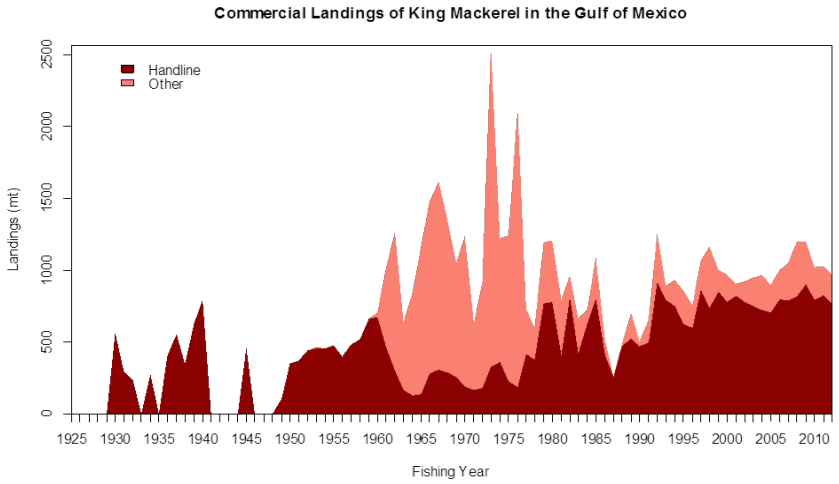
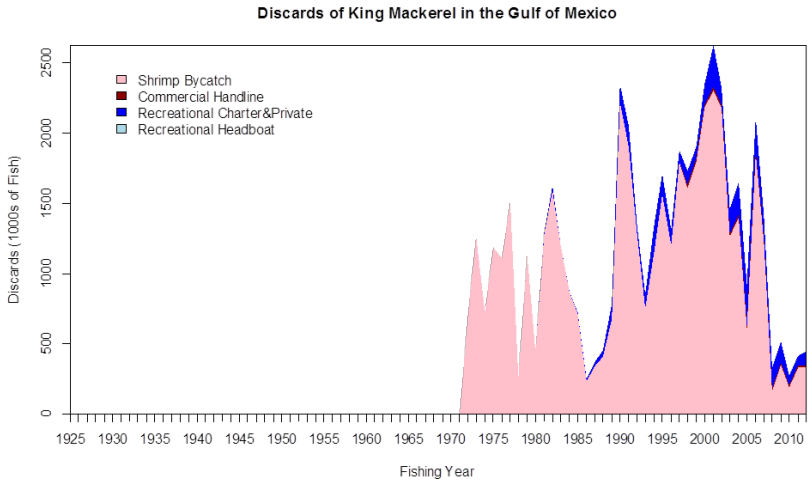
Gulf of Mexico King Mackerel Stock Assessment

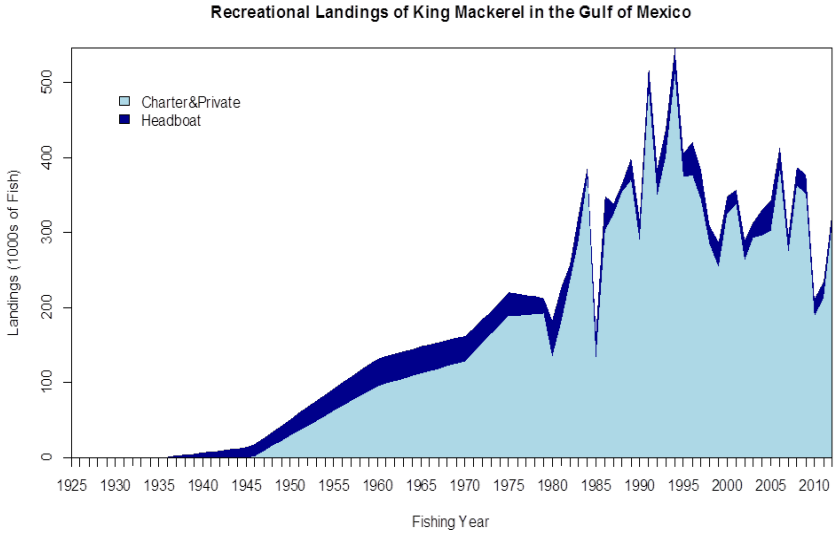
SEDAR 38 Review workshop

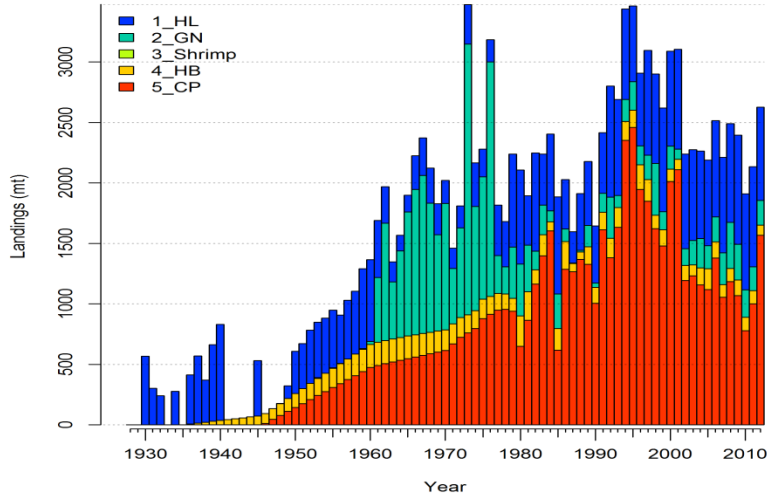
August 12-14, 2014
SEFSC staff
Miami, FL

Landings


Commercial Landings of King Mackerel in the Gulf of Mexico
Handline
Other
Landings (mt)
0
500
1000
1500
2000
2500
1925 1930 1935 1940 1945 1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010
Fishing Year


Discards of King Mackerel in the Gulf of Mexico
Shrimp Bycatch
Commercial Handline
Recreational Charter&Private
Recreational Headboat
Discards (1000s of Fish)
0
500
1000
1500
2000
2500
1925 1930 1935 1940 1945 1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010
Fishing Year


Recreational Landings of King Mackerel in the Gulf of Mexico
Charter&Private
Headboat
Landings (1000s of Fish)
0
100
200
300
400
500
1925 1930 1935 1940 1945 1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010
Fishing Year


1_HL
2_GN
3_Shrimp
4_HB
5_CP
Landings (mt)
0
500
1000
1500
2000
2500
3000
1930 1940 1950 1960 1970 1980 1990 2000 2010
Year

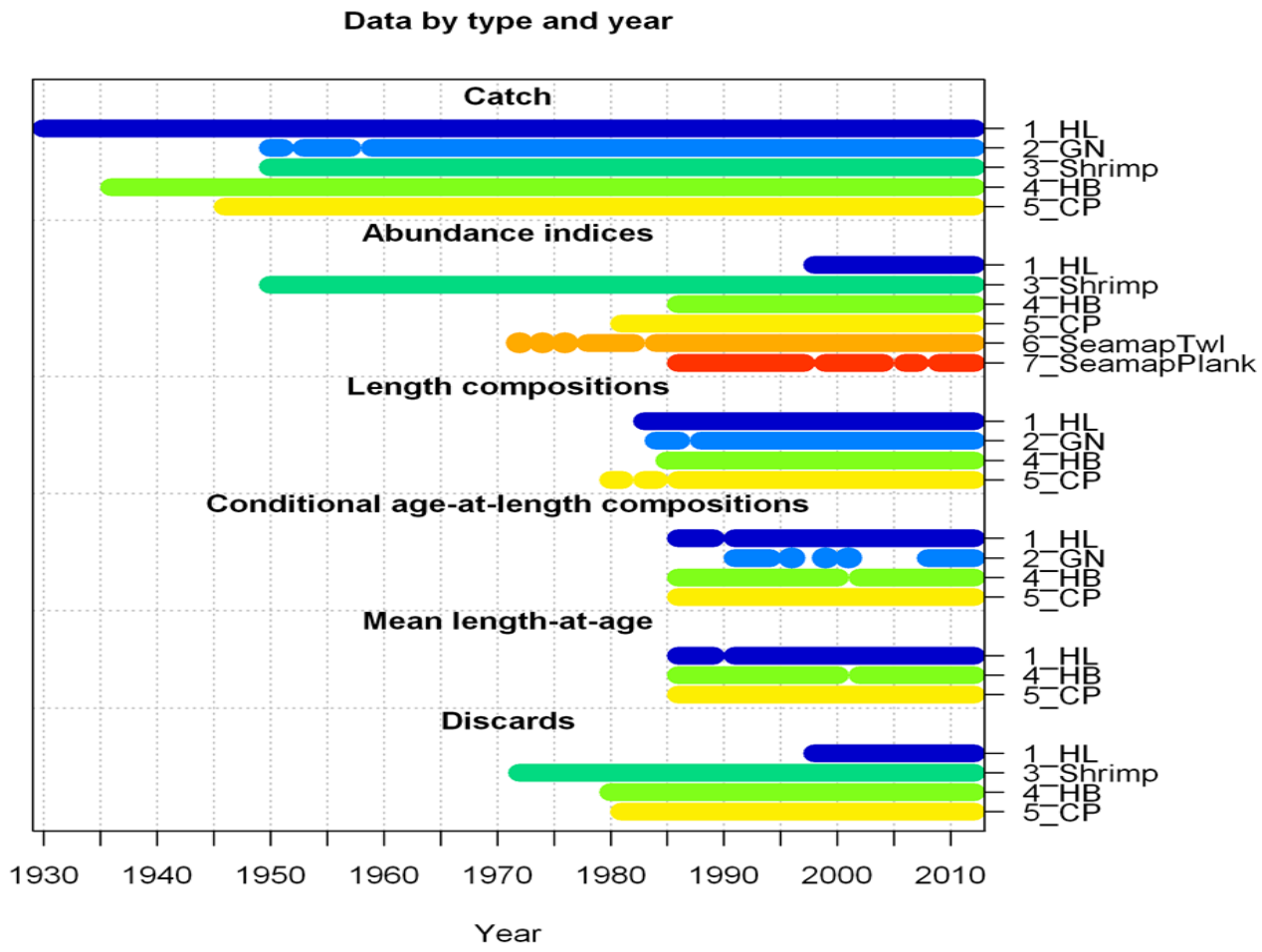


Figure 3.1.1 Data sources used or considered in the GOM king mackerel assessment.

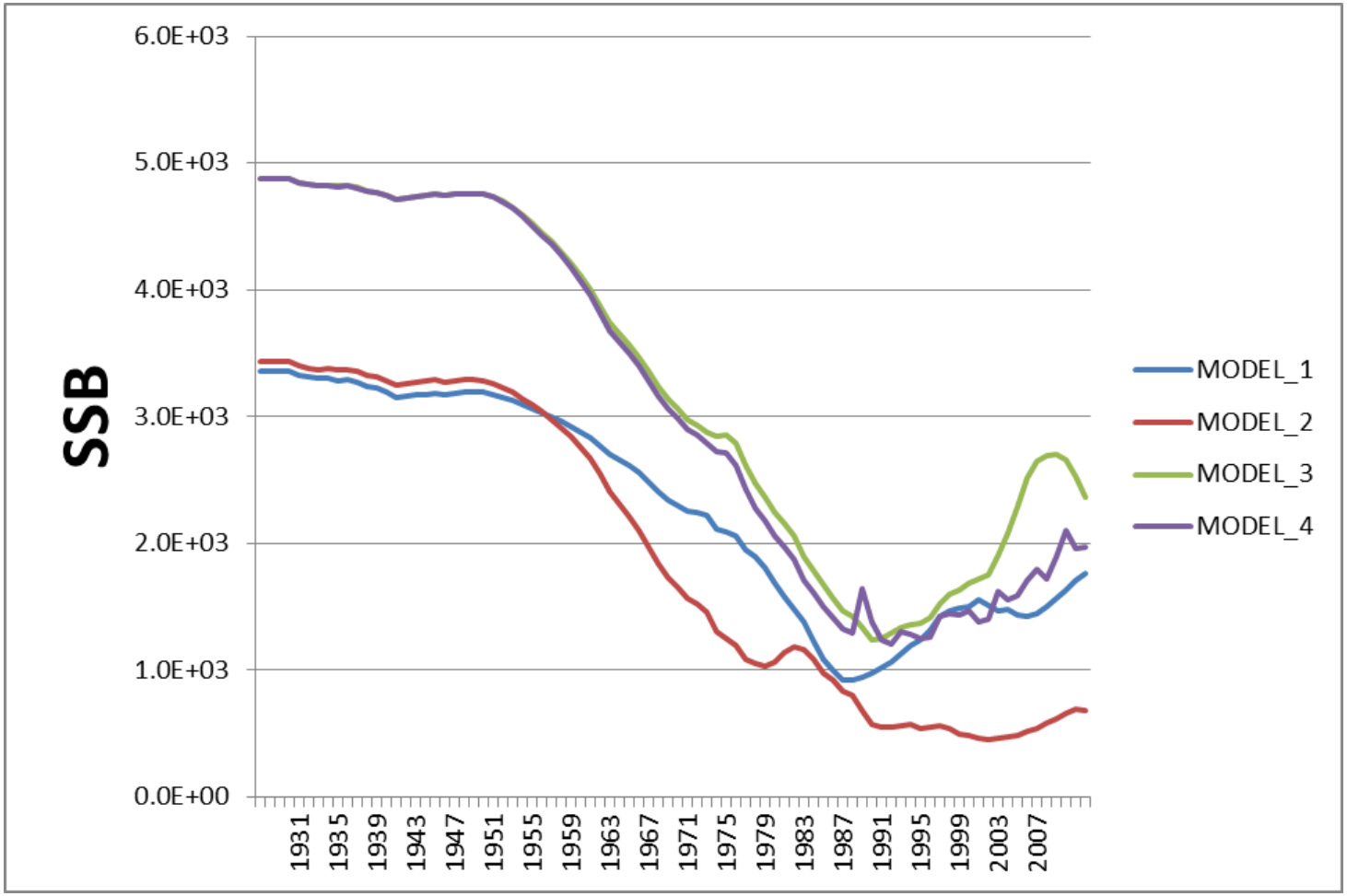
Model Configurations and Equations 3.1.1.3

- The total fishery was parsed into 5 fleets
- Commercial handline and gillnet, and shrimp fishery bycatch
- Recreational fisheries included Headboat and Charter/Private
- Surveys included commercial H&L CPUE, shrimp effort, Headboat CPUE, SEAMAP trawl survey (age_1), and SEAMAP larval survey (SSB)

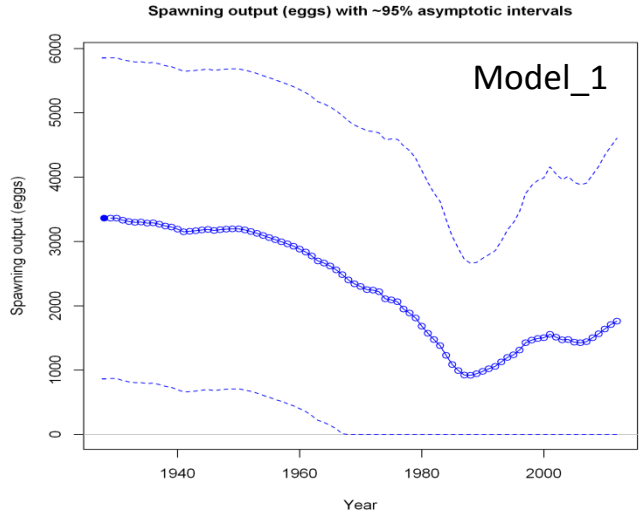
Investigative Model Configures

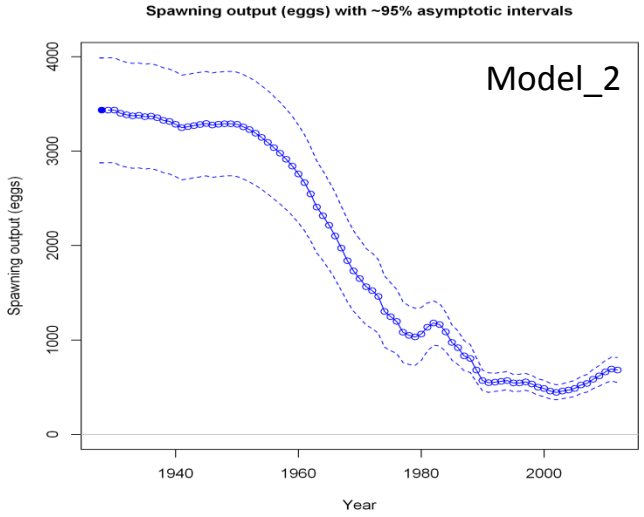
- KMK_GOM_1: This uses CPUE only with no length or age-at-length(AAL);
  Two length bins (i.e. one big plus group)
  Allows recruitment deviations;
  Fixed sex-specific growth at Data Workshop values
- KMK_GOM_2: This start with #1
  Add only lengths and selectivity
- KMK_GOM_3: This starts with #2
  Adds AAL
  Freely estimated constant growth (i.e. no informed priors)
- ~~KMK_GOM_4: This starts with #3~~
  ~~Fixes the growth parameters at those estimated in in #3,~~
  ~~Allows for annual deviations in male and female Linf and k.~~

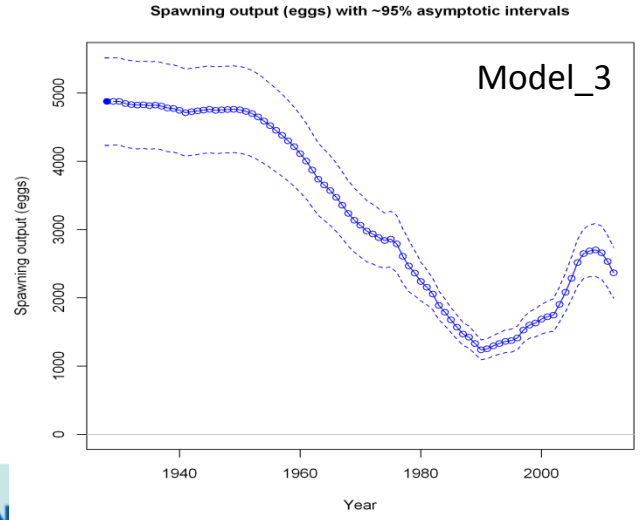
SSB for the four model configurations

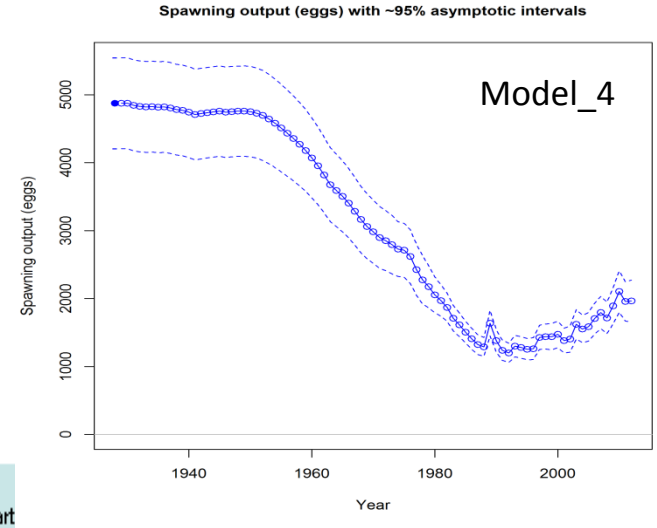


SSB trends are similar; certainty is not

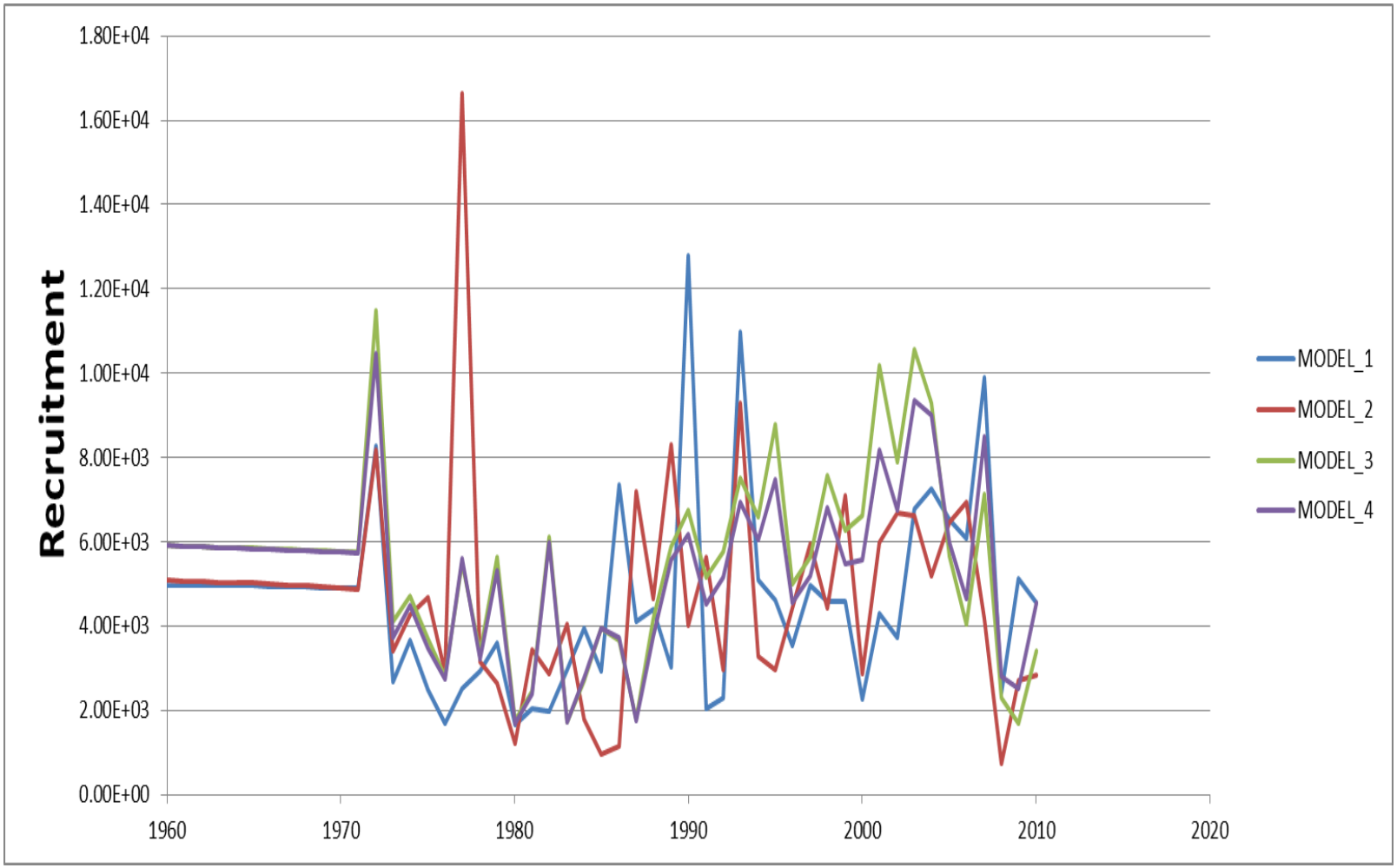




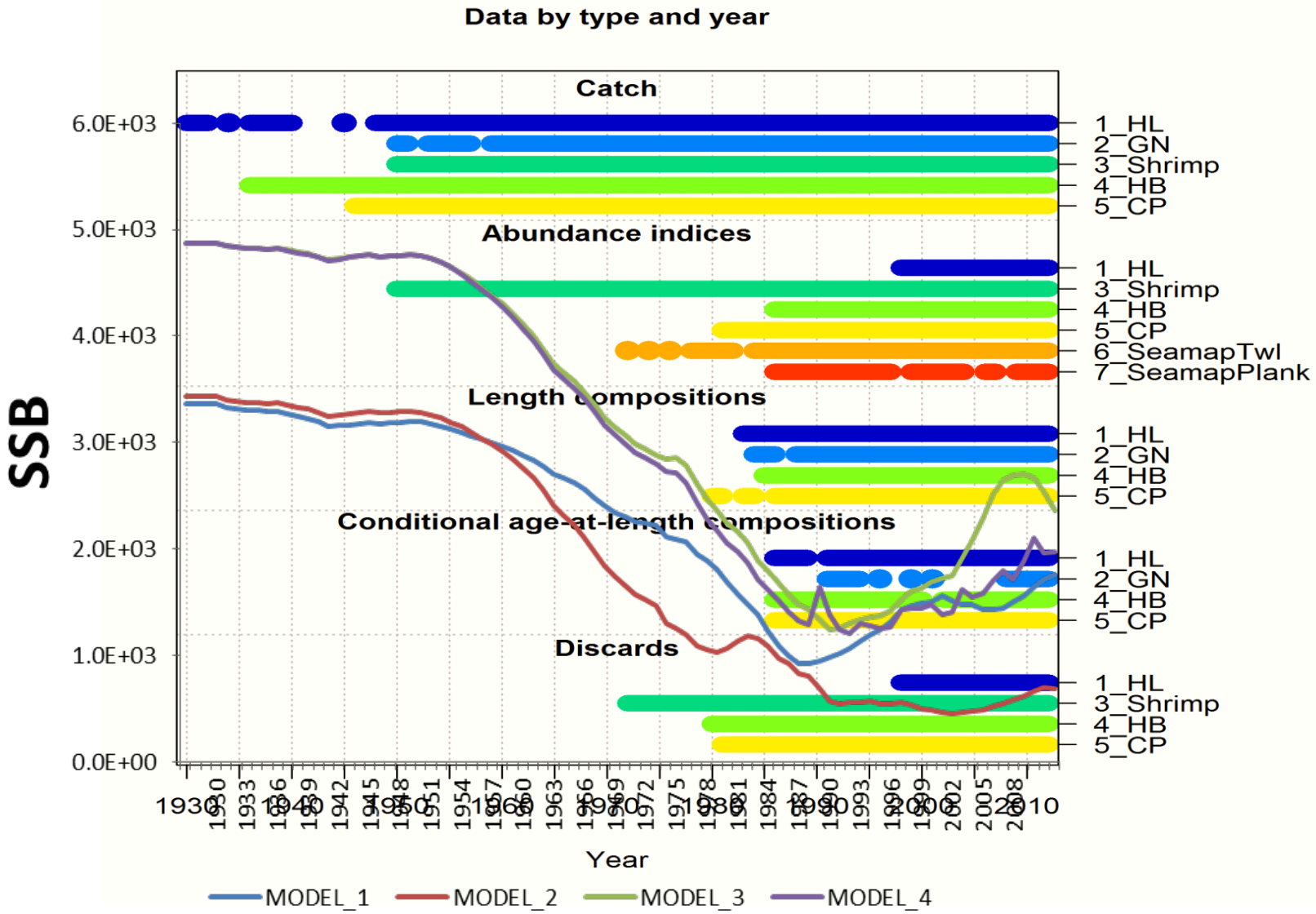




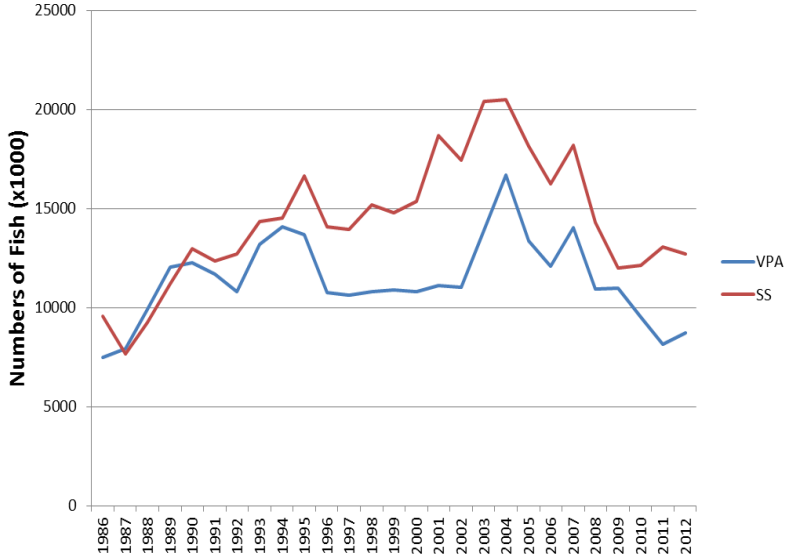
Recruitment

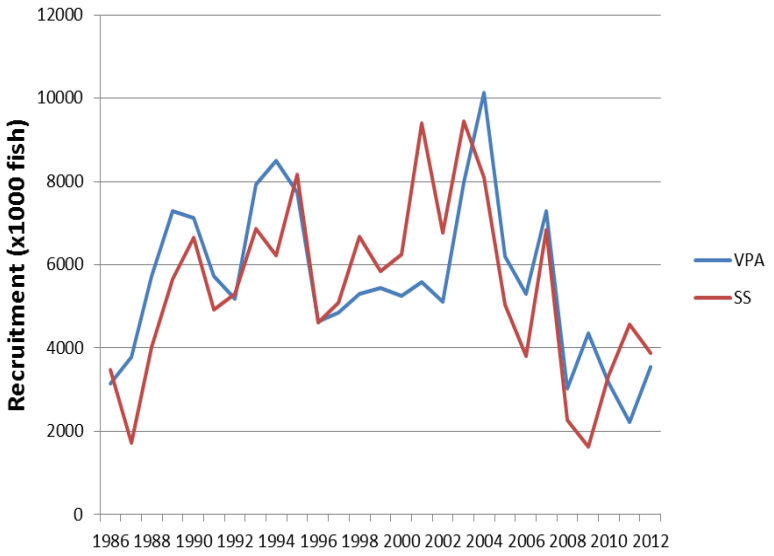


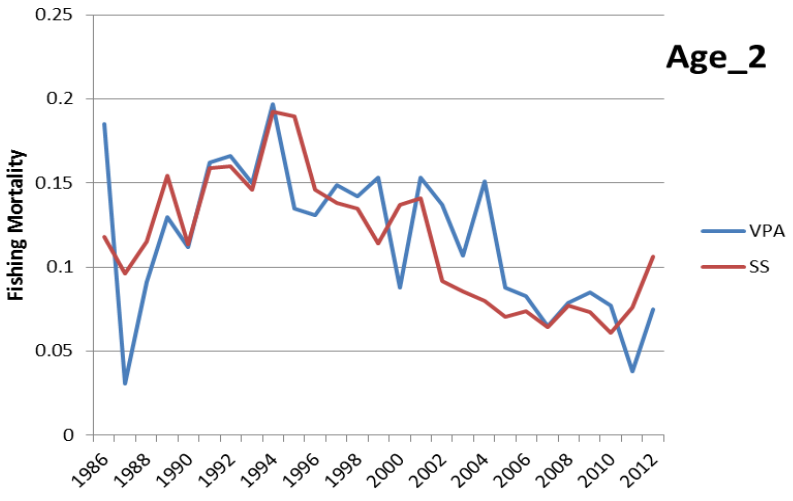
Trends vs. Data

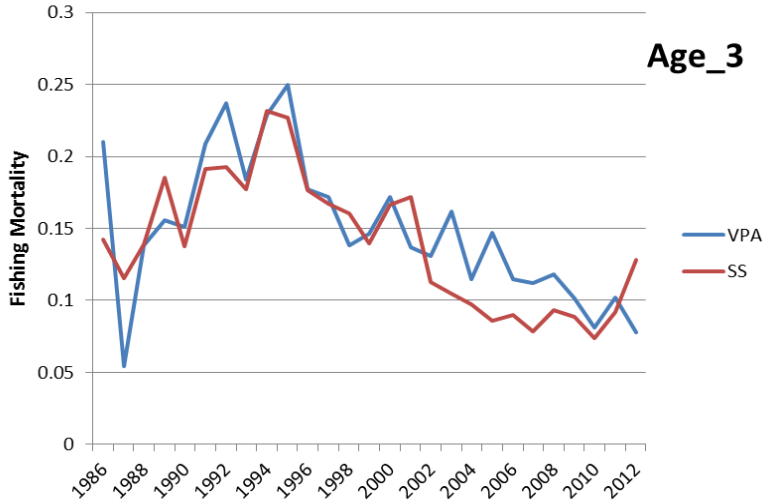


Compare SS to VPA









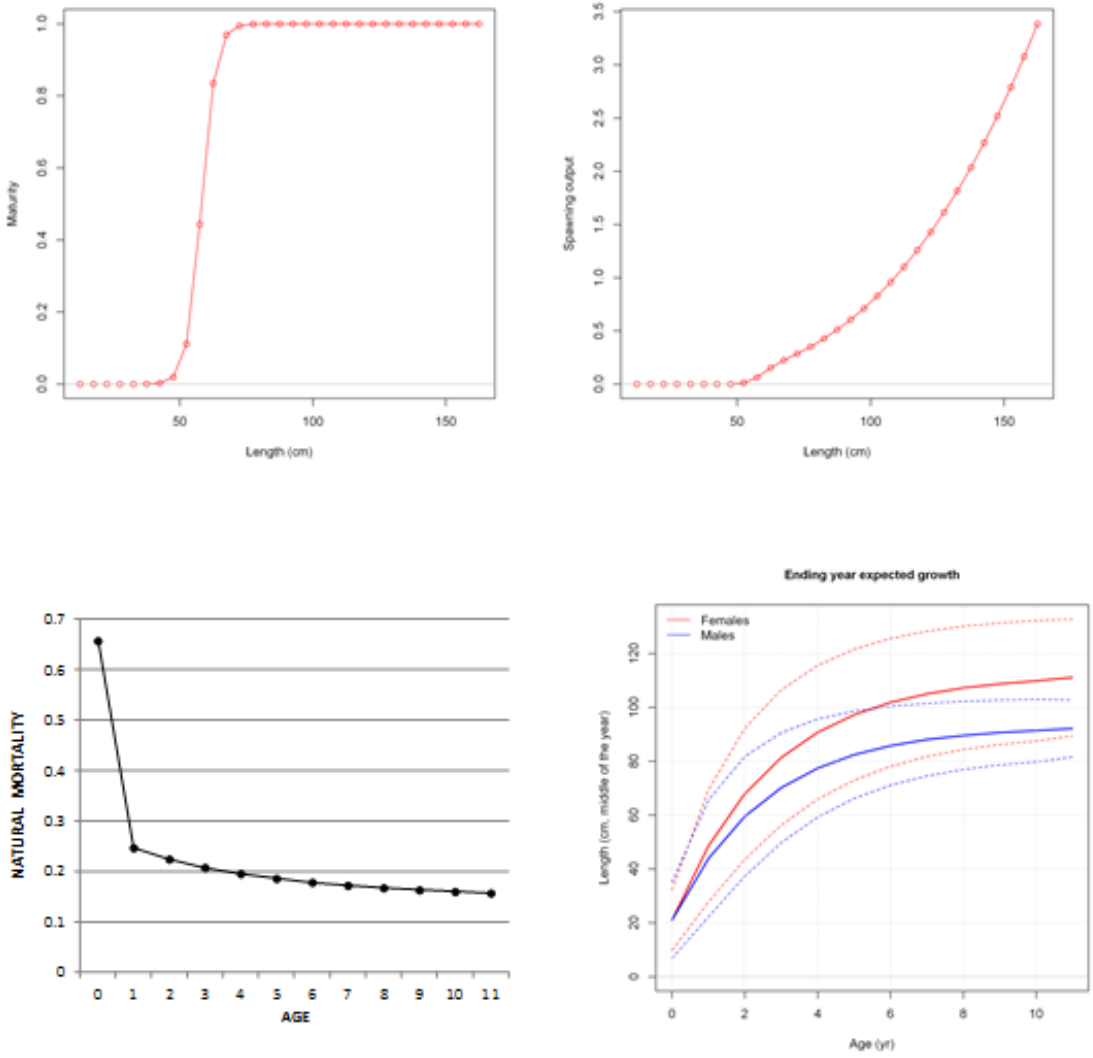


Figure 3.1.2. Critical life history function used for GOM king mackerel.

Label	Value	Active_Cn	Phase	Min	Max	Init	Status	Parm_StD
L_at_Amin_Fem_GP_1	21.00	_	-3	10	80	21.00	NA	_
L_at_Amax_Fem_GP_1	112.15	1	3	100	150	112.03	OK	0.491
VonBert_K_Fem_GP_1	0.36	2	4	0.1	0.5	0.37	OK	0.005
CV_young_Fem_GP_1	0.27	3	6	0.01	0.3	0.27	OK	0.005
CV_old_Fem_GP_1	0.10	4	6	0.01	0.3	0.10	OK	0.002
L_at_Amin_Mal_GP_1	21.00	_	-3	10	80	21.00	NA	_
L_at_Amax_Mal_GP_1	93.06	5	3	70	120	93.11	OK	0.292
VonBert_K_Mal_GP_1	0.38	6	4	0.1	0.7	0.38	OK	0.006
CV_young_Mal_GP_1	0.34	7	6	0.01	0.5	0.35	OK	0.007
CV_old_Mal_GP_1	0.06	8	6	0.01	0.3	0.06	OK	0.001

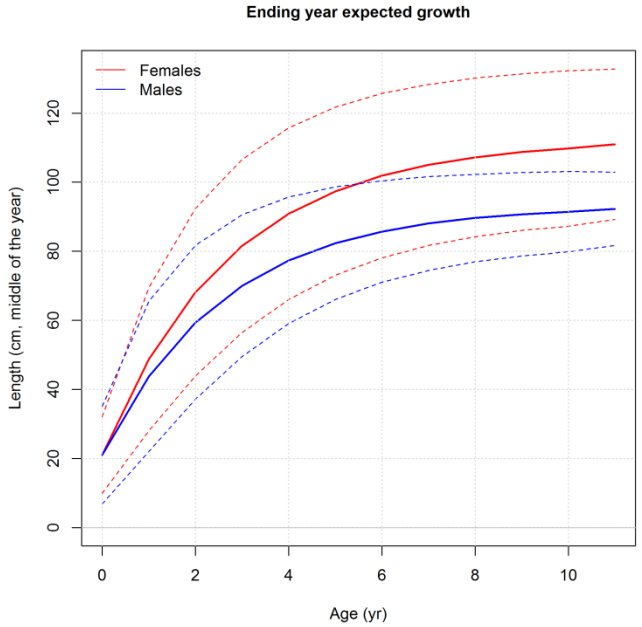


Figure 3.1.1.4.1 Parameter estimates and function for growth, GOM king mackerel.

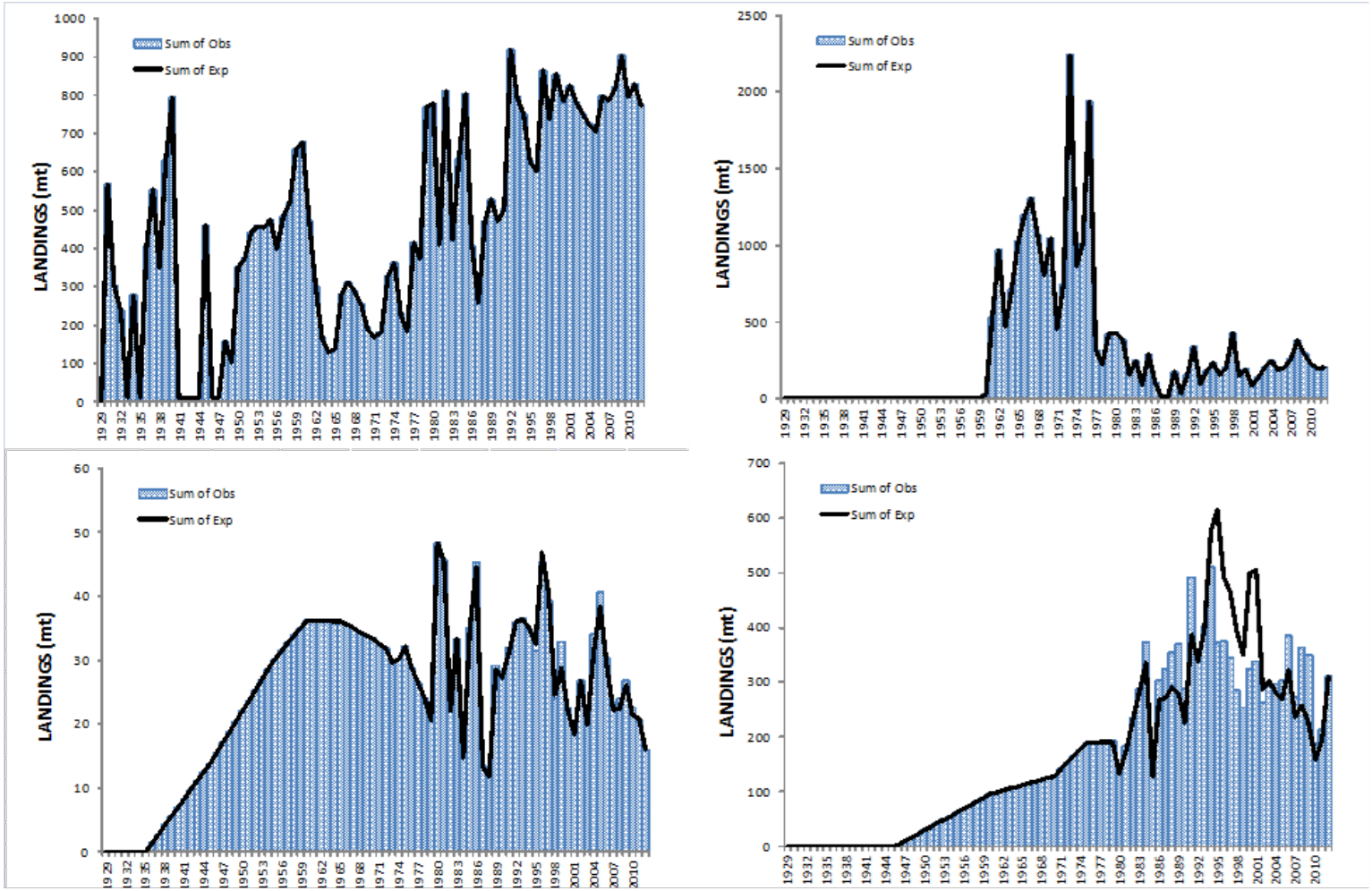


Figure 3.2.1. Observed and expected landings for commercial handline (upper left); gillnet (upper right); headboat (lower left); and Charter-Private (lower right) for GOM king mackerel.

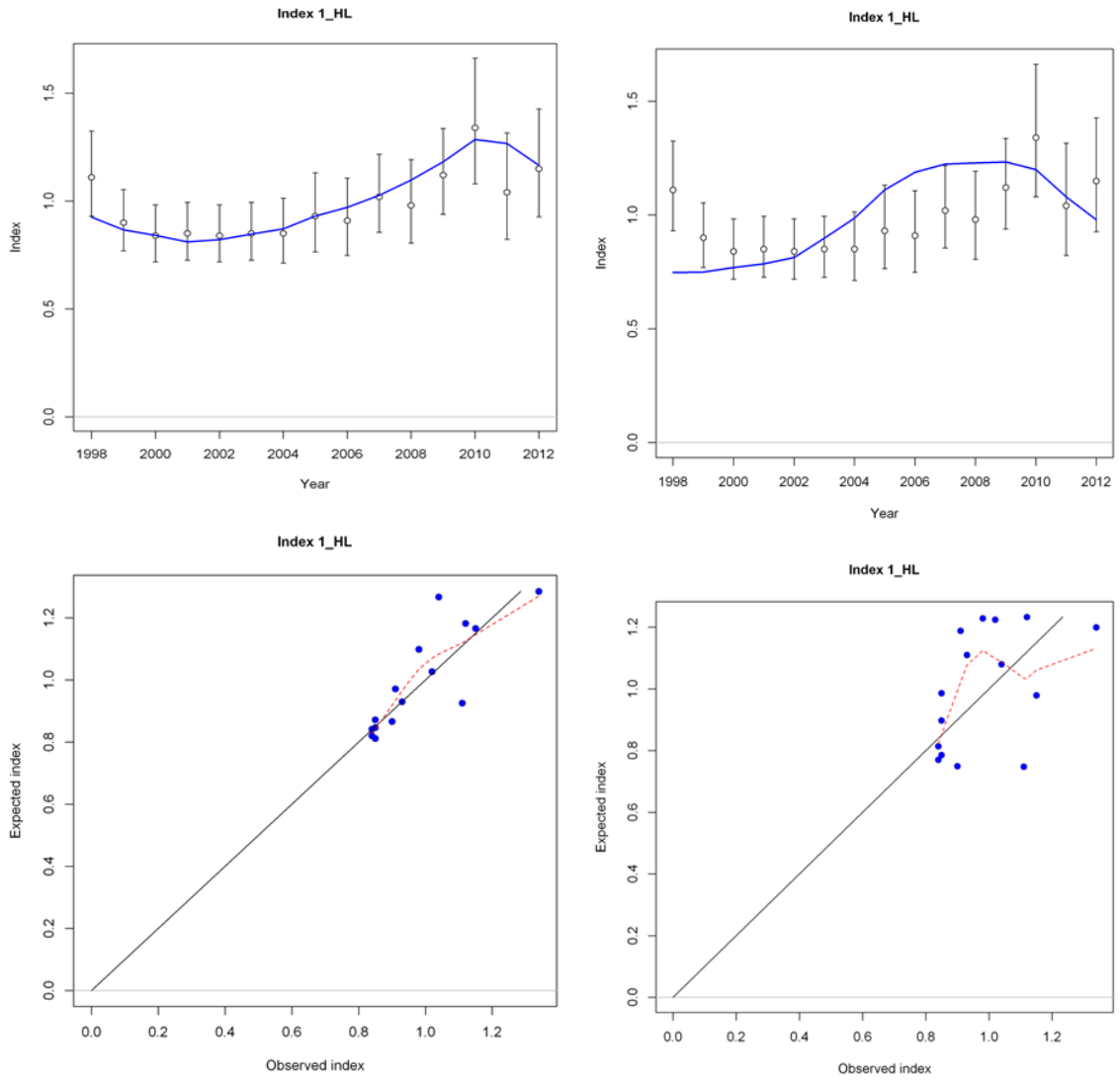


Figure 3.2.2 Model fit (blue line) to the standardized commercial hanadline CPUE index (open circles), 1998-2009 from the "lengths only" model (top left panel) and the "lengths and ages" model (upper right). The bottom panel also shows a comparison of the observed and predicted indices, where the black line is the 1:1 line.

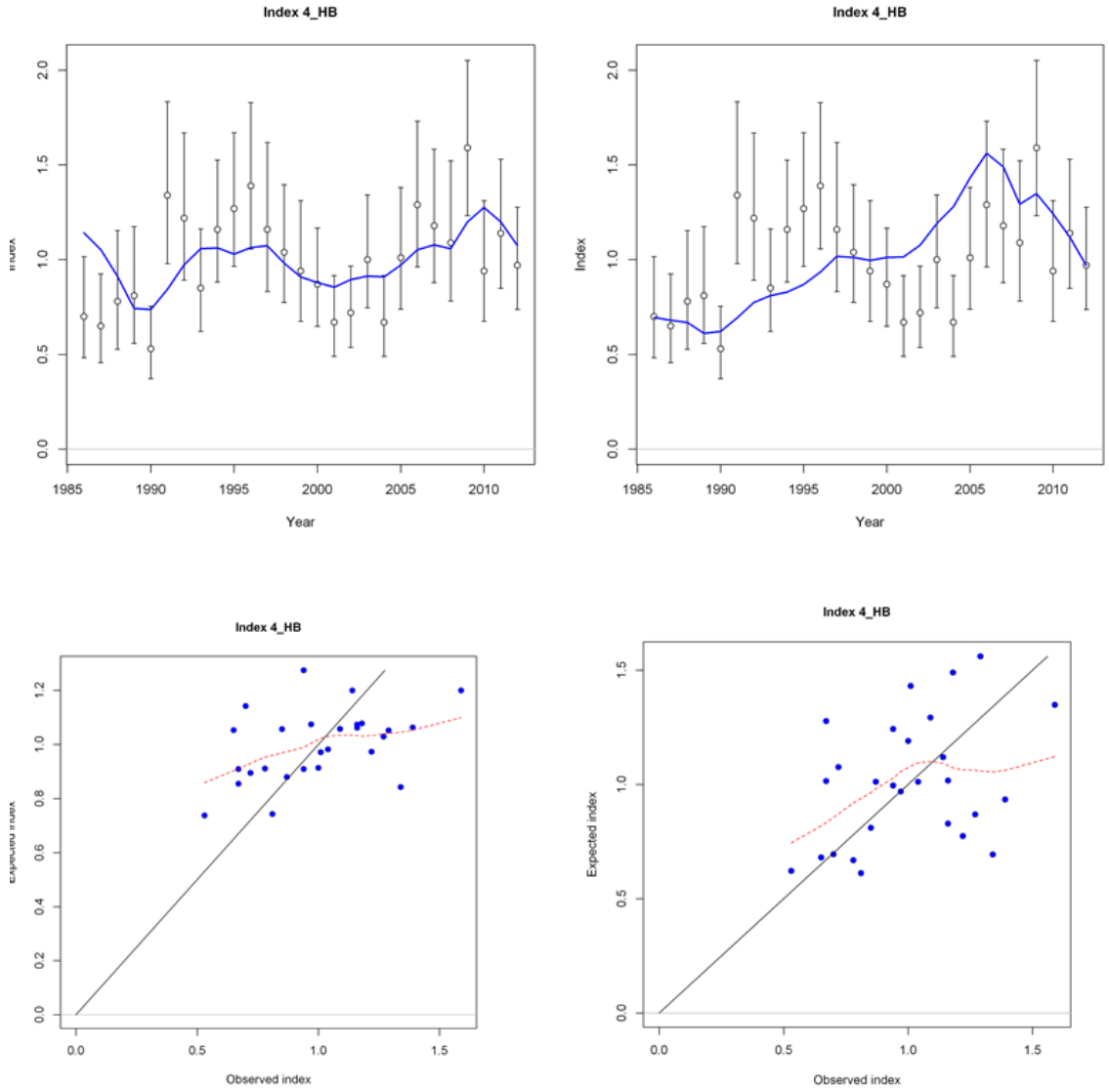


Figure 3.2.3. Model fit (blue line) to the standardized headboat CPUE index (open circles), 1998-2009 from the "lengths only" model (top left panel) and the "lengths and ages" model (upper right). The bottom panel also shows a comparison of the observed and predicted indices, where the black line is the 1:1 line.

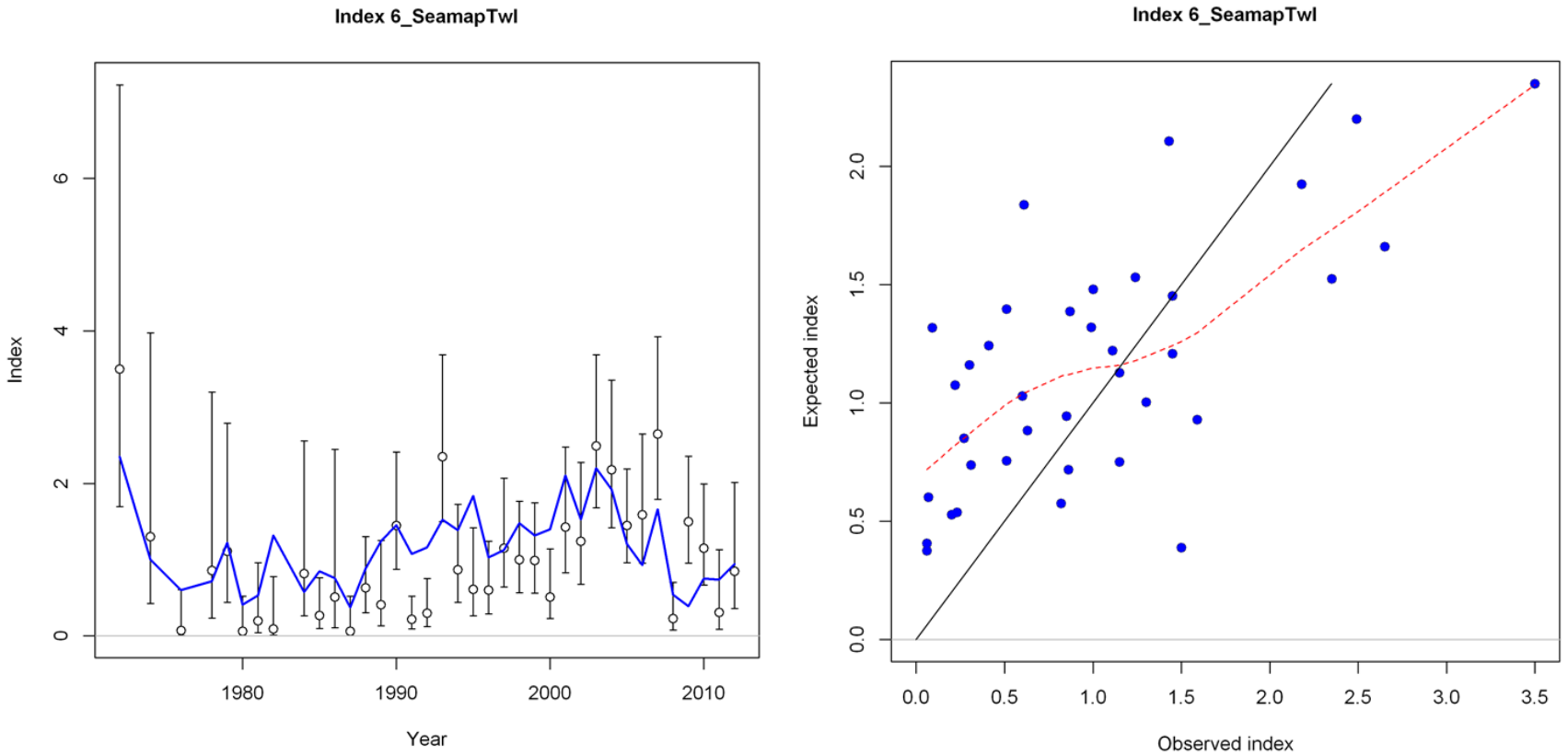


Figure 3.2.4. Model fit (blue line) to the standardized SEAMAP trawl CPUE index (open circles), 1998-2009 (top panel). The bottom panel also shows a comparison of the observed and predicted indices, where the black line is the 1:1 line.

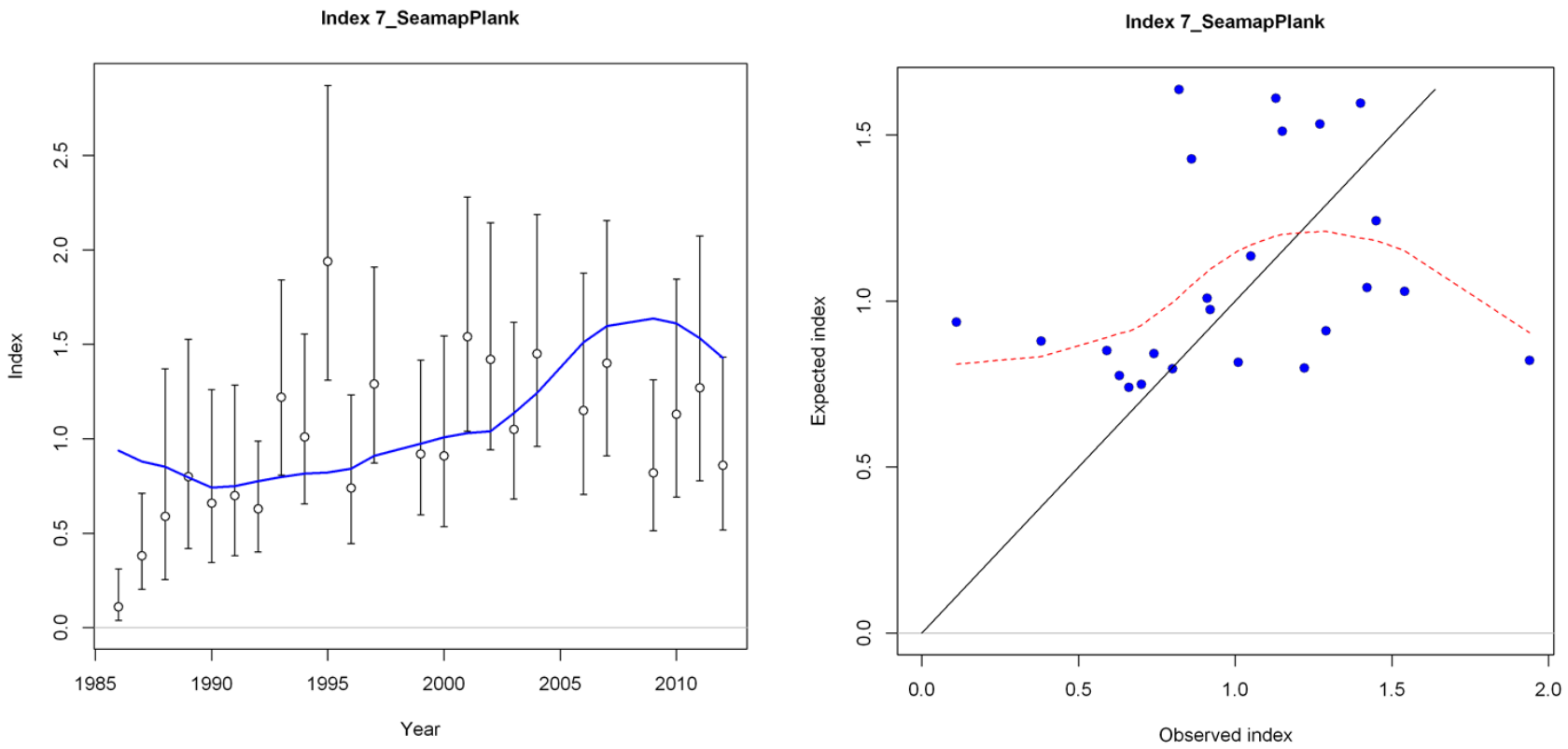
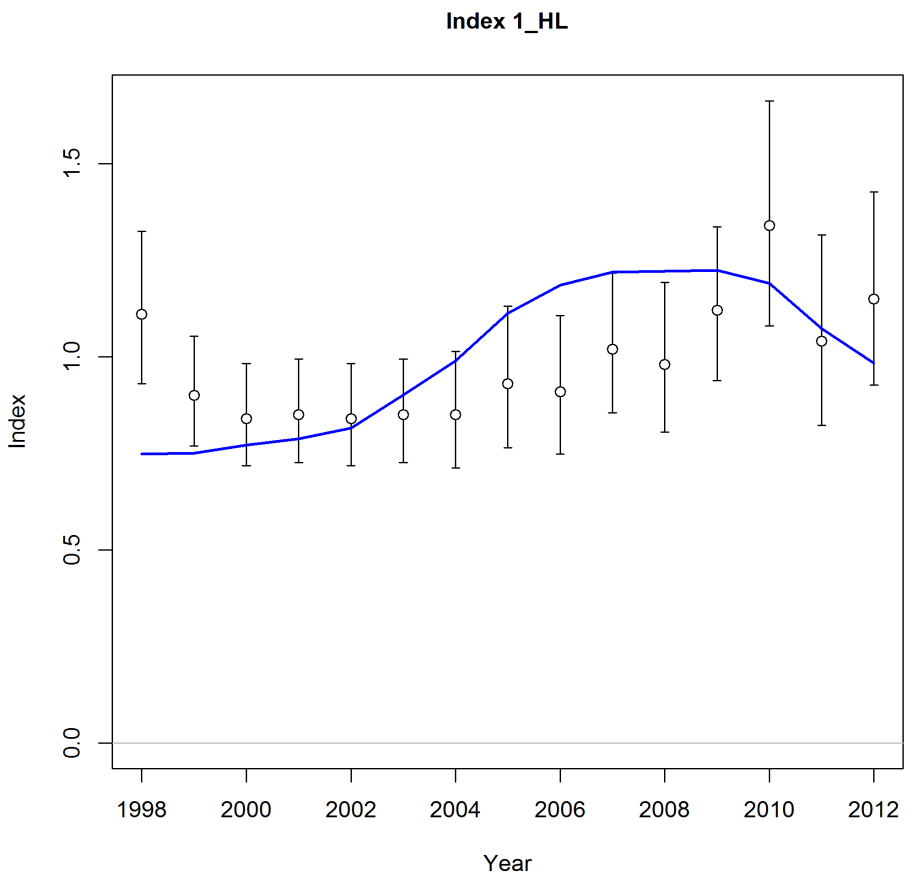
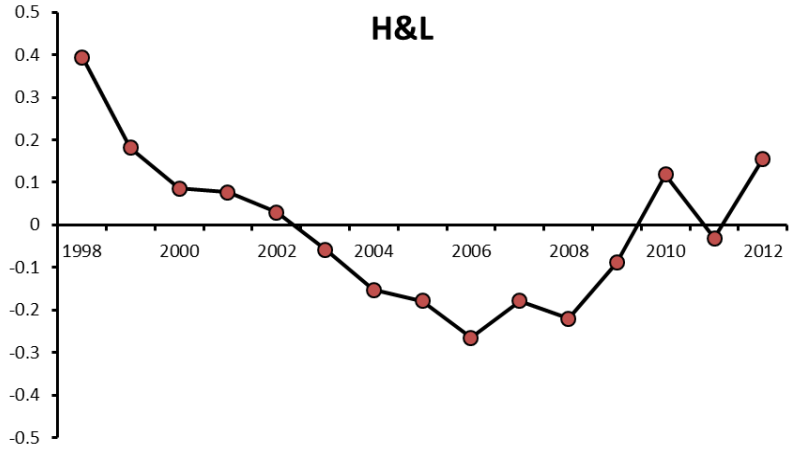
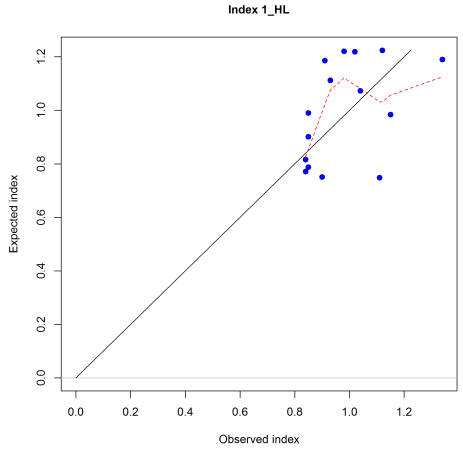


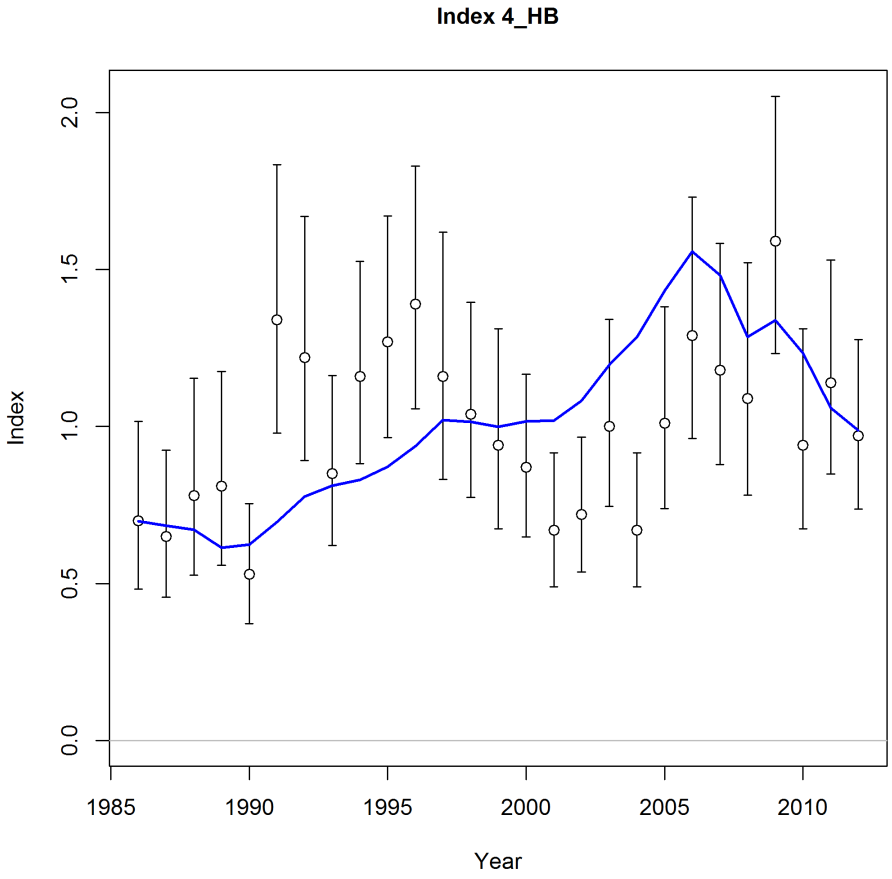
Figure 3.2.5. Model fit (blue line) to the standardized SEAMAP plankton CPUE index (open circles), 1998-2009 (top panel). The bottom panel also shows a comparison of the observed and predicted indices, where the black line is the 1:1 line.

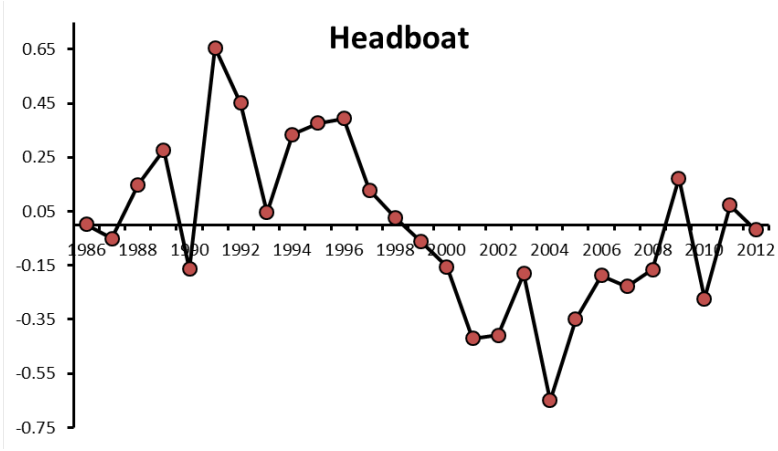






Measures of Overall Model Fit to commercial handline. Fit to index (left), residuals to fit (upper right), and observed vs. expected (lower right) for GOM king mackerel.





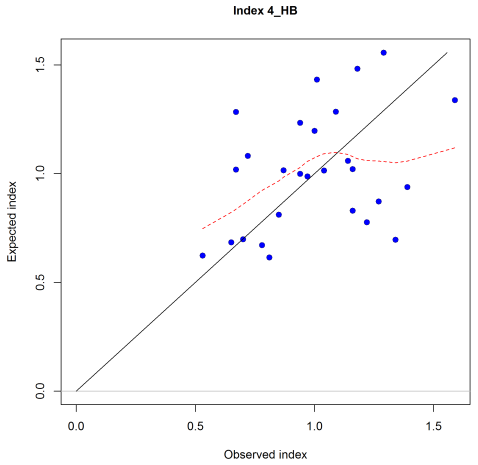


Figure 3.1.2.1.2. Measures of Overall Model Fit to Headboat CPUE. Fit to index (left), residuals to fit (upper right), and observed vs. expected (lower right) for GOM king mackerel.

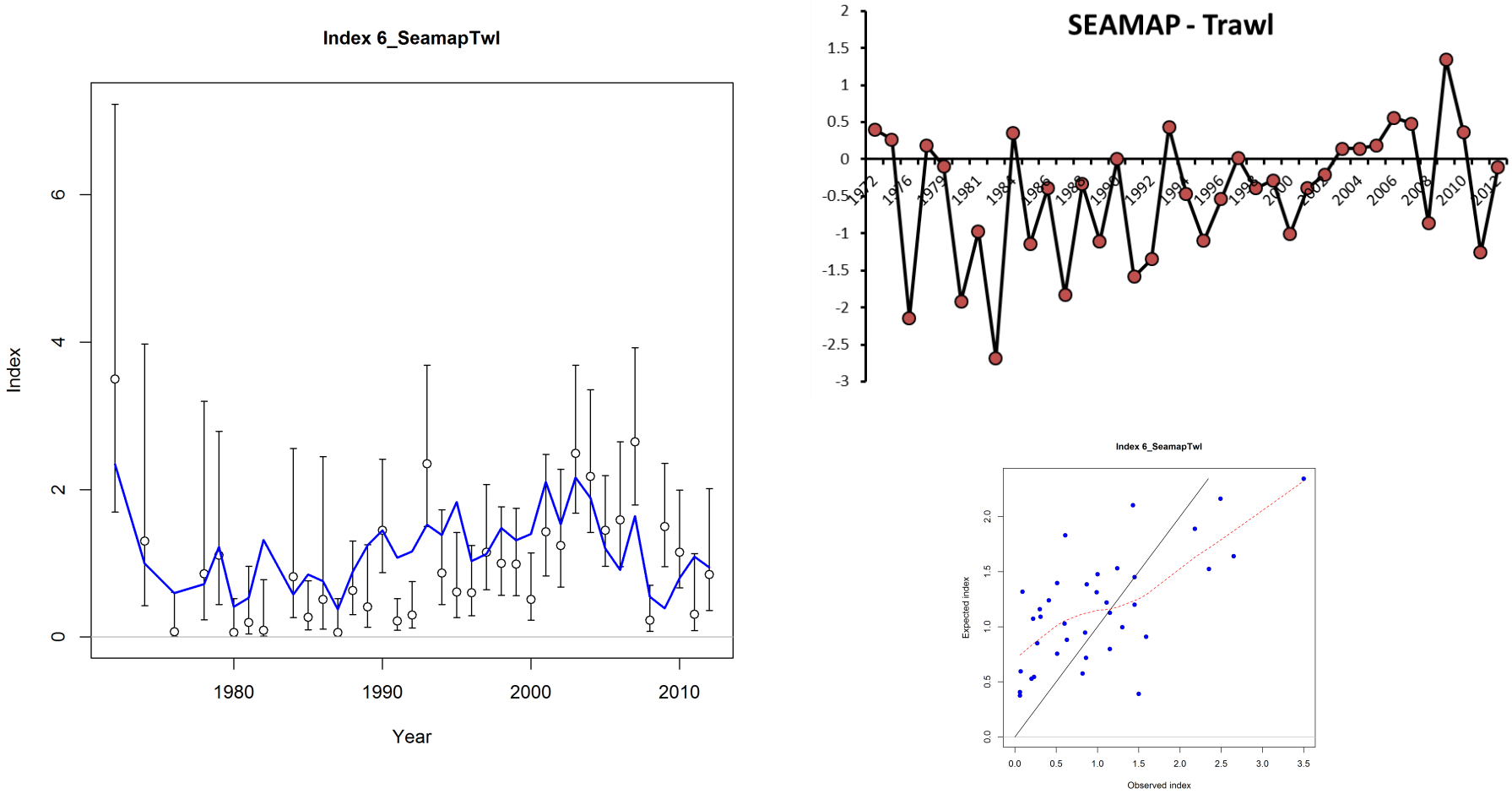


Figure 3.1.2.1.3. Measures of Overall Model Fit to SEAMAP-Trawl CPUE. Fit to index (left), residuals to fit (upper right), and observed vs. expected (lower right) for GOM king mackerel.

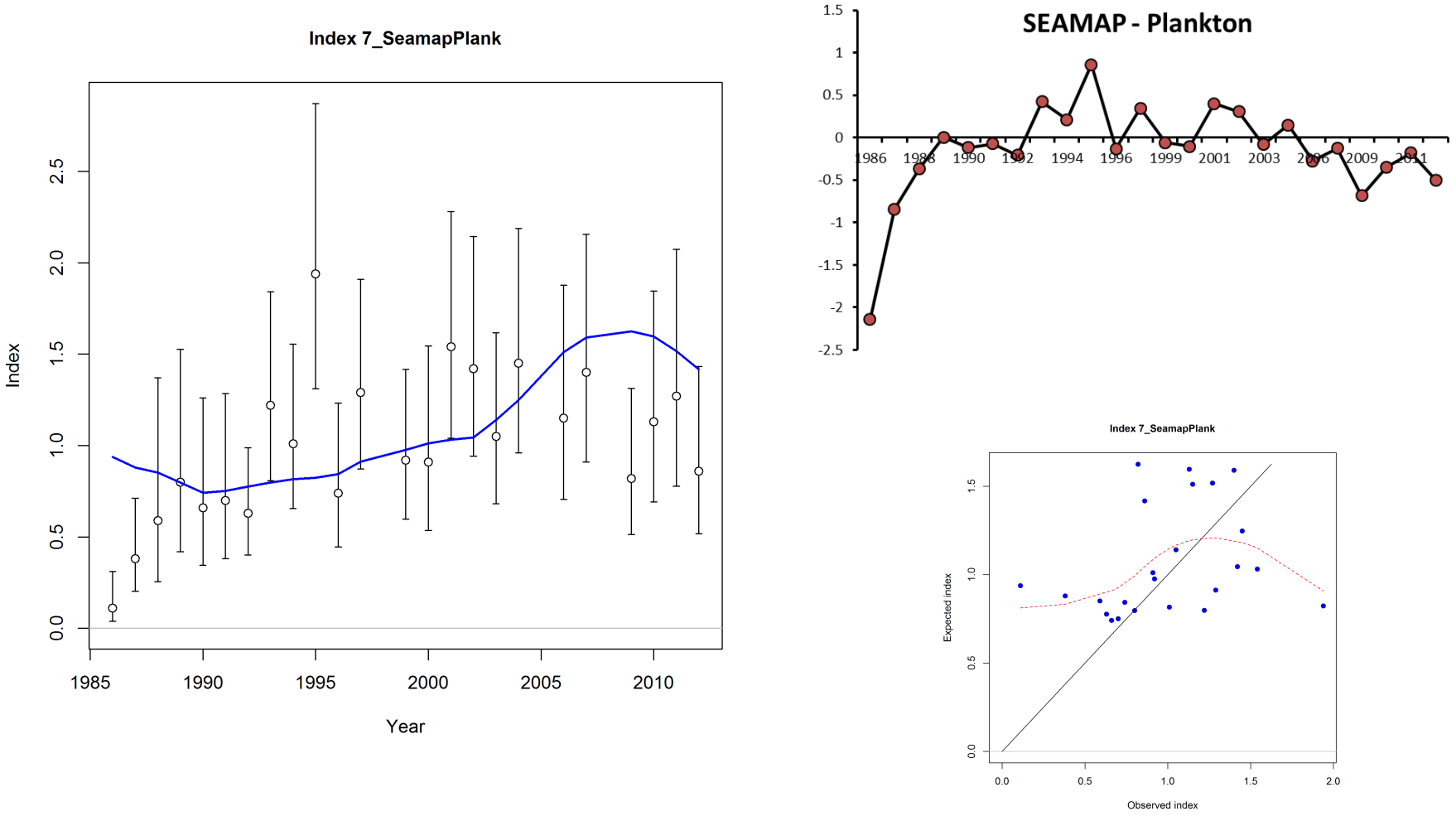


Figure 3.1.2.1.4. Measures of Overall Model Fit to SEAMAP-plankton CPUE. Fit to index (left), residuals to fit (upper right), and observed vs. expected (lower right) for GOM king mackerel.

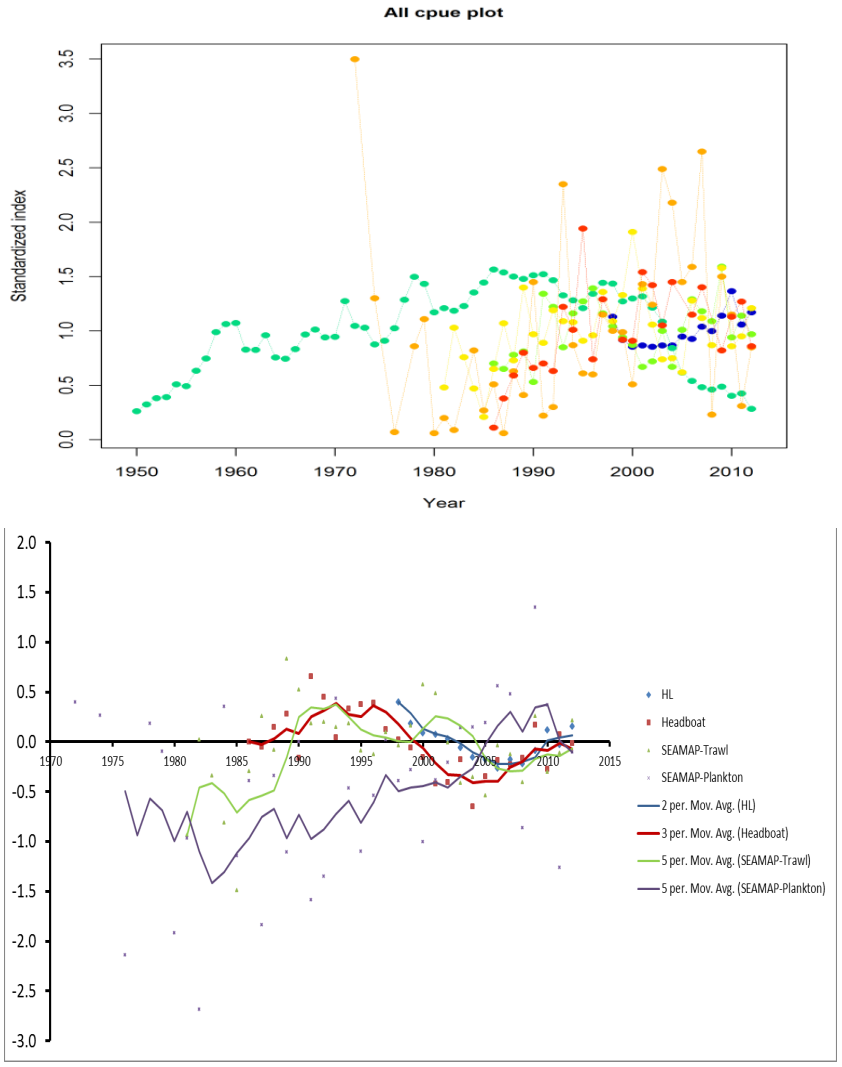


Figure 3.1.2.1.5. Measures of Overall Model Fit to all CPUE time series. Observations of standardized index (top) and residuals to fit with moving average (bottom) for GOM king mackerel.

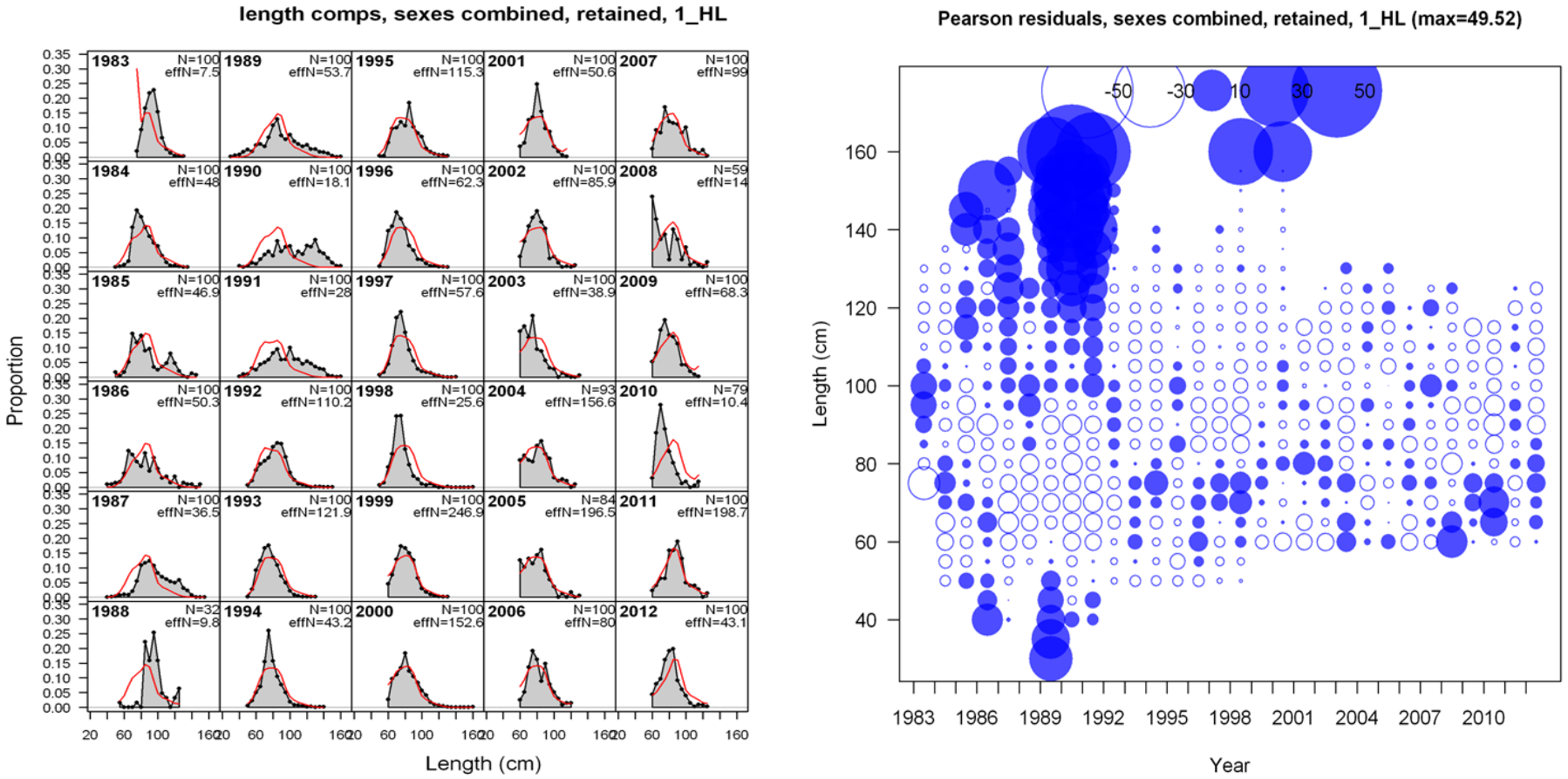


Figure 3.2.6. Observed and predicted length compositions of landings of GOM king mackerel in the commercial handline line fleet (top). Observed (N) sample sizes and effective sample sizes (effN) estimated by SS are also reported. Pearson residuals for the length composition fit (bottom). Solid circles are positive residuals (i.e., observed greater than predicted) and open circles are negative residuals (i.e., predicted greater than observed).

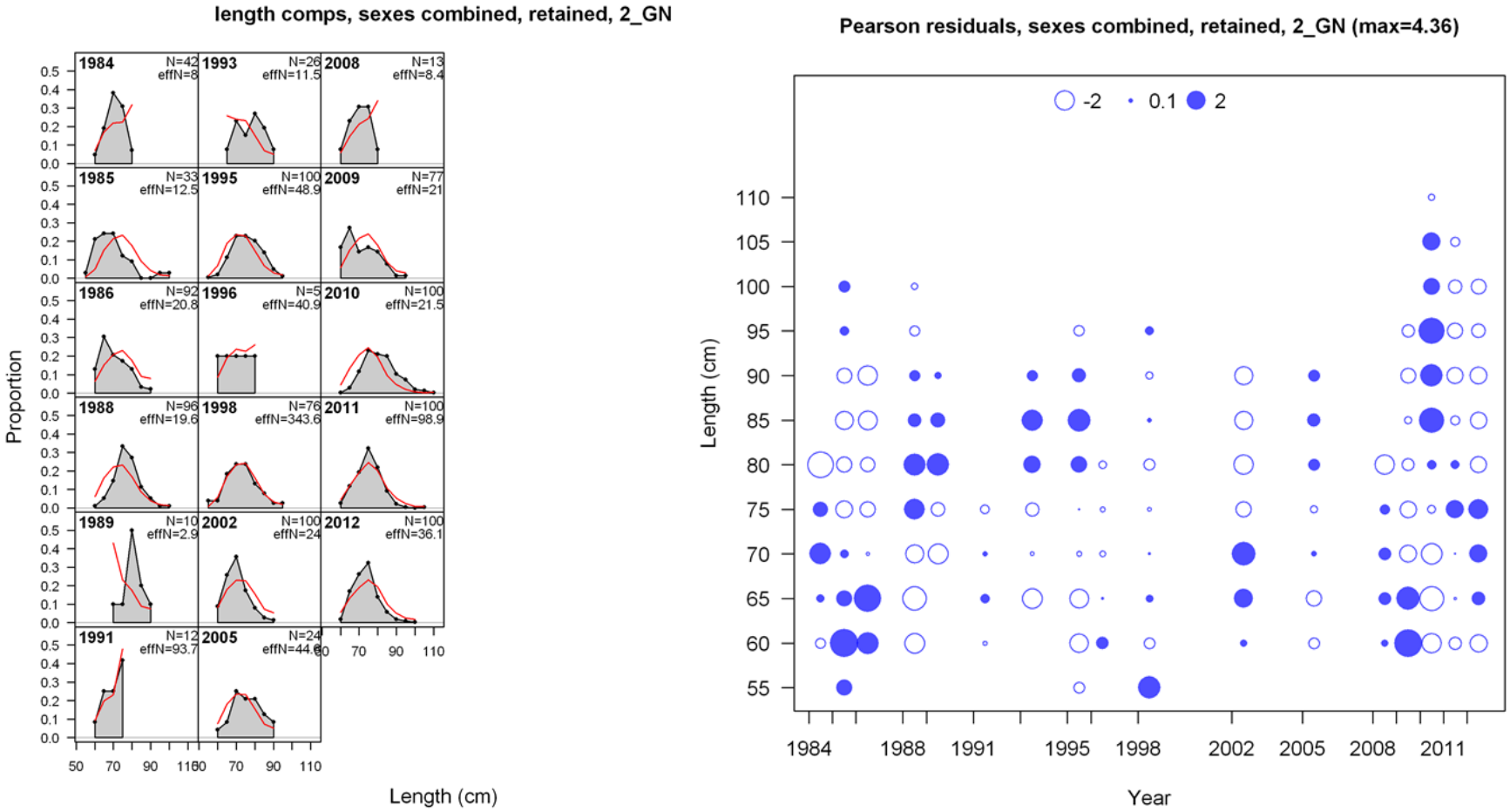


Figure 3.2.7. Observed and predicted length compositions of landings of GOM king mackerel in the commercial gillnet fleet (top). Observed (N) sample sizes and effective sample sizes (effN) estimated by SS are also reported. Pearson residuals for the length composition fit (bottom). Solid circles are positive residuals (i.e., observed greater than predicted) and open circles are negative residuals (i.e., predicted greater than observed).

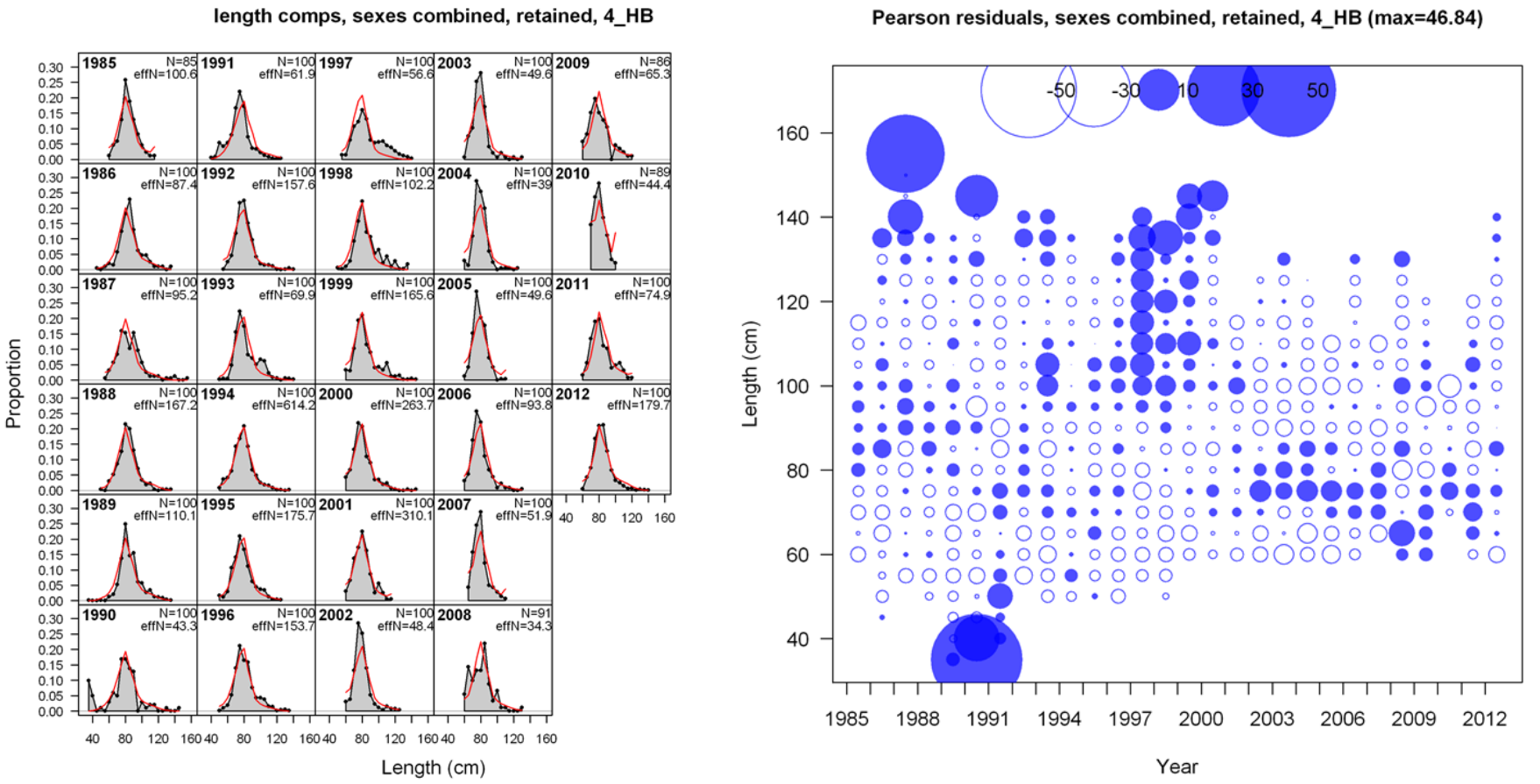
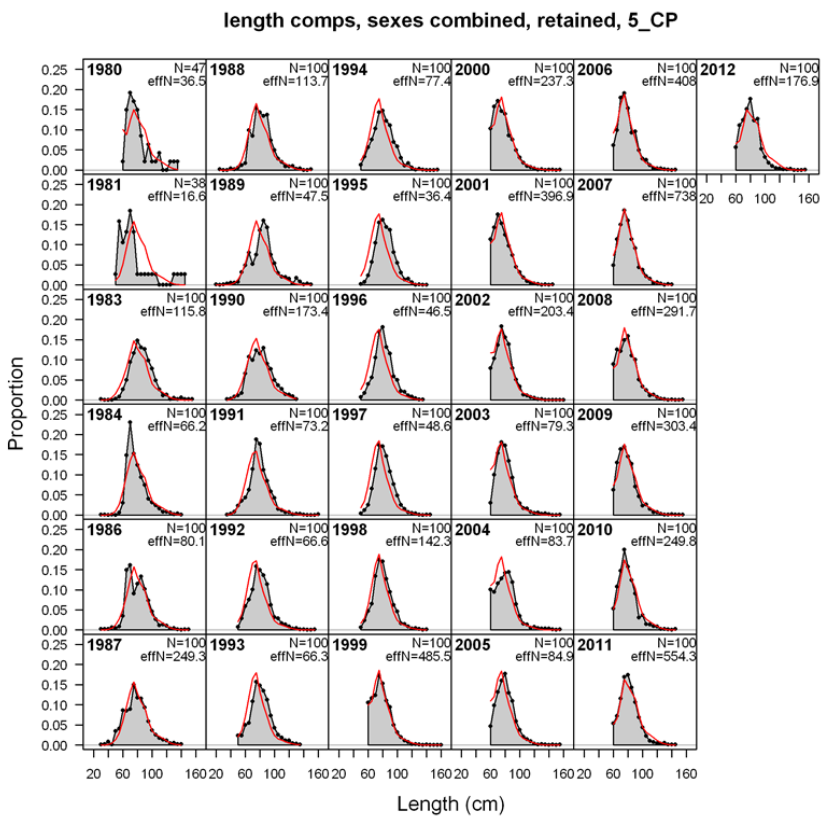


Figure 3.2.8. Observed and predicted length compositions of landings of GOM king mackerel in the recreational headboat fleet (top). Observed (N) sample sizes and effective sample sizes (effN) estimated by SS are also reported. Pearson residuals for the length composition fit (bottom). Solid circles are positive residuals (i.e., observed greater than predicted) and open circles are negative residuals (i.e., predicted greater than observed).



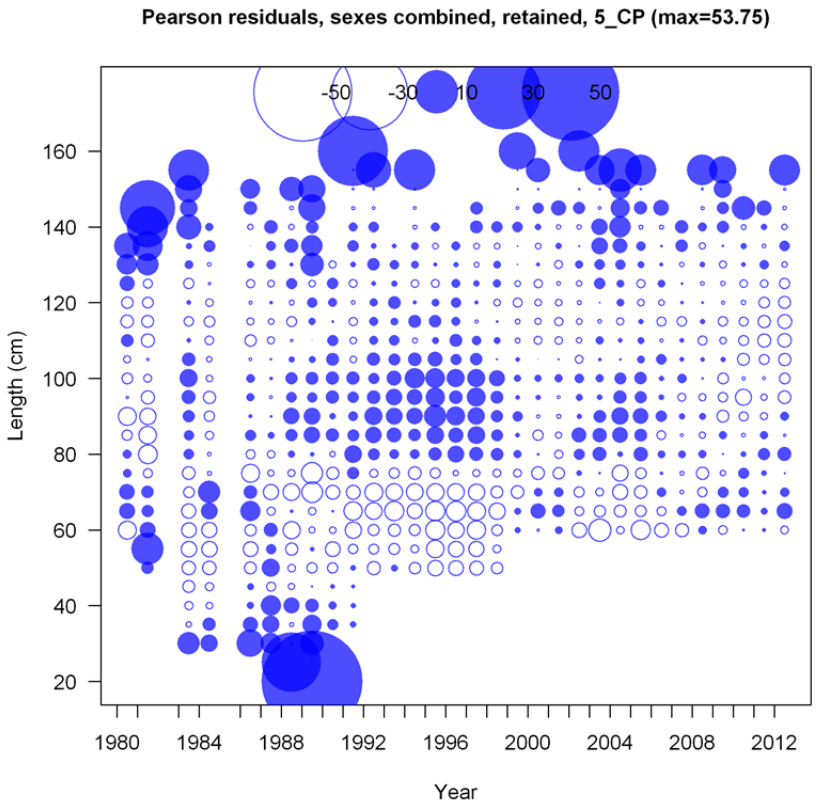
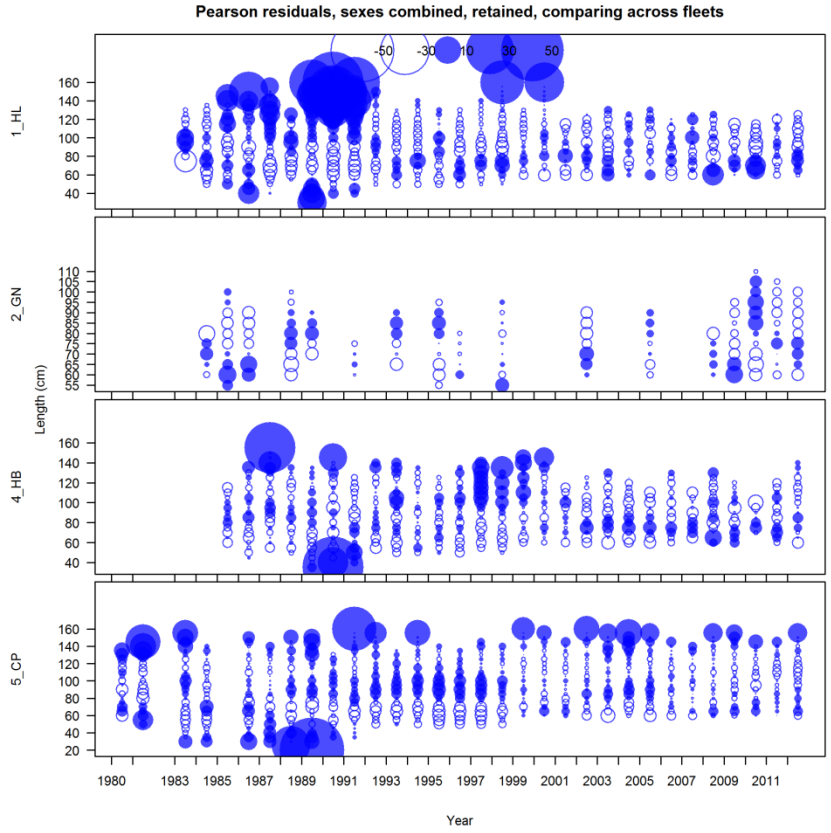
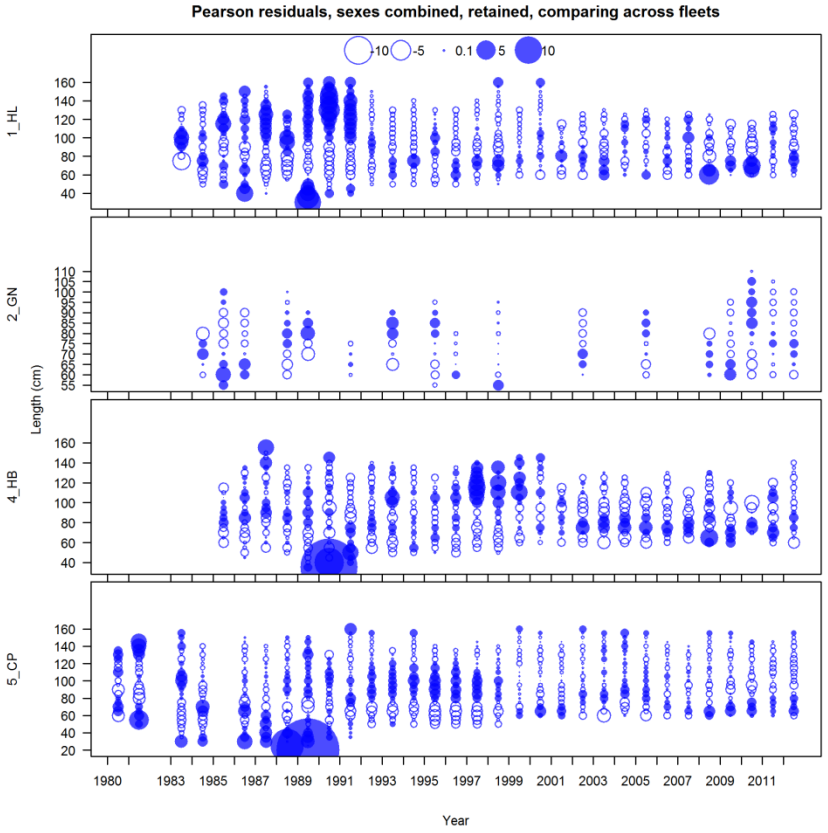


Figure 3.2.9. Observed and predicted length compositions of landings of GOM king mackerel in the recreational charter-private fleet (top). Observed (N) sample sizes and effective sample sizes (effN) estimated by SS are also reported. Pearson residuals for the length composition fit (bottom). Solid circles are positive residuals (i.e., observed greater than predicted) and open circles are negative residuals (i.e., predicted greater than observed).

Pearson Residuals
(sexes combine)





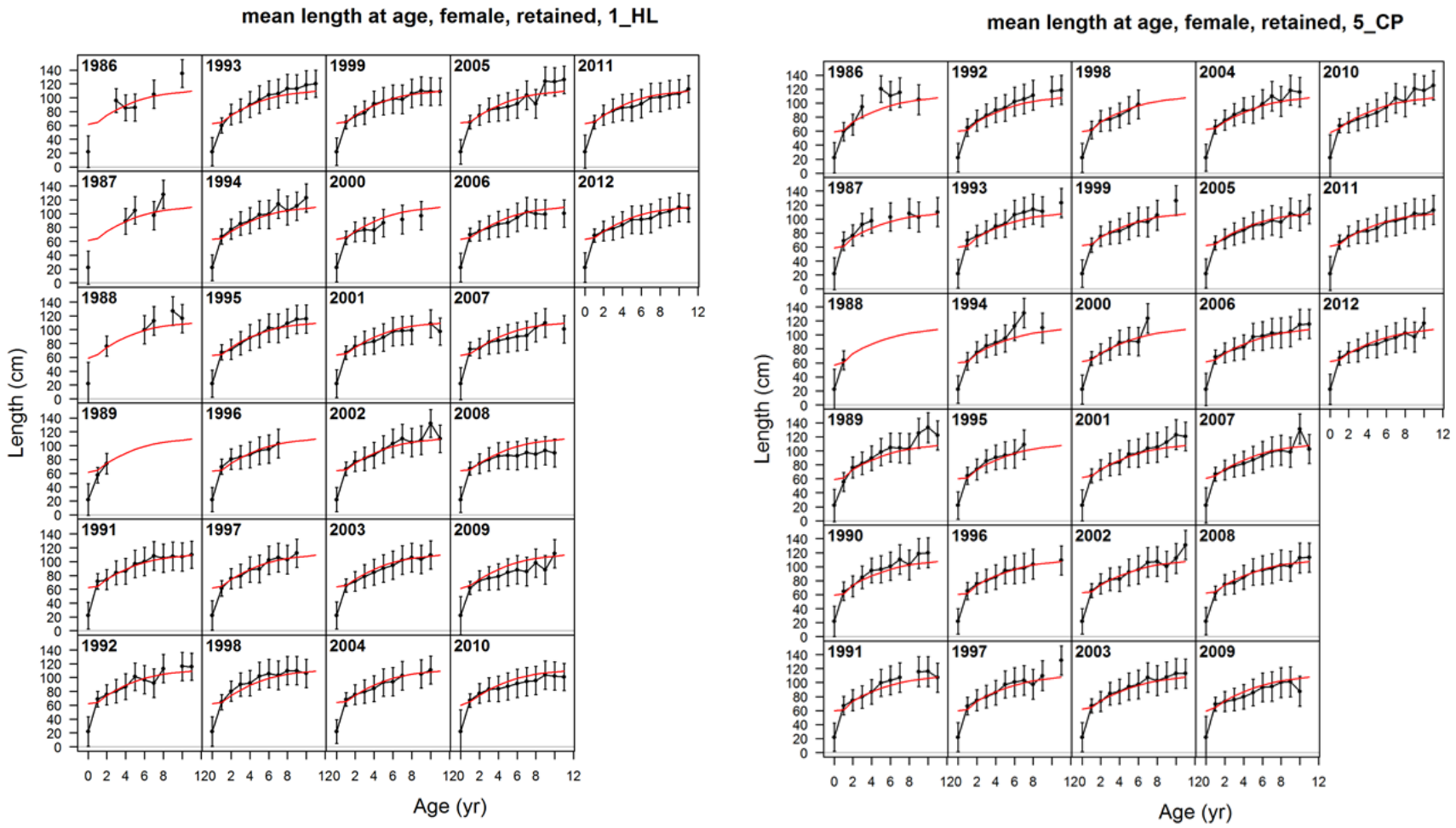


Figure 3.2.10. Fits to mean length-at-age to the commercial handline (top) and charter-private (bottom) sectors for female GOM king mackerel. Note that mean length at age was not used in the model fit, but was included here to depict the fit to the observations.


Intermission

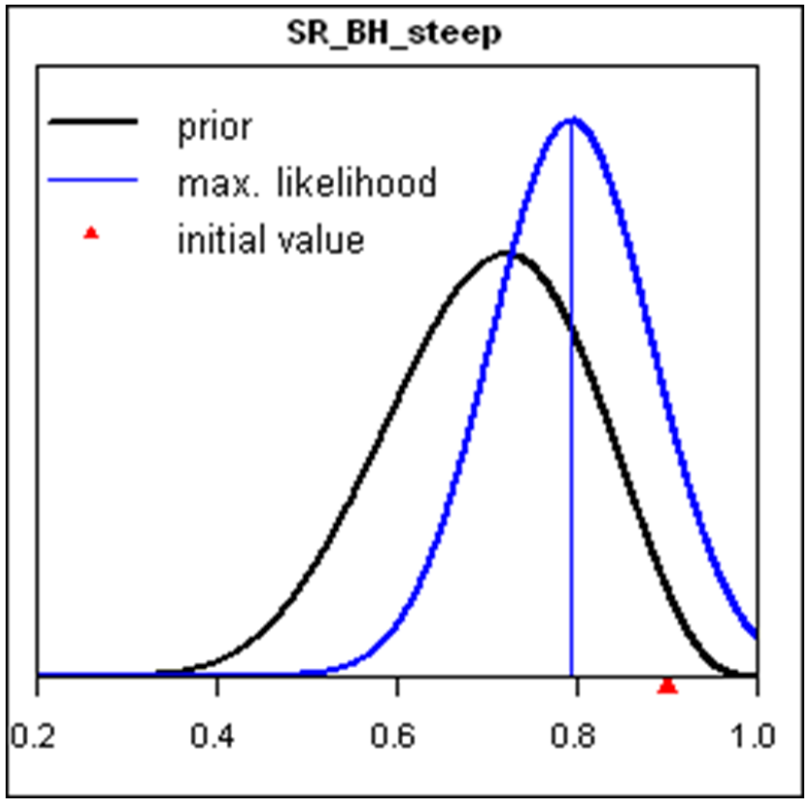
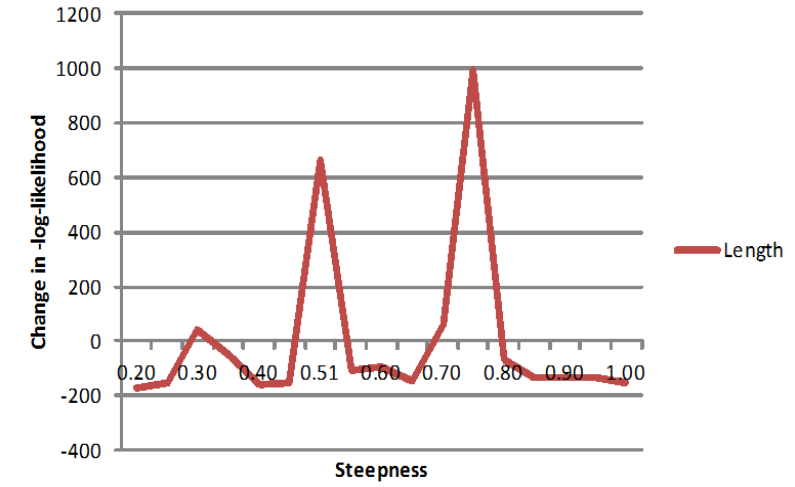
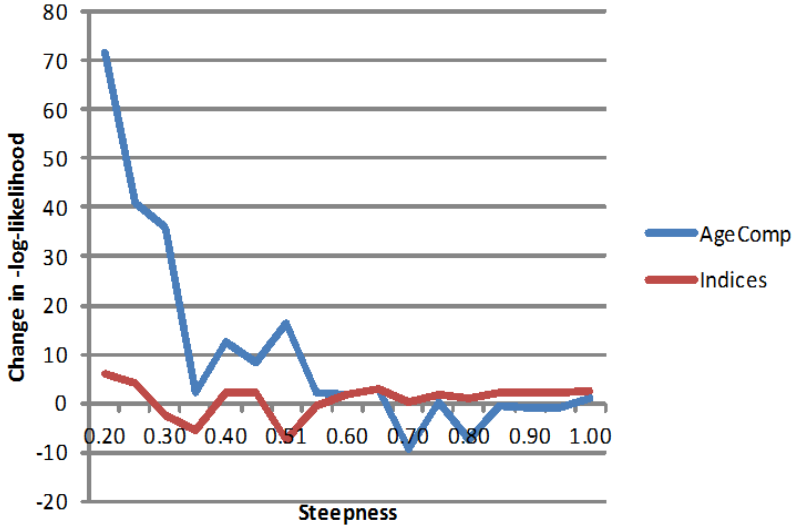


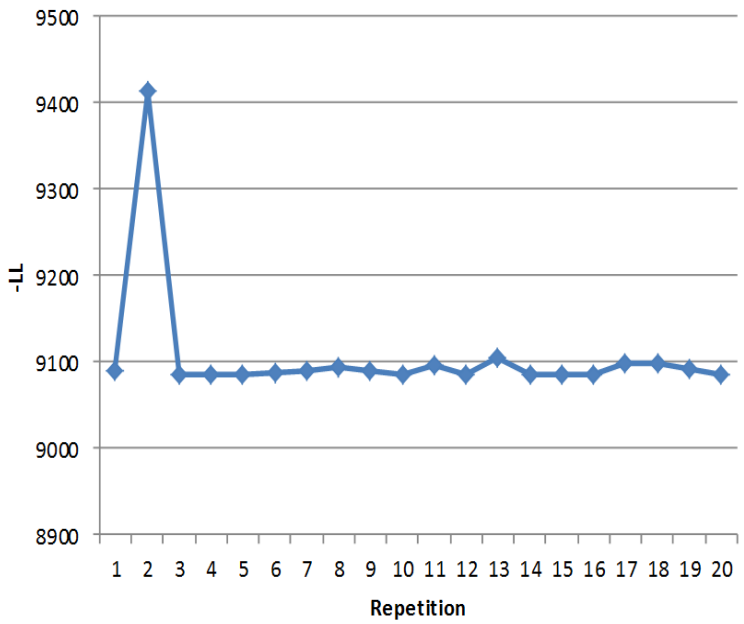
Figure 3.2.12. Prior distribution on steepness utilizing a full beta distribution (black curve) and the maximum posterior density estimates (blue line) using the inverse hessian approximation for the variance for GOM king mackerel. Initial value is irrelevant in this case.

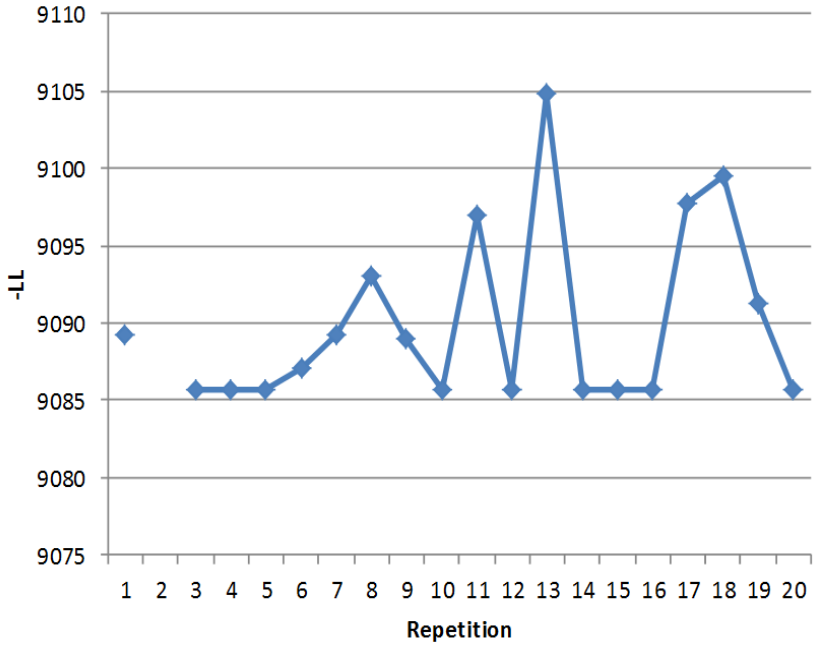
Profile on Steepness



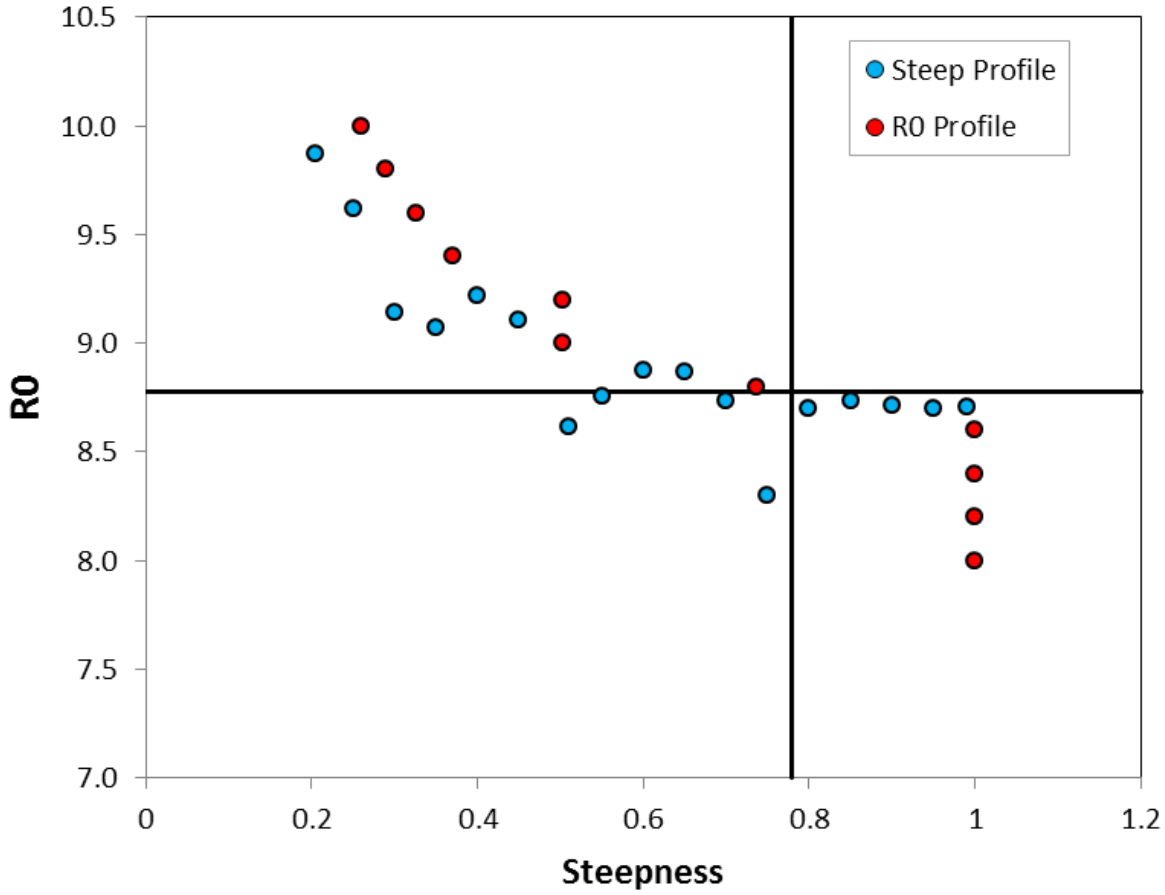


Jitter exercise not very stable





R0 and steepness highly correlated so the prior on h is very influential



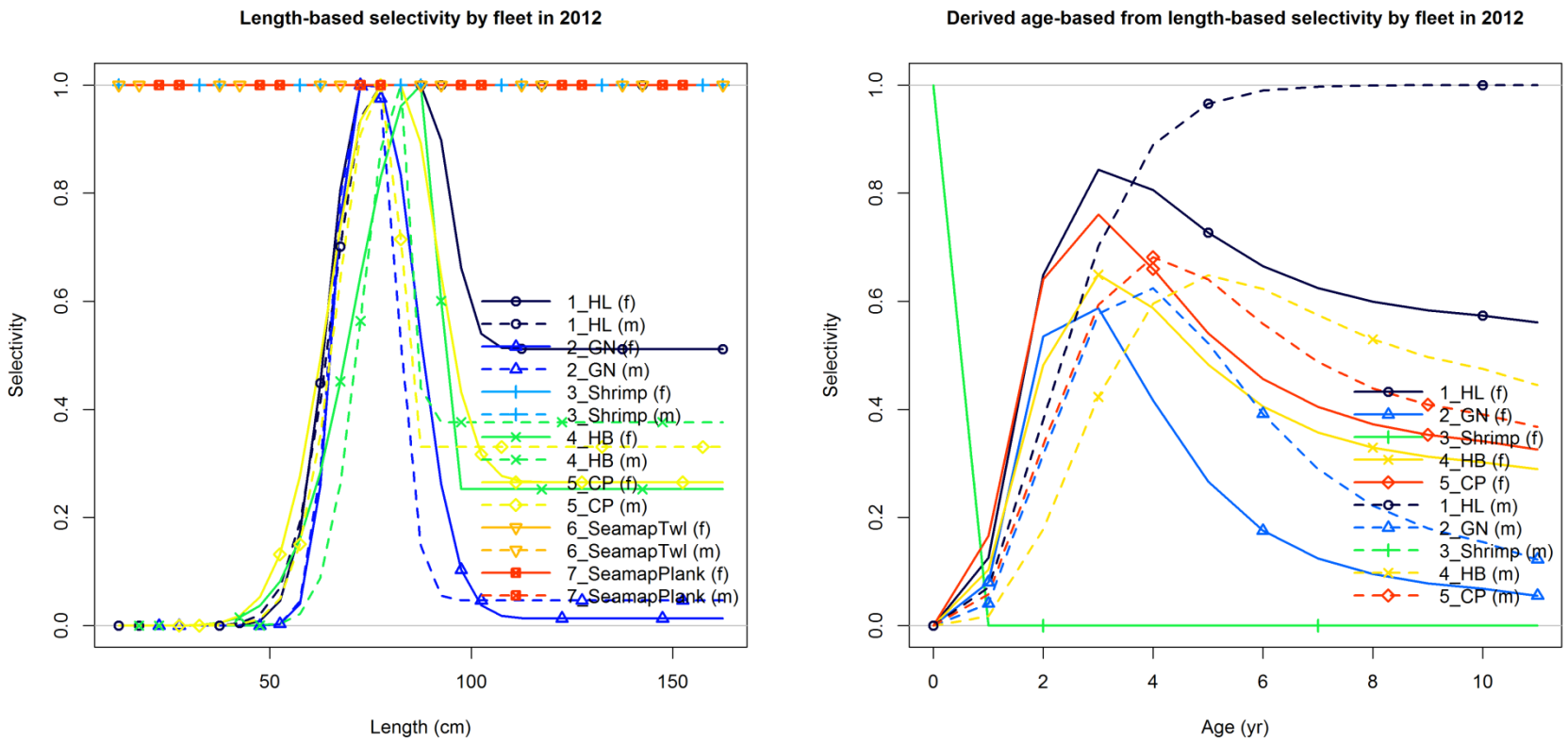


Figure 3.2.15. Estimated fleet selectivities-at-size (top) and derived selectivities-at-age derived (bottom) from the Stock Synthesis model of GOM king mackerel.

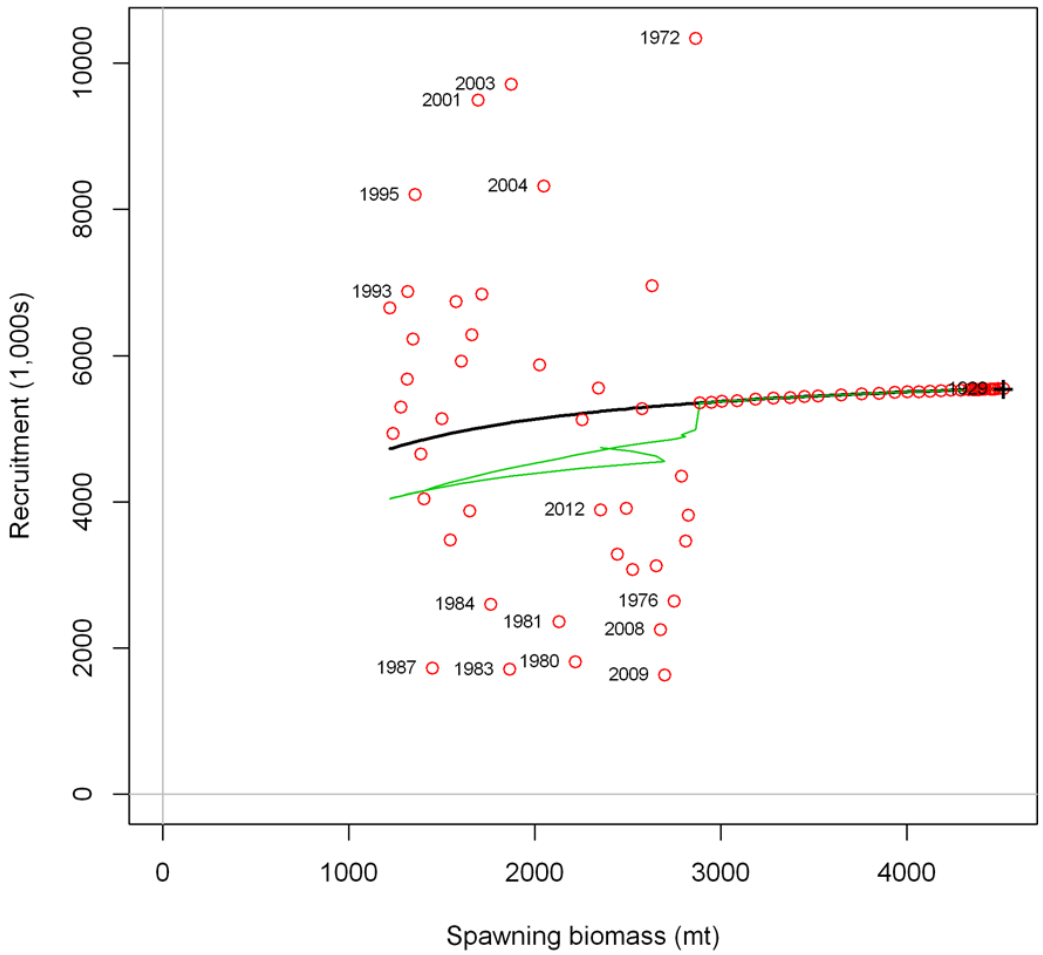


Figure 3.2.16. Predicted stock-recruitment relationship for GOM king mackerel for the base model. Plotted are predicted annual recruitments from SS (circles), expected recruitment from the stock-recruit relationship (black line), and bias adjusted recruitment from the stock-recruit relationship (green line).

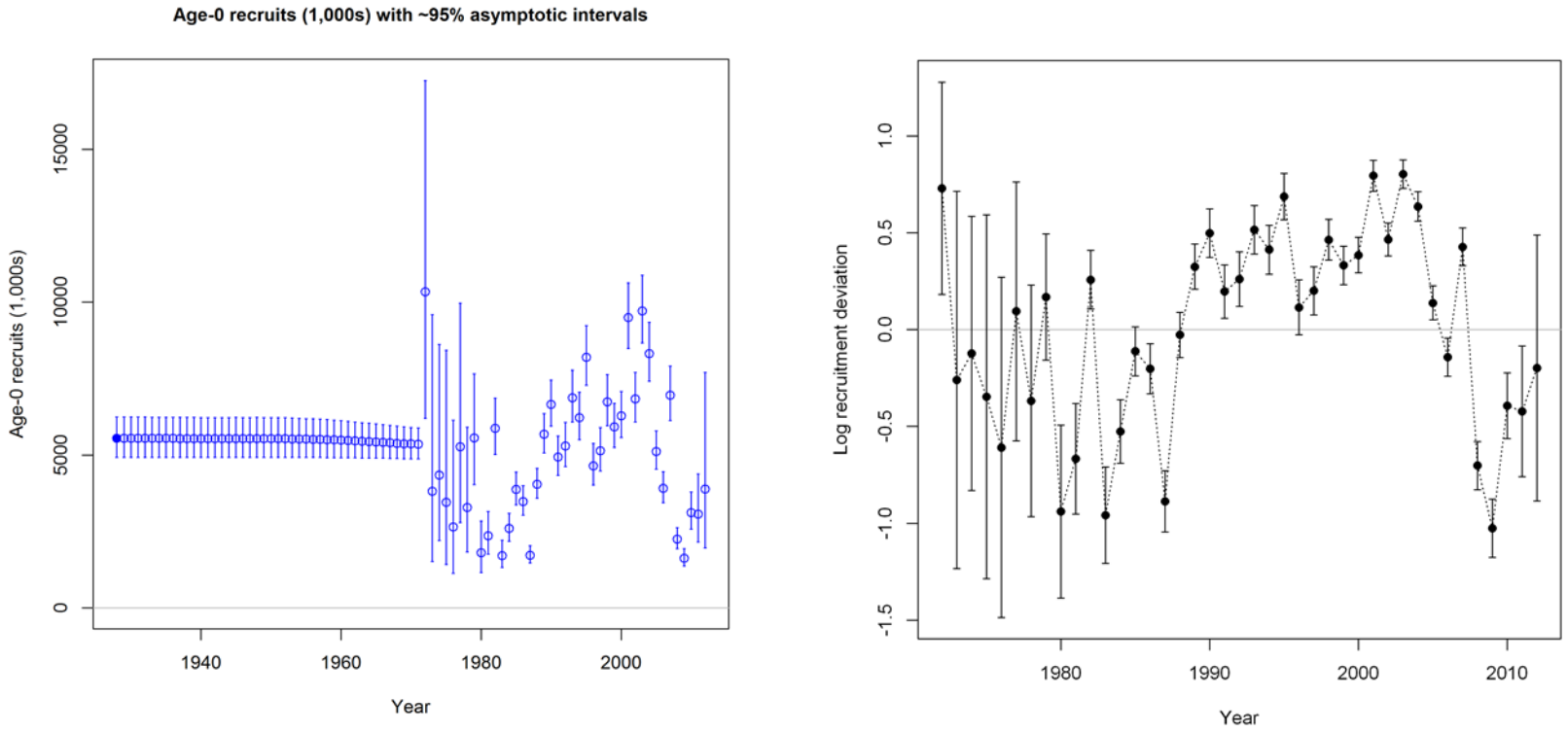


Figure 3.2.17. Estimated recruitment (top) and recruitment deviations of Gulf of Mexico King Mackerel.

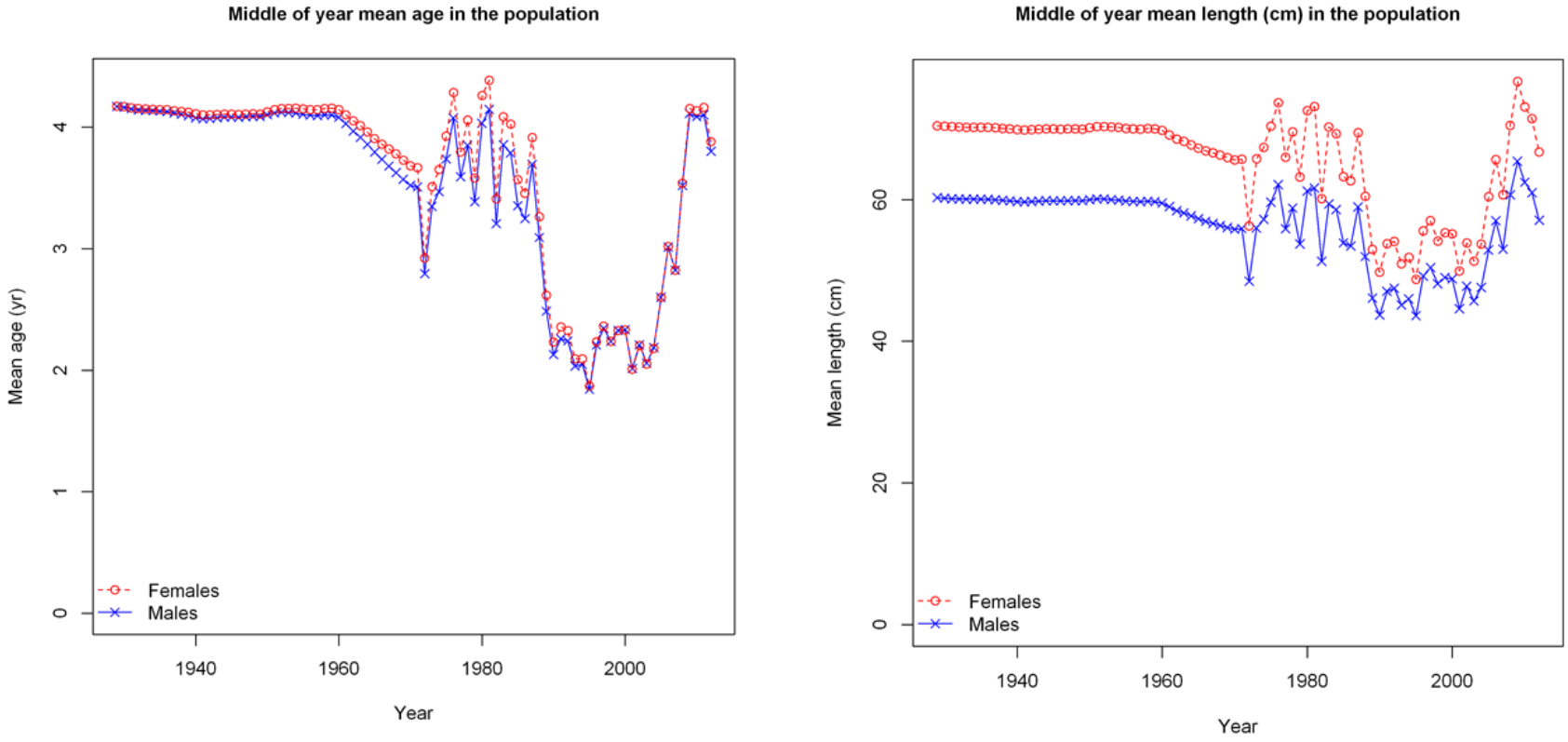
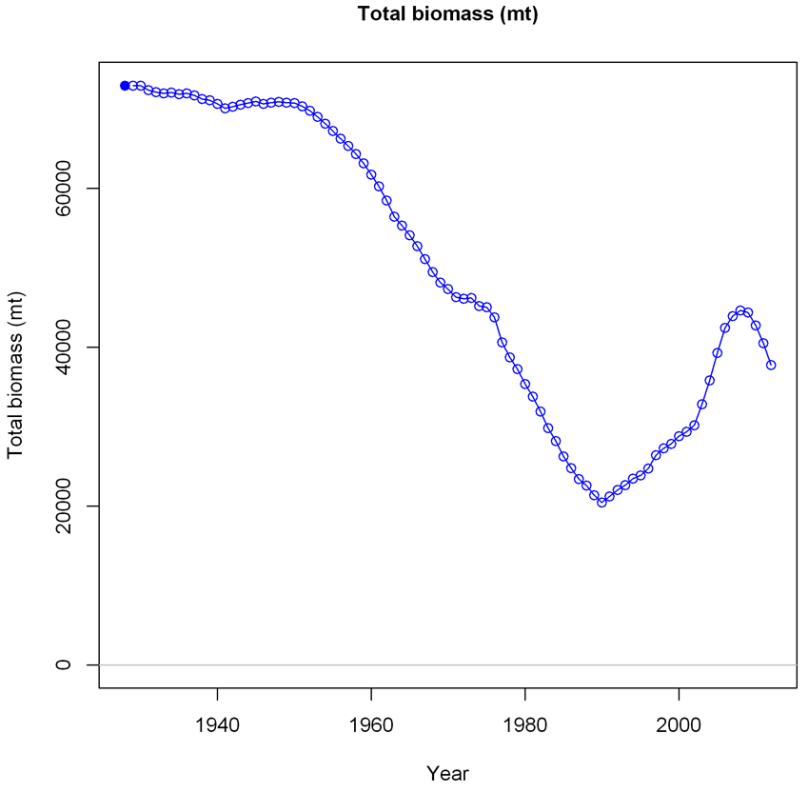


Figure 3.2.18. Mean age (top) and mean length (bottom) of Gulf of Mexico King Mackerel



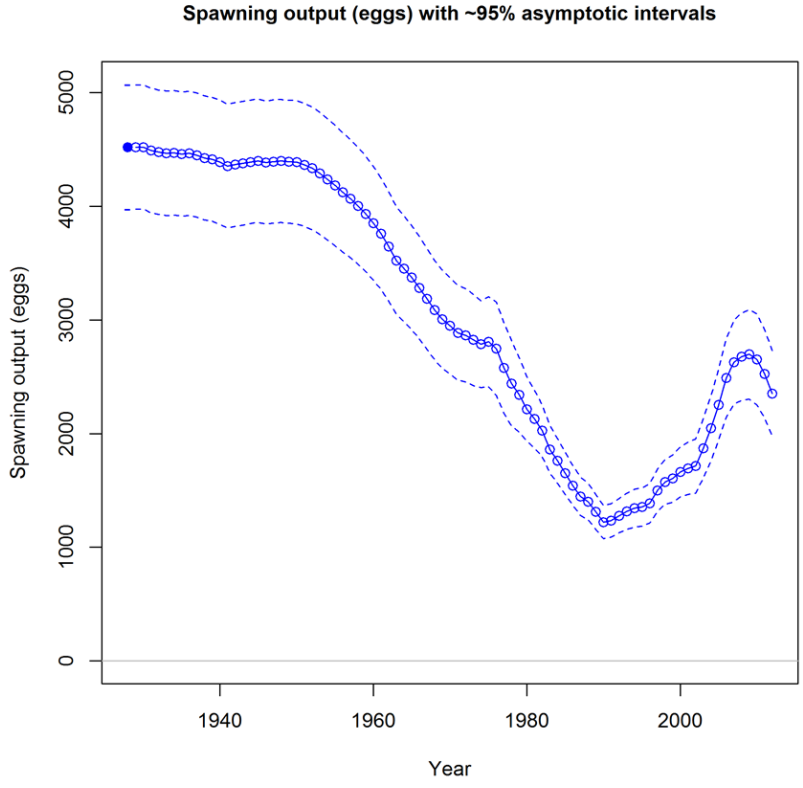


Figure 3.2.19/20. Estimated annual total biomass of Gulf of Mexico King Mackerel.

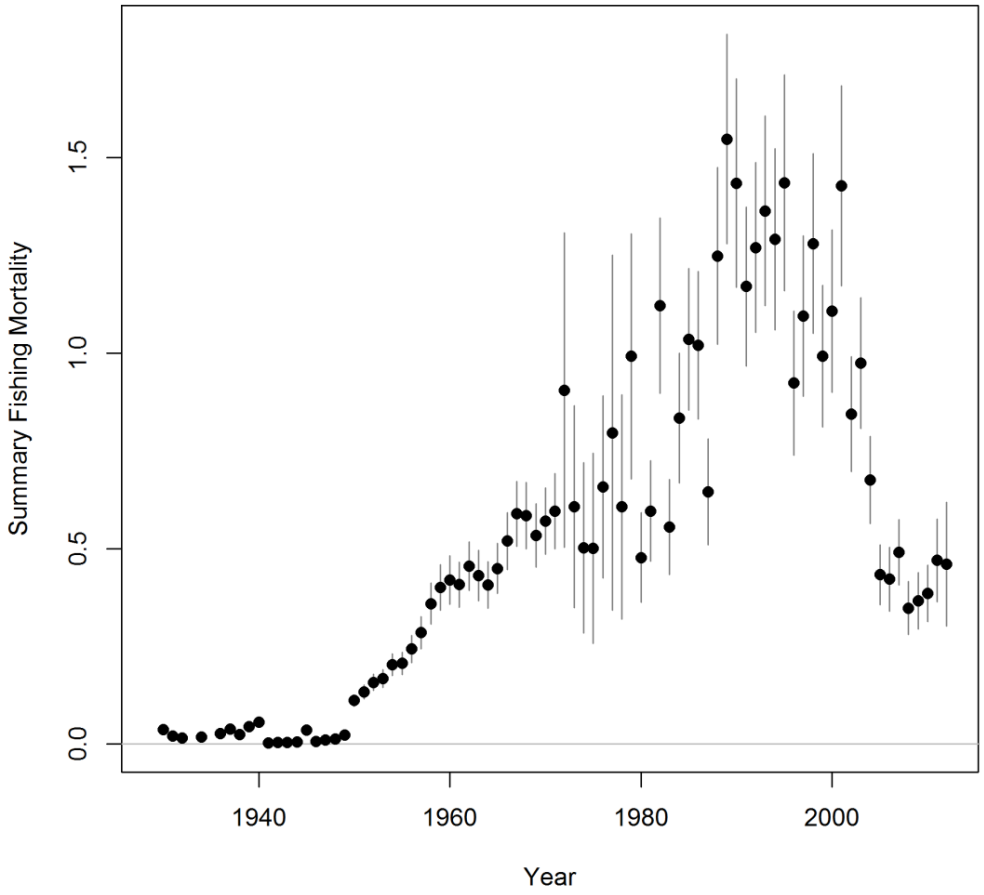


Figure 3.2.21. Predicted annual exploitation rate calculated as the ratio of the total annual catch in biomass to the summary biomass at the beginning of the year

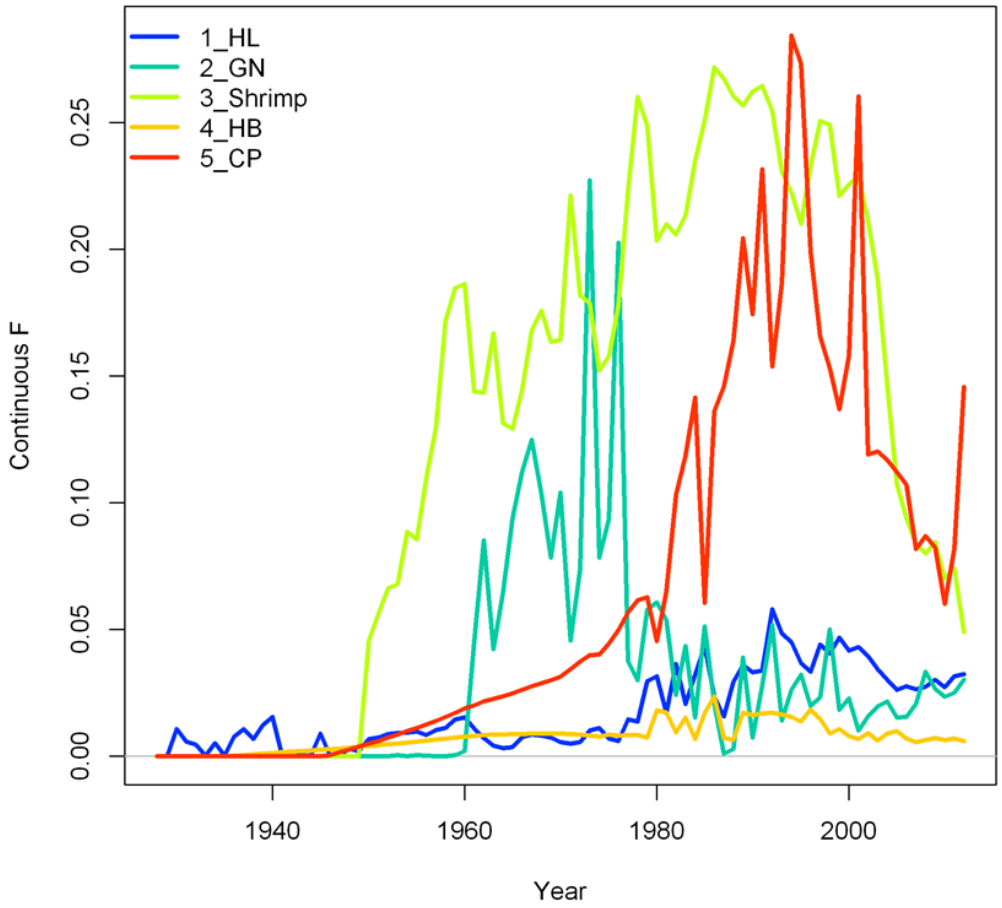


Figure 3.2.22. Predicted fleet specific fishing mortality rates.

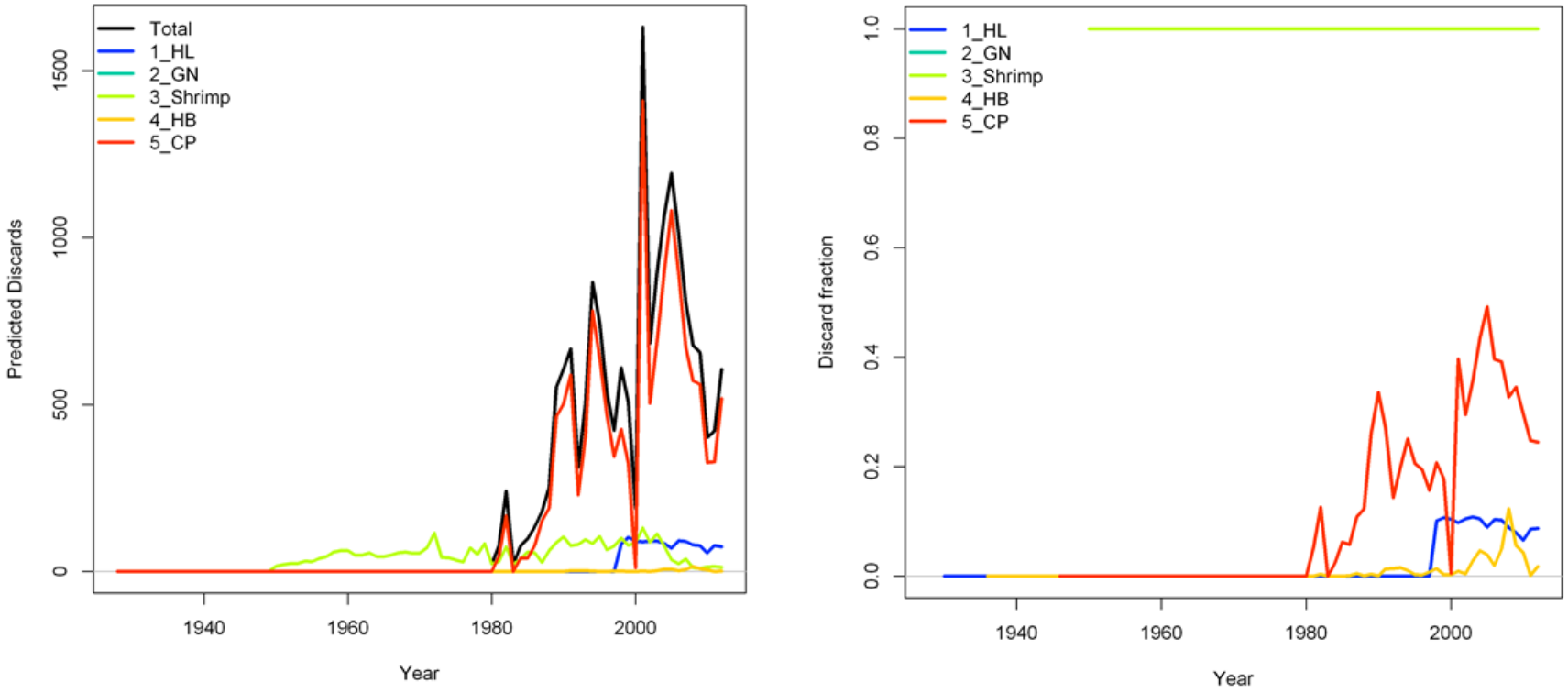


Figure 3.2.24. Predicted discards (top) and discard fraction (bottom) by fleet for GOM king mackerel.

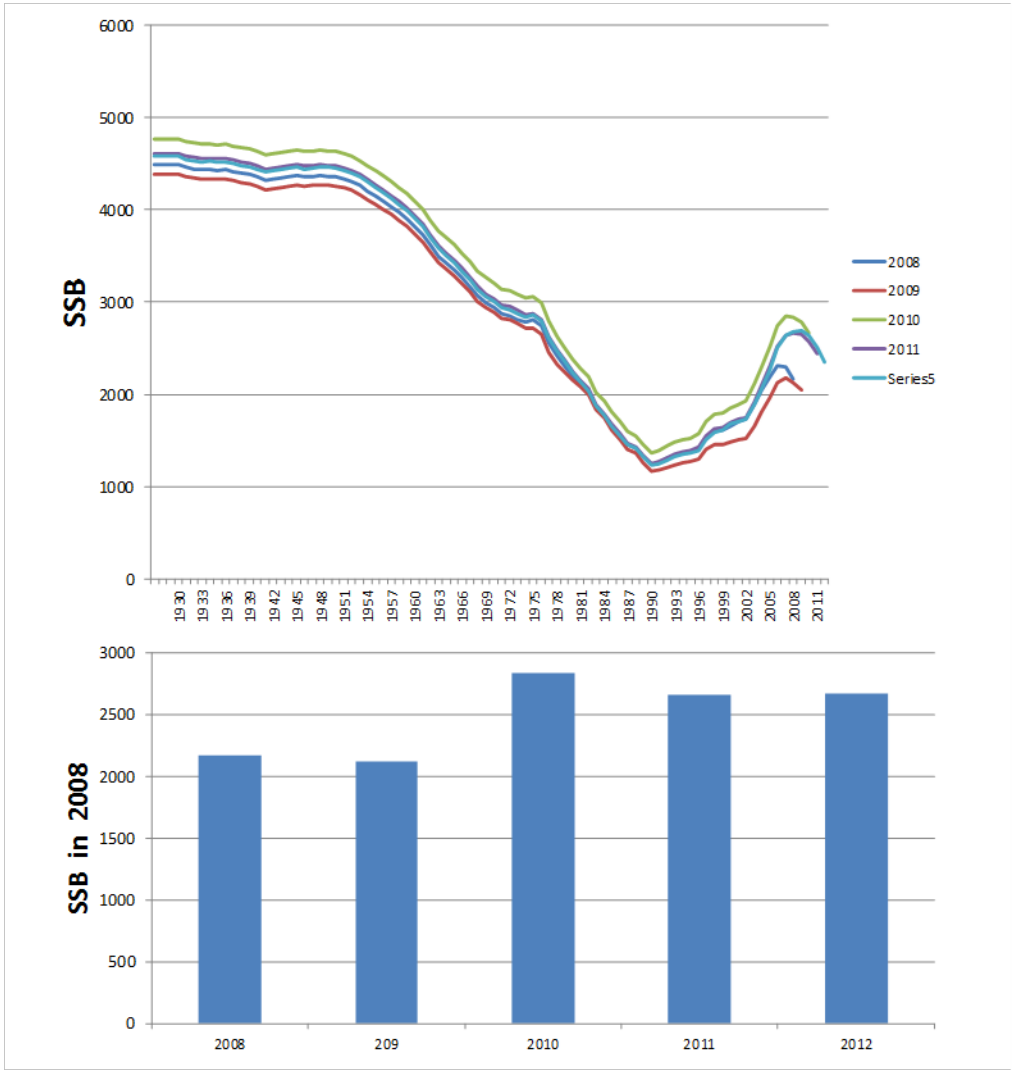
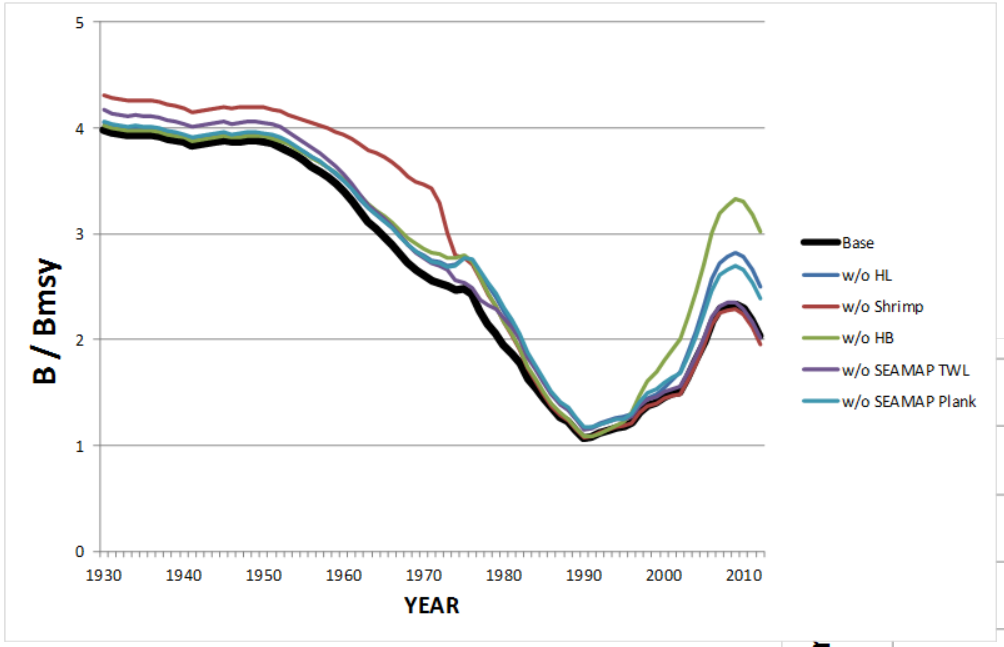
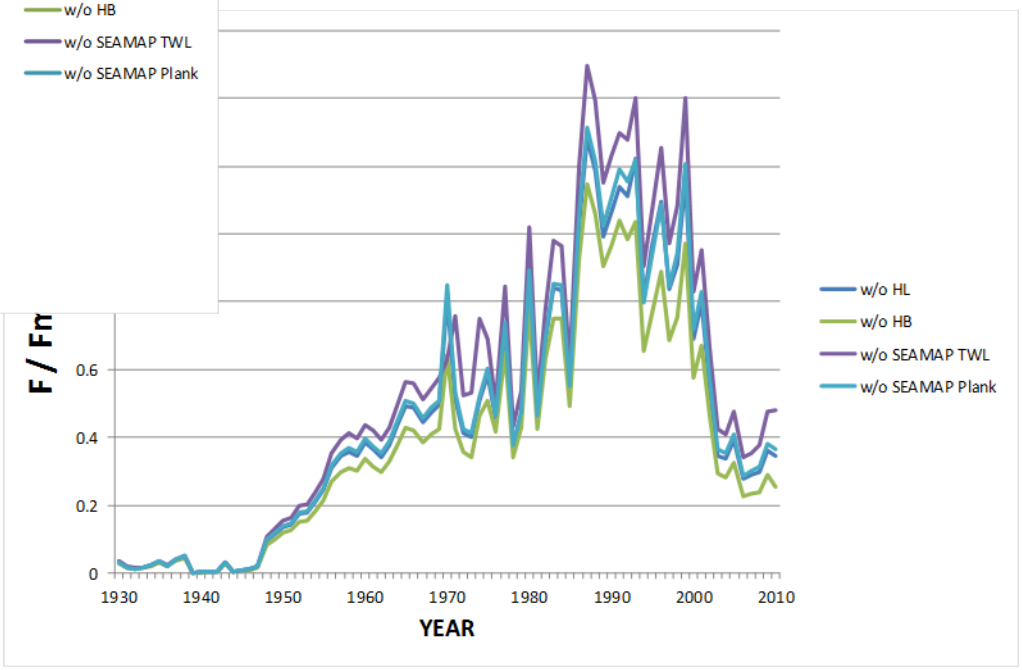


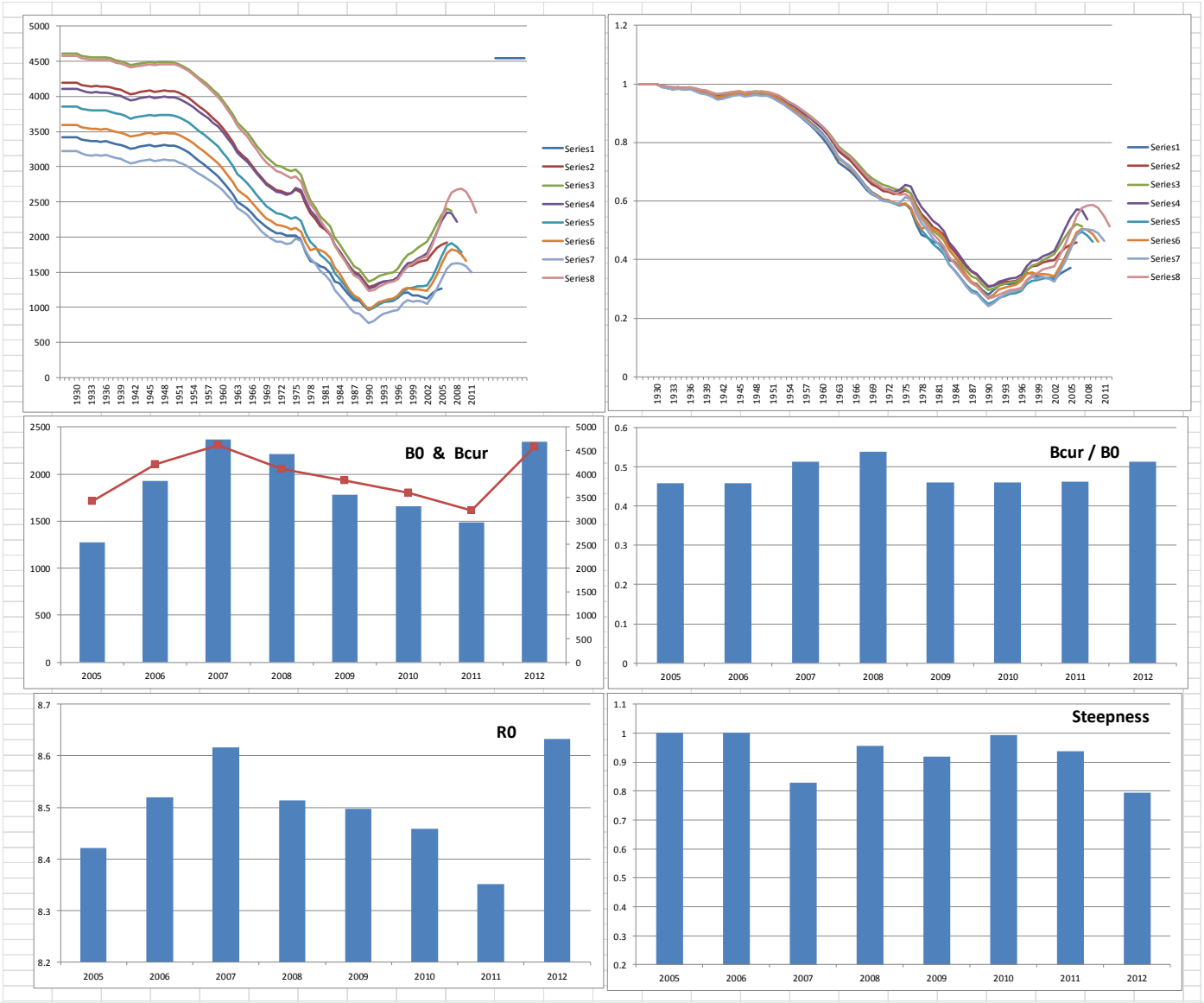
Figure 3.2.25. Resulting trends in SSB (top) and 2008 SSB (bottom) from five year retrospective analysis.

Figure 3.2.26. Trends in B/Bmsy (top) and F/Fmsy resulting from jack-knife analysis of removing one single index of abundance at a time.

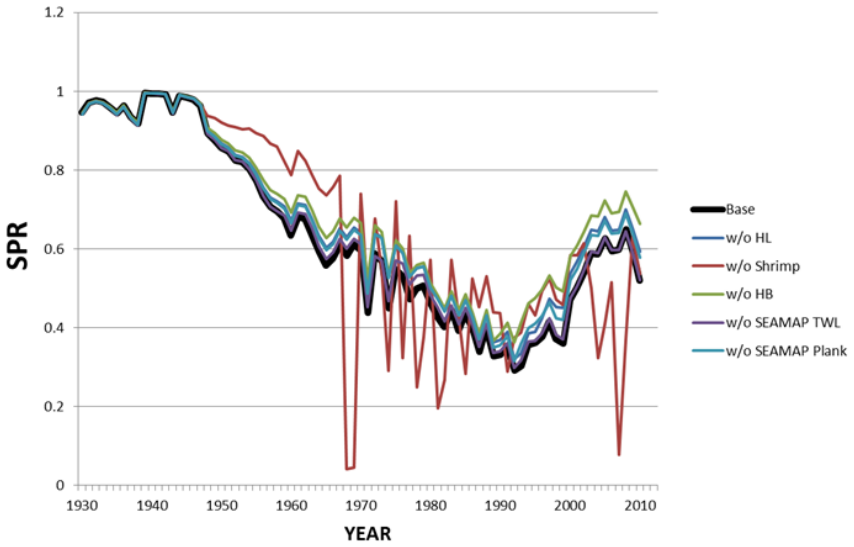


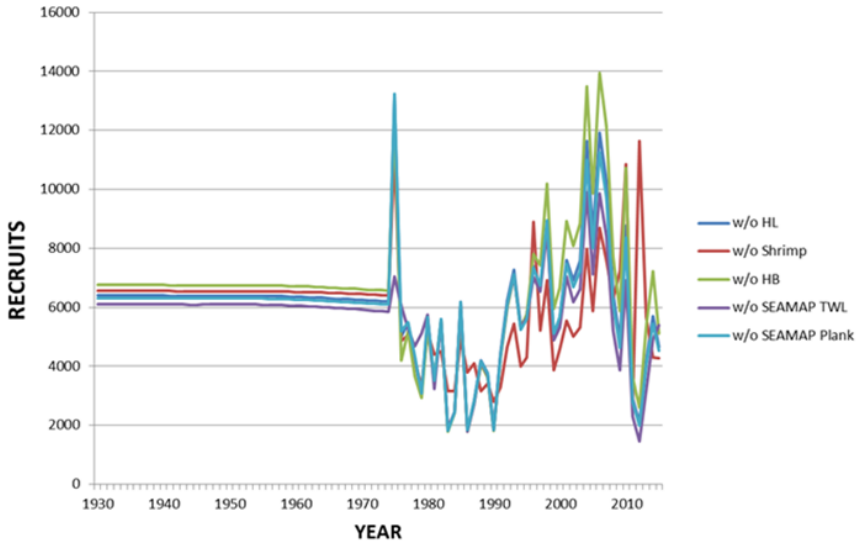


Evaluation of Uncertainty: Retrospective

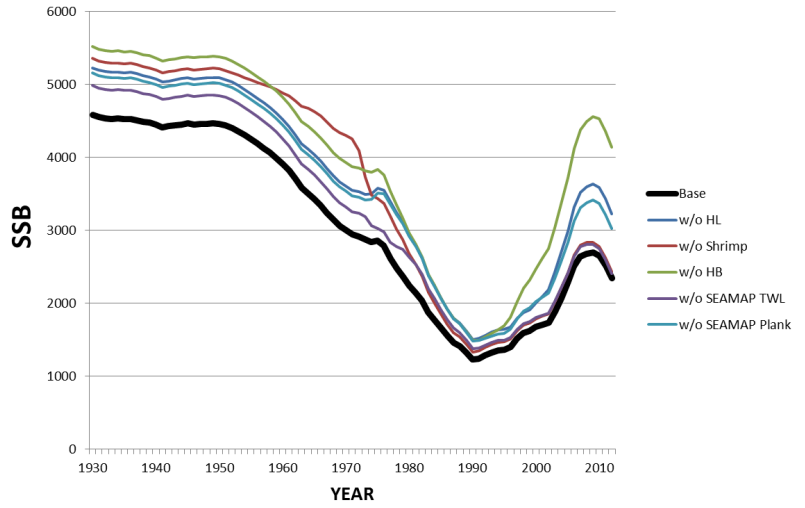


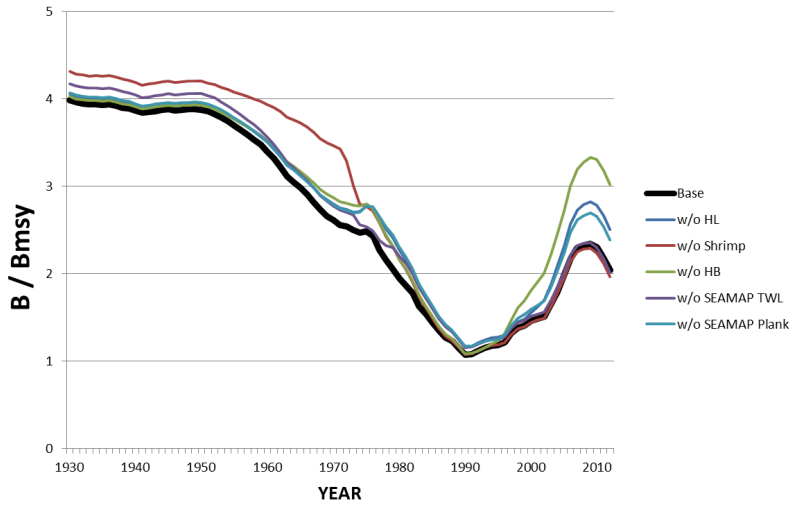
Jackknife on CPUEs
Spawners Per Recruits, Recruits

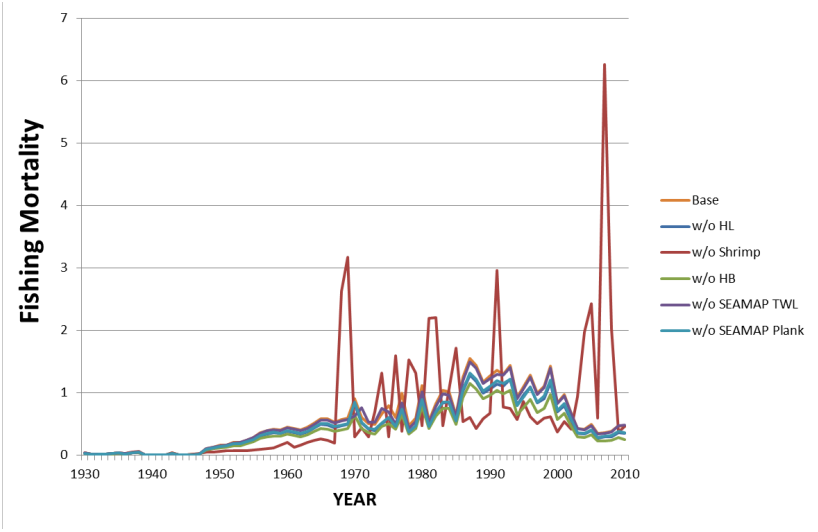


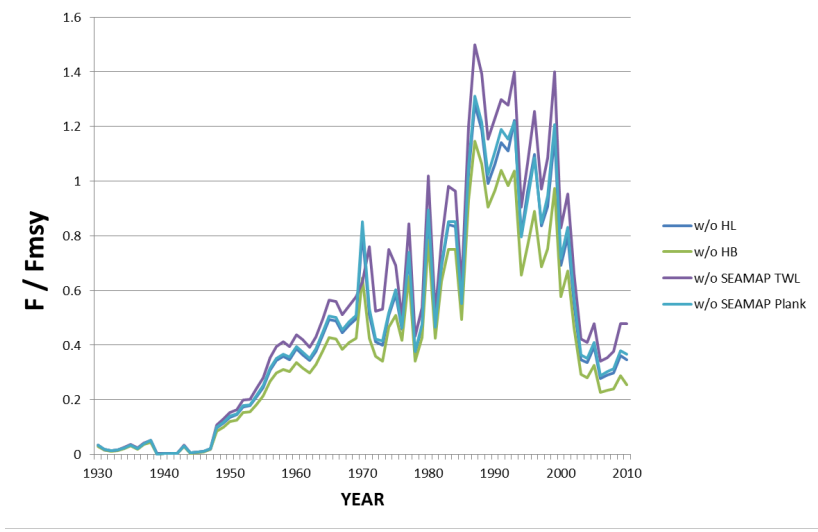


Evaluation of Uncertainty: Jack Knife 3.1.2.8









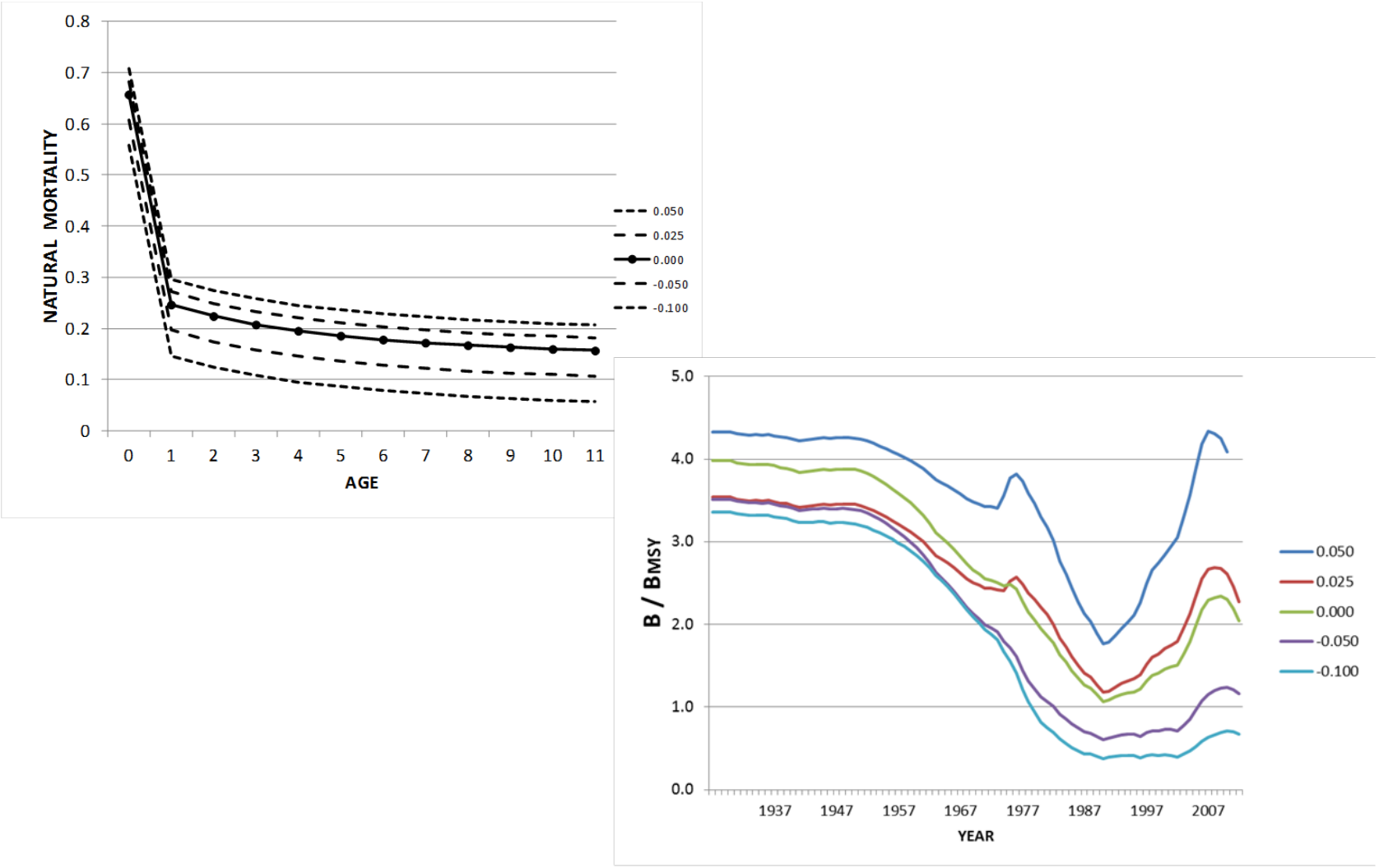


Figure 3.2.27. Various levels of natural mortality used in the sensitivity analysis (top) and the resulting B/BBmsy trends (bottom) for GOM king mackerel.

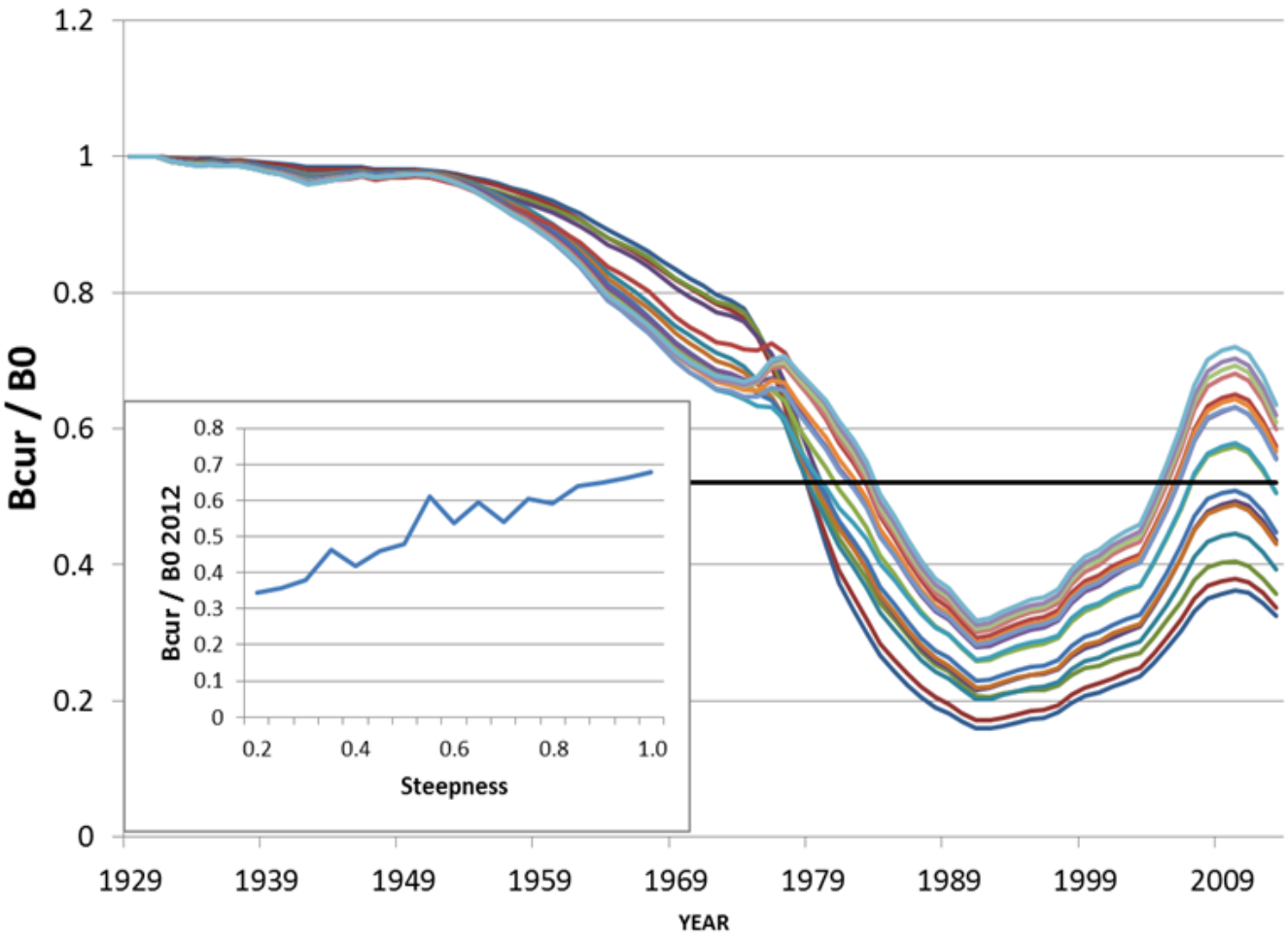
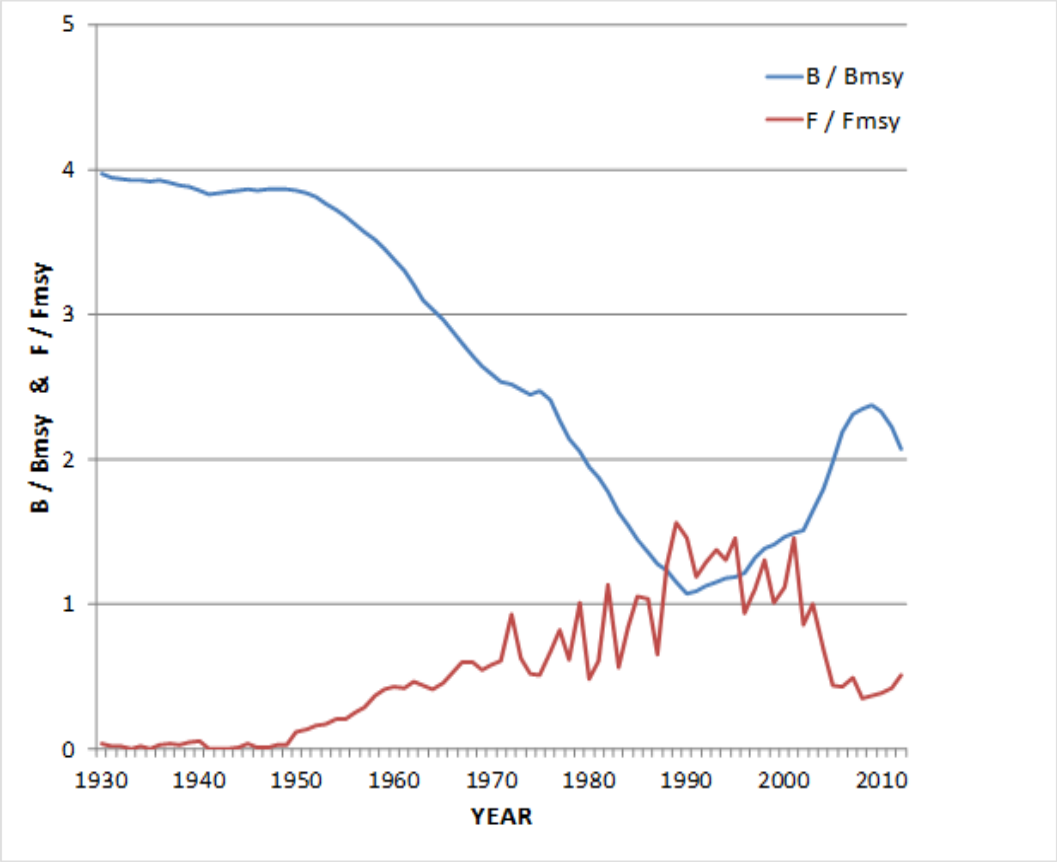
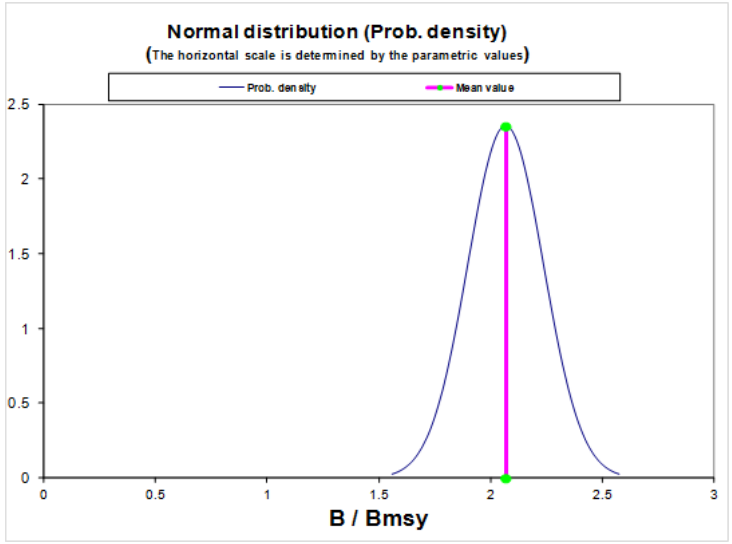


Figure 3.2.28. Trends in Bcurr/B0 assuming various levels of steepness. The black horizontal line depicts the base model estimate. The inner panel depicts the final years estimate.





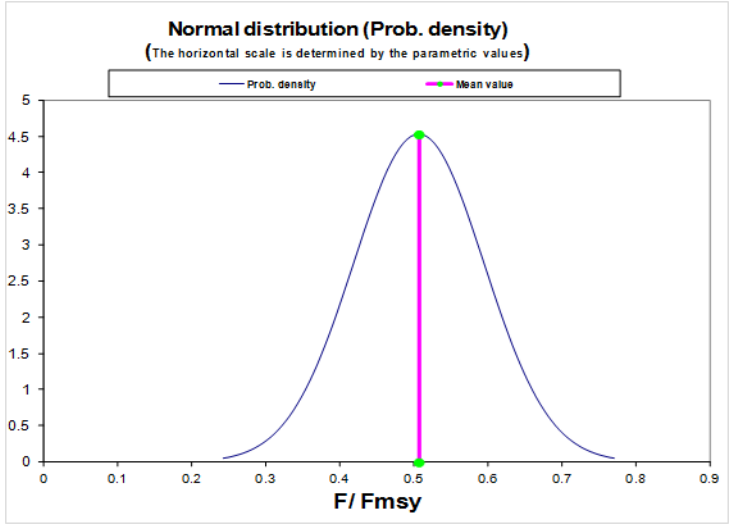
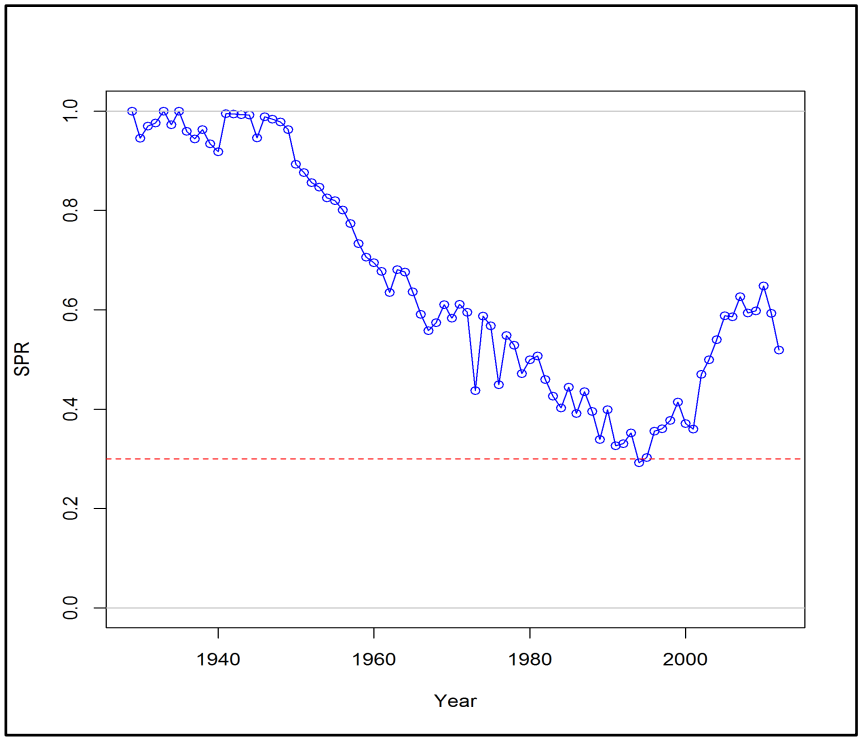
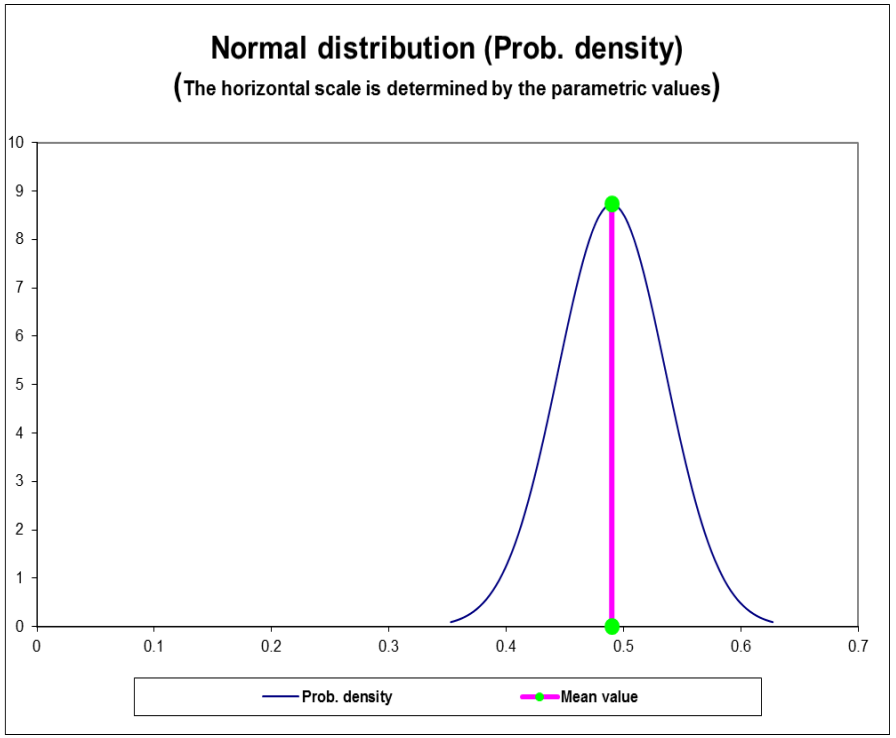


Figure 3.2.29. Fishery status trend for Gulf of Mexico King Mackerel, measured as fishing mortality (F) relative to fishing mortality at maximum sustainable yield (F_{MSY})(top) with probability distributions for year 2012.





Estimates of Spawners-Per-Recruit (SPR, left) and probability distribution based on a normal distribution for GOM king mackerel.

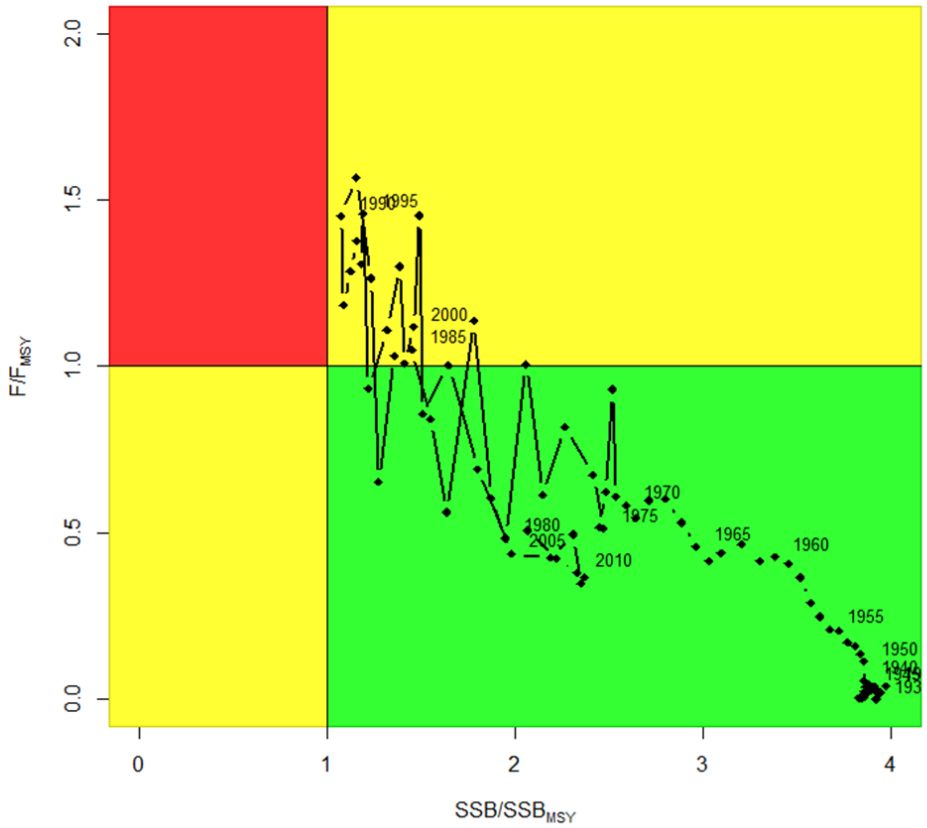


Figure 3.2.30. Kobe plot showing stock status and fishery status trajectory for GOM king mackerel. Green quadrant (lower right) represents a status of not overfished and not undergoing overfishing. The red quadrant (upper left) represents a status of overfished and undergoing overfishing. The yellow quadrants represent statuses of not overfished but undergoing overfishing (upper left), or overfished but not undergoing overfishing (lower left).

Projection Methods

- Final year of selectivity carried forward
- Recruitment taken from the estimated S/R function

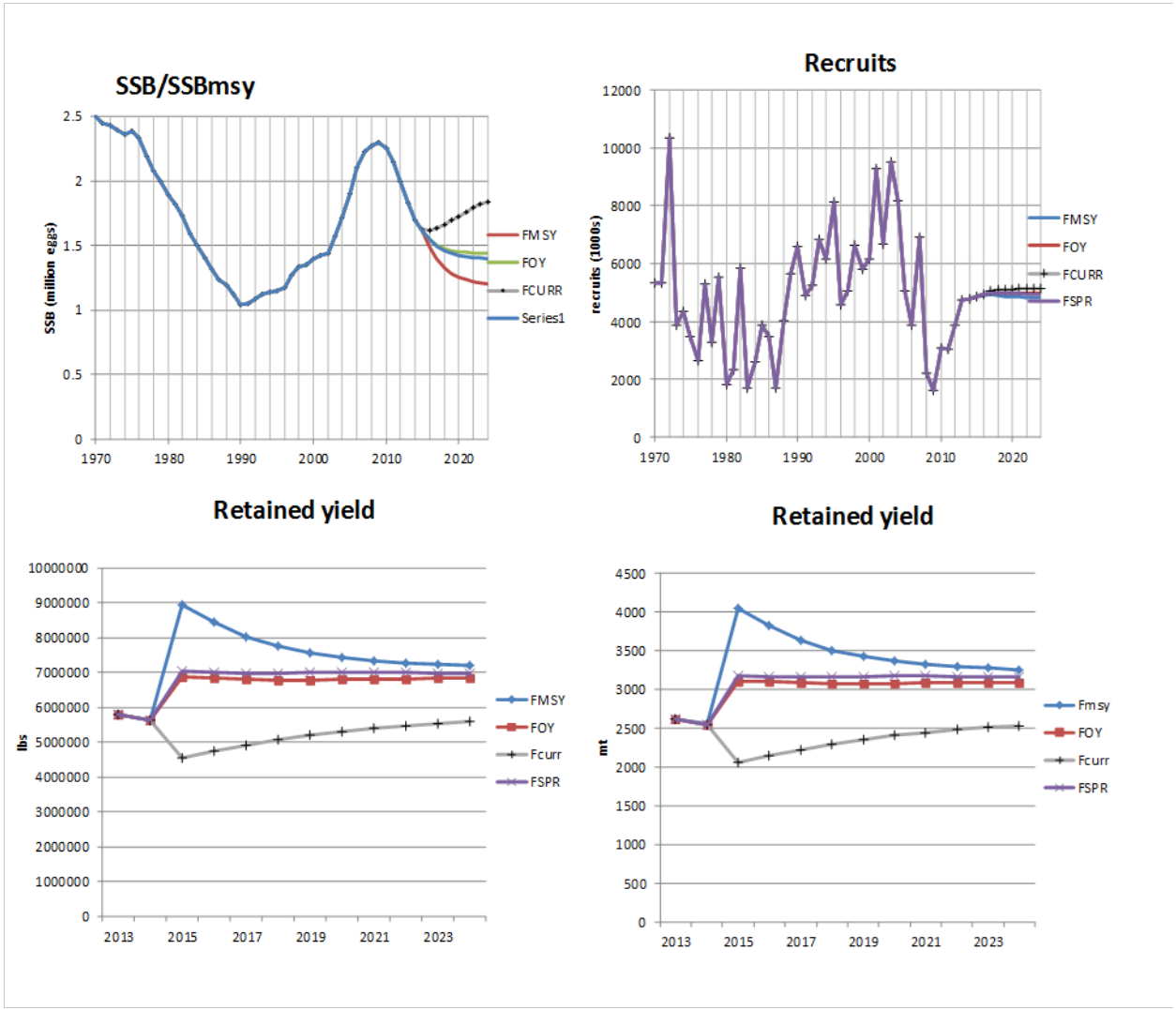


Figure 3.2.31. Projected Spawning stock biomass, recruitment, and yield in pounds and metric tones fishing at estimated Fmsy, Foy, and Fcurr for GOM king mackerel.

Conclusions

- **Weaknesses:** The GOM KMK assessment model is not very stable. The data streams are lacking contrast and thus any real definitive signal with regard to stock status or stock productivity
- **Strengths:** Despite the weaknesses, nearly every model configuration suggests that the stock size has been increasing in size since 1990 with no indication of currently being overfished or experiencing overfishing. The current management strategy seems to be very effective at achieving stated goals and, depending on the desired buffer, there is no evidence to suggest changes in the current quota would be beneficial.
- **General:** It seems that differences with the previous assessment (SEDAR 16) are more attributable to the changing of the size of the Winter Mixing Zone than to the assessment itself

The End?