

2017 Whiting Assessment Update and Proposed ABC Specification for FY 2018-2020

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NEFSC, Population Dynamics Branch

Whiting PDT
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Boston, MA

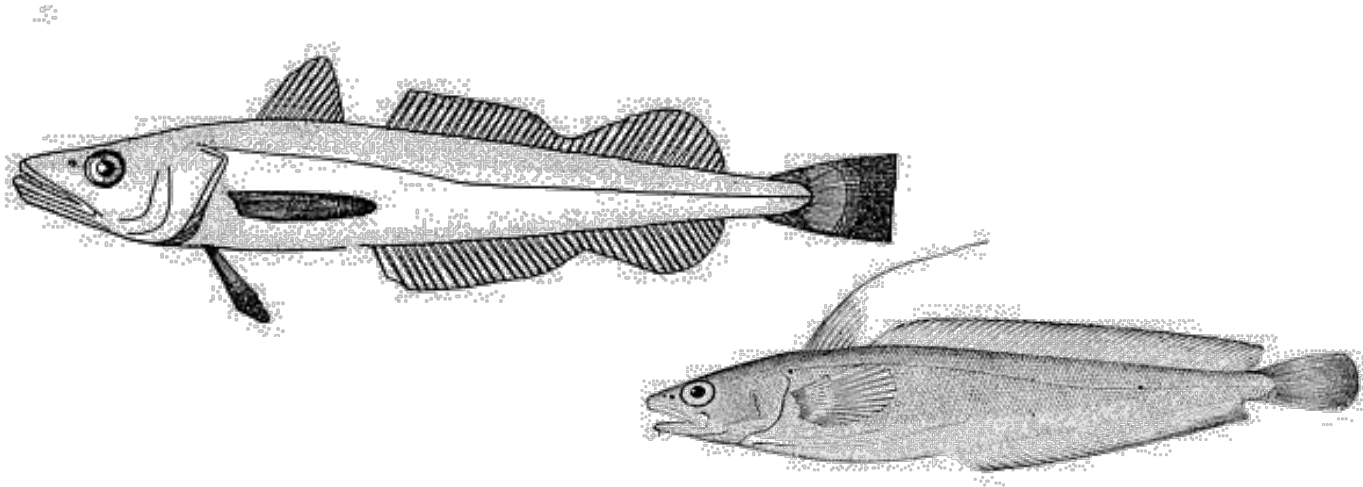
State of the Stocks

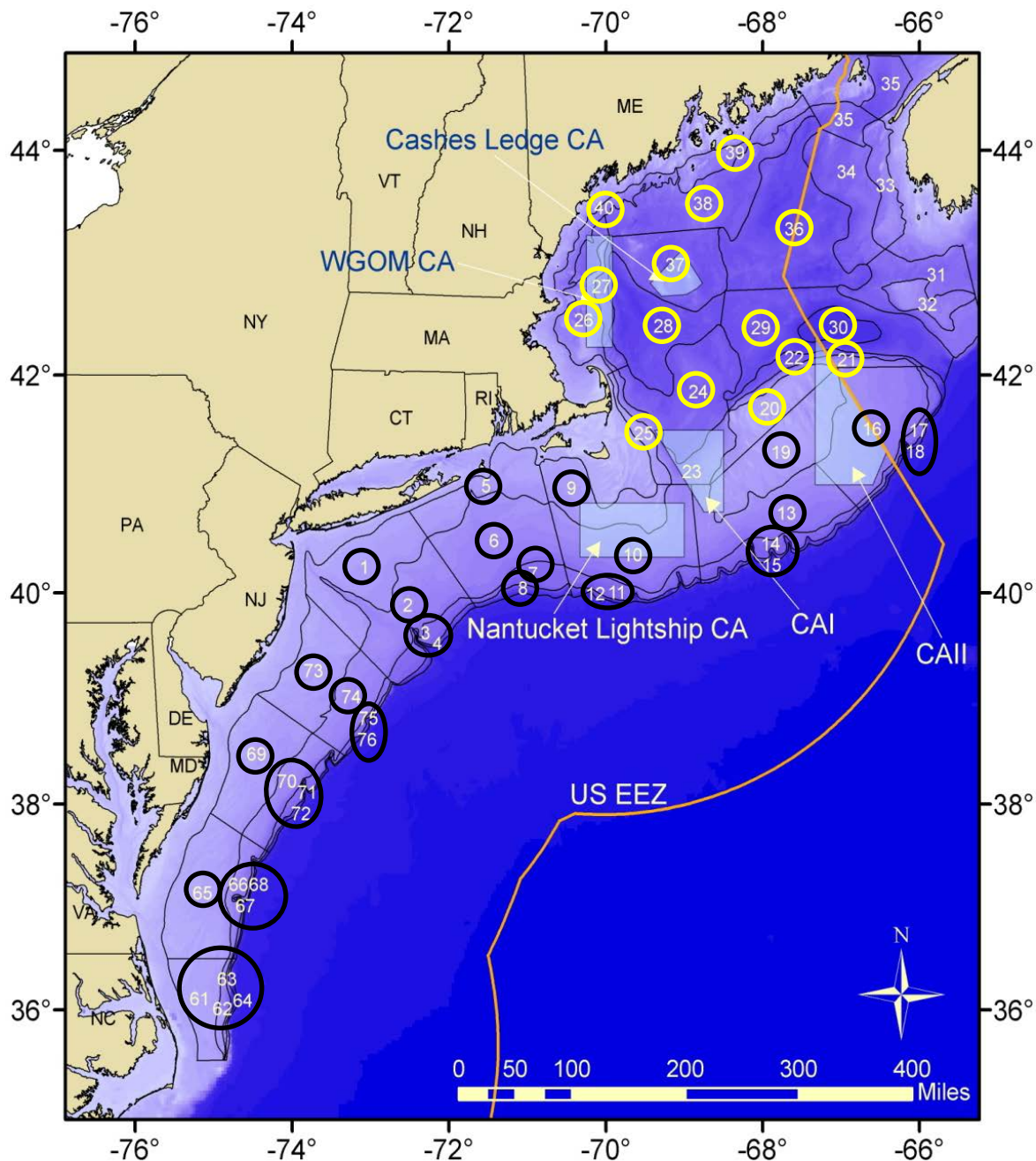
- *Silver hake*
 - Both northern and southern Stocks for are NOT overfished and overfishing is NOT occurring
- *Red Hake*
 - Northern stock is NOT Overfished and Overfishing is NOT occurring
 - Southern stock : Overfished and Overfishing is occurring
(*Change in Stock Status*)
- *Offshore hake*
 - stock status determination remains undetermined because the fishery data were not sufficient and the survey trends did not reflect the stock trends

Outline

- Survey Data
- Catch Data
- OFL and ABC measure of uncertainty
 - NEFSC Survey
 - F_{MSY} Reference Point
- Risk Analyses
- Summary

Silver and red hake Survey Trends





Survey Strata Map

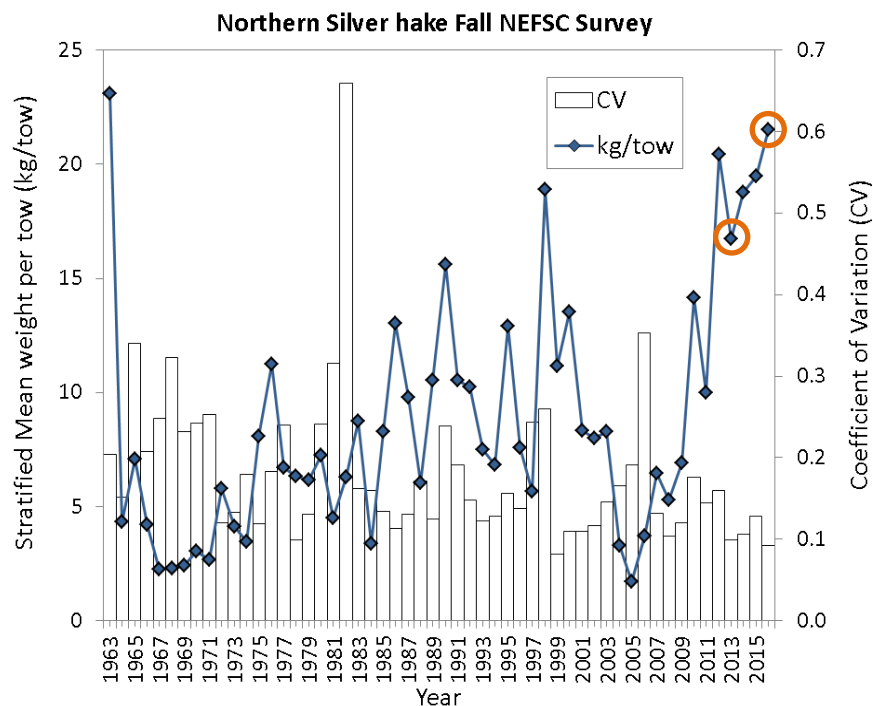
Northern Strata:

20-30, 36-40

Southern Strata:

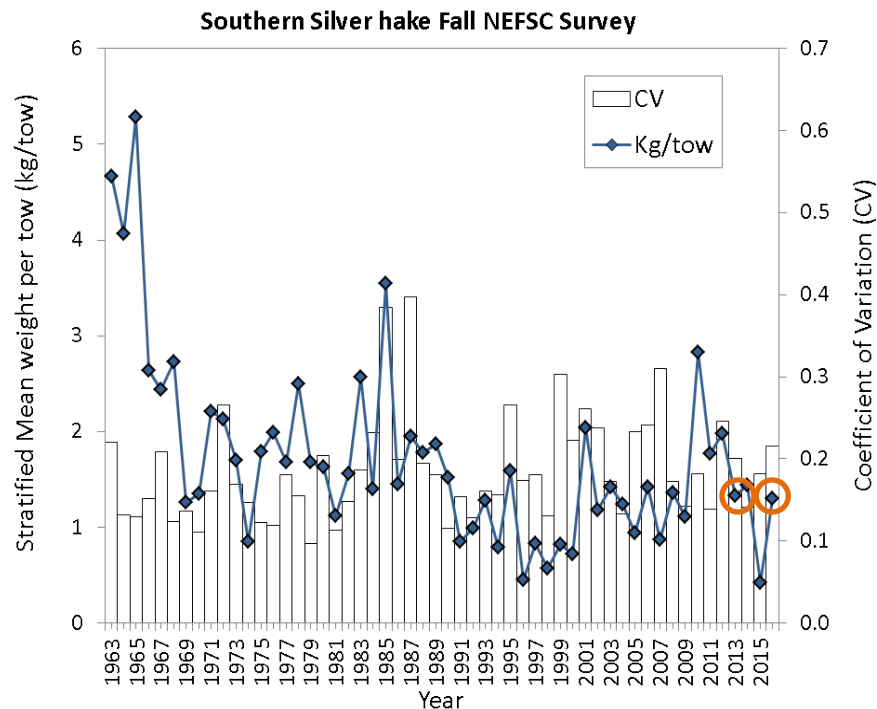
01-19, 61-76

Silver hake Fall NEFSC Survey Biomass



North:

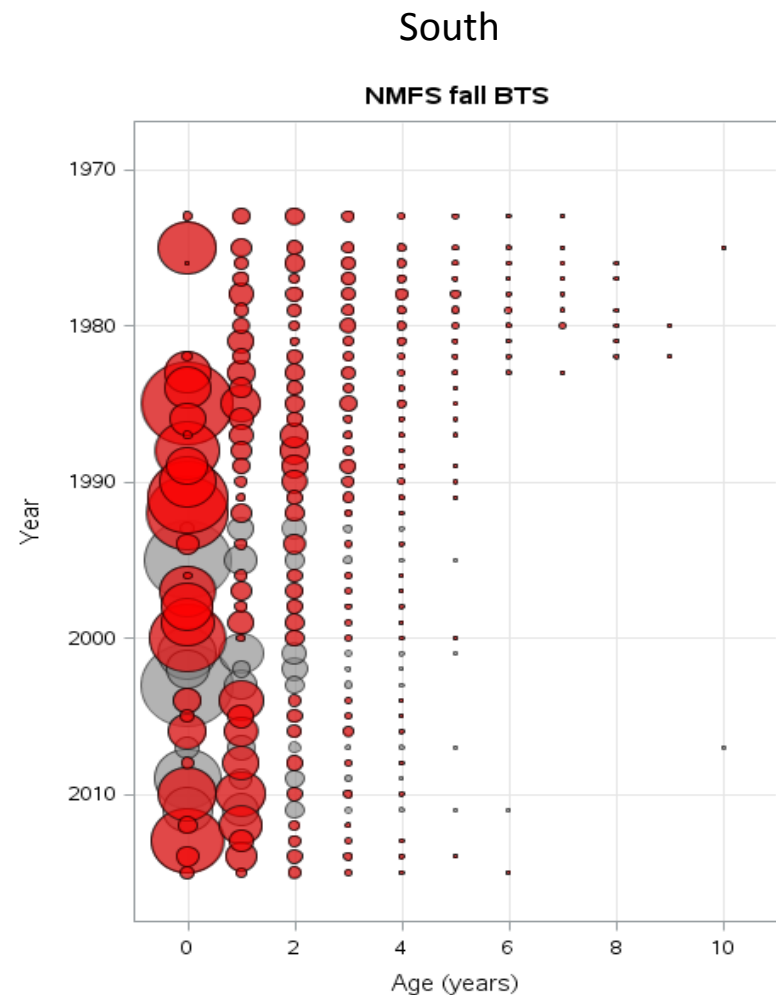
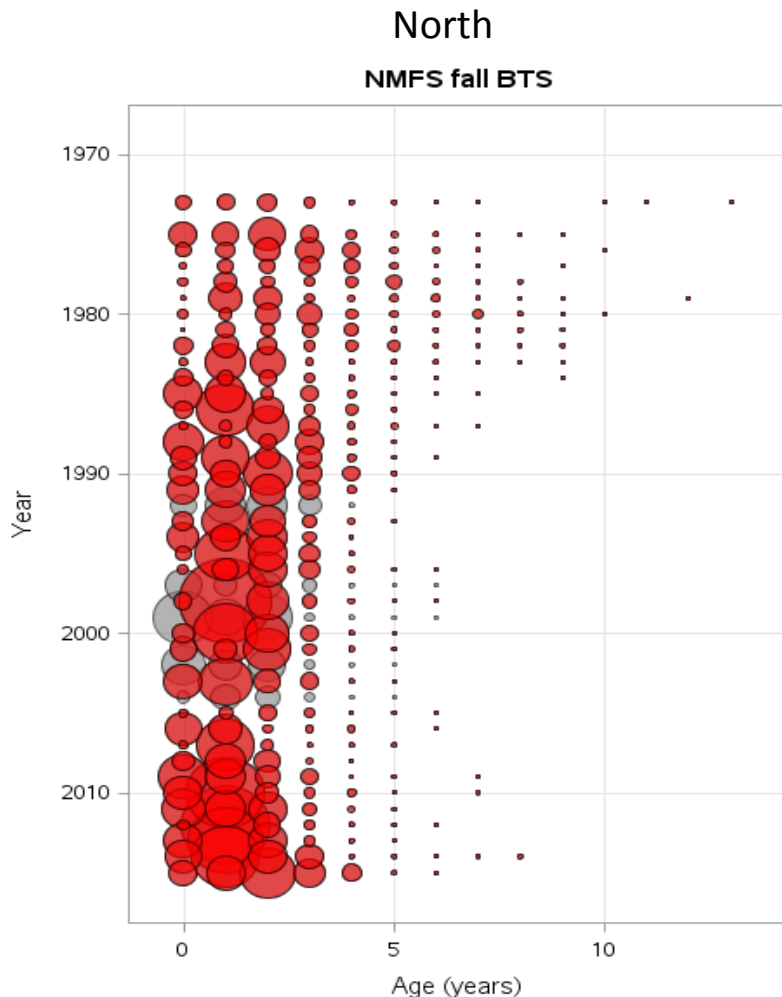
- More abundant relative to the south (note Scale difference)
- Increasing trend since 2013.
- 2016 value, second highest in the time series (21.51 kg/tow)



South:

- Declining since 2011. Slight increase in 2016
- 2015 lowest in time series (Influential in the assessment update)

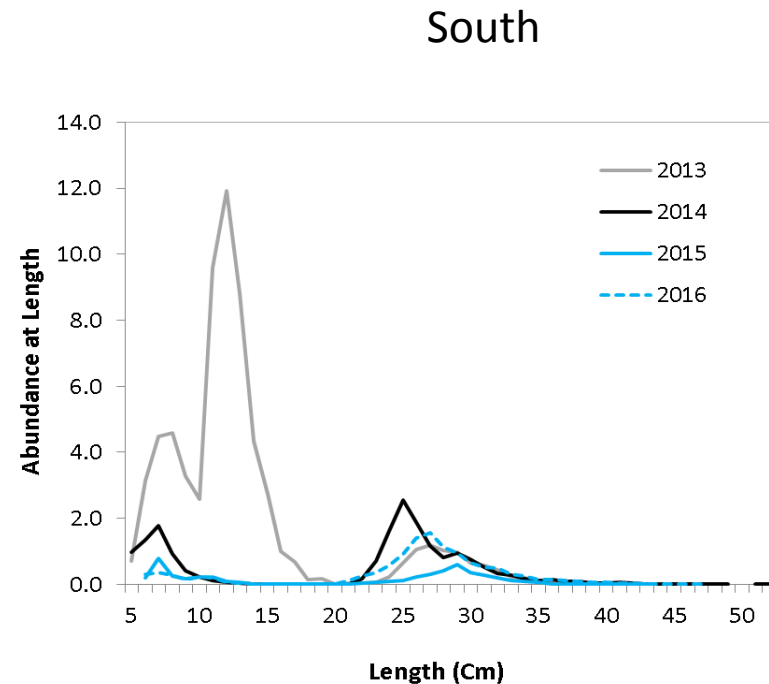
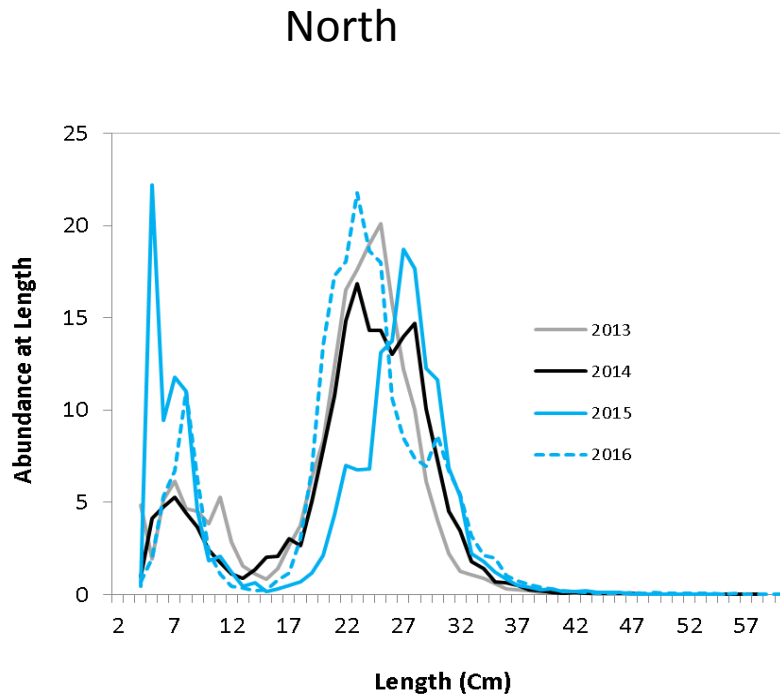
Silver hake NEFSC Fall Survey Abundance Catch-at-age



- Strong recruitment in the recent years
- Lack of expansion in age structure
- Predation and Cannibalism could be a factor

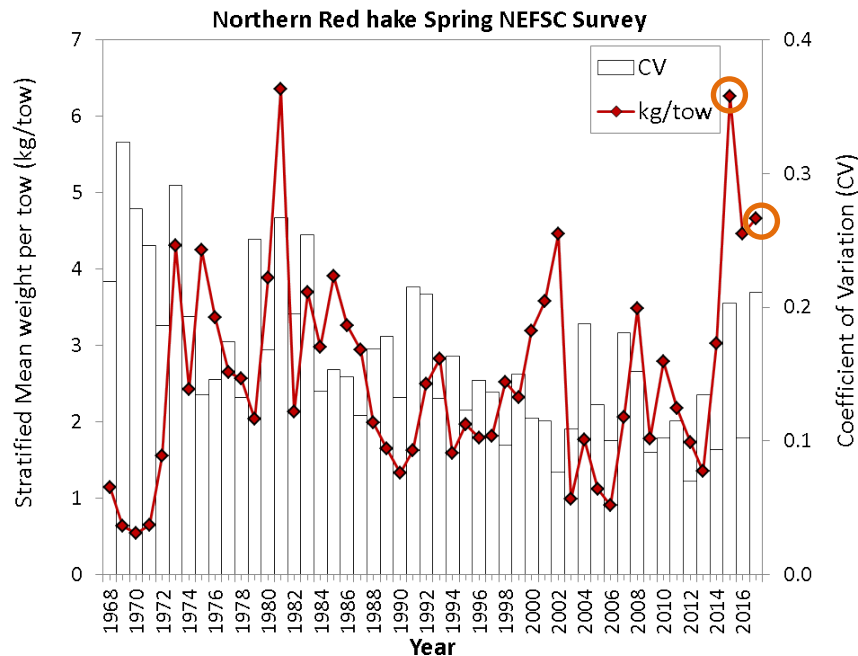
Age1 15-30cm **Age3** 38-45cm **Age5-6** >45 cm
Age2 31-37cm **Age4** 27-49cm

Silver hake NEFSC Fall Survey Abundance Catch-at-Length



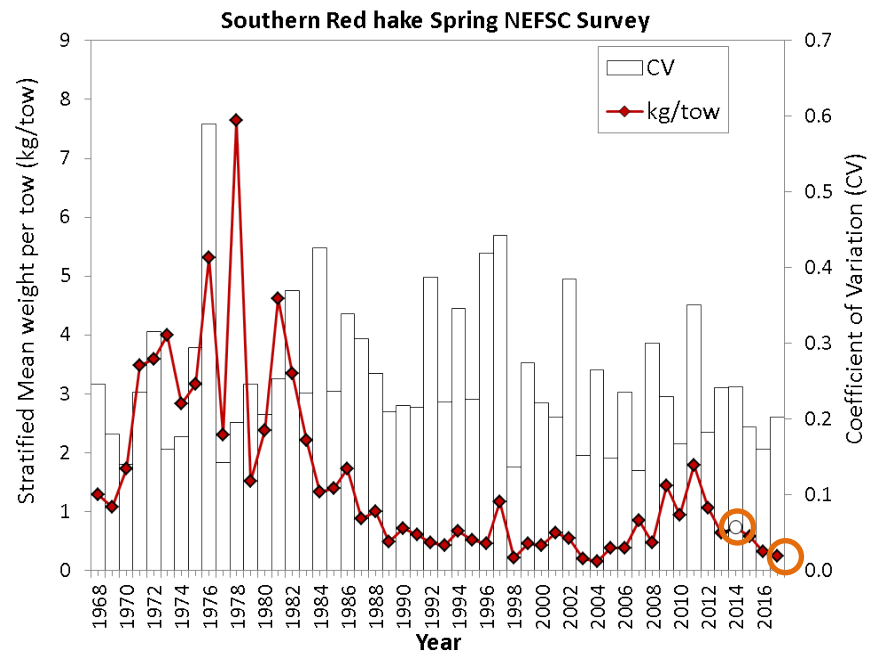
Age1 15-30cm Age3 38-45cm Age5-6 >45 cm
Age2 31-37cm Age4 27-49cm

Red hake Spring NEFSC Survey Biomass



North:

- Interim update in 2015 (account for 2014 YC).
- 2014 spring Survey – Highest on record
- Decline in 2015 and stable
- Note – 2016 value well above TS average (80%)

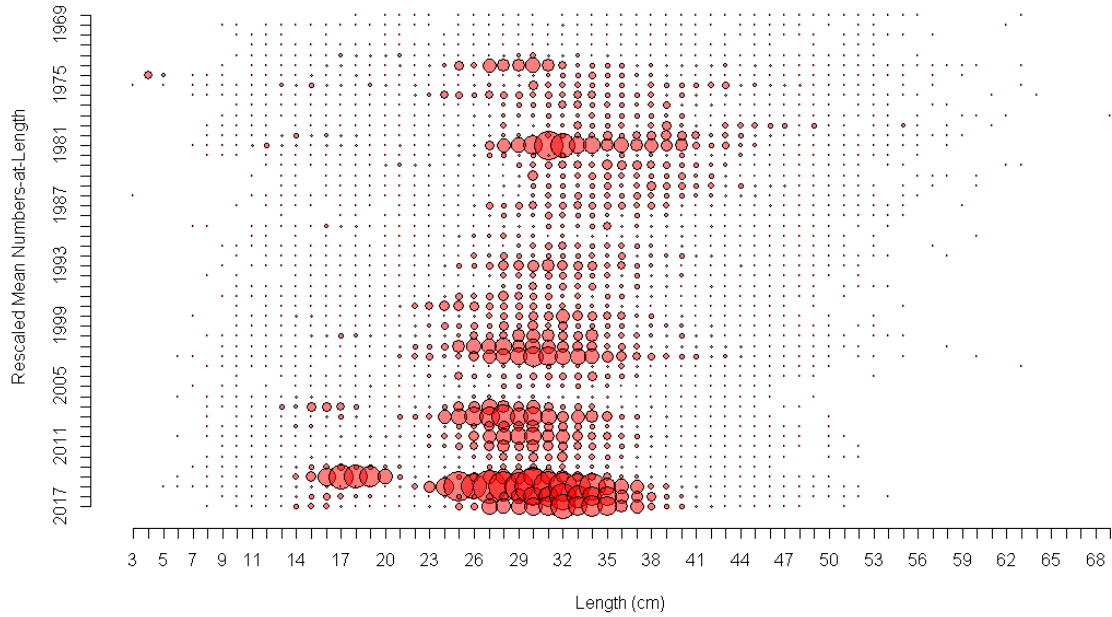


South:

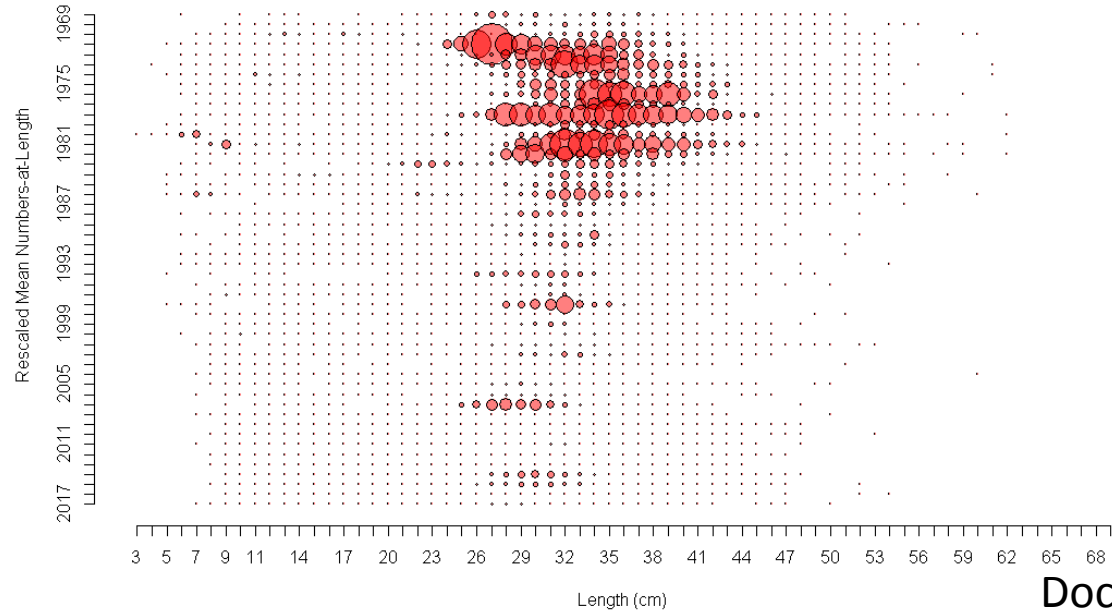
- Declining since 2011. Slight increase in 2016
- 2016 estimate among the lowest in the time series (0.25kg/tow)
- 2016 survey estimate ~ 80% below the time series mean)

Red hake Spring Survey Size Composition

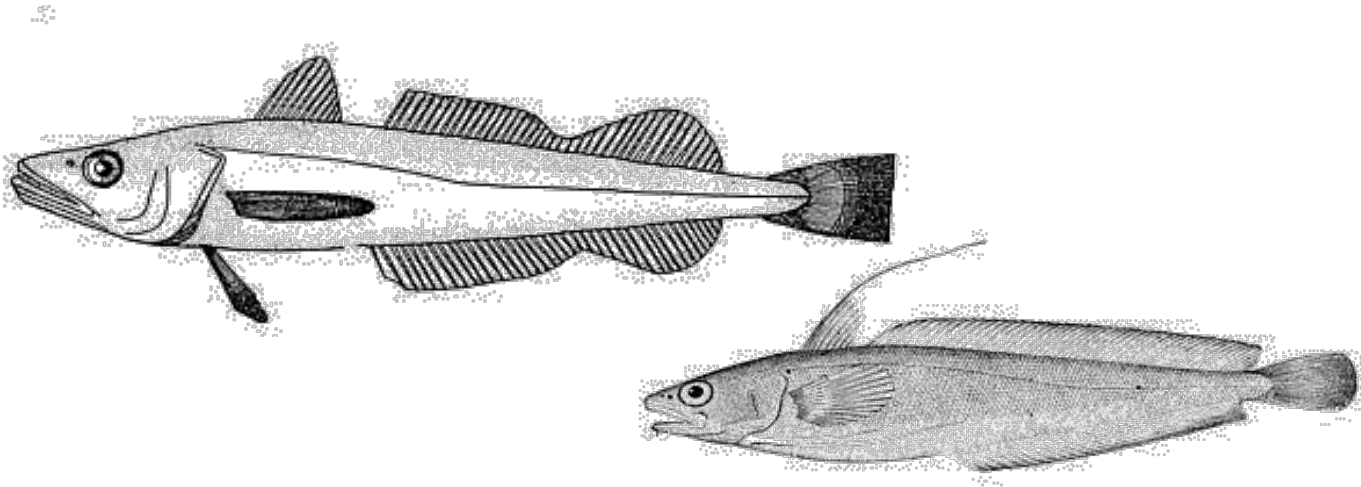
North

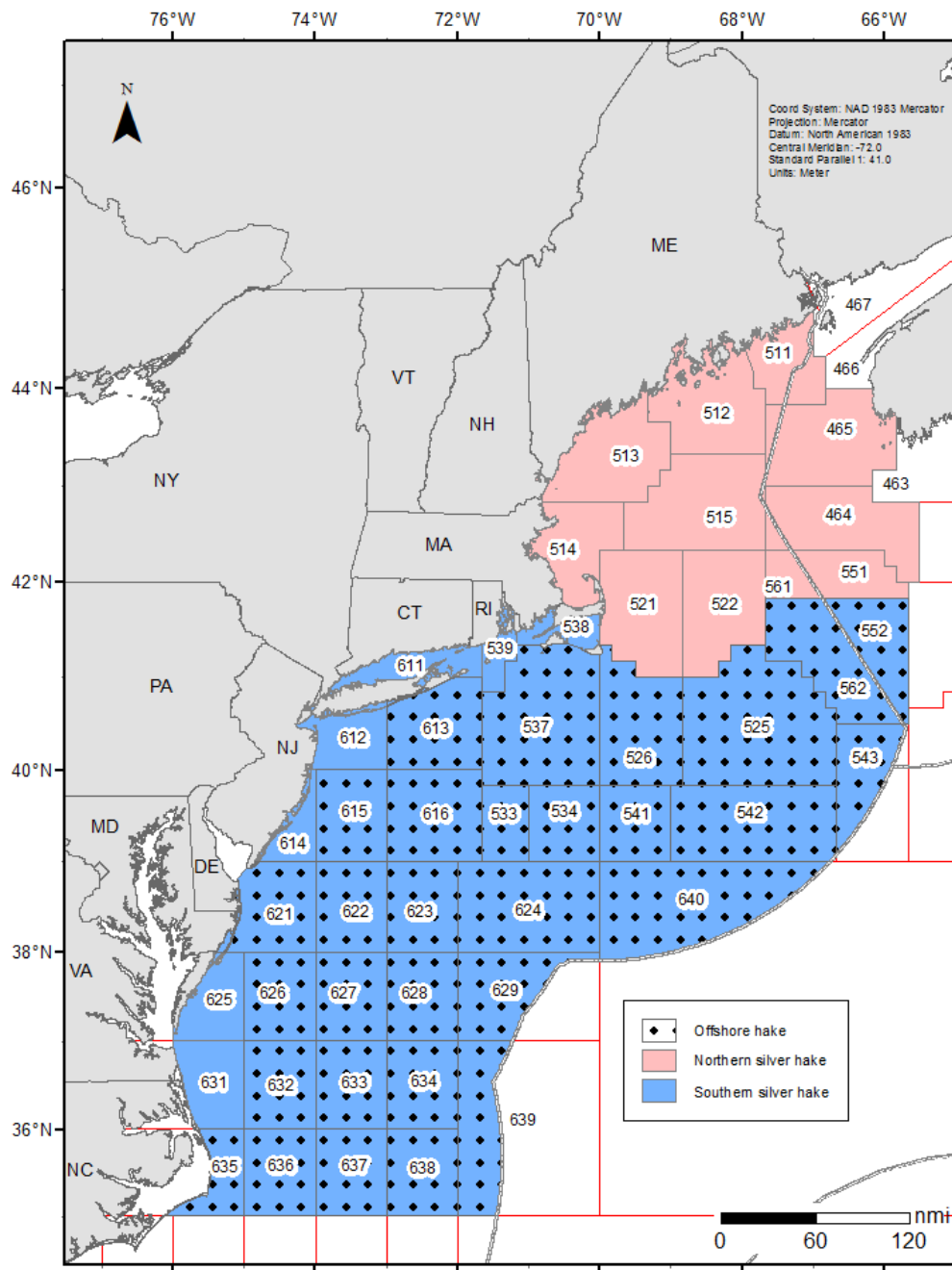


South



Silver and red hake catch Data





Commercial Statistical Areas

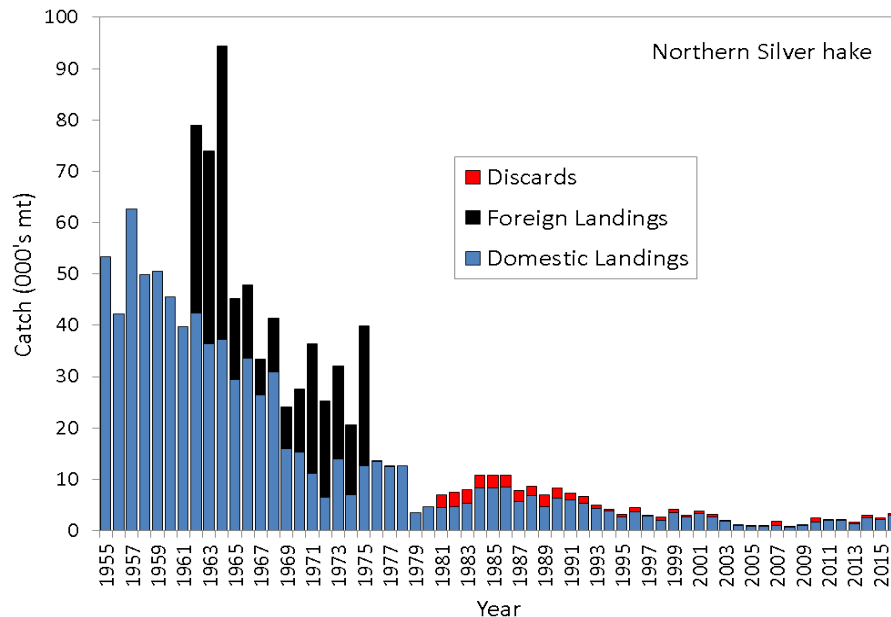
Northern Stock:

512-515, 521-522 and 561

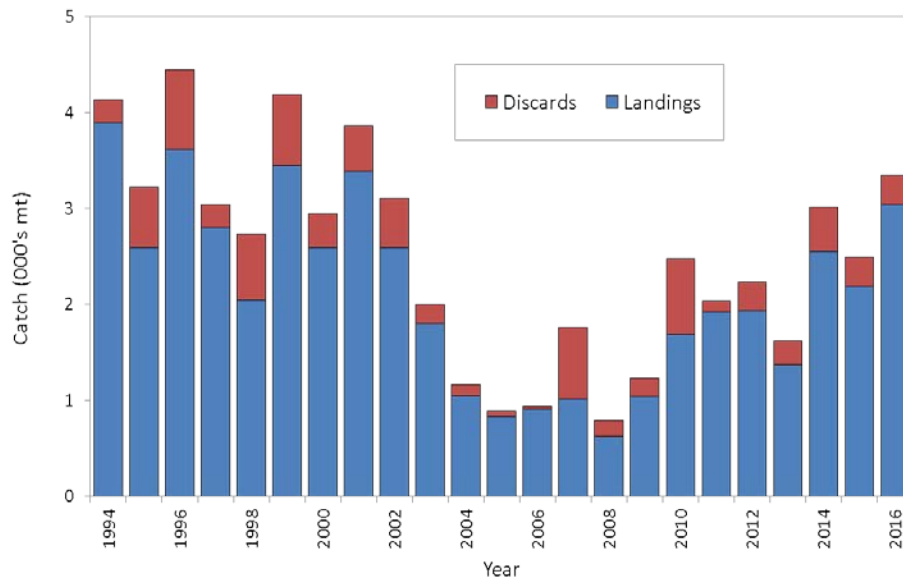
Southern Stock:

525-526, 562, 533-534, 537-539, 541-543, 611-616, 621-623, 625-628, 631-638

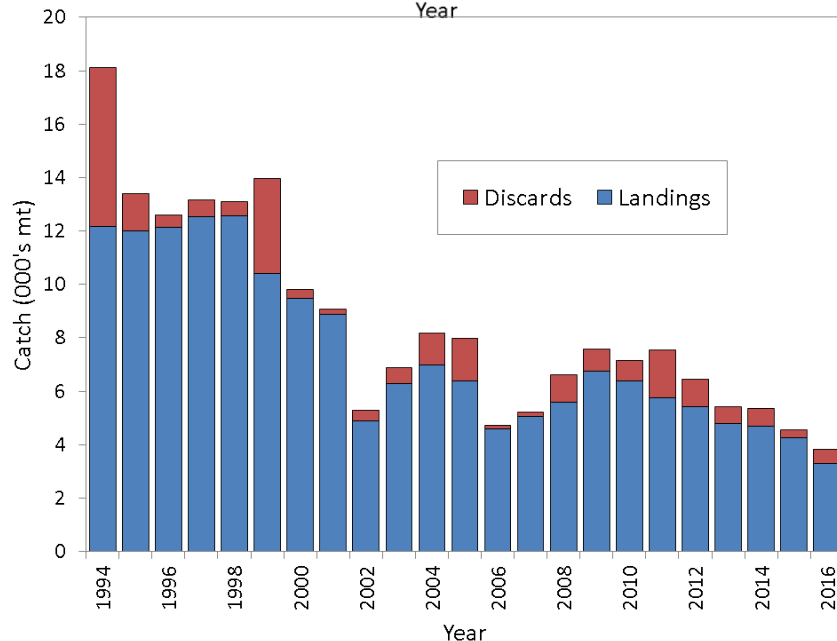
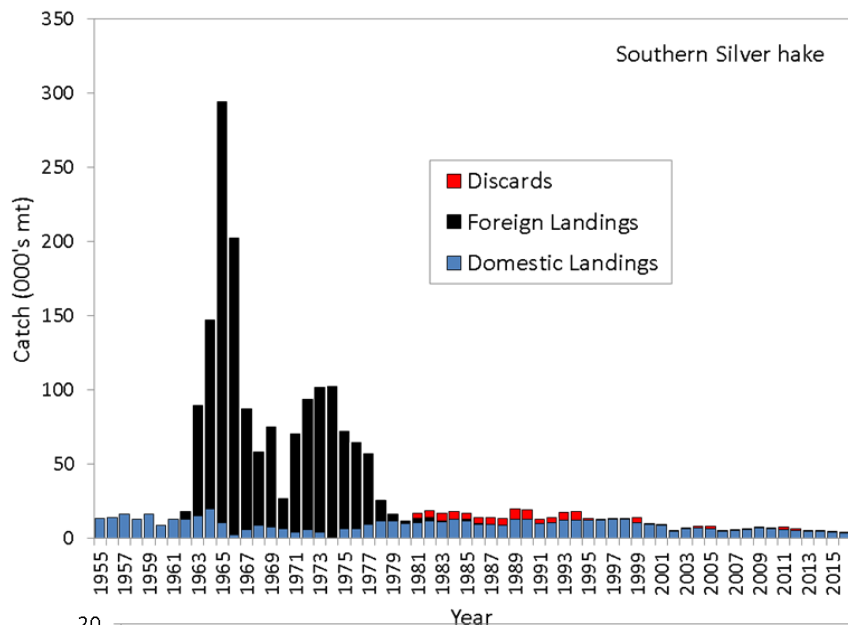
North - Silver hake total catch



- Recent 5 years total catch has been Variable but increasing
- 2016 Landings: 3,290 mt
- 2016 Discards: 310 mt (9%)
- Total Catch: 3,370 mt (more than doubled since 2013)
- > 95% of landings are also by trawl fishery in recent years

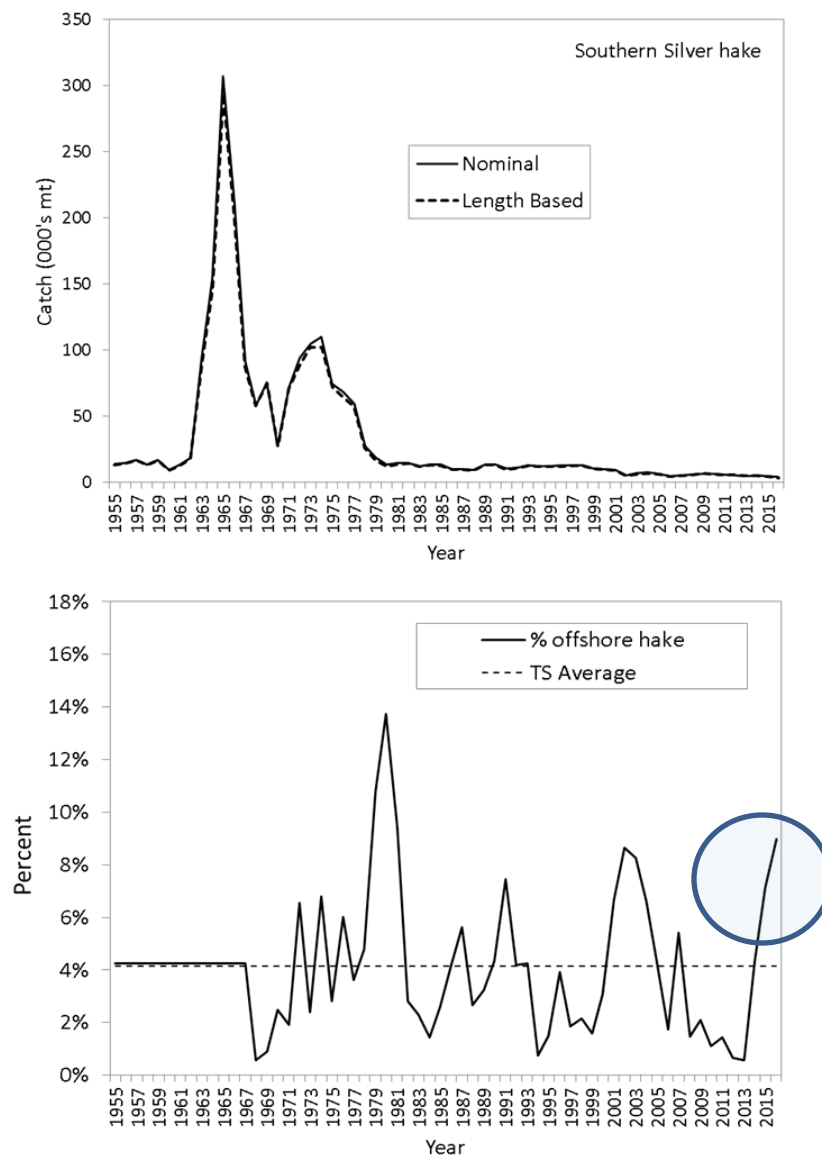


South - Silver hake total catch

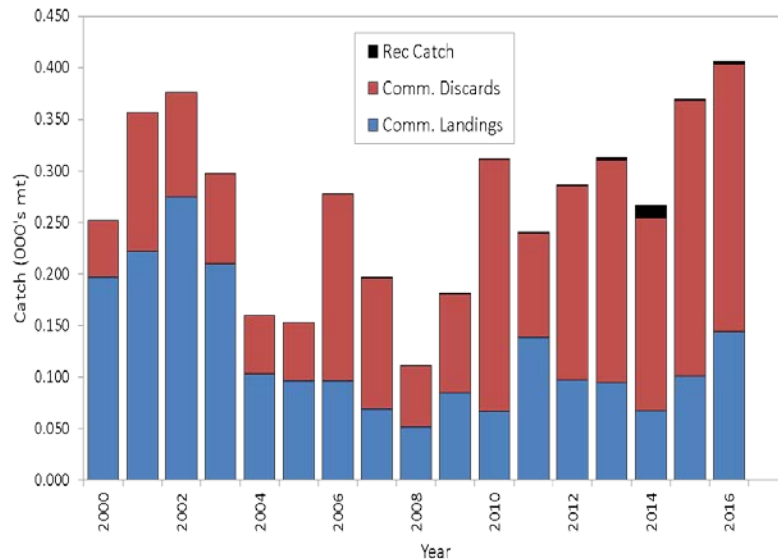
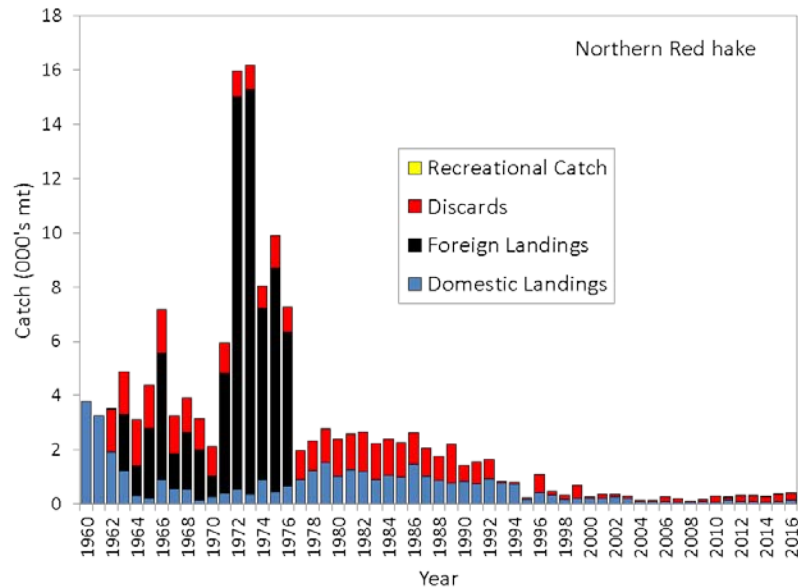


- Recent 5 years total catch has been declining
- 2016 Landings: 3,290 mt
- 2016 Discards: 540 mt (14%)
- Total Catch: 3,830 mt (declined by 29% since 2013)
- 99% of landings are also by trawl fishery in recent years

Percent offshore hake in the *Southern whiting* (BOTTOM) derived from the length-based model for years 1955-2016

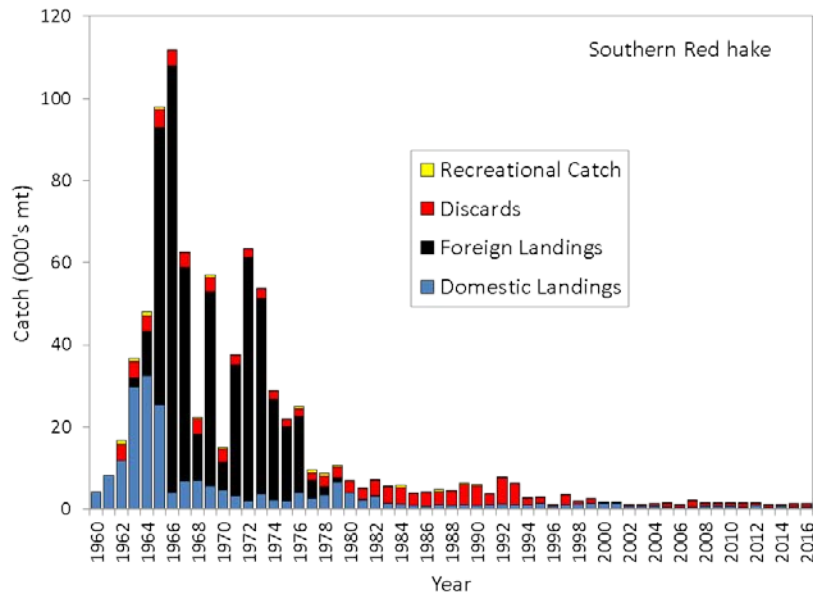


North - Red hake Total Catch

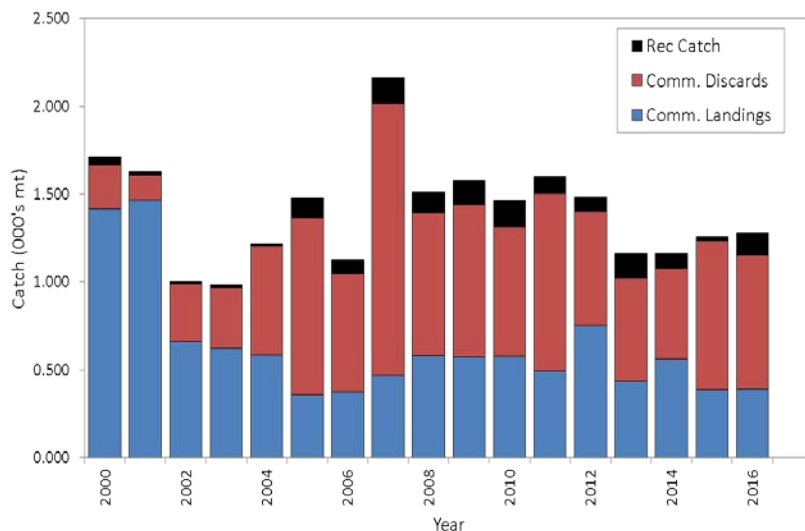


- Recent 5 years total catch has been increasing
- 2016 Landings: 146 mt
- 2016 Discards: 261 mt (64%)
- Total Catch: 407 mt (30% increase since 2013)
- 99% of landings are also by trawl fishery in recent years
- Rec. Catch – Small fraction of removals

South - Red hake Total Catch



- Recent 5 years total catch has been relatively stable
- 2016 Landings: 450 mt
- 2016 Discards: 830 mt (65%)
- Total Catch: 1,280 mt
- 99% of landings are also by trawl fishery in recent years
- Rec. Catch – Small fraction of removals

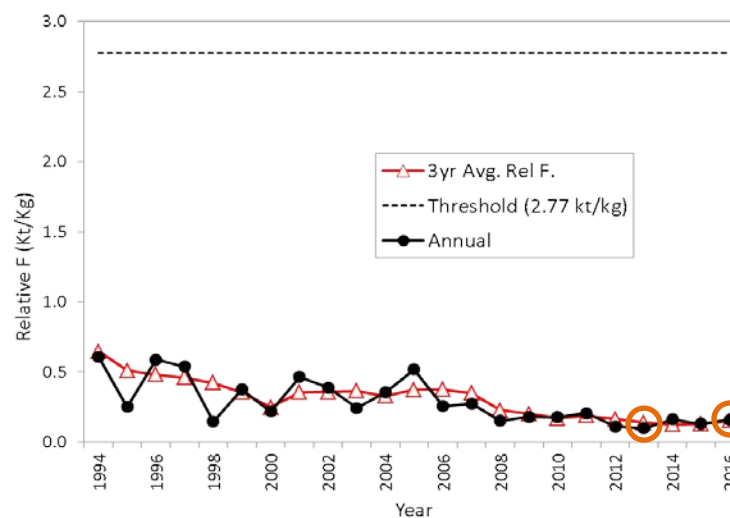
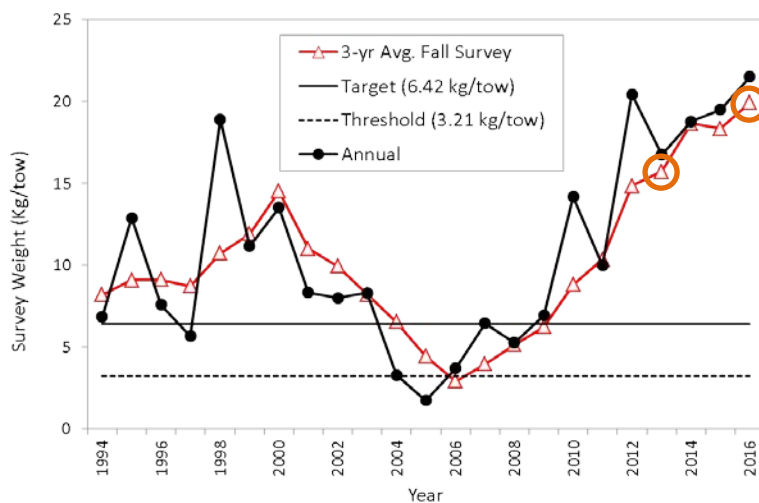
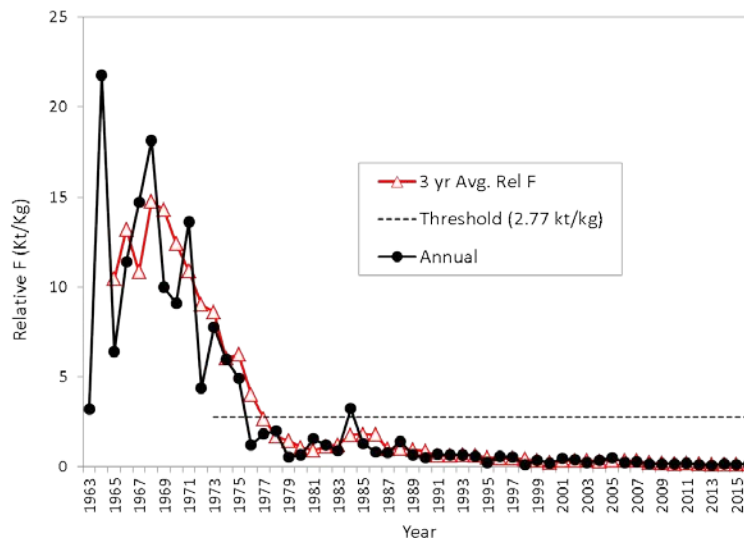
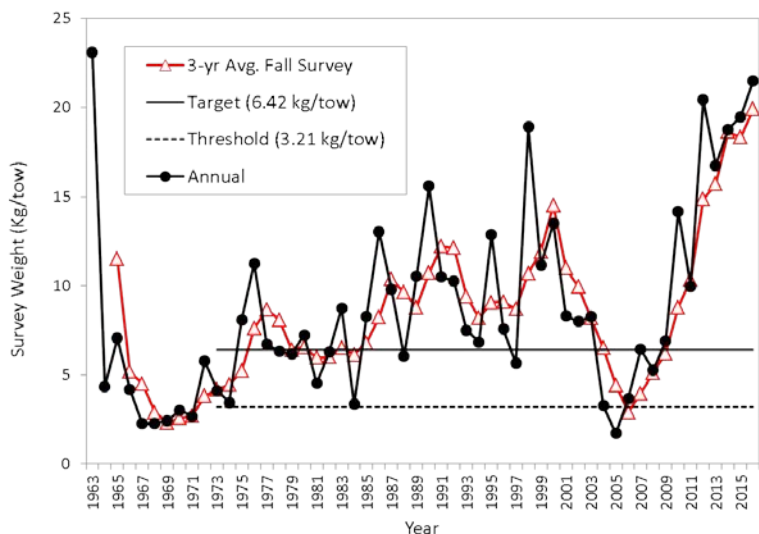


Silver hake Biological Reference Points

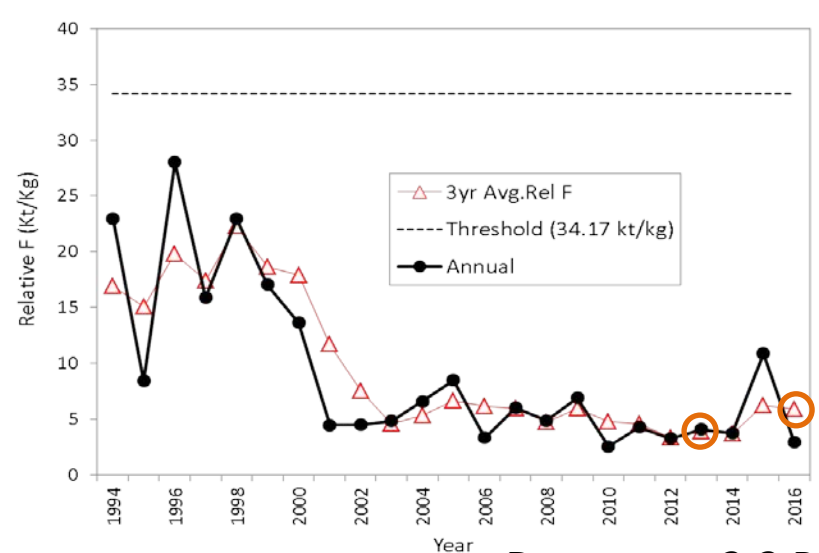
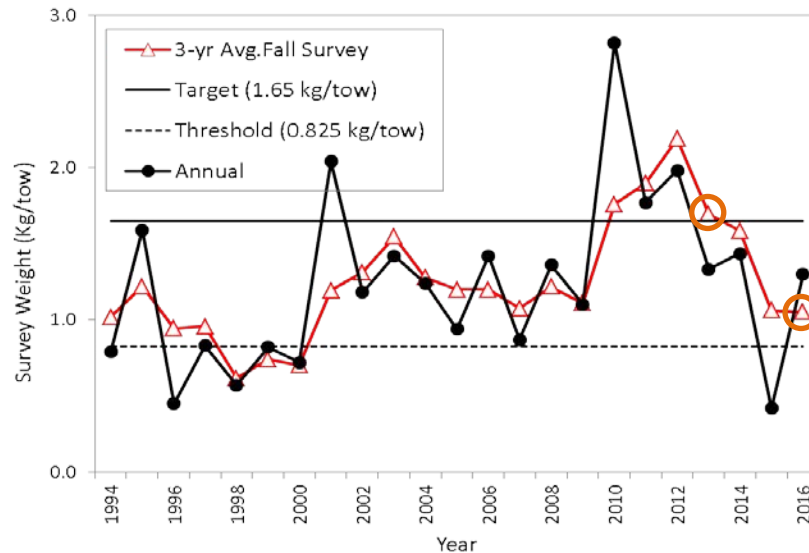
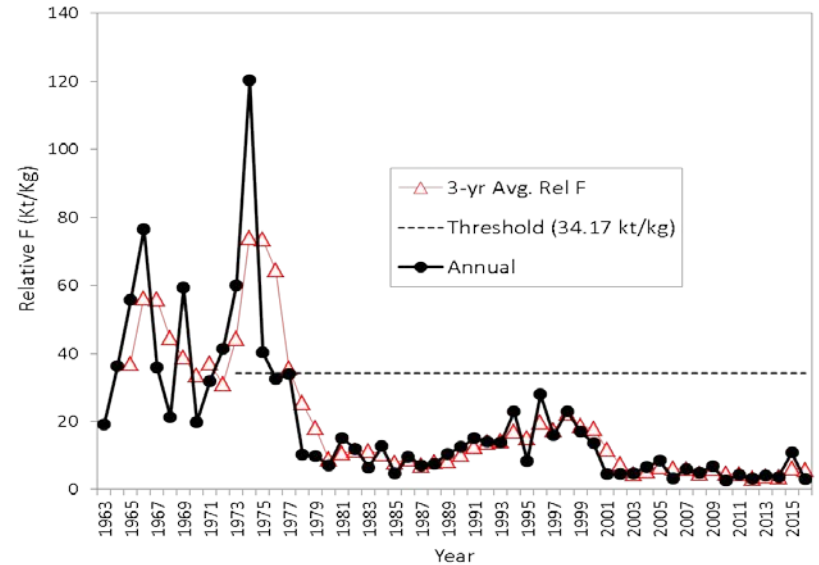
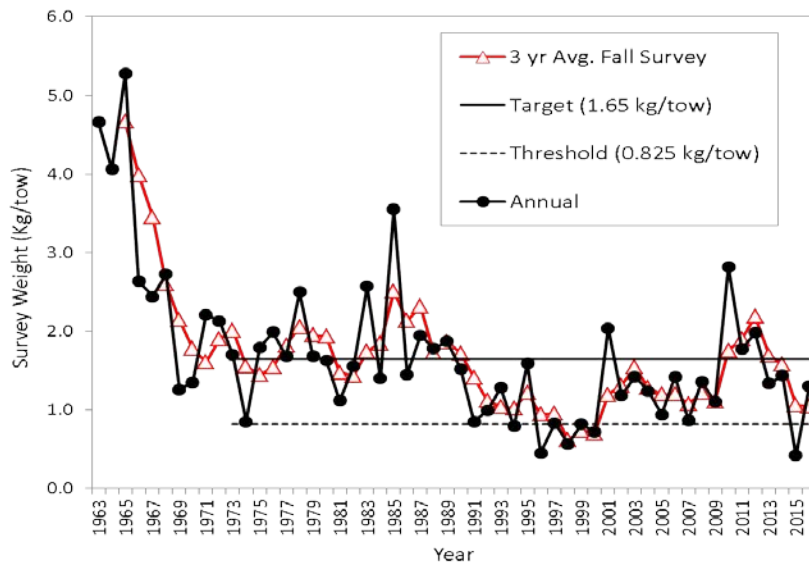
- Biomass reference points based on the arithmetic average of the NEFSC fall Survey (1973-1982)
- Exploitation Index is based on ratio b/w total catch and arithmetic fall survey index averaged from 1973-1982

STOCK	THRESHOLDS (SARC 51)	TARGETS(SARC 51)
Northern Silver Hake	$1/2 B_{MSY}$ Proxy (3.21) F_{MSY} Proxy (2.78)	B_{MSY} Proxy (6.42) F_{MSY} Proxy (NA)
Southern Silver Hake	$1/2 B_{MSY}$ Proxy (0.83) F_{MSY} Proxy (34.17)	B_{MSY} Proxy (1.65) F_{MSY} Proxy (NA)

Northern Silver hake Fall Survey Biomass (kg/tow) and Relative Exploitation (kt/kg)



Southern Silver hake Fall Survey Biomass (kg/tow) and Relative Exploitation (kt/kg)

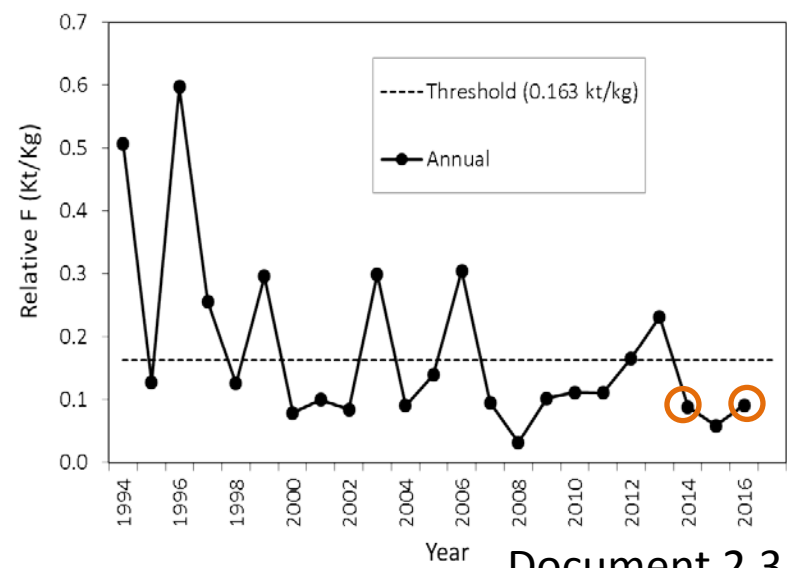
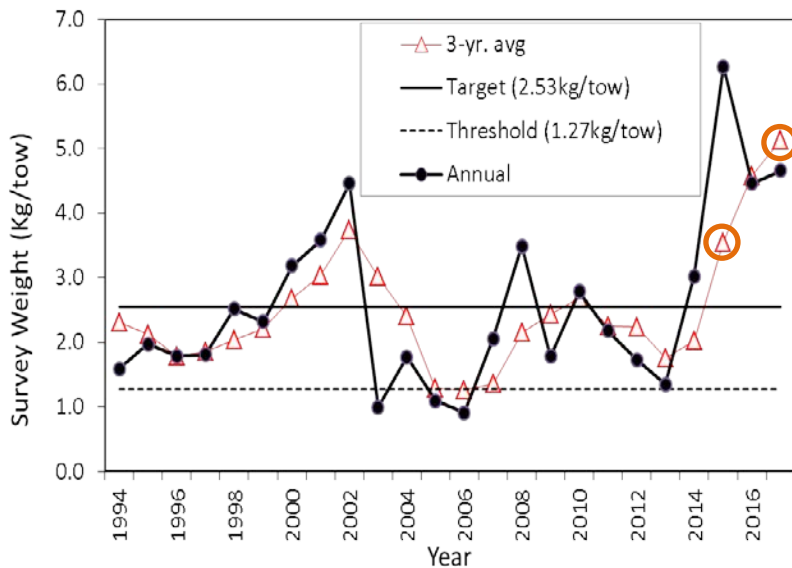
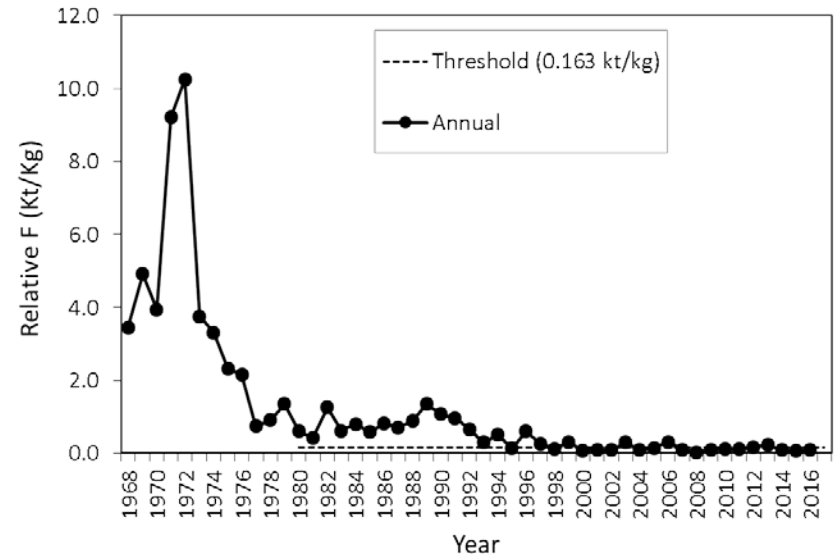
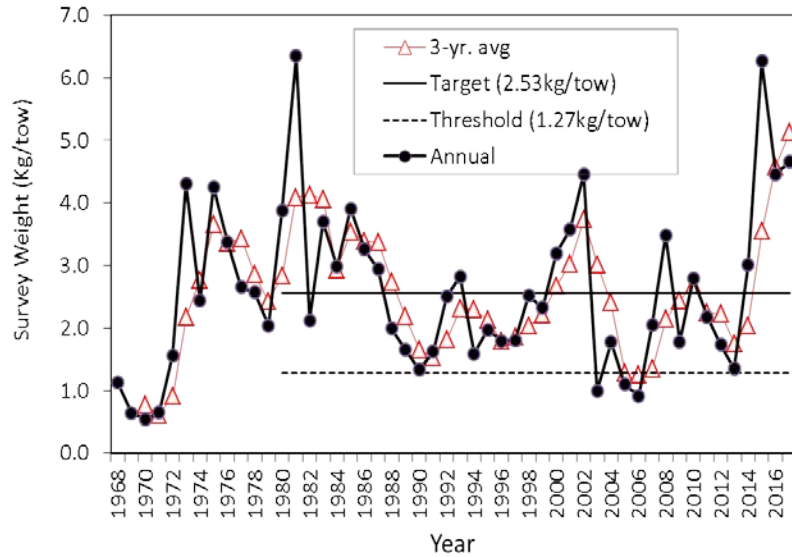


Red hake Biological Reference Points

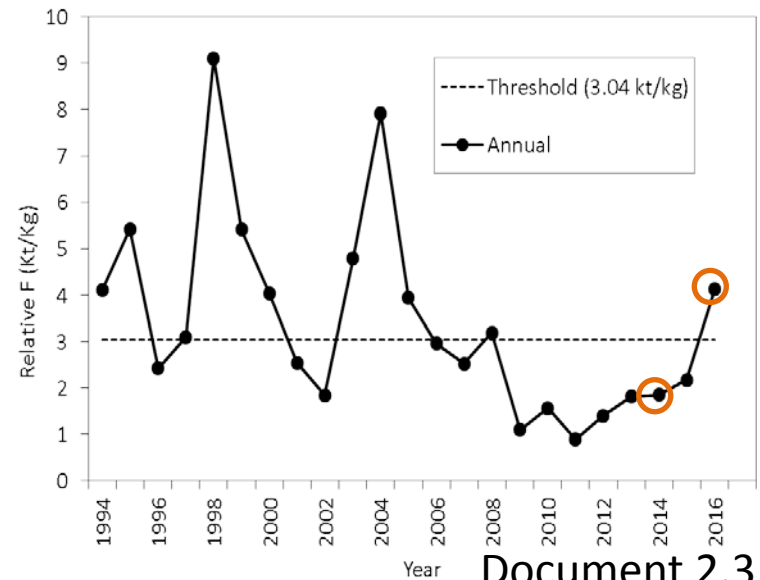
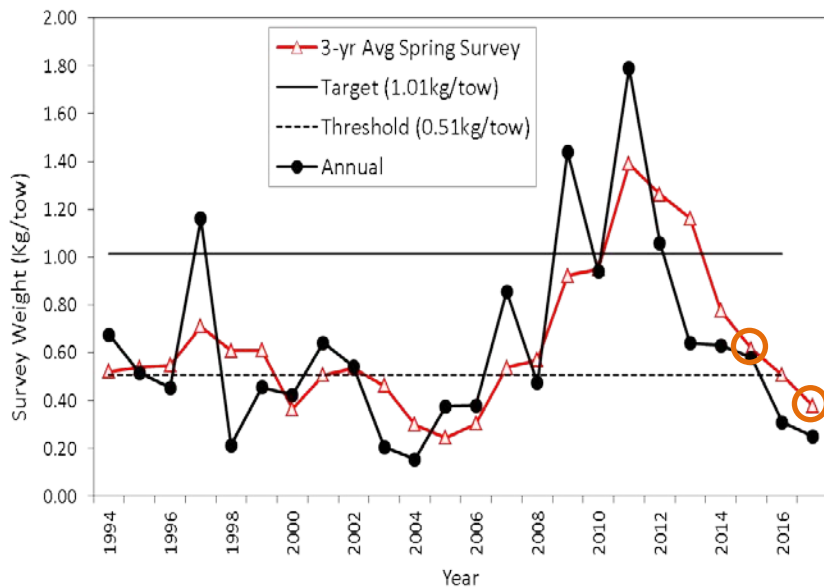
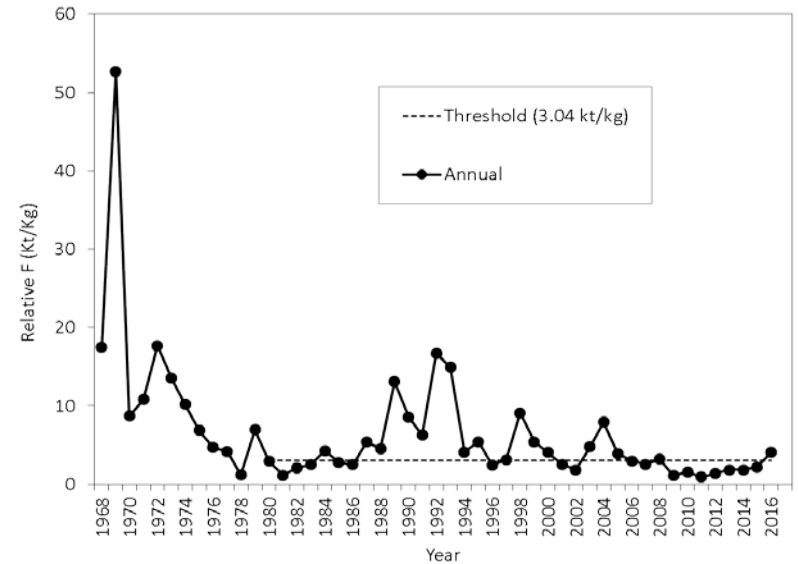
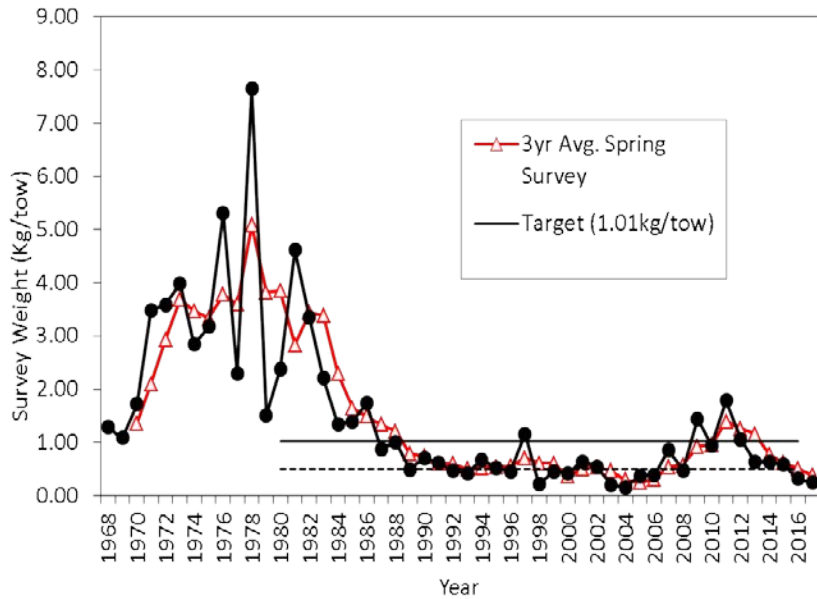
- Biomass reference points based on the arithmetic average of NEFSC Spring Survey (1980-2010)
- Exploitation Index is based on ratio b/w total catch and Spring survey index from 1980-2009 from AIM analyses

STOCK	THRESHOLDS (SARC 51)	TARGETS(SARC 51)
Northern Red Hake	$1/2B_{MSY}$ Proxy (1.27) F_{MSY} Proxy (0.16)	B_{MSY} Proxy (2.54) F_{MSY} Proxy (NA)
Southern Red Hake	$1/2B_{MSY}$ Proxy (0.51) F_{MSY} Proxy (3.04)	B_{MSY} Proxy (1.02) F_{MSY} Proxy (NA)

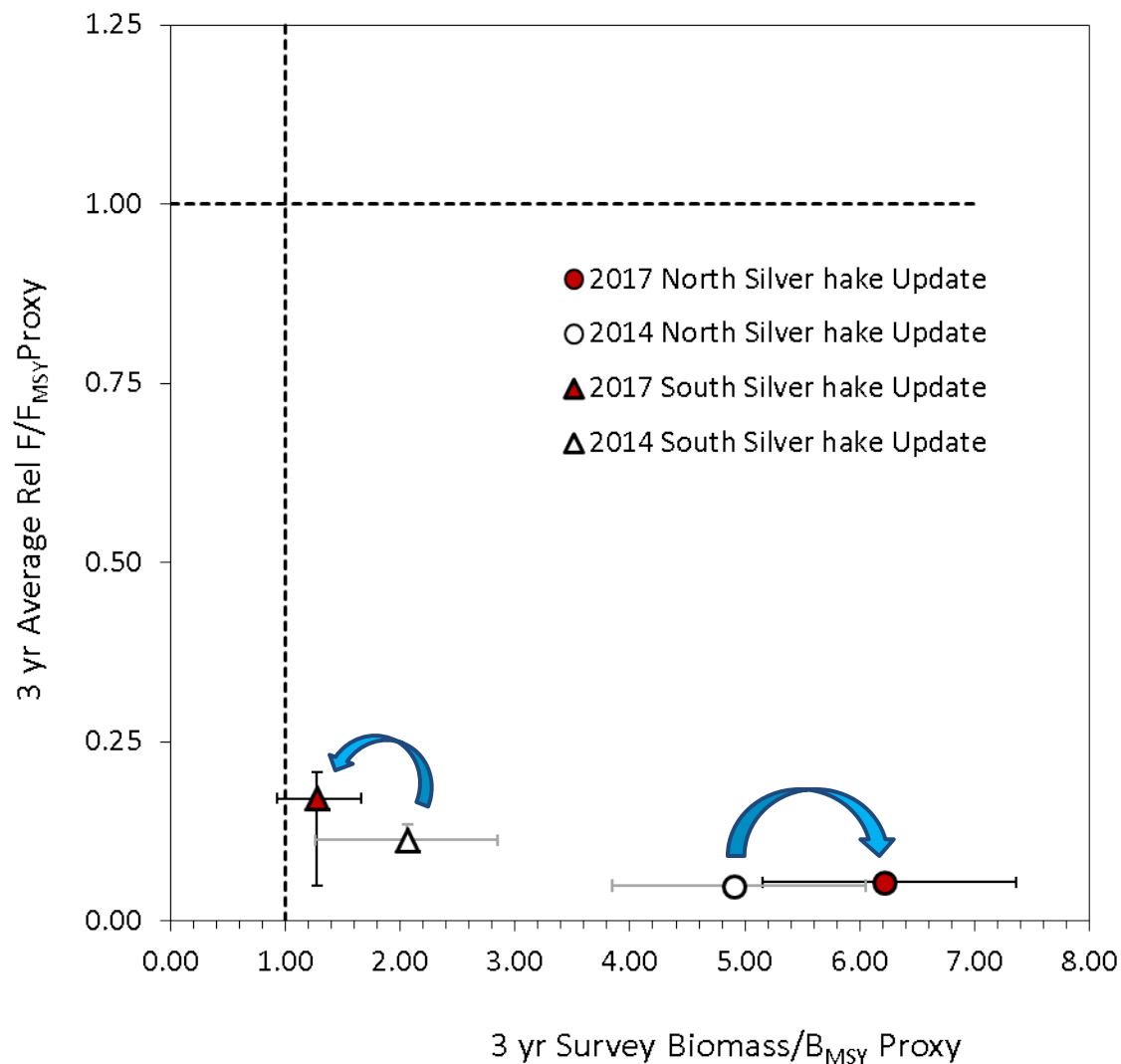
Northern Red hake Fall Survey Biomass (kg/tow) and Relative Exploitation (kt/kg)



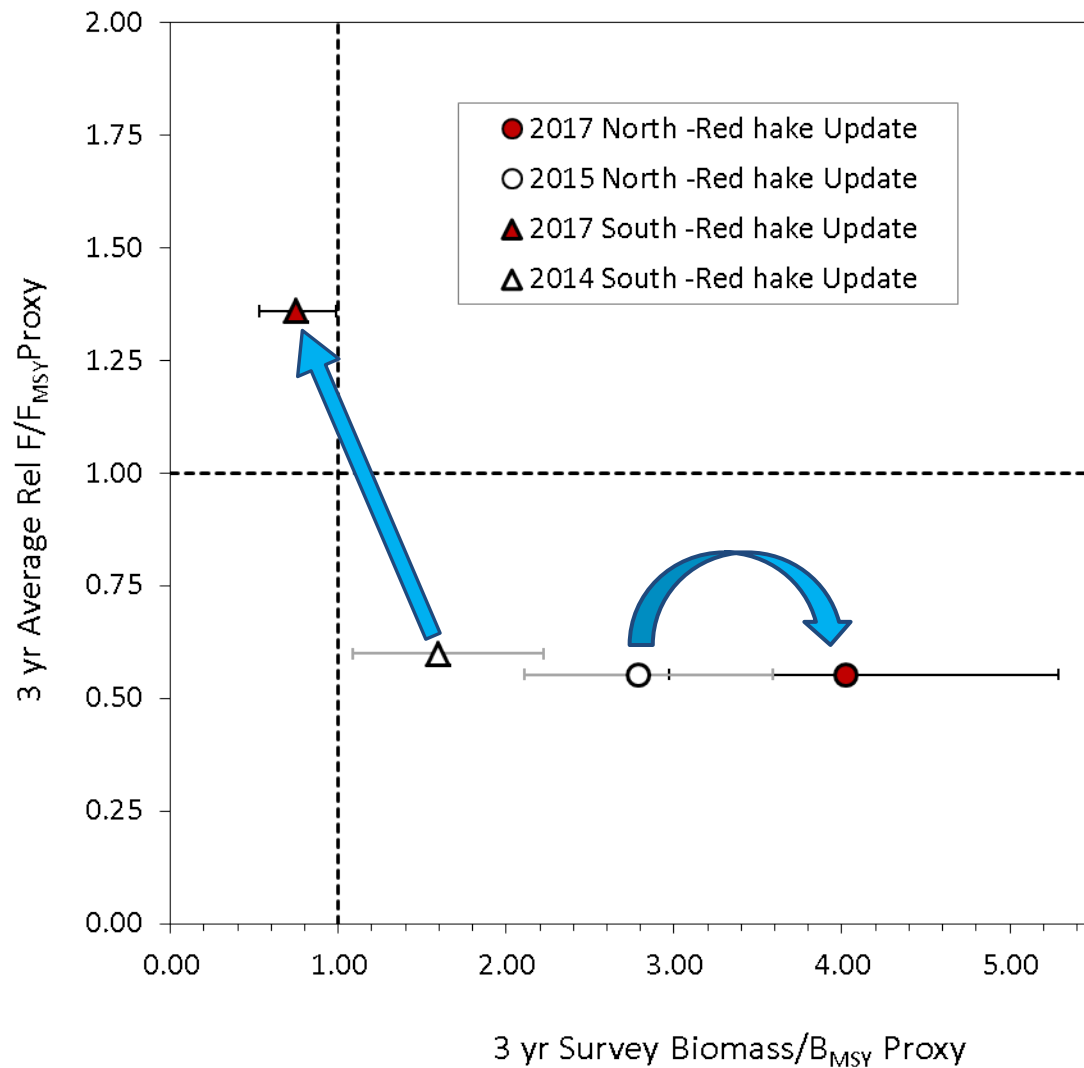
Southern Red hake Fall Survey Biomass (kg/tow) and Relative Exploitation (kt/kg)



Silver hake Stock Status



Red hake Stock Status



Analytical Frame work for Setting ABCs

Overfishing Level (OFL)

$$OFL \sim I_{yr1-yr3}^S (kg) \times F_{MSY}^S proxy (kt / kg)$$

Where

$$I_{2014-2016}^{Silverhake} = Fall\ Biomass$$

$$I_{2015-2017}^{Redhake} = Spring\ Biomass$$

$$F_{MSY} proxy (silver\ hake) = 1973 - 1982$$

$$F_{MSY} proxy (red\ hake) = 1980 - 2010$$

Estimating Uncertainty in OFL

- Uncertainty in OFL
 - Estimated as a cross product between the uncertainty (i.e. probability distribution) in F_{MSY} **proxy** and the most recent **3-year survey Index**
- Uncertainty in F_{MSY}
 - *Silver hake*: Mean and variance of the exploitation ratios from 1973-1982 and assumed lognormal error structure
 - *Red hake*: Based on the bootstrap probability distribution from AIM Model (1980-2010) and assumed a normal error structure

Estimating Uncertainty in OFL cont'd

- Uncertainty in Survey
 - Mean and variance from the most recent three year Survey in Albatross units
 - Bigelow Survey variance application – Caveat
 - Incorporates conversion factor and variances of conversion factor from the calibration experiment
 - Survey mean weights converted to Albatross equivalent (Length based conversion)
 - Variance derived from constant model as a proxy for length-based estimates (mean weights were fairly similar)

Variance Statistics

$$V(I_{survey}) = V\left[\frac{I_{HBB}^{yr1} + I_{HBB}^{yr2} + I_{HBB}^{yr3}}{3}\right]$$

$$V(I_{HBB \rightarrow ALB}^{yr1-yr3}) = \left(\frac{I_{HBB}^{yr}}{\rho}\right)^2 \left[\frac{V(I_{HBB}^{yr})}{E(I_{HBB})^2} + \frac{V(\rho)}{E(\rho)^2}\right]$$

$$V(ReIF) = \left(\frac{E(C)}{E(I)}\right)^2 \left[\frac{V(C)}{E(C)^2} + \frac{V(I)}{E(I)^2} - \frac{2Cov(C,I)}{E(C)E(I)}\right] \dots \text{Alternative}$$

$$V(ReIF) = \frac{\sum_{yr1}^{yr(n)} \left(\frac{C}{I} - \left(\frac{C}{I}\right)\right)^2}{n-1} \quad (\text{basis for update})$$

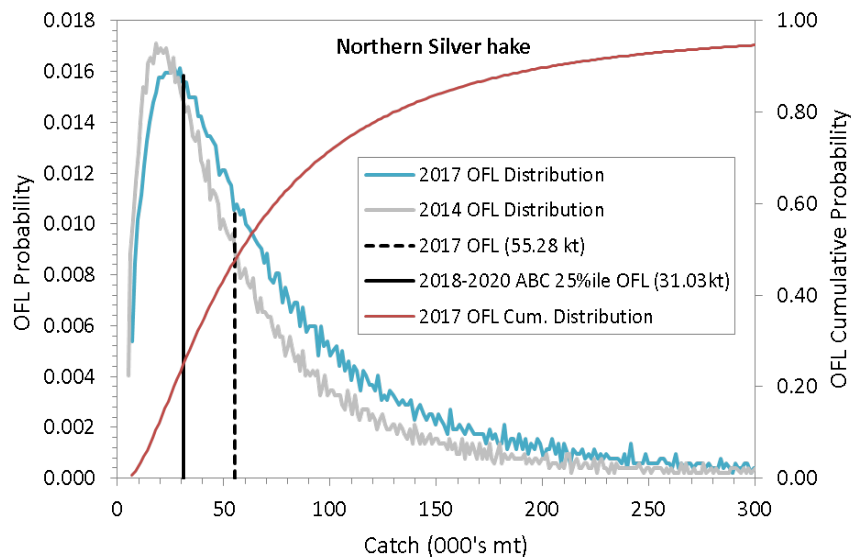
$$V(OFL) = V(ReIF, I_{survey}) \quad \text{cross product}$$

Risk Analyses

- Defined as the probability of exceeding of F_{MSY} proxy given the current population Index (Two step process):
- Calculated corresponding Rel. F for each survey realization from the survey cum. distribution.
 - Corresponding Rel F= (OFLcurrent/Index_distr)
- The Probability of Rel. F for a given catch exceeding F_{MSY} proxy is a function of two probabilities:
 - Probability of each survey realizations
 - Probability of each corresponding Rel F of exceeding F_{MSY} proxy computed over a range of catch

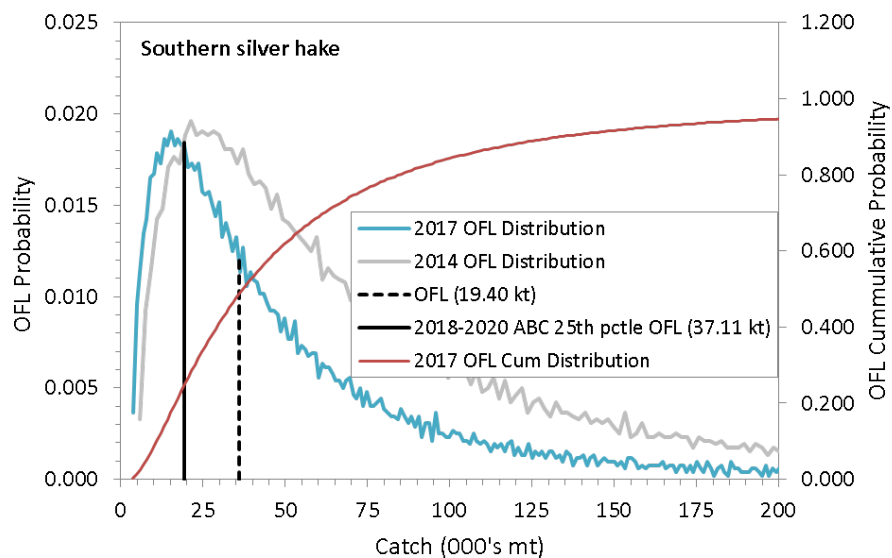
Northern and Southern Silver hake

OFL and proposed ABC's



North: 2017 OFL = 58,350mt ; ABC = 31,030 mt

Pctile of OFL	Catch (kt)	% of OFL (58.35 kt)	% of 2016-2017 FY Catch (3.42kt)	Prob. (F > FMSY _{Proxy})
5	12.73	22%	372%	0%
10	17.67	30%	517%	0%
20	26.56	46%	777%	0%
25	31.03	53%	908%	0%
30	35.69	61%	1044%	0%
40	45.95	79%	1344%	0%
45	51.81	89%	1515%	17%
50	58.35	100%	1707%	75%
60	74.01	127%	2165%	97%
70	95.68	164%	2798%	97%
80	129.94	223%	3801%	97%



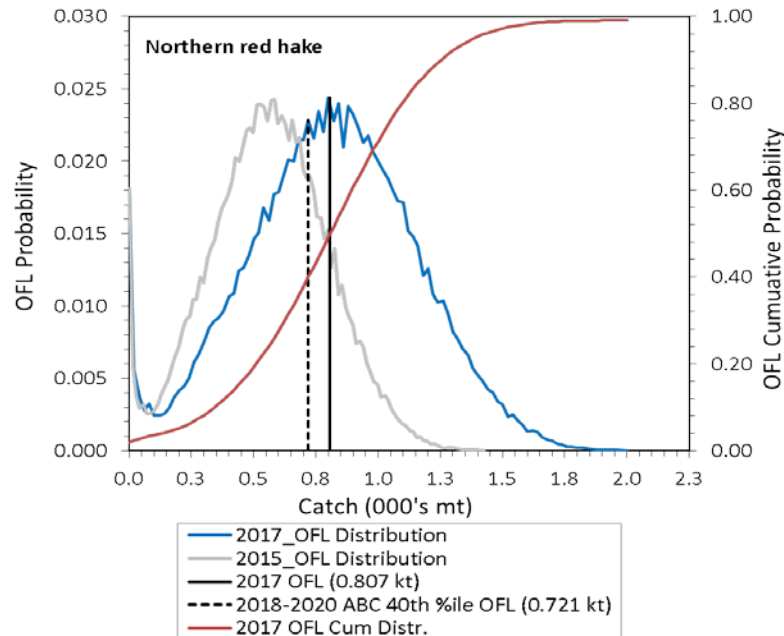
South: 2017 OFL = 37,110 mt ; ABC = 20,170 mt

Pctile of OFL distr.	Catch (kt)	% of OFL (37.11 kt)	% of 2016-2017 FY Catch (3.85kt)	Prob. (F > FMSY _{Proxy})
5	7.74	21%	201%	0%
10	10.84	29%	282%	0%
20	16.55	45%	431%	0%
25	20.17	54%	525%	0%
30	22.45	60%	584%	0%
40	29.14	79%	758%	7%
45	32.91	89%	856%	26%
50	37.11	100%	966%	59%
60	47.41	128%	1234%	97%
70	61.79	167%	1608%	97%
80	84.59	228%	2201%	97%

Northern and Southern Red hake

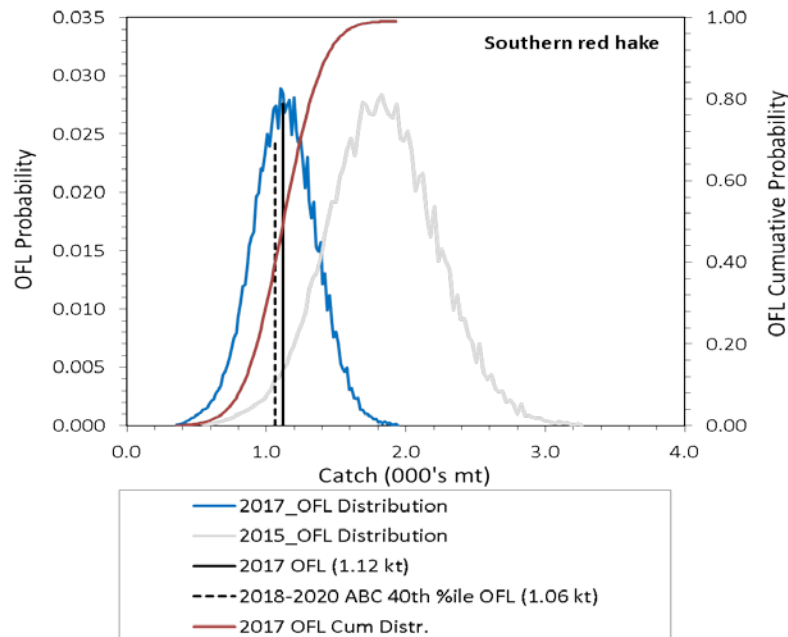
OFL and proposed ABC's

North: 2017 OFL = 807 mt ; ABC = 720 mt



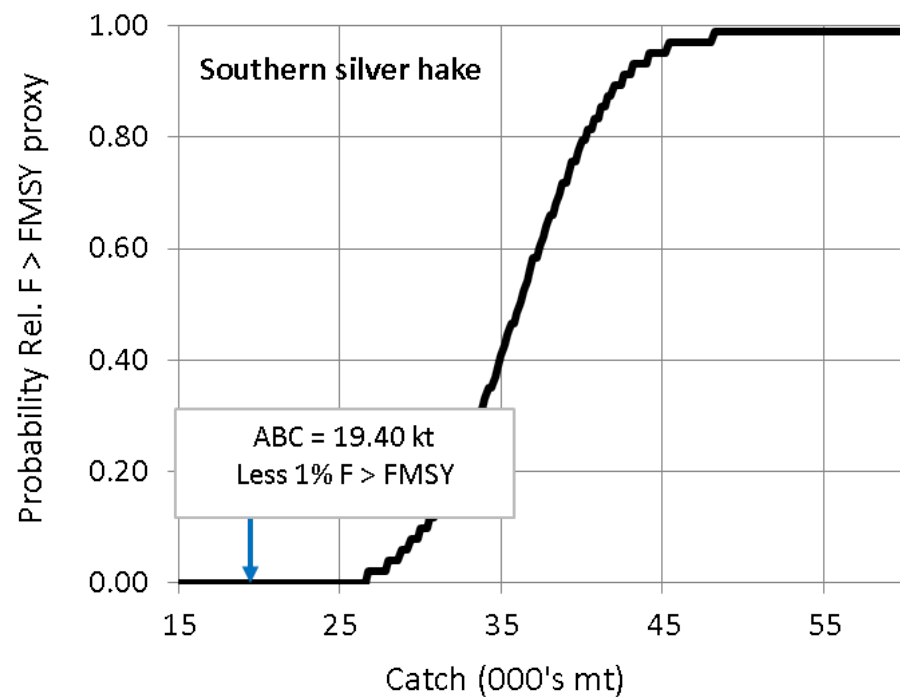
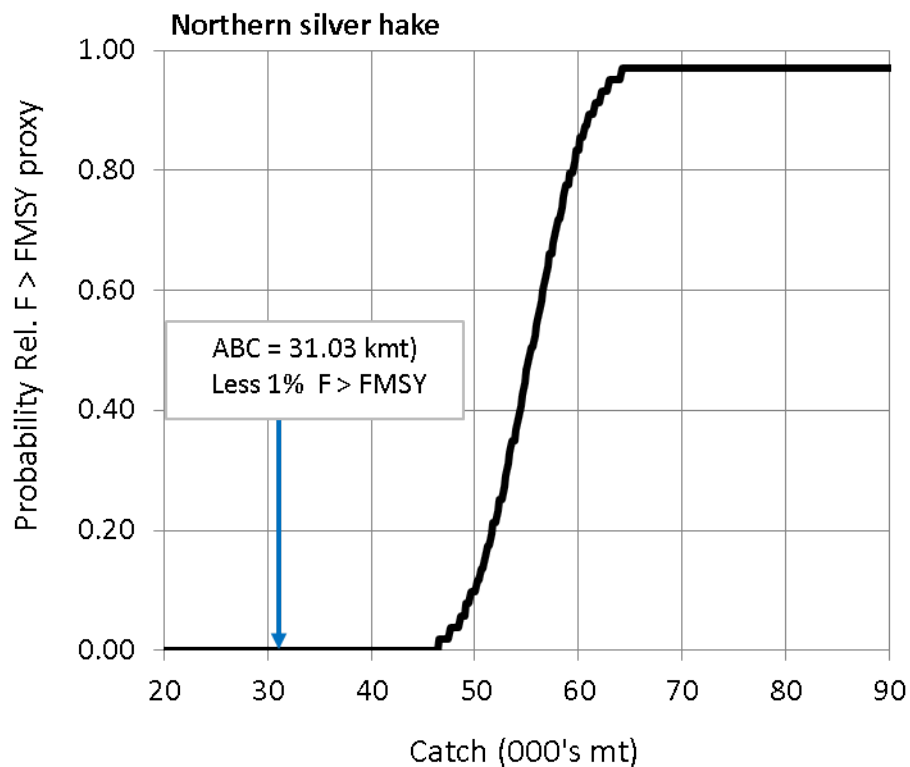
Pctile of OFL	Catch (kt)	% of OFL (0.807 kt)	% of 2016-2017 FY Catch (0.405kt)	Prob. (F > FMSY _{Proxy})
5	0.192	24%	47%	0%
10	0.343	42%	85%	0%
20	0.510	63%	126%	0%
25	0.571	71%	141%	0%
30	0.625	77%	154%	0%
40	0.720	89%	178%	10%
45	0.764	95%	189%	21%
50	0.807	100%	199%	37%
60	0.894	111%	221%	70%
70	0.988	122%	244%	93%
80	1.097	136%	271%	93%

South: 2017 OFL = 1,120 mt ; ABC = 1,060 mt

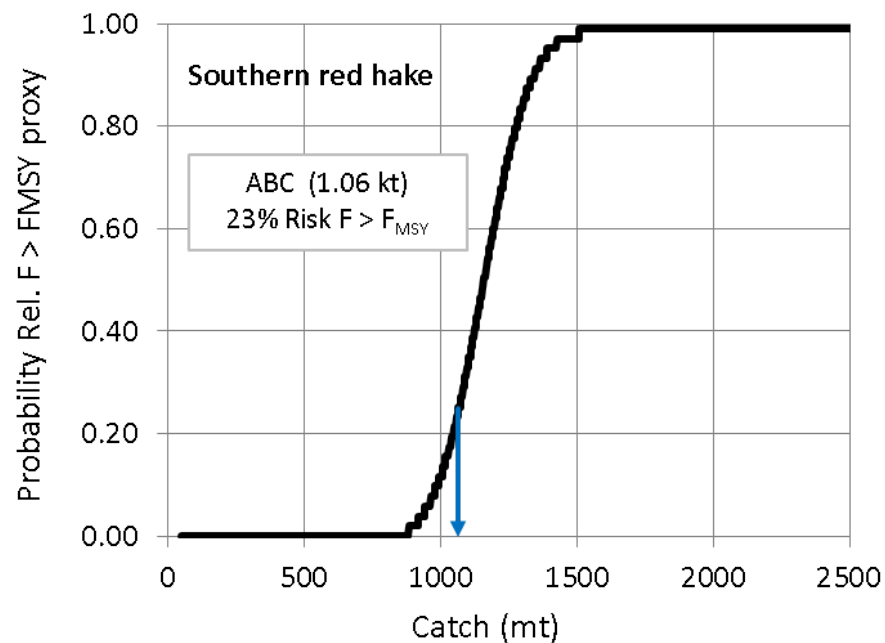
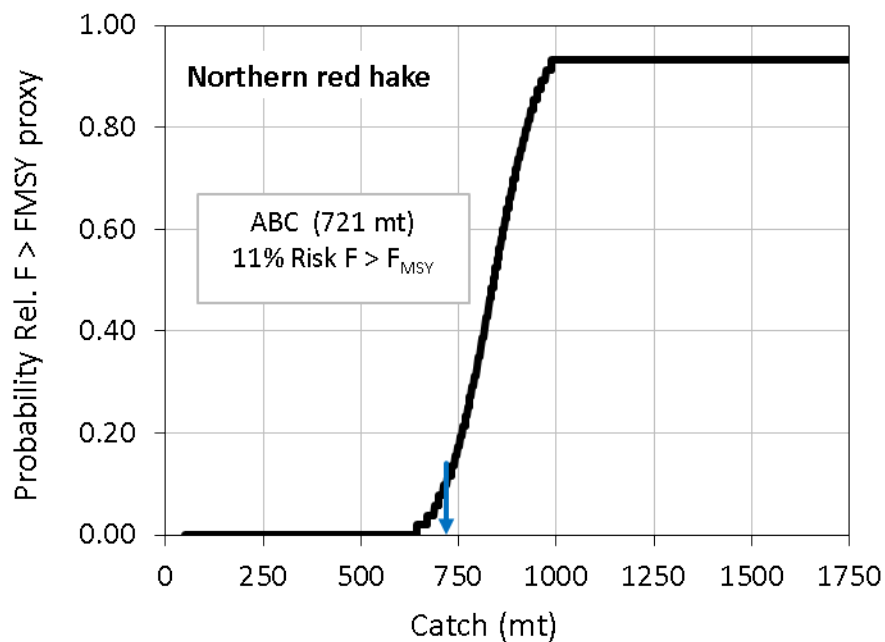


Pctile of OFL distr.	Catch (kt)	% of OFL (1.12 kt)	% of 2016-2017 FY Catch (1.09 kt)	Prob. (F > FMSY _{Proxy})
5	0.75	66%	68%	0%
10	0.83	74%	76%	0%
20	0.93	83%	86%	4%
25	0.97	86%	89%	8%
30	1.00	89%	92%	12%
40	1.06	94%	97%	23%
45	1.09	97%	100%	31%
50	1.12	100%	103%	39%
60	1.18	105%	108%	56%
70	1.24	111%	114%	72%
80	1.32	118%	121%	87%

Silver hake: Probability of exceeding F_{MSY} Proxy



Red hake: Probability of exceeding F_{MSY} Proxy



Summary

- Northern Stocks productivity continues to improve as supported by consistent above average recruitment in recent years
- Southern stocks – reduced stock productivity resulting from poor recruitment
- The proposed northern ABC's - suggest that these stocks can withstand higher level of catches with low risk of exceeding FMSY proxy
- Catch remains a source of uncertainty for silver hake as implied in the OFL estimates. Lacks contemporary measures of stock productivity