2023 Rex Sole Stock Assessment: Pre-assessment Data Workshop

Disclaimer: All data summaries and exploration presented here are preliminary and may not be indicative of the final data that will be incorporated in the 2023 assessment models

March 20th, 2023

Stock Assessment Team

Class members

Markus Min, Emily Sellinger, Terrance Wang, Sabrina Beyer, Adam Hayes, Alberto Rovellini, Ingrid Spies, Matthieu Veron, Kun Wang, Sophia Wassermann

Instructors

Vladlena Gertseva, Melissa Haltuch, Owen Hamel, Kiva Oken

Outline

1. Summary of 2013 Stock Assessment
2. Landings
3. Discards
4. Fishery Length Compositions
5. Survey Length Compositions
6. Indices
7. Biological Information

Rex Sole

- Medium sized (up to 61 cm), moderately long-lived (up to 29 years)
- Distributed from Baja California to the Aleutian Islands
- Larger in Alaska than on the West Coast
- Found commonly up to 500 m, range down to more than 1100 m
- 98% of removals are from commercial bottom trawl

Summary of 2013 Stock Assessment (Cope et al. 2015)

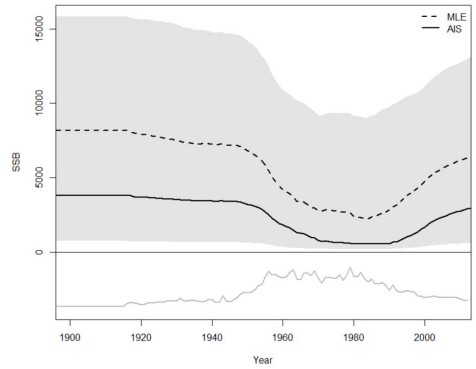


Figure 116. Time series of spawning biomass from the exSSS MLE (broken line) and AIS (solid line with gray uncertainty bars) for rex sole. Catch history is provided below the 0 line.

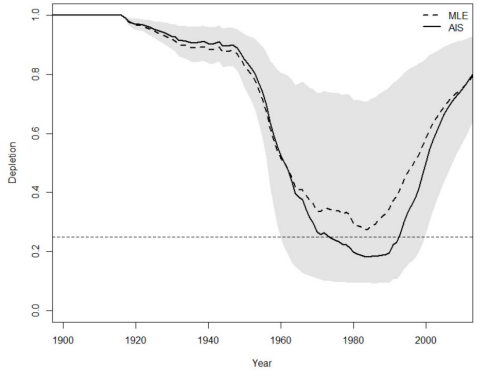


Figure 117. Time series of stock status (depletion) from the exSSS MLE (broken line) and AIS (solid line with gray uncertainty bars) for rex sole.

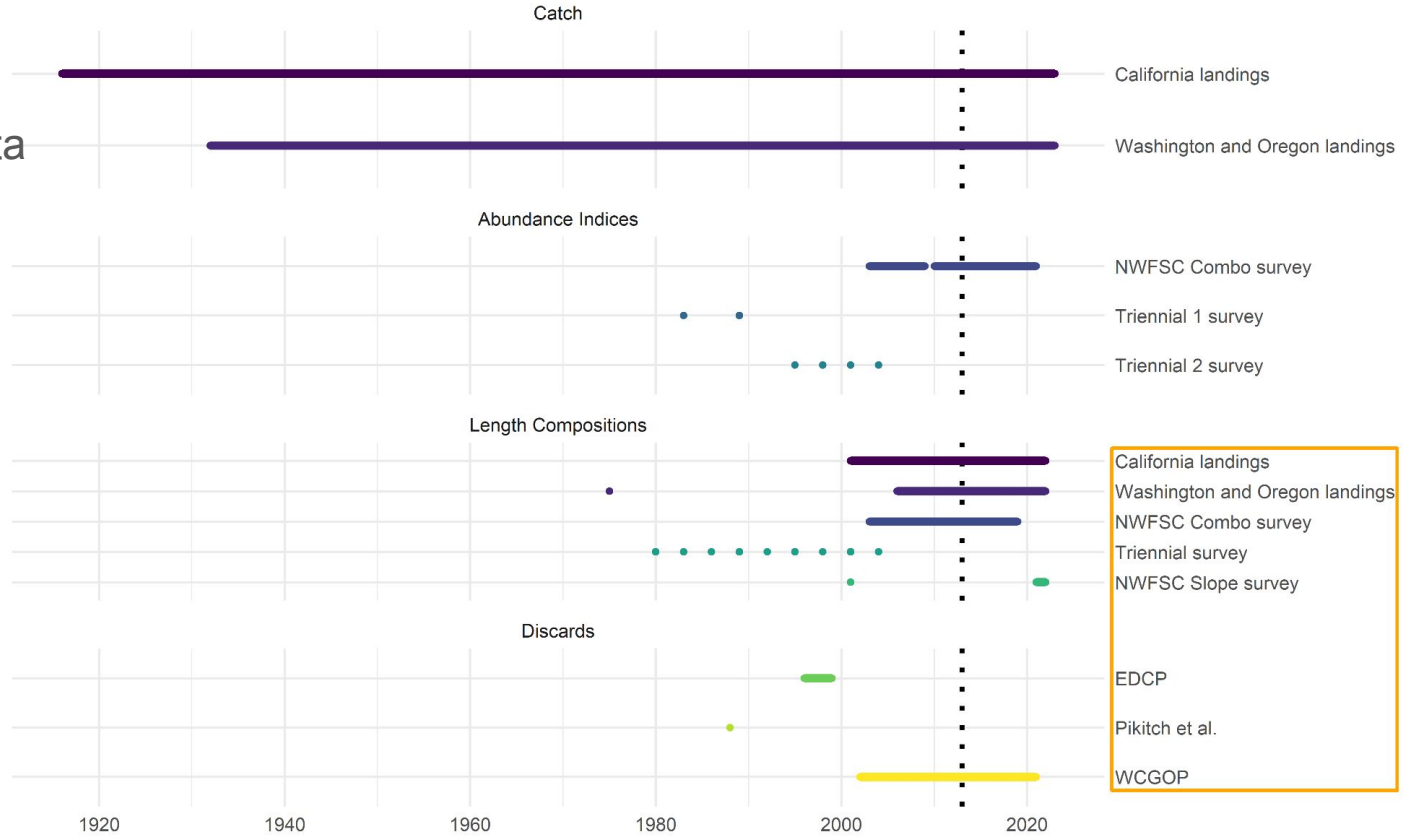
- Category 3 assessments only prior to 2013
- Data-moderate stock assessment: Extended Simple Stock Synthesis (exSSS) applied to **removal and index data** (no length or age data)
- Surveys: Two triennial survey time series (1980-1994, 1995-2004) and one annual survey time series (2003-2012)
- Fishery: One coastwide fleet

- Stock assessed to be at 80% of virgin biomass

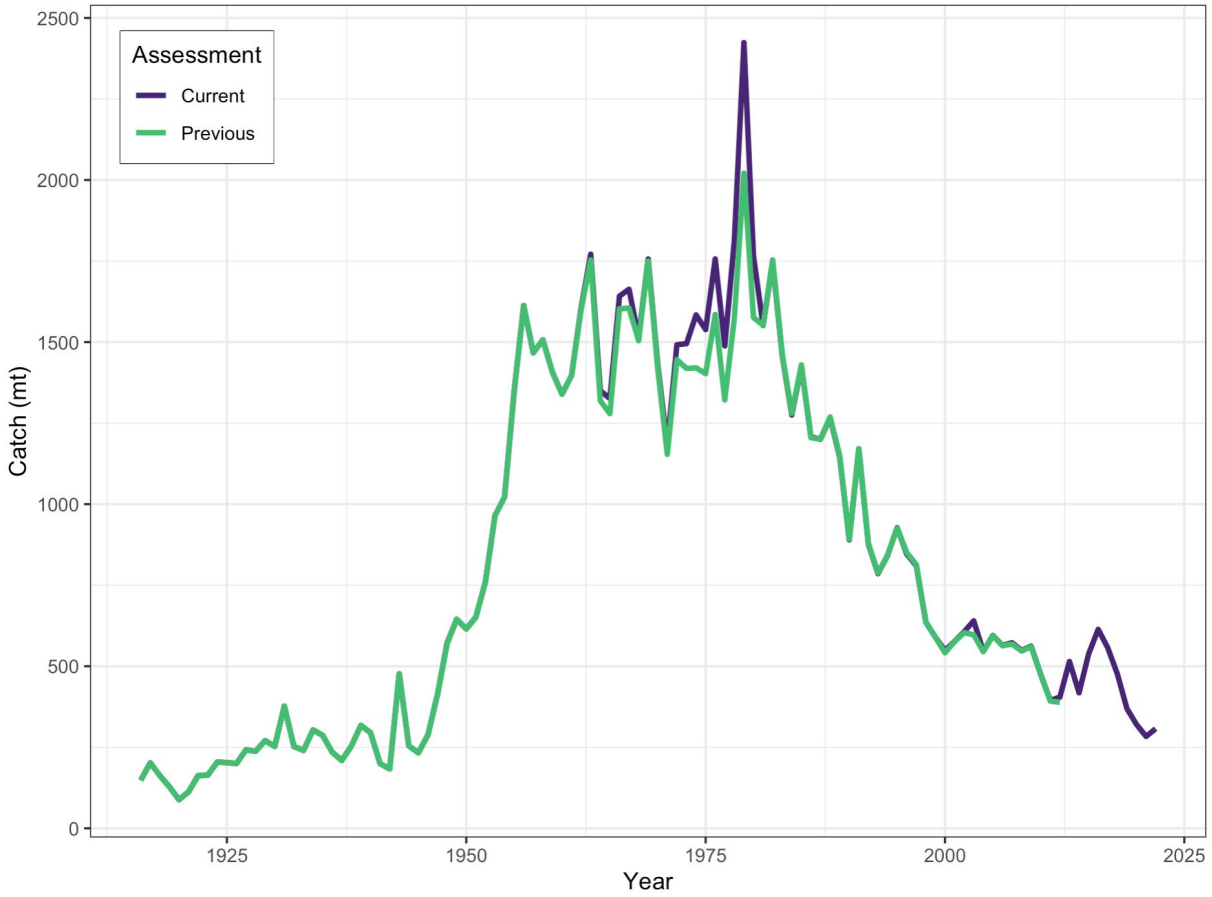
Data Sources timeline

Inclusion of:

- Discards data
- Length composition data

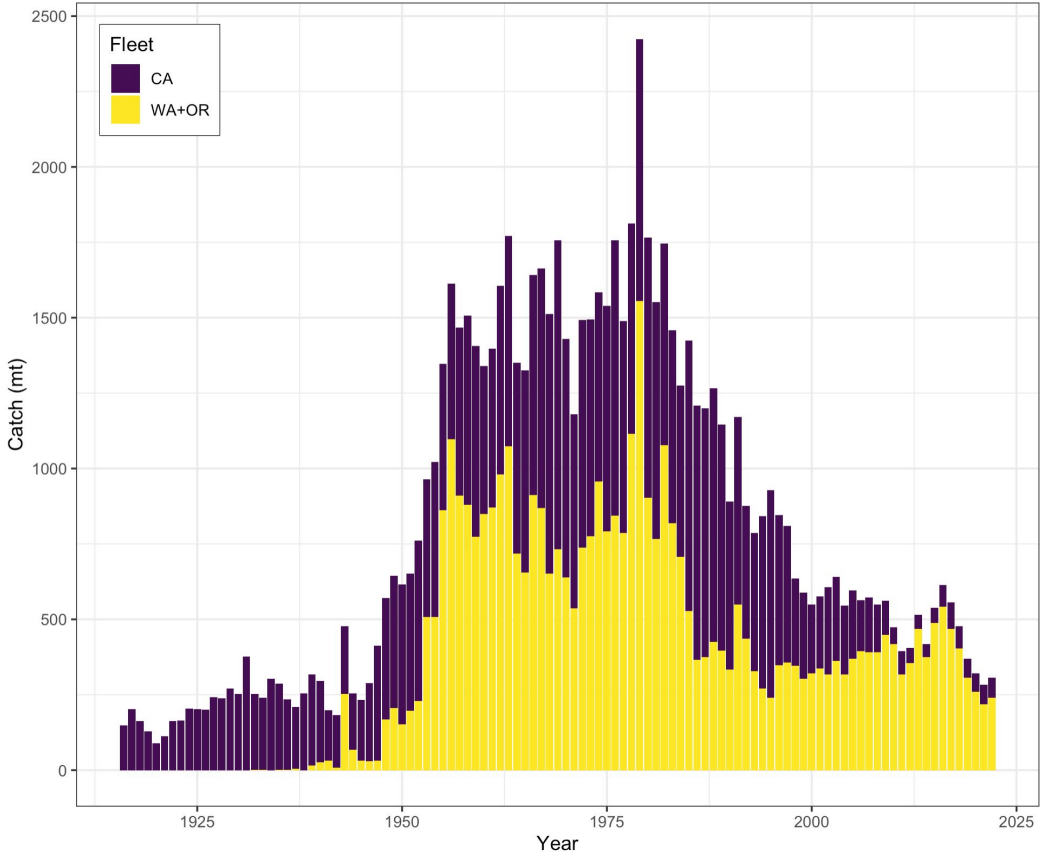


Fishery Landings



- Commercial
  - Previous Assessment
    - CA Comm Recon (1931-1968)
    - CALCOM (1969-1980)
    - CDFG Bulletin (1916-1930)
    - WA PMFC (1956-1976)
  - Updated
    - OR Comm Recon (1929-1980)
    - WA Comm Recon (1948-1980)
    - PacFIN (1981-2022)
    - NORPAC Hake (1990-2022)
- Recreational
  - Negligible (no update)
- Single Gear Fleet
  - >98% Trawl (no update)
- Fleet Structure
  - Coastwide (previous)
  - CA, OR+WA (considering)

Fleet Structure Considerations - Catch History



- Previous fleet structure
  - Coastwide
- Consider fleet structure
  - South (CA)
  - North (OR+WA)
  - Different catch history

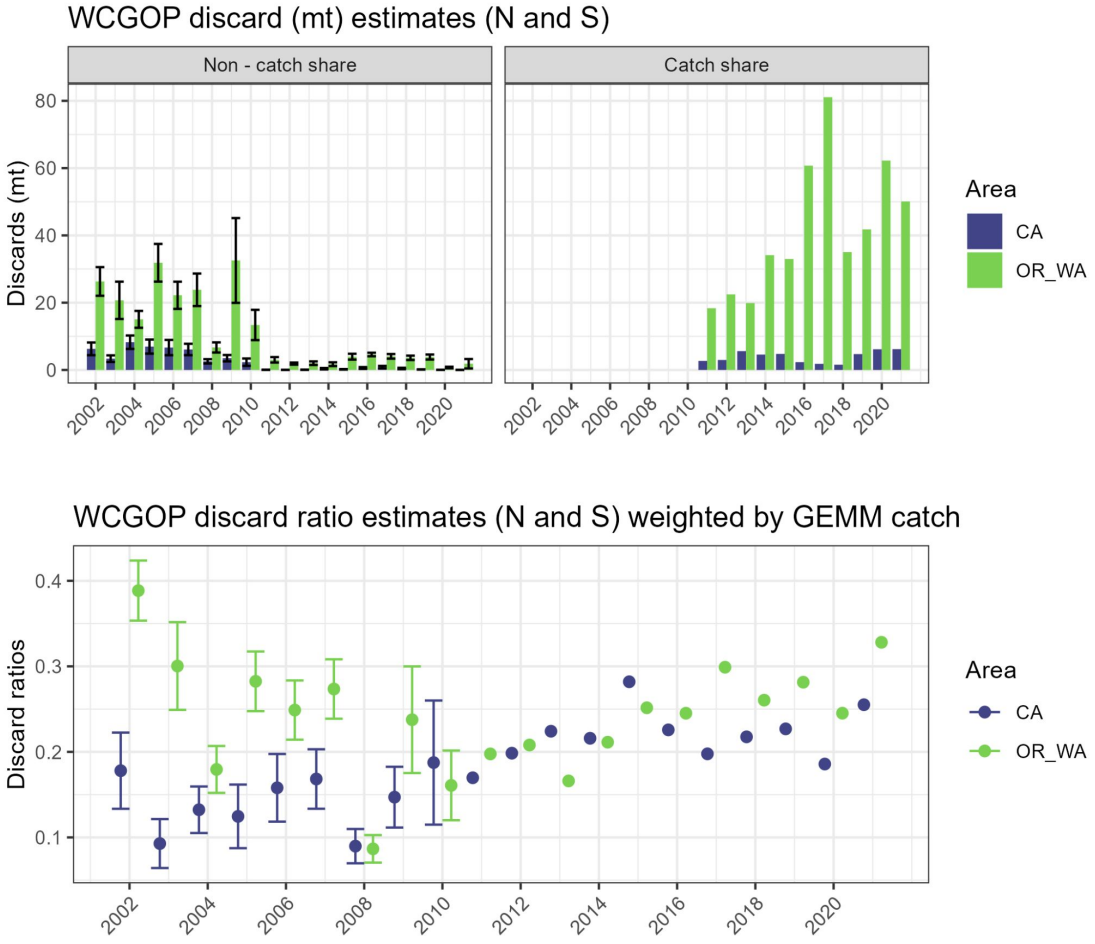
Fishery discards

- 2013: Discards were added to landings within the only fishery fleet
- 2023: Motivation for separating discards from landings:
  a. 20-30% of caught rex sole gets discarded
  b. Discarded fish are smaller than retained fish
  c. Source of length composition data
- Data sources:
  a. West Coast Groundfish Observer Program (WCGOP, 2002-2021): % ratios, length-frequency, average weight
  b. To explore:
     - Enhanced Data Collection Project (EDCP, ODFW 1995-1999): % ratios
     - Pikitch et al. 1988 (1986-1988): % ratios, length-frequency (reanalyzed by John Wallace)

Fishery discards

WCGOP ratios by catch-share and non-catch share

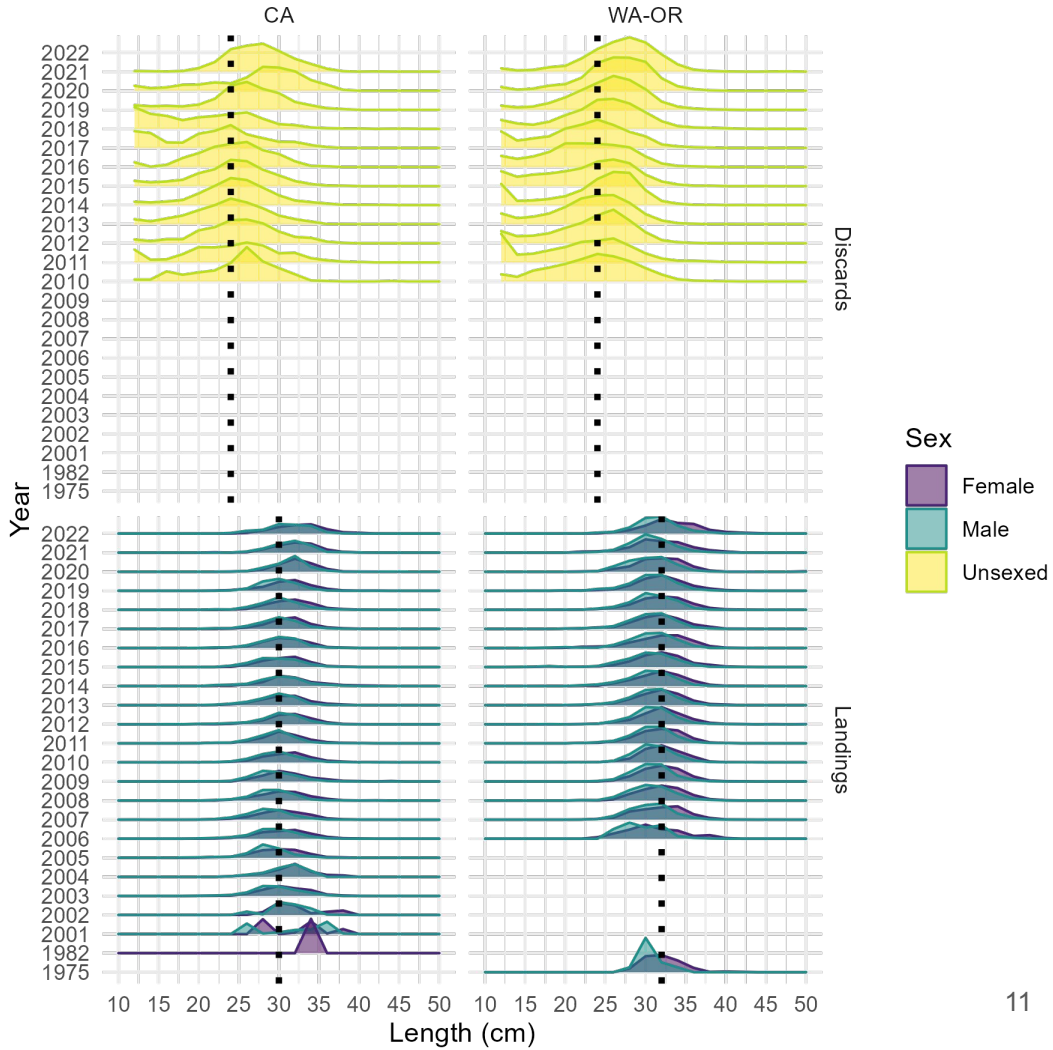
- Before 2011: non-catch share. Observer coverage <100%
- After 2011: low discards from non-catch share
- Ratios for 2011-2021 driven mostly by catch-share sector
- ~25% discarded on average



Fishery discards

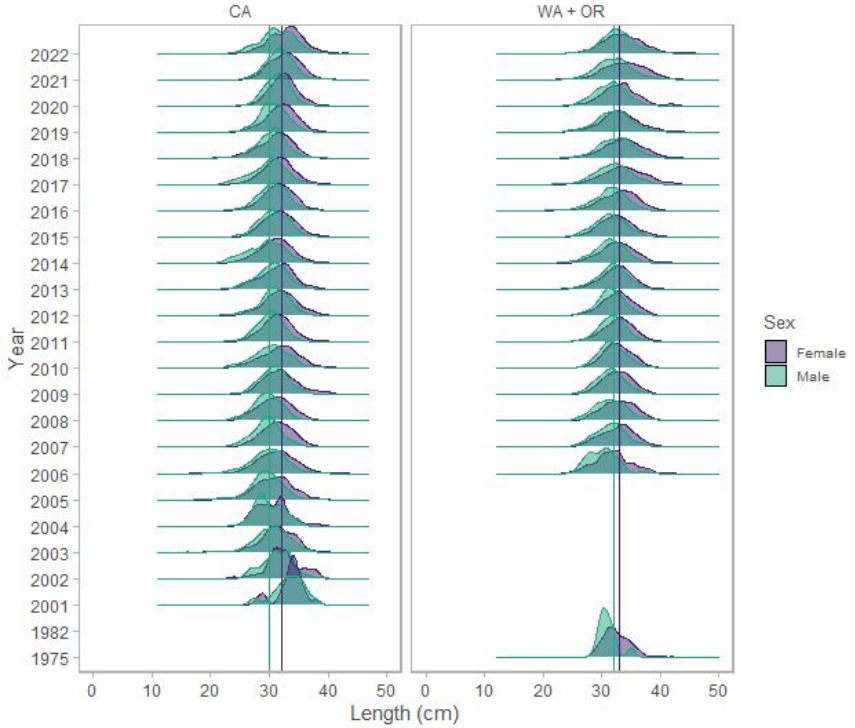
Length compositions:

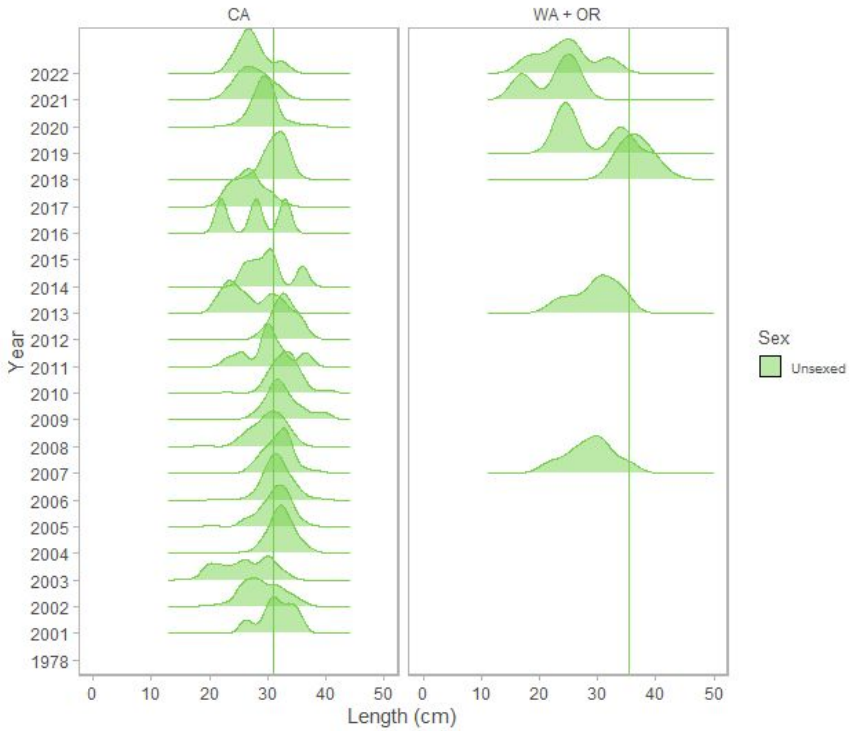
- Discarded fish is smaller than retained fish
- Splitting discards from landings would improve estimates of selectivity



Fishery Lengths

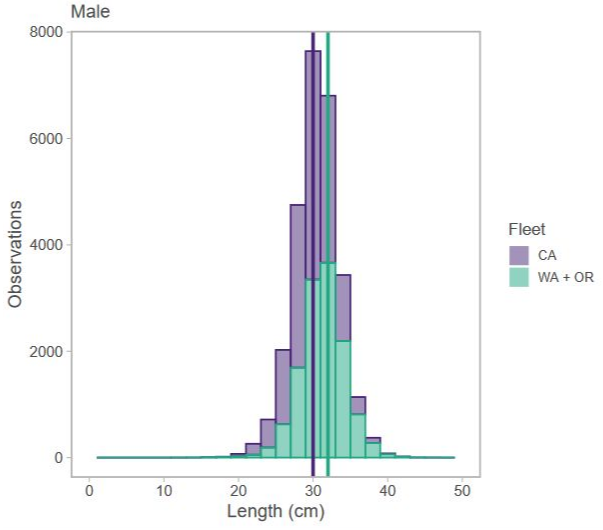
Sexed: 97% of length data, Unsexed: 3% of length data

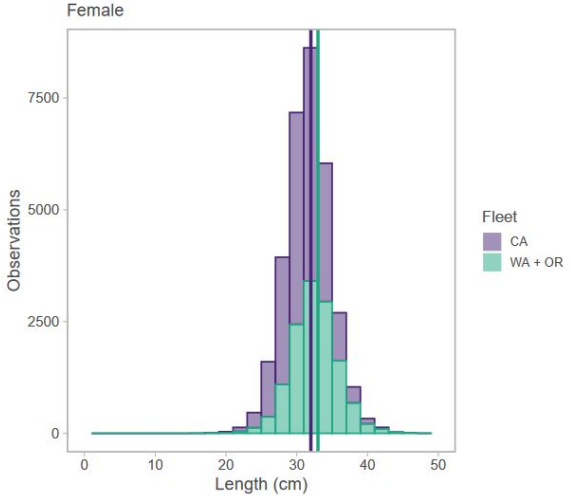




Fishery Lengths

- The median length of males caught in CA is less than the median length of males caught in WA and OR





Fishery-independent data

2013 Assessment

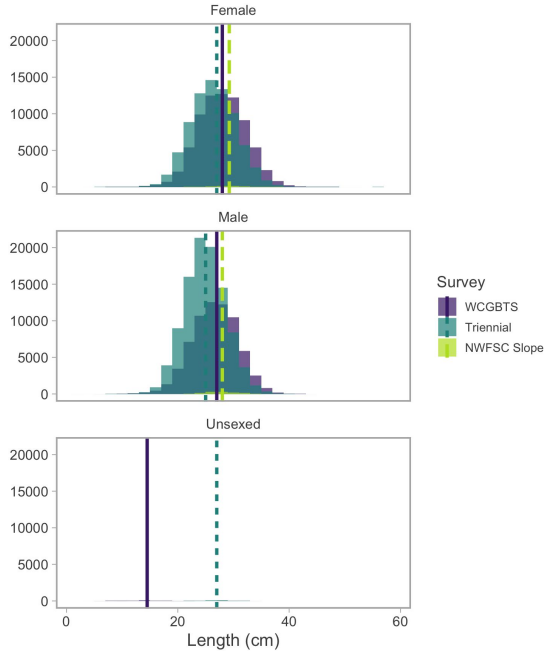
- Delta-GLMM index & length compositions from:
  - WCGBTS (2003-2012)
  - early Triennial (1980-1992)
  - late Triennial (1995-2004)
- Strata:
  - WCGBTS: two latitudinal strata (CA and WA/OR), three depth strata
  - Triennial: three depth strata
- Length bins: 2 to 60 cm, by 2 cm

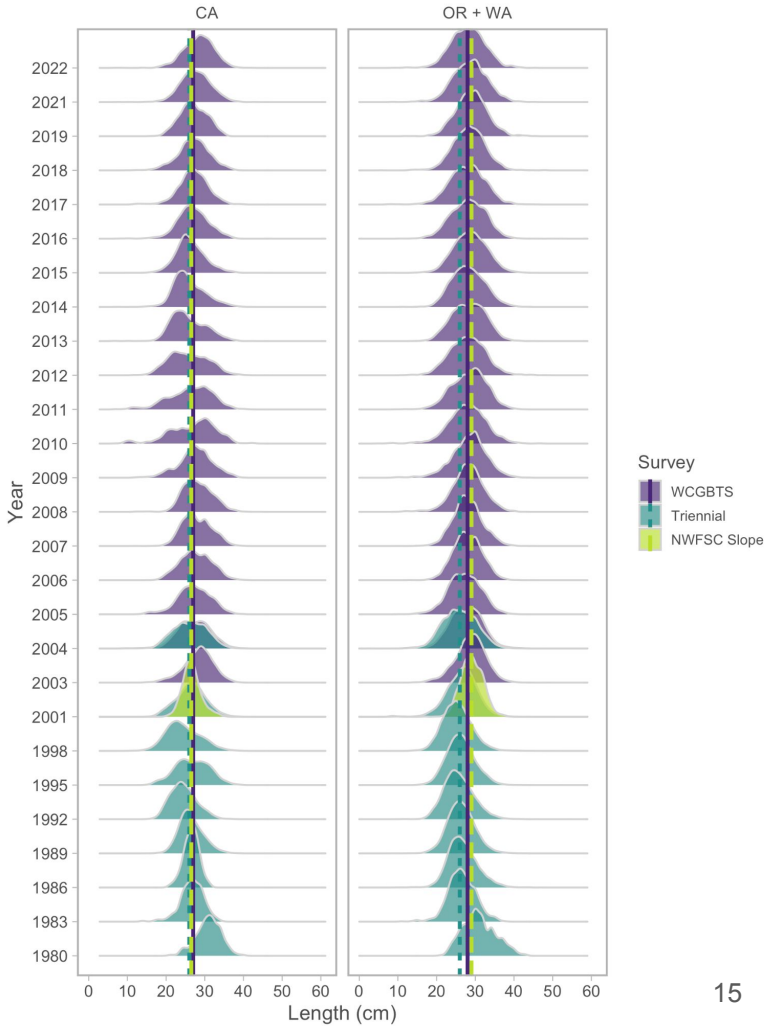
2023 Assessment

- Model-based index & length compositions from:
  - WCGBTS (2003-2022)
  - Triennial (1980-2004)
- Considering 1 year of length data from NWFSC Slope survey (2001)
- Considering additional indices from:
  - NWFSC Slope (1998-2002)
  - AFSC Slope (1990-2001)

Fishery-independent length data

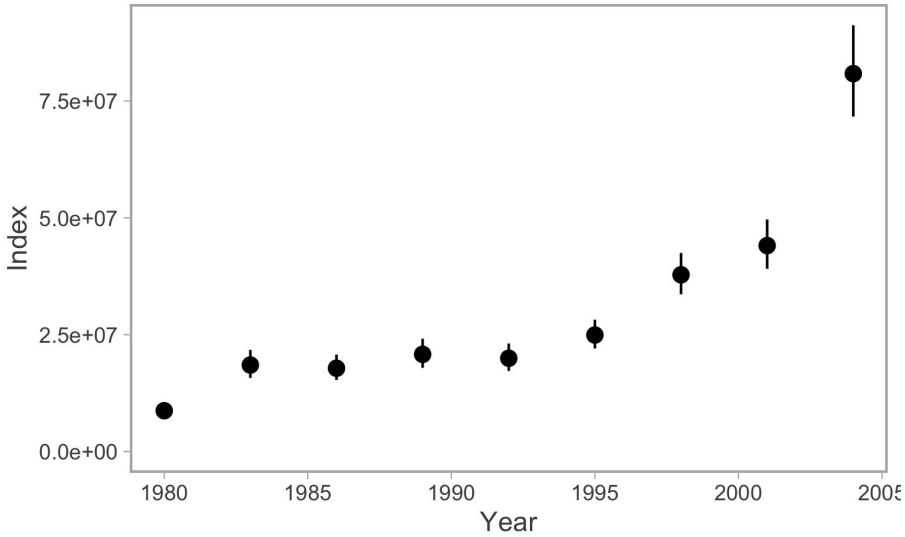
- Lengths for Triennial slightly lower
- More length data for OR/WA & slightly larger fish
- Triennial survey has more length data for males than females
- Unsexed: ~0.3%



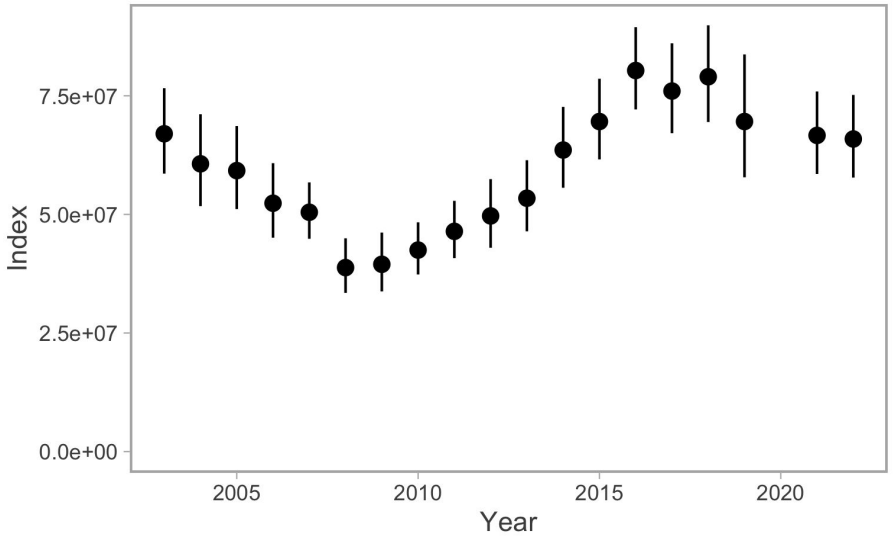


Fishery-independent indices of abundance

Triennial



WCGBTS



NOTE: These are design-based indices; model-based indices (sdmTMB) are being estimated

Biological Data Sources

Type	2013 Assessment	2023 Assessment
Growth	Abookire 2006 - Gulf of Alaska; sexes combined	WCGBTS; sex specific
Maturity	Abookire 2006 - Gulf of Alaska	Hosie and Horton 1977- Oregon
Fecundity	Assumed spawning biomass equivalent to spawning output	Hosie and Horton 1977- Oregon
Natural Mortality	Estimated in the model, M = 0.199	Explore estimating in the model, or fix at a prior of M = 0.186 (median) based on maximum age of 29 years (Hamel and Cope 2022)

WCGBTS = west coast groundfish bottom trawl survey

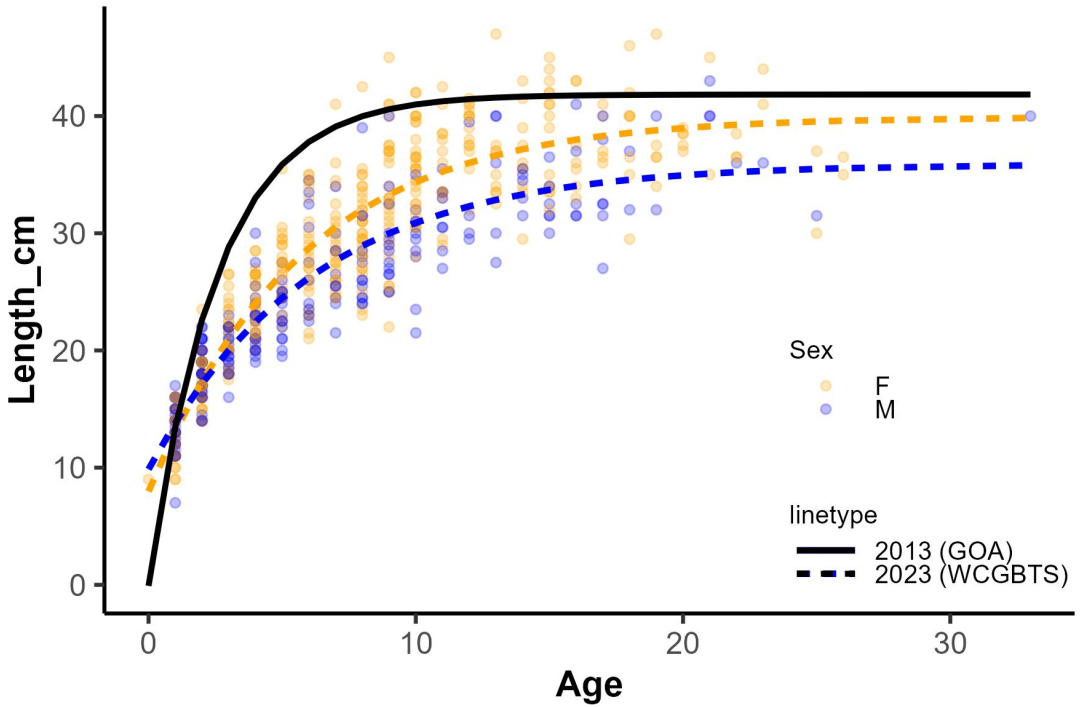
Growth

2013 Assessment

Growth information from Gulf of Alaska fish (Abookire 2006)

2023 Assessment

- WCGBTS (West Coast fish; 2007-2019; 350 F, 231 M, 39 unsexed randomly assigned M or F assuming a 50:50 sex ratio; Schnute VBGF with lognormal errors)
- West Coast fish smaller than Alaska fish
- dimorphic growth

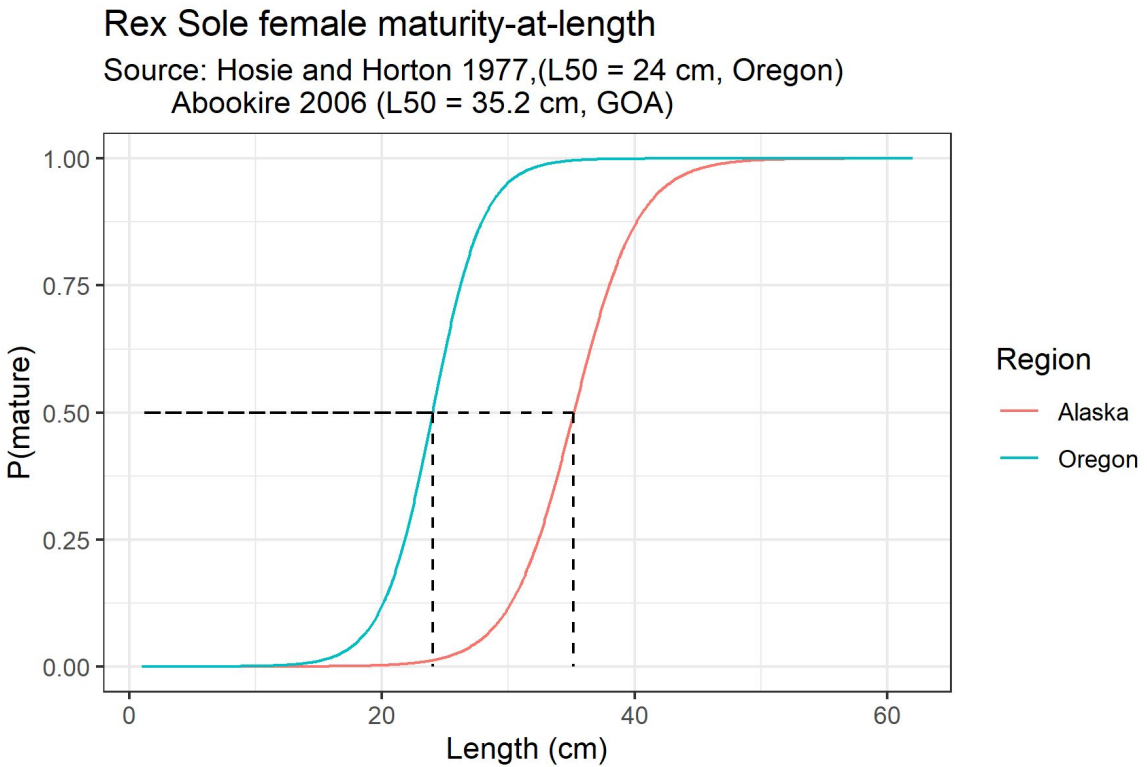


Maturity

2013 assessment
Gulf of Alaska fish
(Abookire 2006)

2023 assessment
Oregon fish
(Hosie and Horton 1977)

- 1969-1973
- macroscopic maturity
- 2013 assessment not aware of this dataset; growth of West Coast Rex Sole more closely matches this study and L50 is more reasonable



Fecundity

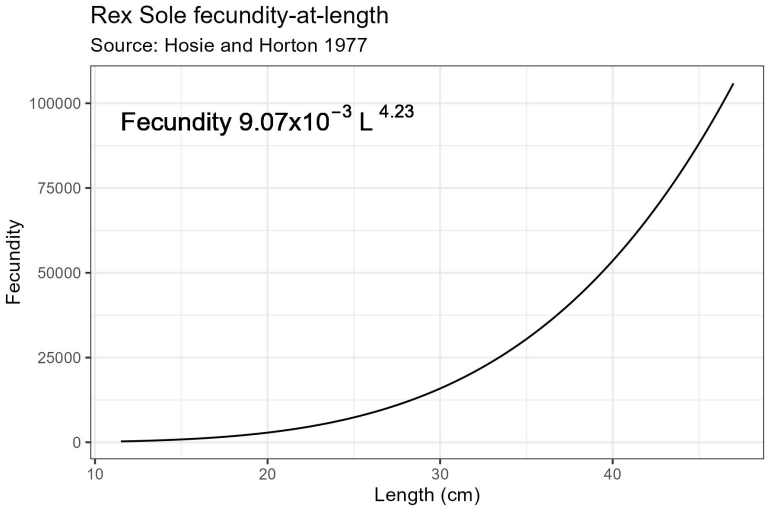
2013 Assessment

Assumed spawning biomass equivalent to spawning output

2023 Assessment

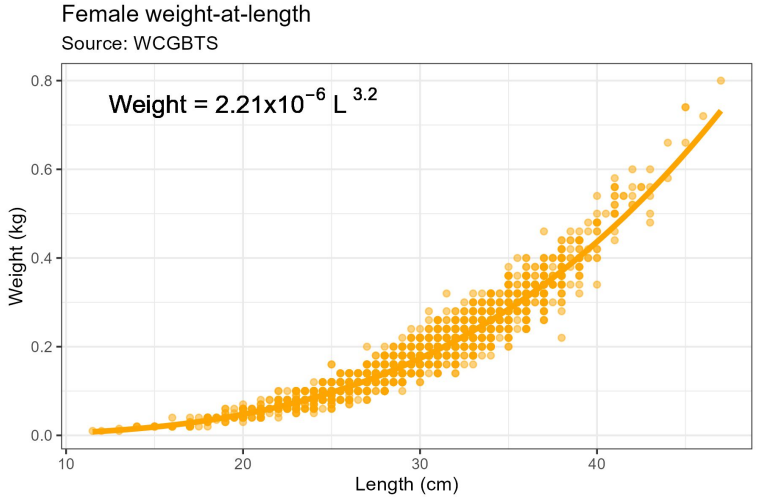
Evidence of greater relative fecundity in large females

- More eggs per kg of body weight
  - Hosie and Horton 1977 (n = 13)
  - Hyper-allometric relationship
- Similar to other west coast flatfish
  - Petrale Sole
  - Lefebvre et al. 2019 (n = 70)
  - *b* = 4.55 (95% CI: 3.97-5.13)



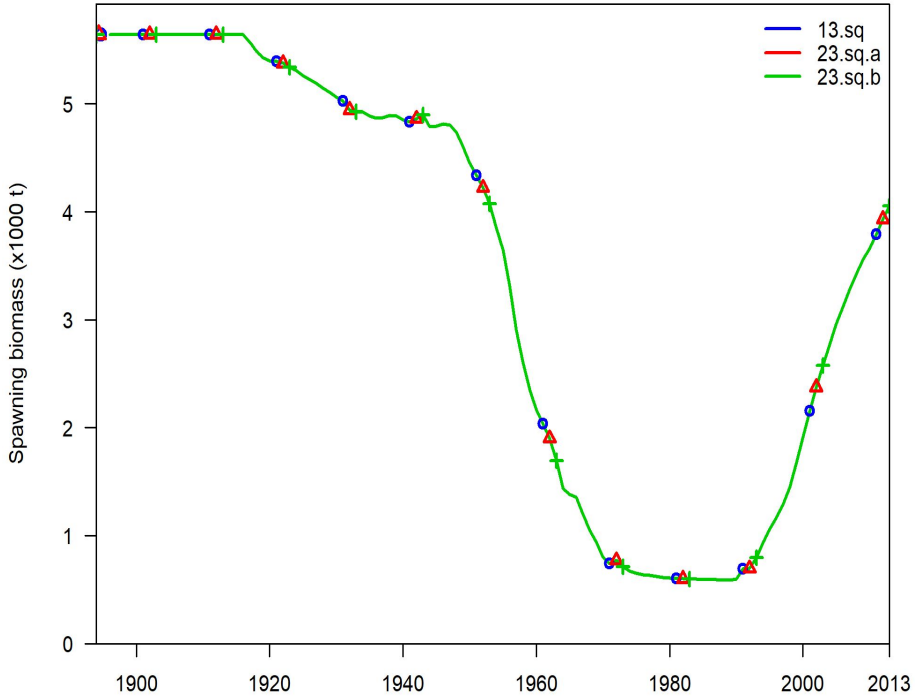
$F = a\,L^{b}$

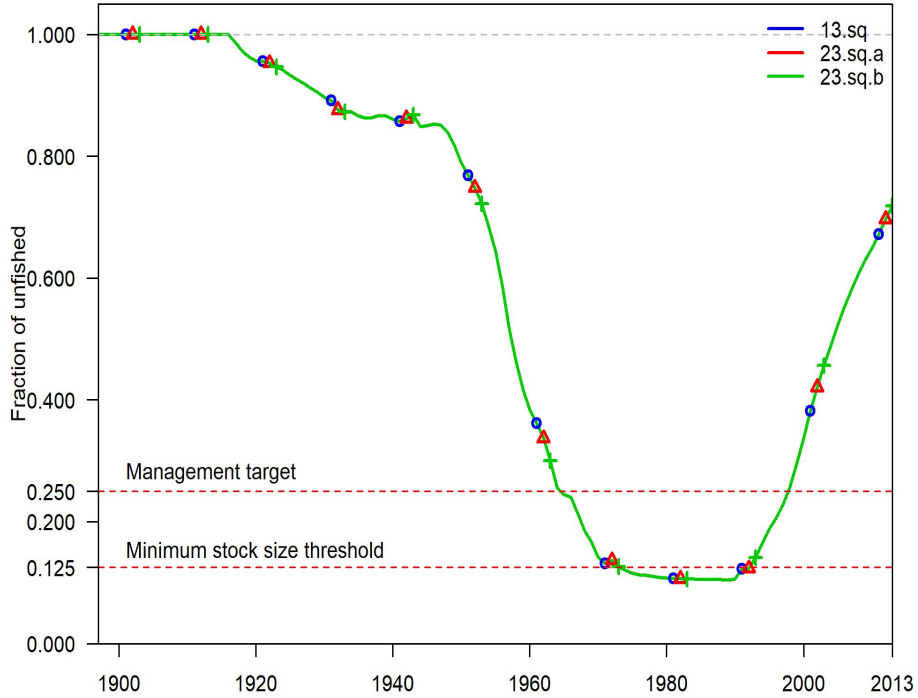
Hyper-allometry when, $b > d$



$W = c\,L^{d}$

Bridging the Assessment model from SS 3.24 to 3.30.21





SS3 version	Model	Description
3.24	13.sq	2013 assessment
3.30.21	23.sq.a	13.sq - All param fixed
3.30.21	23.sq.b	13.sq - All param estimated

Acknowledgements

- Kiva Oken
- Melissa Haltuch
- Owen Hamel
- Vladlena Gertseva
- Jason Cope
- Vanessa Tuttle
- Theresa Tsou
- John Wallace
- Chantel Wetzel
- Andi Stephens
- Kelli Johnson
- Ian Taylor
- Alison Whitman
- NWFSC: Cooperative Ageing Project

Questions?

References

Abookire, A. (2006) Reproductive biology, spawning season, and growth of female rex sole (Glyptocephalus zachirus) in the Gulf of Alaska. Fishery Bulletin 104: 350-359

Cope, J. et al. (2015) Data-moderate stock assessments for brown, China, copper, sharpchin, stripetail, and yellowtail rockfishes and English and rex soles in 2013. Pacific Fisheries Management Council, Portland, Oregon.

Hamel, O. and J. Cope (2022) Development and considerations for application of a longevity-based prior for the natural mortality rate. Fisheries Research 256: 106477

Hosie, M. and H. Horton (1977) Biology of the Rex Sole ,*GLYPTOCEPHALUS ZACHIRUS,* in waters off Oregon. Fishery Bulletin 75: 51-60

Lefebvre, L. S. et al. (2019) Reproductive ecology and size-dependent fecundity in the petrale sole (Eopsetta jordani) in waters of California, Oregon, and Washington. Fishery Bulletin 117: 291-302

Pikitch, E. K. et al. (1988) Final report on the results of the 1988 West Coast groundfish mesh size study. https://repository.library.noaa.gov/view/noaa/45625