

Bonnethead Shark Assessment State-space, Age-structured Production Model



Photo by George Burgess

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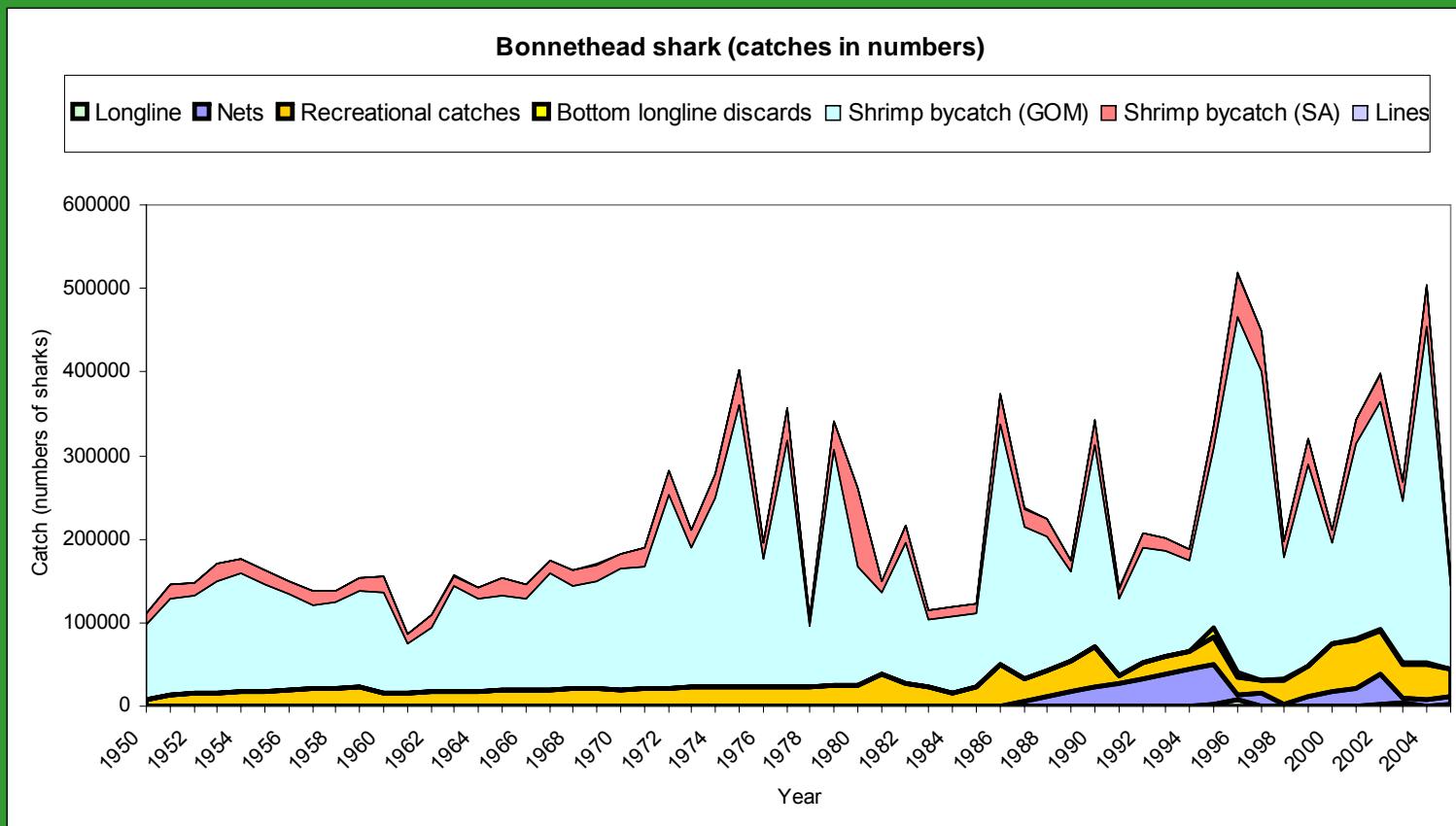
OUTLINE

1. Data Inputs
 - a. Fishery
 - b. Biology
2. Model Description
3. Base Model and Results
4. Sensitivity Cases
5. Summary of all Results

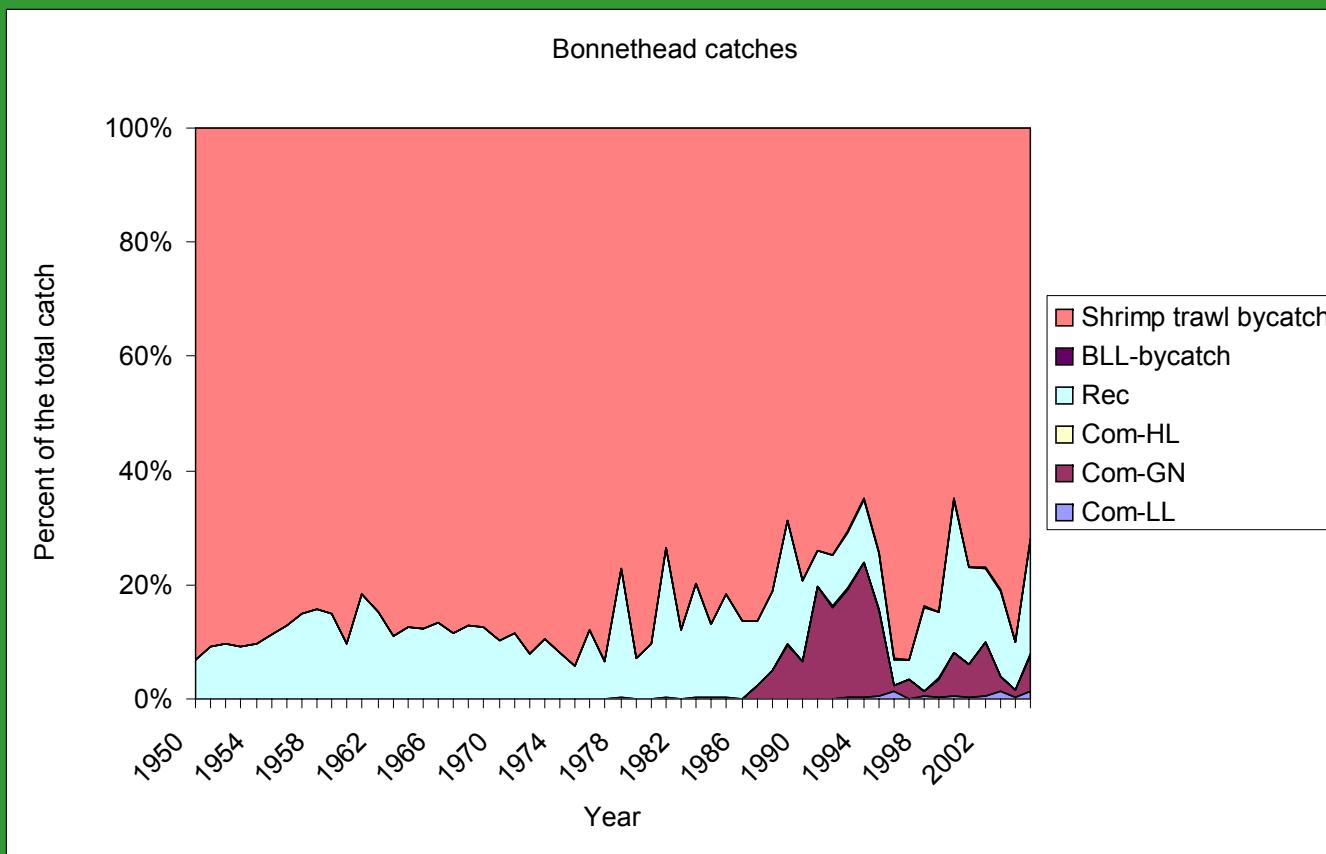
1a. Fishery Inputs

- Catch Series:
 - Commercial
 - Longline
 - Gillnet
 - Handline
 - BLL-discards
 - Recreational
 - Shrimp Bycatch

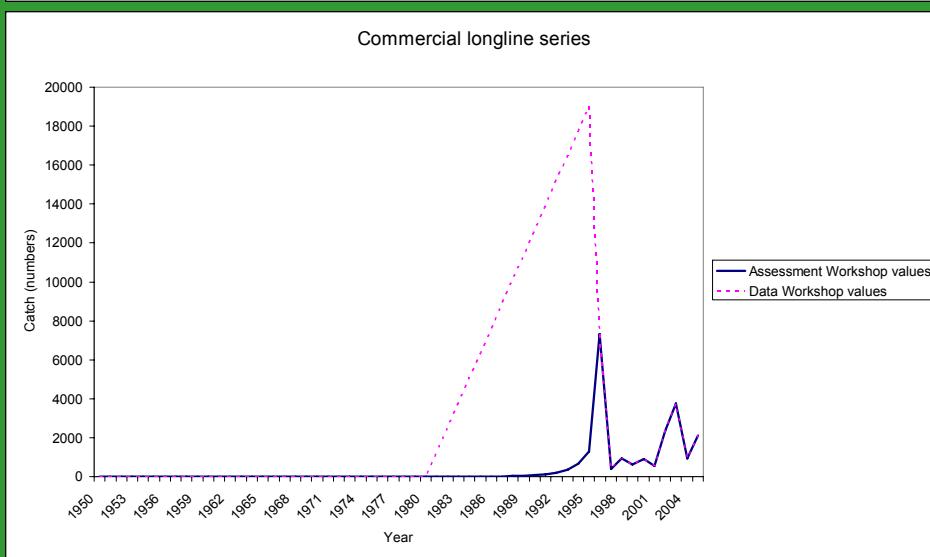
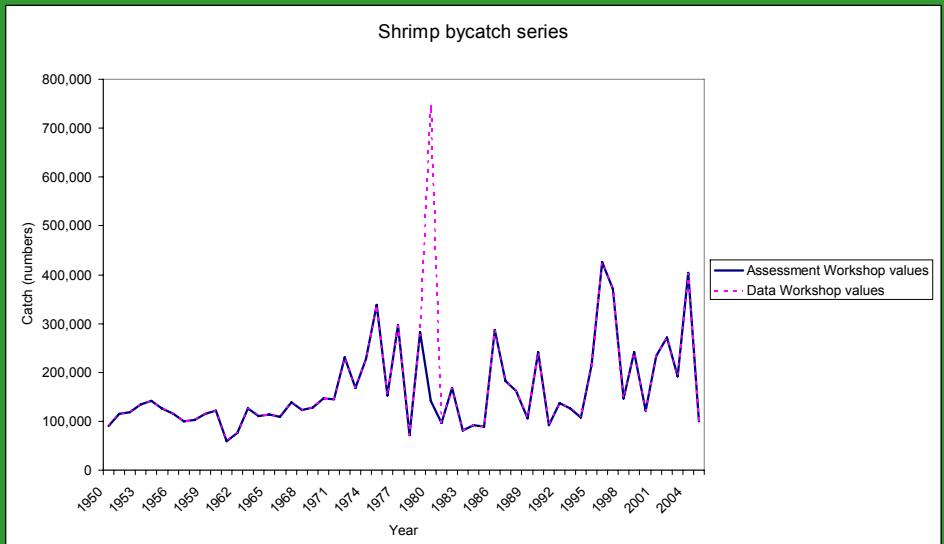
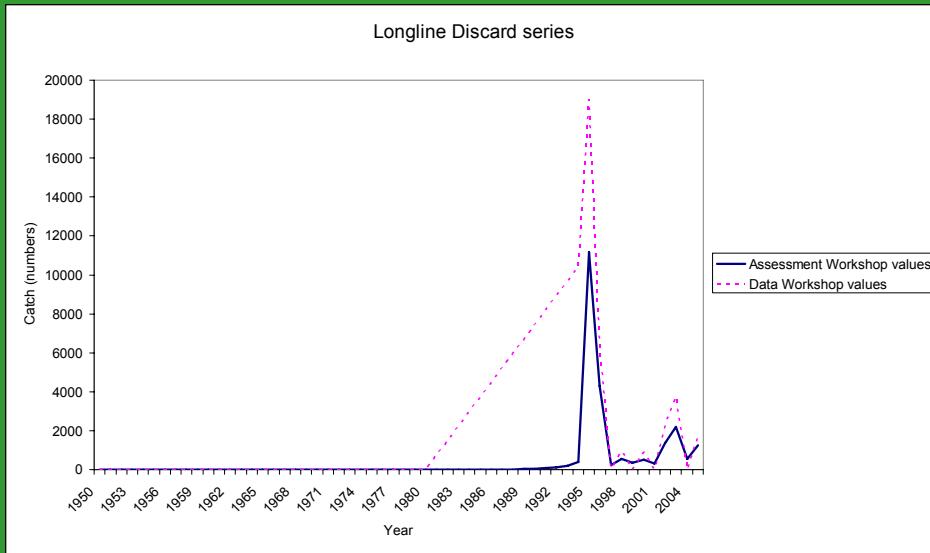
Catches



Catches



Assessment Workshop data issues



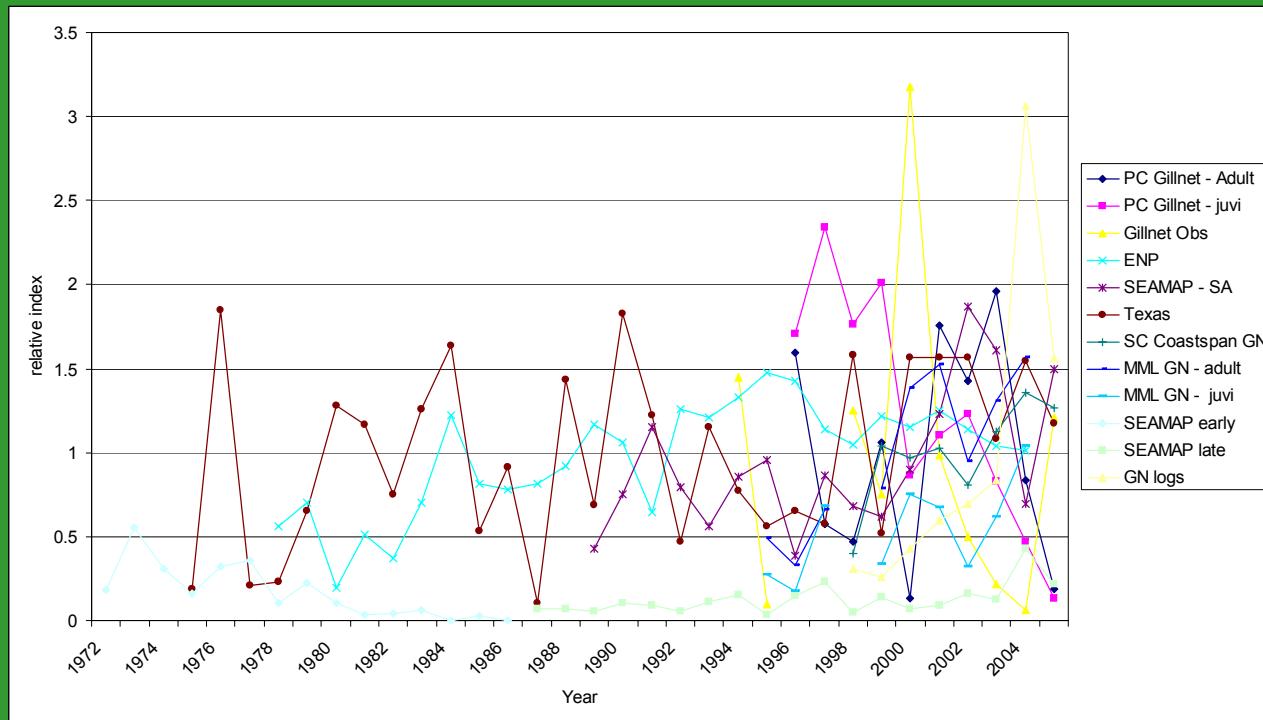
1a. Fishery Inputs

- Indices of Abundance
 - PC Gillnet adult
 - PC Gillnet juvenile
 - Gillnet Observer Program
 - Everglades series
 - SEAMAP SA
 - Texas Gillnet
 - SC Coastspan
 - SEAMAP GOM (early years)
 - SEAMAP GOM (later years)
 - Mote Marine Lab Gillnet (adult)
 - Mote Marine Lab Gillnet (juvenile)
 - Gillnet logbook

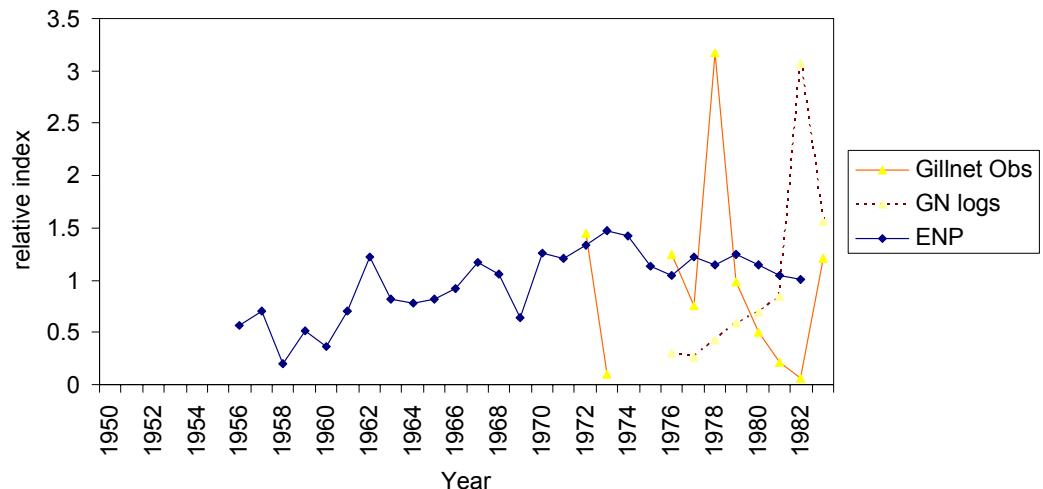
1a. Fishery input changes at the assessment workshop

- SEAMAP Extended Summer (ES) and Extended Fall (EF) were the base case as of the data workshop
- SEAMAP EF was a combination of two series. The AW decided to use the two separate series due to sampling protocol changes.
- SEAMAP ES was excluded because of the low proportion positives (< 5%)

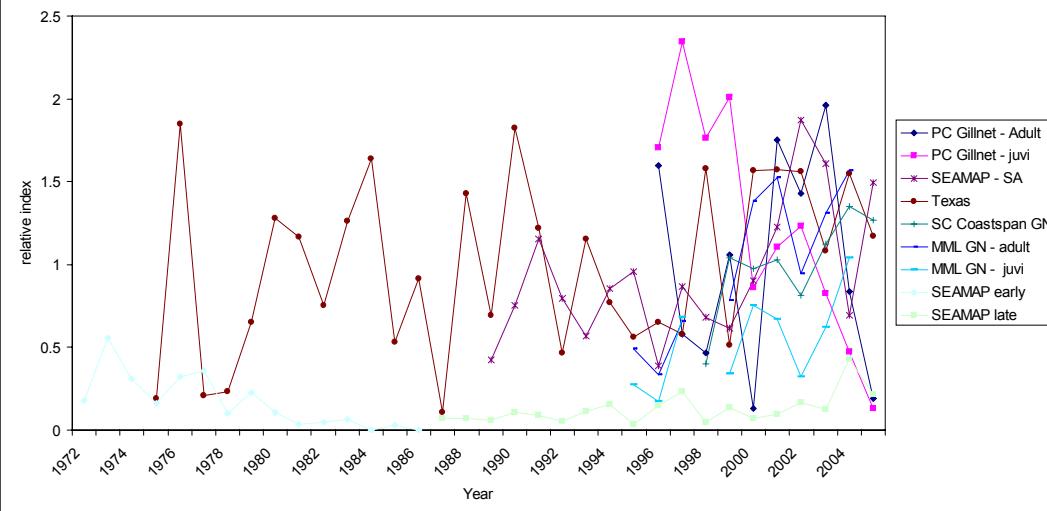
All indices

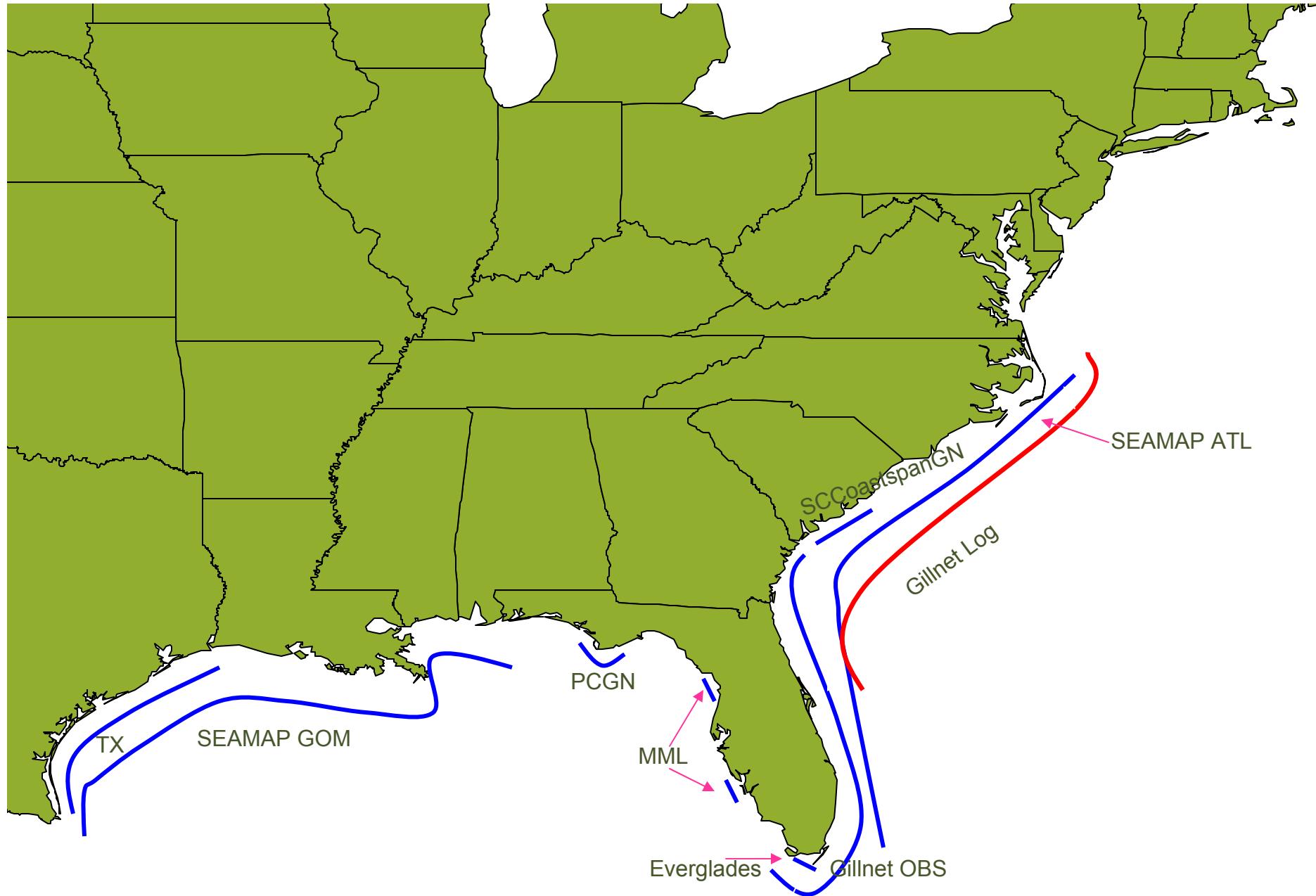


Fishery-Dependent Indices



Fishery-Independent Indices





Bonnethead

sensitivity

base

1a. Fishery Inputs

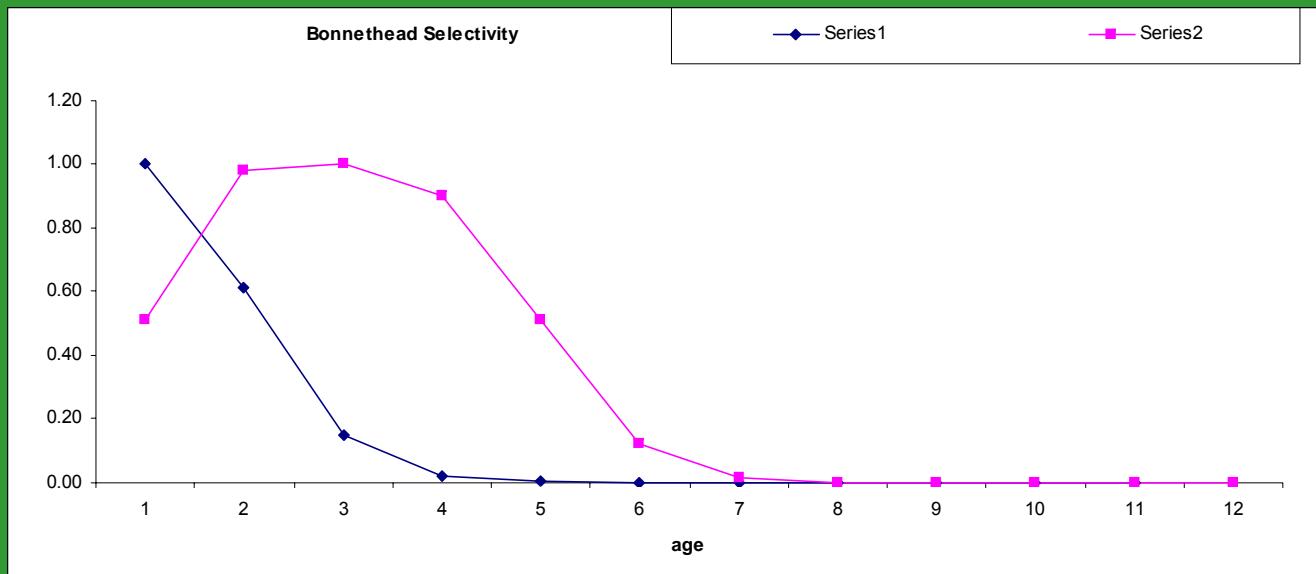
- Selectivity for catches
- Selectivity for indices

Selectivity of the catch



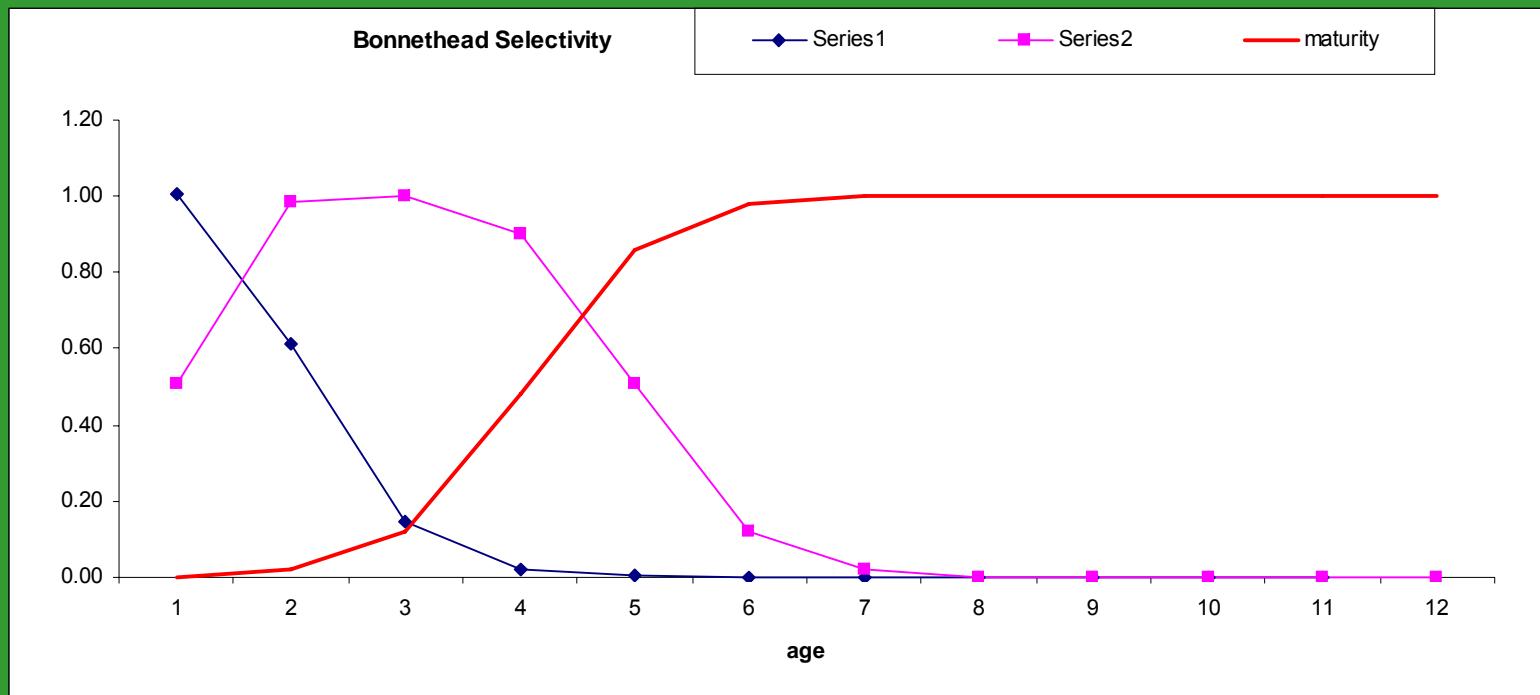
- The longline, lines, and longline bycatch series used selectivity 1
- The gillnet, recreational, and shrimp bycatch series used selectivity 2

Selectivity - Indices



- Selectivity 1: PC GN (j), GNOP, ENP, TX GN, SC Coasts, SEAMAP early and late, MML (j), and GN logs
- Selectivity 2: PC GN (a), SEAMAP SA, MML (a)

Selectivity as it relates to maturity



Selectivity Derivations

- SEDAR 13-AW-02 working document
- Calculated selectivity at age from age frequencies. Age-length keys were used to calculate the age-frequencies.

1b. Biological Inputs – DW values

Parameter	Value
L_∞	113.9 (cm TL)
K	0.22
t_0	-1.25
a	9.52E-11
b	3.59
Pup Survival	0.66
Virgin Recruitment (R_0)	[1.0E+4, 1.0E+10]

Steepness – Max. Repro Rate (α)

- $\alpha = \text{pup.survival} \times \text{virgin.spawners.per.recruit}$

$\alpha = \text{pup.survival} \times$

$$\varphi_0 = \sum_{age} fec_{age} \cdot mat_{age} \prod_{j=1}^{age-1} e^{-M_j}$$

- Steepness = $\alpha / (\alpha+4)$

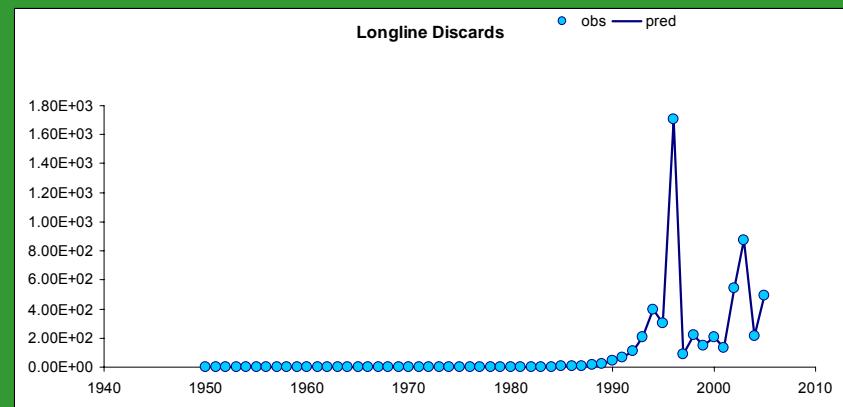
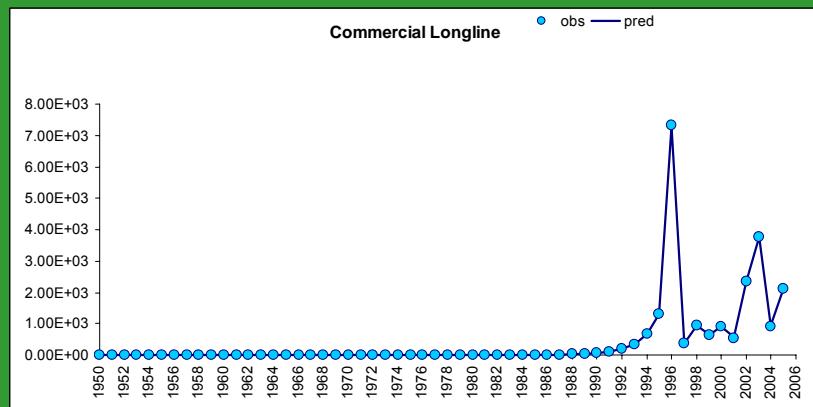
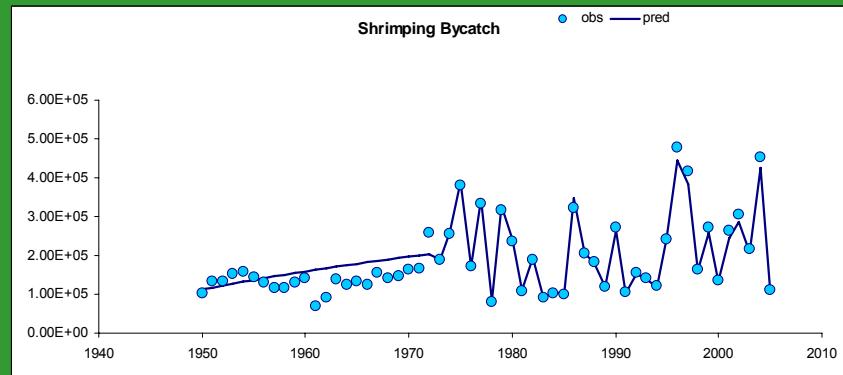
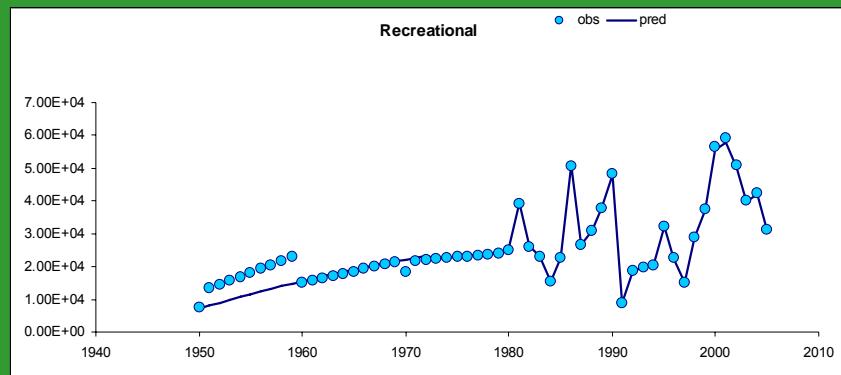
1b. Biological Inputs

age	M at age
1	0.415515
2	0.400478
3	0.385662
4	0.371064
5	0.328504
6	0.287682
7	0.274437
8	0.261365
9	0.248461
10	0.235722
11	0.223144
12	0.210721

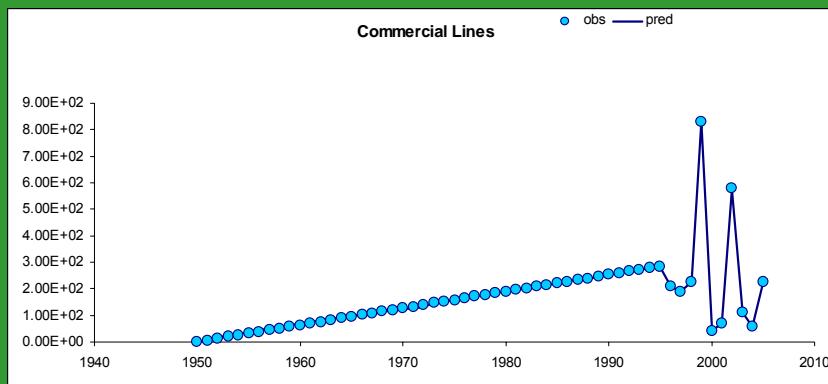
2. Model Description

- Historical period 1950-1971, used reconstructed catches for the shrimp and recreational fisheries
- Catch series begin in 1972 (Shrimp bycatch) and 1981 (Recreational); earliest index (SEAMAP GOM Early) begins in 1972

Model Fit to the Catch Series

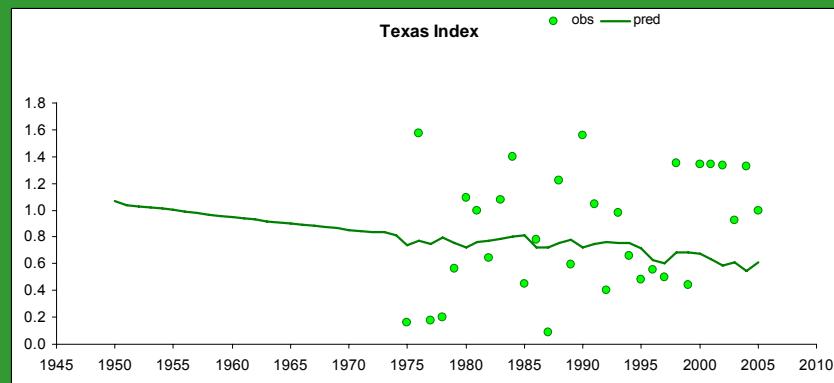
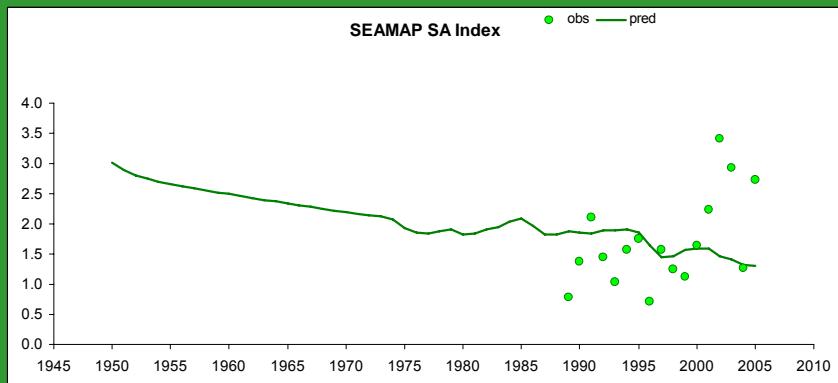
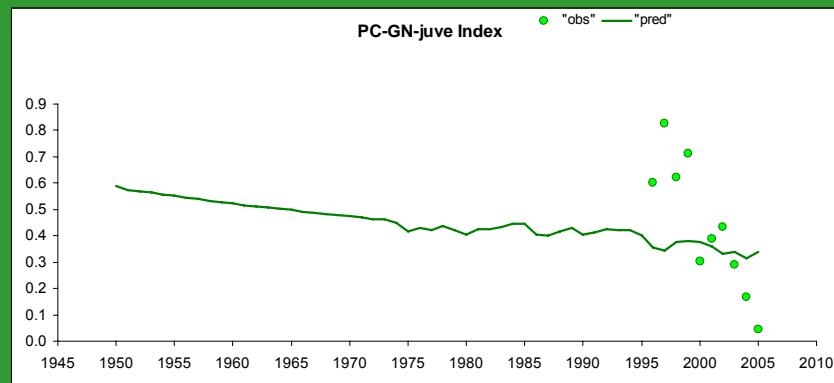
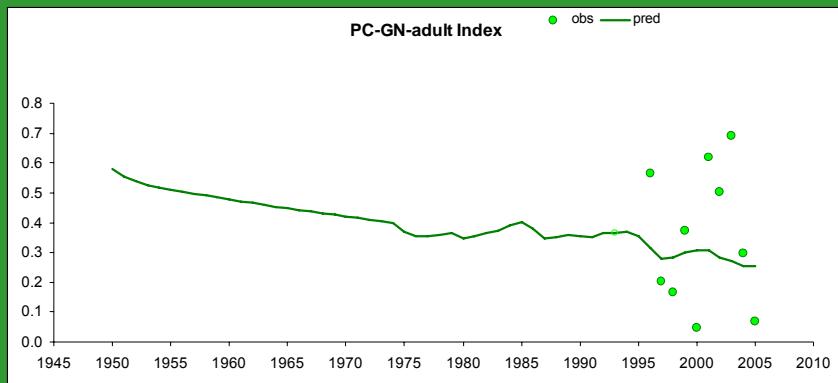


Model fit to catches continued...

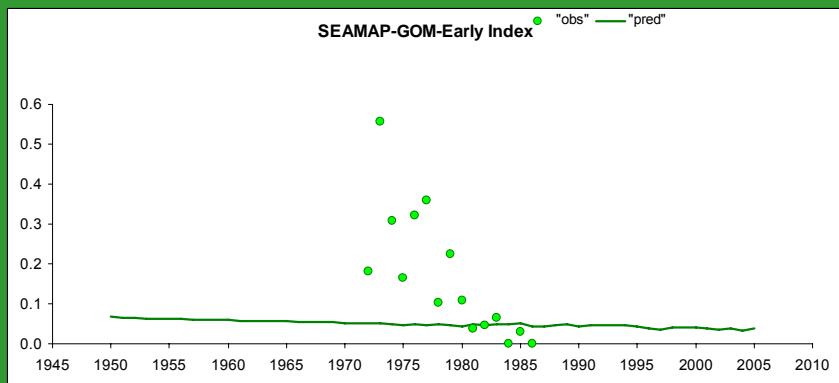
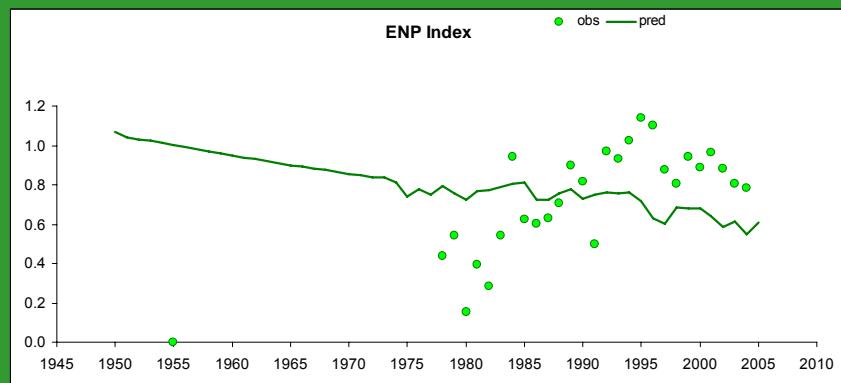
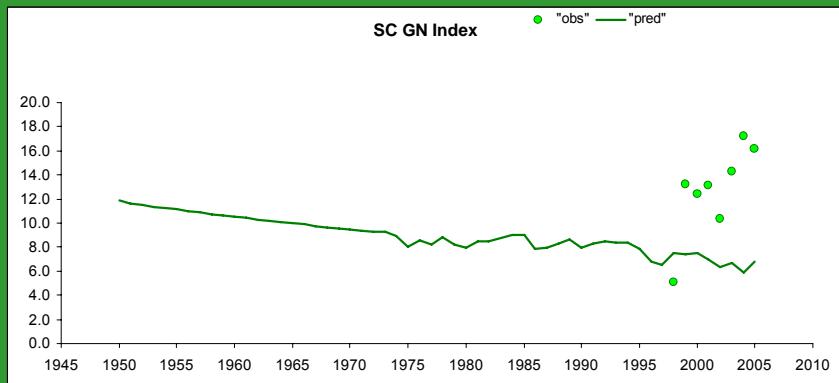
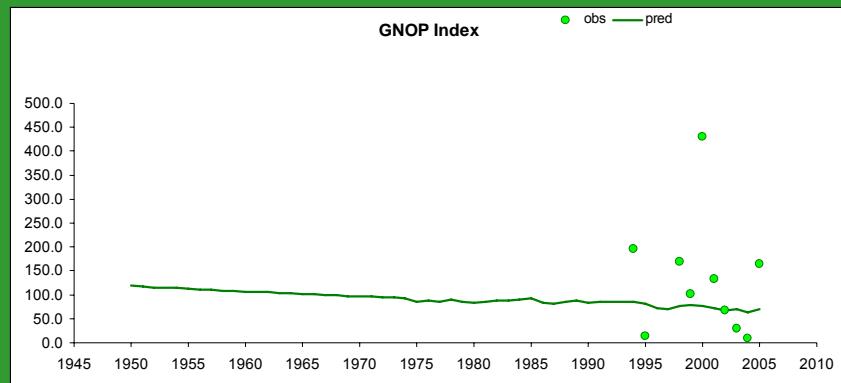


- Model fit to updated catches
- Maintained a linear increase for gillnet and line fisheries
- Exponential increase for longline fishery

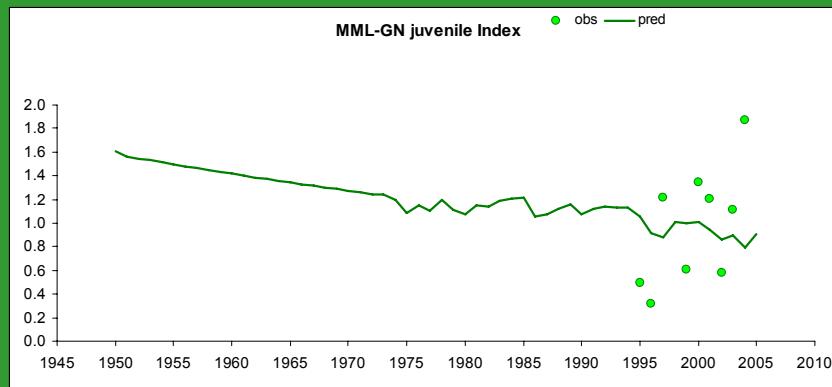
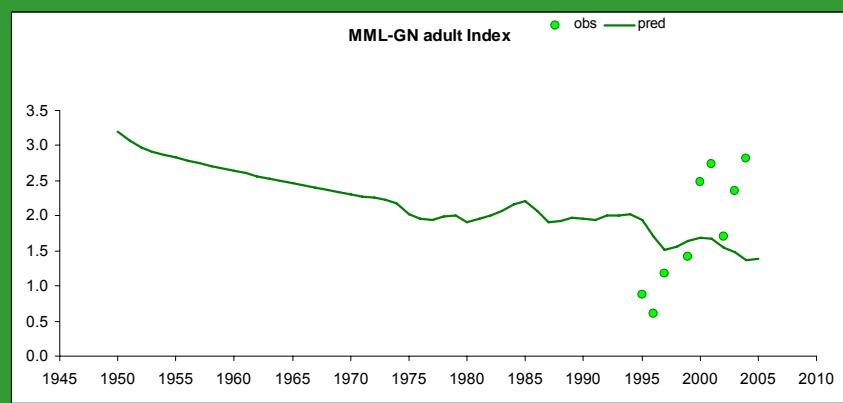
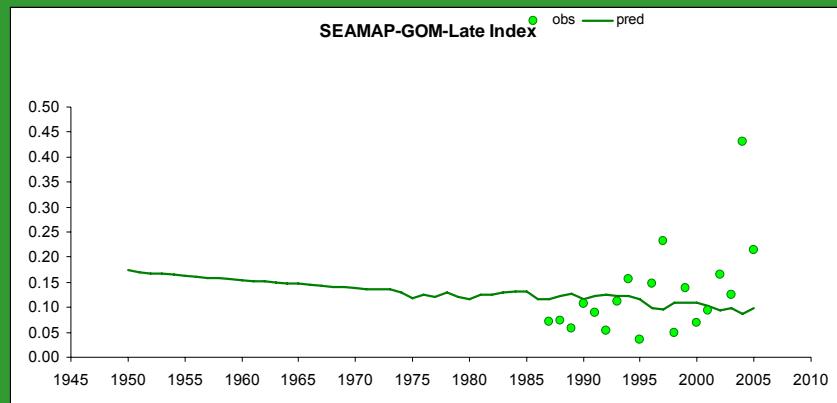
Model Fit to Indices



Model Fit to Indices continued...



Model Fit to Indices continued...



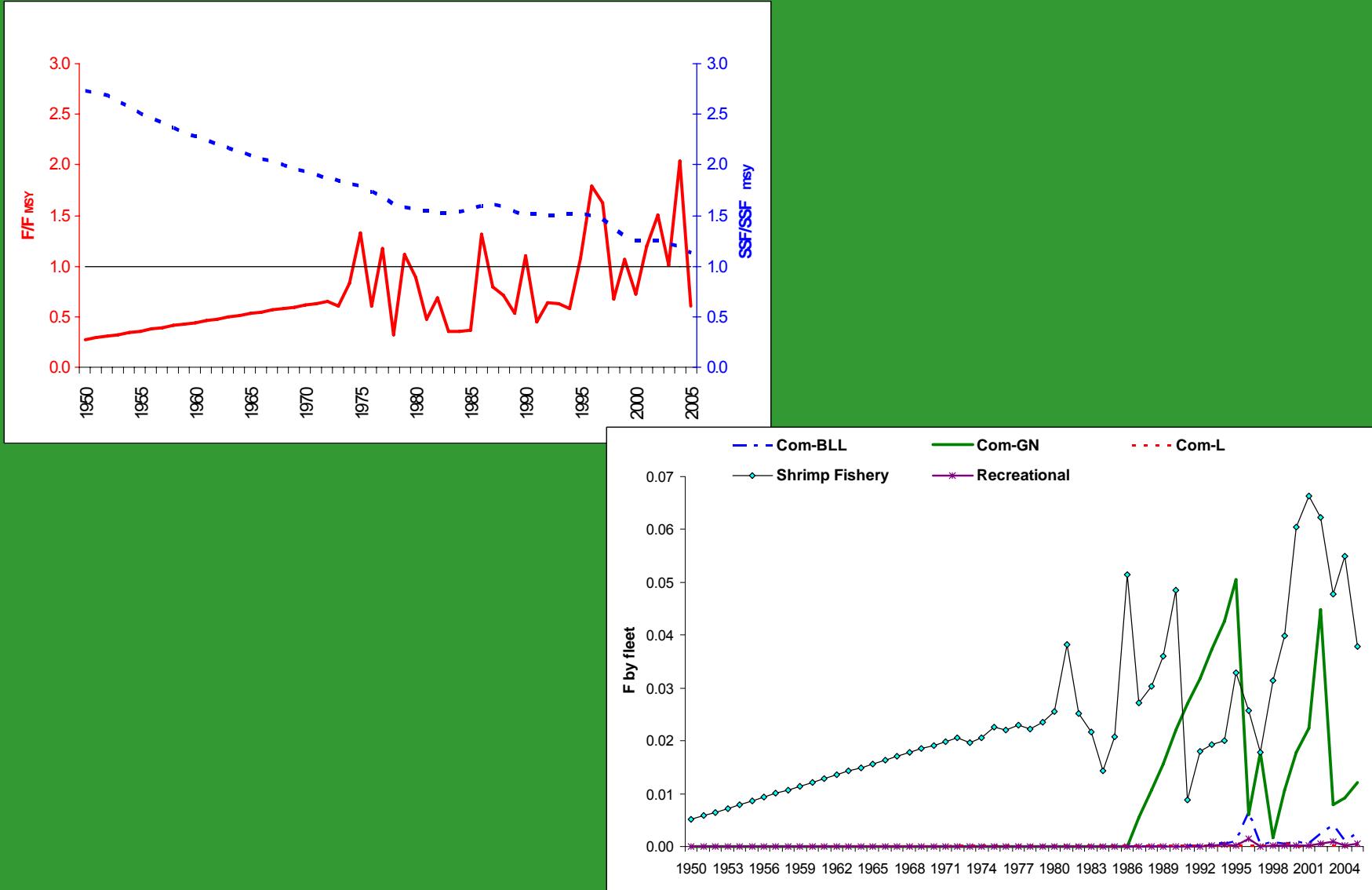
3. Base Model and Results

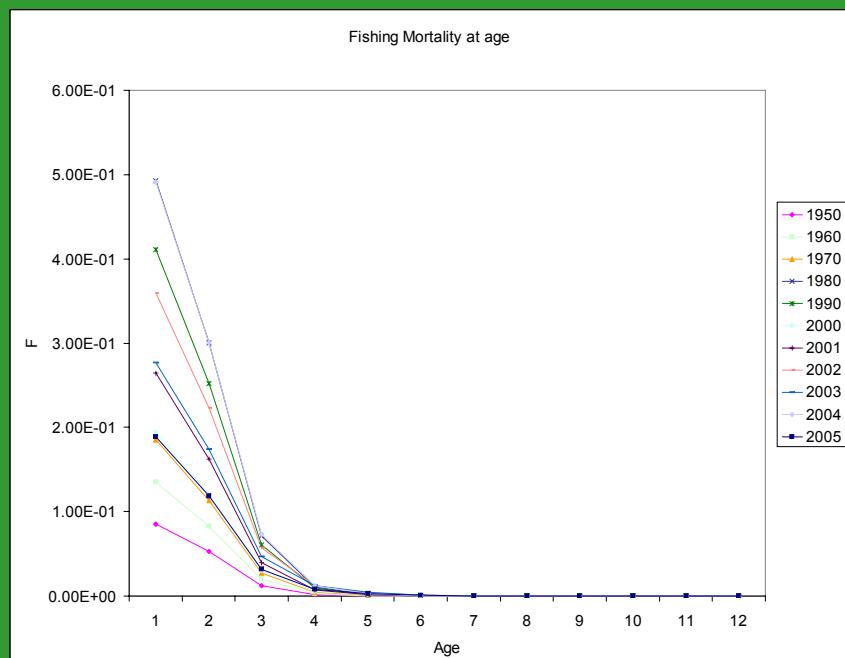
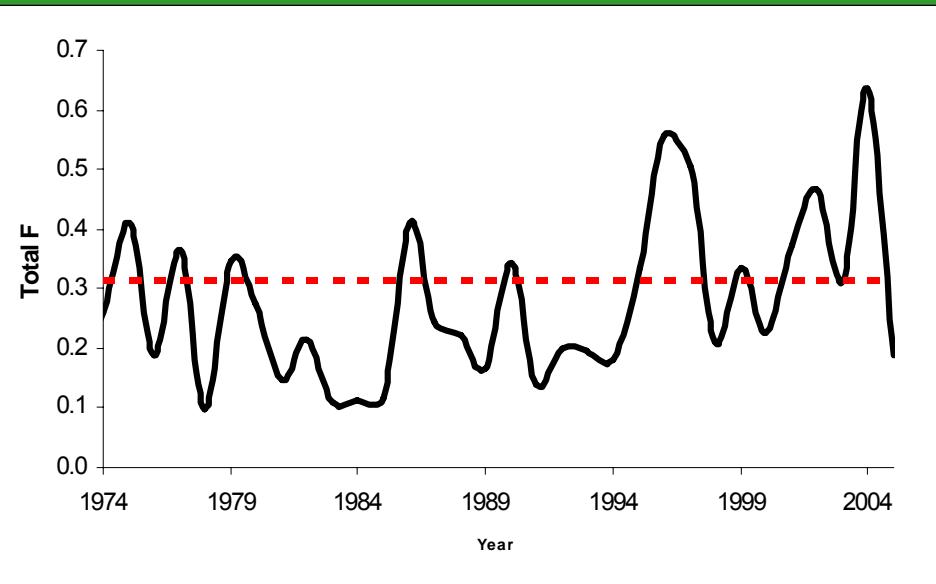
Stock Measure	Estimate	CV
SSF_{2005}/SSF_{MSY}	1.13	0.49
F_{2005}/F_{MSY}	0.61	0.82
N_{2005}/N_{MSY}	0.83	-
MSY	568,871	-
SPR_{MSY}	0.57	0.17
F_{MSY}	0.31	-
SSF_{MSY}	1.99E+06	-
N_{MSY}	1.92E+06	-
F_{2005}	0.19	0.82

3. Base Model and Results

Stock Measure	Estimate	CV
SSF_{2005}	2.26E+06	0.72
N_{2005}	1.59E+06	-
SSF_{2005}/SSF_0	0.41	0.471
B_{2005}/B_0	0.44	0.467
R0	1.22E+06	0.29
Pup-survival	0.70	0.24
alpha	3.14	-
steepness	0.44	-

3. Base Model and Results



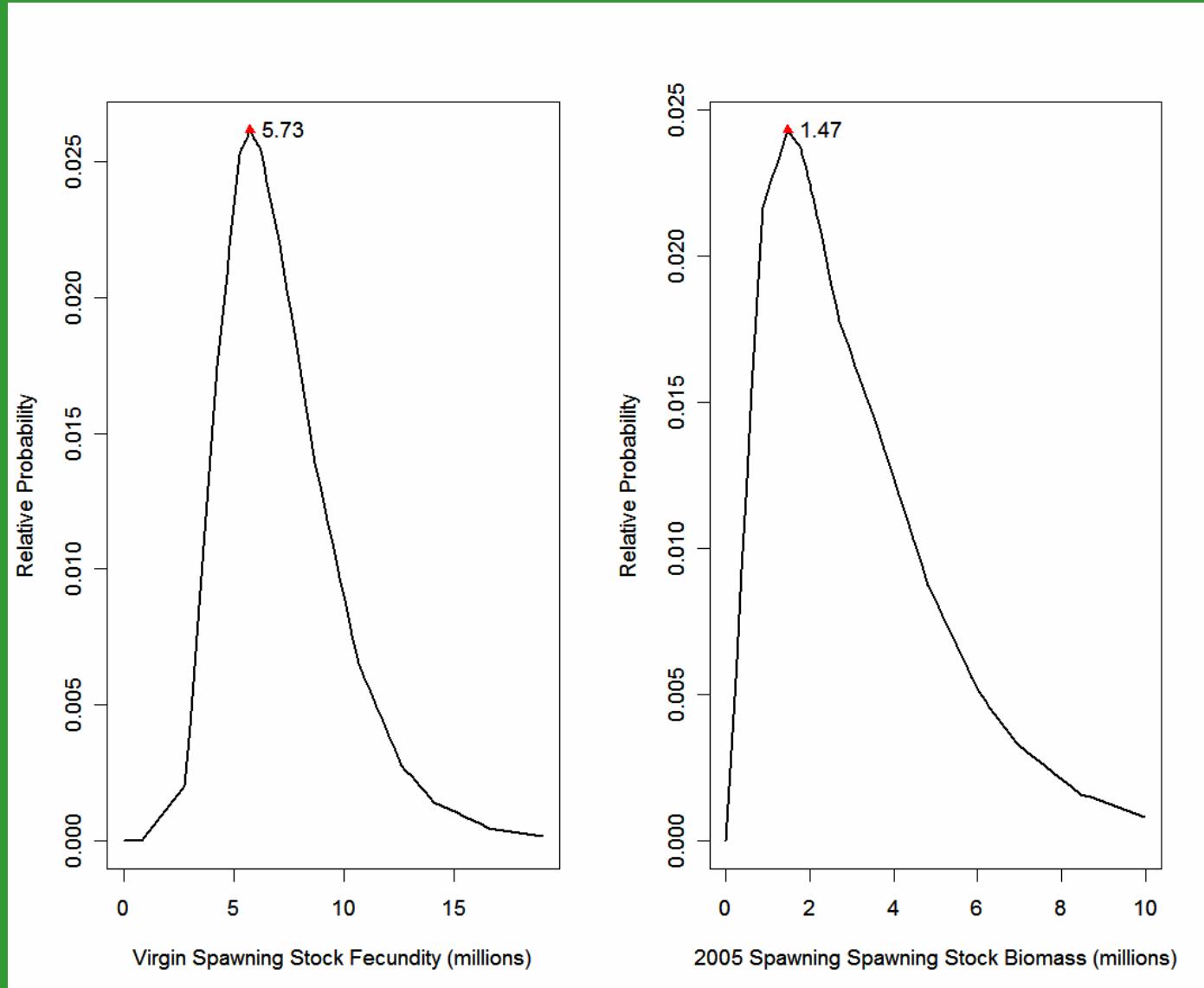


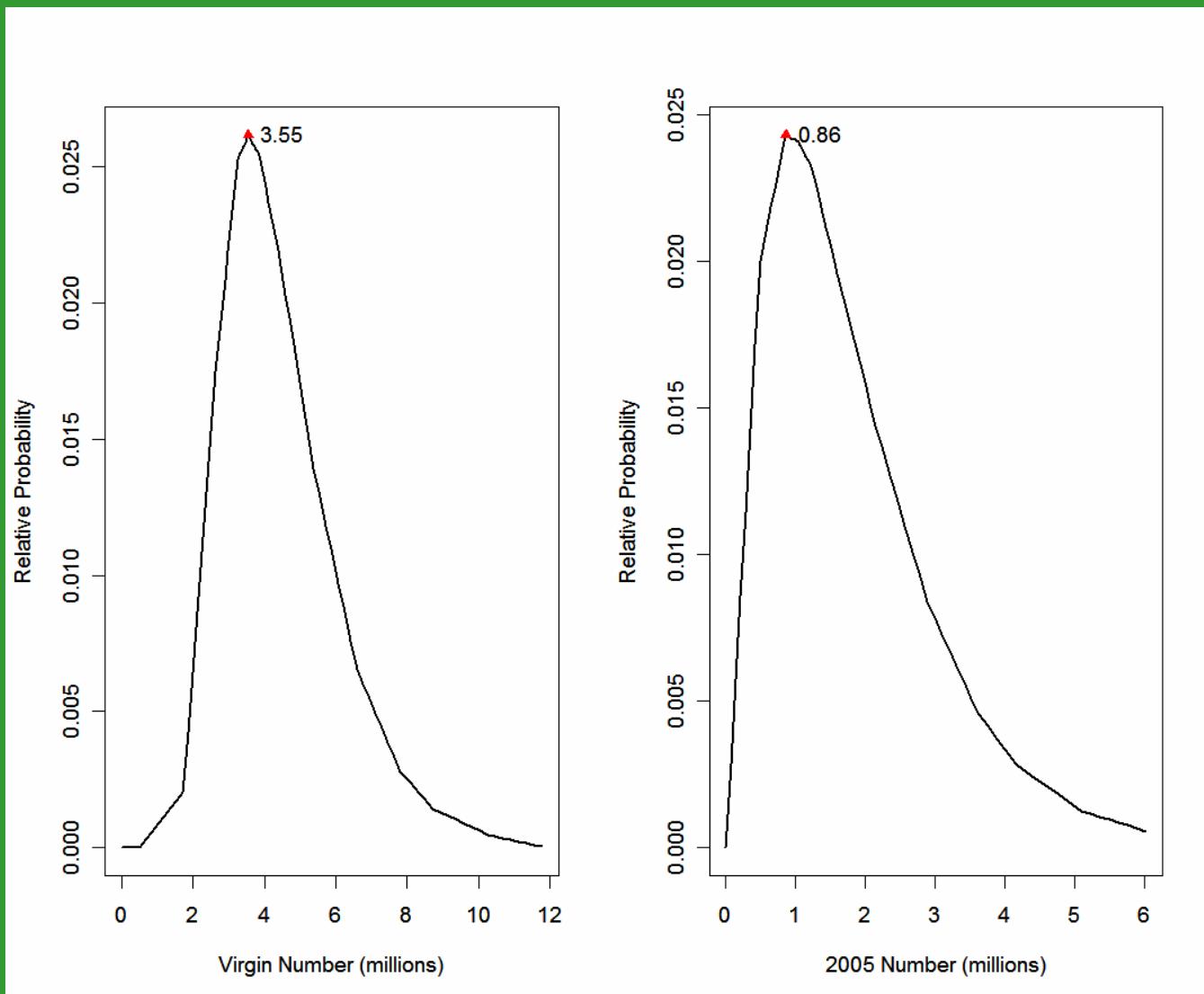
3. Base Model and Results

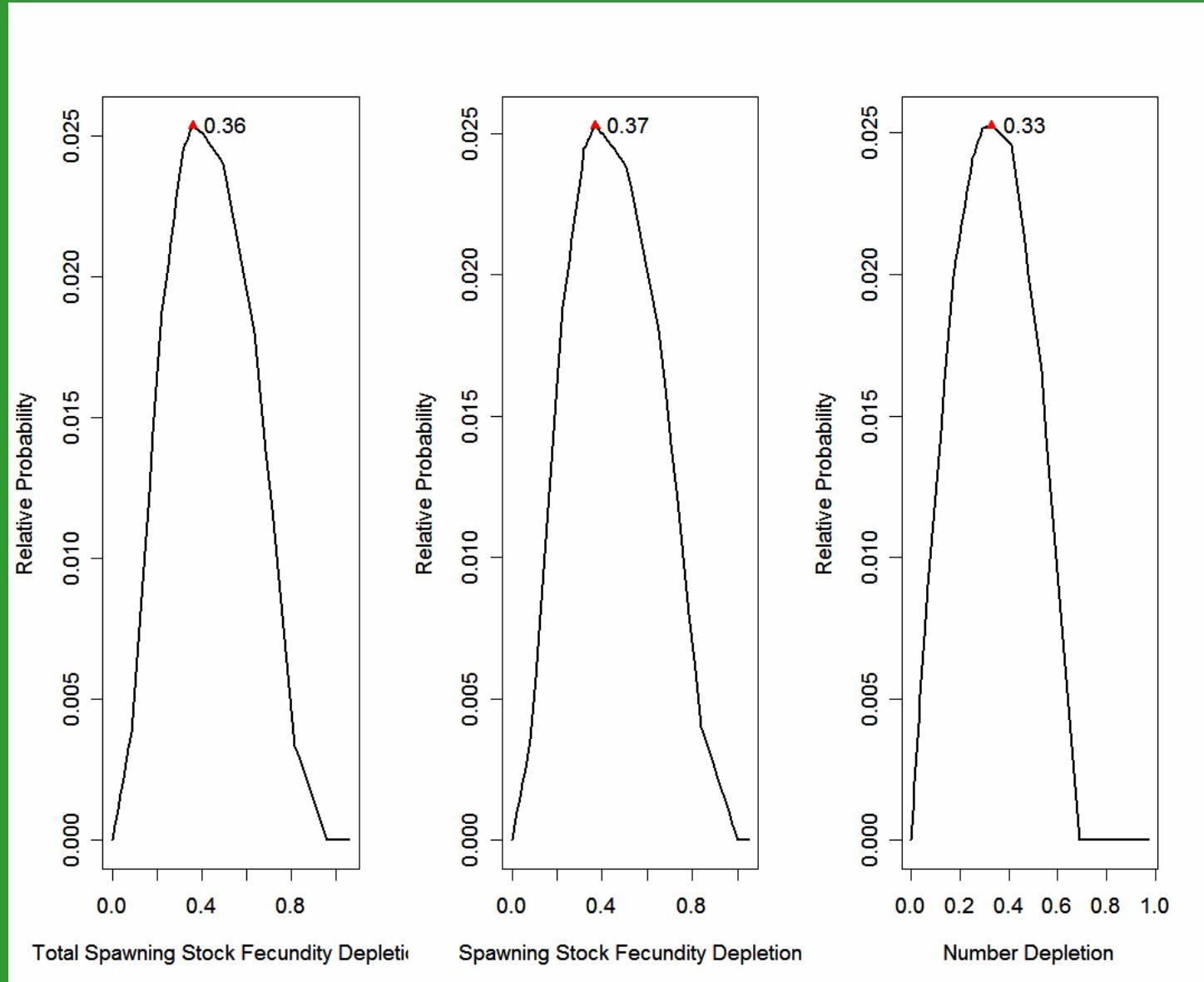
- $\text{SSF}_{2005}/\text{SSF}_{\text{MSY}} = 1.13 \rightarrow \text{not overfished}$
- $F_{2005}/F_{\text{MSY}} = 0.61 \rightarrow \text{no overfishing}$
- Steepness = 0.44
- $\text{SPR}_{\text{MSY}} = 0.42$
- $F_{\text{MSY}} = 0.31$

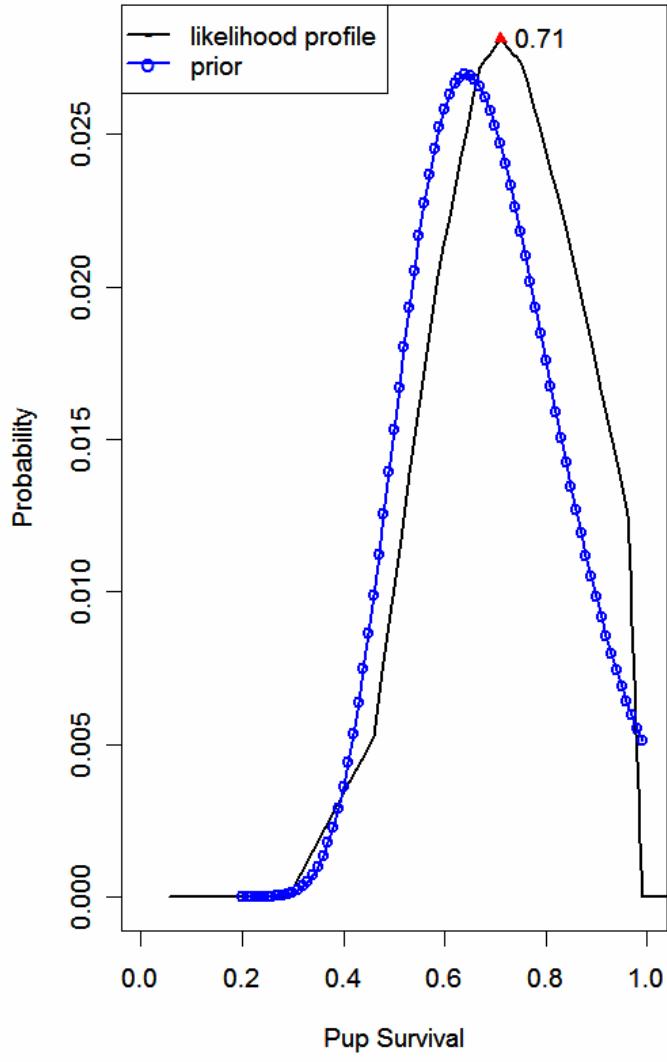
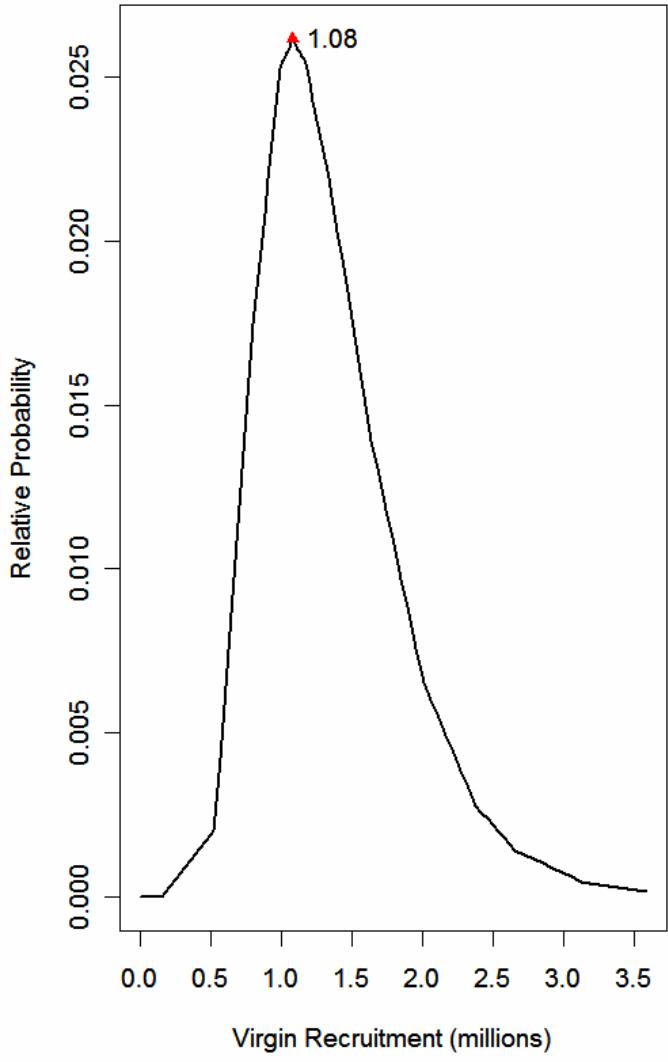
Uncertainty

- Likelihood profiling option in ADMB to estimate posterior distributions for parameters

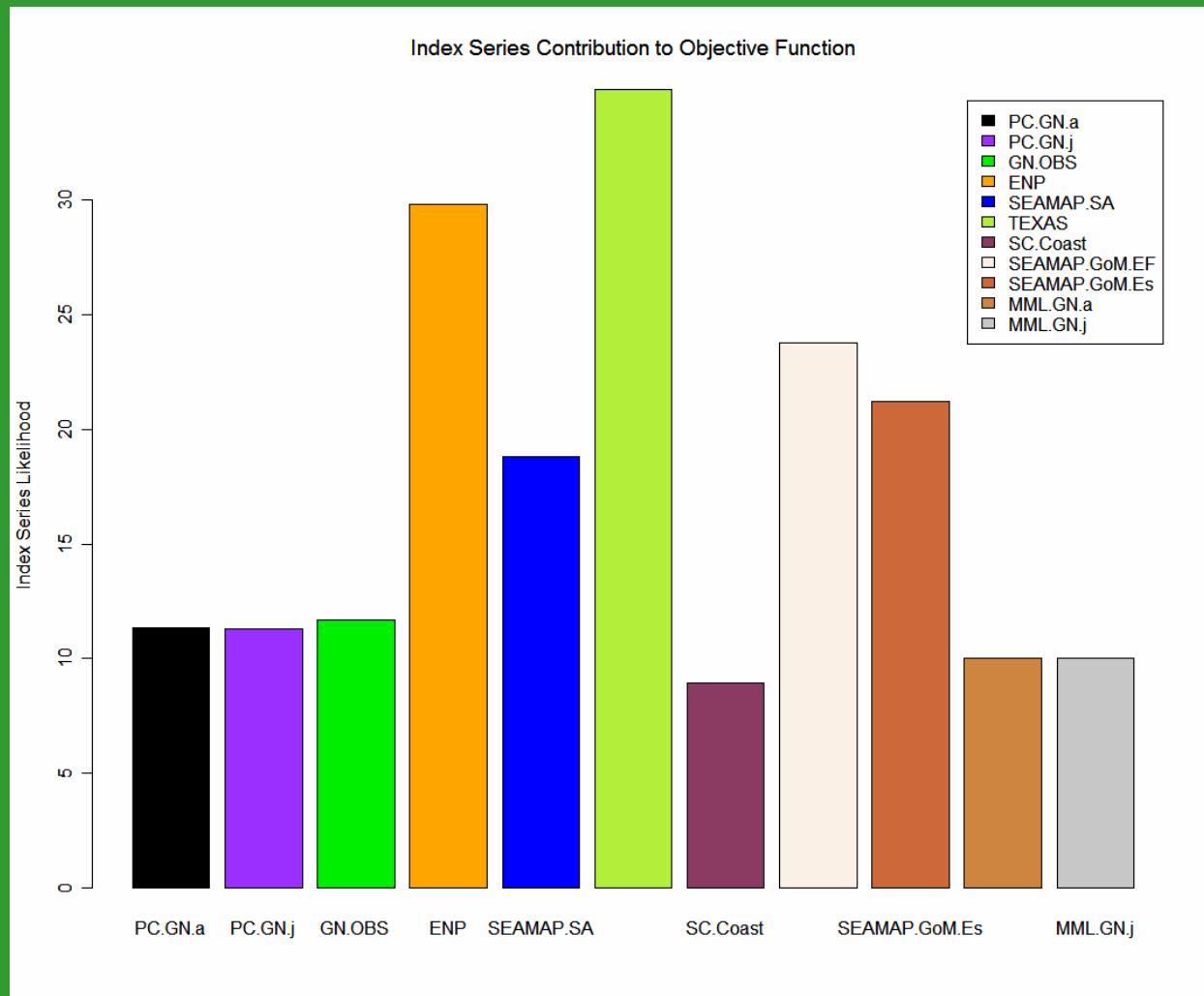




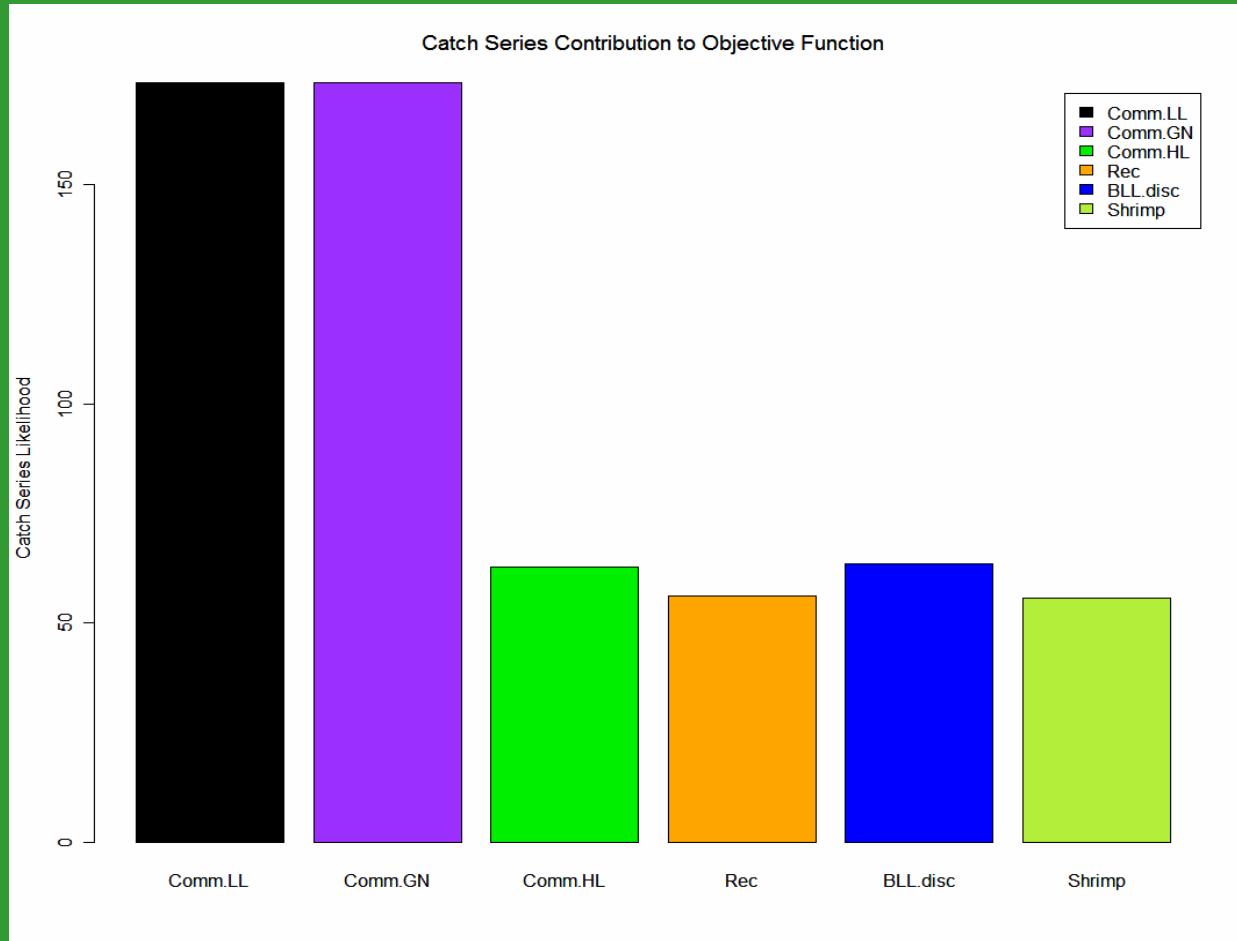




Index contributions to the likelihood



Catch Contributions to the likelihood



4. Sensitivity Analyses

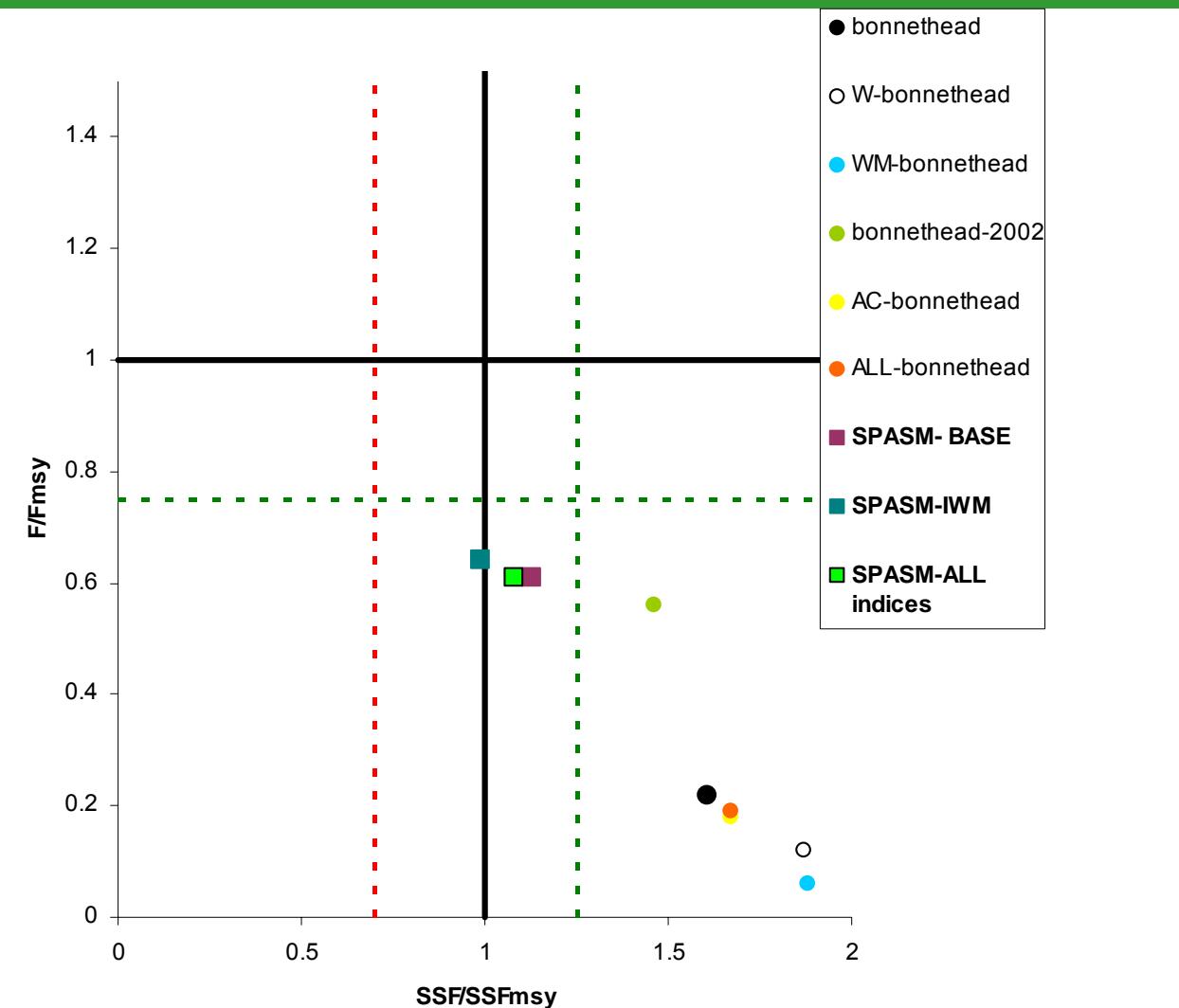
- S1: inverse CV weighting of indices
- S2: all indices used

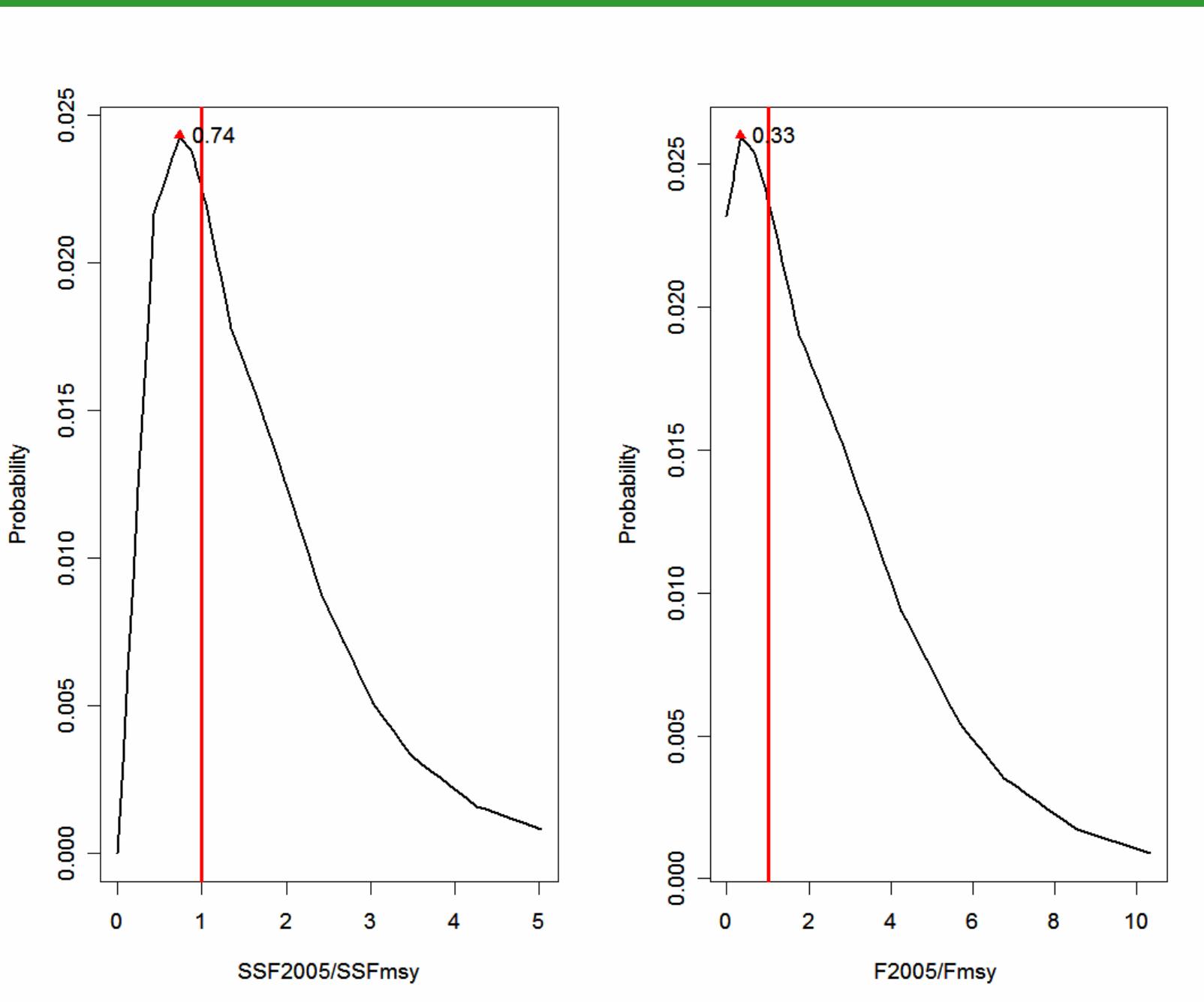
5. Summary of all Results

Stock Measure	S1	S1	S2	S2
	Estimate	CV	Estimate	CV
$\text{SSF}_{2005}/\text{SSF}_{\text{MSY}}$	0.99	0.39	1.08	0.535
F_{2005}/F_{MSY}	0.64	0.68	0.61	0.544
N_{2005}/N_{MSY}	0.75	-	0.78	
MSY	499,839	-	567,756	
SPR_{MSY}	0.49	0.02	0.57	0.30
F_{MSY}	0.40	-	0.31	
SSF_{MSY}	1.99E+05	-	1.90E+06	
N_{MSY}	1.50E+06	-	1.93E+06	
F_{2005}	0.25	0.68	0.19	1.84

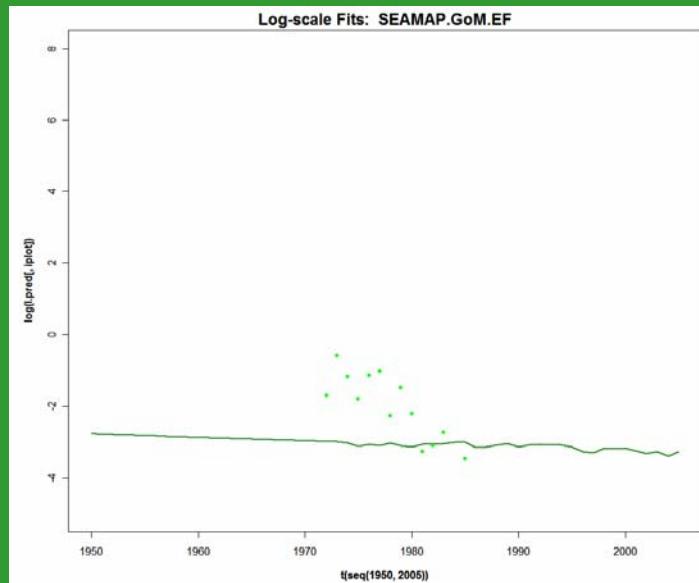
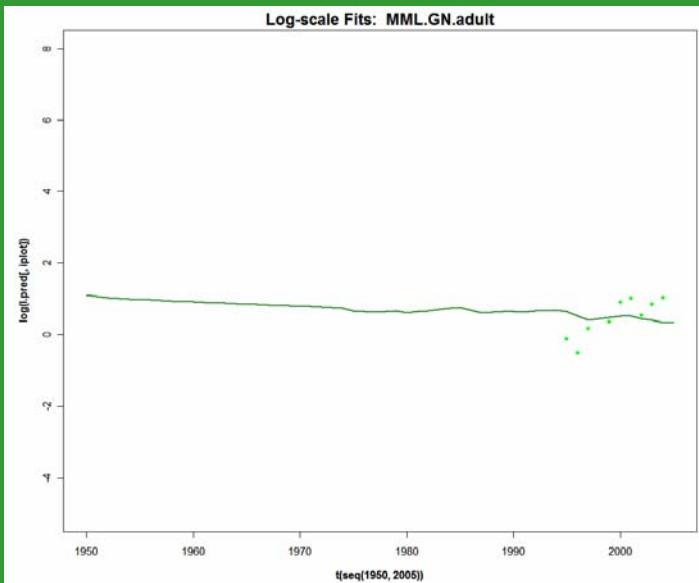
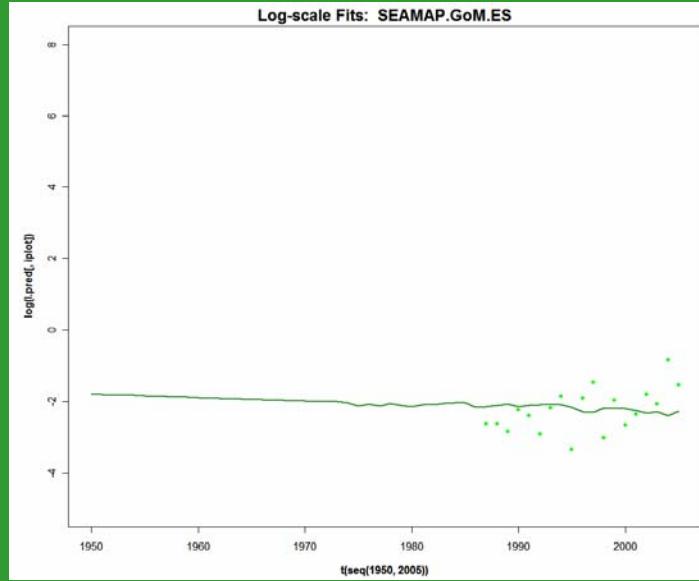
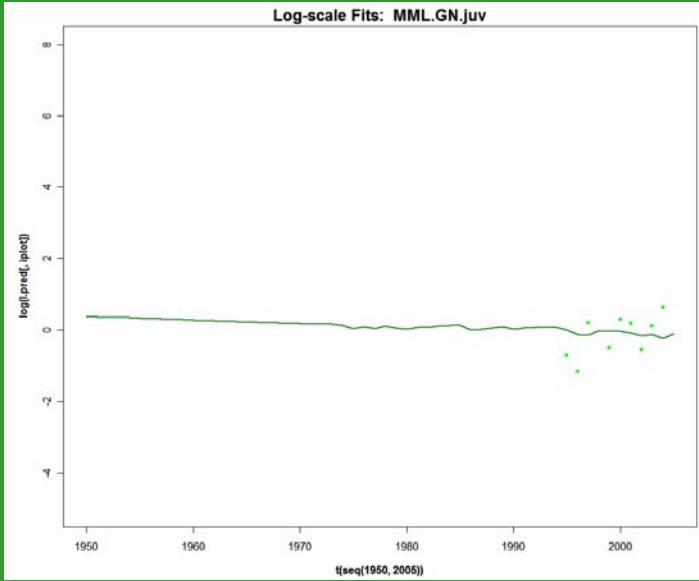
5. Summary of all results

Stock Measure	S1	S1	S2	S2
	Estimate	CV	Estimate	CV
SSF_{2005}	1.97E+06	0.53	2.06E+06	0.67
N_{2005}	1.13E+06	-	1.51E+06	-
SSF_{2005}/SSF_0	0.33	0.38	0.41	0.51
B_{2005}/B_0	0.38	0.34	0.43	0.50
R_0	9.8E+05	0.20	1.15E+06	0.32
Pup survival	0.70	0.24	0.70	0.24
alpha	4.2	-	3.13	-
steepness	0.51	-	0.44	-

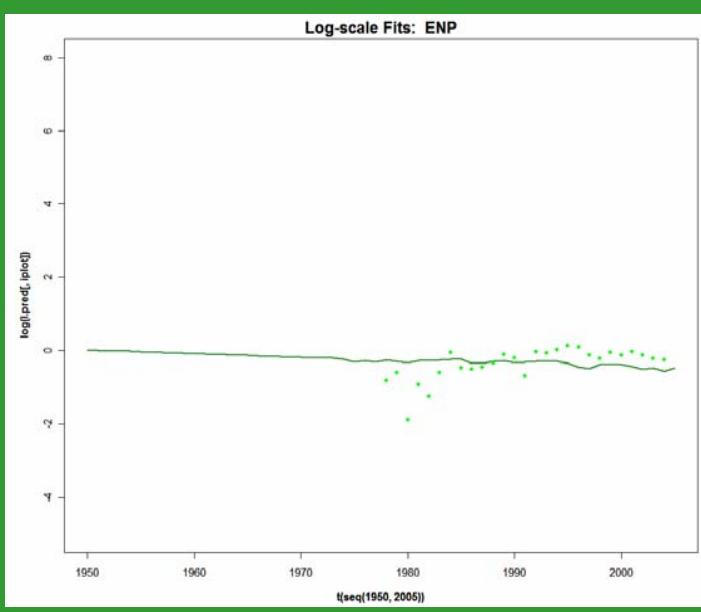
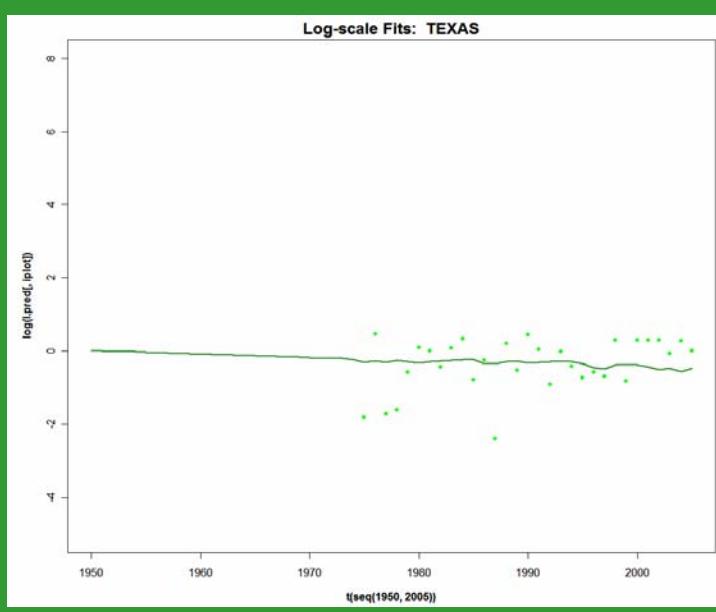
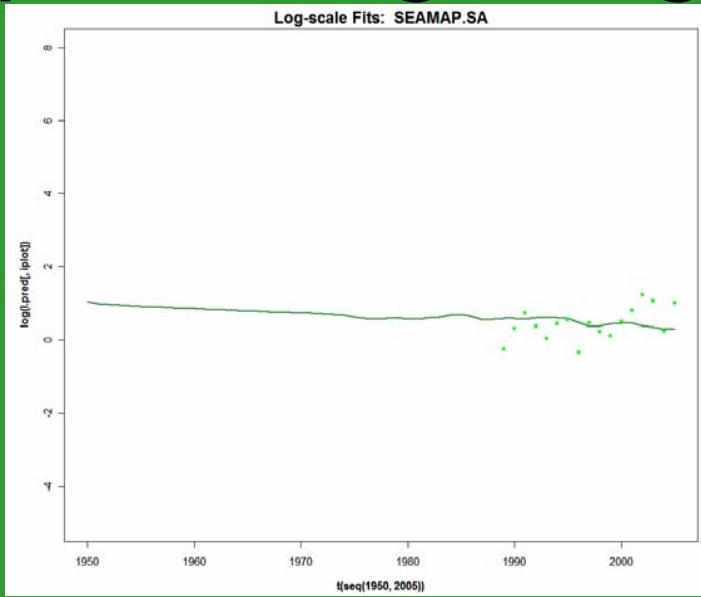
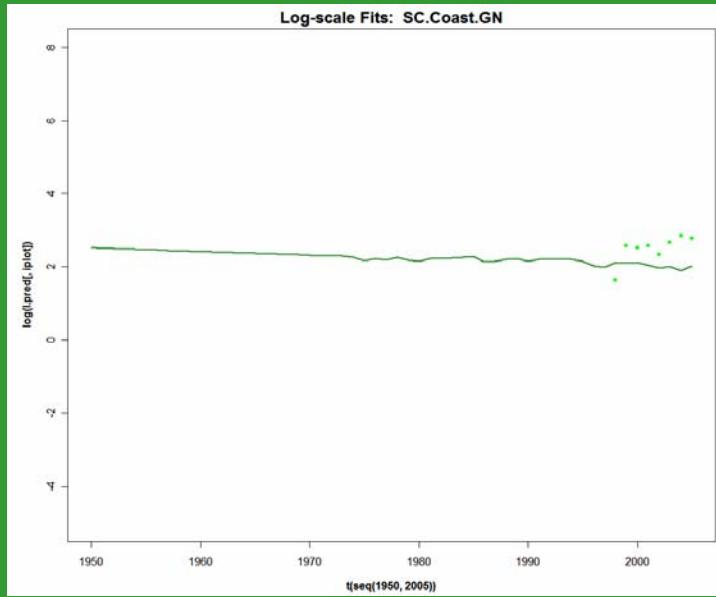




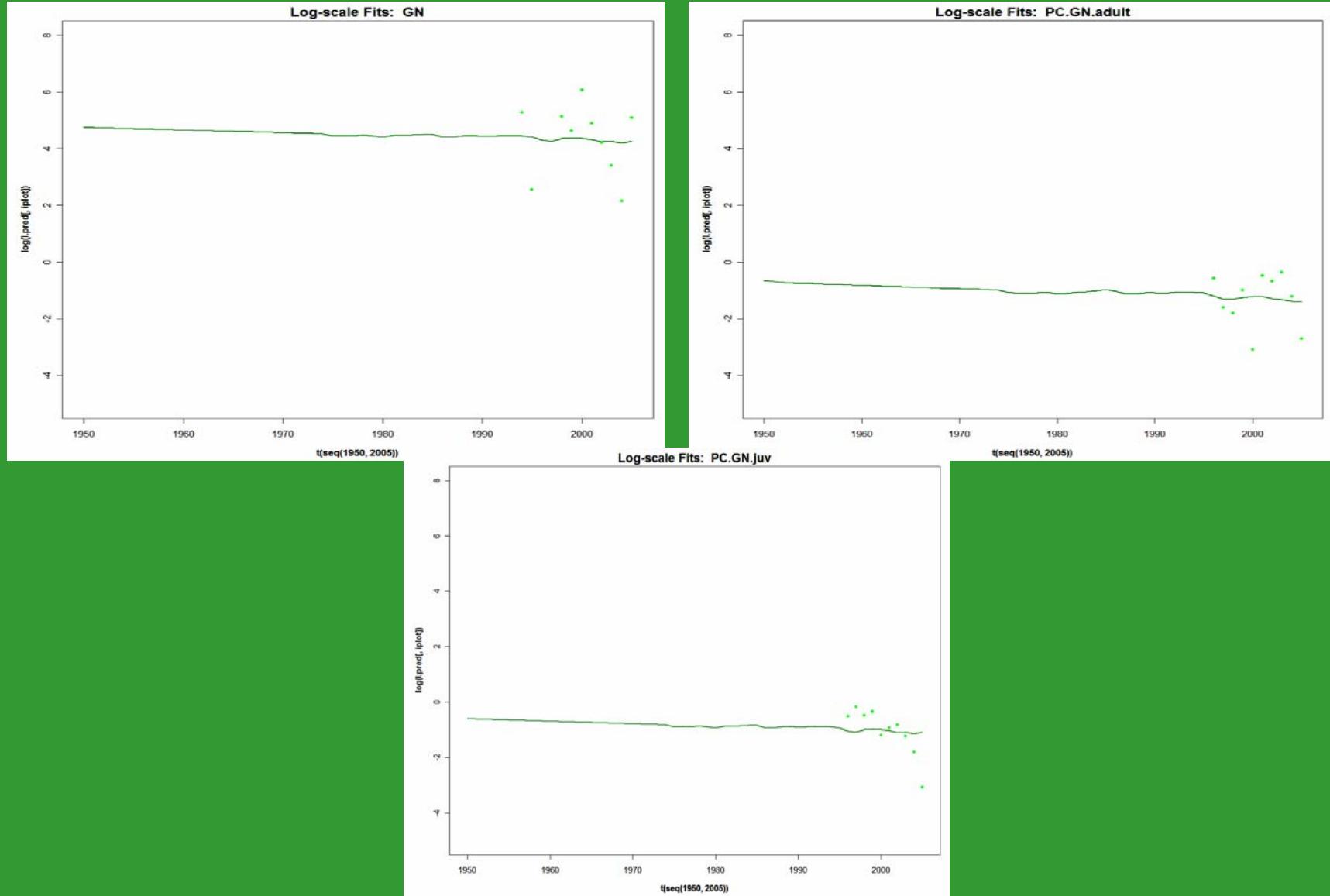
New fits with equal weighting



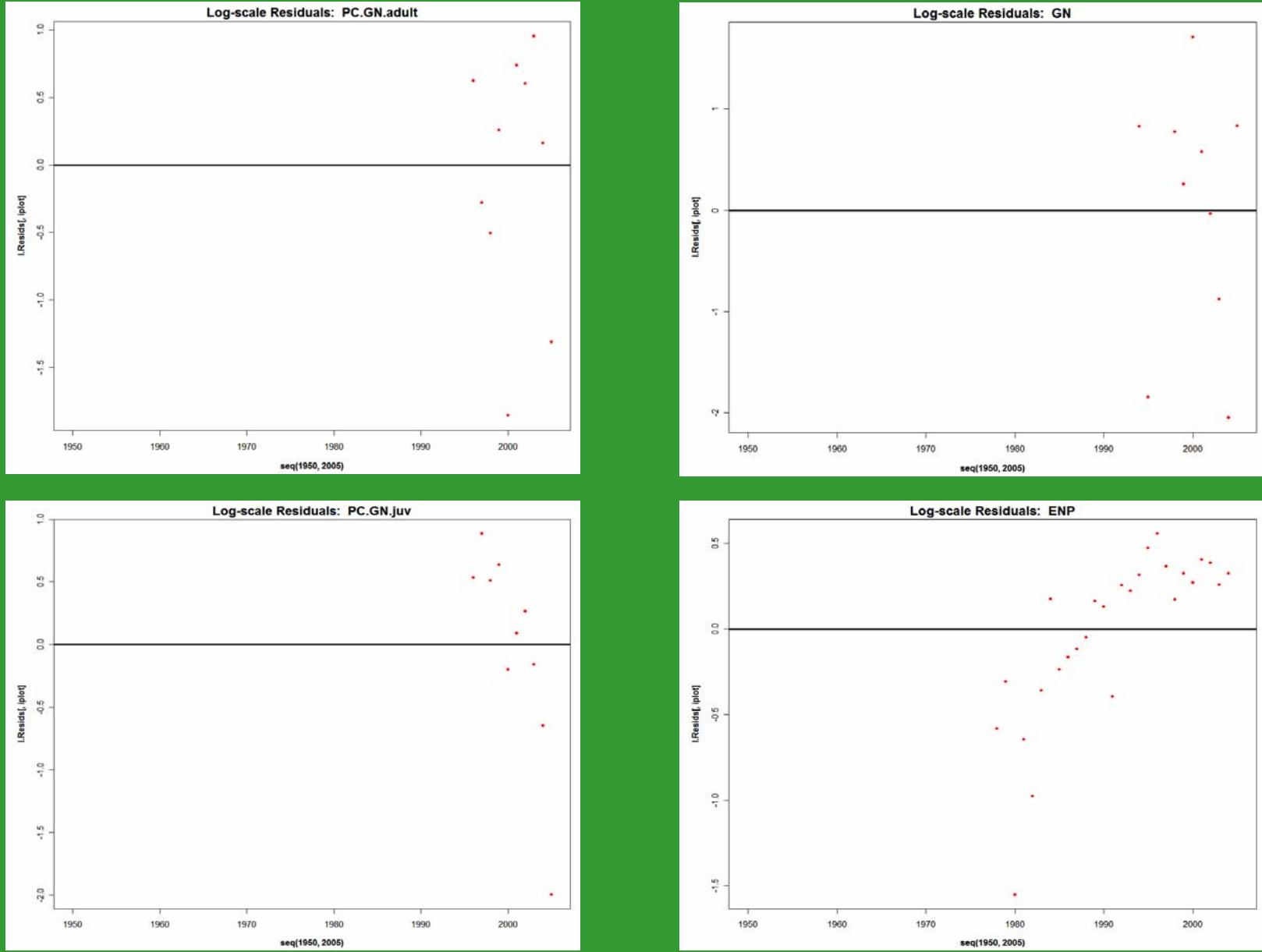
New fits with equal weighting



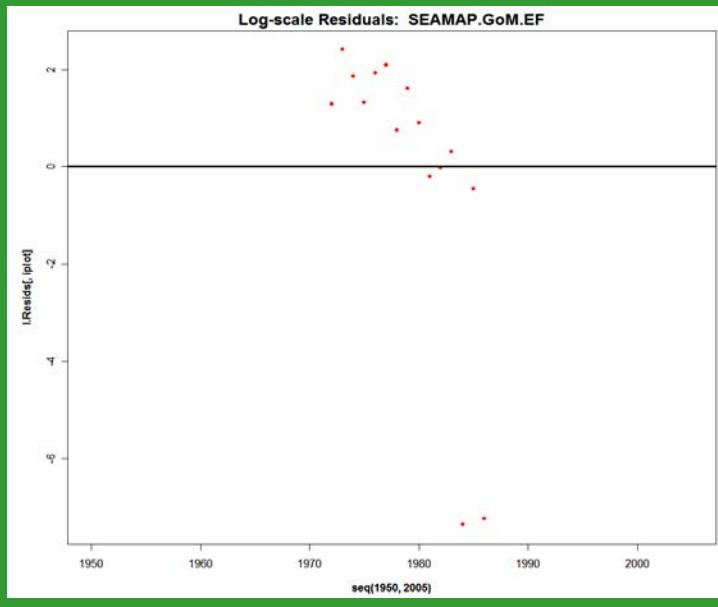
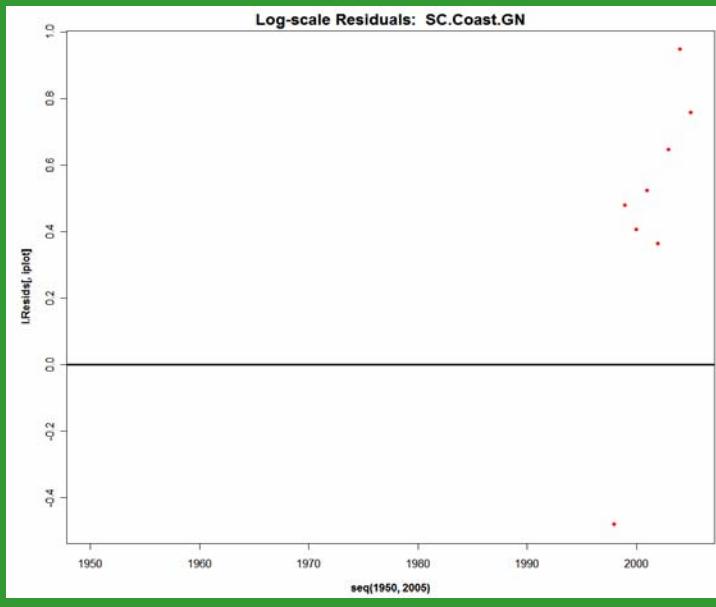
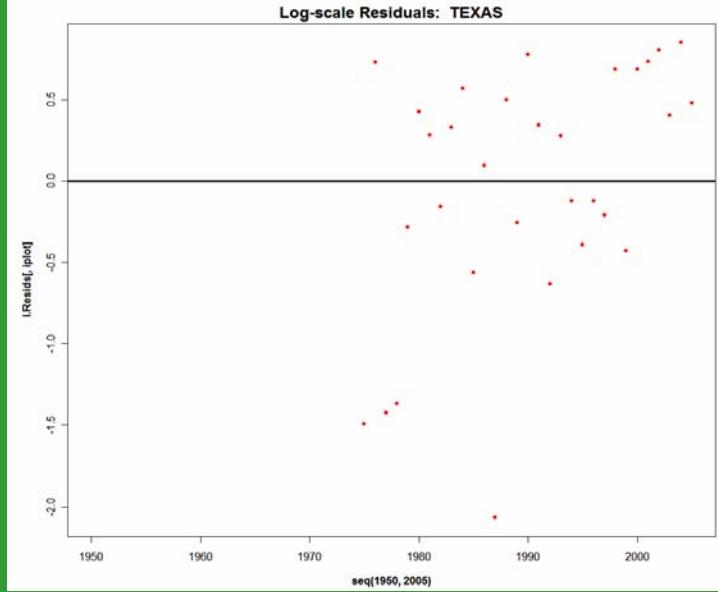
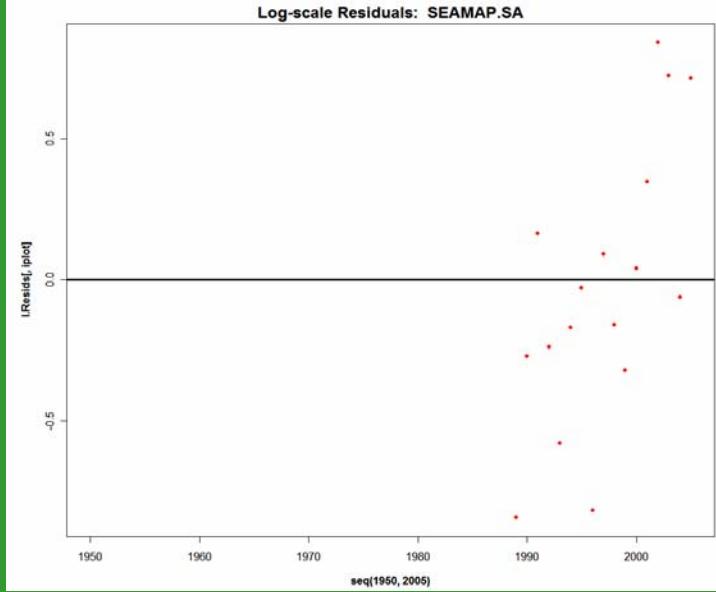
New fits with equal weighting



Residuals



Residuals



Residuals

