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A new approach for estimating stock status from length frequency data

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Additional supplementary material is available at http://oceanrep.geomar.de/43182/: the R-code to run LBB and files with the settings and the data for the analysis of the various stocks. LBB is also available as a function in the TropFishR package (Mildenberger et al. 2018) available from https://cran.r-project.org/package=TropFishR.

Data sources

Length composition data for spiny dogfish (*Squalus acanthias*), winter skate (*Leucoraja ocellata*), and thorny skate (*Amblyraja radiata*) in the Northwest Atlantic were obtained from The Historic Pelagic Shark Commercial Fishery Length Frequency Data provided by Fisheries and Oceans Canada (DFO) (Stone, 2017). Data came from directed fisheries for these species and were collected at landing ports. All individuals were measured in cm total length to the nearest integer.

LF data for six North Sea stocks were obtained from the annual sampling programme according to the EU German Data Collection Framework measuring the catch composition of the main commercial German fishing fleets with the highest catches, values, or effort. Length frequency data were obtained by observers-at-sea mainly covering demersal shrimp and flatfish beam trawlers and otter board trawls on demersal and pelagic fish (Ulleweit *et al.*, 2010).

LF data for 14 stocks from the Mediterranean were obtained from commercial catches, which were collected mostly in the context of the European Data Collection Framework programme (https://stecf.jrc.ec.europa.eu/dd/medbs) and in some cases in the framework of FAO regional projects (e.g. FAO-AdriaMed). In particular, length composition data for blue and red shrimp (*Aristeus antennatus*) from geographical subareas GSA 1 and GSA 5, giant red shrimp (*Aristaeomorpha foliacea*) from GSAs 18–19, European anchovy (*Engraulis encrasicolus*) from GSA06 and GSAs 17–18, European hake (*Merluccius merluccius*) from GSA 9, red mullet (*Mullus barbatus*) from GSA 6 and 25, deep-water rose shrimp (*Parapenaeus longirostris*) from GSA 10, and common cuttlefish (*Sepia officinalis*) from GSA 17 were obtained from the JRC data dissemination tool (https://stecf.jrc.ec.europa.eu/c/document_library/get_file?uuid=e38bf490-ced2-4213-b71e-3902aba6e0a1&groupId=43805) and from the reports and stock assessment forms respectively available from STECF (https://stecf.jrc.ec.europa.eu/reports/medbs) and from FAO-GFCM (http://www.fao.org/gfcm/data/safs/en/). Such datasets included landings from various gears (bottom trawls, nets, longlines) as well as discards.

Data for European pilchard (*Sardina pilchardus*) and European anchovy (*Engraulis encrasicolus*) from the Ionian and Aegean seas came from the catch of purse-seines and were collected onboard and at landing ports (no discards were included because they are considered negligible). Data for red mullet (*Mullus barbatus*) and European hake (*Merluccius merluccius*) from the same areas were also collected onboard and at landing ports, but came from various gears (bottom trawls, nets, longlines) and included discards.

Length composition data for European sprat (*Sprattus sprattus*) from the Black Sea were obtained from STEFC report (2017). Whiting (*Merlangius merlangus*) and Mediterranean horse mackerel (*Trachurus mediterraneus*) from the Black Sea were collected at several landing ports and were caught via different gears such as purse-seines and bottom trawls.

Length composition data for the South African “linefish” stocks carpenter (*Argyrozona argyrozona*; n = 2), silver kob (*Argyrosomus inodorus*; n = 2), slinger (*Chrysoblephus puniceus*; n = 1), caught by the boat-based coastal handline fishery, were sourced from the National Marine Linefish System (NMLS) hosted by the South African Department of Agriculture, Forestry and Fishery (DAFF). Fisheries-dependent length data were sampled as part of a large national landing site observer programme during 2008–2010. Length composition data for carpenter and silver kob were separated into two regions along the South African south coast to match previous formal age-structured stock assessments for these species, whereas a single assessment model has been used for slinger in the South African coast (Winker *et al.*, 2012).

Start values for the nonlinear least squares estimator function

LBB requires priors for L_{inf} and Z/K, which were derived by pooling available LF data across years and fitting equation 2 in the main text to the fully selected part of the catch-in-numbers curve with the nonlinear least squares estimator function nls() in R (Bates and DebRoy, 2016). The method requires start values and ranges for the parameters and these were obtained as described in Table S1.

Derivation of priors

The equations for how the LBB priors for L_{inf}, L_c, α, M/K, and F/K were derived are given in R-notation in Table S2.

Sources of independent stock assessments

The sources (mostly URLs) of independent stock assessments used for comparing the results of LBB are given for every stock in Table S3.

Results based on empirical data

LBB predictions of relative biomass in the final year evaluated against independent estimates of regular stock assessments for a total of 34 stocks are given in Table S4.

Table S1. Start values (Linf.st and ZK.st) and their ranges used for nonlinear least squares estimation, in R-notation, where Length are the observed length classes and Freq are the observed frequencies. L.start is the length class from which onward full selection was assumed.

Parameter	**Mean**	**Range**	**Comment**
Linf.st	max(Length)	0.9*Linf.st – 1.2* Linf.st	Length of largest observed specimen in the dataset
max.Freq	max(Freq)		Highest observed frequency
L10	Length[which(Freq>(0.1*max.Freq))[1]]		Length at 10% selection
L90	Length[which(Freq>(0.9*max.Freq))[1]]		Length at 90% selection
Lc.st	(L10 + L90)/2	(Lc.st-L10)/2	Length at half of peak frequency
alpha.st	-log(max.Freq/Freq[which(Freq > (0.1*max.Freq))[1]])/(L10-Lc.st)	0.2*alpha.st	From main text equation 2 with $L = L_{10}$ and $S_L = 0.1$, solved for α
L.start	Lc.st + 6.9 / alpha.st		Length where $S_L = 0.999$
Lmean	sum(Length[Length>=Lc.st]* Freq[Length>=Lc.st])/ sum(Freq[Length>=Lc.st])		Needed to get a prior for Z/K
ZK.st	(Linf.st-Lmean.st)/(Lmean.st-Lc.st)	0.1*(Linf.st-Lmean.st)/(Lmean.st-Lc.st)	After Beverton and Holt (1956). Used for fitting main text Equation 1

Table S2. Derivation of priors for the Bayesian estimation of parameters in equations 4 and 7 in the main text. Equations are given in R-notation.

Prior	**Distribution**	**Mean**	**SD or tau**	**Comment**
Linf.pr	Gaussian	Linf.nls	Linf.sd.pr = ifelse(Linf.nls.sd/Linf.nls<0.01, Linf.nls.sd,0.01*Linf.nls)	Where Linf.nls and Linf.nls.sd were obtained by fitting equation 1 in the main text to the fully selected length classes, aggregated over all years. S.d. is restricted to *CV* <0.01 to limit interannual variability thought to stem mostly from sampling error.
Lc.pr	Gaussian	1.02*Lc.st	Lc.sd.pr = 0.1*Lc.pr	Where Lc.st is determined as stated in Table S1 and the multiplier accounts for small bias.
r.alpha.st	-log(r.max.Freq/r.Freq.y[which(r.Freq.y > (0.1*r.max.Freq))[1]]) /(L10/Linf.pr-Lc.pr/Linf.pr)			Similar to derivation of alpha.st in Table S1, but here applied to annual standardized data.
r.alpha.pr	Gaussian	r.alpha.st	0.025*r.alpha.st	
MK.pr	Gaussian	1.5	0.15	Evolutionary *M/K* ratio proposed by various authors, see Jensen (1996), Froese *et al.* (2016a).
FK.pr	log-Gaussian	log(ZK.nls - MK.pr)	tau = 4	Where ZK.nls is the Z/K estimate obtained from fitting equation 1 in the main text to the fully selected length classes, aggregated across all years. Precision = 4 gives wide range of uncertainty.

Table S3. Data sources of independent stock assessments.

Species by area	**Data source**
Northeast Atlantic	
Amblyraja radiata	DFO (2003, 2017a)
Leucoraja ocellata	DFO (2017b)
Squalus acanthias	DFO (2014); Fowler and Campana (2015)
North Sea	
Clupea harengus	www.ices.dk/sites/pub/Publication%20Reports/Advice/2017/2017/her.27.3a47d.pdf.
Melanogrammus ae-glefinus	www.ices.dk/sites/pub/Publication%20Reports/Advice/2017/2017/had.27.46a20.pdf
Pleuronectes platessa	www.ices.dk/sites/pub/Publication%20Reports/Advice/2017/2017/ple.27.420.pdf
Pollachius virens	http://www.ices.dk/sites/pub/Publication%20Reports/Advice/2017/2017/pok.27.3a46.pdf
Scophthalmus maximus	www.ices.dk/sites/pub/Publication%20Reports/Advice/2017/2017/tur.27.4.pdf
Solea solea	www.ices.dk/sites/pub/Publication%20Reports/Advice/2017/2017/sol.27.4.pdf
Mediterranean	
Aristeus antennatus	https://gfcmsitestorage.blob.core.windows.net/documents/SAC/SAF/DemersalSpecies/2016/ARA_GSA_01_2015_ESP.pdf.
	https://gfcmsitestorage.blob.core.windows.net/documents/SAC/SAF/DemersalSpecies/2016/ARA_GSA_05_2015_ESP.pdf
Aristaeomorpha foli-acea	https://stecf.jrc.ec.europa.eu/documents/43805/1291370/STECF+16-08+MED+assessments+part+2.pdf
Engraulis encrasicolus	https://stecf.jrc.ec.europa.eu/documents/43805/1517808/STECF+16-22+-+Med+assessments+part+1.pdf
	https://gfcmsitestorage.blob.core.windows.net/documents/SAC/SAF/SmallPelagics/2016/ANE_GSA_17-18_2015_ITA_SVN_HRV_ALB_MNE.pdf
	STECF/Jardim *et al.* (2015)
Merluccius merluccius	https://gfcmsitestorage.blob.core.windows.net/documents/SAC/SAF/DemersalSpecies/2016/HKE_GSA_09_2015_ITA.pdf
	https://gfcmsitestorage.blob.core.windows.net/documents/SAC/SAF/DemersalSpecies/2016/HKE_GSA_17-18_2015_ITA_SVN_HRV_ALB_MNE.pdf
	STECF/Simmonds *et al.* (2018)
Mullus barbatus	https://gfcmsitestorage.blob.core.windows.net/documents/SAC/SAF/DemersalSpecies/2016/MUT_GSA_25_2015_CYP.pdf

	https://gfcmsitestorage.blob.core.windows.net/documents/SAC/SAF/DemersalSpecies/2016/MUT_GSA_06_2015_ESP.pdf
	STECF/Cardinale and Osio (2012)
Parapenaeus longirostris	https://stecf.jrc.ec.europa.eu/documents/43805/1567060/STECF+17-06+-+Med+assessments+2016_p2.pdf
Sardina pilchardus	STECF/Jardim *et al.* (2015)
Sepia officinalis	Scarcella *et al.* (2017)
Black Sea	
Merlangius merlangus	Froese *et al.*, 2016b http://www.fishbase.de/rfroese/Appendix_2.pdf
Sprattus sprattus	Froese *et al.*, (2016b) http://www.fishbase.de/rfroese/Appendix_2.pdf
Trachurus mediterraneus	Froese *et al.*, (2016b) http://www.fishbase.de/rfroese/Appendix_2.pdf
South Africa	
Argyrozona argyrozona	National Marine Linefish System (NMLS), hosted by the South African Department of Agriculture, Forestry and Fishery (DAFF)
Argyrosomus inodorus	National Marine Linefish System (NMLS), hosted by the South African Department of Agriculture, Forestry and Fishery (DAFF)
Chrysoblephus puniceus	National Marine Linefish System (NMLS), hosted by the South African Department of Agriculture, Forestry and Fishery (DAFF)

Table S4. B/B_{msy} and preceding F/M values estimated from commercial length frequencies (and marked "est") compared with F/F_{msy} and approximated B/B_0 estimates from independent assessments (marked "ind"), for 34 stocks of 23 species. Also indicated are the ratios of mean to optimum length (L_{mean}/L_{opt}) in the catch and observed to optimum length at first capture (L_c/L_{copt}). The ratio of the 95[th] percentile to asymptotic length (L_{95th}/L_{inf}) and the percentage of mature individuals in the catch (Mat) is indicated. F/M estimates where confidence limits do not overlap with F/F_{msy} estimates are marked bold (assuming ±20% limits for single F/F_{msy}). B/B_{msy} estimates where confidence limits do not overlap with independent estimates are marked bold (assuming ±20% limits for single B/B_{msy}). Table S3 contains additional information about sources of data for each stock.

Species by area	Stock Years	F/F_{msy} ind	F/M est	B/B_{msy} ind	B/B_{msy} est	L_{mean}/L_{opt} L_c/L_{c_opt}	L_{95th}/L_{inf} Mat (%)	Comment/source (ind)
Northwest Atlantic								
Amblyraja radiata	ThornySkate 2000	–	3.5 2.8–4.5	–	0.42 0.29–0.57	1.1 1.1	0.92 95	Assessment suggests high exploitation and low biomass. L_{m50} = 53 cm. DFO (2003, 2017a)
Leucoraja ocellata	WinterSkate 1995–2004	–	1.1 0.8–1.6	0.35	**1.0** **0.6 – 1.5**	1.1 1.2	0.83 63	L_{m50} = 75 cm. DFO (2017b)
Squalus acanthias	SpinyDogfish 2001–2006	0.15–0.21	**2.0** **1.6–3.3**	0.86	0.7 0.4–1.1	1.1 1.1	0.98 23	L_{m50} = 82.1 cm from Campana *et al.* (2009)

North Sea								
Clupea harengus	her.27.3a47d 2010–2014	0.67 0.54–0.82	**3.1** **2.5–3.8**	0.65 0.57–0.75	0.59 0.41–0.76	1.2 1.4	0.96 100	L_{m50} = 24.1 cm from Froese and Sampang (2013)
Melanogrammus aeglefinus	had.27.46a20 2010–2014	1.55 1.24–1.91	**3.6** **2.7–4.9**	0.69 0.60–0.77	**0.38** **0.25–0.56**	1.0 1.0	0.92 93	L_{m50} = 33 cm from Froese and Pauly (2017)
Pleuronectes platessa	ple.27.420 2010–2014	0.95 0.81–1.1	**2.4** **1.8–3.5**	1.4 1.2–1.6	**0.30** **0.19–0.46**	0.69 0.57	0.87 49	Truncated LF in 2014 suggests high *F* and low *B*. L_{m50} = 22.1 cm from Froese and Sampang (2013). *M* = 0.1 and *Fmsy* = 0.19.
Pollachius virens	pok.27.3a46 2010–2014	0.89 0.64–1.2	1.4 1.1–2.2	0.69 0.55–0.88	0.53 0.34–0.83	0.70 0.62	0.92 39	Truncated LF suggest high *F* and low *B*. In assessment *M* = 0.2 whereas *Fmsy* = 0.38. L_{m50} = 55 cm from Froese and Pauly (2017)
Scophthalmus maximus	tur.27.4 2010–2014	0.63 0.48–0.84	0.84 0.65–1.32	1.18 0.87–1.61	0.85 0.54–1.39	0.64 0.50	0.72 79	L_{m50} = 28 cm from Froese and Sampang (2013)
Solea solea	sol.27.4 2011–2014	1.5 1.15–1.8	2.3 1.56–2.73	0.57 0.46–0.69	0.49 0.31–0.65	0.95 0.87	0.95 100	L_{m50} = 18.8 cm from Froese and Sampang (2013). *M* = 0.1, *Fmsy* = 0.2.
Mediterranean								
Aristeus antennatus	ARA-GSA01 2005–2015	1.9	1.8 1.42–2.36	–	0.37 0.26–0.50	0.61 0.48	0.75 100	L_{m50} = 1.5 cm
	ARA-GSA05 2002–2015	1.0	1.4 1.11–1.85	–	0.48 0.33–0.66	0.64 0.47	0.83 100	L_{m50} = 1.5 cm
Aristaeomorpha foliacea	ARS-GSA18-19 2009–2014	1.1	**5.1** **3.5–6.6**	–	0.13 0.08–0.19	0.68 0.60	0.82 29	LFs noisy with multiple peaks. L_{m50} = 3.3 cm
Engraulis encrasicolus	ANE-GSA06 2005–2015	0.9	**2.0** **1.4–2.6**	1.1	0.65 0.38–0.90	1.1 1.1	0.96 22	L_{m50} = 12 cm
	ANE-GSA17-18 2005–2015	1.8	1.5 1.2–2.1	–	0.89 0.60–1.26	1.2 1.2	0.94 91	*F/M* above but qualitatively compatible with F/F_{msy}. B/B_{msy} *est* is adequate for F/F_{msy}. L_{m50} = 10 cm
	Eengr_Aegean 2003–2008	1.5	**5.5** **5.0–6.2**	0.44	0.27 0.17–0.40	0.97 1.0	0.79 88	STECF/Jardim *et al.* (2015). L_{m50} = 11 cm from Tsikliras and Stergiou (2014)
Merluccius merluccius	HKE-GSA09 2006–2015	3.8	5.7 4.4–7.0	–	0.02 0.01–0.03	0.25 0.1	0.81 1.5	*F/M* above but qualitatively compatible with F/F_{msy}. B/B_{msy} *est* is adequate for F/F_{msy}. L_{m50} = 35 cm.
	HKE-GSA17-18 2009–2015	2.6	**12** **9.1–18.1**	–	0.02 0.01–0.03	0.49 0.45	0.88 5.7	*F/M* above but qualitatively compatible with F/F_{msy}. B/B_{msy} *est* is adequate for high F/F_{msy}. L_{m50} = 35 cm.
	Mmer_Aegean 2004–2014	4.68	3.2 2.6–4.1	–	0.11 0.08–0.15	0.45 0.29	0.84 18	*F/M* above but qualitatively compatible with F/F_{msy}. B/B_{msy} *est* is adequate for high F/F_{msy}. L_{m50} = 30 cm from Tsikliras and Stergiou (2014)
	Mmer_Ionian 2014–2016	2.62	**10** **8–12**	0.34	**0.05** **0.04–0.07**	0.65 0.61	0.89 17	L_{m50} = 30 cm from Tsikliras and Stergiou (2014)
Mullus barbatus	MUT-GSA25 2005–2015	1.0	1.4 1.1–2.0	–	0.67 0.41–0.99	0.87 0.79	0.95 100	L_{m50} = 9 cm
	MUT-GSA6 2006–2015	1.6	**3.4** **2.2–5.0**	–	0.27 0.15–0.44	0.79 0.77	0.98 100	L_{m50} = 12 cm
	Mbar_Aegean 2003–2006	1.18	**3.6** **2.6–6.7**	0.91	**0.21** **0.11–0.40**	0.69 0.64	0.99 49	Assessment for 2007, LBB for 2006. L_{m50} = 13 cm from Tsikliras and Stergiou (2014)
	Mbar_Ionian, 2005 – 2014	1.5	**3.7** **3.0–5.0**	–	0.2 0.13–0.26	0.70 0.60	0.93 66	L_{m50} = 13 cm from Tsikliras and Stergiou (2014)
Parapenaeus longirostris	DPS–GSA10 2009–2015	2.0	2.8 2.2–3.8	–	0.26 0.18–0.36	0.70 0.59	0.89 7.0	L_{m50} = 2.5 cm.
Sardina pilchardus	Spil_Aegean 2004–2008	1.7	**4.0** **3.5–4.7**	0.34	0.32 0.26–0.39	0.96 0.94	0.89 64	*F/M* above but qualitatively compatible with F/F_{msy}. B/B_{msy} *est* is compatible with B/B_{msy} ind. L_{m50} = 12 cm from Tsikliras and Stergiou (2014)
Sepia officinalis	CTC-GSA17 2006–2016	0.8	0.45 0.04–1.9	–	1.4 0–8.3	NA	NA	Assuming Gaussian selection, because catch consists to equal parts of trawls and trammel nets and traps, and catch curve shape is Gaussian symmetric. Note high uncertainty. Trawl selection would suggest strong overexploita-

								tion. L_{m50} = 10 cm.
Black Sea								
Merlangius merlangus	Whiting_BS 2016–2016	1.5 1.1–2.2	1.6 1.32–1.84	0.54 0.36–0.74	0.69 0.55–0.85	0.96 0.93	0.94 12	Assessment for 2014, LBB for 2016. Froese *et al.* (2016c) L_{m50} = 14.5 cm from STECF (2017)
Sprattus sprattus	Spr_BS 2008–2015	0.83 0.7–1.1	**2.4 1.9–3.5**	1.1 0.8–1.3	0.62 0.42–1.0	1.1 1.3	0.92 48	Assessment for 2014, LBB for 2015. L_{m50} = 7.8 cm from STECF (2017)
Trachurus mediterraneus	MHMackerel_BS 2016–2016	7 5–9	4.9 4.0–6.4	0.11 0.09–0.15	0.12 0.08–0.16	0.60 0.55	0.80 0.2	Assessment for 2014, LBB for 2016. L_{m50} = 12.5 cm from STECF (2017)
South Africa								
Argyrozona argyrozona	CRPN-S 2008–2010	0.26 0.14–0.42	**0.99 0.74–1.5**	1.21 0.67–1.8	0.96 0.62–1.47	0.93 0.95	0.97 99	SB/SB0 = 0.423 (0.243–0.631) and SB/SBmsy = 1.21 (0.696–1.803) in official assessment 2011. L_{m50} = 26.7 cm
	CRPN-SE 2008–2010	0.38 0.29–0.47	**1.6 1.1–2.0**	1.08 0.70–1.51	0.71 0.44–0.96	0.97 1.0	0.96 100	SB/SB0 = 0.377 (0.245–0.529) and SB/SBmsy = 1.076 (0.699–1.511) in official assessment 2011. L_{m50} = 26.7 cm.
Argyrosomus inodorus	KOB-S 2008–2010	1.11 0.94–1.30	1.3 0.93–1.71	0.51 0.37–0.65	0.68 0.44–0.94	0.77 0.71	0.93 100	SB/SB2011= 0.178 (0.128–0.229) and SB/SBmsy2011 = 0.509 (0.367–0.653) in official assessment. L_{m50} = 37.5 cm.
	KOB-SE 2008–2010	0.78 0.65–0.91	**1.5 1.1–2.1**	0.61 0.46–0.78	0.59 0.39–0.87	0.77 0.73	0.92 100	SB/SB0= 0.214 (0.161–0.273) and SB/SBmsy = 0.611 (0.459–0.78) in official assessment 2011. L_{m50} = 37.5 cm.
Chrysoblephus puniceus	SLNG-E 2008–2010	0.86 0.62–1.15	1.4 1.05–1.92	0.95 0.56–1.45	0.79 0.52–1.14	0.96 1.0	0.99 87	SB/SB= 0.391 (0.238–0.578) and SB/SBmsy = 0.945 (0.558–1.449) in official assessment 2011. L_{m50} = 24 cm.

Applicability of LBB to populations that continue living after reaching L_{inf}

Tropical small reef fish typically grow fast towards their maximum size which coincides with their maximum age. However, in some species, populations have been found whose adults continue to live for several decades after approaching L_{inf} (e.g. Choat and Axe, 1996; Choat *et al.*, 2003; Trip *et al.*, 2008). Robertson *et al.* (2005) explore possible reasons for such unexpected longevity in the ocean surgeonfish (*Acanthurus bahianus*) across a wide range of localities and habitats. They find that mean annual temperature at the different localities is the strongest predictor of longevity, accounting for 94% of the variability in the data. They observe fast decrease in numbers in the initial 10 years of life in all localities, with the high mortality rate that is typical for fishes of that size. However, in four out of 10 localities, they find adults that continued living up to 30 years and more, with a much slower decrease in numbers and thus much lower mortality rates, and without observable somatic growth. As they state: “[..] at Bermuda, fish settle inshore, grow to about asymptotic size and then, when 2 to 6 yr old, relocate permanently to outer reefs, where they can reach 32 yr. At Belize, fish settle and attain 10 yr on both inner and outer reefs [..].” Small fish that live for 32 years have to drastically reduce their extrinsic mortality rate, driven mostly by predation, and their intrinsic mortality rate, driven mostly by metabolism, which, in ectotherm species, is mainly a function of water temperature. The depth range of *Acanthurus bahianus* is 2–40 m (Desoutter, 1990) and water temperature at Bermuda ranges from 27°C at the surface in summer to about 18°C at 40 m depth. Given the evidence that natural mortality is influenced by environmental temperature (Pauly, 1980), we hypothesize that the observed high longevity in Bermuda is caused by low predation mortality and low water temperature in the outer reefs to which the fish relocate permanently. In contrast, the temperature on the inner and outer reefs in Belize seems to be about the same (about 28°C) and no extended longevity is observed.

Several other studies of long-lived reef fishes also show growth curves with very fast growth up to 0.6–0.8 L_{inf} and much slower growth and high longevity thereafter. For example, Currey *et al.* (2009) show data for four species of Lethrinidae. In three of these (see their Table 2 and their Figure 5), the hypothetical negative age at zero length (t_0) is –3 to –10 years, suggesting that the growth rate observed only at large sizes does not adequately describe growth rate at small sizes, which must be considerably higher.

Also, juveniles of long-lived reef species such as lutjanids and epinephelids occur in warm water such as sea grass beds and shallow sheltered reefs, whereas the long-lived adults occur in colder water on deeper slopes (Longhurst and Pauly, 1987; Froese and Pauly, 2017). Indeed, Pauly (2010) proposes that the migration to deeper, colder water is the key mechanism allowing these fishes to attain the large size and high longevity that characterize their life histories.

This warm-to-cold hypothesis for explanation of growth and mortality patterns in some long-lived populations of reef fishes differs from the one advanced by Hordyk *et al.* (2015a,b) and Prince *et al.* (2015) who (i) propose that high longevity is a general trait of several families of reef fishes such as Acanthuridae or Lethrinidae, (ii) assume that very low mortality acts already during the fast growth phase during the first few years of life, and (iii) therefore assume a very low M/K ratio from early juveniles onward, basically combining the low M of old individuals with the high K of young individuals (see e.g. Table 1 in Prince *et al.* 2015). Instead, we propose that in these populations, there is a joined stanza in growth and mortality schedules and that growth and no-growth phases should be treated separately.

In summary, it seems that fast early growth coupled with extended longevity around maximum size occurs in some populations where large individuals, as they approach maximum length, permanently relocate from warm shallow water to deep colder water. This life history strategy does not occur in all populations of a species, presumably because not all populations have access to suitable nearby deep habitats.

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Detailed results of LBB analysis of simulated and real stocks

The output shown in the subsequent pages is generated by the LBB R-code. Length frequency (LF) data refer to simulated stocks with trawl-like and gillnet-like selection and to data obtained from real stocks from the North Atlantic, North Sea, Mediterranean, Black Sea, and South Africa. The Comment text includes corresponding values from the simulations or from independent stock assessments.

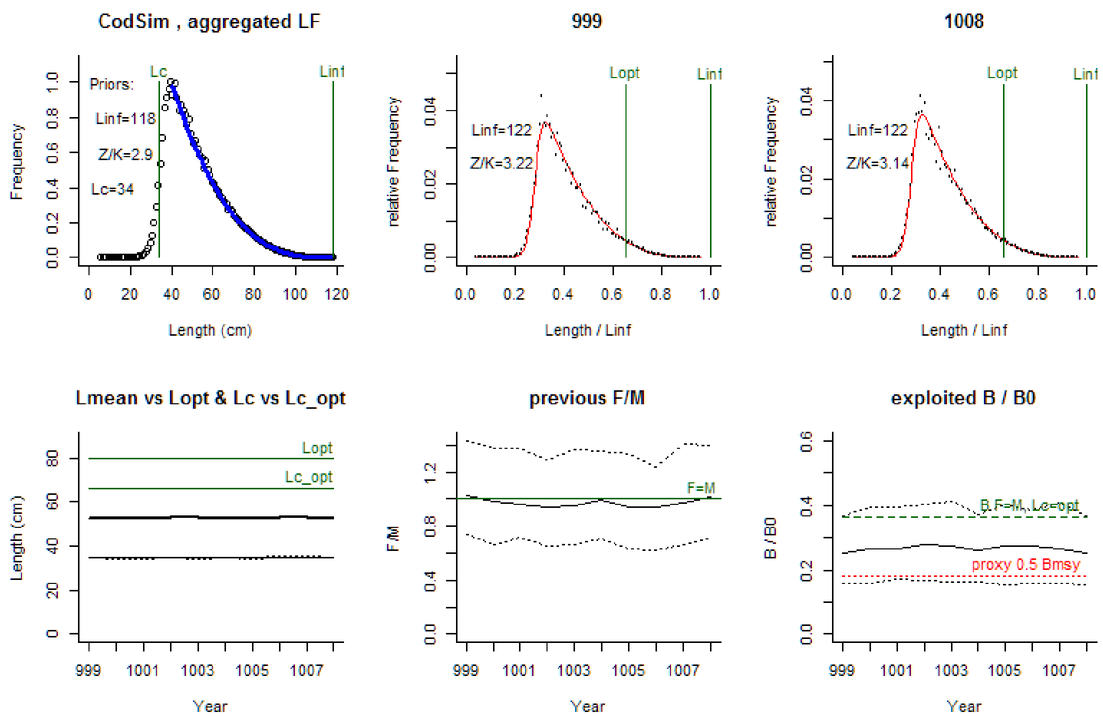
A generic caption to the figures produced by LBB as shown below is given here:

Caption for subsequent figures: The upper left panel shows the standardized length frequencies accumulated over the available years. These accumulated LF data are used to estimate priors for the length at 50% first capture (L_c), for asymptotic length (L_{inf}), and for total mortality relative to somatic growth (Z/K). The blue curve is fitted to fully selected length classes and provides the estimates of L_{inf} and Z/K. The upper middle and right panels show the LF data for the first and last year in the time-series. The red curve shows the fit of the LBB master equation, which provides estimates of Z/K, M/K, F/K, L_c, and L_{inf}. From L_{inf} and M/K, the length L_{opt} is calculated, where the biomass of the unexploited stock is maximum. The lower left panel shows the trajectory of mean length L_{mean} (bold black curve) relative to L_{opt}, and the trajectory of L_c (black curve) with approximate 95% confidence limits (dotted curves) relative to L_{c_opt}, which is a reference level that maximizes catch and biomass for the given fishing pressure and results in $L_{mean} = L_{opt}$ in the exploited part of the stock. The lower middle panel shows relative fishing pressure F/M (black curve), with approximate 95% confidence limits (dotted curves), with indication of the reference level where $F = M$ (green horizontal line). The lower right panel shows relative biomass B/B_0 (black curve) with approximate 95% confidence limits (dotted black curves) with indication of a proxy for the relative biomass that can produce MSY (green dashed line) and a proxy for the precautionary biomass level (red dotted line).

1) Simulations with regular exploitation (True values in Comment, Sim_23.xlsx, LBB_10.R)

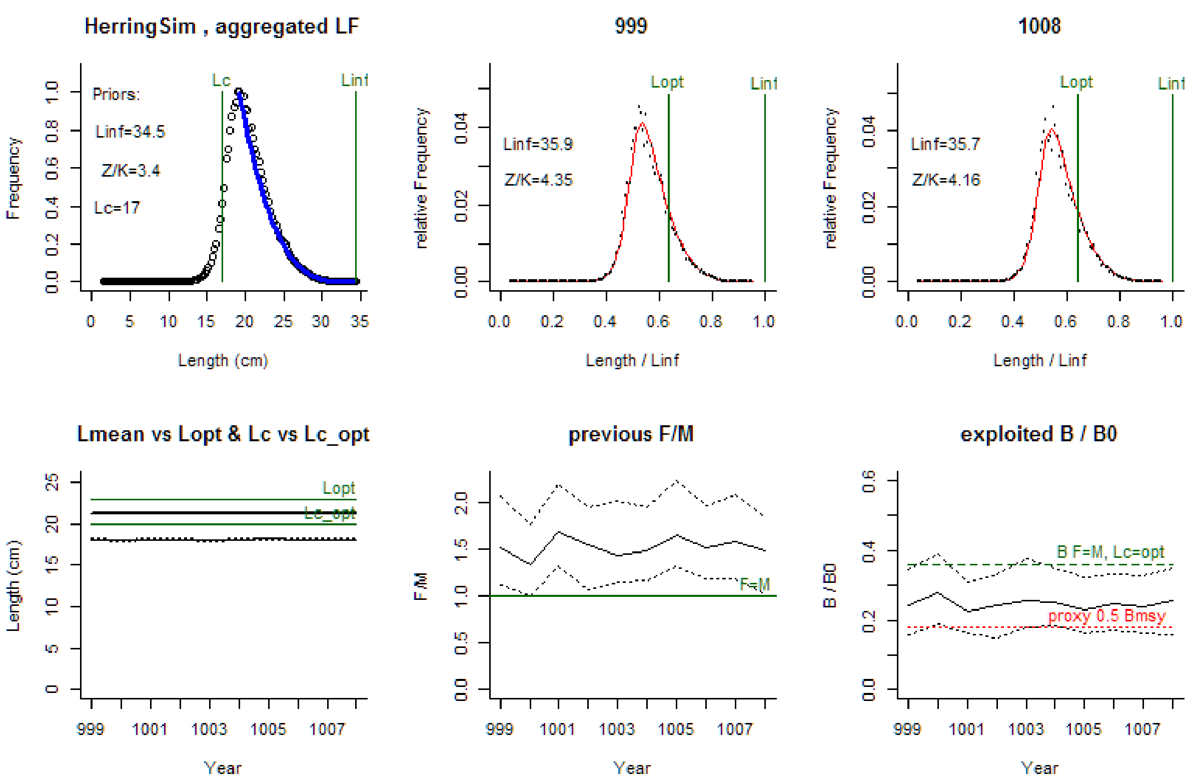
Results for fully exploited cod, stock **CodSim**, 999–1008
(95% confidence limits in parentheses) File: SimDat_10.csv

Linf prior = 118, s.d. = 1.18 (cm)
Z/K prior = 2.9, s.d. = 0.164, M/K prior = 1.5, s.d. = 0.15
F/K prior = 1.4 (wide range with tau = 4 in log-normal distribution)
Lc prior = 34.7, SD = 3.47 (cm), alpha prior = 71.9, s.d. = 7.19
General reference points [median across years]**:**
Linf = 122 (120–124) cm
Lopt = 80 cm, Lopt/Linf = 0.65
Lc_opt = 66 cm, Lc_opt/Linf = 0.54
M/K = 1.58 (1.33–1.85)
F/K = 1.53 (1.22–1.82)
Z/K = 3.11 (2.97–3.25)
F/M = 0.969 (0.667–1.37)
B/B0 F=M Lc=Lc_opt = 0.364
B/B0 = 0.266 (0.16–0.394)
Y/R' F=M Lc=Lc_opt = 0.0422
Y/R' = 0.0358 (0.0213–0.0524) (linearly reduced if B/B0 < 0.25)
Estimates for last year 1008:
Lc = 34.7 (34.5–34.9) cm, Lc/Linf = 0.28 (0.283–0.286)
alpha = 64 (61.2–66.4)
Lmean/Lopt = 0.65, Lc/Lc_opt = 0.52, L95th = 118 cm, L95th/Linf = 0.96, Lm50 = NA cm, Mature = NA%
F/K = 1.6 (1.3–1.9)
F/M = 1 (0.714–1.4)
Z/K = 3.14 (3–3.27)
Y/R' = 0.037 (0.0227–0.054) (linearly reduced if B/B0 < 0.25)
B/B0 = 0.25 (0.155–0.368)
B/Bmsy = 0.69 (0.425–1.01)
Comment: True: Linf=120, Lc=35, alpha=60, M/K=1.54, F/K=1.54, F/M=1, Z/K=3.08, B/B0=0.261, Y/R=0.0377.



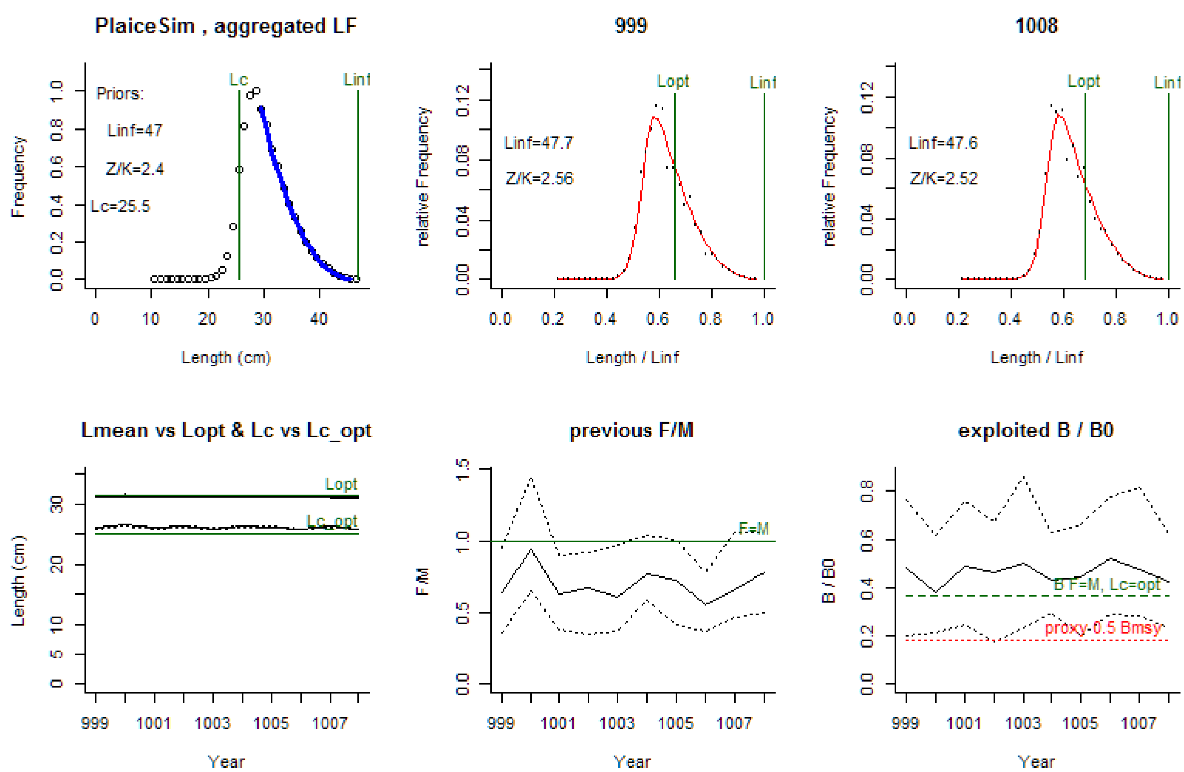
Results for overexploited herring, stock **HerringSim**, 999–1008
(95% confidence limits in parentheses) File: SimDat_10.csv

Linf prior = 34.5, s.d. = 0.345 (cm)
Z/K prior = 3.43, s.d. = 0.335, M/K prior = 1.5, s.d. = 0.15
F/K prior = 1.93 (wide range with tau=4 in log-normal distribution)
Lc prior = 17.3, s.d. = 1.73 (cm), alpha prior= 45.7, s.d. = 4.57
General reference points [median across years]**:**
Linf = 35.8 (35.4–36.3) cm
Lopt = 23 cm, Lopt/Linf = 0.64
Lc_opt = 20 cm, Lc_opt/Linf = 0.55
M/K = 1.69 (1.43–2)
F/K = 2.63 (2.25–2.99)
Z/K = 4.33 (4.12–4.58)
F/M = 1.52 (1.16–2)
B/B0 F=M Lc=Lc_opt = 0.36
B/B0 = 0.245 (0.162–0.339)
Y/R' F=M Lc=Lc_opt = 0.0376
Y/R' = 0.0396 (0.0266–0.0543) (linearly reduced if B/B0 < 0.25)
Estimates for last year 1008:
Lc = 18.1 (18–18.2) cm, Lc/Linf = 0.51 (0.504–0.51)
alpha = 39 (37.8–40)
Lmean/Lopt = 0.93, Lc/Lc_opt = 0.91, L95th = 34.2 cm, L95th/Linf = 0.96, Lm50 = NA cm, Mature = NA%
F/K = 2.5 (2.09–2.7)
F/M = 1.5 (1.03–1.86)
Z/K = 4.18 (3.96–4.35)
Y/R' = 0.041 (0.0256–0.0558) (linearly reduced if B/B0 < 0.25)
B/B0 = 0.26 (0.16–0.349)
B/Bmsy = 0.72 (0.445–0.971)
Comment: Linf=35, Lc=18, alpha=42, M/K=1.6, F/K=2.4, F/M=1.5, Z/K=4.0, B/B0=0.25, Y/R=0.0451.



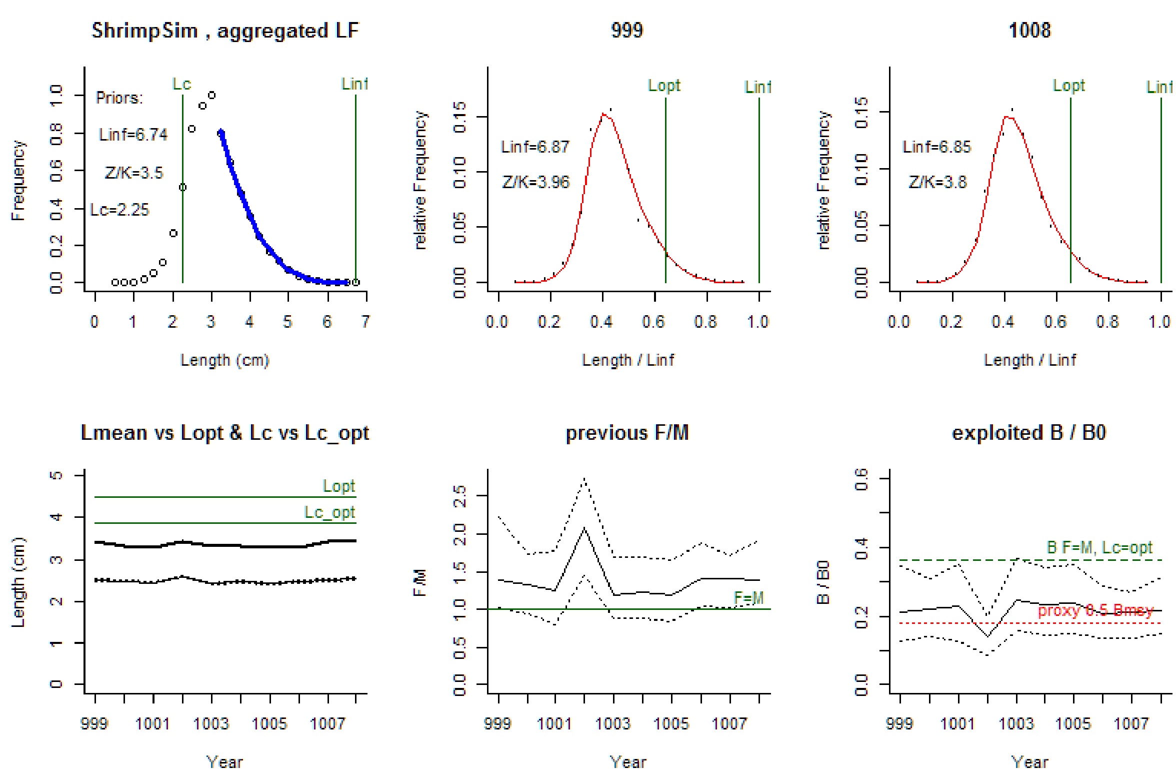
Results for fully exploited plaice, stock **PlaiceSim**, 999–1008
(95% confidence limits in parentheses) File: SimDat_10.csv

Linf prior = 47, s.d. = 0.47 (cm)
Z/K prior = 2.44, s.d. = 0.159, M/K prior = 1.5, s.d. = 0.15
F/K prior = 0.937 (wide range with tau=4 in log-normal distribution)
Lc prior = 26 s.d. = 2.6 (cm), alpha prior= 45.5, s.d. = 4.55
General reference points [median across years]:
Linf = 47.7 (47.1–48.3) cm
Lopt = 31 cm, Lopt/Linf = 0.66
Lc_opt = 25 cm, Lc_opt/Linf = 0.53
M/K = 1.55 (1.34–1.79)
F/K = 1.06 (0.752–1.35)
Z/K = 2.56 (2.41–2.74)
F/M = 0.667 (0.401–0.986)
B/B0 F=M Lc=Lc_opt = 0.365
B/B0 = 0.471 (0.235–0.716)
Y/R' F=M Lc=Lc_opt = 0.0436
Y/R' = 0.0385 (0.0193–0.0607) (linearly reduced if B/B0 < 0.25)
Estimates for last year 1008:
Lc = 25.8 (25.7–25.9) cm, Lc/Linf = 0.54 (0.54–0.544)
alpha = 47.9 (46.3–49.2
Lmean/Lopt = 0.96 Lc/Lc_opt = 1 , L95th = 46.5 cm , L95th/Linf = 0.98, Lm50 = NA cm, Mature = NA%
F/K = 1.1 (0.823–1.35)
F/M = 0.79 (0.506–1.06)
Z/K = 2.55 (2.39–2.67)
Y/R' = 0.047 (0.0259–0.0692) (linearly reduced if B/B0 < 0.25)
B/B0 = 0.42 (0.234–0.624)
B/Bmsy = 1.2 (0.64–1.71)
Comment: Linf=48, Lc=26, alpha=48, M/K=1.33, F/K=1.33, F/M=1, Z/K=2.67, B/B0=0.36, Y/R=0.0553.



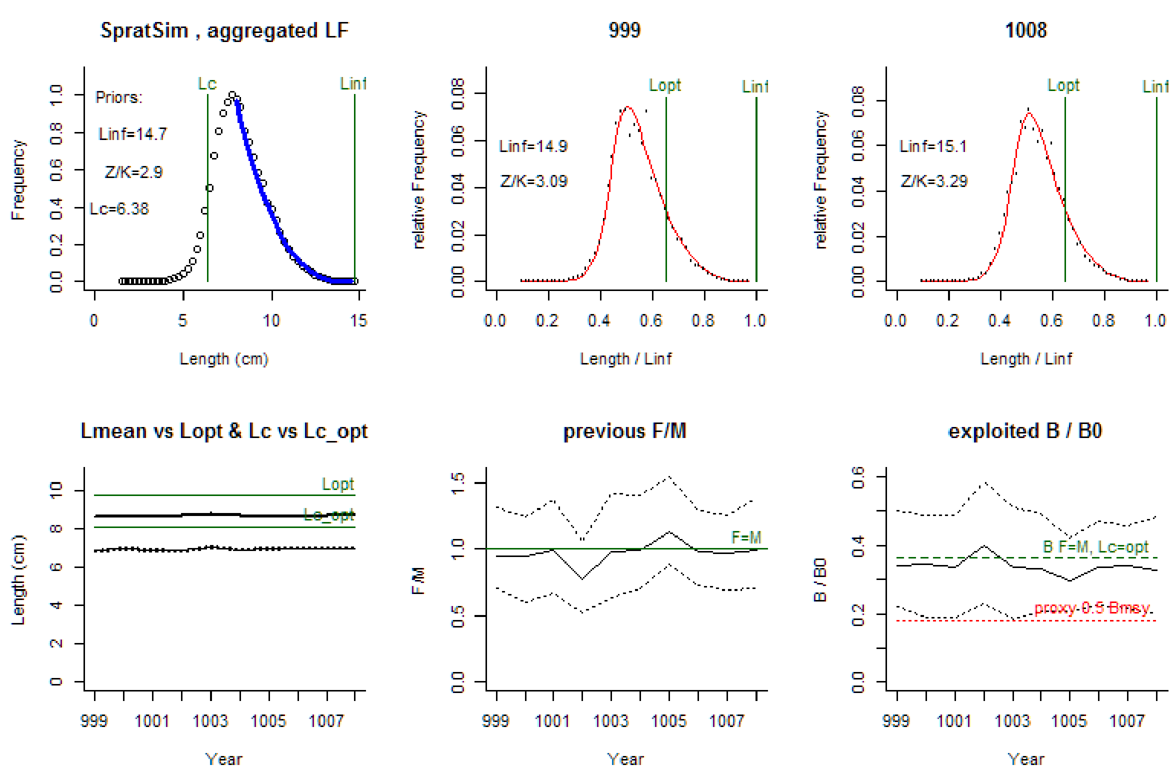
Results for overexploited shrimp, stock **ShrimpSim**, 999–1008
(95% confidence limits in parentheses) File: SimDat_10.csv

Linf prior = 6.74, s.d. = 0.0674 (cm)
Z/K prior = 3.47, s.d. = 0.276, M/K prior = 1.5, s.d. = 0.15
F/K prior = 1.97 (wide range with tau=4 in log-normal distribution)
Lc prior = 2.29, s.d. = 0.23 (cm), alpha prior = 28.1, s.d. = 2.81
General reference points [median across years]:
Linf = 6.83 (6.74–6.94) cm
Lopt = 4.5 cm, Lopt/Linf = 0.66
Lc_opt = 3.9 cm, Lc_opt/Linf = 0.56
M/K = 1.57 (1.31–1.83)
F/K = 2.15 (1.81–2.46)
Z/K = 3.72 (3.54–3.91)
F/M = 1.36 (0.984–1.76)
B/B0 F=M Lc=Lc_opt = 0.363
B/B0 = 0.217 (0.14–0.327)
Y/R' F=M Lc=Lc_opt = 0.0422
Y/R' = 0.0343 (0.0221–0.0502) (linearly reduced if B/B0 < 0.25)
Estimates for last year 1008:
Lc = 2.54 (2.51–2.57) cm, Lc/Linf = 0.37 (0.367–0.376)
alpha = 26.1 (25.1–26.9)
Lmean/Lopt = 0.77, Lc/Lc_opt = 0.66, L95th = 6.5 cm, L95th/Linf = 0.95, Lm50 = NA cm, Mature = NA%
F/K = 2.2 (1.93–2.62)
F/M = 1.4 (1.08–1.93)
Z/K = 3.81 (3.58–4.11)
Y/R' = 0.034 (0.0232–0.0492) (linearly reduced if B/B0 < 0.25)
B/B0 = 0.21 (0.148–0.314)
B/Bmsy = 0.59 (0.408–0.864)
Comment: Linf=7, Lc=2.5, alpha=28, M/K=1.78, F/K=2.22, F/M=1.25, Z/K=4.0, B/B0=0.232, Y/R=0.0328.



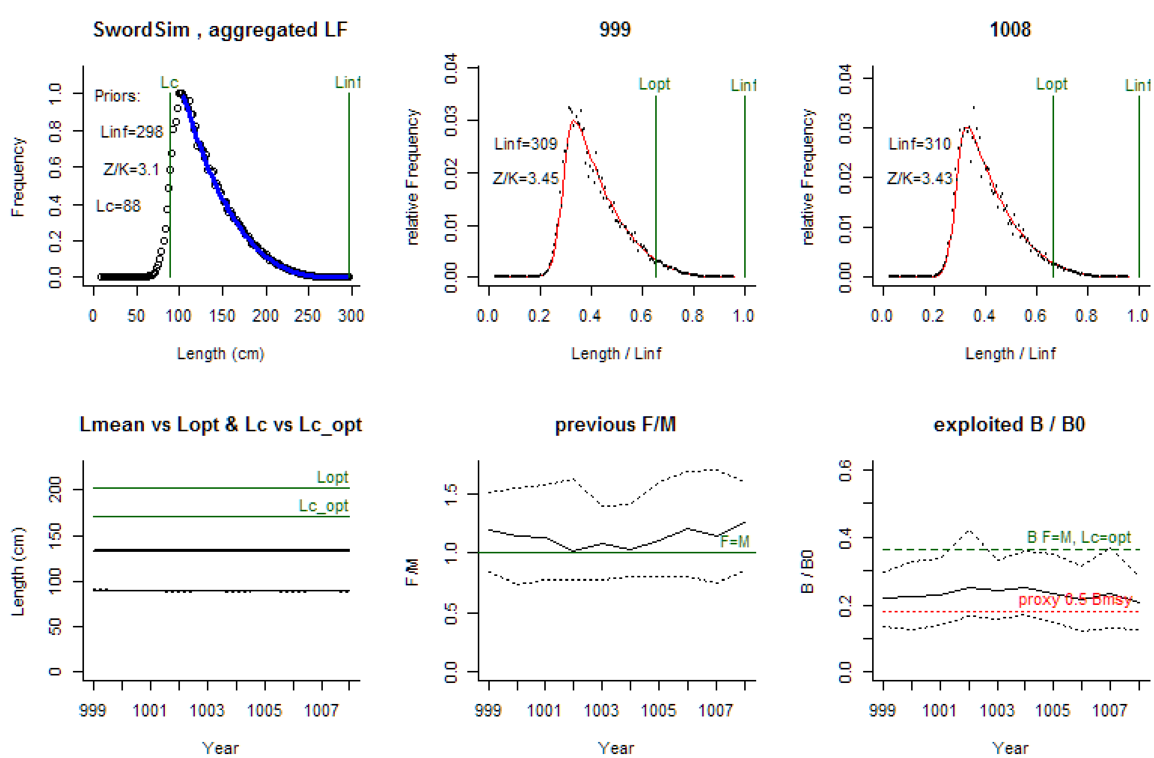
Results for fully exploited sprat, stock **SpratSim**, 999–1008
(95% confidence limits in parentheses) File: SimDat_10.csv

Linf prior = 14.7, s.d. = 0.147 (cm)
Z/K prior = 2.87, s.d. = 0.277, M/K prior = 1.5, s.d. = 0.15
F/K prior = 1.37 (wide range with tau=4 in log-normal distribution)
Lc prior = 6.5, s.d. = 0.65 (cm), alpha prior = 38.6, s.d. = 3.86
General reference points [median across years]:
Linf = 15 (14.8–15.2) cm
Lopt = 9.7 cm, Lopt/Linf = 0.65
Lc_opt = 8.1 cm, Lc_opt/Linf = 0.54
M/K = 1.62 (1.37–1.86)
F/K = 1.57 (1.24–1.82)
Z/K = 3.22 (3.02–3.4)
F/M = 0.982 (0.7–1.35)
B/B0 F=M Lc=Lc_opt = 0.362
B/B0 = 0.337 (0.206–0.488)
Y/R' F=M Lc=Lc_opt = 0.0403
Y/R' = 0.0402 (0.0248–0.0589) (linearly reduced if B/B0 < 0.25)
Estimates for last year 1008:
Lc = 6.99 (6.94–7.06) cm, Lc/Linf = 0.46 (0.461–0.469)
alpha = 30.7 (29.5–31.6)
Lmean/Lopt = 0.89, Lc/Lc_opt = 0.86, L95th = 14.5 cm, L95th/Linf = 0.96, Lm50 = NA cm, Mature = NA%
F/K = 1.6 (1.31–1.97)
F/M = 1 (0.706–1.38)
Z/K = 3.3 (3.07–3.52)
Y/R' = 0.04 (0.0239–0.0582) (linearly reduced if B/B0 < 0.25)
B/B0 = 0.33 (0.199–0.485)
B/Bmsy = 0.91 (0.55–1.34)
Comment: Linf=15, Lc=7, alpha=30, M/K=1.75, F/K=1.5, F/M=0.86, Z/K=3.25, B/B0=0.374, Y/R=0.0342.



Results for overexploited swordfish, stock **SwordSim**, 999–1008
(95% confidence limits in parentheses) File: SimDat_10.csv

Linf prior = 298, s.d. = 2.98 (cm)
Z/K prior = 3.13, s.d. = 0.141, M/K prior = 1.5, s.d. = 0.15
F/K prior = 1.63 (wide range with tau=4 in log-normal distribution)
Lc prior = 89.8, s.d. = 8.98 (cm), alpha prior = 70.9, s.d. = 7.09
General reference points [median across years]:
Linf = 309 (305–313) cm
Lopt = 202 cm, Lopt/Linf = 0.65
Lc_opt = 170 cm, Lc_opt/Linf = 0.55
M/K = 1.59 (1.34–1.88)
F/K = 1.81 (1.47–2.12)
Z/K = 3.38 (3.23–3.54)
F/M = 1.14 (0.789–1.59)
B/B0 F=M Lc=Lc_opt = 0.364
B/B0 = 0.23 (0.139–0.333)
Y/R' F=M Lc=Lc_opt = 0.0421
Y/R' = 0.0327 (0.02–0.0478) (linearly reduced if B/B0 < 0.25)
Estimates for last year 1008:
Lc = 89.2 (88.6–89.8) cm, Lc/Linf = 0.29 (0.286–0.29)
alpha = 61.7 (59.1–64)
Lmean/Lopt = 0.65, Lc/Lc_opt = 0.52, L95th = 297 cm, L95th/Linf = 0.96, Lm50 = NA cm, Mature = NA%
F/K = 1.9 (1.56–2.16)
F/M = 1.2 (0.849–1.6)
Z/K = 3.42 (3.24–3.55)
Y/R' = 0.031 (0.0189–0.0424) (linearly reduced if B/B0 < 0.25)
B/B0 = 0.21 (0.126–0.283)
B/Bmsy = 0.57 (0.346–0.778)
Comment: Linf=299, Lc=90, alpha=59.8, M/K=1.36, F/K=1.82, F/M=1.33, Z/K=3.18, B/B0=0.198, Y/R=0.0450.



2) Simulation of different exploitation, variable F, and recruitment pulse

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Results for lightly exploited cod, stock **CodLightSim**, 999–1008

(95% confidence limits in parentheses) File: SimDat_10.csv

Linf prior = 119, s.d. = 1.19 (cm)

Z/K prior = 2.21, s.d. = 0.0805 , M/K prior = 1.5, s.d. = 0.15

F/K prior = 0.706 (wide range with tau=4 in log-normal distribution)

Lc prior = 34.7, s.d. = 3.47 (cm), alpha prior = 71.2, s.d. = 7.12

General reference points [median across years]:

Linf = 122 (120–123) cm

Lopt = 79 cm, Lopt/Linf = 0.65

Lc_opt = 61 cm, Lc_opt/Linf = 0.5

M/K = 1.6 (1.33–1.87)

F/K = 0.741 (0.47–1.02)

Z/K = 2.37 (2.26–2.48)

F/M = 0.459 (0.257–0.758)

B/B0 F=M Lc=Lc_opt = 0.363

B/B0 = 0.479 (0.207–0.81)

Y/R' F=M Lc=Lc_opt = 0.0416

Y/R' = 0.0302 (0.0121–0.0509) (linearly reduced if B/B0 < 0.25)

Estimates for last year 1008:

Lc = 34.7 (34.4–34.9) cm, Lc/Linf = 0.28 (0.283–0.287)

alpha = 62.3 (59.9–64.9)

Lmean/Lopt = 0.7, Lc/Lc_opt = 0.57, L95th = 118 cm, L95th/Linf = 0.97, Lm50 = NA cm, Mature = NA%

F/K = 0.76 (0.425–0.968)

F/M = 0.48 (0.223–0.71)

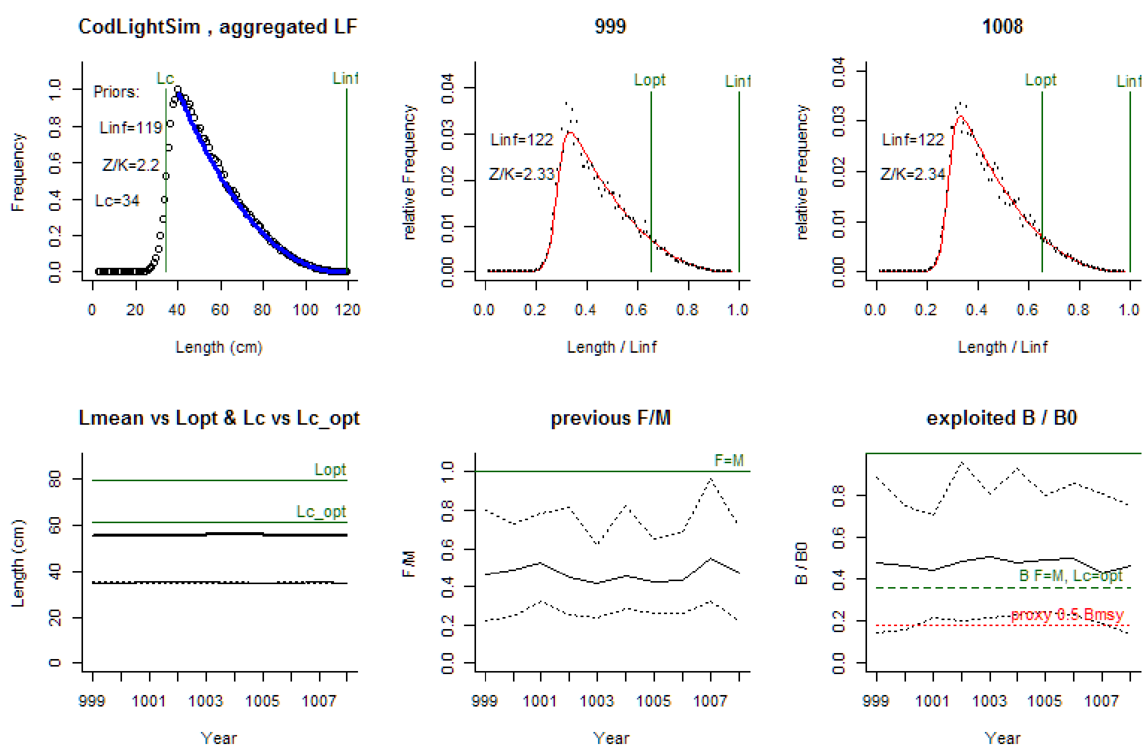
Z/K = 2.32 (2.24–2.48)

Y/R' = 0.031 (0.00928–0.0499) (linearly reduced if B/B0 < 0.25)

B/B0 = 0.47 (0.139–0.75)

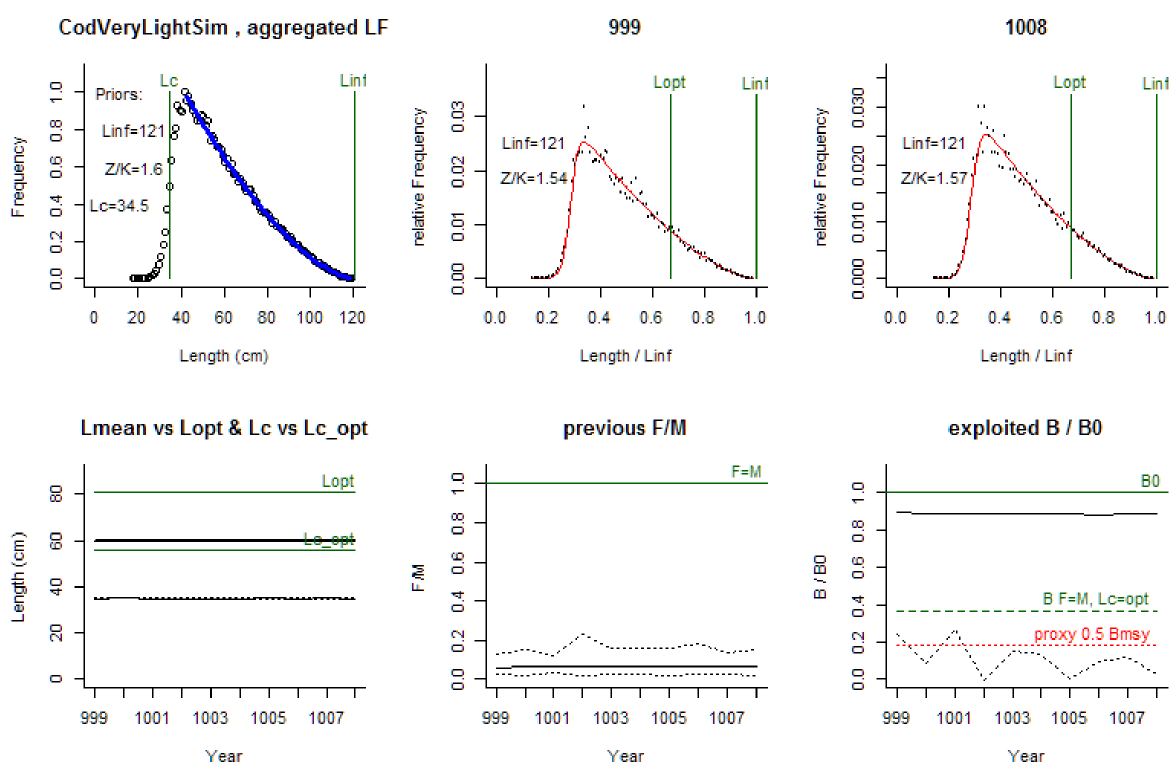
B/Bmsy = 1.3 (0.384–2.06)

Comment: Linf=120, Lc=35, alpha=60, M/K=1.54, F/K=0.77,F/M=0.5, Z/K=2.31, B/B0=0.458, YR=0.0332, YR_FMLcopt=0.0444.



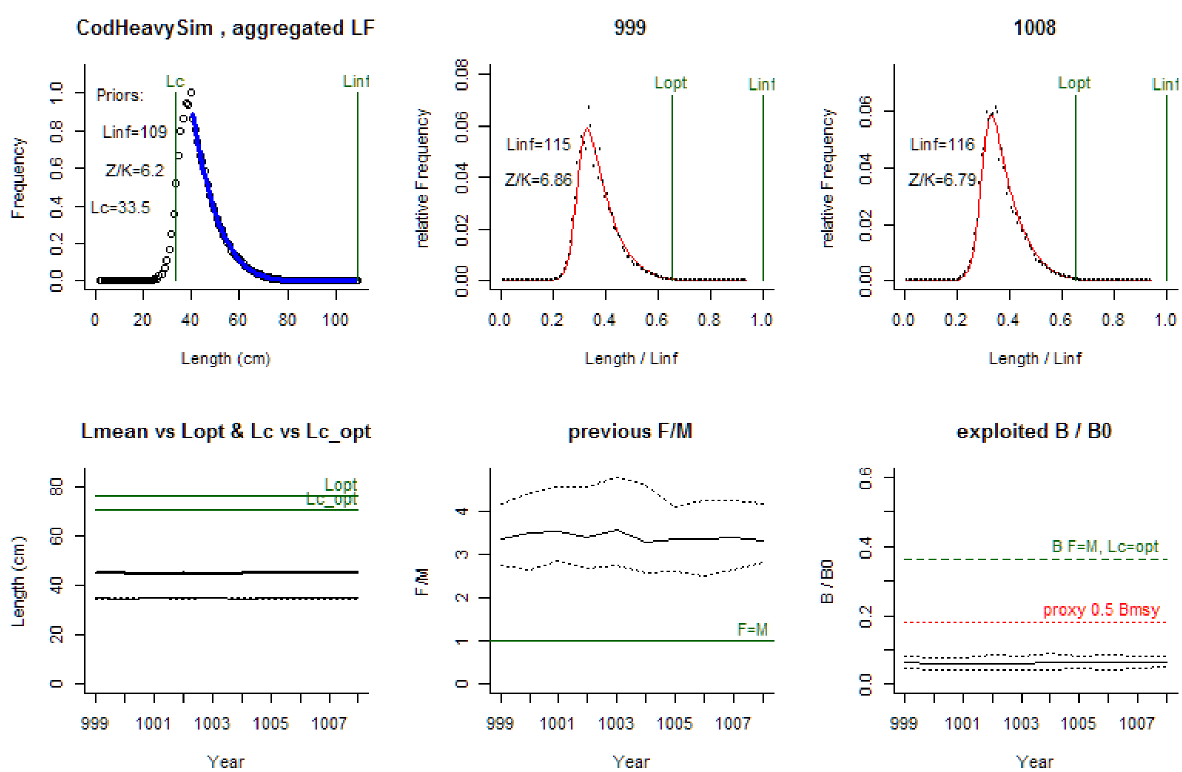
Results for very lightly exploited cod, stock C**odVeryLightSim**, 999–1008
(95% confidence limits in parentheses) File: SimDat_10.csv

Linf prior = 121, s.d. = 1.2 (cm)
Z/K prior = 1.6, s.d. = 0.046 , M/K prior = 1.5, s.d. = 0.15
F/K prior = 0.0978 (wide range with tau=4 in log-normal distribution)
Lc prior = 35.2, s.d. = 3.52 (cm), alpha prior = 56.5, s.d. = 5.65
General reference points [median across years]:
Linf = 121 (120–122) cm
Lopt = 81 cm, Lopt/Linf = 0.67
Lc_opt = 56 cm, Lc_opt/Linf = 0.46
M/K = 1.49 (1.37–1.59)
F/K = 0.0975 (0.0395–0.215)
Z/K = 1.59 (1.52–1.68)
F/M = 0.0654 (0.0249–0.156)
B/B0 F=M Lc=Lc_opt = 0.367
B/B0 = 0.887 (0.106–2.51)
Y/R' F=M Lc=Lc_opt = 0.0464
Y/R' = 0.0087 (0.00106–0.0245) (linearly reduced if B/B0 < 0.25)
Estimates for last year 1008:
Lc = 34.9 (34.7–35.1) cm, Lc/Linf = 0.29 (0.287–0.291)
alpha = 58 (6–60.7)
Lmean/Lopt = 0.74, Lc/Lc_opt = 0.63, L95th = 120 cm, L95th/Linf = 0.99, Lm50 = NA cm, Mature = NA%
F/K = 0.097 (0.0314–0.208)
F/M = 0.066 (0.0207–0.149)
Z/K = 1.57 (1.52–1.67)
Y/R' = 0.009 (3e-04–0.0241) (linearly reduced if B/B0 < 0.25)
B/B0 = 0.89 (0.0296–2.38)
B/Bmsy = 2.4 (0.0807–6.48)
Comment: Linf=120, Lc=35, alpha=60, M/K=1.54, F/K=0.0077,F/M=0.005, Z/K=1.55, B/B0=0.991, YR=0.0007.



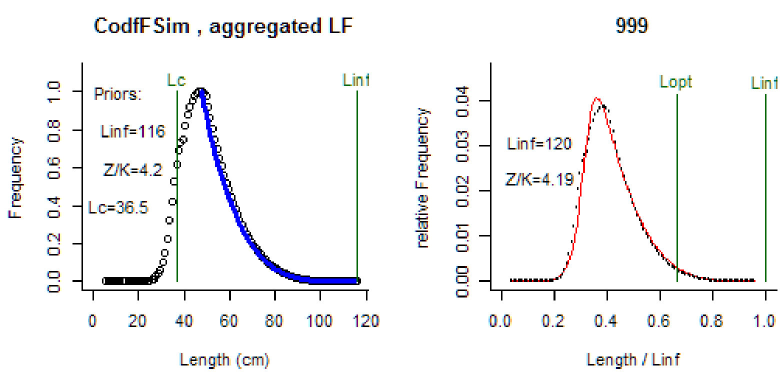
Results for heavily exploited cod, stock **CodHeavySim**, 999–1008
(95% confidence limits in parentheses) File: SimDat_10.csv

Linf prior = 109, s.d. = 1.09 (cm)
Z/K prior = 6.21, s.d. = 0.464 , M/K prior = 1.5, s.d. = 0.15
F/K prior = 4.71 (wide range with tau=4 in log-normal distribution)
Lc prior = 34.2, s.d. = 3.42 (cm), alpha prior = 61, s.d. = 6.1
General reference points [median across years]:
Linf = 115 (114–117) cm
Lopt = 76 cm, Lopt/Linf = 0.66
Lc_opt = 70 cm, Lc_opt/Linf = 0.61
M/K = 1.55 (1.27–1.84)
F/K = 5.23 (4.85–5.6)
Z/K = 6.79 (6.53–7.05)
F/M = 3.36 (2.65–4.33)
B/B0 F=M Lc=Lc_opt = 0.365
B/B0 = 0.0626 (0.043–0.0831)
Y/R' F=M Lc=Lc_opt = 0.0437
Y/R' = 0.00738 (0.0052–0.00984) (linearly reduced if B/B0 < 0.25)
Estimates for last year 1008:
Lc = 34.8 (34.6–34.9) cm, Lc/Linf = 0.3 (0.299–0.302)
alpha = 57.1 (55.4–58.8)
Lmean/Lopt = 0.59, Lc/Lc_opt = 0.5, L95th = 108 cm, L95th/Linf = 0.94, Lm50 = NA cm, Mature = NA%
F/K = 5.2 (4.86–5.5)
F/M = 3.3 (2.82–4.17)
Z/K = 6.77 (6.49–7.06)
Y/R' = 0.0074 (0.00575–0.00964) (linearly reduced if B/B0 < 0.25)
B/B0 = 0.064 (0.0496–0.0831)
B/Bmsy = 0.18 (0.136–0.228)
Comment: Linf=120, Lc=35, alpha=60, M/K=1.54, F/K=6.15, F/M=4, Z/K=7.69, B/B0=0.047, Y/R=0.0272.



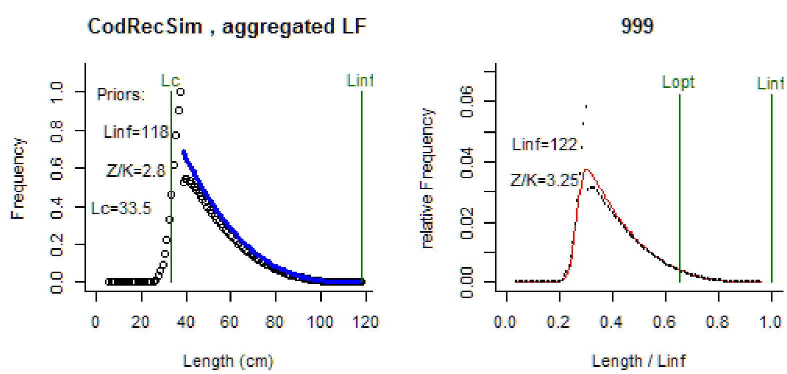
Results for F=0.2 below and 0.4 above 40 cm, stock **CodfFSim**, 999–999
(95% confidence limits in parentheses) File: SimDat_10.csv

Linf prior = 116, s.d. = 1.16 (cm)
Z/K prior = 4.18, s.d. = 0.277 , M/K prior = 1.5, s.d. = 0.15
F/K prior = 2.68 (wide range with tau=4 in log-normal distribution)
Lc prior = 37.2, s.d. = 3.72 (cm), alpha prior = 44.4, s.d. = 4.44
General reference points:
Linf = 120 (118–121) cm
Lopt = 80 cm, Lopt/Linf = 0.67
Lc_opt = 71 cm, Lc_opt/Linf = 0.59
M/K = 1.49 (1.14–1.79)
F/K = 2.7 (2.36–3.1)
Z/K = 4.21 (4.04–4.4)
F/M = 1.81 (1.33–2.74)
B/B0 F=M Lc=Lc_opt = 0.367
B/B0 = 0.145 (0.0902–0.227)
Y/R' F=M Lc=Lc_opt = 0.0463
Y/R' = 0.0227 (0.0142–0.0357) (linearly reduced if B/B0 < 0.25)
Estimates for last year 999:
Lc = 38.6 (38.2–38.9) cm, Lc/Linf = 0.32 (0.319–0.324)
alpha = 42.3 (40.6–43.5)
Lmean/Lopt = 0.66, Lc/Lc_opt = 0.55, L95th = 116 cm, L95th/Linf = 0.96, Lm50 = NA cm, Mature = NA%
F/K = 2.7 (2.36 –3.1)
F/M = 1.8 (1.33–2.74)
Z/K = 4.21 (4.04–4.4)
Y/R' = 0.023 (0.0142–0.0357) (linearly reduced if B/B0 < 0.25)
B/B0 = 0.14 (0.0902–0.227)
B/Bmsy = 0.39 (0.246–0.62)
Comment: Linf=120, Lc=35, alpha=60, M/K=1.54, F/K=1.54–3.08, F/M=1-2, Z/K=3.08–6.16, B/B0=0.142, Y/R=0.0376



Results for stock with ages 3–3.9 with doubled numbers, stock **CodRecSim**, 999–999
(95% confidence limits in parentheses) File: SimDat_10.csv

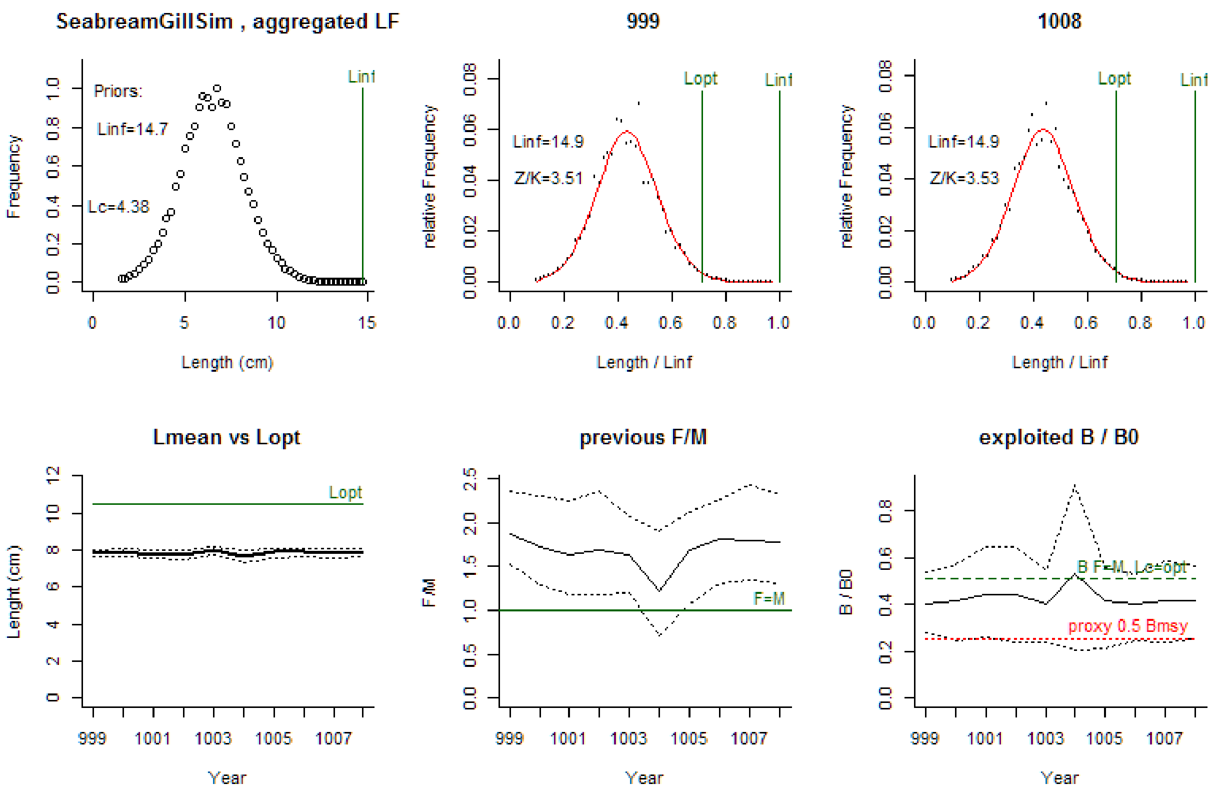
Linf prior = 118, s.d. = 1.18 (cm)
Z/K prior = 2.84, s.d. = 0.162, M/K prior = 1.5, s.d. = 0.15
F/K prior = 1.34 (wide range with tau=4 in log-normal distribution)
Lc prior = 34.2, s.d. = 3.42 (cm), alpha prior = 75.6, s.d. = 7.56
General reference points:
Linf = 122 (120–124) cm
Lopt = 80 cm, Lopt/Linf = 0.65
Lc_opt = 67 cm, Lc_opt/Linf = 0.55
M/K = 1.59 (1.35–1.97)
F/K = 1.66 (1.29–2.01)
Z/K = 3.27 (3.11–3.42)
F/M = 1.04 (0.664–1.46)
B/B0 F=M Lc=Lc_opt = 0.364
B/B0 = 0.24 (0.131–0.363)
Y/R' F=M Lc=Lc_opt = 0.0419
Y/R' = 0.0334 (0.0183–0.0504) (linearly reduced if B/B0 < 0.25)
Estimates for last year 999:
Lc = 32.8 (32.6–32.9) cm, Lc/Linf = 0.27 (0.267–0.27)
alpha = 74 (71.5–76.6)
Lmean/Lopt = 0.63, Lc/Lc_opt = 0.49, L95th = 118 cm, L95th/Linf = 0.96, Lm50 = NA cm, Mature = NA%
F/K = 1.7 (1.29–2.01)
F/M = 1 (0.664–1.46)
Z/K = 3.27 (3.11–3.42)
Y/R' = 0.033 (0.0183–0.0504) (linearly reduced if B/B0 < 0.25)
B/B0 = 0.24 (0.131–0.363)
B/Bmsy = 0.66 (0.361–0.998)
Comment: Linf=120, Lc=35, alpha=60, M/K=1.54, F/K=1.54, F/M=1, Z/K=3.08, B/B0=0.277, Y/R=0.0377



3) Simulations with Gaussian selection (True values in Comment, Sim_23.xlsx, LBB_10.R)

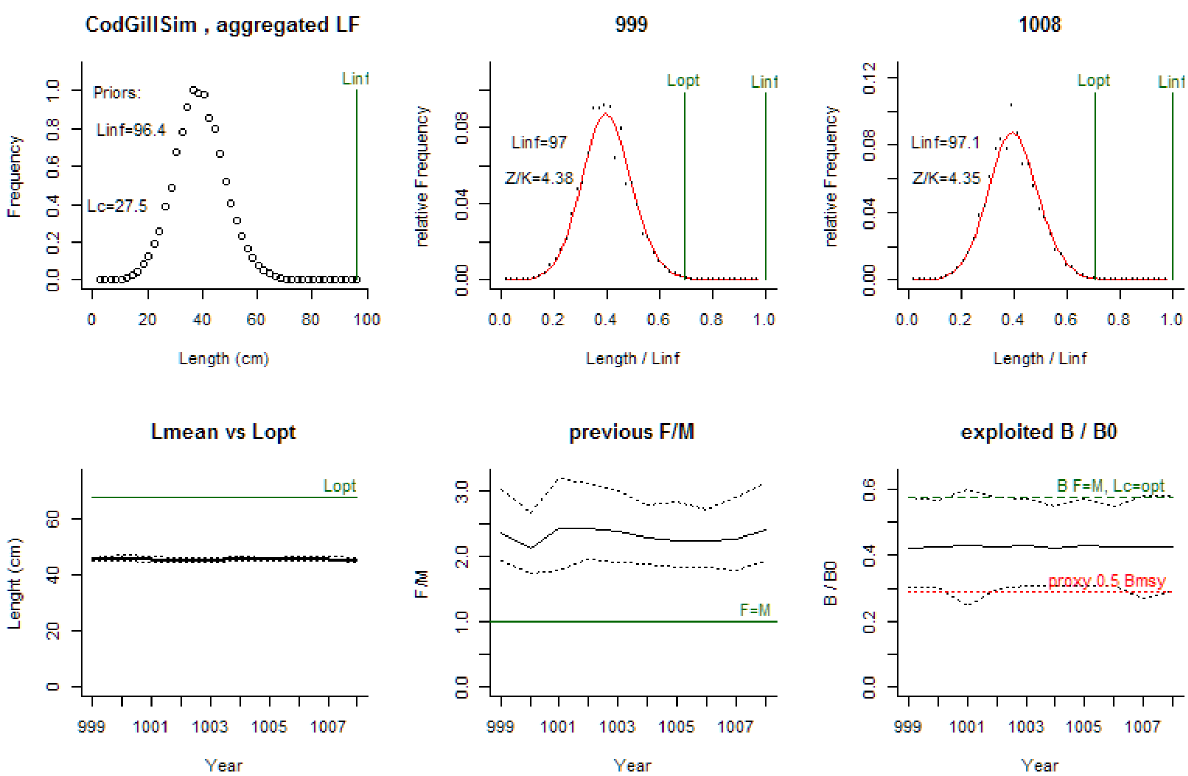
Results for overexploited seabream, stock SeabreamGillSim, 999–1008, Gaussian selection
(95% confidence limits in parentheses) File: SimDat_10.csv

Linf prior = 14.7, s.d. = 0.147 (cm)
Z/K prior = 3.92, s.d. = 0.791 , M/K prior = 1.5, s.d. = 0.15
General reference points [median across years]:
Linf = 14.9 (14.7–15.2) cm
Lopt = 10 cm, Lopt/Linf = 0.7
Lc_opt = 9.2 cm, Lc_opt/Linf = 0.62
M/K = 1.26 (0.994–1.52)
F/K = 2.23 (1.72–2.41)
Z/K = 3.49 (2.94–3.79)
F/M = 1.71 (1.25–2.28)
B/B0 F=M Lmean=Lopt= 0.508
B/B0 = 0.413 (0.242–0.568)
Y/R' F=M Lmean=Lopt= 0.0524
Y/R' = 0.0411 (0.0236–0.0573) (linearly reduced if B/B0 < 0.25)
Estimates for last year 1008:
GLmean/Linf= 0.53, s.d./Linf = 0.131
GLmean = 7.88, s.d. = 1.95
F/K = 2.3 (1.83–2.42)
F/M = 1.8 (1.32–2.31)
Z/K = 3.51 (3.06–3.8)
Y/R' = 0.042 (0.0256–0.0567) (linearly reduced if B/B0 < 0.25)
B/B0 = 0.41 (0.254–0.564)
B/Bmsy = 0.81 (0.5–1.11)
Comment: Linf=15, GLmean=8, s.d. =2, M/K=1.25, F/K=2.5, F/M=2, Z/K=3.75, B/B0=0.372, Y/R=0.0433.



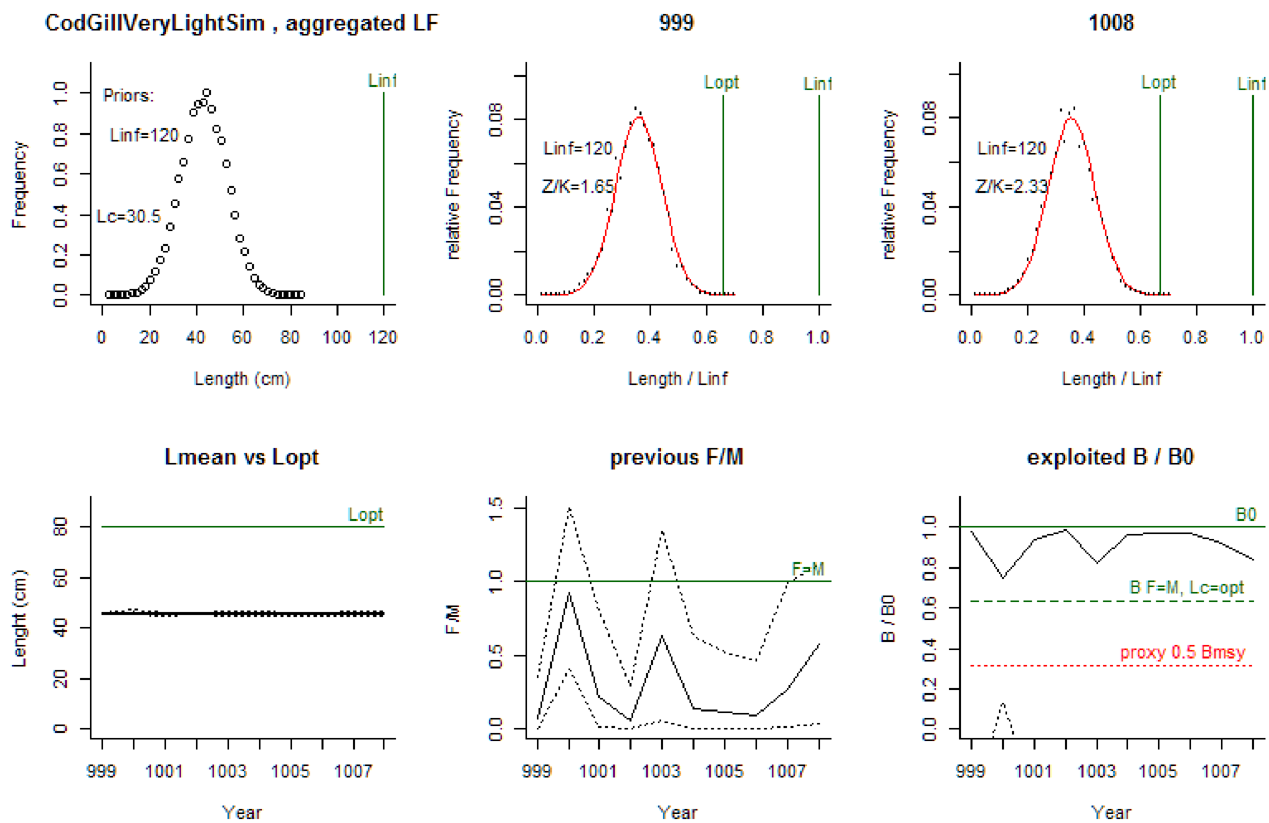
Results for overexploited cod, stock **CodGillSim**, 999–1008, Gaussian selection
(95% confidence limits in parentheses) File: SimDat_10.csv

Linf prior = 96.4, s.d. = 0.964 (cm)
Z/K prior = 4.65, s.d. = 2.1, M/K prior = 1.5, s.d. = 0.15
General reference points [median across years]:
Linf = 97.1 (95.5–98.8) cm
Lopt = 68 cm, Lopt/Linf = 0.7
Lc_opt = 61 cm, Lc_opt/Linf = 0.63
M/K = 1.31 (1.04–1.6)
F/K = 3.08 (2.77–3.15)
Z/K = 4.36 (3.99–4.67)
F/M = 2.32 (1.86–2.94)
B/B0 F=M Lmean=Lopt= 0.574
B/B0 = 0.424 (0.302–0.572)
Y/R' F=M Lmean=Lopt= 0.0461
Y/R' = 0.0321 (0.0226–0.043) (linearly reduced if B/B0 < 0.25)
Estimates for last year 1008:
GLmean/Linf= 0.46, s.d./Linf = 0.105
GLmean = 45.1, s.d. = 10.2
F/K = 3.1 (2.83–3.15)
F/M = 2.4 (1.93–3.11)
Z/K = 4.32 (3.98–4.63)
Y/R' = 0.032 (0.0225–0.0443) (linearly reduced if B/B0 < 0.25)
B/B0 = 0.42 (0.293–0.578)
B/Bmsy = 0.74 (0.51 –1.01)
Comment: Linf=120, GLmean=45, s.d. =10, M/K=1.54, F/K=4.62, F/M=3, Z/K=6.15, B/B0=0.418, Y/R=0.0181.



Results for very lightly exploited cod, stock **CodGillVeryLightSim**, 999–1008, Gaussian selection
(95% confidence limits in parentheses) File: SimDat_10.csv

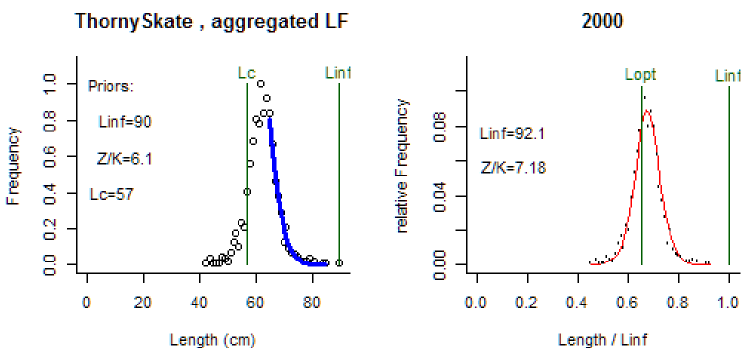
Linf prior = 120, s.d. = 1.2 (cm) (user-defined)
Z/K prior = 3.63, s.d. = 0.857 , M/K prior = 1.5, s.d. = 0.15
General reference points [median across years]:
Linf = 120 (118–122) cm, Prior 120 set by user
Lopt = 80 cm, Lopt/Linf = 0.67
Lc_opt = 57 cm, Lc_opt/Linf = 0.48
M/K = 1.51 (1.22–1.81)
F/K = 0.267 (0.0159–1.05)
Z/K = 1.79 (1.36–2.56)
F/M = 0.177 (0.0102–0.718)
B/B0 F=M Lmean=Lopt= 0.635
B/B0 = 0.945 (–0.329–5.08)
Y/R' F=M Lmean=Lopt= 0.0337
Y/R' = 0.0025 (–0.00069–0.0132) (linearly reduced if B/B0 < 0.25)
Estimates for last year 1008:
GLmean/Linf= 0.38, s.d./Linf = 0.0849
GLmean = 45.6, s.d. = 10.2
F/K = 0.85 (0.05–1.59)
F/M = 0.58 (0.0374–1.11)
Z/K = 2.35 (1.43–3.12)
Y/R' = 0.0073 (–0.00249–0.0167) (linearly reduced if B/B0 < 0.25)
B/B0 = 0.84 (–0.285–1.91)
B/Bmsy = 1.3 (–0.449–3.01)
Comment: Linf=120, GLmean=45, s.d. =10, M/K=1.54, F/K=0.0077, F/M=0.005, Z/K=1.55, B/B0=0.99, Y/R=0.00007.



4) Empirical data from the Northwest Atlantic (Independent assessments in Comment; LBB_10.R)

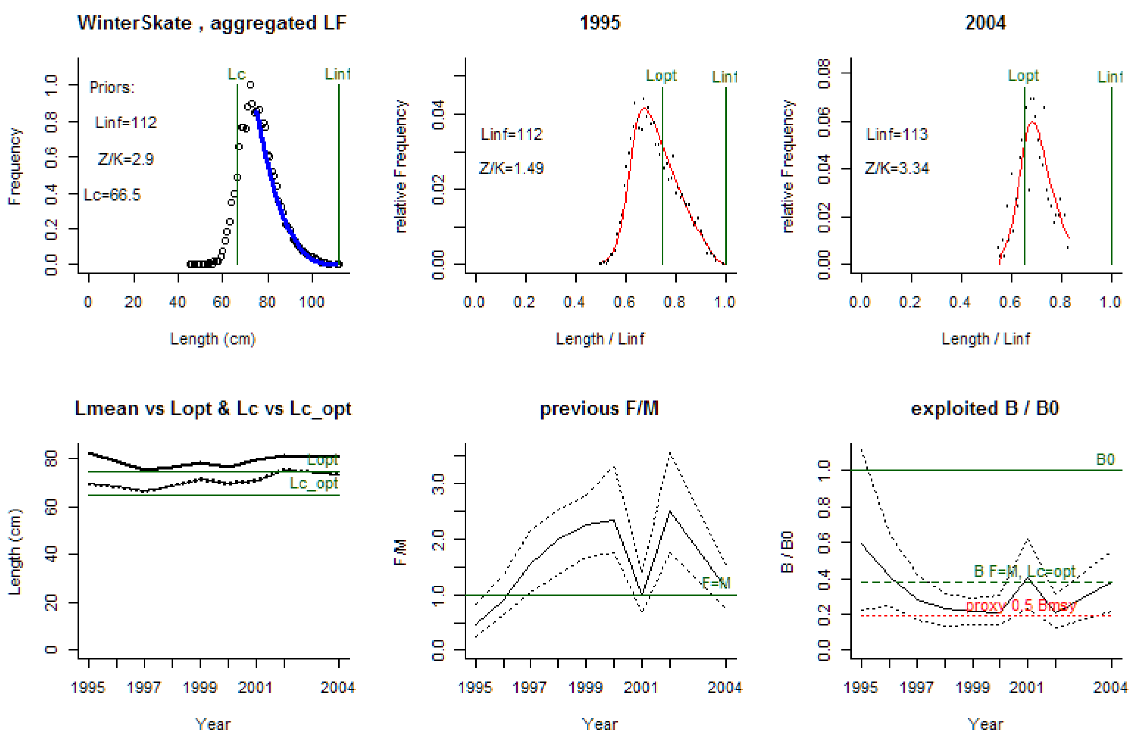
Results for *Amblyraja radiata*, stock **ThornySkate**, 2000–2000
(95% confidence limits in parentheses) File: ComDat_1.csv

Linf prior = 90, s.d. = 0.9 (cm)
Z/K prior = 6.08, s.d. = 3.8 , M/K prior = 1.5, s.d. = 0.15
F/K prior = 4.58 (wide range with tau=4 in log-normal distribution)
Lc prior = 58.1, s.d. = 5.81 (cm), alpha prior = 37, s.d. = 3.7
General reference points [median across years]:
Linf = 92.1 (90.8–93.6) cm
Lopt = 60 cm, Lopt/Linf = 0.65
Lc_opt = 56 cm, Lc_opt/Linf = 0.61
M/K = 1.58 (1.36–1.91)
F/K = 5.6 (4.76–6.27)
Z/K = 7.17 (6.41–7.84)
F/M = 3.56 (2.77–4.51)
B/B0 F=M Lc=Lc_opt = 0.367
B/B0 = 0.153 (0.107–0.208)
Y/R' F=M Lc=Lc_opt = 0.042
Y/R' = 0.0299 (0.0208–0.0406) (linearly reduced if B/B0 < 0.25)
Estimates for last year 2000:
Lc = 61.5 (61.2–61.9) cm, Lc/Linf = 0.67 (0.665–0.672)
alpha = 36.6 (35.6–37.7)
Lmean/Lopt = 1.1, Lc/Lc_opt = 1.1, L95th = 85 cm, L95th/Linf = 0.92, Lm50 = 53 cm, Mature = 95%
F/K = 5.6 (4.76–6.27)
F/M = 3.5 (2.77–4.51)
Z/K = 7.17 (6.41–7.84)
Y/R' = 0.03 (0.0208–0.0406) (linearly reduced if B/B0 < 0.25)
B/B0 = 0.15 (0.107–0.208)
B/Bmsy = 0.42 (0.291–0.567)
Comment: Qualitative assessment suggests high exploitation and low biomass DFO (2003,2017a).



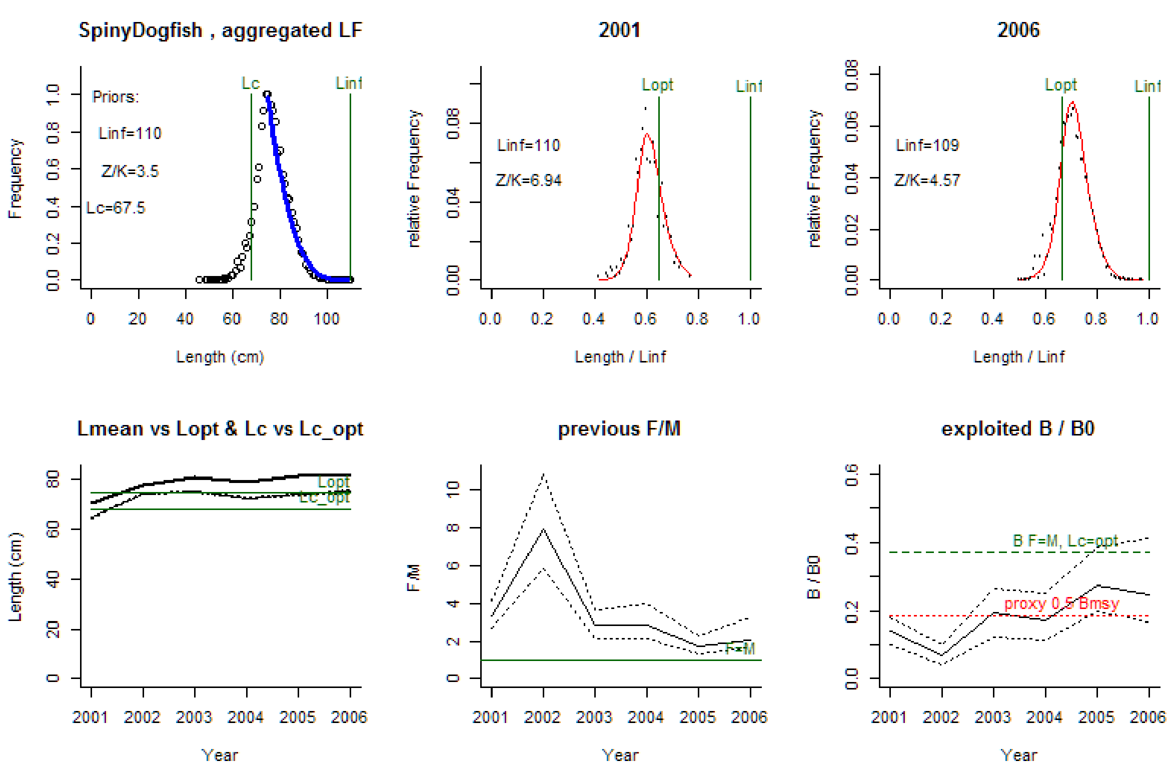
Results for *Leucoraja ocellata*, stock **WinterSkate**, 1995–2004
(95% confidence limits in parentheses) File: ComDat_1.csv

Linf prior = 112, s.d. = 1.12 (cm)
Z/K prior = 2.93, s.d. = 0.483 , M/K prior = 1.5, s.d. = 0.15
F/K prior = 1.43 (wide range with tau=4 in log-normal distribution)
Lc prior = 67.8, s.d. = 6.78 (cm), alpha prior = 38.6, s.d. = 3.86
General reference points [median across years]:
Linf = 112 (110–113) cm
Lopt = 75 cm, Lopt/Linf = 0.67
Lc_opt = 65 cm, Lc_opt/Linf = 0.58
M/K = 1.49 (1.25–1.76)
F/K = 2.15 (1.77–2.59)
Z/K = 3.59 (3.29–3.96)
F/M = 1.55 (1.05–2.15)
B/B0 F=M Lc=Lc_opt = 0.376
B/B0 = 0.281 (0.164–0.422)
Y/R' F=M Lc=Lc_opt = 0.0461
Y/R' = 0.0436 (0.0279–0.0663) (linearly reduced if B/B0 < 0.25)
Estimates for last year 2004:
Lc = 73.7 (73.3–74.1) cm, Lc/Linf = 0.65 (0.651–0.658)
alpha = 37.2 (35.7–38.7)
Lmean/Lopt = 1.1, Lc/Lc_opt = 1.1, L95th = 93 cm, L95th/Linf = 0.83, Lm50 = 75 cm, Mature = 63%
F/K = 1.8 (1.4–2.11)
F/M = 1.1 (0.761–1.55)
Z/K = 3.32 (2.99–3.64)
Y/R' = 0.04 (0.0224–0.0578) (linearly reduced if B/B0 < 0.25)
B/B0 = 0.38 (0.213–0.55)
B/Bmsy = 1 (0.567–1.46)
Comment: DFO (2017b)



Results for *Squalus acanthias*, stock **SpinyDogfish**, 2001–2006
(95% confidence limits in parentheses) File: ComDat_1.csv

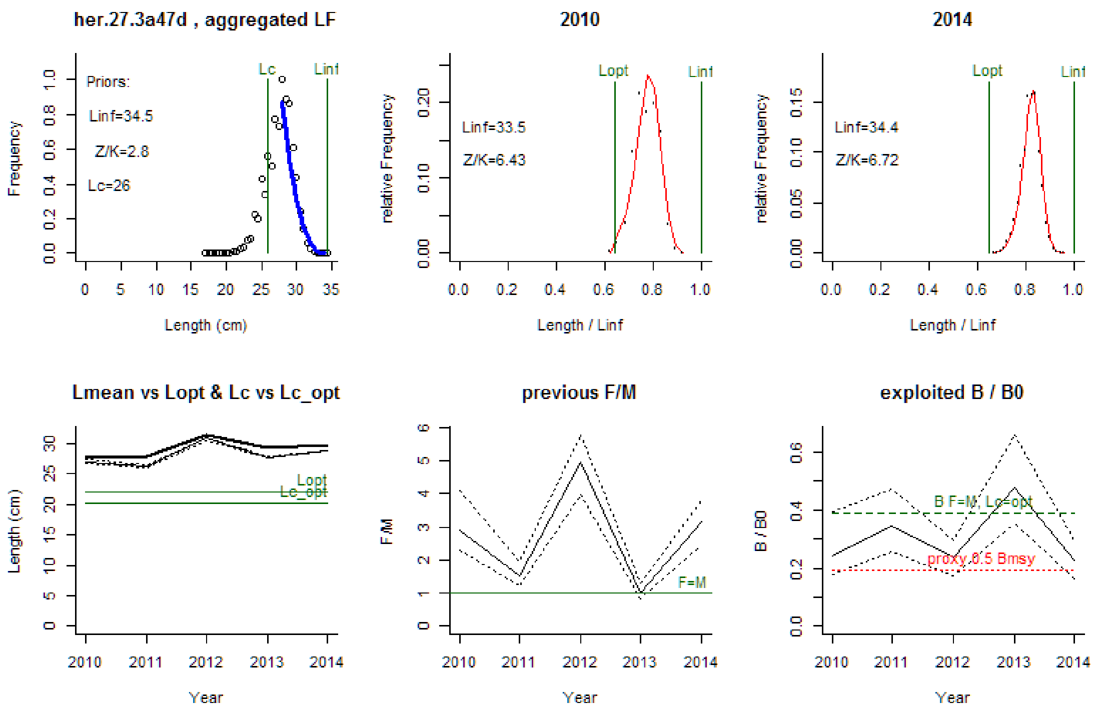
Linf prior = 110, s.d. = 1.1 (cm)
Z/K prior = 3.48, s.d. = 0.714 , M/K prior = 1.5, s.d. = 0.15
F/K prior = 1.98 (wide range with tau=4 in log-normal distribution)
Lc prior = 68.8, s.d. = 6.88 (cm), alpha prior = 39.7, s.d. = 3.97
General reference points [median across years]:
Linf = 110 (108–111) cm
Lopt = 74 cm, Lopt/Linf = 0.68
Lc_opt = 68 cm, Lc_opt/Linf = 0.62
M/K = 1.43 (1.15–1.7)
F/K = 4.05 (3.41–4.6)
Z/K = 5.44 (4.9–5.9)
F/M = 2.87 (2.15–3.84)
B/B0 F=M Lc=Lc_opt = 0.37
B/B0 = 0.182 (0.117–0.257)
Y/R' F=M Lc=Lc_opt = 0.0495
Y/R' = 0.0417 (0.0268–0.059) (linearly reduced if B/B0 < 0.25)
Estimates for last year 2006:
Lc = 74.8 (74.5–75.3) cm, Lc/Linf = 0.68 (0.68–0.687)
alpha = 39.3 (37.8–40.6)
Lmean/Lopt = 1.1, Lc/Lc_opt = 1.1, L95th = 107 cm, L95th/Linf = 0.98, Lm50 = 82.1 cm, Mature = 23%
F/K = 3.1 (2.75–3.79)
F/M = 2 (1.61–3.23)
Z/K = 4.56 (4.29–5.08)
Y/R' = 0.048 (0.0323–0.0803) (linearly reduced if B/B0 < 0.25)
B/B0 = 0.25 (0.166–0.413)
B/Bmsy = 0.67 (0.449–1.12)
Comment: DFO (2014); Fowler and Campana (2015). Lm50 from Campana *et al*. (2009)



5) Empirical data from the North Sea (Independent assessments in Comment; LBB_11.R)

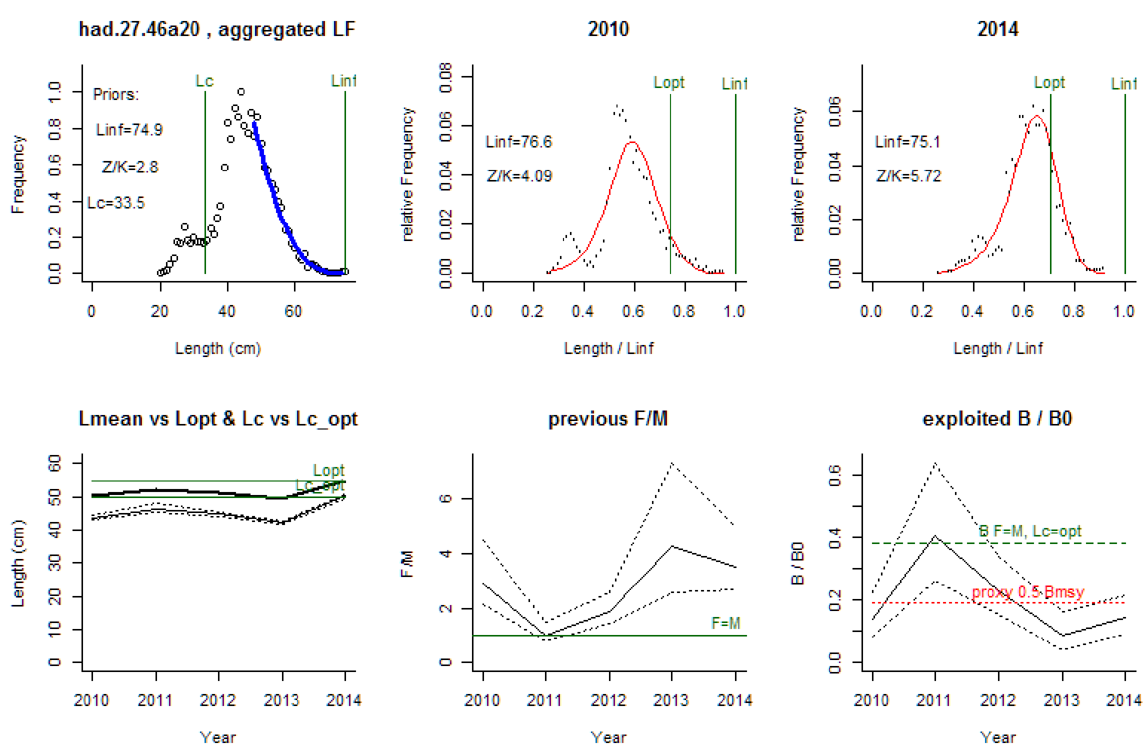
Results for *Clupea harengus*, stock **her.27.3a47d**, 2010–2014
(95% confidence limits in parentheses) File: ComDat_1.csv

Linf prior = 34.5, s.d. = 0.345 (cm)
Z/K prior = 2.78, s.d. = 1.54 , M/K prior = 1.75, s.d = 0.075 (user-defined)
F/K prior = 1.03 (wide range with tau=4 in log-normal distribution)
Lc prior = 26.5, s.d. = 2.65 (cm), alpha prior = 37, s.d = 3.7
General reference points [median across years]:
Linf = 34.4 (34.1–34.9) cm
Lopt = 22 cm, Lopt/Linf = 0.64
Lc_opt = 20 cm, Lc_opt/Linf = 0.59
M/K = 1.68 (1.55–1.84)
F/K = 4.76 (4–5.99)
Z/K = 6.42 (5.76–7.6)
F/M = 2.89 (2.28–3.81)
B/B0 F=M Lc=Lc_opt = 0.39
B/B0 = 0.243 (0.176–0.395)
Y/R' F=M Lc=Lc_opt = 0.0363
Y/R' = 0.0255 (0.018–0.0328) (linearly reduced if B/B0 < 0.25)
Estimates for last year 2014:
Lc = 28.7 (28.6–28.8) cm, Lc/Linf = 0.83 (0.831–0.837)
alpha = 43 (42.1–43.9)
Lmean/Lopt = 1.3, Lc/Lc_opt = 1.4, L95th = 33 cm, L95th/Linf = 0.96, Lm50 = 24.1 cm, Mature = 100%
F/K = 5.1 (4.14–5.99)
F/M = 3.1 (2.47–3.81)
Z/K = 6.68 (5.76–7.6)
Y/R' = 0.026 (0.018–0.0328) (linearly reduced if B/B0 < 0.25)
B/B0 = 0.23 (0.162–0.295)
B/Bmsy = 0.59 (0.414–0.756)
Comment: Gear=OTM_SPF_32–69_0_0. ICES 2014 F/Fmsy=0.67 (0.54–0.82), proxy B/Bmsy=0.65 (0.57–0.75). Lm50 from Froese and Sampang (2013)



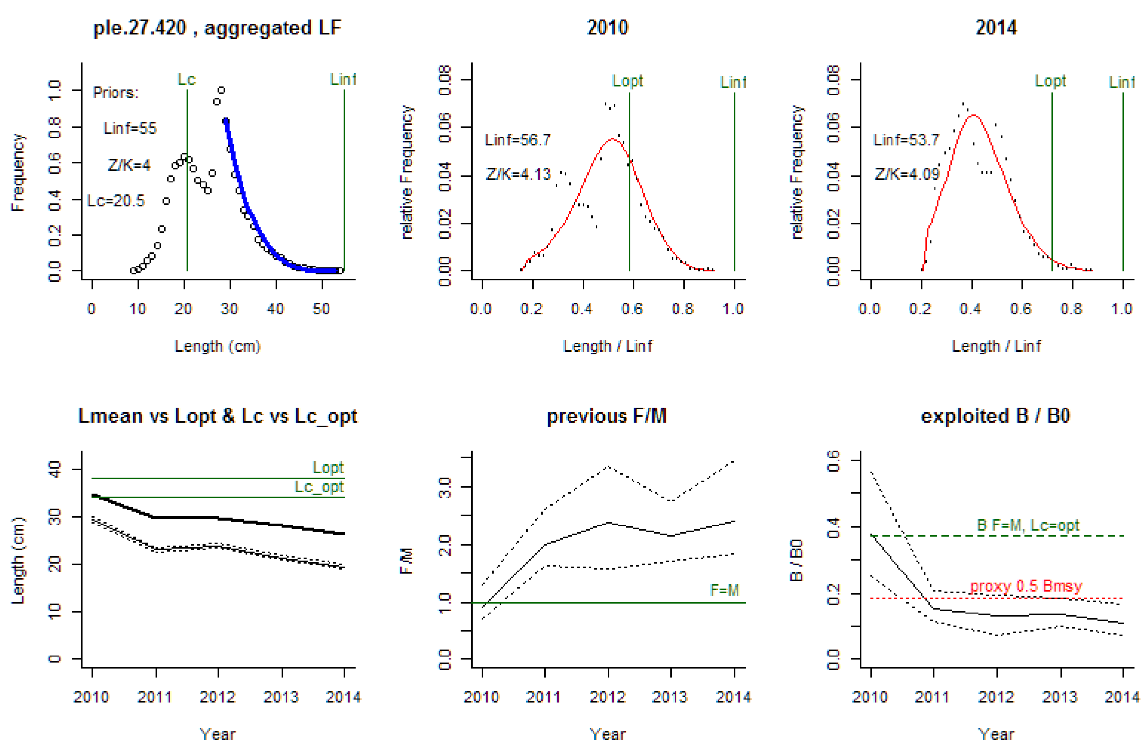
Results for *Melanogrammus aeglefinus*, stock **had.27.46a20**, 2010–2014
(95% confidence limits in parentheses) File: ComDat_1.csv

Linf prior = 74.9, s.d. = 0.749 (cm)
Z/K prior = 2.82, s.d. = 0.696 , M/K prior = 1.5, s.d. = 0.15
F/K prior = 1.32 (wide range with tau=4 in log-normal distribution)
Lc prior = 34.2, s.d. = 3.42 (cm), alpha prior = 14.7, s.d. = 1.47
General reference points [median across years]:
Linf = 75.4 (74.7–76.4) cm
Lopt = 55 cm, Lopt/Linf = 0.73
Lc_opt = 50 cm, Lc_opt/Linf = 0.66
M/K = 1.14 (0.927–1.41)
F/K = 3.05 (2.66–3.44)
Z/K = 4.08 (3.81–4.46)
F/M = 2.9 (2.13–4.47)
B/B0 F=M Lc=Lc_opt = 0.382
B/B0 = 0.146 (0.0941–0.227)
Y/R' F=M Lc=Lc_opt = 0.0671
Y/R' = 0.0429 (0.0263–0.0769) (linearly reduced if B/B0 < 0.25)
Estimates for last year 2014:
Lc = 50.3 (49.6–50.9) cm, Lc/Linf = 0.67 (0.661–0.679)
alpha = 16.2 (15.7–16.6)
Lmean/Lopt = 1, Lc/Lc_opt = 1, L95th = 69 cm, L95th/Linf = 0.92, Lm50 = 33 cm, Mature = 93%
F/K = 4.5 (3.64–5.11)
F/M = 3.6 (2.7–4.93)
Z/K = 5.68 (4.9–6.27)
Y/R' = 0.041 (0.0263–0.0597) (linearly reduced if B/B0 < 0.25)
B/B0 = 0.15 (0.0941–0.214)
B/Bmsy = 0.38 (0.247–0.56)
Comment: Gear=OTB_DEF_>=120_0_0; ICES (2014) F/Fmsy=1.55 (1.24–1.91), proxy SSB/Bmsy=0.69 (0.60–0.77).



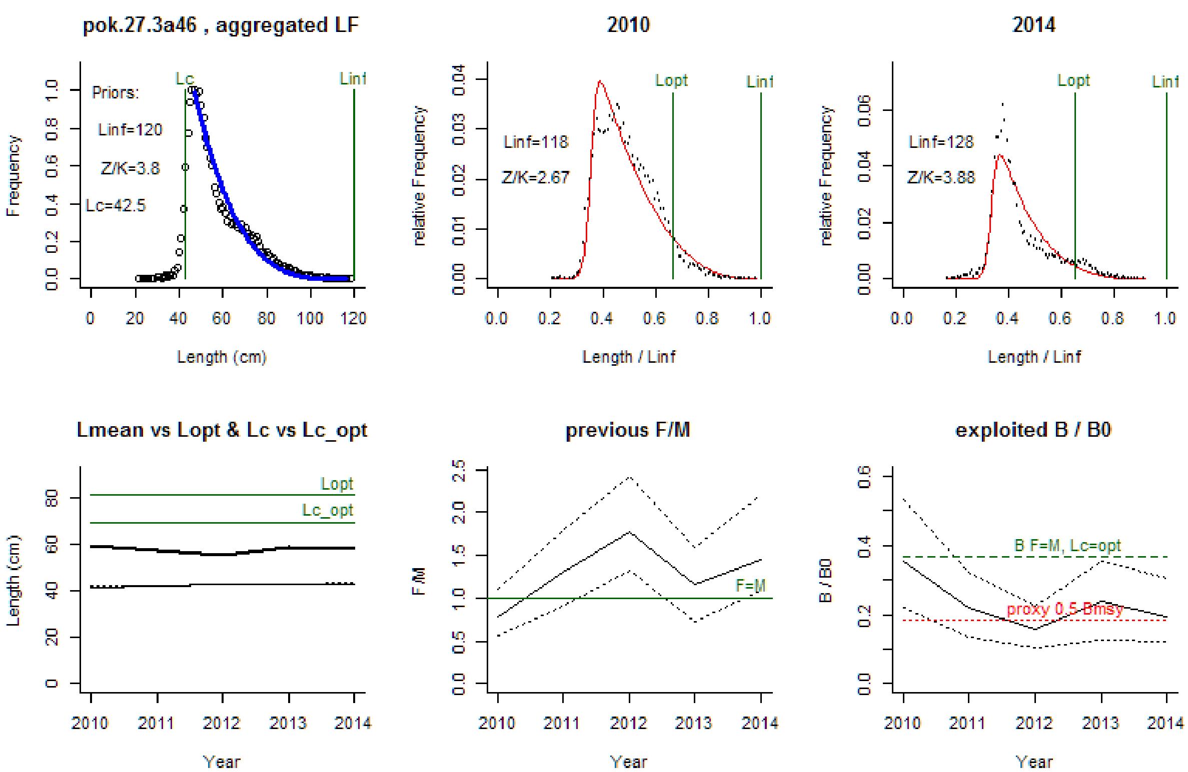
Results for *Pleuronectes platessa*, stock **ple.27.420**, 2010–2014
(95% confidence limits in parentheses) File: ComDat_1.csv

Linf prior = 55, s.d. = 0.55 (cm) (user-defined)
Z/K prior = 4.05, s.d. = 0.107 , M/K prior = 1.5, s.d. = 0.15
F/K prior = 2.55 (wide range with tau=4 in log-normal distribution)
Lc prior = 20.9, s.d. = 2.09 (cm), alpha prior = 14.7, s.d. = 1.47
General reference points [median across years]:
Linf = 55.6 (54.6–56.5) cm
Lopt = 38 cm, Lopt/Linf = 0.68
Lc_opt = 34 cm, Lc_opt/Linf = 0.61
M/K = 1.38 (1.16–1.63)
F/K = 2.9 (2.52–3.32)
Z/K = 4.12 (3.88–4.49)
F/M = 2.14 (1.62–2.74)
B/B0 F=M Lc=Lc_opt = 0.37
B/B0 = 0.135 (0.0981–0.192)
Y/R' F=M Lc=Lc_opt = 0.0506
Y/R' = 0.0251 (0.0152–0.0356) (linearly reduced if B/B0 < 0.25)
Estimates for last year 2014:
Lc = 19.5 (19–20.1) cm, Lc/Linf = 0.36 (0.354–0.374)
alpha = 16.4 (15.7–17)
Lmean/Lopt = 0.69, Lc/Lc_opt = 0.57, L95th = 47 cm, L95th/Linf = 0.87, Lm50 = 22.1 cm, Mature = 49%
F/K = 2.9 (2.52–3.36)
F/M = 2.4 (1.84–3.46)
Z/K = 4.11 (3.78–4.49)
Y/R' = 0.023 (0.0152–0.0356) (linearly reduced if B/B0 < 0.25)
B/B0 = 0.11 (0.0718–0.168)
B/Bmsy = 0.3 (0.194–0.455)
Comment: TBB_DEF_70–99_0_0; ICES (2014) F/Fmsy=0.95 (0.81–1.1), proxy SSB/Bmsy=1.4 (1.2–1.6). Lm50 from Froese and Sampang (2013)



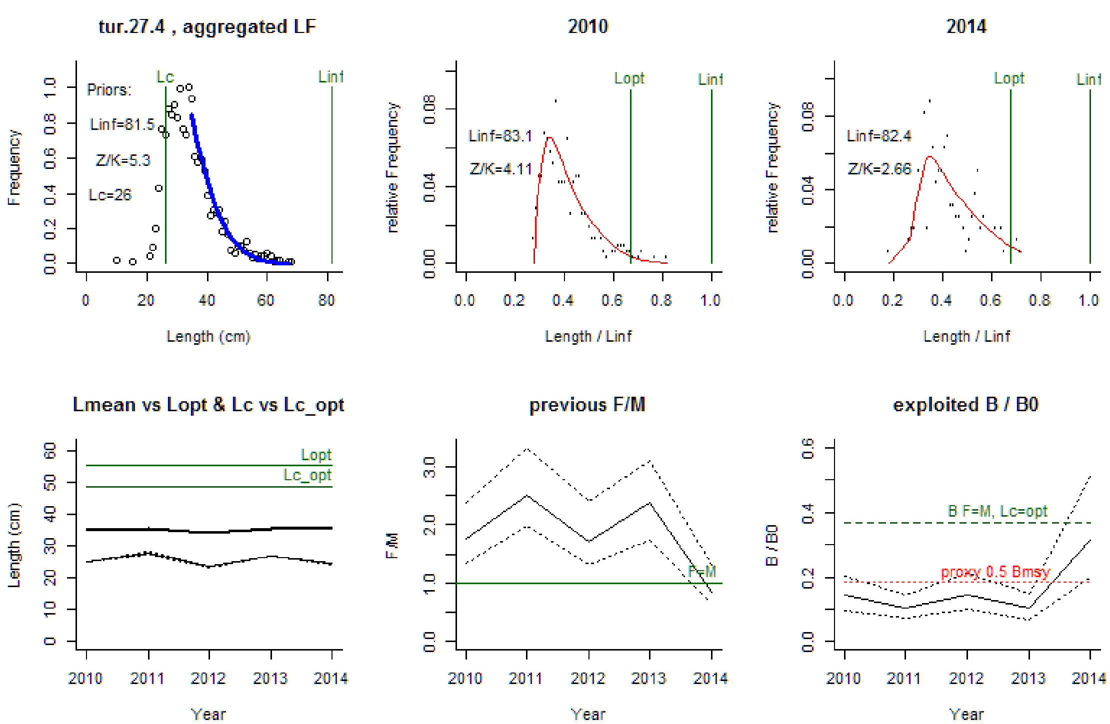
Results for *Pollachius virens*, stock **pok.27.3a46**, 2010–2014
(95% confidence limits in parentheses) File: ComDat_1.csv

Linf prior = 120, s.d. = 1.2 (cm) (user-defined)
Z/K prior = 3.78, s.d. = 0.106 , M/K prior = 1.5, s.d. = 0.15
F/K prior = 2.28 (wide range with tau=4 in log-normal distribution)
Lc prior = 43.4, s.d. = 4.33 (cm), alpha prior = 94.8, s.d. = 9.48
General reference points [median across years]:
Linf = 122 (120–124) cm
Lopt = 82 cm, Lopt/Linf = 0.67
Lc_opt = 70 cm, Lc_opt/Linf = 0.57
M/K = 1.5 (1.24–1.76)
F/K = 1.91 (1.55–2.24)
Z/K = 3.35 (3.23–3.5)
F/M = 1.31 (0.91–1.8)
B/B0 F=M Lc=Lc_opt = 0.367
B/B0 = 0.222 (0.128–0.321)
Y/R' F=M Lc=Lc_opt = 0.0462
Y/R' = 0.0393 (0.021–0.0574) (linearly reduced if B/B0 < 0.25)
Estimates for last year 2014:
Lc = 43.2 (43–43.4) cm, Lc/Linf = 0.34 (0.335–0.338)
alpha = 86.9 (83.2–91.6)
Lmean/Lopt = 0.7, Lc/Lc_opt = 0.62, L95th = 118 cm, L95th/Linf = 0.92, Lm50 = 55 cm, Mature = 39%
F/K = 2.3 (2.02–2.67)
F/M = 1.4 (1.09–2.2)
Z/K = 3.87 (3.7–4.06)
Y/R' = 0.03 (0.0189–0.0466) (linearly reduced if B/B0 < 0.25)
B/B0 = 0.19 (0.123–0.304)
B/Bmsy = 0.53 (0.336–0.83)
Comment: OTB_DEF_>=120_0_0. ICES (2014) F/Fmsy=0.89 (0.64–1.2), proxy SSB/Bmsy=0.69 (0.55–0.88). Lm50 from FishBase.



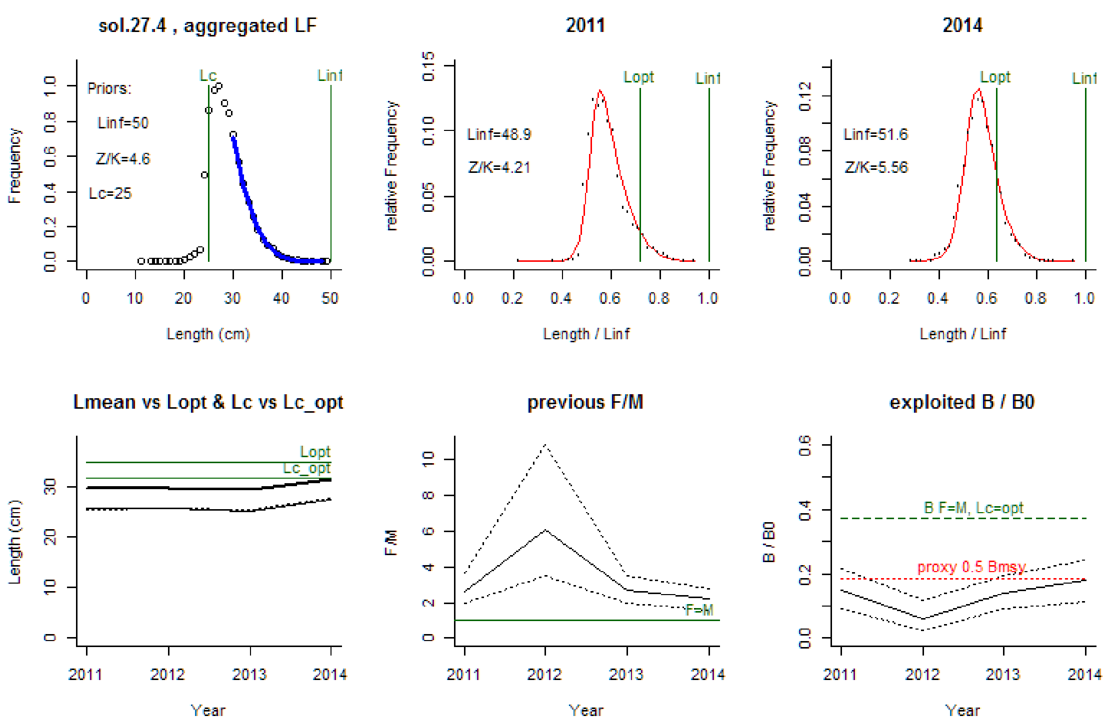
Results for *Scophthalmus maximus*, stock **tur.27.4**, 2010–2014
(95% confidence limits in parentheses) File: ComDat_1.csv

Linf prior = 81.5, s.d. = 0.815 (cm)
Z/K prior = 5.25, s.d. = 3.37 , M/K prior = 1.5, s.d. = 0.15
F/K prior = 3.75 (wide range with tau=4 in log-normal distribution)
Lc prior = 26.5, s.d. = 2.65 (cm), alpha prior = 52.9, s.d. = 5.29
General reference points [median across years]:
Linf = 82.6 (81.1–84) cm
Lopt = 55 cm, Lopt/Linf = 0.67
Lc_opt = 49 cm, Lc_opt/Linf = 0.59
M/K = 1.47 (1.2–1.74)
F/K = 2.63 (2.31–3)
Z/K = 4.12 (3.87–4.32)
F/M = 1.76 (1.34–2.4)
B/B0 F=M Lc=Lc_opt = 0.368
B/B0 = 0.143 (0.0977–0.203)
Y/R' F=M Lc=Lc_opt = 0.0473
Y/R' = 0.0221 (0.015–0.0315) (linearly reduced if B/B0 < 0.25)
Estimates for last year 2014:
Lc = 24.5 (24.4–24.7) cm, Lc/Linf = 0.3 (0.296–0.3)
alpha = 54.1 (51.1–56.2)
Lmean/Lopt = 0.64, Lc/Lc_opt = 0.5, L95th = 59 cm, L95th/Linf = 0.72, Lm50 = 28 cm, Mature = 79%
F/K = 1.2 (0.986–1.53)
F/M = 0.84 (0.65–1.32)
Z/K = 2.65 (2.47–2.81)
Y/R' = 0.042 (0.0263–0.0677) (linearly reduced if B/B0 < 0.25)
B/B0 = 0.31 (0.198–0.511)
B/Bmsy = 0.85 (0.539–1.39)
Comment: Gear=TBB_DEF_70–99_0_0; ICES (2014) F/Fmsy=0.63 (0.48–0.84), SSB/Bmsy=1.18 (0.87–1.61). Lm50 from Froese and Sampang (2013)



Results for *Solea solea*, stock **sol.27.4**, 2011–2014
(95% confidence limits in parentheses) File: ComDat_1.csv

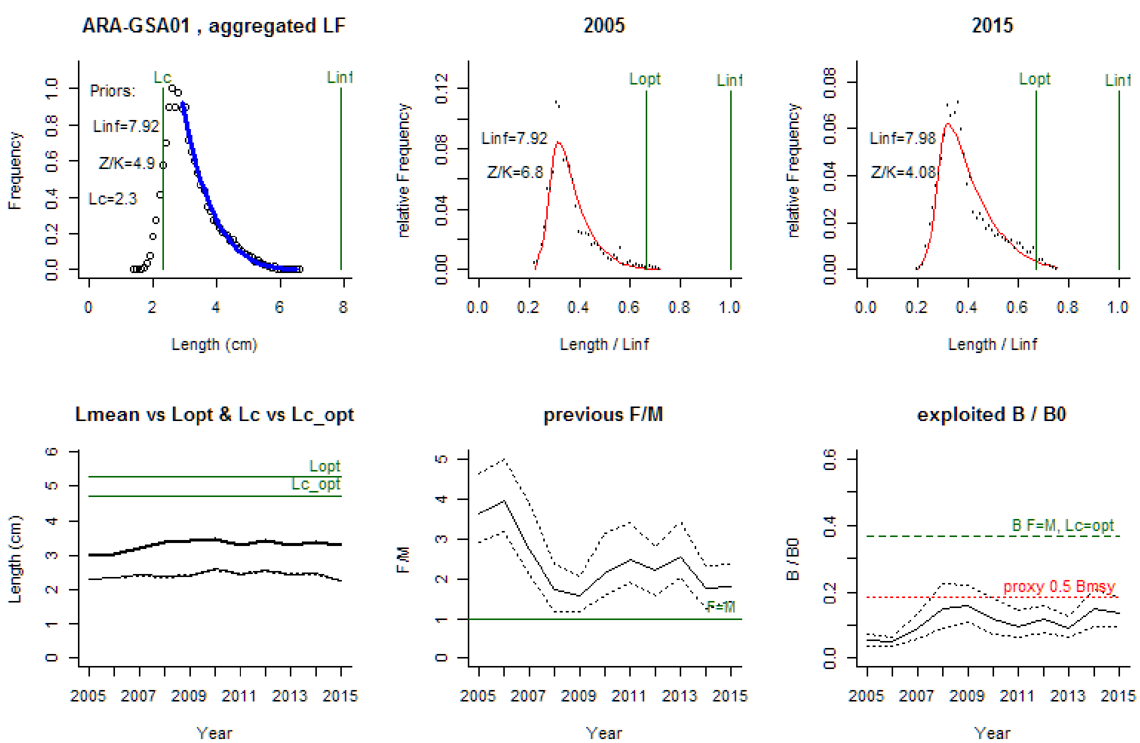
Linf prior = 50, s.d. = 0.5 (cm) (user-defined)
Z/K prior = 4.62, s.d. = 0.0379, M/K prior = 1.5, s.d. = 0.15
F/K prior = 3.12 (wide range with tau=4 in log-normal distribution)
Lc prior = 25.5, s.d. = 2.55 (cm), alpha prior= 65, s.d. = 6.5
General reference points [median across years]:
Linf = 49.5 (48.7–50.2) cm
Lopt = 35 cm, Lopt/Linf = 0.7
Lc_opt = 32 cm, Lc_opt/Linf = 0.64
M/K = 1.27 (1.01–1.56)
F/K = 3.6 (3.1–3.97)
Z/K = 4.65 (4.37–4.9)
F/M = 2.65 (1.94–3.59)
B/B0 F=M Lc=Lc_opt = 0.371
B/B0 = 0.143 (0.0913–0.205)
Y/R' F=M Lc=Lc_opt = 0.058
Y/R' = 0.0332 (0.0202–0.0534) (linearly reduced if B/B0 < 0.25)
Estimates for last year 2014:
Lc = 27.5 (27.3–27.7) cm, Lc/Linf = 0.53 (0.53–0.537)
alpha = 36.8 (35.1–37.9)
Lmean/Lopt = 0.95, Lc/Lc_opt = 0.87, L95th = 49 cm, L95th/Linf = 0.95, Lm50 = 18.8 cm, Mature = 100%
F/K = 3.9 (3.21–4.21)
F/M = 2.3 (1.56–2.73)
Z/K = 5.57 (5.17–5.88)
Y/R' = 0.031 (0.0194–0.0406) (linearly reduced if B/B0 < 0.25)
B/B0 = 0.18 (0.115–0.241)
B/Bmsy = 0.49 (0.31–0.649)
Comment: Gear=TBB_DEF_70–99_0_0; ICES (2014) F/Fmsy=1.5 (1.15–1.8), proxy SSB/Bmsy=0.57 (0.46–0.69). Lm50 from Froese and Sampang (2013)



6) Empirical data from the Mediterranean (Independent assessments in Comment; LBB_11.R)

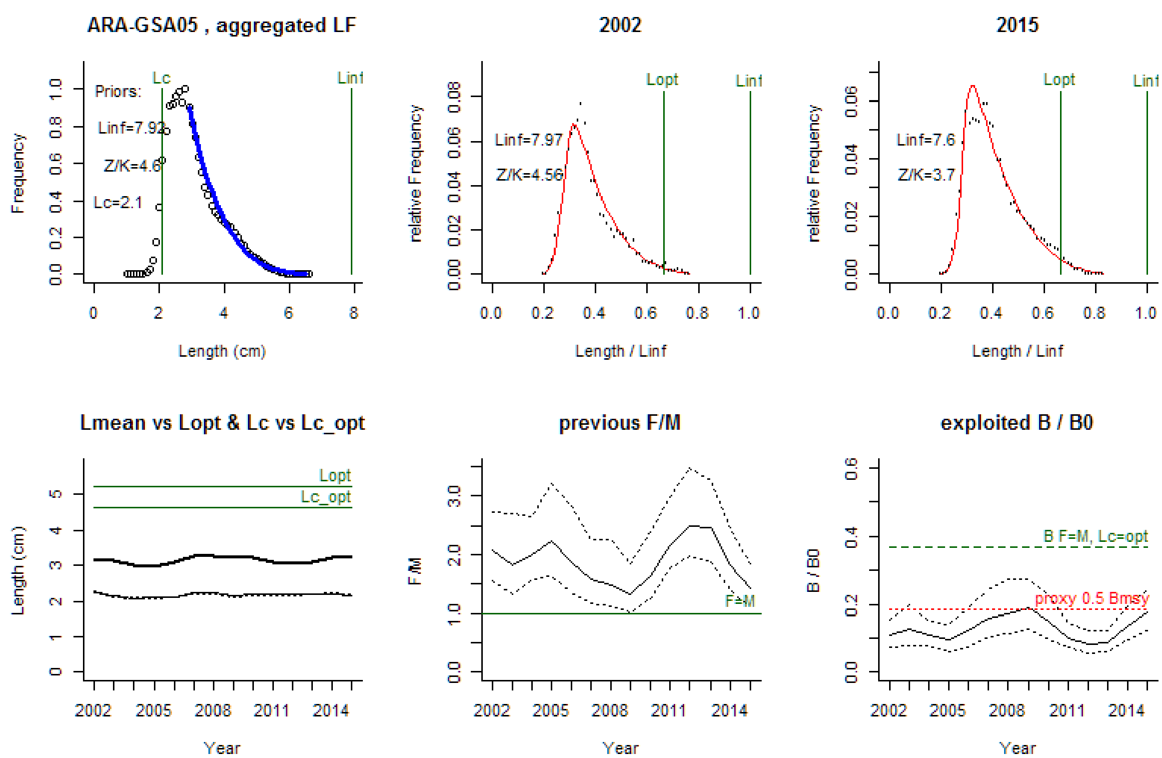
Results for *Aristeus antennatus*, stock **ARA-GSA01**, 2005–2015
(95% confidence limits in parentheses) File: ComDat_1.csv

Linf prior = 7.92, s.d. = 0.0792 (cm)
Z/K prior = 4.88, s.d. = 0.915, M/K prior = 1.5, s.d. = 0.15
F/K prior = 3.38 (wide range with tau=4 in log-normal distribution)
Lc prior = 2.35, s.d. = 0.235 (cm), alpha prior = 51.5, s.d. = 5.15
General reference points [median across years]:
Linf = 7.88 (7.74–8.05) cm
Lopt = 5.3 cm, Lopt/Linf = 0.67
Lc_opt = 4.7 cm, Lc_opt/Linf = 0.6
M/K = 1.48 (1.2–1.8)
F/K = 3.35 (2.9–3.71)
Z/K = 4.75 (4.53–4.99)
F/M = 2.19 (1.59–3.12)
B/B0 F=M Lc=Lc_opt = 0.367
B/B0 = 0.117 (0.075–0.16)
Y/R' F=M Lc=Lc_opt = 0.0468
Y/R' = 0.017 (0.0111–0.0232) (linearly reduced if B/B0 < 0.25)
Estimates for last year 2015:
Lc = 2.26 (2.25–2.28) cm, Lc/Linf = 0.28 (0.281–0.285)
alpha = 53.5 (51.6–55.3)
Lmean/Lopt = 0.61, Lc/Lc_opt = 0.48, L95th = 6 cm, L95th/Linf = 0.75, Lm50 = 1.5 cm, Mature = 100%
F/K = 2.6 (2.32–2.86)
F/M = 1.8 (1.42–2.36)
Z/K = 4.04 (3.84–4.24)
Y/R' = 0.02 (0.0141–0.0273) (linearly reduced if B/B0 < 0.25)
B/B0 = 0.13 (0.0947–0.183)
B/Bmsy = 0.37 (0.258–0.498)
Comment: F/Fmsy2015=1.9 in official assessment, which matches with LBB F/M=1.6–3.1 and B/Bmsy=0.17–0.34.



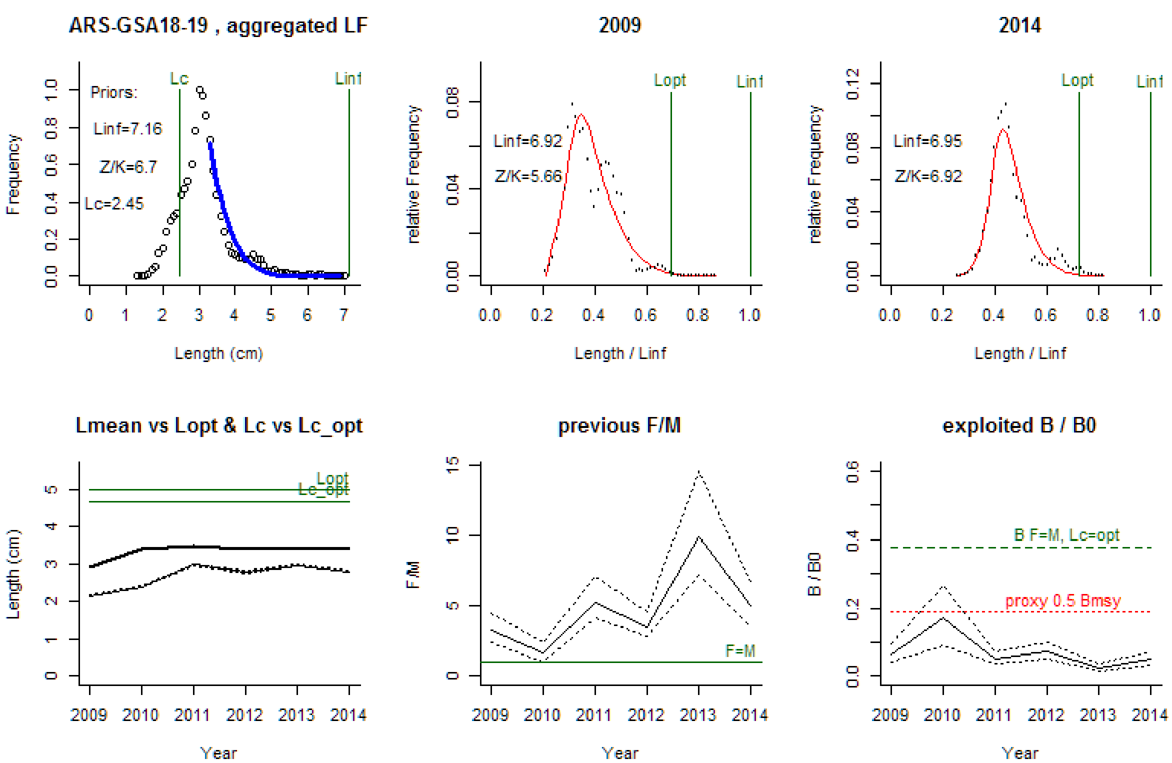
Results for *Aristeus antennatus*, stock **ARA-GSA05**, 2002–2015
(95% confidence limits in parentheses) File: ComDat_1.csv

Linf prior = 7.92, s.d. = 0.0792 (cm)
Z/K prior = 4.57, s.d. = 1.12 , M/K prior = 1.5, s.d. = 0.15
F/K prior = 3.07 (wide range with tau=4 in log-normal distribution)
Lc prior = 2.14, s.d. = 0.214 (cm), alpha prior = 75.1, s.d. = 7.51
General reference points [median across years]:
Linf = 7.8 (7.65–7.92) cm
Lopt = 5.2 cm, Lopt/Linf = 0.67
Lc_opt = 4.6 cm, Lc_opt/Linf = 0.59
M/K = 1.49 (1.2–1.78)
F/K = 2.77 (2.4–3.2)
Z/K = 4.25 (4.06–4.48)
F/M = 1.85 (1.39–2.68)
B/B0 F=M Lc=Lc_opt = 0.367
B/B0 = 0.125 (0.077–0.192)
Y/R' F=M Lc=Lc_opt = 0.0466
Y/R' = 0.0175 (0.0107–0.0273) (linearly reduced if B/B0 < 0.25)
Estimates for last year 2015:
Lc = 2.17 (2.15–2.18) cm, Lc/Linf = 0.29 (0.283–0.287)
alpha = 69.8 (66.7–72.7)
Lmean/Lopt = 0.64, Lc/Lc_opt = 0.47, L95th = 6.3 cm, L95th/Linf = 0.83, Lm50 = 1.5 cm, Mature = 100%
F/K = 2.2 (1.88–2.42)
F/M = 1.4 (1.11–1.85)
Z/K = 3.69 (3.49–3.9)
Y/R' = 0.026 (0.018–0.0356) (linearly reduced if B/B0 < 0.25)
B/B0 = 0.18 (0.122–0.241)
B/Bmsy = 0.48 (0.332–0.656)
Comment: F/Fmsy2015=1.0 in official assessment.



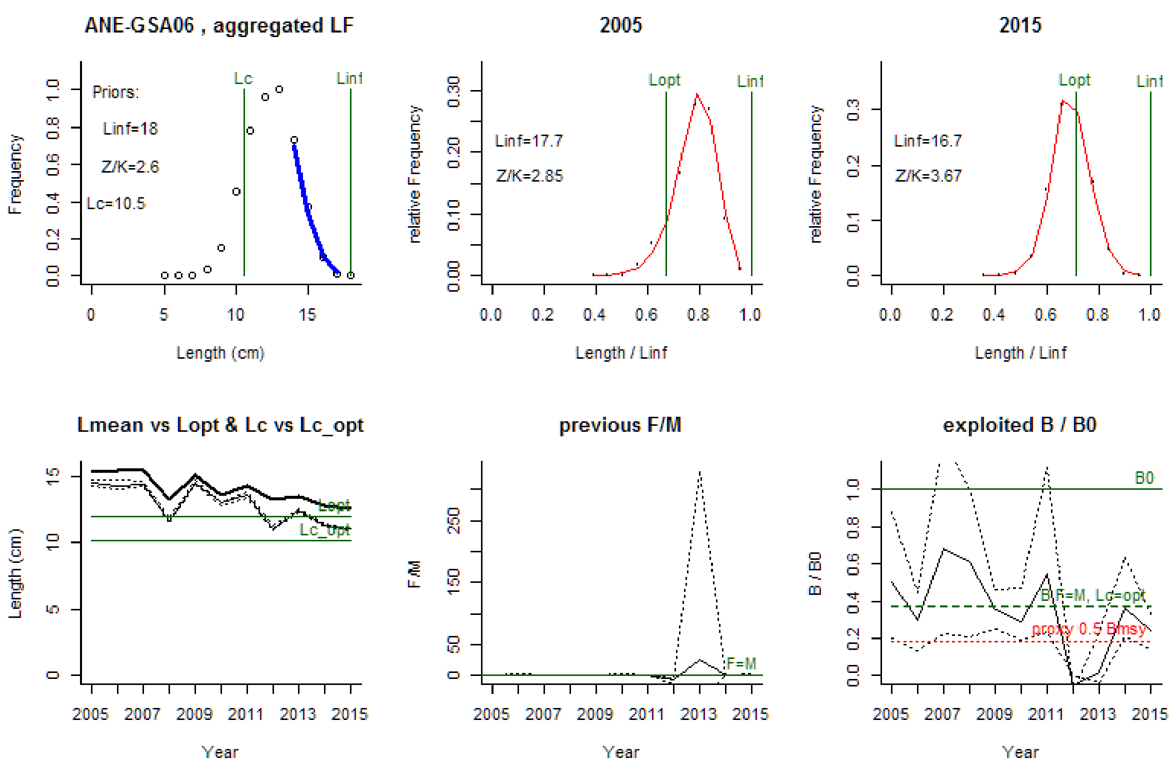
Results for *Aristaeomorpha foliacea*, stock **ARS-GSA18-19**, 2009–2014
(95% confidence limits in parentheses) File: ComDat_1.csv

Linf prior = 7.16, s.d. = 0.0716 (cm)
Z/K prior = 6.67, s.d. = 5.48 , M/K prior = 1.5, s.d. = 0.15
F/K prior = 5.17 (wide range with tau=4 in log-normal distribution)
Lc prior = 2.5, s.d. = 0.25 (cm), alpha prior = 27.9, s.d. = 2.79
General reference points [median across years]:
Linf = 7.03 (6.94–7.12) cm
Lopt = 5 cm, Lopt/Linf = 0.71
Lc_opt = 4.7 cm, Lc_opt/Linf = 0.66
M/K = 1.23 (0.971–1.57)
F/K = 5.63 (5.14–6.14)
Z/K = 6.97 (6.59–7.39)
F/M = 4.29 (3.19–5.63)
B/B0 F=M Lc=Lc_opt = 0.377
B/B0 = 0.0584 (0.0383–0.0832)
Y/R' F=M Lc=Lc_opt = 0.0615
Y/R' = 0.0101 (0.00643–0.0142) (linearly reduced if B/B0 < 0.25)
Estimates for last year 2014:
Lc = 2.81 (2.79–2.82) cm, Lc/Linf = 0.4 (0.402–0.406)
alpha = 37.9 (37.1–38.7)
Lmean/Lopt = 0.68, Lc/Lc_opt = 0.6, L95th = 5.7 cm, L95th/Linf = 0.82, Lm50 = 3.3 cm, Mature = 29%
F/K = 5.8 (5.3–6.25)
F/M = 5.1 (3.54–6.64)
Z/K = 6.92 (6.61–7.34)
Y/R' = 0.01 (0.00666–0.0153) (linearly reduced if B/B0 < 0.25)
B/B0 = 0.05 (0.0315–0.0727)
B/Bmsy = 0.13 (0.0836 –0.193)
Comment: LFs with multiple peaks (Recruitment? Gillnets included?). F/Fmsy2014=1.1 in official assessment.



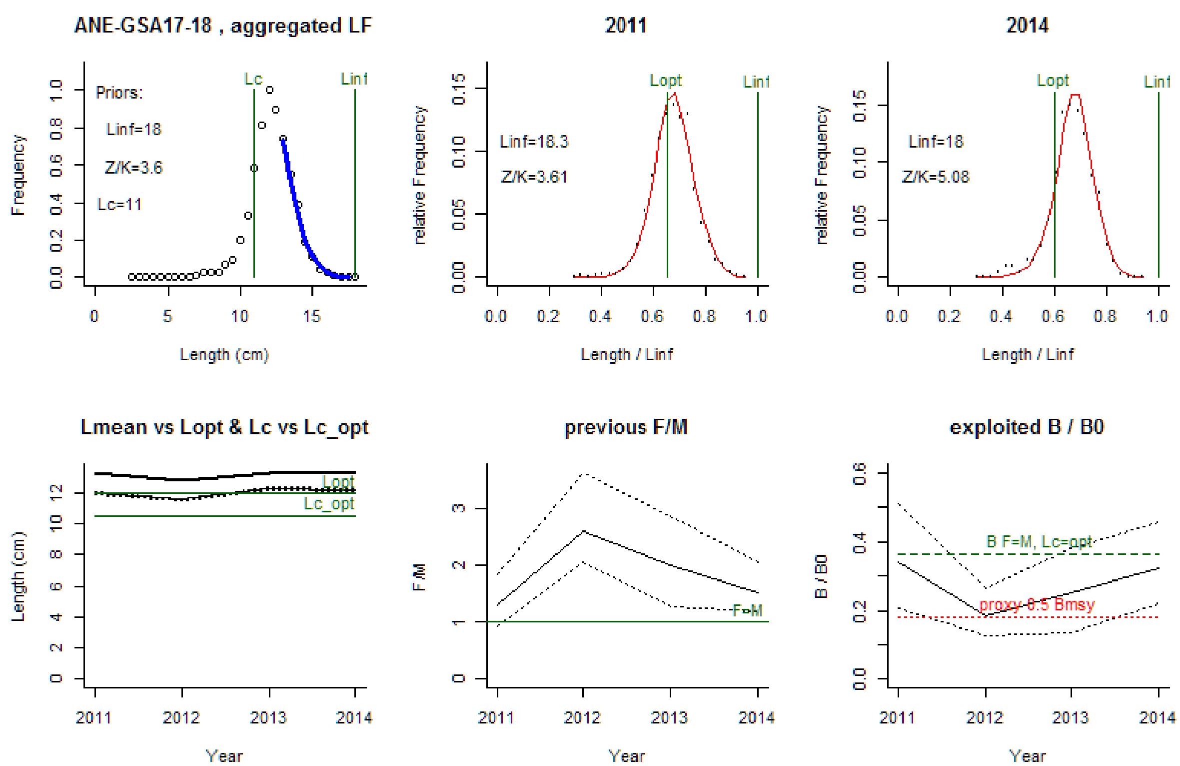
Results for *Engraulis encrasicolus*, stock **ANE-GSA06**, 2005–2015
(95% confidence limits in parentheses) File: ComDat_1.csv

Linf prior = 18, s.d. = 0.18 (cm)
Z/K prior = 2.62, s.d. = 1.01 , M/K prior = 1.5, s.d. = 0.15
F/K prior = 1.12 (wide range with tau=4 in log-normal distribution)
Lc prior = 10.7, s.d. = 1.07 (cm), alpha prior = 26.4, s.d. = 2.64
General reference points [median across years]:
Linf = 17.5 (17.3–17.6) cm
Lopt = 12 cm, Lopt/Linf = 0.68
Lc_opt = 10 cm, Lc_opt/Linf = 0.58
M/K = 1.39 (1.11–1.58)
F/K = 2.1 (1.43–2.45)
Z/K = 3.05 (2.88–3.51)
F/M = 1.17 (0.549–1.87)
B/B0 F=M Lc=Lc_opt = 0.37
B/B0 = 0.354 (0.201–0.474)
Y/R' F=M Lc=Lc_opt = 0.0505
Y/R' = 0.0286 (0.0122–0.0529) (linearly reduced if B/B0 < 0.25)
Estimates for last year 2015:
Lc = 11.1 (11–11.1) cm, Lc/Linf = 0.66 (0.659–0.668)
alpha = 28.1 (27.3–28.9)
Lmean/Lopt = 1.1, Lc/Lc_opt = 1.1, L95th = 16 cm, L95th/Linf = 0.96, Lm50 = 12 cm, Mature = 22%
F/K = 2.4 (1.95–2.77)
F/M = 2 (1.35–2.57)
Z/K = 3.66 (3.22–3.99)
Y/R' = 0.068 (0.0392–0.0936) (linearly reduced if B/B0 < 0.25)
B/B0 = 0.24 (0.14–0.335)
B/Bmsy = 0.65 (0.378–0.904)
Comment: F/Fmsy2015=0.9 in official assessment.



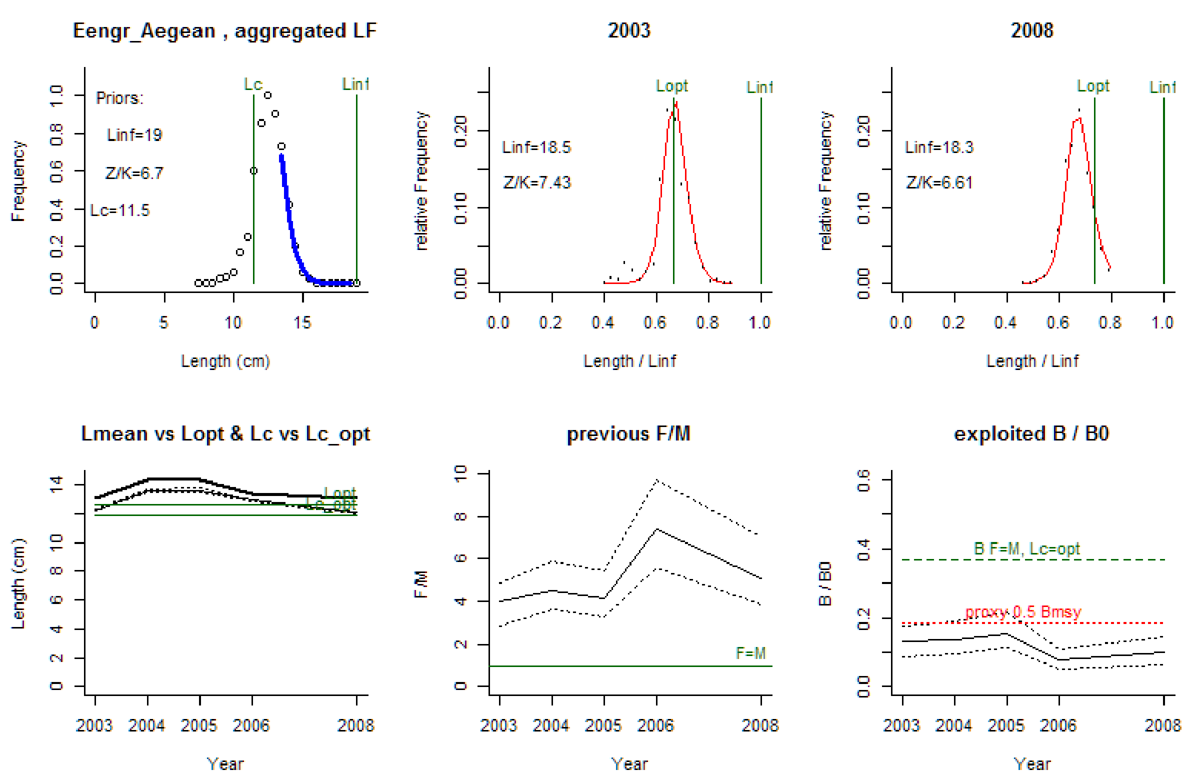
Results for *Engraulis encrasicolus*, stock **ANE-GSA17-18**, 2011–2014
(95% confidence limits in parentheses) File: ComDat_1.csv

Linf prior = 18, s.d. = 0.18 (cm)
Z/K prior = 3.55, s.d. = 1.3 , M/K prior = 1.5, s.d. = 0.15
F/K prior = 2.05 (wide range with tau=4 in log-normal distribution)
Lc prior = 11.2, s.d. = 1.12 (cm), alpha prior = 40.3, s.d. = 4.03
General reference points [median across years]:
Linf = 18.2 (17.9–18.5) cm
Lopt = 12 cm, Lopt/Linf = 0.66
Lc_opt = 11 cm, Lc_opt/Linf = 0.58
M/K = 1.57 (1.29–1.87)
F/K = 3.1 (2.45–3.65)
Z/K = 4.88 (4.34–5.4)
F/M = 1.76 (1.24–2.46)
B/B0 F=M Lc=Lc_opt = 0.363
B/B0 = 0.289 (0.17–0.42)
Y/R' F=M Lc=Lc_opt = 0.0424
Y/R' = 0.0394 (0.0245–0.058) (linearly reduced if B/B0 < 0.25)
Estimates for last year 2014:
Lc = 12.2 (12–12.3) cm, Lc/Linf = 0.67 (0.667–0.679)
alpha = 26.2 (25.2–27)
Lmean/Lopt = 1.2, Lc/Lc_opt = 1.2, L95th = 17 cm, L95th/Linf = 0.94, Lm50 = 10 cm, Mature = 91%
F/K = 3.1 (2.49–3.64)
F/M = 1.5 (1.2–2.05)
Z/K = 5.08 (4.58–5.61)
Y/R' = 0.025 (0.0169–0.0353) (linearly reduced if B/B0 < 0.25)
B/B0 = 0.32 (0.219–0.457)
B/Bmsy = 0.89 (0.604–1.26)
Comment: F/Fmsy2015=1.8 in official assessment.



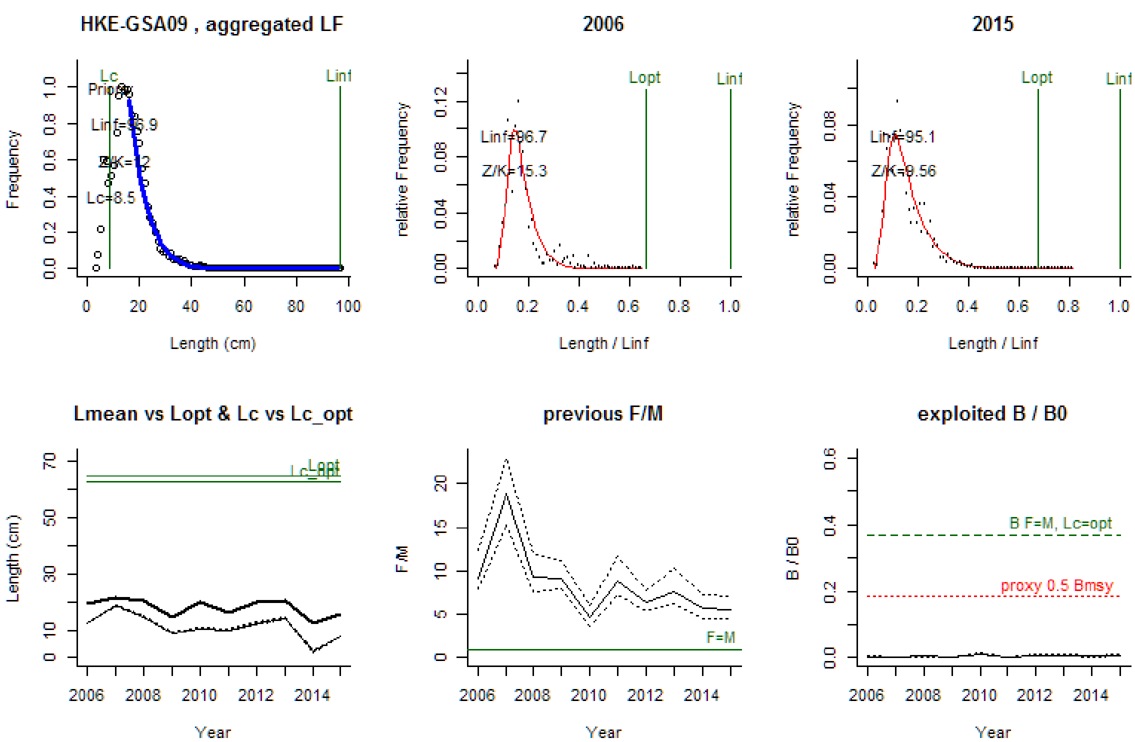
Results for *Engraulis encrasicolus*, stock **Eengr_Aegean**, 2003–2008
(95% confidence limits in parentheses) File: ComDat_1.csv

Linf prior = 19, s.d. = 0.19 (cm)
Z/K prior = 6.74, s.d. = 3.74 , M/K prior = 1.5, s.d. = 0.15
F/K prior = 5.24 (wide range with tau=4 in log-normal distribution)
Lc prior = 11.7, s.d. = 1.17 (cm), alpha prior = 32.3, s.d. = 3.23
General reference points [median across years]:
Linf = 18.9 (18.5–19.3) cm
Lopt = 13 cm, Lopt/Linf = 0.67
Lc_opt = 12 cm, Lc_opt/Linf = 0.63
M/K = 1.49 (1.25–1.83)
F/K = 8.33 (7.14–9.87)
Z/K = 10.4 (9.13–11.9)
F/M = 4.52 (3.62–5.89)
B/B0 F=M Lc=Lc_opt = 0.367
B/B0 = 0.132 (0.086–0.178)
Y/R' F=M Lc=Lc_opt = 0.0462
Y/R' = 0.019 (0.0129–0.0268) (linearly reduced if B/B0 < 0.25)
Estimates for last year 2008:
Lc = 12.1 (12–12.1) cm, Lc/Linf = 0.66 (0.657–0.664)
alpha = 38.1 (37.1–38.9)
Lmean/Lopt = 0.97, Lc/Lc_opt = 1, L95th = 14.5 cm, L95th/Linf = 0.79, Lm50 = 11 cm, Mature = 88%
F/K = 5.5 (5.03–6.23)
F/M = 5.1 (3.86–7.05)
Z/K = 6.65 (6.12–7.19)
Y/R' = 0.036 (0.023–0.0522) (linearly reduced if B/B0 < 0.25)
B/B0 = 0.099 (0.0639–0.145)
B/Bmsy = 0.27 (0.174–0.396)
Comment: Official 2008 assessment F/Fmsy=1.5 and B/Bmsy=0.44. Lm50 from Tsikliras and Stergiou (2014)



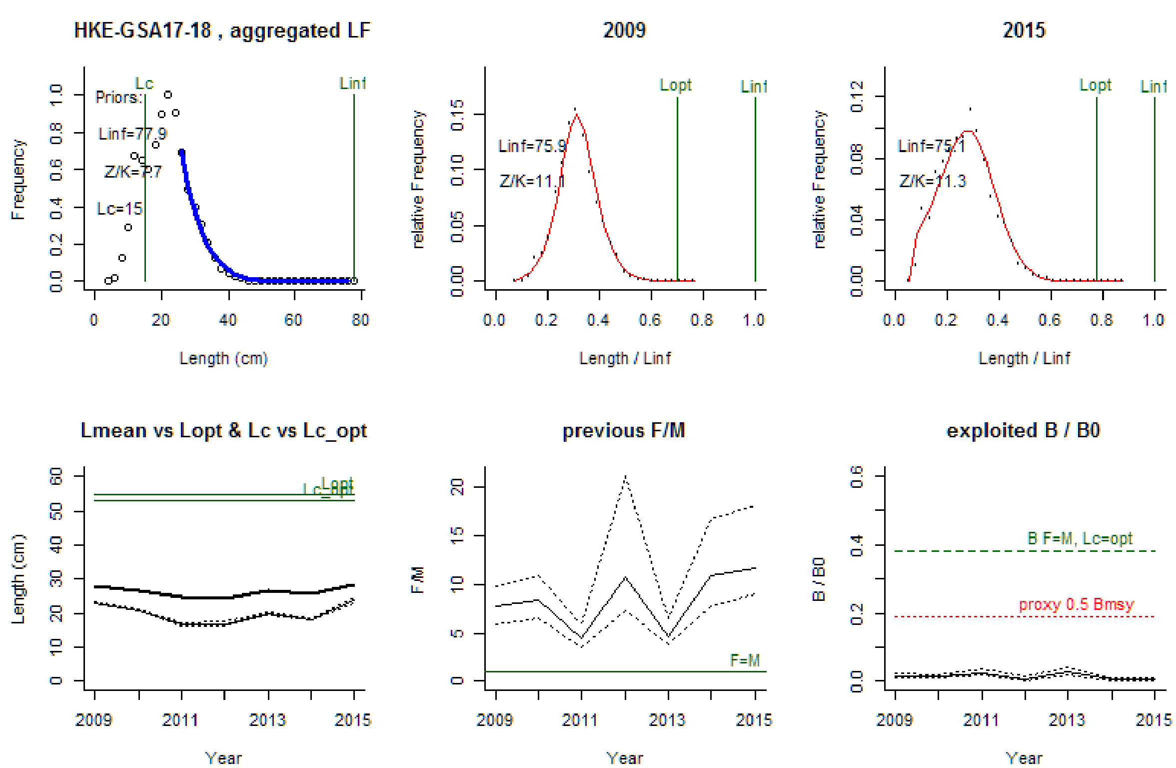
Results for *Merluccius merluccius*, stock **HKE-GSA09**, 2006–2015
(95% confidence limits in parentheses) File: ComDat_1.csv

Linf prior = 96.9, s.d. = 0.969 (cm)
Z/K prior = 11.5, s.d. = 5.71 , M/K prior = 1.5, s.d. = 0.15
F/K prior = 10 (wide range with tau=4 in log-normal distribution)
Lc prior = 8.67, s.d. = 0.867 (cm), alpha prior = 50.7, s.d. = 5.07
General reference points [median across years]:
Linf = 96.7 (94.8–98.2) cm
Lopt = 65 cm, Lopt/Linf = 0.67
Lc_opt = 63 cm, Lc_opt/Linf = 0.65
M/K = 1.47 (1.17–1.77)
F/K = 11.8 (11.3–12.3)
Z/K = 13.2 (12.8–13.7)
F/M = 8.27 (6.76–10.8)
B/B0 F=M Lc=Lc_opt = 0.368
B/B0 = 0.00469 (0.00335–0.00635)
Y/R' F=M Lc=Lc_opt = 0.0474
Y/R' = 0.000109 (7.8e–05–0.000145) (linearly reduced if B/B0 < 0.25)
Estimates for last year 2015:
Lc = 7.71 (7.59–7.82) cm, Lc/Linf = 0.081 (0.0798–0.0822)
alpha = 60.9 (59–62.9)
Lmean/Lopt = 0.25, Lc/Lc_opt = 0.12, L95th = 77 cm, L95th/Linf = 0.81, Lm50 = 35 cm, Mature = 1.5%
F/K = 8.1 (7.66–8.53)
F/M = 5.7 (4.44–7.01)
Z/K = 9.61 (9.29–9.91)
Y/R' = 0.00018 (0.000132–0.000247) (linearly reduced if B/B0 < 0.25)
B/B0 = 0.0071 (0.00507–0.00952)
B/Bmsy = 0.019 (0.0138–0.0259)
Comment: F/Fmsy2015=3.8 in official assessment.



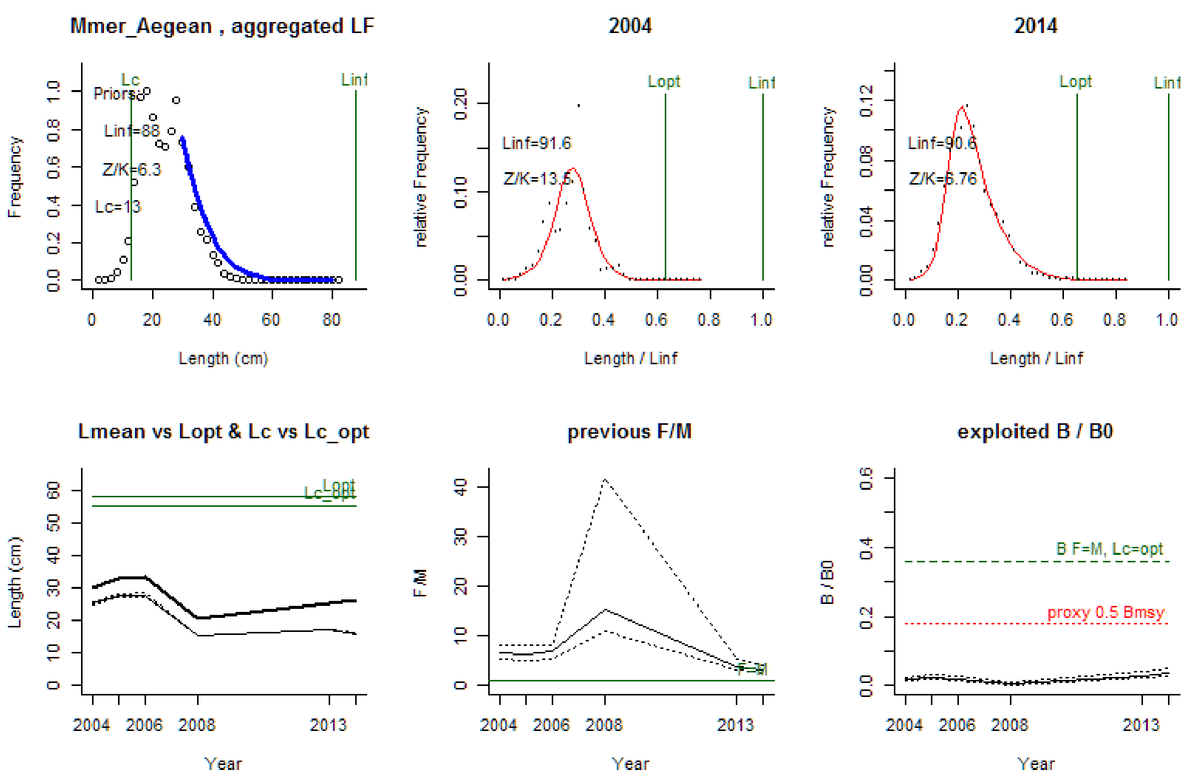
Results for *Merluccius merluccius*, stock **HKE-GSA17-18**, 2009–2015
(95% confidence limits in parentheses) File: ComDat_1.csv

Linf prior = 77.9, s.d. = 0.779 (cm)
Z/K prior = 7.73, s.d. = 2.75, M/K prior = 1.5, s.d. = 0.15
F/K prior = 6.23 (wide range with tau=4 in log-normal distribution)
Lc prior = 15.3, s.d. = 1.53 (cm), alpha prior = 9.6, s.d. = 0.96
General reference points [median across years]:
Linf = 75.1 (73.4–76.3) cm
Lopt = 55 cm, Lopt/Linf = 0.73
Lc_opt = 53 cm, Lc_opt/Linf = 0.7
M/K = 1.12 (0.902–1.38)
F/K = 7.25 (6.91–8.09)
Z/K = 7.94 (7.58–8.7)
F/M = 8.33 (6.48–10.9)
B/B0 F=M Lc=Lc_opt = 0.382
B/B0 = 0.0141 (0.00986–0.0197)
Y/R' F=M Lc=Lc_opt = 0.069
Y/R' = 0.00146 (0.00102–0.00203) (linearly reduced if B/B0 < 0.25)
Estimates for last year 2015:
Lc = 23.9 (23–24.6) cm, Lc/Linf = 0.32 (0.306–0.328)
alpha = 11.9 (11.5–12.3)
Lmean/Lopt = 0.49, Lc/Lc_opt = 0.45, L95th = 66 cm, L95th/Linf = 0.88, Lm50 = 33 cm, Mature = 5.7%
F/K = 10 (9.55–11.3)
F/M = 12 (9.06–18.1)
Z/K = 11.3 (10.4–12.1)
Y/R' = 8e–04 (0.000455–0.00131) (linearly reduced if B/B0 < 0.25)
B/B0 = 0.0077 (0.00438–0.0126)
B/Bmsy = 0.02 (0.0115–0.0329)
Comment: F/Fmsy2015=2.6 in official assessment.



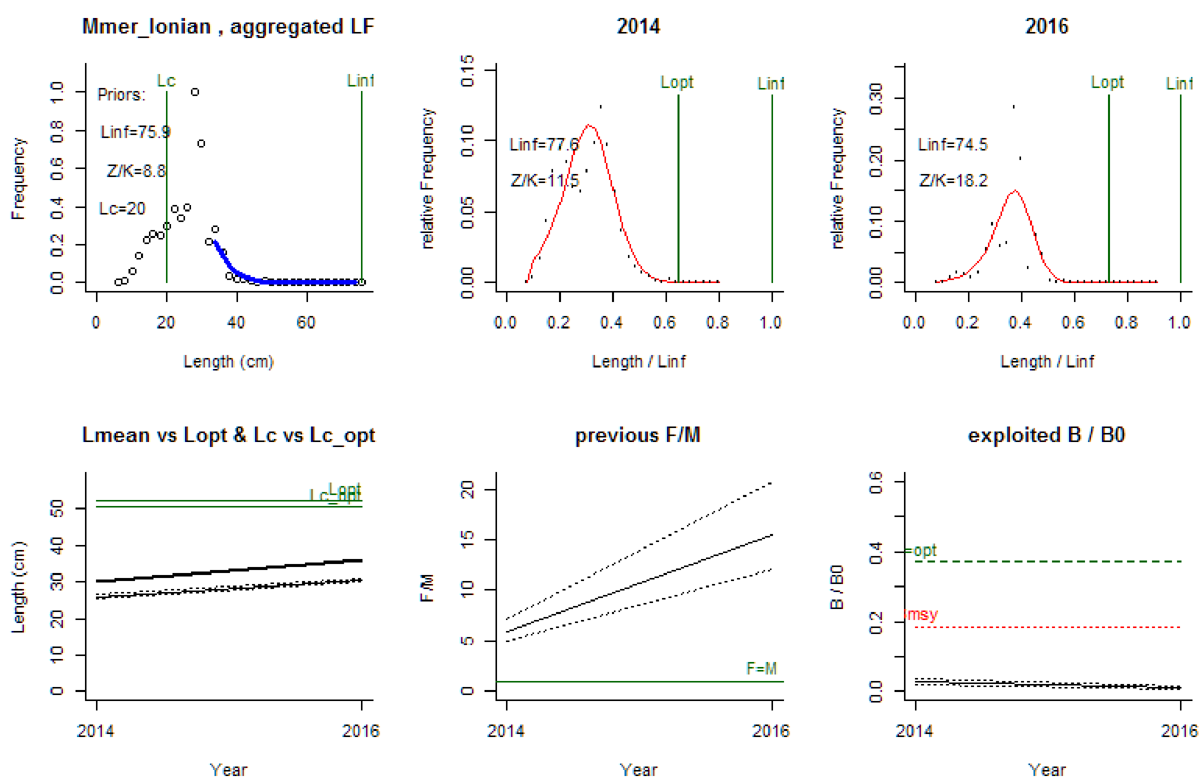
Results for *Merluccius merluccius*, stock **Mmer_Aegean**, 2004–2014
(95% confidence limits in parentheses) File: ComDat_1.csv

Linf prior = 88, s.d. = 0.88 (cm) (user-defined)
Z/K prior = 6.29, s.d. = 0.573 , M/K prior = 1.5, s.d. = 0.15
F/K prior = 4.79 (wide range with tau=4 in log-normal distribution)
Lc prior = 13.3, s.d. = 1.33 (cm), alpha prior = 52.1, s.d. = 5.21
General reference points [median across years]:
Linf = 90.5 (88.7–92.1) cm
Lopt = 58 cm, Lopt/Linf = 0.64
Lc_opt = 56 cm, Lc_opt/Linf = 0.61
M/K = 1.67 (1.38–1.98)
F/K = 9.4 (8.79–10.2)
Z/K = 10.5 (9.92–11.2)
F/M = 6.52 (5.37–8.28)
B/B0 F=M Lc=Lc_opt = 0.36
B/B0 = 0.0226 (0.0169–0.0299)
Y/R' F=M Lc=Lc_opt = 0.0384
Y/R' = 0.00165 (0.00123–0.00218) (linearly reduced if B/B0 < 0.25)
Estimates for last year 2014:
Lc = 16 (15.8–16.4) cm, Lc/Linf = 0.18 (0.174–0.181)
alpha = 38.7 (37–40.6)
Lmean/Lopt = 0.45, Lc/Lc_opt = 0.29, L95th = 76 cm, L95th/Linf = 0.84, Lm50 = 30 cm, Mature = 18%
F/K = 5.1 (4.76–5.53)
F/M = 3.2 (2.57–4.05)
Z/K = 6.78 (6.43–7.01)
Y/R' = 0.0027 (0.00194–0.00357) (linearly reduced if B/B0 < 0.25)
B/B0 = 0.039 (0.0283–0.0522)
B/Bmsy = 0.11 (0.0787–0.145)
Comment: Official assessment F/Fmsy2007=4.68. Lm50 from Tsikliras and Stergiou (2014)



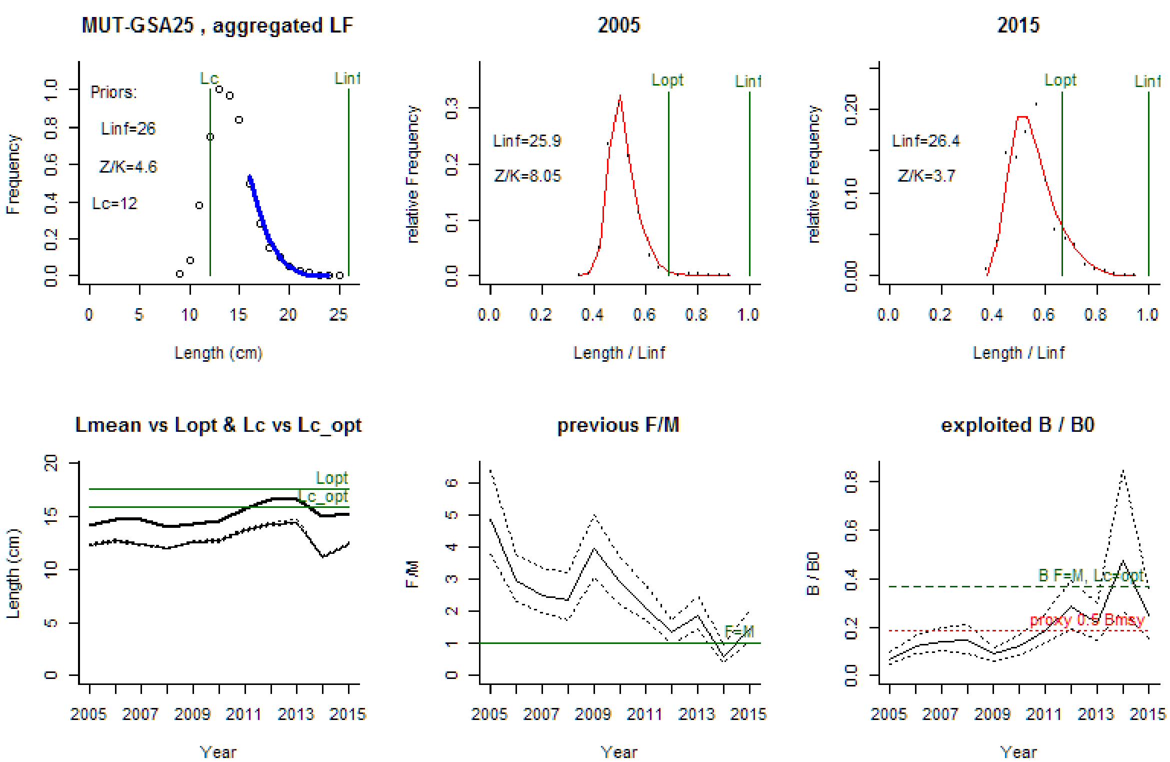
Results for *Merluccius merluccius*, stock **Mmer_Ionian**, 2014–2016
(95% confidence limits in parentheses) File: ComDat_1.csv

Linf prior = 75.9, s.d. = 0.759 (cm)
Z/K prior = 8.79, s.d. = 22.7, M/K prior = 1.5, s.d. = 0.15
F/K prior = 7.29 (wide range with tau=4 in log-normal distribution)
Lc prior = 20.4, s.d. = 2.04 (cm), alpha prior = 15.6, s.d. = 1.56
General reference points [median across years]:
Linf = 76.1 (74.8–77.3) cm
Lopt = 52 cm, Lopt/Linf = 0.69
Lc_opt = 51 cm, Lc_opt/Linf = 0.67
M/K = 1.38 (1.12–1.65)
F/K = 13.5 (12.6–14.5)
Z/K = 14.8 (14–16)
F/M = 10.7 (8.56–14)
B/B0 F=M Lc=Lc_opt = 0.37
B/B0 = 0.0194 (0.0144–0.0256)
Y/R' F=M Lc=Lc_opt = 0.0508
Y/R' = 0.00195 (0.00143–0.00261) (linearly reduced if B/B0 < 0.25)
Estimates for last year 2016:
Lc = 30.4 (30.1–30.9) cm, Lc/Linf = 0.41 (0.404–0.414)
alpha = 19.8 (9.4–20.3)
Lmean/Lopt = 0.67, Lc/Lc_opt = 0.6, L95th = 68 cm, L95th/Linf = 0.91, Lm50 = 30 cm, Mature = 17%
F/K = 17 (16.2–18.4)
F/M = 15 (12–20.7)
Z/K = 18.2 (17.3–19.6)
Y/R' = 0.0015 (0.000996–0.00211) (linearly reduced if B/B0 < 0.25)
B/B0 = 0.011 (0.00718–0.0152)
B/Bmsy = 0.029 (0.0194–0.0412)
Comment: Official assessment F/Fmsy2016=2.62 and B/Bmsy2016=0.34. Lm50 from Tsikliras and Stergiou (2014)



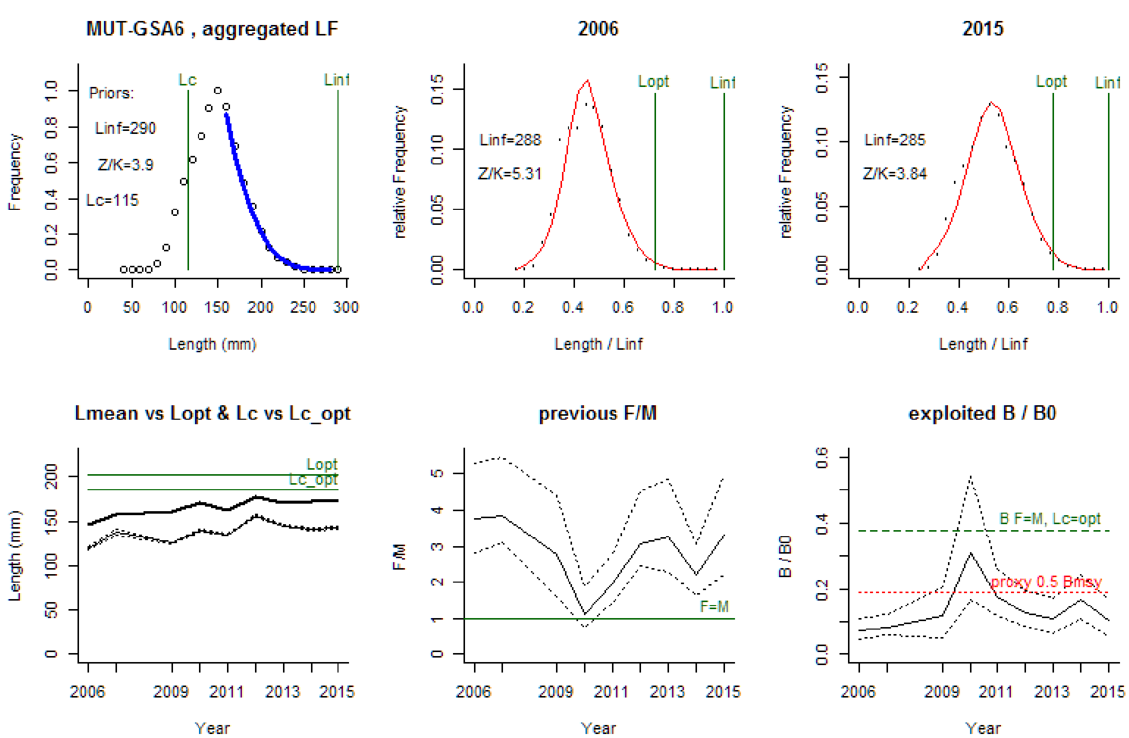
Results for *Mullus barbatus*, stock **MUT-GSA25**, 2005–2015
(95% confidence limits in parentheses) File: ComDat_1.csv

Linf prior = 26, s.d. = 0.26 (cm) (user-defined)
Z/K prior = 4.62, s.d. = 0.183, M/K prior = 1.5, s.d. = 0.15
F/K prior = 3.12 (wide range with tau=4 in log-normal distribution)
Lc prior = 12.2, s.d. = 1.22 (cm), alpha prior = 42.2, s.d. = 4.22
General reference points [median across years]:
Linf = 26.5 (26–26.9) cm
Lopt = 18 cm, Lopt/Linf = 0.66
Lc_opt = 16 cm, Lc_opt/Linf = 0.6
M/K = 1.52 (1.27–1.77)
F/K = 3.81 (3.28–4.22)
Z/K = 5.44 (5.14–5.77)
F/M = 2.37 (1.75–3.2)
B/B0 F=M Lc=Lc_opt = 0.366
B/B0 = 0.146 (0.101–0.207)
Y/R' F=M Lc=Lc_opt = 0.0447
Y/R' = 0.0263 (0.0174–0.0359) (linearly reduced if B/B0 < 0.25)
Estimates for last year 2015:
Lc = 12.4 (12.3–12.5) cm, Lc/Linf = 0.47 (0.467–0.474)
alpha = 37.8 (35.4–39.2)
Lmean/Lopt = 0.87, Lc/Lc_opt = 0.79, L95th = 25 cm, L95th/Linf = 0.95, Lm50 = 9 cm, Mature = 100%
F/K = 2.2 (1.79–2.59)
F/M = 1.4 (1.06–2.01)
Z/K = 3.69 (3.44 – 3.95)
Y/R' = 0.047 (0.0286–0.0681) (linearly reduced if B/B0 < 0.25)
B/B0 = 0.25 (0.151–0.36)
B/Bmsy = 0.67 (0.413–0.985)
Comment: F/Fmsy2015=1.0 in official assessment.



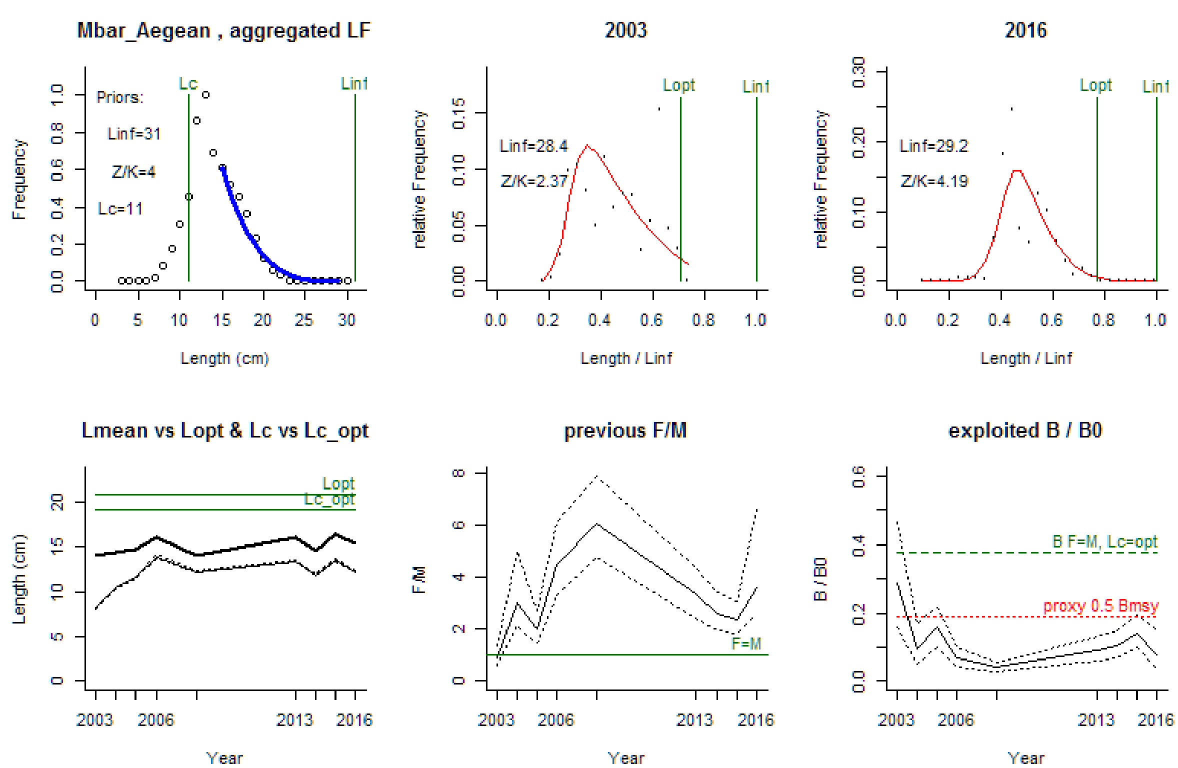
Results for *Mullus barbatus*, stock **MUT-GSA6**, 2006–2015
(95% confidence limits in parentheses) File: ComDat_1.csv

Linf prior = 290, s.d. = 2.9 (cm)
Z/K prior = 3.86, s.d. = 0.533, M/K prior = 1.5, s.d. = 0.15
F/K prior = 2.36 (wide range with tau=4 in log-normal distribution)
Lc prior = 117, s.d. = 11.7 (cm), alpha prior = 13.8, s.d. = 1.38
General reference points [median across years]:
Linf = 285 (282–289) mm
Lopt = 202 mm, Lopt/Linf = 0.71
Lc_opt = 185 mm, Lc_opt/Linf = 0.65
M/K = 1.23 (0.978–1.48)
F/K = 2.98 (2.65–3.42)
Z/K = 4.38 (4.03–4.75)
F/M = 3.06 (2.21–4.51)
B/B0 F=M Lc=Lc_opt = 0.377
B/B0 = 0.117 (0.0639–0.193)
Y/R' F=M Lc=Lc_opt = 0.0604
Y/R' = 0.0356 (0.0207–0.0559) (linearly reduced if B/B0 < 0.25)
Estimates for last year 2015:
Lc = 142 (140–144) mm, Lc/Linf = 0.5 (0.493–0.507)
alpha = 16.7 (16.2–17.2)
Lmean/Lopt = 0.79, Lc/Lc_opt = 0.77, L95th = 280 mm, L95th/Linf = 0.98, Lm50 = 12 mm, Mature = 100%
F/K = 3 (2.54–3.35)
F/M = 3.4 (2.21–4.97)
Z/K = 3.81 (3.61–4.18)
Y/R' = 0.038 (0.0207–0.0616) (linearly reduced if B/B0 < 0.25)
B/B0 = 0.1 (0.0562–0.167)
B/Bmsy = 0.27 (0.149–0.444)
Comment: F/Fmsy2015=1.6 in official assessment.



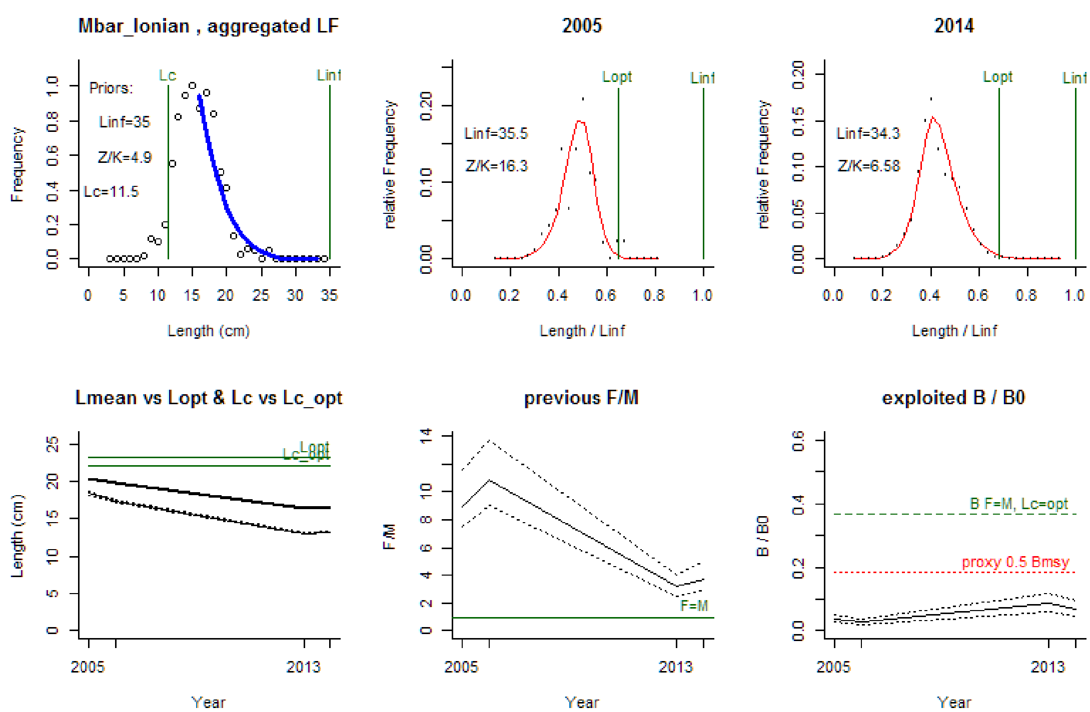
Results for *Mullus barbatus*, stock **Mbar_Aegean**, 2003–2016
(95% confidence limits in parentheses) File: ComDat_1.csv

Linf prior = 31, s.d. = 0.31 (cm) (user-defined)
Z/K prior = 3.99, s.d. = 0.266, M/K prior = 1.5, s.d. = 0.15
F/K prior = 2.49 (wide range with tau=4 in log-normal distribution)
Lc prior = 11.2, s.d. = 1.12 (cm), alpha prior = 21.2, s.d. = 2.12
General reference points [median across years]:
Linf = 29.7 (29.2–30.3) cm
Lopt = 21 cm, Lopt/Linf = 0.7
Lc_opt = 19 cm, Lc_opt/Linf = 0.64
M/K = 1.28 (1.03–1.59)
F/K = 3.41 (3–3.8)
Z/K = 4.85 (4.49–5.17)
F/M = 3.01 (2.12–4.39)
B/B0 F=M Lc=Lc_opt = 0.375
B/B0 = 0.0954 (0.0595–0.15)
Y/R' F=M Lc=Lc_opt = 0.0582
Y/R' = 0.0244 (0.0132–0.039) (linearly reduced if B/B0 < 0.25)
Estimates for last year 2016:
Lc = 12.3 (12.2–12.3) cm, Lc/Linf = 0.42 (0.417–0.422)
alpha = 31 (30.1–31.8)
Lmean/Lopt = 0.69, Lc/Lc_opt = 0.64, L95th = 29 cm, L95th/Linf = 0.99, Lm50 = 13 cm, Mature = 49%
F/K = 3.3 (2.99–3.6)
F/M = 3.6 (2.63–6.7)
Z/K = 4.19 (4.04–4.34)
Y/R' = 0.024 (0.0122–0.0463) (linearly reduced if B/B0 < 0.25)
B/B0 = 0.079 (0.0396–0.15)
B/Bmsy = 0.21 (0.106–0.4)
Comment: Official assessment in 2007 F/Fmsy=1.18 and B/Bmsy=0.91. Lm50 from Tsikliras and Stergiou (2014)



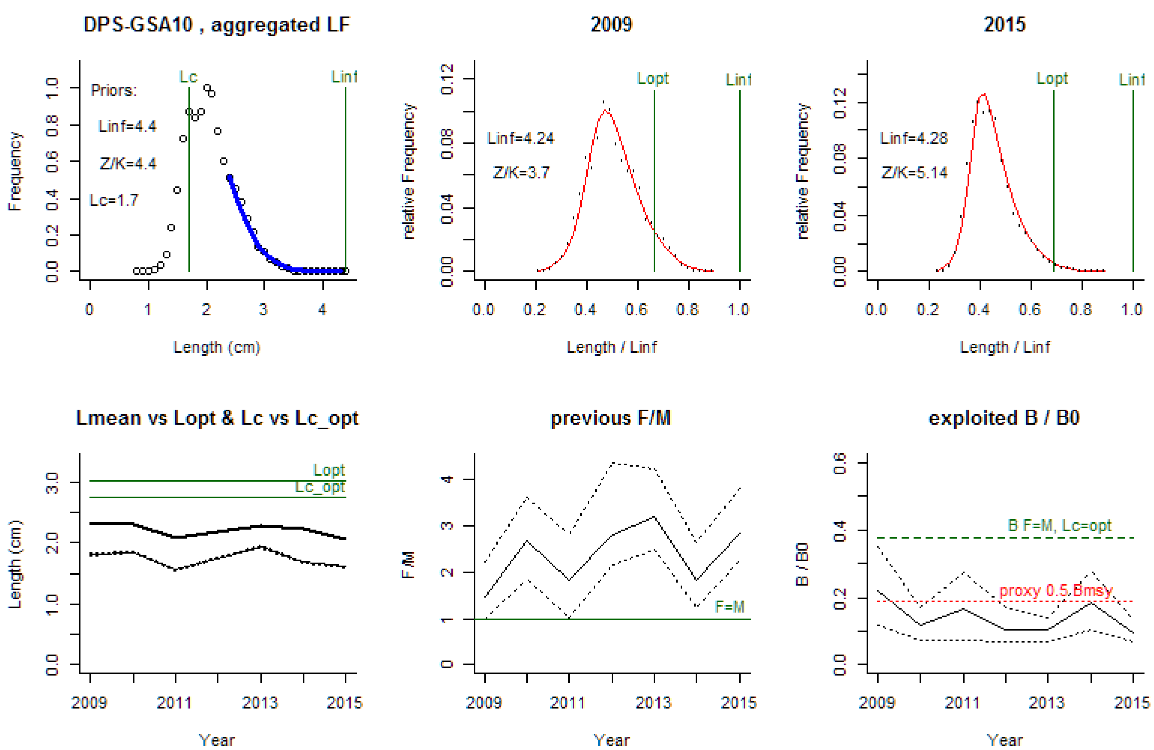
Results for *Mullus barbatus*, stock **Mbar_Ionian**, 2005–2014
(95% confidence limits in parentheses) File: ComDat_1.csv

Linf prior = 35, s.d. = 0.35 (cm) (user-defined)
Z/K prior = 4.85, s.d. = 0.499, M/K prior = 1.5, s.d. = 0.15
F/K prior = 3.35 (wide range with tau=4 in log-normal distribution)
Lc prior = 11.7, s.d. = 1.17 (cm), alpha prior = 26.2, s.d. = 2.62
General reference points [median across years]:
Linf = 34.6 (34.1–35.2) cm
Lopt = 23 cm, Lopt/Linf = 0.67
Lc_opt = 22 cm, Lc_opt/Linf = 0.64
M/K = 1.48 (1.21–1.74)
F/K = 9.95 (8.8–11)
Z/K = 11.5 (10.4–12.4)
F/M = 6.36 (5.22–8.27)
B/B0 F=M Lc=Lc_opt = 0.367
B/B0 = 0.0547 (0.0383–0.0749)
Y/R' F=M Lc=Lc_opt = 0.0463
Y/R' = 0.00908 (0.00636–0.0124) (linearly reduced if B/B0 < 0.25)
Estimates for last year 2014:
Lc = 13.3 (13.1–13.4) cm, Lc/Linf = 0.39 (0.383–0.392)
alpha = 28.4 (27.7–29.2)
Lmean/Lopt = 0.7, Lc/Lc_opt = 0.6, L95th = 32 cm, L95th/Linf = 0.93, Lm50 = 13 cm, Mature = 66%
F/K = 5.2 (4.86–5.67)
F/M = 3.7 (2.98–5)
Z/K = 6.61 (6.33–6.99)
Y/R' = 0.012 (0.00811–0.0163) (linearly reduced if B/B0 < 0.25)
B/B0 = 0.07 (0.048–0.0965)
B/Bmsy = 0.19 (0.131–0.263)
Comment: Official assessment F/Fmsy2007=1.5. Lm50 from Tsikliras and Stergiou (2014)



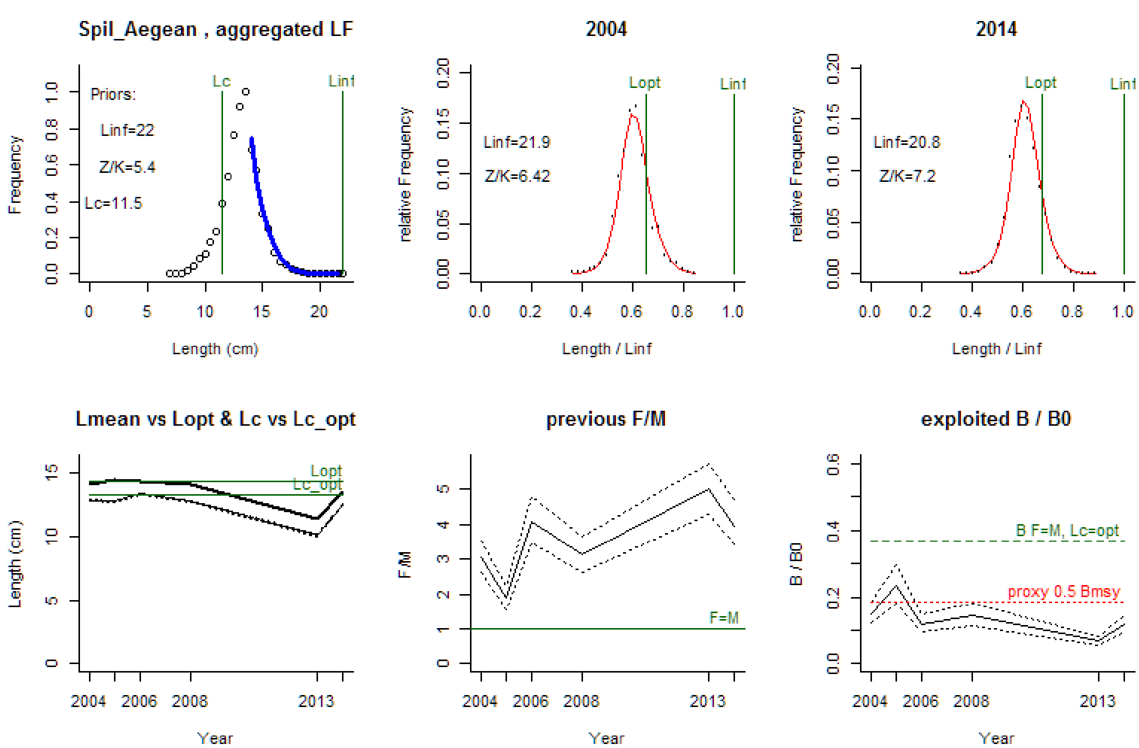
Results for *Parapenaeus longirostris*, stock **DPS-GSA10**, 2009–2015
(95% confidence limits in parentheses) File: ComDat_1.csv

Linf prior = 4.4, s.d. = 0.044 (cm)
Z/K prior = 4.42, s.d. = 1.56, M/K prior = 1.5, s.d. = 0.15
F/K prior = 2.92 (wide range with tau=4 in log-normal distribution)
Lc prior = 1.73, s.d. = 0.173 (cm), alpha prior = 32.4, s.d. = 3.24
General reference points [median across years]:
Linf = 4.23 (4.16–4.31) cm
Lopt = 3 cm, Lopt/Linf = 0.71
Lc_opt = 2.7 cm, Lc_opt/Linf = 0.65
M/K = 1.2 (0.897–1.54)
F/K = 3.08 (2.64–3.34)
Z/K = 4.18 (3.91–4.48)
F/M = 2.67 (1.86–3.59)
B/B0 F=M Lc=Lc_opt = 0.378
B/B0 = 0.12 (0.0715–0.172)
Y/R' F=M Lc=Lc_opt = 0.0635
Y/R' = 0.0308 (0.0172–0.0442) (linearly reduced if B/B0 < 0.25)
Estimates for last year 2015:
Lc = 1.61 (1.6–1.62) cm, Lc/Linf = 0.38 (0.374–0.379)
alpha = 38 (36.9–38.9)
Lmean/Lopt = 0.7, Lc/Lc_opt = 0.59, L95th = 3.8 cm, L95th/Linf = 0.89, Lm50 = 2.5 cm, Mature = 7%
F/K = 3.8 (3.43–4.17)
F/M = 2.8 (2.23–3.8)
Z/K = 5.13 (4.82–5.46)
Y/R' = 0.018 (0.0126–0.0251) (linearly reduced if B/B0 < 0.25)
B/B0 = 0.098 (0.0687–0.136)
B/Bmsy = 0.26 (0.182–0.361)
Comment: F/Fmsy2015=2.0 in official assessment.



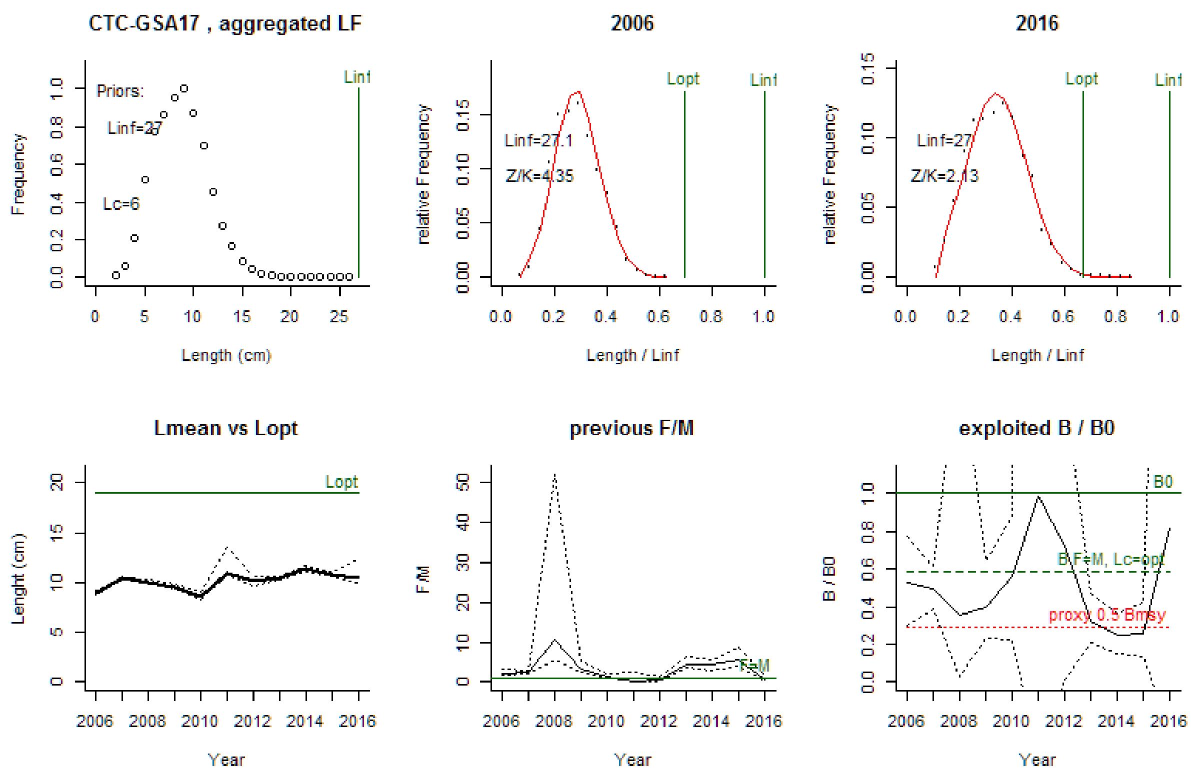
Results for *Sardina pilchardus*, stock **Spil_Aegean**, 2004–2014
(95% confidence limits in parentheses) File: ComDat_1.csv

Linf prior = 22, s.d. = 0.22 (cm)
Z/K prior = 5.44, s.d. = 2.83, M/K prior = 1.6, s.d. = 0.075 (user-defined)
F/K prior = 3.84 (wide range with tau=4 in log-normal distribution)
Lc prior = 11.7, s.d. = 1.17 (cm), alpha prior = 25.6, s.d. = 2.56
General reference points [median across years]:
Linf = 21.3 (21–21.7) cm
Lopt = 14 cm, Lopt/Linf = 0.67
Lc_opt = 13 cm, Lc_opt/Linf = 0.62
M/K = 1.47 (1.34–1.61)
F/K = 5.29 (4.87–5.94)
Z/K = 6.82 (6.38–7.44)
F/M = 3.54 (3.03–4.19)
B/B0 F=M Lc=Lc_opt = 0.367
B/B0 = 0.133 (0.106–0.163)
Y/R' F=M Lc=Lc_opt = 0.0472
Y/R' = 0.028 (0.0229–0.0345) (linearly reduced if B/B0 < 0.25)
Estimates for last year 2014:
Lc = 12.4 (12.4–12.5) cm, Lc/Linf = 0.6 (0.594–0.601)
alpha = 32.4 (31.6–33.1)
Lmean/Lopt = 0.96, Lc/Lc_opt = 0.94, L95th = 18.5 cm, L95th/Linf = 0.89, Lm50 = 12 cm, Mature = 64%
F/K = 5.8 (5.32–6.45)
F/M = 4 (3.45–4.73)
Z/K = 7.22 (6.79–7.84)
Y/R' = 0.027 (0.0218–0.0332) (linearly reduced if B/B0 < 0.25)
B/B0 = 0.12 (0.0951–0.145)
B/Bmsy = 0.32 (0.259–0.394)
Comment: Official assessment F/Fmsy=1.7 and B/Bmsy=0.34. Lm50 from Tsikliras and Stergiou (2014)



Results for *Sepia officinalis*, stock **CTC-GSA17**, 2006–2016, Gaussian selection
(95% confidence limits in parentheses) File: ComDat_1.csv

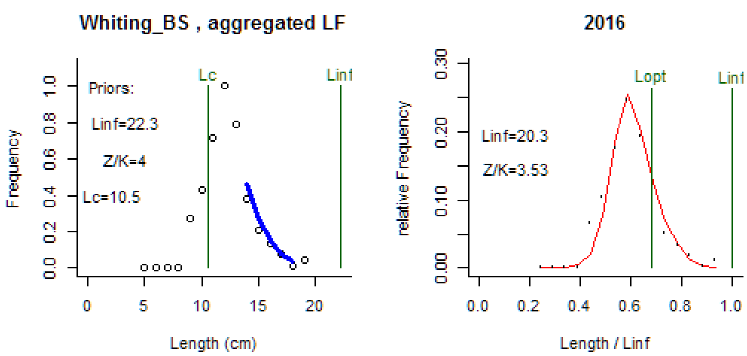
Linf prior = 27, s.d. = 0.27 (cm) (user-defined)
Z/K prior = 6.17, s.d. = 0.21, M/K prior = 1.5, s.d. = 0.15
General reference points [median across years]:
Linf = 27.1 (26.5–27.6) cm
Lopt = 19 cm, Lopt/Linf = 0.7
Lc_opt = 17 cm, Lc_opt/Linf = 0.64
M/K = 1.28 (0.992–1.55)
F/K = 3.8 (3.16–4.63)
Z/K = 4.69 (4.13–5.49)
F/M = 2.56 (2.21–3.14)
B/B0 F=M Lmean=Lopt= 0.585
B/B0 = 0.494 (0.149–0.774)
Y/R' F=M Lmean=Lopt= 0.0471
Y/R' = 0.0165 (0.00783–0.0387) (linearly reduced if B/B0 < 0.25)
Estimates for last year 2016:
GLmean/Linf= 0.38, s.d./Linf = 0.12
GLmean = 10.4, s.d. = 3.24
F/K = 0.66 (0.0555–3.16)
F/M = 0.45 (0.0353–1.85)
Z/K = 2.15 (1.5–4.98)
Y/R' = 0.0087 (–0.00273–0.0516) (linearly reduced if B/B0 < 0.25)
B/B0 = 0.81 (–0.256–4.83)
B/Bmsy = 1.4 (–0.437–8.26)
Comment: Caught to equal parts with trawls and trammel nets and traps. Trawl-like selection suggests strong overexploitation. Gaussian selection gives results similar to official assessment, with F/Fmsy2016=0.8.



7) Empirical data from the Black Sea (Independent assessment in Comment; LBB_11.R)

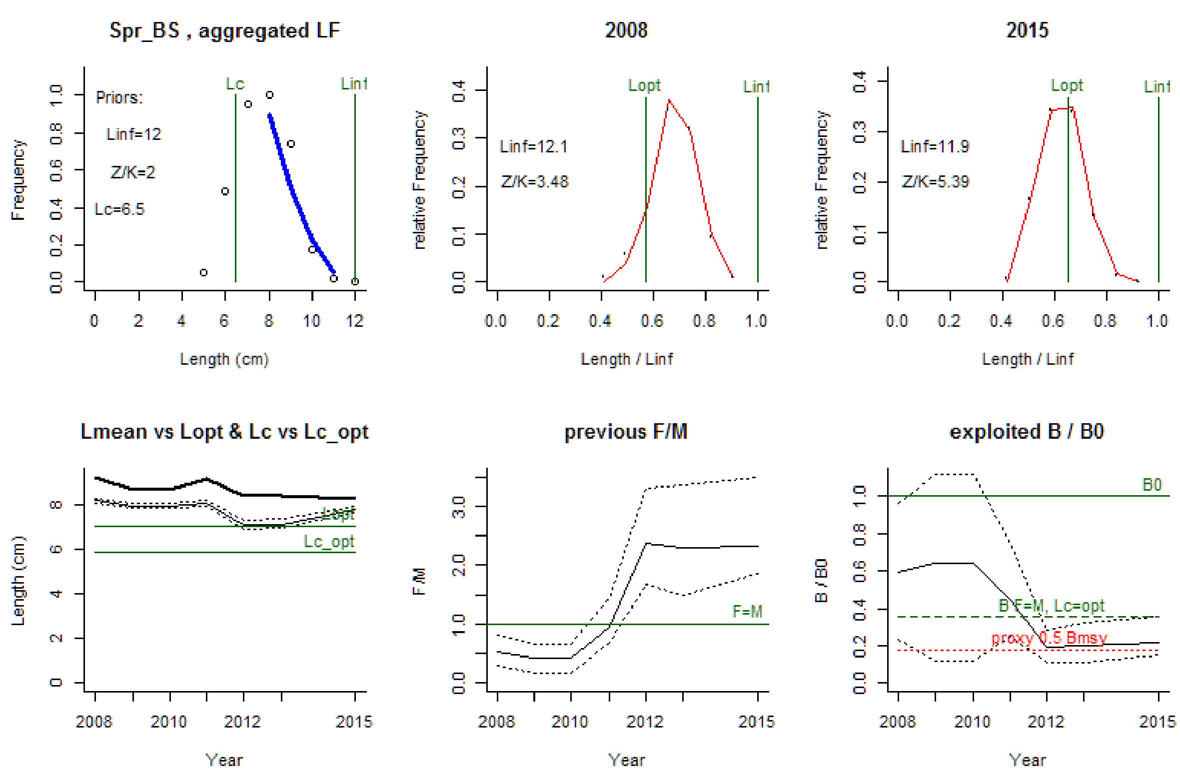
Results for *Merlangius merlangus*, stock **Whiting_BS**, 2016–2016
(95% confidence limits in parentheses) File: ComDat_1.csv

Linf prior = 22.3, s.d. = 0.223 (cm)
Z/K prior = 3.97, s.d. = 3.1, M/K prior = 1.8, s.d. = 0.075 (user-defined)
F/K prior = 2.17 (wide range with tau=4 in log-normal distribution)
Lc prior = 10.7, s.d. = 1.07 (cm), alpha prior = 19.3, s.d. = 1.93
General reference points [median across years]:
Linf = 20.3 (20.1–20.6) cm
Lopt = 14 cm, Lopt/Linf = 0.69
Lc_opt = 12 cm, Lc_opt/Linf = 0.6
M/K = 1.38 (1.24–1.5)
F/K = 2.15 (1.92–2.38)
Z/K = 3.52 (3.32–3.77)
F/M = 1.55 (1.32–1.84)
B/B0 F=M Lc=Lc_opt = 0.371
B/B0 = 0.256 (0.203–0.315)
Y/R' F=M Lc=Lc_opt = 0.0518
Y/R' = 0.0571 (0.0453–0.0704) (linearly reduced if B/B0 < 0.25)
Estimates for last year 2016:
Lc = 11.2 (11.2–11.3) cm, Lc/Linf = 0.55 (0.55–0.555)
alpha = 31.4 (0.7–31.9)
Lmean/Lopt = 0.96, Lc/Lc_opt = 0.93, L95th = 19 cm, L95th/Linf = 0.94, Lm50 = 14.5 cm, Mature = 12%
F/K = 2.2 (1.92–2.38)
F/M = 1.6 (1.32–1.84)
Z/K = 3.52 (3.32–3.77)
Y/R' = 0.057 (0.0453–0.0704) (linearly reduced if B/B0 < 0.25)
B/B0 = 0.26 (0.203–0.315)
B/Bmsy = 0.69 (0.547–0.851)
Comment: Froese *et al*. (2016) estimate for 2014 F/Fmsy=1.5 (1.1–2.2), B/Bmsy=0.54 (0.36–0.74). Lm50 from STECF (2017)



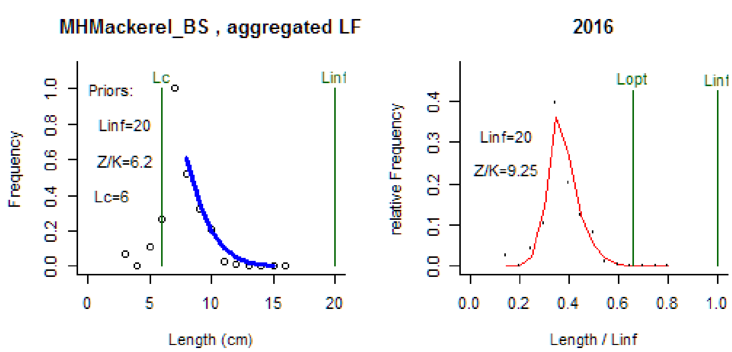
Results for *Sprattus sprattus*, stock **Spr_BS**, 2008–2015
(95% confidence limits in parentheses) File: ComDat_1.csv

Linf prior = 12, s.d. = 0.12 (cm)
Z/K prior = 2.01, s.d. = 2.51, M/K prior = 1.5, s.d. = 0.15
F/K prior = 0.512 (wide range with tau=4 in log-normal distribution)
Lc prior = 6.63, s.d. = 0.663 (cm), alpha prior = 17.3, s.d. = 1.73
General reference points [median across years]:
Linf = 11.9 (11.8–12.2) cm
Lopt = 7.1 cm, Lopt/Linf = 0.59
Lc_opt = 5.9 cm, Lc_opt/Linf = 0.49
M/K = 2.06 (1.88–2.27)
F/K = 2.12 (1.51–3.09)
Z/K = 4.25 (3.78–4.79)
F/M = 0.96 (0.681–1.45)
B/B0 F=M Lc=Lc_opt = 0.353
B/B0 = 0.443 (0.12–0.75)
Y/R' F=M Lc=Lc_opt = 0.0264
Y/R' = 0.0176 (0.00999–0.0297) (linearly reduced if B/B0 < 0.25)
Estimates for last year 2015:
Lc = 7.84 (7.67–7.98) cm, Lc/Linf = 0.66 (0.644–0.67)
alpha = 16.7 (16.2–17.3)
Lmean/Lopt = 1.1, Lc/Lc_opt = 1.3, L95th = 11 cm, L95th/Linf = 0.92, Lm50 = 7.8 cm, Mature = 48%
F/K = 3.8 (3.11–4.96)
F/M = 2.4 (1.86–3.5)
Z/K = 5.46 (4.74–6.36)
Y/R' = 0.039 (0.0267–0.0633) (linearly reduced if B/B0 < 0.25)
B/B0 = 0.22 (0.149–0.353)
B/Bmsy = 0.62 (0.422–1)
Comment: Froese *et al*. (2016) estimate for 2014 F/Fmsy=0.83 (0.7–1.1), B/Bmsy=1.1 (0.8–1.3). Lm50 from STECF (2017)



Results for *Trachurus mediterraneus*, stock **MHMackerel_BS**, 2016–2016
(95% confidence limits in parentheses) File: ComDat_1.csv

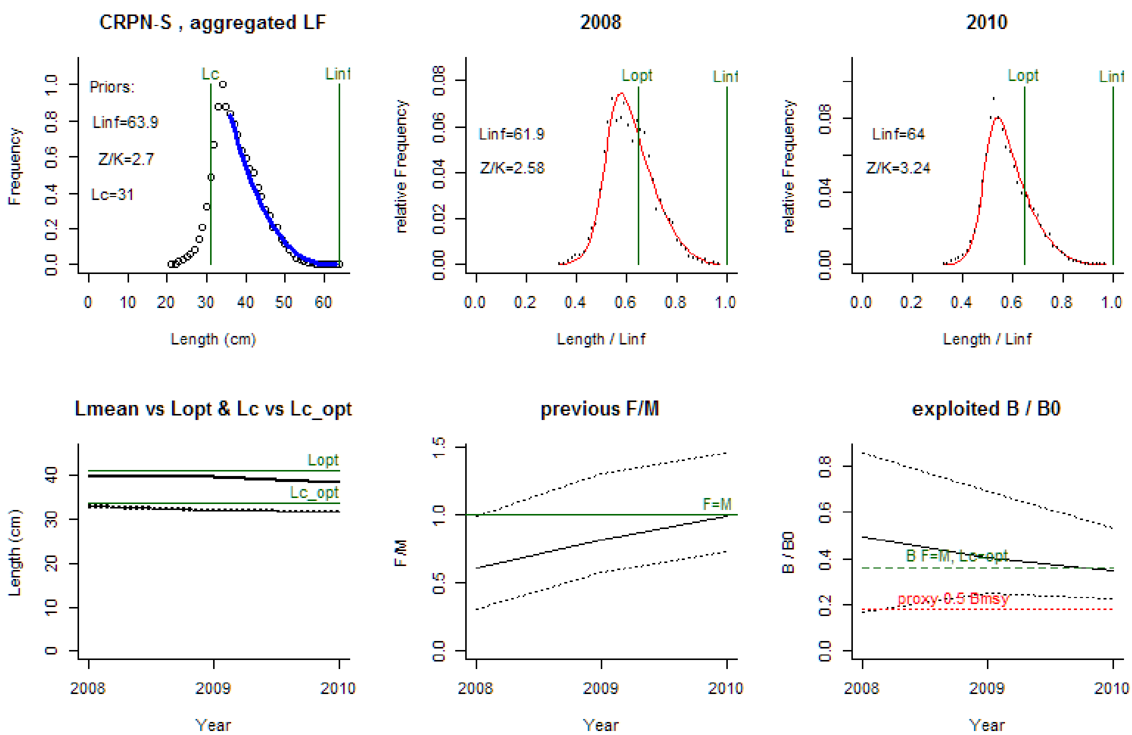
Linf prior = 20, s.d. = 0.2 (cm) (user-defined)
Z/K prior = 6.22, s.d. = 0.606, M/K prior = 1.5, s.d. = 0.15
F/K prior = 4.72 (wide range with tau=4 in log-normal distribution)
Lc prior = 6.12, s.d. = 0.612 (cm), alpha prior = 44.4, s.d. = 4.44
General reference points [median across years]:
Linf = 20 (19.6–20.3) cm
Lopt = 13 cm, Lopt/Linf = 0.66
Lc_opt = 12 cm, Lc_opt/Linf = 0.62
M/K = 1.56 (1.25–1.78)
F/K = 7.69 (7.31–8.24)
Z/K = 9.22 (8.89–9.67)
F/M = 4.93 (4.03–6.38)
B/B0 F=M Lc=Lc_opt = 0.364
B/B0 = 0.0424 (0.0309–0.0567)
Y/R' F=M Lc=Lc_opt = 0.0432
Y/R' = 0.00499 (0.00363–0.00667) (linearly reduced if B/B0 < 0.25)
Estimates for last year 2016:
Lc = 6.76 (6.73–6.8) cm, Lc/Linf = 0.34 (0.337–0.341)
alpha = 44.4 (43.1–45.8)
Lmean/Lopt = 0.6, Lc/Lc_opt = 0.55, L95th = 16 cm, L95th/Linf = 0.8, Lm50 = 12.5 cm, Mature = 0.17%
F/K = 7.7 (7.31–8.24)
F/M = 4.9 (4.03–6.38)
Z/K = 9.22 (8.89–9.67)
Y/R' = 0.005 (0.00363–0.00667) (linearly reduced if B/B0 < 0.25)
B/B0 = 0.042 (0.0309–0.0567)
B/Bmsy = 0.12 (0.0848–0.156)
Comment: Froese *et al*. (2016) estimate for 2014 F/Fmsy=7 (5–9), B/Bmsy=0.11 (0.09–0.15). Lm50 from STECF (2017). Linf from FishBase.



8) Empirical data from South Africa (Independent assessment in Comment; LBB_11.R)

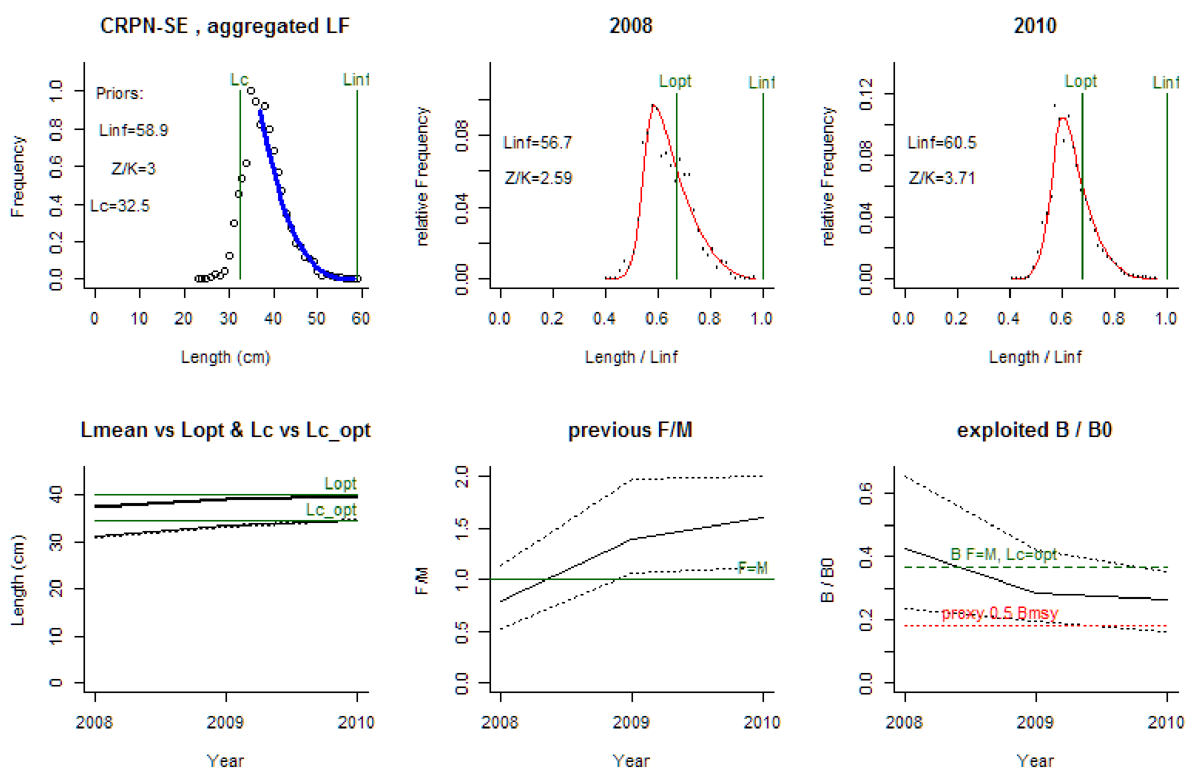
Results for *Argyrozona argyrozona*, stock **CRPN-S**, 2008–2010
(95% confidence limits in parentheses) File: ComDat_1.csv

Linf prior = 63.9, s.d. = 0.639 (cm)
Z/K prior = 2.72, s.d. = 0.384, M/K prior = 1.5, s.d. = 0.15
F/K prior = 1.22 (wide range with tau=4 in log-normal distribution)
Lc prior = 31.6, s.d. = 3.16 (cm), alpha prior = 42.8, s.d. = 4.28
General reference points [median across years]:
Linf = 62.9 (62.4–63.6) cm
Lopt = 41 cm, Lopt/Linf = 0.65
Lc_opt = 33 cm, Lc_opt/Linf = 0.53
M/K = 1.61 (1.31–1.84)
F/K = 1.23 (1.01–1.65)
Z/K = 2.76 (2.64–2.95)
F/M = 0.822 (0.581–1.31)
B/B0 F=M Lc=Lc_opt = 0.363
B/B0 = 0.405 (0.226–0.691)
Y/R' F=M Lc=Lc_opt = 0.041
Y/R' = 0.0404 (0.0263–0.0622) (linearly reduced if B/B0 < 0.25)
Estimates for last year 2010:
Lc = 31.8 (31.6–32) cm, Lc/Linf = 0.5 (0.495–0.5)
alpha = 40.7 (39.4–42.5)
Lmean/Lopt = 0.93, Lc/Lc_opt = 0.95, L95th = 62 cm, L95th/Linf = 0.97, Lm50 = 26.7 cm, Mature = 99%
F/K = 1.6 (1.36–1.95)
F/M = 0.99 (0.735–1.46)
Z/K = 3.22 (3.07–3.48)
Y/R' = 0.04 (0.0263–0.0622) (linearly reduced if B/B0 < 0.25)
B/B0 = 0.35 (0.226–0.533)
B/Bmsy = 0.96 (0.624–1.47)
Comment: SB/SB0 = 0.423 (0.243–0.631) and SB/SBmsy = 1.21 (0.696–1.803) in official assessment 2011.



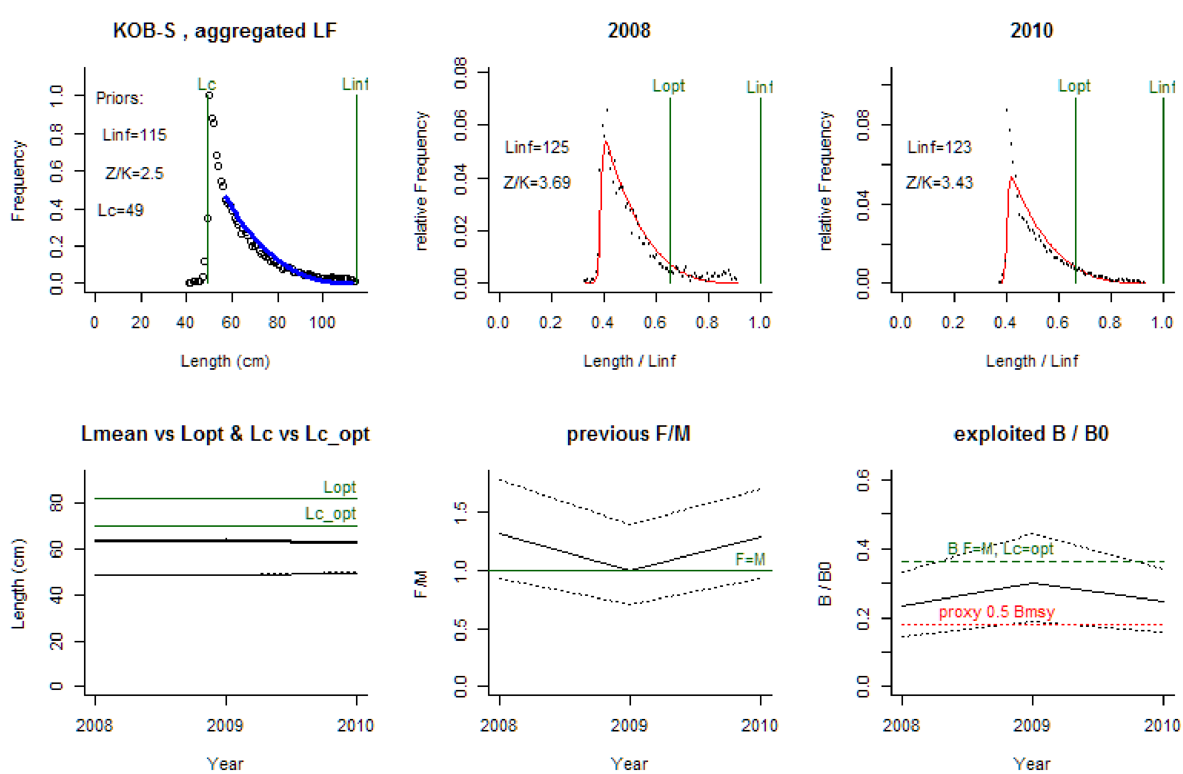
Results for *Argyrozona argyrozona*, stock **CRPN-SE**, 2008–2010
(95% confidence limits in parentheses) File: ComDat_1.csv

Linf prior = 58.9, s.d. = 0.589 (cm)
Z/K prior = 3.03, s.d. = 1.06, M/K prior = 1.5, s.d. = 0.15
F/K prior = 1.53 (wide range with tau=4 in log-normal distribution)
Lc prior = 33.1, s.d. = 3.31 (cm), alpha prior = 43.8, s.d. = 4.38
General reference points [median across years]:
Linf = 59.2 (58.5–60.2) cm
Lopt = 40 cm, Lopt/Linf = 0.68
Lc_opt = 34 cm, Lc_opt/Linf = 0.58
M/K = 1.44 (1.21–1.72)
F/K = 1.95 (1.71–2.28)
Z/K = 3.37 (3.14–3.64)
F/M = 1.39 (1.06–1.97)
B/B0 F=M Lc=Lc_opt = 0.369
B/B0 = 0.286 (0.195–0.423)
Y/R' F=M Lc=Lc_opt = 0.0487
Y/R' = 0.0539 (0.033–0.0724) (linearly reduced if B/B0 < 0.25)
Estimates for last year 2010:
Lc = 34.5 (34.4–34.7) cm, Lc/Linf = 0.57 (0.568–0.573)
alpha = 46.2 (45.1–47.5)
Lmean/Lopt = 0.97, Lc/Lc_opt = 1, L95th = 58 cm, L95th/Linf = 0.96, Lm50 = 26.7 cm, Mature = 100%
F/K = 2.3 (1.84–2.56)
F/M = 1.6 (1.12–2.01)
Z/K = 3.71 (3.44–3.99)
Y/R' = 0.054 (0.033–0.0724) (linearly reduced if B/B0 < 0.25)
B/B0 = 0.26 (0.161–0.353)
B/Bmsy = 0.71 (0.436–0.958)
Comment: SB/SB0 = 0.377 (0.245–0.529) and SB/SBmsy = 1.076 (0.699–1.511) in official assessment 2011.



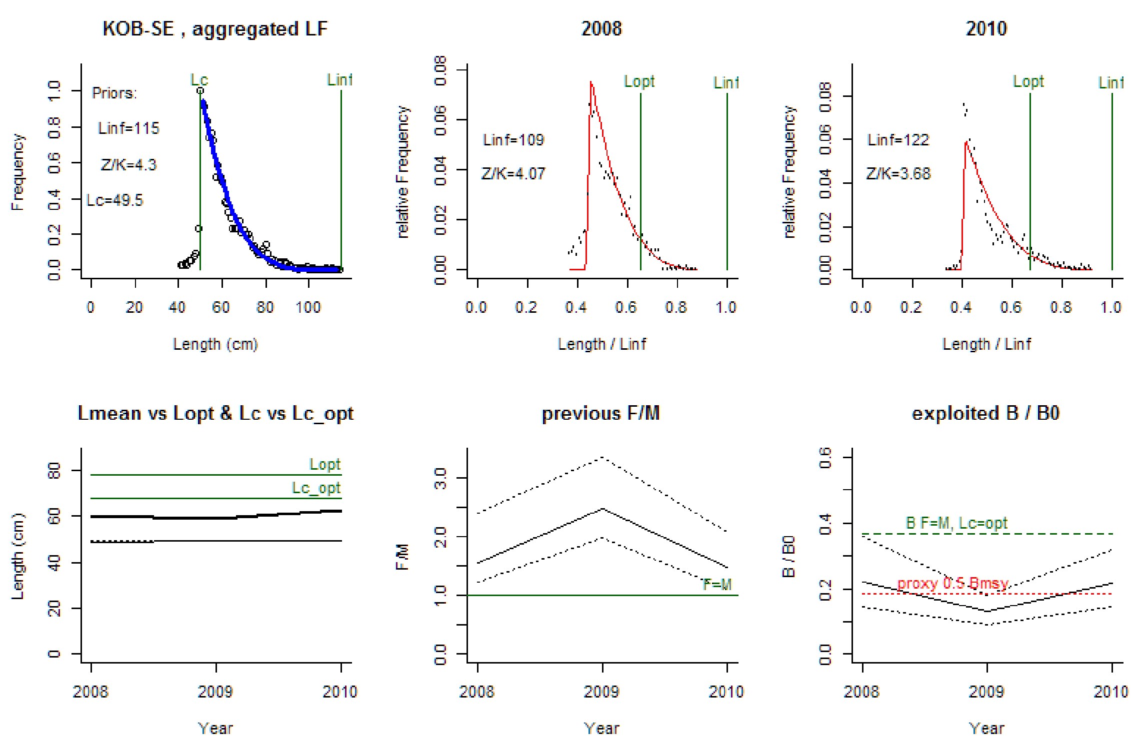
Results for *Argyrosomus inodorus*, stock **KOB-S**, 2008–2010
(95% confidence limits in parentheses) File: ComDat_1.csv

Linf prior = 115, s.d. = 1.15 (cm) (user-defined)
Z/K prior = 2.54, s.d. = 0.0708, M/K prior = 1.5, s.d. = 0.15
F/K prior = 1.04 (wide range with tau=4 in log-normal distribution)
Lc prior = 50, s.d. = 5 (cm), alpha prior = 236, s.d. = 23.6
General reference points [median across years]:
Linf = 125 (123–126) cm
Lopt = 82 cm, Lopt/Linf = 0.66
Lc_opt = 70 cm, Lc_opt/Linf = 0.56
M/K = 1.58 (1.31–1.81)
F/K = 1.92 (1.63–2.19)
Z/K = 3.45 (3.28–3.57)
F/M = 1.3 (0.934–1.71)
B/B0 F=M Lc=Lc_opt = 0.364
B/B0 = 0.247 (0.159–0.343)
Y/R' F=M Lc=Lc_opt = 0.0426
Y/R' = 0.0405 (0.0254–0.0593) (linearly reduced if B/B0 < 0.25)
Estimates for last year 2010:
Lc = 49.3 (49.3–49.4) cm, Lc/Linf = 0.4 (0.401–0.402)
alpha = 256 (248–266)
Lmean/Lopt = 0.77, Lc/Lc_opt = 0.71, L95th = 114 cm, L95th/Linf = 0.93, Lm50 = 37.5 cm, Mature = 100%
F/K = 1.9 (1.63–2.19)
F/M = 1.3 (0.934–1.71)
Z/K = 3.45 (3.28–3.57)
Y/R' = 0.044 (0.0286–0.0616) (linearly reduced if B/B0 < 0.25)
B/B0 = 0.25 (0.159–0.343)
B/Bmsy = 0.68 (0.438–0.941)
Comment: SB/SB2011 = 0.178 (0.128–0.229) and SB/SBmsy2011 = 0.509 (0.367–0.653) in official assessment.



Results for *Argyrosomus inodorus*, stock **KOB-SE**, 2008–2010
(95% confidence limits in parentheses) File: ComDat_1.csv

Linf prior = 115, s.d. = 1.15 (cm) (user-defined)
Z/K prior = 4.34, s.d. = 0.095, M/K prior = 1.5, s.d. = 0.15
F/K prior = 2.84 (wide range with tau=4 in log-normal distribution)
Lc prior = 50.5, s.d. = 5.05 (cm), alpha prior = 496, s.d. = 49.6
General reference points [median across years]:
Linf = 118 (116–119) cm
Lopt = 78 cm, Lopt/Linf = 0.66
Lc_opt = 68 cm, Lc_opt/Linf = 0.57
M/K = 1.54 (1.23–1.8)
F/K = 2.47 (2.13–3.13)
Z/K = 4.08 (3.79–4.52)
F/M = 1.56 (1.22–2.4)
B/B0 F=M Lc=Lc_opt = 0.366
B/B0 = 0.217 (0.143–0.317)
Y/R' F=M Lc=Lc_opt = 0.0443
Y/R' = 0.039 (0.0253–0.0585) (linearly reduced if B/B0 < 0.25)
Estimates for last year 2010:
Lc = 49.4 (49.3–49.4) cm, Lc/Linf = 0.4 (0.404–0.405)
alpha = 479 (450–502)
Lmean/Lopt = 0.77, Lc/Lc_opt = 0.73, L95th = 112 cm, L95th/Linf = 0.92, Lm50 = 37.5 cm, Mature = 100%
F/K = 2.2 (1.91–2.53)
F/M = 1.5 (1.11–2.07)
Z/K = 3.69 (3.53–3.87)
Y/R' = 0.04 (0.0266–0.0585) (linearly reduced if B/B0 < 0.25)
B/B0 = 0.22 (0.144–0.317)
B/Bmsy = 0.59 (0.394–0.867)
Comment: SB/SB0= 0.214 (0.161–0.273) and SB/SBmsy = 0.611 (0.459–0.78) in official assessment 2011.



Results for *Chrysoblephus puniceus*, stock **SLNG-E**, 2008–2010
(95% confidence limits in parentheses) File: ComDat_1.csv

Linf prior = 45, s.d. = 0.45 (cm)
Z/K prior = 2.83, s.d. = 0.947, M/K prior = 1.5, s.d. = 0.15
F/K prior = 1.33 (wide range with tau=4 in log-normal distribution)
Lc prior = 24, s.d. = 2.4 (cm), alpha prior = 29.7, s.d. = 2.97
General reference points [median across years]:
Linf = 44.3 (43.8–44.9) cm
Lopt = 30 cm, Lopt/Linf = 0.68
Lc_opt = 25 cm, Lc_opt/Linf = 0.56
M/K = 1.38 (1.06–1.63)
F/K = 1.27 (0.912–1.7)
Z/K = 2.73 (2.48–3.01)
F/M = 0.84 (0.546–1.6)
B/B0 F=M Lc=Lc_opt = 0.371
B/B0 = 0.412 (0.195–0.688)
Y/R' F=M Lc=Lc_opt = 0.051
Y/R' = 0.0473 (0.0215–0.0882) (linearly reduced if B/B0 < 0.25)
Estimates for last year 2010:
Lc = 25.8 (25.6–26) cm, Lc/Linf = 0.58 (0.575–0.582)
alpha = 32.7 (31.9–33.8)
Lmean/Lopt = 0.96, Lc/Lc_opt = 1, L95th = 44 cm, L95th/Linf = 0.99, Lm50 = 24 cm, Mature = 87%
F/K = 1.8 (1.5–2.04)
F/M = 1.4 (1.05–1.92)
Z/K = 3.02 (2.85–3.26)
Y/R' = 0.063 (0.041–0.0905) (linearly reduced if B/B0 < 0.25)
B/B0 = 0.29 (0.191–0.422)
B/Bmsy = 0.79 (0.515–1.14)
Comment: SB/SB= 0.391 (0.238–0.578) and SB/SBmsy = 0.945 (0.558–1.449) in official assessment 2011.