

## Outline

- Data sources
- Fisheries
- FISS
- Other sources
- Modelling
- Review of process
- Results in 2023


## Summary

- Fishing mortality: down slightly in 2023
- Trends: FISS down 2-4\% (numbers/pounds), fishery down 12\%
- Existing age classes:
- 2012 and 2014 moderately large - not large enough to support a fishery increase at current biomass levels
- Weight-at-age: mixed flat or increasing trends
- Upcoming age classes: possible 2017-2018 year-classes
- Biomass: spawning biomass trend is nearly flat, at $42 \%$ of the unfished level
- Fishing intensity: 2023 lowest in recent years


## Historical mortality



## 2023 Mortality

Projected from AM099 based on adopted mortality limits

|  | Commercial <br> Landings | Commercial <br> discards | Recreational | Subsistence |  | Non- <br> directed <br> discards |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Year | Total |  |  |  |  |  |

Estimated for this year's stock assessment analysis

|  | Commercial <br> Landings | Commercial <br> discards | Recreational | Subsistence |  | Non- <br> directed <br> discards |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | Total

$3-\mathrm{yr}$ avg: 4.56

- Down 7\% from 2022
- 1.64 Mlbs above 2020
- $83 \%$ utilized


## Recent non-directed discard mortality



## Recent TCEYs



## Fishery trends: O32

2A Tribal
2A non-Tribal

Fixed hook
Snap

4C
4D


## Fishery and FISS trends

## Coastwide survey



Coastwide commercial


## Coastwide FISS trends









## FISS ages



## Recent fishery ages



## Female coastwide weight-at-age



Stock distribution (all sizes)


## Empirical harvest rates (1993-2023): Mortality/survey index



## Ecosystem conditions: Pacific Decadal Oscillation (PDO)



## NOAA Fisheries trawl survey - Bering Sea



## NOAA Fisheries trawl survey - Bering Sea

Numbers at age from age-length keys
Caveats:

- 1987 was a much larger recruitment coastwide than 2005
- It will be 2-4 years before we get direct estimates of the 2017/18 cohorts in the FISS and commercial fisheries



## Recent ecosystem conditions

- Bering Sea (2023): Oceanography (e.g., temperature, ice cover) near-normal, but biology/species distributions remain in transition, crab stocks low
- Aleutian Islands (2023): Continued warm water (10+ years), changing relationships between key indicators (e.g., temperature and PDO)
- GOA (2023): No clear indicators, good or bad, for Pacific halibut
- B.C. (2022): Reduced upwelling, warmer waters than usual with negative PDO
- California current (2022/23): Marine heatwave, mixed productivity across species
- Take-away: Continued change, low predictability

References (most recent reports): Bering Sea, $\underline{\text { Gulf of Alaska, Aleutian Islands, B.C., California current }}$

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## Stock assessment development history

- 2015: Full assessment - formalized 4-model ensemble methods
- 2016-2018: Updates
- 2019: Full assessment - included new commercial fishery sex-ratio data
- 2020-2021: Updates
- 2022: Full assessment - improved treatment of natural mortality, data weighting
- 2023: Update
- SRB review of development in June (SRB022)
- Final recommendations in September (SRB023)
- 2024: Update planned
- 2025: Full assessment planned


## 2023 Stock assessment development

- 2023: Update
- SRB review of development options in June (SRB022)
- Model weighting
$\rightarrow$ Continue using equal weighting
- Frequency of commercial sex-ratio processing
- Estimation of natural mortality
- Whale depredation - estimates from logbooks
- Spatial population structure


## 2023 Stock assessment development

- 2023: Update
- Final recommendations in September (SRB023)
- Whale depredation (including observer data) affect on stock assessment
$\rightarrow$ Don't include for 2023
- Model weighting
- Frequency of commercial sex-ratio processing
$\rightarrow$ Continue annual analyses while stock is declining
$\rightarrow$ Investigate approaches to quantifying uncertainty via simulation testing
$\rightarrow$ Including simulation testing with alternative FISS designs


## Whale depredation summary

- Area 4 experiences the highest Orca depredation rates
- Areas 2C and 3A experience the highest Sperm whale depredation rates
- Based on logbook-reported depredation rates and survey-estimated magnitude:
- At least 1.4 Mlbs of lost yield since 1995
- Assessment model spawning biomass scales upward slightly (1-3\%)
- 0.20 Mlbs would have been projected for 2023 (deducted from the directed commercial landings and discard mortality)
- The two effects nearly cancel: mortality limits to achieve the same SPR result in nearly identical net fishery limits (+0.02MIbs)


## 2023 stock assessment ensemble

- Same 4 models as in recent assessments:
- Long and short time-series
- Aggregated, separate data by Region
- Equally weighted
- No changes to assessment or individual model structure for 2023


2024 Spawning biomass (M Ib)

## Fit to FISS index



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## Summary of four individual models



## Comparison to previous assessments



## Effect of updated 2022 and 2023 fishery CPUE



## Relative recruitment estimates



## Learning about year class strengths: 2012



## Learning about year class strengths: 2014



## The 2012 year-class - still rapidly maturing



## Estimated fishing intensity



## Estimated fishing intensity



## Stock status - estimated unfished trend



Allowing for natural/normal stock variability (but not unique catastrophic events)

## Stock status - measuring the effect of fishing



## Stock status - measuring the effect of fishing



## Summary of results

- Fishery CPUE dropped more than expected in 2022 and 2023, this translated to an 11\% decrease in the estimated 2023 spawning biomass from last year's assessment
- Current spawning biomass trend is estimated to be nearly flat from 20222023
- The stock status is at $42 \%$ of the unfished level at the beginning of 2024
- 2012 and 2014 are both moderate year-classes, not large enough to provide for an appreciable stock or fishery increase at current biomass levels
- It will be 1-3 years before we have clear coastwide information on the 2017-2018 year-classes observed in trawl surveys


## Recommendations

That the Commission:

1) NOTE paper IPHC-2023-IM099-10 Rev_1, which provides a summary of the data and the results of the 2023 stock assessment.

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