Red Drum Benchmark Stock Assessments

South Atlantic State/Federal Fisheries Management Board

May 5, 2016

Red Drum Assessment Process

- SEDAR 44 Review Workshop – August 2015
  - Recommendations to achieve stable models with the Stock Synthesis statistical framework (SS3)
  - Peer review panel endorsed transition to Stock Synthesis
  - SEDAR 44 Stock Assessment Report
- ASMFC Desk Review – April 2016
  - Evaluate final models for advising management of the red drum stocks
  - Addendum II to SEDAR 44 Stock Assessment Report

Assessment History

- Vaughan and Helser 1990
- Vaughan 1992, 1993, 1996
- Vaughan and Carmichael 2000 – Virtual Population Analysis
- SEDAR 18 (2009) – Statistical Catch-at-Age

SEDAR 18 Limitations

- Plus group (6+) includes ≈90% of the age structure in the northern stock and ≈83% of the age structure in the southern stock
  - No reliable abundance/biomass benchmarks for either stock
  - Plus group abundances unexpectedly large
- Northern model fit to external tag-based F estimates and is highly dependent on these estimates (inconsistencies between F estimates and other data sources)
  - Lack of a tagging program sampling design (some areas potentially under sampled and others over sampled)
- Catch-at-age data developed externally, some of which was derived with sparse biological data pooled over fleets
- Model structure a major source of uncertainty of estimates of stock status indicators – sensitive to selectivity scalars
- Southern stock estimates too uncertain to make quantitative statements about stock status

Stock Synthesis Framework

- Supported, peer-reviewed framework for calibrating population dynamics models
- Highly flexible and customizable to many data types and stock characteristics
- Comprehensive propagation and quantification of data uncertainty and diagnostics for model misspecification

Red Drum Stocks

- Two management units
  - Northern stock (Atlantic coast north of NC-SC border)
  - Southern stock (Atlantic coast south of NC-SC border)

- Split supported by differences in genetics, life history characteristics, habitat use, and tagging data

Northern Red Drum Model

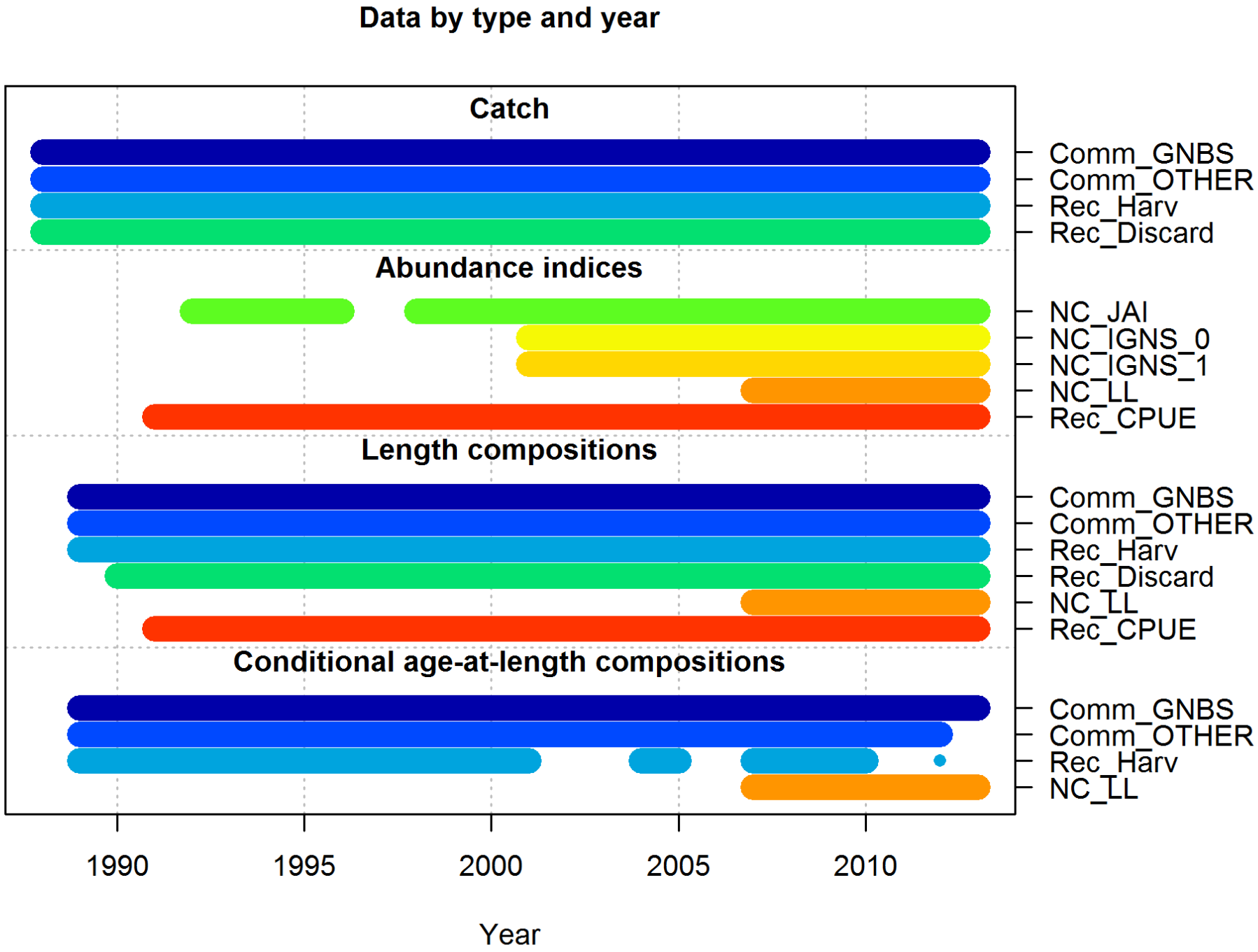
- Age structure from 0 (spawned the previous fall) to 41+

- Initial population (January 1989) estimates informed by previous removals and recruitment

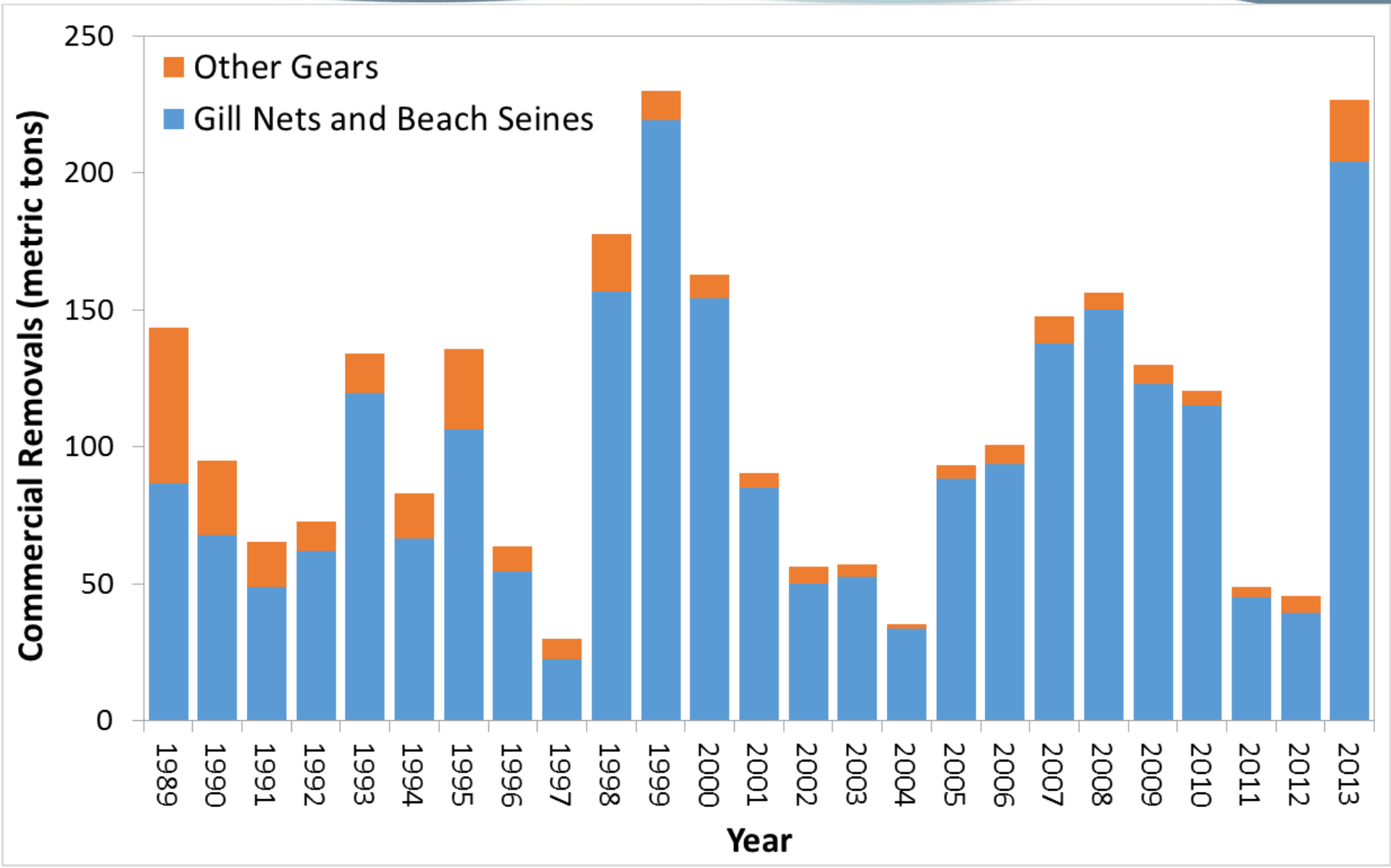
- Annual abundance and biomass projected forward from 1989-2013 as a function of age-0 recruitment, growth, maturity, natural mortality, and fishing mortality

Base Model changes following SEDAR 44 Review Workshop

- Model start year changed from 1950 to 1989
- Fishing mortality parameterization changed
- Selectivity functions for harvest fleets simplified
- Some selectivity changes excluded
  - Harvest fleets in 1999
  - Recreational release mortalities and recreational CPUE in 1992 and 1999
- Tag-recapture sub-model excluded

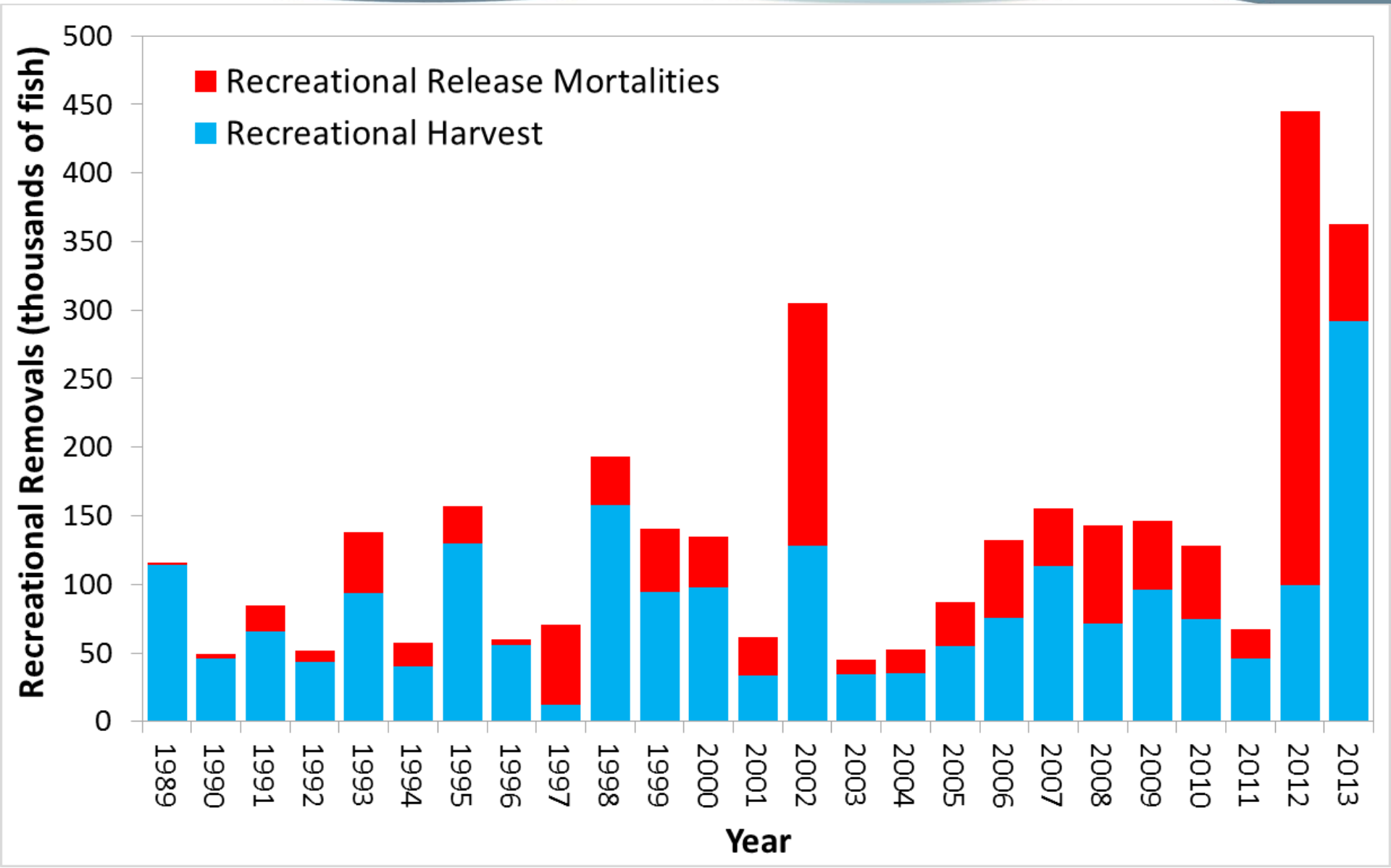

Data by type and year
Catch
Comm_GNBS
Comm_OTHER
Rec_Harv
Rec_Discard
Abundance indices
NC_JAI
NC_IGNS_0
NC_IGNS_1
NC_LL
Rec_CPUE
Length compositions
Comm_GNBS
Comm_OTHER
Rec_Harv
Rec_Discard
NC_LL
Rec_CPUE
Conditional age-at-length compositions
Comm_GNBS
Comm_OTHER
Rec_Harv
NC_LL
1990
1995
2000
2005
2010
Year

Commercial Removals

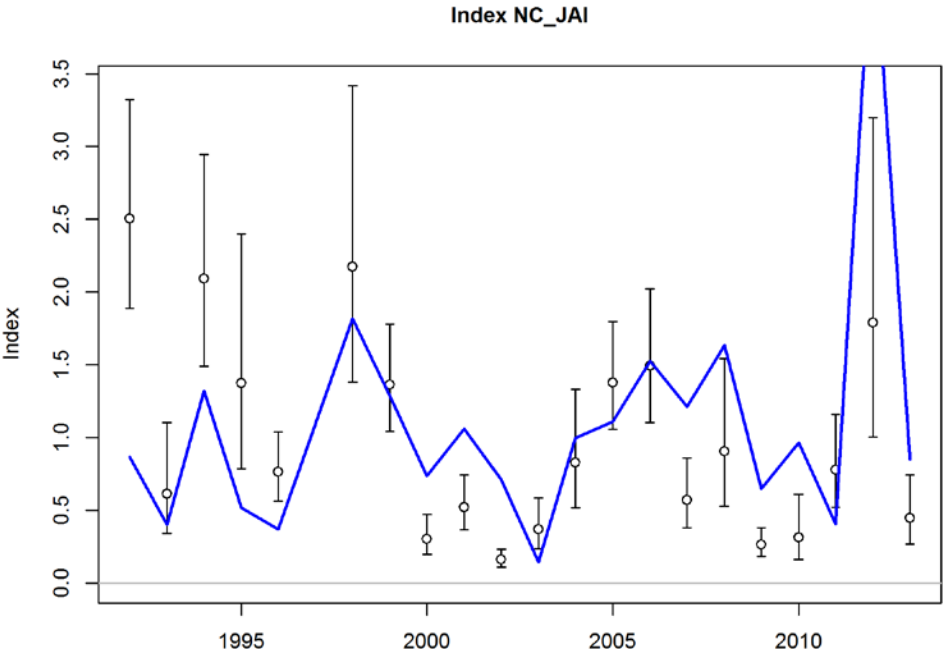


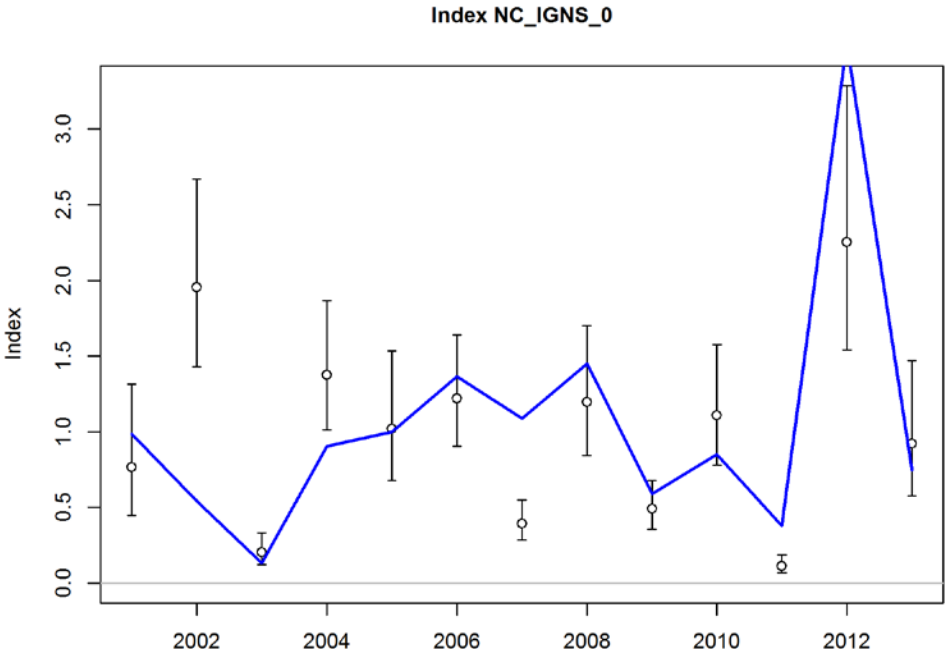
**gill nets include dead discards with 5% of fish discarded alive assumed to die due to capture

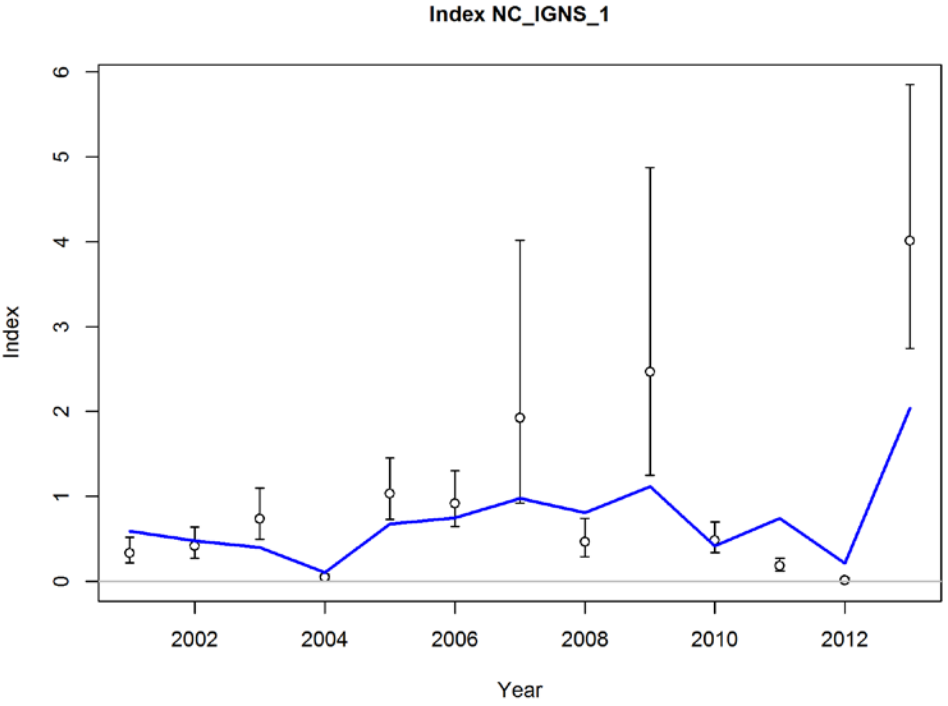
Recreational Removals

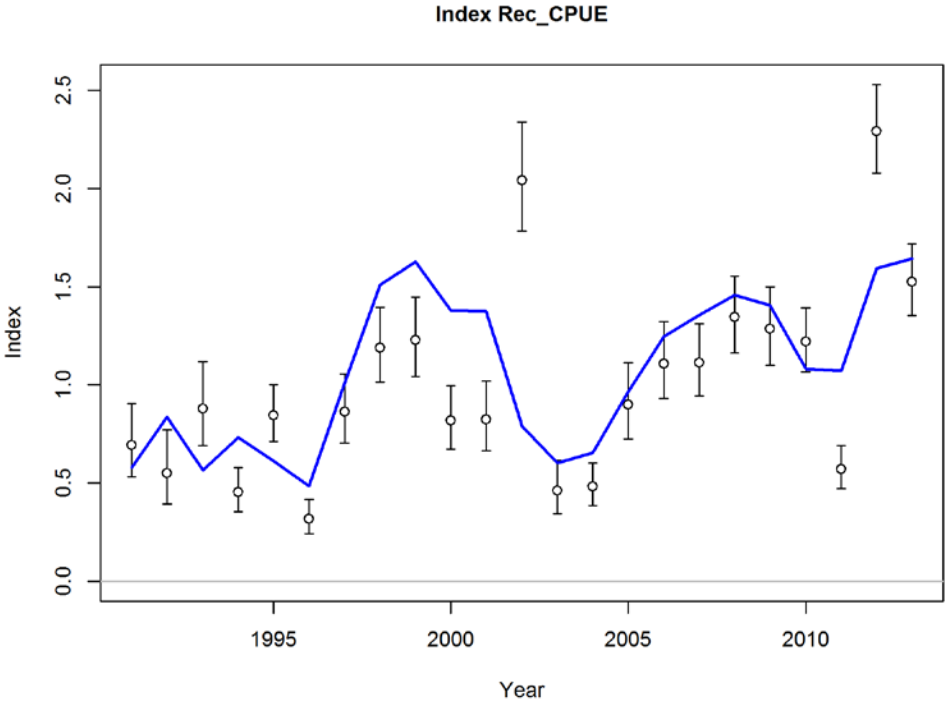


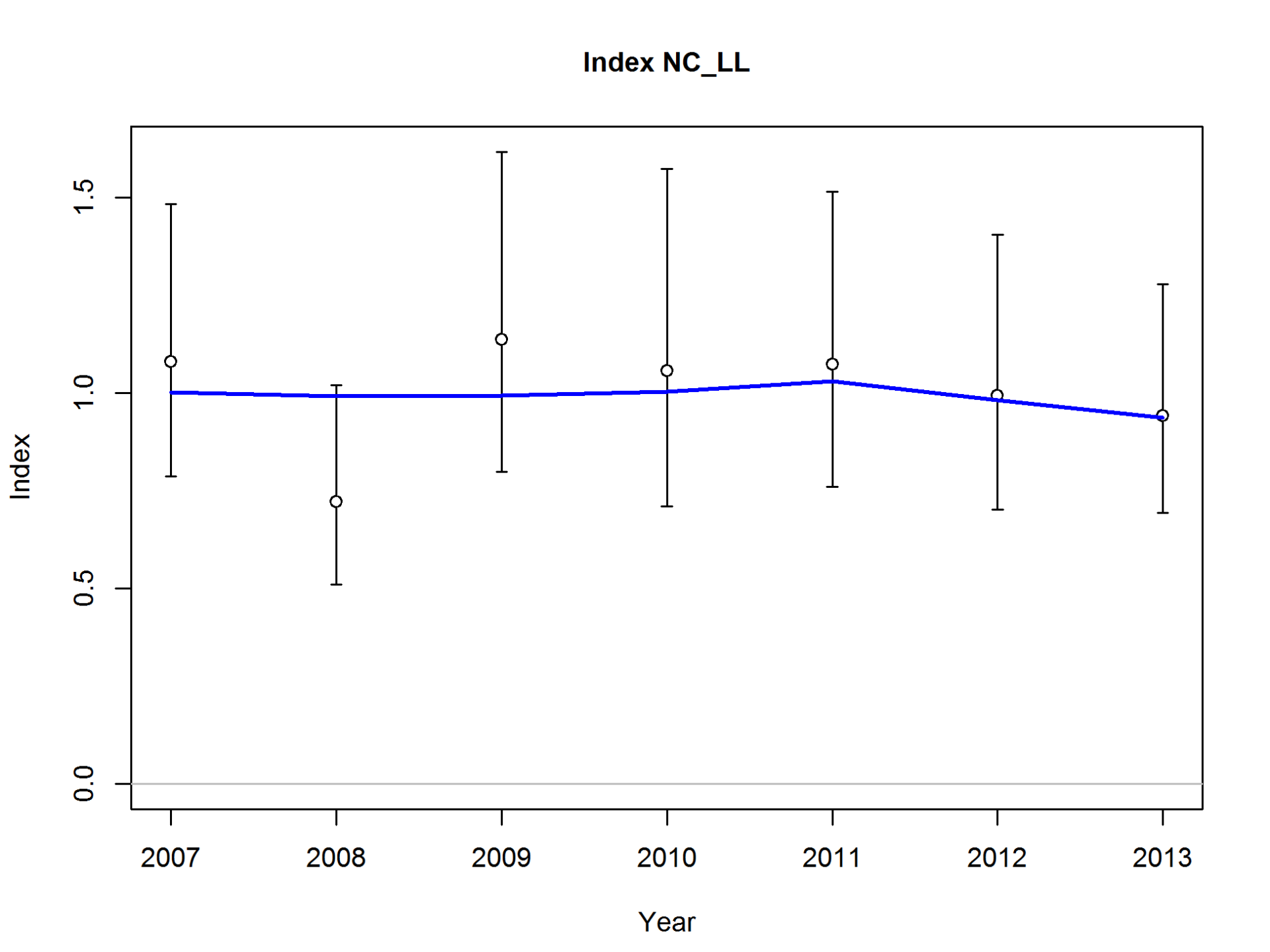
**8% mortality rate assumed for recreational releases

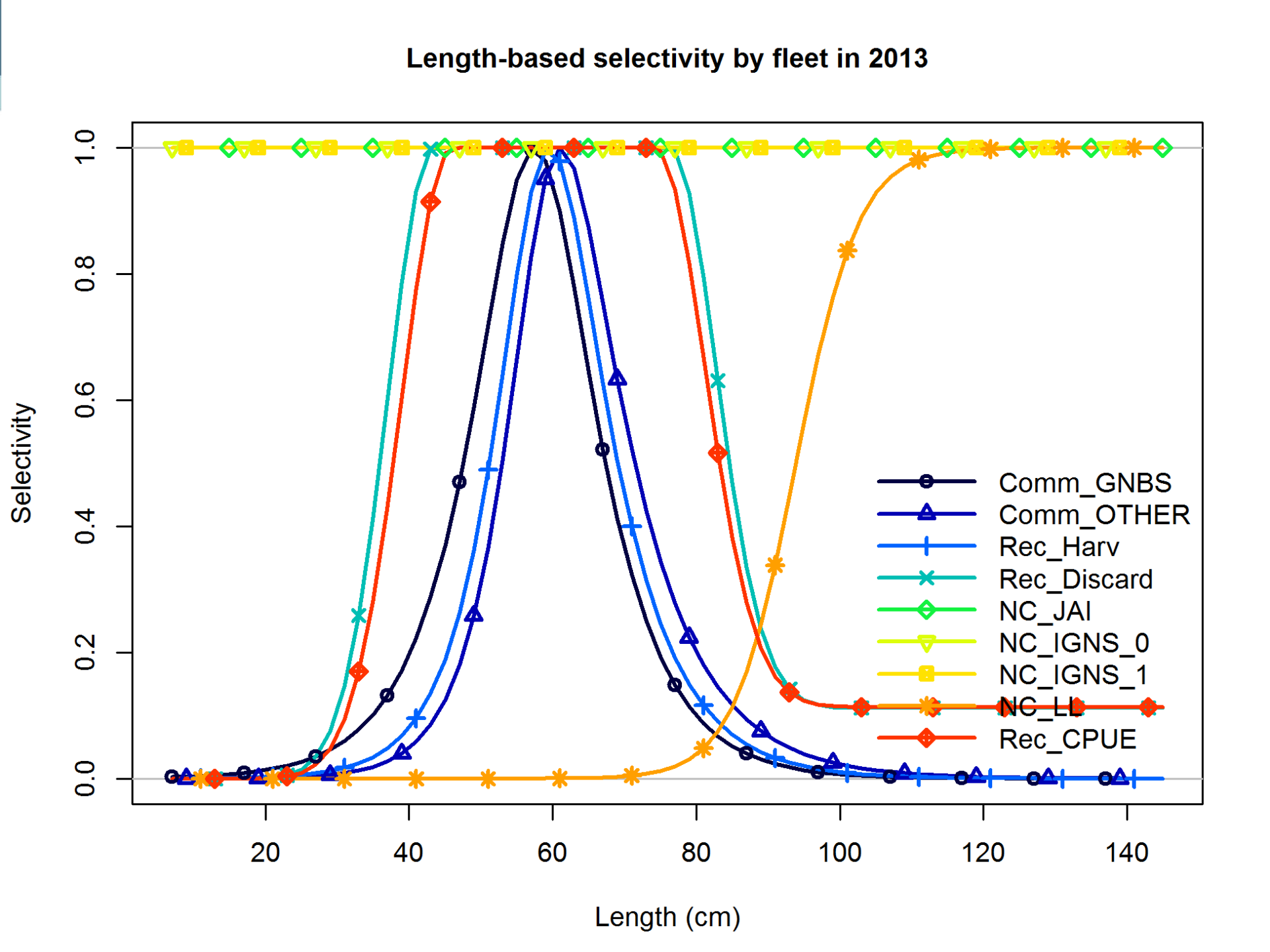

Index NC_JAI
Index
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
1995
2000
2005
2010


Index NC_IGNS_0
Index
0.0
0.5
1.0
1.5
2.0
2.5
3.0
2002
2004
2006
2008
2010
2012

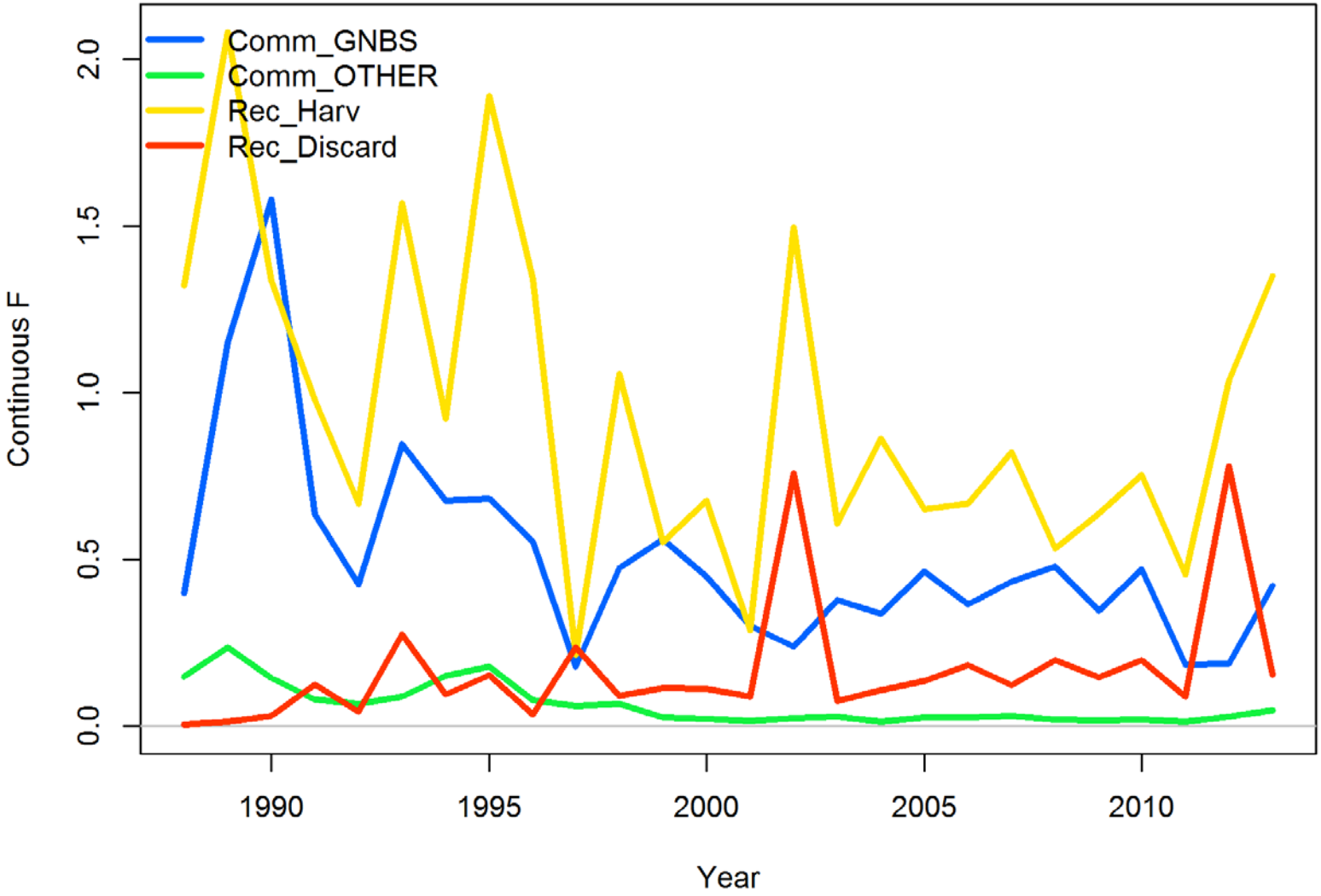

Index NC_IGNS_1
Index
0
1
2
3
4
5
6
2002
2004
2006
2008
2010
2012
Year


Index Rec_CPUE
Index
0.0
0.5
1.0
1.5
2.0
2.5
1995
2000
2005
2010
Year

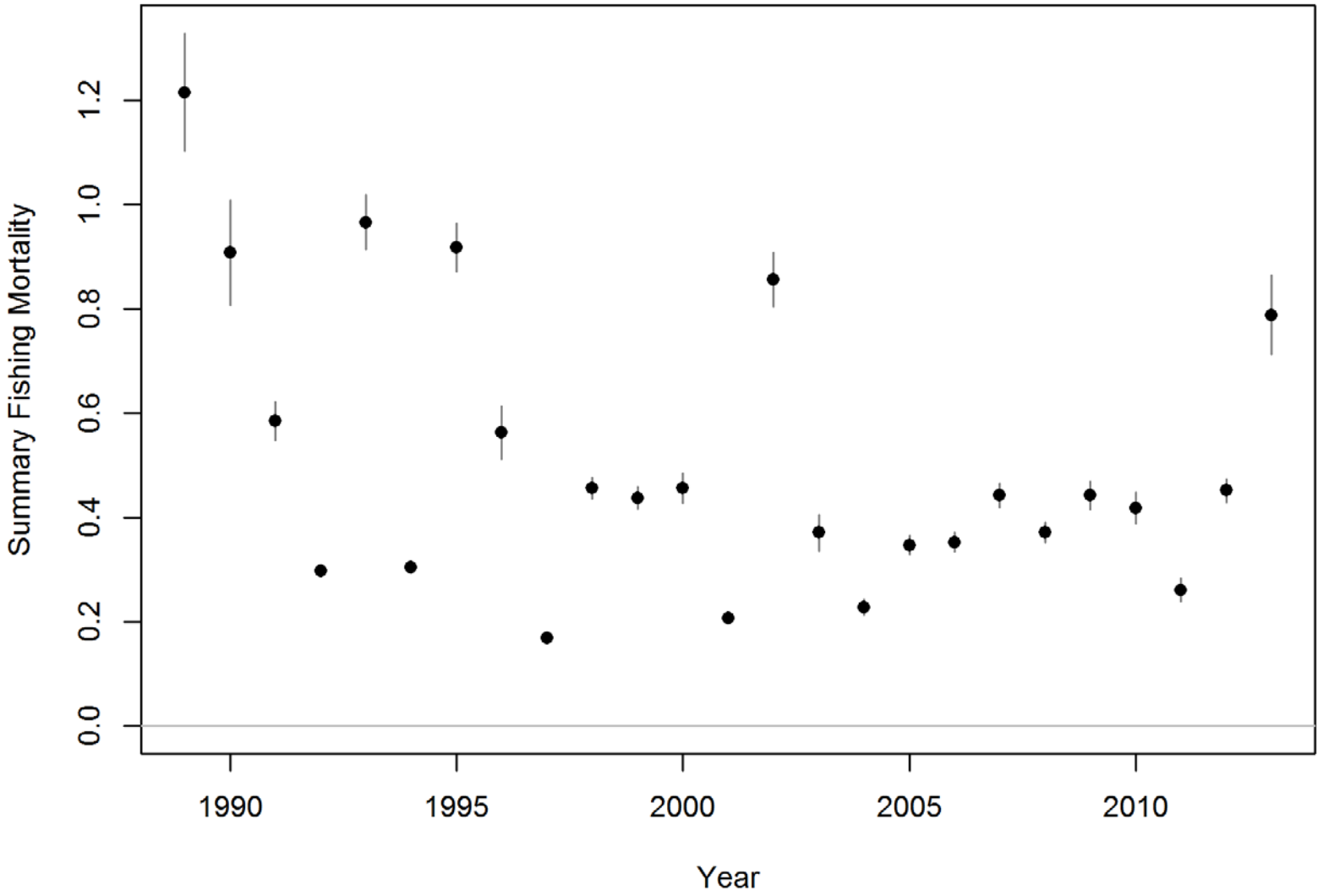

Index NC_LL
Index
0.0
0.5
1.0
1.5
2007
2008
2009
2010
2011
2012
2013
Year

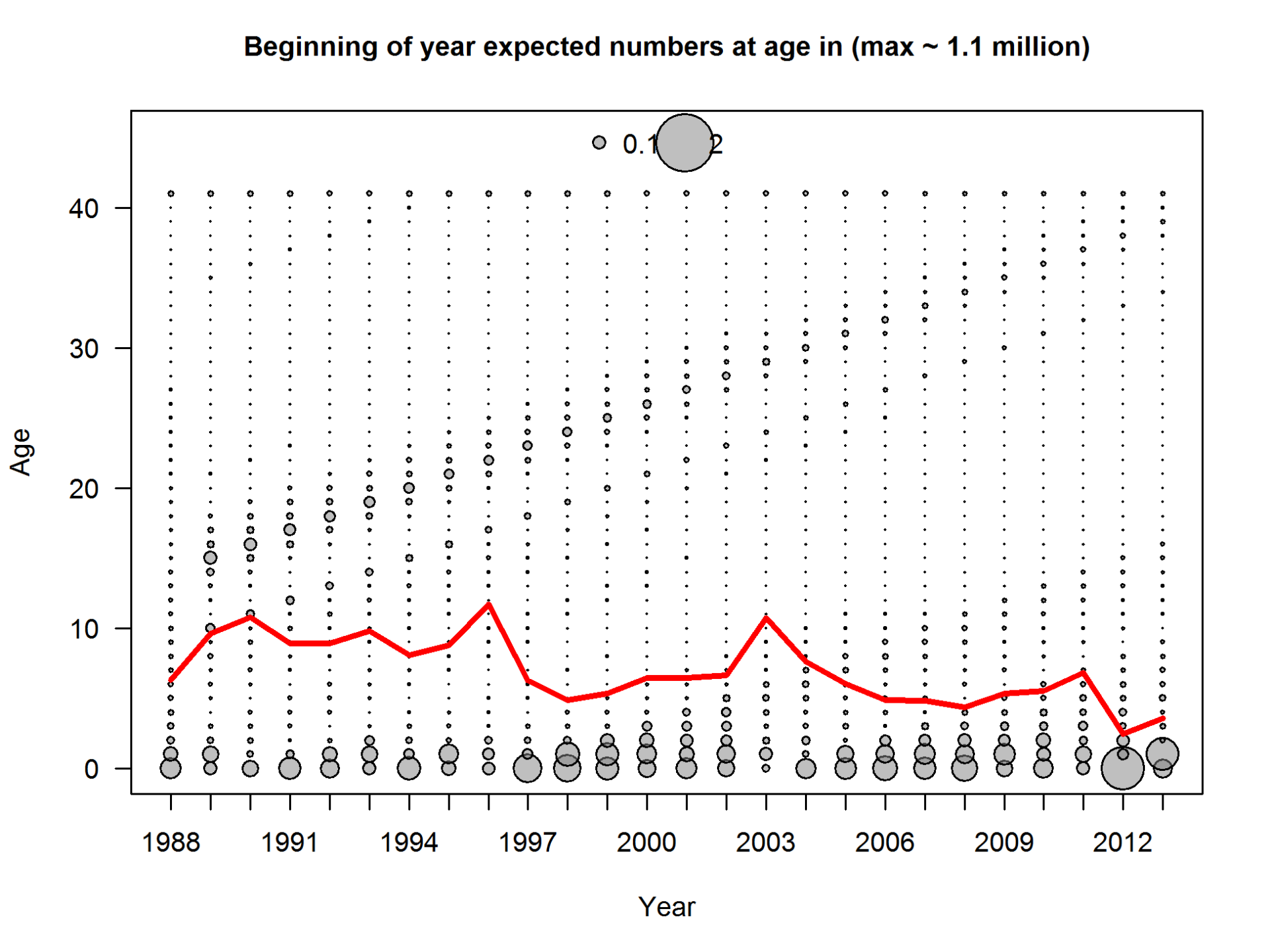

Length-based selectivity by fleet in 2013
Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
20
40
60
80
100
120
140
Length (cm)
Comm_GNBS
Comm_OTHER
Rec_Harv
Rec_Discard
NC_JAI
NC_IGNS_0
NC_IGNS_1
NC_LL
Rec_CPUE

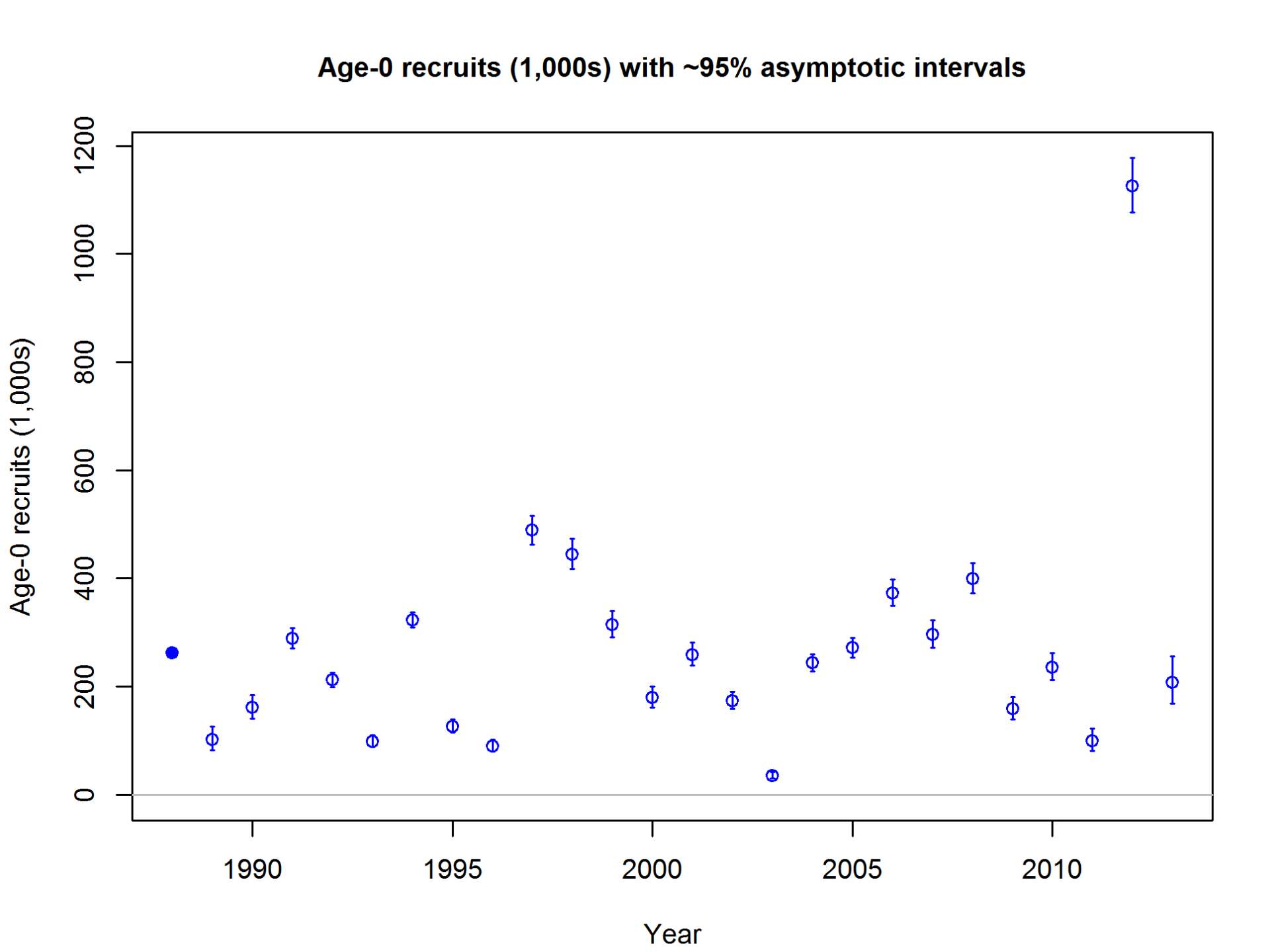
Fleet-Specific F (ages 0-5)



Annual F (ages 0-5)




Beginning of year expected numbers at age in (max ~ 1.1 million)
0.1
2
Age
0
10
20
30
40
1988
1991
1994
1997
2000
2003
2006
2009
2012
Year

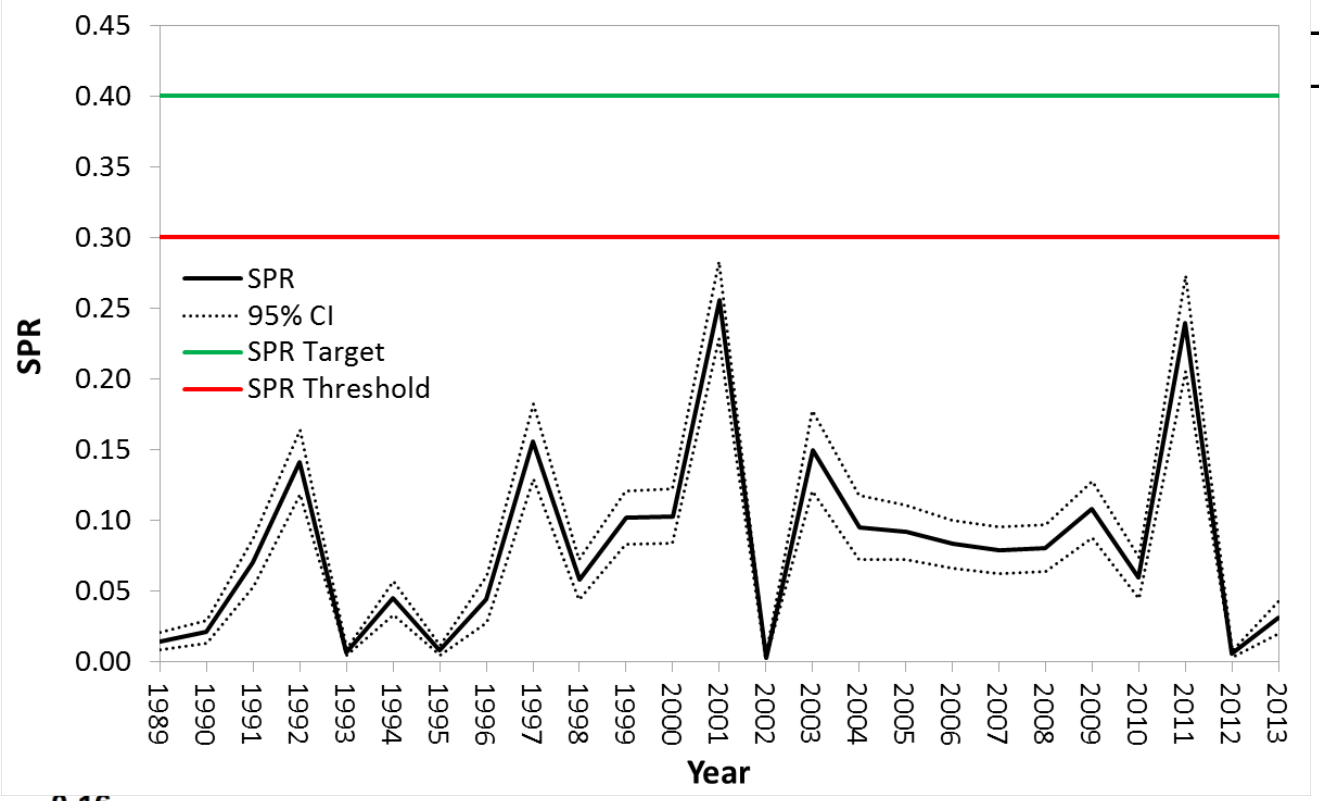

Age-0 recruits (1,000s) with ~95% asymptotic intervals
Age-0 recruits (1,000s)
0
200
400
600
800
1000
1200
1990
1995
2000
2005
2010
Year

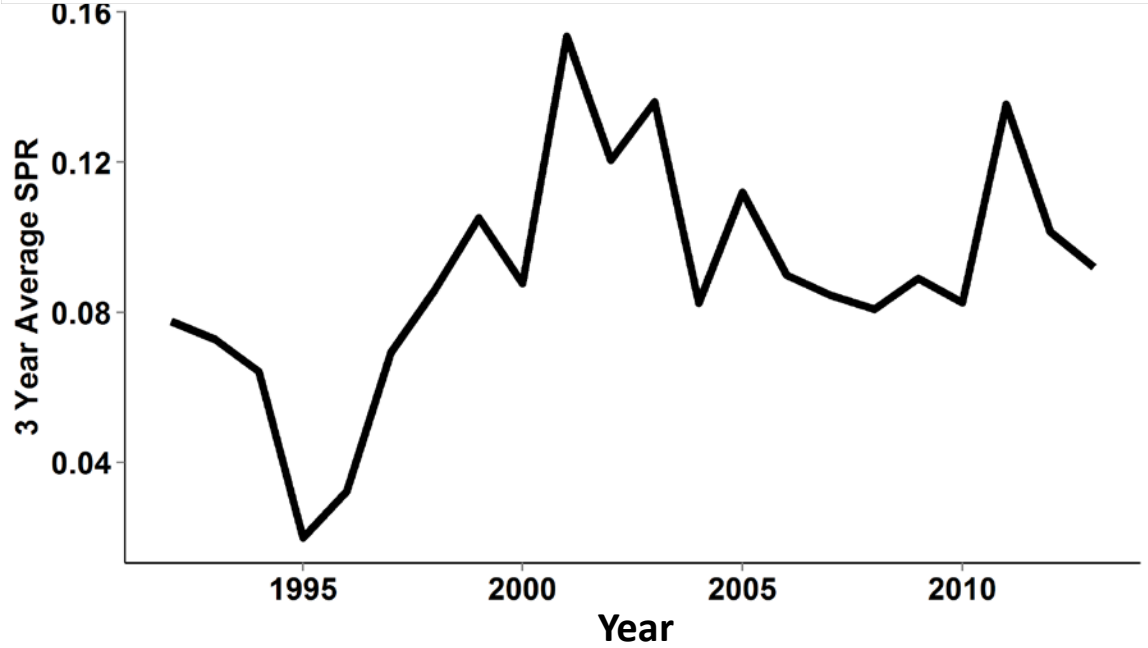
Reference Points

- Amendment 2 to the Red Drum Fishery Management Plan
  - Static Spawning Potential Ratios (SPR)
    - Target = 40% SPR
    - Threshold = 30% SPR
    - SPR below the threshold indicates overfishing

- Benchmarks associated with 40% SPR Target

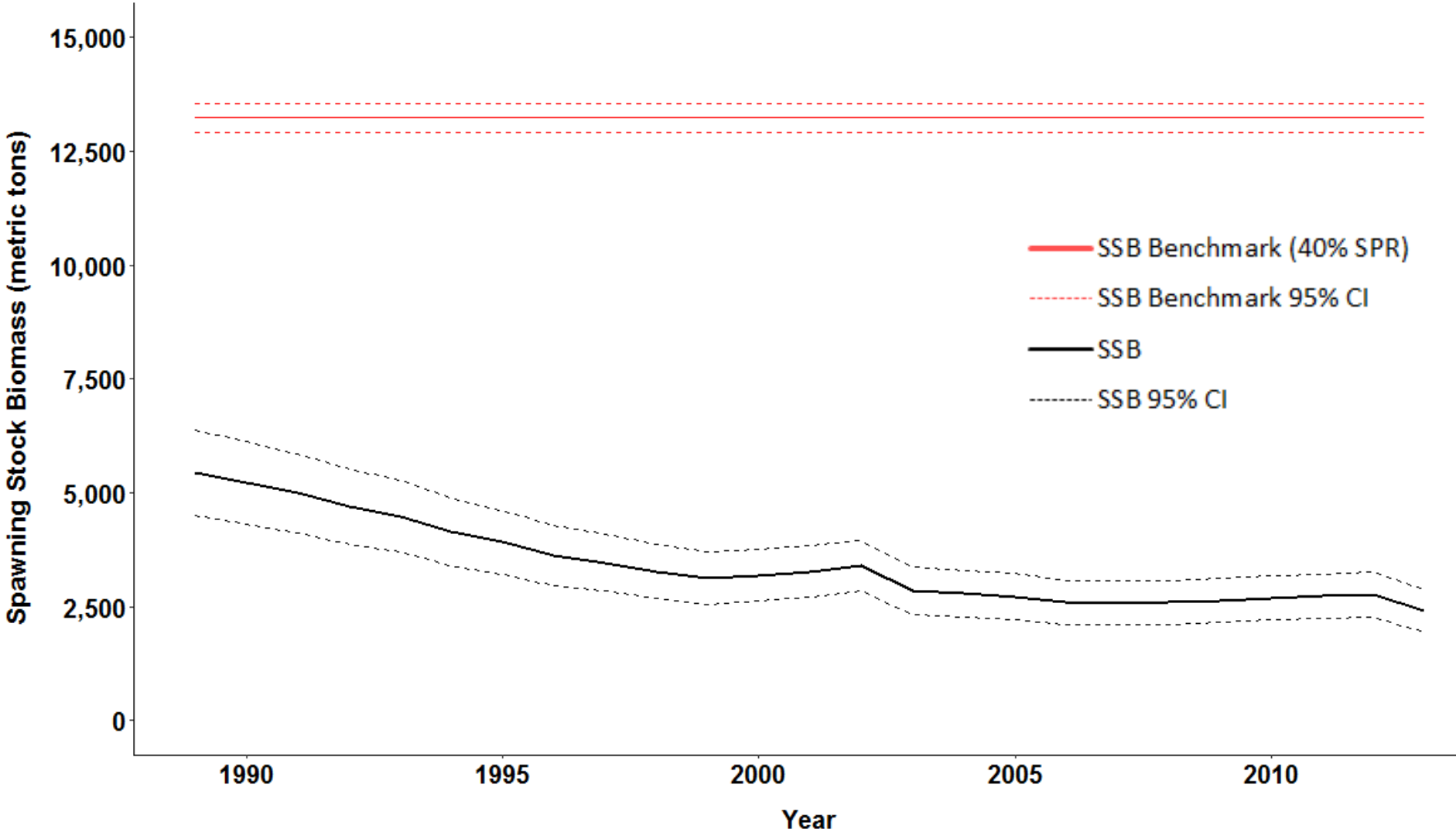
Quantity	Estimate	CV
SSB (metric tons)	13,232	0.012
F (ages 0-5)	0.15	0.011
Yield (metric tons)	345.57	0.017



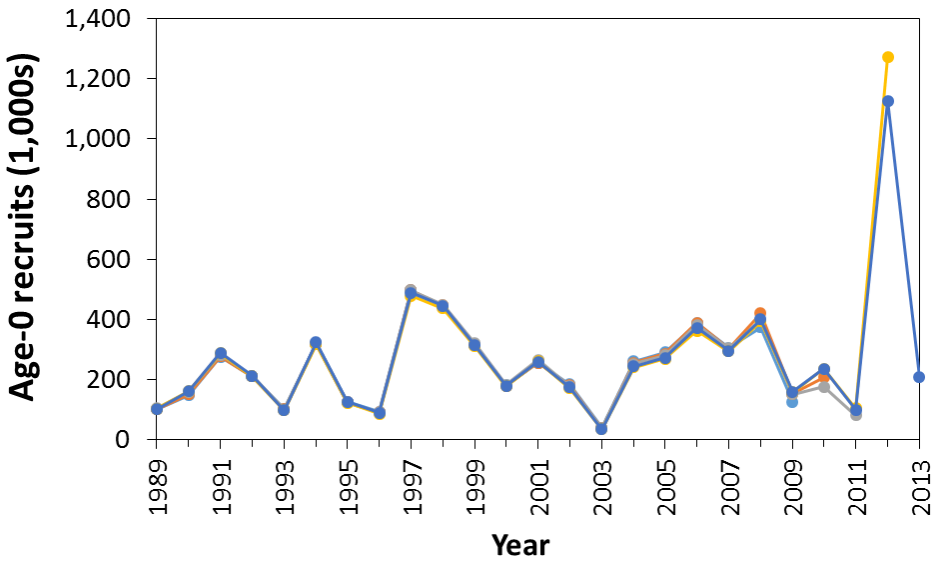


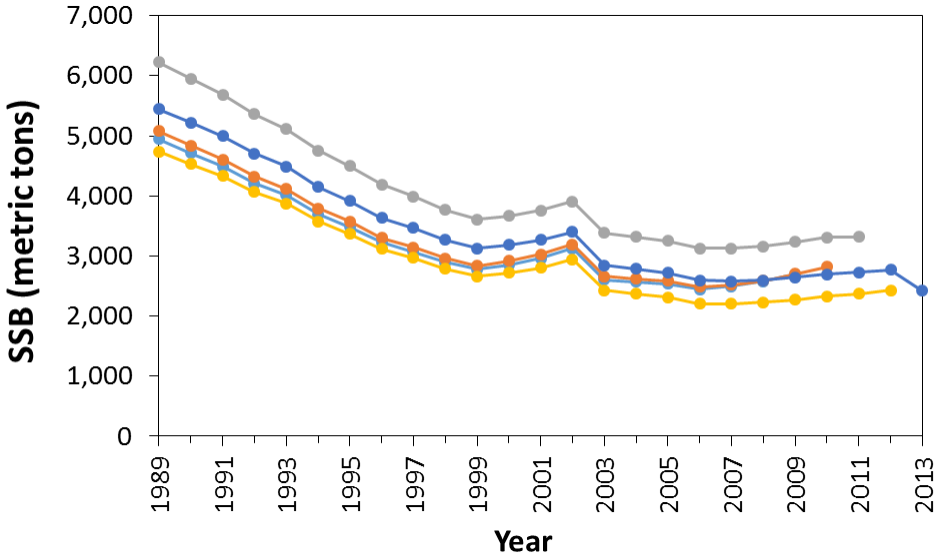
Year	SPR	CV
1989	0.014	0.003
1990	0.021	0.004
1991	0.070	0.009
1992	0.141	0.014
1993	0.007	0.001
1994	0.045	0.006
1995	0.008	0.002
1996	0.044	0.009
1997	0.156	0.016
1998	0.058	0.008
1999	0.102	0.011
2000	0.103	0.011
2001	0.256	0.019
2002	0.003	0.001
2003	0.149	0.017
2004	0.095	0.013
2005	0.092	0.011
2006	0.083	0.009
2007	0.079	0.009
2008	0.081	0.009
2009	0.108	0.011
2010	0.059	0.008
2011	0.239	0.023
2012	0.005	0.001
2013	0.031	0.006

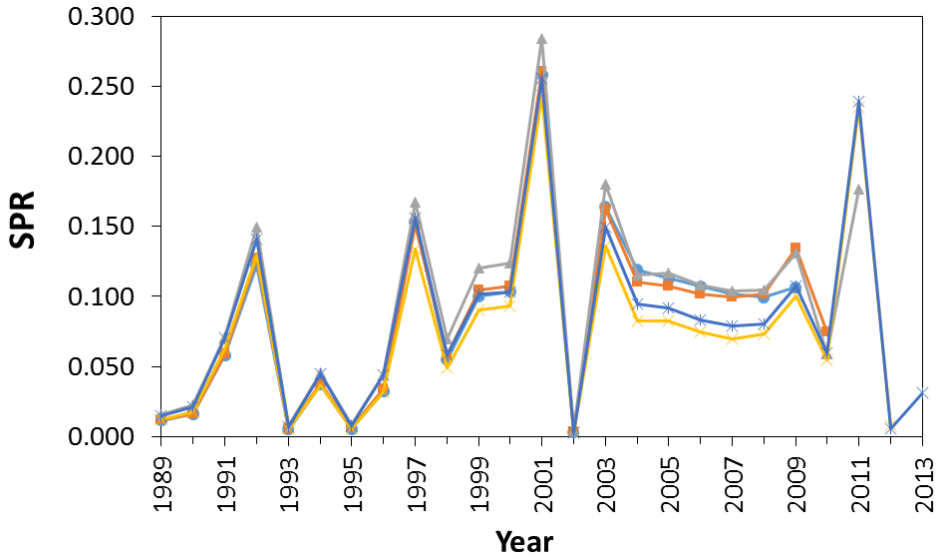
Spawning Stock Biomass



Retrospective Analysis

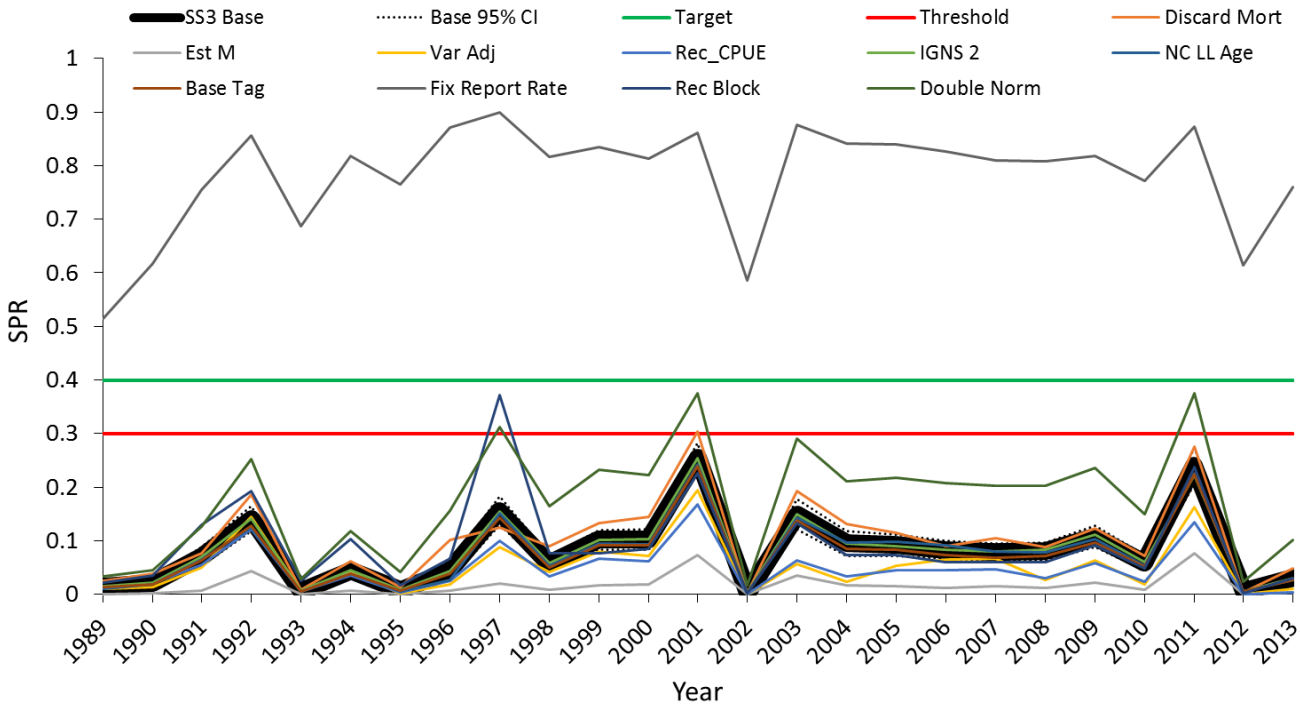


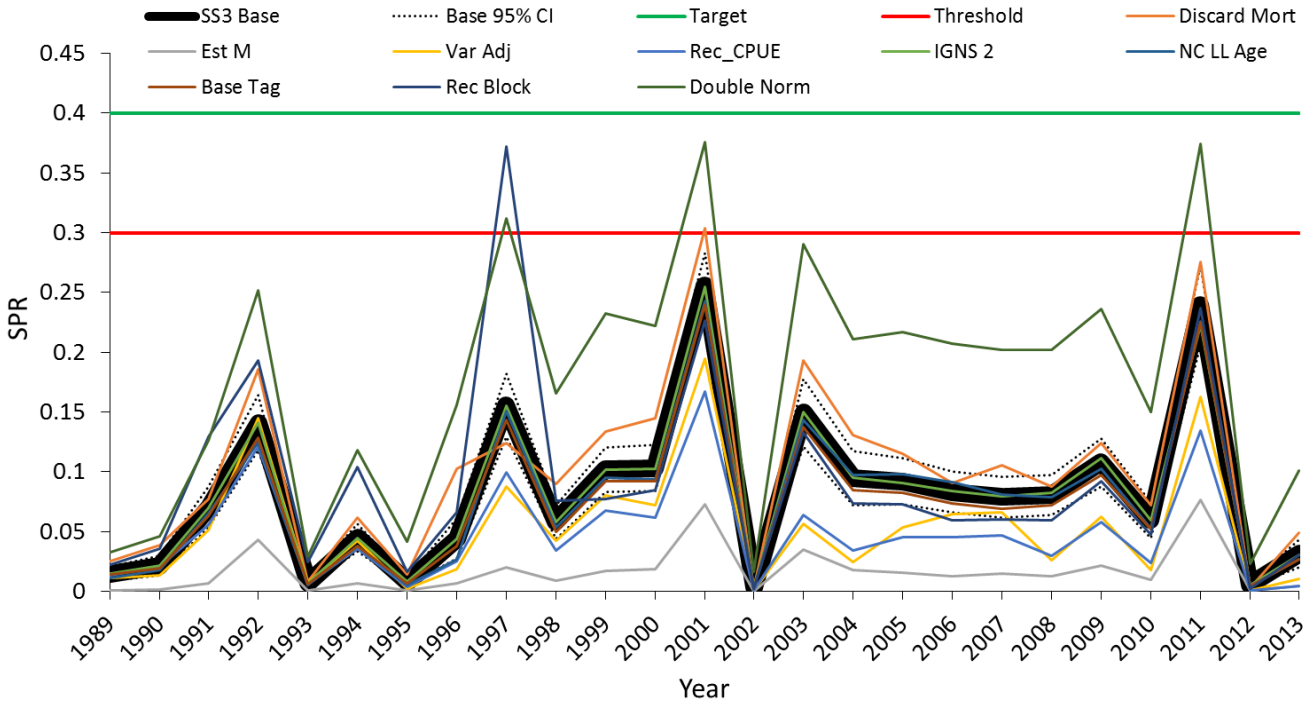




Sensitivity Analysis

- Catch-at-age for NC Longline index
- Different selectivity assumptions and functions
- Higher recreational release mortality rate (16%)
- Estimating M within the model
- Variance adjustments
- Exclusion of Recreational CPUE
- Inclusion of the NC IGNS age-2 index
- Inclusion of base tag-recapture sub-model
- Fixed tag reporting rates
- Alternative with catch-at-age data


SS3 Base
Base 95% CI
Target
Threshold
Discard Mort
Est M
Var Adj
Rec_CPUE
IGNS 2
NC LL Age
Base Tag
Fix Report Rate
Rec Block
Double Norm
SPR
Year

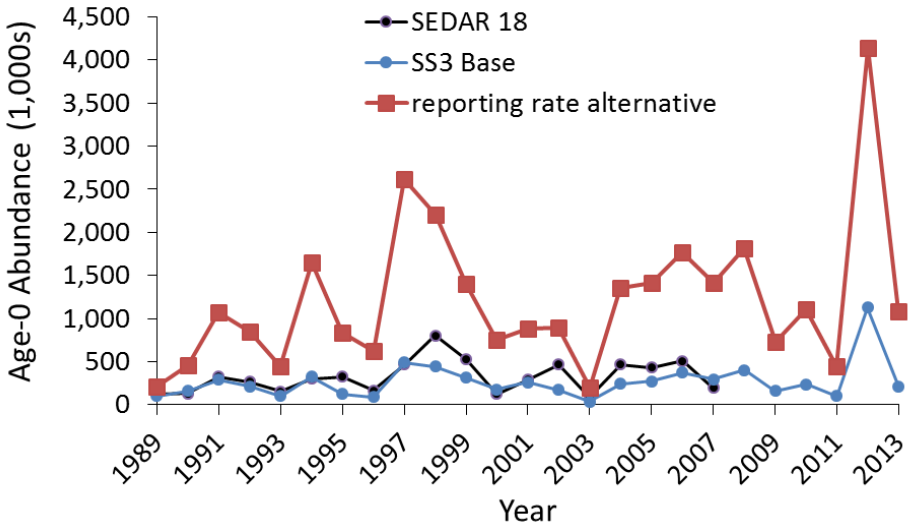

SS3 Base
Base 95% CI
Target
Threshold
Discard Mort
Est M
Var Adj
Rec_CPUE
IGNS 2
NC LL Age
Base Tag
Rec Block
Double Norm
SPR
Year

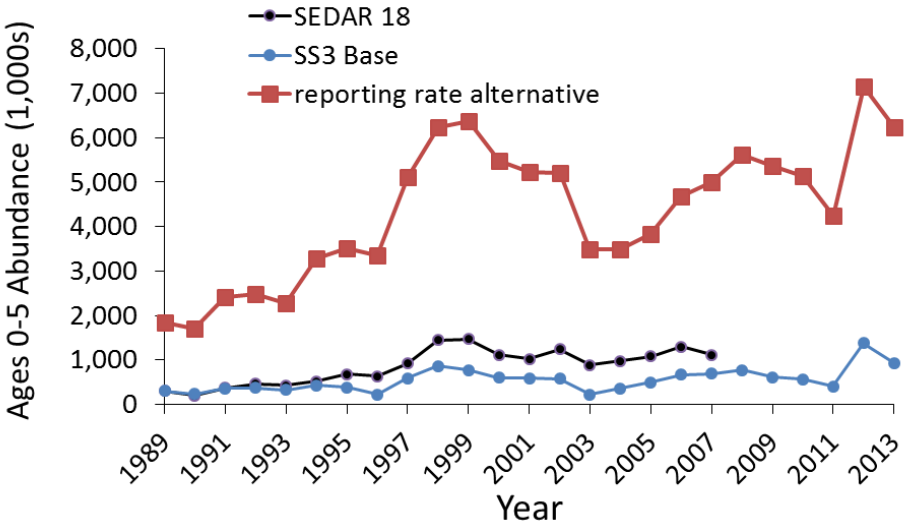
Tag Reporting Rates

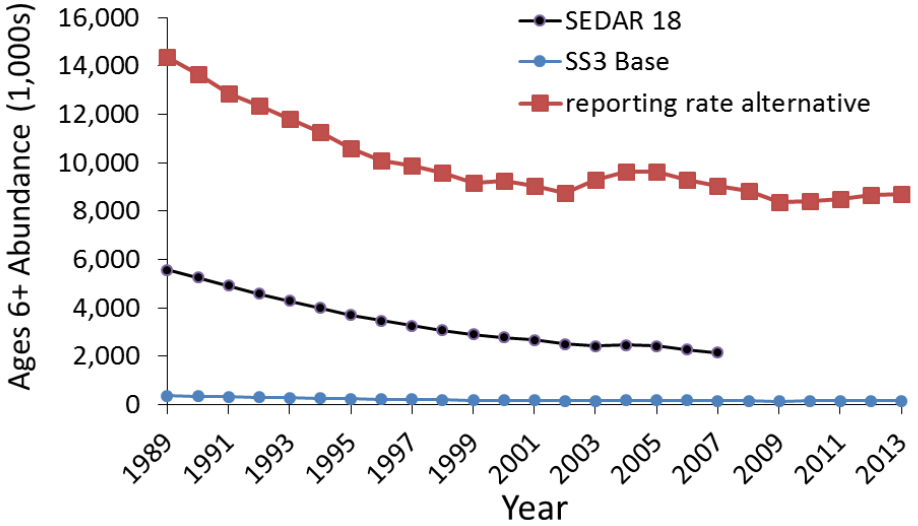
Reporting Rate	Estimate	Ages	Fishery	Time Period of Fish Tagged	Treatment of Released Tags	Tags
Base SS3 Tag Model	0.09-0.12	0-16	Fleet-Specific	1989-2004	Not Included	NC DMF
Bacheler et al. 2008	0.18	0-3+	All Fleets Combined	1983-2006	Included	NC DMF
Bacheler et al. 2009	0.49	1	All Fleets Combined	2005-2007	Included	NC DMF
Bacheler et al. 2009	0.77	1	Recreational Fleets Combined	2005-2007	Included	NCSU
Bacheler et al. 2009	0.44	1	Commercial Fleets Combined	2005-2007	NA	NCSU

*Bacheler et al. 2009 reporting rate estimates based on assumed 100% reporting rate of high reward tags

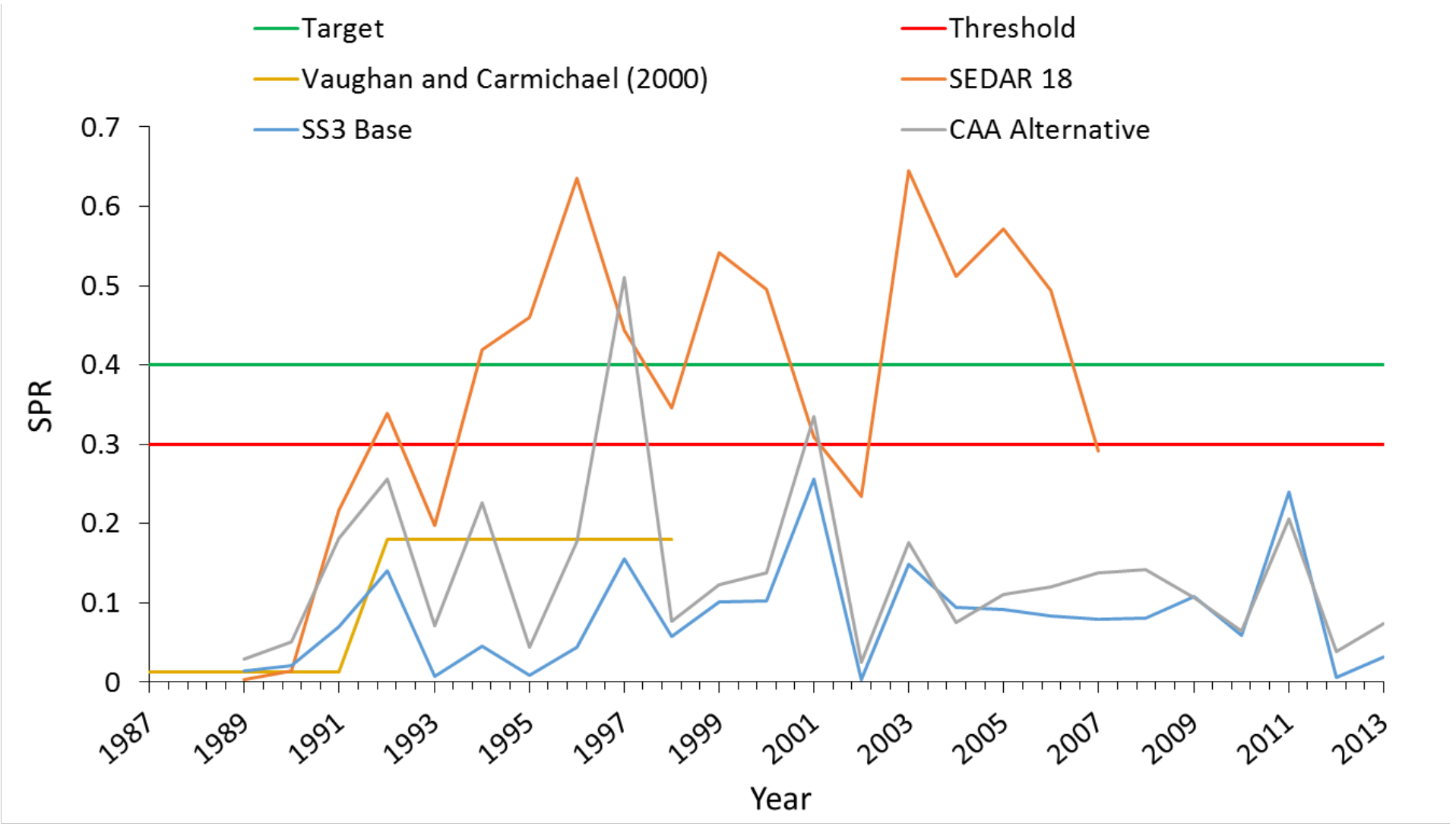
Abundance Estimates



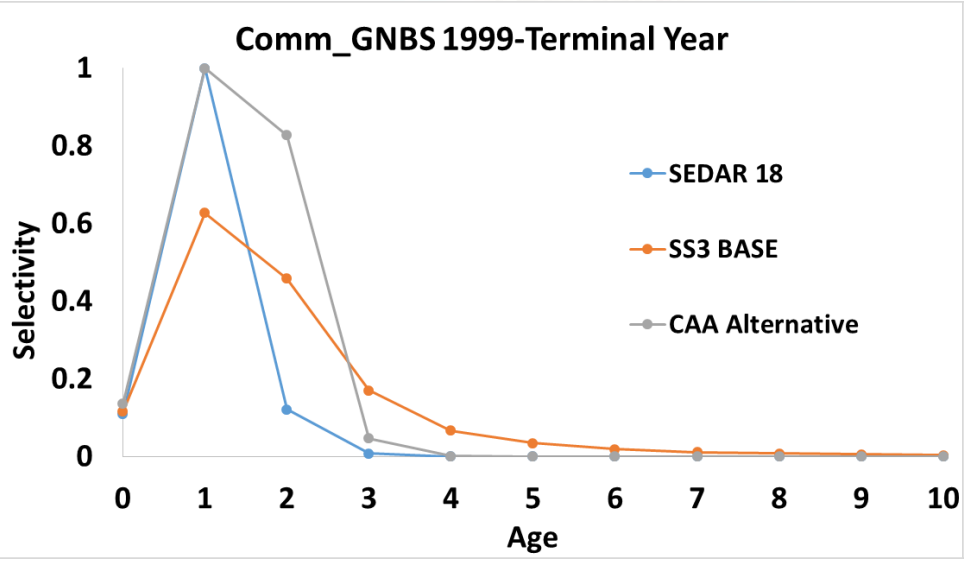


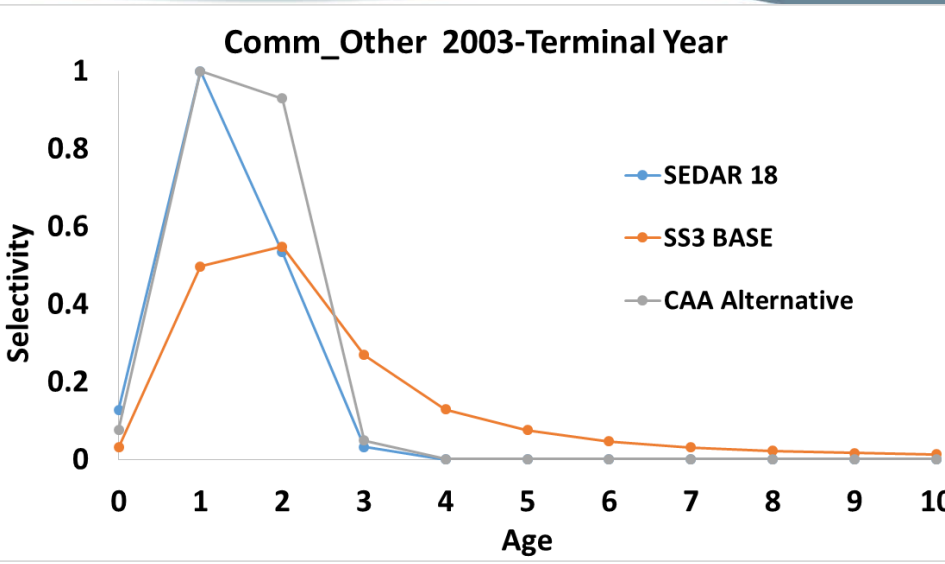


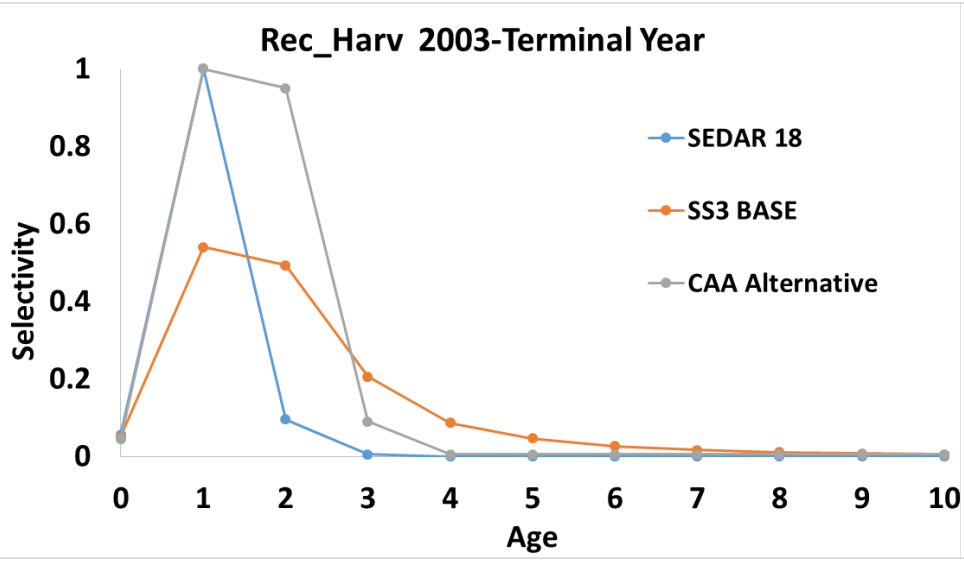
Comparison to Past Assessments

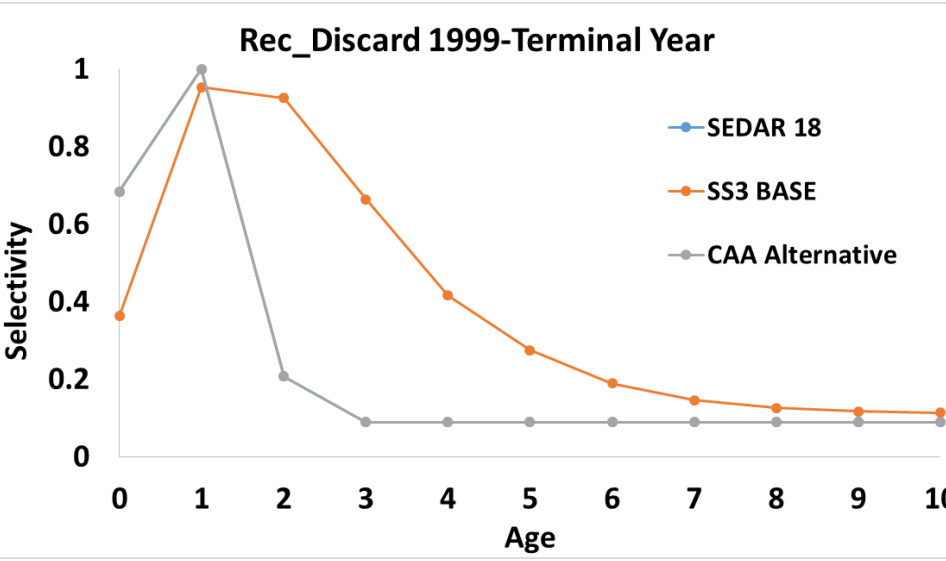


Selectivity

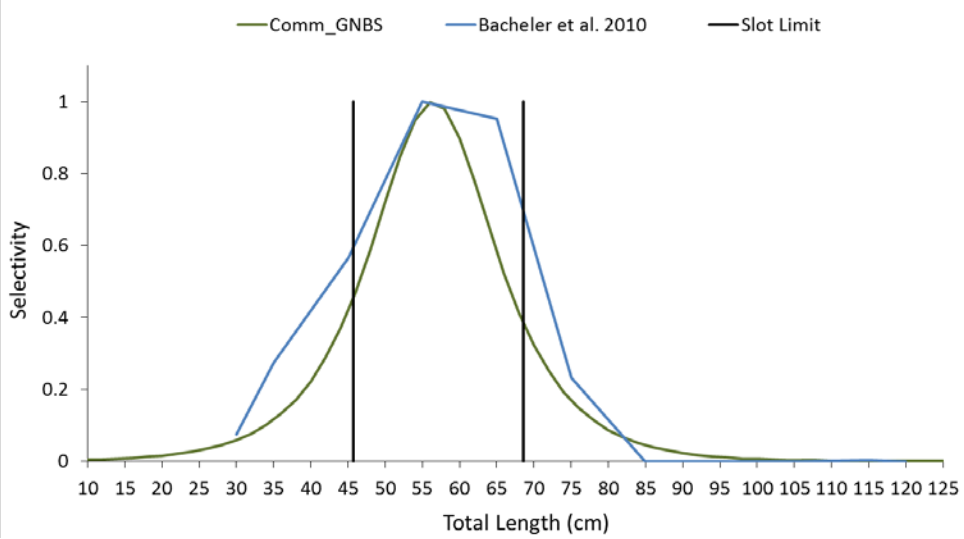


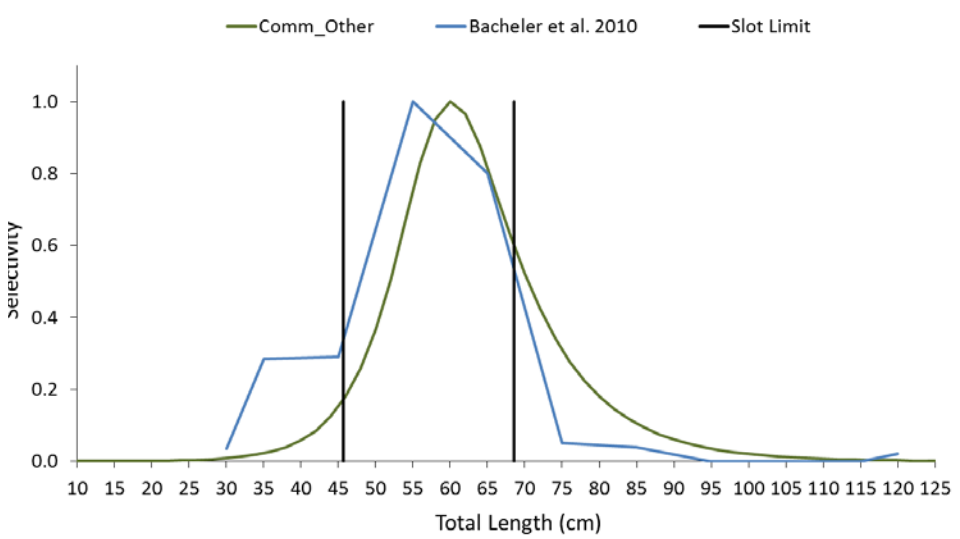


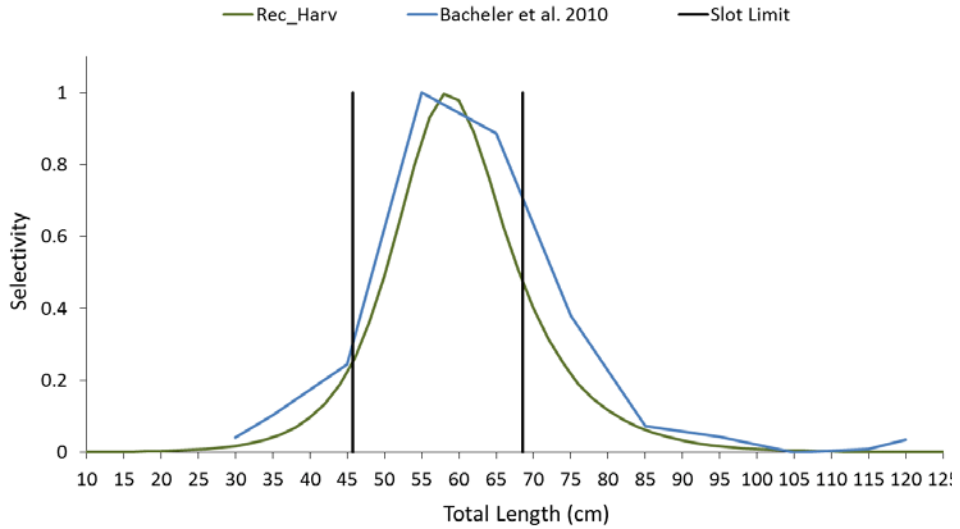


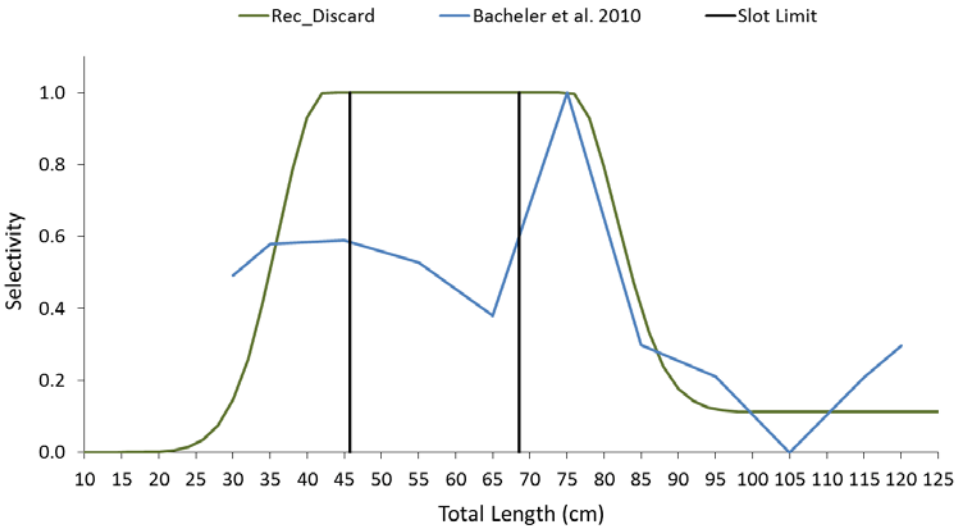


Comparison to Bacheler et al. 2010

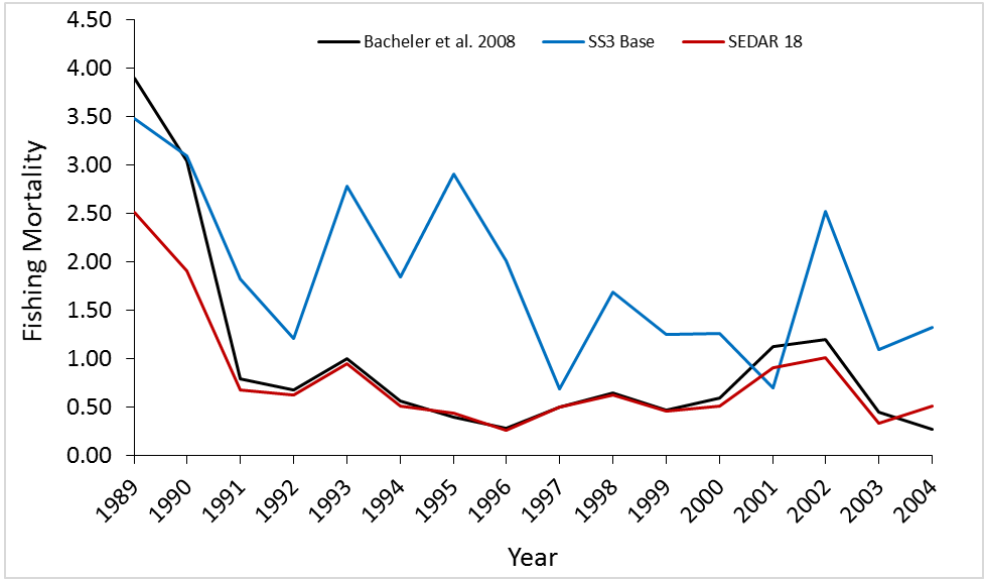


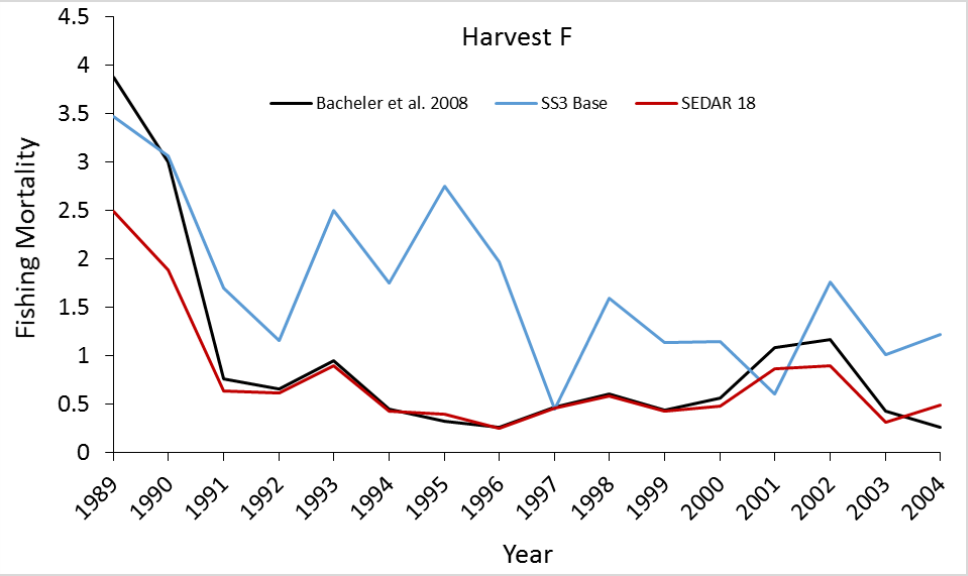


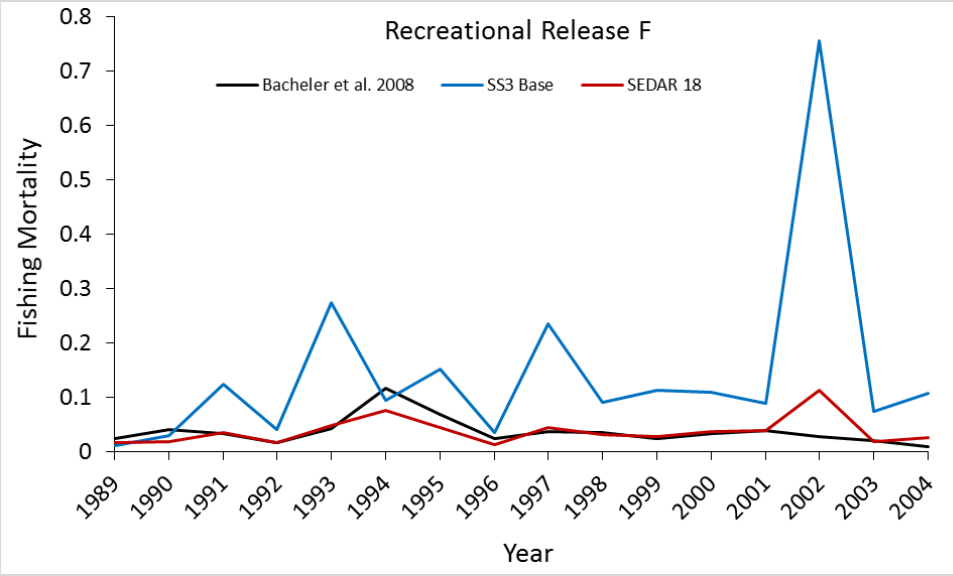




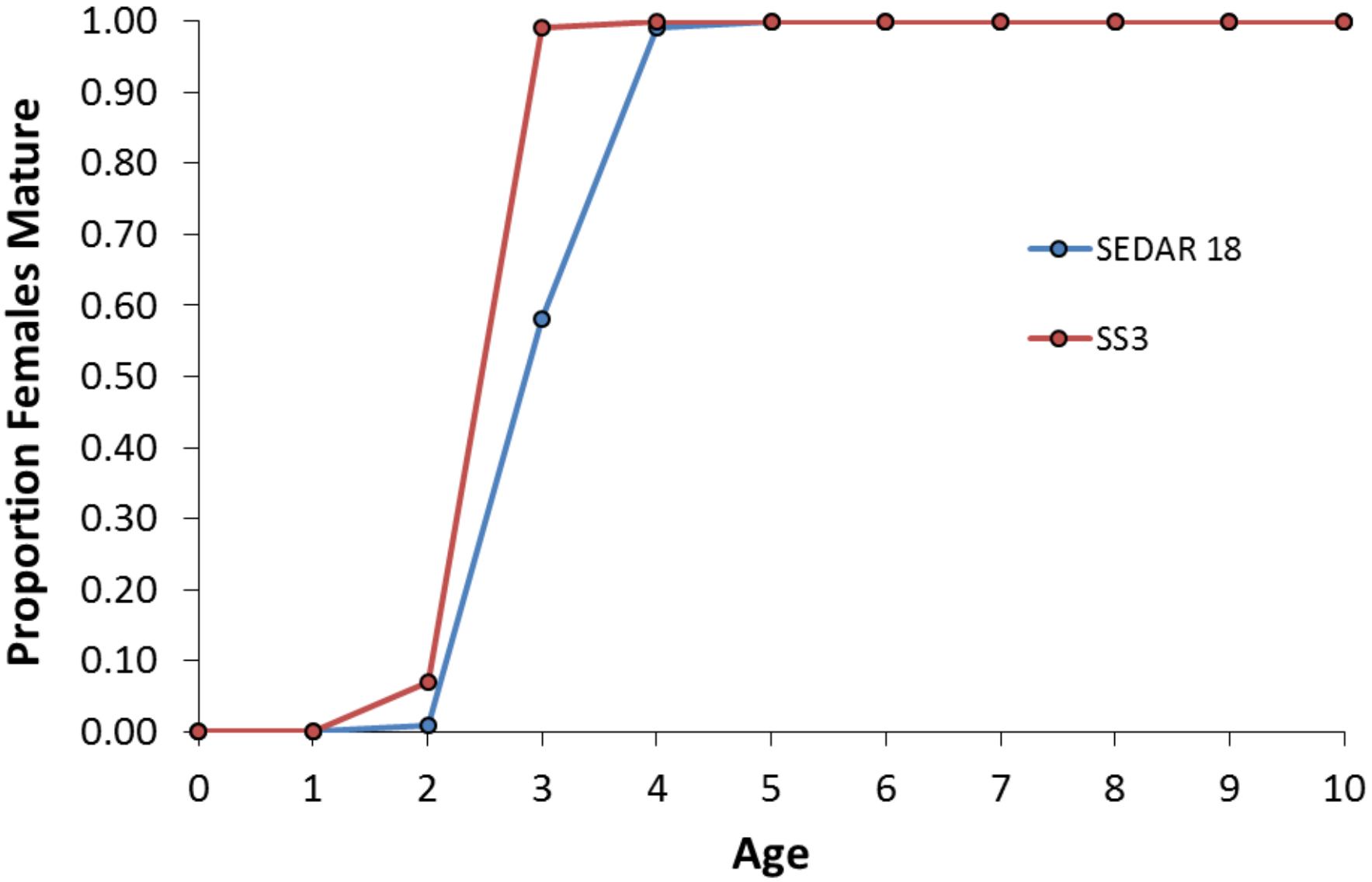
Fishing Mortality



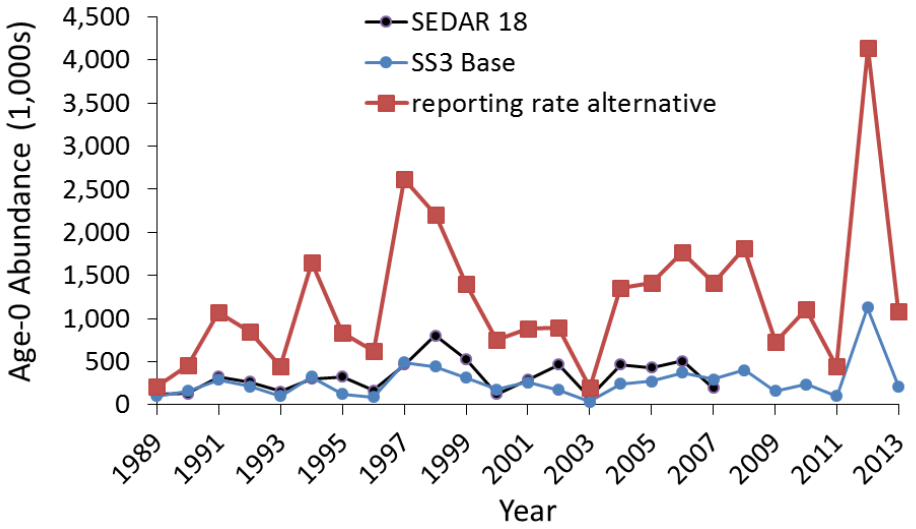


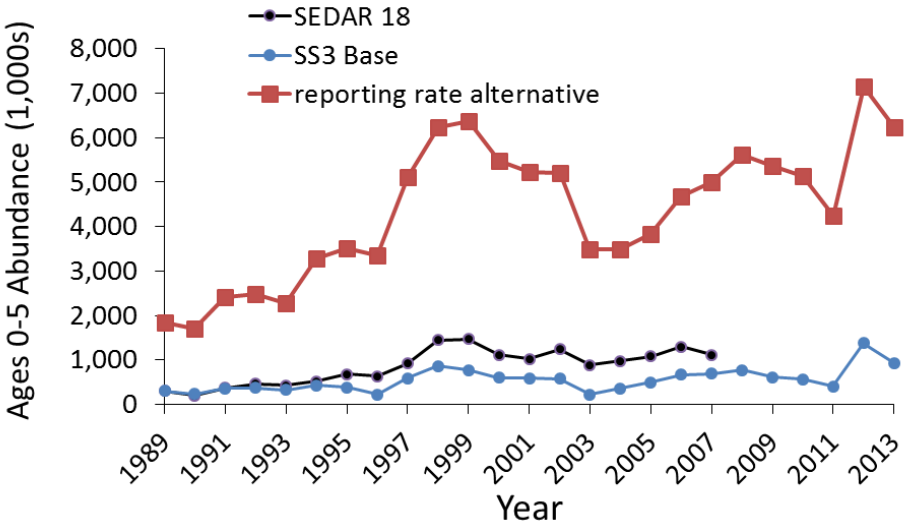


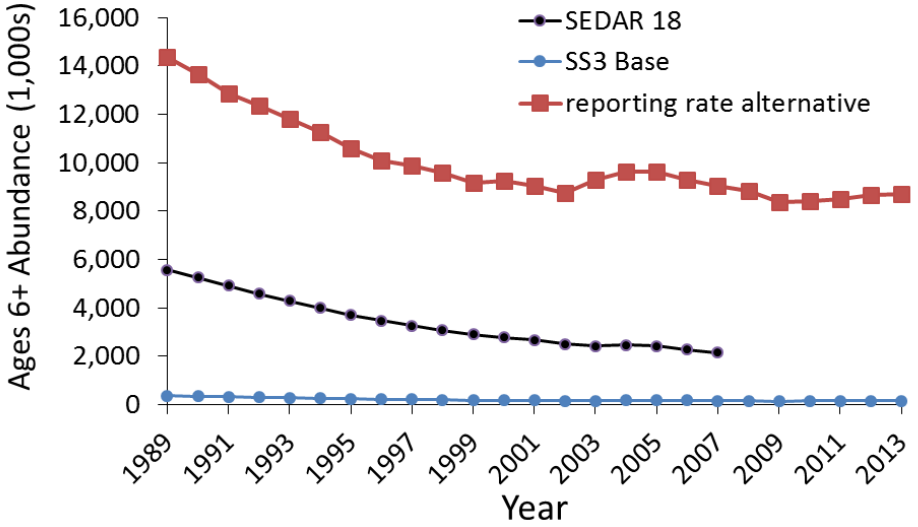
Maturity


Proportion Females Mature
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0
1
2
3
4
5
6
7
8
9
10
Age
SEDAR 18
SS3

Abundance Estimates







Recommendations

- Continue exploration and incorporation of the tag-recapture sub-model
- Increase temporal resolution of model time step (i.e., seasonal growth and fisheries)
- Further evaluate data weighting within the model
- Collect size composition data from recreational releases
- Further investigate discard mortality rates

Southern Red Drum Assessment

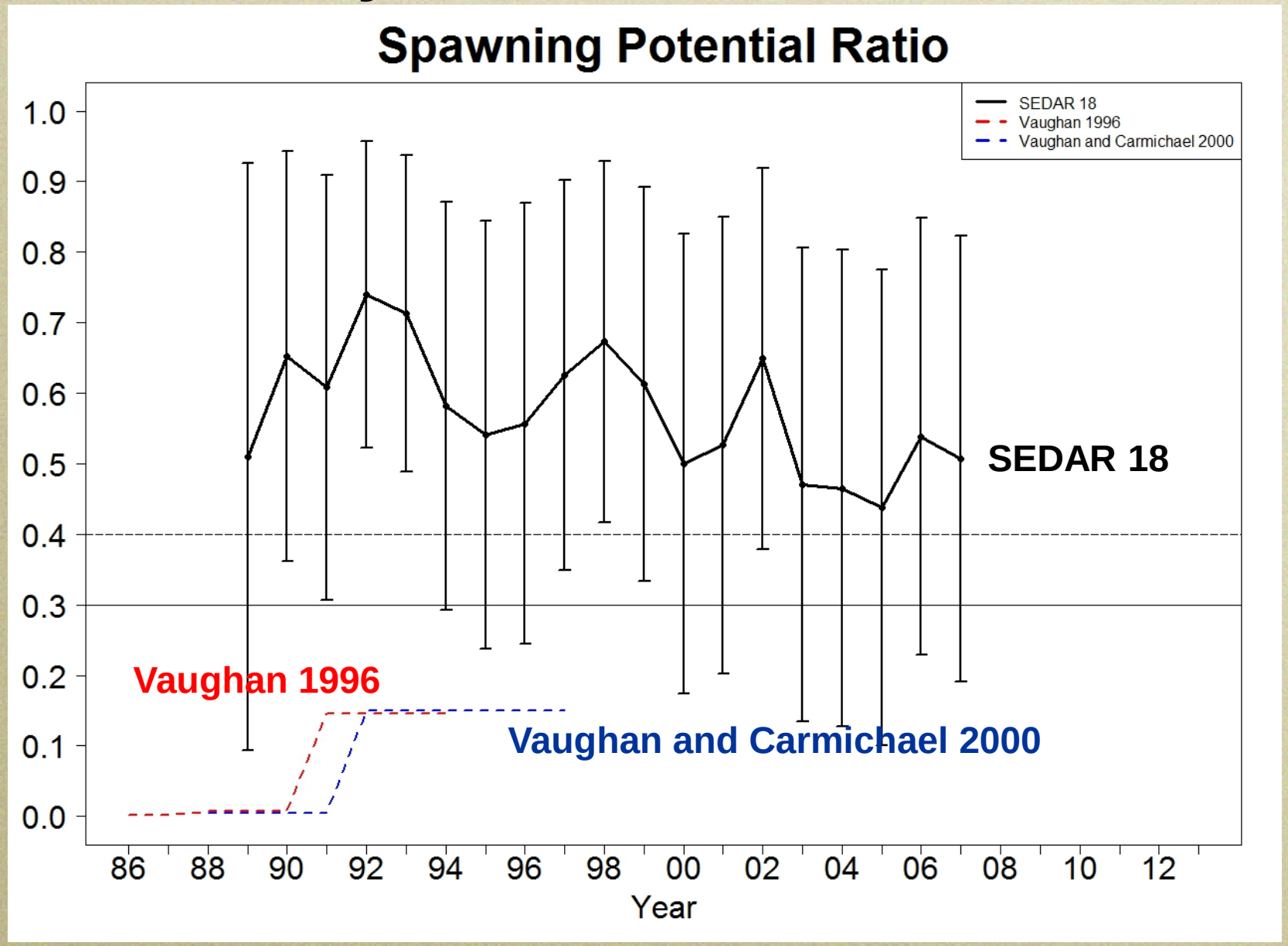
(South Carolina south through Florida)

Quick Assessment History

- Two stocks since 1996.
- Statistic catch-at-age

<u>Management Definitions</u>

- In 1991: goal: 30%
  'first step': 10%
- In 1998, goal: 40%
  overfishing: 30%
  threshold: 10%
- In 2003, target: 40%
  overfishing: 30%

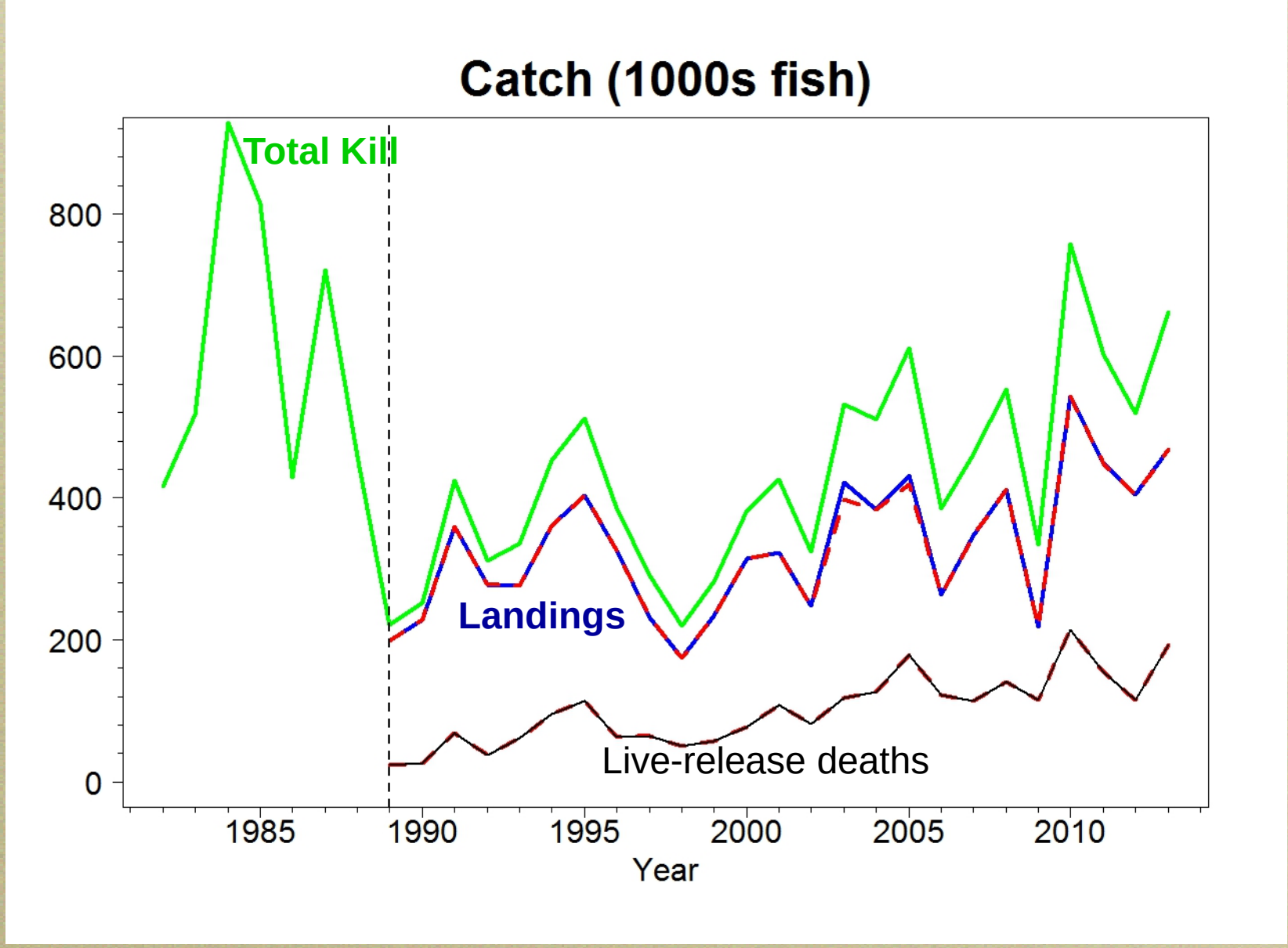


Current Assessment

1989-2013

Removals

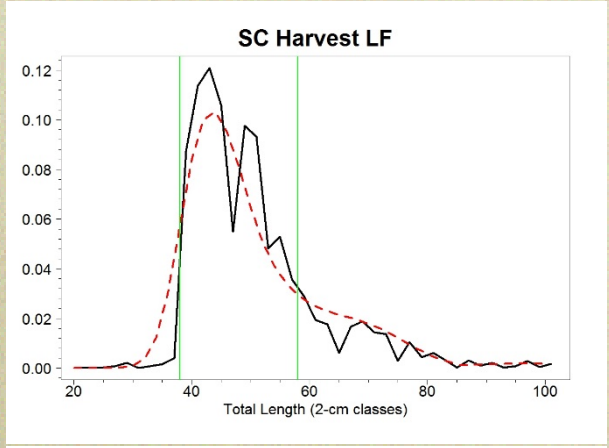
- Recreational landings only

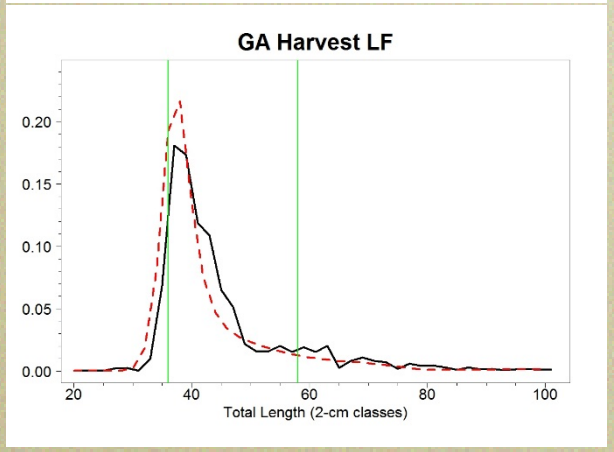


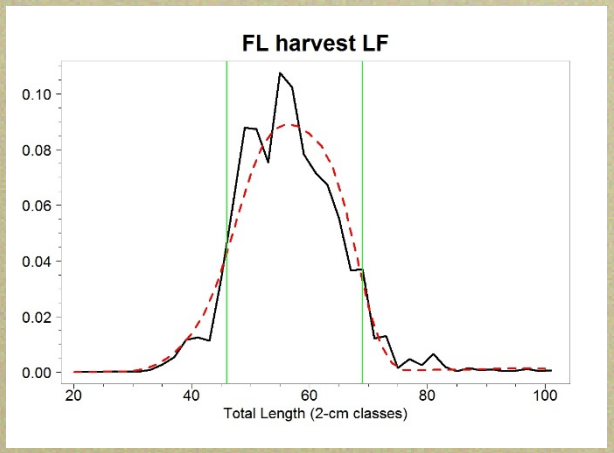
Current Assessment

1989-2013

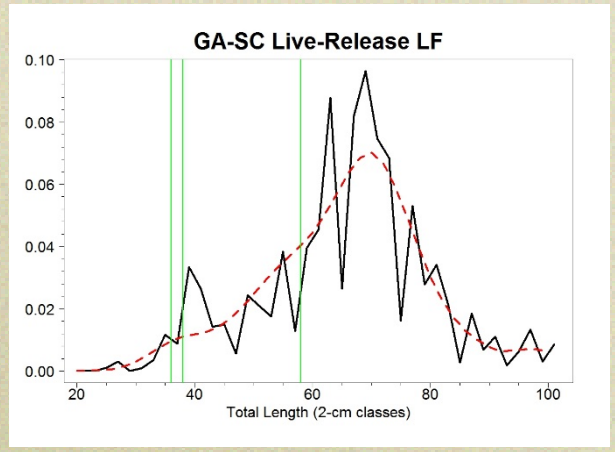
Catch composition (length/age)

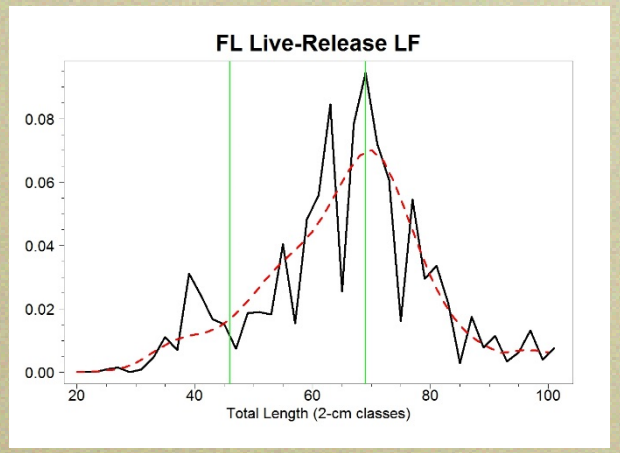






2011-2013 averages

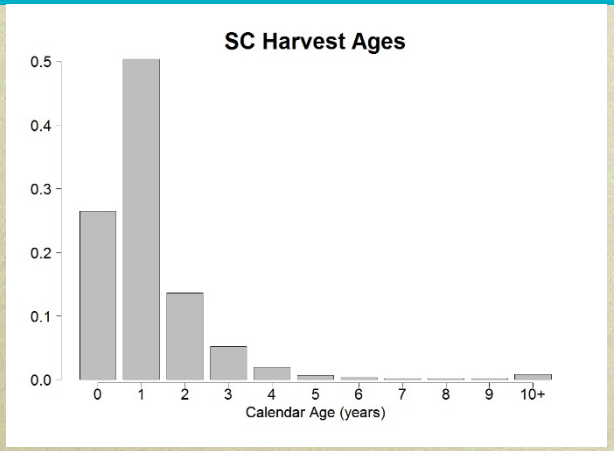


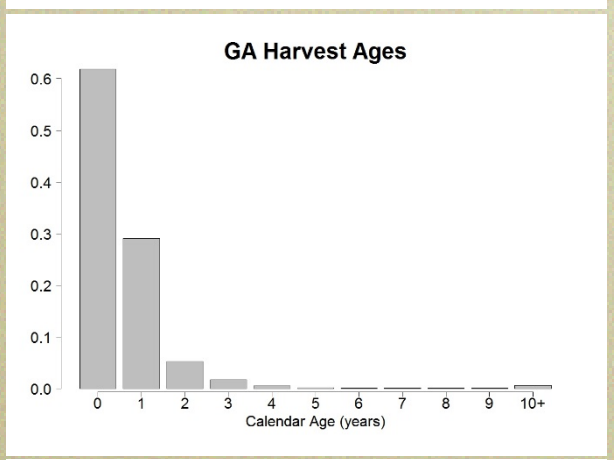


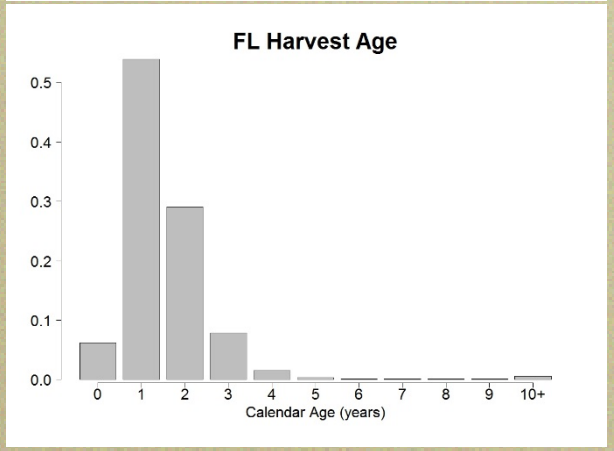
Current Assessment

1989-2013

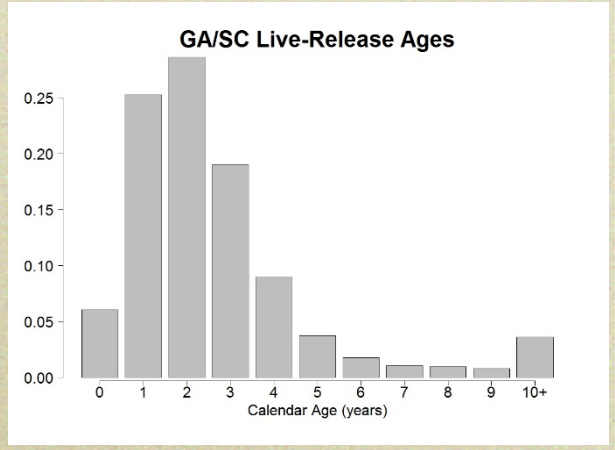
Catch composition (length/age)

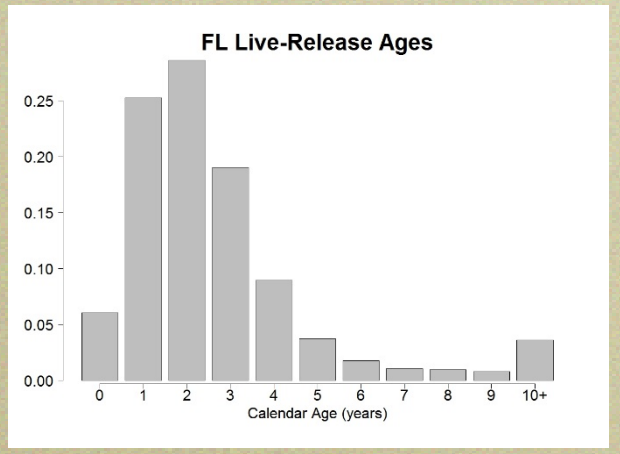






2011-2013 averages

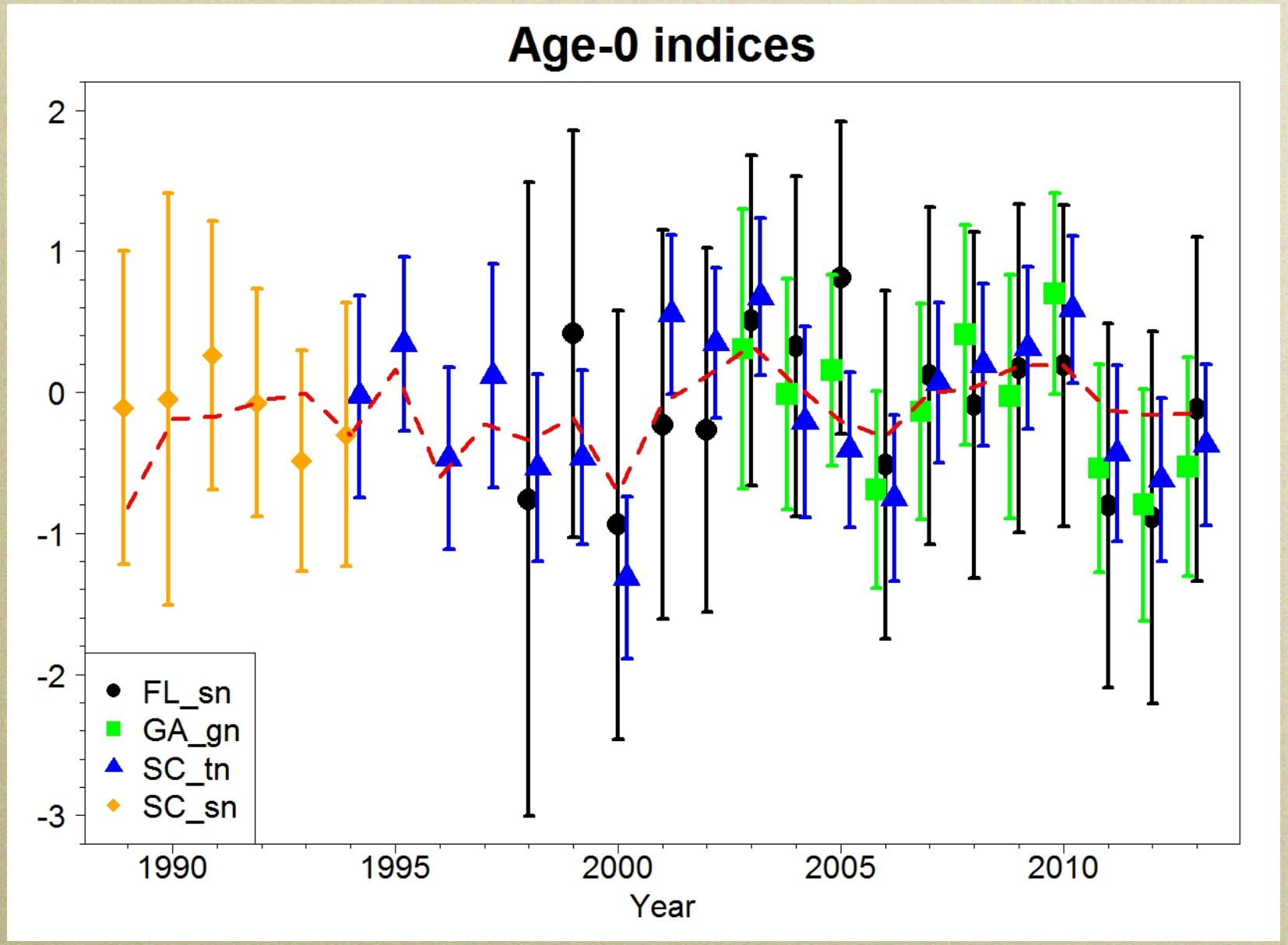




Current Assessment

1989-2013

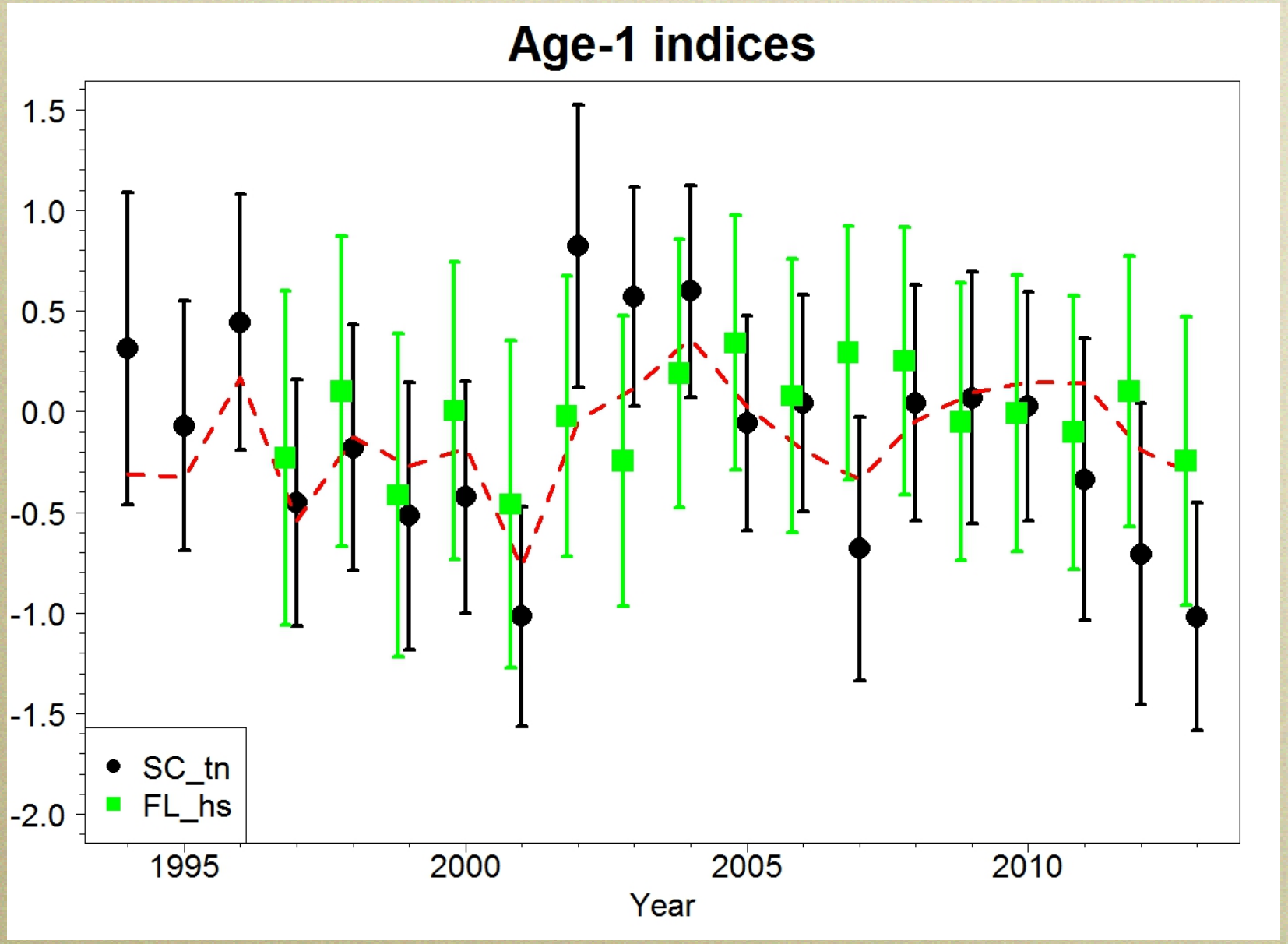
Relative abundance



Current Assessment

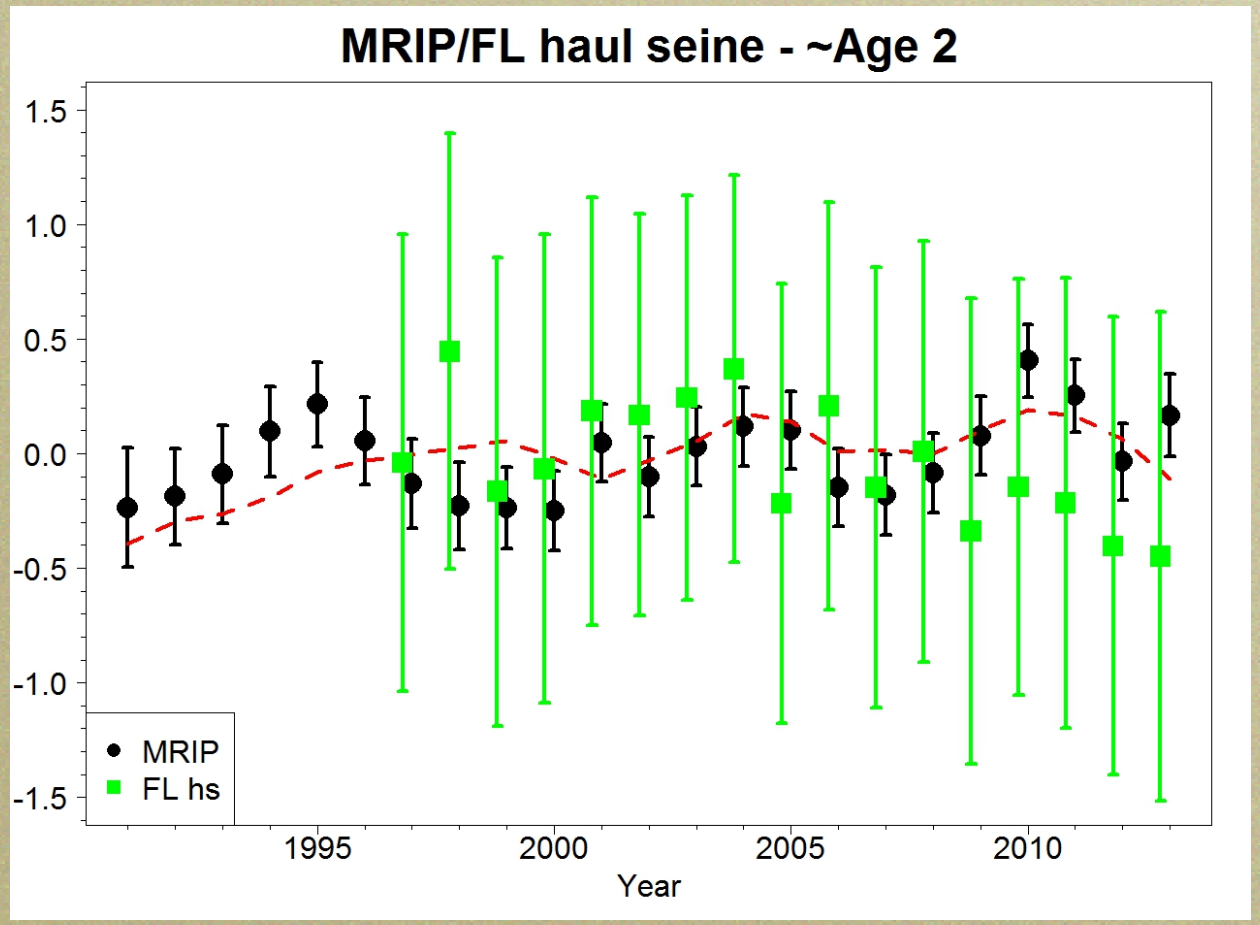
1994-2013

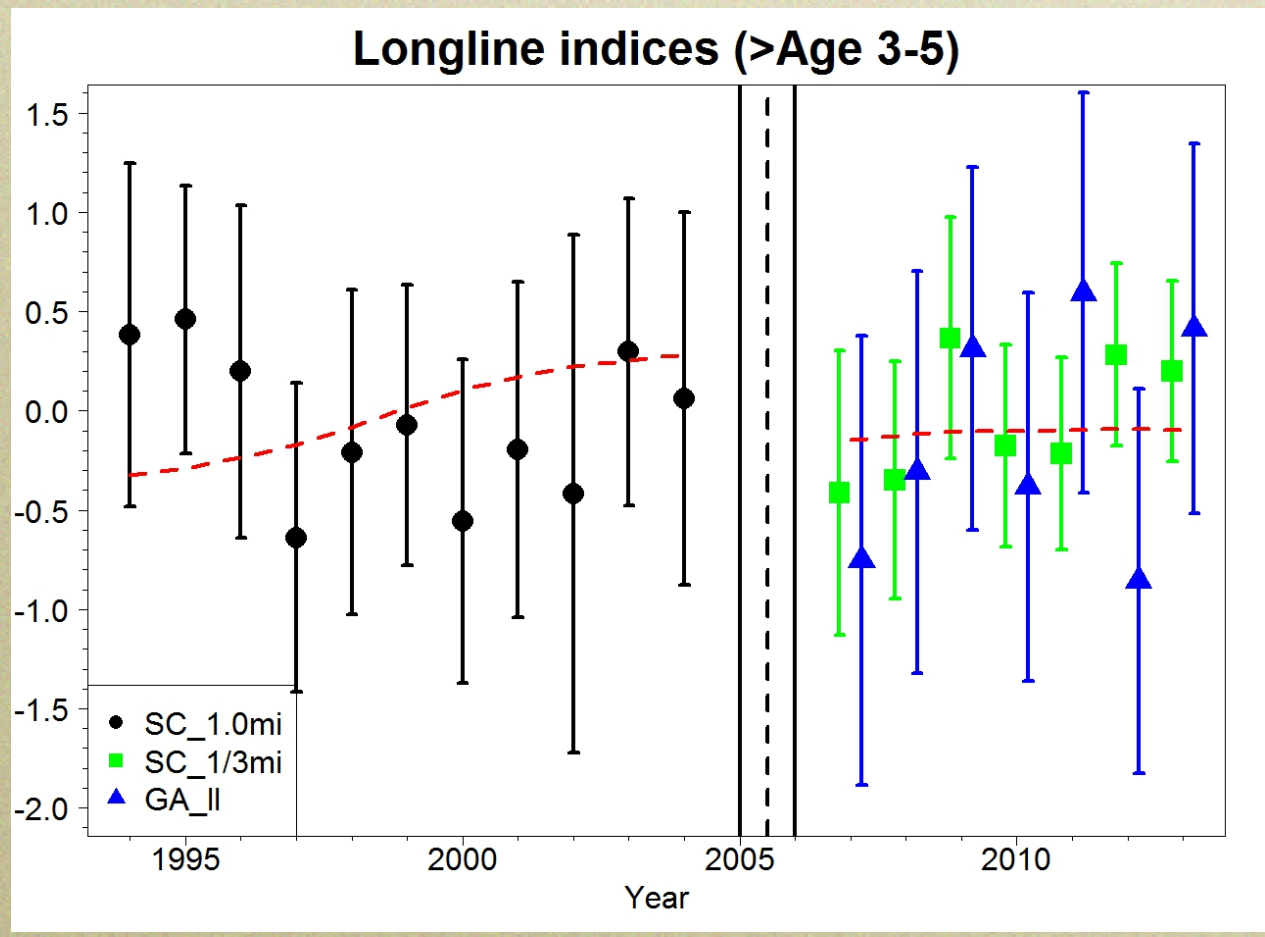
Relative abundance



Current Assessment

1989-2013 Relative abundance





Assessment Development and Review process

Revised Base model

Sensitivities:

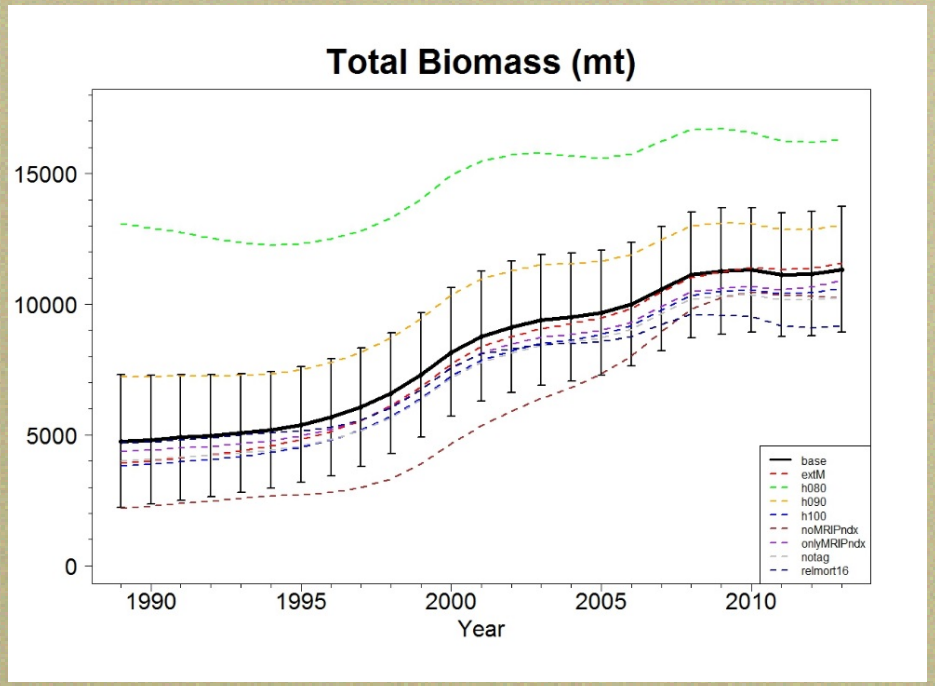
-- *parameters*: natural mortality, steepness

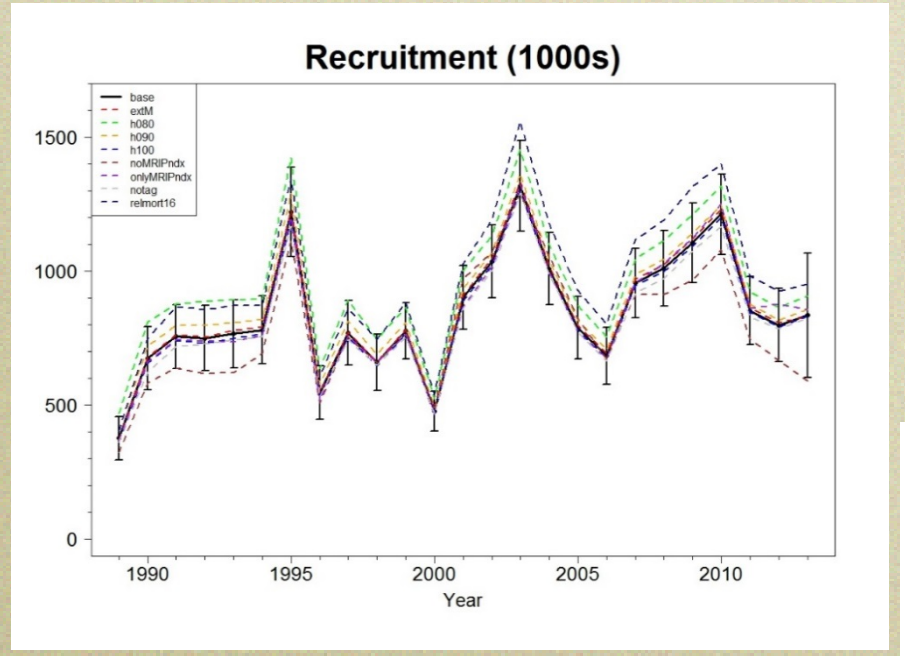
-- *data*: release mortality, MRIP index, tag/recap

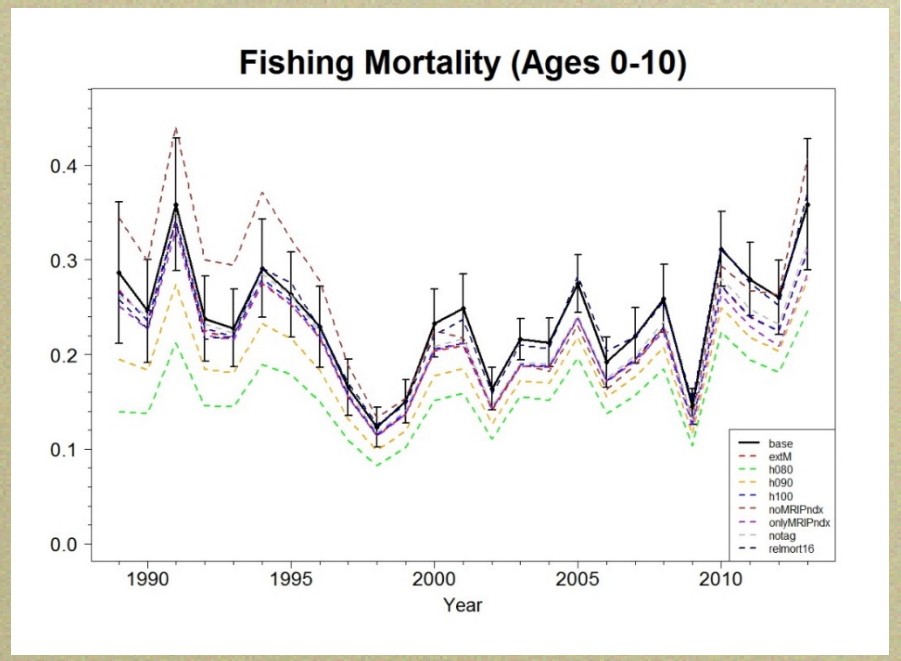
Retrospective: terminal years, 2009-2012

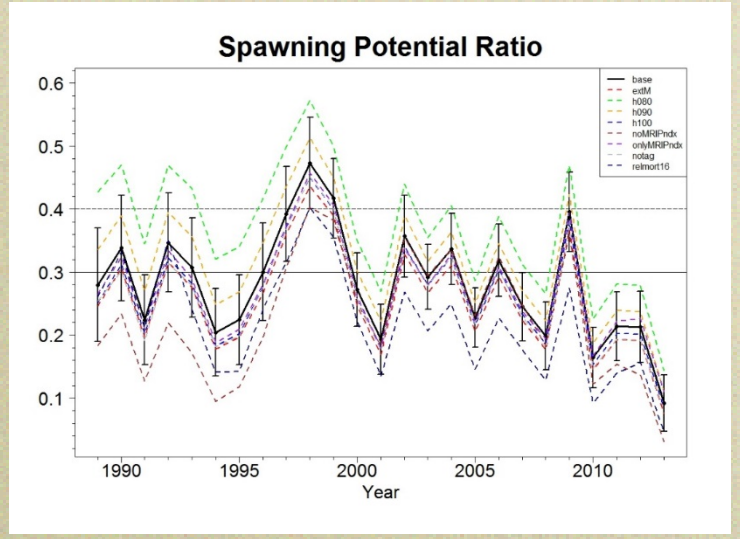
Assessment findings

- recruitment
- stock biomass
- mortality

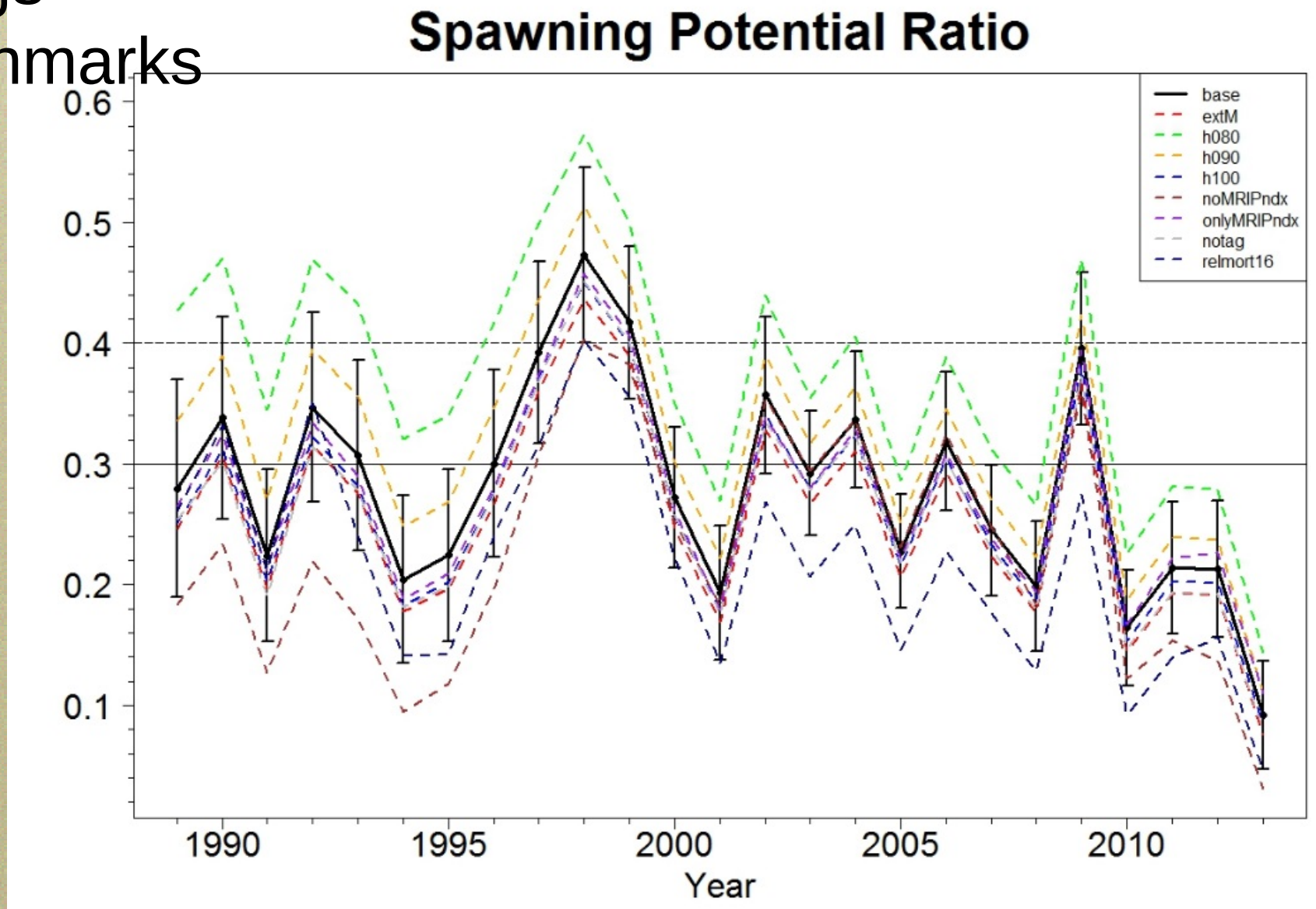








Assessment findings management benchmarks



Changes in the estimated SPR benchmarks across analyses

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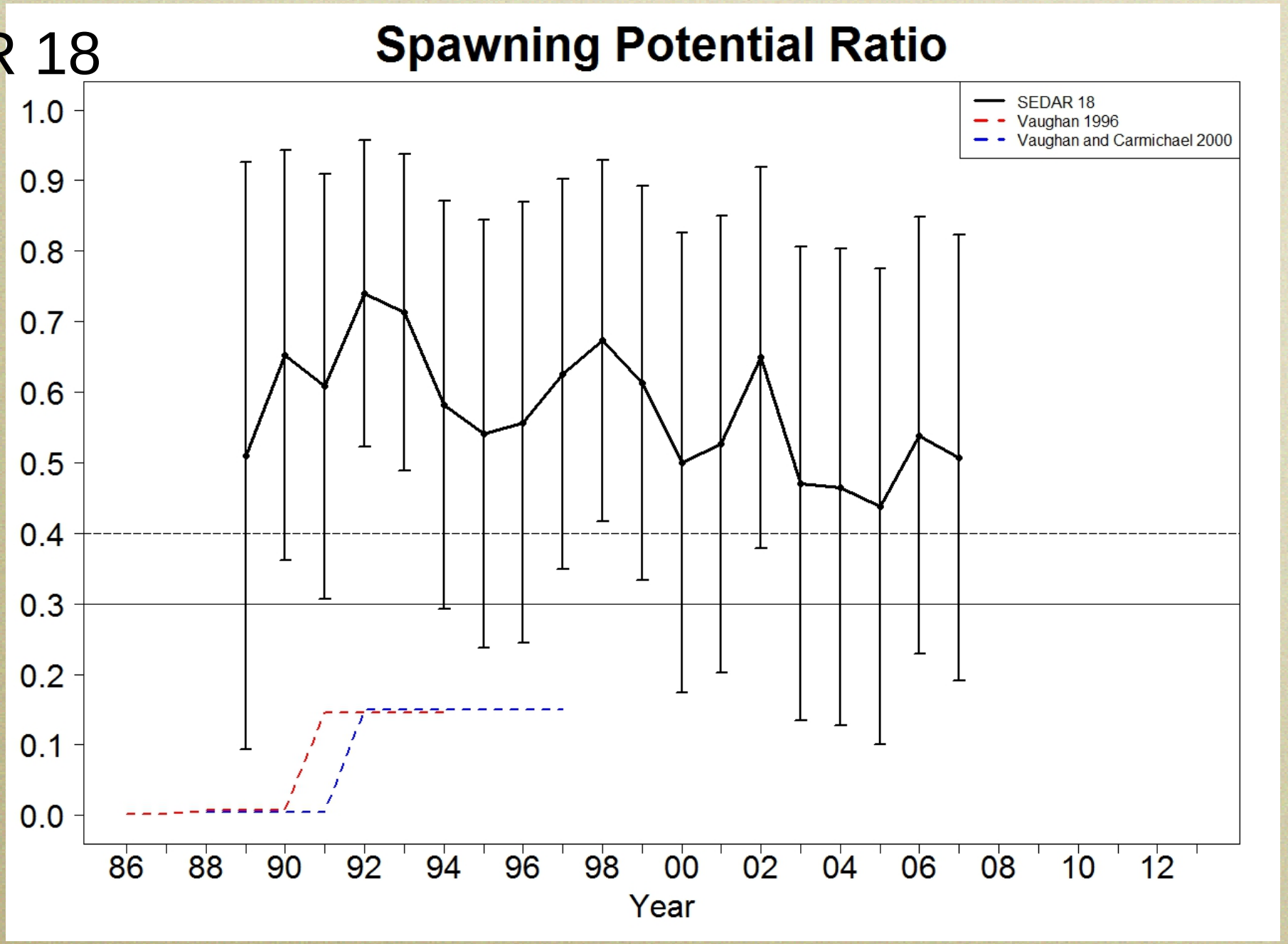
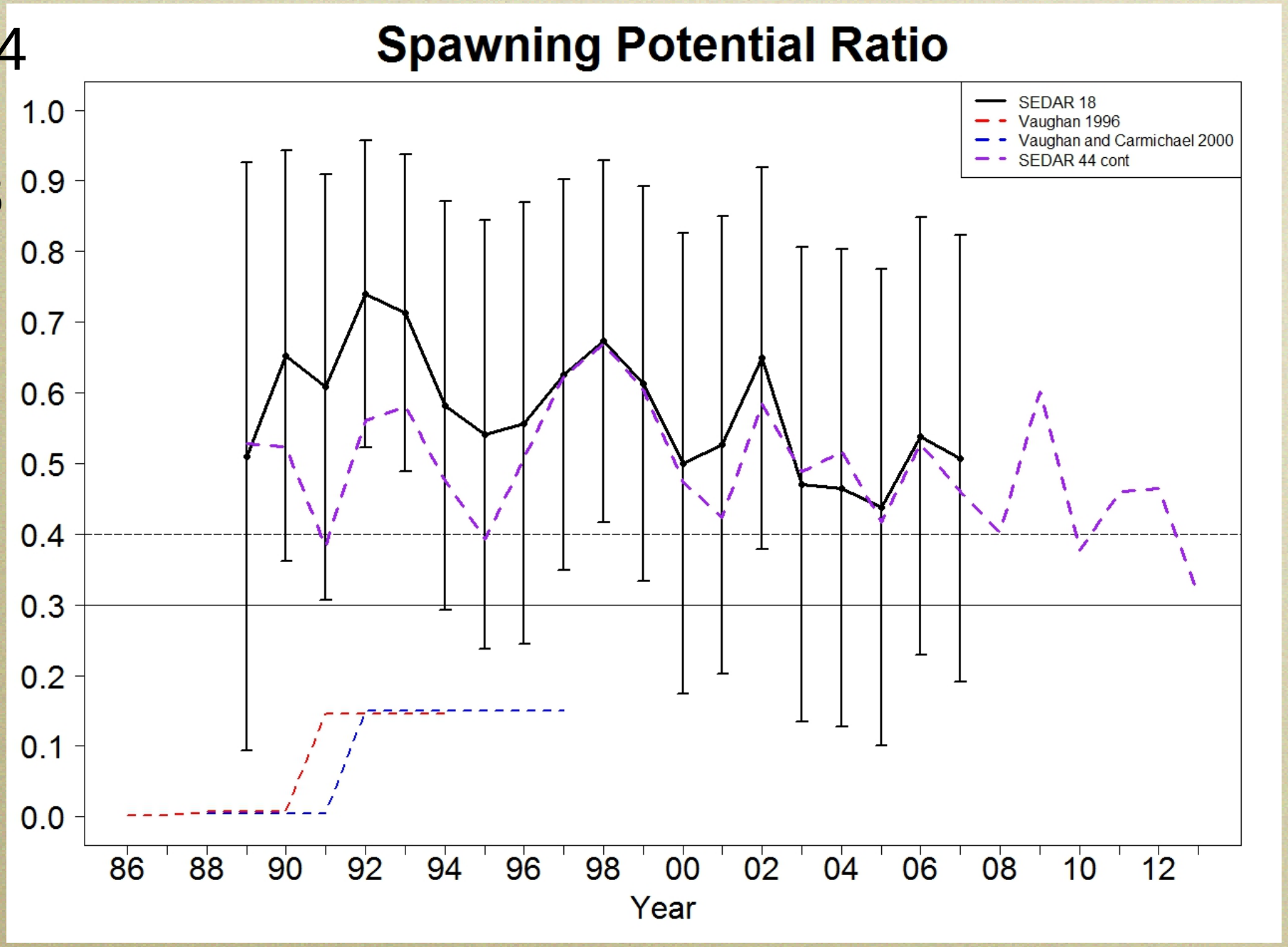
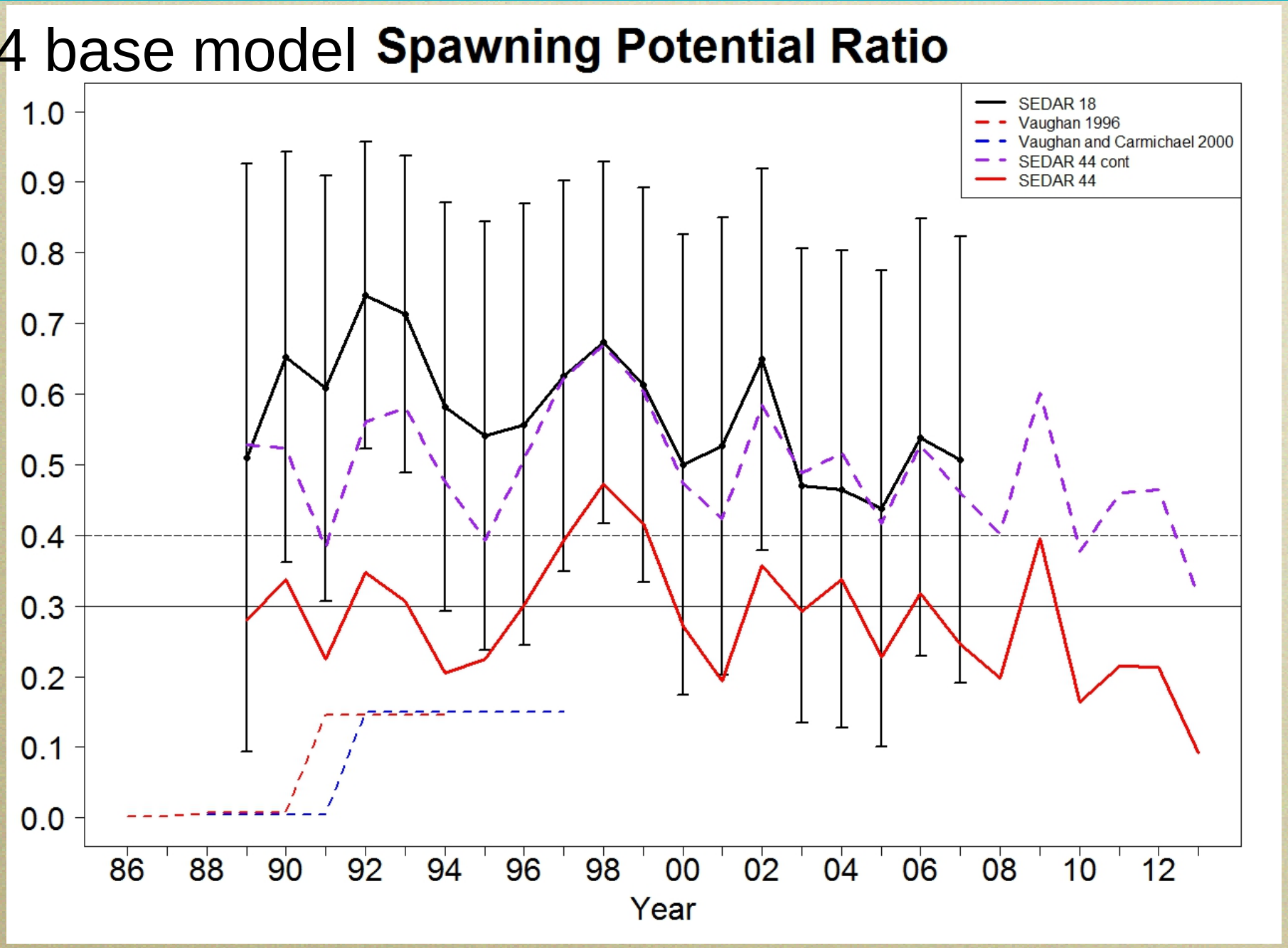
Up through SEDAR 18



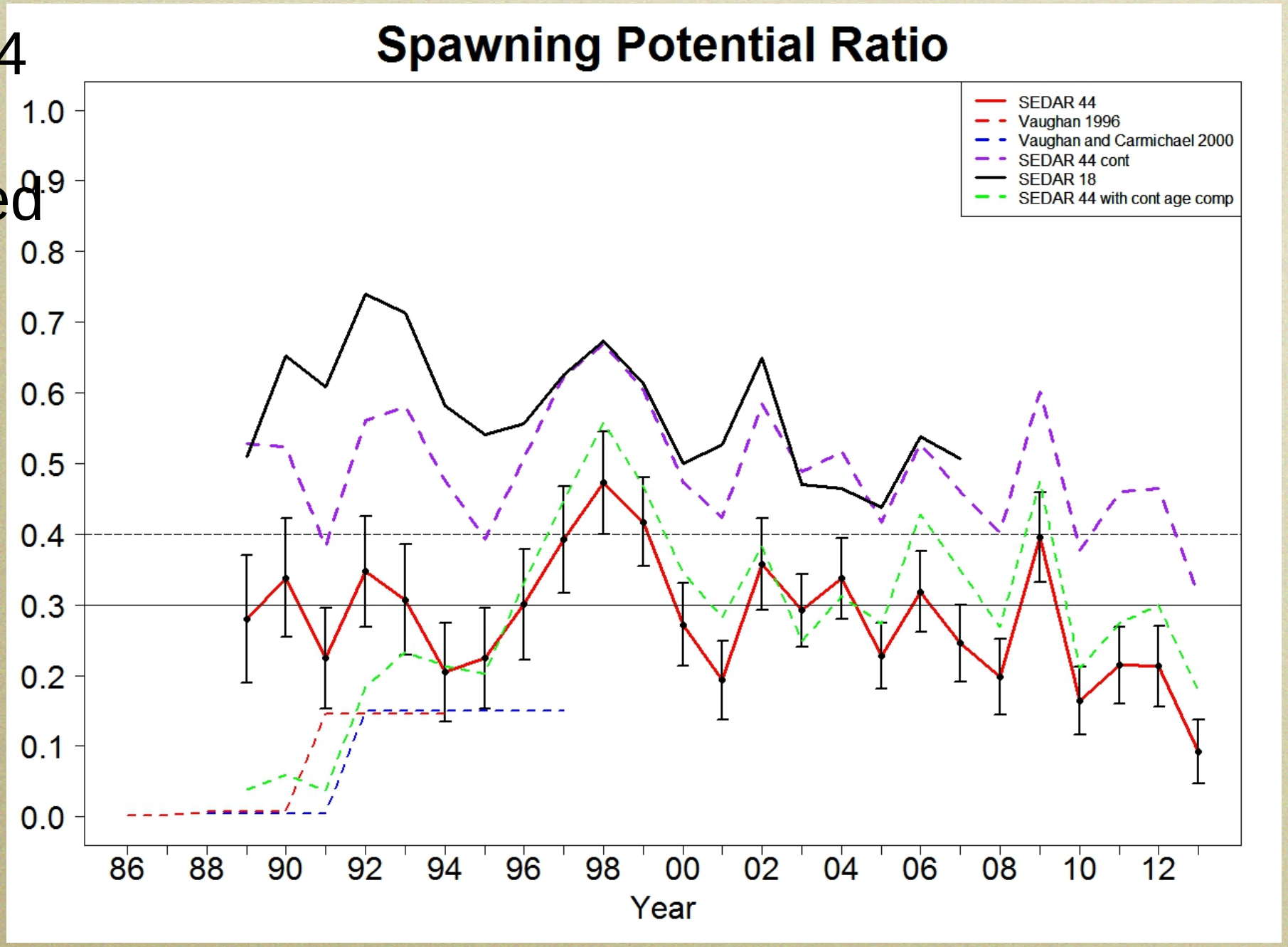
Through SEDAR 44 data using approx. SEDAR 18 model



Through SEDAR 44 base model

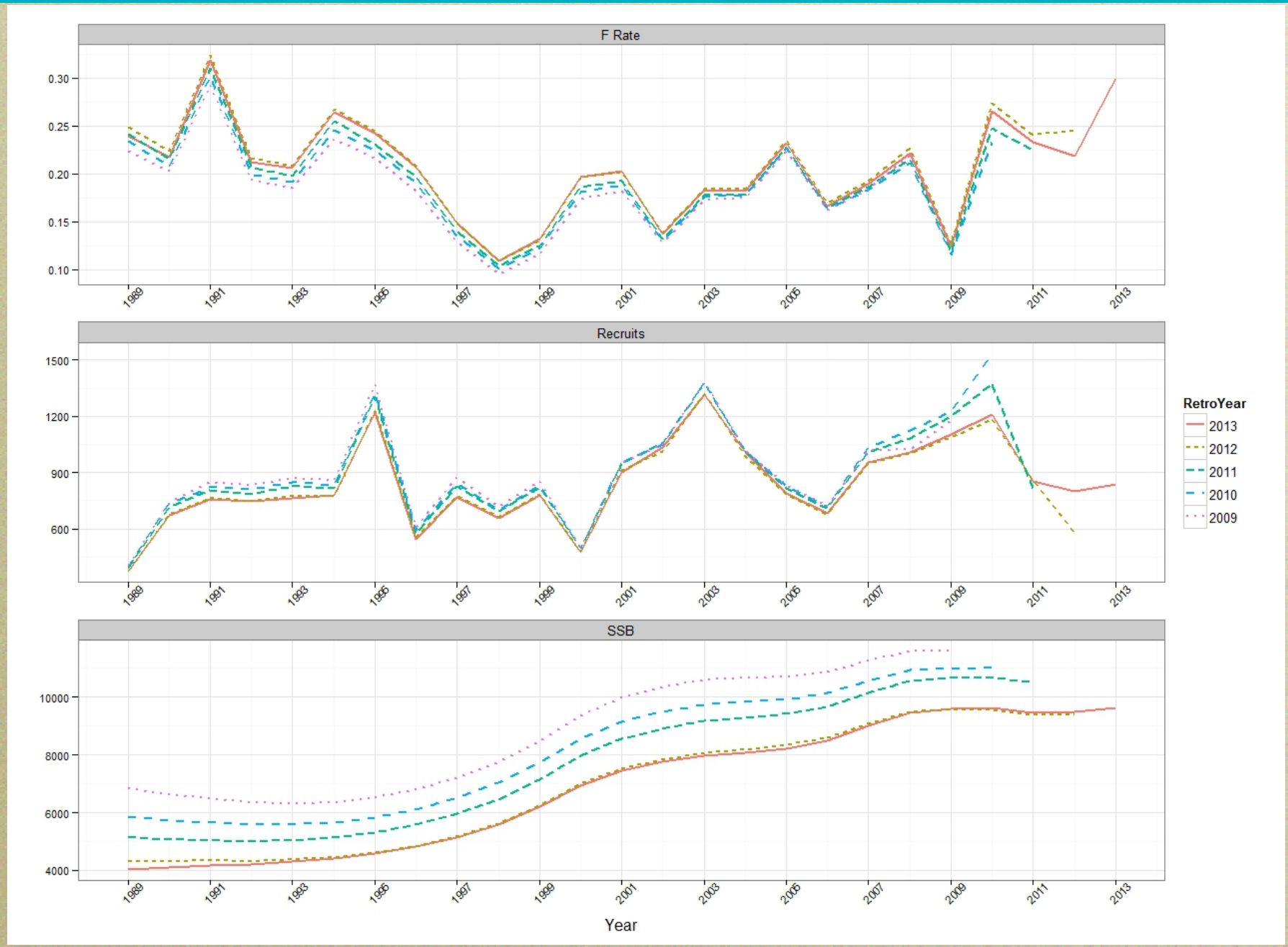


Through SEDAR 44 base and using continuity developed age composition



END

Retrospective:
2009-2012



Atlantic red drum
Assessment Peer Review Report

ASMFC South Atlantic Management Board
Alexandria, VA
May 5, 2016

Overview

- Peer review of northern and southern stocks of Atlantic red drum

- Multi-step review process

SEDAR 44
(August 2015)

Jeff Brust
Dr. Gavin Fay
Dr. Sven Kupschus
Dr. Carmen Fernandez
Dr. Jamie Gibson

ASMFC Desk Review
(Spring 2016)

Jeff Brust
Dr. Gavin Fay

Terms of Reference

TOR	Topic	Reviewed by
1	Presentation and treatment of data sources	SEDAR
2	Stock structure	SEDAR
3	Models and parameterization	SEDAR (partial) Desk review
4	Diagnostic analyses	Desk review
5	Uncertainty in estimated parameters	Desk review
6	Minority report	None
7	Current estimates	Desk review
8	Reference points and stock status	Desk review
9	Research recommendations	SEDAR Desk review (indirect)
10	Timing of next assessment	SEDAR

General conclusions

- Panel supports move to SS3 framework
- Phenomenal effort from Assessment Team to develop models, respond to Panel's inquiries, and address issues with model
- Preferred models represent expert knowledge and best available science
- Both northern and southern stocks are below $SPR_{30\%}$ threshold

TOR 1

- *Evaluate the thoroughness of data collection and the presentation and treatment of fishery-dependent and fishery-independent data in the assessment*

- Assessment Team conducted thorough search and review of available data sources

- Panel support justifications for inclusion/exclusion of individual data sets

- Panel provided guidance on additional methods to evaluate/characterize data

TOR 2

- *Evaluate the definition of stock structure*

- Assessment Team retained previously defined regions
  - NC/SC border
  - Life history differences
  - Limited movement from tagging data
  - Recent genetic work

- Panel concurs that this split is appropriate

TOR 3

- *Evaluate the methods and models used to estimate population parameters and biological reference points*

- Panel agrees with shift to SS3 for the modeling framework
  - More flexible, well tested
  - Newer modules need more exploration

- Recommendation from the August workshop was to simplify the models
  - Issues with selectivity, scale of the model

TOR 3 - continued

- Many improvements to model parameterization since August
  - Different selectivity functions
  - Significant consideration of uncertainty

- Potential to add complexity, but will require considerable investigation

TOR 4

- *Evaluate the diagnostic analyses performed (sensitivity, retrospective)*

- The Assessment Team thoroughly evaluated the sensitivity of the models to assumptions and parameterization

- Models are robust to ***most*** assumptions

- For those that are more sensitive, Panel agrees with the parameterization selected

- No consistent patterns in retrospective

TOR 5

- *Evaluate the methods used to characterize uncertainty in estimated parameters.*

- The methods used to characterize uncertainty are appropriate and well described

- Results consistent between methods
  - Some uncertainty due to error in the southern model

- Panel suggested additional analyses to run and methods to present/summarize results for future assessments

TOR 6

- *Review minority opinion and any minority analyses*

- No minority report was presented

TOR 7

- *Recommend best estimates of stock biomass, abundance, and exploitation from the assessment for use in management*

- The assessment report incorporates expert knowledge and the best available science

- The Panel concludes that the assessment report represents the best estimate of population and fishery dynamics for both regions

TOR 8

- *Evaluate the choice of reference points and the methods used to estimate them. Recommend stock status determination from the assessment*

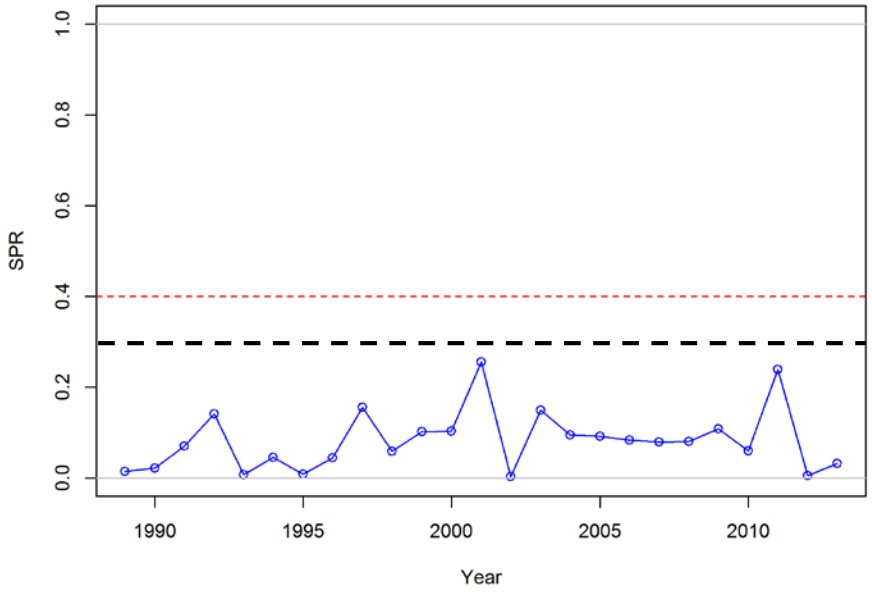
- Reference points were established under Amendment 2 (2002)

- SPR threshold = SPR30%

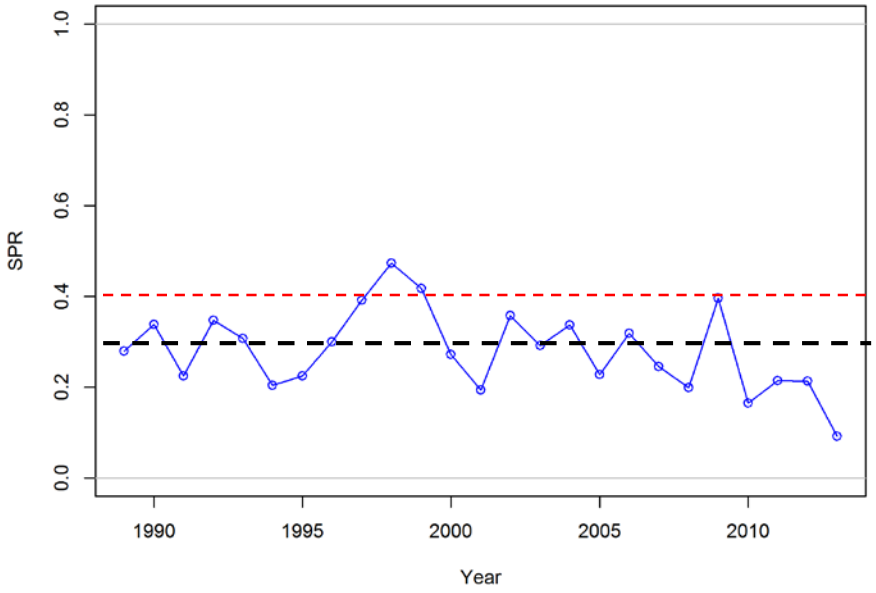
- Average values for 2011 – 2013
  - North = 9.1%
  - South = 17%

TOR 8 - continued

North



South



TOR 9

- *Review the research, data collection, and assessment methodology recommendations*

- Research recommendations in two main categories
  - Life history
  - Model performance

- SEDAR review recommended addressing model performance in short term

- Additional recommendations within desk review

TOR 10

- *Recommend timing of the next benchmark assessment and updates, if necessary, relative to the life history and current manangement*

- SEDAR recommendation was for benchmark as soon as possible once models were finalized
  - Desk review

- Following this, longer time periods may be appropriate between benchmarks, not withholding any new understanding of stock dynamics

Conclusion

- Impressive performance by the Assessment Team
- New modeling framework is improvement
- Both northern and southern models
  - are well described and appropriately parameterized
  - adequately evaluate uncertainty
  - are robust to most assumptions
- Panel recommends both models are suitable for use in management

Additional Modeling Timelines

Option 1 - Old Assessment Update

- add new years of data to SEDAR 18 model (2009)
- 4 months of work by SASC and peer review
- Implications: delay croaker and spot

Option 2 - Alternative Modeling Configuration

- Building from SEDAR 18 model, add data sources (long line surveys) and run diagnostics
- 6 months work by SASC or new state scientist, and peer review
- Implications: delay croaker and spot, potentially river herring and/or sturgeon

Amendment 2

Commercial

- States maintain current level of restrictions
- 27” TL max size

Recreational

- Bag and size limits to meet management goal 40% SPR
- 27” TL max size

State Regulations

State	Recreational	Commercial
NJ	18”-27”, 1 fish	18”-27”, 1 fish
DE	20”-27”, 5 fish	20”-27”, 5 fish
MD	18”-27”, 1 fish	18”-25”, 5 fish
PFRC	18”-25”, 5 fish	18”-25”, 5 fish
VA	18”-26”, 3 fish	18”-26”, 3 fish
NC	18”-27”, 1 fish	18”-27”, 250,000 lb harvest cap w/ overage payback
SC	15”-23”, 3 fish	Gamefish Only
GA	14”-23”, 5 fish	Gamefish Only
FL	18”-27”, North: 2 fish, South: 1 fish	Sale of native fish prohibited

Reference Points

Overfishing

- Target: F40% SPR
- Threshold: F30% SPR

Overfished

- None