Science, Service, Stewardship


Photo by George Burgess

Blacknose shark assessment
Gulf of Mexico and south Atlantic stocks

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SEDAR 21, Review Workshop, April 18-22, 2011

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Outline - GOM

1. Data Inputs
   a. Fisheries
   b. Indices
   c. Life History
2. Model Description
3. Remaining AW issues
4. Base Model and Results
   a. Rebuilding Analysis
5. Sensitivity Cases
6. Summary of all Results

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Fishery Inputs - GOM

Catch Series:

- —Commercial
  - Longline
  - Gillnet
  - Handline
  - BLL-discards
- —Recreational
- —Shrimp Bycatch

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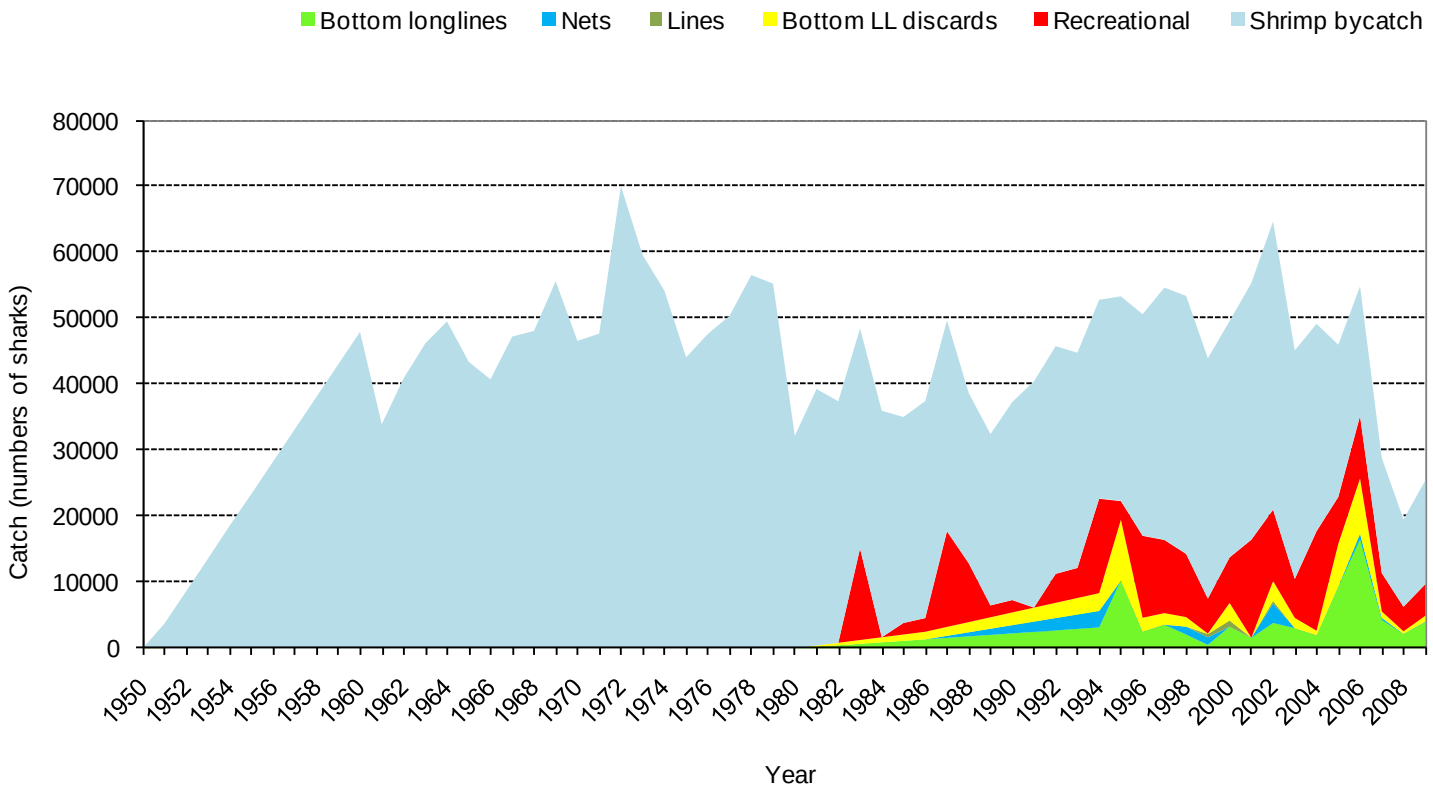
Catches - GOM



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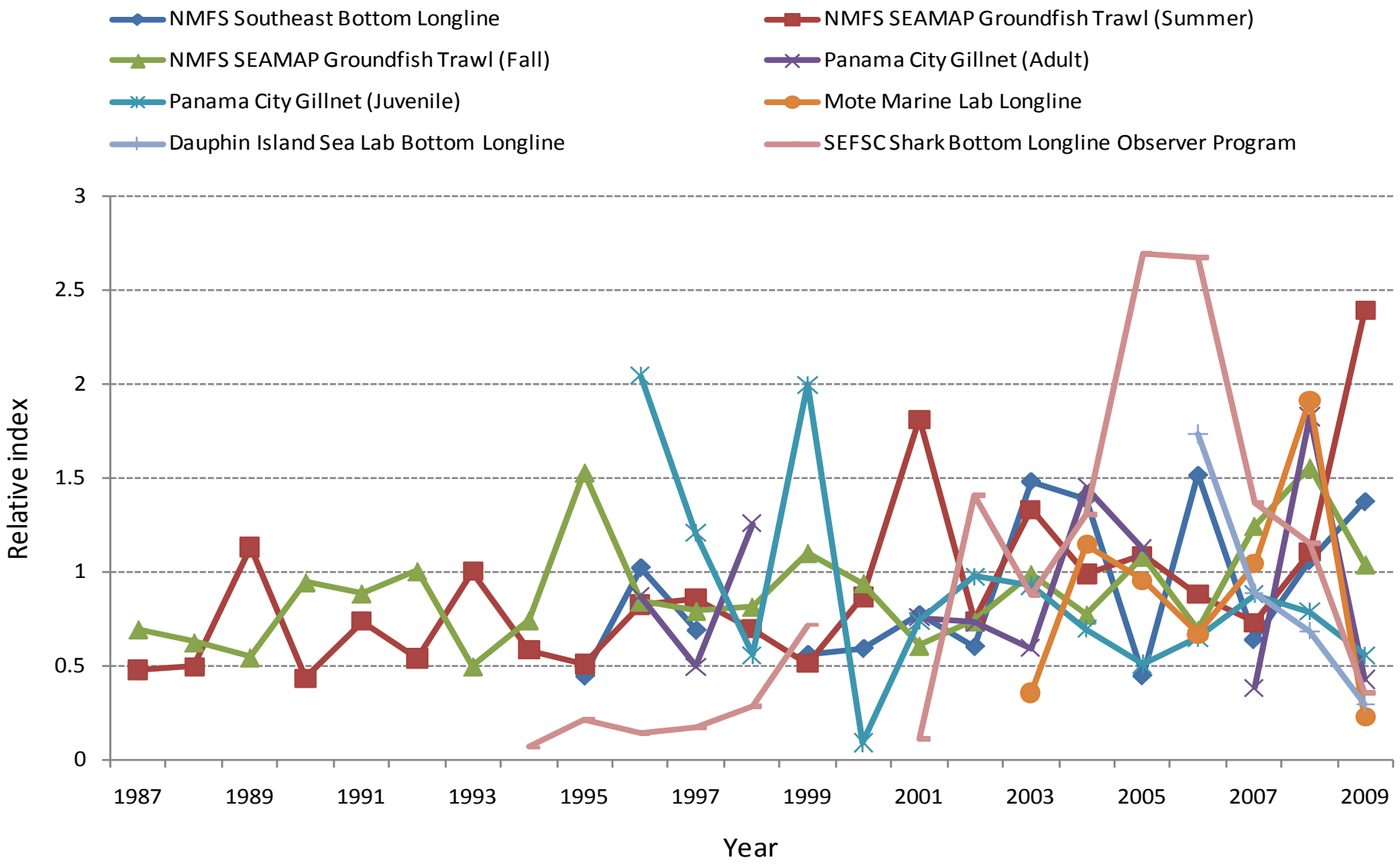
Base indices (GOM)



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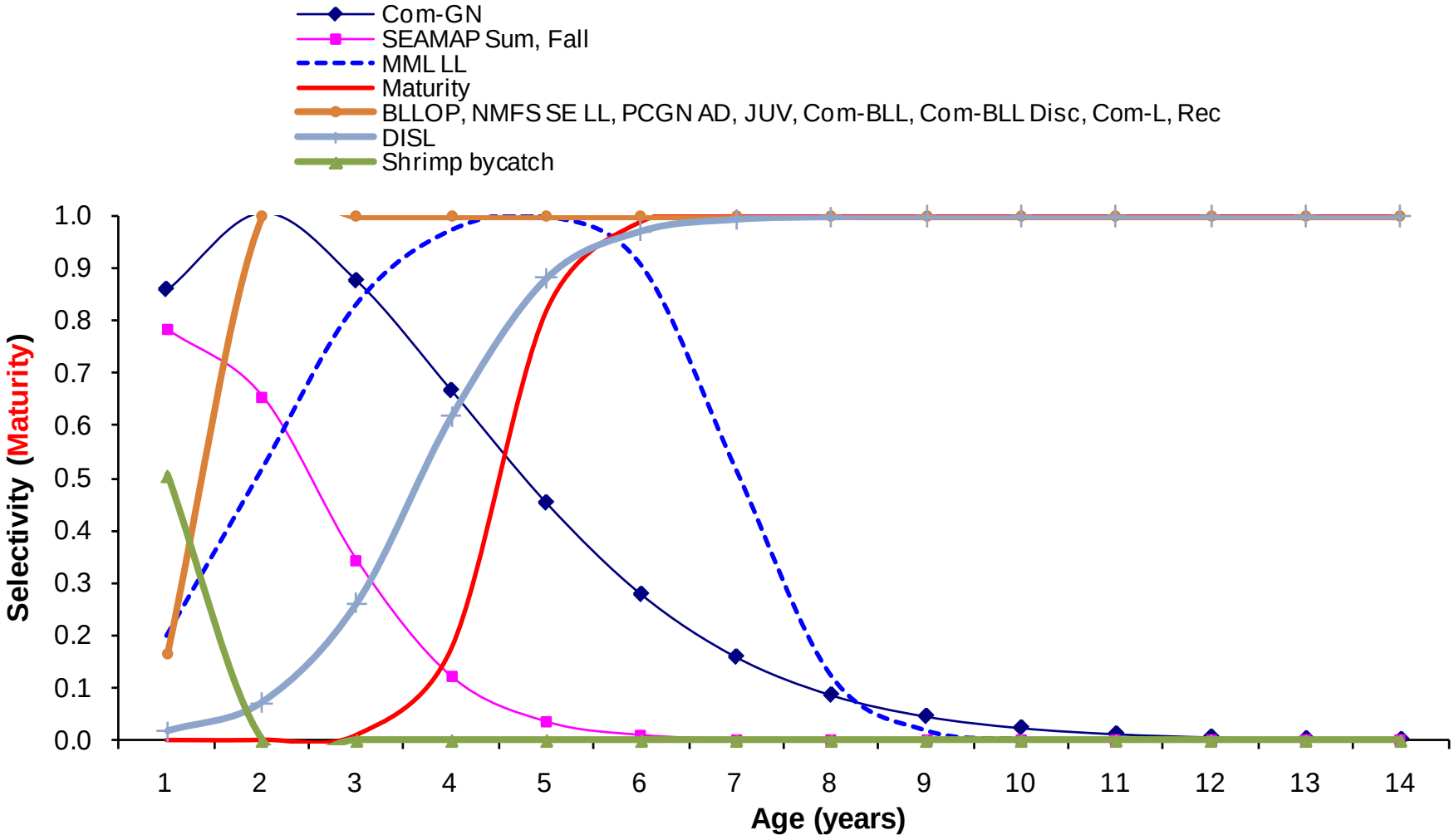
Selectivity and maturity (GOM)



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Life History Inputs (GOM)

L_∞	104.3 (cm FL)
k	0.3
t_0	-1.71
a	1.65E-6
b	3.34
Pup Survival	0.75
Virgin Recruitment (R_0)	[1.0E+4, 1.0E+10]
fecundity	5* (interesting story)

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Model Description – The ASPM

- Time series split into historic (1950 – 1971) and modern period
- Historic period begins in year when virgin conditions can be assumed; spans years where data are very sparse
- Modern period spans recent years, when data are presumed to be more abundant

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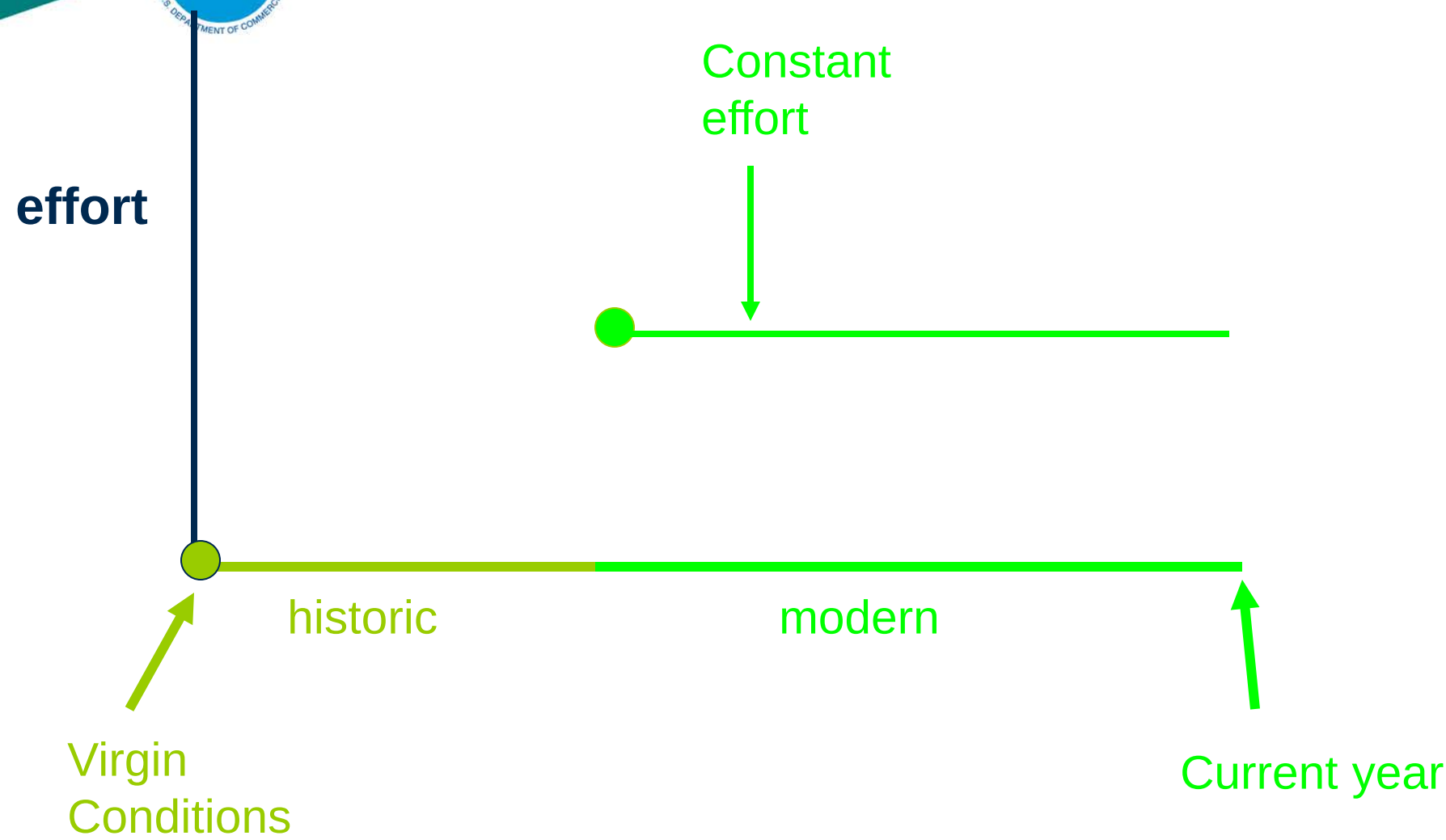

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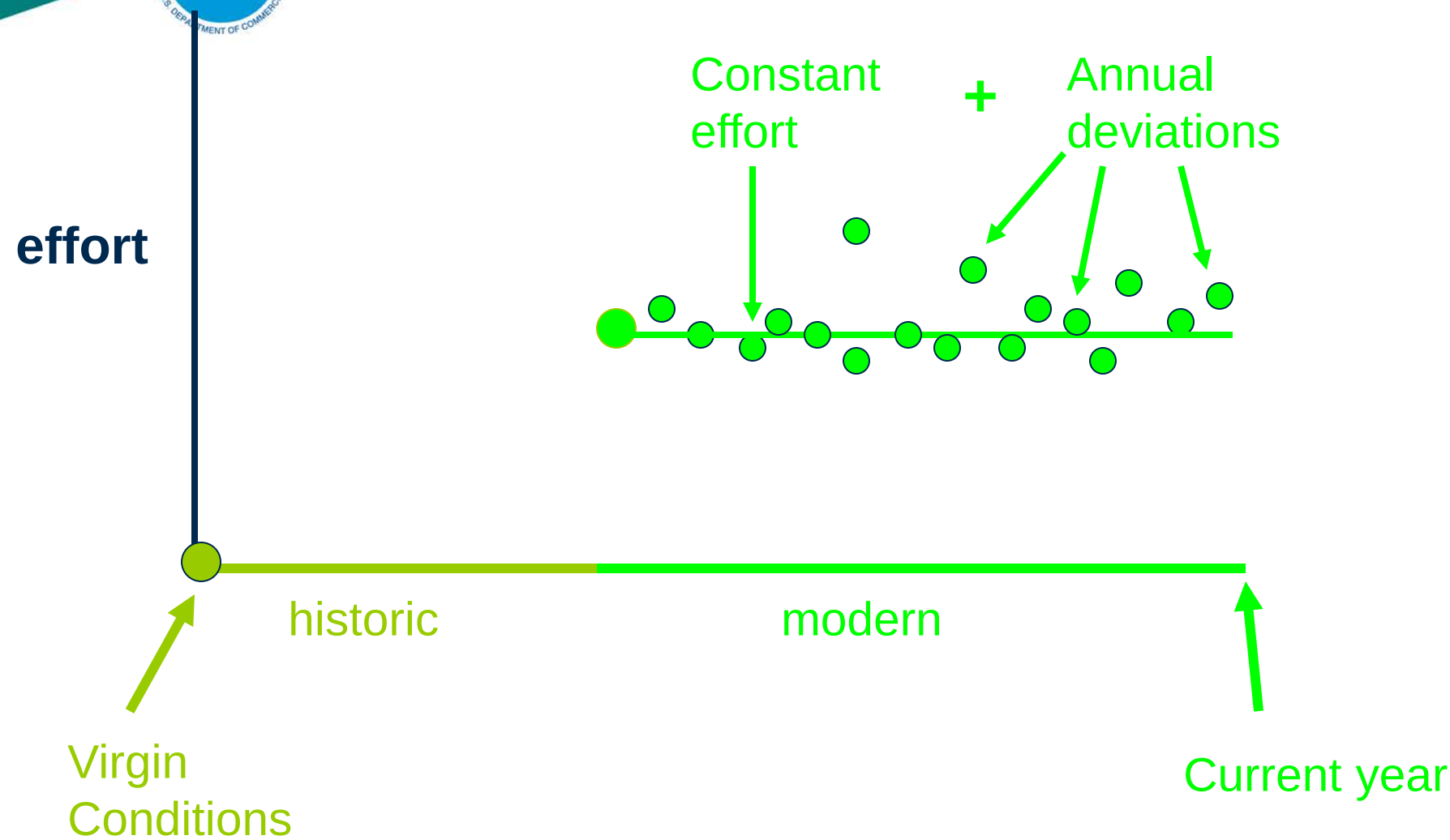

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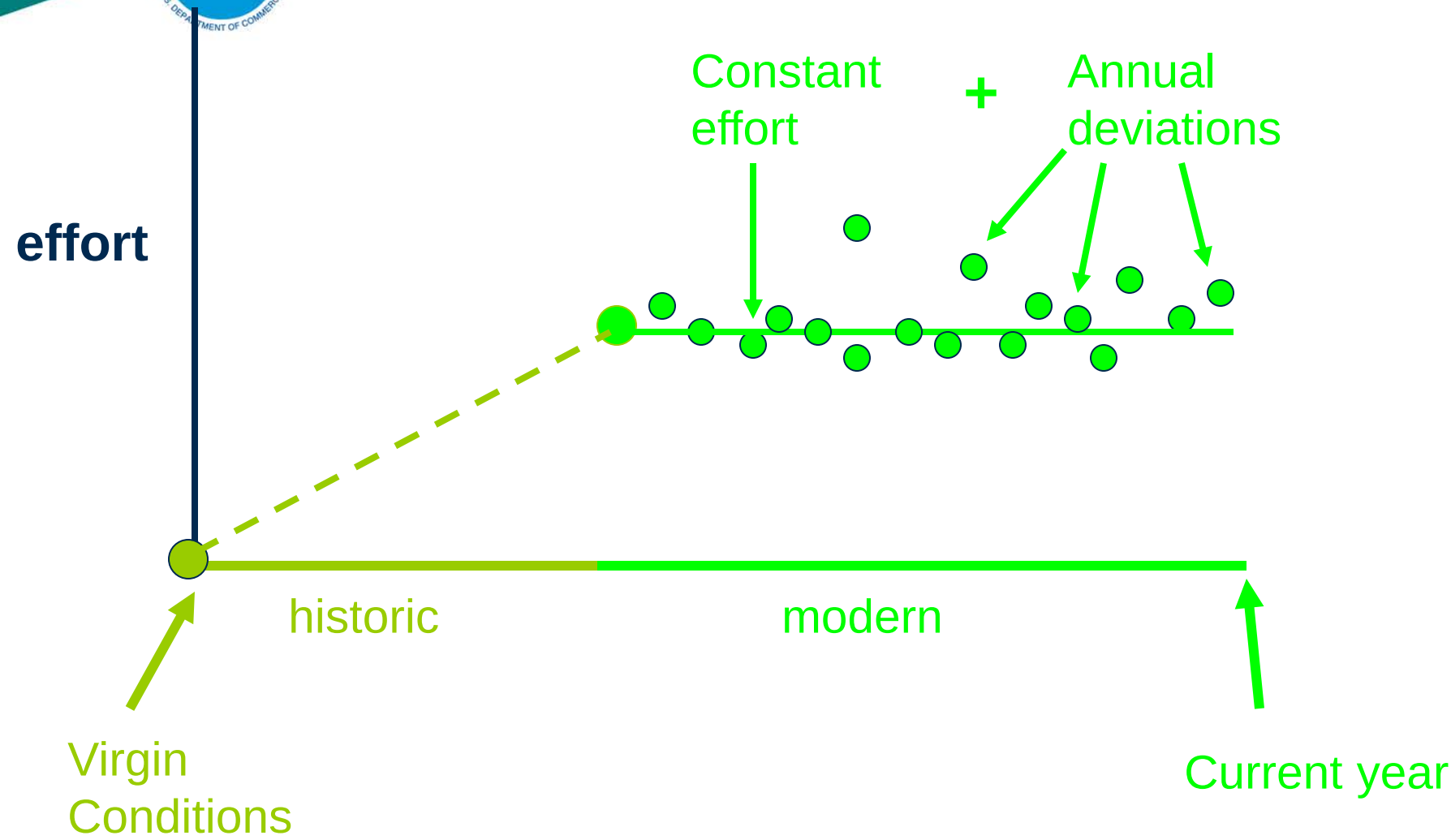

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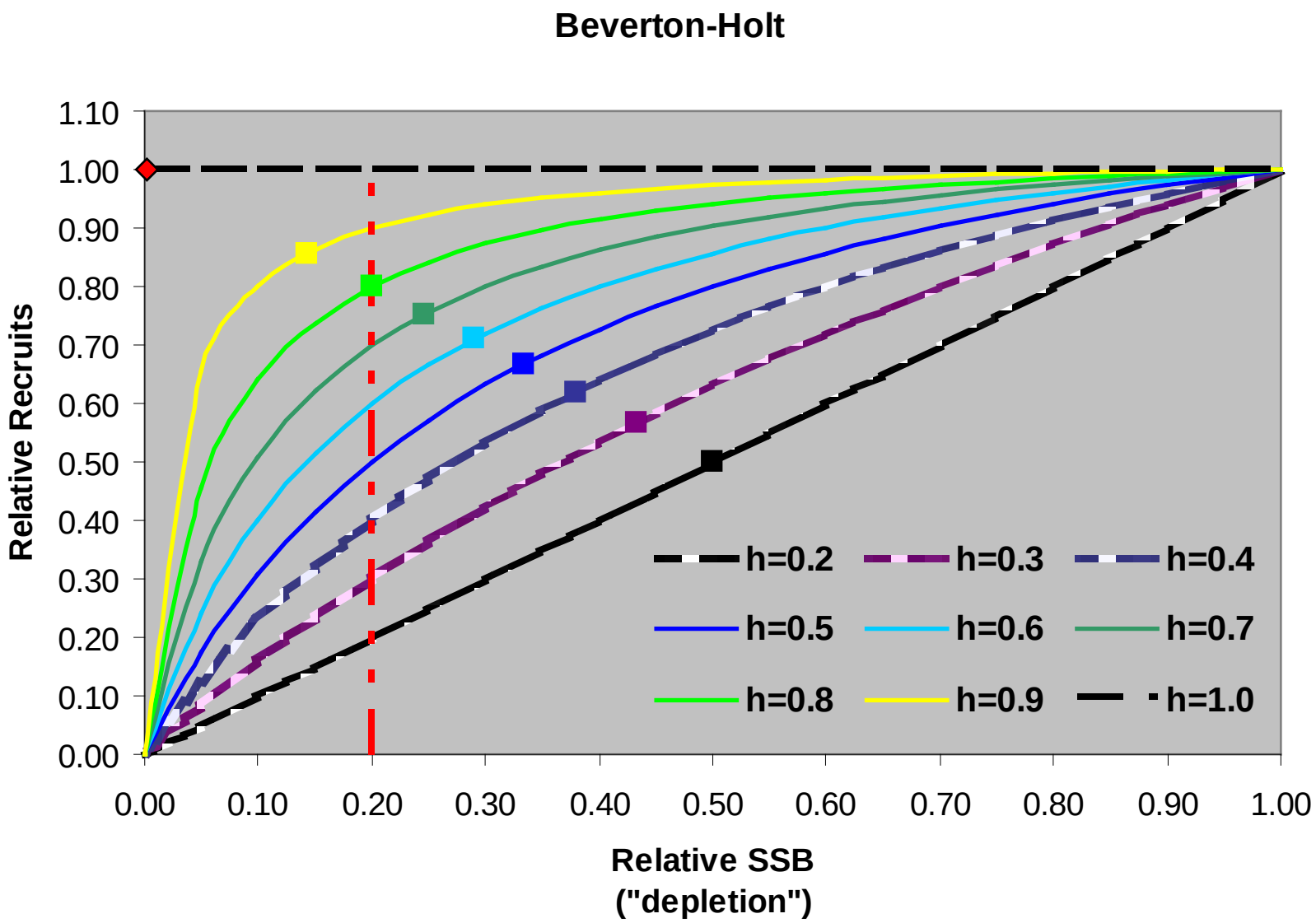
Model description – The ASPM

- Age-structured approach to allow the selectivity and fecundity to vary with age
- The state-space implementation facilitates parameter estimation by
  - Allowing for Bayesian priors
  - Allowing for interannual changes in parameters such as effort
- Monthly intervals for the abundance calculations
- Beverton-Holt stock recruitment



*slope at the origin is equivalent to the density independent pup survival

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Steepness and maximum reproductive rate

- α = pup.survival (slope at the origin) X virgin.spawners.per.recruit
- Steepness = α / (α+4)

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Model description cont'd.

- Catches are removed sequentially as a pulse at the end of each monthly time step
  - Exploratory sensitivities showed the order of removal had little effect.
  - Fleets fish simultaneously
- Selectivities are age-based and calculated external to the model
  - The lack of data prohibits internal calculations
  - Data/estimated parameters is already very low

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Model description cont'd

- Flat priors provided for virgin recruitment, catchabilities, and effort by fleet
- Objective function components
  - Observed data likelihoods
    - Catches
    - Indices
  - Process errors
  - Priors
- Likelihood Profiles used to approximate posteriors (recommended by AW panel)

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Assessment Workshop issues remaining

Shrimp bycatch series –

- Treated as one catch series rather than two
  - They should have the same effort but different catchabilities and selectivities
    - No length data to empirically determine selectivities
    - Model fits them very poorly as scaled versions of the other (SA is just scaled down from the poor fit to the GOM)
- Projections
  - Levels of variance
  - Which scenarios to use as bookends to the base case?

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Base case settings

- Virgin conditions in 1950.
- Modern period begins in 1972.
- Historical catches are downweighted by 1/2

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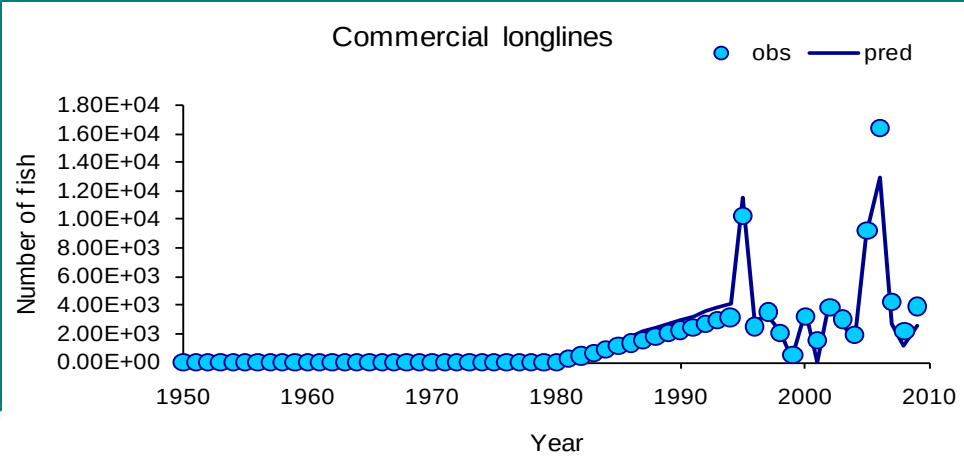
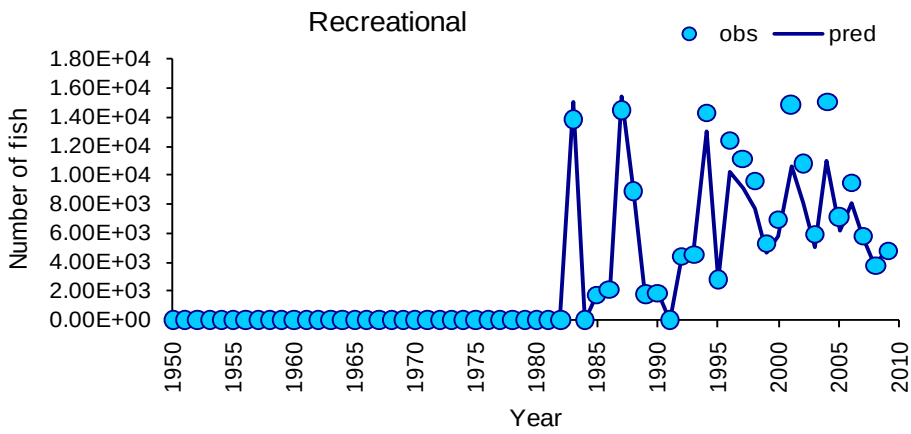
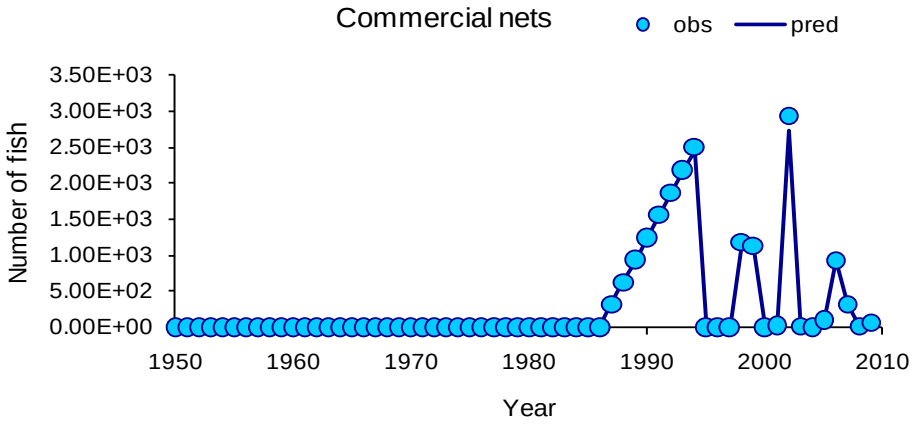
Overfished

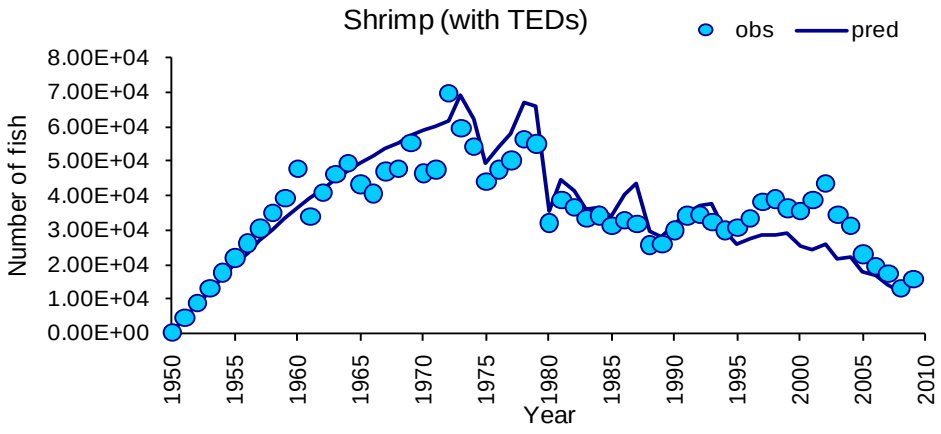
Overfishing

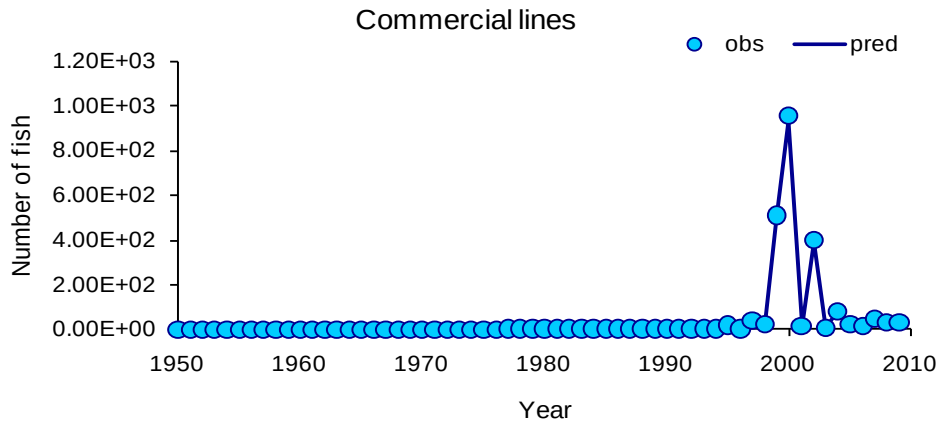
Blacknose - GOM	BASE		Continuity	
	Estimate	CV	Estimate	CV
SSF_{2009}/SSF_{MSY}	**0.53**	0.46	**0.56**	0.75
F_{2009}/F_{MSY}	**1.21**	0.54	**2.78**	1.57
N_{2009}/N_{MSY}	0.61	-	0.57	-
MSY	51443	-	93398	-
SPR_{MSY}	0.55	0.21	0.69	0.15
F_{MSY}	0.232	-	0.07	-
SSF_{MSY}	273810	-	356130	-
N_{MSY}	319006	-	590691	-
F_{2009}	0.28	0.54	0.21	1.57
SSF_{2009}	146230	0.19	198110	0.67
N_{2009}	232839	-	437078	-
SSF_{2009}/SSF_{0}	0.19	0.18	0.23	0.55
B_{2009}/B_{0}	0.21	0.17	0.21	0.60
R_{0}	159440	0.05	332180	0.19
Pup-survival	0.75	-	0.82	0.23
alpha	3.51	-	2.13	-
steepness	0.47	-	0.35	-

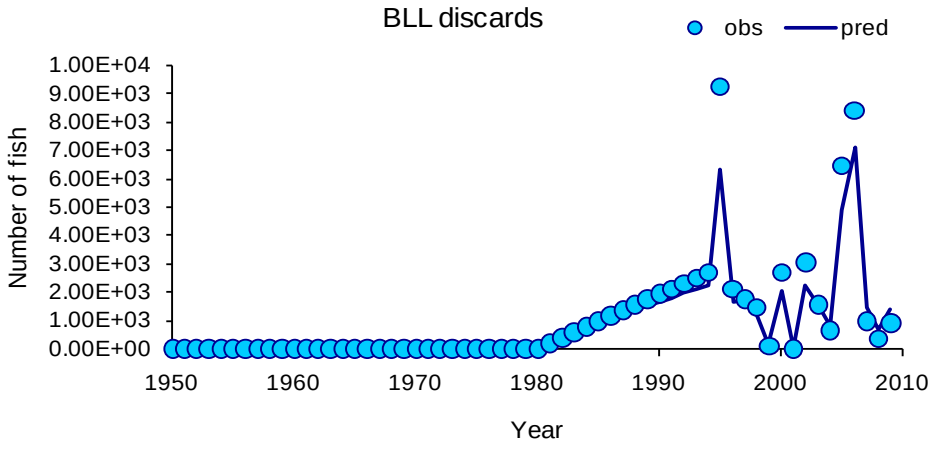

Commercial longlines
obs
pred
Number of fish
1.80E+04
1.60E+04
1.40E+04
1.20E+04
1.00E+04
8.00E+03
6.00E+03
4.00E+03
2.00E+03
0.00E+00
1950
1960
1970
1980
1990
2000
2010
Year

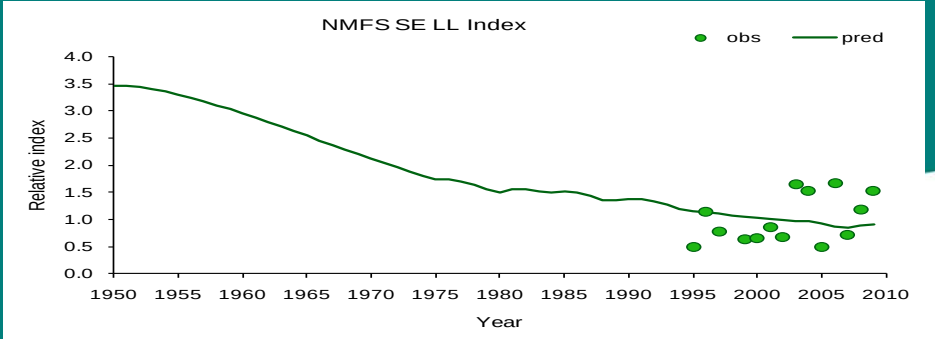

Recreational
obs
pred
Number of fish
1.80E+04
1.60E+04
1.40E+04
1.20E+04
1.00E+04
8.00E+03
6.00E+03
4.00E+03
2.00E+03
0.00E+00
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
Year

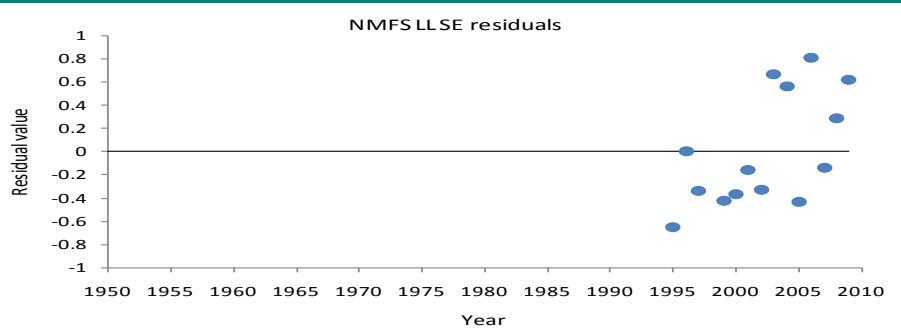

Commercial nets
obs
pred
Number of fish
3.50E+03
3.00E+03
2.50E+03
2.00E+03
1.50E+03
1.00E+03
5.00E+02
0.00E+00
1950
1960
1970
1980
1990
2000
2010
Year

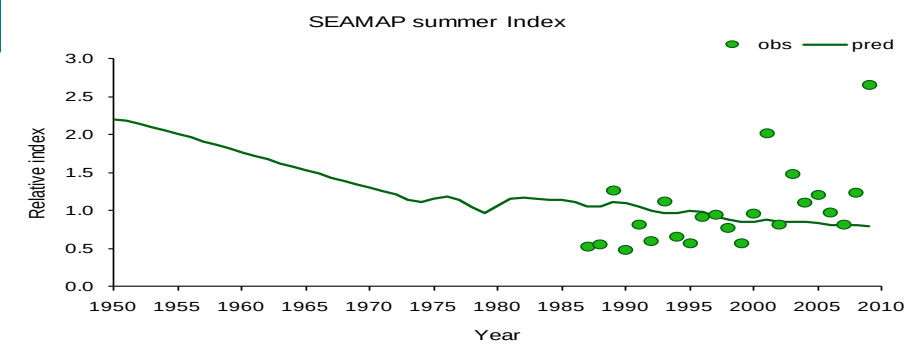

Shrimp (with TEDs)
obs
pred
Number of fish
8.00E+04
7.00E+04
6.00E+04
5.00E+04
4.00E+04
3.00E+04
2.00E+04
1.00E+04
0.00E+00
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
Year

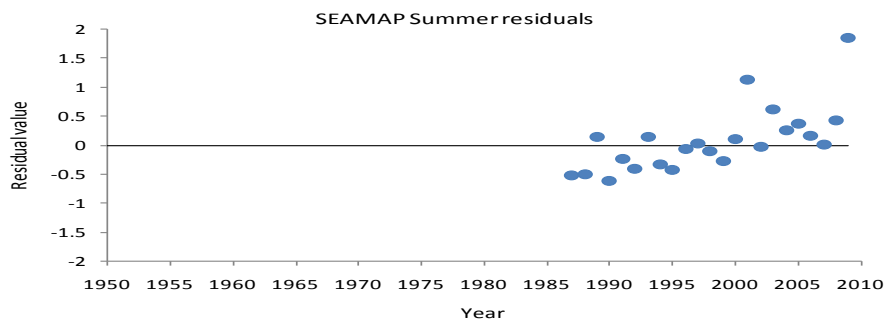

Commercial lines
obs
pred
Number of fish
1.20E+03
1.00E+03
8.00E+02
6.00E+02
4.00E+02
2.00E+02
0.00E+00
1950
1960
1970
1980
1990
2000
2010
Year

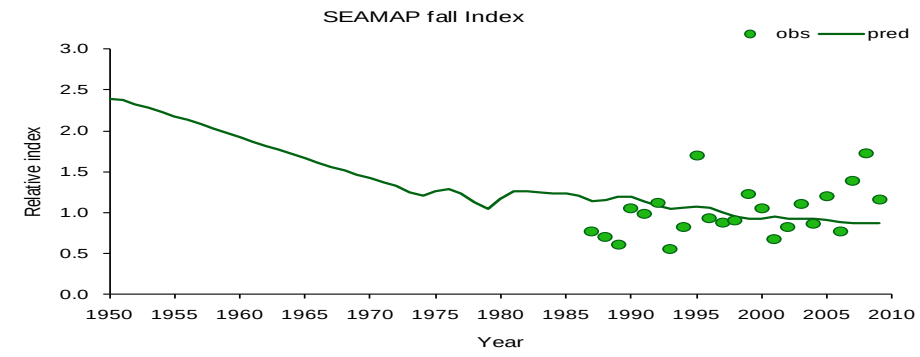

BLL discards
obs
pred
Number of fish
1.00E+04
9.00E+03
8.00E+03
7.00E+03
6.00E+03
5.00E+03
4.00E+03
3.00E+03
2.00E+03
1.00E+03
0.00E+00
1950
1960
1970
1980
1990
2000
2010
Year

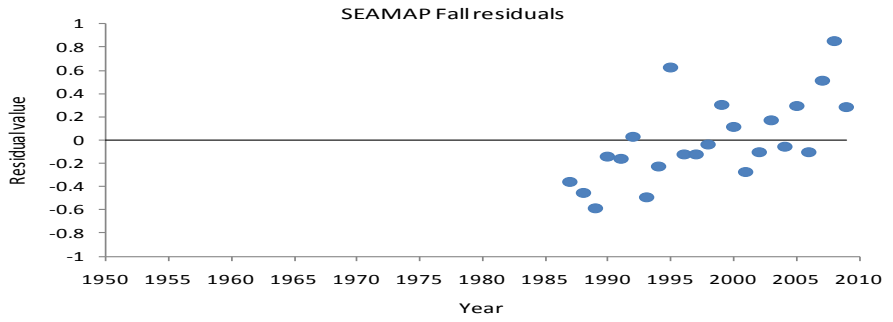

NMFS SE LL Index
obs
pred
Relative index
Year

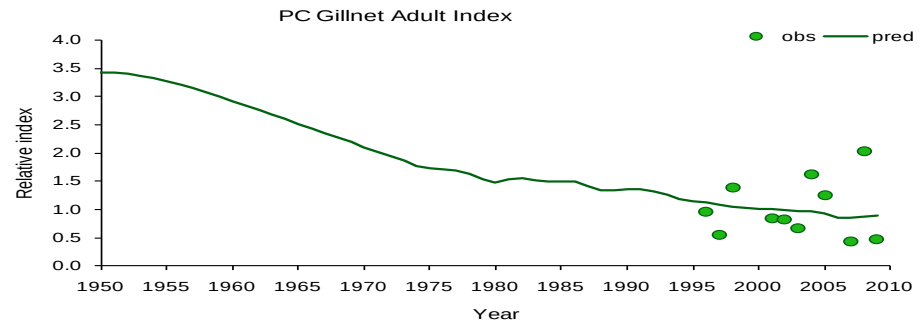

NMFS LLSE residuals
Residual value
Year

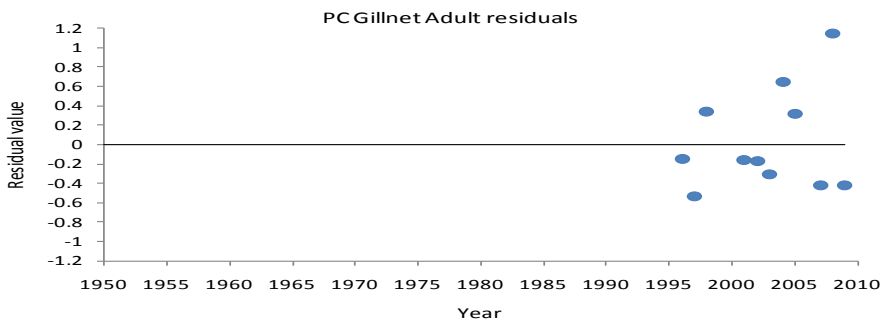

SEAMAP summer Index
obs
pred
Relative index
Year

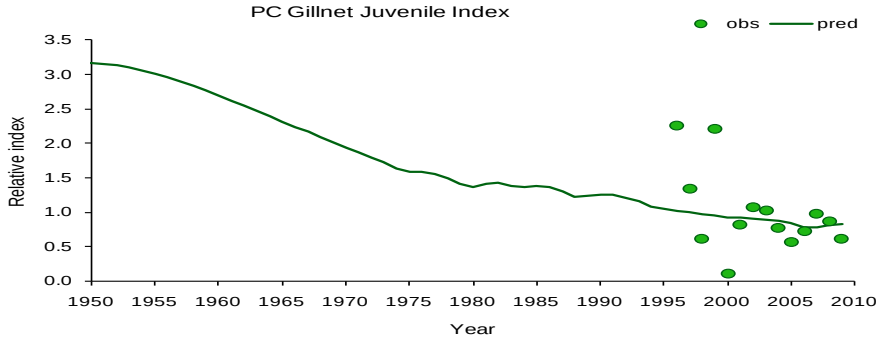

SEAMAP Summer residuals
Residual value
Year

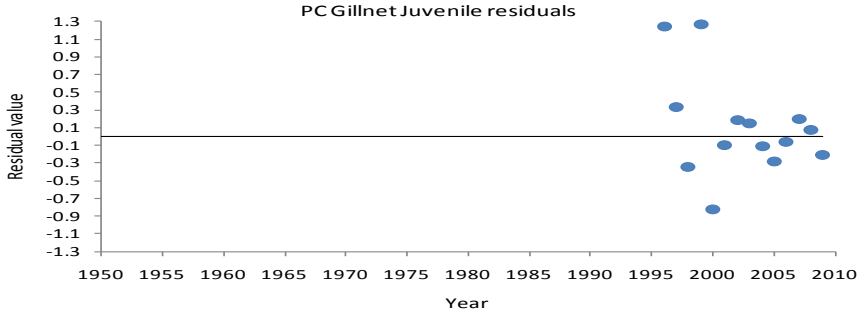

SEAMAP fall Index
obs
pred
Relative index
Year

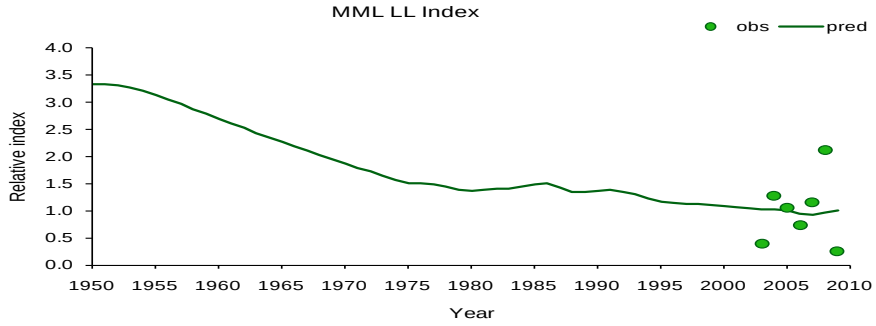

SEAMAP Fall residuals
Residual value
Year

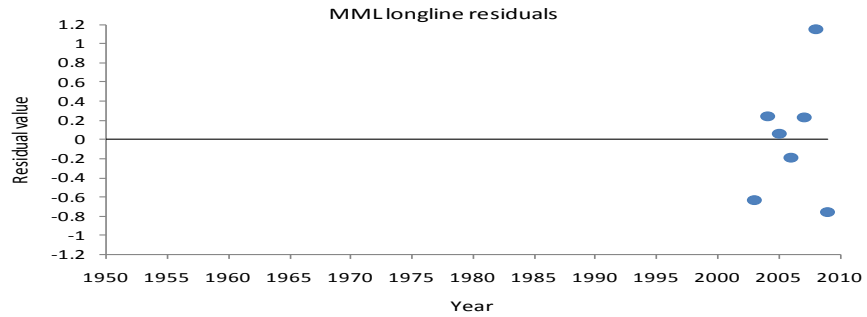

PC Gillnet Adult Index
obs
pred
Relative index
Year

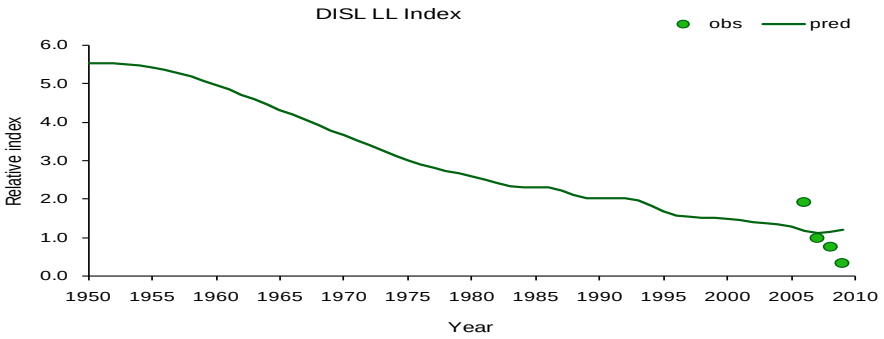

PC Gillnet Adult residuals
Residual value
Year

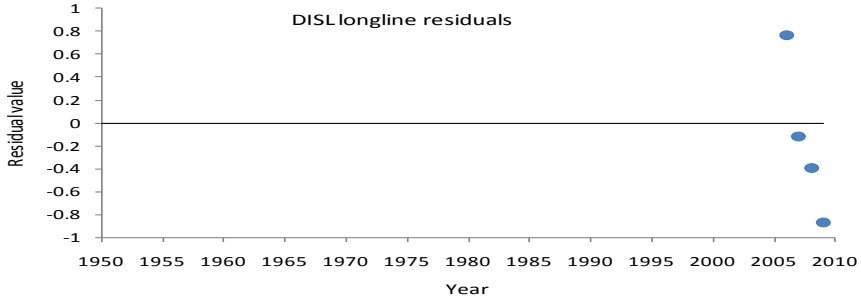

PC Gillnet Juvenile Index
obs
pred
Relative index
Year

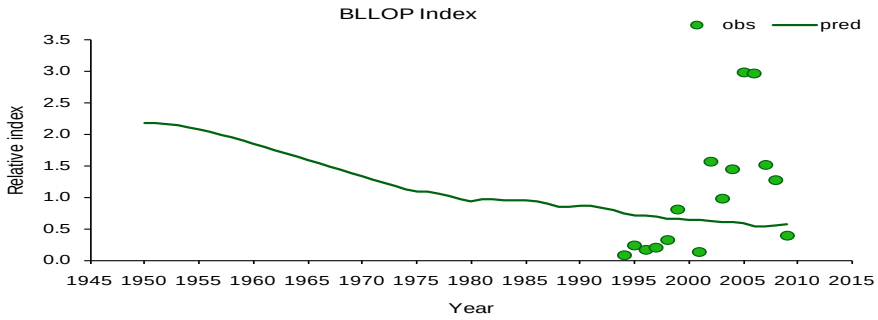

PC Gillnet Juvenile residuals
Residual value
Year

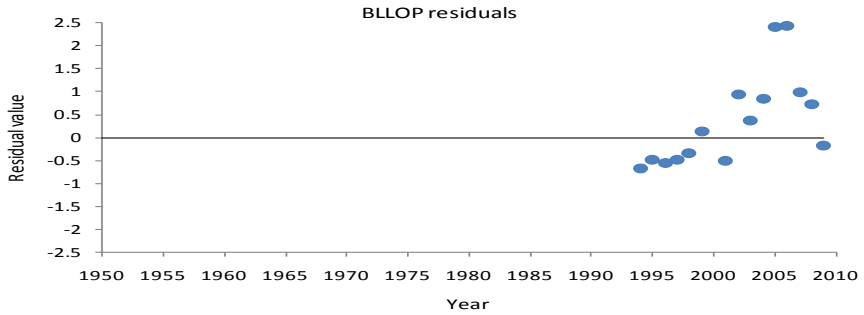

MML LL Index
obs
pred
Relative index
Year


MML longline residuals
Residual value
Year


DISL LL Index
obs
pred
Relative index
Year


DISL longline residuals
Residual value
Year


BLLOP Index
obs
pred
Relative index
Year


BLLOP residuals
Residual value
Year

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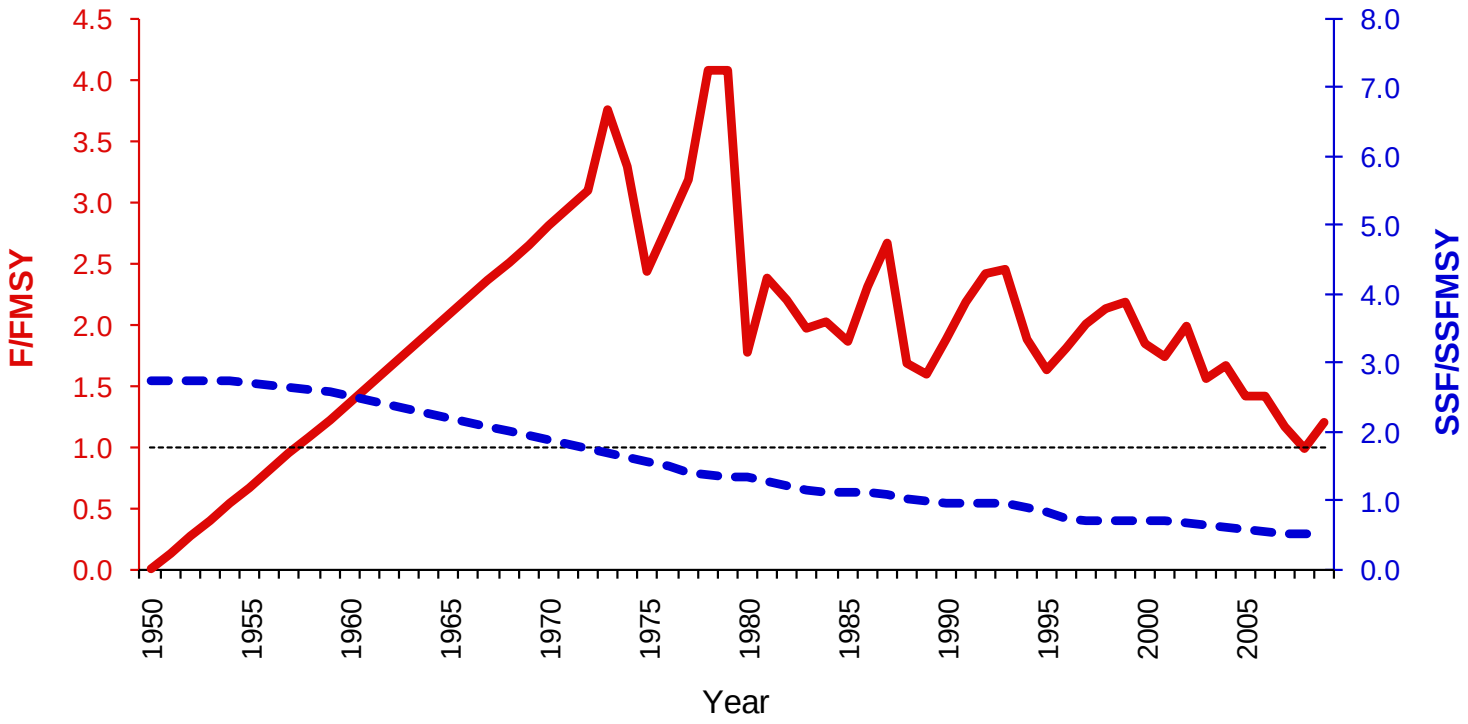
Base model benchmarks



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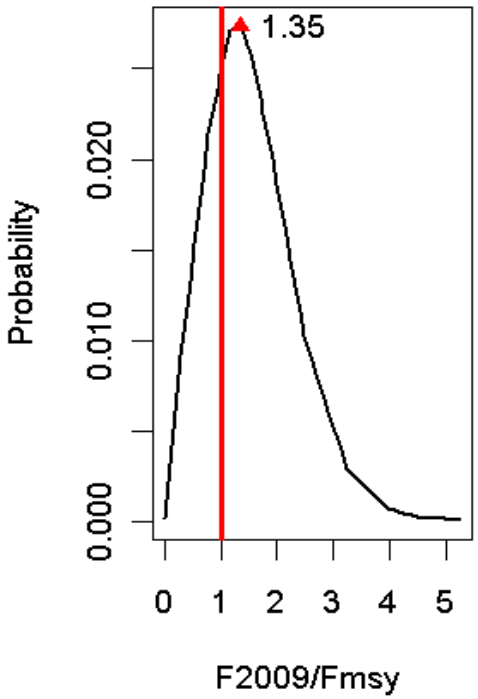
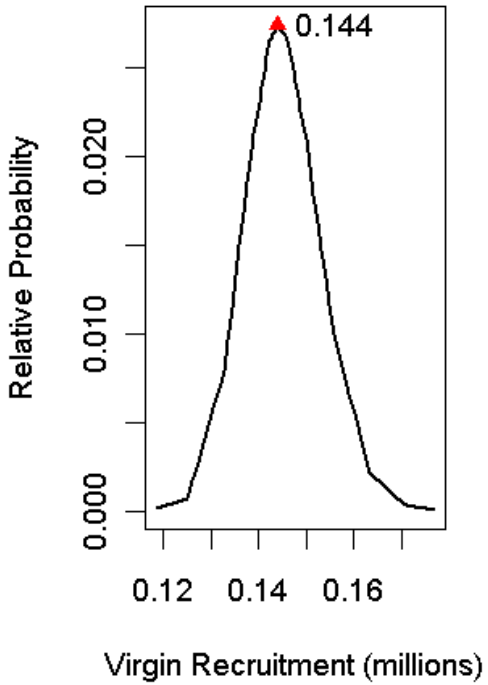
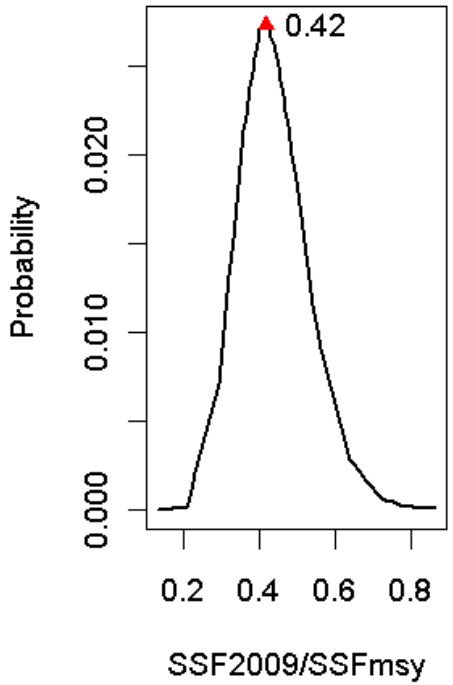
Likelihood profiles







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Projection scenarios

- 19,200 TAC was for a combined stock.
  - We separated the TAC based on the catches in the last three years of the catch series. (51% GOM and 49% SA)
  - Applied the separated TAC in 2010, 2011, and 2012.
- No fishing mortality with interim TAC.
- Interim TAC applied through the whole projections.

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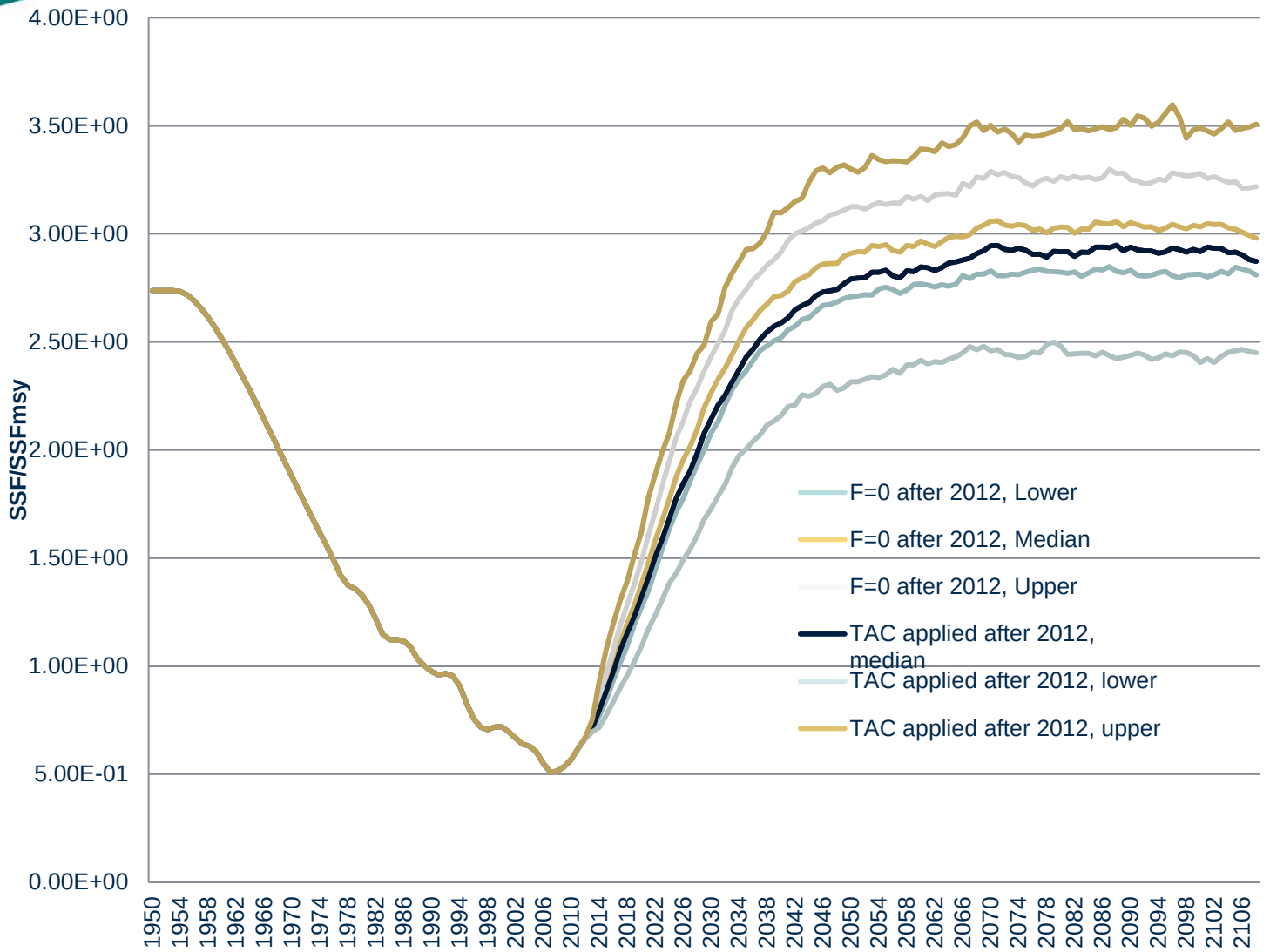
GOM Blacknose Stock Projections

(1) F=0 by 2017

(2) TAC applied by 2019



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Sensitivities

- S1 - Rank-based weightings
- S2 – U-shaped natural mortality
- S3 – FI indices only
- S4 – Hierarchical index only (Did not converge)
- S5 – Low catch (fitting problems)
- S6 – High catch
- S7 – Higher natural mortality

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Blacknose - GOM	BASE		S1 –Rank based	
	Estimate	CV	Estimate	CV
SSF_{2009}/SSF_{MSY}	**0.53**	0.46	**0.42**	0.40
F_{2009}/F_{MSY}	**1.21**	0.54	**1.52**	0.47
N_{2009}/N_{MSY}	0.61	-	0.49	-
MSY	51443	-	50478	-
SPR_{MSY}	0.55	0.21	0.55	0.17
F_{MSY}	0.232	-	0.240	-
SSF_{MSY}	273810	-	267420	-
N_{MSY}	319006	-	310784	-
F_{2009}	0.28	0.54	0.36	0.47
SSF_{2009}	146230	0.19	112040	0.22
N_{2009}	232839	-	186222	-
SSF_{2009}/SSF_{0}	0.19	0.18	0.15	0.20
B_{2009}/B_{0}	0.21	0.17	0.16	0.20
R_{0}	159440	0.05	156070	0.04
Pup-survival	0.75	-	0.75	-
alpha	3.51	-	3.51	-
steepness	0.47	-	0.47	-

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Blacknose - GOM	BASE		S2 U-shape	
	Estimate	CV	Estimate	CV
SSF_{2009}/SSF_{MSY}	**0.53**	0.46	**0.53**	0.42
F_{2009}/F_{MSY}	**1.21**	0.54	**2.62**	0.54
N_{2009}/N_{MSY}	0.61	-	0.46	-
MSY	51443	-	83744	-
SPR_{MSY}	0.55	0.21	0.81	0.08
F_{MSY}	0.232	-	0.080	-
SSF_{MSY}	273810	-	530310	-
N_{MSY}	319006	-	615285	-
F_{2009}	0.28	0.54	0.21	0.54
SSF_{2009}	146230	0.19	280870	0.19
N_{2009}	232839	-	308940	-
SSF_{2009}/SSF_{0}	0.19	0.18	0.24	0.15
B_{2009}/B_{0}	0.21	0.17	0.20	0.16
R_{0}	159440	0.05	301920	0.06
Pup-survival	0.75	-	0.40	-
alpha	3.51	-	1.55	-
steepness	0.47	-	0.28	-

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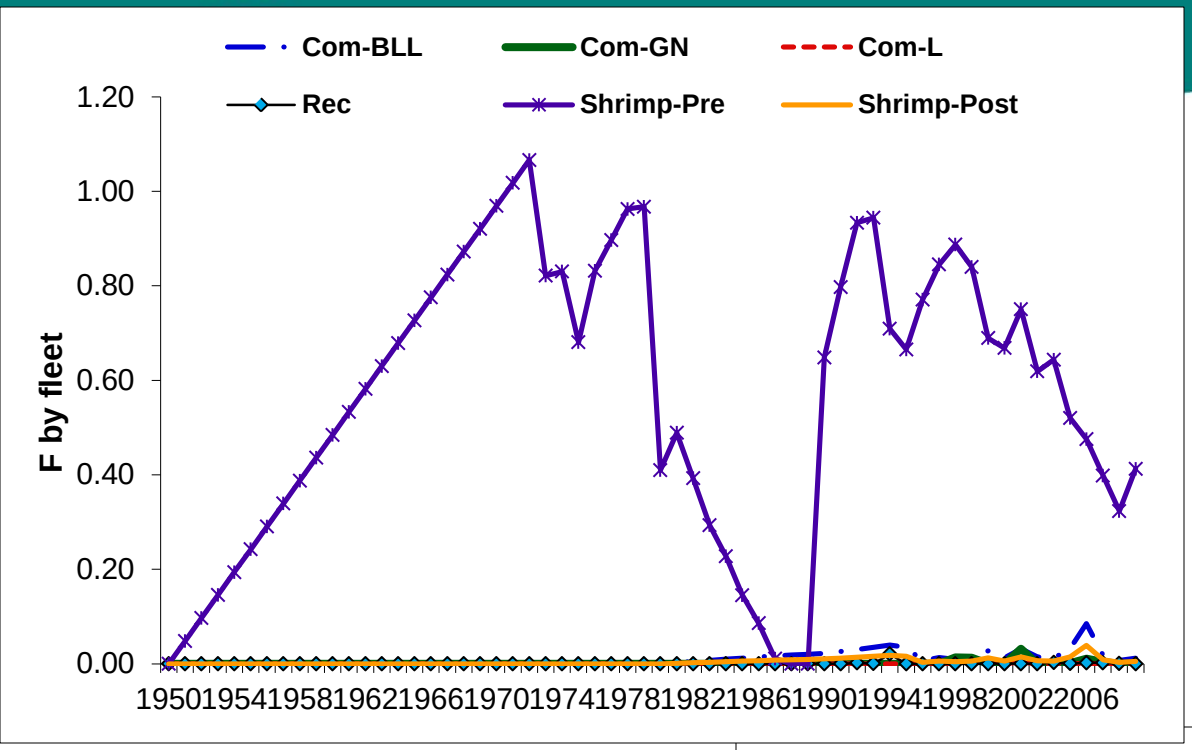
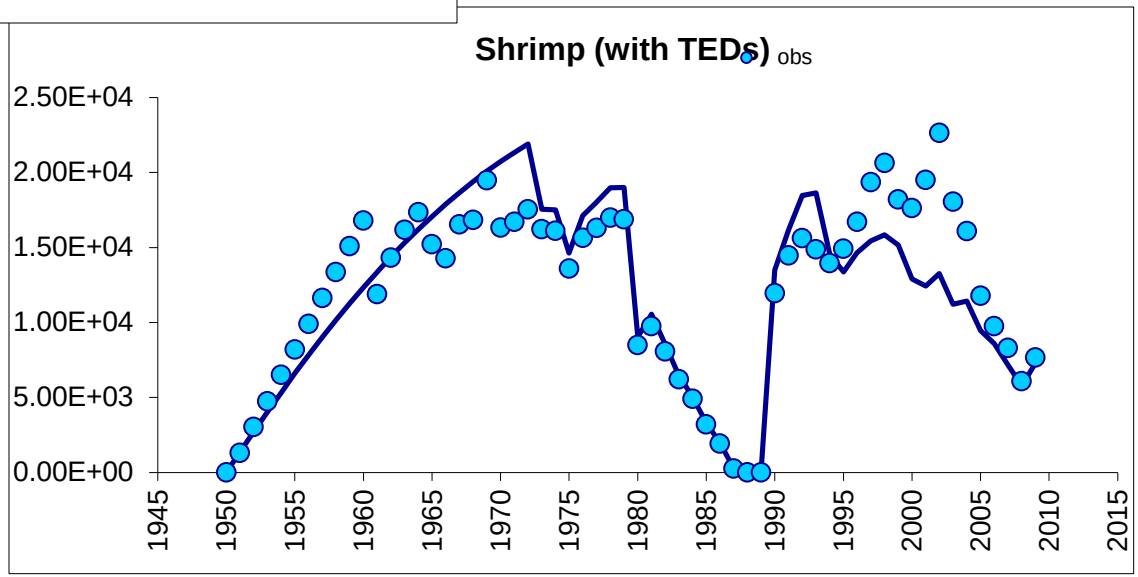
Blacknose - GOM	BASE		S3 FI	
	Estimate	CV	Estimate	CV
SSF_{2009}/SSF_{MSY}	**0.53**	0.46	**0.52**	0.41
F_{2009}/F_{MSY}	**1.21**	0.54	**1.22**	0.47
N_{2009}/N_{MSY}	0.61	-	0.60	-
MSY	51443	-	51362	-
SPR_{MSY}	0.55	0.21	0.55	0.19
F_{MSY}	0.232	-	0.232	-
SSF_{MSY}	273810	-	273200	-
N_{MSY}	319006	-	318479	-
F_{2009}	0.28	0.54	0.28	0.47
SSF_{2009}	146230	0.19	142770	0.20
N_{2009}	232839	-	229651	-
SSF_{2009}/SSF_{0}	0.19	0.18	0.19	0.18
B_{2009}/B_{0}	0.21	0.17	0.21	0.17
R_{0}	159440	0.05	159350	0.05
Pup-survival	0.75	-	0.75	-
alpha	3.51	-	3.51	-
steepness	0.47	-	0.47	-


Com-BLL
Com-GN
Com-L
Rec
Shrimp-Pre
Shrimp-Post
F by fleet
1.20
1.00
0.80
0.60
0.40
0.20
0.00
1950 1954 1958 1962 1966 1970 1974 1978 1982 1986 1990 1994 1998 2002 2006


Shrimp (with TEDs) obs
2.50E+04
2.00E+04
1.50E+04
1.00E+04
5.00E+03
0.00E+00
1945 1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015

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Blacknose - GOM	BASE		S6 HC	
	Estimate	CV	Estimate	CV
SSF_{2009}/SSF_{MSY}	**0.53**	0.46	**0.80**	0.38
F_{2009}/F_{MSY}	**1.21**	0.54	**0.92**	0.38
N_{2009}/N_{MSY}	0.61	-	0.84	-
MSY	51443	-	122971	-
SPR_{MSY}	0.55	0.21	0.55	0.18
F_{MSY}	0.232	-	0.145	-
SSF_{MSY}	273810	-	682630	-
N_{MSY}	319006	-	825117	-
F_{2009}	0.28	0.54	0.13	0.38
SSF_{2009}	146230	0.19	547590	0.16
N_{2009}	232839	-	815440	-
SSF_{2009}/SSF_{0}	0.19	0.18	0.29	0.13
B_{2009}/B_{0}	0.21	0.17	0.31	0.11
R_{0}	159440	0.05	398440	0.05
Pup-survival	0.75	-	0.75	-
alpha	3.51	-	3.51	-
steepness	0.47	-	0.47	-

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Blacknose - GOM	BASE		S7 Hi M	
	Estimate	CV	Estimate	CV
SSF_{2009}/SSF_{MSY}	**0.53**	0.46	**0.55**	0.45
F_{2009}/F_{MSY}	**1.21**	0.54	**1.27**	0.53
N_{2009}/N_{MSY}	0.61	-	0.64	-
MSY	51443	-	59652	-
SPR_{MSY}	0.55	0.21	0.60	0.18
F_{MSY}	0.232	-	0.20	-
SSF_{MSY}	273810	-	274080	-
N_{MSY}	319006	-	333739	-
F_{2009}	0.28	0.54	0.25	0.53
SSF_{2009}	146230	0.19	151390	0.19
N_{2009}	232839	-	266508	-
SSF_{2009}/SSF_{0}	0.19	0.18	0.21	0.16
B_{2009}/B_{0}	0.21	0.17	0.22	0.17
R_{0}	159440	0.05	185040	0.05
Pup-survival	0.75	-	0.75	
alpha	3.51	-	2.88	-
steepness	0.47	-	0.42	-

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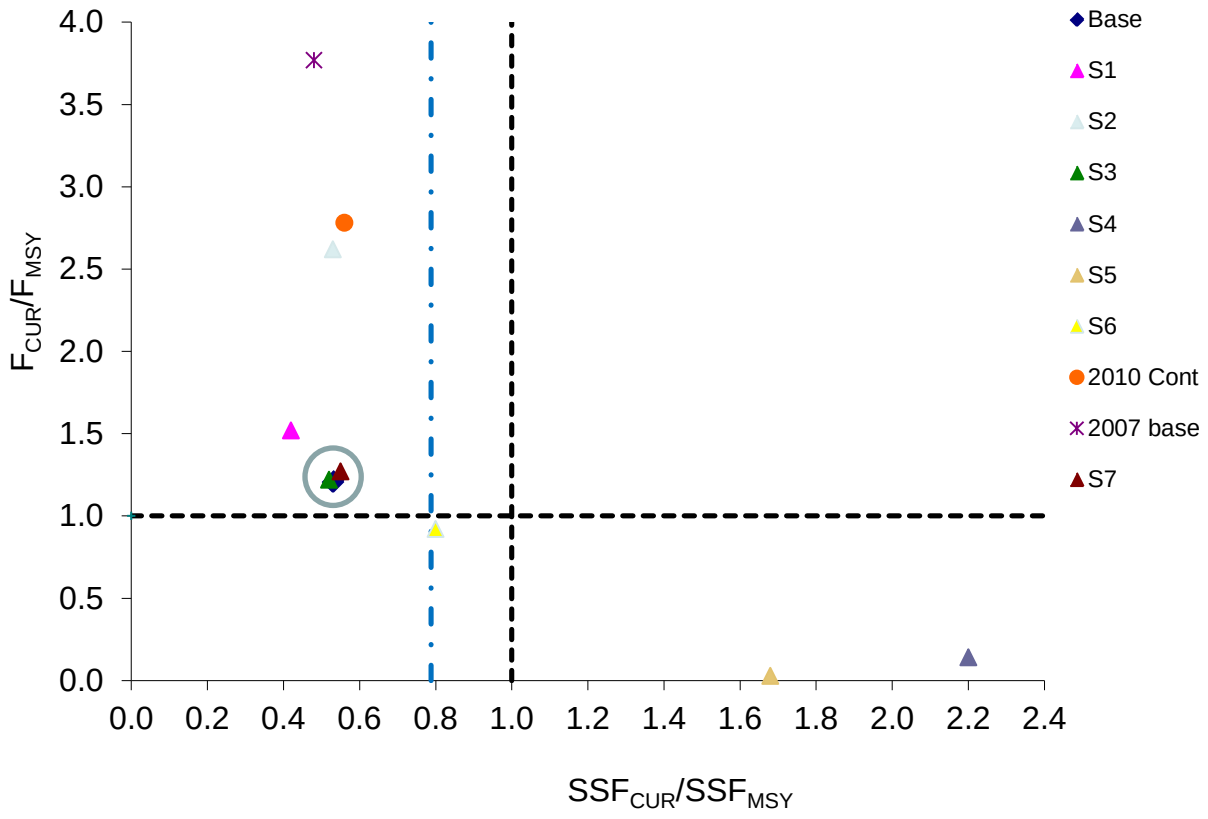
Phase plots including sensitivities



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Moving on to SA stock

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Outline - SA

1. Data Inputs
   a. Fisheries
   b. Indices
   c. Life History
2. Base Model and Results
   a. Rebuilding Analysis
3. Sensitivity Cases
4. Summary of all Results

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Fishery Inputs - SA

Catch Series:

- —Commercial
  - Longline
  - Gillnet
  - Handline
  - BLL-discards
- —Recreational
- —Shrimp Bycatch

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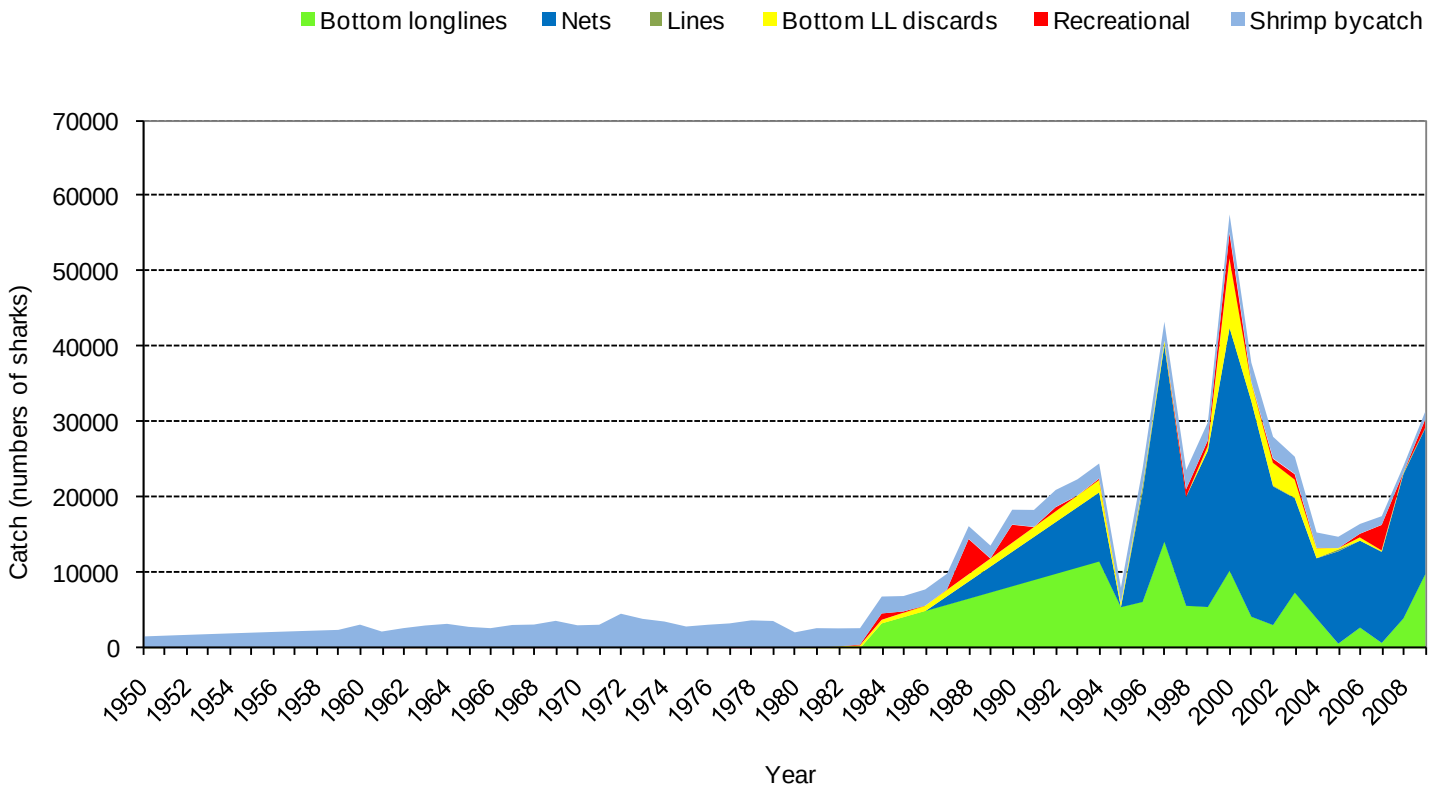
Catches - SA



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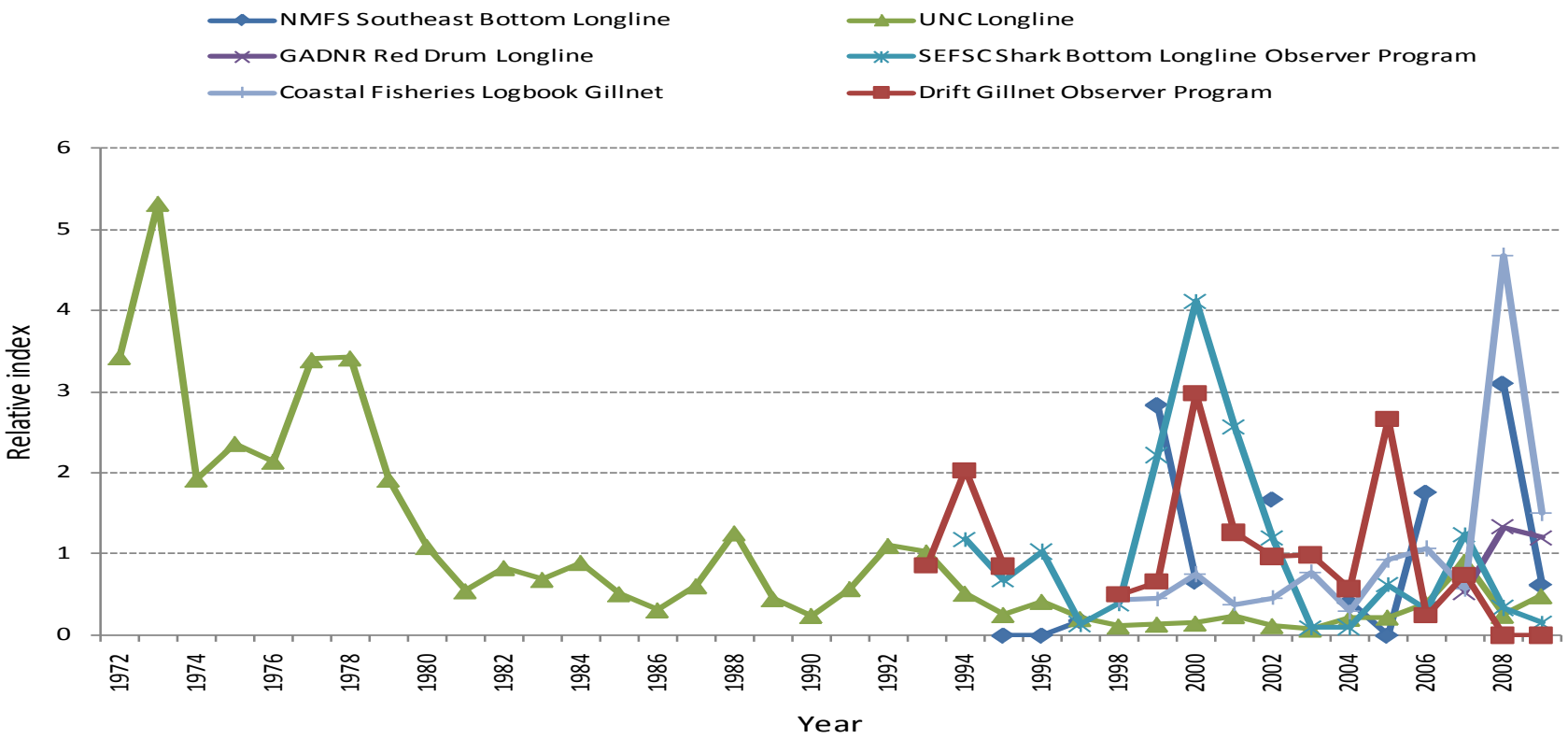
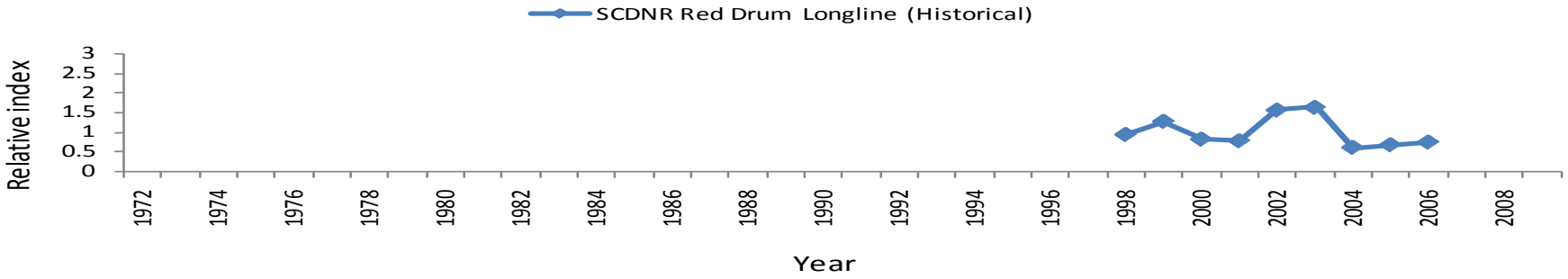
Indices - SA





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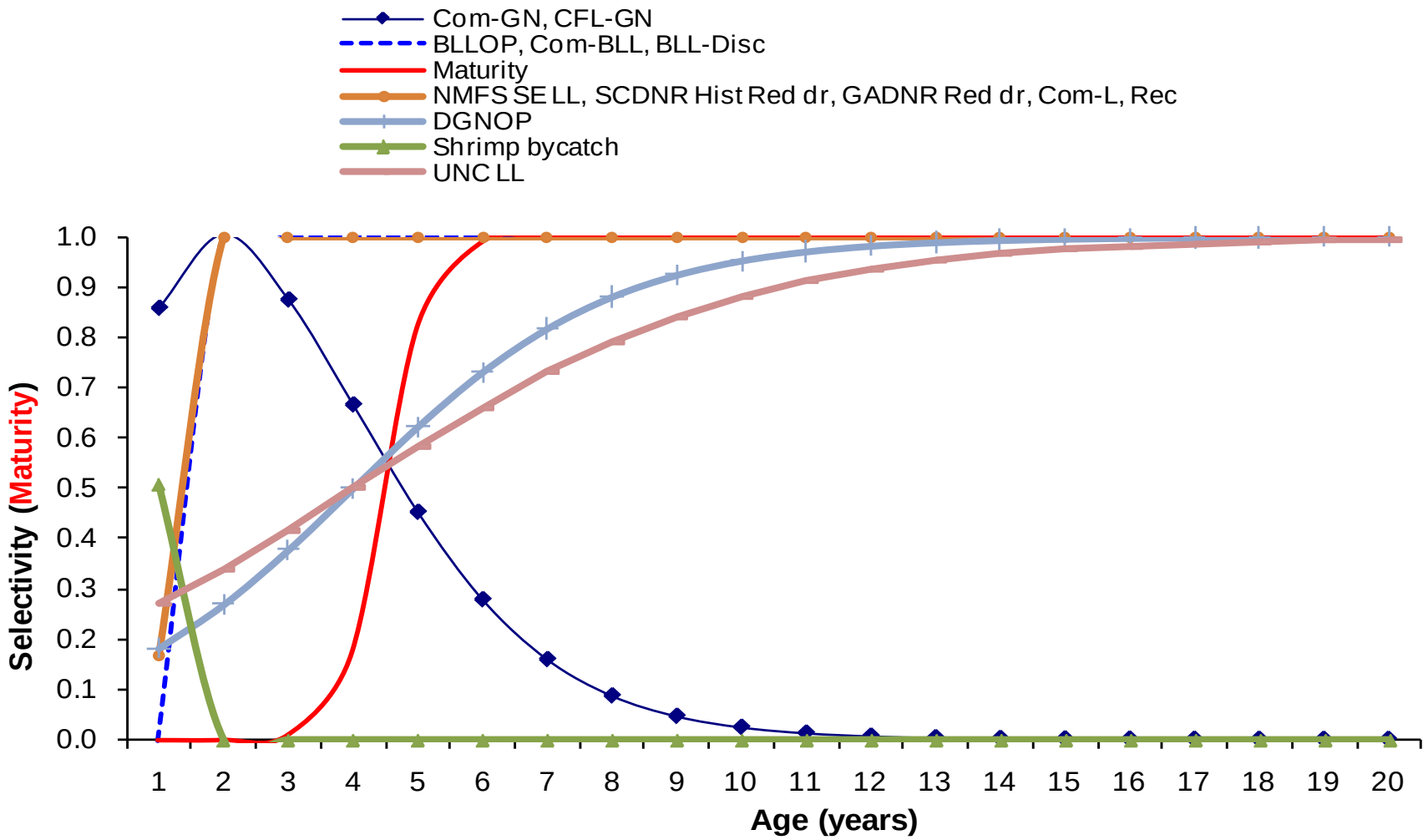
Selectivities and maturity - SA



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Life History Inputs (SA)

L_∞	104.3 (cm FL)
k	0.3
t_0	-1.71
a	1.65E-6
b	3.34
Pup Survival	0.81
Virgin Recruitment (R_0)	[1.0E+4, 1.0E+10]
fecundity	5*(interesting story)

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Assessment Workshop issues remaining

Shrimp bycatch series –

- Treated as one catch series rather than two
  - They should have the same effort but different catchabilities and selectivities
    - No length data to empirically determine selectivities
    - Model fits them very poorly as scaled versions of the other (SA is just scaled down from the poor fit to the GOM)
- Projections
  - Levels of variance
  - Which scenarios to use as bookends to the base case?

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Base case settings

- Virgin conditions in 1950.
- Modern period begins in 1972.
- Catches are fit twice as well when the data are not back-calculated.
- UNC series downweighted by 10 due to initial fitting problems (AW suggestion and guidance).

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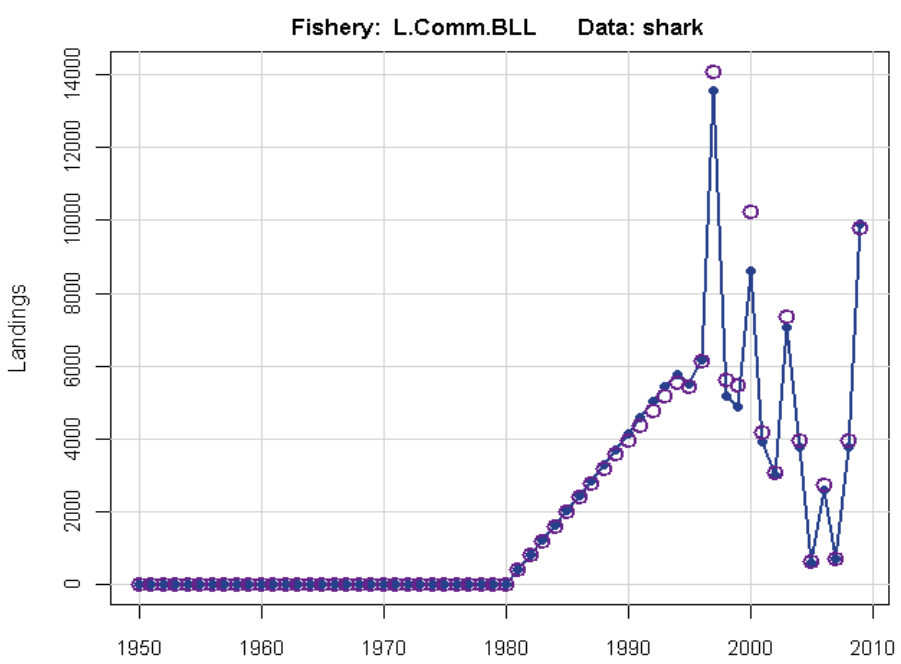
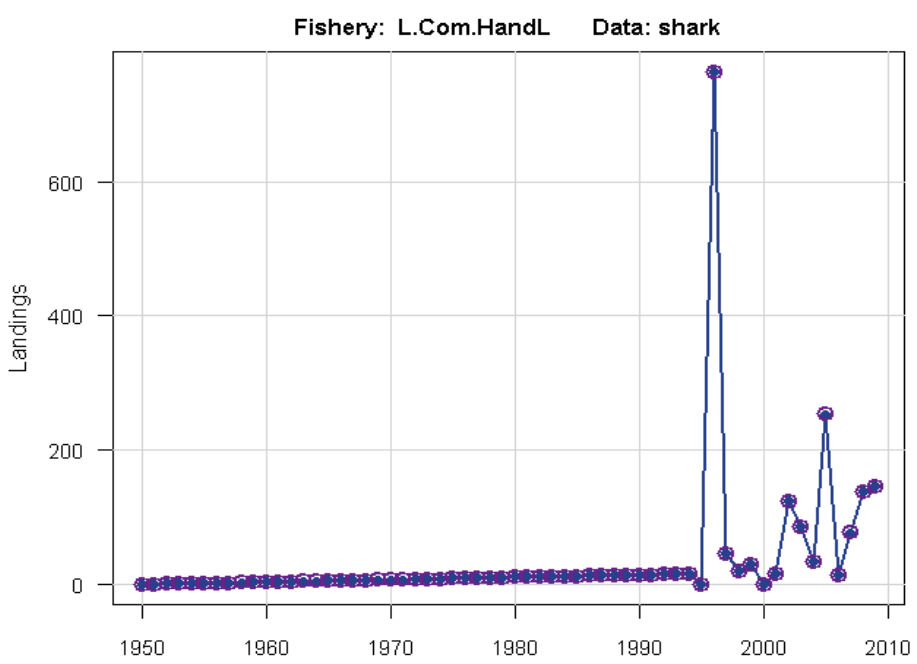
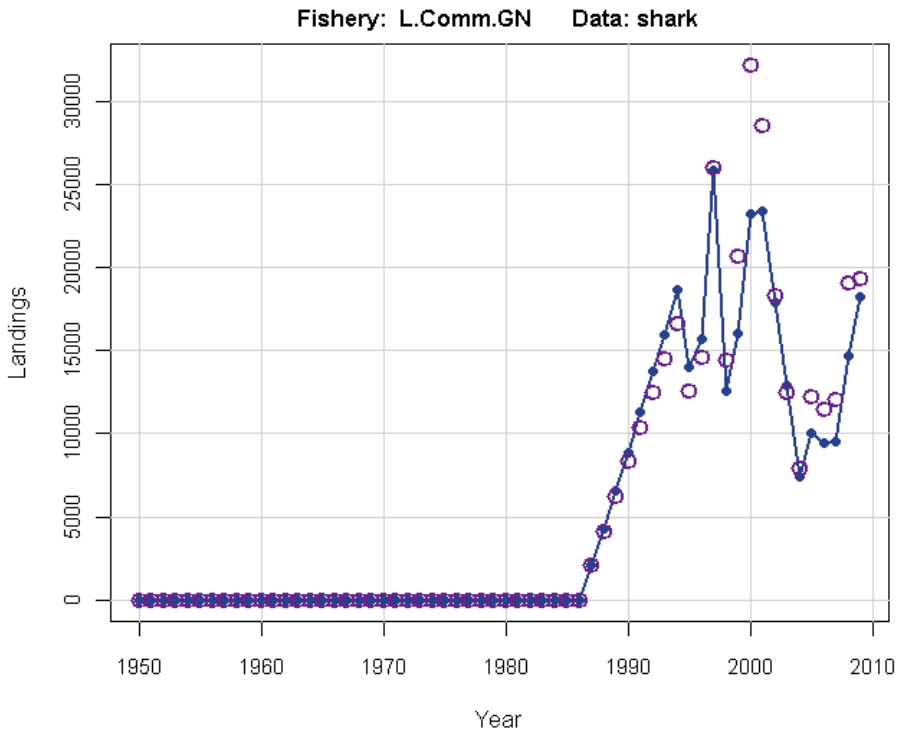
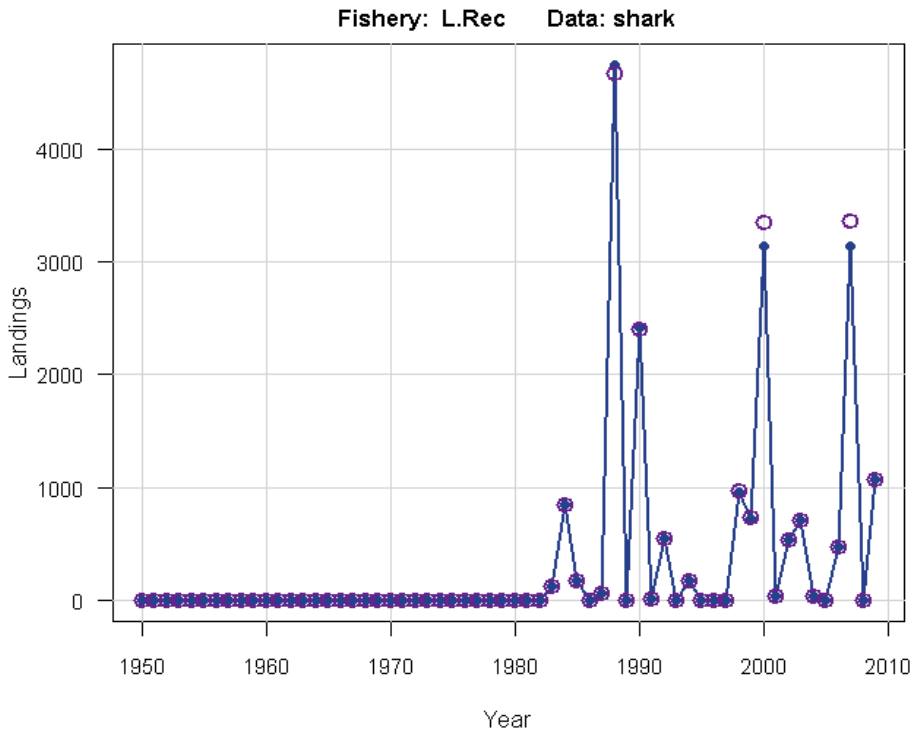
Blacknose - SA	BASE		
	Estimate	CV	
SSF_{2009}/SSF_{MSY}	**0.60**	0.096	**Overfished**
F_{2009}/F_{MSY}	**5.02**	1.60	**Overfishing**
N_{2009}/N_{MSY}	0.379	-	
MSY	24495	-	
SPR_{MSY}	1.87	0.05	
F_{MSY}	0.075	-	
SSF_{MSY}	96809	-	
N_{MSY}	153709	-	
F_{2009}	0.376	0.12	
SSF_{2009}	58409	0.19	
N_{2009}	152057	-	
SSF_{2009}/SSF_{0}	0.27	0.04	
B_{2009}/B_{0}	0.14	0.04	
R_{0}	85148	0.06	
Pup-survival	0.81	-	
alpha	2.26	-	
steepness	0.36	-	


Fishery: L.Comm.BLL Data: shark
Landings
0
2000
4000
6000
8000
10000
12000
14000
1950
1960
1970
1980
1990
2000
2010


Fishery: L.Com.HandL Data: shark
Landings
0
200
400
600
1950
1960
1970
1980
1990
2000
2010


Fishery: L.Comm.GN Data: shark
Landings
0
5000
10000
15000
20000
25000
30000
1950
1960
1970
1980
1990
2000
2010
Year


Fishery: L.Rec Data: shark
Landings
0
1000
2000
3000
4000
1950
1960
1970
1980
1990
2000
2010
Year

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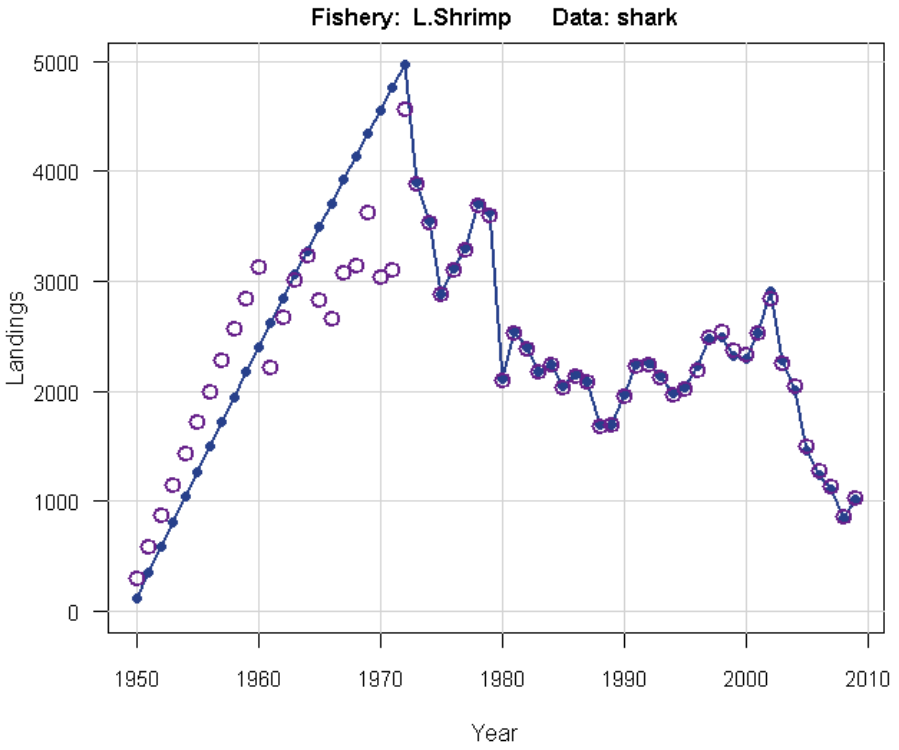
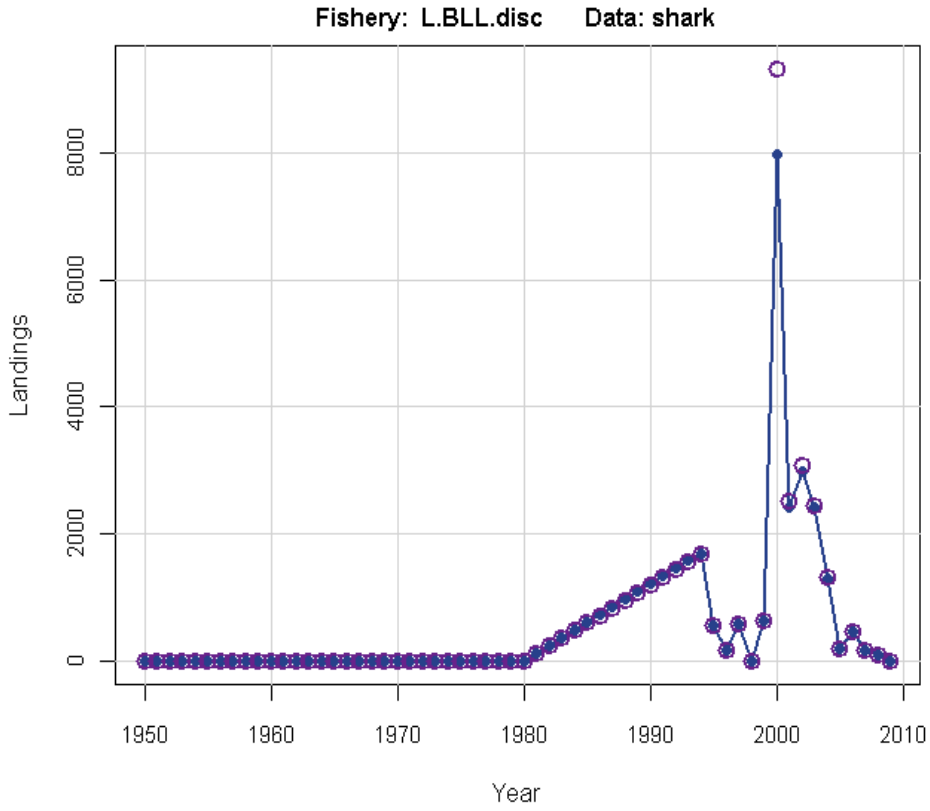
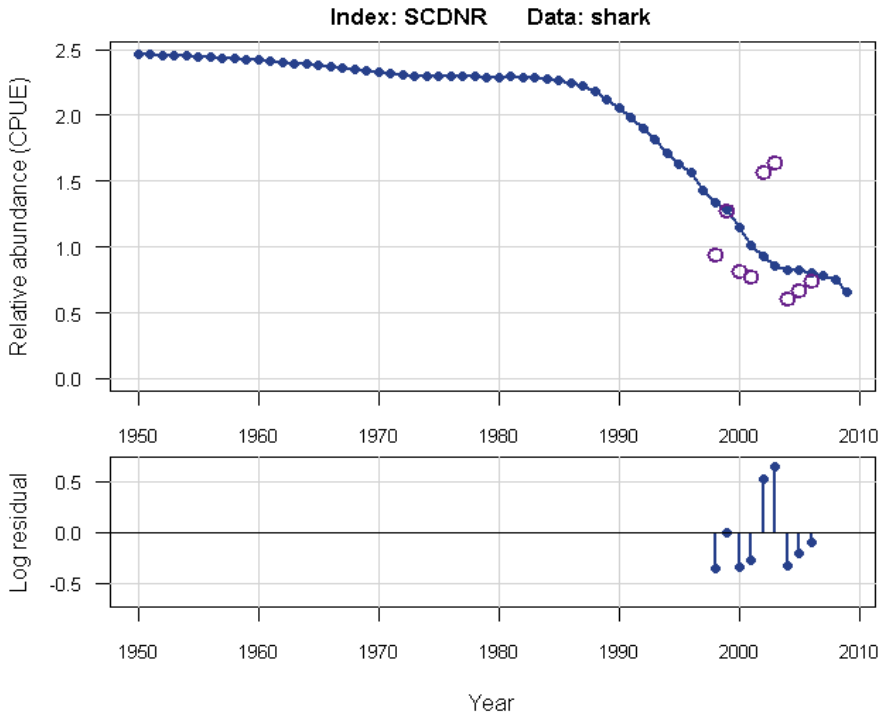
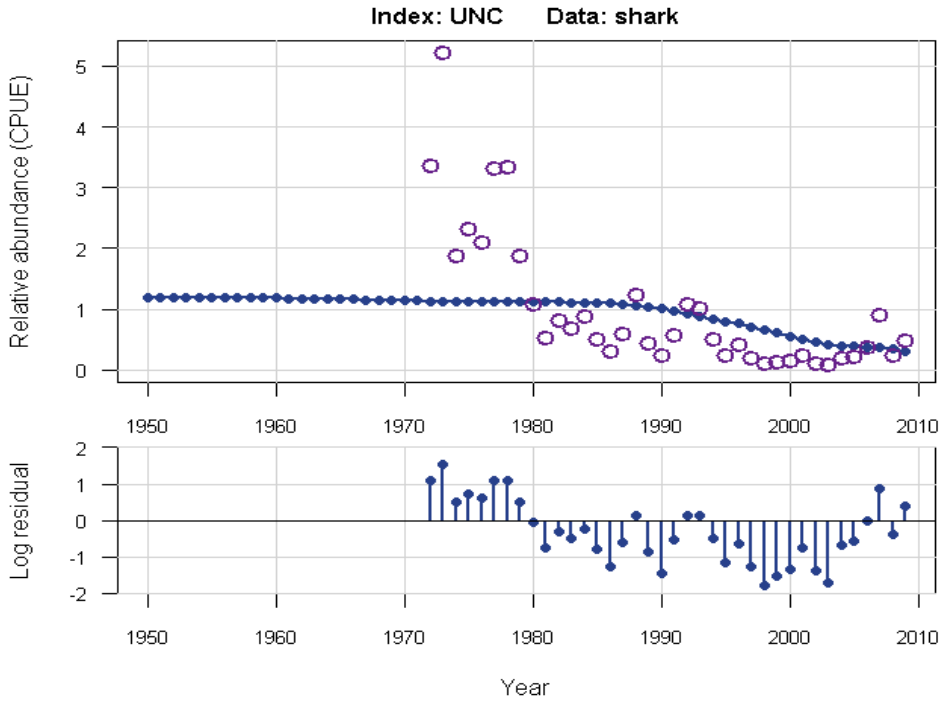
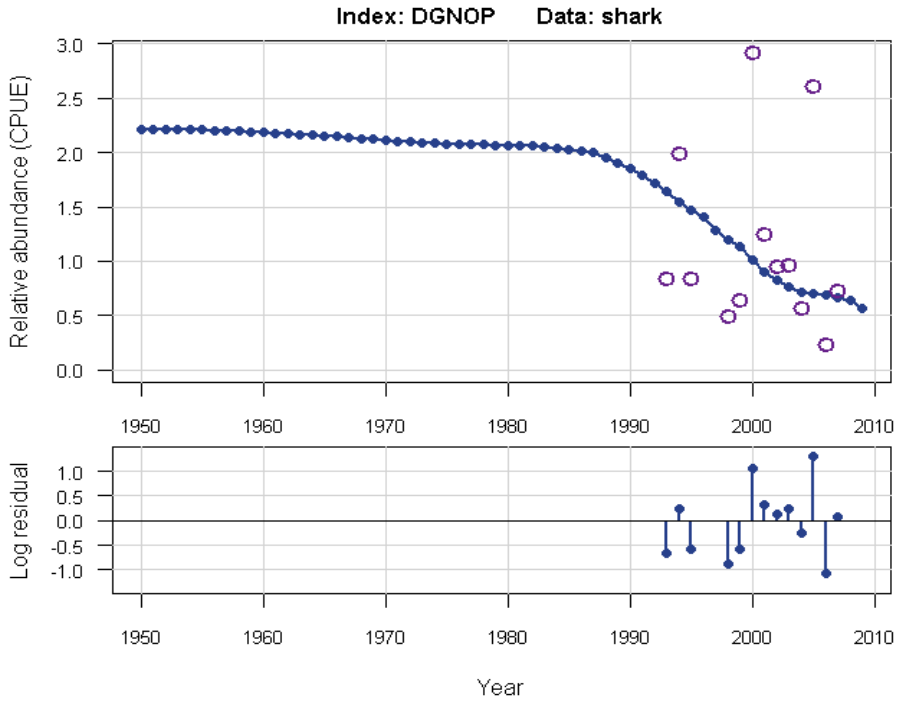
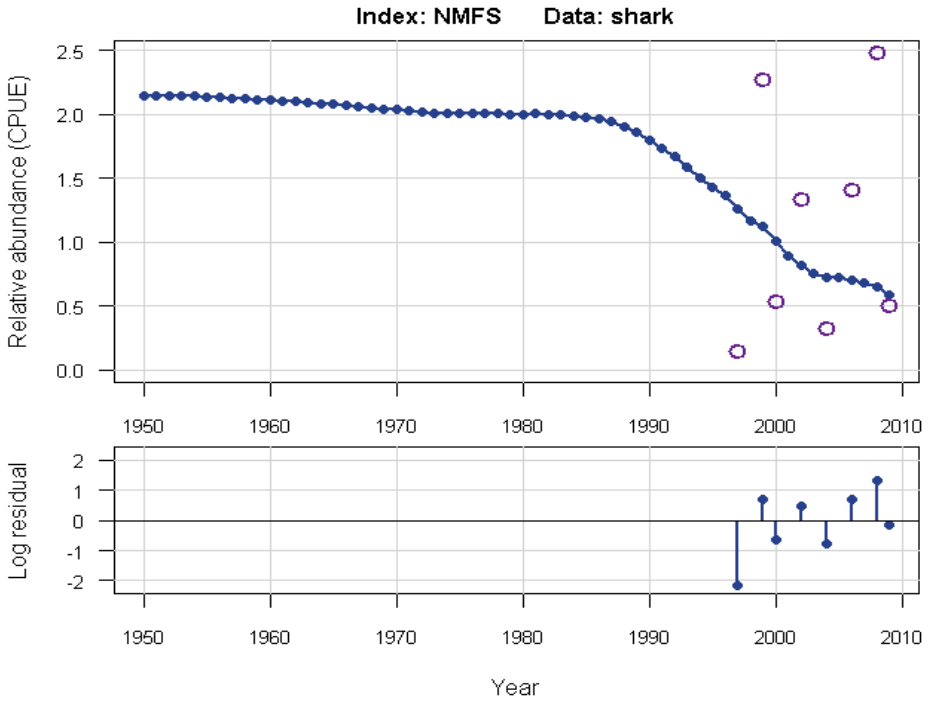




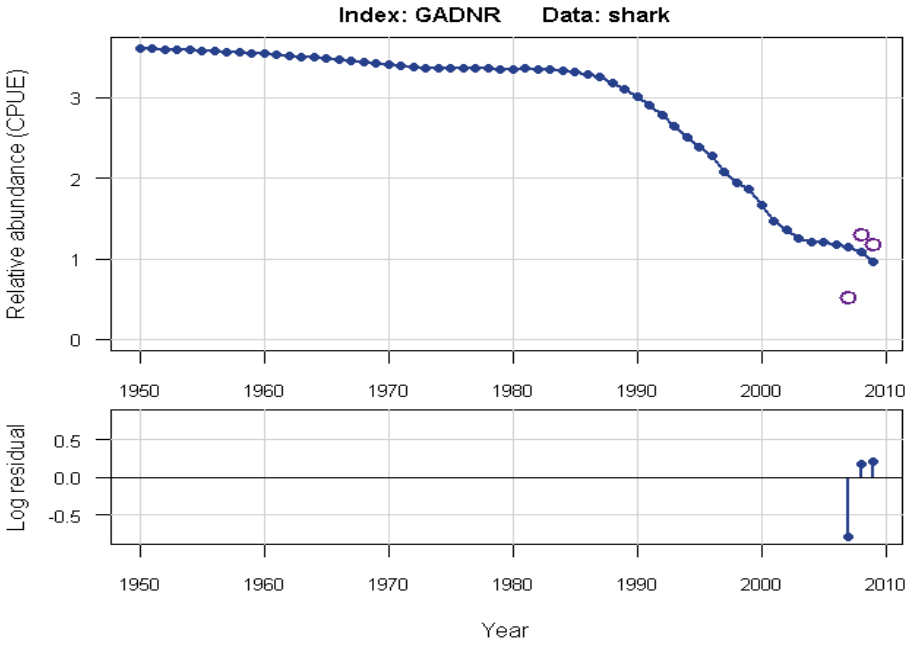

Index: SCDNR Data: shark
Relative abundance (CPUE)
Log residual
Year

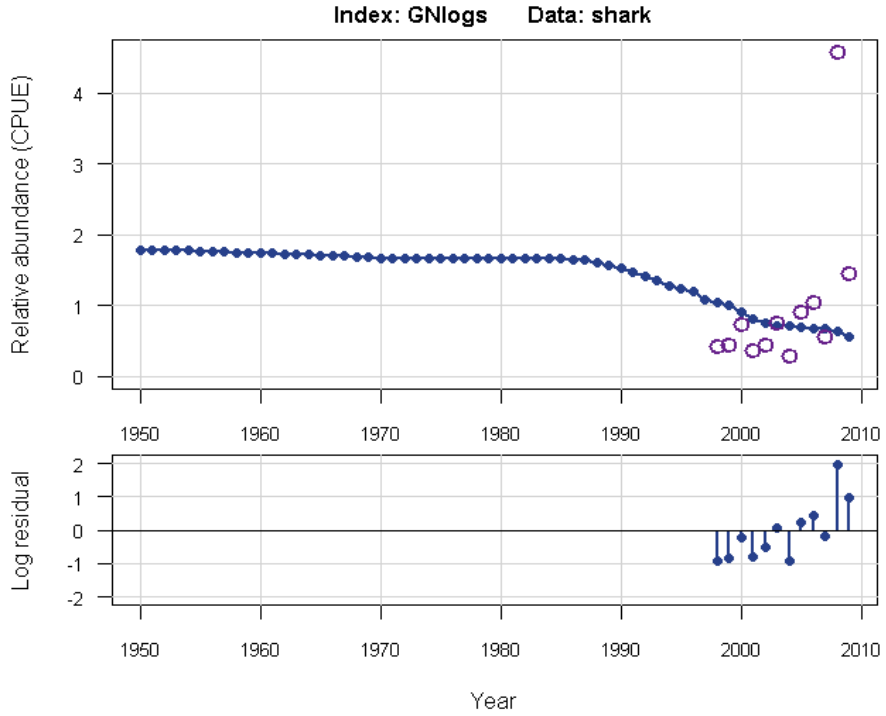

Index: UNC Data: shark
Relative abundance (CPUE)
Log residual
Year

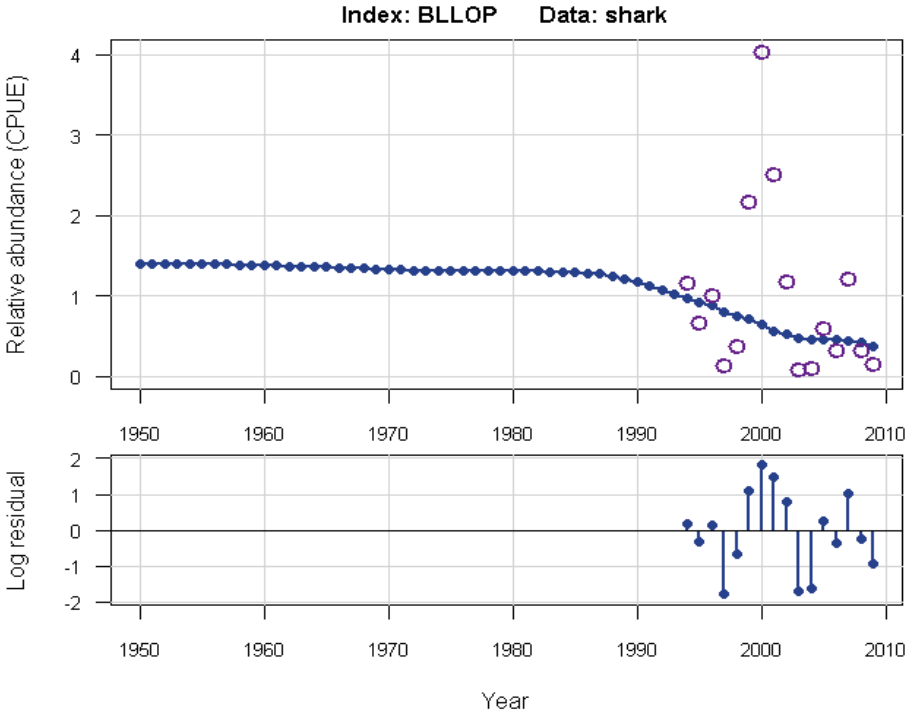

Index: DGNOP Data: shark
Relative abundance (CPUE)
Log residual
Year


Index: NMFS Data: shark
Relative abundance (CPUE)
Log residual
Year

NOAA FISHERIES SERVICE







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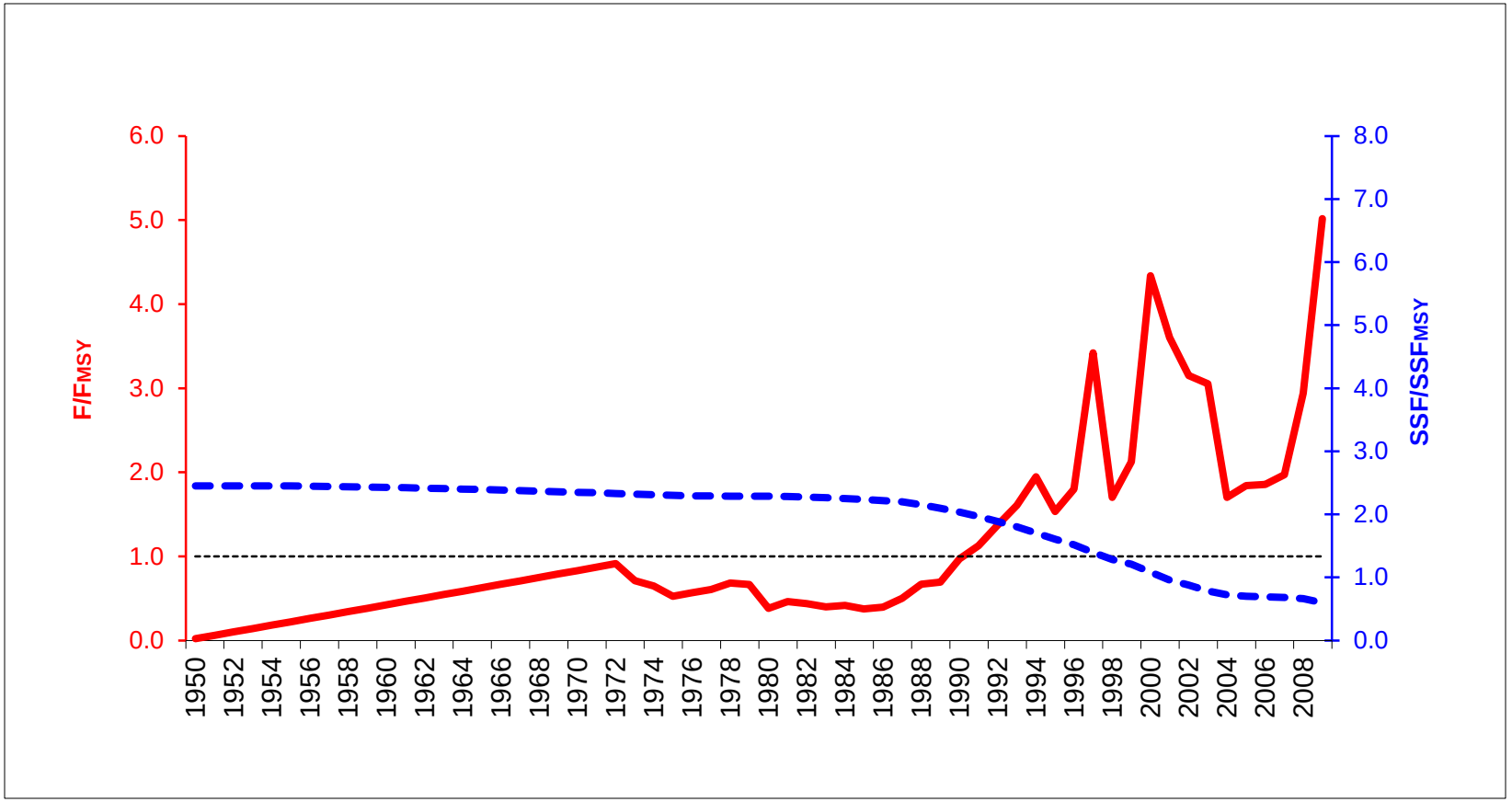
Base model benchmarks



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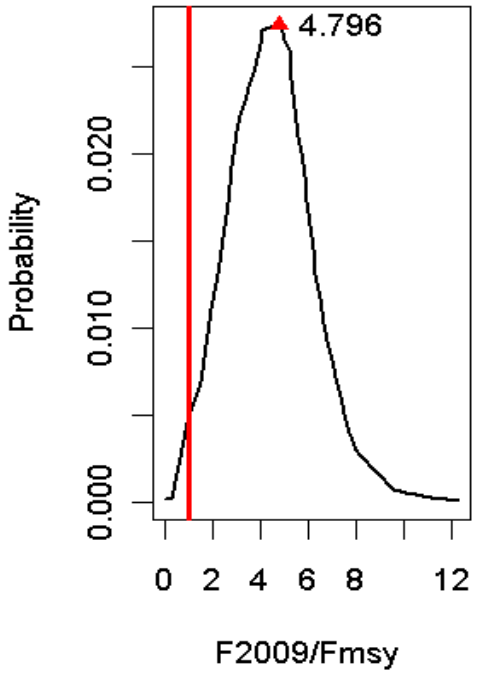
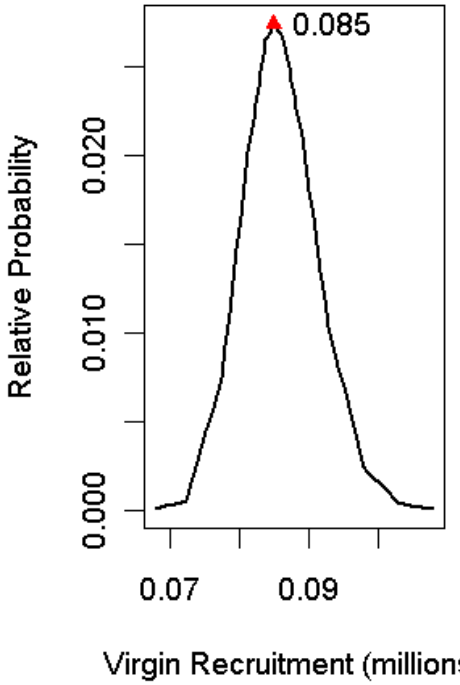
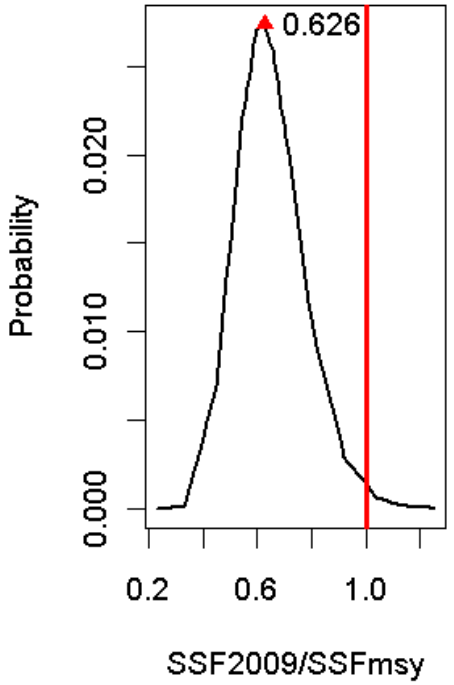
Likelihood Profiles







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Projection scenarios

- 19,200 TAC was for a combined stock.
  - We separated the TAC based on the catches in the last three years of the catch series. (51% GOM and 49% SA)
  - Applied the separated TAC in 2010, 2011, and 2012.
- No fishing mortality with interim TAC.
  - If longer than 10 years to recovery, add the 9 year generation time to find rebuilding time.
- Find TAC that allows stock to recover by rebuilding year.

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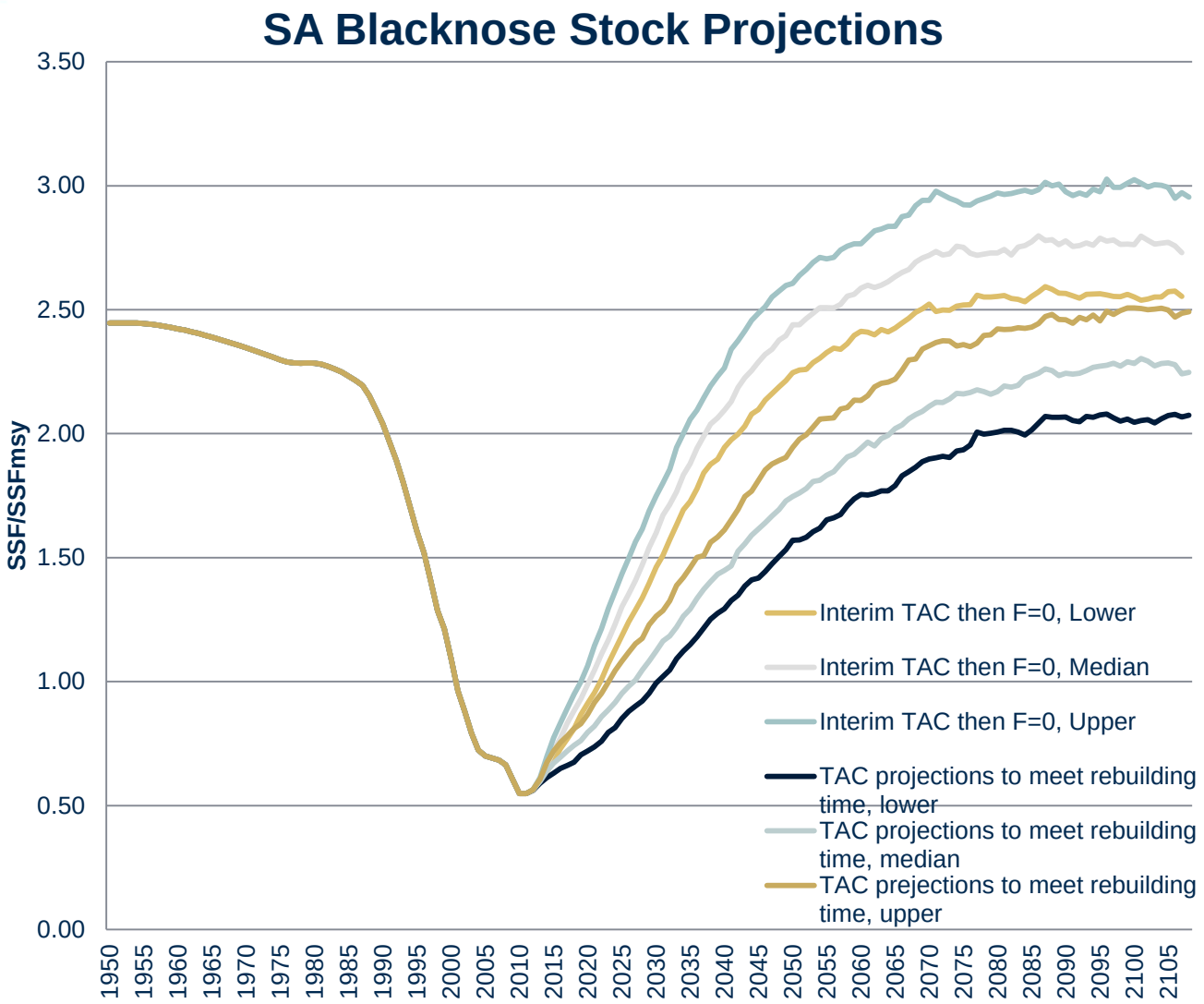
(1) F=0 by 2022

(2) Rebuilt with 70% probability in 2031 with a TAC of 21,500



SA Sensitivities

- S1 – ranked indices (did not converge)
- S2 – U-shaped natural mortality
- S3 – FI indices only (did not converge)
- S4 – hierarchical index (did not converge)
- S5 – low catch
- S6 – high catch
- S7 – all indices
- S8 – higher natural mortality

Phase plot with sensitivities