SEDAR 42: US Gulf of Mexico
Red grouper assessment

NOAA FISHERIES

SEFSC

Review Workshop

Model fit and diagnostics

July 14 - 16, 2015

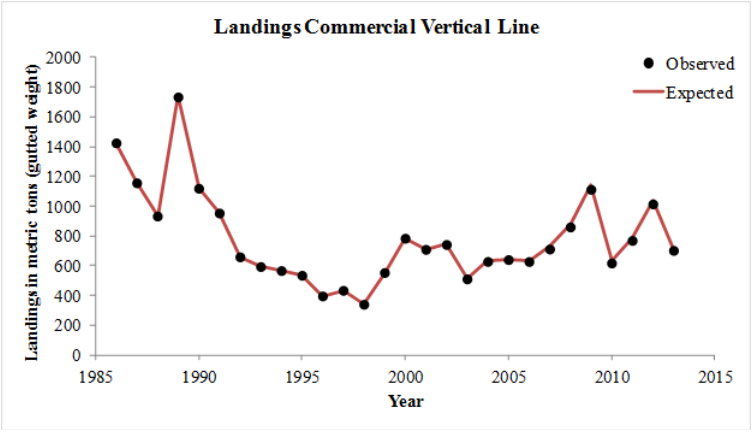
SEDAR 42 Red Grouper Assessment

- Data inputs
- Assessment model configuration
- Model fit to data
- Model diagnostics
- Stock status determination
- Projections

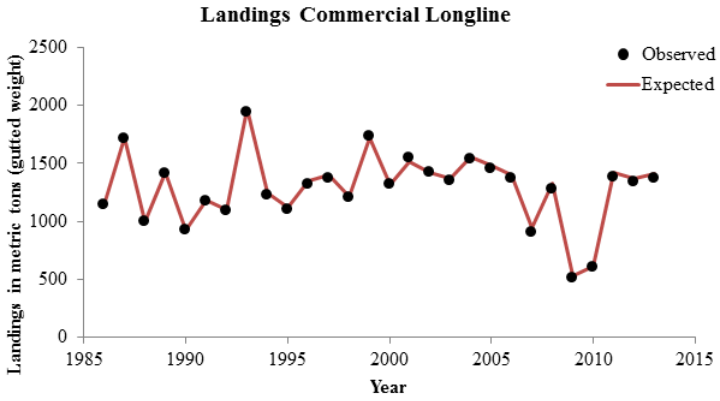
Model fit to data

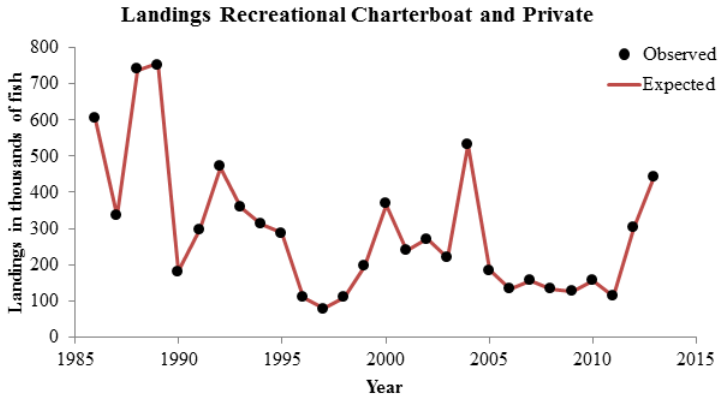
- Landings
- Discards
- Selectivity
- Retention
- Age composition
- Length composition
- Indices

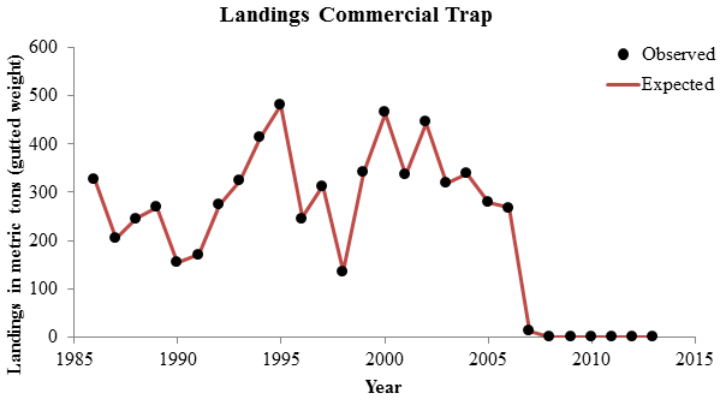
Landings

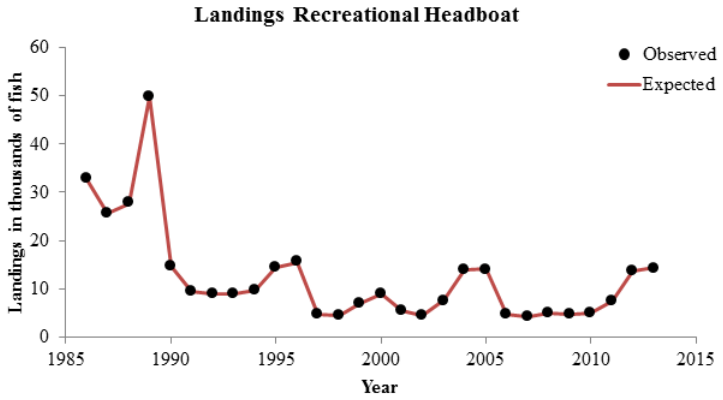


- The expected landings fit the observed exactly



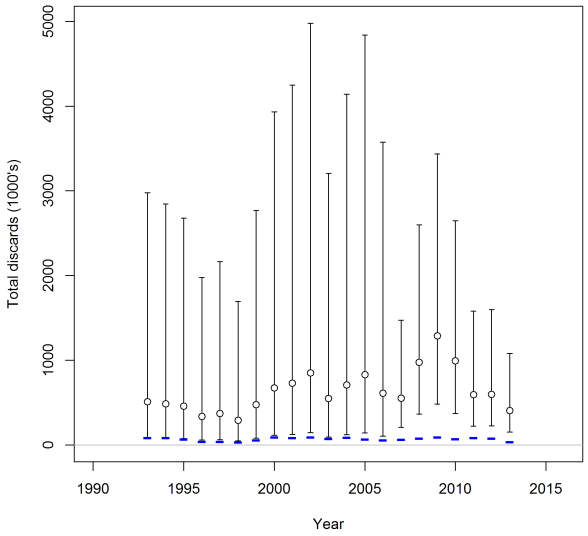




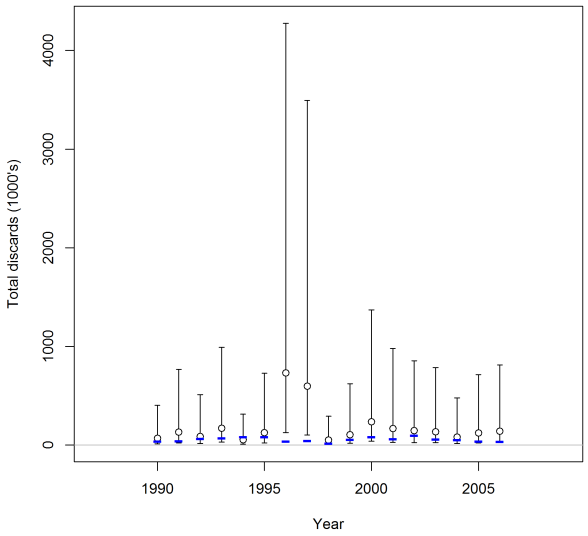


Discards

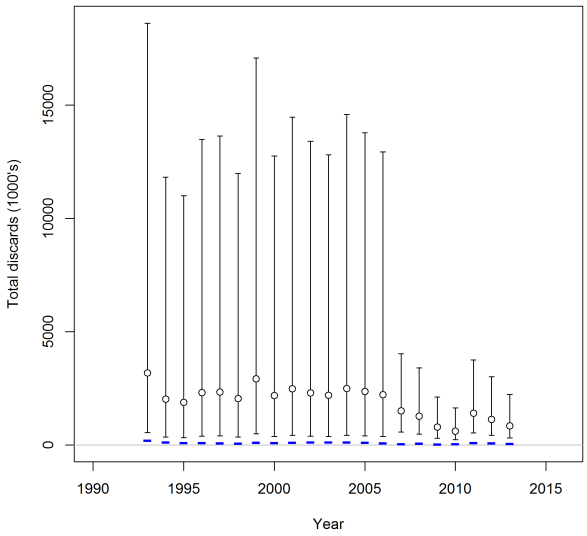
Commercial handline



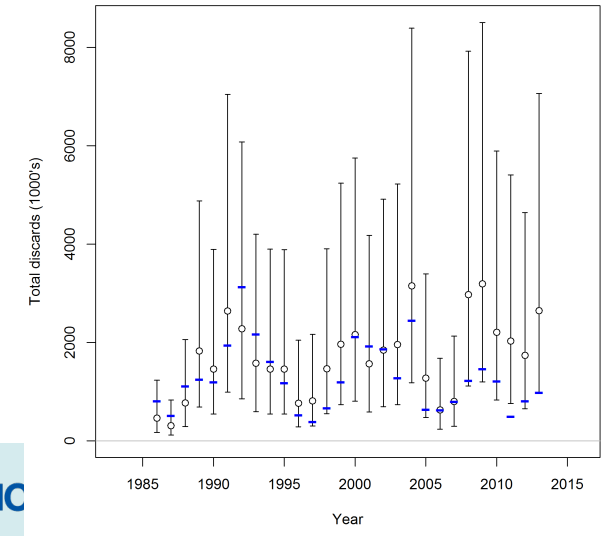
Commercial trap



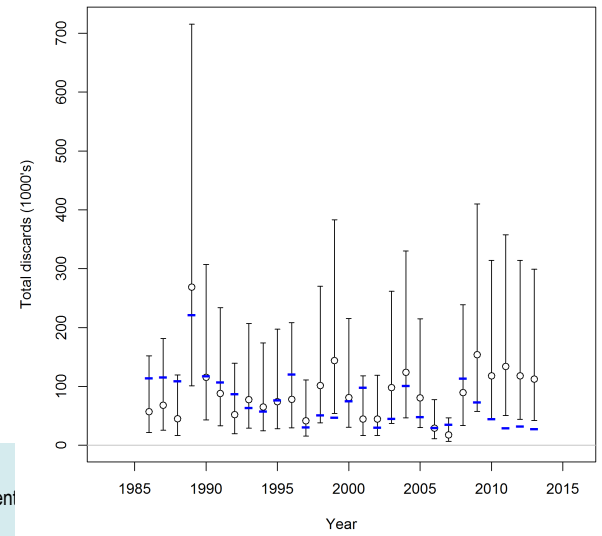
Commercial longline



Charter/Private

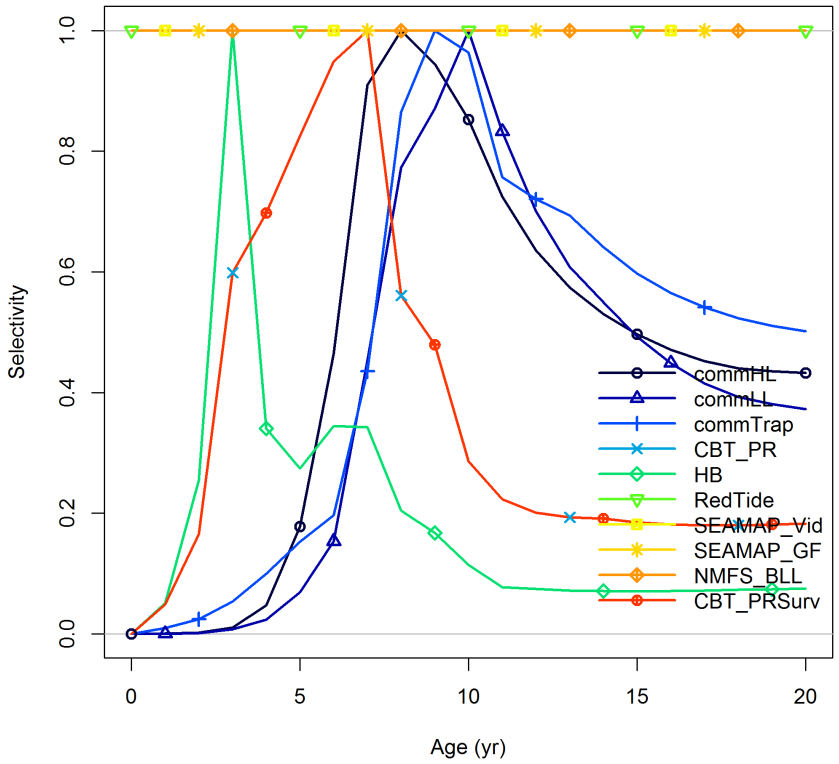


Headboat

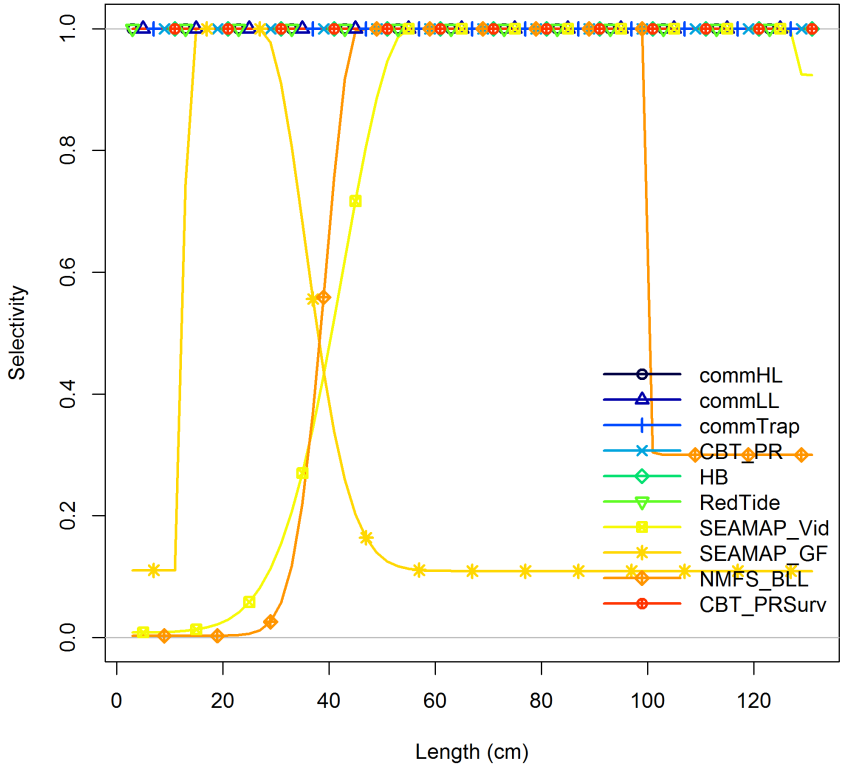


Selectivity

Age-based selectivity

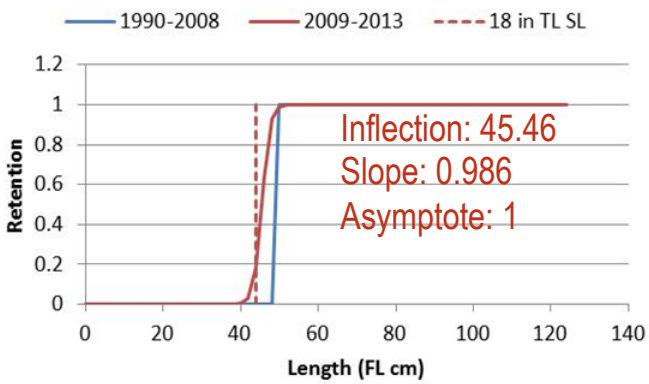


Length-based selectivity

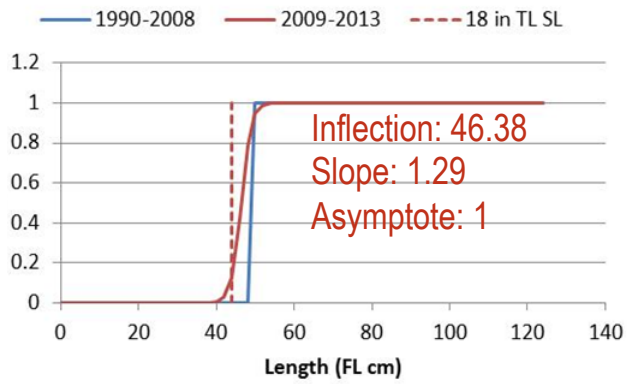


Retention

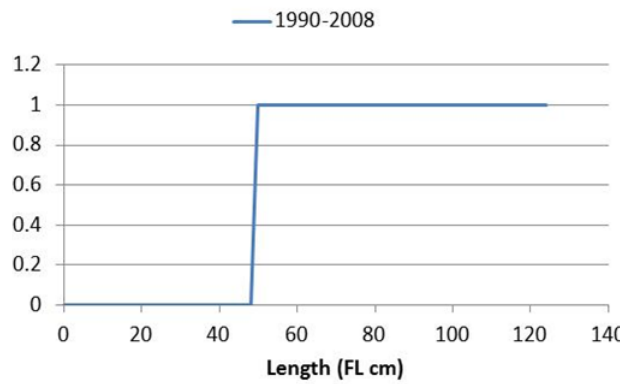
Commercial handline



Commercial longline

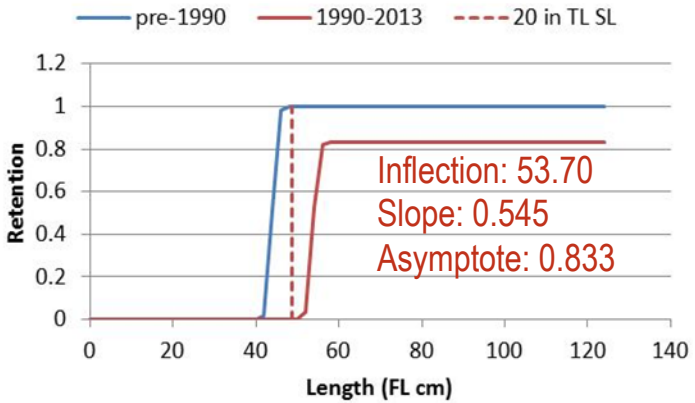


Commercial trap

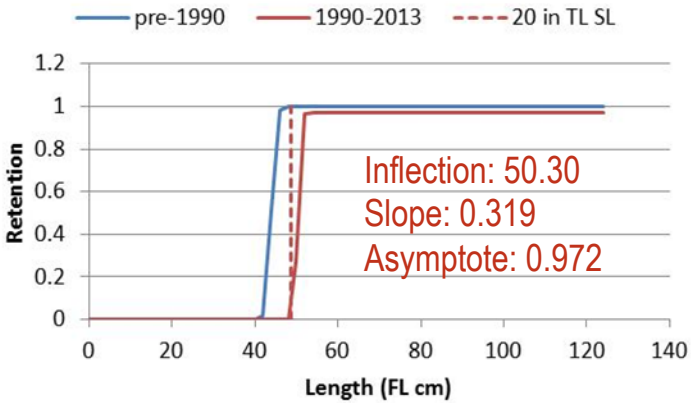


- 1990 – 2008 retention was fixed as knife-edge at the 20 inch TL (48.79 cm FL) commercial size limit

Charter/Private



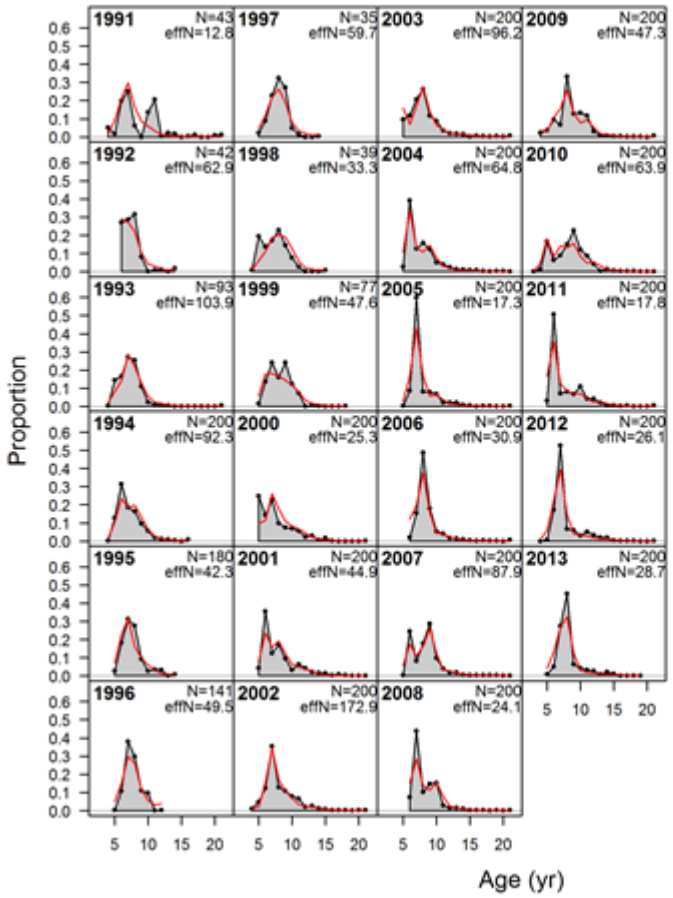
Headboat

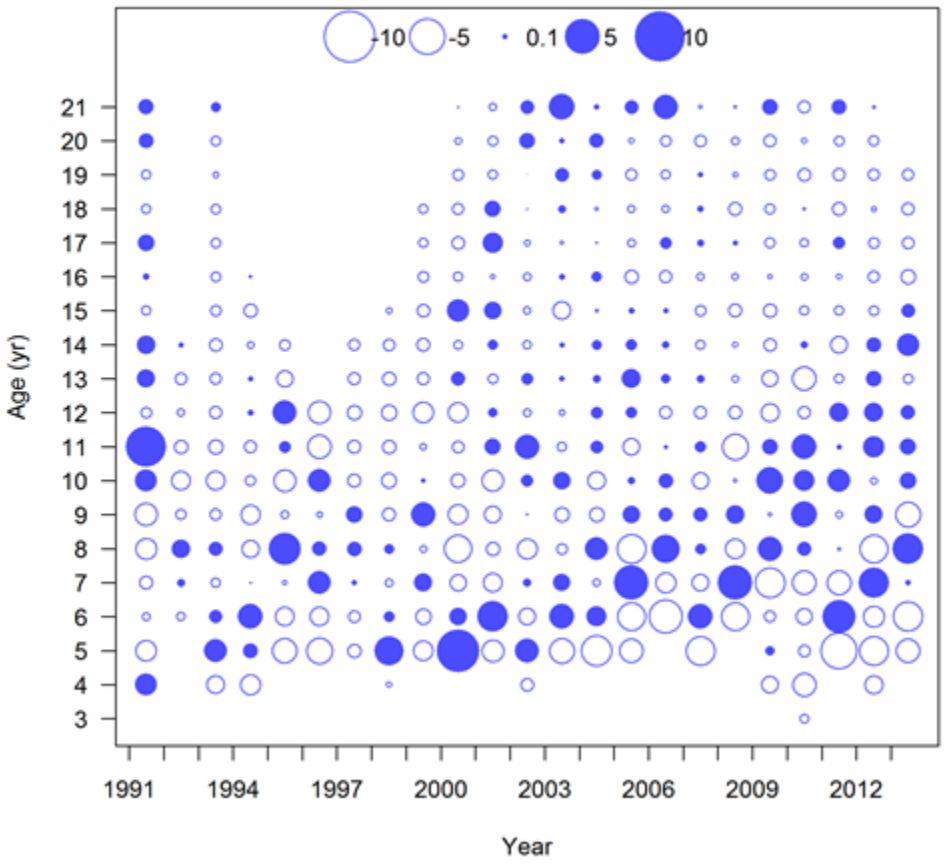


- Pre-1990 retention was fixed as knife-edge at the 18 inch TL (43.96 cm FL) Florida state recreational size limit

Age composition – Commercial handline

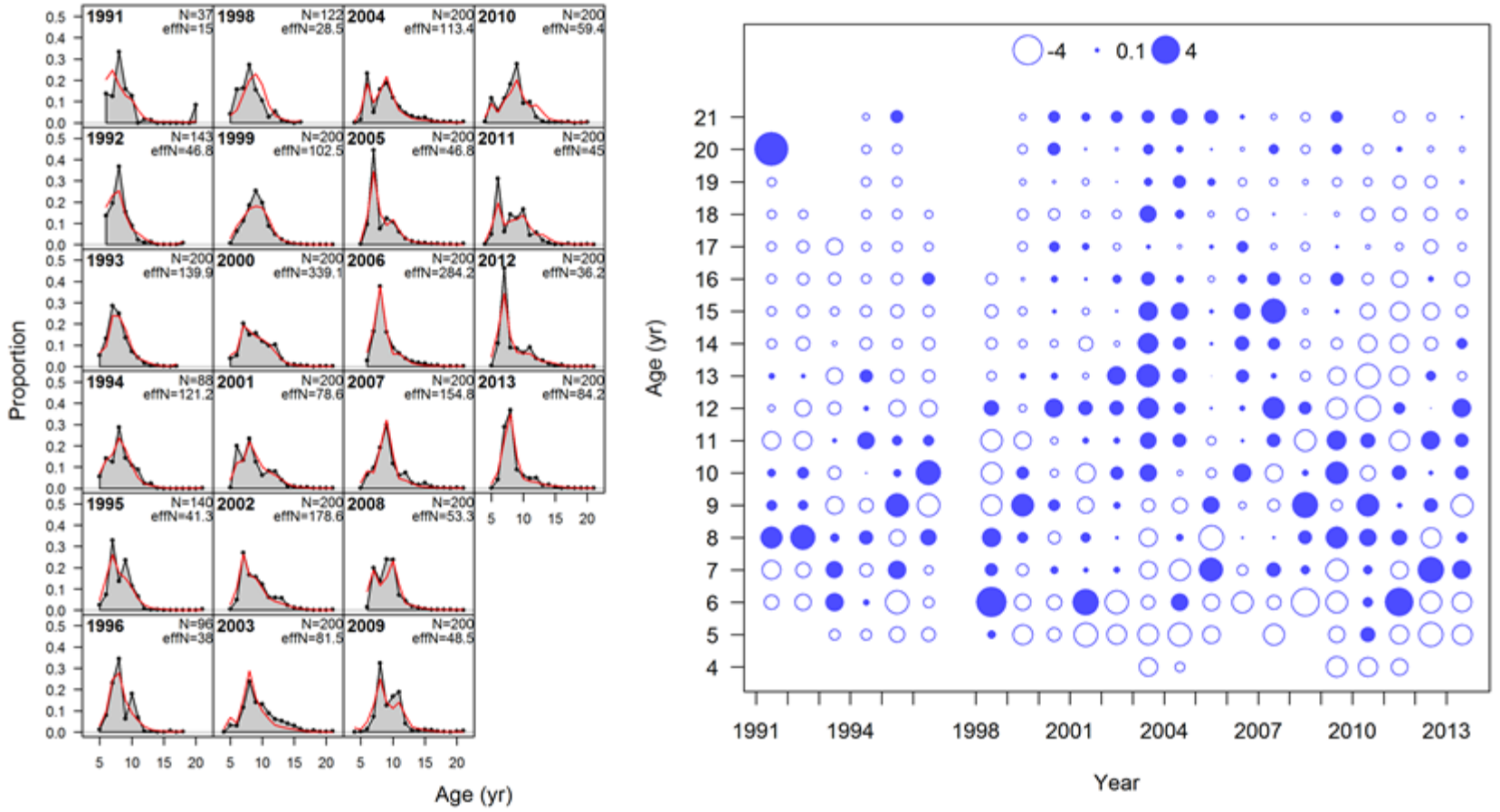
Commercial Handline



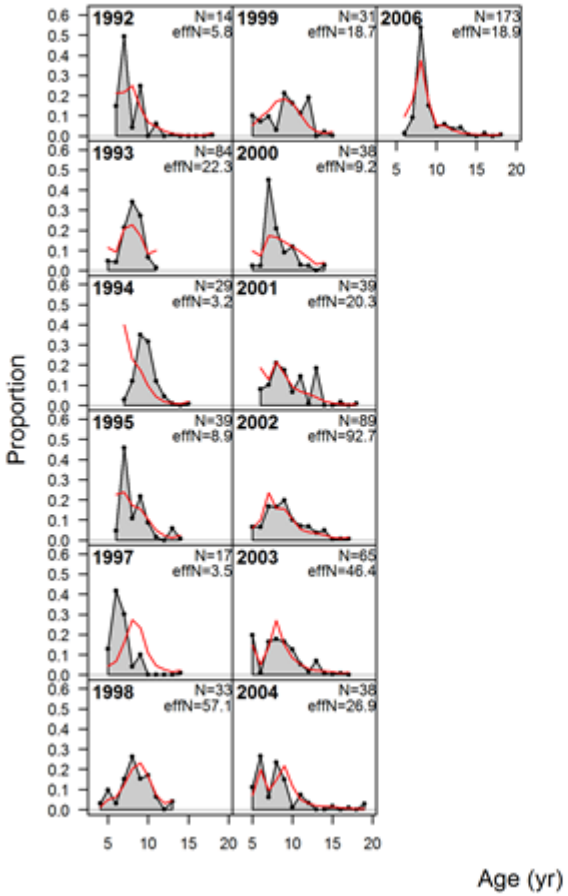


Age composition – Commercial longline

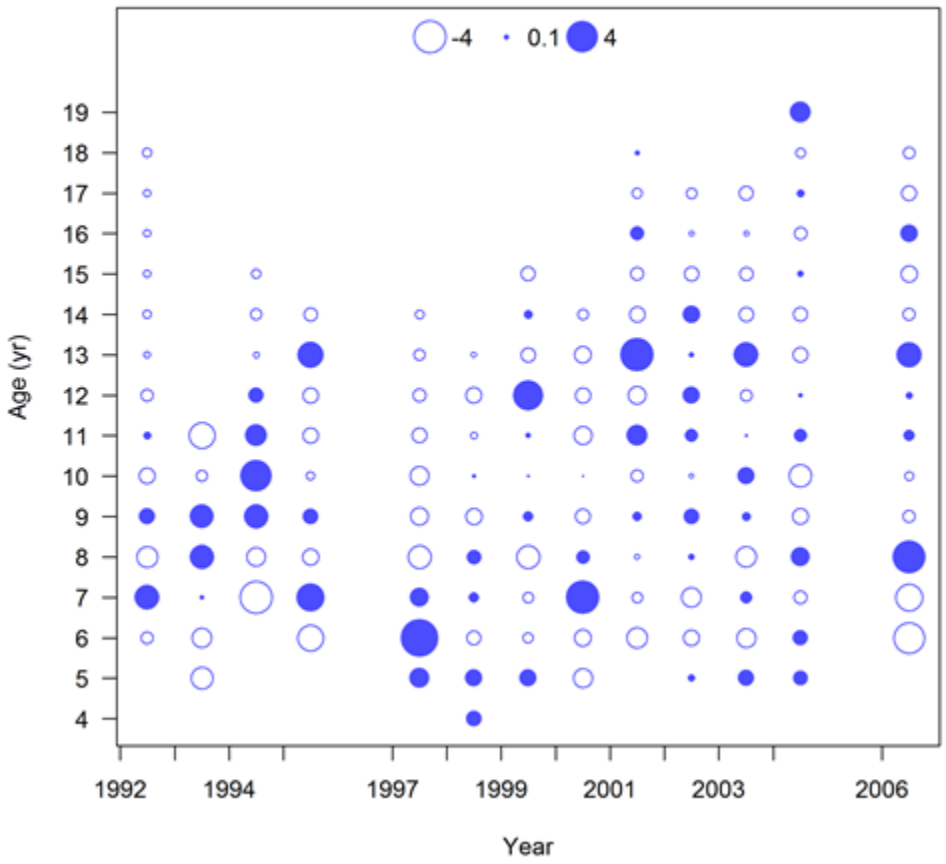
Commercial Longline



Age composition – Commercial trap

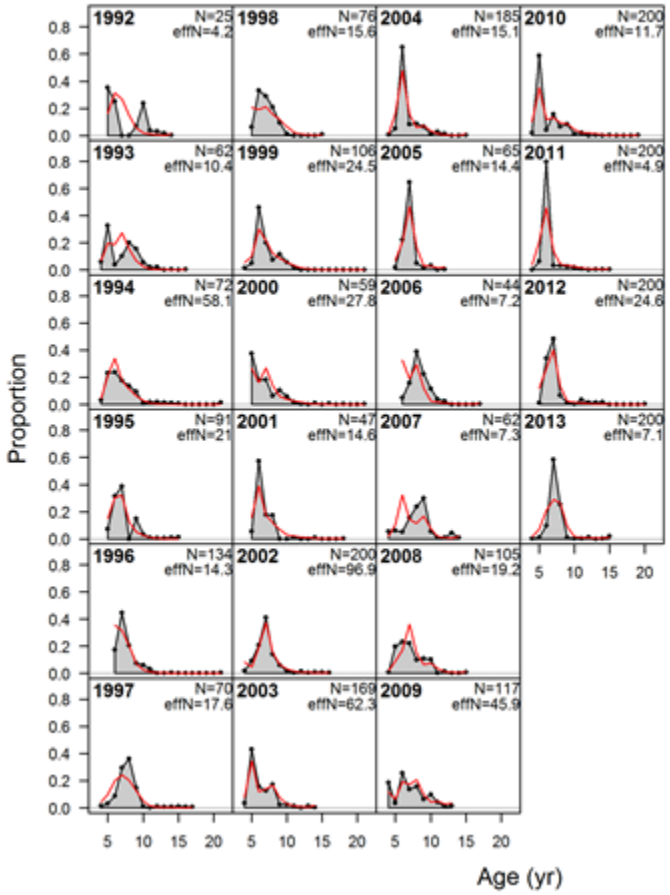


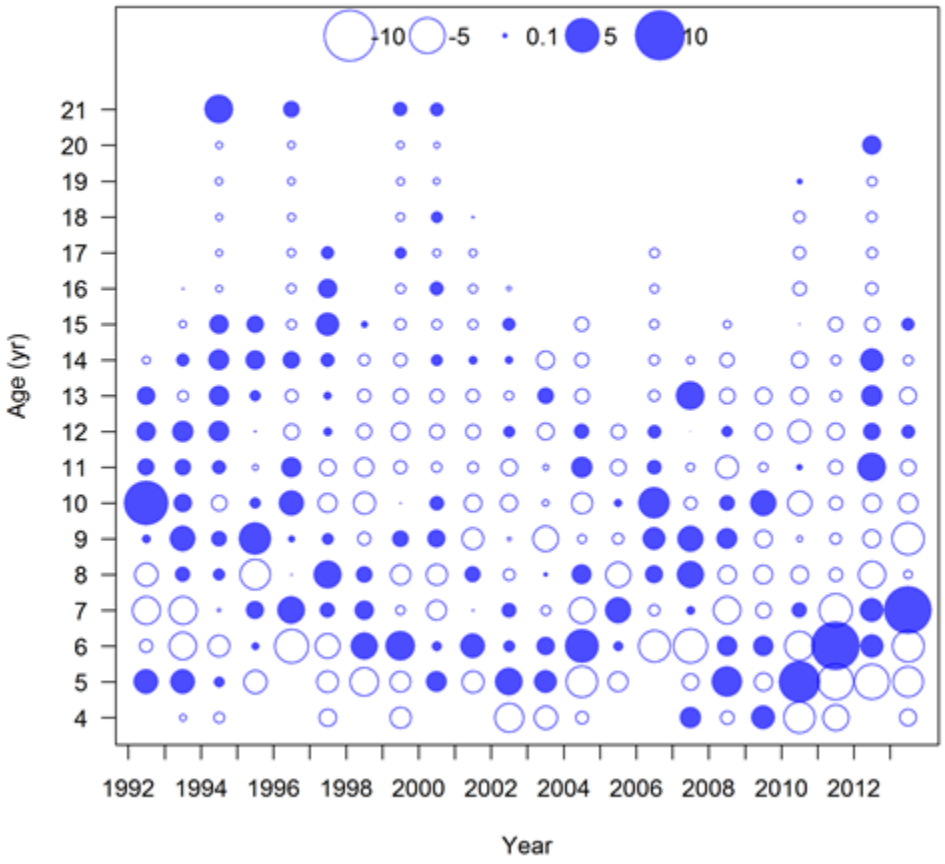
Commercial Trap



Age composition – Charter/Private

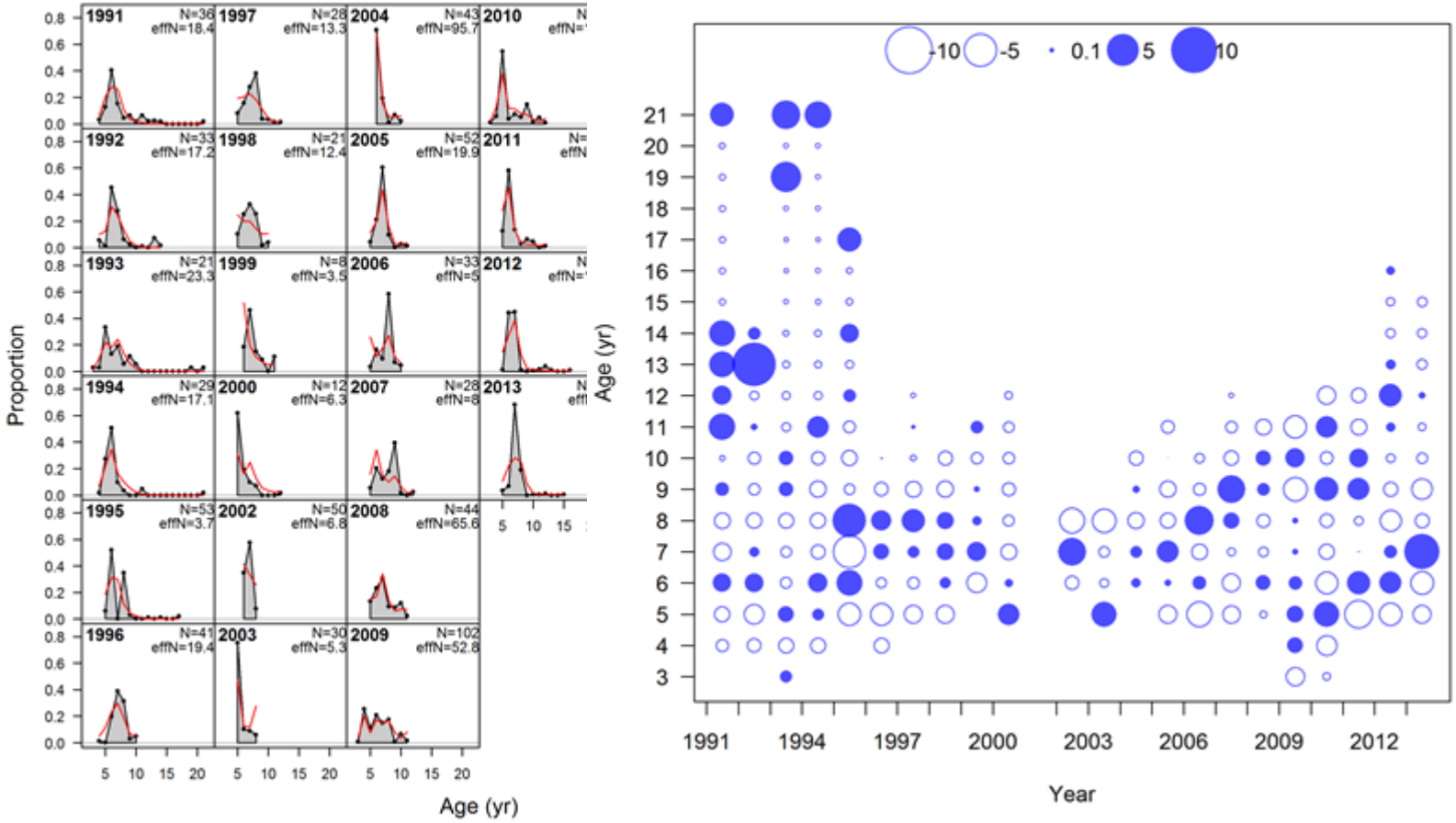
Charter / Private



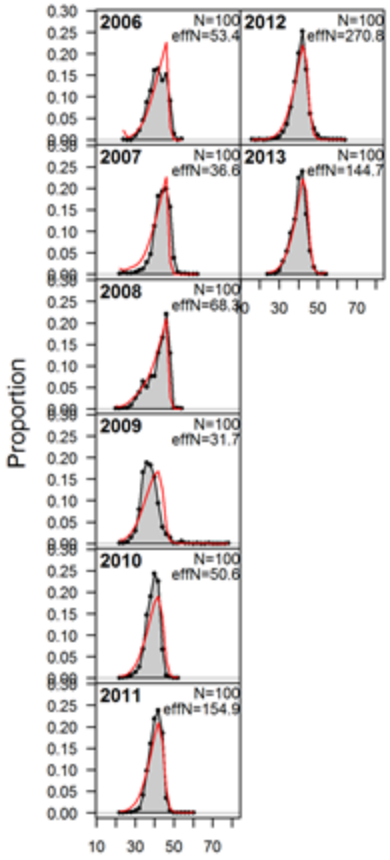


Age composition – Headboat

Headboat

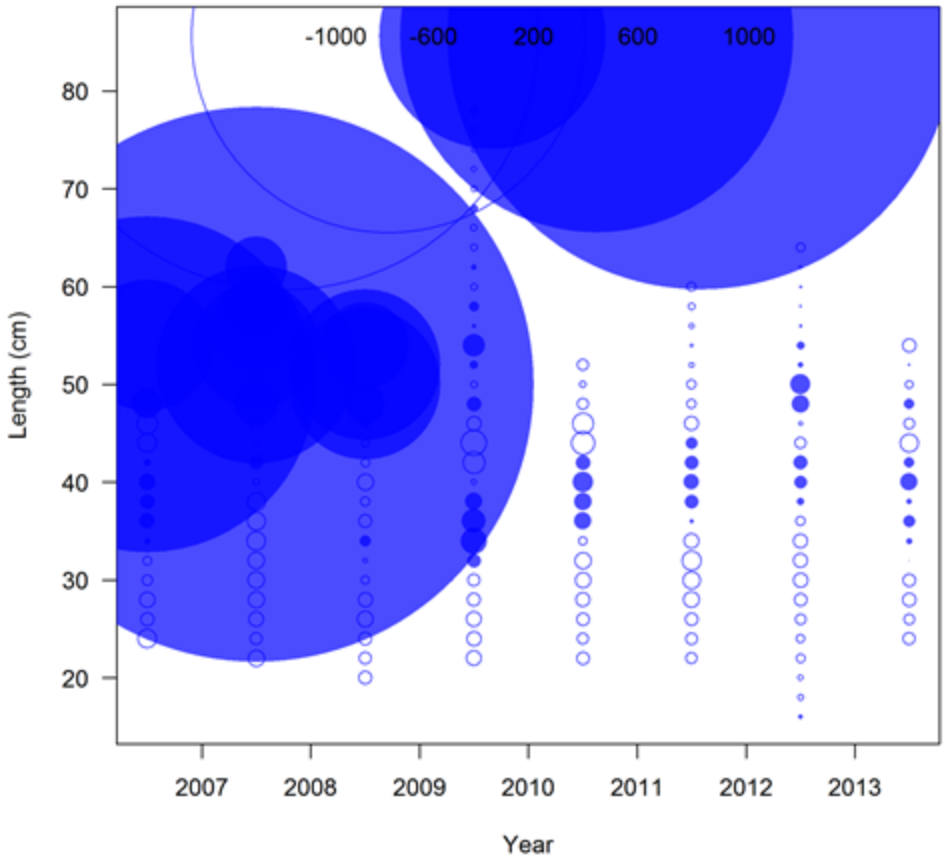


Length composition - discards

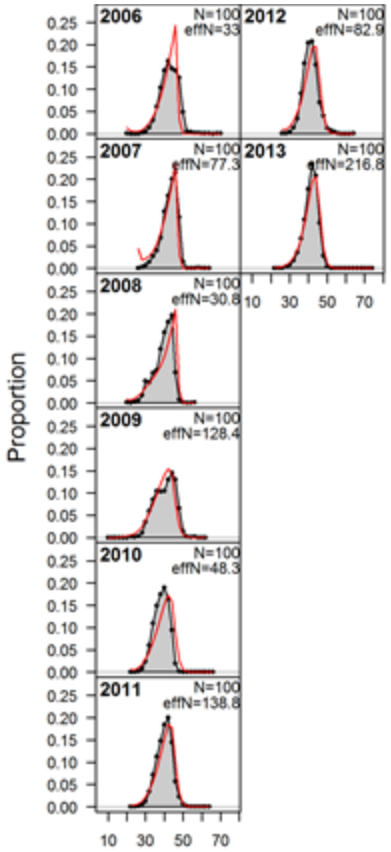


Length (cm FL)

Commercial Handline

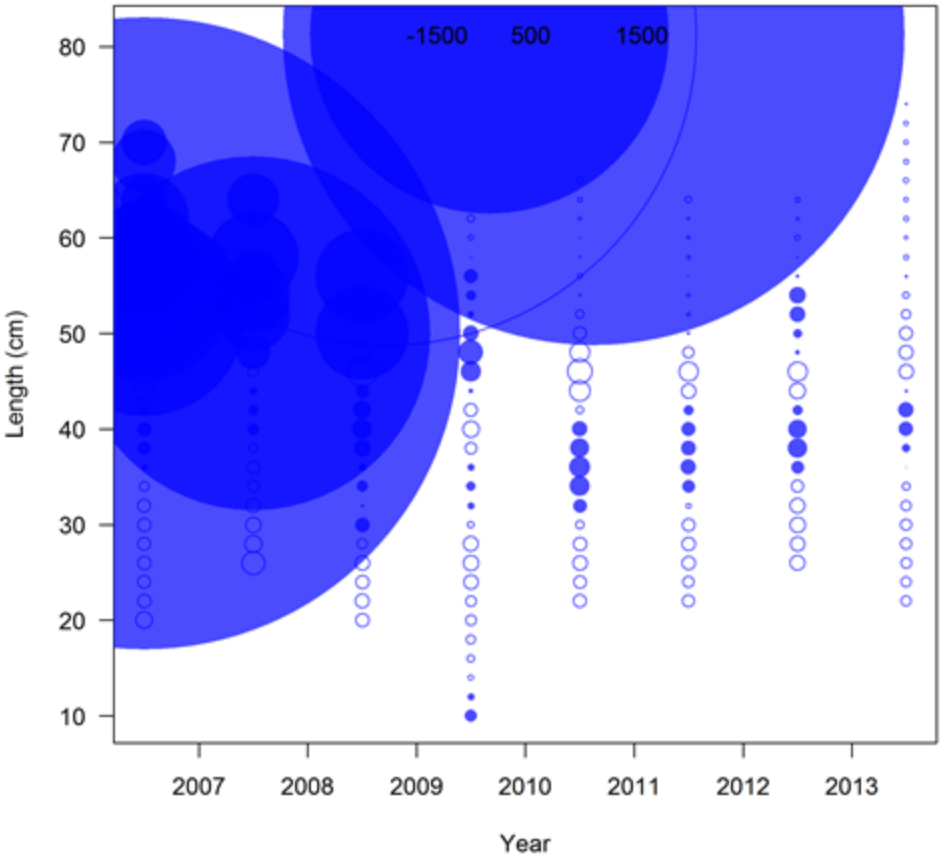


Length composition - discards

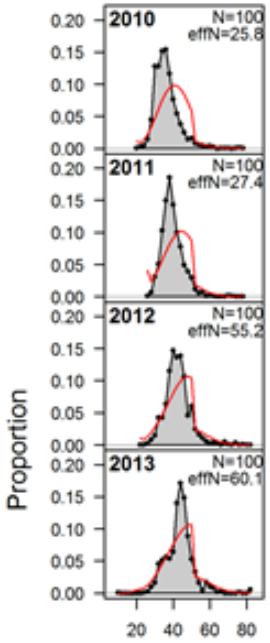


Length (cm FL)

Commercial Longline



Length composition - discards



Length (cm FL)

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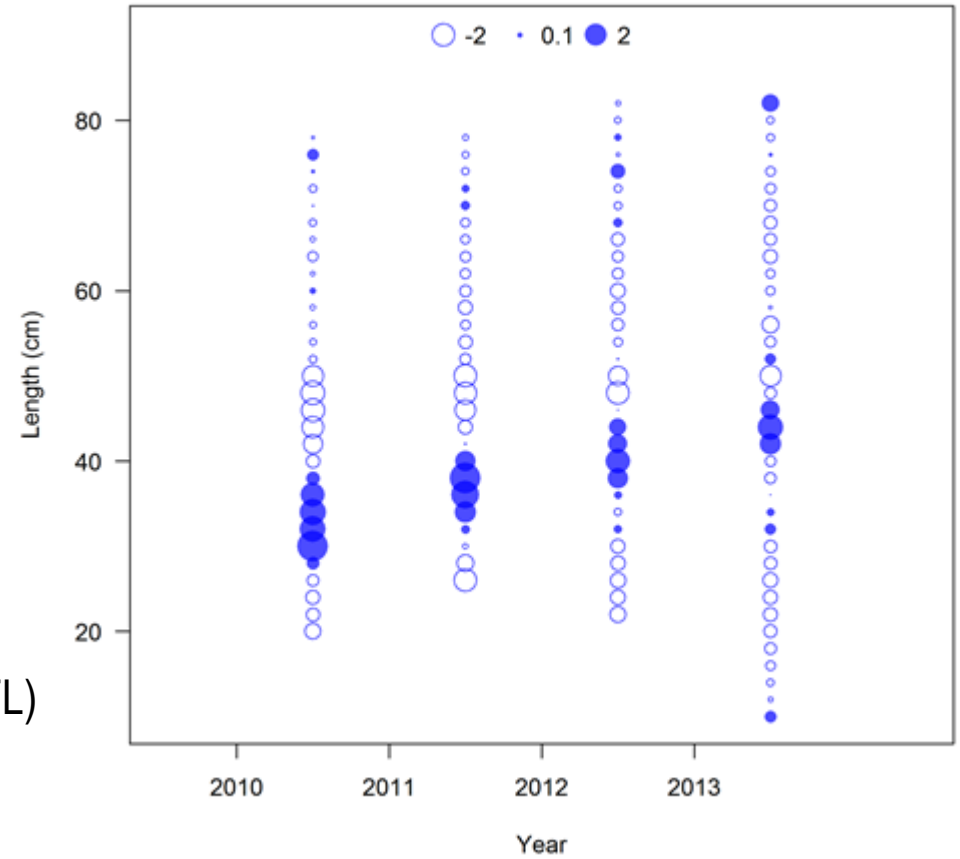
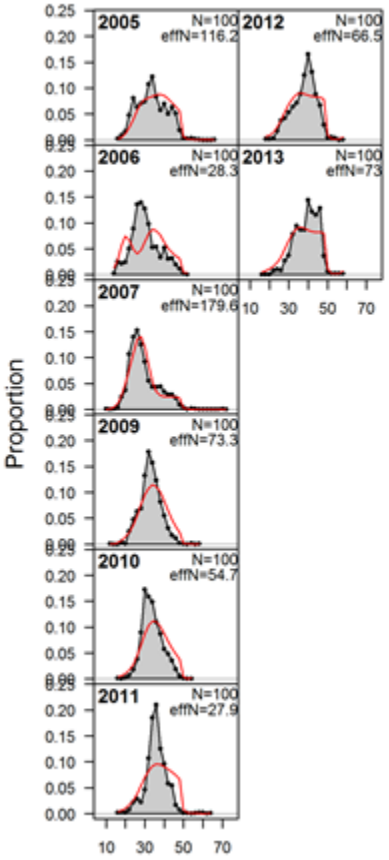
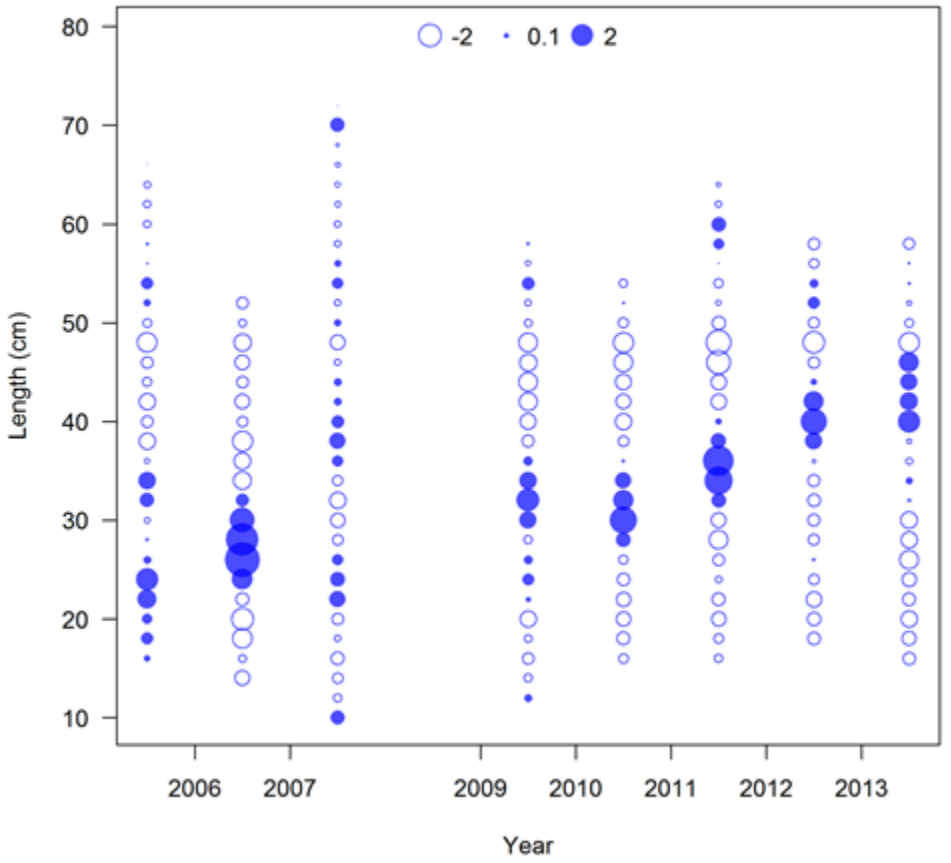


Length composition - discards

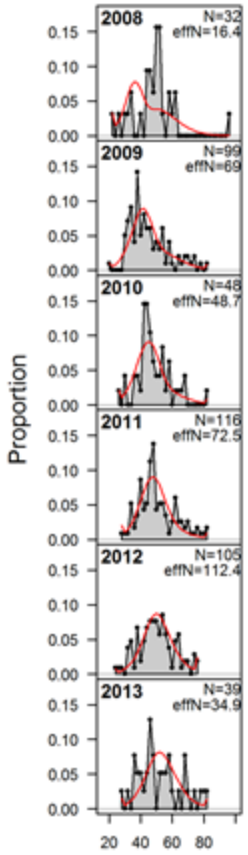
Headboat



Length (cm FL)

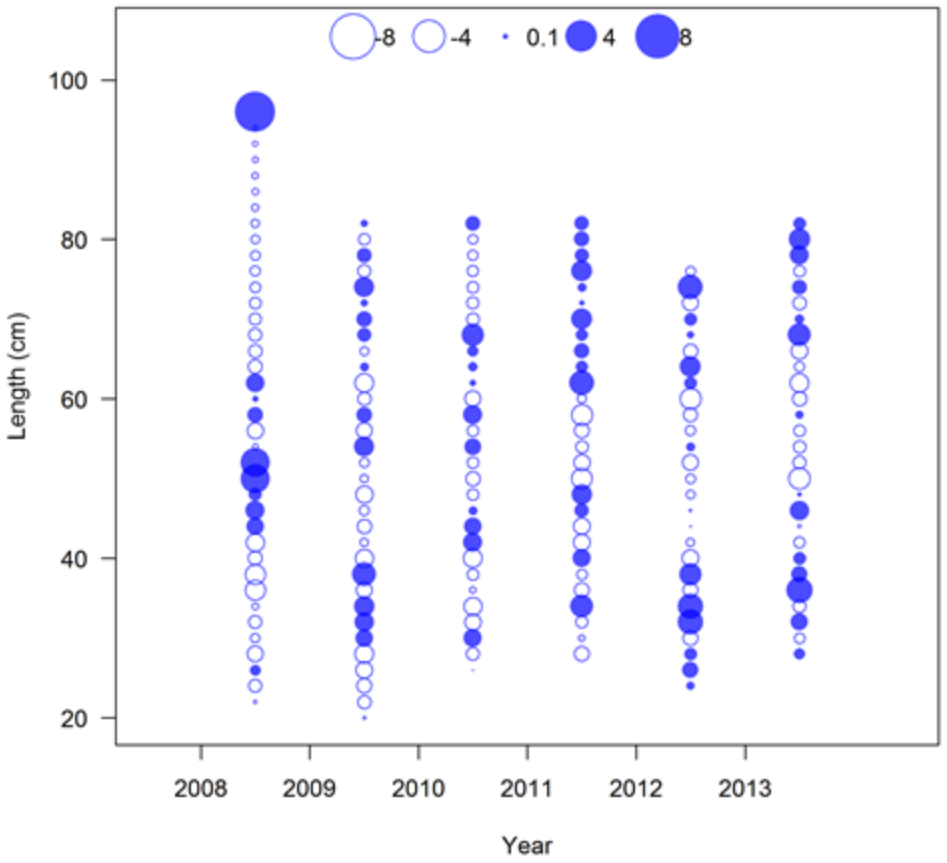


Length composition – Fishery-independent Surveys



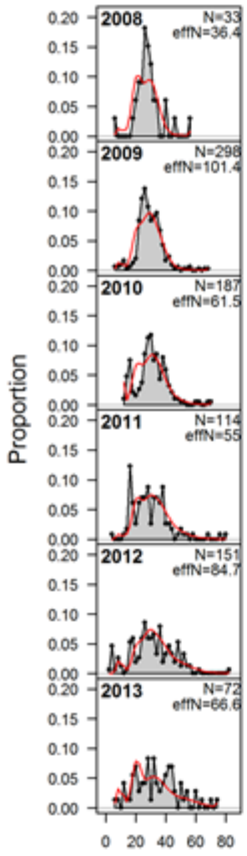
Length (cm FL)

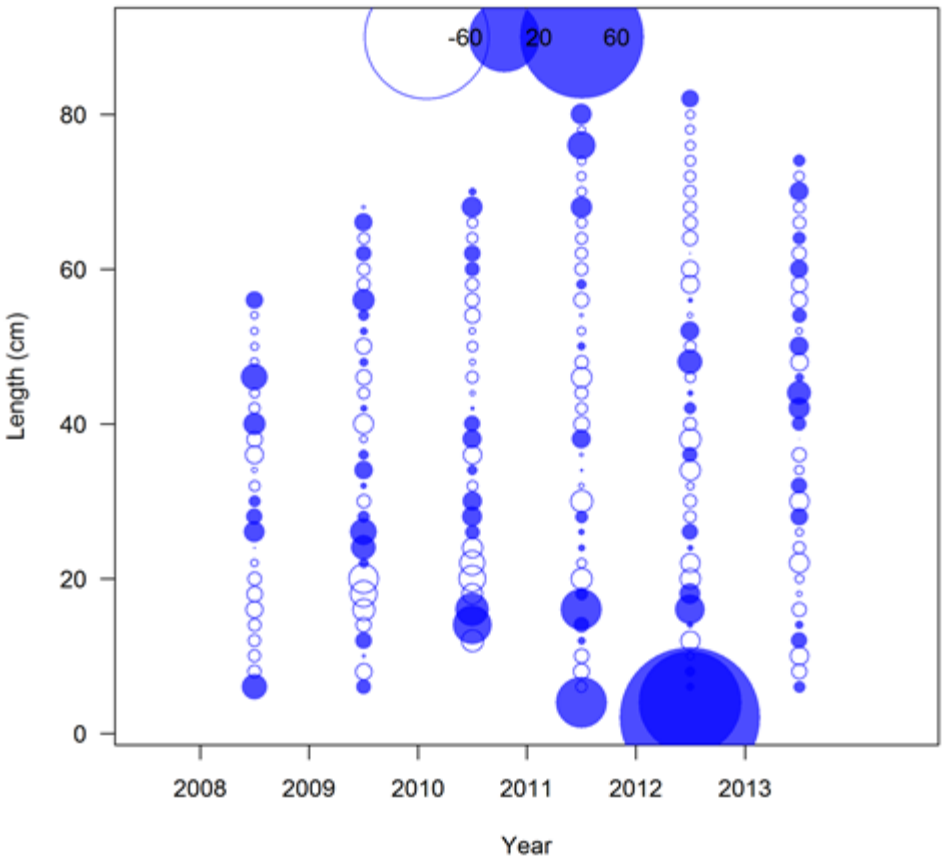
Combined video



Length composition – Fishery-independent Surveys

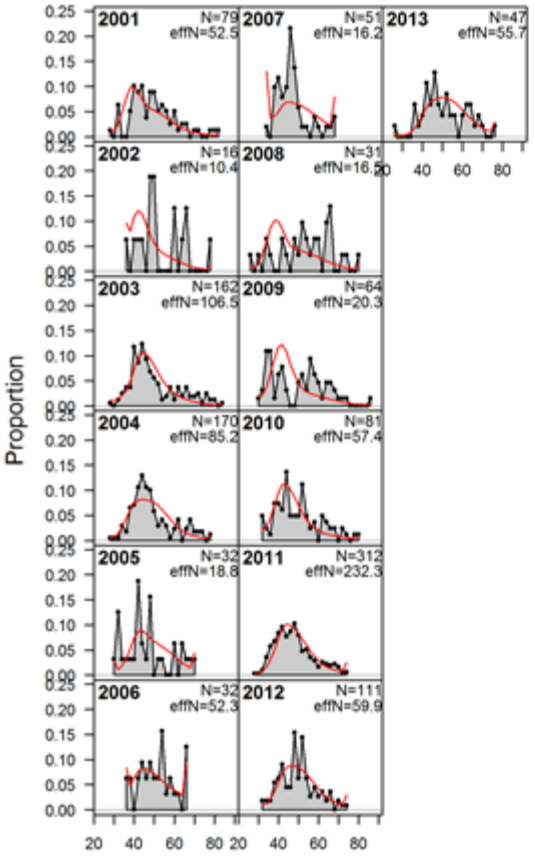
SEAMAP Summer Groundfish Survey

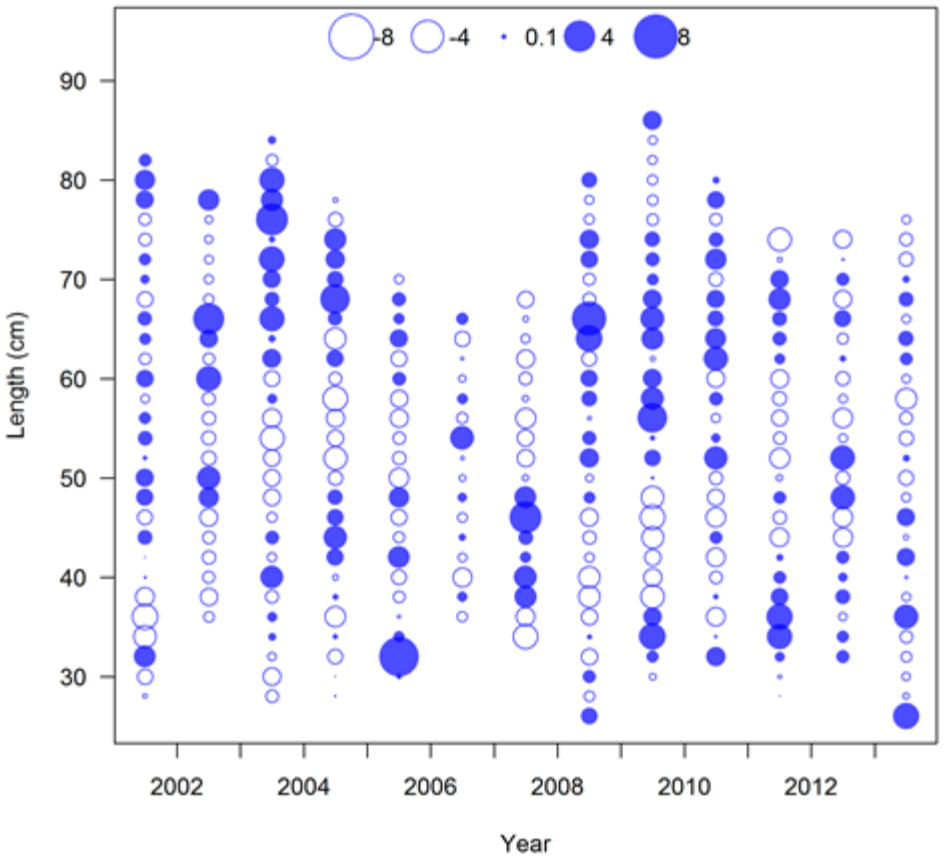




Length composition – Fishery-independent Surveys

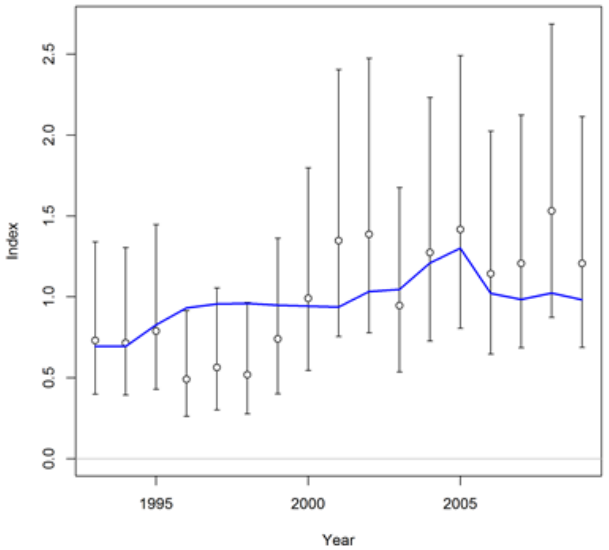
NMFS Bottom Longline Survey



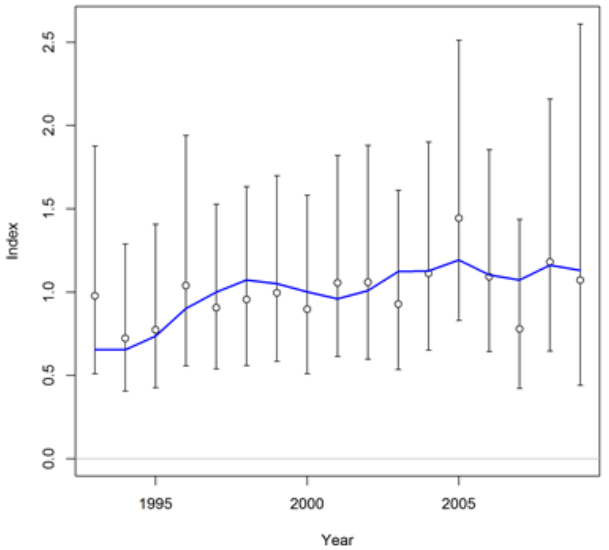


Indices – Fishery-dependent

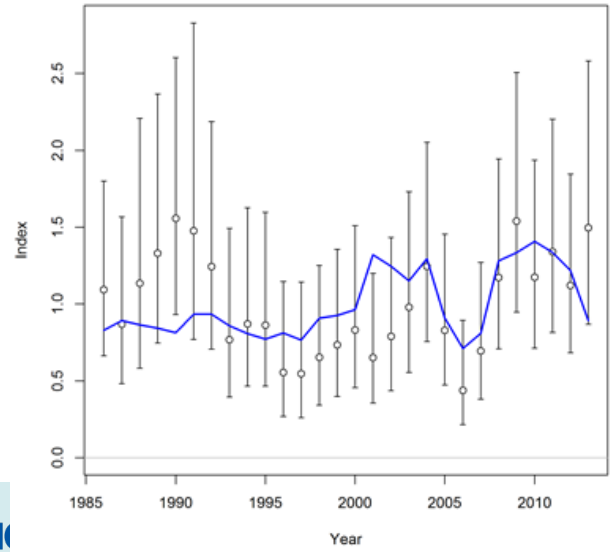
Commercial handline



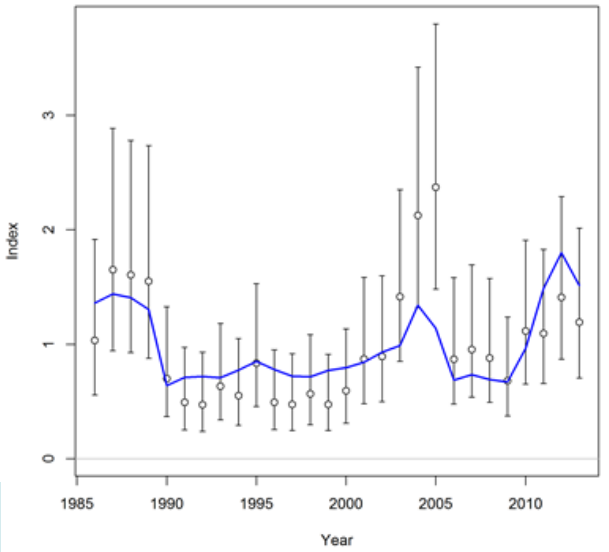
Commercial longline



Charter/Private

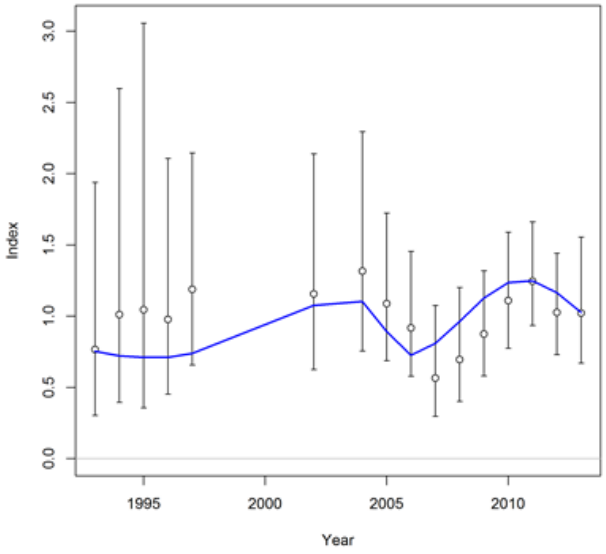


Headboat

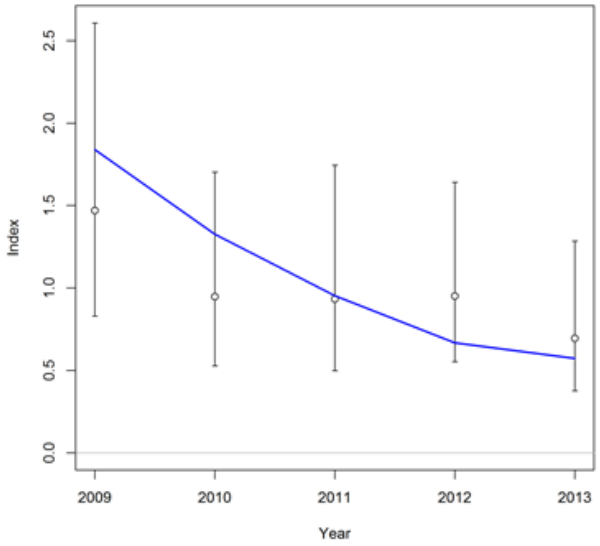


Indices – Fishery-independent

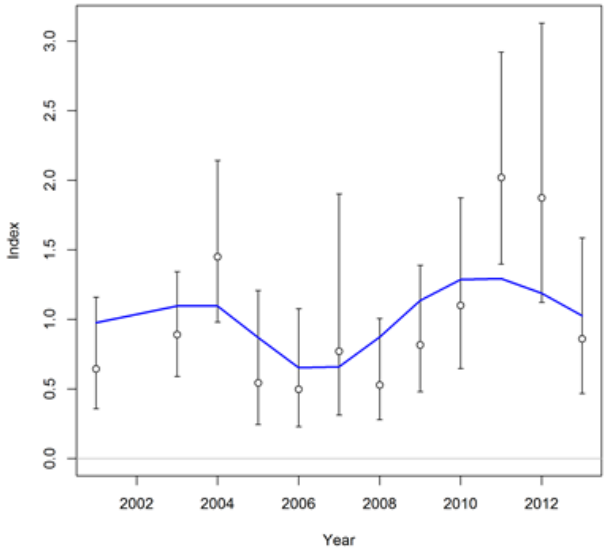
Combined video



SEAMAP groundfish



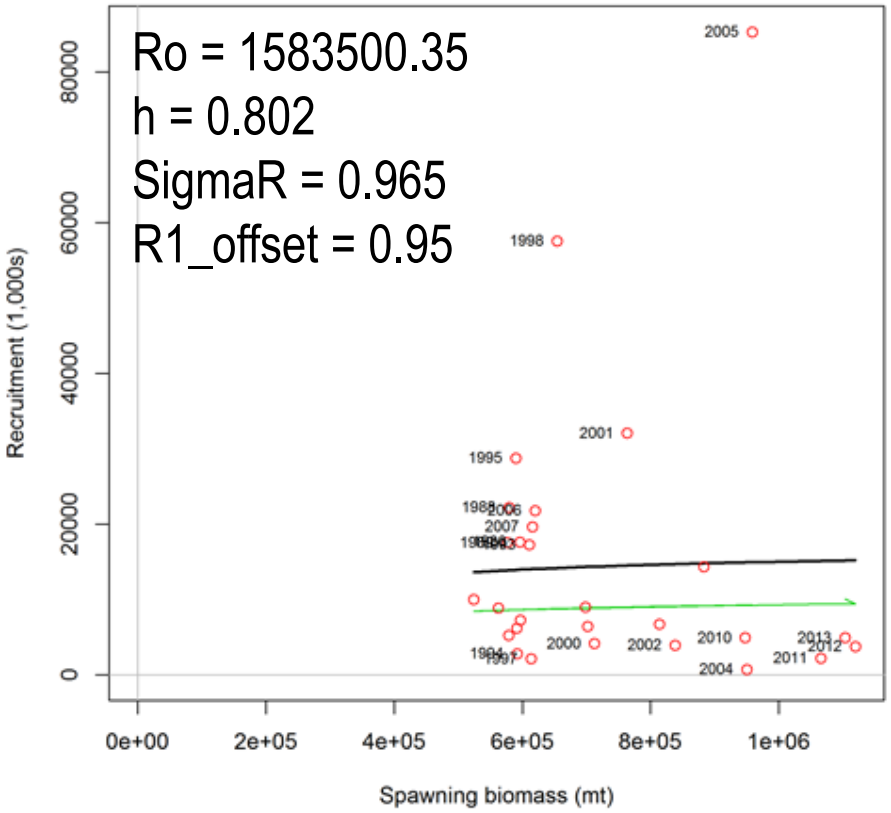
NMFS bottom longline

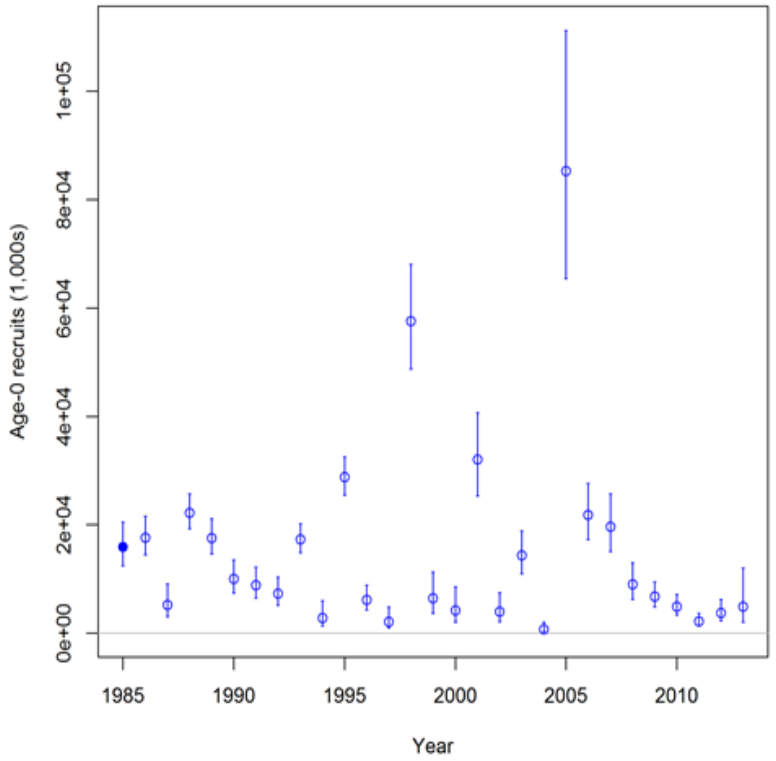


Model output

- Recruitment
- Total and spawning stock biomass
- Predicted numbers at age
- Fishing mortality

Recruitment

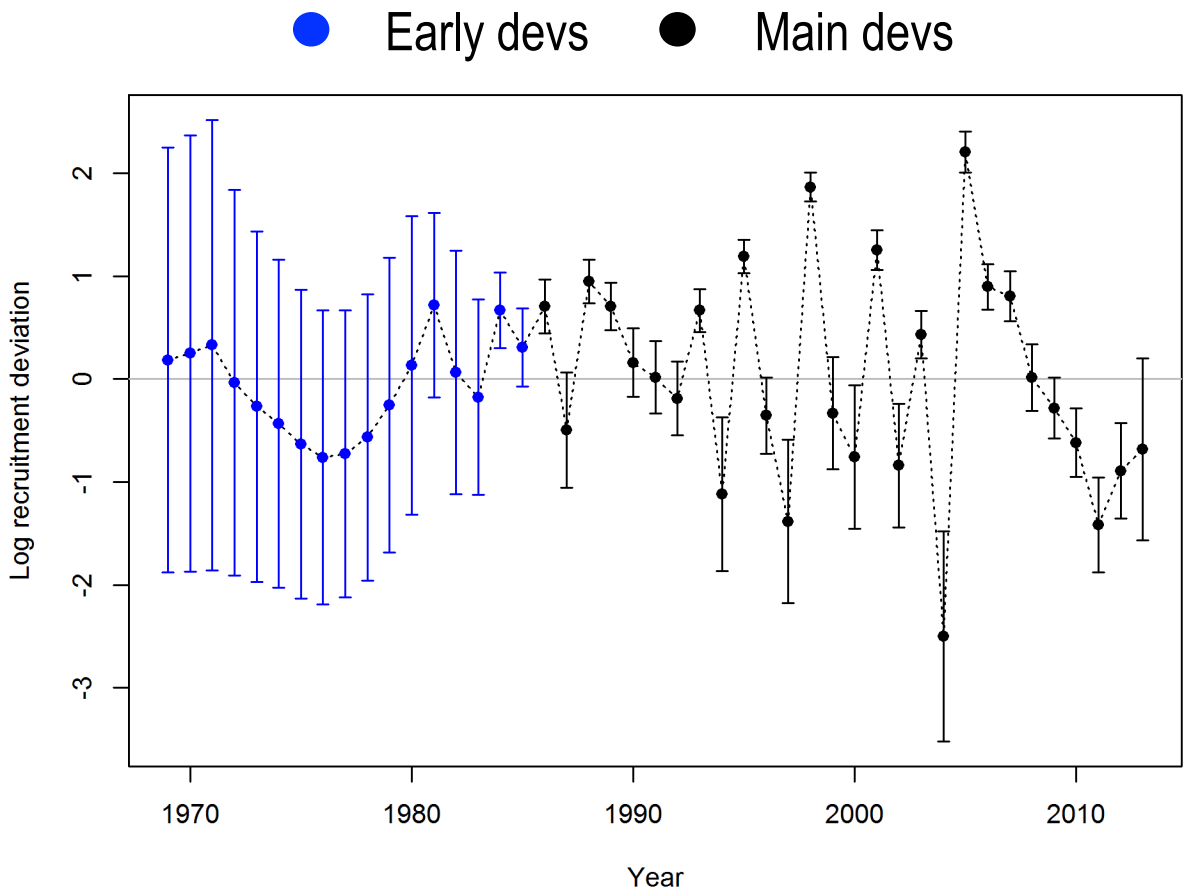




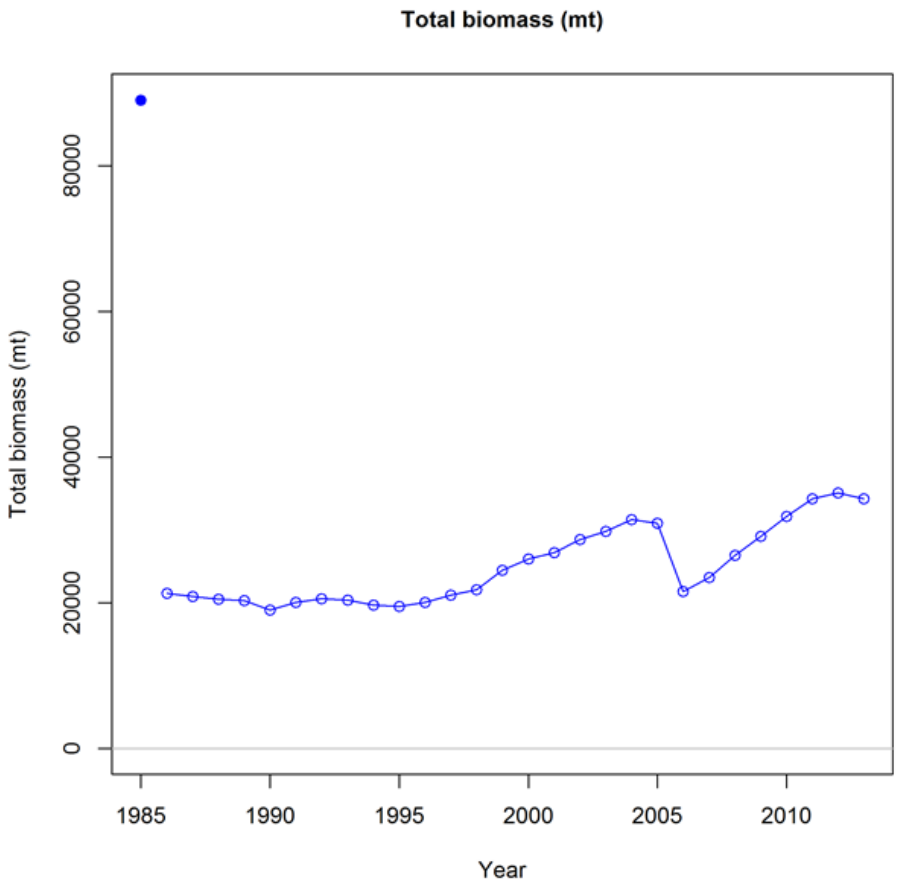
- Stock-recruitment relationship is generally flat
- High recruitment in 1995, 1998, 2001, and 2005

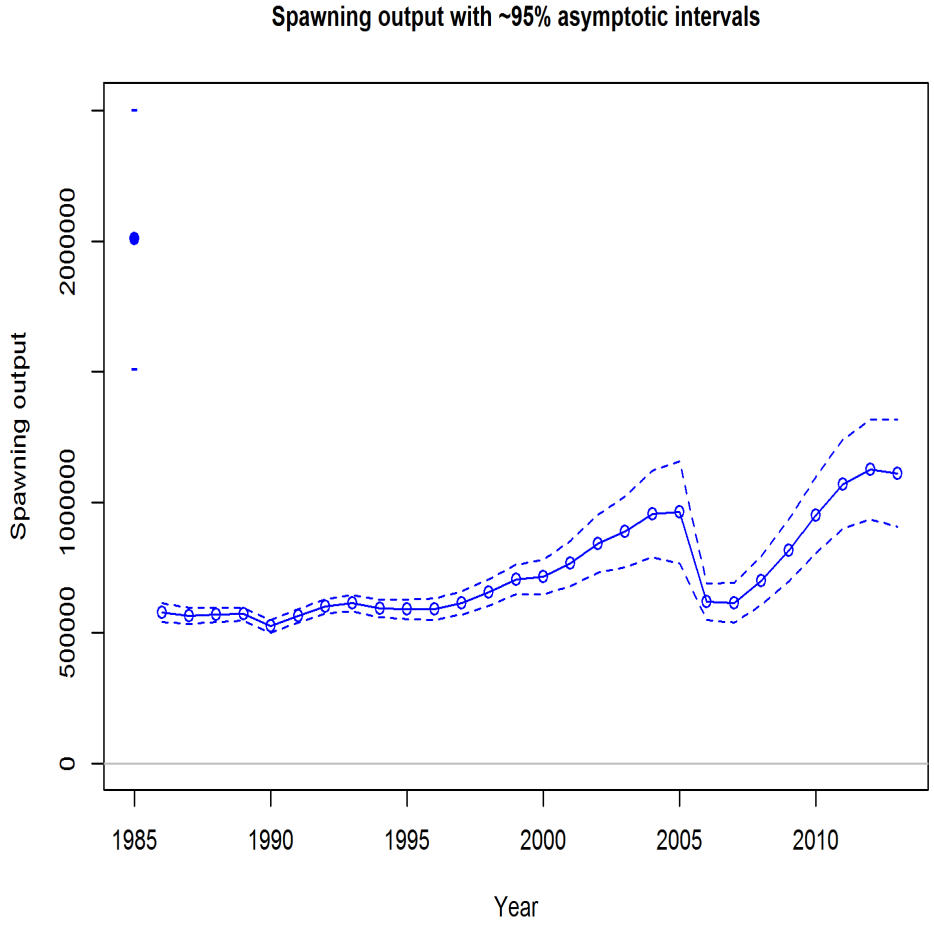
Recruitment

- Deviations



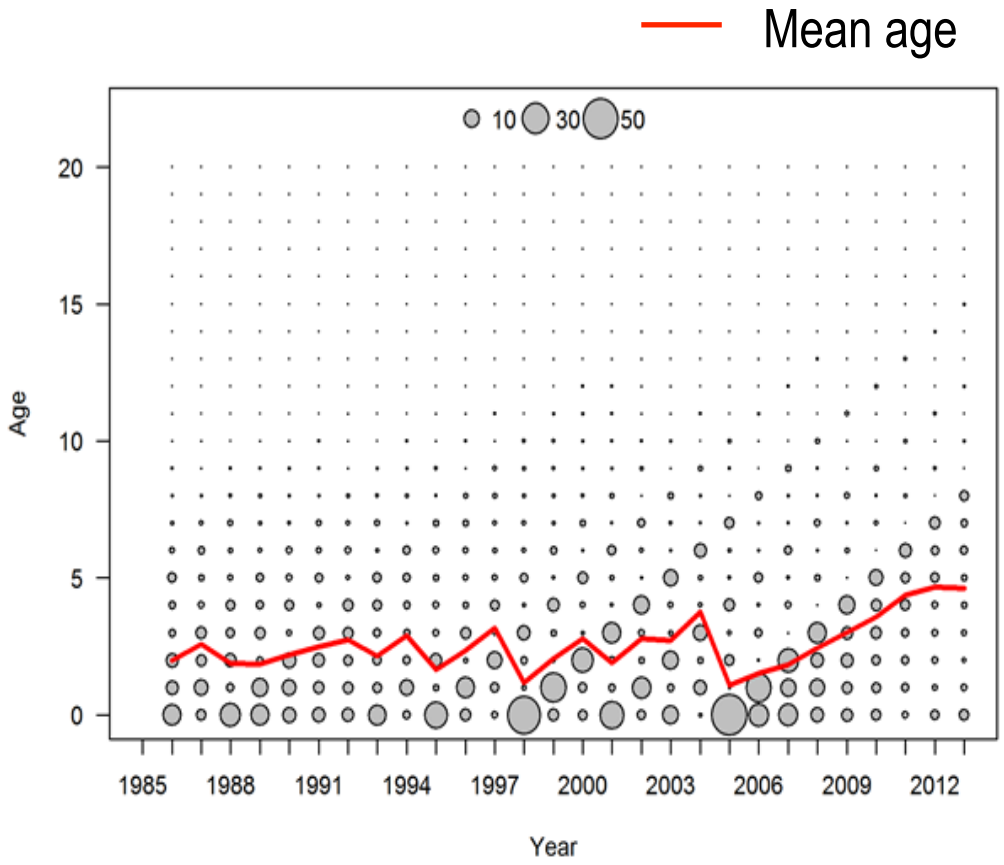
Total biomass and spawning stock biomass



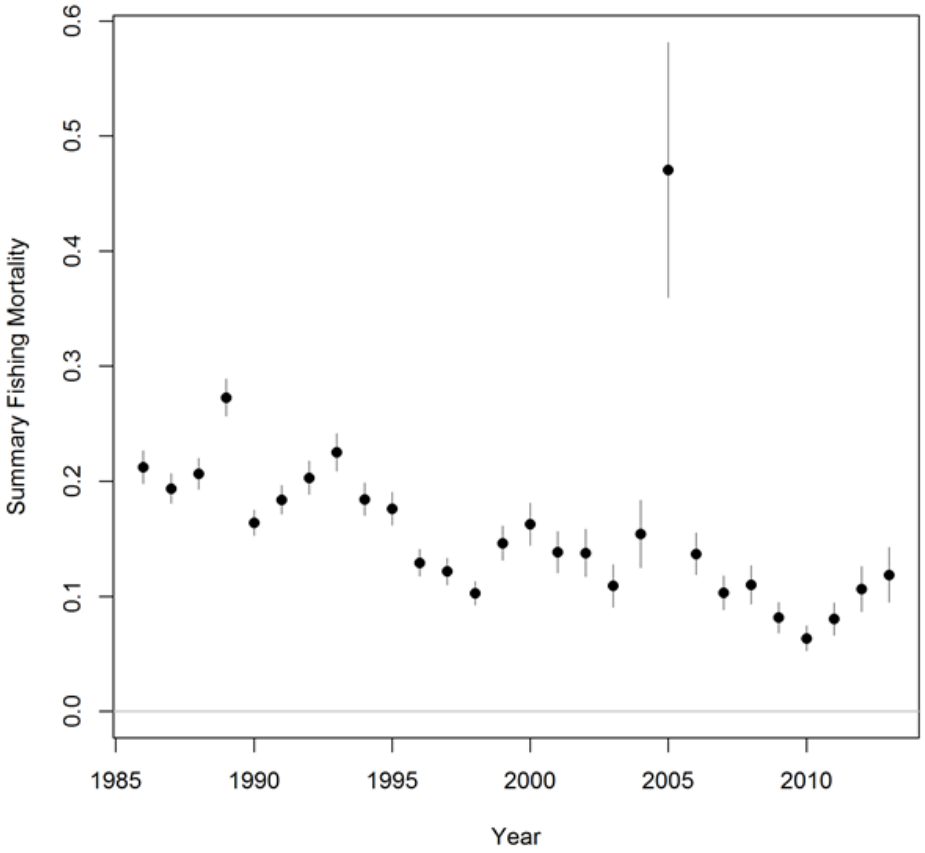


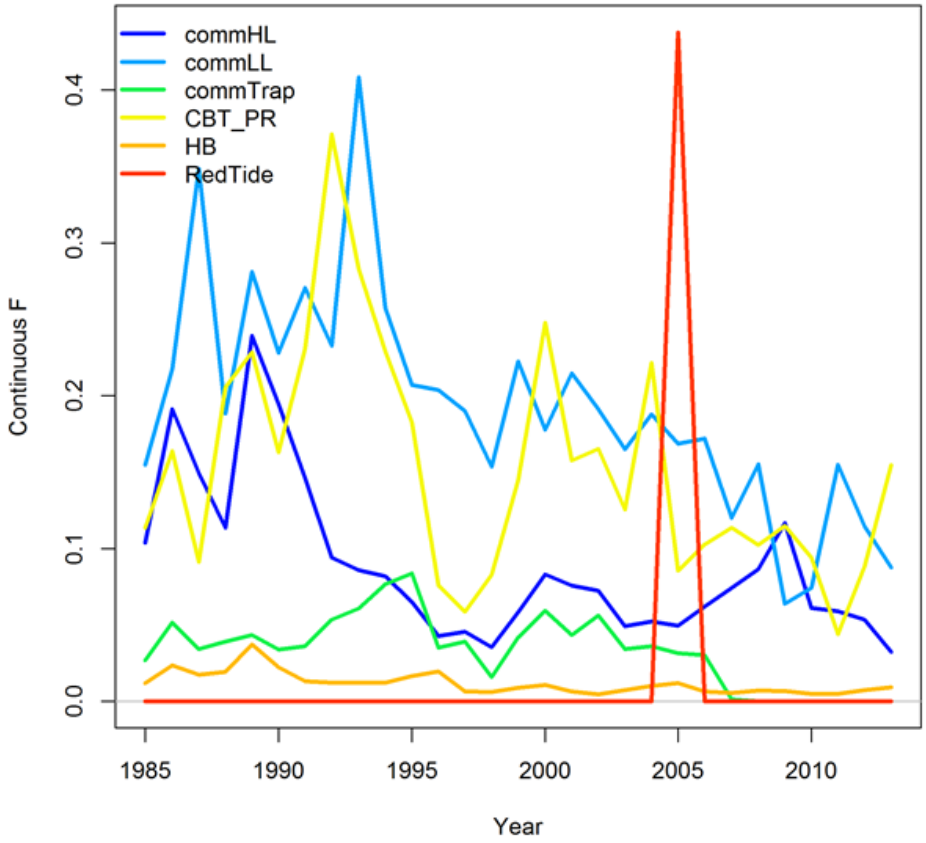
Predicted numbers at age

- Average age was around 2 for many years
  - Declines in years of high recruitment (1998 and 2005)
- After 2005, mean age increases
  - Lack of evidence of strong recruitment events after 2005



Fishing mortality





- Exploitation declined over time
  - 2005 – combination of exploitation and red tide mortality

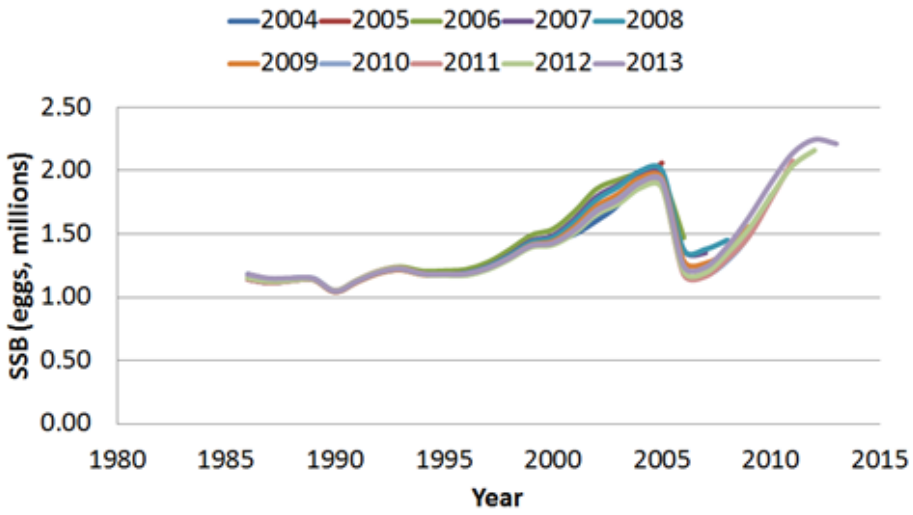
Model diagnostics

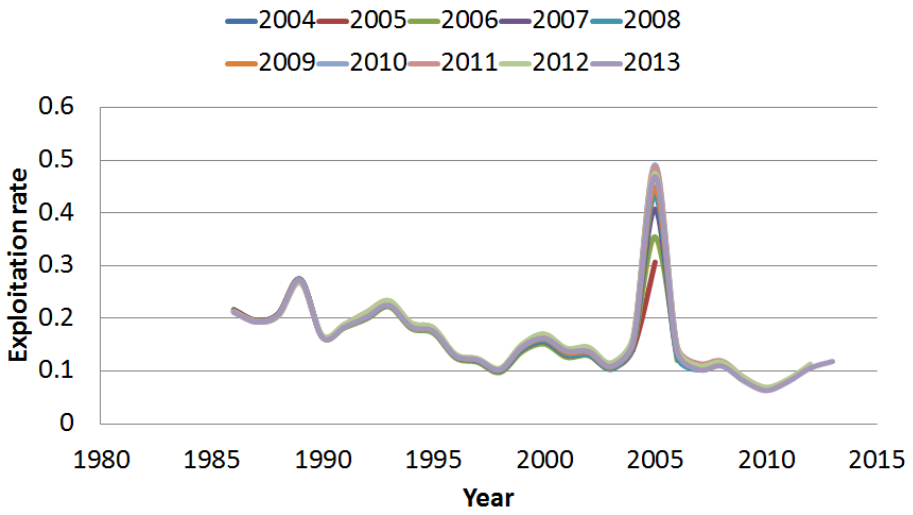
- Retrospective analysis
- Jitter analysis
- Likelihood profiles

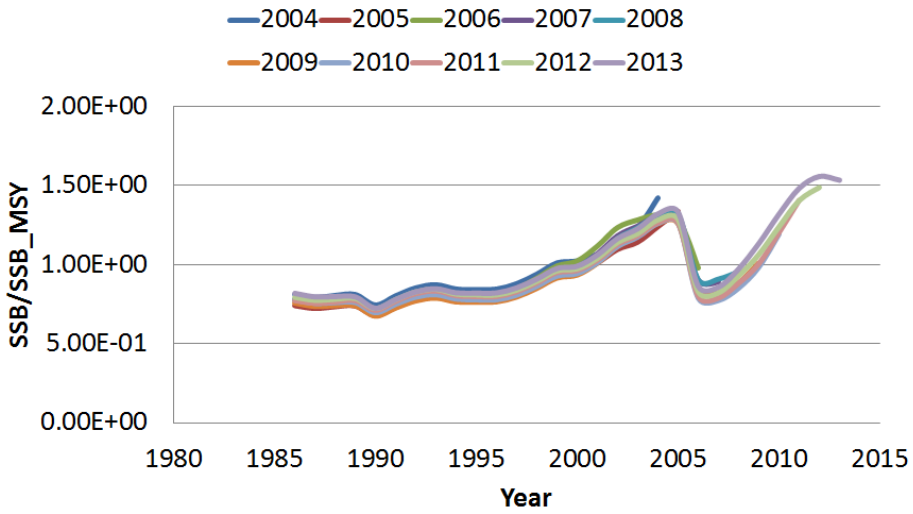
Retrospective analysis

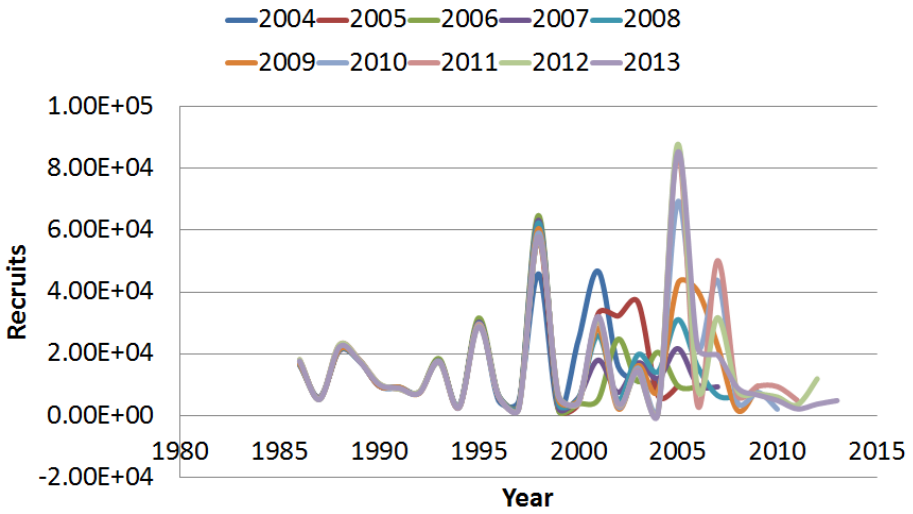
- Purpose: Assess consistency of stock assessment results and potential biases
- Sequentially removed data back to 2004
  - Runs 2004 – 2008 did not include the SEAMAP summer groundfish survey

Retrospective analysis



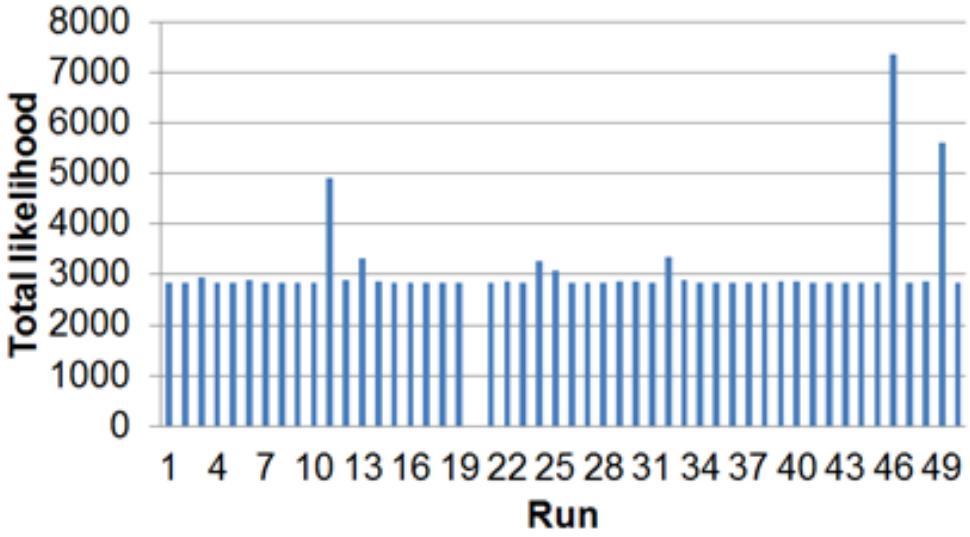






Jitter analysis

- Model convergence was evaluated using jitter analysis
- 30 out of 50 runs were within 5 likelihood units of base likelihood

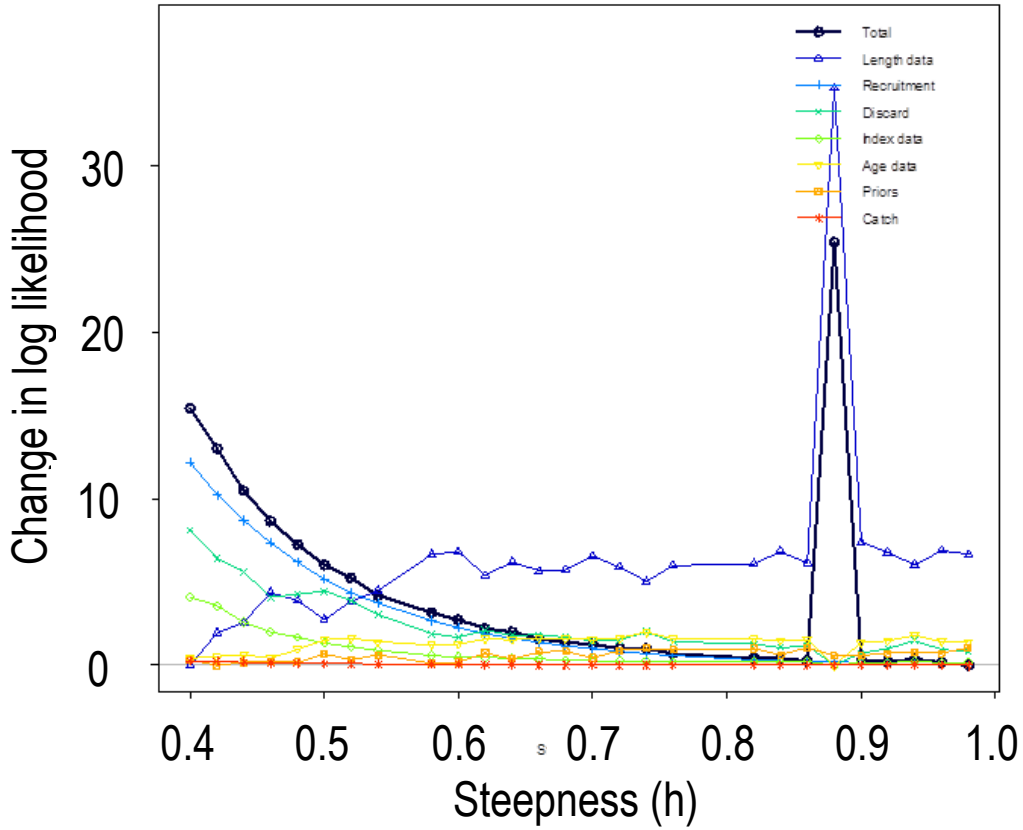


Likelihood profiles

- Evaluate ability to estimate various parameters and most likely values
  - Steepness (h): fraction of the unexploited recruits produced at 20% of the equilibrium spawning biomass level
  - Ln Ro: Log of eqilibrium recruitment
  - Ln R1: offset parameter for initial equilibrium recruitment relative to virgin recruitment
  - Sigma R: standard deviation in recruitment
  - Final parameter of the double normal selectivity pattern

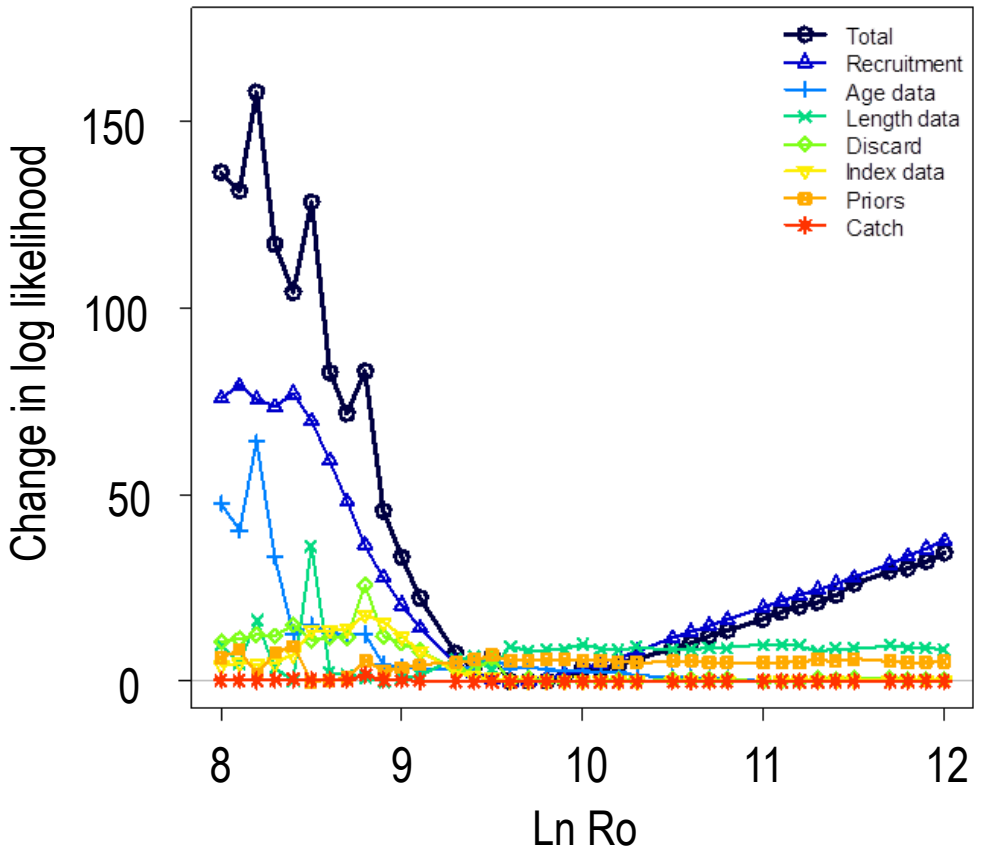
Likelihood profiles

- Profile indicates steepness should be between 0.8 and 0.85
  - Most likelihood components support this
- Length composition does not support estimate of steepness
  - Supports a lower estimate



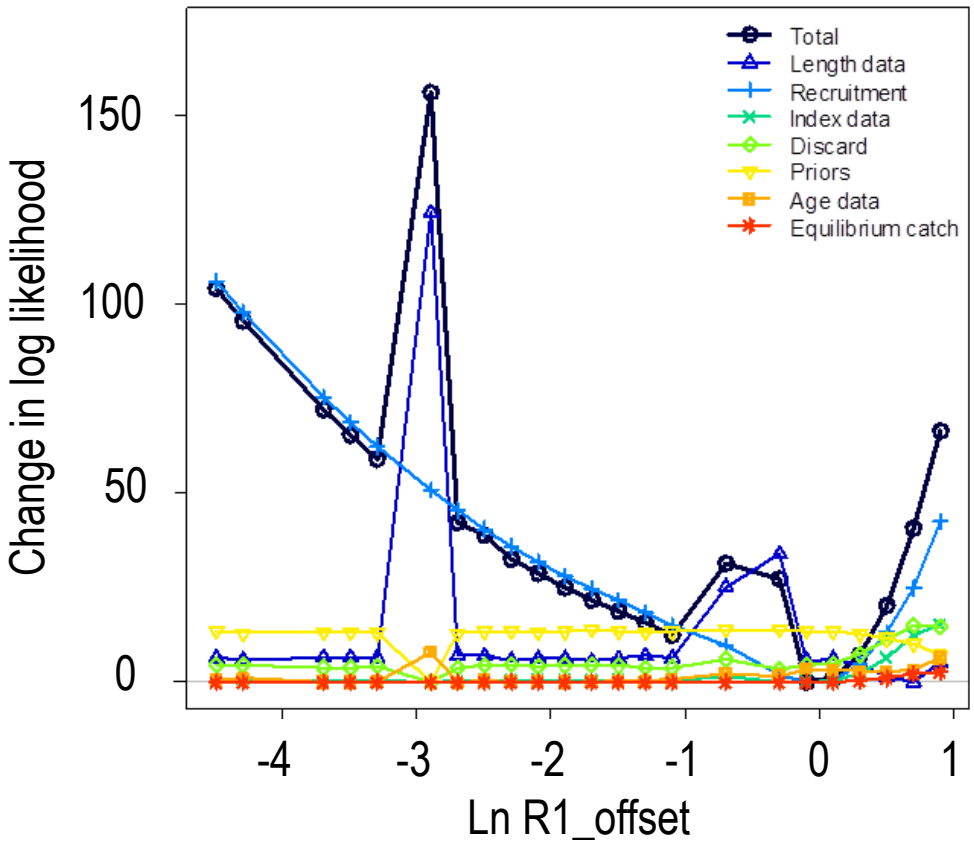
Likelihood profiles

- Profile indicates Ln Ro should be between 9.3 and 10



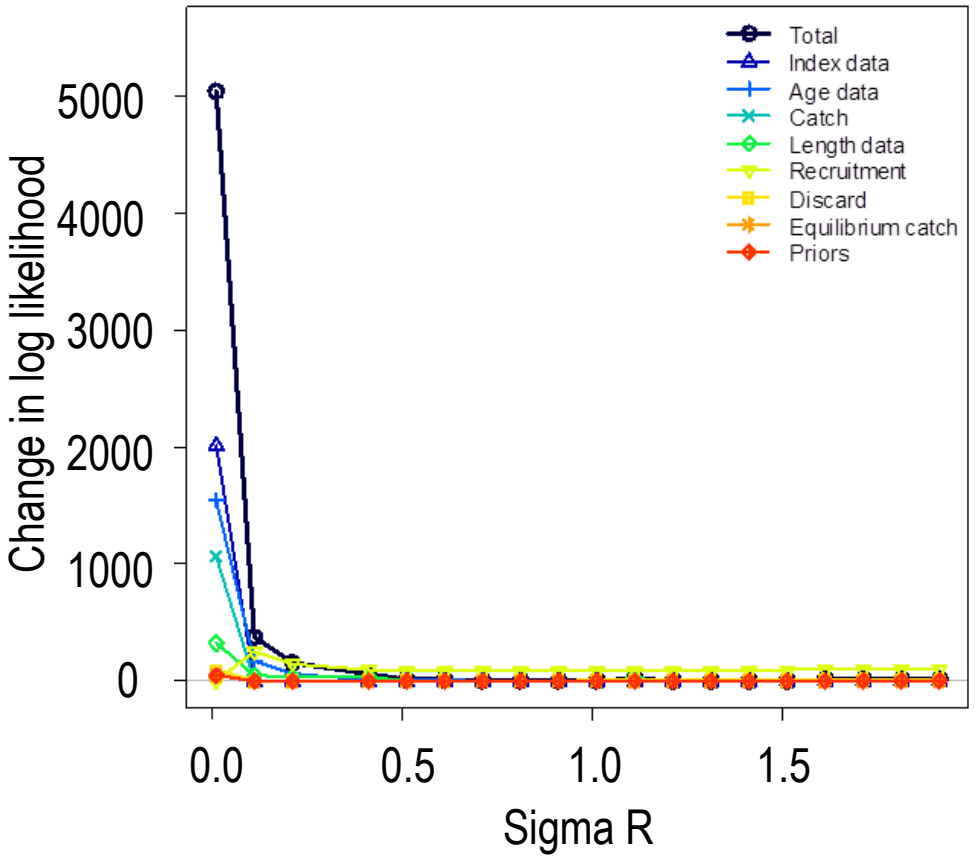
Likelihood profiles

- Profile indicates Ln R1_offset should be between -0.05 and 0.3
  - Most likelihood components support this



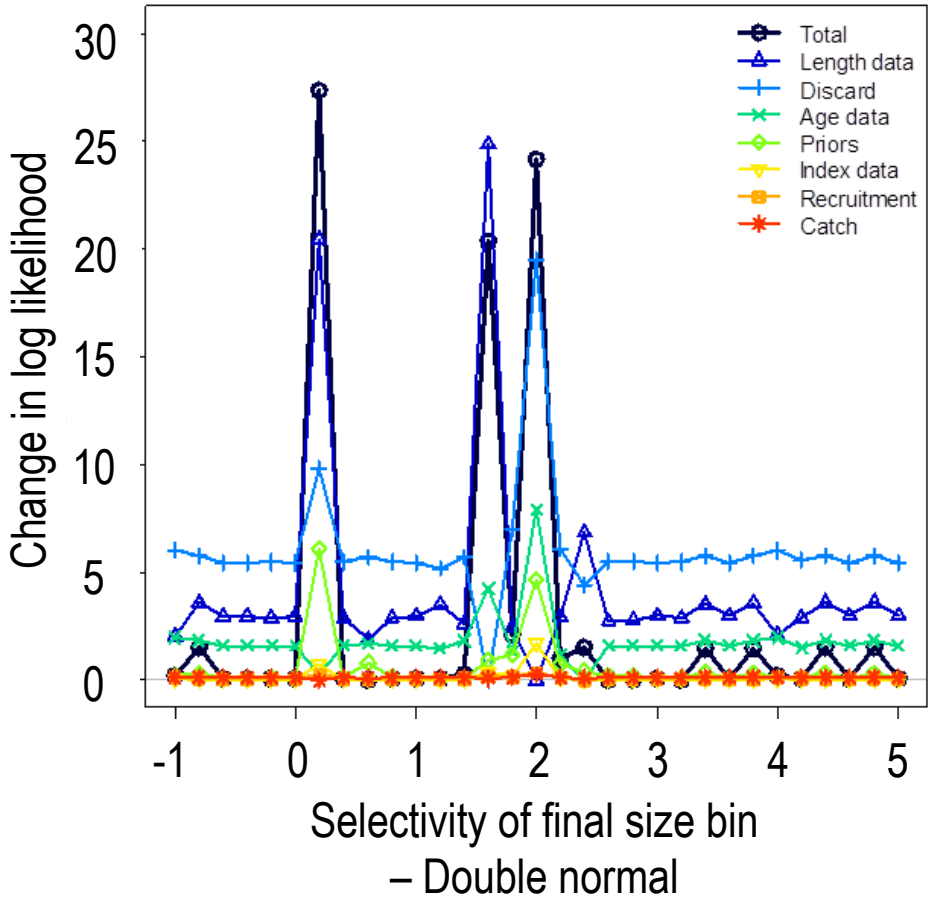
Likelihood profiles

- Profile indicates sigma R greater than 0.4
- Likelihood components are in agreement



Likelihood profiles

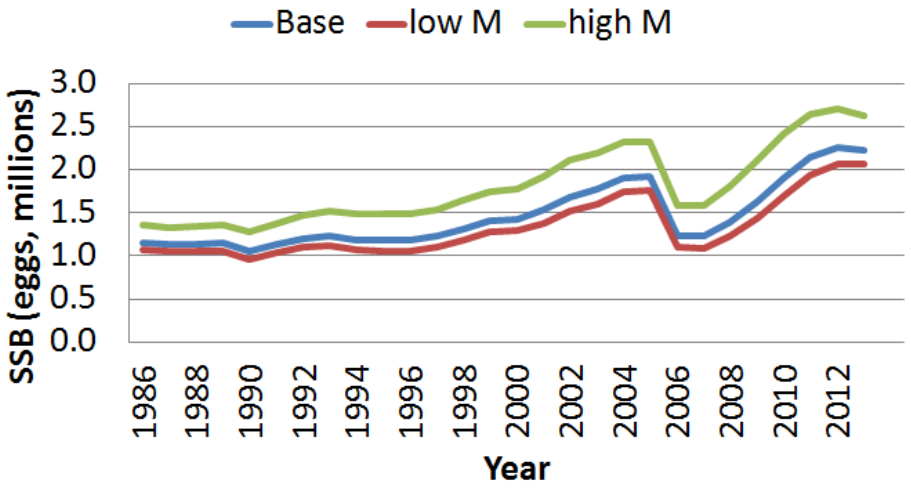
- Profile of the parameter describing the selectivity of the final size bin
- Not well estimated

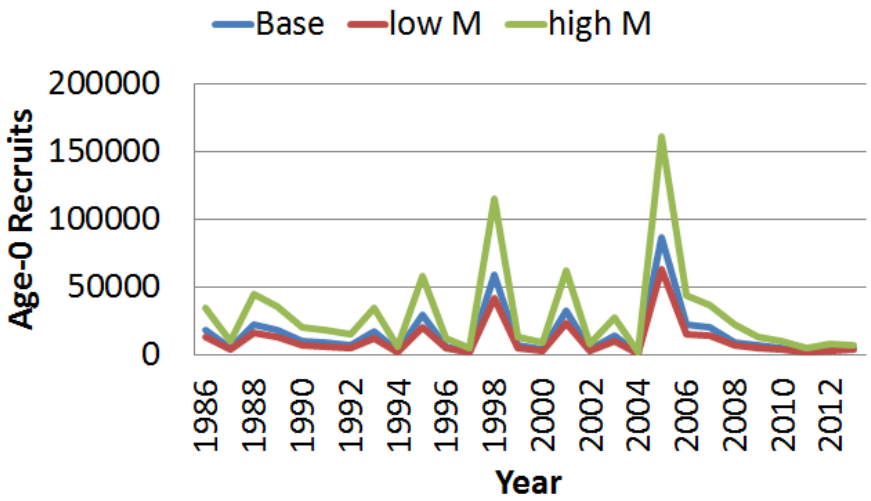


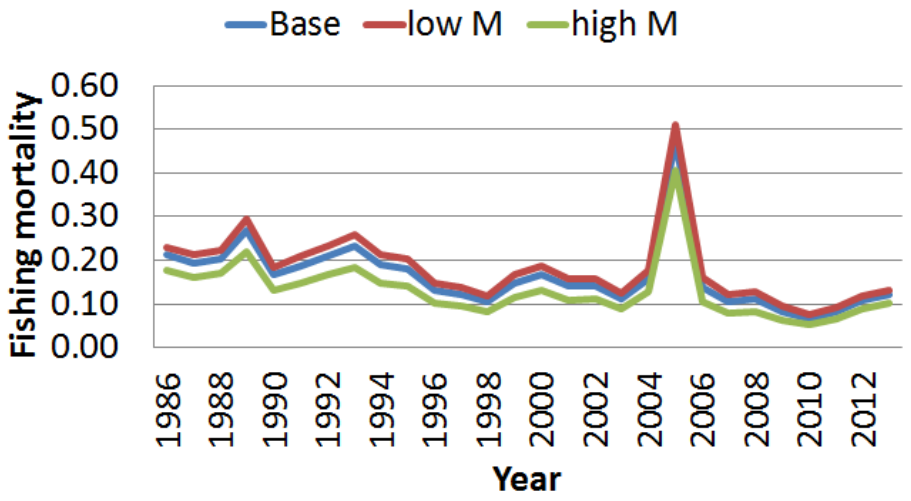
Sensitivities

- Natural mortality
- Steepness
- Discard weighting
- Selectivity of NMFS bottom longline survey
- Jack-knife analysis of abundance indices

Sensitivity – Natural mortality

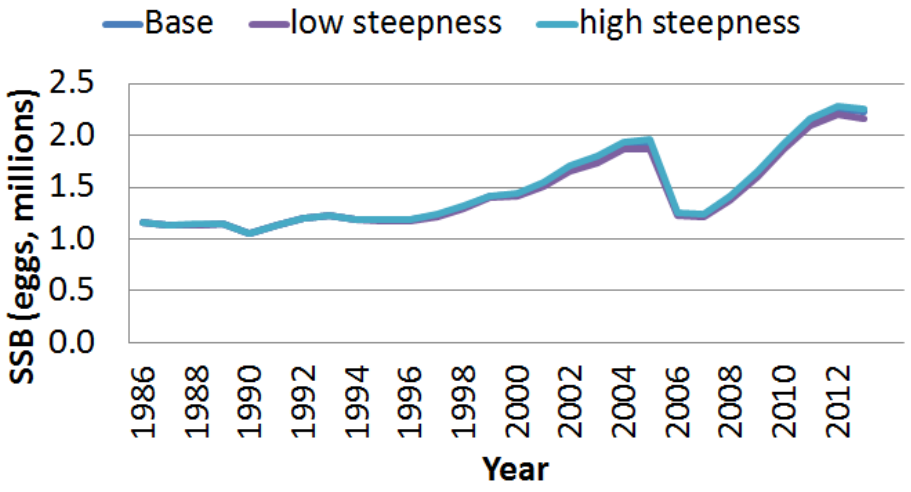


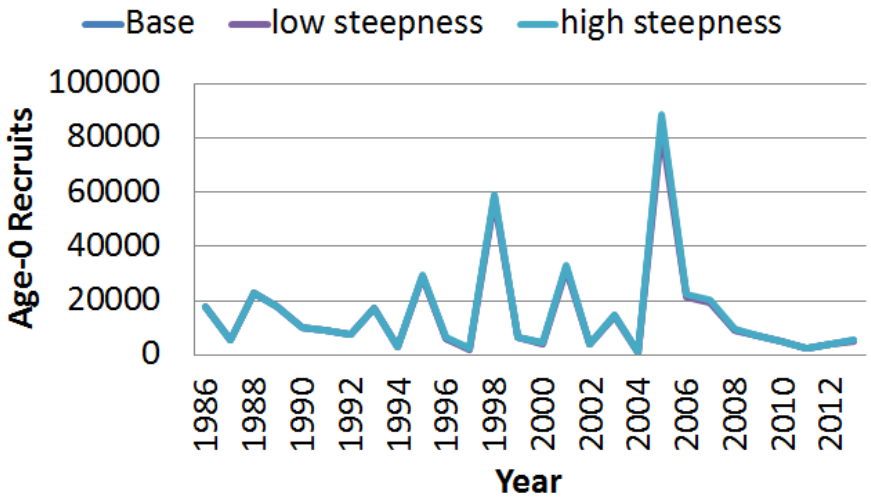


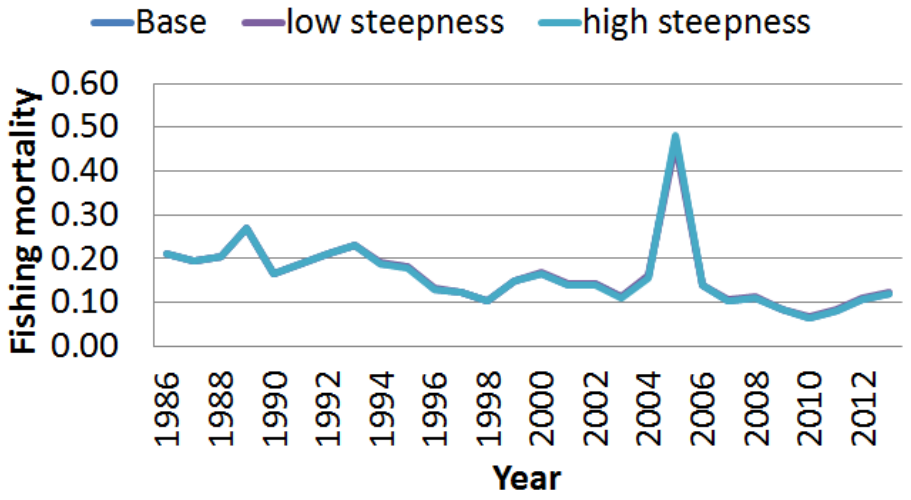


- Natural mortality values: Max_age ± 5
  - Standard deviation around the maximum age

Sensitivity - Steepness

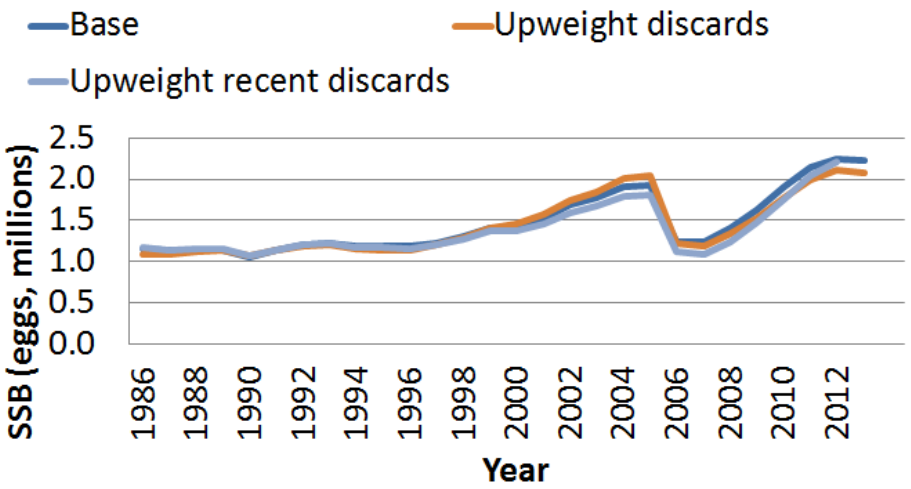


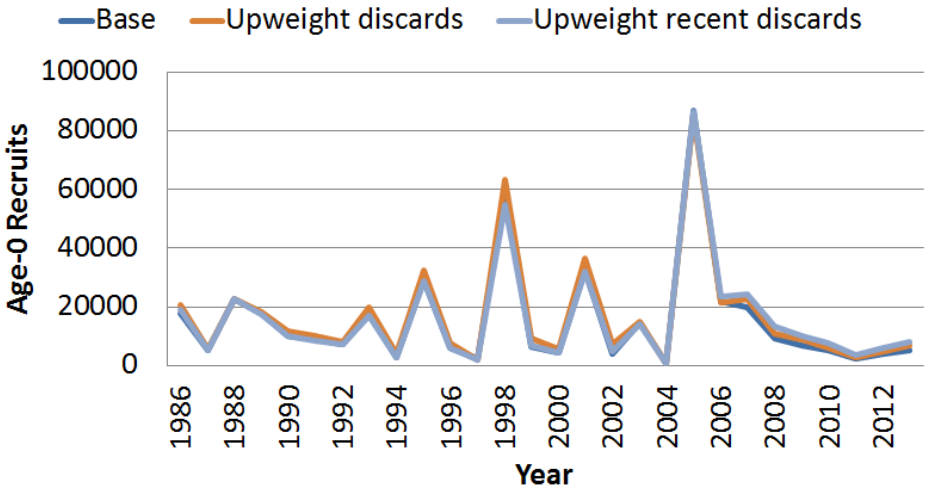


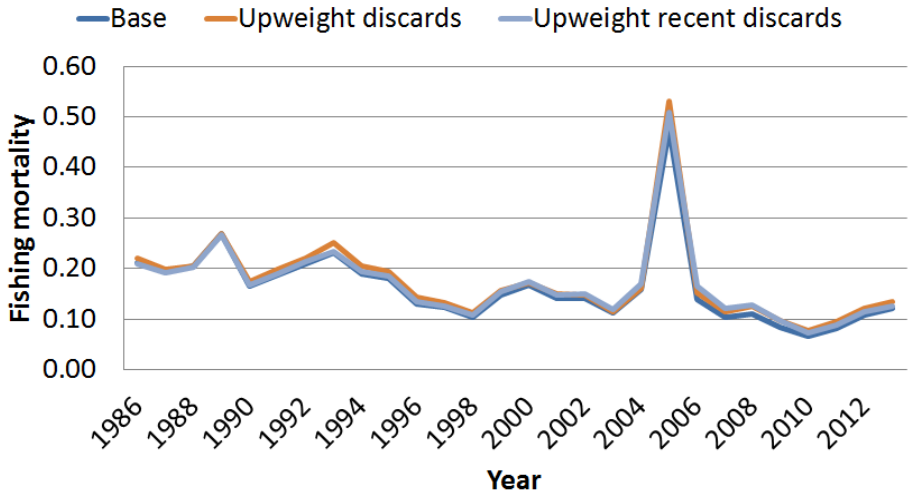


- Steepness values:
  - Low = 0.65
  - High = 0.99

Sensitivity – Discard weighting

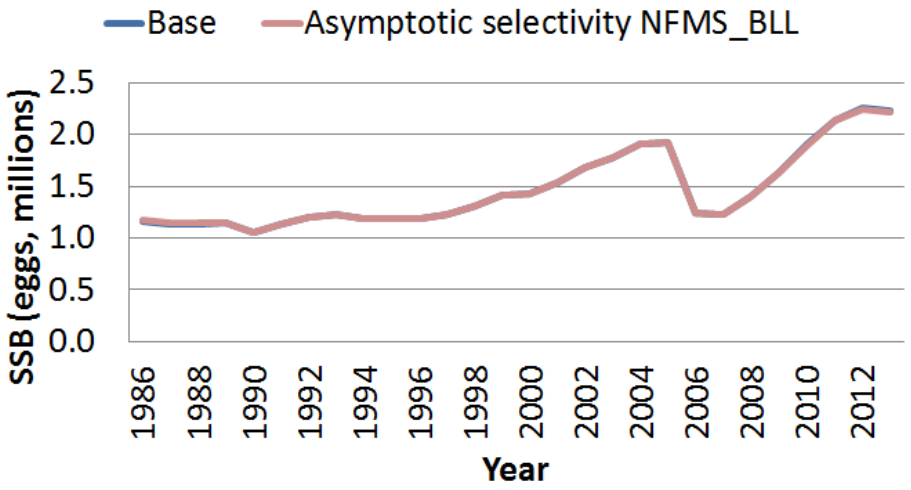


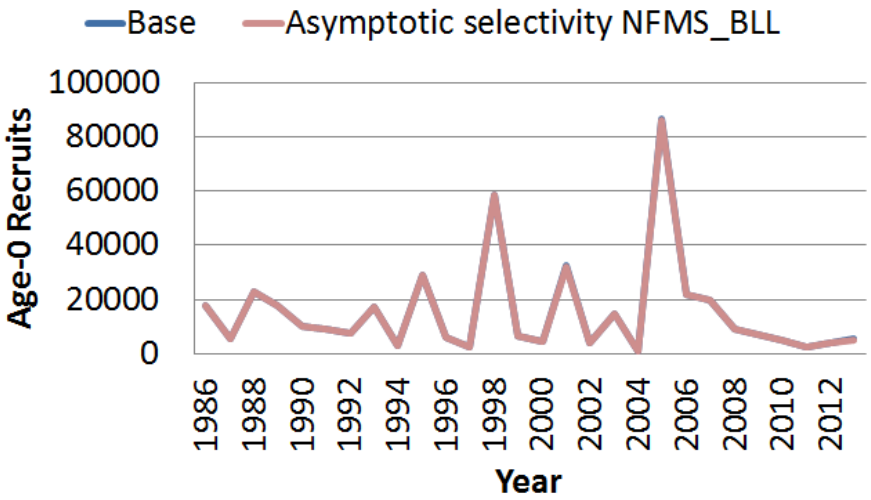


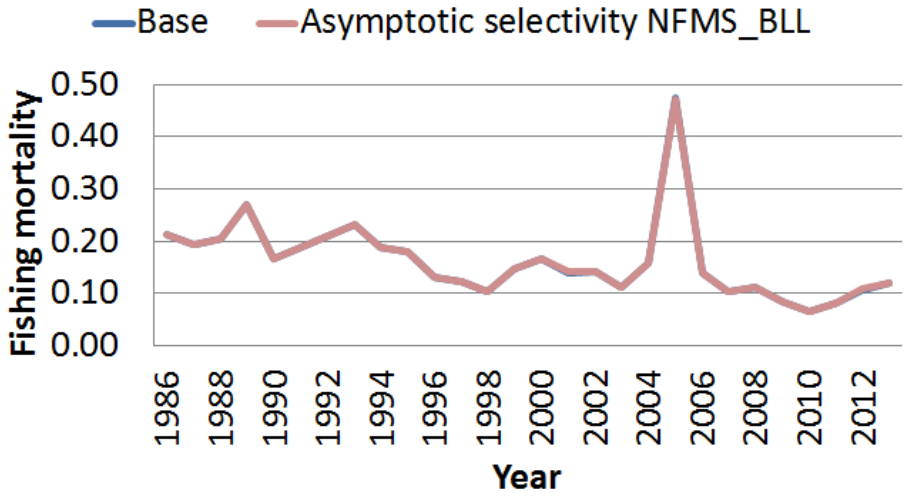


- EXPLAIN WEIGHTING:

Sensitivity -



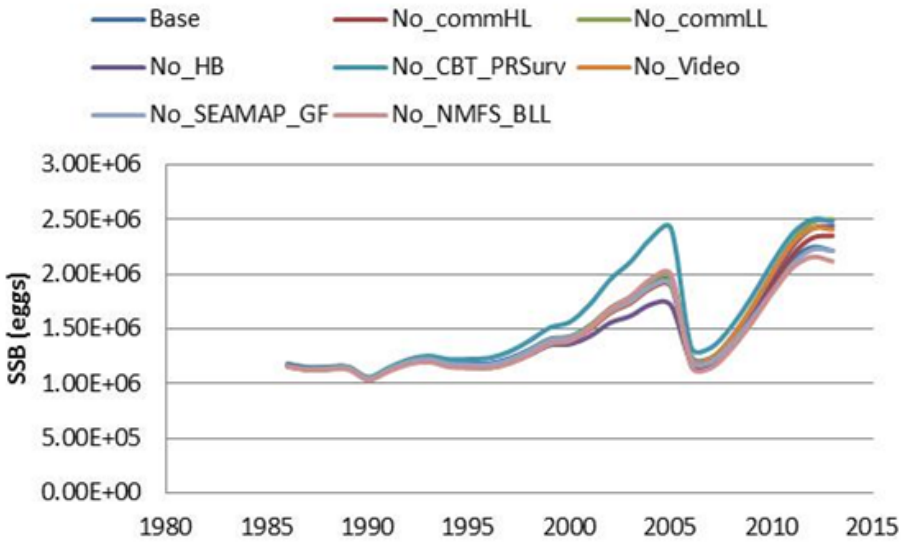


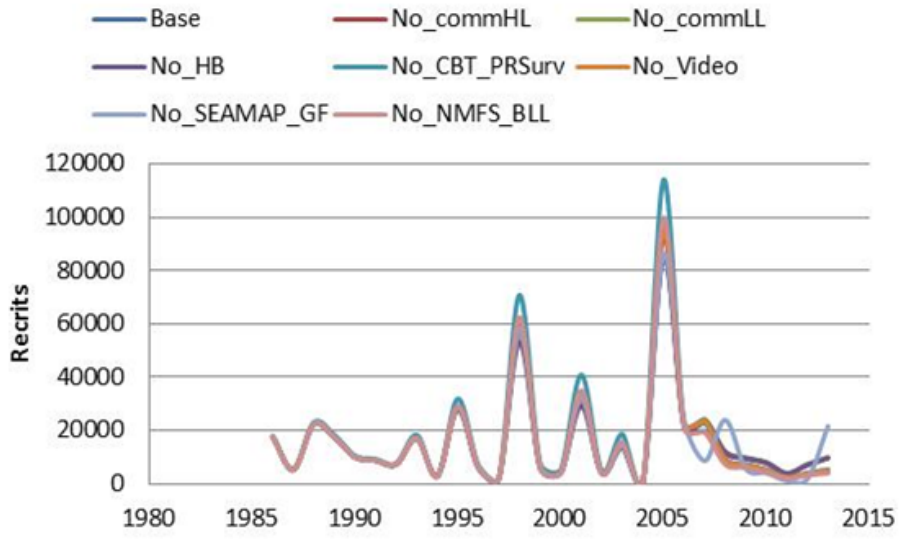


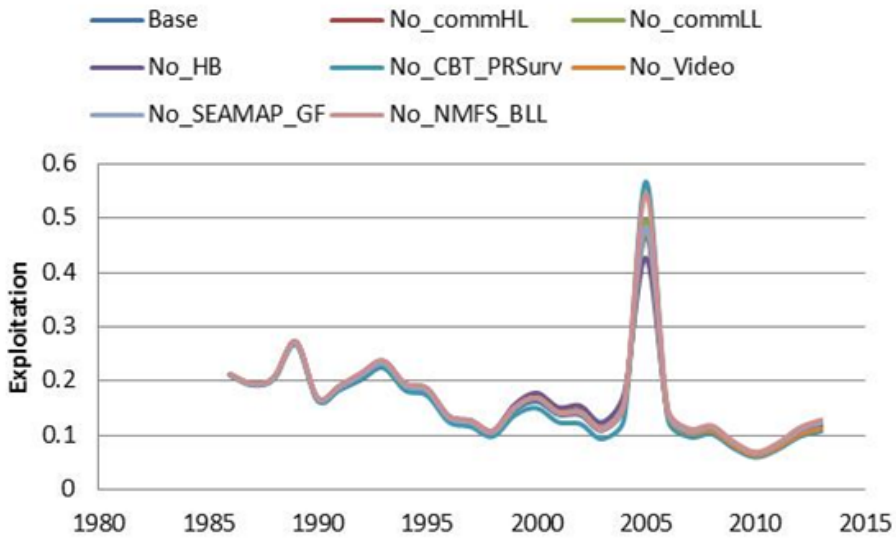
Jack-knife analysis of abundance indices

- Conducted a jack-knife analysis of the abundance indices to determine which index or indices were most influential on abundance estimates, recruitment, and exploitation

Jack-knife analysis of abundance indices







- Charter/Private

Stock status

- Measure of spawning stock biomass
- Benchmarks

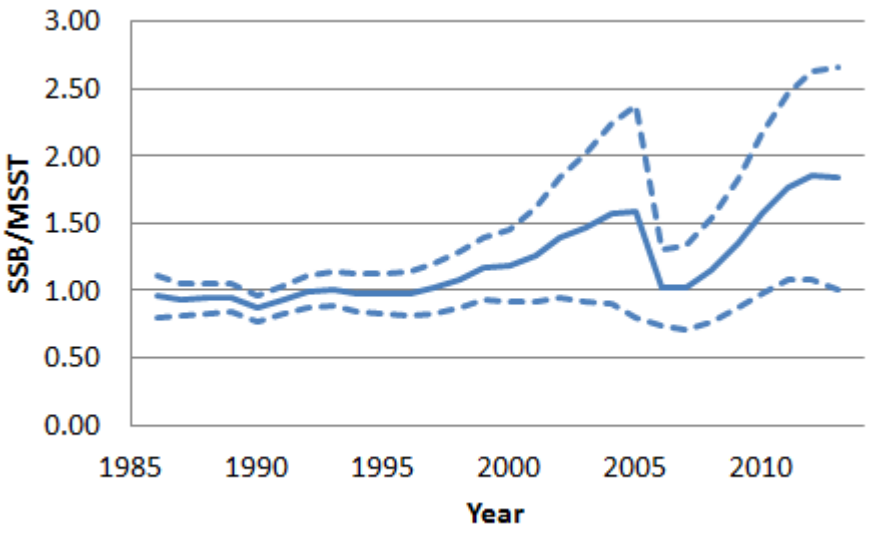
Measure of SSB

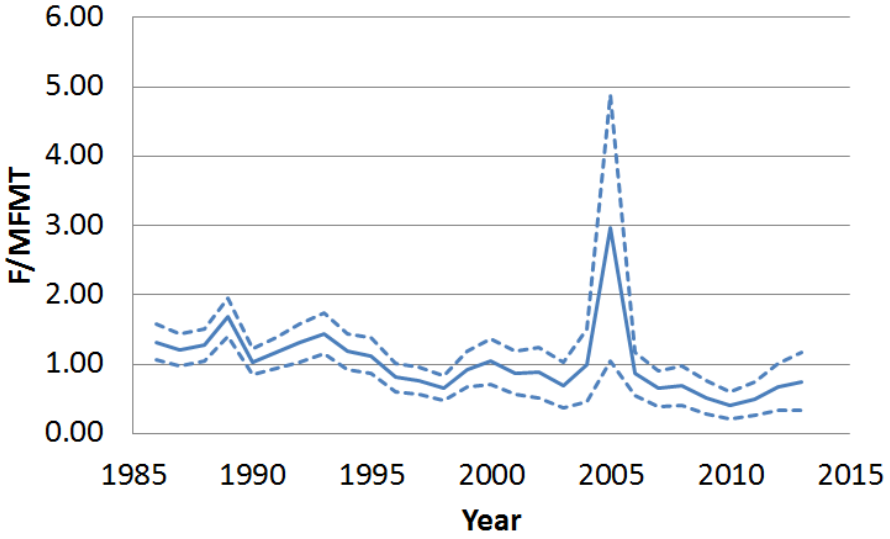
- SSB-female provides best estimates of biological reference points if the potential for decreased fertilization is weak (Brooks et al. 2008)
- SSB-combined is best when the potential for decreased fertility is moderate (Brooks et al. 2008)
- SEDAR 12 and 2009 Update used mature female biomass as the measure of SSB
- AW panel recommended using mature female biomass for S42
  - Red grouper sex ratio: 28% male

Benchmarks

- 2002 assessment, SEDAR 12, and 2009 update used MSY-based reference points to determine stock status
  - Panel thought steepness was estimable
- AW panel S42 also recommended using FMSY to calculate reference points

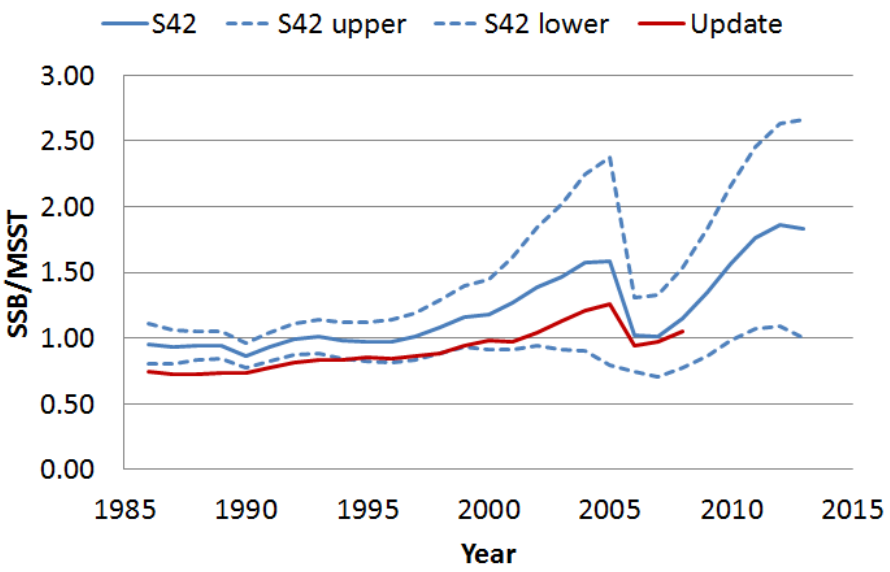
Stock status

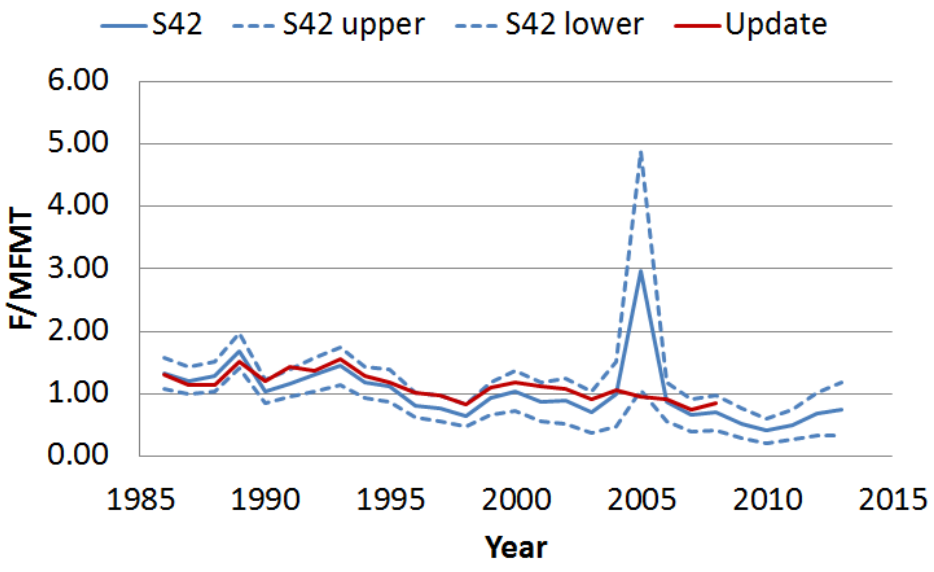




- Stock considered overfished and experiencing overfishing between 1986 and 1995
  - All other years stock not overfished and
  - All other years stock not experiencing overfishing except for 2005

Stock status – Comparison of S42 and Update





- Stock status trends similar
- Difference between S42 and Update in 2005 is due to how red tide was accounted for in the assessment models

Projections

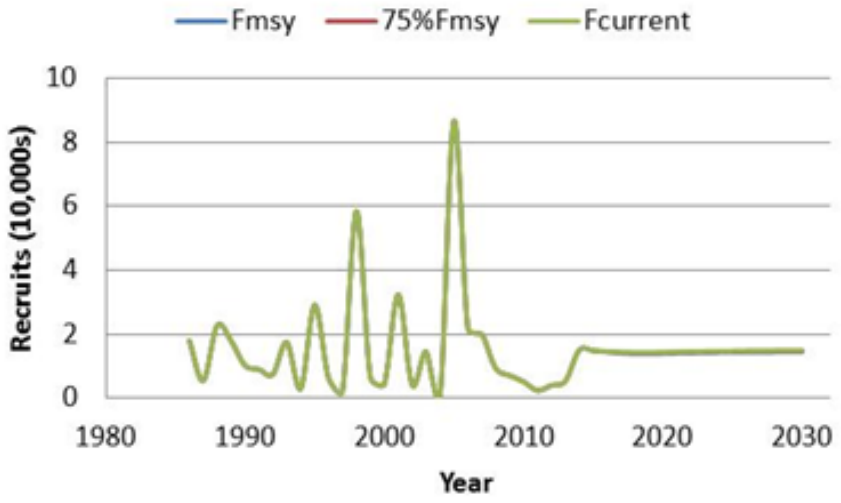
- Projected model forward to 2030 at three fishing mortality rates:
  - Fcurrent
  - FMSY
  - FOY (i.e., 75% of FMSY)

Projection assumptions

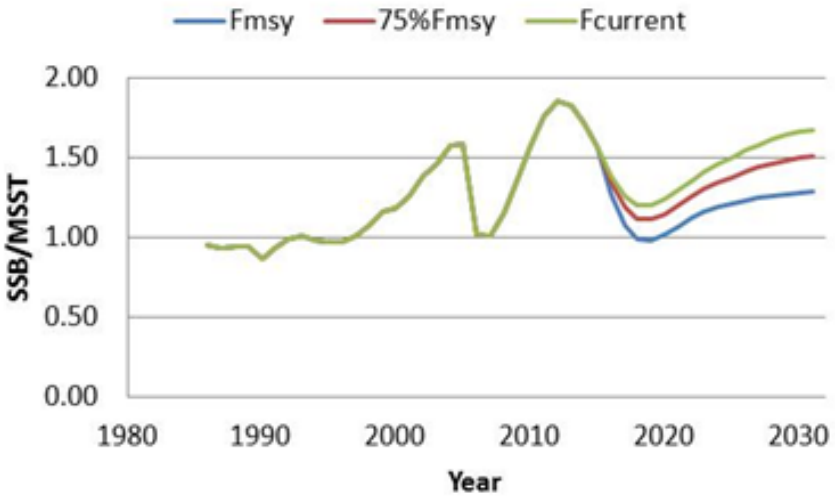
- Assume fishing patterns (selectivity, discard mortality rate, retention rates, etc.) of each fleet same as 2009-2013
- Projections run at three fishing mortality values:
  - Fcurrent
  - FMSY
  - FOY
- Catch allocation by fleet:
  - 76% Commercial
  - 24% Recreational
- Assumed red tide was negligible in 2014

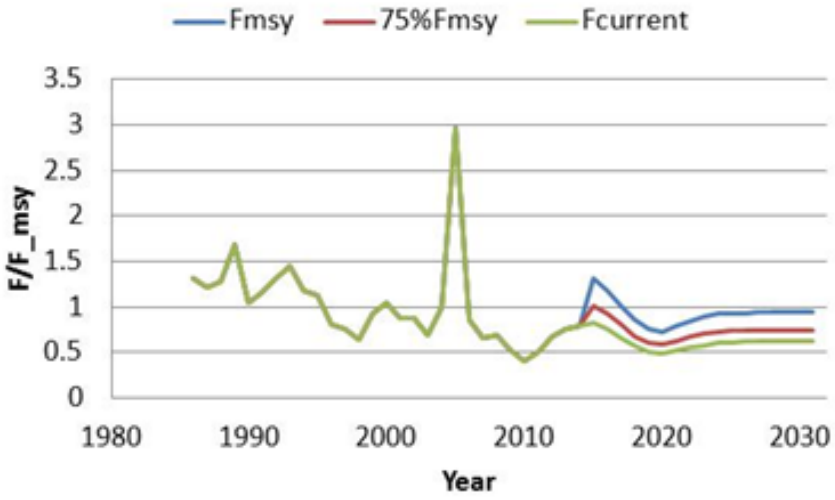
Projections

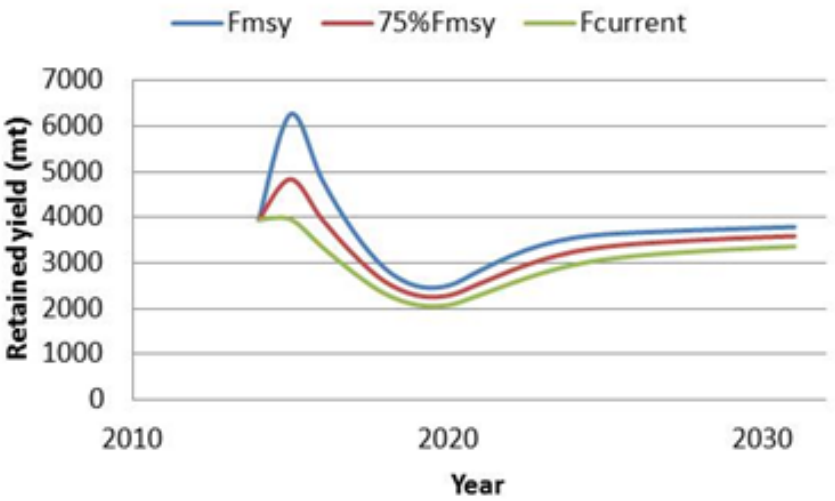
- Assume recruitment comes from stock-recruit relationship for forecast period.
  - Provides future recruitments that are similar to average of 1986-2013 recruitments



Projections







EXTRA SLIDES

Criteria	Definition	Value
Base M		0.144
Steepness		0.801
Virgin Recruitment		15833.9
SSB unfished (eggs)		4017750
	Mortality rate criteria	
Fmsy or proxy	Fmsy	0.1600
MFMT	Fmsy	0.1600
Foy	75% of Fmsy	0.1200
Fcurrent	F2013	0.1209
Fcurrent/MFMT	F2013	0.7554
	Biomass criteria	
SSBmsy (eggs)	SSB at Fmsy	1416320
MSST	(1-M)*SSBmsy	1212370
SSBcurrent (eggs)	SSB2013	2222750
SSBcurrent/MSST	SSB2013	1.83
Equilibrium MSY	Equilibrium yield at Fmsy	3329.33
Equilibrium OY	Equilibrium yield at Foy	2497.00
OFL	Annual yield at MFMT	
	OFL 2014	3946.13
	OFL 2015	6263.09
	OFL 2016	4835.98
	OFL 2017	3700.32
	OFL 2018	2885.36
	OFL 2019	2499.72
	OFL 2020	2503.59