SEDAR 61:
US Gulf of Mexico Red Grouper

NOAA FISHERIES

SEFSC, Miami

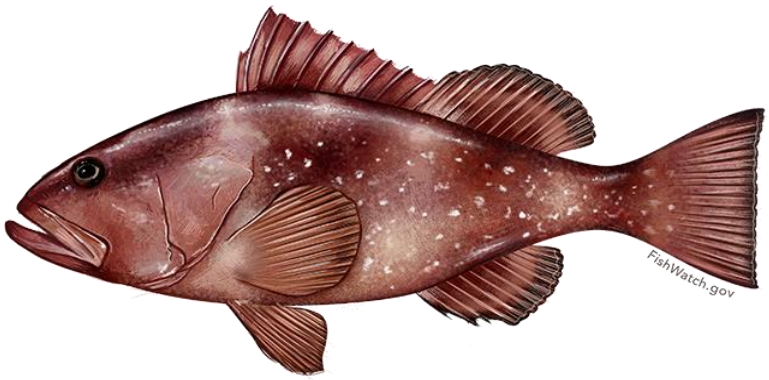
Gulf of Mexico Fishery Management Council

Scientific and Statistical Committee

Assessment Review

September 17, 2019

Outline



- Brief review of SEDAR42
- Overview of data
- Continuity model
- Base model structure & results
- Diagnostics
- Sensitivity runs
- Projections
  - 2018 red tide

Photo Credit: Ed Walker, Venice Area, August 2018

Primary concerns during SEDAR42 Review

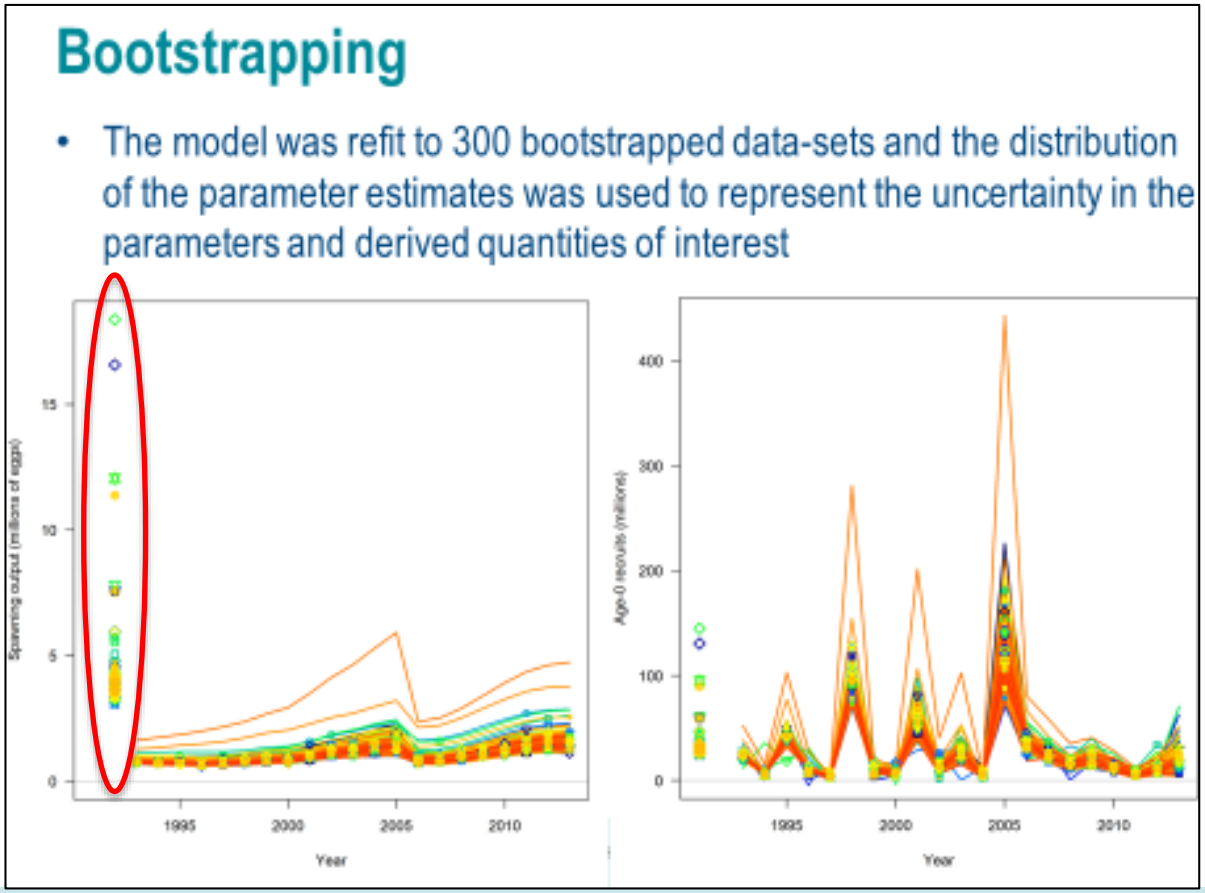
- Fits to the discards and discard length composition
  - Model unable to fit commercial discards
- Start year
  - **DW/AW**: 1986 – landings considered most accurate because of trip tickets and species-specific reporting
  - **RW**: 1993 – majority of informative data start; "more consistent situation for discards (and for the video survey)"

Post-SEDAR42 concerns: initial conditions

Late start (1993) not recommended by Rick Methot, best practice to start as early as feasible

From SEDAR42 *SSC Presentation* (January 2016):

- Fair bit of uncertainty surrounding initial conditions



Data Review

Life History

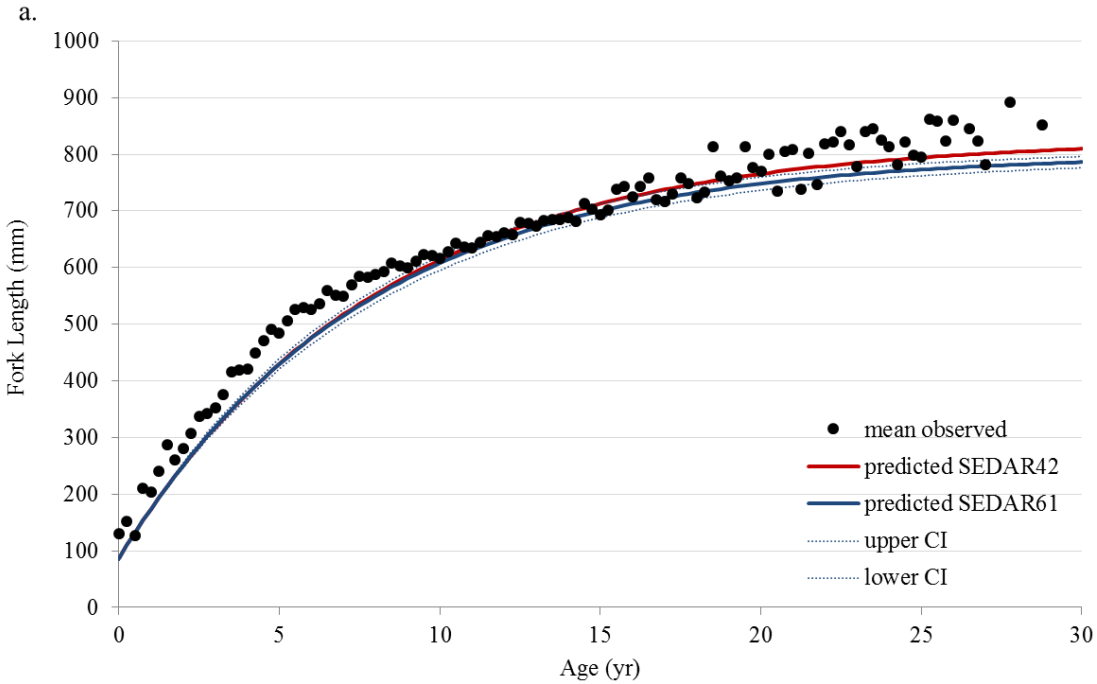
- Many the same as SEDAR42
- Reproductive biology
  - Maturity
  - Hermaphroditism
    - Implicitly accounted for in fecundity*
- Age and growth*
- Meristics
- Natural mortality*

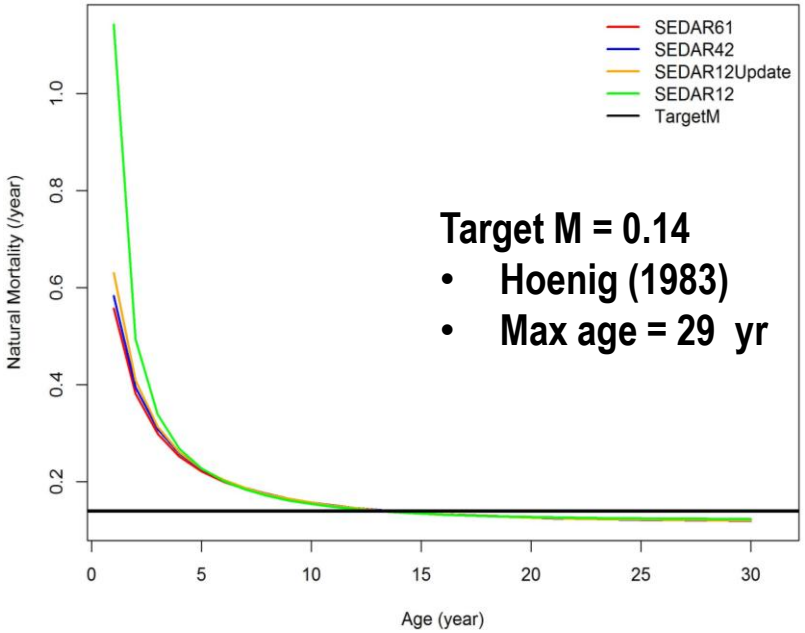
*Updated for SEDAR61

Age-Growth & M

- von Bertalanffy growth model with a linearly increasing CV with length

Parameter	SEDAR42	SEDAR61
Linf	82.719 cm FL	79.995 cm FL
k	0.124 yr^{-1}	0.131 yr^{-1}
t_0	-0.899 yr	-0.875 yr

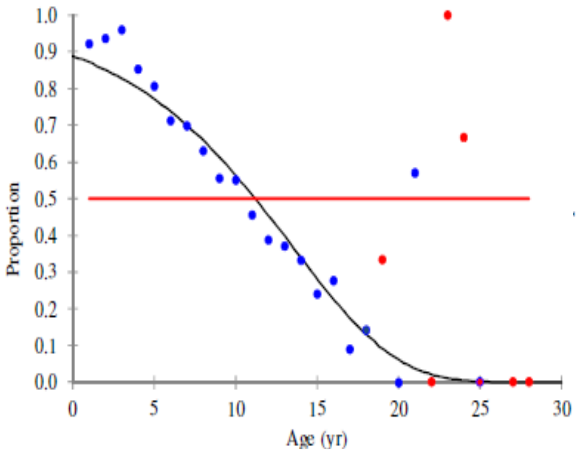


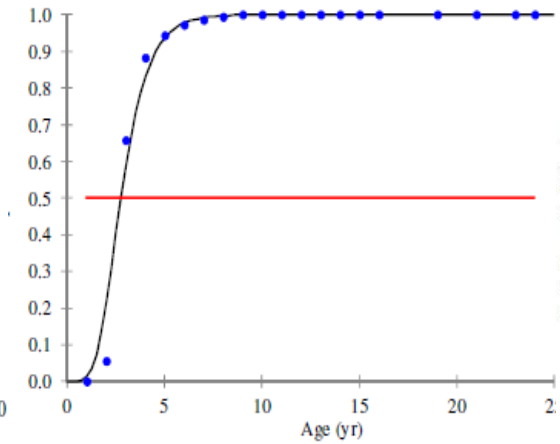


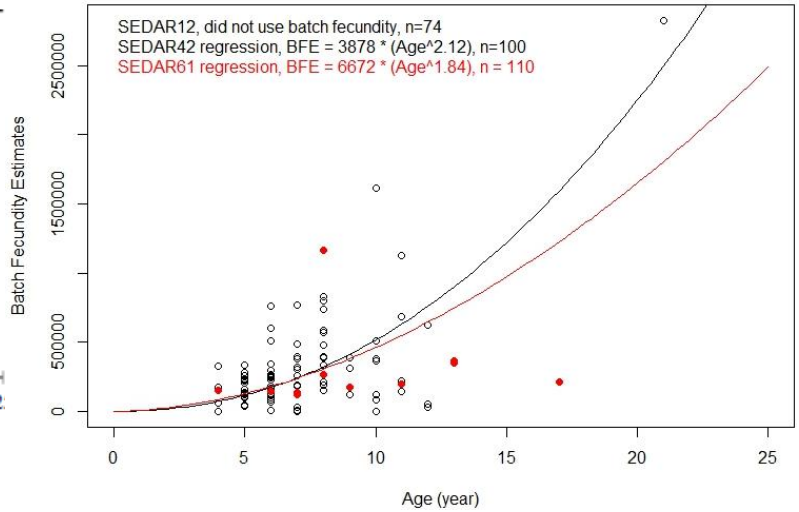
- Lorenzen (2005) estimator
  - Adjusted for May 15 peak spawning period

Per Capita Fecundity =

Proportion Female × Proportion Mature × Batch Fecundity





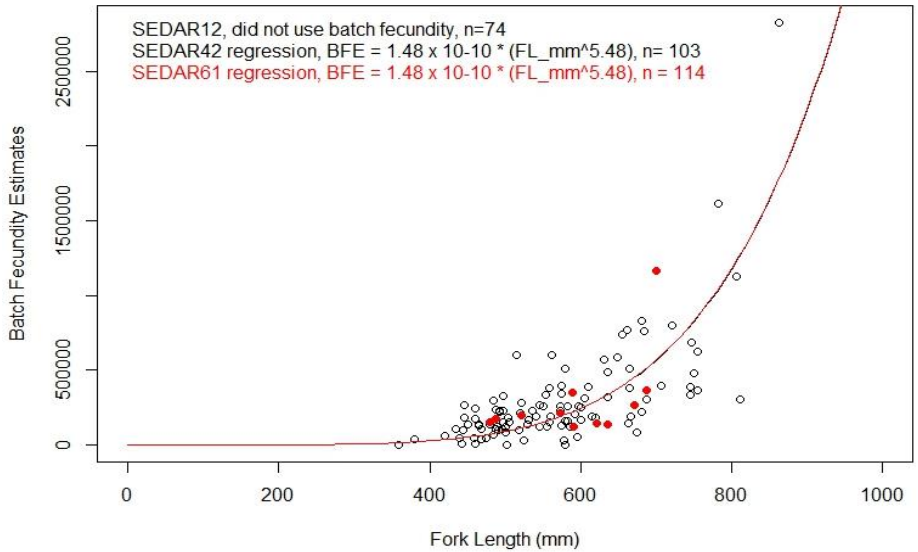


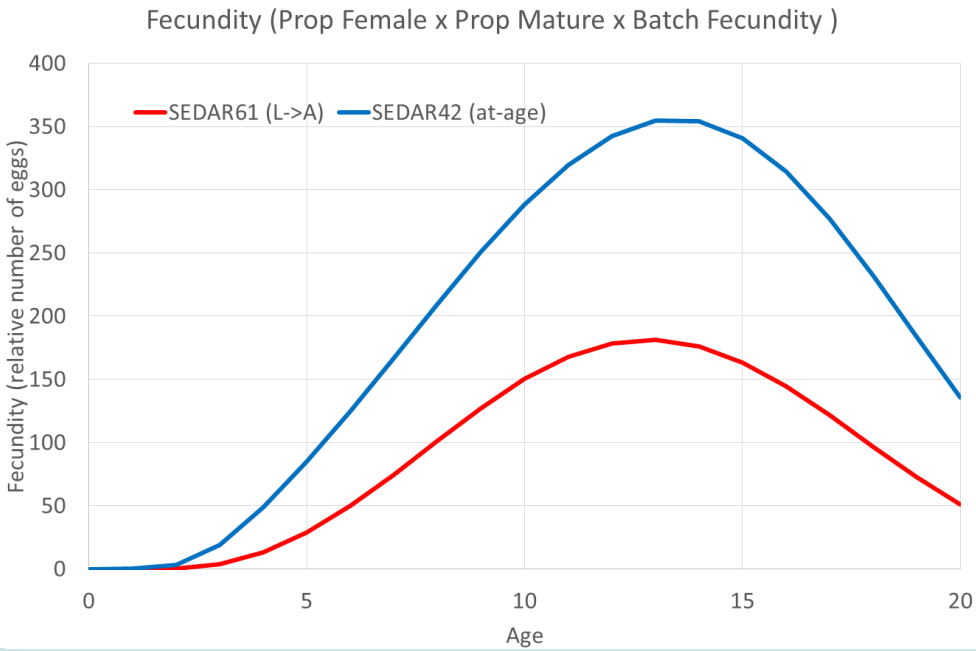
Updated batch fecundity at age sensitive to 10 new samples

- Fecundity vector fixed in SS model
- Female SSB in relative number of eggs, not absolute number of eggs

SEDAR61 concerns

- Recommendation for Fecundity-at-Age:
  - Use batch fecundity as a function of length & convert to age using growth curve
    - Better biological determinant

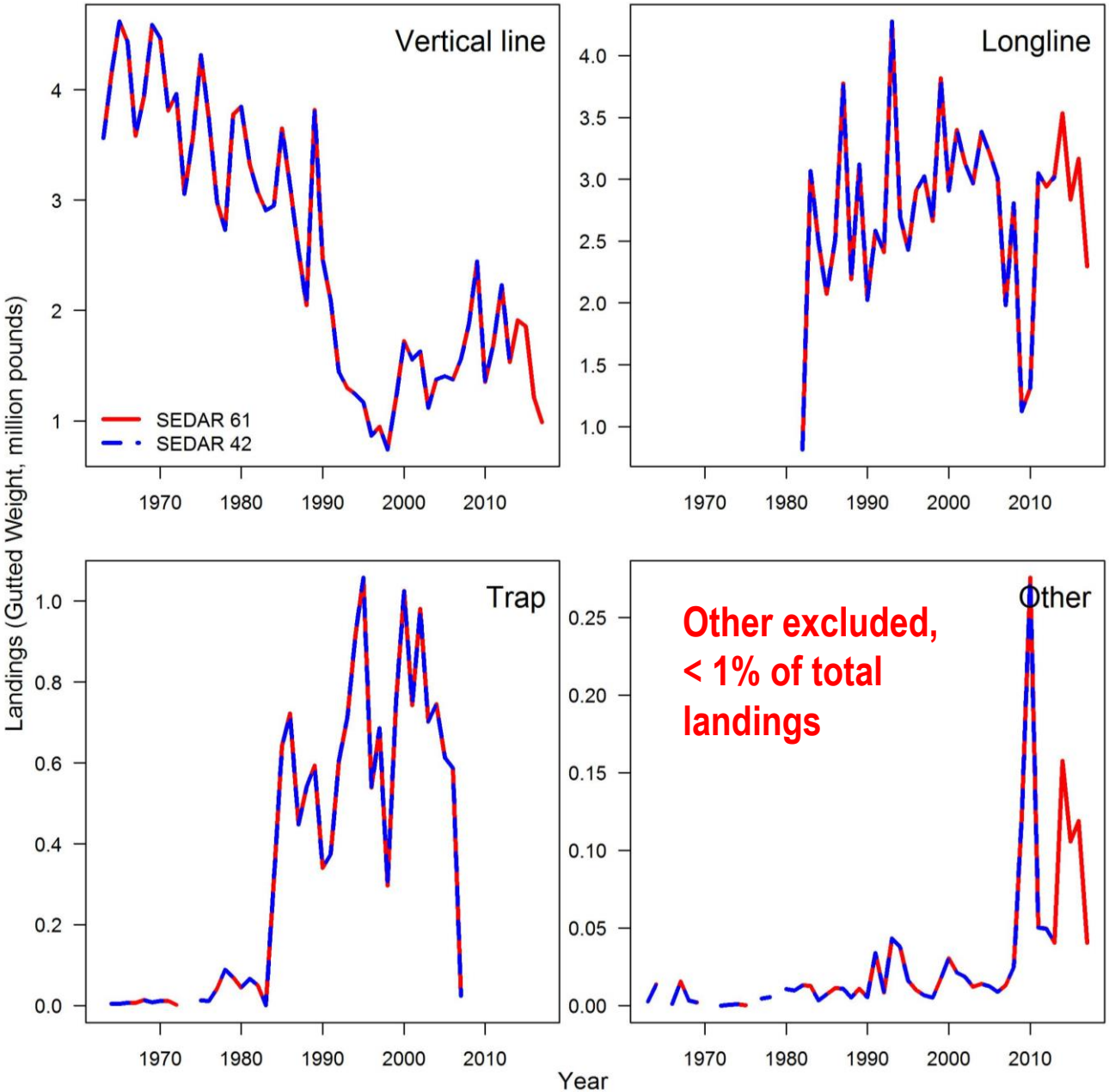




Commercial Landings

Data Sources:

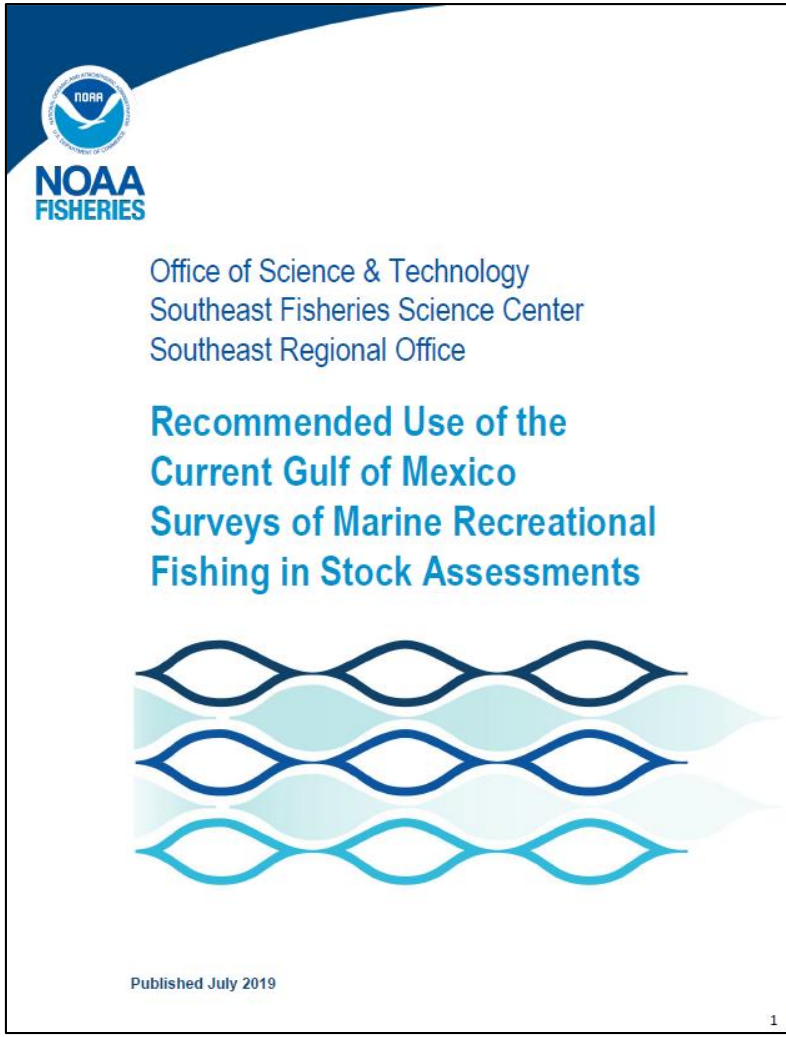
- Accumulated landings system (ALS)
- Florida trip ticket
- Individual Fishing Quota (IFQ) Program (2010+)



SEDAR61-WP21

Recreational Data: Option 1a

- Using fully calibrated MRIP time series of catch estimates for charter and private
  - Peer-reviewed FES mail survey for effort estimates
  - Adjusts past Coastal Household Telephone Survey (CHTS) estimates to account for temporal changes in telephone usage
- Recommended for assessment and management purposes


NOAA FISHERIES

Office of Science & Technology
Southeast Fisheries Science Center
Southeast Regional Office

Recommended Use of the Current Gulf of Mexico Surveys of Marine Recreational Fishing in Stock Assessments

Published July 2019

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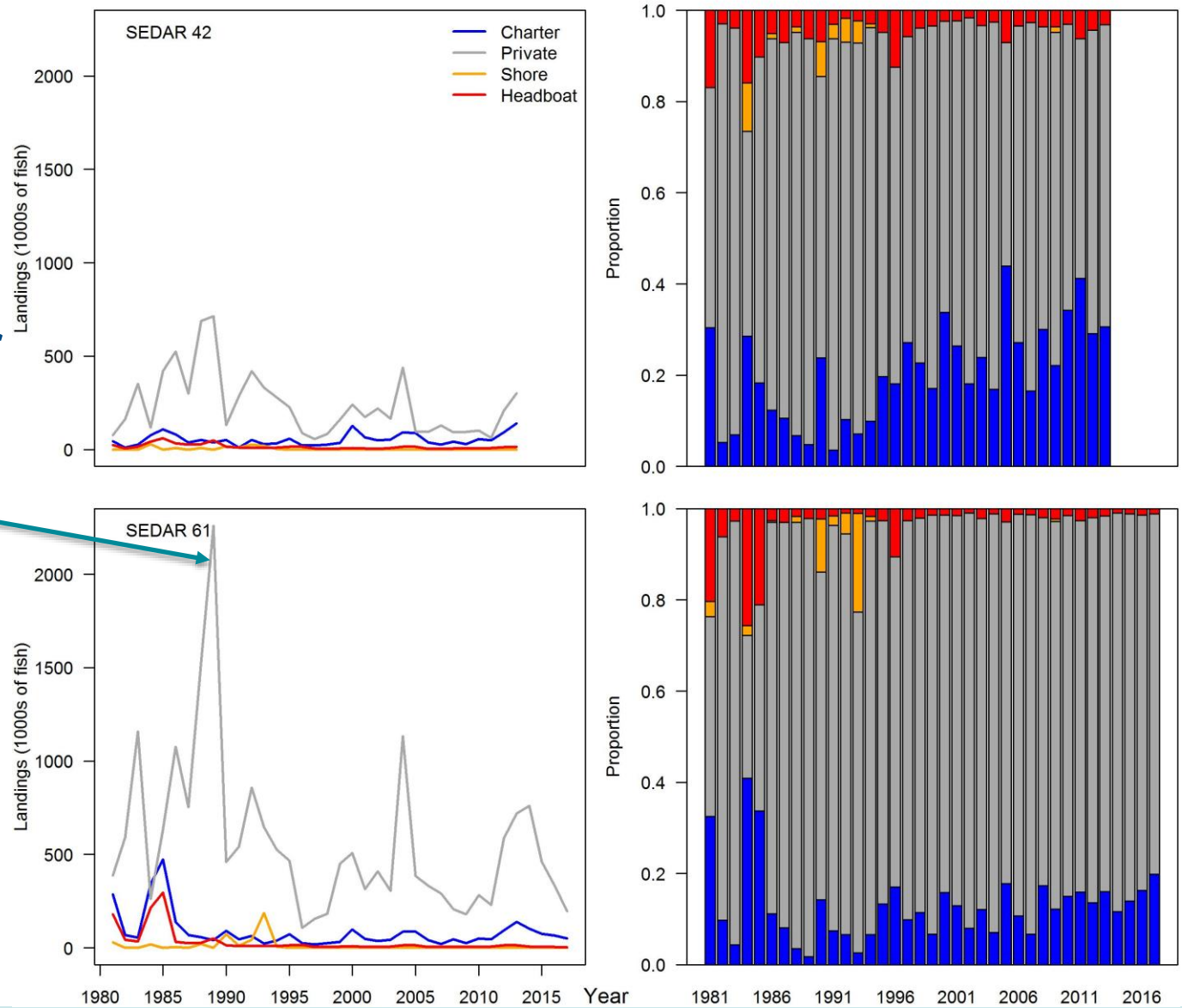
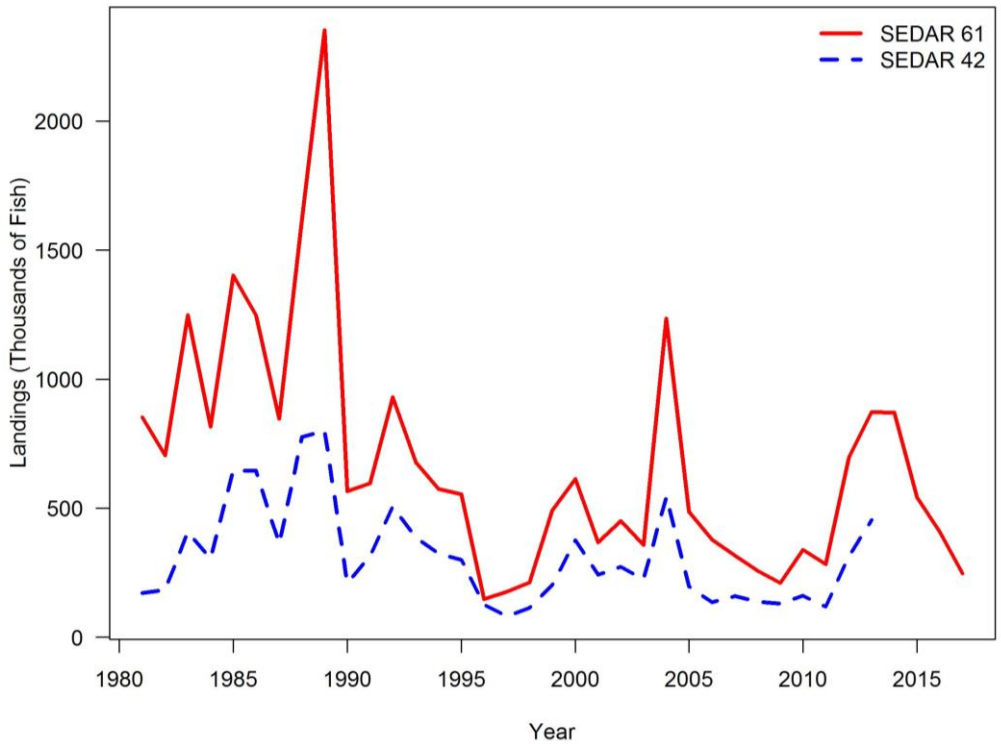
Recreational Landings – Before and After MRIP Transition

- Proportions by mode remain relatively similar
- 18 inch TL size limit in Florida waters in 1990

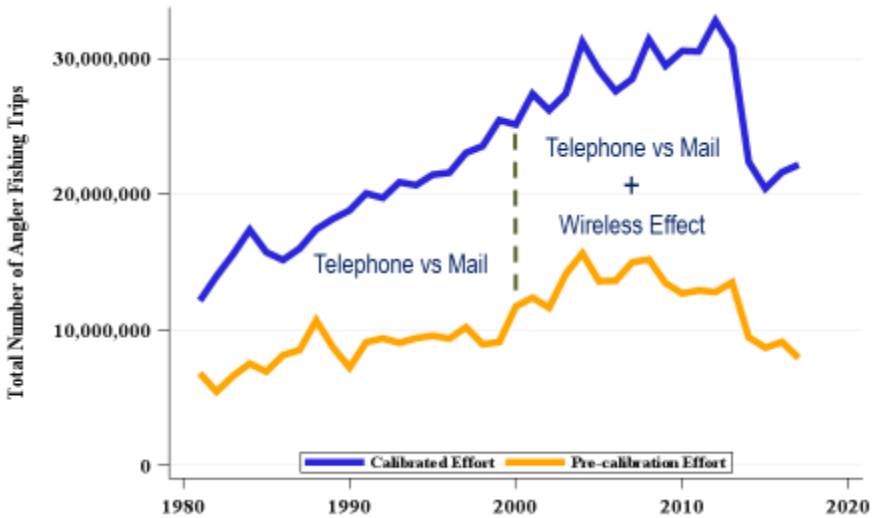


Recreational Landings

- Single fleet recommended during SEDAR42 review



Gulf of Mexico Private Boat Effort*



*Content borrowed from presentations given to GMFMC SSC (Oct 2018)

*Term of Reference

Commercial Discards*

- Catch per unit effort (CPUE) expansion to calculate total catch for SEDAR61

Coastal Observer Program (set level)

$$\text{total Catch} = \frac{\text{Catch}}{\text{Effort}} \times \text{Total Effort}$$

Commercial Reef Logbooks (trip level)

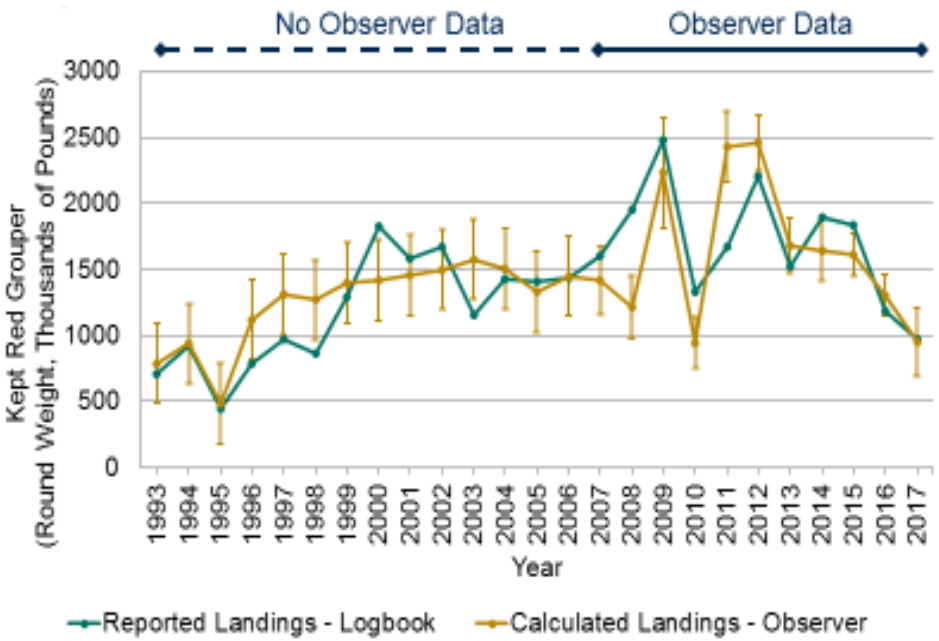
- Evaluated appropriate effort variables by matching trips and comparing effort between datasets
  - Longline: number of sets
  - Vertical line: fishing days (last hook out – first hook in per day, summed over all days)

SEDAR61-WP15

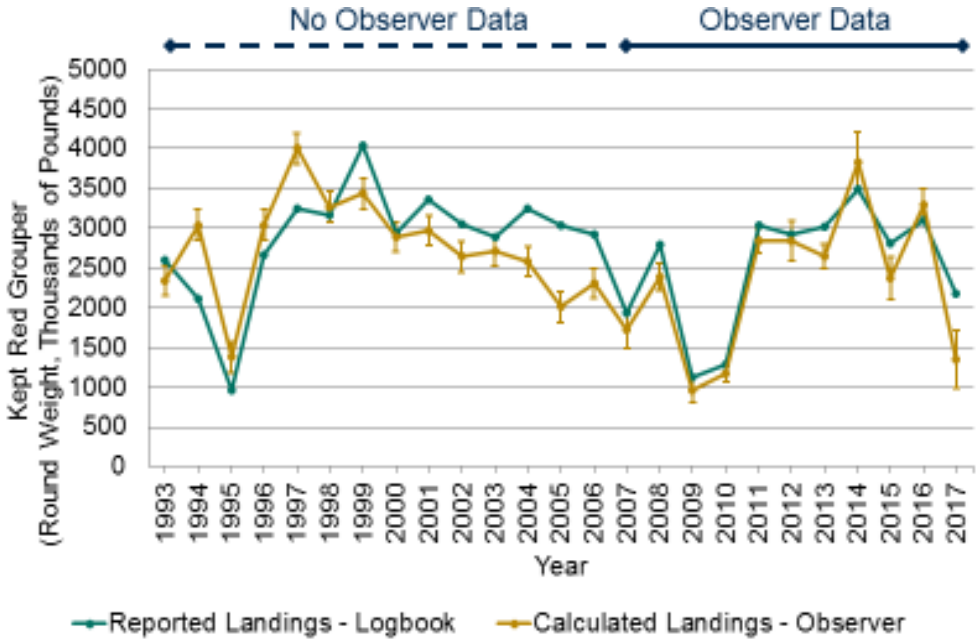
Commercial Discard Catch Expansion

- Estimated landings via CPUE catch expansion closely follow logbook reported landings

Vertical Line



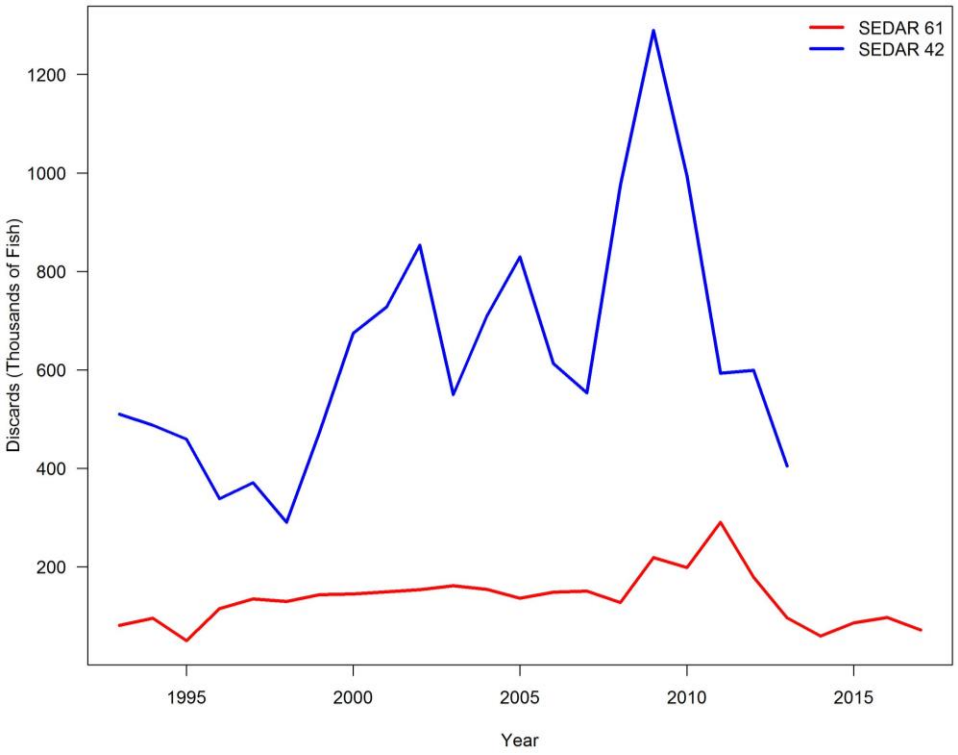
Longline



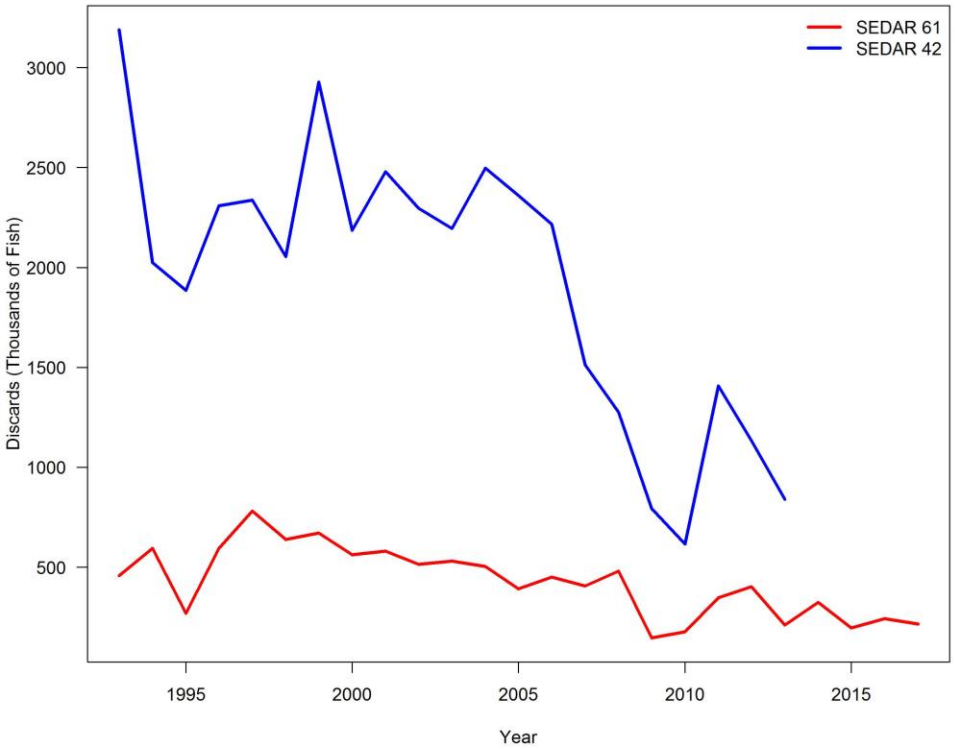
SEDAR61-WP15

Commercial Discards

Vertical Line



Longline

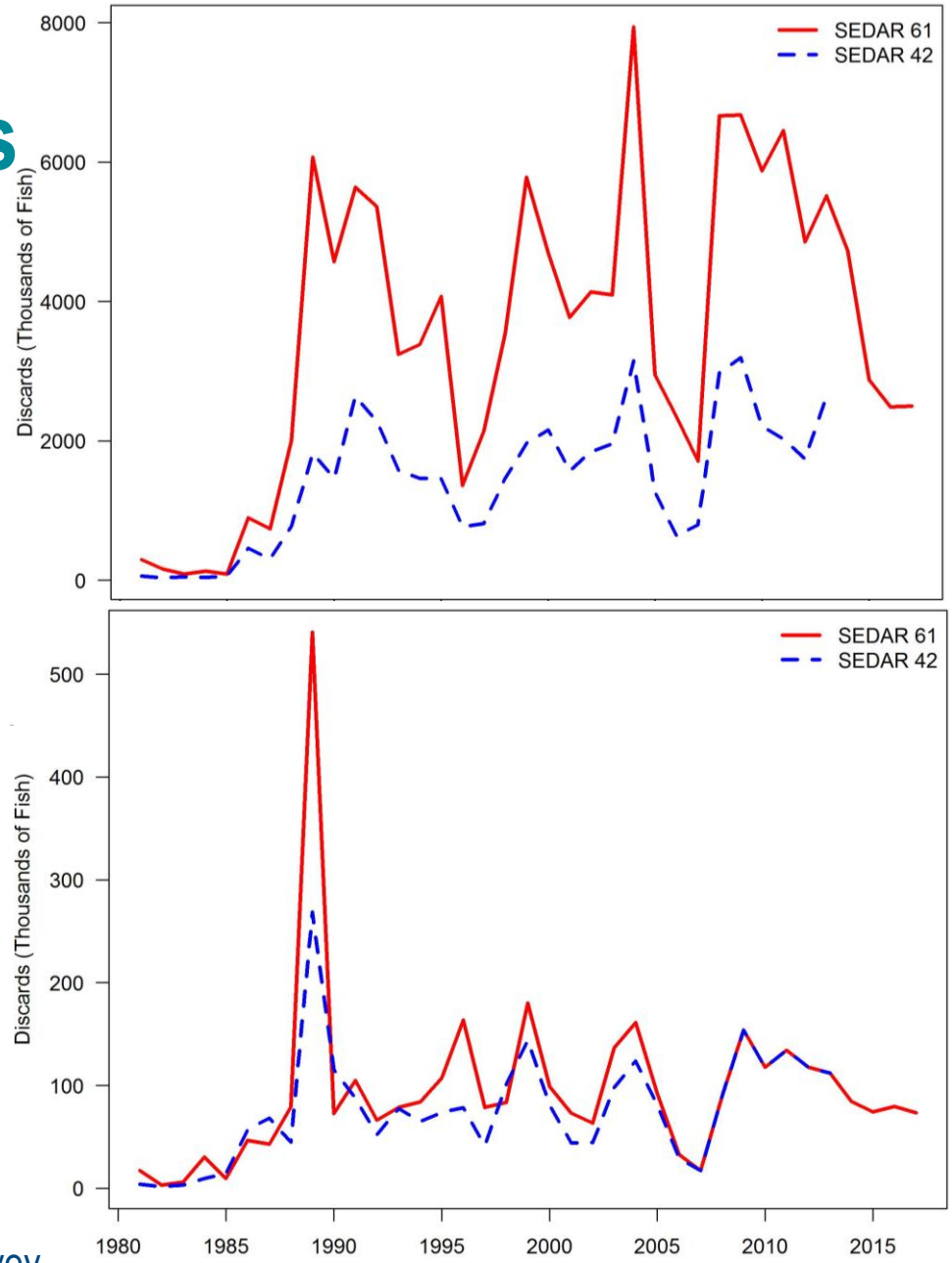


- Commercial trap unchanged from SEDAR42

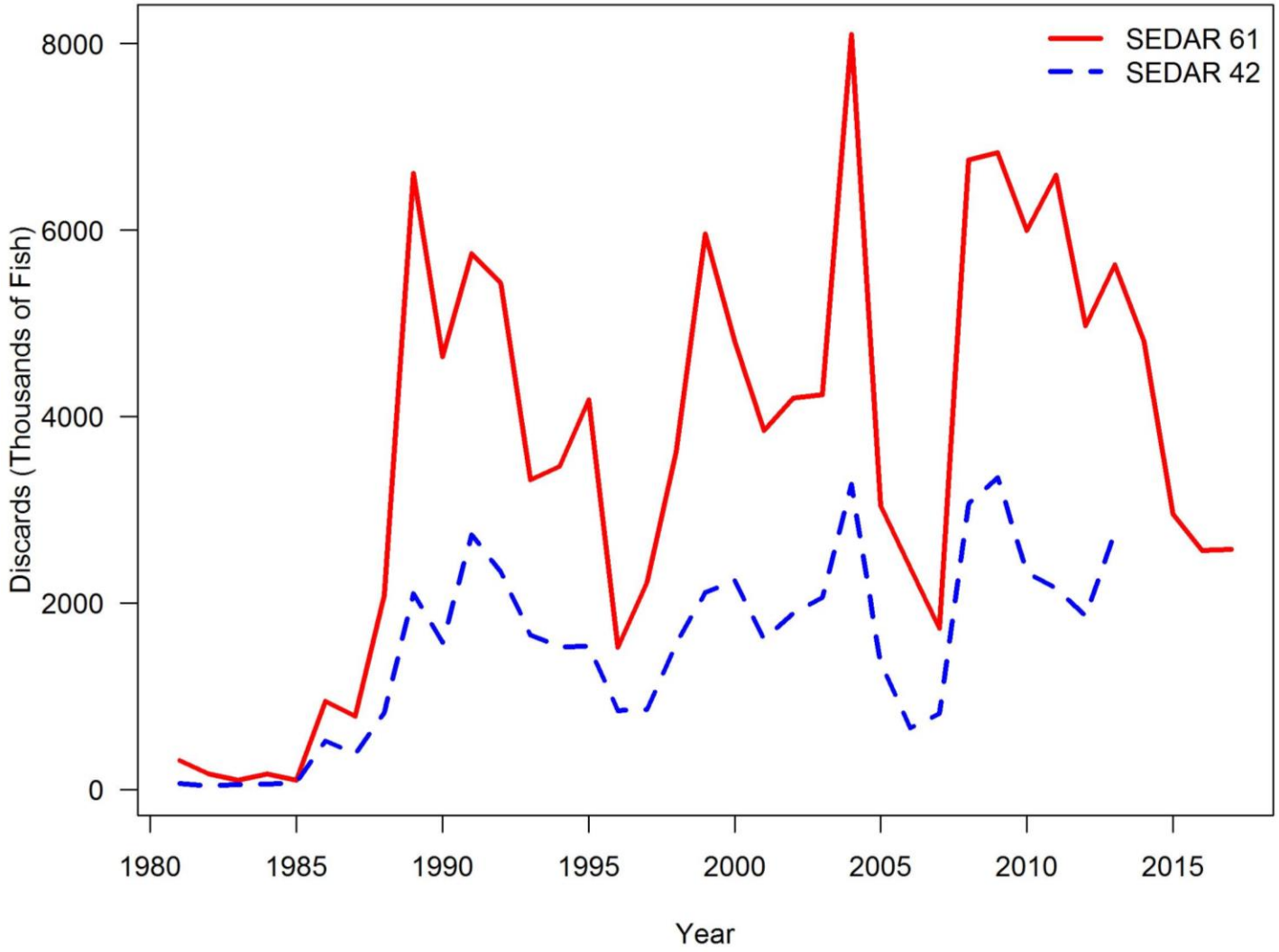
Recreational Discards

- Self-reported
- MRIP: Charter + Private
  - Before and After MRIP Transition
- Headboat:
  - 1981-1985: MRIP
  - 1986-2006: MRIP Charter:SRHS* discard ratio (proxy)
  - 2007+: SRHS discards

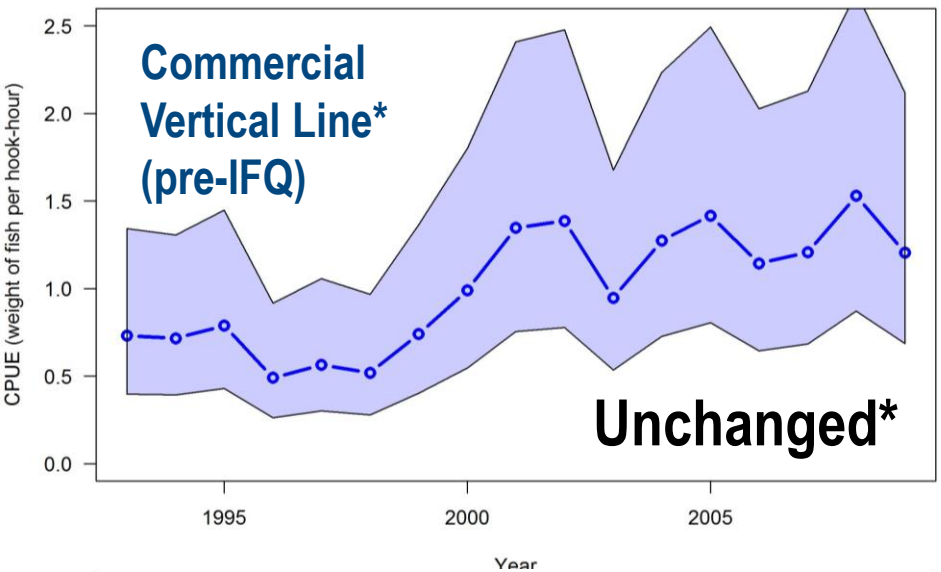
*SRHS = Southeast Region Headboat Survey

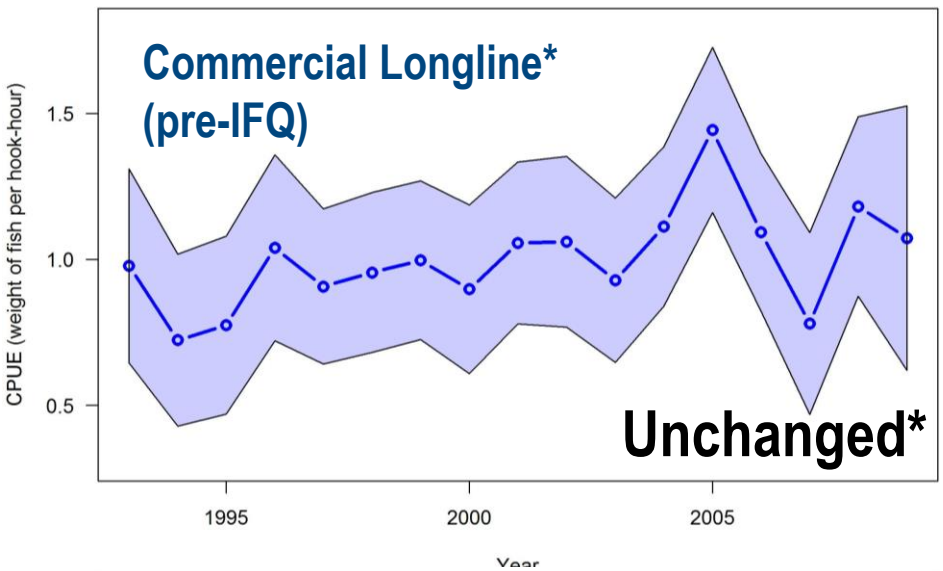


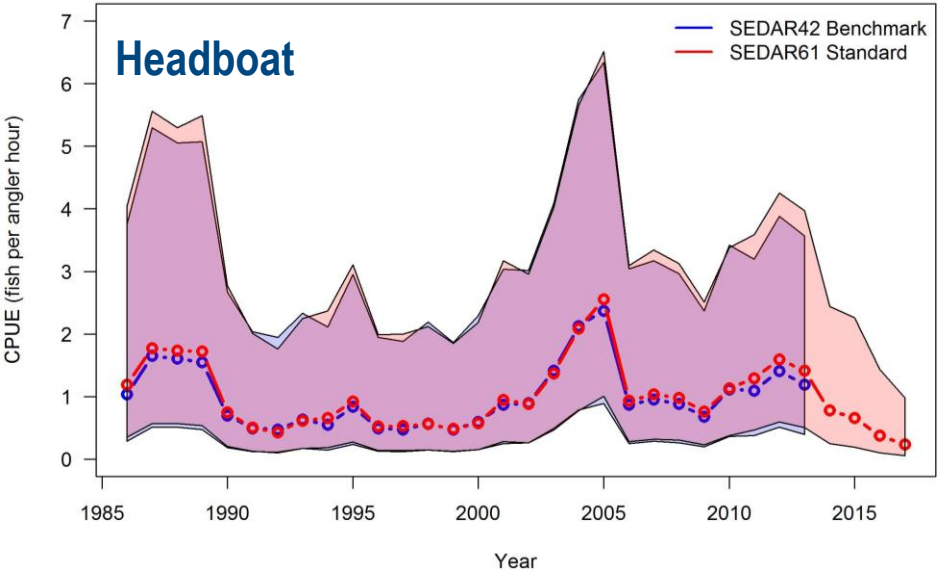
Recreational Discards

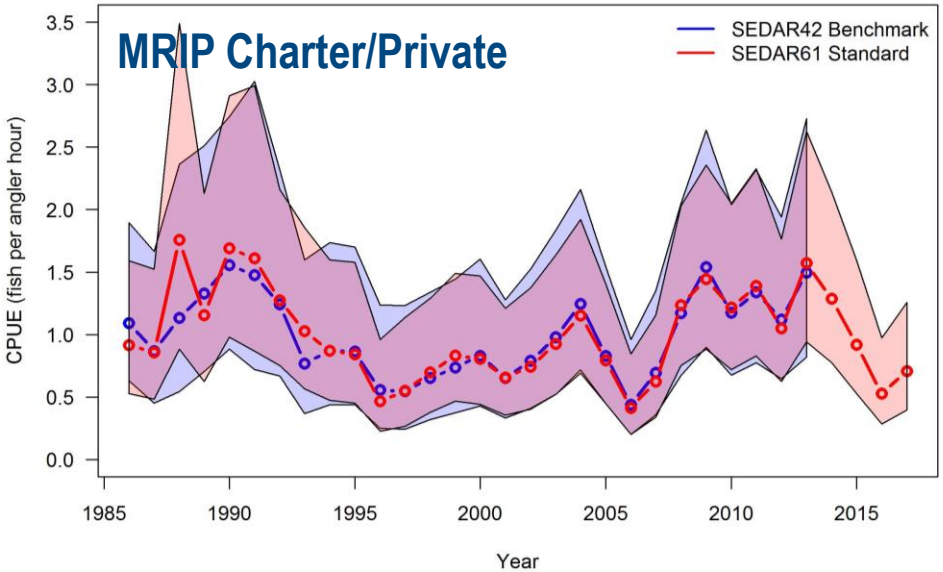


Indices of relative abundance - CPUE

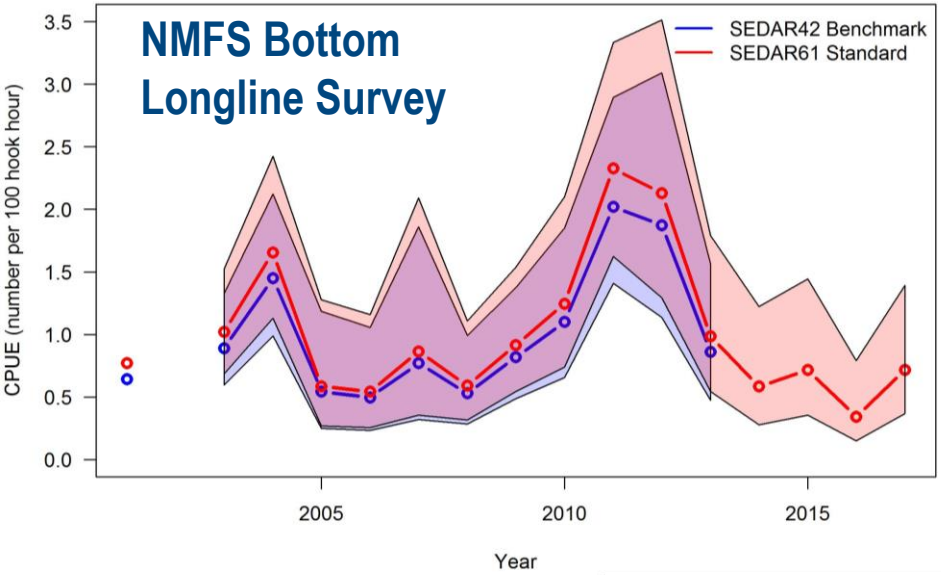


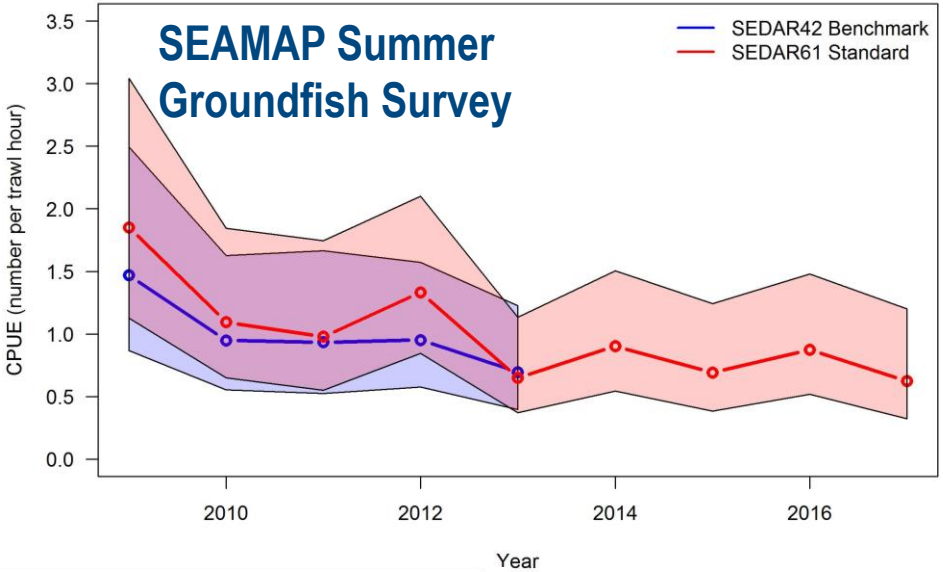


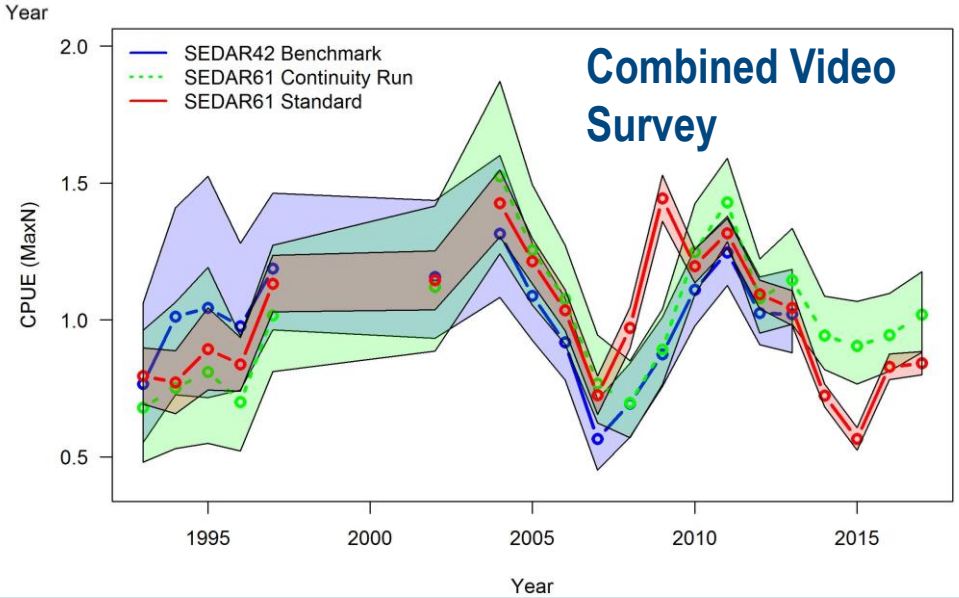




Indices of relative abundance - surveys



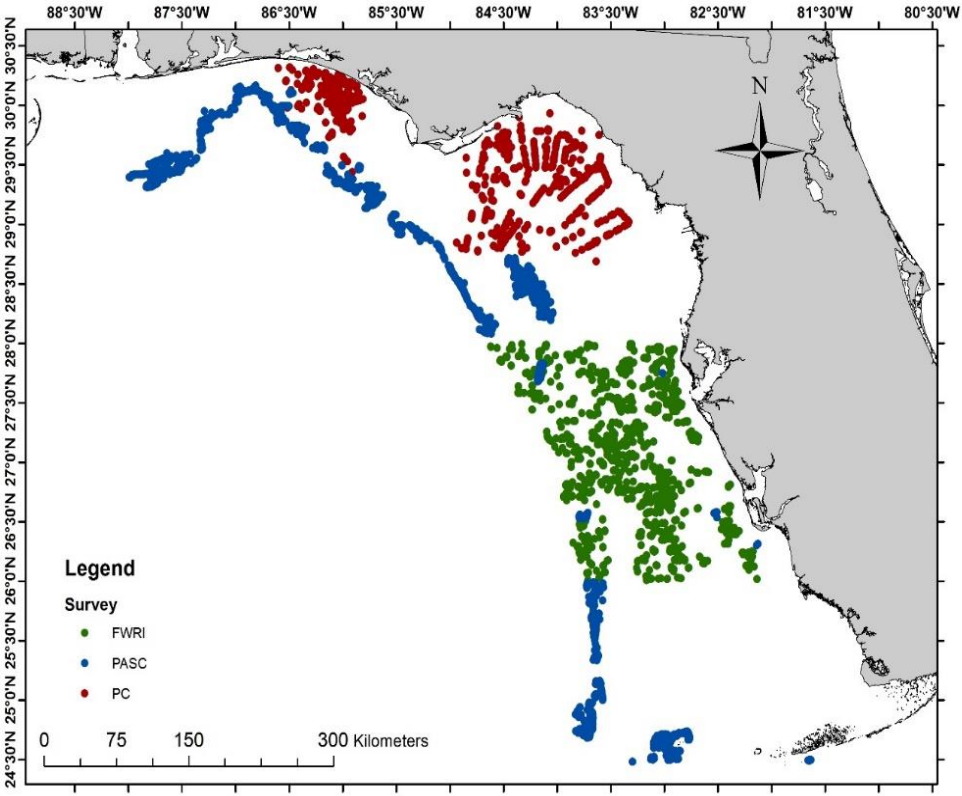




Combined Video Index*

*Term of Reference

- Habitat-based modeling approach to combine relative abundance data
  - Inclusion of habitat variable accounts for changing effort and habitat allocation through time

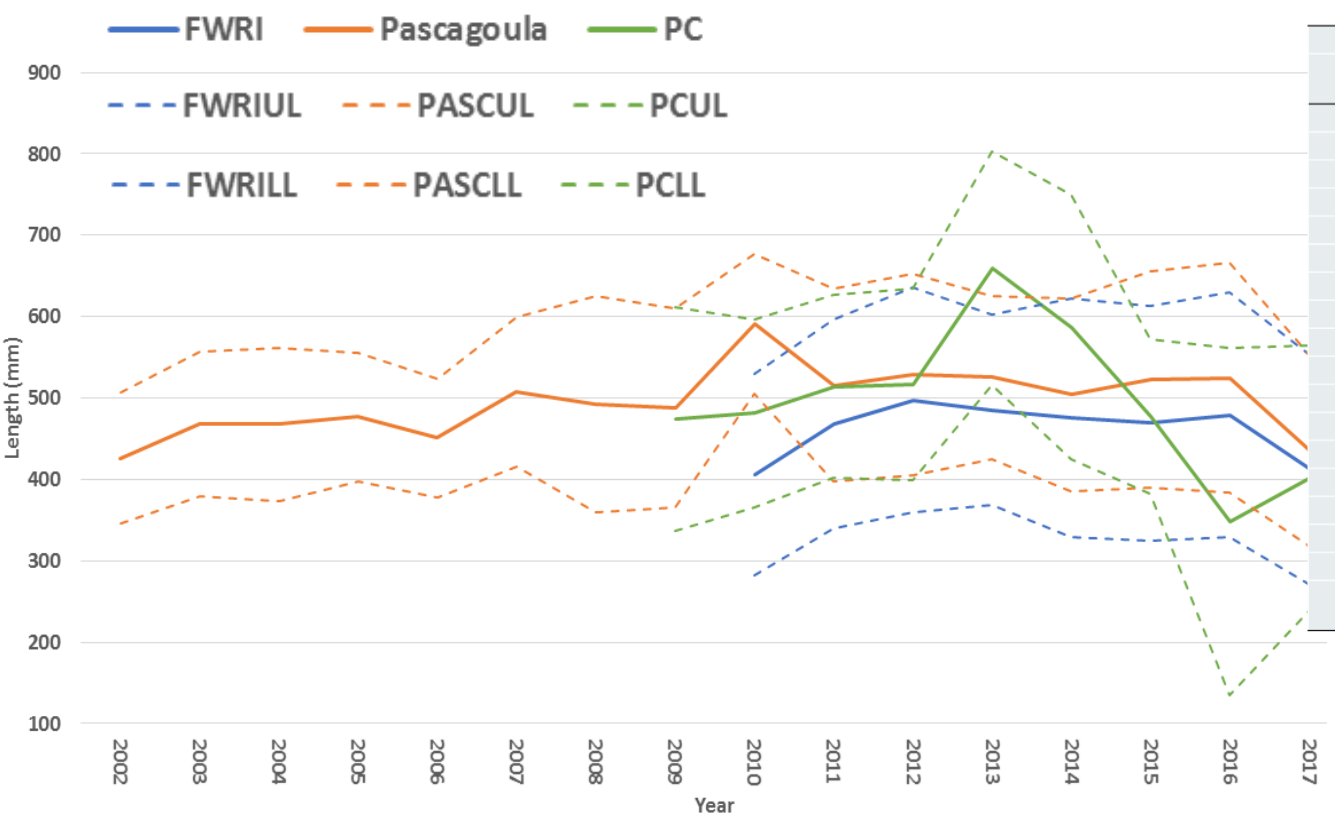


- Account for variation in survey area by weighting the final least square means

SEDAR61-WP03

Combined Video: mean size across surveys

- Mean size by survey remains within confidence intervals, except for 2013 (low sample size)



	Sample sizes			
Year	FWRI	Pascagoula	PC	Total
2002		28		28
2003		22		22
2004		72		72
2005		108		108
2006		95		95
2007		73		73
2008		32		32
2009		64	39	103
2010	19	26	38	83
2011	42	70	45	157
2012	63	91	39	193
2013	16	50	11	77
2014	107	36	18	161
2015	96	14	14	124
2016	101	29	7	137
2017	77	26	22	125
Grand Total	521	842	233	1596

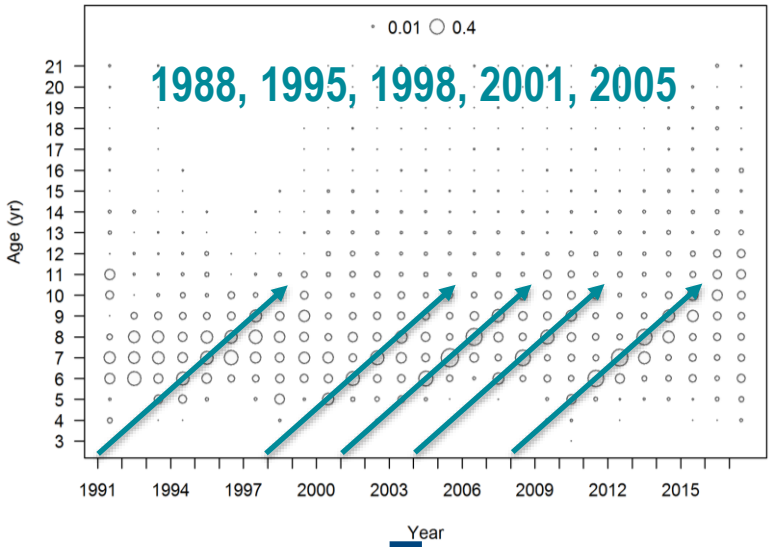
Age Composition

Data Sources

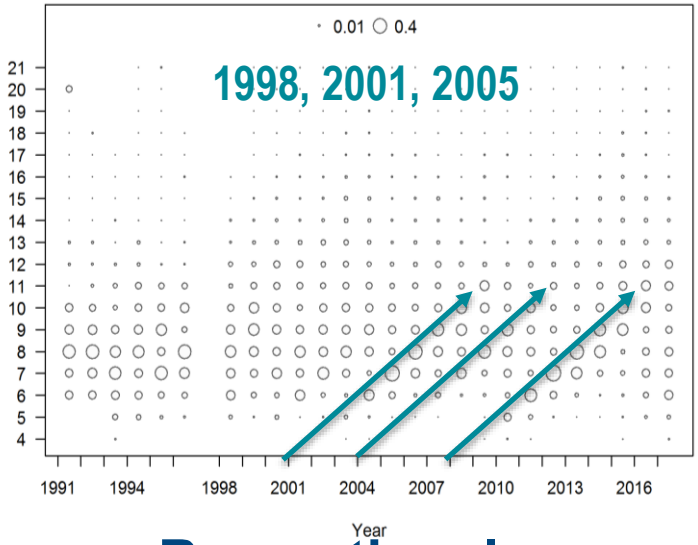
Commercial:
Trip Interview Program (TIP)

Recreational:
MRFSS/MRIP
SRHS
GulfFIN
TIP

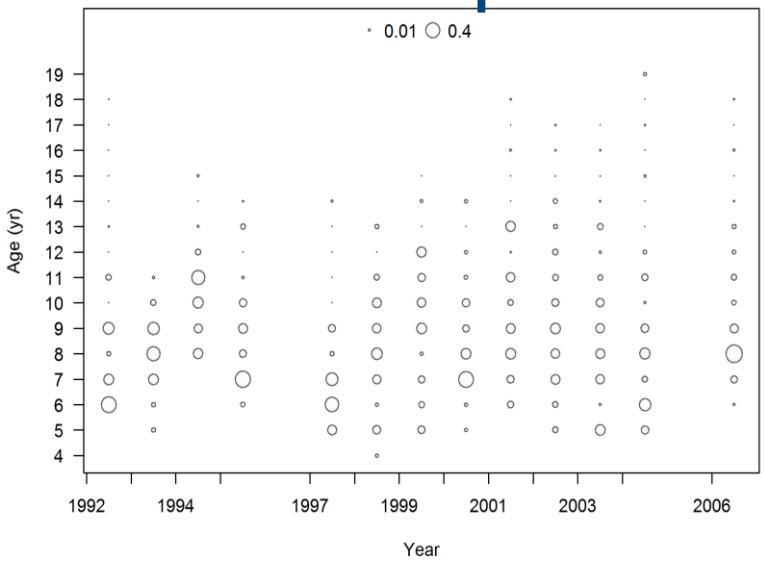
Vertical Line



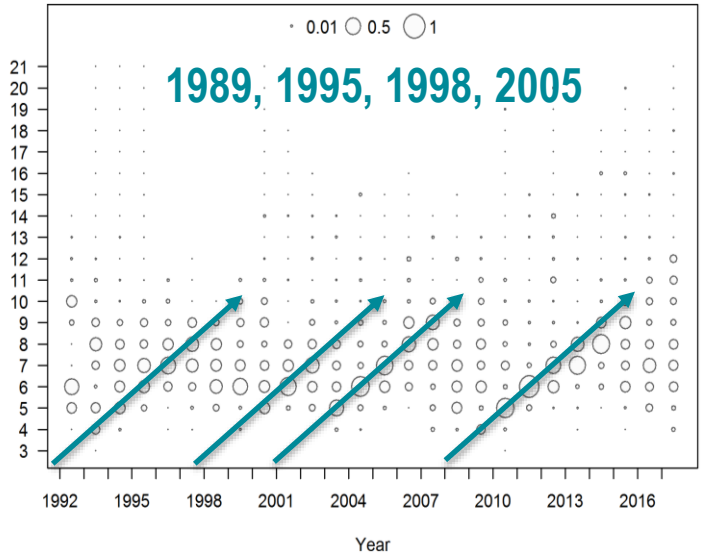
Longline



Trap



Recreational



A note on new MRIP size data

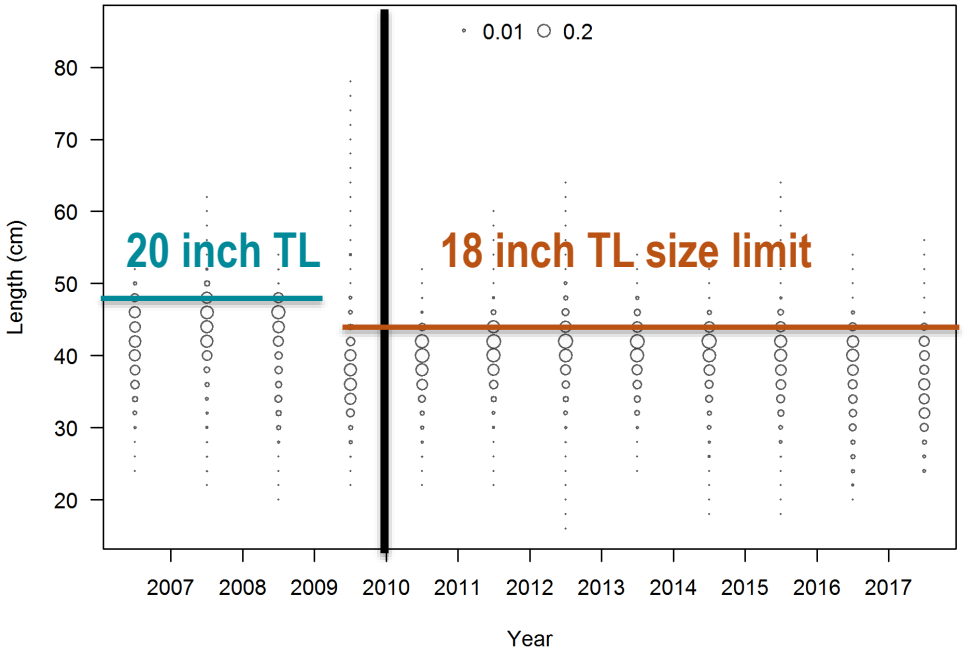
- Use the **complete dataset** (imputed and observed) and **sample weighting**, as recommended by Office of Science & Technology, to reweight age composition
  - Distribution of imputed lengths generally similar to observed lengths
  - Sample weight designed to better capture uncertainty in sampling design
  - Use MRIP length data for Charter & Private, weight by landings

Mode	MRIP (%)	Other (%)
Charter	**82.8**	17.2
Headboat	5.8	**94.2**
Private	**90.9**	9.1
All rec	71	29

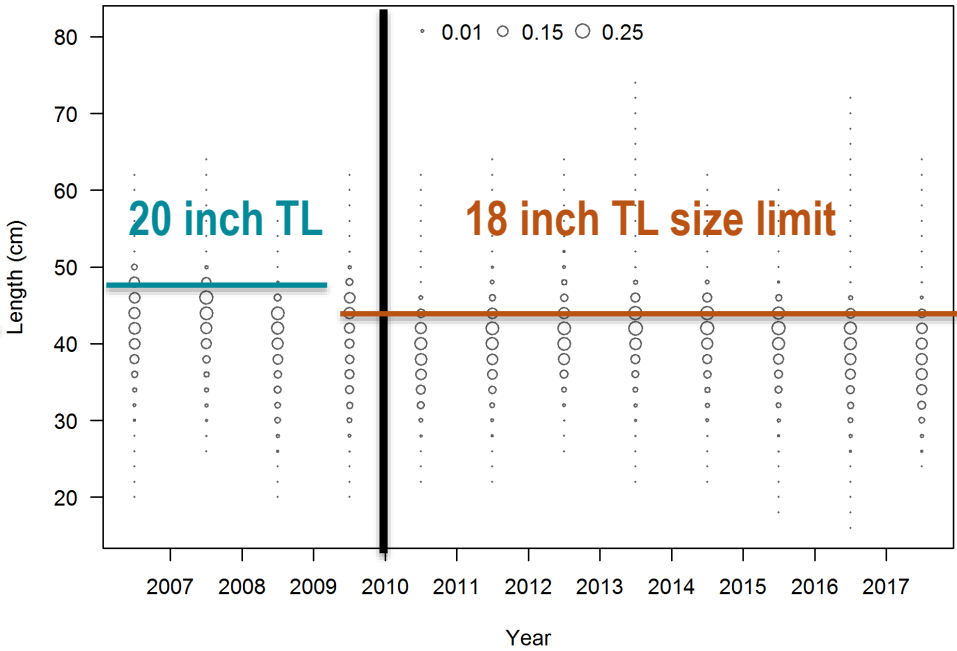
Length composition – Commercial Discards

- NMFS Observer Program

Vertical Line



Longline

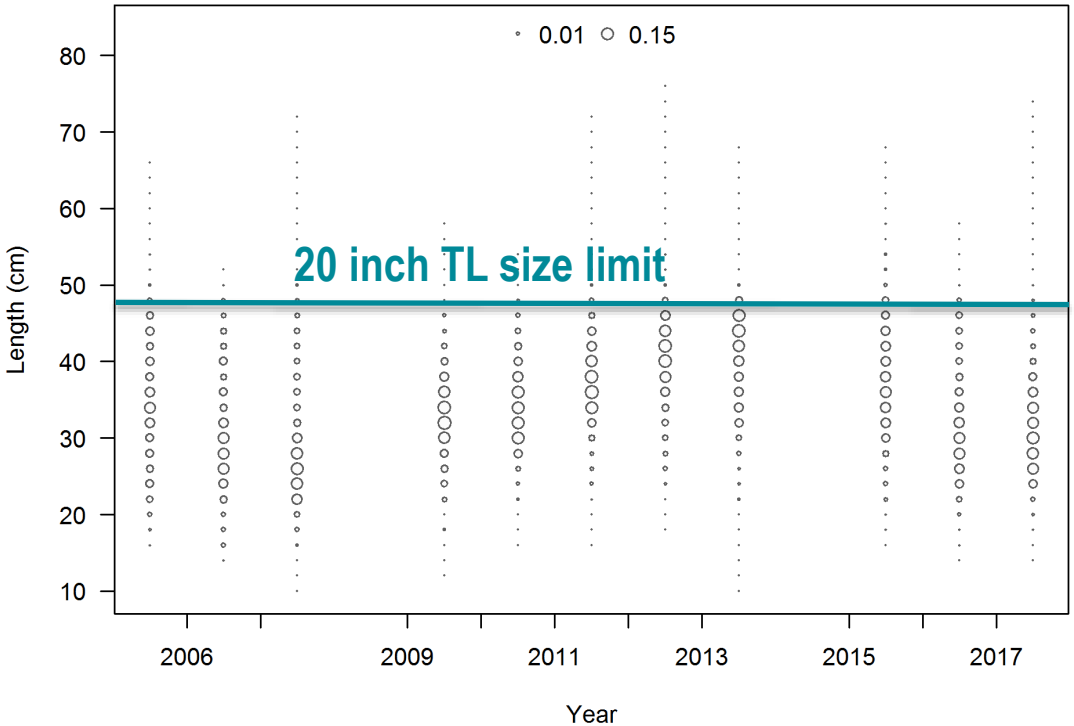


- Majority of discards below size limit
- Some discarding of legal fish

Length composition – Recreational Discards

- FWRI At-Sea Observer Survey
  - Recreational (2005-2007, 2009-2017)
    - Charter since June 2009 (2010 first year)

- Majority of discards below size limit
- Some discarding of legal size fish



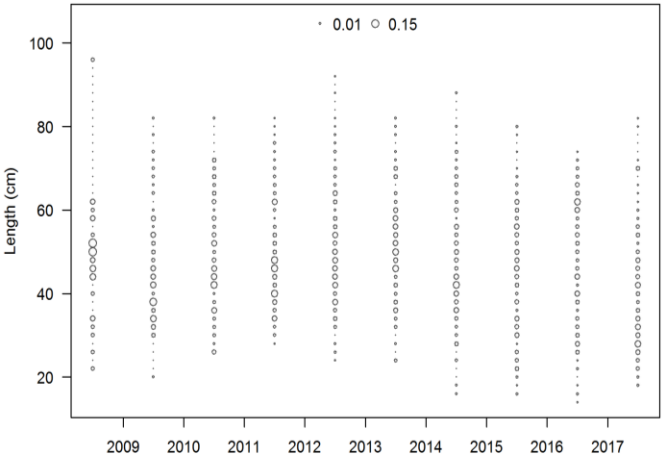
SEDAR61-WP13

Length composition – Fishery independent surveys

Combined Video

Mean: 48 cm FL

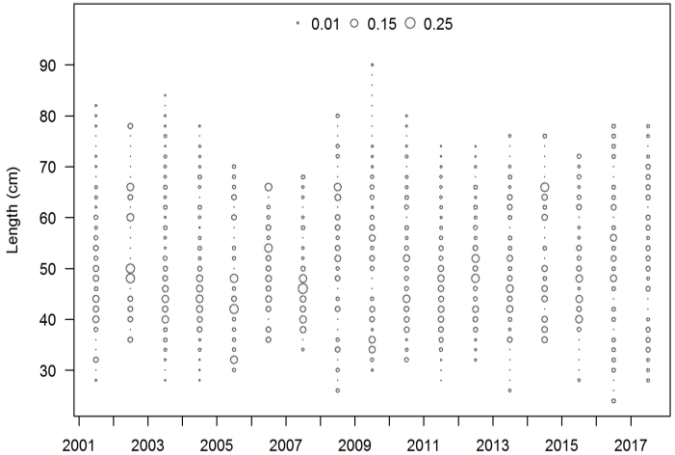
Range: 14 – 97 cm FL



NMFS Bottom Longline

Mean: 51 cm FL

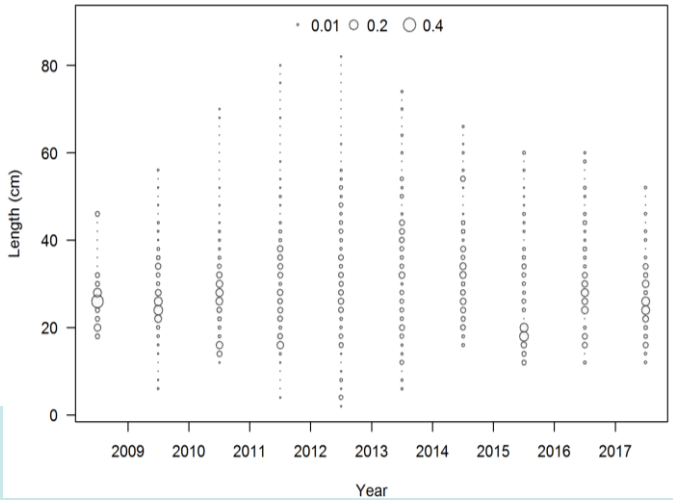
Range: 26 – 91 cm FL



SEAMAP Groundfish

Mean: 30 cm FL

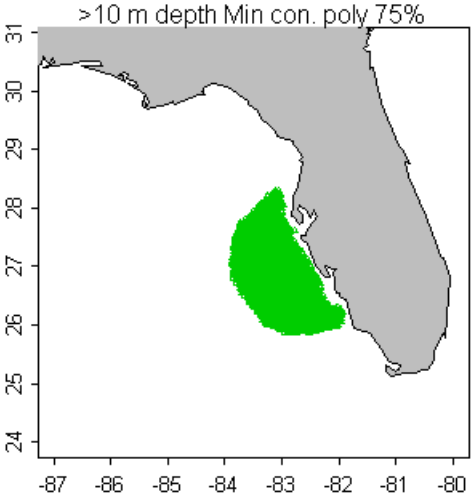
Range: 4 – 84 cm FL

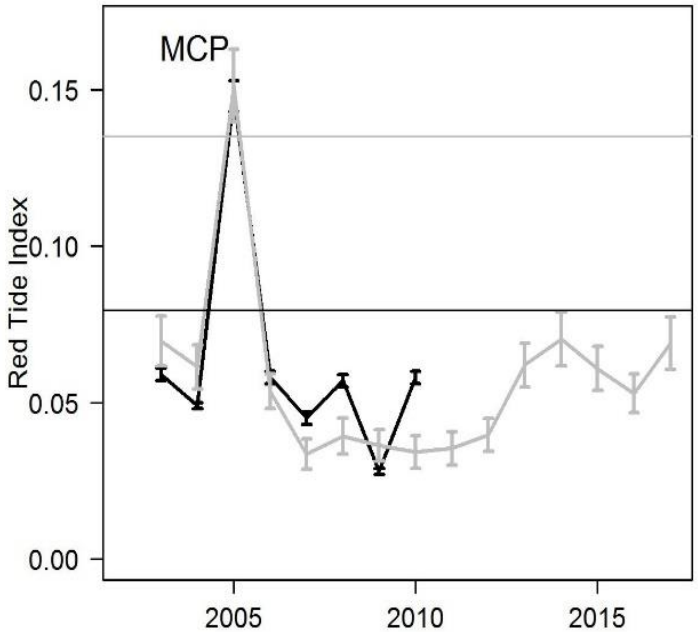


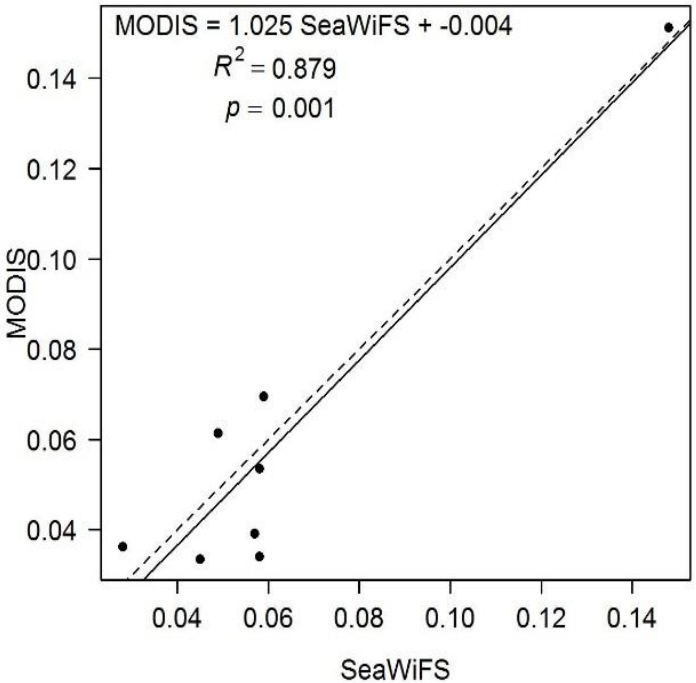
*Term of Reference

Red Tide*

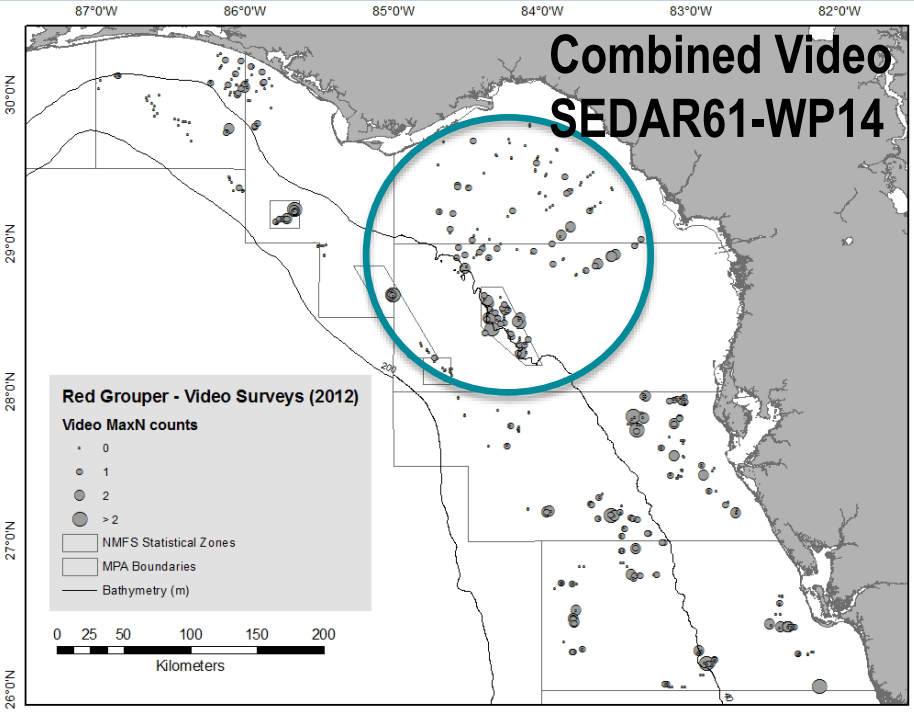
- Updated index of red tide severity (Walter et al. 2013) using MODIS data
  - Concern over MODIS data quality and results

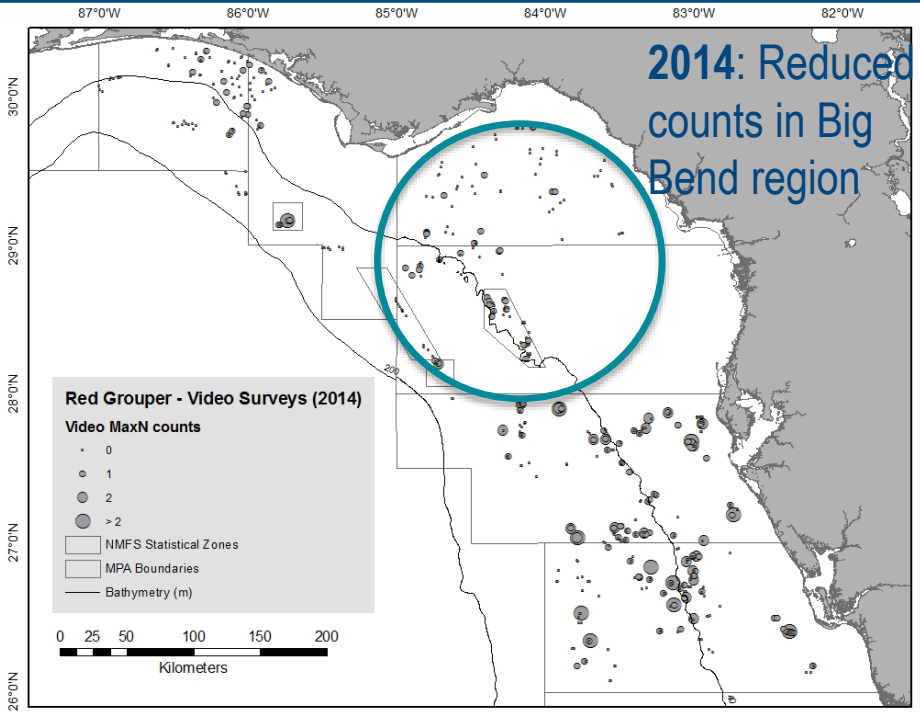


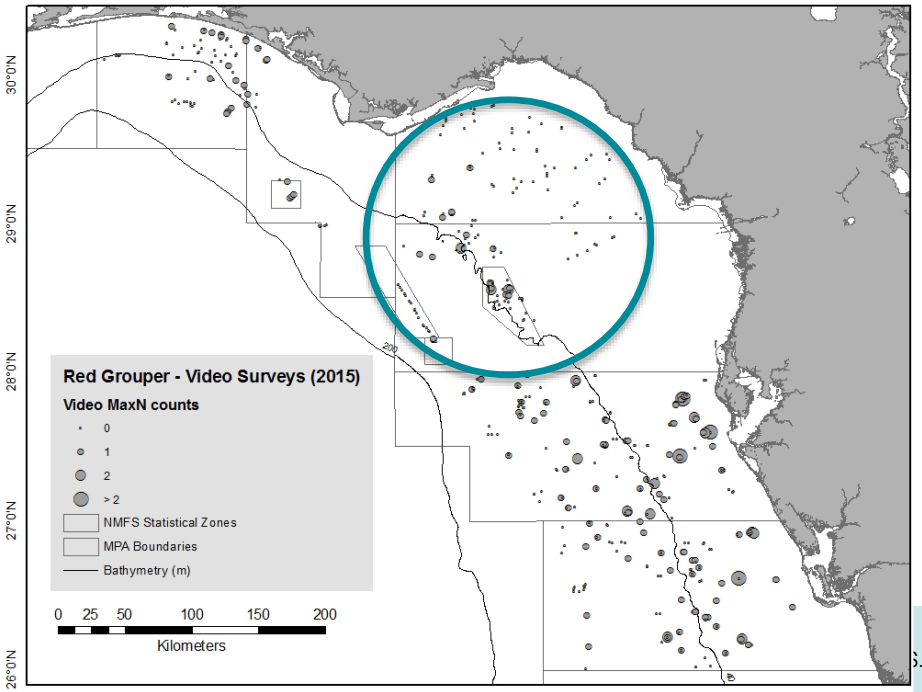


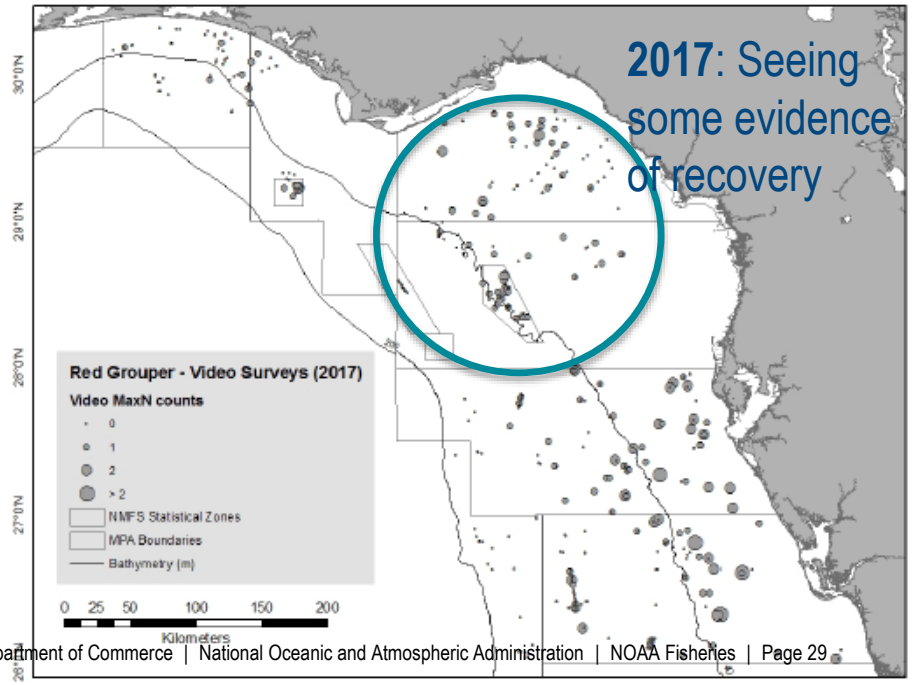


SEDAR61-WP07


Combined Video
SEDAR61-WP14
Red Grouper - Video Surveys (2012)
Video MaxN counts
0
1
2
> 2
NMFS Statistical Zones
MPA Boundaries
Bathymetry (m)
0 25 50 100 150 200
Kilometers
87°0'W
86°0'W
85°0'W
84°0'W
83°0'W
82°0'W
30°0'N
29°0'N
28°0'N
27°0'N
26°0'N


2014: Reduced counts in Big Bend region
Red Grouper - Video Surveys (2014)
Video MaxN counts
0
1
2
> 2
NMFS Statistical Zones
MPA Boundaries
Bathymetry (m)
0 25 50 100 150 200
Kilometers
87°0'W
86°0'W
85°0'W
84°0'W
83°0'W
82°0'W
30°0'N
29°0'N
28°0'N
27°0'N
26°0'N


Red Grouper - Video Surveys (2015)
Video MaxN counts
0
1
2
> 2
NMFS Statistical Zones
MPA Boundaries
Bathymetry (m)
0 25 50 100 150 200
Kilometers
30°0'N
29°0'N
28°0'N
27°0'N
26°0'N

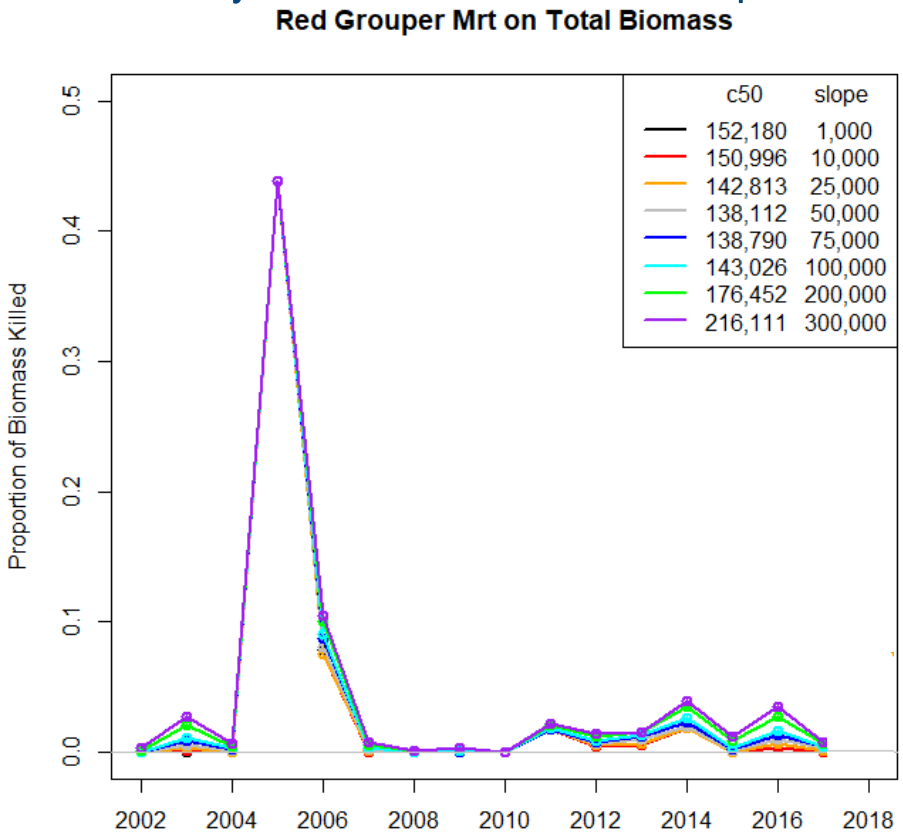

2017: Seeing some evidence of recovery
Red Grouper - Video Surveys (2017)
Video MaxN counts
0
1
2
> 2
NMFS Statistical Zones
MPA Boundaries
Bathymetry (m)
0 25 50 100 150 200
Kilometers
30°0'N
29°0'N
28°0'N
27°0'N

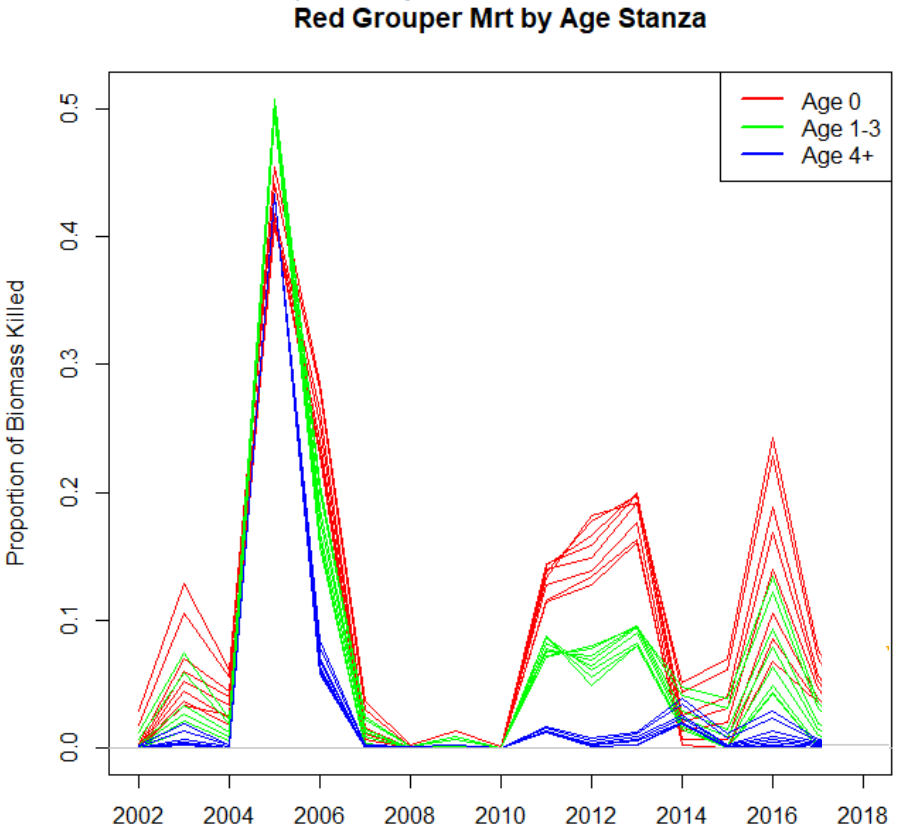
New Data: Ecosystem analysis

- Estimated red tide mortality

- Spatial extent and duration – satellite imagery
- Severity – cell concentration samples

- Species distribution – ecosystem model
- Mortality – logistic response function

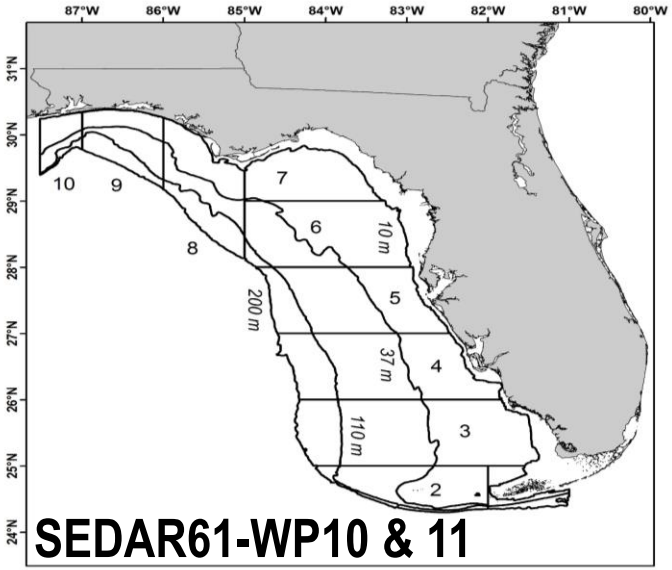


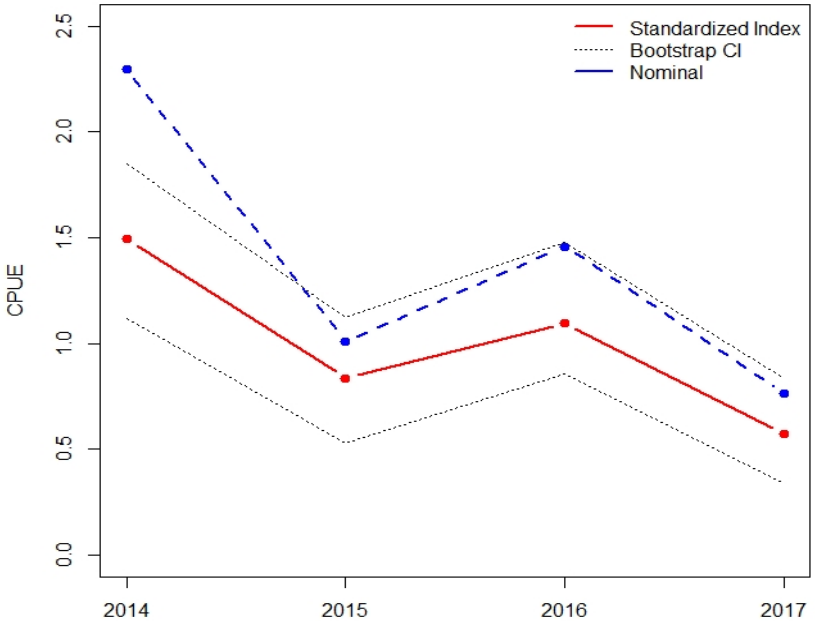


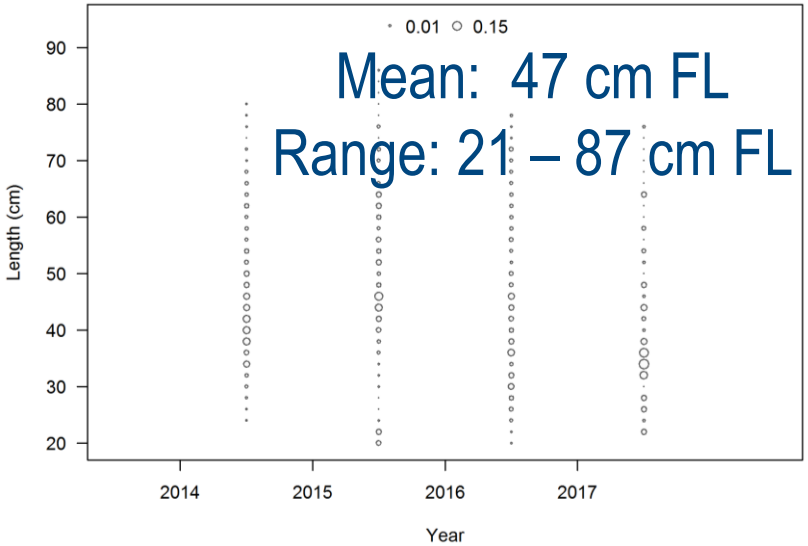
*Term of Reference

New Data: FWRI Surveys*

- Vertical Longline & **Repetitive Time Drop**
- Stratified-random sampling design
  - Zones 4, 5, 9, and 10







SEDAR 61 ‘Continuity’ model (based on SEDAR 42 RW Final Model)

Red grouper continuity model configuration

Identifies model configuration proposed by Assessment Workshop but changed during Review Workshop

- **1993 – 2017** (1986-)
- 1 area, 1 season model
- Combined gender model
- Maturity, protogyny, and fecundity a function of age using life history data inputs (fixed)
- von Bertalanffy growth (fixed)
- Lorenzen natural mortality (fixed)
- **Beverton-Holt spawner-recruitment relationship**
  - **Steepness (fixed at 0.99)** (Estimated)
- **5 fishing fleets – landings and discards**
  - **Single recreational fleet** (2 fleets: MRIP and Headboat)
- 4 fishery-dependent indices of abundance
- 3 fishery-independent indices of abundance
- Red tide mortality estimated in 2005 & 2014
- Age-based selectivity (Fleets)
- **Length-based selectivity**
  - **Fishery-independent surveys**
  - **NMFS Bottom Longline assumed asymptotic** (estimated)
- **Time-varying retention to account for changes in regulations (estimated)** (fixed)

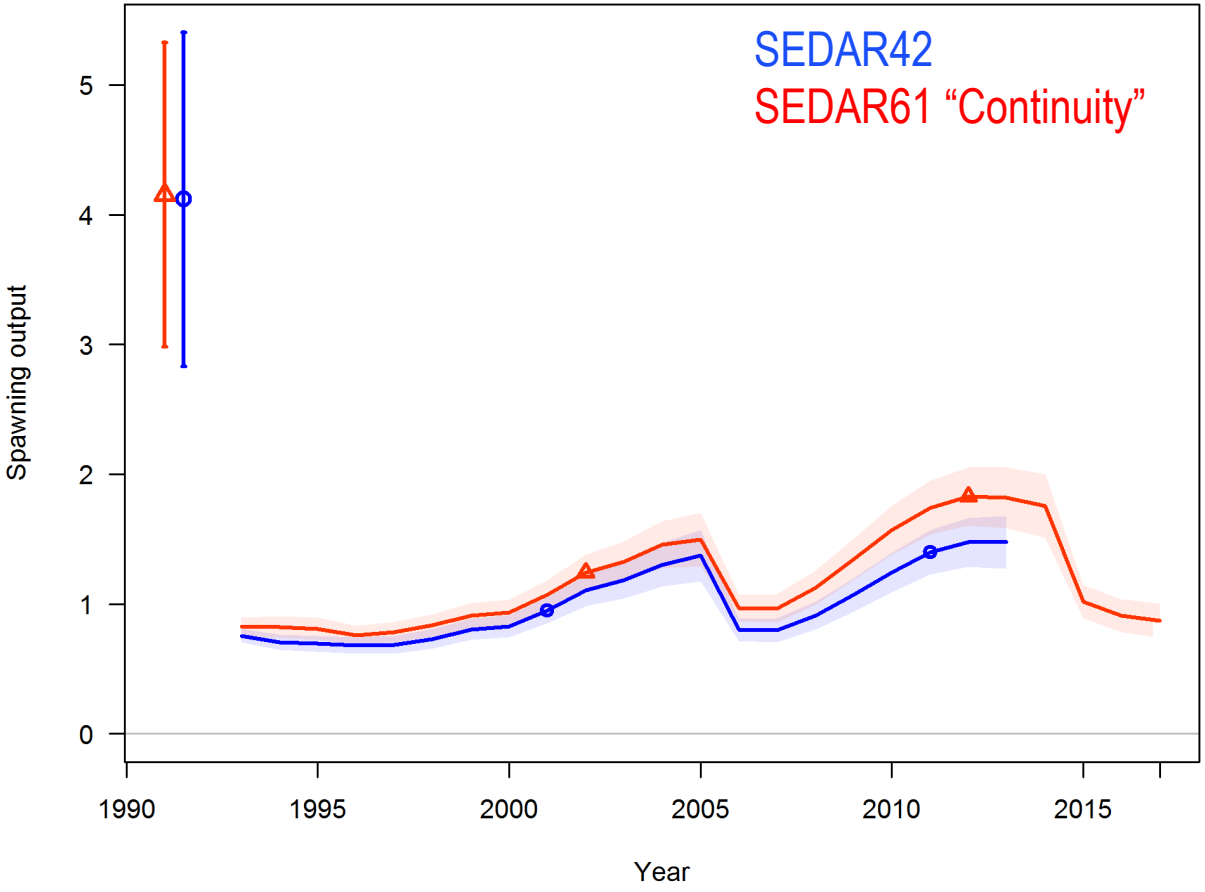
Continuity model review: data inputs

Strict continuity not provided due to improved methodologies

- **Landings**
  - Vertical line: 1993-2017
  - Longline: 1993-2017
  - Trap: 1993-2006
  - Private/Charter/Headboat: 1993-2017
- **Discards**
  - Vertical line: 1993-2006 (reconstructed), 2007-2017 (NMFS observer program)
  - Longline: 1993-2006 (reconstructed), 2007-2017 (NMFS observer program)
  - Trap: 1993-2006 (self reported)*
  - Charter/Headboat/Private: 1993-2017
- **Length composition of discards**
  - Vertical line: 2006-2017 (NMFS observer program)
  - Longline: 2006-2017 (NMFS observer program)
  - Charter: 2010-2017 (FWC observer program)
  - Headboat: 2005-2007, 2009-2017 (FWC observer program)
- **Age composition of retained catch**
  - Vertical line: 1993-2017
  - Longline: 1993-2017
  - Trap: 1993-2006
  - Private/Charter/Headboat: 1993-2017
- **Abundance indices**
  - Vertical line: 1993-2009**
  - Longline: 1993-2009**
  - Charter/Private: 1993-2017
  - Headboat: 1993-2017
  - Video survey (FWRI, PC, SEAMAP): 1993-1997, 2002, 2004-2017
  - SEAMAP summer groundfish survey: 2009-2017
  - NMFS bottom longline survey: 2001, 2003-2017
- **Length composition of survey data**
  - Combined video survey (PC and SEAMAP only): 2008-2017
  - SEAMAP summer groundfish survey: 2009-2017
  - NMFS bottom longline survey: 2001-2017

SEDAR 61 'Continuity' model results

- Remember differences in:
  - Commercial discards
  - MRIP landings
  - MRIP discards
  - MRIP index of abundance



Update/Revision of Initial Conditions

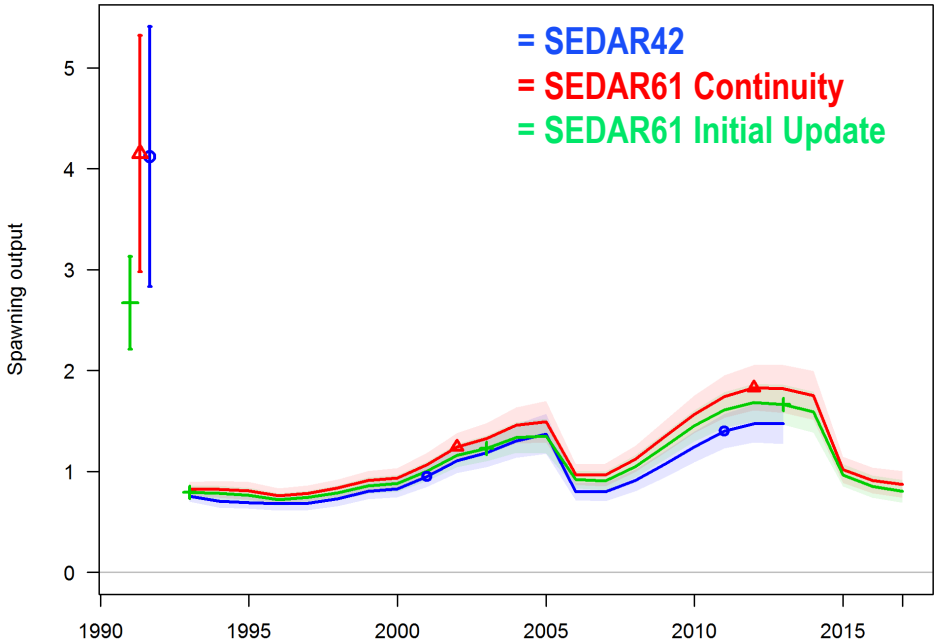
- Since removals occurred prior to start year, the model was started in a non-equilibrium state and estimated:
  - Initial fishing mortality for each fleet
- Starting year of assessment model changed from 1986 to 1993 at Review Workshop
  - Initial equilibrium catch inputs during the Review Workshop were too high (remember slide 4)
    - Reason for large increase in OFL

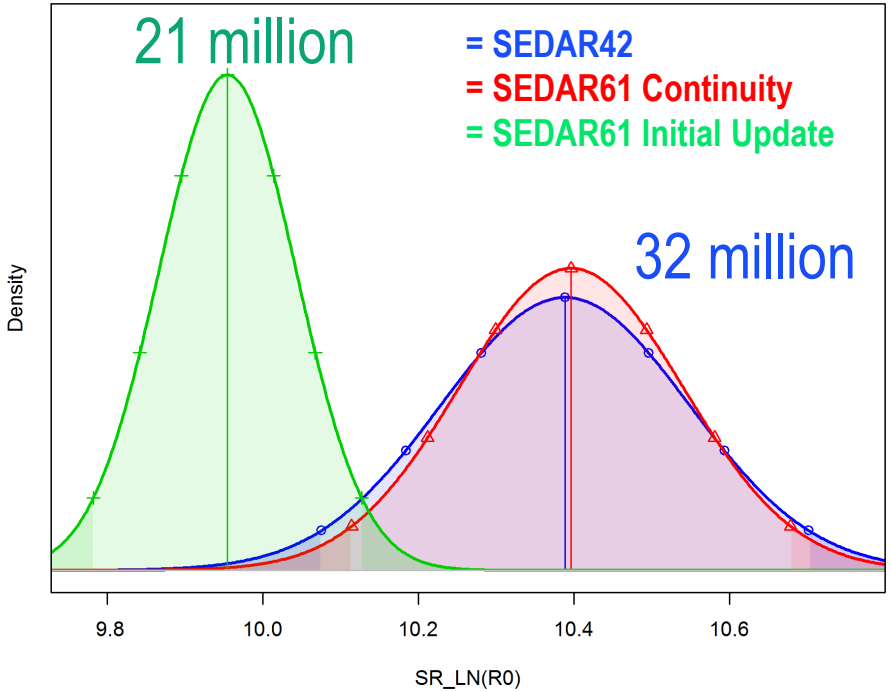
Table A.1.3 (SEDAR42 Addendum)

	AW	RW
Estimated Retained Yield (MSY)	3430.84 mt (7.56 million pounds)	7080.93 mt (15.61 million pounds)

Model Comparison

- Updated initial equilibrium catches for all fleets to reflect average of first 5 years of time series





- SigmaR abnormally high in SEDAR42 model

Model	sigmaR ± CV
SEDAR42	1.24 ± 0.12
SEDAR61 Continuity	1.15 ± 0.12
SEDAR61 Initial Update	0.79 ± 0.12

SEDAR61 Base Model

Review of Data & Updates

Data Updates:

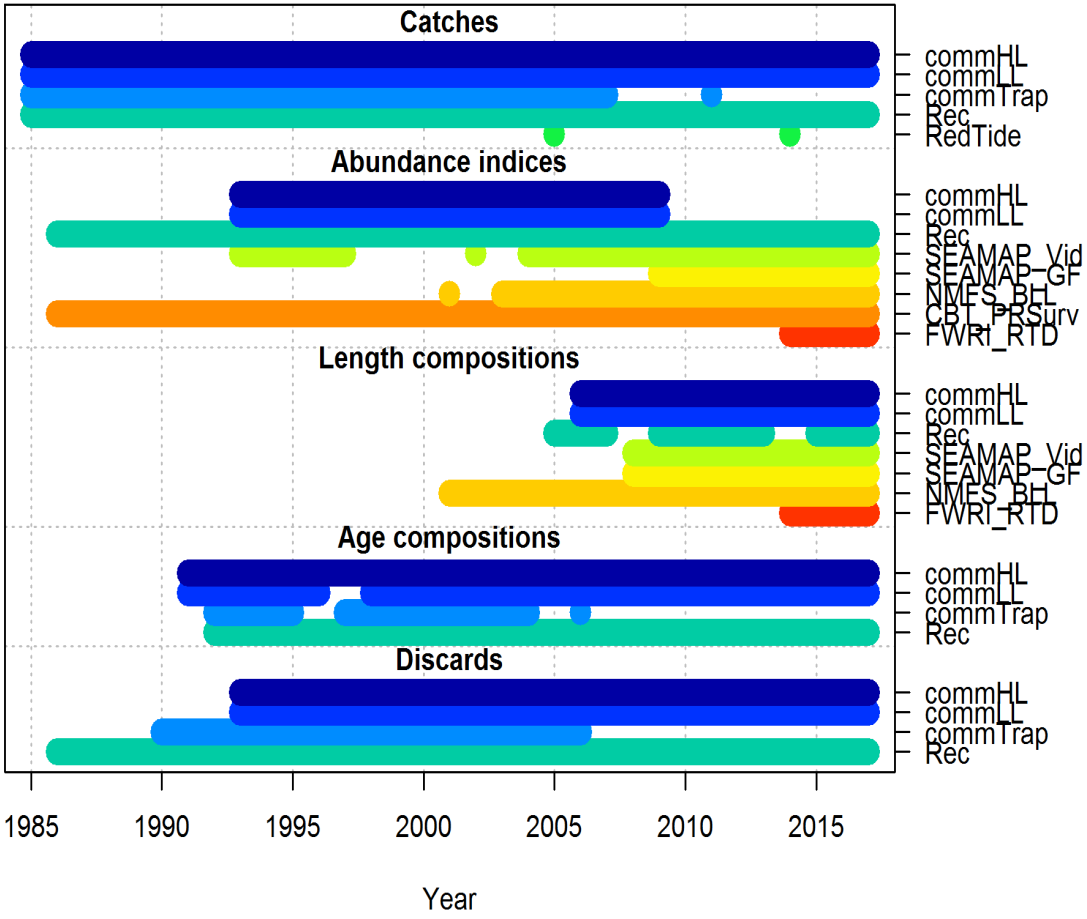
- Combined video index & length composition
- Recreational age composition
- Growth (and M)
- Fecundity

New Data:

- FWRI repetitive time drop index and length composition

Treatment of composition data:

- Use square root of sample sizes for composition data
  - Iteratively reweight effective sample sizes (best practices)



*Term of Reference

SEDAR61 Continuity Model

- 1993 – 2017
- 1 area, 1 season model
- Combined gender model
- Maturity, protogyny, and fecundity a function of age using life history data inputs (fixed)
- von Bertalanffy growth (fixed)
- Lorenzen natural mortality (fixed)
- Beverton-Holt spawner-recruitment relationship
  - Steepness (fixed at 0.99)
- 5 fishing fleets – landings and discards
  - Single recreational fleet
- 4 fishery-dependent indices of abundance
- 3 fishery-independent indices of abundance
- Red tide mortality estimated in 2005 & 2014
- Age-based selectivity (Fleets)
- Length-based selectivity
  - Fishery-independent surveys
  - NMFS BLL assumed asymptotic
- Time-varying retention to account for changes in regulations (estimated)

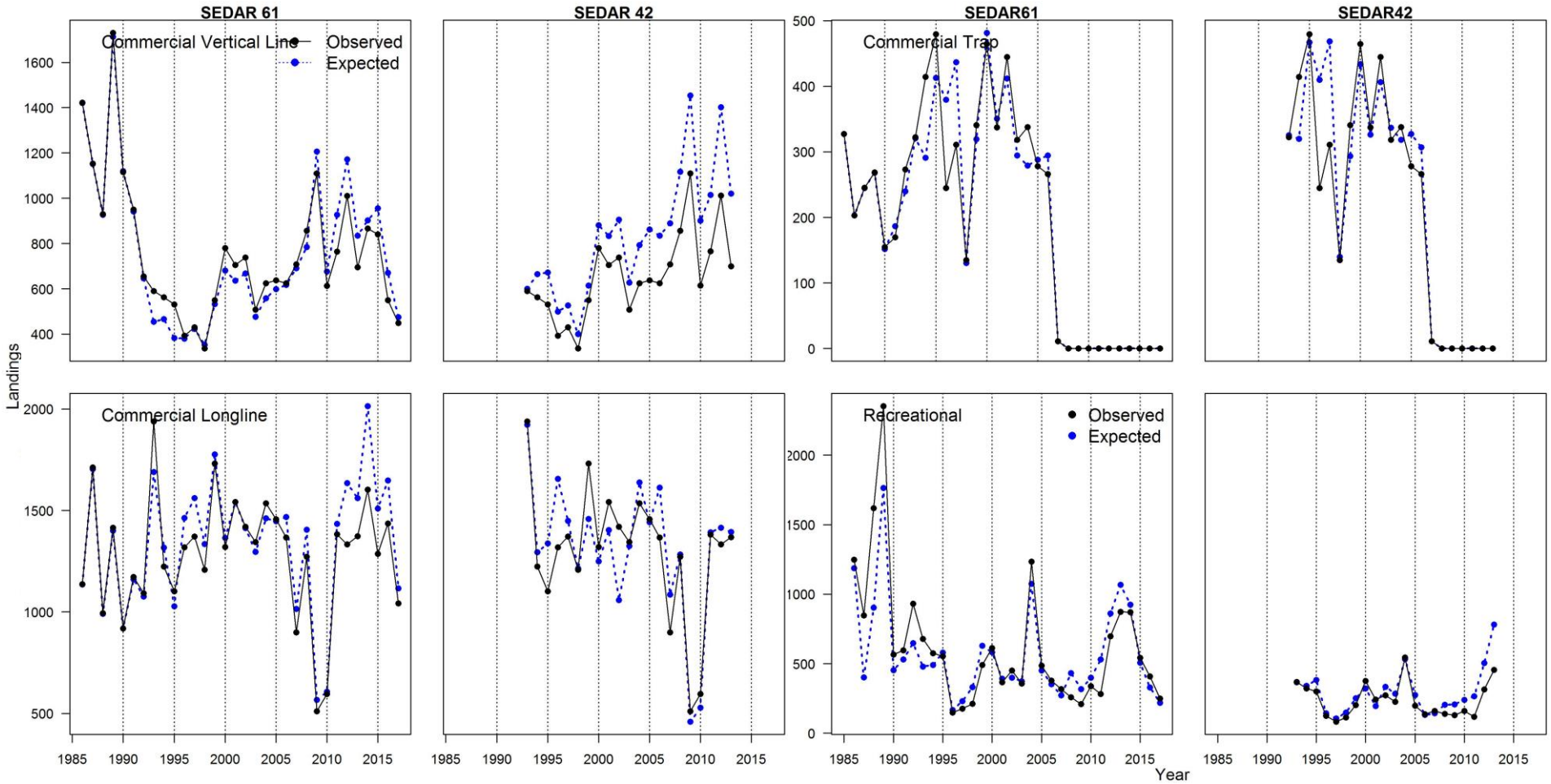
SEDAR61 Base Model

- **1986* – 2017**
- 1 area, 1 season model
- Combined gender model
- Maturity, protogyny and **fecundity** a function of age using LH data inputs (fixed)
- Von Bertalanffy growth (**estimated K, L at Amin**)
- Lorenzen natural mortality (fixed)
- Beverton-Holt spawner-recruitment relationship
  - Steepness fixed (h = 0.99)
- 5 fishing fleets – landings and discards
  - Single recreational fleet
- 4 fishery-dependent indices of abundance
- **4 fishery-independent indices of abundance**
- Red tide mortality estimated in 2005 & 2014* **(no 0s)**
- **Length-based selectivity:**
  - **Fleets***
  - **Fishery-independent surveys**
  - **NMFS BLL, Video, FWRI assumed asymptotic**
- Time-varying retention to account for changes in regulations (**fixed inflection and asymptote**)

Base model review: data inputs

- **Landings**
  - Vertical line: **1986**-2017 (1880)
  - Longline: **1986**-2017 (1982)
  - Trap: **1986**-2006 (1964)
  - Private/Charter/Headboat: **1986**-2017 (1946)
- **Discards**
  - Vertical line: 1993-2006 (reconstructed), 2007-2017 (NMFS observer program)
  - Longline: 1993-2006 (reconstructed), 2007-2017 (NMFS observer program)
  - Trap: **1990**-2006 (self reported)*
  - Charter/Headboat/Private: **1986**-2017 (1981)
- **Length composition of discards**
  - Vertical line: 2006-2017 (NMFS observer program)
  - Longline: 2006-2017 (NMFS observer program)
  - Charter: 2010-2017 (FWC observer program)
  - Headboat: 2005-2007, 2009-2017 (FWC observer program)
- **Age composition of retained catch**
  - Vertical line: **1991**-2017
  - Longline: **1991**-2017
  - Trap: **1991**-2006
  - Private/Charter/Headboat: **1991**-2017
- **Abundance indices**
  - Vertical line: 1993-2009**
  - Longline: 1993-2009**
  - Charter/Private: **1986**-2017
  - Headboat: **1986**-2017
  - Video survey (FWRI, PC, SEAMAP): 1993-1997, 2002, 2004-2017
  - SEAMAP summer groundfish survey: 2009-2017
  - NMFS bottom longline survey: 2001, 2003-2017
- **Length composition of survey data**
  - Combined video survey (PC and SEAMAP only): 2008-2017
  - SEAMAP summer groundfish survey: 2009-2017
  - NMFS bottom longline survey: 2001-2017

Fit to Data: Landings

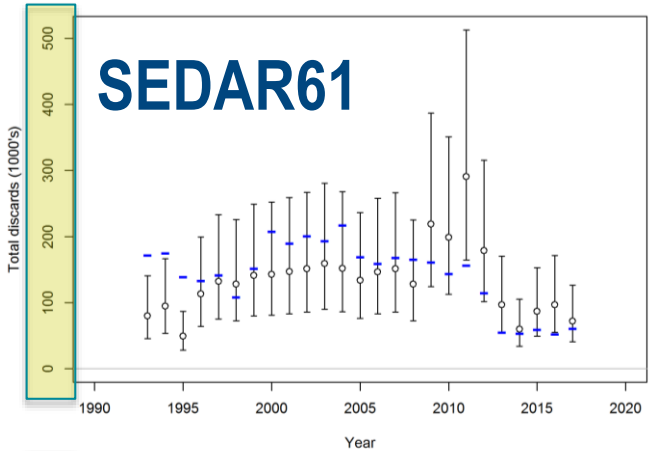


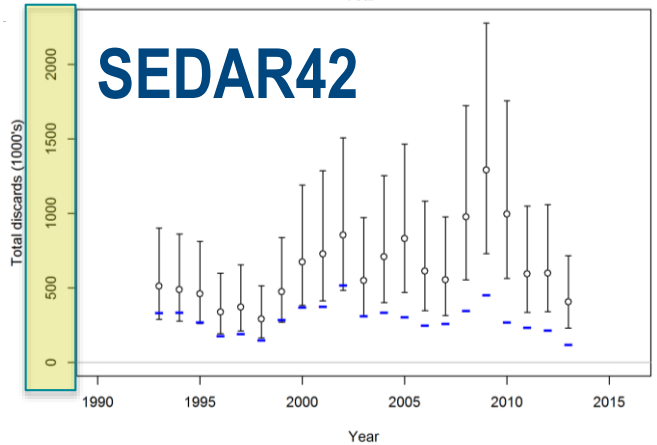
Commercial (metric tons): CV = 0.15 Recreational (Numbers): CV = 0.30

Fit to Data: Commercial Discards

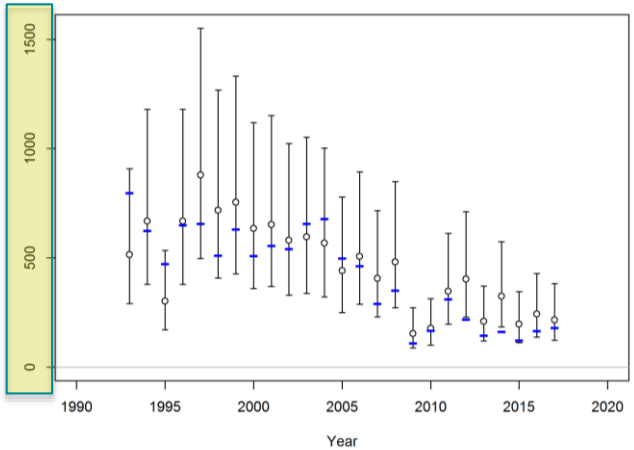
*Note difference in magnitude

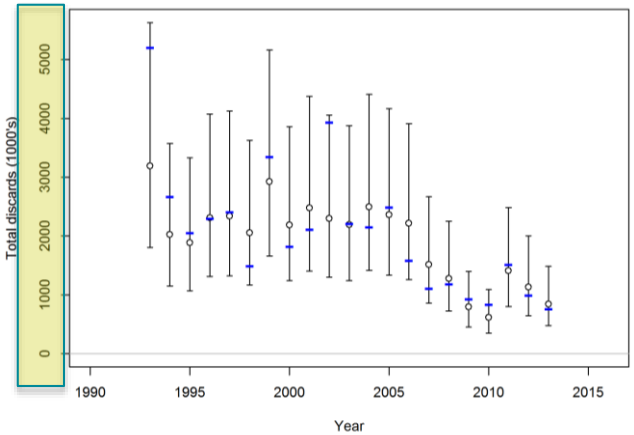
Comm VL*



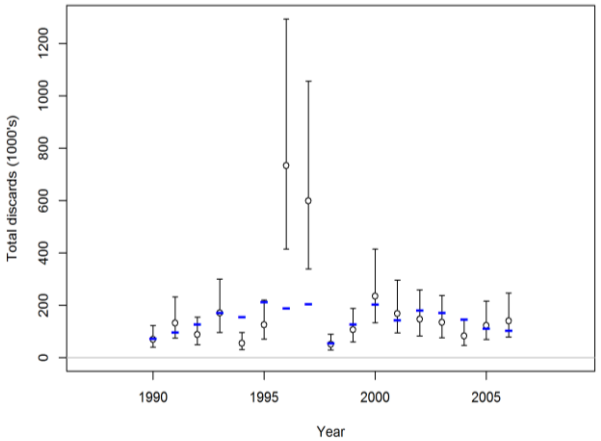


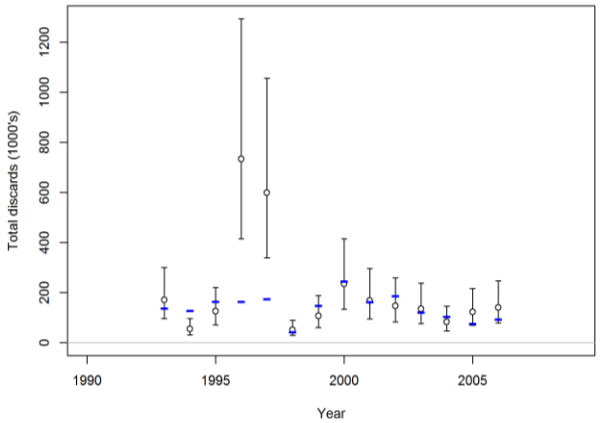
Comm LL*





Comm Trap



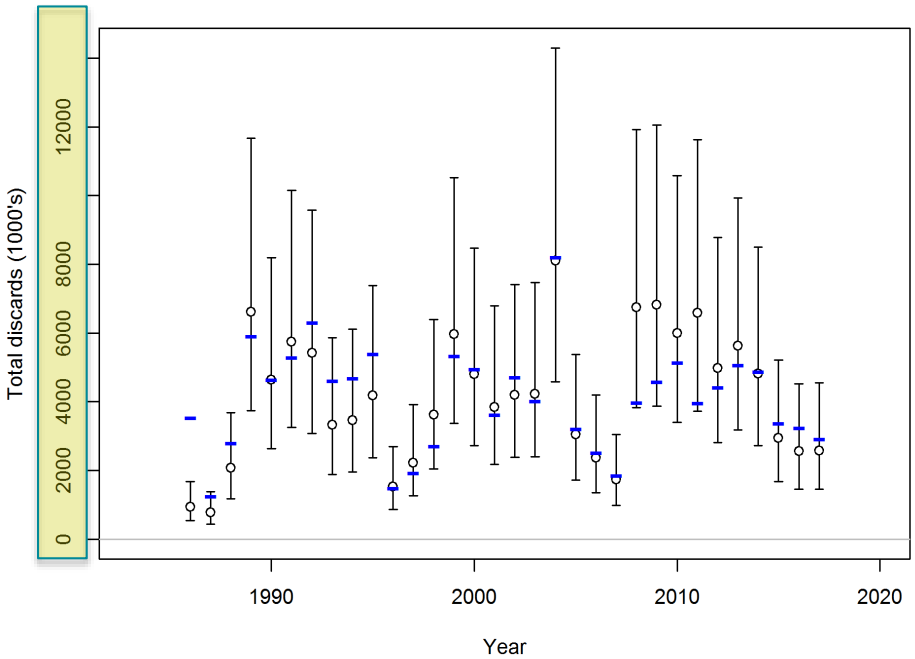


- SEDAR61 discards roughly 3-6X lower than SEDAR 42

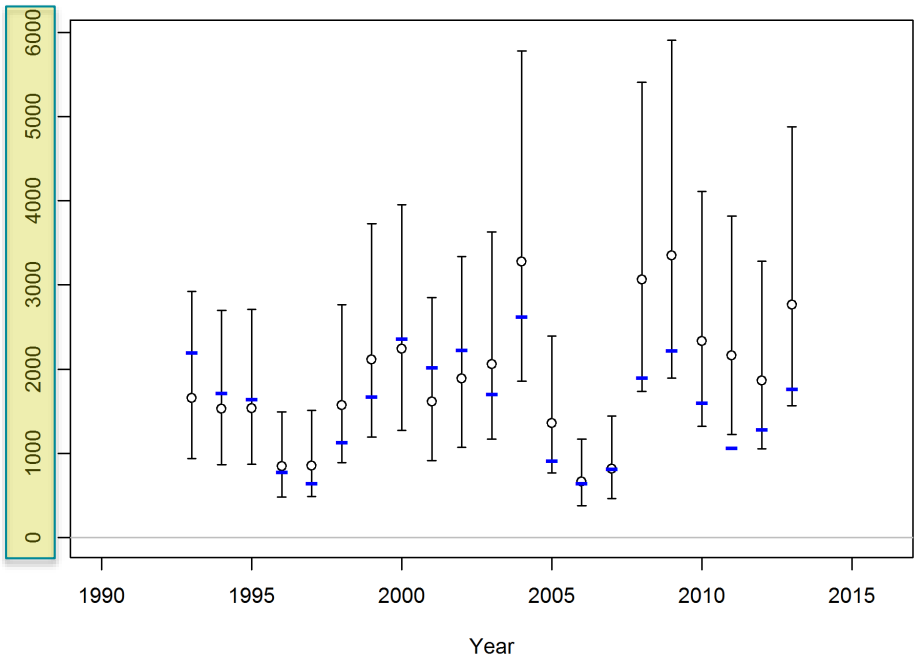
Fit to Data: Recreational Discards

***Note difference in magnitude**

SEDAR61



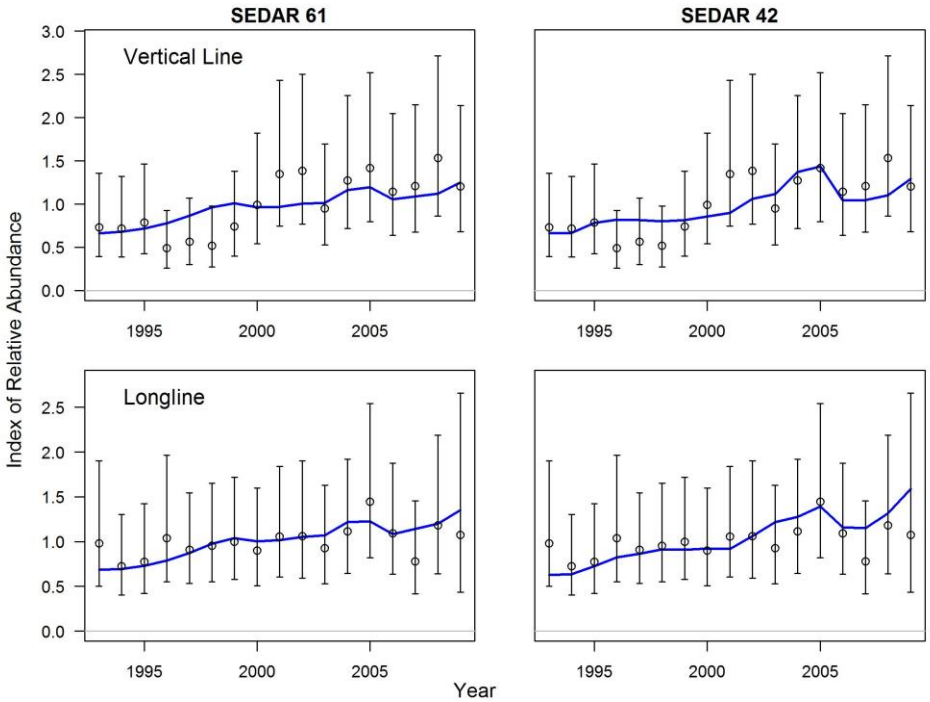
SEDAR42

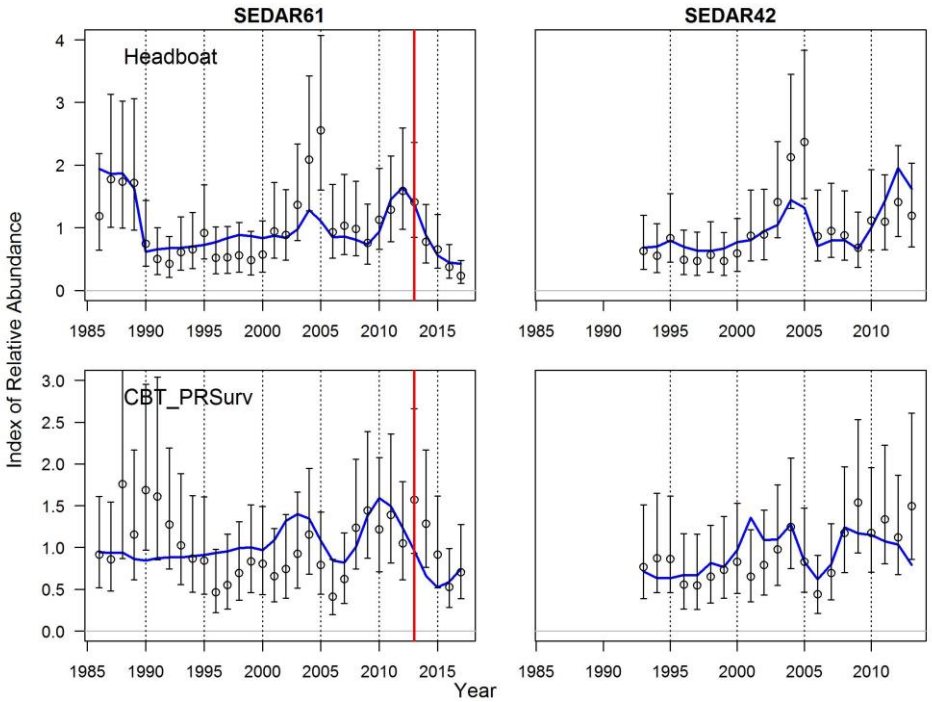


- SEDAR61 discards nearly double magnitude of SEDAR42

Fit to Data: Fishery-Dependent Indices

- Commercial indices truncated in 2009 due to IFQ implementation; not updated due to time constraints

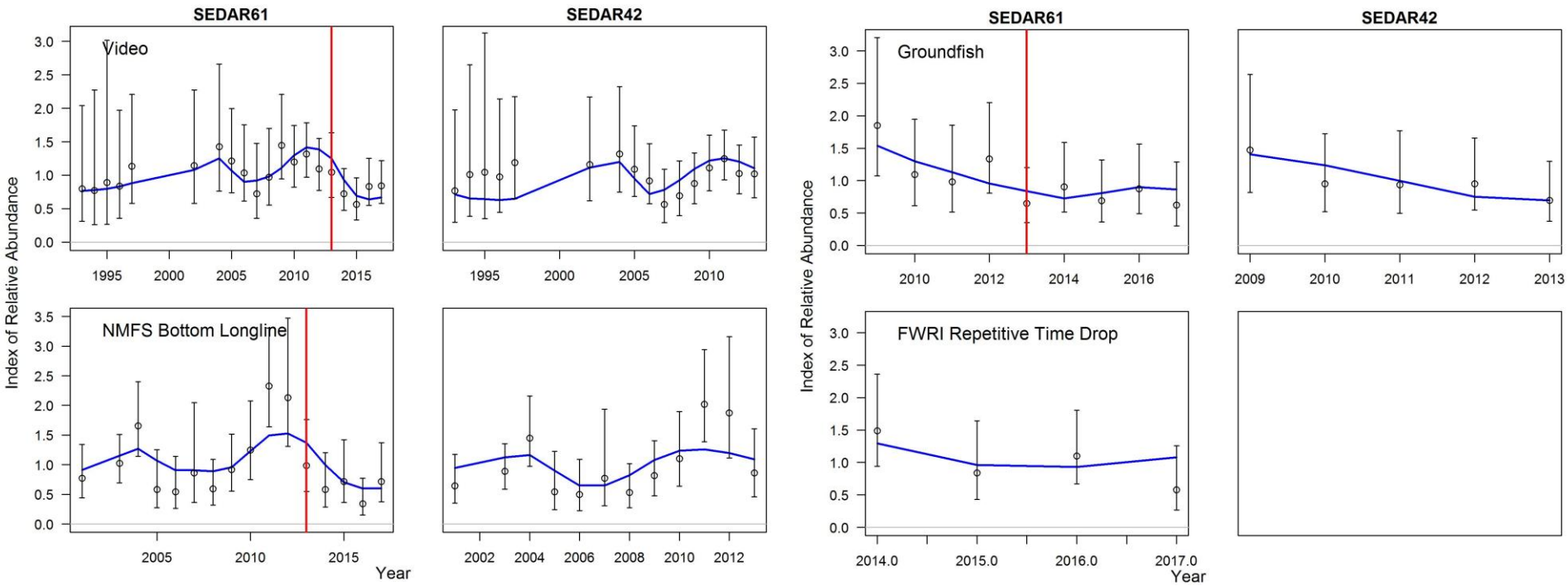




- Recent declines in rec indices

***SEDAR42 terminal year for comparison**

Fit to Data: Fishery-Independent Indices

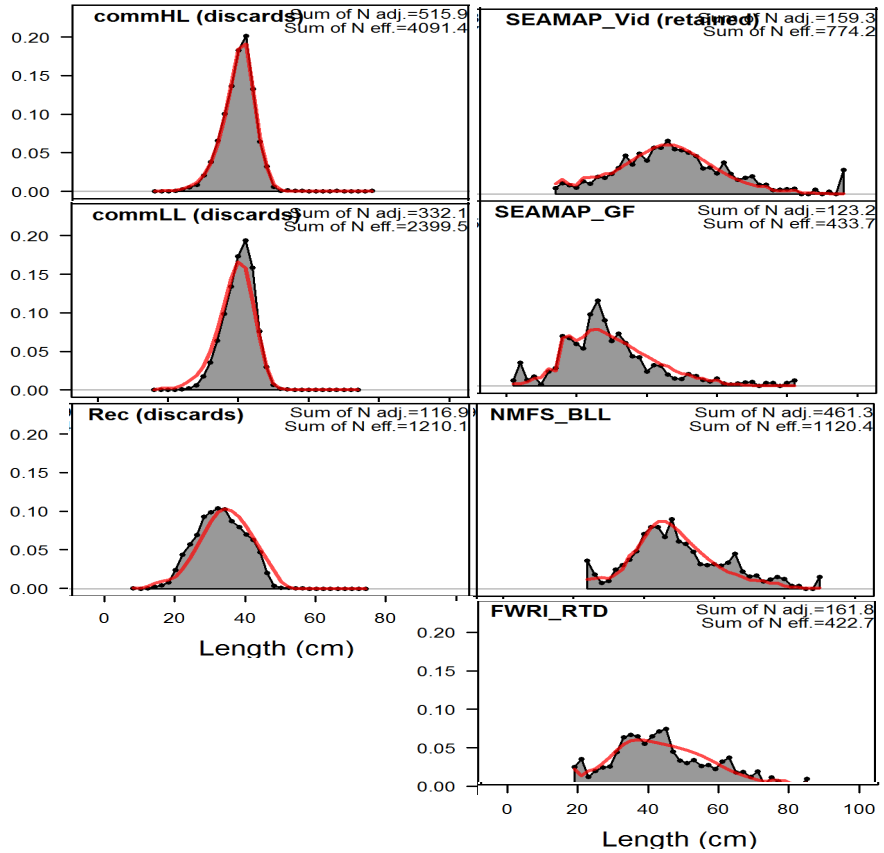


- Recent declines in abundance noted for most surveys

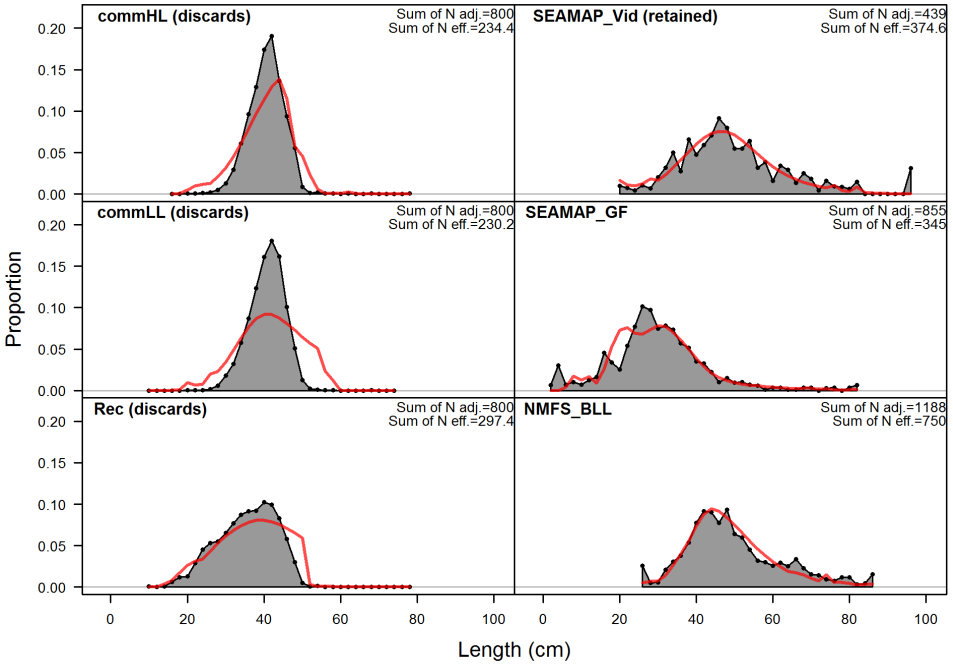
***SEDAR42 terminal year for comparison**

Fit to Data: Length Composition

SEDAR61

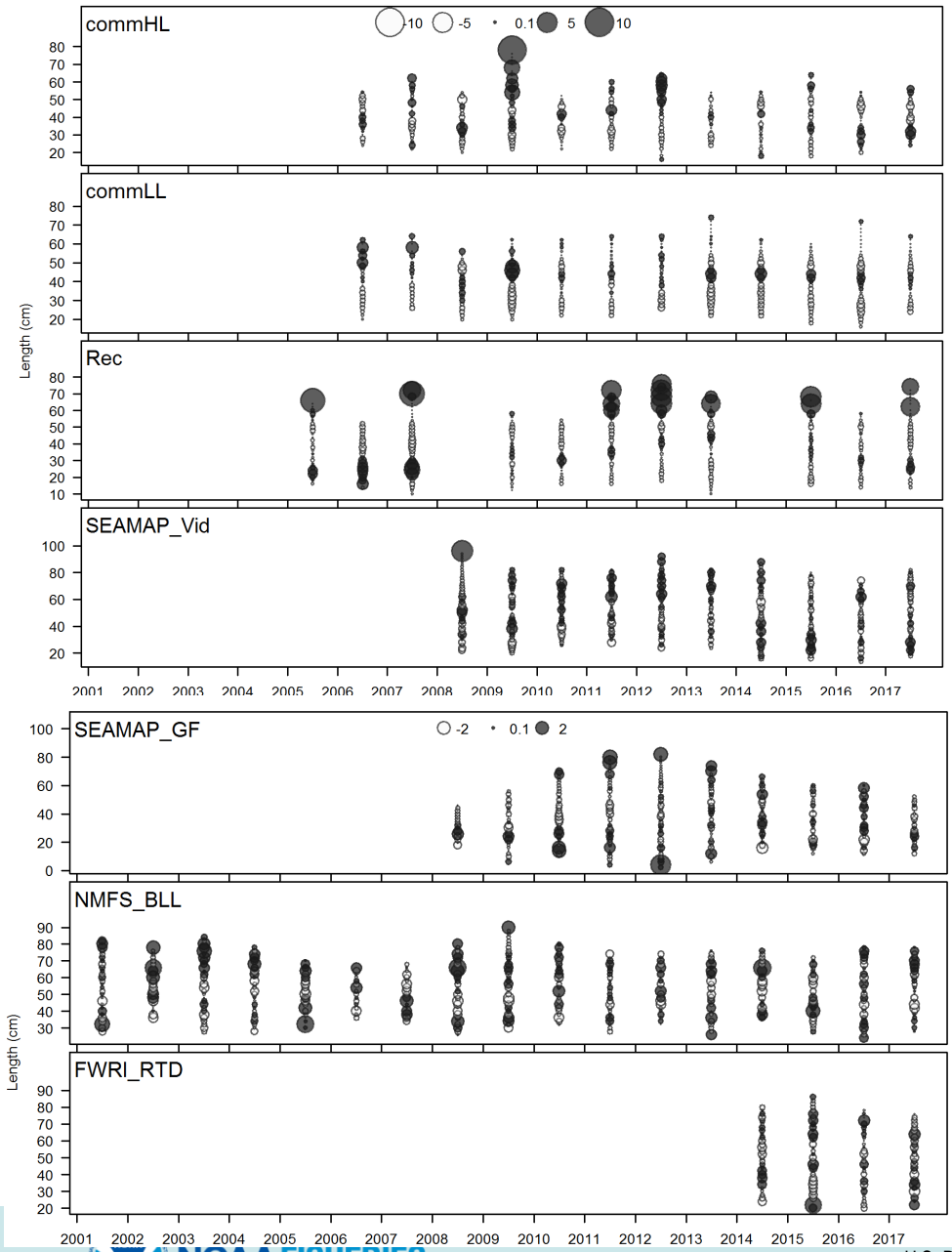


SEDAR42

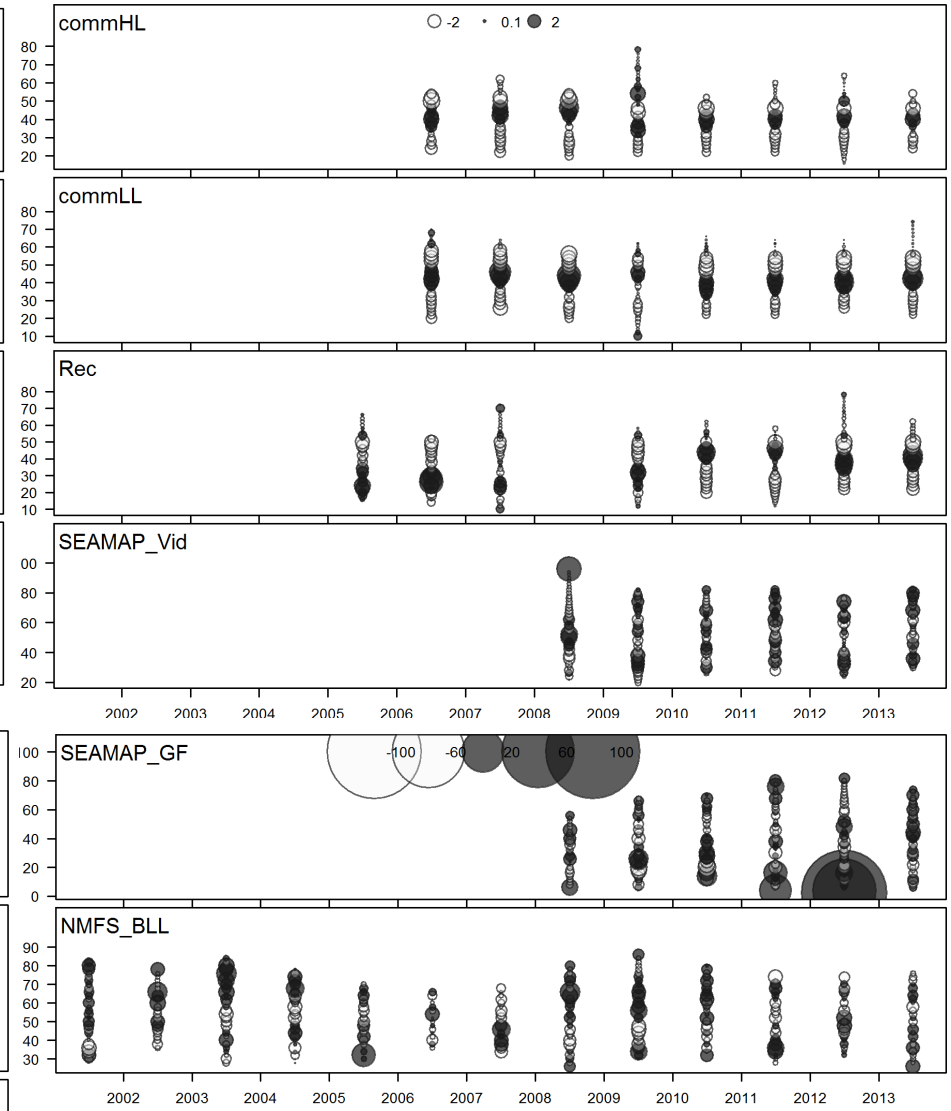


- Improved fits to discard length compositions
  - Size-based selectivity; retention

Residuals: SEDAR61

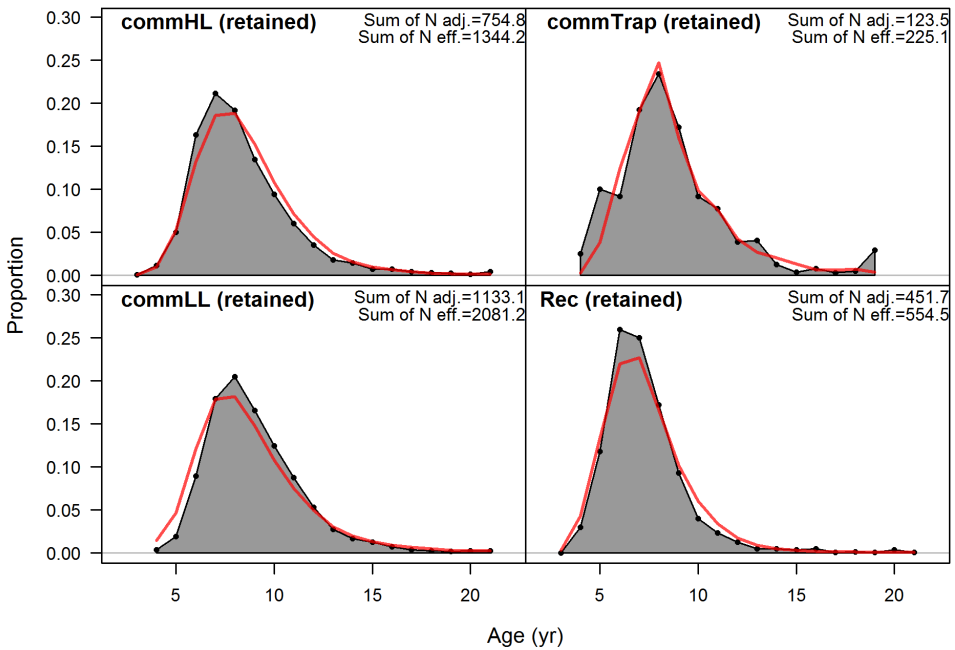


SEDAR42

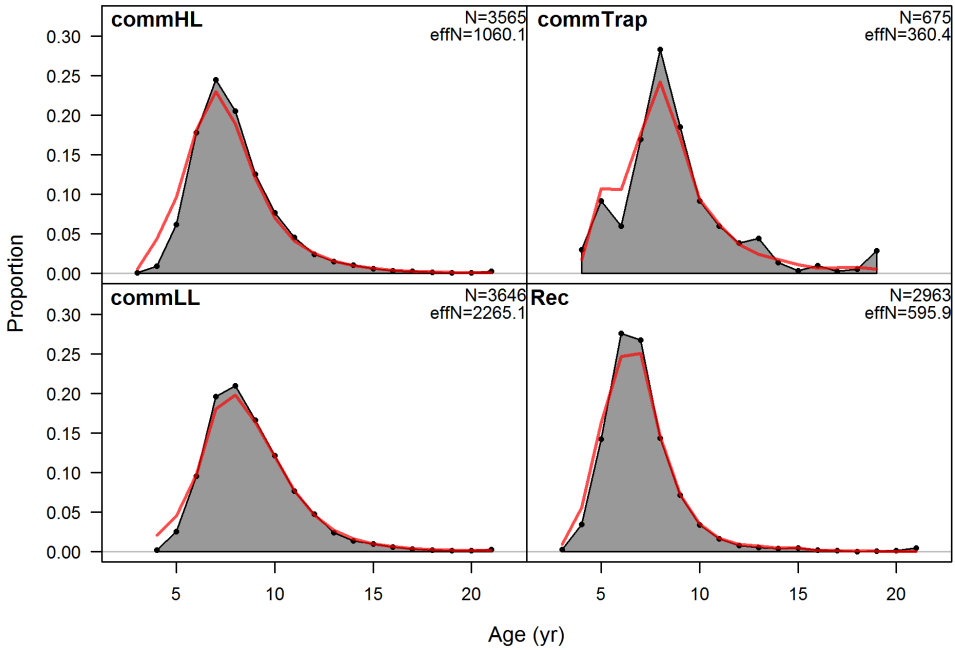


Fit to Data: Age Composition

SEDAR61



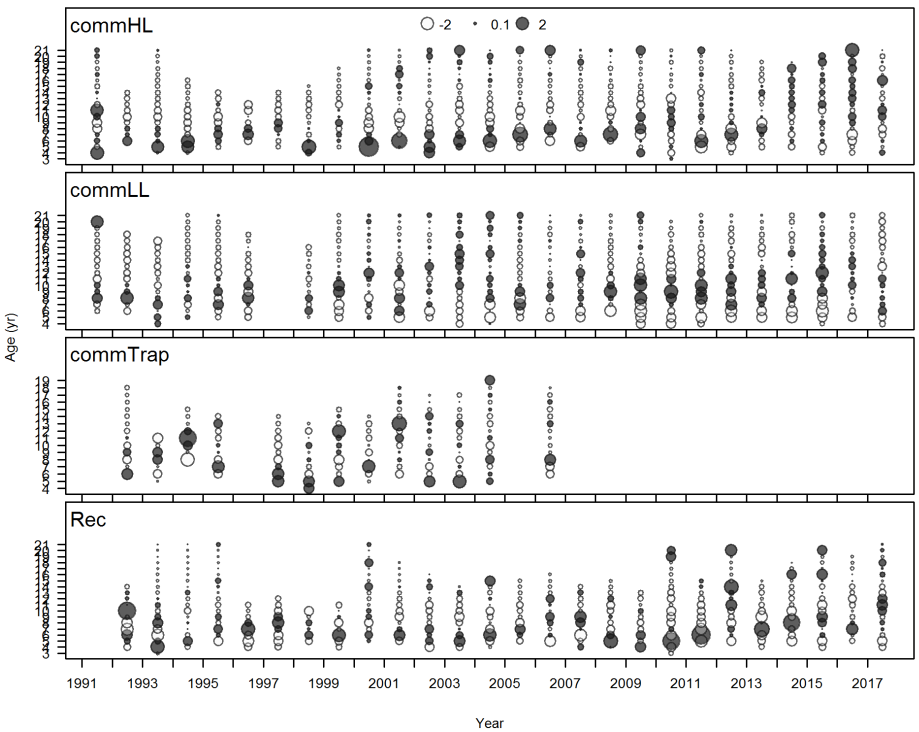
SEDAR42



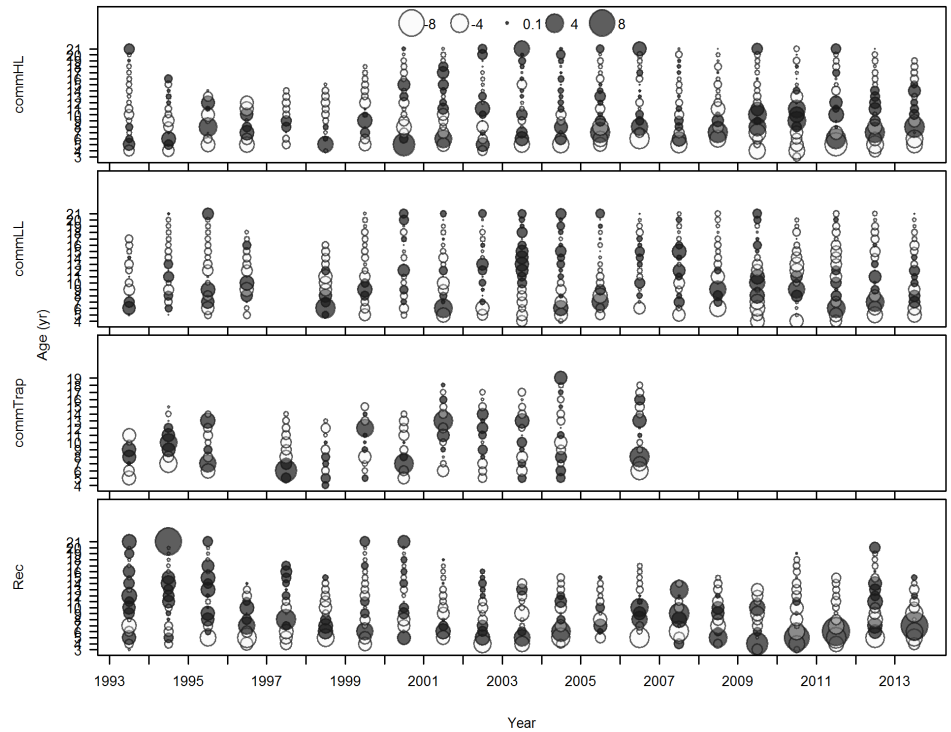
- Trade-off between fitting age compositions and discard length compositions in SEDAR61 model

Residuals: Age Composition

SEDAR61



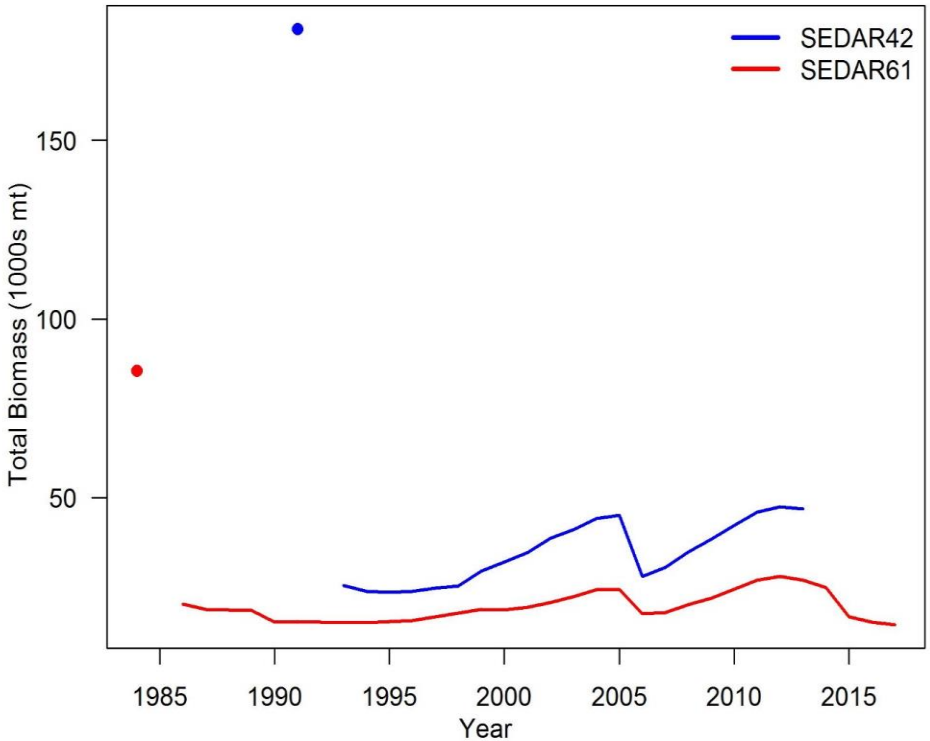
SEDAR42



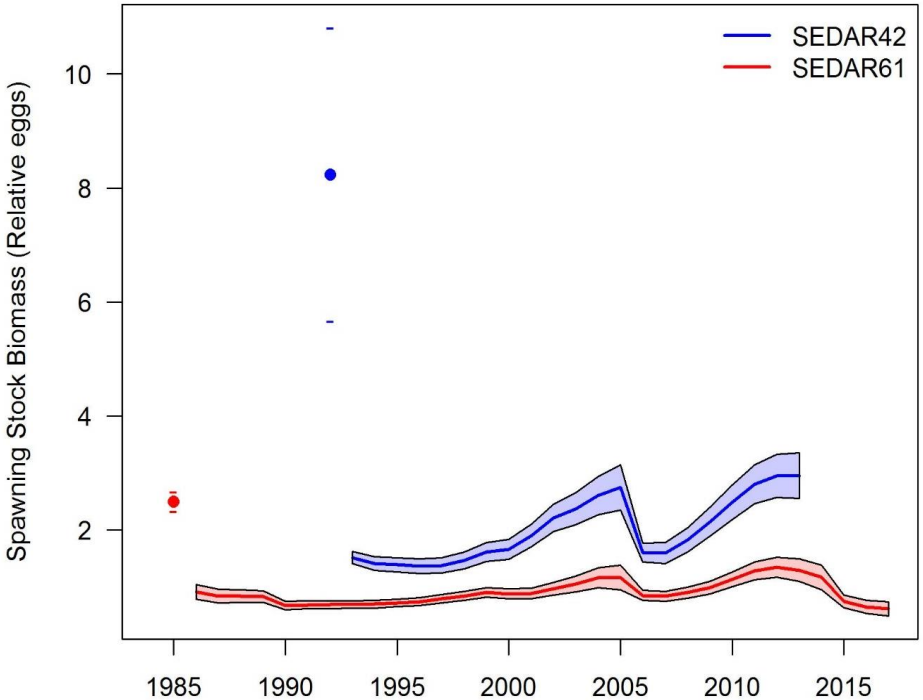
- Less pronounced residual patterns in SEDAR61 model

Biomass

Total Biomass (mt)



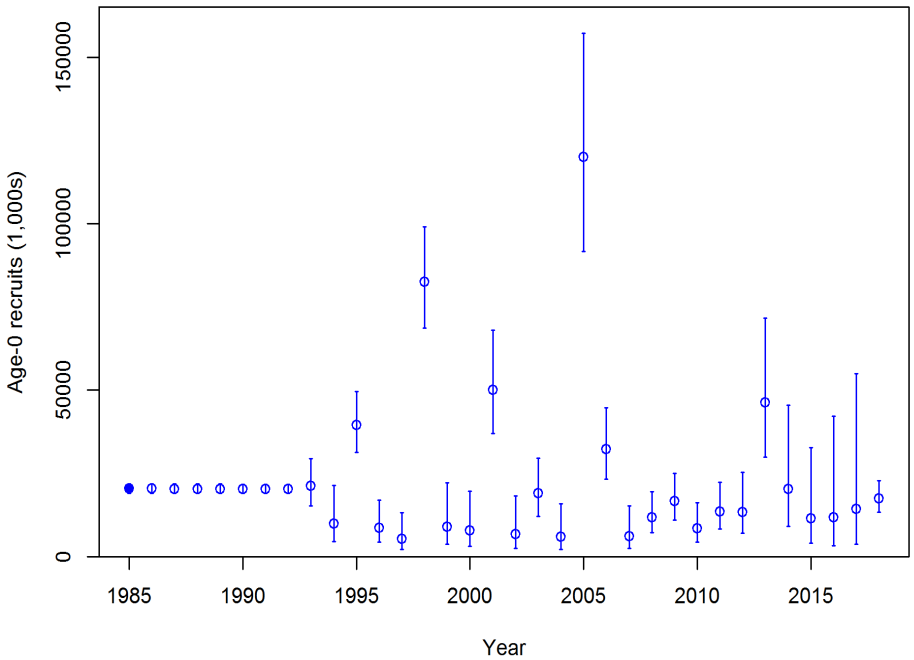
SSB (scaled number of eggs)



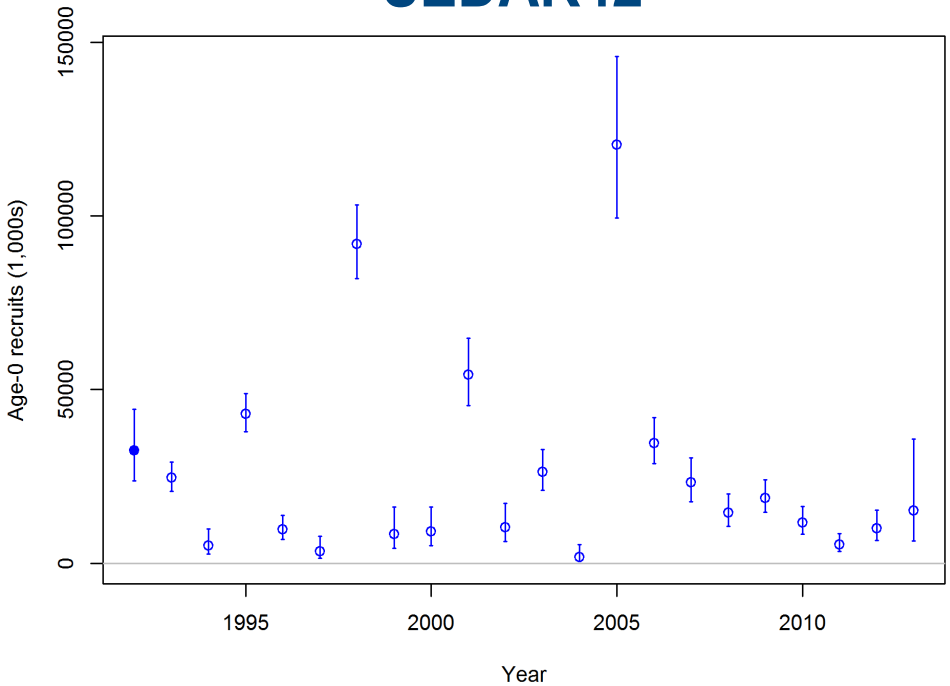
- Higher biomass in SEDAR42 model to sustain higher initial catches
- Declines in 2005 and 2014 following severe red tides

Recruitment

SEDAR61

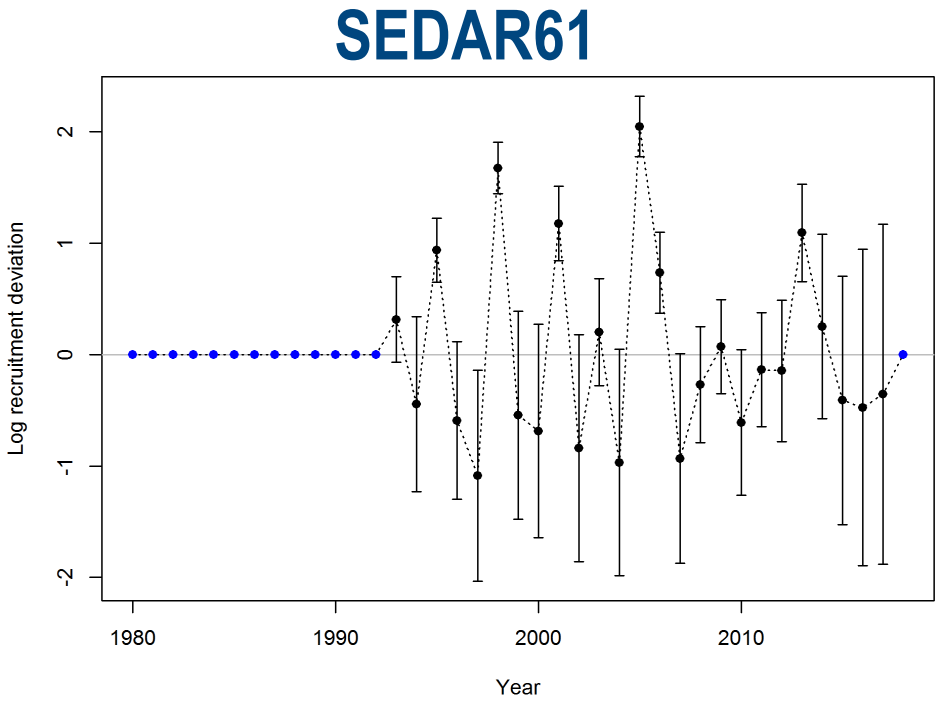


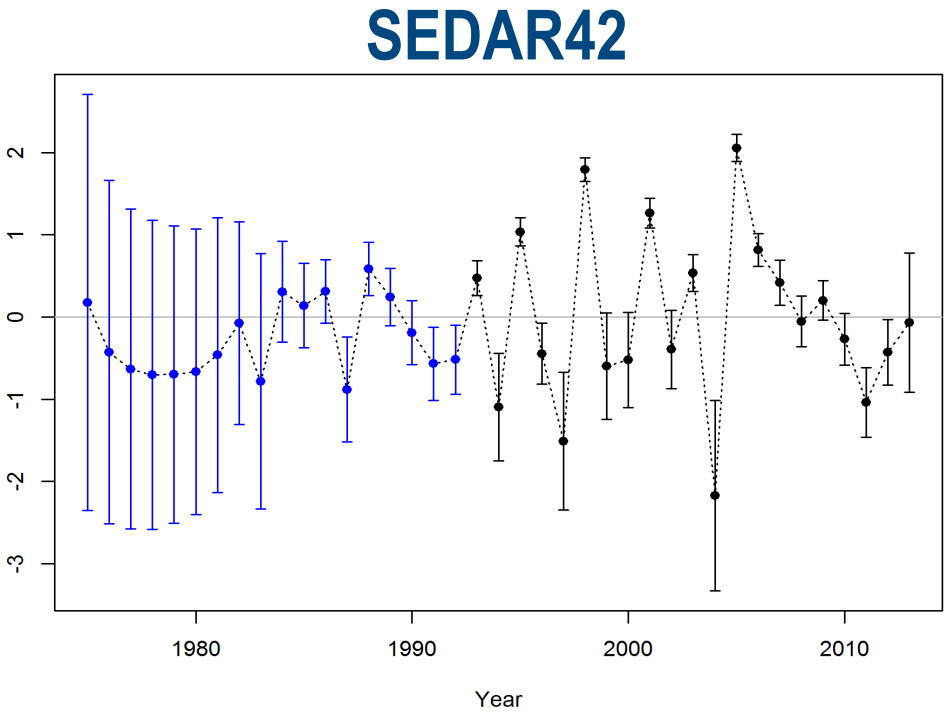
SEDAR42



- Strong recruitment events in 1995, 1998, 2001, 2005, and 2013

Recruitment Deviations

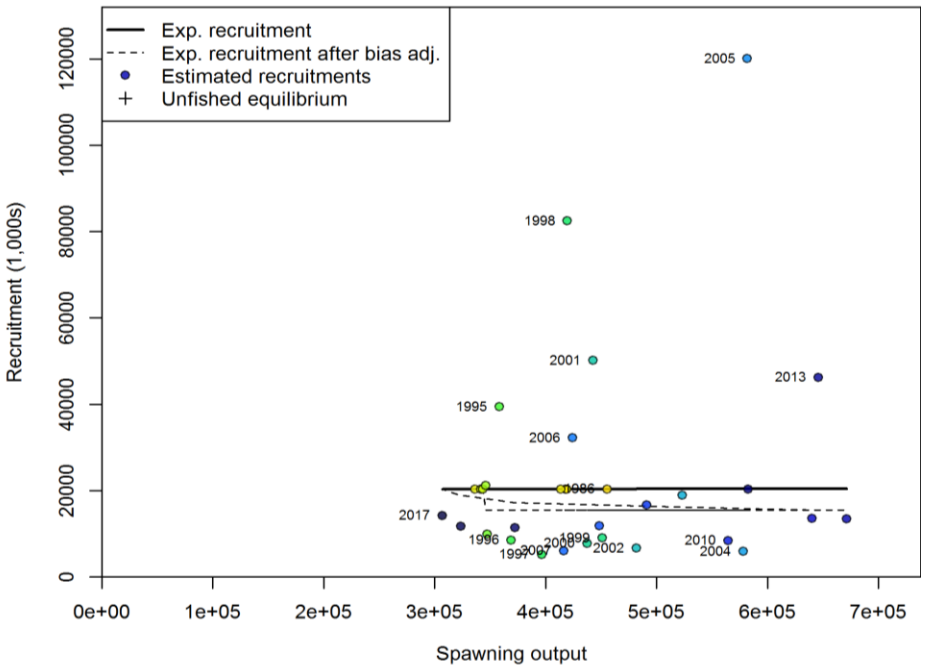




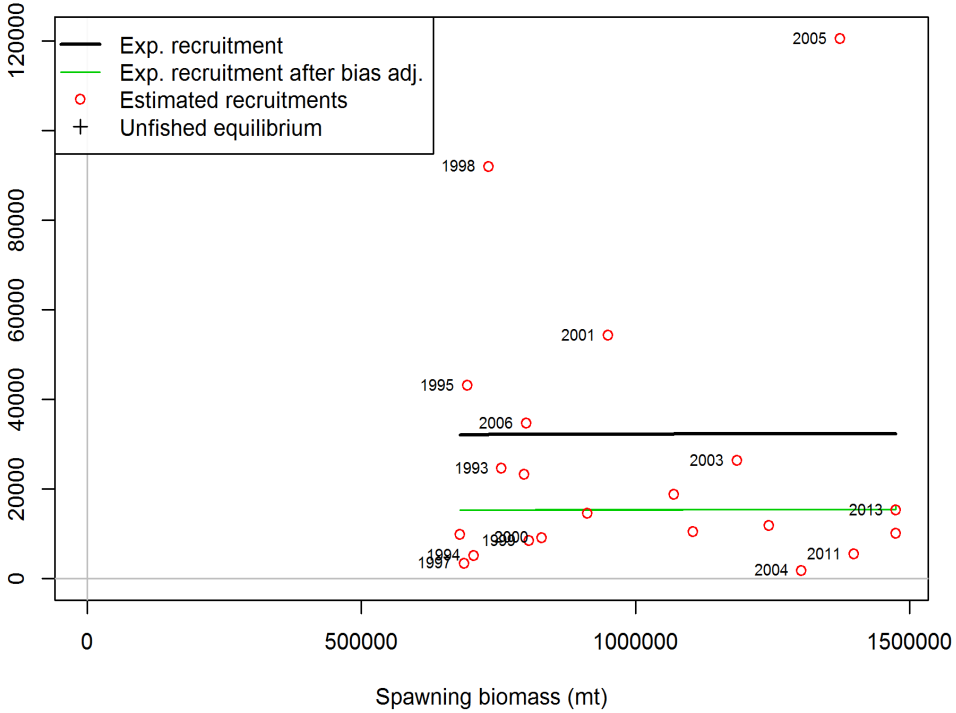
- Early rec devs not estimated in SEDAR61
  - Led to high CVs in estimated deviations and initial ages

Stock-Recruitment Relationship

SEDAR61



SEDAR42

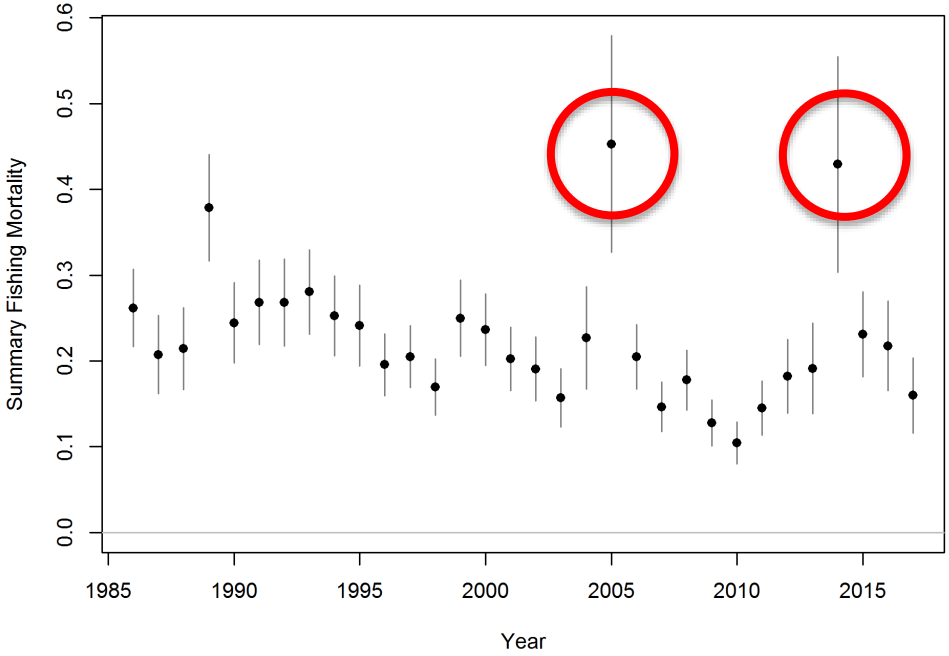


- Steepness fixed at 0.99 in light of flat SR relationship
  - ****Not to be interpreted as a measure of high stock productivity of the stock at low stock sizes

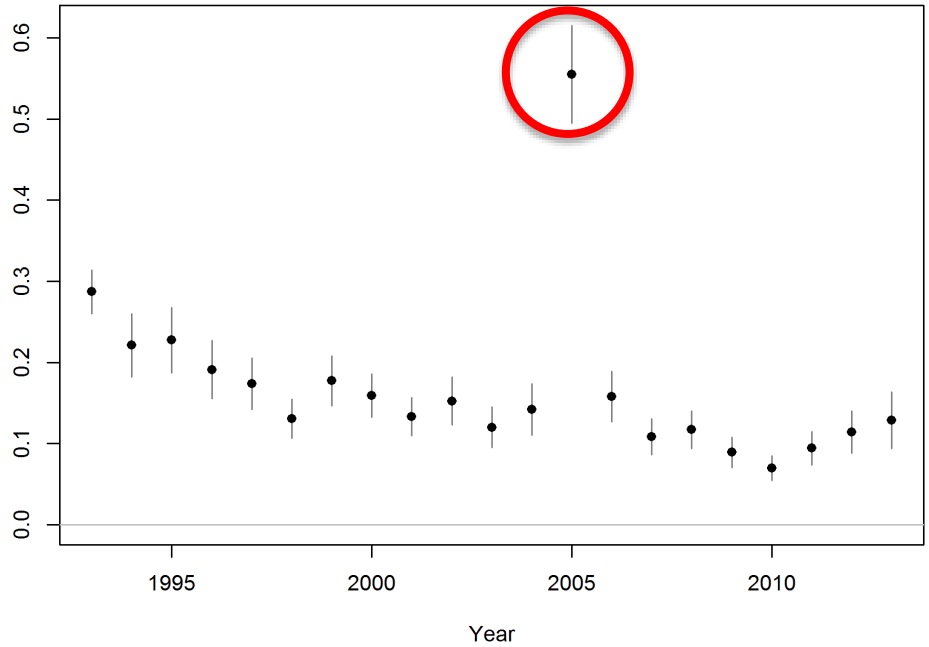
Exploitation Rate

- Fraction of population removed in biomass

SEDAR61



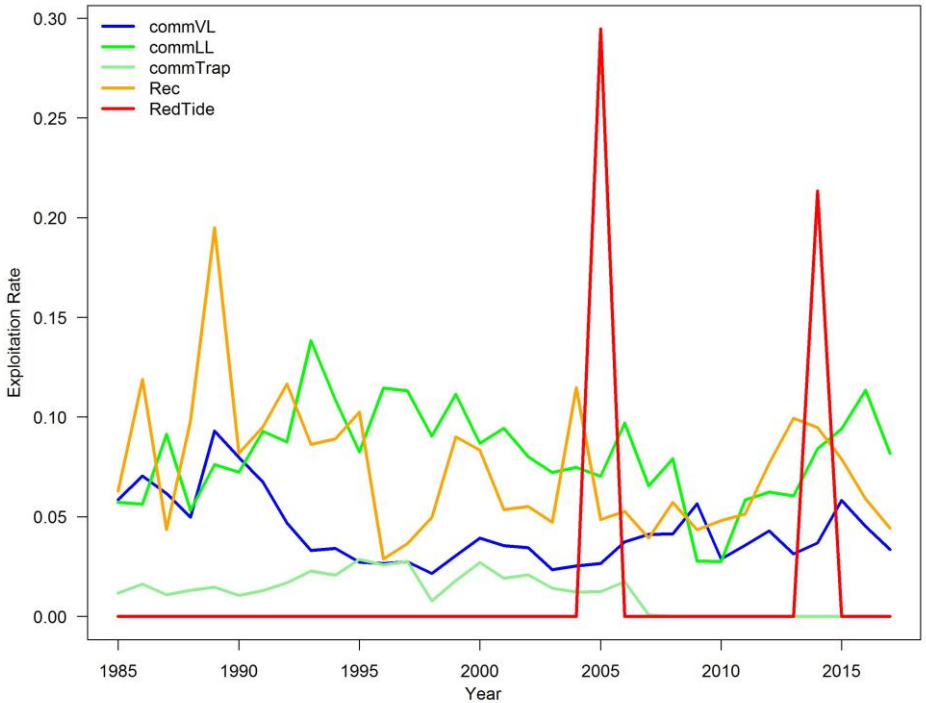
SEDAR42



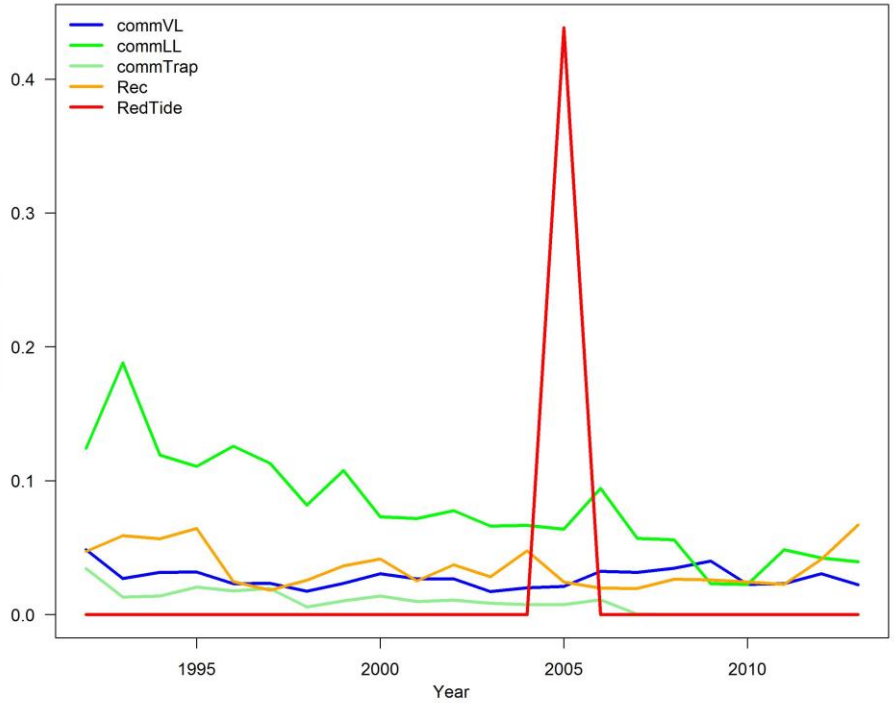
- Red tide mortality included
- Recent fishing mortality rate one of lowest in time series

Fleet-specific Fishing Mortality Rate

SEDAR61



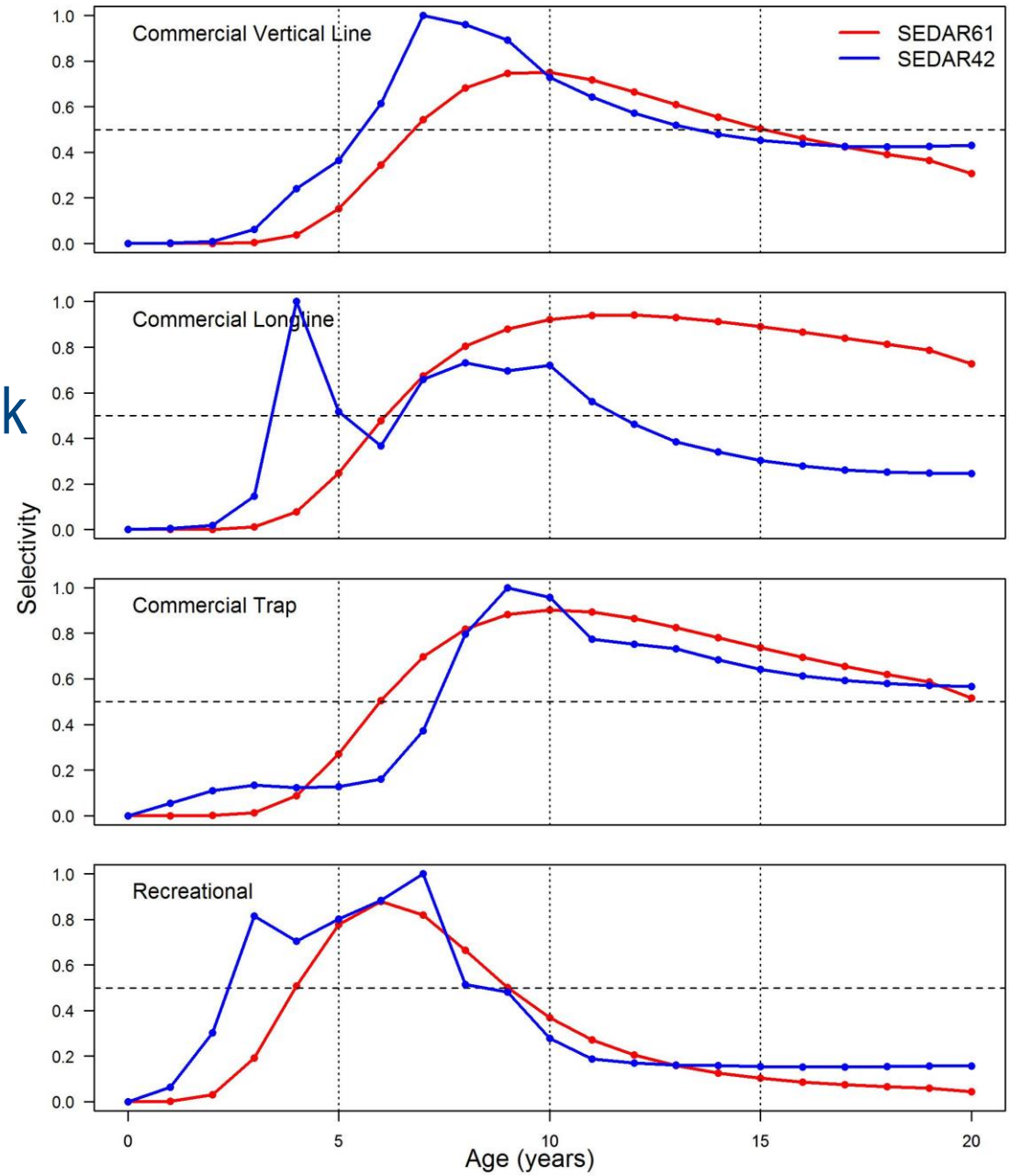
SEDAR42



- Fraction of population removed in biomass
- Red tide modeled as fishing fleet

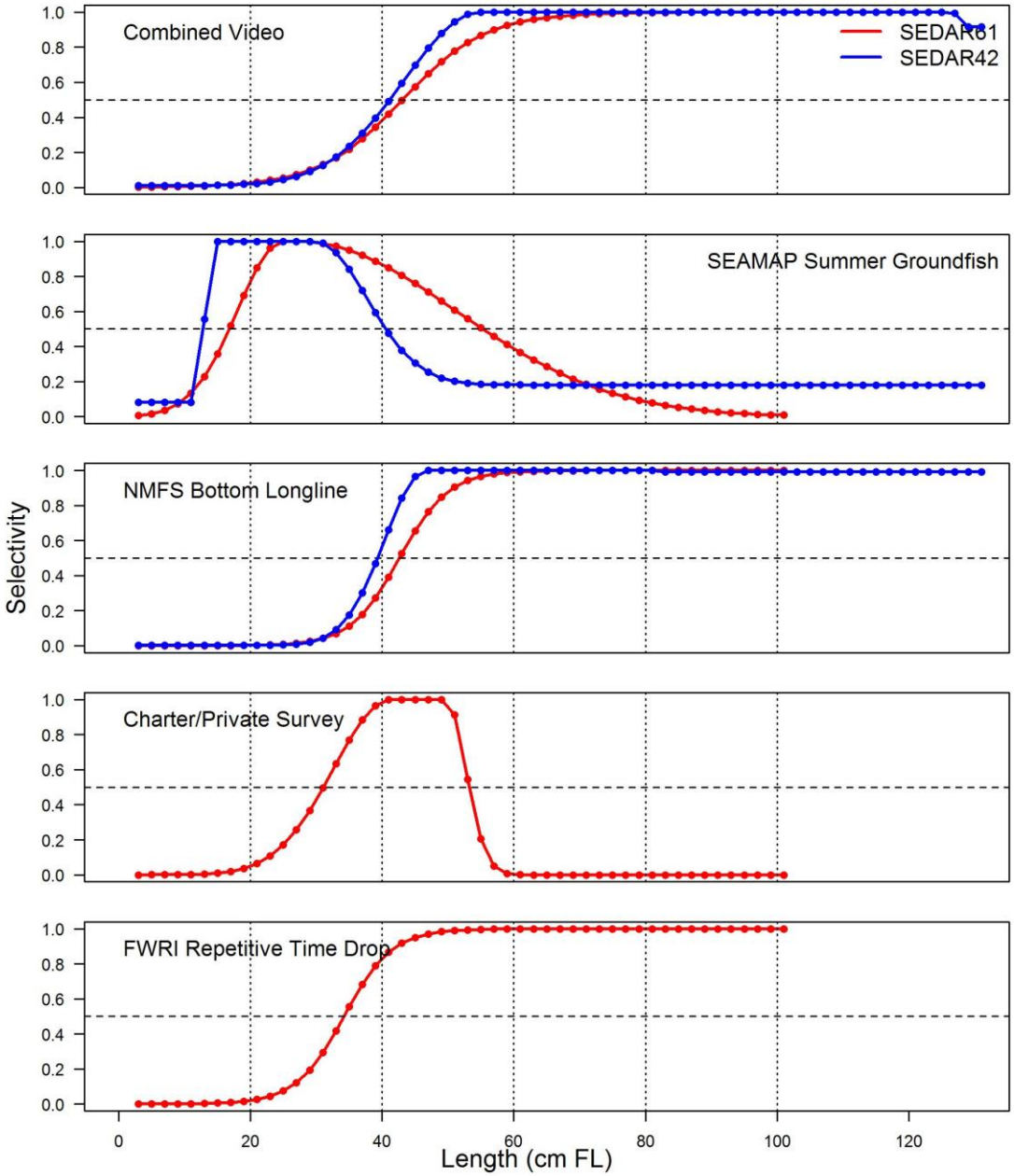
Derived age-based selectivity

- SEDAR42:
  - Age-based, random walk
  - Over-parameterized
- SEDAR61:
  - Length-based, double normal
  - Better able to capture cohorts in data, fewer years with recruitment CVs > 1

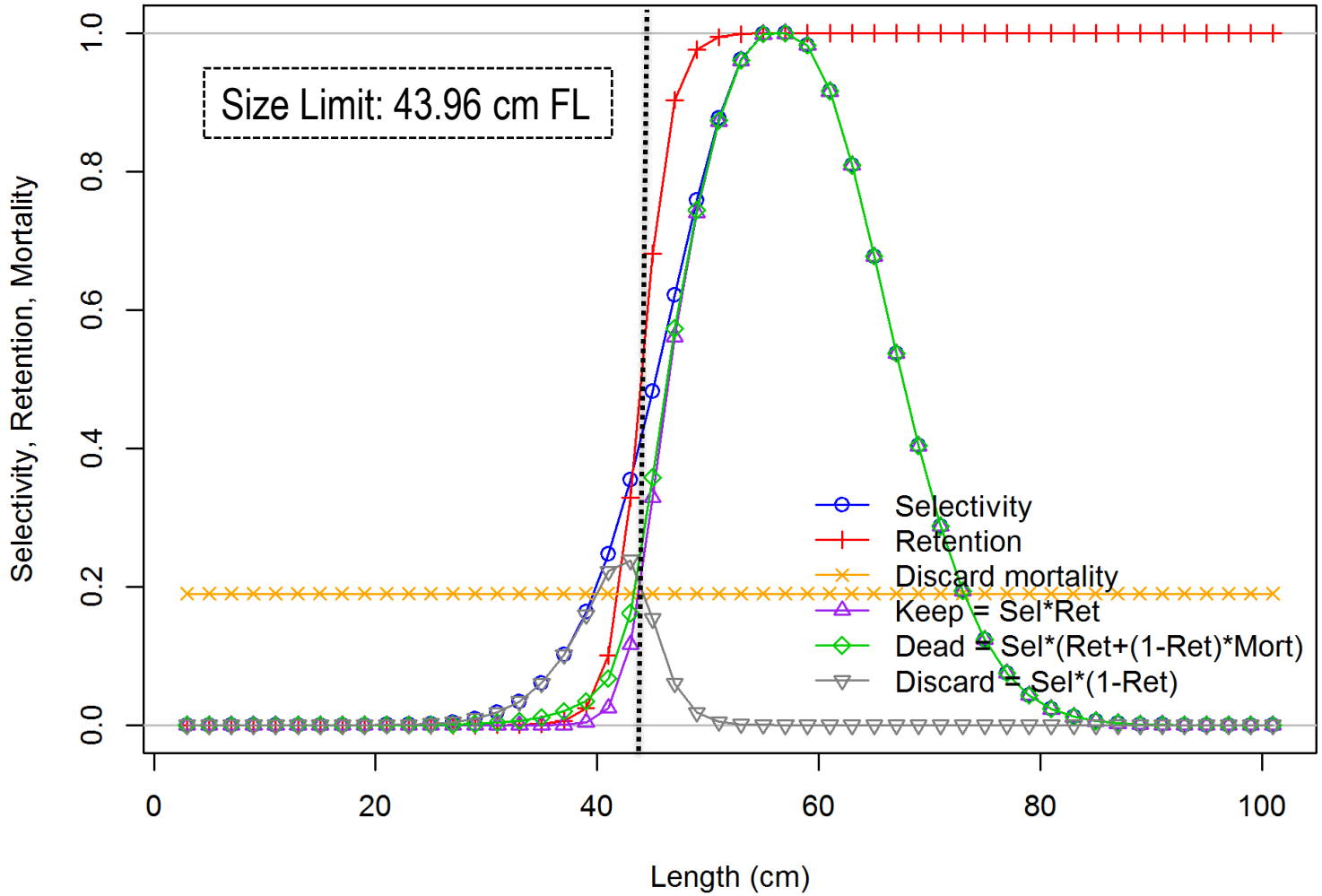


Length-based selectivity

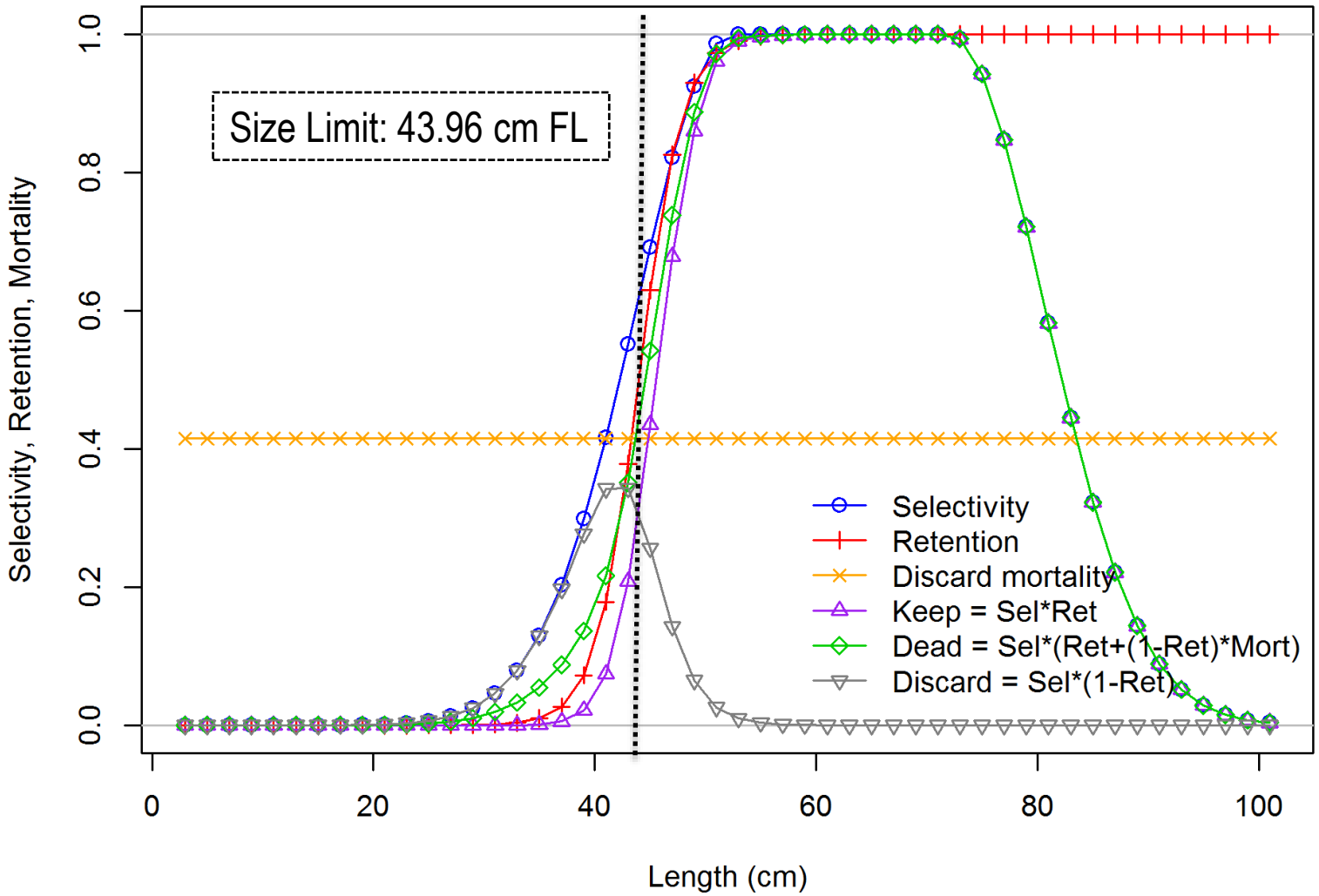
- SEDAR42:
  - Double normal
- SEDAR61:
  - Logistic:
    - Video
    - BLL
    - FWRI
  - MRIP Charter/Private survey mirrors fishery



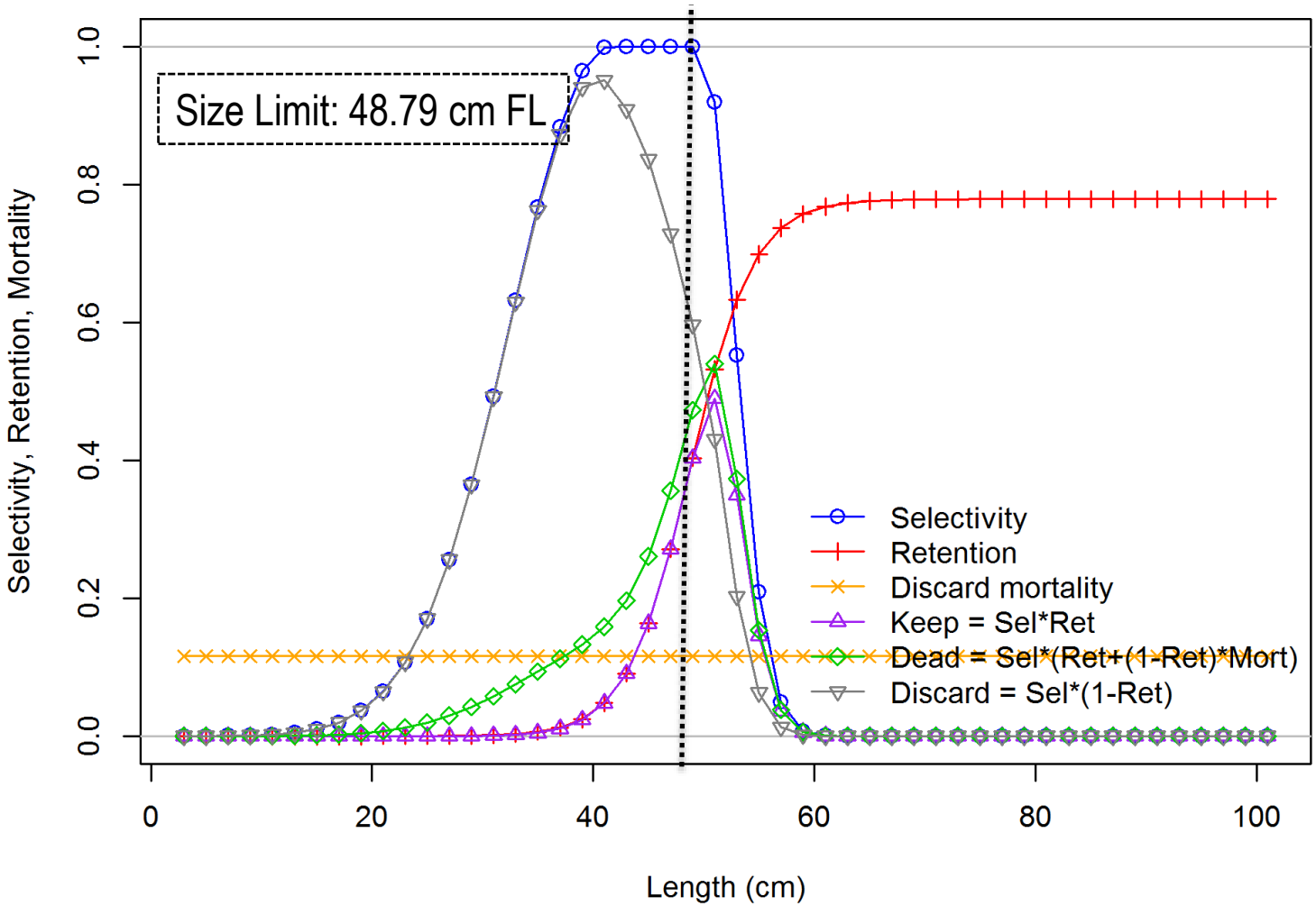
Commercial vertical line: 2017 selectivity



Commercial longline: 2017 selectivity



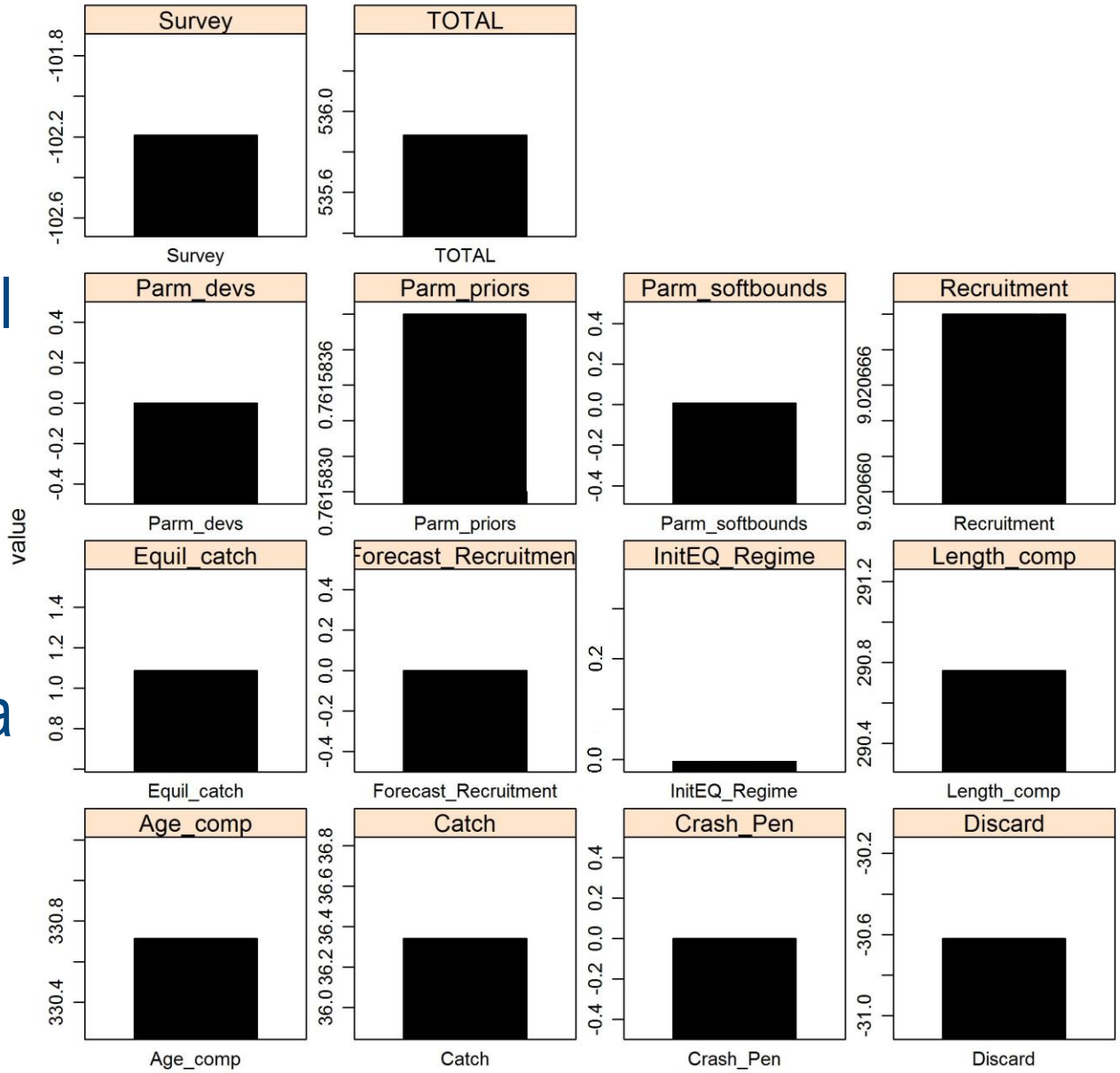
Recreational: 2017 selectivity



Model Diagnostics

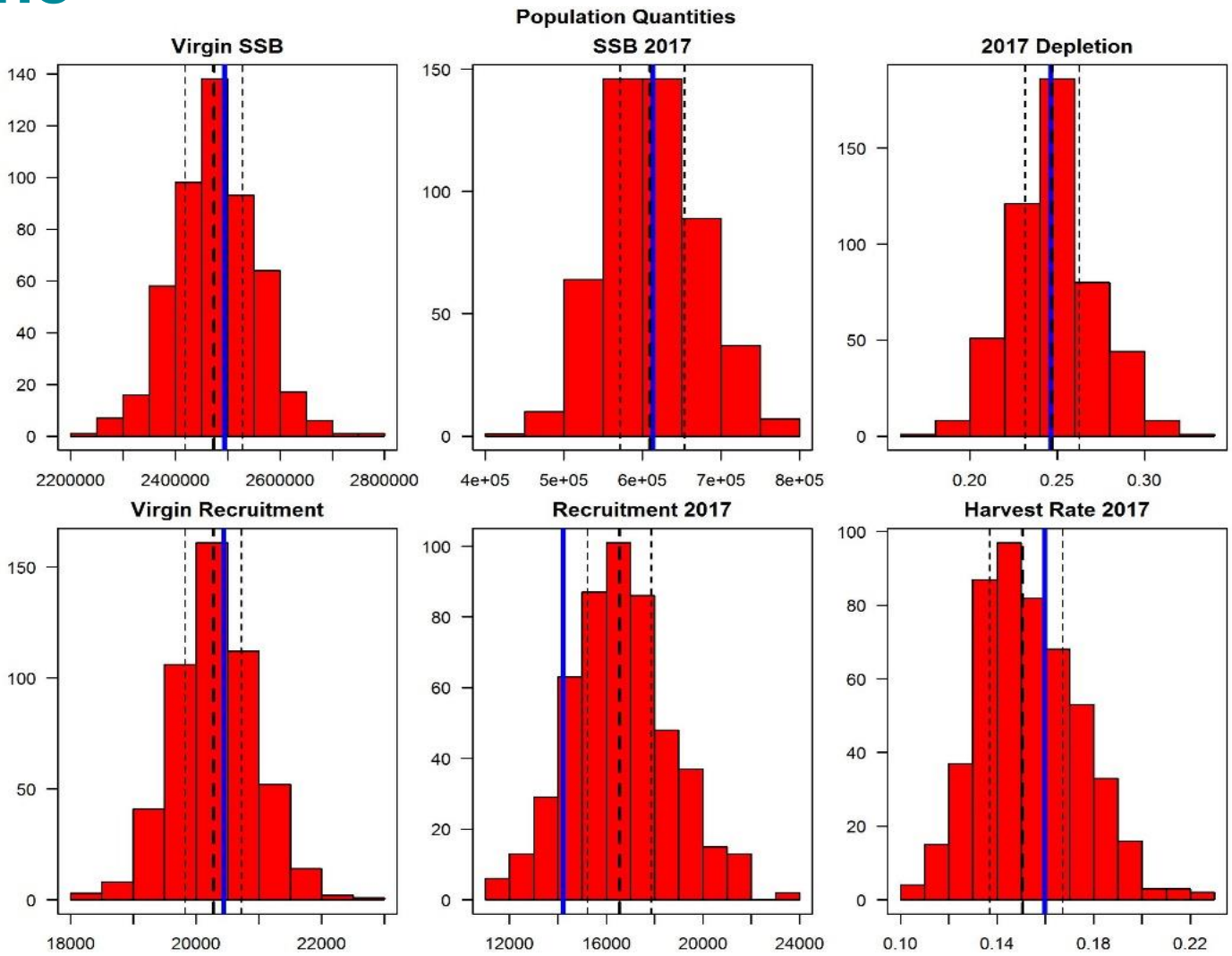
Jitter analysis

- Evaluate model convergence
- N=200
- Suggests we have reached a stable model
- SEDAR42 RW: 52% within 5 NLL units



Bootstrap runs

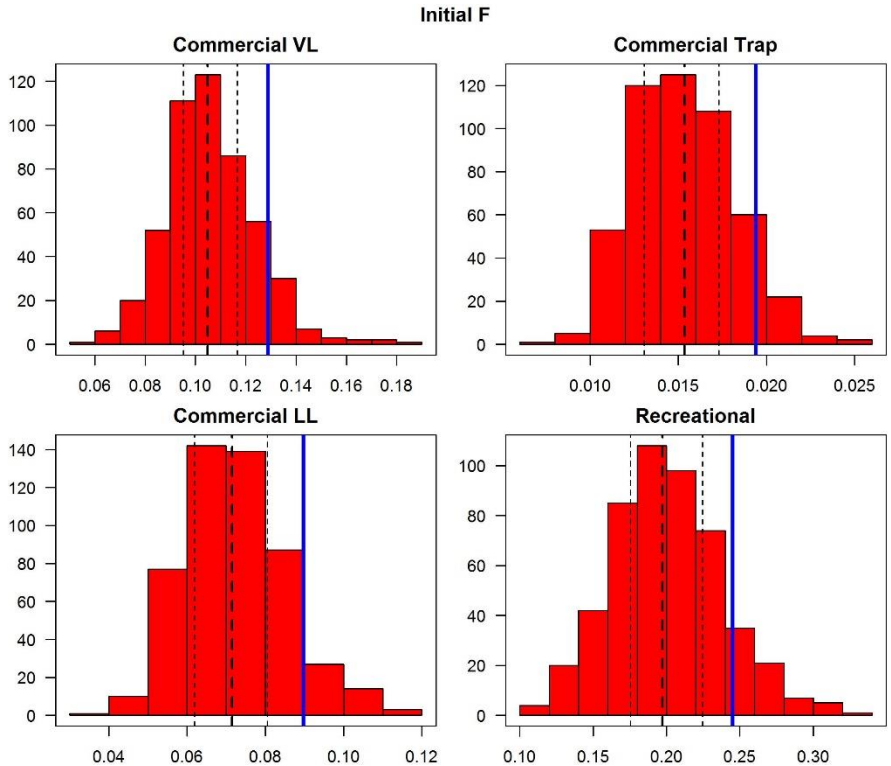
- N = 500
- Blue line reflects model estimate

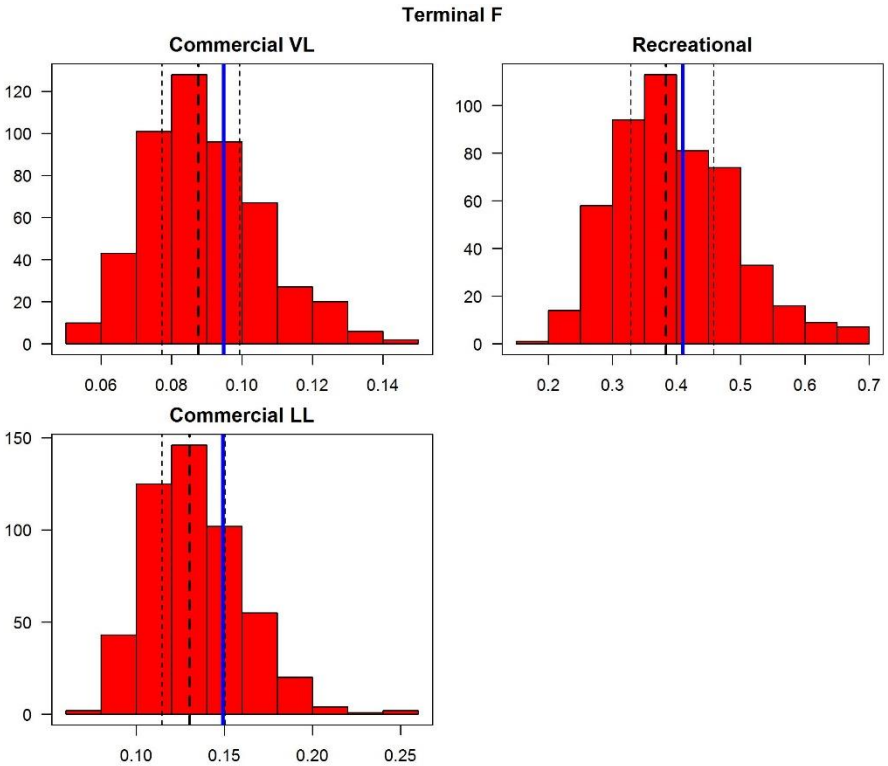


Bootstrap runs

Initial F

2017 F



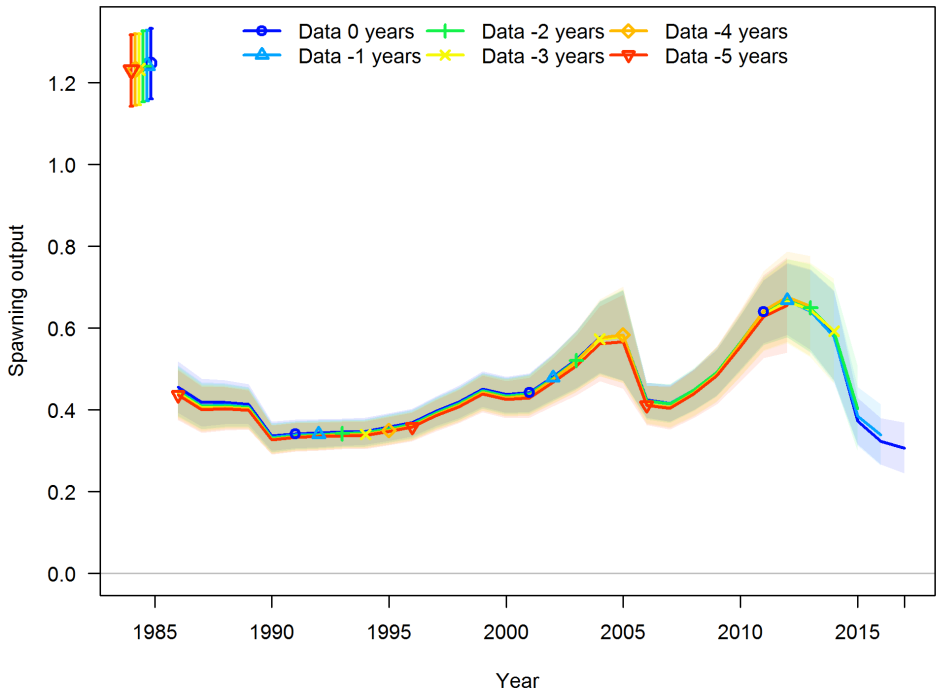


- Initial F's show some variability

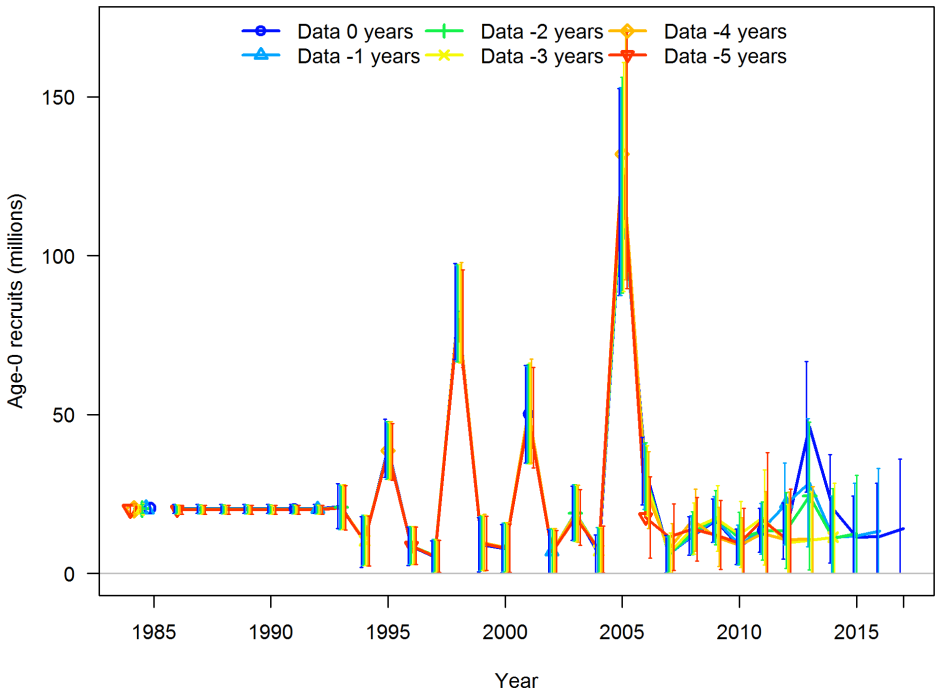
Retrospective runs

- Assess consistency of model results and potential biases

Spawning Output



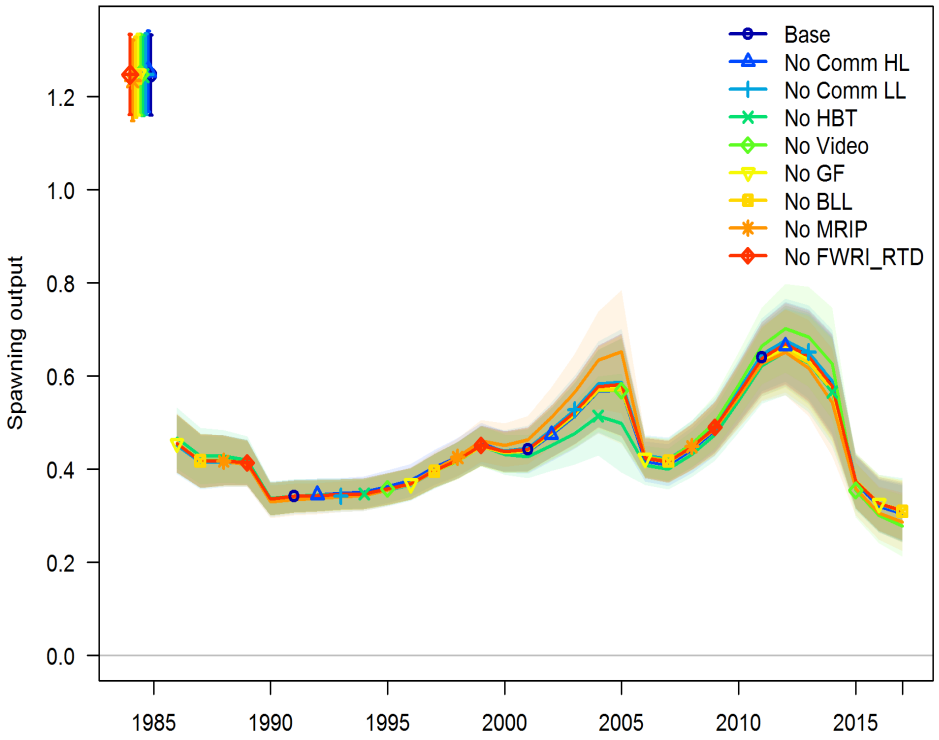
Recruits



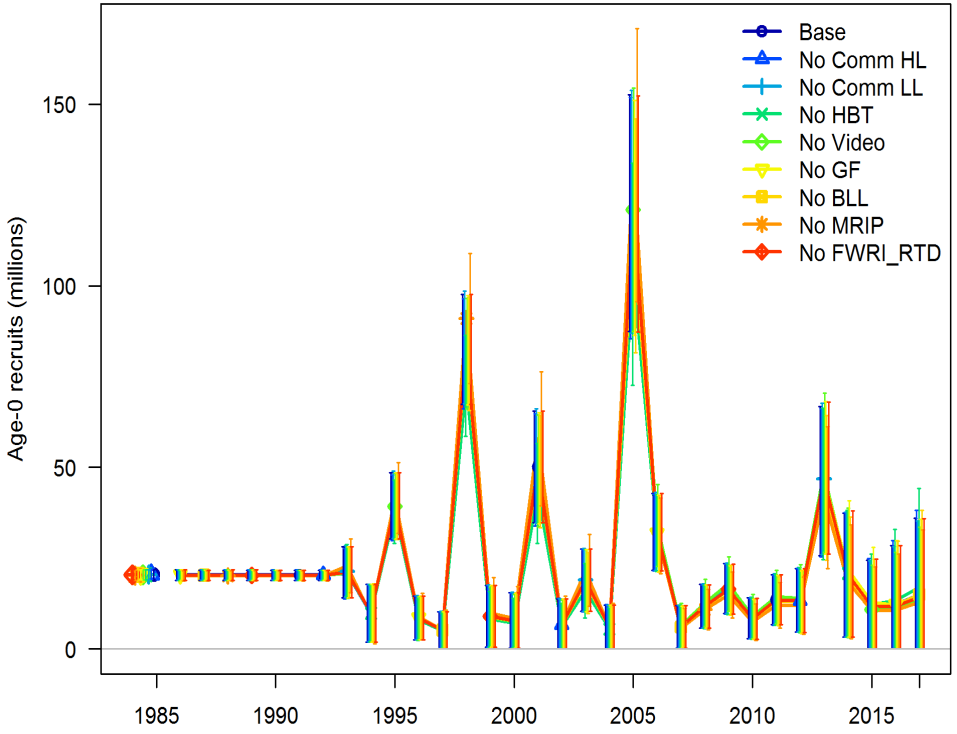
- Lack of systematic retrospective pattern

Index Jack-knife runs

Spawning Output



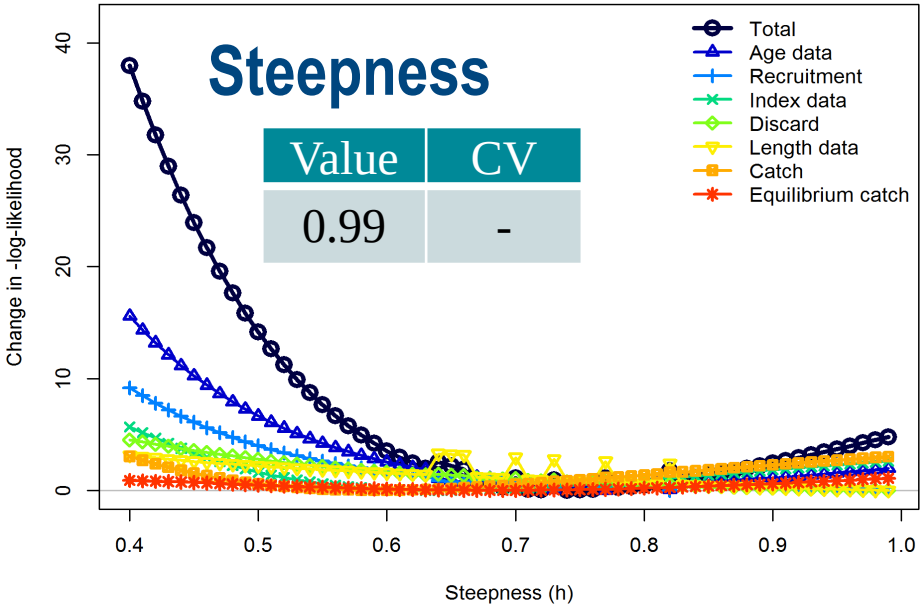
Recruits

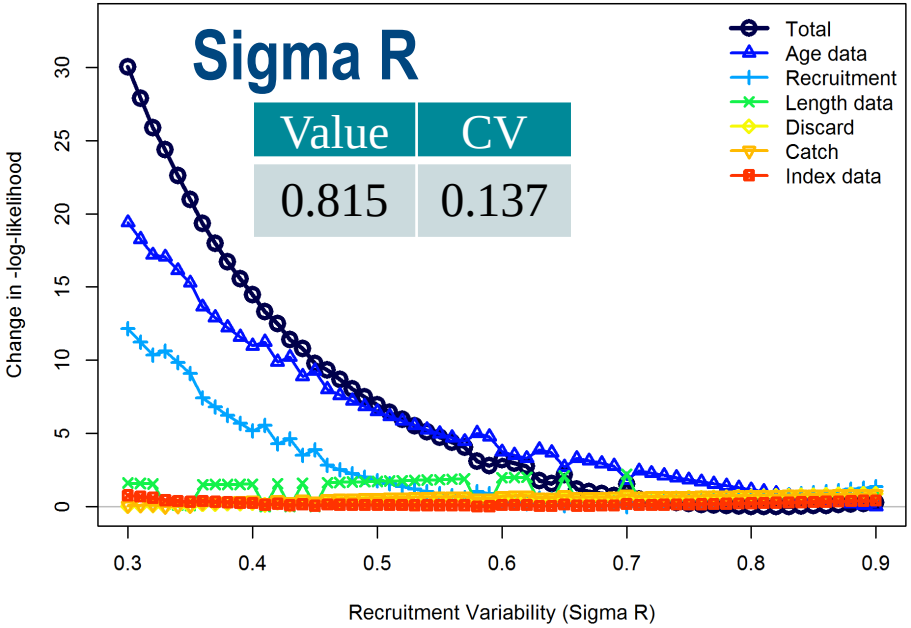


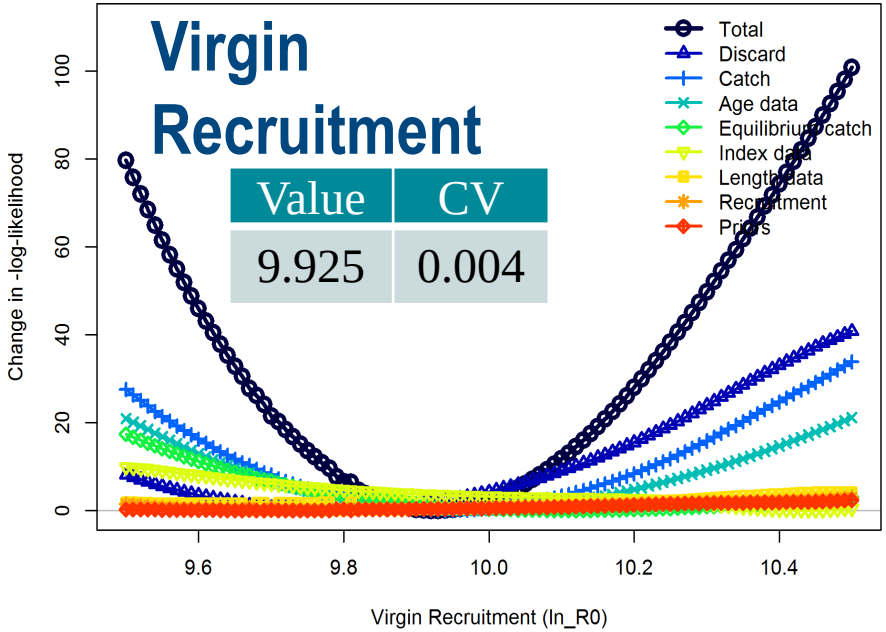
- Model results relatively insensitive to removal of each index

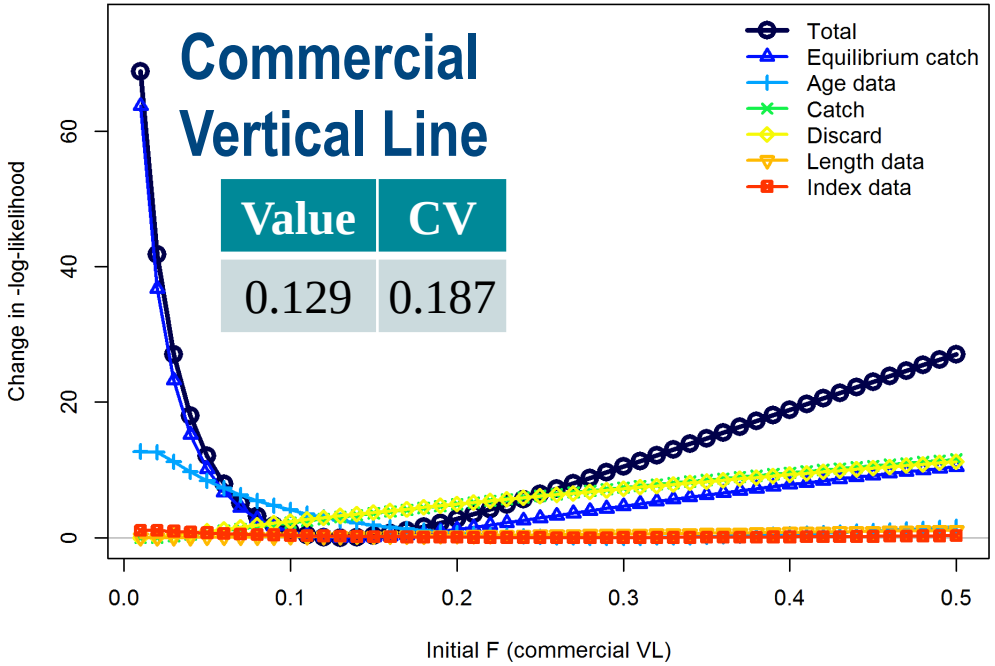
Likelihood profile

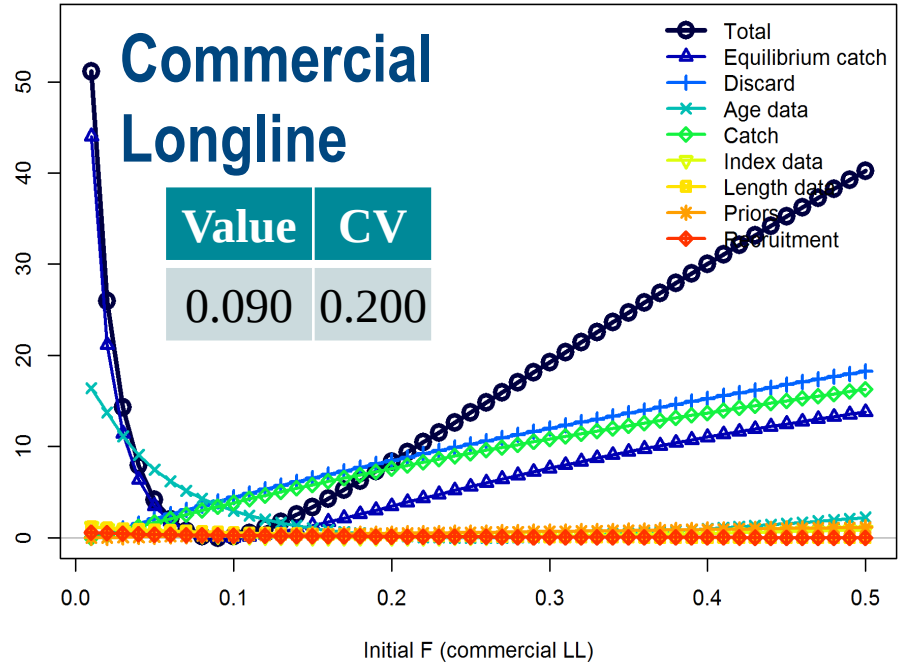
- Evaluate ability of model to estimate various parameters and most likely values

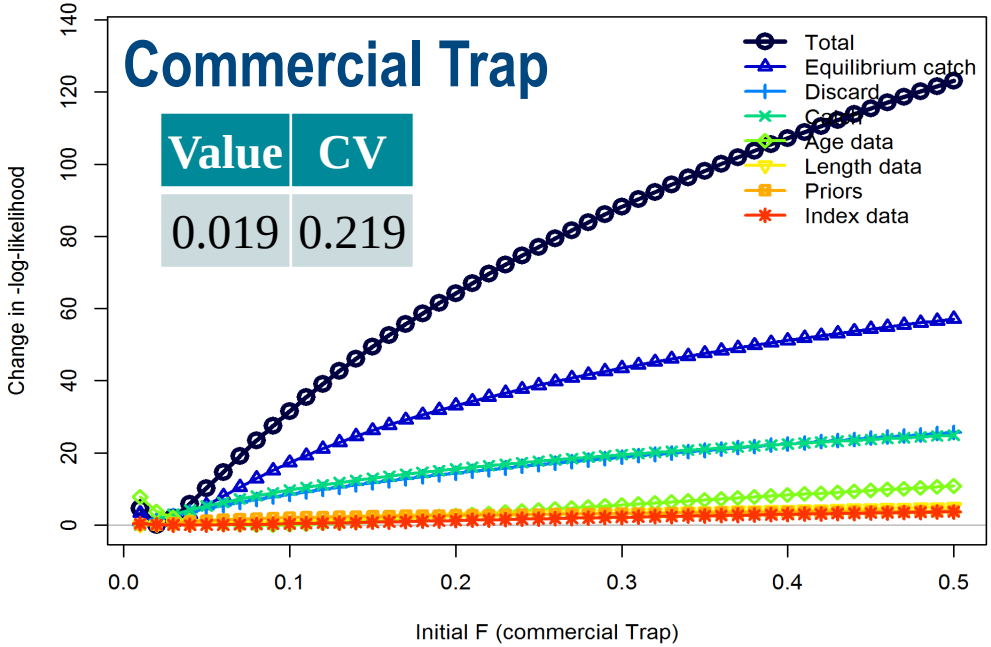


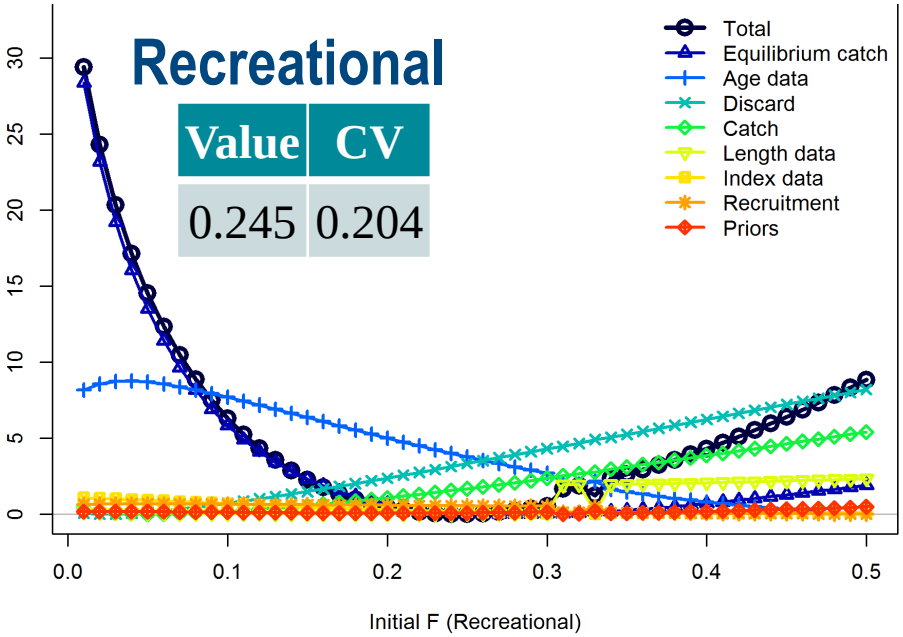





Commercial Vertical Line
Value CV
0.129 0.187
Total
Equilibrium catch
Age data
Catch
Discard
Length data
Index data
Change in -log-likelihood
Initial F (commercial VL)


Commercial Longline
Value CV
0.090 0.200
Total
Equilibrium catch
Discard
Age data
Catch
Index data
Length data
Priors
Recruitment
Initial F (commercial LL)


Commercial Trap
Value CV
0.019 0.219
Total
Equilibrium catch
Discard
Catch
Age data
Length data
Priors
Index data
Change in -log-likelihood
Initial F (commercial Trap)

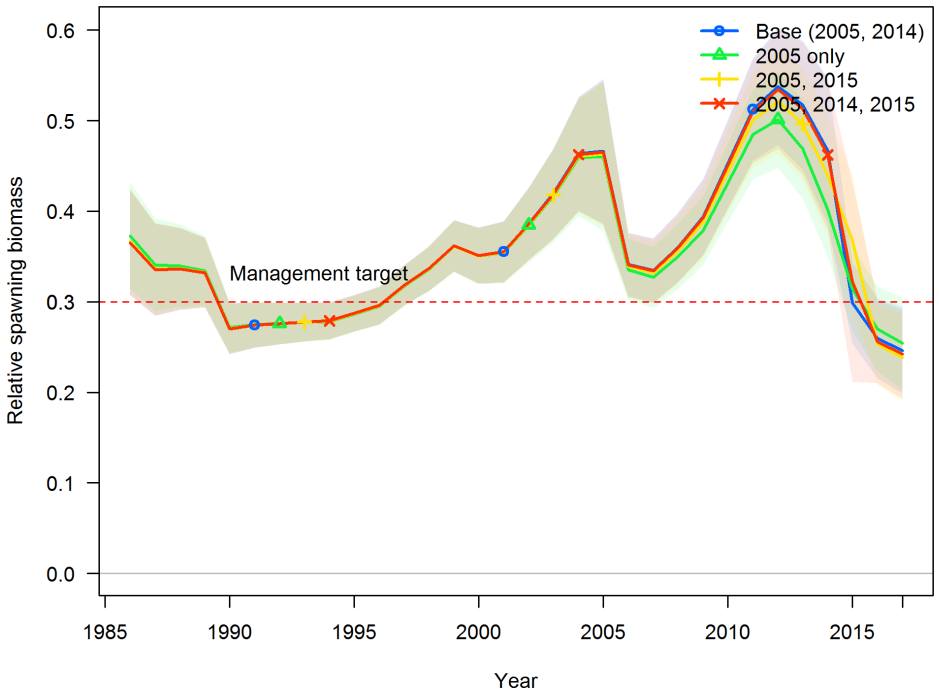

Recreational
Value CV
0.245 0.204
Total
Equilibrium catch
Age data
Discard
Catch
Length data
Index data
Recruitment
Priors
Initial F (Recreational)

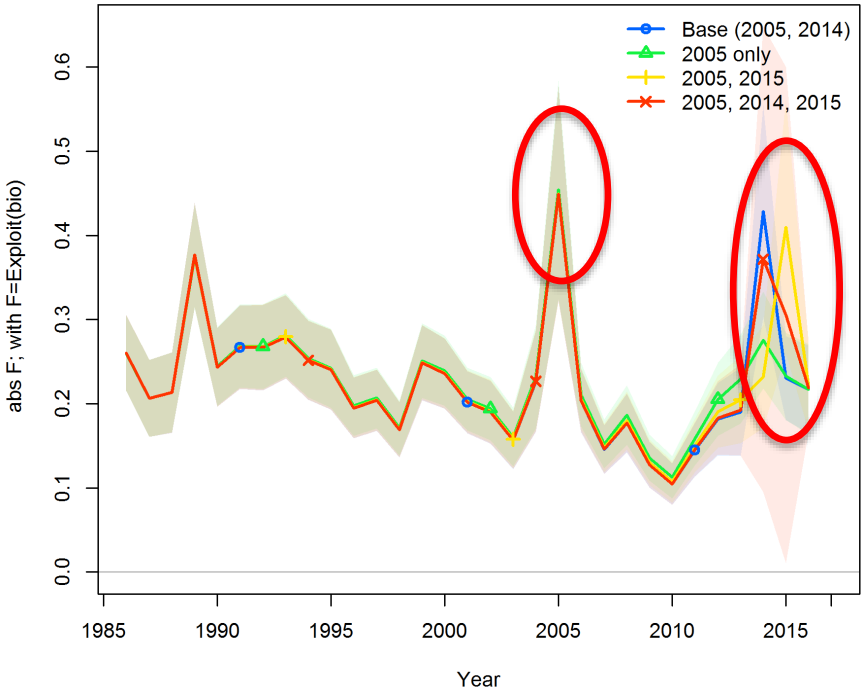
Sensitivity runs

*Term of Reference

Red Tide*

Red Tide M	2005	2014	2015
2005 only	0.339 (0.320)	-	-
2005, 2014	0.339 (0.309)	0.257 (0.429)	-
2005, 2015	0.337 (0.313)	-	0.262 (0.459)
2005, 2014-15	0.338 (0.310)	0.174 (1.126)	0.109 (1.939)

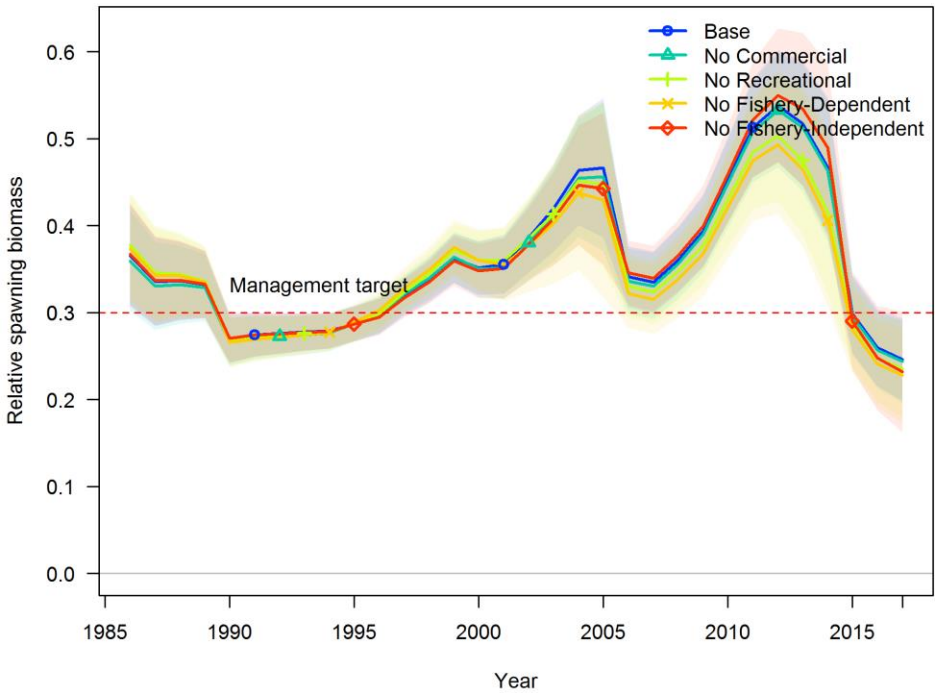


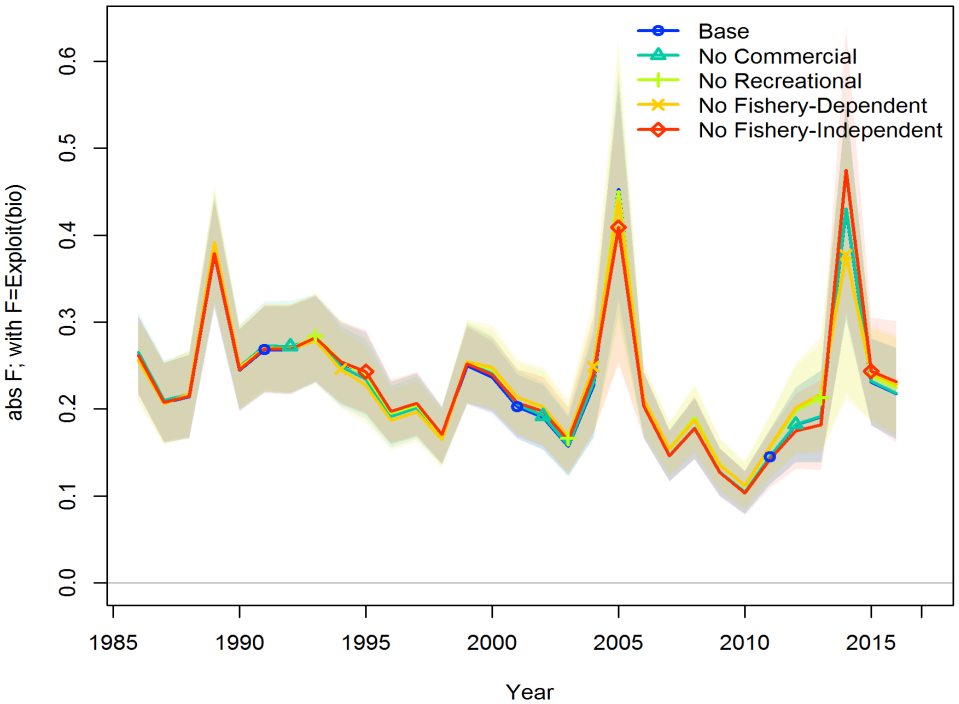


- Model cannot distinguish between a red tide event occurring in 2014 and 2015

No FD Surveys*

*Term of Reference



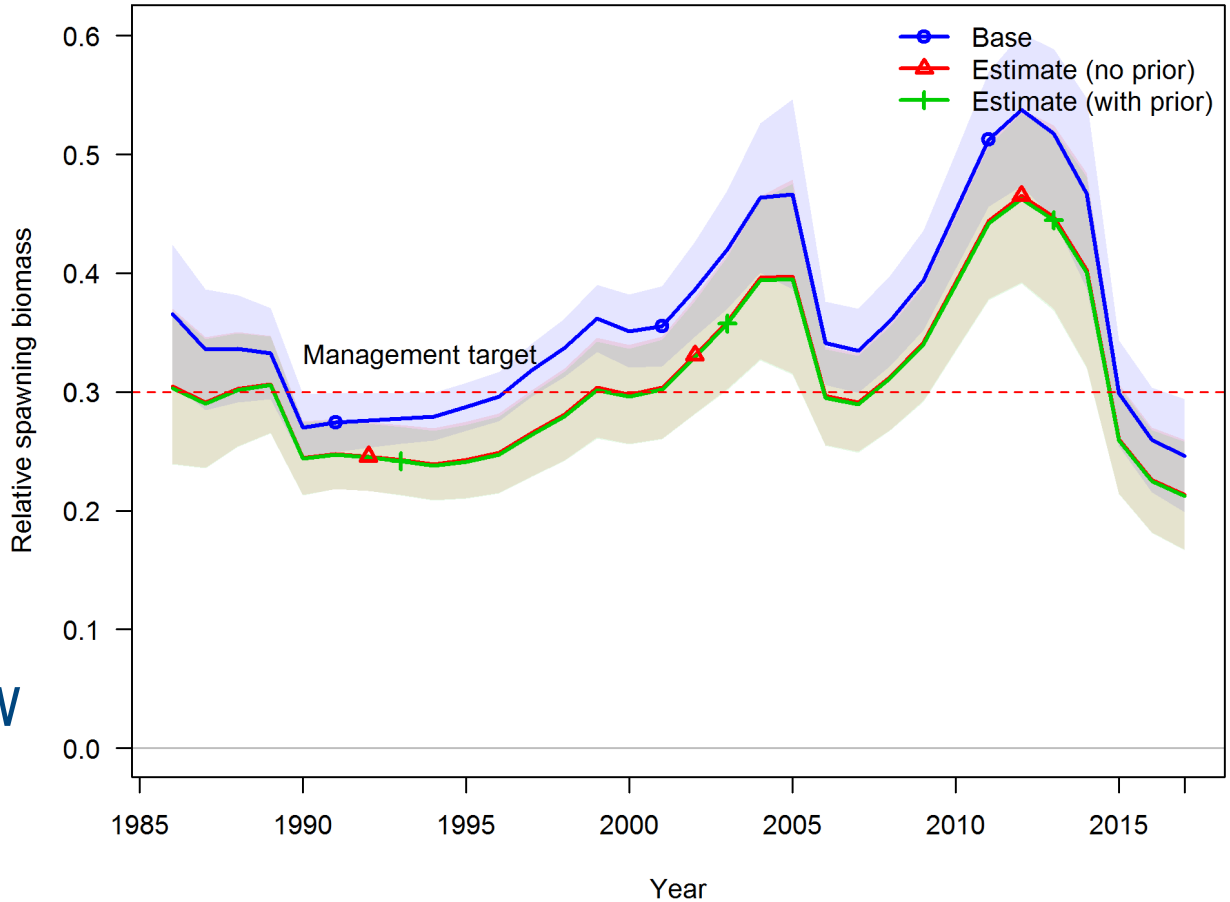


- Removal of indices results in similar overall trends
- Additional work needed on developing post-IFQ CPUE indices

Steepness

Fixed at 0.99:

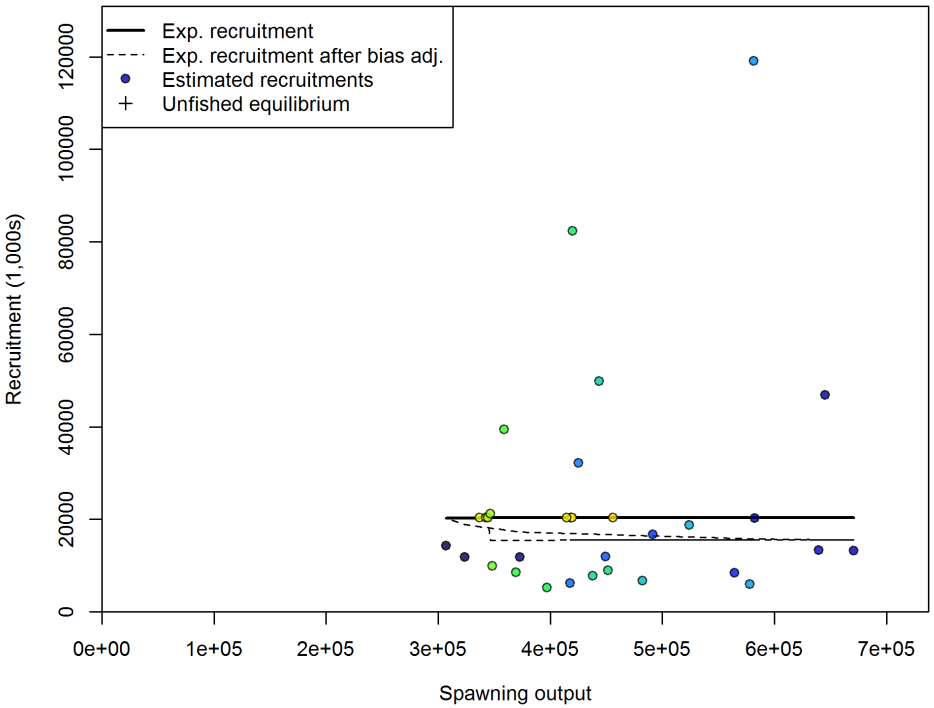
- Should not be interpreted as measure of high stock productivity of the stock at low stock sizes



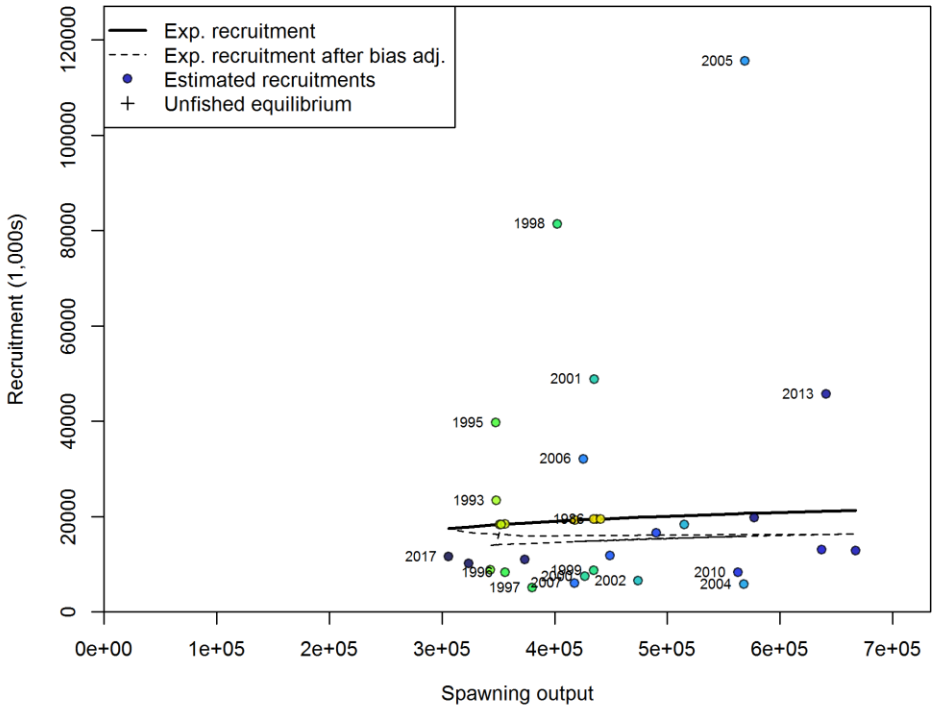
Model run	Steepness (CV)	Prior
Base	0.99 (-)	-
Estimate	0.734 (0.083)	None
Estimate with prior	0.727 (0.079)	0.836 (Shertzer and Conn 2012)

Spawner recruitment relationship

Fixed at 0.99



Estimated with Prior



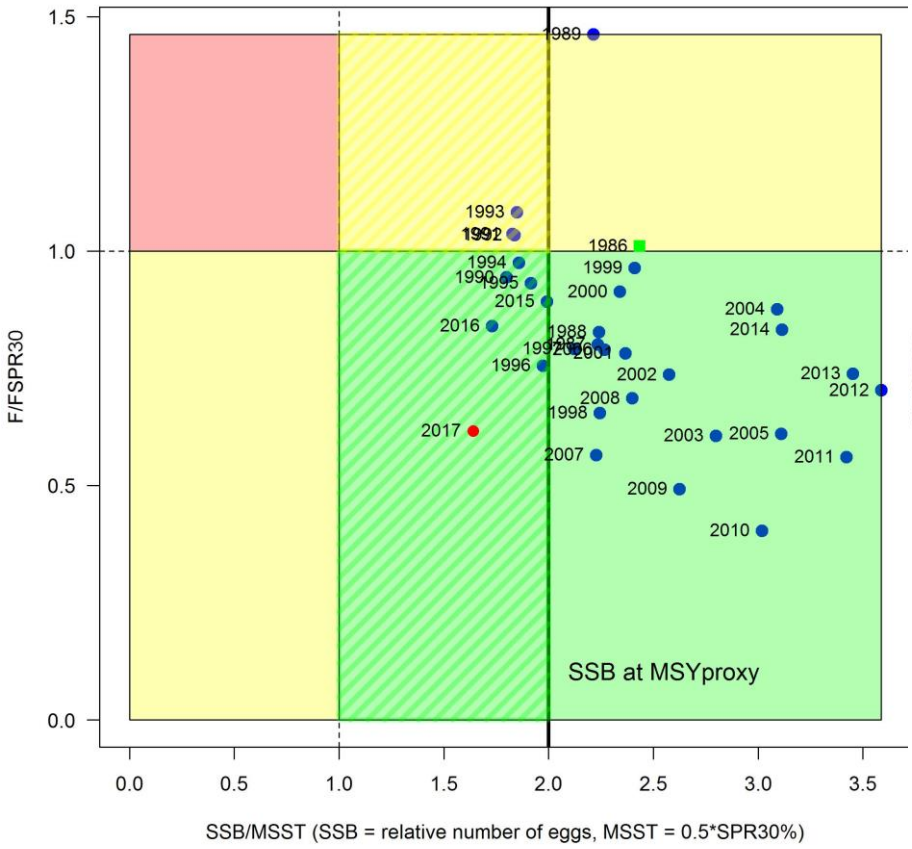
- Lacking strong S-R relationship

Stock Status & Projections

Criteria	Definition	SEDAR42	SEDAR61
Base M	Average M for Fully Selected Ages	0.144	0.144
Mortality rate criteria			
F_{MSY} or Proxy	$F_{SPR30\%}$	0.212	0.259
MFMT	$F_{SPR30\%}$	0.212	0.259
F_{OY}	0.75 * Direct F at $F_{SPR30\%}$	0.159	0.194
Fcurrent	Average F over terminal 3 years	0.126	0.203
Fcurrent/MFMT		0.594	0.784
		Overfishing Occurring	No
Biomass criteria			
SSB_{MSY} or Proxy	$SSB_{SPR30\%}$	2,447,900	748,241
$MSST_{OLD}$	(1 − M) * $SSB_{SPR30\%}$	2,095,402	640,494
$MSST_{NEW}$ (Amendment 44)	0.5 * $SSB_{SPR30\%}$	-	374,120
SSB_0	Virgin SSB	8,236,070	2,494,130
SSB_{2017}	Terminal Year SSB	2,905,630	613,517
SSB_{2017} / $SSB_{FSPR30\%}$		1.19	0.82
SSB_{2017} / $MSST_{OLD}$		1.39	0.96
		Overfished by Old Criteria	Yes
SSB_{2017} / $MSST_{NEW}$		-	1.64
		Overfished by New Criteria	No
SSB_{2017} / SSB_0		0.35	0.25

Stock Status

New MSST Definition



Old MSST Definition

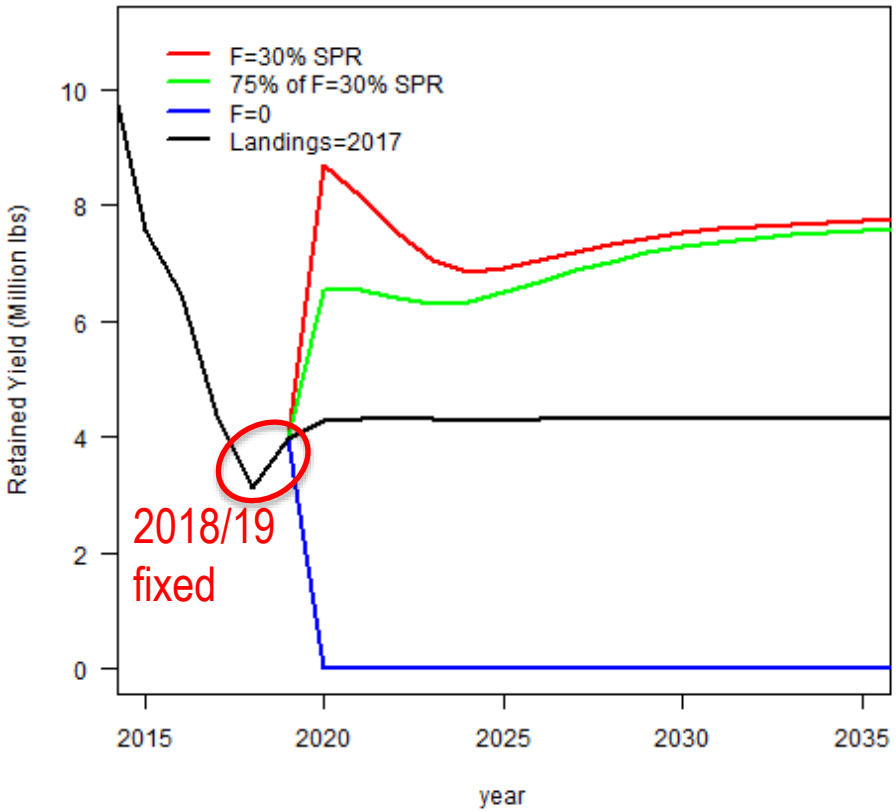
Projection settings

- Constant recruitment based on recent period (2010-2017)
- Selectivity, retention, and discard mortality taken from most recent time block (2010-2017)
- Catch allocation by fleet: 76% Commercial, 24% Recreational

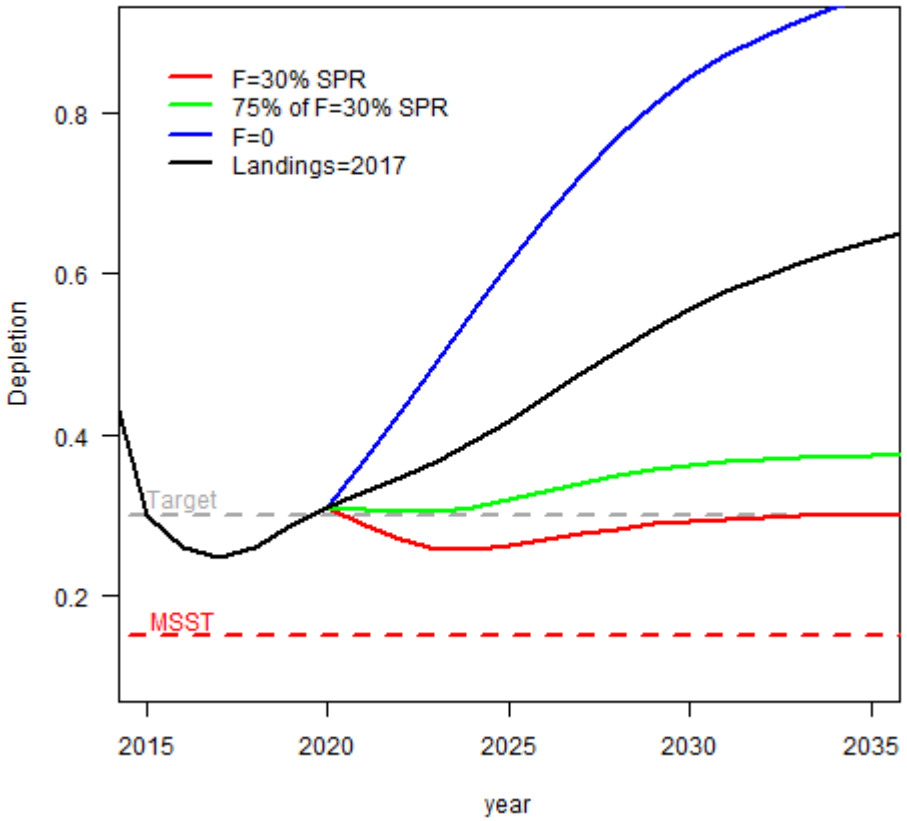
Fleet	Landings	Landings (pounds)	ACL	Breakdown of landings (2017 ratio)
2018 (Final Landings Estimates)				
Commercial vertical line	296 (mt)	652,360	8,190,000	
Commercial longline	759 (mt)	1,673,305		
Recreational	210,613 (Number)	-	2,580,000	
2019 (Emergency Rule effective 5/17/2019)				
Commercial vertical line	430 (mt)		3,160,000	948,000 (30%)
Commercial longline	1,003 (mt)			2,212,000 (70%)
Recreational	210,613 (Number)		1,000,000	

Projections – No 2018 Red Tide

Retained Yield



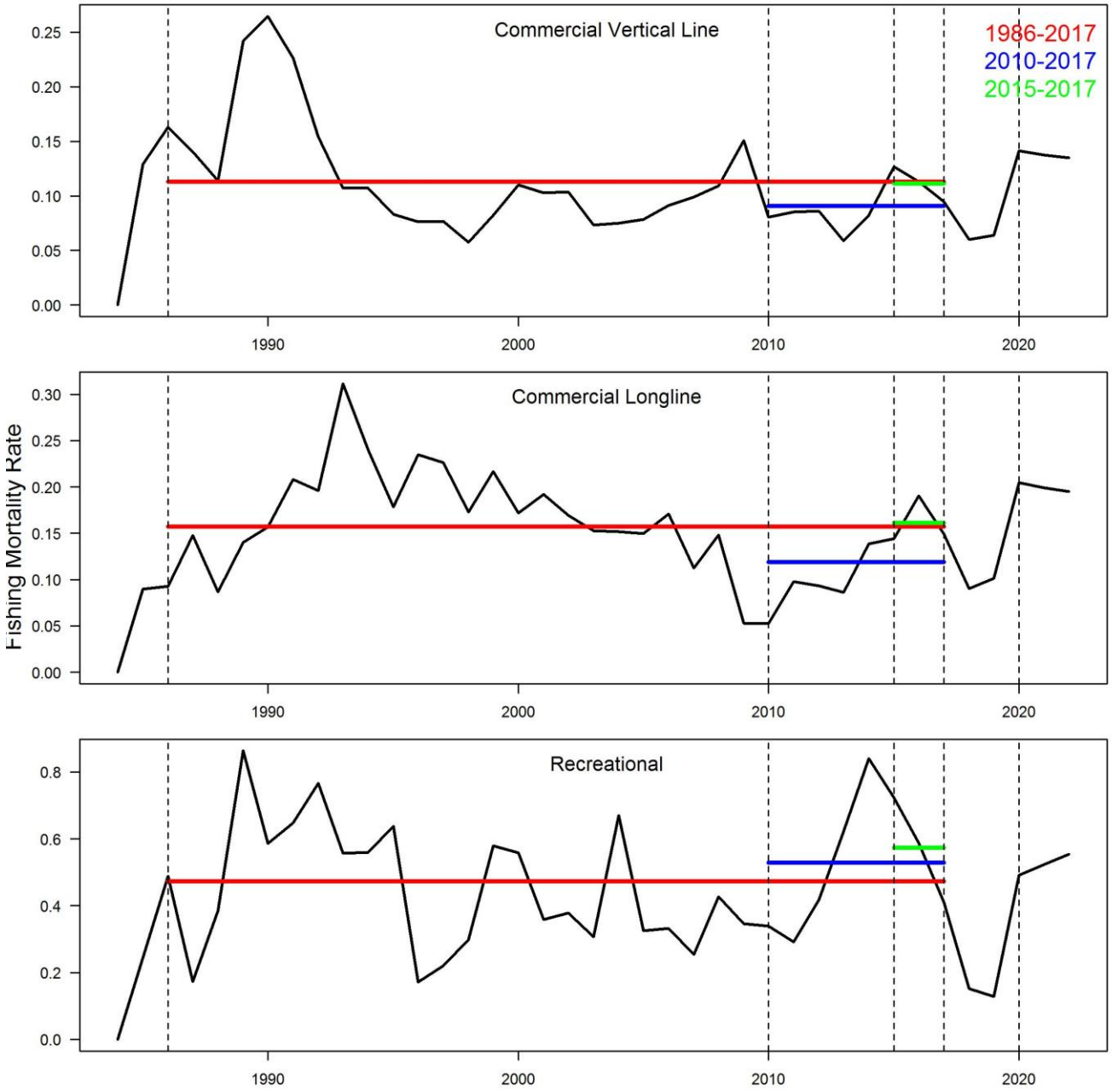
Depletion



- 2020: at SSB target then declines for F=30% SPR

2020 "Spike"?

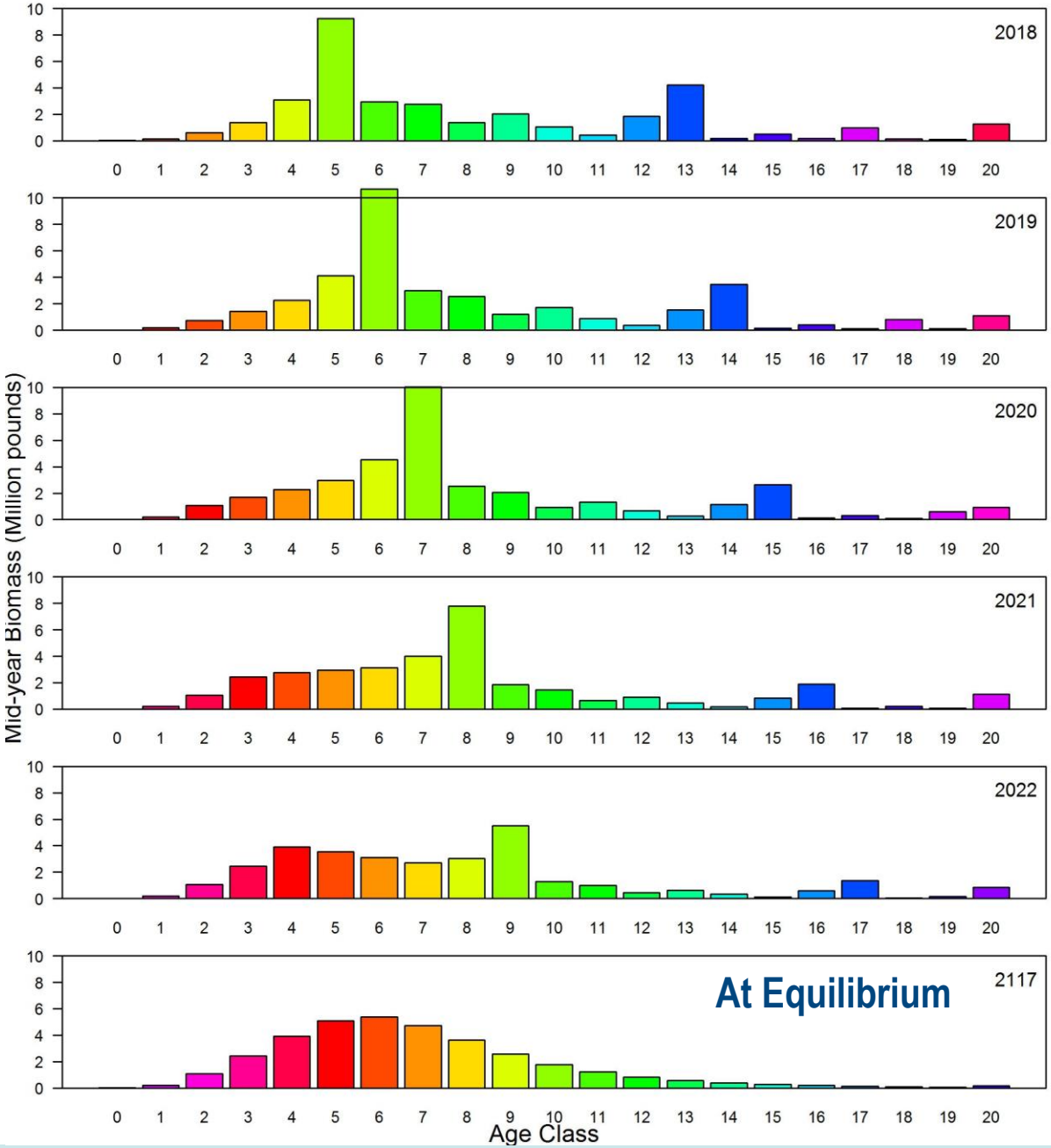
- 2018-2019 apical Fs are very low
- Model predicts an increase in 2020, but why?



Biomass at age

- 2013 & 2005 cohorts are working their way through the fisheries

- But… what about 2018 red tide?



Stakeholder Observations

2018, GMFMC "Something's Fishy with Red Grouper"

Keepers:

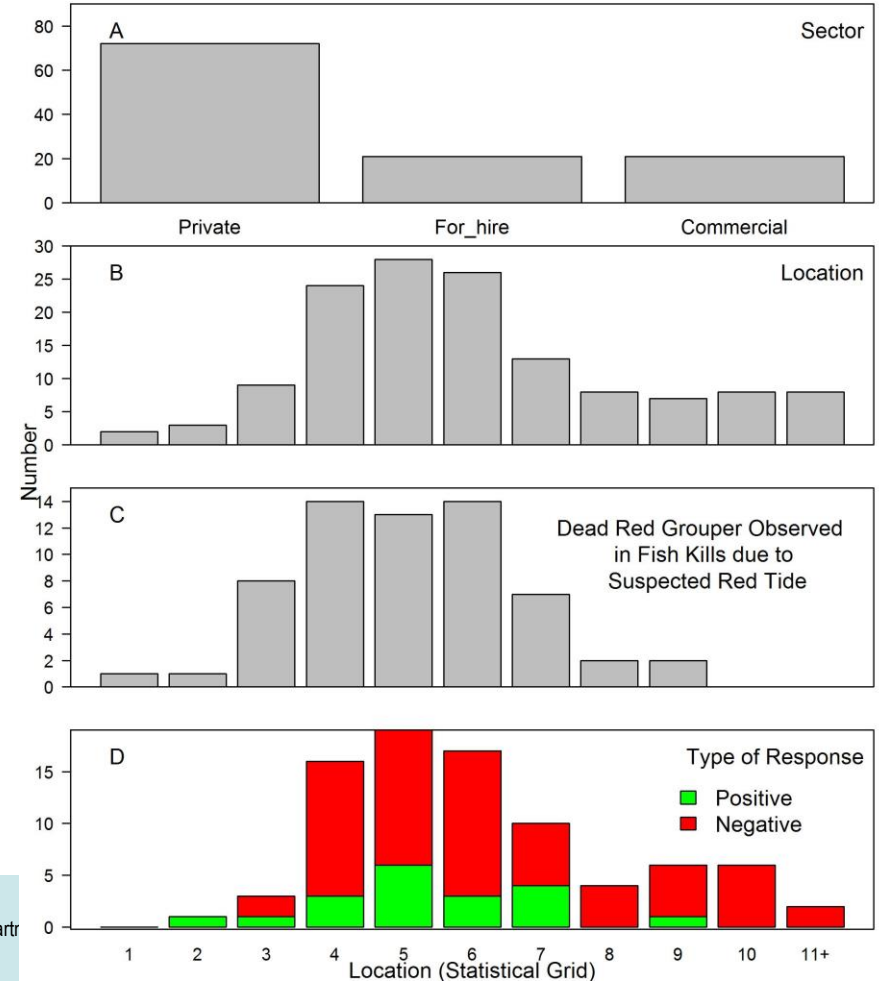
- Deeper than historically
- Fewer in recent years

Recruitment:

- Recent increase in smalls

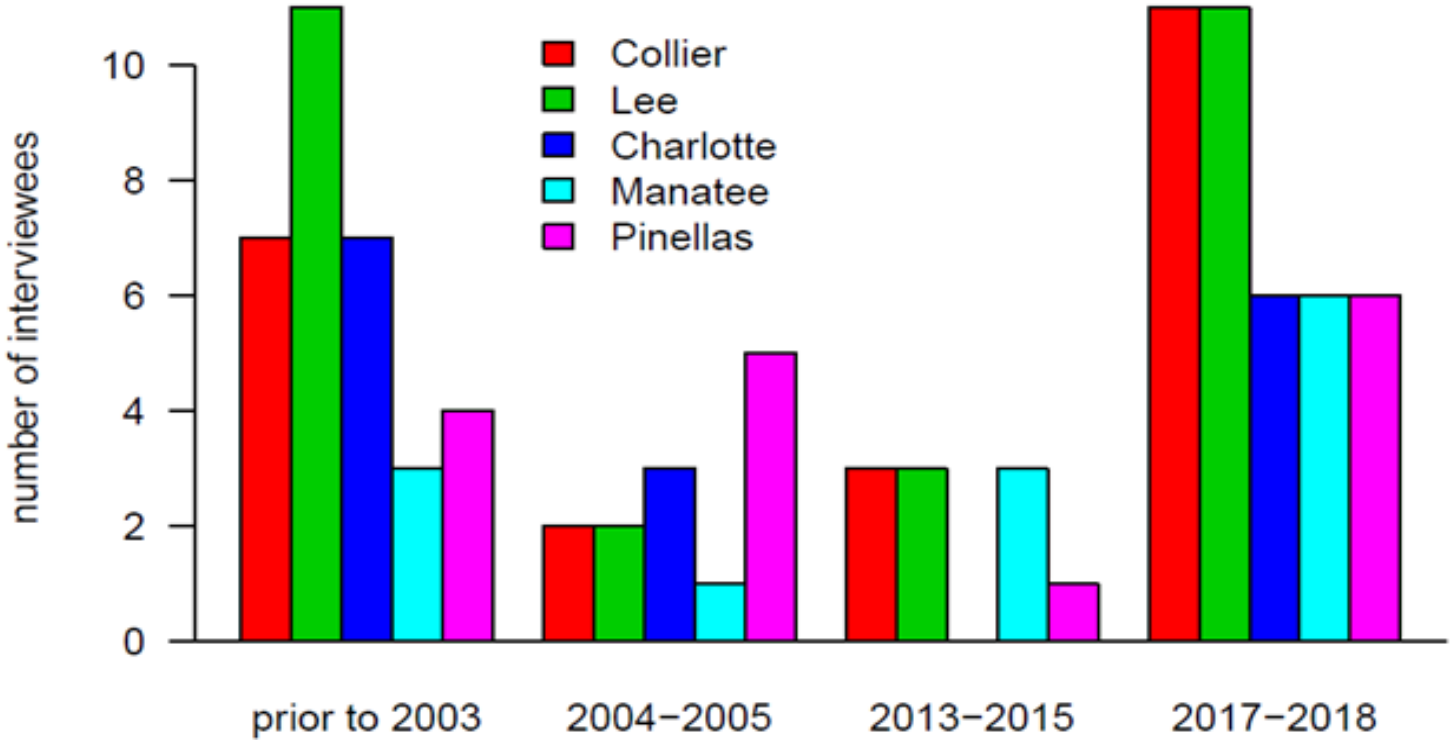
Environment:

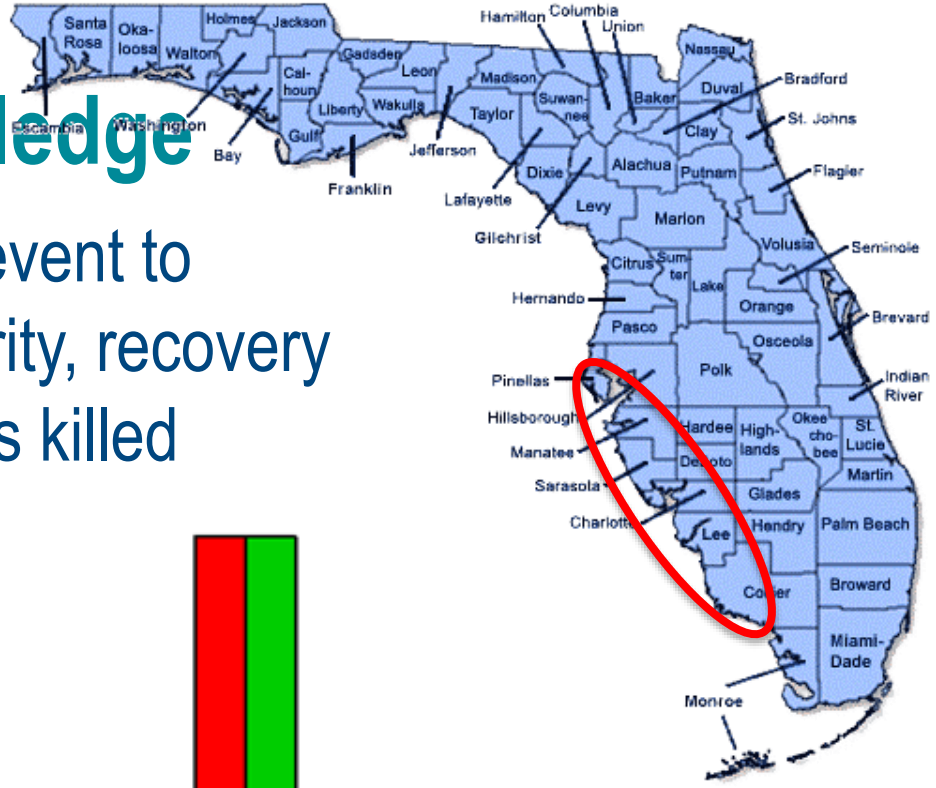
- May shift location due to storms
- Being displaced by red snapper
- Depredation on discards is increasing
- Population hasn't recovered since the 2014 red tide event



Local Ecological Knowledge

- Compare the recent 2017-2019 event to previous events in terms of severity, recovery time, temporal extent and species killed

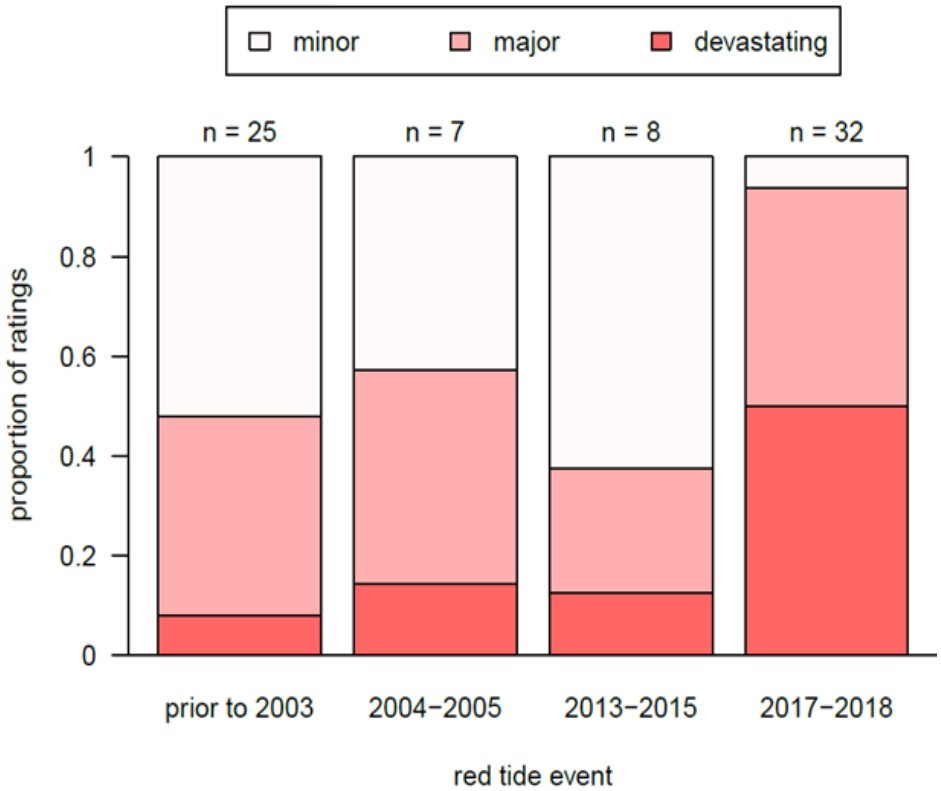




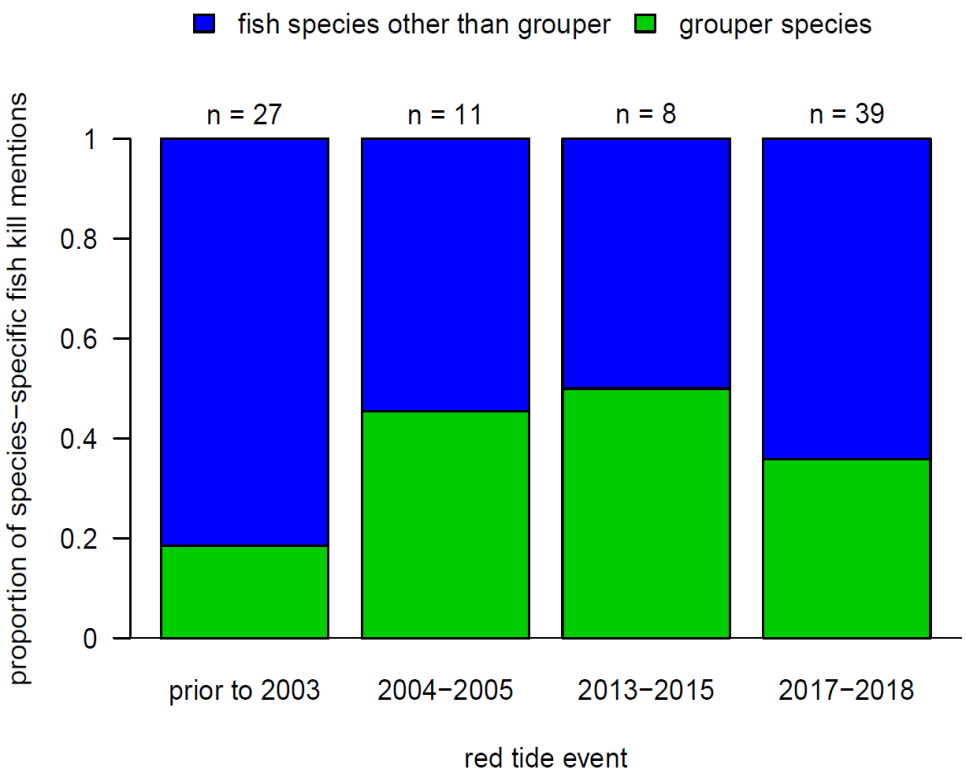
County Image: http://edr.state.fl.us/content/area-profiles/county/index.cfm

Local Ecological Knowledge

By Event



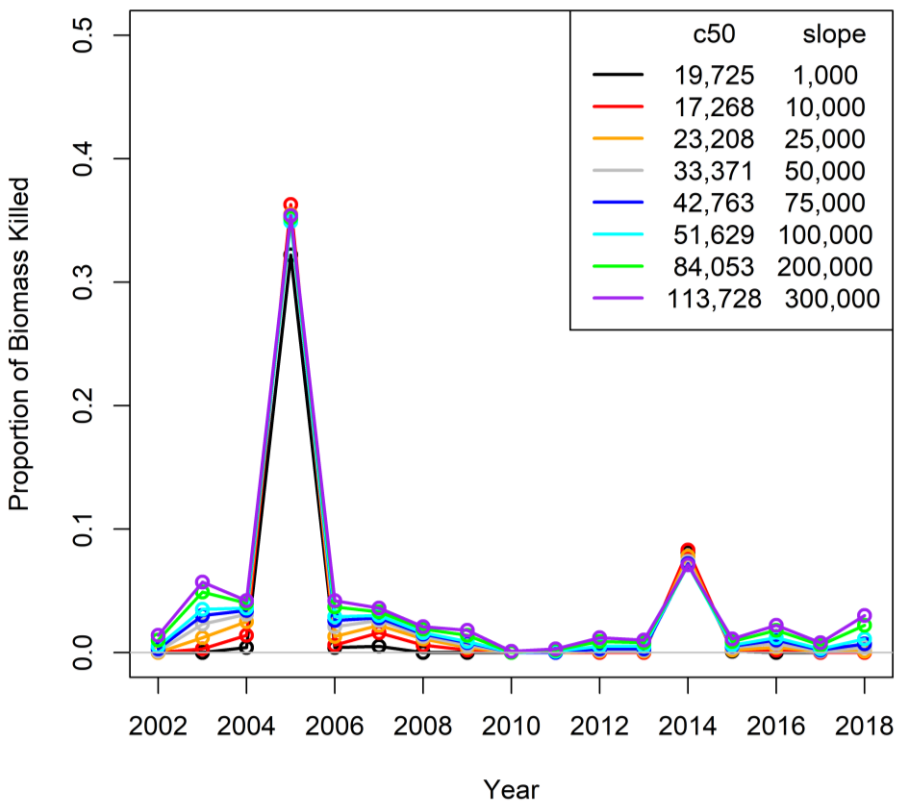
By Species Type

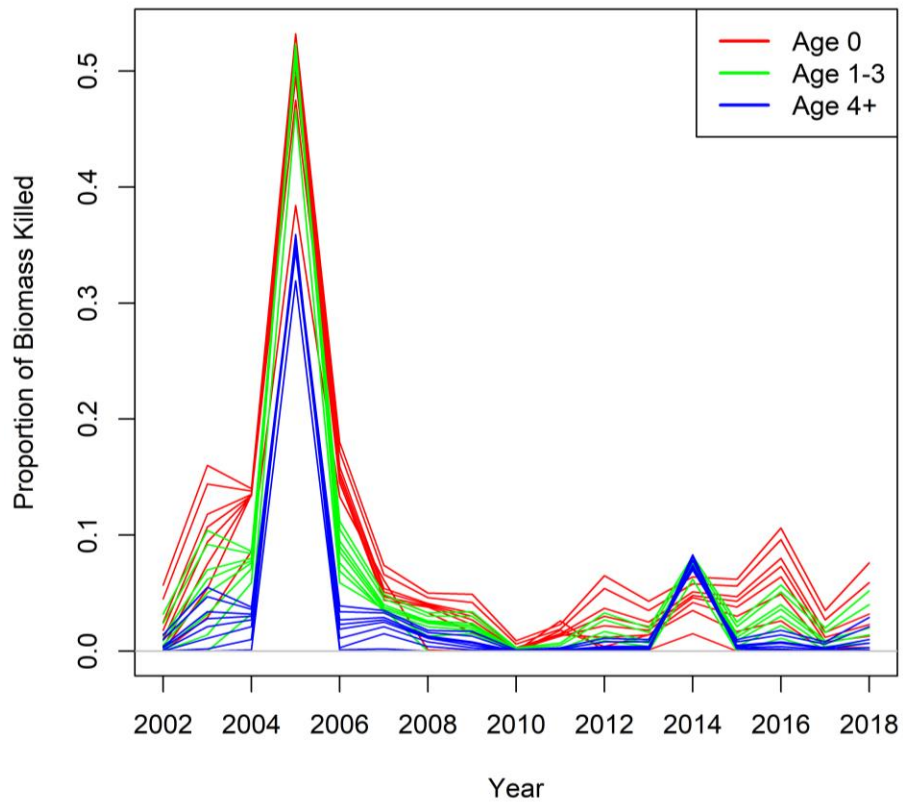


- 2018 frequently ranked as devastating across regions and lasted longer than previous red tide events

Ecosystem analysis: Update

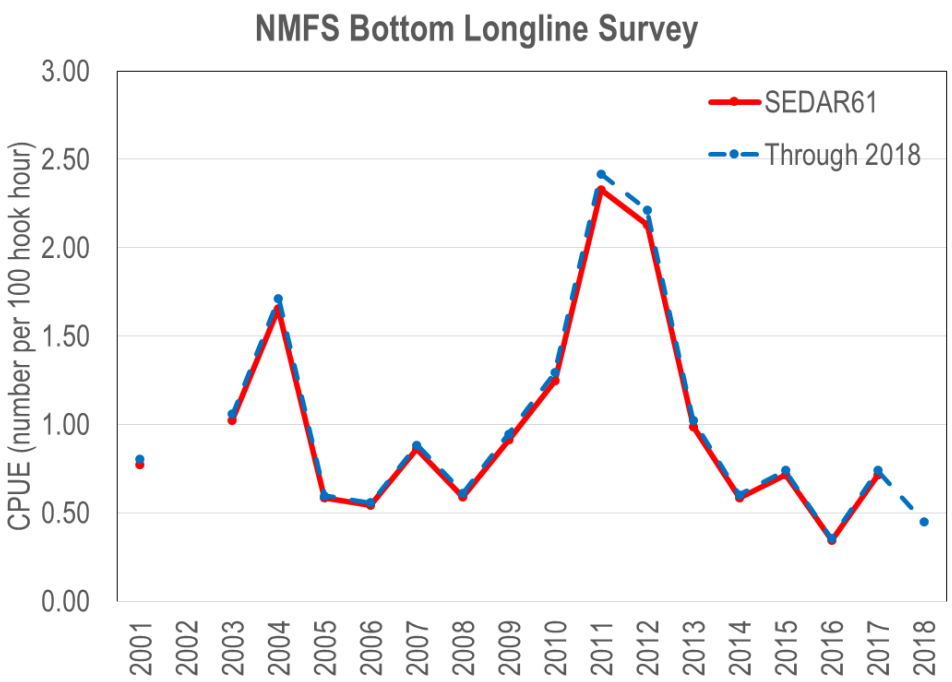
- Updated based on recommendations at Data Workshop
  - Project on UTM coordinates and account for anisotropy
  - Caveats: grouper distribution maps, coverage

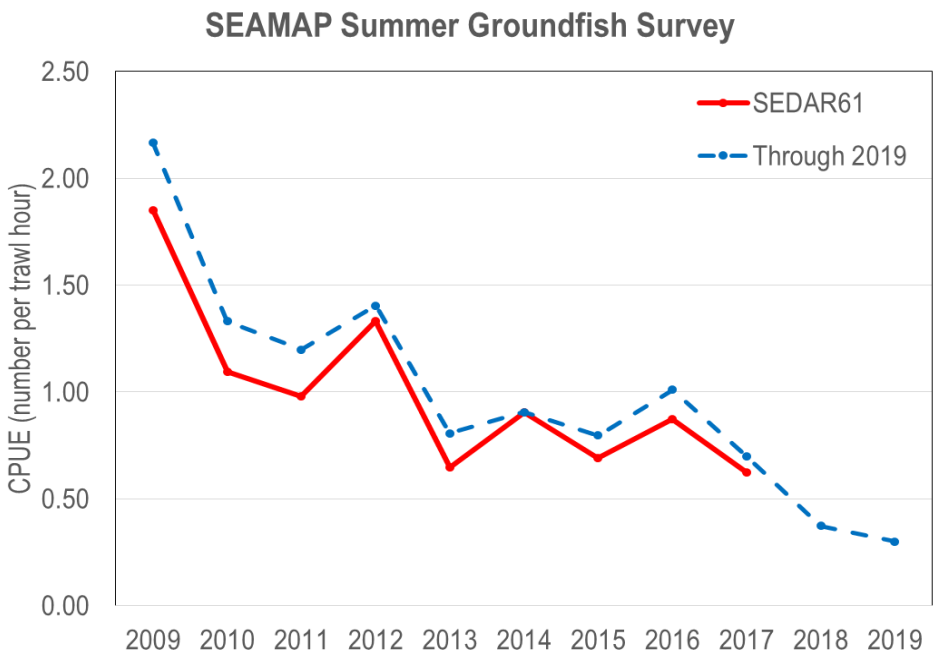




Fishery-independent indices update

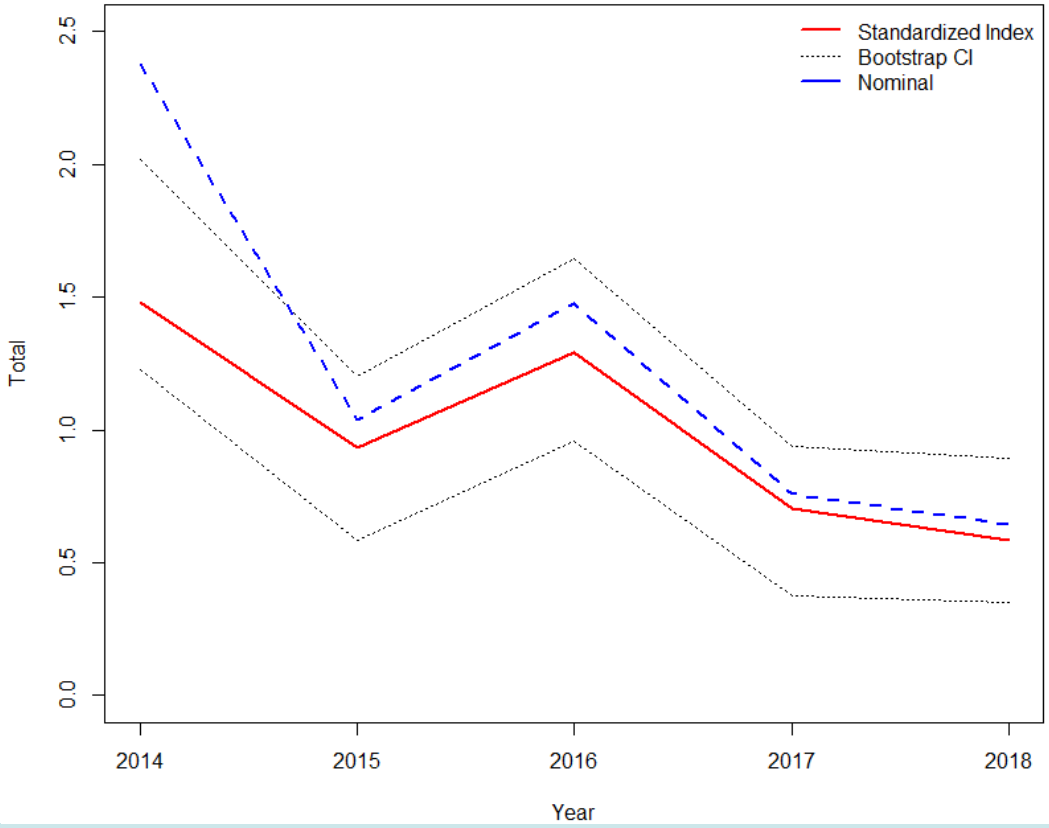
- 2018 is second lowest for bottom longline survey
- 2019 is lowest on record for groundfish survey





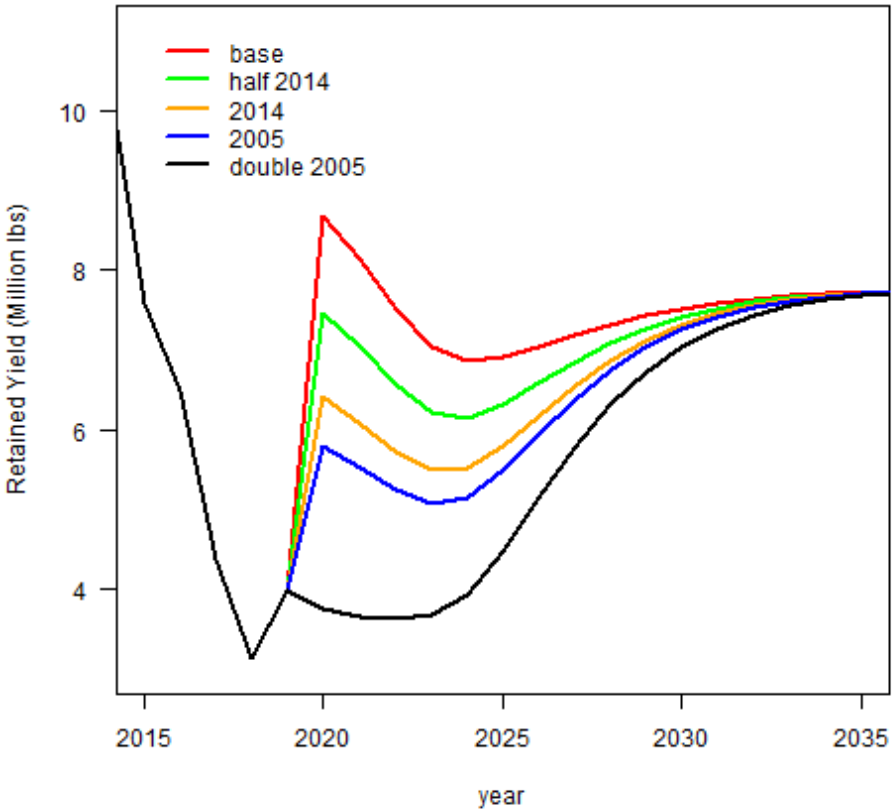
Fishery-independent indices update through 2018

- FWRI repetitive time drop survey also shows low relative abundance in 2018

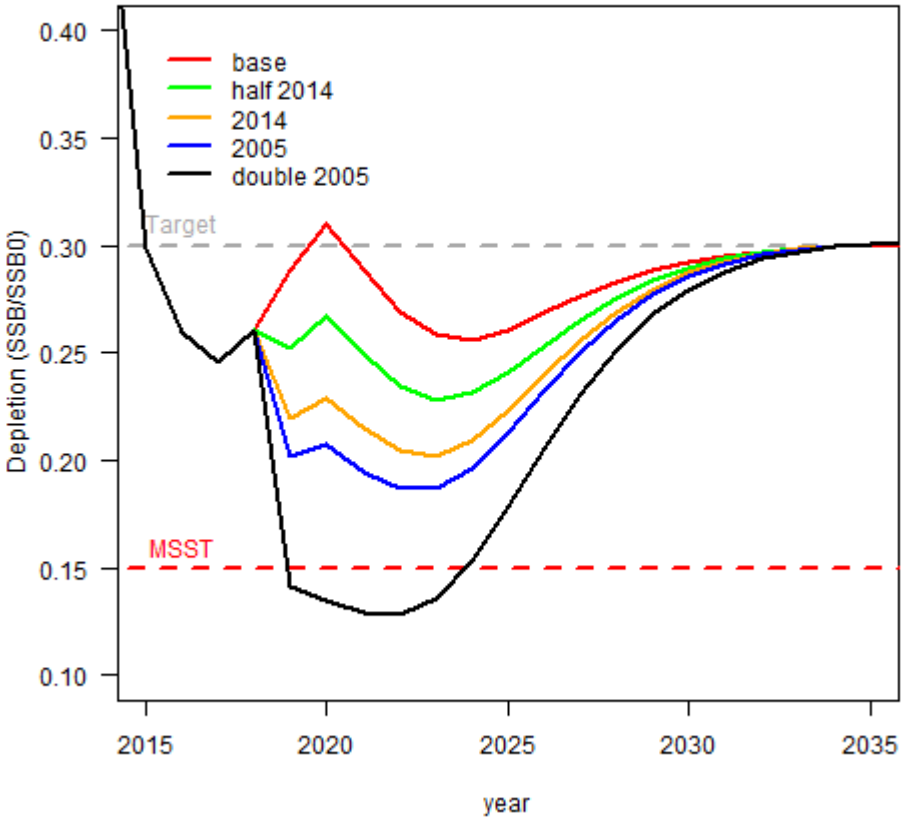


Projections: F = 30% SPR

Retained Yield



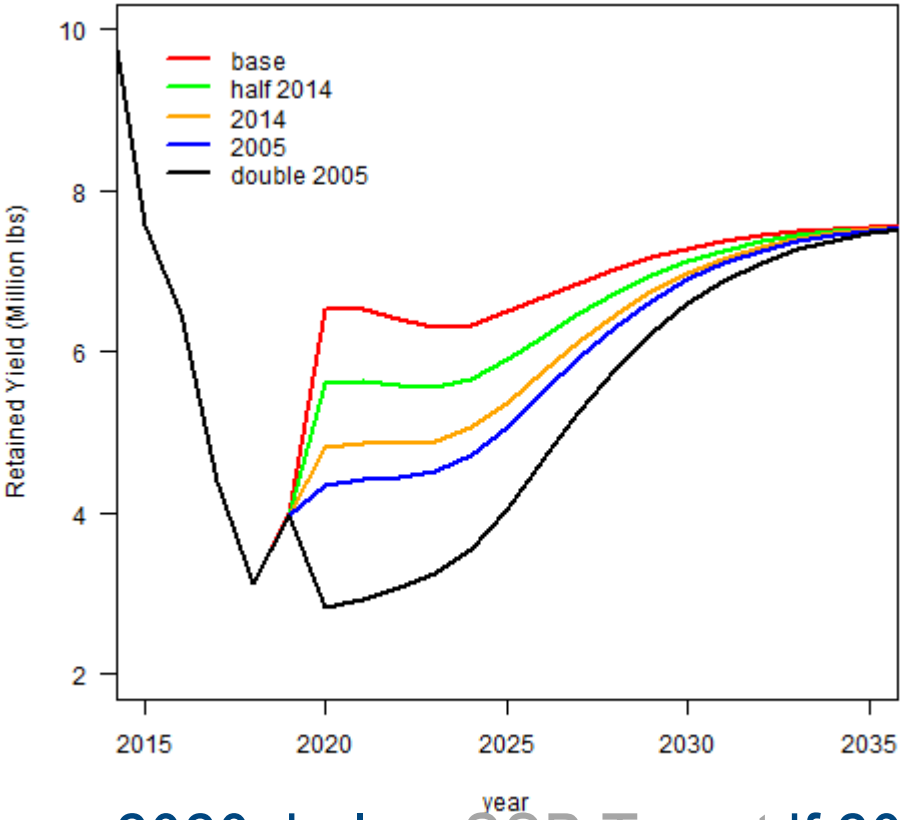
Depletion



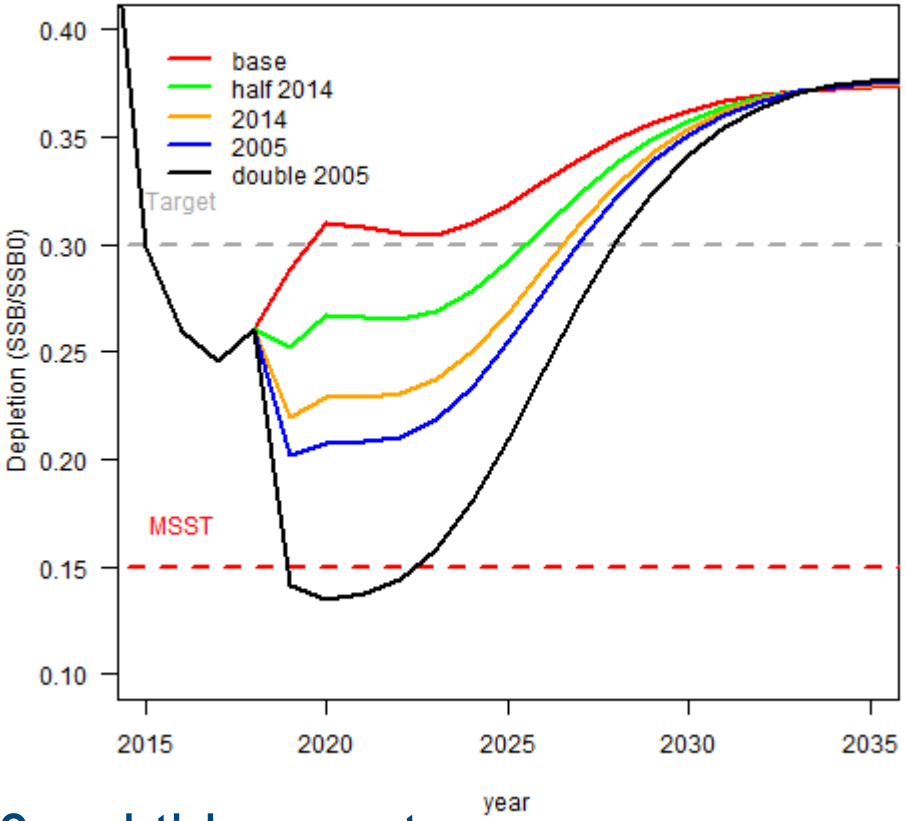
- 2020: below SSB Target if 2018 red tide event was severe
- Reach SSB Target after 2035 for all scenarios

Projections: OY (0.75 x F30%SPR)

Retained Yield



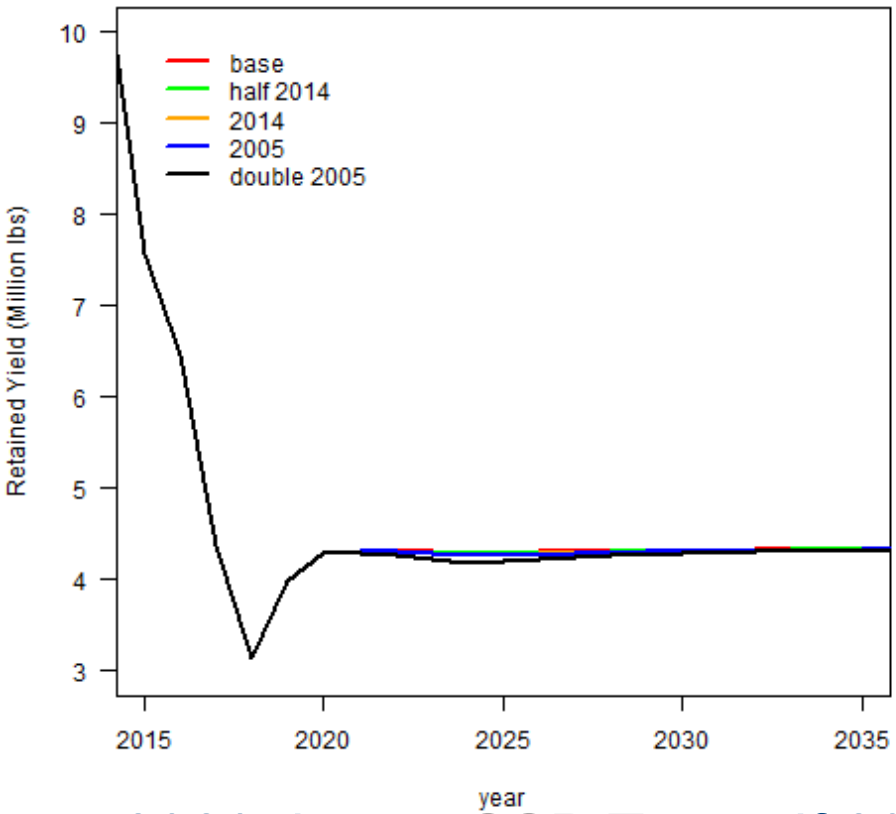
Depletion



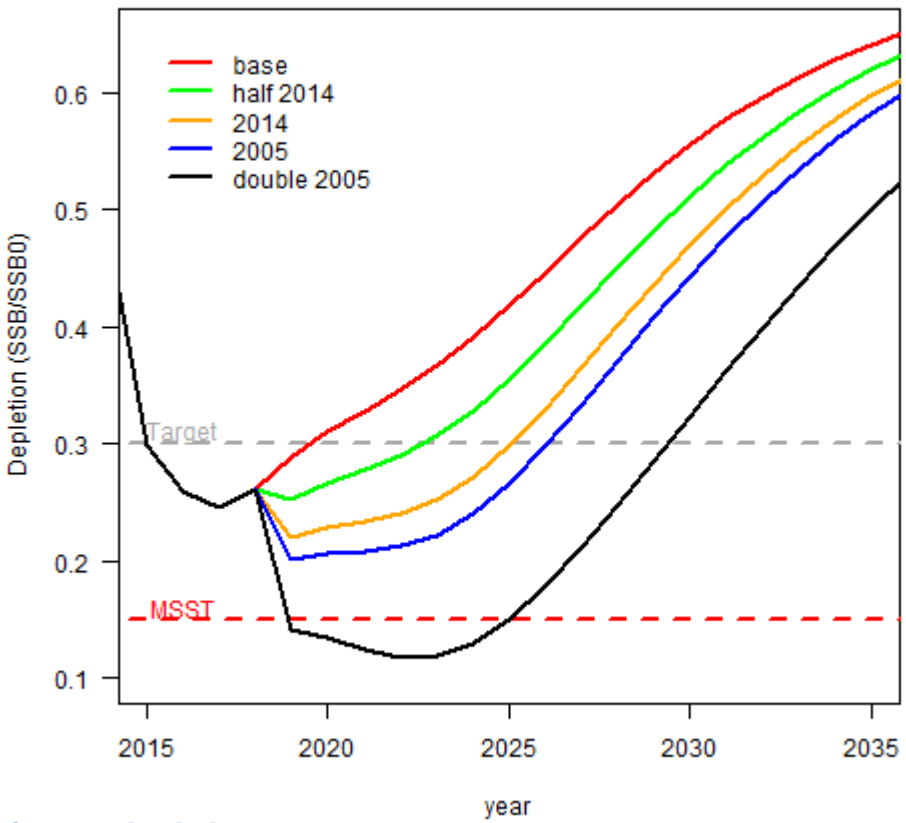
- 2020: below SSB Target if 2018 red tide event was severe
- Reach SSB Target between 2025-2028 depending on severity

Projections: Landings fixed at 2017 target

Retained Yield

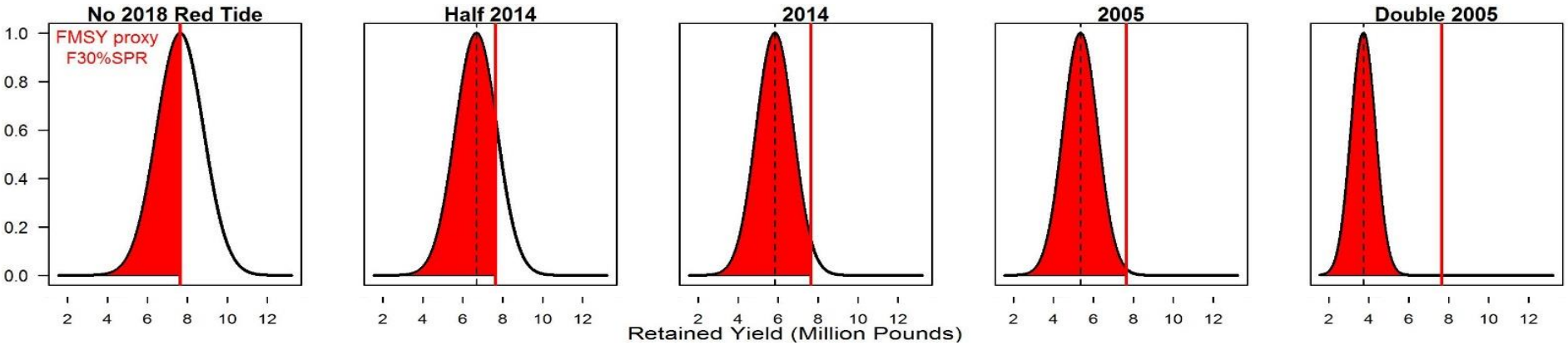


Depletion



- 2020: below SSB Target if 2018 red tide event was severe
- Reach SSB Target between 2023 to 2029 depending on severity

Probability of Overfishing



Scenario	2020-2024 Mean Catch (Pounds)	No 2018 Red Tide	Half 2014	2014	2005	Double 2005
Equilibrium yield at F_{MSY} proxy ($F_{SPR30\%}$)	7,643,329	**0.50**	0.82	0.98	1.00	1.00
F at Optimum Yield (F_{OY} = 75% $F_{SPR30\%}$)	6,423,319	0.15	0.40	0.74	0.90	1.00
Landings fixed at 2017 target	4,305,711	0.00	0.01	0.05	0.11	0.83

Summary

- How we treat the 2018 red tide impacts projected stock size and catches
  - Growing evidence suggests 2018 had a large impact on population
  - Projections using 30%SPR and OY predict **high risk of overfishing (> 50%)** in 2020-2024 in the event of a severe 2018 red tide event
- Maintaining current catch levels reduce this risk

Scenario	Mean Catch (Pounds)	No 2018 Red Tide	Half 2014	2014	2005	Double 2005
Landings fixed at 2017 target	4,305,711	0.00	0.01	0.05	0.11	0.83

Catch advice – using 76% commercial, 24% recreational

Year	OFL (pounds)	ABC (pounds)	% ABC
No 2018 red tide			
2020	8,683,690	8,454,161	97.4
2021	8,127,883	7,918,758	97.4
2022	7,512,794	7,310,173	97.3
2023	7,037,279	6,817,243	96.9
2024	6,855,001	6,641,304	96.9
AVERAGE	**7,643,329**	**7,428,328**	
Half 2014 red tide (~13% of population killed)			
2020	7,465,505	7,263,226	97.3
2021	7,026,080	6,841,575	97.4
2022	6,555,504	6,375,880	97.3
2023	6,213,082	6,016,496	96.8
2024	6,141,432	5,950,189	96.9
AVERAGE	**6,680,320**	**6,489,473**	
2014 red tide (~26% of population killed)			
2020	6,398,910	6,220,578	97.2
2021	6,060,544	5,897,657	97.3
2022	5,715,786	5,556,333	97.2
2023	5,488,313	5,312,312	96.8
2024	5,511,925	5,340,548	96.9
AVERAGE	**5,835,096**	**5,665,486**	

Year	OFL (pounds)	ABC (pounds)	% ABC
2005 red tide (~34% of population killed)			
2020	5,786,113	5,621,581	97.2
2021	5,505,377	5,354,935	97.3
2022	5,232,467	5,084,616	97.2
2023	5,070,119	4,905,969	96.8
2024	5,147,545	4,987,701	96.9
AVERAGE	**5,348,324**	**5,190,960**	
Double 2005 red tide (~68% of population killed)			
2020	3,749,375	3,643,858	97.2
2021	3,656,847	3,556,791	97.3
2022	3,619,126	3,514,604	97.1
2023	3,664,608	3,541,697	96.6
2024	3,913,487	3,793,631	96.9
AVERAGE	**3,720,689**	**3,610,116**	

What about allocation?

- From Reef Fish Amendment 30B:
  - **Preferred Alternative 3.** Establish an interim allocation of TAC between the recreational and commercial fisheries as the average share during the years 1986 through 2005. The recreational:commercial proportions would be red grouper 24:76
- Update of analysis using new MRIP data results in allocation of: 31.25% recreational, 68.75% commercial

Year	Commercial Landings (mt)	Recreational (mt)
1986	2884	2121
1987	3059	716
1988	2162	1609
1989	3381	3133
1990	2191	809
1991	2290	945
1992	1962	1157
1993	2465	855
1994	2074	881
1995	1823	1042
1996	2223	300
1997	2421	416
1998	1819	605
1999	2629	1156
2000	2526	1053
2001	2528	715
2002	2493	734
2003	2066	648
2004	2299	1911
2005	2334	841
AVERAGE	2381	1082
NEW ALLOCATION	**68.75**	**31.25**

Catch advice – using revised allocation

Year	OFL (pounds)	ABC (pounds)	% ABC
No 2018 red tide			
2020	8,130,440	7,914,705	97.3
2021	7,672,386	7,473,537	97.4
2022	7,103,903	6,910,478	97.3
2023	6,649,994	6,440,950	96.9
2024	6,479,180	6,280,516	96.9
AVERAGE	**7,207,181**	**7,004,037**	
Half 2014 red tide (~13% of population killed)			
2020	6,989,682	6,799,687	97.3
2021	6,631,475	6,456,158	97.4
2022	6,196,239	6,024,915	97.2
2023	5,864,840	5,678,416	96.8
2024	5,796,806	5,619,446	96.9
AVERAGE	**6,295,808**	**6,115,724**	
2014 red tide (~26% of population killed)			
2020	5,986,756	5,819,492	97.2
2021	5,716,403	5,561,824	97.3
2022	5,398,012	5,246,142	97.2
2023	5,173,427	5,006,927	96.8
2024	5,194,283	5,035,787	96.9
AVERAGE	**5,493,776**	**5,334,034**	

Year	OFL (pounds)	ABC (pounds)	% ABC
2005 red tide (~34% of population killed)			
2020	5,410,909	5,256,735	97.2
2021	5,190,557	5,047,911	97.3
2022	4,938,768	4,798,083	97.2
2023	4,774,766	4,619,732	96.8
2024	4,845,931	4,698,362	97.0
AVERAGE	**5,032,186**	**4,884,165**	
Double 2005 red tide (~68% of population killed)			
2020	3,499,041	3,400,250	97.2
2021	3,440,464	3,345,684	97.2
2022	3,405,719	3,306,578	97.1
2023	3,434,577	3,319,461	96.6
2024	3,669,281	3,559,464	97.0
AVERAGE	**3,489,816**	**3,386,287**	

Questions?

Thank you to all SEDAR61 data providers and for your attention!