Yellowtail Flounder
(*Limanda ferruginea*)

Southern New England–Mid Atlantic

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2015 Operational Assessment Groundfish Updates
Northeast Fisheries Science Center
Woods Hole, MA
Sept. 14-18th 2015

Previous Assessment

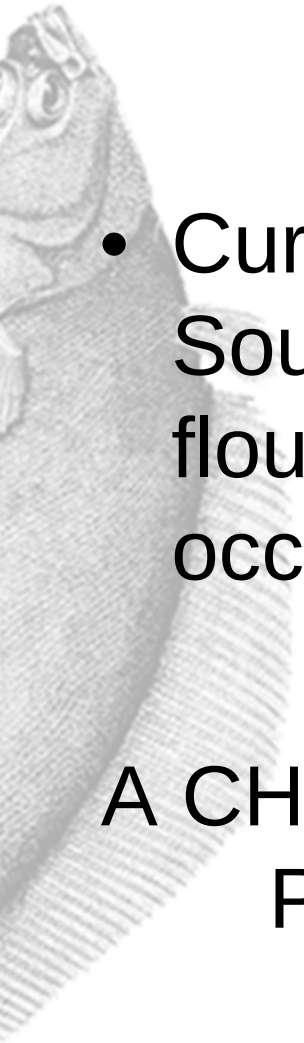
- Benchmark assessment (SAW 54)
- SAW 54 Stock status:
  - F_{2011} = 0.12 SSB_{2011}= 3,873 mt
  - Overfishing was <u>NOT</u> Occurring (38% of $F_{40\%}$).
  - Biomass stock Status was uncertain
    - Contrasting stock status determination was conditioned on recruitment assumption
    - Overfished (LT-rec): 17%SSB_{MSY}
    - Not Overfished (ST-Rec): 129%SSB_{MSY}
  - SAW54 concluded that the stock is likely NOT overfished based on contemporary recruitment assumption (60:40)

This assessment: Data and Model Update

- <u>Fishery dependent data (Commercial)</u>
  - Updated Landings (Trip Based allocation) through 2014
  - Updated Discards (SBRM) through 2014 – 90% discard Mortality
  - Updated Catch #'s and wt. through 2014

- <u>Fishery Independent data – Surveys swept area estimates)</u>
  - Spring Survey updated through 2015 (**<u>Note:</u>** 2015 not used in ASAP)
  - Fall survey updated through 2014
  - Winter 2007 (Discontinued)
  - Larval Index updated through 2013 (Missing years)

- <u>Existing ASAP model (Accepted SARC 54)</u>
  - Maintained the same formulation from SARC 54
  - Total catch, CAA matrix and Catch WAA updated through 2014
  - Survey age comp updated through 2014
  - Biological data (M, maturity and Fecundity) maintained from benchmark
  - Emergence of strong retrospective patterns
  - Terminal year estimates (F and SSB) were retro adjusted

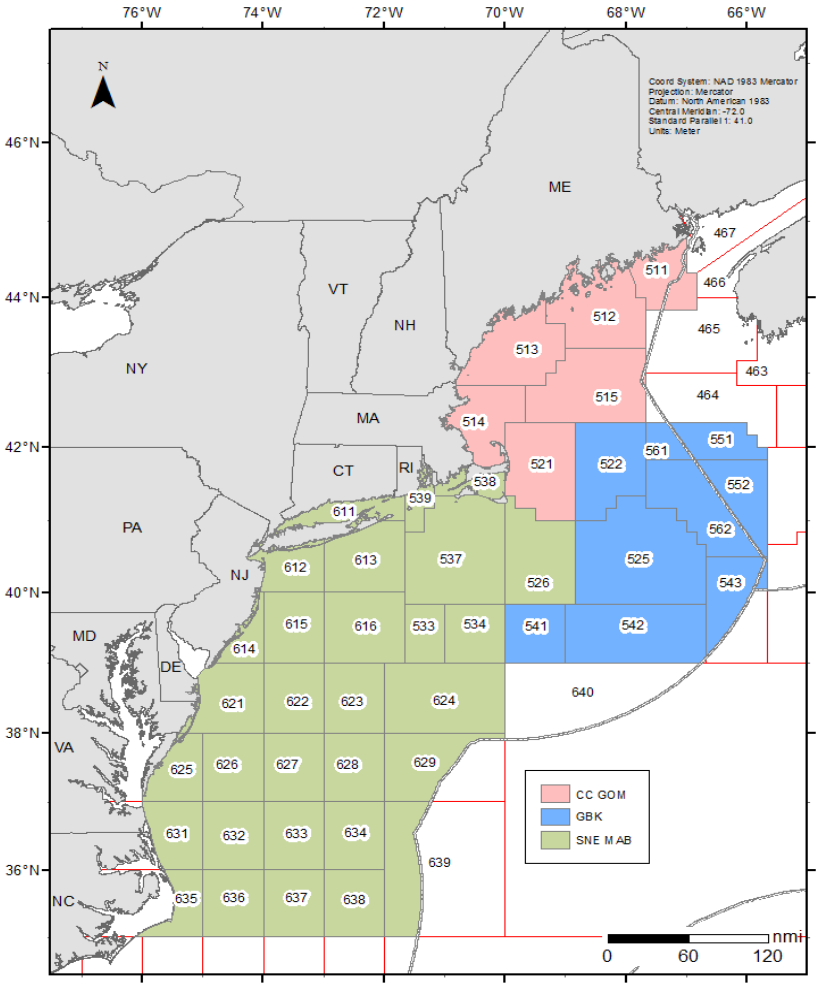


2015 SNEMA yellowtail Stock Status:

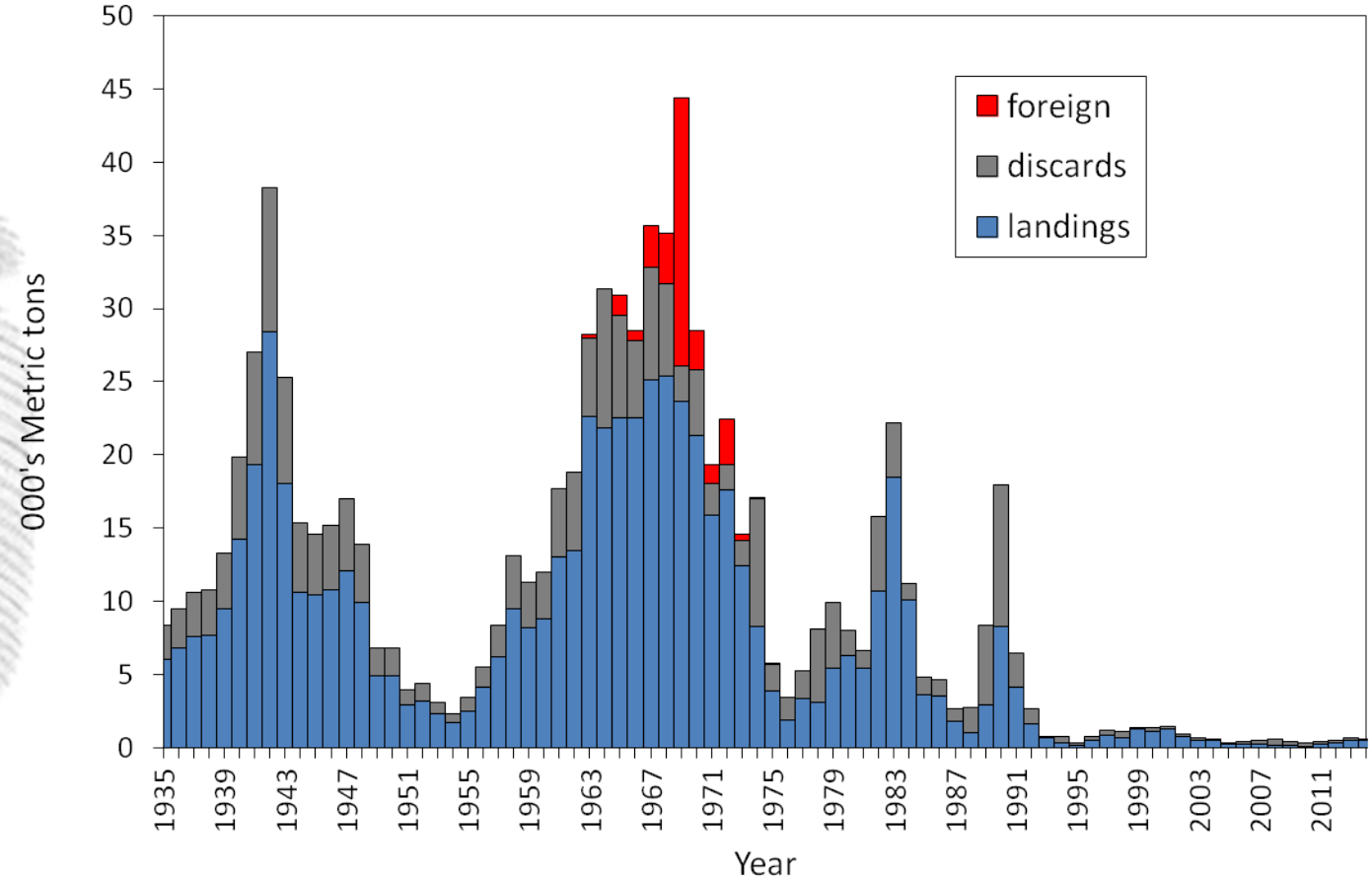
- Current assessments indicates that Southern New England-Atlantic Yellowtail flounder is **overfished** and **overfishing** is occurring.

A CHANGE IN STOCK STATUS FROM THE PREVIOUS SARC54 BENCHMARK ASSESSMENT

Fishery Dependent data



SNEMA YT Total Catch (mt) (1935-2014)



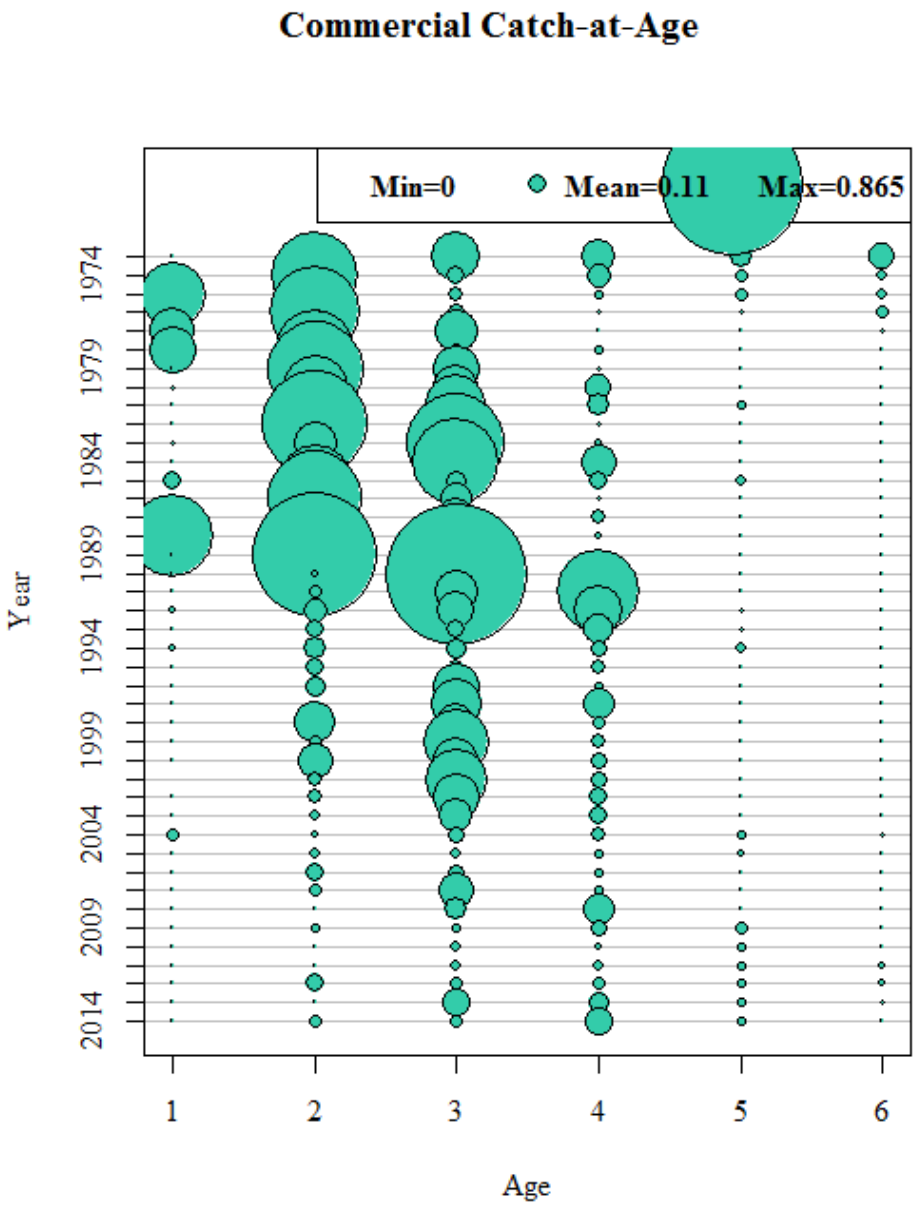
2014 catches = 625 mt (61% increase since 2011) attributed to steady increase in the landings (83% of catch)

CV's Landings at Age

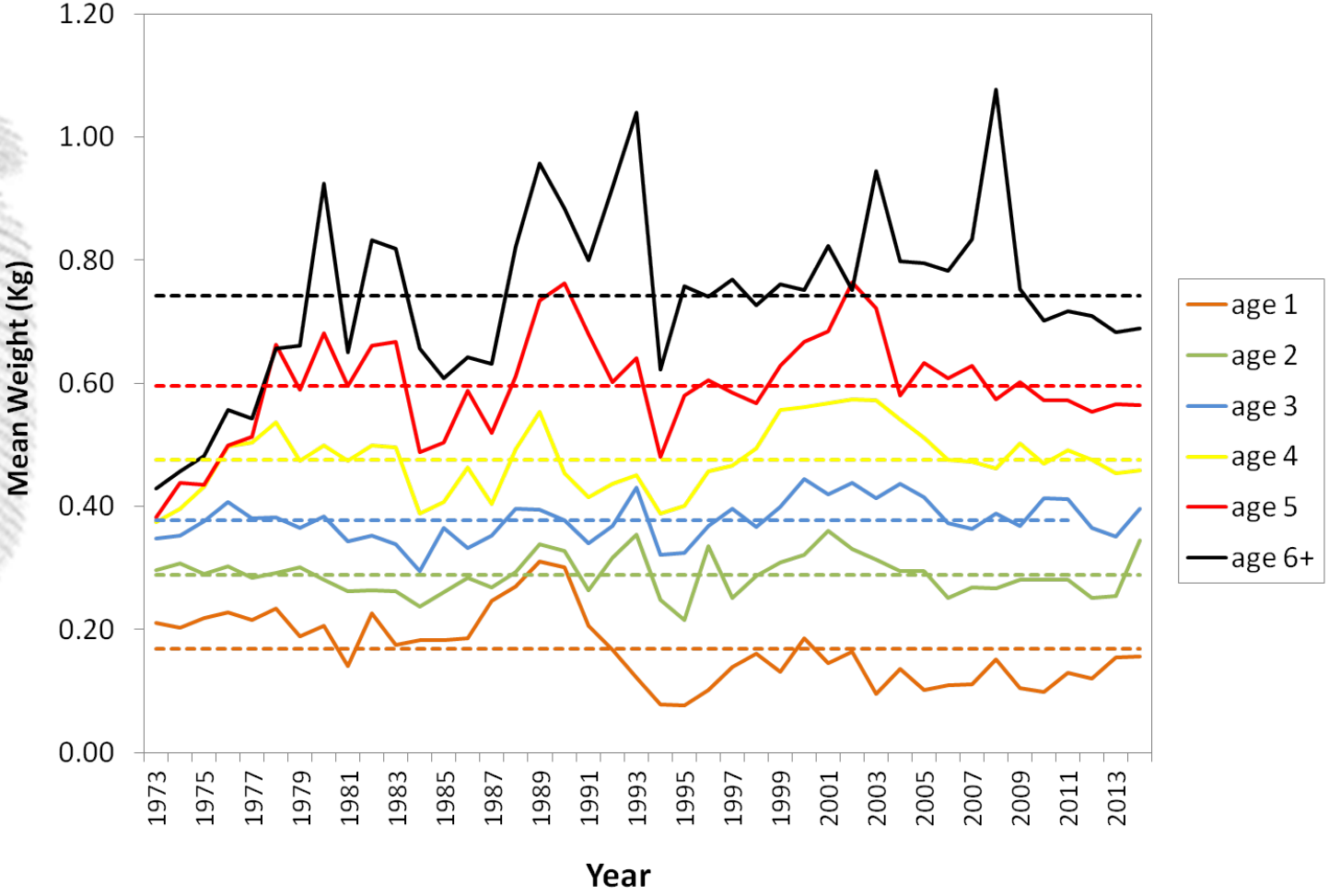
Year	Age-1	Age-2	Age-3	Age-4	Age-5	Age-6+
1994		77%	13%	14%	17%	27%
1995			17%	11%	23%	22%
1996		27%	10%	27%	29%	31%
1997		33%	10%	13%	33%	39%
1998		11%	10%	13%	39%	76%
1999	91%	28%	9%	20%	38%	48%
2000	131%	15%	9%	12%	45%	77%
2001		20%	6%	10%	24%	37%
2002		17%	8%	16%	44%	
2003		16%	8%	15%	50%	74%
2004		32%	8%	11%	15%	17%
2005		12%	13%	13%	10%	25%
2006		12%	8%	8%	13%	13%
2007		12%	3%	7%	15%	14%
2008		32%	7%	3%	15%	26%
2009		16%	16%	5%	7%	38%
2010		12%	4%	2%	1%	4%
2011		13%	6%	6%	7%	8%
2012		5%	3%	2%	1%	3%
2013		11%	3%	2%	2%	4%
2014	133%	5%	2%	2%	2%	6%

Catch at Age

- Age-2,3 & 4 continue to dominate majority of the catches
- Reduction age-1 catches due to management measures since 1994
- Discarding of young age-1 fish is low, likely due to the continued poor recruitment .
- Brief expansion of older age fish (2011-2012)



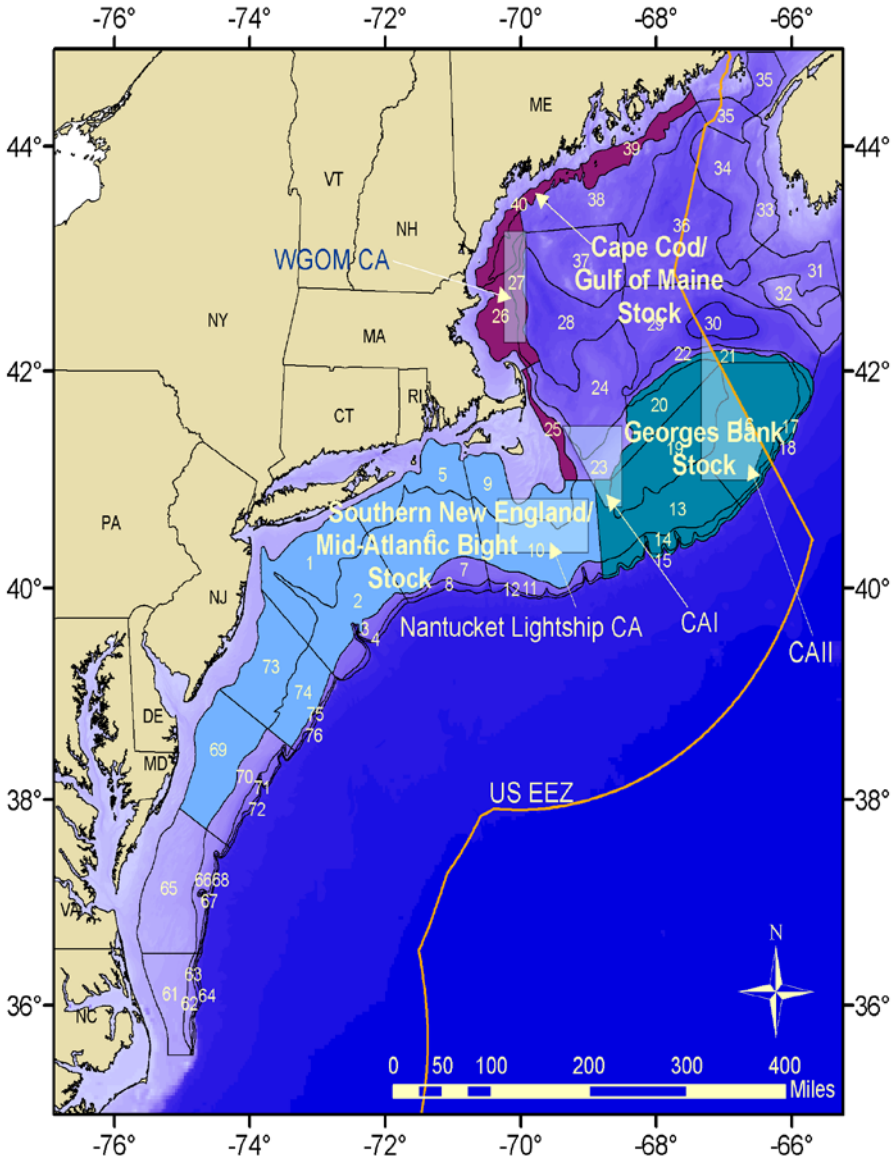
Weights At Age Plots



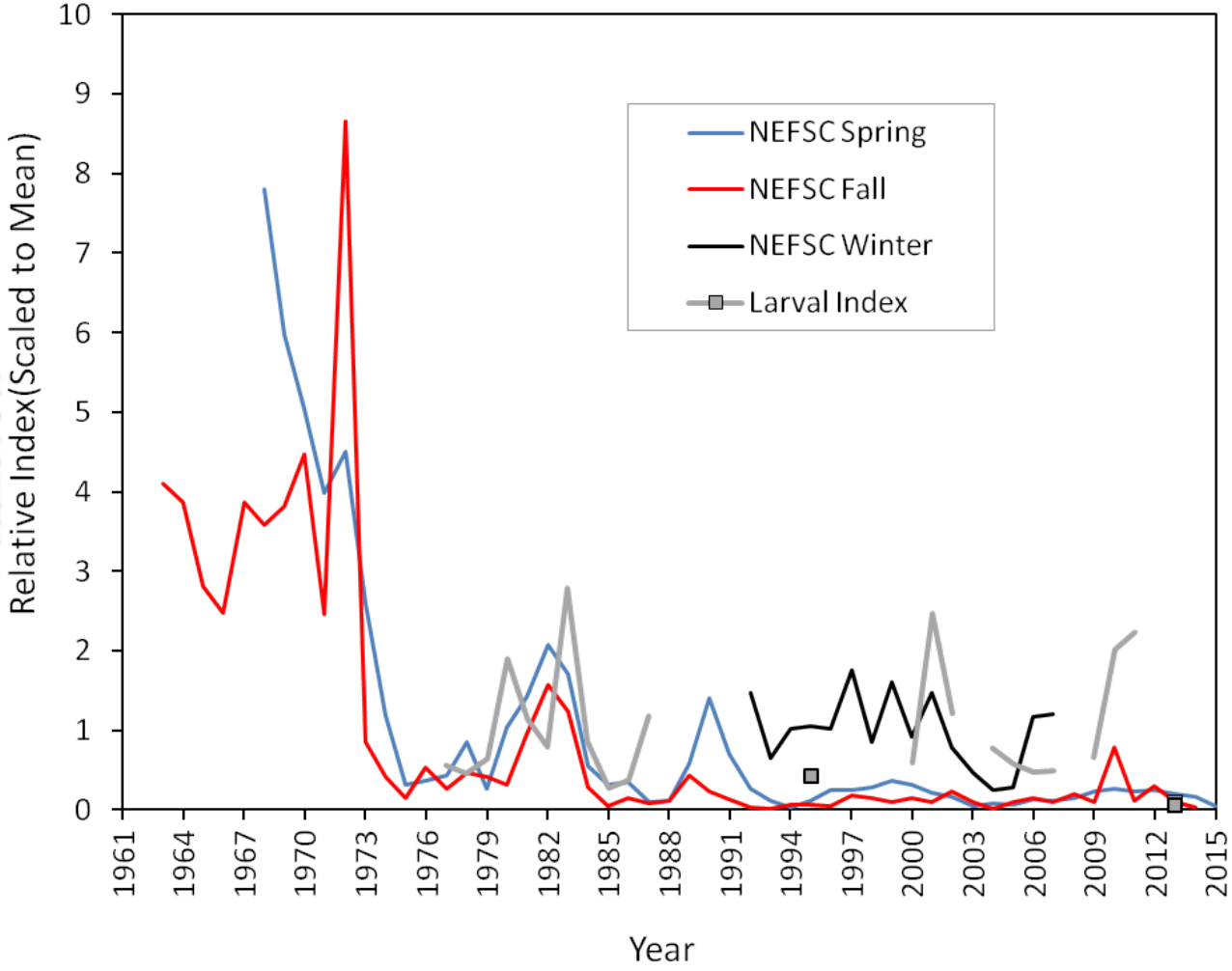
Fishery Independent data

Survey Data

- <u>NEFSC Bottom Trawl Survey Highlights</u>
  - Bigelow conversions applied 2009 forward
  - SHG to TOGA
  - Maintained and updated offshore strata :
    - Fall (strata 1-10)
    - Winter (Strata 1-10)
    - Spring (Strata 1-10 and 69-74)
  - Larval index was maintained and updated
    - MARMAP (1977-1987)
    - EcoMon (1999-2013)

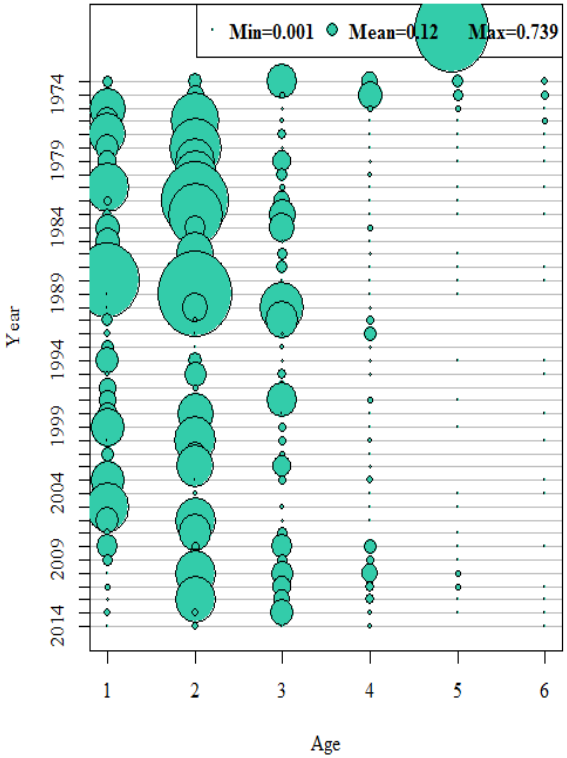


Relative Trend in Survey Index

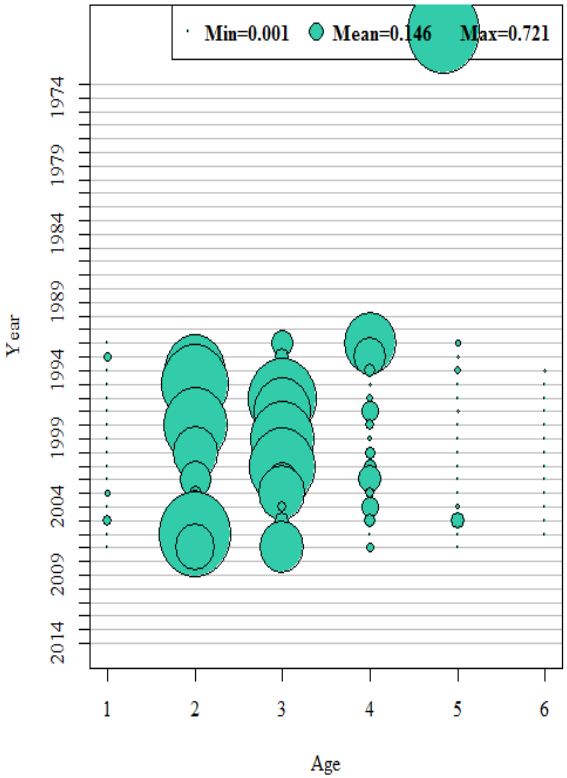


NEFSC Survey Age Proportions (ages1-6+)

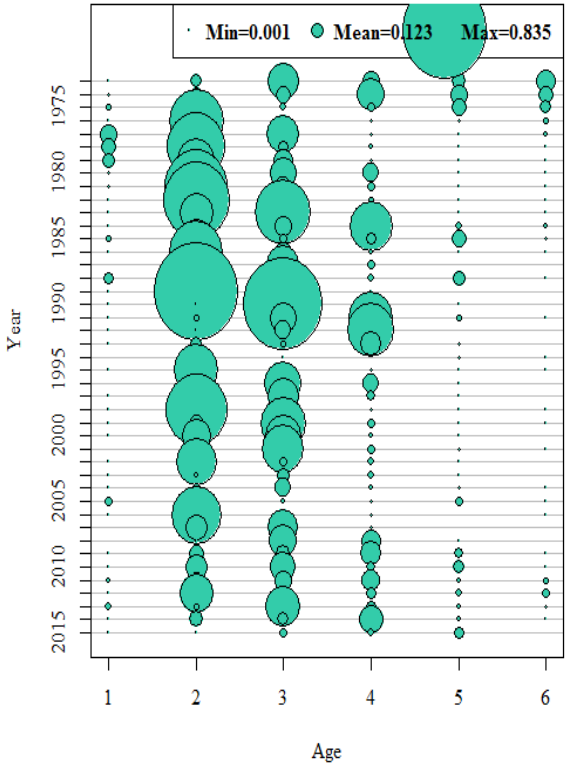
Fall (63-14)



Winter (92-07)



Spring (68-15)



ASAP Model

WP 1.D

ASAP Model Formulation

- SAW 54 Benchmark Assessment Model - Run 26
- Single fleets for the commercial catch (1973-2014)
- Plus group at age 6
- Assumed survey and fishery flat-topped selectivity (fixed age 4+)
- Catchability assumed constant
- 6 time block fishery selectivity (age-specific)
  - 1973-1977; 1978-1985; 1986-1988
  - 1989-1993; 1994-2001 2002-present
- Stock-recruitment relationship was not estimated

ASAP model Formulation cont'd

- Surveys (Fall, Winter and Spring) 1973-2014
- Larval Index
  - 2 block selectivity to reflect changes in the survey (1977-1987 and 1988-2013)
  - Missing years (gap in the coverage 2012 and 2015)
- Time invariant age dependent natural mortality and maturity from SARC 54
- MCMC to evaluate precision of terminal year SSB and fully selected F
- Retrospective analyses (Mohn's Rho – 7yr peel)

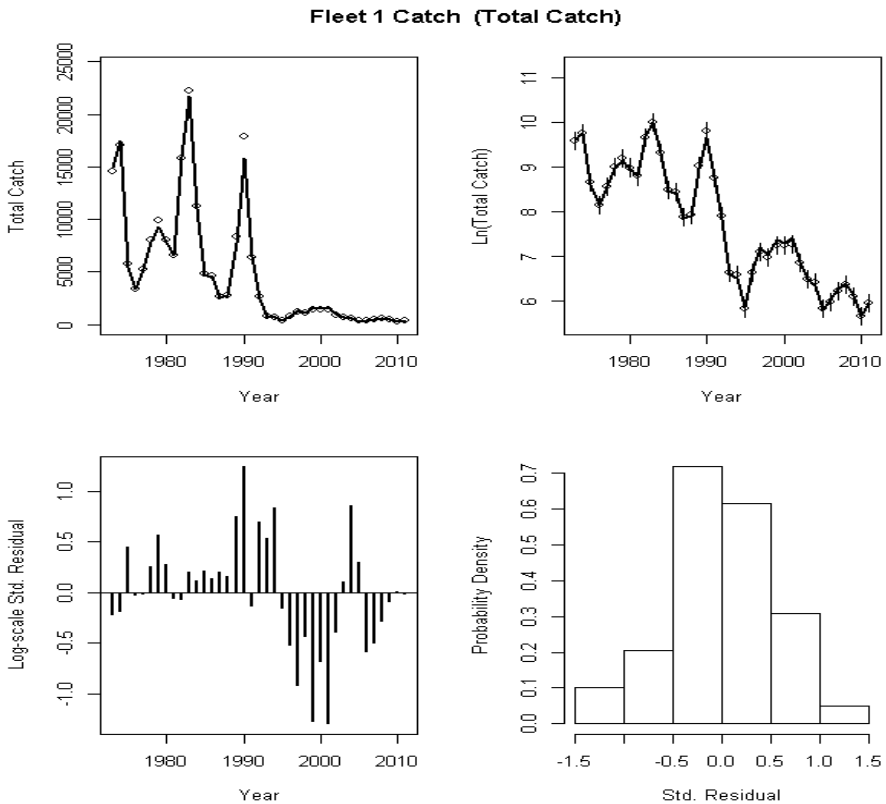
ASAP Model Run 26 (Model Weighting)

- Observed CV on all surveys based on empirical bootstrap values
  - Winter: CV = 0.24-0.61
  - Spring: CV = 0.22-0.68
  - Fall: CV = 0.30-0.79
- Assumed CV = 0.55 for larval index
- Fixed CV's on commercial catch
  - Total catch: CV = 0.1
- Effective sample sizes: total catch (50,50), winter, spring and fall survey (10,10)
- Recruitment CV = 0.5

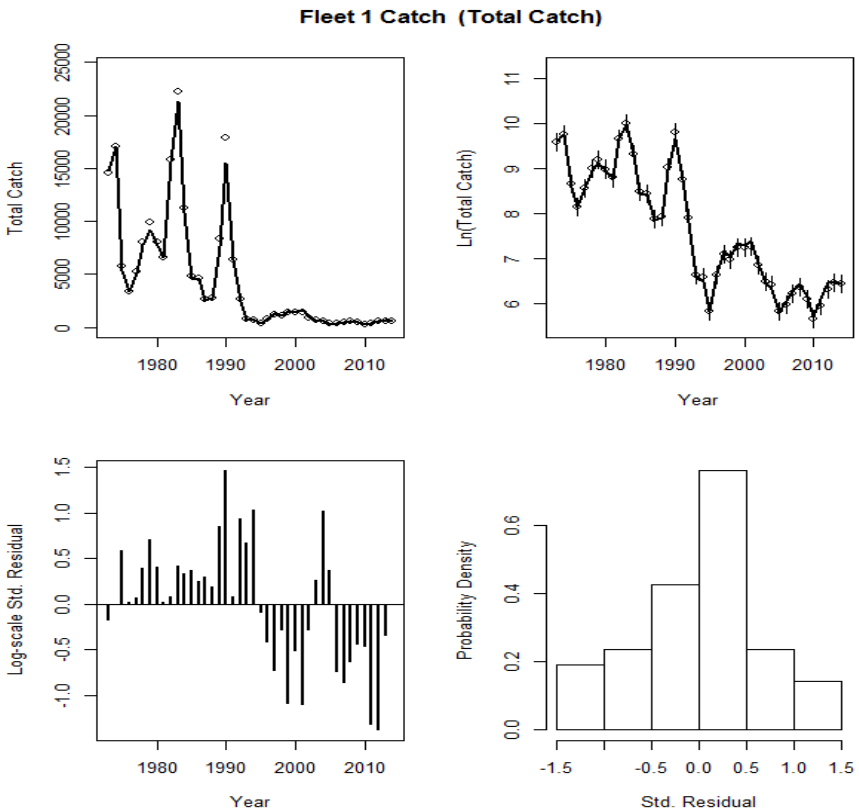
ASAP Results

- ***Diagnostics for Run26 Update***
  - **Fit to the total catch**

SAW 54



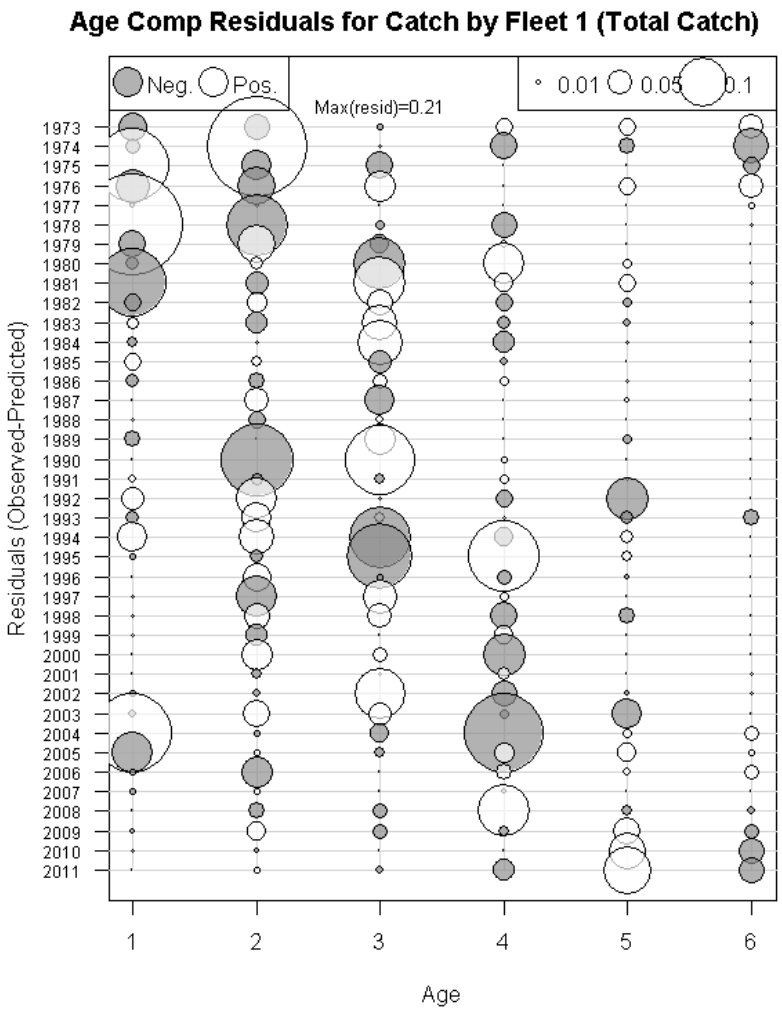
2015



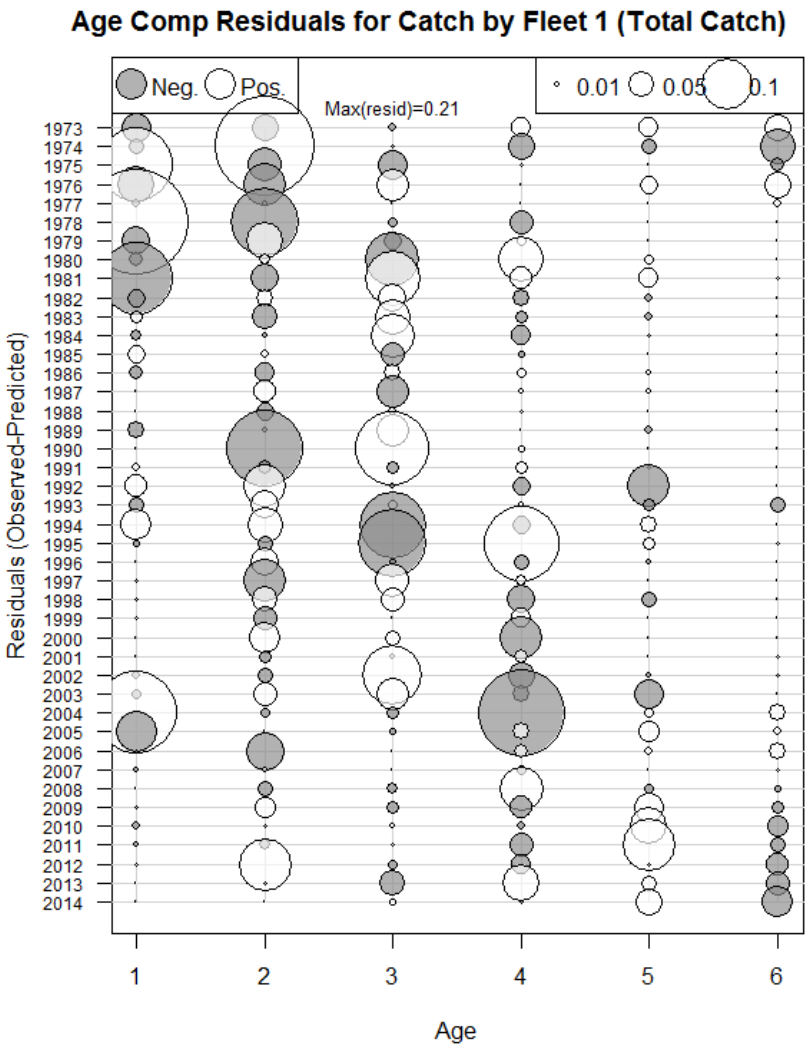
ASAP Results

- ***Diagnostics for Run26 Updated***
  - **Predicted catch age composition residuals**

SAW 54



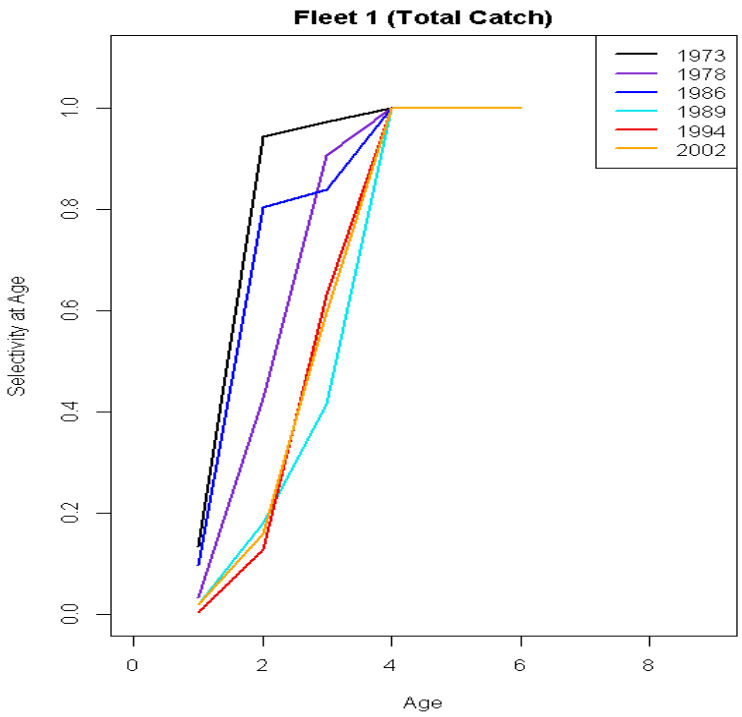
2015



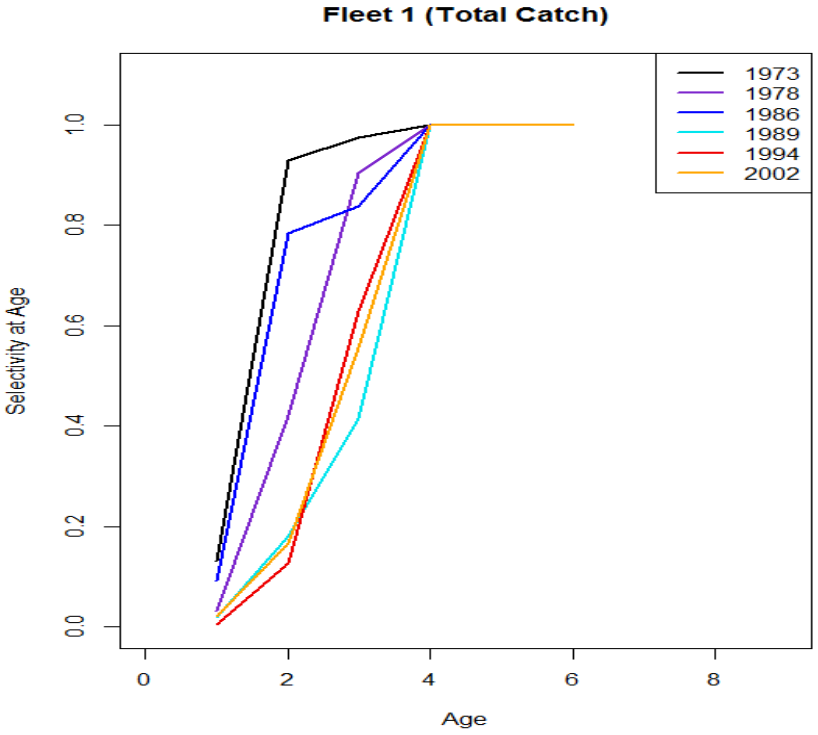
ASAP Results

- ***Diagnostics for Run26 Updated***
  - **Estimated fishery selectivity by block**

SAW 54



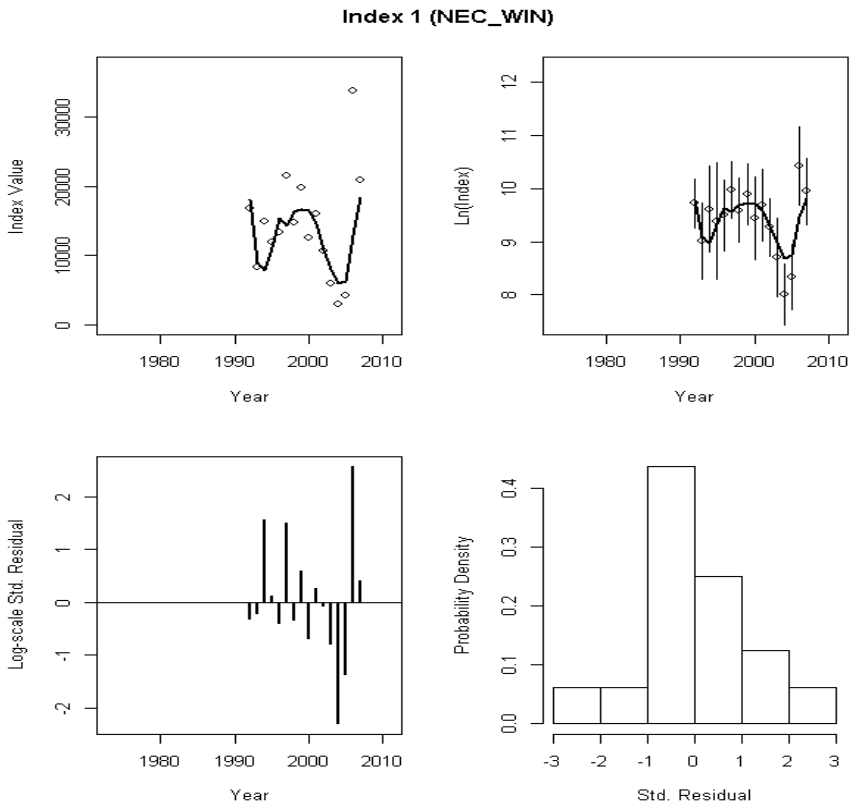
2015



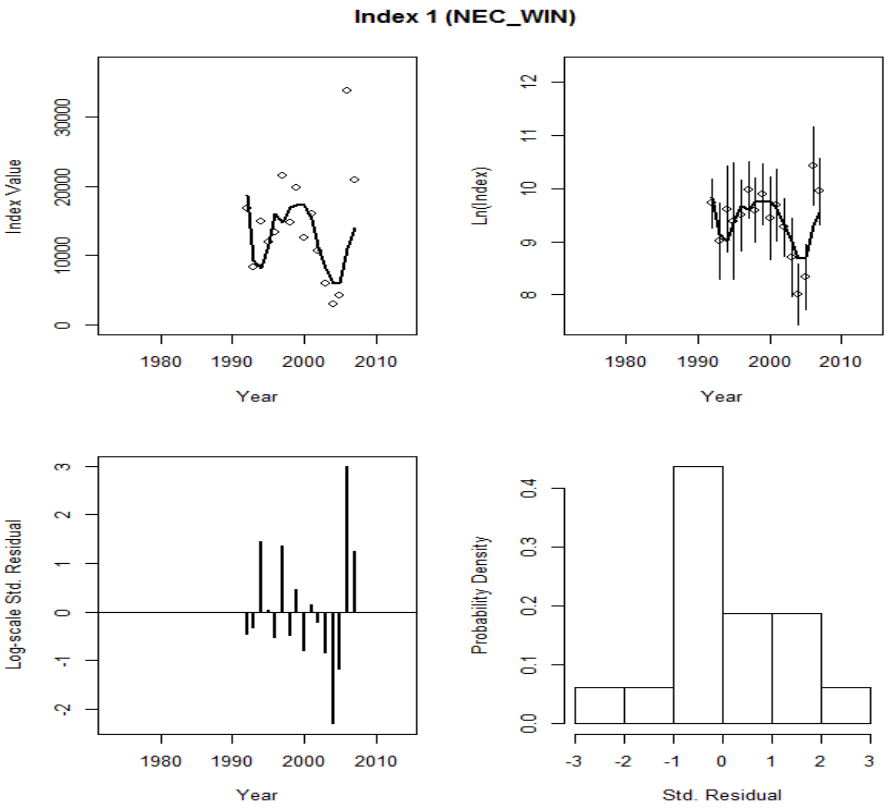
ASAP Results

- ***Diagnostics for Run26_updated***
  - **Fit to aggregated NEFSC Winter abundance (numbers) index**

SAW 54



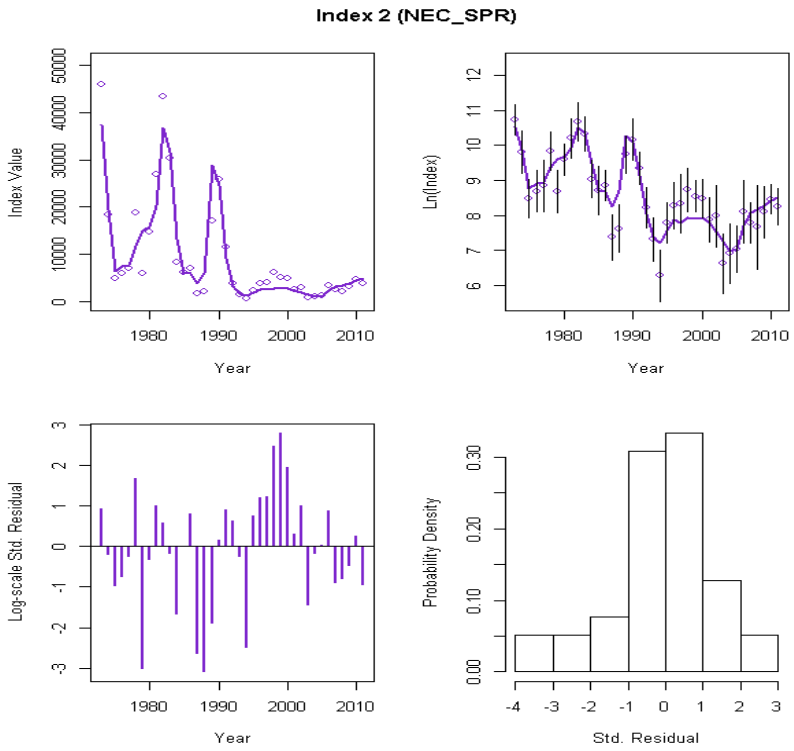
2015



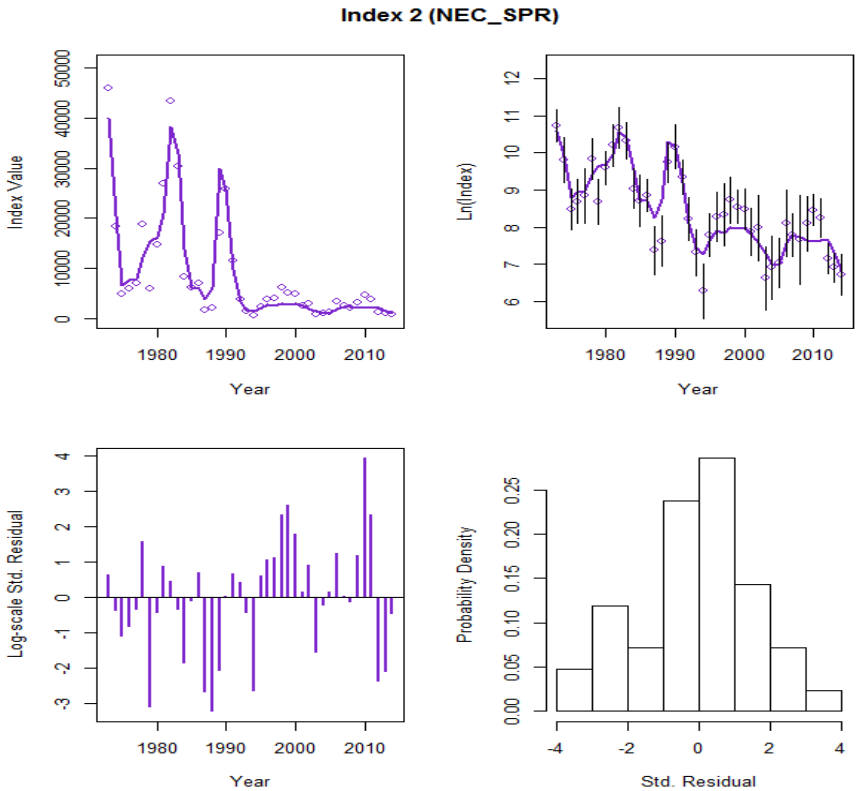
ASAP Results

- ***Diagnostics for Run26Updated***
  - **Fit to aggregated NEFSC Spring abundance (numbers) index**

SAW 54



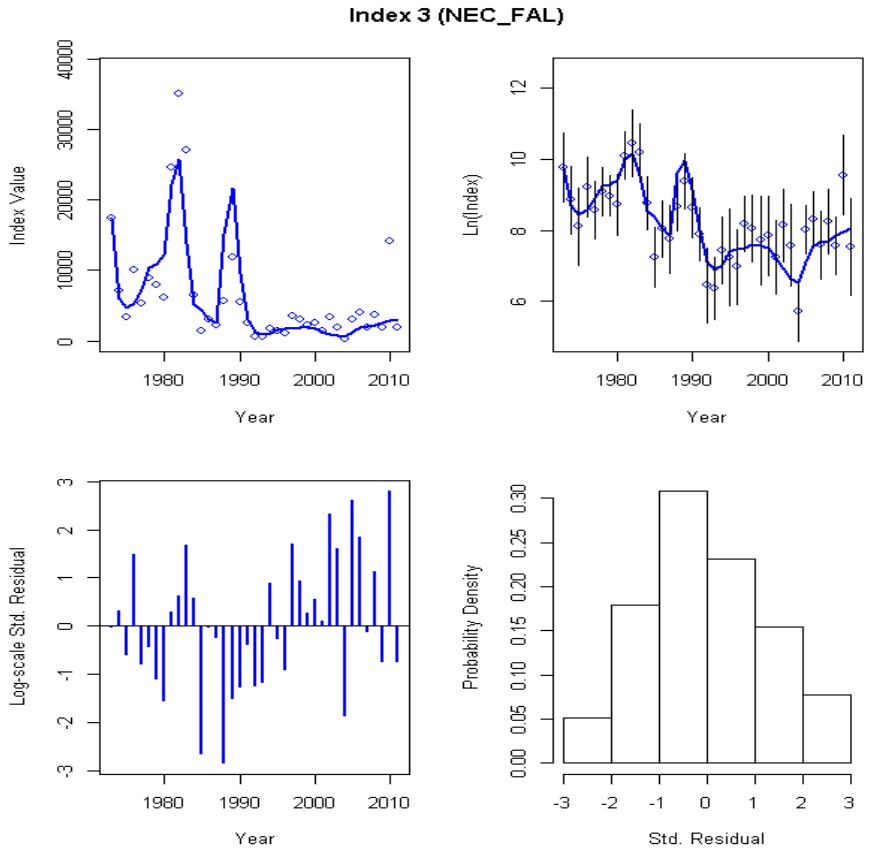
2015



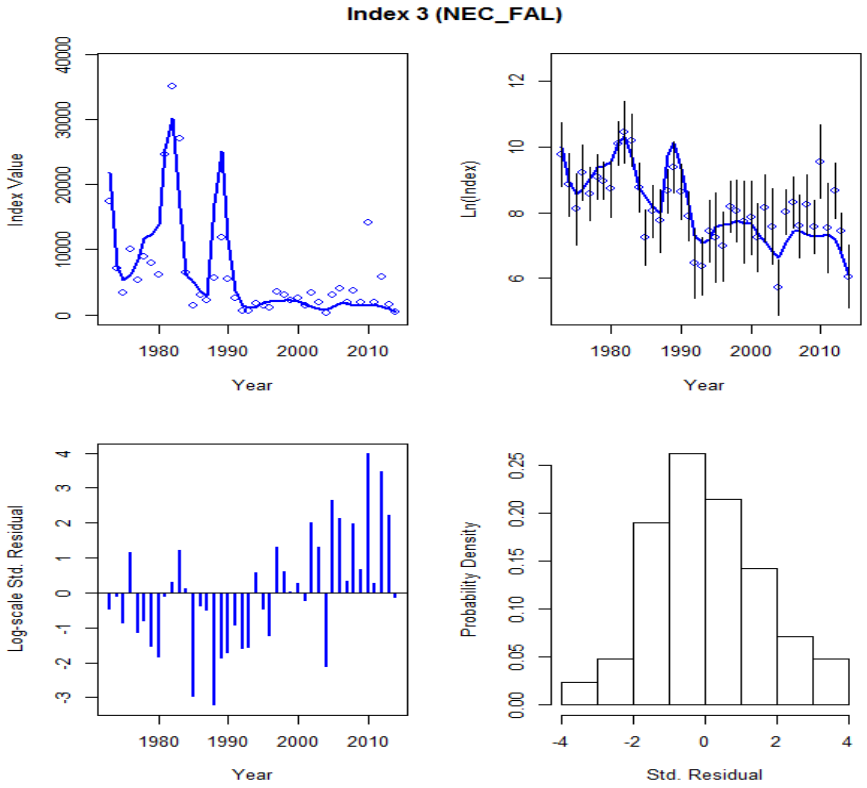
ASAP Results

- ***Diagnostics for Run26Updated***
  - **Fit to aggregated NEFSC Fall abundance (numbers) index**

SAW 54



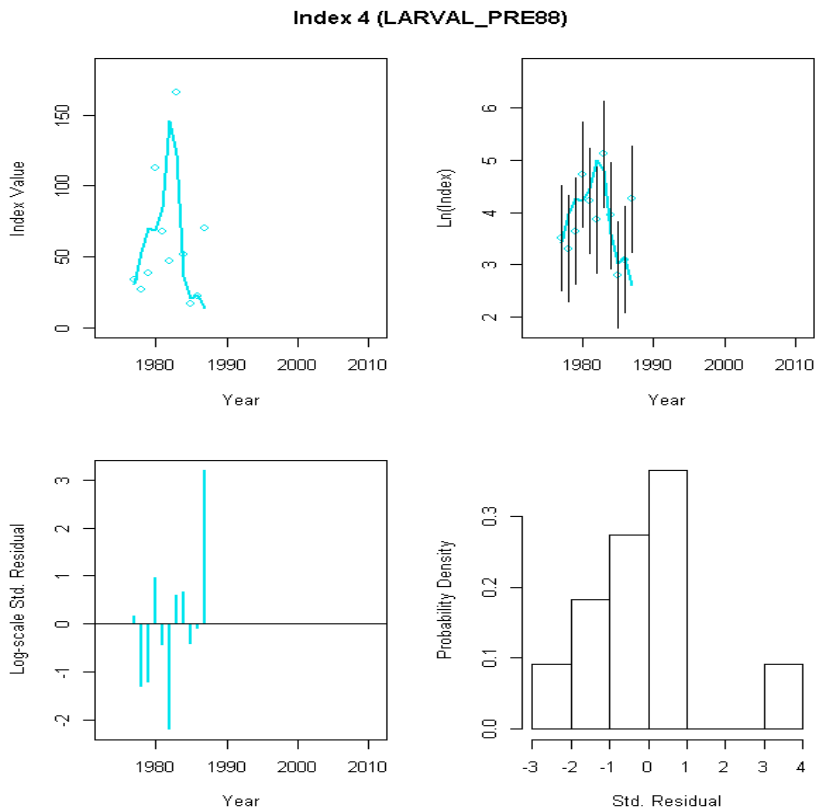
2015



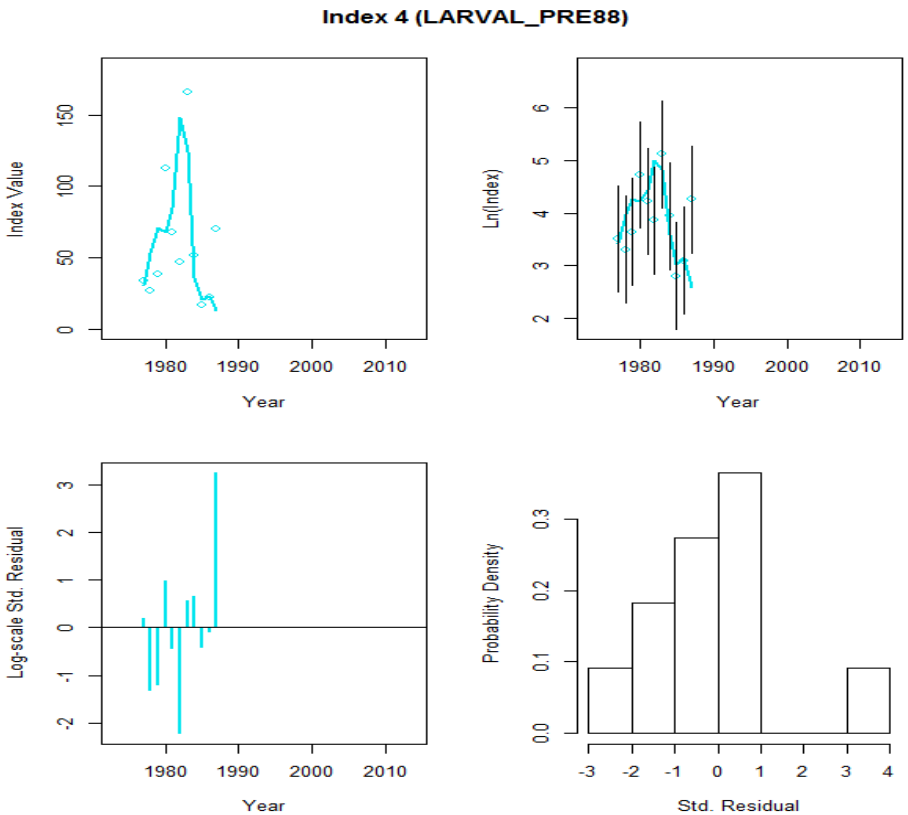
ASAP Results

- ***Diagnostics for Run26Updated***
  - **Fit to aggregated NEFSC larval abundance (numbers) index 1977-1987**

SAW 54



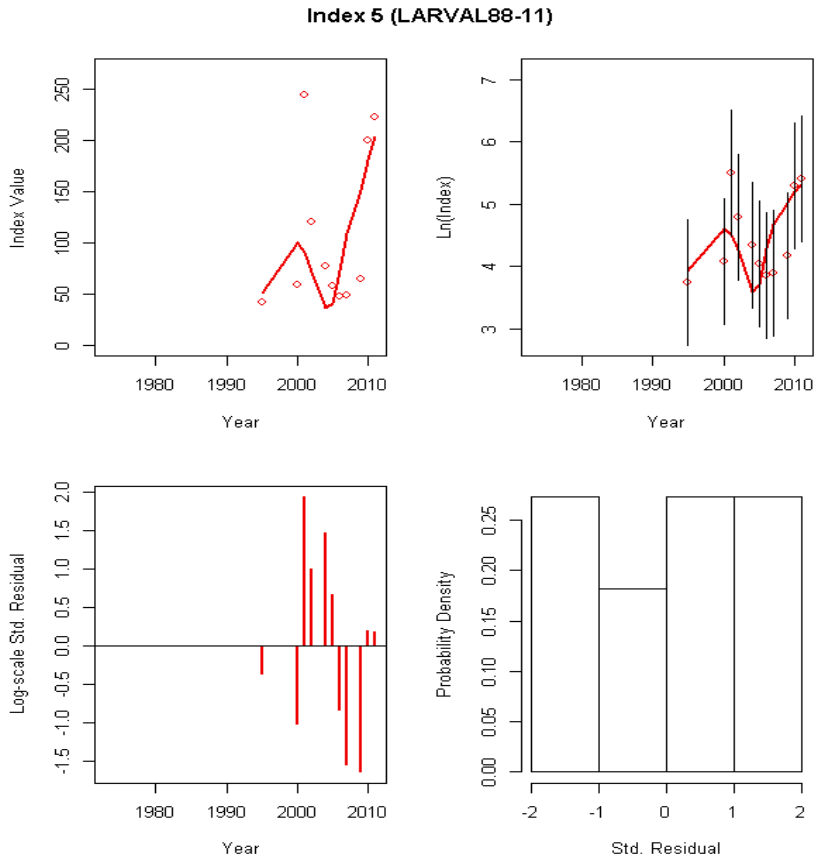
2015



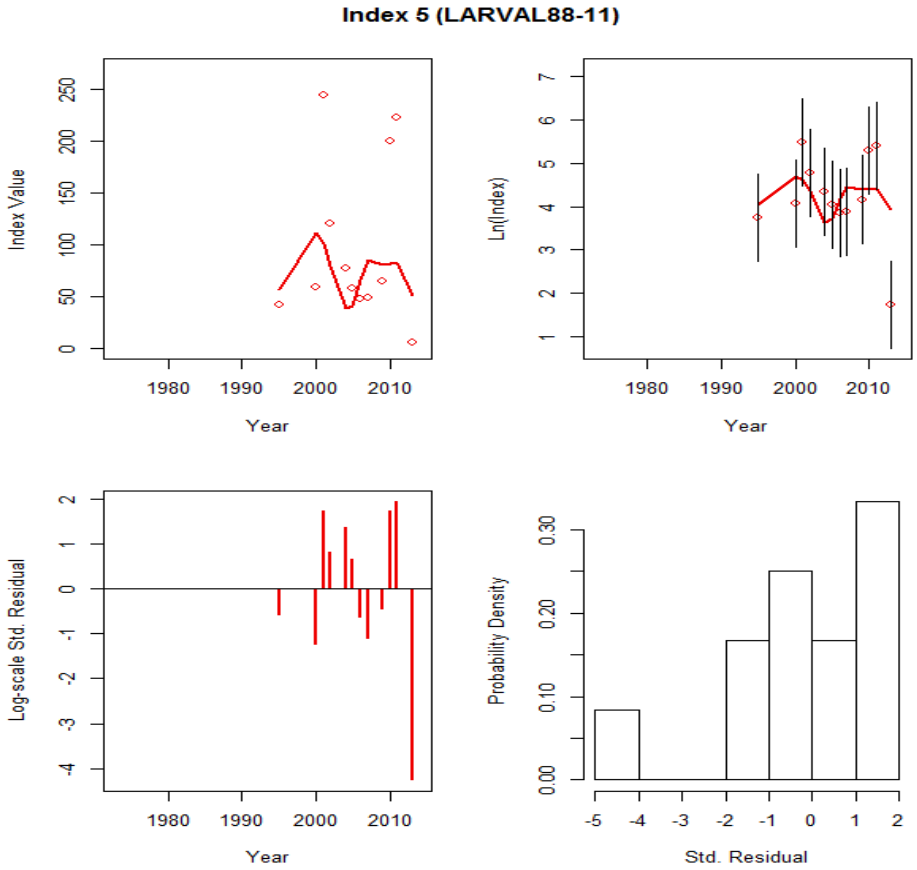
ASAP Results

- ***Diagnostics for Run26Updated***
  - **Fit to aggregated NEFSC larval abundance (numbers) index 1988-2013**

SAW 54



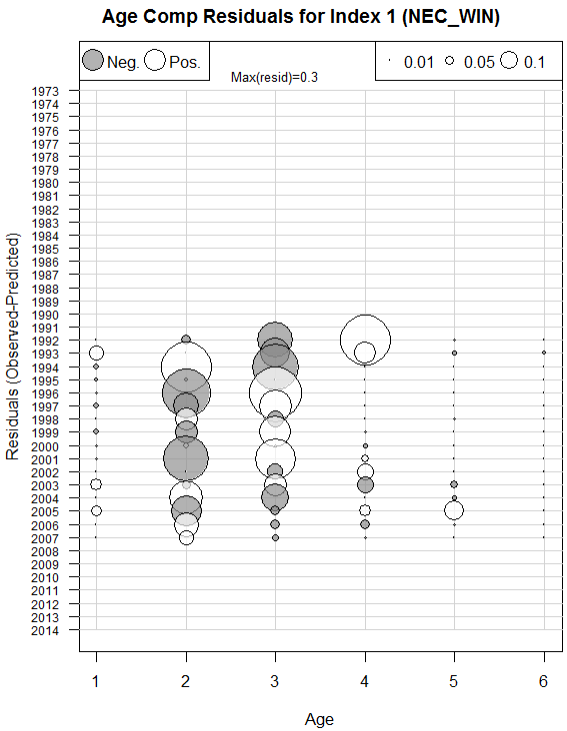
2015



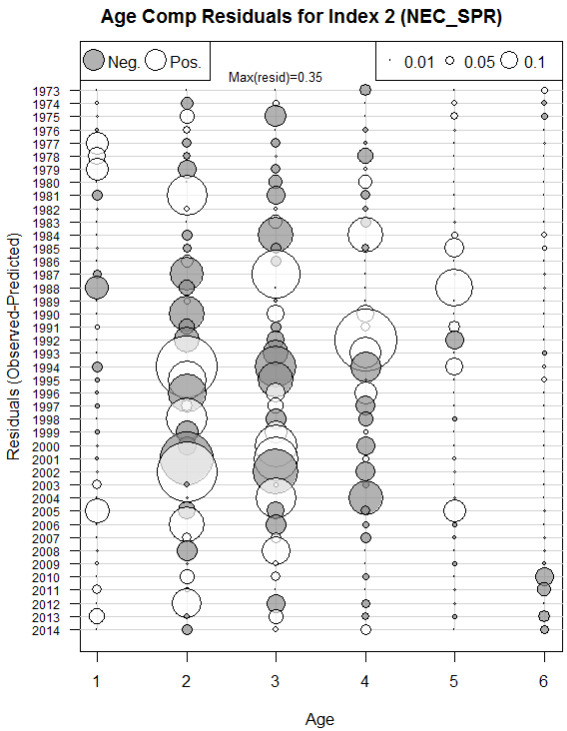
ASAP Results

- *Diagnostics for Run26*
  - **Predicted survey age composition residuals**

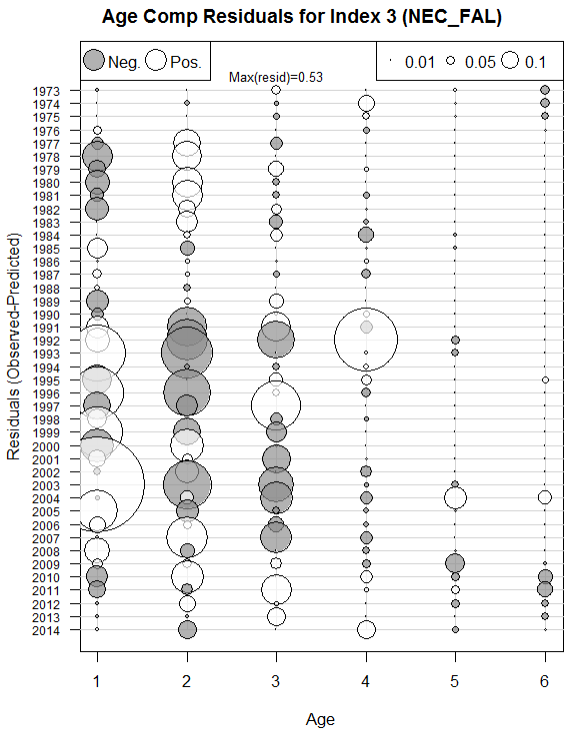
Winter



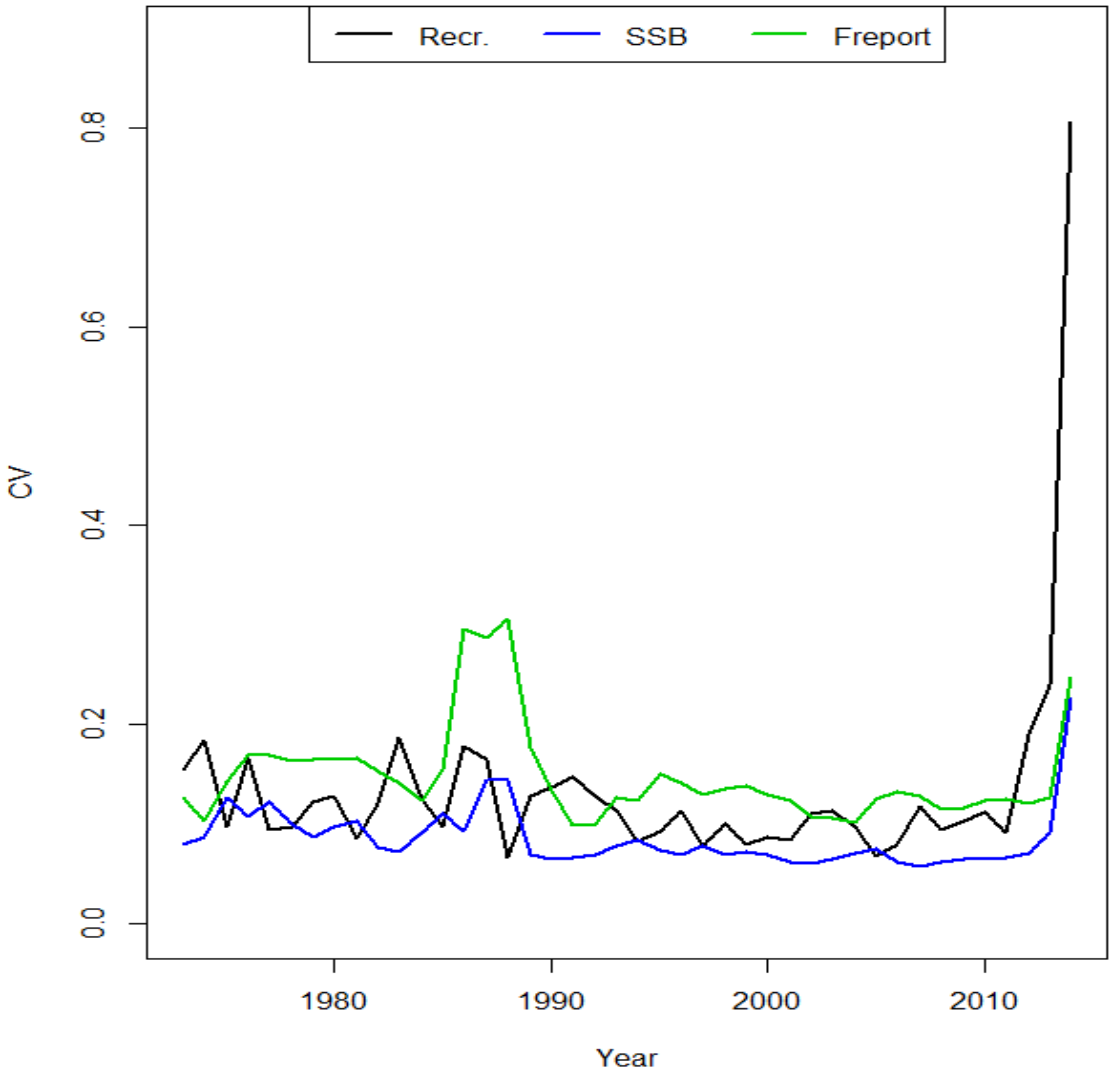
Spring



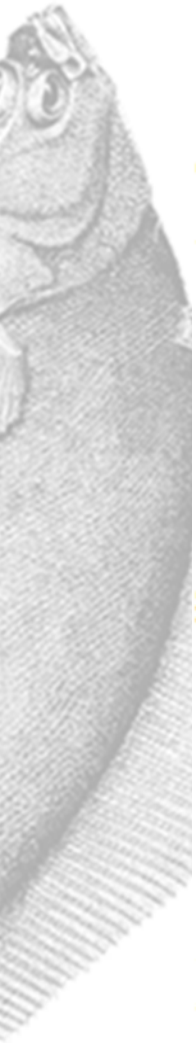
Fall

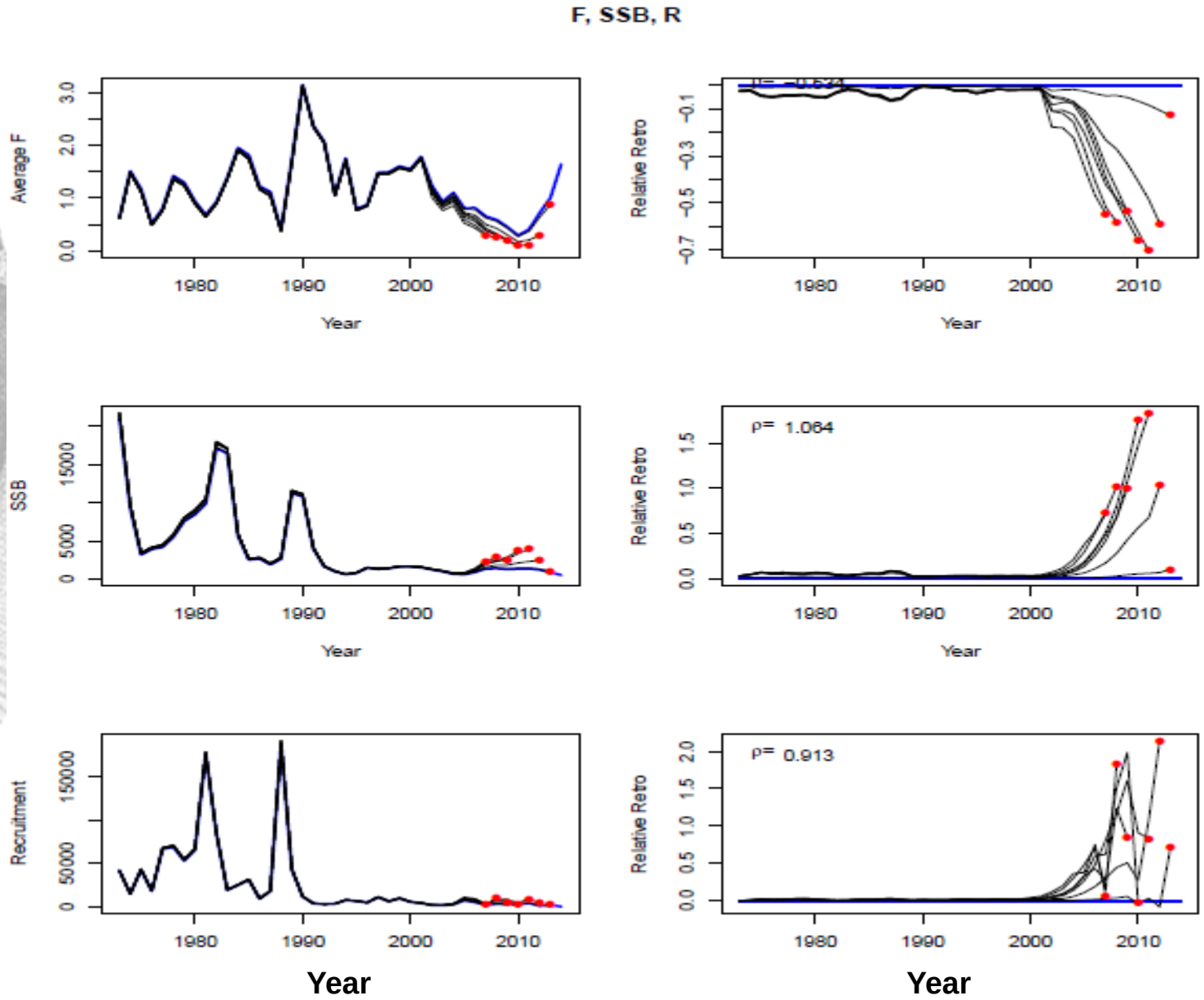


ASAP Model CV Estimate



Retrospective Analyses





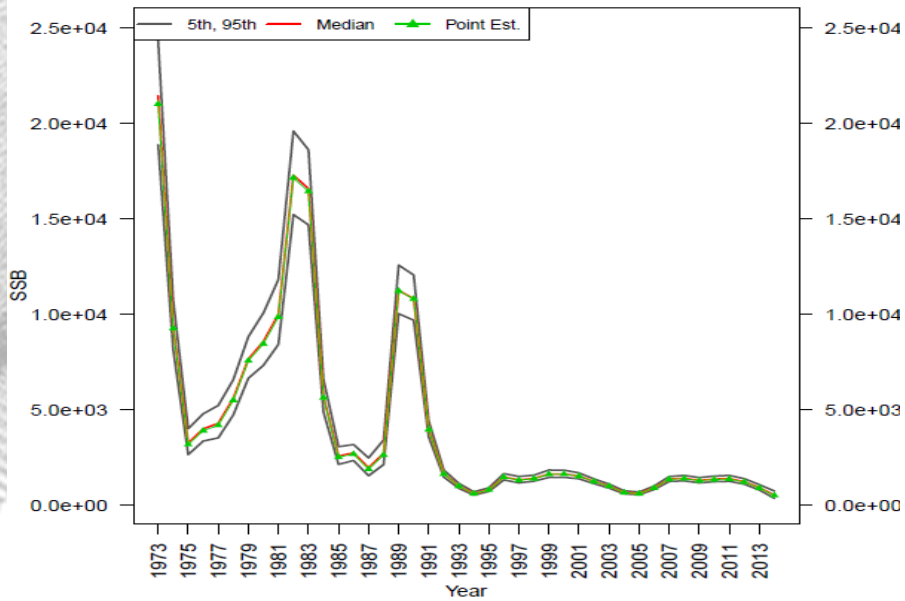
Retrospective Analyses

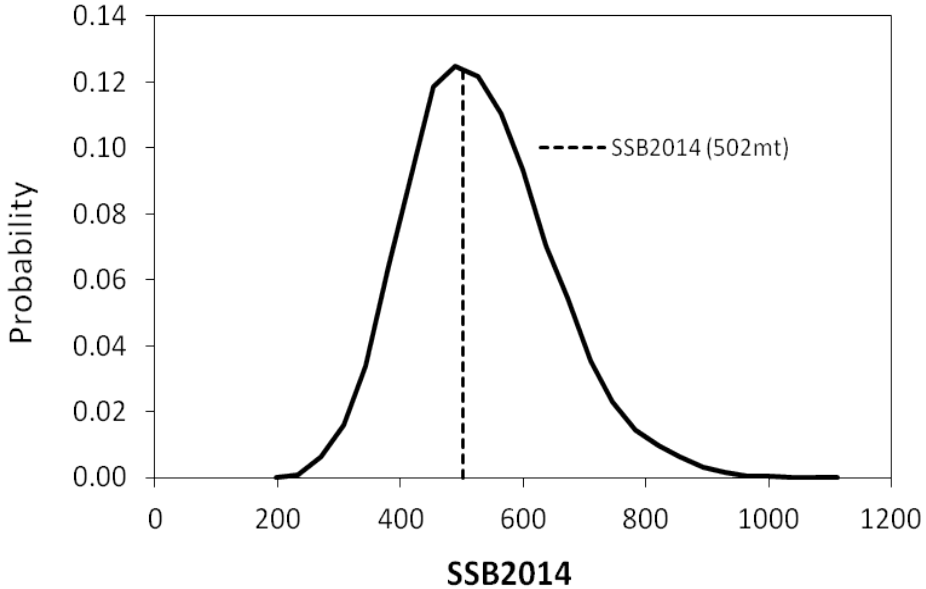
	Mohn's Rho	
Parameter	SAW54	2015 Update
SSB	14%	-53%
F	-16%	106%
N1	0.3%	91%
N2	10%	87%
N3	7%	76%
N4	9%	77%
N5	24%	106%
N6+	44%	135%

- Emergence of Strong retrospective Bias
- F Consistently underestimated
- SSB overestimated

ASAP MCMC Results

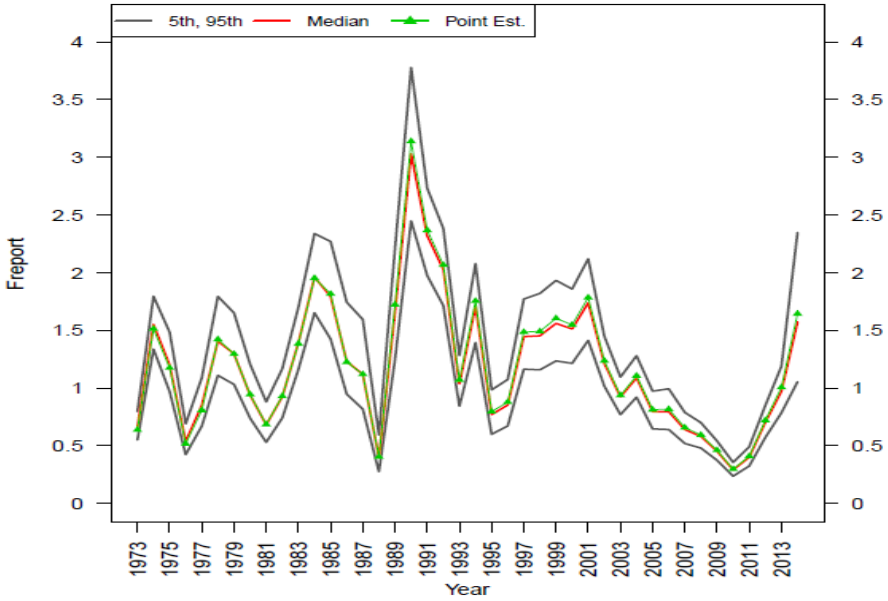
- *SARC 54 ASAP (Run 26Update):*
  - Results: <u>Spawning Biomass</u>
    - Point estimates range from 502 mt (2014) to 21010 mt (1973)
    - 2014 SSB = 502 mt (95% PI = 355 – 739 mt).
    - SSB 2014 “lowest in the time series”

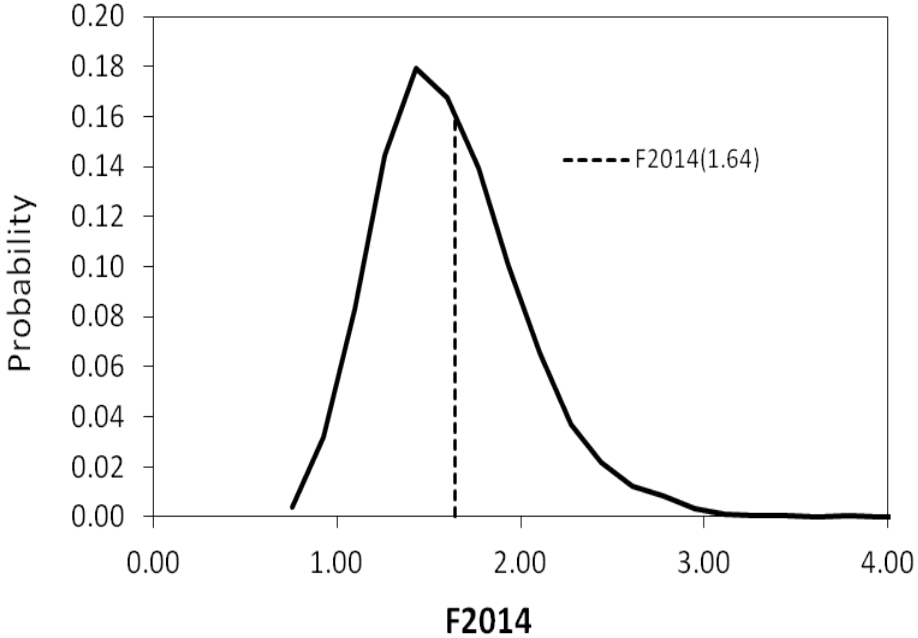




ASAP MCMC Results

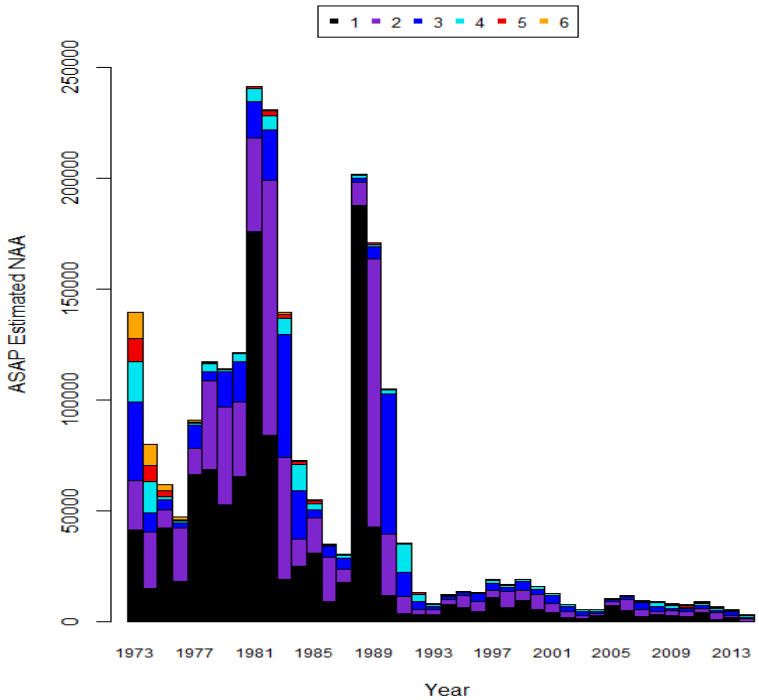
- *SARC 54 ASAP (Run 26Update):*
  - Results: Fully selected fishing mortality
    - Point estimates range from 0.296 (2010) to 3.139 (1990)
    - Current SSB = 1.64 (95% PI = 1.05 – 2.35).

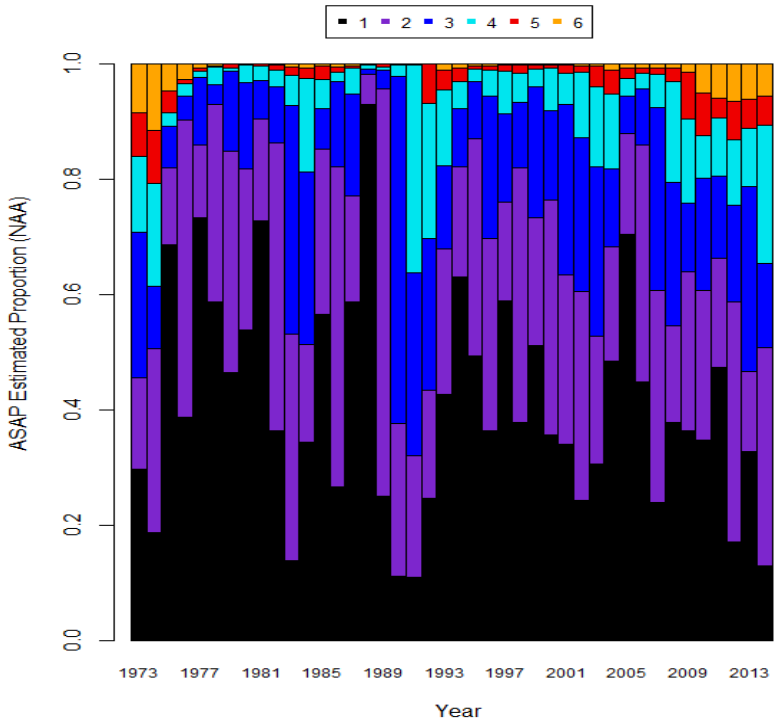




ASAP Estimate of Population Abundance

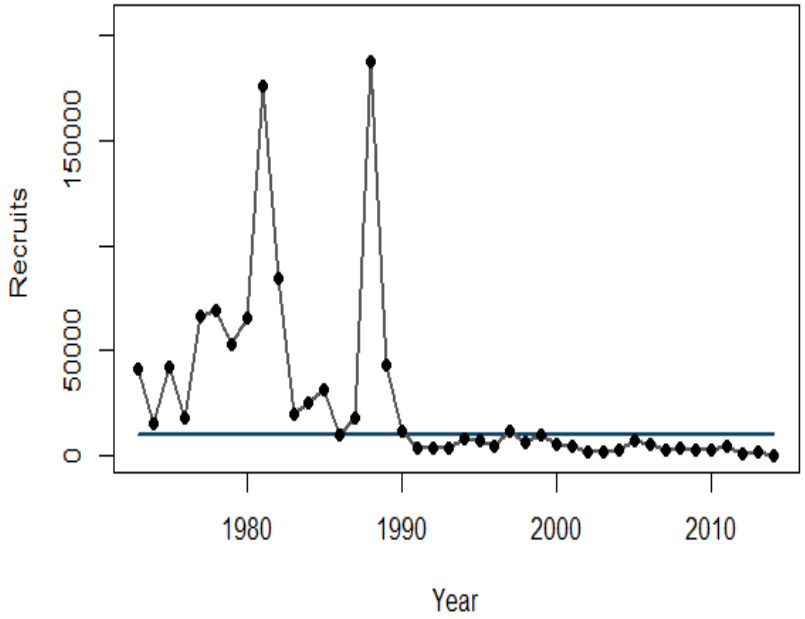
- *SARC 54 ASAP (Run 26Update):*
  - 65% decline in estimated total abundance since last assessment in 2012.
  - Estimated abundance comprises primarily of ages 2-4 (76%) with little expansion in the 6+ group in the last few years
  - Continued decline of age-1, constituting only 13% of the population in 2014

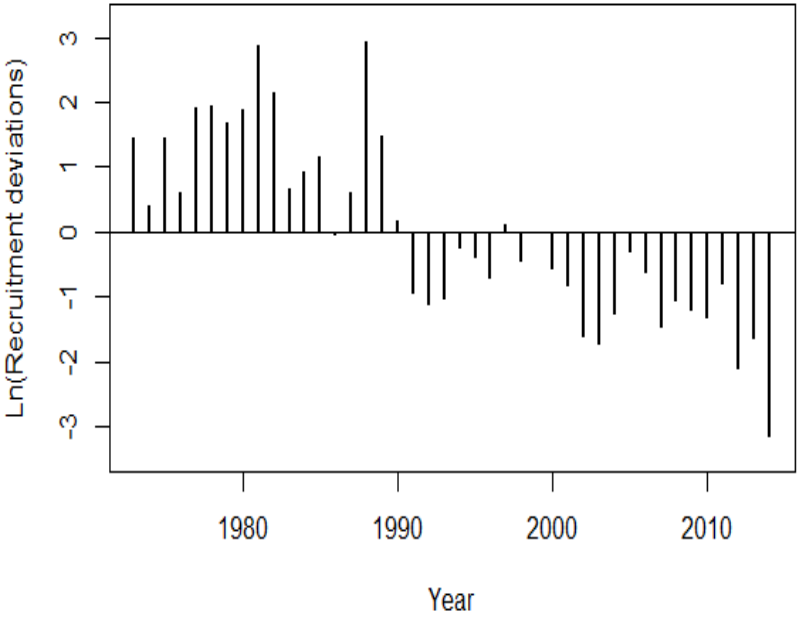




ASAP Estimate of Age-1 Recruitment

- *SARC 54 ASAP (Run 26update):*
  - Results: Geometric mean of age 1 recruitment = 13.4 million fish
  - Recruitment has only exceeded 10 million twice in the last two decades
  - 2014 Recruitment estimated lowest in the time series

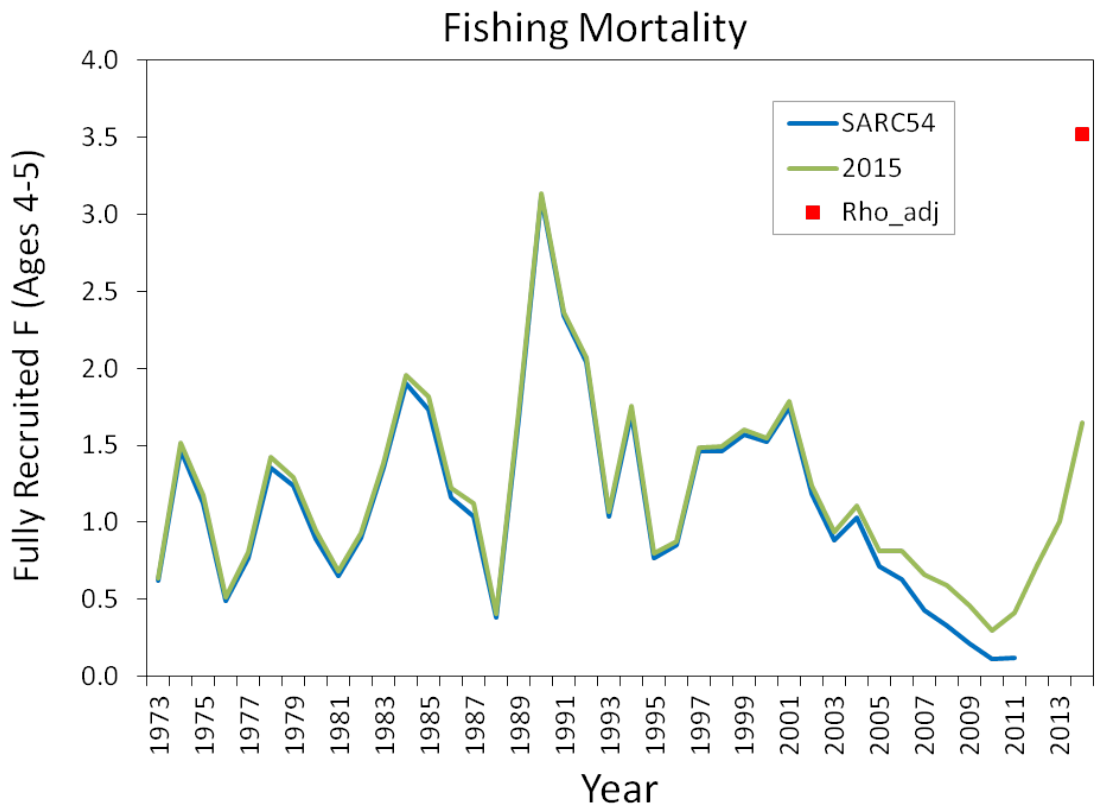




Historical retrospective performance Fishing Mortality

Historical performance of assessment model (Fishing Mortality)

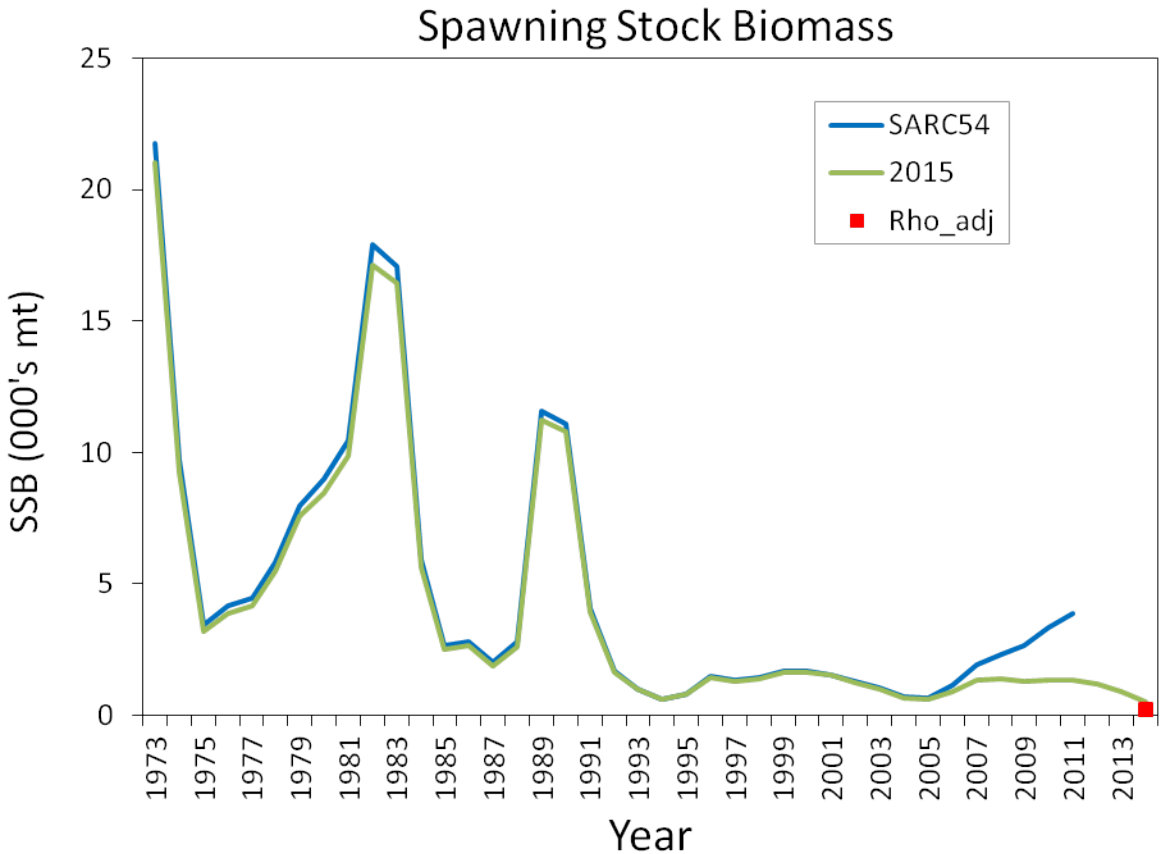
- Highly consistent with precious assessment especially in the early part of the time series
- Divergence begins to occur around the mid-2000's with higher F's in this assessment.



Historical retrospective performance Spawning Stock Biomass

Historical performance of assessment model (SSB)

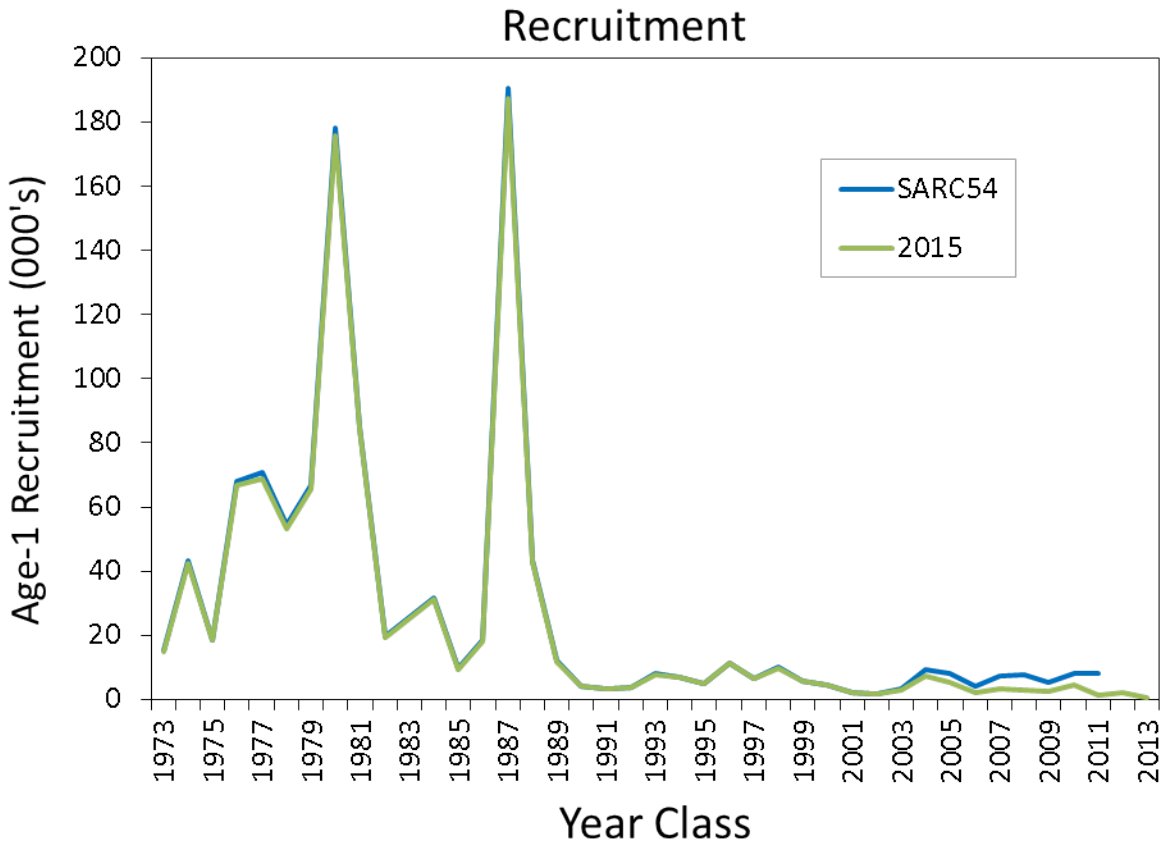
- SSB also shows high consistency relative to previous assessments
- Divergence begins to occur around the mid-2000's with higher F's in this assessment.



Historical retrospective performance Age-1 Recruitment

Historical performance of assessment model (Age-1 Recruitment)

- Age-1 recruitment also shows a similar trend and magnitude in abundance
- Again divergence in the trends is apparent in the mid 2000's.

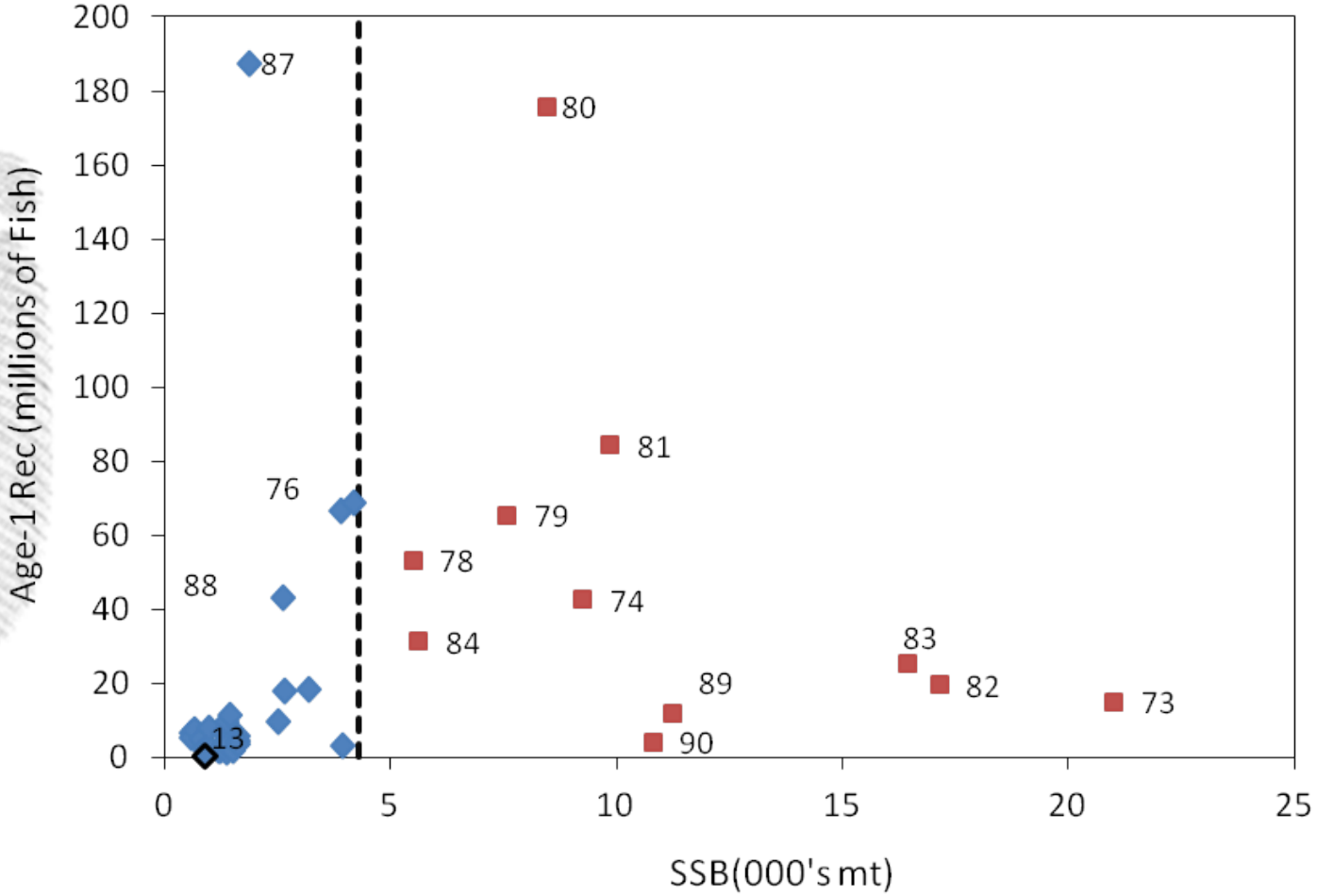


Biological and Fishery Inputs – BRP's

Age	F_Selectivity	M_Selectivity	Catch weights	Maturity
Age1	0.020	1.000	0.132	0.007
Age2	0.166	0.830	0.281	0.470
Age3	0.555	0.731	0.387	0.982
Age4	1.000	0.679	0.469	0.998
Age5	1.000	0.632	0.566	0.997
Age6+	1.000	0.570	0.700	1.000

- Based on recent five year averages
- Starting NAA inputs for 2015 were derived from 10,000 estimates from the MCMC simulations
- F40%MSP as proxy for F_{MSY} in Yield per recruit analyses
- SSB_{MSY} and MSY based on 100yrs stochastic projections and cdf sampling of recruitment from a non-parametric distribution.
- Recruitment series :
  - Contemporary recruitment (1990-2013)
  - Two Stanza recruitment conditioned on SSB <= 4,319 mt

Stock-Recruitment



Biological Reference Points

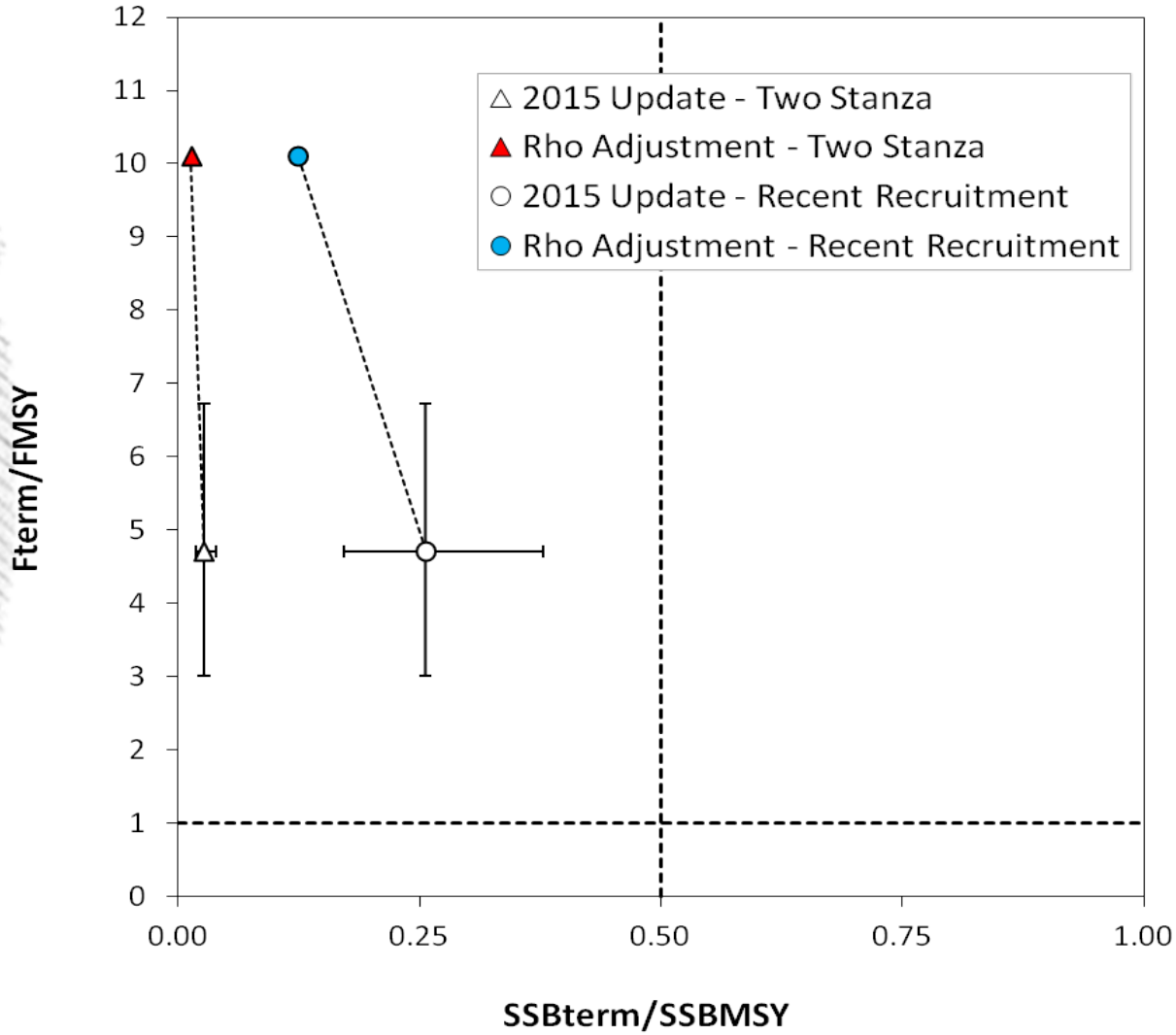
Recent Recruitment (Recruitment Series 1990-2013)

	SARC 54	2015 Update
FMSY	0.32	0.349
SSBMSY (mt)	2,995	1,959
MSY (mt)	773	541

Two Stanza Recruitment (All Recruitment series 1973-2013)

	SARC 54	2015 Update
FMSY	0.32	0.349
SSBMSY (mt)	22,615	18,810
MSY (mt)	5,834	5,180

SNEMA YT Stock Status



Short-Term Projections

- Starting NAA inputs for bridge year 2015 based on estimates from the MCMC simulations
- Recruitment series :
  - Contemporary recruitment (1990-2013)
- Future Rec. Sampling empirical cumulative distribution
- 2015 catch assumption = 478 mt (GARFO)
- WAA, PR, Maturity same as defined in the BRP setup
- Projections for years 2016-2018 were conducted under two F assumptions:
  - FMSY Proxy = 0.349
  - 75%FMSY Proxy =0.262

Projection Results

Recent Recruitment

	Fmsy = 0.349			75%Fmsy = 0.262		
		rho adjust			rho adjust	
	Unadj.	SSB	NAA	Unadj.	SSB	NAA
FS	100%	33%	63%	100%	33%	63%
	Median Catch (mt)					
Year						
2015	478	450	478	478	450	478
2016	130	31	29	101	24	22
2017	162	92	77	131	71	60
2018	233	184	178	191	147	141
	Median Spawning Stock Biomass (mt)					
Year						
2015	597	175	164	597	175	164
2016	477	132	119	490	135	122
2017	643	434	389	682	453	403
2018	1059	920	903	1127	960	940

Projection results

Two Stanza

	Fmsy = 0.349			75%Fmsy = 0.262		
		rho adjust			rho adjust	
	Unadj.	SSB	NAA	Unadj.	SSB	NAA
FS	100%	33%	63%	100%	33%	63%
	Median Catch (mt)					
Year						
2015	478	450	478	478	450	478
2016	137	42	34	106	32	26
2017	184	118	102	149	95	80
2018	321	272	265	259	215	208
	Median Spawning Stock Biomass (mt)					
Year						
2015	597	175	165	597	175	165
2016	487	144	129	499	146	131
2017	740	520	489	781	543	504
2018	1496	1358	1337	1579	1410	1388

Summary of 2015 SNEMA Yellowtail flounder Assessment

- Precision of model parameters were generally reasonable but the emergence of retrospective bias is a major source of uncertainty
- Retrospective adjustment (mohn's rho)
  - Resulted in SSB to decrease by 61% and a more than a doubling effect on F
  - rho adjustment in the projections are problematic (reduced # of feasible solutions)
  - Assumed 2015 catches ~98% of stock biomass
- Recruitment continues to be poor resulting in little to no support to the adult biomass.
- 2014 SSB and recruitment were both estimated to be lowest in the time series

Summary of 2015 SNEMA Yellowtail flounder Assessment

- Recruitment continues to be poor and It is likely the stock is currently in a different productivity regime

- F_{2014} = 1.64 (3.53): 5 or10 times F_{MSY}
- SSB_{2014} = 502 mt (243 mt): 26% or 12% of SSB_{MSY}

- Stock is Overfished and Overfishing is occurring

- Continued catches at current levels could potentially drive the population to much dangerous levels.