 0.8 default , prior range for k = 267 - 6419
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.41 , 95% CL = 0.342 - 0.497 , k = 862 , 95% CL = 754 - 994
 MSY = 88.6 , 95% CL = 73.4 - 108
Biomass in last year = 913 or 1.06 k
 Exploitation rate in last year = 0.117 or 0.572 u.msy
 Results of CMSY analysis with altogether 1407 viable trajectories for 740 r-k pairs
 r = 0.566 , 95% CL = 0.407 - 0.785 , k = 470 , 95% CL = 320 - 689
 MSY = 66.5 , 95% CL = 59.6 - 74.1
 Relative biomass last year= 0.517 k, 2.5th = 0.501 , 97.5th = 0.568
 Relative biomass next year= 0.433 k, 2.5th = 0.354 , 97.5th = 0.5
 Relative exploitation rate in last year= 1.61
 Comment: OK. Fit could be improved by setting intbio Medium in 2000.
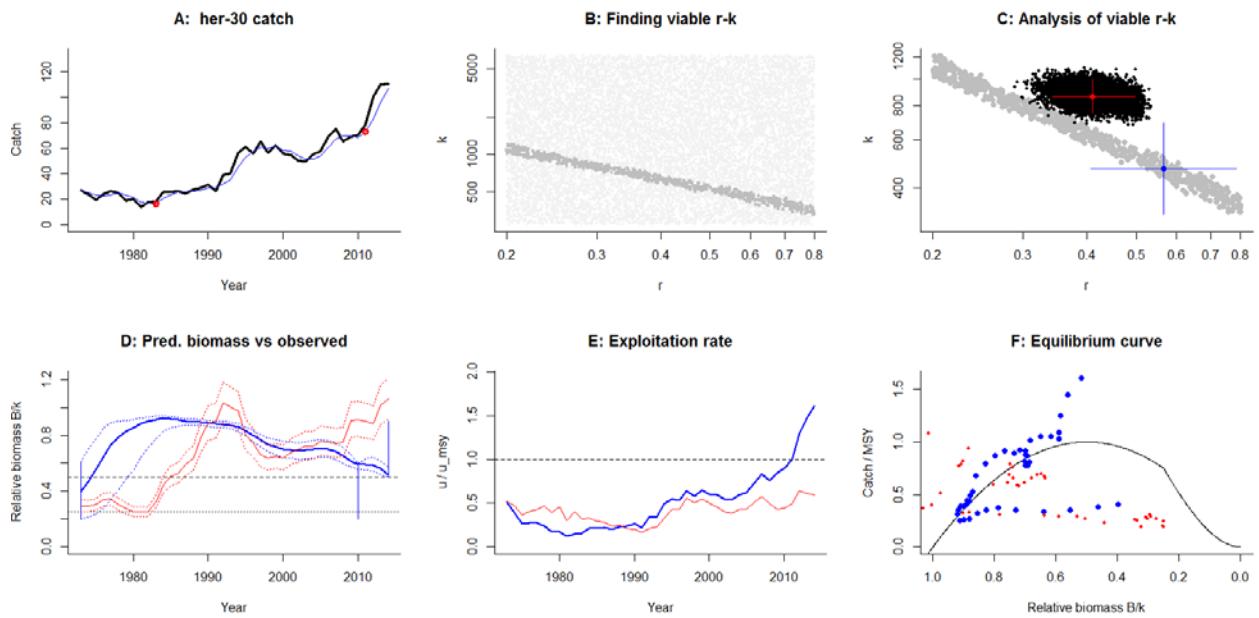
Species: *Clupea harengus* , stock: her-3a22
 Name and region: Herring in Division IIIa and Subdivisions 22 - 24 , ICES
 Catch data used from years 1991 - 2014 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 2010 default
 Prior final relative biomass   = 0.01 - 0.4 , default
 Prior range for r = 0.2 - 0.8 default , prior range for k = 241 - 3860
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.523 , 95% CL = 0.489 - 0.571 , k = 1036 , 95% CL = 891 - 1187
 MSY = 136 , 95% CL = 114 - 163
Biomass in last year = 189 or 0.183 k
 Exploitation rate in last year = 0.211 or 0.805 u.msy
 Results of CMSY analysis with altogether 2449 viable trajectories for 2042 r-k pairs
 r = 0.455 , 95% CL = 0.351 - 0.717 , k = 1647 , 95% CL = 708 - 3148
 MSY = 187 , 95% CL = 87.5 - 401
 Relative biomass last year= 0.16 k, 2.5th = 0.0155 , 97.5th = 0.39
 Relative biomass next year= 0.166 k, 2.5th = -0.00557 , 97.5th = 0.473
 Relative exploitation rate in last year= 0.624
 Comment: OK
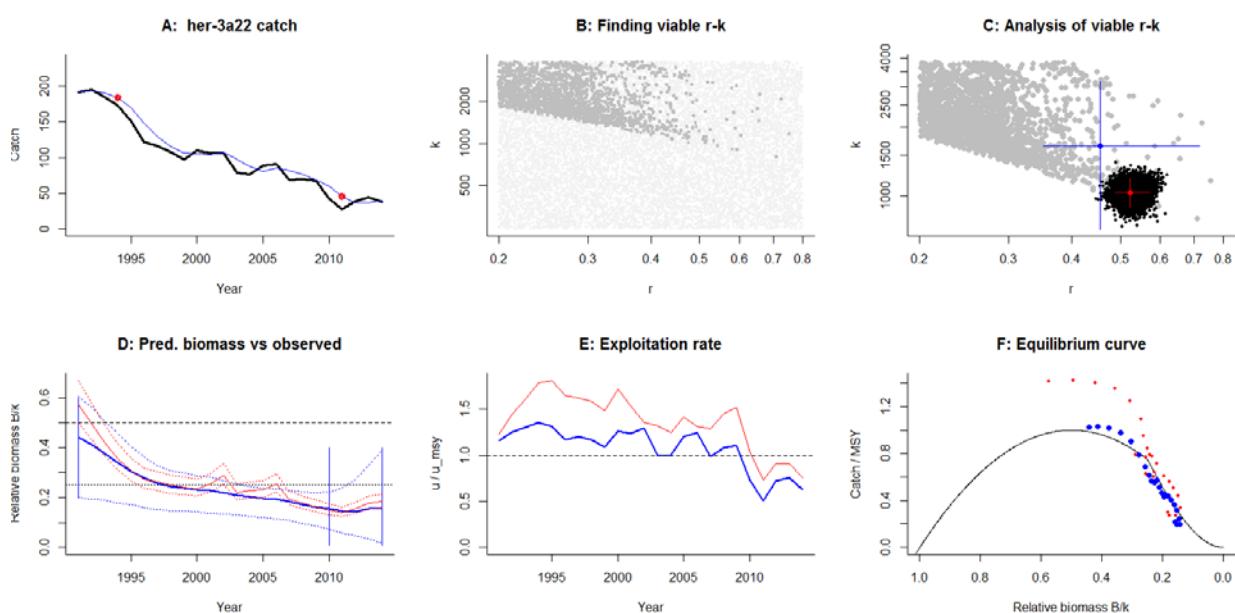
Species: *Clupea harengus* , stock: her-47d3
 Name and region: Herring in Subarea IV and Divisions IIIa and VIId , ICES
 Catch data used from years 1947 - 2014 , biomass = observed
 Prior initial relative biomass = 0.5 - 0.9 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 1978 default
 Prior final relative biomass   = 0.5 - 0.9 expert
 Prior range for r = 0.2 - 0.8 default , prior range for k = 2446 - 58710
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.485 , 95% CL = 0.416 - 0.526 , k = 6369 , 95% CL = 5763 - 7265
 MSY = 767 , 95% CL = 664 - 875
Biomass in last year = 4378 or 0.687 k
 Exploitation rate in last year = 0.111 or 0.46 u.msy
 Results of CMSY analysis with altogether 1058 viable trajectories for 354 r-k pairs
 r = 0.463 , 95% CL = 0.349 - 0.732 , k = 5592 , 95% CL = 3376 - 7762
 MSY = 647 , 95% CL = 591 - 709
 Relative biomass last year= 0.844 k, 2.5th = 0.798 , 97.5th = 0.874
 Relative biomass next year= 0.816 k, 2.5th = 0.783 , 97.5th = 0.847
 Relative exploitation rate in last year= 0.473
 Comment: OK
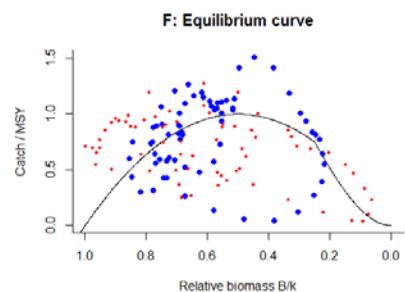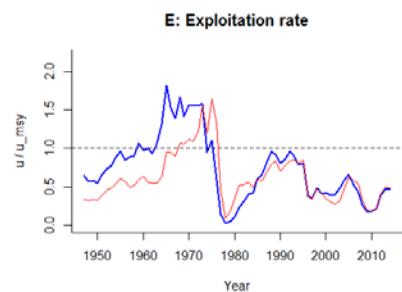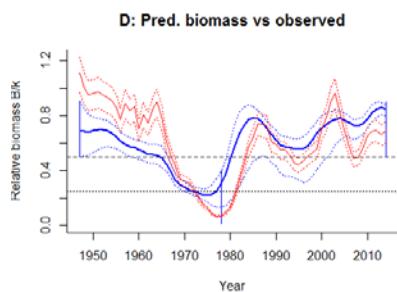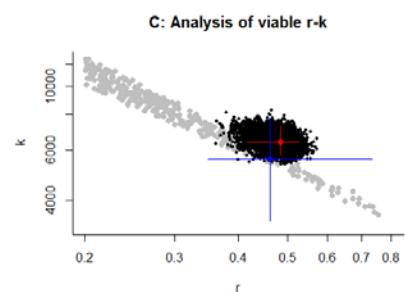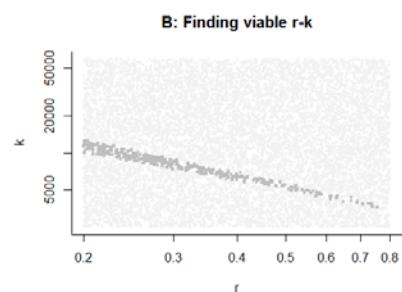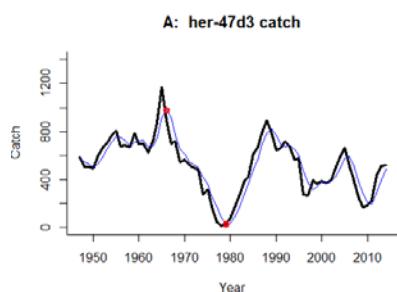
Species: *Clupea harengus* , stock: her-67bc
Name and region: Herring in Divisions VIa and VIIb,c (West of Scotland, West of Ireland) , ICES
Catch data used from years 1957 - 2014 , biomass = observed
Prior initial relative biomass = 0.5 - 0.9 default
Prior intermediate rel. biomass= 0.01 - 0.4 in year 2010 default
Prior final relative biomass = 0.01 - 0.4 , default
Prior range for r = 0.2 - 0.8 default , prior range for k = 274 - 4383
Results from Bayesian Schaefer model using catch & observed biomass
r = 0.39 , 95% CL = 0.329 - 0.471 , k = 1302 , 95% CL = 1177 - 1463
MSY = 127 , 95% CL = 105 - 156
Biomass in last year = 367 or 0.281 k
Exploitation rate in last year = 0.072 or 0.369 u.msy
Results of CMSY analysis with altogether 425 viable trajectories for 384 r-k pairs
r = 0.297 , 95% CL = 0.261 - 0.339 , k = 1375 , 95% CL = 1115 - 1695
MSY = 102 , 95% CL = 87.5 - 119
Relative biomass last year= 0.189 k, 2.5th = 0.0193 , 97.5th = 0.385
Relative biomass next year= 0.199 k, 2.5th = 4.35e-05 , 97.5th = 0.432
Relative exploitation rate in last year= 0.704
Comment: Fit could be improved by setting intbio Medium in 1995.
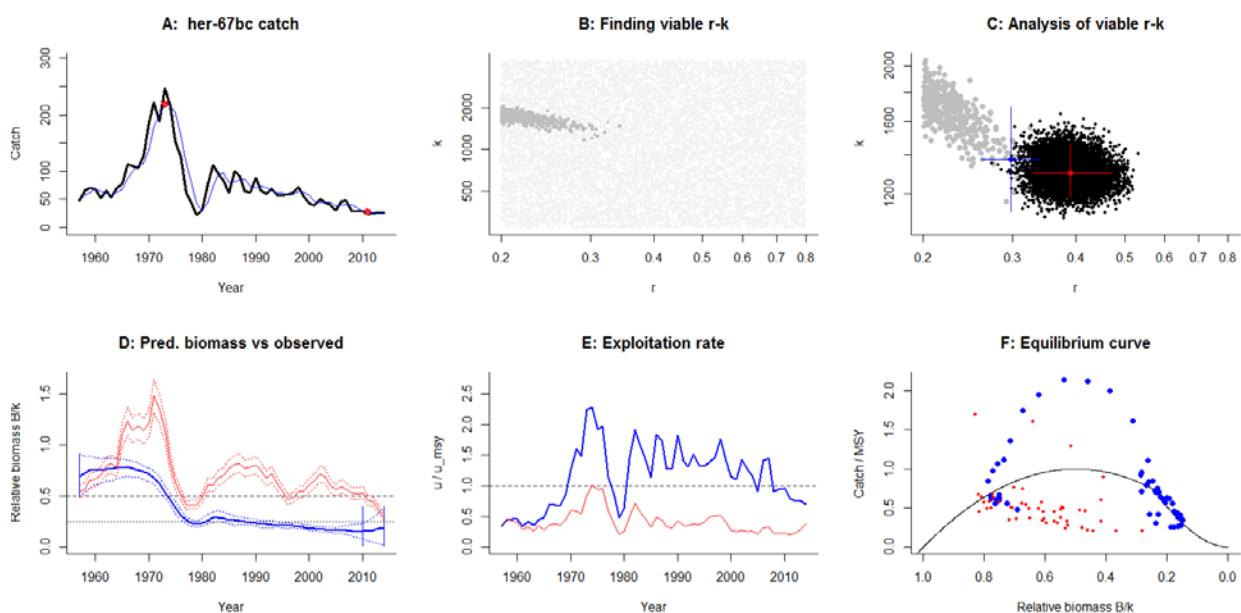
Species: *Clupea harengus* , stock: her-irls
 Name and region: Herring in Division VIIa South of 52° 30' N and VIIg,h,j,k , ICES
 Catch data used from years 1958 - 2014 , biomass = observed
 Prior initial relative biomass = 0.5 - 0.9 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 2009 default
 Prior final relative biomass   = 0.5 - 0.9 expert
 Prior range for r = 0.2 - 0.8 default , prior range for k = 89.6 - 2150
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.462 , 95% CL = 0.384 - 0.515 , k = 249 , 95% CL = 218 - 301
 MSY = 28.7 , 95% CL = 23.9 - 34.5
Biomass in last year = 208 or 0.834 k
 Exploitation rate in last year = 0.0781 or 0.338 u.msy
 Results of CMSY analysis with altogether 2298 viable trajectories for 1639 r-k pairs
 r = 0.387 , 95% CL = 0.312 - 0.479 , k = 212 , 95% CL = 165 - 272
 MSY = 20.5 , 95% CL = 19 - 22
Relative biomass last year= 0.599 k, 2.5th = 0.508 , 97.5th = 0.678
Relative biomass next year= 0.614 k, 2.5th = 0.527 , 97.5th = 0.684
Relative exploitation rate in last year= 0.636
Comment: Fit could be improved by setting intbio Low in 2002.
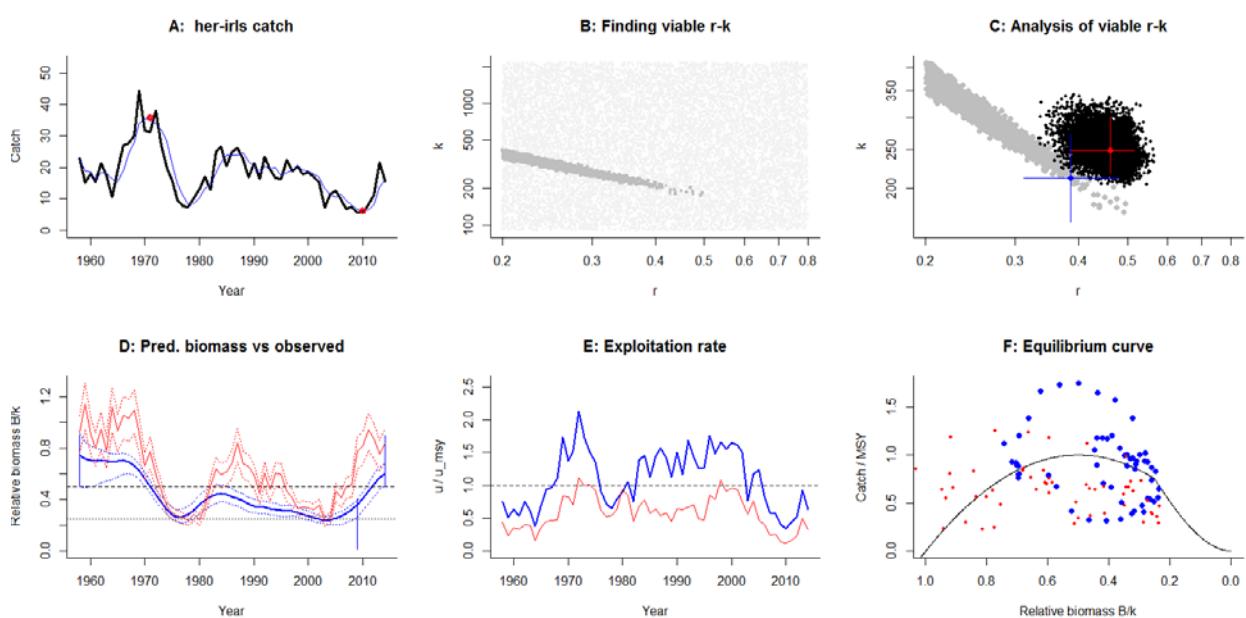
Species: *Clupea harengus* , stock: her-nirs
Name and region: Herring in Division VIIa North of 52° 30' N (Irish Sea) , ICES
 Catch data used from years 1961 - 2014 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 2003 default
 Prior final relative biomass   = 0.01 - 0.4 , default
 Prior range for r = 0.2 - 0.8 default , prior range for k = 36.9 - 591
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.422 , 95% CL = 0.369 - 0.49 , k = 123 , 95% CL = 105 - 145
 MSY = 13 , 95% CL = 10.5 - 16
Biomass in last year = 41.5 or 0.338 k
 Exploitation rate in last year = 0.126 or 0.599 u.msy
 Results of CMSY analysis with altogether 293 viable trajectories for 287 r-k pairs
 r = 0.321 , 95% CL = 0.275 - 0.393 , k = 182 , 95% CL = 135 - 234
 MSY = 14.6 , 95% CL = 12.1 - 17.6
Relative biomass last year= 0.156 k, 2.5th = 0.0153 , 97.5th = 0.381
Relative biomass next year= 0.158 k, 2.5th = -0.0114 , 97.5th = 0.419
Relative exploitation rate in last year= 1.14
Comment: OK
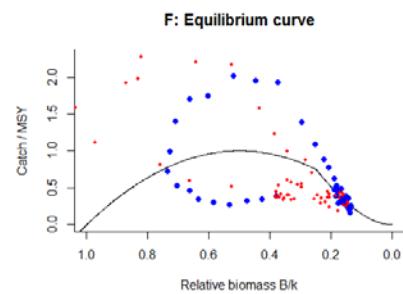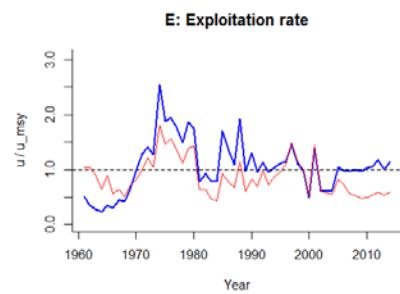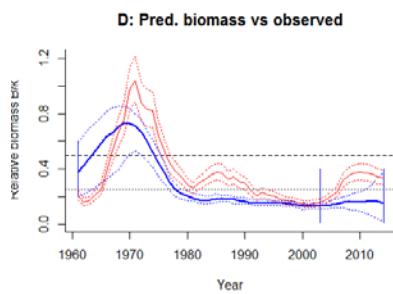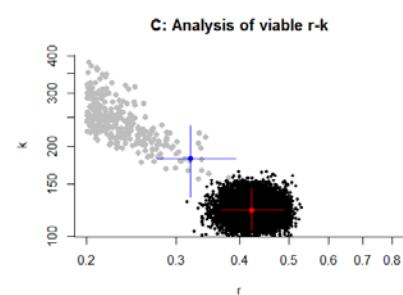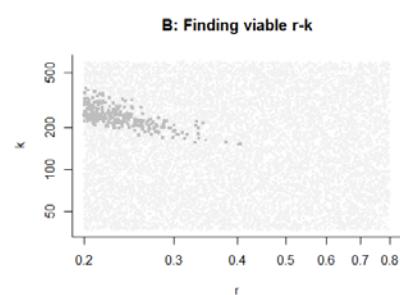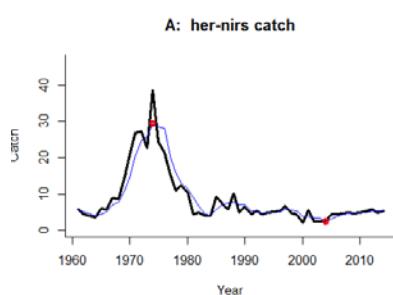
Species: *Clupea harengus* , stock: her-noss
 Name and region: Norwegian spring-spawning herring , ICES
 Catch data used from years 1988 - 2014 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.5 - 0.9 in year 2009 default
 Prior final relative biomass   = 0.2 - 0.6 , default
 Prior range for r = 0.2 - 0.8 default , prior range for k = 1954 - 31267
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.475 , 95% CL = 0.4 - 0.523 , k = 11174 , 95% CL = 10180 - 12366
 MSY = 1319 , 95% CL = 1128 - 1491
Biomass in last year = 5617 or 0.503 k
 Exploitation rate in last year = 0.117 or 0.492 u.msy
 Results of CMSY analysis with altogether 11732 viable trajectories for 1548 r-k pairs
 r = 0.566 , 95% CL = 0.407 - 0.785 , k = 7654 , 95% CL = 4922 - 11904
 MSY = 1082 , 95% CL = 866 - 1353
Relative biomass last year= 0.465 k, 2.5th = 0.22 , 97.5th = 0.595
Relative biomass next year= 0.52 k, 2.5th = 0.212 , 97.5th = 0.67
Relative exploitation rate in last year= 0.458
Comment: OK
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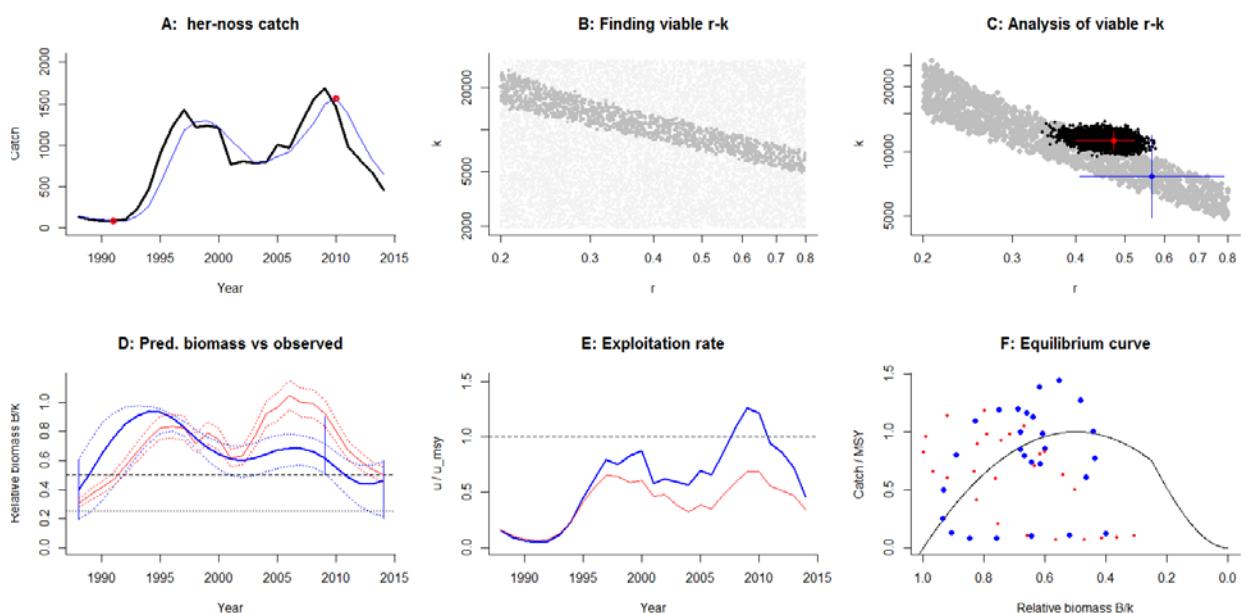
Species: *Clupea harengus* , stock: her-riga
 Name and region: Herring in the Gulf of Riga , ICES
 Catch data used from years 1977 - 2014 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.2 - 0.6 in year 2003 default
 Prior final relative biomass   = 0.2 - 0.6 , default
 Prior range for r = 0.2 - 0.8 default , prior range for k = 49.8 - 797
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.495 , 95% CL = 0.437 - 0.542 , k = 232 , 95% CL = 205 - 270
 MSY = 28.6 , 95% CL = 25.4 - 32.3
Biomass in last year = 126 or 0.545 k
 Exploitation rate in last year = 0.214 or 0.863 u.msy
 Results of CMSY analysis with altogether 5599 viable trajectories for 1086 r-k pairs
 r = 0.566 , 95% CL = 0.407 - 0.785 , k = 221 , 95% CL = 148 - 331
 MSY = 31.3 , 95% CL = 27 - 36.2
 Relative biomass last year= 0.44 k, 2.5th = 0.217 , 97.5th = 0.59
 Relative biomass next year= 0.458 k, 2.5th = 0.174 , 97.5th = 0.624
 Relative exploitation rate in last year= 0.953
 Comment: OK
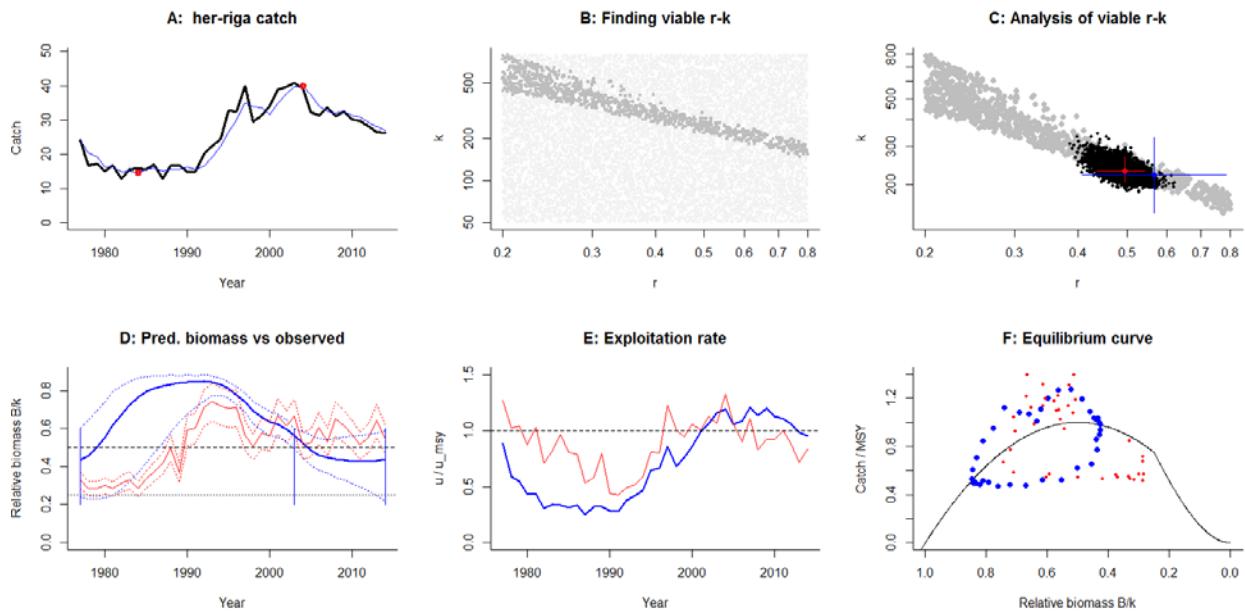
Species: *Clupea harengus* , stock: her-vian
 Name and region: Herring in Division VIa (North) , ICES
 Catch data used from years 1957 - 2013 , biomass = observed
 Prior initial relative biomass = 0.5 - 0.9 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 1979 default
 Prior final relative biomass   = 0.01 - 0.4 , default
 Prior range for r = 0.2 - 0.8 default , prior range for k = 243 - 3881
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.432 , 95% CL = 0.36 - 0.503 , k = 938 , 95% CL = 786 - 1158
 MSY = 102 , 95% CL = 76.7 - 135
Biomass in last year = 114 or 0.121 k
 Exploitation rate in last year = 0.173 or 0.803 u.msy
 Results of CMSY analysis with altogether 266 viable trajectories for 254 r-k pairs
 r = 0.333 , 95% CL = 0.282 - 0.41 , k = 1103 , 95% CL = 832 - 1404
 MSY = 91.8 , 95% CL = 79.4 - 106
 Relative biomass last year= 0.187 k, 2.5th = 0.0157 , 97.5th = 0.38
 Relative biomass next year= 0.204 k, 2.5th = -0.000554 , 97.5th = 0.437
 Relative exploitation rate in last year= 0.668
 Comment: OK
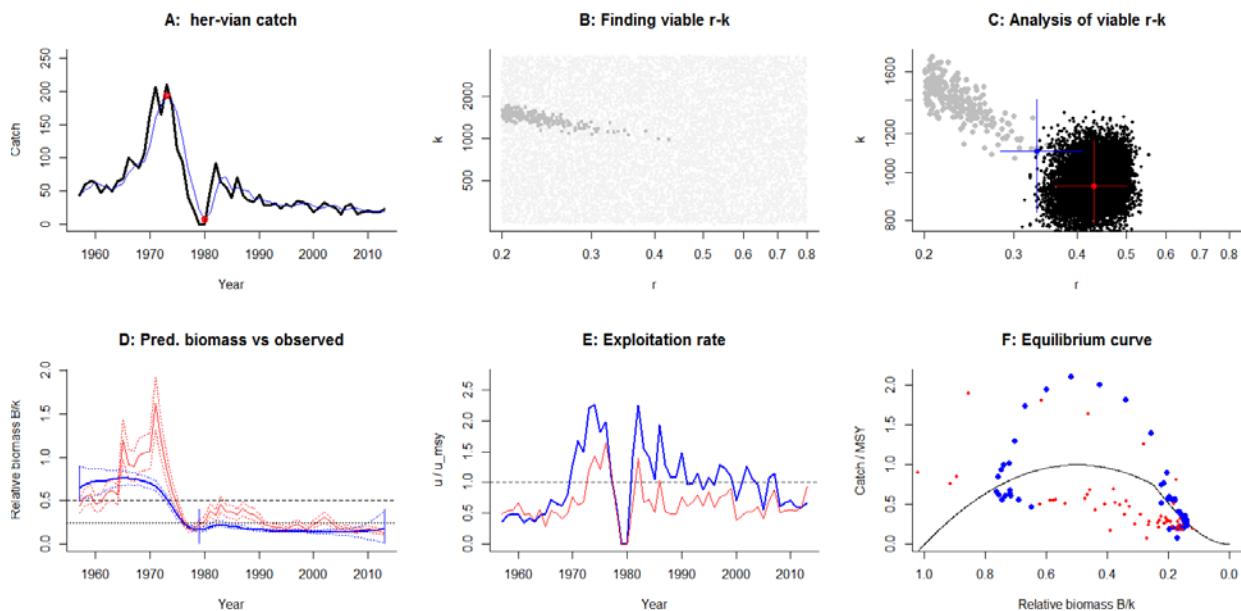
Species: *Merluccius merluccius* , stock: hke-nrtn
Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock) , ICES
 Catch data used from years 1978 - 2014 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.5 - 0.9 in year 2010 default
 Prior final relative biomass   = 0.5 - 0.9 , default
 Prior range for r = 0.2 - 0.8 default , prior range for k = 251 - 6020
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.906 , 95% CL = 0.733 - 1.04 , k = 278 , 95% CL = 247 - 315
 MSY = 63.1 , 95% CL = 48.5 - 76
Biomass in last year = 275 or 0.989 k
 Exploitation rate in last year = 0.362 or 0.799 u.msy
 Results of CMSY analysis with altogether 27131 viable trajectories for 3146 r-k pairs
 r = 0.566 , 95% CL = 0.407 - 0.785 , k = 715 , 95% CL = 383 - 1333
 MSY = 101 , 95% CL = 56.7 - 180
Relative biomass last year= 0.718 k, 2.5th = 0.516 , 97.5th = 0.831
Relative biomass next year= 0.695 k, 2.5th = 0.446 , 97.5th = 0.821
Relative exploitation rate in last year= 0.681
Comment: Fit could be improved by setting intbio Low in 2005.
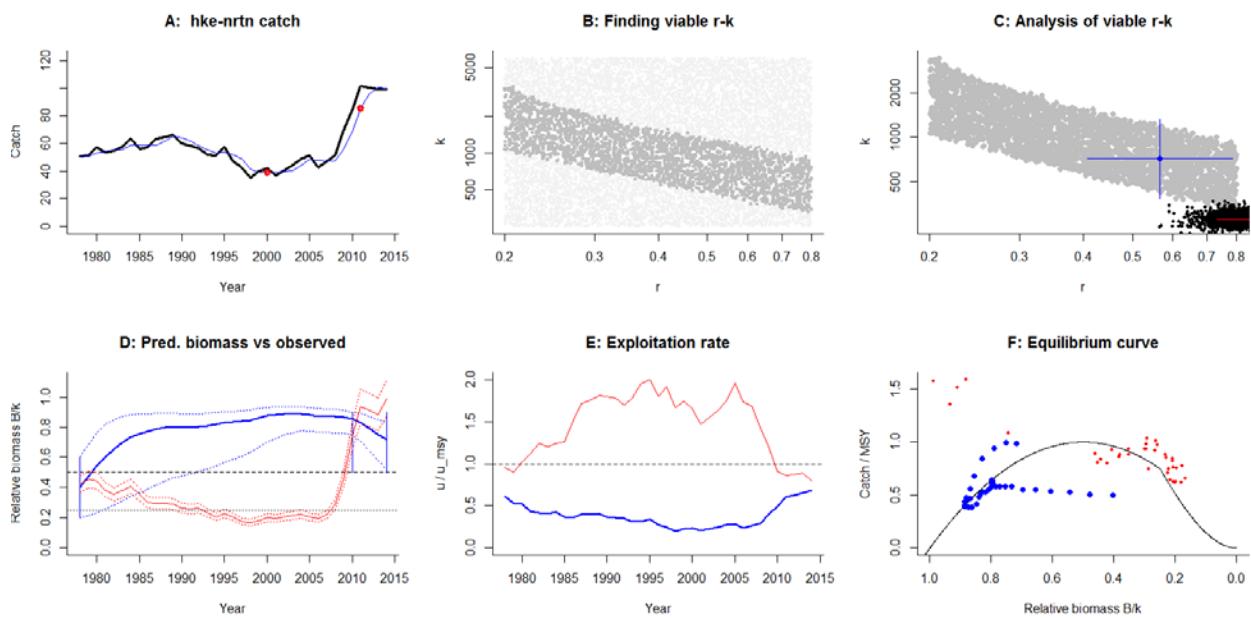
Species: *Merluccius merluccius* , stock: hke-soth
 Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock) , ICES
 Catch data used from years 1982 - 2014 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 2003 default
 Prior final relative biomass = 0.2 - 0.6 , default
 Prior range for r = 0.2 - 0.8 default , prior range for k = 26.7 - 427
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.884 , 95% CL = 0.663 - 1.05 , k = 64.3 , 95% CL = 55.5 - 75.3
 MSY = 14.3 , 95% CL = 10.2 - 17.7
Biomass in last year = 23.5 or 0.366 k
 Exploitation rate in last year = 0.634 or 1.44 u.msy
 Results of CMSY analysis with altogether 2822 viable trajectories for 2152 r-k pairs
 r = 0.465 , 95% CL = 0.357 - 0.725 , k = 134 , 95% CL = 78.2 - 193
 MSY = 15.6 , 95% CL = 12.9 - 18.9
 Relative biomass last year= 0.385 k, 2.5th = 0.216 , 97.5th = 0.562
 Relative biomass next year= 0.381 k, 2.5th = 0.166 , 97.5th = 0.577
 Relative exploitation rate in last year= 1.2
 Comment: OK
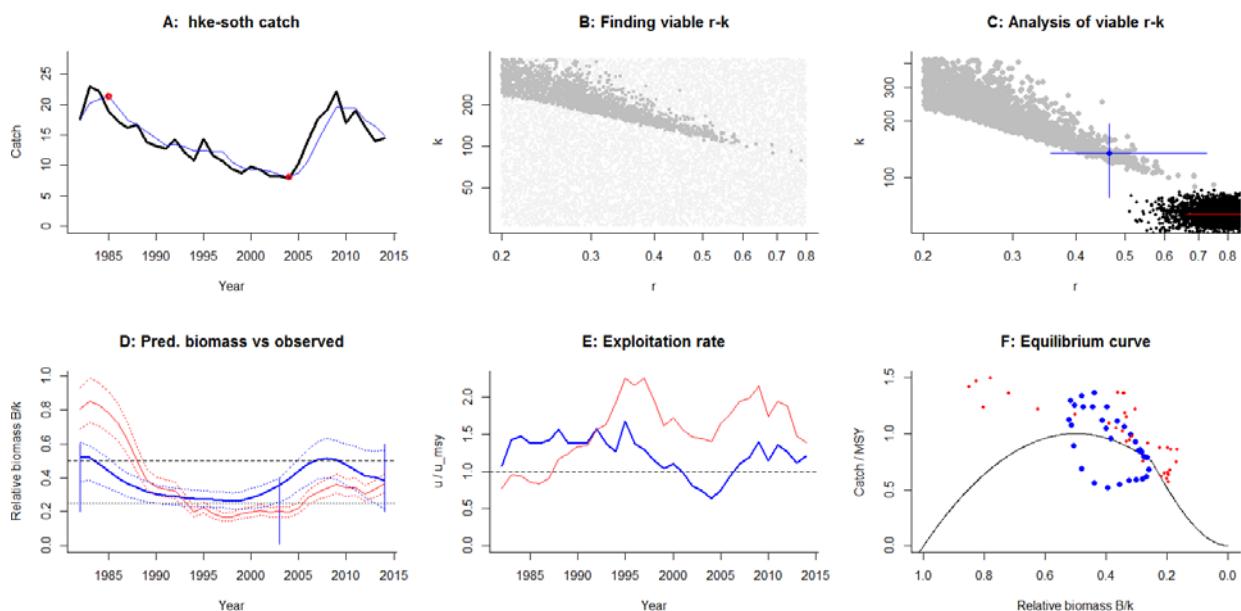
Species: *Trachurus trachurus* , stock: hom-west
Name and region: Horse mackerel in Divisions IIa, IVa, Vb, VIa, VIIa-c, e-k, VIII (Western stock) , ICES
Catch data used from years 1982 - 2014 , biomass = observed
Prior initial relative biomass = 0.2 - 0.6 default
Prior intermediate rel. biomass= 0.5 - 0.9 in year 1996 default
Prior final relative biomass = 0.01 - 0.4 expert
Prior range for r = 0.2 - 0.8 default , prior range for k = 596 - 9538
Results from Bayesian Schaefer model using catch & observed biomass
r = 0.447 , 95% CL = 0.368 - 0.511 , k = 4013 , 95% CL = 3438 - 4927
MSY = 448 , 95% CL = 353 - 564
Biomass in last year = 1144 or 0.285 k
Exploitation rate in last year = 0.136 or 0.609 u.msy
Results of CMSY analysis with altogether 1790 viable trajectories for 1481 r-k pairs
r = 0.498 , 95% CL = 0.373 - 0.752 , k = 2395 , 95% CL = 1486 - 3409
MSY = 298 , 95% CL = 262 - 339
Relative biomass last year= 0.287 k, 2.5th = 0.0214 , 97.5th = 0.396
Relative biomass next year= 0.314 k, 2.5th = -0.0337 , 97.5th = 0.453
Relative exploitation rate in last year= 0.755
Comment: OK
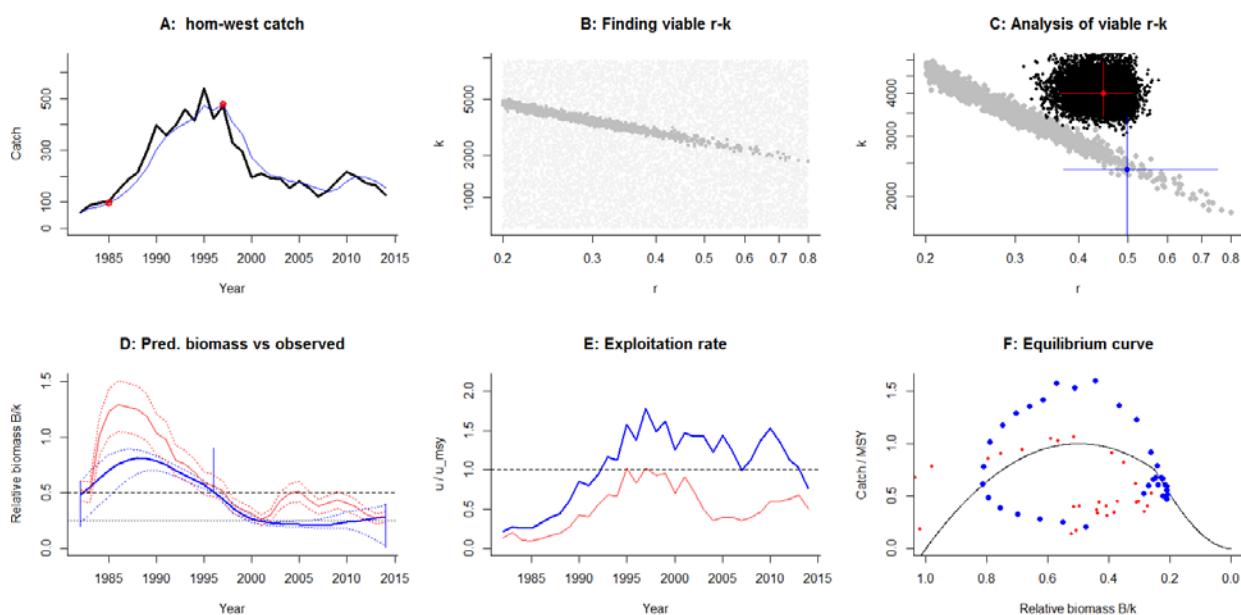
Species: *Molva molva* , stock: lin-icel
Name and region: Ling in Division Va , ICES
Catch data used from years 1982 - 2014 , biomass = observed
Prior initial relative biomass = 0.01 - 0.4 expert
Prior intermediate rel. biomass= 0.5 - 0.9 in year 2010 default
Prior final relative biomass = 0.5 - 0.9 , default
Prior range for r = 0.2 - 0.8 default , prior range for k = 30.9 - 742
Results from Bayesian Schaefer model using catch & observed biomass
r = 0.51 , 95% CL = 0.482 - 0.551 , k = 129 , 95% CL = 115 - 142
MSY = 16.5 , 95% CL = 14.3 - 19
Biomass in last year = 90.9 or 0.706 k
Exploitation rate in last year = 0.136 or 0.533 u.msy
Results of CMSY analysis with altogether 22648 viable trajectories for 4326 r-k pairs
r = 0.566 , 95% CL = 0.407 - 0.785 , k = 98.6 , 95% CL = 49.1 - 198
MSY = 13.9 , 95% CL = 6.75 - 28.8
Relative biomass last year= 0.765 k, 2.5th = 0.516 , 97.5th = 0.878
Relative biomass next year= 0.743 k, 2.5th = 0.446 , 97.5th = 0.867
Relative exploitation rate in last year= 0.638
Comment: Resilience changed from Low to Medium; fit could be improved by setting intbio to Low in 2000.
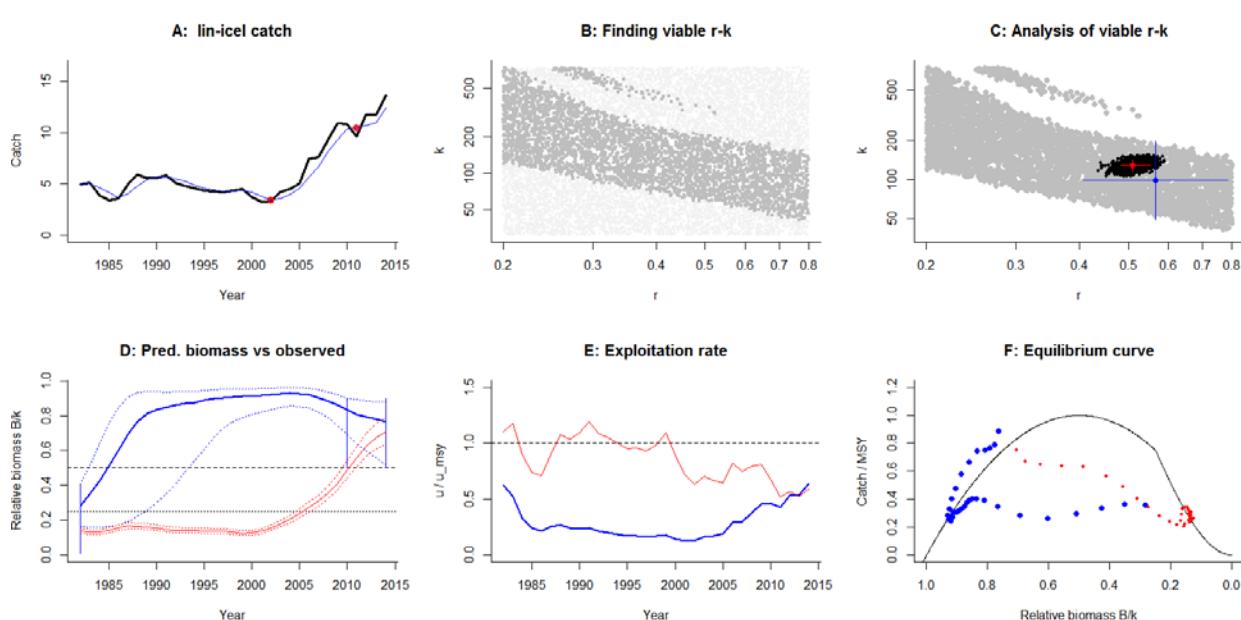
Species: *Scomber scombrus* , stock: mac-nea
Mackerel (combined Southern, Western & N. Sea spawn. comp.) , ICES
 Catch data used from years 1980 - 2011 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.2 - 0.6 in year 1991 default
 Prior final relative biomass   = 0.5 - 0.9 , default
 Prior range for r = 0.2 - 0.8 default , prior range for k = 2133 - 51203
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.438 , 95% CL = 0.367 - 0.504 , k = 7017 , 95% CL = 6248 - 8400
 MSY = 771 , 95% CL = 690 - 871
Biomass in last year = 4891 or 0.697 k
 Exploitation rate in last year = 0.174 or 0.796 u.msy
 Results of CMSY analysis with altogether 7853 viable trajectories for 2797 r-k pairs
 r = 0.566 , 95% CL = 0.407 - 0.785 , k = 6724 , 95% CL = 3719 - 12157
 MSY = 951 , 95% CL = 566 - 1596
Relative biomass last year= 0.7 k, 2.5th = 0.523 , 97.5th = 0.863
Relative biomass next year= 0.665 k, 2.5th = 0.482 , 97.5th = 0.844
Relative exploitation rate in last year= 0.712
Comment: OK. Fit could be improved by setting startbio High and intbio Medium in 2005.

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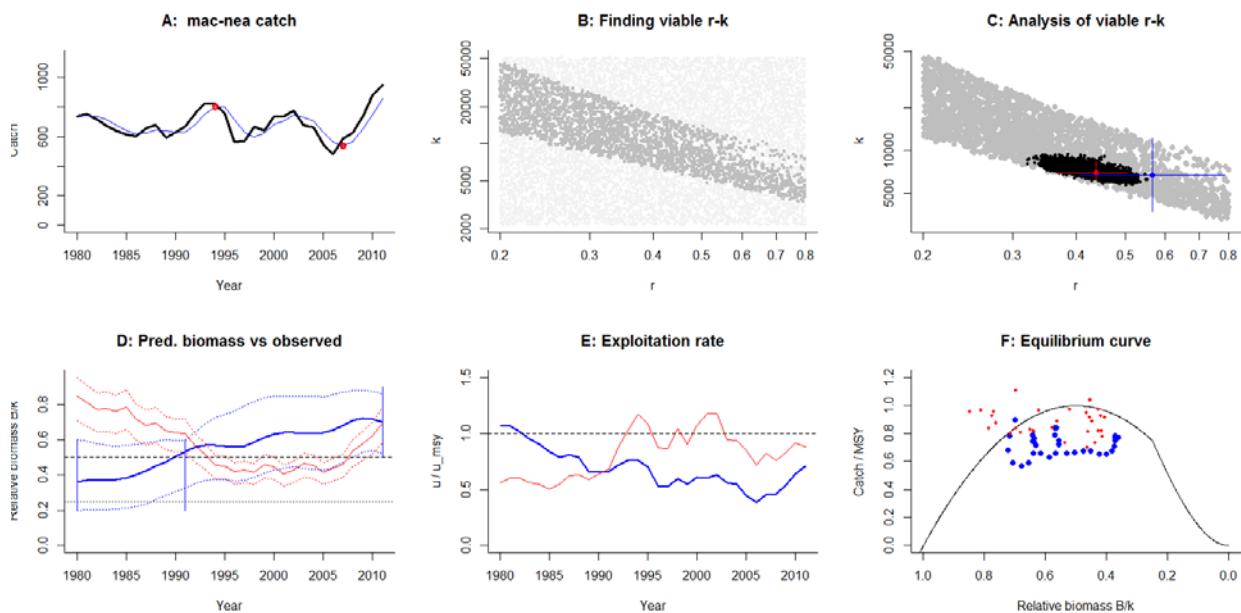
Species: *Lepidorhombus whiffiagonis* , stock: mgw-8c9a
Name and region: Megrim in Divisions VIIIc and IXa , ICES
Catch data used from years 1986 - 2014 , biomass = observed
Prior initial relative biomass = 0.2 - 0.6 default
Prior intermediate rel. biomass= 0.01 - 0.4 in year 2009 default
Prior final relative biomass   = 0.01 - 0.4 expert
Prior range for r = 0.05 - 0.5 default , prior range for k = 1.76 - 70.4
Results from Bayesian Schaefer model using catch & observed biomass
r = 0.315 , 95% CL = 0.268 - 0.377 , k = 6.4 , 95% CL = 5.09 - 8.2
MSY = 0.503 , 95% CL = 0.367 - 0.706
Biomass in last year = 1.44 or 0.225 k
Exploitation rate in last year = 0.218 or 1.39 u.msy
Results of CMSY analysis with altogether 7481 viable trajectories for 4516 r-k pairs
r = 0.262 , 95% CL = 0.155 - 0.465 , k = 10.5 , 95% CL = 4.03 - 26.2
MSY = 0.69 , 95% CL = 0.324 - 1.47
Relative biomass last year= 0.181 k, 2.5th = 0.0142 , 97.5th = 0.393
Relative biomass next year= 0.176 k, 2.5th = -0.0101 , 97.5th = 0.415
Relative exploitation rate in last year= 1.6
Comment: OK
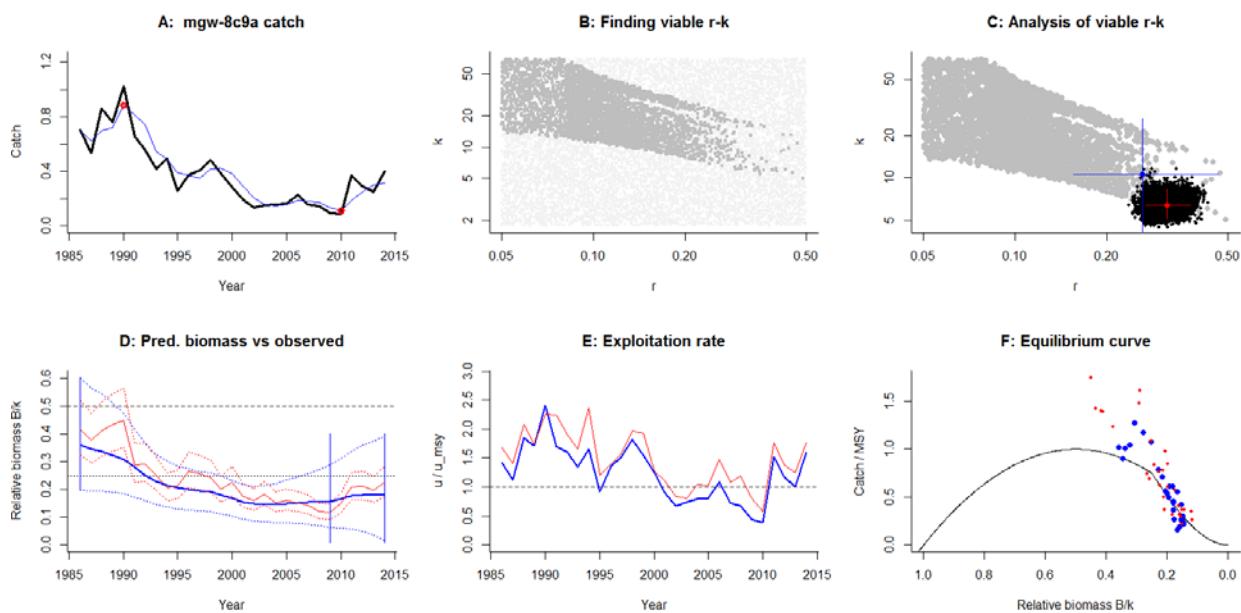
Species: *Nephrops norvegicus* , stock: nep-8ab
Name and region: Nephrops in Divisions VIIIa,b (Bay of Biscay, FU 23, 24) , ICES
Catch data used from years 1984 - 2011 , biomass = observed
Prior initial relative biomass = 0.2 - 0.6 default
Prior intermediate rel. biomass= 0.01 - 0.4 in year 2004 default
Prior final relative biomass   = 0.01 - 0.4 expert
Prior range for r = 0.2 - 0.8 default , prior range for k = 8.42 - 135
Results from Bayesian Schaefer model using catch & observed biomass
r = 0.507 , 95% CL = 0.476 - 0.566 , k = 44.3 , 95% CL = 37.9 - 50.6
MSY = 5.64 , 95% CL = 5.16 - 6.19
Biomass in last year = 16 or 0.36 k
Exploitation rate in last year = 0.256 or 1.01 u.msy
Results of CMSY analysis with altogether 1646 viable trajectories for 846 r-k pairs
r = 0.546 , 95% CL = 0.395 - 0.785 , k = 39.9 , 95% CL = 26.1 - 58.8
MSY = 5.45 , 95% CL = 4.82 - 6.17
Relative biomass last year= 0.305 k, 2.5th = 0.053 , 97.5th = 0.397
Relative biomass next year= 0.312 k, 2.5th = -0.0524 , 97.5th = 0.435
Relative exploitation rate in last year= 1.39
Comment: OK

A: nep-8ab catch

B: Finding viable r-k

C: Analysis of viable r-k

D: Pred. biomass vs observed

E: Exploitation rate

F: Equilibrium curve
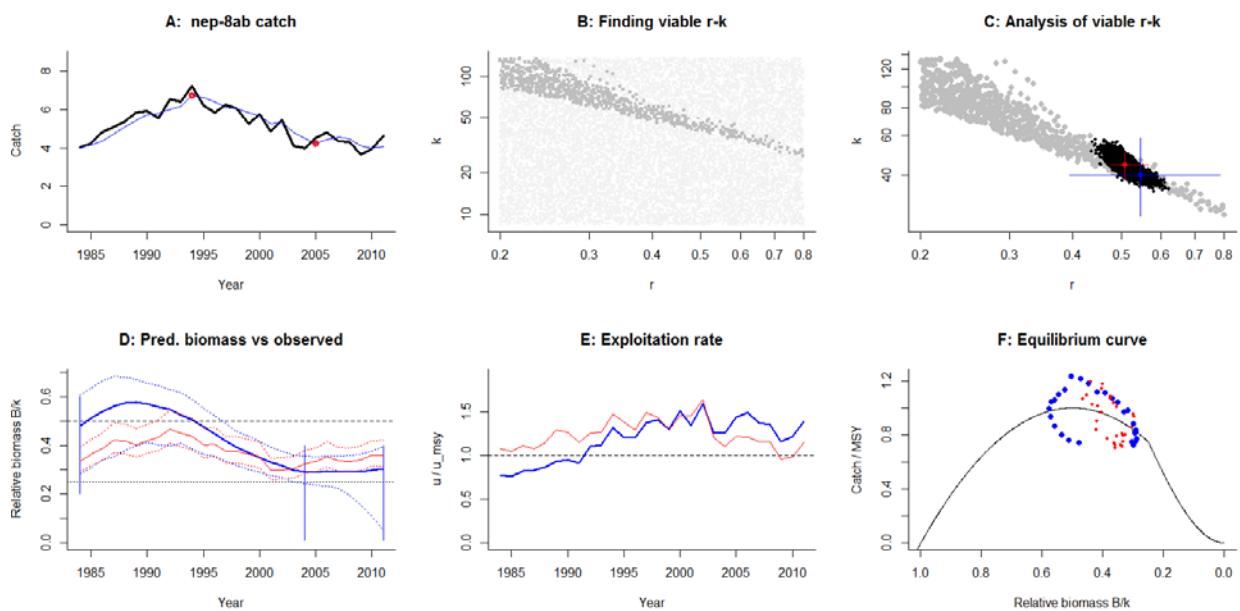
Species: *Trisopterus esmarkii* , stock: nop-34-june
Name and region: Norway Pout in Subarea IV (North S.) and IIIa (Skagerrak - Kattegat) , ICES
Catch data used from years 1983 - 2013 , biomass = observed
Prior initial relative biomass = 0.2 - 0.6 default
Prior intermediate rel. biomass= 0.01 - 0.4 in year 2004 default
Prior final relative biomass   = 0.01 - 0.4 , default
Prior range for r = 0.2 - 0.8 default , prior range for k = 572 - 9152
Results from Bayesian Schaefer model using catch & observed biomass
r = 0.498 , 95% CL = 0.436 - 0.552 , k = 1909 , 95% CL = 1367 - 2780
MSY = 236 , 95% CL = 166 - 346
Biomass in last year = 646 or 0.339 k
Exploitation rate in last year = 0.0596 or 0.239 u.msy
Results of CMSY analysis with altogether 2153 viable trajectories for 1991 r-k pairs
r = 0.43 , 95% CL = 0.337 - 0.605 , k = 3714 , 95% CL = 1673 - 7462
MSY = 399 , 95% CL = 163 - 974
Relative biomass last year= 0.111 k, 2.5th = 0.0138 , 97.5th = 0.371
Relative biomass next year= 0.124 k, 2.5th = 0.000888 , 97.5th = 0.454
Relative exploitation rate in last year= 0.929
Comment: OK
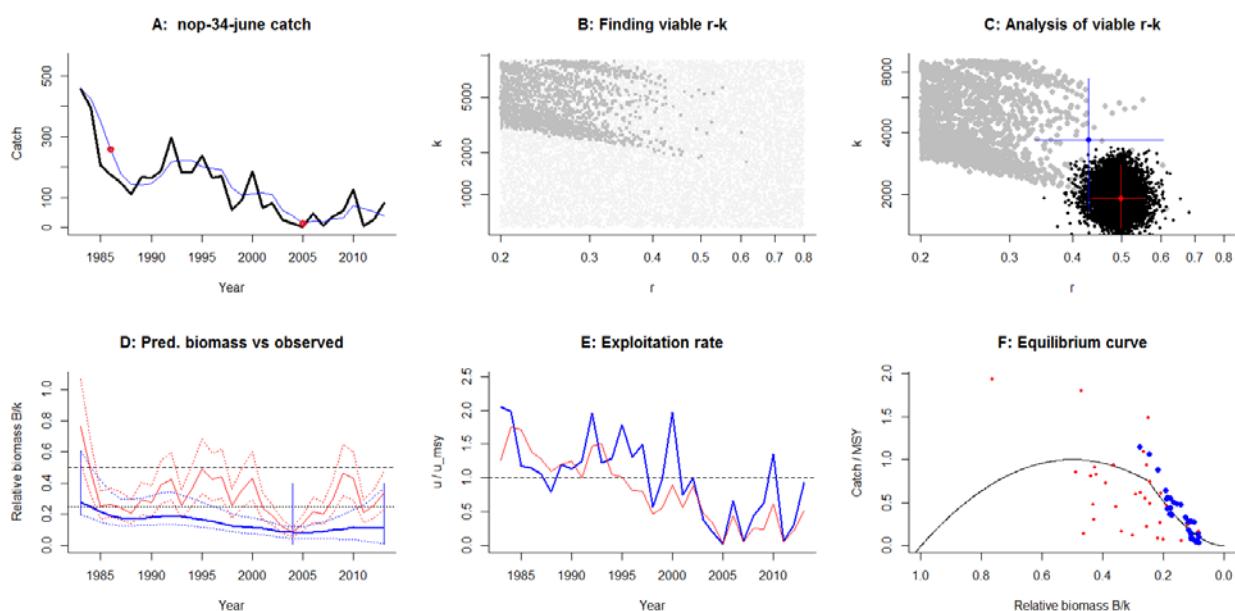
Species: *Pleuronectes platessa* , stock: ple-celt
 Name and region: Plaice in Divisions VIIf,g (Celtic Sea) , ICES
 Catch data used from years 1993 - 2011 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 2007 default
 Prior final relative biomass   = 0.01 - 0.4 , default
 Prior range for r = 0.2 - 0.8 default , prior range for k = 0.546 - 8.74
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.525 , 95% CL = 0.485 - 0.587 , k = 2.23 , 95% CL = 1.85 - 2.62
 MSY = 0.294 , 95% CL = 0.237 - 0.352
Biomass in last year = 0.318 or 0.143 k
 Exploitation rate in last year = 0.246 or 0.939 u.msy
 Results of CMSY analysis with altogether 2529 viable trajectories for 2090 r-k pairs
 r = 0.525 , 95% CL = 0.387 - 0.763 , k = 3.04 , 95% CL = 1.48 - 5.82
 MSY = 0.399 , 95% CL = 0.203 - 0.784
 Relative biomass last year= 0.166 k, 2.5th = 0.0142 , 97.5th = 0.391
 Relative biomass next year= 0.185 k, 2.5th = -0.0114 , 97.5th = 0.477
 Relative exploitation rate in last year= 0.59
 Comment: OK
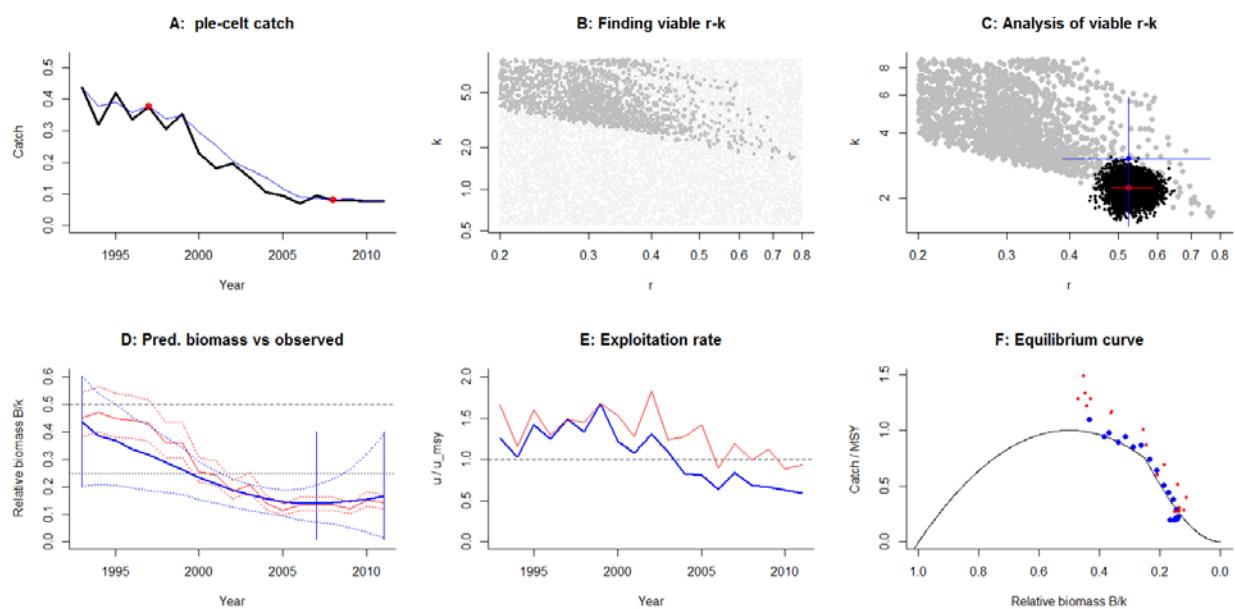
Species: *Pleuronectes platessa* , stock: ple-eche
 Name and region: Plaice in Division VIId (Eastern Channel) , ICES
 Catch data used from years 1980 - 2011 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 2006 default
 Prior final relative biomass   = 0.2 - 0.6 , default
 Prior range for r = 0.2 - 0.8 default , prior range for k = 9.12 - 146
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.589 , 95% CL = 0.503 - 0.673 , k = 31.4 , 95% CL = 26.4 - 37.7
 MSY = 4.61 , 95% CL = 3.74 - 5.59
Biomass in last year = 13 or 0.414 k
 Exploitation rate in last year = 0.228 or 0.774 u.msy
 Results of CMSY analysis with altogether 3192 viable trajectories for 1682 r-k pairs
 r = 0.537 , 95% CL = 0.393 - 0.742 , k = 36.6 , 95% CL = 24.9 - 53.2
 MSY = 4.92 , 95% CL = 4.35 - 5.55
 Relative biomass last year= 0.507 k, 2.5th = 0.271 , 97.5th = 0.596
 Relative biomass next year= 0.554 k, 2.5th = 0.293 , 97.5th = 0.654
 Relative exploitation rate in last year= 0.561
 Comment: OK

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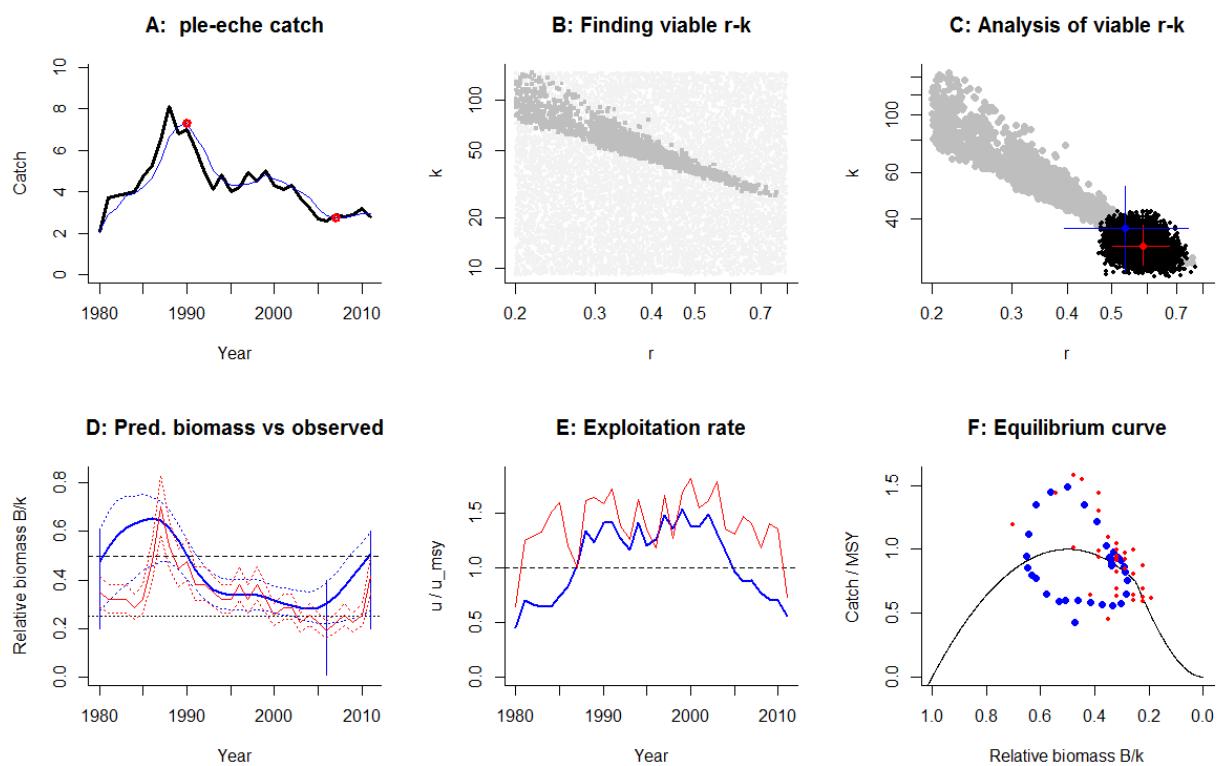
Species: *Pleuronectes platessa* , stock: ple-echw
 Name and region: Plaice in Division VIIe (Western Channel) , ICES
 Catch data used from years 1980 - 2013 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 2008 default
 Prior final relative biomass = 0.2 - 0.6 , default
 Prior range for r = 0.2 - 0.8 default , prior range for k = 3.69 - 59.1
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.5 , 95% CL = 0.46 - 0.55 , k = 14.8 , 95% CL = 12.6 - 17.3
 MSY = 1.85 , 95% CL = 1.61 - 2.12
Biomass in last year = 6.73 or 0.453 k
 Exploitation rate in last year = 0.225 or 0.902 u.msy
 Results of CMSY analysis with altogether 4004 viable trajectories for 2511 r-k pairs
 r = 0.498 , 95% CL = 0.373 - 0.705 , k = 15.3 , 95% CL = 10.1 - 21.8
 MSY = 1.9 , 95% CL = 1.66 - 2.18
 Relative biomass last year= 0.49 k, 2.5th = 0.268 , 97.5th = 0.593
 Relative biomass next year= 0.51 k, 2.5th = 0.267 , 97.5th = 0.618
 Relative exploitation rate in last year= 0.818
 Comment: OK

A: ple-echw catch

B: Finding viable r-k

C: Analysis of viable r-k

D: Pred. biomass vs observed

E: Exploitation rate

F: Equilibrium curve
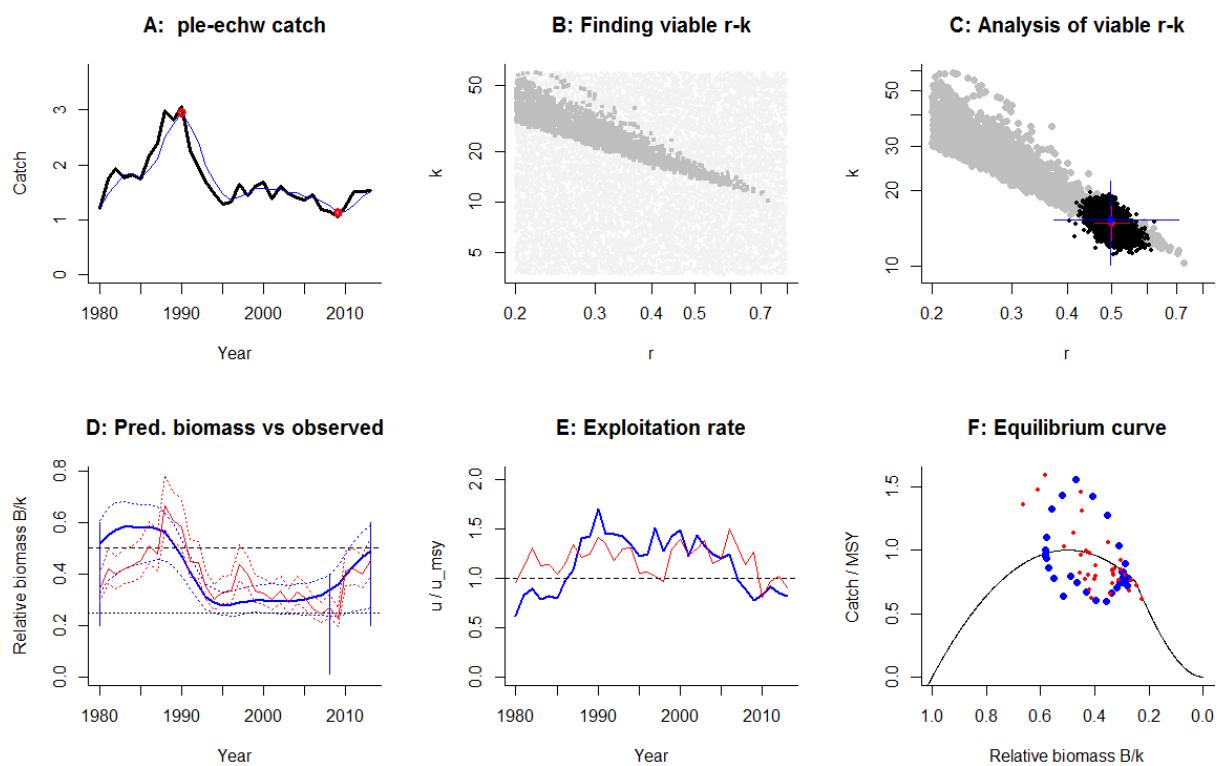
Species: *Pleuronectes platessa* , stock: ple-nsea
 Name and region: Plaice Subarea IV (North Sea) , ICES
 Catch data used from years 1960 - 2011 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 1982 expert
 Prior final relative biomass   = 0.2 - 0.6 , default
 Prior range for r = 0.2 - 0.8 default , prior range for k = 398 - 6365
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.578 , 95% CL = 0.53 - 0.635 , k = 1325 , 95% CL = 1153 - 1480
 MSY = 191 , 95% CL = 172 - 211
Biomass in last year = 610 or 0.46 k
 Exploitation rate in last year = 0.173 or 0.598 u.msy
 Results of CMSY analysis with altogether 524 viable trajectories for 489 r-k pairs
 r = 0.309 , 95% CL = 0.268 - 0.356 , k = 2873 , 95% CL = 2282 - 3618
 MSY = 222 , 95% CL = 187 - 264
 Relative biomass last year= 0.515 k, 2.5th = 0.25 , 97.5th = 0.595
 Relative biomass next year= 0.557 k, 2.5th = 0.291 , 97.5th = 0.643
 Relative exploitation rate in last year= 0.475
 Comment: Start year set to 1960.

A: ple-nsea catch

B: Finding viable r-k

C: Analysis of viable r-k

D: Pred. biomass vs observed

E: Exploitation rate

F: Equilibrium curve
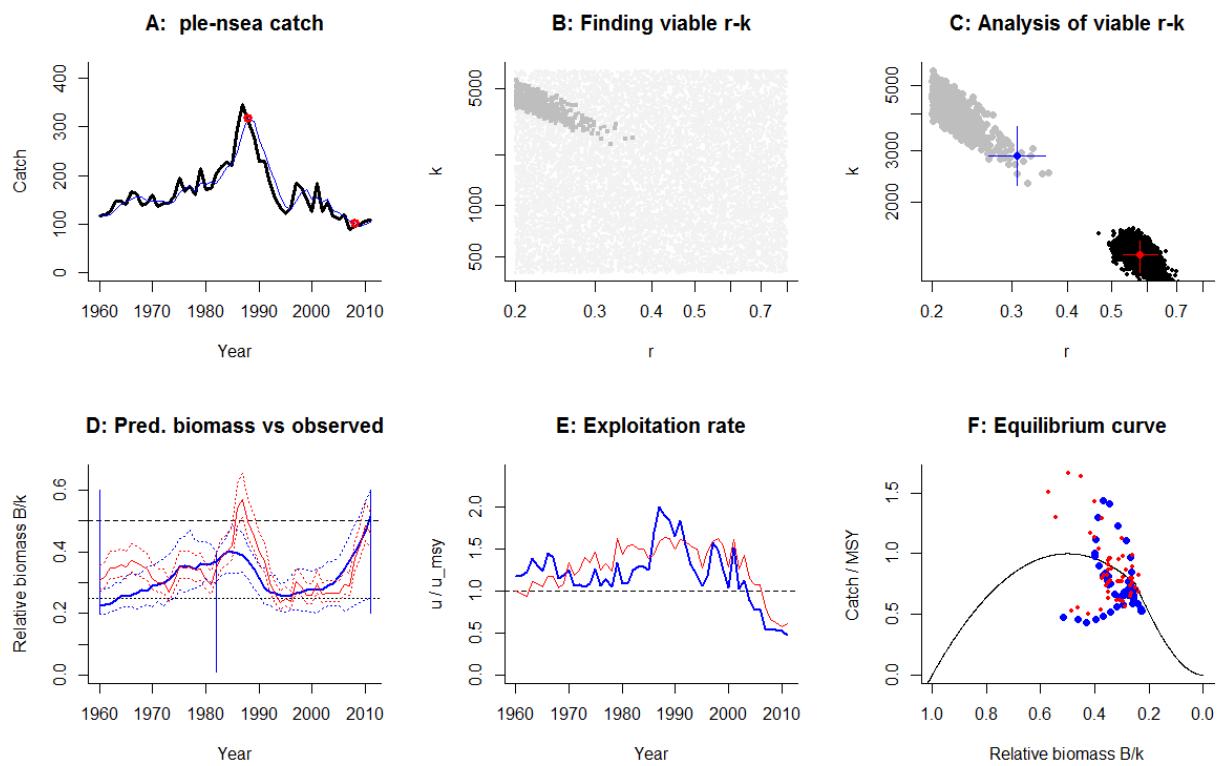
Species: *Pollachius virens* , stock: sai-3a46
 Name and region: Saithe in Subarea IV (North Sea) Division IIIa West and Subarea VI , ICES
 Catch data used from years 1967 - 2014 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 2000 default
 Prior final relative biomass = 0.01 - 0.4 expert
 Prior range for r = 0.2 - 0.8 default , prior range for k = 381 - 6093
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.504 , 95% CL = 0.468 - 0.557 , k = 1253 , 95% CL = 1081 - 1471
 MSY = 159 , 95% CL = 137 - 184
Biomass in last year = 324 or 0.259 k
 Exploitation rate in last year = 0.262 or 1.04 u.msy
 Results of CMSY analysis with altogether 616 viable trajectories for 566 r-k pairs
 r = 0.313 , 95% CL = 0.269 - 0.392 , k = 2395 , 95% CL = 1667 - 3208
 MSY = 188 , 95% CL = 143 - 247
Relative biomass last year= 0.222 k, 2.5th = 0.0268 , 97.5th = 0.399
Relative biomass next year= 0.239 k, 2.5th = -0.0107 , 97.5th = 0.445
Relative exploitation rate in last year= 0.977
Comment: OK

A: sai-3a46 catch

B: Finding viable r-k

C: Analysis of viable r-k

D: Pred. biomass vs observed

E: Exploitation rate

F: Equilibrium curve
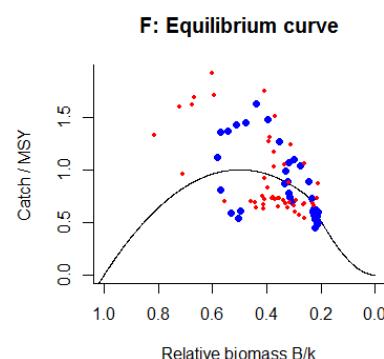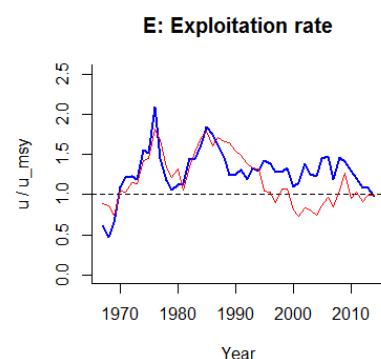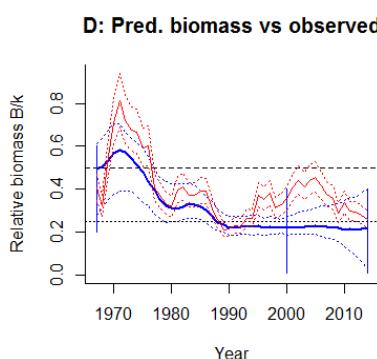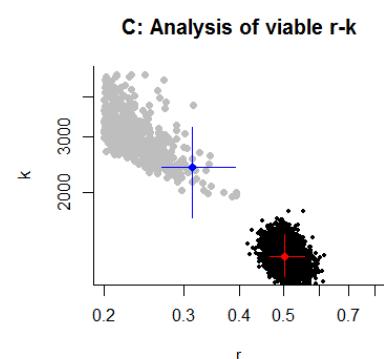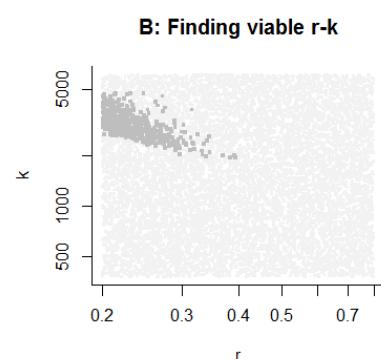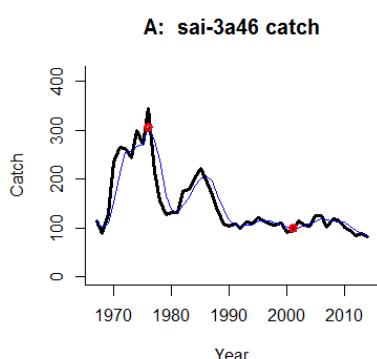
Species: *Pollachius virens* , stock: sai-arct
 Name and region: Saithe in Subareas I and II (Northeast Arctic) , ICES
 Catch data used from years 1960 - 2013 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 1986 default
 Prior final relative biomass   = 0.2 - 0.6 , default
 Prior range for r = 0.2 - 0.8 default , prior range for k = 308 - 4934
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.551 , 95% CL = 0.503 - 0.599 , k = 1280 , 95% CL = 1188 - 1391
 MSY = 176 , 95% CL = 163 - 190
Biomass in last year = 491 or 0.384 k
 Exploitation rate in last year = 0.305 or 1.11 u.msy
 Results of CMSY analysis with altogether 1099 viable trajectories for 499 r-k pairs
 r = 0.529 , 95% CL = 0.389 - 0.778 , k = 1353 , 95% CL = 882 - 1916
 MSY = 179 , 95% CL = 165 - 194
 Relative biomass last year= 0.564 k, 2.5th = 0.449 , 97.5th = 0.599
 Relative biomass next year= 0.578 k, 2.5th = 0.457 , 97.5th = 0.641
 Relative exploitation rate in last year= 0.654
 Comment: OK

A: sai-arct catch

B: Finding viable r-k

C: Analysis of viable r-k

D: Pred. biomass vs observed

E: Exploitation rate

F: Equilibrium curve
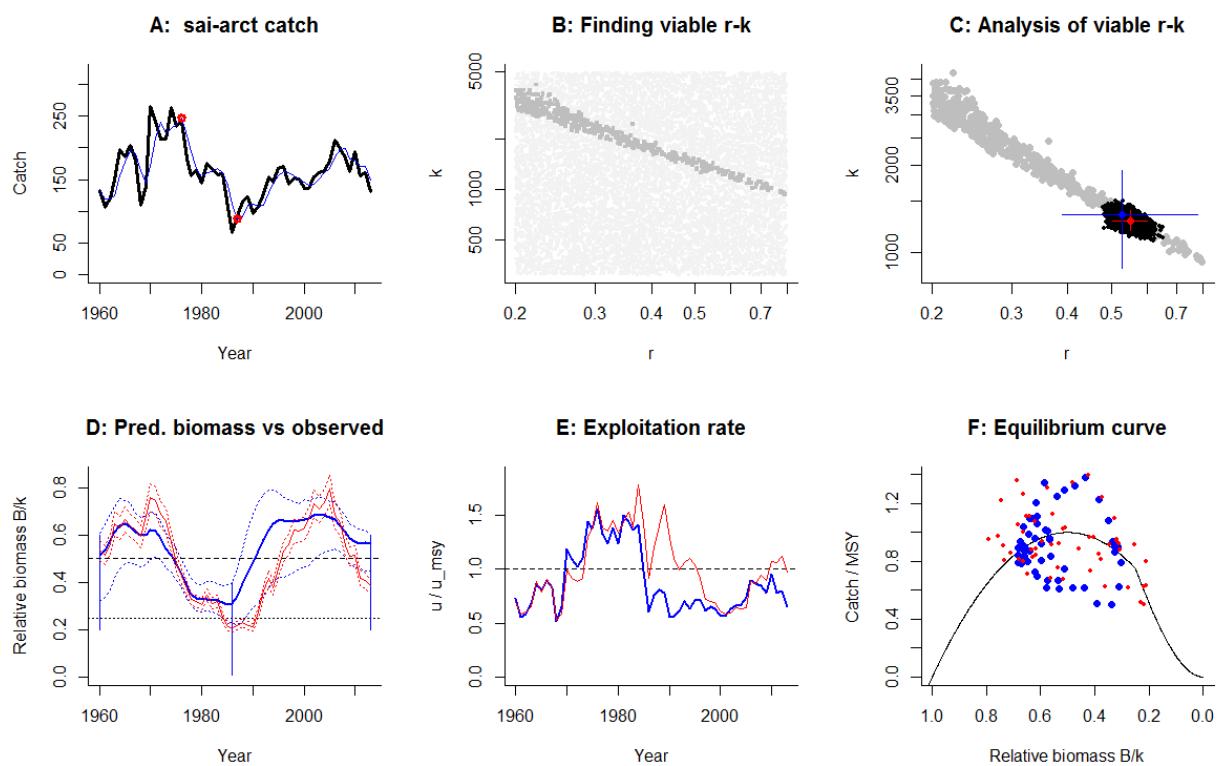
Species: *Pollachius virens* , stock: sai-faro
 Name and region: Saithe in Division Vb (Faroe Saithe) , ICES
 Catch data used from years 1961 - 2014 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.2 - 0.6 in year 2006 default
 Prior final relative biomass   = 0.2 - 0.6 , default
 Prior range for r = 0.2 - 0.8 default , prior range for k = 81.5 - 1304
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.493 , 95% CL = 0.438 - 0.534 , k = 344 , 95% CL = 314 - 385
 MSY = 42.2 , 95% CL = 37.9 - 46.9
Biomass in last year = 213 or 0.619 k
 Exploitation rate in last year = 0.134 or 0.544 u.msy
 Results of CMSY analysis with altogether 4819 viable trajectories for 803 r-k pairs
 r = 0.566 , 95% CL = 0.407 - 0.785 , k = 320 , 95% CL = 213 - 480
 MSY = 45.3 , 95% CL = 38.9 - 52.7
 Relative biomass last year= 0.368 k, 2.5th = 0.213 , 97.5th = 0.568
 Relative biomass next year= 0.408 k, 2.5th = 0.2 , 97.5th = 0.631
 Relative exploitation rate in last year= 0.716
 Comment: OK
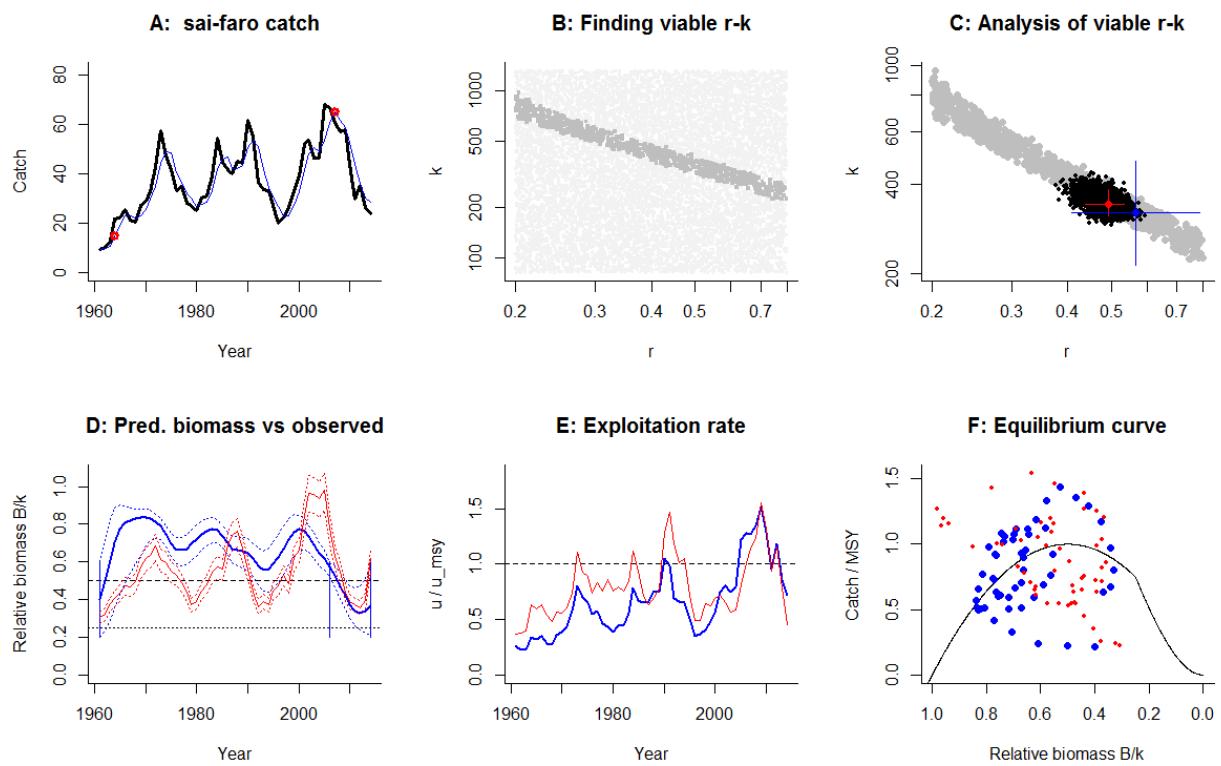
Species: *Pollachius virens* , stock: sai-icel
 Name and region: Icelandic saithe (Division Va) , ICES
 Catch data used from years 1980 - 2011 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 1999 default
 Prior final relative biomass   = 0.2 - 0.6 , default
 Prior range for r = 0.2 - 0.8 default , prior range for k = 118 - 1886
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.477 , 95% CL = 0.414 - 0.522 , k = 550 , 95% CL = 478 - 665
 MSY = 65.2 , 95% CL = 57.7 - 76.5
Biomass in last year = 234 or 0.426 k
 Exploitation rate in last year = 0.238 or 0.995 u.msy
 Results of CMSY analysis with altogether 1897 viable trajectories for 930 r-k pairs
 r = 0.533 , 95% CL = 0.391 - 0.77 , k = 503 , 95% CL = 323 - 738
 MSY = 67 , 95% CL = 58 - 77.5
 Relative biomass last year= 0.545 k, 2.5th = 0.291 , 97.5th = 0.597
 Relative biomass next year= 0.559 k, 2.5th = 0.279 , 97.5th = 0.634
 Relative exploitation rate in last year= 0.7
 Comment: OK

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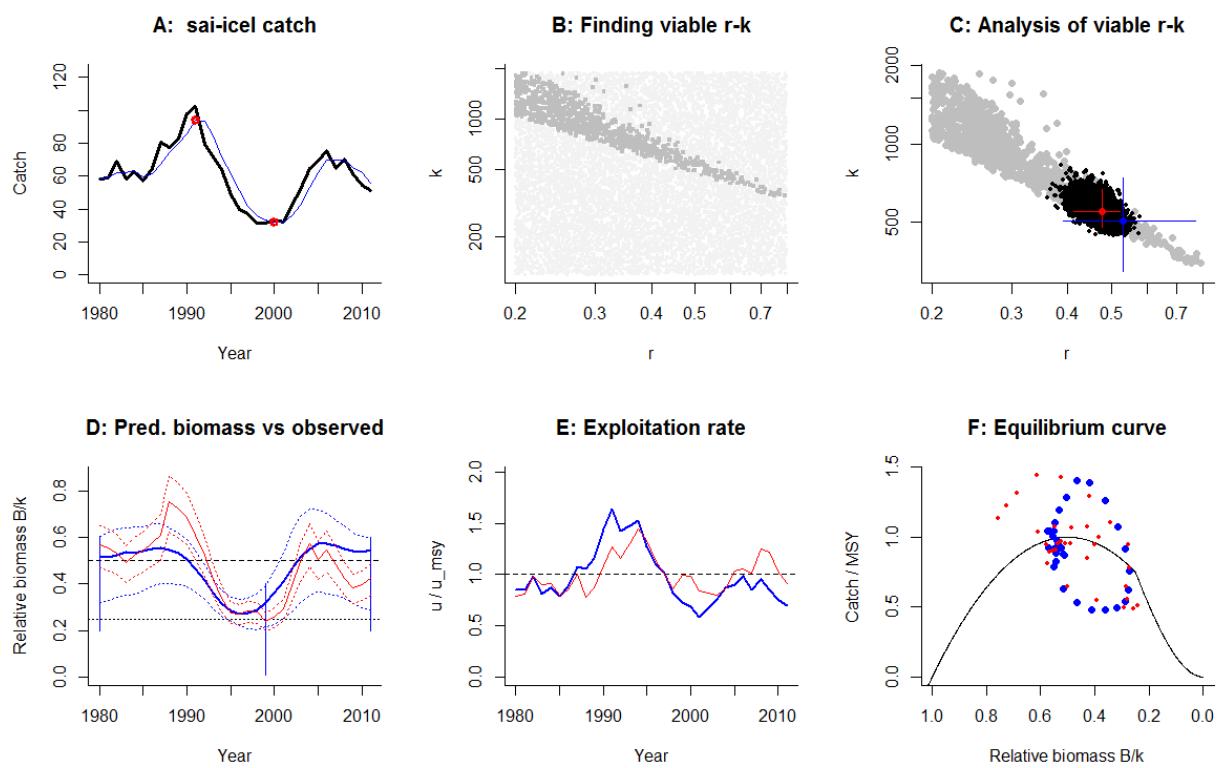
Species: *Ammodytes tobianus* , stock: san-ns1
 Name and region: Sandeel in the Dogger Bank area (SA 1) , ICES
 Catch data used from years 1983 - 2014 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 2004 default
 Prior final relative biomass   = 0.01 - 0.4 , default
 Prior range for r = 0.6 - 1.5 default , prior range for k = 310 - 3097
Results from Bayesian Schaefer model using catch & observed biomass
 r = 1.06 , 95% CL = 0.984 - 1.17 , k = 1406 , 95% CL = 1264 - 1593
 MSY = 373 , 95% CL = 335 - 425
Biomass in last year = 351 or 0.249 k
 Exploitation rate in last year = 0.314 or 0.596 u.msy
 Results of CMSY analysis with altogether 274 viable trajectories for 267 r-k pairs
 r = 0.995 , 95% CL = 0.829 - 1.42 , k = 1482 , 95% CL = 967 - 1910
 MSY = 369 , 95% CL = 321 - 424
Relative biomass last year= 0.312 k, 2.5th = 0.0499 , 97.5th = 0.398
Relative biomass next year= 0.442 k, 2.5th = -0.0218 , 97.5th = 0.61
Relative exploitation rate in last year= 0.33
Comment: OK. Fit could be improved by setting intbio Medium in 2010.
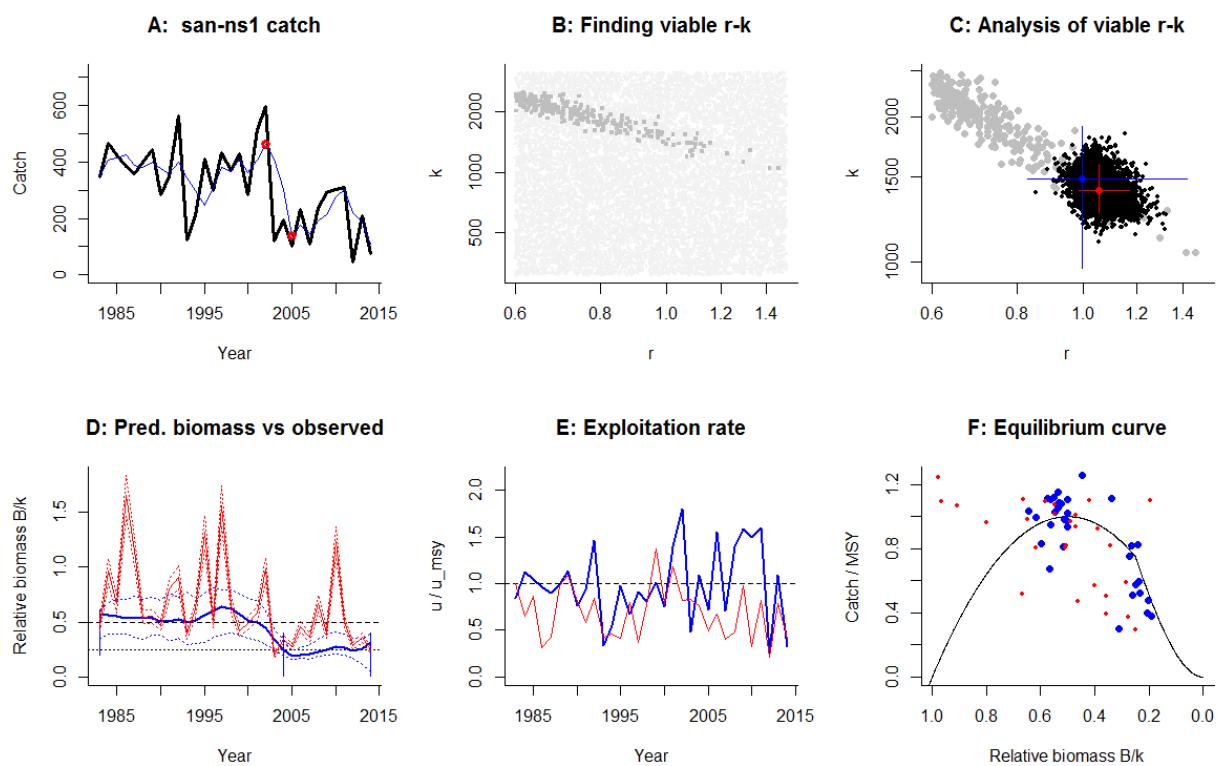
Species: *Ammodytes tobianus* , stock: san-ns2
Name and region: Sandeel in the South Eastern North Sea (SA 2) , ICES
Catch data used from years 1985 - 2014 , biomass = observed
Prior initial relative biomass = 0.2 - 0.6 default
Prior intermediate rel. biomass= 0.01 - 0.4 in year 2008 default
Prior final relative biomass = 0.2 - 0.6 expert
Prior range for r = 0.6 - 1.5 default , prior range for k = 73.6 - 736
Results from Bayesian Schaefer model using catch & observed biomass
r = 1.04 , 95% CL = 0.94 - 1.12 , k = 434 , 95% CL = 380 - 494
MSY = 113 , 95% CL = 95.6 - 131
Biomass in last year = 174 or 0.402 k
Exploitation rate in last year = 0.0771 or 0.148 u.msy
Results of CMSY analysis with altogether 19 viable trajectories for 19 r-k pairs
r = 0.896 , 95% CL = 0.755 - 1.02 , k = 380 , 95% CL = 309 - 488
MSY = 85.1 , 95% CL = 72.9 - 99.4
Relative biomass last year= 0.503 k, 2.5th = 0.362 , 97.5th = 0.581
Relative biomass next year= 0.675 k, 2.5th = 0.526 , 97.5th = 0.823
Relative exploitation rate in last year= 0.101
Comment: OK. Fit could be improved by setting intbio High in 1995.

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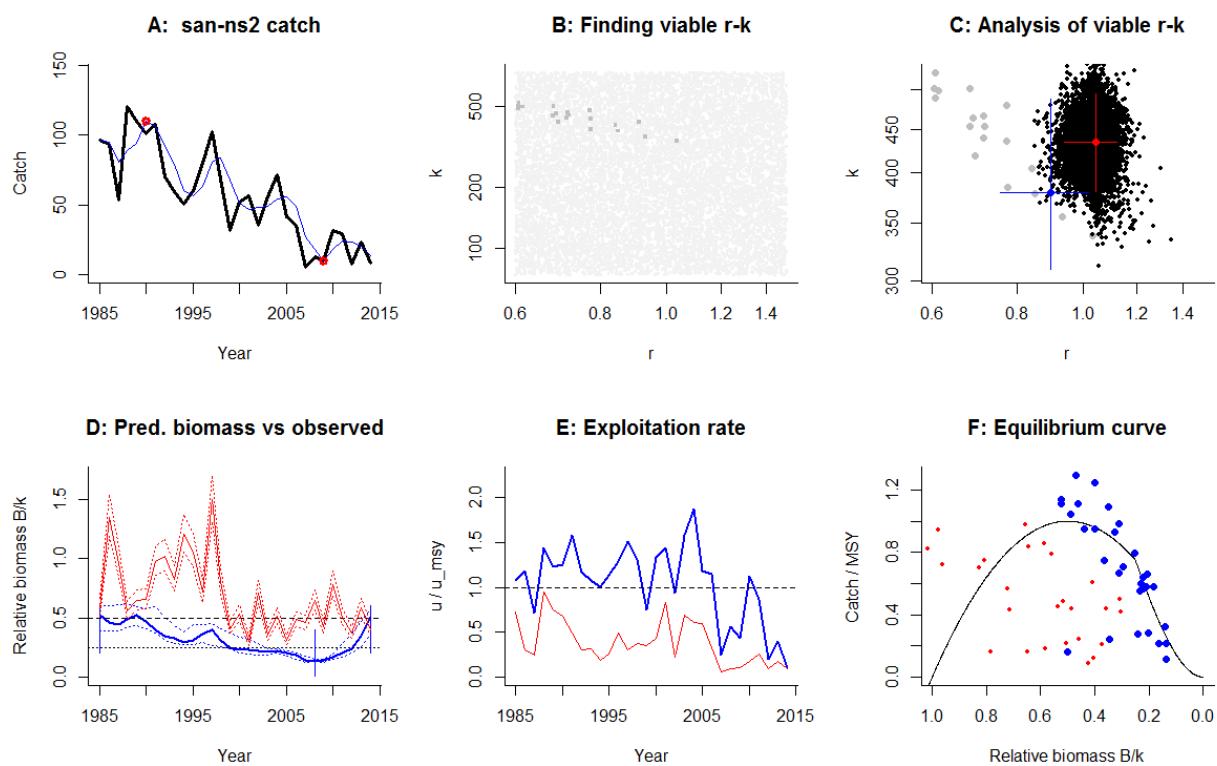
Species: *Ammodytes tobianus* , stock: san-ns3
 Name and region: Sandeel in the Central Eastern North Sea (SA 3) , ICES
 Catch data used from years 1983 - 2014 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 2005 default
 Prior final relative biomass   = 0.2 - 0.6 expert
 Prior range for r = 0.6 - 1.5 default , prior range for k = 300 - 3002
Results from Bayesian Schaefer model using catch & observed biomass
 r = 1.05 , 95% CL = 0.978 - 1.13 , k = 1210 , 95% CL = 1114 - 1307
 MSY = 318 , 95% CL = 299 - 336
Biomass in last year = 535 or 0.442 k
 Exploitation rate in last year = 0.142 or 0.271 u.msy
 Results of CMSY analysis with altogether 359 viable trajectories for 352 r-k pairs
 r = 1.05 , 95% CL = 0.851 - 1.38 , k = 1262 , 95% CL = 890 - 1675
 MSY = 331 , 95% CL = 286 - 383
 Relative biomass last year= 0.387 k, 2.5th = 0.208 , 97.5th = 0.575
 Relative biomass next year= 0.579 k, 2.5th = 0.277 , 97.5th = 0.798
 Relative exploitation rate in last year= 0.564
 Comment: OK
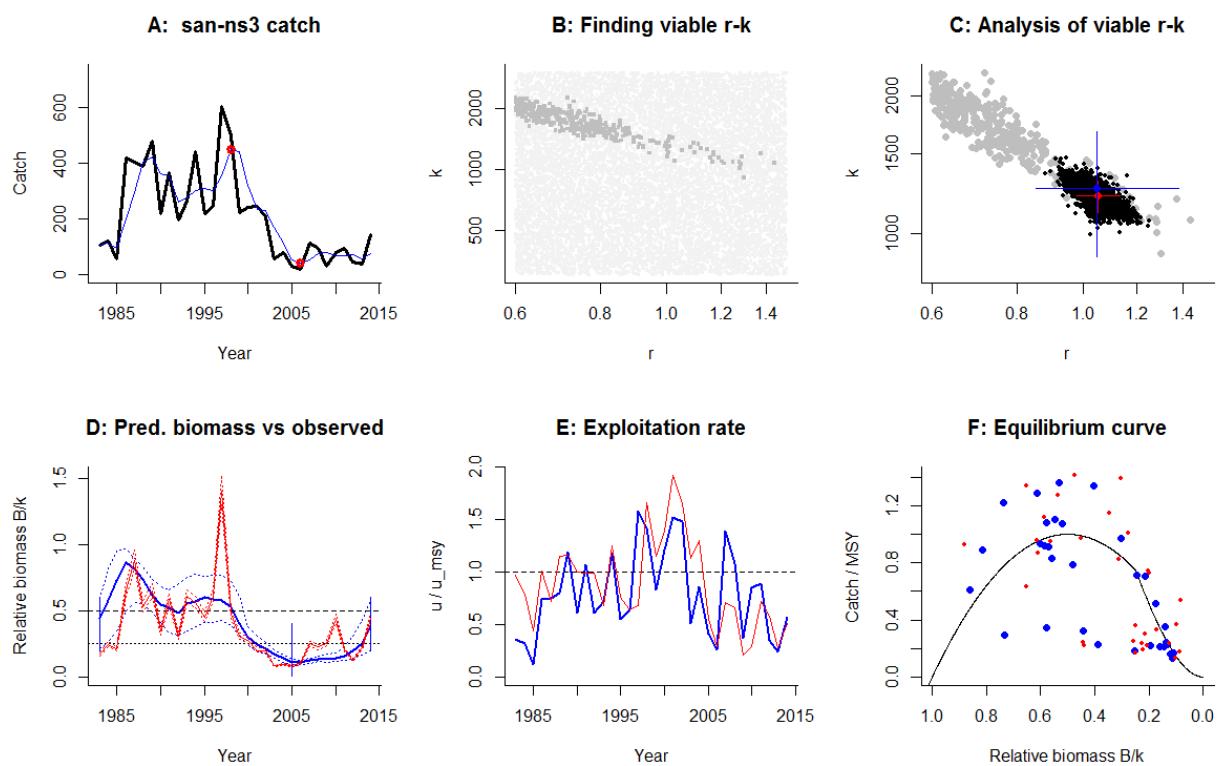
Species: *Sardina pilchardus* , stock: sar-soth
 Name and region: Sardine in Divisions VIIIc and IXa , ICES
 Catch data used from years 1978 - 2014 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 2010 default
 Prior final relative biomass   = 0.01 - 0.4 , default
 Prior range for r = 0.2 - 0.8 default , prior range for k = 258 - 4127
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.509 , 95% CL = 0.465 - 0.591 , k = 1028 , 95% CL = 842 - 1275
 MSY = 133 , 95% CL = 107 - 165
Biomass in last year = 123 or 0.12 k
 Exploitation rate in last year = 0.349 or 1.37 u.msy
 Results of CMSY analysis with altogether 1643 viable trajectories for 1447 r-k pairs
 r = 0.399 , 95% CL = 0.32 - 0.565 , k = 1673 , 95% CL = 980 - 2505
 MSY = 167 , 95% CL = 116 - 240
 Relative biomass last year= 0.228 k, 2.5th = 0.0285 , 97.5th = 0.387
 Relative biomass next year= 0.264 k, 2.5th = 0.00843 , 97.5th = 0.45
 Relative exploitation rate in last year= 0.368
 Comment: OK. Fit could be improved by setting startbio Low and intbio High in 1995.

A: sar-soth catch

B: Finding viable r-k

C: Analysis of viable r-k

D: Pred. biomass vs observed

E: Exploitation rate

F: Equilibrium curve
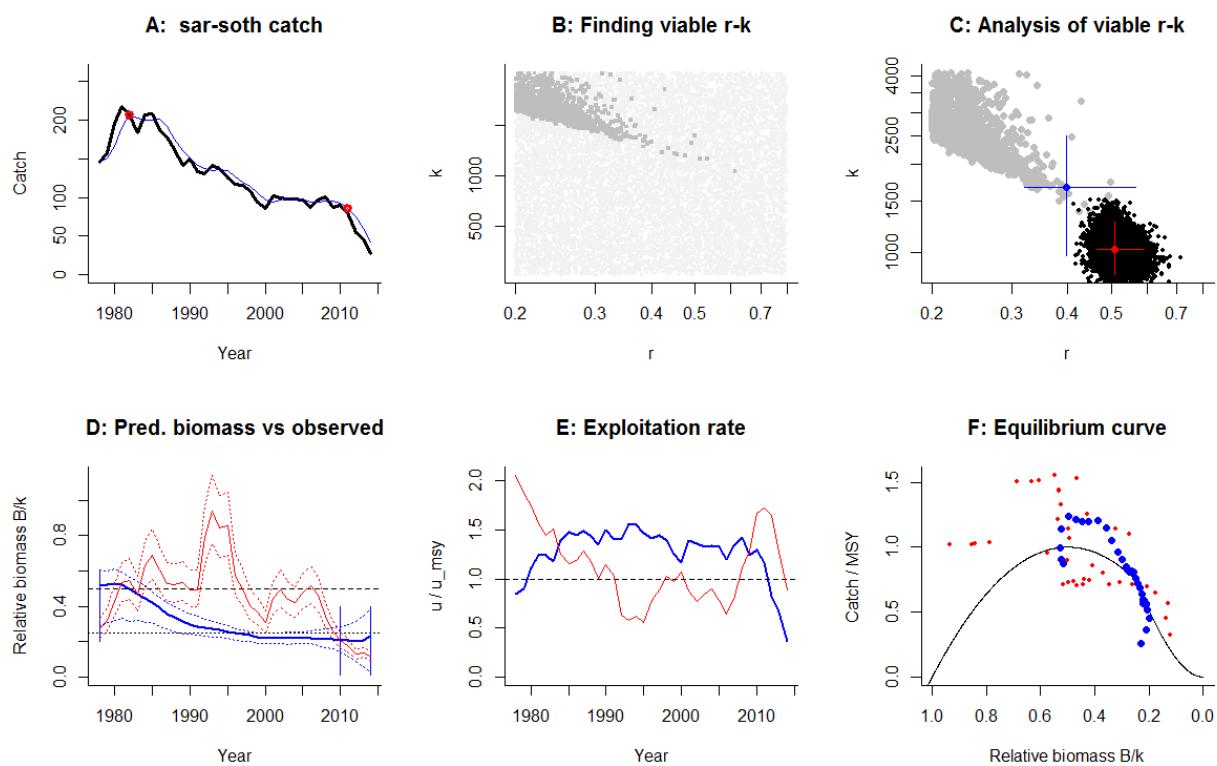
Species: Sebastes *mentella* , stock: smn-con
 Name and region: Beaked redfish in Subarea XIV and Division Va (Icelandic slope stock) (East of Greenland, Iceland grounds) , ICES
 Catch data used from years 2000 - 2014 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 2010 default
 Prior final relative biomass   = 0.2 - 0.6 , default
 Prior range for r = 0.05 - 0.5 default , prior range for k = 62.8 - 2511
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.273 , 95% CL = 0.236 - 0.308 , k = 307 , 95% CL = 241 - 411
 MSY = 20.9 , 95% CL = 16.6 - 28.1
Biomass in last year = 104 or 0.34 k
 Exploitation rate in last year = 0.0966 or 0.707 u.msy
 Results of CMSY analysis with altogether 11247 viable trajectories for 4276 r-k pairs
 r = 0.282 , 95% CL = 0.163 - 0.487 , k = 420 , 95% CL = 156 - 1134
 MSY = 29.6 , 95% CL = 12.3 - 71.2
Relative biomass last year= 0.382 k, 2.5th = 0.211 , 97.5th = 0.562
Relative biomass next year= 0.414 k, 2.5th = 0.215 , 97.5th = 0.624
Relative exploitation rate in last year= 0.42
Comment: OK. Resilience changed from Very low to Low.
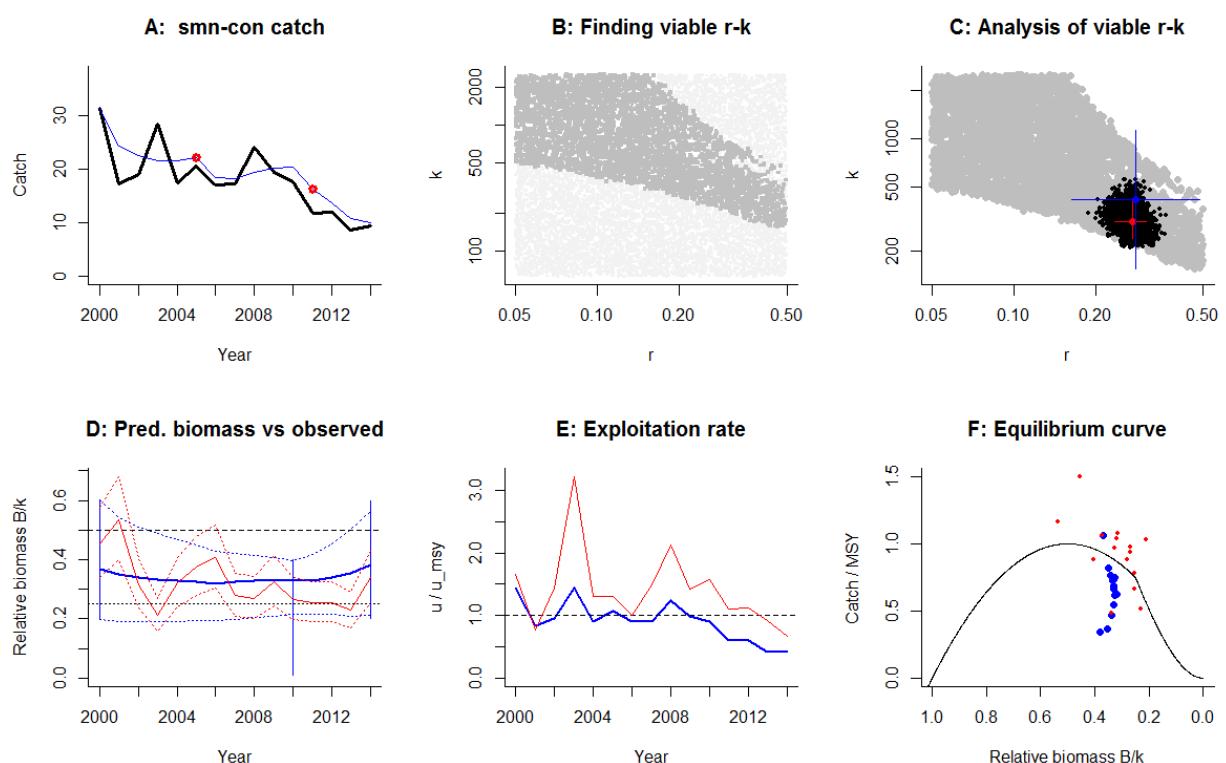
Species: *Solea solea* , stock: sol-bisc
 Name and region: Sole in Divisions VIIIa,b (Bay of Biscay) , ICES
 Catch data used from years 1984 - 2014 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 2009 default
 Prior final relative biomass   = 0.2 - 0.6 , default
 Prior range for r = 0.2 - 0.8 default , prior range for k = 8.42 - 135
 Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.507 , 95% CL = 0.466 - 0.576 , k = 42.5 , 95% CL = 35.6 - 50.7
 MSY = 5.41 , 95% CL = 4.85 - 6.13
Biomass in last year = 14.4 or 0.338 k
 Exploitation rate in last year = 0.29 or 1.14 u.msy
 Results of CMSY analysis with altogether 1547 viable trajectories for 854 r-k pairs
 r = 0.546 , 95% CL = 0.395 - 0.785 , k = 40.6 , 95% CL = 26.3 - 60.3
 MSY = 5.55 , 95% CL = 4.83 - 6.37
 Relative biomass last year= 0.428 k, 2.5th = 0.215 , 97.5th = 0.575
 Relative biomass next year= 0.457 k, 2.5th = 0.197 , 97.5th = 0.607
 Relative exploitation rate in last year= 0.829
 Comment: OK
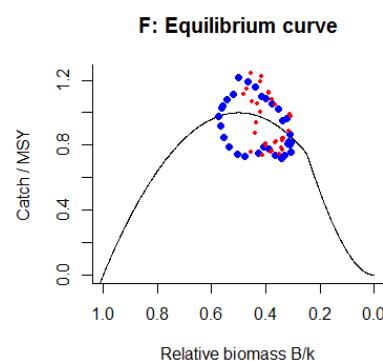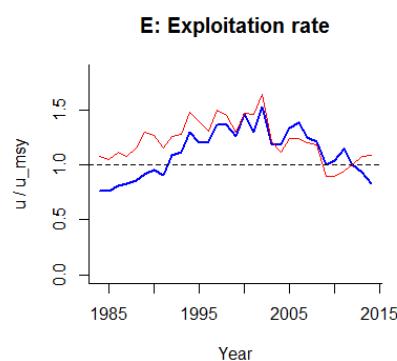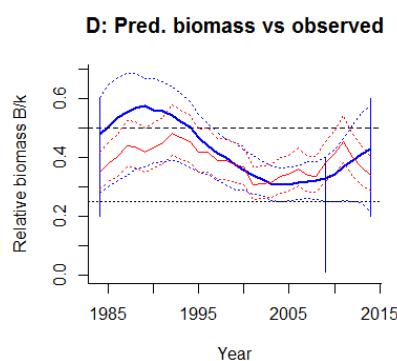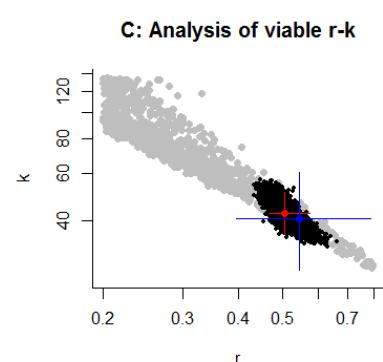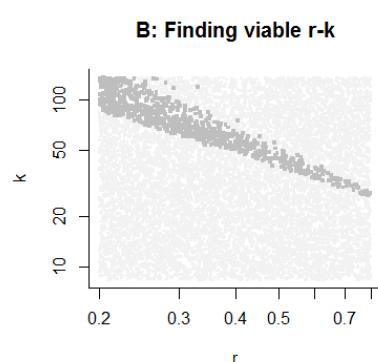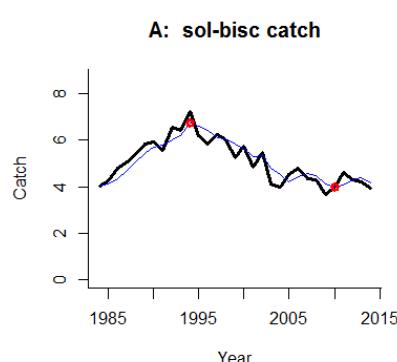
Species: *Solea solea* , stock: sol-celt
 Name and region: Sole in Divisions VIIf, g (Celtic Sea) , ICES
 Catch data used from years 1971 - 2014 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 2009 default
 Prior final relative biomass   = 0.2 - 0.6 , default
 Prior range for r = 0.2 - 0.8 default , prior range for k = 2.33 - 37.2
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.487 , 95% CL = 0.421 - 0.531 , k = 9.68 , 95% CL = 8.53 - 11.8
 MSY = 1.17 , 95% CL = 1.06 - 1.34
Biomass in last year = 4 or 0.413 k
 Exploitation rate in last year = 0.27 or 1.11 u.msy
 Results of CMSY analysis with altogether 2188 viable trajectories for 1627 r-k pairs
 r = 0.505 , 95% CL = 0.377 - 0.712 , k = 9.42 , 95% CL = 6.34 - 13.3
 MSY = 1.19 , 95% CL = 1.07 - 1.32
 Relative biomass last year= 0.427 k, 2.5th = 0.234 , 97.5th = 0.553
 Relative biomass next year= 0.43 k, 2.5th = 0.204 , 97.5th = 0.573
 Relative exploitation rate in last year= 1.03
 Comment: OK

A: sol-celt catch

B: Finding viable r-k

C: Analysis of viable r-k

D: Pred. biomass vs observed

E: Exploitation rate

F: Equilibrium curve
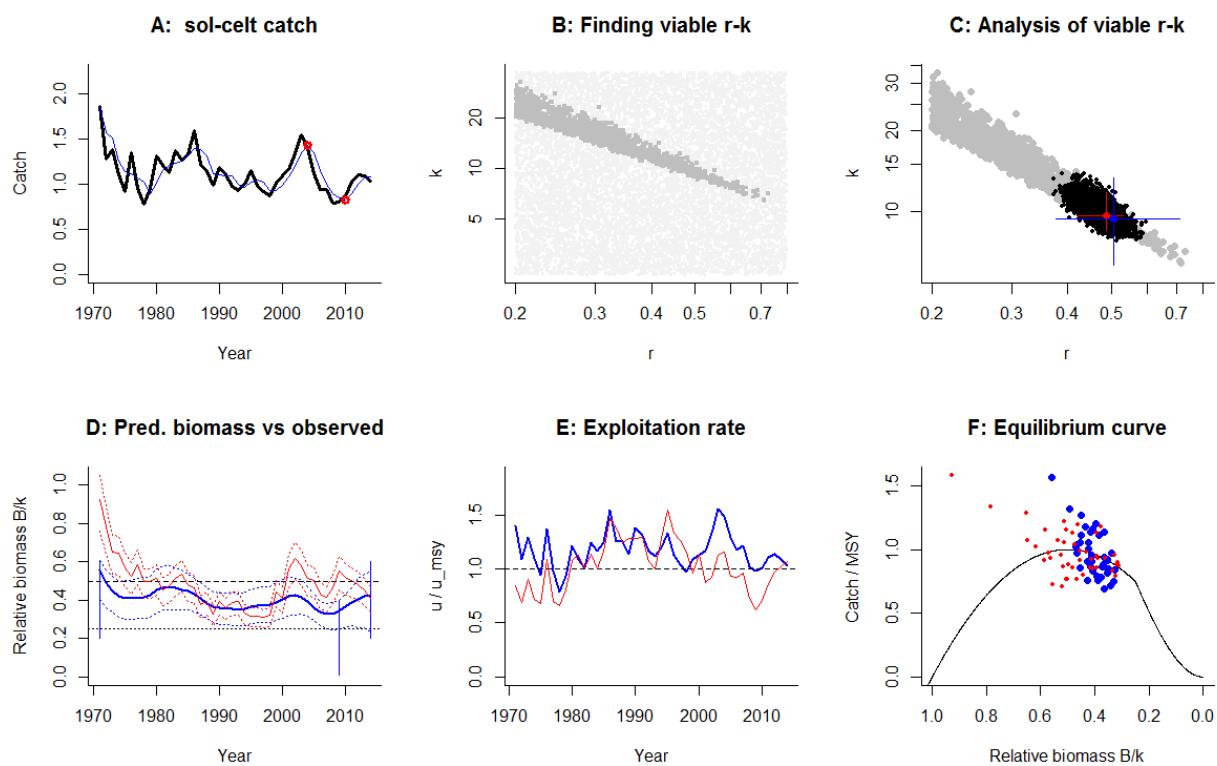
Species: *Solea solea* , stock: sol-eche
 Name and region: Sole in Division VIId (Eastern Channel) , ICES
 Catch data used from years 1982 - 2013 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.2 - 0.6 in year 1997 default
 Prior final relative biomass = 0.2 - 0.6 expert
 Prior range for r = 0.2 - 0.8 default , prior range for k = 6.23 - 99.7
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.517 , 95% CL = 0.476 - 0.6 , k = 33.5 , 95% CL = 28.8 - 39.4
 MSY = 4.39 , 95% CL = 3.92 - 4.92
Biomass in last year = 14.7 or 0.437 k
 Exploitation rate in last year = 0.286 or 1.1 u.msy
 Results of CMSY analysis with altogether 5147 viable trajectories for 1300 r-k pairs
 r = 0.566 , 95% CL = 0.407 - 0.785 , k = 31.6 , 95% CL = 21 - 47.5
 MSY = 4.47 , 95% CL = 3.82 - 5.23
 Relative biomass last year= 0.458 k, 2.5th = 0.218 , 97.5th = 0.593
 Relative biomass next year= 0.465 k, 2.5th = 0.162 , 97.5th = 0.612
 Relative exploitation rate in last year= 1.07
 Comment: OK
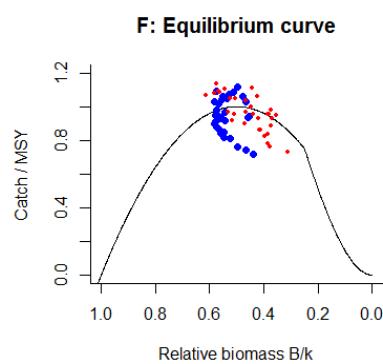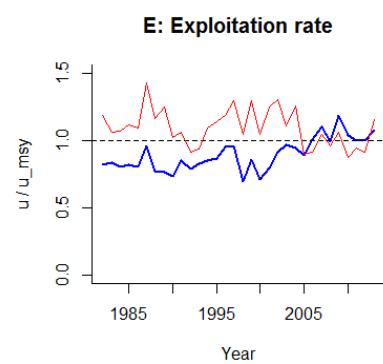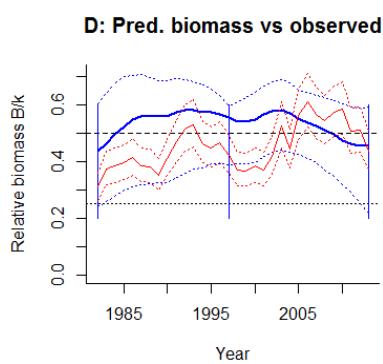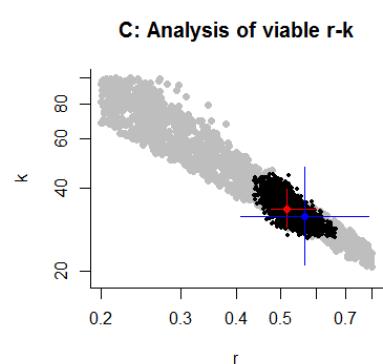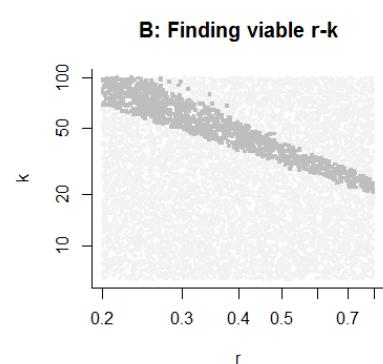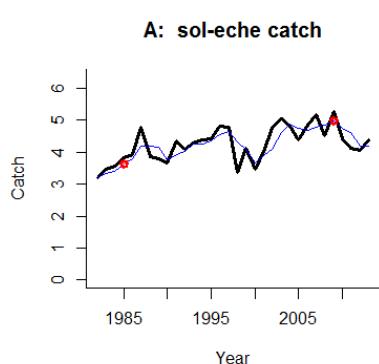
Species: *Solea solea* , stock: sol-echw
 Name and region: Sole in Division VIIe (Western Channel) , ICES
 Catch data used from years 1969 - 2014 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.5 - 0.9 in year 1983 default
 Prior final relative biomass = 0.2 - 0.6 , default
 Prior range for r = 0.2 - 0.8 default , prior range for k = 1.79 - 28.7
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.479 , 95% CL = 0.413 - 0.522 , k = 8.63 , 95% CL = 7.79 - 10
 MSY = 1.03 , 95% CL = 0.944 - 1.12
Biomass in last year = 5.62 or 0.651 k
 Exploitation rate in last year = 0.156 or 0.654 u.msy
 Results of CMSY analysis with altogether 5394 viable trajectories for 1388 r-k pairs
 r = 0.537 , 95% CL = 0.393 - 0.773 , k = 8.04 , 95% CL = 5.35 - 11.5
 MSY = 1.08 , 95% CL = 0.993 - 1.17
 Relative biomass last year= 0.507 k, 2.5th = 0.254 , 97.5th = 0.597
 Relative biomass next year= 0.529 k, 2.5th = 0.248 , 97.5th = 0.626
 Relative exploitation rate in last year= 0.808
 Comment: OK
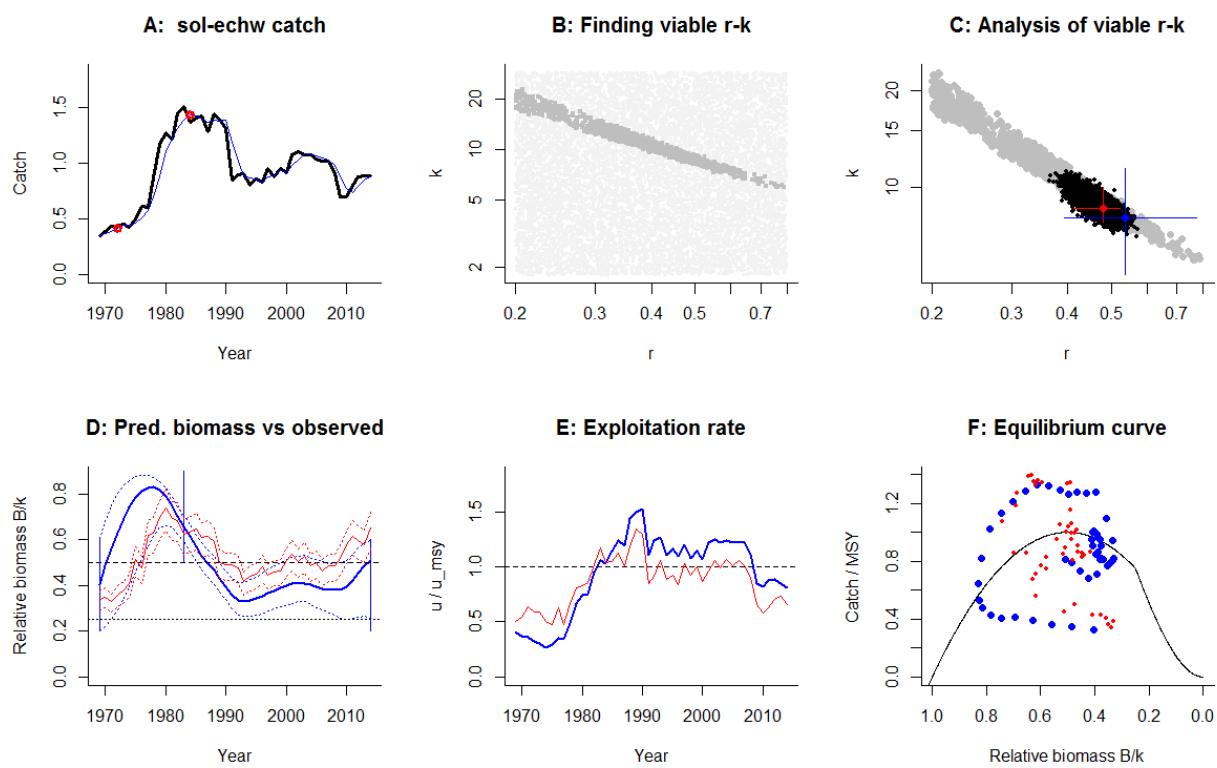
Species: *Solea solea* , stock: sol-iris
 Name and region: Sole in Division VIIa (Irish Sea) , ICES
 Catch data used from years 1970 - 2014 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 2010 default
 Prior final relative biomass   = 0.01 - 0.4 , default
 Prior range for r = 0.2 - 0.8 default , prior range for k = 2.83 - 45.3
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.473 , 95% CL = 0.412 - 0.516 , k = 12.6 , 95% CL = 10.6 - 15.8
 MSY = 1.48 , 95% CL = 1.25 - 1.83
Biomass in last year = 1.02 or 0.0811 k
 Exploitation rate in last year = 0.177 or 0.75 u.msy
 Results of CMSY analysis with altogether 843 viable trajectories for 784 r-k pairs
 r = 0.37 , 95% CL = 0.304 - 0.559 , k = 15.8 , 95% CL = 9.38 - 21.3
 MSY = 1.46 , 95% CL = 1.18 - 1.8
 Relative biomass last year= 0.185 k, 2.5th = 0.0186 , 97.5th = 0.395
 Relative biomass next year= 0.208 k, 2.5th = 0.0102 , 97.5th = 0.462
 Relative exploitation rate in last year= 0.184
 Comment: OK

A: sol-iris catch

B: Finding viable r-k

C: Analysis of viable r-k

D: Pred. biomass vs observed

E: Exploitation rate

F: Equilibrium curve
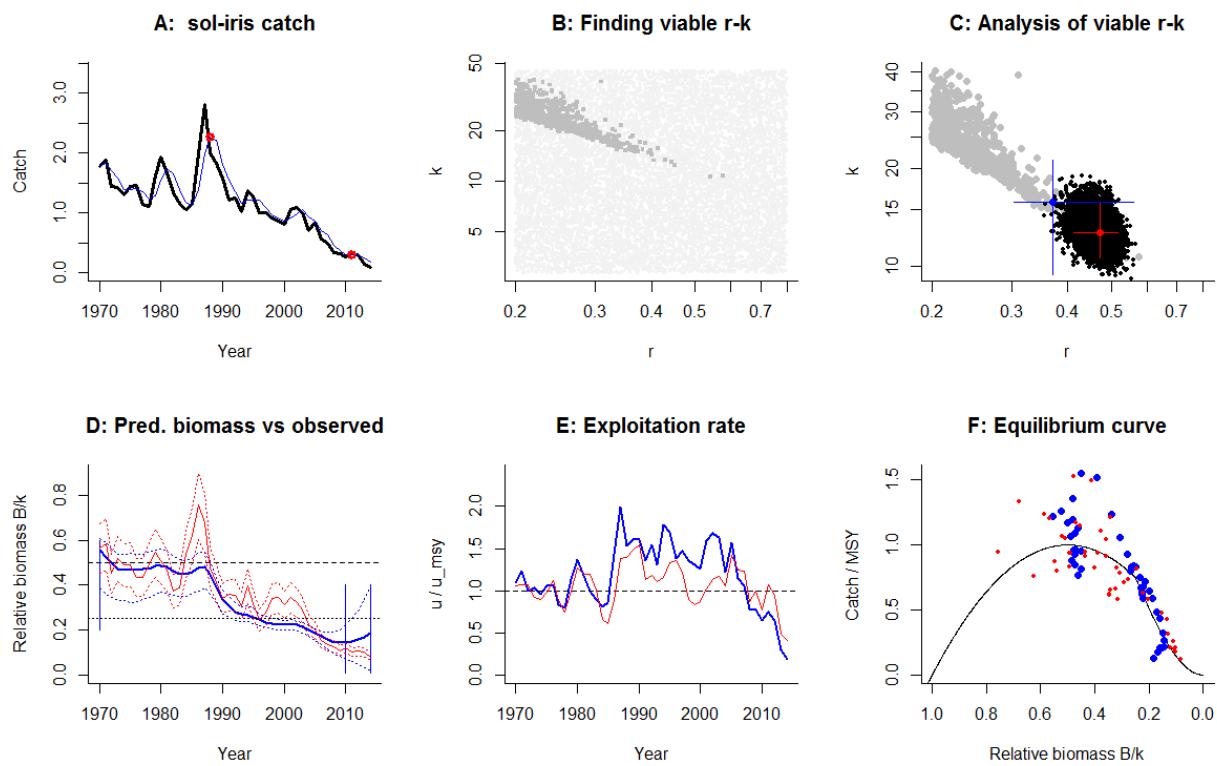
Species: *Solea solea* , stock: sol-kask
 Name and region: Sole in Division IIIa and Subdivisions 22-24 (Skagerrak, Kattegat, and the Belts) ,
ICES
 Catch data used from years 1984 - 2014 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 2010 default
 Prior final relative biomass   = 0.01 - 0.4 , default
 Prior range for r = 0.2 - 0.8 default , prior range for k = 1.64 - 26.2
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.505 , 95% CL = 0.46 - 0.58 , k = 6.1 , 95% CL = 5.34 - 7.22
 MSY = 0.78 , 95% CL = 0.67 - 0.913
Biomass in last year = 2.32 or 0.381 k
 Exploitation rate in last year = 0.147 or 0.581 u.msy
 Results of CMSY analysis with altogether 2447 viable trajectories for 1373 r-k pairs
 r = 0.517 , 95% CL = 0.383 - 0.758 , k = 6.57 , 95% CL = 4.21 - 9.42
 MSY = 0.848 , 95% CL = 0.753 - 0.957
Relative biomass last year= 0.299 k, 2.5th = 0.0175 , 97.5th = 0.396
Relative biomass next year= 0.347 k, 2.5th = -0.028 , 97.5th = 0.466
Relative exploitation rate in last year= 0.656
Comment: OK. Fit could be improved by setting intbio High in 2005.
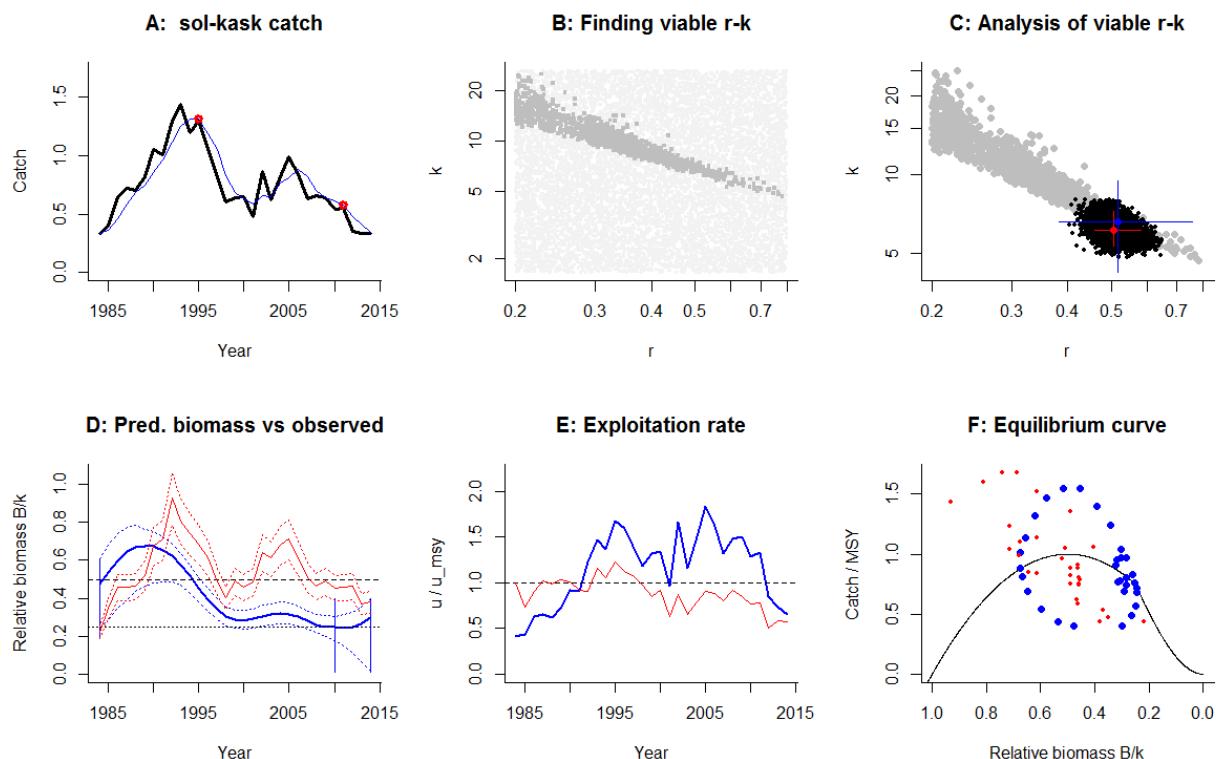
Species: *Solea solea* , stock: sol-nsea
Name and region: Sole in Subarea IV (North Sea) , ICES
Catch data used from years 1960 - 2014 , biomass = observed
Prior initial relative biomass = 0.2 - 0.6 default
Prior intermediate rel. biomass= 0.01 - 0.4 in year 2010 default
Prior final relative biomass = 0.01 - 0.4 expert
Prior range for r = 0.2 - 0.8 default , prior range for k = 54 - 863
Results from Bayesian Schaefer model using catch & observed biomass
r = 0.507 , 95% CL = 0.472 - 0.568 , k = 198 , 95% CL = 168 - 235
MSY = 25.3 , 95% CL = 21.7 - 30
Biomass in last year = 50.7 or 0.257 k
Exploitation rate in last year = 0.318 or 1.25 u.msy
Results of CMSY analysis with altogether 1779 viable trajectories for 1294 r-k pairs
r = 0.456 , 95% CL = 0.349 - 0.673 , k = 227 , 95% CL = 148 - 309
MSY = 25.9 , 95% CL = 23.9 - 28.1
Relative biomass last year= 0.23 k, 2.5th = 0.0232 , 97.5th = 0.395
Relative biomass next year= 0.225 k, 2.5th = -0.0435 , 97.5th = 0.431
Relative exploitation rate in last year= 1.07
Comment: Start year set to 1960.

A: sol-nsea catch

B: Finding viable r-k

C: Analysis of viable r-k

D: Pred. biomass vs observed

E: Exploitation rate

F: Equilibrium curve
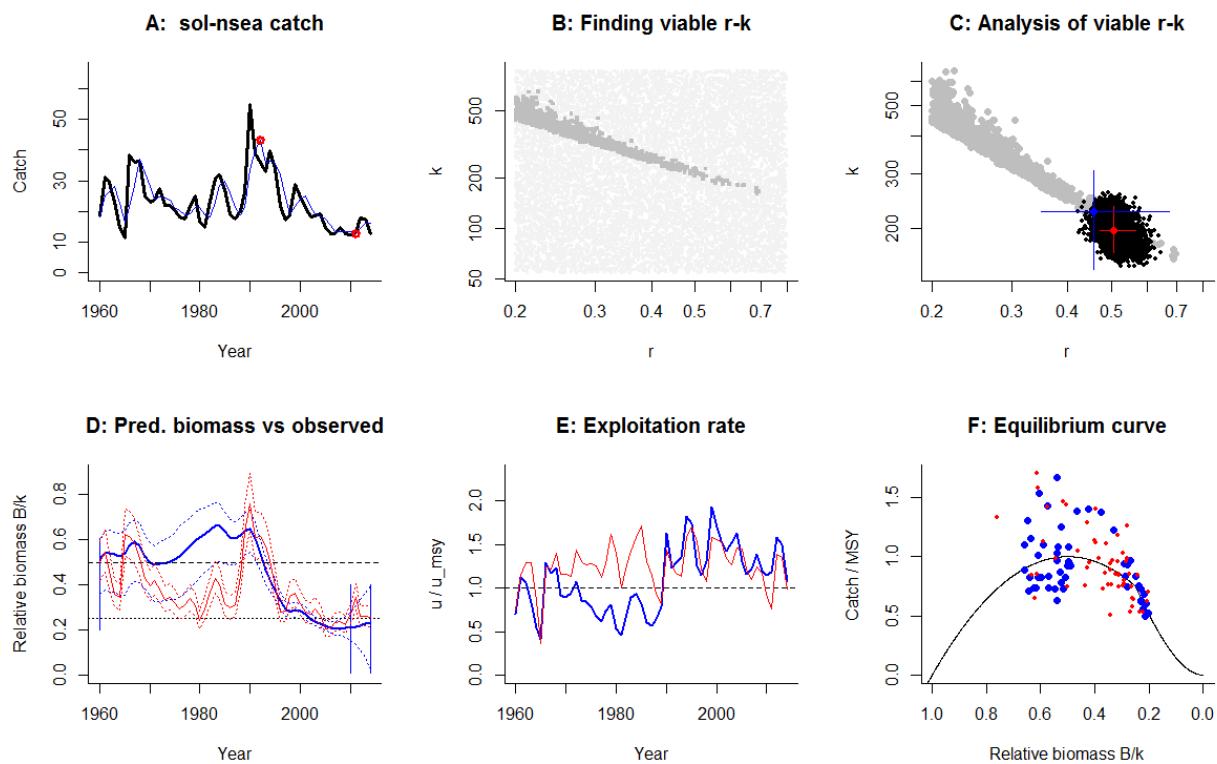
Species: *Sprattus sprattus* , stock: spr-2232
 Name and region: Sprat in Subdivisions 22 - 32 (Baltic Sea) , ICES
 Catch data used from years 1974 - 2014 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.5 - 0.9 in year 1997 default
 Prior final relative biomass   = 0.2 - 0.6 , default
 Prior range for r = 0.2 - 0.8 default , prior range for k = 600 - 9607
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.49 , 95% CL = 0.417 - 0.537 , k = 2756 , 95% CL = 2296 - 3593
 MSY = 334 , 95% CL = 268 - 432
Biomass in last year = 1360 or 0.494 k
 Exploitation rate in last year = 0.183 or 0.747 u.msy
 Results of CMSY analysis with altogether 8252 viable trajectories for 1156 r-k pairs
 r = 0.561 , 95% CL = 0.405 - 0.777 , k = 2466 , 95% CL = 1650 - 3684
 MSY = 346 , 95% CL = 298 - 402
Relative biomass last year= 0.478 k, 2.5th = 0.229 , 97.5th = 0.596
Relative biomass next year= 0.514 k, 2.5th = 0.214 , 97.5th = 0.649
Relative exploitation rate in last year= 0.738
Comment: OK
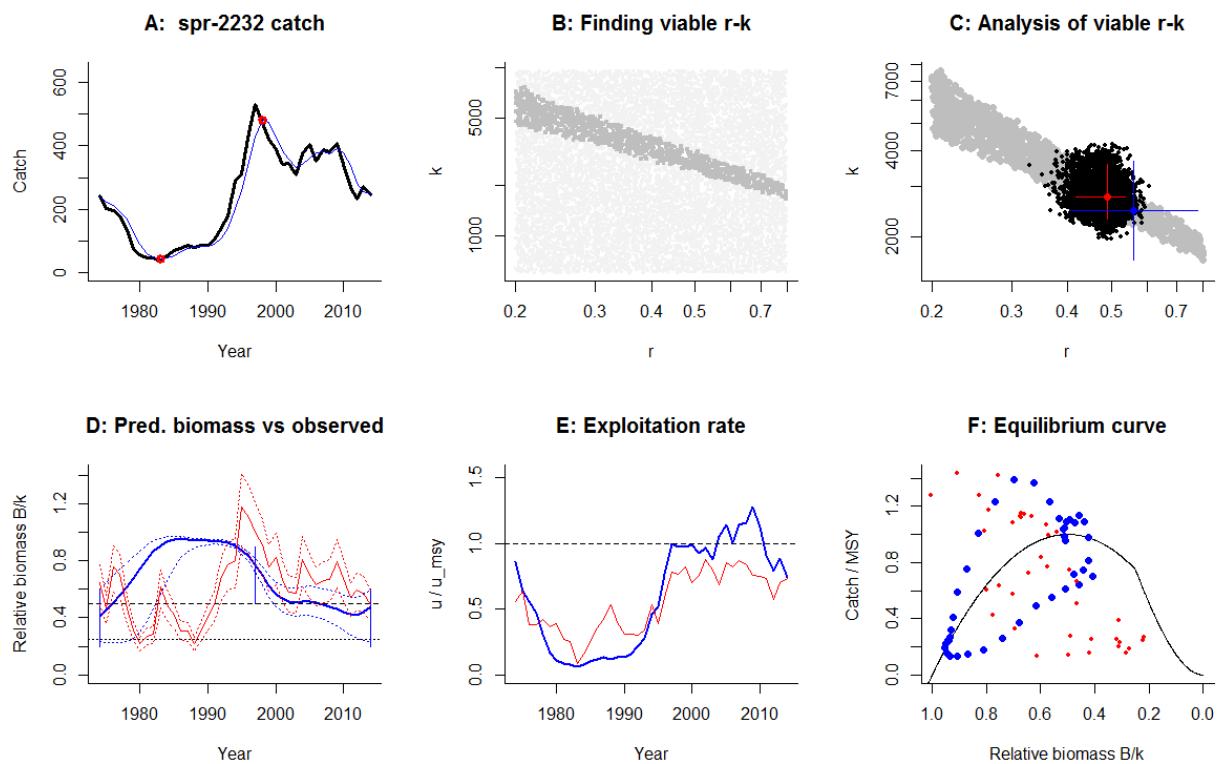
Species: *Sprattus sprattus* , stock: spr-nsea
 Name and region: Sprat in Subarea IV (North Sea) , ICES
 Catch data used from years 1974 - 2014 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 1986 default
 Prior final relative biomass   = 0.5 - 0.9 expert
 Prior range for r = 0.2 - 0.8 default , prior range for k = 1312 - 31488
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.499 , 95% CL = 0.438 - 0.563 , k = 3787 , 95% CL = 2082 - 9737
 MSY = 470 , 95% CL = 258 - 1196
Biomass in last year = 7582 or 2 k
 Exploitation rate in last year = 0.0147 or 0.0591 u.msy
 Results of CMSY analysis with altogether 2665 viable trajectories for 1477 r-k pairs
 r = 0.456 , 95% CL = 0.351 - 0.637 , k = 2794 , 95% CL = 1739 - 4177
 MSY = 319 , 95% CL = 242 - 420
 Relative biomass last year= 0.893 k, 2.5th = 0.853 , 97.5th = 0.9
 Relative biomass next year= 0.896 k, 2.5th = 0.862 , 97.5th = 0.912
 Relative exploitation rate in last year= 0.295
 Comment: OK

A: spr-nsea catch

B: Finding viable r-k

C: Analysis of viable r-k

D: Pred. biomass vs observed

E: Exploitation rate

F: Equilibrium curve
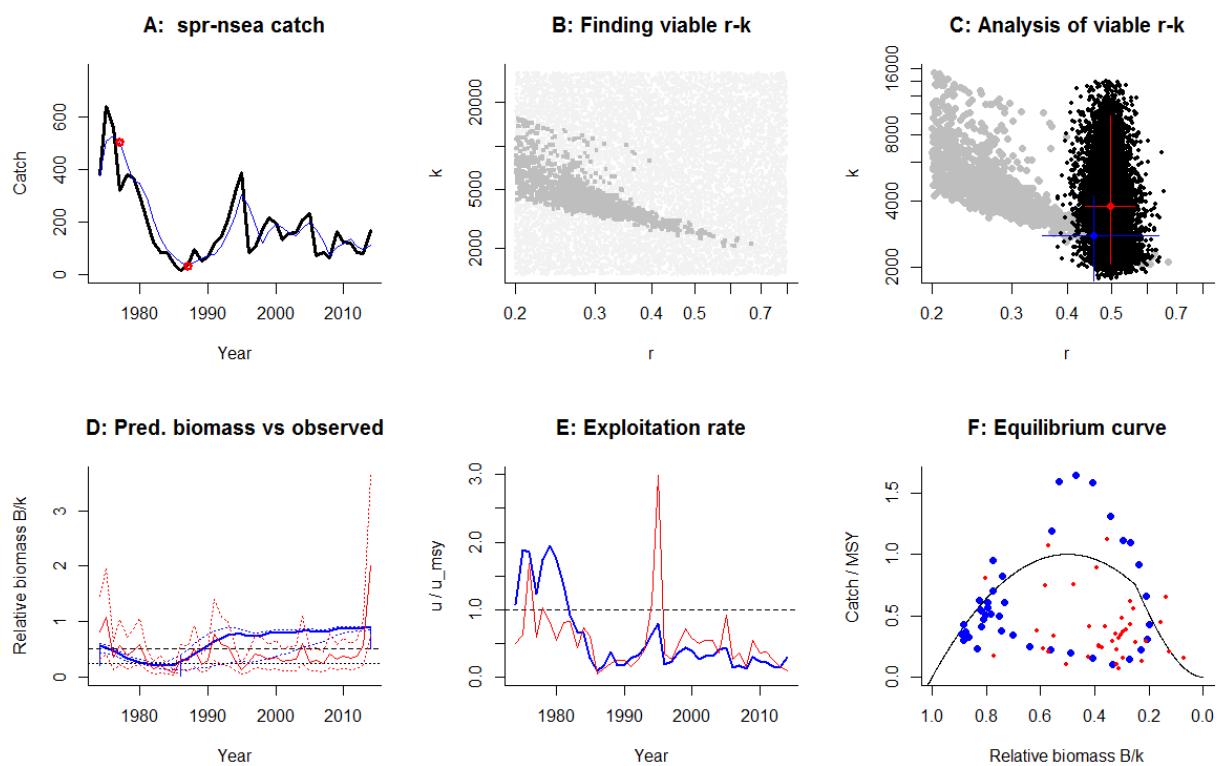
Species: *Brosme brosme* , stock: usk-icel
 Name and region: Tusk in Division Va and Subarea XIV , ICES
 Catch data used from years 1980 - 2014 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.5 - 0.9 in year 2009 default
 Prior final relative biomass   = 0.01 - 0.4 expert
 Prior range for r = 0.05 - 0.5 default , prior range for k = 16.9 - 678
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.33 , 95% CL = 0.299 - 0.372 , k = 85.4 , 95% CL = 69.7 - 100
 MSY = 7.01 , 95% CL = 6.28 - 7.88
Biomass in last year = 22 or 0.257 k
 Exploitation rate in last year = 0.304 or 1.84 u.msy
 Results of CMSY analysis with altogether 1051 viable trajectories for 606 r-k pairs
 r = 0.385 , 95% CL = 0.301 - 0.493 , k = 65.4 , 95% CL = 48.9 - 87.5
 MSY = 6.29 , 95% CL = 5.77 - 6.87
Relative biomass last year= 0.369 k, 2.5th = 0.279 , 97.5th = 0.399
Relative biomass next year= 0.356 k, 2.5th = 0.243 , 97.5th = 0.407
Relative exploitation rate in last year= 1.3
Comment: OK. Fit could be improved by setting intbio Low in 2000.
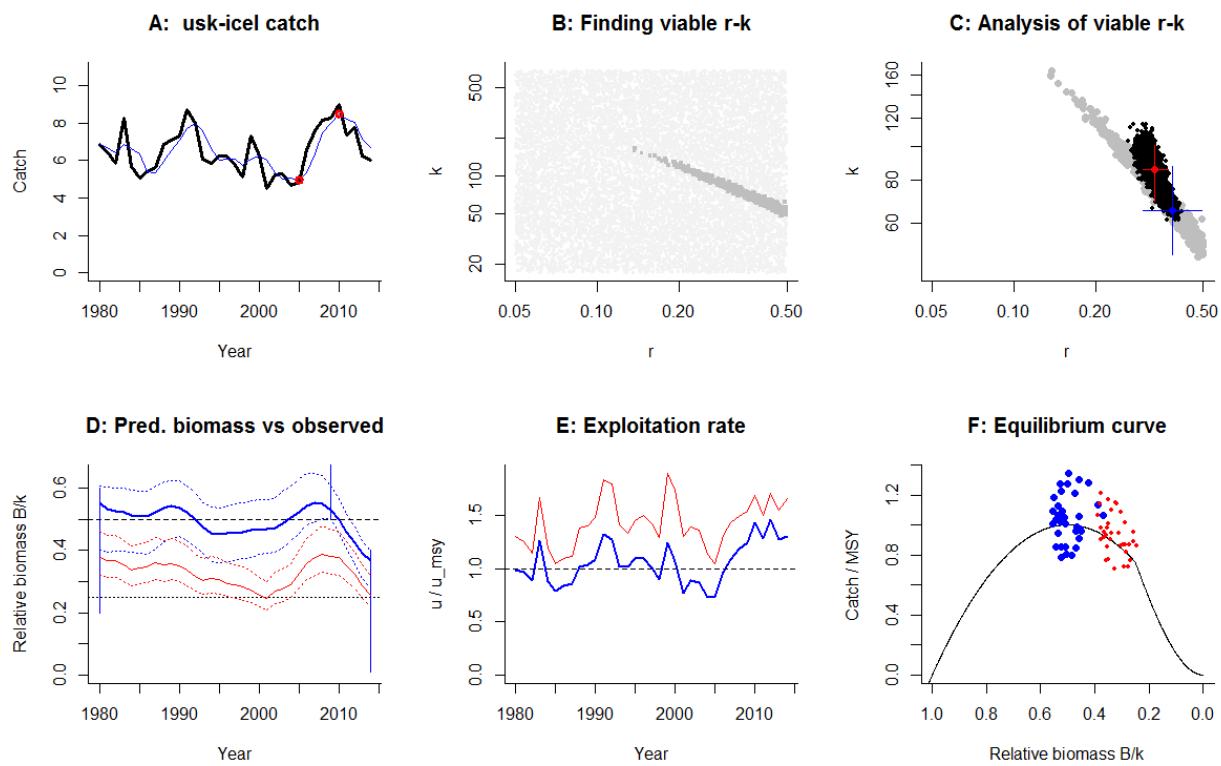
Species: *Micromesistius poutassou* , stock: whb-comb
 Name and region: Blue whiting combined stock (Sub-areas I-IX, XII & XIV) , ICES
 Catch data used from years 1981 - 2014 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 2010 default
 Prior final relative biomass   = 0.2 - 0.6 , default
 Prior range for r = 0.2 - 0.8 default , prior range for k = 2802 - 44840
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.465 , 95% CL = 0.398 - 0.515 , k = 10973 , 95% CL = 9227 - 13398
 MSY = 1269 , 95% CL = 1042 - 1554
Biomass in last year = 5315 or 0.484 k
 Exploitation rate in last year = 0.135 or 0.581 u.msy
 Results of CMSY analysis with altogether 4747 viable trajectories for 951 r-k pairs
 r = 0.557 , 95% CL = 0.403 - 0.785 , k = 9833 , 95% CL = 6425 - 14751
 MSY = 1370 , 95% CL = 1165 - 1610
Relative biomass last year= 0.492 k, 2.5th = 0.221 , 97.5th = 0.596
Relative biomass next year= 0.549 k, 2.5th = 0.228 , 97.5th = 0.671
Relative exploitation rate in last year= 0.85
Comment: OK. Fit could be improved by setting startbio Low and intbio Low in 1995.
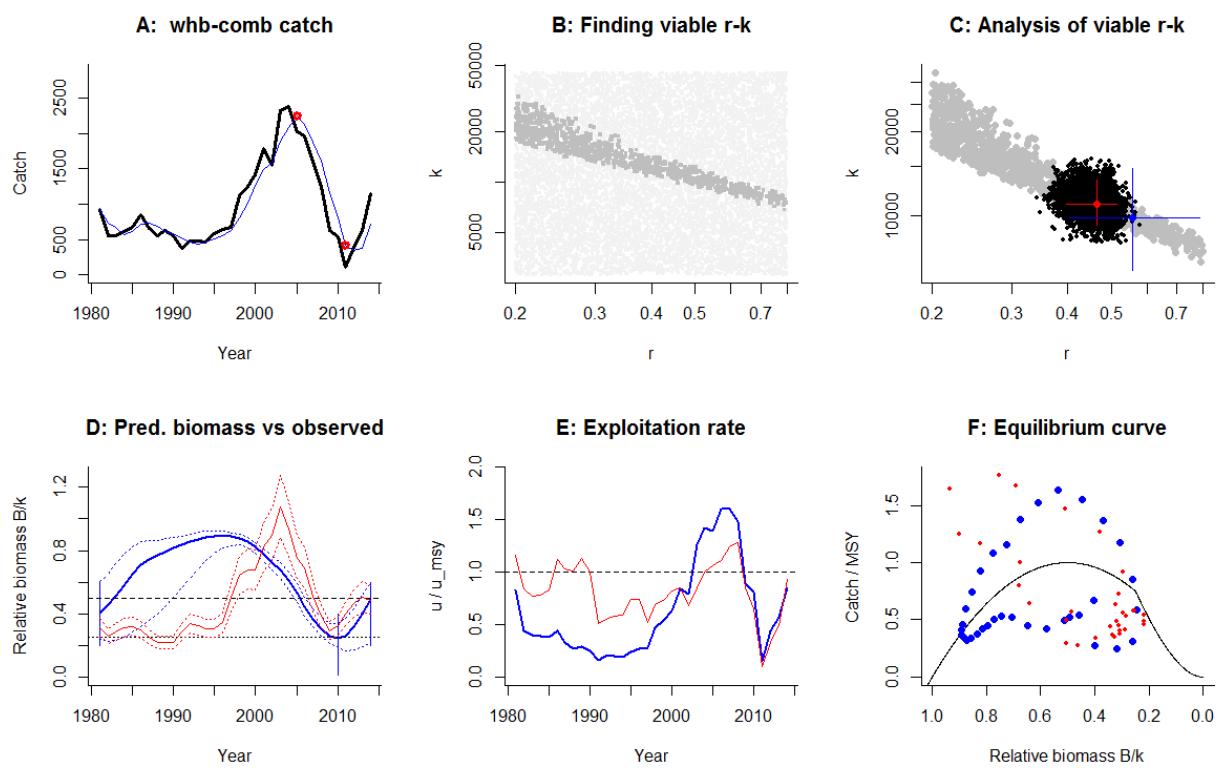
Species: *Merlangius merlangus* , stock: whg-47d
Name and region: Whiting Subarea IV (North Sea) and Division VIId (Eastern Channel) , ICES
Catch data used from years 1990 - 2014 , biomass = observed
Prior initial relative biomass = 0.5 - 0.9 expert
Prior intermediate rel. biomass= 0.01 - 0.4 in year 2008 default
Prior final relative biomass = 0.2 - 0.6 expert
Prior range for r = 0.2 - 0.8 default , prior range for k = 191 - 3052
Results from Bayesian Schaefer model using catch & observed biomass
r = 0.494 , 95% CL = 0.425 - 0.549 , k = 930 , 95% CL = 776 - 1162
MSY = 114 , 95% CL = 91.4 - 145
Biomass in last year = 482 or 0.518 k
Exploitation rate in last year = 0.0572 or 0.231 u.msy
Results of CMSY analysis with altogether 4798 viable trajectories for 2600 r-k pairs
r = 0.452 , 95% CL = 0.349 - 0.664 , k = 699 , 95% CL = 424 - 1012
MSY = 78.9 , 95% CL = 63.2 - 98.6
Relative biomass last year= 0.484 k, 2.5th = 0.216 , 97.5th = 0.594
Relative biomass next year= 0.545 k, 2.5th = 0.243 , 97.5th = 0.664
Relative exploitation rate in last year= 0.402
Comment: OK. Fit could be improved by setting intbio High in 2000.

A: whg-47d catch   B: Finding viable r-k   C: Analysis of viable r-k

D: Pred. biomass vs observed   E: Exploitation rate   F: Equilibrium curve
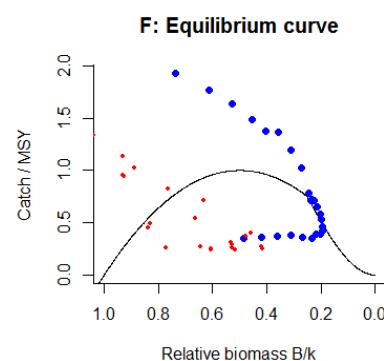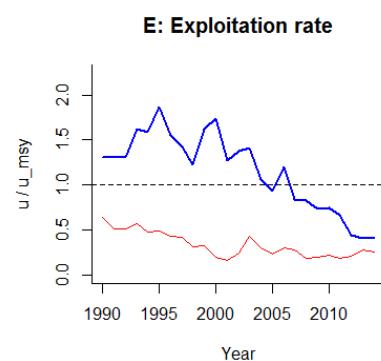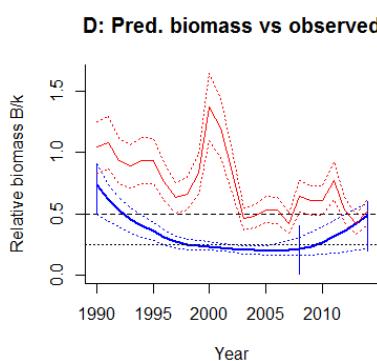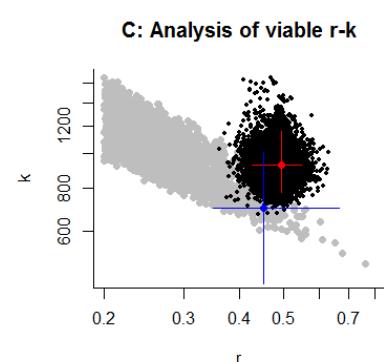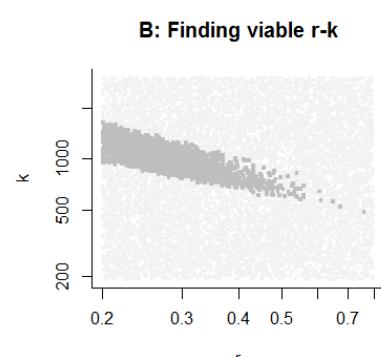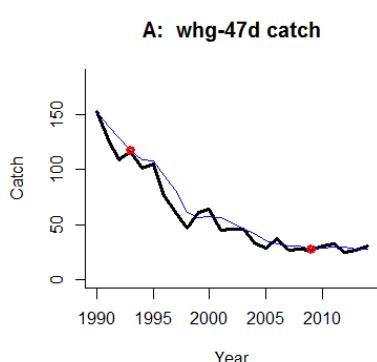
Species: *Merlangius merlangus* , stock: whg-7e-k
Name and region: Whiting in Division VIIe-k , ICES
Catch data used from years 1982 - 2012 , biomass = observed
Prior initial relative biomass = 0.2 - 0.6 default
Prior intermediate rel. biomass= 0.01 - 0.4 in year 2008 default
Prior final relative biomass = 0.5 - 0.9 expert
Prior range for r = 0.2 - 0.8 default , prior range for k = 51.2 - 1229
Results from Bayesian Schaefer model using catch & observed biomass
r = 0.565 , 95% CL = 0.494 - 0.661 , k = 101 , 95% CL = 87 - 123
MSY = 14.4 , 95% CL = 11.9 - 17.5
Biomass in last year = 66.7 or 0.659 k
Exploitation rate in last year = 0.137 or 0.486 u.msy
Results of CMSY analysis with altogether 2090 viable trajectories for 1223 r-k pairs
r = 0.566 , 95% CL = 0.407 - 0.785 , k = 109 , 95% CL = 73.1 - 161
MSY = 15.3 , 95% CL = 13.5 - 17.5
Relative biomass last year= 0.604 k, 2.5th = 0.508 , 97.5th = 0.74
Relative biomass next year= 0.655 k, 2.5th = 0.548 , 97.5th = 0.784
Relative exploitation rate in last year= 0.538
Comment: OK. Fit could be improved by setting startbio Low.
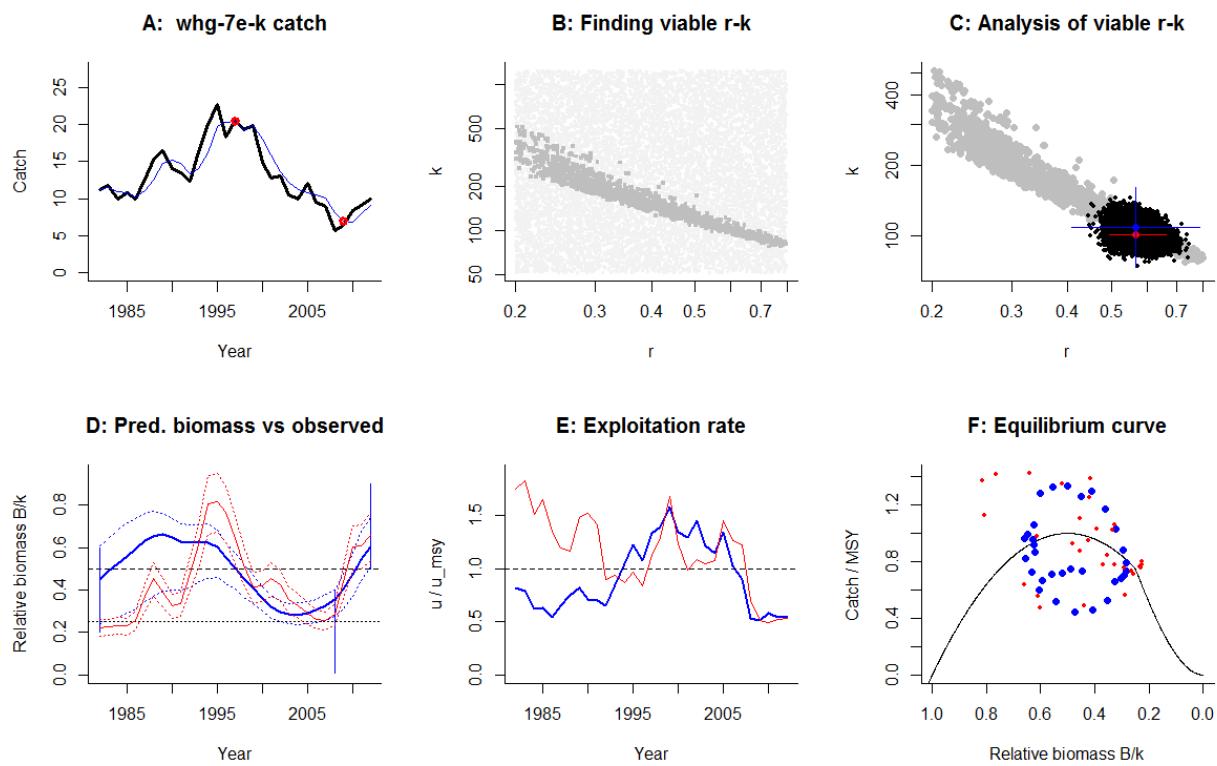
Species: *Merlangius merlangus* , stock: whg-scow
 Name and region: Whiting in Division VIa (West of Scotland) , ICES
 Catch data used from years 1981 - 2014 , biomass = observed
 Prior initial relative biomass = 0.5 - 0.9 expert
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 2008 default
 Prior final relative biomass   = 0.01 - 0.4 , default
 Prior range for r = 0.2 - 0.8 default , prior range for k = 25.9 - 414
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.491 , 95% CL = 0.419 - 0.538 , k = 126 , 95% CL = 101 - 167
 MSY = 15.3 , 95% CL = 12 - 20.4
Biomass in last year = 22.8 or 0.18 k
 Exploitation rate in last year = 0.0435 or 0.177 u.msy
 Results of CMSY analysis with altogether 1937 viable trajectories for 1392 r-k pairs
 r = 0.458 , 95% CL = 0.351 - 0.685 , k = 116 , 95% CL = 72.8 - 163
 MSY = 13.4 , 95% CL = 11.7 - 15.3
 Relative biomass last year= 0.123 k, 2.5th = 0.0122 , 97.5th = 0.372
 Relative biomass next year= 0.134 k, 2.5th = 0.00473 , 97.5th = 0.462
 Relative exploitation rate in last year= 0.234
 Comment: OK

A: whg-scow catch

B: Finding viable r-k

C: Analysis of viable r-k

D: Pred. biomass vs observed

E: Exploitation rate

F: Equilibrium curve
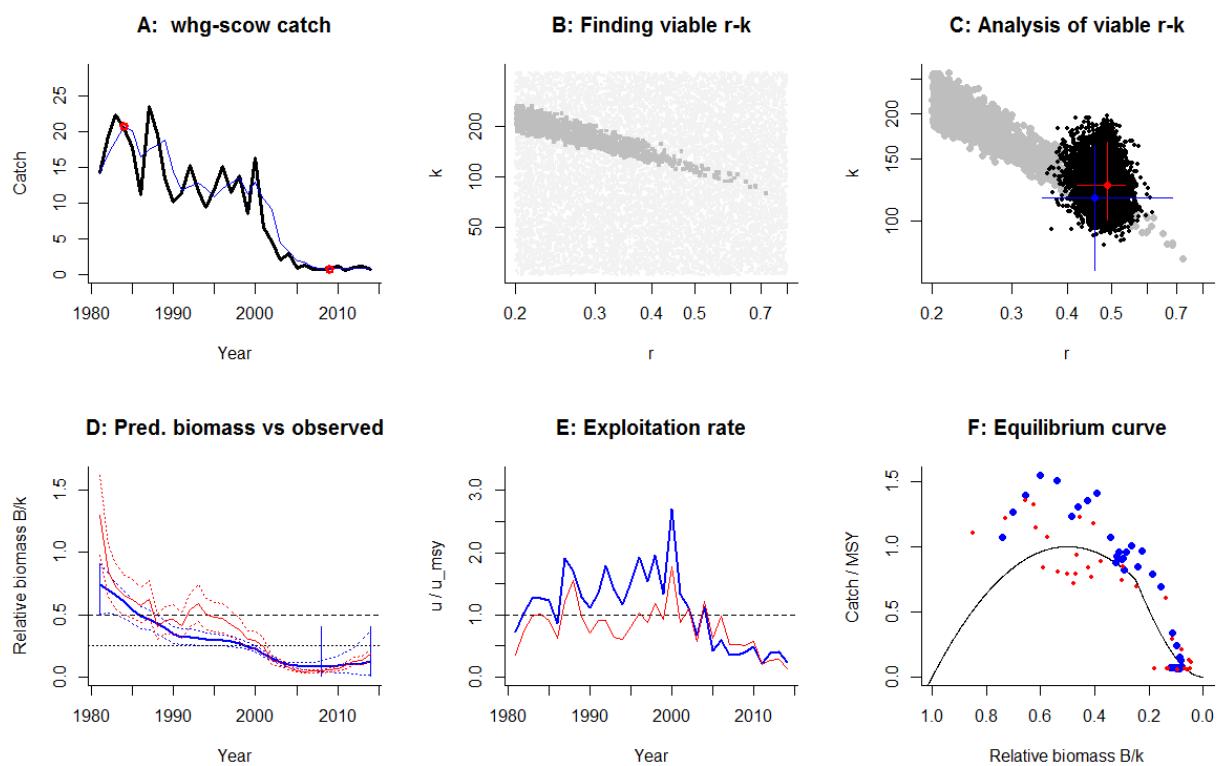
Region: Mediterranean

[CMSY_46e.R, AllStocks_ID20.csv, AllStocks_Spec16.csv]
Species: *Engraulis encrasicolus* , stock: Encr_engr_GSA17
 Name and region: Anchovy - Northern Adriatic /GSA17 , Med
 Catch data used from years 1976 - 2010 , biomass = observed
 Prior initial relative biomass = 0.5 - 0.9 expert
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 1988 default
 Prior final relative biomass   = 0.5 - 0.9 , default
 Prior range for r = 0.2 - 0.8 default , prior range for k = 127 - 3045
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.493 , 95% CL = 0.429 - 0.538 , k = 312 , 95% CL = 259 - 404
 MSY = 38.3 , 95% CL = 31.5 - 49.4
Biomass in last year = 220 or 0.706 k
 Exploitation rate in last year = 0.189 or 0.767 u.msy
 Results of CMSY analysis with altogether 1904 viable trajectories for 1031 r-k pairs
 r = 0.561 , 95% CL = 0.405 - 0.777 , k = 235 , 95% CL = 160 - 345
 MSY = 33 , 95% CL = 29.5 - 36.9
 Relative biomass last year= 0.526 k, 2.5th = 0.501 , 97.5th = 0.596
 Relative biomass next year= 0.491 k, 2.5th = 0.431 , 97.5th = 0.571
 Relative exploitation rate in last year= 1.14
 Comment: Set from High to Medium
 ----

A: Encr_engr_GSA17 catch

B: Finding viable r-k

C: Analysis of viable r-k

D: Pred. biomass vs observed

E: Exploitation rate

F: Equilibrium curve
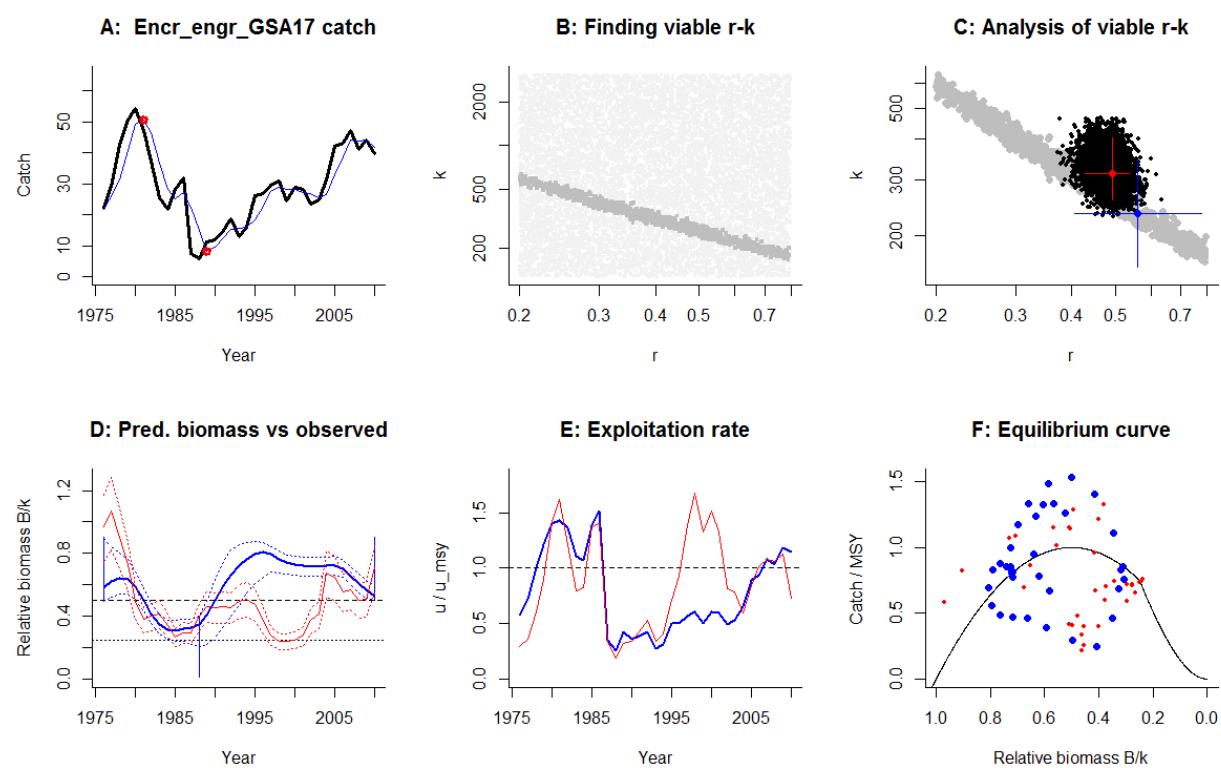
Species: *Mullus barbatus barbatus* , stock: mul-gsa6
 Name and region: Red mullet - Northern Spain /GSA6 , Med
 Catch data used from years 1995 - 2012 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.2 - 0.6 in year 2003 default
 Prior final relative biomass = 0.01 - 0.4 expert
 Prior range for r = 0.2 - 0.8 default , prior range for k = 1.81 - 29
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.537 , 95% CL = 0.491 - 0.621 , k = 9.77 , 95% CL = 7.7 - 11.6
 MSY = 1.31 , 95% CL = 1.13 - 1.5
Biomass in last year = 2.91 or 0.298 k
 Exploitation rate in last year = 0.388 or 1.45 u.msy
 Results of CMSY analysis with altogether 3814 viable trajectories for 1731 r-k pairs
 r = 0.566 , 95% CL = 0.407 - 0.785 , k = 8.61 , 95% CL = 5.49 - 13.5
 MSY = 1.22 , 95% CL = 0.959 - 1.55
 Relative biomass last year= 0.28 k, 2.5th = 0.0296 , 97.5th = 0.396
 Relative biomass next year= 0.26 k, 2.5th = -0.101 , 97.5th = 0.413
 Relative exploitation rate in last year= 1.8
 Comment: OK

A: mul-gsa6 catch

B: Finding viable r-k

C: Analysis of viable r-k

D: Pred. biomass vs observed

E: Exploitation rate

F: Equilibrium curve
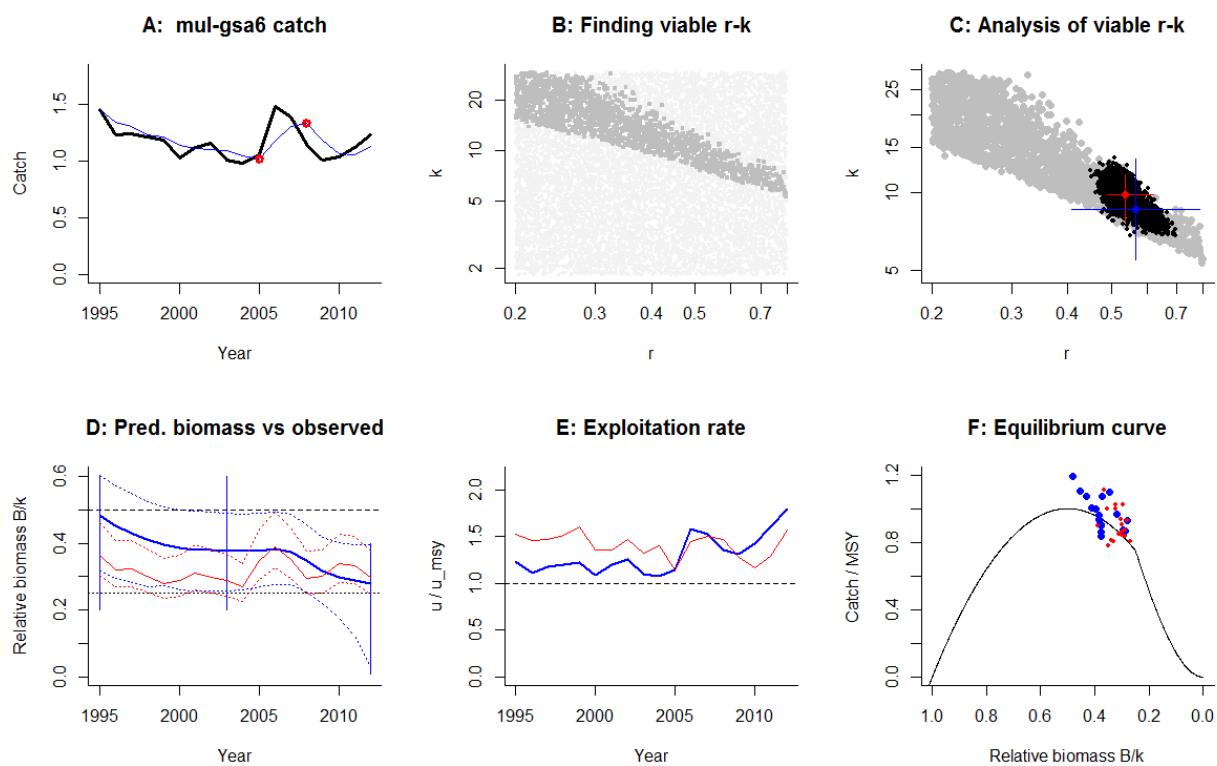
Species: *Mullus surmuletus* , stock: mullsur_gsa1516
 Name and region: Surmullet - Malta Island &South of Sicily /GSA15&16 , Med
 Catch data used from years 2002 - 2012 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 2008 default
 Prior final relative biomass = 0.01 - 0.4 expert
 Prior range for r = 0.6 - 1.5 default , prior range for k = 1.74 - 17.4
Results from Bayesian Schaefer model using catch & observed biomass
 r = 1.07 , 95% CL = 1.01 - 1.19 , k = 6.99 , 95% CL = 5.7 - 8.13
 MSY = 1.87 , 95% CL = 1.56 - 2.15
Biomass in last year = 2.92 or 0.419 k
 Exploitation rate in last year = 0.342 or 0.642 u.msy
 Results of CMSY analysis with altogether 1355 viable trajectories for 905 r-k pairs
 r = 1.16 , 95% CL = 0.943 - 1.45 , k = 7 , 95% CL = 4.65 - 10.5
 MSY = 2.04 , 95% CL = 1.41 - 2.95
 Relative biomass last year= 0.251 k, 2.5th = 0.0166 , 97.5th = 0.395
 Relative biomass next year= 0.305 k, 2.5th = -0.133 , 97.5th = 0.568
 Relative exploitation rate in last year= 0.736
 Comment: OK

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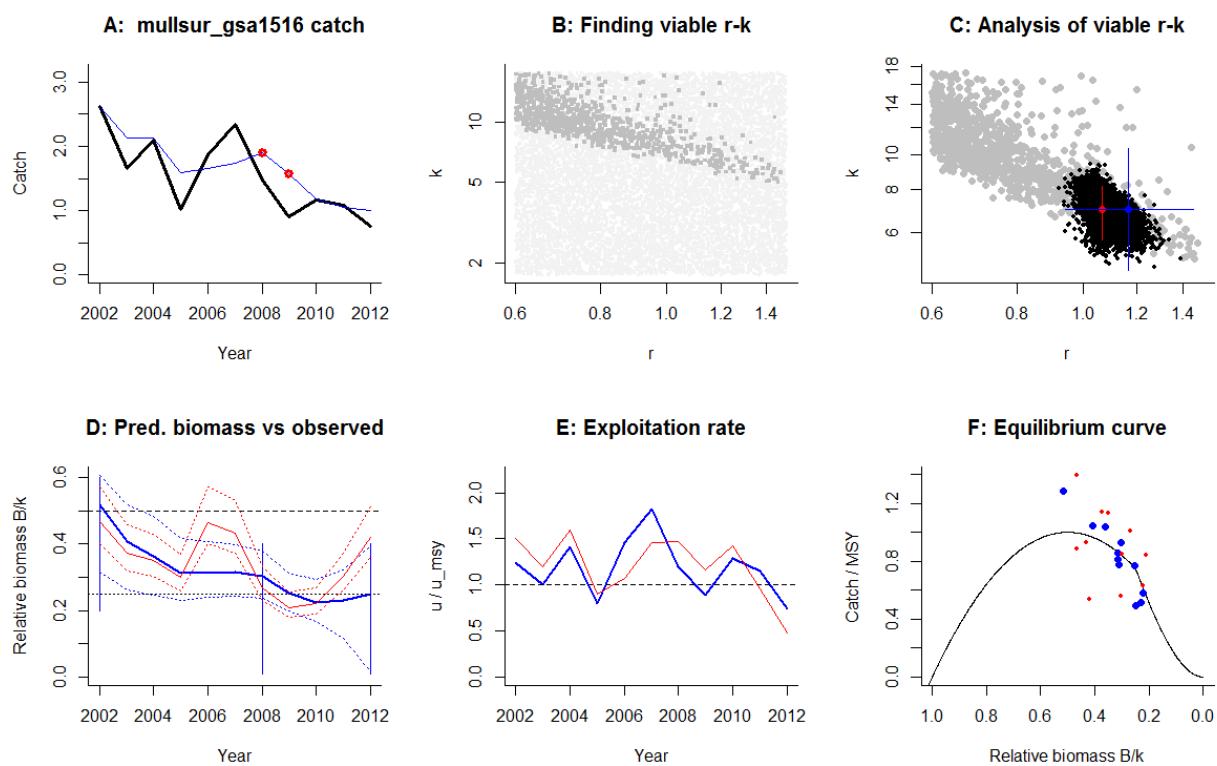
Region: Black Sea

[CMSY_46e.R, AllStocks_ID20.csv, AllStocks_Spec16.csv]
Species: *Engraulis encrasicolus* , stock: BS_anch
 Name and region: Black Sea anchovy , BS
 Catch data used from years 1995 - 2011 , biomass = observed
 Prior initial relative biomass = 0.5 - 0.9 expert
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 2005 default
 Prior final relative biomass   = 0.01 - 0.4 expert
 Prior range for r = 0.2 - 0.8 default , prior range for k = 677 - 10840
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.501 , 95% CL = 0.447 - 0.575 , k = 3550 , 95% CL = 2802 - 4678
 MSY = 447 , 95% CL = 337 - 611
Biomass in last year = 669 or 0.189 k
 Exploitation rate in last year = 0.422 or 1.68 u.msy
 Results of CMSY analysis with altogether 4643 viable trajectories for 1282 r-k pairs
 r = 0.566 , 95% CL = 0.407 - 0.785 , k = 2454 , 95% CL = 1617 - 3724
 MSY = 347 , 95% CL = 291 - 413
 Relative biomass last year= 0.248 k, 2.5th = 0.028 , 97.5th = 0.388
 Relative biomass next year= 0.236 k, 2.5th = -0.087 , 97.5th = 0.419
 Relative exploitation rate in last year= 1.65
 Comment: SSB=TB

A: BS_anch catch   B: Finding viable r-k   C: Analysis of viable r-k
D: Pred. biomass vs observed   E: Exploitation rate   F: Equilibrium curve
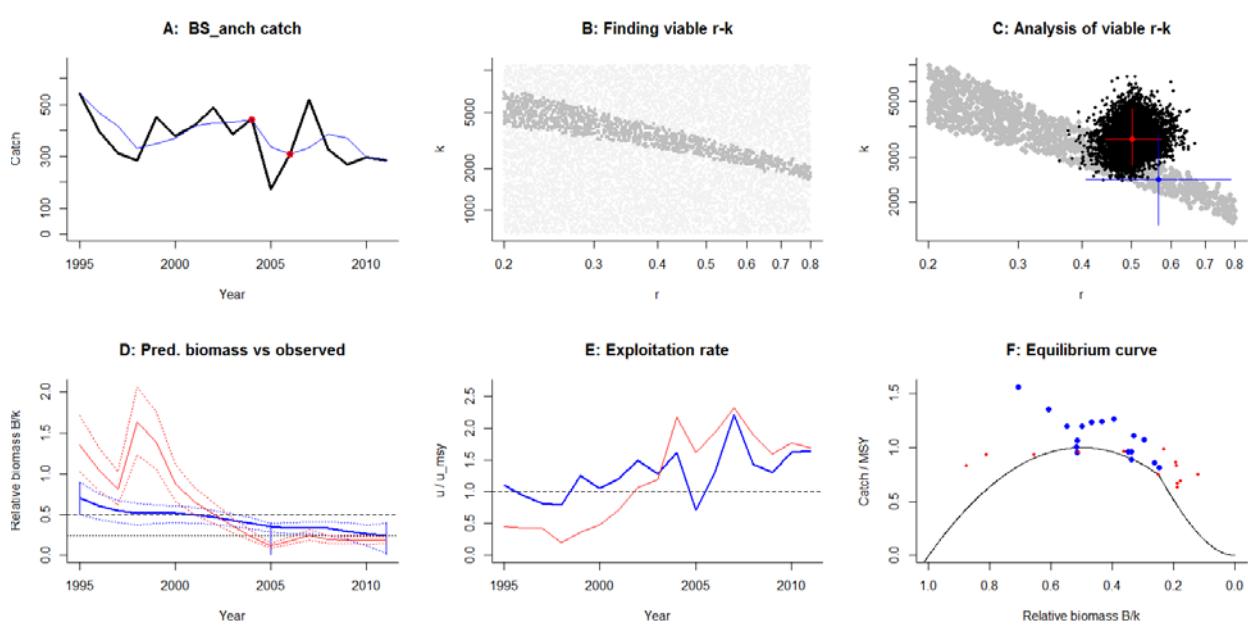
Species: *Sprattus sprattus* , stock: Spr_BS
 Name and region: Black Sea sprat , BS
 Catch data used from years 1992 - 2011 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.5 - 0.9 in year 2002 default
 Prior final relative biomass   = 0.5 - 0.9 , default
 Prior range for r = 0.2 - 0.8 default , prior range for k = 253 - 6074
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.502 , 95% CL = 0.449 - 0.568 , k = 577 , 95% CL = 493 - 694
 MSY = 72.8 , 95% CL = 60.3 - 88.4
Biomass in last year = 414 or 0.718 k
 Exploitation rate in last year = 0.244 or 0.973 u.msy
 Results of CMSY analysis with altogether 38880 viable trajectories for 4560 r-k pairs
 r = 0.566 , 95% CL = 0.407 - 0.785 , k = 616 , 95% CL = 308 - 1231
 MSY = 87 , 95% CL = 42.6 - 178
 Relative biomass last year= 0.752 k, 2.5th = 0.515 , 97.5th = 0.865
 Relative biomass next year= 0.68 k, 2.5th = 0.377 , 97.5th = 0.827
 Relative exploitation rate in last year= 0.922
 Comment: Landings
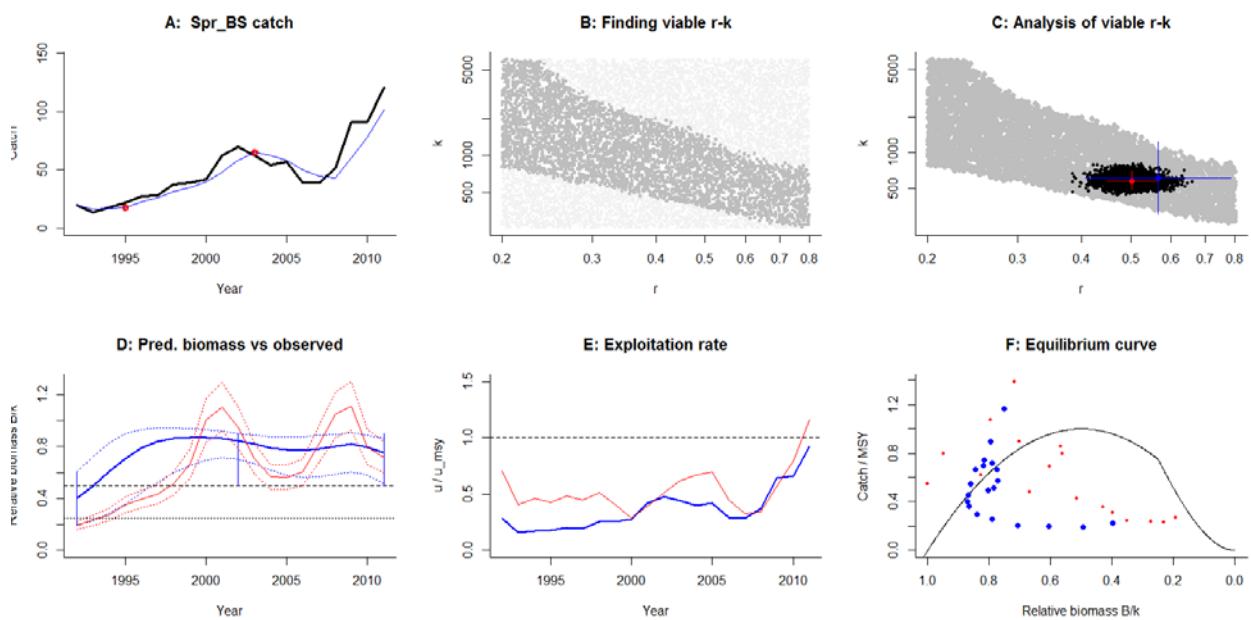
Species: *Scophthalmus maximus* , stock: Tur_BS
 Name and region: Turbot in Black Sea , BS
 Catch data used from years 1950 - 2011 , biomass = observed
 Prior initial relative biomass = 0.5 - 0.9 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 1986 default
 Prior final relative biomass   = 0.01 - 0.4 , default
 Prior range for r = 0.2 - 0.8 default , prior range for k = 6.23 - 99.6
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.498 , 95% CL = 0.459 - 0.534 , k = 23.8 , 95% CL = 21.4 - 26.7
 MSY = 2.96 , 95% CL = 2.62 - 3.34
Biomass in last year = 1.61 or 0.0677 k
 Exploitation rate in last year = 0.775 or 3.11 u.msy
 Results of CMSY analysis with altogether 329 viable trajectories for 309 r-k pairs
 r = 0.309 , 95% CL = 0.268 - 0.356 , k = 40.3 , 95% CL = 32.3 - 50.4
 MSY = 3.11 , 95% CL = 2.66 - 3.64
 Relative biomass last year= 0.333 k, 2.5th = 0.0314 , 97.5th = 0.394
 Relative biomass next year= 0.374 k, 2.5th = 0.00315 , 97.5th = 0.436
 Relative exploitation rate in last year= 0.428
 Comment: Landings + IUU; OK.
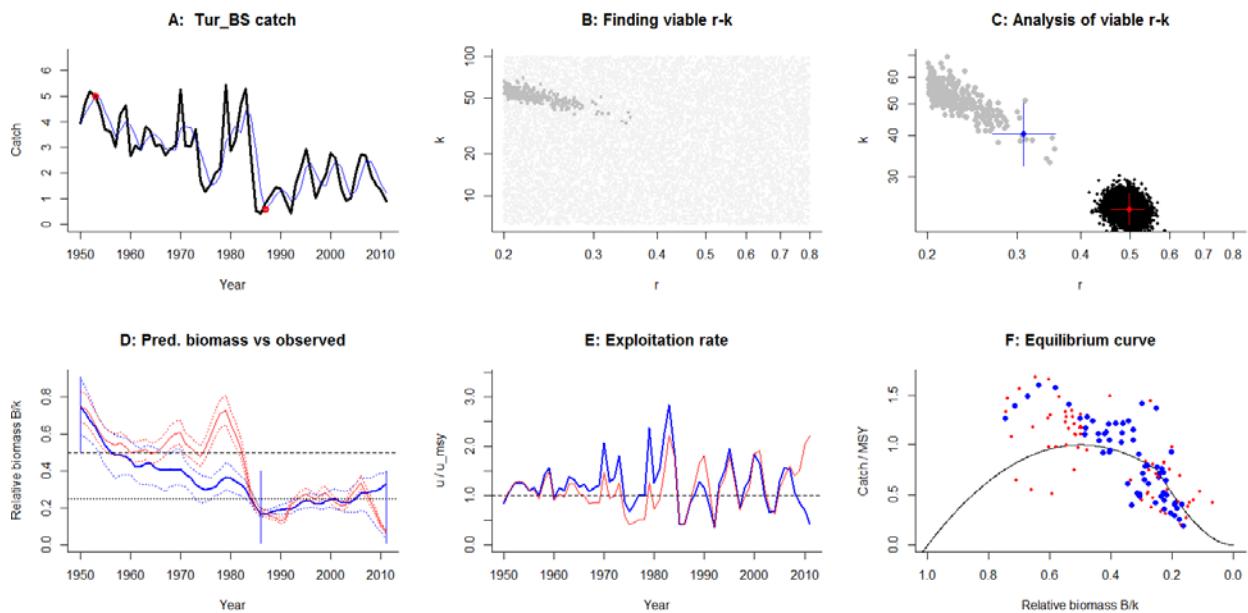
Region: South Africa

[CMSY_46e.R, AllStocks_ID20.csv, AllStocks_Spec16.csv]
Species: *Argyrozona argyrozona* , stock: CRPN_S
 Name and region: Carpenter South Coast , South Africa
 Catch data used from years 1987 - 2011 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.5 - 0.9 in year 2000 expert
 Prior final relative biomass   = 0.5 - 0.9 expert
 Prior range for r = 0.05 - 0.5 default , prior range for k = 1.39 - 83.5
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.227 , 95% CL = 0.17 - 0.28 , k = 6.22 , 95% CL = 5.28 - 9.03
 MSY = 0.358 , 95% CL = 0.293 - 0.442
Biomass in last year = 6.01 or 0.965 k
 Exploitation rate in last year = 0.0169 or 0.149 u.msy
 Results of CMSY analysis with altogether 19976 viable trajectories for 4045 r-k pairs
 r = 0.278 , 95% CL = 0.162 - 0.487 , k = 6.18 , 95% CL = 1.93 - 19.4
 MSY = 0.429 , 95% CL = 0.132 - 1.4
 Relative biomass last year= 0.875 k, 2.5th = 0.767 , 97.5th = 0.899
 Relative biomass next year= 0.881 k, 2.5th = 0.781 , 97.5th = 0.907
 Relative exploitation rate in last year= 0.133
 Comment: OK

A: CRPN_S catch

B: Finding viable r-k

C: Analysis of viable r-k

D: Pred. biomass vs observed

E: Exploitation rate

F: Equilibrium curve
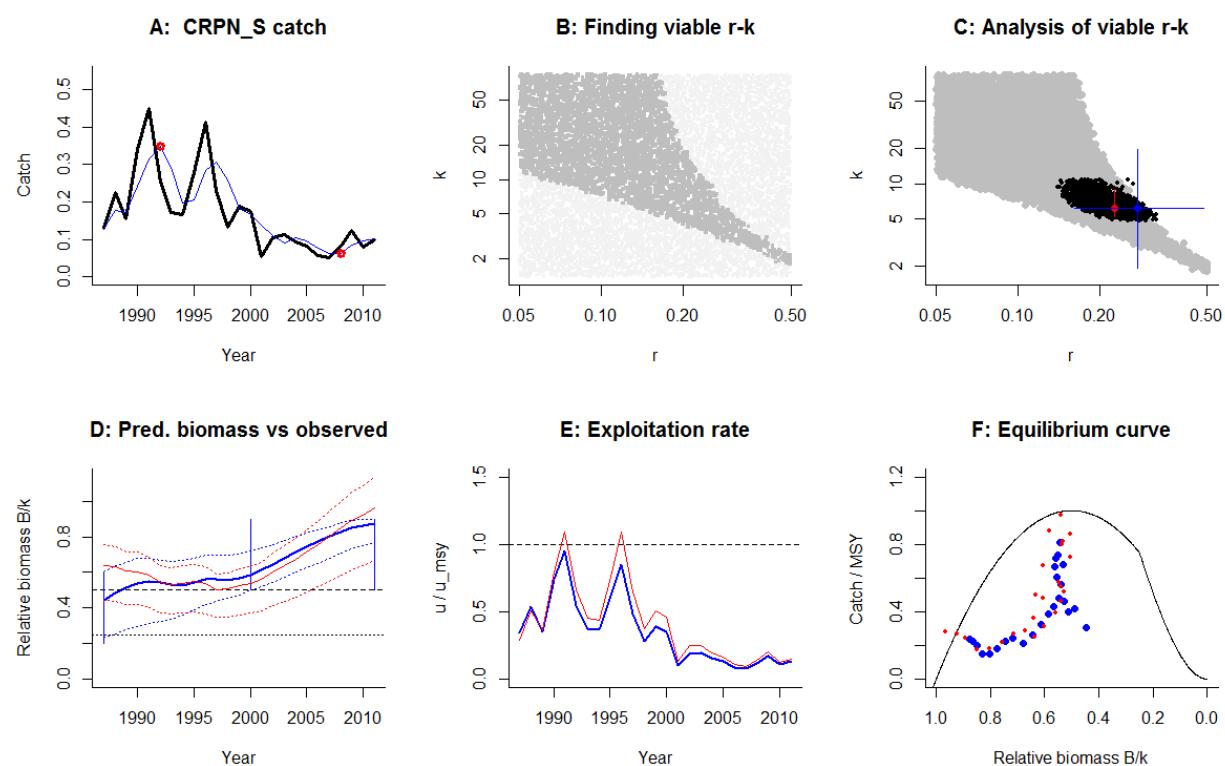
Species: *Argyrozona argyrozona* , stock: CRPN_SE
 Name and region: Carpenter South-East Coast , South Africa
 Catch data used from years 1987 - 2011 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.2 - 0.6 in year 2000 expert
 Prior final relative biomass   = 0.5 - 0.9 expert
 Prior range for r = 0.05 - 0.5 default , prior range for k = 1.96 - 118
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.215 , 95% CL = 0.177 - 0.264 , k = 10.1 , 95% CL = 8.61 - 12.8
 MSY = 0.546 , 95% CL = 0.464 - 0.648
Biomass in last year = 9.34 or 0.926 k
 Exploitation rate in last year = 0.0222 or 0.207 u.msy
 Results of CMSY analysis with altogether 18307 viable trajectories for 4490 r-k pairs
 r = 0.282 , 95% CL = 0.163 - 0.487 , k = 8.43 , 95% CL = 2.67 - 26.7
 MSY = 0.595 , 95% CL = 0.182 - 1.95
 Relative biomass last year= 0.829 k, 2.5th = 0.545 , 97.5th = 0.898
 Relative biomass next year= 0.833 k, 2.5th = 0.563 , 97.5th = 0.9
 Relative exploitation rate in last year= 0.269
 Comment: OK

A: CRPN_SE catch

B: Finding viable r-k

C: Analysis of viable r-k

D: Pred. biomass vs observed

E: Exploitation rate

F: Equilibrium curve
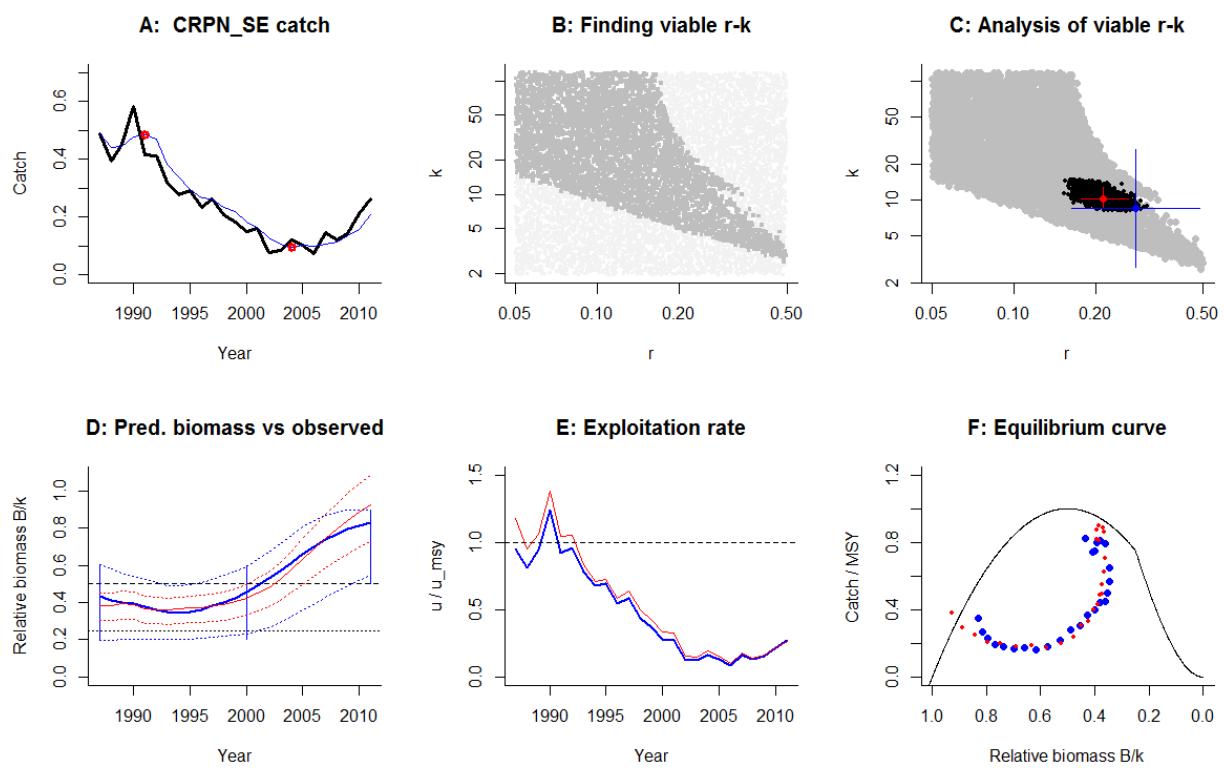
Species: *Pachymetopon blochii* , stock: HTTN_SW
 Name and region: Hottentot South-West Coast , South Africa
 Catch data used from years 1987 - 2011 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.5 - 0.9 in year 1996 expert
 Prior final relative biomass   = 0.5 - 0.9 expert
 Prior range for r = 0.2 - 0.8 default , prior range for k = 0.705 - 16.9
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.479 , 95% CL = 0.389 - 0.531 , k = 1.47 , 95% CL = 1.29 - 1.81
 MSY = 0.174 , 95% CL = 0.15 - 0.205
Biomass in last year = 1.23 or 0.834 k
 Exploitation rate in last year = 0.0456 or 0.191 u.msy
 Results of CMSY analysis with altogether 2868 viable trajectories for 1762 r-k pairs
 r = 0.266 , 95% CL = 0.242 - 0.292 , k = 2.77 , 95% CL = 2.38 - 3.23
 MSY = 0.184 , 95% CL = 0.164 - 0.207
 Relative biomass last year= 0.896 k, 2.5th = 0.882 , 97.5th = 0.9
 Relative biomass next year= 0.899 k, 2.5th = 0.885 , 97.5th = 0.907
 Relative exploitation rate in last year= 0.2
 Comment: OK
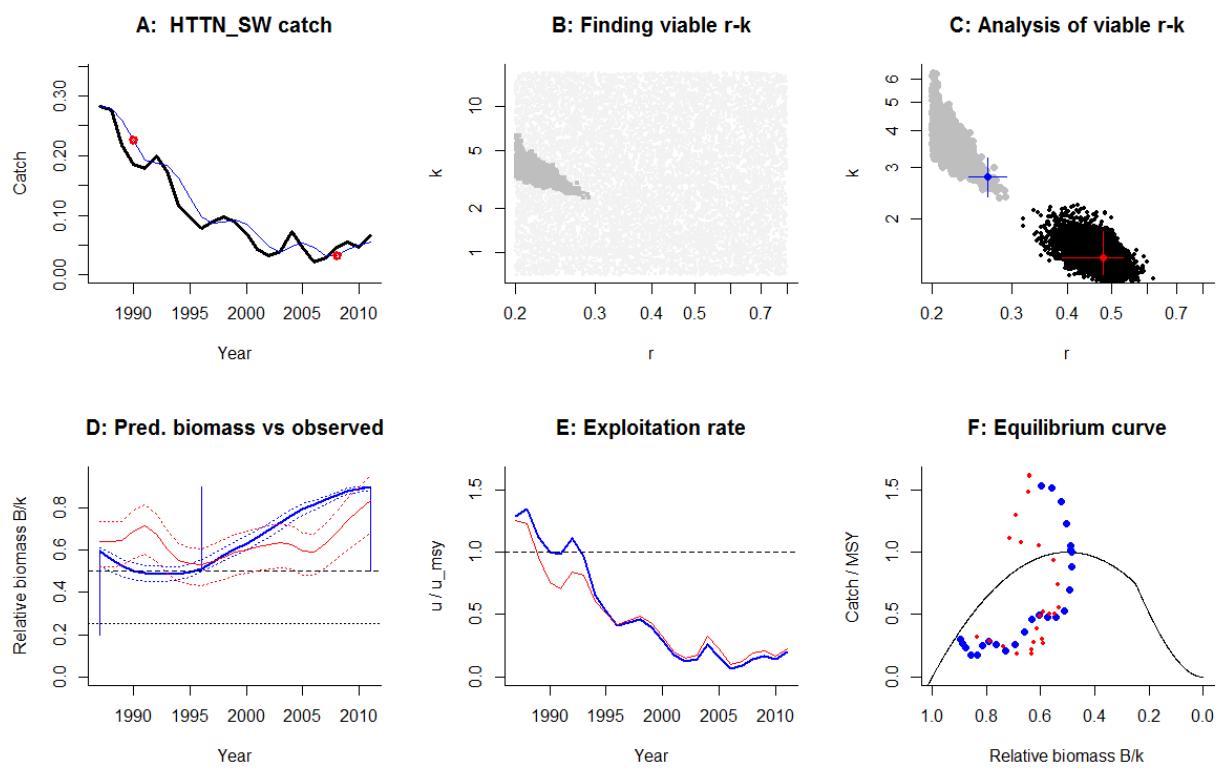
Species: *Pachymetopon blochii* , stock: HTTN_W
Name and region: Hottentot West Coast , South Africa
Catch data used from years 1987 - 2011 , biomass = observed
Prior initial relative biomass = 0.2 - 0.6 default
Prior intermediate rel. biomass= 0.5 - 0.9 in year 1994 expert
Prior final relative biomass   = 0.5 - 0.9 expert
Prior range for r = 0.2 - 0.8 default , prior range for k = 1.63 - 39.1
Results from Bayesian Schaefer model using catch & observed biomass
r = 0.48 , 95% CL = 0.391 - 0.531 , k = 4.05 , 95% CL = 3.65 - 4.8
MSY = 0.482 , 95% CL = 0.411 - 0.557
Biomass in last year = 3.85 or 0.953 k
Exploitation rate in last year = 0.0322 or 0.134 u.msy
Results of CMSY analysis with altogether 3238 viable trajectories for 2042 r-k pairs
r = 0.276 , 95% CL = 0.248 - 0.307 , k = 5.96 , 95% CL = 5.06 - 7.02
MSY = 0.411 , 95% CL = 0.368 - 0.459
Relative biomass last year= 0.895 k, 2.5th = 0.877 , 97.5th = 0.9
Relative biomass next year= 0.899 k, 2.5th = 0.882 , 97.5th = 0.908
Relative exploitation rate in last year= 0.204
Comment: OK

A: HTTN_W catch

B: Finding viable r-k

C: Analysis of viable r-k

D: Pred. biomass vs observed

E: Exploitation rate

F: Equilibrium curve
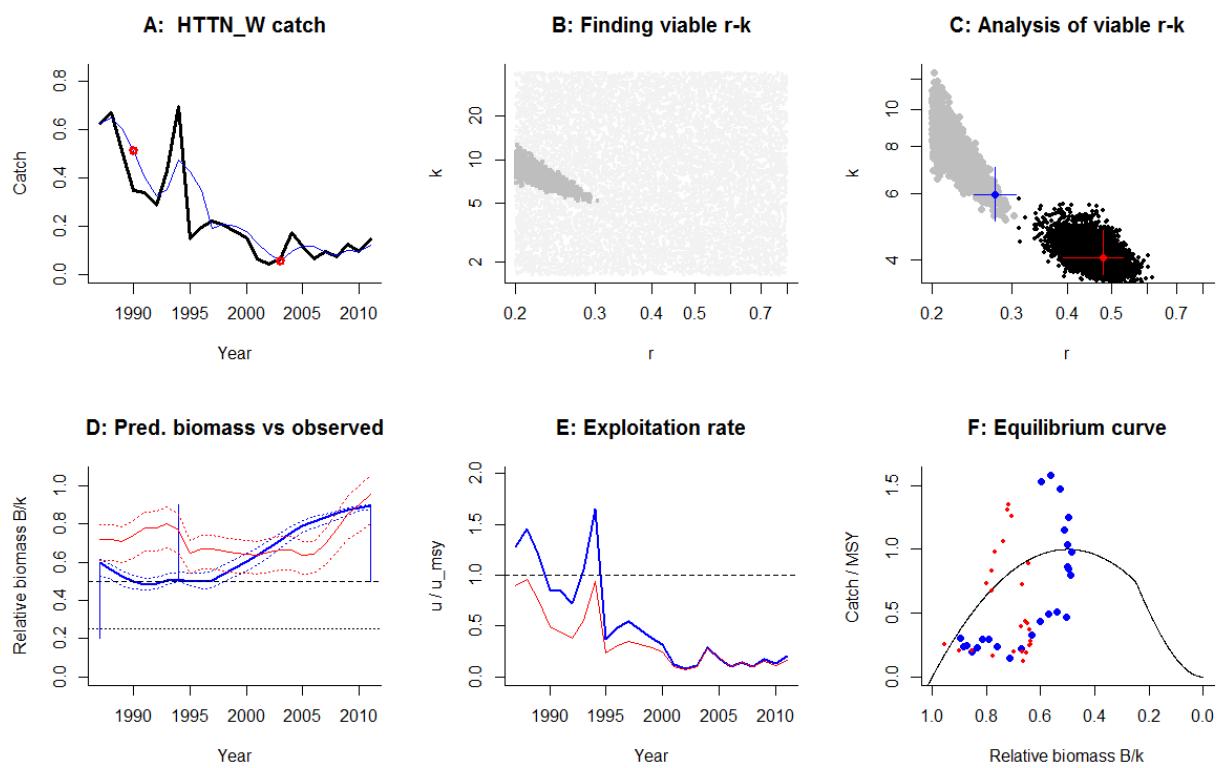
Species: *Genypterus capensis* , stock: KKLI_S
 Name and region: Kingklip South Coast , South Africa
 Catch data used from years 1959 - 2012 , biomass = observed
 Prior initial relative biomass = 0.5 - 0.9 default
 Prior intermediate rel. biomass= 0.5 - 0.9 in year 1986 default
 Prior final relative biomass   = 0.2 - 0.6 expert
 Prior range for r = 0.05 - 0.5 default , prior range for k = 13.4 - 535
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.17 , 95% CL = 0.143 - 0.203 , k = 54.5 , 95% CL = 50.4 - 59.7
 MSY = 2.32 , 95% CL = 2 - 2.71
Biomass in last year = 26.8 or 0.491 k
 Exploitation rate in last year = 0.044 or 0.517 u.msy
 Results of CMSY analysis with altogether 17419 viable trajectories for 2375 r-k pairs
 r = 0.278 , 95% CL = 0.162 - 0.478 , k = 29.2 , 95% CL = 15.2 - 56
 MSY = 2.03 , 95% CL = 1.64 - 2.51
 Relative biomass last year= 0.491 k, 2.5th = 0.231 , 97.5th = 0.596
 Relative biomass next year= 0.515 k, 2.5th = 0.233 , 97.5th = 0.621
 Relative exploitation rate in last year= 0.685
 Comment: OK

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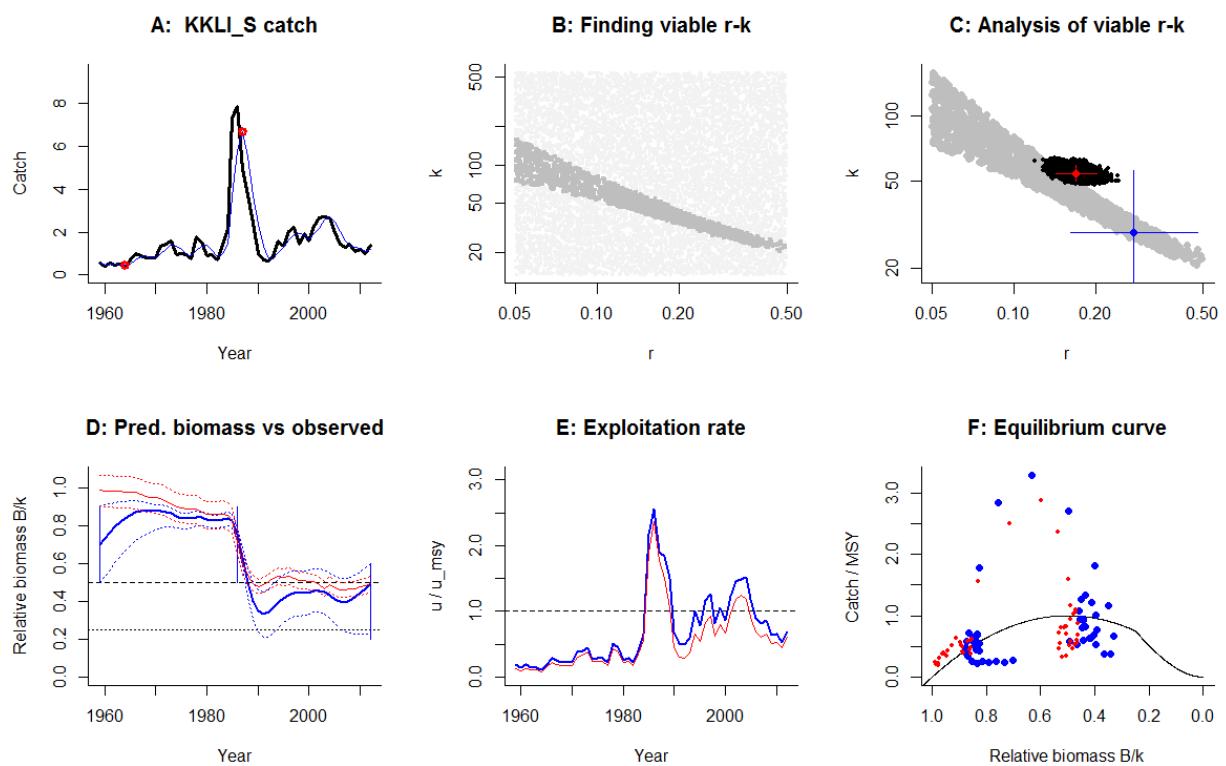
Species: *Argyrosomus inodorus* , stock: KOB_S
 Name and region: Silver Kob South Coast , South Africa
 Catch data used from years 1987 - 2011 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 2004 default
 Prior final relative biomass   = 0.2 - 0.6 , default
 Prior range for r = 0.05 - 0.5 default , prior range for k = 1.4 - 56.2
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.343 , 95% CL = 0.303 - 0.403 , k = 6.94 , 95% CL = 5.44 - 8.11
 MSY = 0.591 , 95% CL = 0.52 - 0.669
Biomass in last year = 3.27 or 0.471 k
 Exploitation rate in last year = 0.136 or 0.793 u.msy
 Results of CMSY analysis with altogether 5709 viable trajectories for 2636 r-k pairs
 r = 0.278 , 95% CL = 0.162 - 0.478 , k = 9.46 , 95% CL = 4.02 - 22.2
 MSY = 0.657 , 95% CL = 0.355 - 1.22
 Relative biomass last year= 0.402 k, 2.5th = 0.218 , 97.5th = 0.573
 Relative biomass next year= 0.41 k, 2.5th = 0.196 , 97.5th = 0.606
 Relative exploitation rate in last year= 0.786
 Comment: OK. Resilience changed from Medium to Low.

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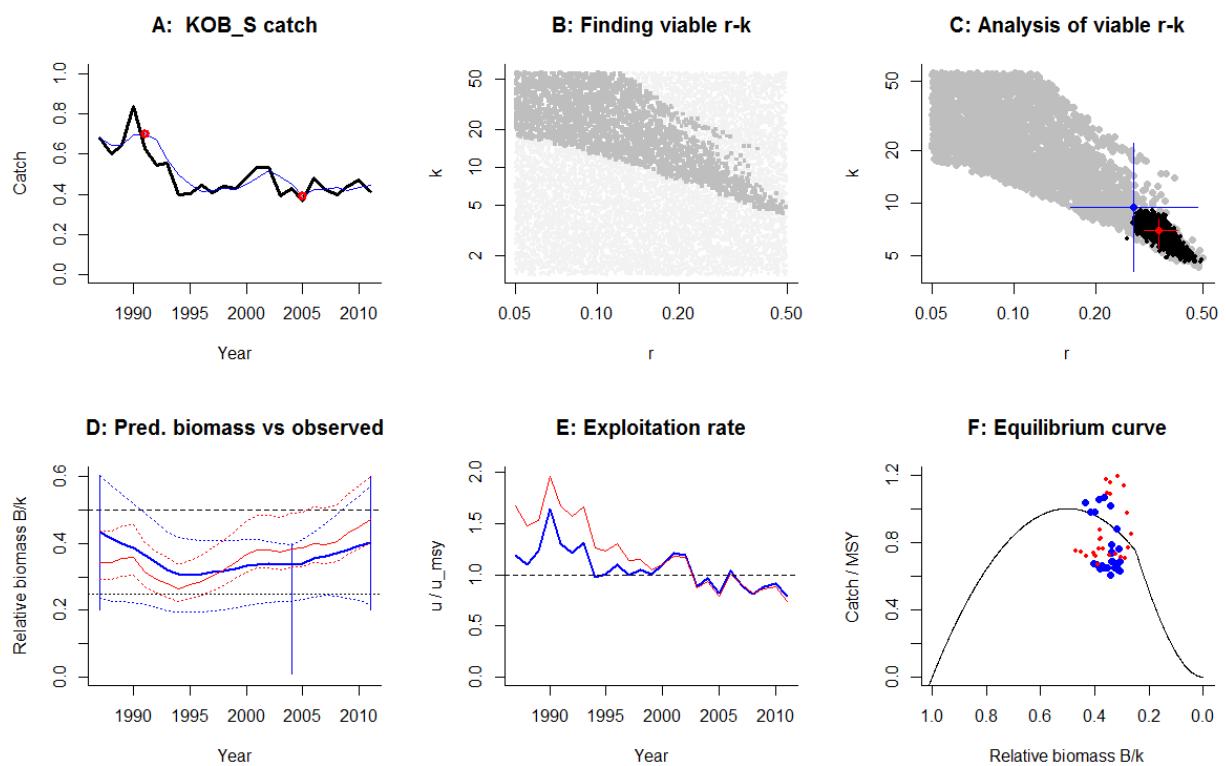
Species: *Argyrosomus inodorus* , stock: KOB_SE
 Name and region: Silver Kob South-East Coast , South Africa
 Catch data used from years 1987 - 2011 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 2006 default
 Prior final relative biomass = 0.2 - 0.6 , default
 Prior range for r = 0.05 - 0.5 default , prior range for k = 0.77 - 30.8
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.356 , 95% CL = 0.307 - 0.416 , k = 3.64 , 95% CL = 2.86 - 4.37
 MSY = 0.322 , 95% CL = 0.274 - 0.374
Biomass in last year = 1.82 or 0.502 k
 Exploitation rate in last year = 0.107 or 0.604 u.msy
 Results of CMSY analysis with altogether 5366 viable trajectories for 2523 r-k pairs
 r = 0.274 , 95% CL = 0.16 - 0.468 , k = 4.96 , 95% CL = 2.12 - 11.6
 MSY = 0.339 , 95% CL = 0.183 - 0.628
 Relative biomass last year= 0.431 k, 2.5th = 0.221 , 97.5th = 0.576
 Relative biomass next year= 0.45 k, 2.5th = 0.218 , 97.5th = 0.612
 Relative exploitation rate in last year= 0.587
 Comment: OK. Resilience changed from Medium to Low.
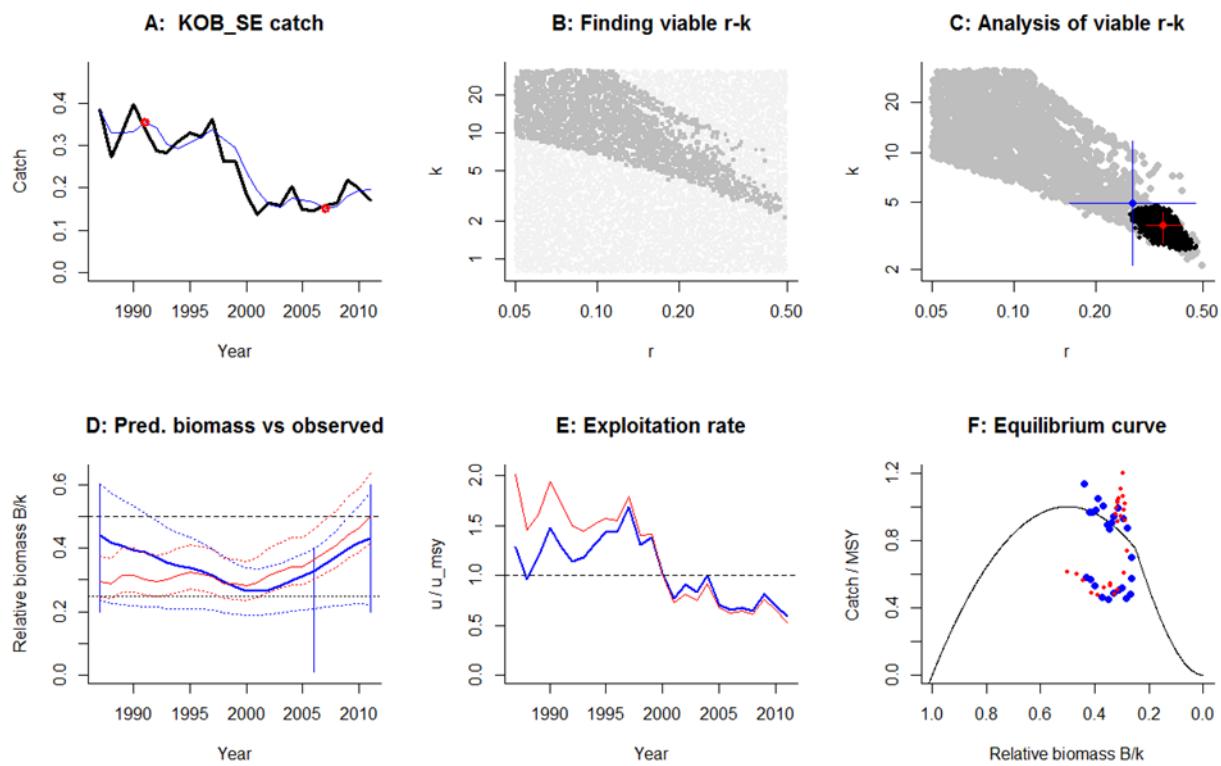
Species: *Chrysoblephus puniceus* , stock: SLNG
 Name and region: Slinger Kwazulu-Natal , South Africa
 Catch data used from years 1987 - 2011 , biomass = observed
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 2002 default
 Prior final relative biomass = 0.2 - 0.6 , default
 Prior range for r = 0.2 - 0.8 default , prior range for k = 0.352 - 5.63
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.494 , 95% CL = 0.439 - 0.533 , k = 1.91 , 95% CL = 1.73 - 2.19
 MSY = 0.235 , 95% CL = 0.216 - 0.259
Biomass in last year = 1.52 or 0.797 k
 Exploitation rate in last year = 0.125 or 0.508 u.msy
 Results of CMSY analysis with altogether 2179 viable trajectories for 1180 r-k pairs
 r = 0.541 , 95% CL = 0.395 - 0.773 , k = 1.52 , 95% CL = 0.972 - 2.29
 MSY = 0.206 , 95% CL = 0.172 - 0.247
Relative biomass last year= 0.506 k, 2.5th = 0.248 , 97.5th = 0.595
Relative biomass next year= 0.505 k, 2.5th = 0.205 , 97.5th = 0.61
Relative exploitation rate in last year= 1
Comment: OK. Fit could be improved by setting intbio to Medium in 2000 and endbio to High.

A: SLNG catch   B: Finding viable r-k   C: Analysis of viable r-k

D: Pred. biomass vs observed   E: Exploitation rate   F: Equilibrium curve
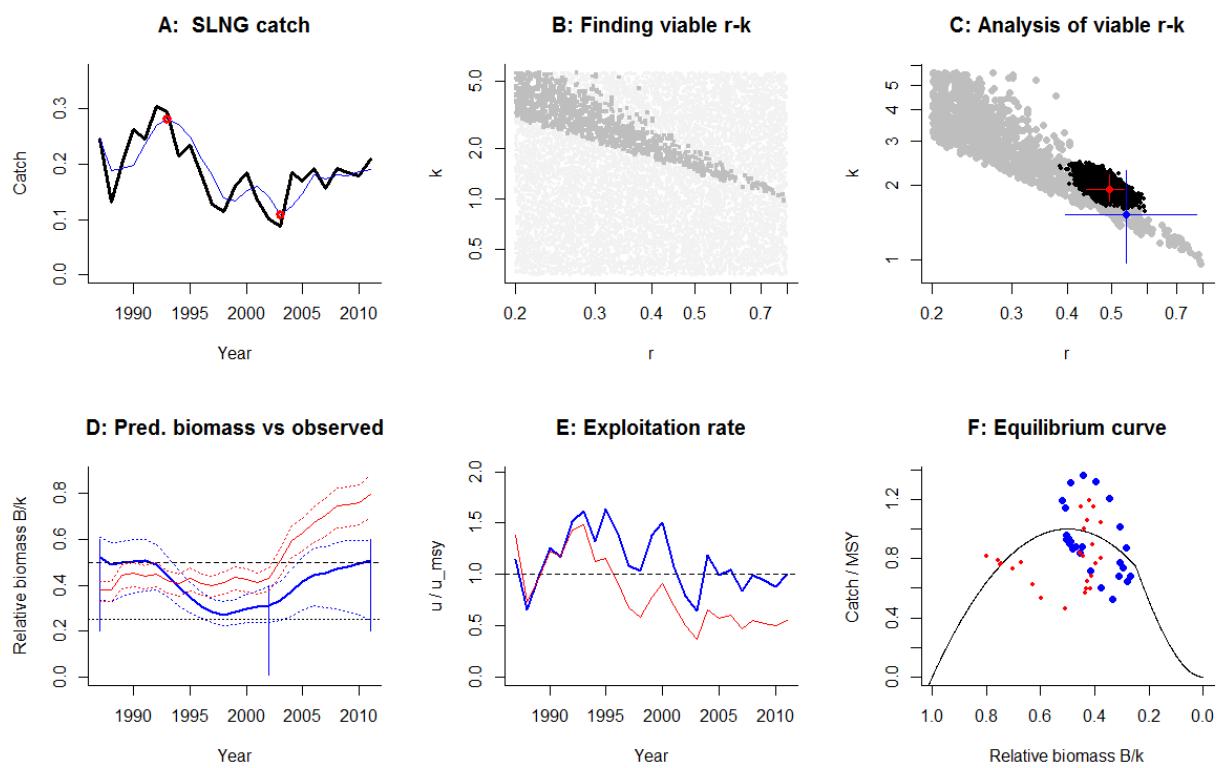
Species: *Prionace glauca* , stock: SA-BSH
 Name and region: South Atlantic Blue Shark , South Africa
 Catch data used from years 1971 - 2013 , biomass = observed
 Prior initial relative biomass = 0.5 - 0.9 expert
 Prior intermediate rel. biomass= 0.2 - 0.6 in year 1996 expert
 Prior final relative biomass = 0.2 - 0.6 expert
 Prior range for r = 0.05 - 0.5 default , prior range for k = 64.9 - 2597
Results from Bayesian Schaefer model using catch & observed biomass
 r = 0.307 , 95% CL = 0.261 - 0.388 , k = 274 , 95% CL = 240 - 324
 MSY = 21.4 , 95% CL = 18.6 - 24.5
Biomass in last year = 146 or 0.533 k
 Exploitation rate in last year = 0.197 or 1.28 u.msy
 Results of CMSY analysis with altogether 1035 viable trajectories for 460 r-k pairs
 r = 0.287 , 95% CL = 0.114 - 0.482 , k = 267 , 95% CL = 136 - 779
 MSY = 19.1 , 95% CL = 14.2 - 25.7
 Relative biomass last year= 0.24 k, 2.5th = 0.201 , 97.5th = 0.365
 Relative biomass next year= 0.185 k, 2.5th = 0.117 , 97.5th = 0.336
 Relative exploitation rate in last year= 2.27
 Comment: OK

A: SA-BSH catch

B: Finding viable r-k

C: Analysis of viable r-k

D: Pred. biomass vs observed

E: Exploitation rate

F: Equilibrium curve
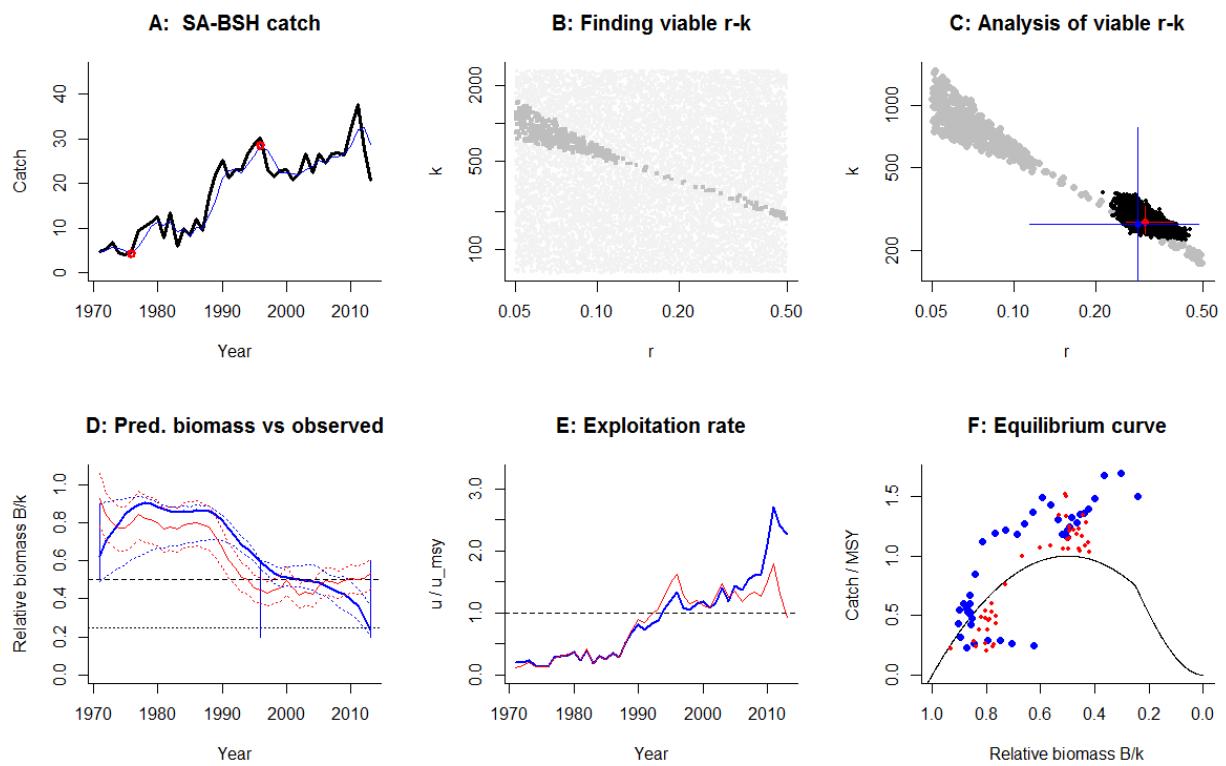
Appendix III. Simulated stock with catch and CPUE stocks

[CMSY_45y.R, SimCatchCPUE_6.csv, SimSpecCPUE_6.csv]

Process error: Sim=0.2, CMSY=0.1; Observation error: Sim=0.1, CMSY=0.1; q error: Sim=0.2, CMSY=NA

Species: NA , stock: HH_H

 Name and region: NA , NA

 Catch data used from years 1 - 50 , biomass = CPUE

 Prior initial relative biomass = 0.5 - 0.9

 Prior intermediate rel. biomass= 0.5 - 0.9 in year 25

 Prior final relative biomass   = 0.5 - 0.9

 Prior range for r = 0.6 - 1.5 , prior range for k = 332 - 4984

Prior range of q = 8.61e-06 - 2.72e-05

True values used in simulation: r = 1.13 , k = 1000 , MSY = 282, q = 1.0e-05

Results from Bayesian Schaefer model using catch & CPUE

 r = 1.05 , 95% CL = 0.975 - 1.15 , k = 924 , 95% CL = 804 - 6945

 MSY = 244 , 95% CL = 216 - 1832

q = 1.31e-05 , lcl = 1.02e-05 , ucl = 1.63e-05

 Biomass in last year from q*CPUE = 498 or 0.539 k

 Exploitation rate in last year = 0.448

 Results of CMSY analysis with altogether 43030 viable trajectories for 4429 r-k pairs

 r = 1.19 , 95% CL = 0.957 - 1.48 , k = 1264 , 95% CL = 717 - 2227

 MSY = 376 , 95% CL = 190 - 745

Relative biomass last year= 0.822 k, 2.5th = 0.606 , 97.5th = 0.897

Relative biomass next year= 0.813 k, 2.5th = 0.585 , 97.5th = 0.91

Relative exploitation rate in last year= 0.351
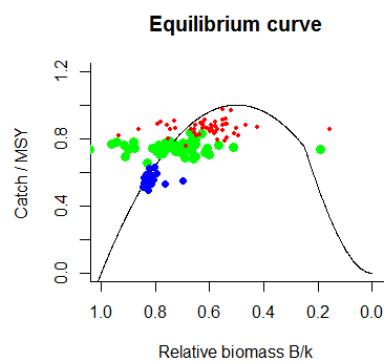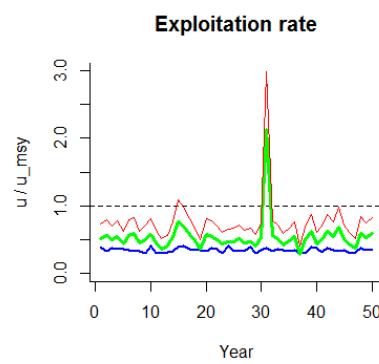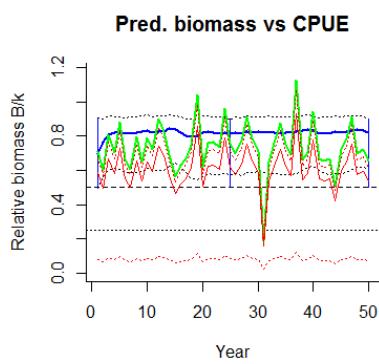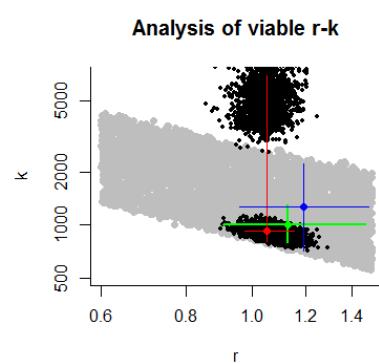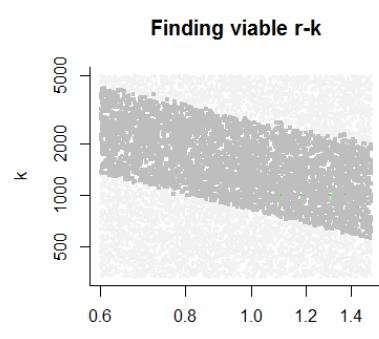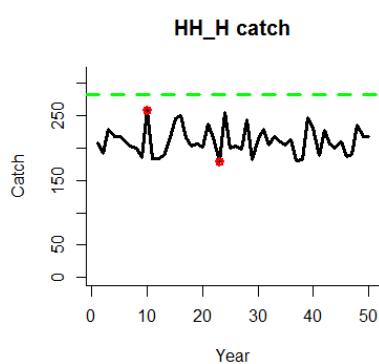
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Species: NA , stock: HH_L
 Name and region: NA , NA
 Catch data used from years 1 - 50 , biomass = CPUE
 Prior initial relative biomass = 0.5 - 0.9
 Prior intermediate rel. biomass= 0.5 - 0.9 in year 25
 Prior final relative biomass   = 0.5 - 0.9
 Prior range for r = 0.05 - 0.5 , prior range for k = 248 - 14890
Prior range of q = 4.91e-06 - 3.11e-05
True values used in simulation: r = 0.278 , k = 1000 , MSY = 69.5, q = 1.0e-05
Results from Bayesian Schaefer model using catch & CPUE
 r = 0.275 , 95% CL = 0.232 - 0.325 , k = 929 , 95% CL = 745 - 1240
 MSY = 63.6 , 95% CL = 51.8 - 86.4
q = 1.1e-05 , lcl = 7.34e-06 , ucl = 1.54e-05
 Biomass in last year from q*CPUE = 520 or 0.56 k
 Exploitation rate in last year = 0.102
 Results of CMSY analysis with altogether 30950 viable trajectories for 3170 r-k pairs
 r = 0.282 , 95% CL = 0.163 - 0.487 , k = 1234 , 95% CL = 507 - 3005
 MSY = 87.1 , 95% CL = 44.4 - 171
 Relative biomass last year= 0.799 k, 2.5th = 0.536 , 97.5th = 0.893
 Relative biomass next year= 0.801 k, 2.5th = 0.534 , 97.5th = 0.895
 Relative exploitation rate in last year= 0.343
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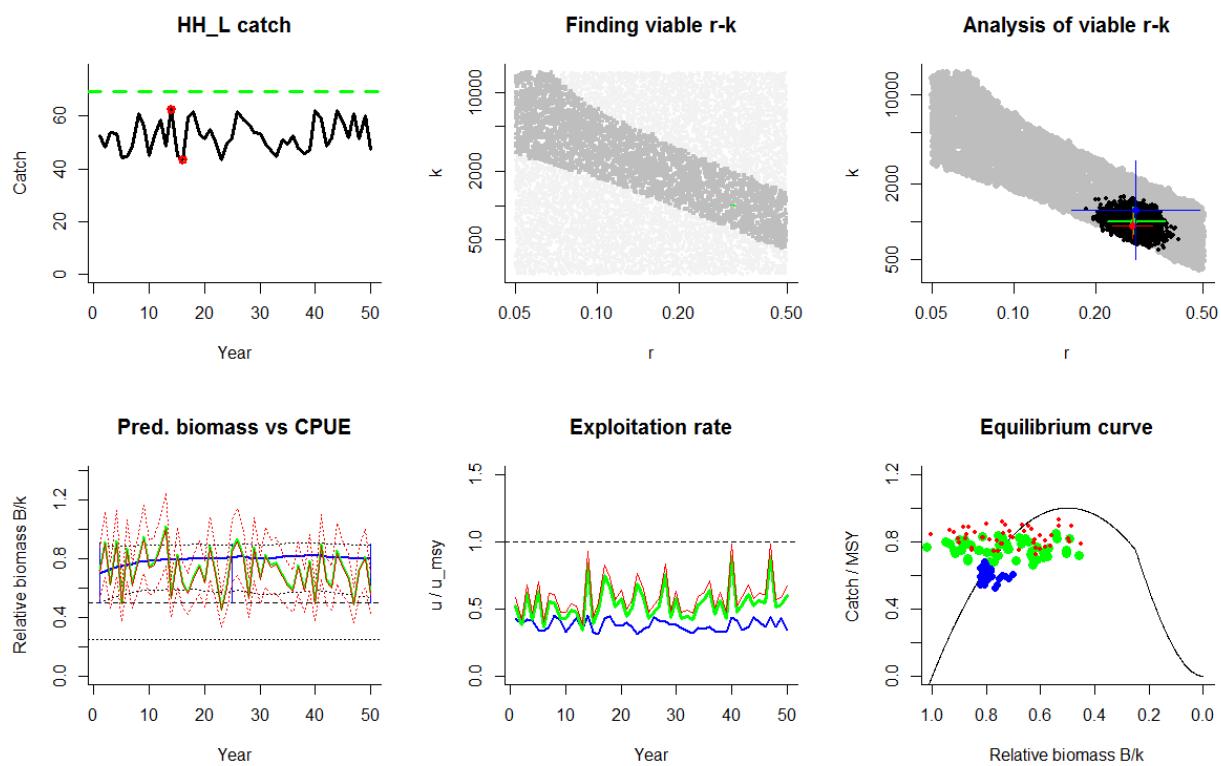
Species: NA , stock: HH_M
 Name and region: NA , NA
 Catch data used from years 1 - 50 , biomass = CPUE
 Prior initial relative biomass = 0.5 - 0.9
 Prior intermediate rel. biomass= 0.5 - 0.9 in year 25
 Prior final relative biomass   = 0.5 - 0.9
 Prior range for r = 0.2 - 0.8 , prior range for k = 193 - 4638
Prior range of q = 1.09e-05 - 4.36e-05
True values used in simulation: r = 0.352 , k = 1000 , MSY = 88, q = 1.0e-05
Results from Bayesian Schaefer model using catch & CPUE
 r = 0.502 , 95% CL = 0.449 - 0.577 , k = 609 , 95% CL = 517 - 745
 MSY = 76.7 , 95% CL = 66.2 - 95.3
q = 1.8e-05 , lcl = 1.33e-05 , ucl = 2.38e-05
 Biomass in last year from q*CPUE = 360 or 0.59 k
 Exploitation rate in last year = 0.179
 Results of CMSY analysis with altogether 36520 viable trajectories for 3625 r-k pairs
 r = 0.566 , 95% CL = 0.407 - 0.785 , k = 797 , 95% CL = 412 - 1541
 MSY = 113 , 95% CL = 58.7 - 216
 Relative biomass last year= 0.818 k, 2.5th = 0.57 , 97.5th = 0.897
 Relative biomass next year= 0.819 k, 2.5th = 0.573 , 97.5th = 0.902
 Relative exploitation rate in last year= 0.375
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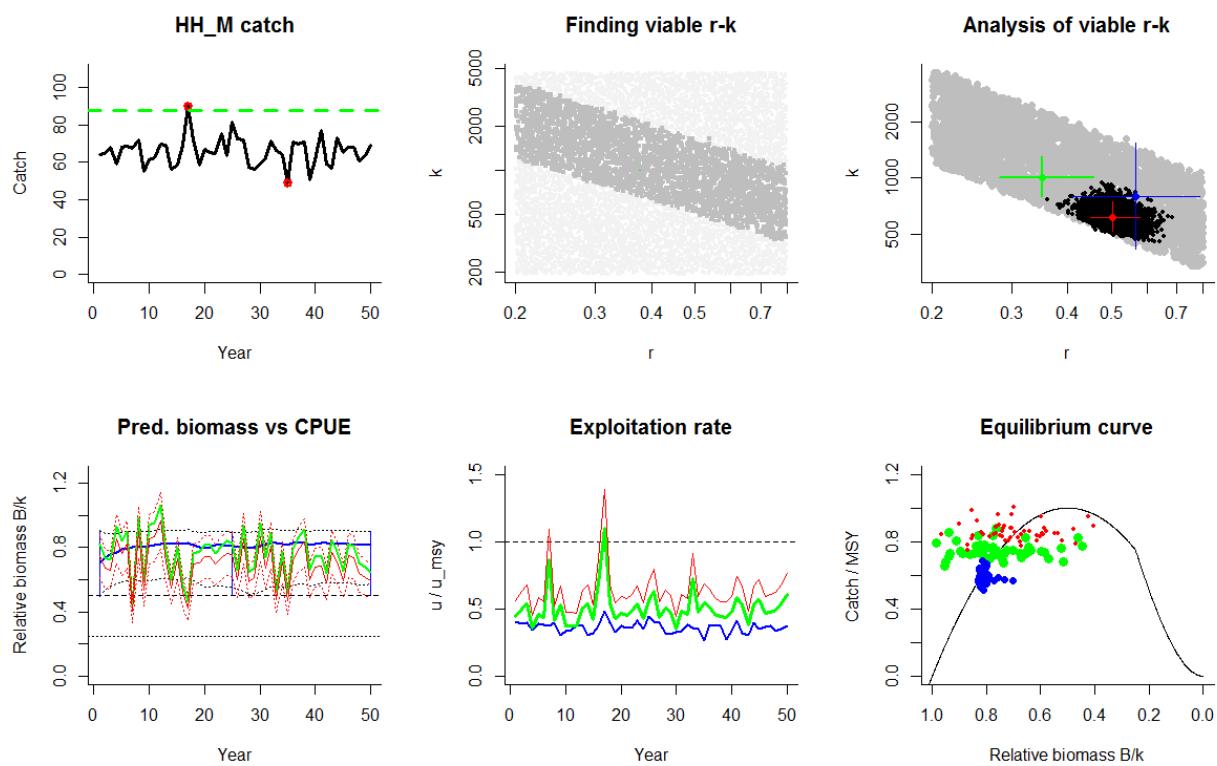
Species: NA , stock: HH_VL
 Name and region: NA , NA
 Catch data used from years 1 - 50 , biomass = CPUE
 Prior initial relative biomass = 0.5 - 0.9
 Prior intermediate rel. biomass= 0.5 - 0.9 in year 25
 Prior final relative biomass   = 0.5 - 0.9
 Prior range for r = 0.015 - 0.1 , prior range for k = 199 - 7966
Prior range of q = 8.06e-06 - 4.16e-05
True values used in simulation: r = 0.047 , k = 1000 , MSY = 11.8, q = 1.0e-05
Results from Bayesian Schaefer model using catch & CPUE
 r = 0.0588 , 95% CL = 0.0313 - 0.137 , k = 662 , 95% CL = 450 - 982
 MSY = 9.96 , 95% CL = 5.51 - 19.8
q = 1.57e-05 , lcl = 1.09e-05 , ucl = 2.26e-05
 Biomass in last year from q*CPUE = 448 or 0.677 k
 Exploitation rate in last year = 0.0198
 Results of CMSY analysis with altogether 53001 viable trajectories for 6272 r-k pairs
 r = 0.062 , 95% CL = 0.0397 - 0.097 , k = 1231 , 95% CL = 387 - 3918
 MSY = 19.1 , 95% CL = 4.73 - 77
 Relative biomass last year= 0.798 k, 2.5th = 0.521 , 97.5th = 0.898
 Relative biomass next year= 0.799 k, 2.5th = 0.519 , 97.5th = 0.898
 Relative exploitation rate in last year= 0.317
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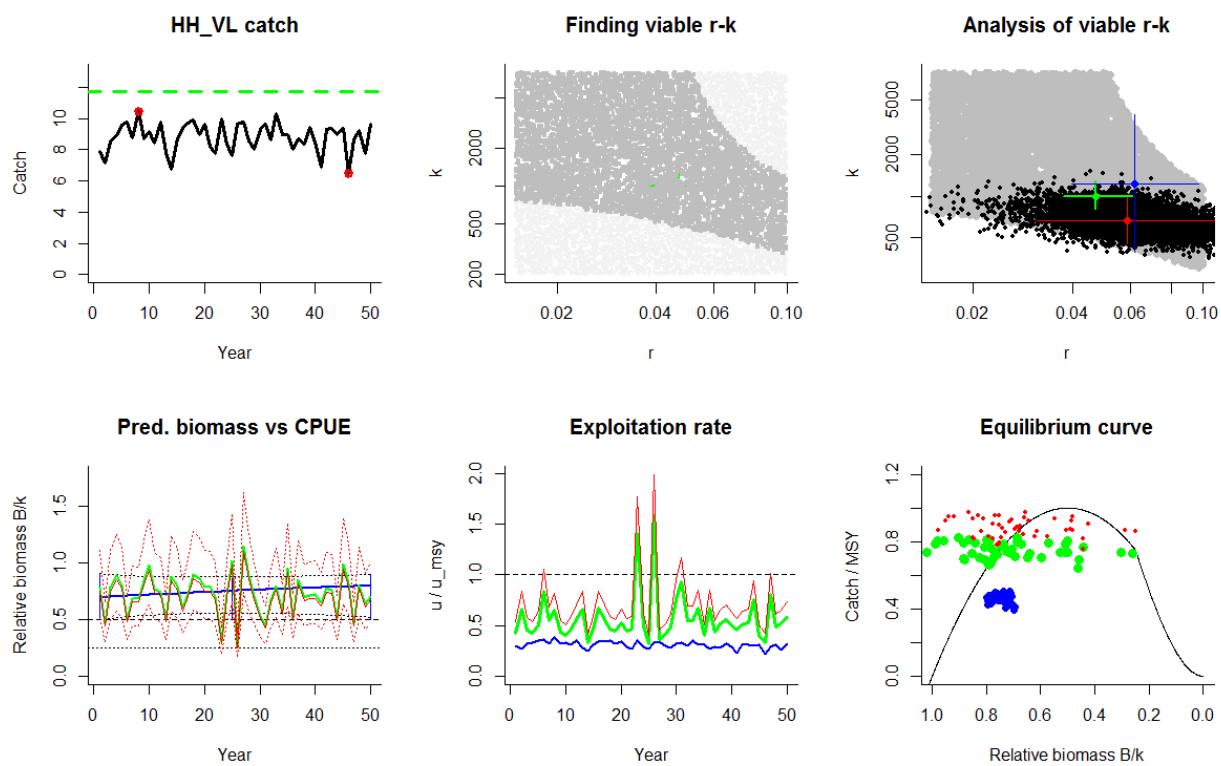
Species: NA , stock: HL_H
 Name and region: NA , NA
 Catch data used from years 1 - 50 , biomass = CPUE
 Prior initial relative biomass = 0.5 - 0.9
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 25
 Prior final relative biomass = 0.01 - 0.4
 Prior range for r = 0.6 - 1.5 , prior range for k = 191 - 1913
Prior range of q = 8.24e-06 - 2.6e-05
True values used in simulation: r = 0.86 , k = 1000 , MSY = 215, q = 1.0e-05
Results from Bayesian Schaefer model using catch & CPUE
 r = 1.06 , 95% CL = 0.982 - 1.16 , k = 843 , 95% CL = 770 - 913
 MSY = 223 , 95% CL = 214 - 233
q = 1.14e-05 , lcl = 1.02e-05 , ucl = 1.27e-05
 Biomass in last year from q*CPUE = 280 or 0.333 k
 Exploitation rate in last year = 0.564
 Results of CMSY analysis with altogether 81 viable trajectories for 81 r-k pairs
 r = 1.01 , 95% CL = 0.833 - 1.44 , k = 897 , 95% CL = 601 - 1138
 MSY = 226 , 95% CL = 207 - 247
 Relative biomass last year= 0.321 k, 2.5th = 0.0349 , 97.5th = 0.392
 Relative biomass next year= 0.349 k, 2.5th = -0.162 , 97.5th = 0.585
 Relative exploitation rate in last year= 1.05
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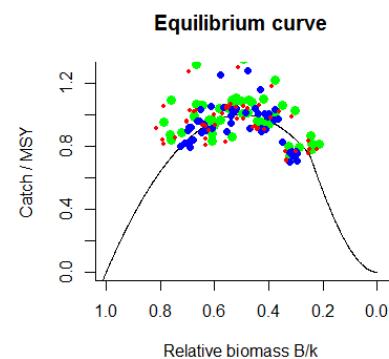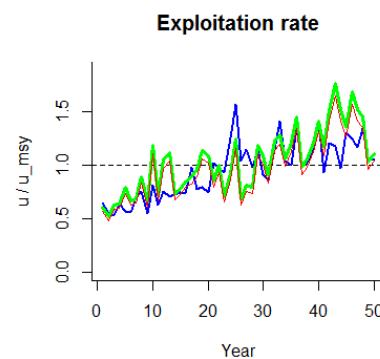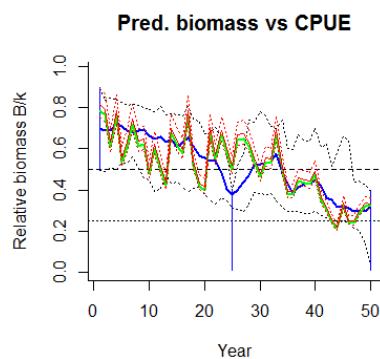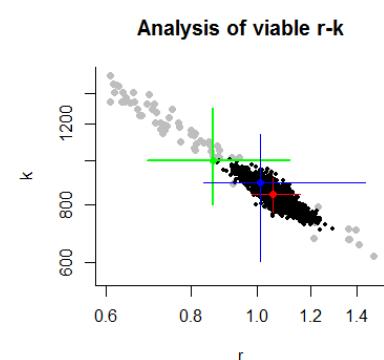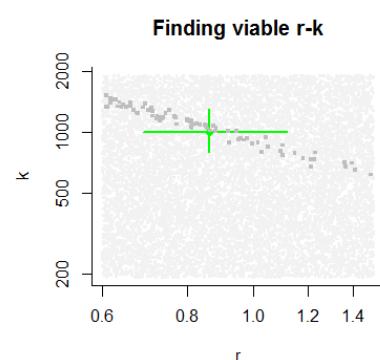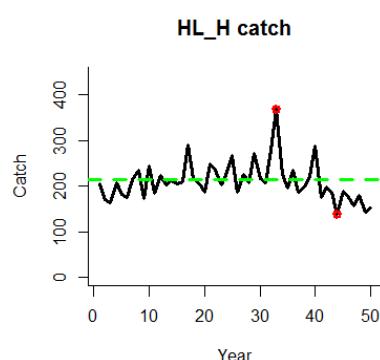
Species: NA , stock: HL_L
 Name and region: NA , NA
 Catch data used from years 1 - 50 , biomass = CPUE
 Prior initial relative biomass = 0.5 - 0.9
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 25
 Prior final relative biomass   = 0.01 - 0.4
 Prior range for r = 0.05 - 0.5 , prior range for k = 194 - 7754
Prior range of q = 3.09e-06 - 1.95e-05
True values used in simulation: r = 0.29 , k = 1000 , MSY = 72.5, q = 1.0e-05
Results from Bayesian Schaefer model using catch & CPUE
 r = 0.265 , 95% CL = 0.212 - 0.299 , k = 1124 , 95% CL = 955 - 1406
 MSY = 73.7 , 95% CL = 64.4 - 85.4
q = 8.58e-06 , lcl = 7.03e-06 , ucl = 9.87e-06
 Biomass in last year from q*CPUE = 87.4 or 0.0777 k
 Exploitation rate in last year = 0.164
 Results of CMSY analysis with altogether 3159 viable trajectories for 1529 r-k pairs
 r = 0.229 , 95% CL = 0.142 - 0.368 , k = 1206 , 95% CL = 704 - 2068
 MSY = 69 , 95% CL = 60.9 - 78.2
 Relative biomass last year= 0.221 k, 2.5th = 0.0201 , 97.5th = 0.395
 Relative biomass next year= 0.242 k, 2.5th = 0.00941 , 97.5th = 0.431
 Relative exploitation rate in last year= 0.381
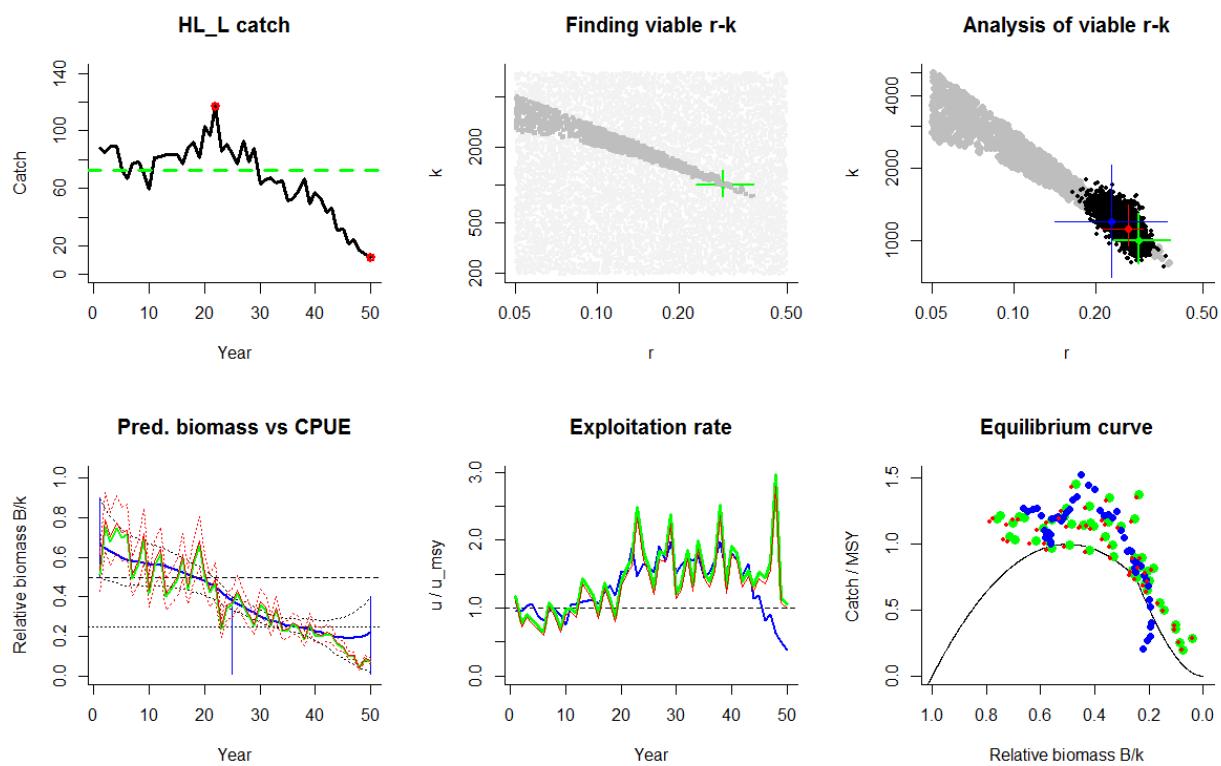
Species: NA , stock: HL_M
 Name and region: NA , NA
 Catch data used from years 1 - 50 , biomass = CPUE
 Prior initial relative biomass = 0.5 - 0.9
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 25
 Prior final relative biomass   = 0.01 - 0.4
 Prior range for r = 0.2 - 0.8 , prior range for k = 192 - 3079
Prior range of q = 3.27e-06 - 1.31e-05
True values used in simulation: r = 0.48 , k = 1000 , MSY = 120, q = 1.0e-05
Results from Bayesian Schaefer model using catch & CPUE
 r = 0.498 , 95% CL = 0.436 - 0.557 , k = 887 , 95% CL = 670 - 1221
 MSY = 110 , 95% CL = 81.5 - 154
q = 6.07e-06 , lcl = 4.54e-06 , ucl = 7.86e-06
 Biomass in last year from q*CPUE = 2.13 or 0.0024 k
 Exploitation rate in last year = 0.372
 Results of CMSY analysis with altogether 1400 viable trajectories for 1045 r-k pairs
 r = 0.463 , 95% CL = 0.355 - 0.649 , k = 1008 , 95% CL = 692 - 1366
 MSY = 117 , 95% CL = 108 - 126
 Relative biomass last year= 0.0962 k, 2.5th = 0.0128 , 97.5th = 0.37
 Relative biomass next year= 0.106 k, 2.5th = 0.0125 , 97.5th = 0.468
 Relative exploitation rate in last year= 0.0198
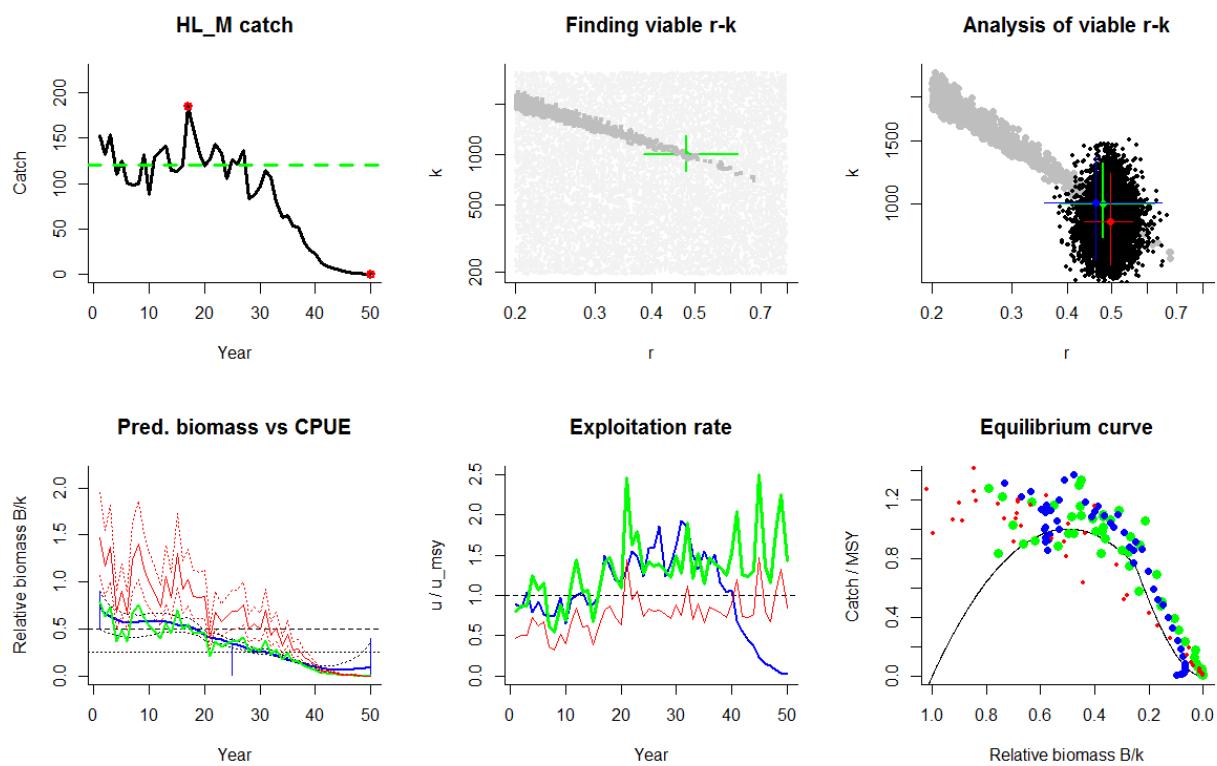
Species: NA , stock: HL_VL
 Name and region: NA , NA
 Catch data used from years 1 - 50 , biomass = CPUE
 Prior initial relative biomass = 0.5 - 0.9
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 25
 Prior final relative biomass   = 0.01 - 0.4
 Prior range for r = 0.015 - 0.1 , prior range for k = 481 - 12824
Prior range of q = 2.13e-06 - 1.1e-05
True values used in simulation: r = 0.068 , k = 1000 , MSY = 17, q = 1.0e-05
Results from Bayesian Schaefer model using catch & CPUE
 r = 0.0284 , 95% CL = 0.0101 - 0.0581 , k = 1901 , 95% CL = 1324 - 2952
 MSY = 13.5 , 95% CL = 5.23 - 28.6
q = 6e-06 , lcl = 4.23e-06 , ucl = 7.96e-06
 Biomass in last year from q*CPUE = 100 or 0.0526 k
 Exploitation rate in last year = 0.0553
 Results of CMSY analysis with altogether 8536 viable trajectories for 2463 r-k pairs
 r = 0.062 , 95% CL = 0.0397 - 0.097 , k = 1167 , 95% CL = 600 - 2268
 MSY = 18.1 , 95% CL = 11.8 - 27.8
 Relative biomass last year= 0.266 k, 2.5th = 0.0158 , 97.5th = 0.397
 Relative biomass next year= 0.272 k, 2.5th = 0.0106 , 97.5th = 0.406
 Relative exploitation rate in last year= 0.51
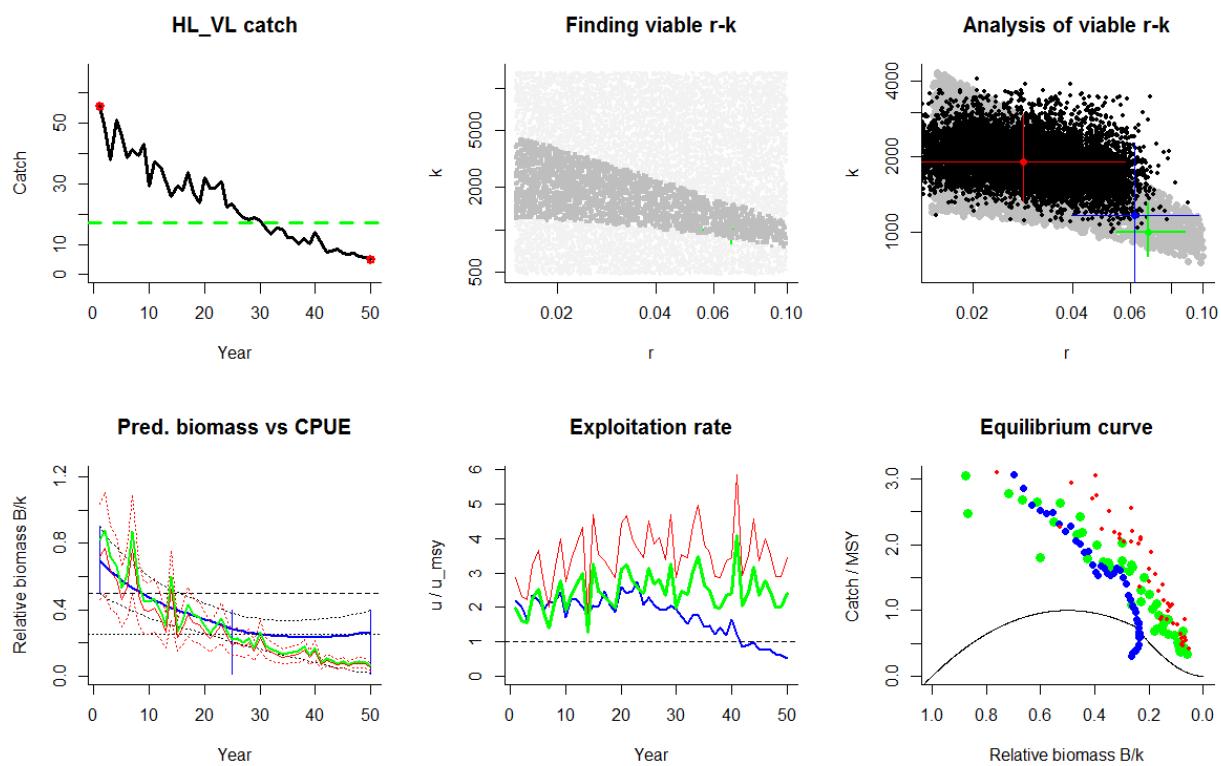
Species: NA , stock: HLH_H
 Name and region: NA , NA
 Catch data used from years 1 - 50 , biomass = CPUE
 Prior initial relative biomass = 0.5 - 0.9
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 25
 Prior final relative biomass   = 0.5 - 0.9
 Prior range for r = 0.6 - 1.5 , prior range for k = 430 - 6454
Prior range of q = 9.76e-06 - 3.09e-05
True values used in simulation: r = 1.05 , k = 1000 , MSY = 262, q = 1.0e-05
Results from Bayesian Schaefer model using catch & CPUE
 r = 1.06 , 95% CL = 0.988 - 1.17 , k = 984 , 95% CL = 892 - 1072
 MSY = 261 , 95% CL = 247 - 278
q = 9.66e-06 , lcl = 8.46e-06 , ucl = 1.1e-05
 Biomass in last year from q*CPUE = 743 or 0.755 k
 Exploitation rate in last year = 0.249
 Results of CMSY analysis with altogether 1813 viable trajectories for 1340 r-k pairs
 r = 1.1 , 95% CL = 0.905 - 1.38 , k = 956 , 95% CL = 725 - 1210
 MSY = 262 , 95% CL = 241 - 285
 Relative biomass last year= 0.776 k, 2.5th = 0.713 , 97.5th = 0.835
 Relative biomass next year= 0.772 k, 2.5th = 0.699 , 97.5th = 0.823
 Relative exploitation rate in last year= 0.468
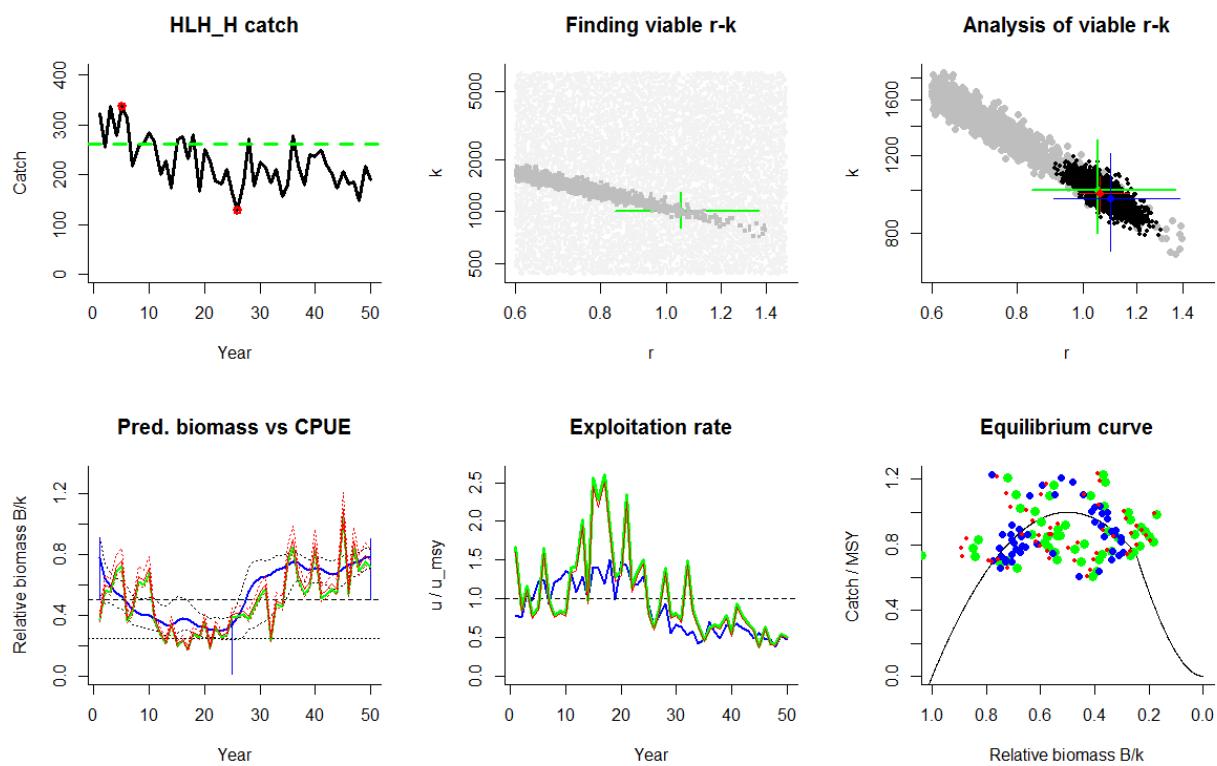
Species: NA , stock: HLH_L
 Name and region: NA , NA
 Catch data used from years 1 - 50 , biomass = CPUE
 Prior initial relative biomass = 0.5 - 0.9
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 25
 Prior final relative biomass = 0.5 - 0.9
 Prior range for r = 0.05 - 0.5 , prior range for k = 403 - 24154
Prior range of q = 6.75e-06 - 4.27e-05
True values used in simulation: r = 0.24 , k = 1000 , MSY = 60, q = 1.0e-05
Results from Bayesian Schaefer model using catch & CPUE
 r = 0.277 , 95% CL = 0.245 - 0.319 , k = 915 , 95% CL = 781 - 1114
 MSY = 63.5 , 95% CL = 56.2 - 75.1
q = 9.97e-06 , lcl = 8.44e-06 , ucl = 1.16e-05
 Biomass in last year from q*CPUE = 828 or 0.905 k
 Exploitation rate in last year = 0.0475
 Results of CMSY analysis with altogether 2392 viable trajectories for 800 r-k pairs
 r = 0.274 , 95% CL = 0.16 - 0.478 , k = 943 , 95% CL = 490 - 1776
 MSY = 64.5 , 95% CL = 53.4 - 78
 Relative biomass last year= 0.82 k, 2.5th = 0.606 , 97.5th = 0.869
 Relative biomass next year= 0.817 k, 2.5th = 0.619 , 97.5th = 0.863
 Relative exploitation rate in last year= 0.369
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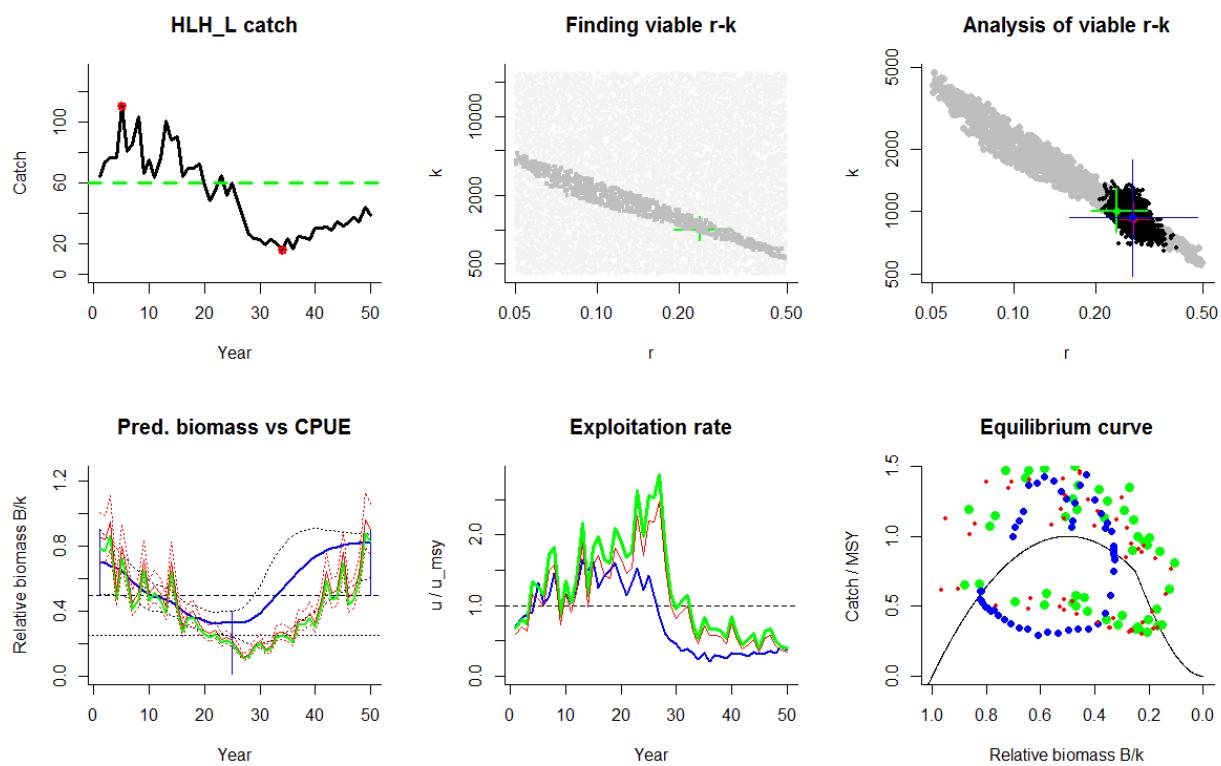
Species: NA , stock: HLH_M
 Name and region: NA , NA
 Catch data used from years 1 - 50 , biomass = CPUE
 Prior initial relative biomass = 0.5 - 0.9
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 25
 Prior final relative biomass   = 0.5 - 0.9
 Prior range for r = 0.2 - 0.8 , prior range for k = 301 - 7236
Prior range of q = 1.26e-05 - 5.04e-05
True values used in simulation: r = 0.32 , k = 1000 , MSY = 80, q = 1.0e-05
Results from Bayesian Schaefer model using catch & CPUE
 r = 0.501 , 95% CL = 0.45 - 0.562 , k = 645 , 95% CL = 569 - 726
 MSY = 80.9 , 95% CL = 75 - 87.2
q = 1.47e-05 , lcl = 1.27e-05 , ucl = 1.7e-05
 Biomass in last year from q*CPUE = 547 or 0.849 k
 Exploitation rate in last year = 0.106
 Results of CMSY analysis with altogether 1552 viable trajectories for 559 r-k pairs
 r = 0.533 , 95% CL = 0.391 - 0.781 , k = 639 , 95% CL = 411 - 924
 MSY = 85.1 , 95% CL = 75.7 - 95.7
 Relative biomass last year= 0.776 k, 2.5th = 0.709 , 97.5th = 0.816
 Relative biomass next year= 0.774 k, 2.5th = 0.72 , 97.5th = 0.82
 Relative exploitation rate in last year= 0.467
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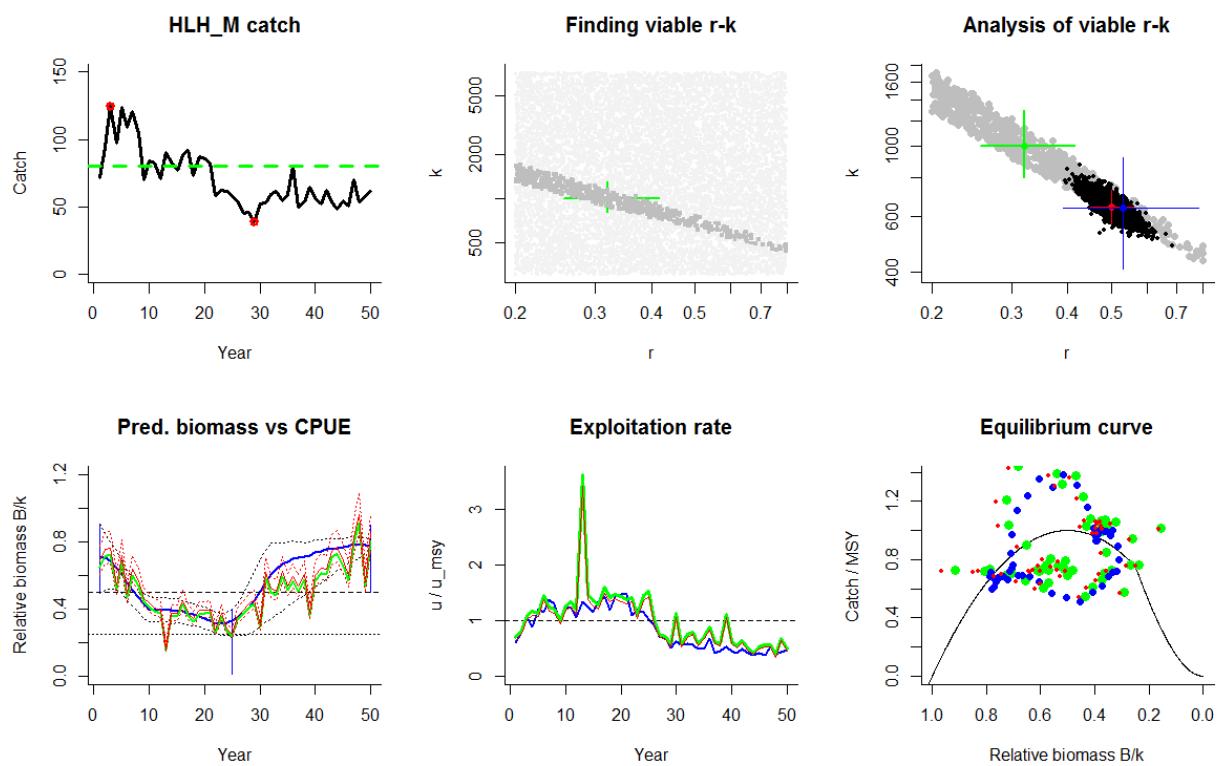
Species: NA , stock: HLH_VL
 Name and region: NA , NA
 Catch data used from years 1 - 50 , biomass = CPUE
 Prior initial relative biomass = 0.5 - 0.9
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 25
 Prior final relative biomass   = 0.5 - 0.9
 Prior range for r = 0.015 - 0.1 , prior range for k = 821 - 65668
Prior range of q = 3.41e-05 - 0.000176
True values used in simulation: r = 0.058 , k = 1000 , MSY = 14.5, q = 1.0e-05
Results from Bayesian Schaefer model using catch & CPUE
 r = 0.0576 , 95% CL = 0.0229 - 0.141 , k = 3661 , 95% CL = 2350 - 6237
 MSY = 53.1 , 95% CL = 19.5 - 144
q = 6.99e-05 , lcl = 4.25e-05 , ucl = 9.85e-05
 Biomass in last year from q*CPUE = 105 or 0.0288 k
 Exploitation rate in last year = 0.019
 Results of CMSY analysis with altogether 4960 viable trajectories for 2679 r-k pairs
 r = 0.0649 , 95% CL = 0.0433 - 0.0972 , k = 1342 , 95% CL = 680 - 2647
 MSY = 21.8 , 95% CL = 12.7 - 37.4
 Relative biomass last year= 0.649 k, 2.5th = 0.51 , 97.5th = 0.82
 Relative biomass next year= 0.66 k, 2.5th = 0.523 , 97.5th = 0.832
 Relative exploitation rate in last year= 0.0613
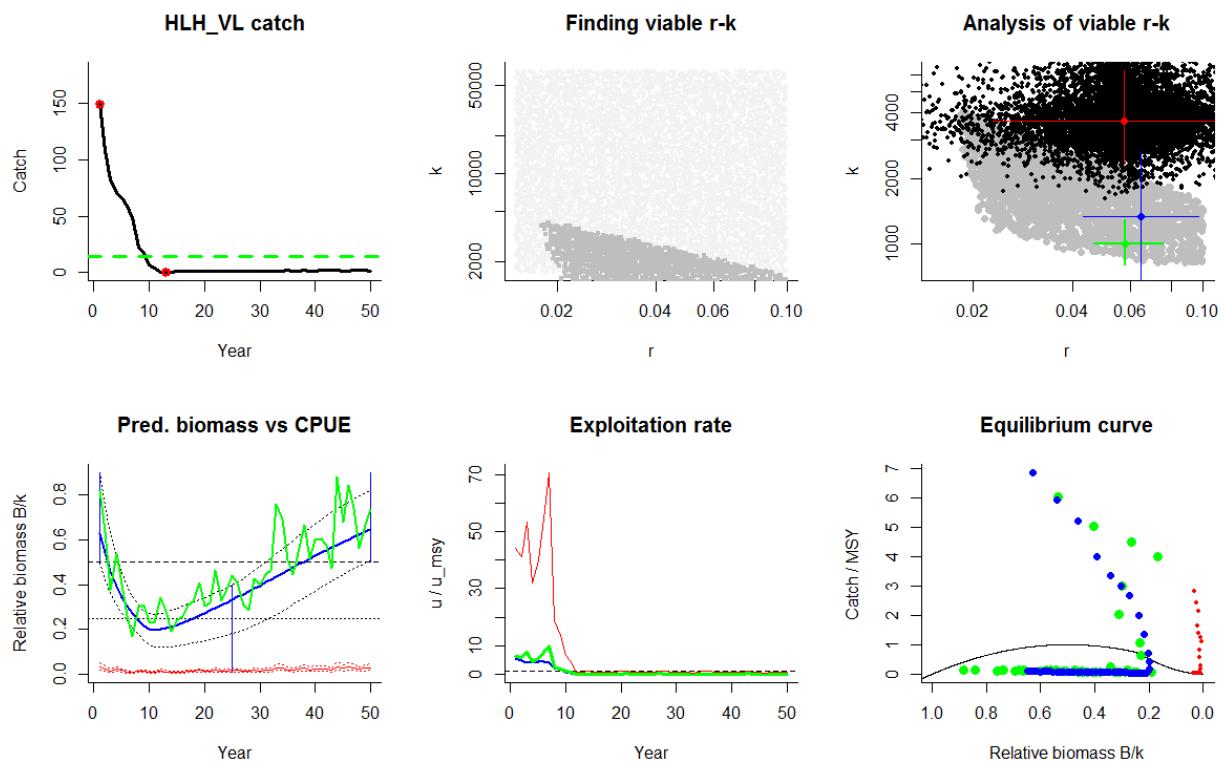
Species: NA , stock: LH_H
 Name and region: NA , NA
 Catch data used from years 1 - 50 , biomass = CPUE
 Prior initial relative biomass = 0.01 - 0.4
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 25
 Prior final relative biomass   = 0.5 - 0.9
 Prior range for r = 0.6 - 1.5 , prior range for k = 296 - 4438
Prior range of q = 1.13e-05 - 3.56e-05
True values used in simulation: r = 0.79 , k = 1000 , MSY = 198, q = 1.0e-05
Results from Bayesian Schaefer model using catch & CPUE
 r = 1.06 , 95% CL = 0.997 - 1.17 , k = 753 , 95% CL = 679 - 825
 MSY = 201 , 95% CL = 190 - 215
q = 1.23e-05 , lcl = 1.07e-05 , ucl = 1.41e-05
 Biomass in last year from q*CPUE = 589 or 0.781 k
 Exploitation rate in last year = 0.267
 Results of CMSY analysis with altogether 1909 viable trajectories for 1432 r-k pairs
 r = 1.19 , 95% CL = 0.962 - 1.48 , k = 660 , 95% CL = 510 - 854
 MSY = 197 , 95% CL = 182 - 214
 Relative biomass last year= 0.722 k, 2.5th = 0.64 , 97.5th = 0.793
 Relative biomass next year= 0.722 k, 2.5th = 0.632 , 97.5th = 0.796
 Relative exploitation rate in last year= 0.529
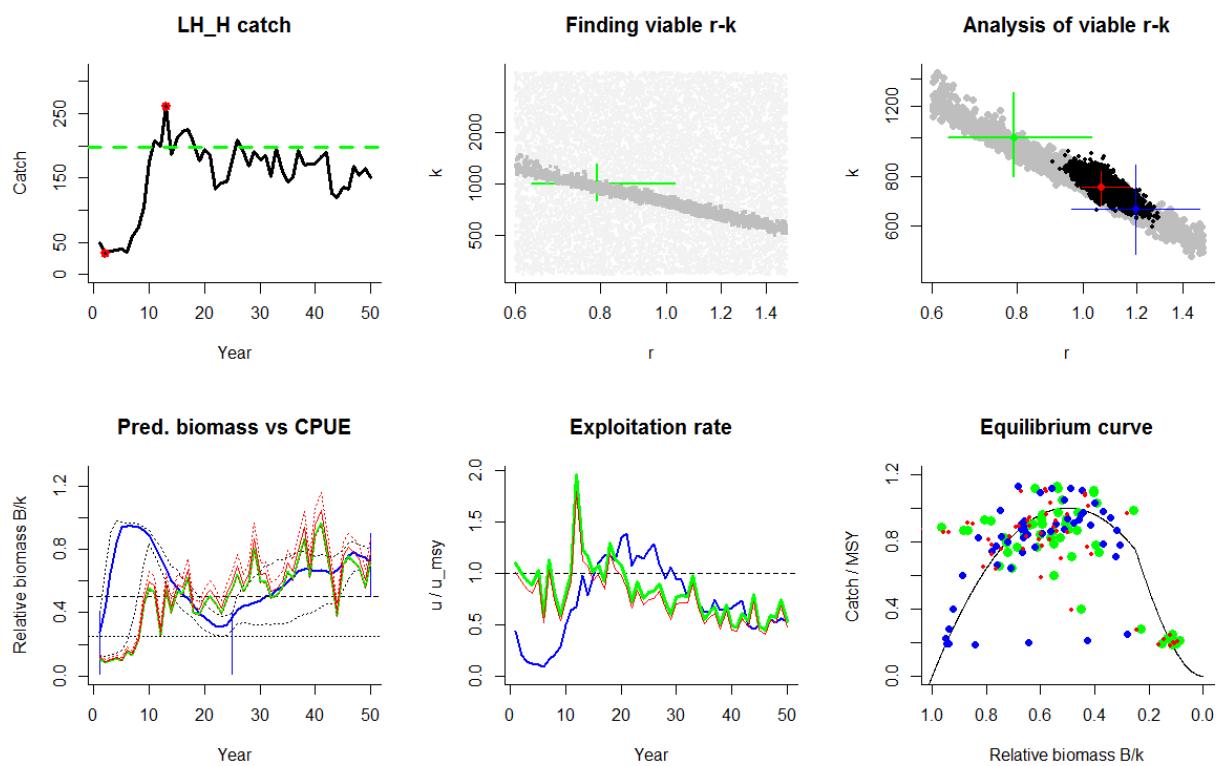
Species: NA , stock: LH_L
 Name and region: NA , NA
 Catch data used from years 1 - 50 , biomass = CPUE
 Prior initial relative biomass = 0.01 - 0.4
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 25
 Prior final relative biomass   = 0.5 - 0.9
 Prior range for r = 0.05 - 0.5 , prior range for k = 184 - 11070
Prior range of q = 6.56e-06 - 4.15e-05
True values used in simulation: r = 0.24 , k = 1000 , MSY = 60, q = 1.0e-05
Results from Bayesian Schaefer model using catch & CPUE
 r = 0.271 , 95% CL = 0.231 - 0.305 , k = 825 , 95% CL = 635 - 1140
 MSY = 55.6 , 95% CL = 44 - 73.7
q = 1.13e-05 , lcl = 8.31e-06 , ucl = 1.47e-05
 Biomass in last year from q*CPUE = 617 or 0.748 k
 Exploitation rate in last year = 0.0682
Results of CMSY analysis with altogether 3111 viable trajectories for 3079 r-k pairs
r = 0.262 , 95% CL = 0.155 - 0.465 , k = 2325 , 95% CL = 655 - 7830
MSY = 152 , 95% CL = 39.2 - 590
Relative biomass last year= 0.838 k, 2.5th = 0.529 , 97.5th = 0.897
Relative biomass next year= 0.845 k, 2.5th = 0.54 , 97.5th = 0.905
Relative exploitation rate in last year= 0.167
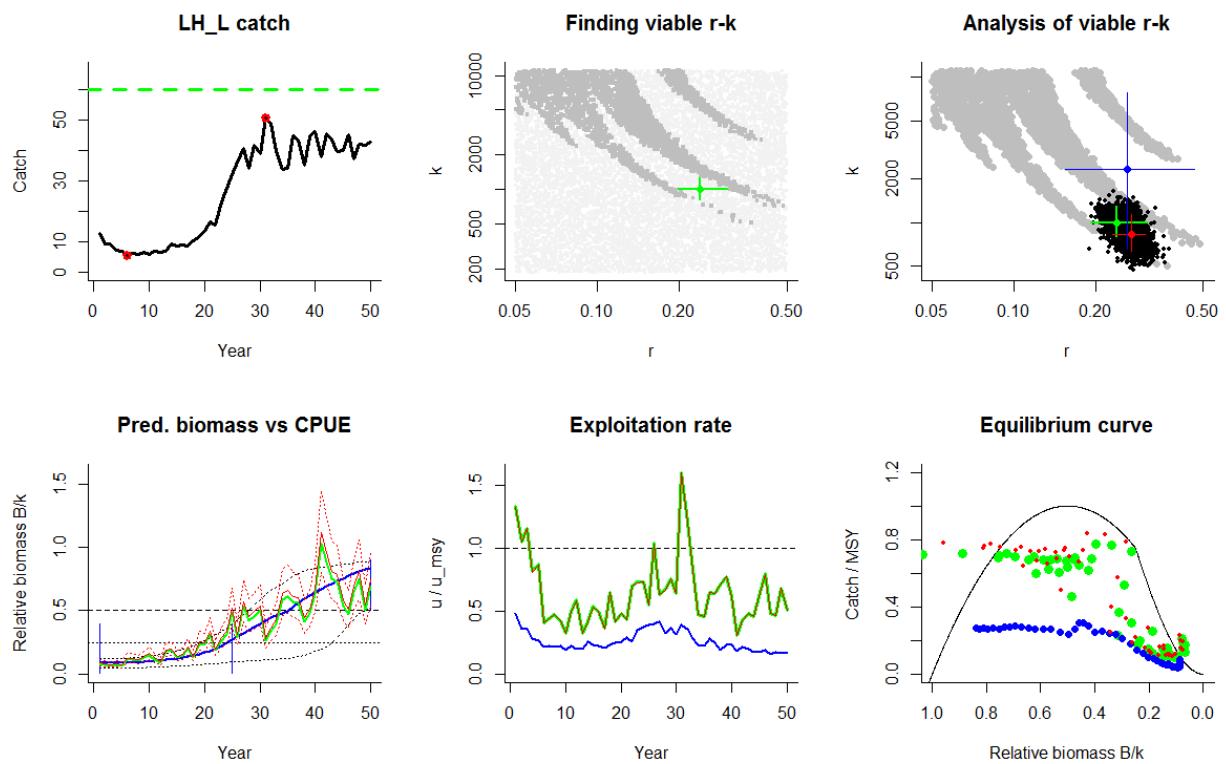
Species: NA , stock: LH_M
 Name and region: NA , NA
 Catch data used from years 1 - 50 , biomass = CPUE
 Prior initial relative biomass = 0.01 - 0.4
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 25
 Prior final relative biomass   = 0.5 - 0.9
 Prior range for r = 0.2 - 0.8 , prior range for k = 449 - 10787
Prior range of q = 5.46e-06 - 2.18e-05
True values used in simulation: r = 0.71 , k = 1000 , MSY = 178, q = 1.0e-05
Results from Bayesian Schaefer model using catch & CPUE
 r = 0.531 , 95% CL = 0.482 - 0.628 , k = 1290 , 95% CL = 1070 - 1516
 MSY = 172 , 95% CL = 156 - 194
q = 7.34e-06 , lcl = 5.89e-06 , ucl = 9.04e-06
 Biomass in last year from q*CPUE = 1338 or 1.04 k
 Exploitation rate in last year = 0.105
 Results of CMSY analysis with altogether 2065 viable trajectories for 1674 r-k pairs
 r = 0.567 , 95% CL = 0.405 - 0.785 , k = 1178 , 95% CL = 663 - 2116
 MSY = 167 , 95% CL = 102 - 273
 Relative biomass last year= 0.657 k, 2.5th = 0.517 , 97.5th = 0.826
 Relative biomass next year= 0.651 k, 2.5th = 0.513 , 97.5th = 0.826
 Relative exploitation rate in last year= 0.612
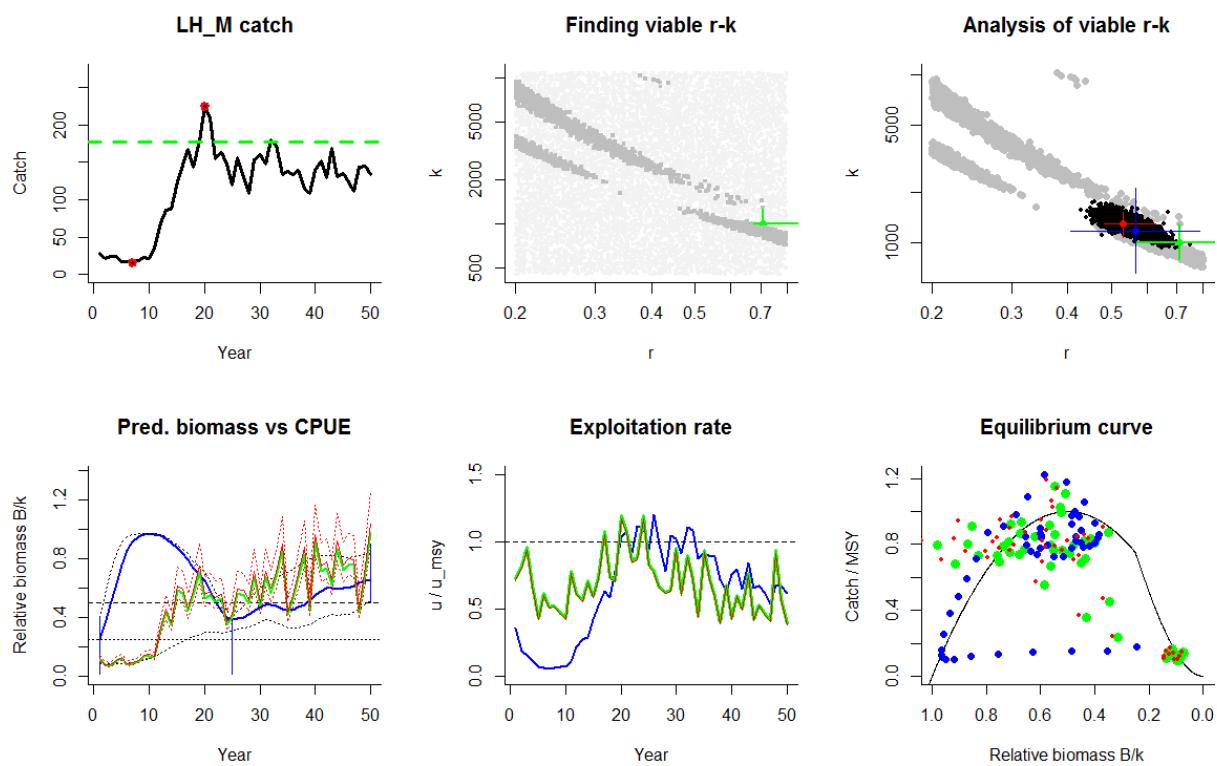
Species: NA , stock: LH_VL
 Name and region: NA , NA
 Catch data used from years 1 - 50 , biomass = CPUE
 Prior initial relative biomass = 0.01 - 0.4
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 25
 Prior final relative biomass   = 0.5 - 0.9
 Prior range for r = 0.015 - 0.1 , prior range for k = 22.9 - 915
Prior range of q = 5.39e-05 - 0.000278
True values used in simulation: r = 0.039 , k = 1000 , MSY = 9.75, q = 1.0e-05
Results from Bayesian Schaefer model using catch & CPUE
 r = 0.0644 , 95% CL = 0.0459 - 0.0951 , k = 135 , 95% CL = 72.4 - 265
 MSY = 2.14 , 95% CL = 1.2 - 4.76
q = 0.000102 , lcl = 7.06e-05 , ucl = 0.000146
 Biomass in last year from q*CPUE = 73.9 or 0.548 k
 Exploitation rate in last year = 0.014
 Results of CMSY analysis with altogether 4315 viable trajectories for 3643 r-k pairs
 r = 0.0682 , 95% CL = 0.0478 - 0.0974 , k = 287 , 95% CL = 98.2 - 839
 MSY = 4.89 , 95% CL = 1.2 - 19.9
 Relative biomass last year= 0.626 k, 2.5th = 0.505 , 97.5th = 0.822
 Relative biomass next year= 0.637 k, 2.5th = 0.515 , 97.5th = 0.833
 Relative exploitation rate in last year= 0.173
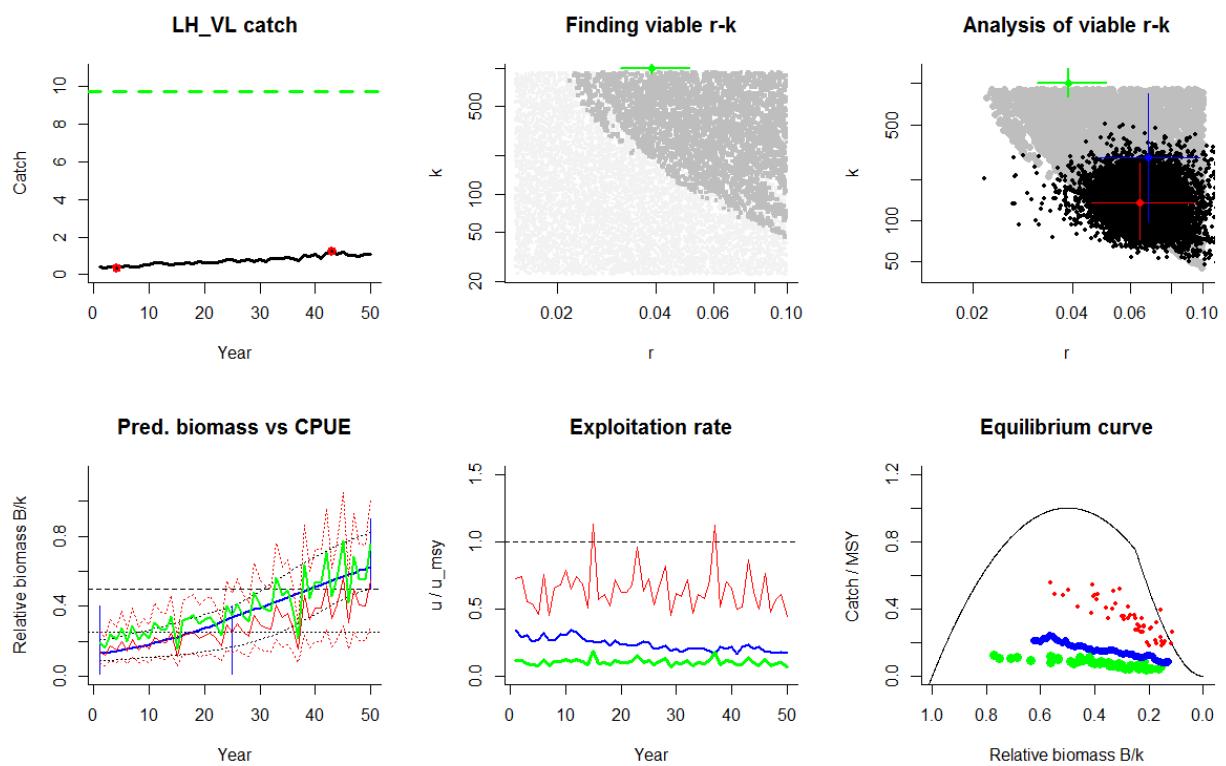
Species: NA , stock: LHL_H
 Name and region: NA , NA
 Catch data used from years 1 - 50 , biomass = CPUE
 Prior initial relative biomass = 0.01 - 0.4
 Prior intermediate rel. biomass= 0.2 - 0.6 in year 25
 Prior final relative biomass   = 0.01 - 0.4
 Prior range for r = 0.6 - 1.5 , prior range for k = 261 - 2610
Prior range of q = 5.23e-06 - 1.65e-05
True values used in simulation: r = 1.19 , k = 1000 , MSY = 298, q = 1.0e-05
Results from Bayesian Schaefer model using catch & CPUE
 r = 1.04 , 95% CL = 0.944 - 1.12 , k = 1149 , 95% CL = 1057 - 1278
 MSY = 298 , 95% CL = 282 - 321
q = 7.83e-06 , lcl = 6.3e-06 , ucl = 9.49e-06
 Biomass in last year from q*CPUE = 360 or 0.313 k
 Exploitation rate in last year = 0.793
 Results of CMSY analysis with altogether 1061 viable trajectories for 477 r-k pairs
 r = 1.19 , 95% CL = 0.962 - 1.48 , k = 1039 , 95% CL = 803 - 1344
 MSY = 310 , 95% CL = 286 - 336
 Relative biomass last year= 0.271 k, 2.5th = 0.0214 , 97.5th = 0.394
 Relative biomass next year= 0.23 k, 2.5th = -0.252 , 97.5th = 0.437
 Relative exploitation rate in last year= 1.71
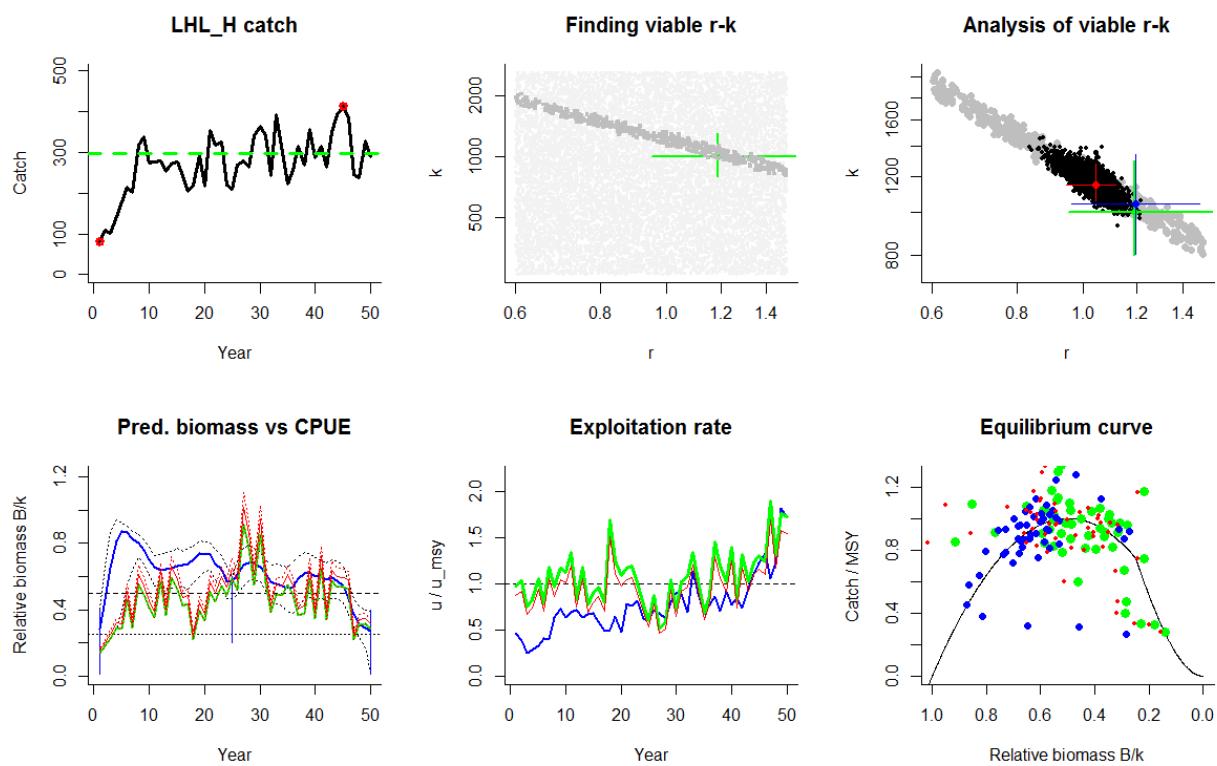
Species: NA , stock: LHL_L
 Name and region: NA , NA
 Catch data used from years 1 - 50 , biomass = CPUE
 Prior initial relative biomass = 0.01 - 0.4
 Prior intermediate rel. biomass= 0.2 - 0.6 in year 25
 Prior final relative biomass   = 0.01 - 0.4
 Prior range for r = 0.05 - 0.5 , prior range for k = 263 - 10526
Prior range of q = 3.08e-06 - 1.95e-05
True values used in simulation: r = 0.33 , k = 1000 , MSY = 82.5, q = 1.0e-05
Results from Bayesian Schaefer model using catch & CPUE
 r = 0.279 , 95% CL = 0.247 - 0.328 , k = 1137 , 95% CL = 957 - 1377
 MSY = 80 , 95% CL = 69.5 - 93.6
q = 8.64e-06 , lcl = 7.1e-06 , ucl = 1.02e-05
 Biomass in last year from q*CPUE = 137 or 0.12 k
 Exploitation rate in last year = 0.295
 Results of CMSY analysis with altogether 3816 viable trajectories for 2192 r-k pairs
 r = 0.197 , 95% CL = 0.128 - 0.388 , k = 1596 , 95% CL = 703 - 2822
 MSY = 78.5 , 95% CL = 59.4 - 104
 Relative biomass last year= 0.259 k, 2.5th = 0.021 , 97.5th = 0.394
 Relative biomass next year= 0.269 k, 2.5th = 0.00176 , 97.5th = 0.412
 Relative exploitation rate in last year= 0.786
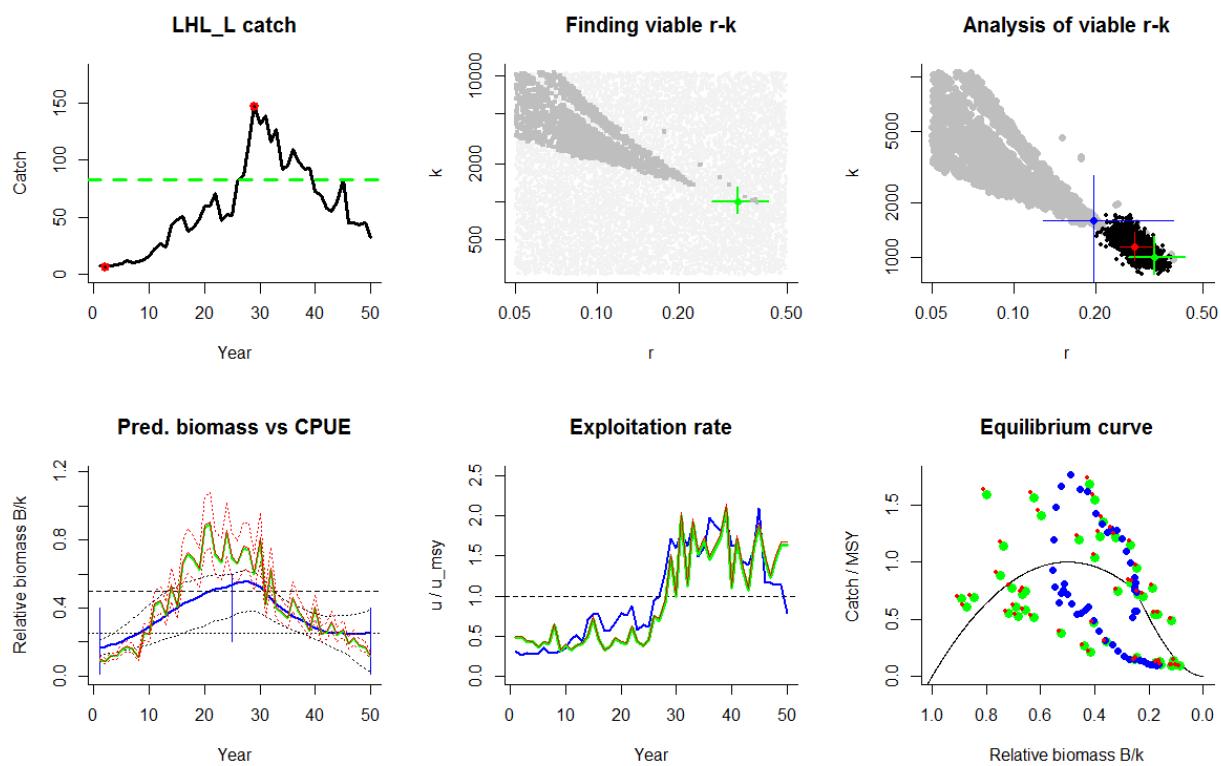
Species: NA , stock: LHL_M
 Name and region: NA , NA
 Catch data used from years 1 - 50 , biomass = CPUE
 Prior initial relative biomass = 0.01 - 0.4
 Prior intermediate rel. biomass= 0.2 - 0.6 in year 25
 Prior final relative biomass = 0.01 - 0.4
 Prior range for r = 0.2 - 0.8 , prior range for k = 236 - 3774
Prior range of q = 7.21e-06 - 2.88e-05
True values used in simulation: r = 0.52 , k = 1000 , MSY = 130, q = 1.0e-05
Results from Bayesian Schaefer model using catch & CPUE
 r = 0.499 , 95% CL = 0.452 - 0.551 , k = 1033 , 95% CL = 919 - 1160
 MSY = 129 , 95% CL = 119 - 140
q = 8.17e-06 , lcl = 7.12e-06 , ucl = 9.36e-06
 Biomass in last year from q*CPUE = 427 or 0.413 k
 Exploitation rate in last year = 0.234
 Results of CMSY analysis with altogether 783 viable trajectories for 783 r-k pairs
 r = 0.301 , 95% CL = 0.261 - 0.372 , k = 1652 , 95% CL = 1139 - 2238
 MSY = 124 , 95% CL = 90.8 - 170
 Relative biomass last year= 0.272 k, 2.5th = 0.0759 , 97.5th = 0.39
 Relative biomass next year= 0.268 k, 2.5th = 0.0164 , 97.5th = 0.396
 Relative exploitation rate in last year= 1.85
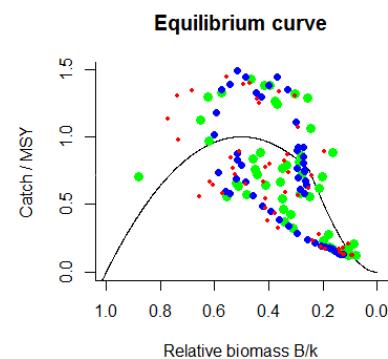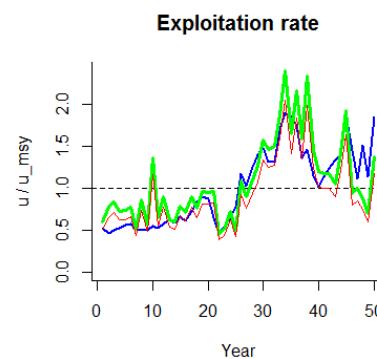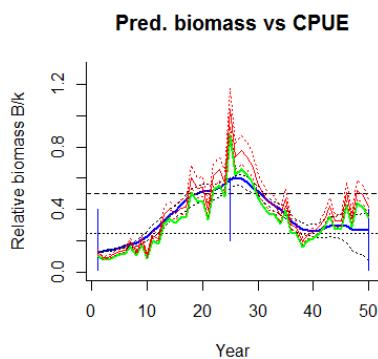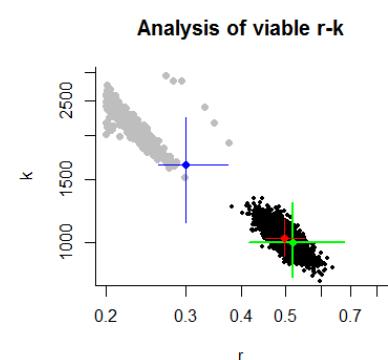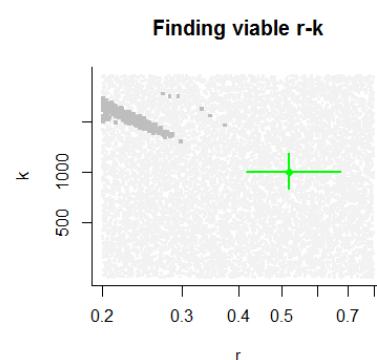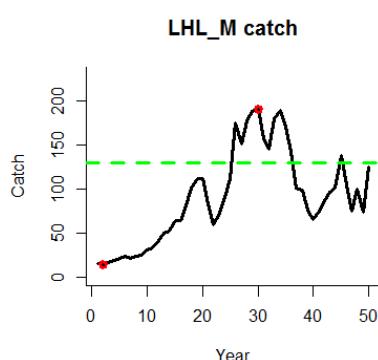
Species: NA , stock: LHL_VL
 Name and region: NA , NA
 Catch data used from years 1 - 50 , biomass = CPUE
 Prior initial relative biomass = 0.01 - 0.4
 Prior intermediate rel. biomass= 0.2 - 0.6 in year 25
 Prior final relative biomass   = 0.01 - 0.4
 Prior range for r = 0.015 - 0.1 , prior range for k = 202 - 10785
Prior range of q = 4.66e-06 - 2.41e-05
True values used in simulation: r = 0.033 , k = 1000 , MSY = 8.25, q = 1.0e-05
Results from Bayesian Schaefer model using catch & CPUE
 r = 0.0514 , 95% CL = 0.0252 - 0.0831 , k = 1636 , 95% CL = 562 - 6973
 MSY = 18.2 , 95% CL = 6.44 - 110
q = 1.06e-05 , lcl = 7.23e-06 , ucl = 1.55e-05
 Biomass in last year from q*CPUE = 298 or 0.182 k
 Exploitation rate in last year = 0.143
 Results of CMSY analysis with altogether 37386 viable trajectories for 12582 r-k pairs
 r = 0.062 , 95% CL = 0.0397 - 0.097 , k = 738 , 95% CL = 220 - 2482
 MSY = 11.5 , 95% CL = 2.55 - 51.4
 Relative biomass last year= 0.276 k, 2.5th = 0.0245 , 97.5th = 0.397
 Relative biomass next year= 0.207 k, 2.5th = -0.12 , 97.5th = 0.363
 Relative exploitation rate in last year= 5.81
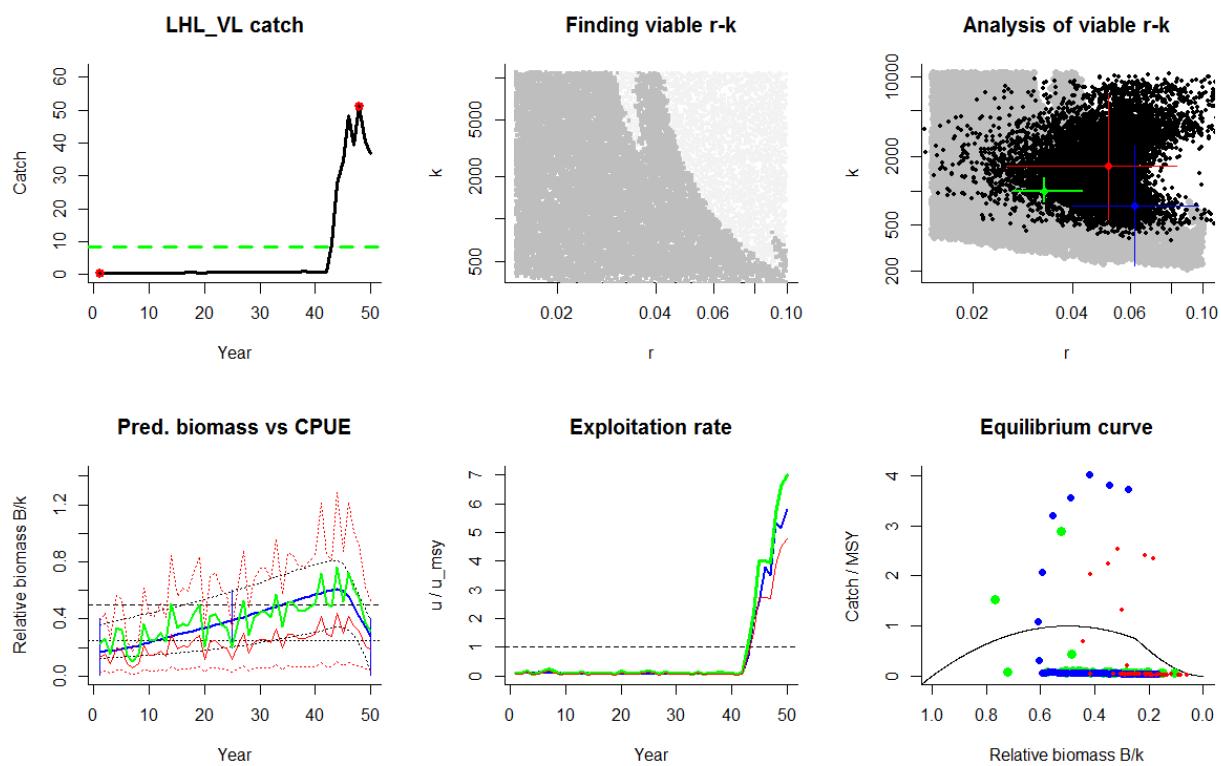
205

Species: NA , stock: LL_H
 Name and region: NA , NA
 Catch data used from years 1 - 50 , biomass = CPUE
 Prior initial relative biomass = 0.01 - 0.4
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 25
 Prior final relative biomass   = 0.01 - 0.4
 Prior range for r = 0.6 - 1.5 , prior range for k = 206 - 2060
Prior range of q = 8.07e-06 - 2.55e-05
True values used in simulation: r = 0.96 , k = 1000 , MSY = 240, q = 1.0e-05
Results from Bayesian Schaefer model using catch & CPUE
 r = 1.05 , 95% CL = 0.969 - 1.14 , k = 928 , 95% CL = 808 - 1088
 MSY = 244 , 95% CL = 217 - 277
q = 1.08e-05 , lcl = 8.81e-06 , ucl = 1.23e-05
 Biomass in last year from q*CPUE = 227 or 0.245 k
 Exploitation rate in last year = 0.745
 Results of CMSY analysis with altogether 165 viable trajectories for 164 r-k pairs
 r = 0.954 , 95% CL = 0.825 - 1.41 , k = 977 , 95% CL = 621 - 1197
 MSY = 233 , 95% CL = 208 - 261
 Relative biomass last year= 0.307 k, 2.5th = 0.0414 , 97.5th = 0.393
 Relative biomass next year= 0.302 k, 2.5th = -0.167 , 97.5th = 0.584
 Relative exploitation rate in last year= 1.06
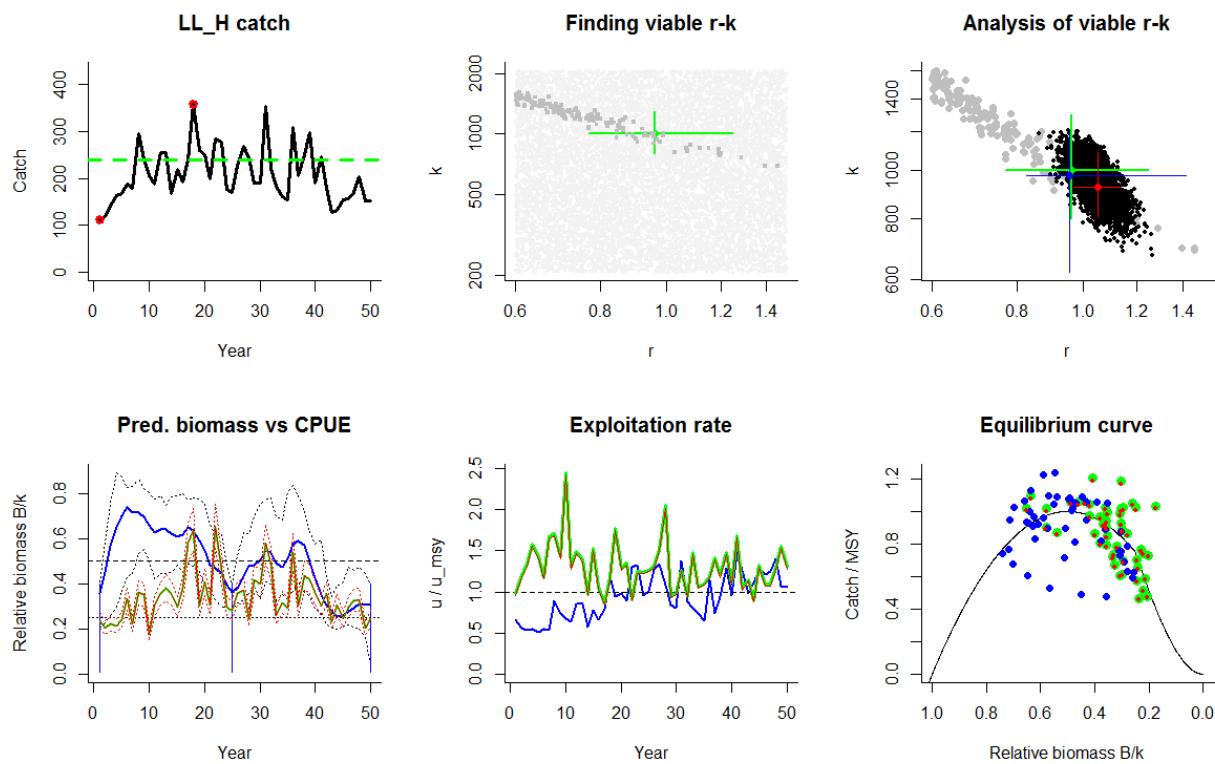
Species: NA , stock: LL_L
 Name and region: NA , NA
 Catch data used from years 1 - 50 , biomass = CPUE
 Prior initial relative biomass = 0.01 - 0.4
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 25
 Prior final relative biomass   = 0.01 - 0.4
 Prior range for r = 0.05 - 0.5 , prior range for k = 57.4 - 2298
Prior range of q = 4.05e-06 - 2.56e-05
True values used in simulation: r = 0.22 , k = 1000 , MSY = 55, q = 1.0e-05
Results from Bayesian Schaefer model using catch & CPUE
 r = 0.265 , 95% CL = 0.21 - 0.3 , k = 320 , 95% CL = 263 - 435
 MSY = 21 , 95% CL = 18.1 - 25.3
q = 1.3e-05 , lcl = 1.06e-05 , ucl = 1.51e-05
 Biomass in last year from q*CPUE = 25.2 or 0.0789 k
 Exploitation rate in last year = 0.32
 Results of CMSY analysis with altogether 2410 viable trajectories for 1725 r-k pairs
 r = 0.183 , 95% CL = 0.122 - 0.323 , k = 589 , 95% CL = 222 - 1325
 MSY = 26.9 , 95% CL = 12.1 - 59.7
 Relative biomass last year= 0.257 k, 2.5th = 0.0212 , 97.5th = 0.396
 Relative biomass next year= 0.273 k, 2.5th = 0.00898 , 97.5th = 0.419
 Relative exploitation rate in last year= 0.531
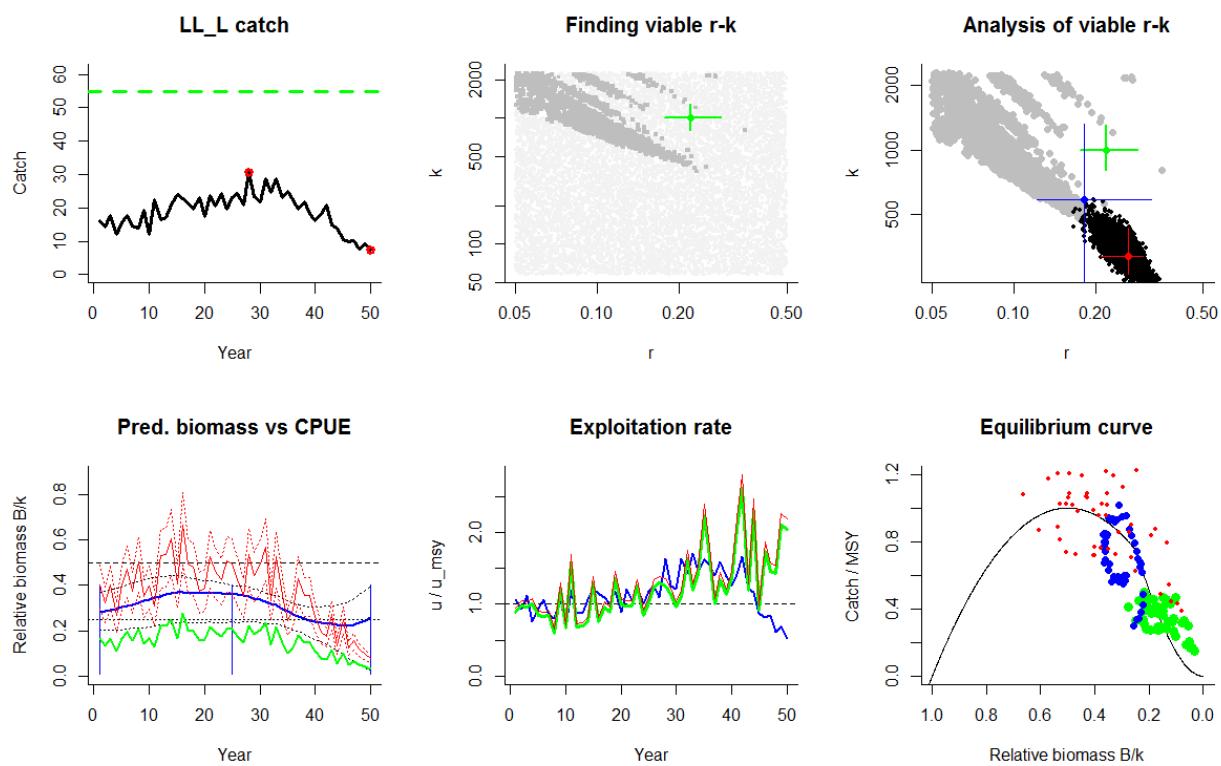
Species: NA , stock: LL_M
Name and region: NA , NA
Catch data used from years 1 - 50 , biomass = CPUE
Prior initial relative biomass = 0.01 - 0.4
Prior intermediate rel. biomass= 0.01 - 0.4 in year 25
Prior final relative biomass = 0.01 - 0.4
Prior range for r = 0.2 - 0.8 , prior range for k = 240 - 3837
Prior range of q = 5.03e-06 - 2.01e-05
True values used in simulation: r = 0.6 , k = 1000 , MSY = 150, q = 1.0e-05
Results from Bayesian Schaefer model using catch & CPUE
 r = 0.492 , 95% CL = 0.423 - 0.542 , k = 1096 , 95% CL = 939 - 1383
 MSY = 134 , 95% CL = 120 - 160
q = 6.43e-06 , lcl = 5.01e-06 , ucl = 7.91e-06
 Biomass in last year from q*CPUE = 400 or 0.365 k
 Exploitation rate in last year = 0.275
 Results of CMSY analysis with altogether 1741 viable trajectories for 1566 r-k pairs
 r = 0.557 , 95% CL = 0.403 - 0.78 , k = 958 , 95% CL = 662 - 1368
 MSY = 133 , 95% CL = 125 - 142
 Relative biomass last year= 0.323 k, 2.5th = 0.0408 , 97.5th = 0.396
 Relative biomass next year= 0.331 k, 2.5th = -0.0627 , 97.5th = 0.423
 Relative exploitation rate in last year= 1.37
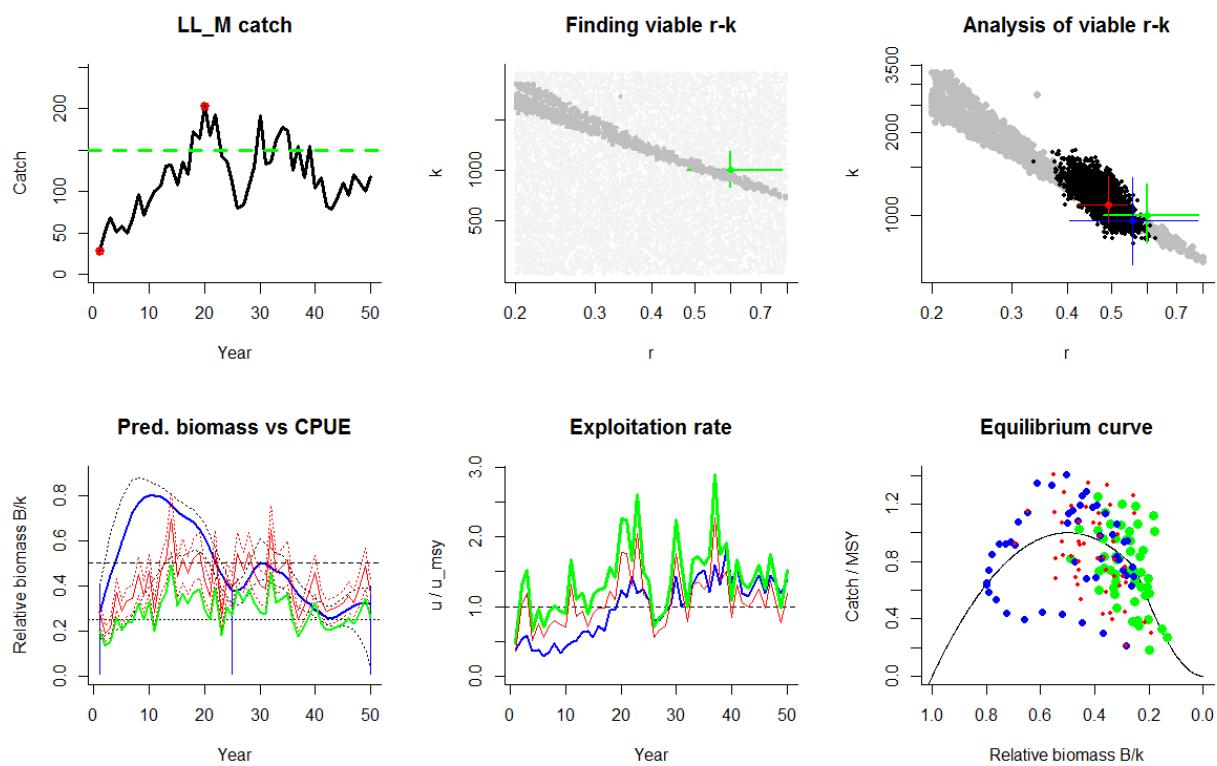
Species: NA , stock: LL_VL
 Name and region: NA , NA
 Catch data used from years 1 - 50 , biomass = CPUE
 Prior initial relative biomass = 0.01 - 0.4
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 25
 Prior final relative biomass   = 0.01 - 0.4
 Prior range for r = 0.015 - 0.1 , prior range for k = 71.5 - 1908
Prior range of q = 5.56e-06 - 2.87e-05
True values used in simulation: r = 0.078 , k = 1000 , MSY = 19.5, q = 1.0e-05
Results from Bayesian Schaefer model using catch & CPUE
 r = 0.0644 , 95% CL = 0.0426 - 0.117 , k = 592 , 95% CL = 327 - 1681
 MSY = 9.12 , 95% CL = 5.38 - 41.2
q = 1.02e-05 , lcl = 7.36e-06 , ucl = 1.41e-05
 Biomass in last year from q*CPUE = 127 or 0.214 k
 Exploitation rate in last year = 0.0572
 Results of CMSY analysis with altogether 10827 viable trajectories for 4203 r-k pairs
 r = 0.062 , 95% CL = 0.0397 - 0.097 , k = 710 , 95% CL = 258 - 1958
 MSY = 11 , 95% CL = 3.62 - 33.5
 Relative biomass last year= 0.239 k, 2.5th = 0.0157 , 97.5th = 0.396
 Relative biomass next year= 0.234 k, 2.5th = 0.00577 , 97.5th = 0.399
 Relative exploitation rate in last year= 1.4
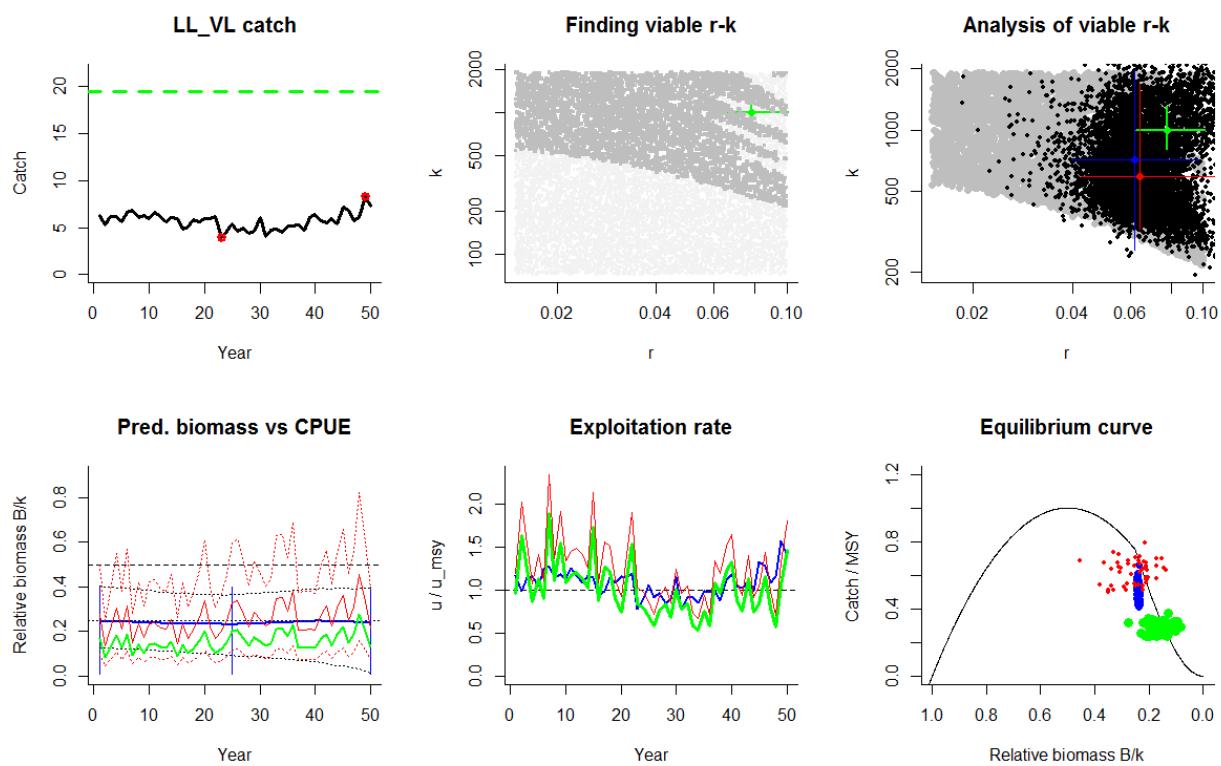
Appendix IV. Data-limited stocks with catch or landings and CPUE

[CMSY_46e.R, AllStocks_Catch16.csv, AllStocks_ID20.csv]

Species: *Argentina silus* , stock: arg-rest

 Name and region: "Greater silver smelt in Subareas VII-X, XII, and Division VIb (other areas)" , ICES

 Catch data used from years 2000 - 2014 , biomass = CPUE

 Prior initial relative biomass = 0.2 - 0.6 default

 Prior intermediate rel. biomass= 0.01 - 0.4 in year 2010 default

 Prior final relative biomass   = 0.01 - 0.4 , default

 Prior range for r = 0.05 - 0.5 default , prior range for k = 7.41 - 296

Prior range of q = 0.0253 - 0.16

Results from Bayesian Schaefer model using catch & CPUE

 r = 0.277 , 95% CL = 0.24 - 0.333 , k = 27.8 , 95% CL = 15.6 - 39.1

 MSY = 1.94 , 95% CL = 1.06 - 2.77

q = 0.0242 , lcl = 0.0184 , ucl = 0.0337

 Biomass in last year from q*CPUE = 3.14 or 0.113 k

 Exploitation rate in last year = 0.00404

 Results of CMSY analysis with altogether 14506 viable trajectories for 5080 r-k pairs

 r = 0.282 , 95% CL = 0.163 - 0.487 , k = 32 , 95% CL = 12 - 85

 MSY = 2.25 , 95% CL = 0.966 - 5.26

Relative biomass last year= 0.13 k, 2.5th = 0.0132 , 97.5th = 0.39

Relative biomass next year= 0.146 k, 2.5th = 0.0129 , 97.5th = 0.45

Relative exploitation rate in last year= 0.00171

Comment: CPUE from Porcupine bank survey. Start year set to 2000.

Catch arg-rest

Relative biomass

Exploitation rate

Stock status

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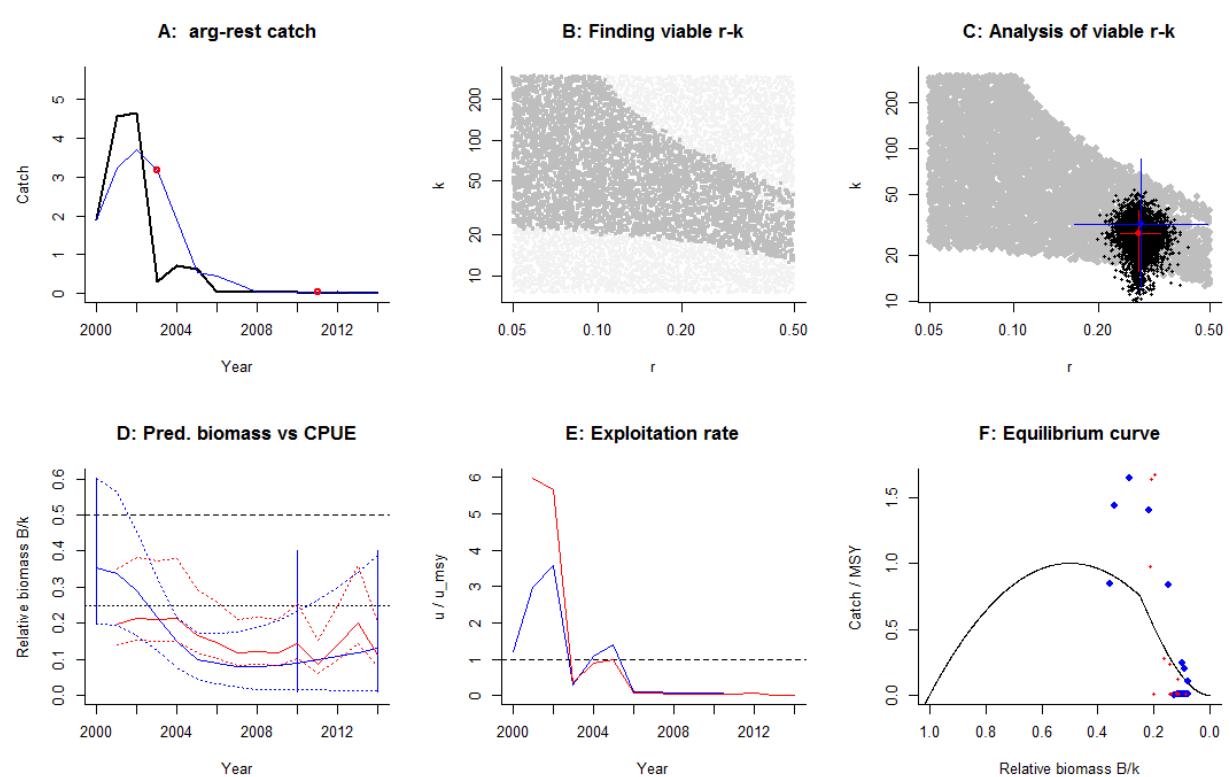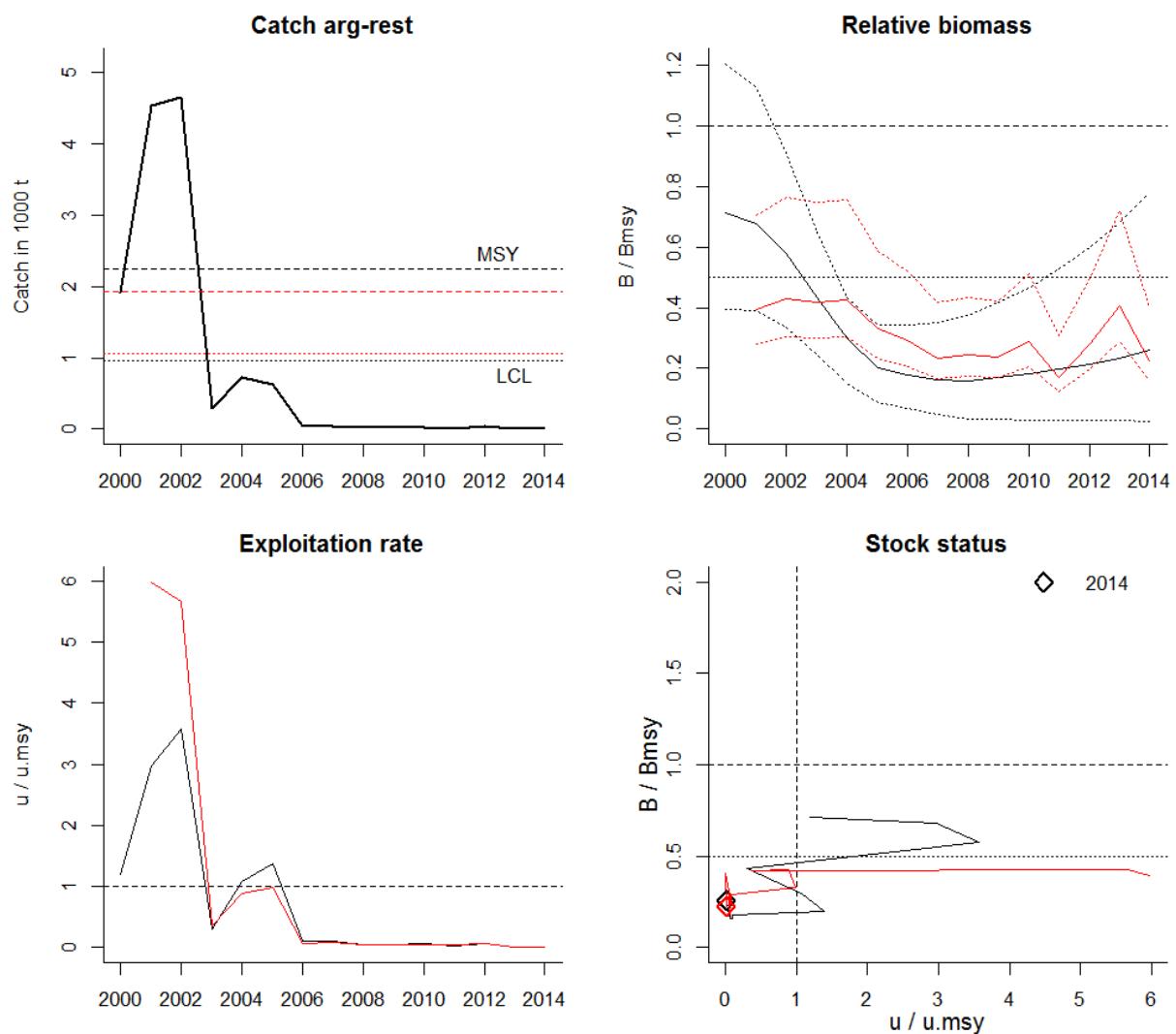
Species: *Scophthalmus rhombus* , stock: bll-2232
 Name and region: Brill in Subdivisions 22–32 (Baltic Sea) , ICES
 Catch data used from years 1993 - 2014 , biomass = CPUE
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 2000 default
 Prior final relative biomass   = 0.2 - 0.6 , default
 Prior range for r = 0.2 - 0.8 default , prior range for k = 0.119 - 1.9
Prior range of q = 0.00486 - 0.0195
Results from Bayesian Schaefer model using catch & CPUE
 r = 0.505 , 95% CL = 0.453 - 0.589 , k = 0.516 , 95% CL = 0.376 - 0.738
 MSY = 0.0655 , 95% CL = 0.0482 - 0.0931
q = 0.00714 , lcl = 0.00513 , ucl = 0.0102
 Biomass in last year from q*CPUE = 0.13 or 0.252 k
 Exploitation rate in last year = 0.241
 Results of CMSY analysis with altogether 4576 viable trajectories for 2070 r-k pairs
 r = 0.566 , 95% CL = 0.407 - 0.785 , k = 0.43 , 95% CL = 0.269 - 0.689
 MSY = 0.0609 , 95% CL = 0.046 - 0.0805
 Relative biomass last year= 0.429 k, 2.5th = 0.217 , 97.5th = 0.592
 Relative biomass next year= 0.489 k, 2.5th = 0.216 , 97.5th = 0.667
 Relative exploitation rate in last year= 0.614
 Comment: Start year set to 1993.
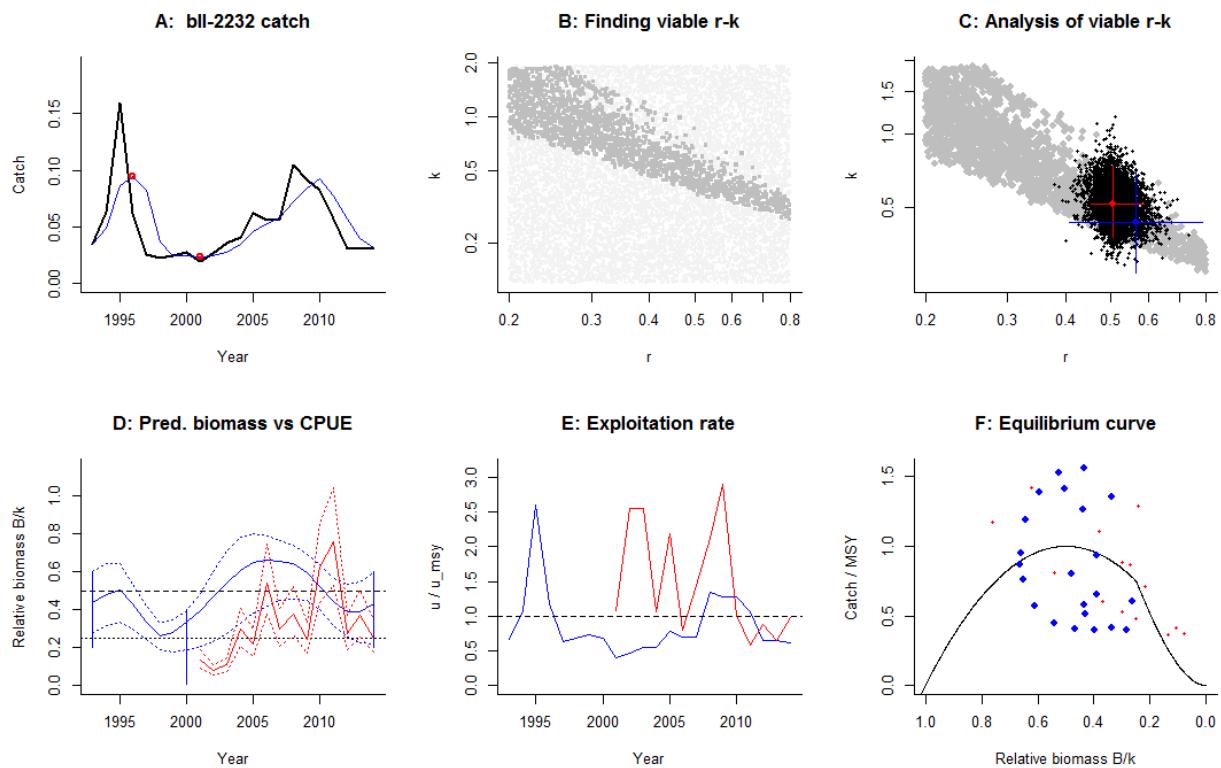
Catch bll-2232
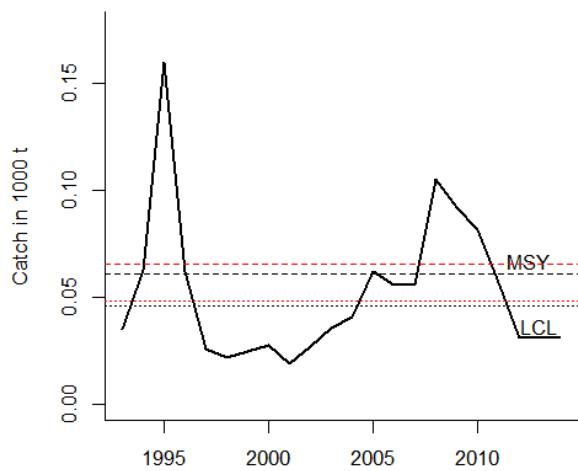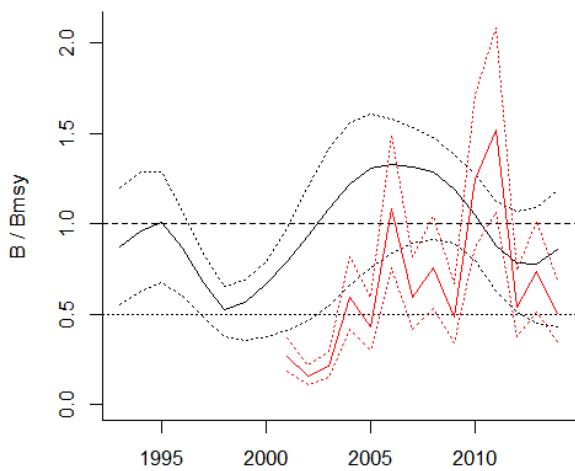
Relative biomass

Exploitation rate
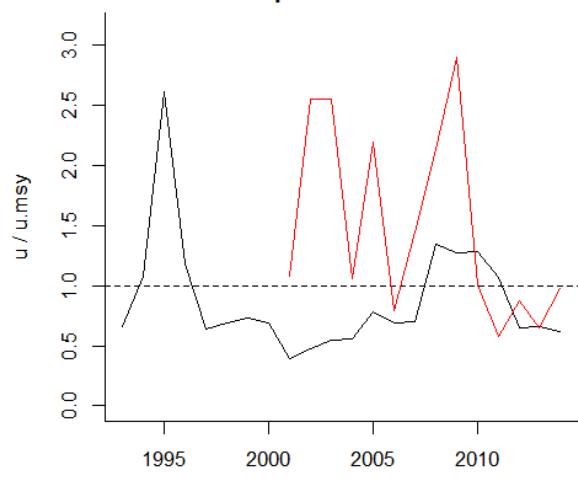
Stock status
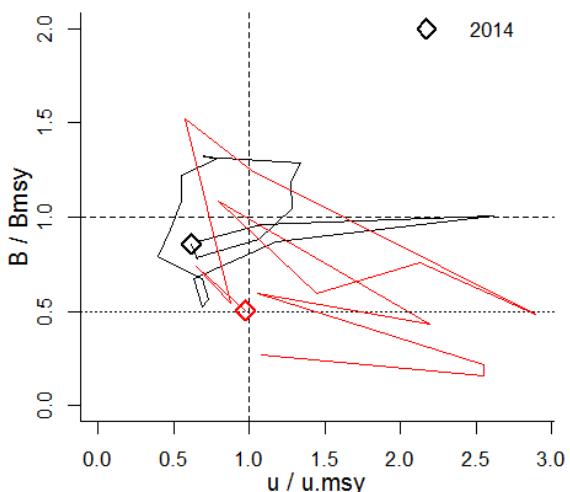
Species: *Scophthalmus rhombus* , stock: bll-nsea
Name and region: Brill in Subarea IV, Divisions IIIa and VIId,e , ICES
Catch data used from years 1980 - 2012 , biomass = CPUE
Prior initial relative biomass = 0.2 - 0.6 default
Prior intermediate rel. biomass= 0.5 - 0.9 in year 1993 default
Prior final relative biomass   = 0.5 - 0.9 , default
Prior range for r = 0.2 - 0.8 default , prior range for k = 6.82 - 164
Prior range of q = 7.27e-05 - 0.000291
Results from Bayesian Schaefer model using catch & CPUE
r = 0.502 , 95% CL = 0.449 - 0.577 , k = 16.9 , 95% CL = 14.6 - 20.3
MSY = 2.13 , 95% CL = 1.88 - 2.56
q = 0.000115 , lcl = 8.73e-05 , ucl = 0.000148
Biomass in last year from q*CPUE = 10.1 or 0.595 k
Exploitation rate in last year = 0.226
Results of CMSY analysis with altogether 32259 viable trajectories for 3624 r-k pairs
r = 0.566 , 95% CL = 0.407 - 0.785 , k = 24.7 , 95% CL = 12.8 - 47.6
MSY = 3.49 , 95% CL = 1.83 - 6.66
Relative biomass last year= 0.822 k, 2.5th = 0.577 , 97.5th = 0.896
Relative biomass next year= 0.813 k, 2.5th = 0.562 , 97.5th = 0.894
Relative exploitation rate in last year= 0.393
Comment: Start year set to 1980.

Catch bll-nsea

Relative biomass

Exploitation rate

Stock status

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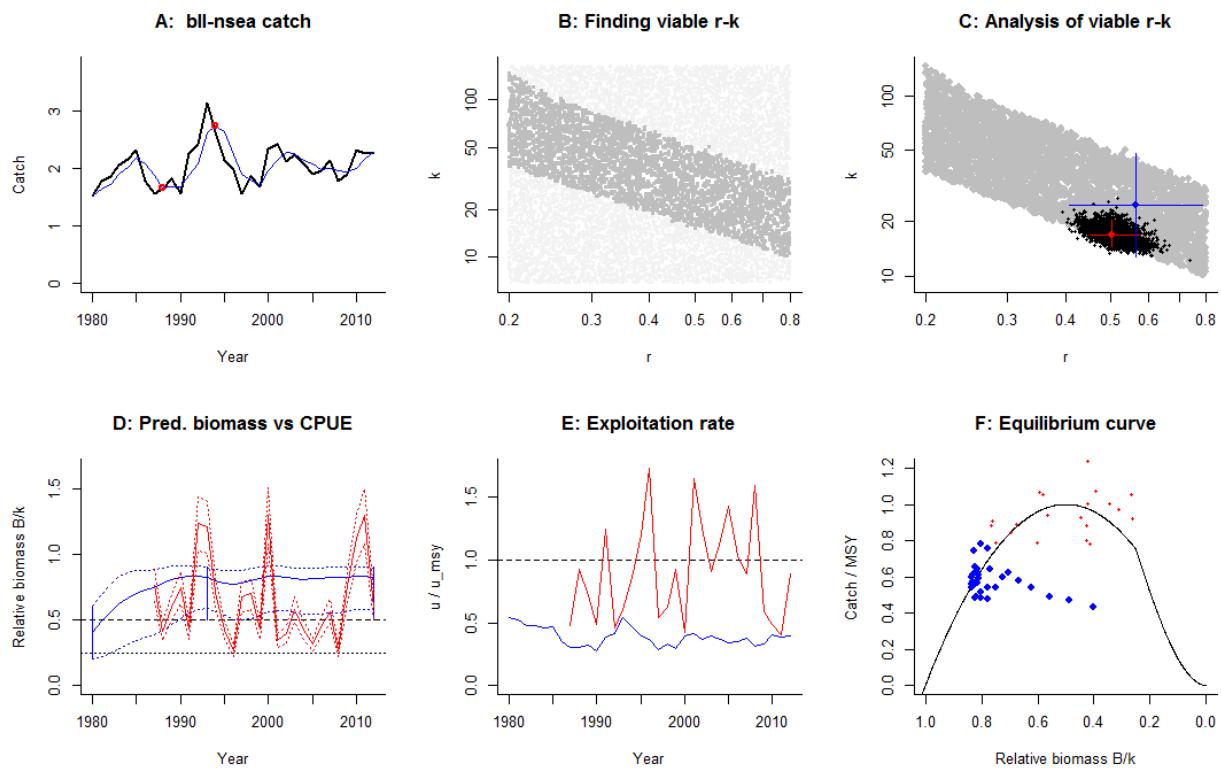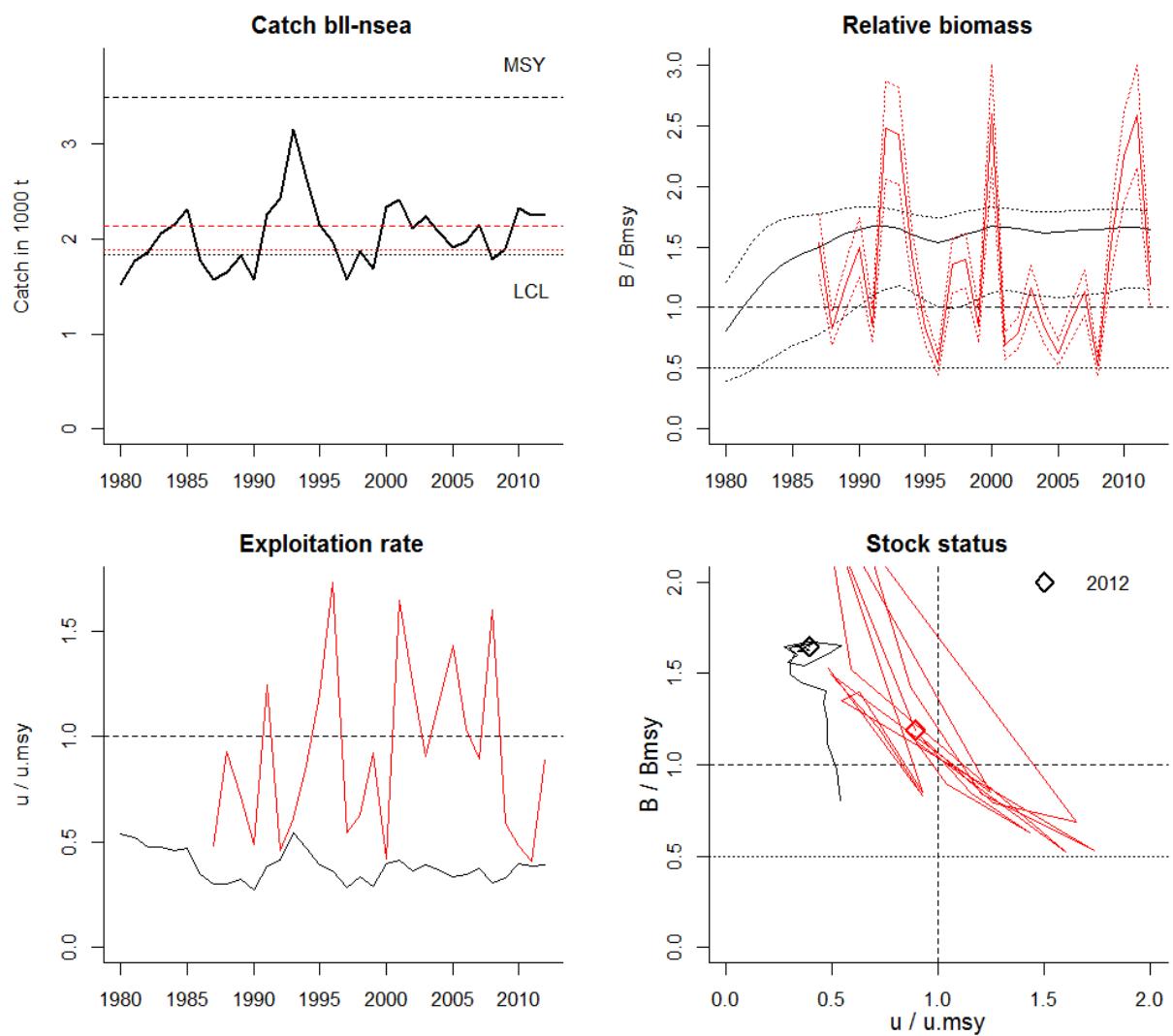
Species*: Capros aper* , stock: boc-nea
Boarfish in Subareas VI–VIII (Celtic Seas and the English Channel, Bay of Biscay)
Catch data used from years 2001 - 2014 , biomass = CPUE
 Prior initial relative biomass = 0.01 - 0.4 expert
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 2008 expert
 Prior final relative biomass   = 0.01 - 0.4 expert
 Prior range for r = 0.05 - 0.5 default , prior range for k = 181 - 7240
Prior range of q = 1.99e-06 - 1.26e-05
Results from Bayesian Schaefer model using catch & CPUE
 r = 0.274 , 95% CL = 0.231 - 0.319 , k = 1296 , 95% CL = 576 - 3752
 MSY = 88.2 , 95% CL = 38 - 264
q = 4.42e-06 , lcl = 3e-06 , ucl = 6.07e-06
 Biomass in last year from q*CPUE = 143 or 0.111 k
Exploitation rate in last year = 0.483
Results of CMSY analysis with altogether 13239 viable trajectories for 5451 r-k pairs
r = 0.282 , 95% CL = 0.163 - 0.487 , k = 2110 , 95% CL = 543 - 8201
MSY = 149 , 95% CL = 30.4 - 730
Relative biomass last year= 0.183 k, 2.5th = 0.0127 , 97.5th = 0.393
Relative biomass next year= 0.172 k, 2.5th = -0.0483 , 97.5th = 0.429
Relative exploitation rate in last year= 0.831
Comment: OK

216

Catch boc-nea

MSY

LCL

Relative biomass

Exploitation rate

Stock status
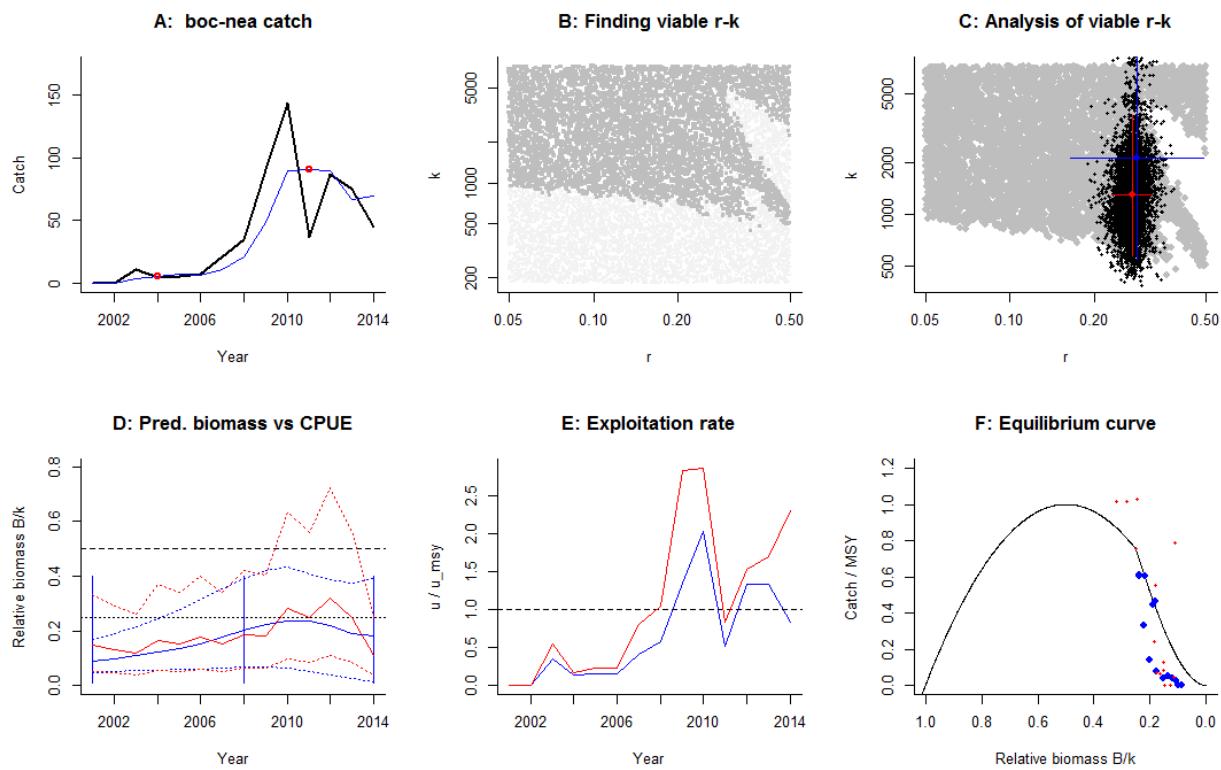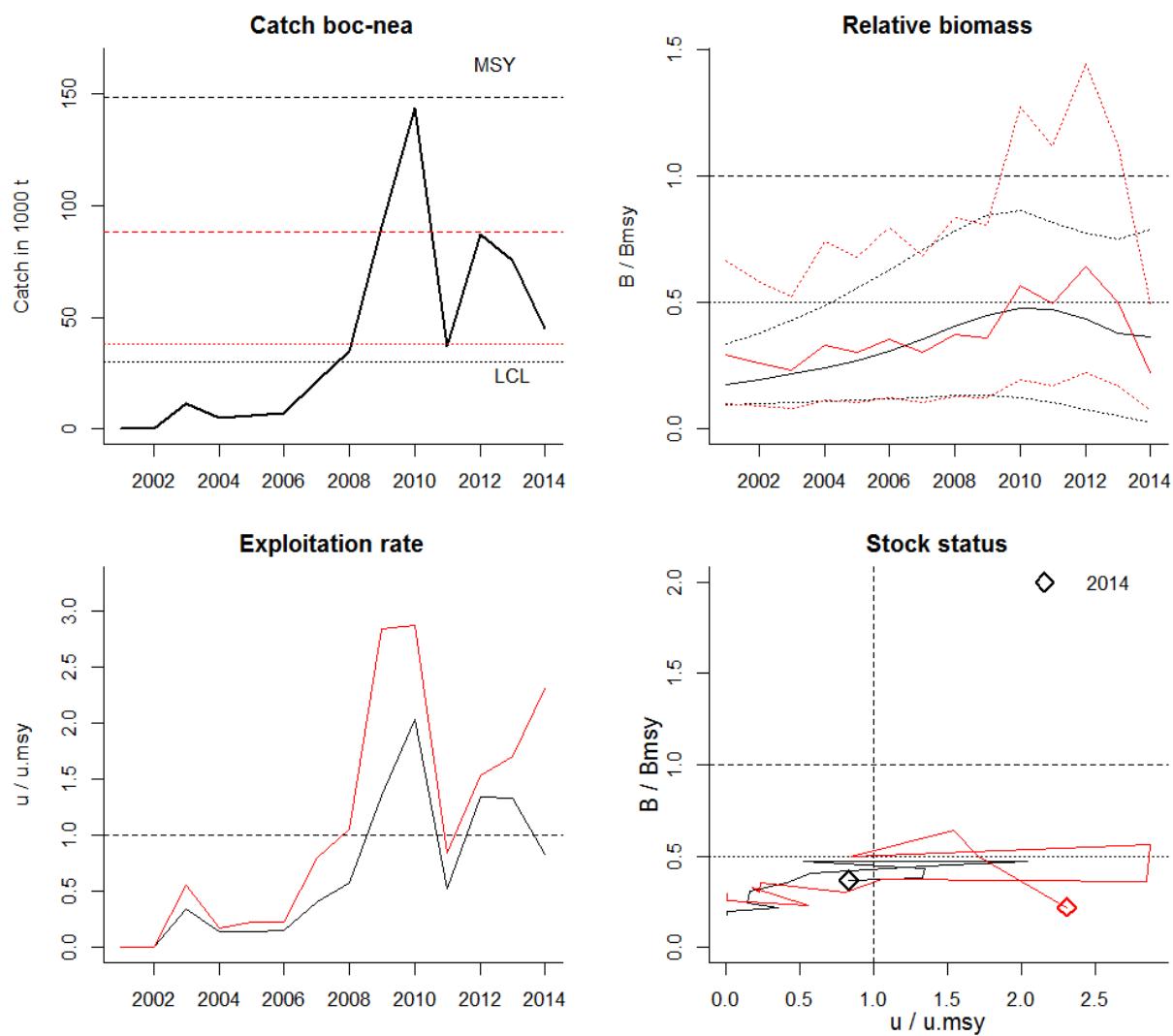
2014

Species: *Cetorhinus maximus* , stock: bsk-nea
 Name and region: Basking shark in the Northeast Atlantic , ICES
 Catch data used from years 1977 - 2014 , biomass = None
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 2010 default
 Prior final relative biomass   = 0.01 - 0.4 , default
 Prior range for r = 0.015 - 0.1 default , prior range for k = 42.1 - 1123
 Results of CMSY analysis with altogether 22612 viable trajectories for 7238 r-k pairs
 r = 0.062 , 95% CL = 0.0397 - 0.097 , k = 128 , 95% CL = 46.7 - 349
 MSY = 1.98 , 95% CL = 0.662 - 5.92
 Relative biomass last year= 0.169 k, 2.5th = 0.0139 , 97.5th = 0.395
 Relative biomass next year= 0.175 k, 2.5th = 0.0139 , 97.5th = 0.408
 Relative exploitation rate in last year= 0
 Comment: No abundance data available.
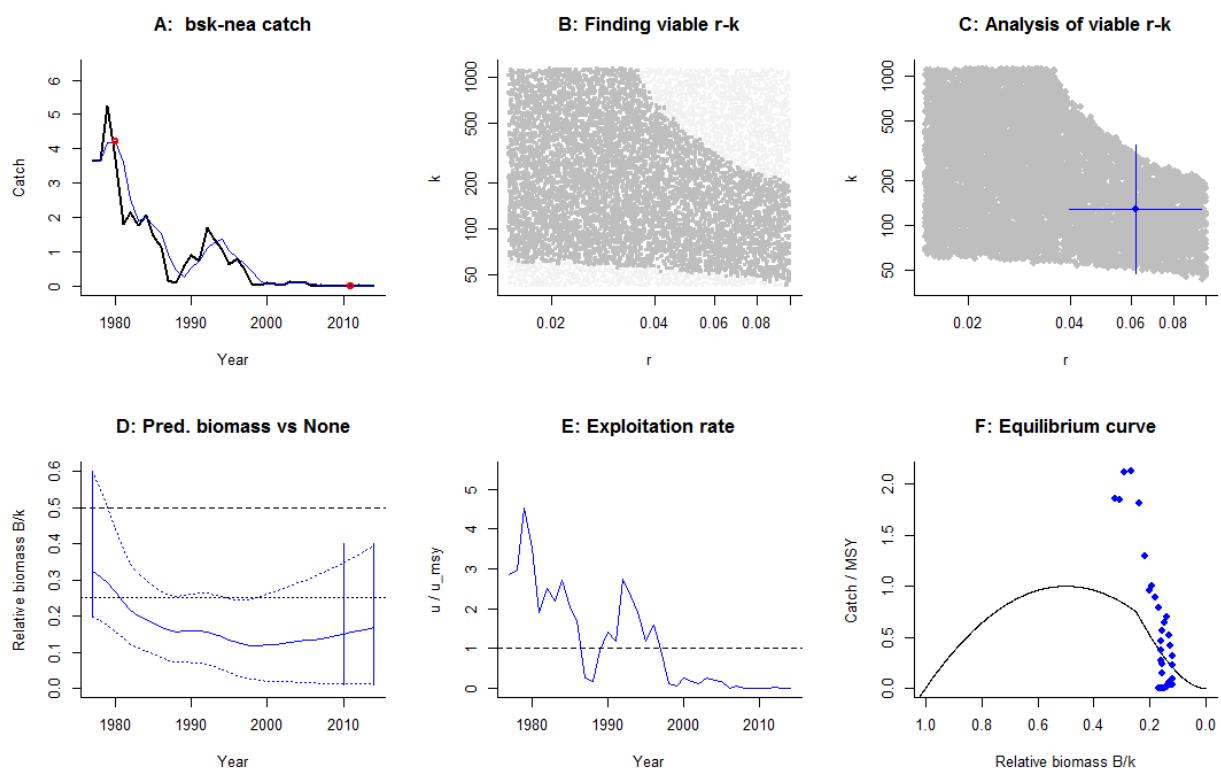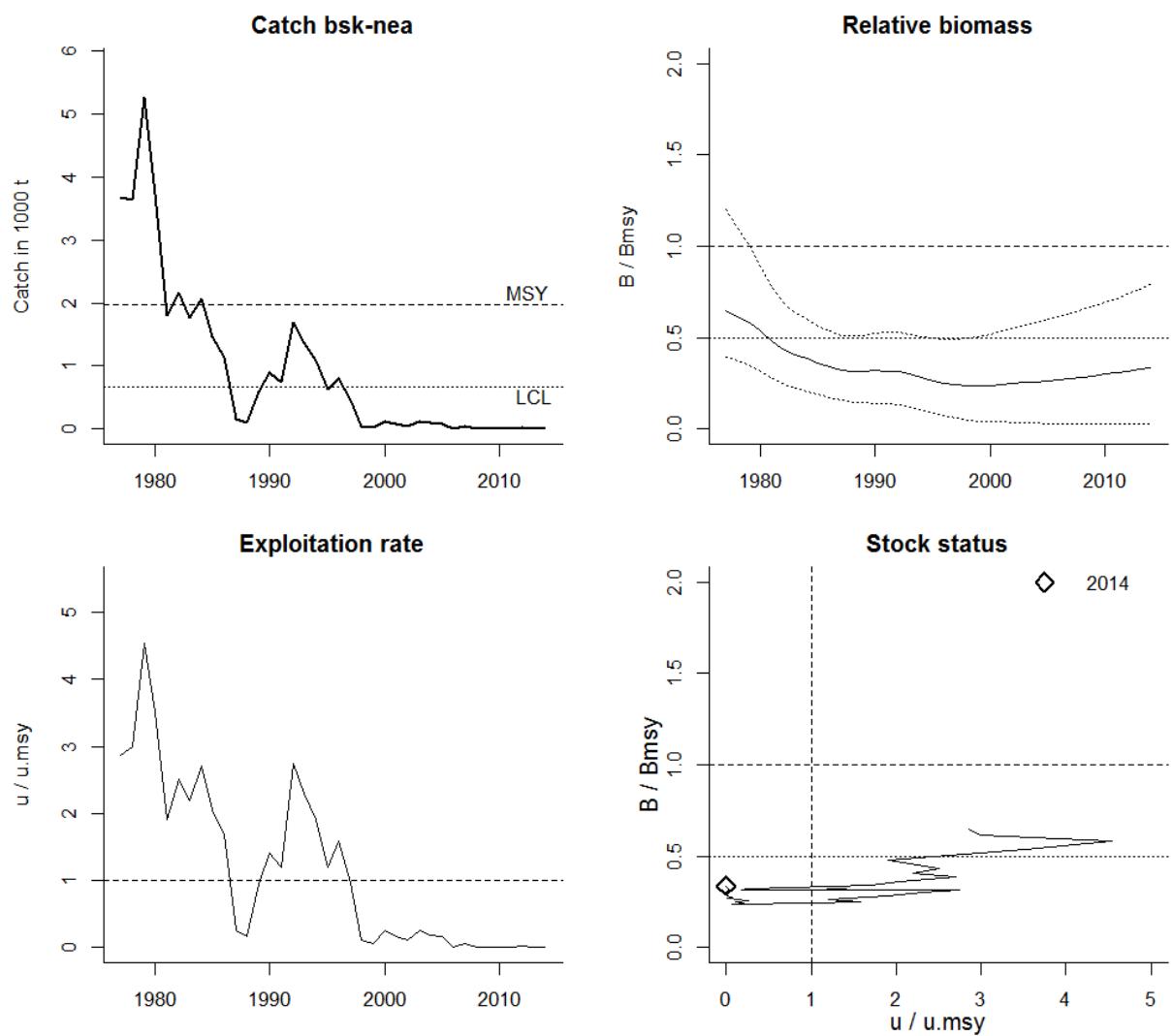
Species: *Gadus morhua* , stock: cod-2532
 Name and region: Cod in Subdivisions 25–32 , ICES
 Catch data used from years 1991 - 2014 , biomass = CPUE
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 2009 default
 Prior final relative biomass   = 0.01 - 0.4 expert
 Prior range for r = 0.2 - 0.8 default , prior range for k = 153 - 2450
Prior range of q = 0.000939 - 0.00376
Results from Bayesian Schaefer model using catch & CPUE
 r = 0.525 , 95% CL = 0.473 - 0.646 , k = 718 , 95% CL = 400 - 958
 MSY = 96.6 , 95% CL = 52.1 - 126
q = 0.00106 , lcl = 0.000686 , ucl = 0.00156
 Biomass in last year from q*CPUE = 119 or 0.166 k
 Exploitation rate in last year = 0.312
 Results of CMSY analysis with altogether 4217 viable trajectories for 2934 r-k pairs
 r = 0.505 , 95% CL = 0.377 - 0.743 , k = 669 , 95% CL = 374 - 1089
 MSY = 84.5 , 95% CL = 57.7 - 124
 Relative biomass last year= 0.289 k, 2.5th = 0.0235 , 97.5th = 0.397
 Relative biomass next year= 0.328 k, 2.5th = -0.0287 , 97.5th = 0.467
 Relative exploitation rate in last year= 0.593
 Comment: Start year set to 1991.

A: cod-2532 catch

B: Finding viable r-k

C: Analysis of viable r-k

D: Pred. biomass vs CPUE

E: Exploitation rate

F: Equilibrium curve

Catch cod-2532

Relative biomass

Exploitation rate

Stock status
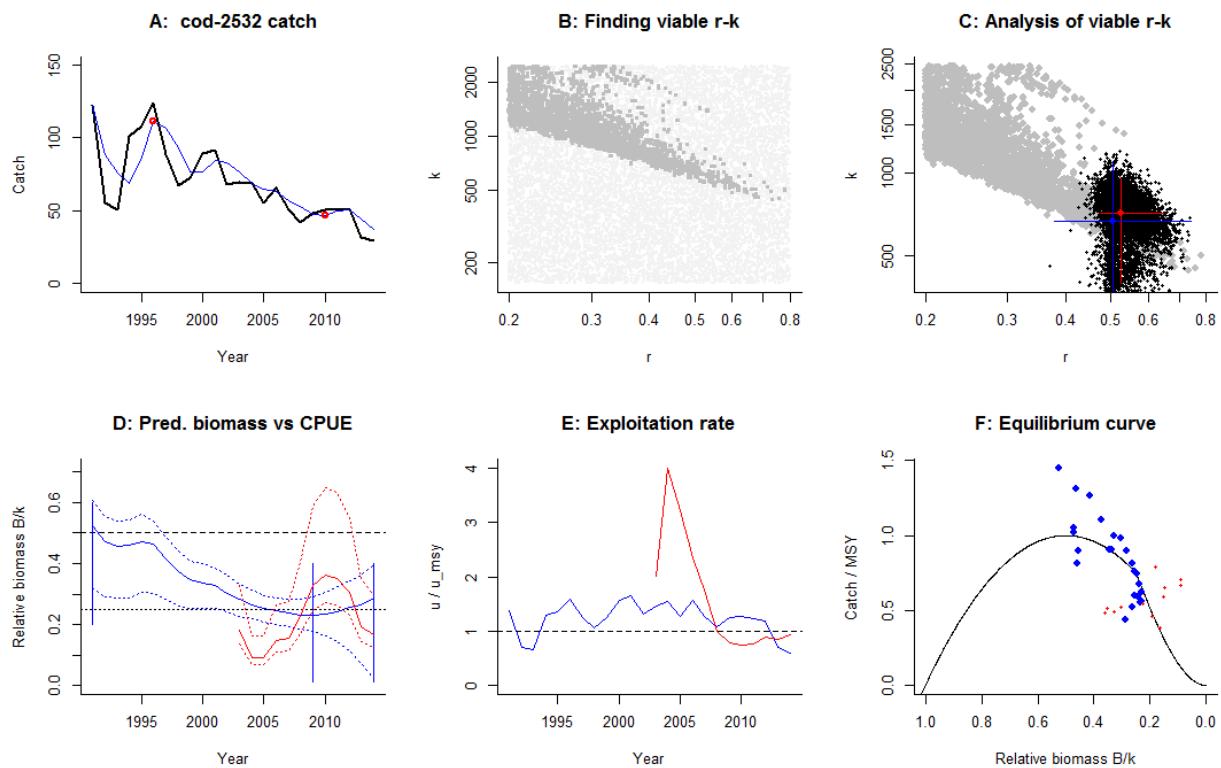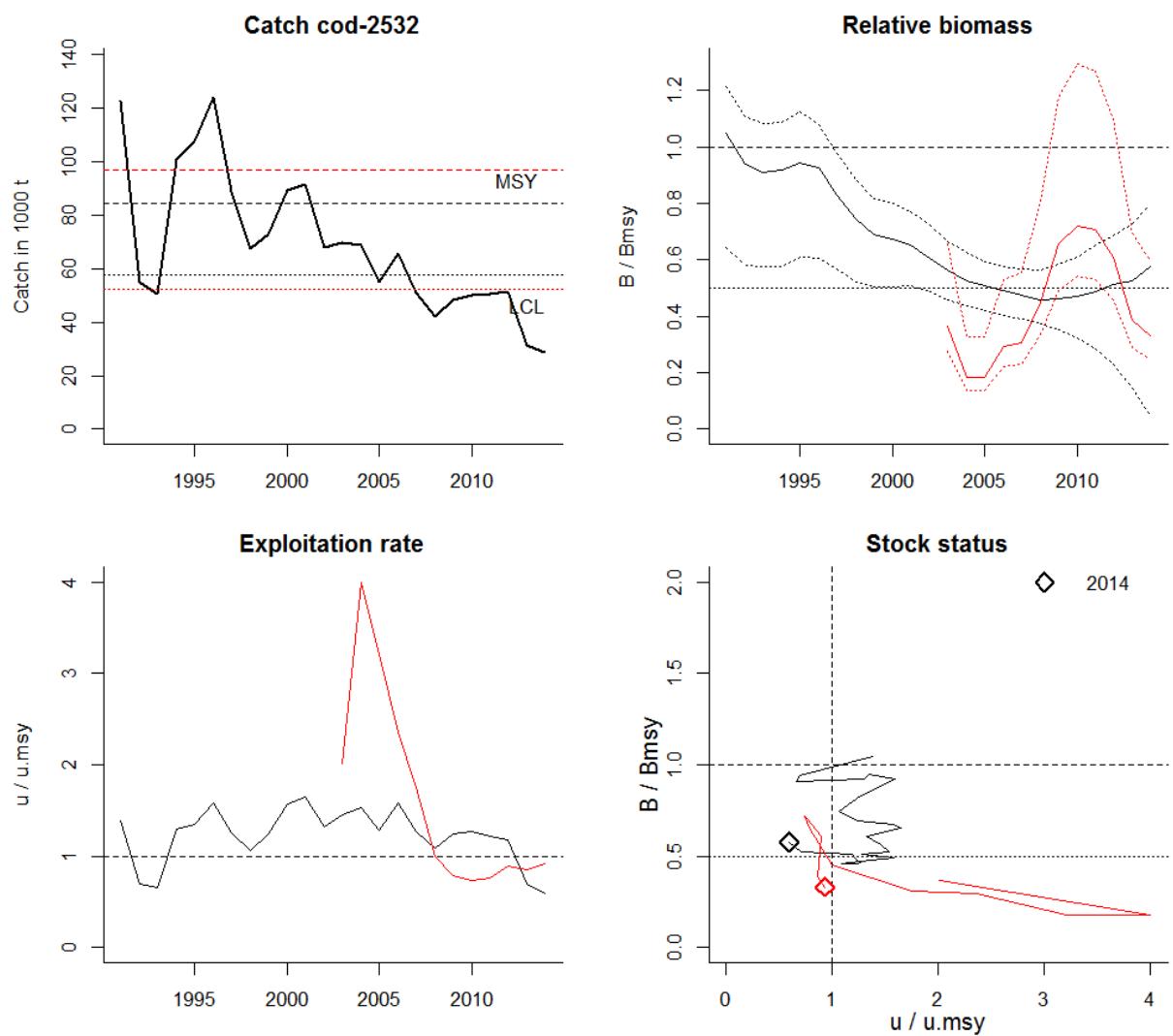
Species: *Gadus morhua* , stock: cod-rock
Name and region: "Cod in Division VIb (Rockall)" , ICES
Catch data used from years 1984 - 2014 , biomass = CPUE
Prior initial relative biomass = 0.2 - 0.6 default
Prior intermediate rel. biomass= 0.01 - 0.4 in year 2006 default
Prior final relative biomass   = 0.01 - 0.4 , default
Prior range for r = 0.2 - 0.8 default , prior range for k = 2.03 - 32.5
Prior range of q = 0.00654 - 0.0262
Results from Bayesian Schaefer model using catch & CPUE
r = 0.5 , 95% CL = 0.44 - 0.568 , k = 15.7 , 95% CL = 11.1 - 22.4
MSY = 1.96 , 95% CL = 1.36 - 2.85
q = 0.0138 , lcl = 0.0103 , ucl = 0.0183
Biomass in last year from q*CPUE = 0.0727 or 0.00462 k
Exploitation rate in last year = 0.238
Results of CMSY analysis with altogether 3093 viable trajectories for 2714 r-k pairs
r = 0.461 , 95% CL = 0.353 - 0.7 , k = 12.3 , 95% CL = 5.99 - 21.7
MSY = 1.42 , 95% CL = 0.787 - 2.55
Relative biomass last year= 0.0978 k, 2.5th = 0.0137 , 97.5th = 0.379
Relative biomass next year= 0.11 k, 2.5th = 0.0126 , 97.5th = 0.491
Relative exploitation rate in last year= 0.0541
Comment: Landings in kg/h of Irish otter trawlers; CMSY would benefit from final 0.01-0.2 prior.

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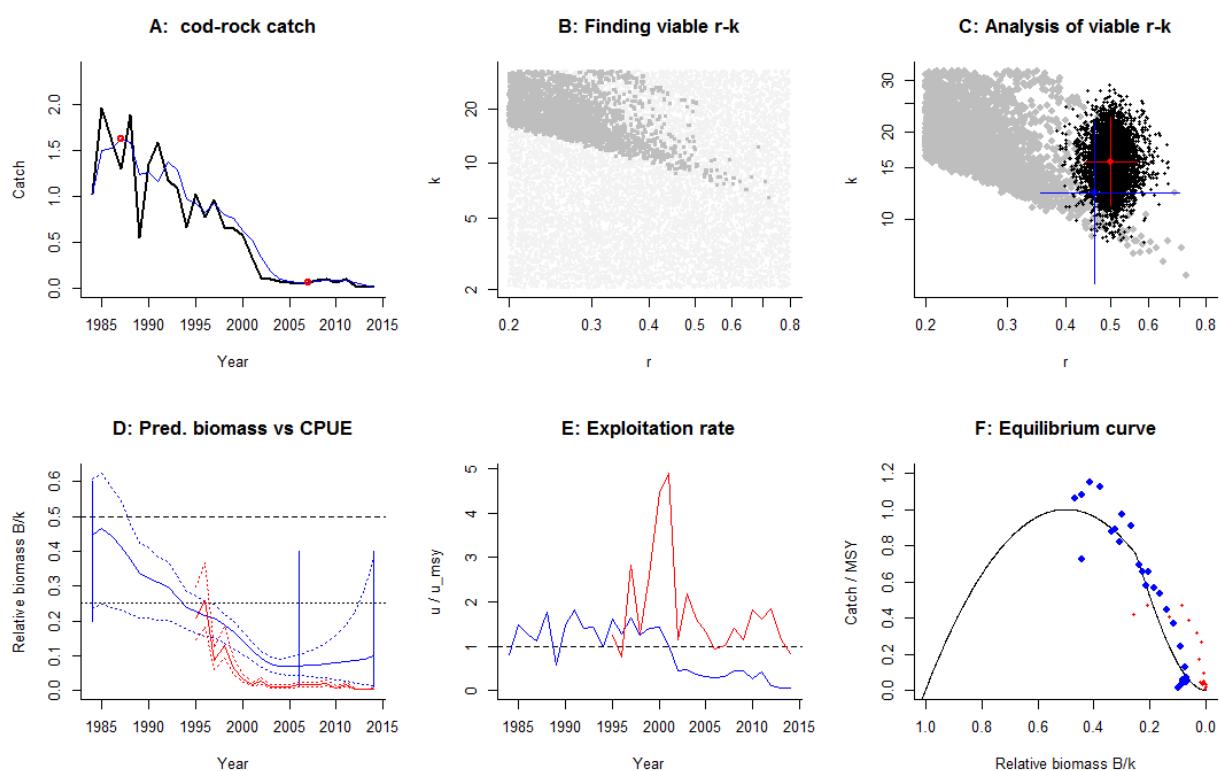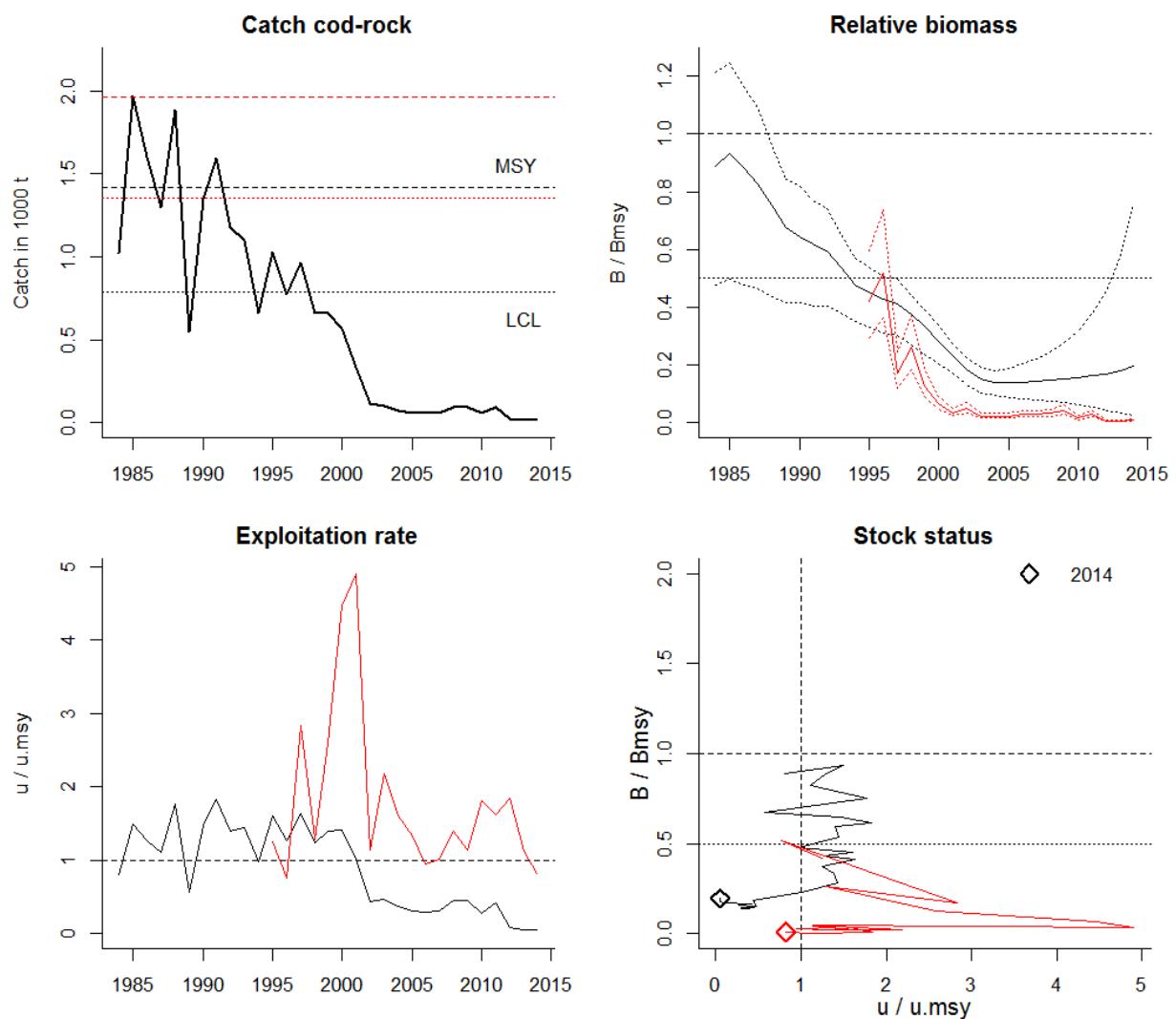
Species: *Limanda limanda* , stock: dab-2232
Name and region: Dab in Subdivisions 22–32 (Baltic Sea) , ICES
Catch data used from years 1970 - 2014 , biomass = CPUE
Prior initial relative biomass = 0.2 - 0.6 default
Prior intermediate rel. biomass= 0.01 - 0.4 in year 2001 default
Prior final relative biomass   = 0.2 - 0.6 , default
Prior range for r = 0.2 - 0.8 default , prior range for k = 3.45 - 55.2
Prior range of q = 0.0162 - 0.0647
Results from Bayesian Schaefer model using catch & CPUE
r = 0.577 , 95% CL = 0.487 - 0.703 , k = 13 , 95% CL = 9.06 - 17.3
MSY = 1.91 , 95% CL = 1.18 - 2.44
q = 0.0159 , lcl = 0.0126 , ucl = 0.0205
Biomass in last year from q*CPUE = 9.03 or 0.695 k
Exploitation rate in last year = 0.145
Results of CMSY analysis with altogether 2506 viable trajectories for 1040 r-k pairs
r = 0.49 , 95% CL = 0.37 - 0.723 , k = 14.8 , 95% CL = 9.62 - 20.5
MSY = 1.82 , 95% CL = 1.67 - 1.97
Relative biomass last year= 0.526 k, 2.5th = 0.263 , 97.5th = 0.598
Relative biomass next year= 0.551 k, 2.5th = 0.268 , 97.5th = 0.632
Relative exploitation rate in last year= 0.665
Comment: OK
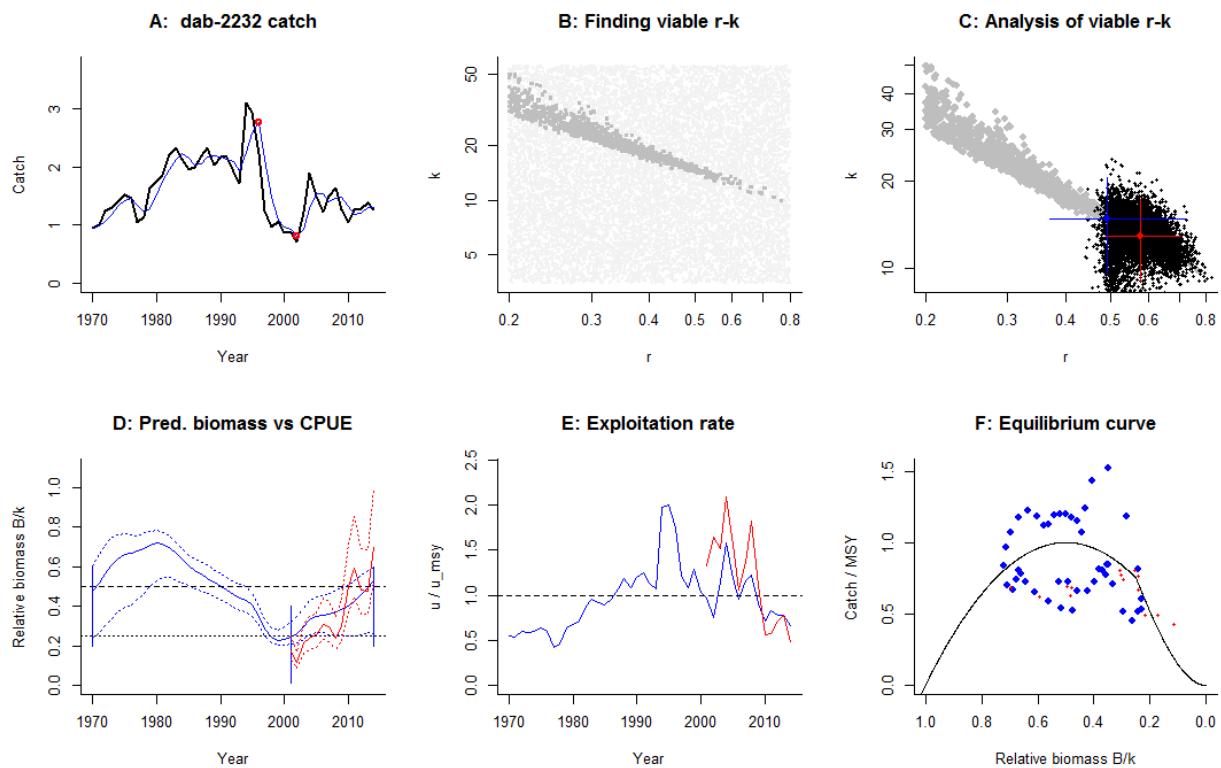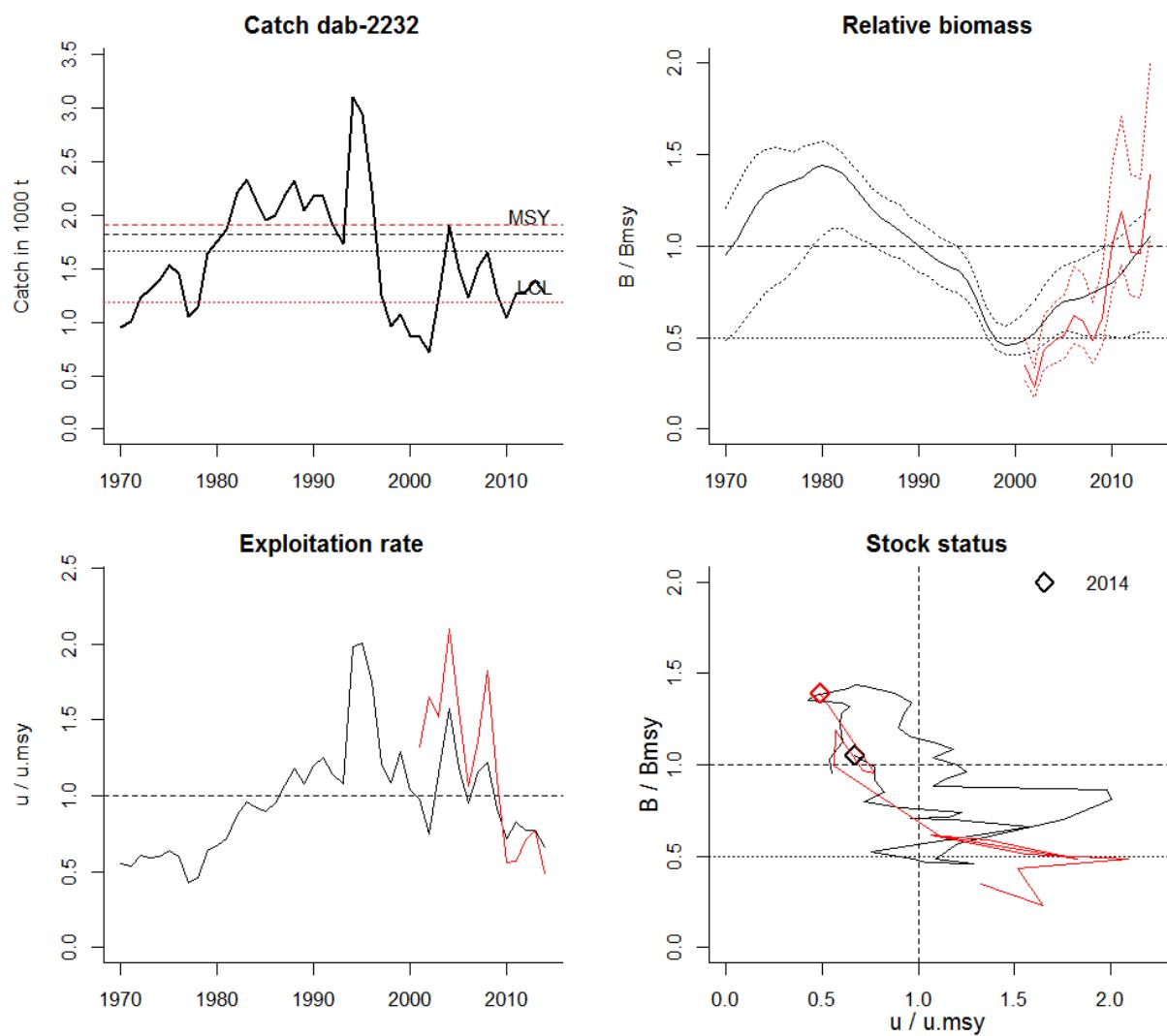
Species: *Limanda limanda* , stock: dab-nsea
 Name and region: Dab in Subarea IV and Division IIIa , ICES
 Catch data used from years 1950 - 2014 , biomass = CPUE
 Prior initial relative biomass = 0.5 - 0.9 default
 Prior intermediate rel. biomass= 0.5 - 0.9 in year 1999 default
 Prior final relative biomass = 0.2 - 0.6 , default
 Prior range for r = 0.2 - 0.8 default , prior range for k = 16.2 - 259
Prior range of q = 0.000705 - 0.00282
Results from Bayesian Schaefer model using catch & CPUE
 r = 0.526 , 95% CL = 0.475 - 0.648 , k = 52 , 95% CL = 41.5 - 65.2
 MSY = 6.97 , 95% CL = 5.46 - 8.82
q = 0.000755 , lcl = 0.000586 , ucl = 0.000952
 Biomass in last year from q*CPUE = 45.7 or 0.881 k
 Exploitation rate in last year = 0.13
 Results of CMSY analysis with altogether 5382 viable trajectories for 744 r-k pairs
 r = 0.559 , 95% CL = 0.405 - 0.77 , k = 65 , 95% CL = 44.6 - 94.8
 MSY = 9.08 , 95% CL = 8.14 - 10.1
 Relative biomass last year= 0.519 k, 2.5th = 0.253 , 97.5th = 0.597
 Relative biomass next year= 0.565 k, 2.5th = 0.268 , 97.5th = 0.657
 Relative exploitation rate in last year= 0.525
 Comment: OK

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Catch dab-nsea

Relative biomass

Exploitation rate

Stock status
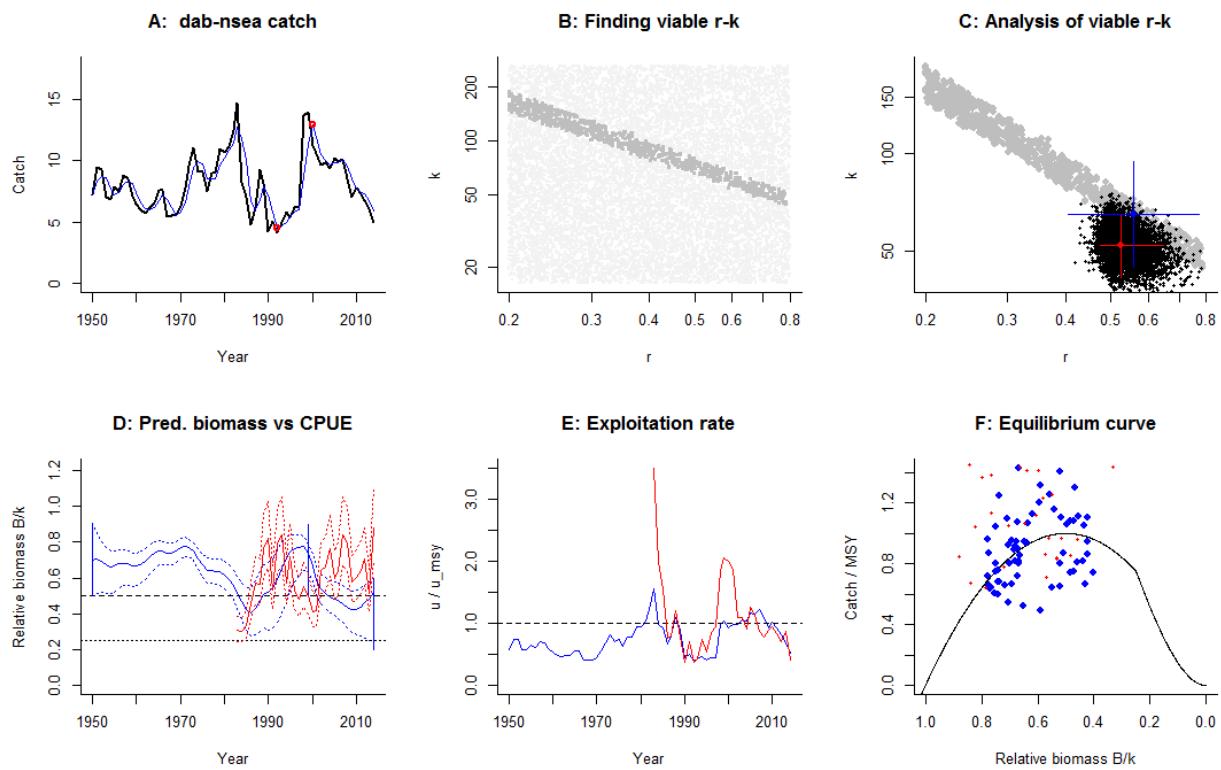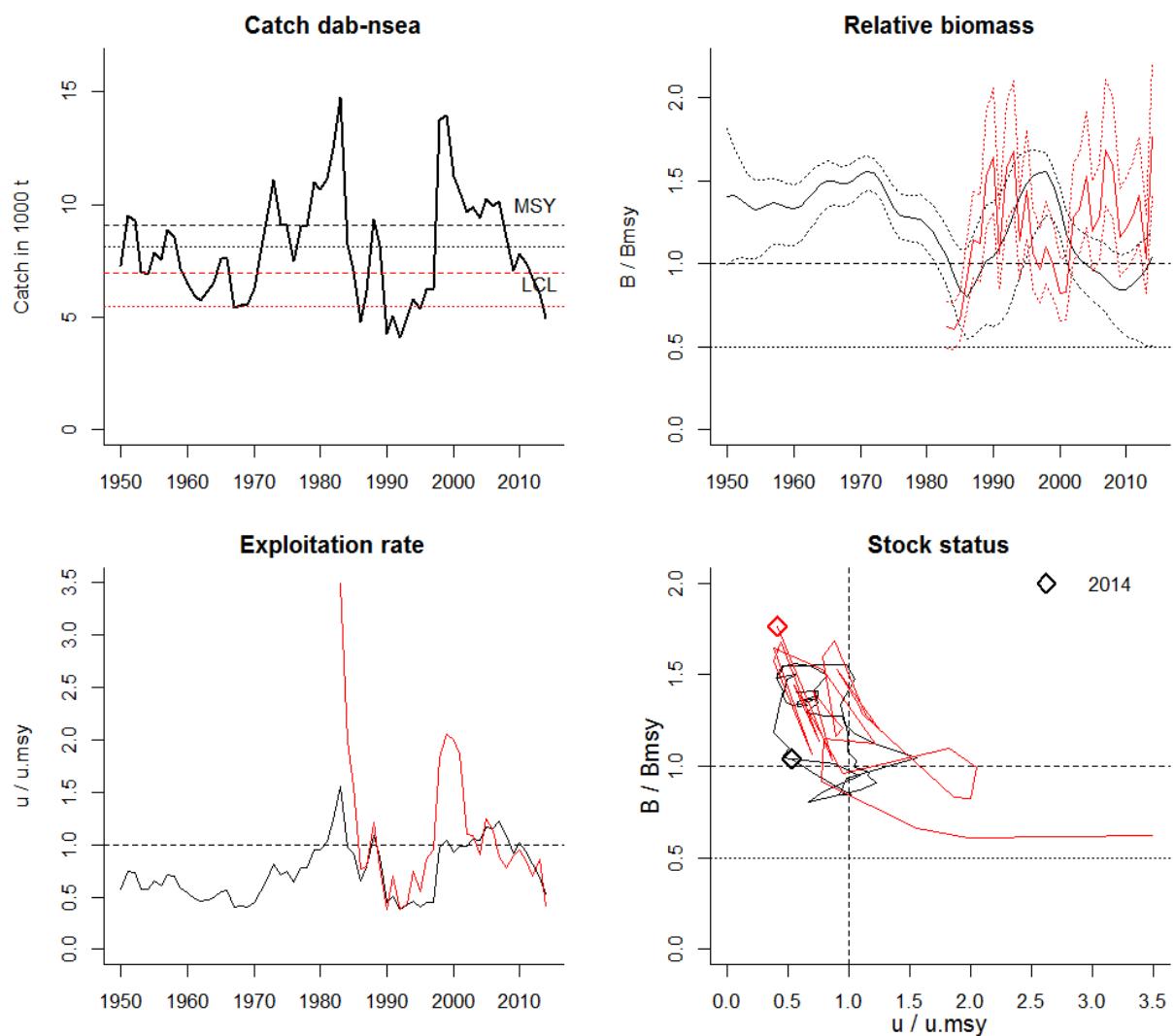
Species: *Anguilla anguilla* , stock: eel-eur
 Name and region: European eel throughout its natural range , ICES
 Catch data used from years 1950 - 2013 , biomass = CPUE
 Prior initial relative biomass = 0.5 - 0.9 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 2009 default
 Prior final relative biomass   = 0.01 - 0.2 expert
 Prior range for r = 0.05 - 0.5 default , prior range for k = 39 - 1562
Prior range of q = 0.000184 - 0.00117
Results from Bayesian Schaefer model using catch & CPUE
 r = 0.262 , 95% CL = 0.205 - 0.297 , k = 396 , 95% CL = 266 - 644
 MSY = 25.4 , 95% CL = 16.9 - 41.2
q = 0.000431 , lcl = 0.000318 , ucl = 0.000563
 Biomass in last year from q*CPUE = 16.2 or 0.041 k
 Exploitation rate in last year = 0.314
 Results of CMSY analysis with altogether 3244 viable trajectories for 1885 r-k pairs
 r = 0.183 , 95% CL = 0.122 - 0.274 , k = 285 , 95% CL = 179 - 456
 MSY = 13 , 95% CL = 11.5 - 14.8
 Relative biomass last year= 0.0928 k, 2.5th = 0.0152 , 97.5th = 0.192
 Relative biomass next year= 0.0823 k, 2.5th = 0.00159 , 97.5th = 0.197
 Relative exploitation rate in last year= 1.56
 Comment: Endbio set to 0.01-0.2. Yellow eel abundance data used as CPUE.

A: eel-eur catch

B: Finding viable r-k

C: Analysis of viable r-k

D: Pred. biomass vs CPUE

E: Exploitation rate

F: Equilibrium curve

Catch eel-eur

Relative biomass

Exploitation rate

Stock status
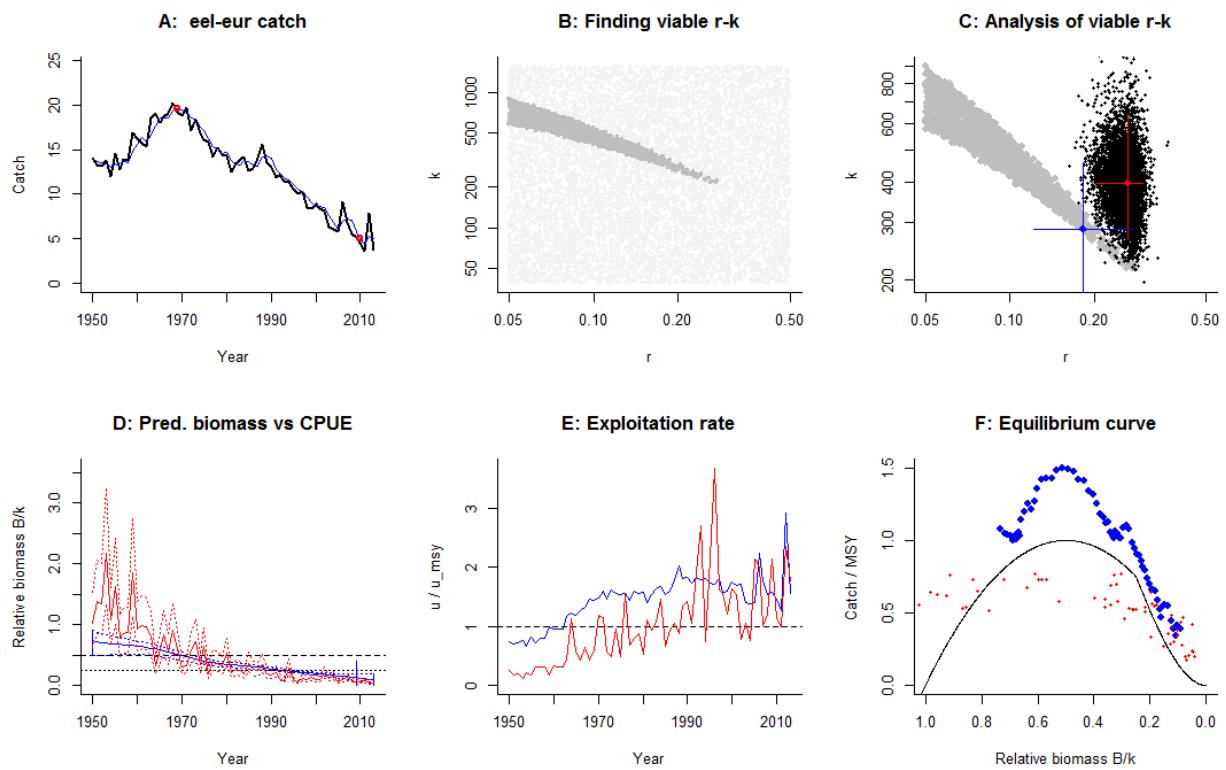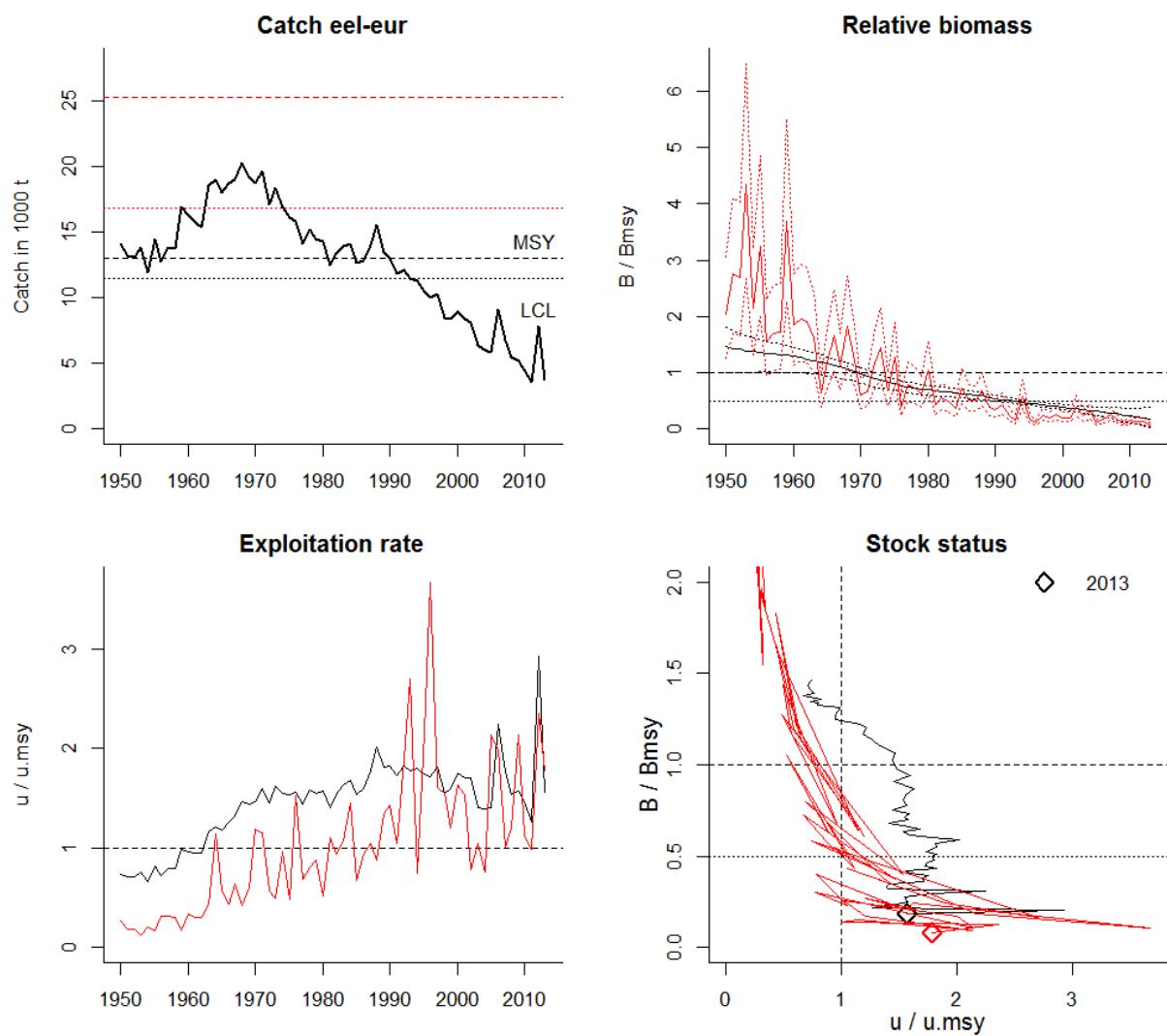
Species: *Platichthys flesus* , stock: fle-2223
Name and region: Flounder in Subdivisions 22–23 (Belts and sound) , ICES
Catch data used from years 1991 - 2014 , biomass = CPUE
Prior initial relative biomass = 0.2 - 0.6 default
Prior intermediate rel. biomass= 0.01 - 0.4 in year 2006 default
Prior final relative biomass   = 0.2 - 0.6 , default
Prior range for r = 0.2 - 0.8 default , prior range for k = 2.98 - 47.7
Prior range of q = 0.0306 - 0.122
Results from Bayesian Schaefer model using catch & CPUE
r = 0.522 , 95% CL = 0.465 - 0.669 , k = 14.5 , 95% CL = 6.42 - 21.2
MSY = 1.95 , 95% CL = 0.821 - 2.88
q = 0.032 , lcl = 0.0226 , ucl = 0.0515
Biomass in last year from q*CPUE = 12 or 0.831 k
Exploitation rate in last year = 0.107
Results of CMSY analysis with altogether 3891 viable trajectories for 1579 r-k pairs
r = 0.553 , 95% CL = 0.401 - 0.777 , k = 11.8 , 95% CL = 7.59 - 18
MSY = 1.63 , 95% CL = 1.34 - 1.98
Relative biomass last year= 0.497 k, 2.5th = 0.252 , 97.5th = 0.595
Relative biomass next year= 0.519 k, 2.5th = 0.239 , 97.5th = 0.625
Relative exploitation rate in last year= 0.736
Comment: Start year set to 1991. CMSY fit could be improved by setting intbio to Low in 2000.
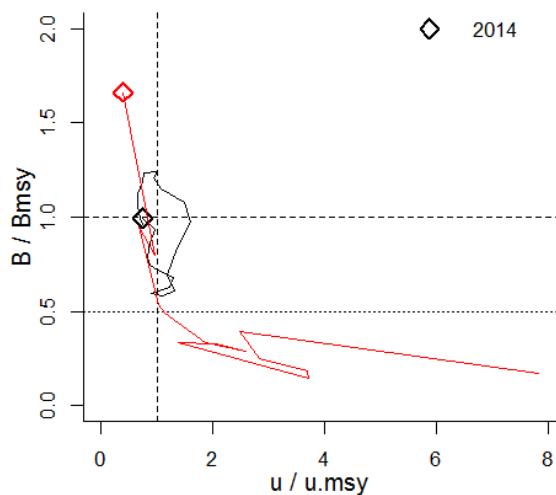
Species: *Platichthys flesus* , stock: fle-2425
 Name and region: Flounder in Subdivisions 24–25 (Southern Baltic Sea) , ICES
 Catch data used from years 1990 - 2014 , biomass = CPUE
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.5 - 0.9 in year 2006 default
 Prior final relative biomass = 0.5 - 0.9 , default
 Prior range for r = 0.2 - 0.8 default , prior range for k = 32.8 - 787
Prior range of q = 0.00093 - 0.00372
Results from Bayesian Schaefer model using catch & CPUE
 r = 0.502 , 95% CL = 0.445 - 0.579 , k = 82.2 , 95% CL = 56.5 - 123
 MSY = 10.3 , 95% CL = 7.01 - 15.6
q = 0.00149 , lcl = 0.00109 , ucl = 0.00201
 Biomass in last year from q*CPUE = 95.3 or 1.16 k
 Exploitation rate in last year = 0.138
 Results of CMSY analysis with altogether 40447 viable trajectories for 4257 r-k pairs
 r = 0.566 , 95% CL = 0.407 - 0.785 , k = 126 , 95% CL = 63.5 - 252
 MSY = 17.9 , 95% CL = 8.81 - 36.3
 Relative biomass last year= 0.804 k, 2.5th = 0.531 , 97.5th = 0.895
 Relative biomass next year= 0.789 k, 2.5th = 0.498 , 97.5th = 0.889
 Relative exploitation rate in last year= 0.508
 Comment: Start year set to 1990. CMSY fit could be improved by setting intbio to Medium in 2000.

Catch fle-2425

Relative biomass

Exploitation rate

Stock status

233
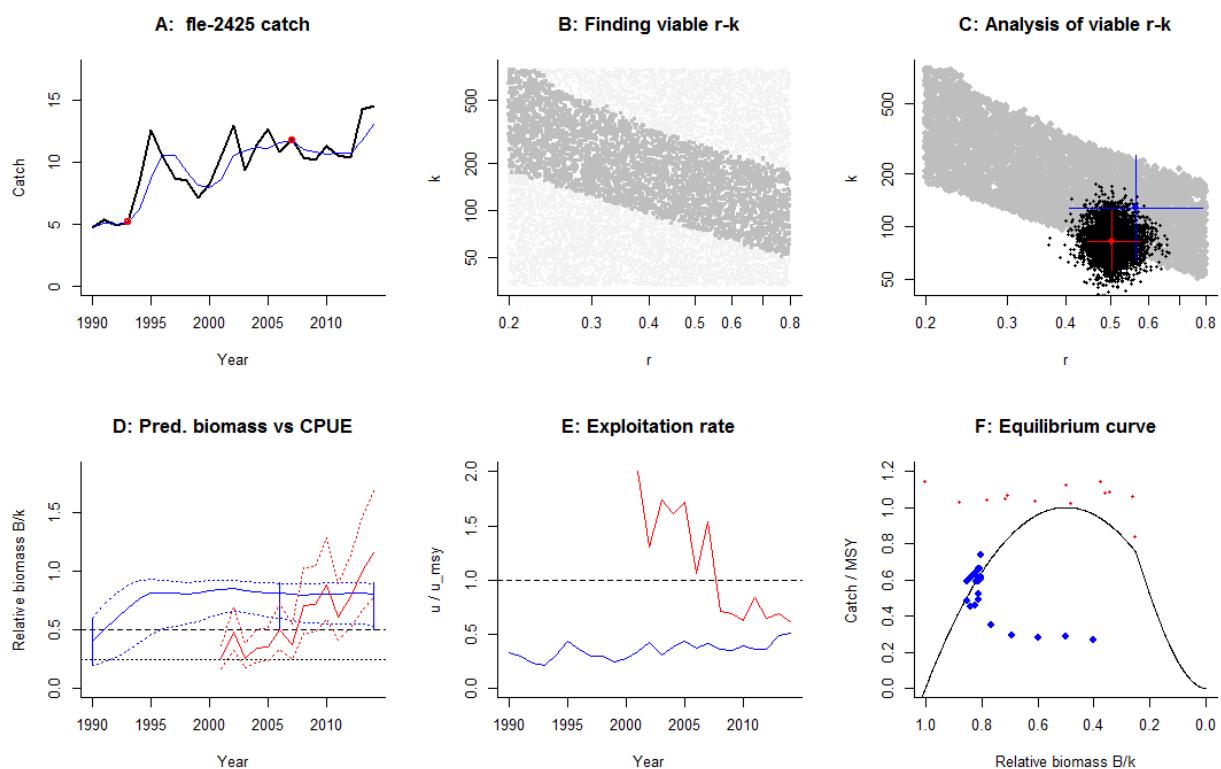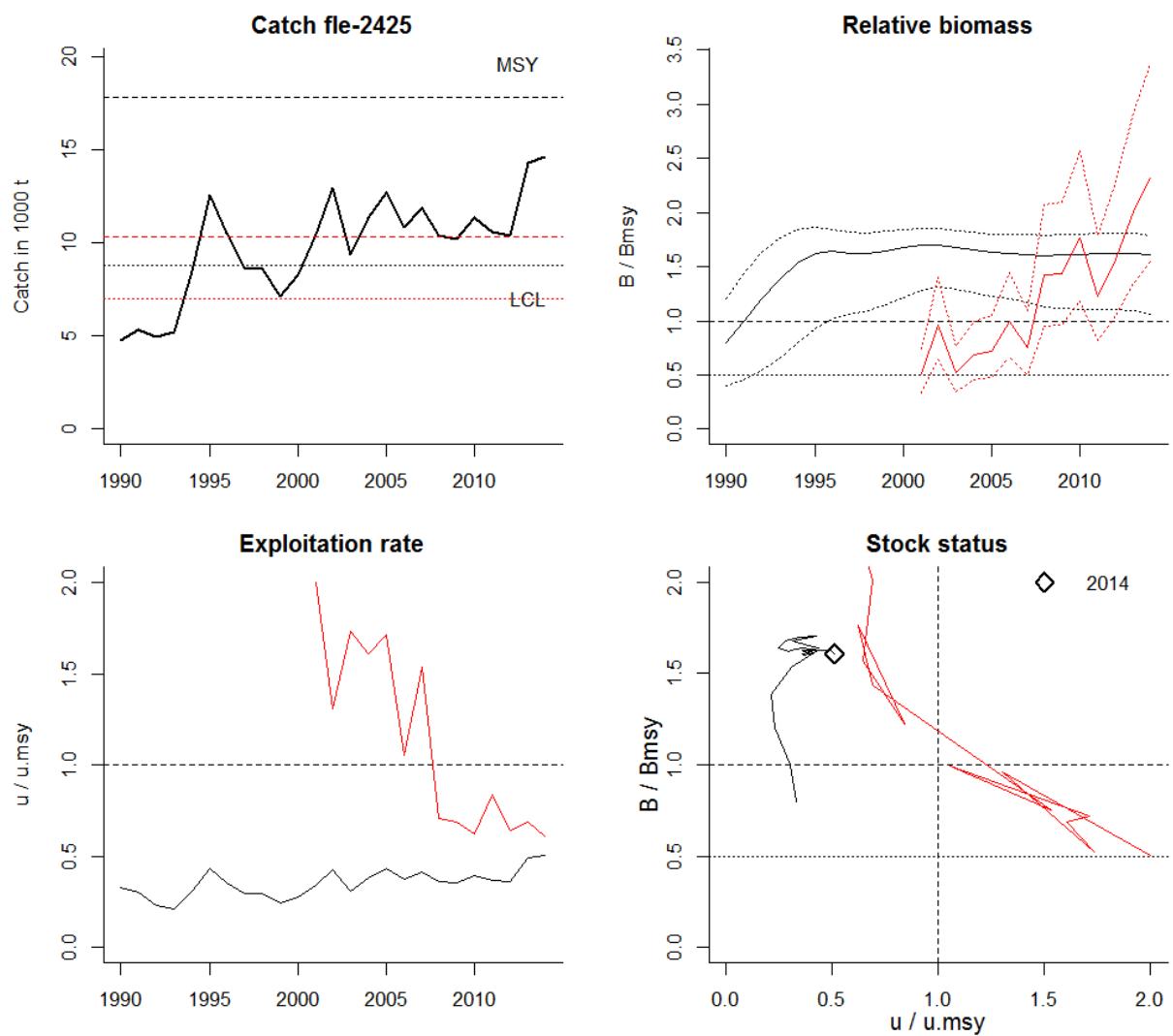
Species: *Platichthys flesus* , stock: fle-2628
 Name and region: Flounder in Subdivisions 26 and 28 (Eastern Gotland and Gulf of Gdansk) , ICES
 Catch data used from years 1996 - 2014 , biomass = CPUE
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.2 - 0.6 in year 2005 default
 Prior final relative biomass   = 0.01 - 0.4 expert
 Prior range for r = 0.2 - 0.8 default , prior range for k = 7.03 - 113
Prior range of q = 0.00808 - 0.0323
Results from Bayesian Schaefer model using catch & CPUE
 r = 0.499 , 95% CL = 0.442 - 0.559 , k = 31.6 , 95% CL = 26.4 - 39.3
 MSY = 3.94 , 95% CL = 3.4 - 4.77
q = 0.0166 , lcl = 0.0134 , ucl = 0.0199
 Biomass in last year from q*CPUE = 4.36 or 0.138 k
 Exploitation rate in last year = 1.04
 Results of CMSY analysis with altogether 4293 viable trajectories for 1734 r-k pairs
 r = 0.566 , 95% CL = 0.407 - 0.785 , k = 30.8 , 95% CL = 19.5 - 48.6
 MSY = 4.35 , 95% CL = 3.38 - 5.61
 Relative biomass last year= 0.278 k, 2.5th = 0.0255 , 97.5th = 0.394
 Relative biomass next year= 0.237 k, 2.5th = -0.14 , 97.5th = 0.395
 Relative exploitation rate in last year= 1.91
 Comment: OK

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Catch fle-2628

Relative biomass

Exploitation rate

Stock status

235
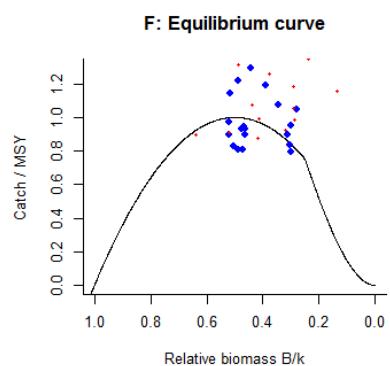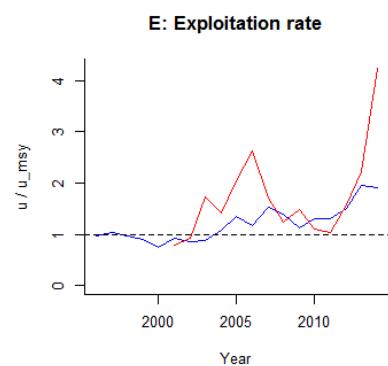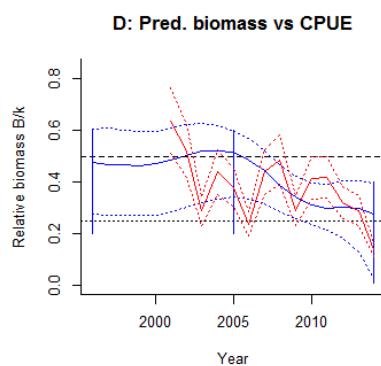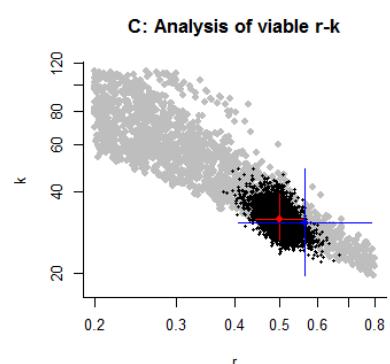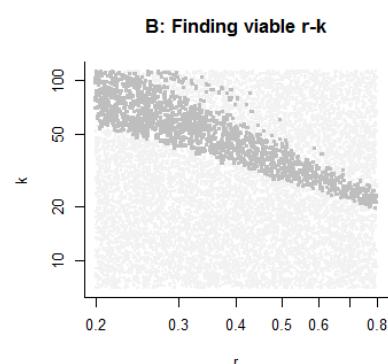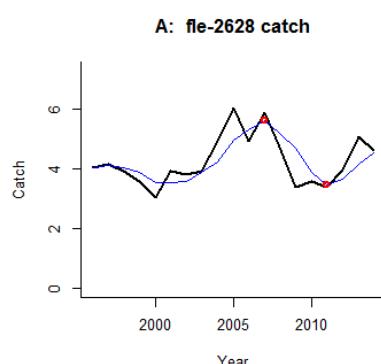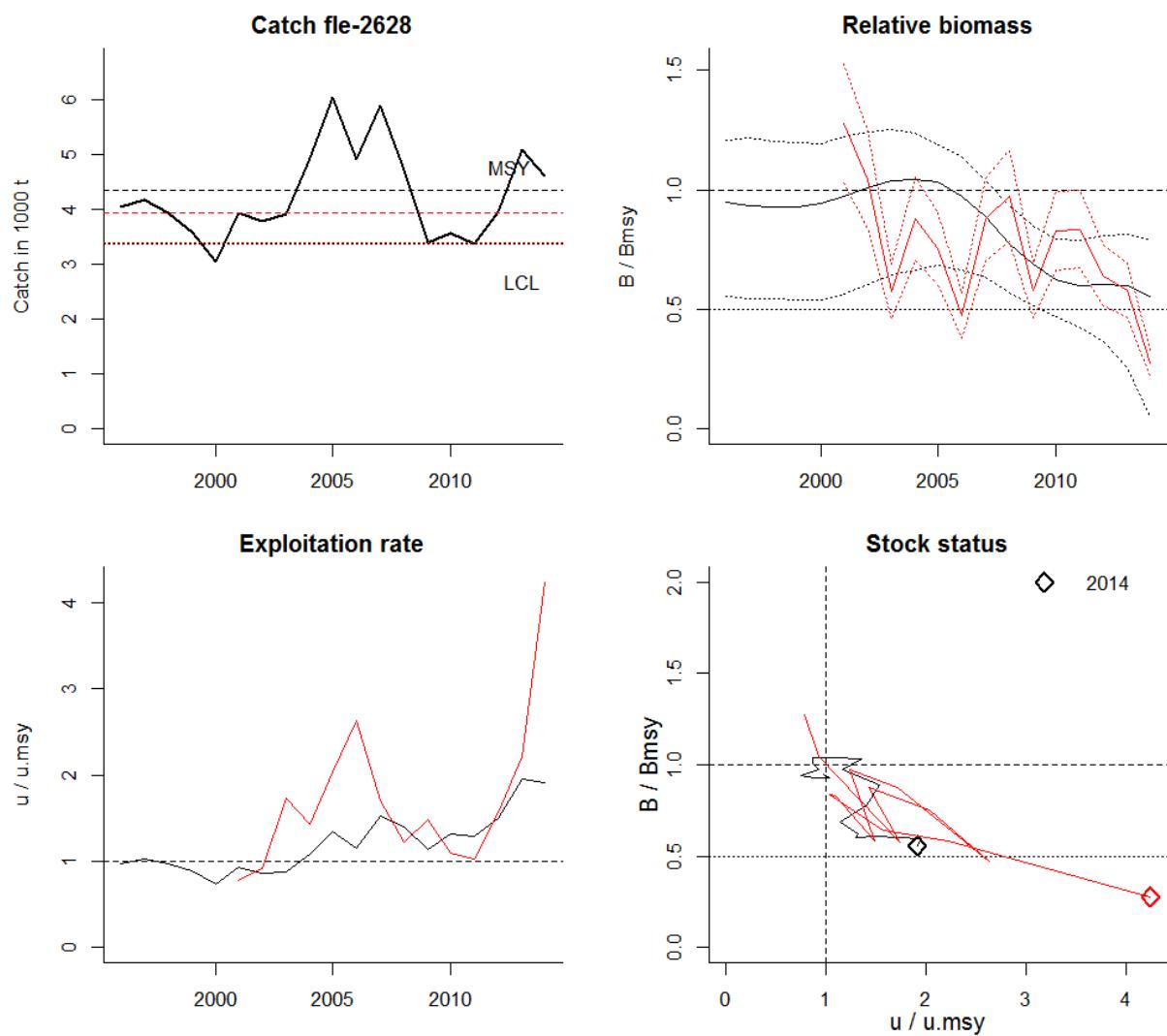
Species: *Platichthys flesus* , stock: fle-2732
Flounder in Subdivisions 27 and 29–32 (Northern Central and Northern Baltic Sea) , ICES
Catch data used from years 1990 - 2014 , biomass = CPUE
Prior initial relative biomass = 0.2 - 0.6 default
Prior intermediate rel. biomass= 0.5 - 0.9 in year 2001 default
Prior final relative biomass = 0.2 - 0.6 , default
Prior range for r = 0.2 - 0.8 default , prior range for k = 0.603 - 9.65
Prior range of q = 0.000733 - 0.00293
Results from Bayesian Schaefer model using catch & CPUE
r = 0.509 , 95% CL = 0.463 - 0.599 , k = 2.34 , 95% CL = 1.75 - 2.8
MSY = 0.301 , 95% CL = 0.222 - 0.356
q = 0.000957 , lcl = 0.000745 , ucl = 0.00126
Biomass in last year from q*CPUE = 1.55 or 0.662 k
Exploitation rate in last year = 0.131
Results of CMSY analysis with altogether 2087 viable trajectories for 828 r-k pairs
r = 0.561 , 95% CL = 0.405 - 0.785 , k = 2.47 , 95% CL = 1.67 - 3.63
MSY = 0.347 , 95% CL = 0.31 - 0.39
Relative biomass last year= 0.497 k, 2.5th = 0.251 , 97.5th = 0.596
Relative biomass next year= 0.555 k, 2.5th = 0.279 , 97.5th = 0.665
Relative exploitation rate in last year= 0.53
Comment: Start year set to 1990.

A: fle-2732 catch

B: Finding viable r-k

C: Analysis of viable r-k

D: Pred. biomass vs CPUE

E: Exploitation rate

F: Equilibrium curve
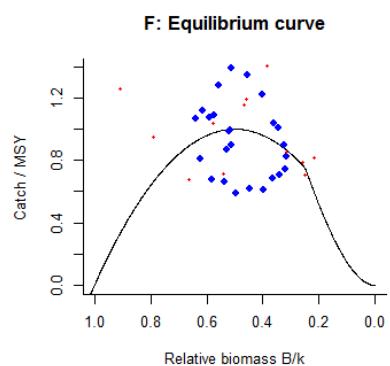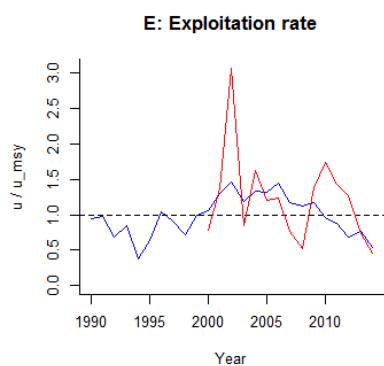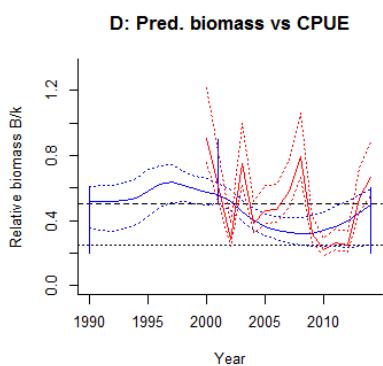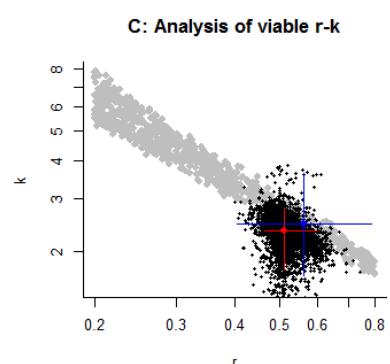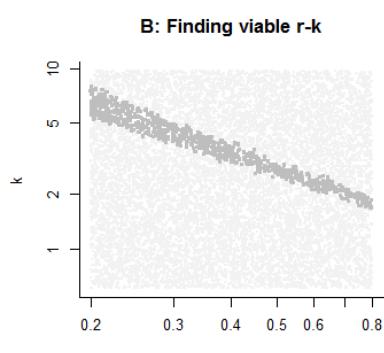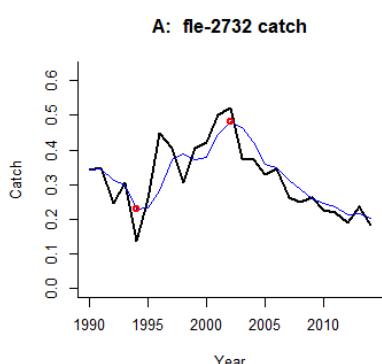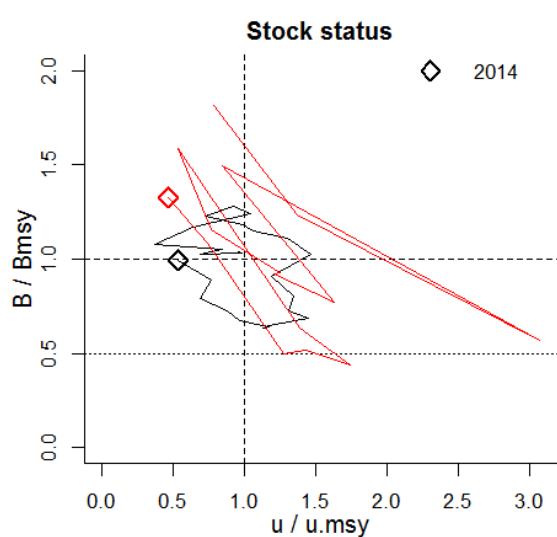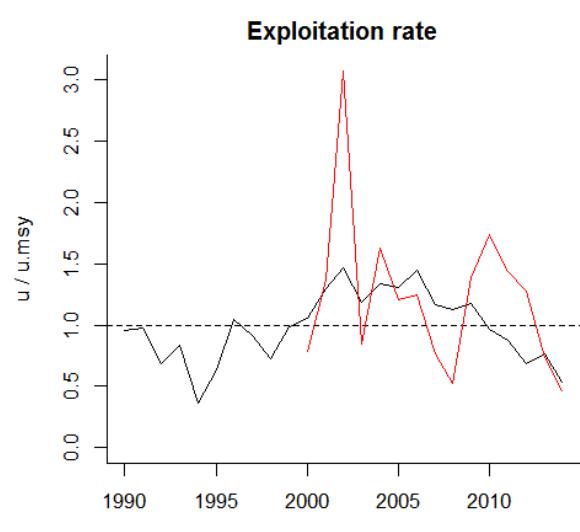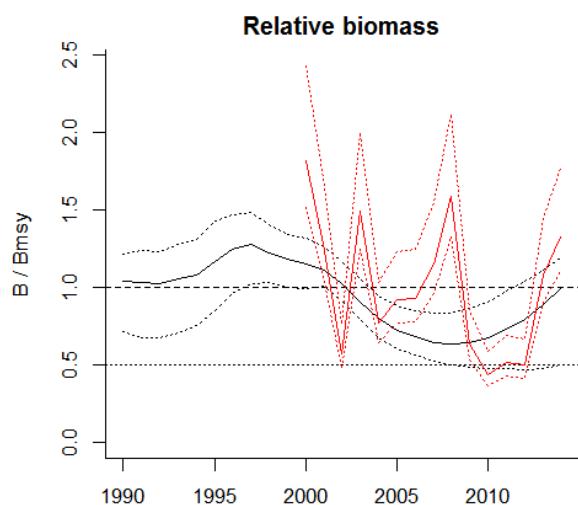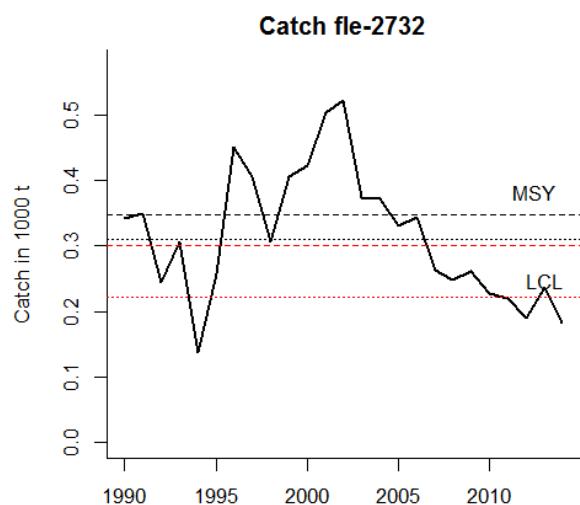
Species: *Platichthys flesus* , stock: fle-nsea
 Name and region: Flounder in Division IIIa and Subarea IV , ICES
 Catch data used from years 1983 - 2014 , biomass = CPUE
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.5 - 0.9 in year 1999 default
 Prior final relative biomass   = 0.2 - 0.6 , default
 Prior range for r = 0.2 - 0.8 default , prior range for k = 6.98 - 112
Prior range of q = 0.000244 - 0.000977
Results from Bayesian Schaefer model using catch & CPUE
 r = 0.513 , 95% CL = 0.466 - 0.615 , k = 25.9 , 95% CL = 20.7 - 34
 MSY = 3.39 , 95% CL = 2.66 - 4.43
q = 0.000296 , lcl = 0.000239 , ucl = 0.000371
 Biomass in last year from q*CPUE = 8.24 or 0.318 k
 Exploitation rate in last year = 0.252
 Results of CMSY analysis with altogether 3922 viable trajectories for 1004 r-k pairs
 r = 0.567 , 95% CL = 0.405 - 0.785 , k = 25.9 , 95% CL = 17.5 - 38.8
 MSY = 3.67 , 95% CL = 3.21 - 4.19
 Relative biomass last year= 0.484 k, 2.5th = 0.245 , 97.5th = 0.596
 Relative biomass next year= 0.549 k, 2.5th = 0.257 , 97.5th = 0.67
 Relative exploitation rate in last year= 0.58
 Comment: OK

Catch fle-nsea

Relative biomass

Exploitation rate

Stock status
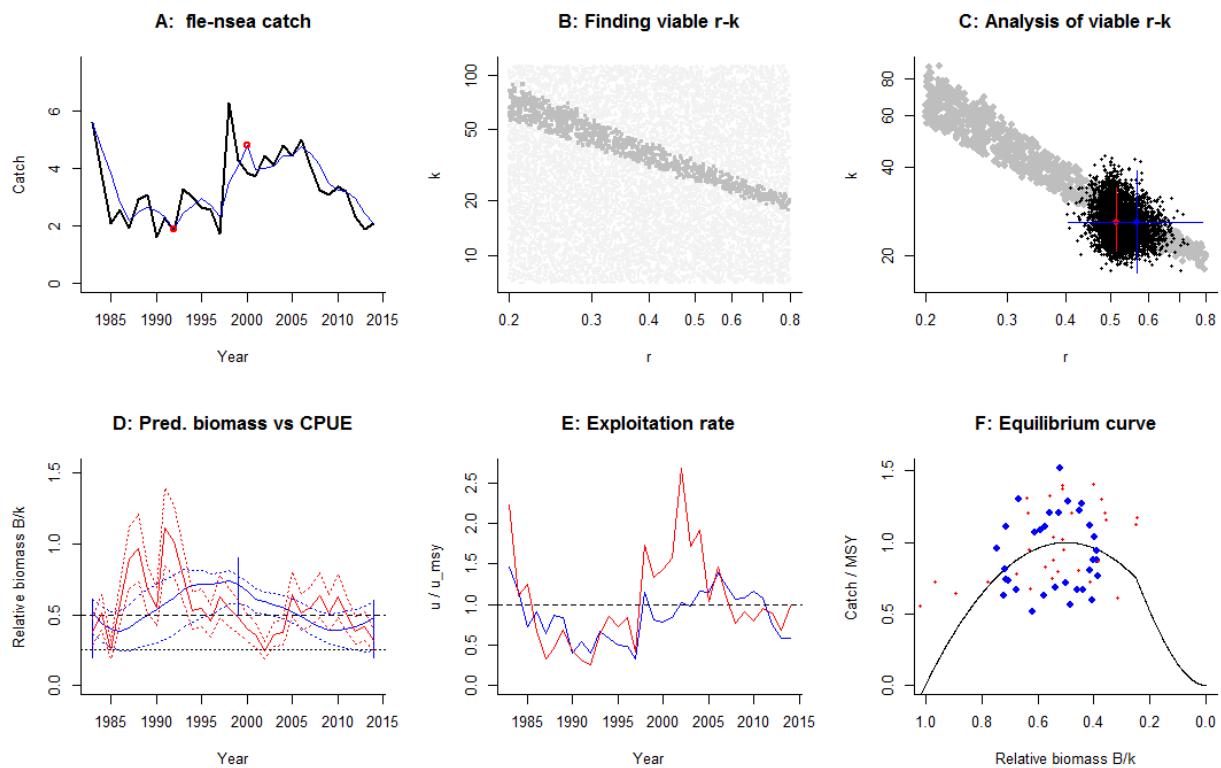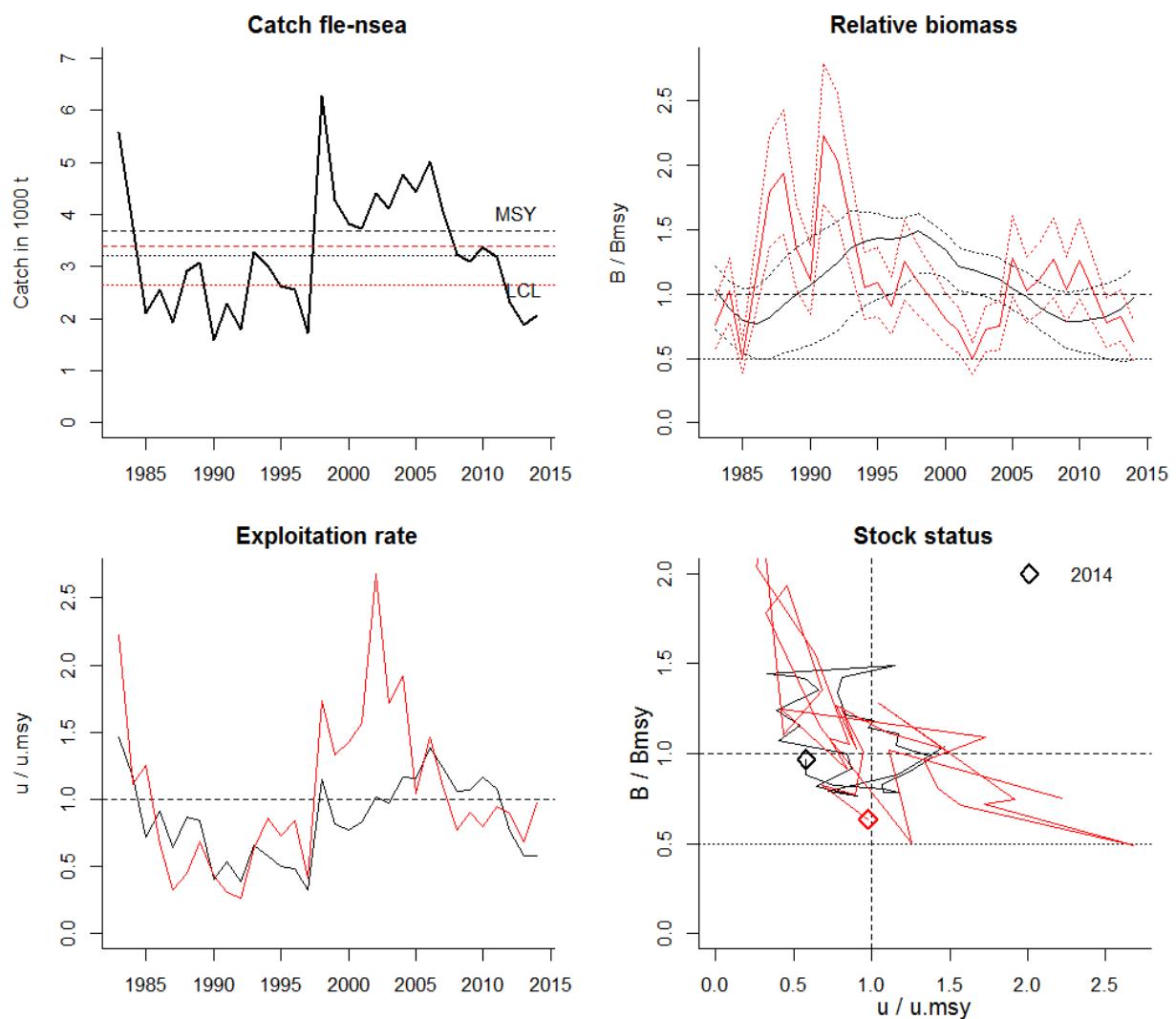
Species: *Phycis blennoides* , stock: gfb-comb
 Name and region: Great forkbeard in Northeast Atlantic , ICES
 Catch data used from years 1988 - 2013 , biomass = CPUE
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 2009 default
 Prior final relative biomass   = 0.2 - 0.6 , default
 Prior range for r = 0.2 - 0.8 default , prior range for k = 6.65 - 106
Prior range of q = 0.000103 - 0.000411
Results from Bayesian Schaefer model using catch & CPUE
 r = 0.509 , 95% CL = 0.461 - 0.604 , k = 22.8 , 95% CL = 15 - 34.7
 MSY = 2.93 , 95% CL = 1.92 - 4.54
q = 0.000143 , lcl = 0.000115 , ucl = 0.00018
 Biomass in last year from q*CPUE = 10.8 or 0.475 k
 Exploitation rate in last year = 0.202
Less than 10 years with abundance data available, shown on second axis
 Results of CMSY analysis with altogether 3688 viable trajectories for 1304 r-k pairs
 r = 0.567 , 95% CL = 0.405 - 0.785 , k = 24.4 , 95% CL = 16.2 - 37
 MSY = 3.45 , 95% CL = 2.93 - 4.07
 Relative biomass last year= 0.498 k, 2.5th = 0.243 , 97.5th = 0.595
 Relative biomass next year= 0.542 k, 2.5th = 0.249 , 97.5th = 0.658
 Relative exploitation rate in last year= 0.534
 Comment: OK

Catch gfb-comb

MSY

LCL

Relative biomass

Exploitation rate

Stock status

2013
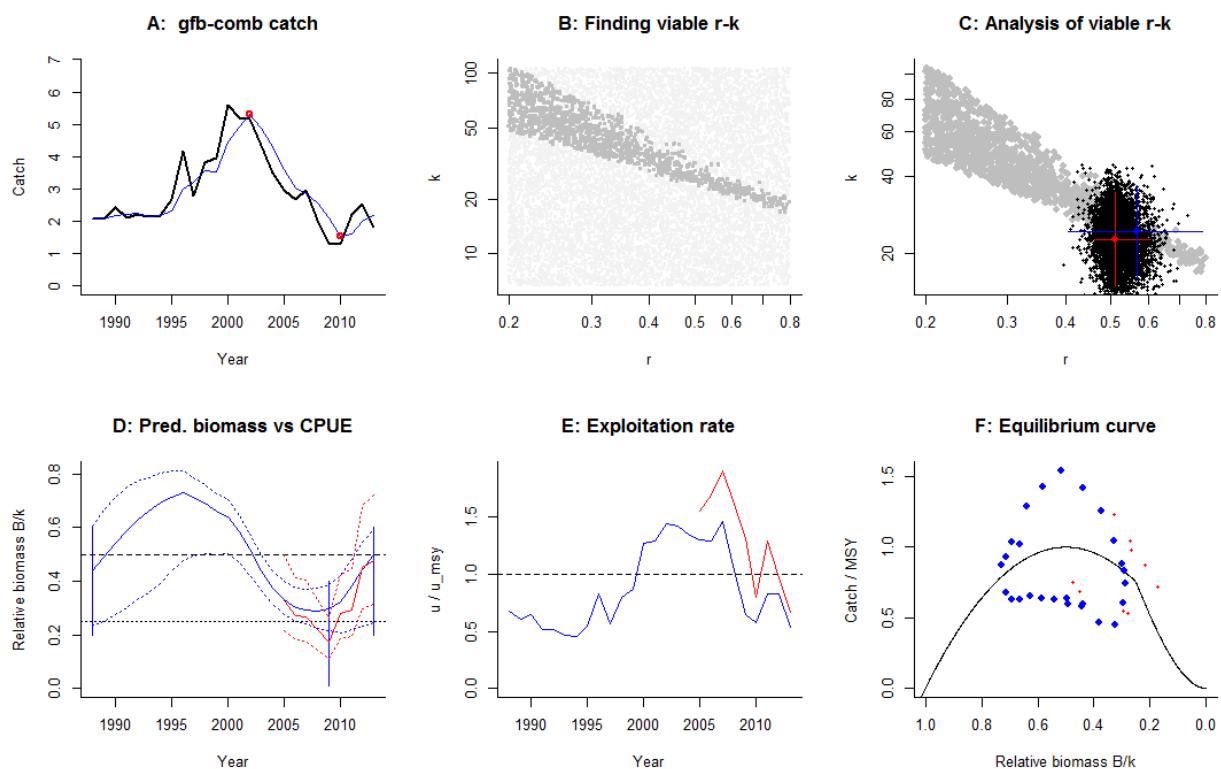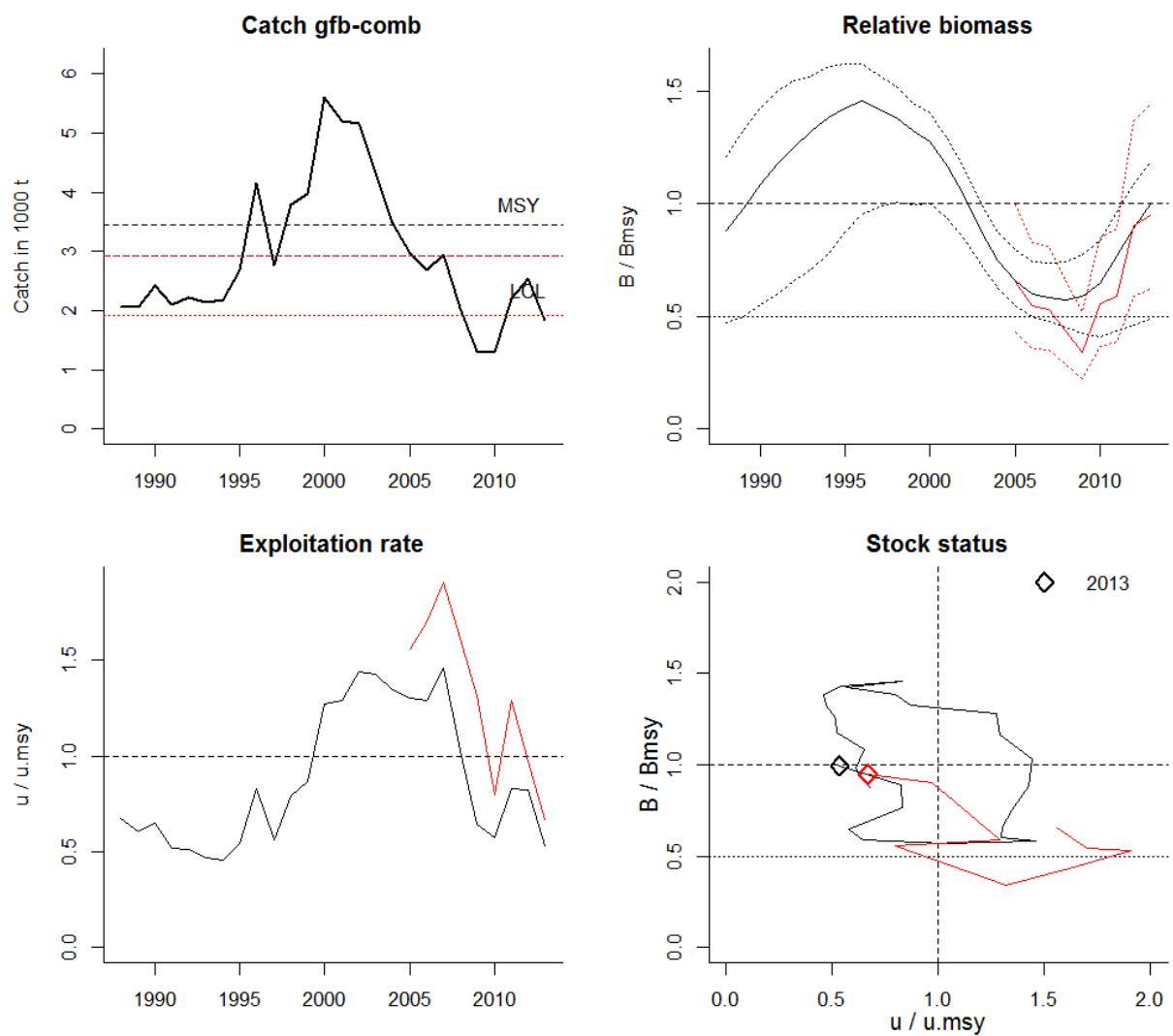
Species: *Microstomus kitt* , stock: lem-nsea

Lemon sole in Subarea IV (North Sea) and Divisions IIIa (Skagerrak–Kattegat) and VIId (Eastern Channel)

Catch data used from years 1975 - 2014 , biomass = CPUE

Prior initial relative biomass = 0.2 - 0.6 default

Prior intermediate rel. biomass= 0.01 - 0.4 in year 2009 default

Prior final relative biomass = 0.2 - 0.6 , default

Prior range for r = 0.2 - 0.8 default , prior range for k = 10.9 - 174

Prior range of q = 8.22e-05 - 0.000329

Results from Bayesian Schaefer model using catch & CPUE

r = 0.525 , 95% CL = 0.477 - 0.627 , k = 54.2 , 95% CL = 43.4 - 64.7

MSY = 7.19 , 95% CL = 6.05 - 8.22

q = 8.9e-05 , lcl = 7.33e-05 , ucl = 0.000108

Biomass in last year from q*CPUE = 17.5 or 0.322 k

Exploitation rate in last year = 0.219

Results of CMSY analysis with altogether 2824 viable trajectories for 1839 r-k pairs

r = 0.465 , 95% CL = 0.357 - 0.711 , k = 58.3 , 95% CL = 36.1 - 80.5

MSY = 6.79 , 95% CL = 6.07 - 7.58

Relative biomass last year= 0.522 k, 2.5th = 0.256 , 97.5th = 0.595

Relative biomass next year= 0.57 k, 2.5th = 0.277 , 97.5th = 0.651

Relative exploitation rate in last year= 0.521

Comment: OK

A: lem-nsea catch

B: Finding viable r-k

C: Analysis of viable r-k

D: Pred. biomass vs CPUE

E: Exploitation rate

F: Equilibrium curve

Catch lem-nsea

Relative biomass

Exploitation rate

Stock status

243
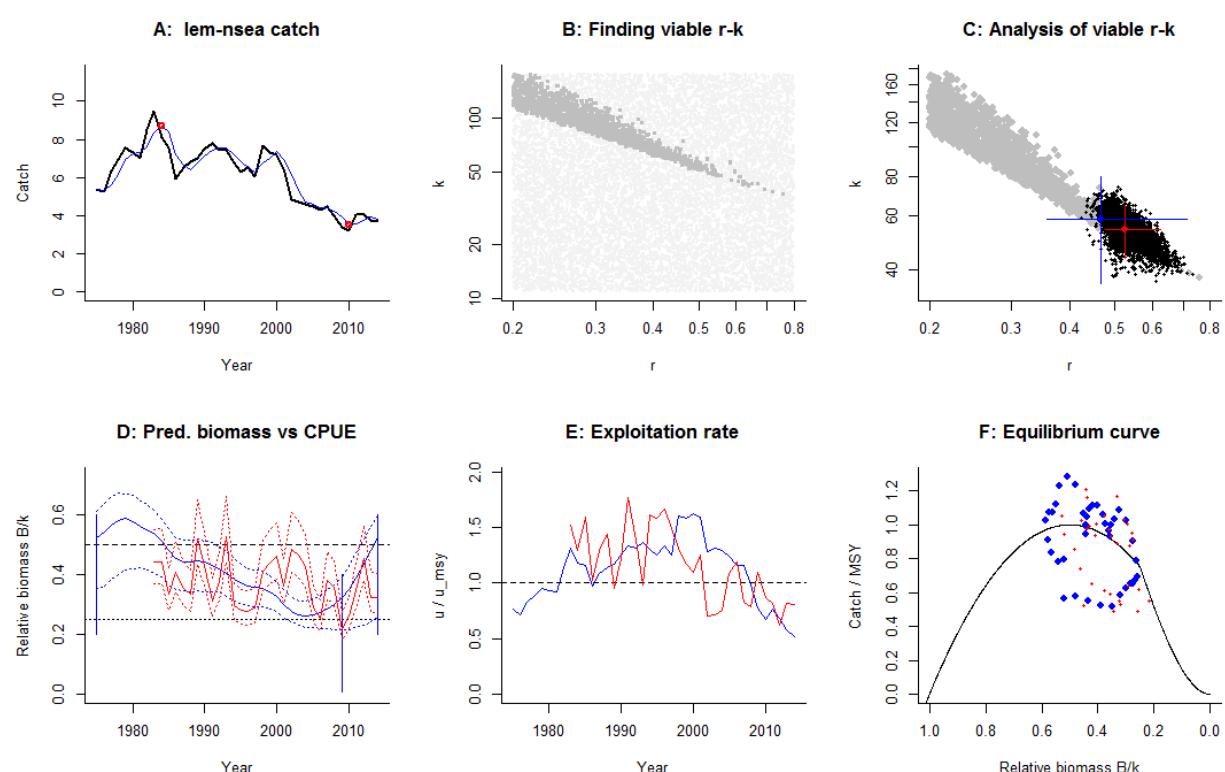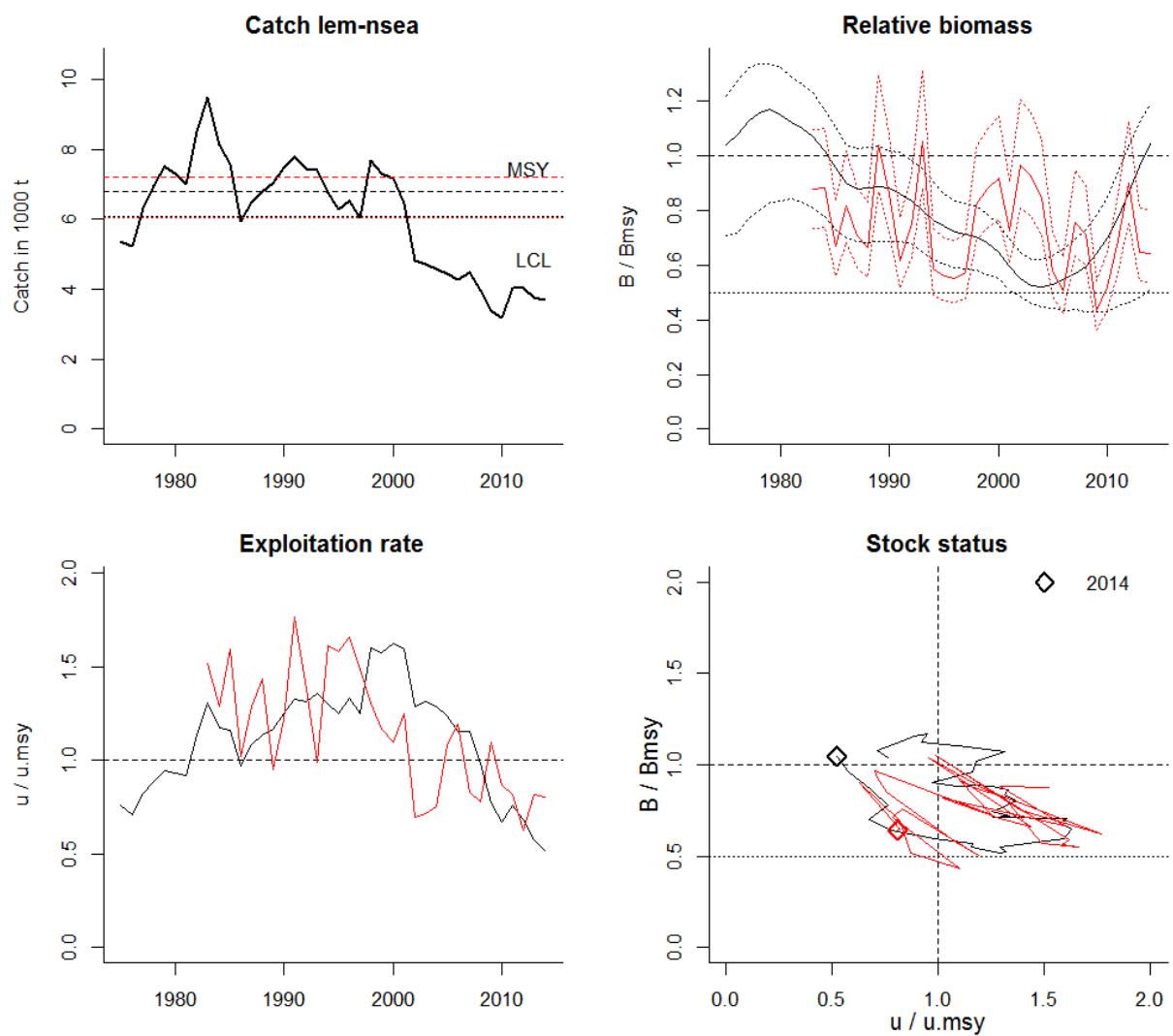
Species: *Mullus surmuletus* , stock: mur-347d
 Name and region: Red striped mullet - in Subarea IV (North Sea) and Divisions VIId (Eastern English Channel) and IIIa (Skagerrak–Kattegat) , ICES
 Catch data used from years 1990 - 2011 , biomass = CPUE
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.5 - 0.9 in year 2007 default
 Prior final relative biomass = 0.01 - 0.4 expert
 Prior range for r = 0.2 - 0.8 default , prior range for k = 4.41 - 70.5
Prior range of q = 6.08e-05 - 0.000243
Results from Bayesian Schaefer model using catch & CPUE
 r = 0.503 , 95% CL = 0.449 - 0.578 , k = 17.2 , 95% CL = 15 - 20.4
 MSY = 2.16 , 95% CL = 1.9 - 2.58
q = 0.000113 , lcl = 8.65e-05 , ucl = 0.000145
 Biomass in last year from q*CPUE = 3.36 or 0.196 k
 Exploitation rate in last year = 0.479
 Results of CMSY analysis with altogether 5678 viable trajectories for 1039 r-k pairs
 r = 0.566 , 95% CL = 0.407 - 0.785 , k = 16.4 , 95% CL = 10.8 - 25
 MSY = 2.32 , 95% CL = 1.94 - 2.78
 Relative biomass last year= 0.331 k, 2.5th = 0.144 , 97.5th = 0.397
 Relative biomass next year= 0.358 k, 2.5th = 0.0806 , 97.5th = 0.458
 Relative exploitation rate in last year= 0.935
 Comment: OK
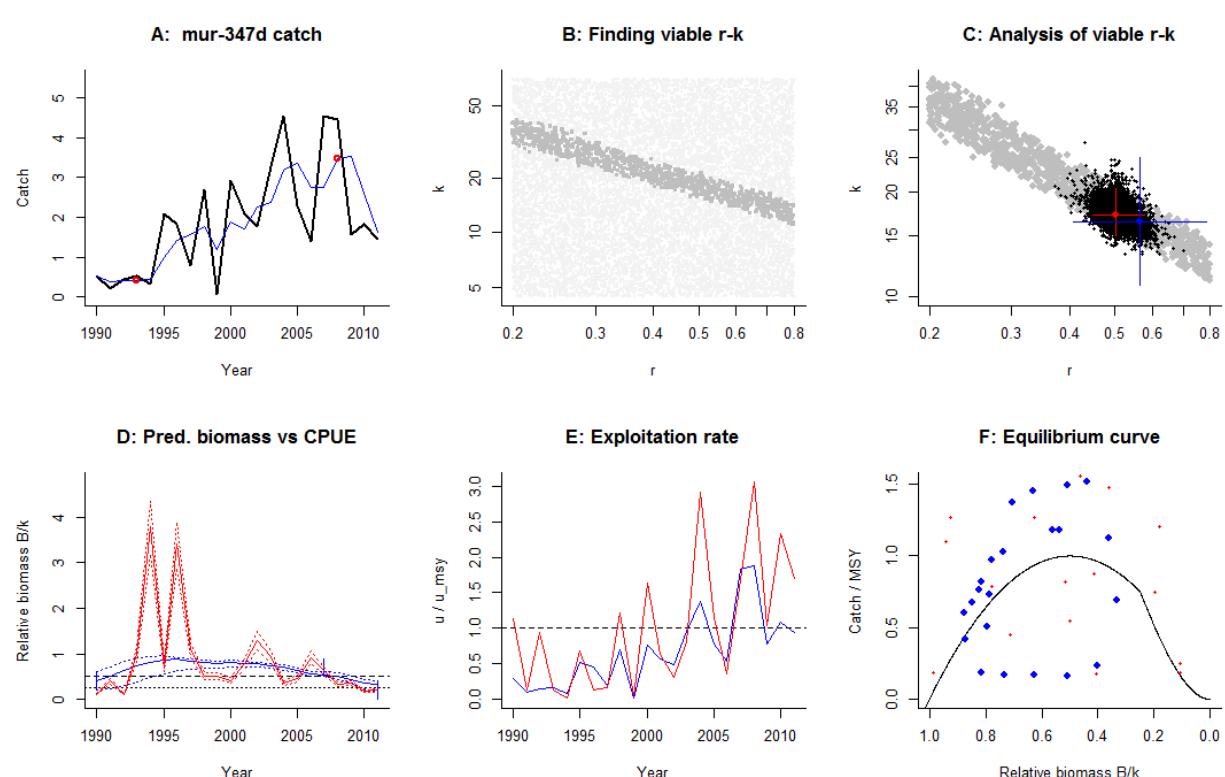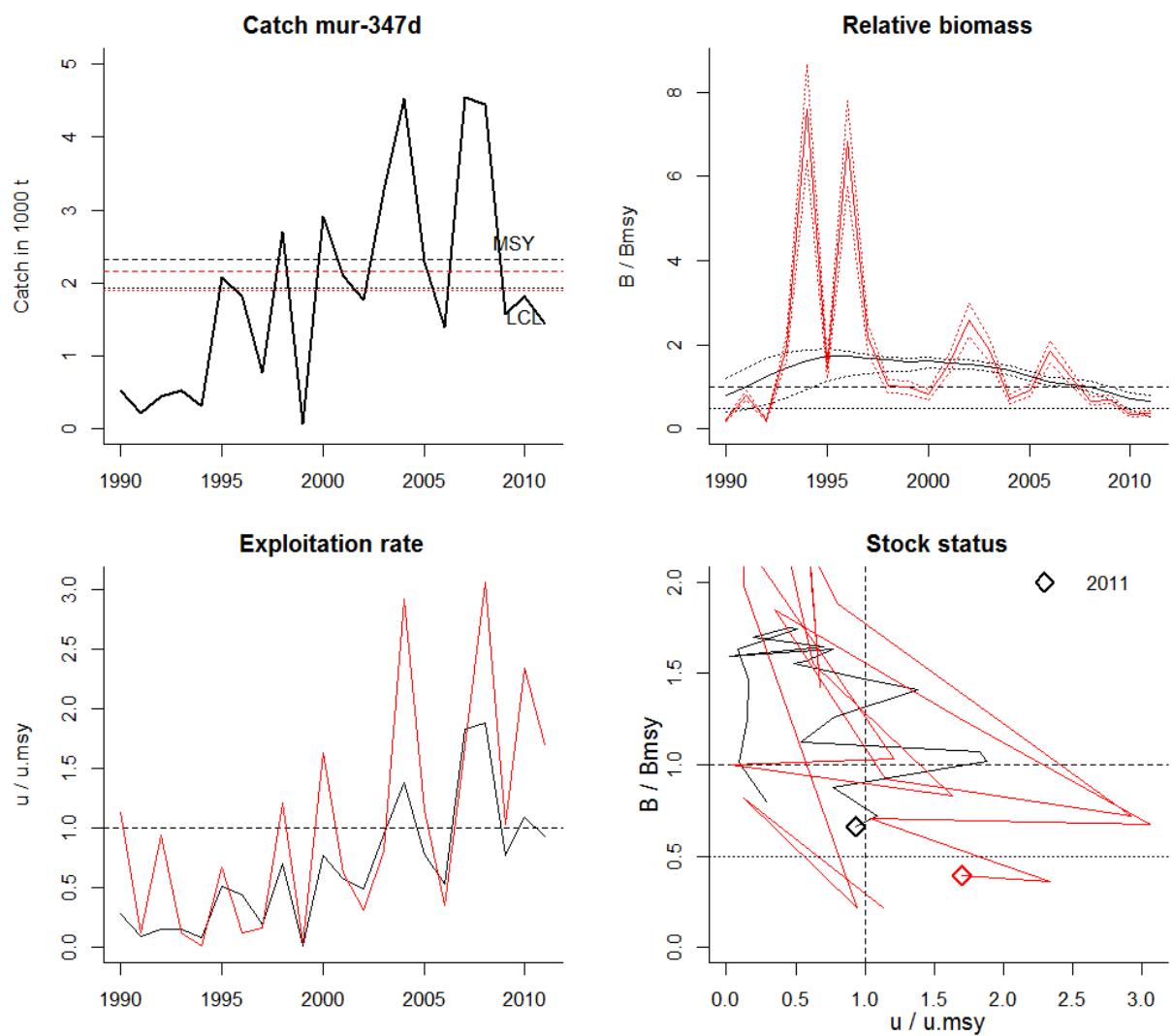
Species: *Nephrops norvegicus* , stock: nep-2829
 Name and region: Neprophs in FUs 28 and 29 , ICES
 Catch data used from years 1984 - 2013 , biomass = CPUE
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 1997 default
 Prior final relative biomass = 0.01 - 0.4 expert
 Prior range for r = 0.2 - 0.8 default , prior range for k = 0.618 - 9.89
Prior range of q = 0.00512 - 0.0205
Results from Bayesian Schaefer model using catch & CPUE
 r = 0.524 , 95% CL = 0.475 - 0.635 , k = 3.11 , 95% CL = 2.17 - 4.45
 MSY = 0.415 , 95% CL = 0.286 - 0.587
q = 0.00494 , lcl = 0.00397 , ucl = 0.00608
 Biomass in last year from q*CPUE = 1.13 or 0.365 k
 Exploitation rate in last year = 0.173
 Results of CMSY analysis with altogether 3058 viable trajectories for 2410 r-k pairs
 r = 0.443 , 95% CL = 0.344 - 0.655 , k = 3.74 , 95% CL = 2.04 - 5.96
 MSY = 0.414 , 95% CL = 0.272 - 0.629
 Relative biomass last year= 0.253 k, 2.5th = 0.0161 , 97.5th = 0.395
 Relative biomass next year= 0.282 k, 2.5th = -0.0281 , 97.5th = 0.439
 Relative exploitation rate in last year= 0.998
 Comment: OK
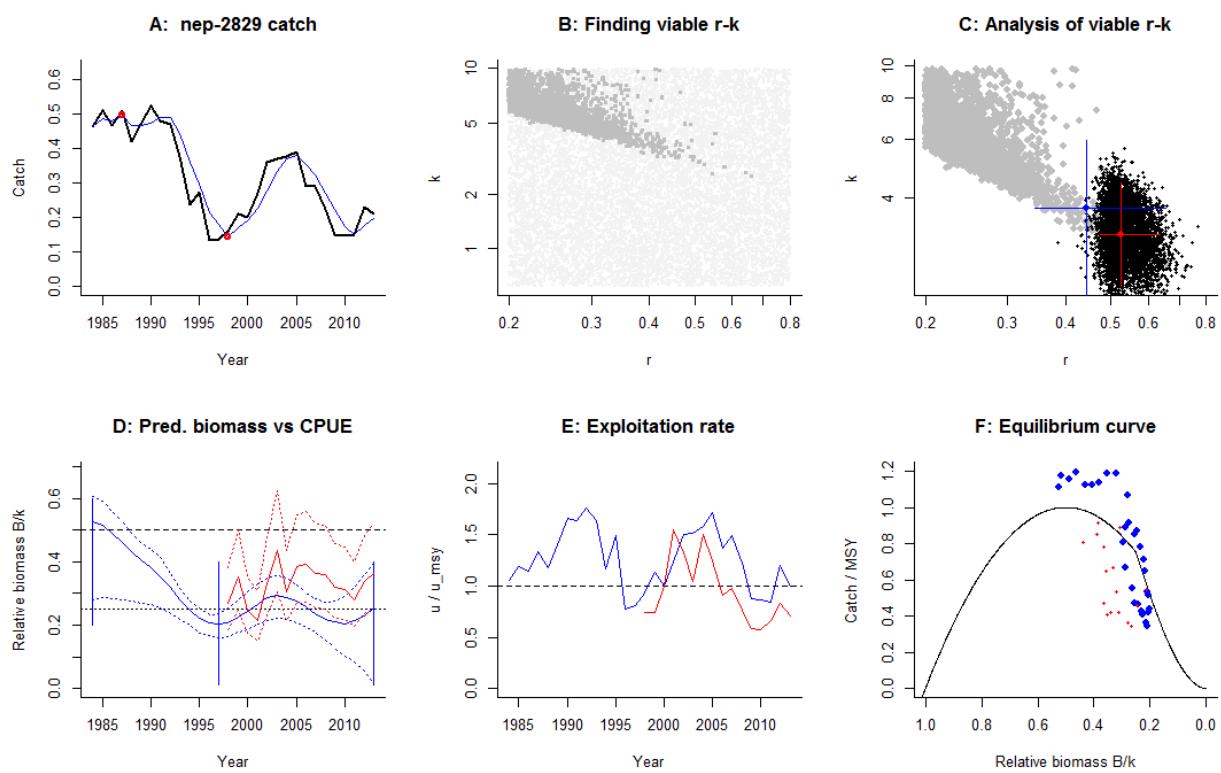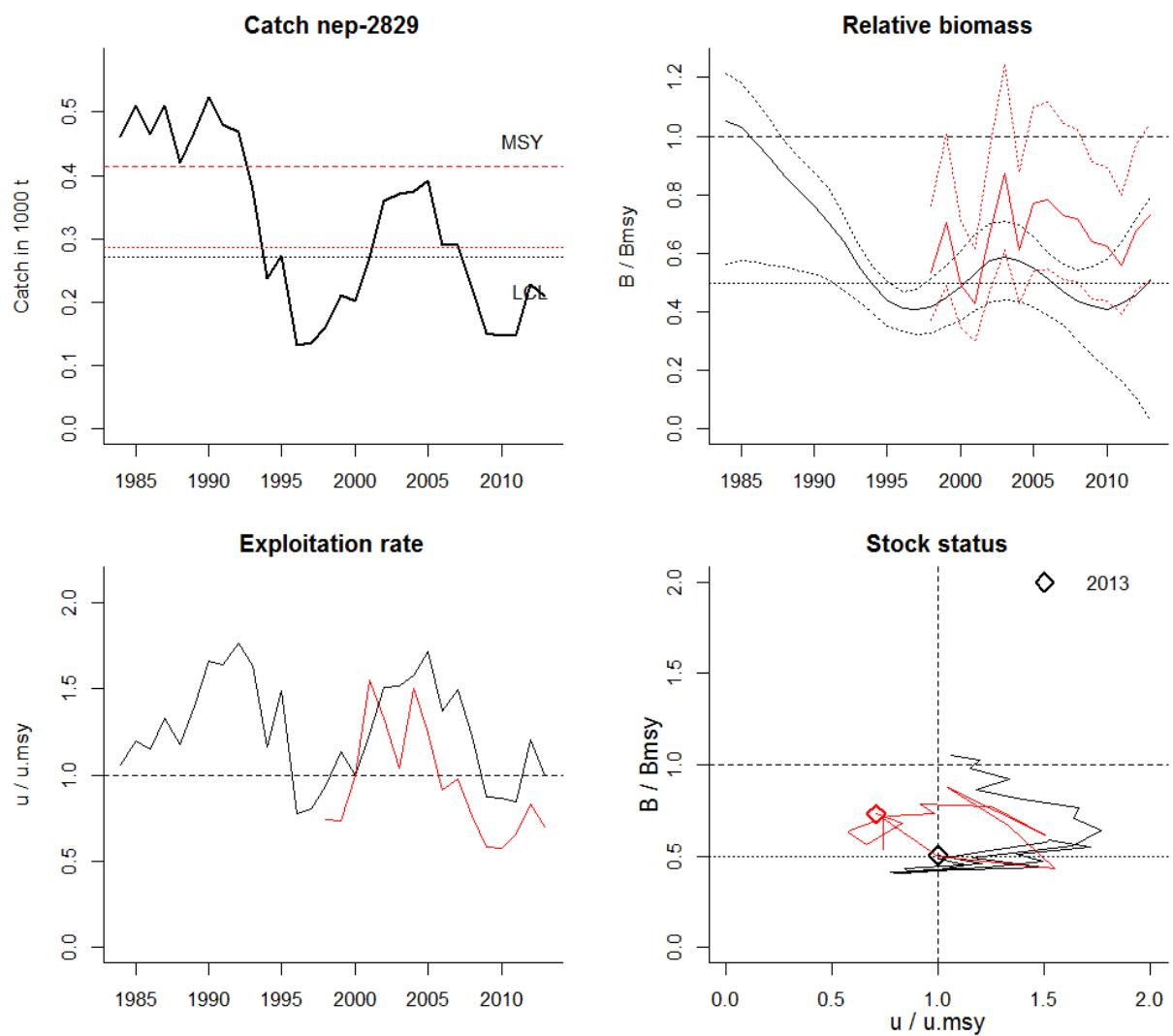
Species: *Pandalus borealis* , stock: Pan_bor_1
 Name and region: Northern shrimp in Arnarfjordur , ICES
 Catch data used from years 1988 - 2013 , biomass = CPUE
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 2006 default
 Prior final relative biomass   = 0.01 - 0.4 expert
 Prior range for r = 0.2 - 0.8 default , prior range for k = 0.96 - 15.4
Prior range of q = 0.702 - 2.81
Results from Bayesian Schaefer model using catch & CPUE
 r = 0.51 , 95% CL = 0.465 - 0.593 , k = 5.23 , 95% CL = 4.38 - 6.25
 MSY = 0.674 , 95% CL = 0.582 - 0.782
q = 0.969 , lcl = 0.822 , ucl = 1.15
 Biomass in last year from q*CPUE = 0.755 or 0.145 k
 Exploitation rate in last year = 0.397
 Results of CMSY analysis with altogether 3146 viable trajectories for 2332 r-k pairs
 r = 0.529 , 95% CL = 0.389 - 0.749 , k = 5.01 , 95% CL = 3.02 - 7.98
 MSY = 0.663 , 95% CL = 0.486 - 0.903
 Relative biomass last year= 0.233 k, 2.5th = 0.0196 , 97.5th = 0.395
 Relative biomass next year= 0.254 k, 2.5th = -0.0358 , 97.5th = 0.455
 Relative exploitation rate in last year= 0.65
 Comment: OK

A: Pan_bor_1 catch

B: Finding viable r-k

C: Analysis of viable r-k

D: Pred. biomass vs CPUE

E: Exploitation rate

F: Equilibrium curve
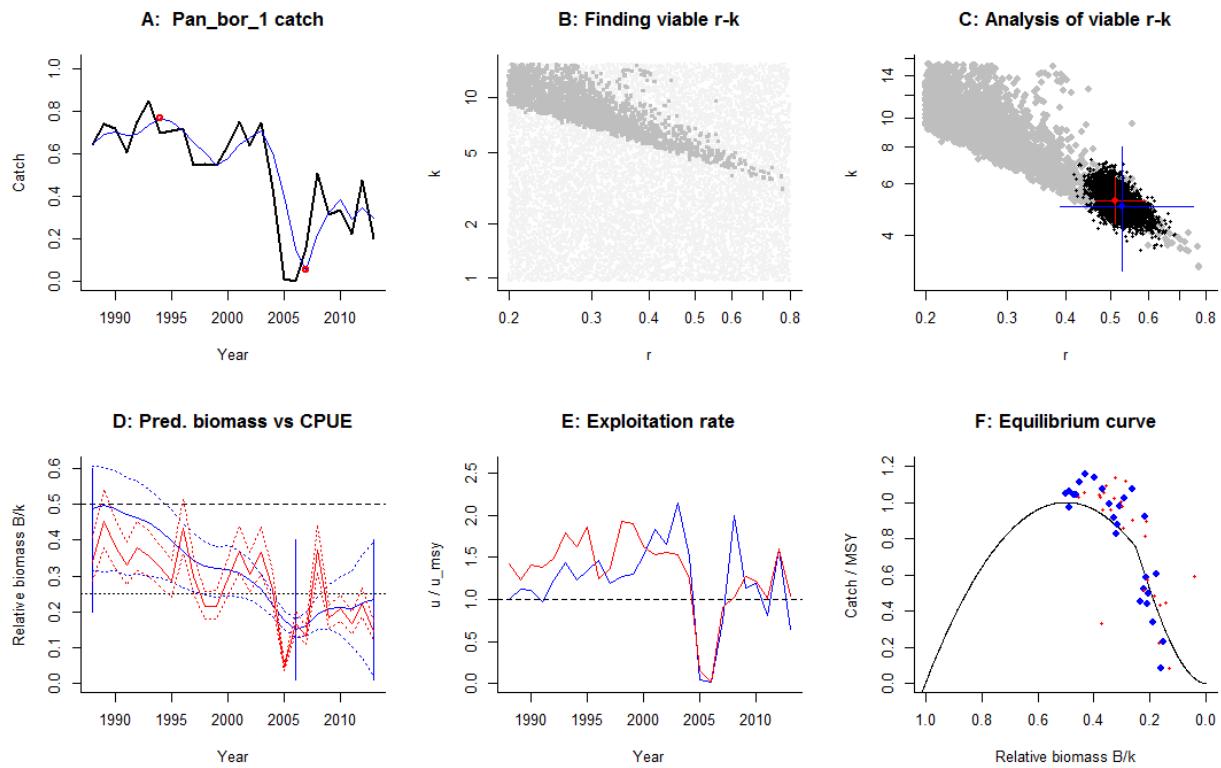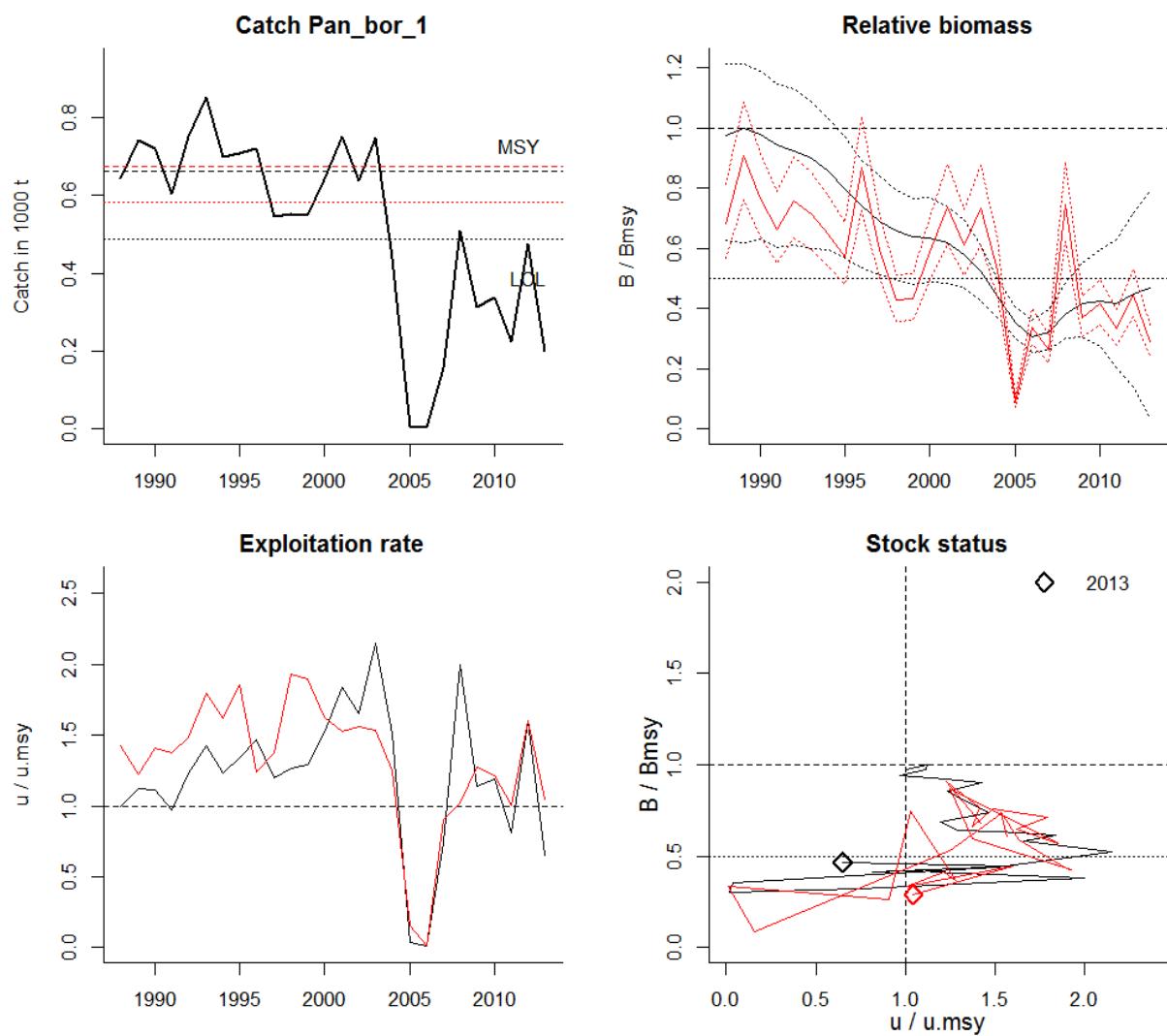
Species: *Pandalus borealis* , stock: Pan_bor_2
 Name and region: Northern shrimp in Isafjardardjup , ICES
 Catch data used from years 1988 - 2013 , biomass = CPUE
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 2004 default
 Prior final relative biomass   = 0.01 - 0.4 expert
 Prior range for r = 0.2 - 0.8 default , prior range for k = 3.4 - 54.4
Prior range of q = 0.632 - 2.53
Results from Bayesian Schaefer model using catch & CPUE
 r = 0.516 , 95% CL = 0.469 - 0.621 , k = 15.3 , 95% CL = 12.4 - 18.7
 MSY = 2 , 95% CL = 1.69 - 2.38
q = 0.719 , lcl = 0.544 , ucl = 1.05
 Biomass in last year from q*CPUE = 2.74 or 0.179 k
 Exploitation rate in last year = 0.328
 Results of CMSY analysis with altogether 3332 viable trajectories for 2735 r-k pairs
 r = 0.513 , 95% CL = 0.381 - 0.74 , k = 16.3 , 95% CL = 9.26 - 26.9
 MSY = 2.1 , 95% CL = 1.41 - 3.11
 Relative biomass last year= 0.137 k, 2.5th = 0.0124 , 97.5th = 0.381
 Relative biomass next year= 0.114 k, 2.5th = -0.0424 , 97.5th = 0.436
 Relative exploitation rate in last year= 1.97
 Comment: OK

A: Pan_bor_2 catch

B: Finding viable r-k

C: Analysis of viable r-k

D: Pred. biomass vs CPUE

E: Exploitation rate

F: Equilibrium curve
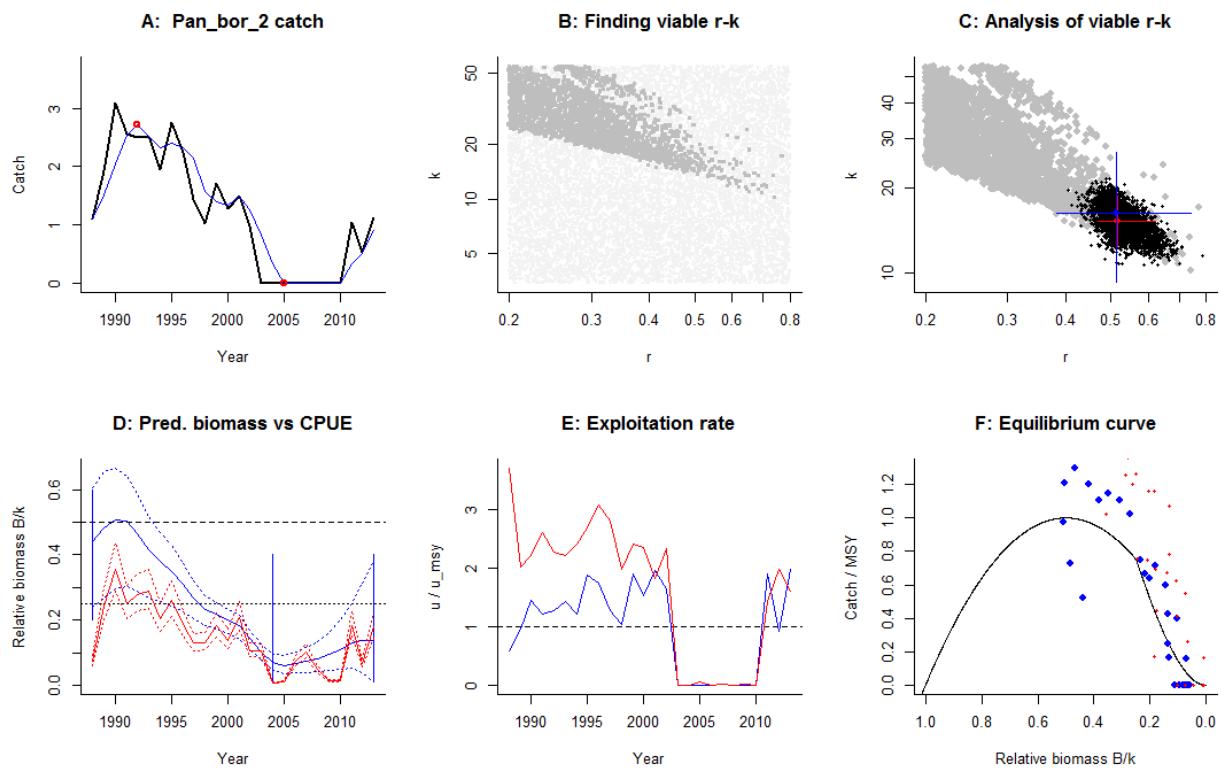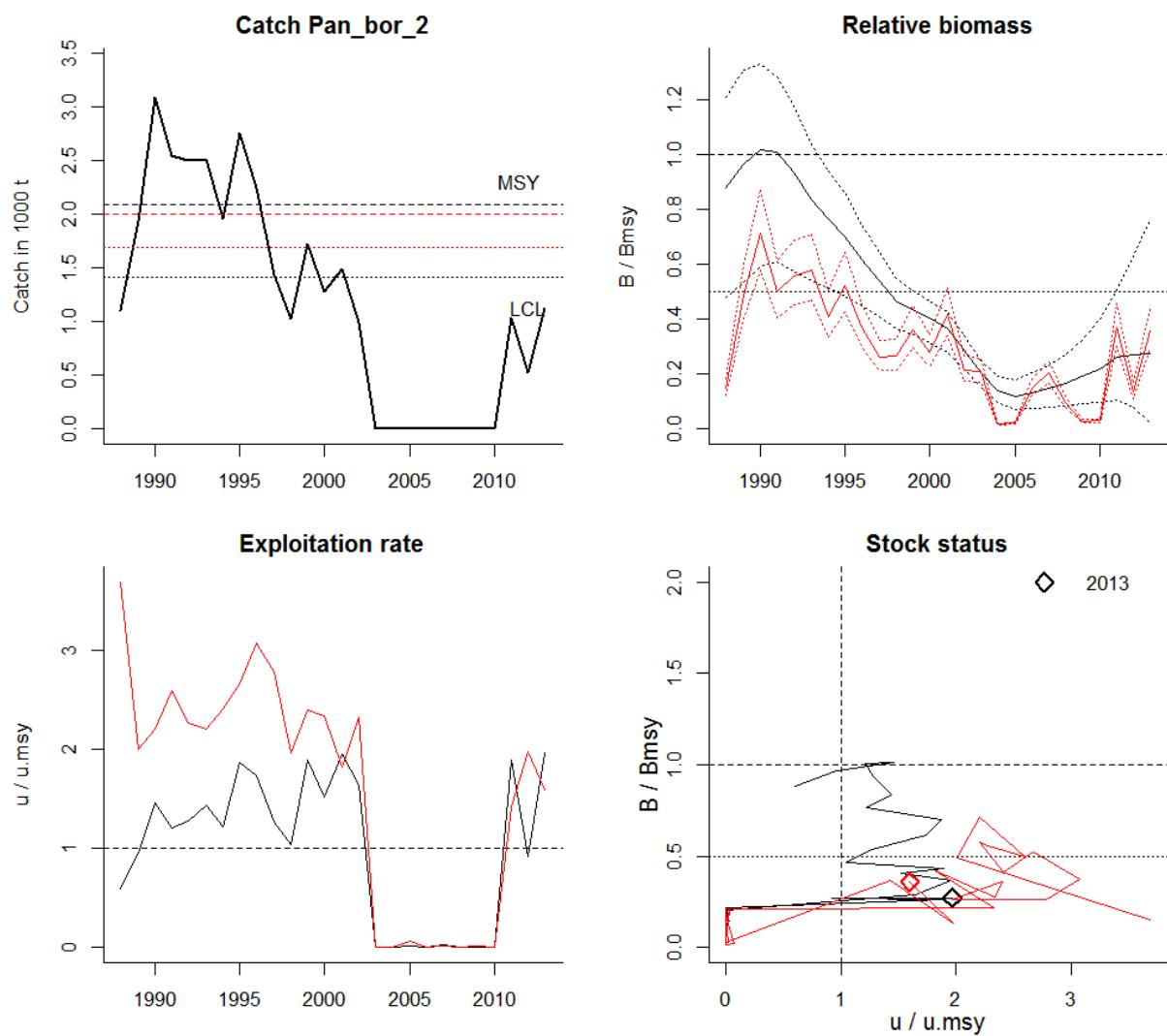
Species: *Pleuronectes platessa* , stock: ple-2123
 Name and region: Plaice in Subdivisions 21, 22, and 23 (Kattegat, Belts, and Sound) , ICES
 Catch data used from years 1991 - 2013 , biomass = CPUE
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 2009 default
 Prior final relative biomass   = 0.2 - 0.6 , default
 Prior range for r = 0.2 - 0.8 default , prior range for k = 4.94 - 79.1
Prior range of q = 0.000111 - 0.000442
Results from Bayesian Schaefer model using catch & CPUE
 r = 0.522 , 95% CL = 0.469 - 0.646 , k = 18.4 , 95% CL = 13 - 25.9
 MSY = 2.45 , 95% CL = 1.66 - 3.5
q = 0.000107 , lcl = 8.27e-05 , ucl = 0.000136
 Biomass in last year from q*CPUE = 18.6 or 1.01 k
 Exploitation rate in last year = 0.0969
 Results of CMSY analysis with altogether 3313 viable trajectories for 1454 r-k pairs
 r = 0.557 , 95% CL = 0.403 - 0.777 , k = 21.6 , 95% CL = 13.8 - 33.6
 MSY = 3.01 , 95% CL = 2.39 - 3.79
 Relative biomass last year= 0.473 k, 2.5th = 0.247 , 97.5th = 0.591
 Relative biomass next year= 0.525 k, 2.5th = 0.258 , 97.5th = 0.653
 Relative exploitation rate in last year= 0.686
 Comment: OK

Catch ple-2123

Relative biomass

Exploitation rate

Stock status
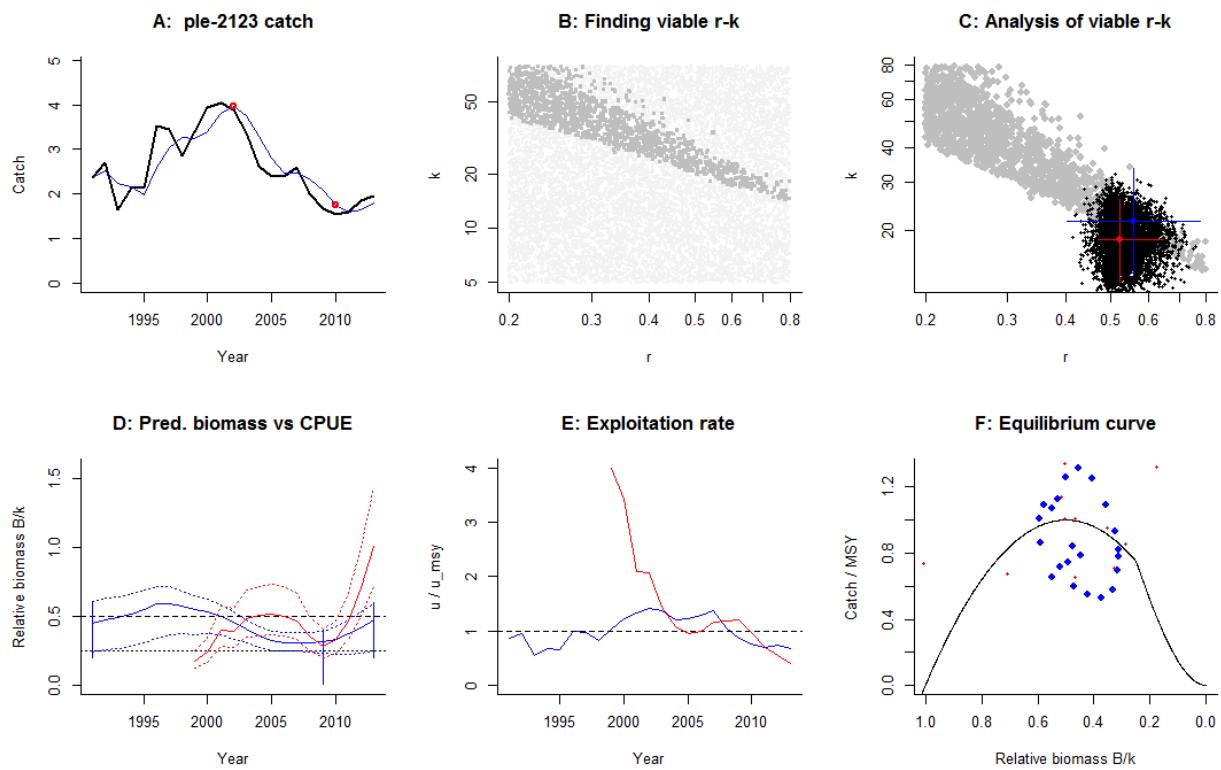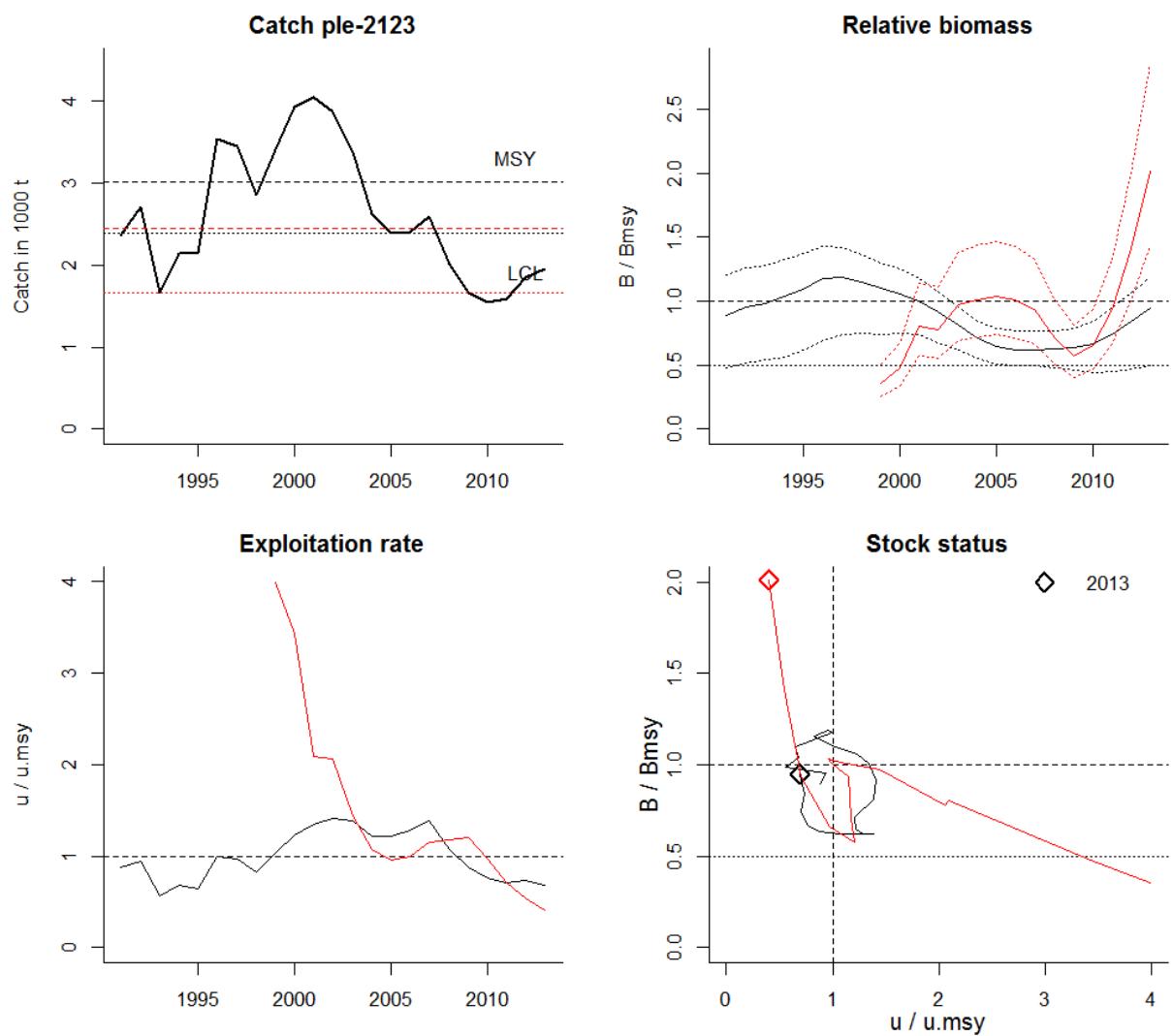
Species: *Pleuronectes platessa* , stock: ple-2432
Name and region: Plaice in Subdivisions 24-32 (Baltic Sea) , ICES
Catch data used from years 1991 - 2013 , biomass = CPUE
Prior initial relative biomass = 0.2 - 0.6 default
Prior intermediate rel. biomass= 0.01 - 0.4 in year 2001 expert
Prior final relative biomass = 0.2 - 0.6 , default
Prior range for r = 0.2 - 0.8 default , prior range for k = 1.46 - 23.3
Prior range of q = 0.00433 - 0.0173
Results from Bayesian Schaefer model using catch & CPUE
r = 0.508 , 95% CL = 0.465 - 0.592 , k = 7.06 , 95% CL = 4.17 - 10.6
MSY = 0.909 , 95% CL = 0.527 - 1.37
q = 0.00712 , lcl = 0.00554 , ucl = 0.00916
Biomass in last year from q*CPUE = 4.35 or 0.617 k
Exploitation rate in last year = 0.179
Results of CMSY analysis with altogether 743 viable trajectories for 704 r-k pairs
r = 0.266 , 95% CL = 0.242 - 0.292 , k = 13.2 , 95% CL = 10.8 - 16.1
MSY = 0.876 , 95% CL = 0.713 - 1.08
Relative biomass last year= 0.267 k, 2.5th = 0.204 , 97.5th = 0.402
Relative biomass next year= 0.256 k, 2.5th = 0.173 , 97.5th = 0.419
Relative exploitation rate in last year= 1.57
Comment: Different trends in CMSY and BSM abundance and exploitation rates. More data needed
to confirm stock status.
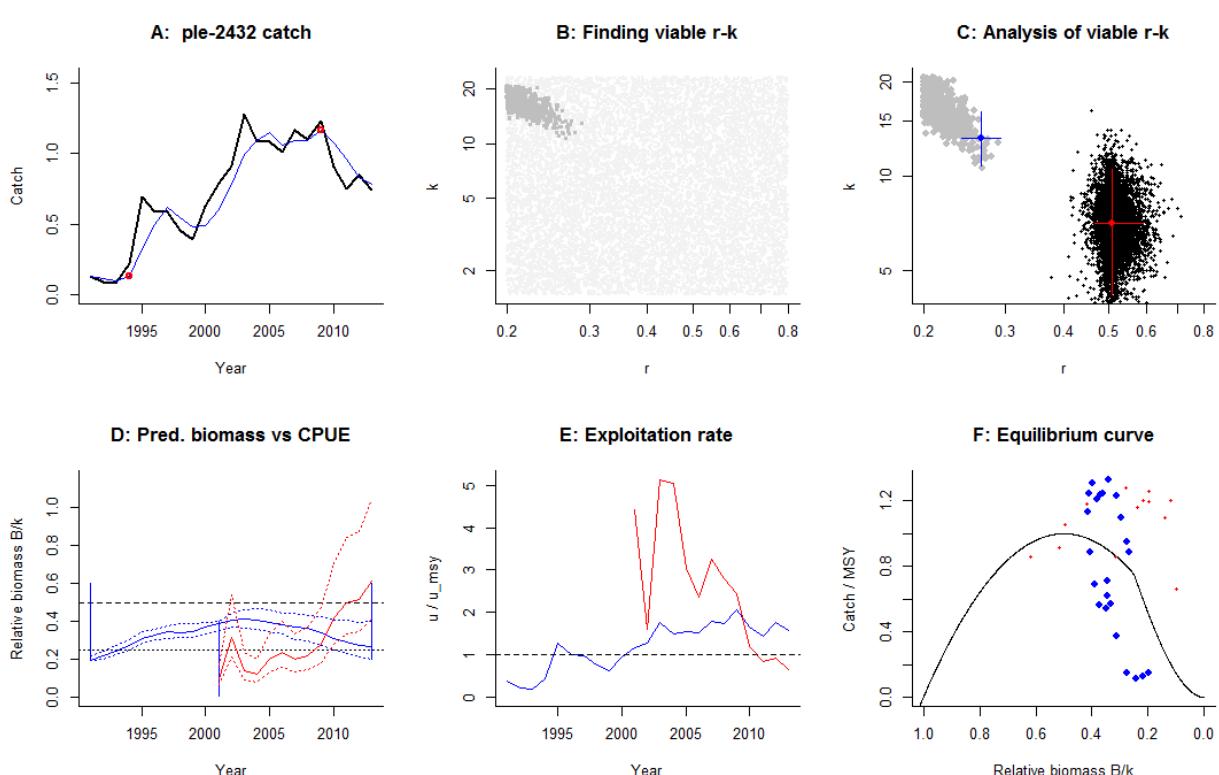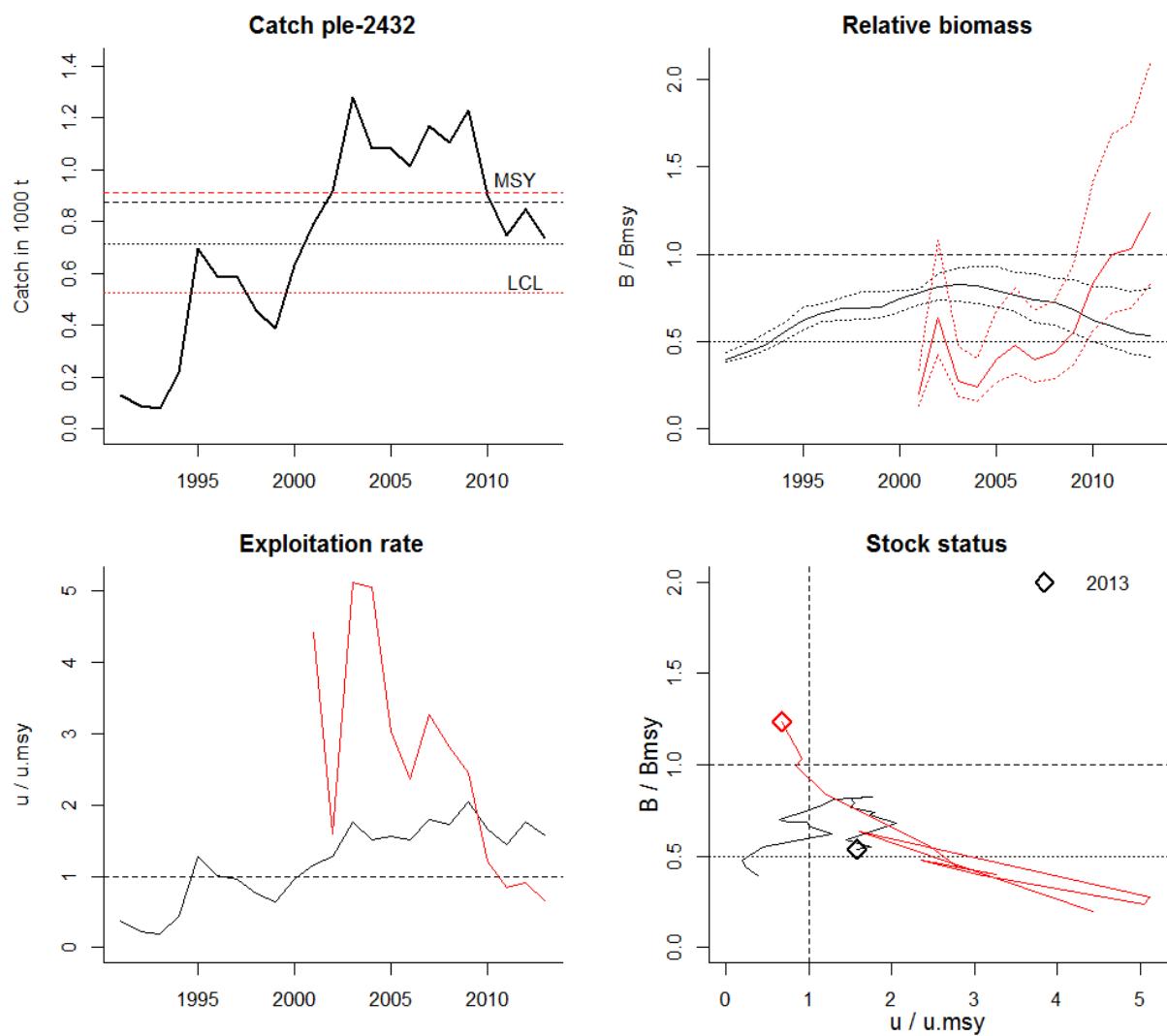
Species: *Raja brachyura* , stock: rjh-pore
Name and region: Blond ray in Division Ixa , ICES
Catch data used from years 2003 - 2013 , biomass = CPUE
Prior initial relative biomass = 0.2 - 0.6 default
Prior intermediate rel. biomass= 0.01 - 0.4 in year 2009 default
Prior final relative biomass   = 0.2 - 0.6 , default
Prior range for r = 0.2 - 0.8 default , prior range for k = 0.722 - 11.6
Less than 10 years with abundance data available, shown on second axis
Results of CMSY analysis with altogether 8717 viable trajectories for 3382 r-k pairs
r = 0.566 , 95% CL = 0.407 - 0.785 , k = 4.11 , 95% CL = 2.09 - 8.07
MSY = 0.581 , 95% CL = 0.295 - 1.15
Relative biomass last year= 0.487 k, 2.5th = 0.223 , 97.5th = 0.595
Relative biomass next year= 0.564 k, 2.5th = 0.255 , 97.5th = 0.69
Relative exploitation rate in last year= 0.486 Comment: Only 5 years of abundance data, too few for BSM. CPUE is therefore plotted on second axis, i.e., with a different scale than CMSY. More data needed to build confidence in CMSY fit.
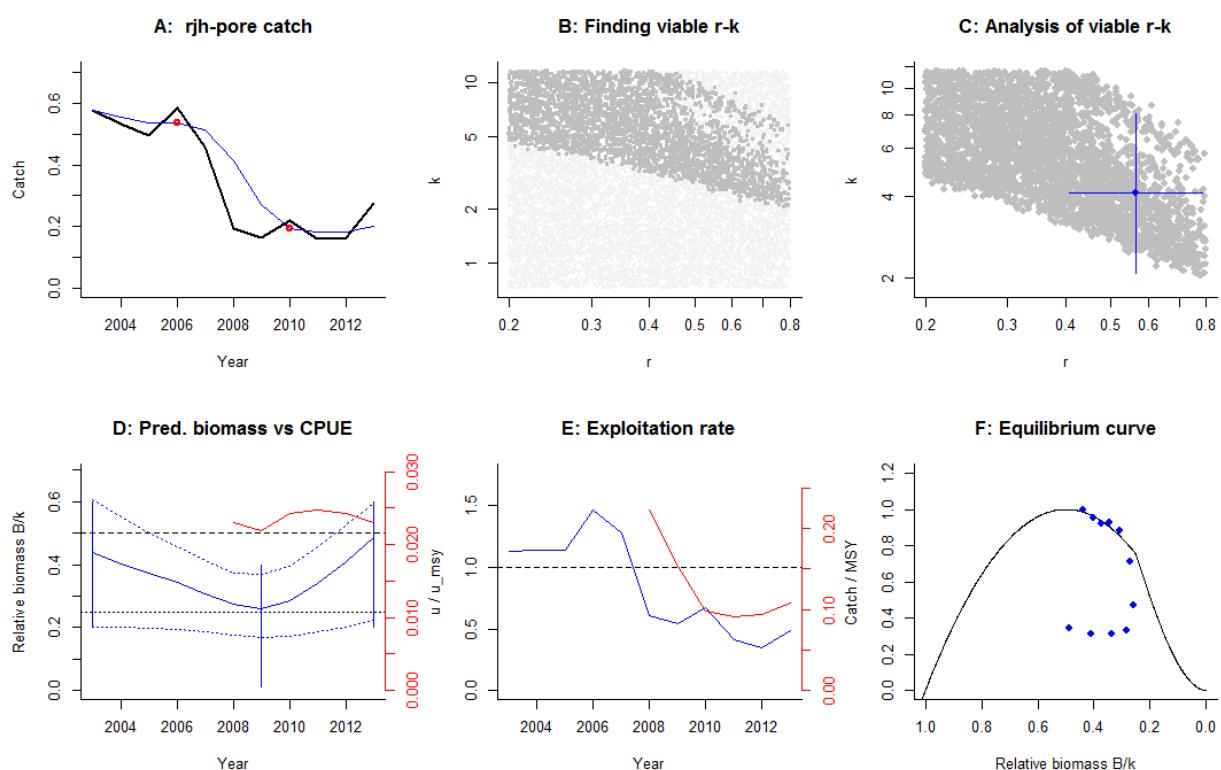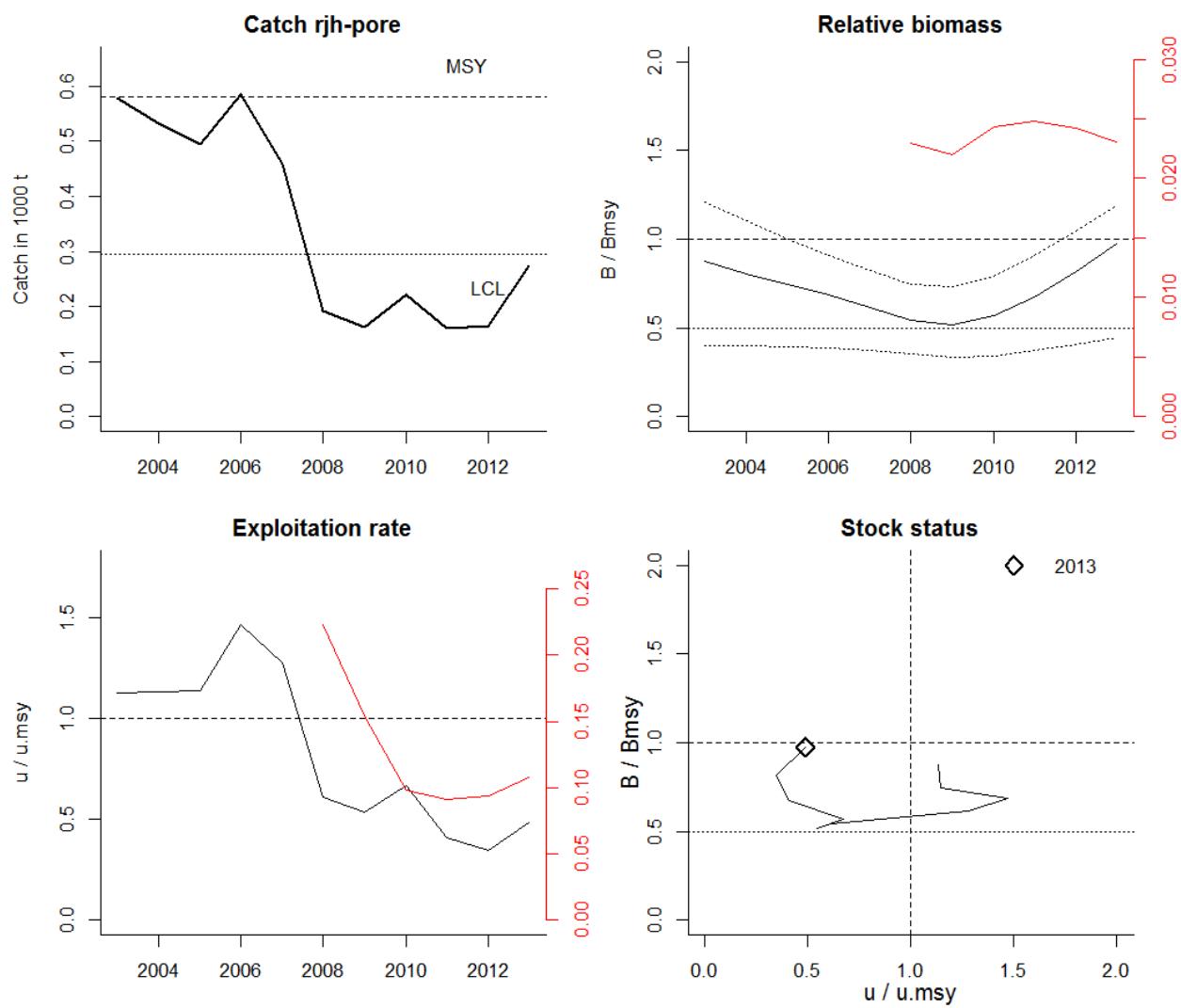
Species: *Sardina pilchardus* , stock: sar-78
Name and region: Sardine in Divisions VIIIa,b,d and Subarea VII , ICES
Catch data used from years 1989 - 2014 , biomass = CPUE
Prior initial relative biomass = 0.2 - 0.6 default
Prior intermediate rel. biomass= 0.5 - 0.9 in year 2002 default
Prior final relative biomass   = 0.5 - 0.9 , default
Prior range for r = 0.2 - 0.8 default , prior range for k = 103 - 2479
Prior range of q = 1.02 - 4.09
Results from Bayesian Schaefer model using catch & CPUE
r = 0.5 , 95% CL = 0.44 - 0.563 , k = 262 , 95% CL = 206 - 351
MSY = 32.7 , 95% CL = 25.8 - 44.4
q = 1.82 , lcl = 1.33 , ucl = 2.49
Biomass in last year from q*CPUE = 186 or 0.71 k
Exploitation rate in last year = 0.221
Results of CMSY analysis with altogether 36408 viable trajectories for 3971 r-k pairs
r = 0.566 , 95% CL = 0.407 - 0.785 , k = 384 , 95% CL = 198 - 743
MSY = 54.3 , 95% CL = 28.3 - 104
Relative biomass last year= 0.792 k, 2.5th = 0.527 , 97.5th = 0.887
Relative biomass next year= 0.776 k, 2.5th = 0.496 , 97.5th = 0.877
Relative exploitation rate in last year= 0.527
Comment: OK

A: sar-78 catch

B: Finding viable r-k

C: Analysis of viable r-k

D: Pred. biomass vs CPUE

E: Exploitation rate

F: Equilibrium curve
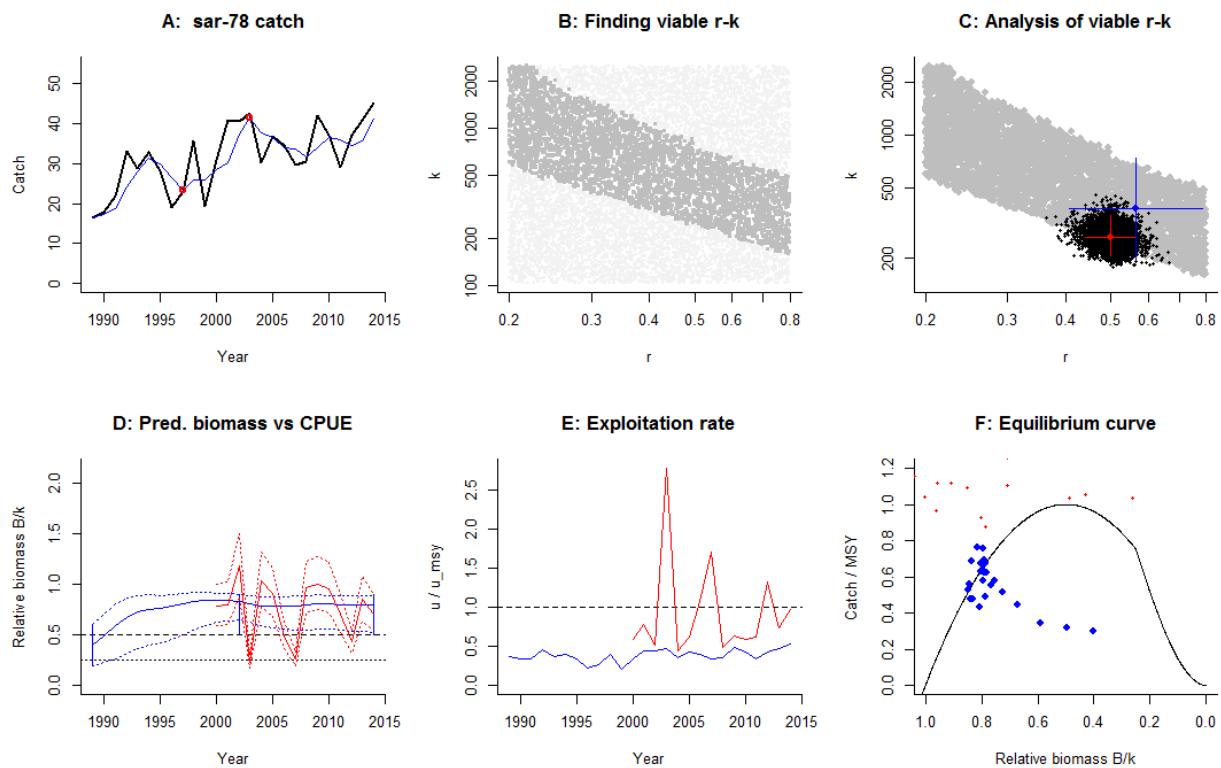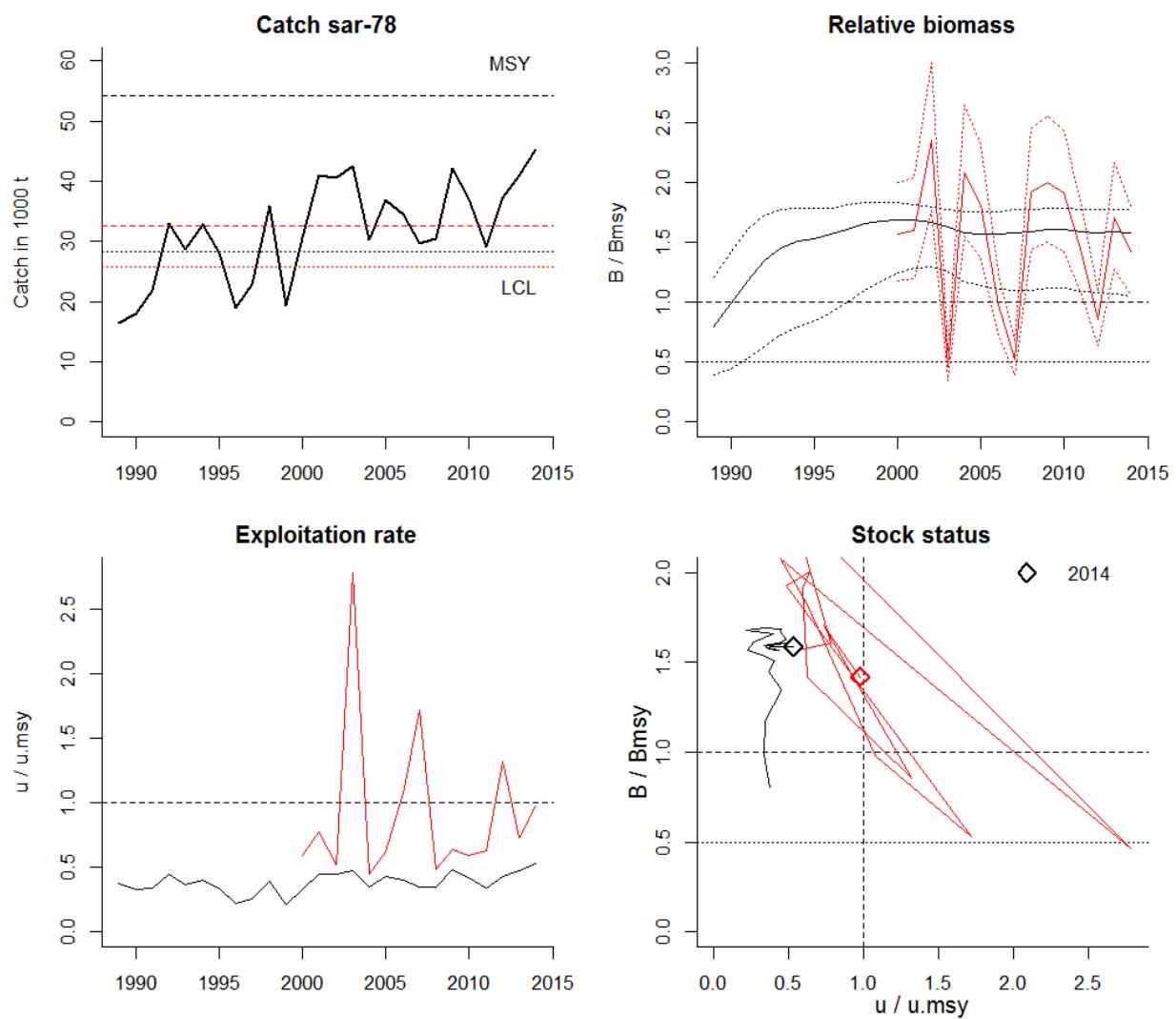
Species: *Dalatias licha* , stock: sck-nea
Name and region: "Kitefin shark in the Northeast Atlantic" , ICES
Catch data used from years 1988 - 2014 , biomass = None
Prior initial relative biomass = 0.2 - 0.6 default
Prior intermediate rel. biomass= 0.01 - 0.4 in year 2009 default
Prior final relative biomass   = 0.01 - 0.4 , default
Prior range for r = 0.05 - 0.5 default , prior range for k = 1.53 - 61
Results of CMSY analysis with altogether 5530 viable trajectories for 2889 r-k pairs
r = 0.27 , 95% CL = 0.159 - 0.459 , k = 8.85 , 95% CL = 3.5 - 22.4
MSY = 0.597 , 95% CL = 0.274 - 1.3
Relative biomass last year= 0.112 k, 2.5th = 0.0137 , 97.5th = 0.387
Relative biomass next year= 0.122 k, 2.5th = 0.0138 , 97.5th = 0.44
Relative exploitation rate in last year= 0
Comment: No abundance data available. CMSY fit seems OK.

Catch sck-nea

MSY

LCL

Relative biomass

Exploitation rate

Stock status

◇ 2014
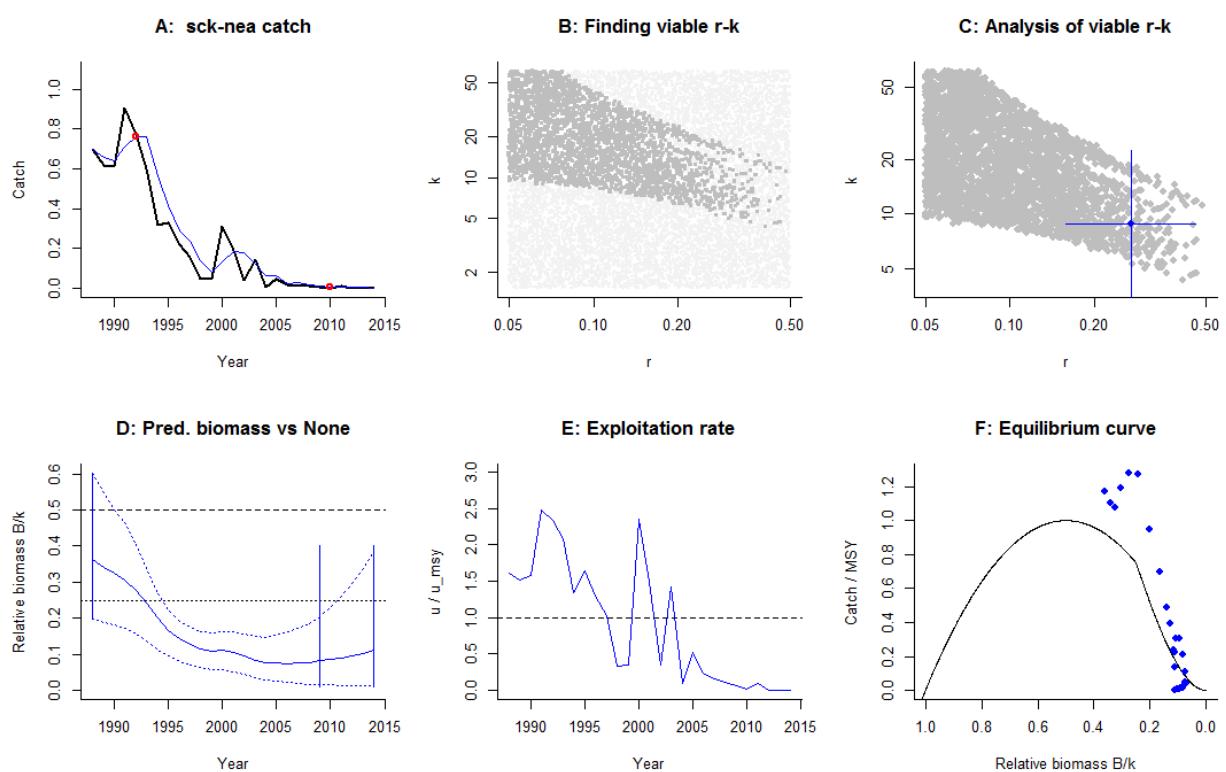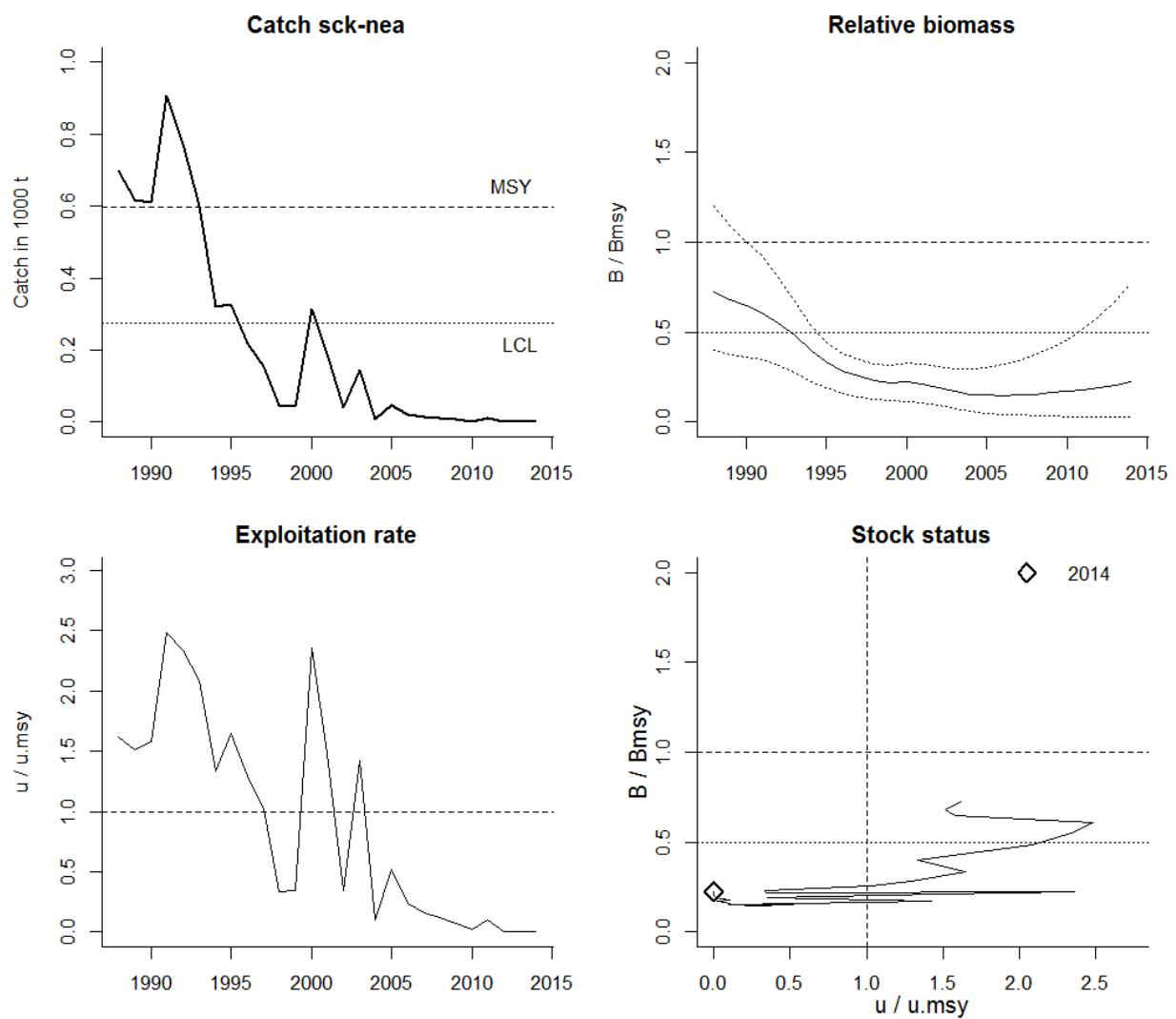
Species: *Sebastes mentella* , stock: smn-dp
 Name and region: "Beaked redfish in Subareas V, XII, and XIV (Iceland and Faroes grounds, north of Azores, east of Greenland)" and NAFO Subareas 1+2 (deep pelagic stock > 500 m) , ICES
 Catch data used from years 1991 - 2014 , biomass = CPUE
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.5 - 0.9 in year 1997 default
 Prior final relative biomass   = 0.01 - 0.4 expert
 Prior range for r = 0.015 - 0.1 default , prior range for k = 1088 - 29018
Prior range of q = 0.000144 - 0.000745
Results from Bayesian Schaefer model using catch & CPUE
 r = 0.0491 , 95% CL = 0.0176 - 0.0846 , k = 4566 , 95% CL = 2712 - 7351
 MSY = 53.1 , 95% CL = 18.1 - 112
q = 0.000311 , lcl = 0.000212 , ucl = 0.000447
 Biomass in last year from q*CPUE = 766 or 0.168 k
 Exploitation rate in last year = 0.0446
 Results of CMSY analysis with altogether 6503 viable trajectories for 2719 r-k pairs
 r = 0.062 , 95% CL = 0.0397 - 0.097 , k = 2355 , 95% CL = 1164 - 4762
 MSY = 36.5 , 95% CL = 22 - 60.5
 Relative biomass last year= 0.27 k, 2.5th = 0.0212 , 97.5th = 0.397
 Relative biomass next year= 0.268 k, 2.5th = 0.00191 , 97.5th = 0.4
 Relative exploitation rate in last year= 1.2
 Comment: Missing years in survey were interpolated. Start year set to 1995.

Catch smn-dp

Relative biomass

Exploitation rate

Stock status
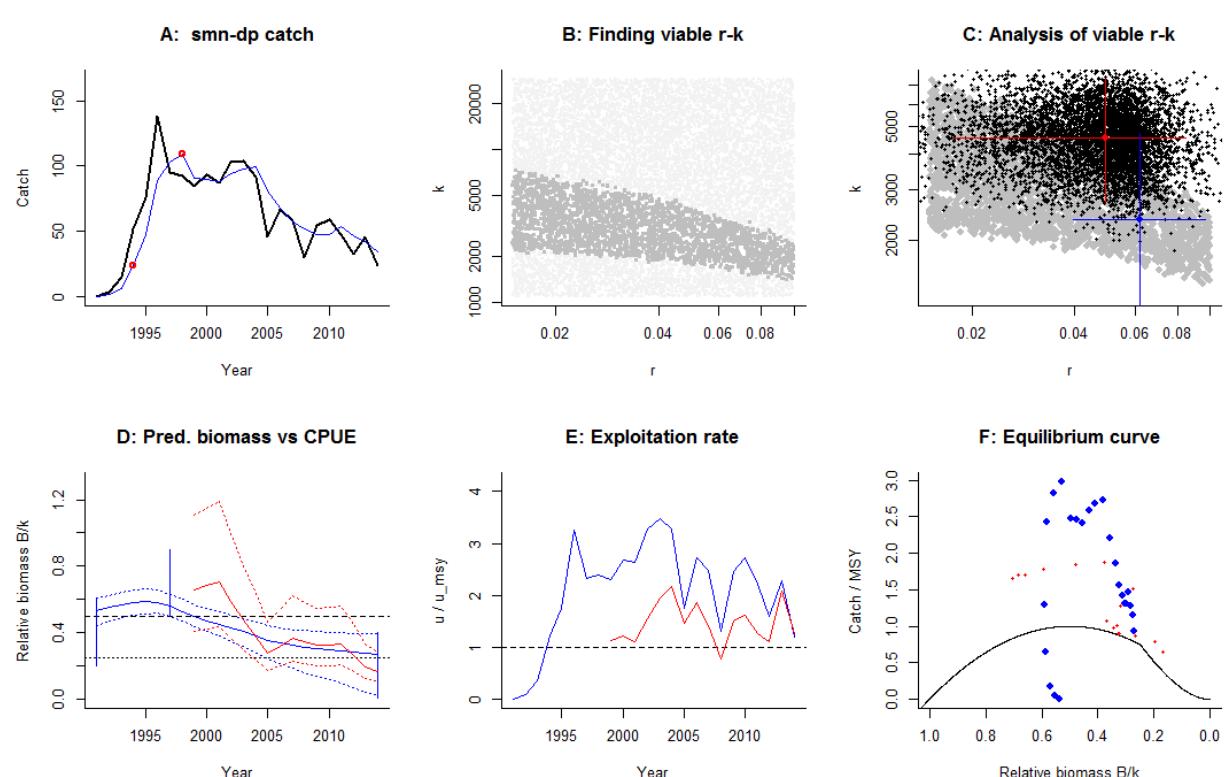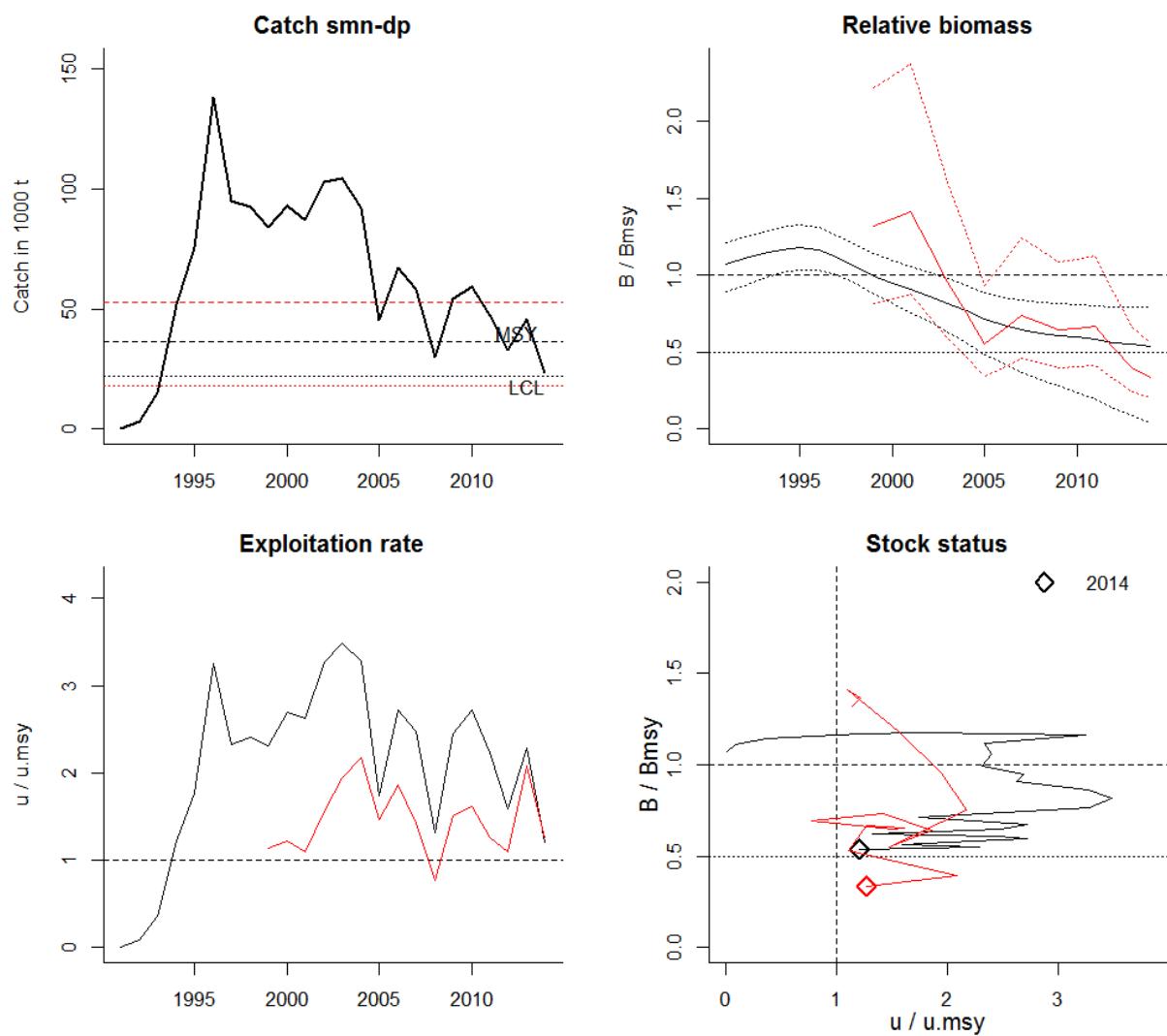
Species: *Sebastes mentella* , stock: smn-sp
 Name and region: "Beaked redfish in Subareas V, XII, and XIV (Iceland and Faroes
grounds, north of Azores, east of Greenland) and NAFO Subareas 1+2 (shallow pelagic
stock < 500 m)" , ICES
 Catch data used from years 1982 - 2014 , biomass = CPUE
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 2010 default
 Prior final relative biomass   = 0.01 - 0.4 , default
 Prior range for r = 0.015 - 0.1 default , prior range for k = 993 - 26469
Prior range of q = 0.000367 - 0.0019
Results from Bayesian Schaefer model using catch & CPUE
 r = 0.0521 , 95% CL = 0.0185 - 0.0952 , k = 7555 , 95% CL = 4280 - 11714
 MSY = 94.1 , 95% CL = 30.6 - 209
q = 0.000786 , lcl = 0.000543 , ucl = 0.00116
 Biomass in last year from q*CPUE = 95.5 or 0.0126 k
 Exploitation rate in last year = 0.0389
Results of CMSY analysis with altogether 24997 viable trajectories for 6781 r-k pairs
 r = 0.062 , 95% CL = 0.0397 - 0.097 , k = 4351 , 95% CL = 1548 - 12232
MSY = 67.5 , 95% CL = 21.4 - 213
Relative biomass last year= 0.233 k, 2.5th = 0.0161 , 97.5th = 0.396
Relative biomass next year= 0.24 k, 2.5th = 0.0147 , 97.5th = 0.41
 Relative exploitation rate in last year= 0.205
 Comment: Acoustic survey data used for abundance; missing years were interpolated. CMSY fit
could be improved by setting endbio to 0.01 – 0.2 k.

Catch smn-sp

MSY

LCL

Relative biomass

Exploitation rate

Stock status
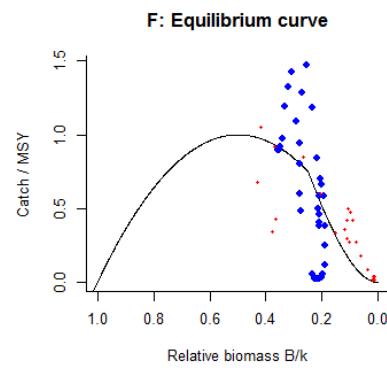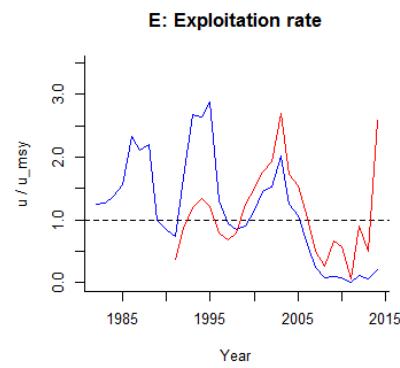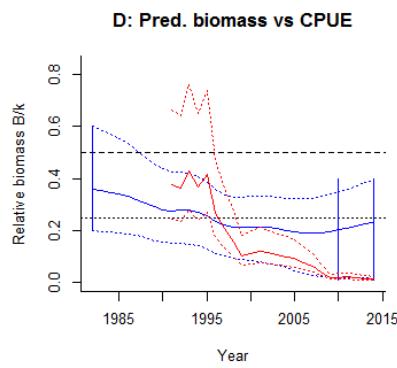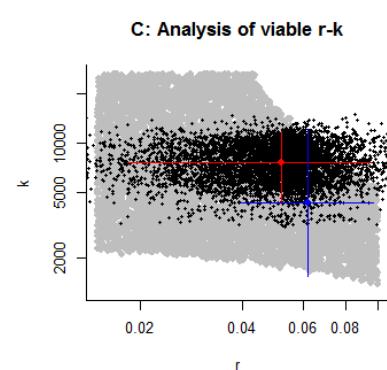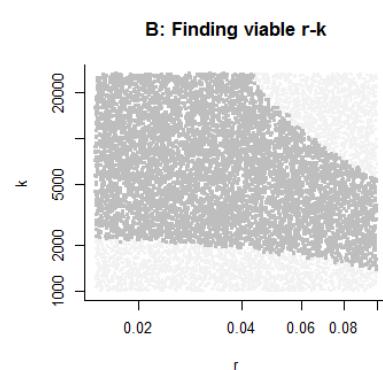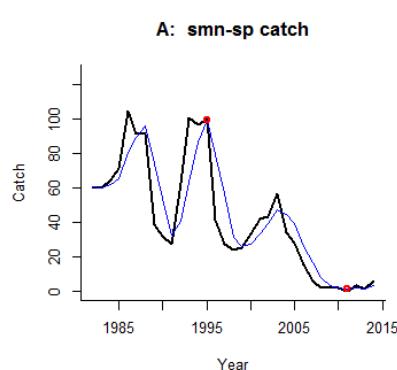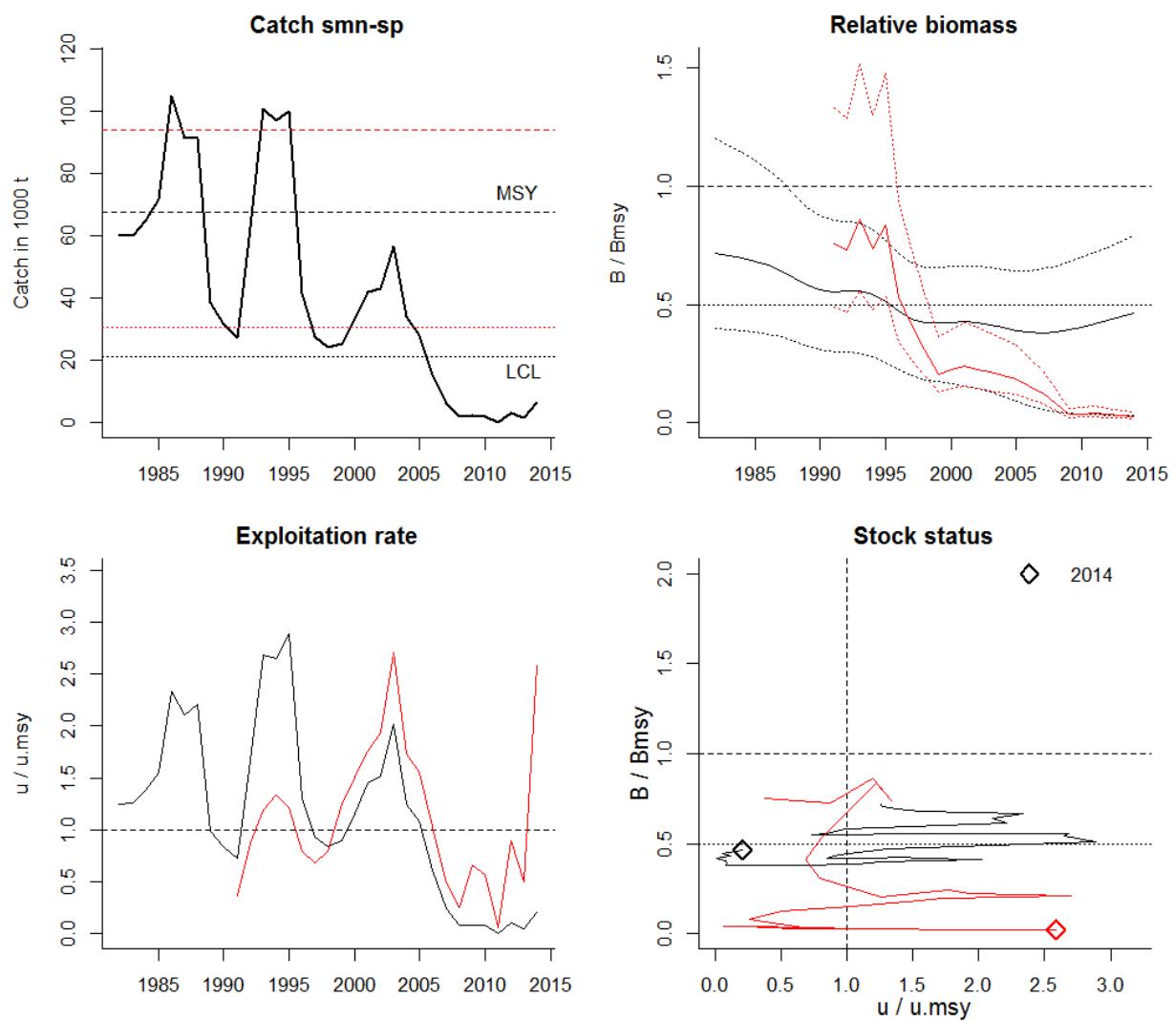
2014

Species: *Scophthalmus maximus* , stock: tur-2232
Name and region: Turbot in Subdivisions 22–32 (Baltic Sea) , ICES
Catch data used from years 1995 - 2014 , biomass = CPUE
Prior initial relative biomass = 0.2 - 0.6 default
Prior intermediate rel. biomass= 0.01 - 0.4 in year 2010 default
Prior final relative biomass   = 0.01 - 0.4 , default
Prior range for r = 0.2 - 0.8 default , prior range for k = 1.27 - 20.4
Prior range of q = 0.00179 - 0.00718
Results from Bayesian Schaefer model using catch & CPUE
r = 0.515 , 95% CL = 0.468 - 0.616 , k = 5.76 , 95% CL = 4.65 - 7.37
MSY = 0.751 , 95% CL = 0.623 - 0.951
q = 0.00213 , lcl = 0.0016 , ucl = 0.00297
Biomass in last year from q*CPUE = 1.04 or 0.18 k
Exploitation rate in last year = 0.257
Results of CMSY analysis with altogether 2081 viable trajectories for 1708 r-k pairs
r = 0.476 , 95% CL = 0.362 - 0.776 , k = 7.52 , 95% CL = 3.14 - 14.5
MSY = 0.894 , 95% CL = 0.42 - 1.9
Relative biomass last year= 0.178 k, 2.5th = 0.0148 , 97.5th = 0.389
Relative biomass next year= 0.181 k, 2.5th = -0.0237 , 97.5th = 0.472
Relative exploitation rate in last year= 0.793
Comment: Start year set to 1995.

Catch tur-2232

Relative biomass

Exploitation rate

Stock status
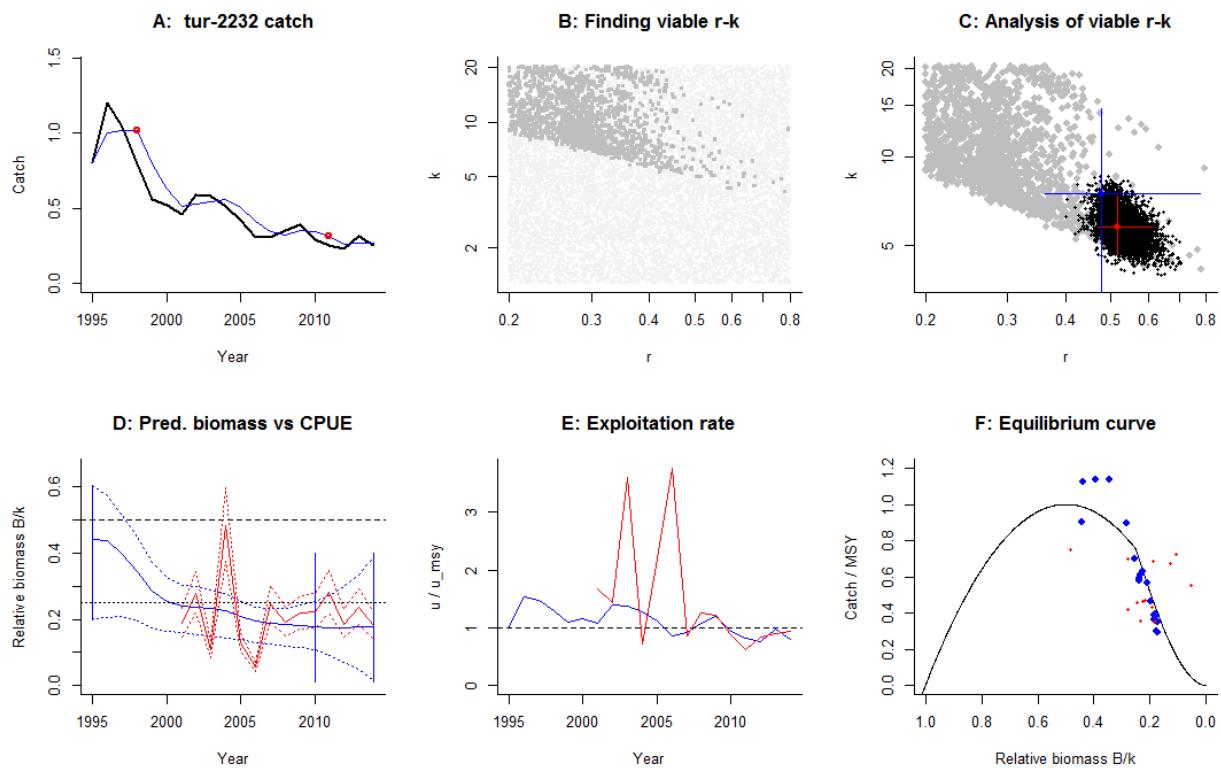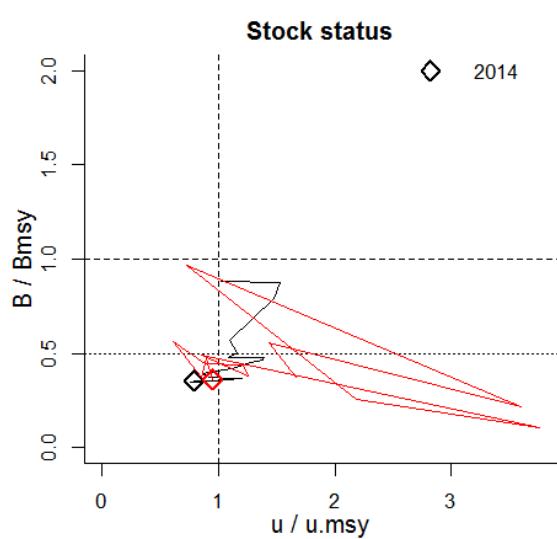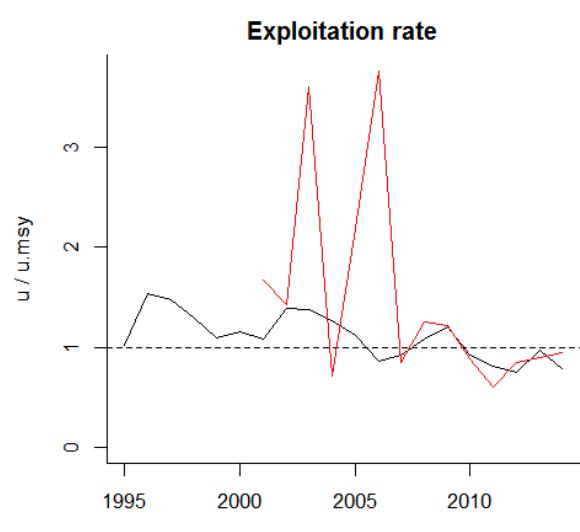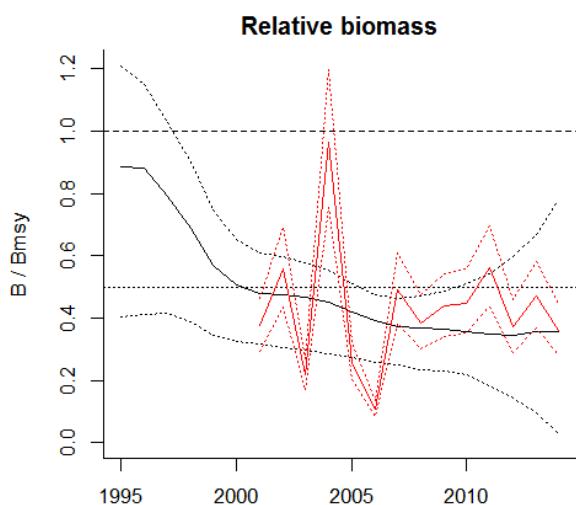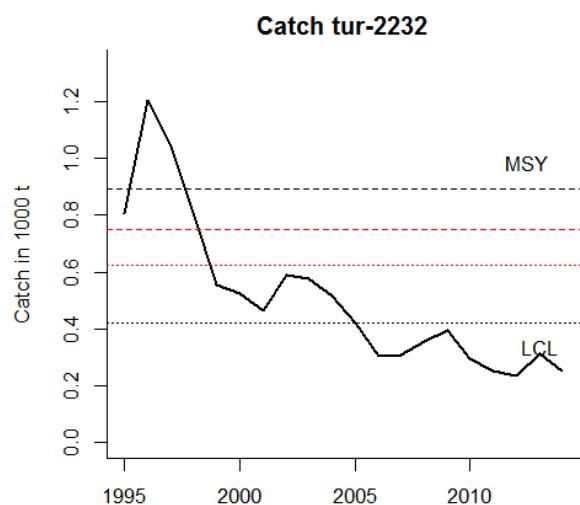
Species: *Scophthalmus maximus* , stock: tur-kask
 Name and region: Turbot in Division IIIa , ICES
 Catch data used from years 1996 - 2012 , biomass = CPUE
 Prior initial relative biomass = 0.2 - 0.6 default
 Prior intermediate rel. biomass= 0.01 - 0.4 in year 2005 default
 Prior final relative biomass   = 0.01 - 0.4 expert
 Prior range for r = 0.2 - 0.8 default , prior range for k = 0.271 - 4.34
Prior range of q = 0.00159 - 0.00638
Results from Bayesian Schaefer model using catch & CPUE
 r = 0.504 , 95% CL = 0.453 - 0.581 , k = 1.43 , 95% CL = 1.18 - 1.8
 MSY = 0.18 , 95% CL = 0.153 - 0.224
q = 0.00261 , lcl = 0.00207 , ucl = 0.0033
 Biomass in last year from q*CPUE = 0.226 or 0.159 k
 Exploitation rate in last year = 0.565
 Results of CMSY analysis with altogether 2992 viable trajectories for 1572 r-k pairs
 r = 0.549 , 95% CL = 0.399 - 0.772 , k = 1.38 , 95% CL = 0.771 - 2.41
 MSY = 0.189 , 95% CL = 0.118 - 0.303
 Relative biomass last year= 0.301 k, 2.5th = 0.0268 , 97.5th = 0.396
 Relative biomass next year= 0.313 k, 2.5th = -0.0725 , 97.5th = 0.436
 Relative exploitation rate in last year= 1.66
 Comment: OK.

Catch tur-kask

Relative biomass

Exploitation rate

Stock status
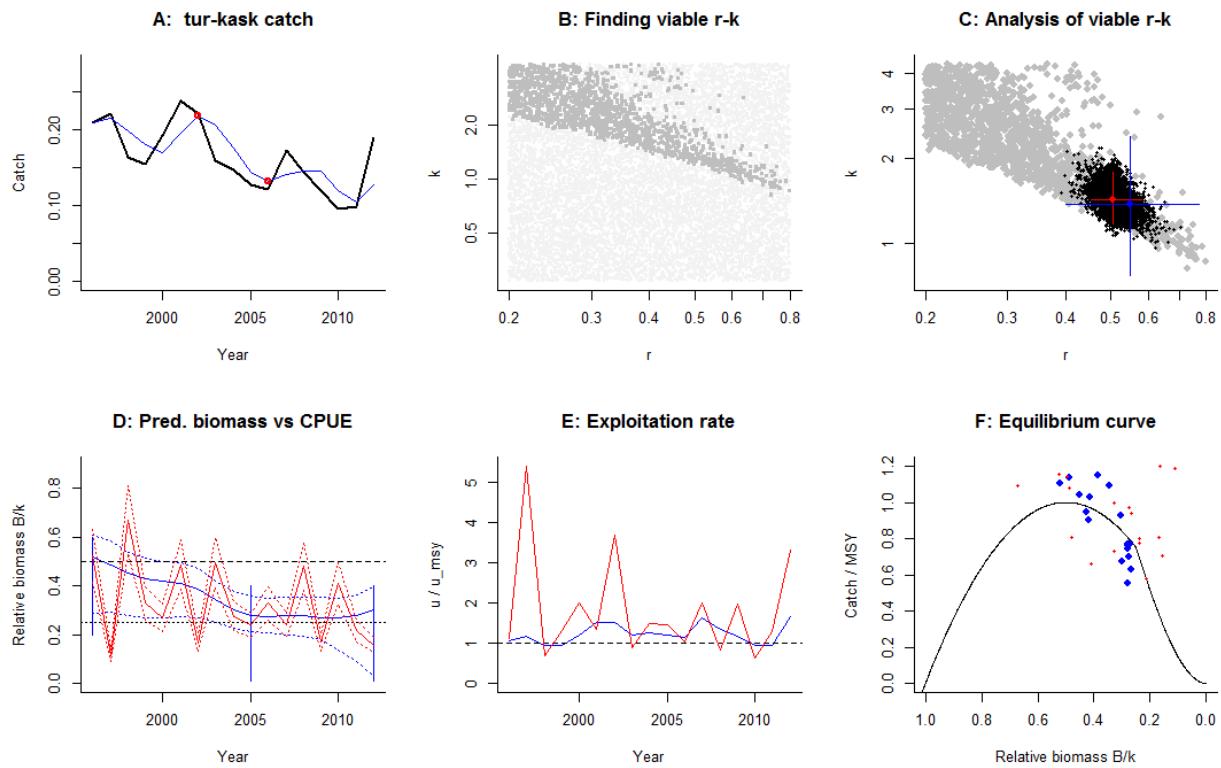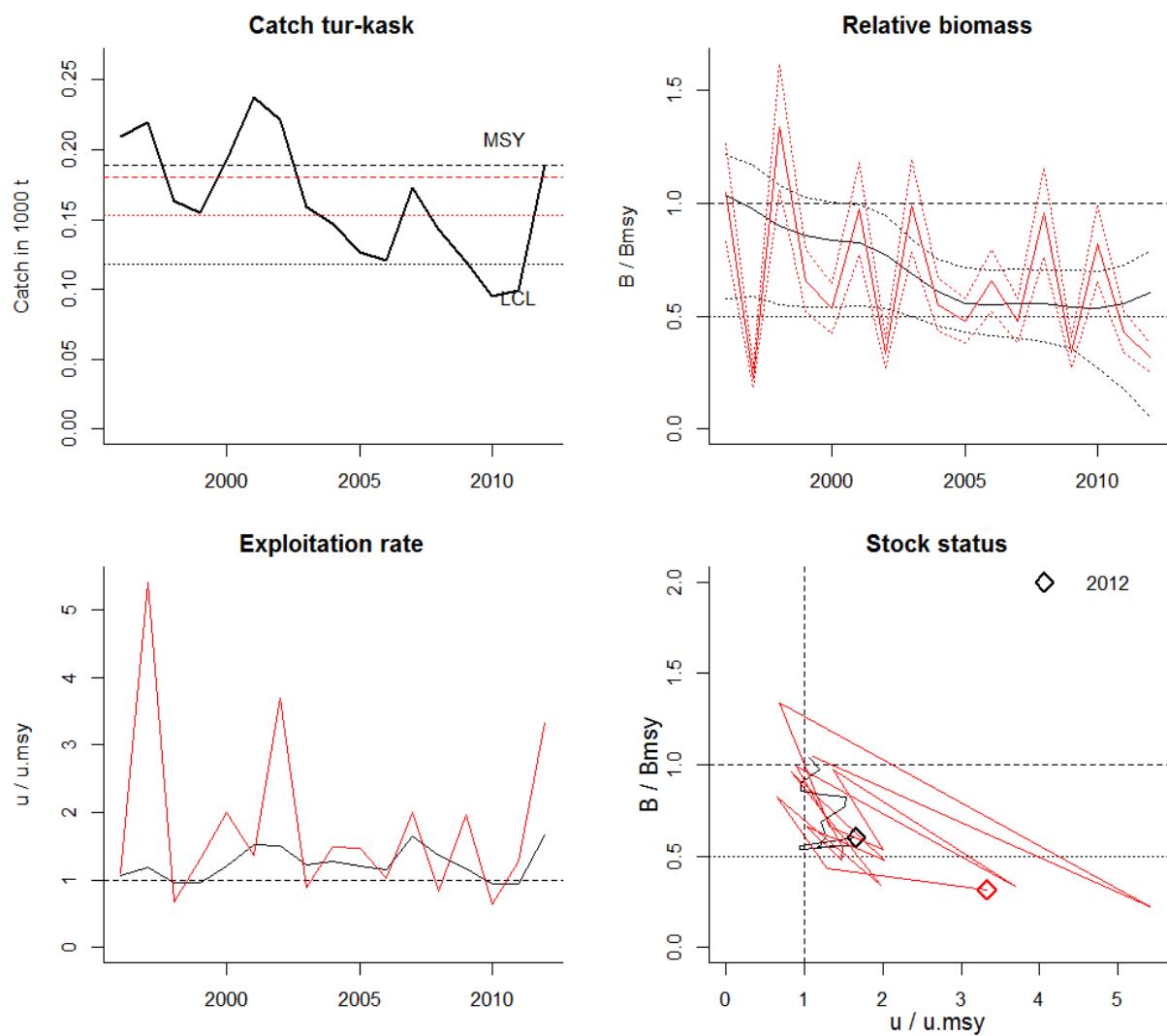
Species: *Brosme brosme* , stock: usk-oth
Tusk in Divisions IIIa, Vb, VIa, and XIIb and Subareas IV, VII, VIII, and IX (other areas). , ICES
Catch data used from years 1988 - 2011 , biomass = CPUE
Prior initial relative biomass = 0.2 - 0.6 default
Prior intermediate rel. biomass= 0.01 - 0.4 in year 2004 default
Prior final relative biomass   = 0.2 - 0.6 , default
Prior range for r = 0.2 - 0.8 default , prior range for k = 16.5 - 264
Prior range of q = 0.00326 - 0.013
Results from Bayesian Schaefer model using catch & CPUE
r = 0.537 , 95% CL = 0.476 - 0.675 , k = 76.8 , 95% CL = 54 - 114
MSY = 10.4 , 95% CL = 7.09 - 16
q = 0.00298 , lcl = 0.00239 , ucl = 0.00376
Biomass in last year from q*CPUE = 43.4 or 0.564 k
Exploitation rate in last year = 0.164
Results of CMSY analysis with altogether 3248 viable trajectories for 2039 r-k pairs
r = 0.49 , 95% CL = 0.37 - 0.687 , k = 84 , 95% CL = 51.9 - 129
MSY = 10.3 , 95% CL = 7.77 - 13.7
Relative biomass last year= 0.503 k, 2.5th = 0.263 , 97.5th = 0.596
Relative biomass next year= 0.535 k, 2.5th = 0.268 , 97.5th = 0.636
Relative exploitation rate in last year= 0.614
Comment: OK. Standardized cpue for 4–5 longliners (<110 GRT) fishing in Faroese waters (criteria:
ling & tusk >60% of catch and depth below 200 m). Set from Low to Medium resilience.

Catch usk-oth

Relative biomass

Exploitation rate

Stock status
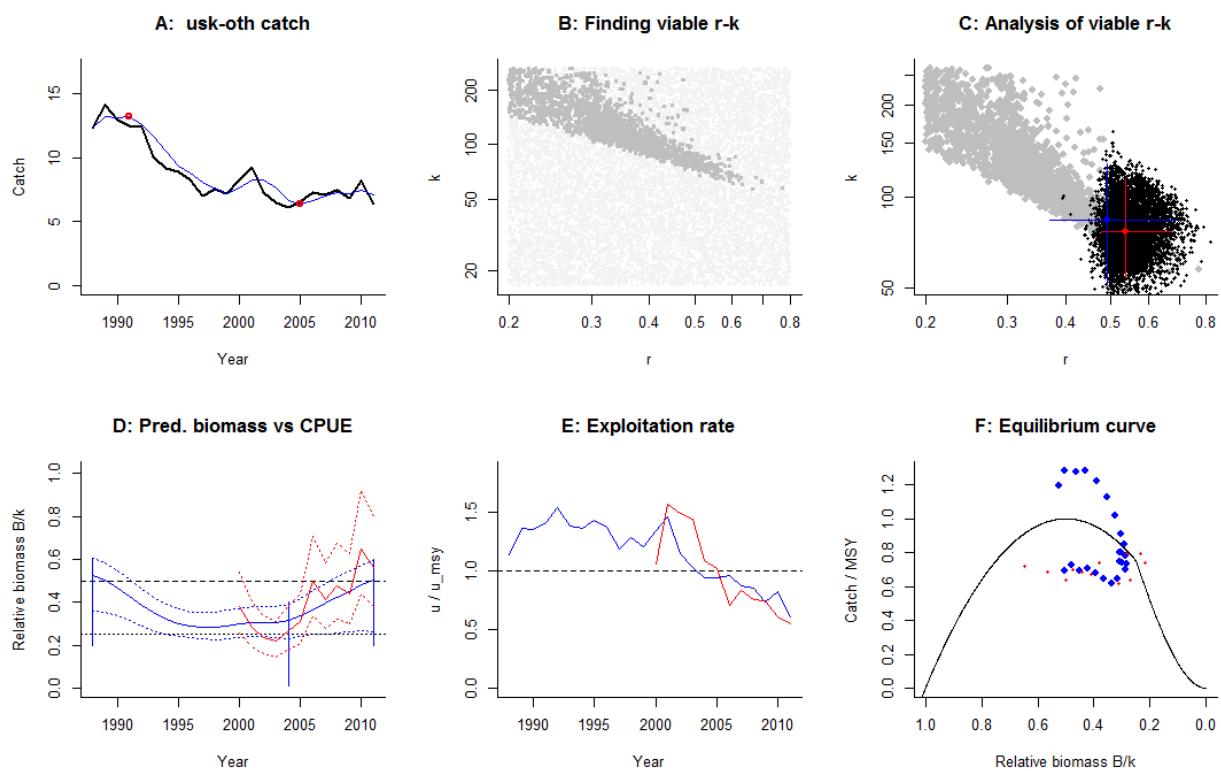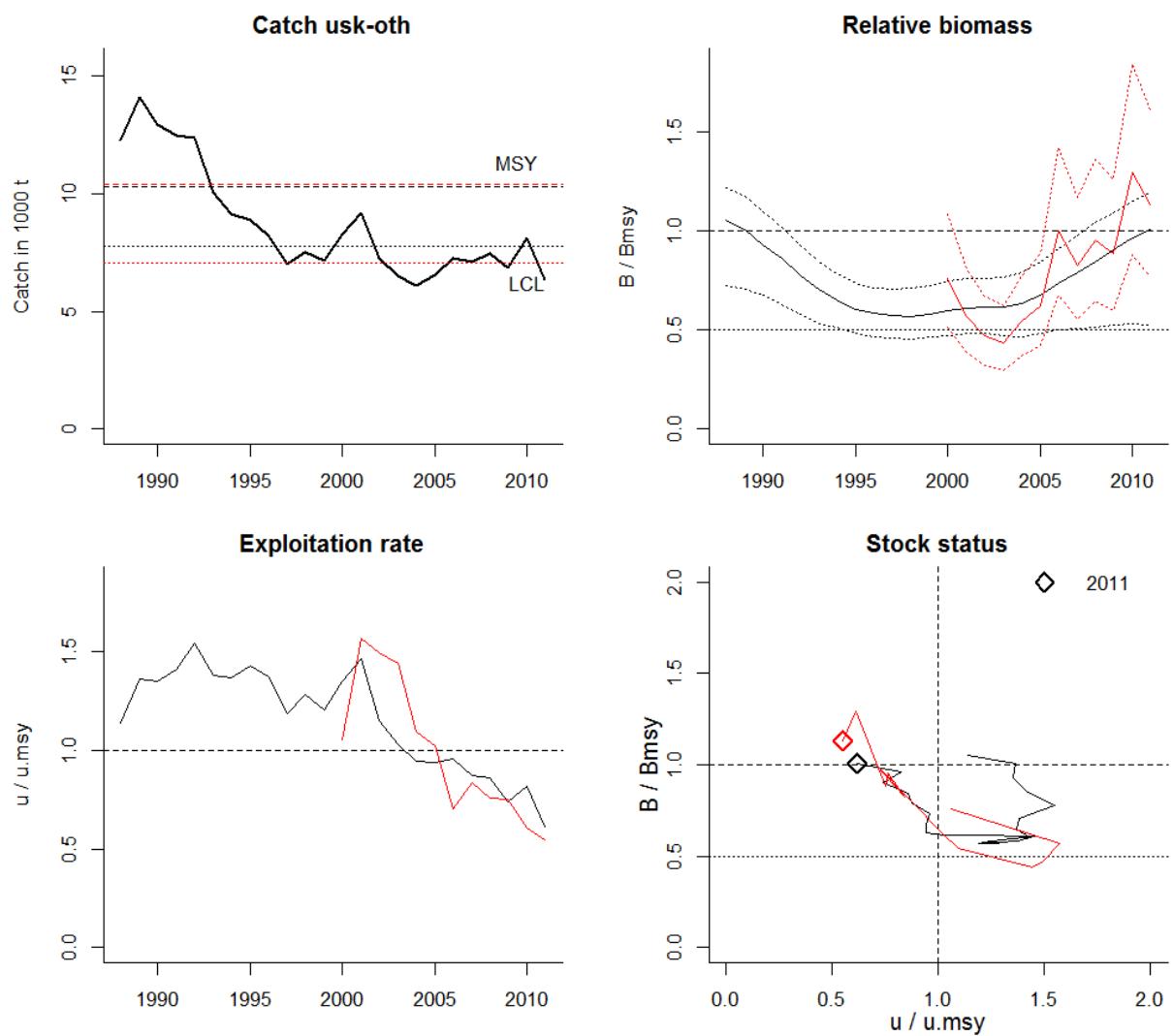
Appendix V: Landings vs catches

[CMSY_44.R, SimCatch07.csv, SimSpec07.csv]

Species: NA , stock: 07_HLH_M

 Name and region: Simulated data , NA

 Catch data used from years 1 - 50 , biomass = simulated

 Prior initial relative biomass = 0.5 - 0.9

 Prior intermediate rel. biomass= 0.01 - 0.4 in year 25

 Prior final relative biomass   = 0.4 - 0.8

 If current catches continue, is the stock likely to crash within 3 years? No

 Prior range for r = 0.2 - 0.8 , prior range for k = 310 - 2480

True r = 0.5 , true k = 1000 (true values known because data were simulated)

 True MSY = 125 , true mean catch / MSY ratio = 0.646

True biomass in last year = 708 or 0.708 k

Results from Bayesian Schaefer model using catch & simulated biomass

 r = 0.392 , 95% CL = 0.349 - 0.442 , k = 922 , 95% CL = 845 - 1021

 MSY = 90.4 , 95% CL = 83.9 - 97.9

 Results of CMSY analysis with altogether 2714 viable trajectories for 640 r-k pairs

 255 r-k pairs above r = 0.367 and 1184 trajectories within r-k CLs were analyzed

 r = 0.549 , 95% CL = 0.384 - 0.784 , k = 651 , 95% CL = 439 - 965

 MSY = 89.3 , 95% CL = 83 - 96.2

 Predicted biomass last year= 0.728 , 2.5th = 0.598 , 25th = 0.713 , 97.5th = 0.757

 Predicted biomass next year= 0.717 , 2.5th = 0.605 , 25th = 0.704 , 97.5th = 0.745
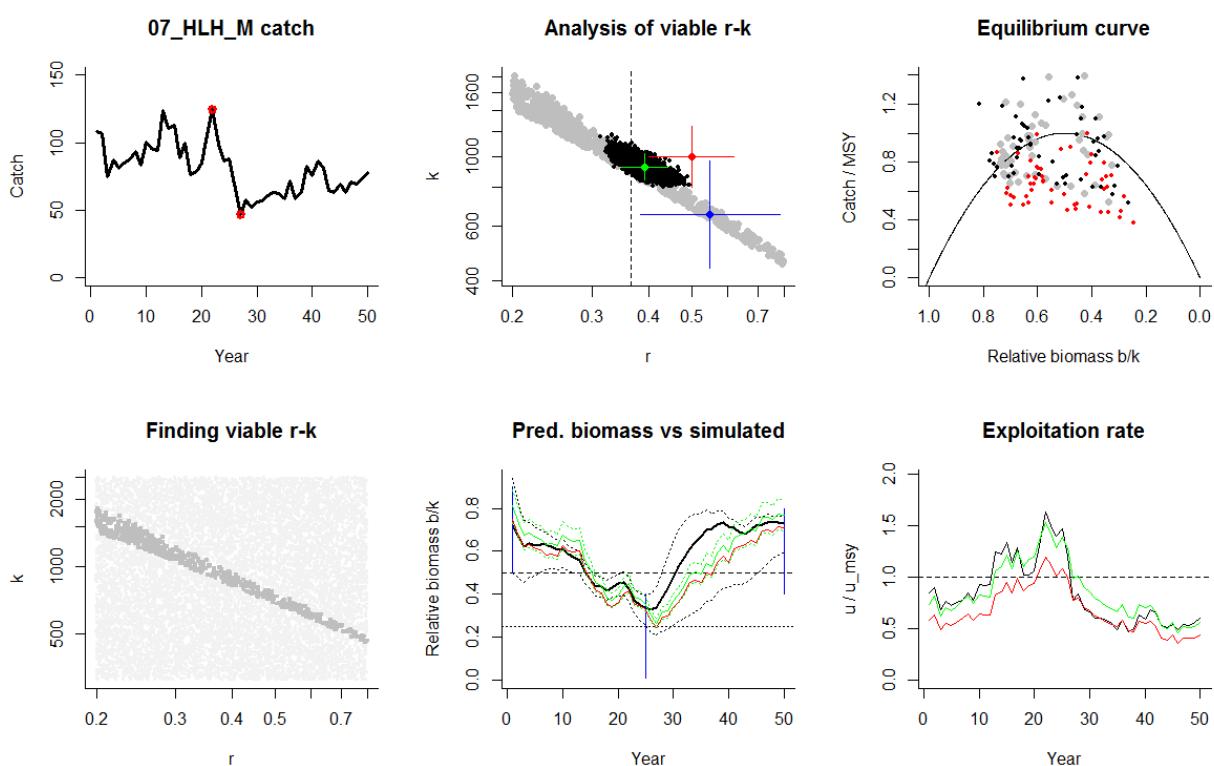
[CMSY_44.R, AllStocks_Catch_07.csv, AllStocks_ID_07.csv]

Species: *Melanogrammus aeglefinus* , stock: had-346a-land

 Name and region: Haddock , Haddock in Sub-area IV (North Sea) and Division IIIa West and Via, Landings only

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Catch data used from years 1972 - 2013 , biomass = observed
Prior initial relative biomass = 0.5 - 0.9
Prior intermediate rel. biomass= 0 - 1 in year 1992
Prior final relative biomass   = 0.01 - 0.4
If current catches continue, is the stock likely to crash within 3 years? Possible
Prior range for r = 0.2 - 0.8 , prior range for k = 263 - 3156
Results from Bayesian Schaefer model using catch & observed biomass
r = 0.489 , 95% CL = 0.414 - 0.537 , k = 2589 , 95% CL = 2084 - 3341
MSY = 315 , 95% CL = 235 - 413
Biomass in last year = 436 or 0.169 k
Results of CMSY analysis with altogether 1047 viable trajectories for 877 r-k pairs
375 r-k pairs above r = 0.243 and 380 trajectories within r-k CLs were analyzed
r = 0.397 , 95% CL = 0.247 - 0.654 , k = 1310 , 95% CL = 729 - 2297
MSY = 130 , 95% CL = 110 - 154
Predicted biomass last year= 0.273 , 2.5th = 0.0211 , 25th = 0.155 , 97.5th = 0.394
Predicted biomass next year= 0.309 , 2.5th = 0.00559 , 25th = 0.169 , 97.5th = 0.446
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had-346a-land catch

Analysis of viable r-k

Equilibrium curve

Finding viable r-k

Pred. biomass vs observed

Exploitation rate