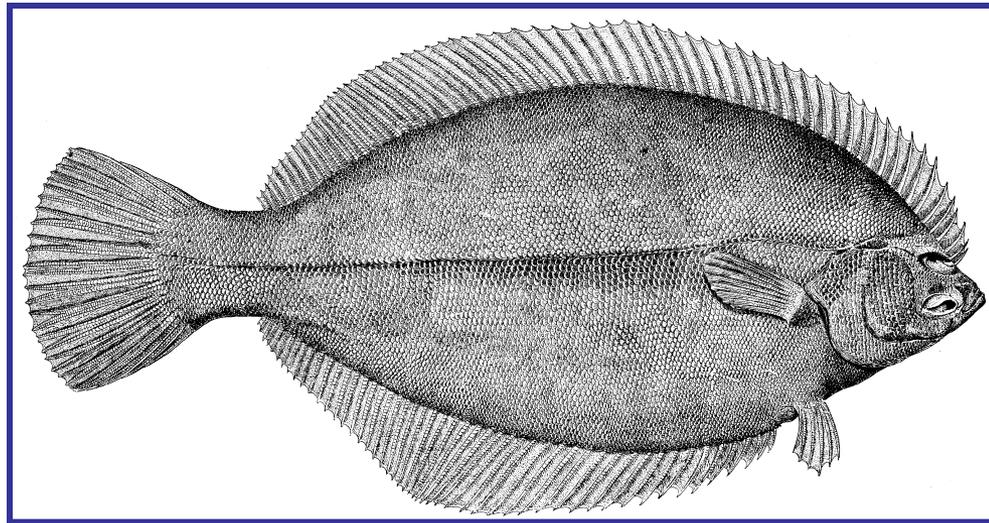




# Georges Bank Winter Flounder 2015 Stock Assessment Update

**NOAA**  
**FISHERIES**

Northeast  
Fishery  
Science Center

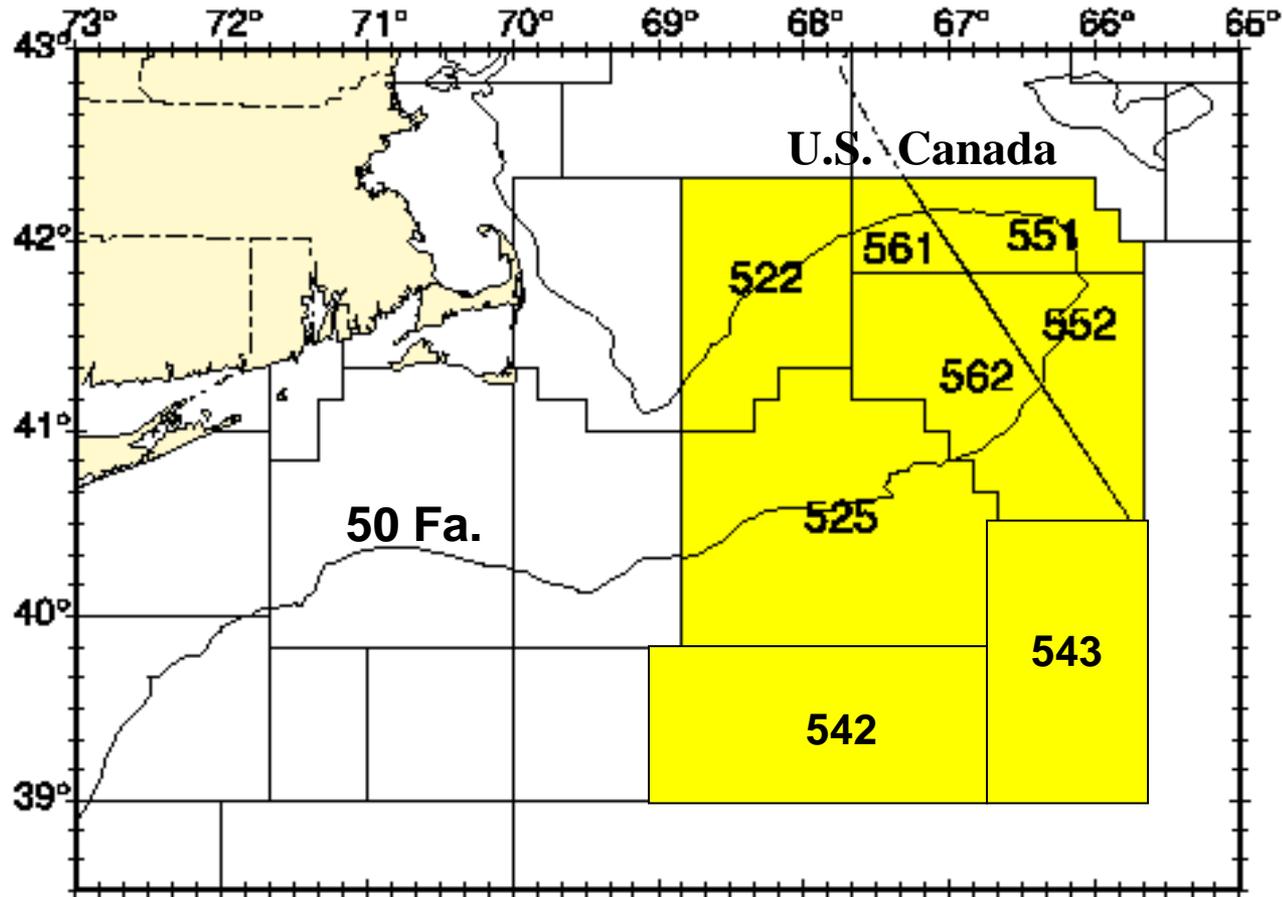


*Pseudopleuronectes americanus*

September, 15 2015

Lisa Hendrickson  
Population Dynamics Branch

# GB winter flounder stock area



# Most Recent Assessment

Operational - conducted during August, 2014 (Hendrickson et al. (2015))

## VPA

- CAA 1982-2013 (ages 1-7+)
  - US BT and scallop dredge (SD) landings and discards
  - CA BT landings and SD discards (CA BT disc. not available)
- Tuning indices Swept-area abundance, ages 1-7+
  - NEFSC spring surveys (1982-2014)
  - NEFSC fall surveys (1981-2013, lagged forward 1 yr and age)
  - CA spring (Feb.) surveys (1987-2014)
- $M = 0.3$
- 3-yr moving window maturity schedule (NEFSC spring survey)
- Flat-topped fishery selectivity (F ages 4-6)
- Estimation of age 1 recruitment
- Retrospective analysis with seven-year peel

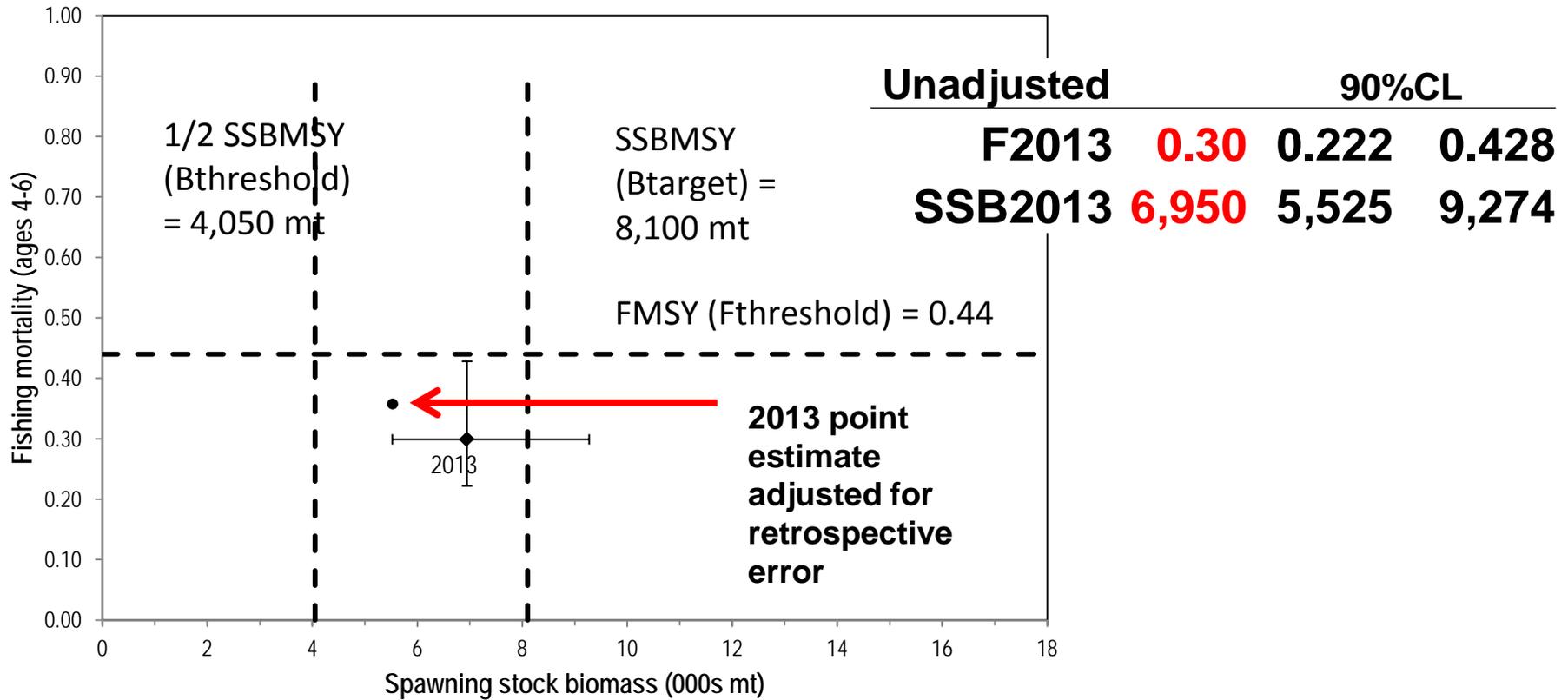
# Most Recent Assessment

- BRPs

**FMSY** (Beverton-Holt S-R model); data for 1982-2012 YC, steepness fixed at 0.78, most recent five-yr means of stock wts, catch wts, fishery selectivity, proportion mature-at-age and  $M=0.3$

**SSBMSY** (100-yr stochastic projection;  $F=FMSY$  and input S-R param. estim. and variance, most recent five-yr means of variables noted above

# 2013 Stock Status



**In 2013, OF was not occurring** ( $F_{2013} = 0.30 < \text{new FMSY threshold} = 0.44$ ) and **not overfished** ( $SSB_{2013} = 6,950 \text{ mt} > \text{updated SSBMSY threshold} = 4,050 \text{ mt}$ )

# Most Recent Assessment

- Short-term stochastic projections

Median catch and SSB during 2014-2017  
(assumed catch in 2014 and  $F=F_{reb}$  (= 0.27)  
during 2015-2017

Retrospective bias adjustment not required

**Results:** 76% prob. of rebuilding to SSBMSY  
(=8,100 mt) by 2017 deadline; 2017 SSB est. =  
9,221 mt (6,909, 12,803)

# 2015 Assessment Update

- Changes to VPA Model

Added 2014 data to: CAA and NEFSC fall survey abundance-at-age

Added 2015 data to: CA and NEFSC spring surveys

Updated proportion mature-at-age (three-yr moving window)

Changed fishery selectivity (PR) to derive a more realistic 2014 age 1 R estimate

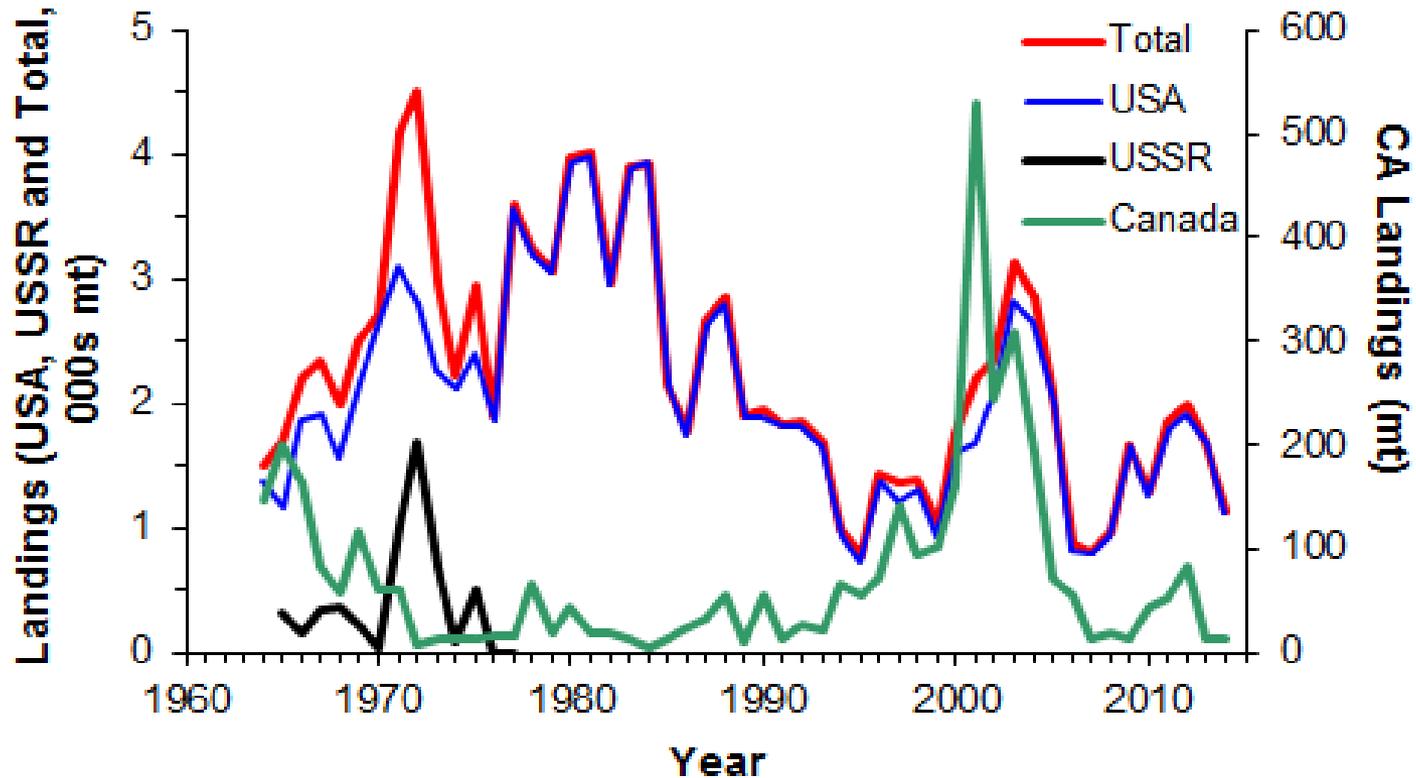
# 2015 Assessment Update

- Updated BRPs

**FMSY** (S-R model) same model formulation, added 2014 data and updated most recent five-yr means of stock wts, catch wts, fishery selectivity, and proportion mature-at-age

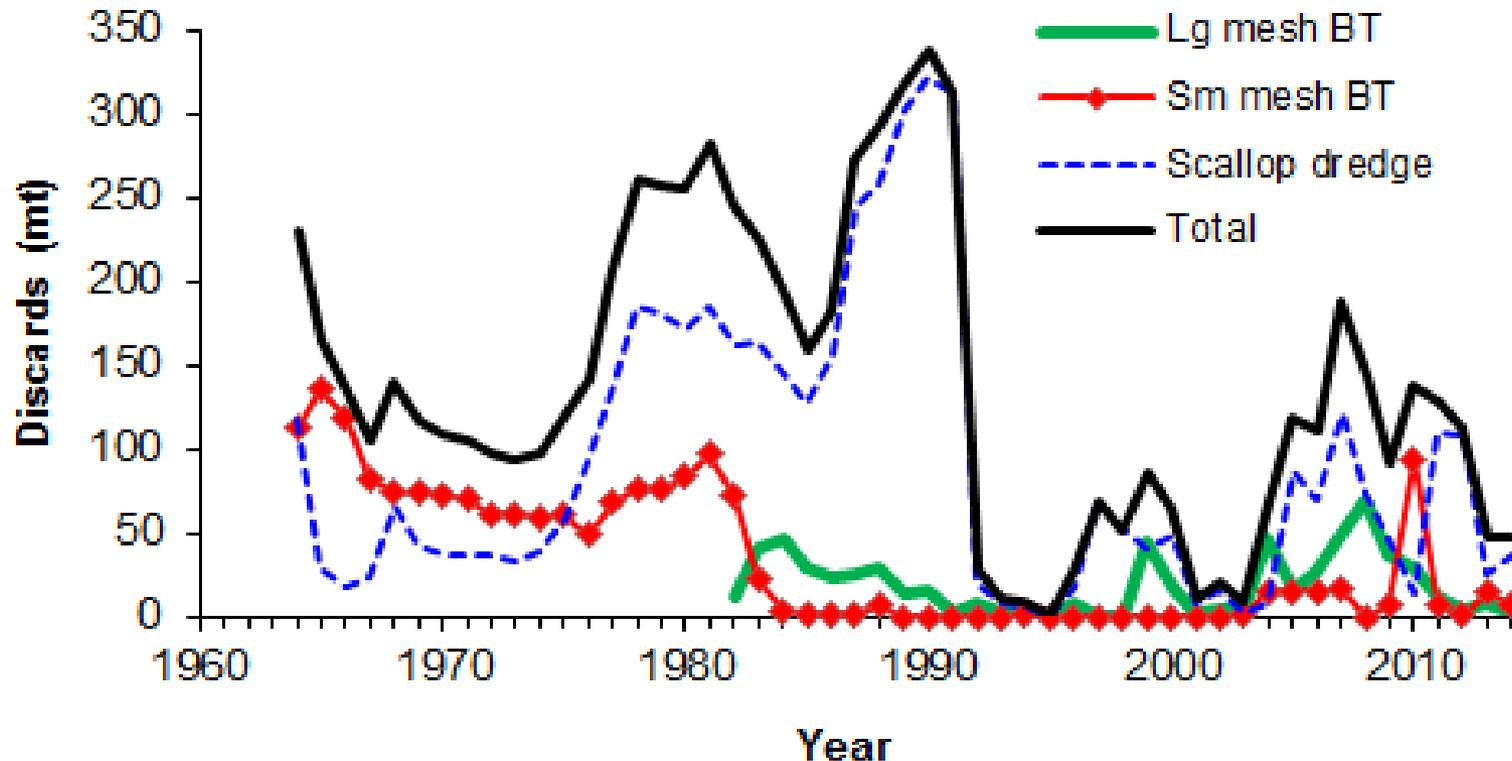
**SSBMSY** (100-yr stochastic projection; input updated S-R param. estim. and variance, most recent five-yr means of variables noted above

# Landings, 1964-2014



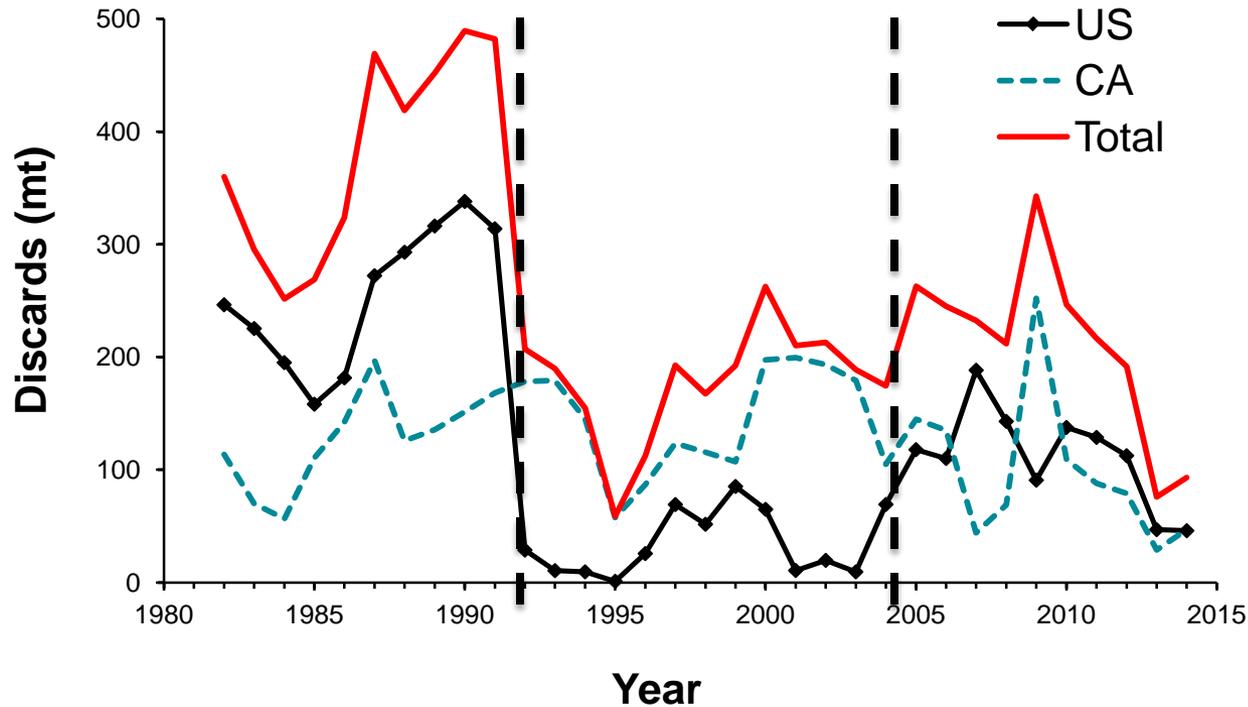
**Landings declined from 1,687 mt in 2013 to 1,126 mt in 2014**

# US Discards, 1982-2014



US discards declined from 188-46 mt, during 2007-2014, and were mostly from the scallop dredge fleet

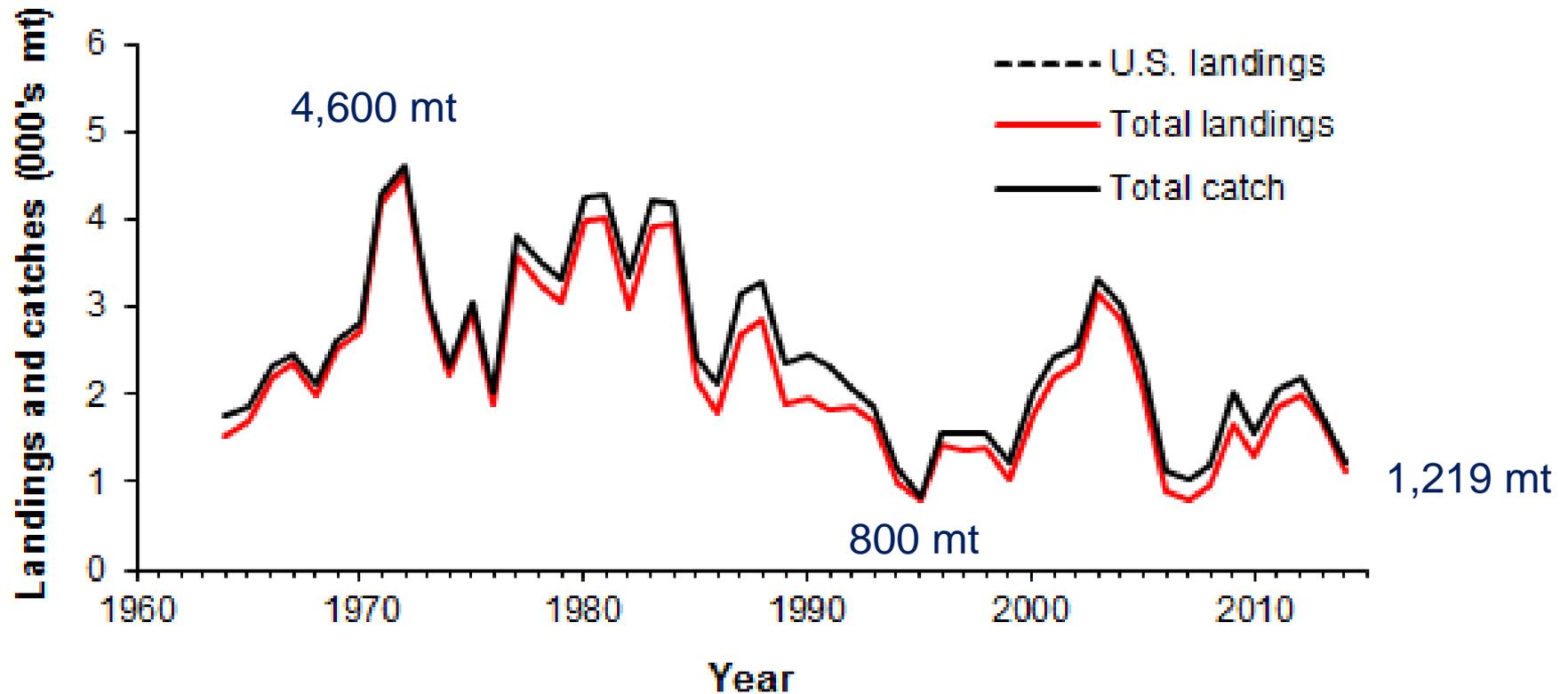
# Total Discards, 1982-2014



1992-2004, CA SD discards highest % of total discards (avg. = 81%)

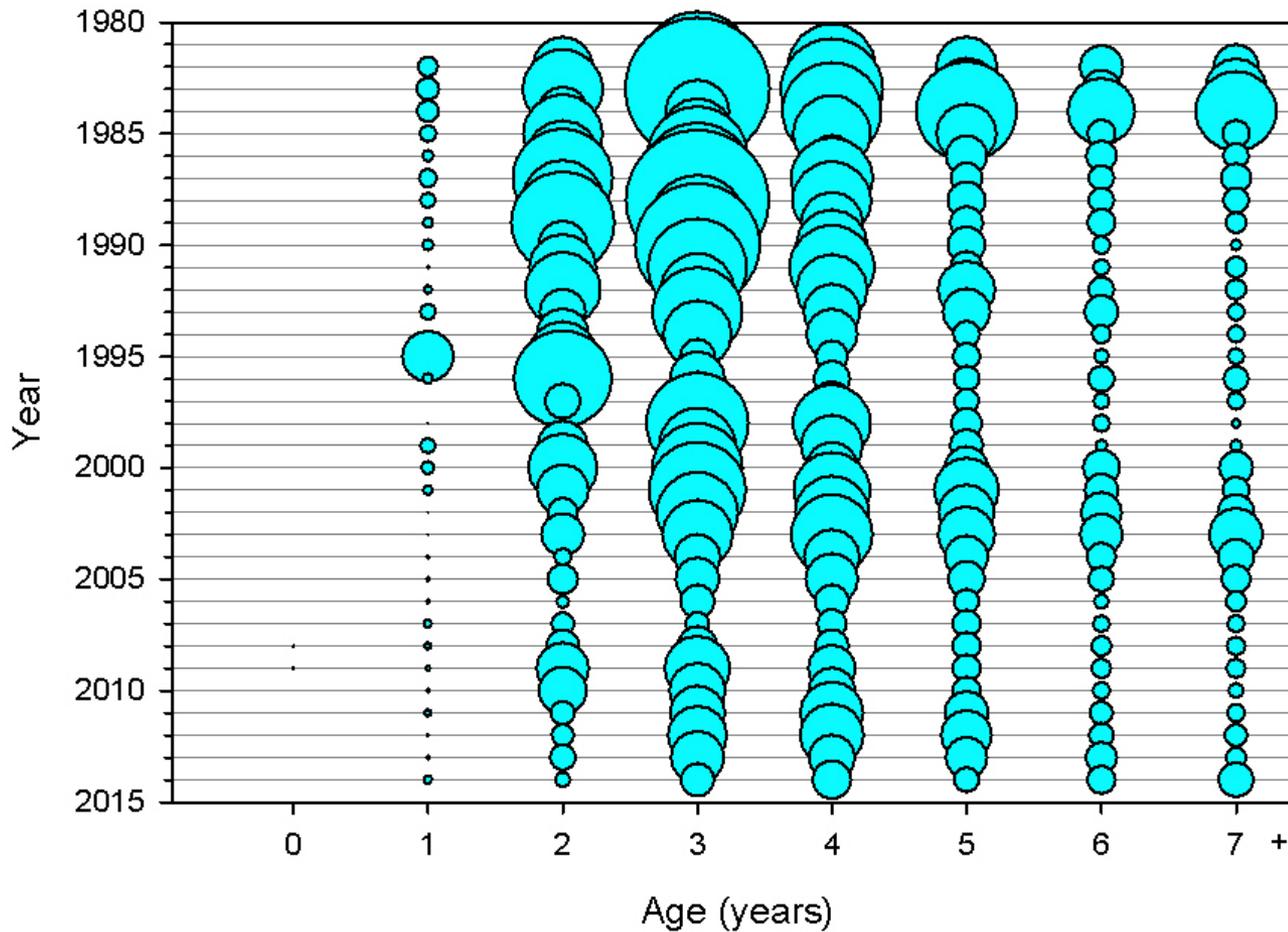
Decline in total discards during 2009-2013 with slight incr. in 2014

# Catch, 1964-2014

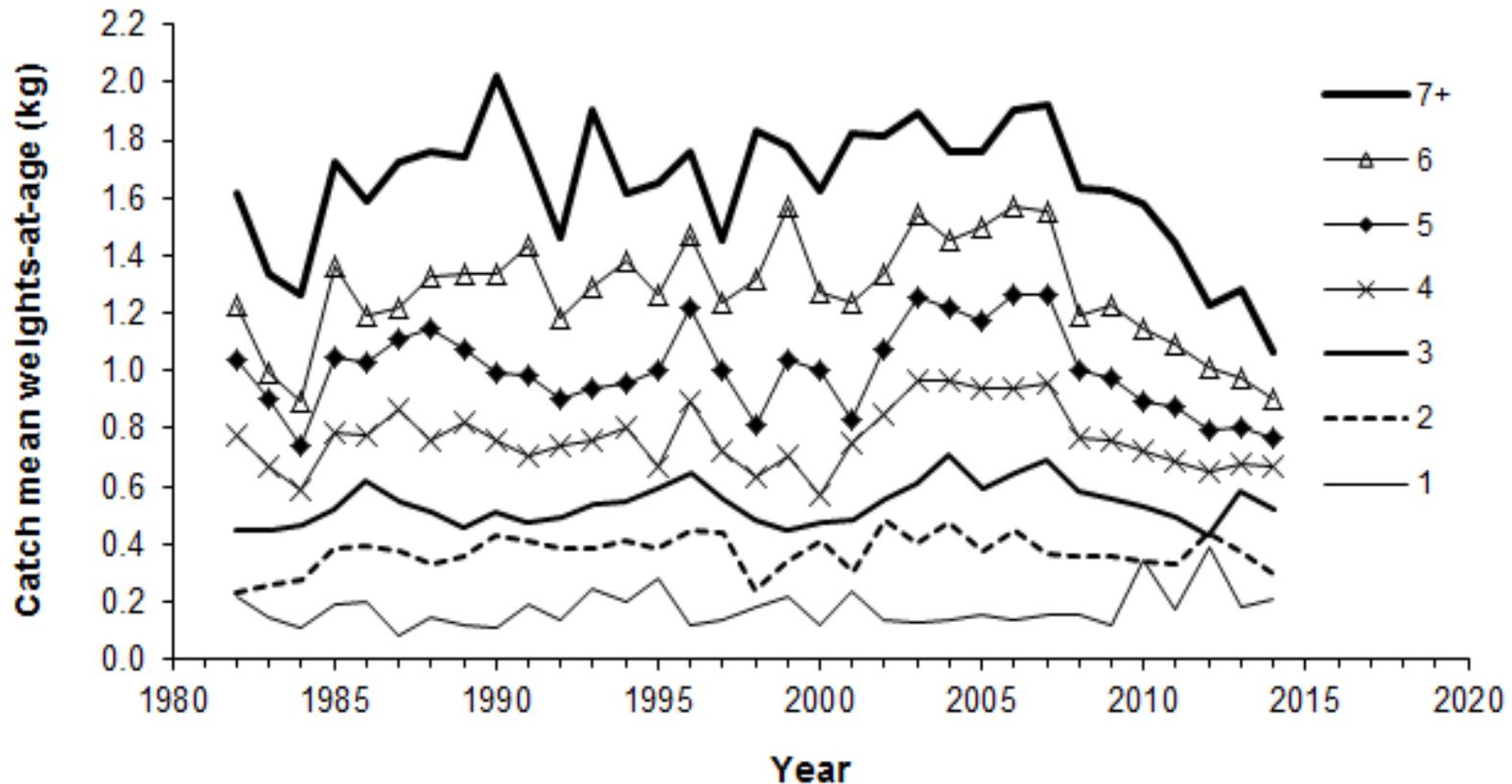


**Most of the catch consists of landings**

# Catch-at-age, 1-7+ (1982-2014)

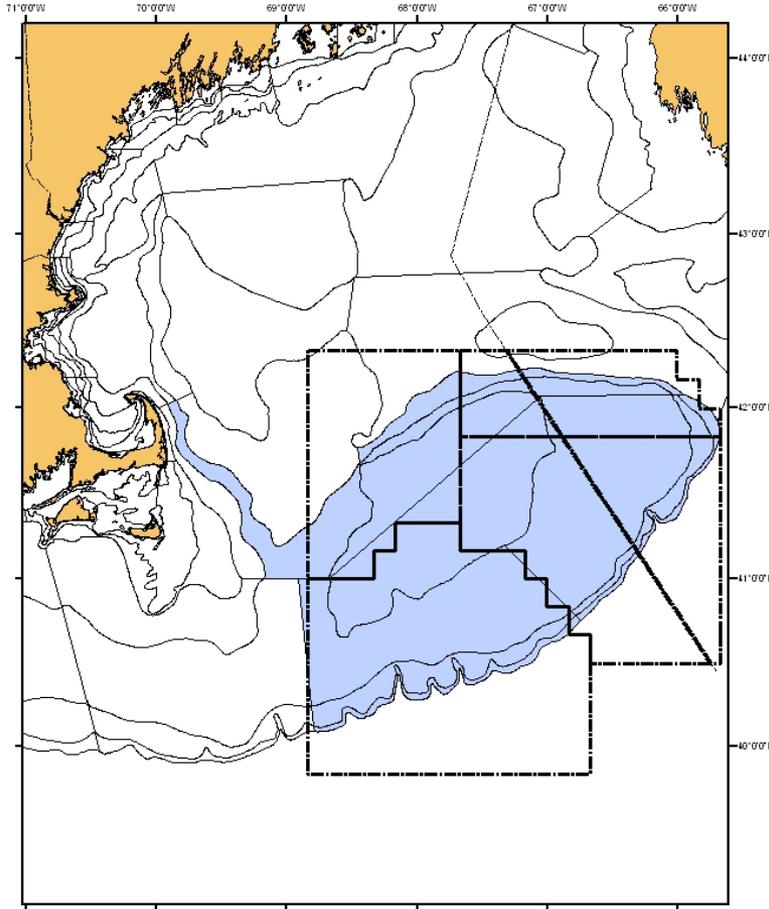


# Catch mean weights-at-age

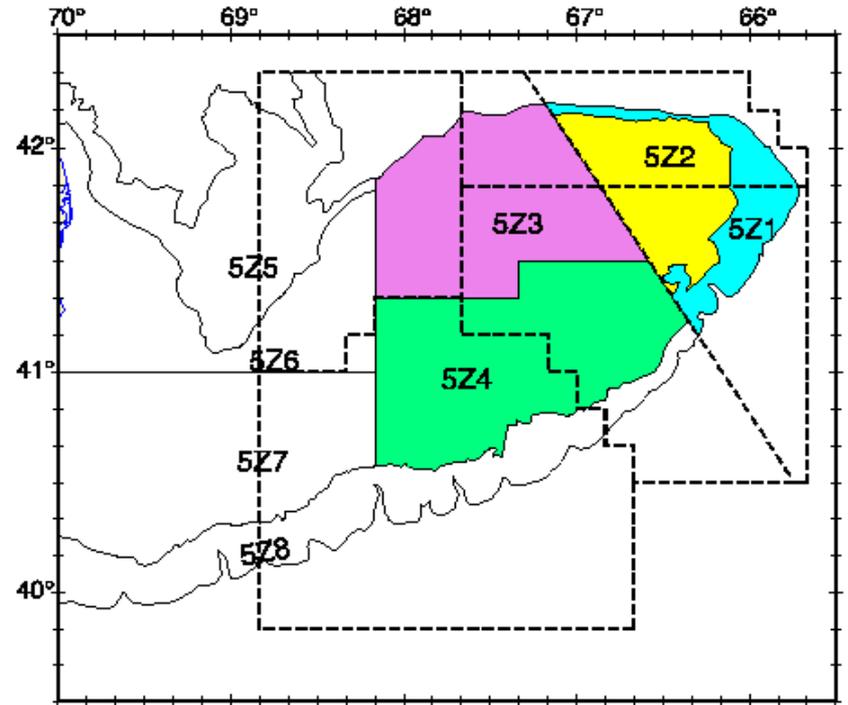


**Catch mean wts. of age 4-7+ fish declined during 2007-2014**

# US and CA BT survey strata



**NEFSC spring and fall surveys, strata 13-23**



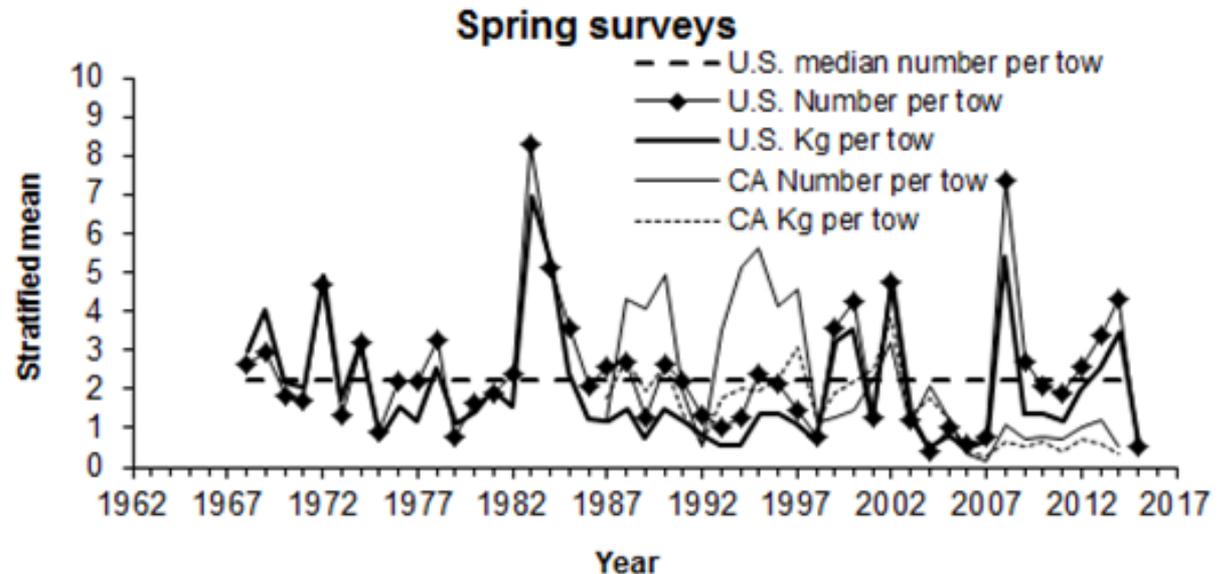
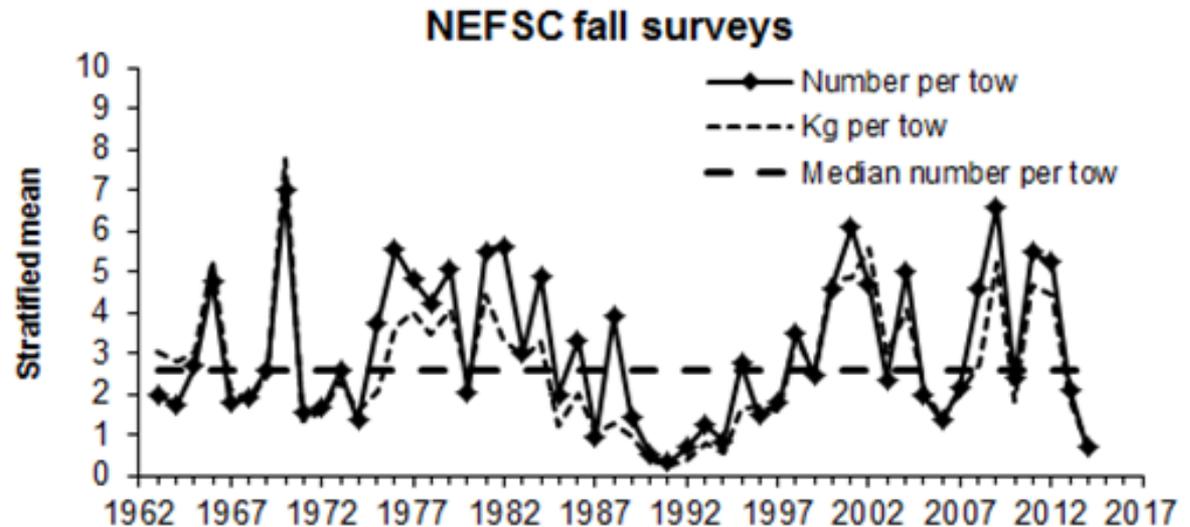
**CA spring surveys, strata 5Z1-4**

# Research Survey Indices

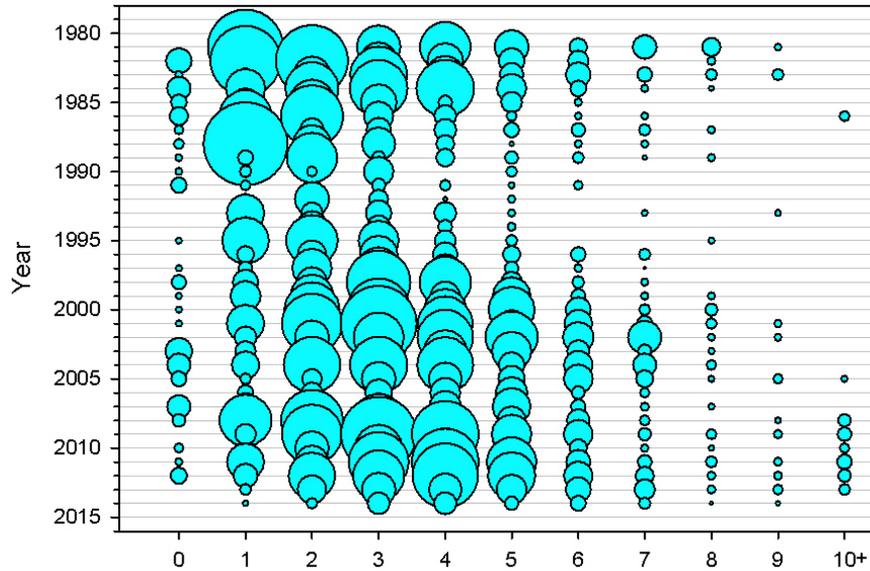
Fall relative abundance declined to 3<sup>rd</sup> lowest level in 2014

NESFC spring svy rel. abund. incr. during 2011-2014 but decr. in 2015 to lowest level since 2004

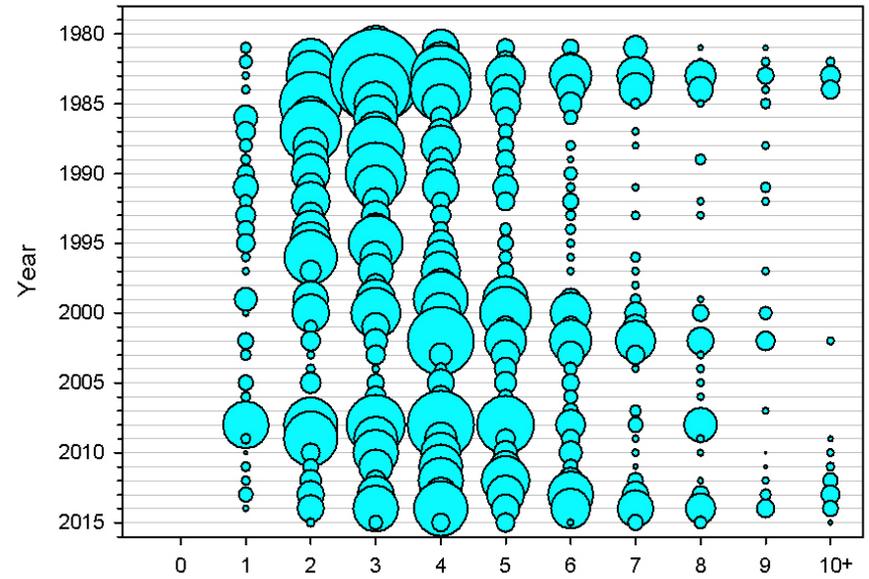
CA spring survey indices remained low during 2006-2015



## NEFSC fall surveys

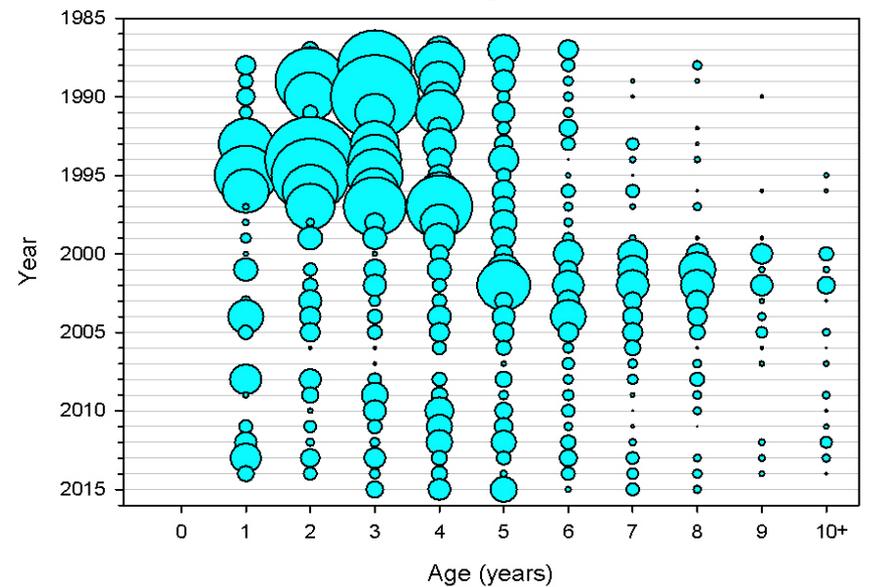


## NEFSC spring surveys



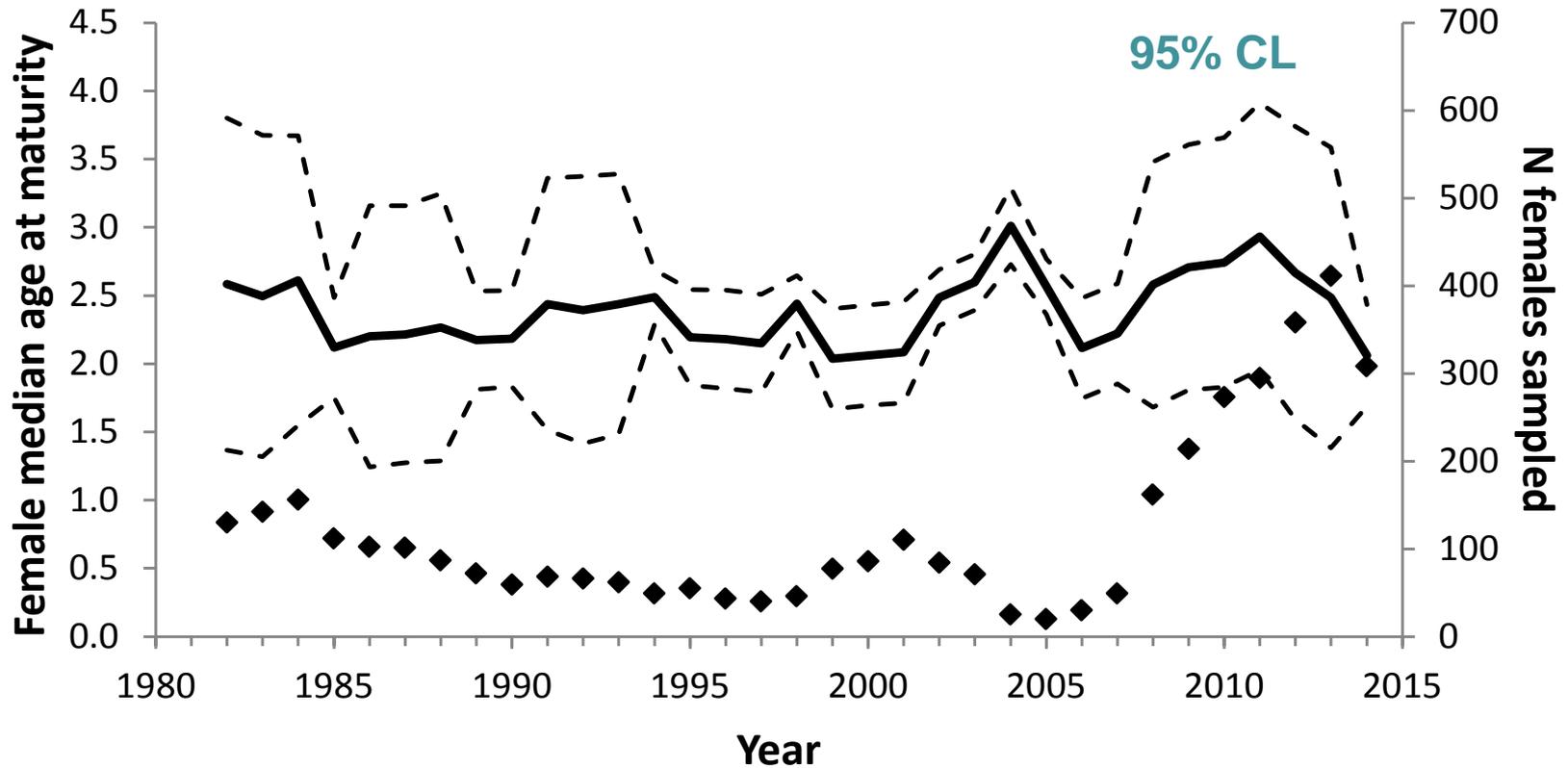
## Survey abundance-at-age (ages 1-10+)

## CA spring surveys



# A50, 3-yr moving window (1982-2014)

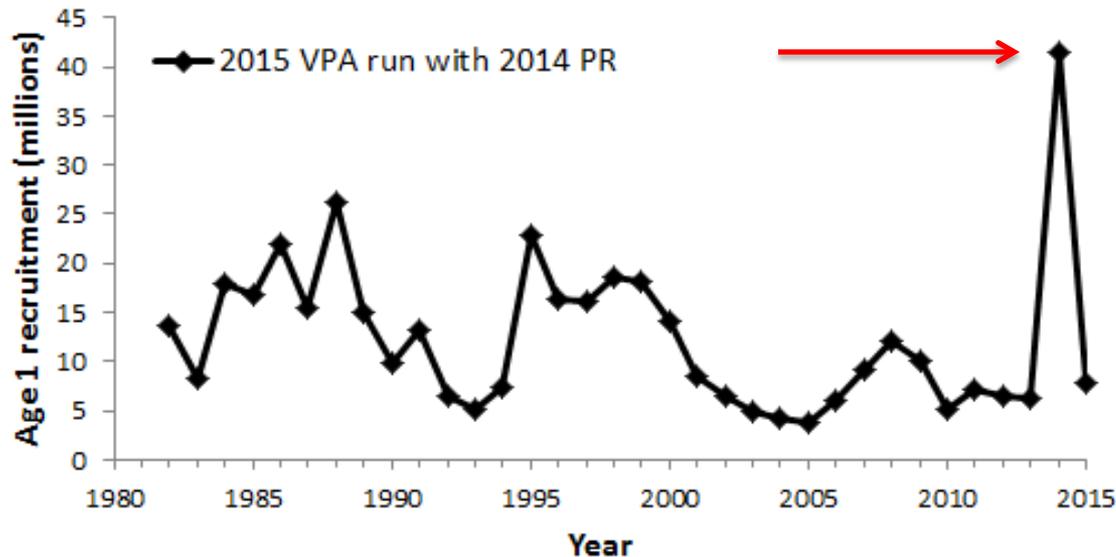
(includes data for 1981-2014)



# 2015 Assessment Update

- Changes to VPA Model

The updated 2015 VPA run (with the PR from the 2014 assessment) resulted in an unrealistic estimate of age 1 R in 2014



Age	2014 VPA
1	0.00
2	0.10
3	0.43
4	1.00
5	1.00
6	1.00

# 2015 Assessment Update

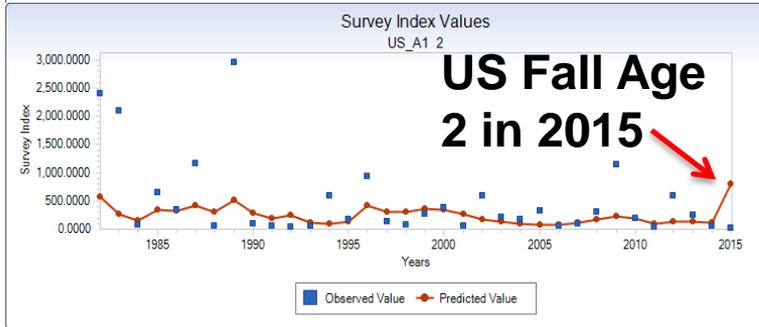
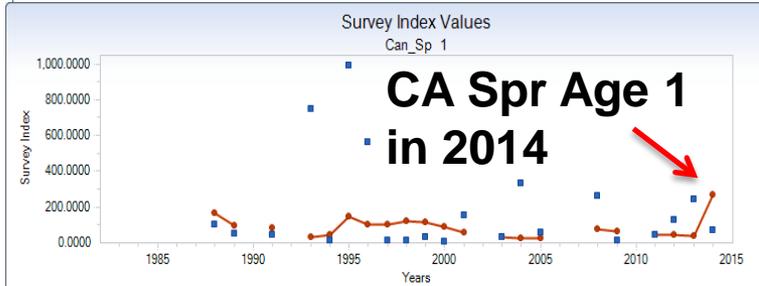
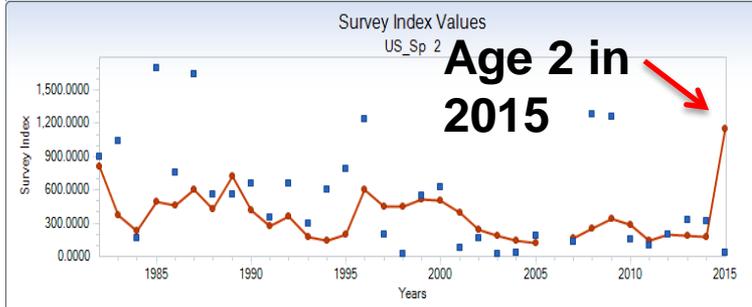
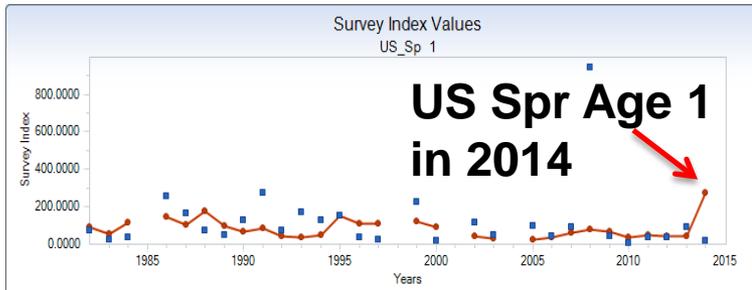
## Reason for this unrealistic estimate

During 2014 assessment, age 1 and age 2 stock sizes in yr  $t+1$  not estimable.

When age 2 stock size is not estim. in yr  $t+1$ , age 1 stock size in terminal yr is estimated using the age 1 PR to calculate  $F$  at age 1 in terminal yr (2014).

Low age 1 catch combined with low age 1 PR in 2014 resulted in the unrealistically high estimate of age 1 stock size in 2014 when compared with survey observations of the same cohort (age 1 in 2014 and age 2 in 2015).

# PR from 2014 assess.

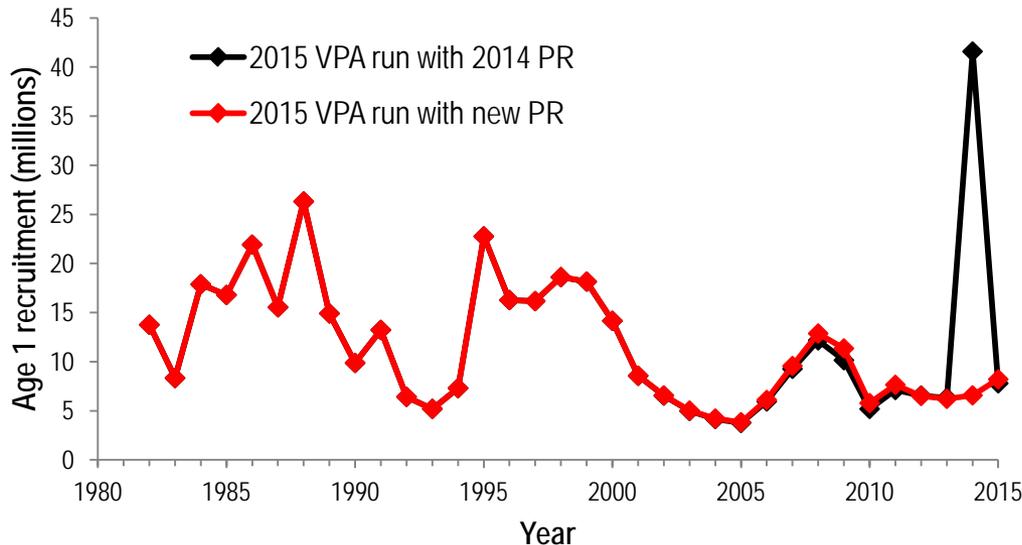


# 2015 Assessment Update

## PR change to VPA Model

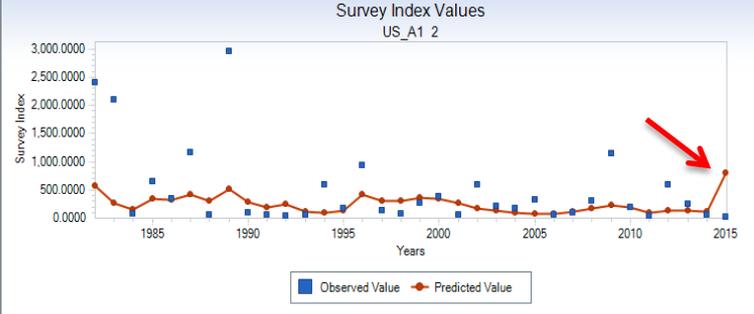
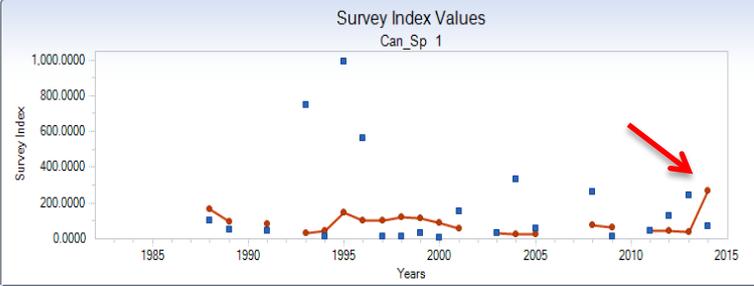
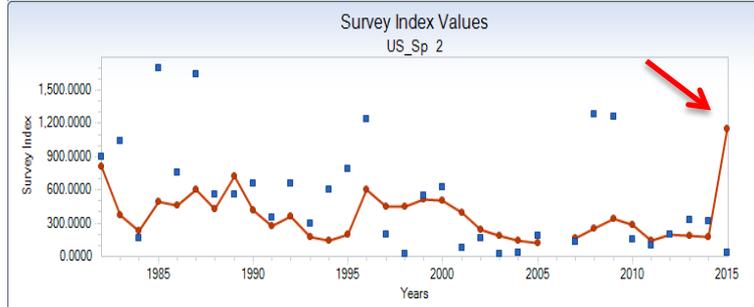
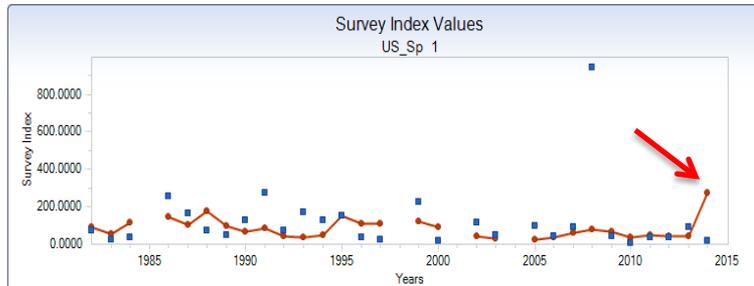
**Solution:** Estimated age 2 in 2015 (to avoid used age 1 PR value for 2014 age 1 stock size est.) with PR from 2014 assessment and used resulting back-calculated PR values (2010-2014 avg.) as the PR in the 2015 final VPA run.

As in 2014 assess., age 2 stock size was not estimated in the 2015 final VPA run.

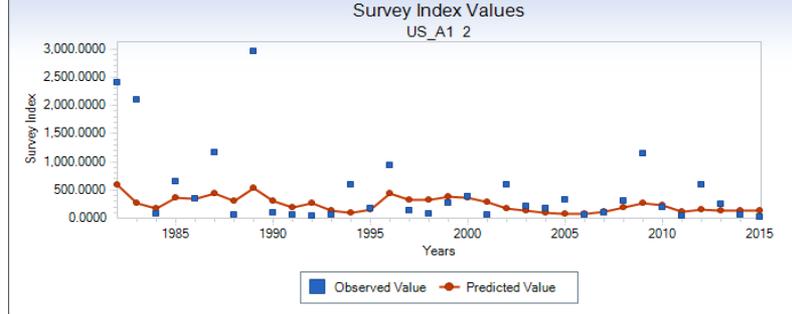
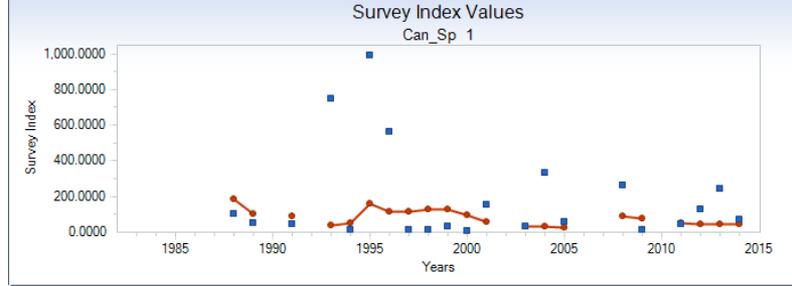
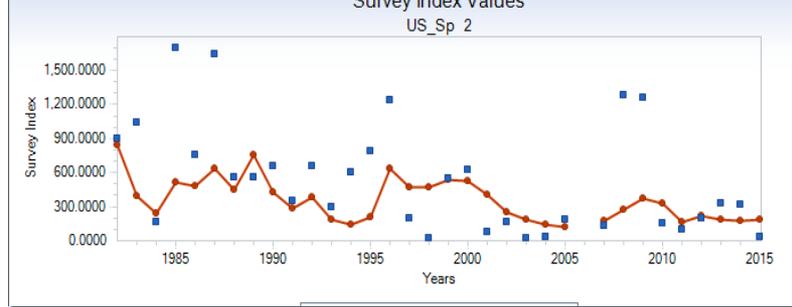
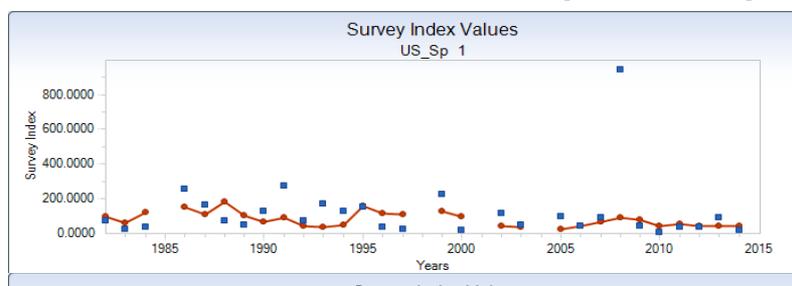


Age	2014 VPA	2015 VPA
1	0.00	0.01
2	0.10	0.08
3	0.43	0.55
4	1.00	1.00
5	1.00	1.00
6	1.00	1.00

# PR from 2014 assess.



# 2015 Final VPA Run (new PR)



# Table G30 in supplemental figures and tables

Year	Avg F (ages 4-6)	SSB (mt)	Recruitment (nos. in thous.)
1982	0	0	0
1983	0	0	0
1984	0	0	0
1985	0	0	0
1986	0	0	0
1987	0	0	0
1988	0	0	0
1989	0	1	0
1990	0	0	0
1991	0	0	1
1992	0	0	0
1993	0.000	1	0
1994	0	1	0
1995	0	0	3
1996	0.000	1	2
1997	0.000	1	4
1998	0.000	1	6
1999	0	3	7
2000	0.000	4	10
2001	0.000	6	16
2002	0.000	9	27
2003	-0.002	16	43
2004	-0.003	19	48
2005	-0.006	36	76
2006	-0.004	58	152
2007	-0.006	77	295
2008	-0.010	98	702
2009	-0.018	154	1,205
2010	-0.022	287	599
2011	-0.050	468	530
2012	-0.092	663	-33
2013	-0.176	738	-96
2014	-0.219	865	-35,012
2015			412

## Change in 2014 values

**F = -63.4%**

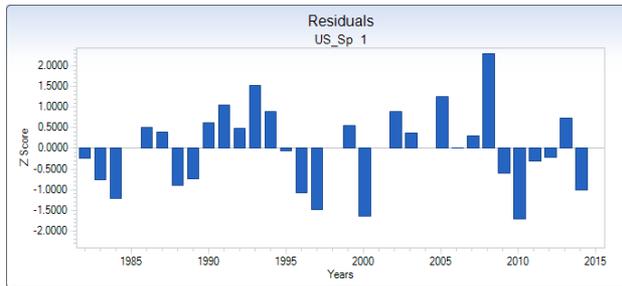
**SSB = 19.6%**

**R = -84.2%**

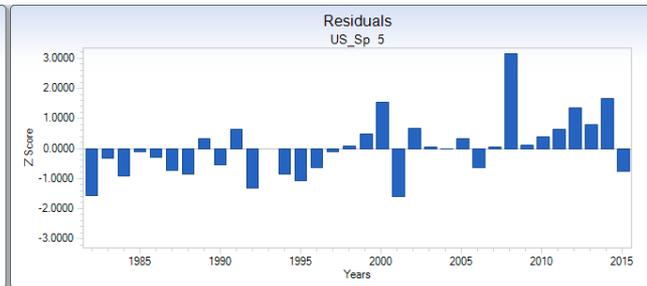
# VPA Model Diagnostics

# Weighted residuals (Z scores), VPA

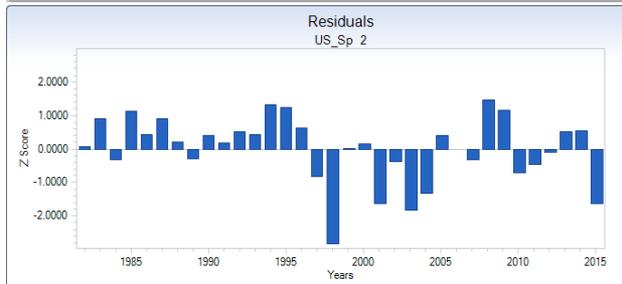
Age 1



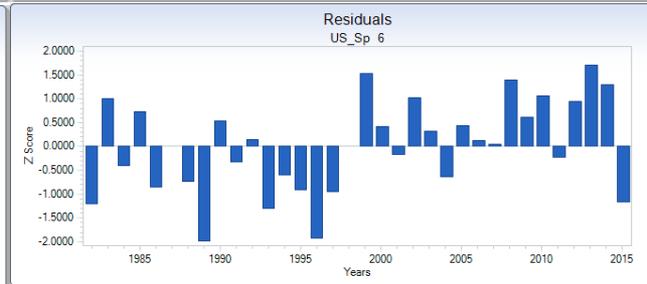
Age 5



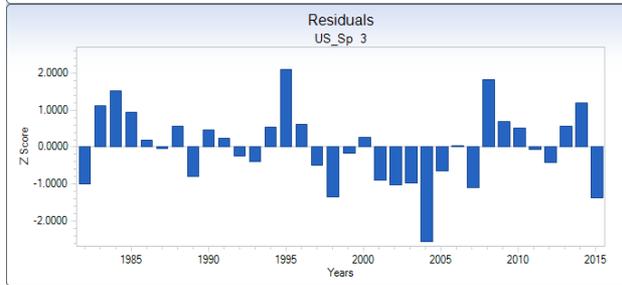
Age 2



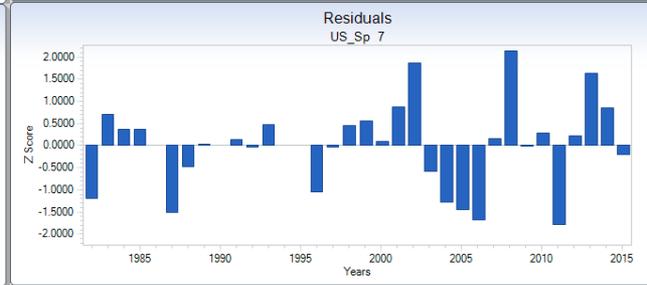
Age 6



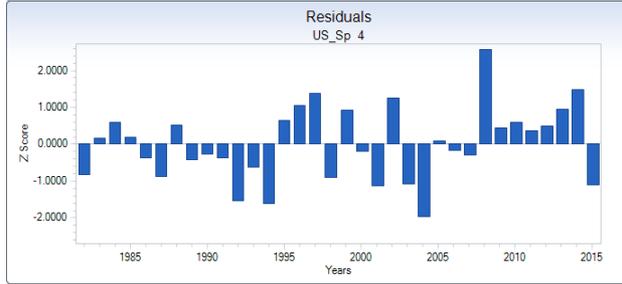
Age 3



Age 7+



Age 4

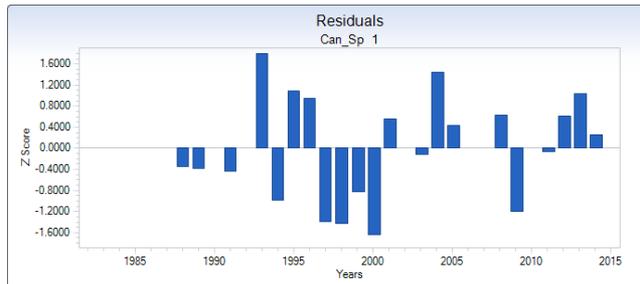


**NEFSC spring surveys**  
1982-2015

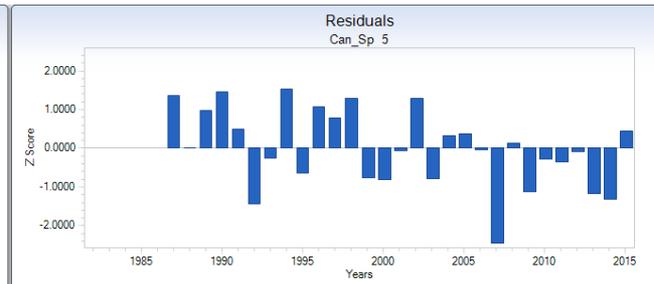
**Pos. and neg. residuals trends for most ages, but varies by survey**

# Weighted residuals (Z scores), VPA

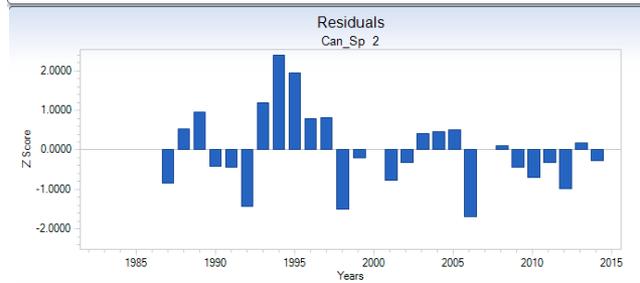
Age 1



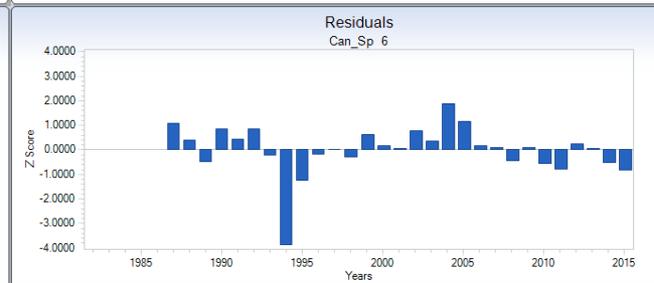
Age 5



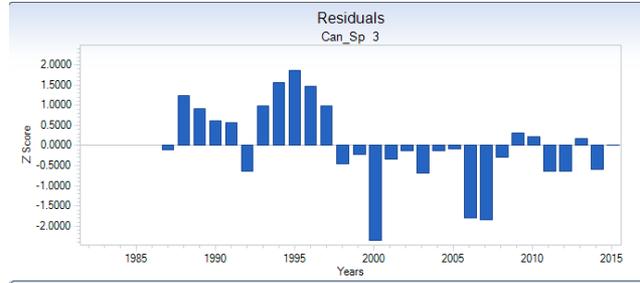
Age 2



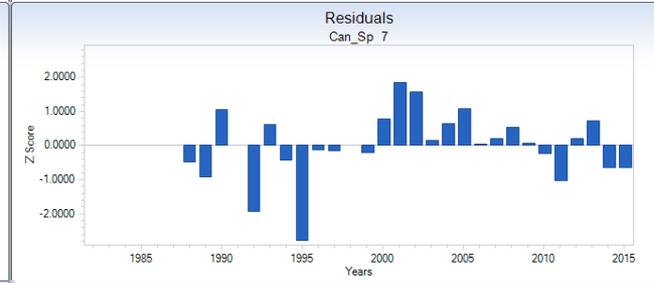
Age 6



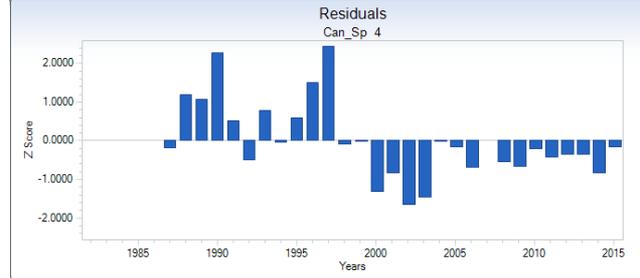
Age 3



Age 7+



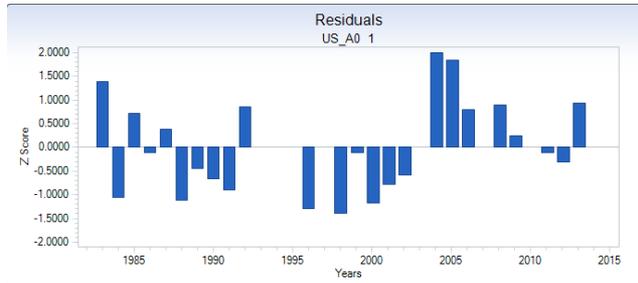
Age 4



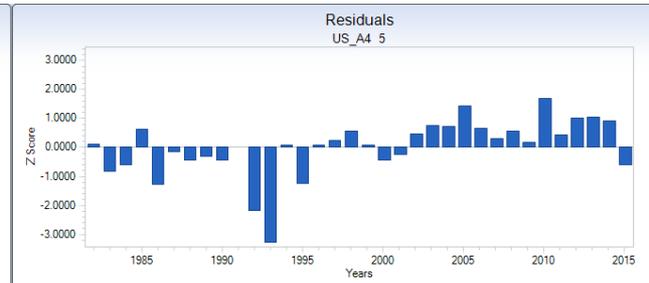
**CA spring surveys**  
1987-2015

# Weighted residuals (Z scores), VPA

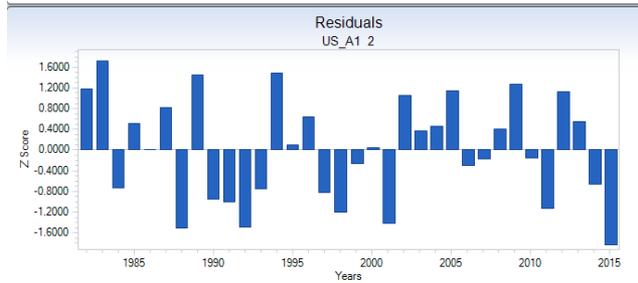
Age 1



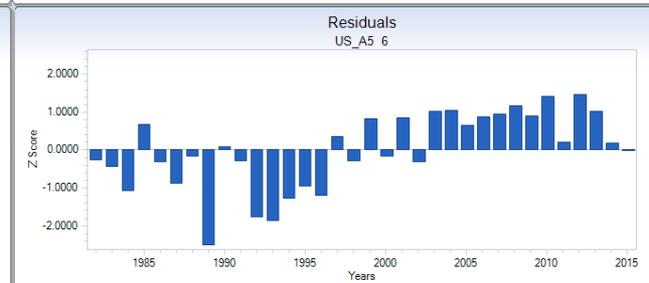
Age 5



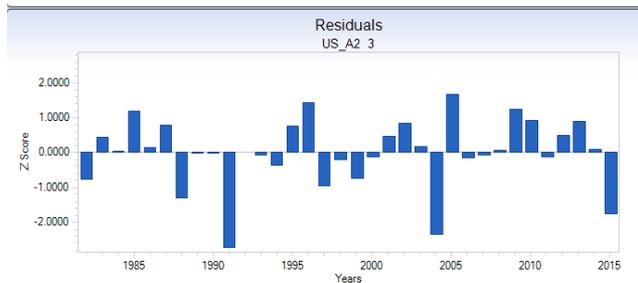
Age 2



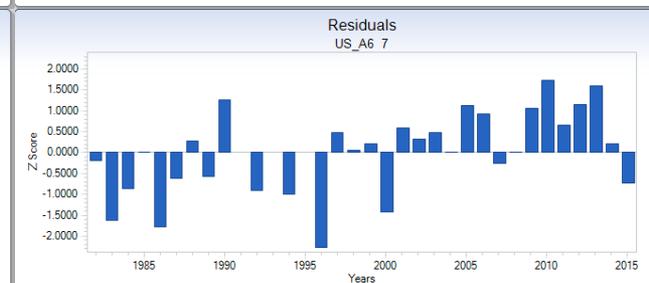
Age 6



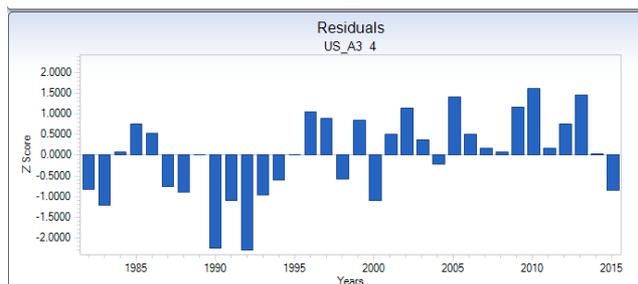
Age 3



Age 7+

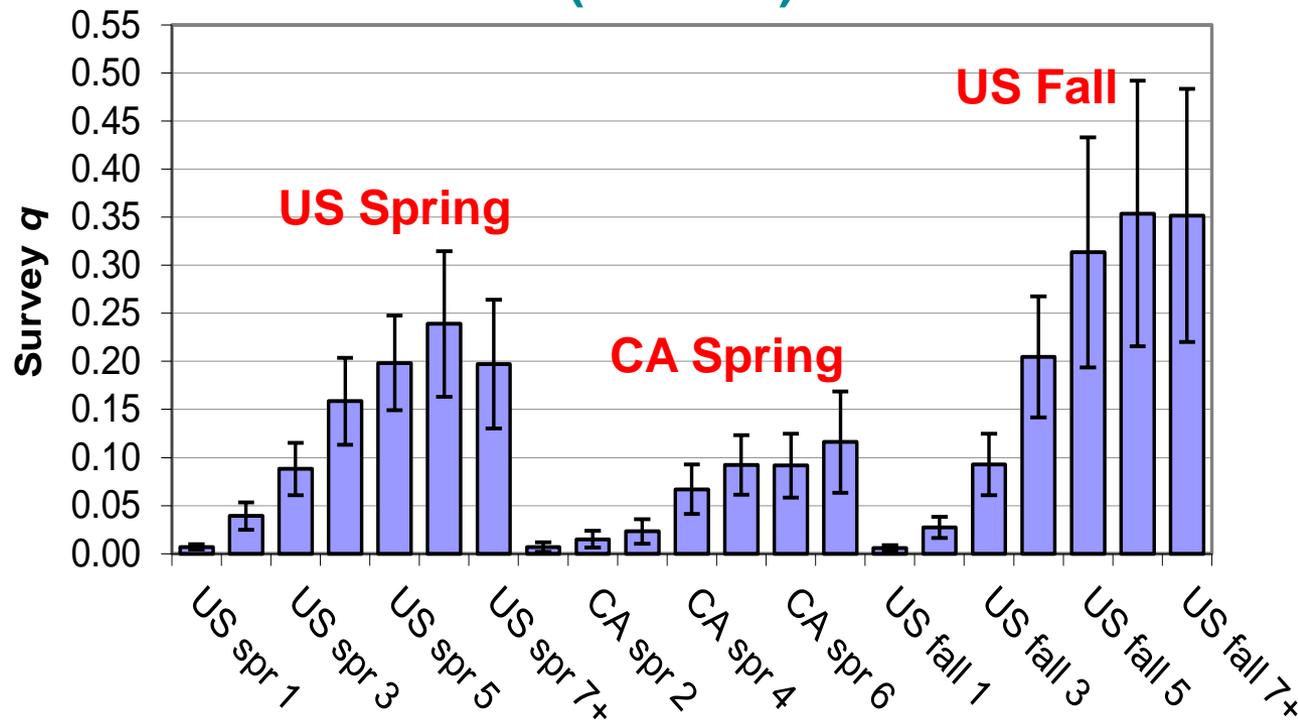


Age 4



**NEFSC fall surveys**  
1982-2014

# Survey $q$ -at-age ( $\pm 2$ SE)



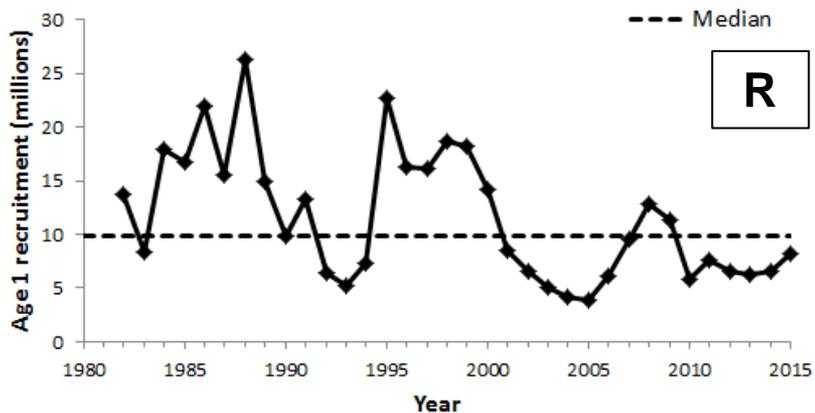
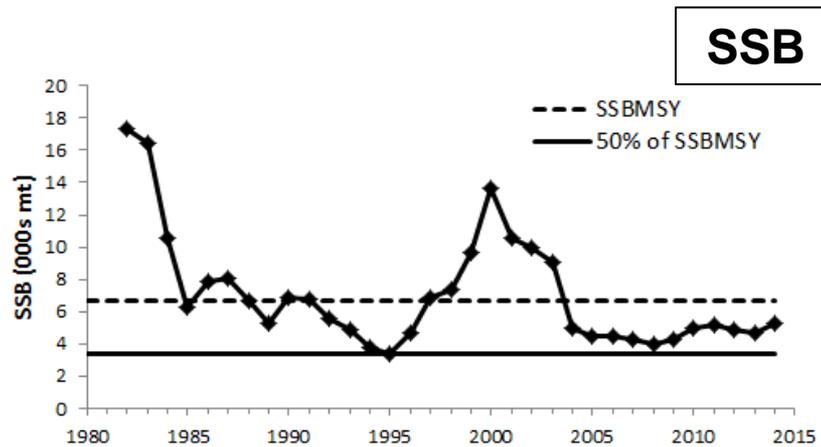
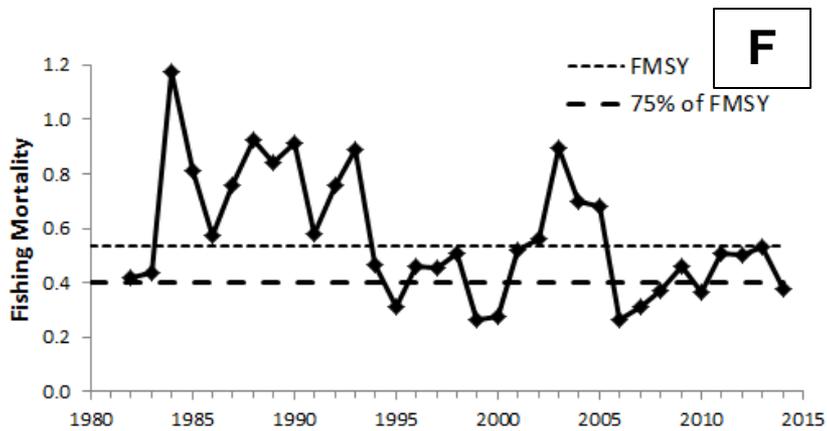
**Ages 1-3  $q$ s significantly lower ( $< 0.10$ ) than for older fish**

**Ages 4-7+  $q$ s higher for US fall (0.2-0.35) than US spring svys (0.16-0.23) but NS**

**US and CA survey  $q$ s not comparable**

# VPA Results

## F, SSB and R in relation to updated BRPs



# Retrospective Analysis

**2007-2013**

**Mohn's rho**

**F -0.51**

**SSB 0.83**

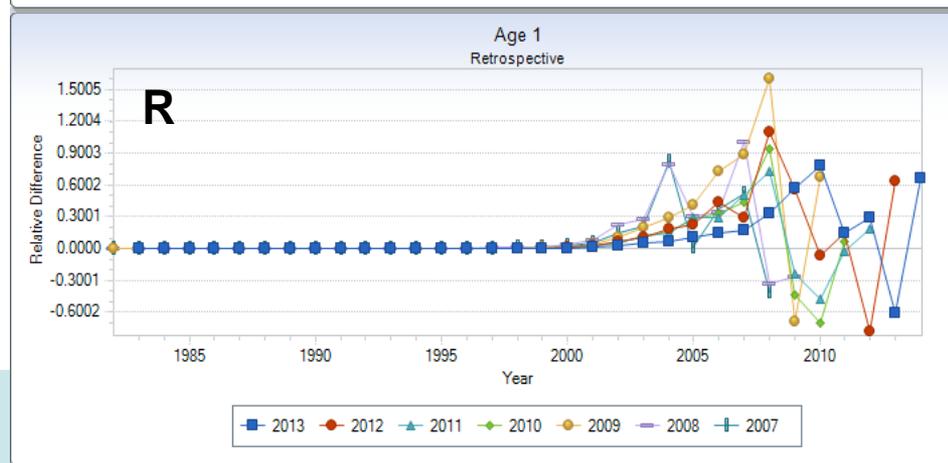
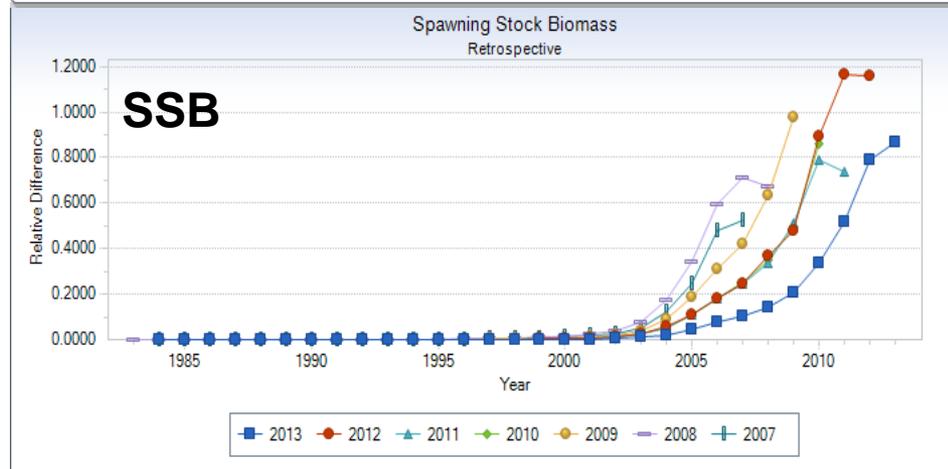
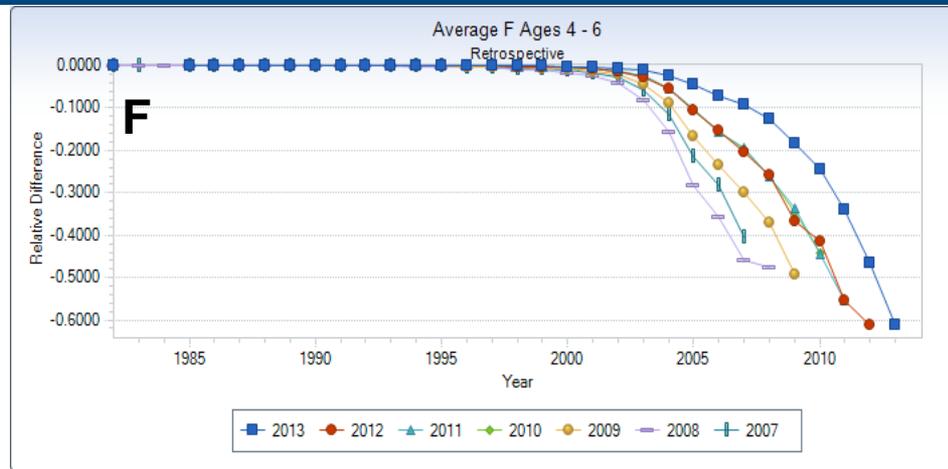
**2014 assessment**

**2006-2012**

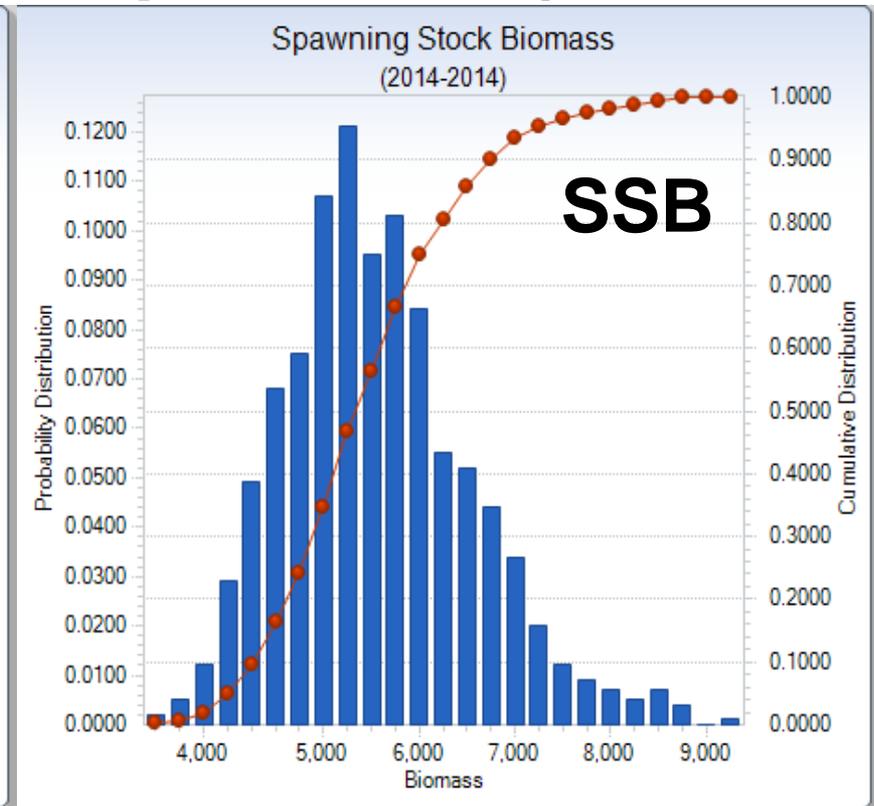
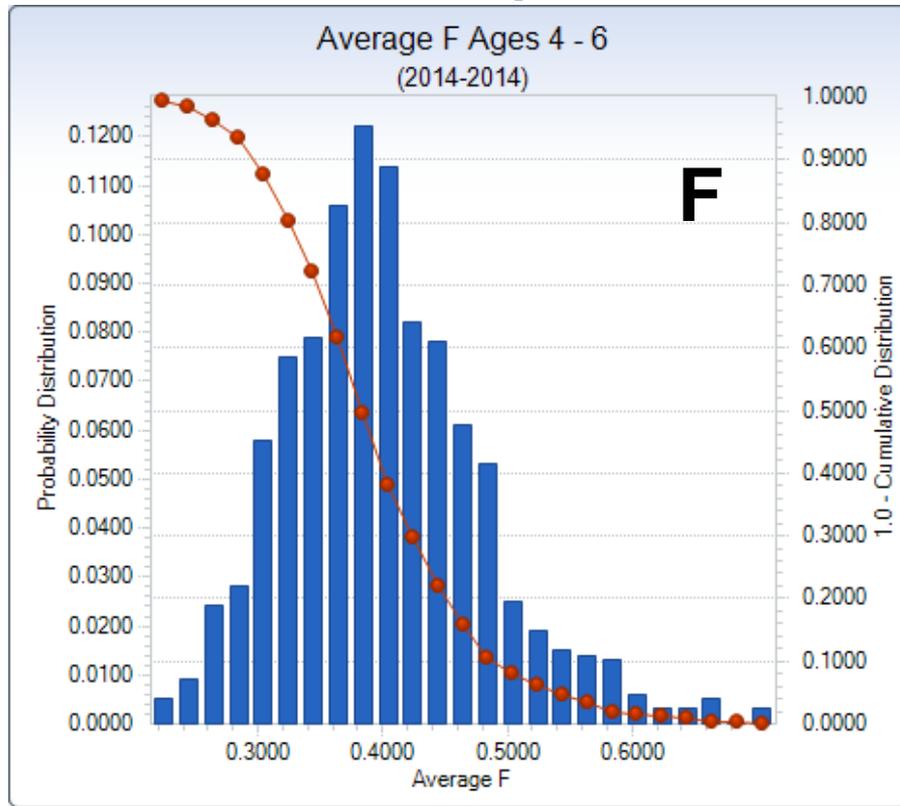
**Mohn's rho**

**F -0.17**

**SSB 0.26**



# Precision of 2014 F and SSB estimates (1,000 bootstrap iterations)



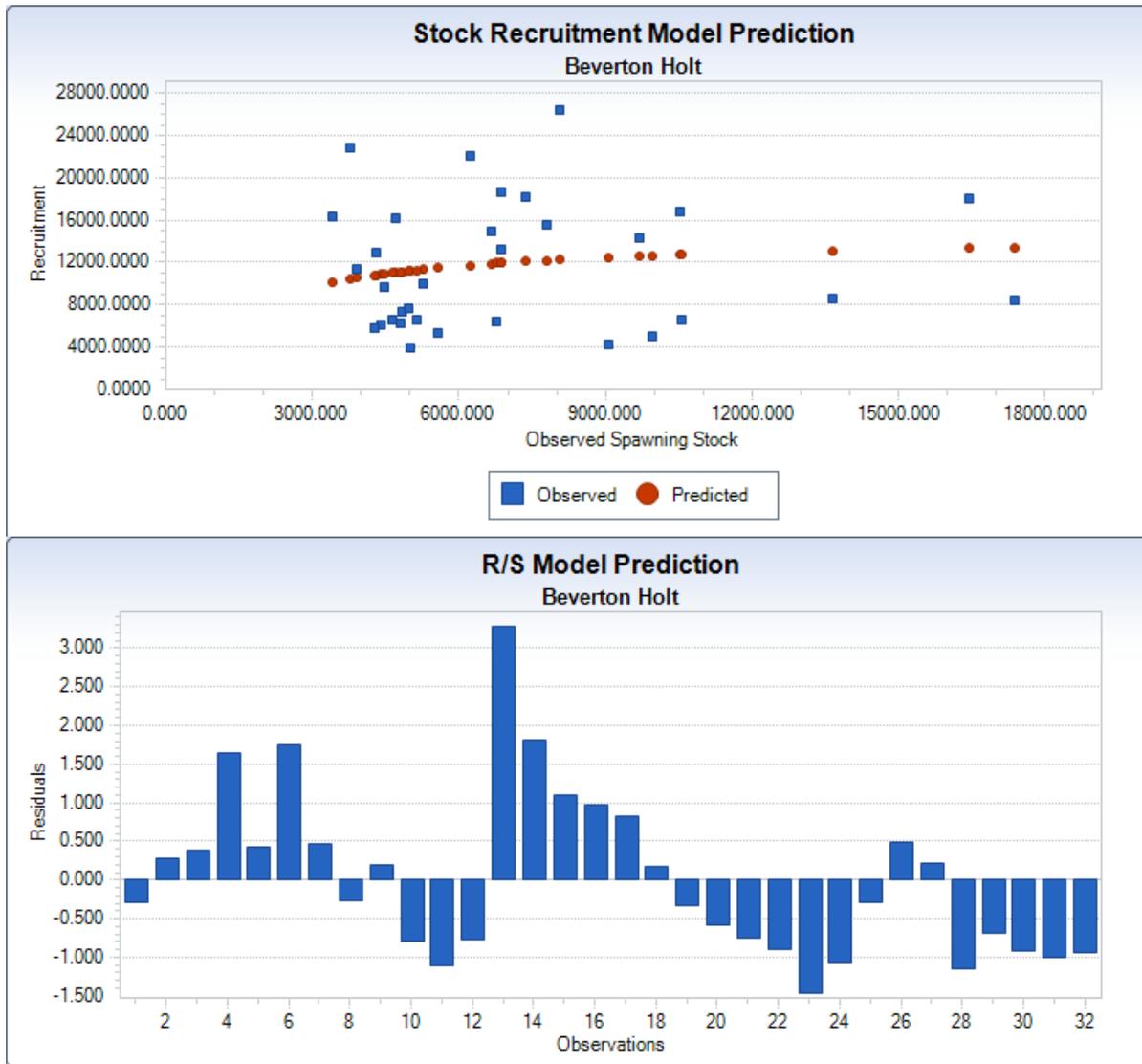
F2014

**0.379** (0.277, 0.540)

SSB2014 (mt)

**5,275** (4,140, 7,173)

# Updated FMSY (B-H S-R Model)



# Beverton-Holt S-R Model Results

	1982-2012 YC	1982-2013 YC
	Existing	Updated
<b>FMSY<sup>1</sup></b>	<b>0.44</b>	<b>0.536</b>
SSBMSY (mt)	6,828	5,438
MSY (mt)	2,807	2,480
<b><i>h</i> (fixed)</b>	0.78	0.78
$R_0$ (mill.)	15.234	13.458
Neg. LL	306.660	314.210
Bias-corrected AIC	632.187	647.255
Variance	0.271	0.281

<sup>1</sup> Only the FMSY estimate was used as a BRP

# Stochastic projections

1. **SSBMSY and MSY BRPs (100-yr projection,  $F = F_{MSY}$ )**
2. **2015-2018 estimates of median catch and SSB**

## Input data:

**2010-2014 avgs.** of PR, propor. mature-at-age and mean catch wts, stock wts and SSB wts from updated VPA

**$M=0.3$**

**Uncertainty (90% CL) based on 1,000 bootstrap iterations and variance in alpha and beta params. from B-H model with lognormal error**

**Assumed 2015 ACL = 1,150 mt (US+CA catch, source: GARFO)**

# Input data for stochastic projections and S-R model (2010-2014 avgs)

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Age	Selectivity on F	Selectivity on M	Stock weights	Catch weights	Spawning stock weights	Proportion mature
1	0.00	1.00	0.238	0.259	0.247	0.00
2	0.08	1.00	0.284	0.354	0.315	0.13
3	0.53	1.00	0.433	0.511	0.470	0.78
4	1.00	1.00	0.593	0.680	0.635	1.00
5	1.00	1.00	0.761	0.829	0.794	1.00
6	1.00	1.00	0.945	1.027	0.985	1.00
7+	1.00	1.00	1.319	1.319	1.319	1.00

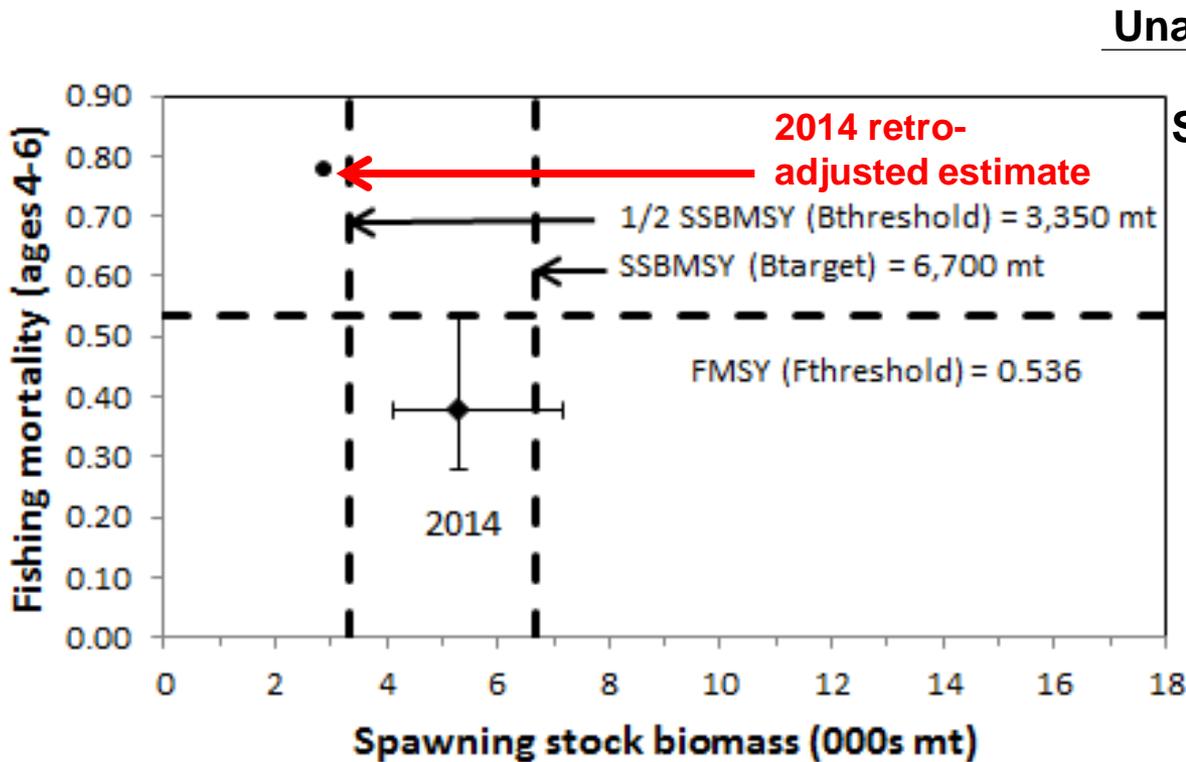
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# Existing and Updated BRPs

	Existing	Updated	
FMSY <sup>1</sup>	0.44	0.536	
SSBMSY(mt)	8,100 (5,890, 11,300)	6,700 (4,370, 10,610)	
MSY (mt)	3,200 (2,340, 4,460)	2,840 (1,850, 4,480)	
		Unadjusted	<u>Retro-adj.</u>
F2014		0.379 (0.277, 0.540)	0.778
SSB2014 (mt)		5,275 (4,140, 7,173)	2,883

<sup>1</sup> Precision estimates not possible because steepness parameter ( $h$ ) fixed at 0.78

# 2014 Stock Status



	Unadjusted	90%CL
F2014	0.379	(0.277, 0.540)
SSB2014	5,275	(4,140, 7,173)

## Retro-adjusted

F2014 = **0.778**

SSB2014 = **2,883 mt**

**In 2014, OF was occurring** (F2014 = 0.778 > new FMSY threshold = 0.536) and the stock **was overfished** (SSB2014 = 2,883 mt < updated SSBMSY threshold = 3,350 mt)

# Stochastic Projections of Catch and SSB 2015-2018

## Fishing at **FMSY** during 2016-2018

Year	Catch (mt)	SSB (mt)	$F_{Full}$
2015	1,150	2,623 (1,802, 3,813)	0.362
2016	957	2,232 (1,435, 3,385)	0.536
2017	982	2,368 (1,743, 3,258)	0.536
2018	1,289	3,218 (2,114, 5,490)	0.536

**SSBMSY =  
6,700 mt**

## Fishing at **75% of FMSY** during 2016-2018

Year	Catch (mt)	SSB (mt)	$F_{Full}$
2015	1,150	2,623 (1,802, 3,813)	0.362
2016	755	2,295 (1,472, 3,482)	0.402
2017	830	2,595 (1,894, 3,594)	0.402
2018	1,110	3,581 (2,390, 5,948)	0.402

# Sources of Uncertainty

- 1. Retrospective bias in F and SSB**
- 2. Underestimation of catch (No CA BT discards available)**
- 3. Precision of CA SD discard estimates is unknown (only 1-2 trips/month)**
- 4. Lack of age data for CA spring survey catches and no length or age data for CA catches**

