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SEDAR 45 Gulf of Mexico Vermilion Snapper Stock Assessment: Data/ Assessment workshop

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November 17, 2015

Outline

- Assessment history
- Data comparisons to 2011 update
- Continuity run development
- Final continuity run
- Base model investigations



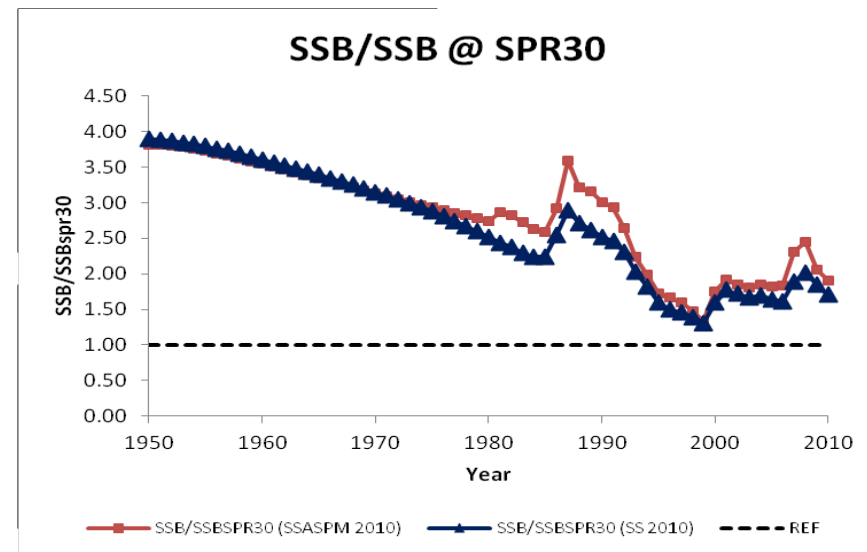
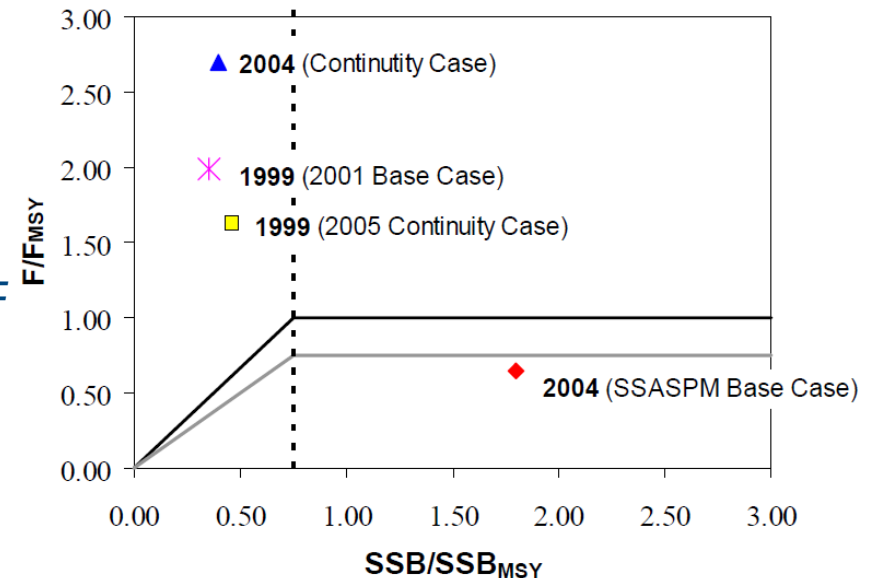
Assessment History



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Previous Assessments

- State-space age-structured production model (SSASPM; SEDAR 9, 2006)
 - Direct age samples
 - Assumed virgin conditions in 1950 (linear F interpolations)
 - Commercial handline CPUE (East/West)
 - Headboat CPUE (East/West)
 - MRFSS (East)
 - Constant shrimp bycatch
- SSASPM (Calay, 2010)
 - Average shrimp bycatch
 - Shrimp effort index
- Stock Synthesis exploratory run (Linton, 2010)
 - Assumed virgin conditions in 1950 (linear *catch* interpolations)
 - No error in catch
 - Recruitment bias adjustment
 - Constant shrimp bycatch



Data



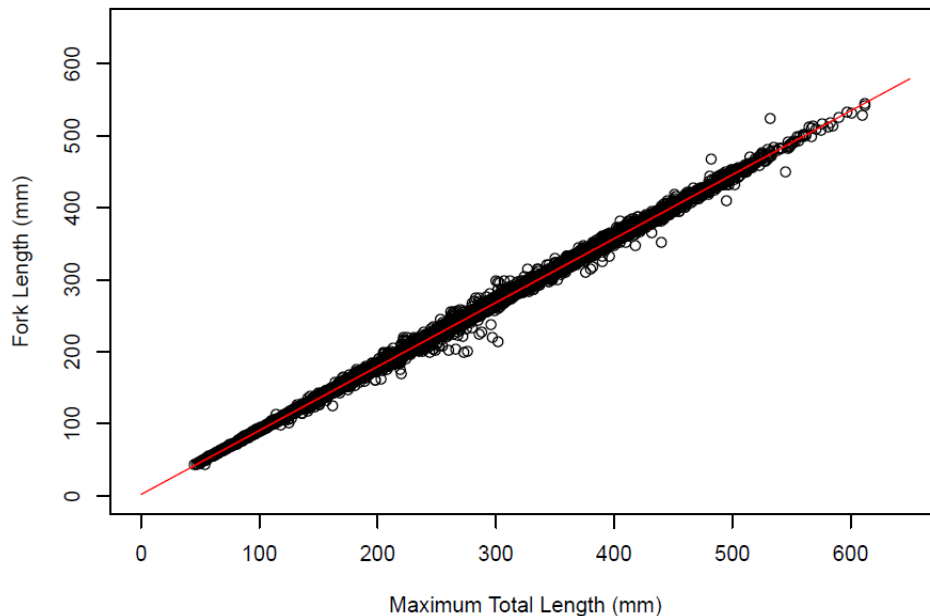
Data

- Submitted data sets
 - Commercial landings
 - Recreational Landings
 - Recreational Discards
 - Reweighted age composition
 - Shrimp effort
 - Commercial CPUE
 - Recreational CPUE
 - Life history relationships (growth and maturity)
 - SEAMAP survey
 - Video survey
- Needed:
 - Shrimp bycatch
 - Historic rec landings
 - Commercial discards



Length-Weight

VS predict FL from Maximum TL, n = 11700



SEDAR 45 (converting to FL)

$$FL \text{ (mm)} = 0.8876 * TL \text{ (mm)} + 1.980$$

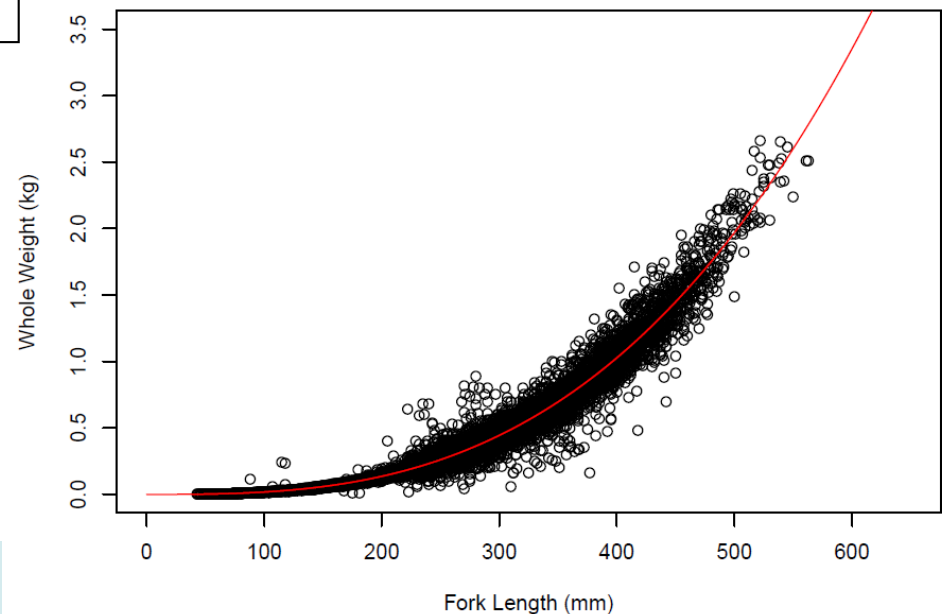
$$WW \text{ (kg)} = 2.66 \text{ E-}08 * FL \text{ (mm)}^{2.916}$$

SEDAR 9 (converting to TL)

$$TL \text{ (mm)} = 1.11 * FL \text{ (mm)} - 0.16$$

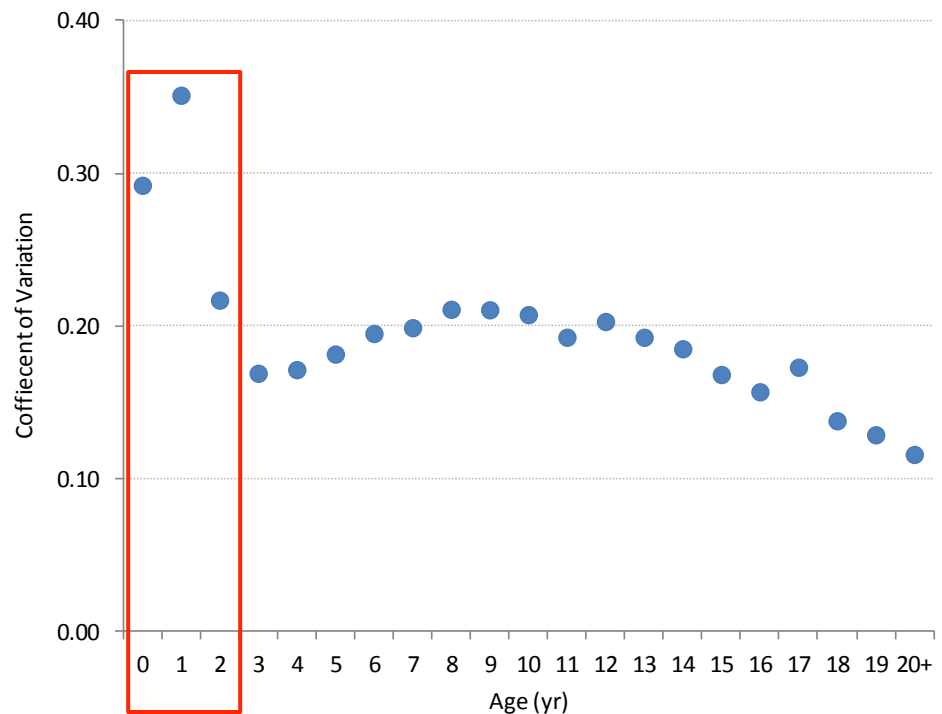
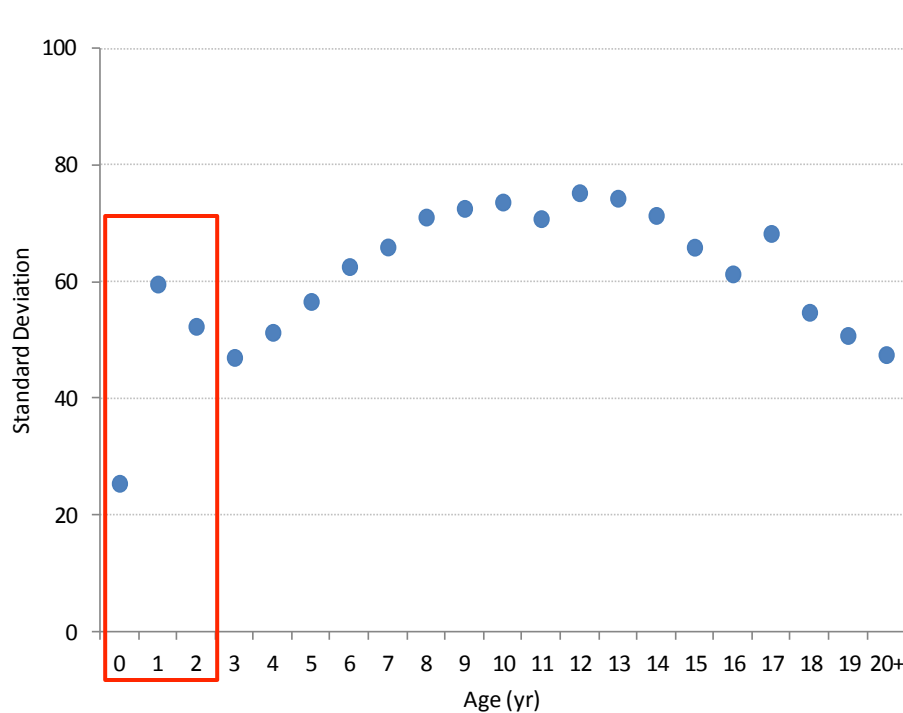
$$WW \text{ (kg)} = 2\text{E-}08 * TL \text{ (mm)}^{2.98}$$

VS predict Whole Wt from FL, n = 16716



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Age and Growth Data: Variation of size-at-age data



VS unique pattern of variation at size-at-age

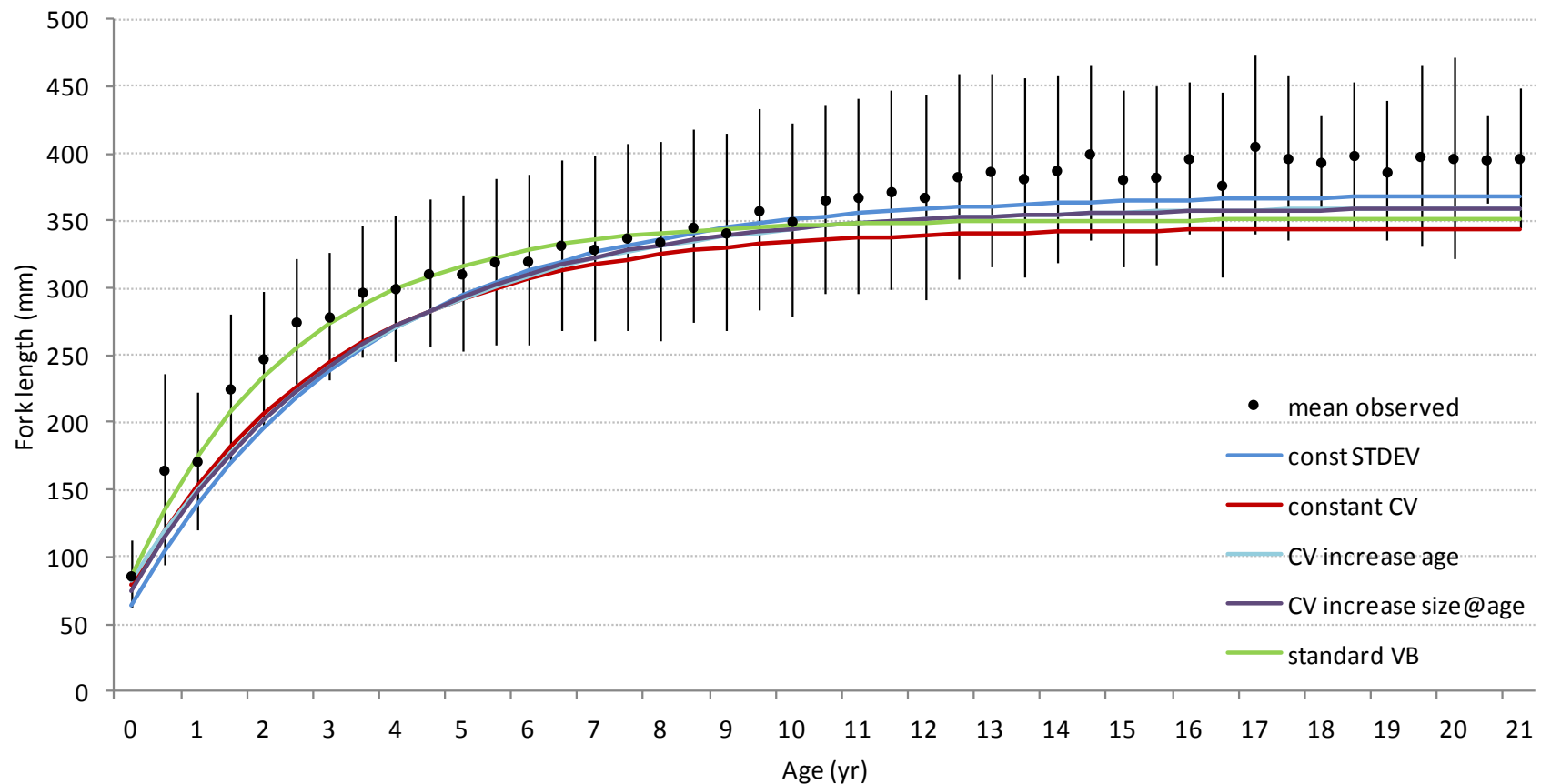


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Age and Growth Data: predicted vs observed



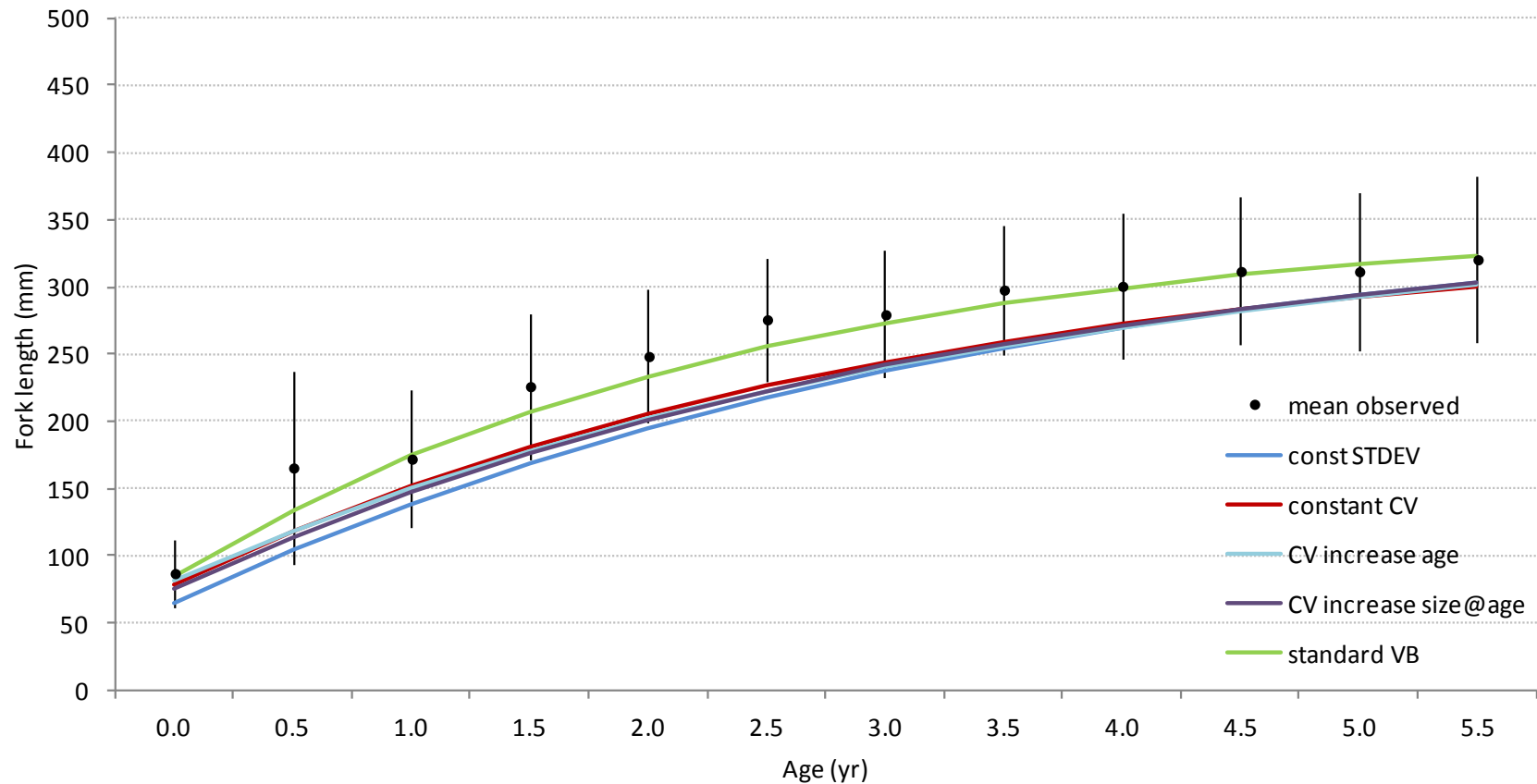
Ages 0 – 21 yrs



Age and Growth Data: predicted vs observed



Ages 0 –5.5 yrs



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Age and Growth Data: predicted parameters



Growth curve parameters $\pm$ standard deviation (L_{∞} - asymptotic length, k – growth coefficient, t_0 – size at time zero, sigma – standard deviation, CV – coefficient of variation)

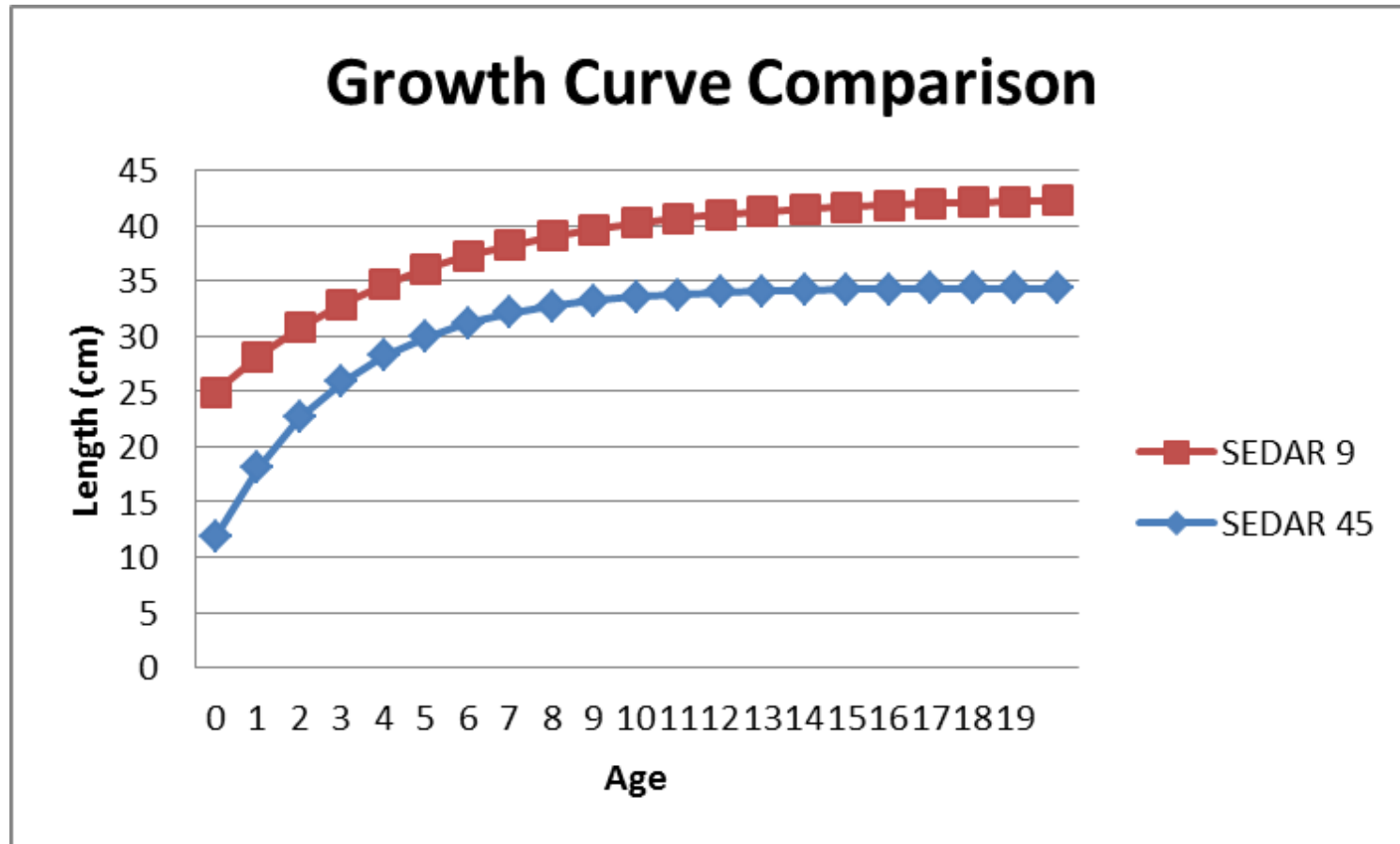
Model	n	L_{∞}	k	t_0	Sigma	CV
Constant CV	46548 ²	344 $\pm$ 1.28 (FL)	0.3254 $\pm$ 4.4 $\times 10^{-3}$	-0.7953 $\pm$ 2.1 $\times 10^{-2}$		0.2535 $\pm$ 1.4 $\times 10^{-3}$
Constant std dev	46548 ²	369 $\pm$ 1.77 (FL)	0.2802 $\pm$ 5.7 $\times 10^{-3}$	-0.6799 $\pm$ 4.6 $\times 10^{-2}$	68.32 $\pm$ 0.30	
Increase CV w/ Age	46548 ²	360 $\pm$ 2.03 (FL)	0.2817 $\pm$ 5.4 $\times 10^{-3}$	-0.9102 $\pm$ 2.8 $\times 10^{-2}$		0.2798 $\pm$ 2.9 $\times 10^{-3}$ 0.1720 $\pm$ 6.6 $\times 10^{-3}$
Increase CV w/ Size-at-Age	46548 ²	360 $\pm$ 1.62 (FL)	0.2922 $\pm$ 4.3 $\times 10^{-3}$	-0.8025 $\pm$ 2.2 $\times 10^{-2}$		0.3350 $\pm$ 4.9 $\times 10^{-3}$ 0.2158 $\pm$ 2.3 $\times 10^{-3}$
Standard VB	47197	351 $\pm$ 7.5 (FL)	0.4100 $\pm$ 5.4 $\times 10^{-3}$	-0.6721 $\pm$ 2.9 $\times 10^{-2}$		
SEDAR9 & update	7980	426 (TL), 380 (¹ FL)	0.20	-3.9		

¹ Fork length predicted from total length, using $FL = 1.98 + TL * 0.8876$

² Size-Modified growth model removes records $FL < \text{size limit}$, $n = 649$



Previous Growth Curve

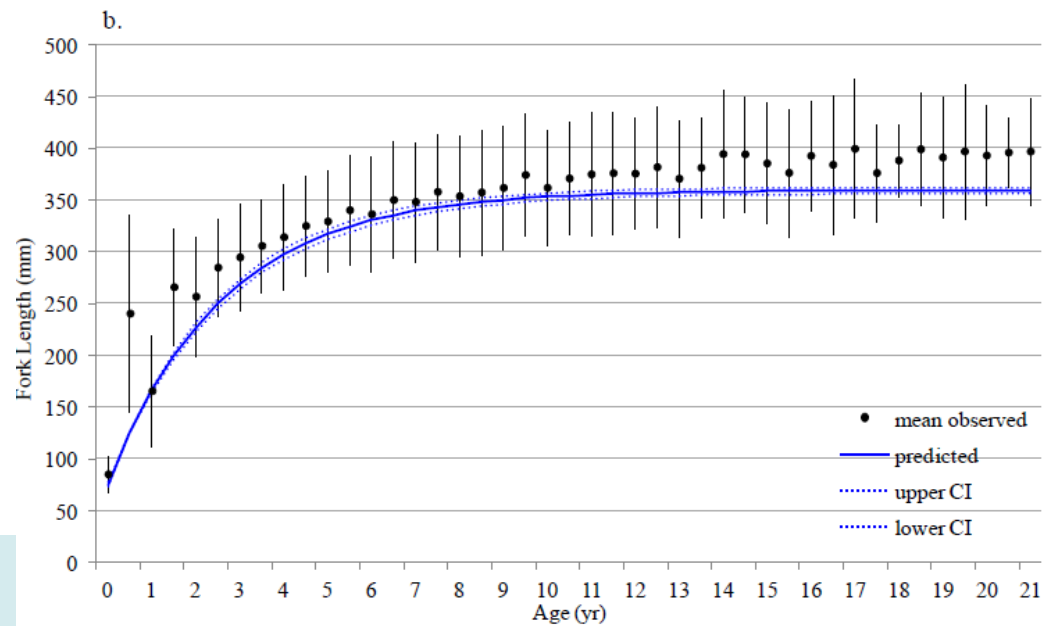
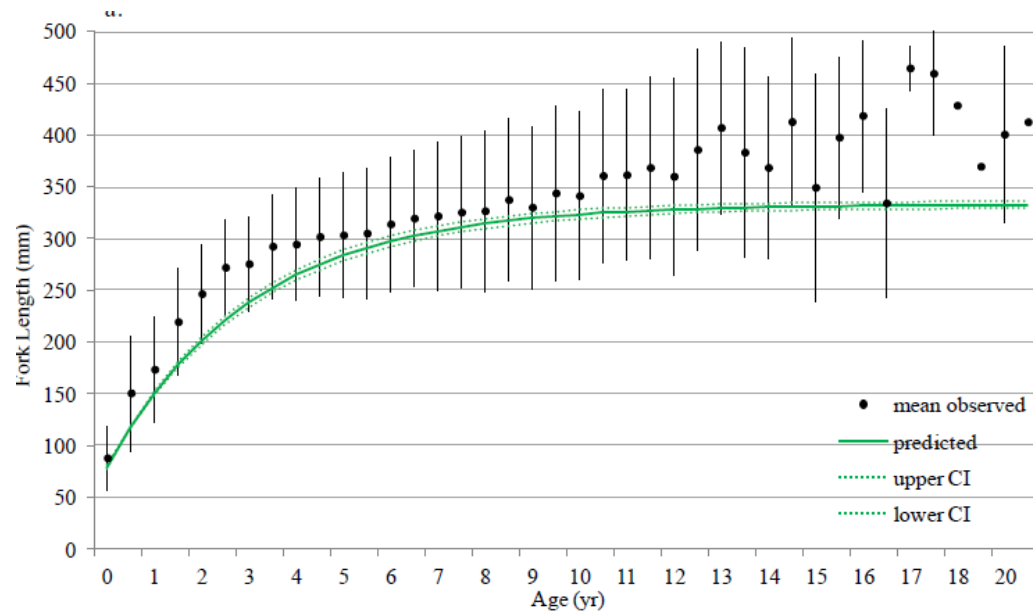


	SEDAR 9	SEDAR 45
L_{∞}	42.6	34.4
K	0.2	0.33
t_0	-3.9	-0.8



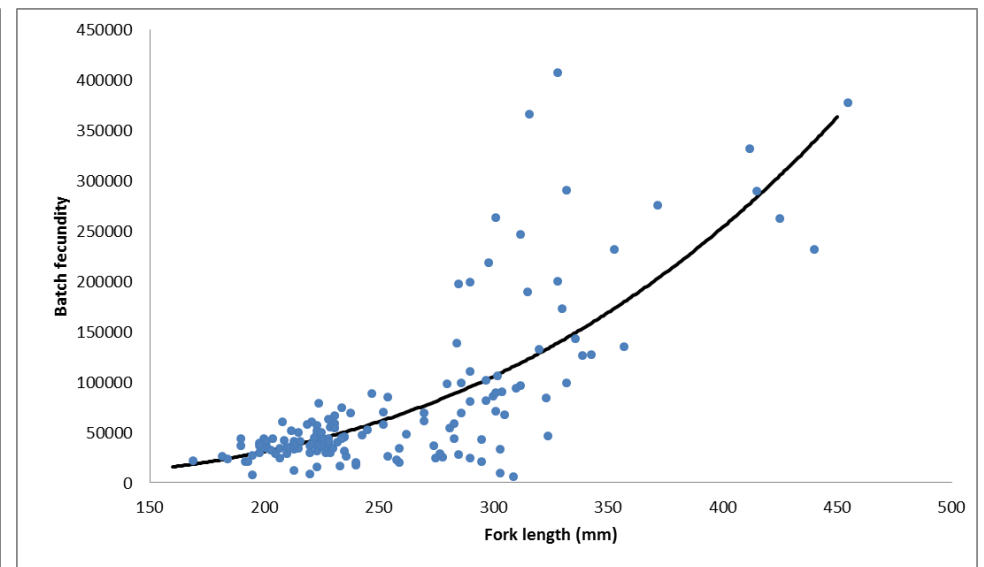
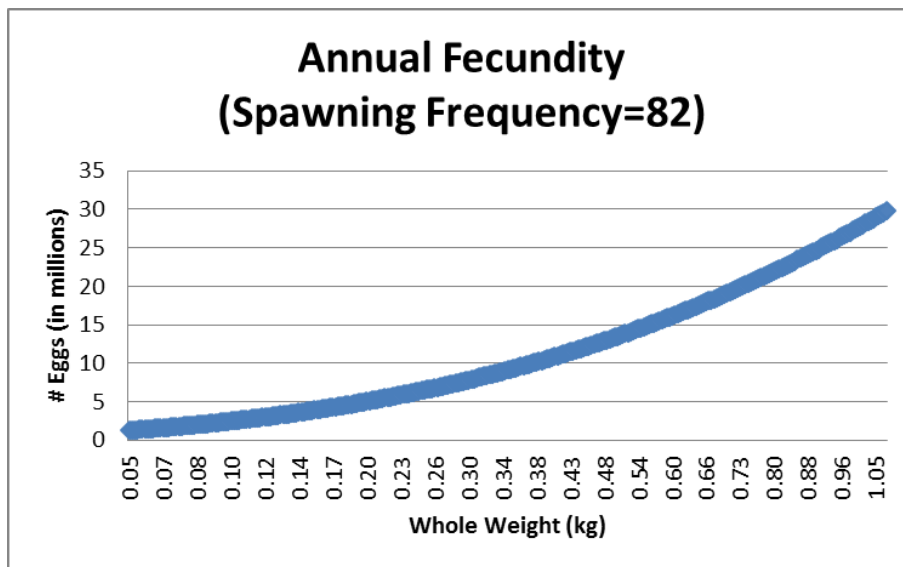
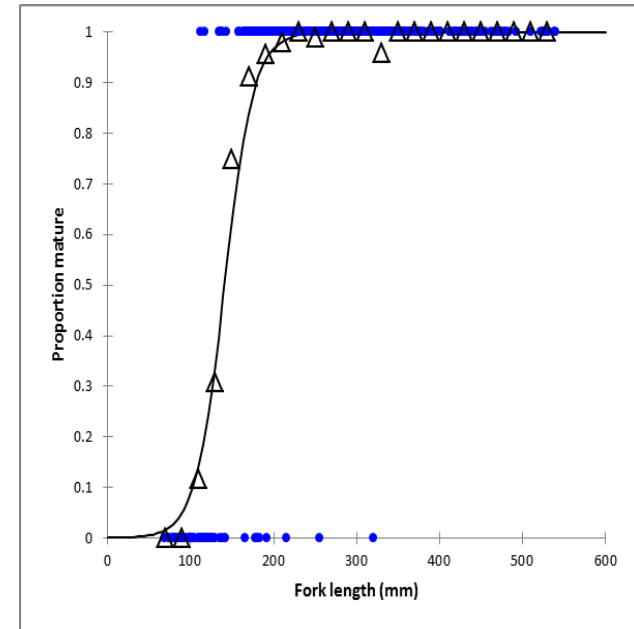
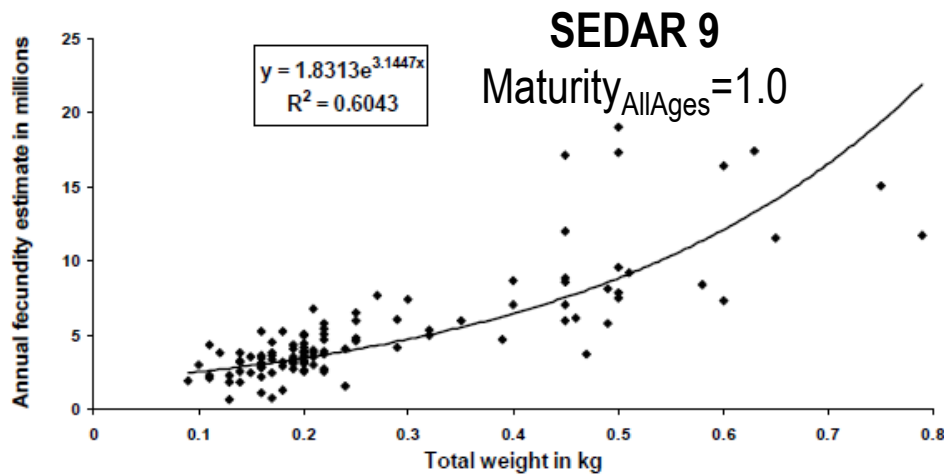
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Growth by Region



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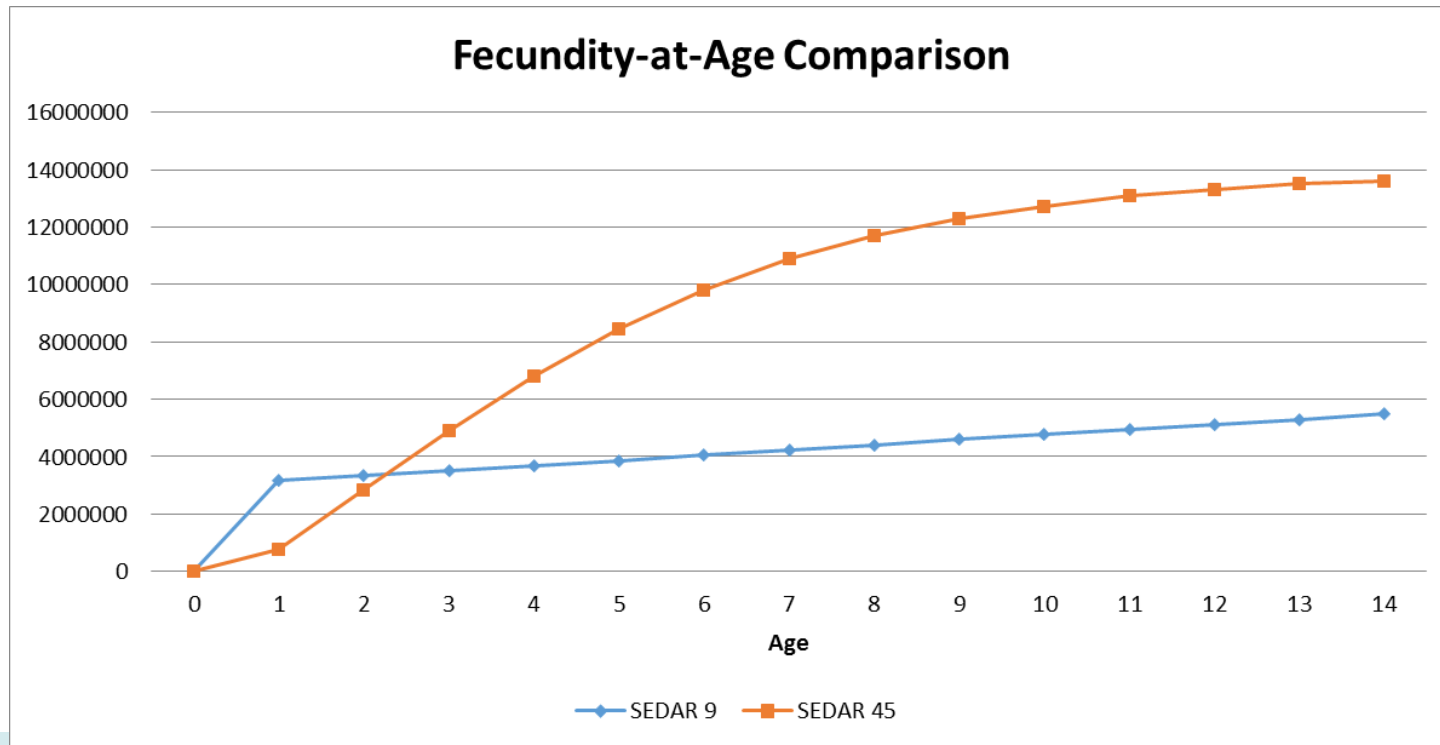
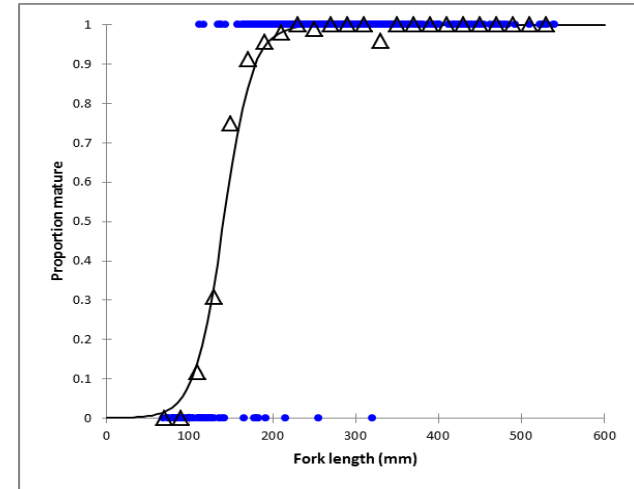
Fecundity and Maturity



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Fecundity and Maturity

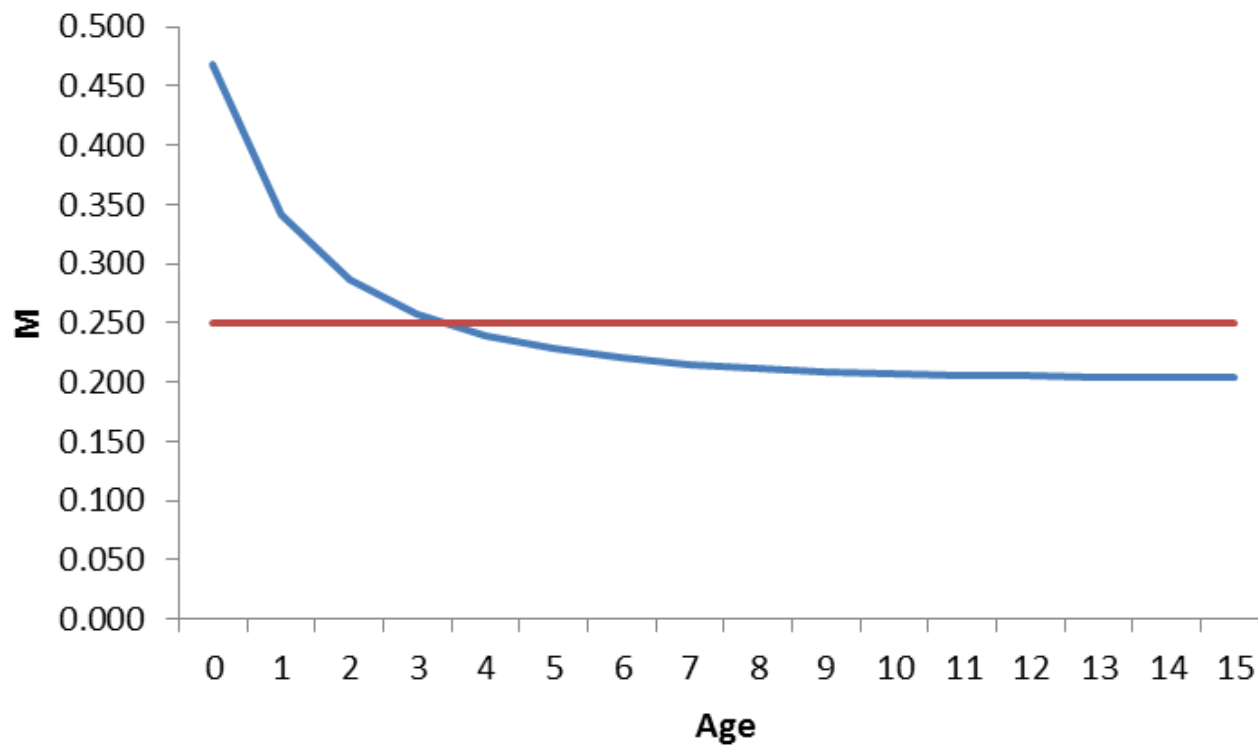
SEDAR 9
 $\text{Maturity}_{\text{AllAges}} = 1.0$



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Natural Mortality

SEDAR 9 used a constant $M=0.25$

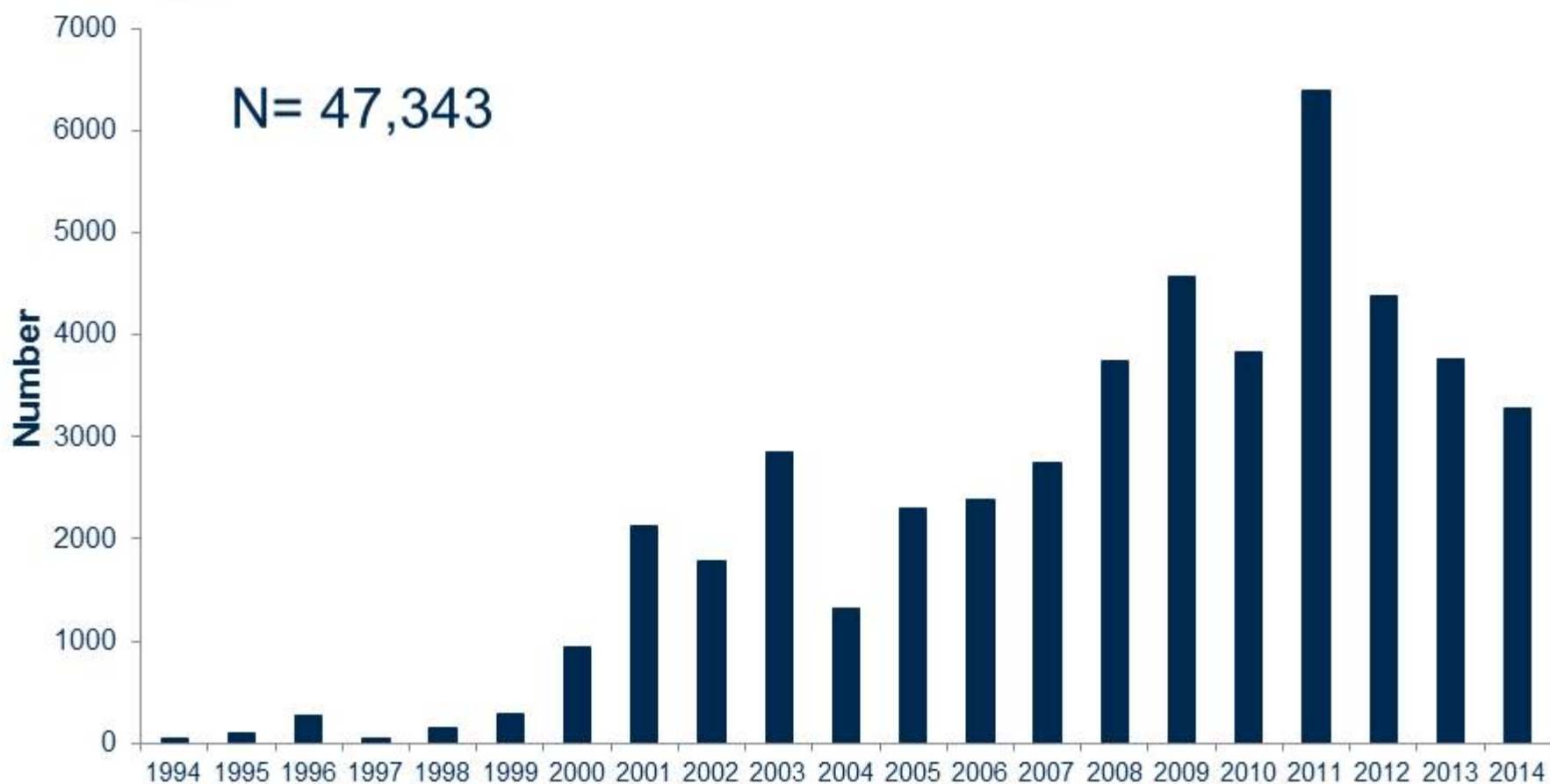


Target M	0.25
max age	29
Linf_all	34.4
K_all	0.3254
t0_all	-0.7953
Start Age	0
End Age	14
Loren_M	6.976176



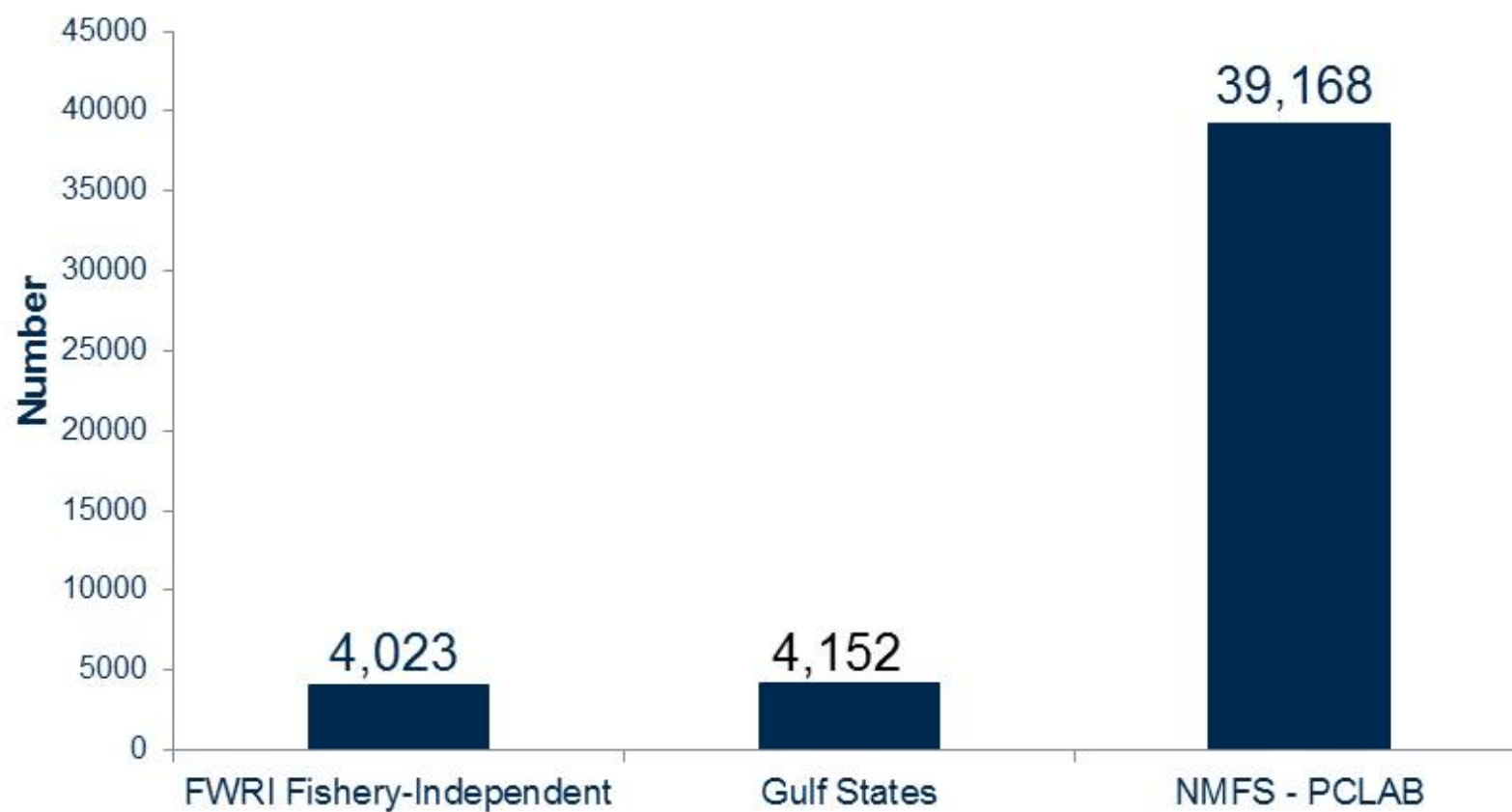


Vermilion snapper Ages by Sampling Year



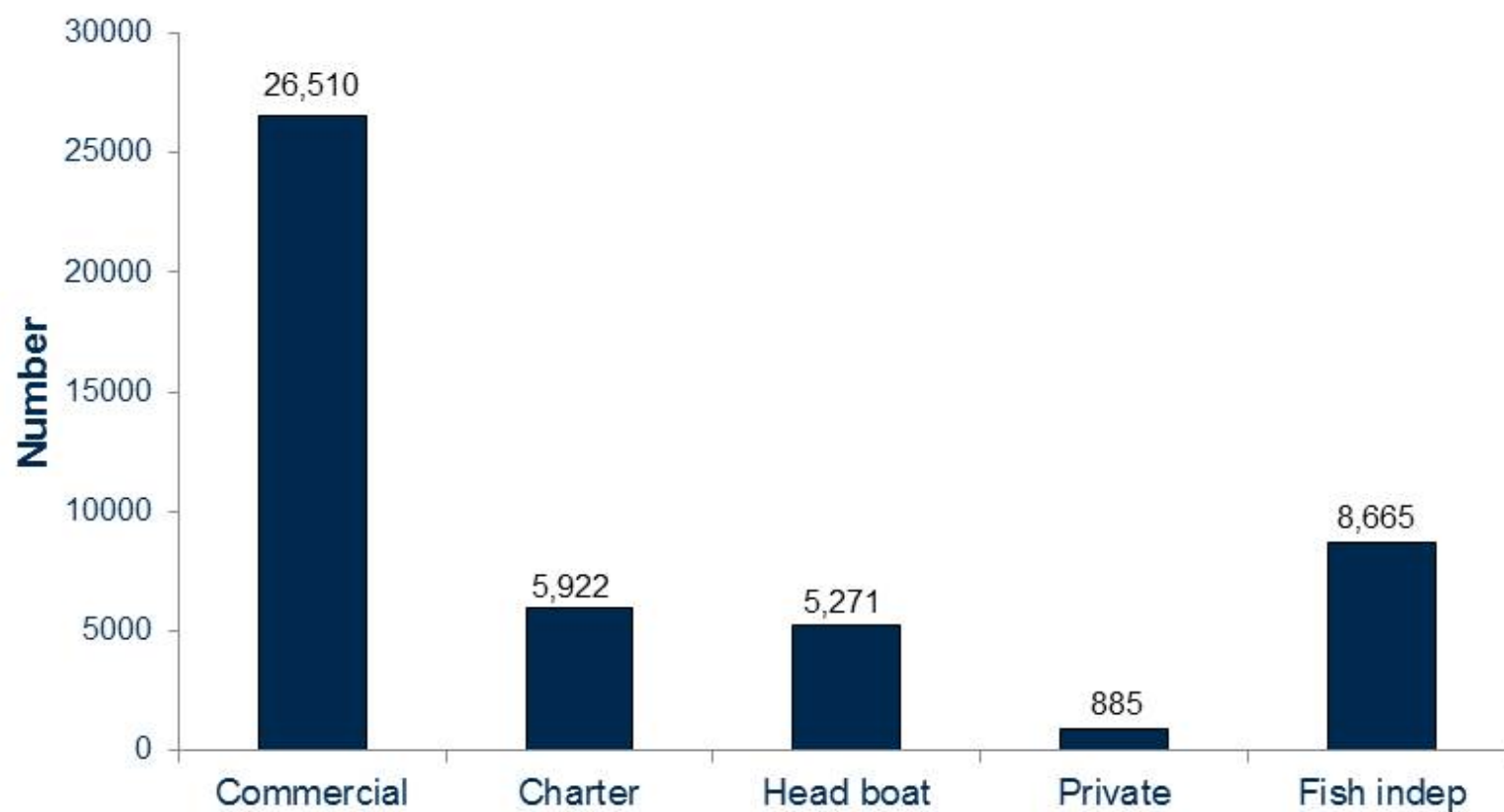


Vermilion Snapper Ages by Program

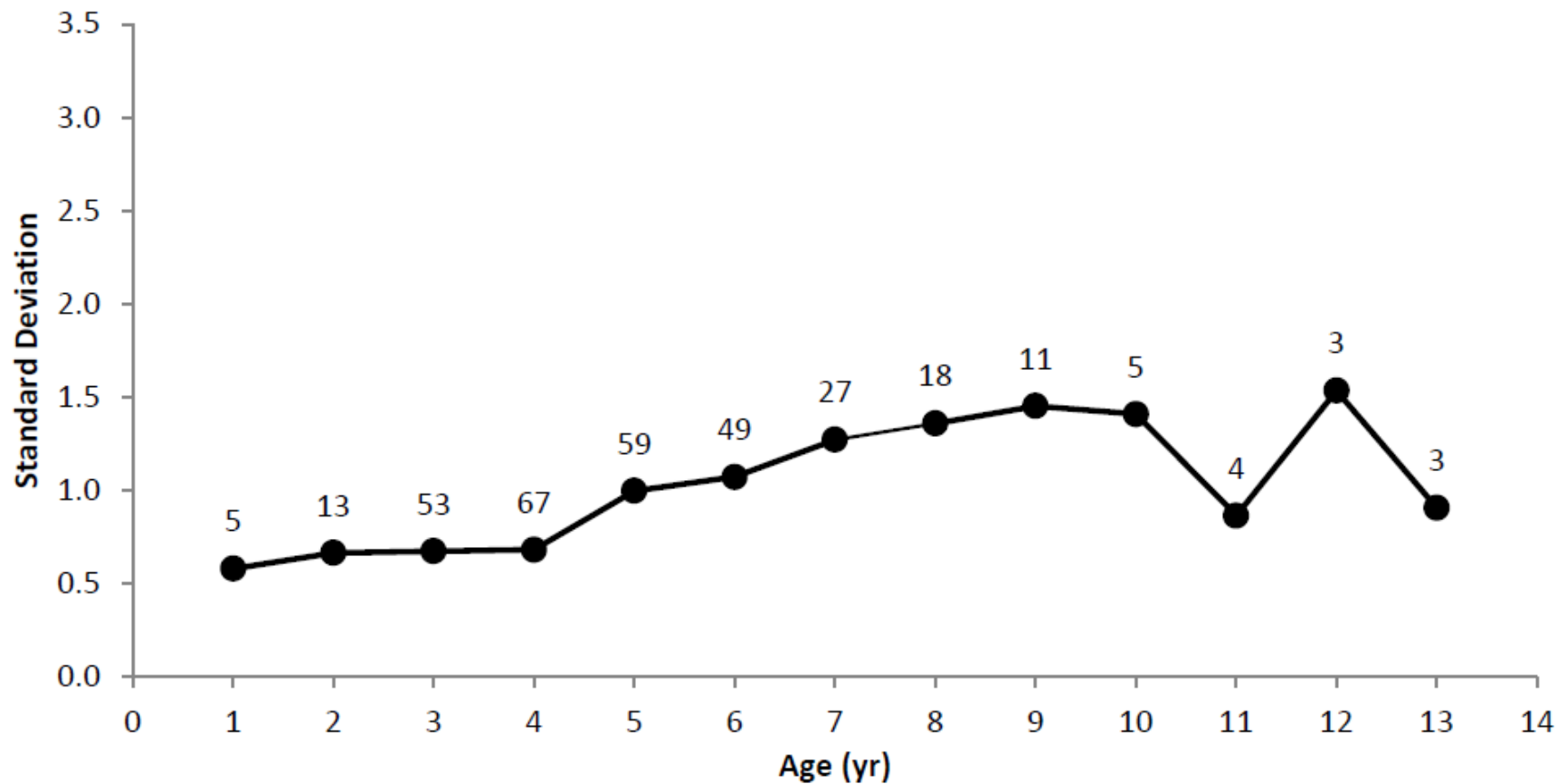




Vermilion snapper Ages by Mode

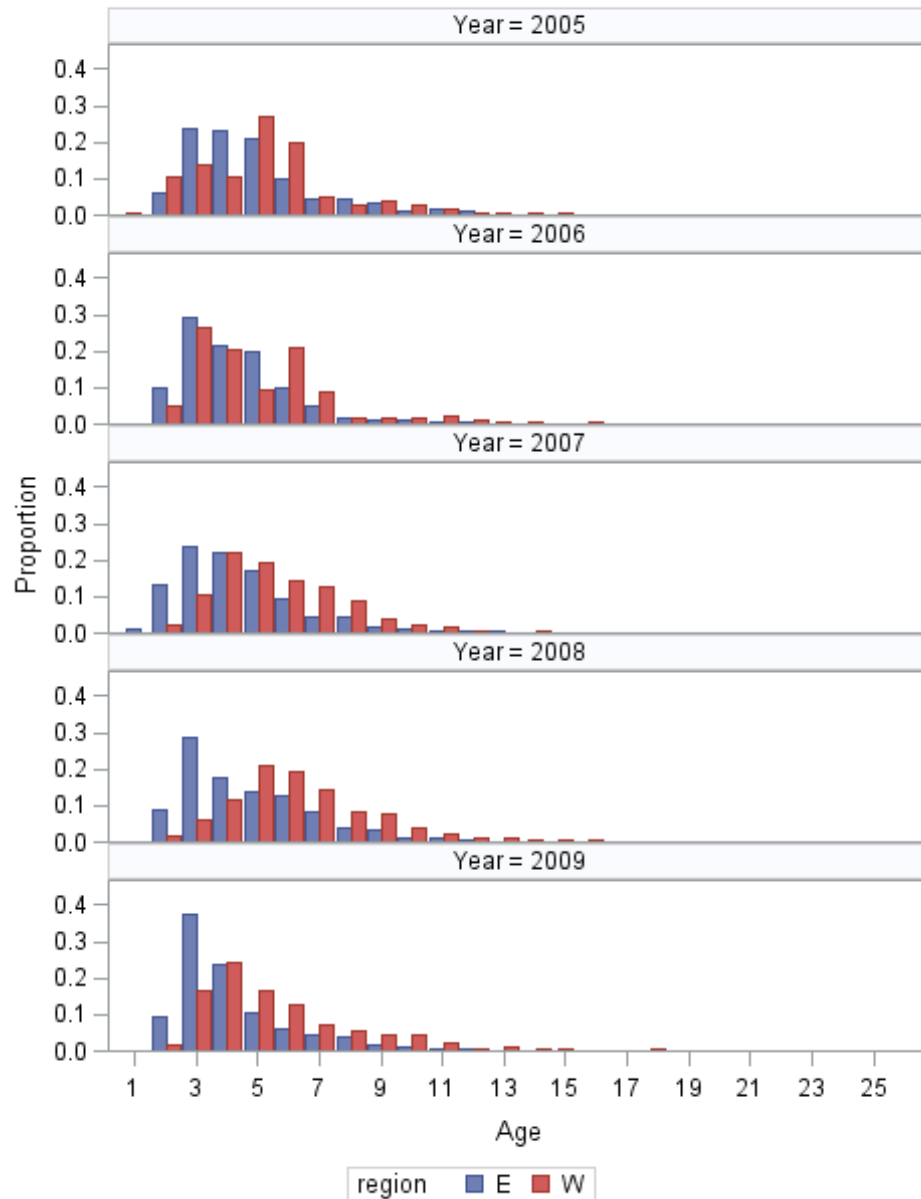


Aging Precision

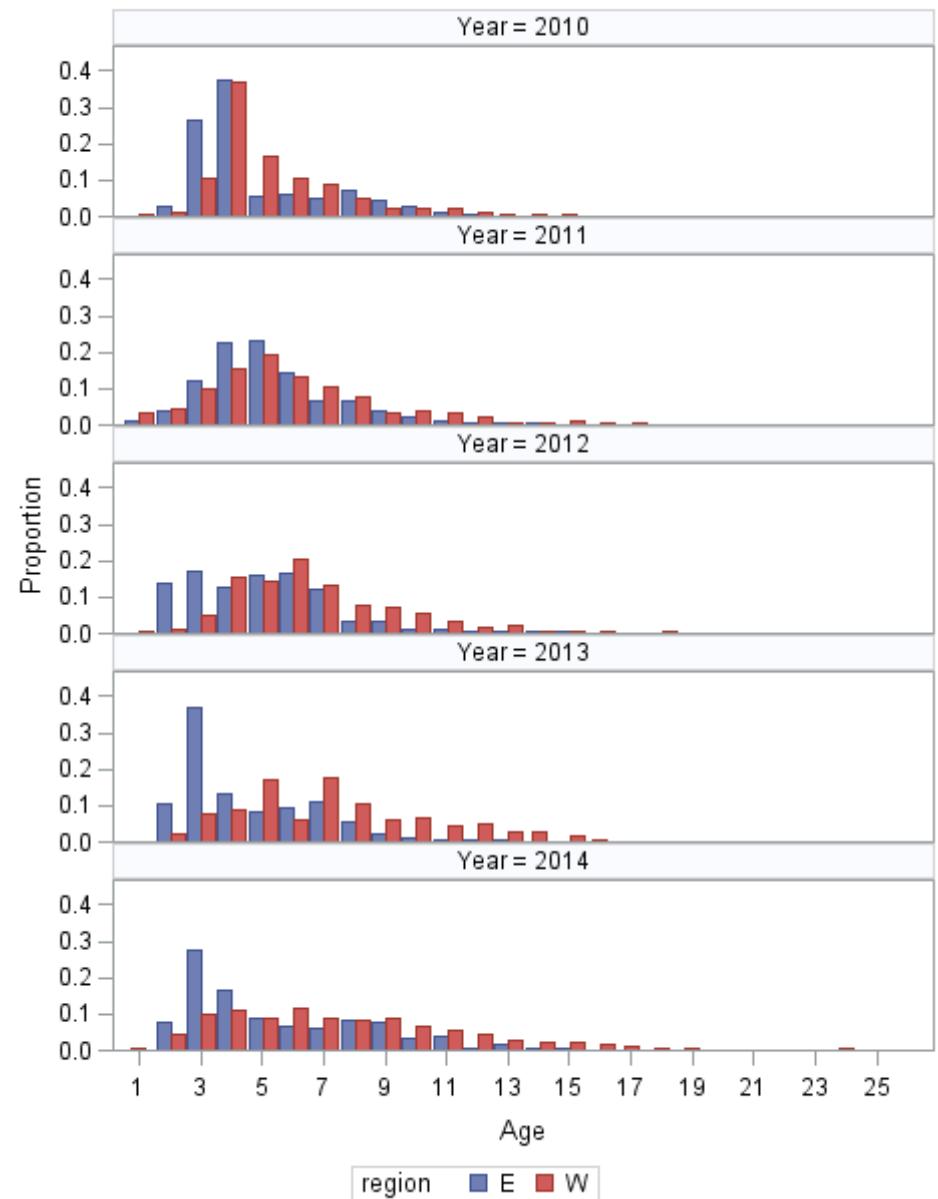


Reweighted Age Compositions—Commercial

Vermilion snapper, rAFDs, HL, West vs East, 2000-2014

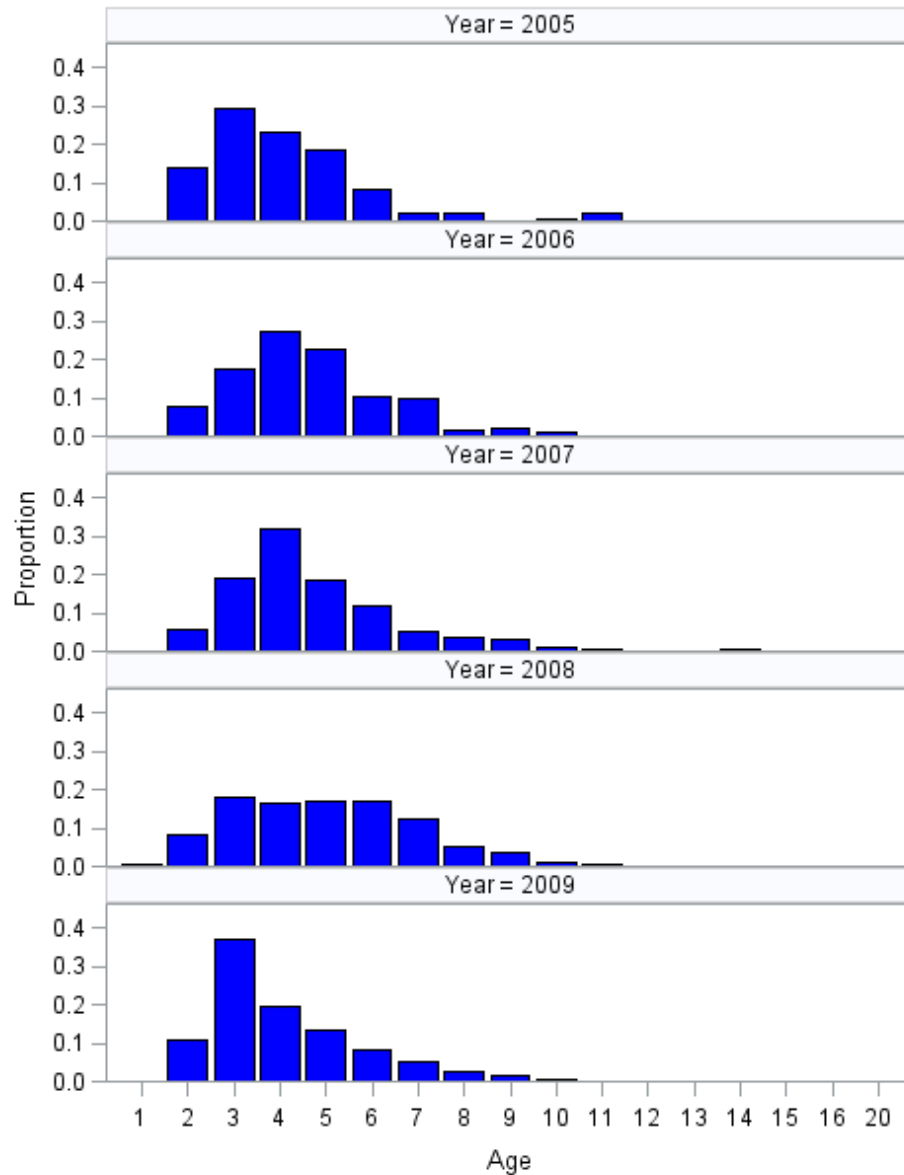


Vermilion snapper, rAFDs, HL, West vs East, 2000-2014

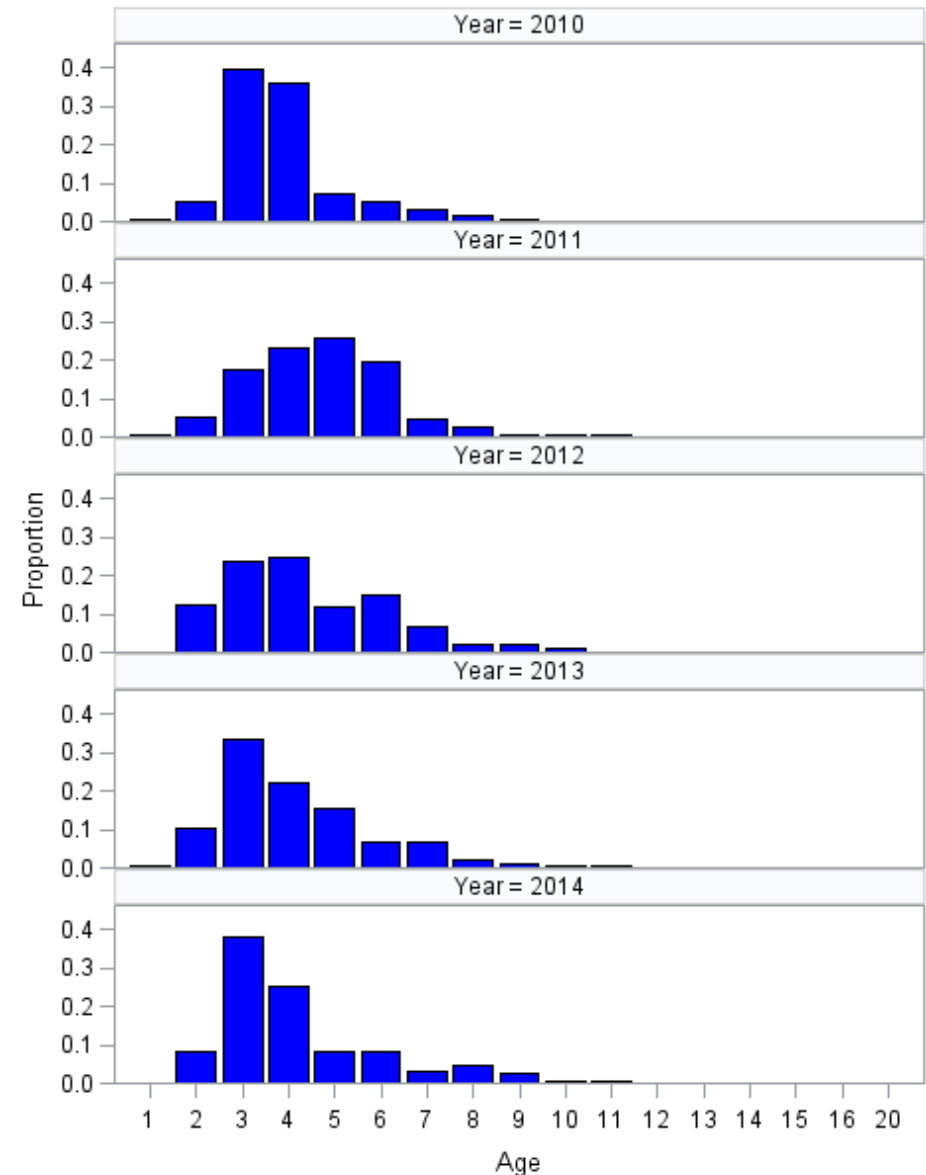


Reweighted Age Compositions—Recreational

Vermilion snapper , rAFD, Recreational samples, 2000-2014

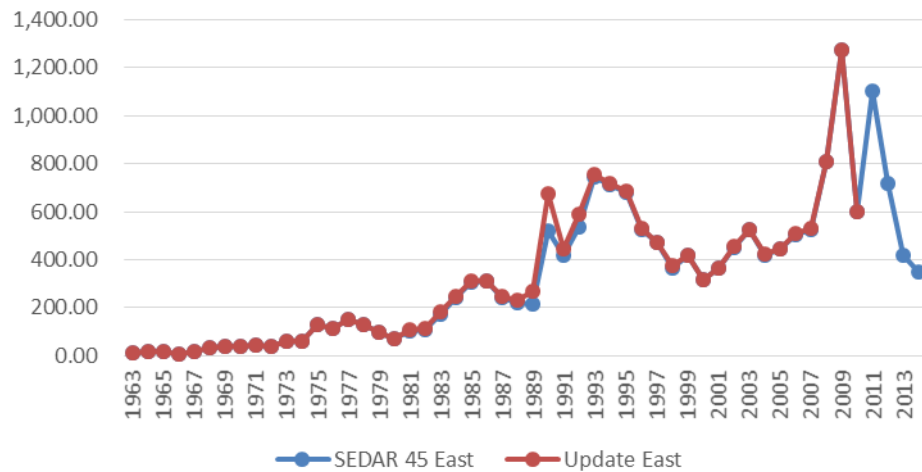


Vermilion snapper , rAFD, Recreational samples, 2000-2014

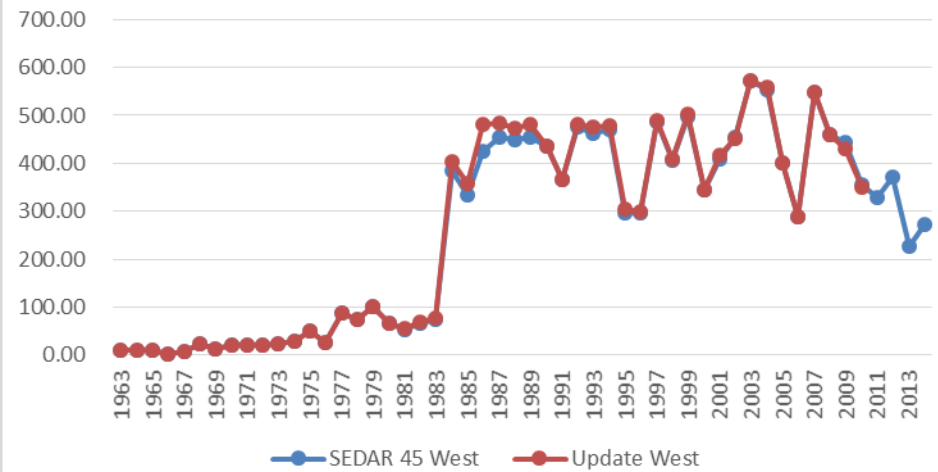


Commercial Landings (mt)

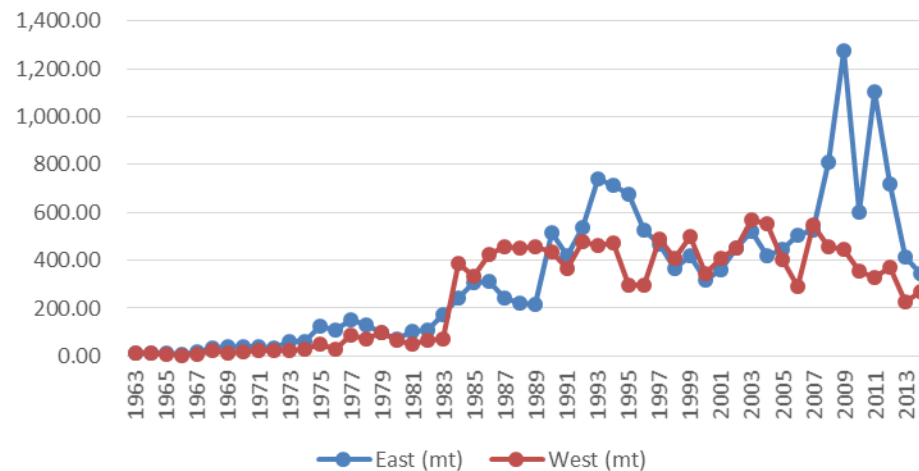
Commercial Handline Landings Eastern GoM



Commercial Handline Landings Western GoM

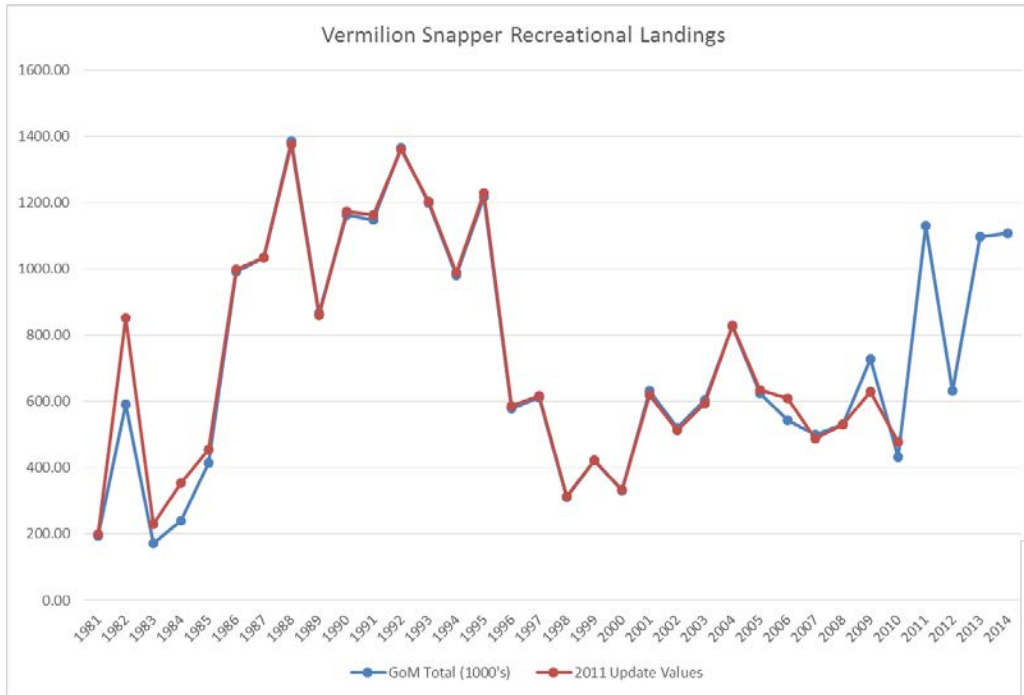


Commercial Landings Regional Comparison



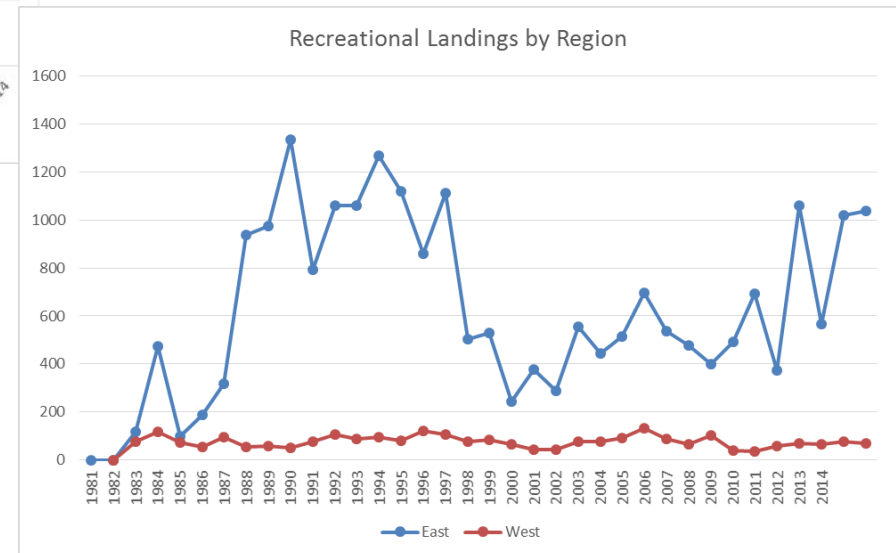
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Recreational Landings (thousands of fish)



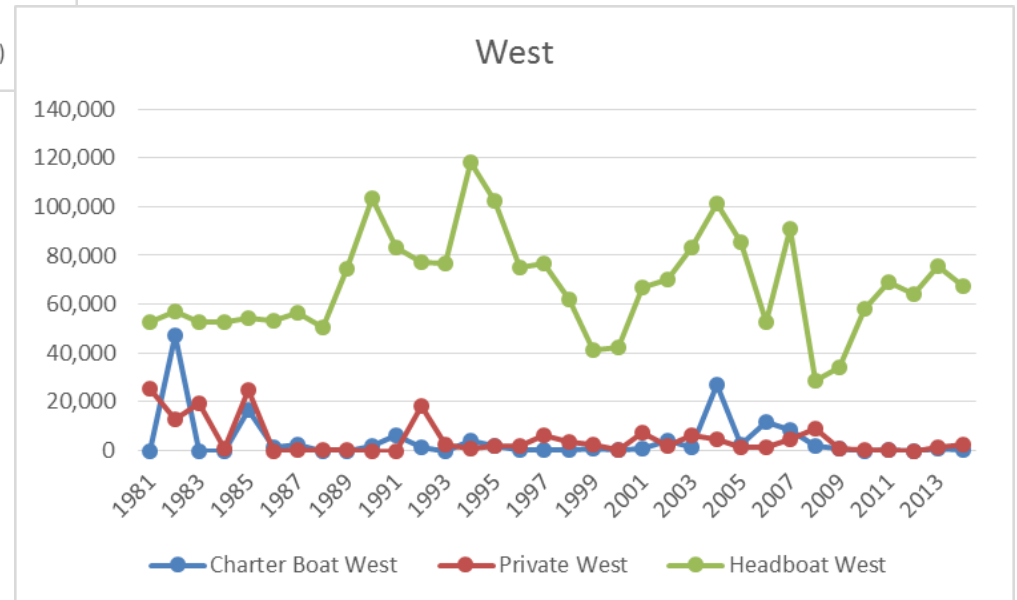
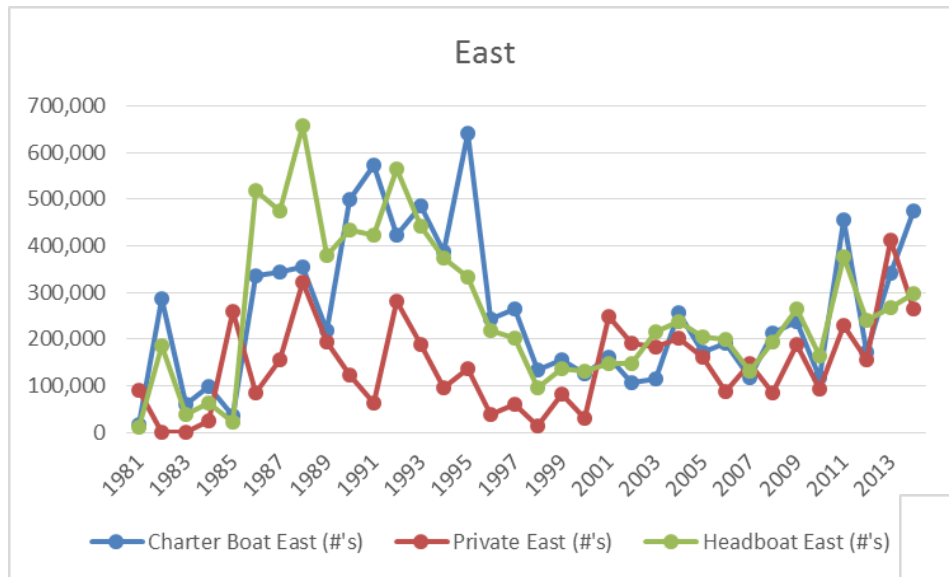
- Calibration ratios changed after 2011 update
- Hbt landings (81 – 85) not affected by change

“The period of 1981-1985 could not be calibrated with the same ratios developed for 1986+ because in the earlier 1981-1985 time period, MRFSS considered charterboat and headboat as a single combined mode in both regions. Thus, in order to properly calibrate the estimates from 1981-1985, headboat data from the Southeast Region Headboat Survey (SRHS) must be included in the analysis. In the Gulf of Mexico, the calibration analysis for 1981-1985 was based on effort estimates from both surveys (SRHS and MRFSS) and assumed that angler trips and angler days are equivalent (SEDAR7-AW-03).”



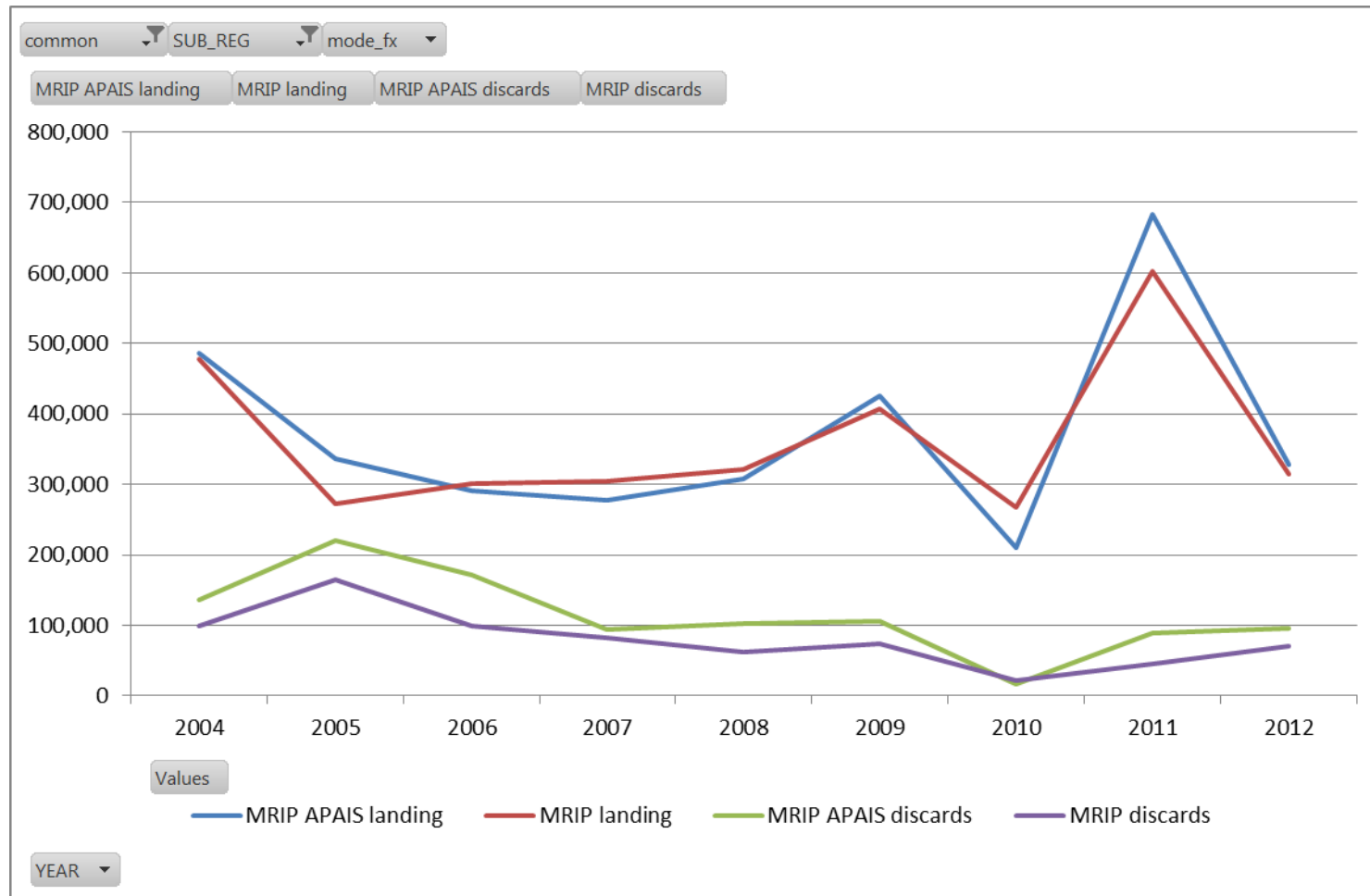
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Recreational Landings—Mode (numbers of fish)



Recreational Landings

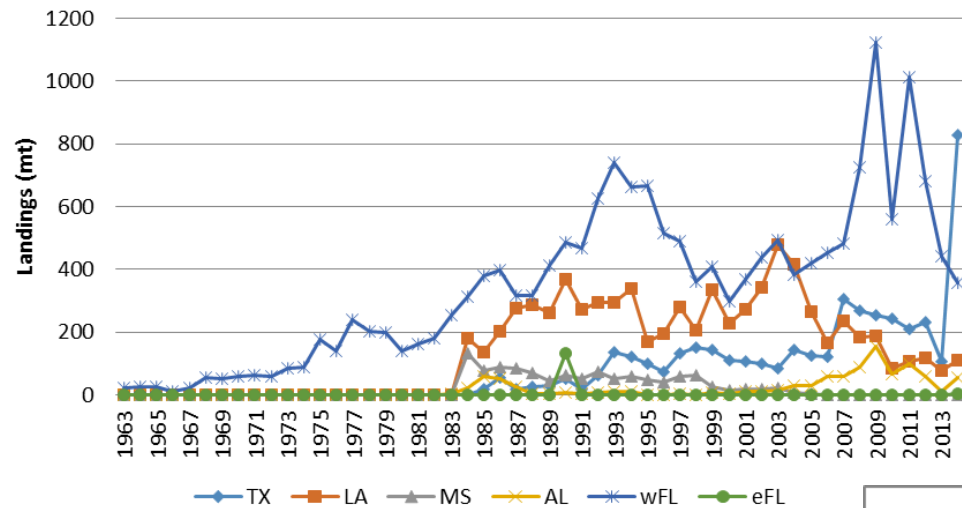
APAIS Adjustment



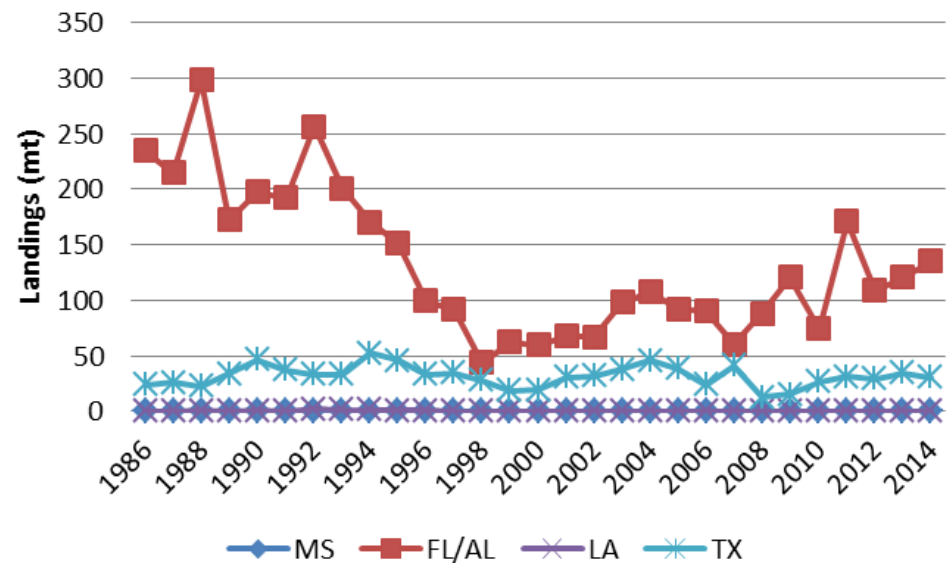
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Landings by State

Commercial Landings by State

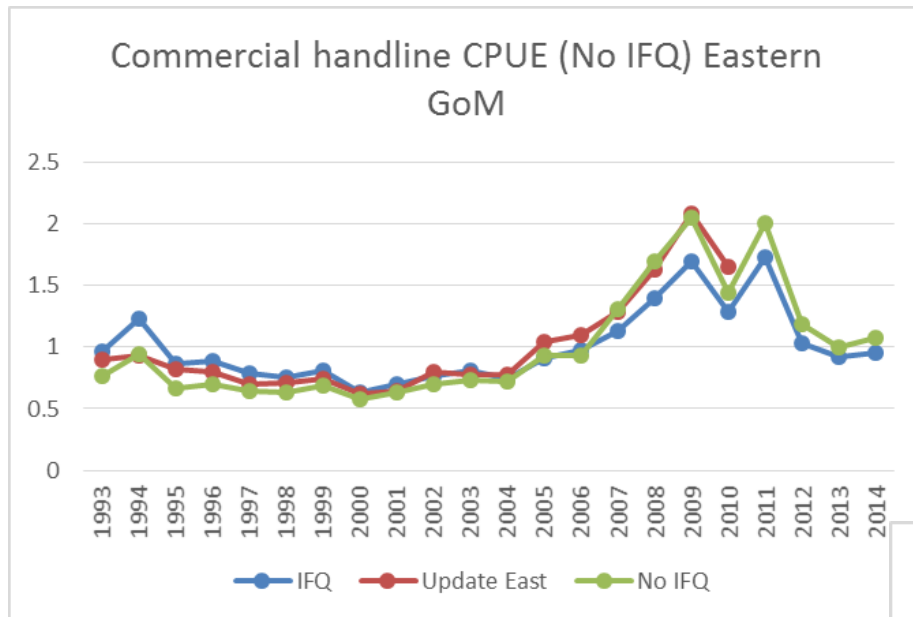


Headboat Landings by State



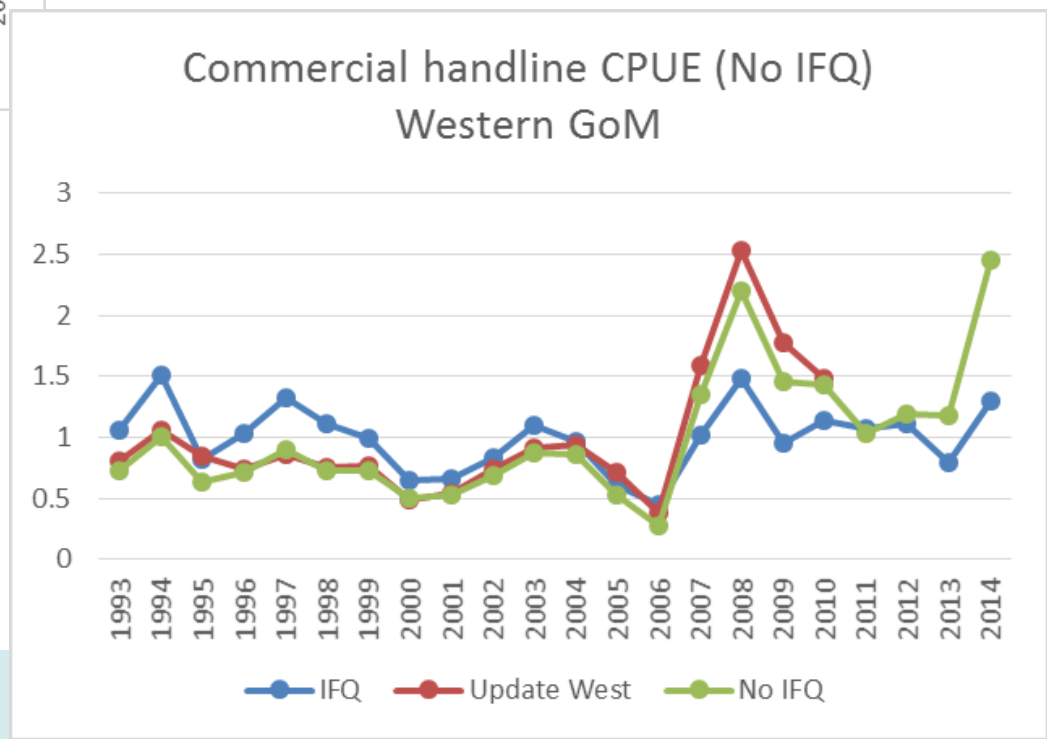
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CPUE—Commercial



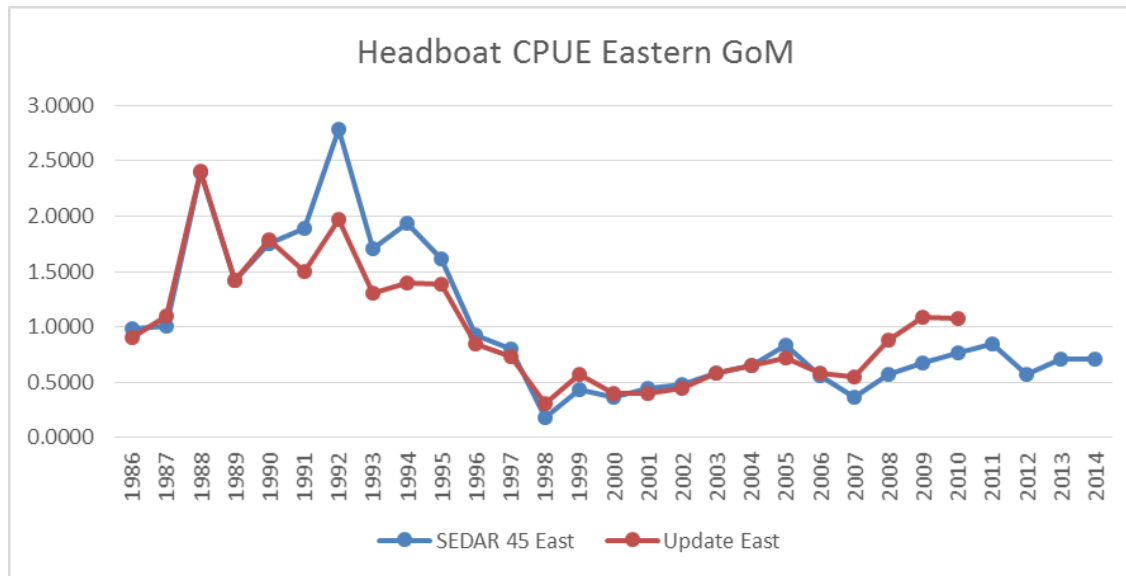
- Red Snapper IFQ introduced in 2007
- Inclusion leads to important differences in CPUE indices (esp. West)
- No standard approach for inclusion in standardization process

- Options:
 - Use CPUE with no IFQ factor
 - Include IFQ factor if significant
 - Force inclusion of IFQ regardless of significance
 - Split series in 2006 and use IFQ as factor from 2007-2014
 - **Use only pre-2007 series with no IFQ factor**

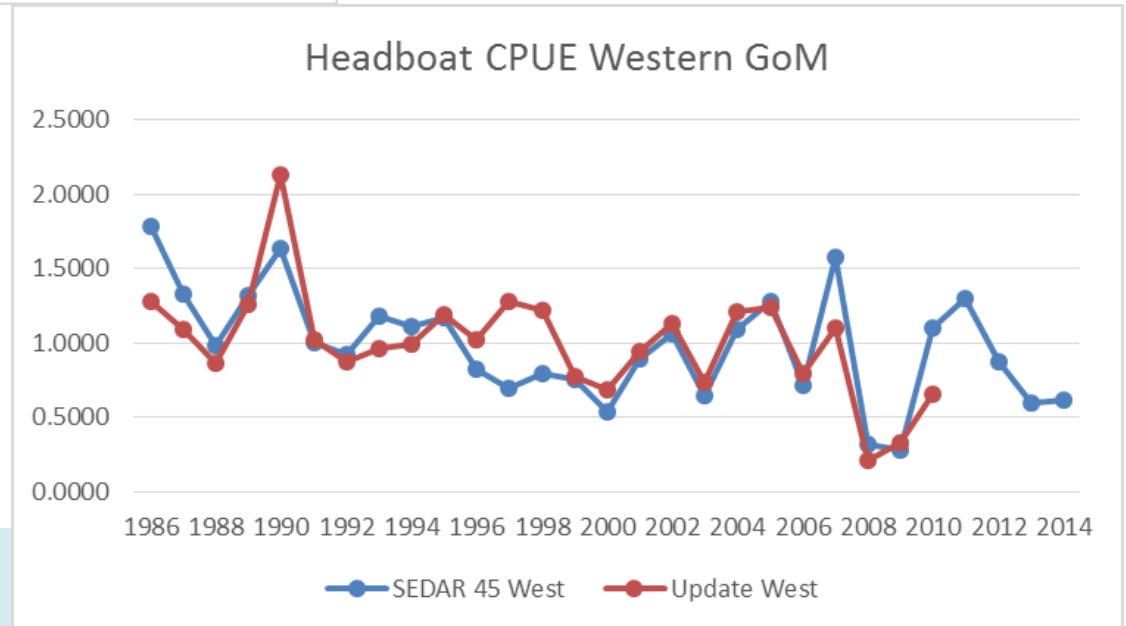


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CPUE—Headboat

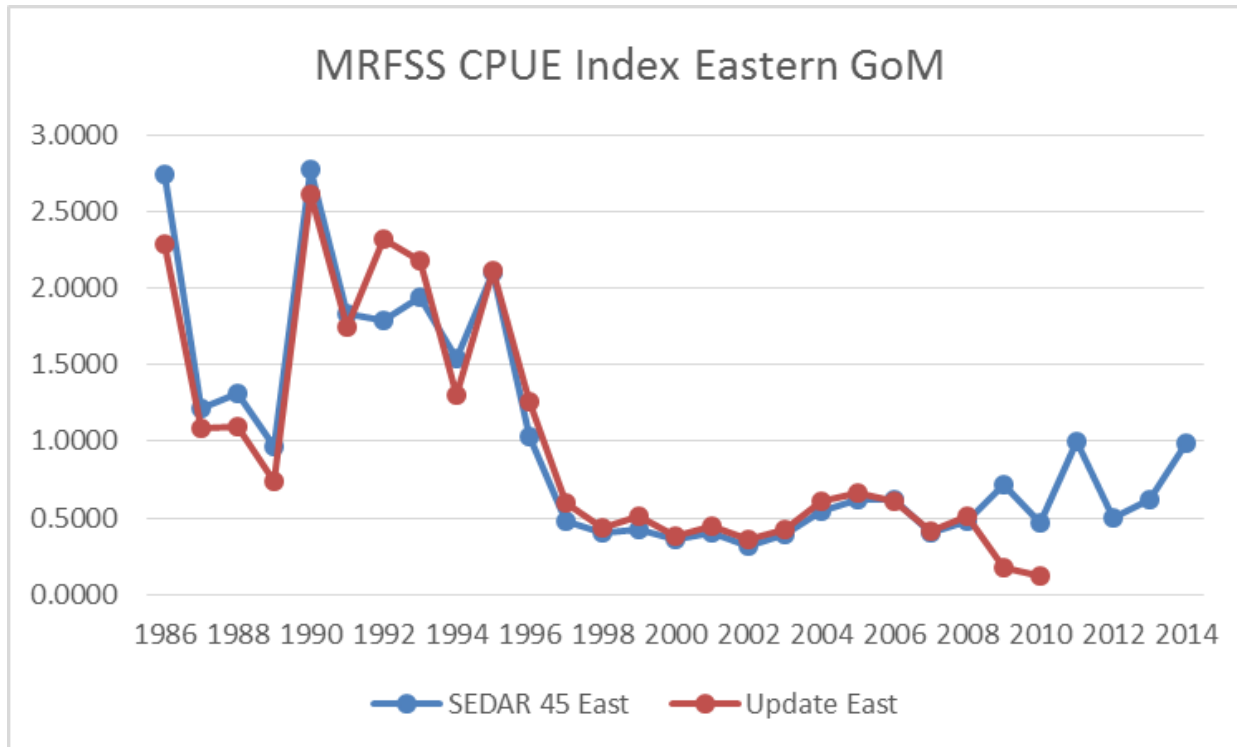


- Differences in Factors
Vessel used in SEDAR 45



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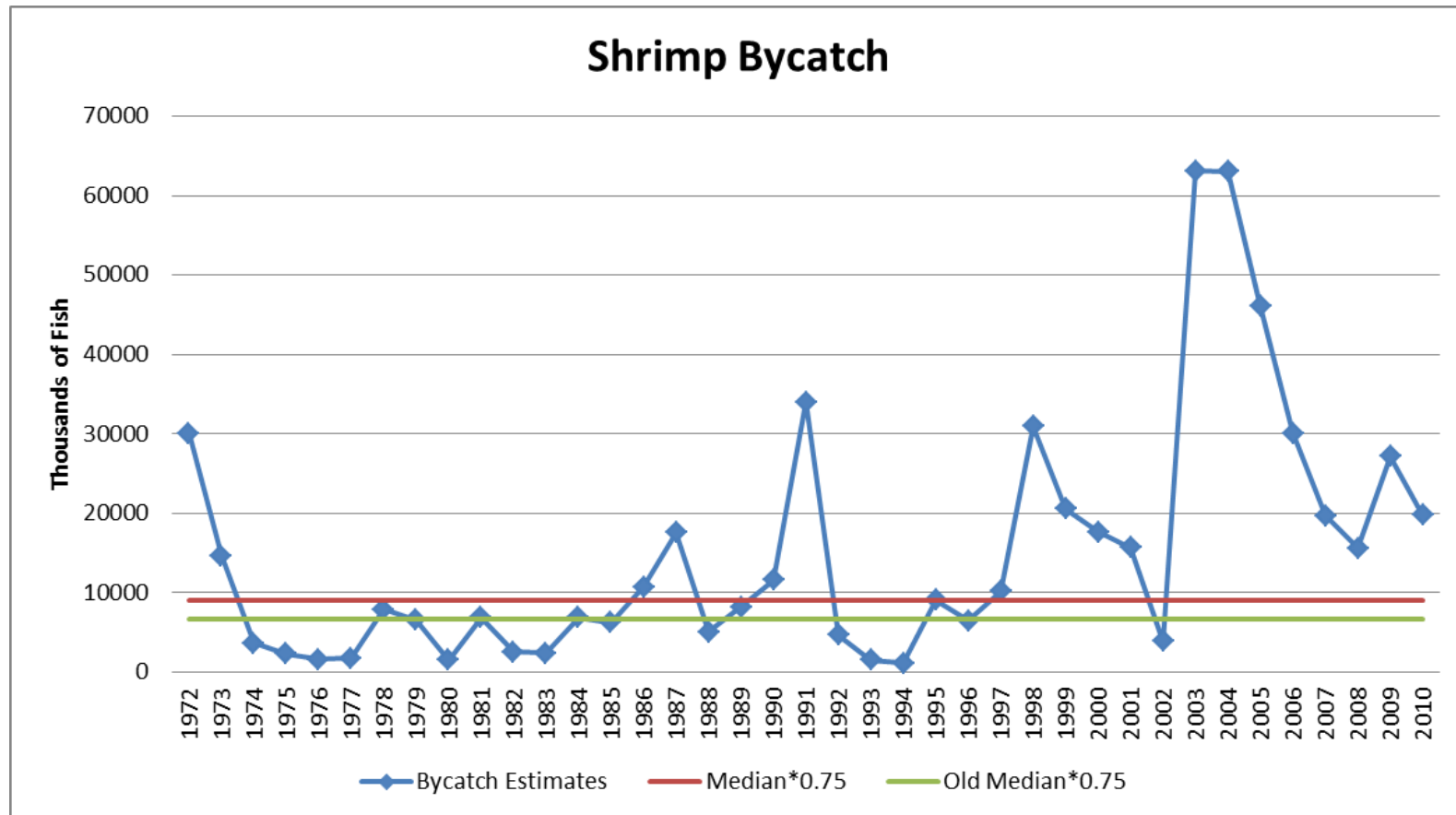
CPUE—MRFSS East



- Difference in Factors:
- Red Snapper Season considered SEDAR 45



Bycatch—Shrimp Discards



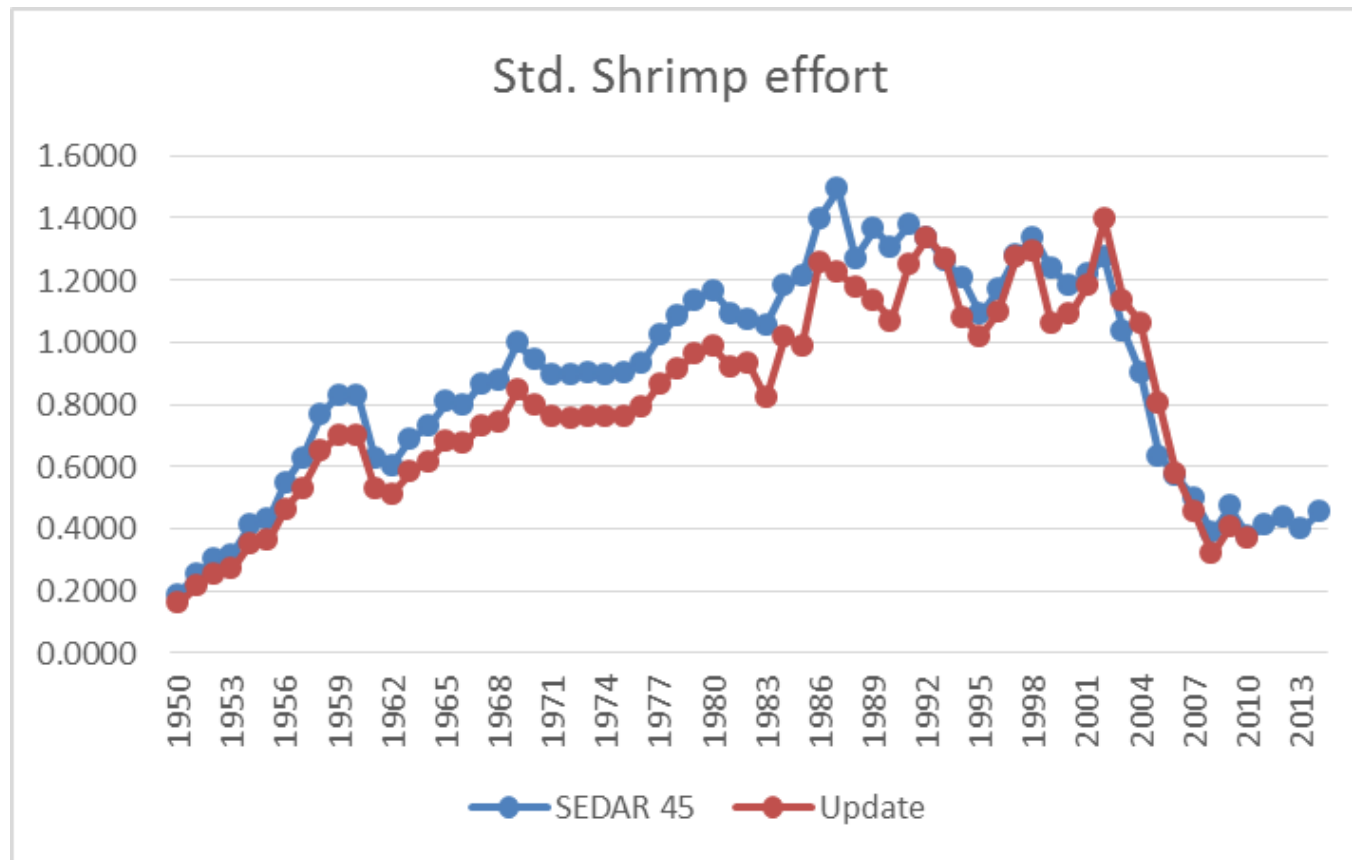
- No updated shrimp bycatch has been provided yet
- Update assessment models assumed a 'superyear' median bycatch of 6.65mil fish ($0.75 \times 8.87\text{mil}$)
- Estimate from available data is 6.822mil ($0.75 \times 9.096\text{mil}$)

Shrimp Bycatch

- “The most recent estimate of shrimp trawl bycatch of vermilion snapper is 9.2 million fish annually. According to Porch and Cass-Calay (2001), the length-distribution obtained from the NMFS observer program is bimodal, and suggests that approximately 25 % of the vermilion snapper landed by the shrimp fleet are age-0 and the remainder are at least age-1. Because SSASPM does not accommodate age-0, the shrimp bycatch estimate was multiplied by the proportion of fish expected to be at least age-1 (9.2 million * 0.75 = 6.9 million fish). Shrimp bycatch was modeled using a fixed selectivity (100% vulnerability at age-1, 30% at age-2, 3% at age-3 and 0% at ages 4-14+).”



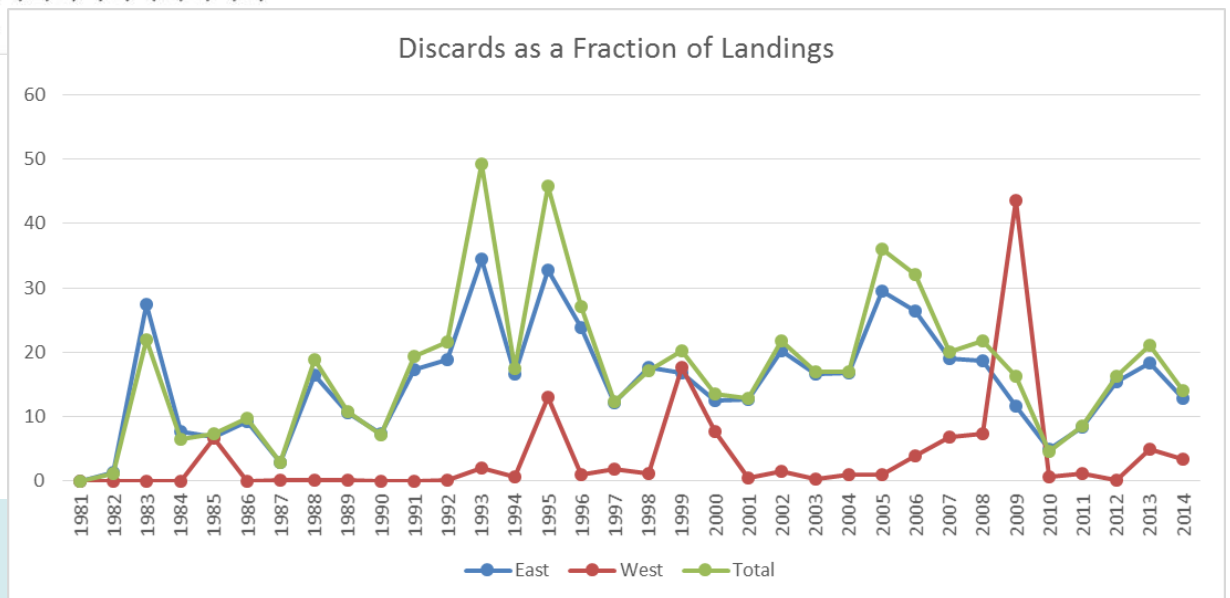
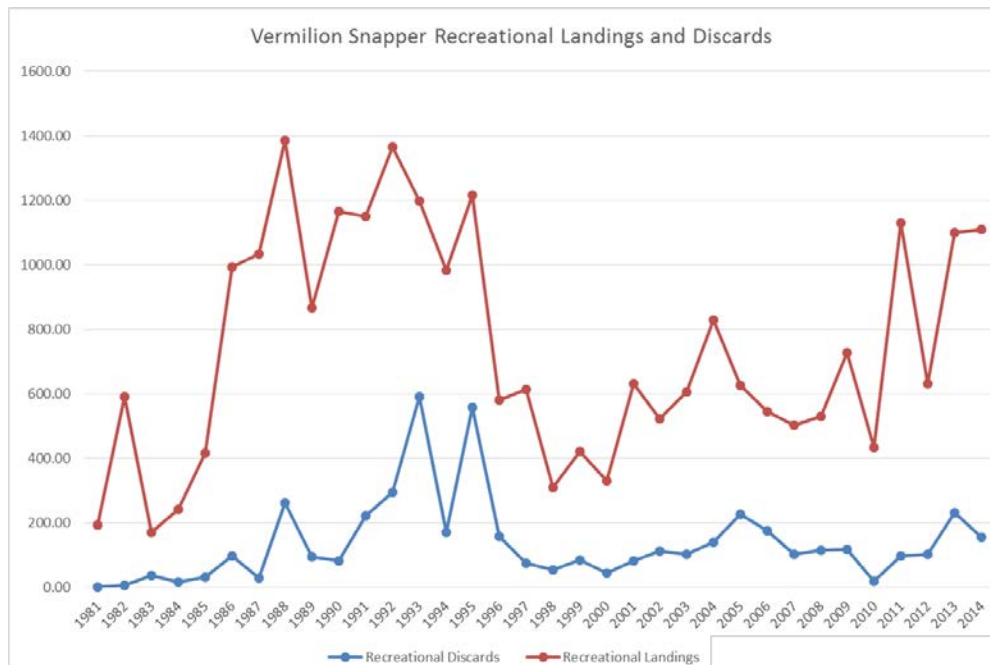
Bycatch—Shrimp Effort



Bycatch—Shrimp Age Composition

- Shrimp observer program does not collect length samples for vermilion snapper
- Still working on compiling available data

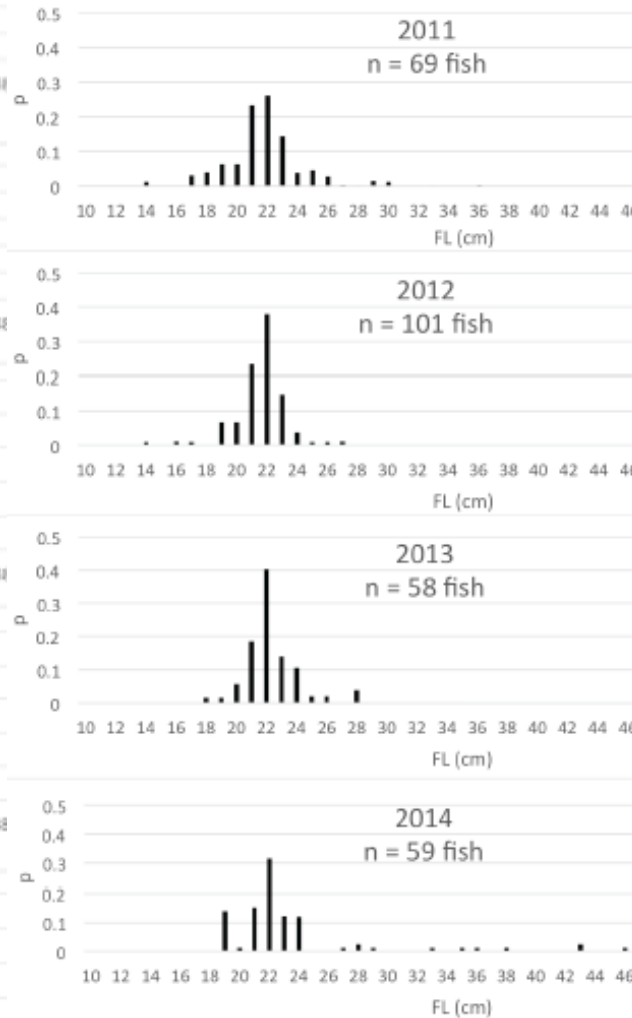
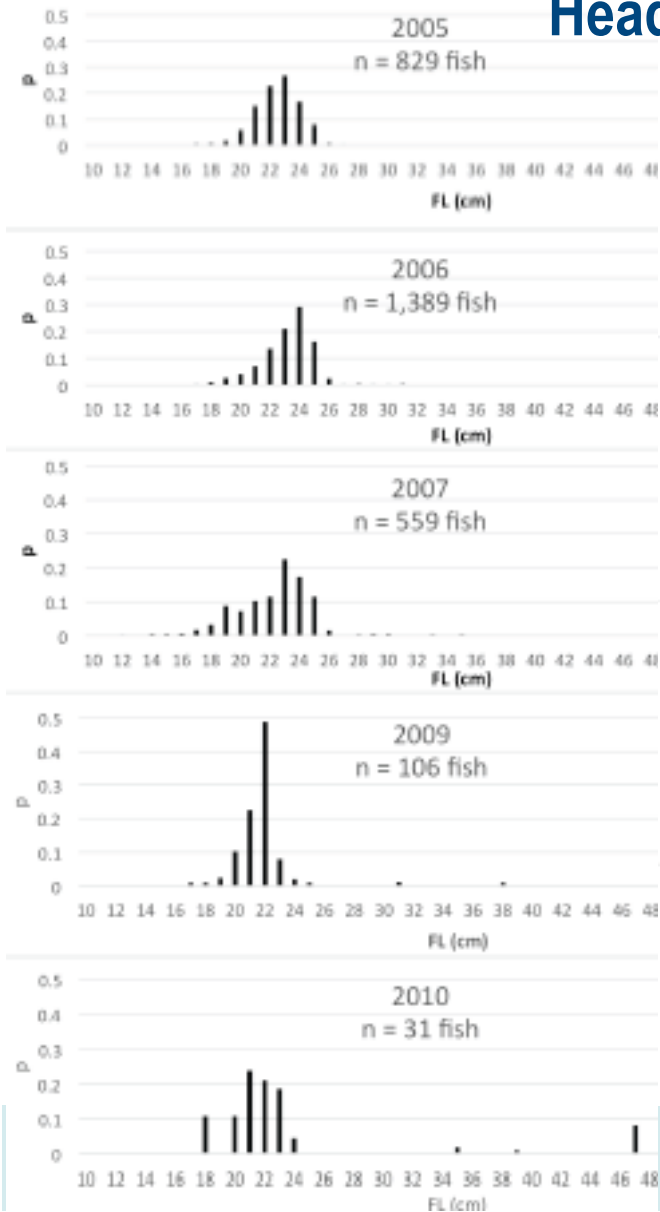
Discards—Recreational



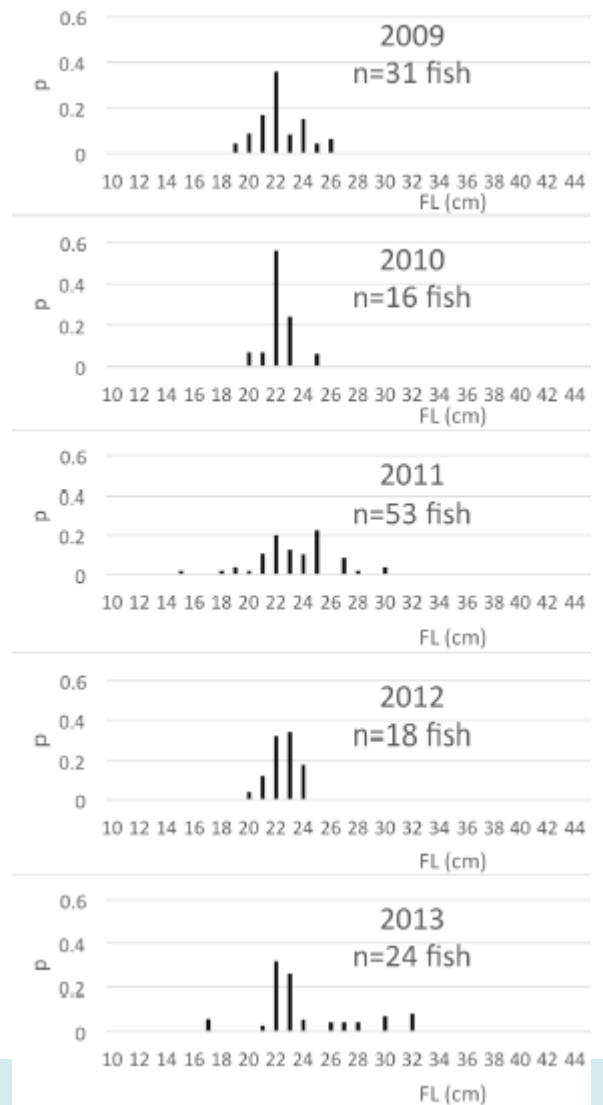
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Discards—Recreational Size Composition

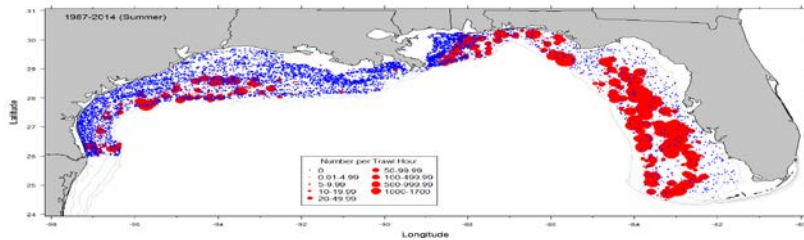
Headboat



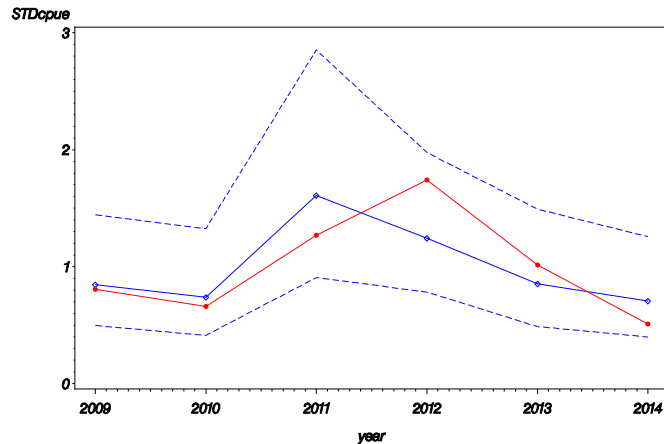
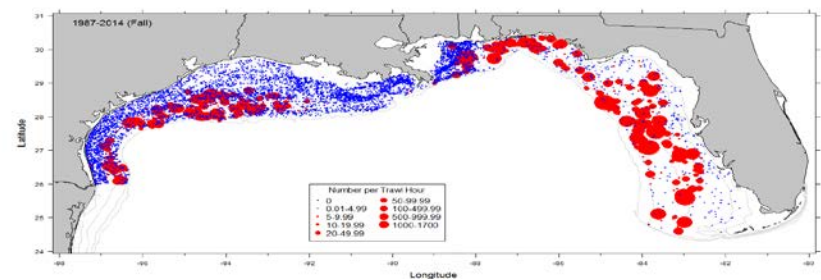
Private/Charter



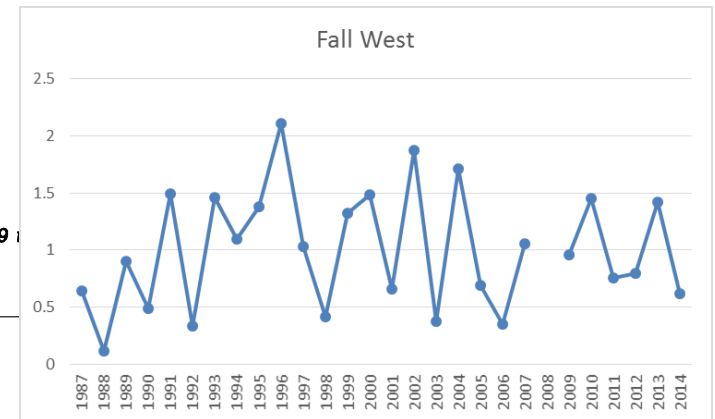
SEAMAP Groundfish Survey



SEAMAP Summer Groundfish Vermilion Snapper Eastern Gulf of Mexico 2009 to 2014
Observed and Standardized CPUE (95% CI)

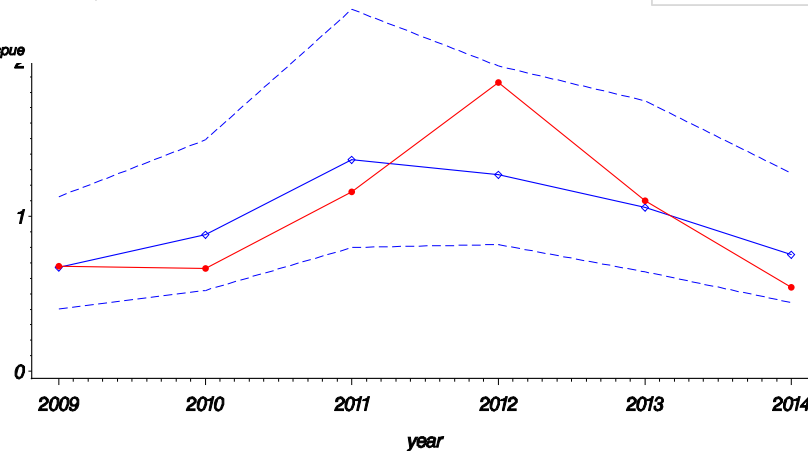


Summer Groundfish Vermilion Snapper Gulf of Mexico 2009
Observed and Standardized CPUE (95% CI)



Fall survey used a
different design
prior to 2009

PLOT STDcpue LCI UCI obscpue

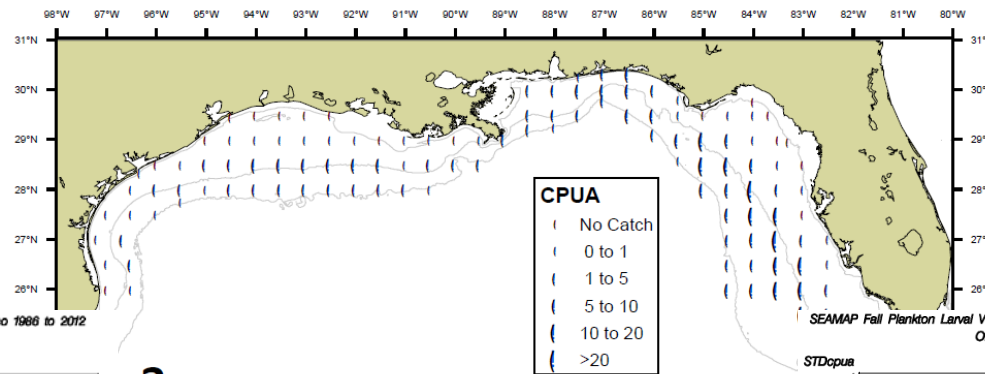


PLOT STDcpue LCI UCI obscpue

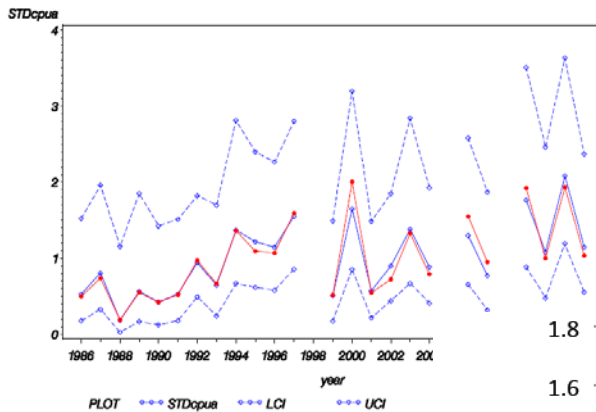


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SEAMAP Larval Survey

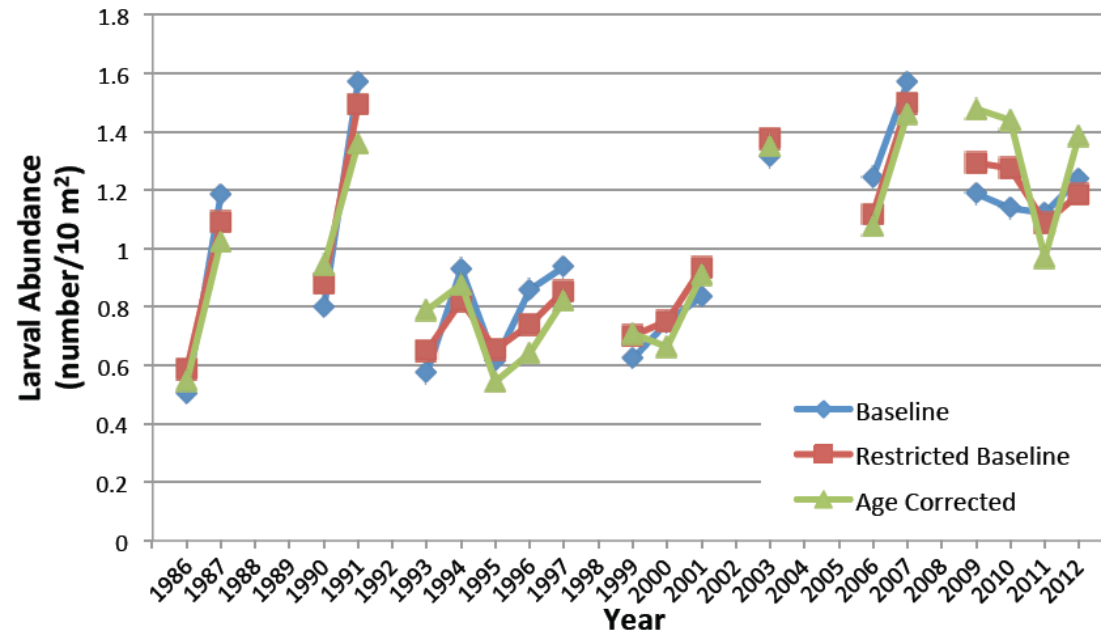
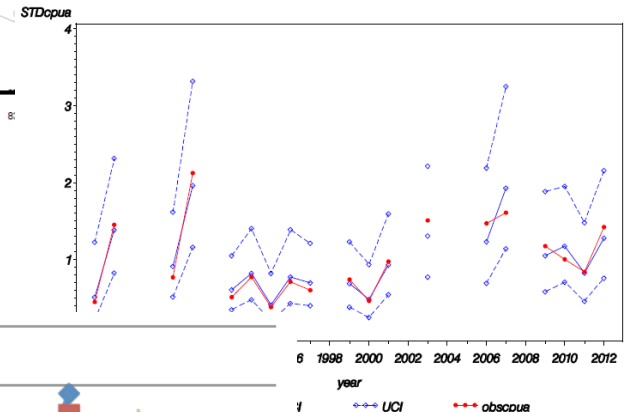


SEAMAP Fall Plankton Larval Vermilion Snapper 3.5 TO 6.4 mm Western Gulf of Mexico 1986 to 2012
Observed and Standardized CPUA (95% CI)



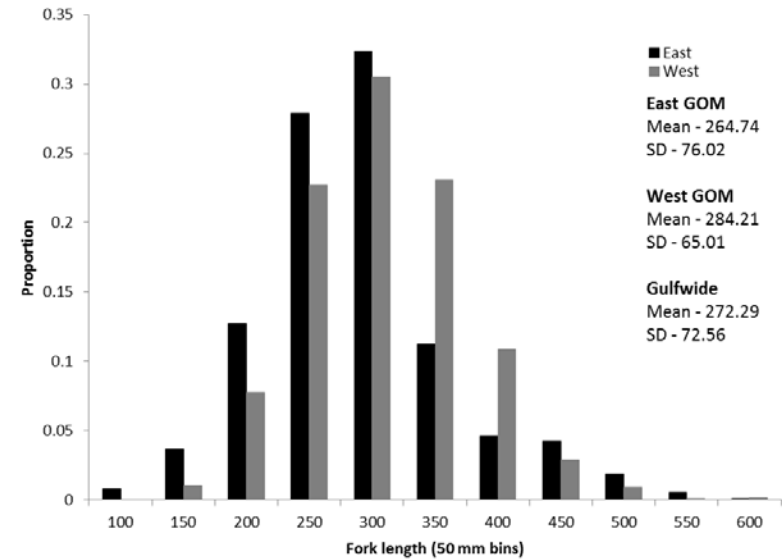
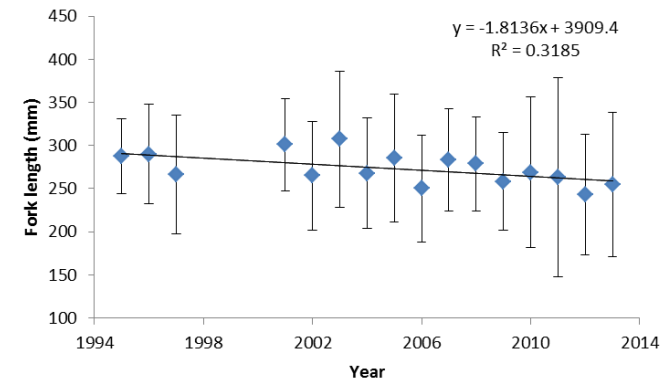
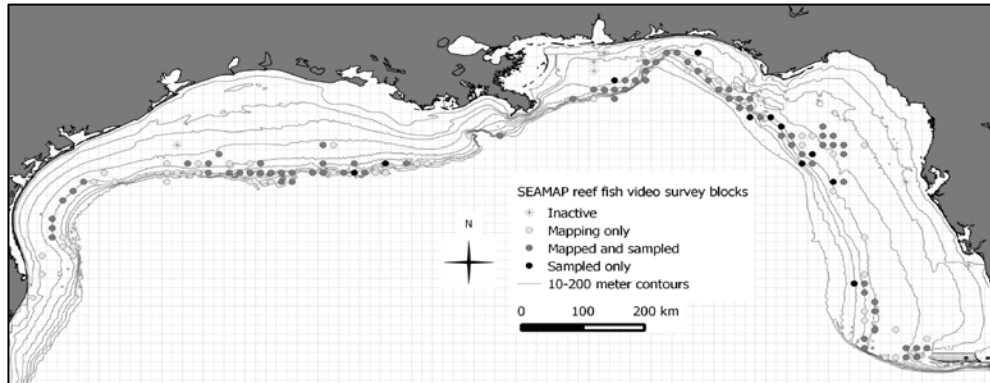
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SEAMAP Fall Plankton Larval Vermilion Snapper 3.5 TO 6.4 mm Eastern Gulf of Mexico 1986 to 2012
Observed and Standardized CPUA (95% CI)



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Video Survey



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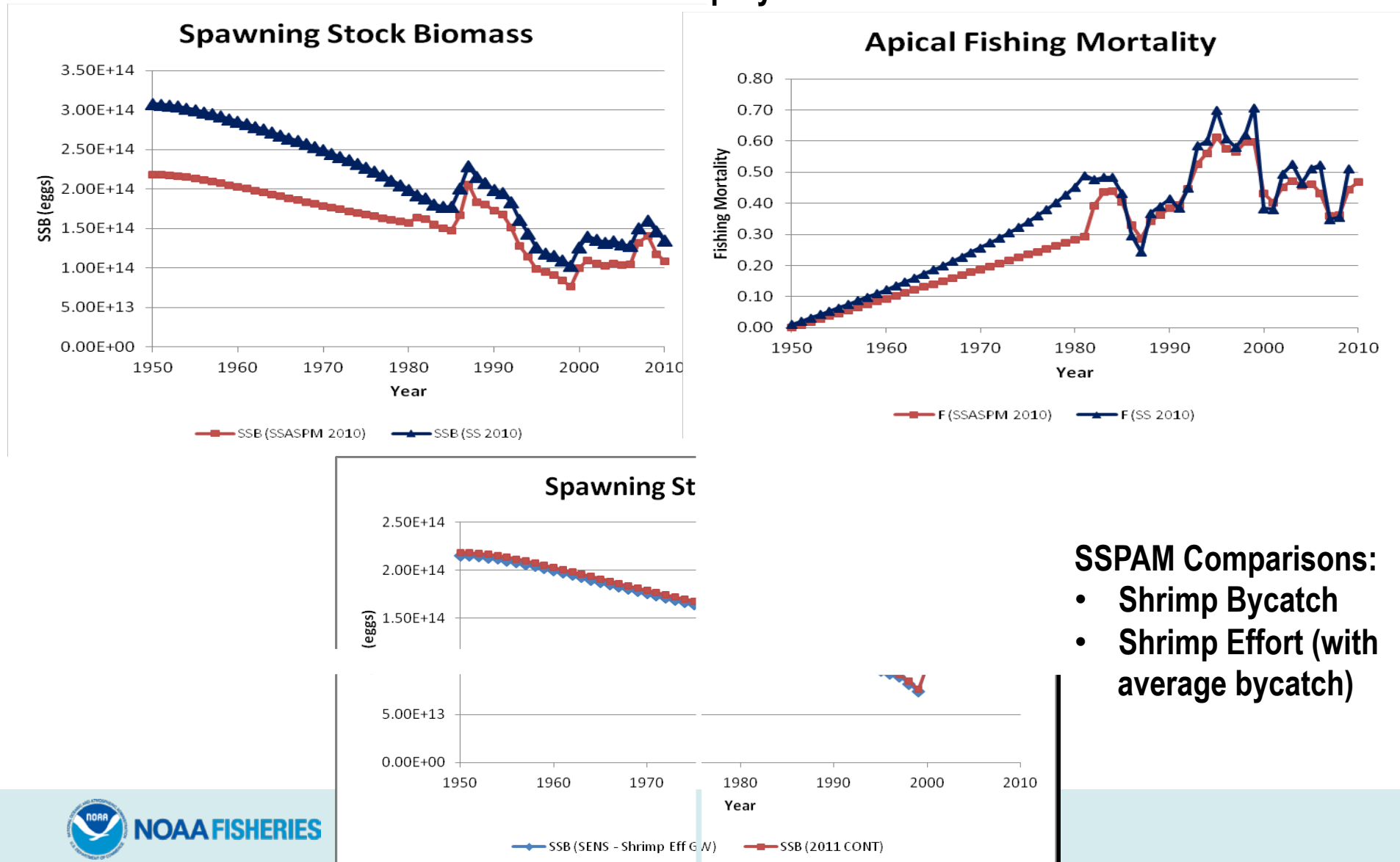
Initial Model Comparisons



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SS3 and SSPAM Comparison (2011 Update)

With Shrimp Bycatch



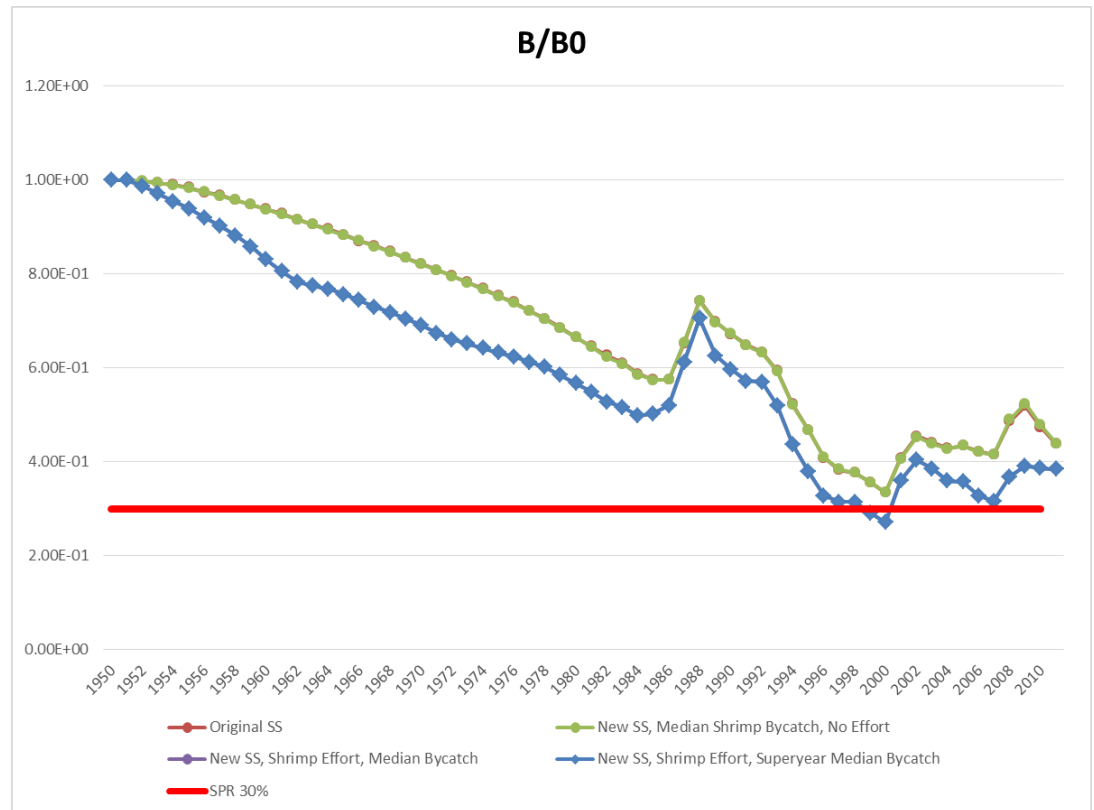
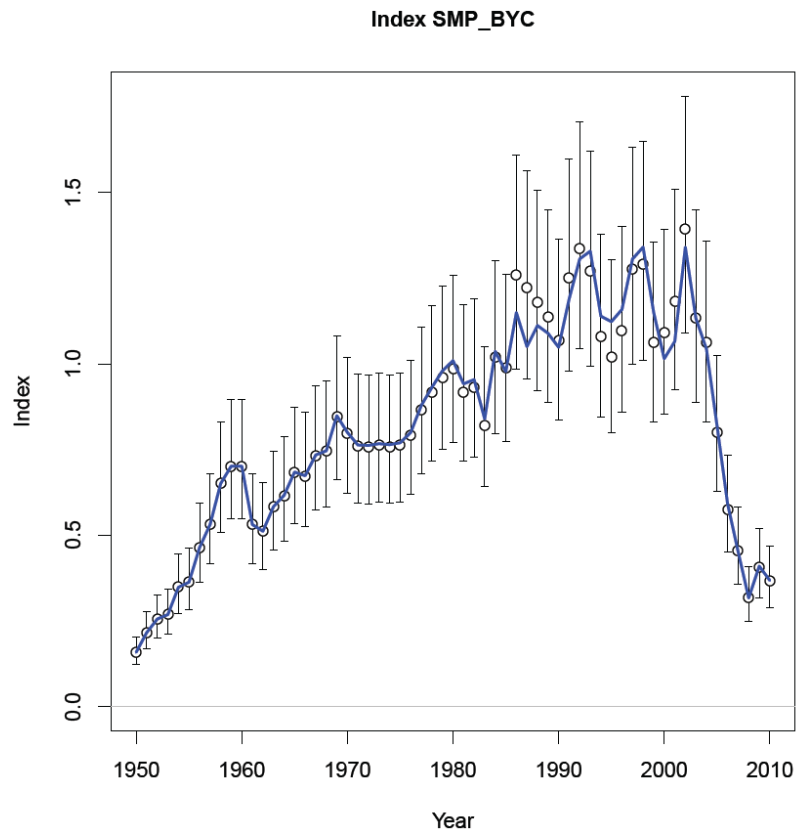
SSPAM Comparisons:

- Shrimp Bycatch
- Shrimp Effort (with average bycatch)



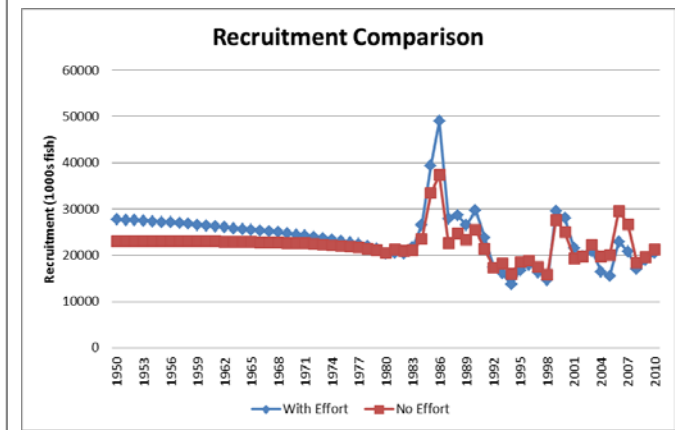
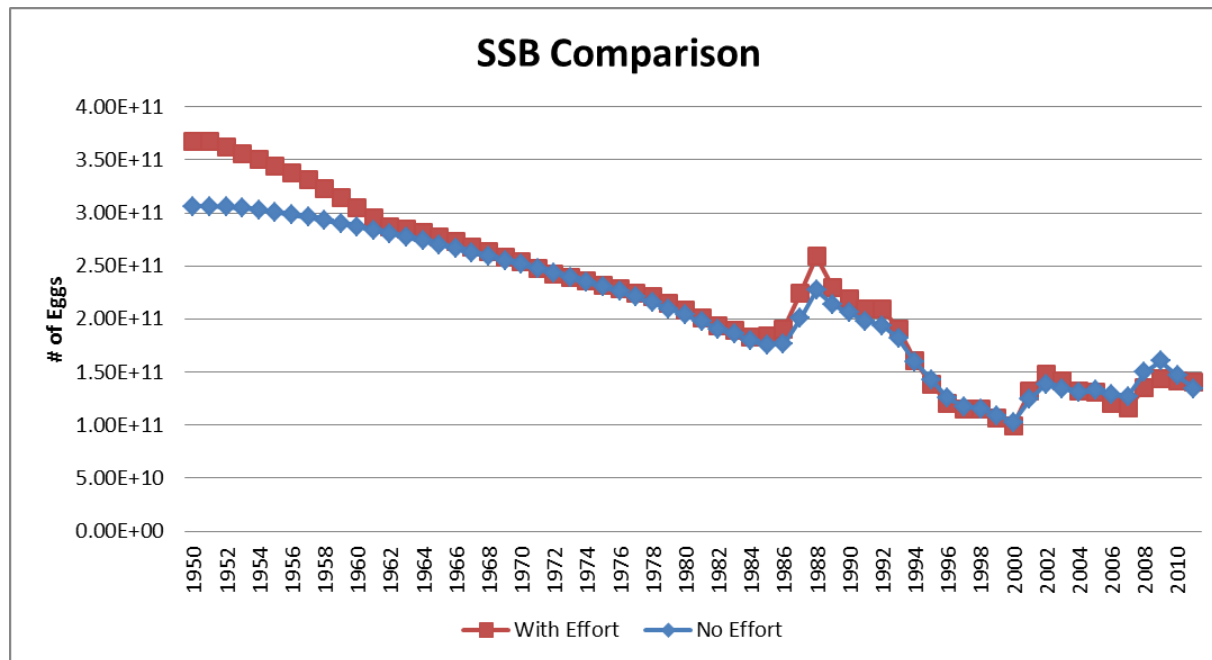
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SS3 Continuity Runs—Shrimp Effort and Bycatch



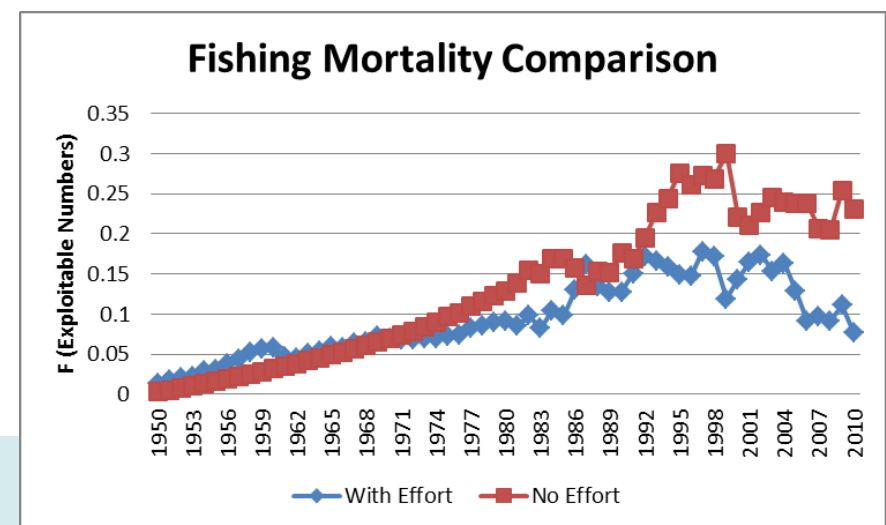
- Median Shrimp Bycatch=6.65mil fish
- Old SS approach fit median bycatch in each year with a linear landings ramp
- Superyear approach assumes median bycatch of 6.65 mil fish (no ramp)
- Including shrimp effort is only change with a significant impact

SS3 Continuity Runs—Shrimp Effort and Bycatch



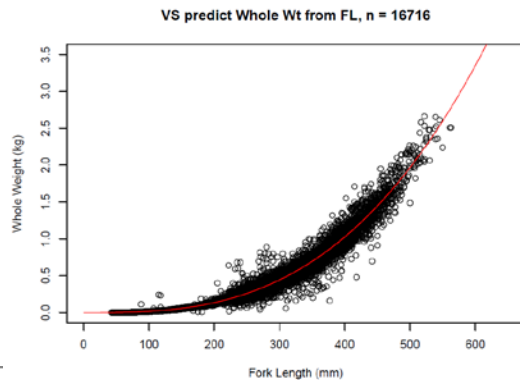
	B0	R0	Steep
No Effort	3.06E+11	10.05	8.23E-01
Effort	3.67E+11	10.2	5.45E-01

- Initial SSB is much higher with effort, but is otherwise comparable for remainder of timeseries
- F starts off higher, but is reduced considerably in last two decades

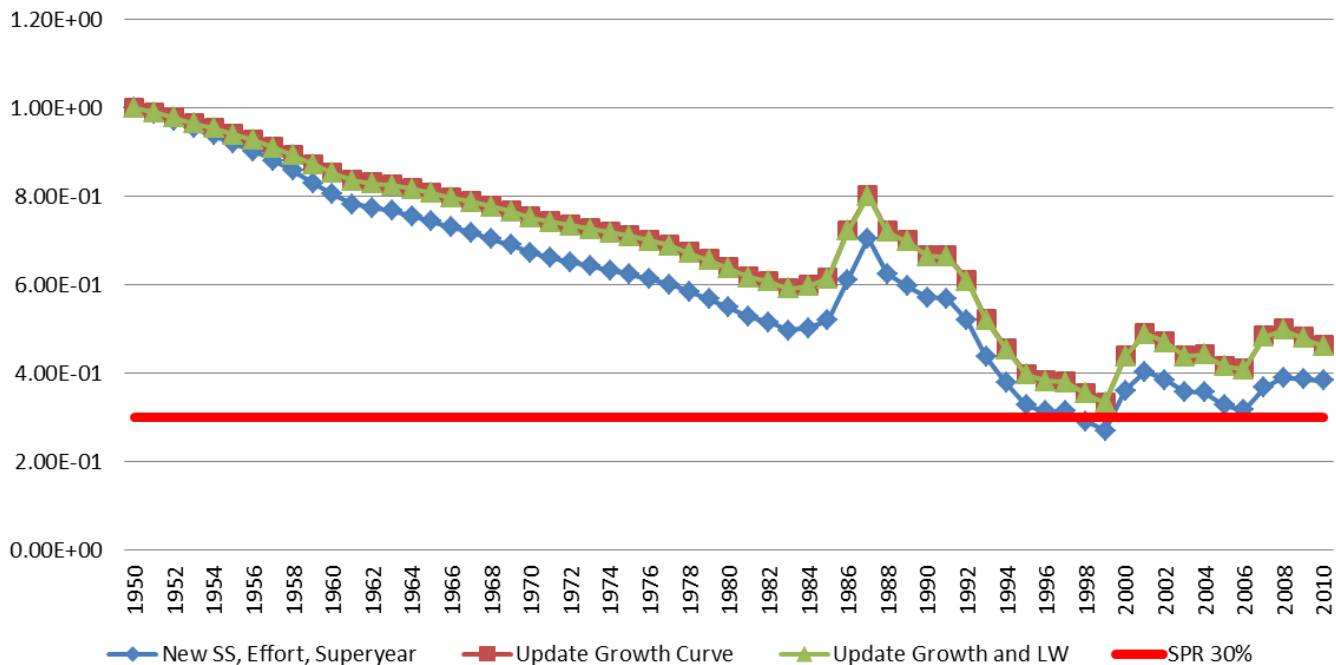


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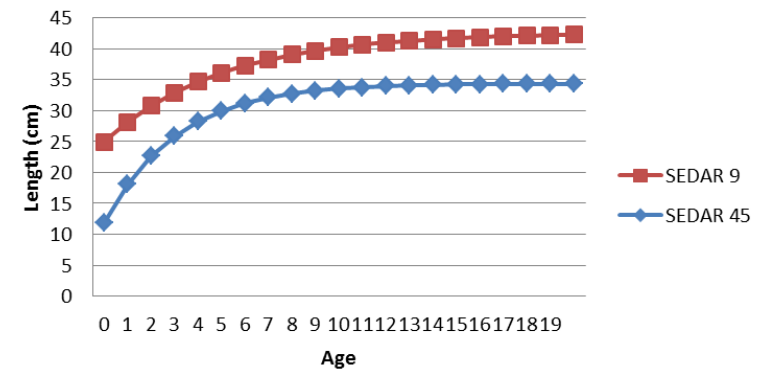
SS3 Continuity Runs—Growth



B/B0



Growth Curve Comparison



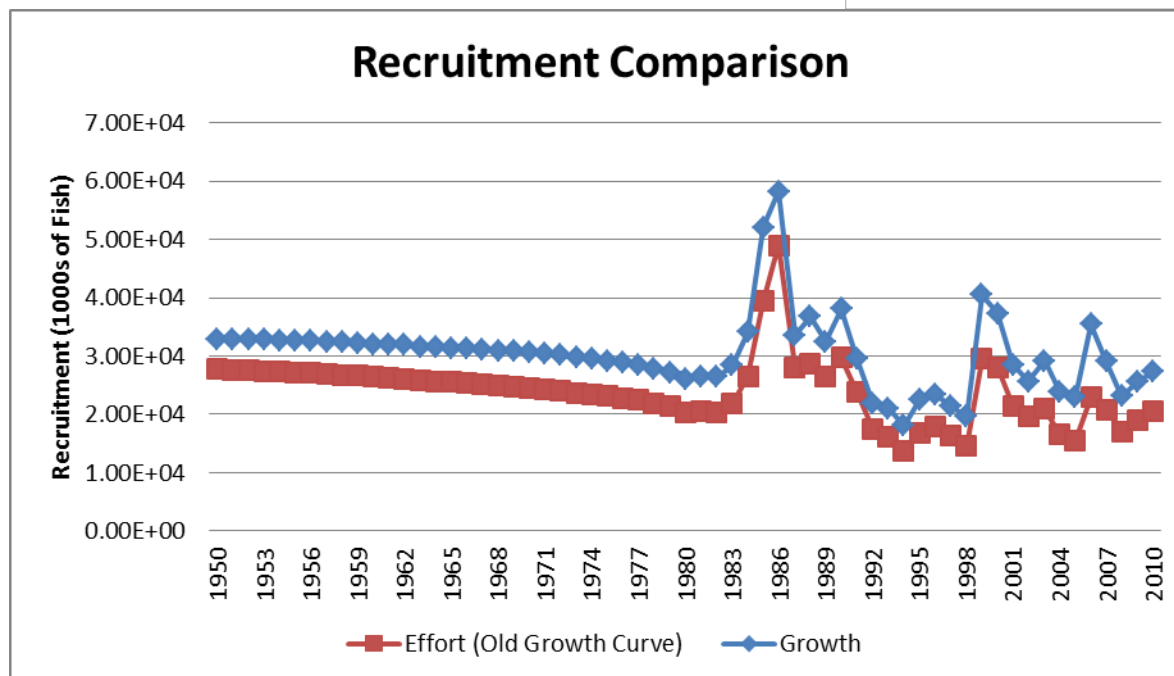
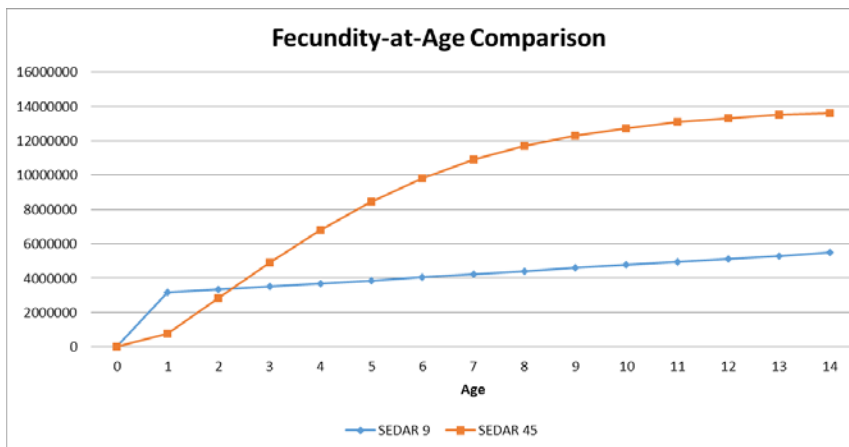
- Faster growing, but smaller sizes
- Little weight difference in smaller fish



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SS3 Continuity Runs—Growth

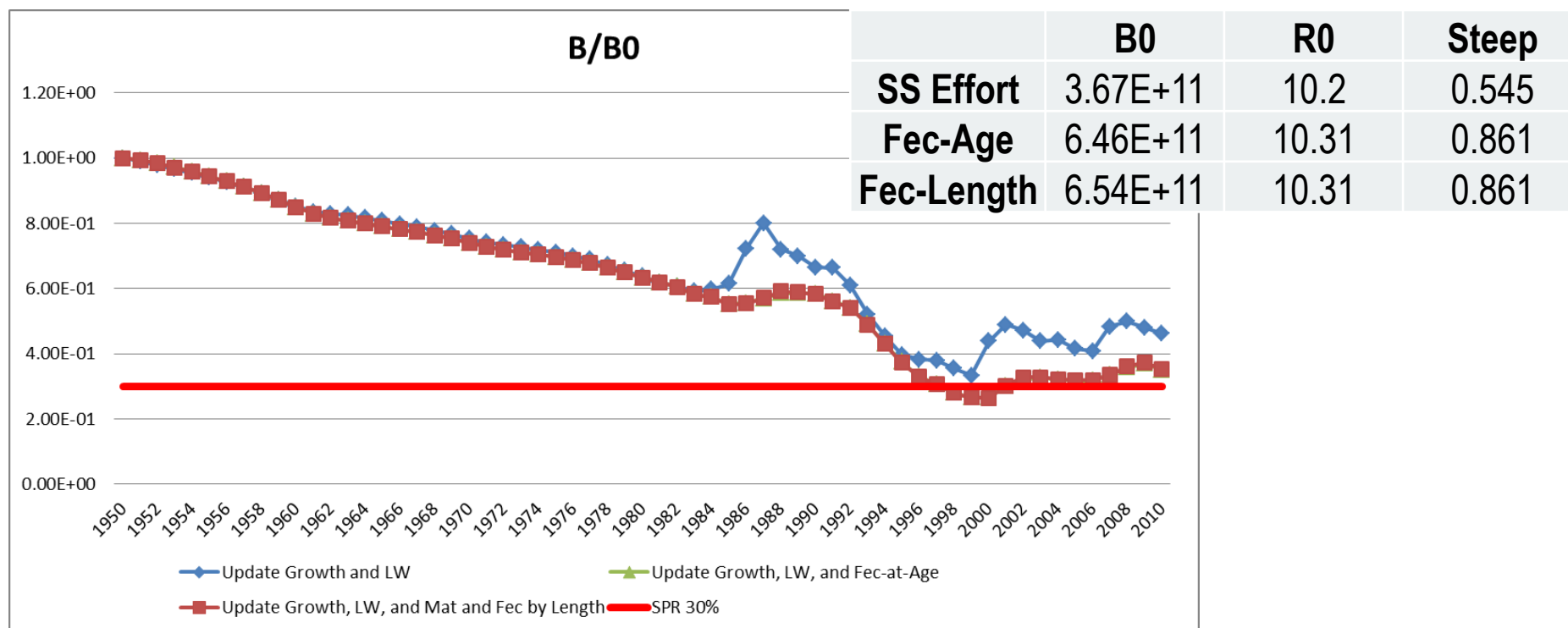
	B0	R0	Steep
SS Effort	3.67E+11	10.2	0.545
Growth	4.36E+11	10.4	0.607
Growth+LW	4.33E+11	10.39	0.606



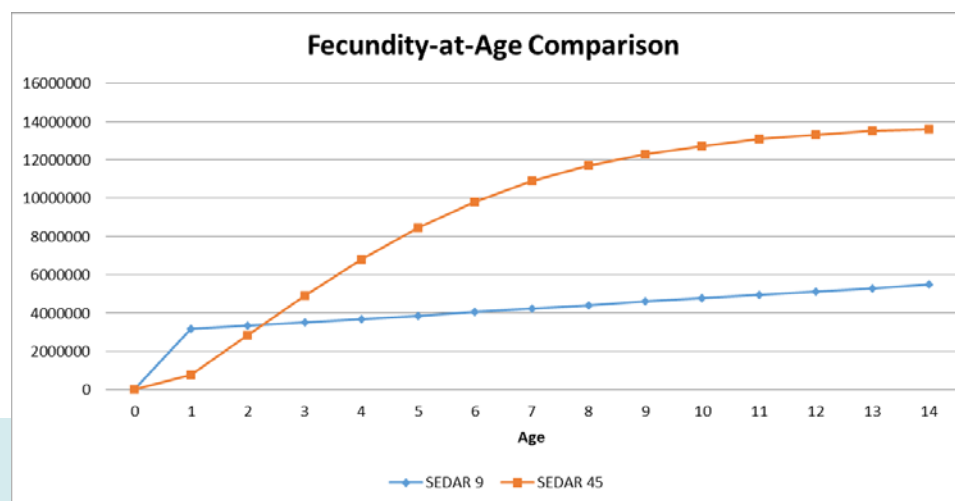
- Higher recruitment driving differences in SSB
- SEDAR 9 Fecundity-at-Age vector assumes 100% maturity at Age-1



SS3 Continuity Runs—Maturity

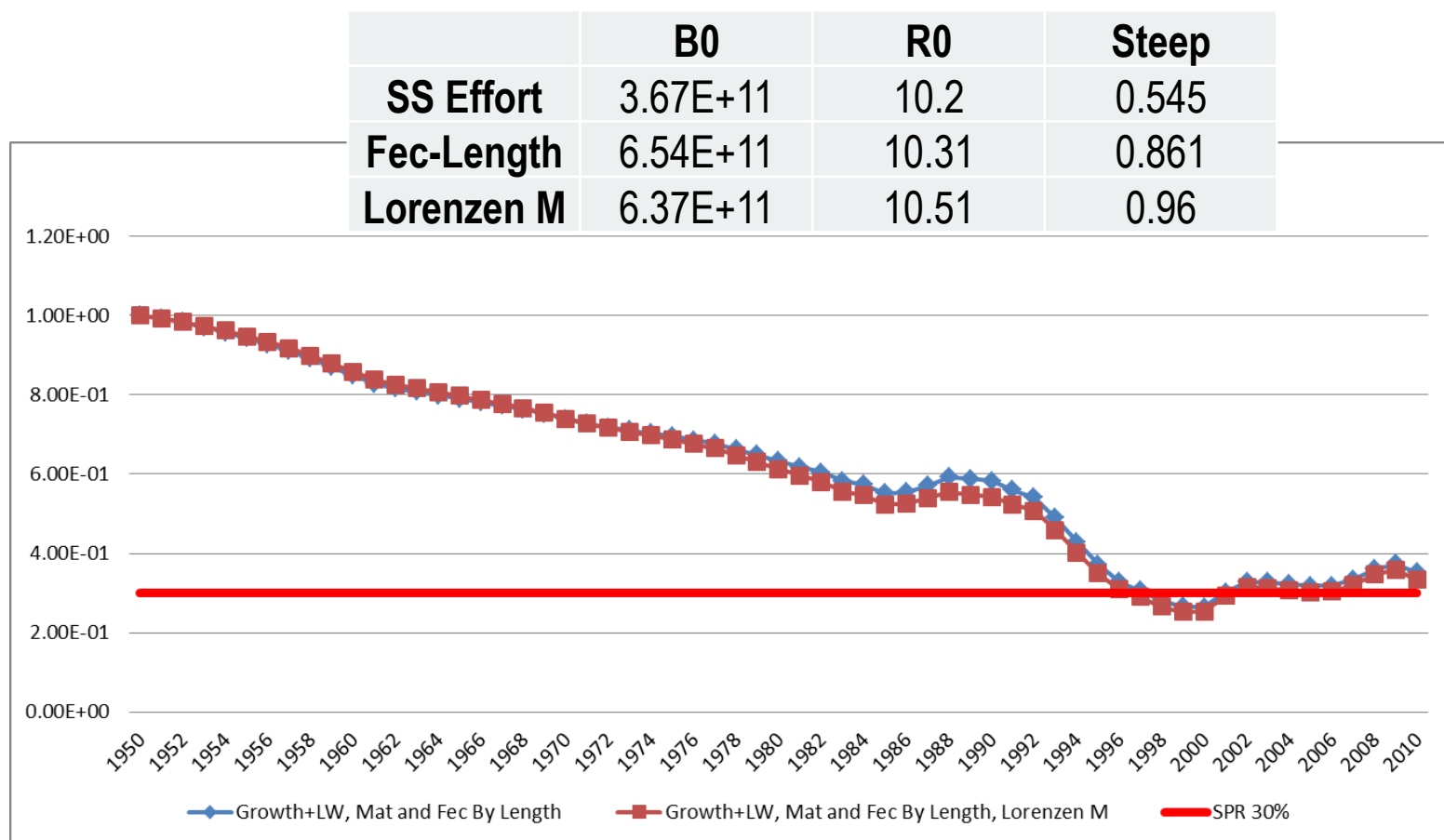


- New fecundity estimates result in smoother SSB curve and lower SSB (no longer follows recruitment spikes as closely)
 - No longer 100% mature at age-1
 - Lower fecundity at younger ages

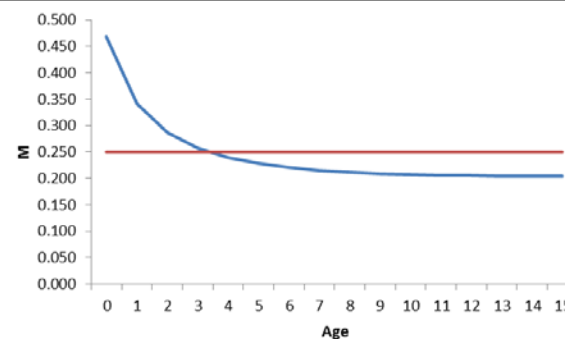


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SS3 Continuity Runs—Lorenzen M

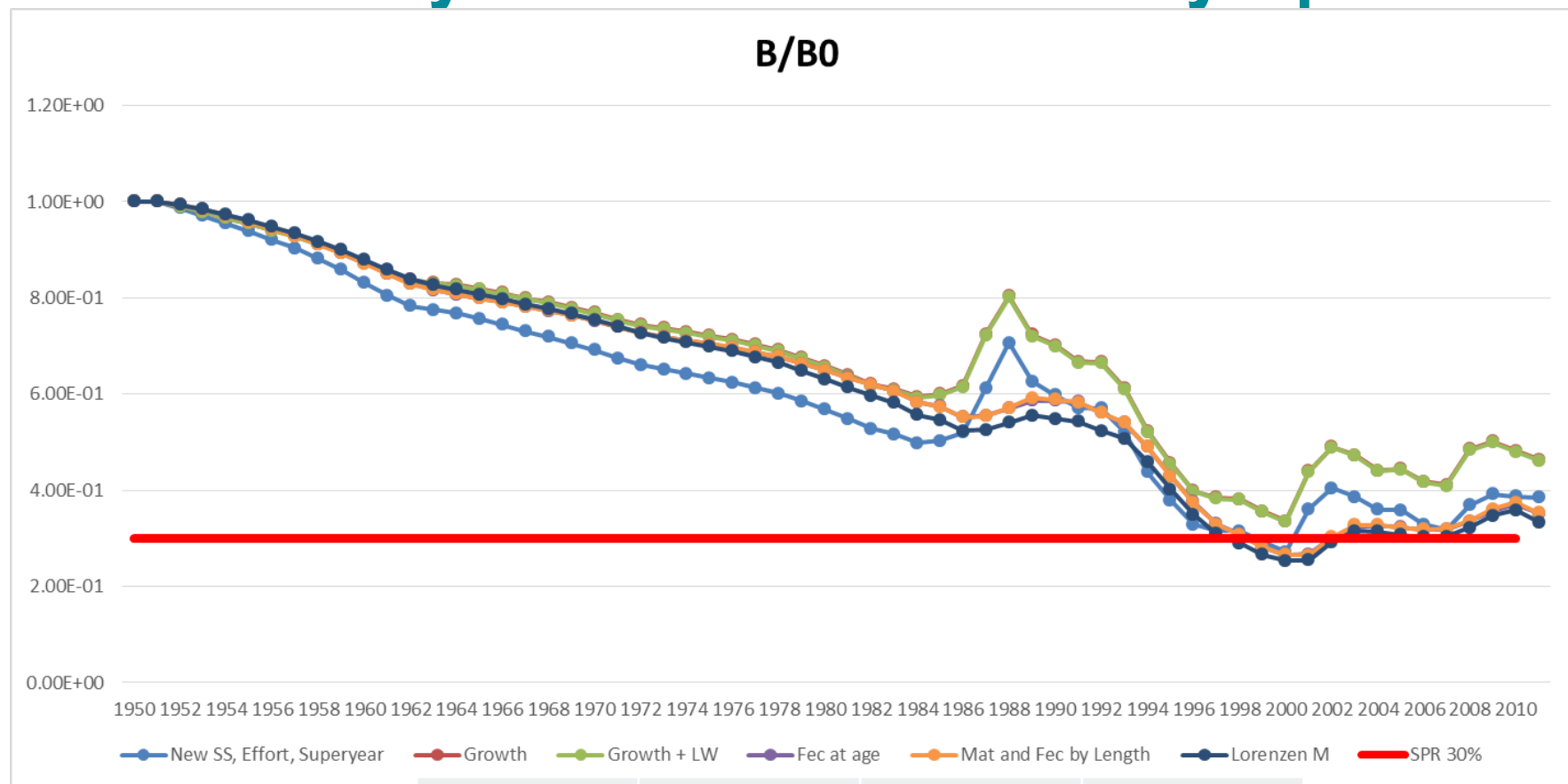


- Higher M at younger ages further reduces SSB
- Reduced fecundity at younger ages (compared to SEDAR 9) minimizes impact on SSB



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SS3 Continuity Runs—All Life History Updates

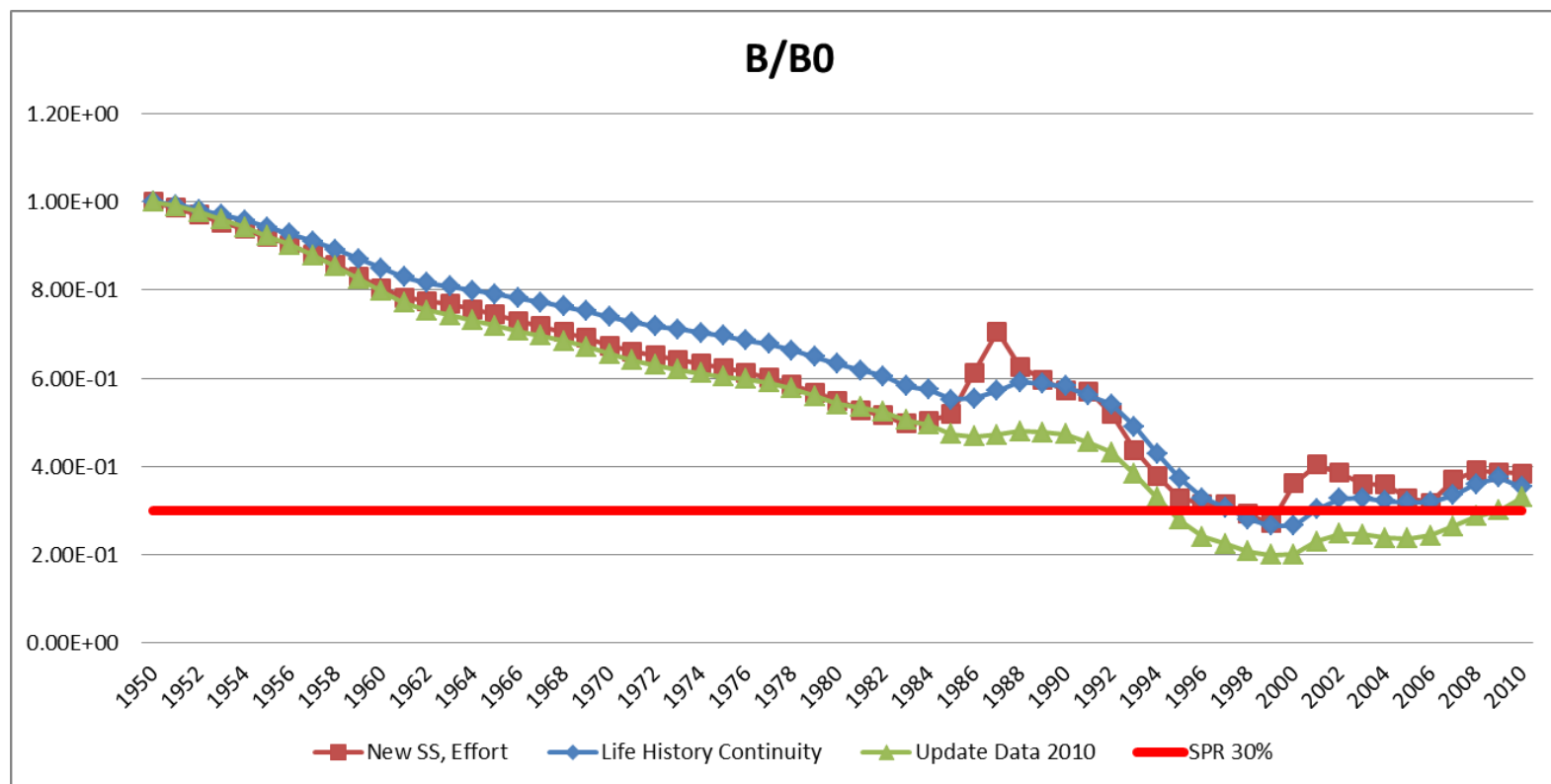


	B0	R0	Steep
SS Effort	3.67E+11	10.2	0.545
Growth	4.36E+11	10.4	0.607
Growth+LW	4.33E+11	10.39	0.606
Fec-Age	6.46E+11	10.31	0.861
Fec-Length	6.54E+11	10.31	0.861
Lorenzen M	6.37E+11	10.51	0.96



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SS3 Continuity Runs—Update Data through 2010

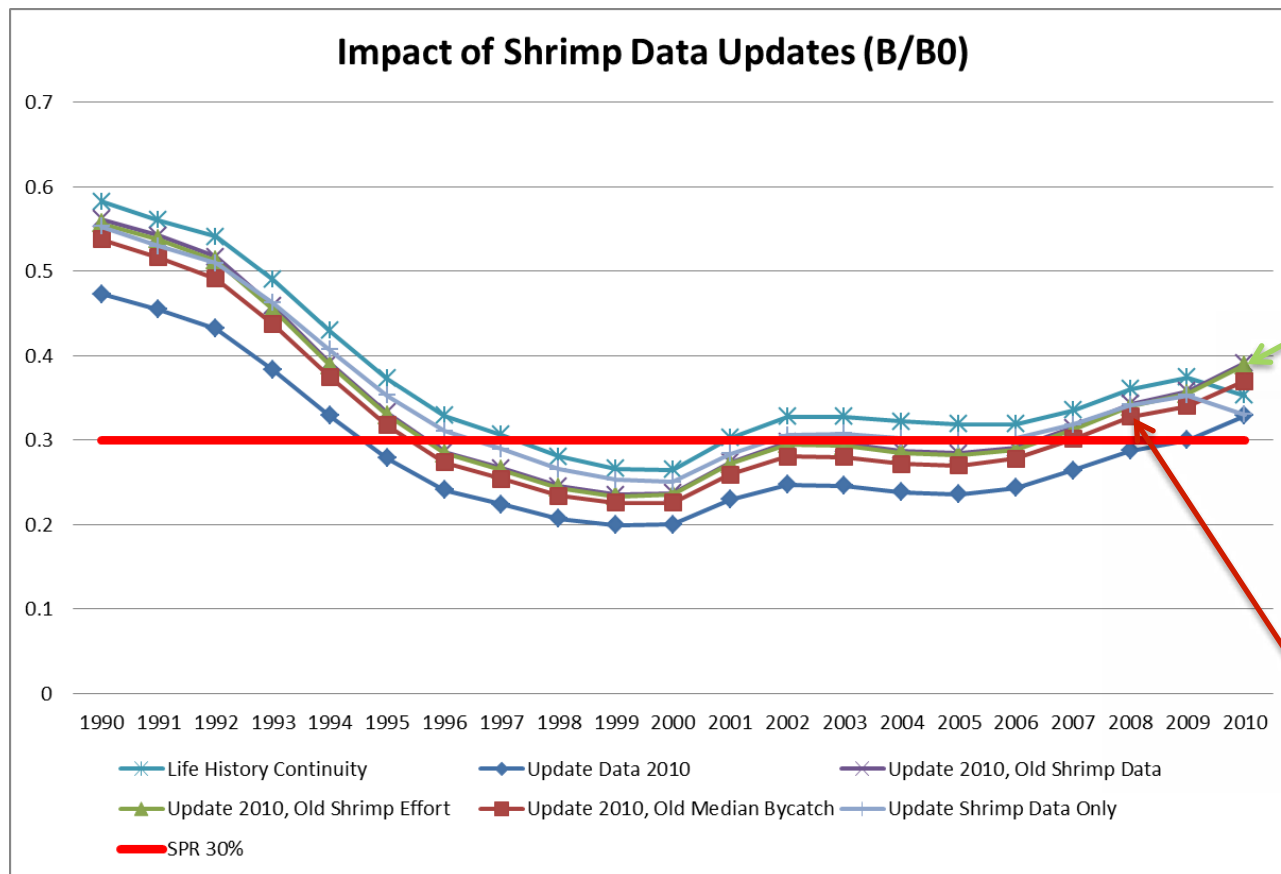


***Shrimp bycatch data has not been updated**

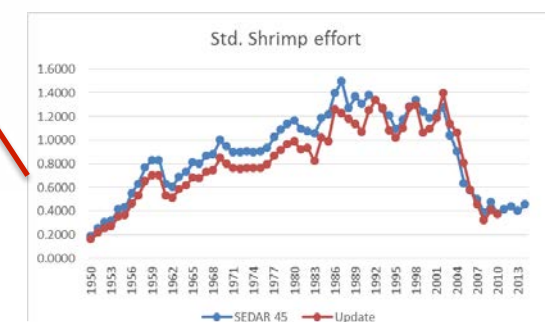
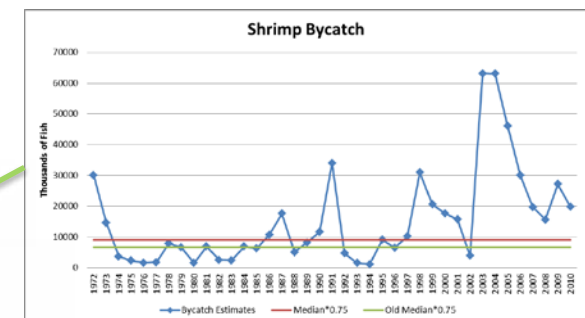
****Using 0.75*Median of available shrimp bycatch (slightly higher than previous median used in update)**

	B ₀	R ₀	Steep
SS Effort	3.67E+11	10.2	0.545
Fec-Length	6.54E+11	10.31	0.861
Update 2010	6.90E+11	10.37	0.76

SS3 Continuity Runs—Impact of Shrimp Bycatch



**Superyear median changed
from 6.65mil to 6.822mil**



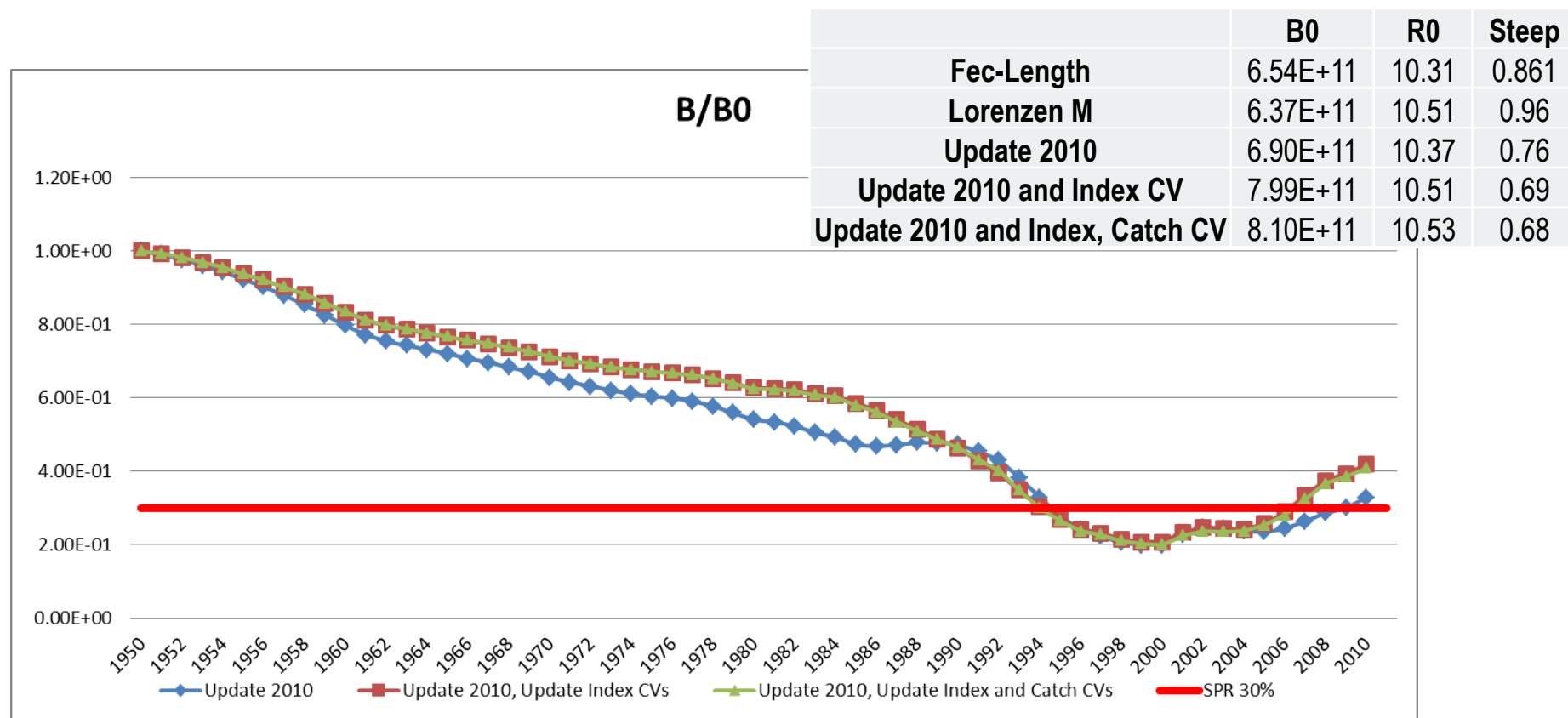
	B0	R0	Steep
SS Effort	3.67E+11	10.2	0.545
Fec-Length	6.54E+11	10.31	0.861
Update 2010	6.90E+11	10.37	0.76
Update 2010, Old Shrimp Data	6.55E+11	10.31	0.85
Update 2010, Old Shrimp Median Bycatch	6.82E+11	10.34	0.76
Update 2010, Old Shrimp Effort	6.62E+11	10.32	0.85

Steepness

- SEDAR 9:
 - The level of assumed shrimp bycatch also impacts the status of vermilion snapper (SEDAR9-AW-04). Lower levels of shrimp bycatch cause lower estimates of productivity (steepness), and consequently poorer status. Therefore, the stock status of vermilion snapper is predicted to be less optimistic if the assumed shrimp bycatch is overestimated.



SS3 Continuity Runs—Update CVs

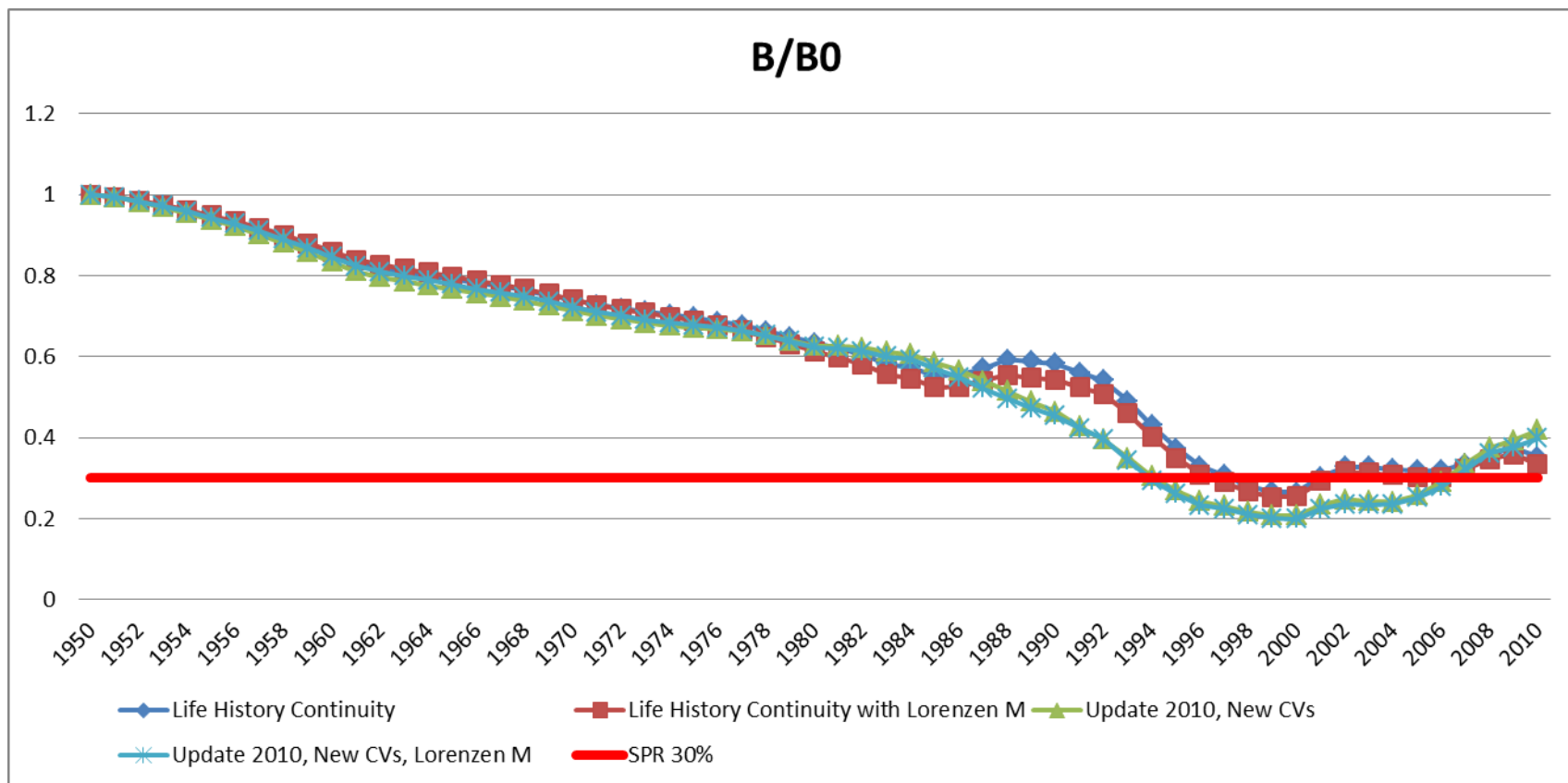


- Update assessment assumed constant index CVs and catch CV=0.05
- Index CVs are updated to those output by standardization routines
- Catch CVs have been updated to reflect assumed relative error per SEFSC best practices (Commercial CV=0.1, Recreational CV=0.3)



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SS3 Continuity Runs—Lorenzen M

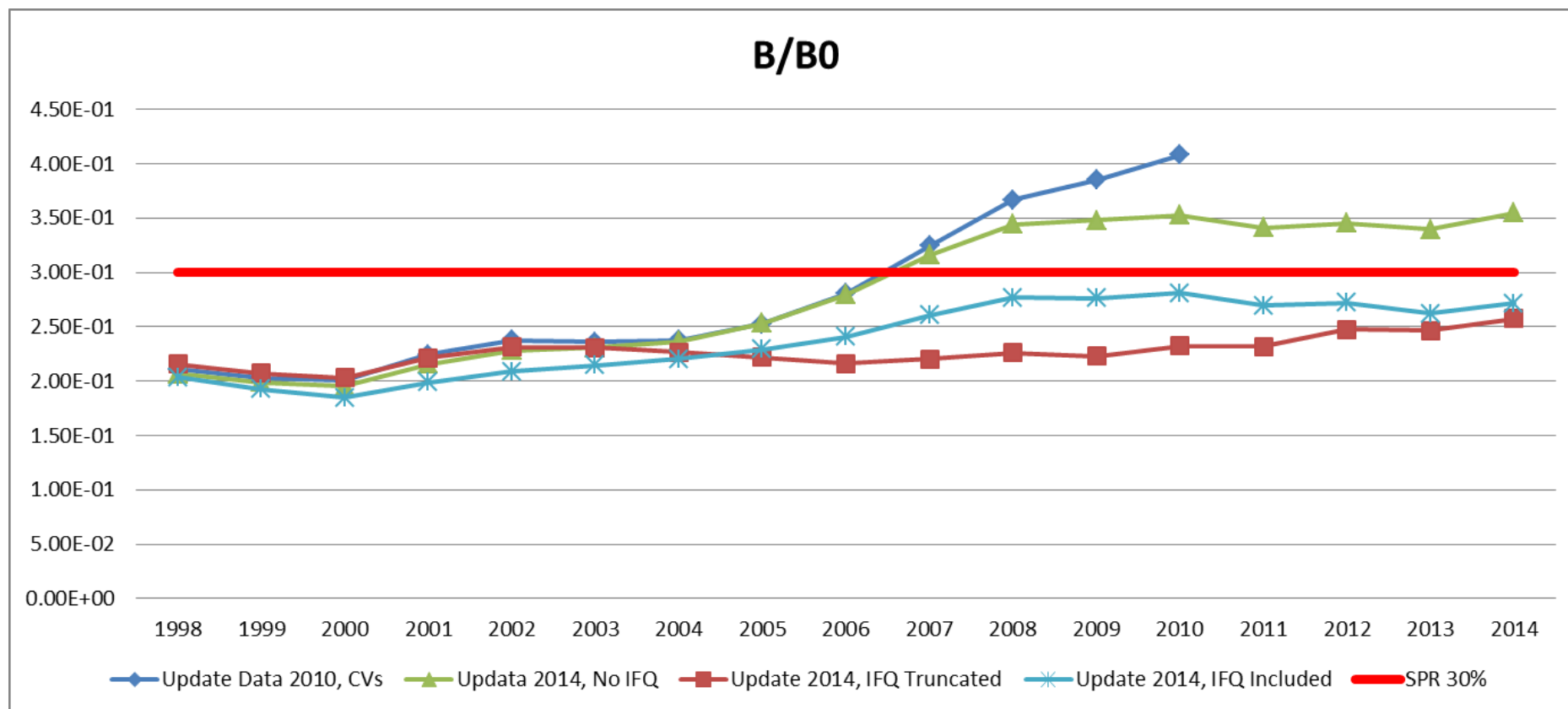


	B0	R0	Steep
Fec-Length	6.54E+11	10.31	0.861
Lorenzen M	6.37E+11	10.51	0.96
Update 2010	6.90E+11	10.37	0.76
Update 2010 and Index, Catch CV	8.10E+11	10.53	0.68
Update 2010, CVs, Lorenzen M	7.66E+11	10.69	0.79



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SS3 Continuity Runs—Update Data 2014



- ****Shrimp bycatch data has not been updated**
- Using superyear through 2010

	B0	R0	Steep
SS Effort	3.67E+11	10.2	0.545
Update 2010 and Index, Catch CV	8.10E+11	10.53	0.68
Update 2014 No IFQ	8.76E+11	10.6	0.57
Update 2014 IFQ	9.61E+11	10.7	0.49
Update 2014 No IFQ Truncated	9.96E+11	10.73	0.48

Final Continuity Run

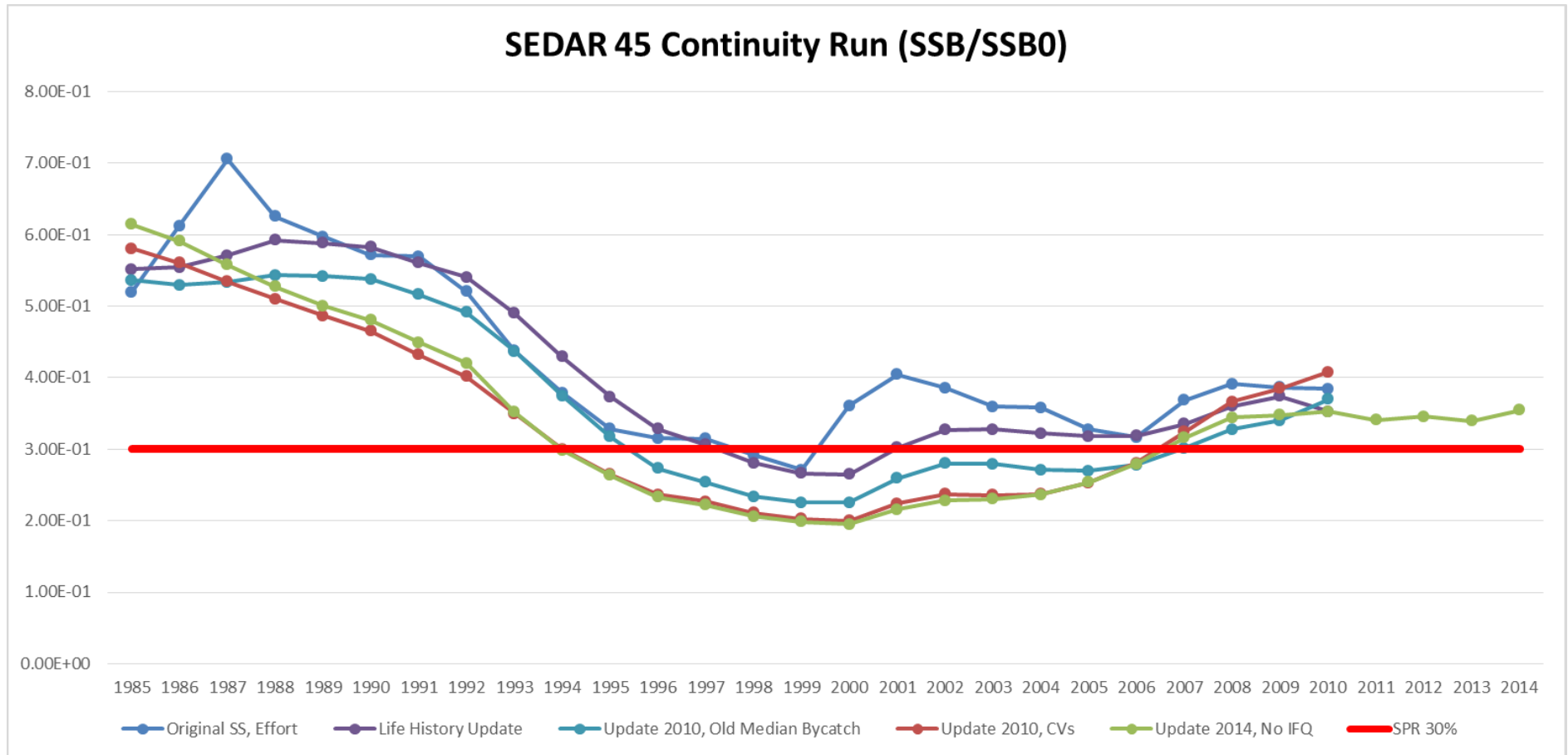


Final Continuity Run

- Constant natural mortality
- Prior on stock-recruit steepness
- Updated life history relationships
- Updated data through 2014
- Gulf-wide shrimp bycatch (fitting median using superyear approach) and fitting to shrimp effort
- No shrimp age compositions (fix selectivity assuming double normal with 100% selection of age-1, 30% age-2, and 3% age-3)
- Updated index CVs (SEDAR 9 assumed constant CV)
- Updated relative catch CVs based on best practices (downweight recreational catch; SEDAR 9 assumed equal weighting)
- Logistic selectivity with no timeblocks
- No discards
- No surveys

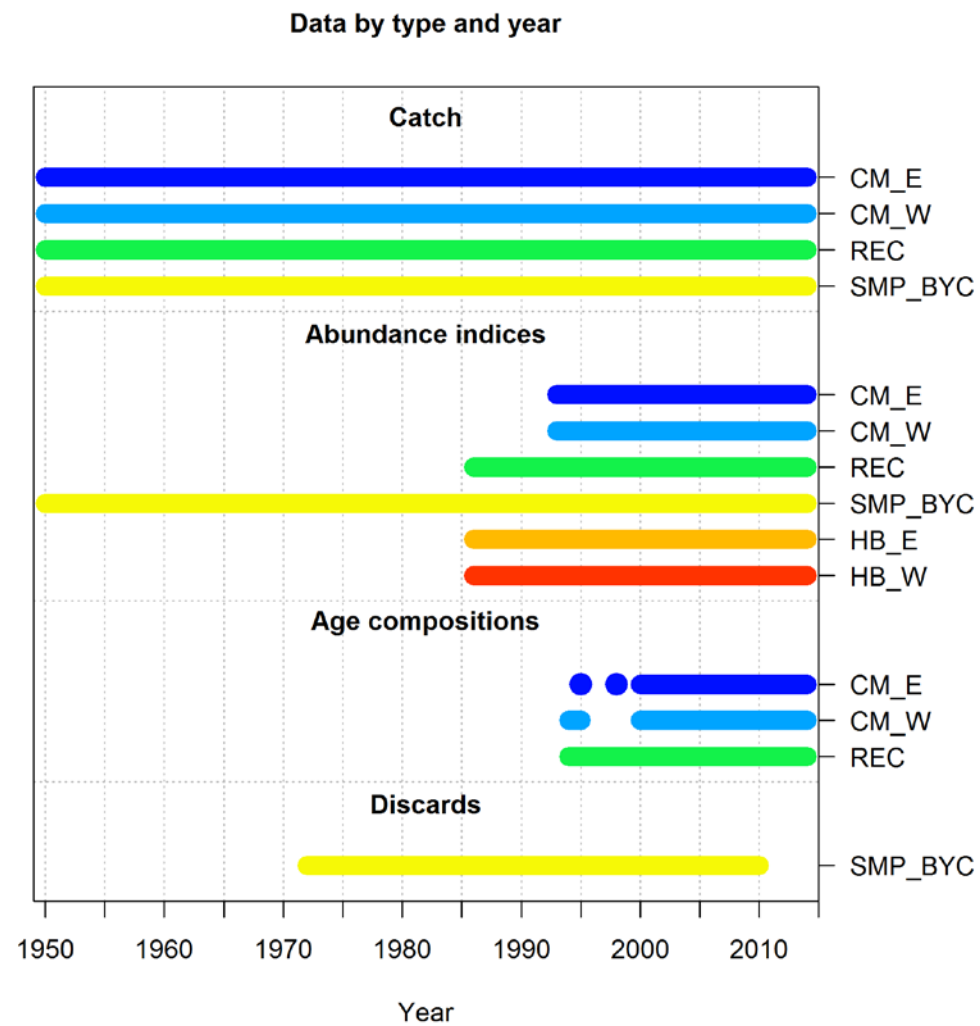


Final Continuity Run

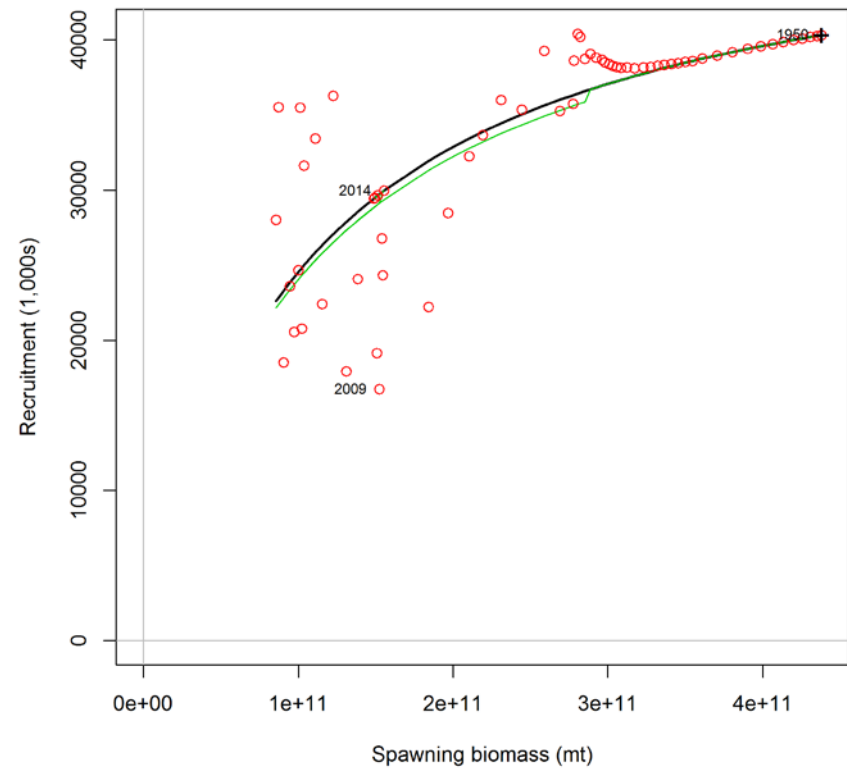
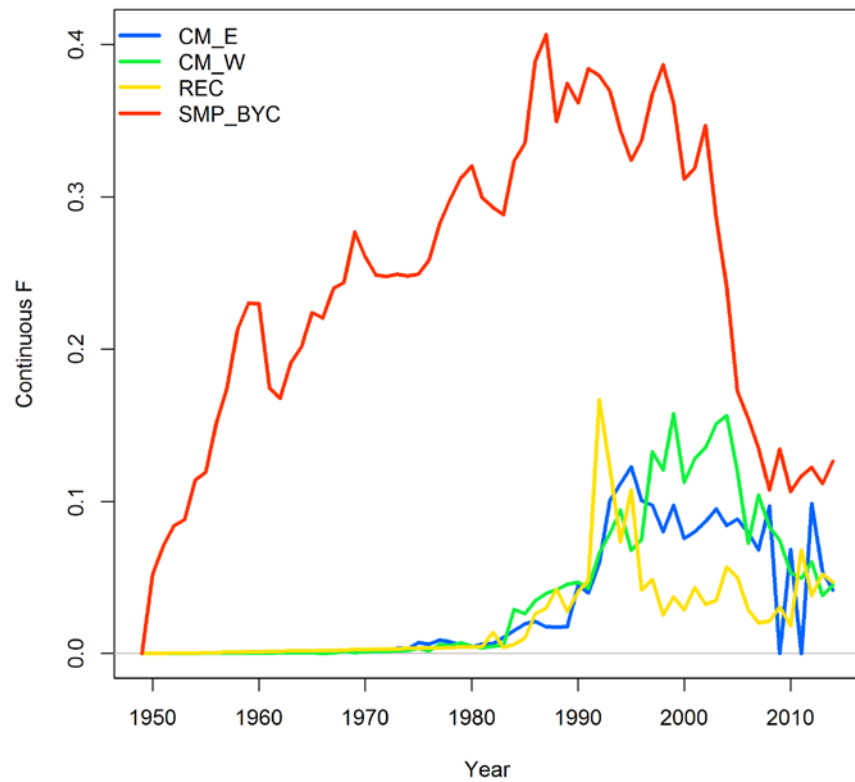


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Data

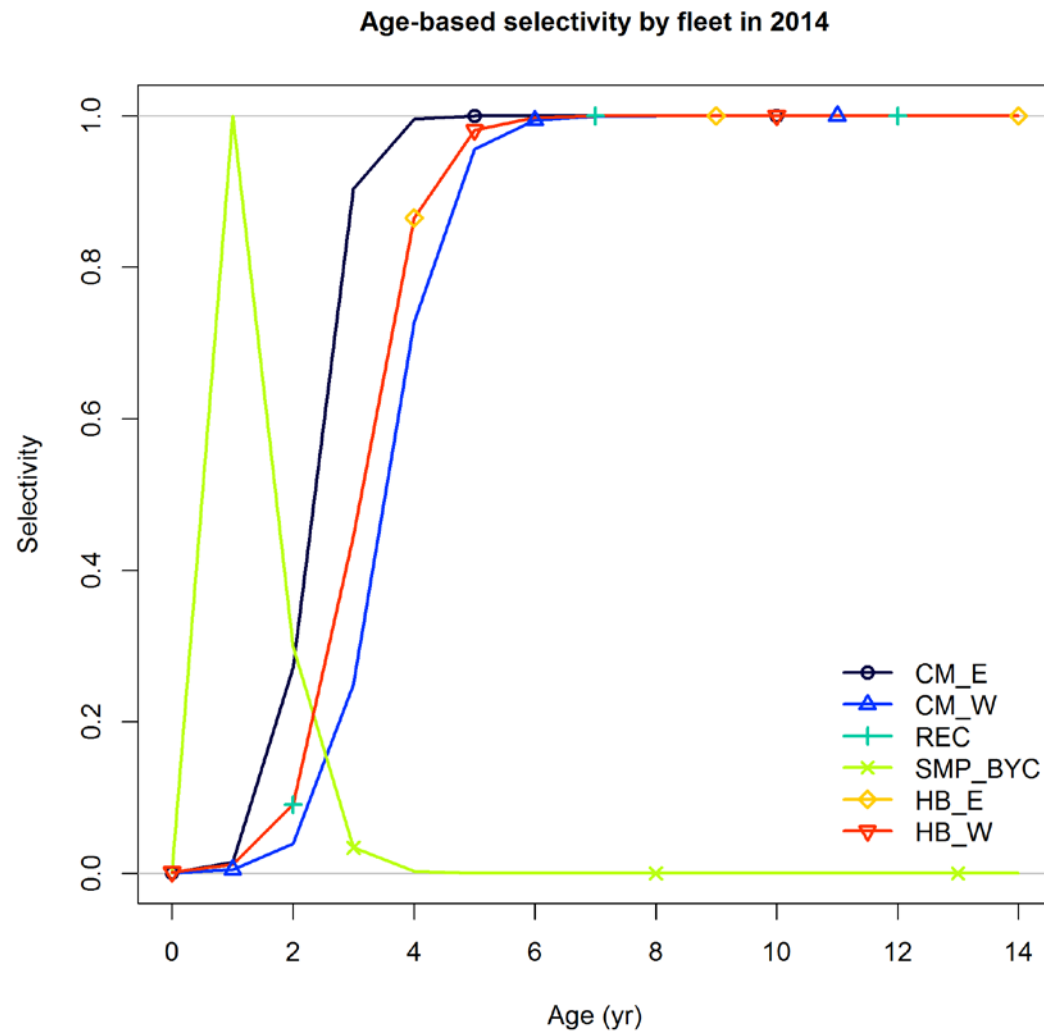


Estimates

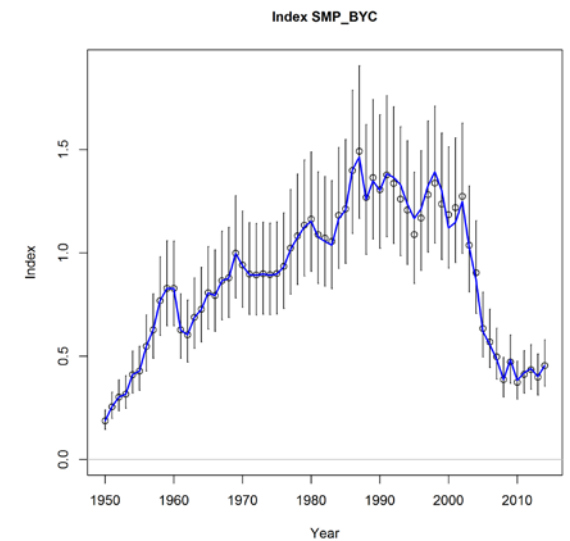
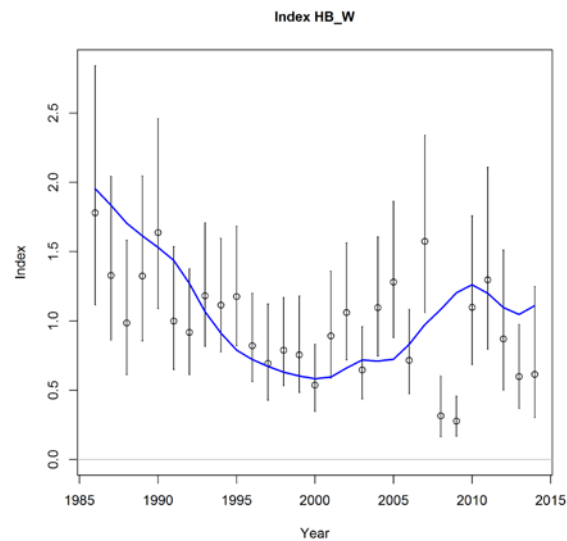
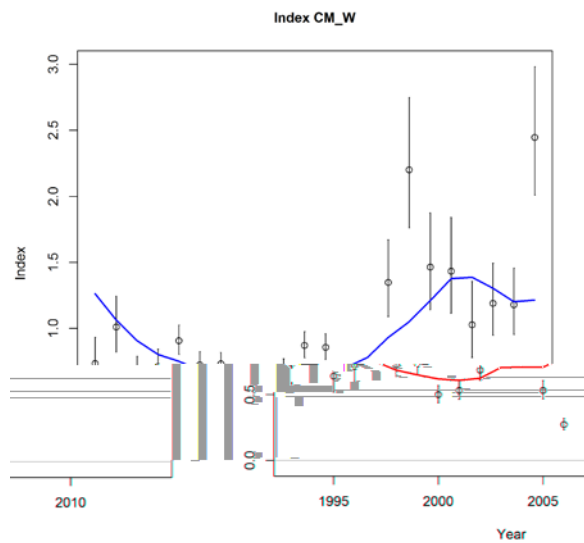
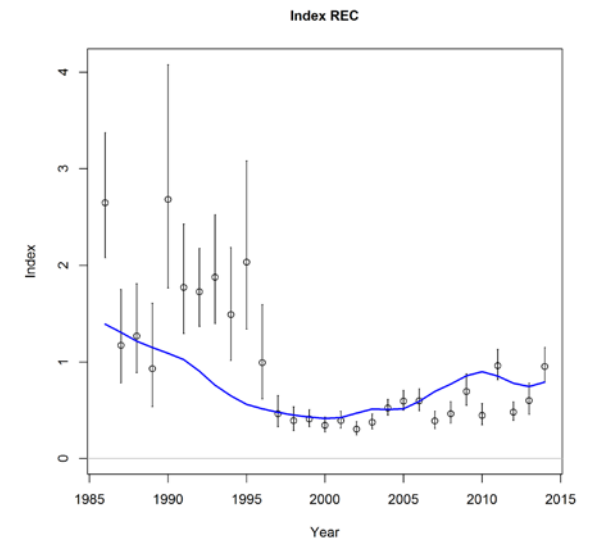
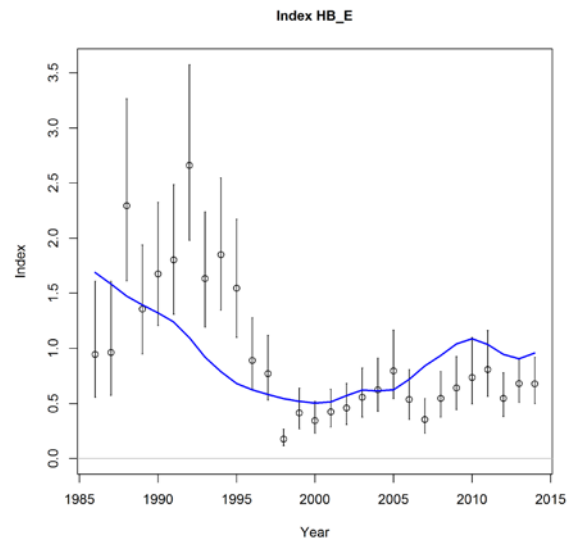
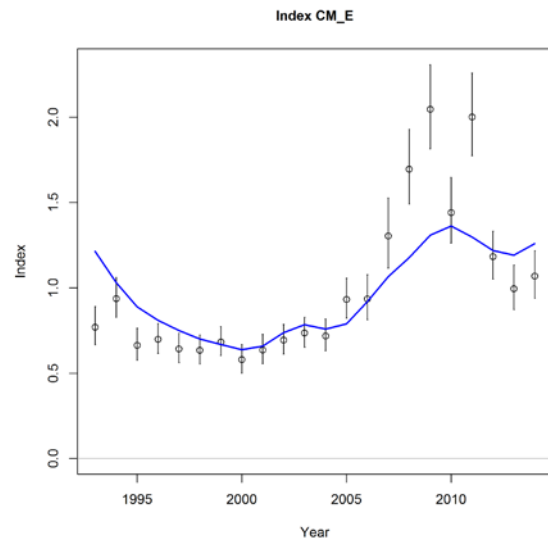


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Estimates



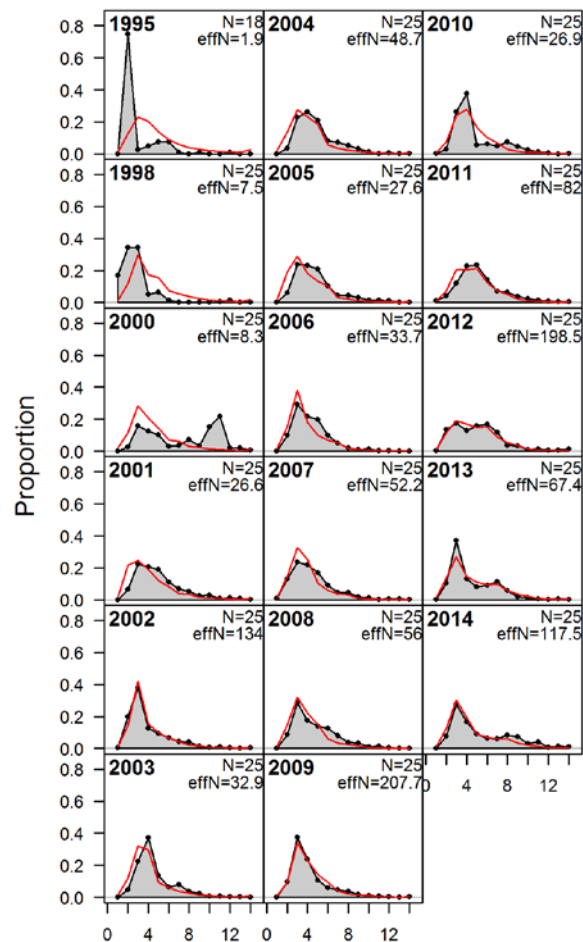
Data Fits



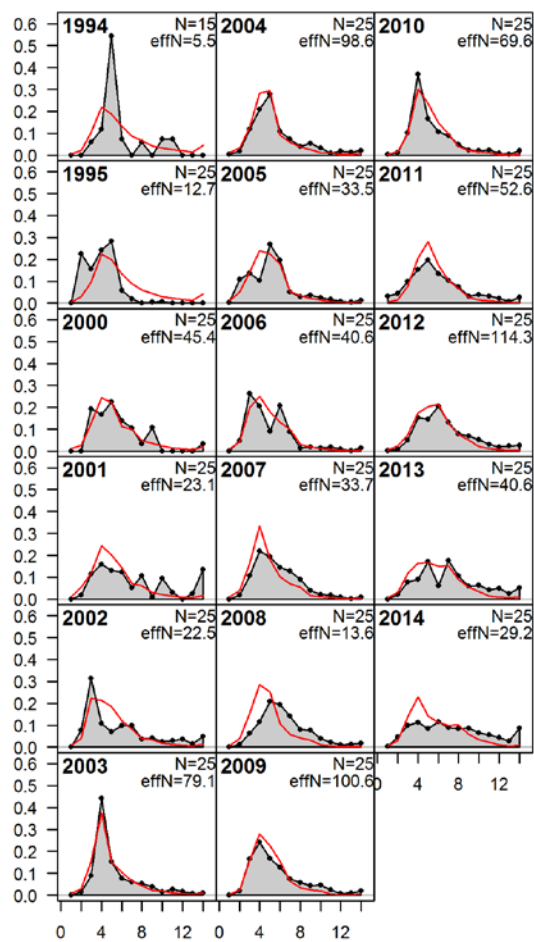
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Age Composition Fits

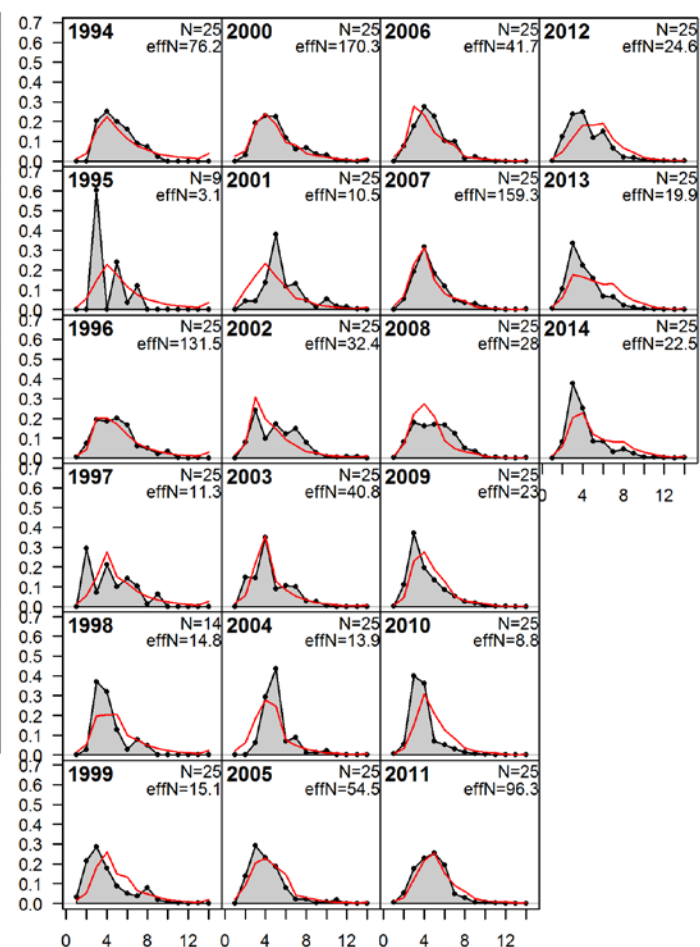
Commercial-East



Commercial-West

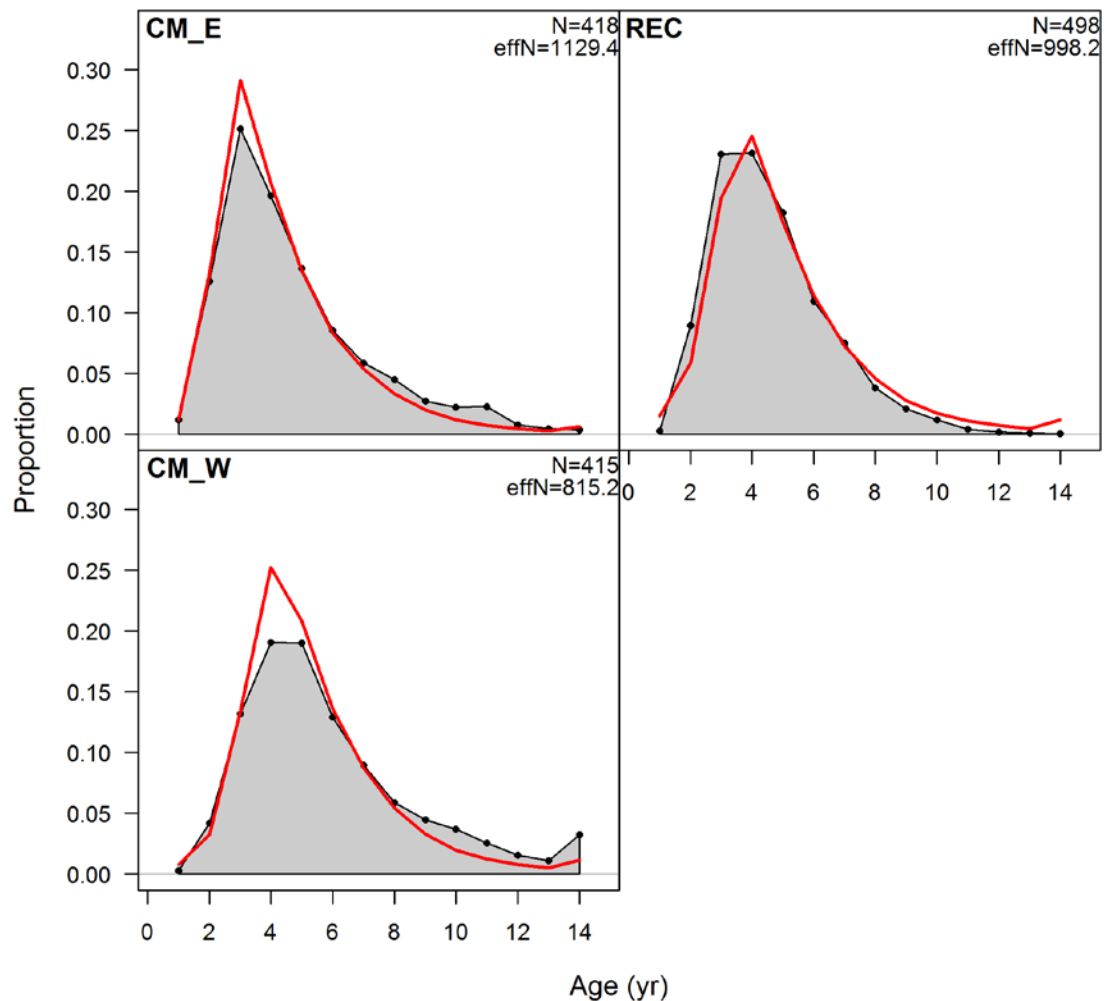


Recreational



Age Composition Fits

age comps, sexes combined, retained, aggregated across time by fleet



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Base Model Methods



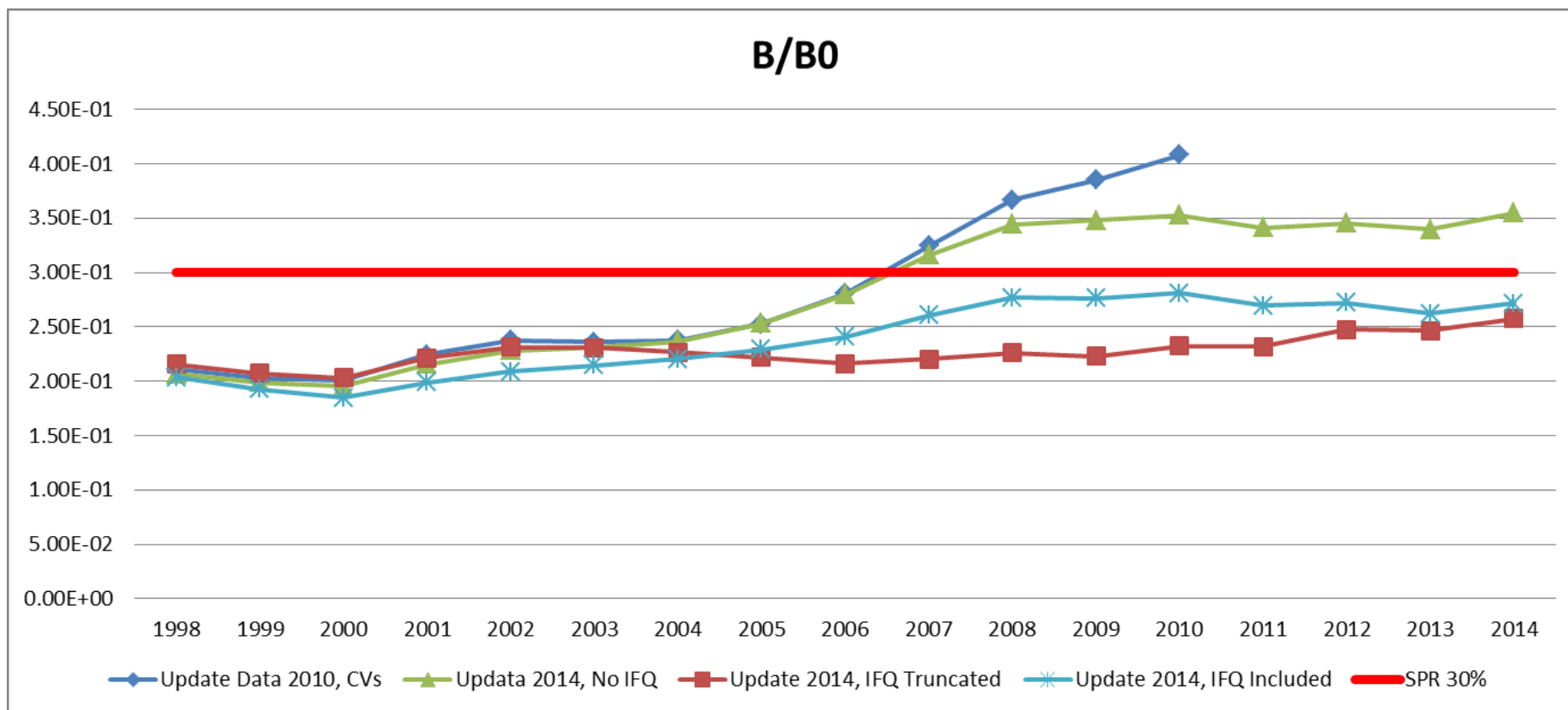
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Base Model Decisions

- Treatment of IFQ in commercial CPUE index
 - No IFQ variable, include IFQ or split series
- Data weighting
 - Relative catch CVs (commercial vs. recreational)
 - Index CVs (fixed vs. true)
 - Relative index CVs (relative to each other and relative to catch; i.e., lambda values)
 - Age composition effective sample sizes
- Shrimp data
 - Fit to shrimp age compositions or fix selectivity
- Natural Mortality
 - Constant $M=0.25$ (SEDAR 9) or Lorenzen M
- Stock-recruit
 - Estimate parameters, prior on steepness (SEDAR 9) or fix parameters
- Selectivity functions
 - Logistic (SEDAR 9) or other (e.g., estimate at age)
 - Timeblocks (SEDAR 9 had no timeblocks)
- Discards
 - Recreational available but no commercial yet
 - Need to setup retention functions (min size/fully recruited retention)
 - Discard mortality
- Surveys
 - SEAMAP
 - Larval
 - Video



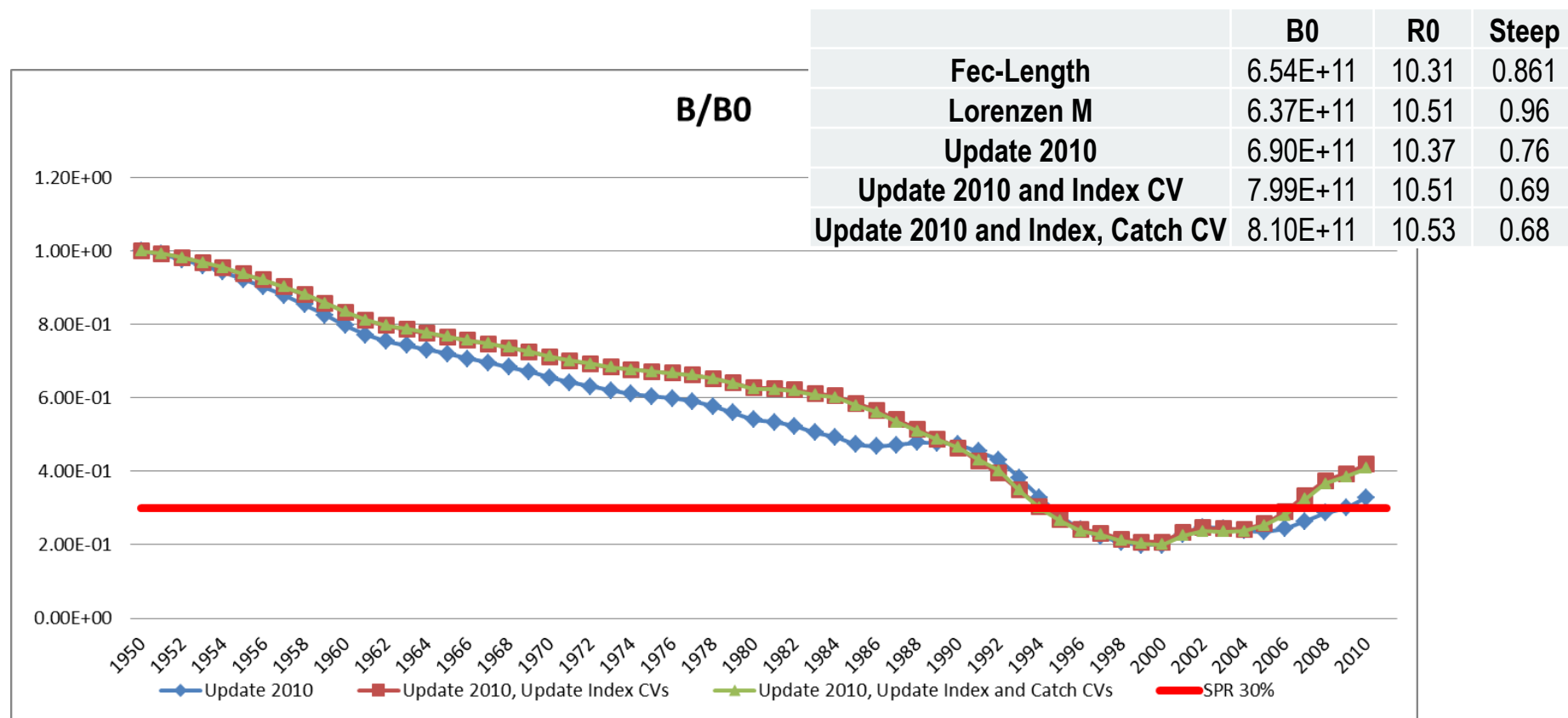
IFQ Factor



- ****Shrimp bycatch data has not been updated**
- Using superyear through 2010

	B0	R0	Steep
SS Effort	3.67E+11	10.2	0.545
Update 2010 and Index, Catch CV	8.10E+11	10.53	0.68
Update 2014 No IFQ	8.76E+11	10.6	0.57
Update 2014 IFQ	9.61E+11	10.7	0.49
Update 2014 No IFQ Truncated	9.96E+11	10.73	0.48

Data Weighting

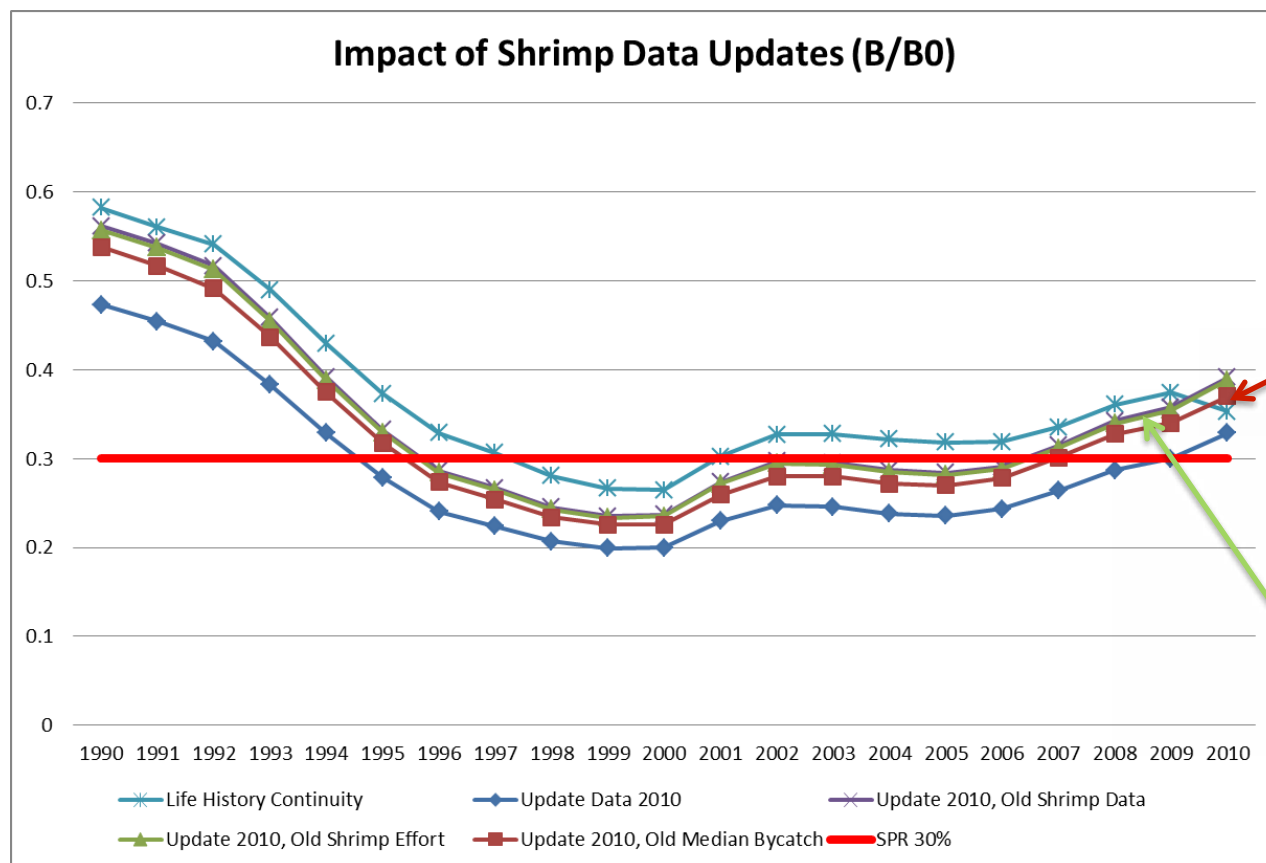


- Update assessment assumed constant index CVs and catch CV=0.05
- Index CVs are updated to those output by standardization routines
- Catch CVs have been updated to reflect assumed relative error per SEFSC best practices (Commercial CV=0.1, Recreational CV=0.3)

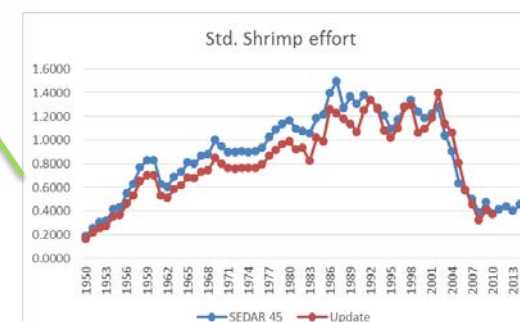
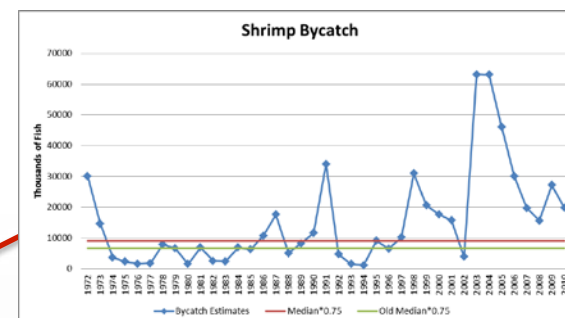


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Bycatch



Superyear median changed from 6.65mil to 6.822mil

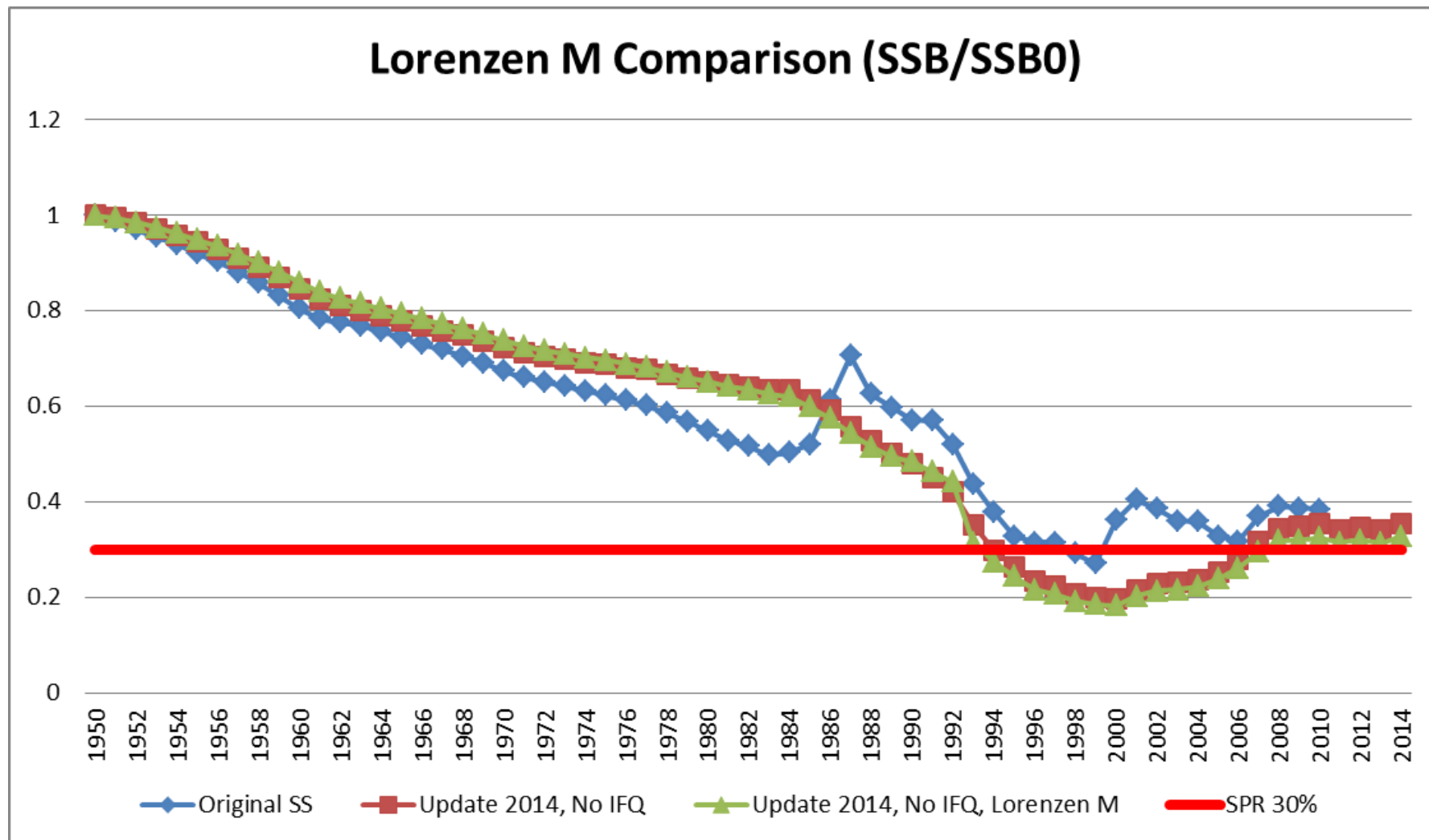


	B0	R0	Steep
SS Effort	3.67E+11	10.2	0.545
Fec-Length	6.54E+11	10.31	0.861
Update 2010	6.90E+11	10.37	0.76
Update 2010, Old Shrimp Data	6.55E+11	10.31	0.85
Update 2010, Old Shrimp Median Bycatch	6.82E+11	10.34	0.76
Update 2010, Old Shrimp Effort	6.62E+11	10.32	0.85



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Lorenzen M

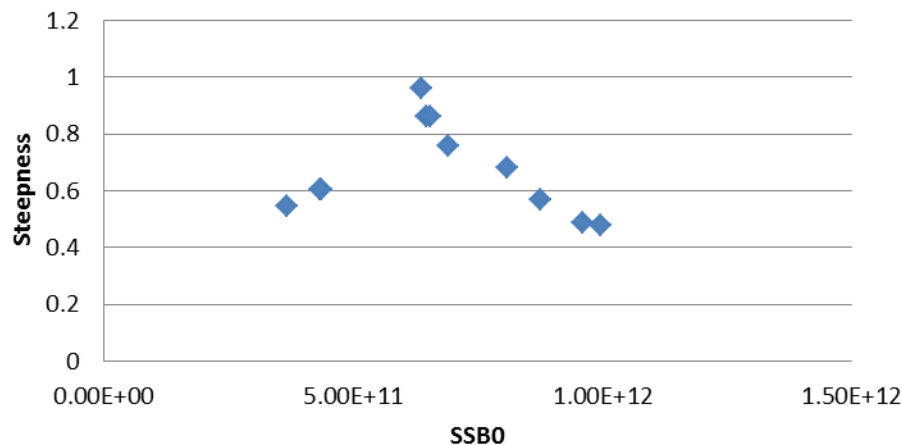


Stock-Recruit Parametrization

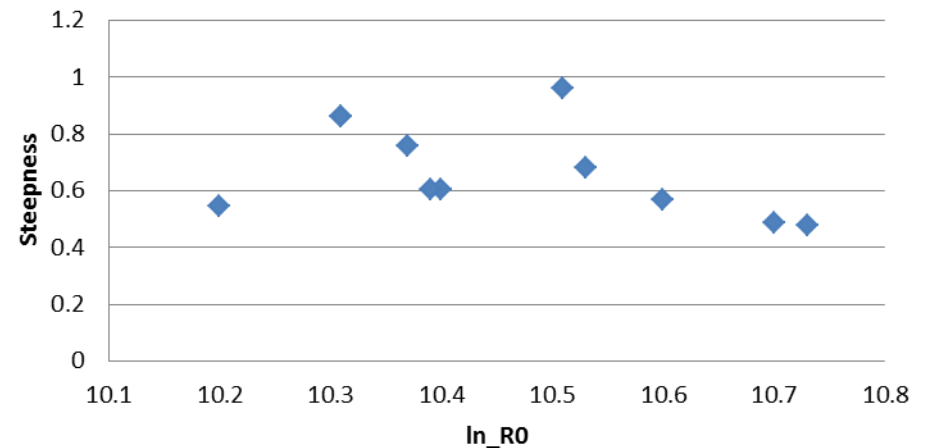
- Steepness not well estimated
 - Ranges from ~0.5-0.96
- Not a strong relationship between R0 and steepness
- SSB0 varies widely and is an important influence on overfishing determination

	B0	ln_R0	Steep
SS Effort	3.67E+11	10.2	0.545
Growth	4.36E+11	10.4	0.607
Growth+LW	4.33E+11	10.39	0.606
Fec-Age	6.46E+11	10.31	0.861
Fec-Length	6.54E+11	10.31	0.861
Lorenzen M	6.37E+11	10.51	0.96
Update 2010	6.90E+11	10.37	0.76
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Update 2014 No IFQ Truncated	9.96E+11	10.73	0.48

Steepness v. SSB0



Steepness v. ln_R0



Steepness

- “The classification scheme developed at the FAO second technical consultation on the suitability of the CITES criteria for listing commercially-exploited aquatic species (Windhoek, Namibia, 22-25 October 2001; FAO 2001) was used to characterize the relative productivity of vermilion snapper. This information is provided in Table 1.3. A productivity rank was assigned to each life-history characteristic (a value of 1 was assigned for low, 2 for medium, and 3 for high productivity characteristics) and the ranks were averaged to produce an overall productivity score. This score was then used to prescribe a prior density function on steepness in the stock-recruitment relationship from the Periodic Life History strategists distribution of steepness values as summarized by Rose et. al. (2001). The dominant portion of the steepness values from these analogous species range from 0.6-0.8 with 90% of the values less than 0.9. As the vermilion snapper productivity score from this exercise is somewhat below the medium category, the data work group recommends that the prior probability density function on steepness for this species be lognormal with a mode of 0.6 and a CV such that there is no greater than a 10% probability of steepness values greater than 0.9.”



Steepness

Table 1.3. Proposed guideline indices of productivity for exploited fish species.

Parameter	Productivity			Species
	Low	Medium	High	
M	<0.2	0.2 - 0.5	>0.5	Vermilion Snapper 0.15, 0.25 , 0.35
K	<0.15	0.15 - 0.33	> 0.33	0.20
t_{mat} (years)	> 8	3.3 - 8	< 3.3	1
t_{max} (years)	>25	14 - 25	<14	26
Examples	orange roughy, many sharks	cod, hake	sardine, anchovy	Vermilion Snapper Productivity Score = 1.88 (Low Medium)

New K=0.33



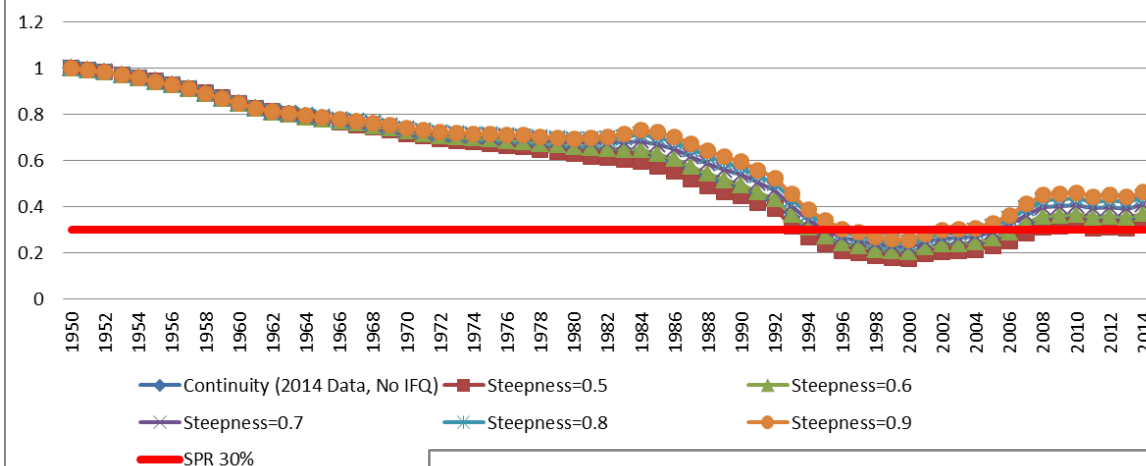
Steepness

- SEDAR 9:
 - “The level of assumed shrimp bycatch also impacts the status of vermilion snapper (SEDAR9-AW-04). Lower levels of shrimp bycatch cause lower estimates of productivity (steepness), and consequently poorer status. Therefore, the stock status of vermilion snapper is predicted to be less optimistic if the assumed shrimp bycatch is overestimated.”



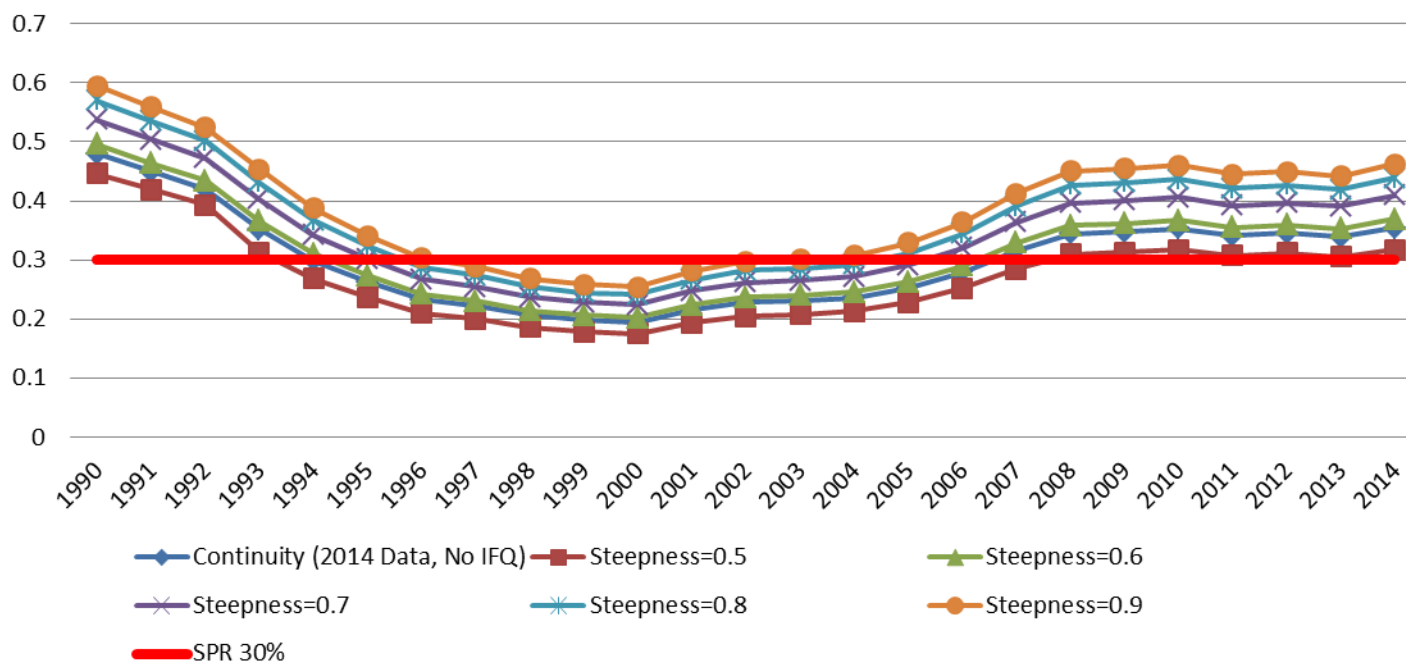
Fixed Steepness Runs

Steepness Comparison (SSB/SSB0)



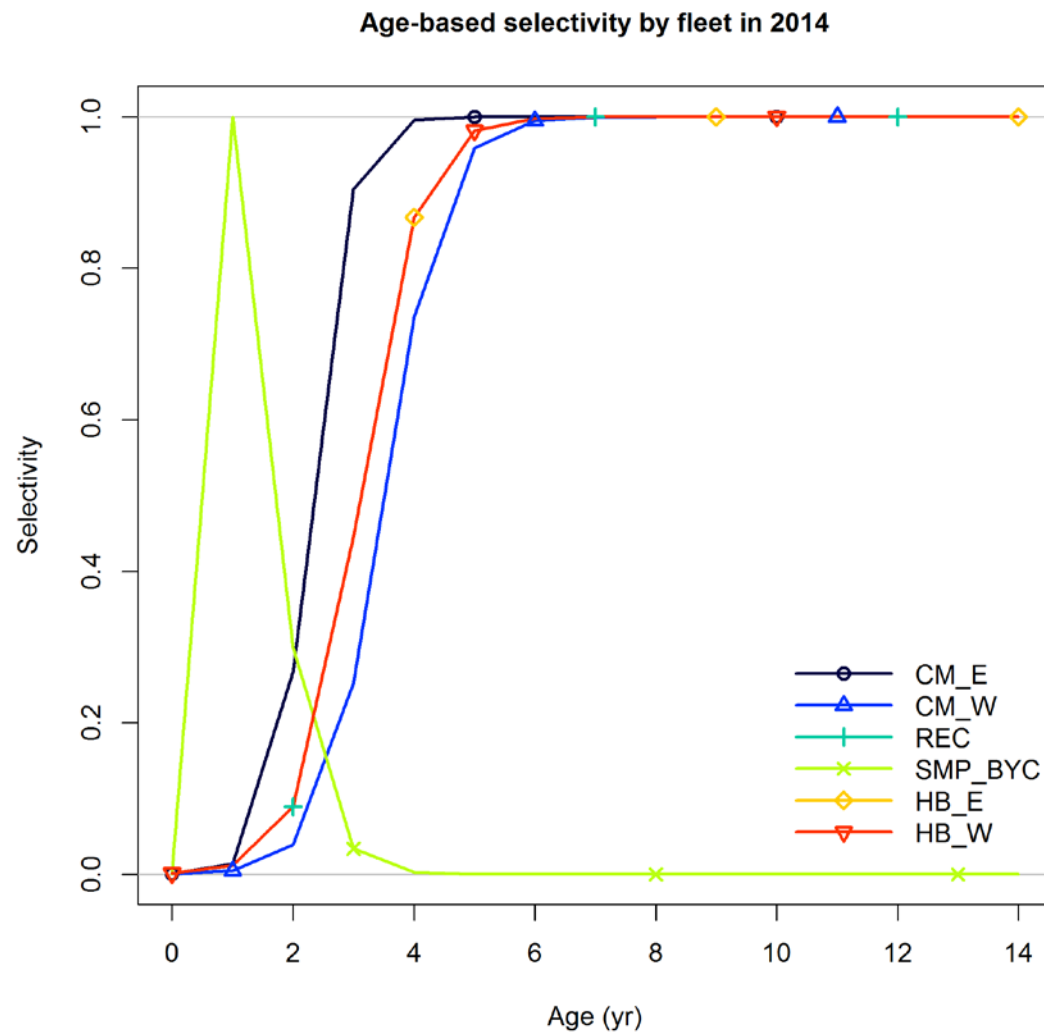
	SSB0	ln_R0	Steep
Steep=0.5	9.82E+11	10.72	0.5
Continuity	1.00E+12	10.74	0.57
Steep=0.6	8.40E+11	10.56	0.6
Steep=0.7	7.59E+11	10.46	0.7
Steep=0.8	7.09E+11	10.39	0.8
Steep=0.9	6.74E+11	10.34	0.9

Steepness Comparison (SSB/SSB0)

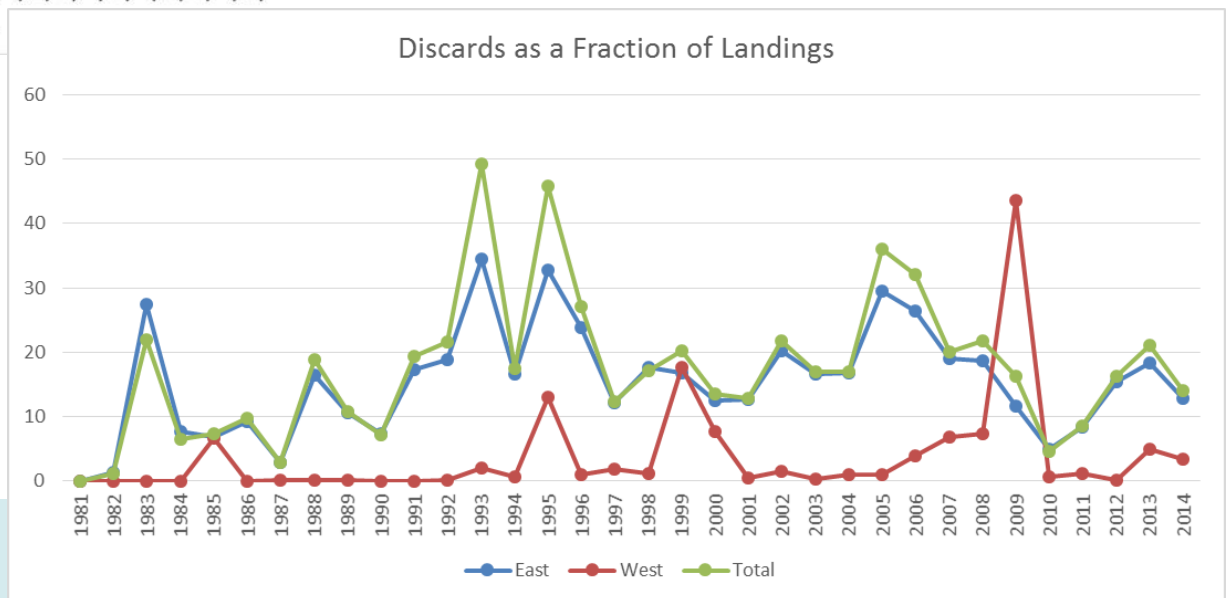
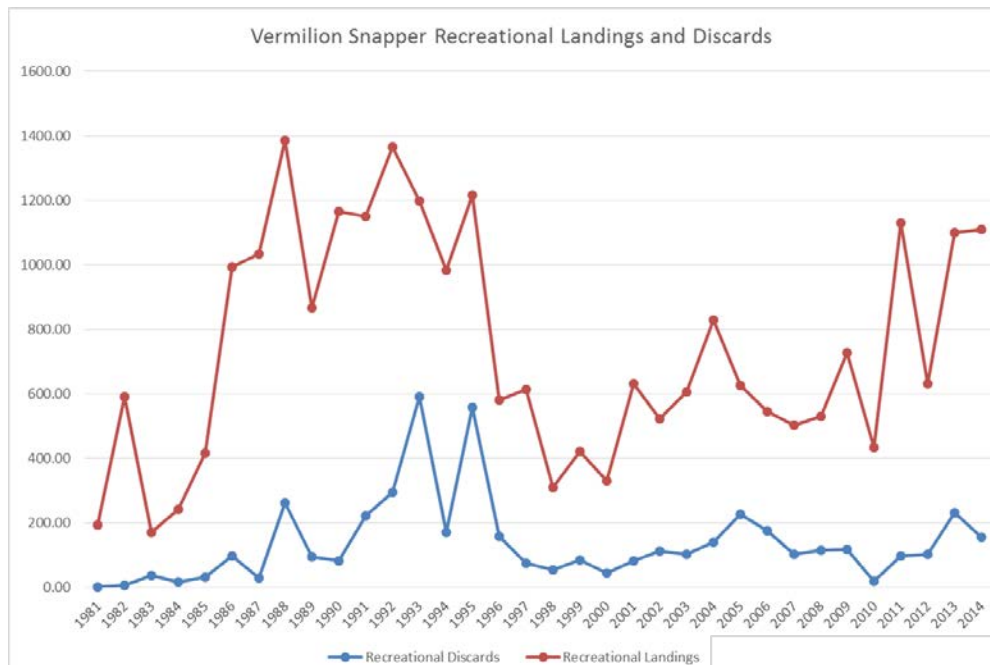


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Selectivity



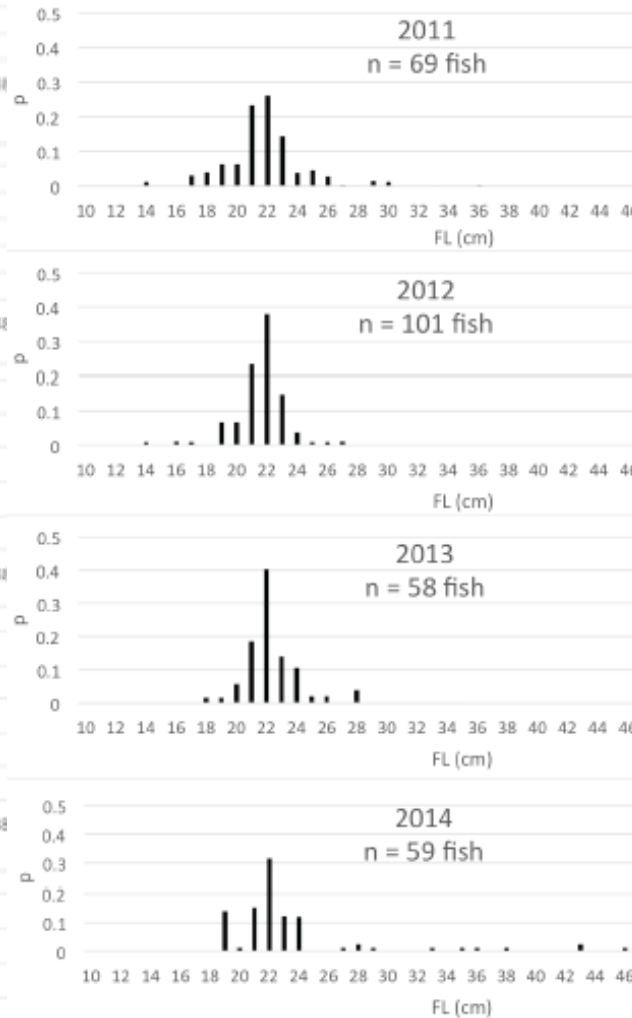
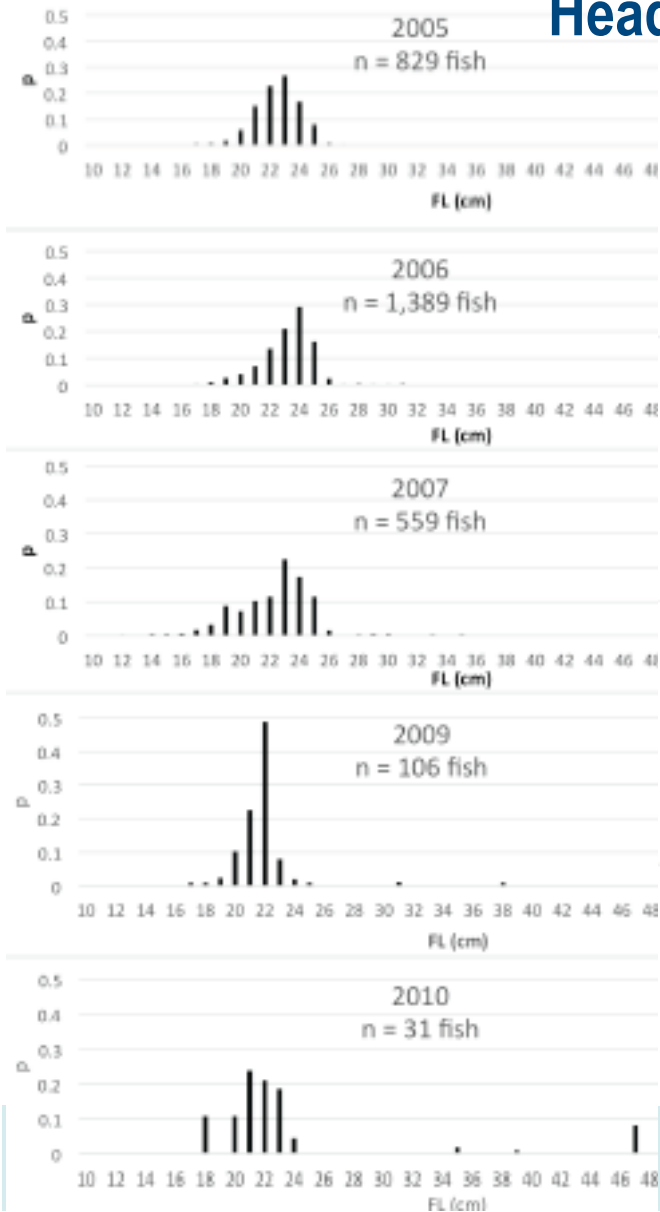
Discards—Recreational



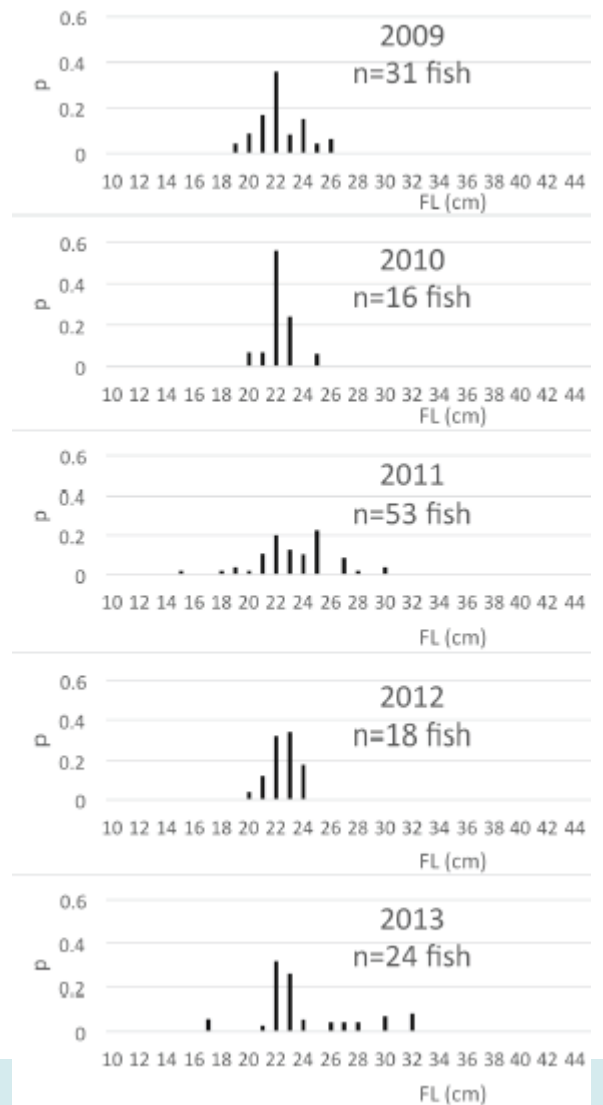
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Discards—Recreational Size Composition

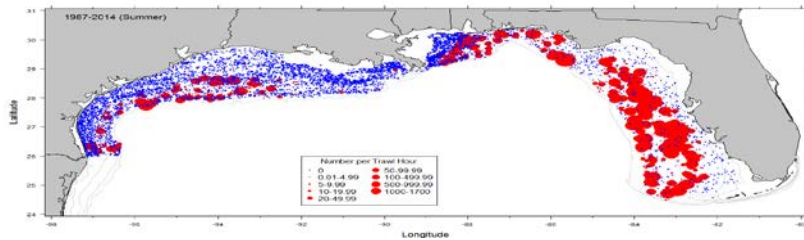
Headboat



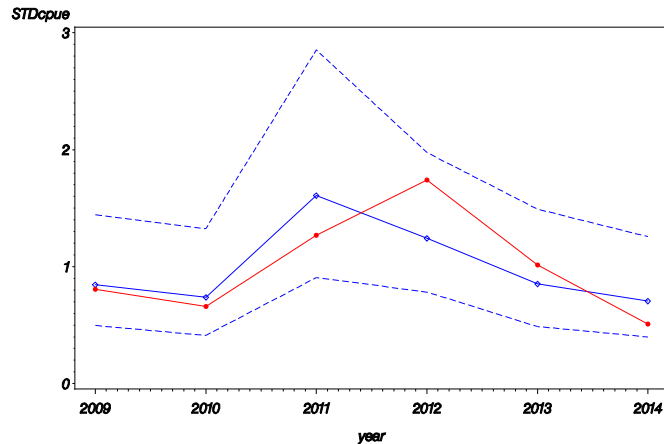
Private/Charter



SEAMAP Groundfish Survey

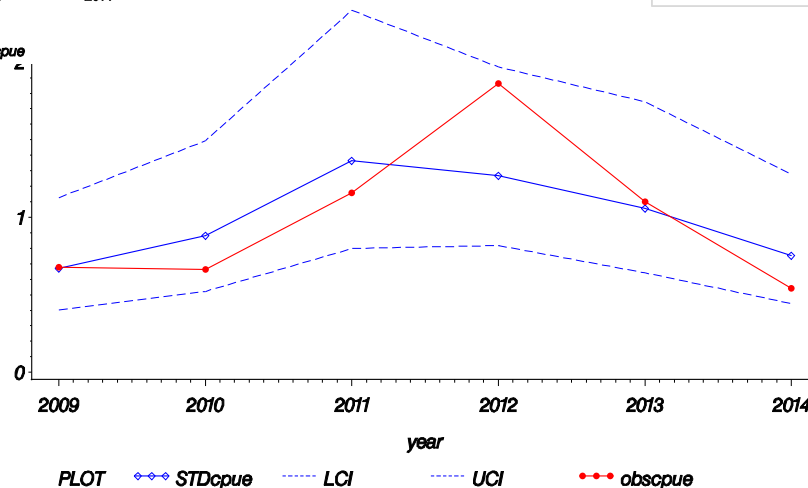


SEAMAP Summer Groundfish Vermilion Snapper Eastern Gulf of Mexico 2009 to 2014
Observed and Standardized CPUE (95% CI)

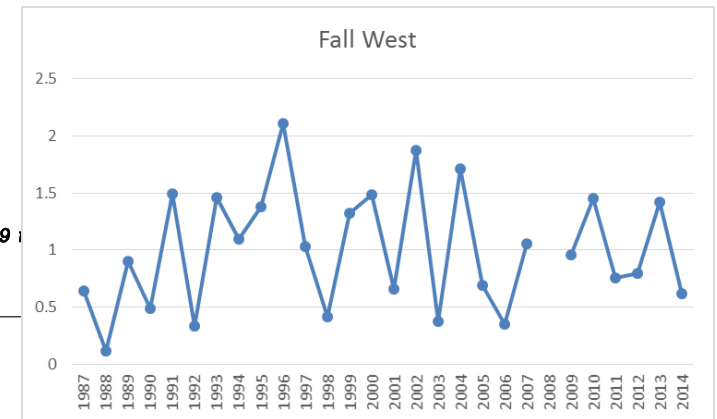
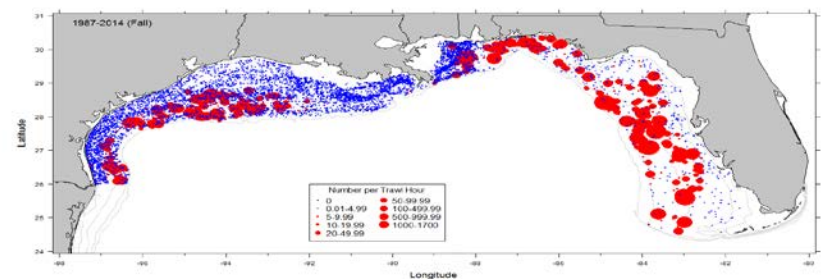


Summer Groundfish Vermilion Snapper Gulf of Mexico 2009
Observed and Standardized CPUE (95% CI)

PLOT ◆ STDcpue --- LCI --- UCI ■ obscpue



PLOT ◆ STDcpue --- LCI --- UCI ■ obscpue

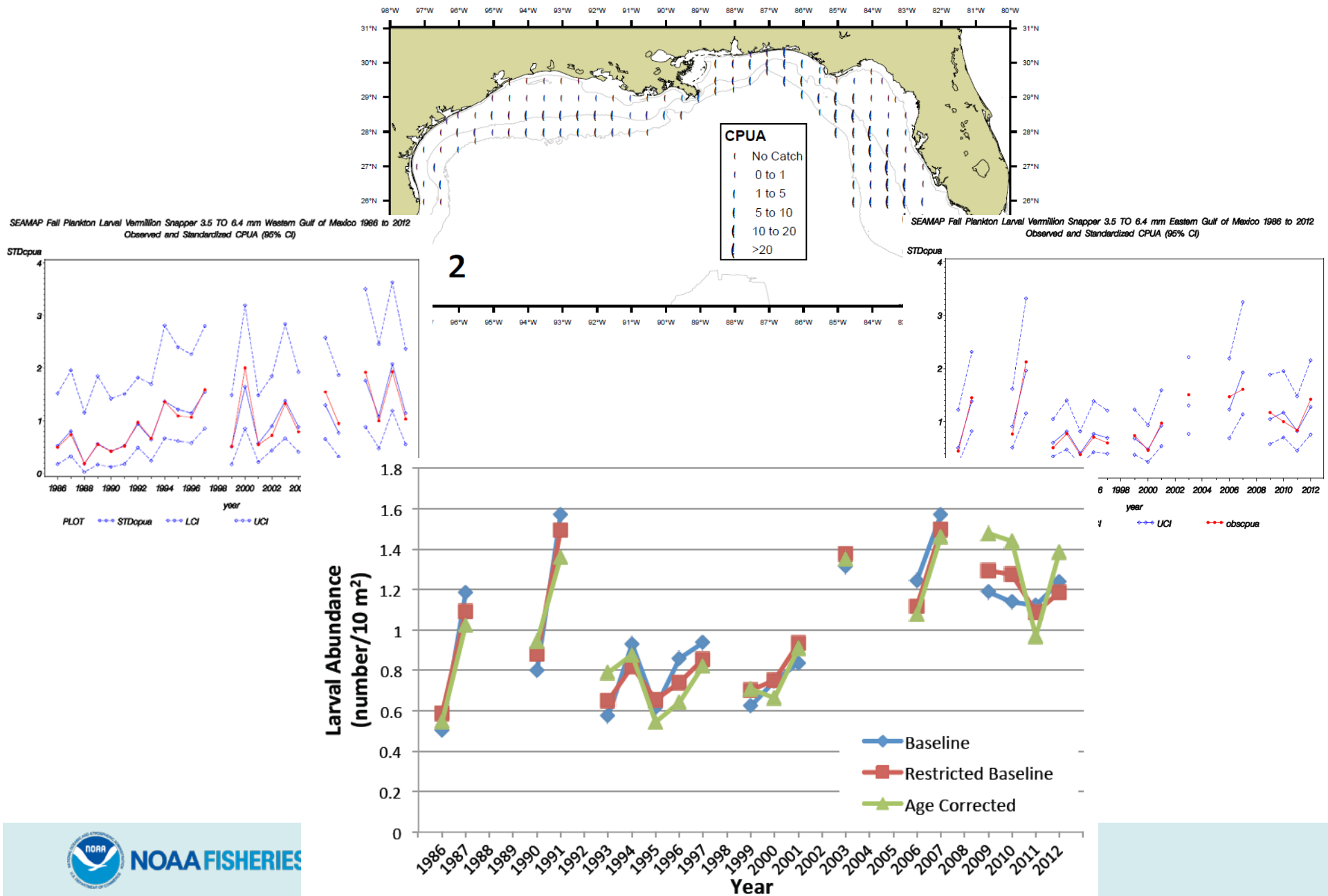


Fall survey used a
different design
prior to 2009



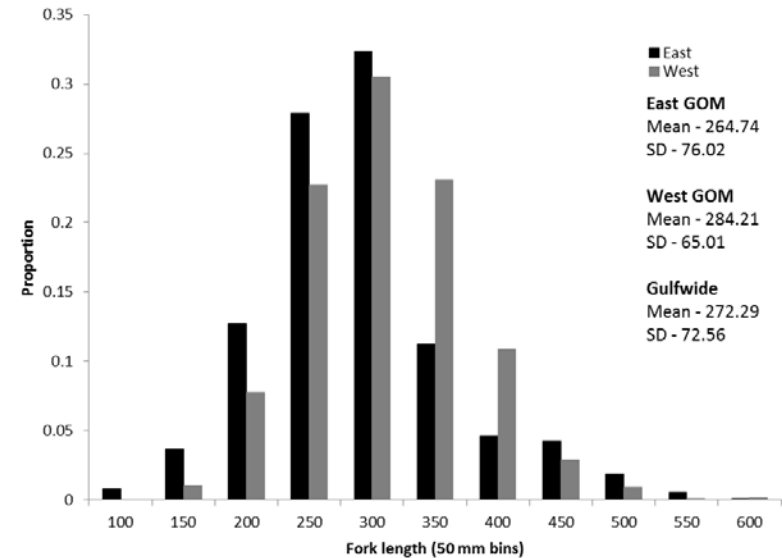
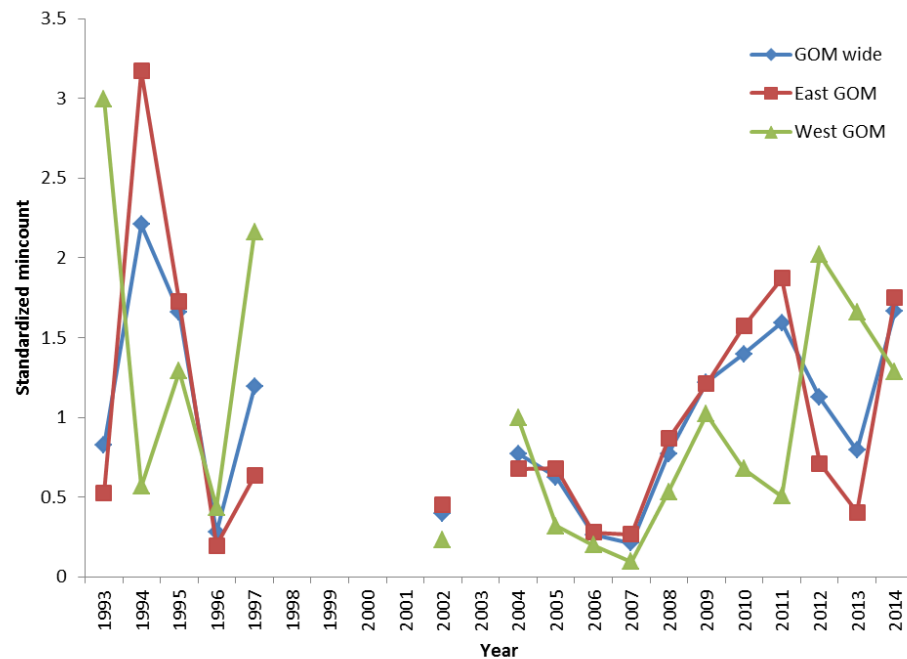
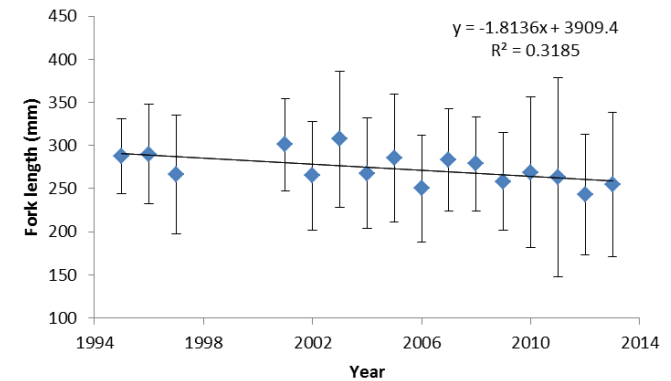
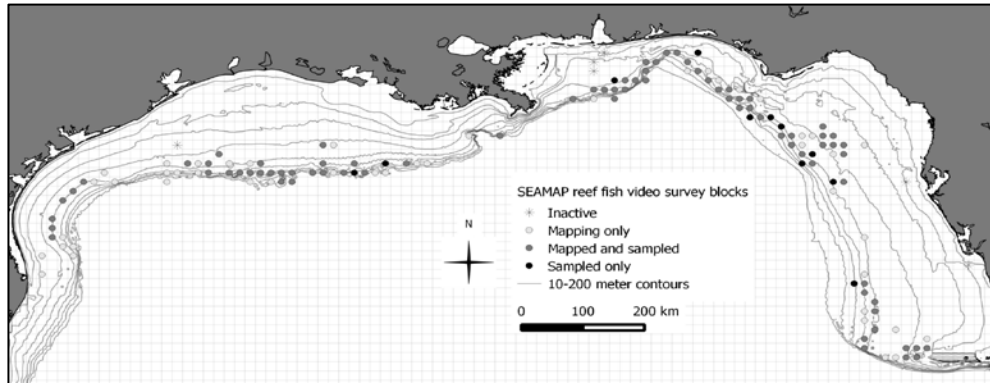
NOAA FISHERIES

SEAMAP Larval Survey



NOAA FISHERIES

Video Survey



NOAA FISHERIES

Projection Methods

- SPR Value (30%)
- P^* value
- Bycatch assumptions
 - Fix shrimp and discard F at recent years
- Maximize directed yield
- Catch in 2015
- Recruitment values
- Selectivity values
- ABC and OFL
- MSST