# Incorporating Measures of Scientific Uncertainty in Red hake OFL

## NEFMC's Science and Statistical Committee Webinar

### Thurs. November 12, 2020

NEFSC

# PDT's proposed options for OFL

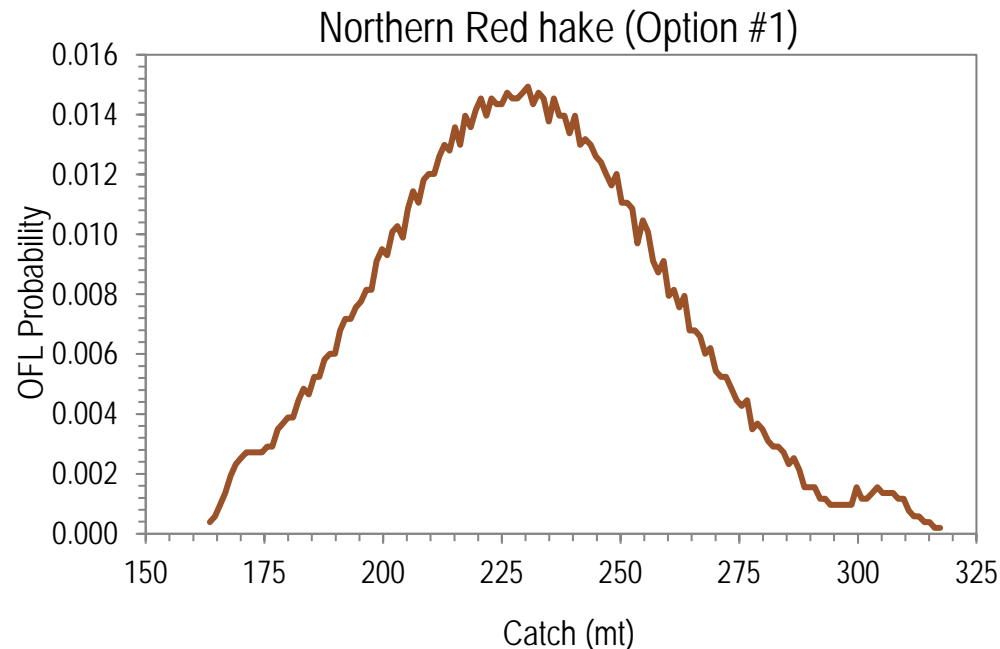| Plan B proportional change (2017-2019) applied to: | Justification | Issues |
|---|---|---|
| **(Option #1)** 2017-2019 actual estimated catch | Follows standard Plan B smooth approach application (yellowtail flounder) | Catch may not be representative of OFL, especially with fishing restrictions. May be driven by circumstances that affect the fishery or by actual catch that exceed the OFL. |
| **(Option #2)** Existing OFL from 2018-2020 specifications | Applies Plan B smooth approach to previous OFL, rather than actual catch | Uses OFL estimate from rejected AIM model application |
| **(Option #3)** 1981(3?)-2009 OFL forecast from Plan B smooth in that time period (previous estimate using the Plan B smooth approach) | Consistent with overfishing definition, but using Plan B method to evaluated OFL during the MSY proxy time period | Period may not be representative of contemporary stock productivity. |
| **(Option #4)** 2017-2019 OFL forecast from Plan B smooth in that time period (previous estimate using the Plan B smooth approach) | Follows Plan B smooth approach, using Plan B estimate for 2017-2019 as representative of MSY proxy, rather than actual catch. | May be sensitive to rapid changes in survey swept area biomass. |
| **(Option #5)** Fixed exploitation rate applied to SWAB 2017-2019 (TYMA). | Fishing mortality estimates are exceptionally low, particularly for the northern stock. Uses an F MSY proxy that is more consistent with life history | Catch limits may exceed availability of the stock due to regulations. Mean exploitation rates for time series were rejected by the MTA as the basis for catch advice. |

# OFL General Framework

- Uncertainty in OFL
  Estimated as a cross product between the uncertainty (i.e. probability distribution) in $I_{2017\text{-}2019}$ (**Slope of the Index multiplier**) and the uncertainty in **catch or forecast OFL**

- Uncertainty in $I_{2017\text{-}2019}$
  Mean and SE of the estimated slope derived from a log-transformed LOESS survey smoother from 2017-2019 and assumed lognormal error structure

# Some additional details….

- **Option #1:** Probability distribution for catch based on estimated variance for catch based on CY catch 2017-2019

- **Option #2:** 2018-2020 OFL probability distribution was directly applied to the distribution for the Index multiplier.
  - Alternatively, the OFL point estimate can be applied to the distribution of the index multiplier

- **Option #3:** Estimated variance for Forecast OFL based on years 1983-2009

- **Option #4:** Same as option #3, but uses limited set of years (2017-2019)

- **Option #5:** Variance for the fixed relative exploitation rate was based on recent 10 year relative exploitation rate. Explored three options for Relative F (0.02. 0.06 and 0.12)
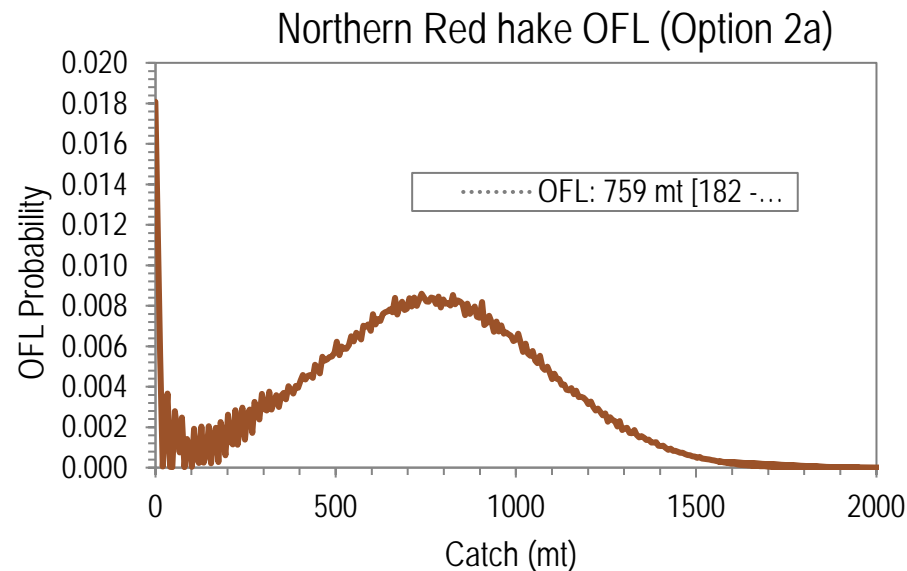
# Option #1: Northern red hake OFL estimate and 90% CI

- Plan B proportional change (2017-2019) applied to 2017-2019 actual estimated catch

- Median OFL = 229 MT [183 – 283MT]

- P*40% = 222 MT



Northern Red hake (Option #1)

# Option #2: Northern red hake OFL estimate and 90% CI

- (2a) Plan B proportional change (2017-2019) applied to existing OFL probability distribution from 2018-2020 specifications
- (2b) 2018-2020 OFL point estimate (836 MT) applied to index multiplier probability distribution
- Median OFL (2a) = 759 MT [182 – 1,306 MT]
- Median OFL (2b) = 782 MT [758 – 808 MT]
- P*40% = 677 MT

Northern Red hake OFL (Option 2a)

OFL: 759 mt [182 -…

OFL Probability

Catch (mt)

# Option #3:  Northern red hake OFL estimate and 90% CI

- Plan B proportional change (2017-2019) applied to 1981(3?)-2009 OFL forecast from Plan B smooth in that time period (previous estimate using the Plan B smooth approach)

- OFL variance estimate was high resulting in unstable probability distribution at low catch values

- Unreliable

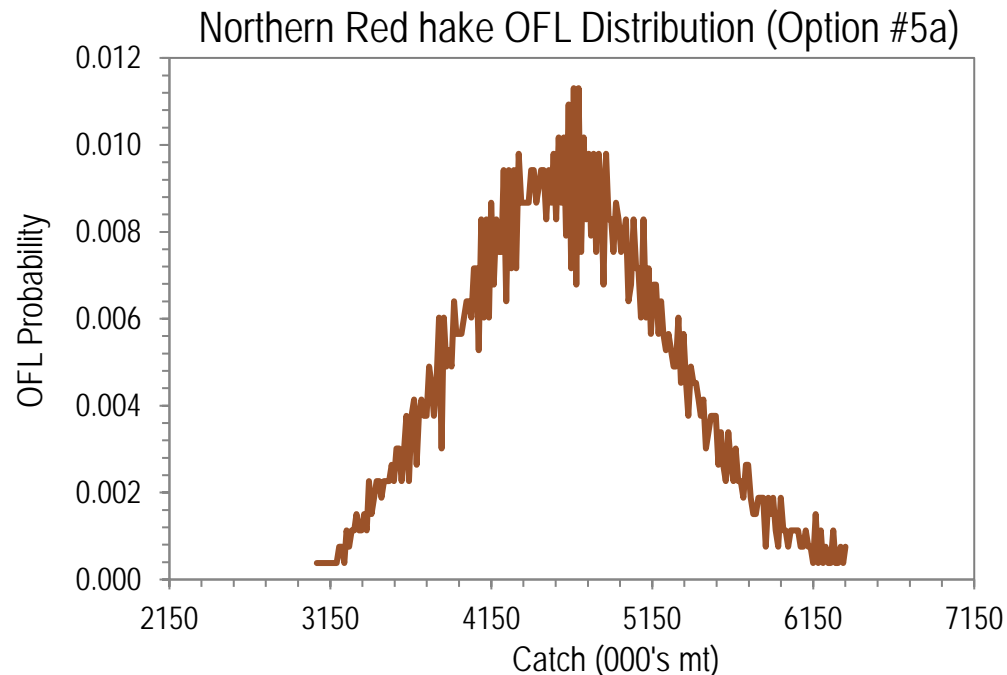### Northern Red hake OFL Distribution (Option #3)
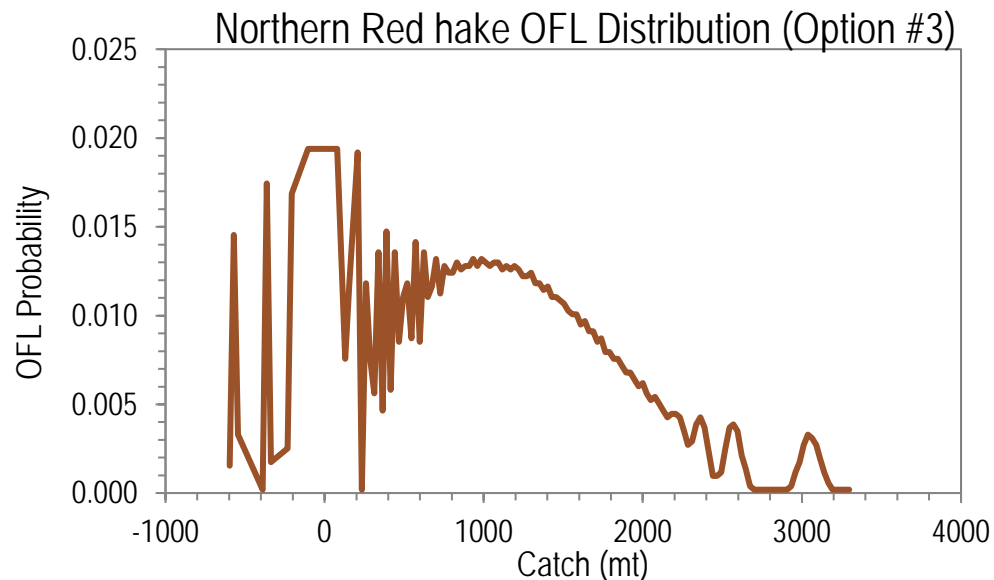
# Option #4: Northern red hake OFL estimate and 90% CI

- Plan B proportional change (2017-2019) applied to 2017-2019 OFL forecast from Plan B smooth in that time period (previous estimate using the Plan B smooth approach)

- Median OFL = 267 MT [190 – 355 MT]

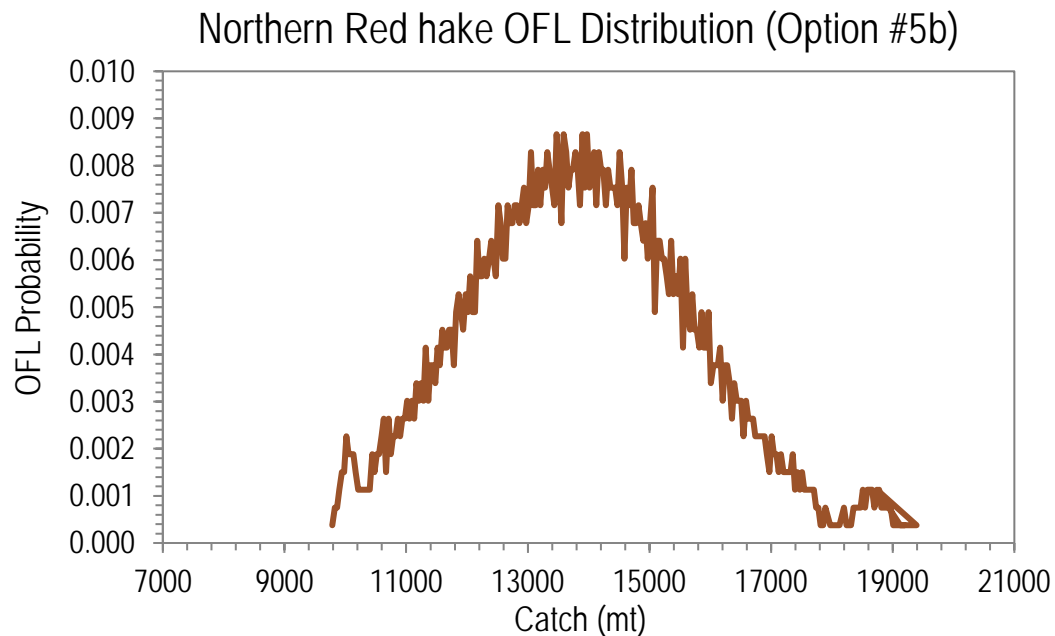- P*40% = 254 MT

Northern Red hake OFL Distribution (Option #4)
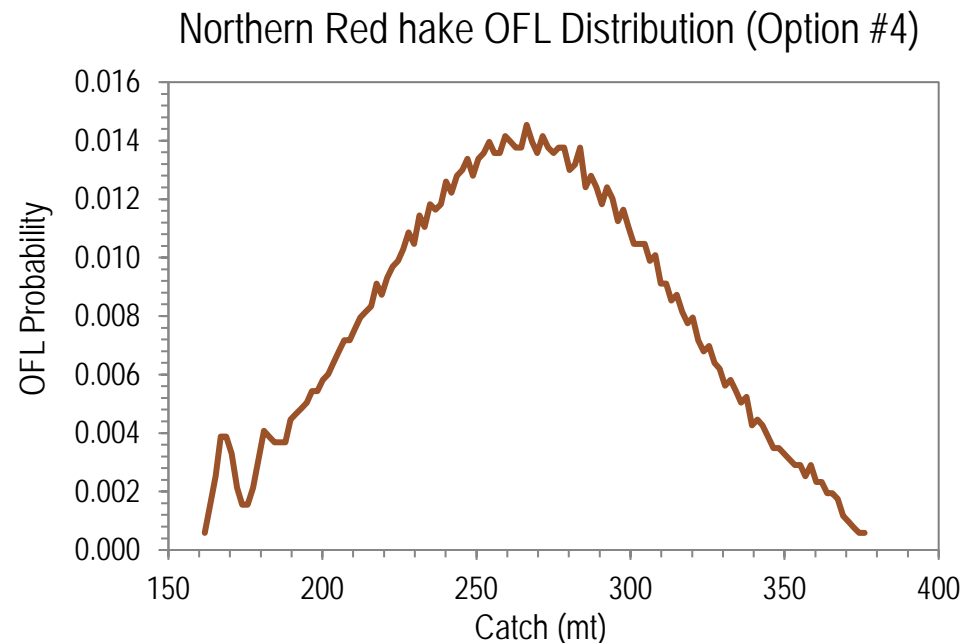
# Option #5a: Northern red hake OFL estimate and 90% CI

- Fixed exploitation rate applied to SWAB 2017-2019 (TYMA).
- Fixed Relative F = 0.02
- Median OFL = 4,621 MT [3,607 – 5,913 MT]
- $P*40\% = 4,453$ MT



Northern Red hake OFL Distribution (Option #5a)

# Option #5b: Northern red hake OFL estimate and 90% CI

- Fixed exploitation rate applied to SWAB 2017-2019 (TYMA).
- Fixed Relative F = 0.06
- Median OFL = 13,873 MT [10,904 – 17,483 MT]
- P*40% = 13,384 MT
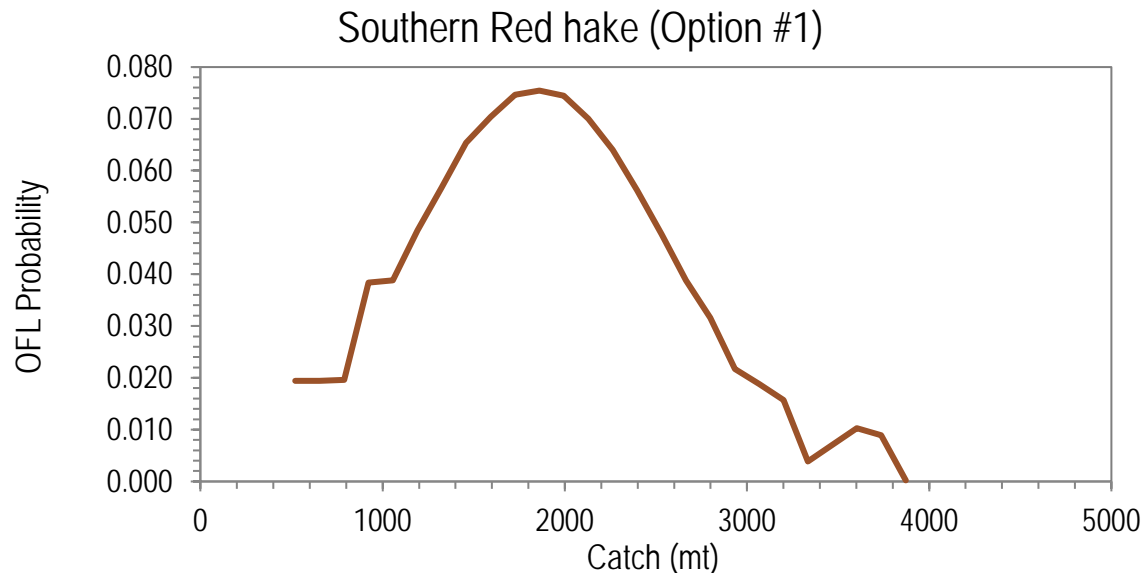
**Northern Red hake OFL Distribution (Option #5b)**

# Option #5c: Northern red hake OFL estimate and 90% CI

- Fixed exploitation rate applied to SWAB 2017-2019 (TYMA).
- Fixed Relative F = 0.12
- Median OFL = 27,742 MT [21,807 – 34,955 MT]
- P*40% = 26,775 MT



Northern Red hake OFL Distribution (Option #5c)
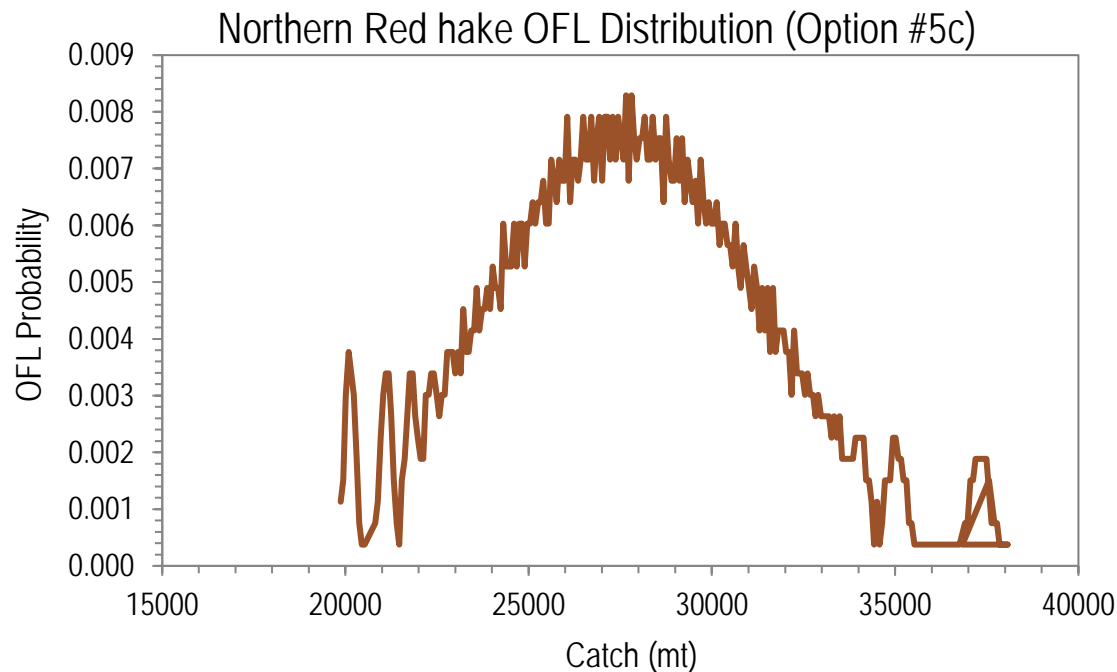
# Option #1: Southern red hake OFL estimate and 90% CI
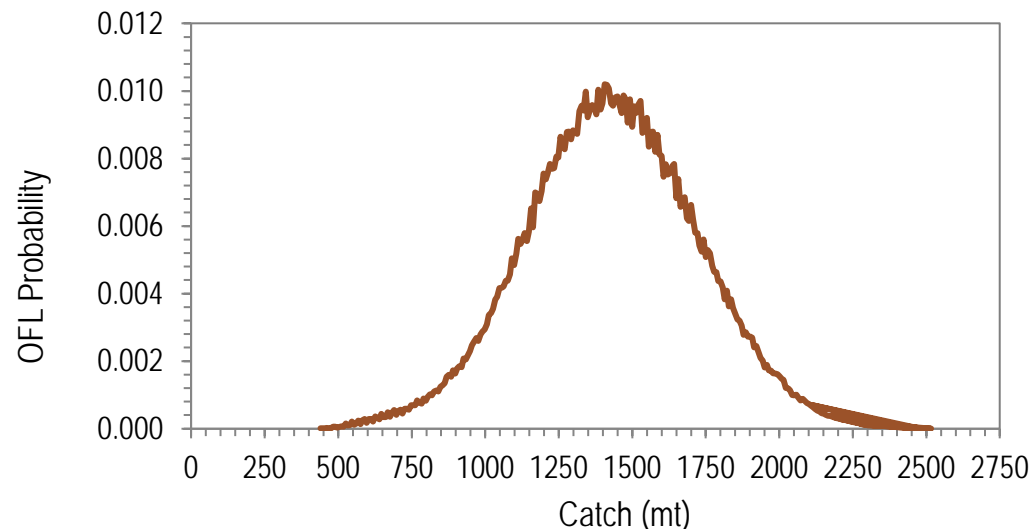
- Plan B proportional change (2017-2019) applied to 2017-2019 actual estimated catch
- Median OFL = 1,813 MT [731 – 3,067 MT]
- P*40% = 1,355 MT



Southern Red hake (Option #1)

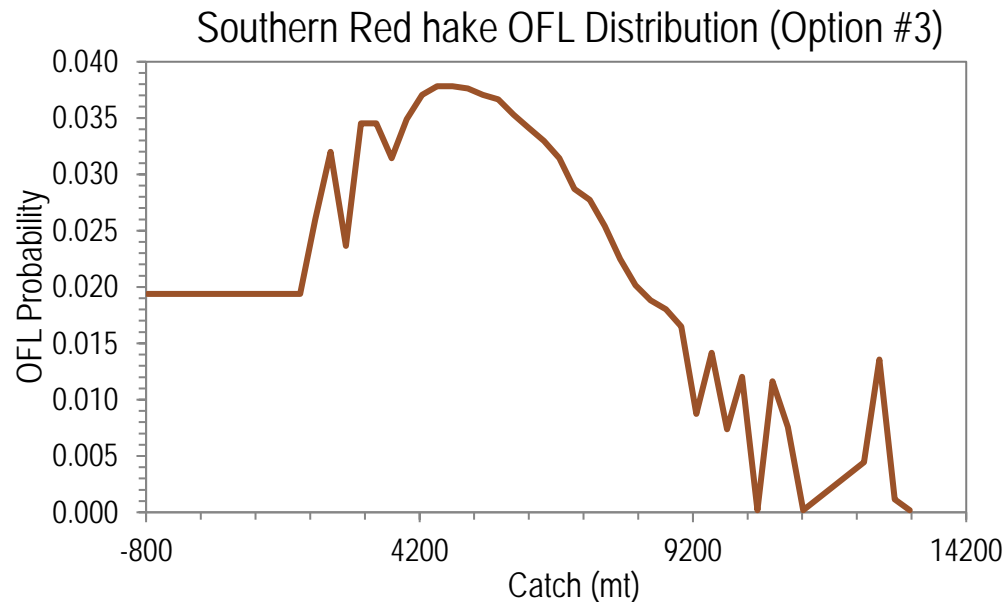# Option #2:  Southern red hake OFL estimate and 90% CI

- (2a) Plan B proportional change (2017-2019) applied to existing OFL probability distribution from 2018-2020 specifications
- (2b) 2018-2020 OFL point estimate (836 MT) applied to index multiplier probability distribution
- Median OFL (2a) = 1,428 MT [950 – 1,940 MT]
- Median OFL (2b) = 1,465 MT [1,443 – 1,489 MT]
- P*40% = 1,355 MT
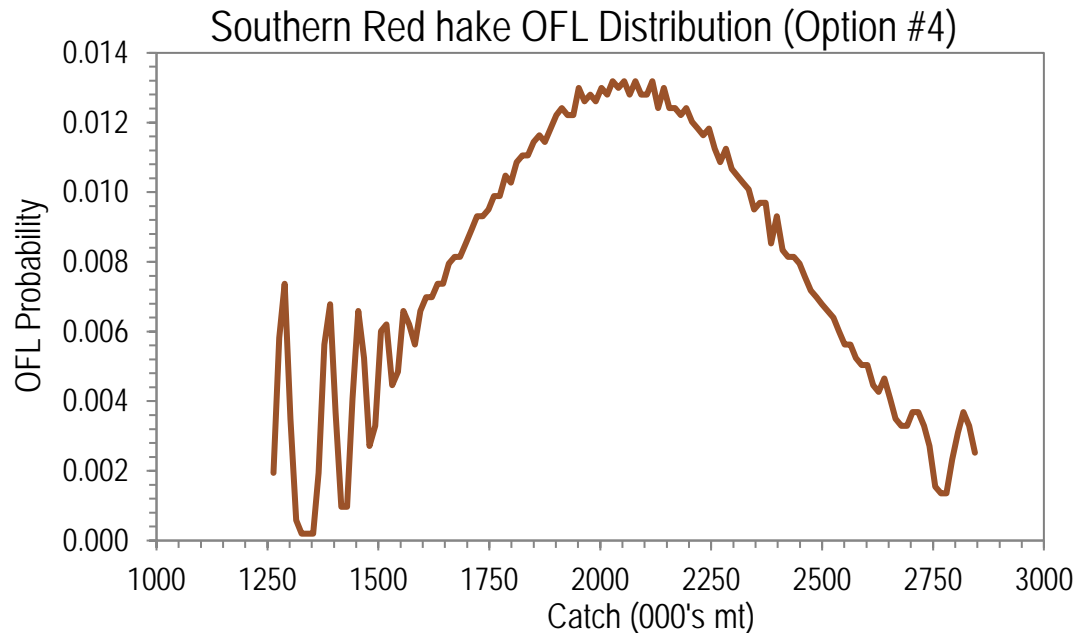
Southern Red hake OFL (Option 2a)

# Option #3: Southern red hake OFL estimate and 90% CI

- Plan B proportional change (2017-2019) applied to 1981(3?)-2009 OFL forecast from Plan B smooth in that time period (previous estimate using the Plan B smooth approach)

- OFL variance estimate was high resulting in unstable probability distribution at low catch values

- Unreliable



Southern Red hake OFL Distribution (Option #3)

# Option #4: Southern red hake OFL estimate and 90% CI

- Plan B proportional change (2017-2019) applied to 2017-2019 OFL forecast from Plan B smooth in that time period (previous estimate using the Plan B smooth approach)
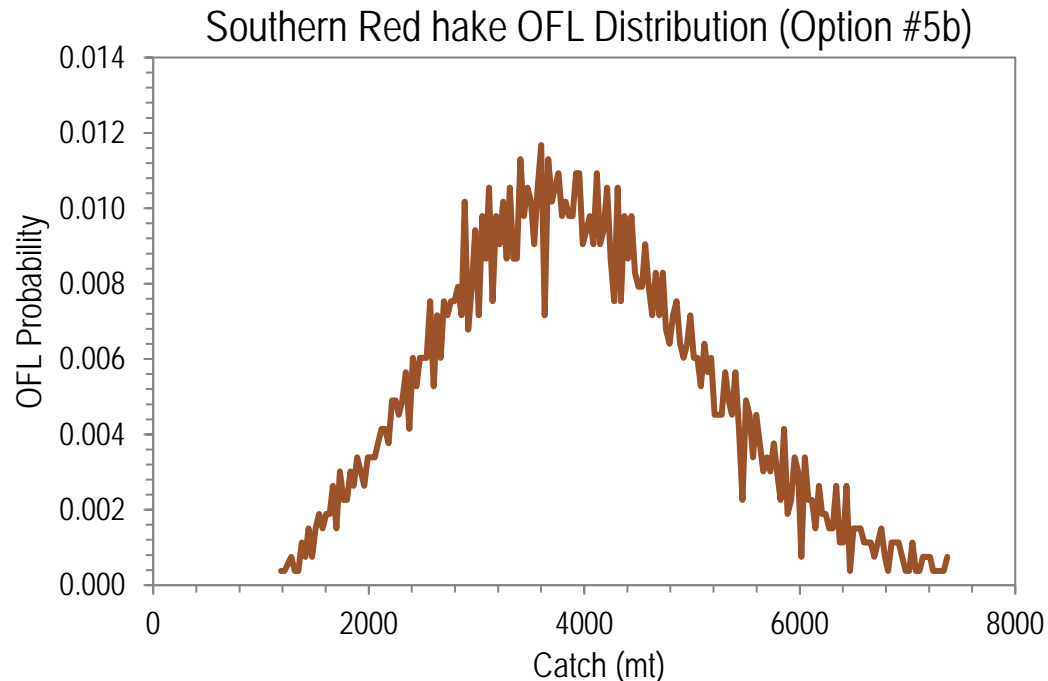
- OFL = 2,062 MT [1,454 – 2,763 MT]

- P*40% = 1,964 MT



Southern Red hake OFL Distribution (Option #4)

# Option #5a:  Southern red hake OFL estimate and 90% CI

- Fixed exploitation rate applied to SWAB 2017-2019 (TYMA).
- Fixed Relative F = 0.02
- Median OFL = 1,253 MT [409 – 2,756 MT]
- P*40% = 1,089 MT



Northern Red hake OFL Distribution (Option #5a)
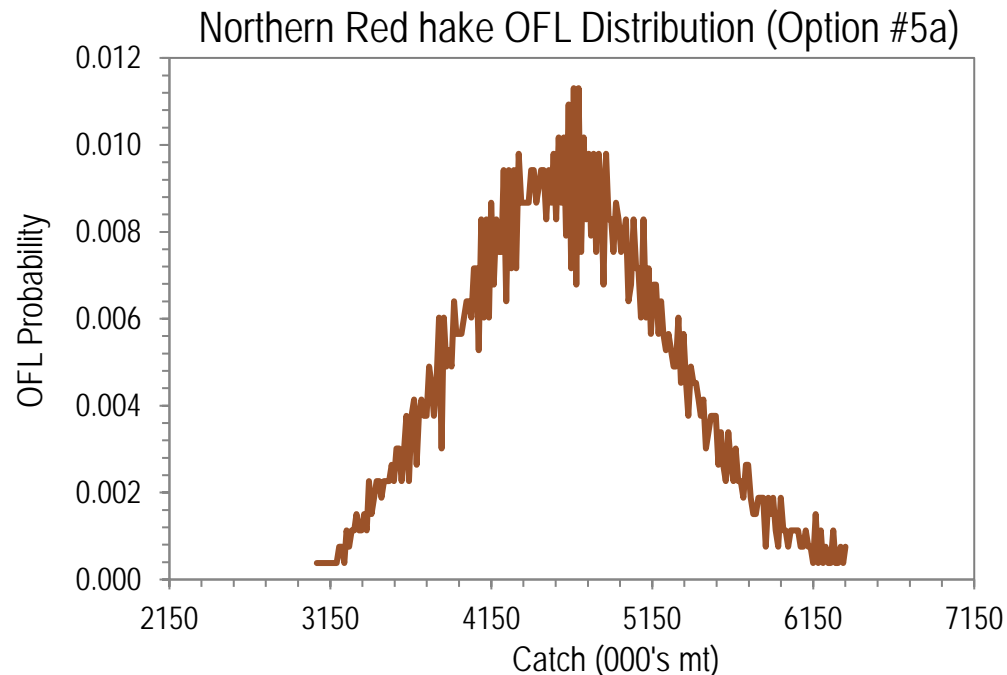
# Option #5b:  Southern red hake OFL estimate and 90% CI

- Fixed exploitation rate applied to SWAB 2017-2019 (TYMA).
- Fixed Relative F = 0.06
- Median OFL = 3,880 MT [2,039 – 6,500 MT]
- P*40% = 3,563 MT
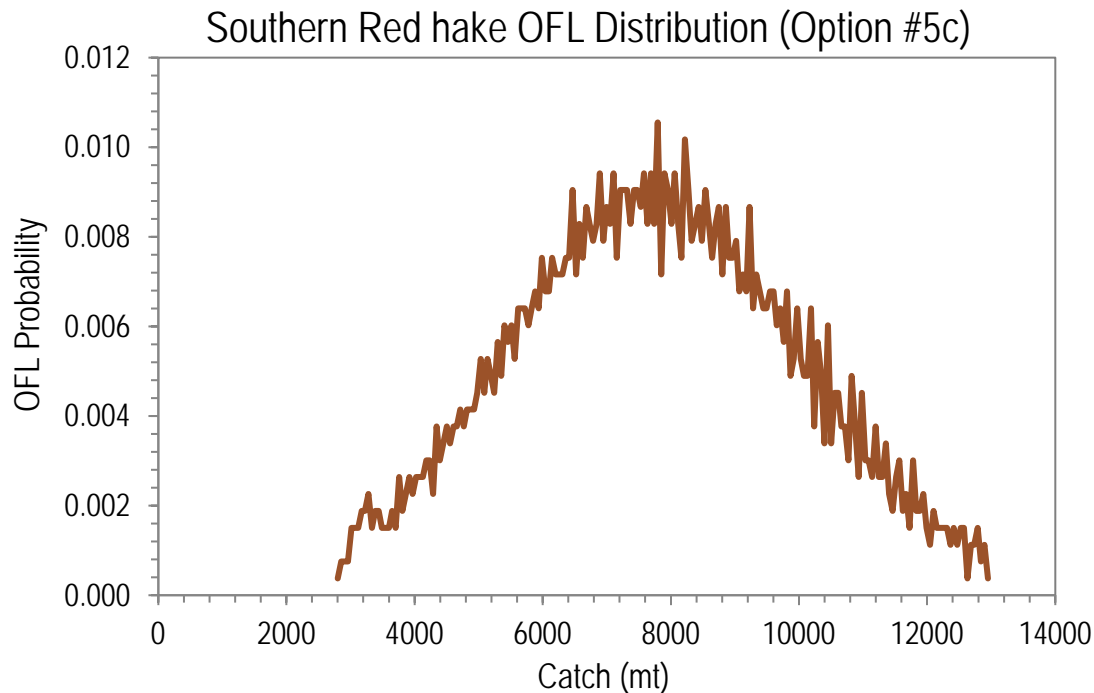


Southern Red hake OFL Distribution (Option #5b)

# Option #5c: Southern red hake OFL estimate and 90% CI

- Fixed exploitation rate applied to SWAB 2017-2019 (TYMA).
- Fixed Relative F = 0.12
- Median OFL = 7,820 MT [4,201 – 12,472 MT]
- P*40% = 7,225 MT



Southern Red hake OFL Distribution (Option #5c)

# Summary Red hake OFL Alternatives

| Alternatives for OFL | Northern OFL [90% CI] (P*40%) (mt) | % Delta OFL | Southern OFL [90% CI] (P*40%) (mt) | % Delta OFL |
|---|---|---|---|---|
| Option #1 | 229 [193 – 283] (222) | -72 | 1,813 [731 – 3,067] (1,635) | 62 |
| Option #2 (a) | 759 [182 – 1,306] (677) | -6 | 1,428 [950 – 1,940] (1,355) | 27 |
| Option #2 (b) | 782 [758 – 808] (NA) | -3 | 1,465 [1,443 – 1,489] (NA) | 31 |
| Option #3 | N/A | | NA | |
| Option #4 | 267 [190 – 355] (254) | -67 | 2,062 [1,454 – 2,763] (1,964) | 84 |
| Option #5 (a) | 4,621 [3,607 – 5,913] (4,453) | 473 | 1,253 [409 – 2,756] (1,089) | 12 |
| Option #5 (b) | 13,873 [10,904 – 17,483] (13,384) | 1619 | 3,880 [2,039 – 6,500] (3,363) | 246 |
| Option #5 (c) | 27,742 [21,807 – 34,955] (26,775) | 3338 | 7,820 [4,201 – 12,472] (7,225) | 597 |