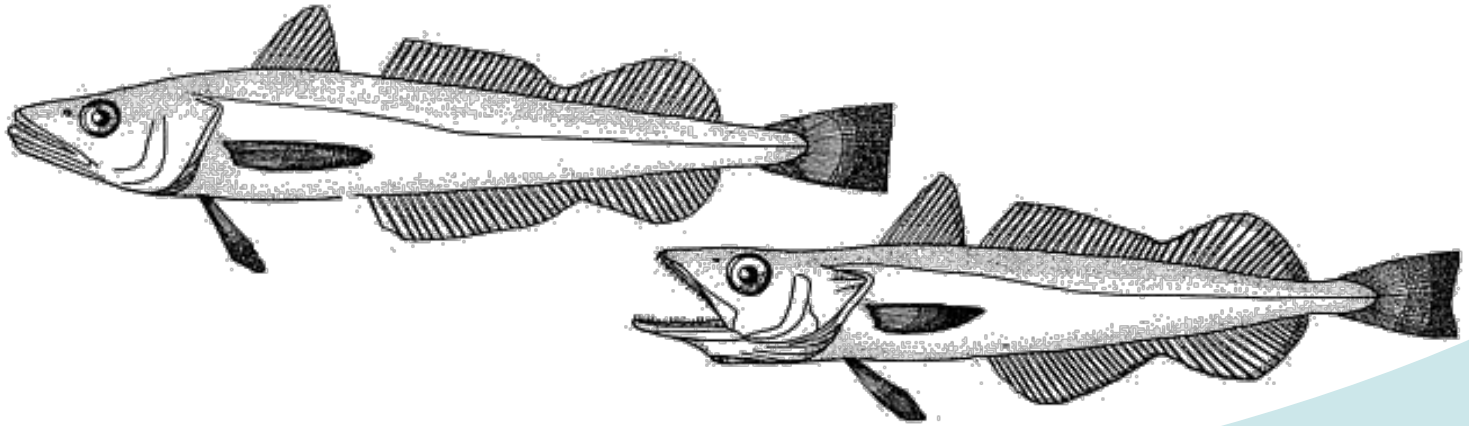
Summary of Northern Silver hake (*Merluccius bilinearis*) Assessment Update through 2019

NOAA FISHERIES

NEFSC

NEFMC's Science and Statistical Committee Webinar

Thurs. November 12, 2020



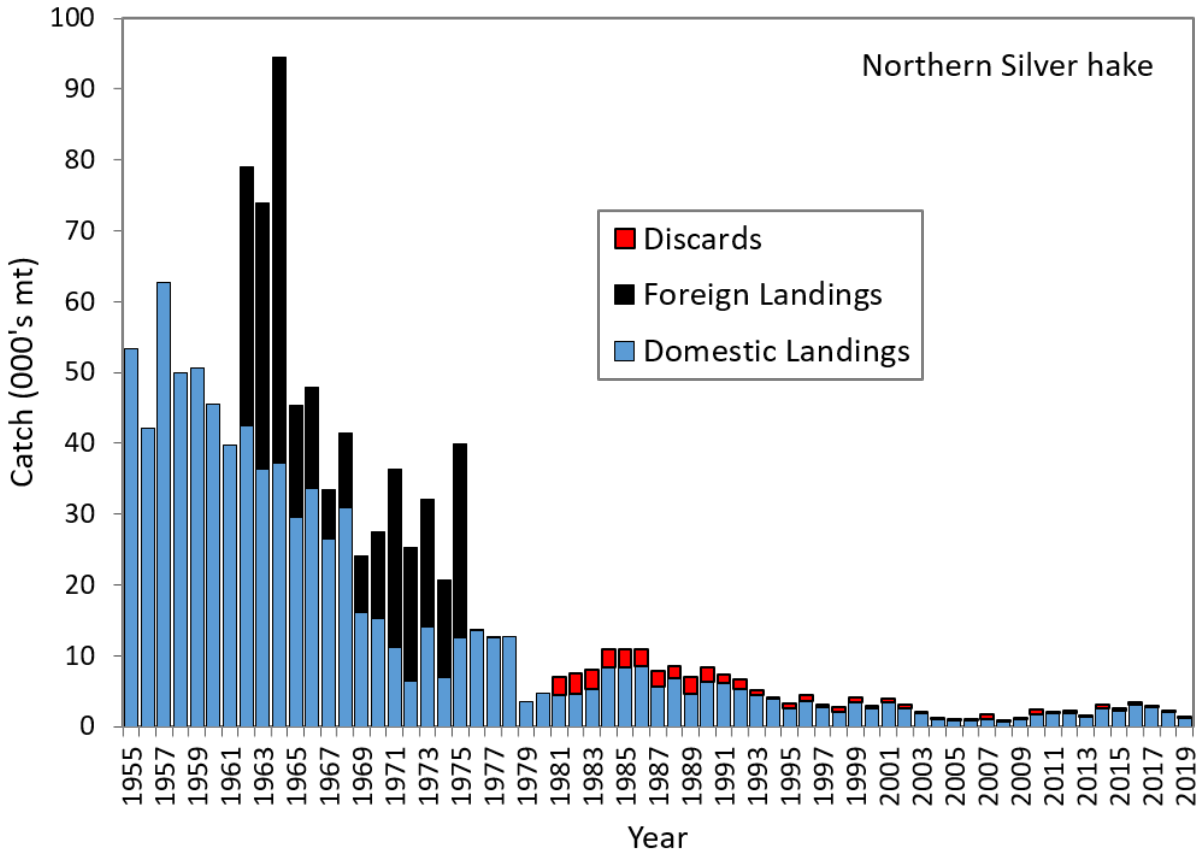
Reviewed at the September Management Track Assessment Review
September 14th – 18th 2020

Level 1 Review

Northern Silver hake

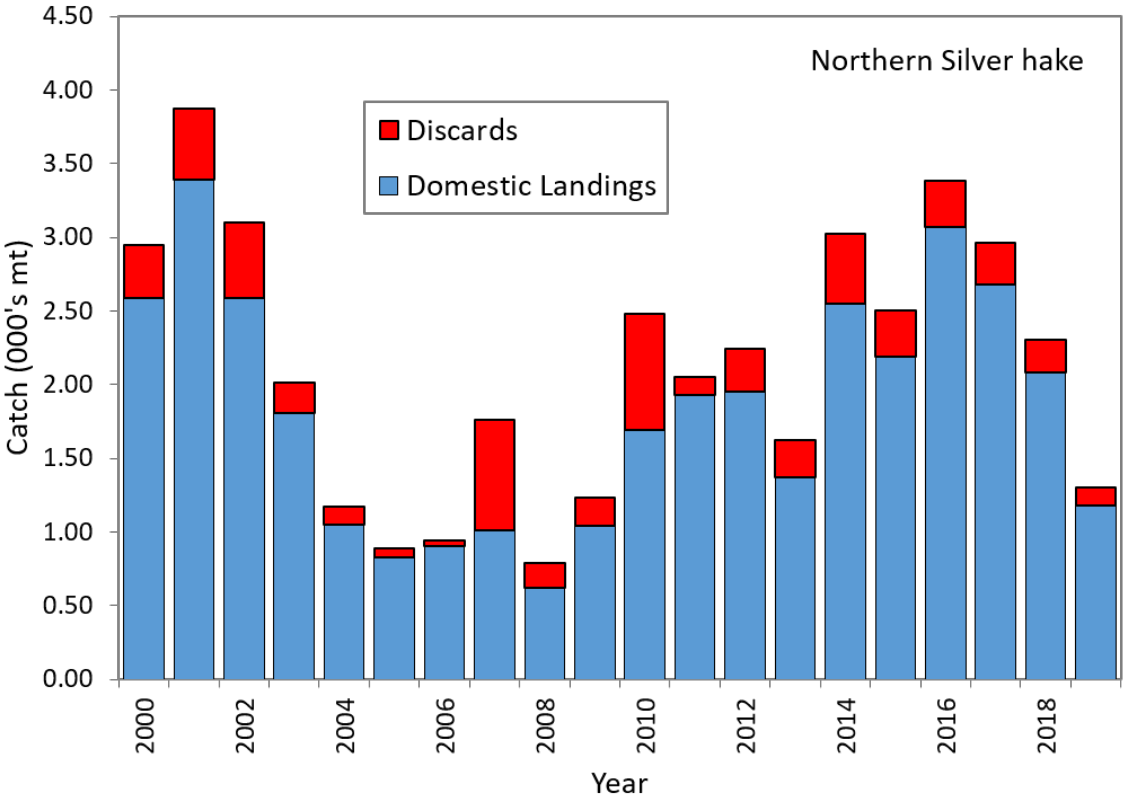
- Last assessment update: 2017 (Peer reviewed through the NEFMC SSC)
- Index-based approach; years 1955-2016
- Reference points
  - F_{MSY} Proxy = 2.77 kt/kg
  - ½ B_{MSY} Proxy = 3.21 kg/tow
- Stock Status:
  - Overfished = No (B_{2016} 19.92 kg/tow)
  - Overfishing = No (Rel. F_{2016} = 0.149 kt/kg)

Northern Silver hake Commercial Catch 1955-2019



- Early 1960's to late 1970's = Period of extreme high catches peaking ~ 95,000 mt in 1964
- Post industrial and distant water fleet, catches averaged ~ 5,400 mt/yr thru the late 1990's

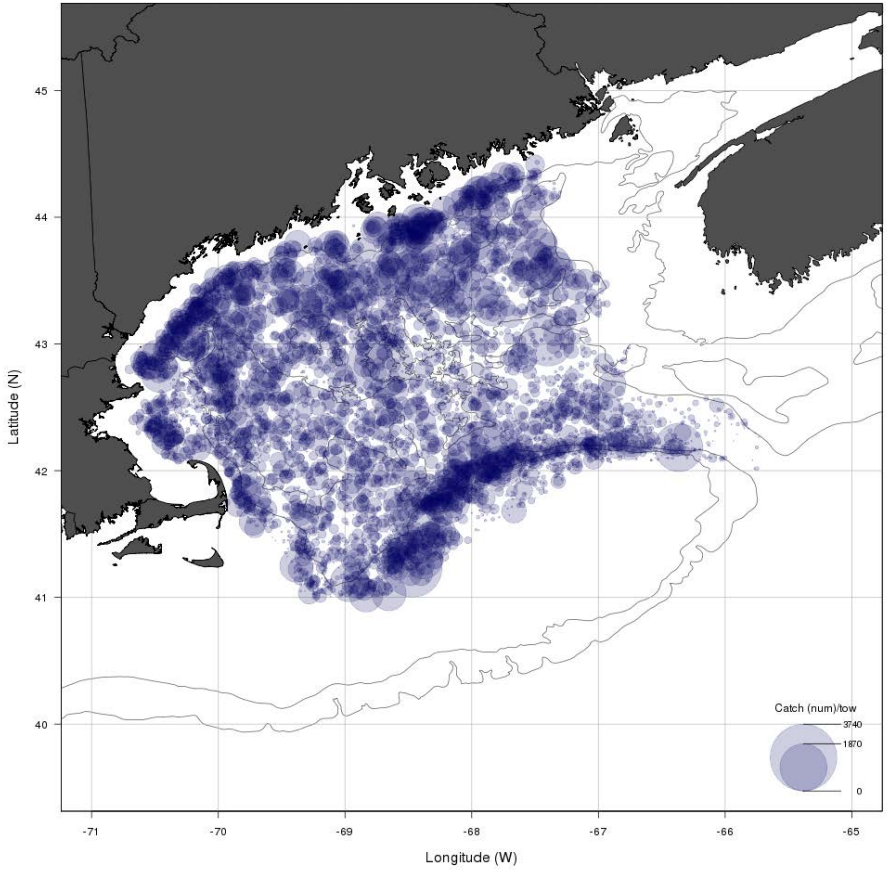
Northern Silver hake Commercial Catch



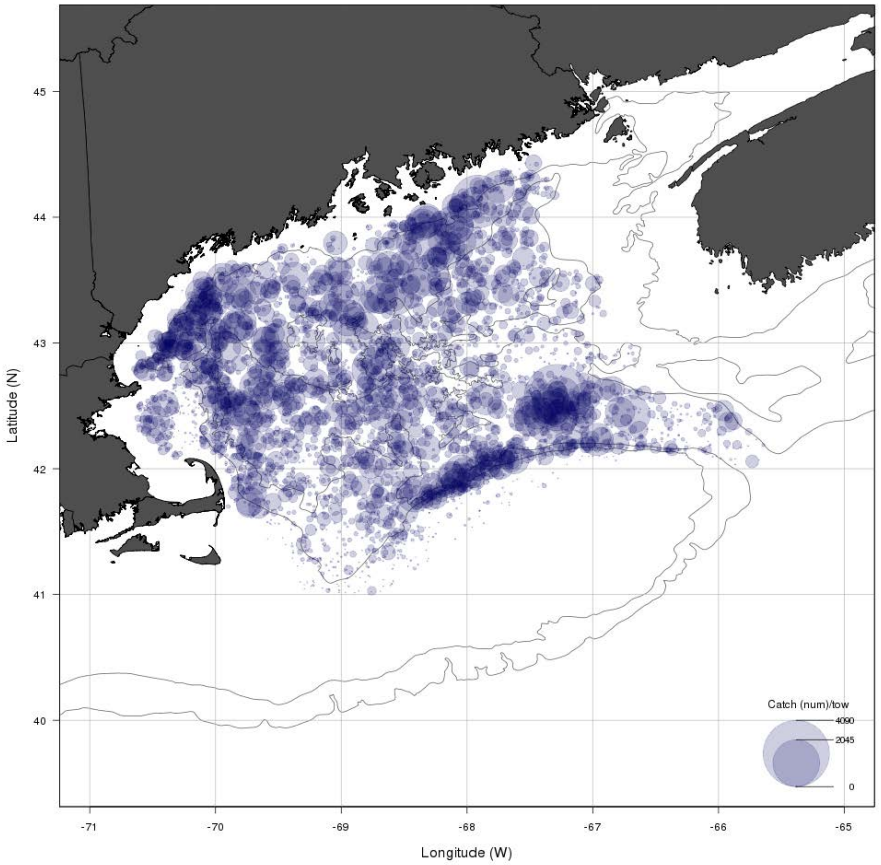
- Since last assessment, catches have decreased by ~62%
- Catches in 2019 = 1,800 MT (below the ACL = 29,480 MT)
- Discards (2017–2019) ~ 10% of total catch

Northern silver hake NEFSC survey distribution

Fall NEFSC BTS

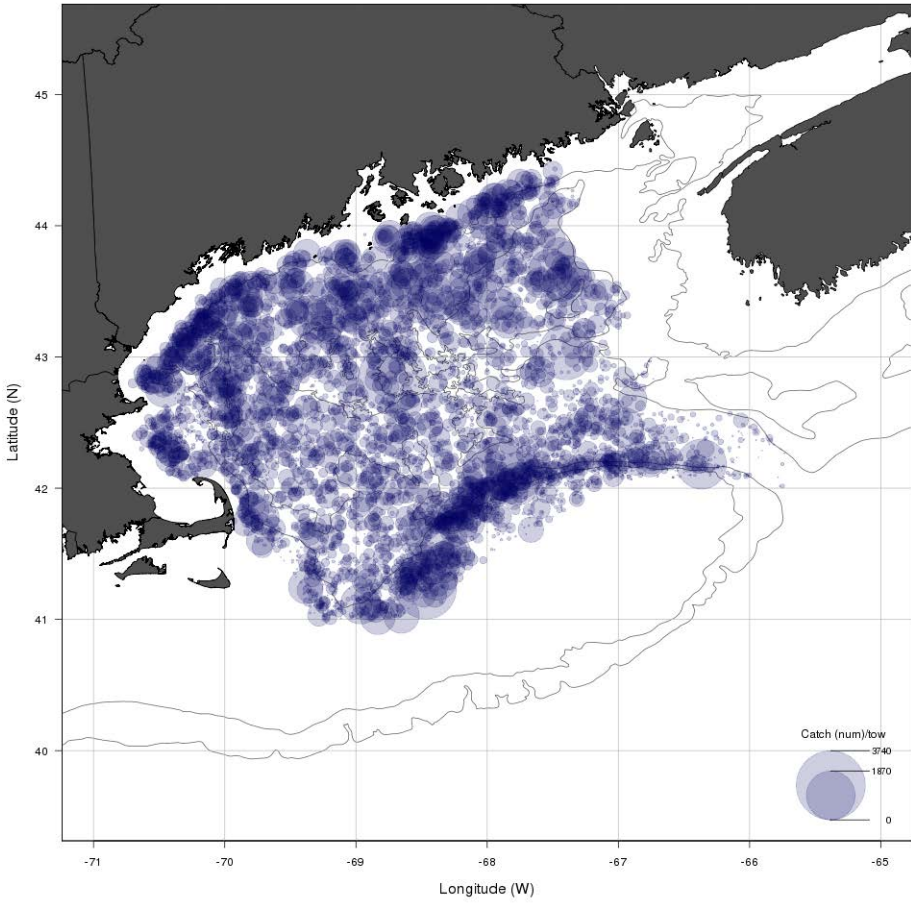


Spring NEFSC BTS

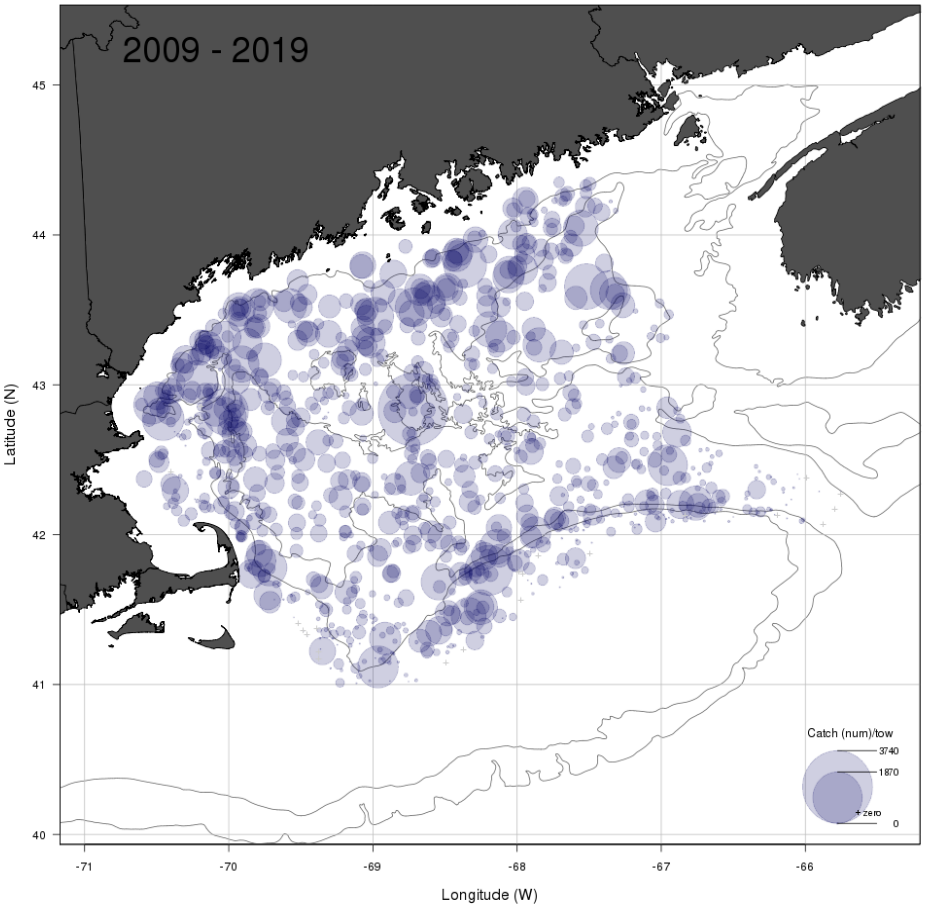


Northern silver hake NEFSC Fall survey distribution

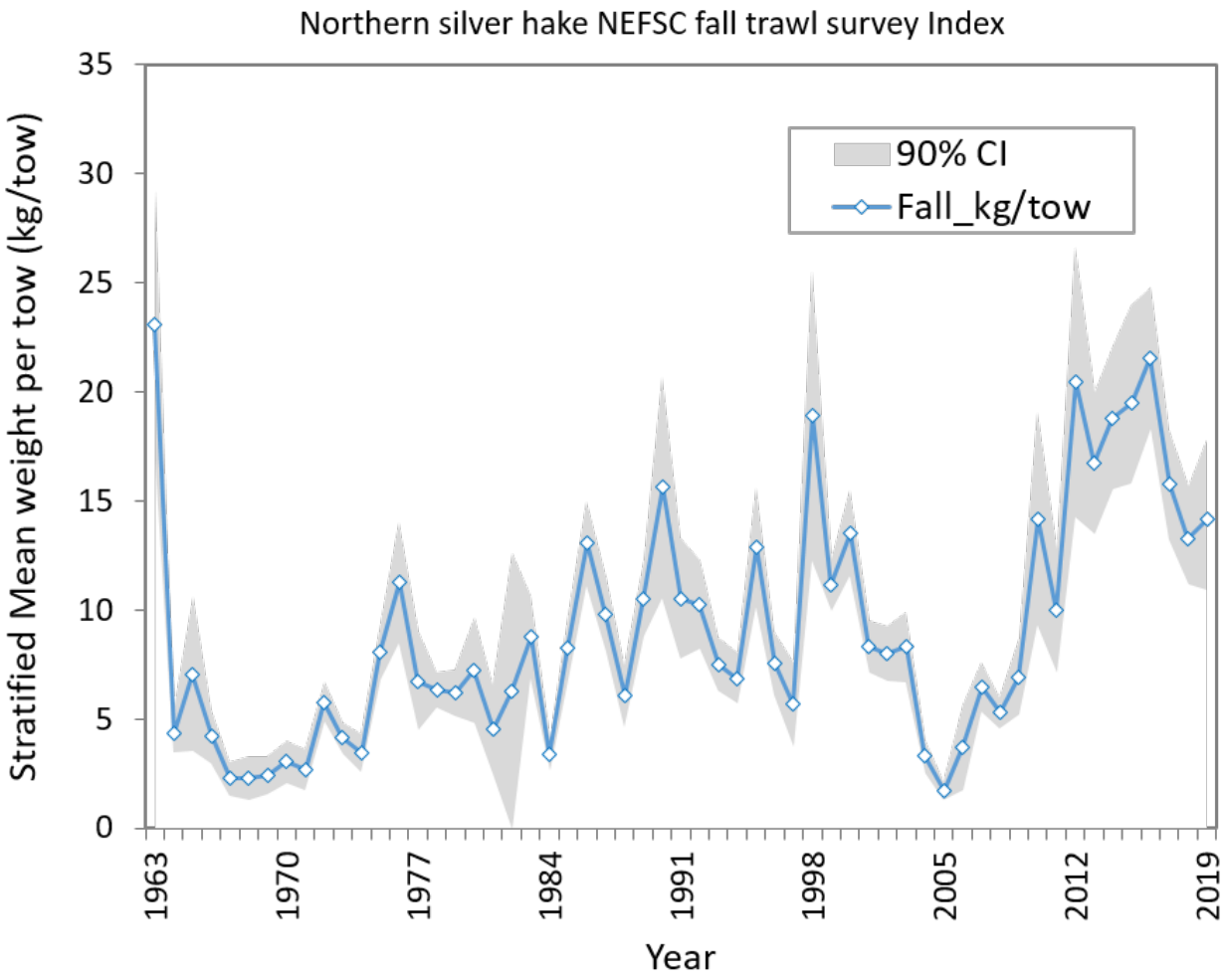
1963-2019



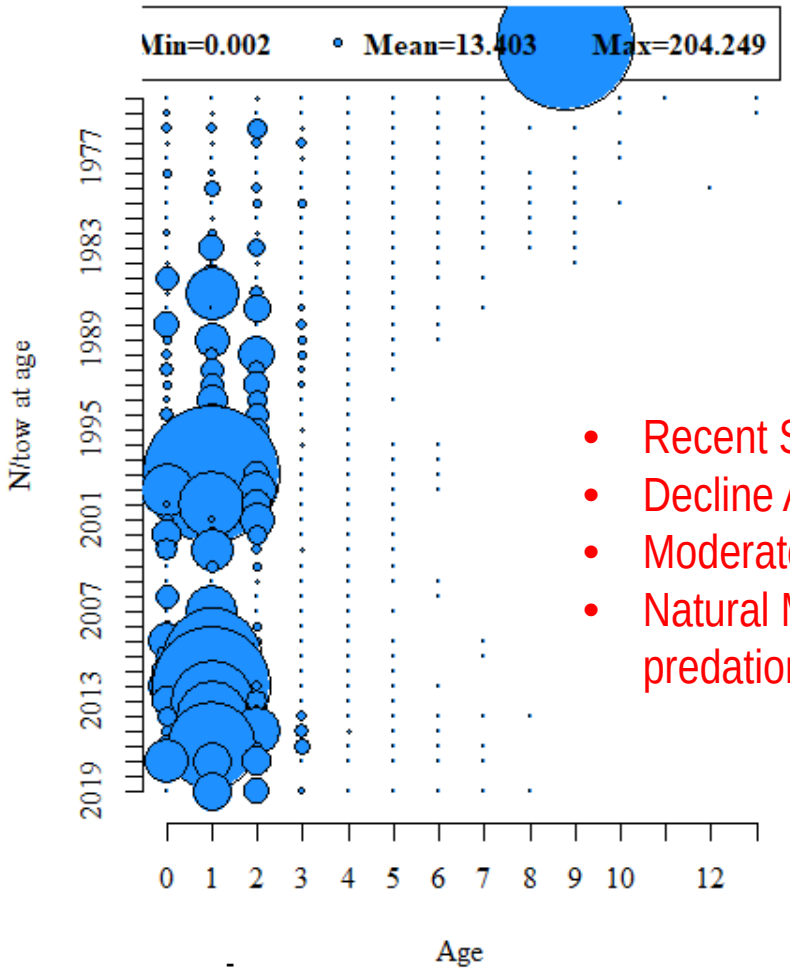
2009-2019



Northern silver hake NEFSC fall survey trends



Northern silver hake NEFSC fall survey Age Comp.



- Recent Strong YC (2012,2013, 2015)
- Decline Age 1 recruit in 2017 and 2019
- Moderate expansion in age structure
- Natural Mortality is likely high due to predation or cannibalism

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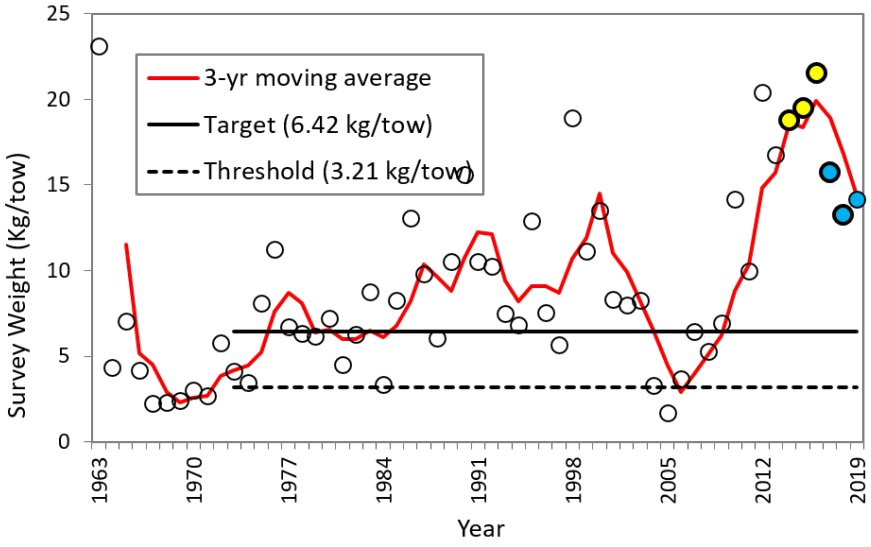
Age1 15-30cm Age3 38-45cm Age5-6 >45 cm
Age2 31-37cm Age4 27-49cm

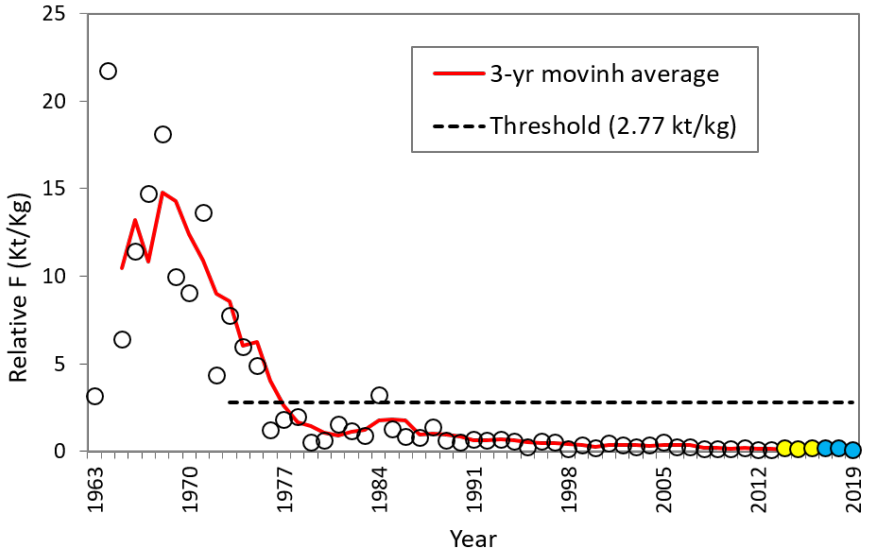
SARC 51 Silver hake Biological Reference Points

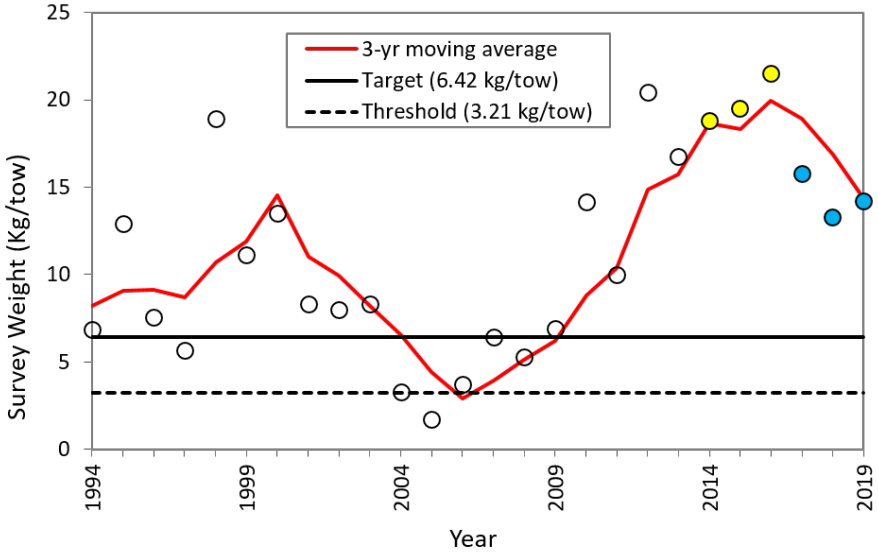
- Lack of ASAP model, the panel recommended the fallback method (Survey Index approach)
- Biomass reference points based on the arithmetic average of fall Survey (1973-1982)
- Exploitation Index is based on ratio b/w total catch and arithmetic fall survey index averaged from 1973-1982

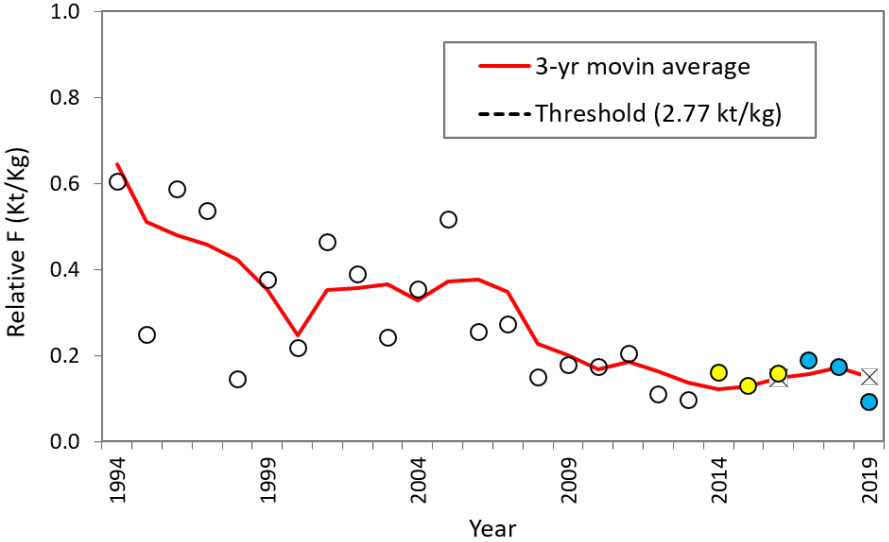
STOCK	THRESHOLDS (SARC 51)	TARGETS(SARC 51)
Northern Silver Hake	1/2 B_{MSY} Proxy (3.21) F_{MSY} Proxy (2.78)	B_{MSY} Proxy (6.42) F_{MSY} Proxy (NA)
Southern Silver Hake	1/2 $_{BMSY}$ Proxy (0.83) F_{MSY} Proxy (34.17)	B_{MSY} Proxy (1.65) F_{MSY} Proxy (NA)

Northern silver hake survey biomass(kg/tow) and Relative Exploitation (kt/kg)

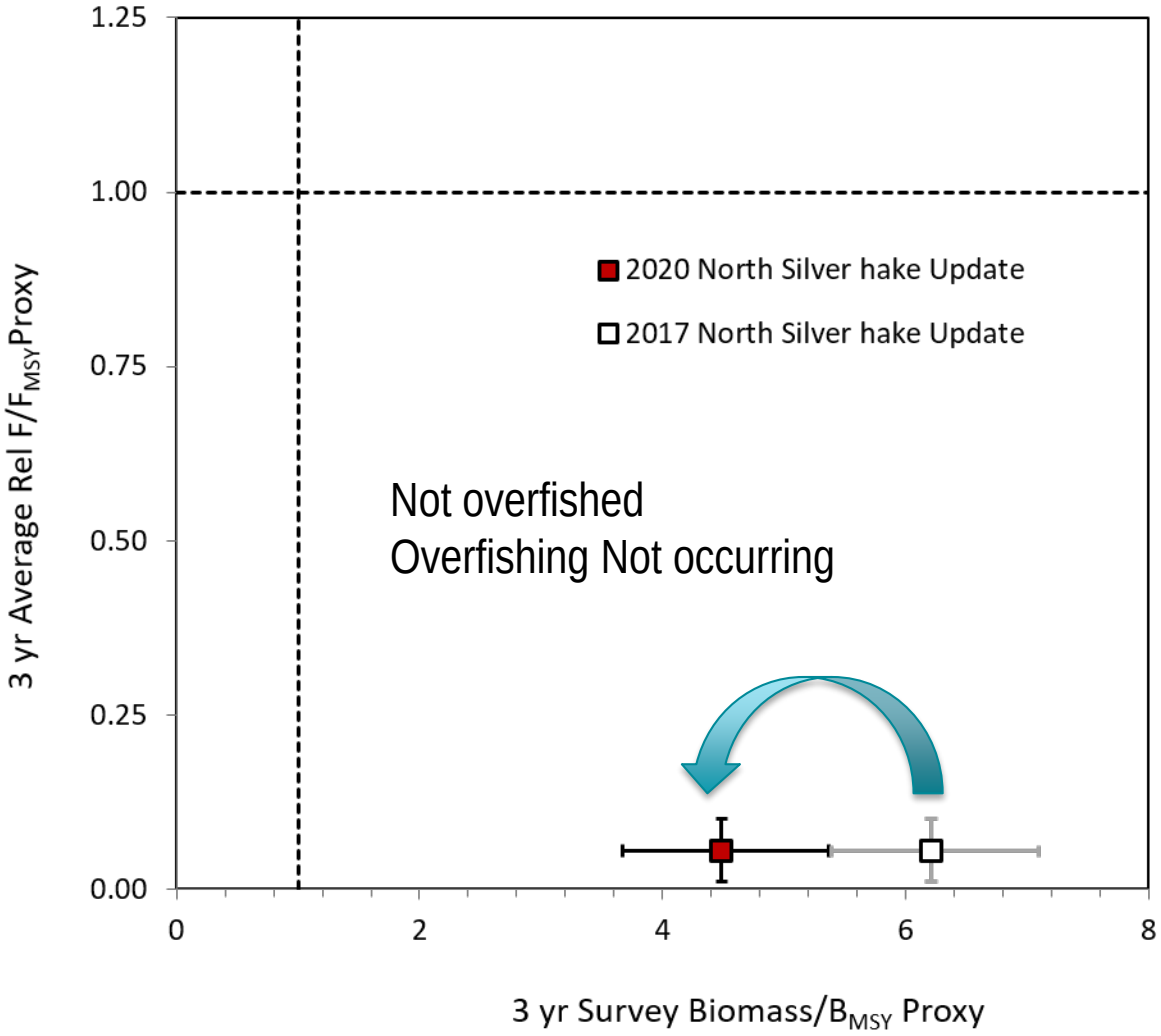








Northern silver hake recommended stock status



Overfishing Limit (OFL)

$$OFL \sim I_{2017-2019} \times F_{MSY}Proxy \left(\frac{kt}{kg}\right)$$

$$F_{MSY}Proxy = 1973 - 1982$$

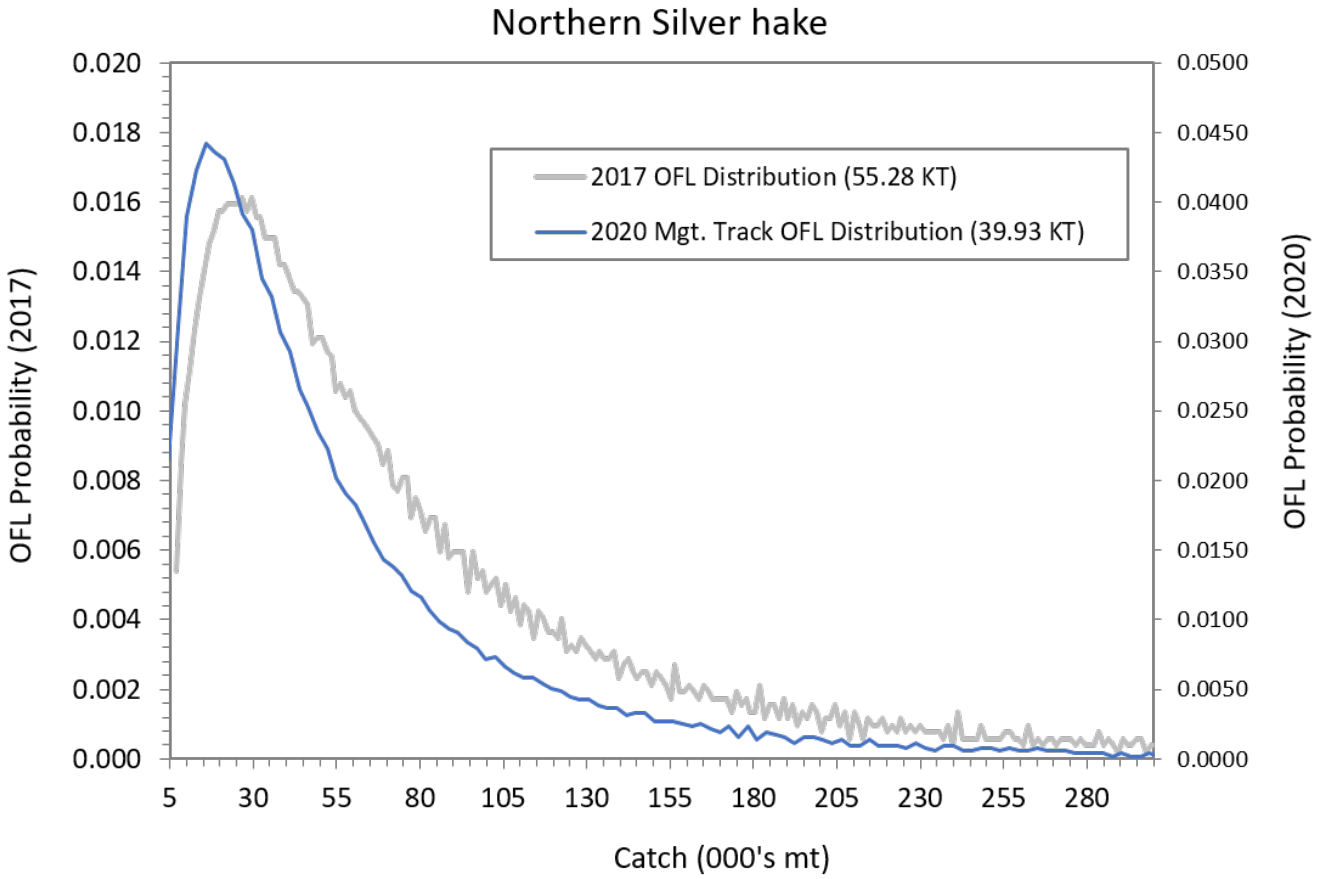
- Uncertainty in OFL
  Estimated as a cross product between the uncertainty (i.e. probability distribution) in **F_{MSY} proxy** and the most recent **3-year survey Index**

- Uncertainty in F_{MSY}
  Mean and variance of the exploitation ratios from 1973-1982 and assumed lognormal error structure

Estimating Uncertainty in OFL

- Uncertainty in Survey
  - Mean and variance from the most recent three year Survey (2018-2019) 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)

Northern silver hake OFL distribution



Proposed OFL 2020: 39,930 MT (7,129 – 213,654 MT)
Highly uncertain due to statistical properties of FMSY proxy (lognormal)
Proposed ABC 2020 = 20,415 MT (25th percentile of the OFL distribution)

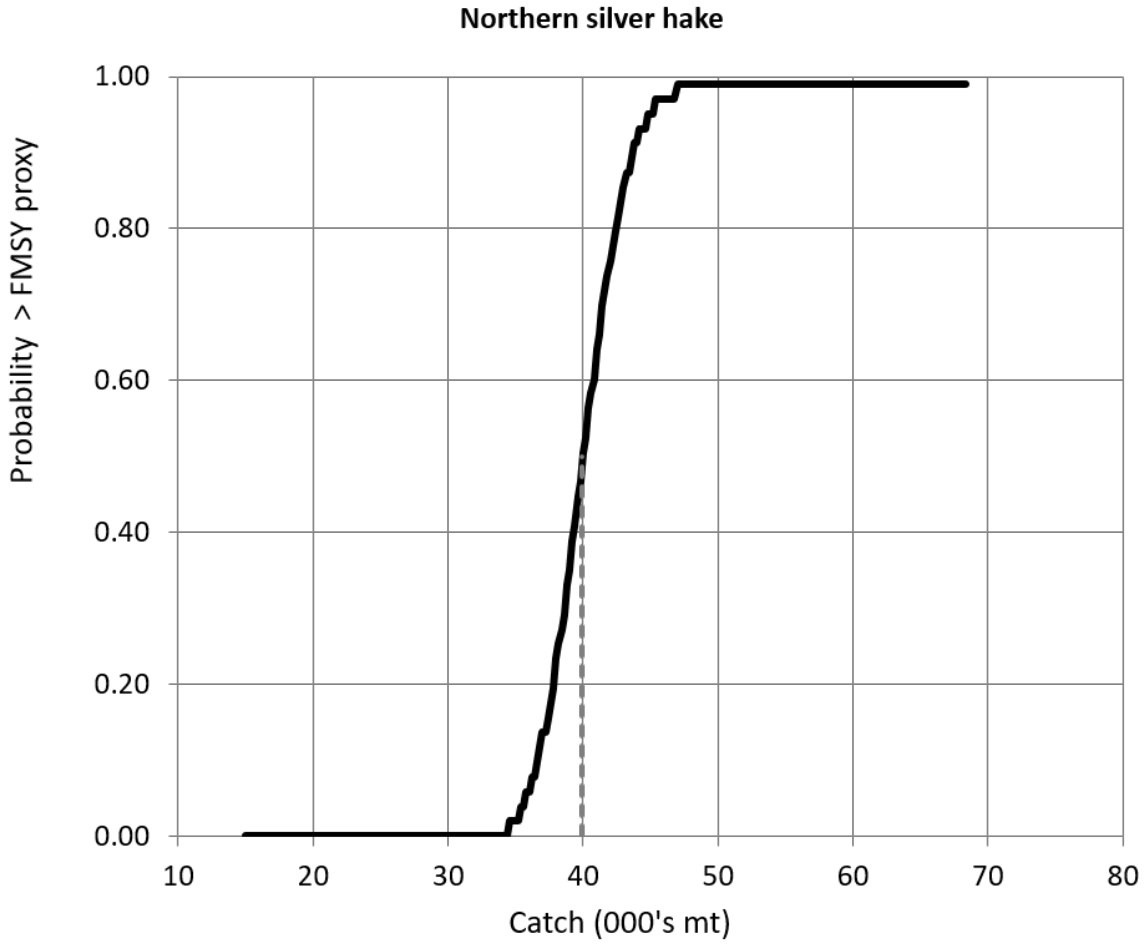
Risk Analyses

- 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 FMSY proxy computed over a range of catch

Northern Silver hake Risk Analyses

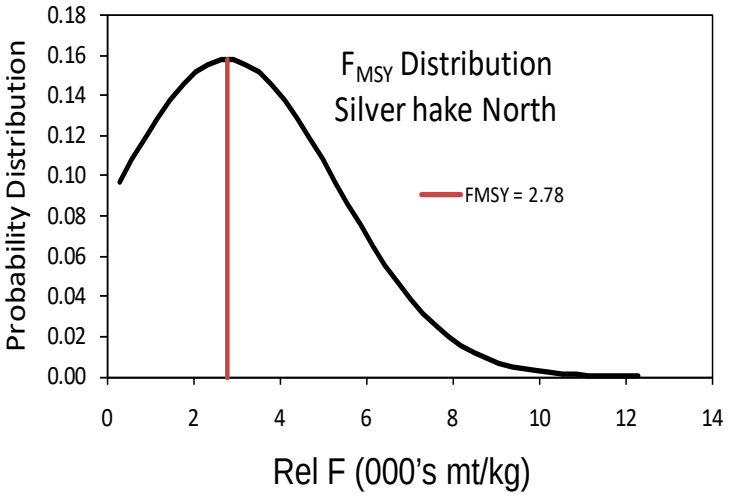
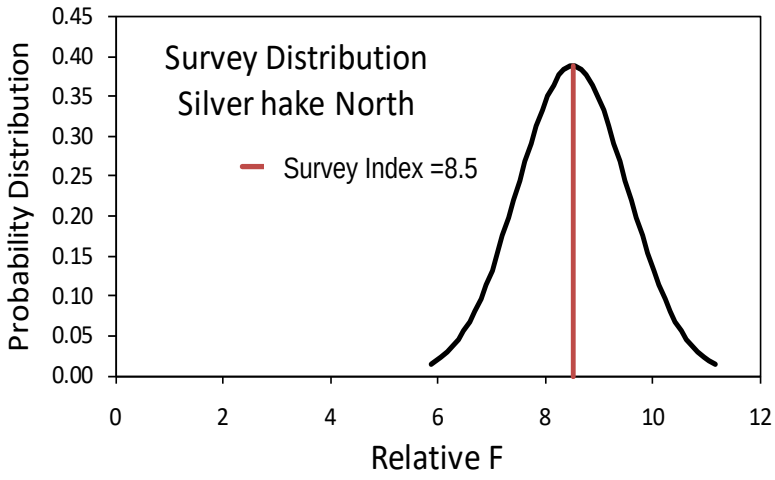
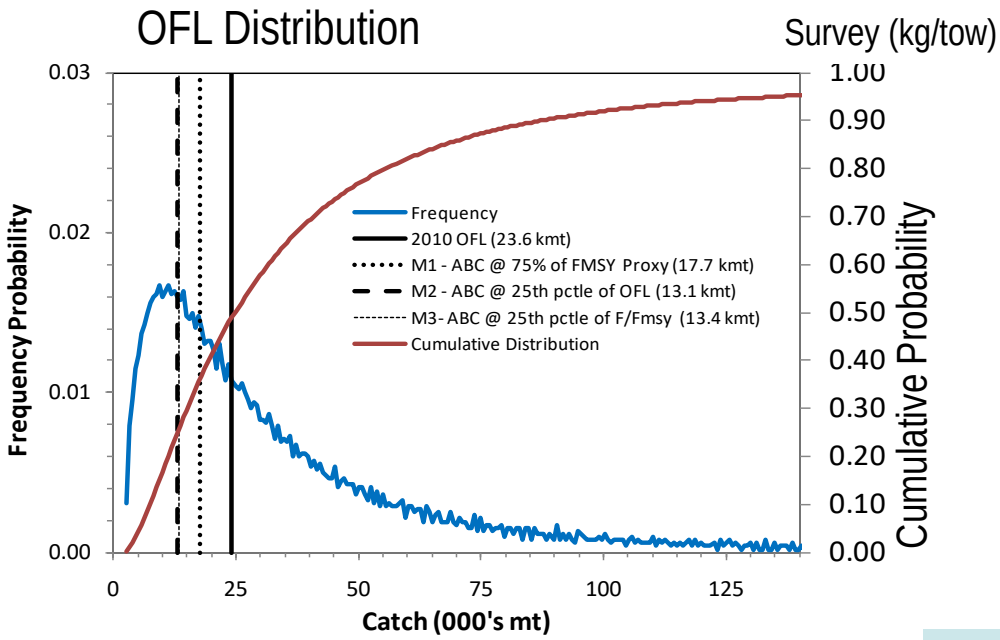


Northern Silver hake Summary Table	2017 Update	2020 Update	% Difference
3-year Average Fall Index (kg/tow)	19.92	14.39	-28%
BMSY Proxy Threshold (kg/tow)	3.21	3.21	NA
BMSY Proxy Target (Kg/tow)	6.42	6.42	NA
Ratio of 3-year average Fall index to BMSY Proxy Threshold	6.21	4.48	-28%
Ratio of 3-year average Fall index to BMSY Proxy Target	3.10	2.24	-28%
3-Year Average Relative Exploitation Index (kt/kg)	0.149	0.151	2%
FMSY Proxy Threshold 1973-1982 (kt/kg)	2.78	2.78	NA
Ratio of 3-year average Exploitation index to FMSY Proxy	0.0535	0.0545	2%
OFL (000's mt) based on median of probability value from the OFL distribution	55.28	39.93	-28%
ABC (000's mt) = 25th Percentile of OFL distribution	31.03	20.41	-34%
ACL (000's mt) = 95% of ABC	29.48	19.39	-34%
Pr (F > FMSY) @ ACL	< 1%	< 1%	NA

Northern silver hake summary

- Although the updated survey index has declined in recent years, the stock remains in good status
  - Survey biomass is well above the target
  - Relative exploitation rate is below the threshold
- A 28% reduction in OFL is proposed but still above any recent observed catch.
- Although OFL is uncertain, the analyses suggest that the stock can withstand higher level of exploitation with negligible risk of exceeding F_{MSY} proxy

Sources of Uncertainty/Research Needs

- Lack analytical framework. Important population quantities such as growth, natural mortality, recruitment etc cannot be explicitly considered in the current empirical framework
- The basis for the existing BRP (1973-1982) assumes conditions have remained relatively static. Alternative BRPs need to be investigated.

Example Probability Distributions