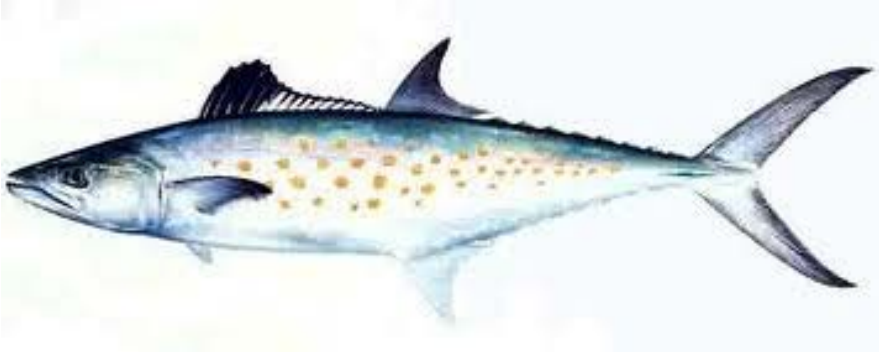
SEDAR 28, south Atlantic Spanish mackerel stock assessment review

October 29th - November 2nd , 2012
Atlanta, GA

NOAA FISHERIES
SEFSC
Sustainable
Fisheries Branch



Data Review

Landings, discards, indices, age compositions, and life history information

Stock definition

- The Atlantic stock is considered to start south of the Keys on up to Maine.

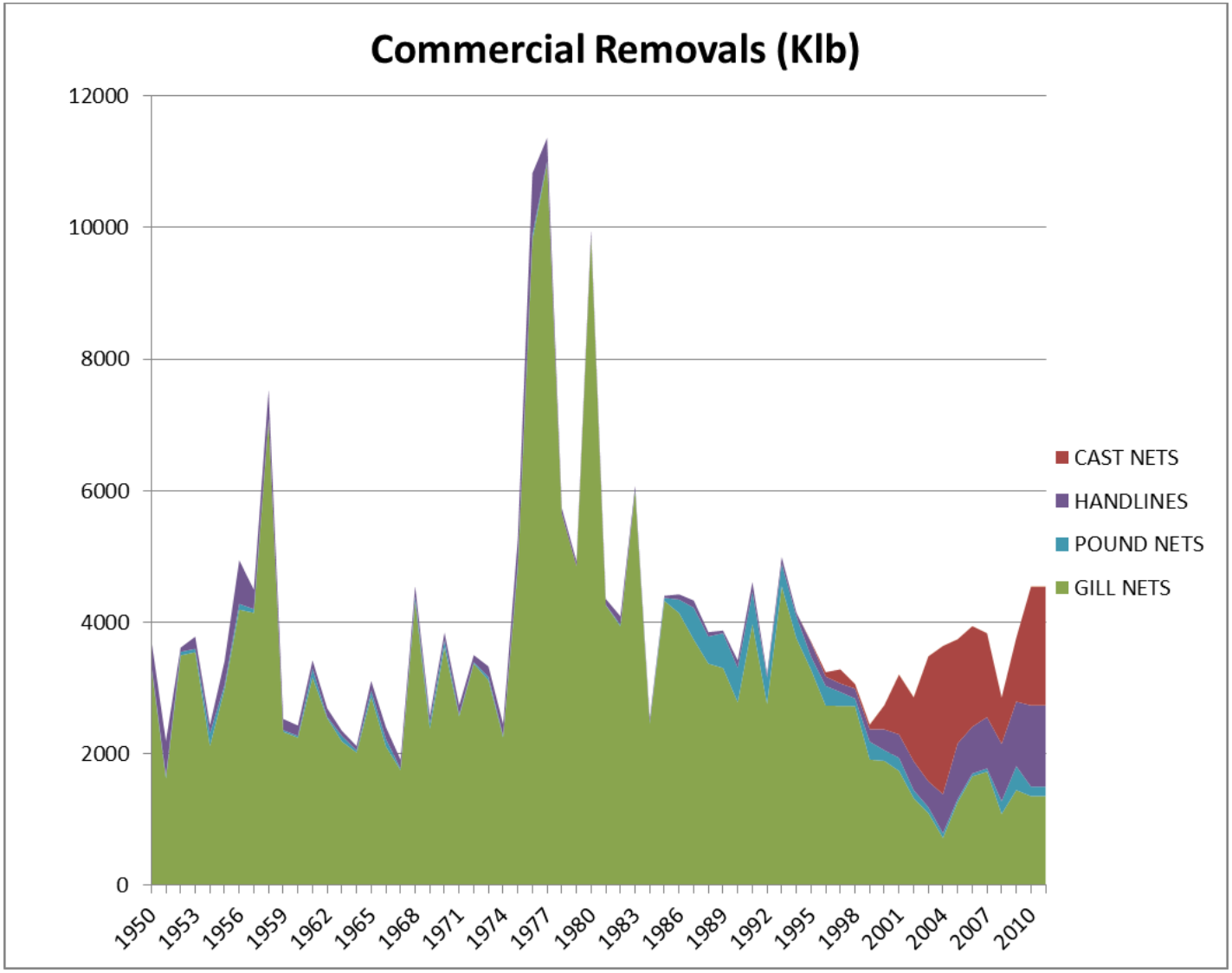
Spatial extent of the fishery

- The majority of the fishery is off the coast of FL, but landings data were also tabulated from Georgia, South Carolina, North Carolina, Virginia, and “north of VA”.

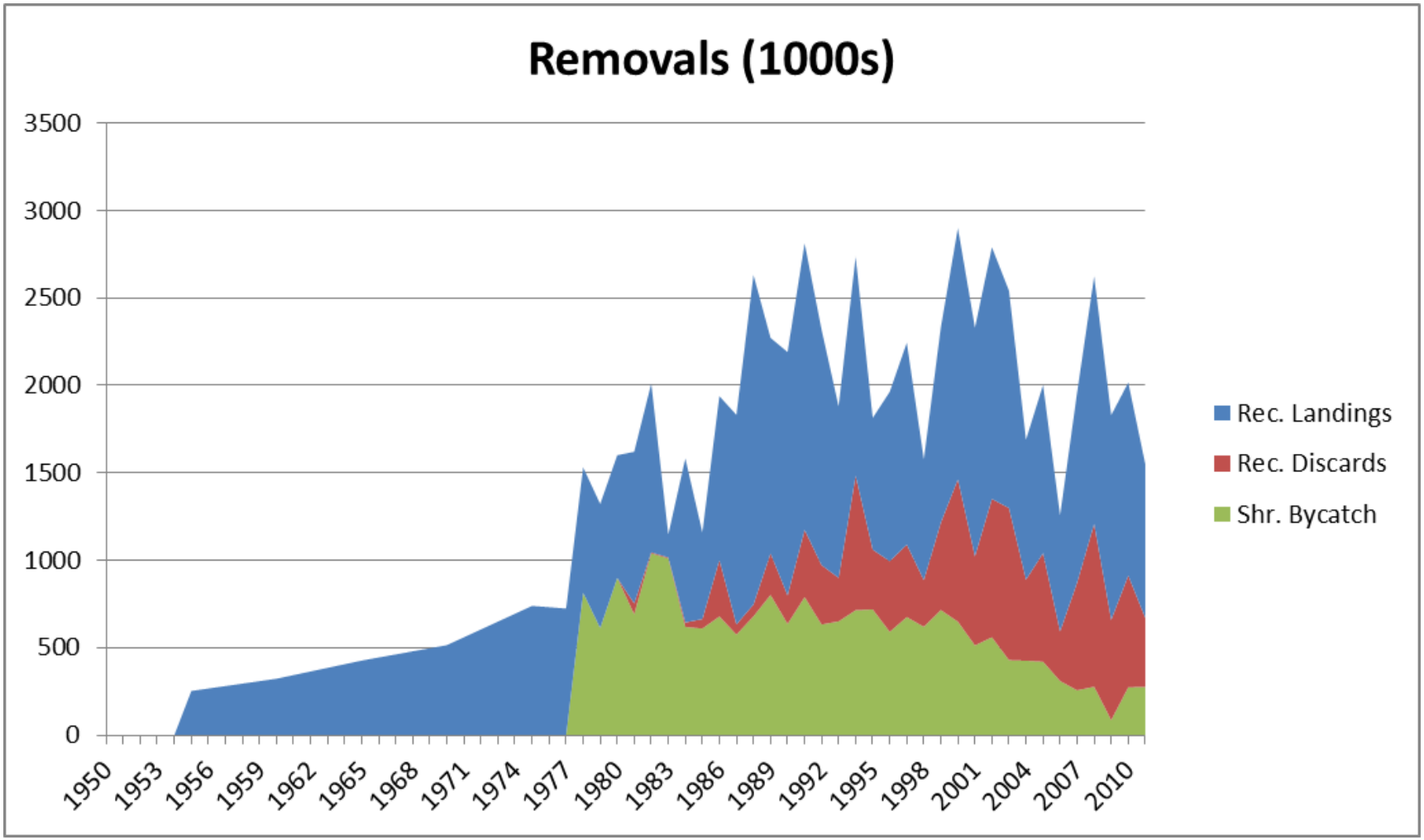
Genetics

- Genetic differentiation of Gulf of Mexico and south Atlantic stocks
  - No evidence of differentiation within the south Atlantic

Landings


Commercial Removals (Klb)
12000
10000
8000
6000
4000
2000
0
1950
1953
1956
1959
1962
1965
1968
1971
1974
1977
1980
1983
1986
1989
1992
1995
1998
2001
2004
2007
2010
CAST NETS
HANDLINES
POUND NETS
GILL NETS

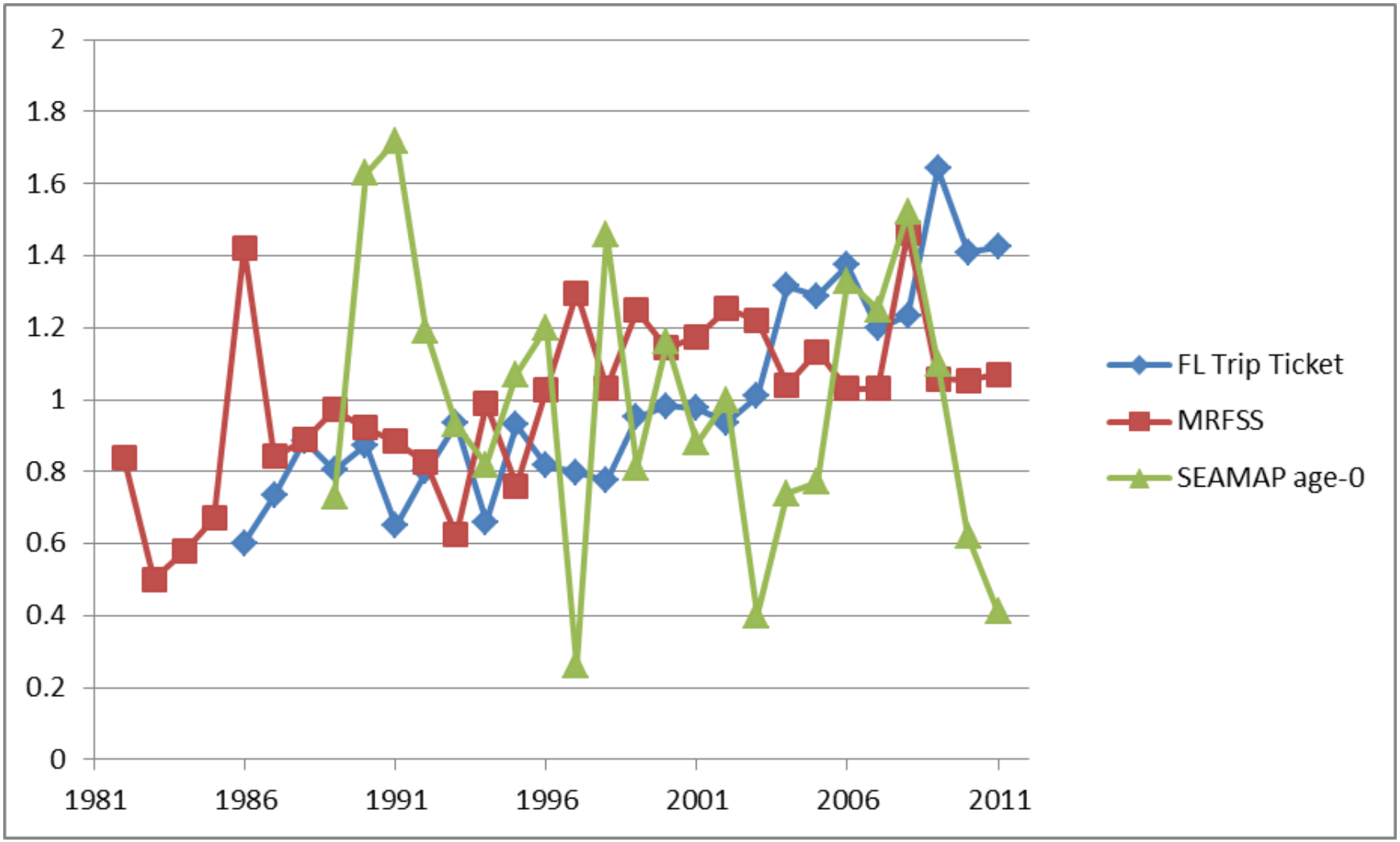
Recreational landings and discards



Indices

- Florida handline (1986-2011), MRFSS (1981-2011), and SEAMAP (1989-2011) indices were standardized using delta-GLMs
- The SEAMAP age-1 index was removed at the assessment workshop due to overlap with the SEAMAP age-0 index.

Indices


2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1981
1986
1991
1996
2001
2006
2011
FL Trip Ticket
MRFSS
SEAMAP age-0

Age compositions

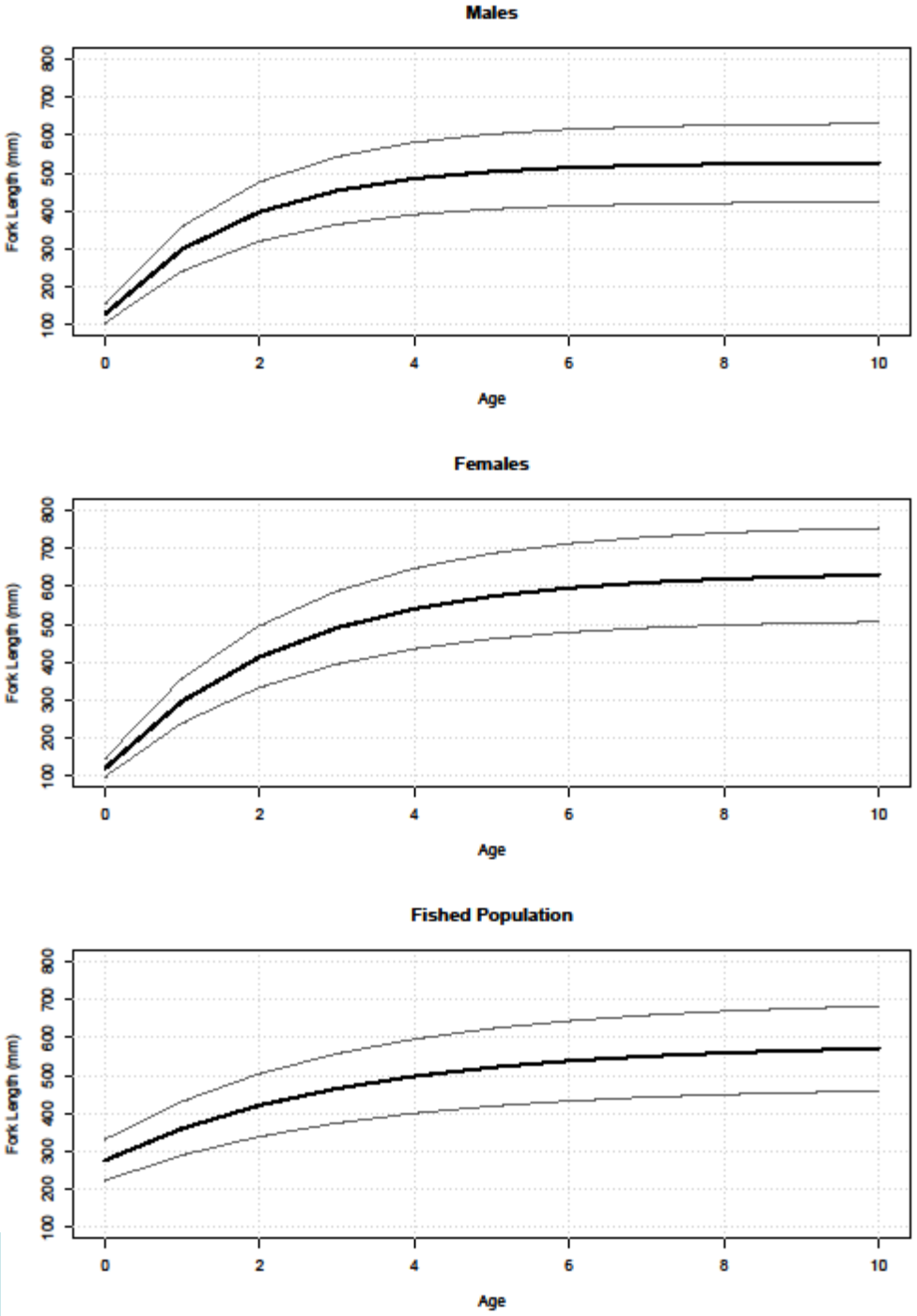
- Available for all fisheries
  - Handline
  - Gill net
  - Pound net
  - Cast net
  - General recreational

Life history information

- Size-dependent natural mortality (not sex-specific) (show plot)
- Female maturity
- Female weight used as a proxy for reproductive potential

Life history information

- von Bertalanffy growth for each sex (size-limit corrected estimation method)
- Another fishery-specific growth curve was estimated external to the model for scaling landings



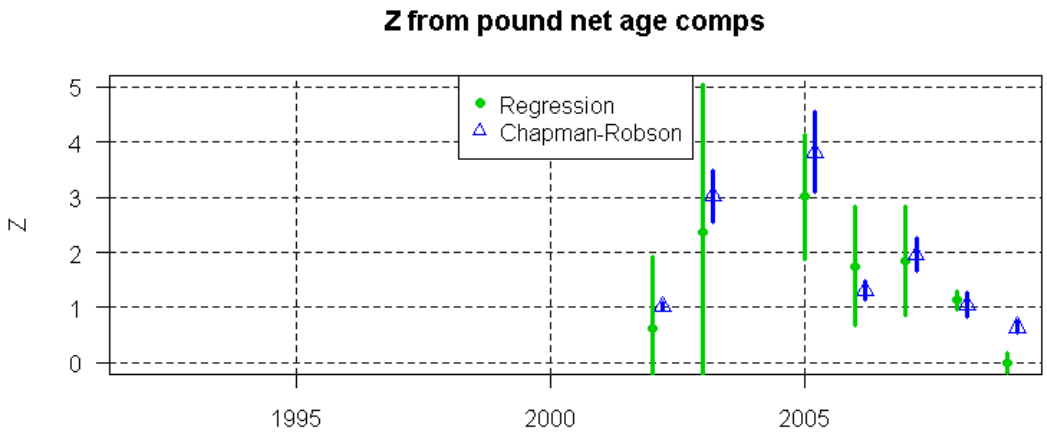
Model assumptions

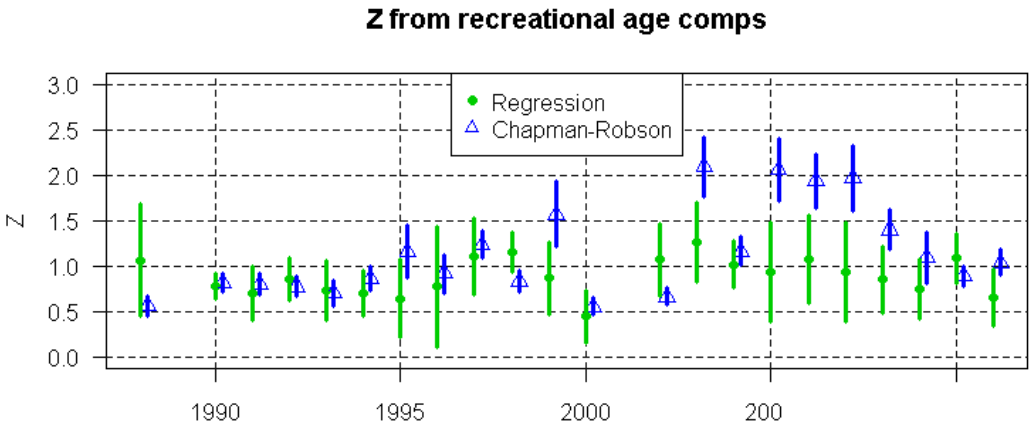
Selectivities, initial conditions, start year, sex-specificity, minimum sample size for composition data, steepness, stock-recruit function

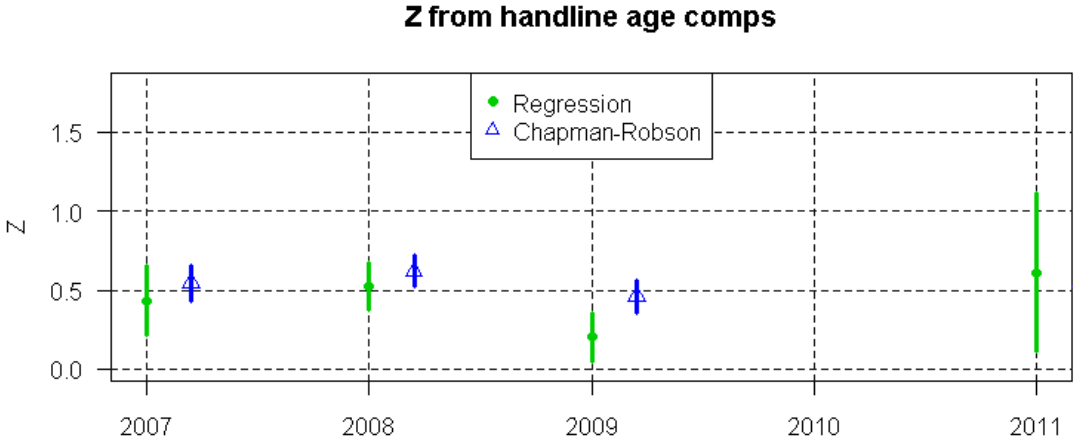
Selectivities

- Fisheries:
  - Handline and gill net assumed logistic
    - Size composition and fishing locations
  - Pound net, cast net and recreational assumed dome-shaped
    - Size composition, catch curves, and fishing locations

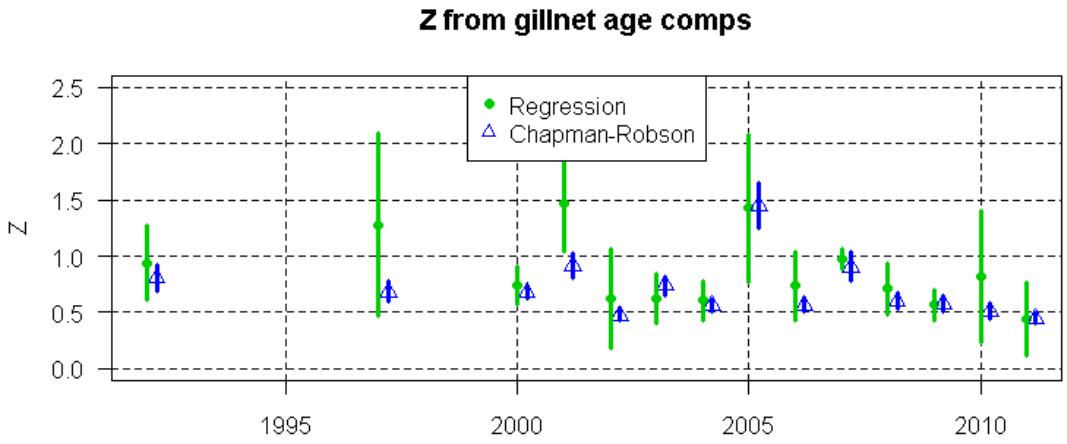
Catch curves

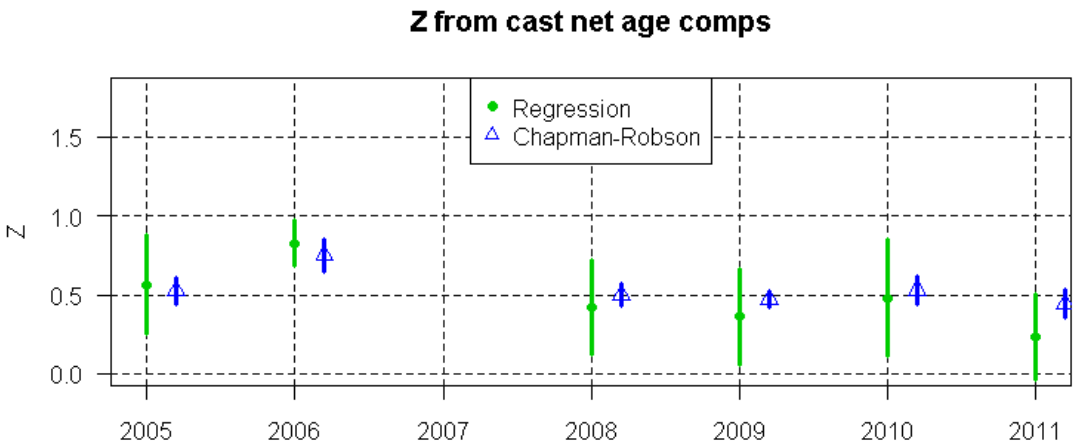






Catch curves



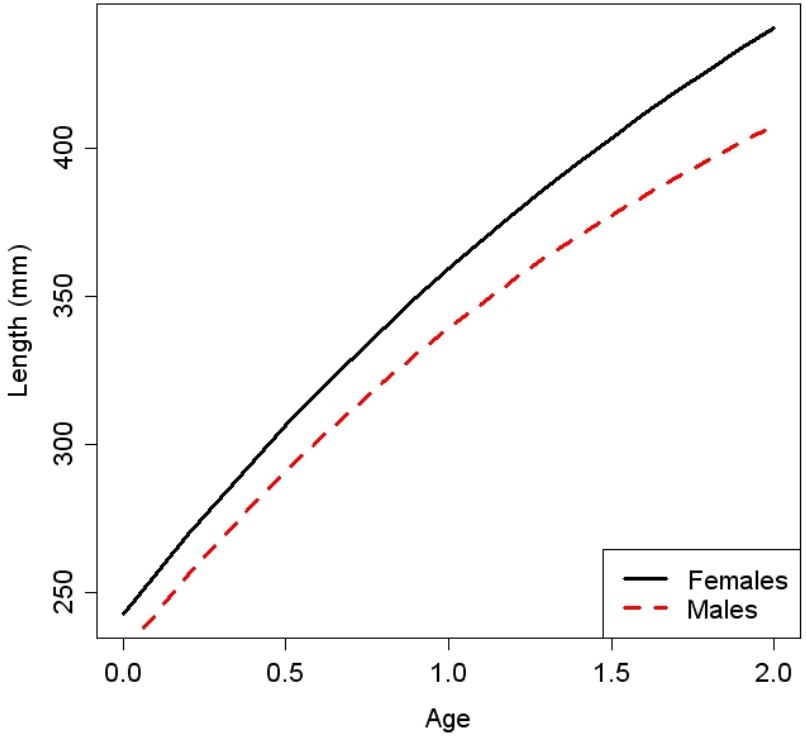


Selectivities

- Shrimp bycatch: assumed age-0 fully selected and a small amount of age-1 fish are caught.
  - Based on size composition of the catch and tow speed
- Sex-specificity: differential growth accounted for
- Discards: A separate F was estimated for discards, requiring specification of discard selectivities
  - Based on the 12 in FL size limit.
- Historical: Chosen to be age-0, age-1, age2+ as 0.05, 0.5 and 1.0 respectively

Differential growth

- Differences in selectivities thought to result from differential growth
- Found constant *c* that minimized squared difference between von Bert curves (age 0-2)
- Applied *c* = 0.2 to logistic selectivity functions



Beaufort Assessment Model description

Statistical catch-age model

- Forward projecting, maximum likelihood (with penalties)
- Models landings (lognormal), age compositions ((robust) multinomial), and indices (lognormal)
- Differences between predicted and observed observations “minimized,” predicated on an underlying discrete time population model
- Baranov catch equation used to predict landings
- Likelihood weights used to control aspects of model fit
- Implemented in AD model builder

Statistical catch-age model

- Two sexes modeled to account for differential growth
- Sex ratio assumed 50/50 at time of recruitment
- Model initialized via an assumed historical fishing mortality and historical selectivity vector applied to initial equilibrium age structure
- Successfully tested on expected value data with one fishery (SEDAR 17)

Recruitment

- Beverton-Holt spawner-recruit model; SSB computed at midyear as product of numbers, weight, proportion females mature
- Lognormal recruitment deviations
- Prior to the initial year of recruitment deviations, recruitment follows the spawner-recruit curve exactly
- MSY-benchmarks from bias-corrected stock-recruit model

Age classes

- 0 – 10+
- Very few individuals sampled >10 years old, observed max is 12 years
- Life-history characteristics have saturated by age 5-6 (maturity, weight)

Minimum sample size of composition data

- Strike a balance by including yrs of comp data with $N>N_{min}$
- Used N_{min} = 10 fish

BAM Estimated Parameters

Estimated parameters (410)

- S-R parameter : R0
- Annual R devs (30): 1982-2011
- Selectivity (16): 8 slopes and 8 A_{50}s for fleets and surveys
- Catchability (3): q for each abundance index
- Fishing mortality (360): average F + annual deviations for each fleet (landings and discards)

Likelihood components

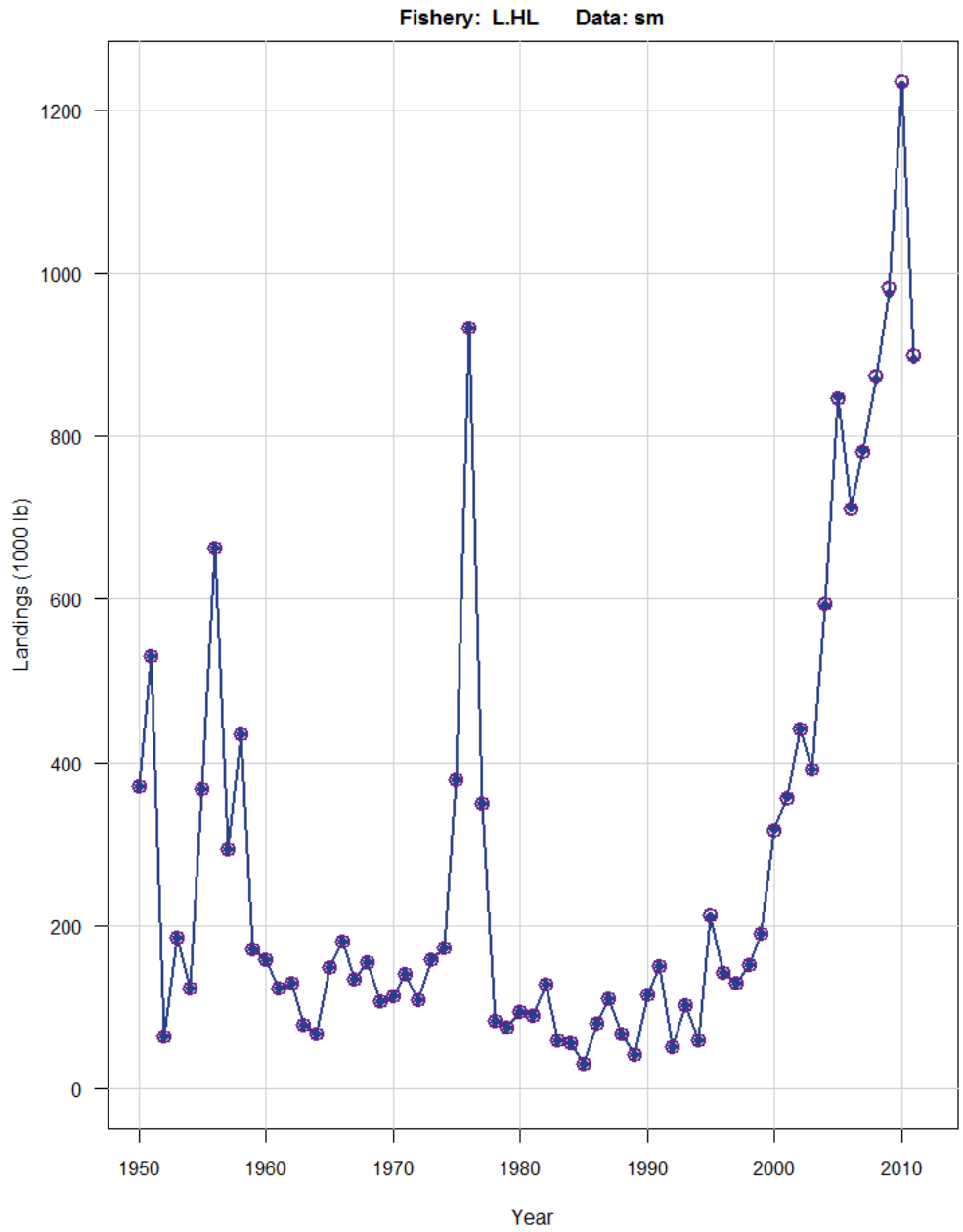
- Input data
  - Landings, indices, age compositions,
- Penalties
  - Selectivity parameters, normal priors with a CV = 0.25 for HL slope, both CN slopes, all parameters for the Recreational fishery and the two parameters from the descending limb of the PN
  - Normal priors with a CV = 0.15 for the two parameters from the ascending limb of the PN selectivity and the slope of the GN selectivity.

Iterative re-weighting

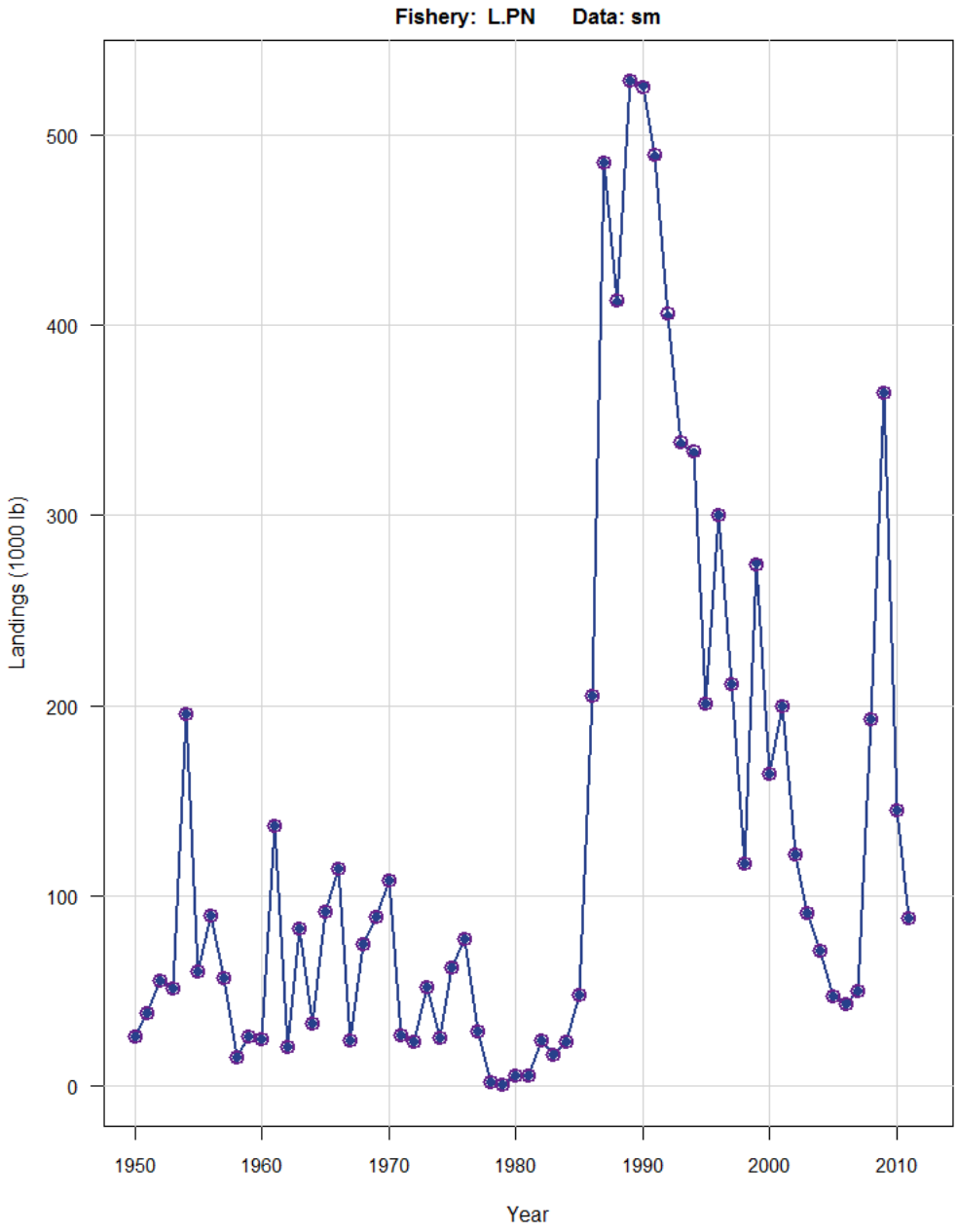
- Same methodology as cobia
  - Age composition data downweighted relative to the indices.

BAM Model Fits

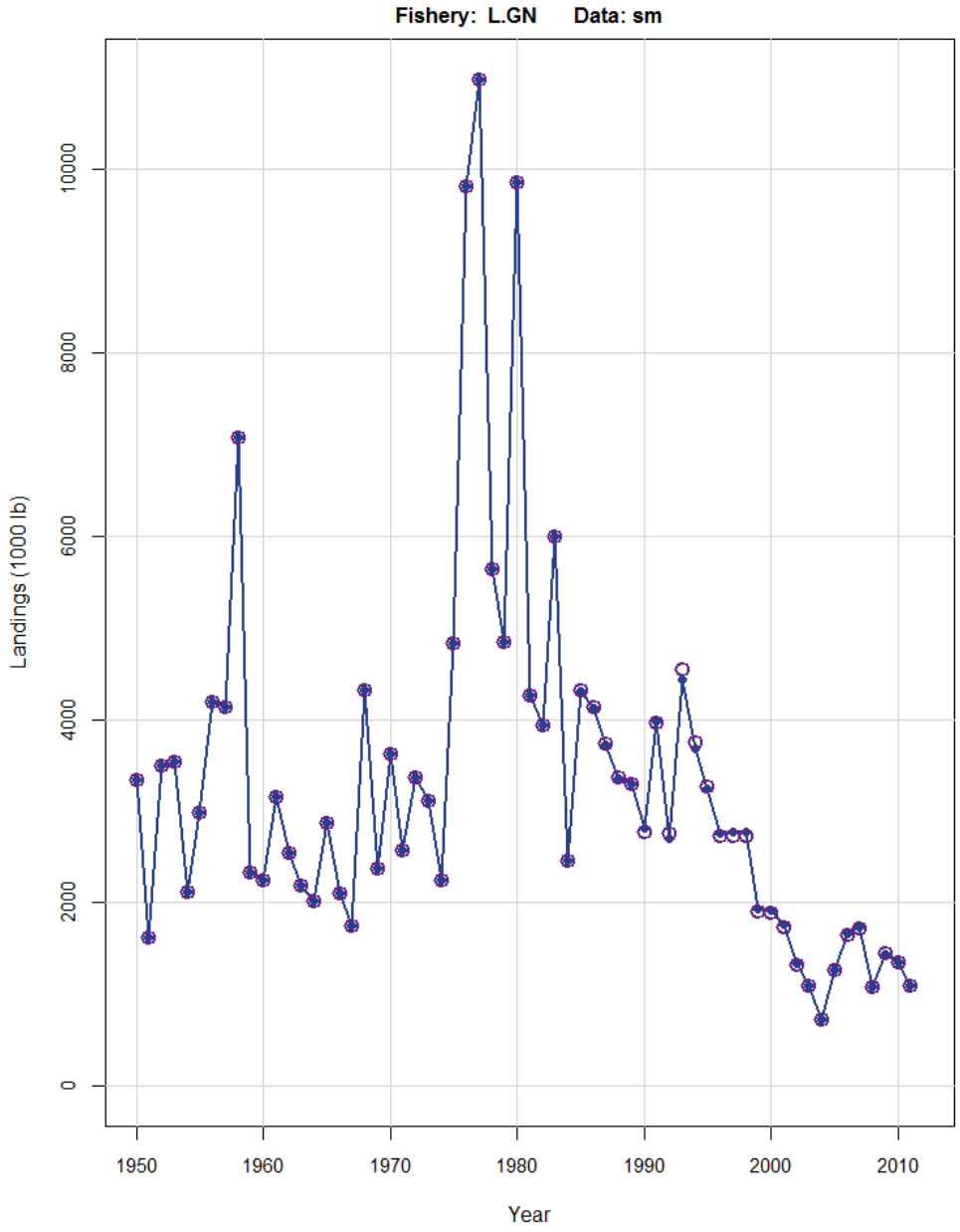
BAM model fit: Handline landings



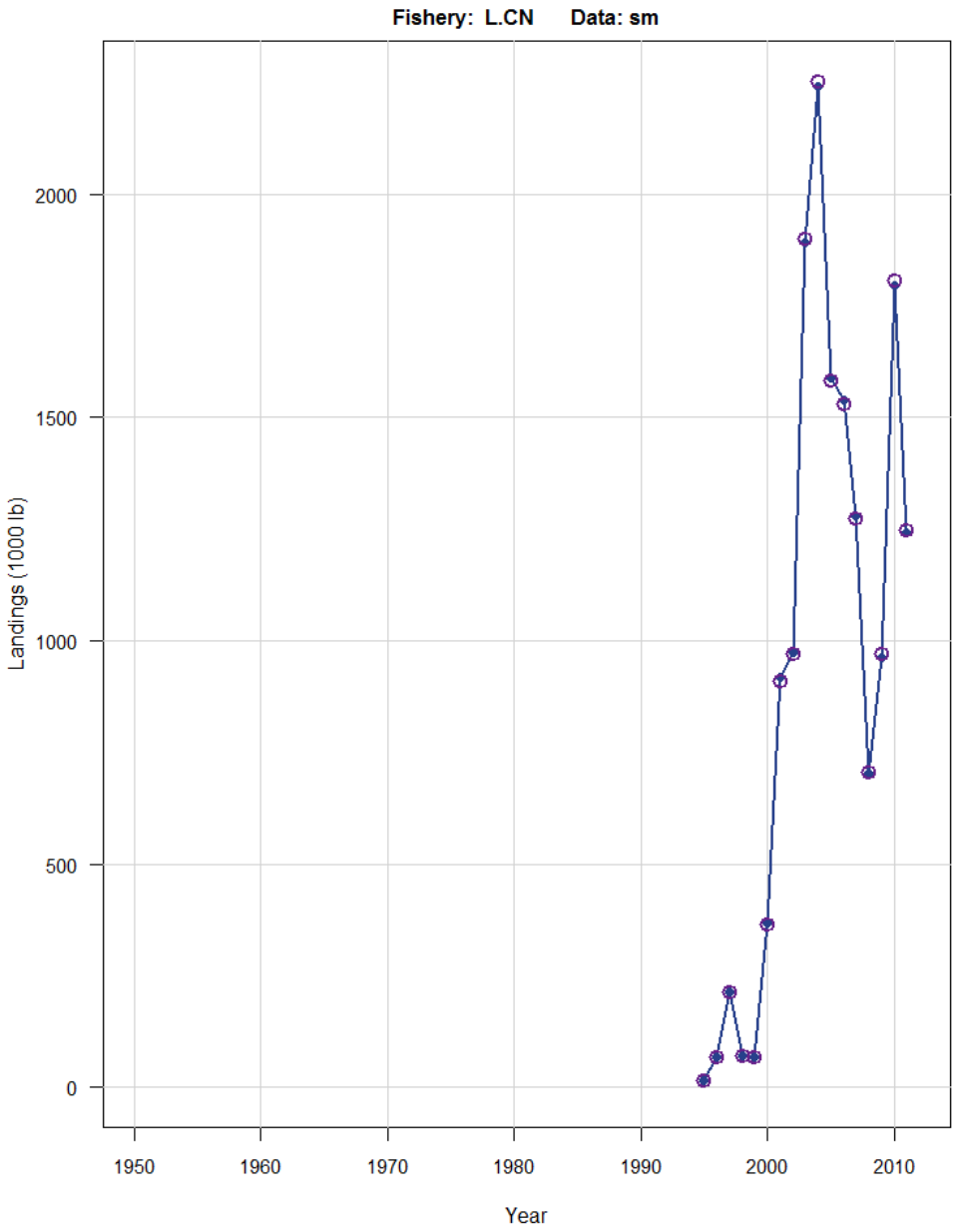
BAM model fit: Poundnet landings



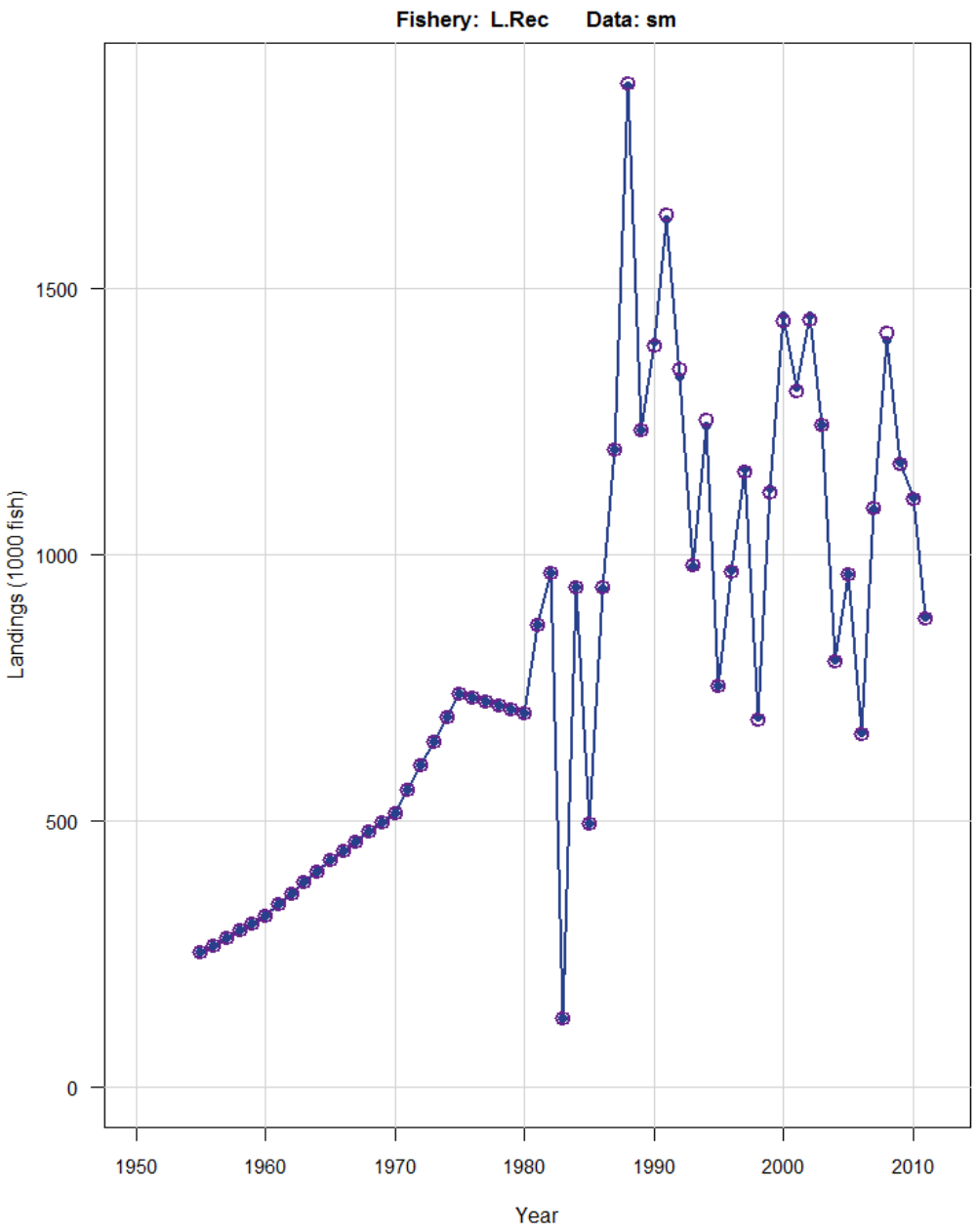
BAM model fit: Gill net landings



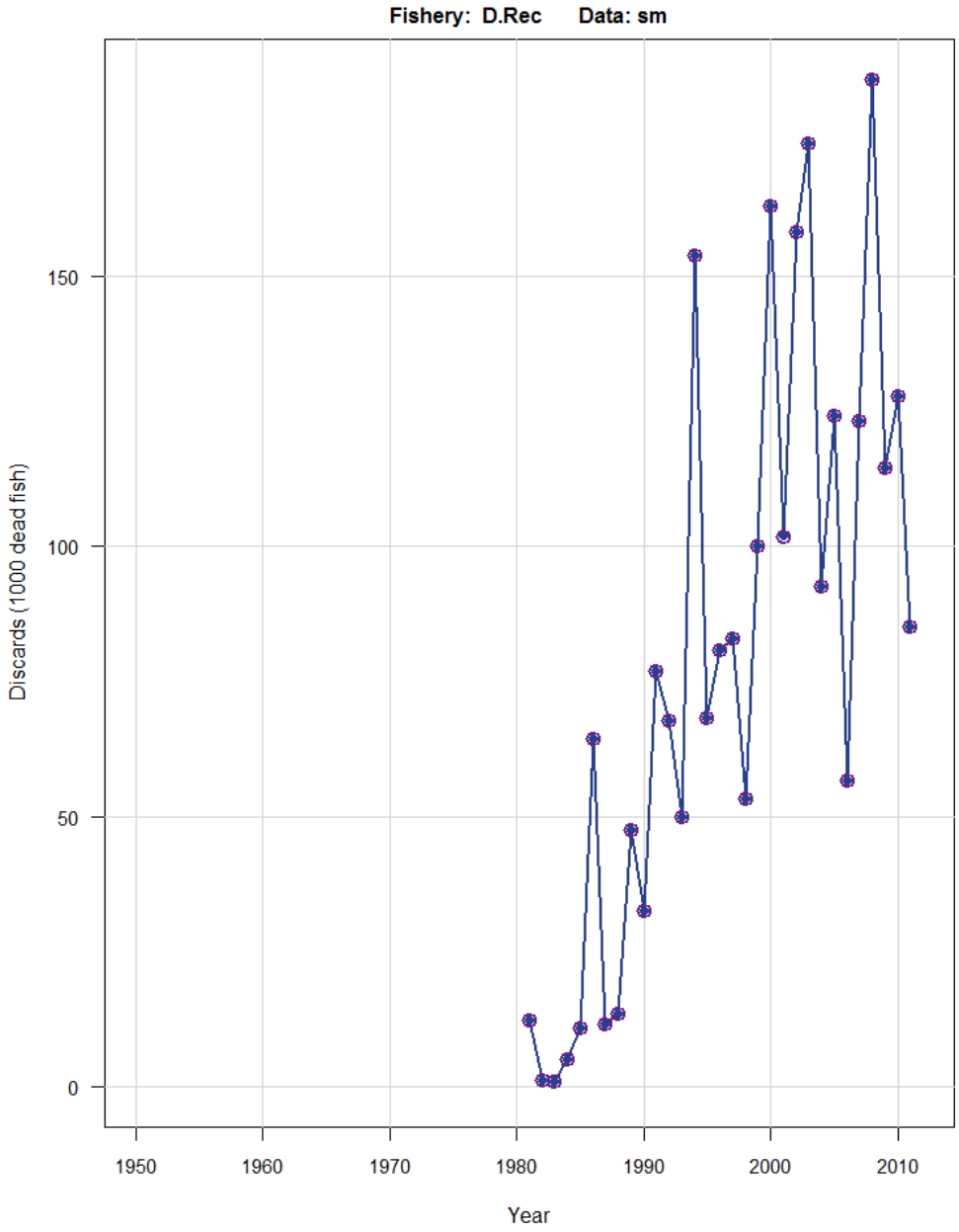
BAM model fit: Castnet landings



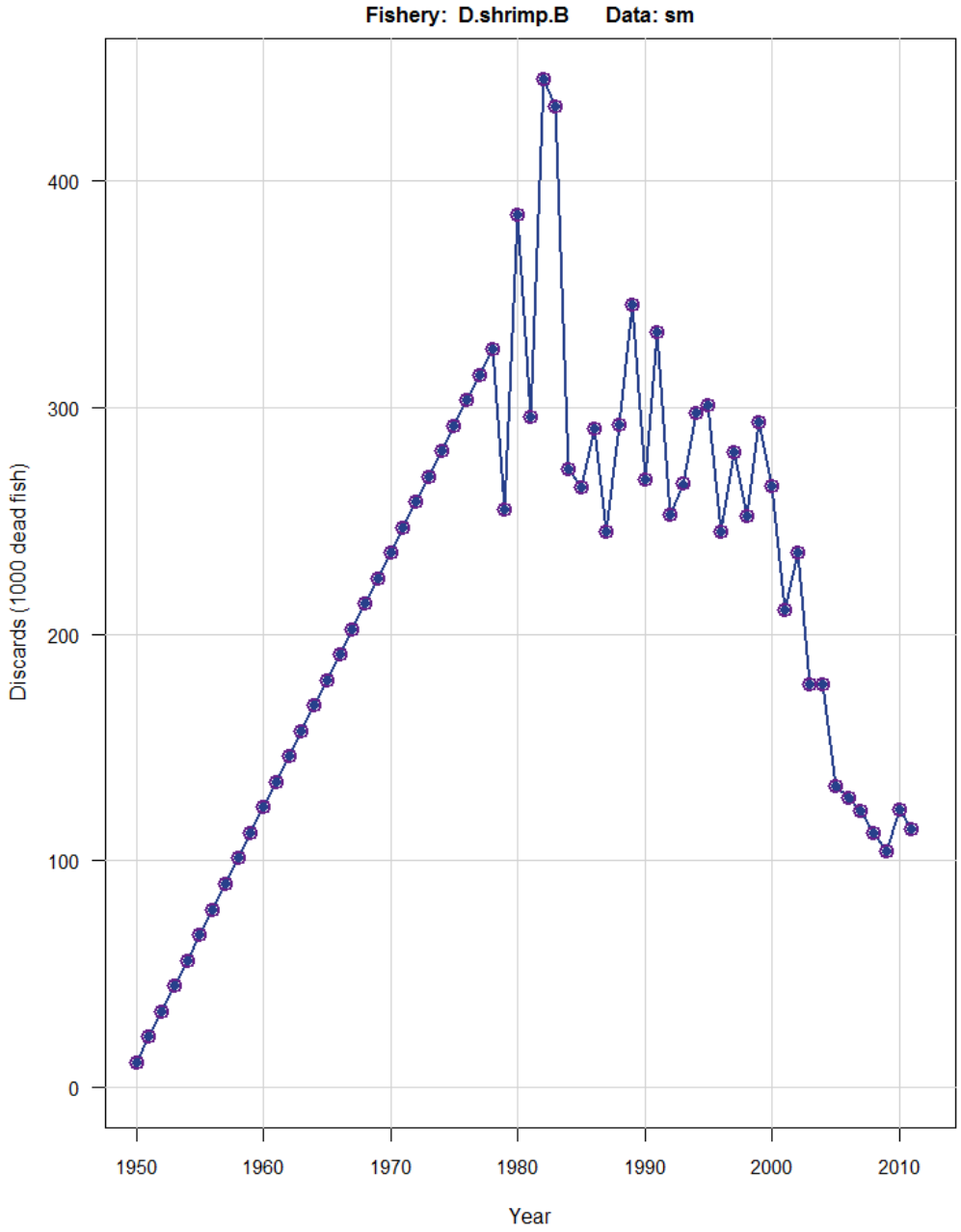
BAM model fit: Recreational landings



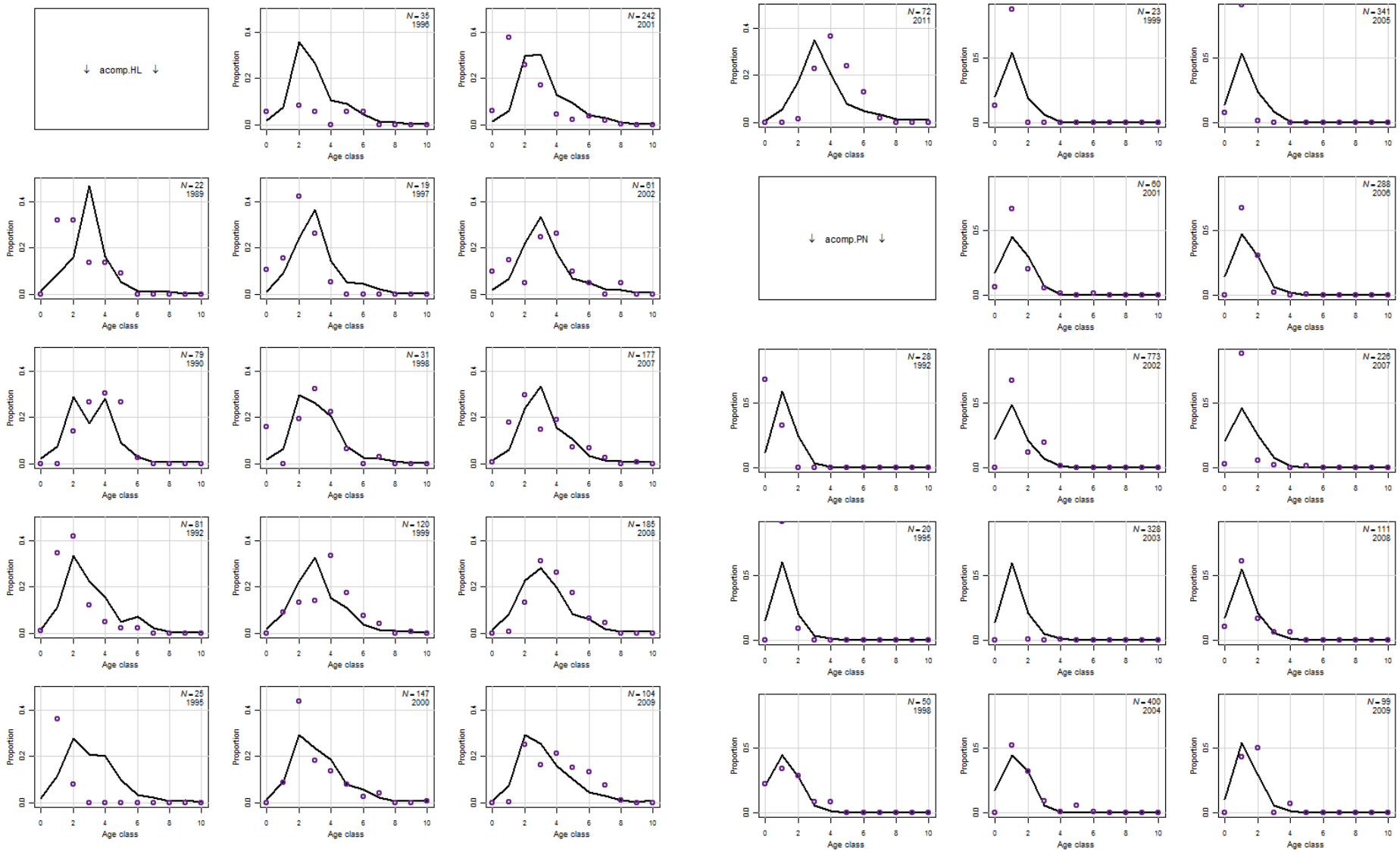
BAM model fit: Recreational discards



BAM model fit: Shrimp bycatch



BAM model fit: age comps



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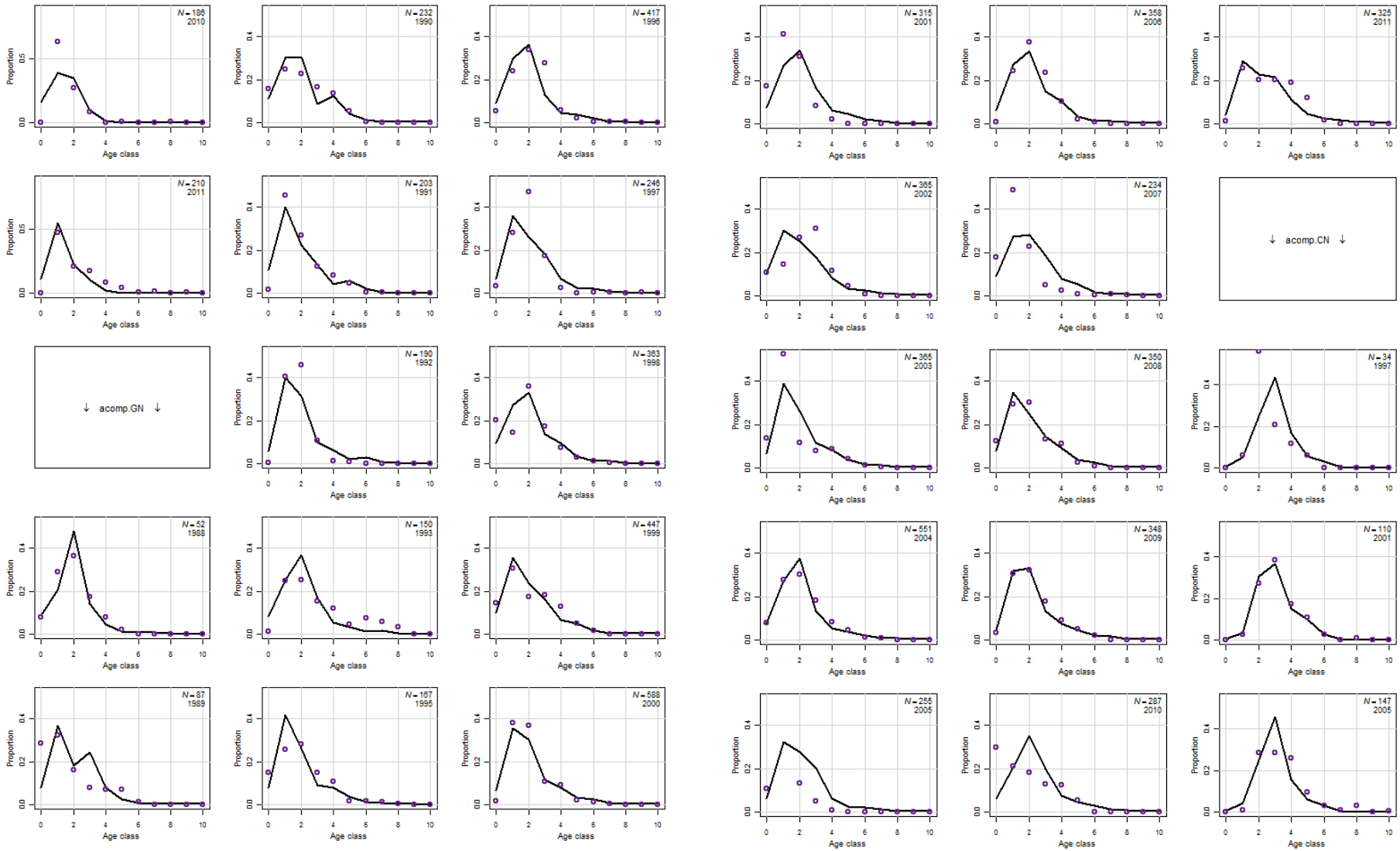

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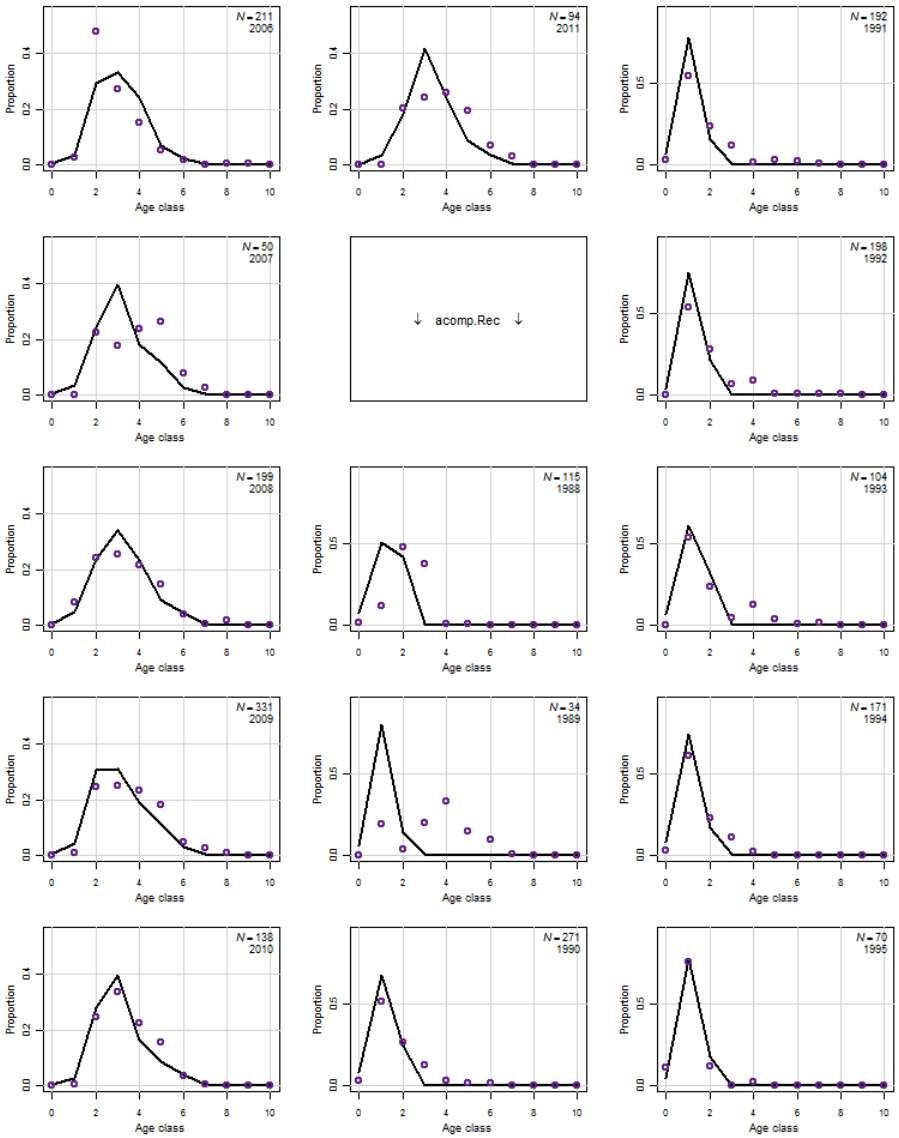

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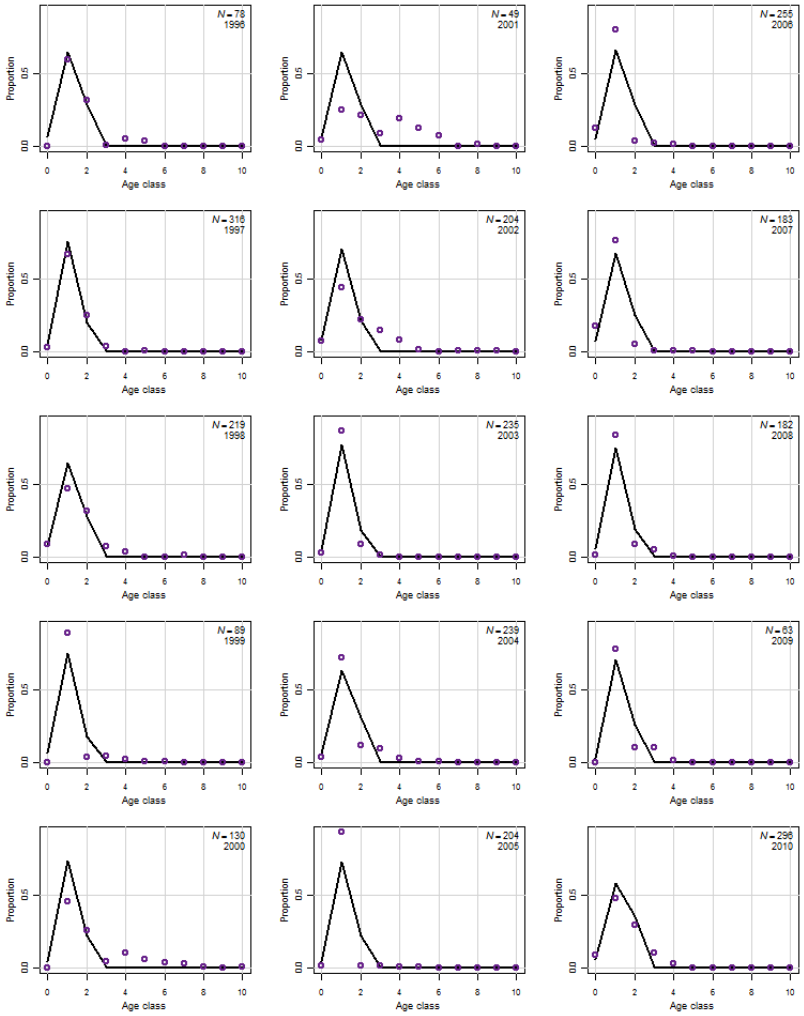

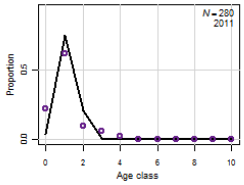

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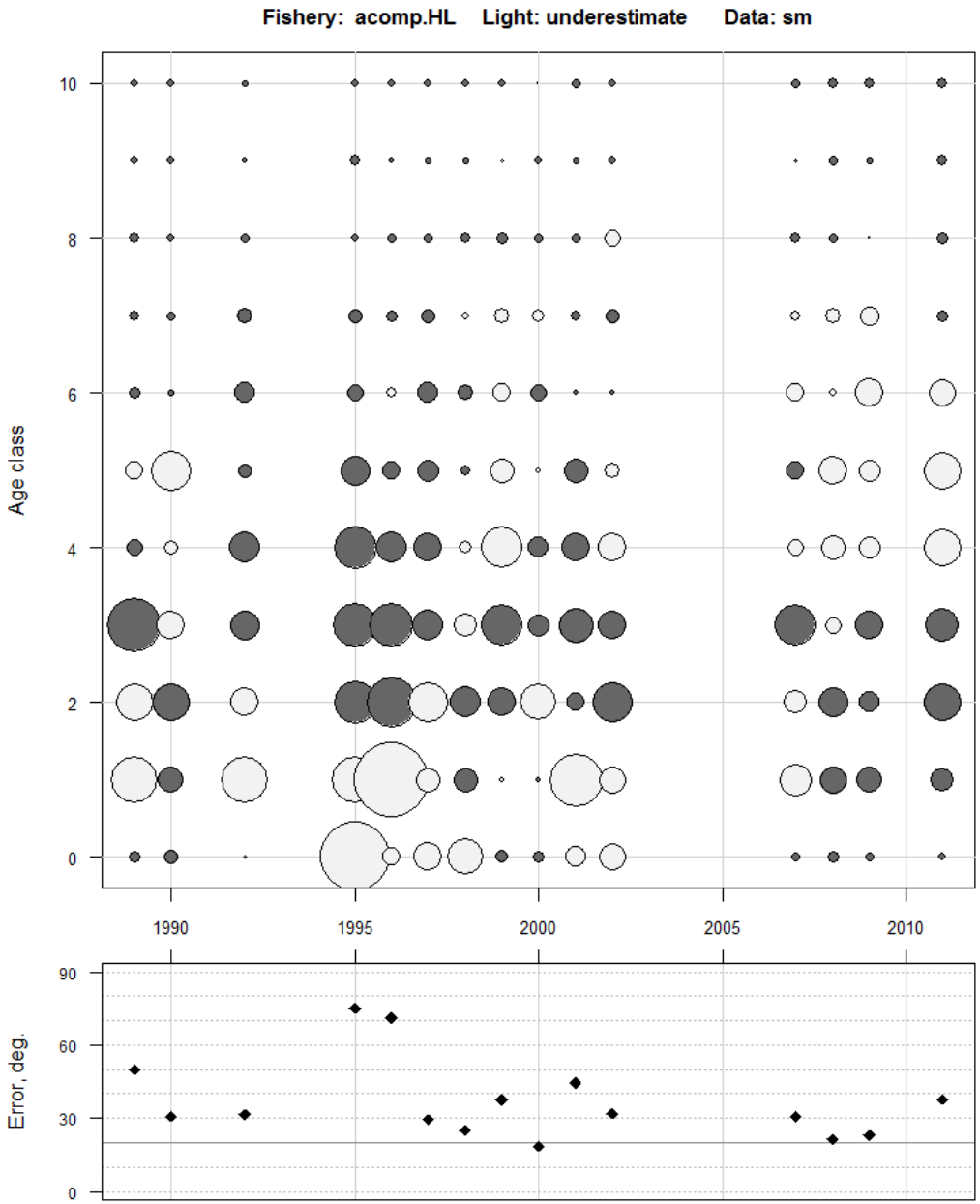

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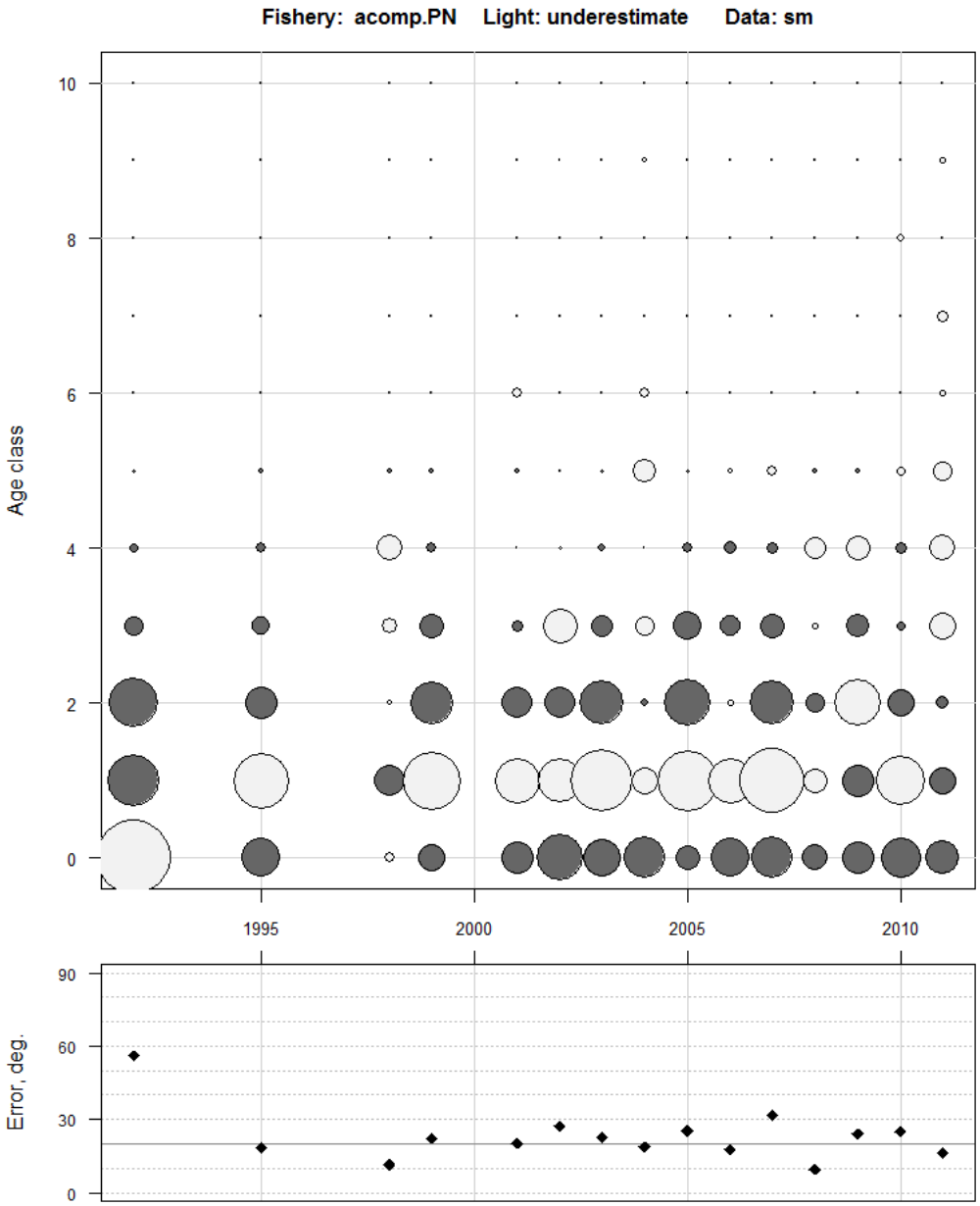
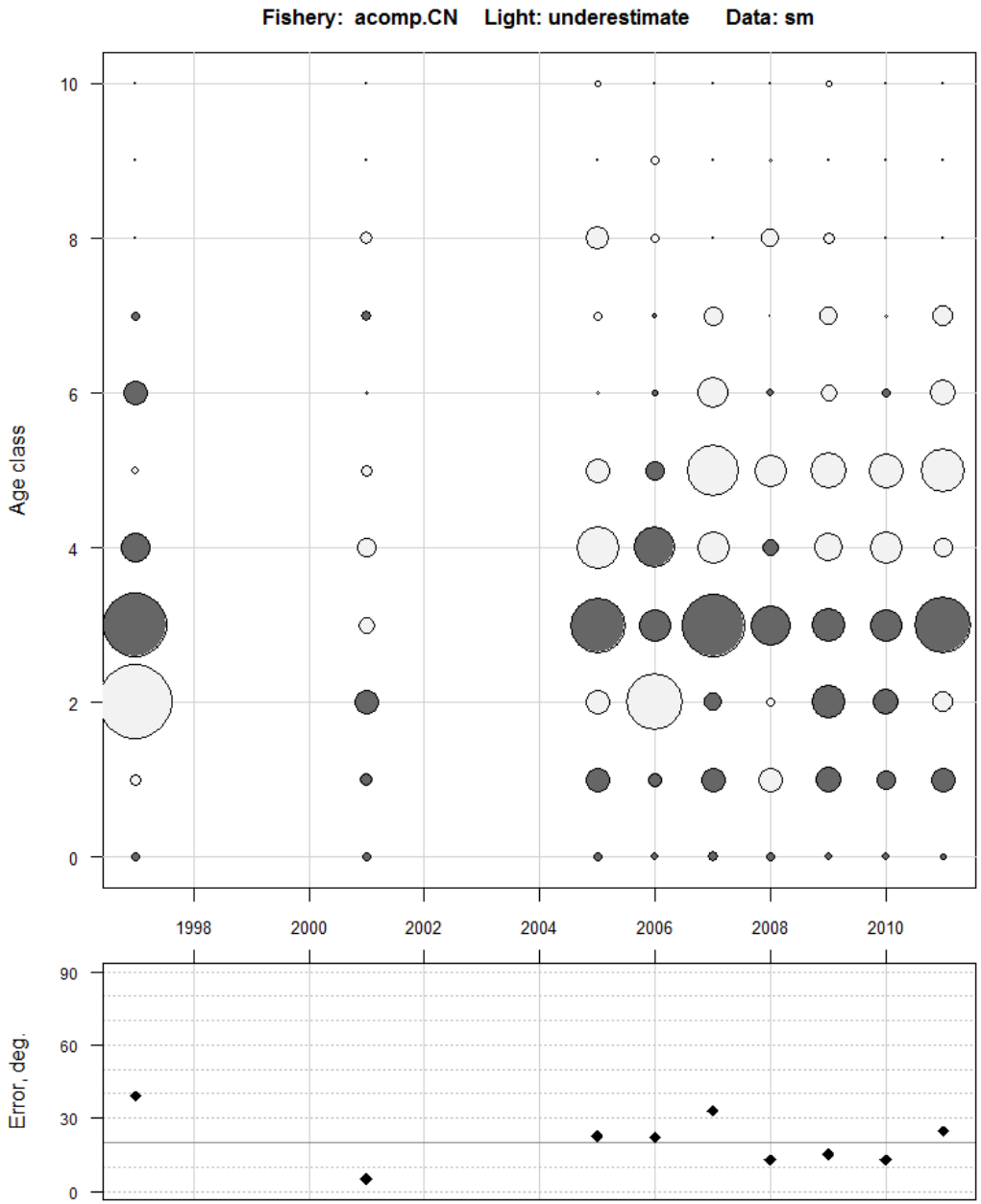


BAM model fit: age comps



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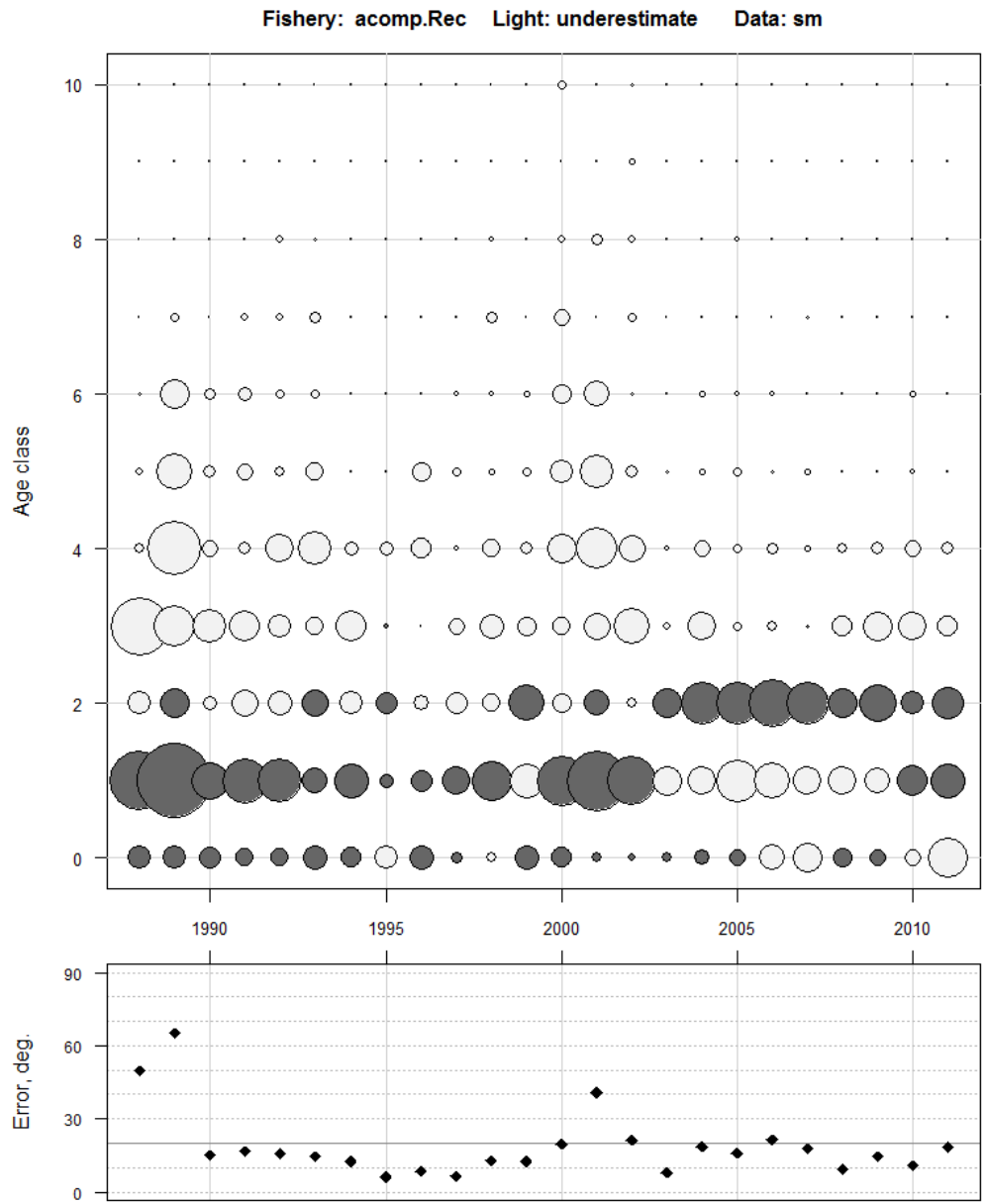
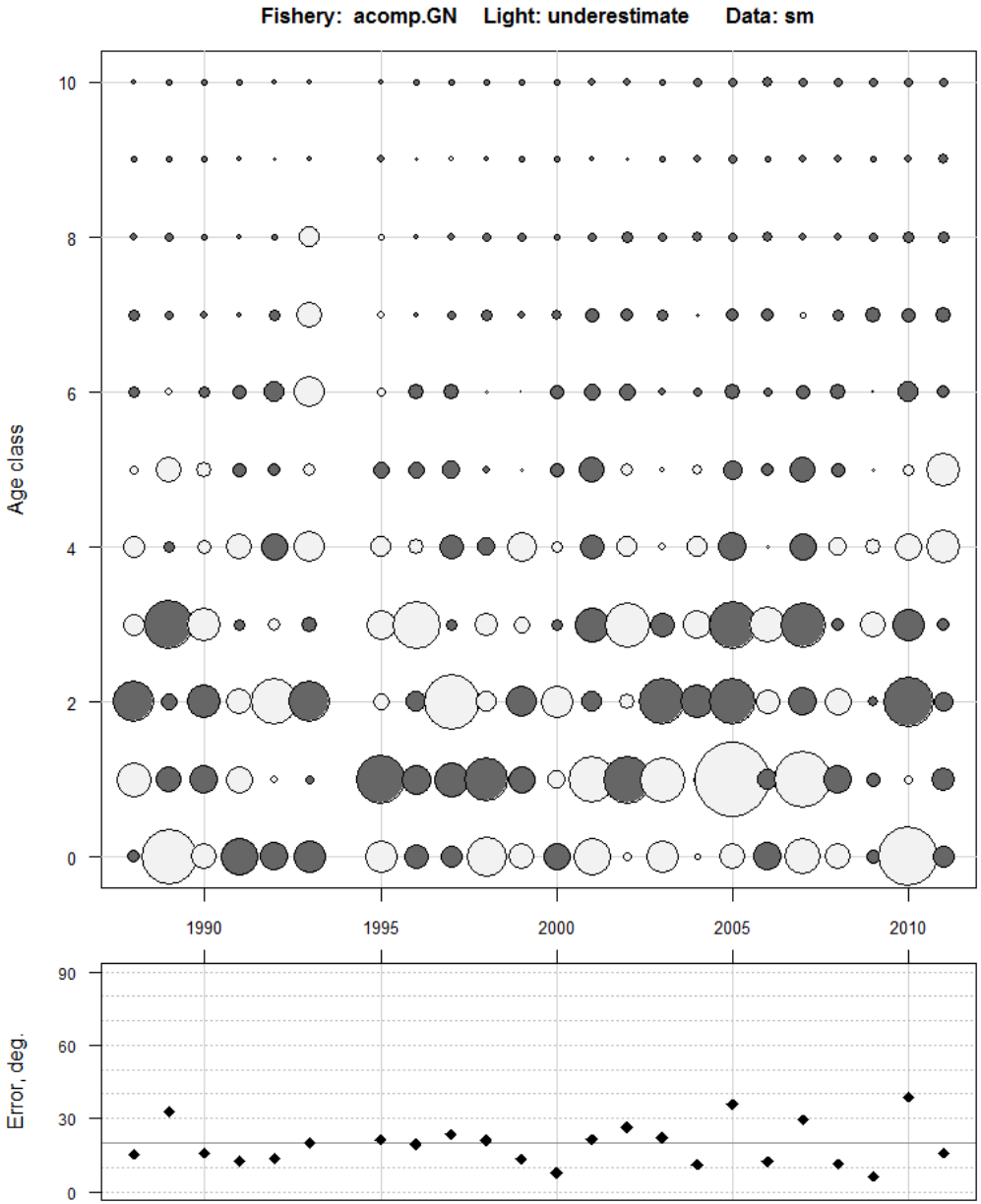
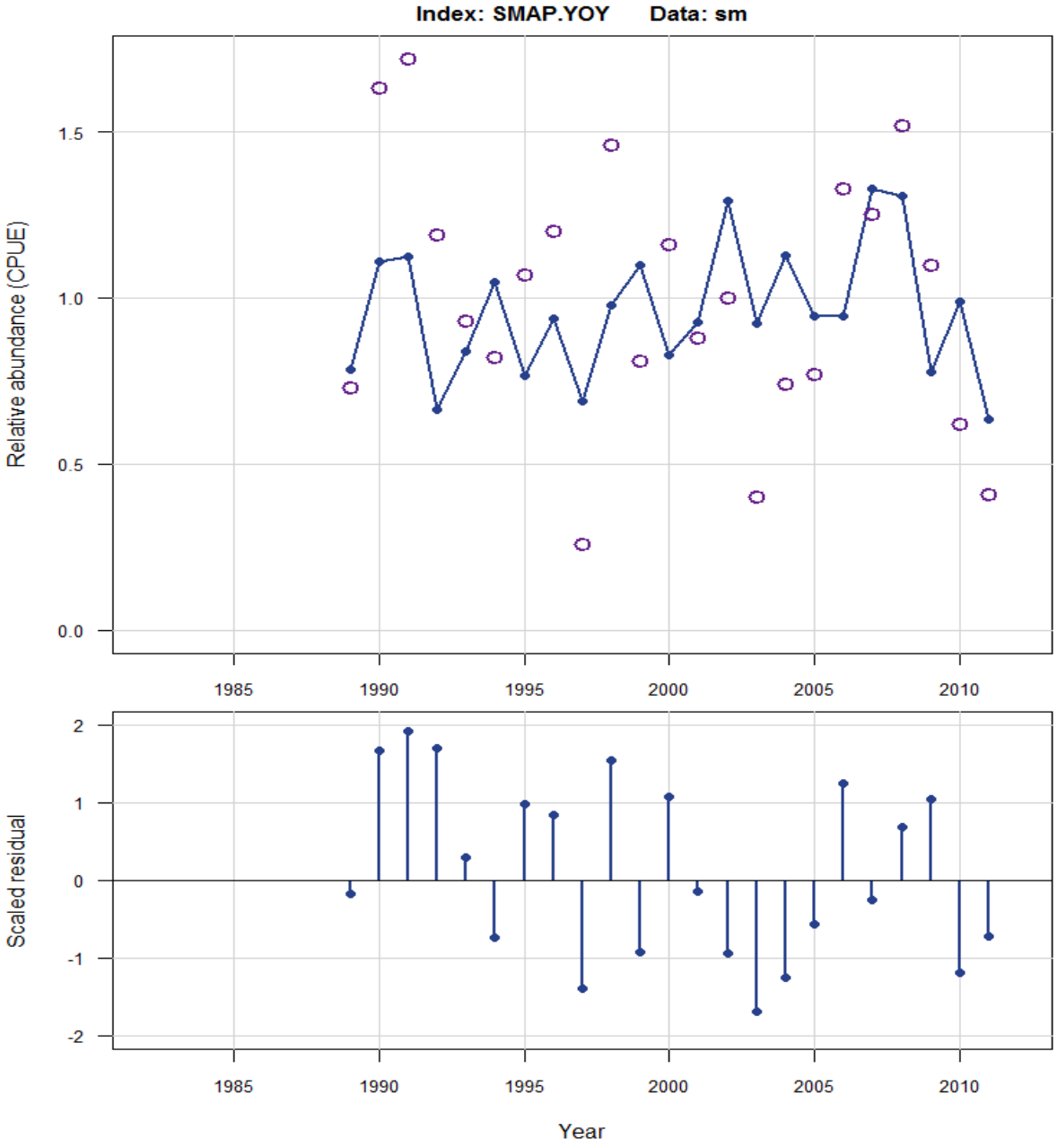


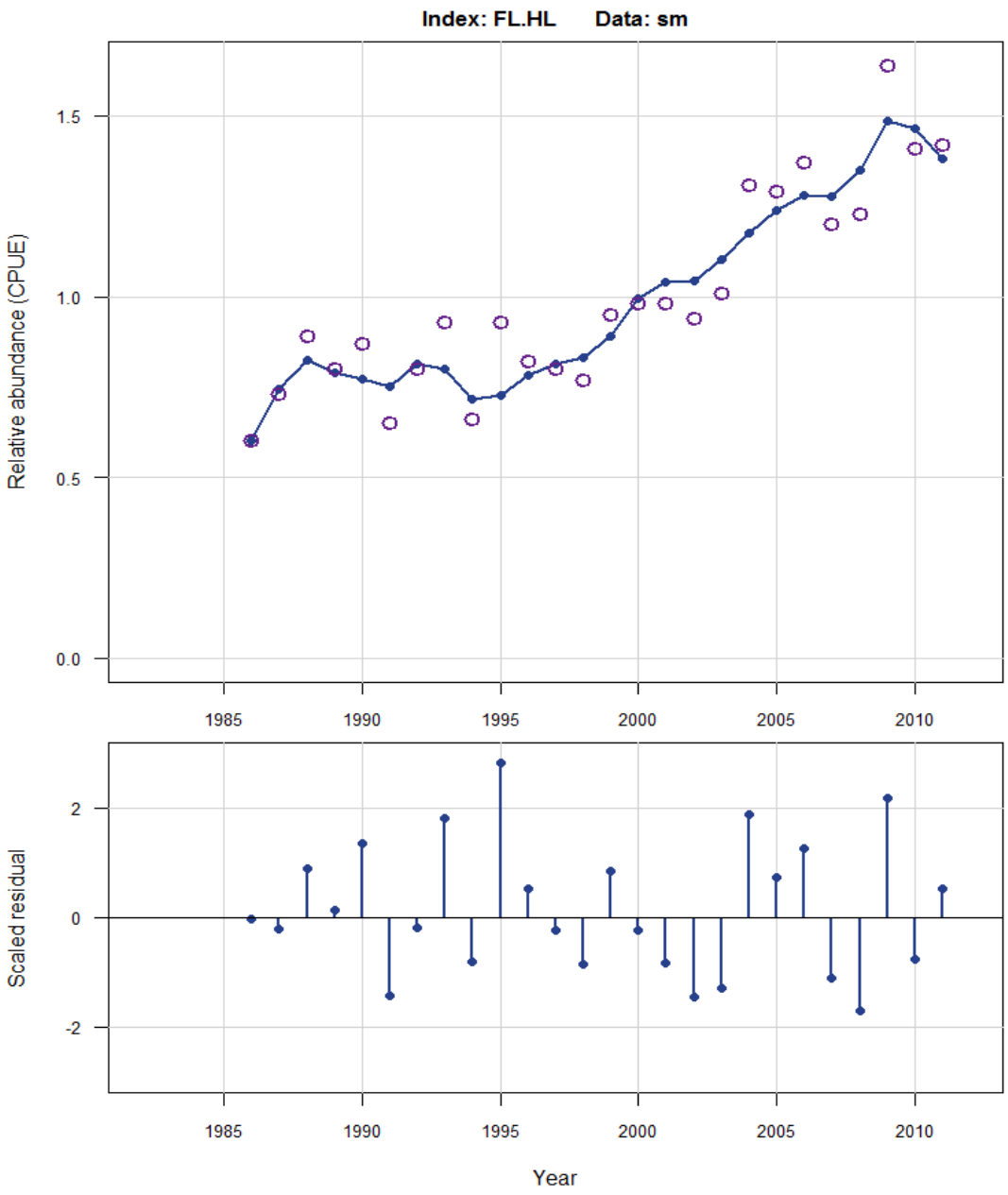
BAM model fit: age comps



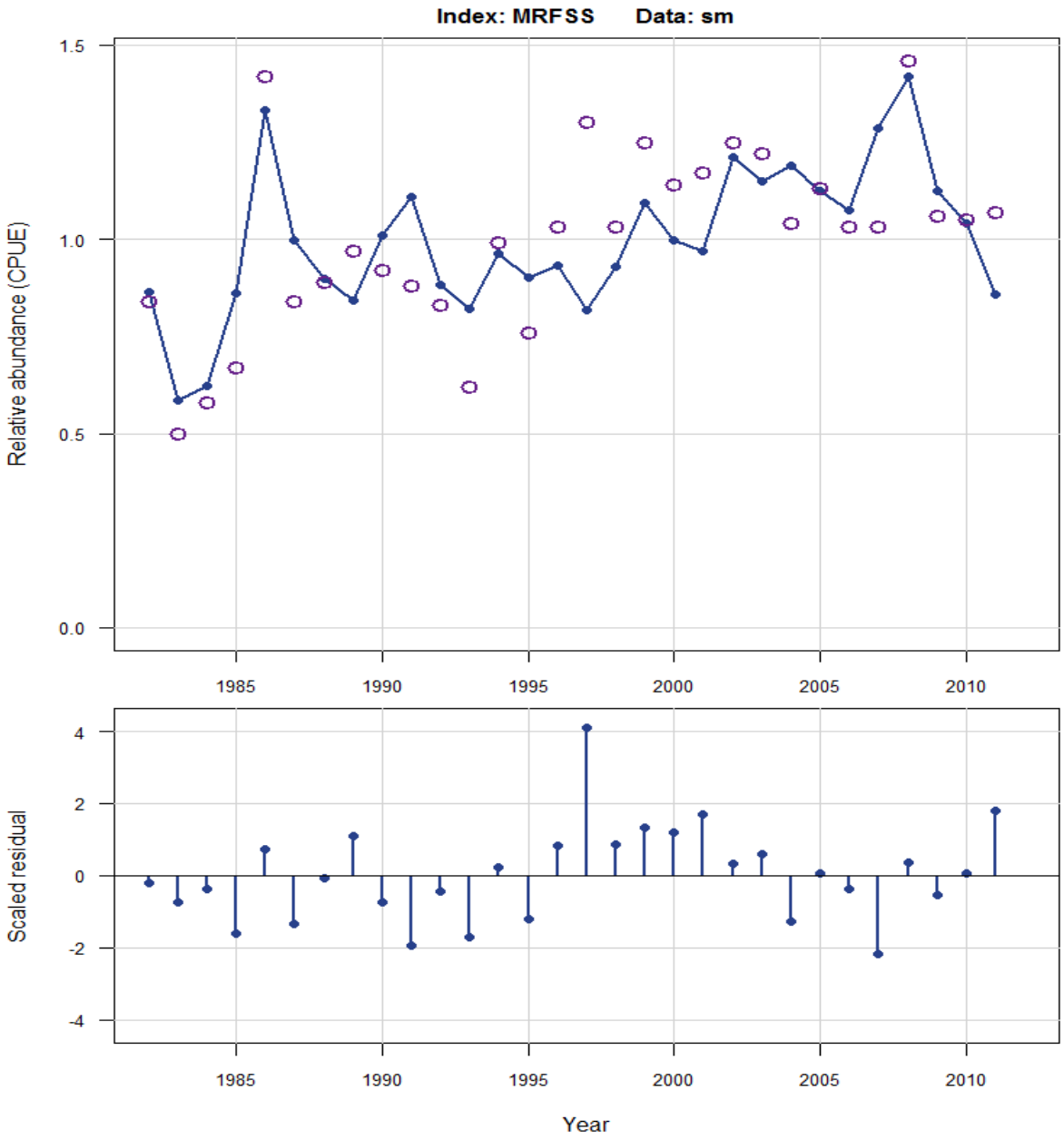
BAM model fit: SEAMAP Index



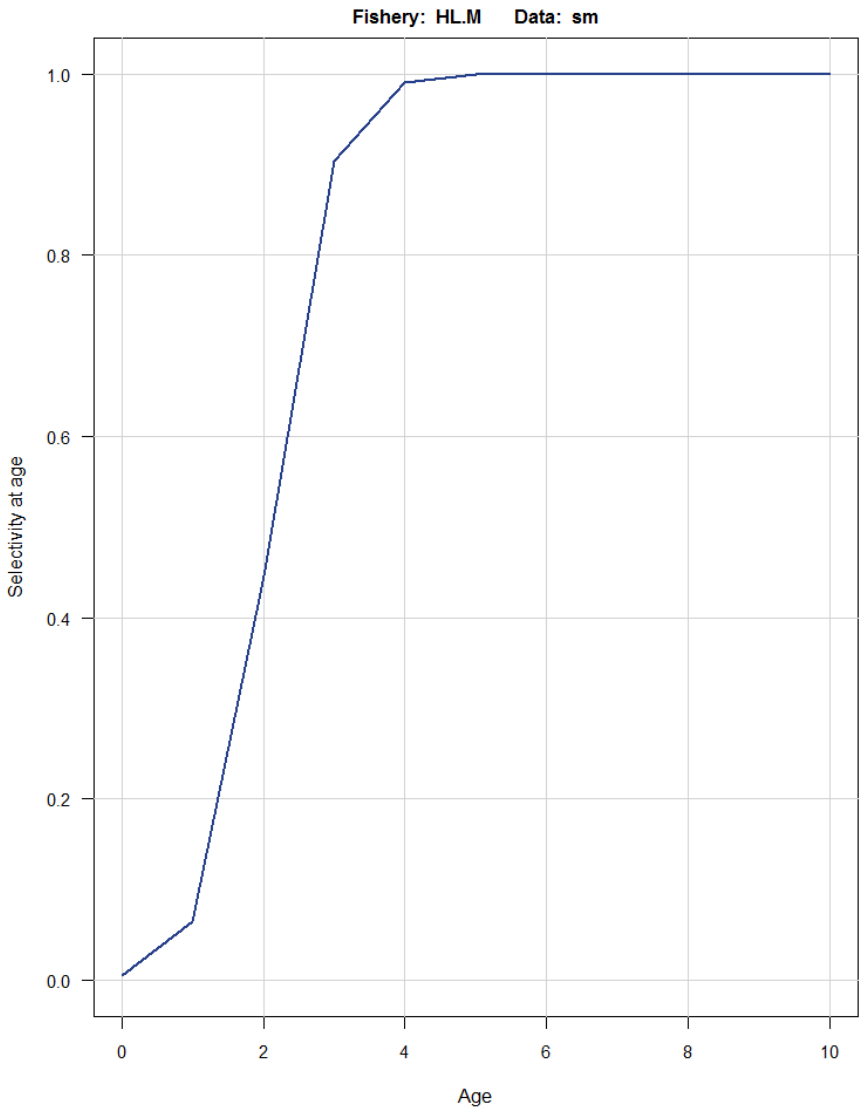
BAM model fit: FL Handline index

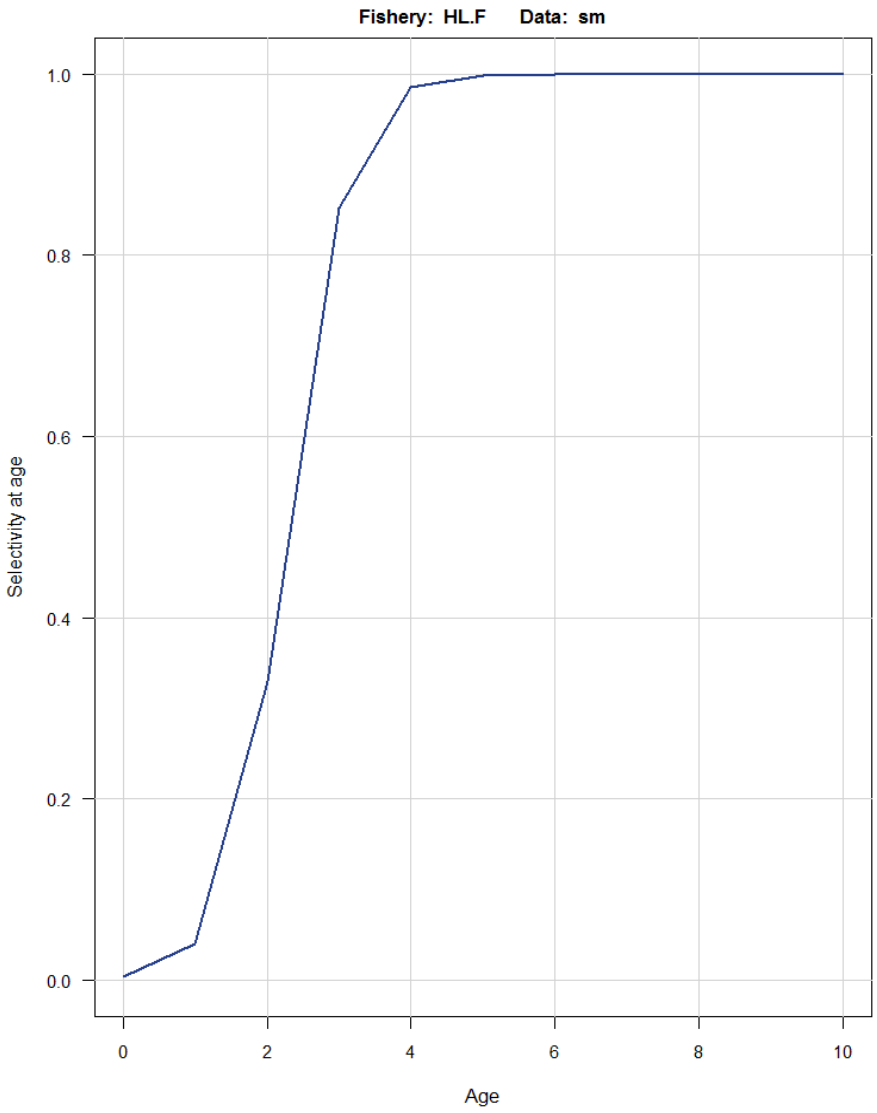


BAM model fit: MRFSS index

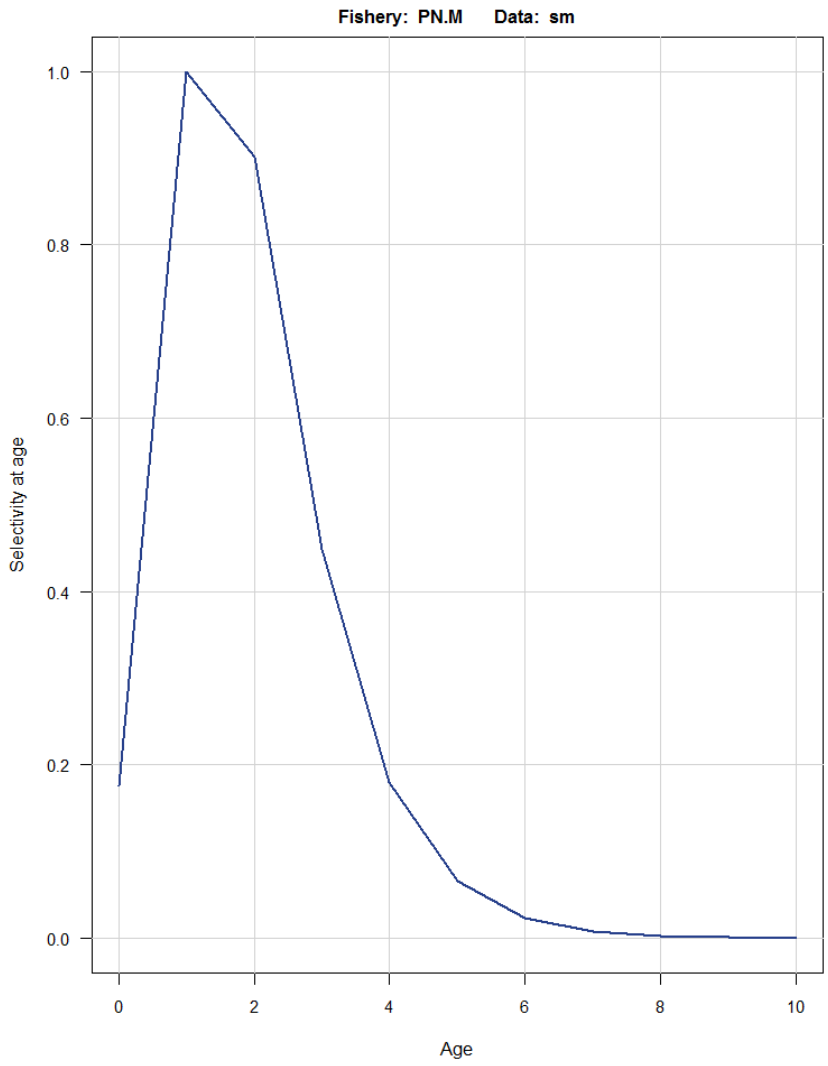


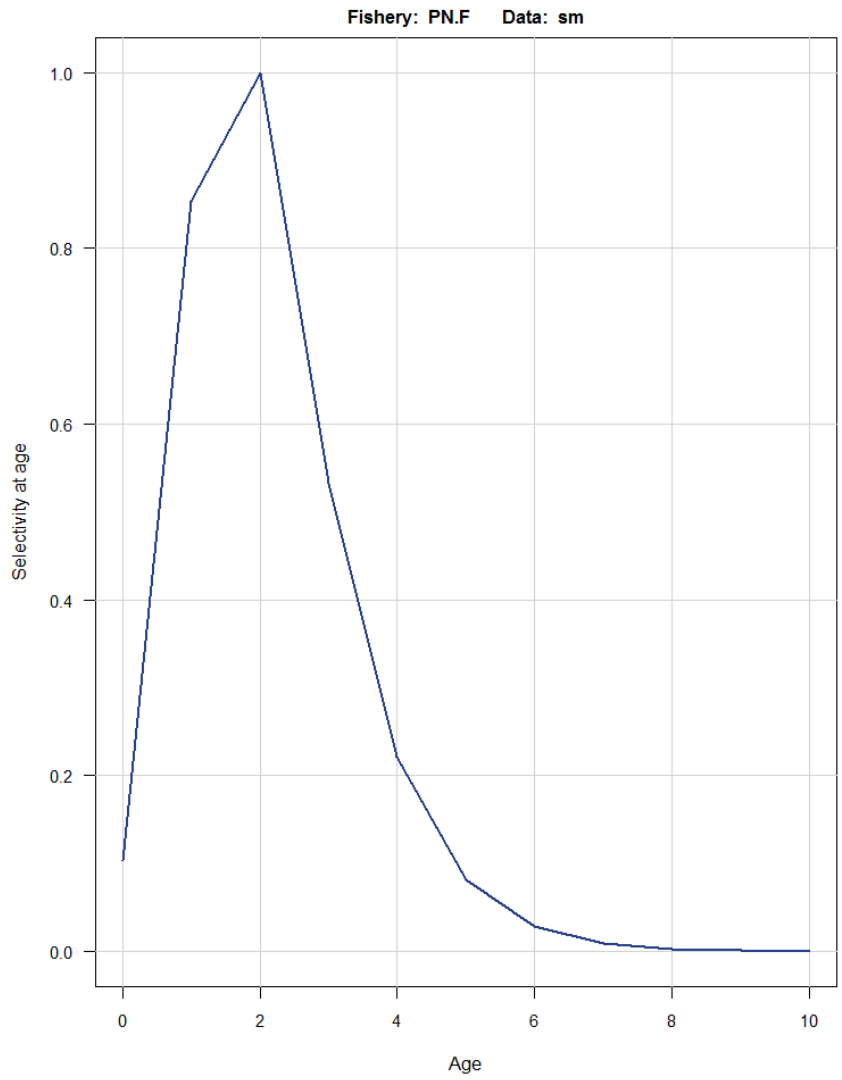
BAM model fit: HL selectivity



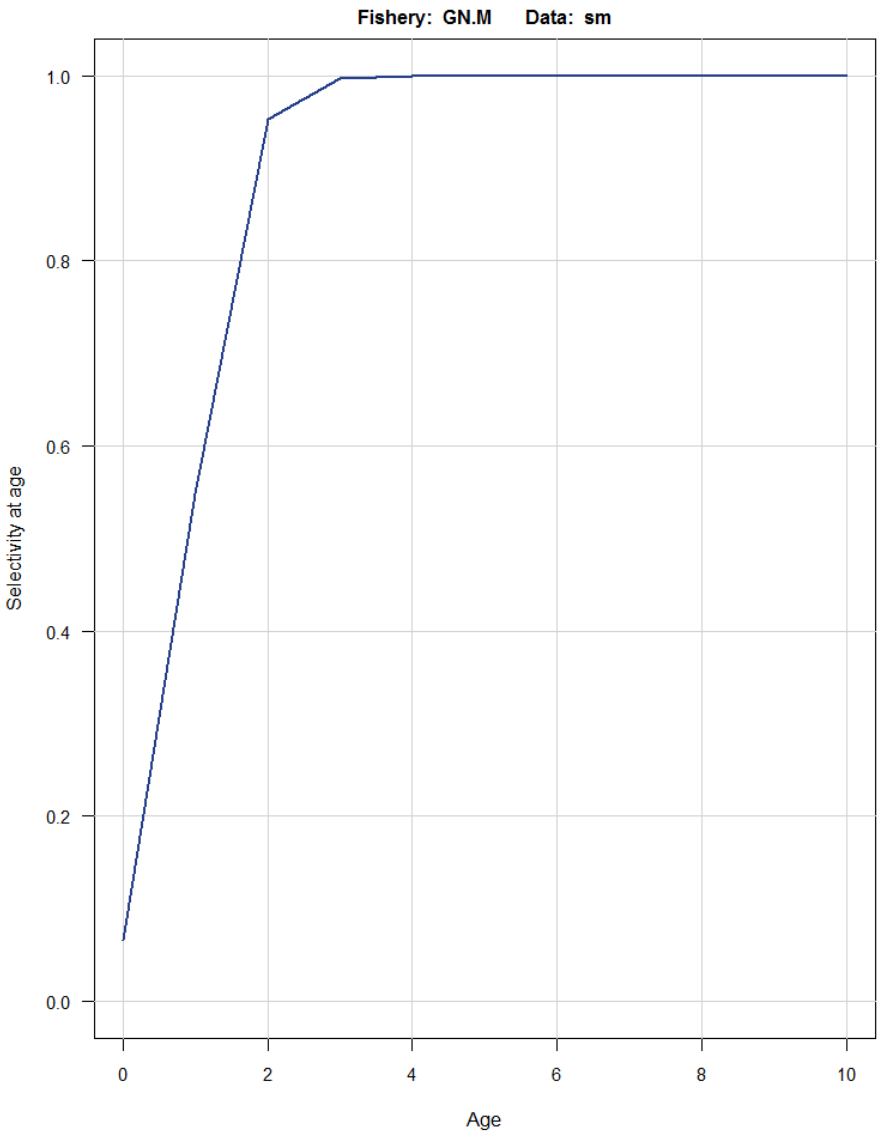


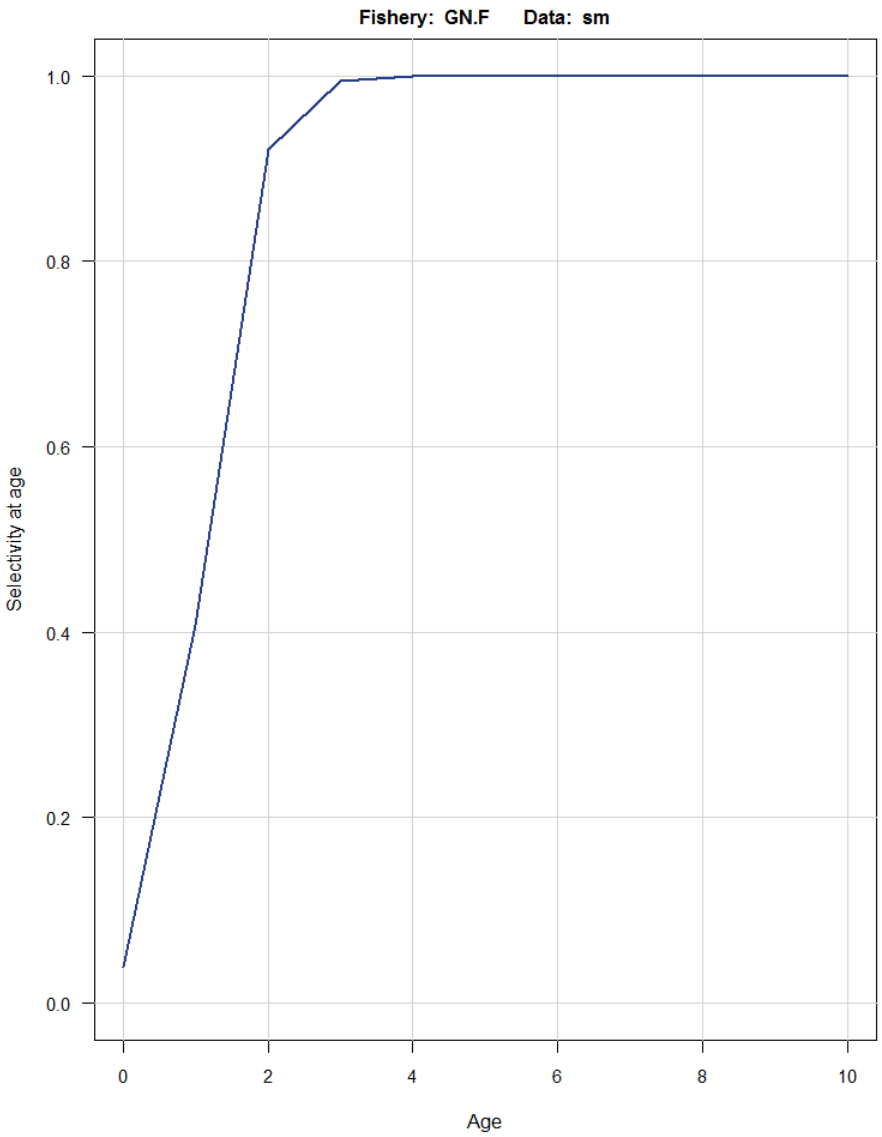
BAM model fit: PN selectivity



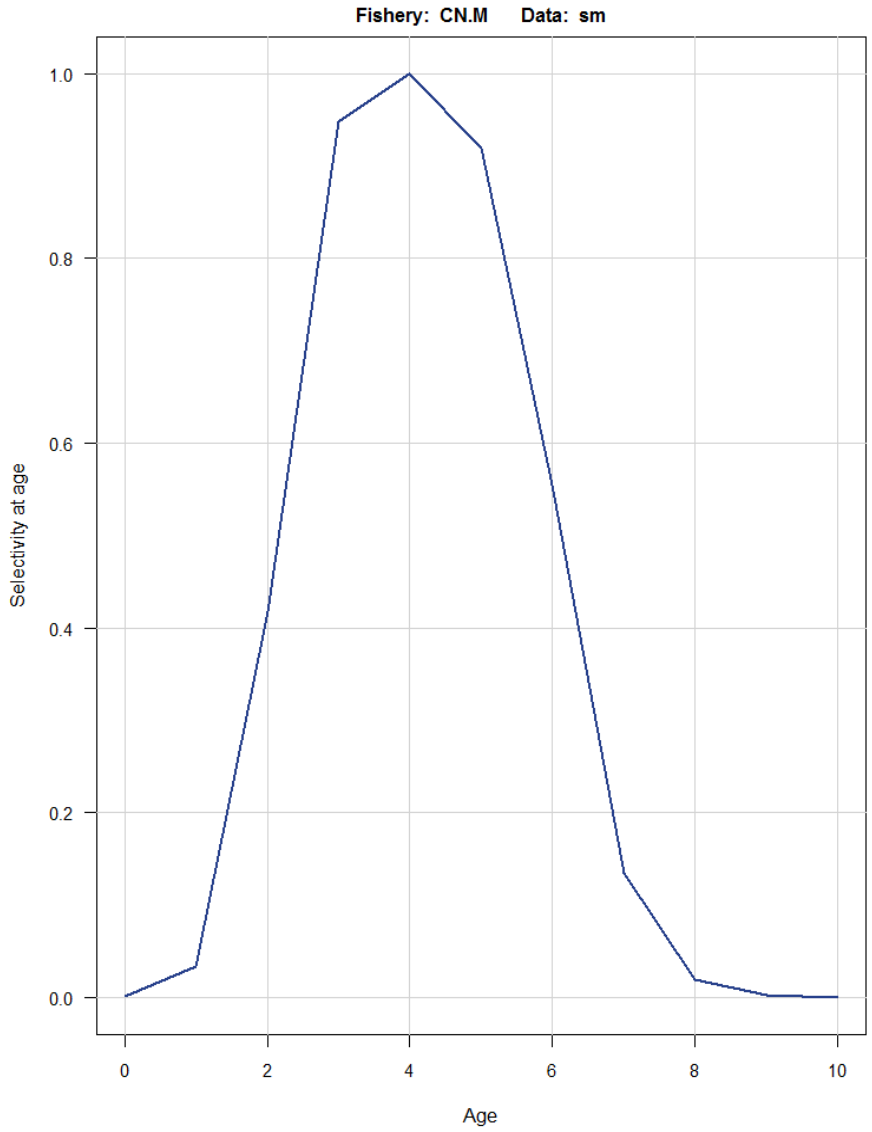


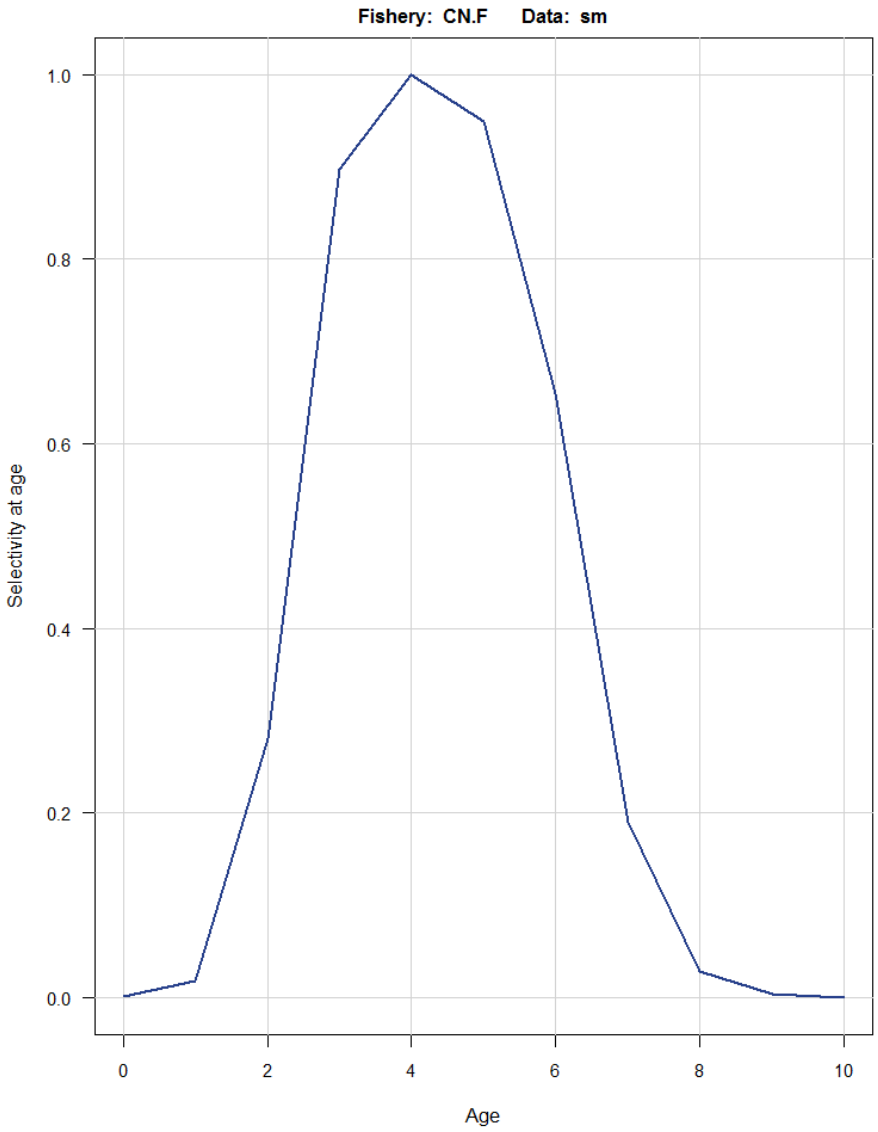
BAM model fit: GN selectivity



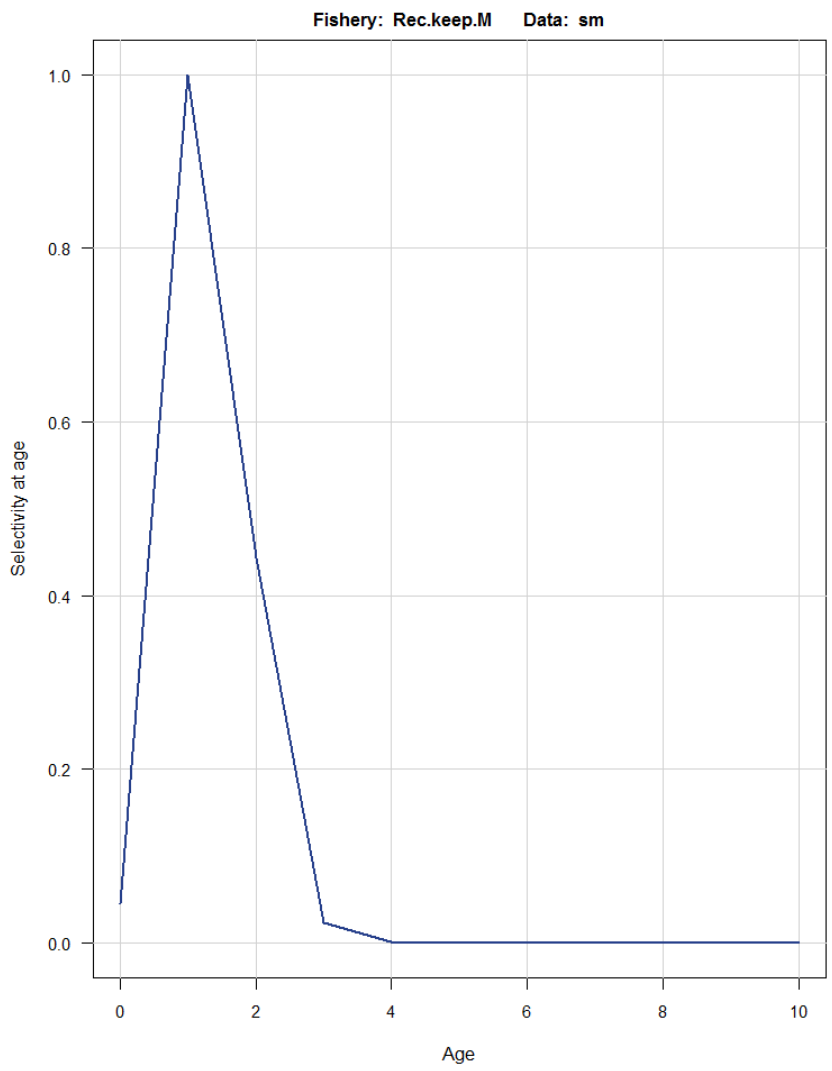


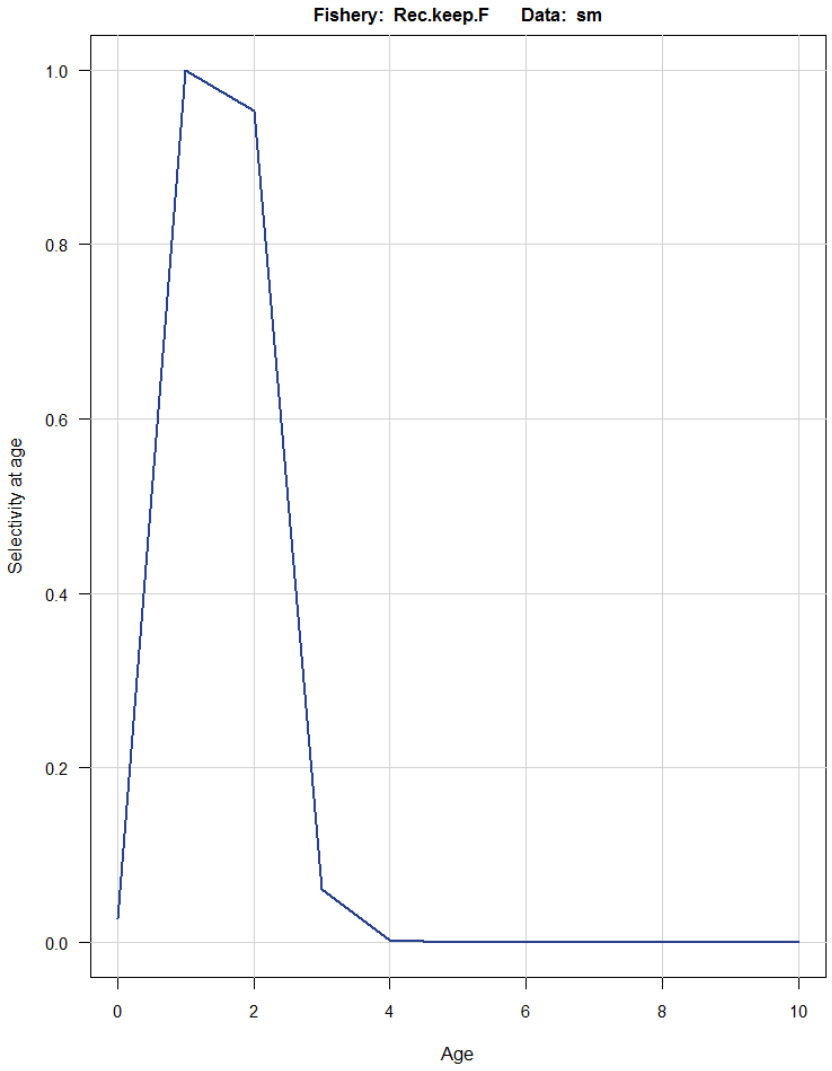
BAM model fit: CN selectivity

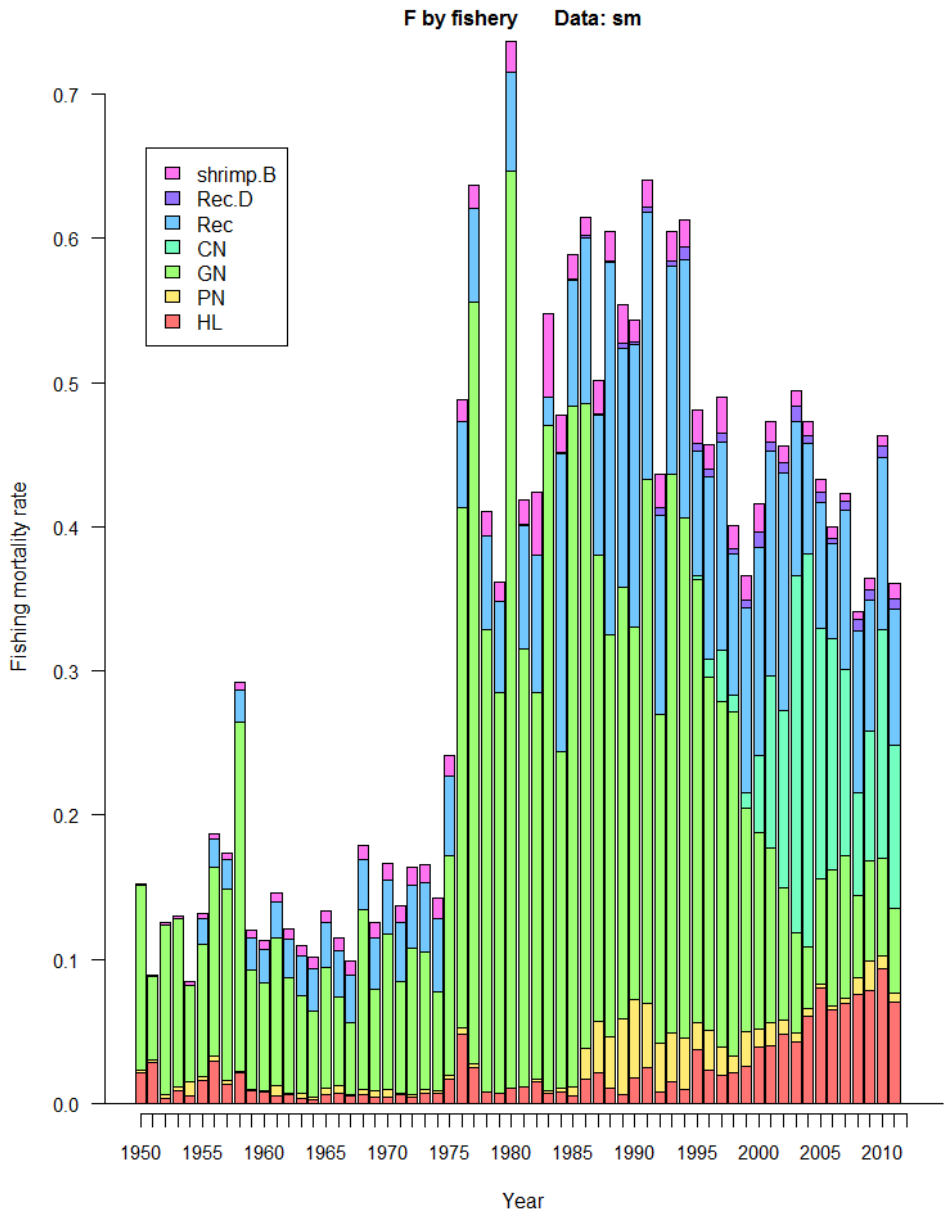




BAM model fit: Rec selectivity

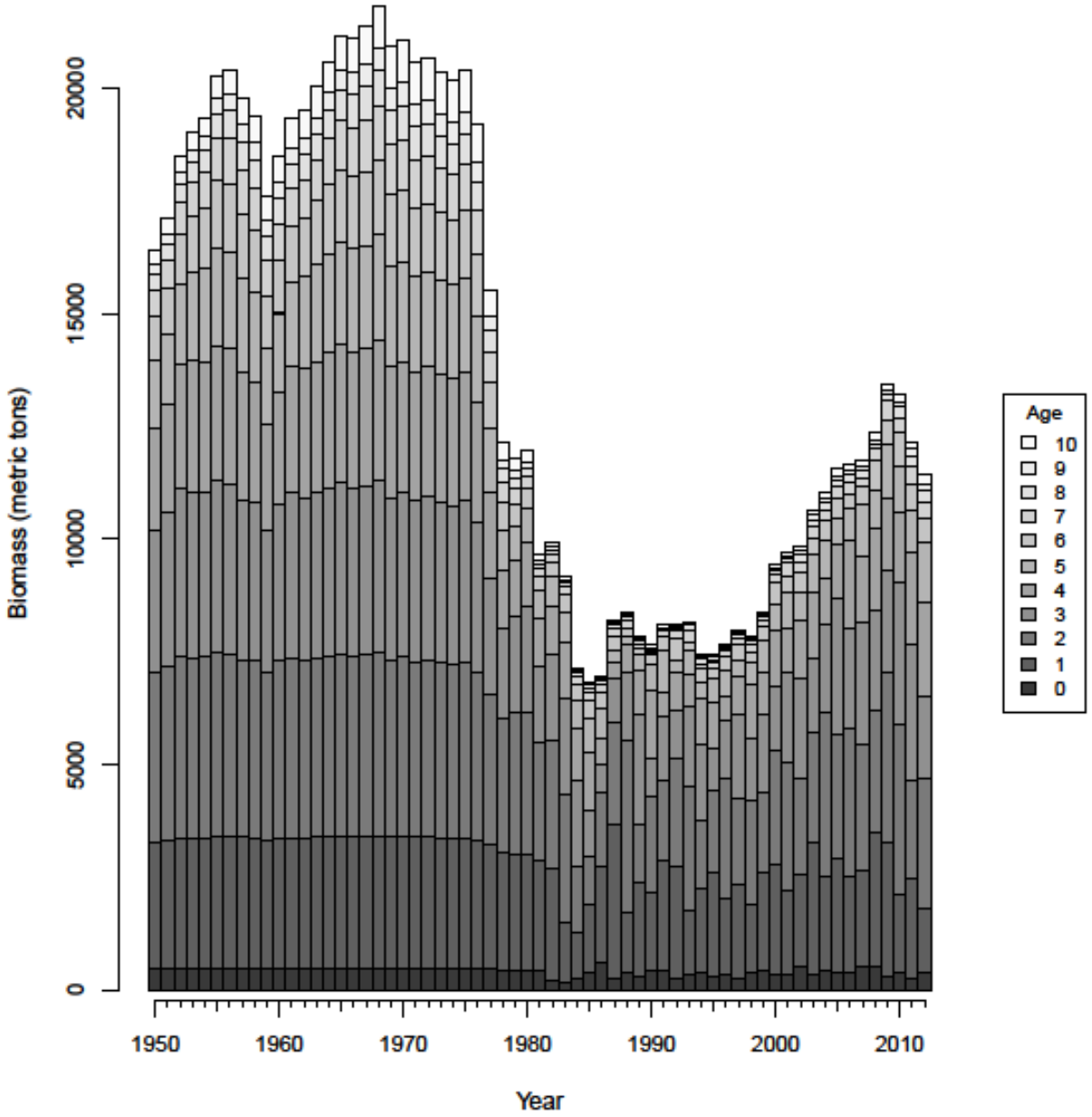




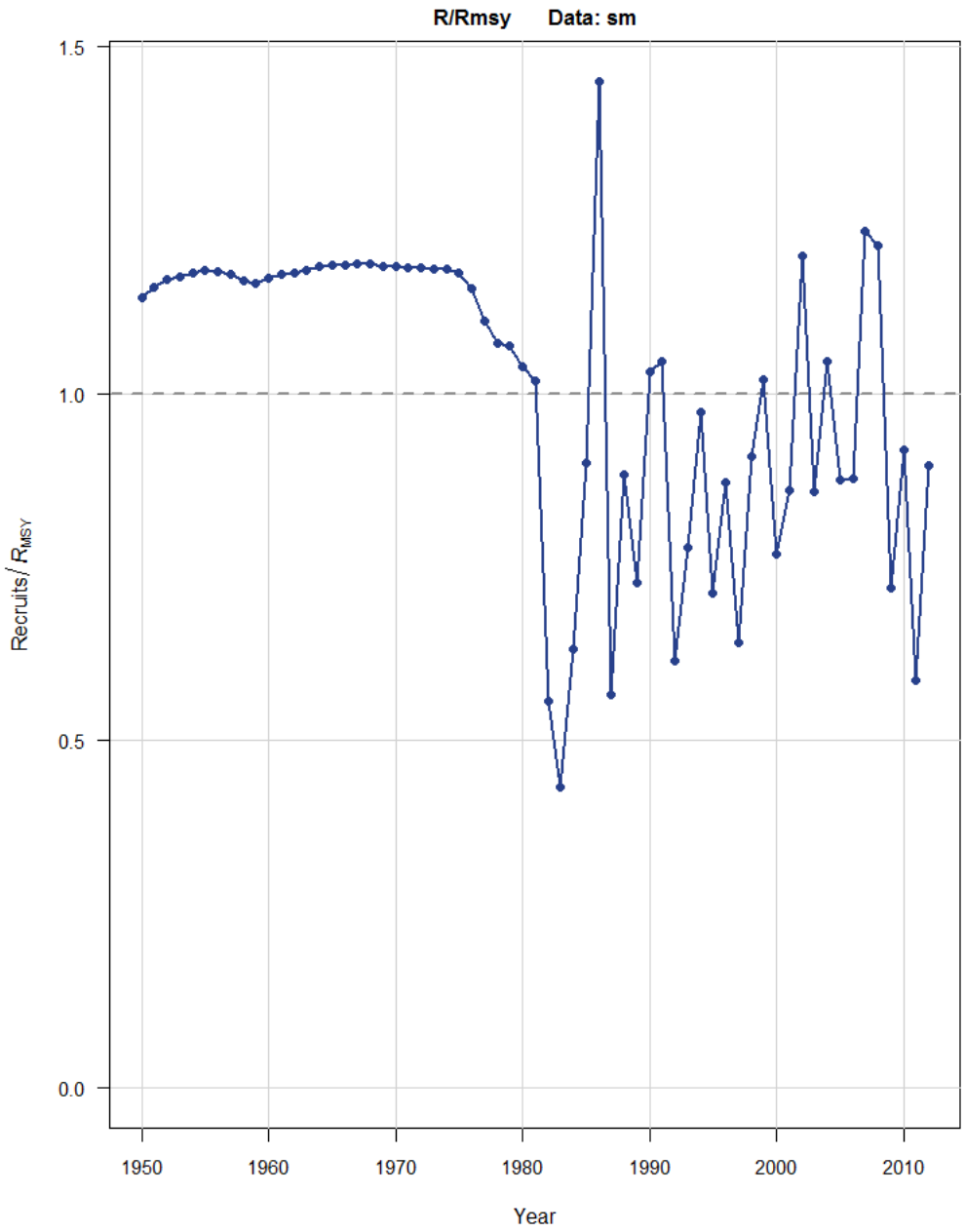


BAM Fully selected F by fishery

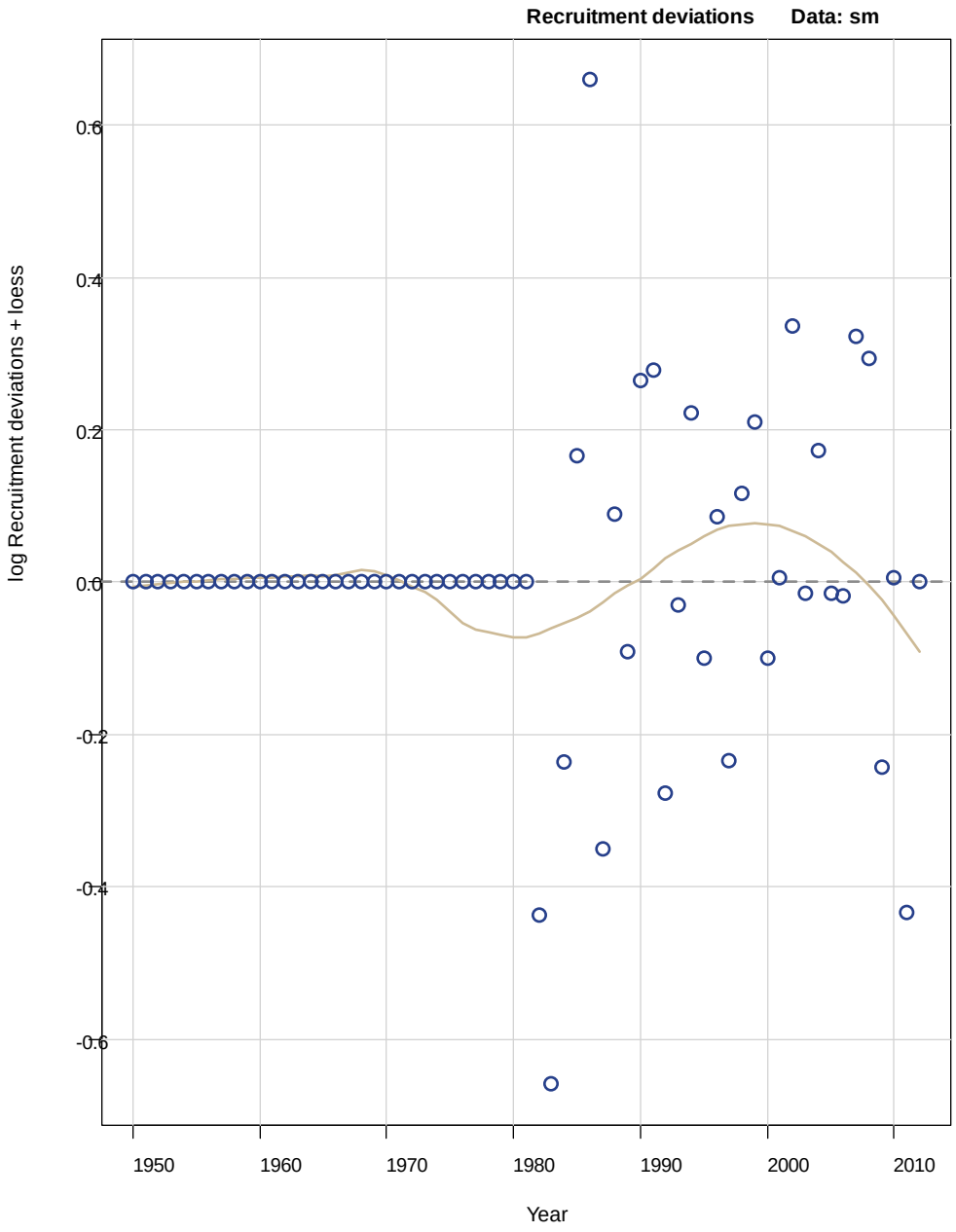
BAM Biomass @ Age



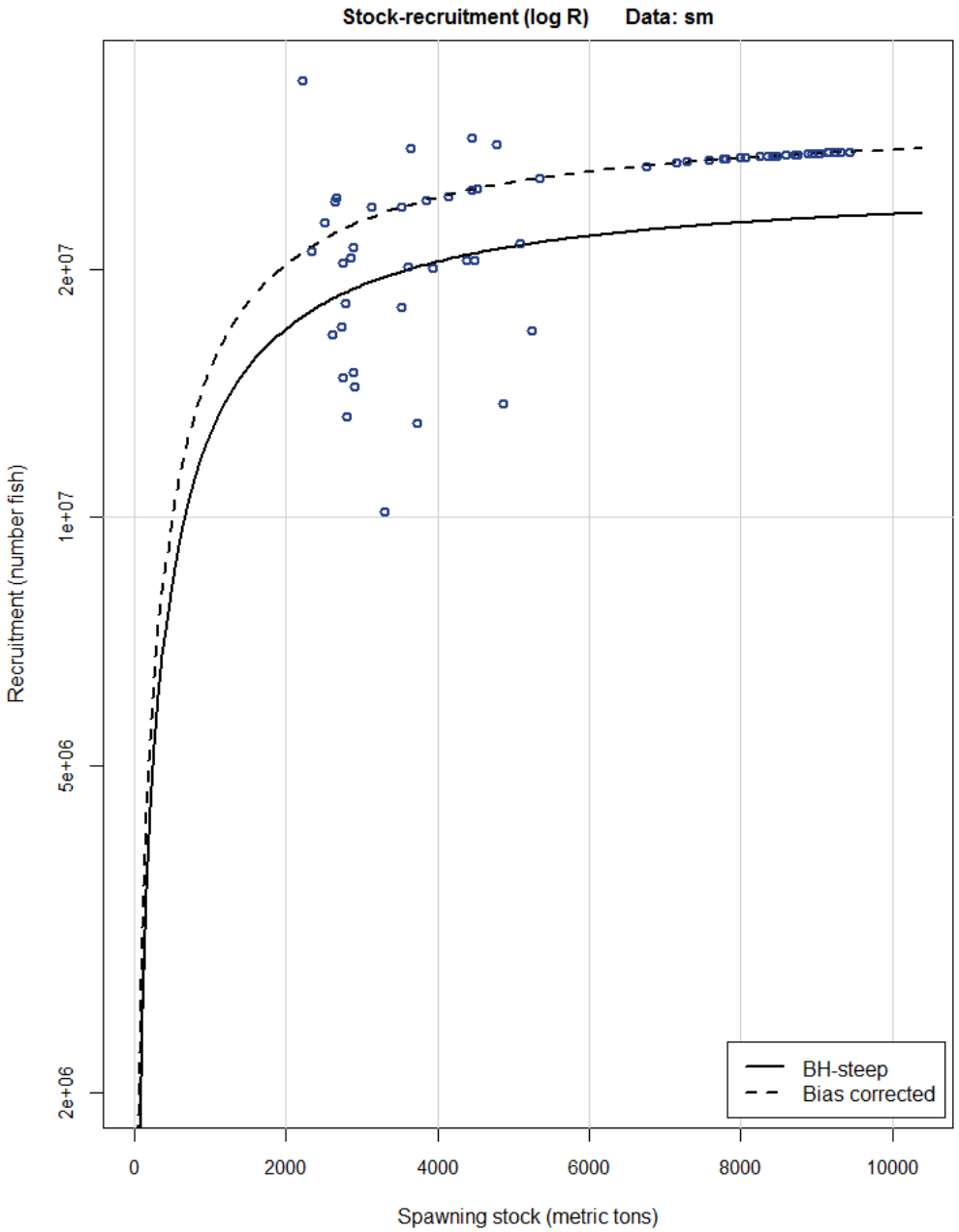
BAM Recruitment



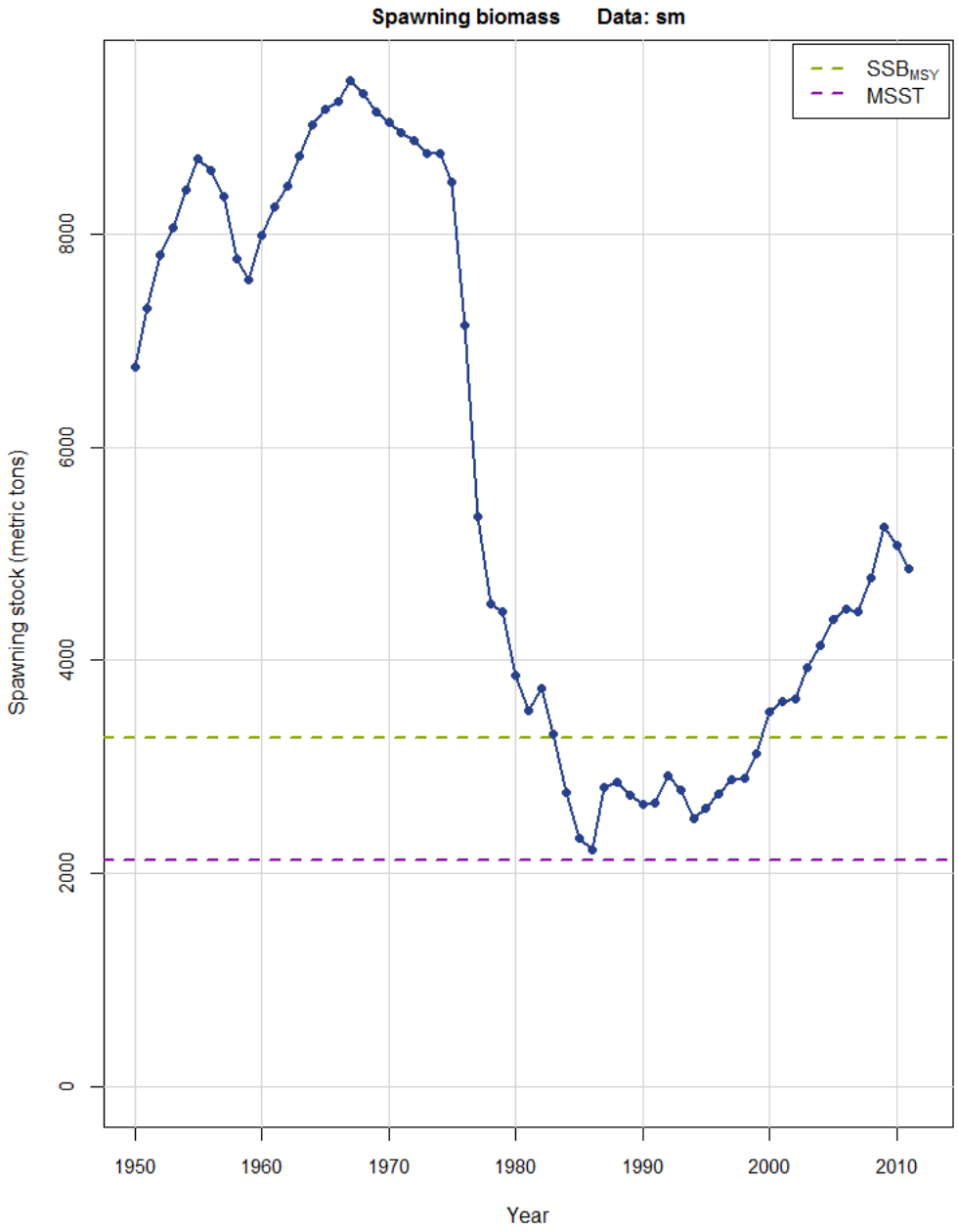
BAM Recruitment



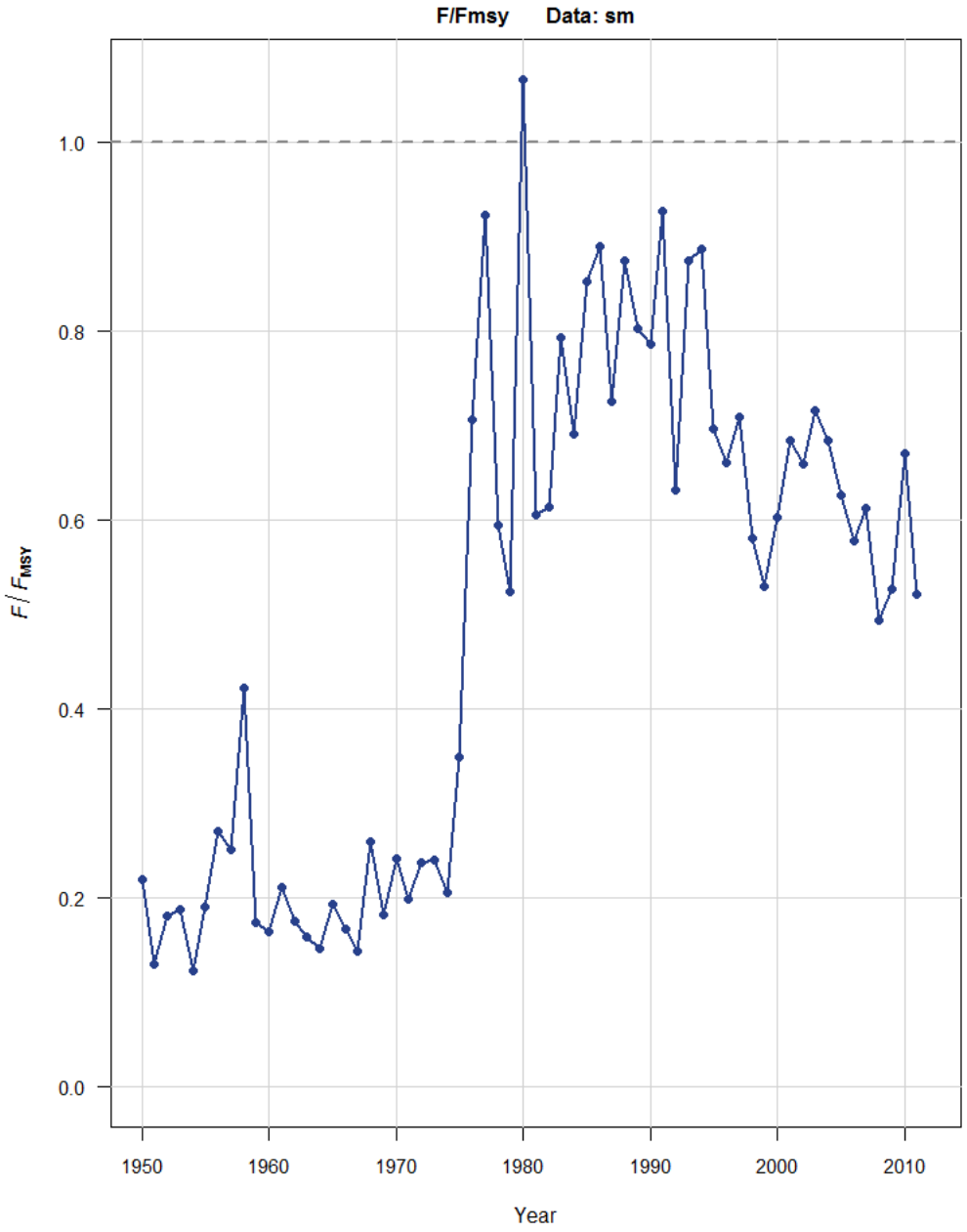
BAM Recruitment



BAM SSB Time Series



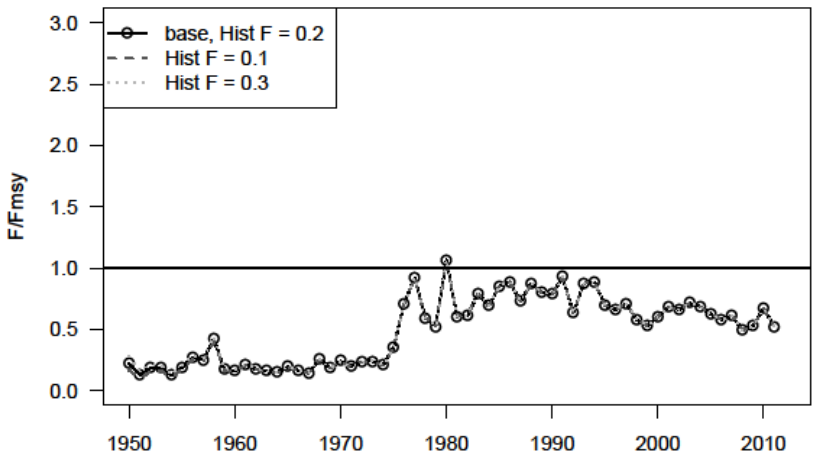
BAM Fishing Mortality Time Series

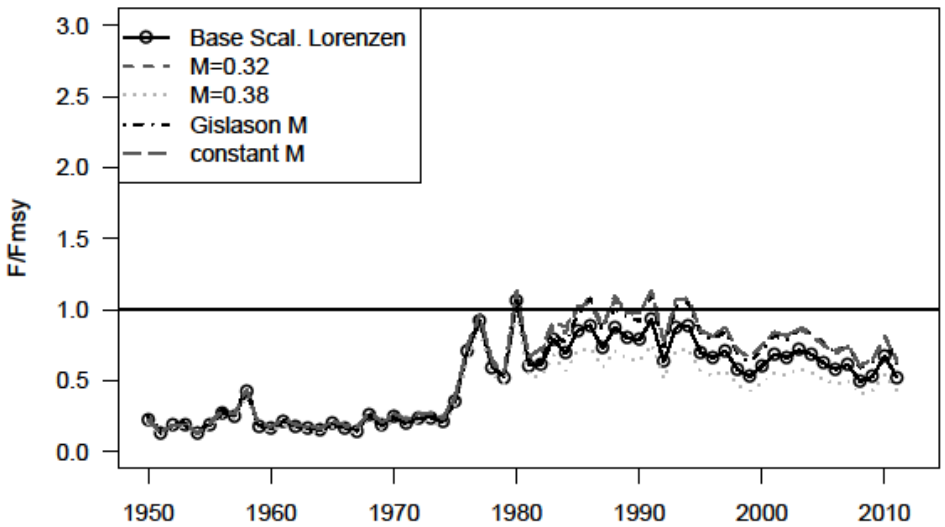


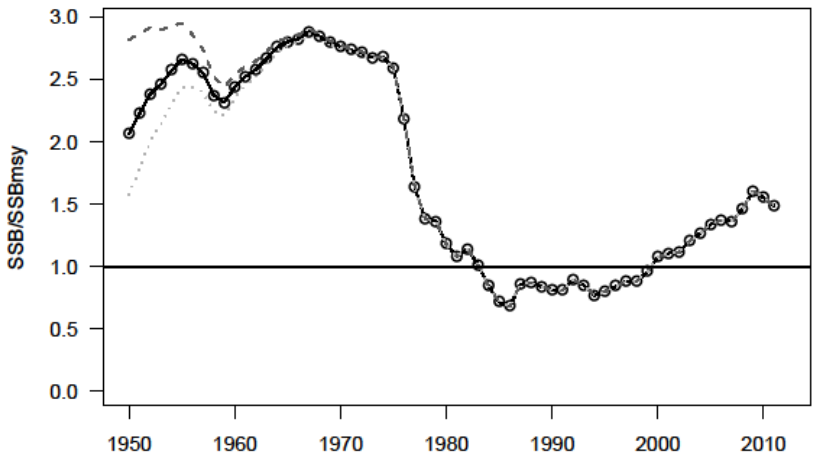
Model Diagnostics

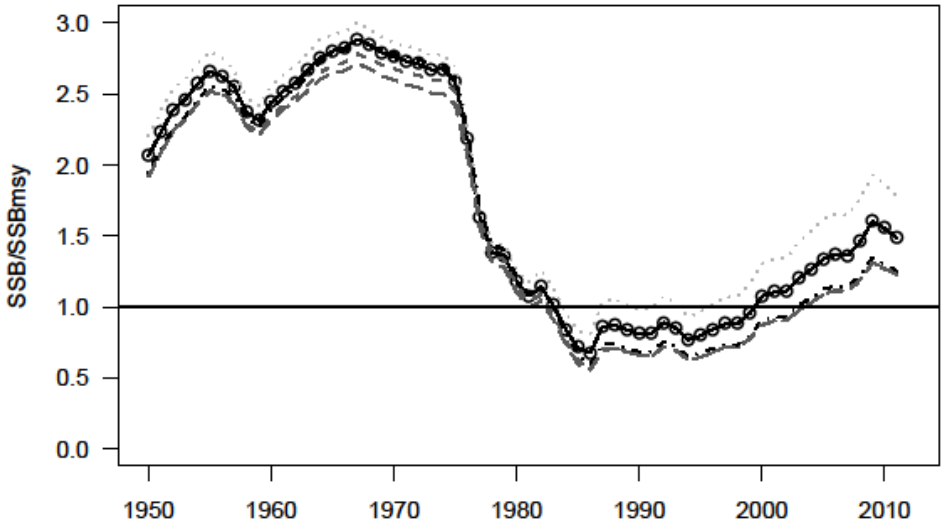
Sensitivites,
Monte Carlo bootstrapping,
retrospectives,
likelihood profiling

BAM Sensitivities

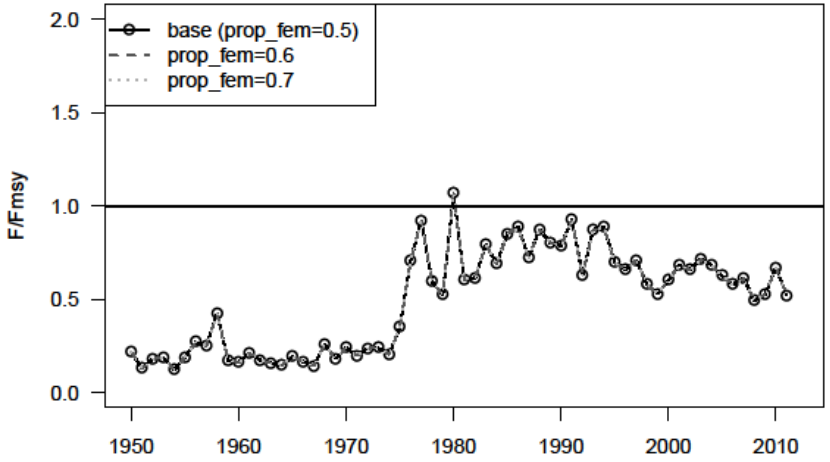


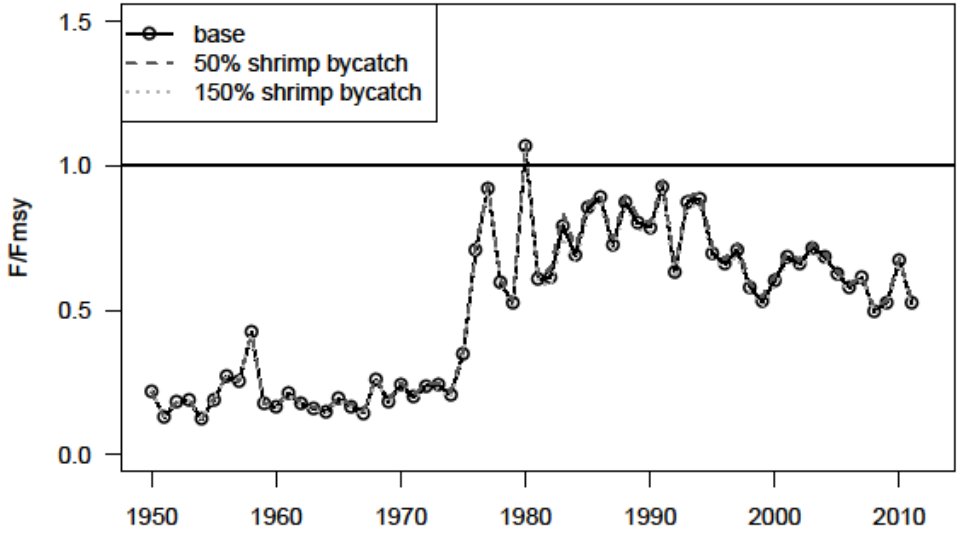


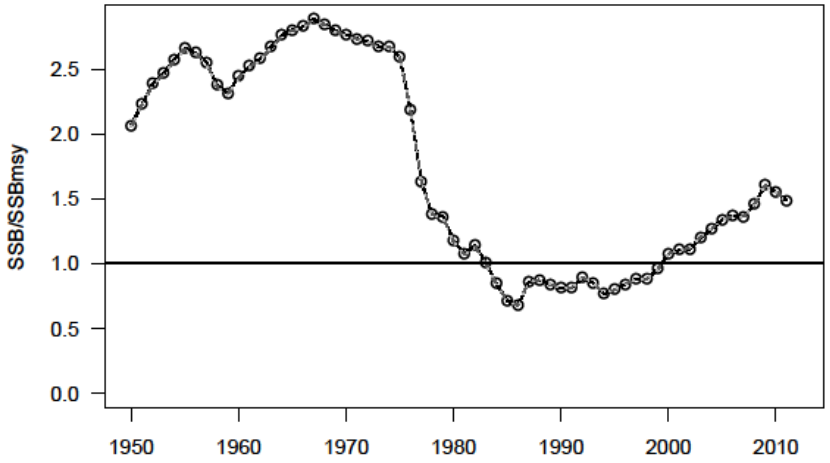


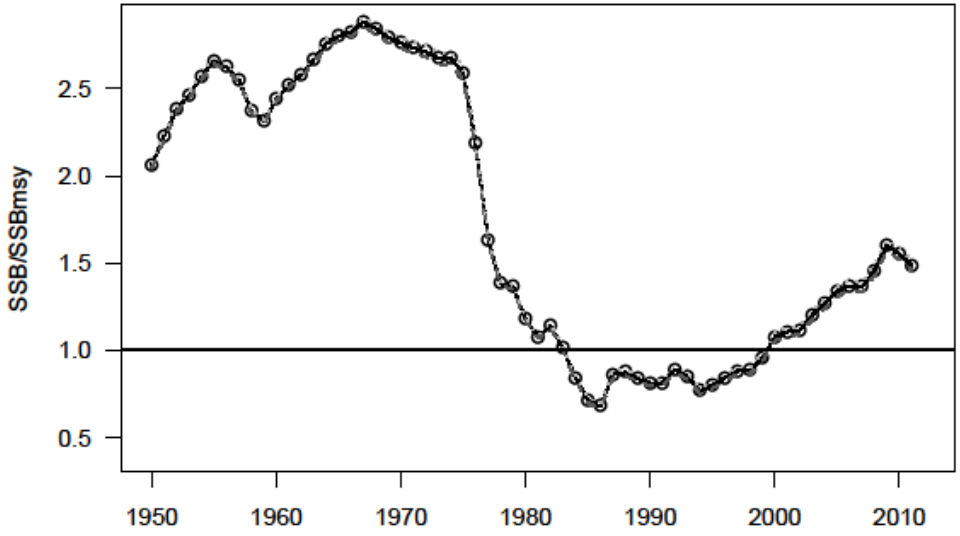


BAM Sensitivities

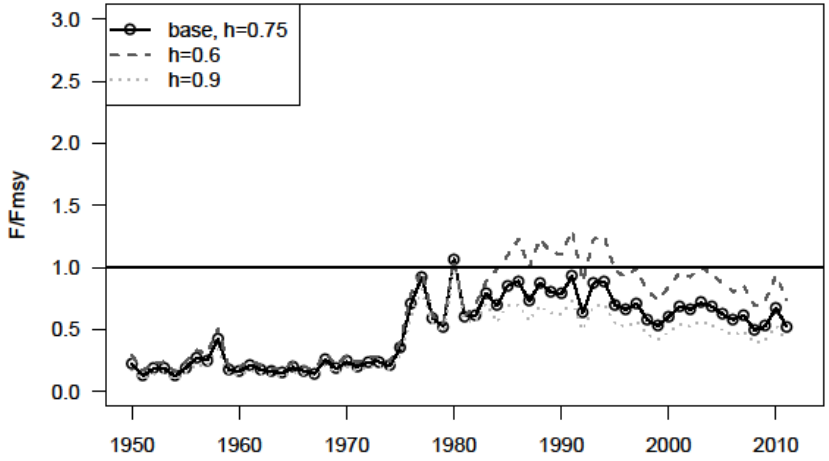


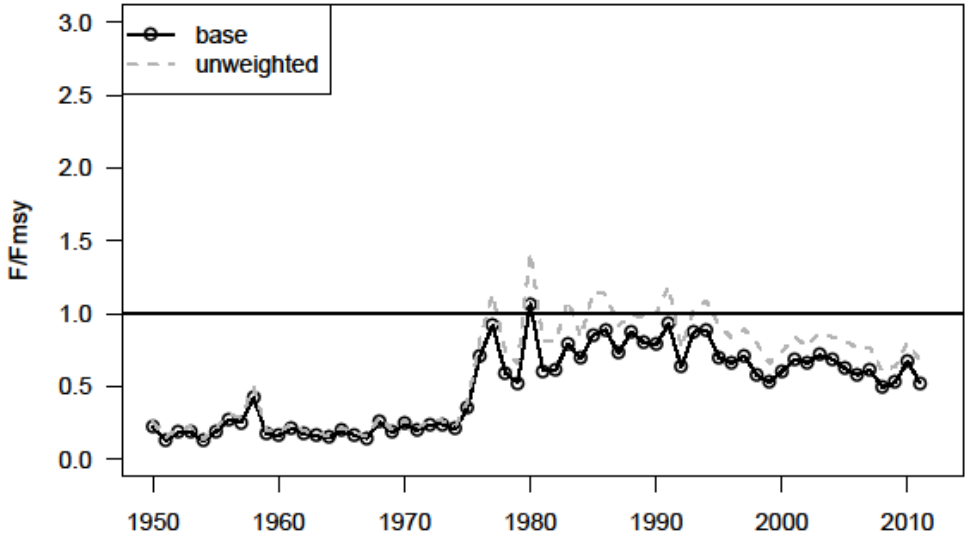


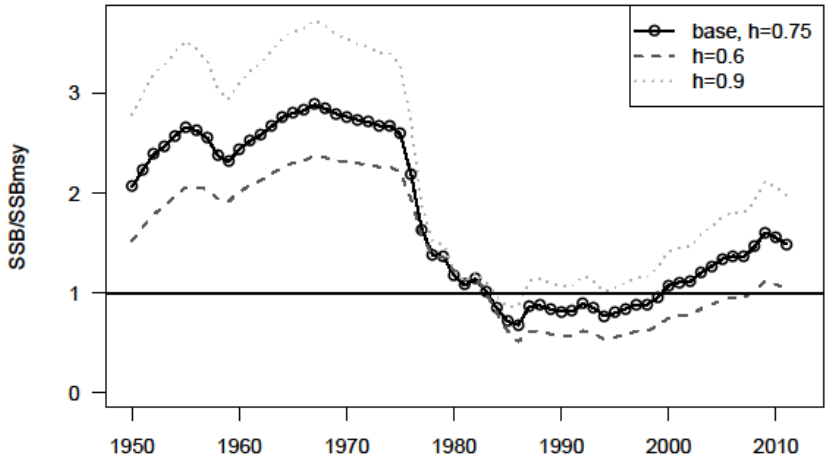


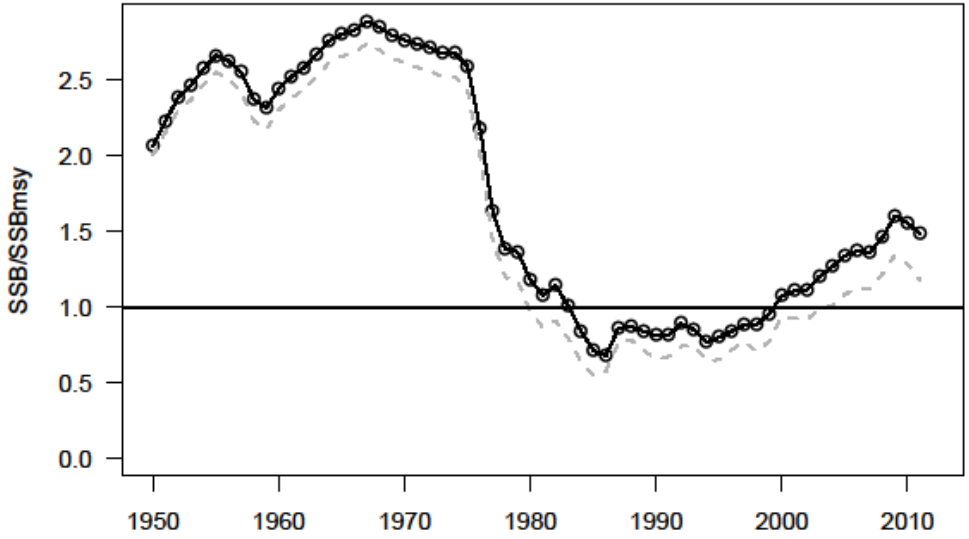


BAM Sensitivities

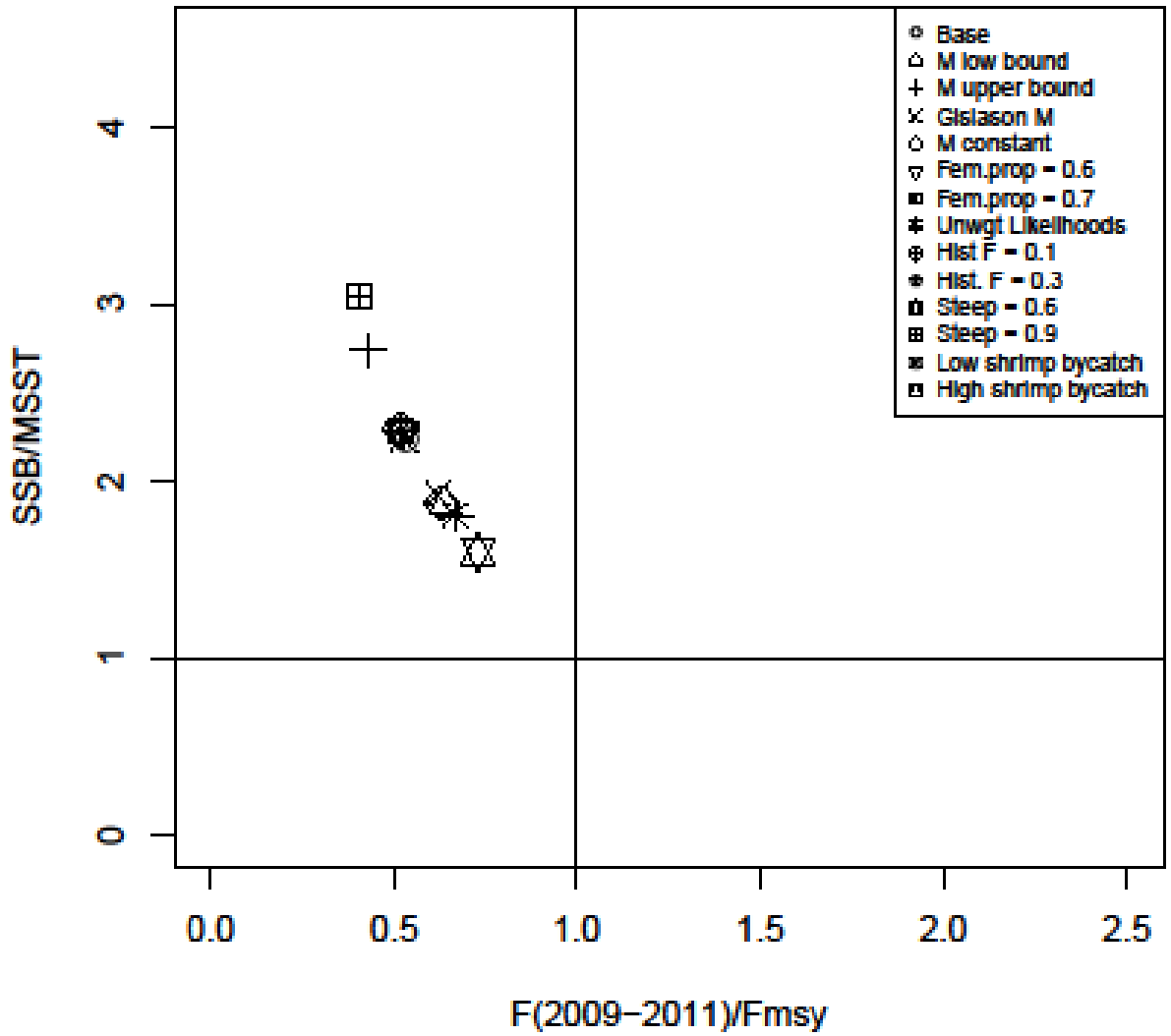








Comparing all sensitivities

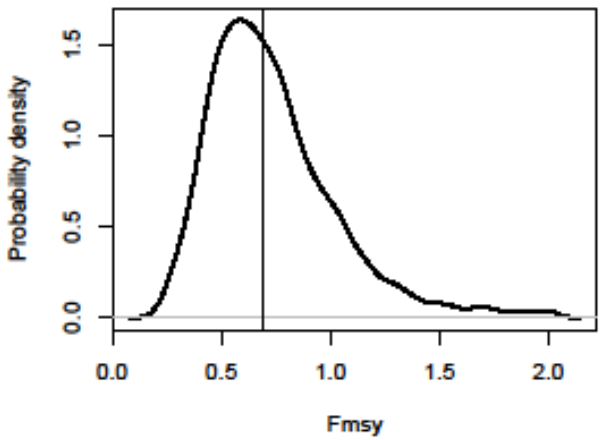


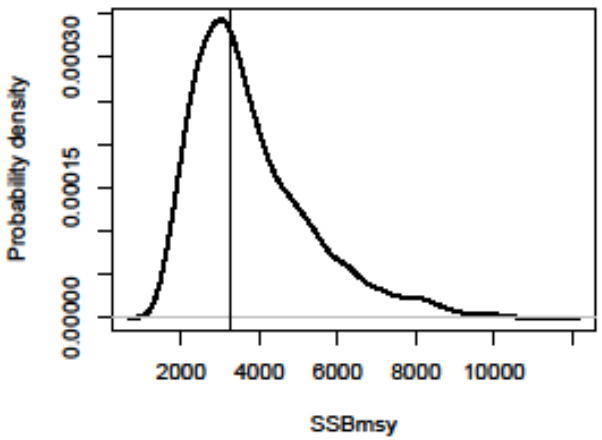
Monte Carlo Bootstrapping

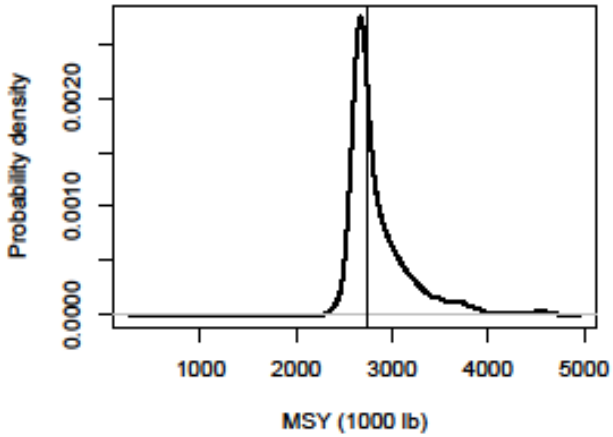
- n=3200 MCB trials attempted; n=3095 retained
- Bootstrap Parts:
  - Lognormal likelihood components (landings, indices): a parametric bootstrap to original data, with CVs as applied in the fitting procedure
  - Multinomial likelihood components (age comps): resample Nfish and assign them to bins with probabilities equal to those from original data

- Monte Carlo Parts:
  - M: drawn from a tnorm distribution, with mean equal to base value, and CV of 0.54 as suggested by the AW panel.
  - Recreational discard mortality: drawn from a tnorm distribution, with mean equal to base value, and SD computed such that the nearest bound is at the 95% confidence limit.
  - Historical recreational catch: drawn from a tnorm distribution, with mean equal to base value and the SD as provided by the DW.

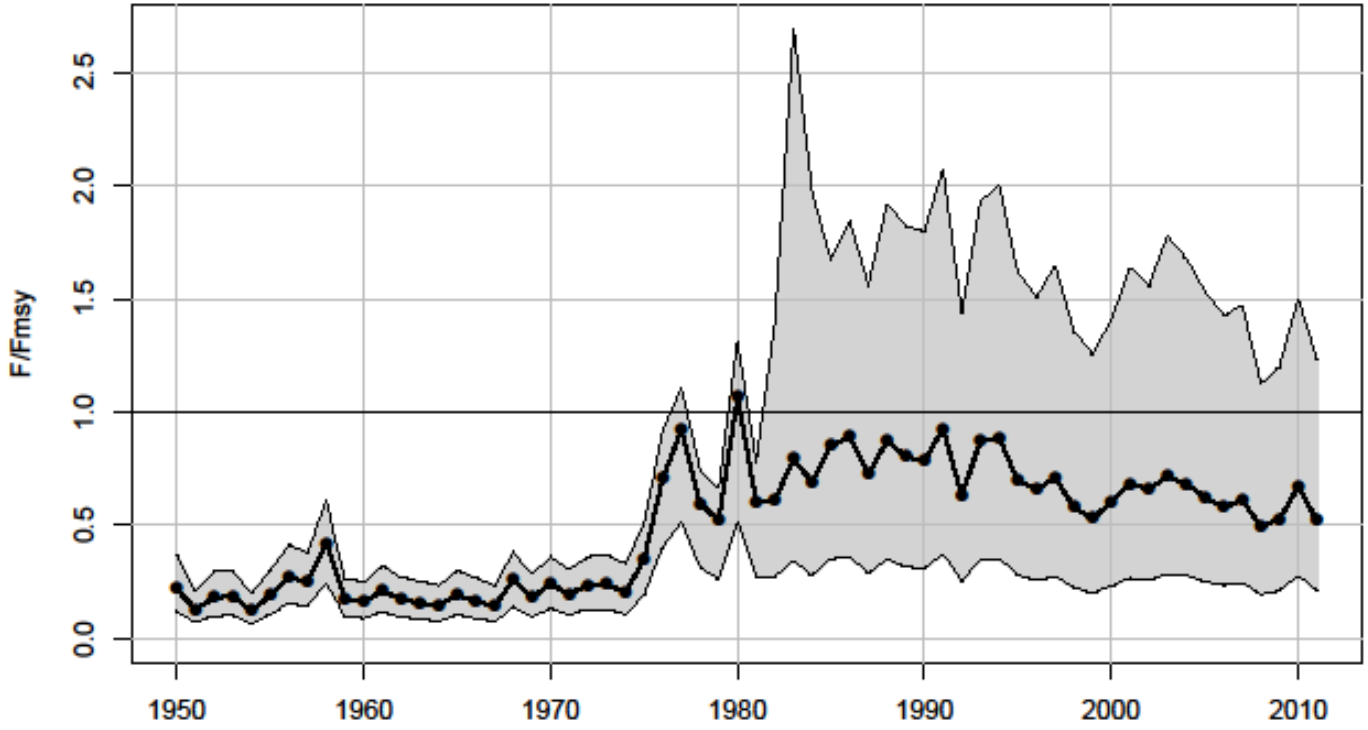
MCB runs


Probability density
0.0
0.5
1.0
1.5
0.0
0.5
1.0
1.5
2.0
Fmsy

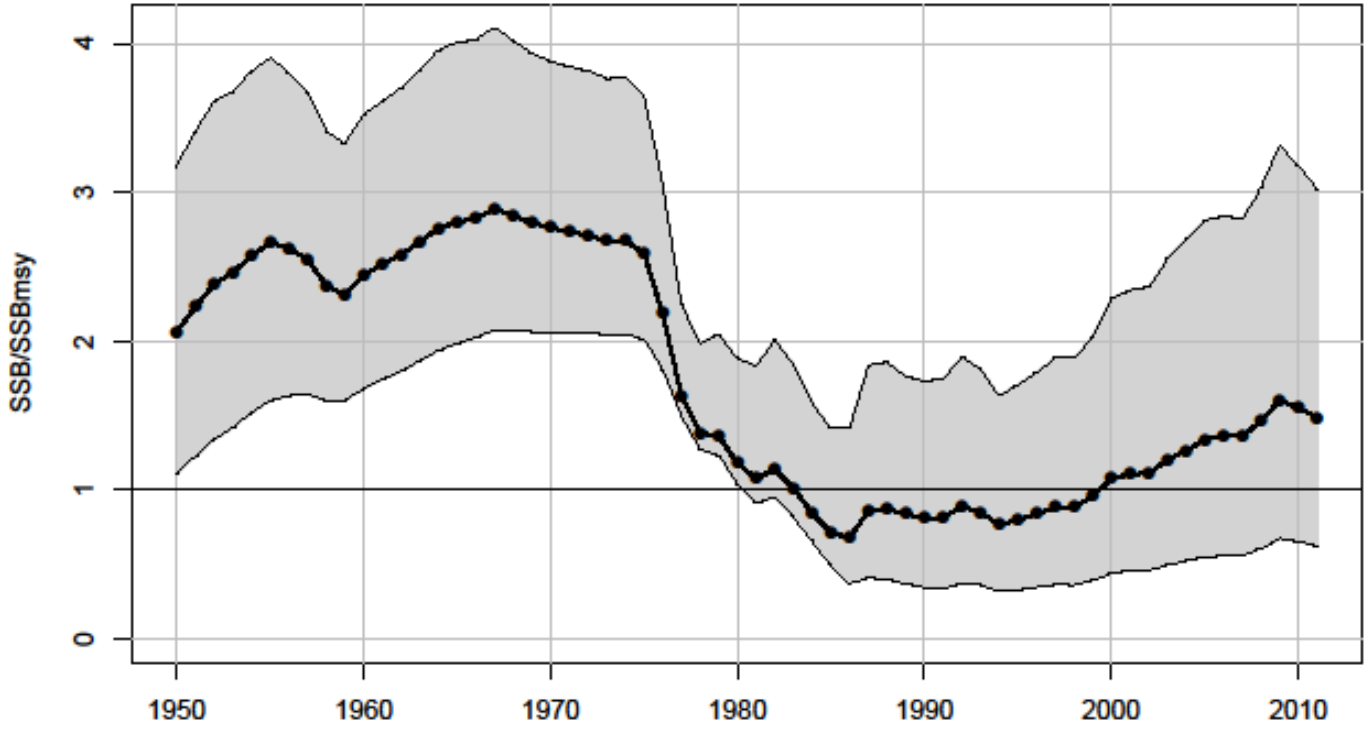

Probability density
0.00000
0.00015
0.00030
2000
4000
6000
8000
10000
SSBmsy


Probability density
0.0000
0.0010
0.0020
1000
2000
3000
4000
5000
MSY (1000 lb)

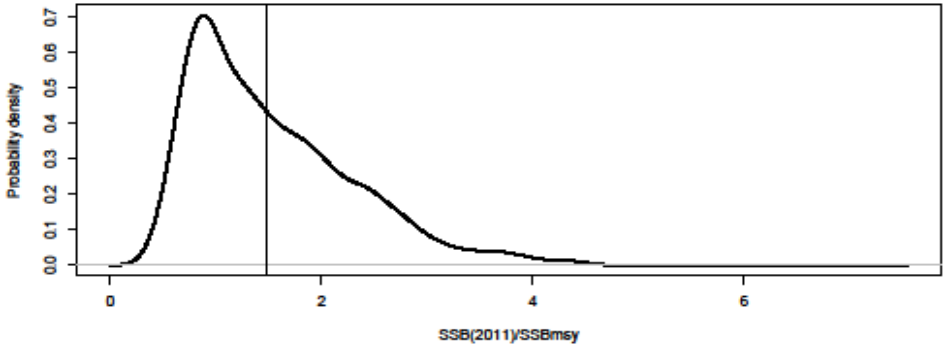
MCB: Benchmark uncertainty

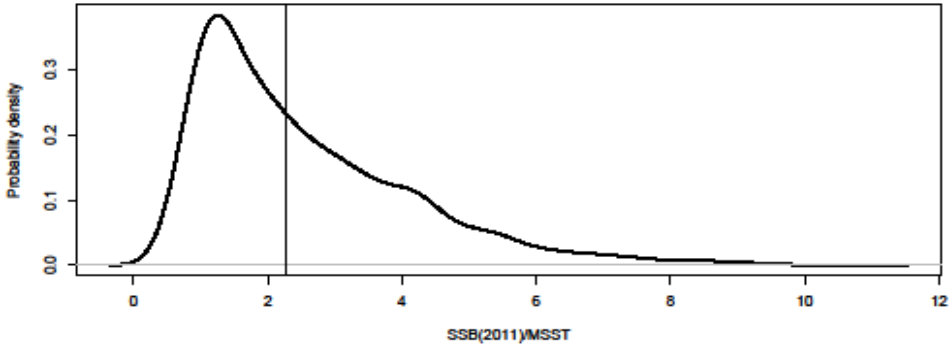


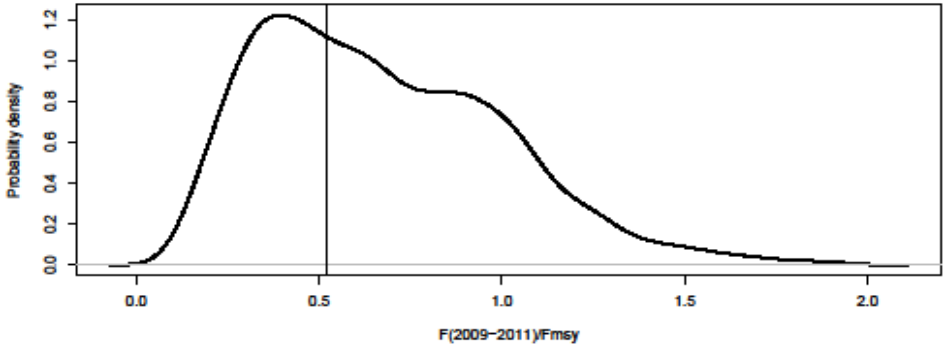
MCB: Benchmark uncertainty



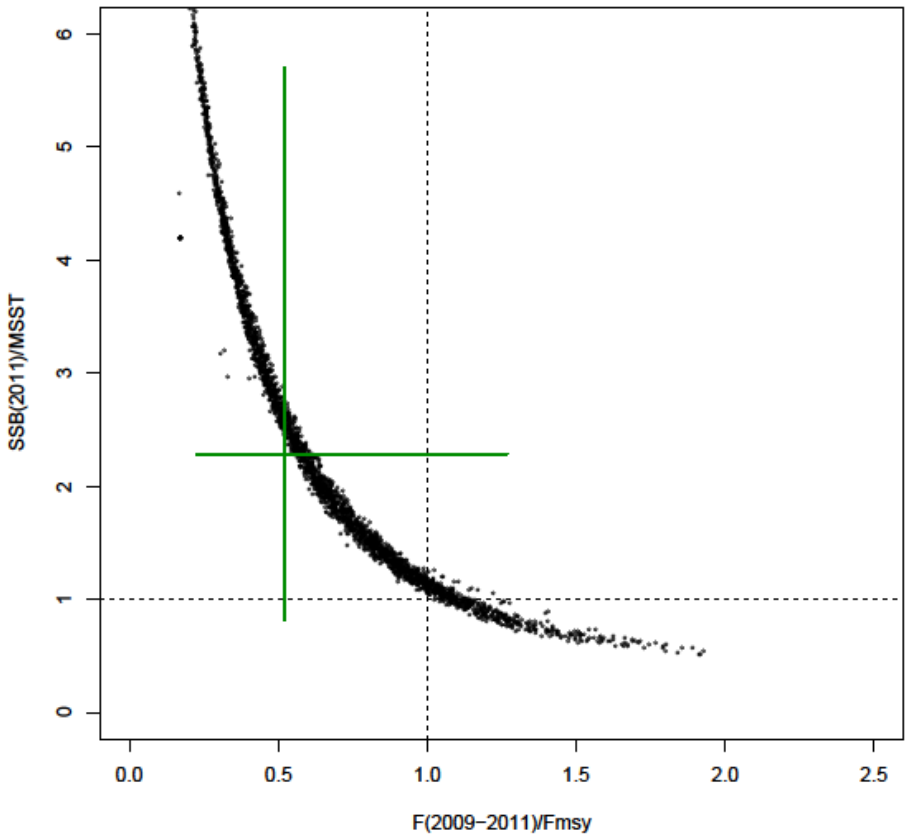
MCB: Status

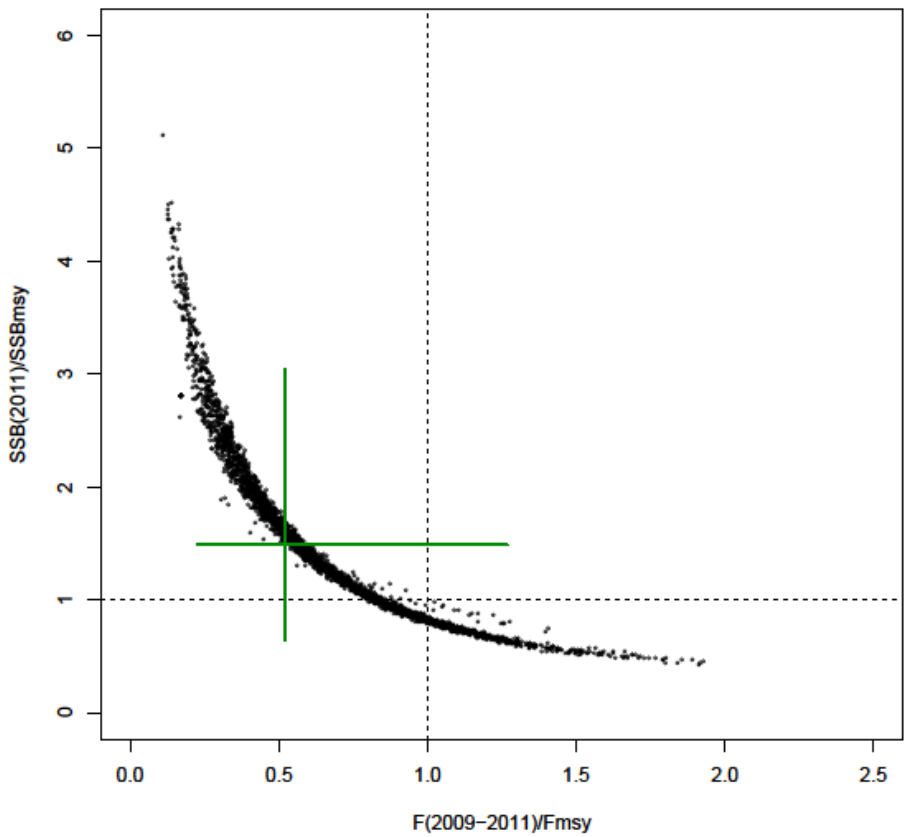

Probability density
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0
2
4
6
SSB(2011)/SSBmsy


Probability density
0.0
0.1
0.2
0.3
0
2
4
6
8
10
12
SSB(2011)/MSST

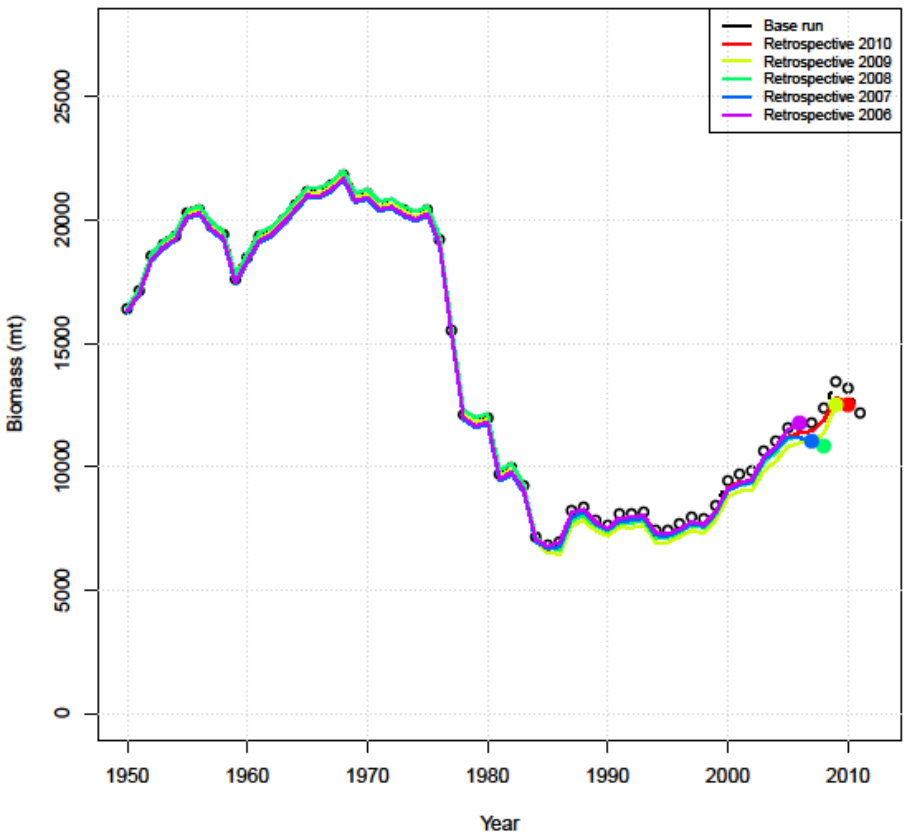

Probability density
0.0
0.2
0.4
0.6
0.8
1.0
1.2
0.0
0.5
1.0
1.5
2.0
F(2009−2011)/Fmsy

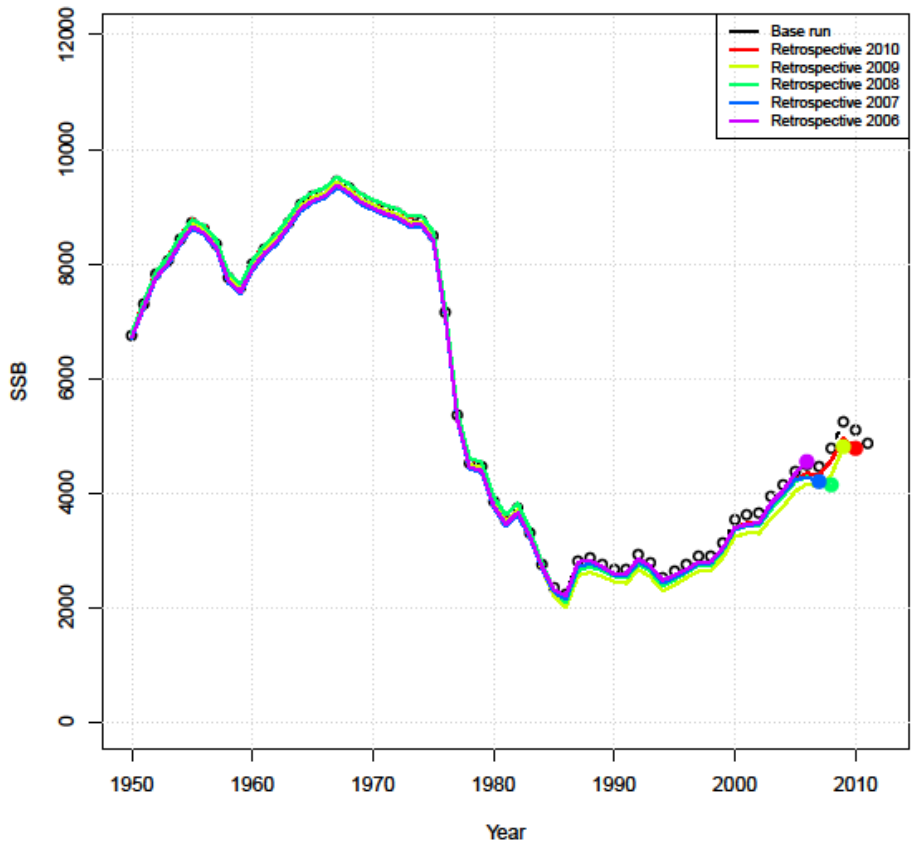
MCB: Status phase plots



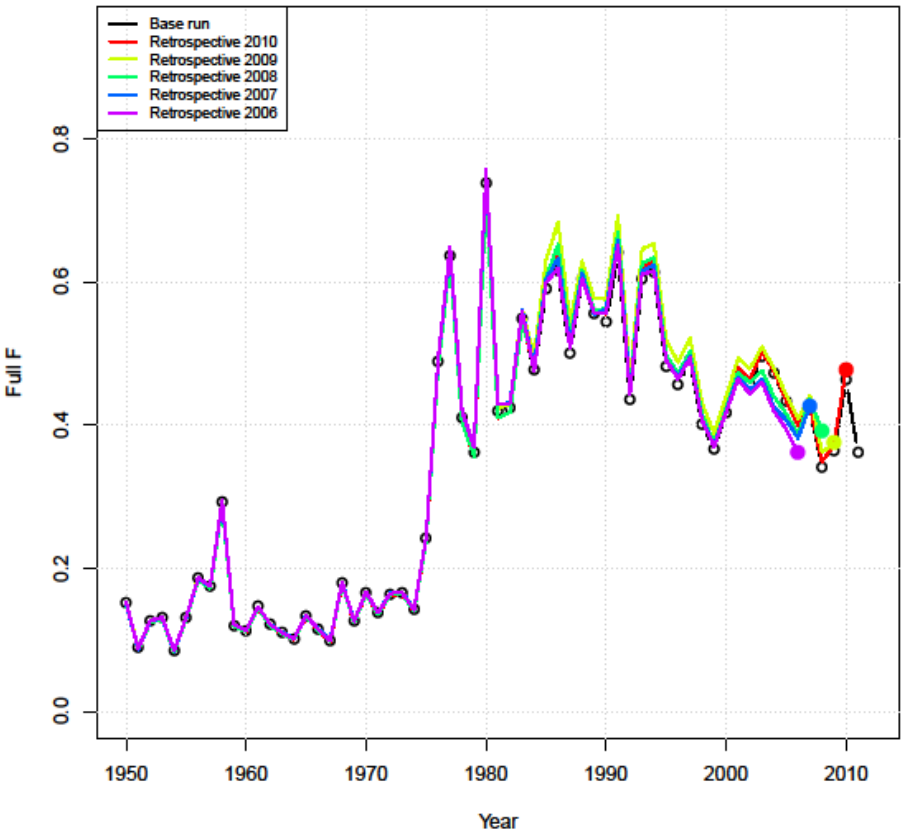


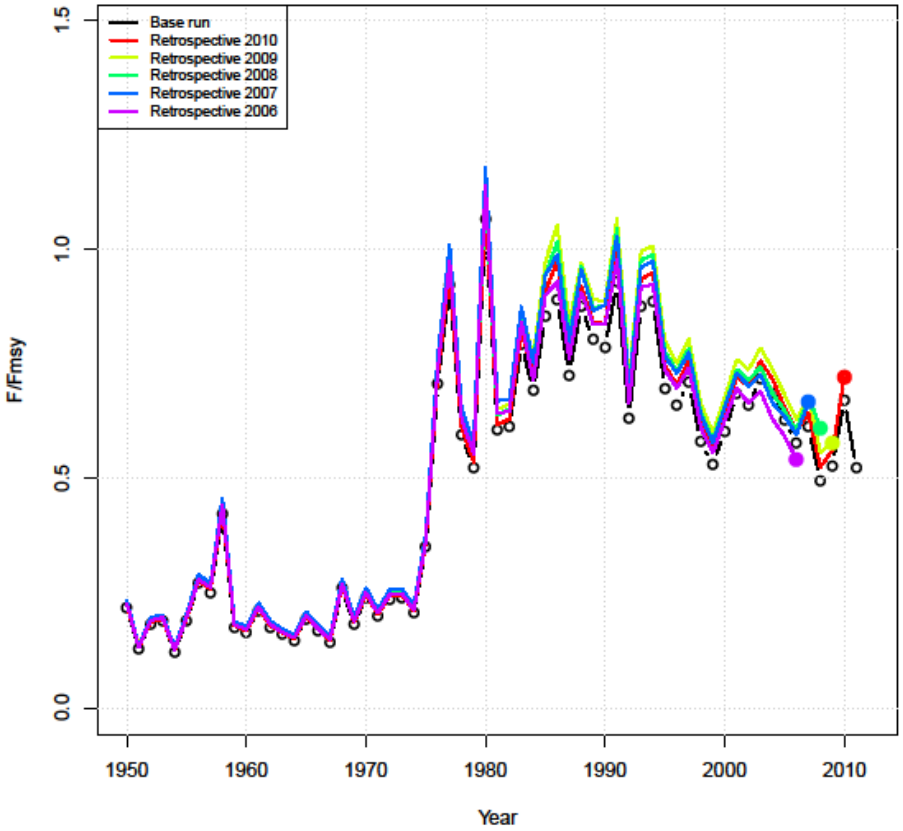
Retrospective Runs



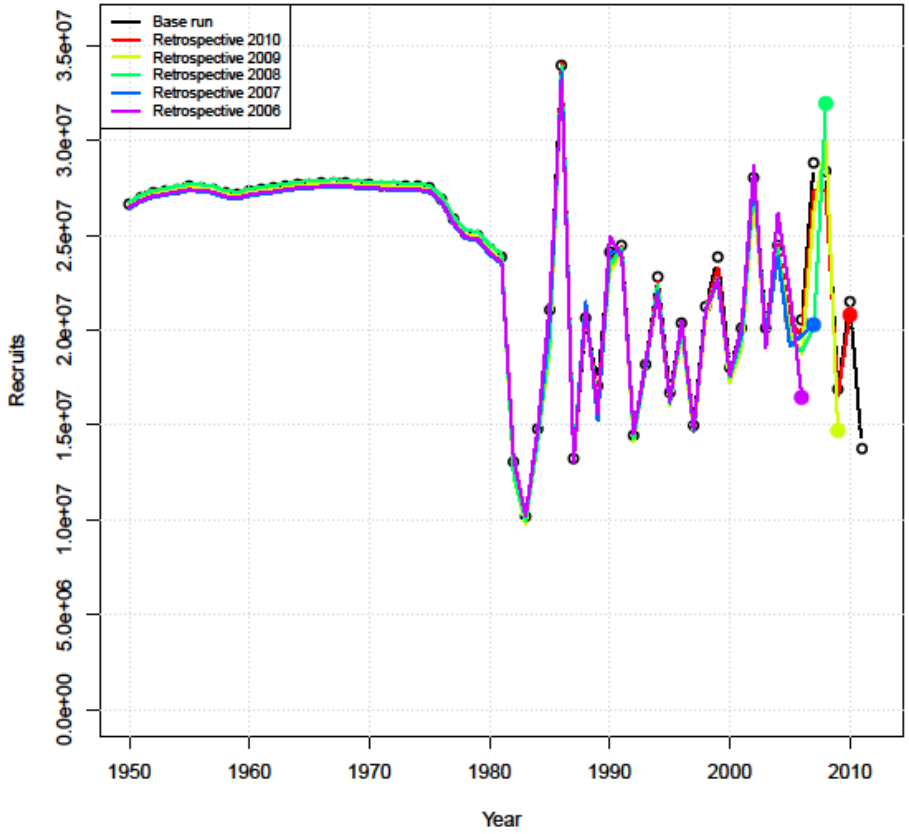


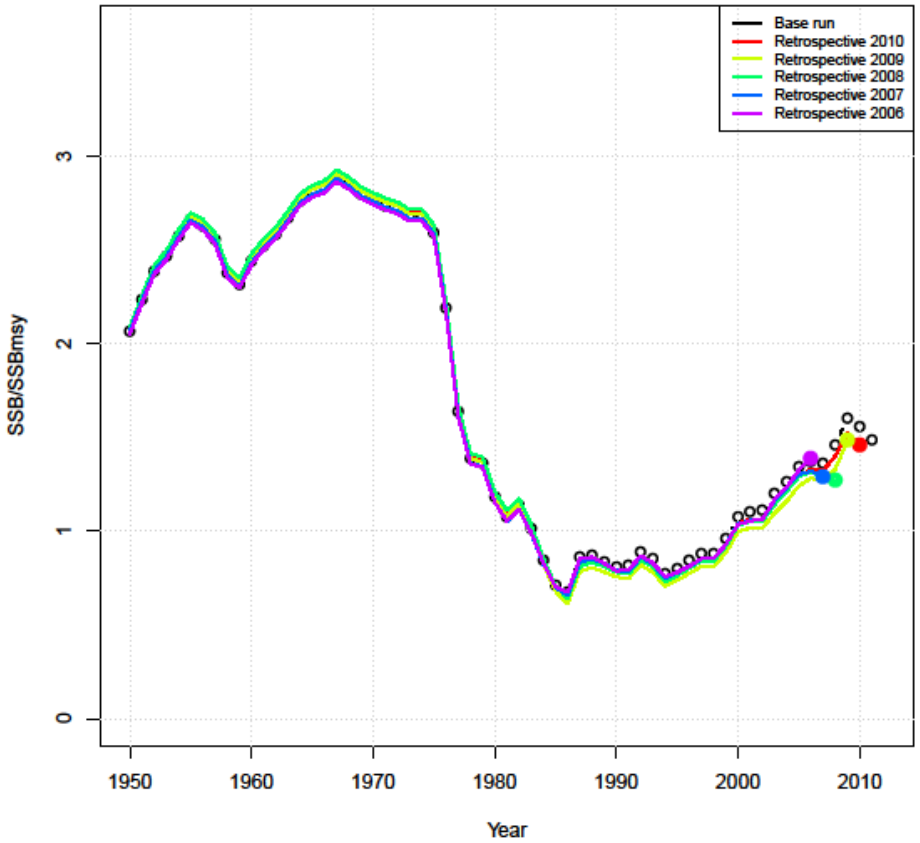
Retrospective Runs



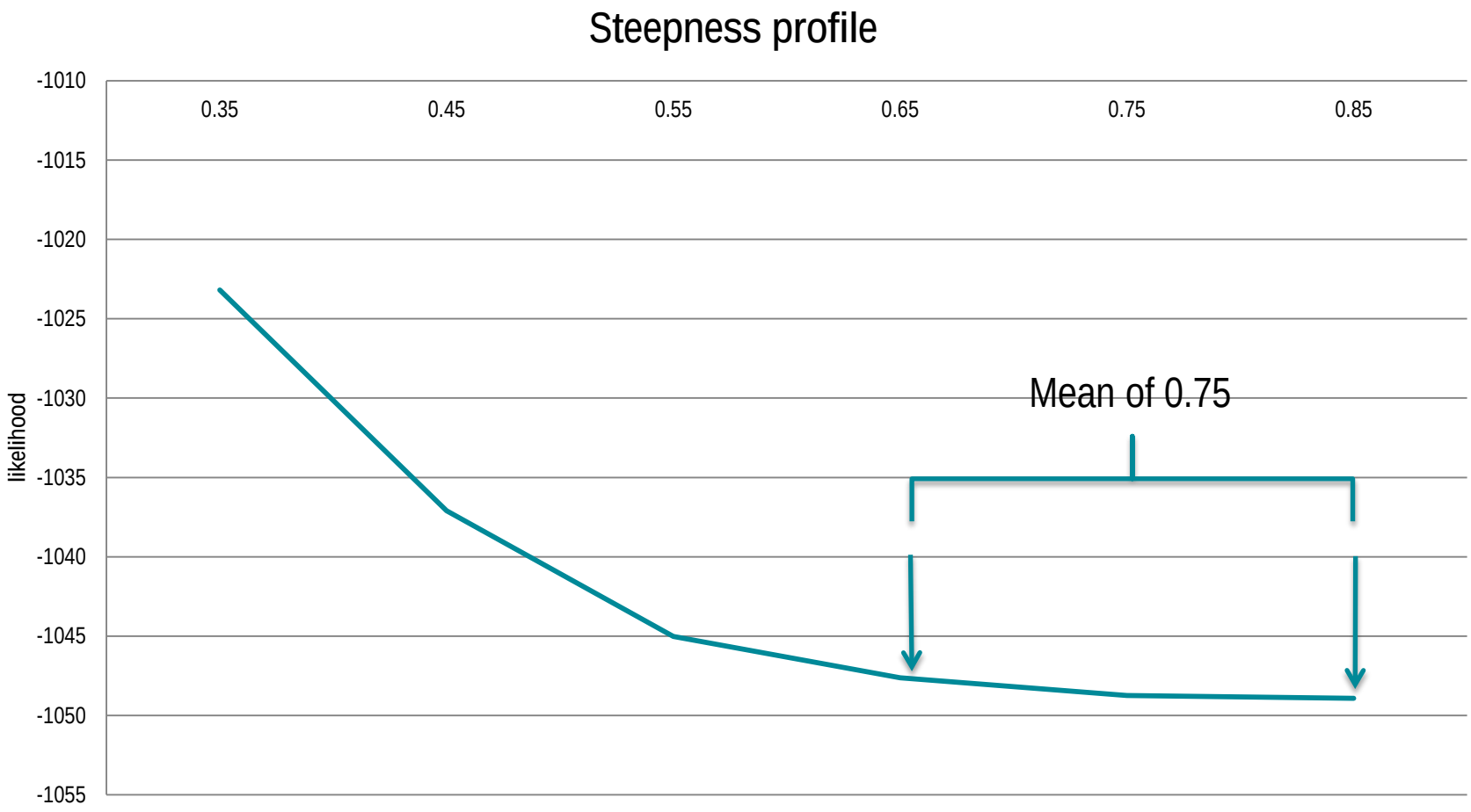


Retrospective Runs

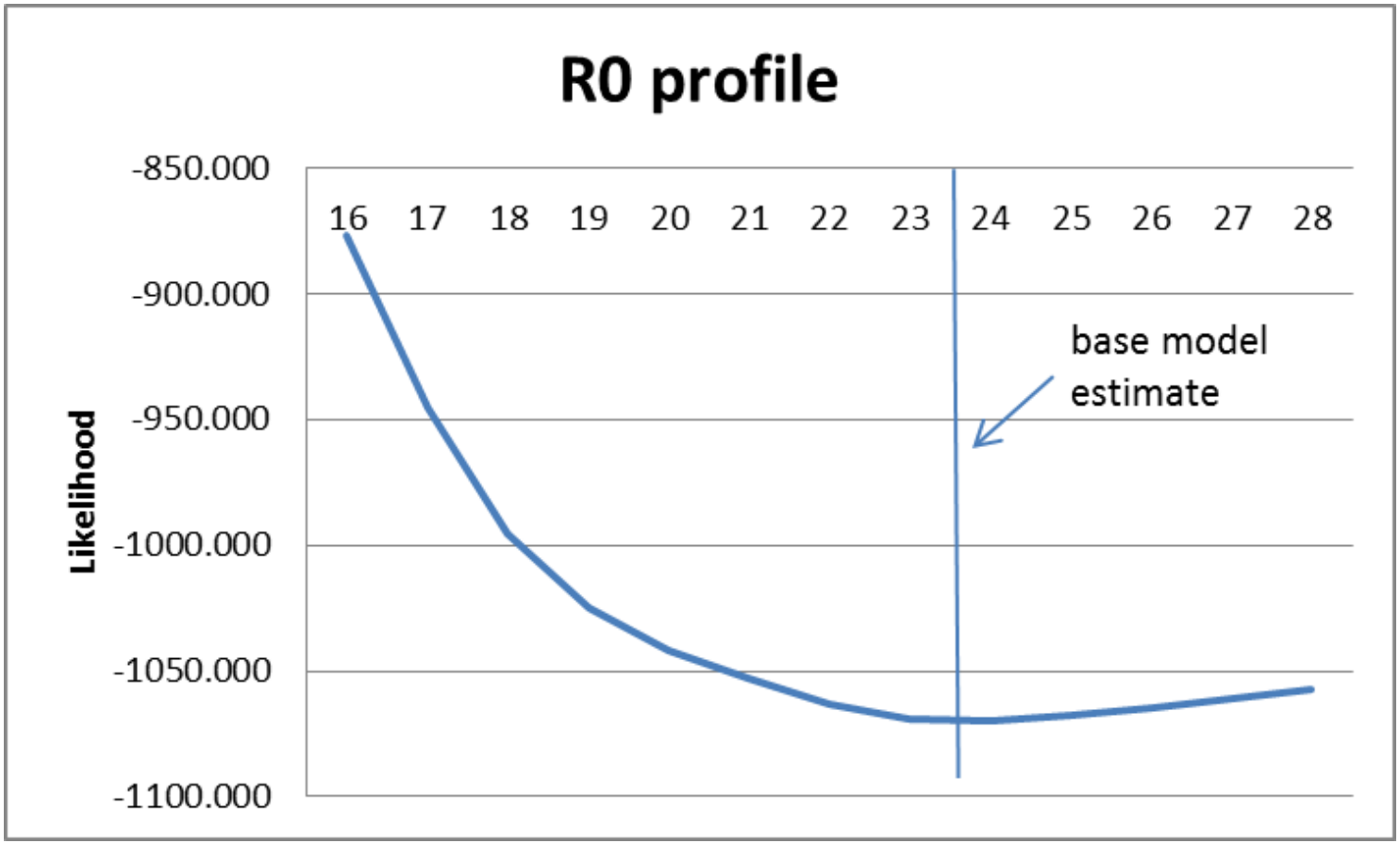




Likelihood Profiling: Steepness



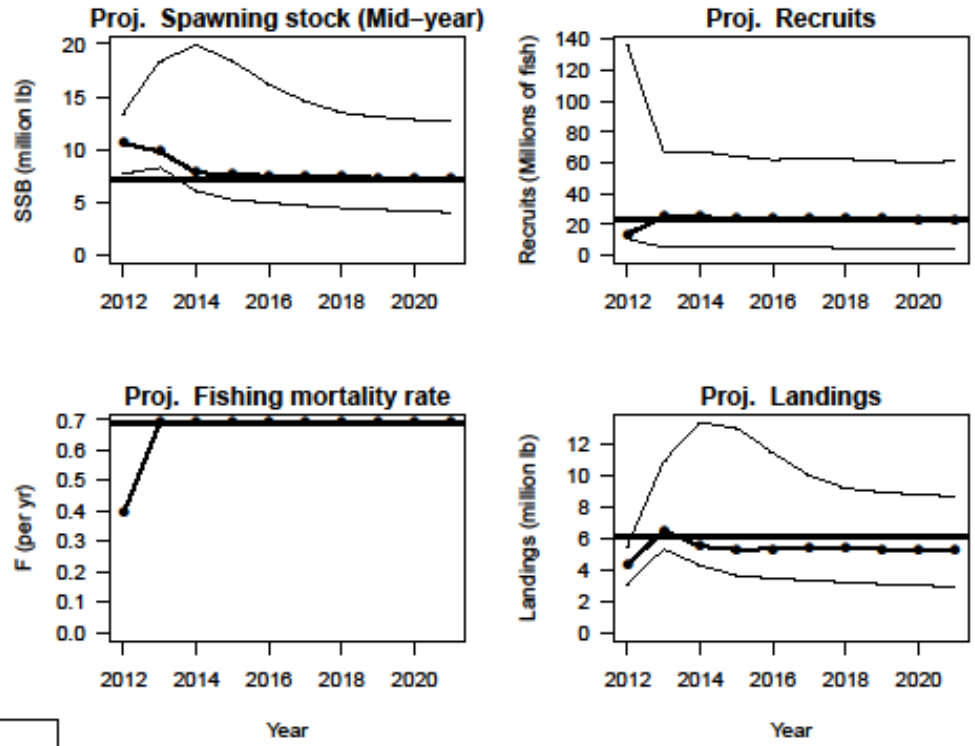
Likelihood Profiling: R_0

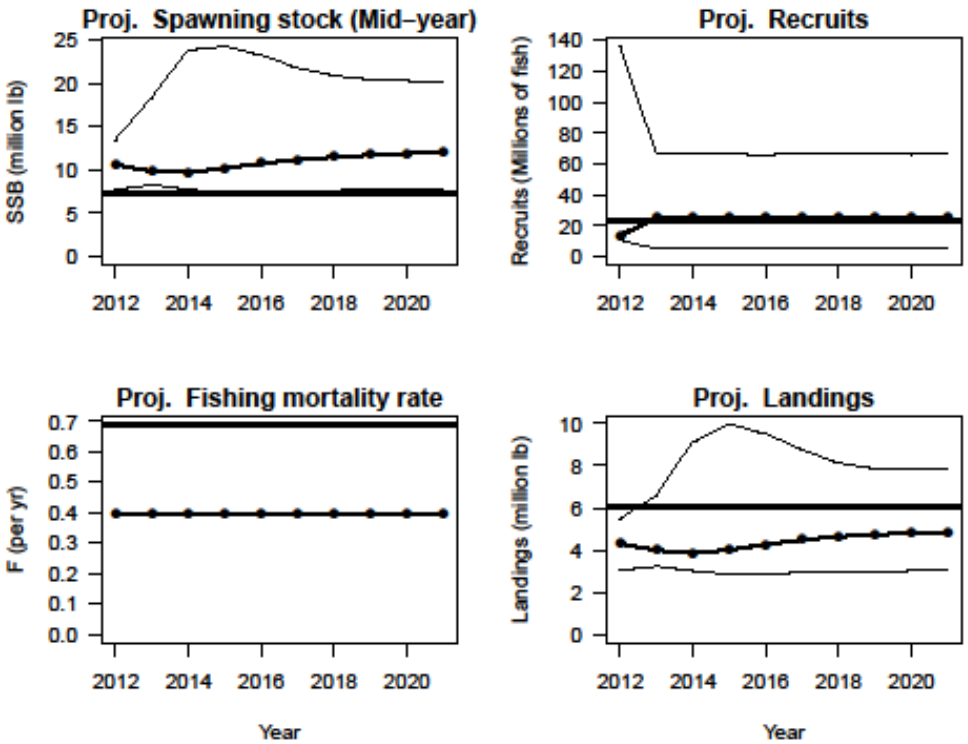


Projections

At F_{msy} and $F_{current}$

At F_{msy}





At $F_{(2009\text{-}2011)}$

Surplus production model (ASPIC)

- Age aggregated
- Modelling in total biomass
- A simple logistic population model used for population dynamics
- An alternative model formulation intended to complement the primary statistical catch-at-age model

- Total Removals
  - Landings
    - Commercial
    - Recreational (1955-1980 converted from numbers to lbs.)
  - Discards (converted from numbers to lbs.)
  - Bycatch from shrimp trawls (converted from numbers to lbs.)
- Indices (SEAMAP indices not included)
  - MRFSS (converted to lbs)
  - Florida trip ticket

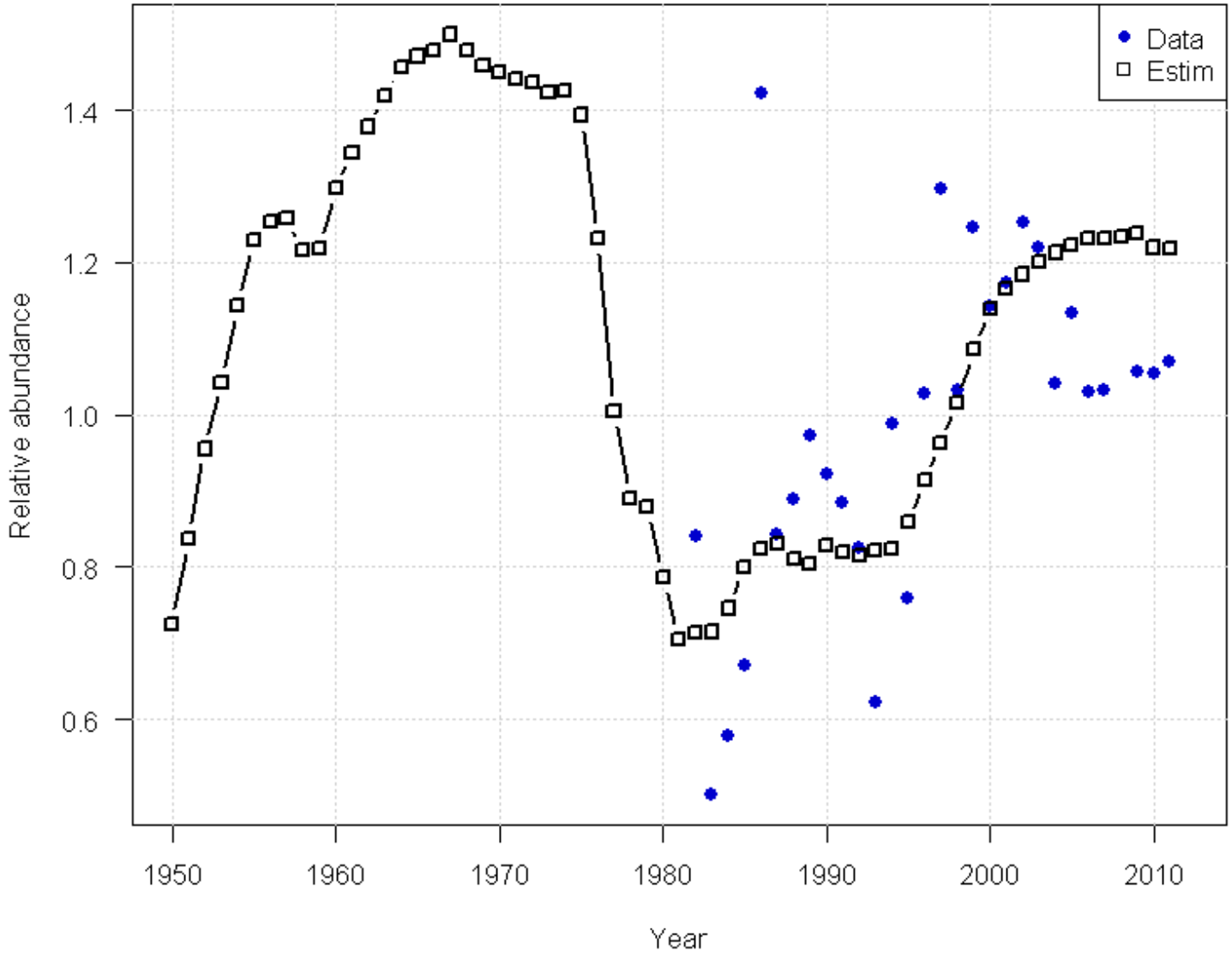
Number to weight conversions

1. Commercial and recreational discard estimates converted to pounds by applying estimated mean weight from 1981-82 MRFSS length composition below the size limit (0.40 lbs.)
2. Recreational landings estimates pre-1981 converted to weight using 1981-83 average MRFSS mean weight estimates from DW (1.67 lbs)
3. Shrimp bycatch estimates converted to weight using the estimated weight at the mean length from observer samples (187mm, 0.145 lbs)

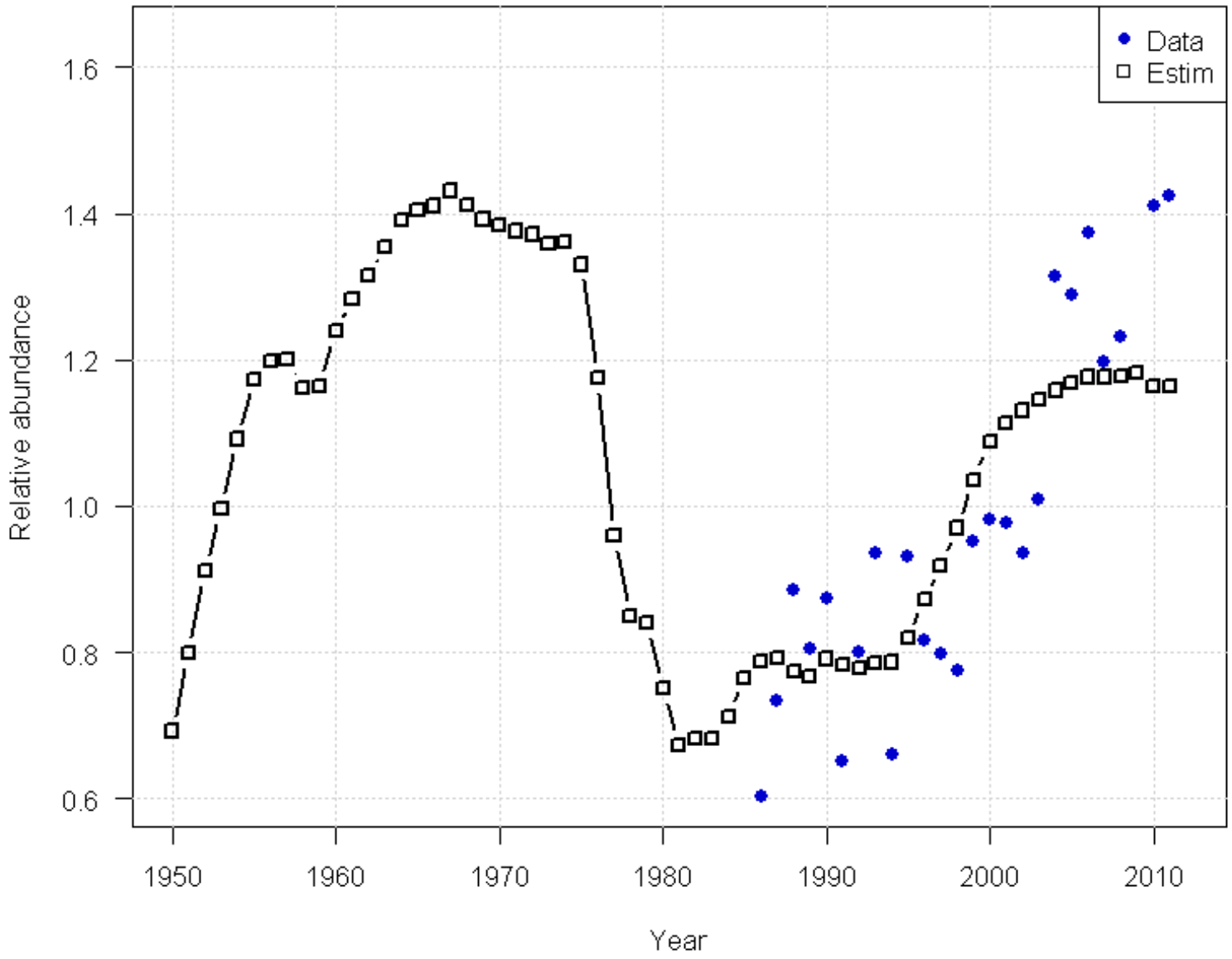
Surplus-production Model Setup

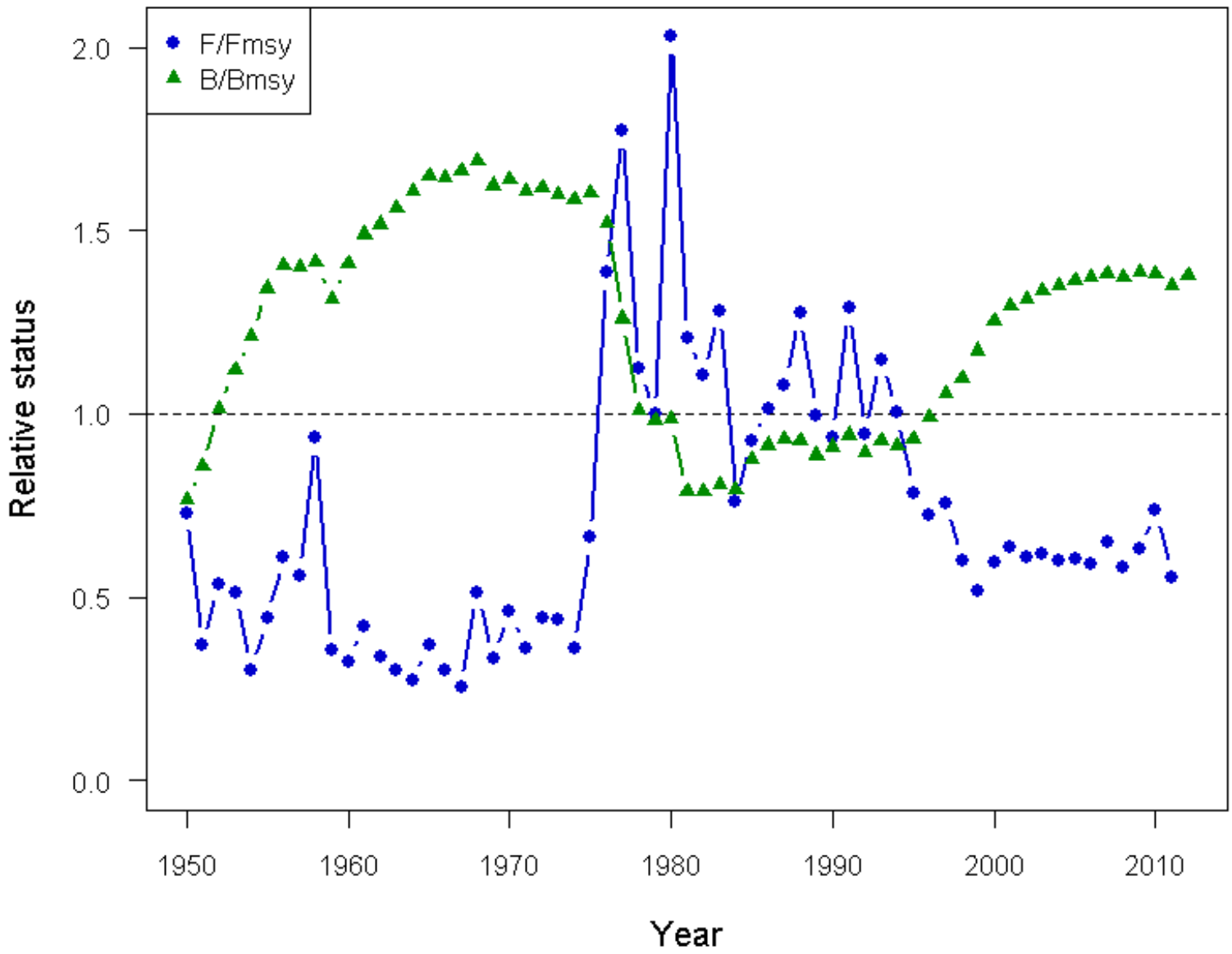
1. Starting year:1950
2. Initial biomass relative to k estimated
3. Starting guess for MSY at 0.5 * maximum landings
4. Starting guess for k at 10 * maximum landings

MRFSS index


Data
Estim
Relative abundance
1.4
1.2
1.0
0.8
0.6
1950
1960
1970
1980
1990
2000
2010
Year

FL trip ticket index

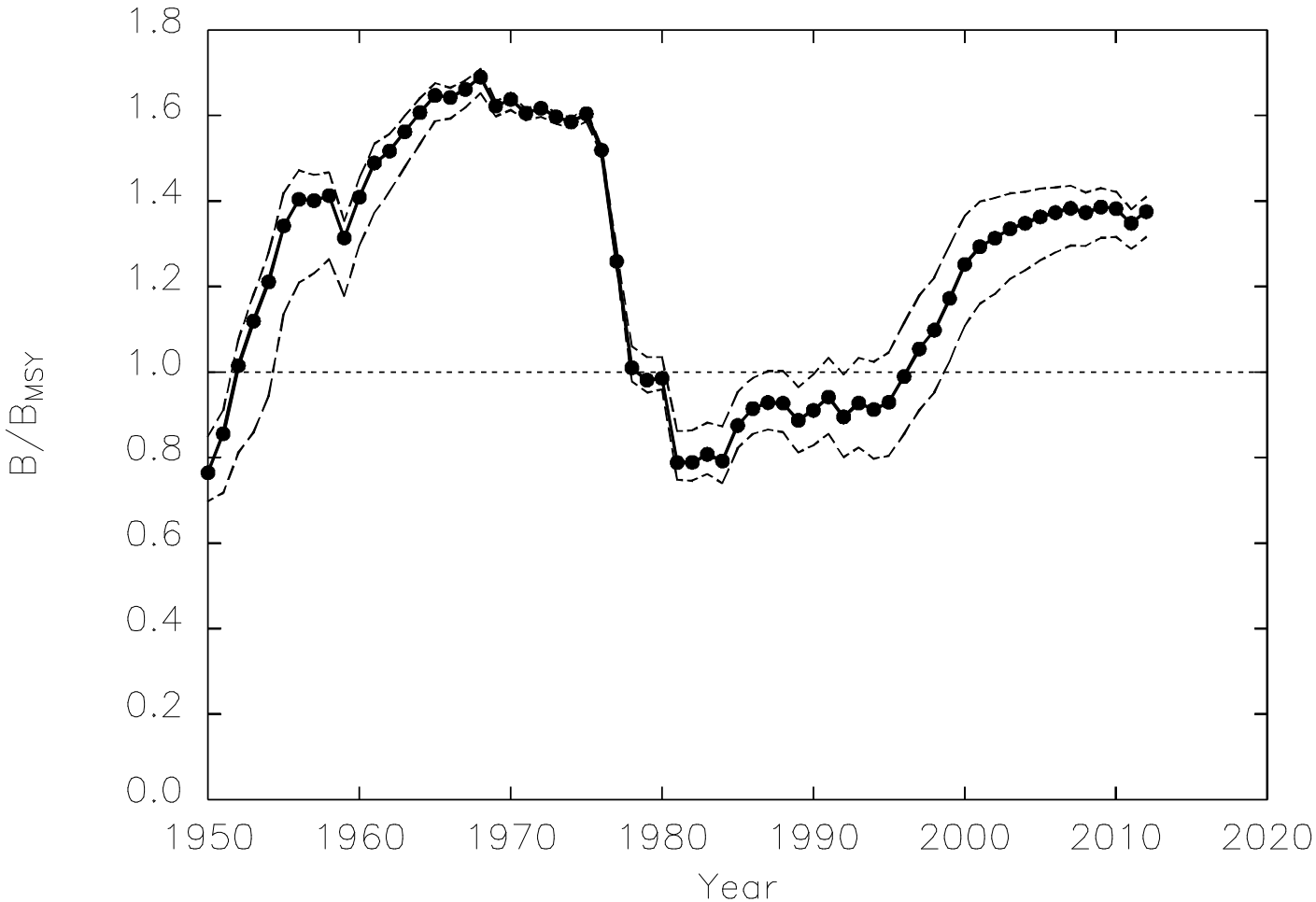
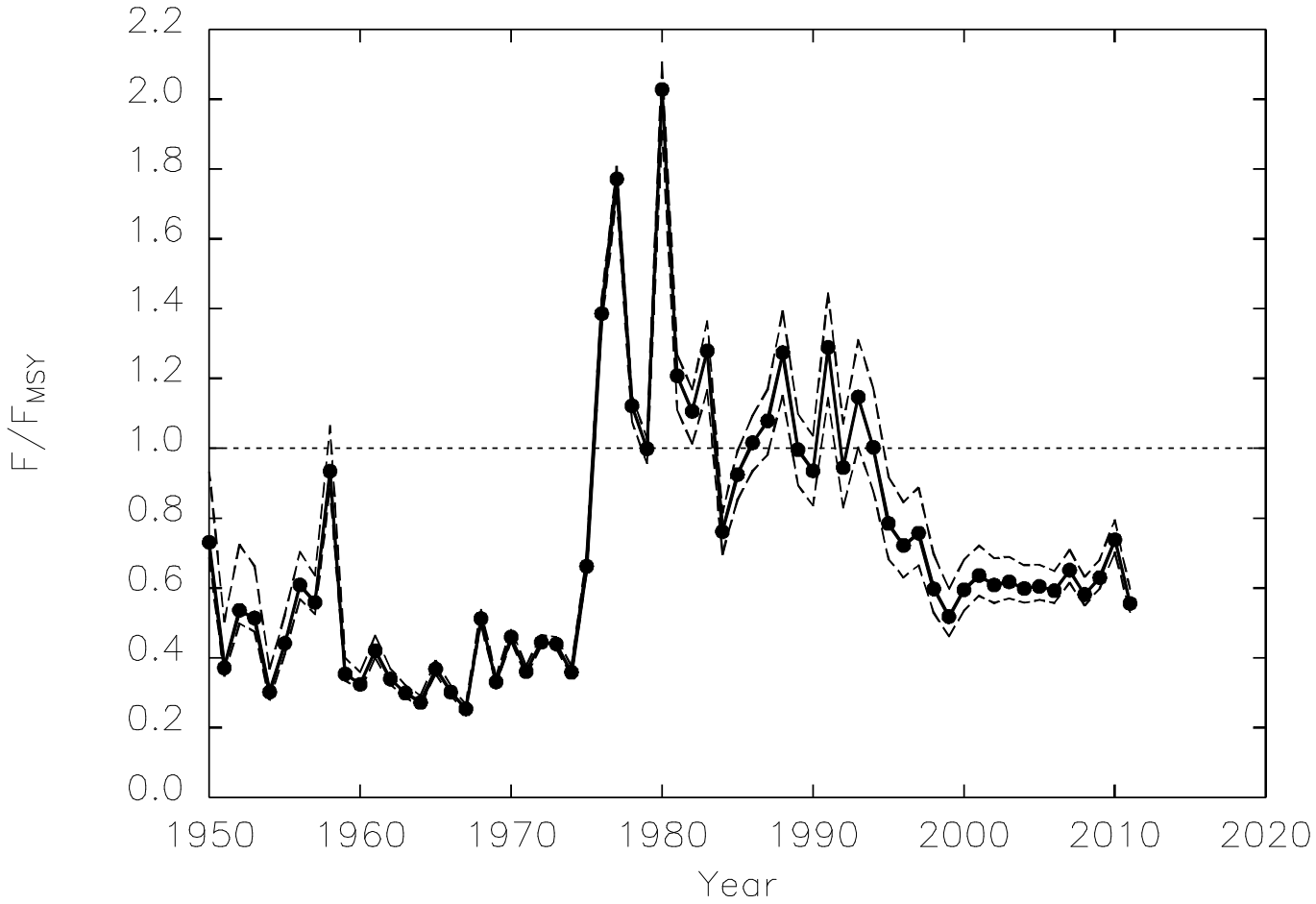



F/Fmsy
B/Bmsy
2.0
1.5
1.0
0.5
0.0
Relative status
1950
1960
1970
1980
1990
2000
2010
Year

Sensitivity and confidence intervals

- Base run
  - B1/k=0.382, F/F_{msy}(2011)=0.56, B/B_{msy}(2012)=1.38
- Sensitivity to B1/k: fixed to 0.2, 0.5, and 0.9
  - B1/k=0.2, F/F_{msy}(2011)=0.56, B/B_{msy}(2012)=1.38
  - B1/k=0.5, F/F_{msy}(2011)=0.56, B/B_{msy}(2012)=1.38
  - B1/k=0.9, F/F_{msy}(2011)=0.56, B/B_{msy}(2012)=1.38
- Confidence intervals of 1000 bootstrap runs

1000 bootstrap runs
80% Confidence Interval



1000 bootstrap runs
80% Confidence Interval